GENERAL DESCRIPTION

The XRP29302 is a 3A, highly accurate voltage regulator with a low dropout voltage of 600mV (typical) at 3A.

This regulator is specifically designed for low voltage applications that require a low dropout voltage and a fast transient response. It is 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.

The XRP29302 is offered in 5-pin TO-220 & TO-263 packages.

APPLICATIONS

- **Adjustable Power Supplies**
- **Constant Current Regulators**
- **Audio and Video/Graphic Cards**
- **Battery Chargers**

FEATURES

- **3A Guaranteed Output Current**
- **Low Dropout Voltage of 600mV @ 3A**
- **Adjustable Output down to 1.25V**
- **1% Output Accuracy**
- **Tight Load and Line Regulation**
- **Fast Transient Response**
- **Reverse Battery Protection**
- **Zero Current Shutdown**
- **Drop-in Replacement to SPX29302**
- **Lead Free 5-pin TO220 and TO263 Packages**

(5-pin TO220 version is obsolete)

TYPICAL APPLICATION DIAGRAM

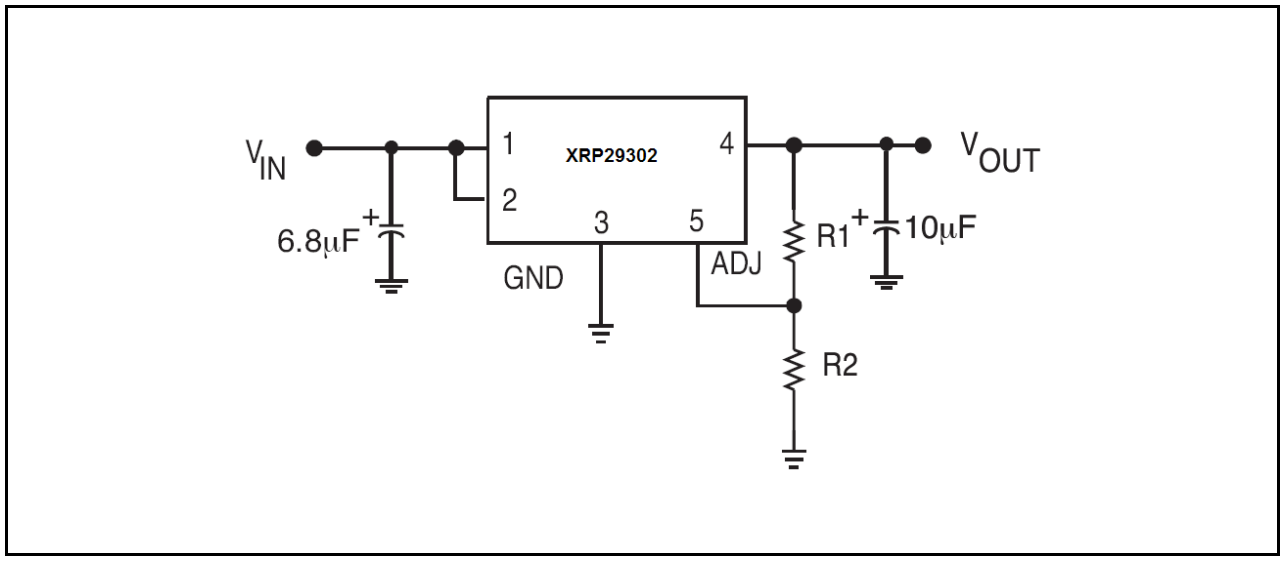


Fig. 1: XRP29302 Application Diagram

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 Junction to Case @ T_A ..... 3°C/W
TO-220 Junction to Ambient ..... 60°C/W
TO-263 Junction to Case @ T_A ..... 3°C/W
TO-263 Junction to Ambient ..... 60°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
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 (note 3)		120	300	mV	•	I_{OUT}=100mA
		380				I_{OUT}=1.5A
		525	650		•	I_{OUT}=2.5A, XRP29302A only
		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	1.228	1.24	1.252	V		
	1.215		1.265	V	•	
Adjust Pin Bias Current		40	80	nA		
			120		•	
Reference Voltage Temperature Coefficient		20		ppm/°C		Note 7
Adjust Pin Bias Current Temperature Coefficient		0.1		nA/°C		
Enable Input						
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 8

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: $V_{EN} \leq 0.8V$ and $V_{IN} \leq 16V$, $V_{OUT} = 0$.

