3A High Current, Low Dropout Voltage Regulator

Adjustable, Fast Response Time

FEATURES

- Adjustable Output Down To 1.25V
- 1% Output Accuracy
- Output Current of 3A
- Low Dropout Voltage of 370mV @ 3A
- Extremely Fast Transient Response
- Reverse-Battery Protection
- Zero Current Shutdown (5 pin version)
- Standard TO-220 and TO-263 Packages

APPLICATIONS

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

Refer to page 7 for pinouts.

Now Available in Lead Free Packaging

DESCRIPTION

The SPX29302A is a 3A, highly accurate voltage regulator with a low drop out voltage of 370mV (typical) @ 3A. These regulators are specifically designed for low voltage applications that require a low dropout voltage and a fast transient response. Fault protection features include over-current, reverse battery, and positive and negative voltage transients. On-Chip trimming adjusts the reference voltage to 1% initial accuracy.

The SPX29302A is offered in 5-pin TO-220 & TO-263 packages.

TYPICAL APPLICATION S CIRCUIT

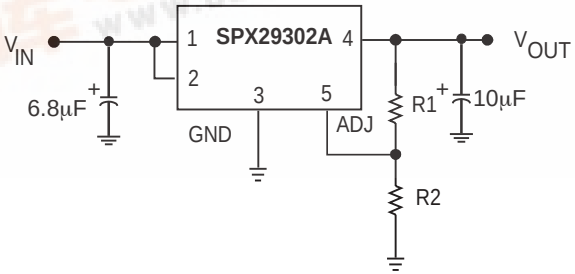


Figure 1. Adjustable Output Linear Regulator

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 7) 16V

ELECTRICAL CHARACTERISTICS

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

		SPX29302A			
PARAMETER	**CONDITIONS**	**TYP**	**MIN**	**MAX**	**UNITS**
Line Regulation	I_{OUT}=10mA,(V_{OUT}+1V) ≤ V_{IN} ≤ 16V	0.06		0.5	%
Load Regulation	$V_{IN}=V_{OUT}$+5V, 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	50 250 370		**175** **600**	mV
Ground Current (Note 5)	I_{OUT}=1.5A, $V_{IN}=V_{OUT}$+1V 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	1.7			mA
Current Limit	V_{OUT}=0V (Note 4)	4.0		5.0	A
Output Noise Voltage (10Hz to 100kHz) I_L=100mA	C_L=10μF C_L=33μF	400 260			μV_{RMS}
Reference Voltage		1.240	1.228 **1.215**	1.252 **1.265**	V_{MAX}
Reference Voltage	(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
ENABLE Input					
ΔInput 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-220 Junction to Case, at Tab TO-220 Junction to Ambient TO-263 Junction to Case, at Tab TO-263 Junction to Ambient	2 60 2 60			°C/W

NOTES:

Note 1: Maximum positive supply voltage of 20V must be of limited duration (<100msecond) < 1% 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

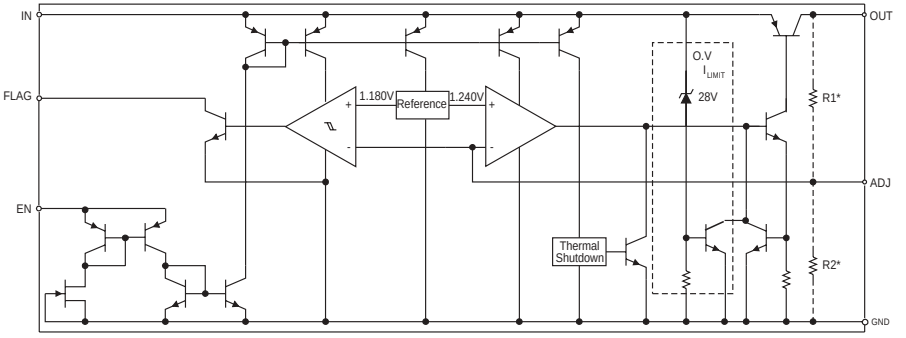
Note 7: Thermal regulation is defined as the change in output voltage at time T after a change in power dissipation is applied, excluding load / line regulation effects. Specifications for a 200mA load pulse as V_{IN} = 16V (a 4W pulse) for t = 10ms.

