

Flash LED Driver IC**High Efficiency Synchronous Boost Converter, 1.5A Flash LED Drivers With PWM Dimming****AS6585B****● General Description**

The AS6585B is a 3MHz fixed frequency synchronous boost converter, optimized for 0.75A/ch, total 1.5A flash current output LED driver with PWM dimming function, for distance dimming camera flash LED application and maximum 800mA movie mode applications using high-current white LEDs in all single cell Li-ion powered products. An adaptive regulation method ensures the current for each LED remains in regulation and maximizes efficiency.

Two simple logic control inputs (ENM and ENF) enable and disable flash and movie mode operation of the AS6585B. The movie-mode and flash-mode current levels are independently fixed by two separate resistors (RSETM and RSETF).

For flash mode, a default timer 800ms can be used either to terminate a flash event or as a safety flash timer. One or two LEDs can be connected to the AS6585B; in the case of two LEDs the output current is matched between each diode. The real LED current at flash mode and movie/torch mode can be programmed by external PWM signal at ENM pin.

The AS6585B integrate an intelligent flash current control mode: during flash current turn-on the input voltage falls below the flash mode VIN Monitor threshold, the flash current is stopped at the level that the current ramp had risen to, at the time of the VIN Flash Monitor events.

The AS6585B contain a thermal management system to protect the device; a internal over-voltage protection (OVP) circuitry prevents damaged to the AS6585B from open LED or open circuit conditions; and a cycle-by-cycle current limit prevents damage to the AS6585B. Built-in circuitry prevents excessive inrush current during start-up. The shutdown feature reduces quiescent current to less than 1.0μA.

The 3MHz switching frequency allow for the use of tiny, low profile (0.47uH or 1.0uH) inductors and 4.7uF ceramic capacitors. The device is available in 14-pin 2mmX3mm DFN package and is rated over the -40°C to 85°C.

● Features

- Input Voltage Range : 2.7V to 5.0V
- Power On Flash Mode Spurious Triggering Suppress
- Up to 3.0MHz Switching Frequency for Smaller Inductor Using
- Output Current Soft-Start
- Optimize Flash Current During Low Battery
- Intelligent Flash Current Control
- Drives up to 1.5A Output Current (0.75A per Channel)
- High Efficiency PWM Boost Converter
- Up to 97% Efficiency with Small Inductor
- Under Voltage Lock-Out
- Over-Temperature Protection
- Over Voltage (Open LED) Protection
- LED Short Circuit Protection
- Flash Mode and Movie/Torch Mode LED Current can be Programmed via PWM Signal at ENM pin
- Flash Mode PWM Dimming Frequency: 1kHz to 200KHz
- 800ms Flash Timer Control
- Cycle by Cycle Current Limit
- Separate Hardware Flash and Movie Enable
- Set Flash/Movie Currents
 - ✓ Flash Mode Current: 0.75A/Ch
 - ✓ Movie Mode Current: 0.40A/Ch
- Two Resistors Set Flash and Movie Current Independently
- Small Solution Size
- Less than 1uA Shutdown Current
- RoHS and Green Compliant
- 14- pin, 2mm X 3mm DFN Packages
- -40°C to +85 °C Temperature Range

● Applications

- Camera Flashes and Movies
- Cell Phones or Smart Phones
- PDAs and Digital Camera
- White LED Biasing
- Mobil Handsets
- Tablet PCs and Laptops/Netbooks
- Camcorder Video Light (Movie Light)

Ordering Information

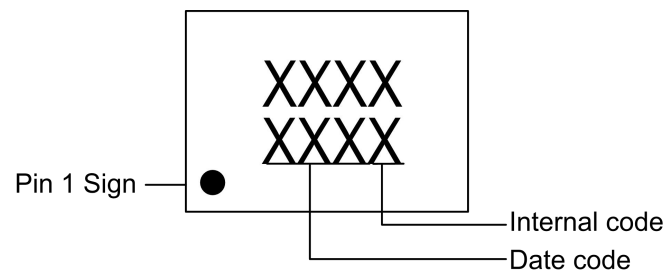
AS6585BXXXX

Package: D:DFN2030-14L Packing: R:Tape&Reel Temperature Grade: N: -40°C~85°C Lead: C:Cu

Part Number	Driver Capability	Package Type	Package Qty	Temperature	Eco Plan	Lead
AS6585BDRNC	1.5A	DFN2030-14L	7-in reel 3000pcs/reel	-40~85°C	Green	Cu

Marking Information

DFN2030-14L



Typical Application Circuit

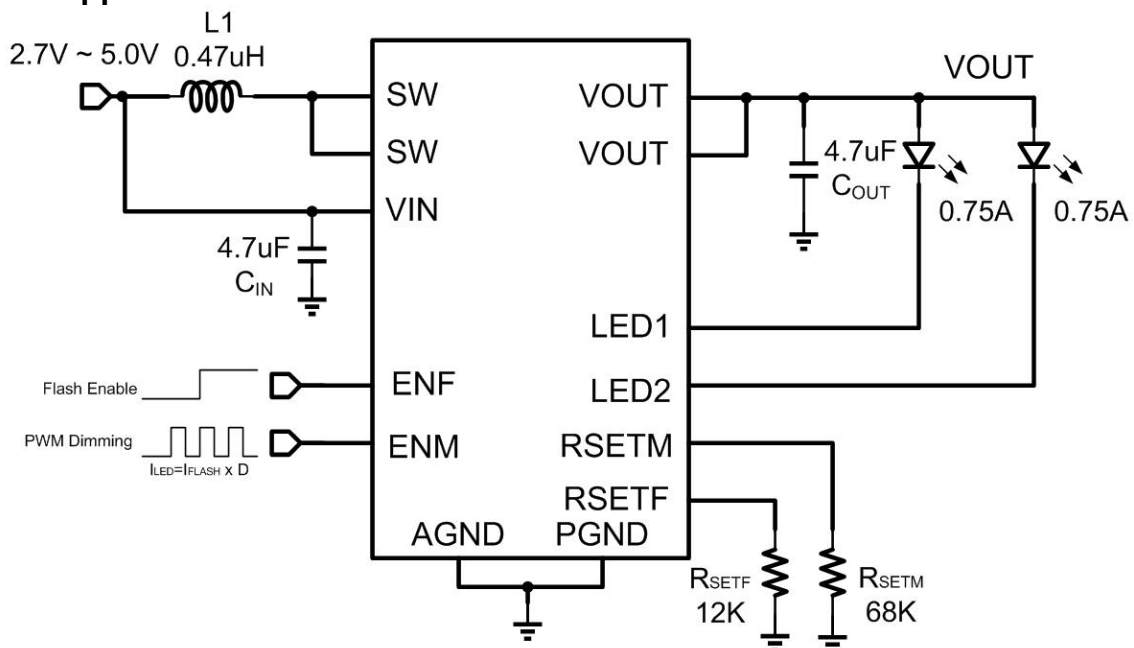


Figure 1, Flash Dimming Typical Application Circuit of AS6585B

■ Pin Configuration

DFN2030-14L (Top View)

