

## 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

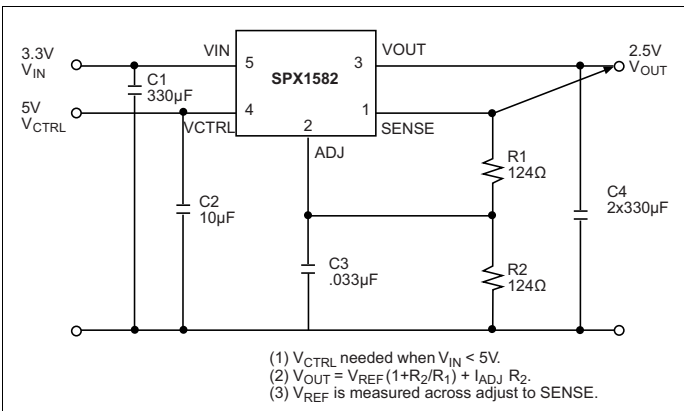
- Low dropout voltage 500mV at 3A full load current
- Adjustable output down to 1.25V from 3.3V and 5V supplies
- Extremely tight load and line regulation
- Standard 5-terminal low-cost TO-263

## Applications

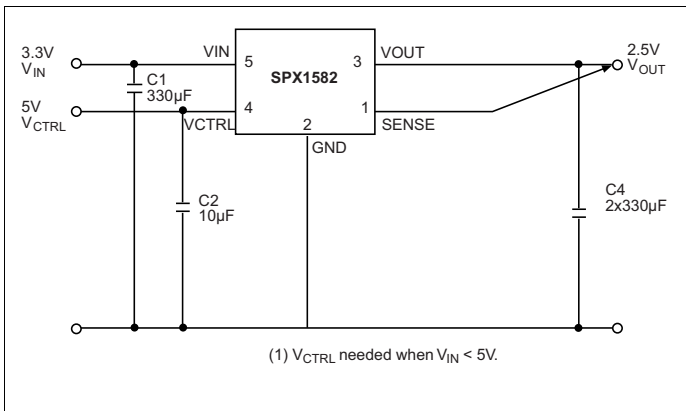
- Microprocessor core and memory supplies
- Low-cost 3.3V, 2.5V, 1.8V, and 1.5V I/O power
- 5.5V to 5V conversion with high power supply rejection ratio (PSRR) isolation

*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	<b>Updated:</b> <ul style="list-style-type: none"><li>■ New template applied, contents rewriting, and obsolete packages highlighted.</li><li>■ Subtitle of the document.</li><li>■ "General Description" section.</li><li>■ "Features" section.</li><li>■ "Applications" section.</li><li>■ "Specifications" section.</li><li>■ "Application Information" section.</li><li>■ "Mechanical Dimensions—5 Pin TO-220" figure.</li><li>■ "Mechanical Dimensions—5 Pin TO-263" figure.</li><li>■ "Ordering Information" section.</li></ul> <b>Added:</b> <ul style="list-style-type: none"><li>■ In "Typical Fixed Regulator" figure, symbol of capacitor C1.</li><li>■ "Pin Configuration" section.</li></ul>
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
<b>Operating Junction Temperature Range</b>			
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
$\theta_{JC}$	Junction to Case	TO-220-5	3	°C/W
$\theta_{JA}$	Junction to Ambient	TO-220-5	29.3	°C/W
$\theta_{JC}$	Junction to Case	TO-263-5	3	°C/W
$\theta_{JA}$	Junction to Ambient	TO-263-5	31.2	°C/W

