

## 3A, 52kHz, Step-down Switching Regulator

### DESCRIPTION

The HT2576HV 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, 5.0V, 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 HT2576HV 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 HT2576HV 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 50uA (typical) standby current. The output switch includes cycle-by-cycle current limiting, as well as thermal shutdown for full protection under fault conditions.

### FEATURES

- Step-down Switching Regulator
- Adjustable Version Output Voltage Range, 1.23V to 50V  
 $\pm 4\%$  Max over Line and Load conditions
- Guaranteed Output Current of 3A
- Fixed Output Voltages : 3.3V, 5.0V, 12V and 15V
- Wide Input Voltage Range 60V
- 52 kHz Fixed Frequency Oscillator
- TTL Shutdown Capability, Low Power Standby Mode
- Requires only 4 External Components
- High Efficiency
- Use Readily Available Standard Inductors
- Available in TO-220, TO-263 and SOP-8PP Packages
- Thermal Shutdown and Current Limit Protection
- Moisture Sensitivity Level 3

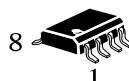
### APPLICATION

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


### ORDERING INFORMATION

Device	Operating Temperature Range	Package	Packing
HT2576HVS-xx	$T_A = -40^\circ$ to $125^\circ$ C for all packages	TO-263	Tape & Reel
HT2576HVT-xx		TO-220	Tube

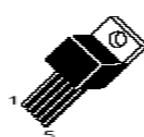
X.X = Output Voltage = 3.3, 5.0, 12, 15



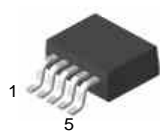
**ESOP8-8L**  
**HT2576HVE-XX**



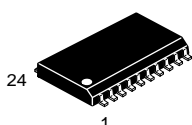
**SOP6L**  
**HT2576HVR-XX**



**TO-220-5L**  
**HT2576HVT-XX**



**TO-263-5L**  
**HT2576HVS-XX**



**WSOP24-24L**  
**HT2576HVM-XX**

$T_A = -40^\circ$  to  $125^\circ\text{C}$  for all packages

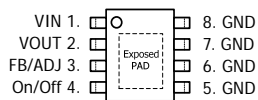
**Absolute Maximum Ratings** (Note 1)

CHARACTERISTIC	SYMBOL	MIN.	MAX.	UNIT
Input Supply Voltage	$V_{IN}$	-	52	V
ON/OFF Pin Input Voltage		-0.3	+ $V_{IN}$	V
Output Voltage to Ground (Steady State)		-0.75		V
Lead Temperature (Soldering, 5 sec)	$T_{SOL}$		260	°C
Storage Temperature Range	$T_{STG}$	-65	150	°C
Maximum Junction Temperature Range	$T_{JOPR}$	-	150	°C

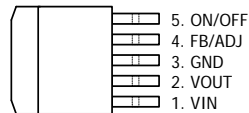
**Operating Ratings**

CHARACTERISTIC	SYMBOL	MIN.	MAX.	UNIT
Supply Voltage	$V_{IN}$	-	52	V
Temperature Range	$T_J$	-40	125	°C

