SPX2941

Data Sheet

1A Low Dropout Fast Response Voltage Regulator

General Description

The SPX2941 is a 1A, accurate voltage regulator with a low drop out voltage of 280mV (Typ.) at1A. These regulators are 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 SPX2941 is offered in a 5-pin TO-263 package. For more information about a 3A version, refer to the SPX29300 data sheet.

TO-263 version available, TO-220 version obsolete

For more details about the ordering information, see "Ordering Information" on page 11.

Features

- Adjustable output down To 1.25V
- Low quiescent current
- Guaranteed 1.5A peak output current
- Low dropout voltage of 280mV @ 1A
- Extremely tight load and line regulation
- Extremely fast transient response
- Reverse-battery protection
- Internal thermal and current limit protection
- Zero current shutdown

Applications

- Industrial equipment
- Telecommunications equipment
- LCD Monitors
- USB Power supply
- SMPS Post-regulator
- Battery charger
- Constant current regulators

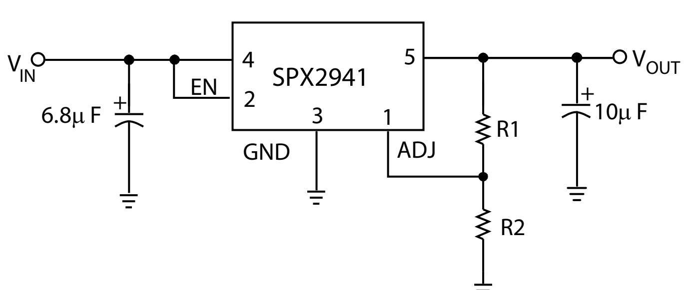

Figure 1: SPX2941 Typical Application

Revision History

Document No.	Release Date	Change Description
244DSR00	May 17, 2023	**Updated:** ■ New template applied, contents rewriting, and obsolete packages highlighted. ■ "General Description" section. ■ "Features" section. ■ "Applications" section. ■ "Specifications" section. ■ "Pin Information" section. ■ "Application Information" section. ■ "Ordering Information" section.
Rev E	Sept 28-06	Legacy Sipex data sheet.

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Specifications

Absolute Maximum Ratings

Important: The stresses above what is listed under the following table may cause permanent damage to the device. This is a stress rating only—functional operation of the device above what is listed under the following table or any other conditions beyond what MaxLinear recommends is not implied. Exposure to conditions above the recommended extended periods of time may affect device reliability. Solder reflow profile is specified in the IPC/JEDEC J-STD-020C standard.

Table 1: Absolute Maximum Ratings

	Min	Max	Units
Lead Temperature (soldering, 5 seconds)	–65	150	°C
Storage Temperature Range	-	260	°C
Operating Junction Temperature Range	–40	125	°C
Input Supply Voltage	-	16	V
Input Supply Voltage <100ms, < 1% duty cycles	-	20	V

Thermal Specifications

TO-263 version available, TO-220 version obsolete

Table 2: Thermal Performance

Symbol	Parameter	Package	Typ	Units
Ψ_{JB}	Junction to Case, at Tab	TO-220	3	°C/W
Θ_{JA}	Junction to Ambient	TO-220	29.3	°C/W
Ψ_{JB}	Junction to Case, at Tab	TO-263	3	°C/W
Θ_{JA}	Junction to Ambient	TO-263	31.2	°C/W

Electrical Characteristics

Electrical characteristics at $V_{IN} = V_{OUT} + 1V$, $T_A = 25°C$, $C_{IN} = 6.8uF$, $C_{OUT} = 10μF$, $I_{OUT} = 10mA$, unless otherwise specified. Adjustable versions are set at 5.0V. The • denotes the specifications that apply over the full operating temperature range of $–40°C \le T_J \le 125°C$, unless otherwise specified.

Table 3: Electrical Characteristics

Parameter	Conditions		Min	Typ	Max	Units
Reference Voltage	Adjustable version only, $2.5 \le V_{IN} \le 16V$		1.228	1.240	1.252	V
		•	1.215	-	1.265	
Adjust Pin Bias Current	-		-	40	80	nA
		•	-	-	120	
Reference Voltage Temperature Coefficient[4]	-		-	20	-	ppm/°C
Adjust Pin Bias Current Temperature Coefficient	-		-	0.1	-	nA/°C
Line Regulation	$I_O = 10mA$, $(V_{OUT} + 1V) \le V_{IN} \le 16V$		-	0.2	1.0	%
Load Regulation	$V_{IN} = V_{OUT} + 1V$, $10mA \le I_{OUT} \le I_{FULLLOAD}$		-	0.3	1.5	%
Dropout Voltage[1] (except 1.8V version)	$I_O = 100mA$	•	-	70	200	mV
	$I_O = 1A$	•	-	280	550	
Ground Current[3]	$I_O = 750mA$, $V_{IN} = V_{OUT}$, +1V	•	-	12	25	mA
	$I_O = 1A$		-	18	-	
I_{GNDDO} Ground Pin Current at Dropout	V_{IN} = 0.1V less than specified V_{OUT} $I_{OUT} = 10mA$		-	1.2	-	mA
Current Limit[2]	$V_{OUT} = 0V$		1.5	2.2	-	A
Output Noise Voltage	(10Hz to 100kHz), $I_L = 100mA$, $C_L = 10μF$		-	400	-	$μV_{RMS}$
	(10Hz to 100kHz), $I_L = 100mA$, $C_L = 33μF$		-	260	-	
Low (OFF)	Input Logic Voltage ($V_{IN} < 10V$)	•	-	-	0.8	V
High (ON)		•	2.4	-	-	
Enable Input Pin Input Current	$V_{EN} = 16V$		-	100	600	μA
		•	-	-	750	
	$V_{EN} = 0.8V$		-	-	1	μA
		•	-	-	2	
Regulator Output Current in Shutdown[5]	-		-	10	-	μA
		•	-	-	500	

