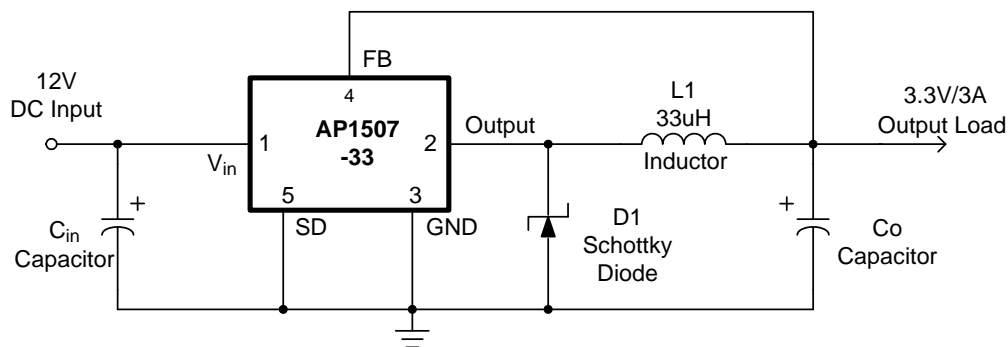
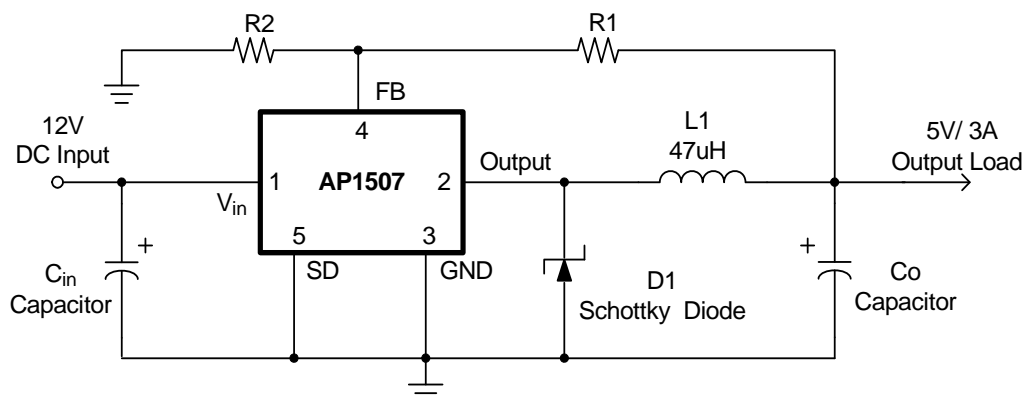


