LM2574, NCV2574

0.5 A, Adjustable Output Voltage, Step-Down Switching Regulator

The LM2574 series of regulators are monolithic integrated circuits ideally suited for easy and convenient design of a step−down switching regulator (buck converter). All circuits of this series are capable of driving a 0.5 A load with excellent line and load regulation. These devices are available in fixed output voltages of 3.3 V, 5.0 V, 12 V, 15 V, and an adjustable output version.

These regulators were designed to minimize the number of external components to simplify the power supply design. Standard series of inductors optimized for use with the LM2574 are offered by several different inductor manufacturers.

Since the LM2574 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. In most cases, the power dissipated by the LM2574 regulator is so low, that the copper traces on the printed circuit board are normally the only heatsink needed and no additional heatsinking is required.

The LM2574 features include a guaranteed ±4% tolerance on output voltage within specified input voltages and output load conditions, and ±10% on the oscillator frequency (±2% over 0°C to +125°C). External shutdown is included, featuring 60 μA (typical) standby current. The output switch includes cycle−by−cycle current limiting, as well as thermal shutdown for full protection under fault conditions.

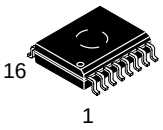
Features

- 3.3 V, 5.0 V, 12 V, 15 V, and Adjustable Output Versions
- Adjustable Version Output Voltage Range, 1.23 to 37 V ±4% max over Line and Load Conditions
- Guaranteed 0.5 A Output Current
- Wide Input Voltage Range: 4.75 to 40 V
- Requires Only 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
- NCV Prefix for Automotive and Other Applications Requiring Site and Control Changes
- Pb−Free Packages are Available*

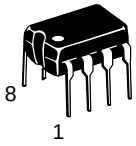
Applications

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

ON Semiconductor®

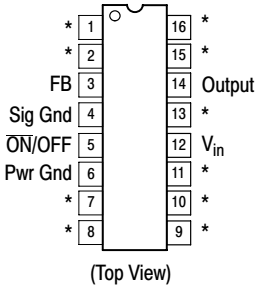


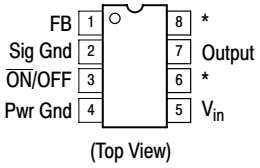
SO−16 WB
DW SUFFIX
CASE 751G



PDIP−8
N SUFFIX
CASE 626

PIN CONNECTIONS





* No internal connection, but should be soldered to PC board for best heat transfer.

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 24 of this data sheet.

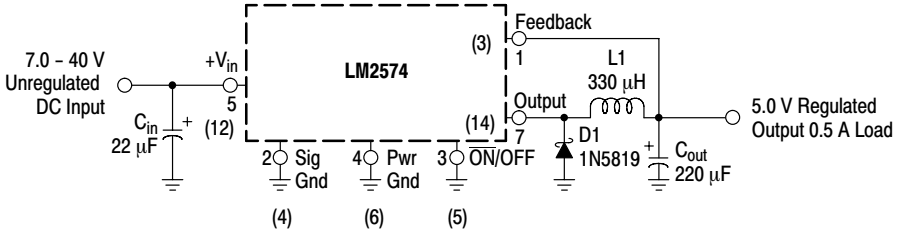
DEVICE MARKING INFORMATION

See general marking information in the device marking section on page 24 of this data sheet.

