SPX1582

Data Sheet

3A Ultra Low Dropout Fast Response Voltage Regulator

General Description

The SPX1582 is a 3A low dropout regulator with extremely low dropout voltage. The adjustable version requires only two external resistors to set the output voltage. The SPX1582 features a low dropout of 400mV (typ.) and offers fast transient response. This device is suitable for applications requiring outputs at low current with an input voltage of 1V greater than the output voltage. With an external SENSE pin, the load regulation is less than 1mV. This device is an excellent choice for use in powering low-voltage microprocessors that require a lower dropout, fast transient response converting from 3.3V and 5V supplies.
The SPX1582 is also an excellent choice as a post-regulator for switching supply applications.

The SPX1582 offers protection against overcurrent faults, reversed input polarity, overtemperature operation, and positive or negative transient voltages.

The SPX1582 is offered in a 5-pin TO-263 compatible with industry standard 5-terminal regulators.

Features

- Low dropout voltage 500mV at 3A full load current
- Adjustable ouput down to 1.25V from 3.3V and 5V supplies
- Extremely tight load and line regulation
- Standard 5-terminal low-cost TO-263

Applications

- Microprocessor core and memory supplies
- Low-cost 3.3V, 2.5V, 1.8V, and 1.5V I/O power
- 5.5V to 5V conversion with high power supply rejection ratio (PSRR) isolation

TO-263 version available, TO-220 version obsolete

Typical Applications Circuits

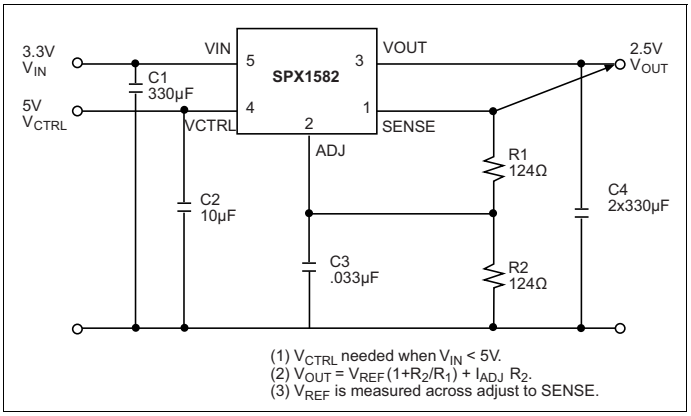


Figure 1: Adjustable Regulator

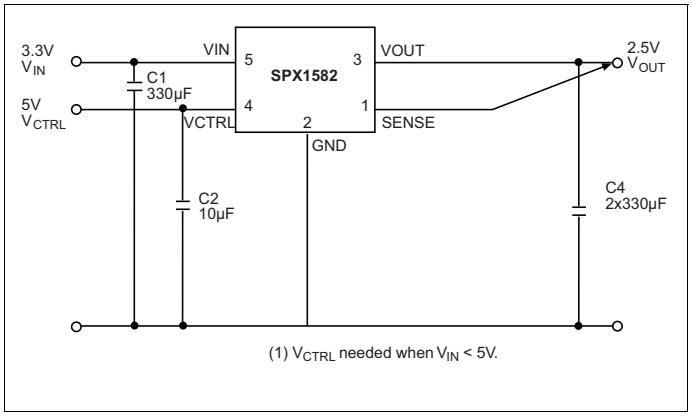


Figure 2: Typical Fixed Regulator

Revision History

Revision	Release Date	Change Description
250DSR00	May 19, 2023	**Updated:** ■ New template applied, contents rewriting, and obsolete packages highlighted. ■ Subtitle of the document. ■ "General Description" section. ■ "Features" section. ■ "Applications" section. ■ "Specifications" section. ■ "Application Information" section. ■ "Mechanical Dimensions—5 Pin TO-220" figure. ■ "Mechanical Dimensions—5 Pin TO-263" figure. ■ "Ordering Information" section. **Added:** ■ In "Typical Fixed Regulator" figure, symbol of capacitor C1. ■ "Pin Configuration" section.
Rev F	June 17, 2006	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

Parameter	Min	Max	Units
Power Dissipation	Internally Limited		-
Storage Temperature Range	–65	150	°C
Operating Junction Temperature Range			
SPX1582 Control Section	0	125	°C
SPX1582 Power Transistor	0	150	°C
Input Supply Voltage	-	6	V
VCTRL Input Voltage	-	13	V

