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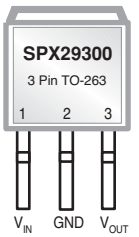
SPX29300/01/02/03

3A High Current, Low Dropout Voltage Regulator

Adjustable & Fixed Output, Fast Response Time

FEATURES

- Adjustable Output Down To 1.25V
- 1% Output Accuracy
- Output Current of 3A
- Low Dropout Voltage of 450mV @ 3A
- Extremely Tight Load and Line Regulation
- Extremely Fast Transient Response
- Reverse-Battery Protection
- Zero Current Shutdown (5 pin version)
- Error Flag Signal Output for Out of Regulation State (5 pin version)
- Standard TO-220 and TO-263 Packages



Now Available in Lead Free Packaging

APPLICATIONS

- Powering VGA & Sound Card
- Power PC™ Supplies
- SMPS Post Regulator
- High Efficiency “Green” Computer Systems
- High Efficiency Linear Power Supplies
- Constant Current Regulators
- Adjustable Power Supplies
- Battery Charger

DESCRIPTION

The SPX29300/01/02/03 are 3A, highly accurate voltage regulators with a low drop out voltage of 450mV dropout (typical) @ 3A. These regulators are specifically designed for low voltage applications that require a low dropout voltage and a fast transient response. They are fully fault protected against over-current, reverse battery, and positive and negative voltage transients. On-Chip trimming adjusts the reference voltage to 1% initial accuracy. Other features in the 5 pin versions include Enable, and Error Flag.

The SPX29300/01/02/03 are offered in 3 & 5-pin TO-220 & TO-263 packages. For a 1.5A version, refer to the SPX29150 data sheet.

TYPICAL APPLICATIONS CIRCUITS

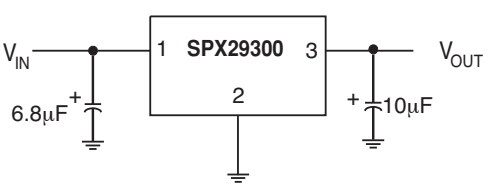


Figure 1. Fixed Output Linear Regulator

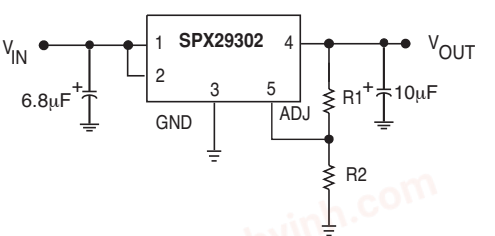


Figure 2. Adjustable Output Linear Regulator

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ABSOLUTE MAXIMUM RATINGS

Lead Temperature (soldering, 5 seconds) .....260°C
Storage Temperature Range.....-65°C to +150°C
Operating Junction Temperature Range.....-40°C to +125°C
Input Voltage (Note 1) 16V

ELECTRICAL CHARACTERISTICS

(Note 1) at $V_{IN}=V_{OUT}+1V$ and $I_{OUT}=10mA$, $C_{IN}=6.8\mu F$, $C_{OUT}=10\mu F$, $T_A=25°C$, unless otherwise specified. The Boldface applies over the junction temperature range.

