

GENERAL DESCRIPTION

The LM2575HV/LM2576HV/HM2676HV series of regulators are monolithic 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 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 LM2575HV/LM2576HV/HM2676HV 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 LM2575HV/LM2576HV/HM2676HV are available from several different manufacturers. This feature greatly simplifies the design of switch-mode power supplies.

Other features include a guaranteed $\pm 4\%$ 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.

FEATURES

- 3.3V, 5V, 12V, 15V and adjustable output versions
- Adjustable version output voltage range, 1.23V to 57V $\pm 4\%$ max over line and load conditions
- Guaranteed 3A output current
- Wide input voltage range, 60V
- Requires only 4 external components
- 52 kHz fixed frequency oscillator
- TTL shutdown capability, low power standby mode
- High efficiency
- Uses readily available standard inductors
- Thermal shutdown and current limit protection

APPLICATIONS

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

PIN ASSIGNMENT

TO-220, TO-263 :	ESOP-8L
(for $I_{load} \leq 3\text{ A}$)	(for $I_{load} \leq 3\text{ A}$)
1-Vin	1- Vin
2-OUTPUT	2- OUTPUT
3-GND	3-FB
4-FB	4-ON/OFF
5-ON/OFF	5, 6, 7, 8-GND

For the best thermal performance, generous amounts of printed circuit board copper should be used in the board layout.

TYPICAL APPLICATION (Fixed Output Voltage Versions)

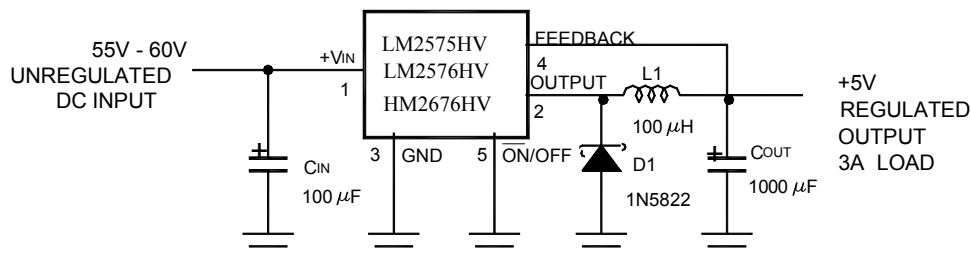
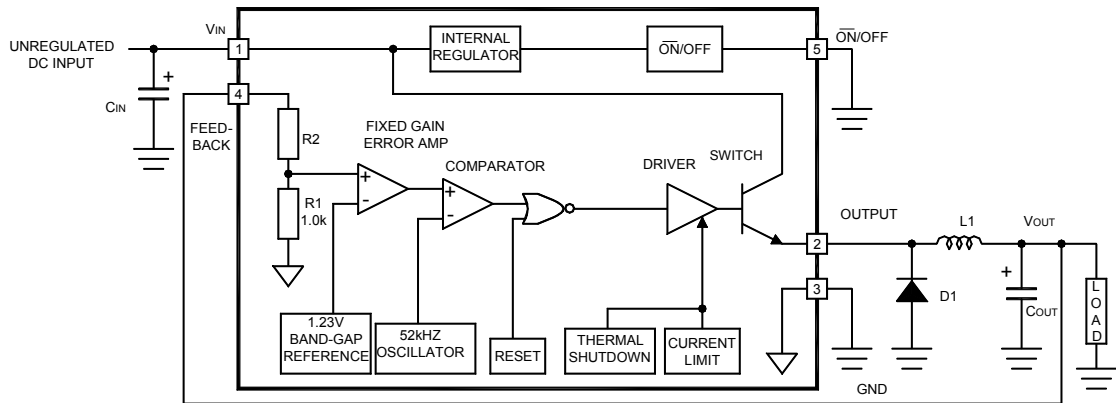


FIGURE 1.

