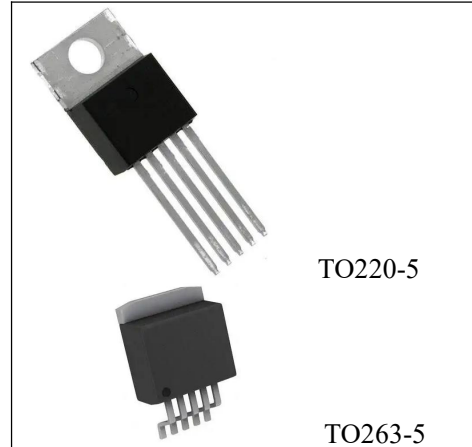


150kHz 3A Step-Down Voltage Regulator

Features

- 3.3V, 5V, 12V and Adjustable Output Versions
- High Efficiency
- Wide Input Voltage Range up to 40V
- Guaranteed 3A Output Current
- Requires only 4 External Components
- 150 kHz 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 37V $\pm 4\%$ Max Over Line and Load Conditions



Package Information

Part NO.	Order NO	Package Description	Package Marking	Package Option
LM2596S-3.3	LM2596S-3.3	TO220-5	LM2596S	50/Tube
LM2596S-3.3	LM2596S-3.3	TO263-5	LM2596S	50/Tube 800/Reel
LM2596S-5.0	LM2596S-5.0	TO220-5	LM2596S	50/Tube
LM2596S-5.0	LM2596S-5.0	TO263-5	LM2596S	50/Tube 800/Reel
LM2596S-12	LM2596S-12	TO220-5	LM2596S	50/Tube
LM2596S-12	LM2596S-12	TO263-5	LM2596S	50/Tube 800/Reel
LM2596S-ADJ	LM2596S-ADJ	TO220-5	LM2596S	50/Tube
LM2596S-ADJ	LM2596S-ADJ	TO263-5	LM2596S	50/Tube 800/Reel

Applications

- Simple High-Efficiency Step-Down (Buck) Regulator
- Efficient Pre-Regulator for Linear Regulators
- On-Card Switching Regulators
- Positive to Negative Converter (Buck-Boost)

3.3V, $R2 = 1.7\text{ k}$
 5V, $R2 = 3.1\text{ k}$
 12V, $R2 = 8.84\text{ k}$
 ADJ, $R2 = 0\Omega$
 $R1 = \text{OPEN}$

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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 (+V _{IN} V _{SAT}) 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}	45	V
$\overline{ON} / OFF$ Pin Input Voltage	$\overline{ON} / OFF$	$-0.3V \leq V \leq +V_{IN}$	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}	6~40	V
Operating temperature range	T _{opr}	-40~+125	°C

Electrical Characteristics

(Unless otherwise specified: $T_J = 25^{\circ}\text{C}$)

Parameter Name	Symbol	Test Conditions	Min	Typ	Max	Units
Device Parameters						
Feedback Bias Current	I_b	Adjustable version only, $V_{OUT}=5V$		50	100	nA
Oscillator Frequency	f_o		127	150	173	kHz
V_{SAT} 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)	3.6	4.5	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}	$\overline{ON} / OFF$ 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}	$\overline{ON} / OFF$ pin=5V(OFF)		12	30	μA
	I_{IL}	$\overline{ON} / OFF$ pin=0V(ON)		0	10	μA

