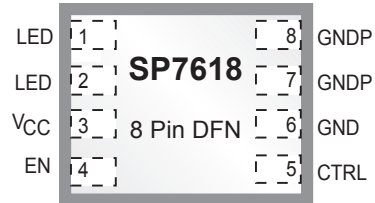


Constant Current LED Driver

FEATURES

- Very low dropout voltage (100mV @ 1A)
- Accurate current regulation down to dropout voltage
- No external components
- Built-in current DAC
- Output current adjustable with 33.3 mA/steps
- Power-saving shutdown mode of 1 μ A
- Fast turn-on (<50 μ s)
- Timeout function to protect the LED
- Thermal Shutdown protection
- 1A current capability
- RoHS compliant, Lead Free packaging:
Space saving 2mmx3mm 8pin DFN



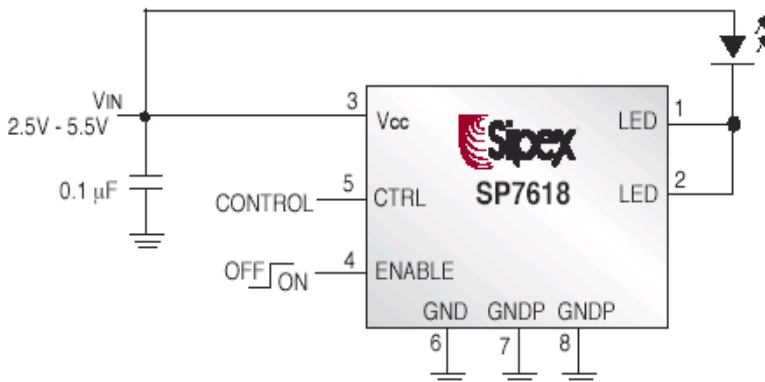
APPLICATIONS

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

GENERAL DESCRIPTION

The SP7618 is a linear, low-side constant-current driver designed to drive high power LEDs from an input voltage rail. The driver acts as a current source, ensuring constant LED current for a range of input voltages. The SP7618 allows implementing the lowest cost LED driver for a variety of applications. Internal circuitry maintains the preset constant current output for a wide voltage range at the LED input. The LED current can be adjusted up to 1033mA with an external clock applied to the CTRL pin. The built-in thermal protection automatically stops LED current to prevent overheating. A timeout function serves as a failsafe, shutting down the output for currents greater than 266mA after 4 seconds of continuous operation if the enable input is not cycled. The part can be shut down by using the EN pin, or sent into Sleep Mode holding the CTRL pin low for more than 100 μ S.

TYPICAL APPLICATION CIRCUIT



ABSOLUTE MAXIMUM RATINGS

Supply Voltage (Vcc)	6.0V
Input Voltage at any input	-0.6V to Vcc +0.5V
8-pin DFN Package	
Thermal Resistance.....	59°C/W
Junction Temperature	-40 °C to +170 °C*
Storage Temperature	-65°C to +150°C
Soldering Temperature	+240°C**

*) Internally limited

**) Duration 10s maximum

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

Ambient temperature $T_A = 25^\circ\text{C}$, $3.0\text{V} < V_{CC} < 5.5\text{V}$, $1.0\text{V} < V_{LED} < 3.0\text{V}$, $100\text{mA} < I_{LED} < 1033\text{A}$. **Bold** denotes specifications which apply over the full operating temperature range, -40°C to $+85^\circ\text{C}$.

PARAMETER		MIN	TYP	MAX	UNITS	CONDITIONS
Vcc Voltage Operating Range ¹		2.5		5.5	V	
Quiescent Current			350	420	μA	I _{LED} = 35mA
Supply Current	Shutdown Mode			1	μA	EN = GND, CTRL = DC
	Sleep Mode			350		EN = Vcc, CTRL = GND
	After Time Duration ²			350		EN = Vcc, CTRL = DC
LED Output Current after	0 pulses on CTRL ³		125		nA	V _{LED} = 1.0V, Vcc = 5.5V
	1 pulse on CTRL ⁴		35		mA	
	3 pulses on CTRL ⁴		102			
	31 pulses on CTRL		1033			
LED Current Accuracy ⁵		-8		8	%	35mA < I _{LED} < 1033 mA
LED Current Line Regulation ⁶			0.1	0.5	%/V	3.0 < Vcc < 5.5V, V _{LED} = 1V
LED Current Load Regulation ⁷			1.5	6	%	1 < V _{LED} < 2.5V, Vcc = 5.5V
LED Current Thermal Regulation			0.01		%/°C	I _{LED} = 100 mA
V _{LED} Dropout Voltage ⁸			50	100	mV	I _{LED} = 100mA @ 25°C
			90	185		I _{LED} = 700mA @ 25°C
			100	210		I _{LED} = 1033mA @ 25°C
Thermal Shutdown Die Temperature			160		°C	I _{LED} = 35mA
Thermal Shutdown Hysteresis			25		°C	
Setup Time after last count ⁹				50	μs	
CTRL input Data Rate			4		MHz	
Wake-up Time from Shutdown				50	μs	EN = LOW to HIGH, CTRL = DC
Turn-off Time into Shutdown				30	μs	EN = HIGH to LOW, CTRL = DC
Turn-off Time into Sleep Mode			125	450	μs	EN = HIGH, CTRL = HIGH to LOW
Time Duration before Sleep Mode		2	4	7	s	I _{LED} > 266 mA, EN = HIGH, CTRL = HIGH
EN and CTRL pin Logic Voltage	LOW			0.4	V	Driver in Shutdown Mode
	HIGH	1.4		Vcc ¹⁰		2.5V ≤ Vcc ≤ 5.5V
Power-on-Reset ¹¹				20	ms	

See notes on next page

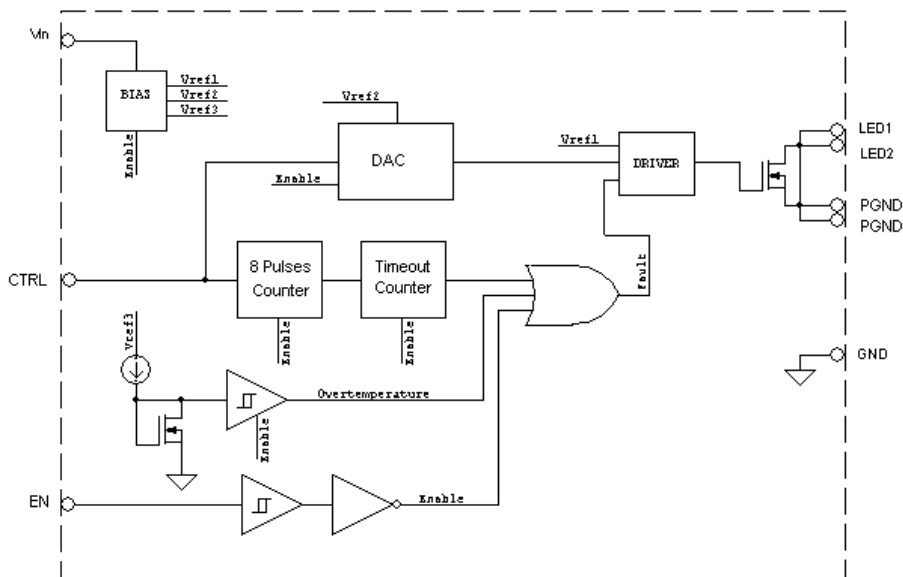
Notes (Continued from previous page)

