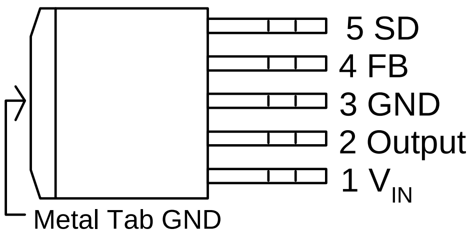
Pin Assignments

(Top View)

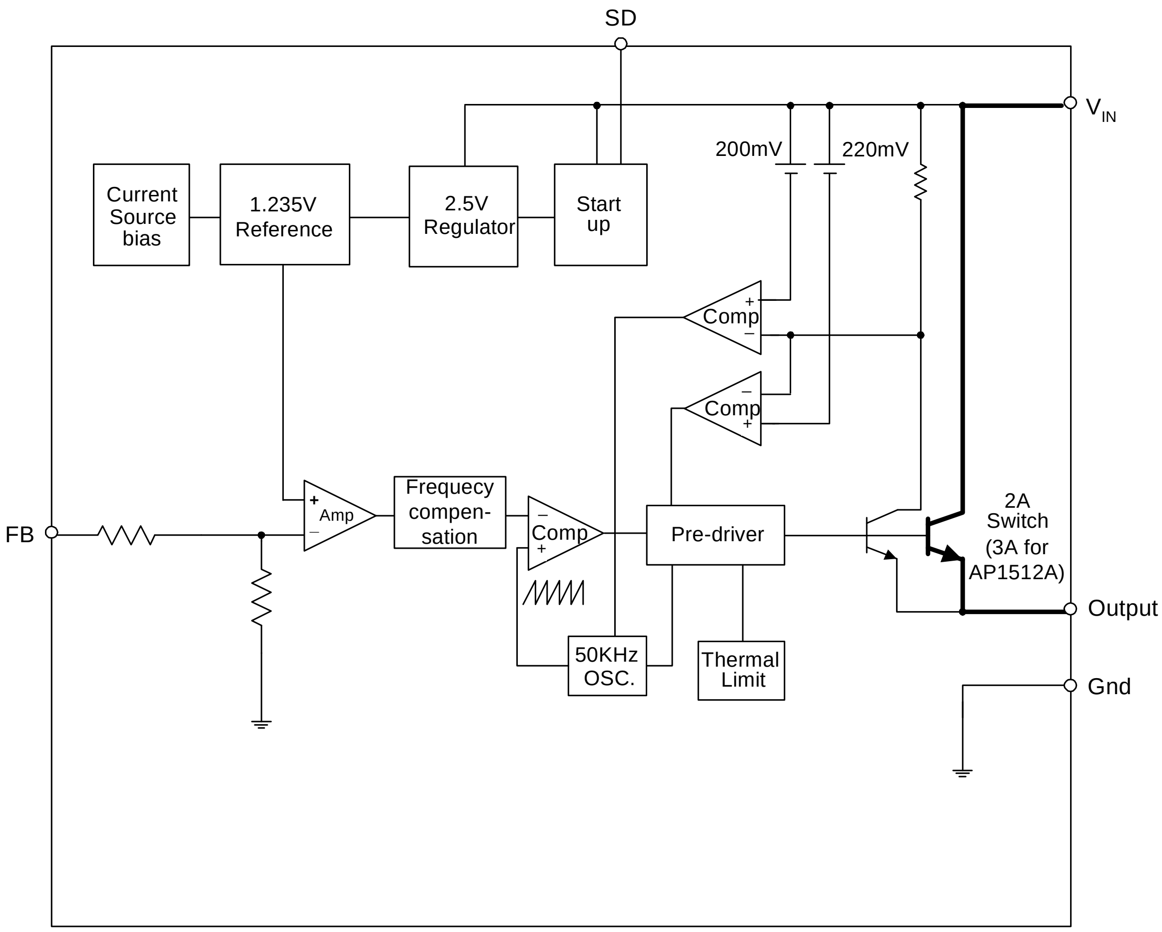


TO263-5L

Pin Descriptions

Name	Description
V_{IN}	Operating voltage input
Output	Switching output
GND	Ground
FB	Output voltage feedback control
SD	ON/OFF Shutdown