Typical Application Circuit

(1) Fixed Type Circuit



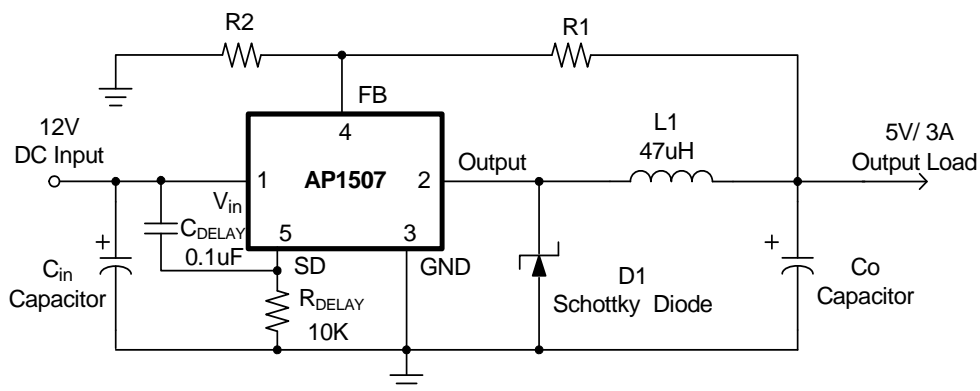
(2) Adjustable Type Circuit



$$V_{OUT} = V_{FB} \times \left(1 + \frac{R1}{R2}\right)$$

$$V_{FB} = 1.23V, R2 = 1K \sim 3K$$

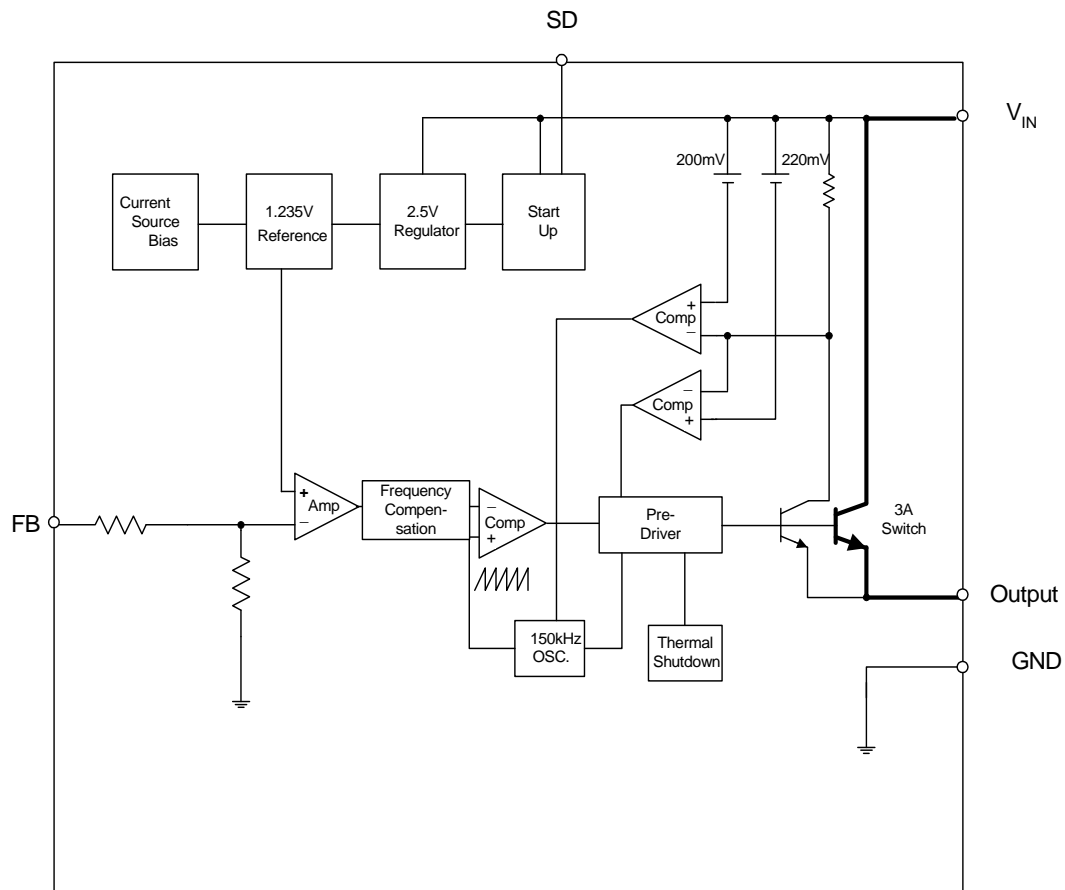
(3) Delay Start Circuit



Pin Descriptions

Pin Number	Pin Name	Description
1	V _{IN}	Operating Voltage Input
2	Output	Switching Output
3	GND	Ground
4	FB	Output Voltage Feedback Control
5	SD	ON / OFF Shutdown

Functional Block Diagram



Absolute Maximum Ratings ($T_A = 25^\circ\text{C}$) (Note4)