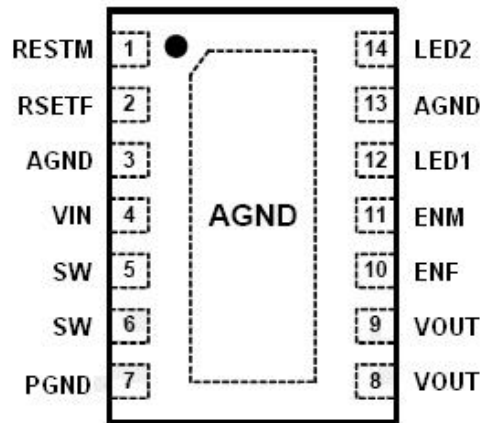


Figure 2, Pin Assignments of AS6585B

Pin Name	Pin No.	I/O	Pin Function
	DFN2030-14L		
RSETM	1	I/O	Movie mode current setting input. A 68kΩ resistor from RSETM to GND sets the desired movie current available at LED1 and LED2 up to 200mA total current. Each LED1 and LED2 channel will conduct 50% of the maximum programmed current.
RSETF	2	I/O	Flash mode current setting input. A 12kΩ resistor from RSETF to GND sets the maximum flash current available at LED1 and LED2 up to 1.5A total current. Each LED1 and LED2 channel will conduct 50% of the maximum programmed current.
AGND	3	P	Analog Ground and flash ground.
VIN	4	P	Power input. Connect VIN to the input power supply voltage. Connect a 4.7uF ceramic capacitor from VIN to GND as close as possible to AS6585B.
SW	5, 6	O	Drain connection for internal NMOS and Synchronous PMOS Switches.
PGND	7	P	Boost power ground pin.
VOUT	8, 9	O	Power output of the boost converter. Connect a 4.7uF ceramic capacitor from OUT to PGND as close as possible to the AS6585B.
ENF	10	I	Flash mode enable pin. No matter the status of ENM, only when ENF = "High", Flash mode is in active and the flashing current is equal to $I_{FLASH} \times D$. D is the duty cycle of PWM signal at ENM pin. The frequency of PWM is larger than 1kHz, and less than 200KHz.
ENM	11	I	Movie/Torch mode enable pin. In flash mode, the PWM signal at ENM pin is the flashing current dimming control. When ENF="Low" and ENM="high", movie/torch mode will be in active. The LED current should be equal to $I_{MOVIE} \times D$. D is the duty cycle of PWM signal at ENM pin. When ENF="Low" and the time of ENM="Low" is not less than 5mS, the chip will enter into shutdown mode.
LED1	12	O	Channel 1 flash LED pin. Connect cathode of a flash LED to AGND. For a single flash LED, connect LED1 and LED2 together. For two flash LEDs, each output will conduct of 50% of the total flash current. LED1 is high impedance during shutdown.
AGND	13	P	Analog Ground and flash ground.
LED2	14	O	Channel 2 flash LED pin. Connect cathode of a flash LED to AGND. For a single flash LED, connect LED1 and LED2 together. For two flash LEDs, each output will conduct of 50% of the total flash current. LED2 is high impedance during shutdown.
GND	EP	P	Exposed paddle (bottom). Connect EP to PGND as close as possible.

Figure 3, Block Diagram of AS6585B

Parameter	Symbol	Rating	Unit
V _{IN} Pin to GND	V _{IN}	-0.3 to +6.0	V
All Other Pins to GND		-0.3 to V _{IN} + 0.3	V
Storage Temperature Range	T _S	-55 to +150	°C
Operating Junction Temperature Range	T _J	-40 to +150	°C
Maximum Soldering Temperature (at leads, 10 sec)	T _{LEAD}	300	°C

Parameter		Symbol	Rating	Unit
V _{IN} Pin Voltage to GND		V _{IN}	+2.7 to +5.0	V
Flash LED Current		I _{FLASH}	Up to 1500	mA
Movie LED Current		I _{MOVIE}	Up to 800	mA
Operating Temperature Range		T _{OP}	-40 to +85	°C
Maximum Thermal Resistance	DFN2030-14L	Θ _{JA}	75	°C/W
Maximum Power Dissipation	T _A <25°C	P _D	1.35	W

■ Electrical Characteristics

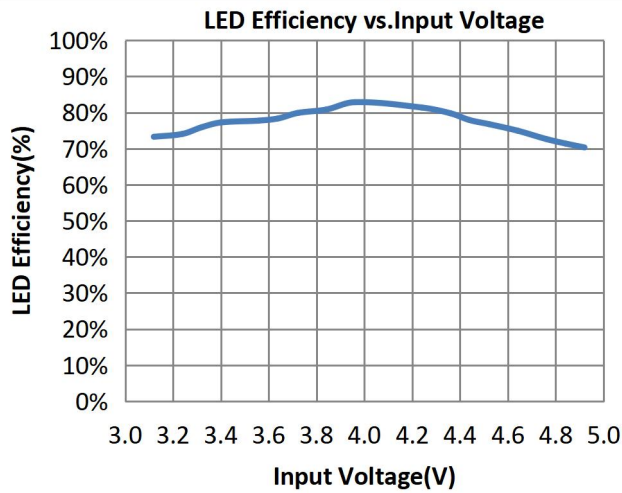
($T_A = -40$ to $+85^\circ\text{C}$ unless otherwise noted. Typical values are at $T_A = +25^\circ\text{C}$, $V_{IN} = V_{EN} = 3.6\text{V}$, $C_{IN}=C_{OUT}=4.7\mu\text{F}$, $L=0.47\mu\text{H}$, $R_{RSETF}=12\text{k}\Omega$, $R_{RSETM}=68\text{k}\Omega$)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
Supply						
V_{IN}	Input Voltage		2.7	-	5.0	V
I_Q	Supply Current (non switching)	$V_{OUT} = 3.0\text{V}$	-	450	900	μA
	Supply Current (switching)	$V_{OUT} = 4.5\text{V}$	-	1.5	2.5	mA
I_{SHDN}	Supply Current Shutdown	$V_{ENM} = V_{ENF} = 0\text{V}$	-	0.1	1	μA
V_{UV}	V_{IN} Under Voltage Lockout	V_{IN} Rising	-	2.50	2.70	V
V_{UVLO}	Under Voltage Lockout Hysteresis		-	150		mV
V_{FLASH_TH}	V_{IN} Flash Monitor Threshold		-	3.05	-	V
T_{ST}	Soft Start Time		-	1.8	-	mS
Boost DC-DC Converter						
R_{NMOS}	NMOS Switch On-Resistance	$I_{NMOS}=1\text{A}$	-	80	-	m Ω
R_{PMOS}	PMOS Switch On-Resistance	$I_{PMOS}=1\text{A}$	-	65	-	m Ω
I_{CL}	Switch Current Limit	$3.0\text{V} < V_{IN} < 4.2\text{V}$	-	3.7	-	A
F_{SW}	Switching Frequency	$3.0\text{V} < V_{IN} < 4.2\text{V}$	-	3.0	-	MHz
D_{MAX}	Maximum Duty Cycle		65	75	-	%
T_{TF}	Movie to Flash Current Settling Time		-	2.5	-	mS
V_{OVP}	Output Over Voltage Protection		-	5.1	-	V
	Output Over Voltage Hysteresis		-	0.2	-	V
η_1	Boost Output Efficiency	$I_{FLASH} = 1.5\text{A}$	-	97	-	%
η_2	LED Efficiency	$I_{LED} = 0.2\text{A}$	-	85	-	%
LED Current Sink						
I_{FLASH}	Maximum Flash Current	$R_{RSETF}=12\text{k}\Omega$, LED1+LED2	1.35	1.5	1.65	A
I_{MOVIE}	Maximum Movie Current	$R_{RSETM}=68\text{k}\Omega$, LED1+LED2	180	200	210	mA
I_{LEDF_ACC}	Flash Current Sink Current Accuracy	$I_{LED1}=I_{LED2}=0.75\text{A}$	-10	1	+10	%
I_{LEDM_ACC}	Movie Current Sink Current Accuracy	$I_{LED1}=I_{LED2}=0.2\text{A}$	-10	1	+5	%
I_{LED_DIS}	LED1 and LED2 Dismatch	$I_{LED1}=I_{LED2}=0.75\text{A}$	-	1	-	%
$V_{LED1/2}$	Current Sink Saturation Voltage	$I_{LED1}=I_{LED2}=0.75\text{A}$	-	350	-	mV
T_{CT}	Maximum Flash ON Time		-	800	-	mS
I_{LEDSC}	LED Short Circuit Sink Current		-	1.0	-	mA
$F_{Dimming}$	Flash Mode Dimming Frequency		1	-	200	kHz
Delay Time to Shutdown Status in Movie/Torch Mode (For PWM Dimming LED Current)						
T_D	Delay Time		5	-	-	mS
ENM and ENF Enable Specifications						
V_{ENL}	EN OFF Threshold	V_{EN} Falling	0	-	0.4	V
V_{ENH}	EN ON Threshold	V_{EN} Rising	1.0	-	V_{IN}	V
R_{EN}	EN Pin Pull-down Resistor		200	300	400	k Ω
T_{ENF_ON}	Flash Mode ON Delay Time		-	2.5	-	mS
T_{ENF_OFF}	Flash Mode OFF Delay Time		-	2	-	μS
Thermal Shutdown						
T_{TH}	Thermal Shutdown		-	150	-	$^\circ\text{C}$
T_{HS}	Thermal Shutdown Hysteresis		-	25	-	$^\circ\text{C}$

