SPX2940

1A Low Dropout Voltage Regulator

August 2009
Rev. 2.0.0

GENERAL DESCRIPTION

The SPX2940 is a 1A, accurate voltage regulators with a low drop out voltage of 280mV (typical) at 1A.

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.

The SPX2940 is offered in 3-pin TO-220 & TO-263 packages. For a 3A version, refer to the SPX29300 data sheet.

APPLICATIONS

- Power Supplies
- LCD Monitors
- Portable Instrumentation
- Medical and Industrial Equipments

FEATURES

- Guaranteed 1.5A Peak Current
- Low Quiescent Current
- Low Dropout Voltage of 280mV at 1A
- Extremely Tight Load and Line Regulation
- Extremely Fast Transient Response
- Reverse-battery Protection
- Internal Thermal Protection
- Internal Short Circuit Current Limit
- Replacement for LM2940, MIC2940A, AS2940
- Standard TO-220 and TO-263 packages

TYPICAL APPLICATION DIAGRAM

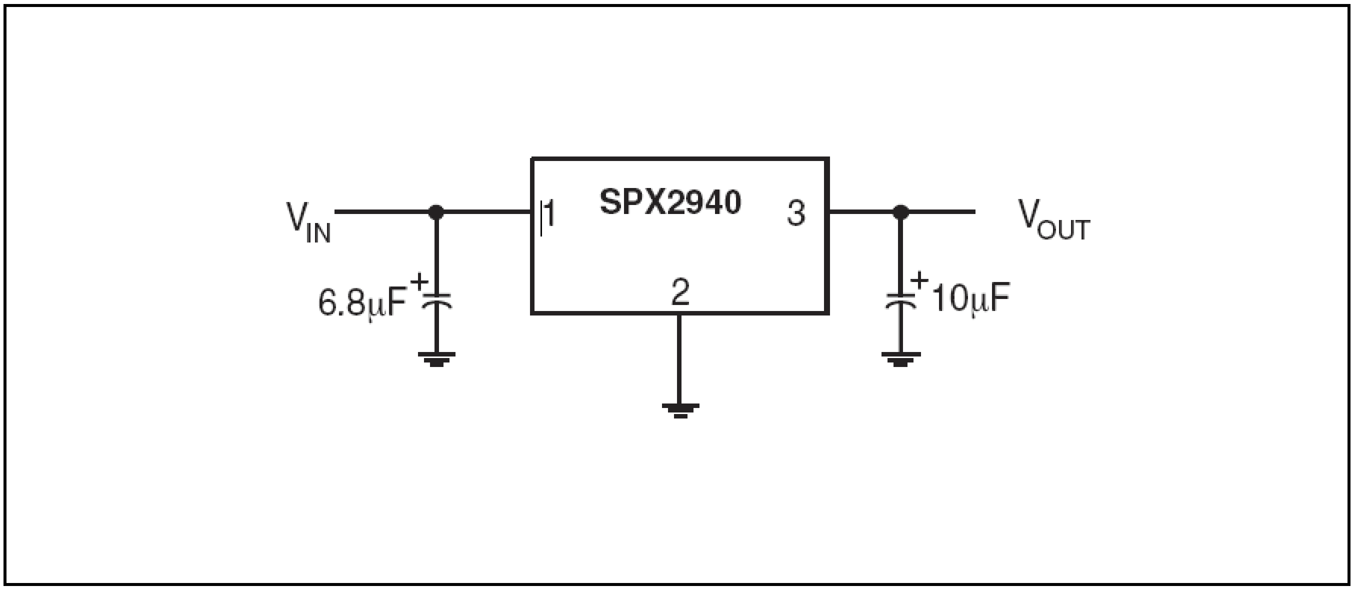

Fig. 1: SPX2940 Application Diagram – Fixed Output Linear Regulator

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} .... 16V[1]
Storage Temperature .... -65°C to 150°C
Lead Temperature (Soldering, 5 sec) .... 260°C

