

GENERAL DESCRIPTION

The LM2596HV/HM1509HV series of regulators are monolithic integrated circuits that provide all the active functions for a step-down (buck) switching regulator, capable of driving a 3A load with excellent line and load regulation. These devices are available in fixed output voltages of 3.3V, 5V, 12V, and an adjustable output version.

Available in a standard 5-lead TO-220 package, 5-lead TO-263 surface mount package and ESOP-8L package.

External shutdown is included, featuring typically 30 μ A standby current. The output switch includes cycle-by-cycle current limiting, as well as thermal shutdown, and protection from output short for full protection under fault conditions.

FEATURES

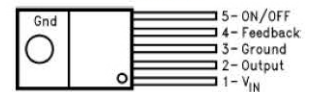
- 3.3V, 5V, 12V, and adjustable output versions
- Adjustable version output voltage range, 1.2V to 57V
- $\pm 4\%$ maximum over line and load conditions
- Available in TO-220 and TO-263 packages and ESOP-8L (for $I_{load} < 3A$)
- Guaranteed 3A output load current
- Input voltage range up to 60V
- Requires only 4 external components
- Excellent line and load regulation specifications
- 150 kHz fixed frequency internal oscillator
- Low power standby mode, I_{stb} typically 30 μ A
- High efficiency
- Thermal shutdown and current limit protection
- Output short protection by reduction of frequency by 3 times.

APPLICATIONS

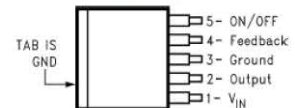
- Simple high-efficiency step-down (buck) regulator
- On-card switching regulators
- Efficient pre-regulator for linear regulators

PIN CONFIGURATION

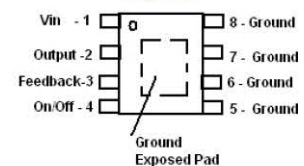
Straight Leads
5-Lead TO-220
Top View



TO-263
5-Lead Surface-Mount Package
Top View



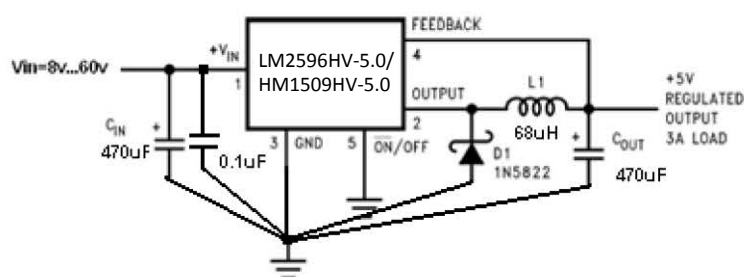
ESOP-8L
Top View



PIN ASSIGNMENT

Pin	ESOP-8L(for $I_{load} < 3A$)	Pin	TO-220, TO-263
1	Vin	1	Vin
2	Output	2	Output
3	FB	3	Gnd
4	On/Off	4	FB
5 to 8	Gnd	5	On/Off

Typical Application (Fixed Output Voltage Versions)



ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Ratings	Unit
Maximum supply voltage	V_{IN}	63	V
ON/OFF Pin input voltage	$V_{ON/OFF}$	-0.3 to 60, $\leq V_{IN}$	V
FB (Feedback) pin voltage	V_{FB}	-0.3 to 25, $\leq V_{IN}$	V
Output voltage to GND	V_{OUT}	-1	V
Power dissipation	P_D	Internally limited	W
Minimum ESD rating HBM (C=100pF, R=1.5k)	ESD	2.0	kV
Maximum junction temperature	$T_{J,max}$	150°C	°C

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Ratings	Unit
Temperature range	T_J	-40°C $\leq T_J \leq$ +125°C	°C
Supply voltage	V_{op}	4.5 to 60	V
I_{LOAD}	I_{LOAD}	$I_{LOAD} \leq 3.0$	A

