ABSOLUTE MAXIMUM RATINGS

These are stress ratings only and functional operation of the device at these ratings or any other above those indicated in the operation sections of the specifications below is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability.

Input Voltage V_{IN}[1] 20V
Storage Temperature .... -65°C to 150°C
Lead Temperature (Soldering, 5 sec) .... 260°C
ESD Rating (HBM - Human Body Model) ....
All pins except EN 2kV
En pin 1kV

OPERATING RATINGS

Input Voltage Range V_{IN} 16V
Junction Temperature Range ....-40°C to 125°C
Thermal Resistance ....
TO-220-5 Junction to Ambient .... 29.3°C/W
TO-263-3 Junction to Ambient .... 31.4°C/W
TO-263-5 Junction to Ambient .... 31.2°C/W
TO-220-5, TO-263-3, TO-263-5 Junction to Case .. 3°C/W

Note 1: Maximum positive supply voltage of 20V must be of limited duration (<100ms) and duty cycle of less than 1%. The maximum continuous supply voltage is 16V.

ELECTRICAL SPECIFICATIONS

Specifications with standard type are for an Operating Junction Temperature of T_J = T_A = 25°C only; limits applying over the full Operating Junction Temperature range are denoted by a "•". Minimum and Maximum limits are guaranteed through test, design, or statistical correlation. Typical values represent the most likely parametric norm at T_J = 25°C, and are provided for reference purposes only. Unless otherwise indicated, V_{IN} = V_{OUT} + 1V and I_{OUT}=10mA, C_{IN} = 6.8µF, C_{OUT} = 10µF, T_A= 25°C.

Parameter	Min.	Typ.	Max.	Units		Conditions
Fixed Voltage Versions						
Output Voltage, 1.8V Version	1.782	1.800	1.818	V		I_{OUT}=10mA
	1.764	1.800	1.836		•	10mA≤I_{OUT}≤3A, 2.8V≤V_{IN}≤16V
Output Voltage, 2.5V Version	2.475	2.500	2.525	V		I_{OUT}=10mA
	2.450	2.500	2.550		•	10mA≤I_{OUT}≤3A, 3.5V≤V_{IN}≤16V
Output Voltage, 3.3V Version	3.267	3.300	3.333	V		I_{OUT}=10mA
	3.234	3.300	3.366		•	10mA≤I_{OUT}≤3A, 4.3V≤V_{IN}≤16V
Output Voltage, 5.0V Version	4.950	5.000	5.050	V		I_{OUT}=10mA
	4.900	5.000	5.100		•	10mA≤I_{OUT}≤3A, 6.0V≤V_{IN}≤16V
All Voltage Versions						
Line Regulation		0.06	0.5	%		I_{OUT}=10mA, (V_{OUT}+1V)≤V_{IN}≤16V
Load Regulation		0.2	1	%		V_{IN}=V_{OUT} + 1V, 10mA≤I_{OUT} ≤I_{FL} (note 2)
ΔV/ΔT		20	100	ppm/°C	•	V_{OUT} Temp Coefficient (note 6)
Dropout Voltage Except 1.8V Version (note 3)		120	300	mV	•	I_{OUT}=100mA
		380				I_{OUT}=1.5A
		600	800		•	I_{OUT}=3A
Ground Current (note 5)		30	60	mA	•	I_{OUT}=1.5A
		40				I_{OUT}=3A
Ground Pin Current at Dropout		0.9		mA		V_{IN} = 0.5V less than specified V_{OUT} I_{OUT}=10mA
Current Limit	3.0	4.5		A		V_{OUT}=0V (note 4)
Output Noise Voltage		400		μV_{RMS}		10Hz-100KHz, I_{OUT}=100mA, C_{OUT}=10µF
		260				10Hz-100KHz, I_{OUT}=100mA, C_{OUT}=33µF
Reference Voltage Temperature Coefficient		20		ppm/°C		Note 7
Reference Voltage and Adjustable Pin - SPX29302						
Reference Voltage	1.228	1.24	1.252	V		
	1.215		1.265		•	
	1.203		1.277			V_{REF}≤V_{OUT}≤(V_{IN}-1), 2.3V≤V_{IN}≤16V 10mA≤I_L≤I_{FL}, T_J<T_{JMAX}
Adjust Pin Bias Current		40	80	nA		
			120		•	
Adjust Pin Bias Current Temperature Coefficient		0.1		nA/°C		