Block Diagram



Absolute Maximum Ratings

Symbol	Parameter	Rating	Unit
ESD HBM	Human Body Model ESD Protection	4.5	KV
ESD MM	Machine Model ESD Protection	450	V
V_{CC}	Supply Voltage	+63	V
V_{SD}	ON/OFF Pin Input Voltage	-0.3 to +40	V
V_{FB}	Feedback Pin Voltage	-0.3 to +40	V
V_{OUT}	Output Voltage to Ground	-1	V
T_{ST}	Storage Temperature	-65 to +150	^oC
T_J	Operating Junction Temperature	-40 to +125	^oC
V_{OP}	Operating Voltage	+4.5 to +60	V

Recommended Operating Conditions

Symbol	Parameter	Min	Max	Unit
V_{IN}	Input Voltage	4.5	60	V
I_{OUT}	Output Current	0	2	A
T_A	Operating Ambient Temperature	-20	85	^oC

Electrical Characteristics (All Output Voltage Versions)

Unless otherwise specified, V_{IN} = 30V for all version. I_{LOAD} = 0.5A
Specifications with **boldface** type are for full operating temperature range, the other type are for T_A = 25ºC.

Symbol	Parameter	Conditions	Min	Typ.	Max	Unit
I_B	Feedback Bias Current	V_{FB} = 1.3V (Adjustable version only)		5	8 **10**	μA
F_{OSC}	Oscillator Frequency		42.5 **40**	50	57.5 **60**	KHz
V_{SAT}	Saturation Voltage	I_{OUT} = 2A no outside circuit V_{FB} = 0V force driver on		1.3	1.4 **1.5**	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 for AP1512	peak current no outside circuit V_{FB} = 0V force driver on	2.5	3	4.5 **5.5**	A
I_{CL}	Current Limit for AP1512A	peak current no outside circuit V_{FB} = 0V force driver on	3.2	4	5 6	A
I_L	Output = 0 — Output leakage current	no outside circuit V_{FB} = 12V force driver off			-250	uA
	Output = -1 — Output leakage current	V_{IN} = 60V		-2	-60	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} = 60V		350	450 **500**	uA
V_{IL}	ON/OFF pin logic input threshold voltage	Low (regulator ON)	-	1.3	0.6	V
V_{IH}		High (regulator OFF)	2.0		-	V
I_H	ON/OFF pin logic input current	V_{LOGIC} = 2.5V (OFF)		0	-5	uA
I_L	ON/OFF pin input current	V_{LOGIC} = 0.5V (ON)		-0.8	-10	uA
θ_{JC}	Thermal Resistance	TO263-5L — Junction to case		2.5 3.5		^{o}C/W
θ_{JA}	Thermal Resistance With copper area of approximately 3 in^2	TO263-5L — Junction to ambient		28 23		^{o}C/W

Electrical Characteristics (Continued)

AP1512

	Symbol	Parameter	Conditions	V_{MIN}	Typ.	V_{MAX}	Unit
AP1512-ADJ	V_{FB}	Output Feedback	$10V \le V_{IN} \le 60V$ $0.2A \le I_{LOAD} \le 2A$ V_{OUT} programmed for 3V	1.193 **1.18**	1.23	1.267 **1.28**	V
AP1512-3.3V	V_{OUT}	Output voltage	$10V \le V_{IN} \le 60V$ $0.2A \le I_{LOAD} \le 2A$	3.168 **3.135**	3.3	3.432 **3.465**	V
AP1512-5V	V_{OUT}	Output voltage	$10V \le V_{IN} \le 60V$ $0.2A \le I_{LOAD} \le 2A$	4.8 **4.75**	5	5.2 **5.25**	V
AP1512-12V	V_{OUT}	Output voltage	$15V \le V_{IN} \le 60V$ $0.2A \le I_{LOAD} \le 2A$	11.52 **11.4**	12	12.48 **12.6**	V
	η	Efficiency	$V_{IN} = 30V$, $I_{LOAD} = 2A$		83		%

Specifications with **boldface** type are for full operating temperature range, the other type are for $T_A = 25°C$.