ELECTRICAL CHARACTERISTICS

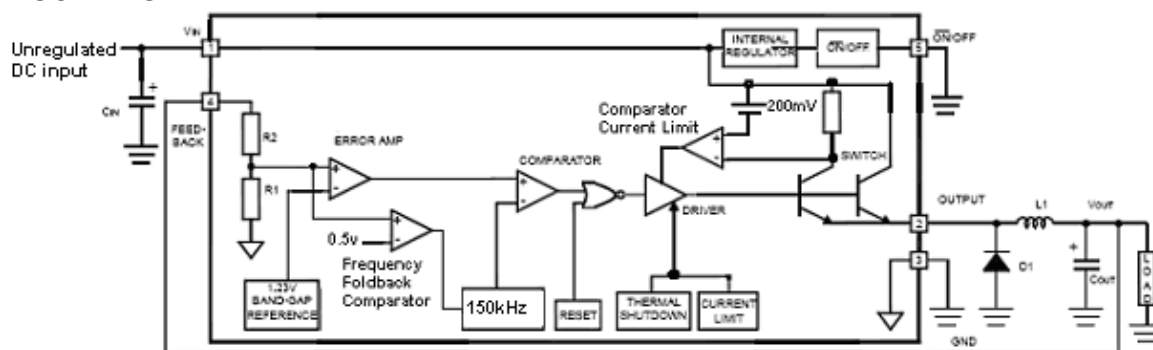
Unless specified otherwise, $V_{IN}=12V$ for the 3.3V, 5V and adjustable versions, $I_{LOAD}=0.5A$, $V_{IN}=18V$ for 12V version.

The * denotes the specifications, which apply over full operating temperature range $T_J = -40$ to $+125^\circ\text{C}$.

Parameter	Symbol	Conditions	*	Min	Typ	Max	Unit	
SYSTEM PARAMETERS Test Circuit Figure 1								
Output voltage	LM2596HV-3.3 HM1509HV-3.3	V_{OUT} $5.5V \leq V_{IN} \leq 60V, 0.2A \leq I_{LOAD} \leq 3A$		3.185	3.300	3.432	V	
			*	3.152		3.465		
	LM2596HV-5.0 HM1509HV-5.0	$8V \leq V_{IN} \leq 60V, 0.2A \leq I_{LOAD} \leq 3A$		4.825	5.00	5.20	V	
			*	4.775		5.25		
	LM2596HV-12 HM1509HV-12	$15V \leq V_{IN} \leq 60V, 0.2A \leq I_{LOAD} \leq 3A$		11.58	12.00	12.48	V	
			*	11.46		12.60		
	LM2596HV-adj HM1509HV-adj	$8V \leq V_{IN} \leq 60V, 0.2A \leq I_{LOAD} \leq 3A$		1.193	1.230	1.273	V	
			*	1.180		1.285		
Line Regulation		Line Reg	$8 \leq V_{IN} \leq 60V, I_{LOAD} = 0.2A$			0.3	%	
Load Regulation		Load Reg	$10mA \leq I_{LOAD} \leq 3A, V_{IN} = 12V$			0.3		
Efficiency	LM2596HV-3.3 HM1509HV-3.3	η $V_{IN}=12V, I_{LOAD}=3A$			77		%	
					79			
	LM2596HV-5.0 HM1509HV-5.0	$V_{IN}=12V, I_{LOAD}=3A$			83			
			LM2596HV-12 HM1509HV-12	$V_{IN}=15V I_{LOAD}=3A$				79
LM2596HV-adj HM1509HV-adj	$V_{IN}=12V, I_{LOAD}=3A V_{OUT}=5V$							
DEVICE PARAMETERS								
Quiescent current		I_Q	$V_{FB}=12V$ force driver off			5	8	mA
Feedback bias current		I_{FB}	$V_{FB}=1.3V$ (Adjustable version only)		-250	-70		nA
				*	-450			
Shutdown supply current		I_{STB}	$V_{ON/OFF}=5V, V_{IN}=60V$			30	220	μA
				*			280	
Oscillator frequency		F_{OSC}			133	150	168	kHz
				*	120		180	
Oscillator frequency of Short Circuit Protect (SCP)		F_{SCP}	When $V_{OUT}<40\%$ from nominal, $I_{OUT}= CL$			50		kHz
Max. duty cycle		$DC_{(Max)}$	$V_{FB}=0V$ force driver on		*	100		%
Min. duty cycle		$DC_{(Min)}$	$V_{FB}=12V$ force driver off ($V_{FB}=15V$ for -12V version)		*		0	