Symbol	Parameter	Rating	Unit
ESD HBM	Human Body Model ESD Protection	2	KV
ESD MM	Machine Model ESD Protection	200	V
V_{CC}	Supply Voltage	+24	V
V_{SD}	ON/OFF Pin Input Voltage	-0.3 to +18	V
V_{FB}	Feedback Pin Voltage	-0.3 to +18	V
V_{OUT}	Output Voltage to Ground	-1	V
P_D	Power Dissipation	Internally Limited	W
T_{ST}	Storage Temperature	-65 to +150	$^\circ\text{C}$
T_J	Operating Junction Temperature	-40 to +125	$^\circ\text{C}$

Note: 4. Stresses greater than the 'Absolute Maximum Ratings' specified above, may cause permanent damage to the device. These are stress ratings only; functional operation of the device at these or any other conditions exceeding those indicated in this specification is not implied. Device reliability may be affected by exposure to absolute maximum rating conditions for extended periods of time.

Recommended Operating Conditions ($T_A = 25^\circ\text{C}$)

Symbol	Parameter	Min	Max	Unit
I_{OUT}	Output Current	0	3	A
V_{OP}	Operating Voltage	4.5	22	V
T_A	Operating Ambient Temperature	-20	+85	$^\circ\text{C}$

Electrical Characteristics (All Output Voltage Versions)

Unless otherwise specified, $V_{IN} = 12V$ for 3.3V, 5V, adjustable version and $V_{IN} = 18V$ for the 12V version. $I_{LOAD} = 0.5A$
 Specifications with **boldface type** are for full operating temperature range, the other type are for $T_J = 25^\circ C$.