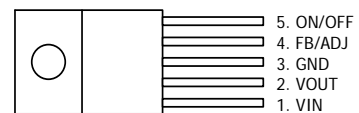
## PIN CONFIGURATION



ESOP8L/SOP6L



TO-263



TO-220

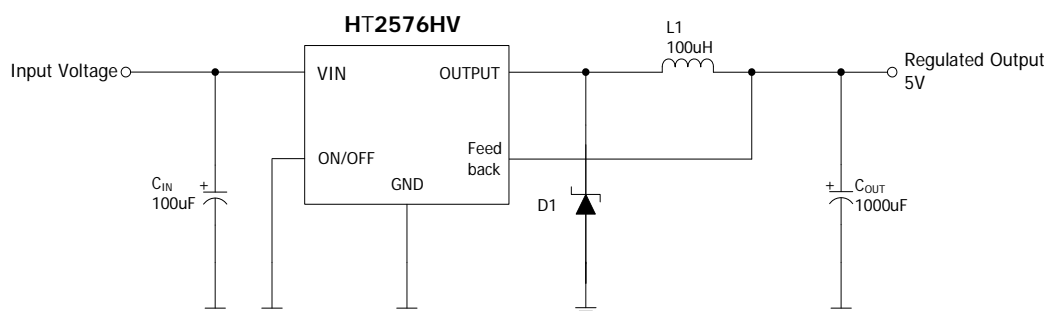
## PIN DESCRIPTION

Pin No.	TO-263 / TO-220 5 LEAD		ESOP8/SOP6L LEAD	
	Name	Function	Name	Function
1	VIN	Input Supply	VIN	Input Supply
2	VOUT	Output Voltage	VOUT	Output Voltage
3	GND	Ground	FB / ADJ	Output Voltage Feedback or Output Adjust
4	FB / ADJ	Output Voltage Feedback or Output Adjust	ON/OFF	ON/OFF Shutdown
5/ 6/ 7/ 8	ON/OFF	ON/OFF Shutdown	GND	Ground

\* Exposed Pad of ESOP8/SOP6L package should be externally connected to GND.

## TYPICAL APPLICATION

- Fixed Output Voltage Version



## 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,  $I_{LOAD} = 500\text{mA}$ .

PARAMETER	SYMBOL	TEST CONDITION <sup>(Note 2)</sup>		MIN.	TYP.	MAX.	UNIT
SYSTEM PARAMETERS <sup>(Note 3)</sup>							
Feedback Voltage	V <sub>FB</sub>	HT2576HV-ADJ	V <sub>IN</sub> =12V, I <sub>LOAD</sub> =0.5A	1.217	1.230	1.243	V
			0.5A ≤ I <sub>LOAD</sub> ≤ 3A , 8V ≤ V <sub>IN</sub> ≤ 55V	1.193 <b>1.180</b>	1.230	1.273 <b>1.286</b>	V
Output Voltage	V <sub>O</sub>	HT2576HV-3.3	V <sub>IN</sub> =12V, I <sub>LOAD</sub> =0.5A	3.234	3.300	3.366	V
			0.5A ≤ I <sub>LOAD</sub> ≤ 3A , 6V ≤ V <sub>IN</sub> ≤ 55V	3.168 <b>3.135</b>	3.300	3.450 <b>3.482</b>	V
		HT2576HV-5.0	V <sub>IN</sub> =12V, I <sub>LOAD</sub> =0.5A	4.900	5.000	5.100	V
			0.5A ≤ I <sub>LOAD</sub> ≤ 3A , 8V ≤ V <sub>IN</sub> ≤ 55V	4.800 <b>4.750</b>	5.000	5.225 <b>5.275</b>	V
		HT2576HV-12	V <sub>IN</sub> =25V, I <sub>LOAD</sub> =0.5A	11.76	12.00	12.24	V
			0.5A ≤ I <sub>LOAD</sub> ≤ 3A , 15V ≤ V <sub>IN</sub> ≤ 55V	11.52 <b>11.40</b>	12.00	12.54 <b>12.66</b>	V
		HT2576HV-15	V <sub>IN</sub> =25V, I <sub>LOAD</sub> =0.5A	14.70	15.00	15.30	V
			0.5A ≤ I <sub>LOAD</sub> ≤ 3A , 18V ≤ V <sub>IN</sub> ≤ 55V	14.40 <b>14.25</b>	15.00	15.68 <b>15.83</b>	V
Efficiency		HT2576HV-ADJ	V <sub>IN</sub> =12V, I <sub>LOAD</sub> =3A, V <sub>O</sub> = 5V		77		%
		HT2576HV-3.3	V <sub>IN</sub> =12V, I <sub>LOAD</sub> =3A		75		%
		HT2576HV-5.0	V <sub>IN</sub> =12V, I <sub>LOAD</sub> =3A		77		%
		HT2576HV-12	V <sub>IN</sub> =15V, I <sub>LOAD</sub> =3A		88		%
		HT2576HV-15	V <sub>IN</sub> =18V, I <sub>LOAD</sub> =3A		88		%
DEVICE PARAMETERS							
Feedback Bias Current	I <sub>b</sub>	V <sub>O</sub> = 5V (Adjustable Version Only)			50	100 <b>500</b>	nA
Oscillator Frequency	f <sub>O</sub>	(Note 8)		47 <b>42</b>	52	58 <b>63</b>	kHZ
Saturation Voltage	V <sub>SAT</sub>	I <sub>O</sub> = 3A (Note 4)			1.4	1.55 <b>1.70</b>	V
Max Duty Cycle(ON)	DC	(Note 5)		93	98		%
Current Limit	I <sub>CL</sub>	(Note 4, 8)		4.2 <b>3.5</b>	5.8	6.9 <b>7.5</b>	A