OPERATING RATINGS

Junction Temperature Range ....-40°C to 125°C
TO-220 Package
Thermal Resistance, Junction to Case (at T_A) .... 4°C/W
TO-263 Package
Thermal Resistance, Junction to Case (at T_A) .... 4°C/W

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

ELECTRICAL SPECIFICATIONS

Specifications with standard type are for an Operating Ambient Temperature of $T_A = 25°C$ 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 $T_A = 25°C$, and are provided for reference purposes only. Unless otherwise indicated, $V_{IN} = V_{IN} + 1V$, $I_{OUT} = 10mA$, $C_{IN} = 6.8\mu F$, $C_{OUT} = 10\mu F$, $T_A = 25°C$.

Parameter	Min.	Typ.	Max.	Units		Conditions
5.0V version						
Output Voltage	4.850	5.0	5.150	V		I_{OUT}=10mA
	4.750	5.0	5.250	V	•	10mA≤I_{OUT}≤1A, 6V≤V_{IN}≤16V
Line Regulation		0.2	1.0	%		I_{OUT}=10mA, (V_{OUT}+1V)≤V_{IN}≤16V
Load Regulation		0.3	1.5	%		$V_{IN} = V_{OUT}$ +1V,10mA≤I_{OUT}≤1A
$\frac{\Delta V}{\Delta T}$ - Output Voltage temperature Coefficient		20	100	ppm/°C	•	
Dropout Voltage[2] (except 1.8V version)		70	200	mV	•	I_{OUT}=100mA
		280	550	mV	•	I_{OUT}=1A
Ground Current[3]		12	25	mA	•	I_{OUT}=750mA, $V_{IN} = V_{OUT}$ +1V
		18		mA		I_{OUT}=1A
I_{GNDDO} Ground Pin Current at Dropout		1.2		mA		V_{IN} = 0.1V less than specified V_{OUT} I_{OUT}=10mA,
Current Limit		1.5	2.2	A		V_{OUT} = 0V[4]
Output Noise Voltage		400		μV_{RMS}		10Hz-100KHz, I_L=100mA, C_L=10µF
		260		μV_{RMS}		10Hz-100KHz, I_L=100mA, C_L=33µF

Note 2: Dropout voltage is defined as the input to output differential when the output voltage drops to 99% of its normal value.
Note 3: 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 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.

