

LM2594_ADJ

Product Preview

0.5 A, Step-Down Switching Regulator

The LM2594 regulator is monolithic integrated circuit ideally suited for easy and convenient design of a step-down switching regulator (buck converter). It is capable of driving a 0.5 A load with excellent line and load regulation. This device is available in adjustable output version. It is internally compensated to minimize the number of external components to simplify the power supply design.

Since LM2594 converter is a switch-mode power supply, its efficiency is significantly higher in comparison with popular three-terminal linear regulators, especially with higher input voltages. The LM2594 operates at a switching frequency of 150 kHz thus allowing smaller sized filter components than what would be needed with lower frequency switching regulators. Available in a standard 8-Lead PDIP and 8-Lead Surface Mount packages.

The other features include a guaranteed $\pm 4\%$ tolerance on output voltage within specified input voltages and output load conditions, and $\pm 15\%$ on the oscillator frequency. External shutdown is included, featuring 50 μA (typical) standby current. Self protection features include switch cycle-by-cycle current limit for the output switch, as well as thermal shutdown for complete protection under fault conditions.

Features

- 5.0 V, and Adjustable Output Versions
- $\pm 4\%$ Max Over Line and Load Conditions
- Guaranteed 0.5 A Output Load Current
- Wide Input Voltage Range up to 40 V
- 150 kHz Fixed Frequency Internal Oscillator
- TTL Shutdown Capability
- Low Power Standby Mode, typ 80 μA
- Thermal Shutdown and Current Limit Protection
- Internal Loop Compensation
- Moisture Sensitivity Level (MSL) Equals 1
- These are Pb-Free Devices

Applications

- Simple High-Efficiency Step-Down (Buck) Regulator
- Efficient Pre-Regulator for Linear Regulators
- On-Card Switching Regulators
- Positive to Negative Converter (Buck-Boost)
- Negative Step-Up Converters
- Power Supply for Battery Chargers

This document contains information on a product under development. ON Semiconductor reserves the right to change or discontinue this product without notice.

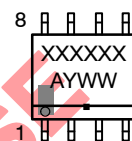


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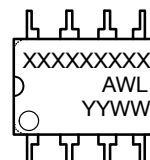
<http://onsemi.com>

MARKING DIAGRAMS

SOIC-8
DW SUFFIX
CASE 751

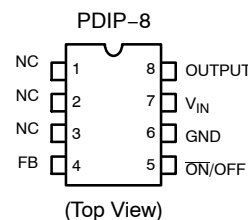
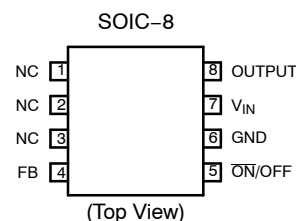


PDIP-8
N SUFFIX
CASE 626



XXXXXX = Specific Device Code
A = Assembly Location
WL = Wafer Lot
YY = Year
WW = Work Week
G or ■ = Pb-Free Package

PIN CONNECTIONS



ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 4 of this data sheet.

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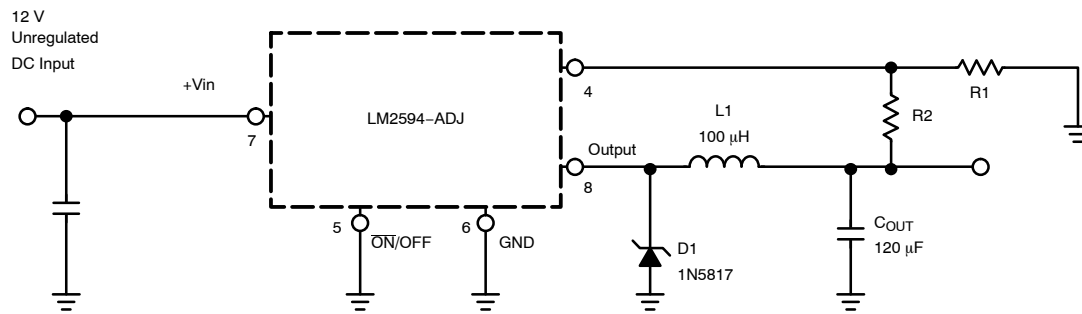


