

LM2576xx Series SIMPLE SWITCHER® 3-A Step-Down Voltage Regulator

1 Features

- 3.3-V, 5-V, 12-V, 15-V, and Adjustable Output Versions
- Adjustable Version Output Voltage Range, 1.23 V to 37 V (57 V for HV Version) $\pm 4\%$ Maximum Over Line and Load Conditions
- Specified 3-A Output Current
- Wide Input Voltage Range: 40 V Up to 60 V for HV Version
- 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

2 Applications

- Simple High-Efficiency Step-Down (Buck) Regulator
- Efficient Preregulator for Linear Regulators
- On-Card Switching Regulators
- Positive-to-Negative Converter (Buck-Boost)

3 Description

The LM2576 series of regulators are monolithic integrated circuits that provide all the active functions for a step-down (buck) switching regulator,

capable of driving 3-A load with excellent line and load regulation. These devices are available in fixed output voltages of 3.3 V, 5 V, 12 V, 15 V, and an adjustable output version.

Requiring a minimum number of external components, these regulators are simple to use and include fault protection and a fixed-frequency oscillator.

The LM2576 series offers a high-efficiency replacement for popular three-terminal linear regulators. It substantially reduces the size of the heat sink, and in some cases no heat sink is required.

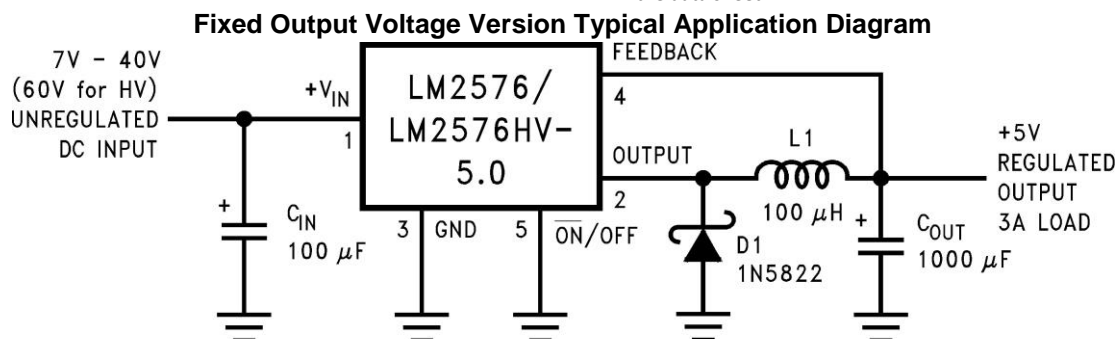
A standard series of inductors optimized for use with the LM2576 are available from several different manufacturers. This feature greatly simplifies the design of switch-mode power supplies.

Other features include a $\pm 4\%$ tolerance on output voltage within specified input voltages and output load conditions, and $\pm 10\%$ on the oscillator frequency. External shutdown is included, featuring 50- μ A (typical) standby current. The output switch includes cycle-by-cycle current limiting, as well as thermal shutdown for full protection under fault conditions.

Device Information⁽¹⁾

PART NUMBER	PACKAGE	BODY SIZE (NOM)
LM2576	TO-220 (5)	10.16 mm \times 8.51 mm
LM2576HV	DDPAK/TO-263 (5)	10.16 mm \times 8.42 mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.



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4 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision C (April 2013) to Revision D

Page

- Added *ESD Ratings* table, *Feature Description* section, *Device Functional Modes*, *Application and Implementation* section, *Power Supply Recommendations* section, *Layout* section, *Device and Documentation Support* section, and *Mechanical, Packaging, and Orderable Information* section..... [1](#)
- Moved the thermal resistance data from the *Electrical Characteristics: All Output Voltage Versions* table to the *Thermal Information* table..... [4](#)

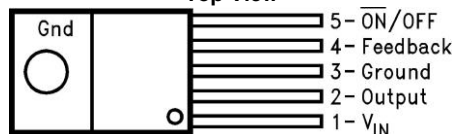
Changes from Revision B (April 2013) to Revision C