(Continued)

PARAMETER	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Leakage Current	$I_L$	(Notes 6, 7) Output=0V			7.5		mA
Quiescent Current	$I_Q$	(Note 6)			5	10	mA
Standby Quiescent Current	$I_{STBY}$	ON/OFF Pin = 5V (OFF)	$V_{IN} = 60V$		50	200	uA
<b><math>\overline{ON/OFF}</math> CONTROL</b>							
$\overline{ON/OFF}$ Pin Logic Input Level	$V_{IH}$	$V_O = 0V$		2.2 <b>2.4</b>	1.4		V
	$V_{IL}$	$V_O = \text{Nominal Output Voltage}$			1.2	1.0 <b>0.8</b>	V
$\overline{ON/OFF}$ Pin Input Current	$I_{IH}$	$\overline{ON/OFF}$ Pin = 5V (OFF)			12	30	uA
	$I_{IL}$	$\overline{ON/OFF}$ Pin = 0V (ON)			0	10	uA

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. 50V or above, it is recommended to add a resistor at the input end.

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 HT2576HV 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.

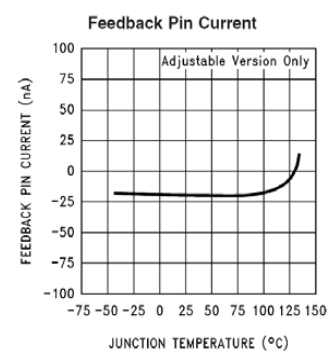
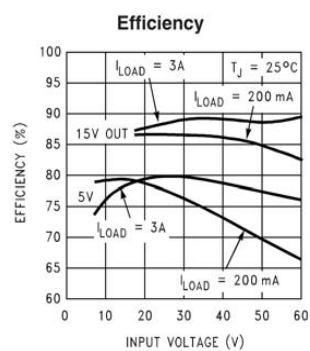
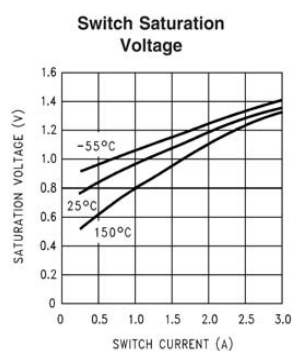
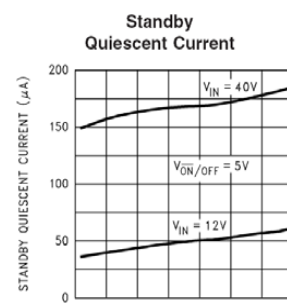
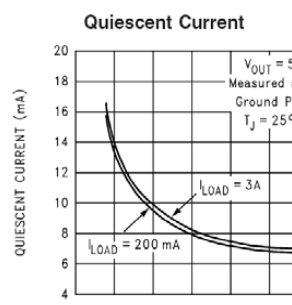
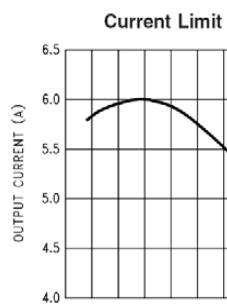
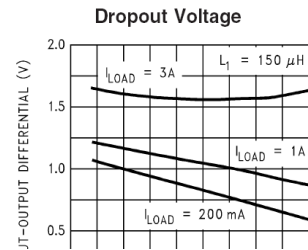
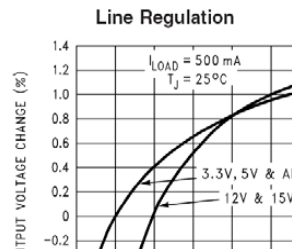
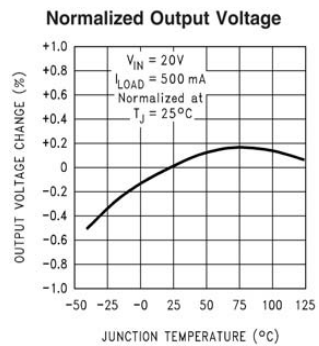
Note 5. Feedback pin removed from output and connected to 0V.

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.  $V_{IN} = 60V$ .

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%.