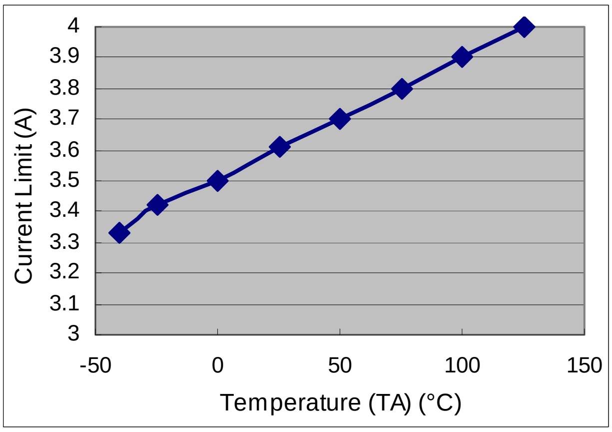
AP1512A

	Symbol	Parameter	Conditions	V_{MIN}	Typ.	V_{MAX}	Unit
AP1512A-ADJ	V_{FB}	Output Feedback	$10V \le V_{IN} \le 60V$ $0.2A \le I_{LOAD}$ V_{OUT} programmed for 3V	1.193 **1.18**	1.23	1.267 **1.28**	V
AP1512A-3.3V	V_{OUT}	Output voltage	$10V \le V_{IN} \le 60V$ $0.2A \le I_{LOAD}$	3.168 **3.135**	3.3	3.432 **3.465**	V
AP1512A-5V	V_{OUT}	Output voltage	$10V \le V_{IN} \le 60V$ $0.2A \le I_{LOAD}$	4.8 **4.75**	5	5.2 **5.25**	V
AP1512A-12V	V_{OUT}	Output voltage	$15V \le V_{IN} \le 60V$ $0.2A \le I_{LOAD}$	11.52 **11.4**	12	12.48 **12.6**	V
	η	Efficiency	$V_{IN} = 30V$, $I_{LOAD} = 3A$		80		%

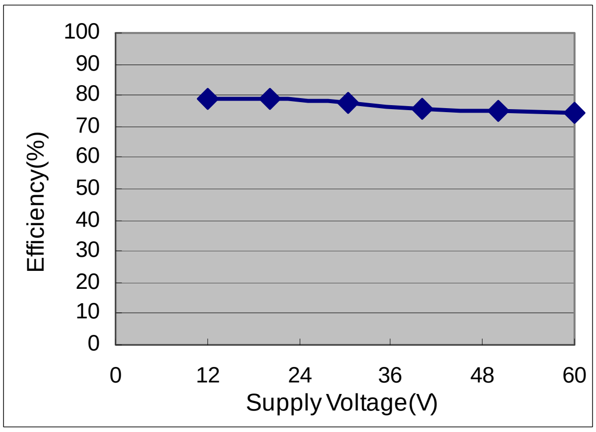
Specifications with **boldface** type are for full operating temperature range, the other type are for $T_A = 25°C$.

Typical Performance Characteristics

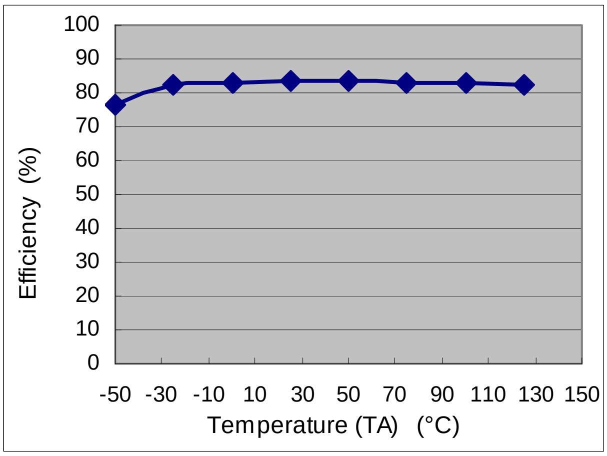
AP1512A Current Limit vs. Temperature
(V_{cc} = 60V, V_{out} = 5V)



