Simple switcher 1A step-down Voltage regulator

General Description

The LM2575S-xxx-Y of regulators are monolithic integrated circuits that provide all the active functions for a step-down (buck) switching regulator, capable of driving 1A load with excellent line and load regulation. These devices are available in fixed output voltages of 3.3V,5V,12V,15V,and an adjustable output version.

Requiring a minimum number of external components,these regulators are simple to use and include internal frequency compensation and afixed-frequency oscillator.

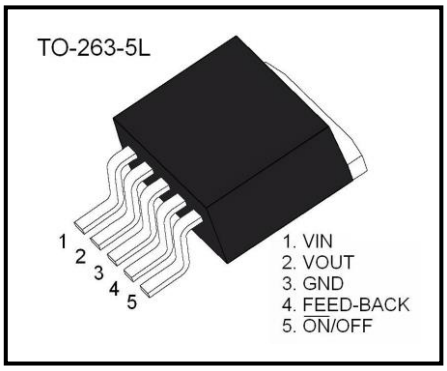
The LM2575S-xxx-Y offers a high-efficiency replacement for popular three-terminal linear regulators.It substantially reduces the size of the heatsink,and in some cases no heat sink is required.

A standard series of inductors optimized for use with the LM2575S-xxx-Y are available from several different manufacturers. This feature greatly simplifies the design of switch-mode power supplies.

Other features include a guaranteed ±4% tolerance on output voltage with inspecified input voltages and output load conditions,and ±10% on the oscillator frequency.External shutdown is included,featuring 50μA(typical) standby current. The output switch includes cycle-by-cycle current limiting, as well as thermal shutdown for full protection under fault conditions.

Applications

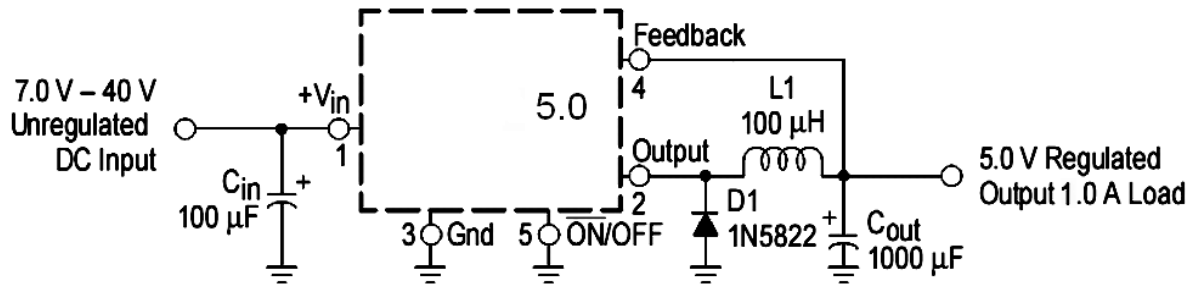
- Simple high-efficiency step-down(buck) regulator
- Efficient pre-regulator for linear regulators
- On-card switching regulators
- Positive to negative converter(Buck-Boost)