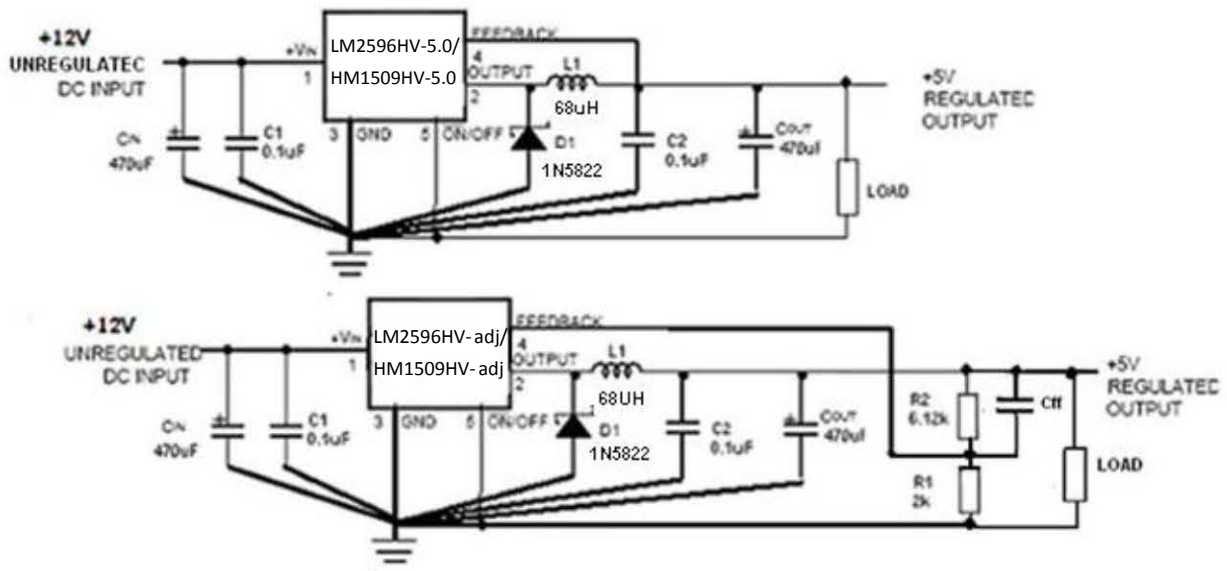
Current limit	CL	Peak current. No outside circuit. $V_{FB}=0V$		4.1	5.3	6.7	A
			*	3.8		7.0	
Saturation voltage	V_{SAT}	$I_{OUT}=3A$. No outside circuit. $V_{FB}=0V$			1.35	1.50	V
			*			1.70	
Output leakage current	I_L	$V_{OUT}=0V$. No outside circuit. $V_{FB}=12V$		-300	-50		μA
Output leakage current	I_{L1}	$V_{OUT}=-1V$. No outside circuit. $V_{FB}=12V$		-30	-3		mA
ON/OFF input threshold	V_{TH}		*	0.6	1.3	2.0	V
ON/OFF input current	I_H	$V_{ON/OFF}=2.5V$		-5	-0.1	5	μA
ON/OFF input current	I_L	$V_{ON/OFF}=0.5V$		-1	-0.01	1	μA
Thermal shutdown temperature	T_{SD}	T_J			160		$^{\circ}C$

BLOCK DIAGRAM



For ADJ Version
R1 = Open, R2 = 0 Ω

TEST CIRCUIT AND LAYOUT GUIDELINES



$V_{out} = V_{ref} \cdot (1 + R_2/R_1)$, where $V_{ref} = 1.23V$; R_1 between 1k and 5k.

FIGURE 1.

For minimal inductance and ground loops, the wires indicated by **heavy lines** should be wide printed circuit traces and **kept as short as possible**. Keep the FEEDBACK wiring away from the inductor flux.

$C_{ff} \sim 1$ to 10nF – as option.