		SPX29300/01			
PARAMETER	**CONDITIONS**	**TYP**	**MIN**	**MAX**	**UNITS**
Fixed Voltage Options					
1.8V Version					
Output Voltage	I_{OUT} = 10mA 10mA ≤ I_{OUT} ≤ 3A, 2.8V ≤ V_{IN} ≤ 16V	1.800 **1.800**	1.782 **1.764**	1.818 **1.836**	V
2.5V Version					
Output Voltage	I_{OUT} = 10mA 10mA ≤ I_{OUT} ≤ 3A, 3.5V ≤ V_{IN} ≤ 16V	2.500 **2.500**	2.475 **2.450**	2.525 **2.550**	V
3.3V Version					
Output Voltage	I_{OUT} = 10mA 10mA ≤ I_{OUT} ≤ 3A, 4.3V ≤ V_{IN} ≤ 16V	3.300 **3.300**	3.267 **3.234**	3.333 **3.366**	V
5.0V Version					
Output Voltage	I_{OUT} = 10mA 10mA ≤ I_{OUT} ≤ 3A, 6.0V ≤ V_{IN} ≤ 16V	5.000 **5.000**	4.950 **4.900**	5.050 **5.100**	V
All Voltage Options		**SPX29300/01/02/03**			
Line Regulation	I_{OUT}=10mA,(V_{OUT}+1V) ≤ V_{IN} ≤ 16V	0.06		0.5	%
Load Regulation	$V_{IN}=V_{OUT}+1V$, 10mA≤ I_{OUT} ≤ I_{FL} (Note 2)	0.2		1	%
ΔV/ΔT	V_{OUT} Temp Coefficient (Note 6)	**20**		**100**	ppm/°C
Dropout Voltage, except 1.8V, (Note 3)	I_{OUT}=100mA I_{OUT}=1.5A I_{OUT}=3.0A	50 150 450		**175** **700**	mV
Ground Current (Note 5)	I_{OUT}=1.5A I_{OUT}=3.0A	10 37		**35**	mA
Ground Pin Current at Dropout	V_{IN}=0.5V less than specified V_{OUT}, I_{OUT}=10mA	0.9			mA
Current Limit	V_{OUT}=0V (Note 4)	4.5	3.0		A
Output Noise Voltage (10Hz to 100kHz) I_L=100mA	C_L=10μF C_L=33μF	400 260			μV_{RMS}
Reference Voltage	Adjustable version only	1.240	1.228 **1.215**	1.252 **1.265**	V
Reference Voltage	Adjustable version only (Note 8)		1.203	1.277	V
Adjust Pin Bias Current		40		80 **120**	nA
Reference Voltage Temp. Coeff.	(Note 7)	20			ppm/°C
Adjust Pin Bias Current Temp. Coeff.		0.1			nA/°C

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ELECTRICAL CHARACTERISTICS

at $V_{IN}=V_{OUT}+1V$ and $I_{OUT}=10mA$, $C_{IN}=6.8\mu F$, $C_{OUT}=10\mu F$, $T_A=25°C$, unless otherwise specified. The Boldface applies over the junction temperature range. Adjustable versions are set to 5.0V.

PARAMETER	CONDITIONS	TYP	MIN	MAX	UNITS
FLAG OUTPUT (ERROR COMPARATOR)			**SPX29301/03**		
Output Leakage Current	V_{OH}=16V	0.01		1 **2**	µA
Output Low Voltage	Device set for 5V, V_{IN}=4.5V, I_{OL}=250µA	220		300 400	mV
Upper Threshold Voltage	Device set for 5V, (Note 9)	60	40 **25**		mV
Lower Threshold Voltage	Device set for 5V, (Note 9)	75		95 **140**	mV
Hysteresis	Device set for 5V, (Note 9)	15			mV
ENABLE Input			**SPX29301/02**		
Input Logic Voltage Low (OFF) High (ON)	V_{IN}<10V		 **2.4**	**0.8**	V
ENABLE Input Pin	V_{EN}=16V V_{EN}=0.8V	100		600 **750** **1** **2**	µA µA
Regulator Output Current in Shutdown	(Note 10)	10		**500**	µA
Thermal Resistance	TO-200 Junction to Case, at Tab TO-220 Junction to Ambient TO-263 Junction to Case, at Tab TO-263 Junction to Ambient	3 60 3 60			°C/W

NOTES:

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.

Note 2: Full load current (I_{FL}) is defined as 3.0A.

Note 3: Dropout voltage is defined as the input to output differential when the output voltage drops to 99% of its nominal value.

Note 4: $V_{IN}=V_{OUT\ (NOMINAL)}+1V$. For example, use $V_{IN}=4.3V$ for a 3.3V regulator. Employ 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

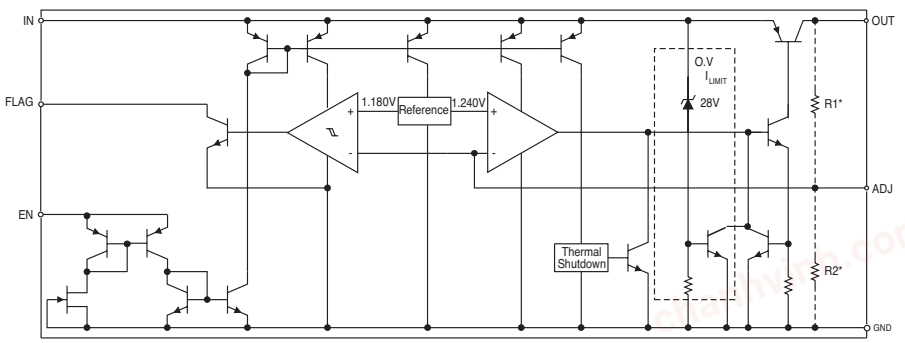
Note 7: Thermal regulation is defined as the change in output voltage at time T after a change in power dissipation is applied, excluding load / line regulation effects. Specifications for a 200mA load pulse as $V_{IN}=20V$ (a 4W pulse) for t = 10ms.