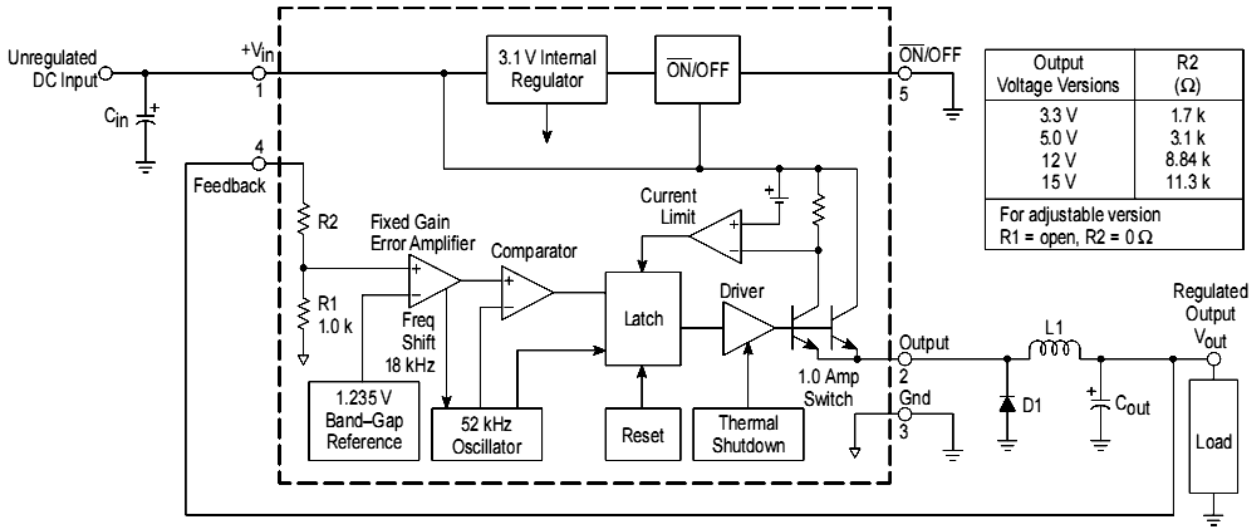
Features

- Guaranteed 1A output current
- Requiresonly 4 external components
- 52 kHz fixed frequency internal oscillator
- TTL shutdown capability,low power standby mode
- High efficiency
- Uses readily available standard inductors
- Thermal shutdown and current limit protection

Typical Application (FixedOutputVoltage Versions)



Block Diagram and Typical Application



Absolute Maximum Ratings

Parameter	Symbol	Conditions	Ratings	Unit
Supply Voltage	V_{IN}		45	V
$\overline{ON}$/OFF Pin Input Voltage	$V_{\overline{ON}/OFF}$		-0.3 ~ + V_{IN}	V
Output Voltage to Ground	V_{OG}	Steady State	-1	V
Power Dissipation	P_D		Internally Limited	W
Junction Temperature	T_j		-40 ~ 125	℃
Storage Temperature	T_{stg}		-65 ~ 150	℃
Minimum ESD Rating	V_{ESD}	C=100pF, R=1.5kΩ	2	kV
Lead Temperature	T_{LEAD}	Soldering,10 Seconds	260	℃

Note1. Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but do not guarantee specific performance limits.For guaranteed specifications and test conditions,see the Electrical Characteristics.

2. All limits guaranteed at room temperature (standard type face) and at temperature extremes (bold type face) .All limits are used to calculate Average Out going Quality Level, and all are100%production tested.
3. All limitsguaranteed at room temperature (standardtypeface) and at temperature extremes (bold type face) .All room temperature limits are 100% production tested. All limits at temperature extremes are guaranteed via correlation using standard Statistical Quality Control (SQC) methods.

Electrical Characteristics LM2575S-3.3-Y

Specification swith standard type face are for T_j =25℃

Parameter	Symbol	Conditions		Value			Unit
				Min	Typ	Max	
Output Voltage	V_{OUT}	V_{IN}=12V, I_{LOAD} =0.2A,		3.234	3.3	3.366	V
Output Voltage	V_{OUT}	4.75V ≤ V_{IN}≤ 40V, 0.2A ≤ I_{LOAD} ≤ 1A	T_j= 25℃	3.168	3.3	3.432	V
			T_j=-40~125℃	3.135	3.3	3.465	
Efficiency	η	V_{IN}=12V, I_{LOAD} =1.0A,			75		%

Electrical Characteristics LM2575S-5.0-Y

Specification swith standard type face are for T_j =25℃

Parameter	Symbol	Conditions		Value			Unit
				Min	Typ	Max	
Output Voltage	V_{OUT}	V_{IN}=12V, I_{LOAD} =0.2A,		4.900	5.0	5.100	V
Output Voltage	V_{OUT}	8V ≤ V_{IN}≤ 40V, 0.2A ≤ I_{LOAD} ≤ 1A	T_j= 25℃	4.800	5.0	5.200	V
			T_j=-40~125℃	4.750	5.0	5.250	
Efficiency	η	V_{IN}=12V, I_{LOAD} =1.0A,			77		%