Thermal Specifications

TO-263 version available, TO-220 version obsolete

Table 2: Thermal Performance

Symbol	Parameter	Package	Max	Units
θ_{JC}	Junction to Case	TO-220-5	3	ºC/W
θ_{JA}	Junction to Ambient	TO-220-5	29.3	ºC/W
θ_{JC}	Junction to Case	TO-263-5	3	ºC/W
θ_{JA}	Junction to Ambient	TO-263-5	31.2	ºC/W

Electrical Characteristics

Electrical characteristics at $V_{OUT} = V_{SENSE}$, $V_{ADJ} = 0V$, $T_A = 25°C$, $C_{CTL} = C_{PWR} = C_{OUT} = 33\mu F$ tantalum capacitor, unless otherwise specified. The • denotes the specifications that apply over the full temperature range of –40°C to 85°C, unless otherwise specified.

Table 3: Electrical Characteristics

Parameter	Conditions		Min	Typ	Max	Units
2.5V Version						
Output Voltage	V_{CTRL} = 6.0V to 12V, V_{IN} = 3.0V to 5.0V, I_O = 10mA		2.450	2.5	2.550	V
	V_{CTRL} = 6.0V to 12V, V_{IN} = 3.0V to 5.0V, I_O = 10mA to 3A	•	2.400	-	2.600	
2.8V Version						
Output Voltage	V_{CTRL} = 6.3V to 12V, V_{IN} = 3.3V + 0.8V, I_O = 10mA		2.744	2.8	2.856	V
	V_{CTRL} = 6.3V to 12V, V_{IN} = 3.3V + 0.8V, I_O = 10mA to 3A	•	2.688	-	2.912	
3.3V Version						
Output Voltage	V_{CTRL} = 6.3V to 12V, V_{IN} = 3.3V + 0.8V, I_O = 10mA		3.234	3.3	3.366	V
	V_{CTRL} = 6.3V to 12V, V_{IN} = 3.3V + 0.8V, I_O = 10mA to 3A	•	3.168	3.3	3.432	
All Voltage Options						
Reference Voltage	V_{CTRL} = 2.75V, V_{IN} = 2.00V, I_O = 10mA		1.238	1.25	1.263	V
	V_{CTRL}= 2.7V to 12V, V_{IN} = 2.05V to 5.5V, I_O = 10mA to 3A		1.238	1.25	1.263	
Line Regulation	V_{CTRL} = 2.5V to 12V, V_{IN} = 1.75 to 5.5V, I_O= 10mA, V_{ADJ} = 0V	•	-	1.0	3.0	mV
Load Regulation[1]	V_{CTRL} = 2.75V, V_{IN} = V_{OUT} + 1.5V, I_O = 10mA to 3A, V_{ADJ} = 0V	•	-	1.0	5.0	mV
Dropout Voltage Min. V_{CTRL}[2] (V_{IN} – V_{OUT})	V_{ADJ} = 0V, V_{IN} = 2.05V, I_O = 1A		-	1.05	1.18	V
Dropout Voltage Min. V_{IN}[2] (V_{IN} – V_{OUT})	V_{ADJ} = 0V, V_{IN} = 2.75V, I_O = 3A		-	0.40	0.50	V
Current Limit	V_{CTRL} = 2.75V, V_{IN} = 2.05V, Δ V_{OUT} = 100mV, V_{ADJ} = 0V		3.1	-	-	A
Minimum Load Current	V_{CTRL} = 5V, V_{IN} = 3.3V, V_{ADJ} = 0V	•	-	5	10	mA
Thermal Regulation	30ms pulse		-	0.002	0.02	%/W
Ripple Rejection	V_{CTRL} = 3.75V, V_{IN} = 3.75V, I_O = 2.3A, V_{ADJ} = 0V, T_J = 25, V_{RIPPLE} = 1Vpp at 120Hz		60	80	-	dB
Control Pin Current	V_{ADJ} = 0V, V_{CTRL} = 2.75V, V_{IN} = 2.05V, I_O = 3A	•	-	60	120	mA
Adjustable Pin Current	V_{CTRL} = 2.75V, V_{IN} = 2.05V, V_{ADJ} = 0V, I_O = 10mA	•	-	50	120	µA

1. Low duty cycle pulse testing with Kelvin connections is required to order to maintain accurate data.

2. Dropout voltage is defined as the minimum differential between V_{IN} and V_{OUT} or V_{CTRL} and V_{OUT} required to maintain regulation at V_{OUT} 95% nominal V_{OUT}.

