DMS2576 Series 3A Step-Down Voltage Regulator

Description

The DMS2576 series of regulators are mono-lithic integrated circuits that provide all the active functions 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, 5V, 12V, 15V, and 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.

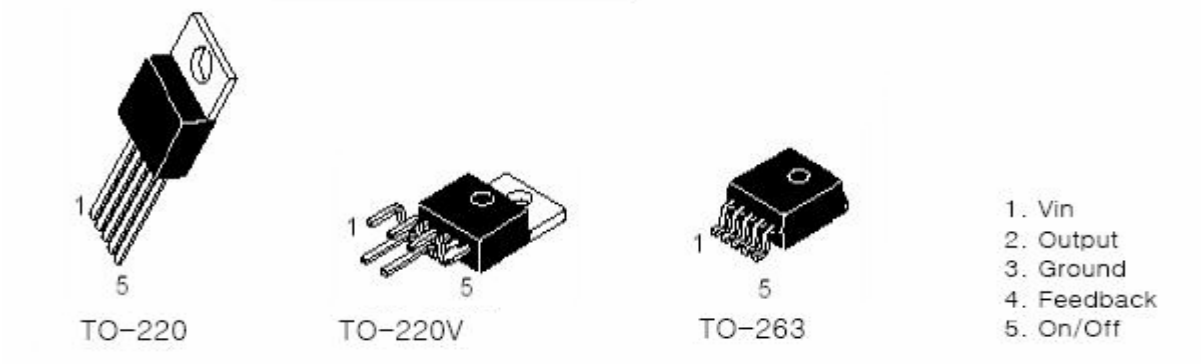
The DMS2576 series offers a high-efficiency re-placement for popular three-terminal linear regulators. It substantially reduces the size of the heat sink, and in some cases no heat sink is required. A standard series of inductors optimized for use with the DMS2576 are available from several different 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 80 μA (typical) standby current. The output switch includes cycle-by-cycle current limiting. full protection under fault conditions.

Features

- ●3.3V, 5V, 12V, 15V, and adjustable output versions
- ● Adjustable version output voltage range, 1.23V to 37V ±4% max over line and load conditions
- ● Guaranteed 3A output current
- ● Wide input voltage range, 40V
- ● 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
- ● P+ Product Enhancement tested

Applications

– Simple high-efficiency step-down (buck) regulator
– Efficient pre-r egul ator for linear regulators
– On-card switching regulators
– Positive to negative converter (Buck-Boost)



Typical Application (Fixed Output Voltage Versions)

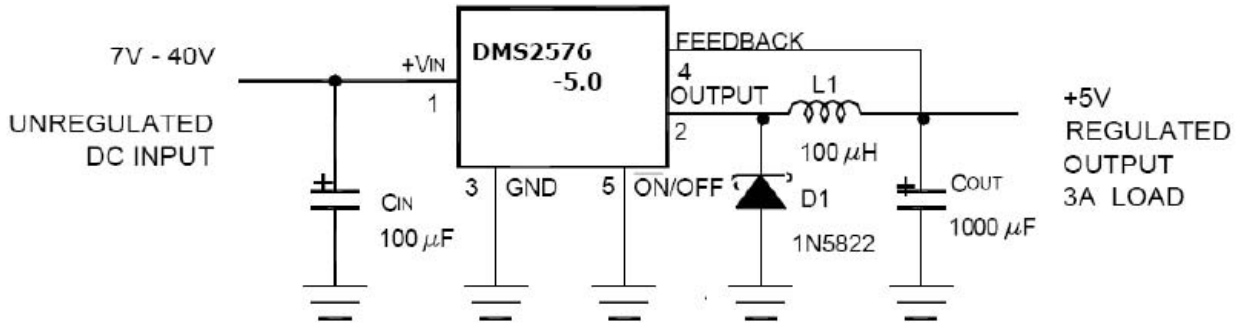
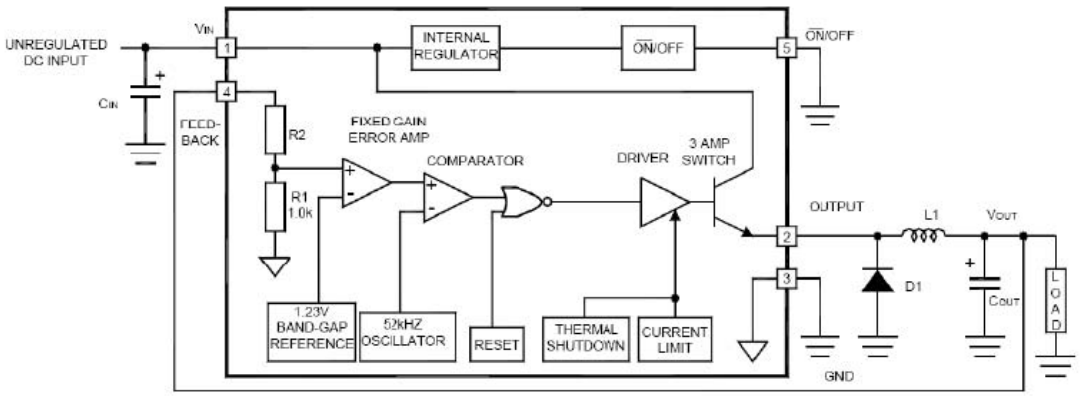