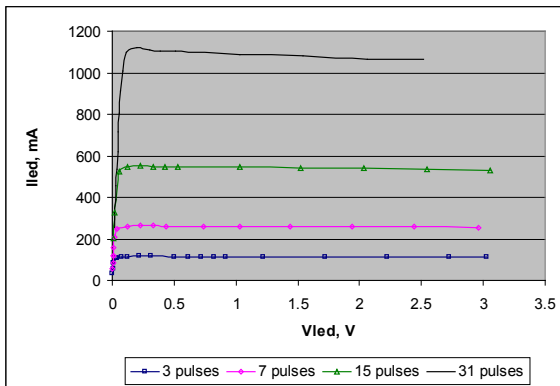
1. V_{CC} must be always higher than LED pin voltage (V_{LED})
2. After 4s at current higher than 266 mA
3. Power MOSFET leakage current
4. Three initial I_{LED} current steps are higher than other 28
5. I_{LED} Variations from specified I_{LED} value
6. I_{LED} Variations per volt V_{CC} change
7. I_{LED} Variations at V_{LED} change from 1 to 2.5V
8. 5% change of I_{LED} compared with I_{LED} value at $V_{LED} = 1V$
9. $I_{LED} = 100$ mA settles 50 μ s later after 3rd pulse
10. Logic HIGH level should never exceed V_{CC} voltage
11. Delay between applying V_{CC} voltage and operating condition

PIN ASSIGNMENTS

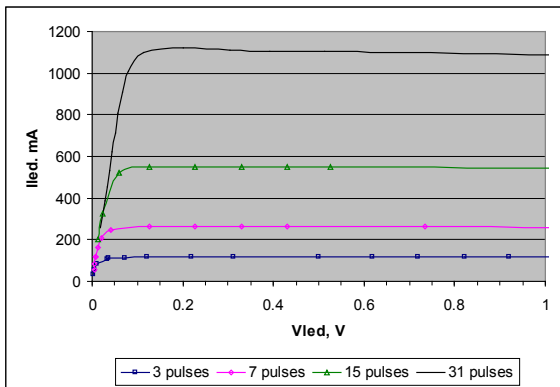
Pin #	Pin Name	Pin Function
1 - 2	LED	LED Current Sink. Connect LED cathode to this pin. Voltage at this pin should be above 100 mV to maintain regulation.
3	Vcc	Power Supply Input. Place 1 μ F decoupling capacitor next to this pin.
4	EN	Enable/Shutdown pin used to enable/disable driver and reset DAC: Logic High – enable, Logic Low – disable/reset.
5	CTRL	DAC Serial Input pin is used to control LED current. Positive pulse edges sequentially increase LED current with 33.33mA steps up to 1033 mA (31 steps). When this pin is held LOW for longer than 100 μ s the part enters Sleep Mode.
6	GND	Ground pin for control and bias blocks.
7 - 8	GNDP	Ground pin. LED current flows through this pin to ground.

BLOCK DIAGRAM

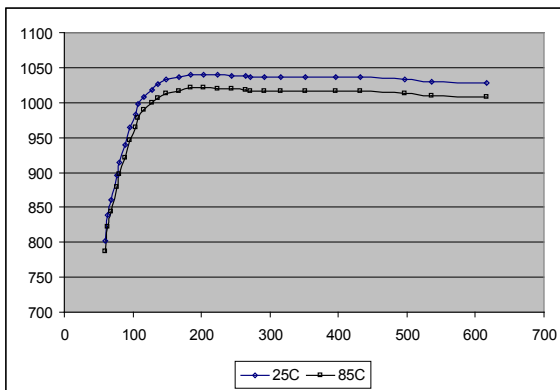




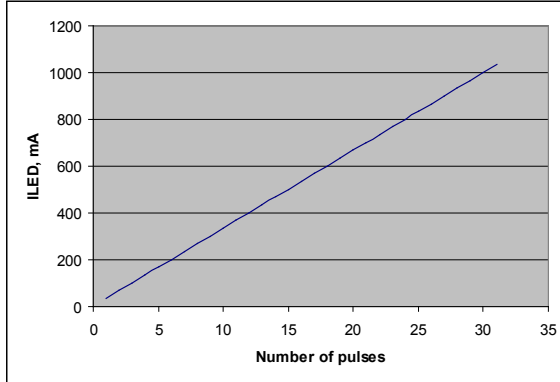
Load regulation at Vcc = 5.5V @ 25°C



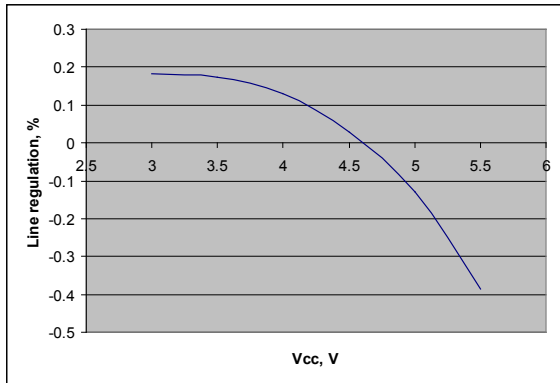
Load regulation at Vcc = 5.5V @ 25°C



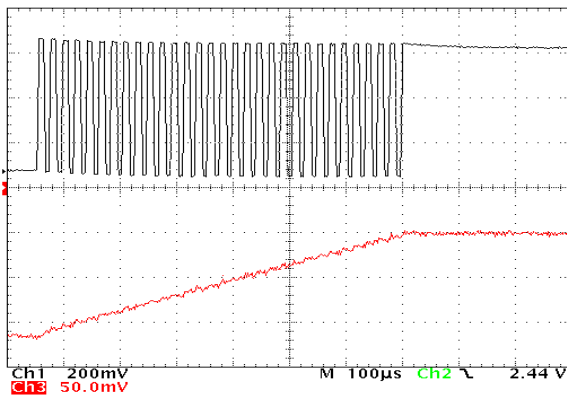
Load regulation vs. temperature at ILED = 1A and Vcc = 5.5V



DAC linearity at $V_{LED} = 500mV$



Line regulation at $V_{LED} = 100mA$



Setup Time at $I_{LED} = 1033A$

Introduction

The SP7618 is a linear low-side, constant-current driver designed to drive high power LEDs from an input voltage rail. The design consists of a regulator reference voltage source, DAC, voltage-to-current converter, thermal shutdown, timeout shutdown, and output driver. The precision reference voltage ensures good performance over voltage and temperature. The built-in thermal protection automatically stops LED current to prevent overheating. A timeout function serves as a failsafe, shutting down the output for currents greater than 266mA after 4 seconds of continuous operation if the enable input is not cycled.

Current Setting DAC

The LED output current is defined by a current control DAC. The input to the DAC is the CTRL pin. The DAC outputs a unit current of 33.33mA with each applied pulse at the CTRL pin. The DAC has 5 bits, so the total number of steps that can be achieved is 2^5 or 32. The initial step of the DAC corresponds to zero, so the maximum current output is 31 times the unit current. Any multiple of the 33.33mA output current can be achieved from 1 to 31 sequentially.

The DAC CTRL input is positive-edge triggered and may be either at high or low logic state when the part is powered up. The ENABLE pin logic HIGH level may be applied with V_{cc} voltage.

The CTRL input allows an increase in LED current only. If a lower I_{LED} current value is required, the device should be sent into shutdown mode (EN =HIGH to LOW/LOW to HIGH) and a new pulse sequence should be applied to the CTRL pin.

If the pulse number exceeds 31, all other pulses are ignored and 1033 mA current is set.

The SP7618 can be placed into Sleep Mode by applying a logic LOW on the CTRL pin for longer than 100 μ s after any pulse sequence. In the Sleep Mode, the driver is disabled and I_{LED} current is zero, but blocks associated with the DAC remain active, and I_{cc} Sleep Mode Current is always higher than I_{cc} current in Shutdown Mode. This function is used to output the I_{LED} current for a specified duration.

If the I_{LED} current exceeds 266 mA (8 pulses) the maximum Time Duration is 4s. After that, the device is automatically sent into Sleep Mode. This function is intended to protect the LED if, for example, the device was left on in a high current condition for a long period of time.

Applying a new pulse sequence to the CTRL pin at Sleep Mode will wake up the device but increase the I_{LED} current at 33.3mA multiplied by the number of pulses. To return the device to the previous or lower I_{LED} current value, use Shutdown (EN =HIGH to LOW/LOW to HIGH) and apply a new pulse sequence to the CTRL pin.

The current control DAC accepts clock rates up to 4MHz. The code for the DAC loads while the output driver takes 50 μ s to respond. This implies that the LED output current will reach its final value 50 μ s after the final pulse is applied to the CTRL pin.

