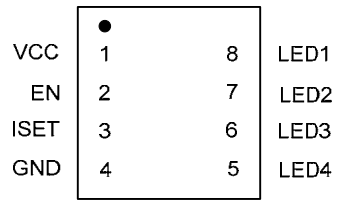
IA2505 Four Channel LED Current Source for Flash and Backlighting

IA2505

3x3 DFN PIN ASSIGNMENT



See back page for ordering information.

DESCRIPTION

The IA2505 is a high-efficiency, low-cost, high-current, parallel LED driver current source specifically designed for running flash and backlighting LEDs. The LED current can be set from 5mA to 80mA on each channel, and the individual LED currents are matched to within +/-10%. LED pulse current can be as high as 200mA for duration of 20msec or less.

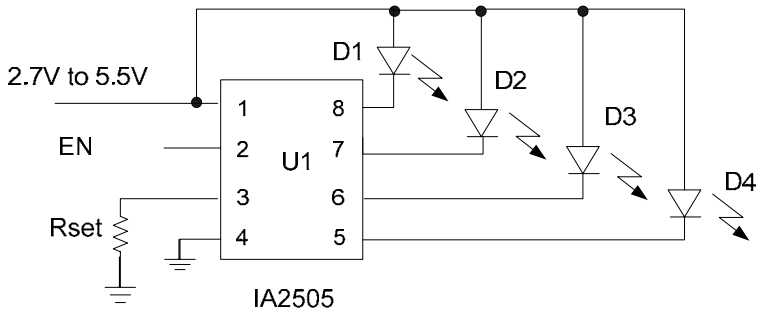
LED brightness can be varied up to the programmed LED current by applying a Pulse Width Modulated (PWM) signal to the EN pin of the device. The LED output current of the IA2505 is tightly controlled over temperature and voltage.

The input supply range is from 2.7V to 5.5V which is ideally suited for single-cell Li-Ion battery supplies. Dropout voltage is only 30mV at 20mA, permitting direct operation from a Li-Ion battery. The IA2505 can also be operated from two or three Alkaline batteries. The only external component required is a resistor that sets the current on each of the four channels.

The IA2505 typically draws only 40µA when operating in the no-load condition and draws less than 0.01µA when the device is shutdown.

The IA2505 is available in a space-saving 3mm x 3mm DFN package.

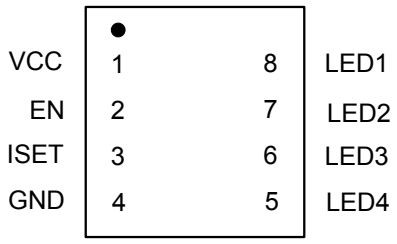
TYPICAL APPLICATION



FEATURES

- High efficiency of 83% at VCC = 3.6V for V_F = 3V
- 30mV dropout at 20mA allows operation at low V_{in}
- No internal switching signals – Eliminates EMI
- LED current settable from 5mA to 80mA with single resistor
- Capable of 200mA pulse current with duration of 20msec or less
- Currents matched to within ±10%
- Minimum external components
- Input voltage from 2.7V to 5.5V
- 1µA maximum shutdown current
- Brightness control using PWM signals
- Rated at -40°C to +85°C operating temperature range
- 3mm x 3mm DFN package

PACKAGE PIN DEFINITIONS



3x3 DFN PIN ASSIGNMENT

Pin Number	Pin Name	Pin Function
1	VCC	Battery input to run the IC and power the LED. Bypass with a 1µF ceramic capacitor to GND
2	EN	Enable pin. Driving this pin to logic high or connecting to VCC enables the device. Driving this pin to logic low shuts down the device. Dimming can be achieved by driving EN with a PWM signal
3	ISET	A resistor to ground sets the output current.
4	GND	**Ground**.
5-8	LED1-4	**LED Cathodes**. Connect these pins to the cathodes of the LEDs. Any number of these pins may be tied together for higher current.