Note 8: $V_{REF} \le V_{OUT} \le (V_{IN}-1)$, $2.3V \le V_{IN} \le 16V$, $10mA \le I_L \le I_{FL}$, $T_j < T_{jmax}$.

Note 9: 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 = 38mV. 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 10: $V_{EN} \le 0.8V$ and $V_{IN} \le 16V$, $V_{OUT}=0$.

BLOCK DIAGRAM



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TYPICAL PERFORMANCE CHARACTERISTICS

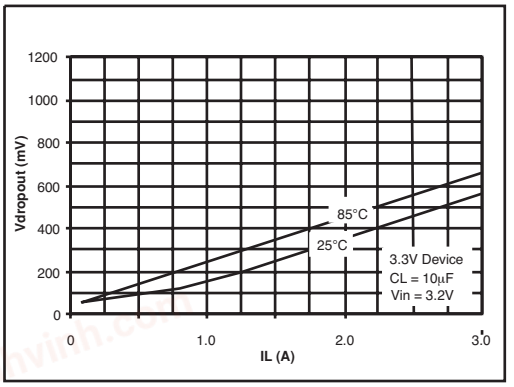


Figure 3. Dropout Voltage vs Load Current

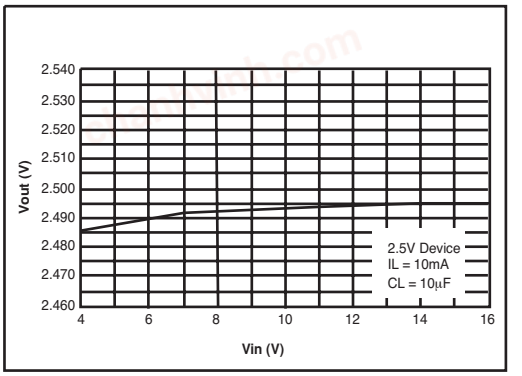


Figure 4. Line Regulation

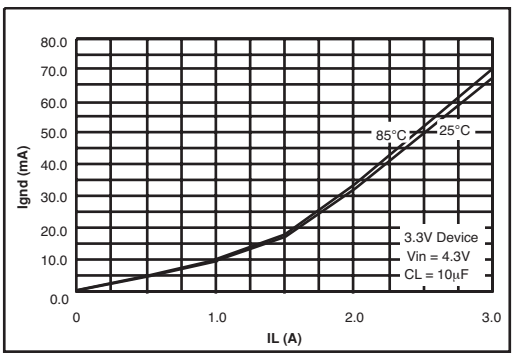


Figure 5. Ground Current vs Load Current

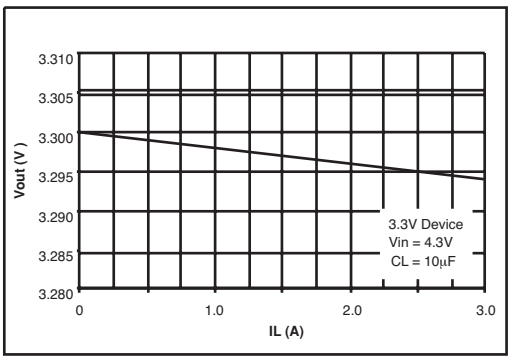


Figure 6. Load Regulation

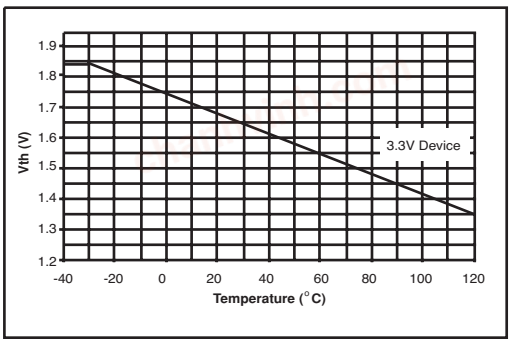


Figure 7. Enable Threshold vs Temperature

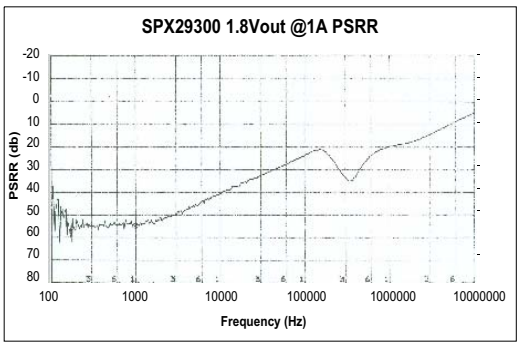


Figure 8. Power Supply Rejection Ratio

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The SPX29300/01/02/03 incorporates protection against over-current faults, reversed load insertion, over temperature operation, and positive and negative transient voltage.

Thermal Considerations

Although the SPX29300/01/02/03 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:

$$P_D = (V_{IN} - V_{OUT}) * I_{OUT} = 7.5W.$$

And the junction temperature is calculated as