TYPICAL CHARACTERISTICS

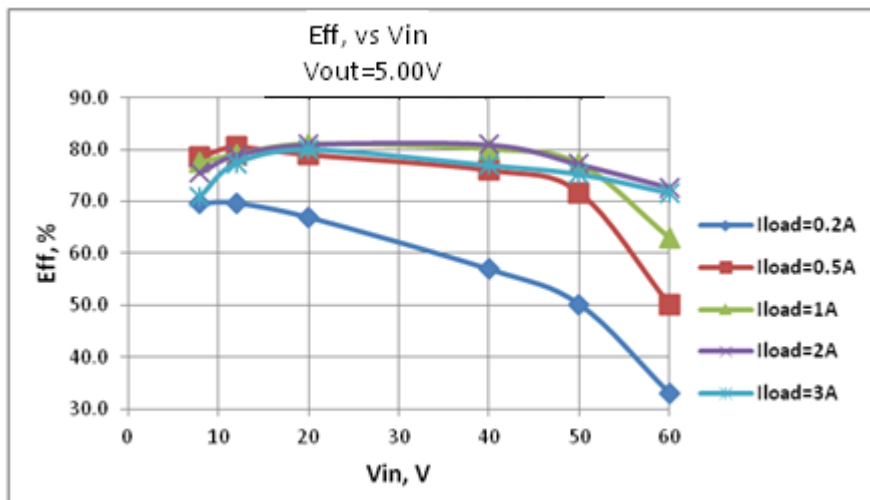


Fig.1. Eff, vs Vin

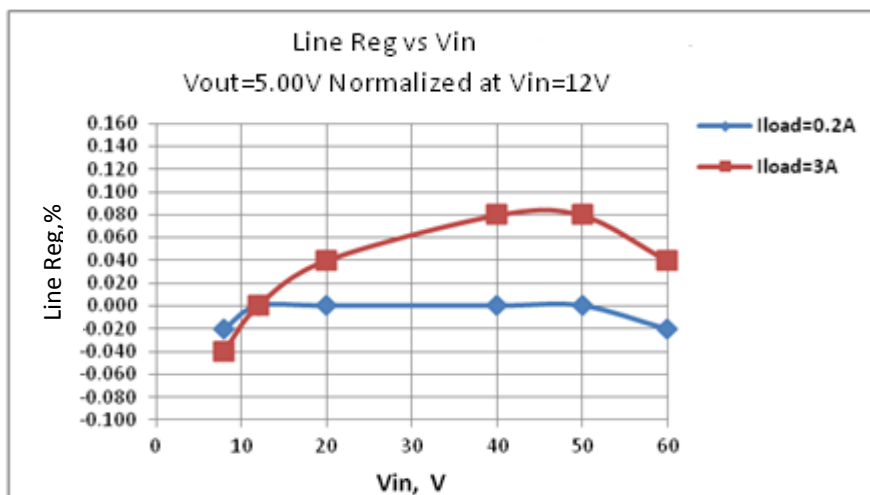


Fig.2. Line Reg vs Vin

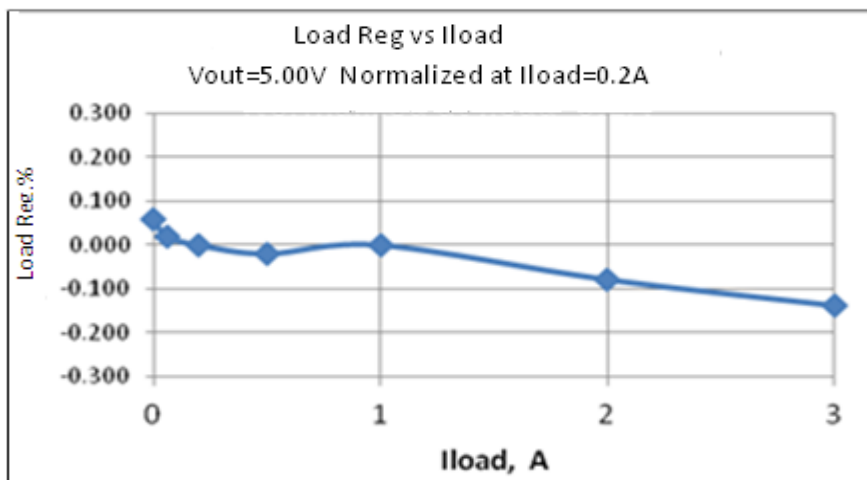