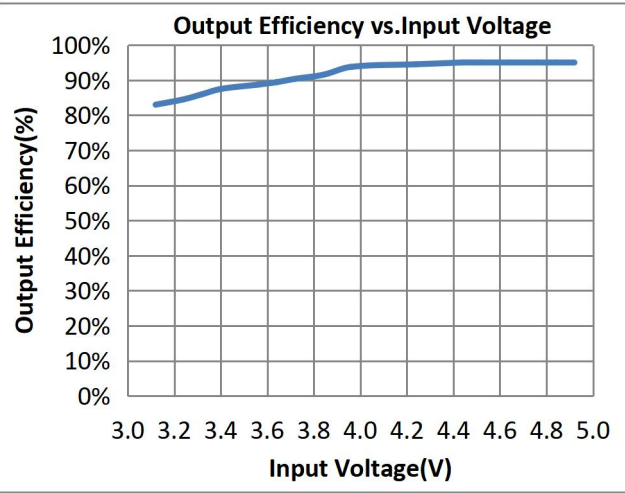
■ Typical Characteristics—AS6585B

(Unless otherwise noted, $V_{IN} = V_{EN} = 3.6V$, $C_{IN} = C_{OUT} = 4.7\mu F$, $L = 0.47\mu H$, $R_{RSETF} = 12k\Omega$, $R_{RSETM} = 68k\Omega$)

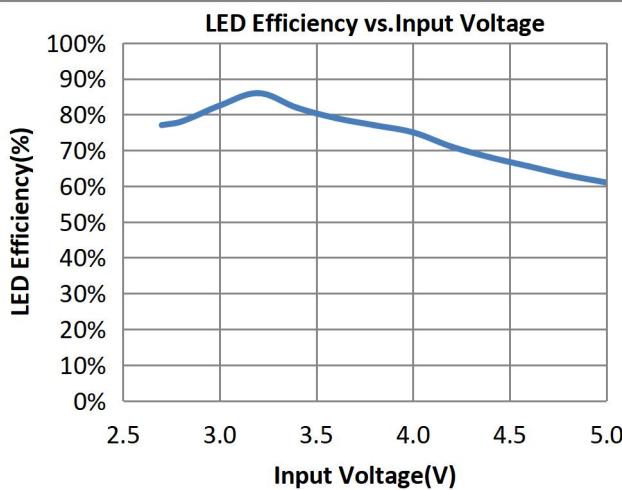
Flash Mode LED Efficiency vs. Input Voltage
($I_{LED} = 1.5A$)



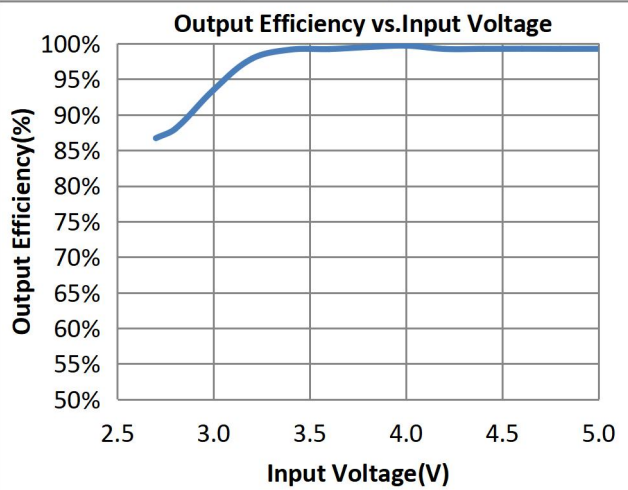
Flash Mode Output Efficiency vs. Input Voltage
($I_{LED} = 1.5A$)



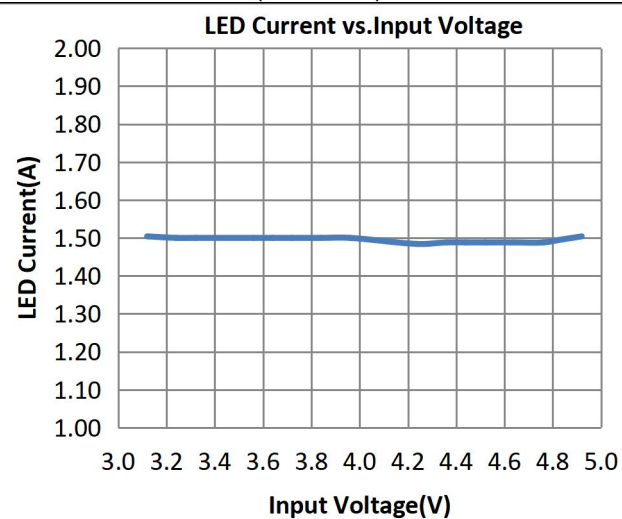
Movie Mode LED Efficiency vs. Input Voltage
($I_{LED} = 200mA$)



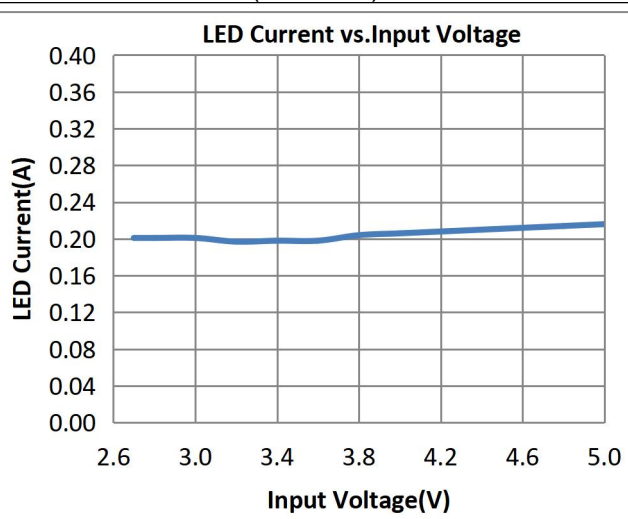
Movie Mode Output Efficiency vs. Input Voltage
($I_{LED} = 200mA$)



Flash Mode LED Current vs. Input Voltage
($I_{LED} = 1.5A$)



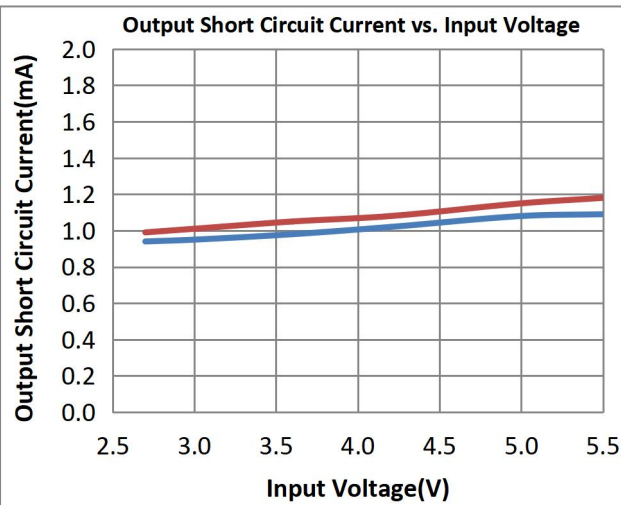
Movie Mode LED Current vs. Input Voltage
($I_{LED} = 0.2A$)



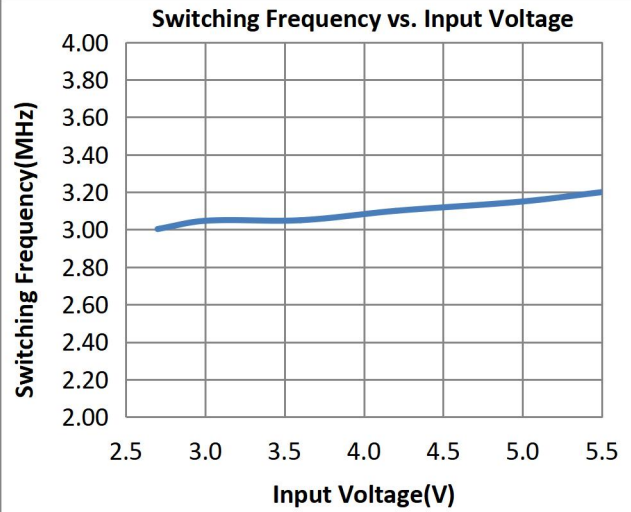
Typical Characteristics—AS6585B

(Unless otherwise noted, $V_{IN} = V_{EN} = 3.6V$, $C_{IN} = C_{OUT} = 4.7\mu F$, $L = 0.47\mu H$, $R_{RSETF} = 12k\Omega$, $R_{RSETM} = 68k\Omega$)