Page

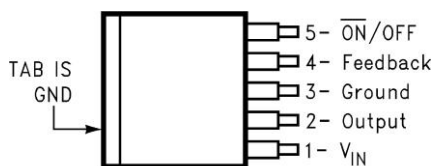
- Changed layout of National Data Sheet to TI format [3](#)

5 Pin Configuration and Functions

**KC Package
5-Pin TO-220
Top View**



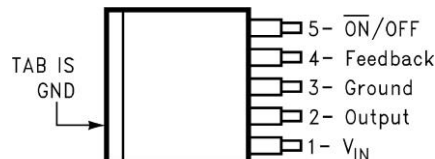
**KTT Package
5-PIN DDPAK/TO-263
Top View**



Side View



**DDPAK/TO-263 (S) Package
5-Lead Surface-Mount Package
Top View**



Side View



Pin Functions

PIN		I/O ⁽¹⁾	DESCRIPTION
NO.	NAME		
1	V _{IN}	I	Supply input pin to collector pin of high-side transistor. Connect to power supply and input bypass capacitors C _{IN} . Path from V _{IN} pin to high frequency bypass C _{IN} and GND must be as short as possible.
2	OUTPUT	O	Emitter pin of the power transistor. This is a switching node. Attached this pin to an inductor and the cathode of the external diode.
3	GROUND	—	Ground pin. Path to C _{IN} must be as short as possible.
4	FEEDBACK	I	Feedback sense input pin. Connect to the midpoint of feedback divider to set V _{OUT} for ADJ version or connect this pin directly to the output capacitor for a fixed output version.
5	— ON/OFF	I	Enable input to the voltage regulator. High = OFF and low = ON. Connect to GND to enable the voltage regulator. Do not leave this pin float.
—	TAB	—	Connected to GND. Attached to heatsink for thermal relief for TO-220 package or put a copper plane connected to this pin as a thermal relief for DDPACK package.

(1) I = INPUT, O = OUTPUT

6 Specifications

6.1 Absolute Maximum Ratings

over the recommended operating junction temperature range of -40°C to 125°C (unless otherwise noted)⁽¹⁾⁽²⁾

		MIN	MAX	UNIT
Maximum supply voltage	LM2576		45	V
	LM2576HV		63	
ON /OFF pin input voltage		-0.3V ≤ V ≤ +V _{IN}		V
Output voltage to ground	(Steady-state)	-1		V
Power dissipation		Internally Limited		
Maximum junction temperature, T _J		150		°C
Storage temperature, T _{stg}		-65		150
				°C

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

(2) If Military/Aerospace specified devices are required, please contact the TI Sales Office/ Distributors for availability and specifications.

6.2 ESD Ratings

			VALUE	UNIT
V _(ESD)	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 ⁽¹⁾	±2000	V

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

6.3 Recommended Operating Conditions

over the recommended operating junction temperature range of -40°C to 125°C (unless otherwise noted)

		MIN	MAX	UNIT
Temperature	LM2576, LM2576HV	-40	125	°C
Supply voltage	LM2576		40	V
	LM2576HV		60	

6.4 Thermal Information

THERMAL METRIC ⁽¹⁾⁽²⁾⁽³⁾		LM2576, LM2576HV		UNIT
		KTT (TO-263)	KC (TO-220)	
		5 PINS	5 PINS	
R _{θJA}	Junction-to-ambient thermal resistance	42.6	32.4	°C/W
R _{θJC(top)}	Junction-to-case (top) thermal resistance	43.3	41.2	°C/W
R _{θJB}	Junction-to-board thermal resistance	22.4	17.6	°C/W
ψ _{JT}	Junction-to-top characterization parameter	10.7	7.8	°C/W
ψ _{JB}	Junction-to-board characterization parameter	21.3	17	°C/W
R _{θJC(bot)}	Junction-to-case (bottom) thermal resistance	0.4	0.4	°C/W

(1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC Package Thermal Metrics* application report, [SPRA953](#) and the *Using New Thermal Metrics* applications report, [SBVA025](#). (2) The package thermal impedance is calculated in accordance with JESD 51-7 (3) Thermal Resistances were simulated on a 4-layer, JEDEC board.

6.5 Electrical Characteristics: 3.3 V

Specifications are for T_J = 25°C (unless otherwise noted).

