LM2576HV
DATASHEET

Specification Revision History：

Version	Date	Description
V1.0	2019/03	New
V1.1	2021/02	Modify Ordering Information
V1.2	2025/02	Modify Ordering Information
V1.3	2025/03	Add application precautions and overall typesetting.

Description

The LM2576HV series of regulators are monolithic integrated circuit that provides all the active functions for a step-down(buck)switching regulator, capable of driving 3A load with excellent line and load regulation.The LM2576HV available in fixed output voltages of 3.3V,5V,12Vand an adjustable output version. Requiring a minimum number of external components,these regulators are simple to use and include internal frequency compensation and a fixed- frequency oscillator.

The LM2576HV 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 LM2576HV are available from several different manufacturers.This feature greatly simplifies the design of switch-mode power supplies.

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

The LM2576HV is available in TO220T-5L,TO220B-5 and TO263-5L package.

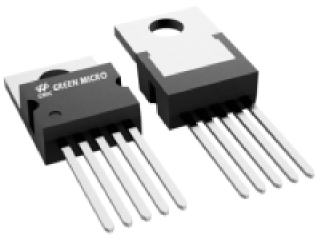
Features

· 3.3V,5V,12V and adjustable output versions
· Wide input voltage range,40Vup to 60V for HV version
· High efficiency
· Specified 3A output current
· 52kHz fixed frequency internal oscillator
· TTL shutdown capability,low power standby mode
· Uses readily available standard inductors
· Thermal shutdown and current limit protection
· Adjustable version output voltage range,1.23V to 57V±4%max over line and load conditions

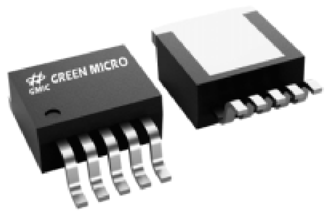
Applications

.Simple high-efficiency step-down(Buck)regulator
.Efficient pre-regulator for linear regulators
.On-card switching regulators
.Positive to negative converter(Buck-Boost)

The appearance of the product



TO-220

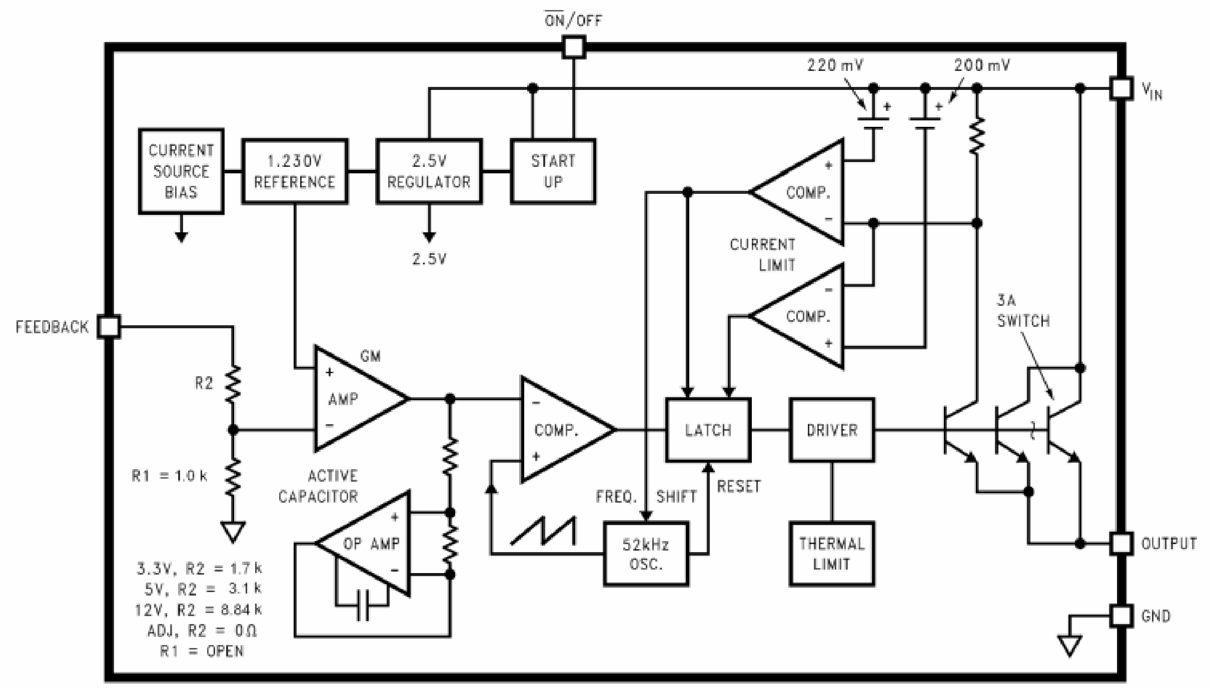


TO-263

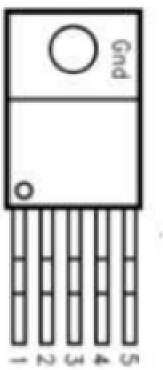
Ordering Information

Product Model	Package Type	Marking	Packing	Packing Qty
LM2576HVS-ADJTO	TO-263-5盘	LM2576HVS-ADJ	REEL	500PCS/REEL
LM2576HVS-3.3TO		LM2576HVS-3.3	REEL	500PCS/REEL
LM2576HVS-5.0TO		LM2576HVS-5.0	REEL	500PCS/REEL
LM2576HVS-12TO		LM2576HVS-12	REEL	500PCS/REEL
LM2576HVS-ADJTN	TO-263-5管	LM2576HVS-ADJ	TUBE	1000PCS/BOX
LM2576HVS-3.3TN		LM2576HVS-3.3	TUBE	1000PCS/BOX
LM2576HVS-5.0TN		LM2576HVS-5.0	TUBE	1000PCS/BOX
LM2576HVS-12TN		LM2576HVS-12	TUBE	1000PCS/BOX
LM2576HVT-ADJTE	TO-220-5	LM2576HVT-ADJ	TUBE	1000PCS/BOX
LM2576HVT-3.3TE		LM2576HVT-3.3	TUBE	1000PCS/BOX
LM2576HVT-5.0TE		LM2576HVT-5.0	TUBE	1000PCS/BOX
LM2576HVT-12TE		LM2576HVT-12	TUBE	1000PCS/BOX