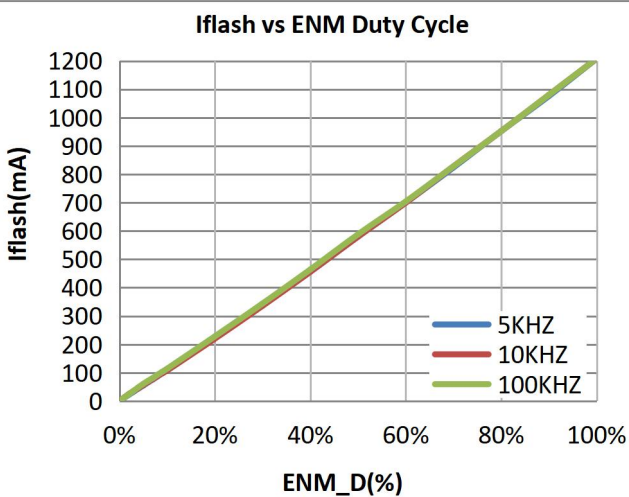
LED Short-circuit Current Limit vs. Input Voltage



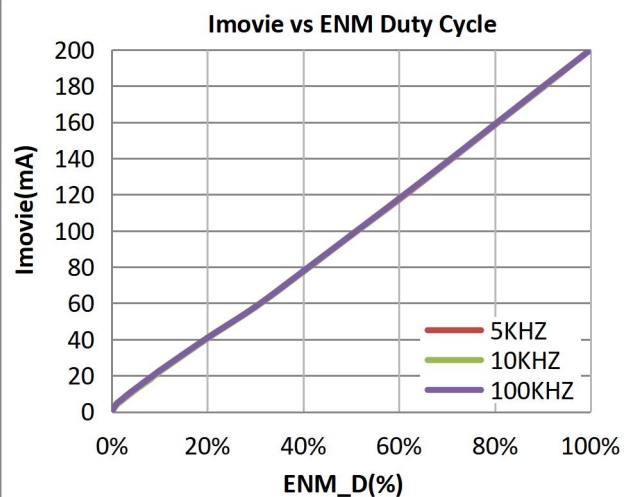
Switch Operation Frequency vs. Input Voltage
(Temp=25°C)



Flash Current vs. PWM Duty Cycle
($R_{RSETF} = 15k\Omega$)



Movie Current vs. ENM Pin PWM Duty Cycle



Flash Timeout Time Waveform
(CH1=V_{SW}, CH2=V_{ENM}, CH3=V_{OUT}, CH4=I_{LED})



Open-LED Protection Waveform
(CH1=V_{SW}, CH2=V_{ENM}, CH3=V_{OUT}, CH4=I_{LED})



■ Typical Characteristics—AS6585B

(Unless otherwise noted, $V_{IN} = V_{EN} = 3.6V$, $C_{IN} = C_{OUT} = 4.7\mu F$, $L = 0.47\mu H$, $R_{RSETF} = 12k\Omega$, $R_{RSETM} = 68k\Omega$)

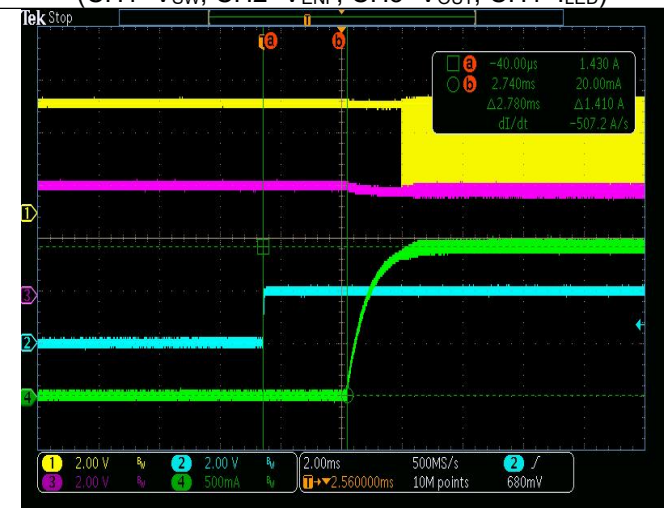
Flash to Movie Mode Current Response Waveform
(CH1= V_{SW} , CH2= V_{ENM} , CH3= V_{OUT} , CH4= I_{LED})



Movie to Flash Mode Current Response Waveform
(CH1= V_{SW} , CH2= V_{ENF} , CH3= V_{OUT} , CH4= I_{LED})



LED Current for Flash On Waveform
(CH1= V_{SW} , CH2= V_{ENF} , CH3= V_{OUT} , CH4= I_{LED})



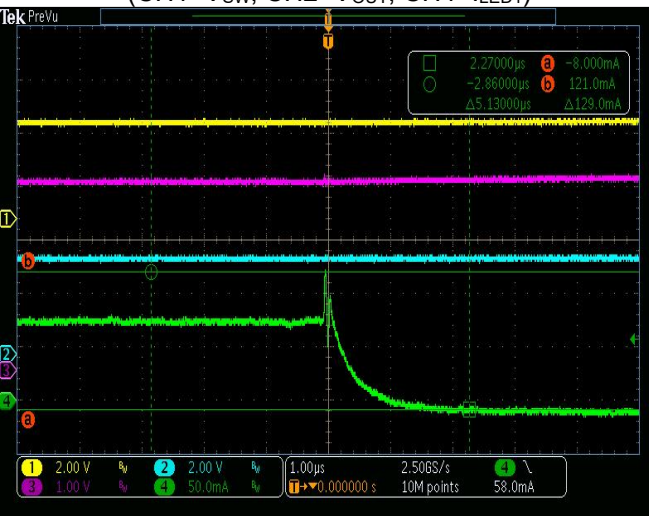
LED Current for Flash Off Waveform
(CH1= V_{SW} , CH2= V_{ENF} , CH3= V_{OUT} , CH4= I_{LED})



LED Current for Movie On Waveform
(CH1= V_{SW} , CH2= V_{ENM} , CH3= V_{OUT} , CH4= I_{LED})



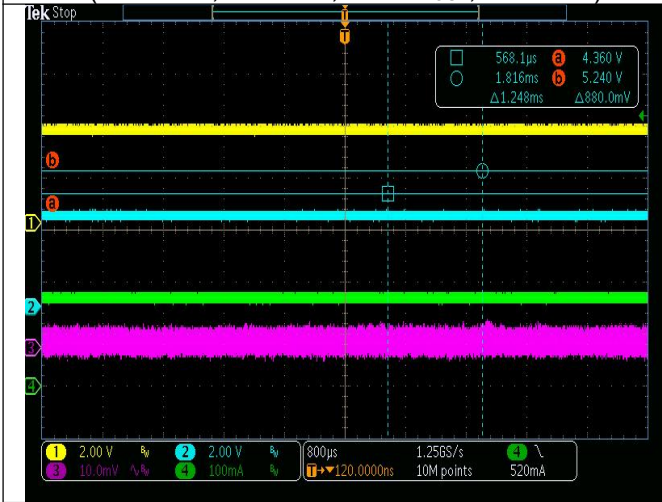
Short-LED Protection Waveform
(CH1= V_{SW} , CH2= V_{OUT} , CH4= I_{LED1})



■ Typical Characteristics—AS6585B

(Unless otherwise noted, $V_{IN} = V_{EN} = 3.6V$, $C_{IN} = C_{OUT} = 4.7\mu F$, $L = 0.47\mu H$, $R_{RSETF} = 12k\Omega$, $R_{RSETM} = 68k\Omega$)

Movie Mode Switch Ripple Waveform
(CH1= V_{SW} , CH2= V_{IN} , CH3= V_{OUT} , CH4= I_{LED})



Flash Mode Switch Ripple Waveform
(CH1= V_{SW} , CH2= V_{IN} , CH3= V_{OUT} , CH4= I_{LED})



■ Functional Description

The AS6585B is a 3MHz fixed frequency synchronous boost converter, optimized for 0.75A/ch, total 1.5A flash current output LED driver with PWM dimming function, for distance dimming camera flash LED application and maximum 800mA movie mode applications using high-current white LEDs in all single cell Li-ion powered products. An adaptive regulation method ensures the current for each LED remains in regulation and maximizes efficiency.

