1.9A Fixed Frequency White LED Driver

Features

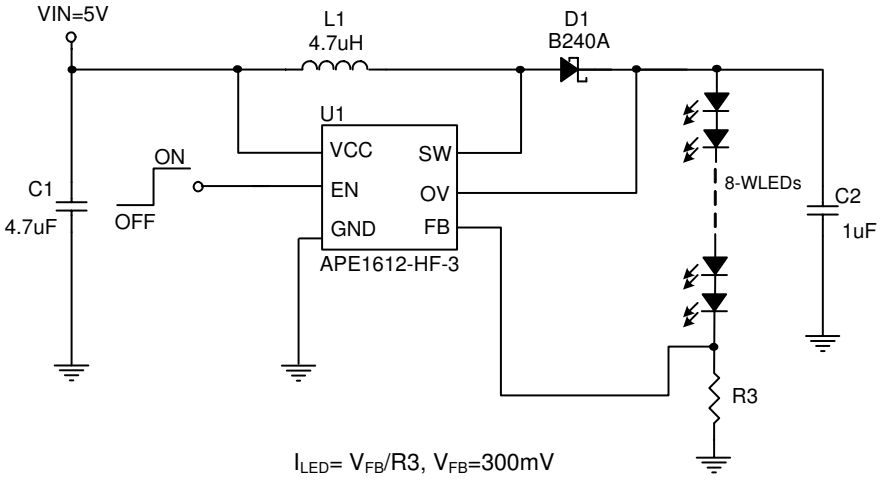
- **Operating Input Voltage Range of 2.5V to 5.5V**
- **Drives up to 8 White LEDs in Series**
- **Fixed Switching Frequency of 1.2MHz**
- **Wide Range for PWM Dimming (200Hz to 200KHz)**
- **Internal 1.9A Switching Current Limit**
- **Over Voltage Protection (OVP)**
- **Internal Soft-start Function**
- **Current Limit and Thermal Shutdown Protection**
- **Under Voltage Lockout**
- **RoHS-compliant Halogen-free TSOT-26 Package**

Description

The APE1612 is a step-up converter designed for driving up to 8 white LEDs in series for backlighting applications. The APE1612 uses current mode, 1.2MHz fixed frequency architecture to regulate the LED current, which is set through an external current sense resistor. Its low 300mV feedback voltage reduces power loss and improves efficiency. The OV pin monitors the output voltage and turns off the converter if an over-voltage condition is present due to an open circuit condition. The APE1612 includes under-voltage lockout, current limiting and thermal shutdown protection preventing damage from an output overload. The device is shipped in a RoHS/REACH-compliant TSOT-26 package.

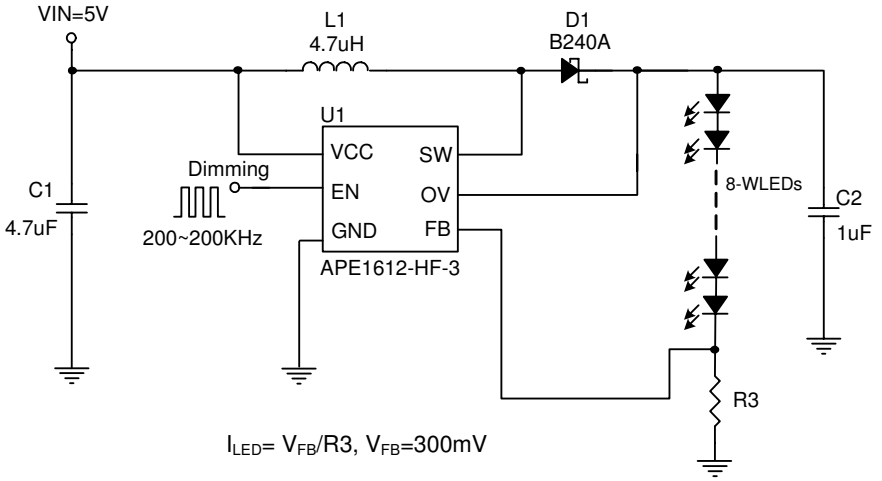
Typical Applications

1. 8 series LED application



$I_{LED}= V_{FB}/R3$, V_{FB}=300mV

2. LED Dimming application



$I_{LED}= V_{FB}/R3$, V_{FB}=300mV

Ordering Information

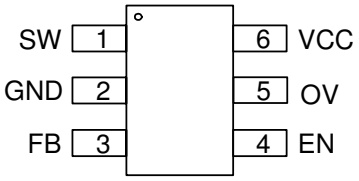
APE1612TY-HF-3TR

Package Type:

TY : TSOT-26

Pin Configuration

(Top View)



TSOT-26

Absolute Maximum Ratings (Note 1) at T_A= 25℃

VCC Pin Voltage (V_{CC})	GND - 0.3 to GND + 6V
EN, FB, OV Pin Voltage	GND - 0.3 to VCC + 0.3V
SW Pin Voltage (V_{SW})	30V
Power Dissipation(P_D)	(T_J-T_A) / Rth_{ja}
Storage Temperature Range(T_{ST})	-65℃ To 150℃
Operating Junction Temperature Range(T_{OP})	-40℃ To 125℃
Thermal Resistance from Junction to Case(Rth_{JC})	180℃/W
Thermal Resistance from Junction to Ambient(Rth_{JA})	250℃/W

Note: Rth_{JA} is measured with the PCB copper area of approximately 1 in^2 (Multi-layer)

Note 1: Absolute Maximum Ratings are limits beyond which damage to the device may occur. Operating Conditions are conditions under which the device functions but the specifications might not be guaranteed. For guaranteed specifications and test conditions see the Electrical Specifications.

Note2: The maximum power dissipation is a function of the maximum junction temperature, T_{Jmax} , total thermal resistance, $R_{th(ja)}$ and ambient temperature T_A . The maximum allowable power dissipation at any ambient temperature is (T_{jmax} -T_A) / $R_{th(ja)}$.

Note3: Low duty pulse techniques are used during test to maintain a junction temperature as close to ambient as possible.

Electrical Specifications (V_{CC}=5V, I_{OUT} = 20mA, T_A = 25°C, unless otherwise noted)

