PRELIMINARY

60V, 350MA, 4-CHANNEL CONSTANT CURRENT REGULATOR WITH OTP

GENERAL DESCRIPTION

The IS32LT3117 is a 4-channel, linear regulated, constant current LED driver which can provide 4 equal currents of up to 350mA per channel to drive high brightness LEDs over an input voltage range of 5.5V to 60V, while maintaining an output leakage current of less than 100 uA. The output current is easily programmed using a single external resistor. The outputs of the IS32LT3117 may be connected in parallel to allow greater than 350mA of LED current.

The IS32LT3117 also features a PWM input to enable simple dimming control using a digital control signal. Rise & fall times are optimized to minimize EMI while allowing PWM frequencies of up to 1kHz.

The IS32LT3117 features a unique over temperature protection scheme. A hard shutdown, all LED currents are off, occurs if the die junction temperature exceed the maximum value of 160ºC, however, as the die junction temperature is rising, once the temperature exceeds 140ºC the output current will begin to roll off at a rate of 3.5%/°C. If the die temperature continues to rise above the hard shutdown temperature threshold, then the LED currents will drop to zero until the temperature returns to a lower value.

The IS32LT3117 is offered in an SOP8-PP package with an operating temperature range of -40°C to +85°C.

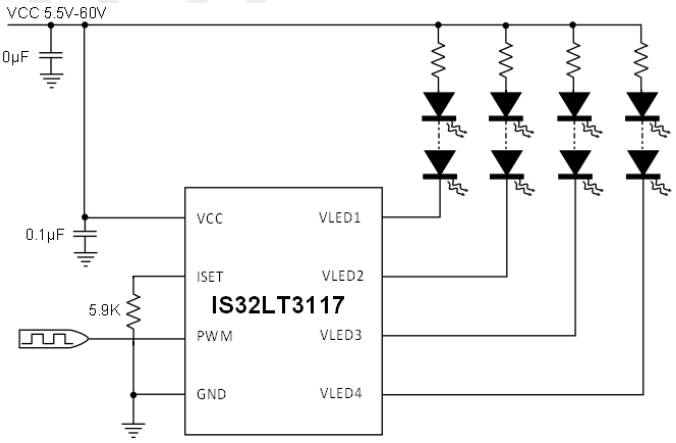
FEATURES

- 5.5V to 60V input supply voltage range
- Up to 1.4A total output current
- Current shared equally up to 350 mA by up to 4 strings
- Over temperature protection
- Thermal current regulation above 140ºC
- Output current matching TBD between channels
- PWM dimming and Shutdown control input
- Very few external components
- Current set by external reference resistor
- Automotive grade (pending)

Applications

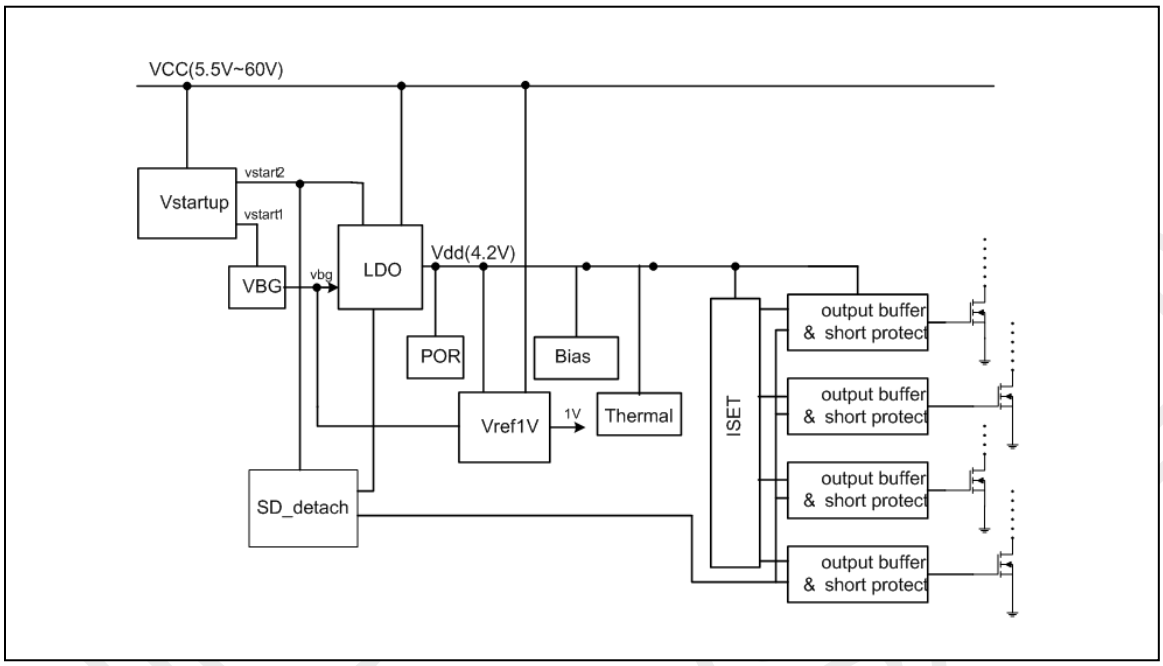
- High Power LED Lighting
- Automotive Lighting
- Low EMI lighting applications
- Constant current source