Fig.3. Load Reg vs Iload

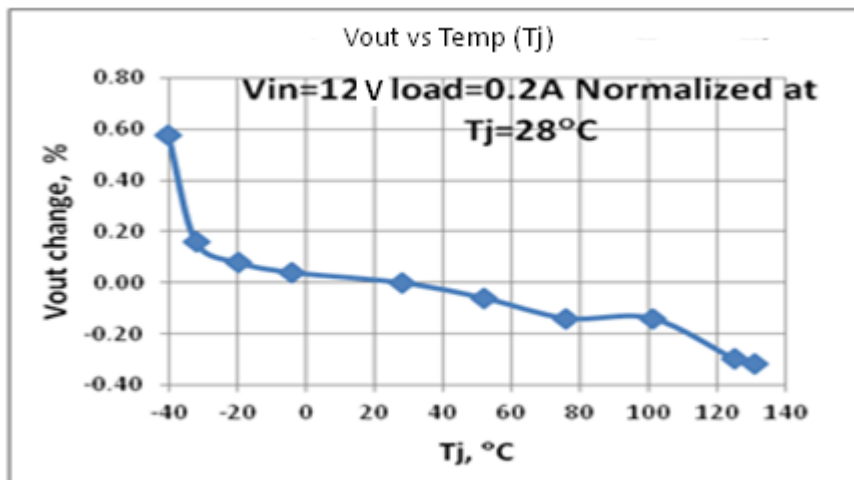


Fig.4. Vout vs Temp (Tj)

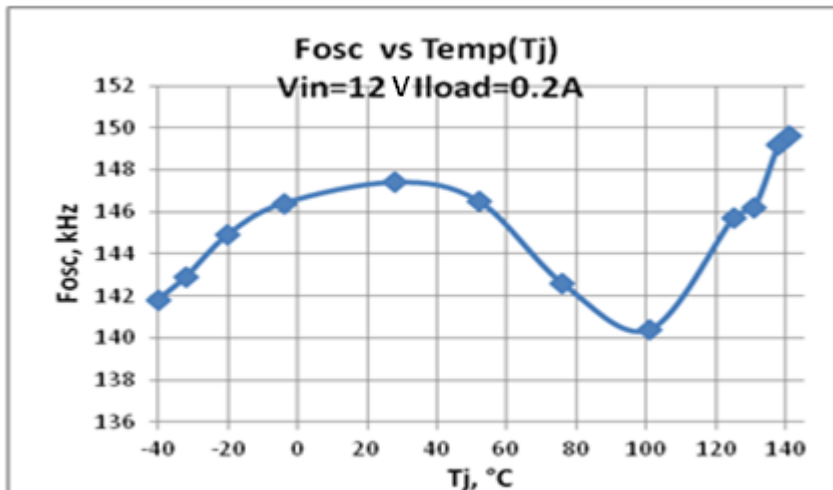


Fig.5. Fosc vs Temp (Tj)