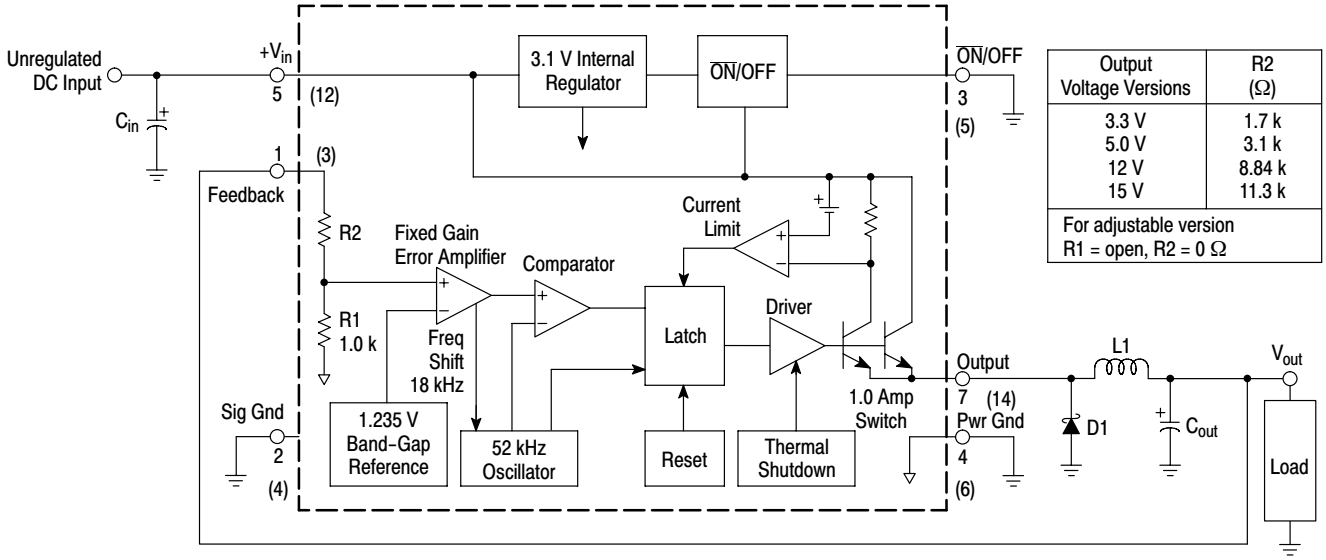
*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

Publication Order Number:
LM2574/D

Typical Application (Fixed Output Voltage Versions)



Representative Block Diagram and Typical Application



Output Voltage Versions	R2 (Ω)
3.3 V	1.7 k
5.0 V	3.1 k
12 V	8.84 k
15 V	11.3 k
For adjustable version R1 = open, R2 = 0 Ω	

NOTE: Pin numbers in ( ) are for the SO−16W package.

Figure 1. Block Diagram and Typical Application

ABSOLUTE MAXIMUM RATINGS (Absolute Maximum Ratings indicate limits beyond which damage to the device may occur).

Rating	Symbol	Value	Unit
Maximum Supply Voltage	V_{in}	45	V
$\overline{ON}$/OFF Pin Input Voltage	–	$-0.3\ V \le V \le +V_{in}$	V
Output Voltage to Ground (Steady State)	–	−1.0	V
DW Suffix, Plastic Package Case 751G Max Power Dissipation Thermal Resistance, Junction−to−Air	 P_D $R_{\theta JA}$	 Internally Limited 145	 W °C/W
N Suffix, Plastic Package Case 626 Max Power Dissipation Thermal Resistance, Junction−to−Ambient Thermal Resistance, Junction−to−Case	 P_D $R_{\theta JA}$ $R_{\theta JC}$	 Internally Limited 100 5.0	 W °C/W °C/W
Storage Temperature Range	T_{stg}	−65°C to +150°C	°C
Minimum ESD Rating (Human Body Model: C = 100 pF, R = 1.5 kΩ)	–	2.0	kV
Lead Temperature (Soldering, 10 seconds)	–	260	°C
Maximum Junction Temperature	T_J	150	°C

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

NOTE: ESD data available upon request.

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).

Rating	Symbol	Value	Unit
Operating Junction Temperature Range	T_J	−40 to +125	°C
Supply Voltage	V_{in}	40	V

SYSTEM PARAMETERS ([Note 1] Test Circuit Figure 16)

ELECTRICAL CHARACTERISTICS (Unless otherwise specified, V_{in} = 12 V for the 3.3 V, 5.0 V, and Adjustable version, V_{in} = 25 V for the 12 V version, V_{in} = 30 V for the 15 V version. I_{Load} = 100 mA. For typical values T_J = 25°C, for min/max values T_J is the operating junction temperature range that applies [Note 2], unless otherwise noted).