Pin Information

Pin Configuration

TO-263 version available, TO-220 version obsolete

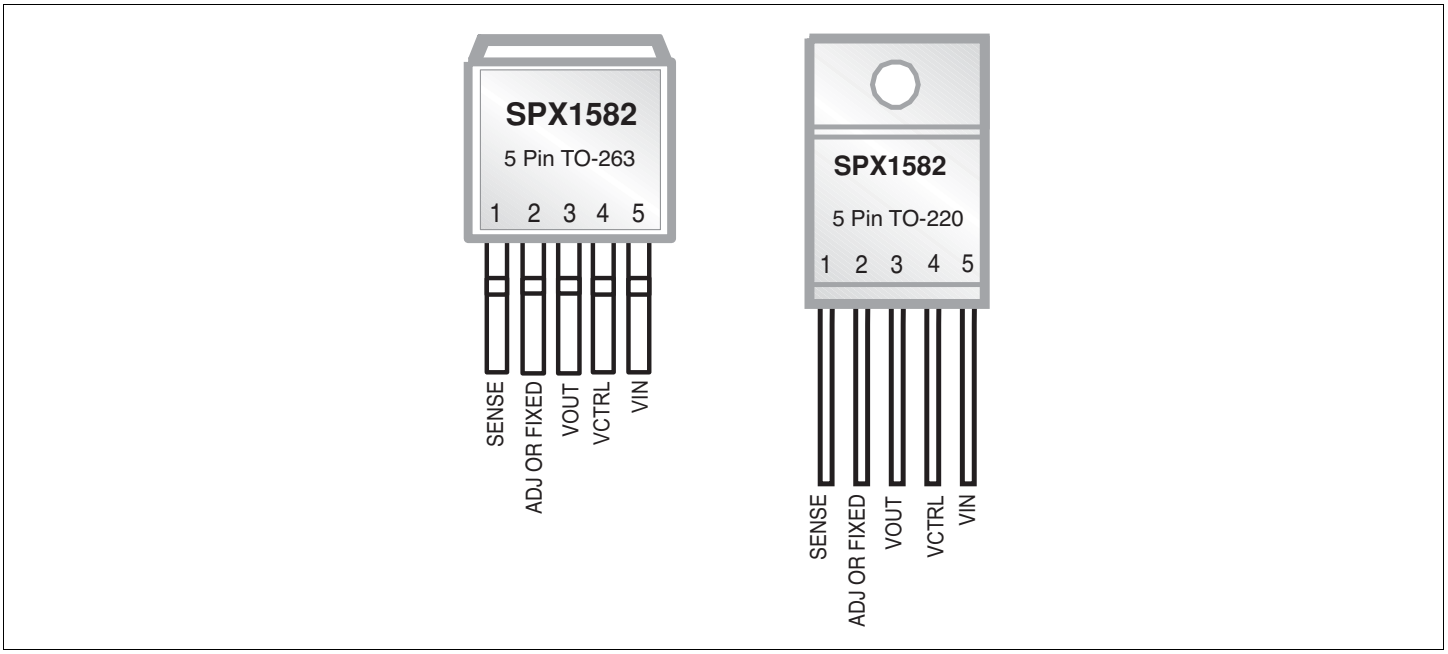


Figure 3: SPX1582 Pinout (Top View)

Pin Description

Table 4: Pin Description

Pin Number	Pin Name	Description
1	SENSE	Allows Kelvin sense of V_{OUT} at the load (positive side of the device´s reference voltage).
2	ADJ	Negative side of the device´s reference voltage. Adding a small bypass capacitor from the ADJ pin to ground improves the transient response.
3	VOUT	Power output of the device.
4	VCTRL	Supply pin for the device´s control circuitry. The current flow into this pin is about 1% of the output current. V_{CTRL} must be 1.0V to 1.3V greater than the output voltage for the device to regulate.
5	VIN	Output load current is supplied through this pin. V_{IN} must be 0.1V to 0.8V greater than the output voltage for this device to regulate.