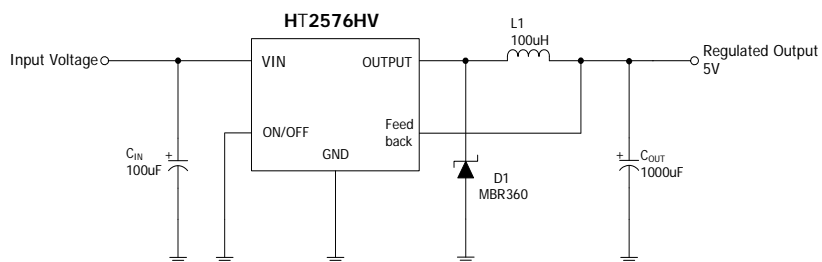
## TYPICAL OPERATING CHARACTERISTIC



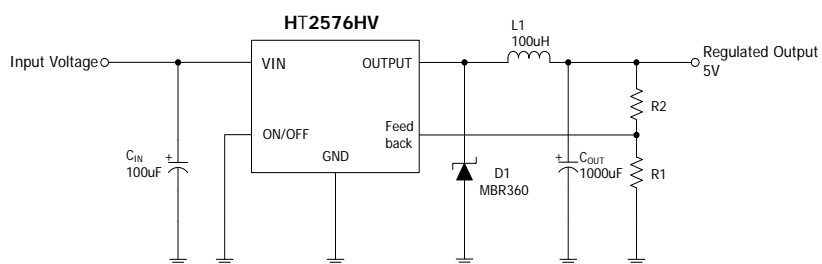
## APPLICATION INFORMATION

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 Version



### - Adjustable Output Voltage Version



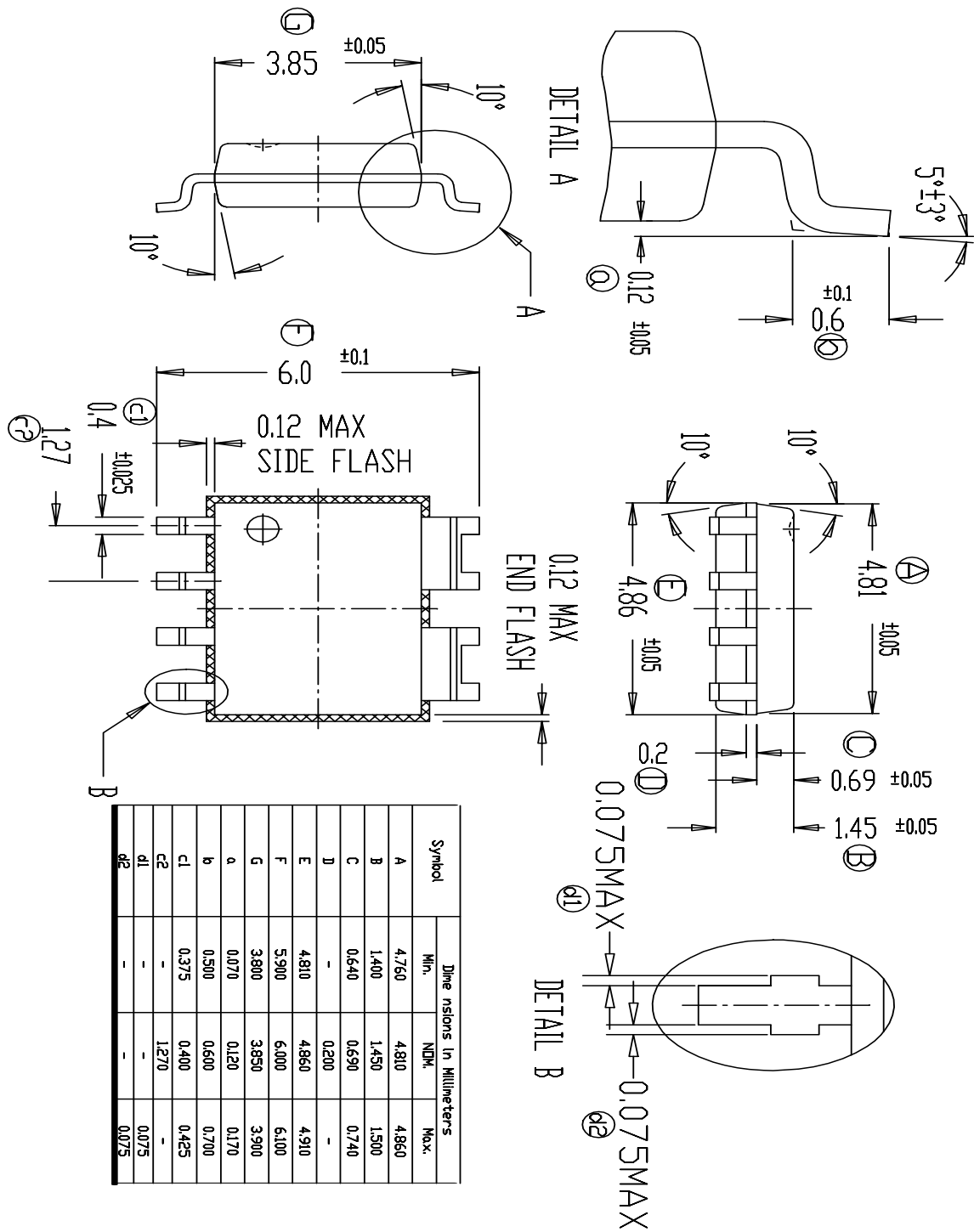
$$* V_{OUT} = V_{REF} \left(1 + \frac{R2}{R1}\right)$$