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
SYSTEM PARAMETERS TEST CIRCUIT Figure 26 and Figure 32 ⁽¹⁾							
V _{OUT}	Output Voltage	V _{IN} = 12 V, I _{LOAD} = 0.5 A Circuit of Figure 26 and Figure 32		3.234	3.3	3.366	V
	Output Voltage: LM2576	6 V ≤ V _{IN} ≤ 40 V, 0.5 A ≤ I _{LOAD} ≤ 3 A Circuit of Figure 26 and Figure 32	T _J = 25°C	3.168	3.3	3.432	V
			Applies over full operating temperature range	3.135		3.465	
	Output Voltage: LM2576HV	6 V ≤ V _{IN} ≤ 60 V, 0.5 A ≤ I _{LOAD} ≤ 3 A Circuit of Figure 26 and Figure 32	T _J = 25°C	3.168	3.3	3.45	V
			Applies over full operating temperature range	3.135		3.482	
η	Efficiency	V _{IN} = 12 V, I _{LOAD} = 3 A		75%			

(1) External components such as the catch diode, inductor, input and output capacitors can affect switching regulator system performance. When the LM2576/LM2576HV is used as shown in [Figure 26](#) and [Figure 32](#), system performance is as shown in [Electrical Characteristics: All Output Voltage Versions](#).

6.6 Electrical Characteristics: 5 V

Specifications are for T_J = 25°C for the [Figure 26](#) and [Figure 32](#) (unless otherwise noted).

PARAMETER		TEST CONDITIONS		MIN		TYP		MAX	UNIT
SYSTEM PARAMETERS TEST CIRCUIT Figure 26 and Figure 32 ⁽¹⁾									
V _{OUT}	Output Voltage	V _{IN} = 12 V, I _{LOAD} = 0.5 A Circuit of Figure 26 and Figure 32		4.9	5	5.1	V		
V _{OUT}	Output Voltage LM2576	0.5 A ≤ I _{LOAD} ≤ 3 A, 8 V ≤ V _{IN} ≤ 40 V Circuit of Figure 26 and Figure 32	T _J = 25°C	4.8	5	5.2	V		
			Applies over full operating temperature range	4.75		5.25			
V _{OUT}	Output Voltage LM2576HV	0.5 A ≤ I _{LOAD} ≤ 3 A, 8 V ≤ V _{IN} ≤ 60 V Circuit of Figure 26 and Figure 32	T _J = 25°C	4.8	5	4.75	V		
			Applies over full operating temperature range	5.225		5.275			
η	Efficiency	V _{IN} = 12 V, I _{LOAD} = 3 A		77%					

(1) External components such as the catch diode, inductor, input and output capacitors can affect switching regulator system performance. When the LM2576/LM2576HV is used as shown in [Figure 26](#) and [Figure 32](#), system performance is as shown in [Electrical Characteristics: All Output Voltage Versions](#).

6.7 Electrical Characteristics: 12 V

Specifications are for T_J = 25°C (unless otherwise noted).

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
SYSTEM PARAMETERS TEST CIRCUIT Figure 26 and Figure 32 ⁽¹⁾							
V _{OUT}	Output Voltage	V _{IN} = 25 V, I _{LOAD} = 0.5 A Circuit of Figure 26 and Figure 32		11.76	12	12.24	V
V _{OUT}	Output Voltage LM2576	0.5 A ≤ I _{LOAD} ≤ 3 A, 15 V ≤ V _{IN} ≤ 40 V Circuit of Figure 26 and Figure 32 and	T _J = 25°C	11.52	12	12.48	V
			Applies over full operating temperature range	11.4		12.6	
V _{OUT}	Output Voltage LM2576HV	0.5 A ≤ I _{LOAD} ≤ 3 A, 15 V ≤ V _{IN} ≤ 60 V Circuit of Figure 26 and Figure 32	T _J = 25°C	11.52	12	12.54	V
			Applies over full operating temperature range	11.4		12.66	
η	Efficiency	V _{IN} = 15 V, I _{LOAD} = 3 A		88%			

(1) External components such as the catch diode, inductor, input and output capacitors can affect switching regulator system performance. When the LM2576/LM2576HV is used as shown in [Figure 26](#) and [Figure 32](#), system performance is as shown in [Electrical Characteristics: All Output Voltage Versions](#).