Output Driver

The SP7618 features a low-side regulated output current driver. A large MOSFET device is connected between the LED and GNDP pins. The MOSFET drain is connected to the LED pins and the MOSFET source is connected to the GNDP pins. There are two pins on each terminal of the MOSFET in order to minimize power dissipation inside the package. Even though there are two LED and GNDP pins, there is actually only one output intended to drive one LED.

The light emitting diode connects from VCC to the LED pins. The I_{LED} current regulation is guaranteed at dropout at the LED pins to be less than 100mV. The output current is regulated to within five percent of nominal value even if the voltage between the LED and GNDP pins varies over a wide range. The nominal output is guaranteed within $\pm 8\%$ of the defined current.

Thermal Protection

The SP7618 has built-in thermal protection. An internal P-N junction is compared to the internal temperature compensated reference. When the P-N junction reaches a temperature specific voltage, it trips a comparator which shuts down the driver stage of the part placing the device into sleep mode while DAC circuit remains active. The shutdown temperature is defined to be 160°C.

The comparator circuit has built-in hysteresis corresponding to 25°C. The output stage will resume operation and start sinking the current that was defined prior to shutdown when

the internal temperature drops by 25°C. If the part remains in a high ambient temperature environment or if a high power dissipation condition exists, the output stage will cycle on and off to maintain a preset internal junction temperature to avoid catastrophic damage. In that case, the LED will appear to be blinking. Lower the LED voltage to avoid excess power dissipation in the IC.

Shutdown

The SP7618 has a low current shutdown function. In shutdown mode, the part draws less than 0.1 μ A current maximum. The part can be placed into shutdown using the EN pin.

ENABLE and CTRL pins cannot be tri-stated or left floating. There are no predefined internal states, so leaving these pins open will cause the part to operate incorrectly.

Timeout

A Time Duration Before Shutdown feature acts as a failsafe to protect the LED from long ON times. The nominal timeout is defined as 4 seconds.

Power-on-Reset

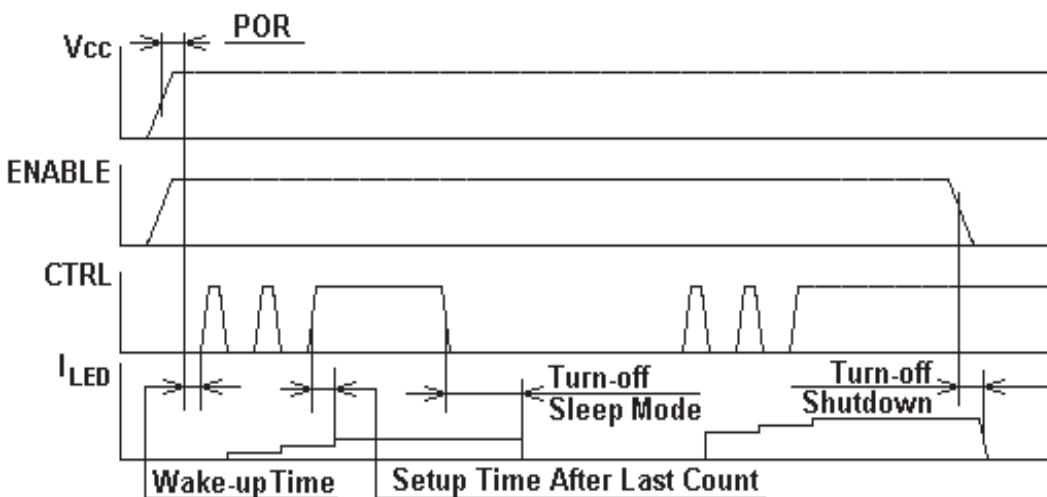
This function is used to set DAC and Time Duration counters into their initial state after power up. No signal applied to the CTRL pin can be accepted during this time, even if the input voltage is applied simultaneously to Vcc and ENABLE pins.

BOARD LAYOUT AND GROUNDING

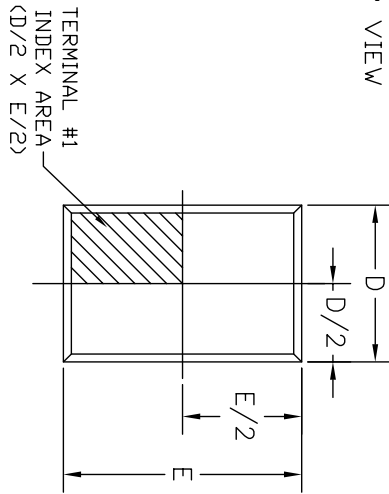
To obtain the best performance from the SP7618, a printed circuit board with ground plane is required. High quality, low series resistance ceramic $1\mu\text{F}$ bypass capacitors should be used at the V_{CC} pin (pin 3). These capacitors must be located as close to pins 3 – 6 as possible. The traces connecting the pins and the bypassing capacitors must be kept short and should be made as wide as possible. Pins 1 – 2 are connected together internally but we recommend connecting the

LED cathode to both pins to avoid additional power losses at high current. Pins 6, 7 and 8 should be connected to the ground plane. Board layout should prevent high LED ground current from flowing through signal ground connected to pin 6. This pin is a separate ground for the reference and logic sections of the SP7618. The quiescent current for the part flows into the V_{CC} pin and out of the GND pin. This current is proportional to the I_{LED} current divided by approximately 1500.

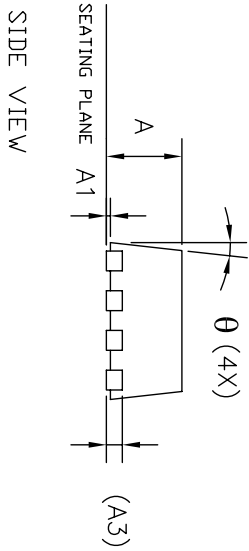
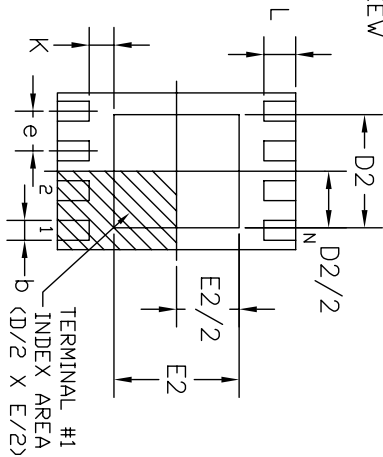
TIMING DIAGRAM



TOP VIEW



BOTTOM VIEW



8LD 2x3 DFN		JEDEC MO-229 Variation VCED-2		
SYMBOLS	DIMENSIONS IN MM (Control Unit)		DIMENSIONS IN INCH (Reference Unit)	
	MIN	NOM	MIN	MAX
A	0.80	0.90	0.032	0.036
A1	0.00	0.02	0.000	0.001
A3	0.20	REF	0.008	REF
b	0.18	0.25	0.007	0.010
D	1.50	2.00	0.079	BSC
D2	1.50	1.75	0.059	—
E	—	3.00	—	0.118 BSC
E2	1.60	—	0.063	—
e	0.50	BSC	0.020	BSC
L	0.30	0.40	0.012	0.016
K	0.20	—	0.008	—
theta	0°	—	14°	—
N	—	8	—	14°
ND	—	4	—	8

REVISION HISTORY			
REV	DESCRIPTION	DATE	APP'D
A	DRAWING ORIENTATION	09/18/05	JL
B	MODIFY DRAWING FORMAT	07/17/06	JL

SIPLEX CORPORATION

8 PIN 2x3 DFN PACKAGE OUTLINE

Packaging Approval: **SIPLEX CORPORATION**

Drawing No: 8-PIN 2x3 DFN

Rev: B

Date: 07/17/06

Sheet: 1 OF 1

Part Number	Operating Temperature Range	Package Type
SP7618ER-L.....	-40°C to +85°C	Lead Free 8 Pin DFN (2mm x 3mm)
SP7618ER-L/TR	-40°C to +85°C	Lead Free 8Pin DFN (2mm x 3mm)

/TR = Tape and Reel

Pack quantity is 3,000 for DFN.



