

General Description

The SPX1585 is a very easy-to-use low-power 5A adjustable and fixed voltage regulator. It requires only two external resistors to set the output voltage for the adjustable version. The SPX1585 device is designed for low-voltage applications that offer lower dropout voltage and faster transient response. This device is an excellent choice for use in powering low-voltage microprocessors that require lower dropout and faster transient response to regulate from 2.5V to 3.8V supplies, and as a post-regulator for switching supplies applications. The SPX1585 features low dropout of a maximum of 1.2V.

The SPX1585 offers full protection against overcurrent faults, reversed input polarity, reversed load insertion, and positive and negative transient voltage. On-chip trimming adjusts the reference voltage to 1%. The I_Q of this device flows into the load, which increases efficiency.

The SPX1585 device is offered in a 3-pin TO-263 package compatible with other 3-terminal regulators.

Features

- Adjustable output down to 1.25V
- Output current of 5A
- Low dropout voltage 1.1V typ at 5A
- Extremely tight load and line regulation
- Current and thermal limiting
- Standard 3-terminal low-cost TO-263
- Compatible with industry standard *LT1085/LT1585*

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
- SMPS post-regulator
- High-efficiency linear power supplies
- Instrumentation
- Constant current regulators
- Battery charger

Typical Application

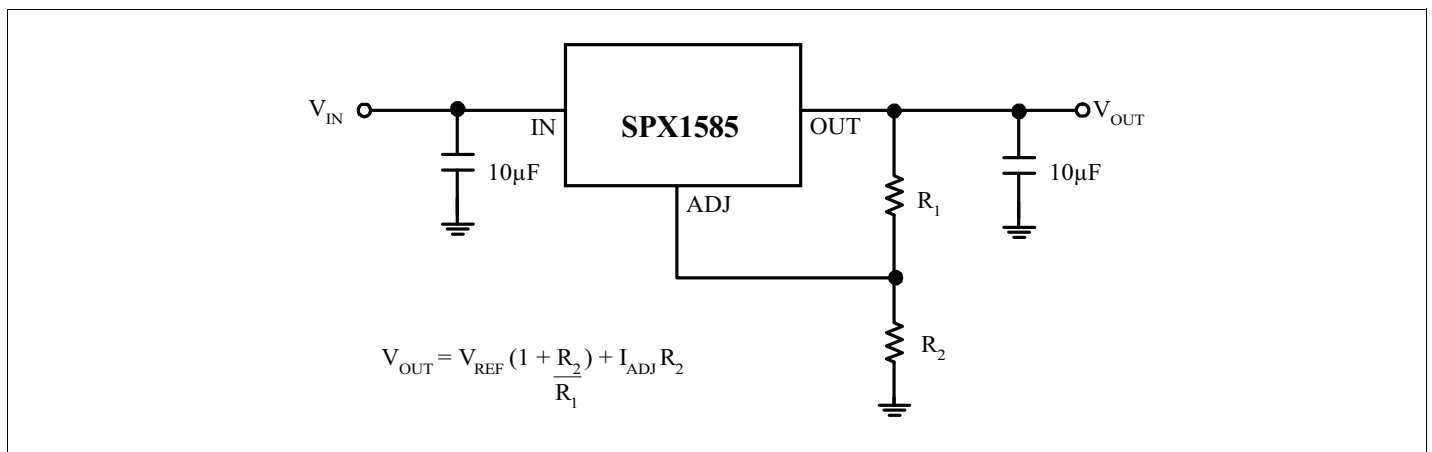


Figure 1: Typical Adjustable Regulator

Revision History

| Revision | Release Date | Change Description |
|----------|--------------|---|
| 252DSR00 | May 17, 2023 | Updated: <ul style="list-style-type: none">■ New template applied, contents rewriting, and obsolete packages highlighted.■ Subtitle of the document.■ "General Description" section.■ "Features" section.■ "Applications" section.■ "Specifications" section.■ "Adjustable Regulator Best Practices" figure caption.■ "Load Regulation" section.■ In "Improving Ripple Rejection" figure, bold sentence replaced with a note placed below.■ "Ordering Information" section. Added: <ul style="list-style-type: none">■ "Typical Application" section.■ "Pin Information" section. |
| Rev1A | July 5, 2016 | Legacy Exar 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 |
|---|-----|-----|-------|
| Lead Temperature (soldering, 10 seconds) | - | 300 | °C |
| Storage Temperature Range | -65 | 150 | °C |
| Operating Junction Temperature Range | | | |
| SPX1585 Control Section | -45 | 125 | °C |
| SPX1585 Power Transistor | -45 | 150 | °C |
| Input Voltage | - | 10 | V |
| Input to Output Voltage Differential | - | 10 | V |

Thermal Specifications

Table 2: Thermal Performance

| Symbol | Parameter | Package | Max | Units |
|---------------|---------------------|------------|-----|-------|
| Ψ_{JB} | Junction to Tab | TO-220 | 3.0 | °C/W |
| θ_{JA} | Junction to Ambient | TO-220 | 60 | °C/W |
| Ψ_{JB} | Junction to Tab | DD Package | 3.0 | °C/W |
| θ_{JA} | Junction to Ambient | DD Package | 60 | °C/W |

Electrical Characteristics¹

Electrical characteristics at $V_{OUT} = 10\text{mA}$, $T_A = 25^\circ\text{C}$, unless otherwise specified. The • denotes the specifications that apply over the full temperature range of -45°C to 125°C , unless otherwise specified.