FIGURE 1.

Block Diagram



1.5V, R2=220Ω
1.8V, R2=467Ω
2.5V, R2=1.036Ω
3.3V, R2 =1.7K
5V, R2 = 3.1K
12V, R2 = 8.84K
15V, R2 =11.3K
For ADJ, Version
R1 = Open, R2 =0Ω

Absolute Maximum Ratings (Note 1)

Maximum Supply Voltage 45V

ON/OFF Pin Input Voltage −0.3V≦V≦V_{IN}

Output Vpltage to Ground

(Steady State) −1V

Power Dissipation Internally Limited

Storage Temperature Range -65℃ to 150℃

Minimum ESD Rating

Electrical Characteristics Specifications with standard type face are for T_J = 25^{0}C, and those with boldface type apply over full Operating Temperature Range.

(C=100 PF,R=15 kΩ 25 Kv

Lead Temperature

(Soldering, 10 Seconds) 260℃

Maximum Junction Temperature 150℃

Operating Ratings

Temperature Range –40 ℃ ≤ T_J ≤ +125℃

Supply Voltage 40V

DMS2576-3.3

Symbol	Parameter	Conditions	DMS2576-3.3V		Units(Limits)
			Typ	Limit(Note 2)	
SYSTEM PARAMETERS(Note 2)					
VOUT	Output Voltage	V_{IN}=12V,I_{LOAD}=0.5A	3.3	3.234 3.366	V V(Min) V(Max)
VOUT	Output Voltage	6V≦V_{IN}≦40V 0.5A≦I_{LOAD}≦3A	3.3	3.168/3.135 3.432/3.465	V V(Min) V(Max)
η	Efficiency	V_{IN} =12V, I_{LOAD} =3A	75		%

DMS2576-5.0

Electrical Characteristics Specifications with standard type face are for T_J = 25^{0}C, and those with boldface type apply over full Operating Temperature Range.

Symbol	Parameter	Conditions	DMS2576-5.0V		Units(Limits)
			Typ	Limit(Note 2)	
SYSTEM PARAMETERS(Note 3)					
VOUT	Output Voltage	V_{IN} =12V, I_{LOAD} =0.5A	5.0	4.900 5.100	V V(Min) V(Max)
VOUT	Output Voltage	8V≦V_{IN}≦40V 0.5A≦I_{LOAD}≦3A	5.0	4.800/4.750 5.200/5.250	V V(Min) V(Max)
η	Efficiency	V_{IN} =12V, I_{LOAD} =3A	77		%

DMS2576-12

Electrical Characteristics Specifications with standard type face are for T_J = 25^{0}C, and those with boldface type apply over full Operating Temperature Range.

Symbol	Parameter	Conditions	DMS2576-12V		Units(Limits)
			Typ	Limit(Note 2)	
SYSTEM PARAMETERS(Note 3)					
VOUT	Output Voltage	V_{IN} =25V, I_{LOAD} =0.5A	12	11.76 12.24	V V(Min) V(Max)
VOUT	Output Voltage	15V≦V_{IN}≦40V 0.5A≦I_{LOAD}≦3A	12	11.52/11.40 12.48/12.60	V V(Min) V(Max)
η	Efficiency	V_{IN} =15V, I_{LOAD} =3A	88		%

DMS2576-15

Electrical Characteristics Specifications with standard type face are for T_J = 25^{0}C, and those with boldface type apply over full Operating Temperature Range.