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Appendix and Web Link Information

For further assistance:

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WWW Support page: <http://www.sipex.com/content.aspx?p=support>
Sipex Application Notes: <http://www.sipex.com/applicationNotes.aspx>
Product Change Notices: <http://www.sipex.com/content.aspx?p=pcn>



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The following sections contain information which is more changeable in nature and is therefore generated as appendices.

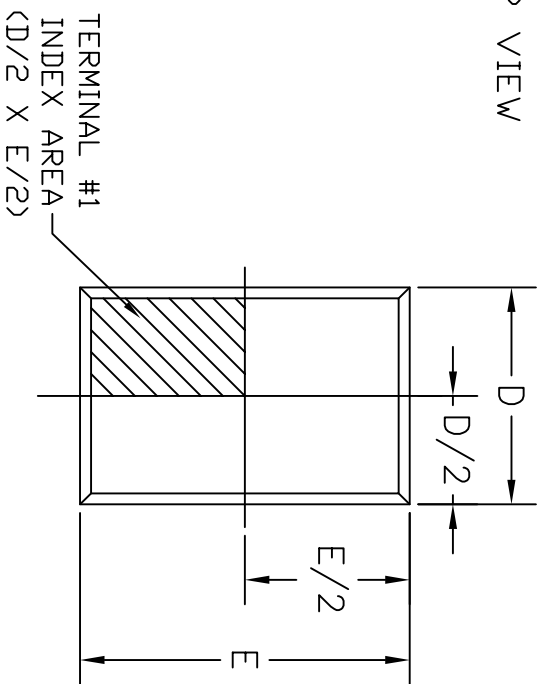
- 1) Package Outline Drawings**
- 2) Ordering Information**

If Available:

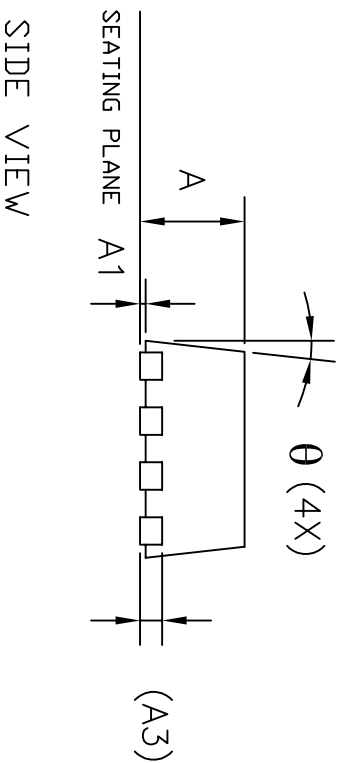
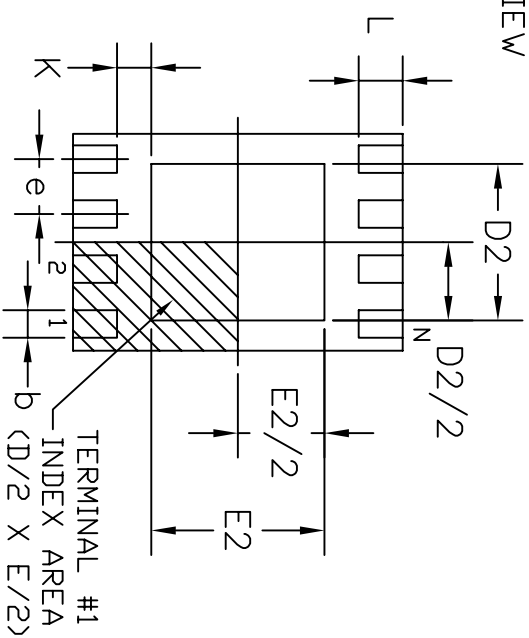
- 3) Frequently Asked Questions**
- 4) Evaluation Board Manuals**
- 5) Reliability Reports**
- 6) Product Characterization Reports**
- 7) Application Notes for this product**
- 8) Design Solutions for this product**

REVISION HISTORY			
REV.	DESCRIPTION	DATE	APP'D
A	DRAWING ORIGINATION	08/18/05	JL
B	MODIFY DRAWING FORMAT	07/17/06	JL

TOP VIEW



BOTTOM VIEW



SIDE VIEW

SYMBOLS		DIMENSIONS IN MM (Control Unit)			DIMENSIONS IN INCH (Reference Unit)		
	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			
b	0.18	0.25	0.30	0.007	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	
K	0.20	—	—	0.008	—	—	
theta	0°	—	14°	0°	—	14°	
N	8			8			
ND	4			4			

8LD 2x3 DFN JEDEC MO-229 Variation VCED-2



SIPEX CORPORATION

Packaging Approval: 8 PIN 2x3 DFN PACKAGE OUTLINE

Drawing No: 8-PIN 2x3 DFN

By: JL Date: 07/17/06 Revision: B Sheet: 1 OF 1

Powering Flash LEDs with a Supercap

INTRODUCTION

New cellular phones have incorporated high resolution cameras, which require high brightness illumination of the ambient area in order to achieve high quality pictures. Traditional xenon-filled photo flash cannot be used in the very tight space available to photo cameras in cellular phones. Instead, design engineers use a white LED with high pulsed current. It occupies small PCB space when compared with a traditional photo flash, however, it also provides significantly lower light. Additionally, this high current can overload the phone battery during flash. A possible solution to this problem is to use two or three LEDs instead of one in order to improve the light output and use a super capacitor to avoid battery overload. An example of this solution is shown below in Figures 1 and 2. The circuit uses three SP7618 LED driver ICs with one photo flash LED connected to each driver and 0.5F super capacitor that acts as an energy storage element during the flash pulse.

DESCRIPTION AND BOARD SCHEMATIC

The SP7618 is a linear low-side constant-current driver designed to drive high power LEDs from an input voltage rail. The driver acts as a high current source, ensuring constant LED current for the full range of input voltage. The SP7618 allows implementing the lowest cost LED driver for a variety of applications. Internal circuitry maintains the preset constant current output for a wide voltage range at the LED input. The LED current can be adjusted up to 1033mA with an external clock applied to the CTRL pin. Dimming can be achieved by using the sequencing CTRL pin or feeding a PWM signal to the EN pin. The built-in thermal protection automatically stops LED current to prevent overheating. A timeout function serves as a fail safe, shutting down the output for currents greater than 266mA after 4 seconds of continuous operation. The part can be shut down by using the EN pin or holding the CTRL pin low for more than 100 μ S.

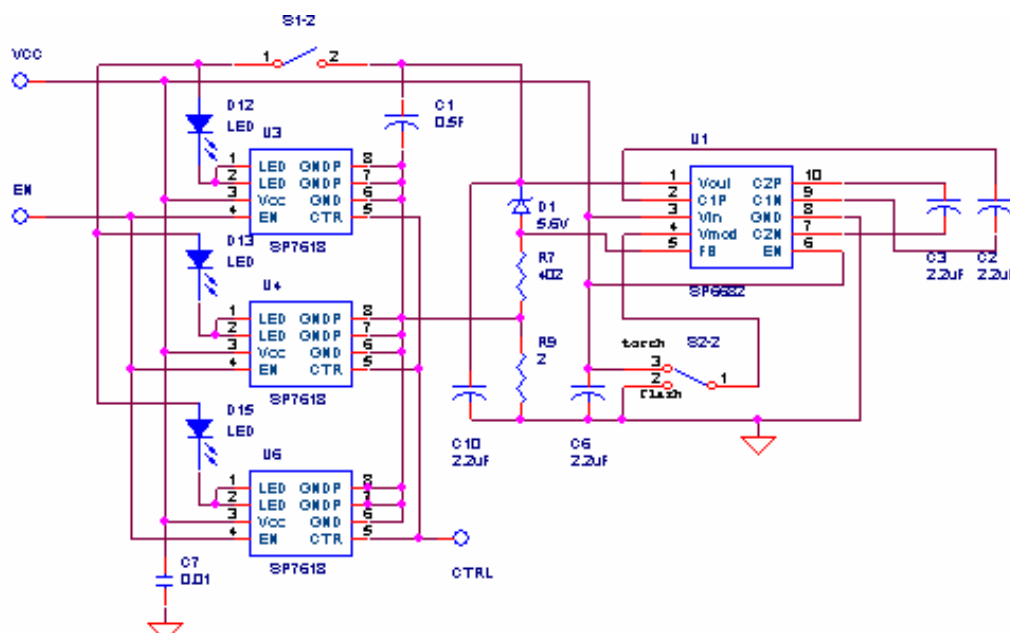


Figure 1. SP7618 Evaluation Board Schematic Diagram (charge pump and drivers)