ELECTRICAL SPECIFICATION

Absolute Maximum Ratings (Note 1, 2)

Parameter	Min	Max	Units
All Pins	-0.3	+6	V
LED Sink Current (per channel)		200	mA
Junction Temperature Range		+150	°C
Storage temperature	-65	+150	°C
Max lead temperature during soldering (5 sec.)		260	°C

Note 1. Operation beyond absolute maximum rating or improper use may result in permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods or to conditions beyond absolute maximum rating conditions may adversely affect device reliability. Functional operation under absolute maximum rating conditions is not implied.

Note 2. Devices are ESD sensitive. Handling precautions are recommended.

Operating Ratings (Note 3)

Parameter	Min	Max	Units
Supply Voltage	2.7	5.5	V
LED Continuous Sink Current (per channel)	5	80	mA
LED1 – LED4 Pin Voltage		5.5	V
Operating Ambient Temperature Range	-40	+85	°C
LED Pulse Sink Current for 20msec Duration		200	mA

Note 3. The device is not designed to function outside its operating ratings.

Package Information

Package Type	Tj(max)	θjA
8 – Lead (3mm x 3mm) Plastic DFN	150°C	43°C/W

Dissipation Ratings (Note 4)

Package Type	θjA	T_A = 70°C Power Rating	T_A = 85°C Power Rating
8 – Lead (3mm x 3mm) Plastic DFN	43°C/W	1.86W	1.51W

Note 4. Power ratings were calculated with Tj(max) = 150°C

Electrical Characteristics

Test conditions T_A = 25 °C, VCC = +5V, unless otherwise noted.
The • denotes specifications which apply over the full operating temperature range.

Parameters	Condition		Min	Typ	Max	Units
VCC						
Supply Current	EN = 0V EN ≥ 4.5V(No Load) with Rset = open	• •		0.01 40	1 55	µA µA
EN (ENABLE)						
Enable Threshold	Logic Low Logic High	• •	 0.9VCC		0.8	V V
Enable Input Current		•	-1	0.01	1	µA
Turn-on Time				600		µsec
Turn-off Time				10		µsec
LED CURRENT						
Sink Current	Rset = 60KΩ Rset = 15KΩ		15 70	20 80	25 90	mA mA
Channel Current Matching	Rset = 60KΩ, LED Pins Voltage = 1V Rset = 15KΩ, LED Pins Voltage = 1V			10 5		% %
Dropout Voltage (Note 5)	Rset = 60KΩ	•		30	50	mV
LED Leakage Current	LED Pins Voltage = 3.0V	•	-1	0.01	1	µA
ISET						
Iset Voltage	Rset = 60KΩ, VCC = 5V	•	1.12	1.20	1.32	V
Leakage Current	Iset Voltage = 1.2V	•	-1	0.01	1	µA
LED Current Set Factor, α	Rset = 60KΩ, $\alpha = I_{led} * Rset$		900	1200	1500	
OTHER						
Thermal Shutdown				160		°C
Thermal Shutdown Hysteresis				10		°C

Note 5. Dropout voltage is defined as the LED pin voltage at which the LED current is 80% of the LED nominal current at VCC = 5V

DETAILED DESCRIPTION

The IA2505 is a high-efficiency, low-cost, high-current, four channel LED current source specifically designed for running flash and backlighting LEDs. LED current can be set from 5mA to 80mA on each channel, and the individual LED currents are matched to within +/-10%. LED pulse current can be as high as 200mA for duration of 20msec or less. Dropout voltage is only 30mV at 20mA, permitting direct operation from a Li-Ion battery. The IA2505 can also be operated from two or three Alkaline batteries or a Lithium battery cell. The only external component required is a resistor that sets the current. The IA2505 is available in an MSOP-8 and a space-saving 3mm x 3mm DFN package.

Startup

When the IA2505 EN pin is pulled high, the four outputs begin pulling the correct current within 600µsec. No soft-start capacitor is required.