Symbol	Parameter	Conditions	DMS2576-15V	Units(Limits)

			Typ	Limit(Note 2)	
SYSTEM PARAMETERS(Note 3)					
VOUT	Output Voltage	V_{IN} =25V, I_{LOAD} =0.5A	15	14.70 15.30	V V(Min) V(Max)
VOUT	Output Voltage	18V≦V_{IN}≦40V 0.5A≦I_{LOAD}≦3A	15	11.40/14.25 15.60/15.75	V V(Min) V(Max)
η	Efficiency	V_{IN} =18V, I_{LOA}D =3A	88		%

DMS2576-ADJ

Electrical Characteristics Specifications with standard type face are for T_J = 25^{0}C, and those with boldface type apply over full Operating Temperature Range.

Symbol	Parameter	Conditions	DMS2576-ADJ		Units(Limits)
			Typ	Limit(Note 2)	
SYSTEM PARAMETERS(Note 3)					
VOUT	Output Voltage	V_{IN} =12V, I_{LOAD} =0.5A	1.230	1.217 1.230	V V(Min) V(Max)
VOUT	Output Voltage	8V≦V_{IN}≦40V 0.5A≦I_{LOAD}≦3A	1.230	1.193/1.18 1.267/1.28	V V(Min) V(Max)
η	Efficiency	V_{IN} =12V, I_{LOAD} =3A	77		%

All Output Voltage Versions

Electrical Characteristics Specifications with standard type face are for TJ=25°C, and those with boldface type apply over full Operating Temperature Range. Unless otherwise specified, VIN= 12V for the 3.3V, 5V, and Adjustable version, VIN = 25V for the 12V version, and VIN = 30V for the 15V version. I_{LOAD}=500 mA.

Symbol	Parameter	Conditions	DMS2576-XX		Units (Limits)
			Typ	Limit (Note 2)	
DEVICE PARAMETERS					
Ib	Feedback Bias Current	VOUT = 5V (Adjustable Version Only)	50	100/500	nA
f_O	Oscillator Frequency	(Note 11)	52		kHz

				47/42 58/63	kHz (Min) kHz (Max)
V_{SAT}	Saturation Voltage	IOUT = 3A (Note 4)	1.4	1.8/2.0	V V(Max)
DC	Max Duty Cycle (ON)	(Note 5)	98	 93	% %(Min)
I_{CL}	Current Limit	(Notes 4 and 11)	5.8	 4.2/3.5 6.9/7.5	A A(Min) A(Max)
I_L	Output Leakage Current	(Notes 6 and 7) Output = 0V Output = –1V Output = –1V	7.5	2 30	mA(Max) mA mA(Max)
I_Q	Quiescent Current	(Note 6)	5	 10	mA mA(Max)
I_{STBY}	Standby Quiescent Current	ON/OFF Pin = 5V (OFF)	50	 200	μA μA(Max)
ON/OFF CONTROL					
VIH	ON/OFF Pin Logic Input Level	VOUT = 0V	1.4	2.2/2.4	V(Min)
VIL		VOUT = Nominal Output Volt-age	1.2	1.0/0.8	V(Max)
IIH	ON/OFF Pin Input Current	ON/OFF Pin = 5V (OFF)	12	 30	μA μA(Max)
IIL		ON/OFF Pin = 0V (ON)	0	 10	μA 0μA(Max)

Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. 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.

Note 2: All limits guaranteed at room temperature (standard type face) and at temperature extremes (bold type face). All room temperature limits are 100% production tested. All limits at temperature extremes are guaranteed via correlation using standard Statistical Quality Control (SQC) methods.

Note 3: External components such as the catch diode, inductor, input and output capacitors can affect switching regu-lator system performance. When the DMS2576 is used as shown in the Figure 2 test circuit, system performance will be as shown in system parameters section of Electrical Characteristics.

Note 4: Output pin sourcing current. No diode, inductor or capacitor connected to output.

Note 5: Feedback pin removed from output and connected to 0V.

Note 6: Feedback pin removed from output and connected to a12V for the Adjustable, 3.3V, and 5V versions, and a 25V for the 12V and 15V versions, to force the output transistor OFF.

Note 7: VIN = 40V.