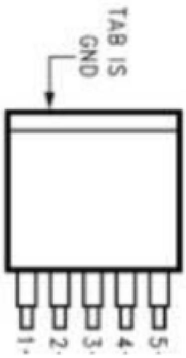
Functional Block Diagram



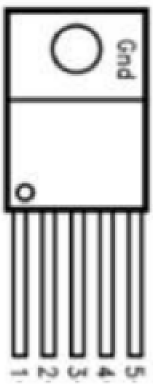
Pin Configuration



TO220B5



TO220T-5L



TO263-5L

Pin Description

Pin Number	Pin Name	Function Description
1	VIN	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.
2	OUTPUT	Internal switch,the voltage at this pin switches between(+VInVsAT)and approximately -0.5V.To minimize coupling to sensitive circuitry,the PC board copper area connected to this pin should be kept to a minimum.
3	GND	Circuit Ground
4	FEEDBACK	Senses the regulated output voltage to complete the feedback loop.
5	$\overline{ON}$ /OFF	Allows the switching regulator circuit to be shut down using logic level signals

Absolute Maximum Ratings

Parameter Name	Symbol	Value	Unit
Maximum Supply Voltage	V_{IN}	63	V
$\overline{ON}$ /OFF Pin Input Voltage	$\overline{ON}$ /OFF	$-0.3V \leqslant V \leqslant +V_{IN}$	V
Output Voltage to Ground(steady state)	V_{OUT}	-1	V
Power Dissipation	P_{DMAX}	Internally Limited	
Storage Temperature Range	T_{stg}	-65~+150	°C
Maximum Junction Temperature	T_{JA}	150	°C
ESD Susceptibility(Human Body Model)	ESD	2	kV
Lead Temperature (Soldering,10 Seconds)	T_L	260	°C

Recommended Operating Conditions

Parameter Name	Symbol	Value	Unit
Supply Voltage	V_{IN}	6~60	V
Operating temperature range	Topr	-40~+125	°C

Electrical Characteristics

(Unless otherwise specified: T_J=25°C)

Parameter Name	Symbol	Test Conditions	Min	Typ	Max	Units
Device Parameters						
Feedback Bias Current	Ib	Adjustable version only, V_{OUT}=5V		50	100	nA
Oscillator Frequency	fo	(Note 1)	47	52	58	kHz
VsAT Saturation Voltage	V_{SAT}	I_{OUT}=3A		1.4	1.8	V
Max. Duty Cycle(ON)	DC		93	98		%
Current Limit	I_{CL}	(Note 1)	4.2	5.8	6.9	A
Output Leakage Current	I_L	Output=0V			2	mA
		Output=-1V		7.5	30	mA
Quiescent Current	I_Q			5	10	mA
Standby Quiescent Current	I_{STBY}	ON/OFF pin=5V(OFF)		50	200	μA
$\overline{ON}$ /OFF Control						
$\overline{ON}$ /OFF Pin Logic Input Level	V_{IH}	V_{OUT}=0V	2.0			V
	V_{IL}	V_{OUT}=nominal output voltage			0.8	V
$\overline{ON}$ /OFF Pin Input Current	I_{IH}	ON/OFF pin=5V(OFF)		12	30	μA
	I_{IL}	ON/OFF pin=0V(ON)		0	10	μA

Note 1:The oscillator frequency reduces to approximately 11kHz in the event of an output short or an overload which causes thee

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%.

Output pin sourcing current.No diode,inductor or capacitor connected to output.

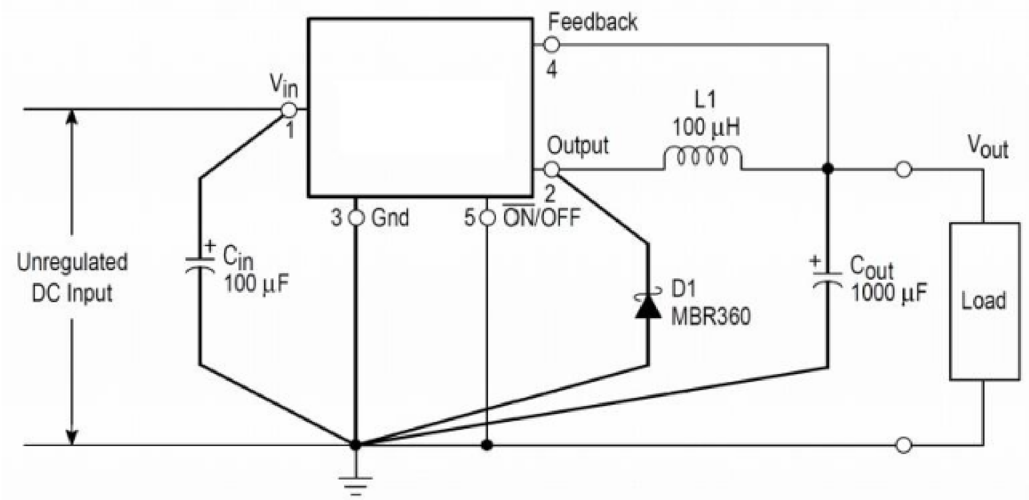
3A Step-Down HV Voltage Regulator

Parameter Name	Symbol	Test Conditions	Min	Typ	Max	Units
LM2575HV-3.3V						
Output Voltage	V_{OUT}	V_{IN}=12V,Io=500mA	3.234	3.3	3.366	V
		6V≤V_{IN}≤60V 0.5A≤I_{LOAD}≤3A	3.168	3.3	3.450	V
Efficiency	n□	V_{IN}=12V,I_{LOAD}=3A		75		%
LM2576HV-5.0V						
Output Voltage	V_{OUT}	V_{IN}=12V,I_O=500mA	4.90	5.00	5.10	V
		8V≤V_{IN}≤60V 0.5A≤I_{LOAD}≤3A	4.800	5.0	5.225	V
Efficiency	η□	V_{IN}=12V,I_{LOAD}=3A		77		%
LM2576HV-12V						
Output Voltage	V_{OUT}	V_{IN}=25V,Io=500mA	11.76	12.00	12.24	V
		15V≤V_{IN}≤60V 0.5A≤I_{LOAD}≤3A	11.52	12.00	12.54	V
Efficiency	η	V_{IN}=25V,I_{LOAD}=3A		88		%