Backlight Operation

The IA2505 can be used for backlight operation with four channels in parallel. The current is set by the resistor connected from the I_{set} pin, the output current being inversely proportional to the resistor value according to the formula

$I_{out} = \alpha / R_{set} = 1200 / R_{set}$,

where I_{out} is the current in each single LED. As the voltage applied to the anodes of the LEDs decreases, the current through the LEDs will remain constant, until there is insufficient voltage to forward bias the LEDs at that current. This occurs when the voltage on the LED pin of the IA2505 reaches approximately 30mV. For best operation, the battery voltage should be at least 30mV higher than the maximum LED forward bias voltage.

Flash-Mode Operation

The IA2505 is suitable for running one to two standard LEDs for use in a camera flash, or for running a high-power LED for the same purpose. To run two LEDs for flash, the current may be set to 200mA/LED by selecting a 5.6KΩ SET resistor, and then running the EN from the shutter signal. The flash duration should be 20msec or less. As shown in the Typical Characteristics, turn-on time is < 600µsec, and turn-off is about 10µsec

The 1W LEDs in this configuration can also be run as a flashlight (torch) by attaching another resistor to the SET pin through a switch. The designer need only be careful to avoid excessive power dissipation in the IC.

Input and Output Capacitors

Since the IA2505 has no switching, input capacitor is optional for this circuit. However, if the LED current is intended to be modulated, for example by Pulse Width Modulating the EN pin for dimming, or for camera flash, an input capacitor of 100nF value is recommended. A surface-mount multi-layer ceramic capacitor (MLCC) is recommended. MLCCs are small, inexpensive and have very low equivalent series resistance (ESR, ≤15mΩ). Table 1, Ceramic Capacitor Manufacturers lists suggested capacitor suppliers for the typical application circuit

Manufacturer	Contact
TDK	www.component.tdk.com
Murata	www.murata.com
Taiyo Yuden	www.t-yuden.com

Table 1: Ceramic Capacitor Manufacturers

EMI

Since the IA2505 doesn't switch, it generates no noise, eliminating troublesome electromagnetic interference (EMI).

Enable

The IA2505 can be turned off by pulling the EN pin low. It has an active-high EN pin (LOW = shutdown, HIGH = ON). In the shutdown condition, there is extremely low leakage current into the IC, and very low current into the LEDs. The IA2505 typically draws only 40µA when operating in the no-load condition and draws less than 0.01µA when the device is shutdown.