Note: TAB is internally connected to Pin 3.

Block Diagram

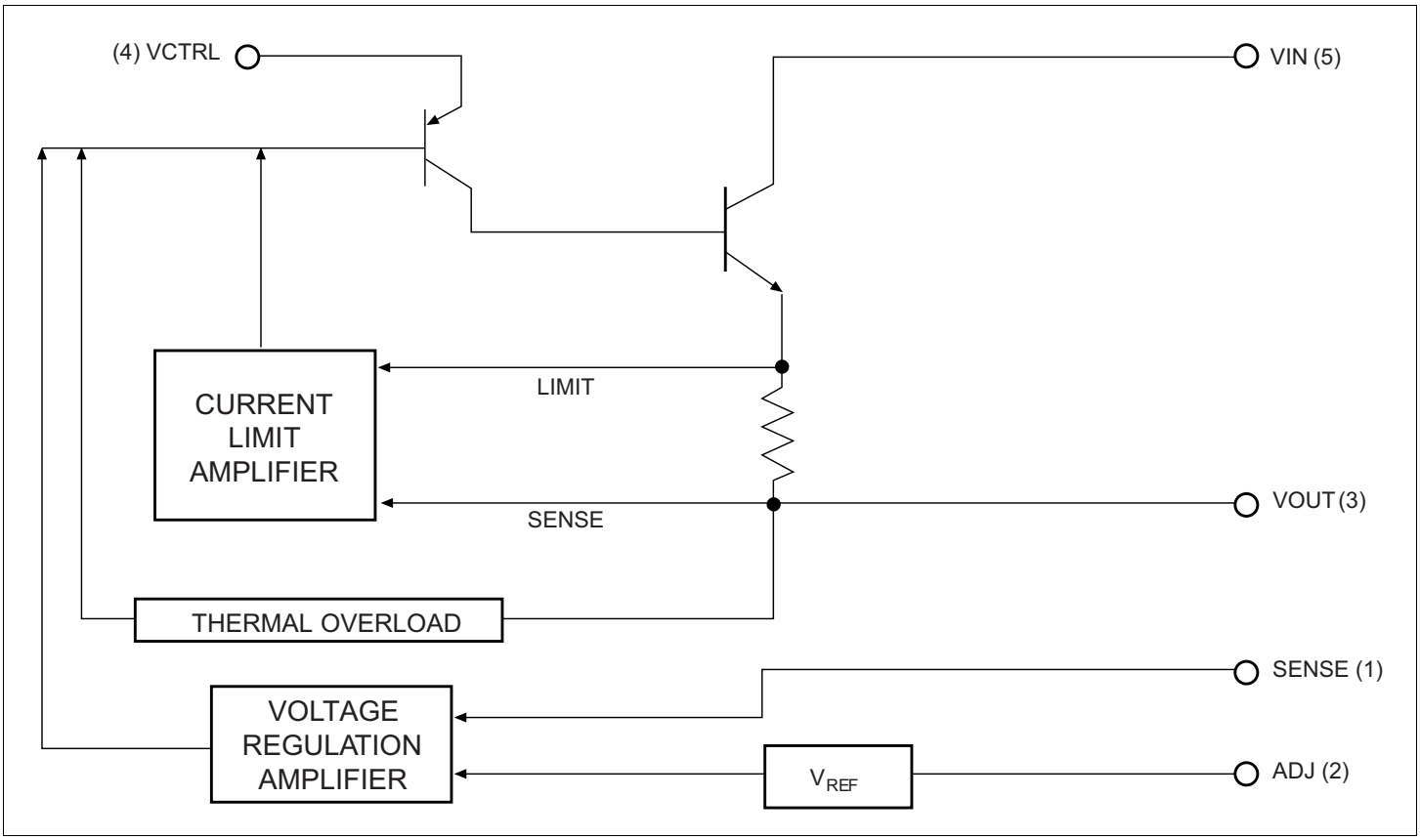


Figure 4: Functional Block Diagram

Application Information

The SPX1582 is designed as a high-performance, low-cost solution for applications requiring a lower dropout than traditional NPN regulators.

The SPX1582 uses a separate V_{CTRL} input voltage ($V_{CTRL} \geq V_{OUT} + 1.3V$) to minimize the dropout voltage. This allows the 2.5V power for the load to come from a 3.3V system supply. As an added benefit, this reduces the heat dissipation, and lower heatsink and cooling fan costs.