Parameter Name	Symbol	Test Conditions	Min	Typ	Max	Units
LM2576HV-ADJ						
Output Voltage	V_{OUT}	V_{IN}=12V,I_O=500mA, V_{OUT}=5V	1.217	1.230	1.243	V
		8V≤V_{IN}≤60V,Vour=5V 0.5A≤I_{LOAD}≤3A	1.193	1.230	1.273	V
Efficiency	η	V_{IN}=12V,I_{LOAD}=3A, V_{OUT}=5V		77		%

Test Circuit

Fixed Output Voltage Versions



C_{in} - 100μF,100V,Aluminium Electrolytic

C_{out} -1000μF,25V,Aluminium Electrolytic

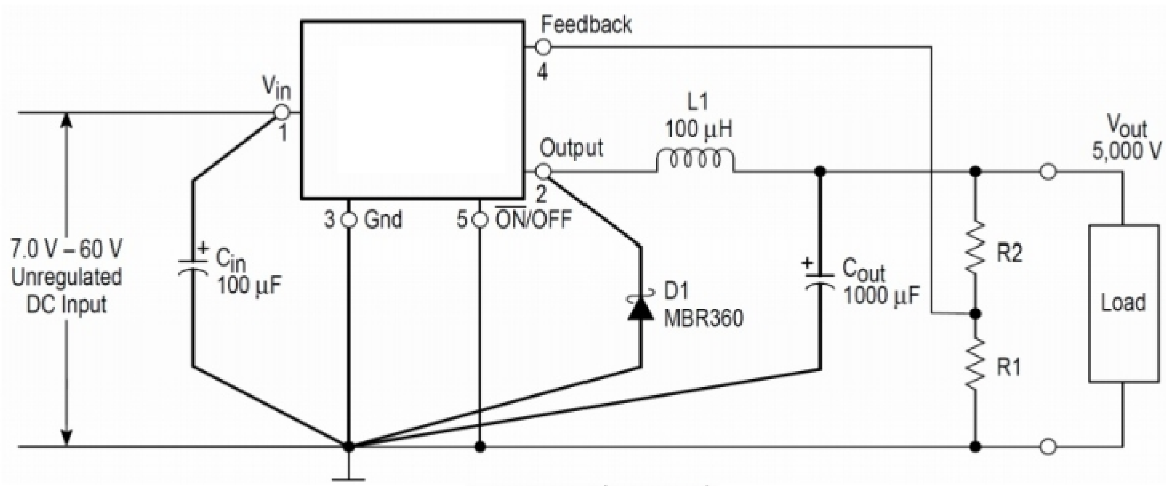
D1 - Schottky,MBR360

L1 -100μH,Pulse Eng.PE-92108

R1 - 2.0k,0.1%

R2 - 6.12k,0.1%

Adjustable Output Voltage Versions



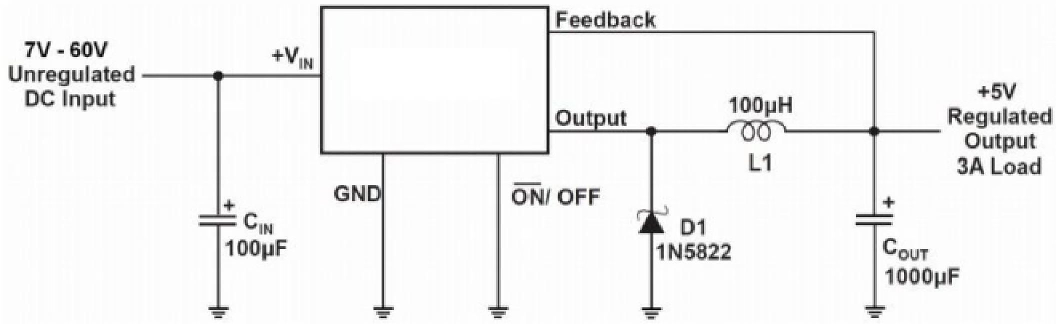
$$V_{out} = V_{ref}\left(1.0 + \frac{R2}{R1}\right)$$

$$R2 = R1\left(\frac{V_{out}}{V_{ref}} - 1.0\right)$$

Where V_{ref}=1.23 V,R1

between 1.0k and 5.0k

Typical Application



Application Information Input

Capacitor(C_{IN})

To maintain stability,the regulator input pin must be bypassed with at least a 100µFelectrolytic capacitor.Thee
capacitor's leads must be kept short,and located near the regulator.If the operating temperature range includes
temperatures below-25°C,the input capacitor value may need to be larger.With most electrolytic capacitors,thee capacitance value decreases and the ESR increases with lower temperatures and age.Paralleling a ceramic or solid tantalum capacitor will increase the regulator stability at cold temperatures.For maximum capacitor operating
lifetime,the capacitor's RMS ripple current rathan

$$1.2 \times \left(\frac{t_{ON}}{T} \right) \times I_{LOAD}$$

Where $\frac{t_{ON}}{T} = \frac{V_{OUT}}{V_{IN}}$ for a buck regulator

and $\frac{t_{ON}}{T} = \frac{|V_{OUT}|}{|V_{OUT}| + V_{IN}}$ for a buck-boost regulator.

Inductor Selection

All switching regulators have two basic modes of operation:continuous and discontinuous.The difference between the two types relates to the inductor current,whether it is flowing continuously,or if it drops to zero for a period of time in the normal switching cycle.Each mode has distinctively different operating characteristics, which can affect the regulator performance and requirements.The LM2576HV can be used for both continuous and discontinuous modes of operation.When using inductor values shown in the inductor selection guide,the peak-to-peak inductor ripple current will be approximately 20%to 30%of the maximum DC current.With relatively heavy load currents,the circuit operates in the continuous mode (inductor current always flowing), but under light load conditions,the circuit will be forced to the discontinuous mode(inductor current falls to zero for a period of time).This discontinuous mode of operation is perfectly acceptable. For light loads(less than approximately 300mA)it may be desirable to operate the regulator in the discontinuous mode,primarily because of the lower inductor values required for the discontinuous mode.The selection guide chooses inductor values suitable for continuous mode operation,but if the inductor value chosen is prohibitively high,the designer should investigate the possibility of discontinuous operation.