Parameter	Min.	Typ.	Max.	Units		Conditions
Power Good Flag Output – SPX29301						
Output Leakage Current		0.01	1	µA		V_{OH}=16V
			2		•	
Output Low Voltage		220	300	mV		Device set for 5V, V_{IN}=4.5V, I_{OL}=250µA
			400		•	
Upper Threshold Voltage	40	60		mV		Device set for 5V, Note 8
	25				•	
Lower Threshold Voltage		75	95	mV		Device set for 5V, Note 8
			140		•	
Hysteresis		15		mV		Device set for 5V, Note 8
Enable Input – SPX29301/02						
Input Logic Voltage Low (OFF)			0.8	V	•	V_{IN}<10V
Input Logic Voltage High (ON)	2.4				•	
Enable Input Pin		100	600	µA		V_{EN}=16V
			750		•	
			1		•	V_{EN}=0.8V
			2		•	
Regulator Output Current in Shutdown		10	500	µA	•	Note 9

Note 2: Full load current (I_{FL}) is defined as 3.0A.
Note 3: Dropout voltage is defined (V_{IN}-V_{OUT}) when the output voltage drops to 99% of its nominal value.
Note 4: V_{IN}=V_{OUT}(nom)+1V. Use pulse-testing procedures to minimize temperature rise.
Note 5: Ground pin current is the regulator quiescent current. The total current drawn from the source is the sum of the load current to the ground current.
Note 6: Output voltage temperature coefficient is defined as the worst case voltage change divided by the total temperature range
Note 7: Thermal regulation is defined as the change in output voltage at time T after a change in power dissipation is applied, excluding load/line regulation effects. Specifications for a 200mA load pulse as V_{IN}=20V (a 4W pulse) for t=10ms.
Note 8: Comparator threshold is expressed in terms of a voltage differential at the Adjust terminal below the nominal reference voltage measured 6V input. To express these thresholds in terms of output voltage change, multiply the error amplifier gain = V_{OUT}/V_{REF} = (R1 + R2)/R2. For example, at a programmable output voltage of 5V, the Error output is guaranteed to go low when the output drops by 95mVx 5V/ 1.240V = 383mV. Threshold remain constant as a percent of V_{OUT} as V_{OUT} is varied, with the dropout warning occurring at typically 5% below nominal, 7.7% guaranteed.
Note 9: V_{EN} ≤ 0.8V and V_{IN} ≤ 16V, V_{OUT} = 0.