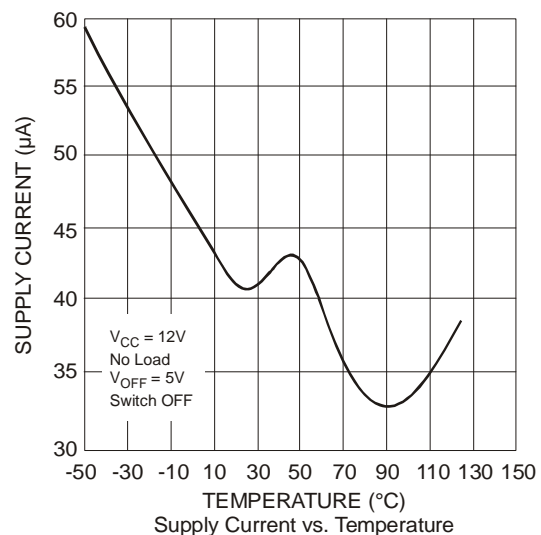
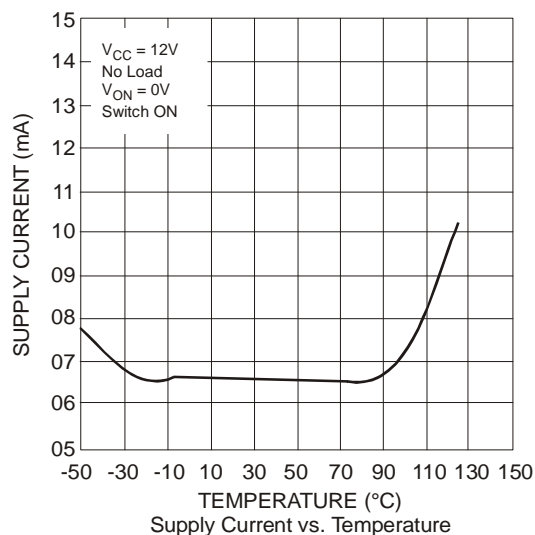
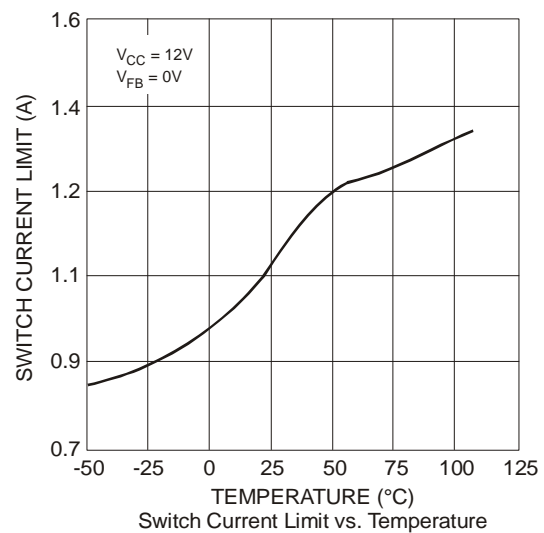
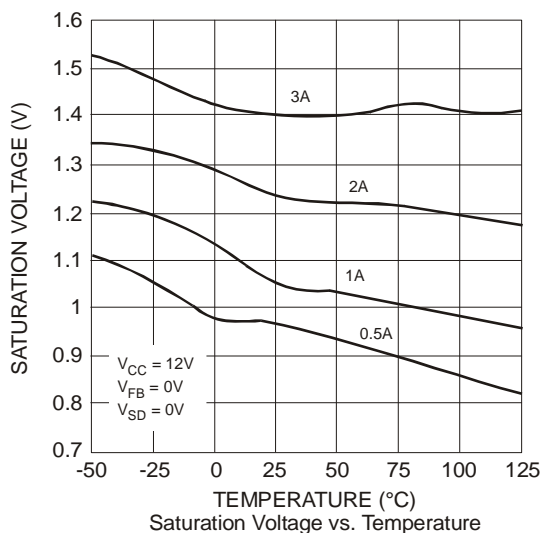
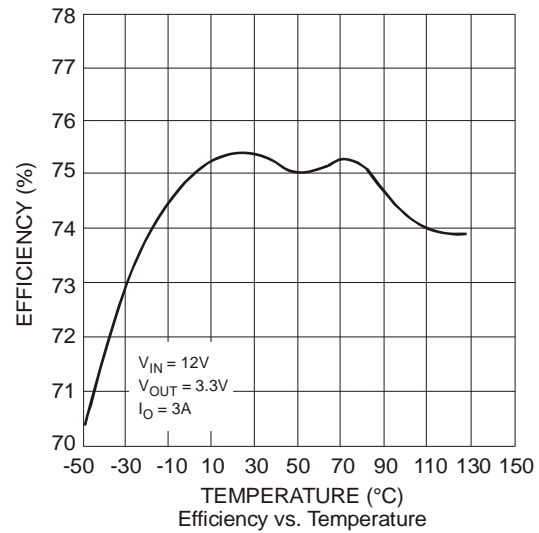
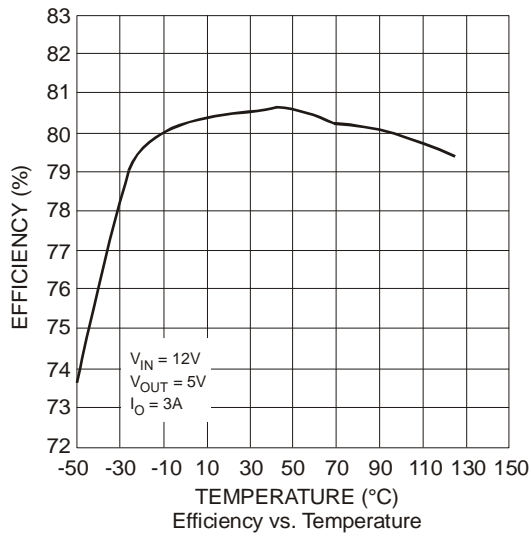
Symbol	Parameter		Conditions	Min	Typ	Max	Unit
I _{FB}	Feedback Bias Current		V _{FB} = 1.3V (Adjustable Version Only)		-10	-50 -100	nA
F _{OSC}	Oscillator Frequency			127 110	150	173 173	KHz
F _{SCP}	Oscillator Frequency of Short Circuit Protect		When current limit Occurred and V _{FB} < 0.5V, T _A = 25°C	10	30	50	KHz
V _{SAT}	Saturation Voltage		I _{OUT} = 3A No Outside Circuit V _{FB} = 0V Force Driver On		1.4	1.6 1.7	V
DC	Max. Duty Cycle (ON)		V _{FB} = 0V Force Driver On		100		%
	Min. Duty Cycle (OFF)		V _{FB} = 12V Force Driver Off		0		
I _{CL}	Current Limit		Peak Current No Outside Circuit V _{FB} = 0V Force Driver On	3.6	4.5	5.5 6.5	A
I _{LEAK}	Output = 0V	Output leakage current	No Outside Circuit V _{FB} = 12V Force Driver Off			-200	μA
	Output = -1V		V _{IN} = 22V		-5		mA
I _Q	Quiescent Current		V _{FB} = 12V Force Driver Off		5	10	mA
I _{STBY}	Standby Quiescent Current		ON/OFF Pin = 5V V _{IN} = 22V		70	150 200	μA
V _{IL}	ON/OFF Pin Logic Input Threshold		Low (Regulator ON)	-	1.3	0.6	V
V _{IH}	Voltage		High (Regulator OFF)	2.0		-	
I _H	ON/OFF Pin Logic Input Current		V _{LOGIC} = 2.5V (OFF)			-0.01	μA
I _L	ON/OFF Pin Input Current		V _{LOGIC} = 0.5V (ON)		-0.1	-1	
θ _{JA}	Thermal Resistance		TO252-5L	Junction to Case	10		°C/W
θ _{JC}	Thermal Resistance with copper area of approximately 2cm x2cm		TO252-5L	Junction to Ambient	50		°C/W