Inductors are available in different styles such as pot core,toriod,E-frame,bobbin core,etc.,as well as different core materials,such as ferrites and powdered iron.The least expensive,the bobbin core type,consists of wire wrapped on a ferrite rod core.This type of construction makes for an inexpensive inductor,but since the magnetic flux is not completely contained within the core,it generates more electromagnetic interference(EMI).This EMI can cause problems in sensitive circuits,or can give incorrect scope readings because of induced voltages in the scope probe.The inductors listed in the selection chart include ferrite pot core construction for AIE,powdered iron toroid for Pulse Engineering,and ferrite bobbin core for Renco.

An inductor should not be operated beyond its maximum rated current because it may saturate.When an inductor begins to saturate,the inductance decreases rapidly and the inductor begins to look mainly resistive(the DC resistance of the winding)This will cause the switch current to rise very rapidly.Different inductor types have different saturation characteristics,and this should be kept in mind when selecting an inductor.

The inductor manufacturer's data sheets include current and energy limits to avoid inductor saturation.

Inductor Ripple Current

When the switcher is operating in the continuous mode,the inductor current waveform ranges from a triangular to a sawtooth type of waveform(depending on the input voltage).For a given input voltage and output voltage,the peak-to-peak amplitude of this inductor current waveform remains constant.As the load current rises or falls,thee entire sawtooth current waveform also rises or falls.The average DC value of this waveform is equal to the DC load current(in the buck regulator configuration).If the load current drops to a low enough level,the bottom of the sawtooth current waveform will reach zero,and the switcher will change to a discontinuous mode of operation. This is a perfectly acceptable mode of operation.Any buck switching regulator(no matter how large the inductor value is)will be forced to run discontinuous if the load current is light enough.

Catch Diode

Buck regulators require a diode to provide a return path for the inductor current when the switch is off.This diode should be located close to the LM2576HV using short leads and short printed circuit traces.Because of their fast switching speed and low forward voltage drop,Schottky diodes provide the best efficiency,especially in low output voltage switching regulators (less than 5V).Fast-Recovery,High-Efficiency, or Ultra-Fast Recovery diodes are also suitable,but some types with an abrupt turn-off characteristic may cause instability and EMI problems.A fast-recovery diode with soft recovery characteristics is a better choice.Standard 60 Hz diodes (e.g.,1N4001 or1N5400,etc.)are also not suitable.

Output Capacitor

An output capacitor is required to filter the output voltage and is needed for loop stability.The capacitor should bee located near the LM2576HV using short pc board traces.Standard aluminum electrolytics are usually adequate,

but low ESR types are recommended for low output ripple voltage and good stability.The ESR of a capacitor depends

on many factors,some which are:the value,the voltage rating,physical size and the type of construction.In general,low value or low voltage (less than 12V)electrolytic capacitors usually have higher ESR numbers. The amount of output ripple voltage is primarily a function of the ESR(Equivalent Series Resistance)of the output capacitor and the amplitude of the inductor ripple current($\triangle I_{IND}$).See the section on inductor ripple current in Application Hints.The lower capacitor values(220μF-1000μF)will allow typically 50mV to 150mV of output ripple voltage,while larger-value capacitors will reduce the ripple to approximately20mV to 50mV.Output Ripple Voltage=($\triangle I_{IND}$)(ESR of C_{OUT}).To further reduce the output ripple voltage,several standard electrolytic capacitors may be paralleled,or a higher-grade capacitor may be used.Such capacitors are oftencalled

"high-frequency" "low-inductance" or "low-ESR" These will reduce the output ripple to 10mV or 20mV. However,when operating in the continuous mode,reducing the ESR below 0.03ΩCan cause instability in the regulator.Tantalum capacitors can have a very low ESR,and should be carefully evaluated if it is the only output capacitor.Because of their good low temperature characteristics,a tantalum can be used in parallel with aluminum electrolytics,with the tantalum making up 10%or 20%of the total capacitance.The capacitor's ripple current

rating at 52kHz should be at least 50%higher than the peak-to-peak inductor ripple current.

Output Voltage Ripple and Transients

The output voltage of a switching power supply will contain a sawtooth ripple voltage at the switcher frequency, typically about 1%of the output voltage,and may also contain short voltage spikes at the peaks ofthe sawtooth

waveform.The output ripple voltage is due mainly to the inductor sawtooth ripple current multiplied by the ESR

of the output capacitor.The voltage spikes are present because of the fast switching action of the output switch,

and the parasitic inductance of the output filter capacitor.To minimize these voltage spikes,special low inductance capacitors can be used,and their lead lengths must be kept short.Wiring inductance,stray capacitance, as well as the scope probe used to evaluate these transients,all contribute to the amplitude of these spikes.An

additional smallLC filter(20µH&100 µF)can be added to the output to further reduce the amount of output ripple and transients.A 10×reduction in output ripple voltage and transients is possible with this filter.

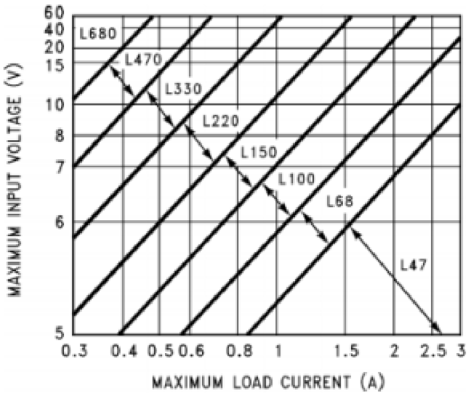
Feedback Connection

The LM2575HV(fixed voltage versions)feedback pin must be wired to the output voltage point of the switching power supply.When using the adjustable version,physically locate both output voltage programming resistors near the LM2576HV to avoid picking up unwanted noise.Avoid using resistors greater than 100kΩ because of the increased chance of noise pickup.