During operation when the output voltage is greater than $V_{IN} - 150\text{mV}$, the boost converter switches and maintains at least 350mV across both current sink (LED1 and LED2). This minimum headroom voltage ensures that the current sink remain in regulation. When the input voltage rises above the LED voltage + current sink headroom voltage, the device stops switching and turns the PMOS on continuously (Pass Mode). In pass mode the difference between $(V_{IN} - I_{LED} \times R_{ONP})$ and the voltage across the LED's is dropped across the current sink.

Two simple logic control inputs (ENM and ENF) enable and disable flash and movie mode operation of the AS6585B. The movie-mode and flash-mode current levels are independently fixed by two separate resistors (RSETM and RSETF).

For flash mode, a default timer 0.8S can be used either to terminate a flash event or as a safety flash timer. One or two LEDs can be connected to the AS6585B; in the case of two LEDs the output current is matched between each diode. The real LED current at flash mode and movie/torch mode can be programmed by external PWM signal at ENM pin.

The AS6585B integrate an intelligent flash current control mode: during flash current turn-on the input voltage falls below the flash mode VIN Monitor threshold, the flash current is stopped at the level that the current ramp had risen to, at the time of the VIN Flash Monitor events.

The AS6585B contain a thermal management system to protect the device; a internal over-voltage protection (OVP) circuitry prevents damaged to the AS6585B from open LED or open circuit conditions; and a cycle-by-cycle current limit prevents damage to the AS6585B. Built-in circuitry prevents excessive inrush current during start-up. The shutdown feature reduces quiescent current to less than 1.0μA.

The 3MHz switching frequency allow for the use of tiny, low profile (0.47uH or 1.0uH) inductors and 4.7uF ceramic capacitors.

Pass Mode

On turn-on when output voltage charges up to $(V_{IN} - 150\text{mV})$, the AS6585B will decide if the part operates in Pass Mode or Boost Mode. If the voltage difference between V_{LED} and GND is less than 350mV, the device operates in Boost Mode. If the difference between V_{LED} and GND is greater than 350mV, the device operates in Pass Mode. In Pass Mode the boost converter stops switching and the synchronous PMOS turns fully on bringing V_{OUT} up to $(V_{IN} - I_{LED} \times R_{ONP})$. In pass mode the inductor current is not limited by the peak current limit. In this situation the output current must be limited to 3A.

Over-Voltage Protection (Open-LED Protection)

The output voltage is limited to typically 5.1V. In situations such as the current source open, the AS6585B will raise the output voltage to try to keep the LED current at its target value. When V_{OUT} reaches 5.1V the over-voltage comparator will trip and turn off both the internal NMOS and PMOS. When V_{OUT} falls below 5.1V (typical), the AS6585B will begin switching again.

When the output reaches 5.1V, the AS6585B automatically changes to light load mode operation to maintain output regulation at light load or no load condition. This is the discontinuous mode operation, and is normal behavior for a switching regulator. At this point, the LEDs are ready to be flashed.

Auto-Disable Feature (Short-LED Protection)

The AS6585B is equipped with an auto-disable feature for each LED channel. After the IC is enabled and started up, a test current of 2.5mA (typical) is forced through each sink channel. The channel will be disabled if the voltage of that particular sink pin does not drop to a certain threshold. This feature is very convenient for disabling an unused channel or during an LED fail-short event. This small test current should be added to the set output current in both flash and movie mode conditions.

Under-Voltage Lockout

The AS6585B contains under-voltage-lockout (UVLO) circuitry that disables the IC until V_{IN} is greater than 2.50V.

MOSFET Current Limit

The AS6585B features current limit of 3.7A. When the current limit is reached, the AS6585B stops switching for the remainder of the switching cycle.

Since the 3.7A current limit is sensed in the NMOS switch there is no mechanism to limit the current when the device operates in Pass Mode. In situations where there could potentially be large load currents at OUT, and the AS6585B is operating in Pass Mode, the load current must be limited to 3.0A.

Table 1, Enable Truth Table

ENM	ENF	Status
0	0	Shut Down
0	1	0% Flash Mode
1	0	Movie Mode
1	1	100% Flash Mode

PWM Dimming Movie Mode Operation

When ENF = “Low” and the time of ENM = “High” is not less than 5ms, Movie/Torch mode will be in active. The LED current should be equal to $I_{MOVIE} \times D_{ENM}$. D_{ENM} is the duty cycle of PWM signal at ENM pin. This PWM signal is sent to ENM pin after the first pulse which “High” level time is more than 5ms. When ENF = “Low” and the time of ENM = “Low” is not less than 5ms, the chip will enter into shutdown mode.

Channel current outputs (LED1 and LED2) in movie mode operate in the same manner. The flash timer function is disabled in movie mode to permit constant LED illumination. The ENF signal takes priority over movie-mode operation.

The AS6585B movie mode current settling can be programmable by the external resistor RSETM:

$$I_{MOVIE} = I_{MOVIE(LED1)} + I_{MOVIE(LED2)} = 2 * \frac{6800}{R_{RSETM}}$$

In applications where only one LED is connected to either LED1 or LED2, the unused current channel must be directly connected to VOUT, thereby disabling that channel.

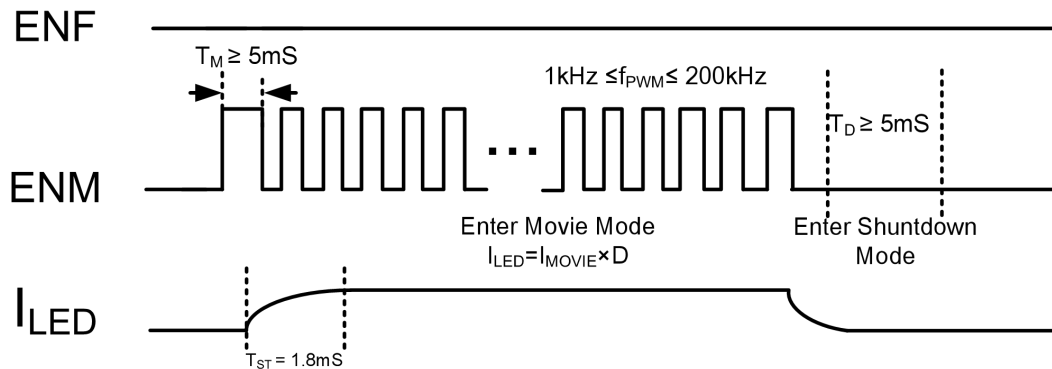


Figure 4, Timing Diagram of PWM Dimming Movie/Torch Mode

PWM Dimming Flash Mode Operation

No matter the status of ENM, only when ENF = “High”, Flash mode is in active and the flashing current is equal to $I_{FLASH} \times D$. D is the duty cycle of PWM signal at ENM pin. The frequency of PWM is larger than 1kHz, less than 200kHz.

The AS6585B flash mode current settling can be programmable by the external resistor RSETF:

$$I_{FLASH} = I_{FLASH(LED1)} + I_{FLASH(LED2)} = 2 * \frac{9000}{R_{RSETF}}$$

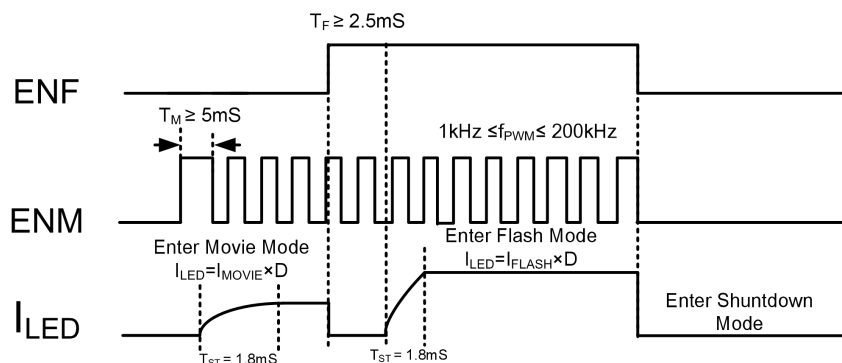


Figure 5, Timing Diagram of PWM Dimming Flash Mode

FLASH Timeout Protection:

Due to the high currents typically available in Flash mode, it is necessary to protect the white LED from damage if left on too long. The AS6585B has a timeout in Flash mode of about 800mS (typical) after which it will shut down operation. Operation will not begin again in Flash mode until the ENM pin low and Flash pin have been set Low and then High again.

Over Thermal Protection

Thermal protection disables the AS6585B when internal power dissipation becomes excessive, as it disables both MOSFETs. The junction over-temperature threshold is 150°C with 25°C of temperature hysteresis. The output voltage automatically recovers when the over-temperature fault condition is removed.