BLOCK DIAGRAM



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

ORDERING INFORMATION

Temperature Range	Output Voltage				
	3.3	5.0	12	15	ADJ
-40°C ≤ TA ≤ 125°C	LM2575HV-3.3 LM2576HV-3.3 HM2676HV-3.3	LM2575HV-5.0 LM2576HV-5.0 HM2676HV-5.0	LM2575HV-12 LM2576HV-12 HM2676HV-12	LM2575HV-15 LM2576HV-15 HM2676HV-15	LM2575HV-ADJ LM2576HV-ADJ HM2676HV-ADJ

Absolute Maximum Ratings (Note 1)

Minimum ESD Rating	2kV
(C= 100pF, R = 1.5 kΩ)	
Lead Temperature (Soldering, 10 Seconds)	260°C

Maximum Supply Voltage

Operating Ratings

LM2575HV/LM2576HV/HM2676HV 63V

Temperature Range

ON/OFF Pin Input Voltage	-0.3V ≤ V ≤ +V _{IN}	LM2575HV/LM2576HV/HM2676HV	-40°C ≤ T _J ≤ +125°C
Output Voltage to Ground (Steady State)	-0.75V	LM2575HV/LM2576HV/HM2676HV	60V
Power Dissipation	Internally Limited		
Storage Temperature Range	-65°C to +150°C		
Maximum Junction Temperature	150°C		

LM2575HV-3.3 /LM2576HV-3.3/HM2676HV-3.3

Electrical Characteristics

Specifications with standard type face are for T_J = 25°C, and those with **boldface type** apply over full Operating Temperature Range.

Symbol	Parameter	Conditions	Typ	Limit (Note 2)	Units (Limits)
SYSTEM PARAMETERS (Note 3) Test Circuit Figure 2					
V _{OUT}	Output Voltage	V _{IN} =12V, I _{LOAD} =0.5A Circuit of Figure 2	3.3	3.234 3.366	V V(Min) V(Max)
V _{OUT}	Output Voltage LM2576HV HM2676HV	6V ≤ V _{IN} ≤ 60V, 0.5A ≤ I _{LOAD} ≤ 3A Circuit of Figure 2	3.3	3.168/ 3.135 3.450/ 3.482	V V(Min) V(Max)
V _{OUT}	Output Voltage LM2575HV	5.5V ≤ V _{IN} ≤ 60V, 0.5A ≤ I _{LOAD} ≤ 2A Circuit of Figure 2	3.3	3.168/ 3.135 3.450/ 3.482	V V(Min) V(Max)
η	Efficiency	V _{IN} =12V, I _{LOAD} =3A (LM2576HV/HM2676HV) I _{LOAD} =2A (LM2575HV)	75		%

LM2575HV-5.0/LM2576HV-5.0/HM2676HV-5.0

Electrical Characteristics

Specifications with standard type face are for T_J = 25°C, and those with **Figure 2 boldface type** apply over full Operating Temperature Range.

Symbol	Parameter	Conditions	Typ	Limit (Note 2)	Units (Limits)
SYSTEM PARAMETERS (Note 3) Test Circuit Figure 2					
V _{OUT}	Output Voltage	V _{IN} =12V, I _{LOAD} =0.5A Circuit of Figure 2	5.0	4.900 5.100	V V(Min) V(Max)
V _{OUT}	Output Voltage LM2576HV HM2676HV	0.5A ≤ I _{LOAD} ≤ 3A, 8V ≤ V _{IN} ≤ 60V	5.0	4.800/ 4.750 5.225/ 5.275	V V(Min) V(Max)

		Circuit of <i>Figure 2</i>			
V _{OUT}	Output Voltage LM2575HV	0.5A ≤ I _{LOAD} ≤ 2A, 7.5V ≤ V _{IN} ≤ 60V Circuit of <i>Figure 2</i>	5.0	4.800/4.750 5.225/5.275	V V(Min) V(Max)
η	Efficiency	V _{IN} =12V, I _{LOAD} =3A (LM2576HV/HM2676HV) I _{LOAD} =2A (LM2575HV)	77		%

LM2575HV-12 / LM2576HV-12/HM2676HV-12

Electrical Characteristics

Specifications with standard type face are for T_J = 25°C, and those with **boldface type** apply over full Operating Temperature Range.