$$* R2 = R1 \left(\frac{V_{OUT}}{V_{REF}} - 1\right)$$

where  $V_{REF} = 1.23V$ ,  $R1$  between  $1K\Omega$  and  $5K\Omega$ .

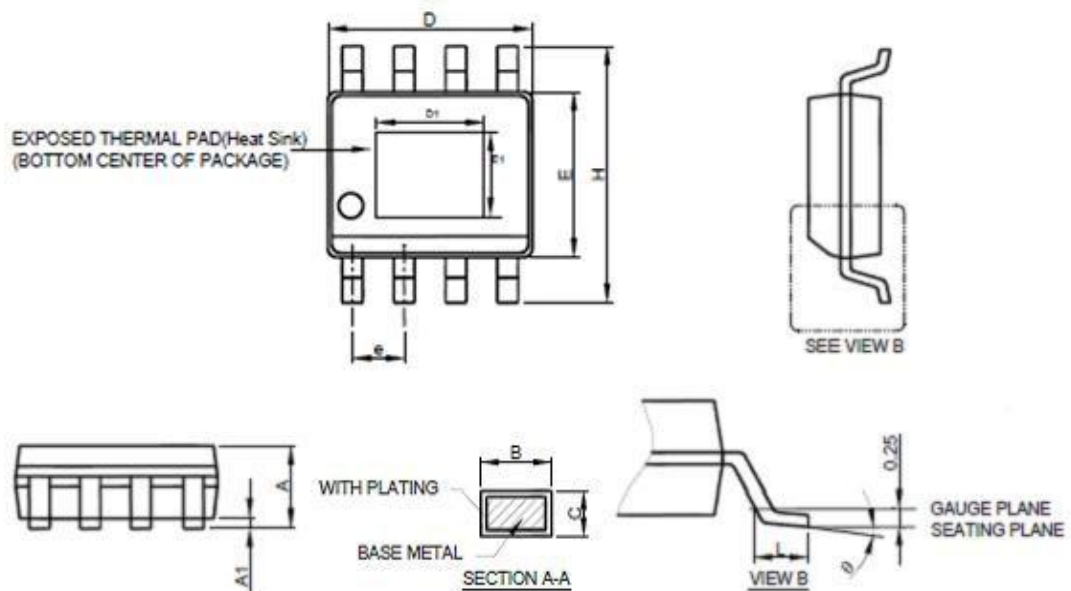
- $C_{IN}$  : 100uF, 75V, Aluminum Electrolytic
- $C_{OUT}$  : 1000uF, 25V, Aluminum Electrolytic
- D1 - Schottky, MBR360
- L1 : 100uH, Pulse Eng. PE-92108
- R1 : 2K, 0.1%
- R2 : 6.12K, 0.1%