The schematic in Figure 1 contains three SP7618 drivers (U3, U4, and U6), each of which has one Luxeon Flash LED as a load (D12, D13, and D15) with preset current of 1033mA at flash mode and 33mA at torch mode. The charge pump SP6682 (U1) with capacitors (C2, C3, C6, and C10) provides current to charge super capacitor C1 up to 5.5V in flash mode. To avoid the battery overstress, the maximum for the charge pump's input current is limited to 300mA both at torch and flash mode. In the flash mode, the super capacitor provides 3A pulse current during 200ms. In the torch mode, current consumption is limited by the charge pump and linear drivers and should not exceed 100mA. The charge pump is used in the current regulation mode when the super capacitor is discharged and in the voltage regulation mode if the super capacitor's voltage exceeds 5.5V.

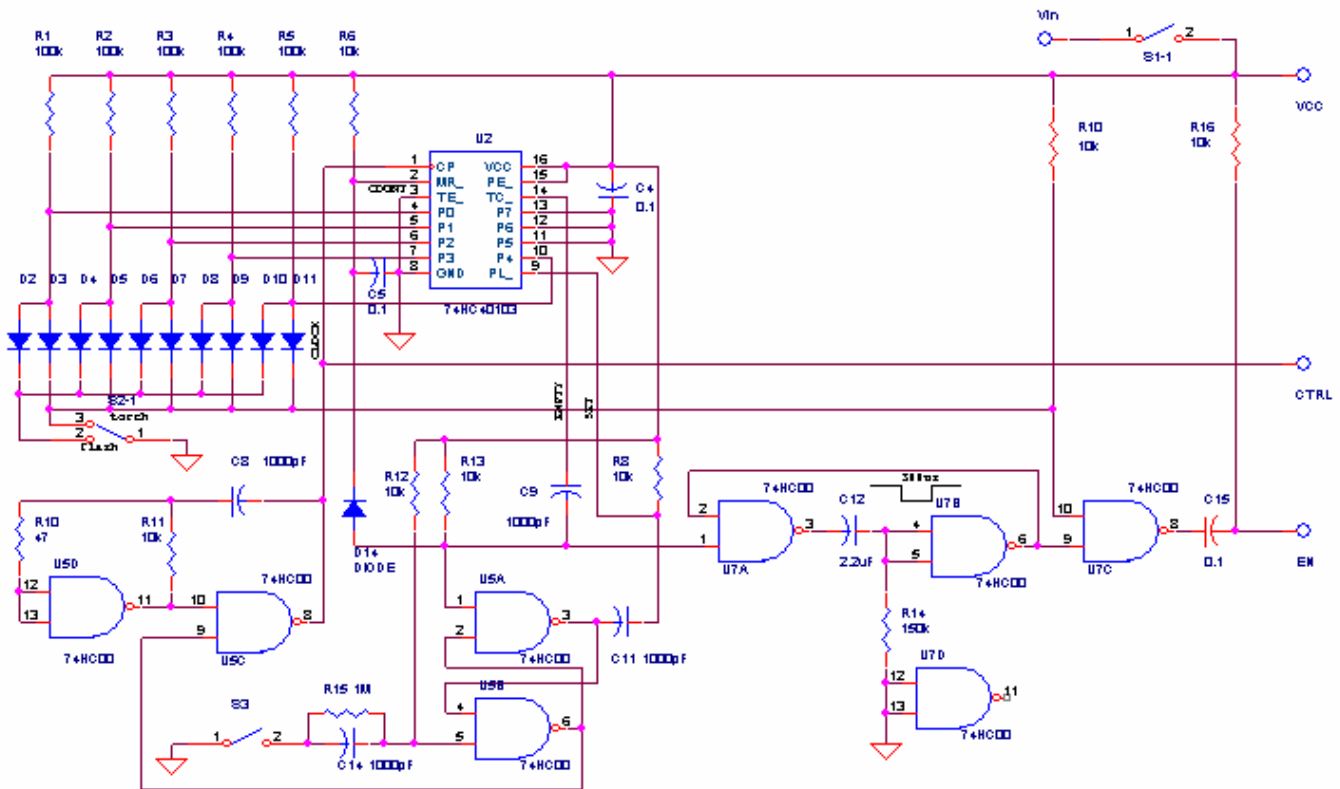


Figure 2. SP7618 Evaluation Board Schematic Diagram (pulse generator)

Figure 2 shows the implementation of the pulse generator. This circuit is used to program the SP7618 drivers. It is designed specifically for evaluation purpose and is NOT required in a real system, as the programming is handled by a uP through its GPIO output. This pulse generator (U2, U5, and U7) is used to provide a pulse sequence to the driver's CTRL and EN pins to set LED current and turn the driver on/off. The number of pulses that determines LED current may be set separately both at flash and torch modes by diodes U2 – U11 using binary code. Preset value is 1 pulse at torch and 31 pulses at flash mode; that is equal 33mA and 1033mA LED current respectively.

In flash mode every push of the button S3 generates 31 positive pulses at the driver's control pin and 200ms later, one negative pulse at the enable pin to turn drivers off and reset internal counters. Because the super capacitor charge current is limited at 300mA, allow 3 – 5s to completely charge it after every flash.

In torch mode every push of the button S3 generates only 1 pulse, turning on LEDs for an unlimited time. To turn LEDs off, turn power off (switch S1) or set the flash mode using the switch S2. If you continue to press S3, the LED current will increase gradually by 33mA for every pulse, up to three pulses. After three pulses, the LED current remains constant because the charge pump current is limited at 300mA. After 8 pulses drivers, turn off with the typical time duration 4s.

Selecting the LED current

LED current can be adjusted up to 1033mA with a series of pulses applied to the CTRL pin. Each pulse increases the output current at 33.33mA steps. The maximum number of the pulses is 31. The 32nd and following pulses are ignored. The number of pulses depend on diode position is shown in Table 1.

Number of pulses	Torch Mode					Flash Mode				
	D3	D5	D7	D9	D11	D2	D4	D6	D8	D10
1		+	+	+	+		+	+	+	+
2	+		+	+	+	+		+	+	+
3			+	+	+			+	+	+
4	+	+		+	+	+	+		+	+
5		+		+	+		+		+	+
6	+			+	+	+			+	+
7				+	+				+	+
8	+	+	+		+	+	+	+		+
9		+	+		+		+	+		+
10	+		+		+	+		+		+
11			+		+			+		+
12	+	+			+	+	+			+
13		+			+		+			+
14	+				+	+				+
15					+					+
16	+	+	+	+		+	+	+	+	
17		+	+	+			+	+	+	
18	+		+	+		+		+	+	
19			+	+				+	+	
20	+	+		+		+	+		+	
21		+		+			+		+	
22	+			+		+			+	
23				+					+	
24	+	+	+			+	+	+		
25		+	+				+	+		
26	+		+			+		+		
27			+					+		
28	+	+				+	+			
29		+					+			
30	+					+				
31										

Table 1. Code table

Note: “+” means this diode should be installed

If the LED current is set higher than 100mA per LED in torch mode it will be limited by the charge pump. If the LED current is set higher than 266mA per LED (8 or more CTRL pulses), the device will go into shutdown after 4 seconds (typ).

Powering Up the SP7618 Circuit

The SP7618 Evaluation Board can be powered from a 4.5V power supply or from 3 alkaline cells, or from a single cell Li-Io battery. Connect the 4.5V source pin with a short lead directly to the “Vin” and -4.5V /GND pin to the “GND” posts.

Torch Mode

Set switch S2 in Torch Mode. Turn the power on using switch S1. Push the button S3. The device will generate continuous light. To turn the light off turn the power off using switch S1 or set Flash mode using switch S2 (in this case the device still running).