BLOCK DIAGRAM

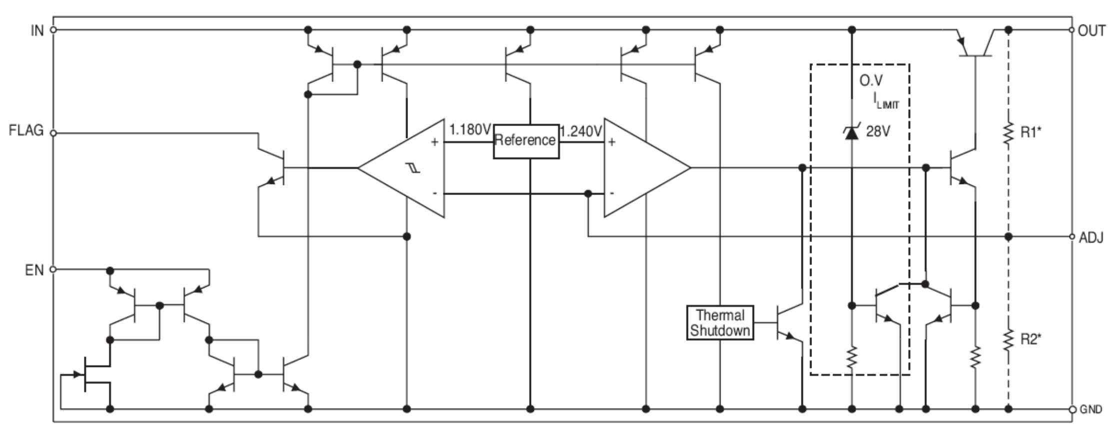


Fig. 2: SPX29300/01/02 Block Diagram

PIN ASSIGNMENT

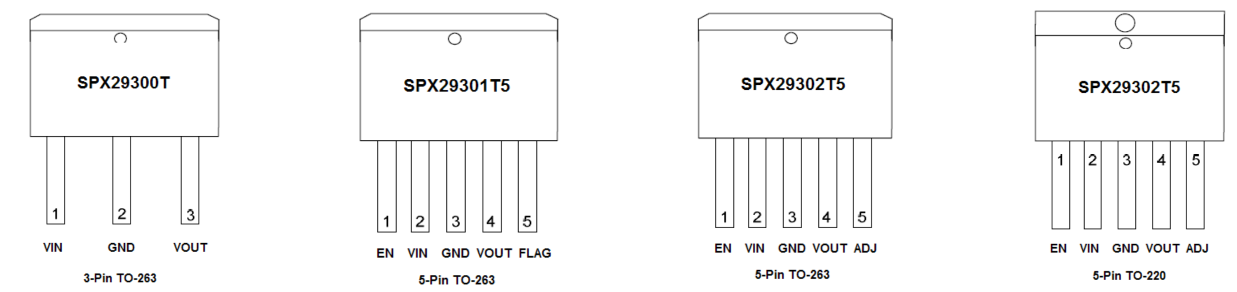


Fig. 3: SPX29300/01/02 Pin Assignment

ORDERING INFORMATION

Part Number	Junction Temperature Range	Marking	Package	Packing Quantity	Note 1	Note 2
SPX29300T-L-1-8	-40°C≤T_J≤+125°C	SPX29300T 18YYWWLX	3-pin TO263	Bulk	Lead Free	
SPX29300T-L-1-8/TR	-40°C≤T_J≤+125°C	SPX29300T 18YYWWLX	3-pin TO263	500/Tape & Reel	Lead Free	
SPX29300T-L-2-5	-40°C≤T_J≤+125°C	SPX29300T 25YYWWLX	3-pin TO263	Bulk	Lead Free	
SPX29300T-L-2-5/TR	-40°C≤T_J≤+125°C	SPX29300T 25YYWWLX	3-pin TO263	500/Tape & Reel	Lead Free	
SPX29300T-L-3-3	-40°C≤T_J≤+125°C	SPX29300T 33YYWWLX	3-pin TO263	Bulk	Lead Free	
SPX29300T-L-3-3/TR	-40°C≤T_J≤+125°C	SPX29300T 33YYWWLX	3-pin TO263	500/Tape & Reel	Lead Free	
SPX29300T-L-5-0	-40°C≤T_J≤+125°C	SPX29300T 50YYWWLX	3-pin TO263	Bulk	Lead Free	
SPX29300T-L-5-0/TR	-40°C≤T_J≤+125°C	SPX29300T 50YYWWLX	3-pin TO263	500/Tape & Reel	Lead Free	
SPX29301T5-L-3-3	-40°C≤T_J≤+125°C	293001T5 33YYWWLX	5-pin TO263	Bulk	Lead Free	
SPX29301T5-L-3-3/TR	-40°C≤T_J≤+125°C	293001T5 33YYWWLX	5-pin TO263	500/Tape & Reel	Lead Free	
SPX29301T5-L-5-0	-40°C≤T_J≤+125°C	293001T5 50YYWWLX	5-pin TO263	Bulk	Lead Free	
SPX29301T5-L-5-0/TR	-40°C≤T_J≤+125°C	293001T5 50YYWWLX	5-pin TO263	500/Tape & Reel	Lead Free	
SPX29302T5-L	-40°C≤T_J≤+125°C	29302T5 YYWWLX	5-pin TO263	Bulk	Lead Free	
SPX29302T5-L/TR	-40°C≤T_J≤+125°C	29302T5 YYWWLX	5-pin TO263	500/Tape & Reel	Lead Free	
SPX29302U5-L	-40°C≤T_J≤+125°C	29302U5 YYWWLX	5-pin TO220	Bulk	Lead Free	

"YY" = Year – "WW" = Work Week – "L" = Lead Free Designator – "X" = Lot Number

TYPICAL PERFORMANCE CHARACTERISTICS

All data taken at $V_{IN} = V_{OUT} + 1V$, $T_J = T_A = 25°C$, unless otherwise specified.