BLOCK DIAGRAM

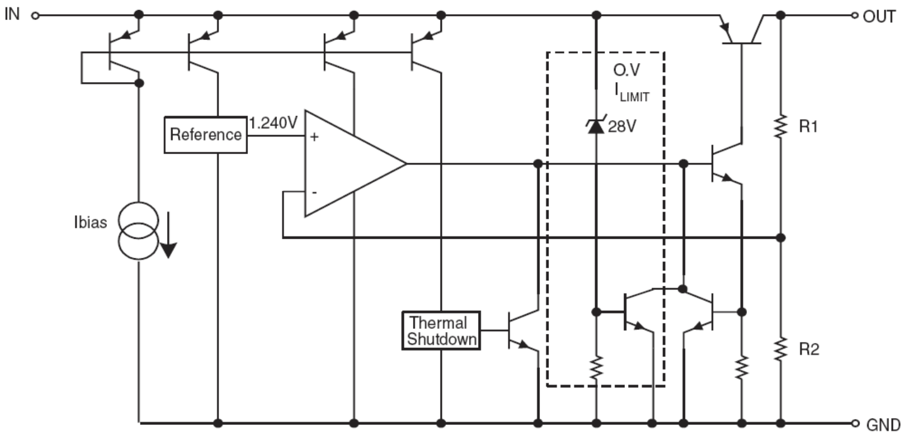

Fig. 2: SPX2940 Block Diagram

PIN ASSIGNMENT

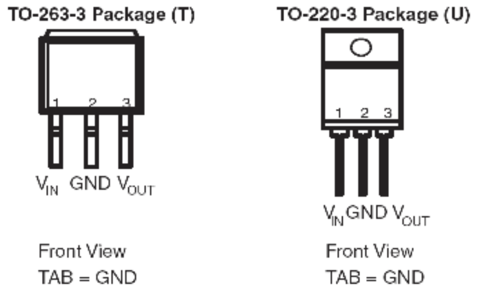

Fig. 3: SPX2940 Pin Assignment

ORDERING INFORMATION

Part Number	Temperature Range	Marking	Package	Packing Quantity	Note 1	Note 2
SPX2940T-L-5-0/TR	-40°C≤T_J≤+125°C	SPX2940T 50YYWWLX	3-pin TO-263	500/Tape & Reel	Lead Free	5.0V Output Voltage
SPX2940U-L-5-0	-40°C≤T_J≤+125°C	SPX2940U 50YYWWLX	3-pin TO-220	Bulk	Lead Free	5.0V Output Voltage

“YY” = Year – “WW” = Work Week – “X” = Lot Number

TYPICAL PERFORMANCE CHARACTERISTICS

Schematic and BOM from Application Information section of this datasheet.