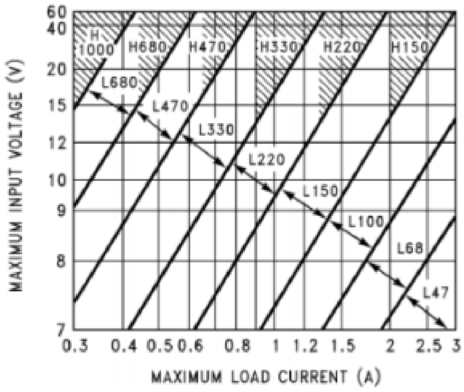
$\overline{\text{ON}}$ /OFF Input

For normal operation,the $\overline{\text{ON}}$ /OFF pin should be grounded or driven with a low-level TTL voltage(typically below 1.6V).To put the regulator into standby mode,drive this pin with a high-level TTL or CMOS signal.The $\overline{\text{ON}}$ /OFF pin can be safely pulled up to+V_{IN} without a resistor in series with it.The $\overline{\text{ON}}$ /OFF pin should not be left open.

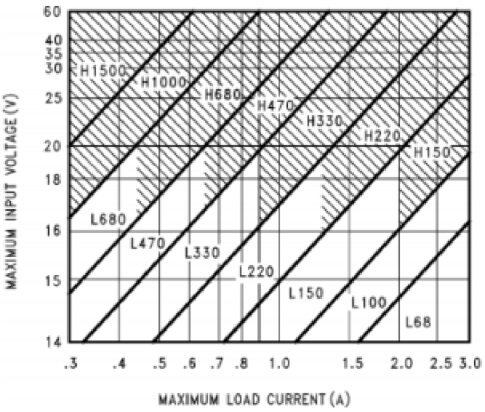
Inductor Value Selection Guides(For Continuous Mode Operation)



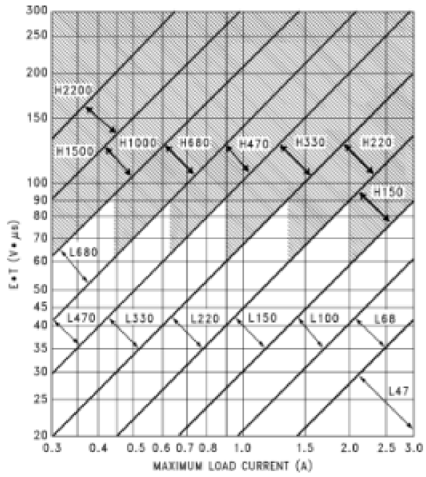
LM2575HV-3.3



LM2575HV-5.0



LM2575HV-12



LM2575HV-ADJ

Inductor Code	Inductor Value	Schott	Pulse Eng.	Renco
L47	47μH	67126980	PE-53112	RL2442
L68	68 μH	67126990	PE-92114	RL2443
L100	100 μH	67127000	PE-92108	RL2444
L150	150 μH	67127010	PE-53113	RL1954
L220	220μH	67127020	PE-52626	RL1953
L330	330 μH	67127030	PE-52627	RL1952
L470	470 μH	67127040	PE-53114	RL1951
L680	680 μH	67127050	PE-52629	RL1950
H150	150 μH	67127060	PE-53115	RL2445
H220	220 μH	67127070	PE-53116	RL2446
H330	330 μH	67127080	PE-53117	RL2447
H470	470 μH	67127090	PE-53118	RL1961
H680	680 μH	67127100	PE-53119	RL1960
H1000	1000 μH	67127110	PE-53120	RL1959
H1500	1500 μH	67127120	PE-53121	RL1958
H2200	2200μH	67127130	PE-53122	RL2448

Inductor Selection Guide

VR	Schottky		Fast Recovery	
	3A	4A-6A	3A	4A-6A
20V	1N5820 MBR320P SR302	1N5823	The following diodes are all rated to 100V 31DF1 HER302	The following diodes are all rated to 100V 50WF10 MUR410 HER602
30V	1N5821 MBR330 31DQ03 SR303	50WQ03 1N5824		
40V	1N5822 MBR340 31DQ04 SR304	MBR340 50WQ04 1N5825		
50V	MBR350 31DQ05 SR305	50WQ05		
60V	MBR360 DQ06 SR306	50WR06 50SQ060		

Diode Selection Guide

Grounding

To maintain output voltage stability,the power ground connections must be low-impedance.For the 5-lead TO-220T TO220B and TO-263 style package,both the tab and pin 3 are ground and either connection may be used,as they are both part of the same copper lead frame.

Heat Sink/Thermal Considerations

In many cases,only a small heat sink is required to keep the LM2576HV junction temperature within the allowed operating range.For each application,to determine whether or not a heat sink will be required,the following

1.Maximum ambient temperature(in the application).

2.Maximum regulator power dissipation (in application).

3.Maximum allowed junction temperature(125°C for the LM2575HV).For a safe,conservative design,a temperature approximately 15°C cooler than the maximum temperatures should be selected.

4.LM2575HV package thermal resistances θ_{JA} and θ_{JC}.

Total power dissipated by the LM2575HV can be estimated as follows:

$PD=(V_{IN})(I_Q)+(V_O/V_{IN})(I_{LOAD})(V_{SAT})$

where

· I_Q(quiescent current)and V_{SAT} can be found in Typical Performance Characteristics shown previously,

· V_{IN} is the applied minimum input voltage,V_O is the regulated output voltage,

· and I_{LOAD} is the load current. (3)

The dynamic losses during turn-on and turn-off are negligible if a Schotky type catch diode is used.

When no heat sink is used,the junction temperature rise can be determined by the following:

$\triangle T_J=(P_D)(\theta_{JA})$ (4)

To arrive at the actual operating junction temperature,add the junction temperature rise to the maximum ambient temperature.

$T_J=\triangle T_J+T_A$ (5)

If the actual operating junction temperature is greater than the selected safe operating junction temperature determined in step 3,then a heat sink is required.