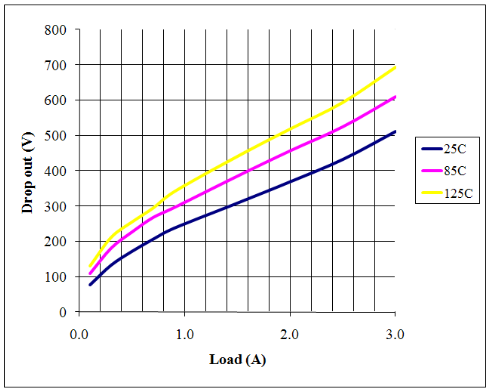


Fig. 4: Dropout Voltage vs Load Current

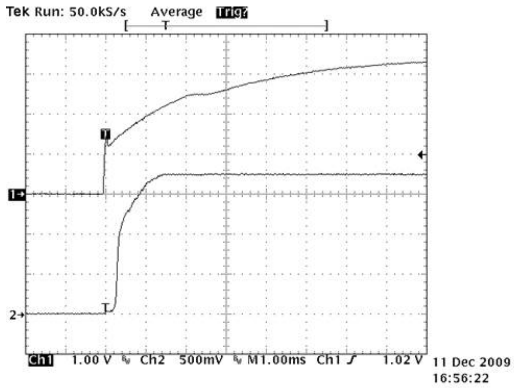


Fig. 5: Startup

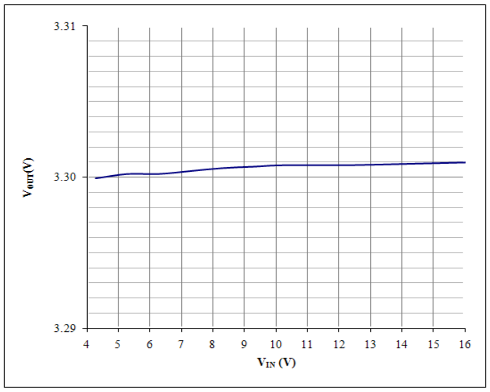


Fig. 6: Line Regulation
I_{OUT}=10mA, V_{OUT}=3.3V

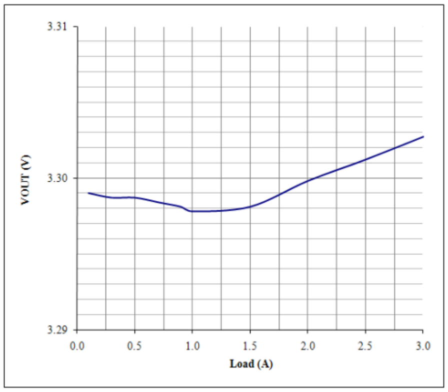


Fig. 7: Load Regulation
V_{OUT}=3.3V

THEORY OF OPERATION

The SPX29300/01/02 incorporates protection against over-current faults, reversed load insertion, over temperature operation, and positive and negative transient voltage.

THERMAL CONSIDERATIONS

Although the SPX29300/01/02 offers limiting circuitry for overload conditions, it is still necessary to insure that the maximum junction temperature is not exceeded in the application. Heat will flow through the lowest resistance path, the junction-to-case path. In order to insure the best thermal flow of the component, proper mounting is required.