Electrical Characteristics (All Output Voltage Versions)

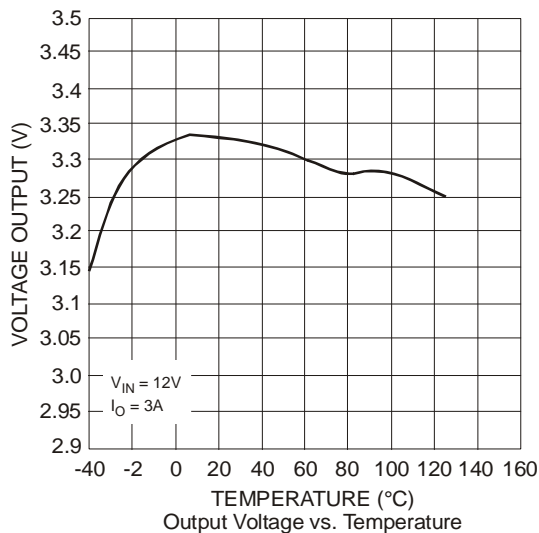
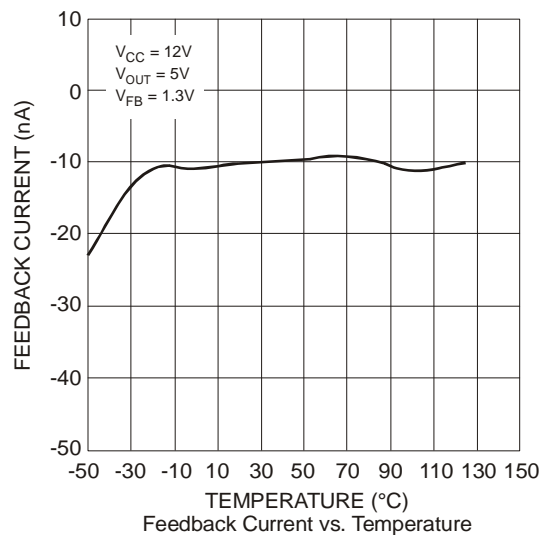
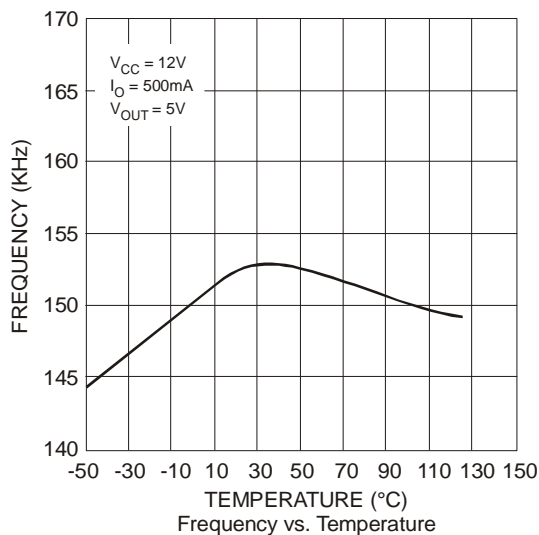
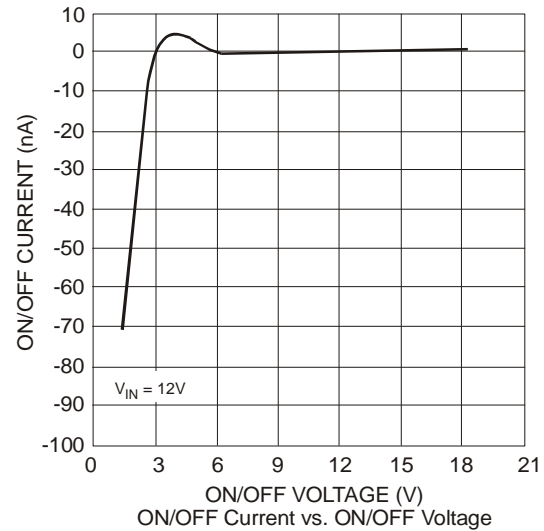
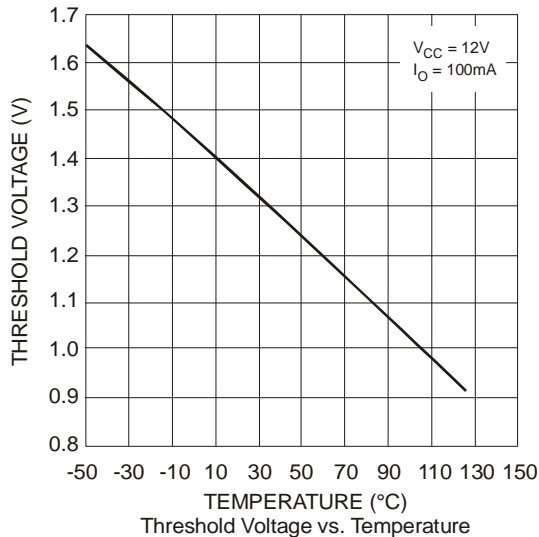
Specifications with **boldface type** are for full operating temperature range, the other type are for $T_J = 25^\circ\text{C}$.

	Symbol	Parameter	Conditions	V _{MIN}	Typ.	V _{MAX}	Unit
AP1507-ADJ	V _{FB}	Output Feedback	$5\text{V} \leq V_{IN} \leq 22\text{V}$ $0.2\text{A} \leq I_{LOAD} \leq 3\text{A}$ V _{OUT} Programmed for 3V	1.193 1.18	1.23	1.267 1.28	V
	η	Efficiency	V _{IN} = 12V, I _{LOAD} = 3A		74		%
AP1507-3.3V	V _{OUT}	Output Voltage	$5.5\text{V} \leq V_{IN} \leq 22\text{V}$ $0.2\text{A} \leq I_{LOAD} \leq 3\text{A}$	3.168 3.135	3.3	3.432 3.465	V
	η	Efficiency	V _{IN} = 12V, I _{LOAD} = 3A		75		%
AP1507-5V	V _{OUT}	Output Voltage	$8\text{V} \leq V_{IN} \leq 22\text{V}$ $0.2\text{A} \leq I_{LOAD} \leq 3\text{A}$	4.8 4.75	5	5.2 5.25	V
	η	Efficiency	V _{IN} = 12V, I _{LOAD} = 3A		80		%
AP1507-12V	V _{OUT}	Output Voltage	$15\text{V} \leq V_{IN} \leq 22\text{V}$ $0.2\text{A} \leq I_{LOAD} \leq 3\text{A}$	11.52 11.4	12	12.48 12.6	V
	η	Efficiency	V _{IN} = 16V, I _{LOAD} = 3A		89		%