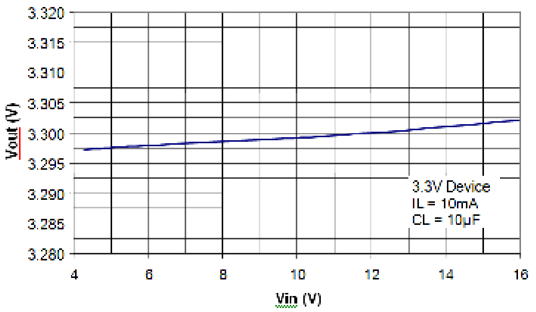

Fig. 4: Line Regulation

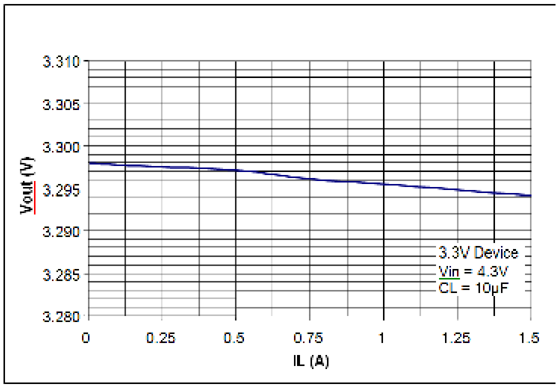

Fig. 5: Load Regulation

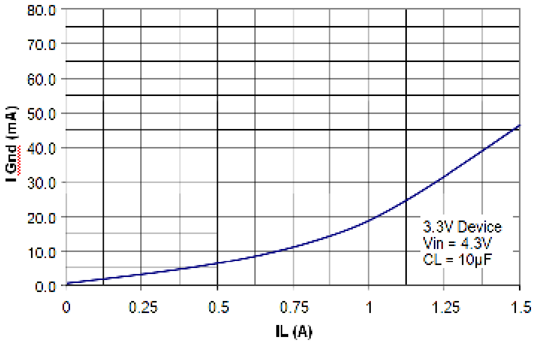

Fig. 6: Ground Current vs Load Current

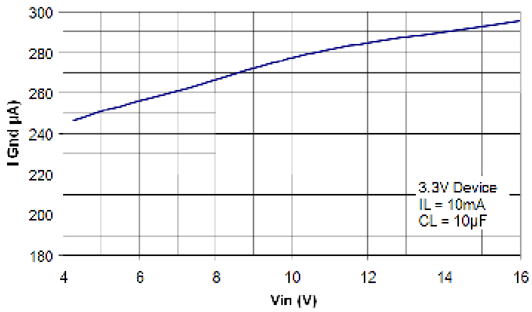

Fig. 7: Ground Current vs Input Voltage

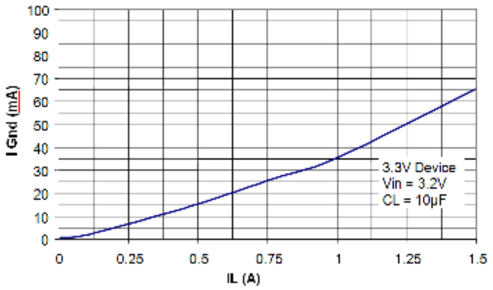

Fig. 8: Ground Current vs Current in Dropout

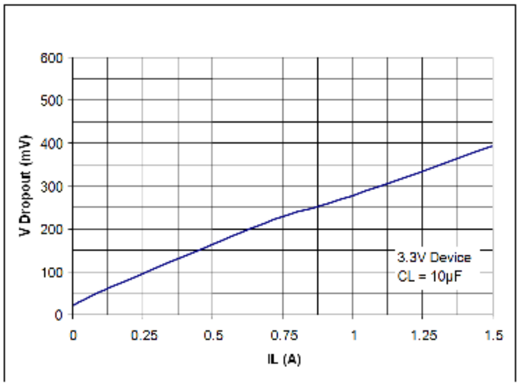

Fig. 9: Dropout Voltage vs Load Current

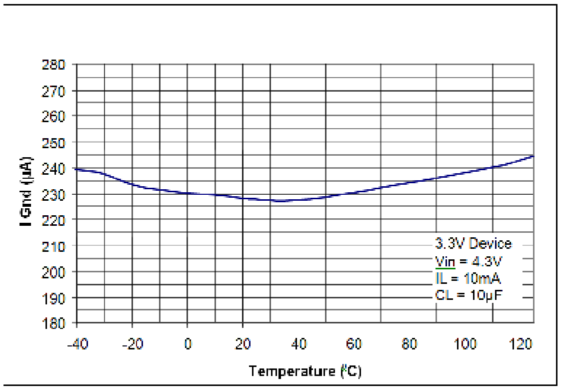

Fig. 10: Ground Current vs Temperature
I_{LOAD}= 100mA

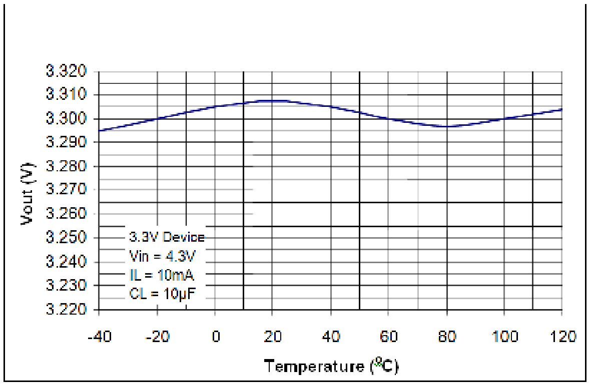

Fig. 11: Output Voltage vs Temperature
I_{LOAD}= 100mA

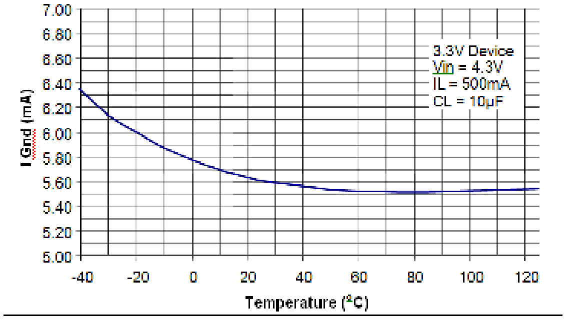

Fig. 12: Ground Current vs Temperature
I_{LOAD}= 500mA