Figure 1. Typical Application

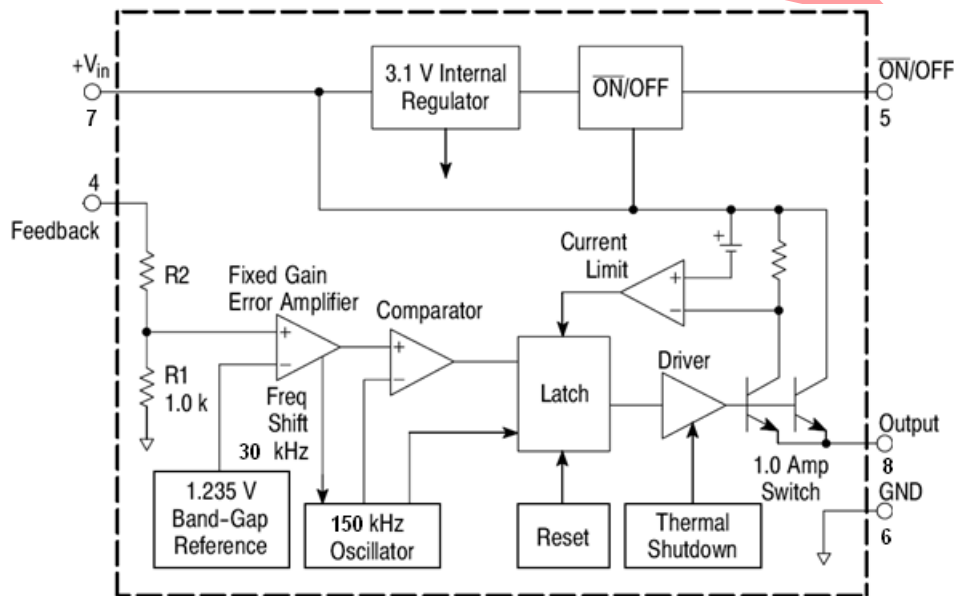


Figure 2. Representative Block Diagram and Typical Application

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MAXIMUM RATINGS

Symbol	Rating	Value	Unit
V_{in}	Maximum Supply Voltage	45	V
–	ON/OFF Pin Input Voltage	$-0.3\text{ V} \leq V \leq +V_{in}$	V
–	Output Voltage to Ground (Steady-State)	–1.0	V
P_D	Power Dissipation 8-Lead DIP	Internally Limited	W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	TBD	°C/W
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	TBD	°C/W
P_D	Power Dissipation 8-Lead Surface Mount	Internally Limited	W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	TBD	°C/W
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	TBD	°C/W
T_{stg}	Storage Temperature Range	–65 to +150	°C
–	Minimum ESD Rating (Human Body Model: $C = 100\text{ pF}$, $R = 1.5\text{ k}\Omega$)	2.0	kV
–	Lead Temperature (Soldering, 10 seconds)	260	°C
T_J	Maximum Junction Temperature	150	°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

PIN FUNCTION DESCRIPTION (Common for Both Packages)

Pin No.	Symbol	Description (Refer to Figure 1)
1 – 3	NC	Not Connected
4	FB	Direct input of error amplifier, depending on the fixed (adjustable) version of the feedback resistor network, R1, R2 is connected internally (externally).
5	ON/OFF	Allows the switching regulator circuit to be shut down using logic levels, thus dropping the total input supply current to approximately 80 μA . The threshold voltage is typical. 1.4 V. Applying a voltage above this value (up to V_{IN}) shuts the regulator off. If the voltage applied to this pin is lower than 1.4 V or if this pin is left open, the regulator will be in the “on” condition.
6	GND	Circuit ground pin. See the information about the printed circuit board layout.
7	V_{IN}	Positive input supply for LM2594 step-down switching regulator. In order to minimize voltage transients and to supply the switching currents needed by the regulator, a suitable input bypass capacitor must be present (C_{IN} in Figure 1)
8	OUTPUT	Emitter of the internal switch. The saturation voltage V_{sat} of the output switch is typically 1 V. It should be kept in mind that PCB area connected to this pin should be kept to a minimum in order to minimize coupling to sensitive circuitry