BLOCK DIAGRAM

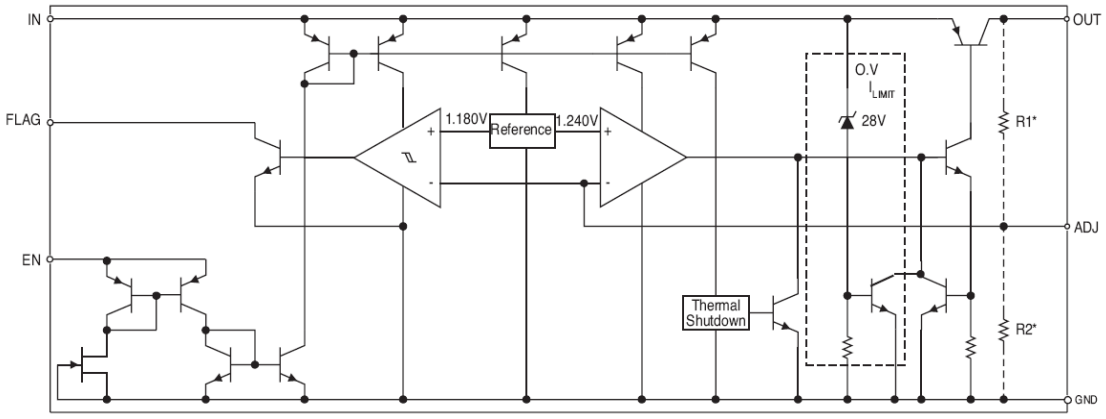
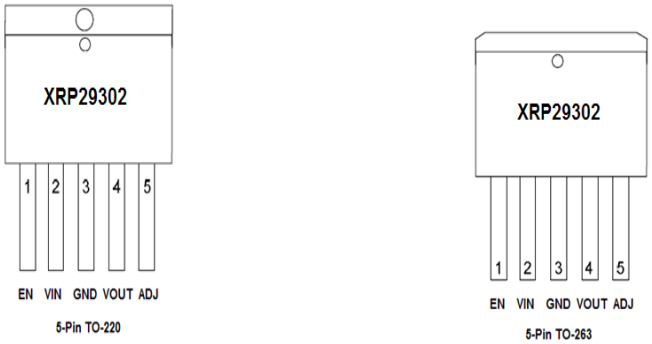


Fig. 2: XRP29302 Block Diagram

PIN ASSIGNMENT



5-pin TO-220 version is obsolete

Fig. 3: XRP29302 Pin Assignment

ORDERING INFORMATION(1), (2)

Part Number	Junction Temperature Range	Package	Packing Method	Lead Free(3)	Note 1
XRP29302ETBTR-L	-40°C ≤ T_J ≤ +125°C	5-pin TO263	Tape & Reel	Yes	
XRP29302AETBTR-L	-40°C ≤ T_J ≤ +125°C	5-pin TO263	Tape & Reel	Yes	Adjustable

Notes:

1. Refer to www.maxlinear.com/XRP29302 for most up-to-date Ordering Information.
2. 5-pin TO220 version is obsolete.
3. Visit www.maxlinear.com for additional information on Environmental Rating.
4. XRP29302AETBTR-L has the same package marking as XRP29302ETBTR-L. The "A" designator is only provided on the packaging label.