Typical Application Circuit

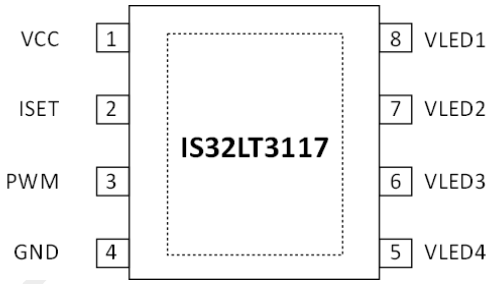


IS32LT3117A directly driving 4 LED strings

FUNCTIONAL BLOCK DIAGRAM



PIN CONFIGURATION

Package	Pin Configuration (Top view)
SOP8-PP	

PIN DESCRIPTION

SOP-8	Pin	I/O	Description
1	VCC	I	Voltage supply input (5.5V~60V).
2	ISET	O	Set output current.
3	PWM	I	PWM control pin (PWM=high, enable. PWM=low, disable).
4	GND	-	Ground.
5-8	VLED1-VLED4	O	Current source outputs.
	Thermal Pad*	-	Connect to GND.

*Note: The package has an exposed PAD (GND) from the bottom view.

The exposed PAD serves as radiator and must be soldered to PCB.

ABSOLUTE MAXIMUM RATINGS

Parameter	Range	Unit
V_{IN} pin to GND	-0.3 ~ 66	V
ISET pin	-0.3 ~ 6	V
PWM pin	-0.3 ~ 66	V
VLEDx pin	-0.3 ~ 66	V
Operating temperature(T_A=T_J)	-40 - 125	°C
Junction temperature	-40 ~ 160	°C
Device storage temperature	-65 ~ 150	°C
ESD (Human Body Model)	4k	V

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other condition beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

(Specification are at TA=25°C, VIN=12V, RIN=TBD, unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{IN}	Supply Voltage Range		5.5		60	V
I_{IN}	Quiescent Input supply current			2		mA
I_{SD}	Shutdown input current	VPWM = 0V		200		uA
$t_{STARTUP}$	Startup Time	VPWM = 2V to I_{OUT} > 80%		TBD		μs
I_{OUT}	Maximum Output current per channel			350		mA
ΔI_{OUT}	Current matching between Channels			±1.5		%
V_{OUT}	VLED output voltage headroom	IOUT = 350mA		0.6		V
t_{RISE}	Output current Rise Time			TBD		μs
V_{ISET}	ISET pin output voltage			1.2		V
V_{PWMH}	PWM pin input logic high voltage	5V < VIN < 55V	1.4			V
V_{PWML}	PWM pin input logic low voltage	5V < VIN < 55V			0.4	V
T_{RO}	Thermal roll off threshold			140		°C
ΔT_{RO}	Output current thermal roll off rate			3.5		%/°C
T_{SD}	Thermal shutdown threshold	Temperature increasing		160		°C
T_{SDR}	Thermal shutdown restart threshold	Temperature decreasing		100		°C
Θ_{JC}	Thermal Resistance Junction to Case	SOP8-PP		10		°C/W
Θ_{JA}	Thermal Resistance Junction to Ambient (Note1)	SOP8-PP		40		°C/W