A typical application would use 3.3V for V_{IN} and 5.0V for V_{CTRL} from the system power to provide a nominal 2.5V, 1.8V, or 1.5V output. Using the SENSE pin provides a Kelvin measurement of the output to reduce resistance-associated errors. This makes the SPX1582 well suited for loads requiring tight load regulation.

Power-Up Sequencing

The SPX1582 requires a power-up sequence in which V_{IN} must be applied before V_{CTRL} to prevent a latchup condition. If this is not possible, a 10Ω series resistor should be added to the V_{CTRL} input to prevent the device from entering into latchup if V_{CTRL} is applied before V_{IN}.

Adjustable Regulator Design

A 1.25V reference voltage is developed between the SENSE pin and the ADJ pin of the SPX1582. Adding two external resistors (see Figure 1 on page i and Figure 2 on page i) allows setting the output voltage from 1.25V to 6V. R_1 is chosen so that this current is specified at a minimum load current of 10mA.
R_2 is given by the following formula:

$V_{OUT} = V_{REF} (1+ R_2/R_1) + I_{ADJ} (R_2)$.

The current flowing from the ADJ pin is typically 50μA. This ADJ pin contributes to the final V_{OUT} but is usually neglected. Connecting the SENSE pin to the top of the resistor divider improves load regulation.

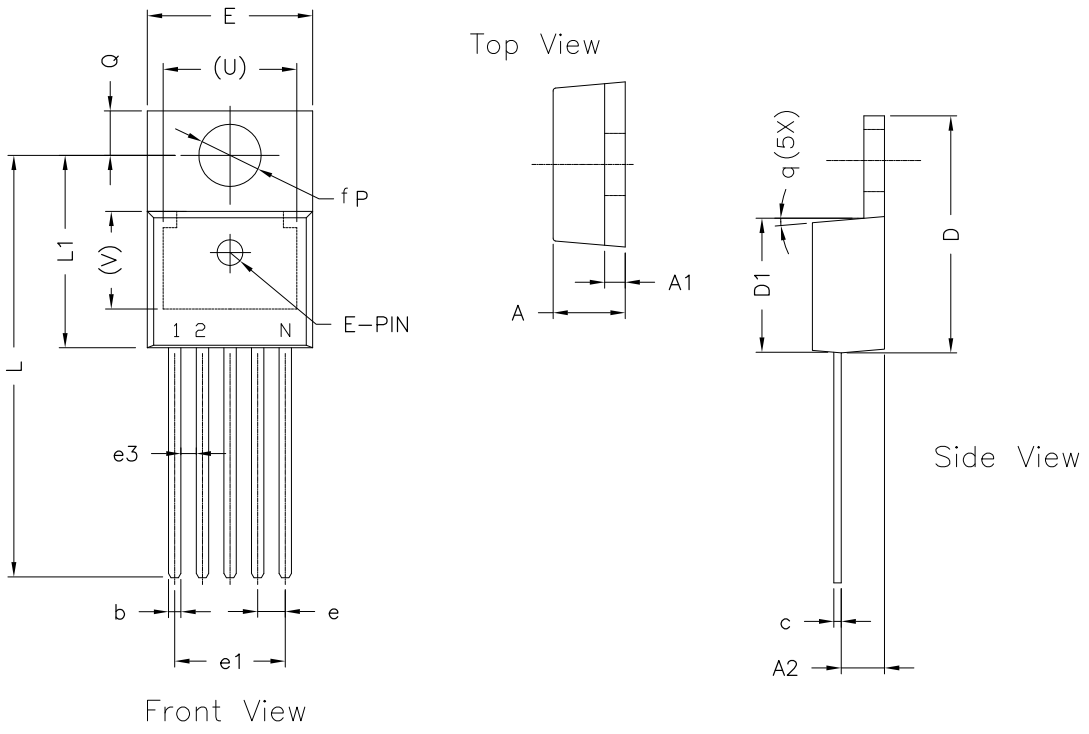
Lowering Noise

For the fixed voltage device, adding a capacitor at the GND pin improves transient response. This capacitor is chosen in the range of 1μF to 0.1μF and depends on the amount of output capacitance in the system.