TYPICAL PERFORMANCE CHARACTERISTICS

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

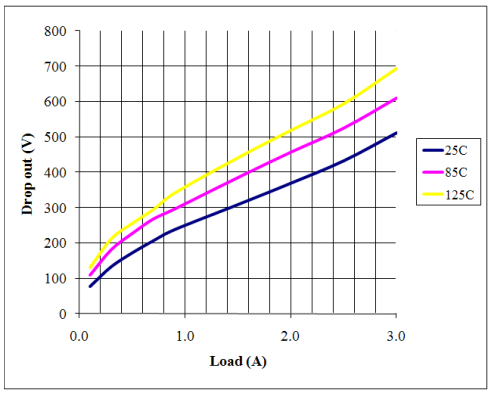


Fig. 4: Dropout Voltage vs Load Current

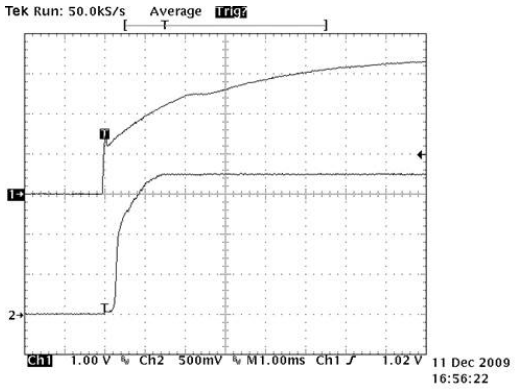


Fig. 5: Startup

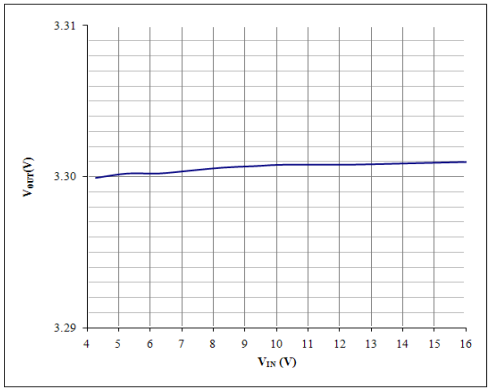


Fig. 6: Line Regulation
I_{OUT}=10mA, V_{OUT}=3.3V

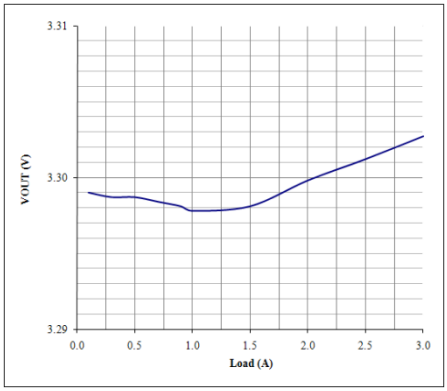


Fig. 7: Load Regulation
V_{OUT}=3.3V

THEORY OF OPERATION

The XRP29302 incorporates protection against over-current faults, reversed load insertion, over temperature operation, and positive and negative transient voltage.

THERMAL CONSIDERATIONS

Although the XRP29302 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

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 XRP29302 is required.

ADJUSTABLE REGULATOR DESIGN

The XRP29302 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:

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

ENABLE INPUT

The XRP29302 has an Enable function that switches the regulator on and off. Their thresholds are TTL compatible. When the regulator is active, approximately 20 µA flows through the Enable pin.