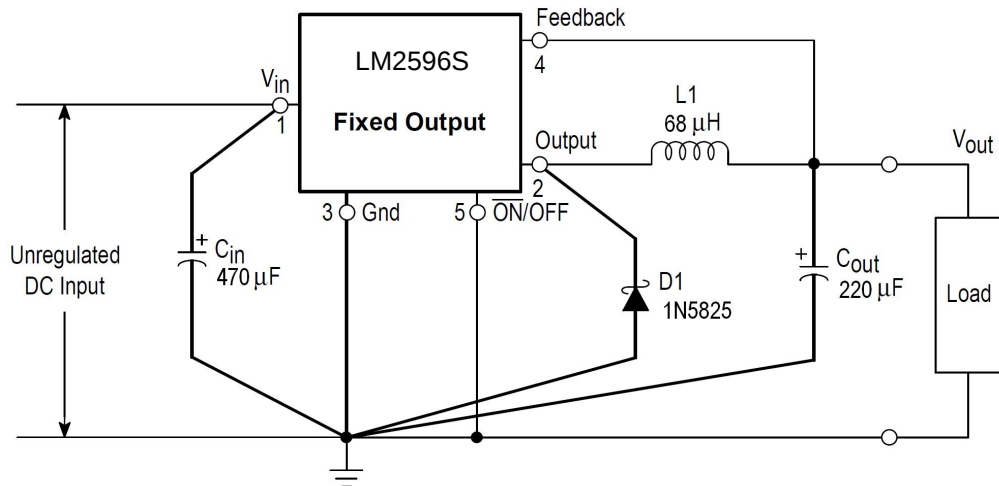
Note 1: The oscillator frequency reduces to approximately 11 kHz in the event of an output short or an overload which causes the regulated output voltage to drop approximately 40% from the nominal output voltage. This self protection feature lowers the average power dissipation of the IC by lowering the minimum duty cycle from 5% down to approximately 2%.

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

Parameter Name	Symbol	Test Conditions	Min	Typ	Max	Units
LM2596S-3.3						
Output Voltage	V_{OUT}	$V_{IN}=12V, I_O=500mA$	3.234	3.3	3.366	V
		$6V \leq V_{IN} \leq 40V$ $0.5A \leq I_{LOAD} \leq 3A$	3.168	3.3	3.450	V
Efficiency	η	$V_{IN}=12V, I_{LOAD}=3A$		73		%
LM2596S-5.0						
Output Voltage	V_{OUT}	$V_{IN}=12V, I_O=500mA$	4.90	5.00	5.10	V
		$8V \leq V_{IN} \leq 40V$ $0.5A \leq I_{LOAD} \leq 3A$	4.80	5.00	5.20	V
Efficiency	η	$V_{IN}=12V, I_{LOAD}=3A$		77		%
LM2596S-12						
Output Voltage	V_{OUT}	$V_{IN}=25V, I_O=500mA$	11.76	12.000	12.24	V
		$15V \leq V_{IN} \leq 40V$ $0.5A \leq I_{LOAD} \leq 3A$	11.52	12.00	12.48	V
Efficiency	η	$V_{IN}=25V, I_{LOAD}=3A$		88		%
LM2596S-ADJ						
Output Voltage	V_{OUT}	$V_{IN}=12V, I_O=500mA,$ $V_{OUT}=5V$	1.217	1.230	1.243	V
		$8V \leq V_{IN} \leq 40V, V_{OUT}=5V$ $0.5A \leq I_{LOAD} \leq 3A$	1.193	1.230	1.267	V
Efficiency	η	$V_{IN}=12V, I_{LOAD}=3A,$ $V_{OUT}=5V$		77		%