Note1: Thermal resistance with copper area of approximately 3 in^2

Typical Operating Curves (TBD)

** ICC vs. Supply Voltage**

** ICC vs. Temperature**

** Iout vs. Supply Voltage**

** Iout vs. Rset**

** Iout vs. VOUT**

** Iout vs Temperature (Iout = 25mA/ch) **

** VISET vs. Supply Voltage**

** VISET vs. Temperature**

** VREF vs. Supply Voltage**

Functional Description

IS32LT3117 is a linear current regulator designed to drive high brightness LEDs. The device integrates 4 channels capable of driving up to 350mA each and operates over a supply voltage range of 5.5V to 60V. IS32LT3117 incorporates a special protection feature of thermal regulation which prevents the die temperature from exceeding the maximum rated junction temperature of 150°C. Output current is easily programmed using a single resistor.

IS32LT3117 features a PWM/enable input which may be used to realize PWM dimming of the LEDs. In addition, the enable input may be used to place the device into a low power consumption or shutdown mode. In shutdown, the device consumes only 75uA of supply current.

VCC

The VCC input pin provides power to the internal circuitry of the IC. Nominal supply current is 10mA during operation. The supply current of IS32LT3117 will vary strongly as a function of the output current setting due to the internal reference currents generated in each channel. The operating supply current can be estimated based on the output current setting by the following equation:

$I_{CC} = 1.5mA + I_{OUT}/175$

ISET

Output current for IS32LT3117 is programmed by connecting a resistor from the ISET pin to GND. An internal 1.2V reference supplies current to the external current setting resistor. The reference current is internally amplified by a gain of 1600 to each of the 4 outputs.

PWM

When the PWM input pin is low, VPWM < 0.4V, IS32LT3117 is in a low power consumption mode with all of the outputs off. In this mode, IS32LT3117 consumes only 75uA (typ) of supply current. Raising the PWM pin voltage above 1.4V causes the device to resume normal operation and all outputs are turned on. A PWM input signal to the PWM pin can be used to realize dimming of the HBLEDs. IS32LT3117 can accept an input pulse width as short as TBD (****).

GND

The ground current return pin. This pin should be connected to as large as possible of a copper pad to allow for the best possible thermal performance of the circuit.

VLEDx

Constant current output driver for the IC. Each of the 4 output pins are capable of sinking up to 350mA of current at a headroom voltage of 0.5V.

Output Current

The output current is set by the external programming resistor, and is the same in each of the four output channels. A maximum current of 350mA per channel is allowed, however, the channels may be connected in parallel to allow for larger currents in the HBLEDs. The output current for each output of the device can be calculated by the following:

$I_{OUT} = 1600 * 1.2/R_{ISET}$

The following table computes some typical values of RISET for some typical output current settings:

I_{OUT} (mA)	R_{ISET} (kΩ)
10	192
100	19.2
350	5.5

If less than 4 channels are required for a particular application, it is recommended to parallel the channels if possible. This reduces the individual, internal bias currents and, thus, the overall power dissipation of the device. If connecting some or all of the outputs in parallel is not possible, the unused channel should be connected to GND.

LED BRIGHTNESS CONTROL

IS32LT3117 allows the user to control the LED intensity in two ways. First, the output current level can be adjusted by changing the external resistance, or by using an external current source on the ISET pin to provide the reference current. However, the spectral output of the LED may shift slightly at different current levels, thus adversely affecting the color temperature of the light output.

IS32LT3117 also provides a PWM input pin to control the on/off state of all four channels. Using a PWM input signal of some duty cycle allows the average LED current to be adjusted linearly and proportional to the input duty cycle, while maintaining the same peak current through the LEDs. In this way, the light intensity can be reduced without affecting the spectral content of the light, effectively dimming the light without changing the color temperature.