Intelligent Flash Current Control

During the flash current turn-on the input voltage falls below the VIN flash mode monitor threshold (3.05V typical), the flash current is stopped at the level that the current ramp had risen to, at the time of the VIN flash mode monitor threshold event. The VIN flash mode monitor threshold only operates during the ramping up of the flash LED current.

To avoid noise from falsely triggering the VIN flash mode monitor threshold voltage, this mode incorporates an 8µs de-glitch timer as well as an internal analog filter at the input of the Monitor Comparator. With the VIN flash mode monitor threshold active, VIN must go below the VIN flash mode monitor threshold (typical 3.05V), and remain below it, for 8µs before the flash current ramp is halted.

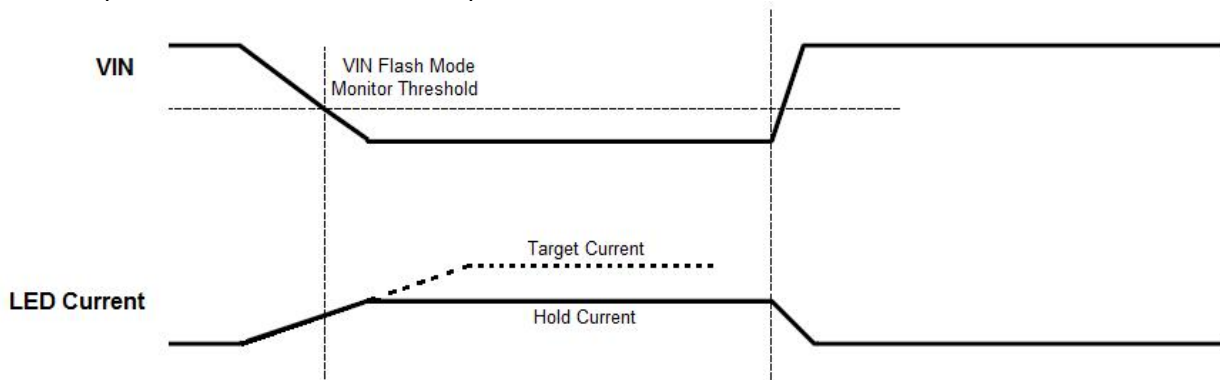


Figure 6, Intelligent Flash Current Control

Application Information

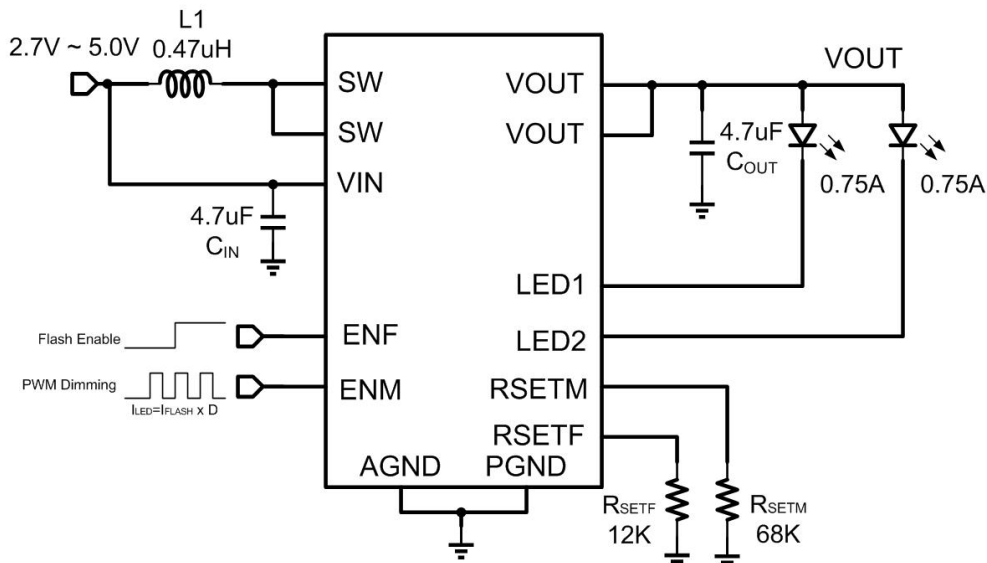


Figure 7, Flash Mode PWM Dimming Typical Application Circuit of AS6585B

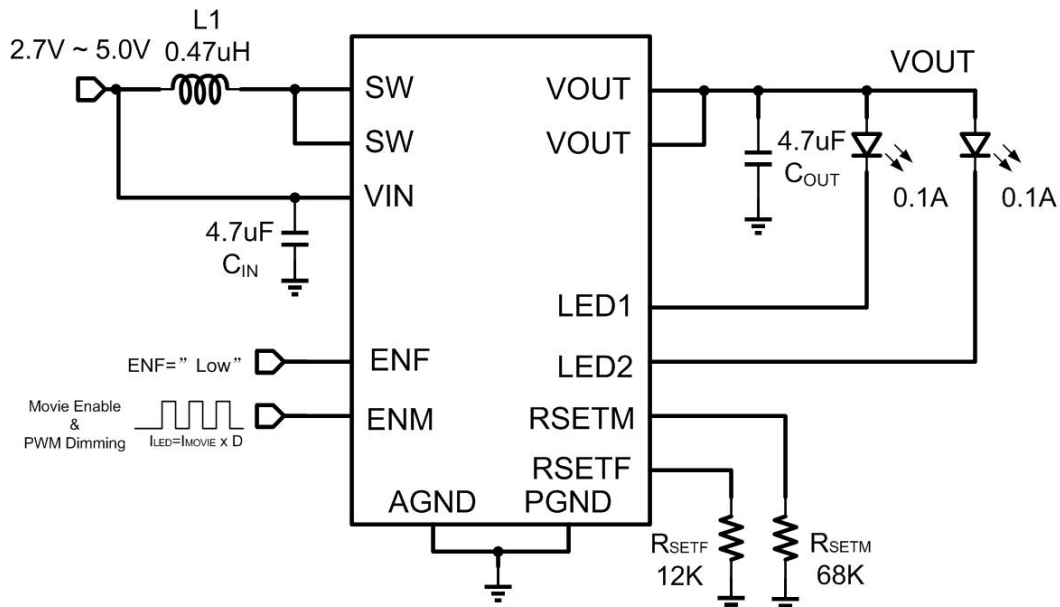


Figure 8, Movie Mode PWM Dimming Typical Application Circuit of AS6585B

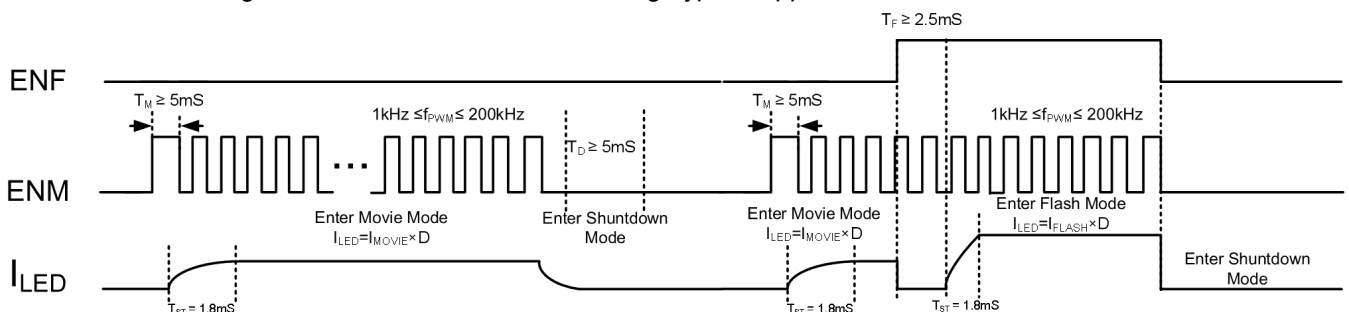


Figure 9, Typical Application Waveform of AS6585B

Flash Disable

In mobile 2G/3G/4G systems where the phone remains in constant contact with the base station by regular communication, ENF should be pulled down to prevent both the camera flash and PA transmission pulses from occurring simultaneously. This avoids potential dips to the Li-ion battery voltage below the system's under-voltage lockout threshold (UVLO).