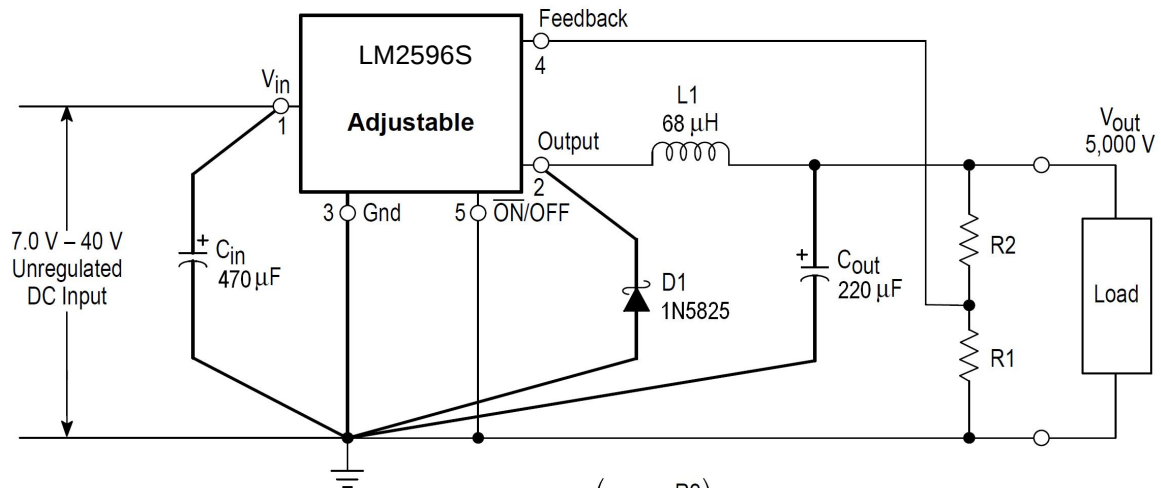
Test Circuit

Fixed Output Voltage Versions



- C_{in} - 470 µF, 75 V, Aluminium Electrolytic
- C_{out} - 220 µF, 25 V, Aluminium Electrolytic
- D1 - Schottky, 1N5825
- L1 - 68 µH, L38
- R1 - 2.0 k, 0.1%
- R2 - 6.12 k, 0.1%

Adjustable Output Voltage Versions

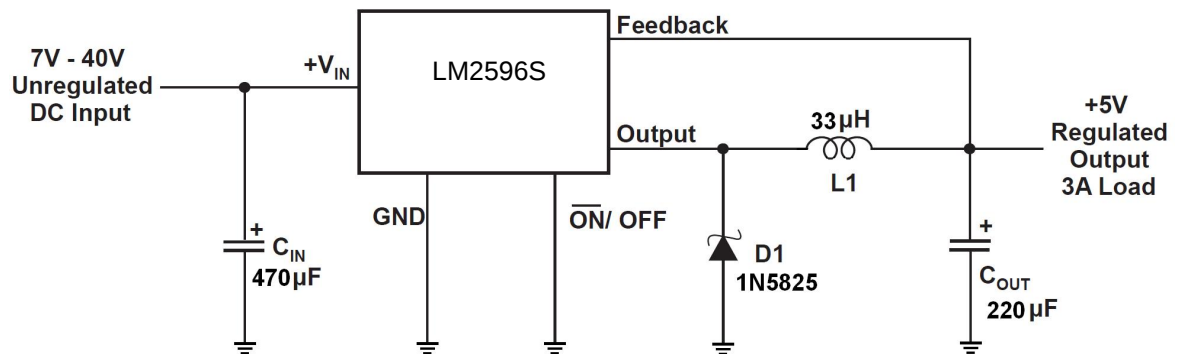


$$V_{out} = V_{ref} \left(1.0 + \frac{R2}{R1} \right)$$

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

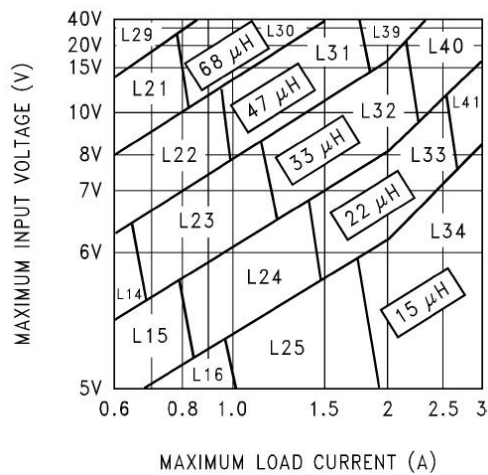
Where $V_{ref} = 1.23$ V, R1
between 1.0 k and 5.0 k