Typical Characteristics



Typical Characteristics (cont.)



Application Information

Pin Functions

+V_{IN}

This is the positive input supply for the IC switching regulator. A suitable input bypass capacitor must be present at this pin to minimize voltage transients and to supply the switching currents needed by the regulator.

Ground

Circuit ground.

Output

Internal switch. The voltage at this pin switches between (+V_{IN} - V_{SAT}) and approximately -0.5V, with a duty cycle of approximately V_{OUT} / V_{IN}. To minimize coupling to sensitive circuitry, the PC board copper area connected to this pin should be kept at a minimum.

Feedback (FB)

Senses the regulated output voltage to complete the feedback loop.

ON/OFF (SD)

Allows the switching regulator circuit to be shutdown using logic level signals thus dropping the total input supply current to approximately 150uA. Pulling this pin below a threshold voltage of approximately 1.3V turns the regulator on, and pulling this pin above 1.3V (up to a maximum of 18V) shuts the regulator down. If this shutdown feature is not needed, the ON/OFF pin can be wired to the ground pin.

Thermal Considerations

The TO-252 surface mount package tab is designed to be soldered to the copper on a printed circuit board. The copper and the board are the heat sink for this package and the other heat producing components, such as the catch diode and inductor. The PC board copper area that the package is soldered to should be at least 0.8 in², and ideally should have 2 or more square inches of 2 oz. additional copper area which improves the thermal characteristics. With copper areas greater

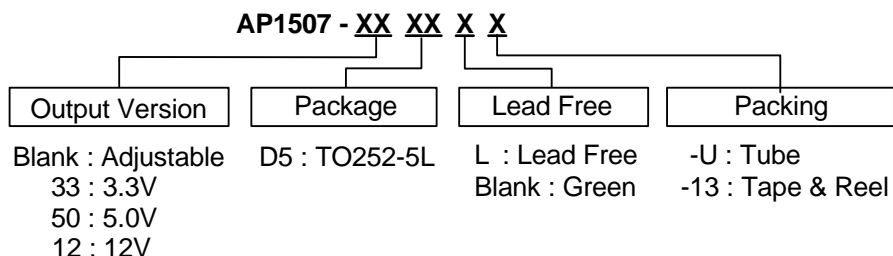
than approximately 6in², only small improvements in heat dissipation are realized. If further thermal improvements are needed, double sided, multi-layer PC board with large copper areas and/or airflow will be recommended.

The AP1507 (TO-252 package) junction temperature rises above ambient temperature with a 3A load for various input and output voltages. This data was taken with the circuit operating as a buck-switching regulator with all components mounted on a PC board to simulate the junction temperature under actual operating conditions. This curve can be used for a quick check for the approximate junction temperature for various conditions, but there are many factors that can affect the junction temperature. When load currents higher than 3A are used, double sided or multi-layer PC boards with large copper areas and/or airflow might be needed, especially for high ambient temperatures and high output voltages.

For the best thermal performance, wide copper traces and generous amounts of printed circuit board copper should be used in the board layout. (One exception to this is the output (switch) pin, which should not have large areas of copper.) 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 such as the catch diode will add heat to the PC board and the heat can vary as the input voltage changes. For the inductor, depending on the physical size, type of core material and the DC resistance, it could either act as a heat sink taking heat away from the board, or it could add heat to the board.