Electrical Characteristics LM2575S-12-Y

Specification swith standard type face are for T_j =25℃

Parameter	Symbol	Conditions		Value			Unit
				Min	Typ	Max	
Output Voltage	V_{OUT}	V_{IN}=25V, I_{LOAD} =0.2A,		11.76	12	12.24	V
Output Voltage	V_{OUT}	15V ≤ V_{IN}≤ 40V, 0.2A ≤ I_{LOAD} ≤ 1A	T_j= 25℃	11.52	12	12.48	V
			T_j=-40~125℃	11.40	12	12.60	
Efficiency	η	V_{IN}=15V, I_{LOAD} =1.0A,			88		%

Electrical Characteristics LM2575S-15-Y

Specification swith standard type face are for T_j =25℃

Parameter	Symbol	Conditions		Value			Unit
				Min	Typ	Max	
Output Voltage	V_{OUT}	V_{IN}=25V, I_{LOAD} =0.2A,		14.70	15	15.30	V
Output Voltage	V_{OUT}	18V ≤ V_{IN}≤ 40V, 0.2A ≤ I_{LOAD} ≤ 1A	T_j= 25℃	14.40	15	15.60	V
			T_j=-40~125℃	14.52	15	15.75	
Efficiency	η	V_{IN}=18V, I_{LOAD} = 1.0A,			88		%

Electrical Characteristics LM2575S-ADJ-Y

Specification swith standard type face are for T_j =25℃

Parameter	Symbol	Conditions		Value			Unit
				Min	Typ	Max	
Output Voltage	V_{OUT}	V_{IN}=12V, I_{LOAD} =0.2A, V_{OUT}= 5V		1.217	1.230	1.243	V
Output Voltage	V_{OUT}	8V ≤ V_{IN}≤ 40V, 0.2A ≤ I_{LOAD} ≤ 1A V_{OUT}= 5V	T_j= 25℃	1.193	1.230	1.267	V
			T_j=-40~125℃	1.180	1.230	1.286	
Efficiency	η	V_{IN}=12V, I_{LOAD} =1.0A, V_{OUT}=5V			77		%

All Output Voltage Versions Electrical Characteristics

V_{IN} =12V for the 3.3V,5V,and Adjustable version,V_{IN} =25V for the 12V version,and V_{IN} =30V for the 15V version. I_{LOAD} =200mA. Specification swith standard type face are for T_j =25˚C, unless other wises pecified,

Parameter	Symbol	Conditions		Value			Unit
				Min	Typ	Max	
Feedback Bias Current	I_b	V_{OUT}= 5V, Adjustable Only			50	100	nA
Oscillator Frequency	f_{OSC}	Note11			52		kHz
Saturation Voltage	V_{sat}	I_{OUT} = 1.0A (Note 5)			0.9	1.2	V
Max Duty Cycle (“on”)	DC			93	98		%
Current Limit	I_{CL}	Peak Current (Note 5,11)		1.7	2.2	3	A
Output Leakage Current	I_L	Output = 0 V Output = -1.0 V (Note 7,8)		2	 7.5	 30	mA
Quiescent Current	I_Q	Note 7			5	10	mA
Standby Quiescent Current	I_{stby}	$\overline{ON}$/OFF Pin=5.0V (off)			50	200	μA
$\overline{ON}$/OFF Pin Logic Input Level	V_{IH}	V_{OUT} = 0	T_j = 25℃			2.2	V
			T_j=-40~ 125℃			2.4	
$\overline{ON}$/OFF Pin Logic Input Level	V_{IL}	V_{OUT} = Nominal Output Voltage	T_j = 25℃			1.0	V
			T_j=-40~ 125℃			0.8	
$\overline{ON}$/OFF Pin Input Current	I_{IH}	$\overline{ON}$/OFF Pin=5.0V (“off”)				30	μA
$\overline{ON}$/OFF Pin Input Current	I_{IL}	$\overline{ON}$/OFF Pin=5.0V (“on”)				5.0	μA

Notes:

