SP7619/19A

Constant Current LED Driver

FEATURES

- Very low dropout voltage (60mV@200mA)
- Accurate current regulation down to dropout voltage
- No external components
- Selectable output current levels: 200mA & 500mA (700mA for SP7619A)
- Power-saving shutdown mode of 1μA
- Fast turn-on (<50μs)
- Timeout function to protect the LED
- Thermal Shutdown protection
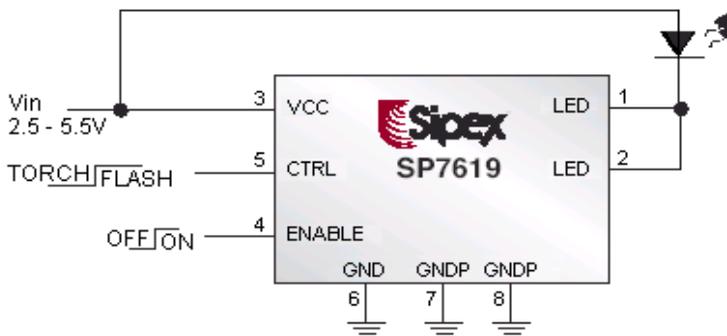- RoHS compliant, Lead Free packaging: Space saving 2mmx3mm 8pin DFN

SP7619 — 8 Pin DFN

Pin		Pin	
LED	1	8	GNDP
LED	2	7	GNDP
V_{CC}	3	6	GND
EN	4	5	CTRL

APPLICATIONS

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

GENERAL DESCRIPTION

The SP7619 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 across a range of input voltages. The SP7619 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 set at 200mA at torch mode or 500mA (700mA SP7619A) at flash mode by selecting CTRL pin low/high respectively. Dimming or shutdown can be done by feeding a PWM signal to the EN pin. Fast EN turn-on/off time allows for very fast dimming frequencies, completely eliminating flicker. The built-in thermal protection automatically stops LED current to prevent overheating. A timeout function serves as a fail safe, shutting down the output at 500mA (700mA) current after 4 seconds of continuous operation if the enable input is not cycled. The Enable pin should be cycled HIGH/LOW/HIGH to restart the driver.

TYPICAL APPLICATION CIRCUIT

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°C, 3.0V < Vcc < 5.5V, 1.0V < V_{LED} < 3.0V. **Bold** denotes specifications which apply over the full operating temperature range, -40°C to +85°C.

PARAMETER		MIN	TYP	MAX	UNITS	CONDITIONS
Vcc Voltage Operating Range 1		**2.5**		**5.5**	V	
Supply Current	Shutdown Mode			1	μA	EN = GND, CTRL = DC
	After Time Duration 2		350	420		EN = Vcc, CTRL = Vcc
LED Output Current		180	200	220	mA	CTRL pin LOW
		450	500	550		SP7619 CTRL pin HIGH
		630	700	770		SP7619A CTRL pin HIGH
LED Current Line Regulation 3			0.1	**0.5**	%/V	3.0 < Vcc < 5.5V, V_{LED} =1V
LED Current Load Regulation 4			1.5	**6**	%	1.0 < V_{LED} < 2.5V, Vcc = 5.5V
LED Current Thermal Regulation			0.01		%/°C	I_{LED} = 200 mA
V_{LED} Dropout Voltage 5			75	160	mV	I_{LED} = 500mA for SP7619@25°C
			90	185		I_{LED} =700 mA for SP7619A@25°C
			60	140		I_{LED} =200 mA for both SP7619 & SP7619A @25°C
Thermal Shutdown Die Temperature			160		°C	I_{LED} = 200mA
Thermal Shutdown Hysteresis			**25**		°C	
Setup Time 6				50	μs	
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
Time Duration before Sleep Mode		**2**	**4**	**7**	s	I_{LED} = 500/700 mA, EN = HIGH, CTRL = HIGH
EN and CTRL pin Logic Voltage	LOW			**0.4**	V	Driver in Shutdown Mode
	HIGH	**1.4**		**Vcc7**		2.5V ≤ Vcc ≤ 5.5V