Symbol	Parameter	Conditions	Typ	Limit (Note 2)	Units (Limits)
SYSTEM PARAMETERS (Note 3) Test Circuit <i>Figure 2</i>					
V _{OUT}	Output Voltage	V _{IN} =25V, I _{LOAD} =0.5A Circuit of <i>Figure 2</i>	12	11.76 12.24	V V(Min) V(Max)
V _{OUT}	Output Voltage LM2576HV HM2676HV	0.5A ≤ I _{LOAD} ≤ 3A, 15V ≤ V _{IN} ≤ 60V Circuit of <i>Figure 2</i>	12	11.52/ 11.40 12.54/ 12.66	V V(Min) V(Max)
V _{OUT}	Output Voltage LM2575HV	0.5A ≤ I _{LOAD} ≤ 2A, 14.5V ≤ V _{IN} ≤ 60V Circuit of <i>Figure 2</i>	12	11.52/ 11.40 12.54/ 12.66	V V(Min) V(Max)
η	Efficiency	V _{IN} =15V, I _{LOAD} =3A (LM2576HV/HM2676HV) I _{LOAD} =2A (LM2575HV)	88		%

LM2575HV-15 / LM2576HV-15/HM2676HV-15

Electrical Characteristics

Specifications with standard type face are for T_J = 25°C, and those with **boldface type** apply over full Operating Temperature Range.

Symbol	Parameter	Conditions	Typ	Limit (Note 2)	Units (Limits)
SYSTEM PARAMETERS (Note 3) Test Circuit <i>Figure 2</i>					
V _{OUT}	Output Voltage	V _{IN} =25V, I _{LOAD} =0.5A Circuit of <i>Figure 2</i>	15	14.70 15.30	V V(Min) V(Max)
V _{OUT}	Output Voltage LM2576HV HM2676HV	0.5A ≤ I _{LOAD} ≤ 3A, 18V ≤ V _{IN} ≤ 60V Circuit of <i>Figure 2</i>	15	14.40/ 14.25 15.68/ 15.83	V V(Min) V(Max)
V _{OUT}	Output Voltage LM2575HV	0.5A ≤ I _{LOAD} ≤ 2A, 17.5V ≤ V _{IN} ≤ 60V Circuit of <i>Figure 2</i>	15	14.40/ 14.25 15.68/ 15.83	V V(Min) V(Max)
η	Efficiency	V _{IN} =18V, I _{LOAD} = 3A (LM2576HV) I _{LOAD} =2A (LM2575HV)	88		%

LM2575HV-ADJ /LM2576HV-ADJ /HM2676HV-ADJ

Electrical Characteristics

Specifications with standard type face are for $T_J = 25^\circ\text{C}$, and those with **boldface type** apply over full Operating Temperature Range.

Symbol	Parameter	Conditions	Typ	Limit (Note 2)	Units (Limits)
SYSTEM PARAMETERS (Note 3) Test Circuit Figure 2					
V_{OUT}	Feedback Voltage	$V_{IN} = 12\text{V}$, $I_{LOAD} = 0.5\text{A}$, $V_{OUT} = 5\text{V}$ Circuit of <i>Figure 2</i>	1.230	1.217 1.243	V V(Min) V(Max)
V_{OUT}	Feedback Voltage LM2576HV HM2676HV	$0.5\text{A} \leq I_{LOAD} \leq 3\text{A}$, $8\text{V} \leq V_{IN} \leq 60\text{V}$ $V_{OUT} = 5\text{V}$ Circuit of <i>Figure 2</i>	1.230	1.193/1. 180 1.273/1. 286	V V(Min) V(Max)
V_{OUT}	Feedback Voltage LM2575HV	$0.5\text{A} \leq I_{LOAD} \leq 2\text{A}$, $7.5\text{V} \leq V_{IN} \leq 60\text{V}$ $V_{OUT} = 5\text{V}$ Circuit of <i>Figure 2</i>	1.230	1.193/1. 180 1.273/1. 286	V V(Min) V(Max)
η	Efficiency	$V_{IN} = 12\text{V}$, $I_{LOAD} = 3\text{A}$ (LM2576HV /HM2676HV) $I_{LOAD} = 2\text{A}$ (LM2575HV) $V_{OUT} = 5\text{V}$	77		%

**All Output Voltage Versions
 Electrical Characteristics**

Specifications with standard type face are for $T_J = 25^\circ\text{C}$, and those with **boldface type** apply over full Operating Temperature Range. Unless otherwise specified, $V_{IN} = 12\text{V}$ for the 3.3V, 5V, and Adjustable version, $V_{IN} = 25\text{V}$ for the 12V version, and $V_{IN} = 30\text{V}$ for the 15V version, , $I_{LOAD} = 500\text{mA}$.