## Electrical Characteristics

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

**Table 3: Electrical Characteristics**

Parameter	Conditions		Min	Typ	Max	Units
<b>2.5V Version</b>						
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	
<b>2.8V Version</b>						
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	
<b>3.3V Version</b>						
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	
<b>All Voltage Options</b>						
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 <sup>1</sup>	$V_{CTRL} = 2.75V$ , $V_{IN} = V_{OUT} + 1.5V$ , $I_O = 10mA$ to $3A$ , $V_{ADJ} = 0V$	•	-	1.0	5.0	mV
Dropout Voltage Min. $V_{CTRL}$ <sup>2</sup> ( $V_{IN} - V_{OUT}$ )	$V_{ADJ} = 0V$ , $V_{IN} = 2.05V$ , $I_O = 1A$		-	1.05	1.18	V
Dropout Voltage Min. $V_{IN}$ <sup>2</sup> ( $V_{IN} - V_{OUT}$ )	$V_{ADJ} = 0V$ , $V_{IN} = 2.75V$ , $I_O = 3A$		-	0.40	0.50	V
Current Limit	$V_{CTRL} = 2.75V$ , $V_{IN} = 2.05V$ , $\Delta V_{OUT} = 100mV$ , $V_{ADJ} = 0V$		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	$V_{CTRL} = 3.75V$ , $V_{IN} = 3.75V$ , $I_O = 2.3A$ , $V_{ADJ} = 0V$ , $T_J = 25$ , $V_{RIPPLE} = 1V_{pp}$ 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	$\mu A$

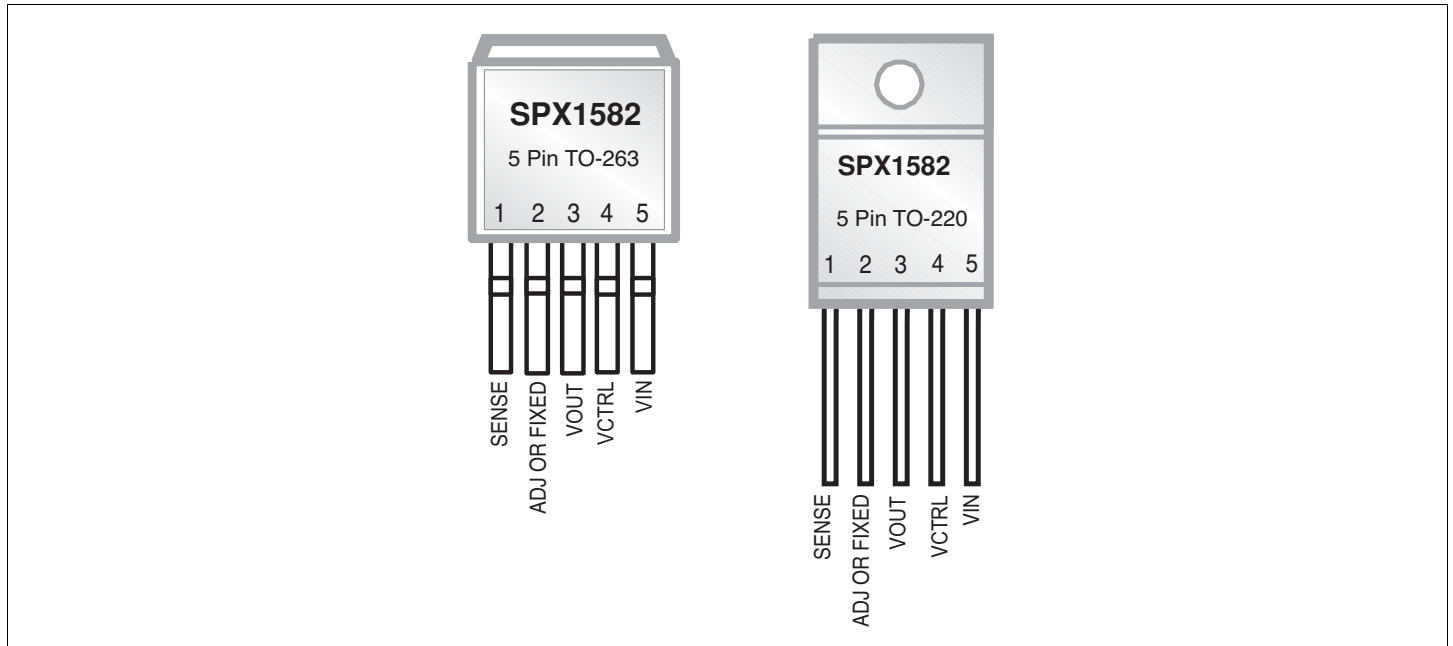
1. Low duty cycle pulse testing with Kelvin connections is required in order to maintain accurate data.