When using a heat sink,the junction temperature rise can be determined by the following:

$\triangle T_J=(P_D)(\theta_{JC}+\theta_{interface}+\theta_{Heat\ sink})$ (6)

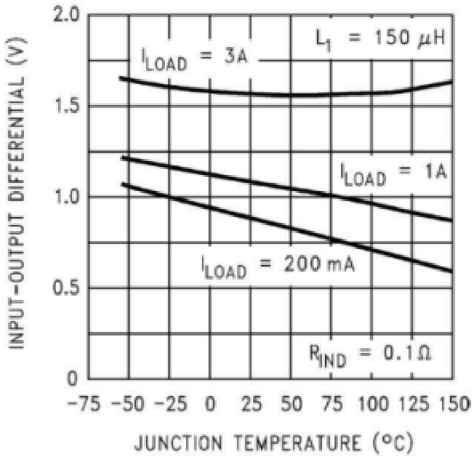
The operating junction temperature will be:

$T_J=T_A+\triangle T_J$ (7)

If the actual operating junction temperature is greater than the selected safe operating junction temperature,then a larger heat sink is required(one that has a lower thermal resistance).Included on the Switcher Made Simple design software is a more precise(non-linear)thermal model that can be used to determine junction temperature with different input-output parameters or different component values.It can also calculate the heat sink thermal resistance required to maintain the regulators junction temperature below the maximum operating temperature.

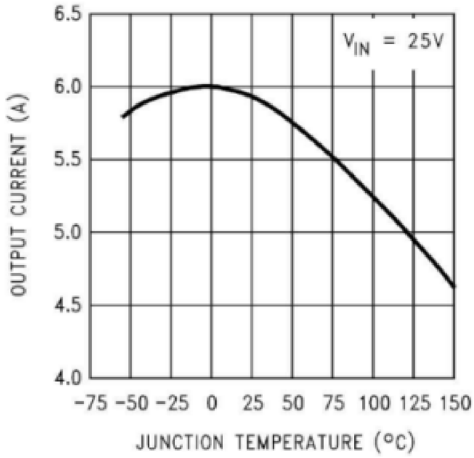
Characteristic Curves

Dropout Voltage



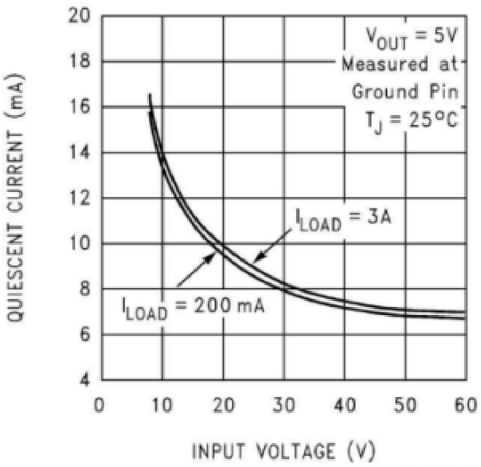
01147629

Current Limit



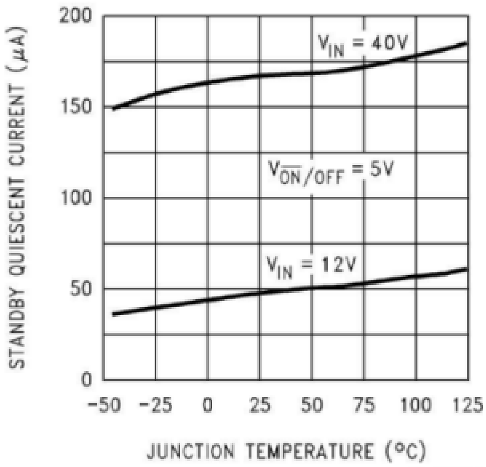
01147630

Quiescent Current



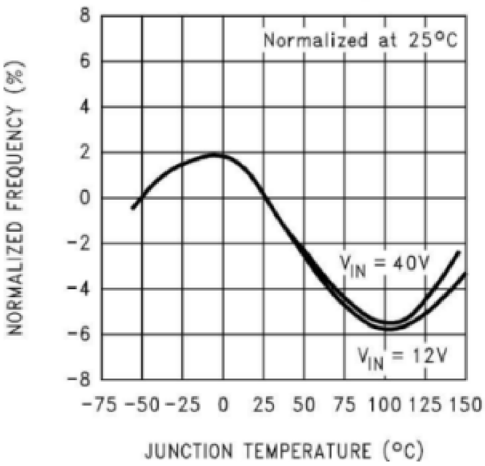
01147631

Standby Quiescent Current

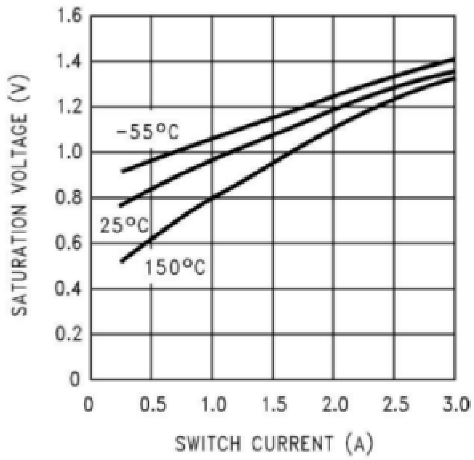


01147632

Oscillator Frequency

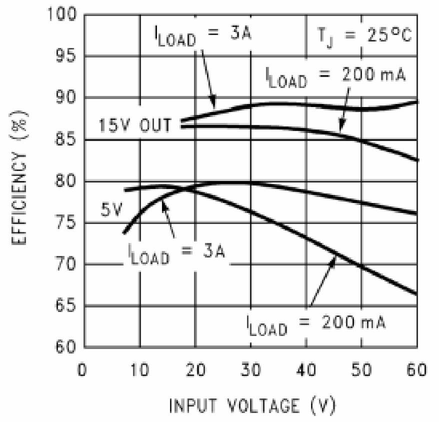


Switch Saturation Voltage

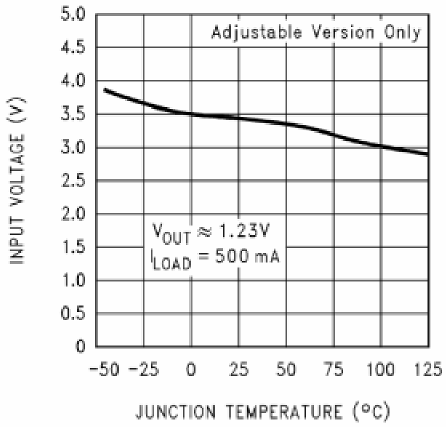


Characteristic Curves(Continued)