Temperature Regulation

IS32LT3117 integrates a thermal regulation block which is designed to protect the IC from overheating when dissipating high power. If the junction temperature of the device exceeds 130°C, the output current in each channel will begin reducing linearly at a rate of 5%/°C, and consequently reduce the power dissipation of the IC. If the junction temperature of the IC continues to increase to the point where the thermal shutdown is exceeded, the IC will go into shutdown mode and reduce the power dissipation of the IC to a minimum.

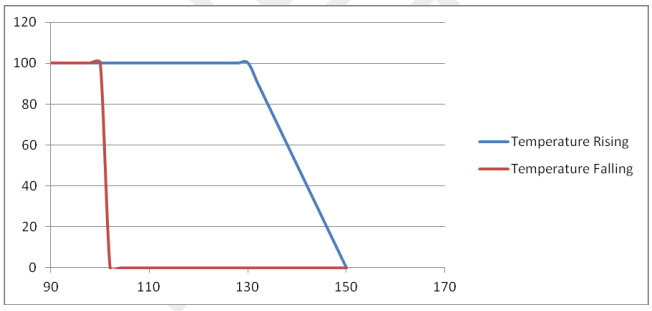
If the junction temperature of the device is above 130°C, and if thermal shutdown is not initiated, the output current will continue to regulate based on the junction temperature. In the temperature range 130°C<T_J<150°C, the output current will regulate based on the following equation:

$I_{OUT} = (150\text{-}T_J)*0.05*I_{OUTMAX}$

Thermal Shutdown

When the junction temperature of IS32LT3117 exceeds 150°C, the IC will switch all outputs and internal output bias currents off. This reduces the power dissipation of the IC to the minimum, and, under normal conditions, the IC will begin to cool. After thermal shutdown is initiated, the temperature of the IC must drop below 100°C before returning to normal operation. If thermal shutdown is not initiated, the output current will continue to regulate based on the junction temperature.

The plot below illustrates the simulated output current in the case of temperature rising and, if the thermal shutdown is initiated, the temperature falling, as a function of percentage of output current programmed value.



Thermal Considerations

The IS32LT3117 is available in SOP8-PP package. The package has an exposed PAD (GND) from the bottom view. The exposed PAD serves as radiator and must be soldered to PCB.

The SOP8-PP package needs a heat sink under most conditions. The size of the heat sink depends on the input voltage, the output voltage, the load current and the ambient temperature. The IS32LT3117 junction temperature rises above ambient temperature (25°C in still air) for a xA (TBD) load and different input and output voltages. These temperature rise numbers are all approximate and there are many factors that can affect these temperatures. Higher ambient temperatures require more heat sinking.

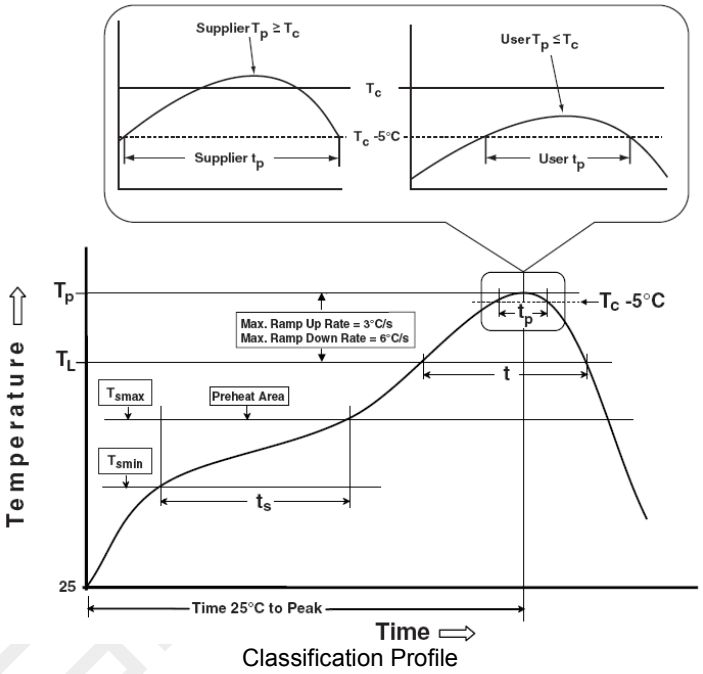
For the best thermal performance, wide copper traces and generous amounts of printed circuit board copper should be used in the board layout. Large areas of copper provide the best transfer of heat (lower thermal resistance) to the surrounding air, and moving air lowers the thermal resistance even further.