Typical Application

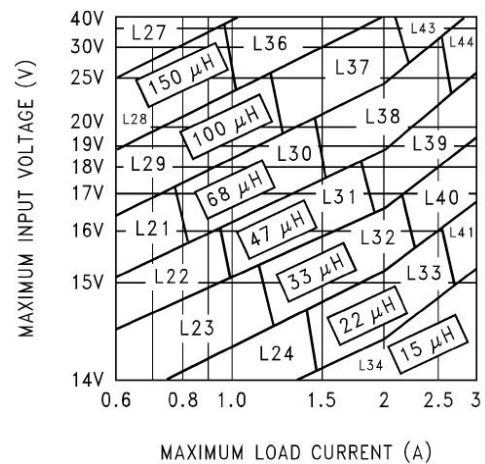


Parameter	TO220-5	TO263-5
Capacitors	Through hole electrolytic	Surface mount tantalum, molded "D" size
Inductor	Through hole, Renco	Surface mount, Pulse Engineering, 68 μ H
Diode	Through hole, 5A 40V, Schottky	Surface mount, 5A 40V, Schottky
PC Board	3 square inches single sided 2 oz. copper (0.0028")	9 square inches single sided 2 oz. copper (0.0028")

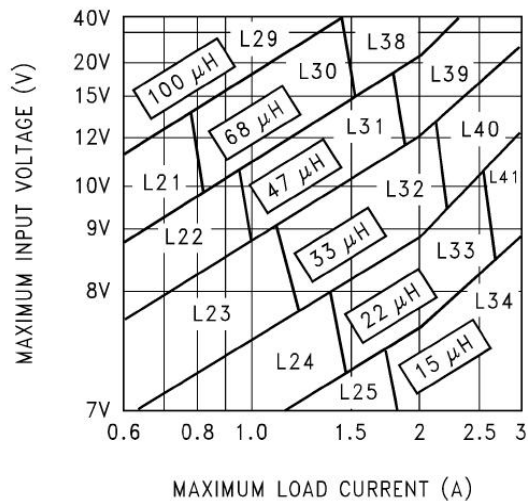
Inductor Value Selection Guides (For Continuous Mode Operation)