Characteristic	Symbol	Min	Typ	Max	Unit
LM2574−3.3 ([Note 1] Test Circuit Figure 16)					
Output Voltage (V_{in} = 12 V, I_{Load} = 100 mA, T_J = 25°C)	V_{out}	3.234	3.3	3.366	V
Output Voltage (4.75 V ≤ V_{in} ≤ 40 V, 0.1 A ≤ I_{Load} ≤ 0.5 A) T_J = 25°C T_J = −40 to +125°C	V_{out}	 3.168 3.135	 3.3 −	 3.432 3.465	V
Efficiency (V_{in} = 12 V, I_{Load} = 0.5 A)	η	−	72	−	%
LM2574−5 ([Note 1] Test Circuit Figure 16)					
Output Voltage (V_{in} = 12 V, I_{Load} = 100 mA, T_J = 25°C)	V_{out}	4.9	5.0	5.1	V
Output Voltage (7.0 V ≤ V_{in} ≤ 40 V, 0.1 A ≤ I_{Load} ≤ 0.5 A) T_J = 25°C T_J = −40 to +125°C	V_{out}	 4.8 4.75	 5.0	 5.2 5.25	V
Efficiency (V_{in} = 12 V, I_{Load} = 0.5 A)	η	−	77	−	%
LM2574−12 ([Note 1] Test Circuit Figure 16)					
Output Voltage (V_{in} = 25 V, I_{Load} = 100 mA, T_J = 25°C)	V_{out}	11.76	10	12.24	V
Output Voltage (15 V ≤ V_{in} ≤ 40 V, 0.1 A ≤ I_{Load} ≤ 0.5 A) T_J = 25°C T_J = −40 to +125°C	V_{out}	 11.52 11.4	 12 −	 12.48 12.6	V
Efficiency (V_{in} = 15 V, I_{Load} = 0.5 A)	η	−	88	−	%
LM2574−15 ([Note 1] Test Circuit Figure 16)					
Output Voltage (V_{in} = 30 V, I_{Load} = 100 mA, T_J = 25°C)	V_{out}	14.7	15	15.3	V
Output Voltage (18 V < V_{in} < 40 V, 0.1 A < I_{Load} < 0.5 A) T_J = 25°C T_J = −40 to +125°C	V_{out}	 14.4 14.25	 15	 15.6 15.75	V
Efficiency (V_{in} = 18 V, I_{Load} = 0.5 A)	η	−	88	−	%
LM2574 ADJUSTABLE VERSION ([Note 1] Test Circuit Figure 16)					
Feedback Voltage V_{in} = 12 V, I_{Load} = 100 mA, V_{out} = 5.0 V, T_J = 25°C	V_{FB}	1.217	1.23	1.243	V
Feedback Voltage 7.0 V ≤ V_{in} ≤ 40 V, 0.1 A ≤ I_{Load} ≤ 0.5 A, V_{out} = 5.0 V T_J = 25°C T_J = −40 to +125°C	V_{FBT}	 1.193 1.18	 1.23	 1.267 1.28	V
Efficiency (V_{in} = 12 V, I_{Load} = 0.5 A, V_{out} = 5.0 V)	η	−	77	−	%

1. External components such as the catch diode, inductor, input and output capacitors can affect the switching regulator system performance. When the LM2574 is used as shown in the Figure 16 test circuit, the system performance will be as shown in the system parameters section of the Electrical Characteristics.
2. Tested junction temperature range for the LM2574, NCV2574: T_{low} = −40°C T_{high} = +125°C.

SYSTEM PARAMETERS ([Note 3] Test Circuit Figure 16)

ELECTRICAL CHARACTERISTICS (continued) (Unless otherwise specified, V_{in} = 12 V for the 3.3 V, 5.0 V, and Adjustable version, V_{in} = 25 V for the 12 V version, V_{in} = 30 V for the 15 V version. I_{Load} = 100 mA. For typical values T_J = 25°C, for min/max values T_J is the operating junction temperature range that applies [Note 4], unless otherwise noted).