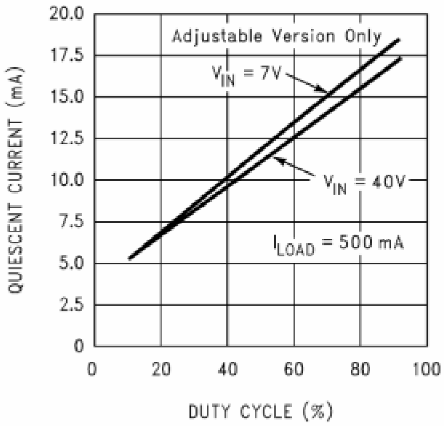
Efficiency



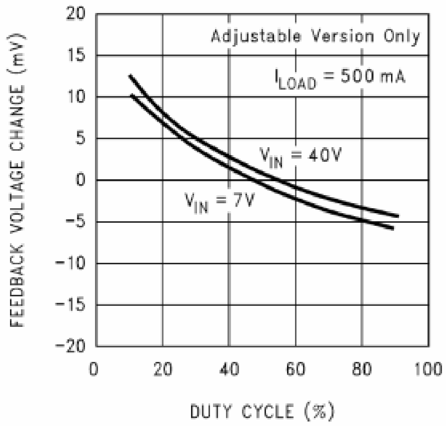
Minimum Operating Voltage



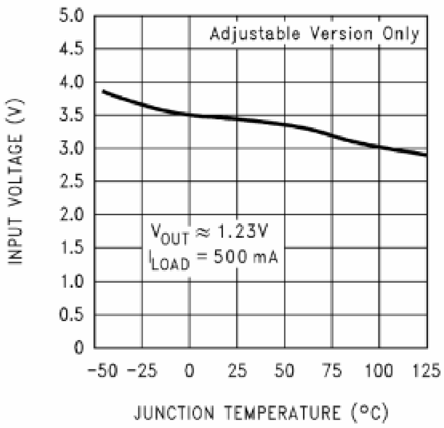
Quiescent Current vs Duty Cycle



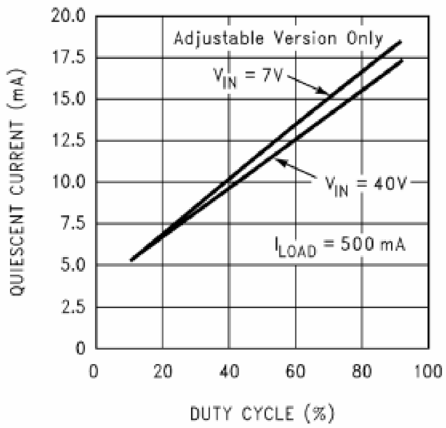
Feedback Voltage vs Duty Cycle



Minimum Operating Voltage

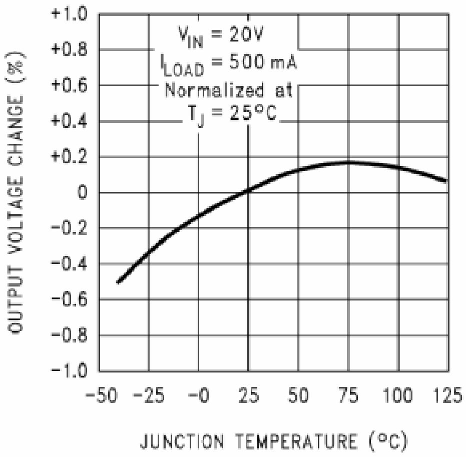


Quiescent Current vs Duty Cycle

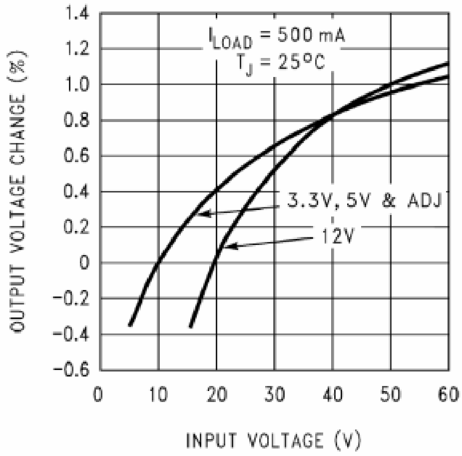


Characteristic Curves(Continued)