TYPICAL APPLICATION CIRCUITS

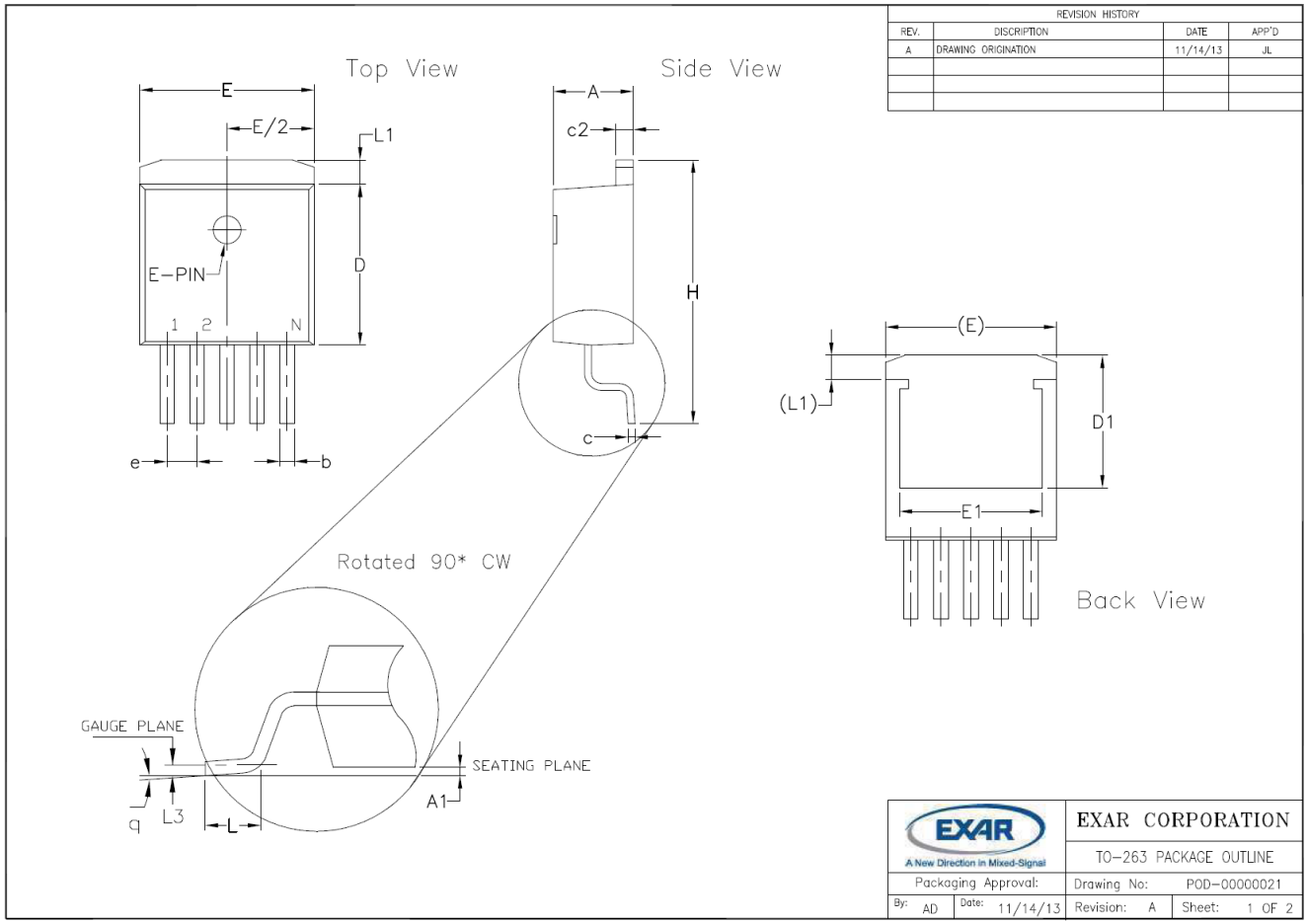
Figure 1 represents the typical implementation for an adjustable output regulator. The values of R1 and R2 set the output voltage value as follows:

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

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

PACKAGE SPECIFICATION

5-PIN TO263



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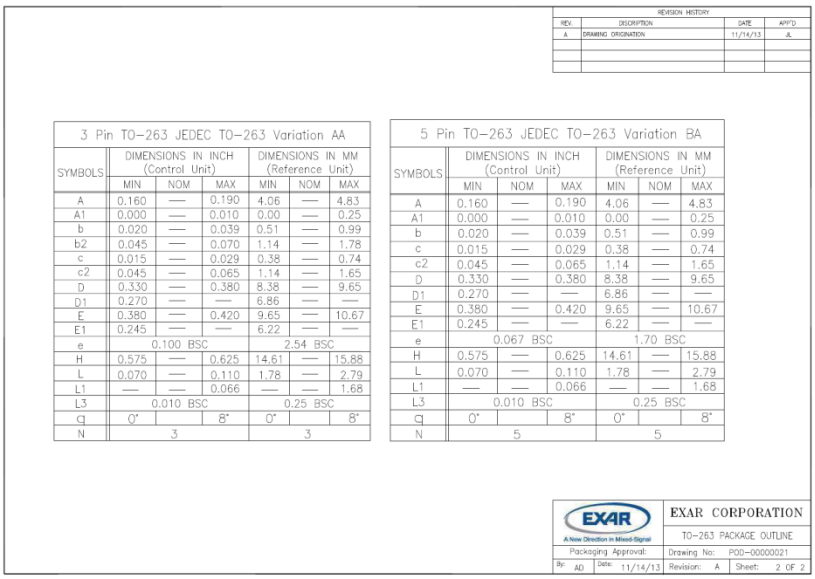