$$T_J = T_A + P_D * (\theta_{HA} + \theta_{CH} + \theta_{JC}) \text{ or}$$
$$T_J = 50 + 7.5 * (1+2+3) = 95°C$$

Reliable operation is insured.

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 a 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 SPX29300/01/02/03 is required.

Adjustable Regulator Design

The SPX29302/03 are adjustable regulators that can be programmed to any value between 1.25V and 16V using 2 resistors, R1 and R2. The relationship between the resistors is:

R1 = R2(Vout/1.240-1).

Error Flag

The SPX29301/03 features an error flag that indicates either an over current or under voltage condition. The flag output goes low, sinking 10mA when either condition occurs.

Enable Input

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

Typical Application Circuits

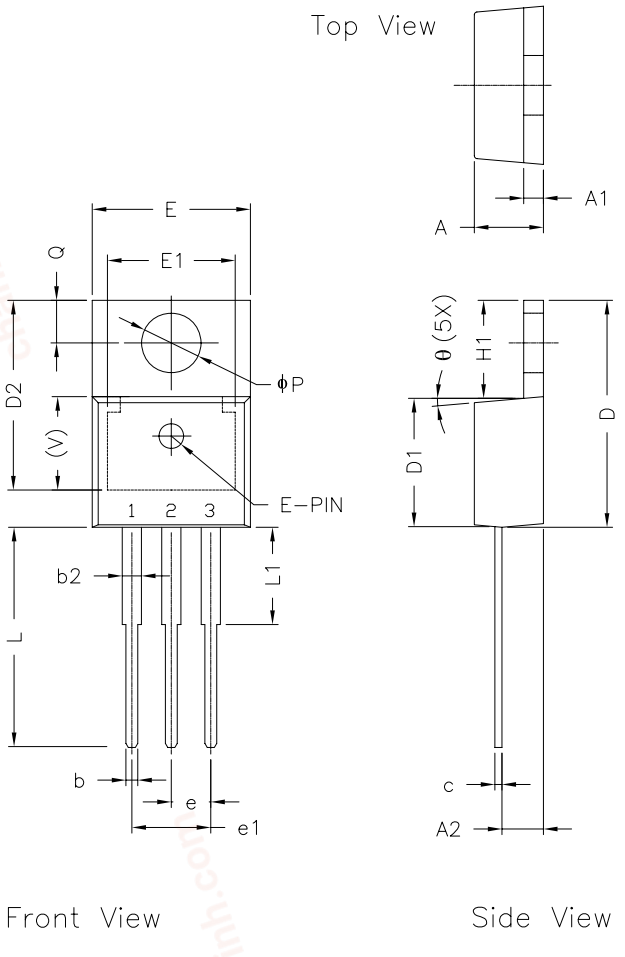
Figure 1 represents at typical fixed output regulator. Figure 2 represents an adjustable output regulator. The values of R1 and R2 set the output voltage value as follows:

$$V_{OUT} = V_{REF} * [1 + (R1/R2)].$$

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

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REVISION HISTORY			
REV.	DISCRIPTION	DATE	APP'D
A	DRAWING ORIGINATION	08/04/05	JL
B	DRAWING FORMAT MODIFICATION	05/25/06	JL