Characteristic	Symbol	Min	Typ	Max	Unit
ALL OUTPUT VOLTAGE VERSIONS					
Feedback Bias Current V_{out} = 5.0 V (Adjustable Version Only)	I_b				nA
T_J = 25°C		–	25	100	
T_J = −40 to +125°C		–	–	200	
Oscillator Frequency (Note 5)	f_O				kHz
T_J = 25°C		–	52	–	
T_J = 0 to +125°C		47	52	58	
T_J = −40 to +125°C		42	–	63	
Saturation Voltage (I_{out} = 0.5 A, [Note 6])	V_{sat}				V
T_J = 25°C		–	1.0	1.2	
T_J = −40 to +125°C		–	–	1.4	
Max Duty Cycle (“on”) (Note 7)	DC	93	98	–	%
Current Limit Peak Current (Notes 5 and 6)	I_{CL}				A
T_J = 25°C		0.7	1.0	1.6	
T_J = −40 to +125°C		0.65	–	1.8	
Output Leakage Current (Notes 8 and 9), T_J = 25°C	I_L				mA
Output = 0 V		–	0.6	2.0	
Output = − 1.0 V		–	10	30	
Quiescent Current (Note 8)	I_Q				mA
T_J = 25°C		–	5.0	9.0	
T_J = −40 to +125°C		–	–	11	
Standby Quiescent Current ($\overline{ON}$/OFF Pin = 5.0 V (“off”))	I_{stby}				μA
T_J = 25°C		–	60	200	
T_J = −40 to +125°C		–	–	400	
$\overline{ON}$/OFF Pin Logic Input Level					V
V_{out} = 0 V	V_{IH}				
T_J = 25°C		2.2	1.4	–	
T_J = −40 to +125°C		2.4	–	–	
Nominal Output Voltage	V_{IL}				
T_J = 25°C		–	1.2	1.0	
T_J = −40 to +125°C		–	–	0.8	
$\overline{ON}$/OFF P_{in} Input Current					μA
$\overline{ON}$/OFF P_{in} = 5.0 V (“off”), T_J = 25°C	I_{IH}	–	15	30	
$\overline{ON}$/OFF P_{in} = 0 V (“on”), T_J = 25°C	I_{IL}	–	0	5.0	

3. External components such as the catch diode, inductor, input and output capacitors can affect the switching regulator system performance. When the LM2574 is used as shown in the Figure 16 test circuit, the system performance will be as shown in the system parameters section of the Electrical Characteristics.
4. Tested junction temperature range for the LM2574, NCV2574: T_{low} = −40°C T_{high} = +125°C.
5. The oscillator frequency reduces to approximately 18 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 power dissipation of the IC by lowering the minimum duty cycle from 5% down to approximately 2%.
6. Output (Pin 2) sourcing current. No diode, inductor or capacitor connected to the output pin.
7. Feedback (Pin 4) removed from output and connected to 0 V.
8. Feedback (Pin 4) removed from output and connected to 12 V for the Adjustable, 3.3 V, and 5.0 V versions, and 25 V for the 12 V and 15 V versions, to force the output transistor OFF.
9. V_{in} = 40 V.

ORDERING INFORMATION

Device	Nominal Output Voltage	Operating Junction Temperature Range	Package	Shipping
LM2574DW−ADJ	1.23 V to 37 V	T_J = −40° to +125°C	SO−16 WB	47 Units/Rail
LM2574DW−ADJR2			SO−16 WB	1000 Units/Tape & Reel
LM2574DW−ADJR2G			SO−16 WB (Pb−Free)	
LM2574N−ADJ			PDIP−8	50 Units/Rail
LM2574N−ADJG			PDIP−8 (Pb−Free)	
NCV2574DW−ADJR2			SO−16 WB	1000 Units/Tape & Reel
NCV2574DW−ADJR2G			SO−16 WB (Pb−Free)	
LM2574N−3.3	3.3 V	T_J = −40° to +125°C	PDIP−8	50 Units/Rail
LM2574N−3.3G			PDIP−8 (Pb−Free)	
LM2574N−5	5.0 V	T_J = −40° to +125°C	PDIP−8	
LM2574N−5G			PDIP−8 (Pb−Free)	
LM2574N−12	12 V	T_J = −40° to +125°C	PDIP−8	
LM2574N−12G			PDIP−8 (Pb−Free)	
LM2574N−15	15 V	T_J = −40° to +125°C	PDIP−8	
LM2574N−15G			PDIP−8 (Pb−Free)	

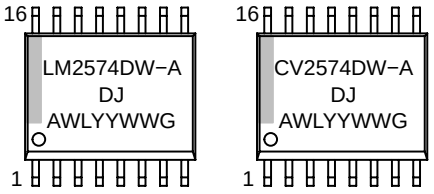
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

*NCV devices: T_{low} = −40°C, T_{high} = +125°C. Guaranteed by Design. NCV prefix is for automotive and other applications requiring site and change control.