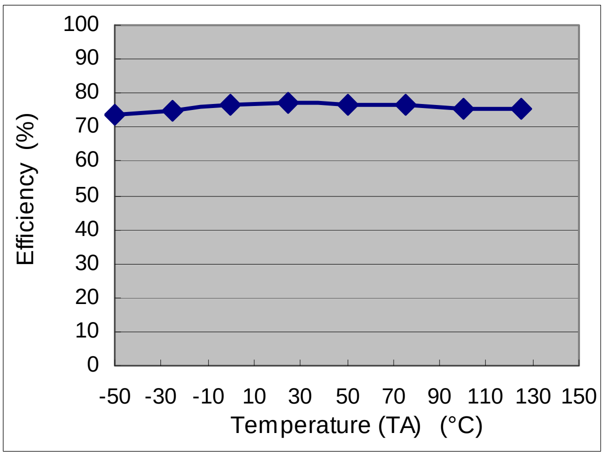
AP1512A Efficiency vs. Supply Voltage
(V_{out} = 5V, I_{out} = 3A)



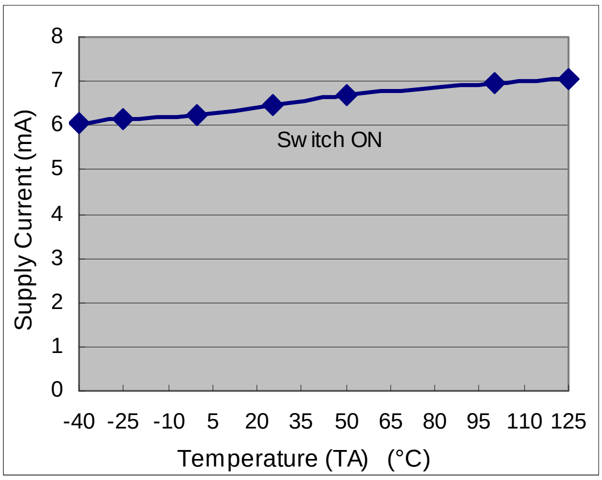
AP1512 Efficiency vs. Temperature
(V_{in} = 12V, V_{out} = 5V, I_o = 2A)

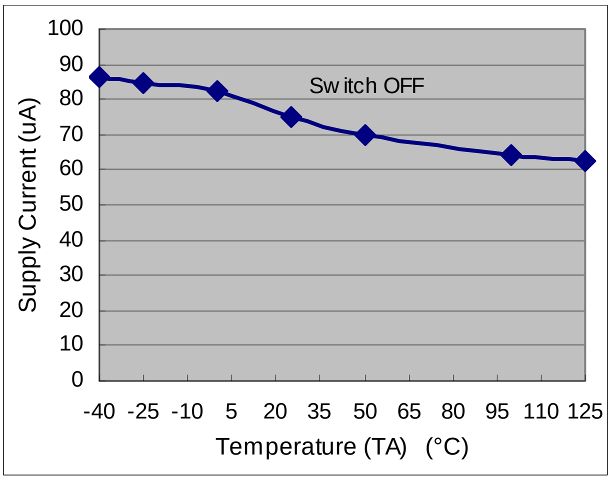


AP1512 Efficiency vs. Temperature
(V_{in} = 12V, V_{out} = 3.3V, I_o = 2A)



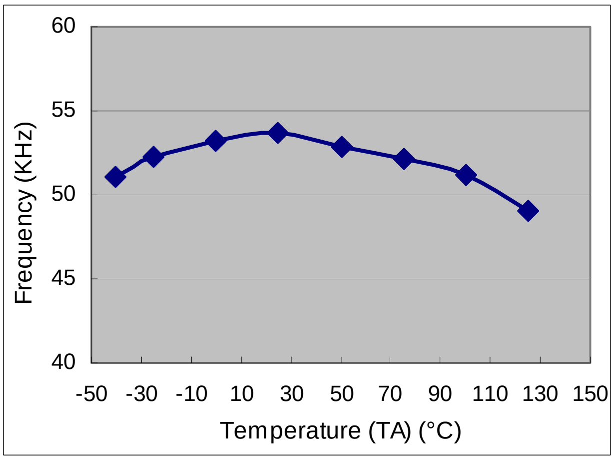
AP1512 Supply Current vs. Temperature
(V_{cc} = 12V, No Load, $V_{on/off}$ = 0V (Switch ON), $V_{on/off}$ = 5V (Switch OFF))