Package thermal resistance and junction temperature rise numbers are all approximate, and there are many factors that will affect these numbers. Some of these factors include board size, shape, thickness, position, location, and even board temperature. Other factors are, trace width, total printed circuit copper area, copper thickness, single or double-sided, multi-layer board and the amount of solder on the board.

The effectiveness of the PC board to dissipate heat also depends on the size, quantity and spacing of other components on the board, as well as whether the surrounding air is still or moving. Furthermore, some of these components will add heat to the PC board and the heat can vary as the input voltage changes.

Classification Reflow Profiles

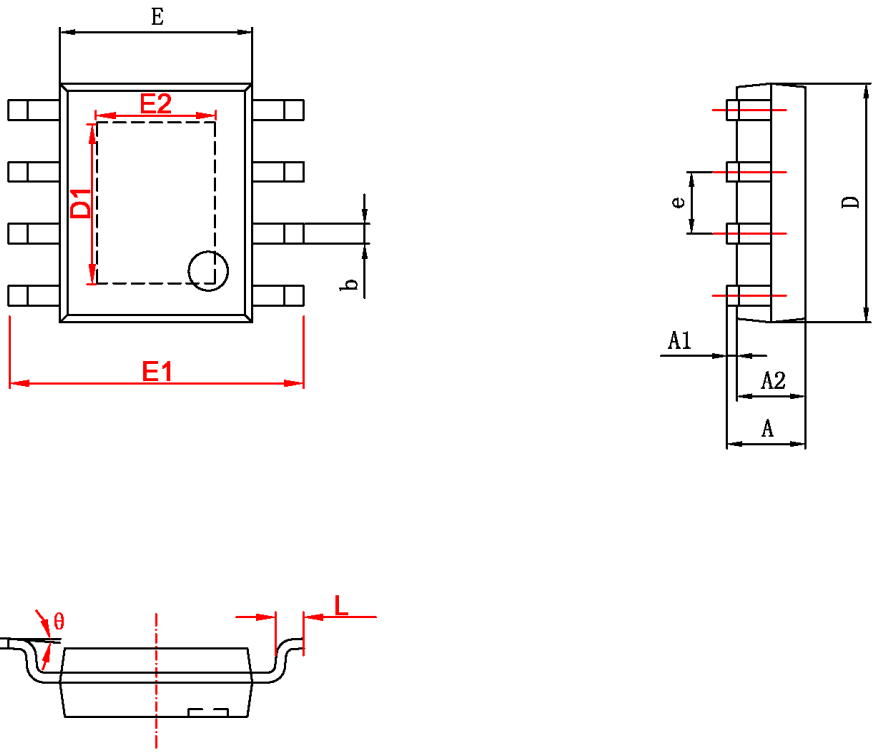
Profile Feature	Pb-Free Assembly
Preheat & Soak Temperature min (Tsmin) Temperature max (Tsmax) Time (Tsmin to Tsmax) (ts)	150°C 200°C 60-120 seconds
Average ramp-up rate (Tsmax to Tp)	3°C/second max.
Liquidous temperature (TL) Time at liquidous (tL)	217°C 60-150 seconds
Peak package body temperature (Tp)*	Max 260°C
Time (tp)** within 5°C of the specified classification temperature (Tc)	Max 30 seconds
Average ramp-down rate (Tp to Tsmax)	6°C/second max.
Time 25°C to peak temperature	8 minutes max.



Classification Profile

PACKAGE INFORMATION

SOP8-PP(EXP PAD) PACKAGE OUTLINE DIMENSIONS



字符	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.050	0.150	0.002	0.006
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.700	5.100	0.185	0.200
D1	3.202	3.402	0.126	0.134
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
E2	2.313	2.513	0.091	0.099
e	1.270 (BSC)		0.050 (BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

The package has an exposed PAD (GND) from the bottom view.
The exposed PAD serves as radiator and must be soldered to PCB.