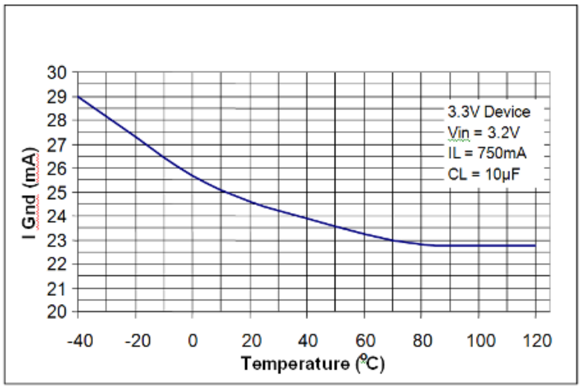

Fig. 13: Ground Current vs Temperature
Dropout, I_{LOAD}= 750mA

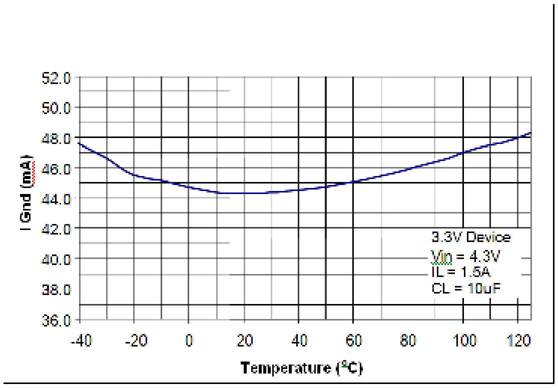

Fig. 14: Ground Current vs Temperature
I_{LOAD}= 1.5A

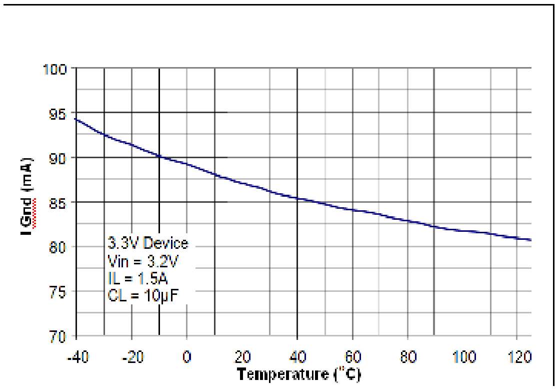

Fig. 15: Ground Current vs Temperature
Dropout, I_{LOAD}= 1.5A

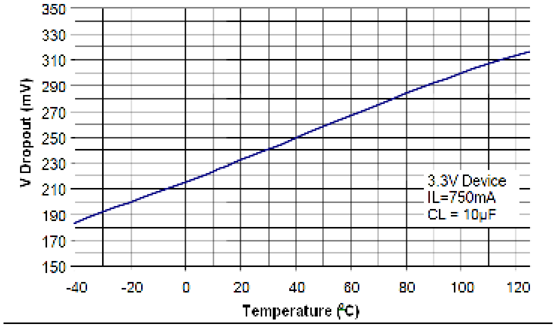

Fig. 16: Dropout Voltage vs Temperature
I_{LOAD}= 750mA

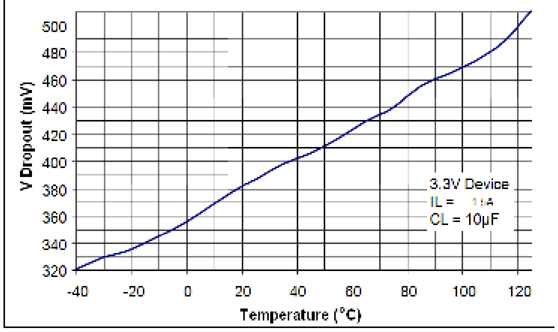

Fig. 17: Dropout Voltage vs Temperature
I_{LOAD}= 1.5A

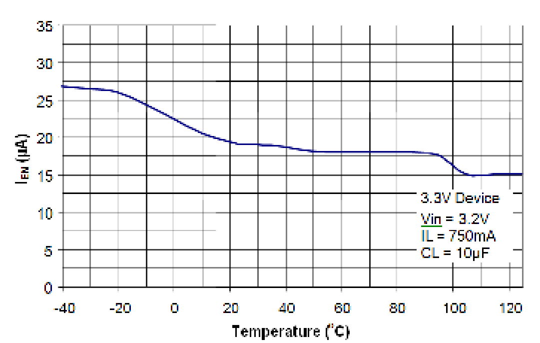

Fig. 18: Enable Current vs Temperature
V_{EN}= 16V

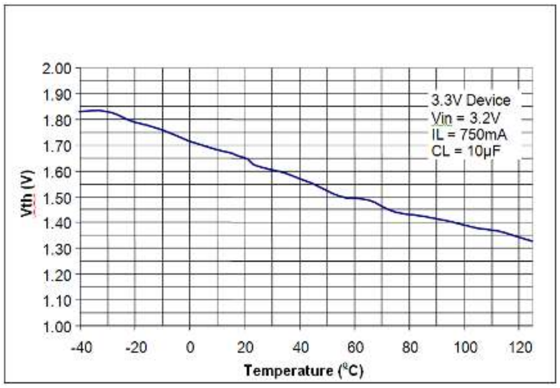

Fig. 19: Enable Threshold vs Temperature

THEORY OF OPERATION

The SPX2940 incorporates protection against over-current faults, reversed load insertion, over temperature operation, and positive and negative transient voltage.

THERMAL CONSIDERATIONS

Although the SPX2940 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. Since the case of the device is electrically connected to the output, the case must be electrically isolated using a thermally conductive spacer, which itself contributes some small additional thermal resistance. Consult heatsink manufacturer for thermal resistance and design of heatsink.

TO-220 Design Example:

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

$T_J = T_A + P_D * (\theta_{HA} + \theta_{CH} + \theta_{JC})$ 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 SPX2940 is required.

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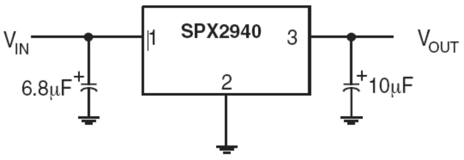