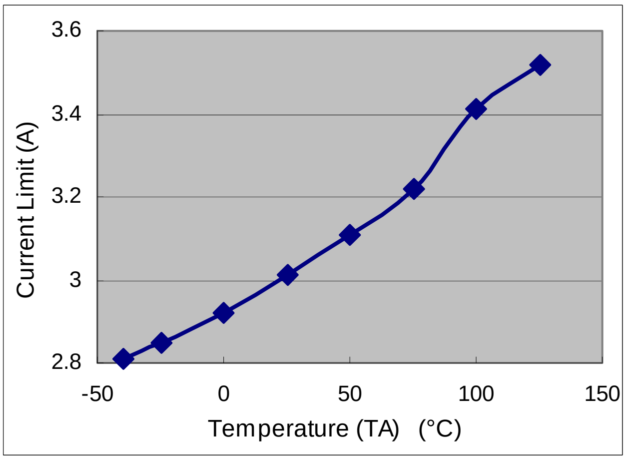


Typical Performance Characteristics (Continued)

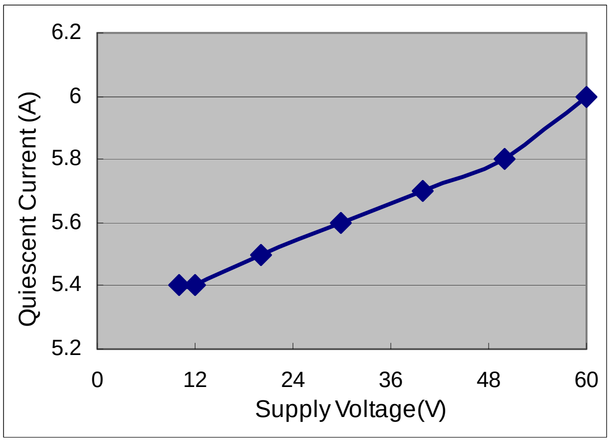
AP1512 Frequency vs. Temperature
(V_{cc} = 12V, I_o = 1A, V_{out} = 5V)



AP1512 Current Limit vs. Temperature
(V_{cc} = 60V, V_{out} = 5V)



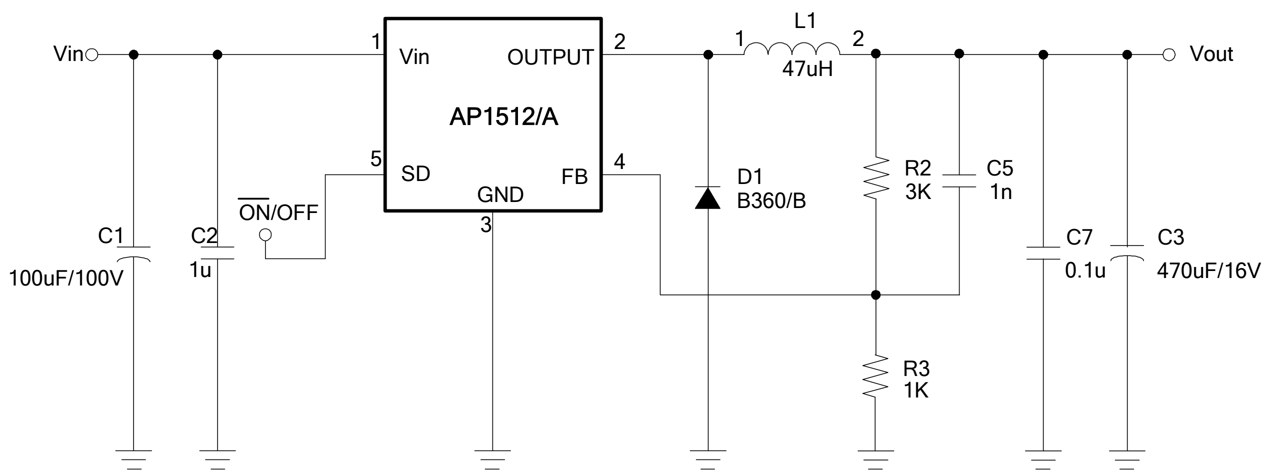
AP1512 Quiescent Current vs. Supply Voltage
(force driver off)