TO-220 DESIGN EXAMPLE:

Assume that V_{IN} = 10V, V_{OUT} = 5V, I_{OUT} = 1.5A, T_A = 50°C, θ_{HA}= 1°C/W, θ_{CH}= 2°C/W, and θ_{JC}= 3C°/W, where:

T_A = ambient temperature,

θ_{HA}= heatsink to ambient thermal resistance

θ_{CH}= case to heatsink thermal resistance

θ_{JC} = junction to case thermal resistance

The power calculated under these conditions is:

$$P_D = (V_{IN} - V_{OUT}) \times I_{OUT} = 7.5W$$

And the junction temperature is calculated as

$$T_J = T_A + P_D \times (\theta_{HA} + \theta_{CH} + \theta_{JC})$$

or

$$T_J = 50 + 7.5 \times (1 + 2 + 3) = 95°C$$

Reliable operation is insured.Capacitor Requirements

CAPACITOR REQUIREMENTS

The output capacitor is needed to insure stability and minimize the output noise. The value of the capacitor varies with the load. However, a minimum value of 10µF aluminum capacitor will guarantee stability over all load conditions.

A tantalum capacitor is recommended if a faster load transient response is needed. If the power source has high AC impedance, a 0.1µF ceramic capacitor between input & ground is recommended.

MINIMUM LOAD CURRENT

To ensure a proper behavior of the regulator under light load, a minimum load of 5mA for SPX29300/01/02 is required.

ADJUSTABLE REGULATOR DESIGN

The SPX29300/01/02 is an adjustable regulator that can be programmed to any value between 1.25V and 16V using 2 external resistors, R1 and R2. The relationship between the resistors and the output voltage is:

$$R_1 = R_2 \times \left(\frac{V_{OUT}}{1.240} - 1\right)$$

ERROR FLAG

The SPX29301 features an error flag that indicates either an over current or under current voltage condition. The flag output goes low, sinking 10mA when either conditions occurs.

ENABLE INPUT

The SPX29301/02 has an Enable function that switches the regulator on and off. Their thresholds are TTL compatible. When the regulator is active, approximately 20µA flows through the Enable pin.

TYPICAL APPLICATION CIRCUITS

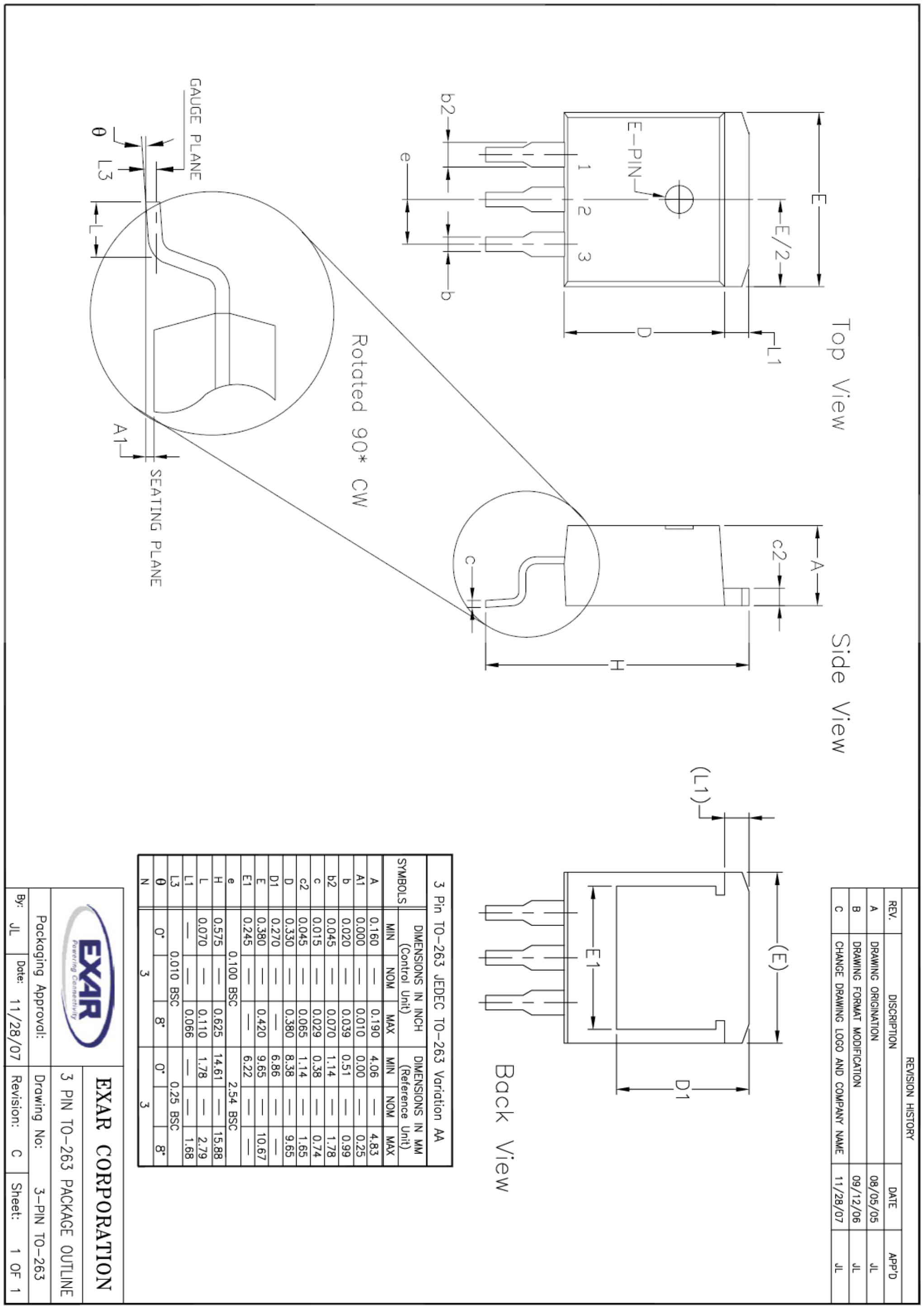
Figure 1 represents the typical implementation for an adjustable output regulator. The values of R1 and R2 set the output voltage value as follows:

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

A minimum value of 10kohms is recommended for R2 with a range between 10kΩ and 47kΩ.

PACKAGE SPECIFICATION

3-PIN TO-263



3 Pin TO-263 JEDEC TO-263 Variation AA

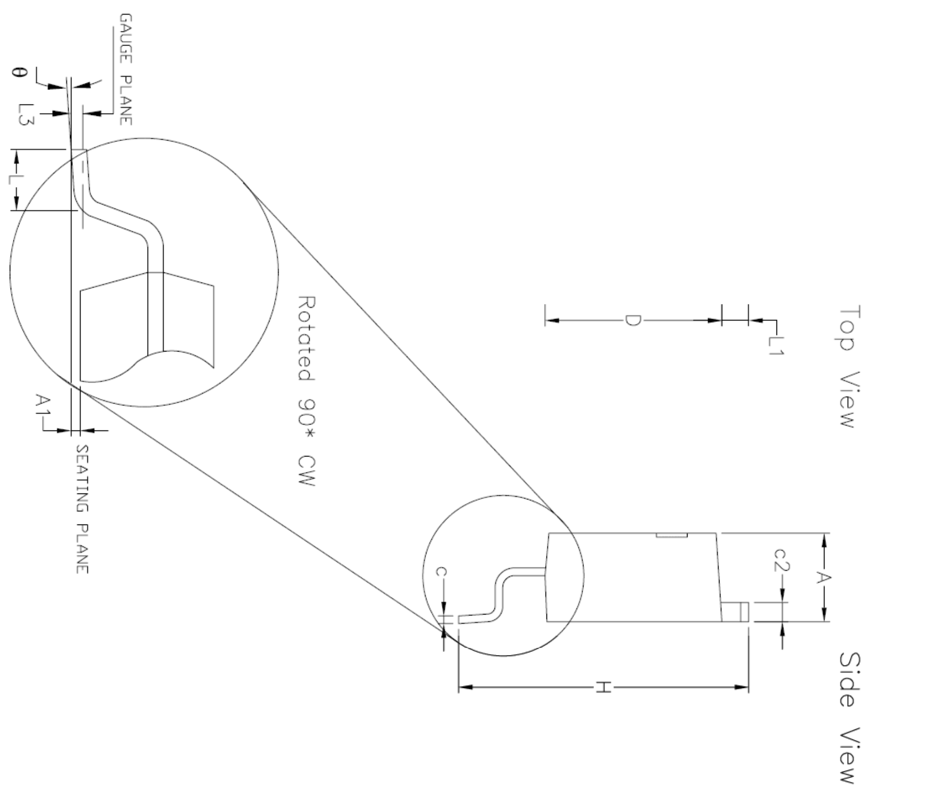
SYMBOLS	DIMENSIONS IN INCH (Control Unit)			DIMENSIONS IN MM (Reference Unit)		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.160	—	0.190	4.06	—	4.83
A1	0.000	—	0.010	0.00	—	0.25
b	0.020	—	0.039	0.51	—	0.99
b2	0.045	—	0.070	1.14	—	1.78
c	0.015	—	0.029	0.38	—	0.74
c2	0.045	—	0.065	1.14	—	1.65
D	0.330	—	0.380	8.38	—	9.65
D1	0.270	—	—	6.86	—	—
E	0.380	—	0.420	9.65	—	10.67
E1	0.245	—	—	6.22	—	—
e	0.100 BSC			2.54 BSC		
H	0.575	—	0.625	14.61	—	15.88
L	0.070	—	0.110	1.78	—	2.79
L1	—	—	0.066	—	—	1.68
L3	0.010 BSC			0.25 BSC		
θ	0°		8°	0°		8°
N	3			3		