Notes:
1. Vcc must be always higher than LED pin voltage (V_{LED})
2. After 4s at 500 (700) mA current
3. I_{LED} variations per volt Vcc change
4. I_{LED} variations at V_{LED} change from 1 to 2.5V
5. 5% change of I_{LED} compared with I_{LED} value at V_{LED} = 1V
6. I_{LED} settles 50μs later after CTRL from LOW to HIGH or from HIGH to LOW
7. Logic HIGH level should never exceed Vcc voltage

| 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 1μF decoupling capacitor next to this pin
4	EN	Enable/Shutdown pin used to enable/disable driver and reset time count Logic High – enable, Logic Low – disable/reset.
5	CTRL	This pin is used to switch I$_{LED}$ current between two internally preset levels for Flash or Torch mode. CTRL = LOW selects Torch mode (200mA), CTRL = HIGH selects Flash mode 500 (700)mA.
6	GND	Ground pin for control and bias blocks.
7 - 8	GNDP	Ground pin. LED current flows through this pin to ground.

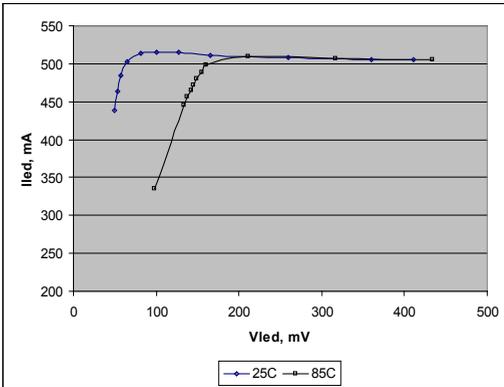## BLOCK DIAGRAM
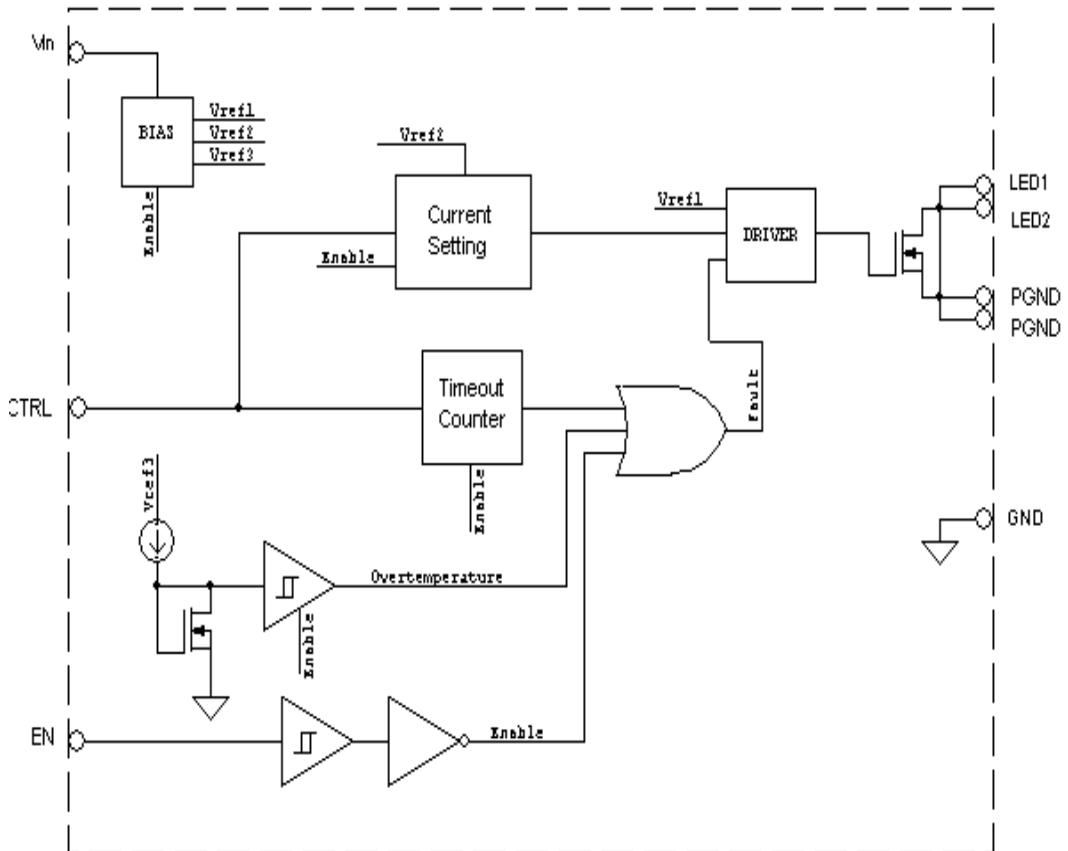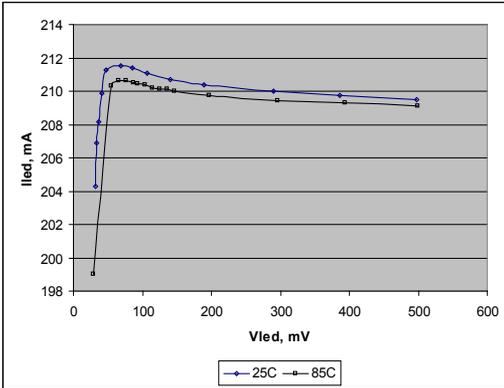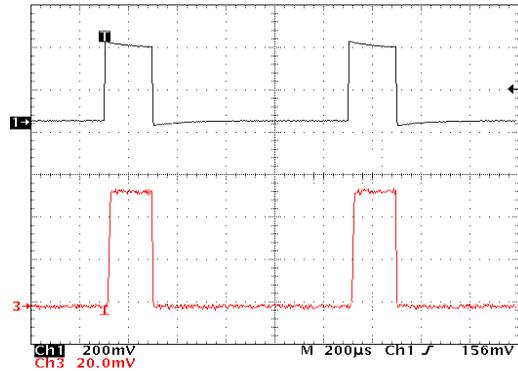
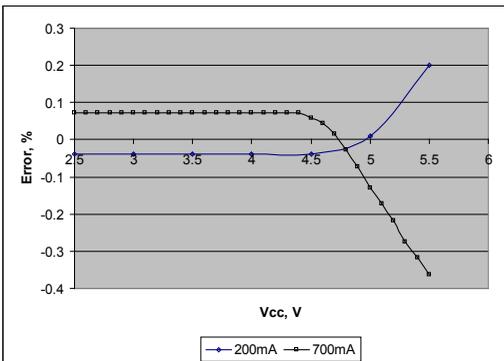SP7619 Load regulation at 200mA I_{LED} current
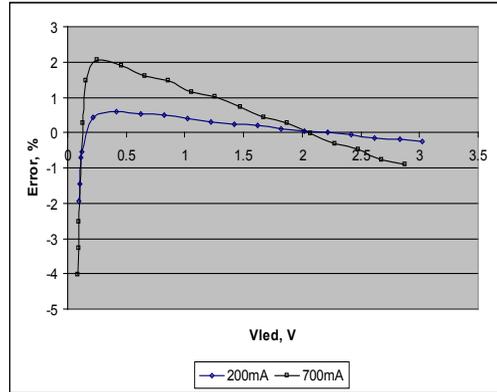
SP7619A Load Regulation at 25°C