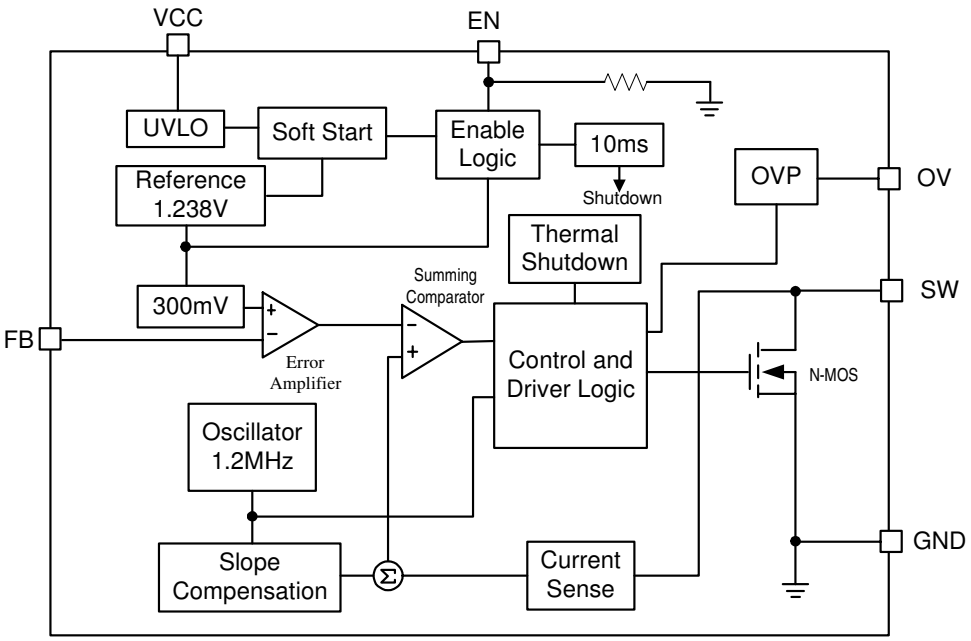
Parameter		SYM	TEST CONDITION	MIN	TYP	MAX	UNITS
Input Voltage Range		V_{CC}		2.5	-	5.5	V
Step-Up Voltage Range		V_{OUT}		3	-	27	V
OV Sense Voltage		V_{OV}		27.5	29	30.5	V
Under Voltage Lockout		U_{VLO}	Rising	-	2.25	2.45	V
UVLO Hysteresis				-	100	-	mV
Feedback Voltage		V_{FB}		285	300	315	mV
EN Threshold	Logic-High Voltage	V_{IH}		1.4	-	-	V
	Logic-Low Voltage	V_{IL}		-	-	0.4	V
EN Hysteresis				-	200	-	mV
Operating Quiescent Current		I_{CCQ}	I_{OUT}= 0mA, V_{FB} =0.5V	-	170	-	μA
Shutdown Current		I_{SD}	V_{EN}=0V, t_{EN} > 20ms	-	-	1	μA
N-Channel MOSFET Current Limit Note1		I_{LIM}	Duty=50%	-	1.9	-	A
MOSFET On-resistance (Note1)		$R_{DS(on)}$	V_{CC}=3V, I_{SW}=1A	-	650	-	mΩ
			V_{CC}=5V, I_{SW}=1A	-	500	-	
Maximum Duty Cycle		D_{MAX}		85	90	-	%
Line Regulation			V_{CC} = 3V to 5V	-	1	-	%
Switching Frequency		F_{OSC}		0.9	1.2	1.5	MHz
Dimming Clock Rate		F_{DIM}		0.2	-	200	KHz
FB Input Leakage Current		I_{FB-LKG}	V_{FB} = 0.5V	-	0.01	100	nA
SW Leakage Current		I_{SWL}	V_{LX} = 27V, V_{FB} =0.5V	-	-	1	μA
EN Input Leakage Current		$I_{EN-LKG1}$	V_{EN}= V_{CC}	-	1.5	3	μA
		$I_{EN-LKG2}$	V_{EN}= GND	-	0.01	0.1	μA
Shutdown Delay		T_{SHDN}		-	1	0	- ms
Thermal Shutdown		T_{SD}		-	150	-	°C
Thermal Shutdown Hysteresis		T_{SH}		-	30	-	

Note1 : Guaranteed by design.

Pin Descriptions

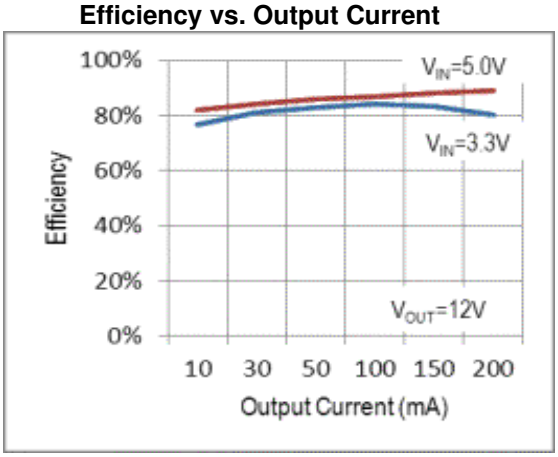
PIN SYMBOL	PIN DESCRIPTION
VCC	Power Input Pin
EN	Enable dimming pin, internal pull-high.
FB	Feedback Pin; connect via a resistor to GND to set the current
GND	Ground Pin
OV	OVP Sense Pin
SW	Switch Output Pin