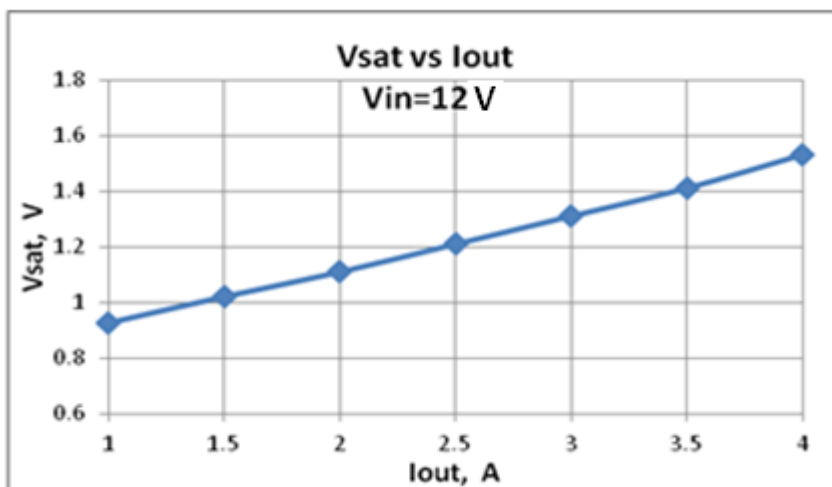


Fig.6. Vsat vs Iout

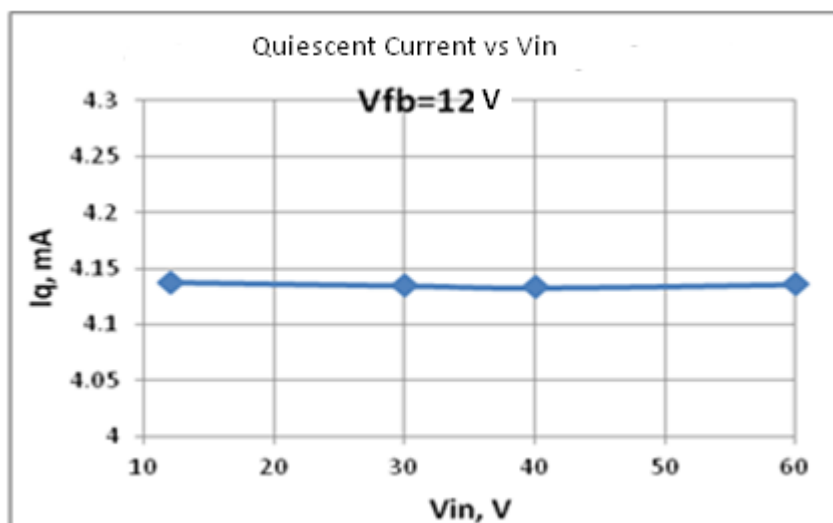


Fig.7. Quiescent Current vs Vin

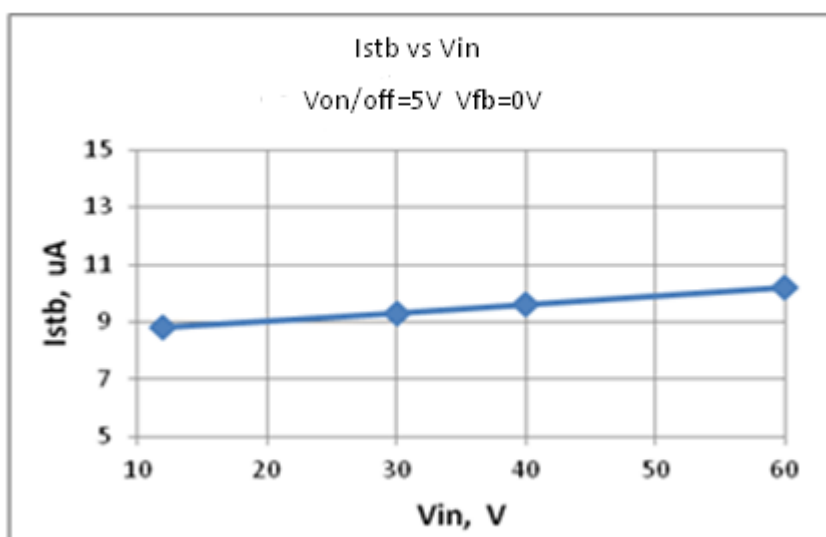
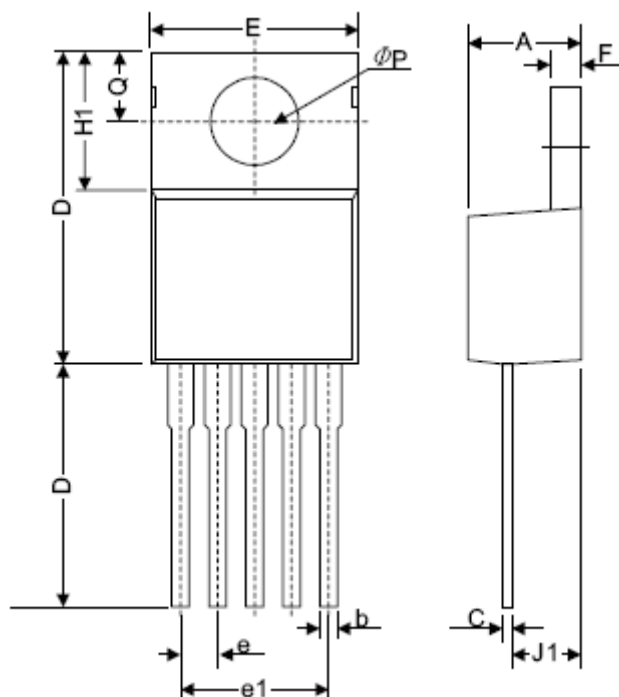