1. Dropout voltage is defined as the input to output differential at which the output voltage drops to 99% of its nominal value.

2. $V_{IN} = V_{OUT}$ (NOMINAL) + 1V; for example, $V_{IN} = 4.3V$ for a 3.3V regulator. Employ pulse-testing procedures to minimize temperature rise.

3. Ground pin current is the regulator quiescent current. The total current drawn from the source is the sum of the load and ground currents.

4. Thermal regulation is defined as the change in the output voltage at a time T after a change in power dissipation is applied, excluding load or line regulation effects.

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

Pin Information

TO-263 version available, TO-220 version obsolete

Pin Configuration

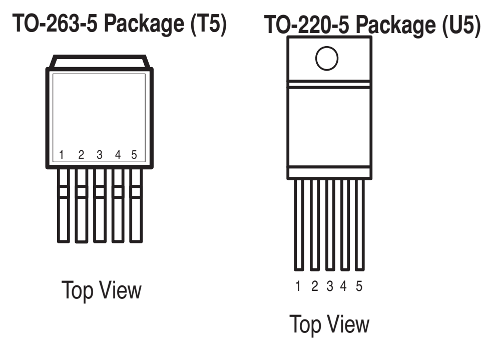


Figure 2: SPX2941 Pin Configuration

Pin Description

Table 4: Pin Description

Pin Number	Pin Name	Description
1	ADJ	Output voltage adjust pin. For more information on how to set the output voltage, see "Application Information" on page 8.
2	EN	Enable pin. < 0.8V the device is turned off and >2.4V the device is guaranteed to be turned on.
3	GND	Ground pin. Connect to tab.
4	VIN	Input voltage pin. Bypass to GND with ≥6.8µF capacitor.
5	VOUT	Output voltage pin. Bypass to GND with ≥10µF capacitor.
Tab	GND	Ground and die attach paddle. Best thermal performance requires heat sinking to internal ground planes using multiple vias.