Flash LED Connection

The AS6585B supports up to two 0.75A Flash WLEDs. The two LEDs are connected from VOUT pin to LED1 pin and LED2 pin respectively. We can connect LED1 pin and LED2 pin together to driver one 1.5A WLED. If LED1 pin or LED2 pin is not used, the LED1 pin or LED2 pin should be connected to VOUT.

LED Selection

The AS6585B is specifically designed to drive ultra bright flash LEDs with typical forward voltage of 2.5V to 4.5V within 0.75A forward current. Since the LED1 and LED2 pins have internal current-mirror circuitry which matches both channels with tight accuracy up to 0.75A per channel; the LED-to-LED brightness will be matched regardless of the individual LED forward voltage (VF). Circuit designers should consult the LED supplier for LED specifications.

Shutdown

The current sink devices (LED1 and LED2) are the power returns for all loads, there is no leakage current through load if the current sink devices are disabled. When ENF and ENM are both held at logic low level, the AS6585B is disabled and draws less than 1uA of leakage current from VIN.

Inductor Selection

The selection of the inductor affects steady state operation as well as transient behavior and loop stability. These factors make it the most important component in power regulator design. There are three important inductor specifications, inductor value, DC resistance and saturation current. Considering inductor value alone is not enough.

The inductor value determines the inductor ripple current. Choose an inductor that can handle the necessary peak current without saturating, according to half of the peak-to-peak ripple current given by I_P equation, pause the inductor DC current given by:

$$I_{IN_DC} = \frac{V_{OUT} * I_{OUT}}{V_{IN} * \eta}$$

Inductor peak-to-peak current ripple:

$$I_{L_PP} = \frac{V_{IN} * (V_{OUT} - V_{IN})}{V_{OUT} * L * F_S}$$

Inductor peak current:

$$I_{L_PPEAK} = I_{IN} + \frac{I_{L_PP}}{2} = \frac{V_{OUT} * I_{LED}}{V_{IN} * \eta} + \frac{V_{IN} * (V_{OUT} - V_{IN})}{2 * V_{OUT} * L * F_S}$$

Inductor values can have $\pm 20\%$ tolerance with no current bias. When the inductor current approaches saturation level, its inductance can decrease 20% to 35% from the 0A value depending on how the inductor vendor defines saturation current. Using an inductor with a smaller inductance value forces discontinuous PWM when the inductor current ramps down to zero before the end of each switching cycle. This reduces the boost converter's maximum output current, causes large input voltage ripple and reduces efficiency. Large inductance value provides much more output current and higher conversion efficiency.

For these reasons, a 0.47uH to 1.0uH inductor value range is recommended. The inductor parameters, current rating, DCR and physical size, should be considered. The DCR of inductor with lowest DCR is chosen for highest efficiency. The saturation current rating of inductor must be greater than the switch peak current, typically 4.5A. These factors affect the efficiency, output load capability, output voltage ripple, and cost. A 0.47uH inductor optimized the efficiency for most application while maintaining low inductor peak to peak ripple. Customers need to verify the inductor in their application if it is different from the recommended values.

For a given inductor type, smaller inductor size leads to an increase in DCR winding resistance and, in most cases, increased thermal impedance. Winding resistance degrades boost converter efficiency and increases the inductor's operating temperature:

$$P_{LOSS(INDUCTOR)} = I_{RMS}^2 * DCR$$

Table 2, Recommended Inductor

Manufacturer	L	Part Number	Dimensions (L*W*H)	Isat	RDC
TOKO	0.47uH	DFE201610P-R470M	2.0 mm x 1.6 mm x 1.0 mm	4.1A	32mΩ
TOKO	1.0uH	DFE201610P-1R0M	2.0 mm x 1.6 mm x 1.0 mm	3.7A	58mΩ

Output Capacitor Selection

The ceramic capacitor is ideal for AS6585B application. X5R or X7R types are recommended because they hold their capacitance over wide voltage and temperature ranges than other Y5V or Z5U types. The input capacitor can reduced peak current and noise at power source. For proper operation the output capacitor must be at least a 10μF ceramic. Larger capacitors such as a 22μF or multiple capacitors in parallel can be used if lower output voltage ripple is desired. To estimate the output voltage ripple considering the ripple due to capacitor discharge (ΔV_Q) and the ripple due to the capacitors ESR (ΔV_{ESR}) use the following equations.

The output capacitor is mainly selected to meet the requirements for the output ripple and loop stability. This ripple voltage is related to the capacitor's capacitance and its equivalent series resistance (ESR). Assuming a capacitor with zero ESR, the minimum capacitance needed for a given ripple can be calculated by:

$$C_{OUT} = \frac{I_{OUT} * (V_{OUT} - V_{IN})}{V_{OUT} * V_{RIPPLE} * F_S}$$

Where, V_{RIPPLE} = peak-to-peak output ripple. The additional output ripple component caused by ESR is calculated using:

$$V_{RIPPLE_ESR} = \left[\left(\frac{I_{OUT} * V_{OUT}}{V_{IN}} \right) + \frac{V_{IN} * (V_{OUT} - V_{IN})}{2 * F_S * L * V_{OUT}} \right] * R_{ESR}$$

Due to its low ESR, V_{RIPPLE_ESR} can be neglected for ceramic capacitors, but must be considered if tantalum or electrolytic capacitors are used.

Input Capacitor Selection

Choosing the correct size and type of input capacitor helps minimize the input voltage ripple caused by the switching of the AS6585B's boost converter, and reduces noise on the boost converters input terminal that can feed through and disrupt internal analog signals. In the Typical Application Circuit a 10μF ceramic input capacitor works well. It is important to place the input capacitor as close as possible to the AS6585B's input (IN) terminals. This reduces the series resistance and inductance that can inject noise into the device due to the input switching currents.

Table 3, Recommended Input / Output Capacitors (X5R/X7R Dielectric)

Manufacturer	Value	Part Number	Dimensions (L*W*H)	Voltage Rating
TDK Corporation	4.7uF	C1608JB0J475M	0603 (1.6mm x 0.8mm x 0.8mm)	6.3V
TDK Corporation	4.7uF	C2012JB1A475M	0805 (2.0mm x 1.25mm x 1.25mm)	10V
TDK Corporation	10uF	C1608JB0J106M	0603 (1.6mm x 0.8mm x 0.8mm)	6.3V
TDK Corporation	10uF	C2012JB1A106M	0805 (2.0mm x 1.25mm x 1.25mm)	10V
Murata	4.7uF	GRM188R60J475M	0603 (1.6mm x 0.8mm x 0.8mm)	6.3V
Murata	4.7uF	GRM21BR61A475KE19	0805 (2.0mm x 1.25mm x 1.25mm)	10V
Murata	10uF	GRM188R60J106M	0603 (1.6mm x 0.8mm x 0.8mm)	6.3V
Murata	10uF	GRM21BR61A106KE19	0805 (2.0mm x 1.25mm x 1.25mm)	10V

Thermal Considerations

The maximum IC junction temperature should be restricted to 125°C under normal operating conditions. This restriction limits the power dissipation of the AS6585B. Calculate the maximum allowable dissipation, $P_{D(max)}$, and keep the actual dissipation less than or equal to $P_{D(max)}$. The maximum-power-dissipation limit is determined using following equation:

$$P_{D(MAX)} = \frac{125^{\circ}\text{C} - T_A}{R_{\theta JA}}$$

Where, T_A is the maximum ambient temperature for the application. $R_{\theta JA}$ is the thermal resistance junction-to-ambient given in Power Dissipation Table.

Layout Considerations

The high switching frequency and large switching currents of the AS6585B make the choice of layout important. The following steps should be used as a reference to ensure the device is stable and maintains proper LED current regulation across its intended operating voltage and current range.

1. Place C_{IN} on the top layer (same layer as the AS6585B) and as close to the device as possible. The input capacitor conducts the driver currents during the low side MOSFET turn-on and turn-off and can see current spikes over 0.75A in amplitude. Connecting the input capacitor through short wide traces to both the IN and GND terminals will reduce the inductive voltage spikes that occur during switching and which can corrupt the VIN line.

2. Place C_{OUT} on the top layer (same layer as the AS6585B) and as close as possible to the OUT and GND terminal. The returns for both C_{IN} and C_{OUT} should come together at one point, and as close to the GND pin as possible. Connecting C_{OUT} through short wide traces will reduce the series inductance on the OUT and GND terminals that can corrupt the V_{OUT} and GND line and cause excessive noise in the device and surrounding circuitry.