Flash Mode

Set switch S2 in Flash Mode. Turn the power on using switch S1. Let 5 – 10s to charge the super capacitor. Push the button S3. The device will generate a 200ms light pulse. Allow 3 – 5s to charge the super capacitor before repeating the pulse. Turn the power off.

Note:

1. We recommend powering up the device at torch mode to avoid overstressing the battery if the super capacitor is completely discharged.
2. In torch mode, light generation has unlimited time duration. If you continue to push S3 without resetting drivers, the LED current will increase gradually by 33mA at every pulse provided but three first pulses only. After that, the LED current remains stable because the charge pump current is limited at 300mA. After 8 pulses, drivers turn off with time duration 2 – 7s typical.

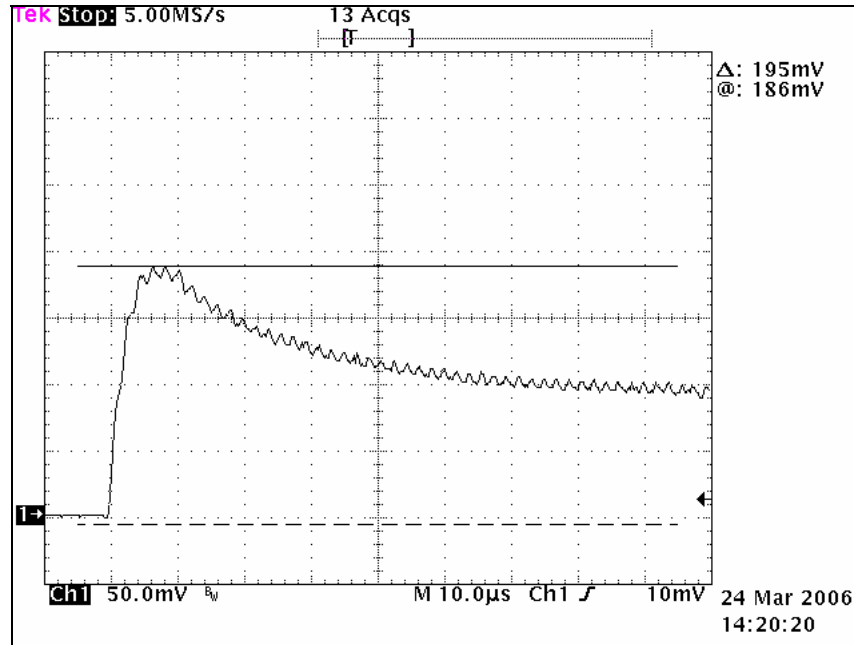


Figure 3. SP7618 Input Current During Power-up in Torch Mode With Discharged Super Capacitor (CH1: 50mA/DIV)

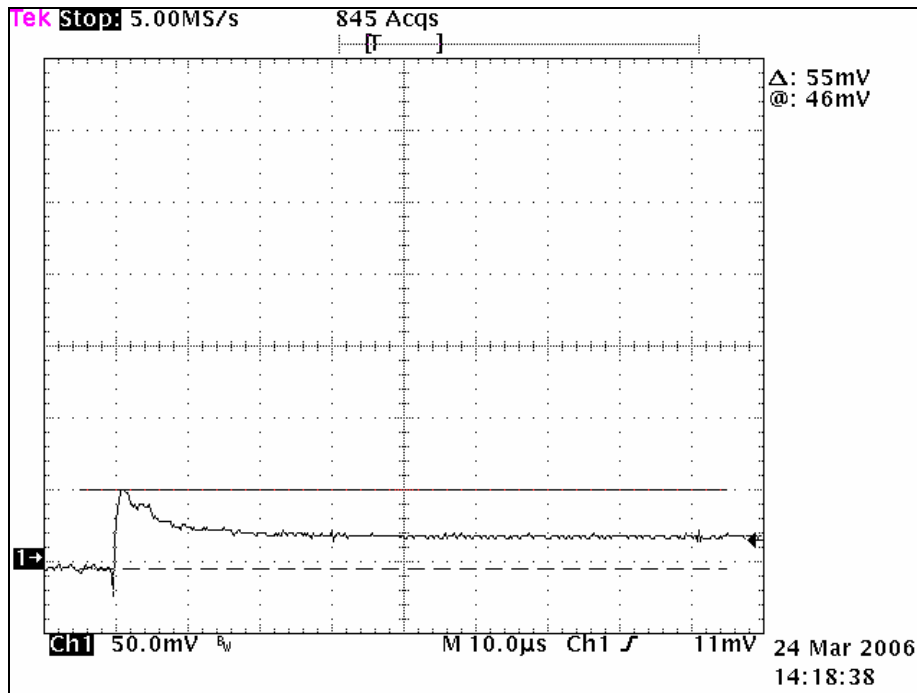


Figure 4. SP7618 Input Current During Switching From Torch Mode to Flash Mode (CH1: 50mA/DIV)

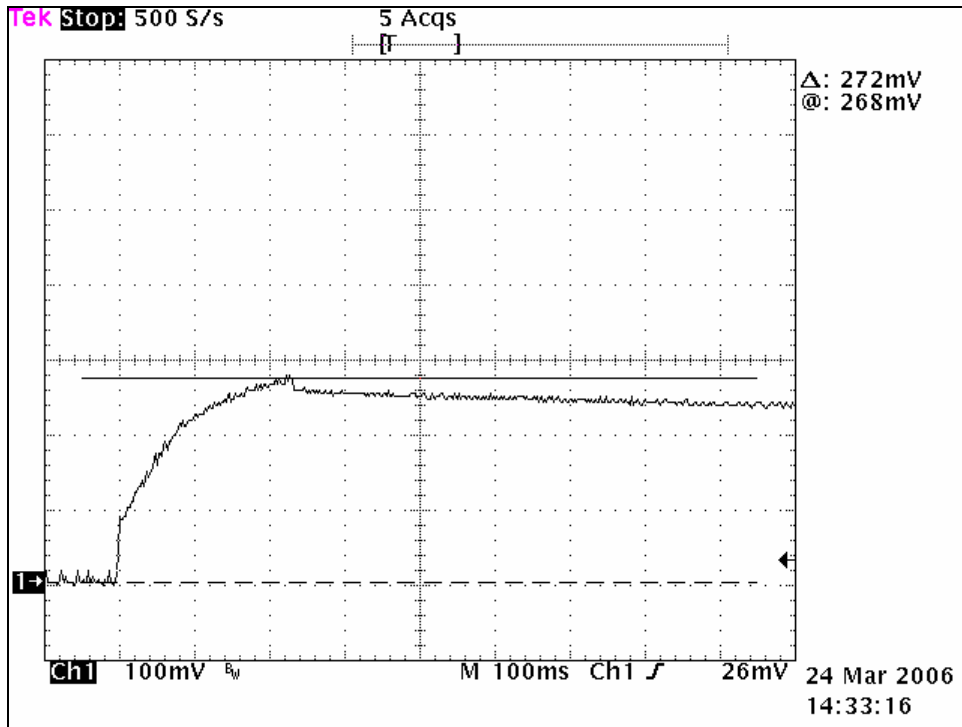


Figure 5. SP7618 Input Current During Flash Pulse and After Flash Pulse (CH1: 50mA/DIV)