3 Pin TO-263 JEDEC TO-263 Variation AA

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		
q	0°		8°	0°		8°
N	3			3		

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		
q	0°		8°	0°		8°
N	5			5		

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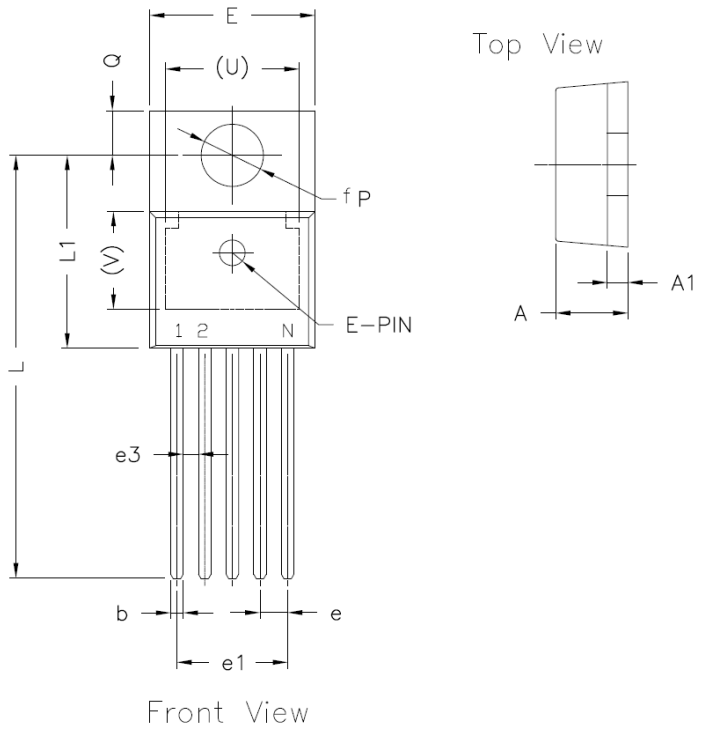
*: Dimension "A" (overall package thickness) is controlled to 0.181" maximum for XRP29302 only. Typical dimension "A" guaranteed for any other device in a 5-pin TO263 is 0.190" inch maximum.

(THIS PACKAGE VERSION IS OBSOLETE) 5-PIN TO220

REVISION HISTORY			
REV.	DISCRIPTION	DATE	APP'D
A	DRAWING ORIGINATION	11/14/13	AD



EXAR A New Direction in Mixed-Signal		EXAR CORPORATION	
		TO-220 PACKAGE OUTLINE	
Packaging Approval:		Drawing No:	POD-00000020
By: AD	Date: 11/14/13	Revision: A	Sheet: 1 OF 2

ECN 1346-06 11/14/2013

REVISION HISTORY			
REV.	DISCRIPTION	DATE	APP'D
A	DRAWING ORIGINATION	11/14/13	AD

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	
q	3°	7°	3°	7°
N	3		3	

* Refer to product datasheet for POD option being used

3 Pin TO-220 (Option 2)*

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	0.345 BSC		8.76 BSC	
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	
q	3°	7°	3°	7°
N	3		3	

* Refer to product datasheet for POD option being used

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	
q	3°	7°	3°	7°
N	5		5	

EXAR A New Direction in Mixed-Signal		EXAR CORPORATION	
		TO-220 PACKAGE OUTLINE	
Packaging Approval:		Drawing No:	POD-00000020
By: AD	Date: 11/14/13	Revision: A	Sheet: 2 OF 2

ECN 1346-06 11/14/2013

REVISION HISTORY

Revision	Date	Description
1.0.0	12/17/2009	Initial Release of Datasheet
1.1.0	12/23/2009	Addition of ESD data
1.2.0	10/19/2010	Corrected Adjustable Regulator Design paragraph equation
1.3.0	11/25/2013	Added XRP29302A with 2.5A dropout specification Updated Package Outline Drawing. ECN 1348-10
1.4.0	03/25/2014	Corrected pin out drawings where EN was shown as VIN. ECN 14xx-xx
1.4.1	11/04/2019	Updated to MaxLinear logo. Updated Ordering Information.

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