Typical Performance Characteristics

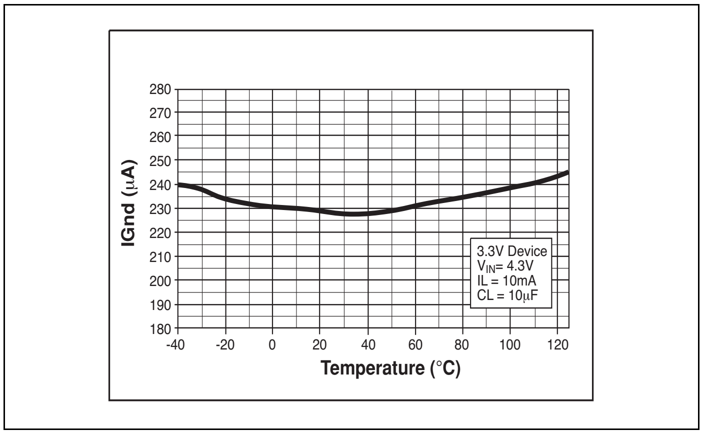


Figure 3: Line Regulation for 3.3V Device

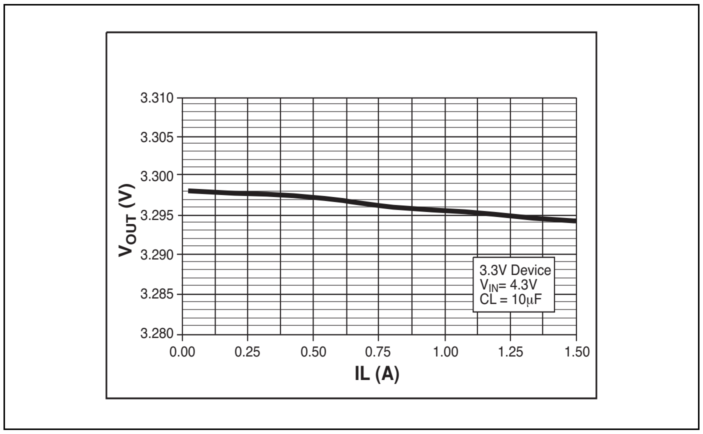


Figure 4: Load Regulation for 3.3V Device

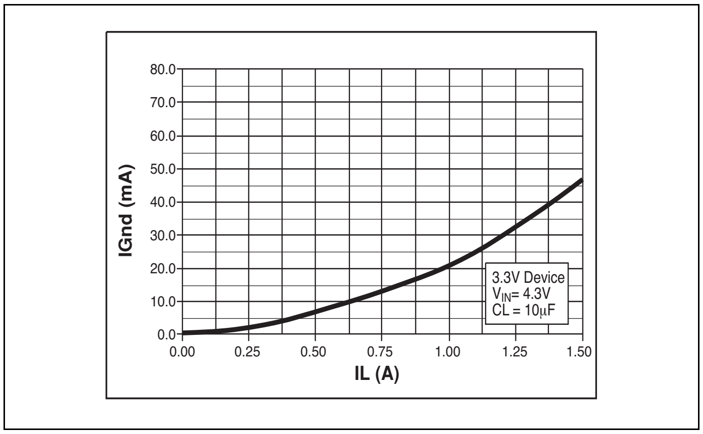


Figure 5: Ground Current vs Load Current for 3.3V Device

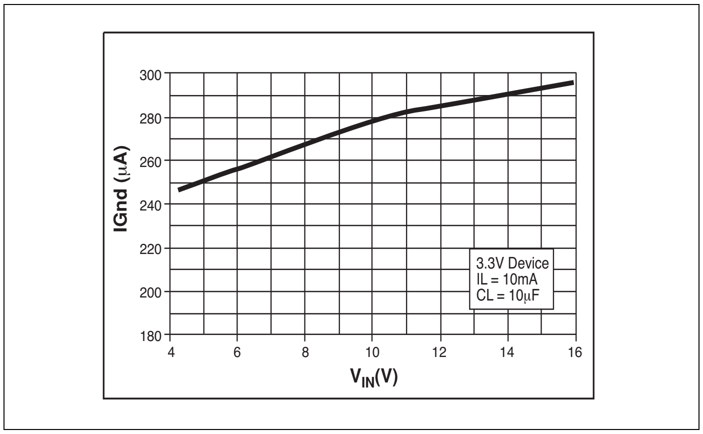


Figure 6: Ground Current vs Input Current

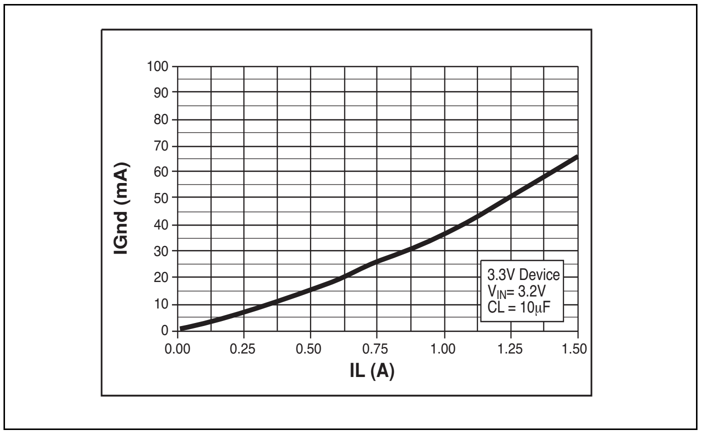


Figure 7: Ground Current vs Load Current in Dropout

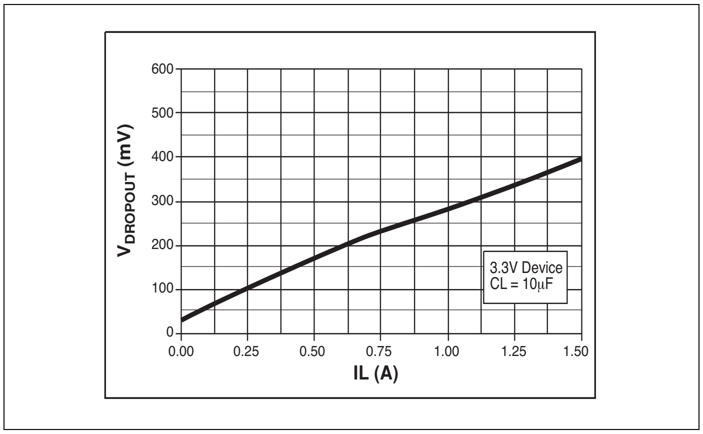


Figure 8: Dropout Voltage vs Load Current for 3.3V

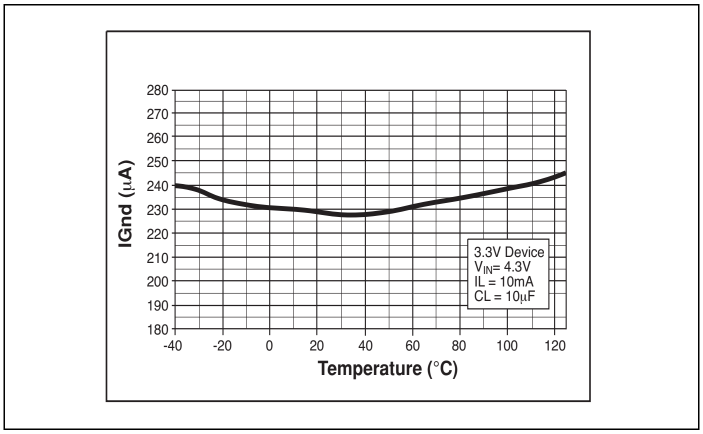