OPERATING RATINGS (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 table)

Symbol	Rating	Value	Unit
T_J	Operating Temperature Range	–40 to +125	°C
V_{IN}	Supply Voltage	4.5 V to 40 V	V

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SYSTEM PARAMETERS

ELECTRICAL CHARACTERISTICS Specifications with standard type face are for $T_j=25^{\circ}\text{C}$, and those with boldface type apply over full Operating Temperature Range -40 to $+125^{\circ}\text{C}$

Symbol	Characteristics	Min	Typ	Max	Unit
LM2594-ADJ (Note 1) (Figure TBD)					
V_{OUT}	Feedback Voltage ($V_{\text{IN}} = 12\text{ V}$, $I_{\text{LOAD}} = 0.1\text{ A}$, $V_{\text{OUT}} = 5.0\text{ V}$)	1.217	1.23	1.243	V
V_{OUT}	Feedback Voltage ($8.0\text{ V} \leq V_{\text{IN}} \leq 40\text{ V}$, $0.1\text{ A} \leq I_{\text{LOAD}} \leq 0.5\text{ A}$, $V_{\text{OUT}} = 5.0\text{ V}$)	1.193 1.18		1.267 1.28	V
η	Efficiency ($V_{\text{IN}} = 12\text{ V}$, $I_{\text{LOAD}} = 0.5\text{ A}$, $V_{\text{OUT}} = 3.0\text{ V}$)	–	TBD	–	%
I_{b}	Feedback Bias Current ($V_{\text{OUT}} = 5.0\text{ V}$), Adjustable Version Only		25	100 200	nA
f_{osc}	Oscillator Frequency (Note 2)				kHz
		135	150	165	
		120		180	
V_{sat}	Saturation Voltage ($I_{\text{OUT}} = 0.5\text{ A}$) (Notes 3 and 4)		1.0	1.2 1.4	V
DC	Max Duty Cycle (ON) Note 4				
I_{CL}	Current Limit (Peak Current) (Notes 2 and 3)	0.7 0.65	1	1.6 1.8	A
I_{L}	Output Leakage Current (Notes 5 and 6) Output = 0 V Output = -1.0 V		0.5 15	2.0 30	mA
I_{Q}	Quiescent Current (Note 5)		5.0	10	mA
I_{stby}	Standby Quiescent Current ($\text{ON/OFF Pin} = 5.0\text{ V}$ ("off")) (Note 6)		50	200 250	μA

ON/OFF PIN LOGIC INPUT

	Threshold Voltage		1.6		V
V_{ih}	$V_{\text{out}}=0\text{ V}$ (Regulator OFF)	2.2 2.4			V
V_{IL}	$V_{\text{OUT}} = \text{Nominal Output Voltage}$ (Regulator ON)			1.0 0.8	V

ON/OFF PIN INPUT CURRENT

I_{IH}	ON/OFF Pin = 2.5 V (Regulator OFF)	–	15	30	μA
I_{IL}	ON/OFF Pin = 0.5 V (regulator ON)	–	0.01	5.0	μA

1. External components such as the catch diode, inductor, input and output capacitors can affect switching regulator system performance. When the LM2594 is used as shown in the Figure TBD, system performance will be as shown in system parameters section.
2. The oscillator frequency reduces to approximately 35 kHz 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 dissipation of the IC by lowering the minimum duty cycle from 5% down to approximately 2%.
3. No diode, inductor or capacitor connected to output pin.
4. Feedback (Pin 4) removed from output and connected to 0 V.
5. Feedback (Pin 4) removed from output and connected to +12 V to force the output transistor "off".
6. $V_{\text{in}}=40\text{ V}$