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

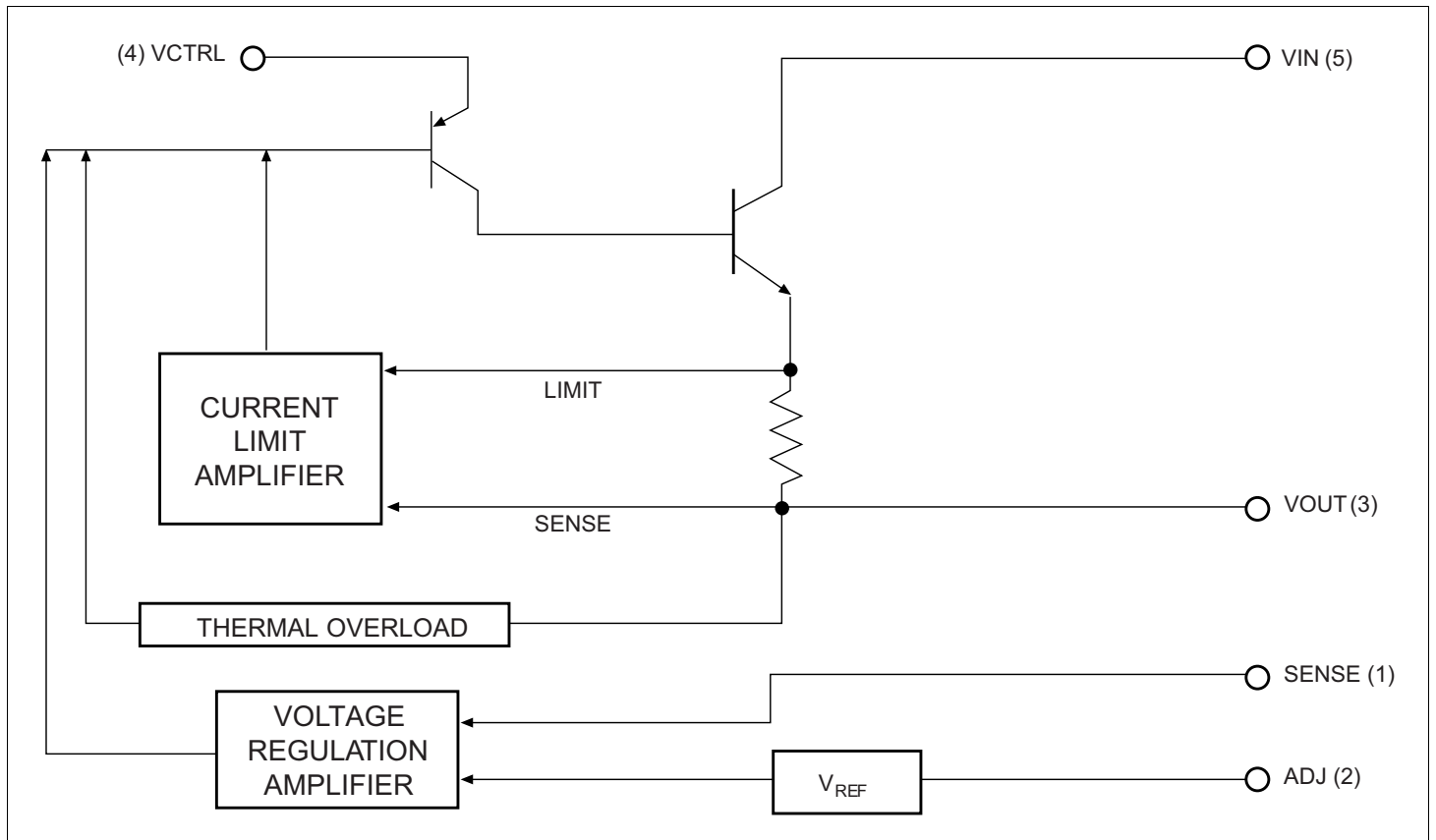
**Table 4: Pin Description**

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  $10\Omega$  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  $50\mu A$ . 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.