4. External components such as the catch diode, inductor, input and output capacitors can affect switching regulator system performance. When the LM2575S is used as shown in the Figure2 testcircuit, system performance will be as shown in system parameters section of Electrical Characteristics.
5 .Output (pin2) sourcing current.No diode, inductor or capacitor connected to output pin.
6.Feedback (pin4) removed from output and connected to 0V.
7.Feedback (pin4) removed from output and connected to +12V for the Adjustable, 3.3V, and 5V versions, and +25V for the 12V and 15V versions, to force the output transistor OFF.
8. Vin = 40 V.
9. Junction to ambient thermal resistance with approximately 1 square inch of pc board copper surrounding the leads .Additional copper area will resistance further. See the rmal model in Switchers made Simple software
10 If the TO-263 package is If theTO-263 packag eisused ,the thermal resistance can be reduced by increasing the PC board copper area t
hermally connected to the package: Using 0.5 square inche sof copper area, θ_{JA}
Is 50˚C/W; with 1square inch of copper area, θ_{JA} is 37˚C/W; and with1.6 or mores quare inches of copper area, θ_{JA} is 32˚ C/W.
11 The oscillator frequency reduces to approximately 18kHz in the event of an output short or an overload which causes the regulated output voltage to drop approximately 40% from the nominal output voltage. This self protection feature lowers the average power dissipation of the IC by lowering the minimum duty cycle from 5% down to approximately 2%.