Symbol	Parameter	Conditions	LM2575HV/LM2576HV /HM2676HV		Units (Limits)
			Typ	Limit (Note 2)	
DEVICE PARAMETERS					
I_b	Feedback Bias Current	$V_{OUT} = 5\text{V}$ (Adjustable Version Only)	50	100/ 500	nA
f_o	Oscillator Frequency	(Note 8)	52	47/42 58/ 63	kHz kHz (Min) kHz (Max)
V_{SAT}	Saturation Voltage LM2576HV/HM2676HV	$I_{OUT} = 3\text{A}$ (Note 4)	1.4	1.55/ 1.70	V V(Max)
V_{SAT}	Saturation Voltage LM2575HV	$I_{OUT} = 2\text{A}$ (Note 4)	1.2	1.35/ 1.45	V V(Max)
DC	Max Duty Cycle (ON)	(Note 5)	98	93	% %(Min)
I_{CL}	Current Limit	LM2576HV/HM2676HV	5.8	4.2/ 3.5 6.9/ 7.5	A A(Min) A(Max)
I_{CL}	Current Limit	LM2575HV	3.4	2.5/2.3 4.6/4.9	A
I_L	Output Leakage Current	(Notes 6, 7): Output = 0V Output = -0.75V Output = -0.75V	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)	$V_{in} = 60\text{V}$	50 200	μA $\mu\text{A}(\text{Max})$

All Output Voltage Versions

Electrical Characteristics (Continued)

Specifications with standard type face are for $T_J = 25^\circ\text{C}$, and those with **boldface type** apply over full Operating Temperature Range. Unless otherwise specified, $V_{IN} = 12\text{V}$ for the 3.3V, 5V, and Adjustable version, $V_{IN} = 25\text{V}$ for the 12V version, and $V_{IN} = 30\text{V}$ for the 15V version, $I_{LOAD} = 500\text{mA}$.

Symbol	Parameter	Conditions	LM2575HV/LM2576HV /HM2676HV		Units (Limits)
			Typ	Limit (Note 2)	
ON/OFF CONTROL					
V_{IH}	$\overline{\text{ON/OFF}}$ Pin	$V_{OUT} = 0\text{V}$	1.4	2.2/2.4	V(Min)
V_{IL}	Logic Input Level	$V_{OUT} = \text{Nominal Output Voltage}$	1.2	1.0/0.8	V(Max)
I_{IH}	$\overline{\text{ON/OFF}}$ Pin Input Current	$\overline{\text{ON/OFF}}$ Pin = 5V (OFF)	12	30	μA $\mu\text{A}(\text{Max})$
I_{IL}		$\overline{\text{ON/OFF}}$ Pin = 0V (ON)	0	10	μA $\mu\text{A}(\text{Max})$

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).

Note 3: External components such as the catch diode, inductor, input and output capacitors can affect switching regulator system performance. When the LM2575HV/LM2576HV/HM2676HV 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.

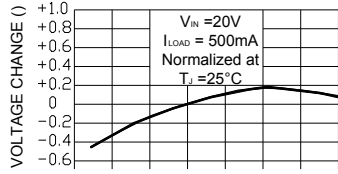
Note 5: Feedback pin removed from output and connected to 0V.

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

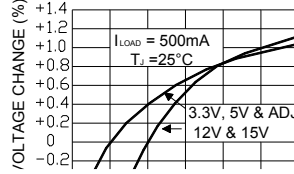
Note 7: $V_{IN} = 60\text{V}$.

Note 8: 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 protections feature lowers the average power dissipation of the IC by lowering the minimum duty cycle from 5% down to approximately 2%.

