3A, 300kHz, Step-Down Switching Regulator LM4576

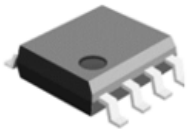
FEATURES

- 3.3V, 5.0V, 12V, 15V and Adjustable Output Versions
- Adjustable Version Output Voltage Range, 1.23V to 37V +/- 4% maximum over line and load conditions
- Guaranteed 3A Output Current
- Wide Input Voltage Range
- Requires Only 4 External Components
- 300KHz Fixed Frequency Internal Oscillator
- TTL Shutdown Capability, Low Power Standby Mode
- Uses Readily Available Standard Inductors
- Thermal Shutdown and Current Limit Protection
- Moisture Sensitivity Level 3 for SMD packages

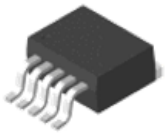
APPLICATION

- Simple High-Efficiency Step-Down(Buck) Regulator
- On-Card Switching Regulators
- Positive to Negative Converter

SOP8-PP PKG



TO-263-5L PKG



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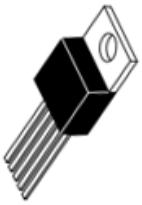

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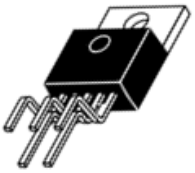


ORDERING INFORMATION

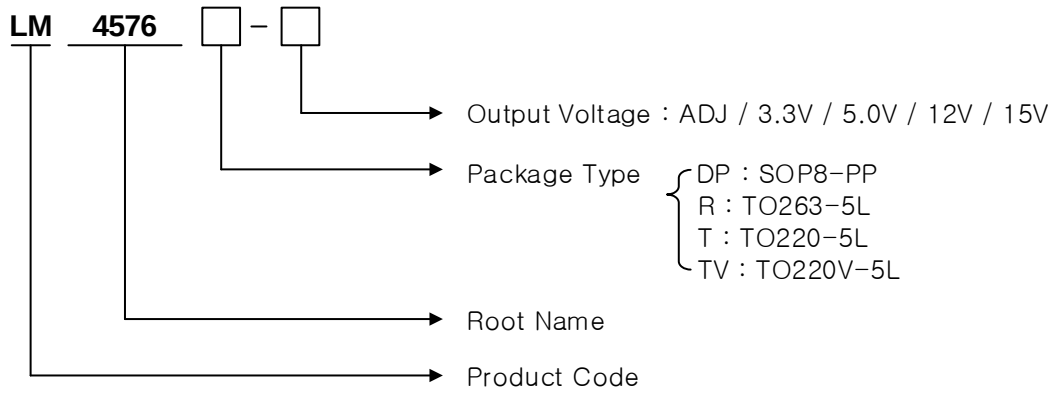
Device	Marking	Package
LM4576DP-X.X	LM4576-X.X	SOP8-PP
LM4576R-X.X	LM4576-X.X	TO-263-5L
LM4576T-X.X	LM4576-X.X	TO-220-5L
LM4576TV-X.X	LM4576-X.X	TO-220V-5L

DESCRIPTION

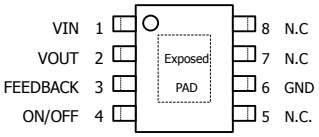
The LM4576 series of regulators are monolithic integrated circuits that provide all the active functional for a step-down (buck) switching regulator, capable of driving 3A load with excellent line and load regulation.
These devices are available in fixed output voltages of 3.3V, 5.0V, 12V, 15V and an adjustable output versions. Requiring a minimum number of external components, these regulators are simple to use and include internal frequency compensation, and a fixed-frequency oscillator.
The LM4576 series operates at a switching frequency of 300KHz thus allowing smaller sized filter components than what would be needed with lower frequency switching regulators.
Some features include a guaranteed +/- 4% tolerance on output voltage under specified input voltage and output load conditions, and +/- 15% on the oscillator frequency. External shutdown is included, featuring typically 60uA standby current. The output switch includes cycle-by-cycle current limiting, as well as thermal shutdown for full protection under fault conditions. The oscillator frequency is reduced 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.