Figure 9: Ground Current vs Temperature at I_{LOAD} = 10mA

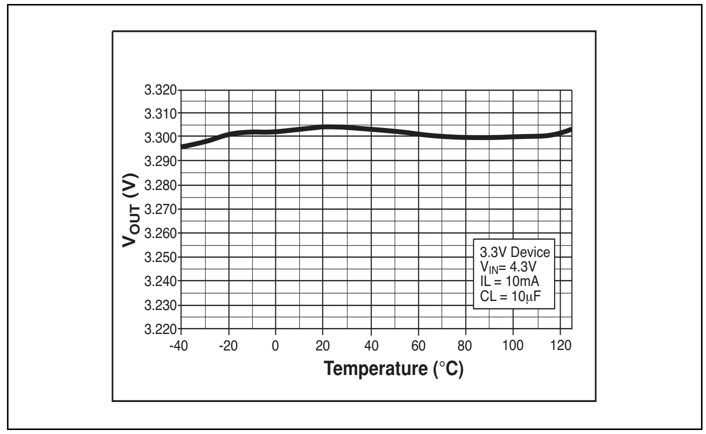


Figure 10: Output Voltage vs Temperature at I_{LOAD} = 10mA

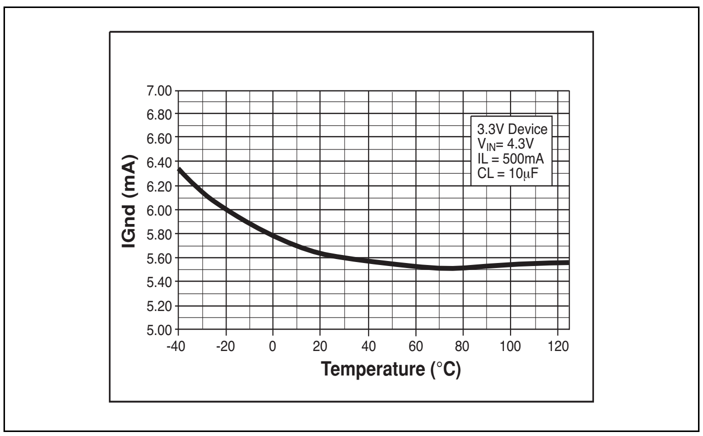


Figure 11: Ground Current vs Temperature at I_{LOAD} = 500mA

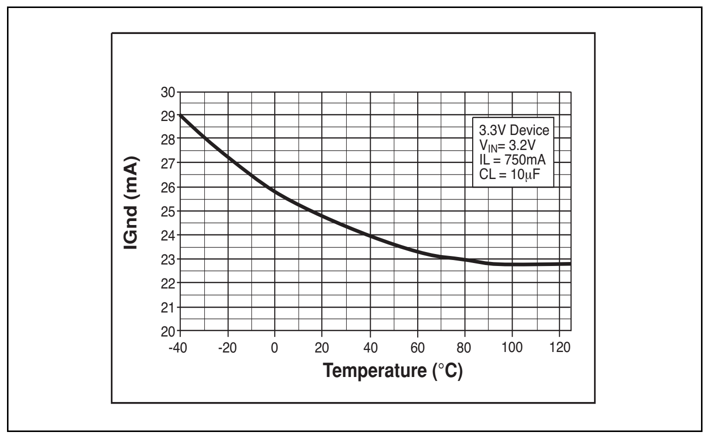


Figure 11: Ground Current vs Temperature in Dropout at I_{LOAD} = 750mA

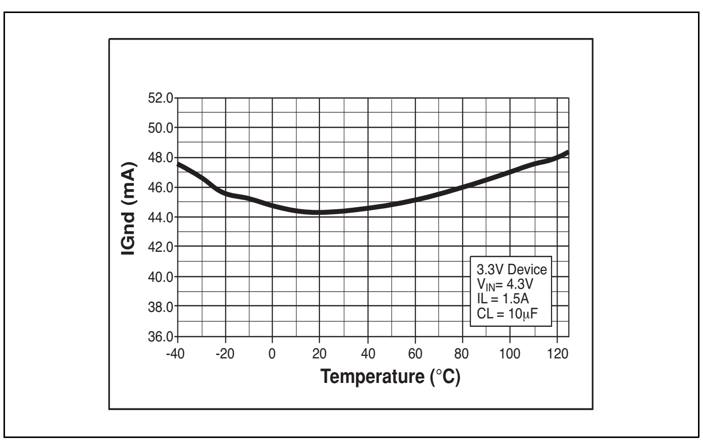


Figure 12: Ground Current vs Temperature at I_{LOAD} = 10mA

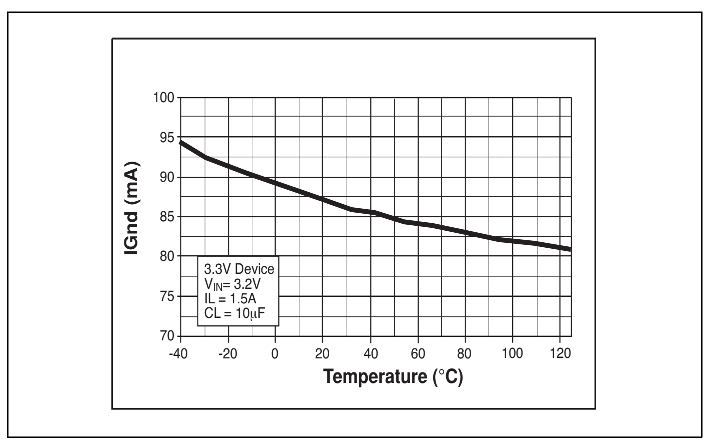


Figure 13: Ground Current vs Temperature in Dropout at I_{LOAD} = 1.5mA

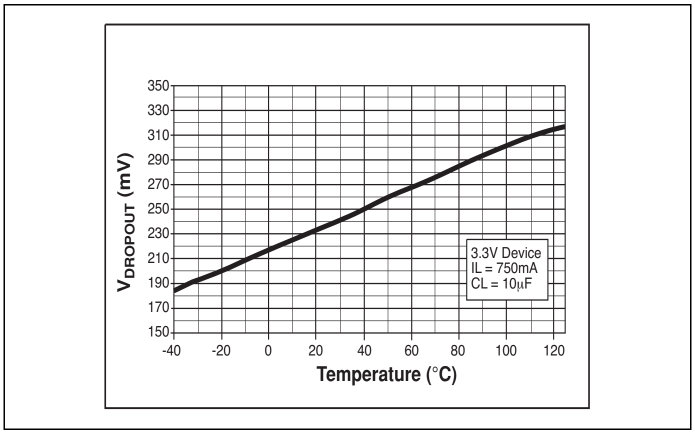