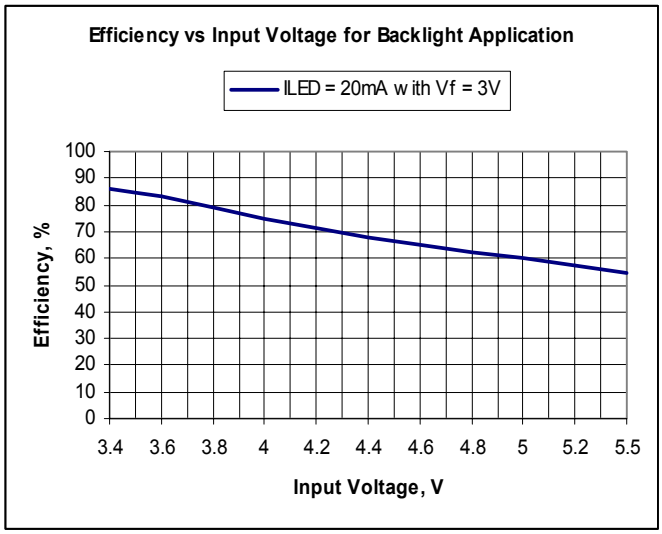
PWM Brightness Control

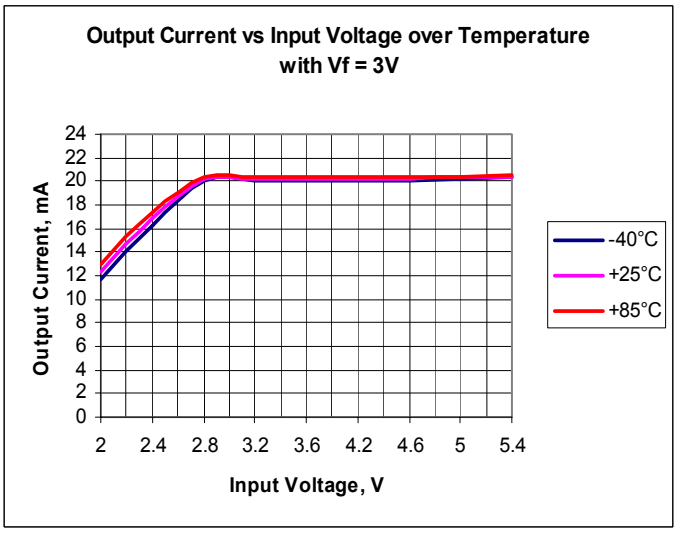
The brightness of the LEDs can be varied from zero up to the maximum programmed current level by applying a Pulse Width Modulated (PWM) signal to the EN pin of the IA2505. LED brightness is proportional to the duty cycle of the PWM signal. PWM frequency greater than 100Hz is recommended to avoid flickering of the LED