Mechanical Dimensions

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	

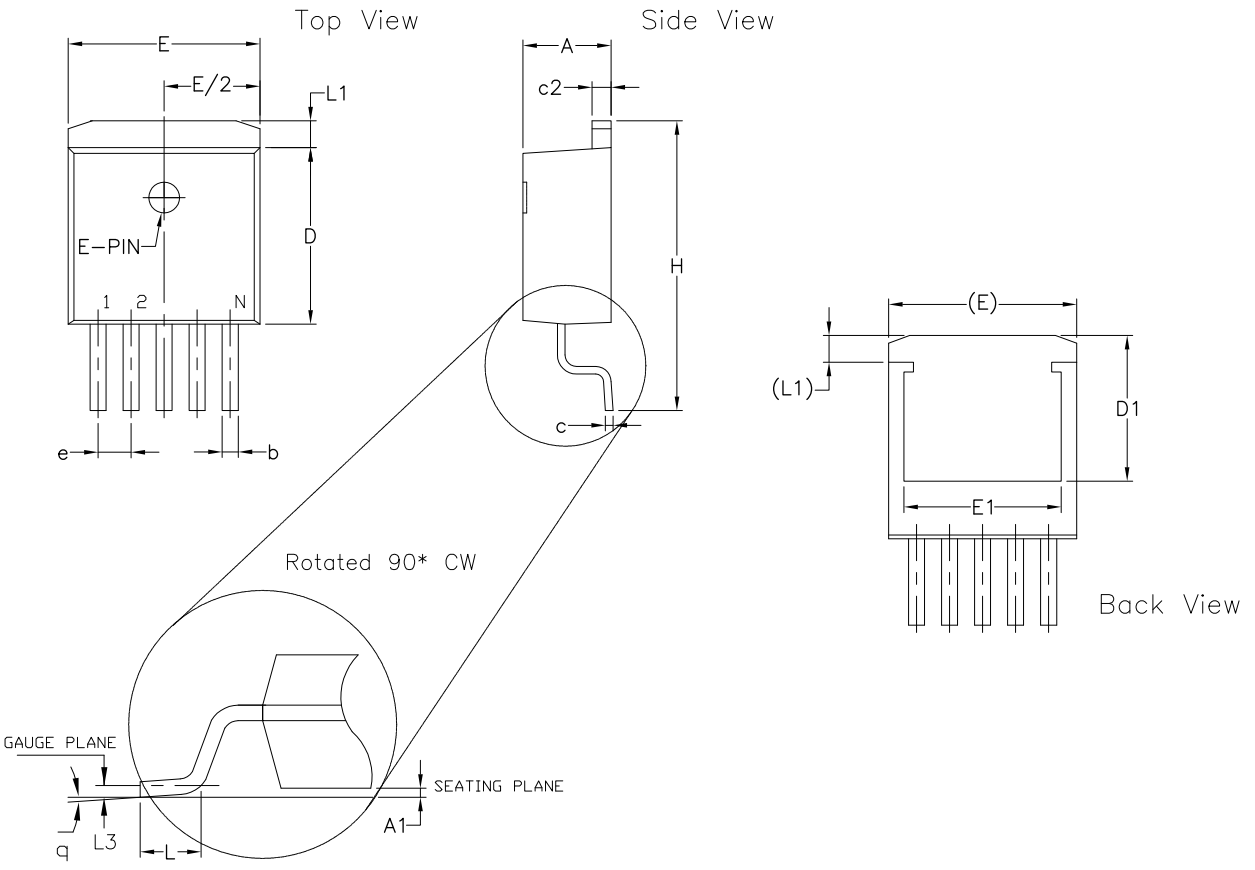
* Refer to product datasheet for POD option being used

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 5: Mechanical Dimensions—5-Pin TO-220

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 6: Mechanical Dimensions—5-Pin TO-263

Ordering Information

TO-263 version available, TO-220 version obsolete

Table 5: Ordering Information

Ordering Part Number	Operating Temperature Range	Accuracy	Output Voltage	Package	Packaging
SPX1582T5-L/TR	$0°C \le T_J \le 125°C$	2.0%	ADJ	5-Pin TO-263	Tape and Reel

Note: For more information about part numbers, as well as the most up-to-date information and additional information on environmental rating, go to www.maxlinear.com/SPX1582.

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