SOP6L



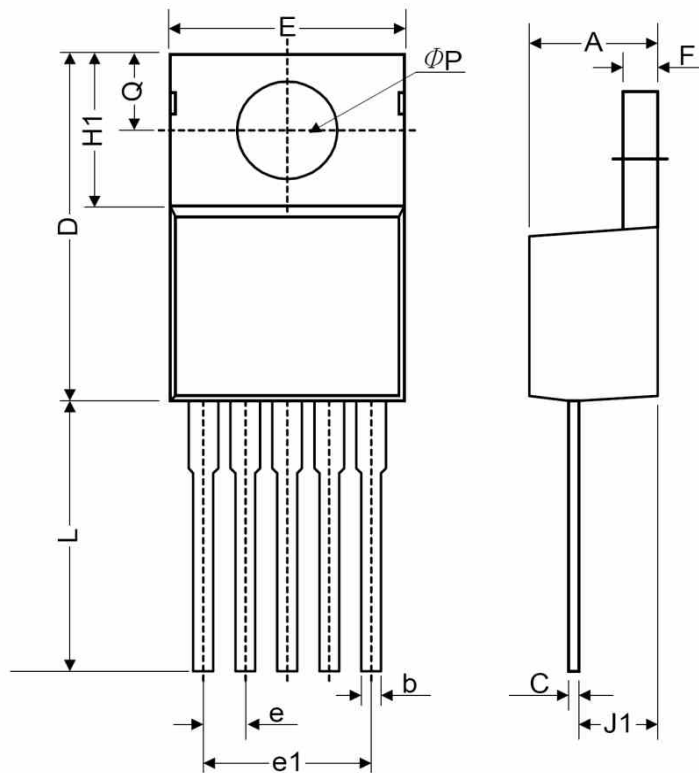


## ESOP8L



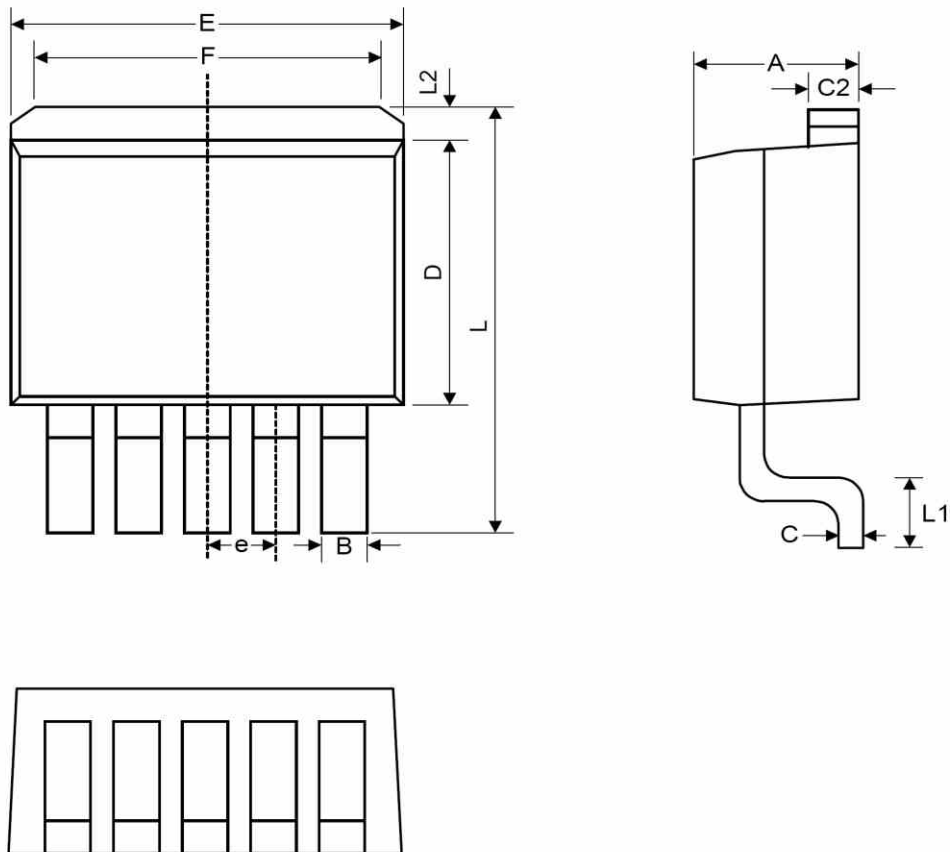
Symbol	Dimensions In Millimeters	
	Min	Max
A	1.35	1.75
A1	0.05	0.25
B	0.31	0.51
C	0.17	0.25
D	4.70	5.10
E	3.70	4.10
e	1.27BSC	
H	5.80	6.20
L	0.40	1.27
$\theta$	0°	8°
D1	3.10REF	
E1	2.21REF	

## TO220-5L



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
$\phi p$	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