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

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



TYPICAL PERFORMANCE CHARACTERISTICS

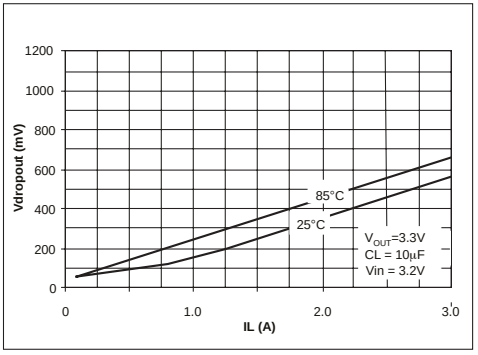


Figure 2. Dropout Voltage vs Load Current

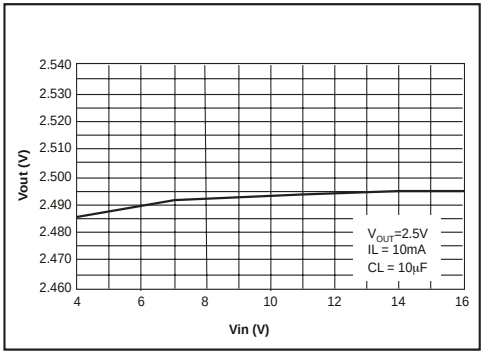


Figure 3. Line Regulation

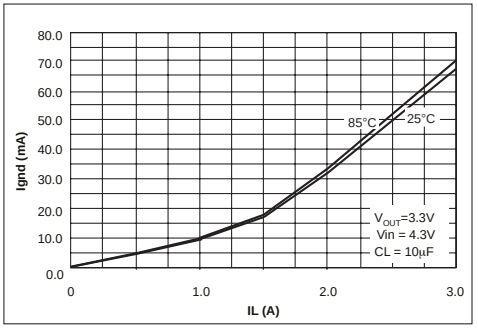


Figure 4. Ground Current vs Load Current

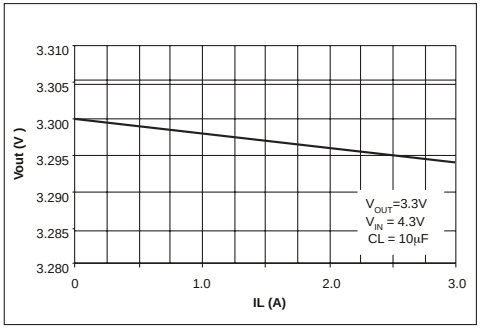


Figure 5. Load Regulation

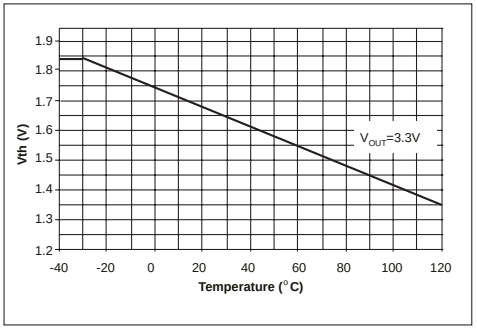


Figure 6. Enable Threshold vs Temperature

APPLICATION INFORMATION

The SPX29302A incorporates protection against over-current faults, reversed load insertion, over temperature operation, and positive and negative transient voltage.

Thermal Considerations
Although the SPX29302A 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 below 125°C.

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 SPX29302A is required.

Adjustable Regulator Design
The SPX29302A 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:

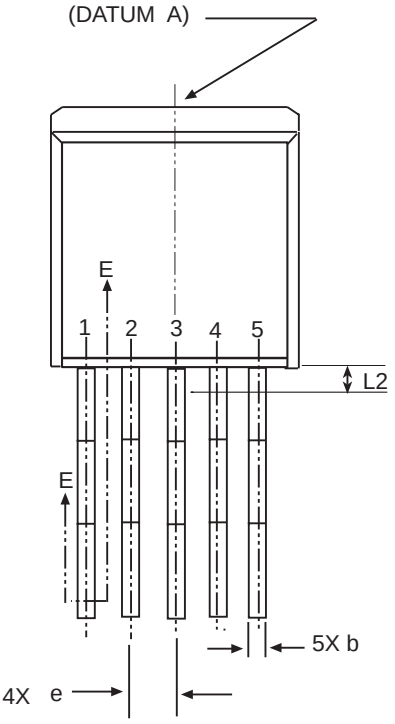
$$R1 = R2(V_{OUT}/1.240-1).$$

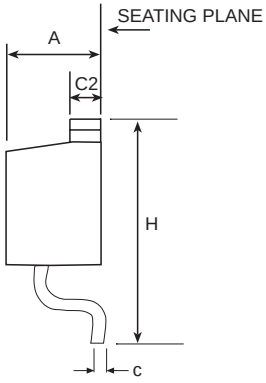
Enable Input
The SPX29302A has an Enable function that switches the regulator on and off.
Its thresholds is TTL compatible. When the regulator is active, approximately 20 uA flows through the Enable pin.

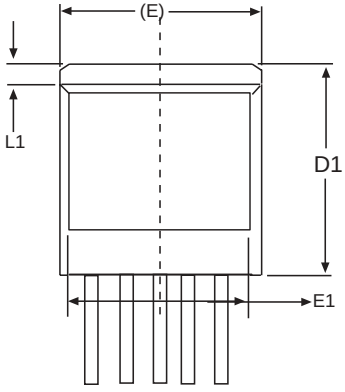
Typical Application Circuits
Figure 1 represents an adjustable output linear regulator. The values of R1 and R2 set the output voltage value as follows:

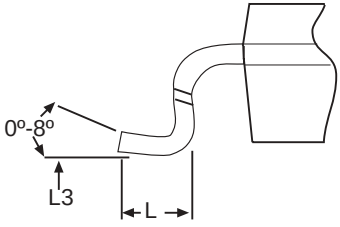
$$V_{OUT} = V_{REF} * [1 + (R1/R2)].$$

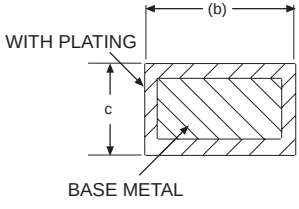
For best results, the total series resistance should be small enough to pass a minimum regulator load current of 5 mA. A minimum value of 10kohms is recommended for R2 with a range between 10kohms and 47 kohms.