ORDERING INFORMATION

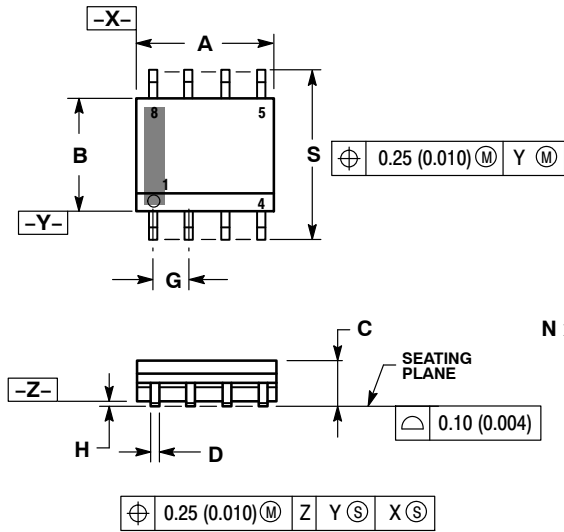
Device	Package	Shipping†
LM2594-ADJ	SO-16 WB (Pb-Free)	TBD
LM2594-ADJ	PDIP-8 (Pb-Free)	TBD

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

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PACKAGE DIMENSIONS

SOIC-8 NB
CASE 751-07
ISSUE AJ

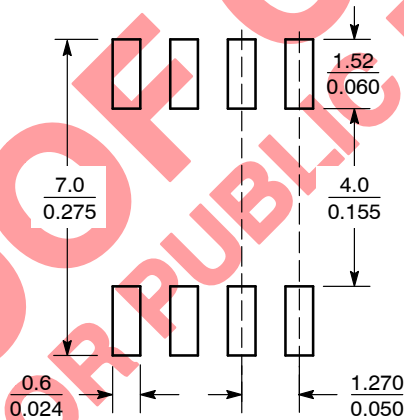


NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. 751-01 THRU 751-06 ARE OBSOLETE. NEW STANDARD IS 751-07.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.80	5.00	0.189	0.197
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.053	0.069
D	0.33	0.51	0.013	0.020
G	1.27 BSC		0.050 BSC	
H	0.10	0.25	0.004	0.010
J	0.19	0.25	0.007	0.010
K	0.40	1.27	0.016	0.050
M	0°	8°	0°	8°
N	0.25	0.50	0.010	0.020
S	5.80	6.20	0.228	0.244

SOLDERING FOOTPRINT*



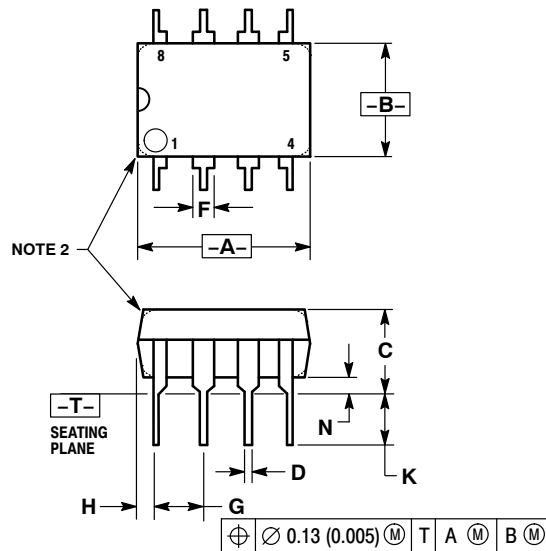
SCALE 6:1 $\left(\frac{\text{mm}}{\text{inches}} \right)$

*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERM/D.

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PACKAGE DIMENSIONS

8 LEAD PDIP CASE 626-05 ISSUE L



- NOTES:
1. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
 2. PACKAGE CONTOUR OPTIONAL (ROUND OR SQUARE CORNERS).
 3. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9.40	10.16	0.370	0.400
B	6.10	6.60	0.240	0.260
C	3.94	4.45	0.155	0.175
D	0.38	0.51	0.015	0.020
F	1.02	1.78	0.040	0.070
G	2.54 BSC		0.100 BSC	
H	0.76	1.27	0.030	0.050
J	0.20	0.30	0.008	0.012
K	2.92	3.43	0.115	0.135
L	7.62 BSC		0.300 BSC	
M	---	10°	---	10°
N	0.76	1.01	0.030	0.040

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