light. For the IA2505, zero duty cycle will turn off the LEDs and a 50% duty cycle will result in an average output current being half of the programmed LED current.

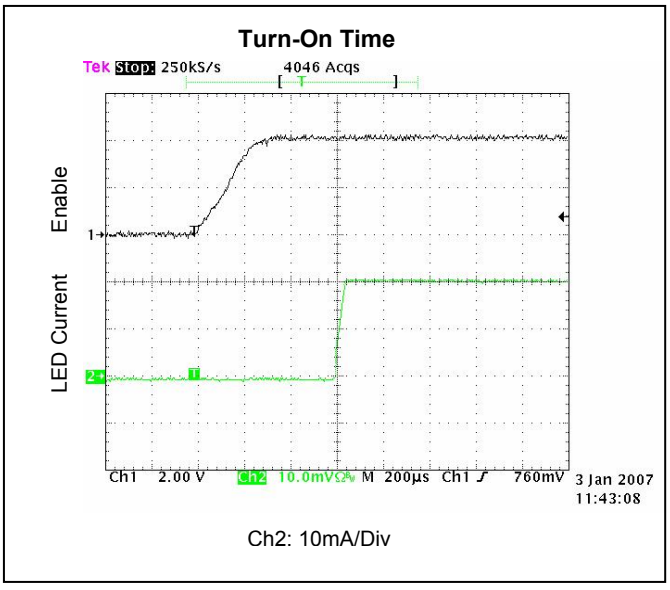
Thermal Shutdown

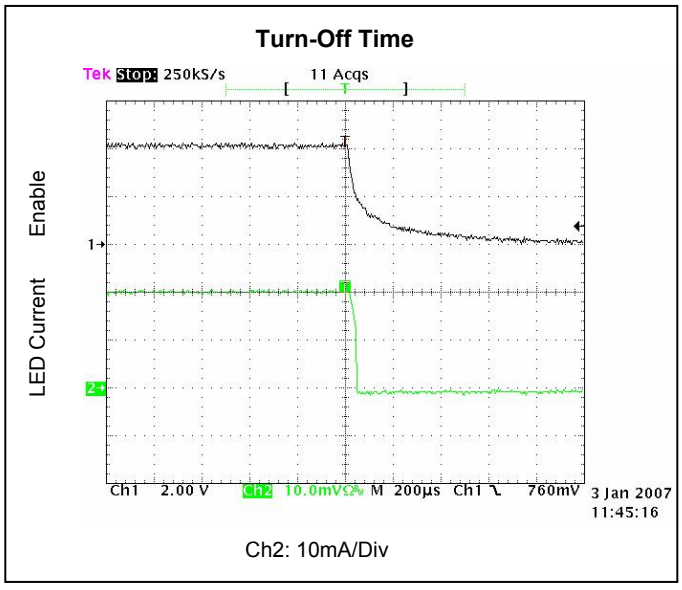
If the IA2505 junction temperature reaches 160°C, the IC will automatically shutdown. Once the junction temperature cools down by 10°C, the device will turn on.