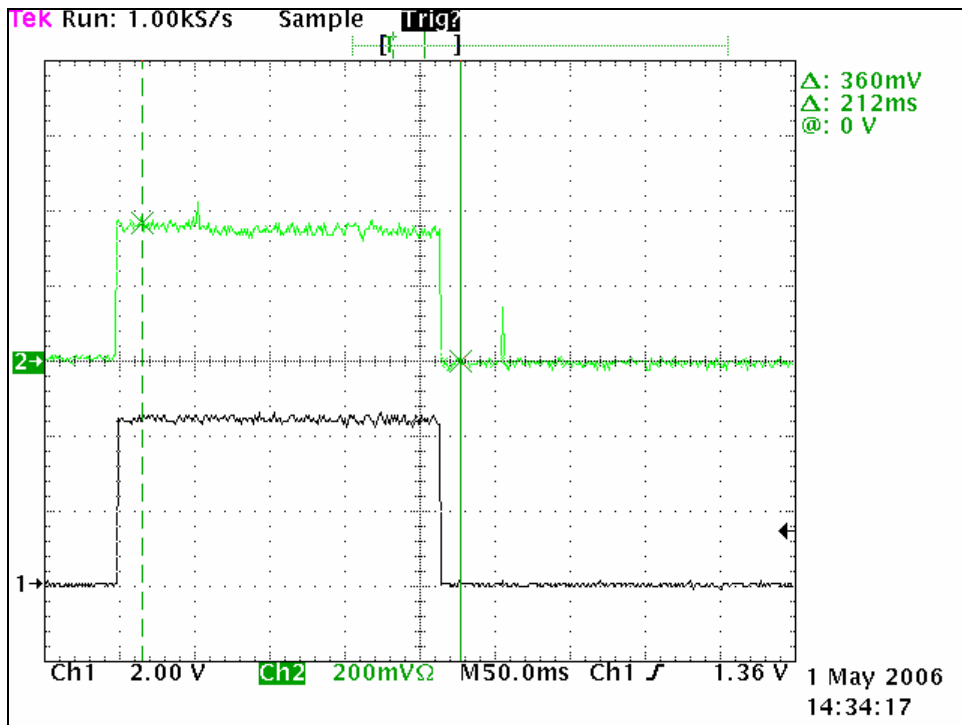


Figure 6. SP7618 Super Capacitor Discharge Current (green) during the flash pulse (black)

EVALUATION BOARD LAYOUT

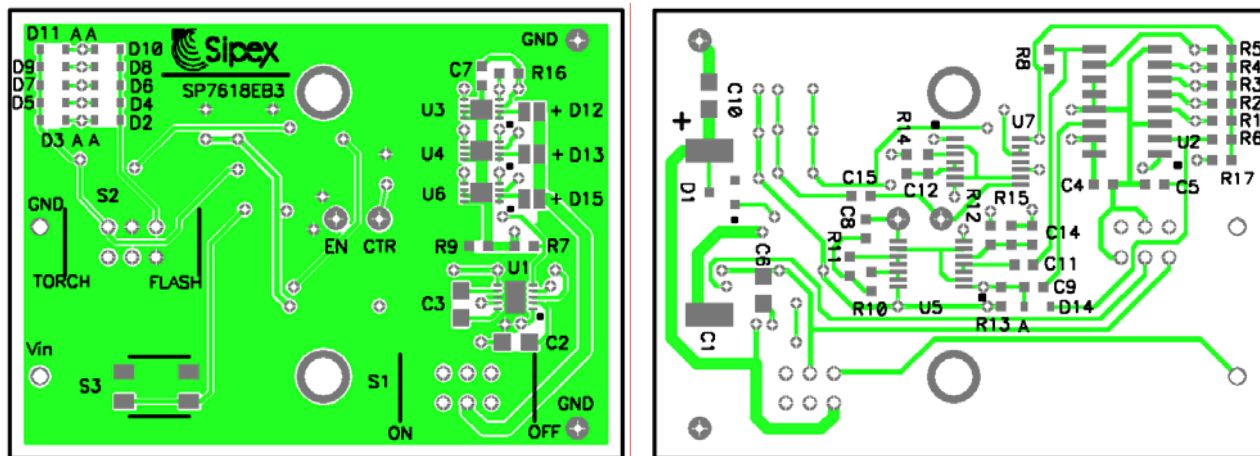


Figure 7. SP7618 Evaluation Board Layout top and bottom side (not to scale)

Table 2. SP7618EB List of Materials

Item	Quantity	Reference	Part
1	1	C1	GS2 06F Cap-XX
2	5	C2,C3,C6,C10,C12	2.2uF
3	4	C4,C5,C7,C15	0.1uF
4	4	C8,C9,C11,C14	1000pF
5	1	D1	MMBZ5232BW Diodes Inc.
6	11	D2, D3, D4, D5, D6, D7, D8, D9, D10, D11, D14	BAT42WS Diodes Inc.
7	3	D12,D13,D15	LXCL-PWF1 Lumileds
8	5	R1,R2,R3,R4,R5	100k
9	7	R6,R8, R11,R12,R13, R16, R17	10k
10	1	R7	402 ohms
11	1	R9	2 ohms
12	1	R10	47 ohms
13	1	R14	150k
14	1	R15	1M
15	5	S1,S2	EG2209 E-Switch
16	1	S3	7914G-1-000E Switch Key
17	1	U1	SP6682
18	1	U2	CD74HC40103M
19	3	U3,U4,U6	SP7618
20	2	U5,U7	74VHC00MTC Fairchild

ORDERING INFORMATION



Model

Temperature Range

Package Type

SP7618EB..... -40°C to +85°C..... SP7618 Evaluation Board

SP7618ER/TR.....-40°C to +85°C..... 8-pin DFN (2 x 3 mm)

/TR = Tape and Reel

Pack quantity is 3000 for DFN.

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

Example: SP7618ER/TR = standard; SP7618ER-L/TR = lead free

The **SP7618 Evaluation Board** is designed to help the user evaluate the performance of the SP7618 for use as a single photo flash Luxeon LED Driver. The evaluation board is a completely assembled and tested surface mount board which provides easy probe access points to all SP7618 inputs and outputs so that the user can quickly connect and measure electrical characteristics and waveforms. The Evaluation Board schematic diagram is shown at Figure 1.

The SP7618 is a linear low side constant current driver designed to drive high power LEDs from an input voltage rail. The driver acts as a high current source ensuring constant LED current for a range of input voltage. The SP7618 allows implementing the lowest cost LED driver for a variety of applications. Internal circuitry maintains the preset constant current output for a wide voltage range at the LED input.

The LED current can be adjusted up to 1033mA with an external clock applied to the CTRL pin. The built-in thermal protection automatically stops LED current to prevent overheating. A timeout function serves as a fail safe, shutting down the output for currents greater than 266mA after 4 seconds of continuous operation if the enable input is not cycled. The part can be shutdown by using the EN pin or holding the CTRL pin low for more than 100 μ S.

The evaluation board contains SP7618 driver (U2) with one Luxeon Flash LED as a load (D1) and pulse generator.

The pulse generator (U1, U4, and U5) is used to provide a pulse sequence to the driver's CTRL and EN pins to set LED current and turn the driver on/off. The number of pulses that determines LED current may be set by 5-bit dip-switch (U3) using binary code. The number of pulses depend on switch position is shown on Table 1.

USING THE EVALUATION BOARD

1) Selecting the LED current

LED current can be adjusted up to 1033mA with a series of pulses applied to the CTRL pin. Each pulse increases the output current in steps of 33.33mA. The maximum number of the pulses is 31. The 32nd and following pulses are ignored. The number of pulses depends on the switch position as shown on Table 1, which is on the next page.

Number of pulses	Position of DIP-Switches				
	1	2	3	4	5
1	+	+	+	+	
2	+	+	+		+
3	+	+	+		
4	+	+		+	+
5	+	+		+	
6	+	+			+
7	+	+			
8	+		+	+	+
9	+		+	+	
10	+		+		+
11	+		+		
12	+			+	+
13	+			+	
14	+				+
15	+				
16		+	+	+	+
17		+	+	+	
18		+	+		+
19		+	+		
20		+		+	+
21		+		+	
22		+			+
23		+			
24			+	+	+
25			+	+	
26			+		+
27			+		
28				+	+
29				+	
30					+
31					

Table 1. Code Table

Note: "+"- this switch is in ON position
 If all switches are in ON position the number of pulses is 256.