SP7619 Load regulation at 500mA I_{LED} current

SP7619 PWM modulation (Channel 1 – PWM signal 1kHz, 20% Duty cycle, 2V/div, Channel 3 -I_{LED} current - 1mV is equal 10mA current)

SP7619A Line Regulation at 25°C

Constant Current LED Driver

Introduction

The SP7619 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, 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 at Flash Mode after 4 seconds of continuous operation if the enable input is not cycled.

Current Setting

The LED output current is defined by internal circuitry. The input to this circuitry is the CTRL pin. LOW logic level determines Torch Mode while HIGH logic level determines Flash Mode with appropriate output currents. The ENABLE pin and CTRL pin logic HIGH level may be applied with Vcc voltage. At Flash Mode 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.

To return the device to the Flash Mode use Shutdown (EN = HIGH to LOW/LOW to HIGH). Switching the CTRL pin LOW during Sleep Mode sets the device into Torch Mode. The LED output current will reach its final value $50\mu s$ after the CTRL pin transition from LOW to HIGH or from HIGH to LOW.

Output Driver

The SP7619 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 LED pins. The I$_{LED}$ current regulation is guaranteed at dropout at the LED pins to be less than 100mV. The regulation attempts to maintain the output current to within five percent of nominal even if the voltage between the LED and GNDP pins varies over a wide range. The nominal output is guaranteed within ±10% of the defined current.

Thermal Protection

The SP7619 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 current setting circuitry remains active. The shutdown temperature is defined to be 160°C typical.

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 SP7619 has a low current shutdown function. In shutdown mode the part draws less than 1µA 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 at 500 (700)mA output current.
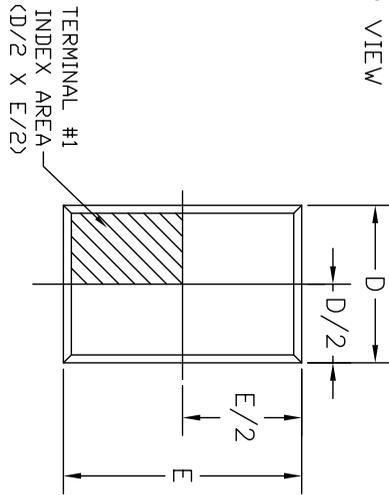
Power-on-Reset

This function is used to set 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 the Vcc and ENABLE pins.

BOARD LAYOUT AND GROUNDING

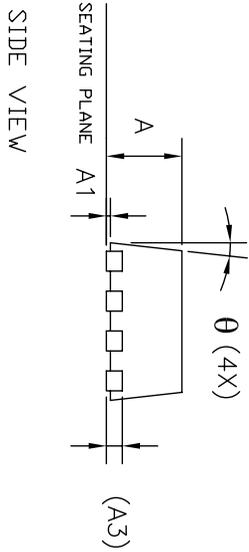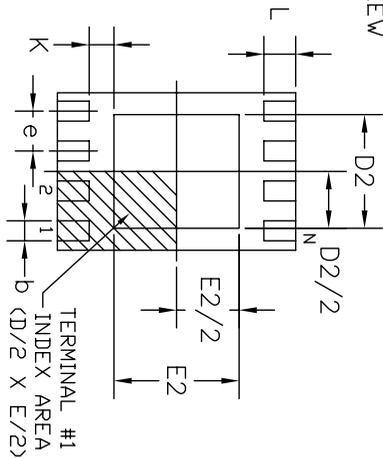To obtain the best performance from the SP7619, a printed circuit board with ground plane is required. High quality, low series resistance ceramic 1µF bypass capacitors should be used at the Vcc pin (pin 3). These capacitors must be located as close to the pins 3 – 6 as possible. The traces connecting the pins and the bypassing capacitor 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 SP7619. The quiescent current for the part flows into the VCC pin and out of the GND pin. This current is proportional to the I_{LED} current divided by approximately 1500.

TOP VIEW

SIDE VIEW

SEATING PLANE

A

A1

A3

θ (4X)

TERMINAL #1
INDEX AREA
(D/2 X E/2)

D

D/2

E/2

E

BOTTOM VIEW

TERMINAL #1
INDEX AREA
(D/2 X E/2)

L

K

e

D2

D2/2

E2/2

E2

b

N

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

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	—	—
θ	0°	—	14°	0°	—	14°
N	8			8		
ND	4			4		

SIPEX CORPORATION

8 PIN 2x3 DFN PACKAGE OUTLINE

Drawing No: 8-PIN 2x3 DFN

Revision: B

Sheet: 1 OF 1

Packaging Approval:

By: JL

Date: 07/17/06

Sipex
Solved by

Part Number	Operating Temperature Range	Package Type
SP7619ER-L...................... ………............	-40 ˚C to +85 ˚C .... …………..8 Pin DFN	
	(Lead Free, 2mm x 3mm)	
SP7619ER-L/TR .... ……….........	-40 ˚C to +85 ˚C .... …………..8 Pin DFN	
	(Lead Free, 2mm x 3mm)	
SP7619AER-L	-40 ˚C to +85 ˚C ....8 Pin DFN	
	(Lead Free, 2mm x 3mm)	
SP7619AER-L/TR	-40 ˚C to +85 ˚C .... …………..8 Pin DFN	
	(Lead Free, 2mm x 3mm)	

/TR = Tape and Reel

Pack quantity is 3,000 for DFN.

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