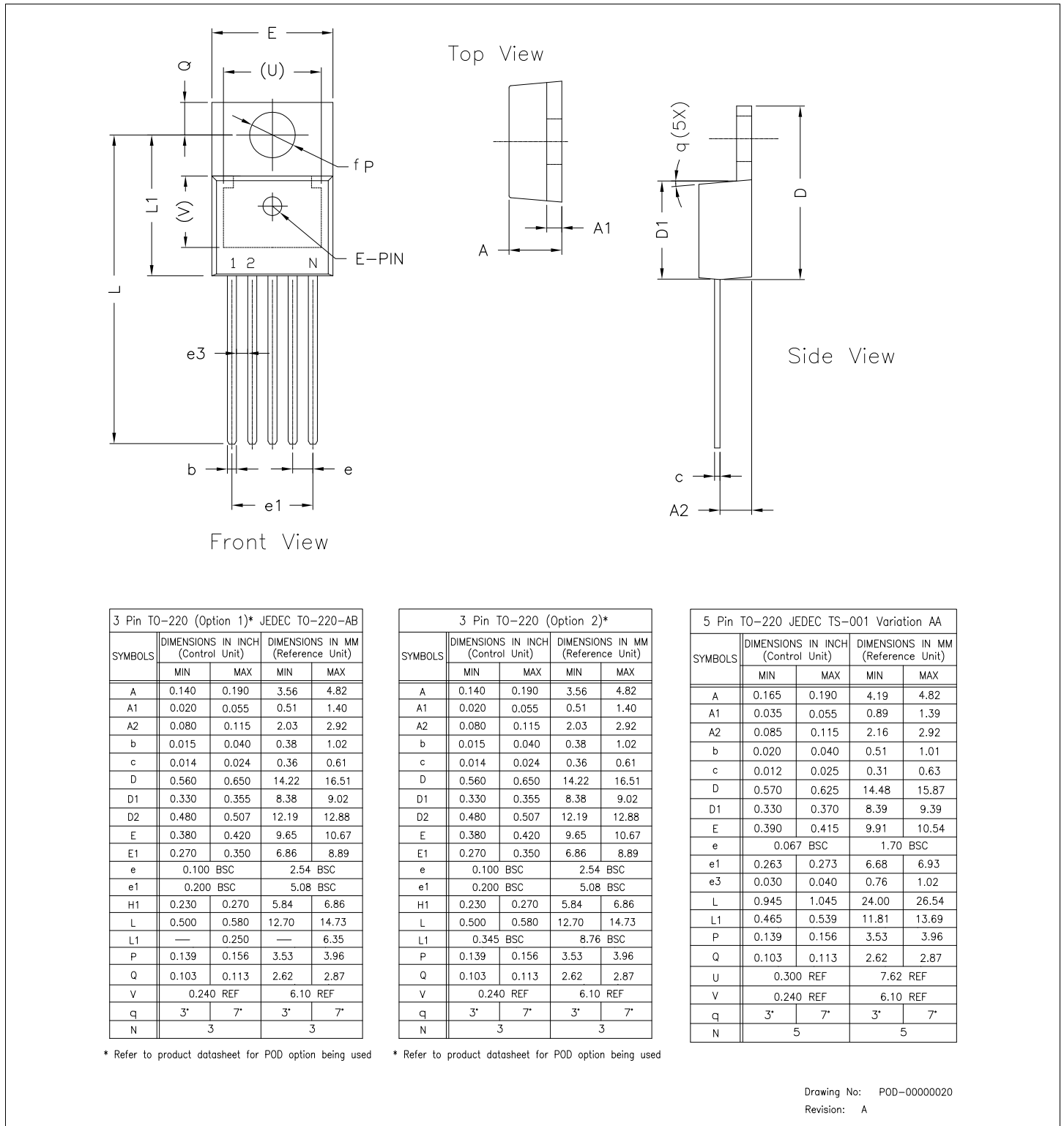
### Lowering Noise

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

# Mechanical Dimensions

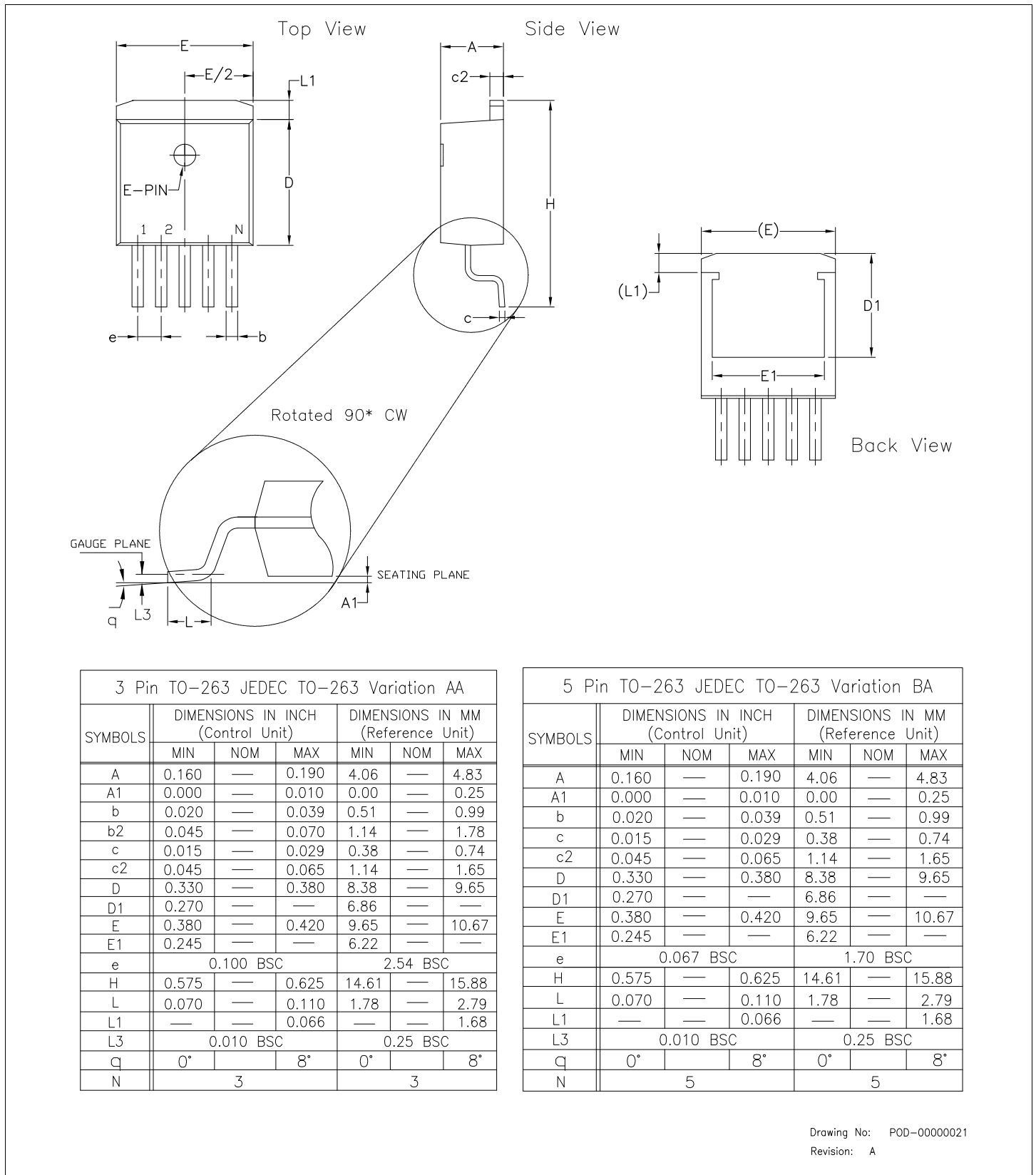
## 5-Pin TO-220

*TO-220 version obsolete*



**Figure 5: Mechanical Dimensions—5-Pin TO-220**

# 5-Pin TO-263



Drawing No: POD-0000021  
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	$0^{\circ}\text{C} \leq T_J \leq 125^{\circ}\text{C}$	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](http://www.maxlinear.com/SPX1582).



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