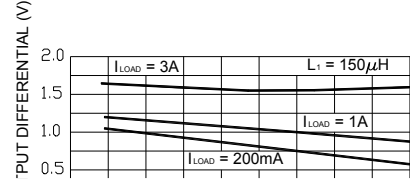
Normalized Output Voltage



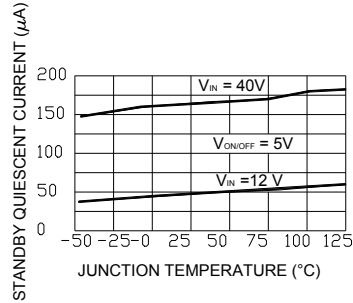
Line Regulation



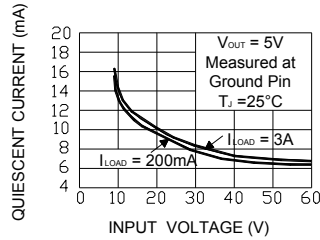
Dropout Voltage



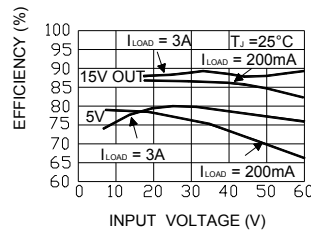
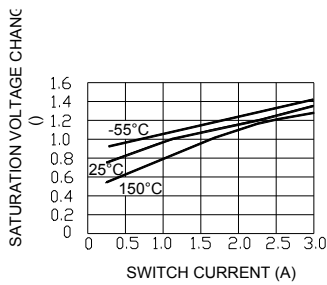
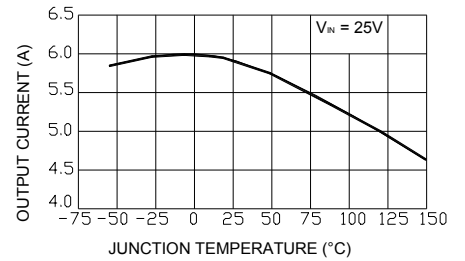
Standby Quiescent Current



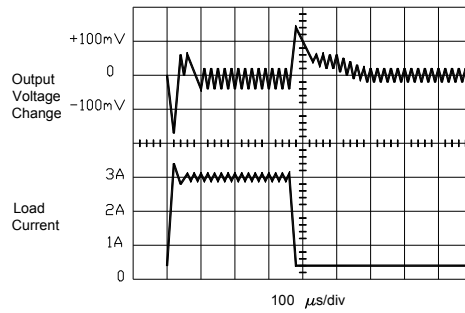
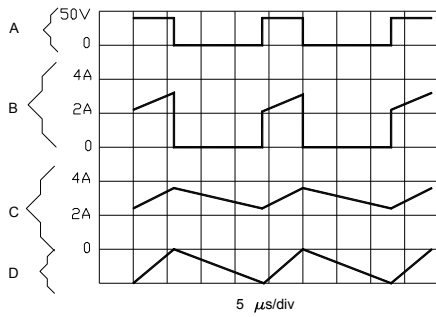
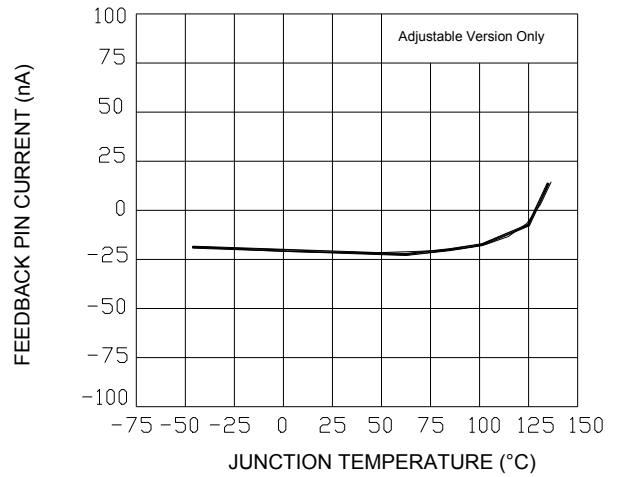
Quiescent Current