Block Diagram

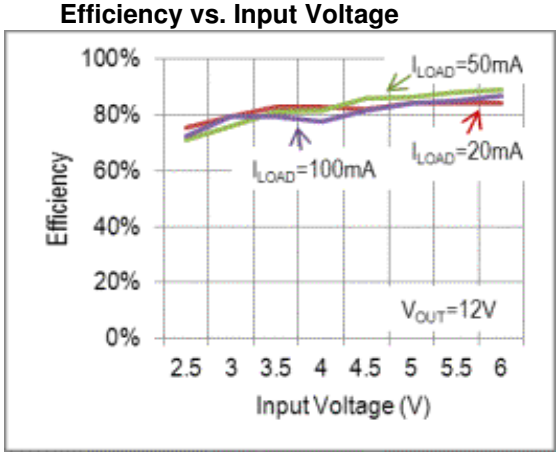


Typical Performance Characteristics

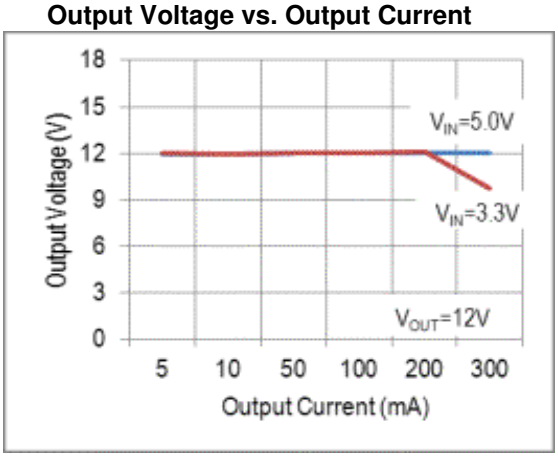
Efficiency vs. Output Current



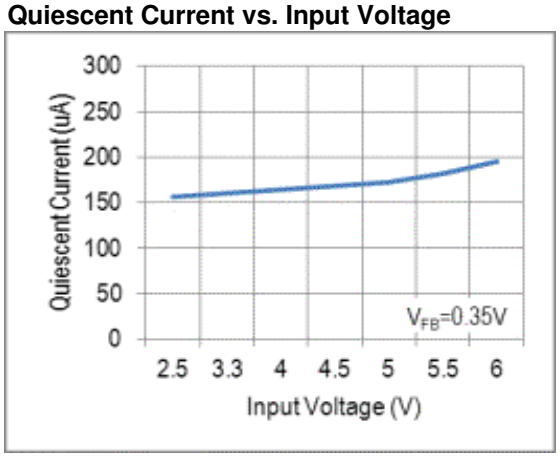
Efficiency vs. Input Voltage



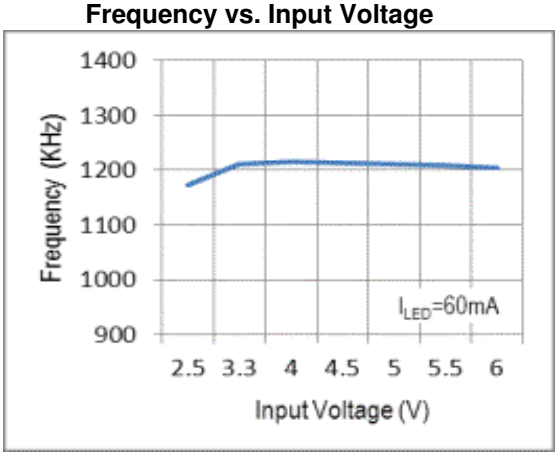
Output Voltage vs. Output Current



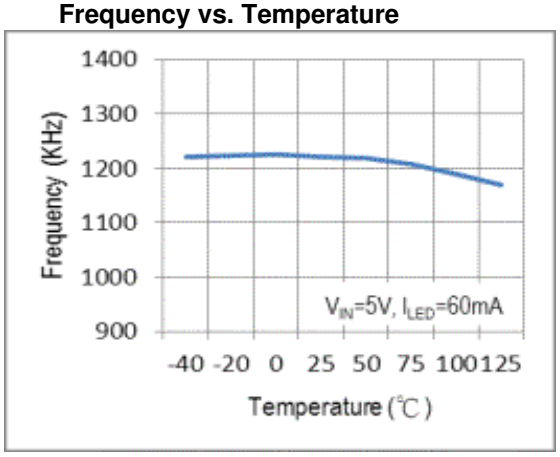
Quiescent Current vs. Input Voltage



Frequency vs. Input Voltage

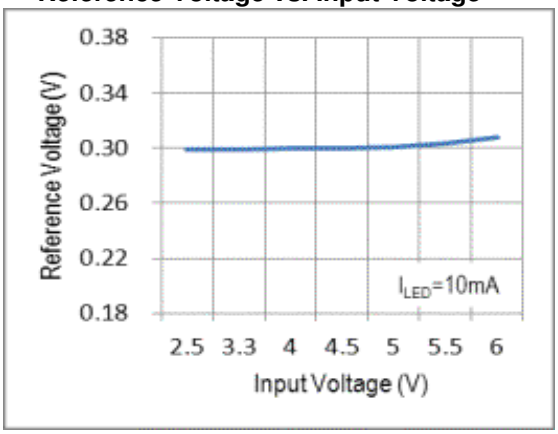


Frequency vs. Temperature

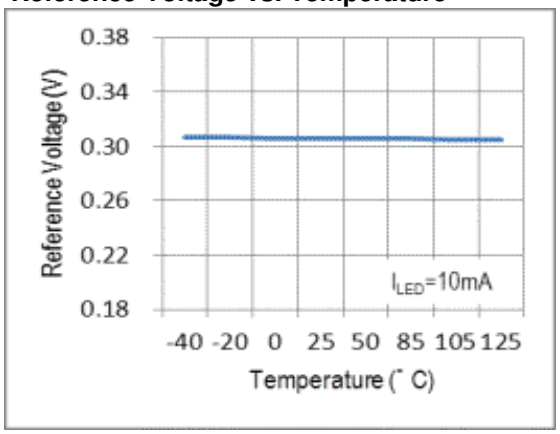


Typical Performance Characteristics (continued)