Ordering Information

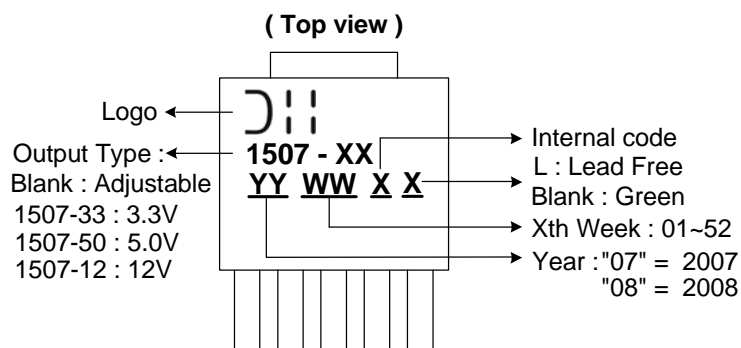


Device	Package Code	Packaging (Note 5)	Tube/Bulk		13" Tape and Reel	
			Quantity	Part Number Suffix	Quantity	Part Number Suffix
AP1507-XXD5L-XX	D5	TO252-5L	80	-U	2500/Tape & Reel	-13
AP1507-XXD5-XX	D5	TO252-5L	Not available		2500/Tape & Reel	-13

Note: 5. Pad layout as shown on Diodes Inc. suggested pad layout document AP02001, which can be found on our website at <http://www.diodes.com/datasheets/ap02001.pdf>

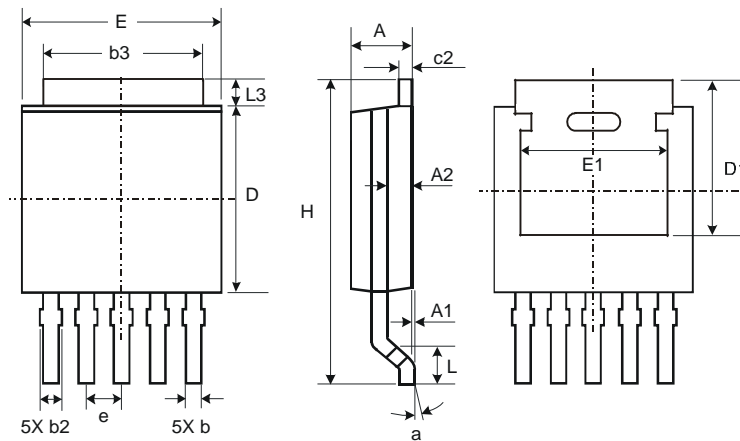
Marking Information

(1) TO252-5L



Package Outline Dimensions (All Dimensions in mm)

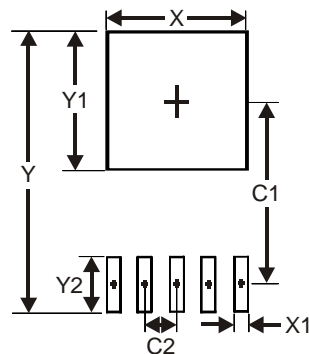
Package Type: TO252-5L



TO252-5L			
Dim	Min	Max	Typ
A	2.19	2.39	2.29
A1	0.00	0.13	0.08
A2	0.97	1.17	1.07
b	0.51	0.71	0.583
b2	0.61	0.79	0.70
b3	5.21	5.46	5.33
c2	0.45	0.58	0.531
D	6.00	6.20	6.10
D1	5.21	—	—
e	—	—	1.27
E	6.45	6.70	6.58
E1	4.32	—	—
H	9.40	10.41	9.91
L	1.40	1.78	1.59
L3	0.88	1.27	1.08
a	0°	10°	—
All Dimensions in mm			

Suggested Pad Layout

Package Type: TO252-5L



Dimensions	Value (in mm)
X	5.6
X1	0.6
Y	11.0
Y1	5.6
Y2	2.0
C1	7.2
C2	1.27

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