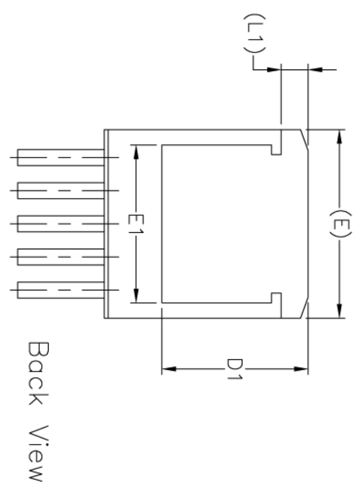
REVISION HISTORY

REV.	DISCRIPTION	DATE	APP'D
A	DRAWING ORIGINATION	08/05/05	JL
B	DRAWING FORMAT MODIFICATION	09/12/06	JL
C	CHANGE DRAWING LOGO AND COMPANY NAME	11/28/07	JL

EXAR CORPORATION			
3 PIN TO-263 PACKAGE OUTLINE			
Packaging Approval:		Drawing No: 3-PIN TO-263	
By: JL	Date: 11/28/07	Revision: C	Sheet: 1 OF 1

5-PIN TO-263





5 Pin TO-263 JEDEC TO-263 Variation BA

SYMBOLS	DIMENSIONS IN INCH (Control Unit)			DIMENSIONS IN MM (Reference Unit)		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.160	—	0.190*	4.06	—	4.83
A1	0.000	—	0.010	0.00	—	0.25
b	0.020	—	0.039	0.51	—	0.99
c	0.015	—	0.029	0.38	—	0.74
c2	0.045	—	0.065	1.14	—	1.65
D	0.330	—	0.380	8.38	—	9.65
D1	0.270	—	—	6.86	—	—
E	0.380	—	0.420	9.65	—	10.67
E1	0.245	—	—	6.22	—	—
e	0.067 BSC			1.70 BSC		
H	0.575	—	0.625	14.61	—	15.88
L	0.070	—	0.110	1.78	—	2.79
L1	—	—	0.066	—	—	1.68
L3	0.010 BSC			0.25 BSC		
θ	0°		8°	0°		8°
N	5			5		

REVISION HISTORY

REV.	DISCRIPTION	DATE	APP'D
A	DRAWING ORIGINATION	01/18/06	JL
B	CORRECTED JEDEC VARIATION FROM BB TO BA	06/12/06	JL
C	DRAWING FORMAT MODIFICATION	09/12/06	JL
D	CHANGE DRAWING LOGO AND COMPANY NAME	11/28/07	JL