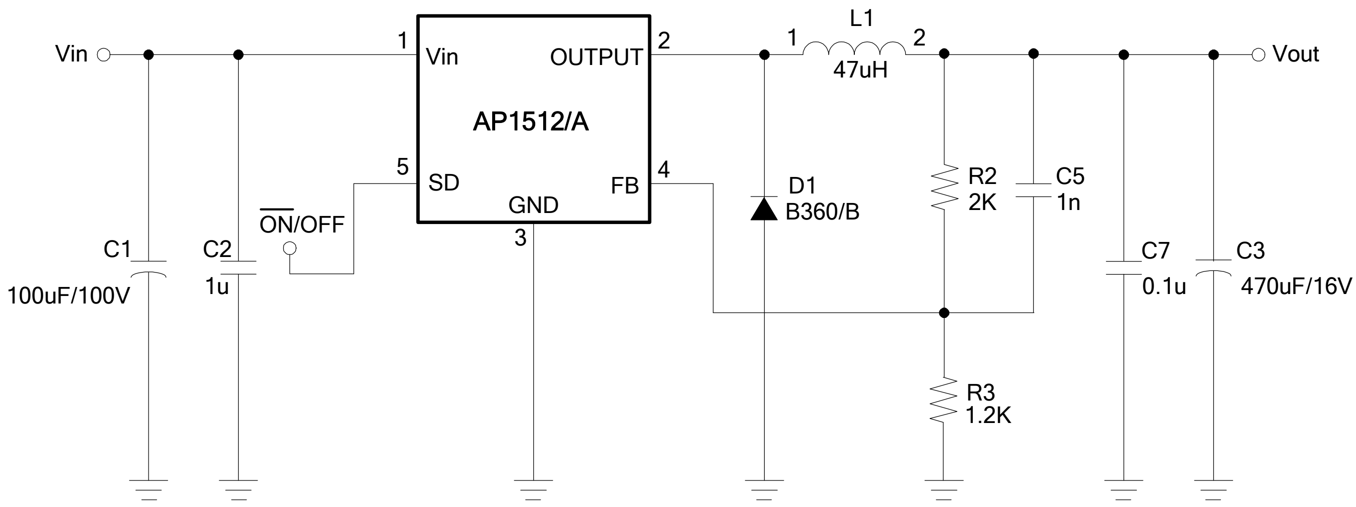
Typical Application Circuit

(1) Adjustable Type Circuit

A. V_{in} = 10V~60V, V_{out} = 5V; I_{out} = 0.3A~2A, I_{out} below 0.3A DCM



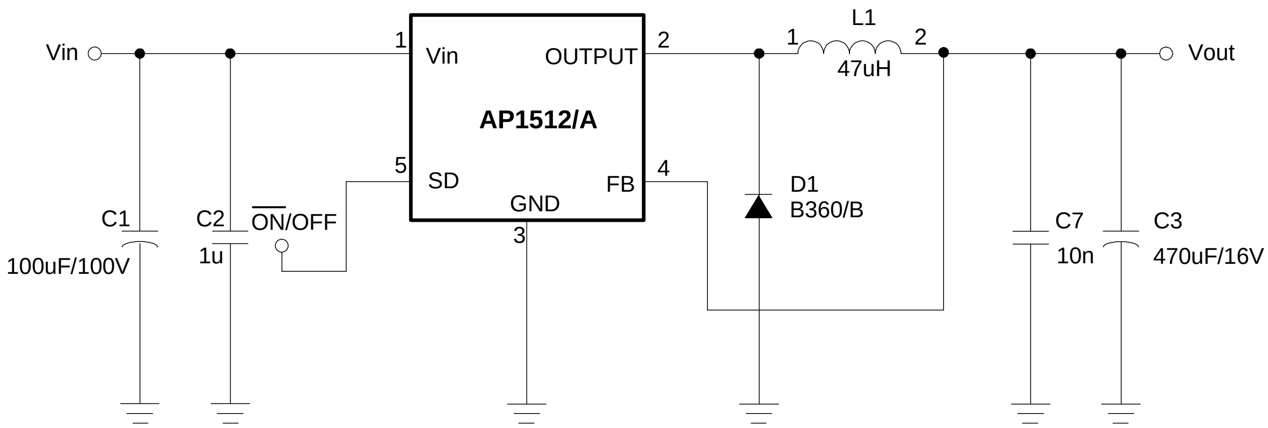
B. V_{in} = 10V~60V, V_{out} = 3.3V, I_{out} = 0.3A~2A, I_{out} below 0.3A DCM