3 Pin TO-220 (Option 1)* JEDEC TO-220-AB				
SYMBOLS	DIMENSIONS IN INCH (Control Unit)		DIMENSIONS IN MM (Reference Unit)	
	MIN	MAX	MIN	MAX
A	0.140	0.190	3.56	4.82
A1	0.020	0.055	0.51	1.40
A2	0.080	0.115	2.03	2.92
b	0.015	0.040	0.38	1.02
c	0.014	0.024	0.36	0.61
D	0.560	0.650	14.22	16.51
D1	0.330	0.355	8.38	9.02
D2	0.480	0.507	12.19	12.88
E	0.380	0.420	9.65	10.67
E1	0.270	0.350	6.86	8.89
e	0.100 BSC		2.54 BSC	
e1	0.200 BSC		5.08 BSC	
H1	0.230	0.270	5.84	6.86
L	0.500	0.580	12.70	14.73
L1	—	0.250	—	6.35
P	0.139	0.156	3.53	3.96
Q	0.103	0.113	2.62	2.87
V	0.240 REF		6.10 REF	
θ	3°	7°	3°	7°
N	3		3	

* Refer to product datasheet for POD option being used

Solved by Sipex	SIPEX CORPORATION		
	3 PIN TO-220 PACKAGE OUTLINE		
Packaging Approval:		Drawing No:	3-PIN TO-220
By: JL	Date: 05/25/06	Revision: B	Sheet: 1 OF 2

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PACKAGE: 5 PIN TO-220

REVISION HISTORY			
REV.	DISCRIPTION	DATE	APP'D
A	DRAWING ORIGINATION	06/30/05	JL
B	DRAWING FORMAT MODIFICATION	05/09/06	JL

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	

SIPEX CORPORATION

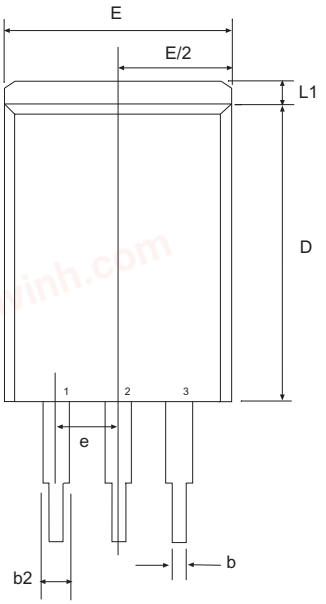
5 PIN TO-220 PACKAGE OUTLINE

Packaging Approval:		Drawing No:	5-PIN TO-220
By: JL	Date: 05/09/06	Revision: B	Sheet: 1 OF 1

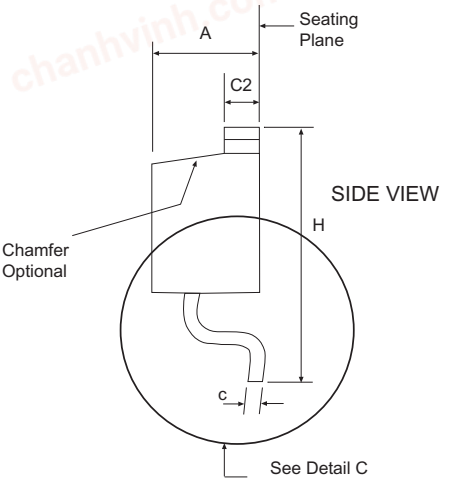
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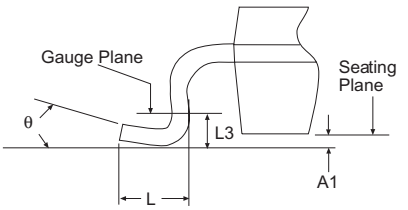
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PACKAGE: 3 PIN TO-263