Typical Characteristics

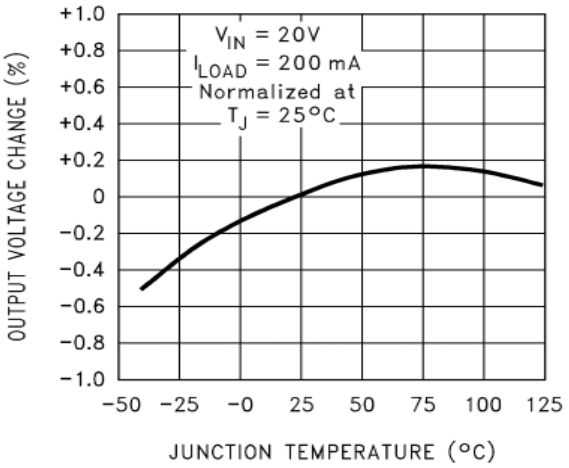


Figure 1. Normalized Output Voltage

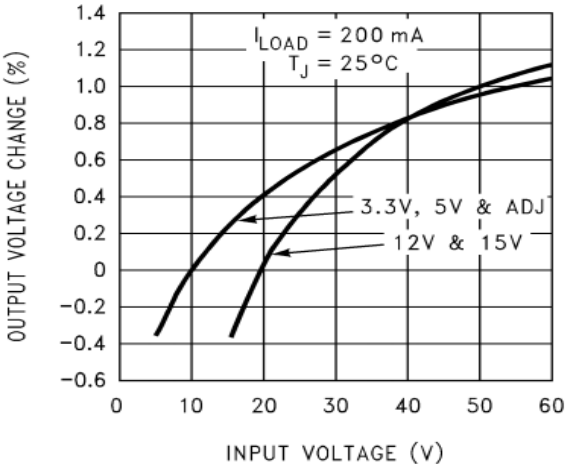


Figure 2. Line Regulation

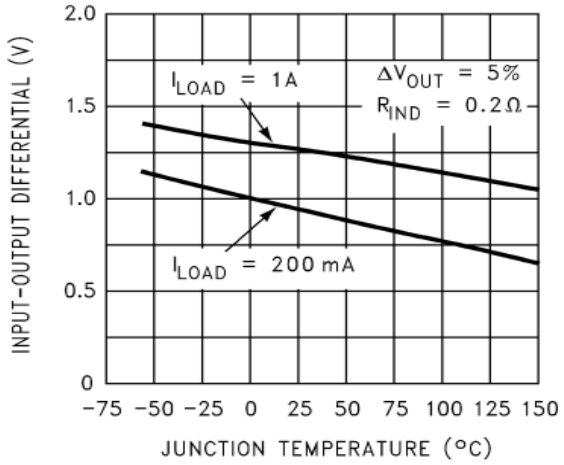


Figure 3. Dropout Voltage

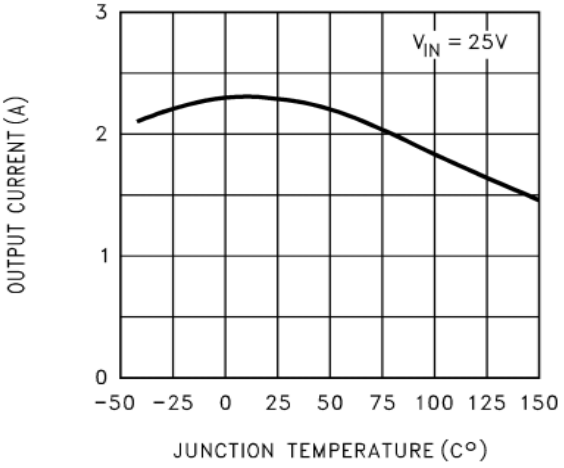


Figure 4. Current Limit

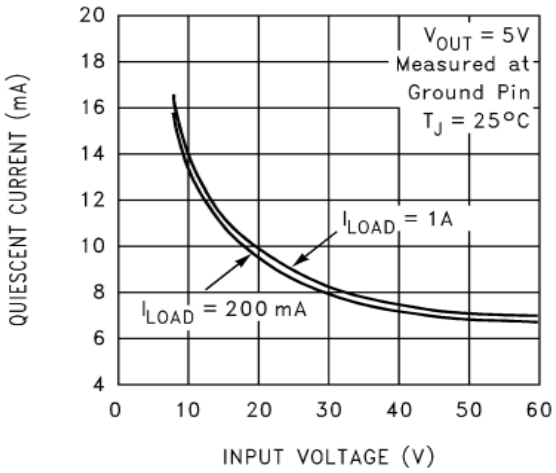


Figure 5. Quiescent Current

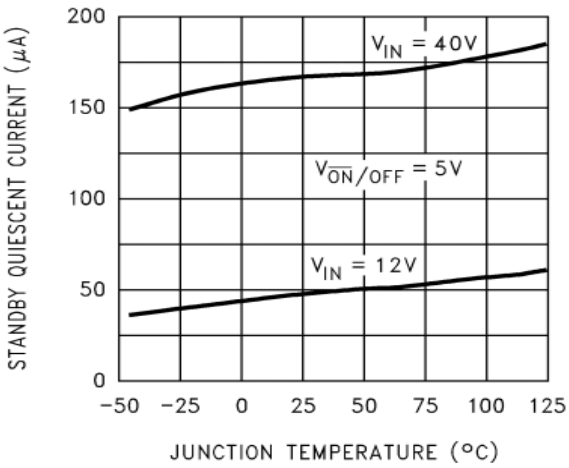


Figure 6. Standby Quiescent Current

Typical Characteristics

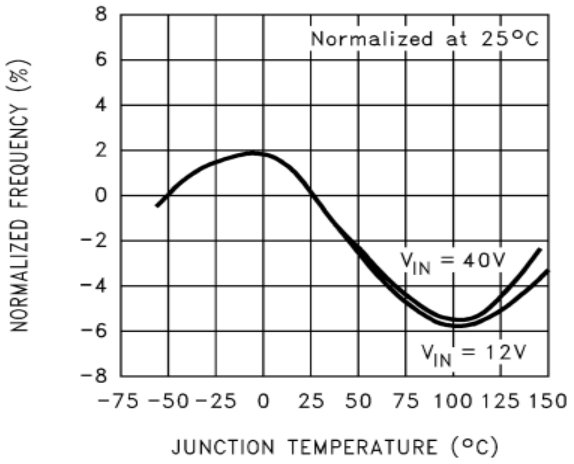