Current Limit



Feedback Pin Current



$V_{OUT} = 15V$

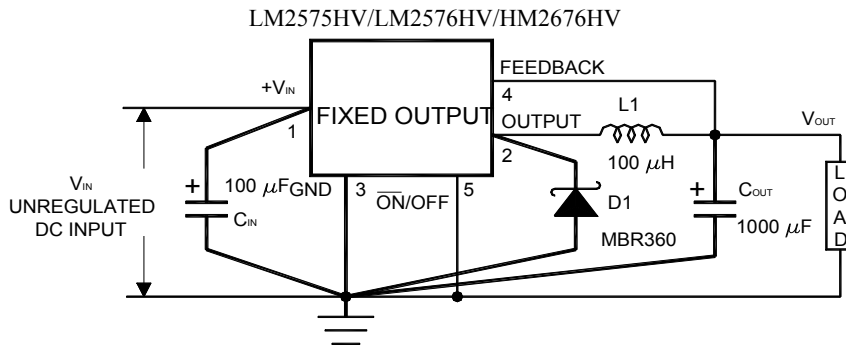
- A: Output Pin Voltage, 50V/div
 - B: Output Pin Current, 2A/div
 - C: Inductor Current, 2A/div
 - D: Output Ripple Voltage, 50mV/div,
- AC-Coupled
Horizontal Time Base: 5μs/div

Test Circuit and Layout Guidelines

As in any switching regulator, layout is very important. Rapidly 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.

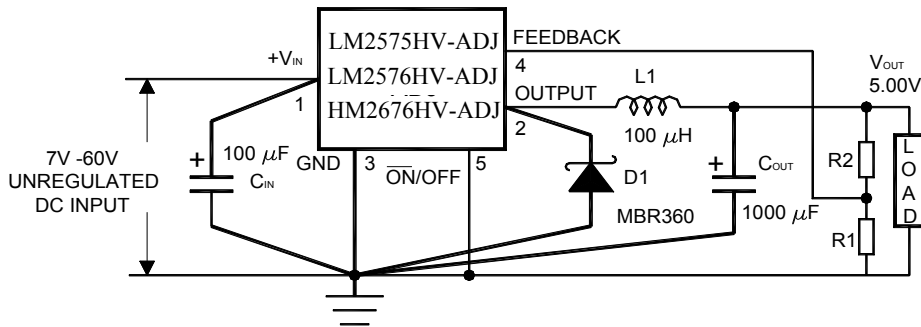
Single-point grounding (as indicated) or ground plane construction should be used for best results. When using the Adjustable version, physically locate the programming resistors near the regulator, to keep the sensitive feedback wiring short.

Fixed Output Voltage Versions



- C_{IN} — 100μF, 75V, Aluminum Electrolytic
- C_{OUT} — 1000μF, 25V, Aluminum Electrolytic
- D1 — Schottky, MBR360
- L₁ — 100μH, Pulse Eng. PE-92108
- R₁ — 2k, 0.1%
- R₂ — 6.12k, 0.1%

Adjustable Output Voltage Version



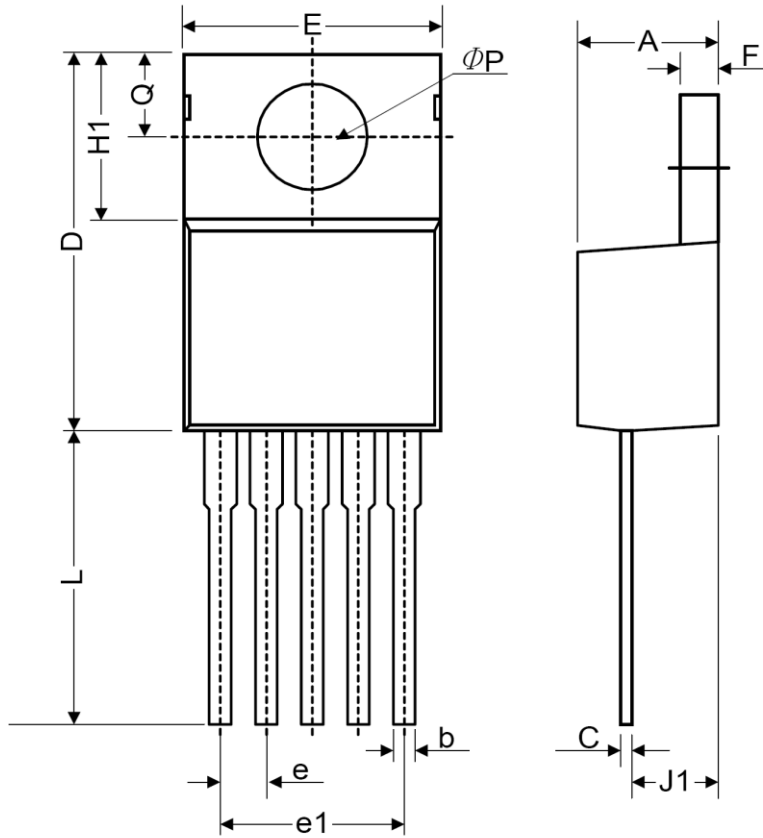
$$V_{OUT} = V_{REF} \left(1 + \frac{R_2}{R_1} \right)$$