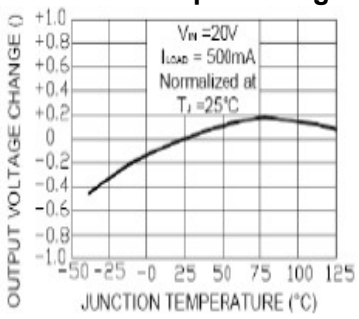
Note 8: Junction to ambient thermal resistance (no external heat sink) for the 5 lead TO-220 package mounted vertically, with % inch leads in a socket, or on a PC board with minimum copper area.

Note 9: Junction to ambient thermal resistance (no external heat sink) for the 5 lead TO-220 package mounted vertically, with % inch leads soldered to a PC board containing approximately 4 square inches of copper area surrounding the leads.

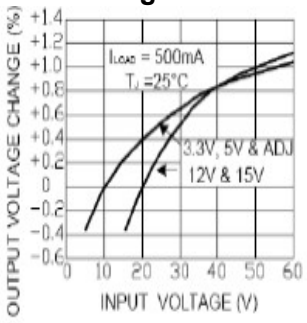
Note 10: If the TO-263 package is used, the thermal resistance can be reduced by increasing the PC board copper area thermally connected to the package. Using 0.5 square inches of copper area, θ_{JA} is 50°C/W, with 1 square inch of copper area, θ_{JA} is 37°C/W, and with 1.6 or more square inches of copper area, θ_{JA} is 32°C/W.

Note 11: The oscillator frequency reduces to approximately 11 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 1C by lowering the minimum duty cycle from 5% down to ap-proximately 2%.