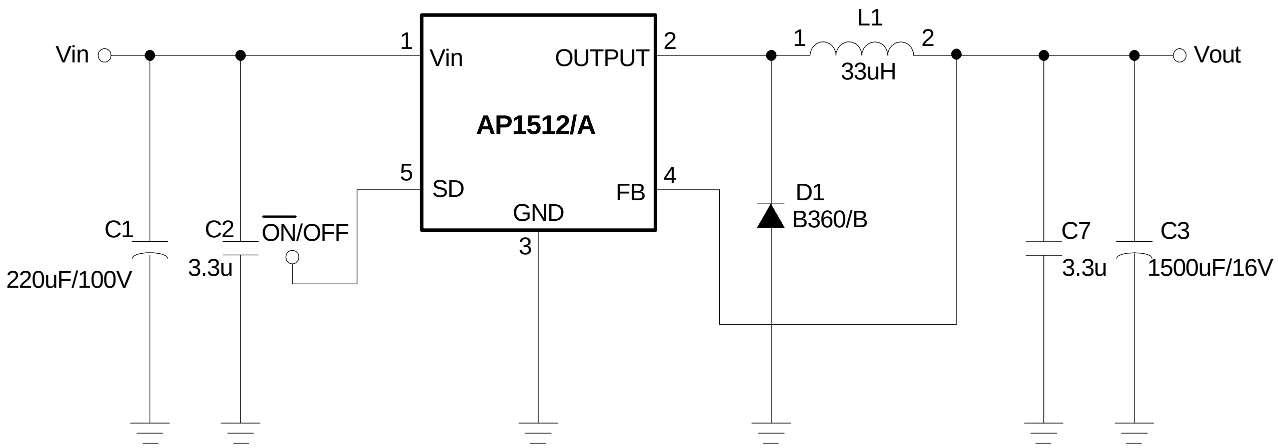
Typical Application Circuit (Continued)

(2) Fixed Type Circuit

A. V_{in} = 10V~60V, V_{out} = 5V, I_{out} = 0.7A~2A, I_{out} below 0.7A DCM



B. V_{in} = 10V~60V, V_{out} = 3.3V, Iout = 0.7A~2A, I_{out} below 0.7A DCM



Functional Description

+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 a minimum.

Feedback
Senses the regulated output voltage to complete the feedback loop.

ON/OFF
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 40V) shuts the regulator down. If this shutdown feature is not needed, the SD pin can be wired to the ground pin or it can be left open, in either case the regulator will be in the ON condition.
Thermal Considerations
The AP1512/A is available in a 5-pin surface mount TO-263 package.

The TO-263 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 0.4 in^2, and ideally should have 2 or more square inches of 2 oz. Additional copper area improves the thermal characteristics, but with copper areas greater than approximately 6 in^2, only small improvements in heat dissipation are realized. If further thermal improvements are needed, double sided, multilayer PC boards with large copper areas and/or airflow are recommended.

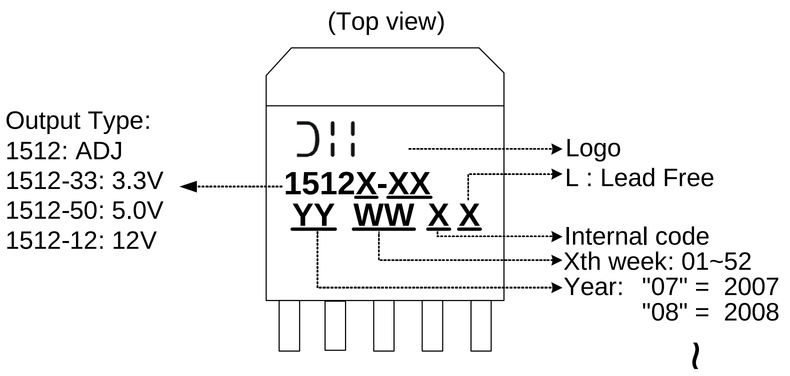
The AP1512/A (TO-263 package) junction temperature rises above ambient temperature with a 2A load for various input and output voltages. This data was taken with the circuit operating as a buck switching regulator with all components mounted on a PC board to simulate the junction temperature under actual operating conditions. This curve can be used for a quick check for the approximate junction temperature for various conditions, but be aware that there are many factors that can affect the junction temperature. When load currents higher than 2A are used, double sided or multilayer 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. (Once 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, multilayer 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.

Marking Information

(1) TO263-5L



Package Information (All Dimensions in mm)

(1) Package Type: TO263-5L