Figure 14: **Dropout Voltage vs Temperature at I_{LOAD} = 750mA**

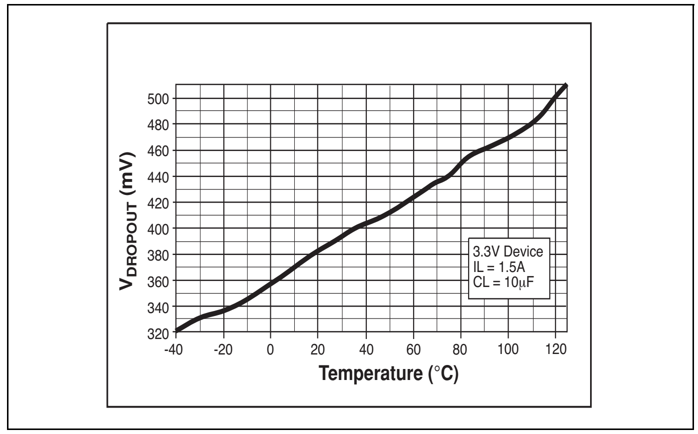


Figure 15: **Dropout Voltage vs Temperature at I_{LOAD} = 1.5mA**

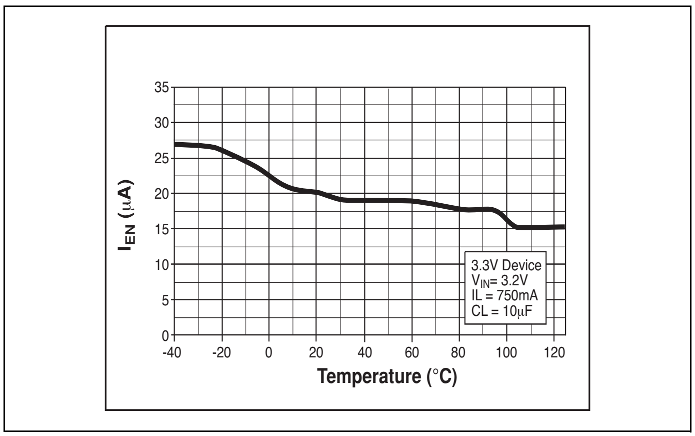


Figure 16: **Enable Current vs Temperature for 3.3V Devices**

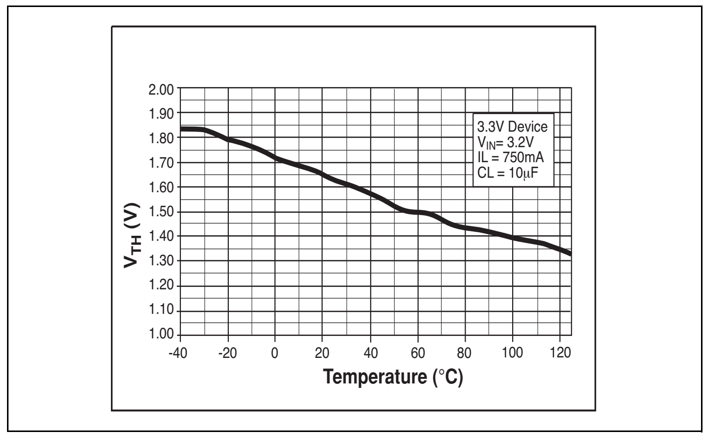


Figure 17: **Enable Threshold vs Temperature for 3.3V Devices**

Block Diagram

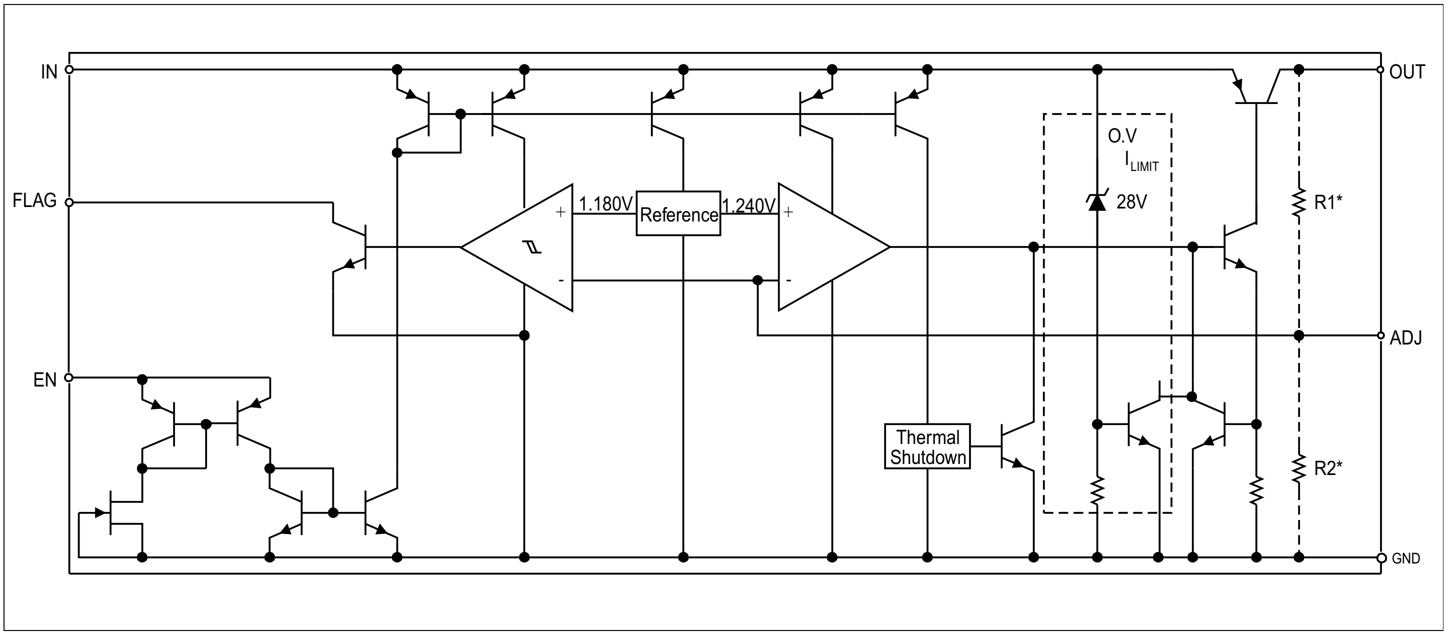


Figure 18: SPX2941 Block Diagram

Application Information

The SPX2941 incorporates protection against over-current faults, reversed load insertion, over temperature operation, and positive and negative transient voltage.

Thermal Considerations

Although he SPX2941 offers limiting circuitry for overload conditions, it is still necessary to ensure that the maximum junction temperature is not exceeded in the application. Heat flows through the lowest resistance path, the junction-to-case path. The tab of the device is electrically connected to GND. To ensure the best thermal flow of the component, proper mounting is required.The tab of the device should be electrically and thermally connected to the PCB's main ground plane with multiple vias to get the best thermal performance.