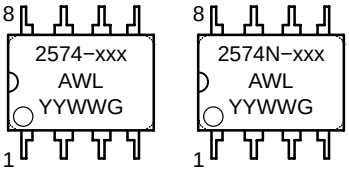
MARKING DIAGRAMS

SO−16 WB
DW SUFFIX
CASE 751G

*NCV part



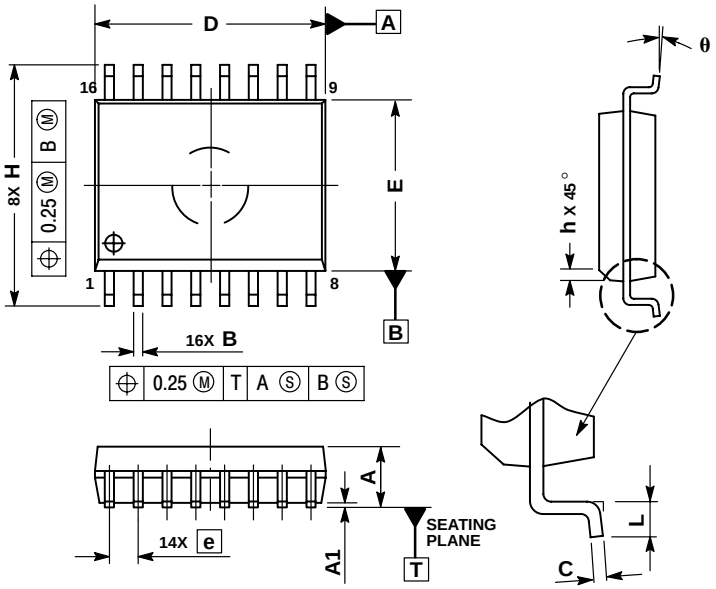
PDIP−8
N SUFFIX
CASE 626



xxx = 3.3, 5.0, 12, 15, or ADJ
A = Assembly Location
WL = Wafer Lot
Y = Year
WW = Work Week
G = Pb−Free Package

PACKAGE DIMENSIONS

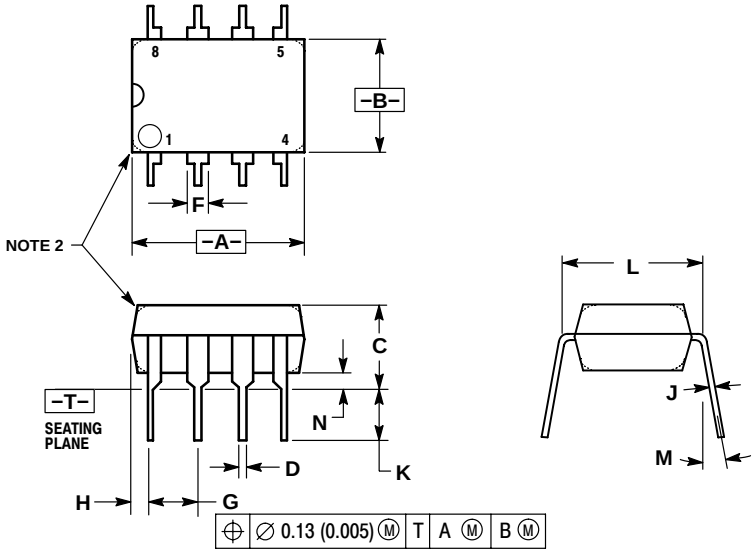
SO−16 WB
DW SUFFIX
CASE 751G−03
ISSUE C



NOTES:
1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSIONS D AND E DO NOT INLCUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF THE B DIMENSION AT MAXIMUM MATERIAL CONDITION.

	MILLIMETERS	
DIM	MIN	MAX
A	2.35	2.65
A1	0.10	0.25
B	0.35	0.49
C	0.23	0.32
D	10.15	10.45
E	7.40	7.60
e	1.27 BSC	
H	10.05	10.55
h	0.25	0.75
L	0.50	0.90
q	0 °	7 °

PDIP−8
N SUFFIX
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.

	MILLIMETERS		INCHES	
DIM	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