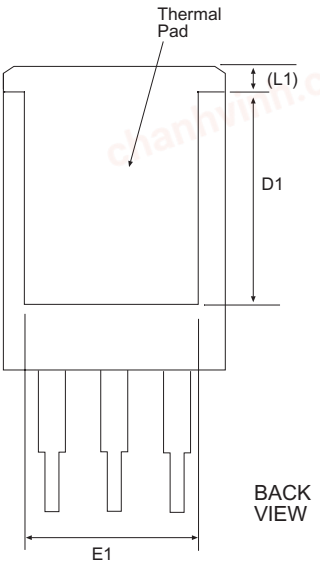


FRONT VIEW





DETAIL C

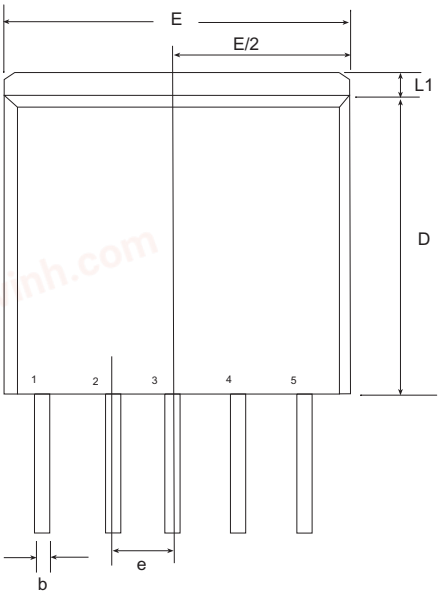


3 Pin TO-263 JEDEC TO-263 Variation AA						
SYMBOL	Inches Controlling Dimension			Millimeters Conversion Factor: 1 Inch = 25.40 mm		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.160	-	0.190	4.06	-	4.83
A1	0.000	-	0.010	0.00	-	0.25
b	0.020	-	0.039	0.51	-	0.99
b2	0.045	-	0.070	1.14	-	1.78
c	0.015	-	0.029	0.38	-	0.74
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	.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	.010 BSC			0.25 BSC		
Θ	0°	-	8°	0°	-	8°
SIPEX Pkg Signoff Date/Rev:				JL Aug5-05 / Rev A		

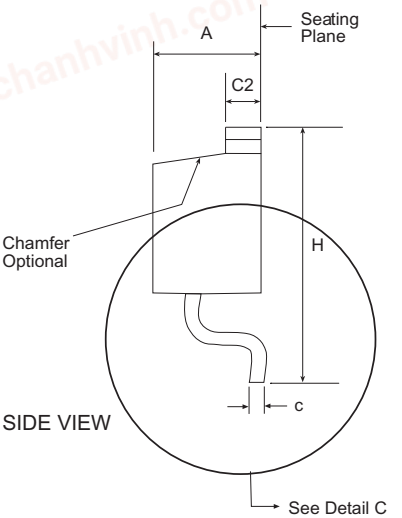
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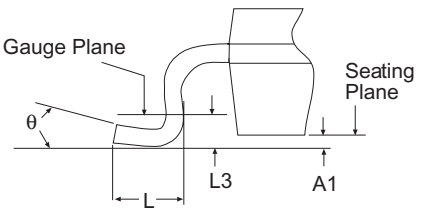
PACKAGE: 5 PIN TO-263



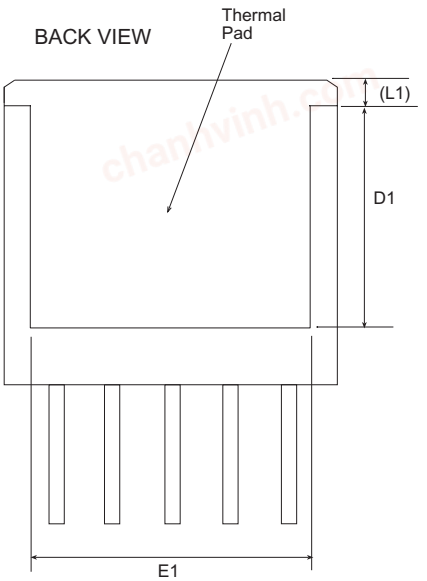
FRONT VIEW



SIDE VIEW



DETAIL C



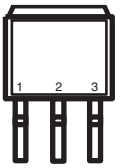
5 Pin TO-263 JEDEC TO-263 Variation BA						
	Dimensions in Inches: Controlling Dimension			Dimensions in Millimeters Conversion Factor: 1 Inch = 25.40 mm		
SYMBOL	MIN	NOM	MAX	MIN	NOM	MAX
A	0.160	-	0.190	4.06	-	4.83
A1	0.000	-	0.010	0.00	-	0.25
b	0.020	-	0.039	0.51	-	0.99
c	0.015	-	0.029	0.38	-	0.74
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	.067 BSC			1.702 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	.010 BSC			0.254 BSC		
Θ	0°	-	8°	0°	-	8°
SIPEX Pkg Signoff Date/Rev:				JL Jun12-06 / Rev B		

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PACKAGE PINOUTS

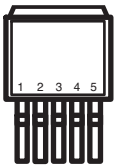
TO-263-3 Package (T)