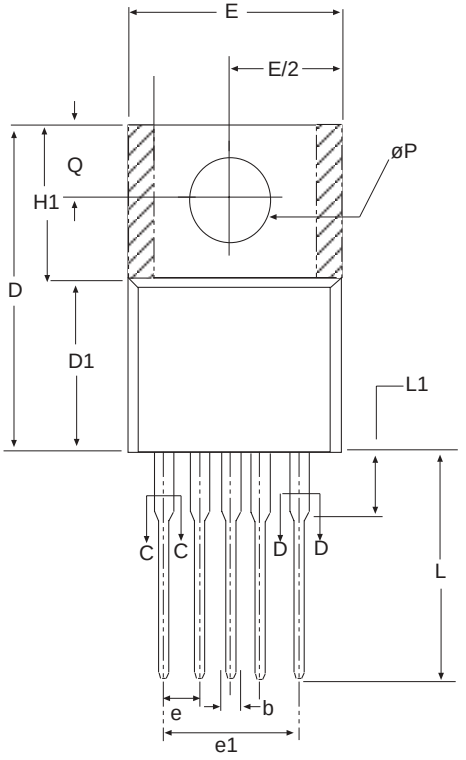


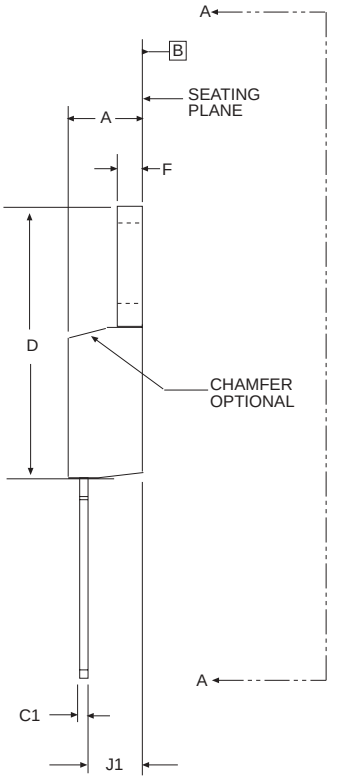


5 PIN TO-263 JEDEC TO-263 (BB) Variation	Dimensions in (mm)		
	MIN	NOM	MAX
A	.160	-	.190
A1	0	-	.010
b	.020	-	.039
c	.015	-	.029
c2	.045	-	.023
D1	.270	-	-
E	.380	-	.420
E1	.245	-	-
e	.067 BSC		
H	.575	-	.625
L	.070	-	.110
L1	-	-	.066
L2	-	-	.070
L3	.010 BSC		

5 PIN TO-263

PACKAGE: 5 PIN TO-220



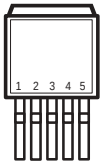


5 PIN TO-220	Dimensions in (inches)		
	MIN	NOM	MAX
A	.160	-	.190
b	.015	-	.040
C1	.014	-	.022
D	.560	-	.590
E	.385	-	.415
e	.385	-	.415
e1	.062	-	.072
F	.045	-	.055
H1	.234	-	.258
J1	.090	-	.115
L	.540	-	.560
L1		-	.250
ΔP	.146	-	.156
Q	.103	-	.113
U	-	.30	-
V	-	.24	-

5 PIN TO-220

PACKAGE: PINOUTS

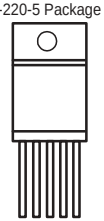
TO-263-5 Package (T5)



Top View

SPX29302A
1) ENABLE
2) INPUT
3) GND
4) OUTPUT
5) ADJUST

TO-220-5 Package (U5)



1 2 3 4 5
Top View

SPX29302A
1) ENABLE
2) INPUT
3) GND
4) OUTPUT
5) ADJUST

*Tab is internally connected to GND

ORDERING INFORMATION

PART NUMBER	ACCURACY	TOP MARK	OUTPUT VOLTAGE	PACKAGE
SPX29302AT5	1.0%	29302AT5YYWW	Adj	5 lead TO-263
SPX29302AT5/TR	1.0%	29302AT5YYWW	Adj	5 lead TO-263
SPX29302AU5	1.0%	29302AU5YYWW	Adj	5 lead TO-220

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

Example: SPX29302A/TR = standard; SP6685ER-L/TR = lead free

/TR = Tape and Reel

Pack quantity is 500 for TO-263.

Sipex Corporation

ANALOG EXCELLENCE

Sipex Corporation

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