ORDERING INFORMATION

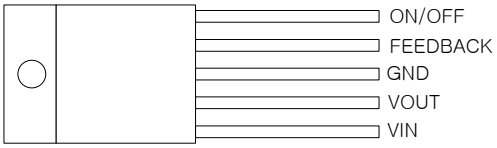
V_{OUT}	Package	Order No.	Description	Package Marking	Status
ADJ	SOP8-PP	LM4576DP-ADJ	3A, Adjustable, 300kHz, On/off	LM4576-ADJ	Contact Us
	TO-263-5L	LM4576R-ADJ	3A, Adjustable, 300kHz, On/off	LM4576-ADJ	Contact Us
	TO-220-5L	LM4576T-ADJ	3A, Adjustable, 300kHz, On/off	LM4576-ADJ	Active
	TO-220V-5L	LM4576TV-ADJ	3A, Adjustable, 300kHz, On/off	LM4576-ADJ	Contact Us
3.3V	SOP8-PP	LM4576DP-3.3	3A, Fixed, 300kHz, On/off	LM4576-3.3	Contact Us
	TO-263-5L	LM4576R-3.3	3A, Fixed, 300kHz, On/off	LM4576-3.3	Contact Us
	TO-220-5L	LM4576T-3.3	3A, Fixed, 300kHz, On/off	LM4576-3.3	Contact Us
	TO-220V-5L	LM4576TV-3.3	3A, Fixed, 300kHz, On/off	LM4576-3.3	Contact Us
5.0V	SOP8-PP	LM4576DP-5.0	3A, Fixed, 300kHz, On/off	LM4576-5.0	Contact Us
	TO-263-5L	LM4576R-5.0	3A, Fixed, 300kHz, On/off	LM4576-5.0	Contact Us
	TO-220-5L	LM4576T-5.0	3A, Fixed, 300kHz, On/off	LM4576-5.0	Contact Us
	TO-220V-5L	LM4576TV-5.0	3A, Fixed, 300kHz, On/off	LM4576-5.0	Contact Us
12V	SOP8-PP	LM4576DP-12	3A, Fixed, 300kHz, On/off	LM4576-12	Contact Us
	TO-263-5L	LM4576R-12	3A, Fixed, 300kHz, On/off	LM4576-12	Contact Us
	TO-220-5L	LM4576T-12	3A, Fixed, 300kHz, On/off	LM4576-12	Contact Us
	TO-220V-5L	LM4576TV-12	3A, Fixed, 300kHz, On/off	LM4576-12	Contact Us
15V	SOP8-PP	LM4576DP-15	3A, Fixed, 300kHz, On/off	LM4576-15	Contact Us
	TO-263-5L	LM4576R-15	3A, Fixed, 300kHz, On/off	LM4576-15	Contact Us
	TO-220-5L	LM4576T-15	3A, Fixed, 300kHz, On/off	LM4576-15	Contact Us
	TO-220V-5L	LM4576TV-15	3A, Fixed, 300kHz, On/off	LM4576-15	Contact Us