TYPICAL CHARACTERISTICS

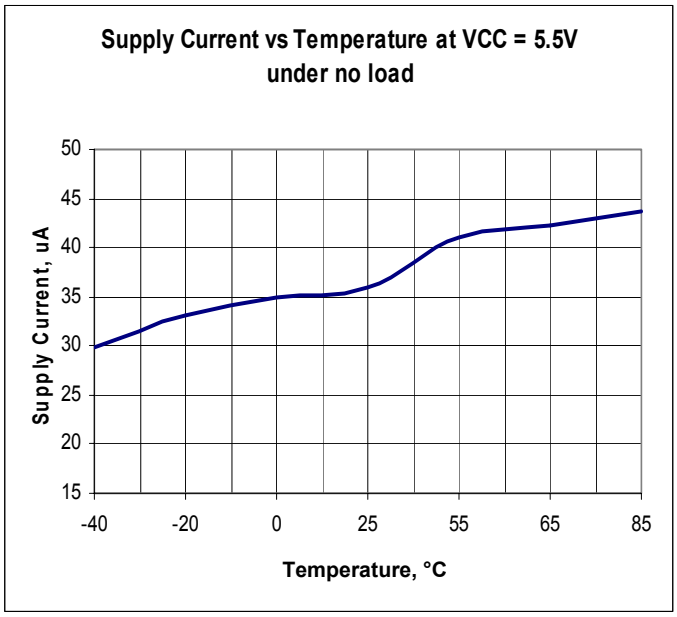


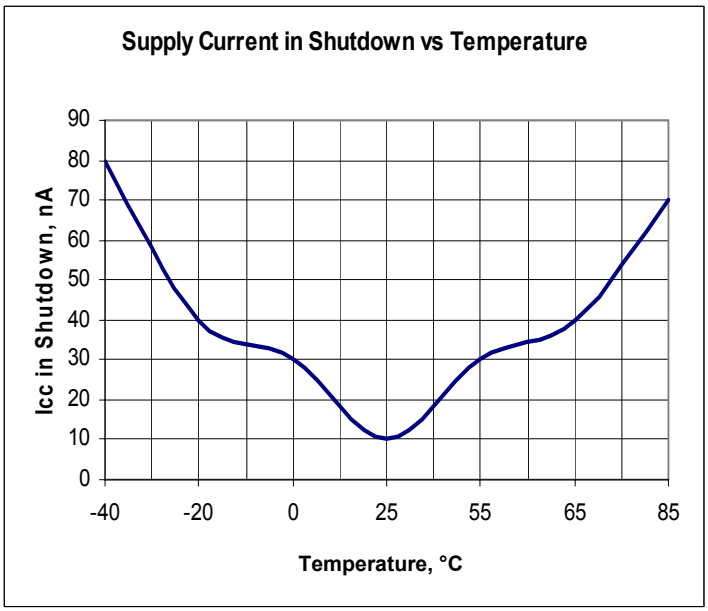


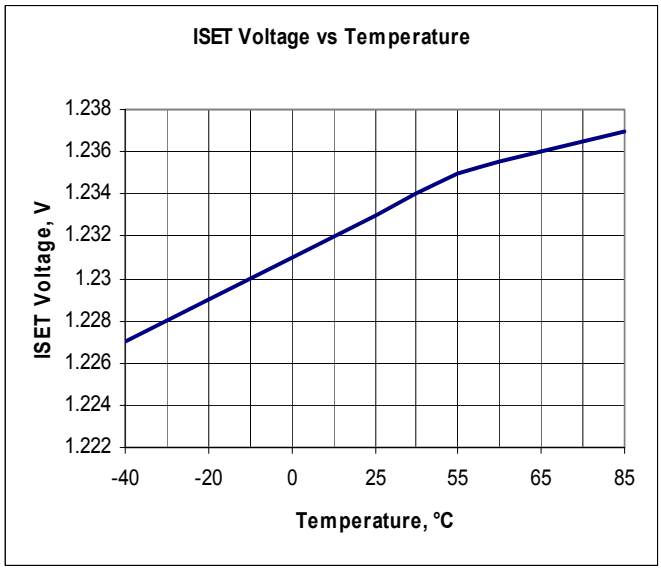


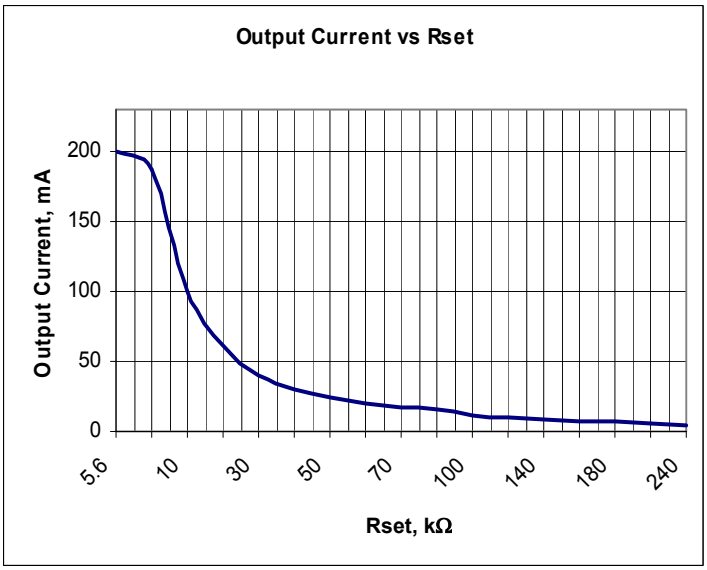


TYPICAL CHARACTERISTICS (CONT.)