Fig. 20: Fixed Output Linear Regulator

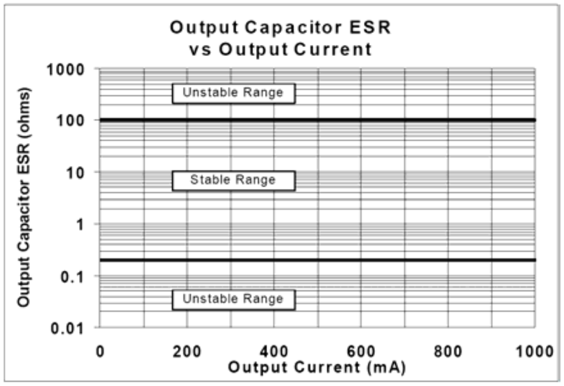


Fig. 21: Ouput Cap ESR vs I_{OUT}

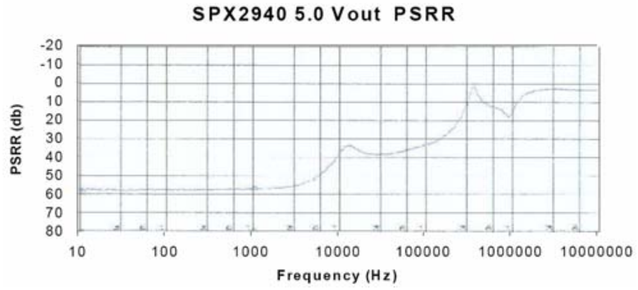
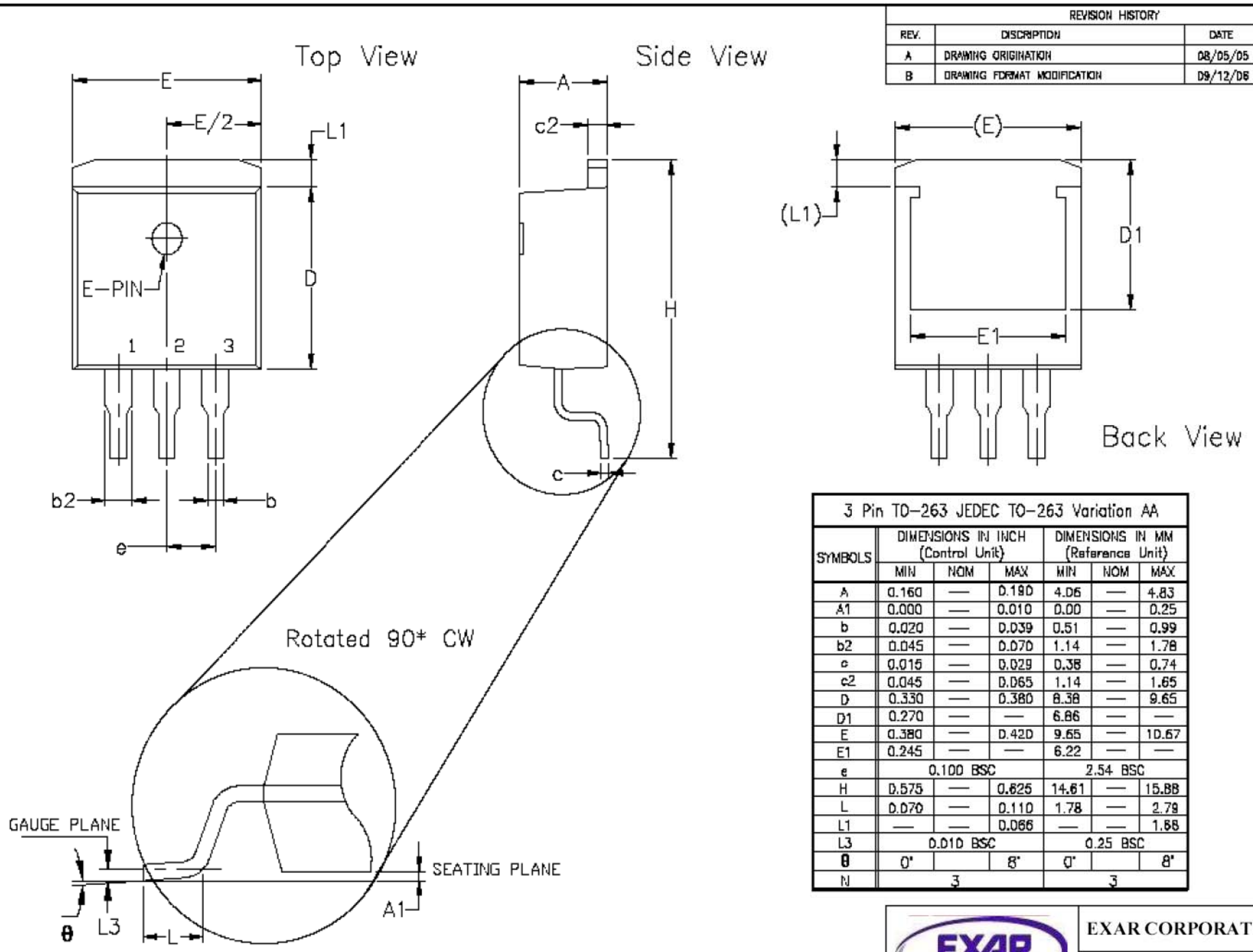