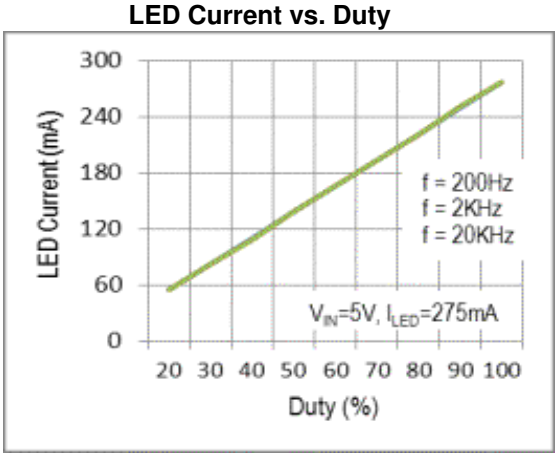
Reference Voltage vs. Input Voltage



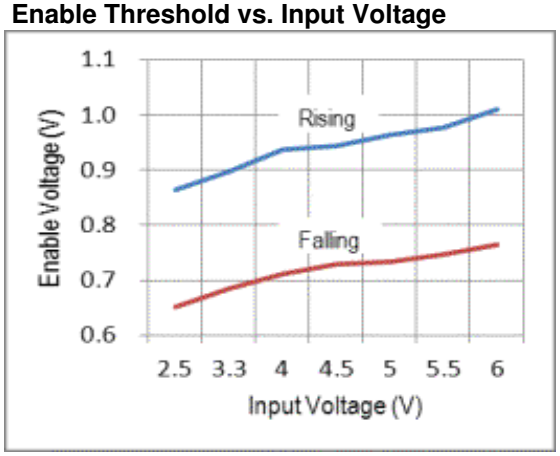
Reference Voltage vs. Temperature



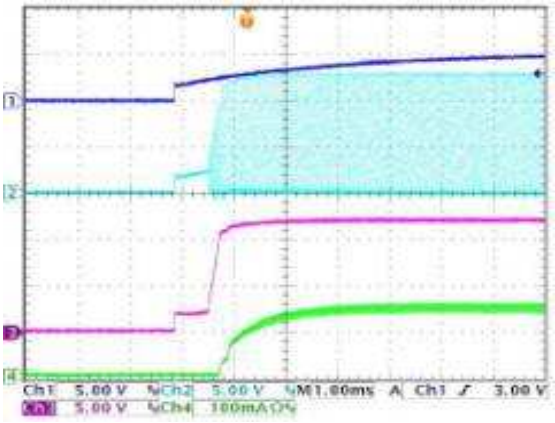
LED Current vs. Duty



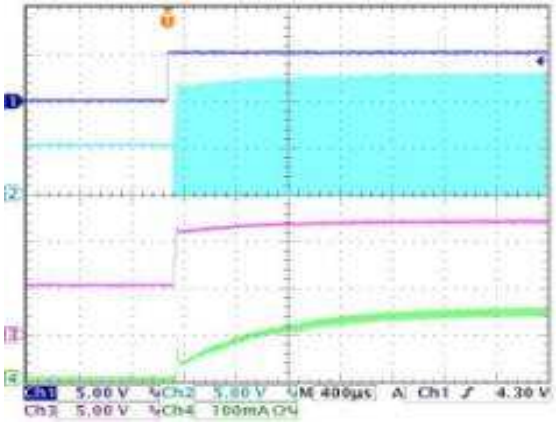
Enable Threshold vs. Input Voltage



Power ON from VIN

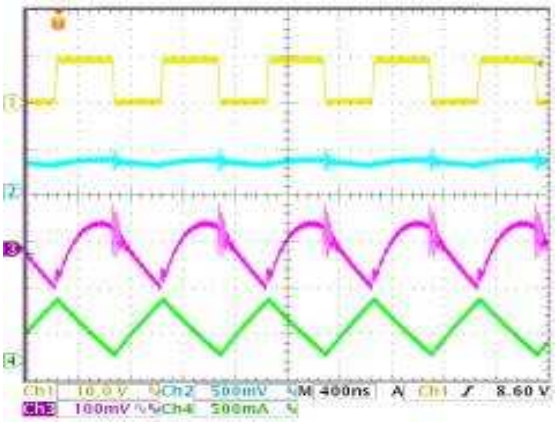


Power ON from EN



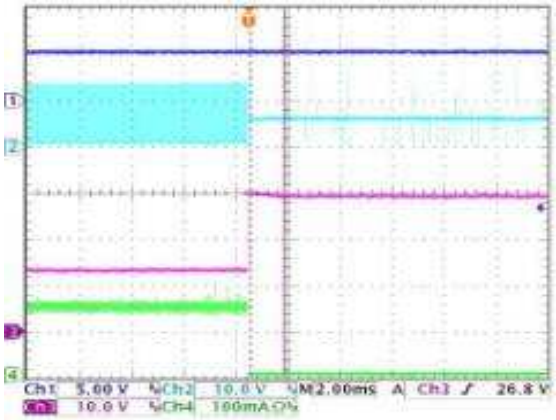
Typical Performance Characteristics (continued)

Steady State Operation

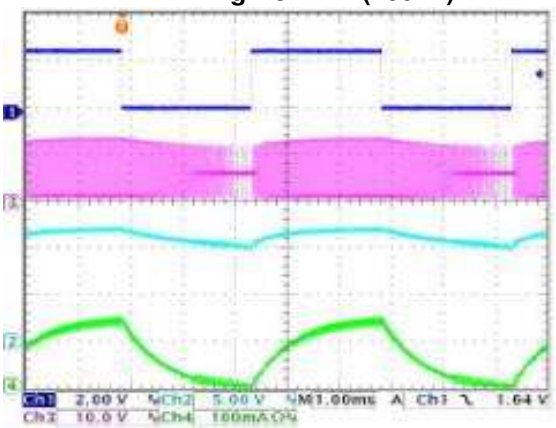


(V_{OUT}, I_{OUT}: measured by AC coupled mode)

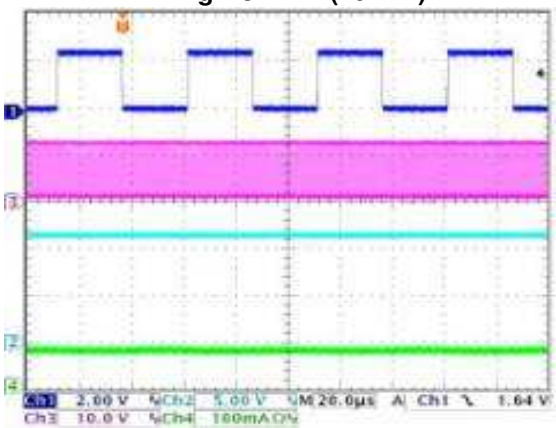
Normal Operation into OVP



PWM Dimming from EN (200Hz)



PWM Dimming from EN (20KHz)



Application Information

Setting the ILED Current

The application circuits on page 1 show the basic circuits for the APE1612 adjustable output version. The external resistor sets the LED output current according to the following equation:

$$I_{LED} = \left(\frac{0.3V}{R3} \right)$$

I_{LED}	R3	
20mA	15Ω	6mW
350mA	0.857Ω	105mW

Over Voltage Protection

The OV pin monitors the output voltage for open circuit protection, and should be connected to the output at the top of the LED string. If V_{OUT} is above 29V, the OVP protection is implemented and stops the internal driver until V_{OUT} falls below 29V.