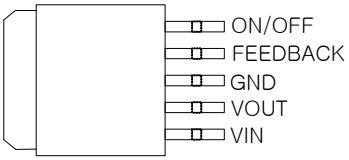
PIN CONFIGURATION



SOP8-PP



TO-220-5L / TO-220V-5L



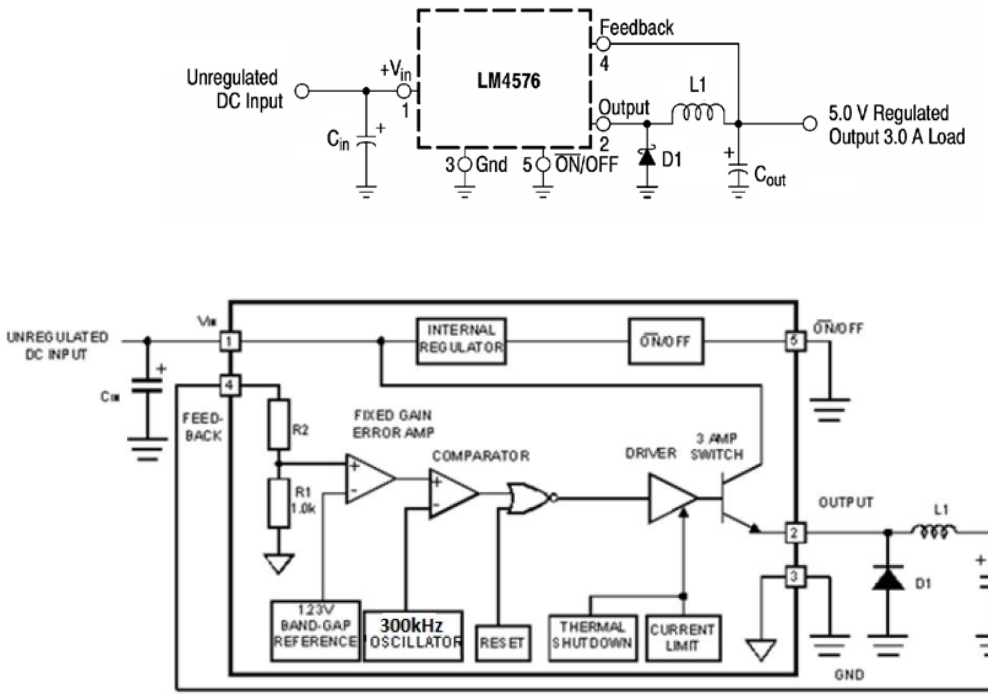
TO-263-5L

PIN DESCRIPTION

Package		Symbol	Description
TO-263-5L TO-220-5L TO-220V-5L	SOP8-PP		
1	1	VIN	This pin is the positive input supply for the LM4576 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. (Cin in Figure 1).
2	2	VOUT	This is the emitter of the internal switch. The saturation voltage V_{SAT} of this output switch is typically 1.4V. It should be kept in mind that the PCB area connected to this pin should be kept to a minimum in order to minimize coupling to sensitive circuitry.
3	6	GND	Circuit ground pin. See the information about the printed circuit board layout.
4	3	FEEDBACK	This pin senses regulated output voltage to complete the feedback loop. The signal is divided by the internal resistor divider network R1, R2 and applied to the non–inverting input of the internal error amplifier. In the adjustable version of the LM4576 switching regulator this pin is the direct input of the error amplifier and the resistor network R1, R2 is connected externally to allow programming of the output voltage.
5	4	ON/OFF	It allows the switching regulator circuit to be shutdown using logic level signals, thus dropping the total input supply current to approximately 60uA. The threshold voltage is typically 1.4V. Applying a voltage above this value (up to +Vin) shuts the regulator off. If the voltage applied to this pin is lower than 1.4V or if this pin is left open, the regulator will be in the "on" condition
-	5, 7, 8	N.C.	No Connect.

* Exposed Pad of SOP8-PP package should be externally connected to GND.

TYPICAL APPLICATION (Fixed Output Voltage Versions)



3.3V, R2 =1.7K
5V, R2 = 3.1K
12V, R2 = 8.84K
15V, R2 =11.3K
For ADJ Version R1 = Open, R2 =0Ω

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
On/Off Pin Input Voltage	$V_{ON/OFF}$	-0.3V ≤ V ≤ +Vin	V
FB Pin Voltage	V_{FB}	-0.3V ≤ V ≤ +Vin	V
Output Voltage to Ground (Steady-State)	V_{OUT}	-0.8	V
Power Dissipation SOP8-PP Thermal Resistance, Junction to Ambient Thermal Resistance, Junction to Case	 P_D θ_{JA} θ_{JC}	 Internally Limited Contact us Contact us	 W ℃/W ℃/W
TO-263-5L Thermal Resistance, Junction to Ambient Thermal Resistance, Junction to Case	P_D θ_{JA} θ_{JC}	Internally Limited 70 5	W ℃/W ℃/W
TO-220-5L Thermal Resistance, Junction to Ambient Thermal Resistance, Junction to Case	P_D θ_{JA} θ_{JC}	Internally Limited 65 5	W ℃/W ℃/W
TO-220V-5L Thermal Resistance, Junction to Ambient Thermal Resistance, Junction to Case	P_D θ_{JA} θ_{JC}	Internally Limited 65 5	W ℃/W ℃/W
Storage Temperature Range	T_{STG}	-65 to +150	℃
Maximum Junction Temperature	T_J	150	℃

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, see the Electrical Characteristics.)

Rating	Symbol	Value.	Unit
Operating Junction Temperature Range	T_J	-40 to +125	℃
Maximum Supply Voltage	V_{IN}	40	V
Output Current	I_{OUT}	3	A

ELECTRICAL CHARACTERISTICS / System Parameters [Note 1]

(Unless otherwise specified, V_{IN} = 12V for the 3.3V, 5.0V, and Adjustable version, V_{IN} = 25V for the 12V and 15V version. I_{LOAD} = 500 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.)