Power dissipation is calculated as follows:

$P_D = (V_{IN} – V_{OUT}) × I_{OUT}$

Junction temperature range is calculate as follows:

$T_J = T_A(max) + PD × θ_{JA}$ (thermal resistance, junction-to-ambient)

The maximum junction temperature must not exceed 125°C.

Capacitor Requirements

The output capacitor s needed to ensure stability and minimize the output noise. The value of the capacitor varies with the load. However, a minimum value of 10µF aluminum capacitor guarantees stability over all load conditions. MaxLinear recommends a tantalum capacitor if a faster load transient response is needed. If the power source has a high AC impedance, MaxLinear also recommends a 0.1µF ceramic capacitor between input and ground.

Minimum Load Current

To ensure the expected regulator performance under the light load, a minimum load of 5mA for the SPX2941 device is required.

Typical Application Circuits

Figure 19 shows a typical applications circuit for an adjustable output regulator. The values of R1and R2 set the output voltage value as follows:

$V_{OUT} = V_{REF} × [1 + (R1/R2)]$

MaxLinear recommends a minimum value of 10kΩ is for R2 with a range from 10kΩ to 47kΩ.

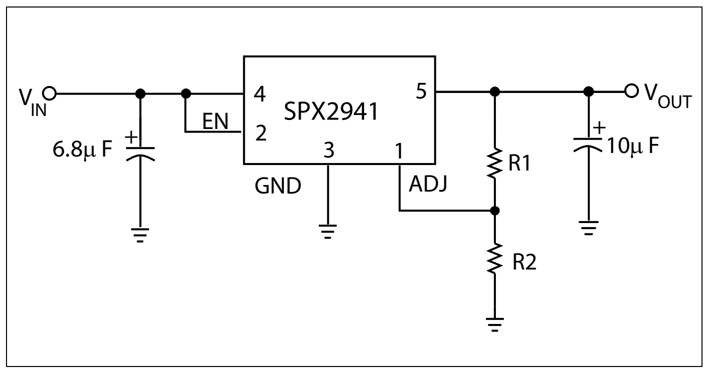
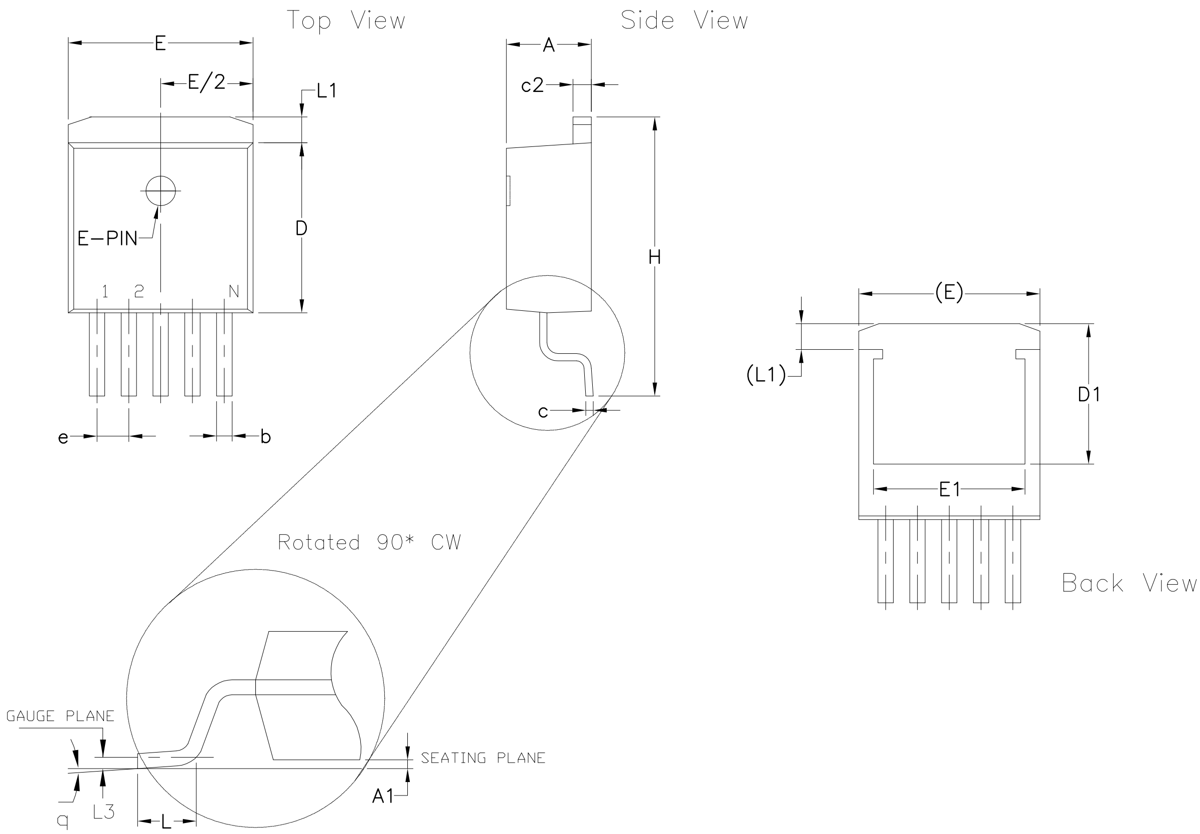