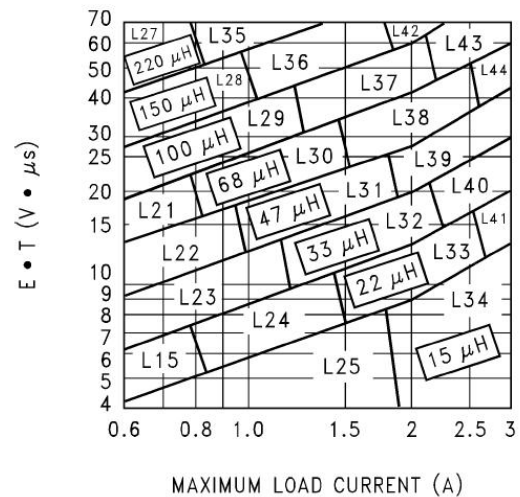
LM2596S-3.3



LM2596S-12



LM2596S-5.0



LM2596S-ADJ

	Inductance (μ H)	Current (A)	Schott		Renco		Pulse Engineering		Coilcraft
			Through Hole	Surface Mount	Through Hole	Surface Mount	Through Hole	Surface Mount	Surface Mount
L15	22	0.99	67148350	67148460	RL-1284-22-43	RL1500-22	PE-53815	PE-53815-S	DO3308-223
L21	68	0.99	67144070	67144450	RL-5471-5	RL1500-68	PE-53821	PE-53821-S	DO3316-683
L22	47	1.17	67144080	67144460	RL-5471-6	—	PE-53822	PE-53822-S	DO3316-473
L23	33	1.40	67144090	67144470	RL-5471-7	—	PE-53823	PE-53823-S	DO3316-333
L24	22	1.70	67148370	67148480	RL-1283-22-43	—	PE-53824	PE-53825-S	DO3316-223
L25	15	2.10	67148380	67148490	RL-1283-15-43	—	PE-53825	PE-53824-S	DO3316-153
L26	330	0.80	67144100	67144480	RL-5471-1	—	PE-53826	PE-53826-S	DO5022P-334
L27	220	1.00	67144110	67144490	RL-5471-2	—	PE-53827	PE-53827-S	DO5022P-224
L28	150	1.20	67144120	67144500	RL-5471-3	—	PE-53828	PE-53828-S	DO5022P-154
L29	100	1.47	67144130	67144510	RL-5471-4	—	PE-53829	PE-53829-S	DO5022P-104
L30	68	1.78	67144140	67144520	RL-5471-5	—	PE-53830	PE-53830-S	DO5022P-683
L31	47	2.20	67144150	67144530	RL-5471-6	—	PE-53831	PE-53831-S	DO5022P-473
L32	33	2.50	67144160	67144540	RL-5471-7	—	PE-53932	PE-53932-S	DO5022P-333
L33	22	3.10	67148390	67148500	RL-1283-22-43	—	PE-53933	PE-53933-S	DO5022P-223
L34	15	3.40	67148400	67148790	RL-1283-15-43	—	PE-53934	PE-53934-S	DO5022P-153
L35	220	1.70	67144170	—	RL-5473-1	—	PE-53935	PE-53935-S	—
L36	150	2.10	67144180	—	RL-5473-4	—	PE-54036	PE-54036-S	—
L37	100	2.50	67144190	—	RL-5472-1	—	PE-54037	PE-54037-S	—
L38	68	3.10	67144200	—	RL-5472-2	—	PE-54038	PE-54038-S	—
L39	47	3.50	67144210	—	RL-5472-3	—	PE-54039	PE-54039-S	—
L40	33	3.50	67144220	67148290	RL-5472-4	—	PE-54040	PE-54040-S	—
L41	22	3.50	67144230	67148300	RL-5472-5	—	PE-54041	PE-54041-S	—
L42	150	2.70	67148410	—	RL-5473-4	—	PE-54042	PE-54042-S	—
L43	100	3.40	67144240	—	RL-5473-2	—	PE-54043		—
L44	68	3.40	67144250	—	RL-5473-3	—	PE-54044		—