$$R_2 = R_1 \left(\frac{V_{OUT}}{V_{REF}} - 1 \right)$$

where V_{REF} = 1.23V, R₁ between 1k and 5k

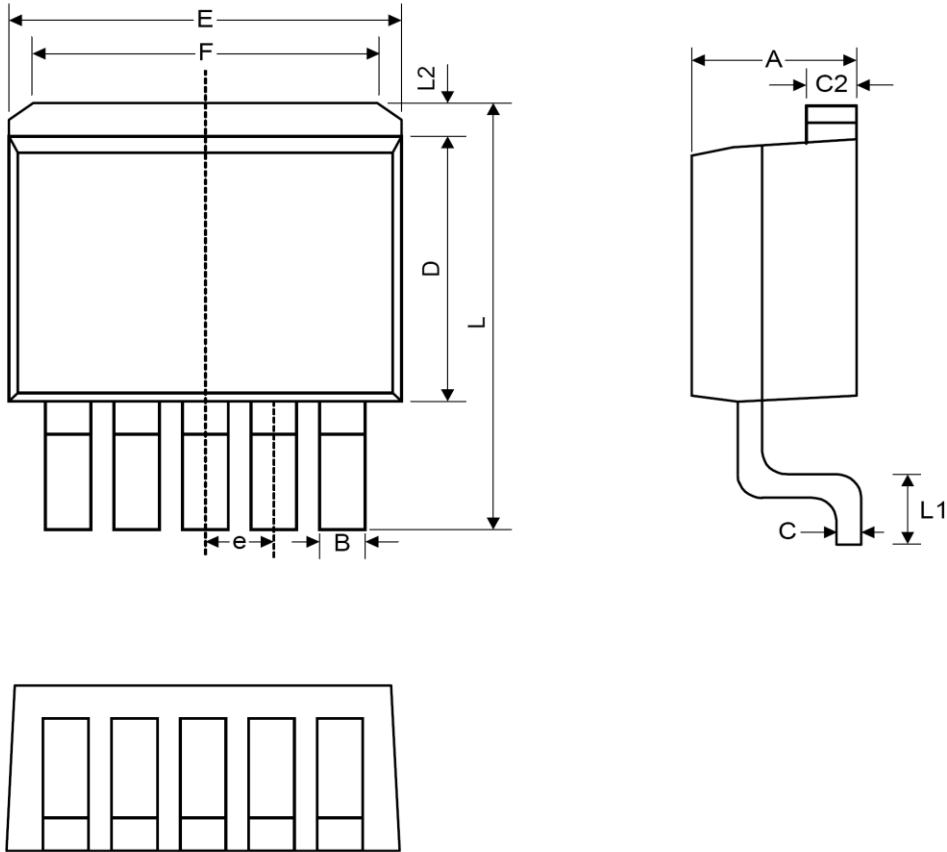
FIGURE 2.