Characteristics	Symbol	Min	TYP	Max	Unit
LM4576-3.3 ([Note 1] Test Circuit Figure 2)					
Output Voltage (5.5V ≤ V_{IN} ≤ 40V, 0.2A ≤ I_{LOAD} ≤ 3A) T_J=25℃ T_J= -40℃ ~ +125℃	V_{OUT}	 3.168 3.135	 3.3 -	 3.432 3.465	V
Efficiency (V_{IN}=12V, I_{LOAD}=3A)	η	-	73	-	%
LM4576-5.0 ([Note 1] Test Circuit Figure 2)					
Output Voltage (8V ≤ V_{IN} ≤ 40V, 0.2A ≤ I_{LOAD} ≤ 3A) T_J=25℃ T_J= -40℃ ~ +125℃	V_{OUT}	 4.800 4.750	 5.0 -	 5.200 5.250	V
Efficiency (V_{IN}=12V, I_{LOAD}=3A)	η	-	75	-	%
LM4576-12 ([Note 1] Test Circuit Figure 2)					
Output Voltage (15V ≤ V_{IN} ≤ 40V, 0.2A ≤ I_{LOAD} ≤ 3A) T_J=25℃ T_J= -40℃ ~ +125℃	V_{OUT}	 11.520 11.400	 12 -	 12.480 12.600	V
Efficiency (V_{IN}=15V, I_{LOAD}=3A)	η	-	86	-	%
LM4576-15 ([Note 1] Test Circuit Figure 2)					
Output Voltage (18V ≤ V_{IN} ≤ 40V, 0.2A ≤ I_{LOAD} ≤ 3A) T_J=25℃ T_J= -40℃ ~ +125℃	V_{OUT}	 14.400 14.250	 15 -	 15.600 15.750	V
Efficiency (V_{IN}=18V, I_{LOAD}=3A)	η	-	86	-	%
LM4576-ADJ ([Note 1] Test Circuit Figure 2)					
Feedback Voltage (8V ≤ V_{IN} ≤ 40V, 0.2A ≤ I_{LOAD} ≤ 3A, V_{OUT} programmed for 5V) T_J=25℃ T_J= -40℃ ~ +125℃	V_{OUT}	 1.193 1.180	 1.230 -	 1.267 1.280	V
Efficiency (V_{IN}=12V, I_{LOAD}=3A, V_{OUT}=5V)	η	-	75	-	%

1. External components such as the catch diode, inductor, input and output capacitors can affect switching regulator system performance.
2. Tested junction temperature range for the LM4576 : T_{LOW} = –40°C, T_{HIGH} = +125°C

ELECTRICAL CHARACTERISTICS / Device Parameters

(Unless otherwise specified, V_{IN} = 12V for the 3.3V, 5.0V, and Adjustable version, V_{IN} = 25V for the 12V and 15V version. I_{LOAD} = 500 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.)

Characteristics	Symbol	MIN.	TYP.	MAX.	Unit
All Output Voltage Versions					
Feedback Bias Current (V_{OUT}=5.0V [Adjustable Version Only]) T_J=25℃ T_J= -40 to +125℃	I_b	- -	50 -	100 500	nA
Oscillator Frequency [Note 3] T_J=25℃ T_J= -40 to +125℃	F_{OSC}	255 230	300 -	345 370	KHz
Saturation Voltage (I_{OUT}=3.0A [note 4]) T_J= 25℃ T_J= -40 to +125℃	V_{SAT}	- -	1.4 -	1.6 1.8	V
Max Duty Cycle (“0”) [Note 5]	D/C	93	98	-	%
Current Limit (Peak Current [Note 3 and 4]) T_J= 25℃ T_J= -40 to +125℃	I_{CL}	4.0 3.5	5.7 -	6.9 7.5	A
Output Leakage Current [Note 6 and 7] Output = 0V Output = -0.8V	I_L	- -	0.4 10	2 30	mA
Quiescent Current [Note 6] T_J= 25℃	I_Q	-	5	10	mA
Standby Quiescent Current (ON/OFF Pin = 5.0V ("off")) T_J=25℃	I_{STBY}	-	60	200	µA
ON/OFF Pin Logic Input Level (V_{OUT}=0V) T_J=25℃ T_J= -40 to +125℃	V_{IH}	2.2 2.4	1.4 -	- -	V
V_{OUT}=Nominal Output Voltage T_J=25℃ T_J= -40 to +125℃	V_{IL}	- -	1.2 -	1.0 0.8	V
ON/OFF Pin Input Current ON/OFF Pin = 5.0V (Regulator OFF), T_J=25℃ ON/OFF Pin = 0V (Regulator ON), T_J=25℃	I_{IH} I_{IL}	- -	12 0	30 10	µA

3. The oscillator frequency reduces to approximately 75 KHz in the event of an output short or an overload which causes the regulated output voltage to drop approximately 40% from the nominal voltage. This self protection feature lowers the average dissipation of the IC by lowering the minimum duty cycle from 5% down to approximately 2%
4. Output pin sourcing current. No diode, inductor or capacitor connected to output.
5. Feedback pin removed from output and connected to 0V.
6. Feedback pin removed from output and connected to +12V for the Adjustable, 3.3V, and 5.0V versions, and +25V for the 12V and 15V version, to force the output transistor “off”.
7. Vin = 40V.

TYPICAL PERFORMANCE CHARACTERISTICS

T.B.D

REVISION NOTICE

The description in this datasheet can be revised without any notice to describe its electrical characteristics properly

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