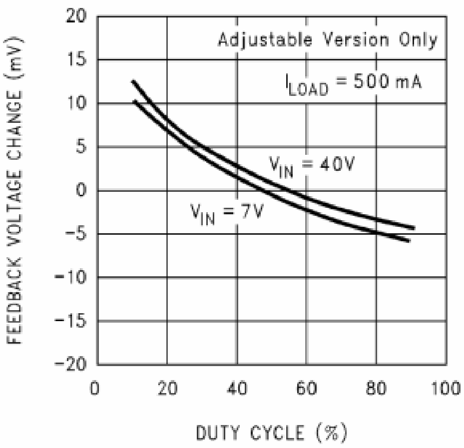
Normalized Output Voltage



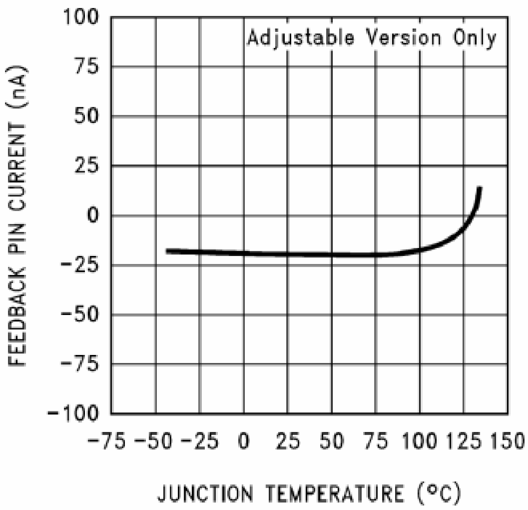
Line Regulation



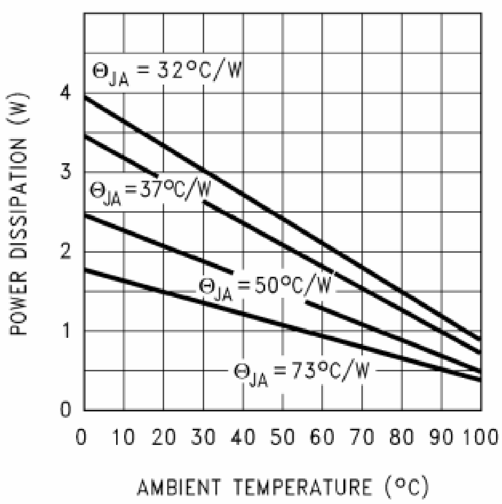
Feedback Voltage vs Duty Cycle



Feedback Pin Current

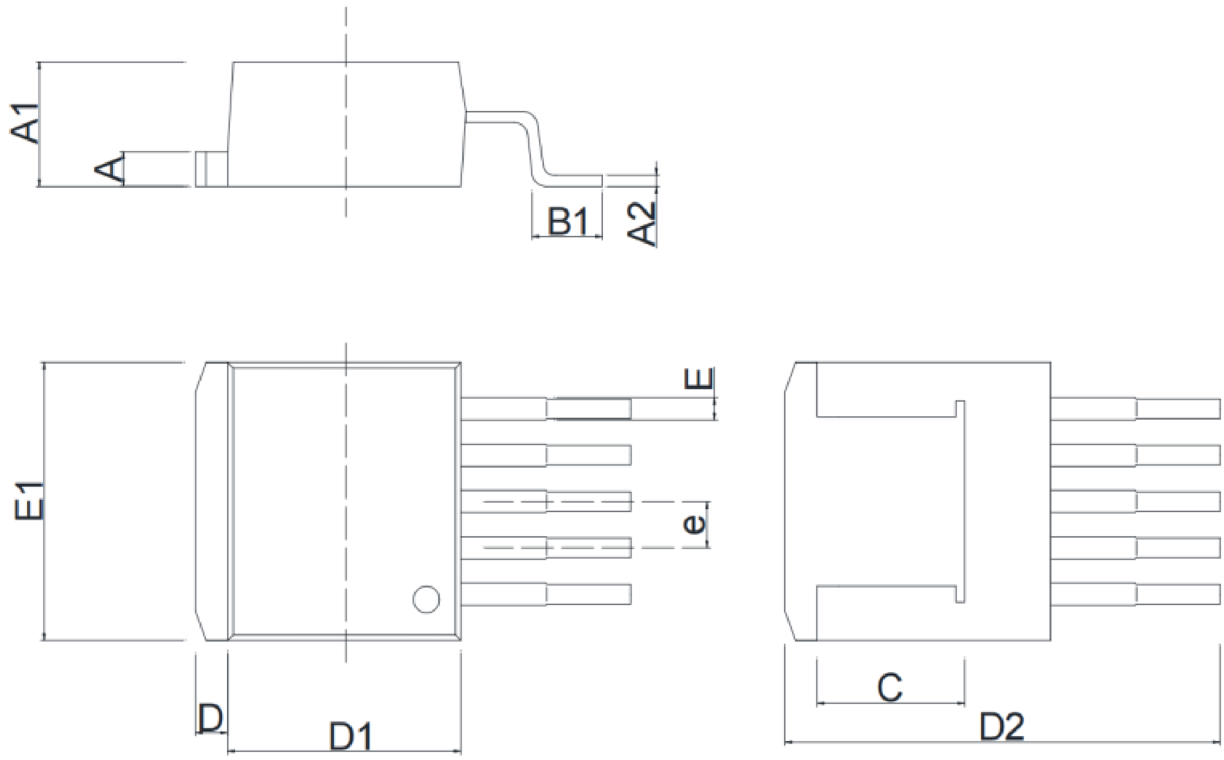


Maximum Power Dissipation (TO-263)



封装外形图

TO-263-5 Unit : mm



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.170	1.370	0.046	0.054
A1	4.470	4.670	0.176	0.184
A2	0.310	0.530	0.012	0.021
B1	2.340	2.740	0.092	0.108
C	5.080 REF		0.200 REF	
D	1.170	1.370	0.046	0.054
D1	8.500	8.900	0.335	0.350
D1	14.550	15.550	0.572	0.612
E	0.660	0.860	0.025	0.034
E1	10.010	10.310	0.394	0.406
e	1.700 （BSC）		0.067 （BSC）	

Important Notice:

- Green Micro chip reserves the right to change products and documents without notice. Customers should obtain and verify the completeness of the latest technical information before placing orders. Meanwhile, Green Micro chip shall not assume any responsibility or obligation for non-officially revised documents.

- Any parameters in the entire product specification are for reference only, and actual application testing shall prevail. When customers use the products for system design, they must comply with safety regulations and independently assume the following responsibilities: selecting suitable Green Micro chip products according to application requirements; completing design verification and full-link testing of the application; and ensuring that the application complies with safety regulations or other requirements of the target market. Customers shall bear all personal or property losses caused by design defects or illegal operations, which shall have no relation to Green Micro chip.

- Green Micro chip products are prohibited from being used in scenarios such as life support, military equipment, and key aerospace applications. All accidents and legal liabilities arising from out-of-scope use shall be borne by the user, and Green Micro chip shall not be held responsible.

- All technical resources of Green Micro chip (including data sheets and reference designs) are provided "as is", without guarantee of no defects or universality, and without any express or implied warranties. The documents are only authorized for product development and research described in this document. Unauthorized use of intellectual property, public reproduction, and reverse engineering are strictly prohibited. All claims and losses caused by illegal use shall be borne by the user, and Green Micro chip shall not be liable.