V_{IN} GND V_{OUT}

Front View

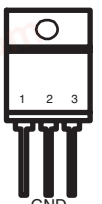
TO-263-5 Package (T5)



Top View

SPX29301	SPX29302	SPX29303
1)ENABLE	1) ENABLE	1)FLAG
2)INPUT	2) INPUT	2)INPUT
3)GND	3) GND	3)GND
4)OUTPUT	4) OUTPUT	4)OUTPUT
5)FLAG	5) ADJUST	5)ADJUST

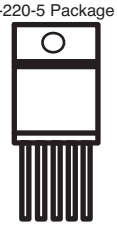
TO-220-3 Package (U)



V_{IN} GND V_{OUT}

Front View

TO-220-5 Package (U5)



1 2 3 4 5

Top View

SPX29301	SPX29302	SPX29303
1)ENABLE	1) ENABLE	1)FLAG
2)INPUT	2) INPUT	2)INPUT
3)GND	3) GND	3)GND
4)OUTPUT	4) OUTPUT	4)OUTPUT
5)FLAG	5) ADJUST	5)ADJUST

*Tab is internally connected to GND

ORDERING INFORMATION

PART NUMBER	ACCURACY	OUTPUT VOLTAGE	PACKAGE
SPX29300U-1-8	1.0%	1.8V	3 lead TO-220
SPX29300U-2-5	1.0%	2.5V	3 lead TO-220
SPX29300U-3-3	1.0%	3.3V	3 lead TO-220
SPX29300U-5-0	1.0%	5.0V	3 lead TO-220
SPX29300T-1-8	1.0%	1.8V	3 lead TO-263
SPX29300T-1-8/TR	1.0%	1.8V	3 lead TO-263
SPX29300T-2-5	1.0%	2.5V	3 lead TO-263
SPX29300T-2-5/TR	1.0%	2.5V	3 lead TO-263
SPX29300T-3-3	1.0%	3.3V	3 lead TO-263
SPX29300T-3-3/TR	1.0%	3.3V	3 lead TO-263
SPX29300T-5-0	1.0%	5.0V	3 lead TO-263
SPX29300T-5-0/TR	1.0%	5.0V	3 lead TO-263

Available in lead free packaging. To order add "-L" suffix to part number.

Example: SPX29300T-5-0/TR = standard; SPX29300T-L-5-0/TR = lead free

/TR = Tape and Reel

Pack quantity is 500 for TO-263.

Sipex Corporation

Headquarters and Sales Office
233 South Hillview Drive
Milpitas, CA 95035
TEL: (408) 934-7500
FAX: (408) 935-7600

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ORDERING INFORMATION

PART NUMBER	ACCURACY	OUTPUT VOLTAGE	PACKAGE
SPX29301U5-1-8	1.0%	1.8V	5 lead TO-220
SPX29301U5-2-5	1.0%	2.5V	5 lead TO-220
SPX29301U5-3-3	1.0%	3.3V	5 lead TO-220
SPX29301U5-5-0	1.0%	5.0V	5 lead TO-220
SPX29301T5-1-8	1.0%	1.8V	5 lead TO-263
SPX29301T5-1-8/TR	1.0%	1.8V	5 lead TO-263
SPX29301T5-2-5	1.0%	2.5V	5 lead TO-263
SPX29301T5-2-5/TR	1.0%	2.5V	5 lead TO-263
SPX29301T5-3-3	1.0%	3.3V	5 lead TO-263
SPX29301T5-3-3/TR	1.0%	3.3V	5 lead TO-263
SPX29301T5-5-0	1.0%	5.0V	5 lead TO-263
SPX29301T5-5-0/TR	1.0%	5.0V	5 lead TO-263
SPX29302T5	1.0%	Adj	5 lead TO-263
SPX29302T5/TR	1.0%	Adj	5 lead TO-263
SPX29302U5	1.0%	Adj	5 lead TO-220
SPX29303T5	1.0%	Adj	5 lead TO-263
SPX29303T5/TR	1.0%	Adj	5 lead TO-263
SPX29303U5	1.0%	Adj	5 lead TO-220

Available in lead free packaging. To order add "-L" suffix to part number.
Example: SPX29302T5/TR = standard; SPX29302T5-L/TR = lead free

/TR = Tape and Reel
Pack quantity is 500 for TO-263.

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Headquarters and Sales Office
233 South Hillview Drive
Milpitas, CA 95035
TEL: (408) 934-7500
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