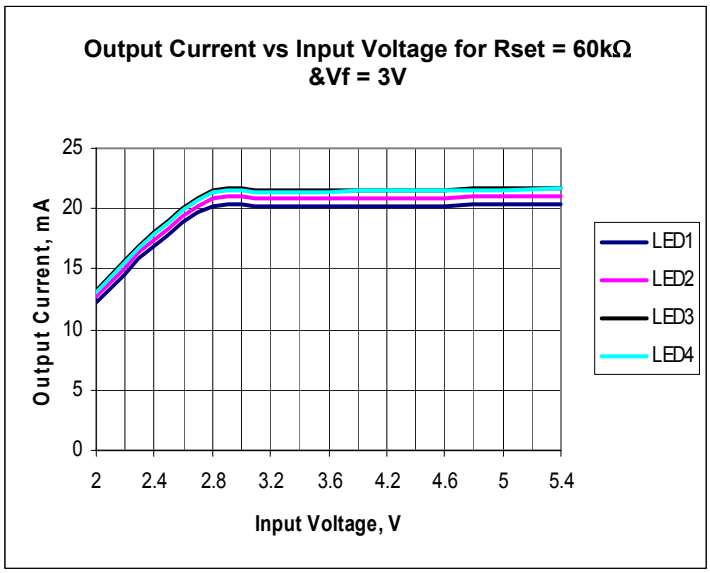


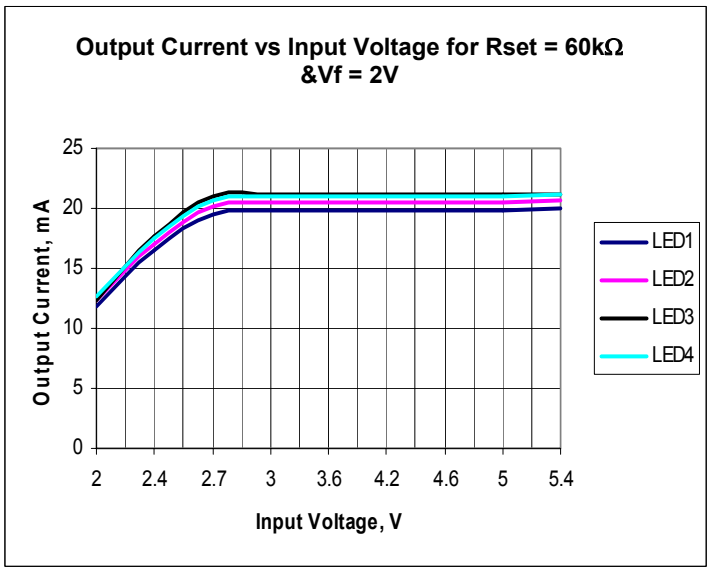


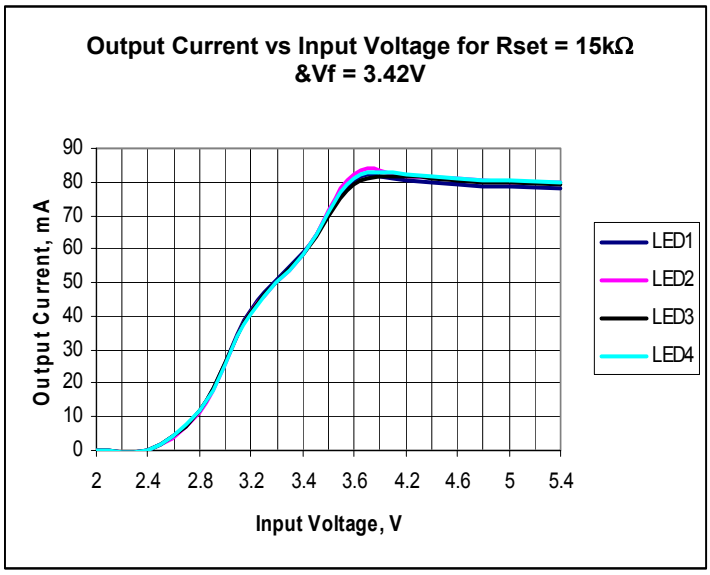




TYPICAL CHARACTERISTICS (CONT.)







TYPICAL APPLICATIONS

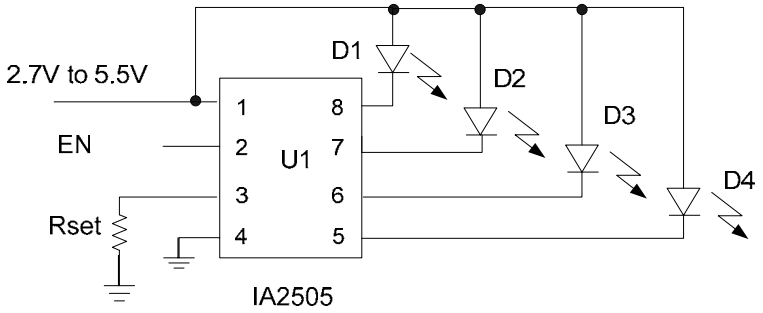


Figure 1: Application Circuit for 4 Super-bright White LEDs at 20mA Each

Bill of Materials for Figure 1:

Reference	Manufacturer Example Part #	Quantity	Description	Notes
R1	Any	1	59.7KΩ	SMD 0805 size
D1-4	Lumex LX5093UWC/C	4	Super-bright White LED	V_F = 3.0V @ 25mA
U1	Silicon Labs IA2505	1	Four Channel LED Current Source for Flash and Backlighting	