Fig. 22: 5.0V_{OUT} PSSR V_{IN}=10V, V_{OUT}=5V
C_{OUT}=22F, I_{OUT}=10mA

PACKAGE SPECIFICATION

3-PIN TO-263

REVISION HISTORY			
REV.	DISCRIPTION	DATE	APP'D
A	DRAWING ORIGINATION	08/05/05	JL
B	DRAWING FORMAT MODIFICATION	09/12/06	JL

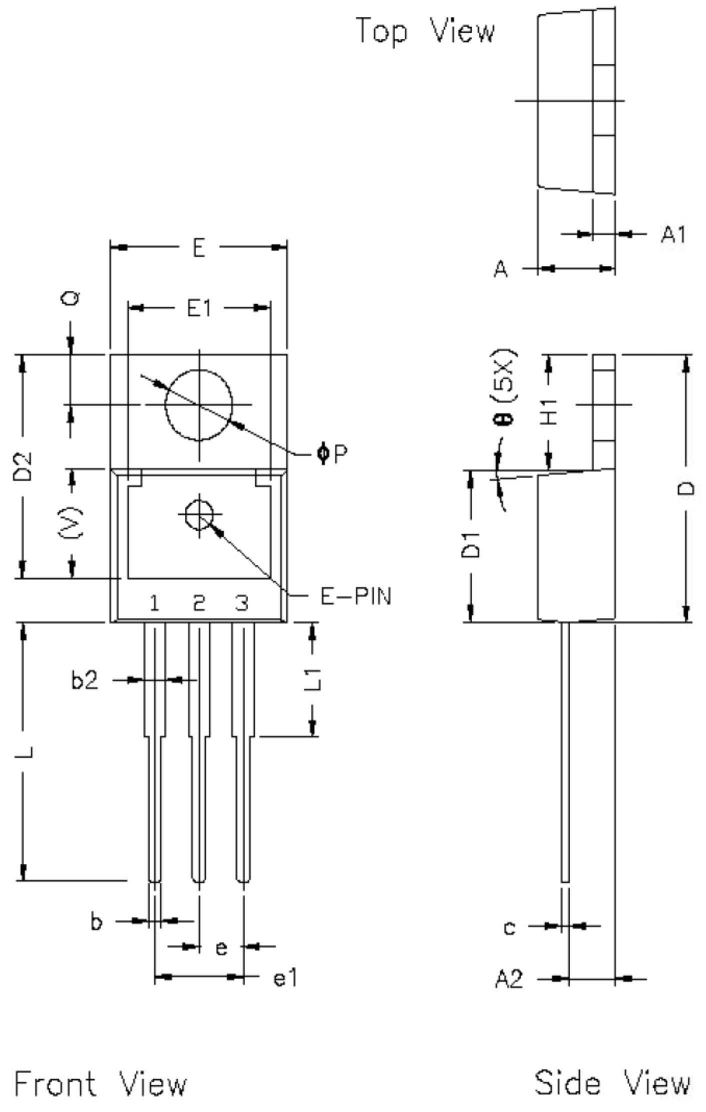


3 Pin TO-263 JEDEC TO-263 Variation AA						
SYMBOLS	DIMENSIONS IN INCH (Control Unit)			DIMENSIONS IN MM (Reference Unit)		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.160	—	0.190	4.06	—	4.83
A1	0.000	—	0.010	0.00	—	0.25
b	0.020	—	0.039	0.51	—	0.99
b2	0.045	—	0.070	1.14	—	1.78
c	0.015	—	0.029	0.38	—	0.74
c2	0.045	—	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		

		EXAR CORPORATION	
		3 PIN TO-263 PACKAGE OUTLINE	
Packaging Approval:		Drawing No:	3-PIN TO-263
By: JL	Date: 09/12/06	Revision: B	Sheet: 1 OF 1

3-PIN TO-220

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

EXAR 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

REVISION HISTORY

Revision	Date	Description
F	11/03/2007	
2.0.0	08/06/2009	Reformat of Datasheet Updated θ_{JC} values

FOR FURTHER ASSISTANCE

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