Under Voltage Lockout (UVLO)

To avoid mis-operation of the device at low input voltages an under-voltage lockout is included which disables the device when the input voltage falls below (2.25V-100mV).

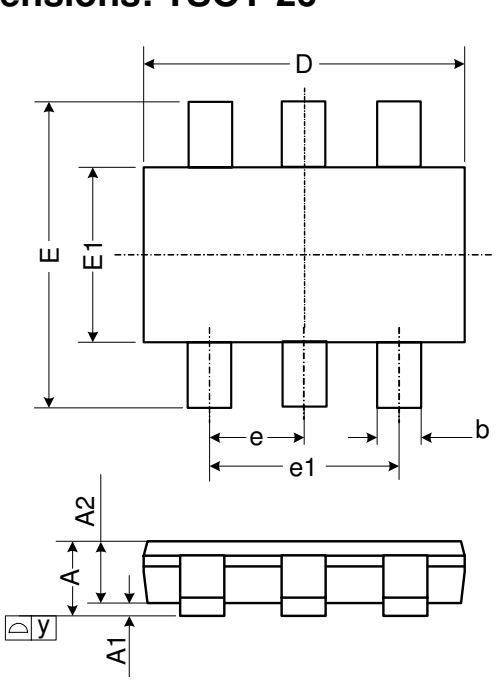
Input Capacitor Selection

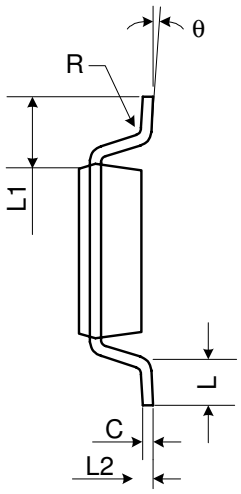
The input capacitor reduces both the surge current drawn from the input and the switching noise from the device. The input capacitor impedance at the switching frequency should be less than input source impedance to prevent high frequency switching current passing to the input. A low ESR input capacitor sized for maximum RMS current must be used. Ceramic capacitors with X5R or X7R dielectrics are highly recommended because of their low ESR and small temperature coefficients. A 4.7 µF ceramic capacitor is sufficient for most applications . For a lower output power requirement application, this value can be decreased.

Output Capacitor Selection

The output capacitor is required to keep the output voltage ripple small and to ensure regulation loop stability. The output capacitor must have low impedance at the switching frequency. Ceramic capacitors with X5R or X7R dielectrics are recommended due to their low ESR and high ripple current. A 1uF ceramic capacitors works for most of the applications. Higher capacitor values can be used to improve the load transient response.

Package Dimensions: TSOT-26





1. All dimensions are in millimeters.
2. Dimensions do not include mold protrusions.

Symbol	Dimensions in Millimeters			Dimensions in Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	-	-	1.10	-	-	0.043
A1	0.00	-	0.10	0	-	0.004
A2	0.70	0.90	1.00	0.028	0.035	0.039
b	0.30	0.40	0.50	0.012	0.016	0.020
C	0.08	0.14	0.20	0.003	0.006	0.008
D	2.80	2.90	3.00	0.110	0.114	0.118
E	2.60	2.80	3.00	0.102	0.110	0.118
E1	1.50	1.60	1.70	0.059	0.063	0.067
e	0.95 BSC.			0.037 BSC.		
e1	1.90 BSC.			0.075 BSC.		
L	0.30	0.45	0.60	0.012	0.018	0.024
L1	0.60 REF.			0.024 REF.		
L2	0.25 BSC.			0.010 BSC.		
y	-	-	0.10	-	-	0.004
R	0.10	-	-	0.004	-	-
θ	0°	-	8°	0°	-	8°

JEDEC outline: MO-193 AA

Marking Information