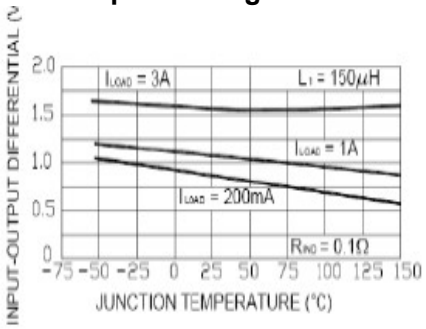
Normalized Output Voltage



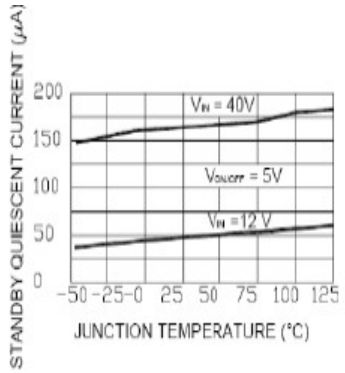
Line Regulation



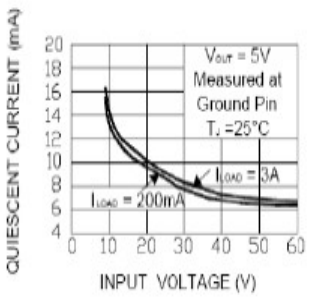
Dropout voltage



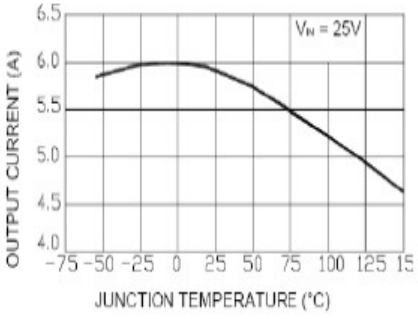
Standby Quiescent Current



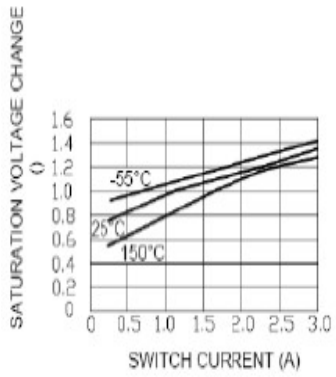
Quiescent Current



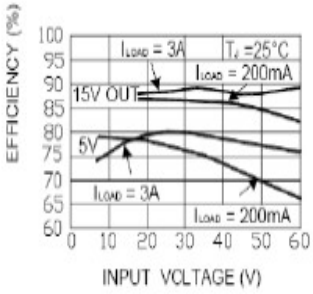
Current Limit



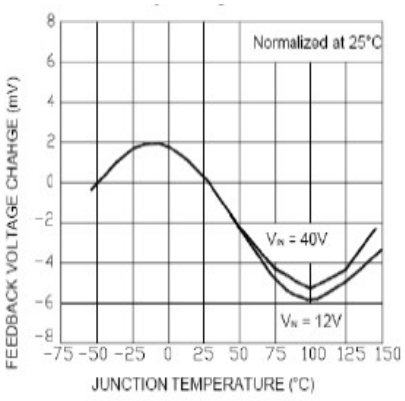
Switch Saturation Voltage



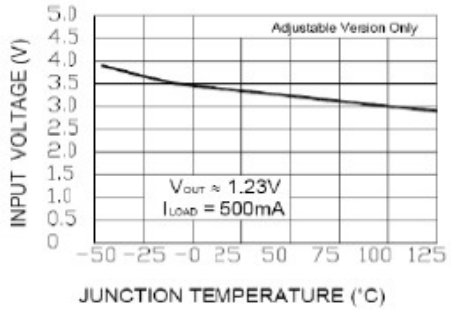
Efficiency



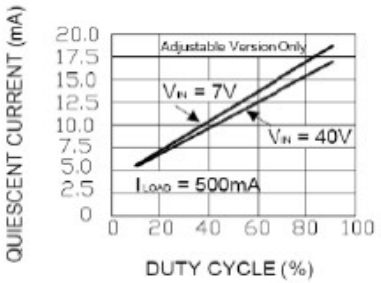
Oscilator Frequency



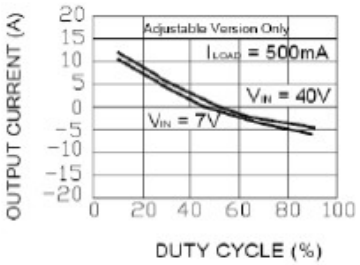
Minimum Operating Voltage



Quiescent Current Vs Duty Cycle

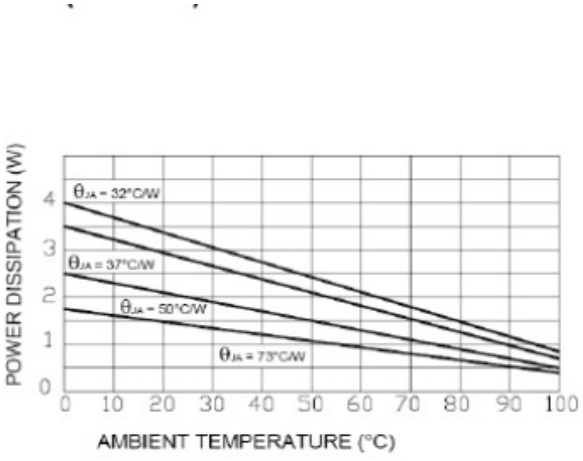


Feedback Viltage vs Duty Cycle

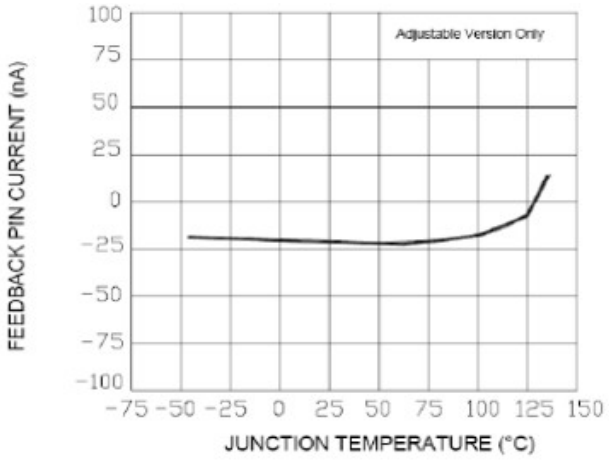


Typicl Performance sharacteristics(Circuit of Figure)(Continued)

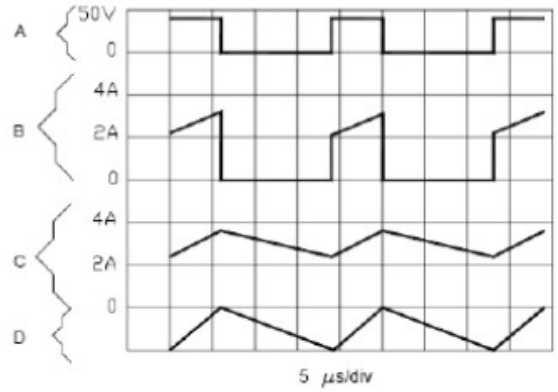
Maximum Power Dissipation (TO-263)