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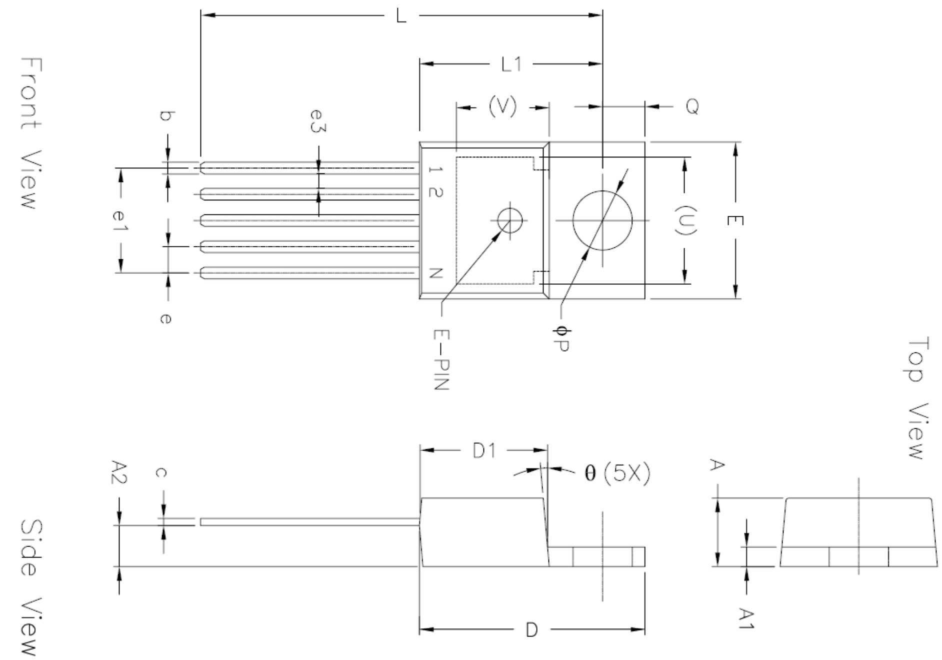
5 PIN TO-263 PACKAGE OUTLINE

Packaging Approval:	Drawing No: 5-PIN TO-263
By: JL	Date: 11/28/07
Revision: D	Sheet: 1 OF 1

5-PIN TO-220



5 Pin TO-220 JEDEC TS-001 Variation AA				
SYMBOLS	DIMENSIONS IN INCH (Control Unit)		DIMENSIONS IN MM (Reference Unit)	
	MIN	MAX	MIN	MAX
A	0.165	0.190	4.19	4.82
A1	0.035	0.055	0.89	1.39
A2	0.085	0.115	2.16	2.92
b	0.020	0.040	0.51	1.01
c	0.012	0.025	0.31	0.63
D	0.570	0.625	14.48	15.87
D1	0.330	0.370	8.39	9.39
E	0.390	0.415	9.91	10.54
e	0.067 BSC		1.70 BSC	
e1	0.263	0.273	6.68	6.93
e3	0.030	0.040	0.76	1.02
L	0.945	1.045	24.00	26.54
L1	0.465	0.539	11.81	13.69
P	0.139	0.156	3.53	3.96
Q	0.103	0.113	2.62	2.87
U	0.300 REF		7.62 REF	
V	0.240 REF		6.10 REF	
θ	3°	7°	3°	7°
N	5		5	

REVISION HISTORY			
REV.	DESCRIPTION	DATE	APP'D
A	DRAWING ORIGINATION	06/30/05	JL
B	DRAWING FORMAT MODIFICATION	05/09/06	JL
C	CHANGE DRAWING LOGO AND COMPANY NAME	11/28/07	JL

EXAR CORPORATION

5 PIN TO-220 PACKAGE OUTLINE

Packaging Approval:

Drawing No: 5-PIN TO-220

By: JL Date: 11/28/07 Revision: C Sheet: 1 OF 1

REVISION HISTORY

Revision	Date	Description
1.0.0	12/17/2009	Initial Release of Datasheet
2.0.0	03/31/2010	Reformat of datasheet Inserted ESD data Modified Dropout Voltage and Ground Current values in electrical characteristics table Corrected typographical error in result of calculus in note 8 Removed "Gound Current vs Load Current", "Enable Threshold vs Temperature" and "Power Supply Rejection Ratio curves" Updated "Dropout Voltage vs Load Current", "Line Regulation" and "Load Regulation" curves Added "start Up" curve
2.1.0	10/19/2010	Corrected Adjustable Regulator Design paragraph equation

FOR FURTHER ASSISTANCE

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