Figure 7. Oscillator Frequency

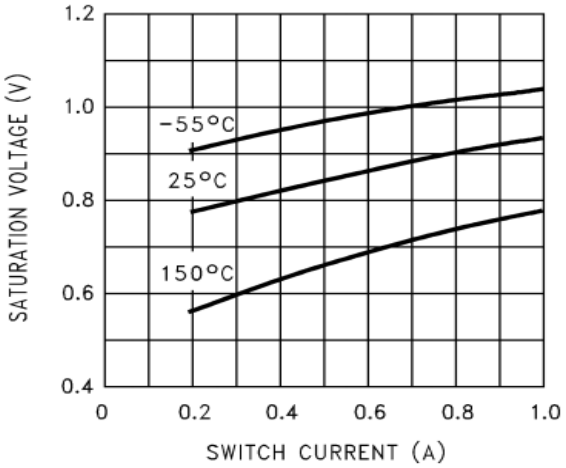


Figure 8. Switch Saturation Voltageon

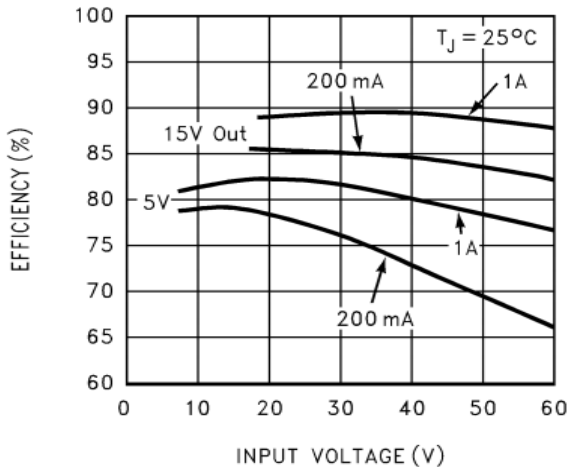


Figure 9. Efficiency

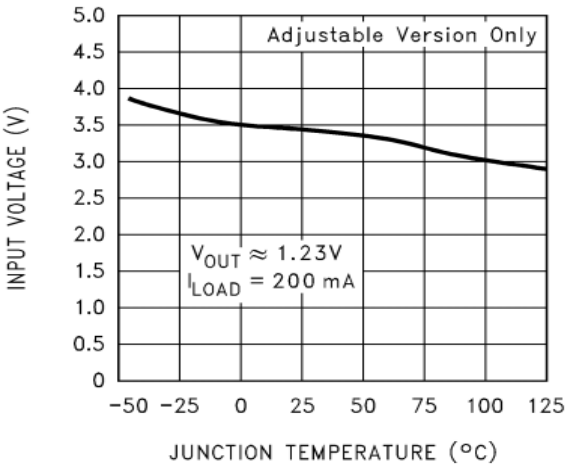


Figure 10. Minimum Operating Voltage

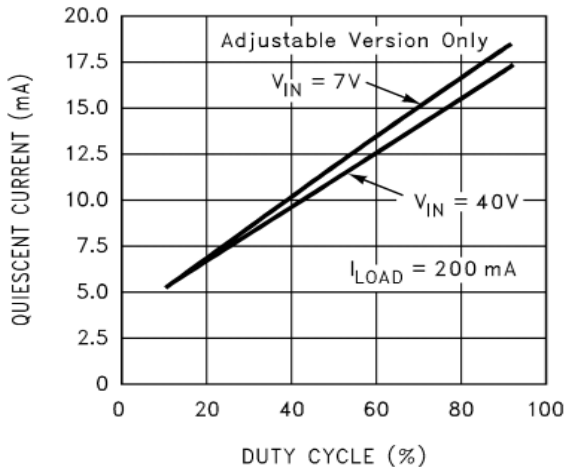


Figure 11. Quiescent Current vs Duty Cycle

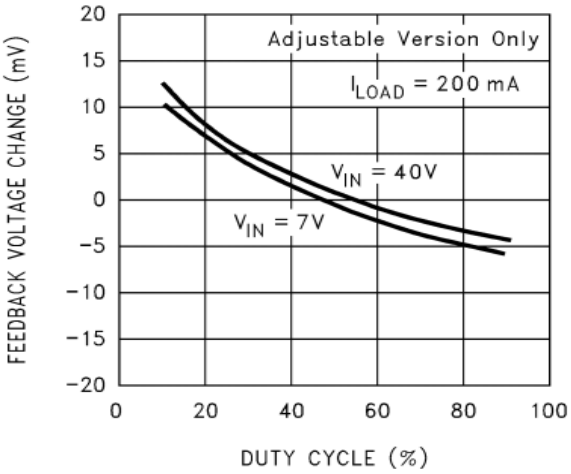


Figure 12. Feedback Voltage vs Duty Cycle

Typical Characteristics

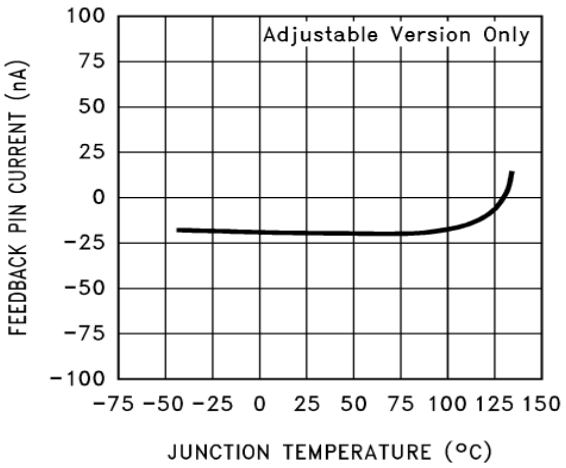


Figure 13. Feedback Pin Current

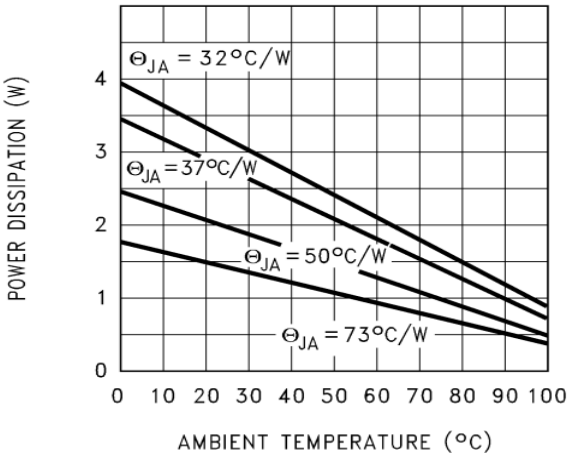