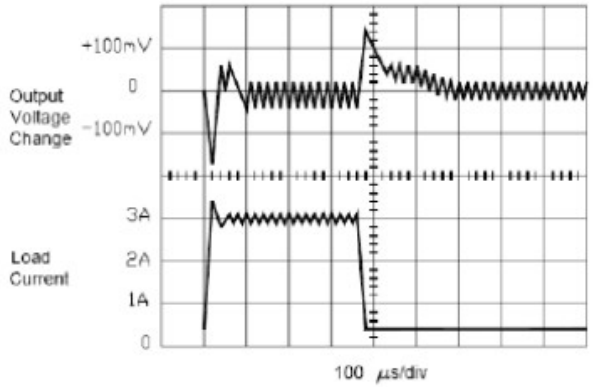
Feedback Pin Current



Switching Waveforms



Load Transient Response



Vout=15v
A: Output Pin Voltage, 50v/div
B: Output Pin Current,2A/div
C: Inductor Current, 2A/div
D: Output Ripple Voltage, 50v/div
AC-Coupled
Horizontal Time Base:5μs/div

Test Circuit and Layout Guidelines

As in any switching regulator ,layout is important. Rapidly switching switching currents associated with wiring inductance generate voltage transients which can cause problems. For minimal inductance and ground loops, the length of the leads indicated by heavy lines should be kept as short as possible. Single-point grounding (as indicated)or ground plane construction should be used for best results. When using the Adjustable version, physically locate the programming resistors near the regulator, to keep the sensitive feedback wiring short.

Fixed Output Voltage Versions

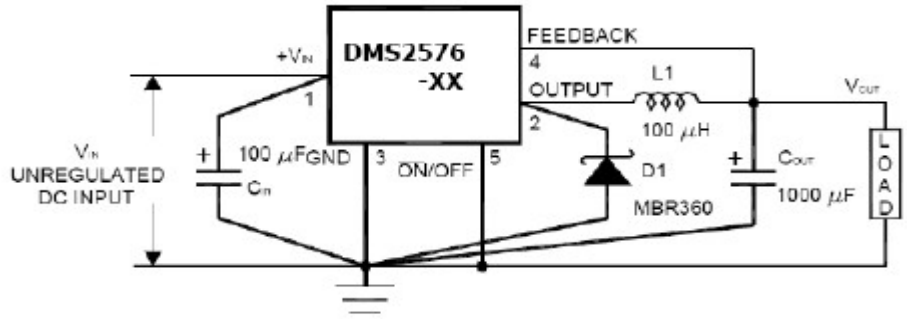


Figure1

Cln-100μF, 75V, Aluminum Electrolytic

Cout-1000μF,25V, Aluminum Electrolytic

D_1-Schottky, MBR360

L_1-100μH, Pulse Eng .PE-92108

R_1-2K, 0.1%

R_2-6.12K, 0.1%

Adjustable Output Voltage Version

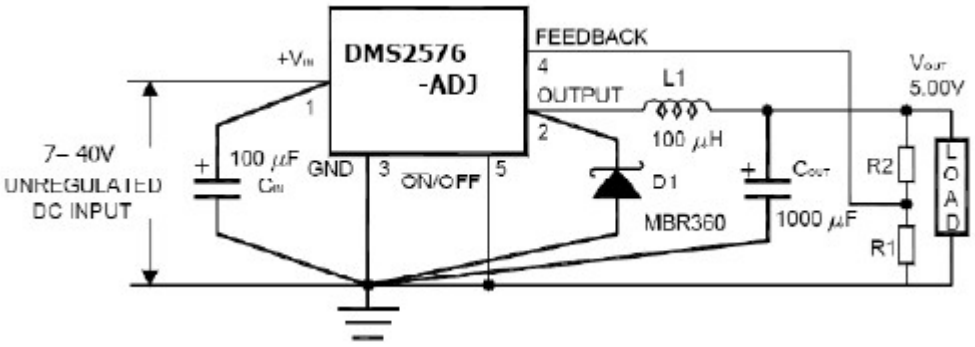


Figure2.

$$VOUT = VREF(1+\frac{R2}{R1})$$

$$R2 = R1(\frac{VOUT}{VREF}-1)$$

Where V_{REF}=1.23V, R1 between 1K and 5K