6.8 Electrical Characteristics: 15 V

over operating free-air temperature range (unless otherwise noted).

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
SYSTEM PARAMETERS TEST CIRCUIT Figure 26 and Figure 32 ⁽¹⁾							
V _{OUT}	Output Voltage	V _{IN} = 25 V, I _{LOAD} = 0.5 A Circuit of Figure 26 and Figure 32		14.7	15	15.3	V
V _{OUT}		0.5 A ≤ I _{LOAD} ≤ 3 A,	T _J = 25°C	14.4	15	15.6	V

Output Voltage LM2576	$18\text{ V} \leq V_{IN} \leq 40\text{ V}$ Circuit of Figure 26 and Figure 32	Applies over full operating temperature range	14.25	15.75	
Output Voltage LM2576HV	$0.5\text{ A} \leq I_{LOAD} \leq 3\text{ A}$, $18\text{ V} \leq V_{IN} \leq 60\text{ V}$ Circuit of Figure 26 and Figure 32	$T_J = 25^\circ\text{C}$	14.4	15	14.25
V_{OUT}		Applies over full operating temperature range	15.68	15.83	V
η Efficiency	$V_{IN} = 18\text{ V}$, $I_{LOAD} = 3\text{ A}$		88%		

(1) External components such as the catch diode, inductor, input and output capacitors can affect switching regulator system performance. When the LM2576/LM2576HV is used as shown in [Figure 26](#) and [Figure 32](#), system performance is as shown in [Electrical Characteristics: All Output Voltage Versions](#).

6.9 Electrical Characteristics: Adjustable Output Voltage

over operating free-air temperature range (unless otherwise noted).

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
SYSTEM PARAMETERS TEST CIRCUIT Figure 26 and Figure 32 ⁽¹⁾					
Feedback voltage V_{OUT}	$V_{IN} = 12\text{ V}$, $I_{LOAD} = 0.5\text{ A}$ $V_{OUT} = 5\text{ V}$, Circuit of Figure 26 and Figure 32	1.217	1.23	1.243	V
Feedback Voltage LM2576 V_{OUT}	$0.5\text{ A} \leq I_{LOAD} \leq 3\text{ A}$, $8\text{ V} \leq V_{IN} \leq 40\text{ V}$ $V_{OUT} = 5\text{ V}$, Circuit of Figure 26 and Figure 32	$T_J = 25^\circ\text{C}$	1.193	1.23	1.267
		Applies over full operating temperature range	1.18	1.28	V
Feedback Voltage LM2576HV V_{OUT}	$0.5\text{ A} \leq I_{LOAD} \leq 3\text{ A}$, $8\text{ V} \leq V_{IN} \leq 60\text{ V}$ $V_{OUT} = 5\text{ V}$, Circuit of Figure 26 and Figure 32	$T_J = 25^\circ\text{C}$	1.193	1.23	1.273
		Applies over full operating temperature range	1.18	1.286	V
η Efficiency	$V_{IN} = 12\text{ V}$, $I_{LOAD} = 3\text{ A}$, $V_{OUT} = 5\text{ V}$		77%		

(1) External components such as the catch diode, inductor, input and output capacitors can affect switching regulator system performance. When the LM2576/LM2576HV is used as shown in [Figure 26](#) and [Figure 32](#), system performance is as shown in [Electrical Characteristics: All Output Voltage Versions](#).

6.10 Electrical Characteristics: All Output Voltage Versions

over operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP ⁽¹⁾	MAX	UNIT
SYSTEM PARAMETERS TEST CIRCUIT Figure 26 and Figure 32 ⁽²⁾					
Feedback Bias Current I_b	$V_{OUT} = 5\text{ V}$ (Adjustable Version Only)	$T_J = 25^\circ\text{C}$	100	50	nA
		Applies over full operating temperature range	500		
Oscillator Frequency ⁽³⁾ f_o	$T_J = 25^\circ\text{C}$	47	52	58	kHz
	Applies over full operating temperature range	42		63	