2) Powering Up the SP7618 Circuit

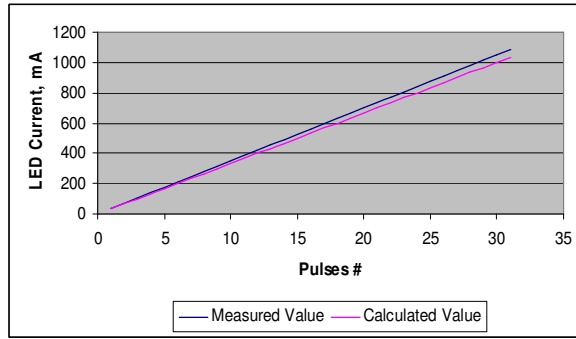
The SP7618 Evaluation Board can be powered from a 4.5V power supply or from 3 alkaline cells.

Connect 4.5V source pin with short lead directly to the "Vin" and -4.5V/GND pin to the "GND" posts.

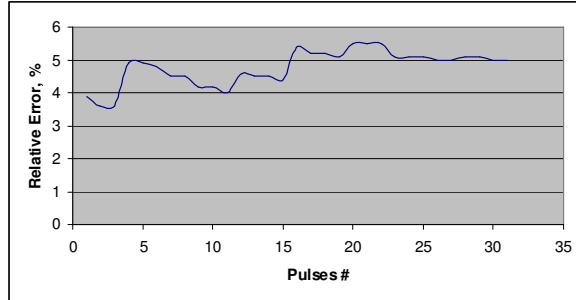
Install shunt S1 to short pins 2-3 (The Evaluation board is delivered by default with shunt in this position. If shunt S1 isn't installed or short pins 1-2 the driver SP7618 is disabled).

Push the button S2. Driver (U2) will provide to the LED current in respect to dip-switch (U3) position. If the output current is higher than 266mA (8 pulses), the driver will turn off after 4s to prevent LED damage. Every push on button S2 turns the driver off/on and sends the CTRL pin a new pulse sequence depending on the dip-switch position.

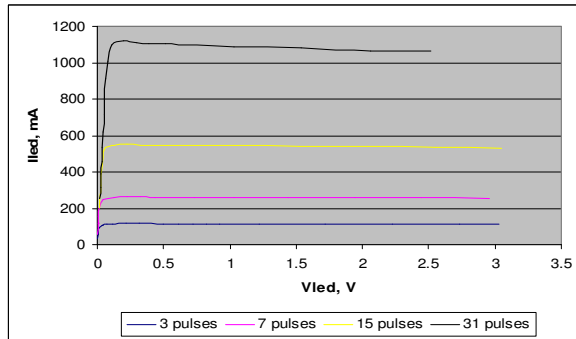
Disconnect Evaluation board from power supply to turn it off.



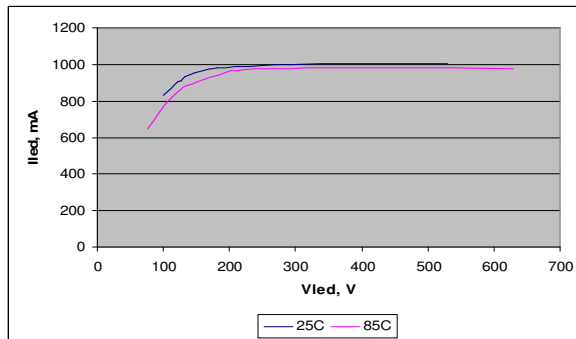
Graph 1. LED Current vs. number of input pulses



Graph 2. LED Current Relative Error vs. number of input pulses



Graph 3. Load regulation at Vin = 5.5V



Graph 4. Load regulation at 25°C and 85°C

ORDERING INFORMATION

Model	Temperature Range	Package Type
SP7618EB.....	-40°C to +85°C.....	SP7618 Evaluation Board
SP7618ER-L/TR.....	-40°C to +85°C.....	Lead Free 8-pin DFN (2 x 3 mm)

/TR = Tape and Reel
Pack quantity is 3000 for DFN.

For further assistance:

Email: Sipexsupport@sipex.com
WWW Support page: <http://www.sipex.com/content.aspx?p=support>
Live Technical Chat: <http://www.geolink-group.com/sipex/>
Sipex Application Notes: <http://www.sipex.com/applicationNotes.aspx>



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Reliability and Qualification Report

SP7618/SP7619

Prepared by: G. West
Quality Manager
Date: 12/04/06

Reviewed by: Fred Claussen
VP Quality & Reliability
Date: 12/04/06



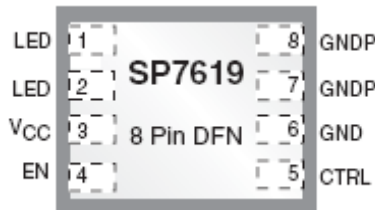
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Device Description:

The SP7618/9 is a linear low side constant current driver designed to source two preset currents of 200mA/500mA (SP7619), 200mA/700mA (SP7619A)*. The preset currents can be set by driving the CTRL pin high or low. Dimming or shutdown can be done 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 driver acts as a current source ensuring constant LED current for a range of input voltage. The SP7619 is useful for implementing the lowest cost LED driver for a variety of applications. Internal circuitry maintains the preset constant current output for a wide voltage range at the LED input. The built-in thermal protection automatically stops LED current to prevent overheating. A timeout function serves as a fail safe, shutting down the output for currents greater than 266mA after 4 seconds of continuous operation if the enable input is not cycled.

Pin Out:



Manufacturing Information:

Products:	SP7618/SP7619
Description:	Constant Current LED Driver
Mask Set(s):	MS1473
Lot Number:	DA10028, DA10229
Package:	8L DFN
Mold Compound:	Sumitomo G770HT
Die Attach Material:	Ablebond 8290
Bond Diagram:	501-4091



Reliability Qualification Test Summary:

Stress Level	Device	Mask Set	Lot Number	Burn-In Temp	Sample Size	No. Fail
1000Hrs	SP7619	MS1473	DA10028	125 °C	77	0
1000Hrs	SP7619	MS1473	DA10229	125 °C	77	0

Life Test

Life testing is conducted to determine if there are any fundamental reliability related failure mechanism(s) present in the device.

These failure mechanisms can be divided roughly into four groups:

1. Process or die related failures, such as oxide-related defects, metalization-related defects and diffusion-related defects.
2. Assembly-related defects such as chip mount wire bond or package-related failures.
3. Design related defects.
4. Miscellaneous, undetermined or application-induced failures.

Life Test Results

As part of the Sipex design qualification program, the Engineering group had subjected 154 units of SP7619 for a 1000 Hour reliability life test at 125° C.

168 hour Life test

154 units of the SP7619 parts were subjected to the life test profile and completed 168hr the test without any part failures.

500 hour Life test

154 units of the SP7619 parts were reintroduced to the second phase of the test, where the parts again successfully completing the 500-hour life test without any failures.



1000 hour Life test

154 units of the SP7619 parts were reintroduced to the final phase of the test, where the parts again successfully completed 1000-hour life test without any shift on the process parameters.

FIT Rate Calculations

The FIT (failures in time) rate is the predicted number of failures per billion device-hours. This predicted value is based upon the:

1. Life Test conditions (time and temperature, device quantity and number of failures) are summarized under HTOL test table.
2. Activation Energy (E_a) of the potential failure modes.

The weighted Activation Energy, E_a , of observed failure mechanisms of Sipex products has been determined to be 0.8 eV.

Based on the above criteria, the FIT rates at 25°, 55° and 70°C operation at both 60% and 90% confidence levels for the SP508 have been calculated and are listed below.

FIT Failure Rates SP7619 Product

Confidence Level	+25°C	+55°C	+70°C
60%	3.1	47.3	156.0
90%	7.9	122.3	403.3

1 FIT = 1 Failure per Billion Device-Hours

MTBF Calculation for SP7619 Product

Confidence Level	+25°C	+55°C	+70°C
60%	3.27E+08	2.11E+07	6.41E+06
90%	1.26E+08	8.17E+06	2.48E+06



ESD Testing

HBM ESD Testing - 3 units from each of two lots were subjected to +2000V Human Body Model (HBM) ESD stress and 3 units from each of two lots were subjected to -2000V Human Body Model (HBM) ESD stress. Each pin was subjected to three pulses with respect to ground. All units passed testing after ESD stress.

Latch-up Testing

Latch-up Testing - 5 units from each of two lots were subjected to latch-up testing at +/-100mA and 85C. All units passed.