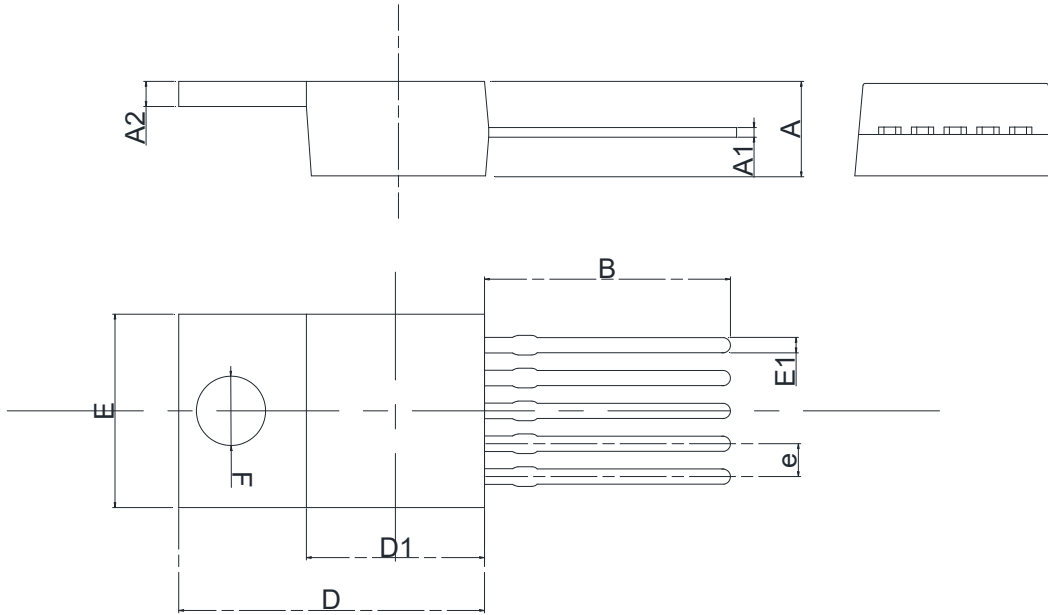
Inductor Selection Guide

V_R	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		

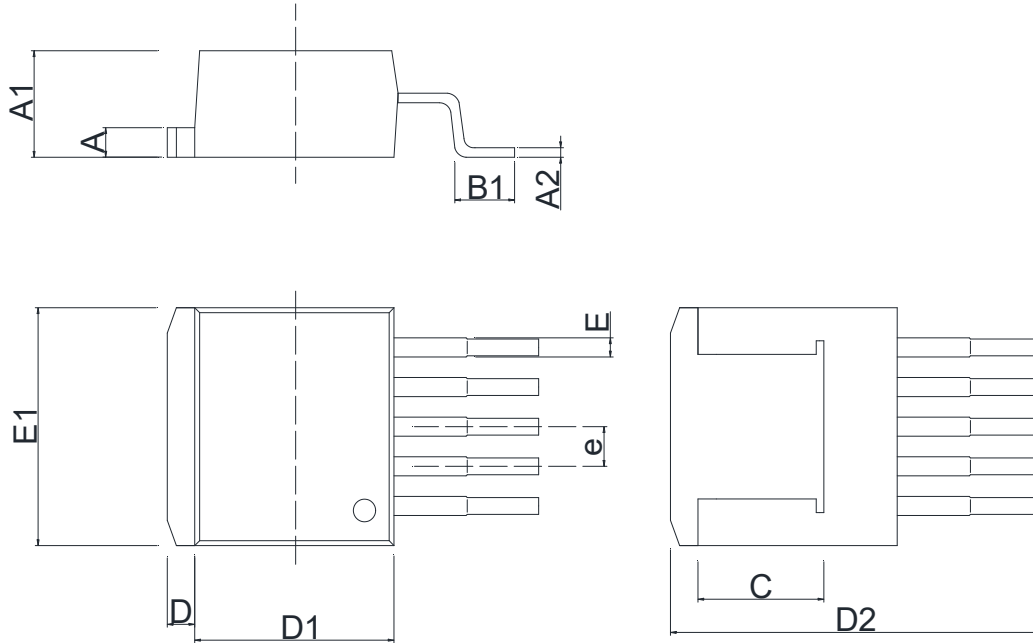
Diode Selection Guide

Outline Dimensions

TO220-5:



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	4.300	4.700	0.169	0.185
A1	0.450	0.600	0.017	0.023
A2	1.250	1.400	0.049	0.055
B	12.880	13.380	0.507	0.527
D	15.500	15.900	0.610	0.626
D1	9.000	9.400	0.354	0.370
E	9.700	10.100	0.381	0.398
E1	0.660	0.914	0.025	0.036
e	1.702 (BSC)		0.670 (BSC)	
F	Φ 3.500	Φ 3.700	Φ 0.137	Φ 0.146

TO263-5:


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.150	1.400	0.045	0.055
A1	4.350	4.750	0.171	0.187
A2	0.310	0.530	0.012	0.021
B1	1.300	2.740	0.051	0.108
C	5.080 REF		0.200 REF	
D	0.900	1.700	0.035	0.067
D1	8.100	8.900	0.318	0.350
D2	13.900	15.550	0.547	0.612
E	0.660	0.970	0.025	0.038
E1	9.800	10.400	0.385	0.409
e	1.700 (BSC)		0.067 (BSC)	