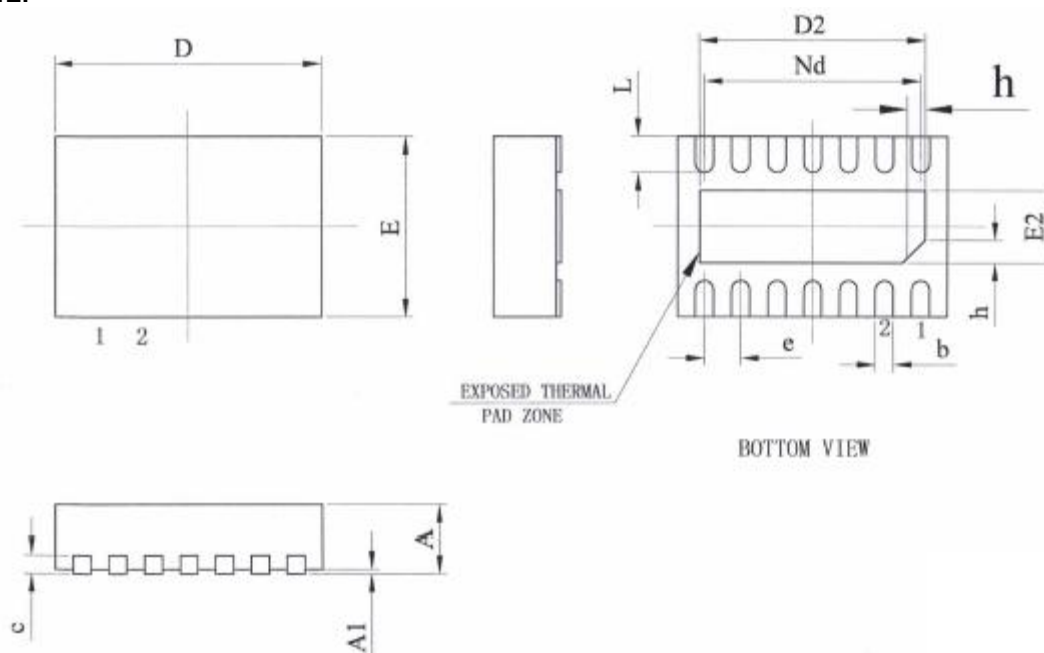
3. Connect the inductor on the top layer close to the SW pin. There should be a low-impedance connection from the inductor to SW due to the large DC inductor current, and at the same time the area occupied by the SW node should be small so as to reduce the capacitive coupling of the high dV/dt present at SW that can couple into nearby traces.

4. Avoid routing logic traces near the SW node so as to avoid any capacitively coupled voltages from SW onto any high-impedance logic lines such as ENM, ENF, RF and RM. A good approach is to insert an inner layer GND plane underneath the SW node and between any nearby routed traces. This creates a shield from the electric field generated at SW.

5. For Flash LEDs that are routed relatively far away from the AS6585B, a good approach is to sandwich the forward and return current paths over the top of each other on two layers. This will help in reducing the inductance of the LED current paths. Consider additional PCB exposed area for the flash LEDs to maximize heatsinking capability. This may be necessary when using high current application and long flash duration application.

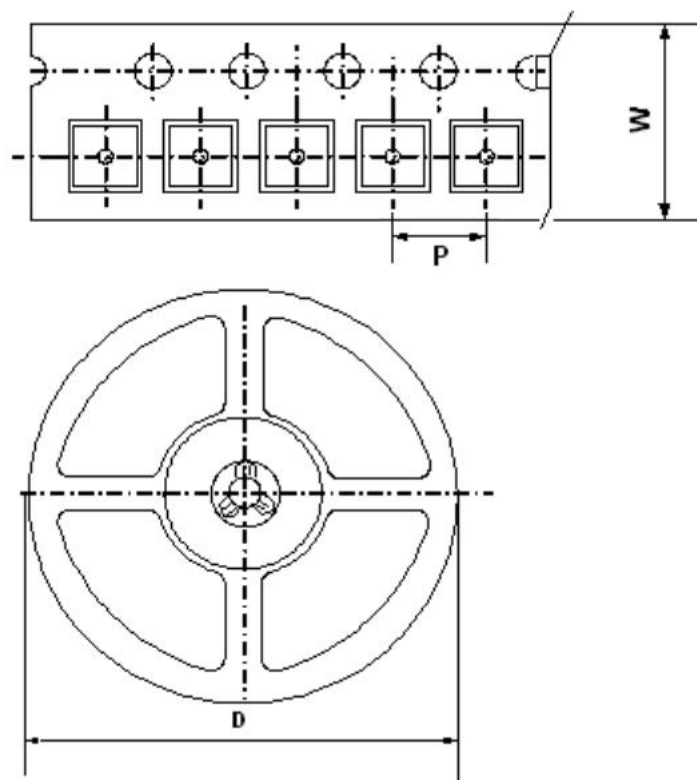
■ Package Information

DFN2030-14L:

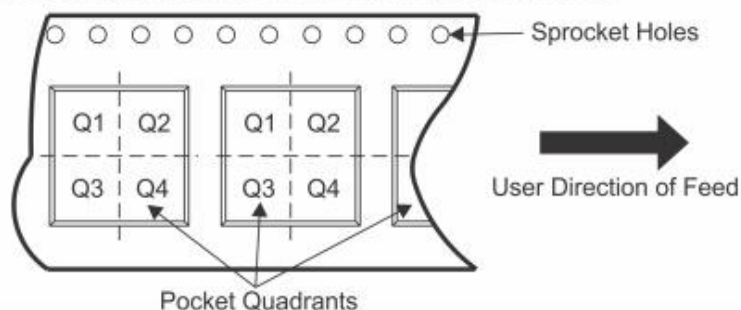


Symbol	Dimensions In Millimeters			Dimensions In Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	0.45	0.75	0.80	0.018	0.029	0.031
A1	0.00	0.02	0.05	0.00	0.001	0.002
b	0.15	0.18	0.25	0.006	0.007	0.010
c	0.15	0.20	0.25	0.006	0.008	0.010
D	2.90	3.00	3.10	0.115	0.118	0.122
D2	2.40	2.50	2.60	0.094	0.098	0.102
e	0.40 BSC			0.016 BSC		
Nd	2.40 BSC			0.094 BSC		
E	1.90	2.00	2.10	0.075	0.079	0.083
E2	0.70	0.80	0.90	0.028	0.031	0.035
L	0.30	0.35	0.40	0.012	0.014	0.016
h	0.20	0.25	0.30	0.008	0.010	0.012

Packing Information



QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



Device	Package Type	SPQ	Carrier Width (W)	Pitch(P)	Reel Size(D)	Pin1 Quadrant
AS6585BDRNC	DFN2030-14L	3000pcs	8.0±0.1 mm	4.0±0.1 mm	180±1 mm	Q1

*All dimensions are nominal

■ Revision History:

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision 1.4 (January 2025) to Revision 1.5 Page

● Modify the EN On Threshold Voltage to Minimum 1.0V.....	5
● Modify the Chip Pitch to 4mm.....	18

Changes from Revision 1.3 (January 2024) to Revision 1.4 Page

● Modify the Flash Current Accuracy to $\pm 10.0\%$	5
● Modify the Movie Current Accuracy to $-10.0\% \sim +5.0\%$	5

Changes from Revision 1.2 (November 2021) to Revision 1.3 Page

● Changed the Movie Setting Resistance in application circuit figure 1 (From 74K Ω to 68K Ω)	2
● Modify the ENM pin Resistance from 74K Ω to 68K Ω	3
● Modify the Maximam Movie Current Setting Resistance to 68K Ω	5
● Modify the Movie Current Equation.....	11
● Added the Reel Pin 1 Quadrant.....	18

Changes from Revision 1.1 (December 2020) to Revision 1.2 Page

● Changed the Product Name from AS6585 to AS6585B.....	all Page
● Changed the output current equation in application circuit figure 1 ($I_{LED} = I_{FLASH} * D$).....	2
● Changed the ENF pin description, the flash output current equation.....	3
● Changed the Enable Truth Table 1.....	11
● Changed the Figure 5 Flash Output Current Equation.....	11
● Changed the Figure 7 and Figure 9 Flash Output Current Equation.....	13

Changes from Revision 1.0 (December 2015) to Revision 1.1 Page

● Modify the electrical characteristics and fill in the Parameter.....	5
● Added the tested curve	6-9

Changes from Original (October 2015) to Revision A Page

● Initial Release Specification	
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