Fig.8. Istb vs Vin

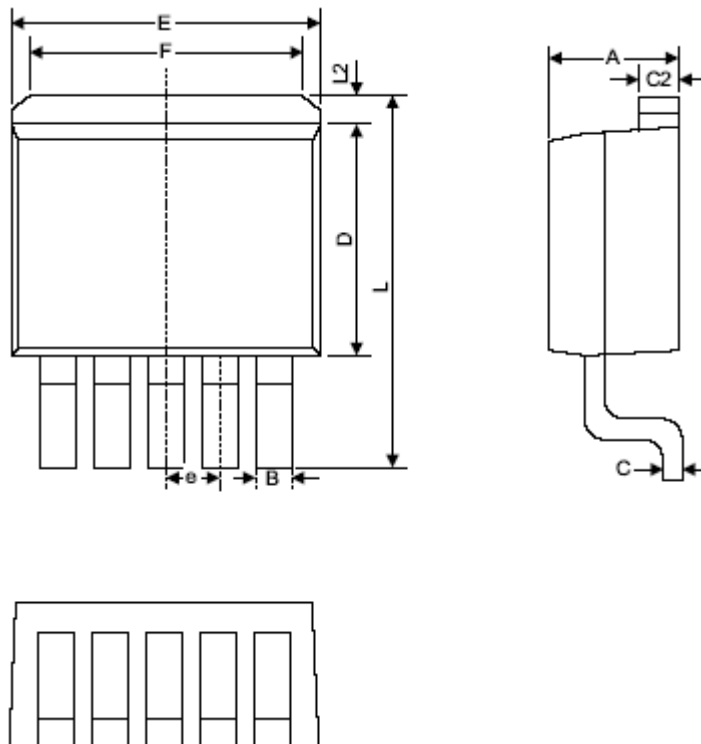
Package Information

TO-220-5L



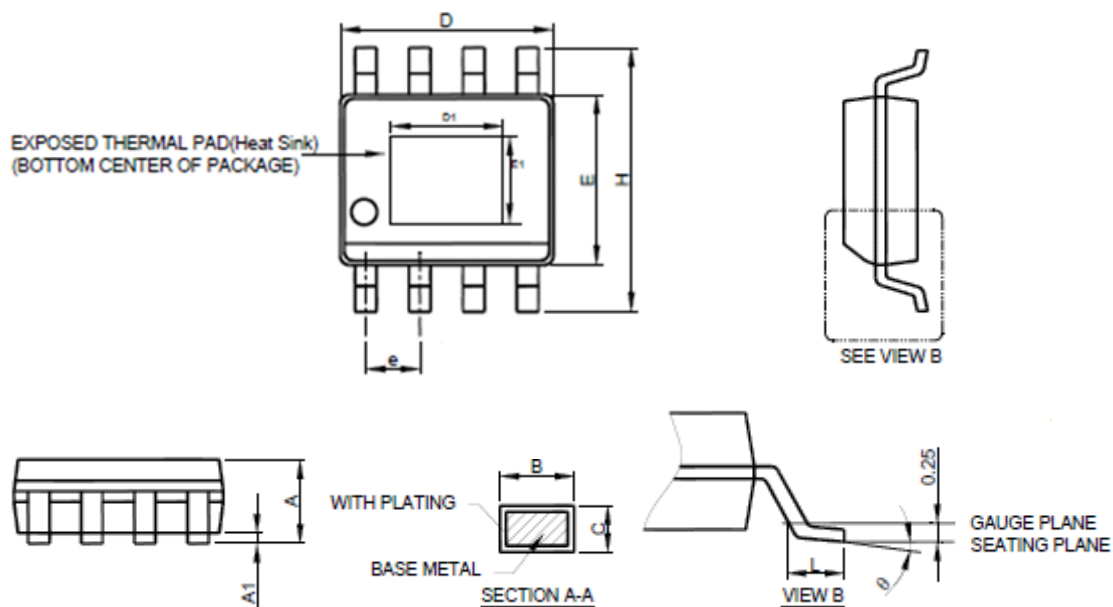
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.06	4.83	0.160	0.190
b	0.76	1.02	0.030	0.040
C	0.36	0.64	0.014	0.025
D	14.22	15.49	0.560	0.610
E	9.78	10.54	0.385	0.415
e	1.57	1.85	0.062	0.073
e(1)	6.68	6.93	0.263	0.273
F	1.14	1.40	0.045	0.055
H(1)	5.46	6.86	0.215	0.270
J(1)	2.29	3.18	0.090	0.125
L	13.21	14.73	0.520	0.580
ϕP	3.68	3.94	0.145	0.155
Q	2.54	2.92	0.100	0.115

TO-263-5L



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	4.440	4.650	0.175	0.183
B	0.710	0.970	0.028	0.038
C	0.360	0.640	0.014	0.025
C2	1.255	1.285	0.049	0.051
D	8.390	8.890	0.330	0.350
E	9.960	10.360	0.392	0.408
e	1.550	1.850	0.061	0.073
F	6.360	7.360	0.250	0.290
L	13.950	14.750	0.549	0.581
L2	1.120	1.420	0.044	0.056

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	