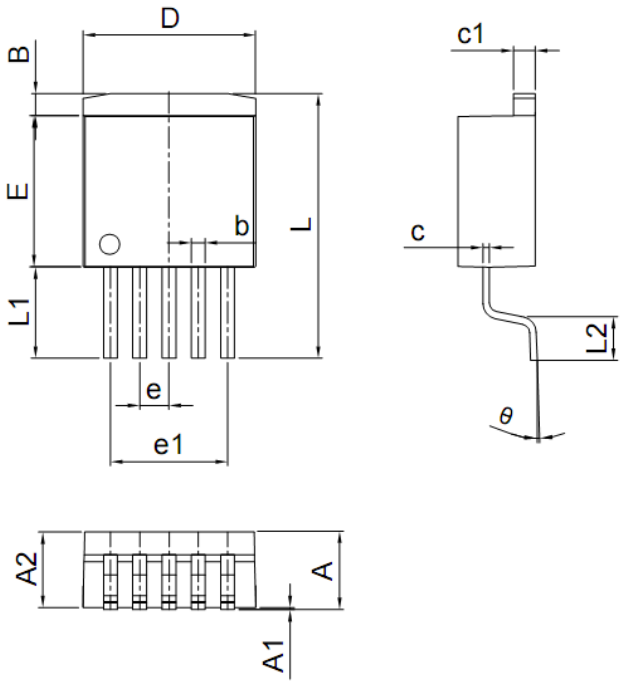


Figure 14. Maximum Power Dissipation

Package Dimensions



Dim	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	4.30	4.70	0.169	0.185
A1	0.00	0.15	0.000	0.006
A2	4.30	4.55	0.169	0.179
B	1.20	1.60	0.047	0.063
b	0.70	0.90	0.028	0.035
b1	1.20	1.50	0.047	0.059
c	0.30	0.60	0.012	0.024
c1	1.17	1.37	0.046	0.054
D	9.90	10.20	0.390	0.402
E	8.50	8.90	0.335	0.350
e	1.60	1.80	0.096	0.104
e1	6.40	7.20	0.252	0.283
L	14.60	15.00	0.575	0.590
L1	4.70	5.30	0.205	0.213
L2	2.30	2.60	0.091	0.110