Figure 19: Adjustable Output Linear Regulator

Mechanical Dimensions

5-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		
q	0°		8°	0°		8°
N	3			3		

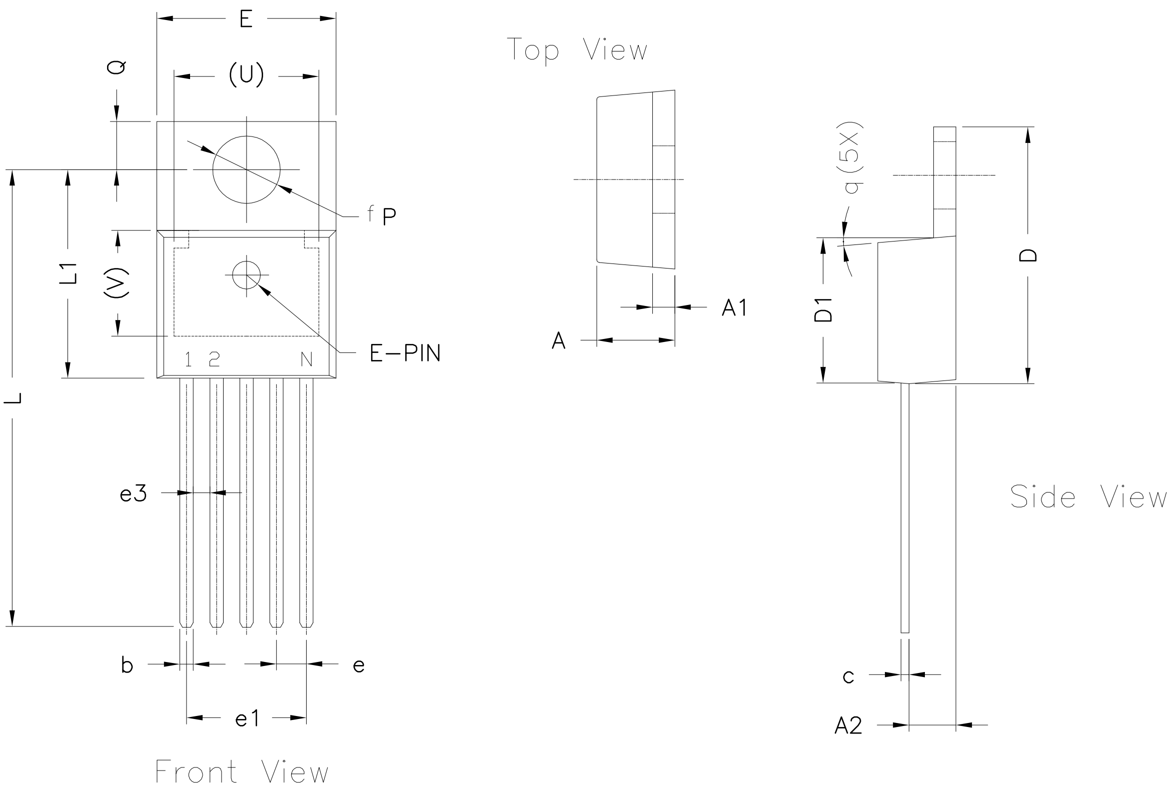
5 Pin TO-263 JEDEC TO-263 Variation BA						
SYMBOLS	DIMENSIONS IN INCH (Control Unit)			DIMENSIONS IN MM (Reference Unit)		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.160	—	0.190	4.06	—	4.83
A1	0.000	—	0.010	0.00	—	0.25
b	0.020	—	0.039	0.51	—	0.99
c	0.015	—	0.029	0.38	—	0.74
c2	0.045	—	0.065	1.14	—	1.65
D	0.330	—	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		

Drawing No: POD-00000021
Revision: A

Figure 20: SPX2941 Mechanical Dimensions–5-Pin TO-263

5-pin TO-220

TO-220 version obsolete



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	

Drawing No: POD-00000020
Revision: A

Figure 21: SPX2941 Mechanical Dimensions–5-Pin TO-220

Ordering Information

Table 5: Ordering Information

Ordering Part Number	Operating Temperature Range	Accuracy	Output Voltage	Package	Packaging Method
SPX2941T5-L/TR	$-40°C \leq T_J \leq 125°C$	3%	Adj	5 lead TO-263	Tape and Reel

Note: For more information about part numbers, as well as the most up-to-date ordering information and additional information on environmental rating, go to www.maxlinear.com/SPX2941.

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