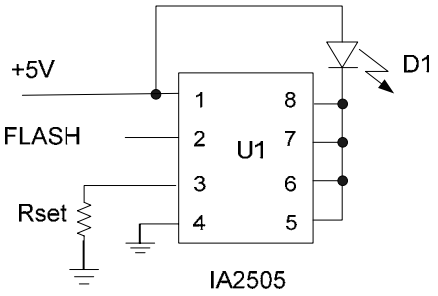
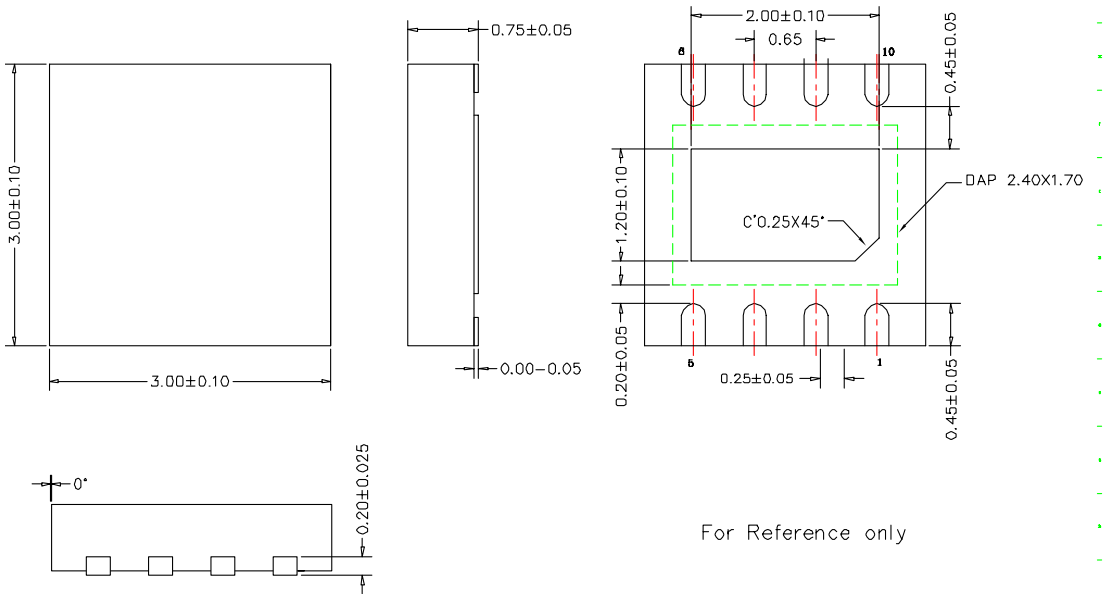


Figure 2: Application Circuit for 3W White LED Flash at 800mA (20msec duration or less)

Bill of Materials for Figure 2:

Reference	Example Manufacturers Part #	Quantity	Description	Notes
R1	Any	1	5.6KΩ	SMD 0805 size
D1	Lumileds LXHL-PW09	2	3W Super-bright White LED	V_F = 3.7V @ 700mA
U1	Silicon Labs IA2505	1	Four Channel LED Current Source for Flash and Backlighting	

PACKAGE INFORMATION



3x3 DFN PACKAGE NOTES:

Dimensions and tolerance per ANSI Y14.5M-1982.
Dimensions A and B are datum's and T is a datum surface.
Controlling dimensions: Millimeters
Dimension A and B do not include mold flash. Mold flash shall not exceed 0.15mm [0.006] per side.
Dimension D does not include interlead flash. Interlead flash shall not exceed 0.25 mm [0.010].

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RELATED PRODUCTS AND DOCUMENTS

IA2505 4-Channel LED Current Source for Flash and Backlighting

DESCRIPTION	ORDERING NUMBER	
IA2505 DFN 3x3	IA2505-IC CP8	Revision #

Demo Boards and Development Kits

DESCRIPTION	ORDERING NUMBER
TBD	See www.silabs.com/integration for details
TBD	See www.silabs.com/integration for details

Note: Volume orders must include chip revision to be accepted.

Silicon Labs, Inc.
400 West Cesar Chavez
Austin, Texas 78701
Tel: 512.416.8500
Fax: 512.416.9669
Toll Free: 877.444.3032
www.silabs.com/integration
powerproducts@silabs.com