TO-220-5L



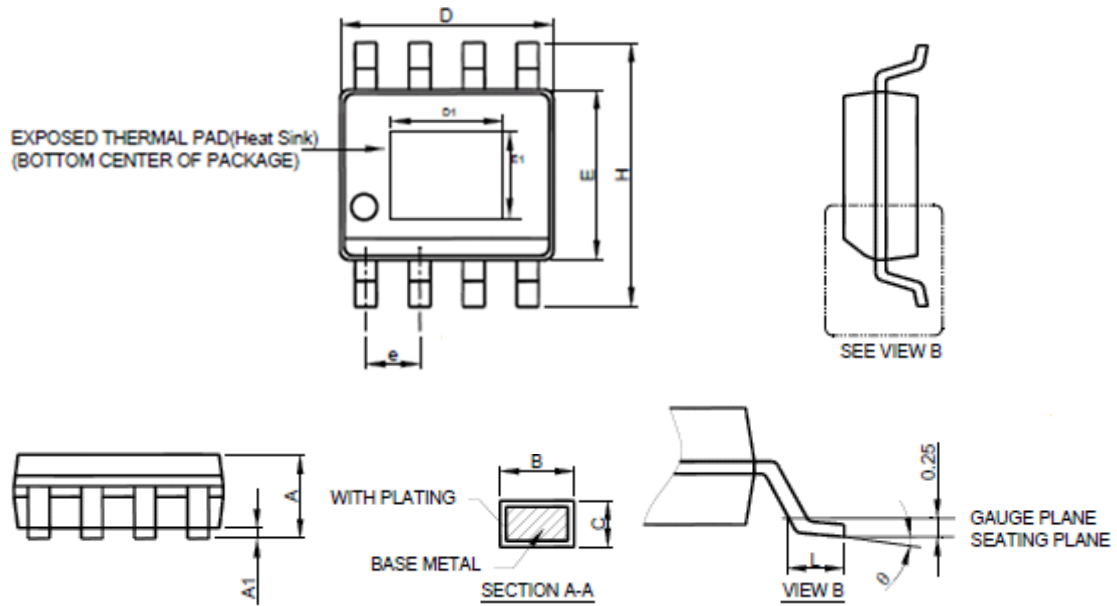
Symbol	Dimensions In Millimeters			Dimensions In Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	4.07	4.45	4.82	0.160	0.175	0.190
b	0.76	0.89	1.02	0.030	0.035	0.040
C	0.36	0.50	0.64	0.014	0.020	0.025
D	14.22	14.86	15.50	0.560	0.585	0.610
E	9.78	10.16	10.54	0.385	0.400	0.415
e	1.57	1.71	1.85	0.062	0.067	0.073
e1	6.68	6.81	6.93	0.263	0.268	0.273
F	1.14	1.27	1.40	0.045	0.050	0.055
H1	5.46	6.16	6.86	0.215	0.243	0.270
J1	2.29	2.74	3.18	0.090	0.108	0.125
L	13.21	13.97	14.73	0.520	0.550	0.580
ϕp	3.68	3.81	3.94	0.145	0.150	0.155
Q	2.54	2.73	2.92	0.100	0.107	0.115

TO-263-5L



Symbol	Dimensions In Millimeters			Dimensions In Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	4.07	4.46	4.85	0.160	0.176	0.191
B	0.66	0.84	1.02	0.026	0.033	0.040
C	0.36	0.50	0.64	0.014	0.020	0.025
C2	1.14	1.27	1.40	0.045	0.050	0.055
D	8.65	9.15	9.65	0.341	0.360	0.380
E	9.78	10.16	10.54	0.385	0.400	0.415
e	1.57	1.71	1.85	0.062	0.068	0.073
F	6.60	6.86	7.11	0.260	0.270	0.280
L	14.61	15.24	15.88	0.575	0.600	0.625
L1	2.29	2.54	2.79	0.090	0.100	0.110
L2	-	-	2.92	-	-	0.115

ESOP-8L



Symbol	Dimensions In Millimeters	
	Min	Max
A	1.35	1.75
A1	0.05	0.25
B	0.31	0.51
C	0.17	0.25
D	4.70	5.10
E	3.70	4.10
e	1.27BSC	
H	5.80	6.20
L	0.40	1.27
θ	0°	8°
D1	3.10REF	
E1	2.21REF	