Table 3: Electrical Characteristics

| Parameter | Conditions | | Typ | SPX1585A | | SPX1585 | | Units |
|----------------------------------|---|---|--------------------|----------|-------|---------|-------|-------|
| | | | | Min | Max | Min | Max | |
| 1.5V Version | | | | | | | | |
| Output Voltage ⁽²⁾ | SPX1585 – 1.5V, $0 < I_{OUT} < 5\text{A}$, $3.3\text{V} < V_{IN} < 10\text{V}$ | | 1.5 | 1.485 | 1.515 | 1.47 | 1.53 | V |
| | | • | 1.5 | 1.47 | 1.53 | 1.455 | 1.545 | |
| 2.5V Version | | | | | | | | |
| Output Voltage ⁽²⁾ | SPX1585 – 2.5V, $0 < I_{OUT} < 5\text{A}$, $4.0\text{V} < V_{IN} < 10\text{V}$ | | 2.5 | 2.475 | 2.525 | 2.45 | 2.55 | V |
| | | • | 2.5 | 2.45 | 2.55 | 2.425 | 2.575 | |
| 3.3V Version | | | | | | | | |
| Output Voltage ⁽²⁾ | SPX1585 – 3.3V, $0 < I_{OUT} < 5\text{A}$, $4.8\text{V} < V_{IN} < 10\text{V}$ | | 3.3 | 3.267 | 3.333 | 3.234 | 3.366 | V |
| | | • | 3.3 | 3.234 | 3.366 | 3.069 | 3.399 | |
| All Voltage Options | | | | | | | | |
| Reference Voltage | $V_{IN} \leq 7\text{V}$, $P \leq P_{MAX}$ $1.5\text{V} \leq (V_{IN} - V_{OUT}) \leq 5.75\text{V}$, $10\text{mA} \leq I_{OUT} \leq 5\text{A}$ | • | 1.250 | 1.225 | 1.270 | 1.225 | 1.270 | V |
| Min. Load Current ⁽³⁾ | $1.5\text{V} \leq (V_{IN} - V_{OUT}) \leq 5.75\text{V}$ | • | 5 | - | 10 | - | 10 | mA |
| Line Regulation | $2.75\text{V} \leq V_{IN} \leq 7\text{V}$, $I_{OUT} = 10\text{mA}$, $T_J = 25^\circ\text{C}$ ⁽³⁾ | | 0.005 | - | 0.2 | - | 0.2 | % |
| | $V_{IN} \leq 7\text{V}$, $I_{OUT} = 0\text{mA}$, $T_J = 25^\circ\text{C}$ ⁽²⁾ | | 0.005 | - | 0.2 | - | 0.2 | % |
| Load Regulation | $10\text{mA} \leq I_{OUT} \leq 5\text{A}$, $(V_{IN} - V_{OUT}) = 3\text{V}$, $T_J = 25^\circ\text{C}$ ⁽³⁾ | | 0.05 | - | 0.3 | - | 0.3 | % |
| | $0 \leq I_{OUT} \leq 5\text{A}$, $V_{IN} = 7\text{V}$, $T_J = 25^\circ\text{C}$ ⁽²⁾ | | 0.05 | - | 0.3 | - | 0.3 | % |
| Dropout Voltage | $\Delta V_{REF} = 1\%$ | | 1.1 | - | 1.2 | - | 1.2 | V |
| Current Limit | $V_{IN} = 7\text{V}$ $1.4\text{V} \leq (V_{IN} - V_{OUT})$ ⁽³⁾ | | 6 | 5.2 | - | 5.2 | - | A |
| Long Term Stability | $T_A = 125^\circ\text{C}$, 1000 Hrs. | | 0.3 ⁽²⁾ | - | 1 | - | 1 | % |
| Thermal Regulation | $T_A = 25^\circ\text{C}$, 20ms pulse | | 0.01 | - | 0.020 | - | 0.020 | %/W |
| Temperature Stability | - | | 0.25 | - | - | - | - | % |
| Output Noise, RMS | 10Hz to 10kHz | | 0.003 | - | - | - | - | % Vo |

1. Changes in output voltage due to heating effects are covered by the thermal regulation specification.

2. Fixed version only.

3. Adjustable version only.

Pin Information

Pin Configuration

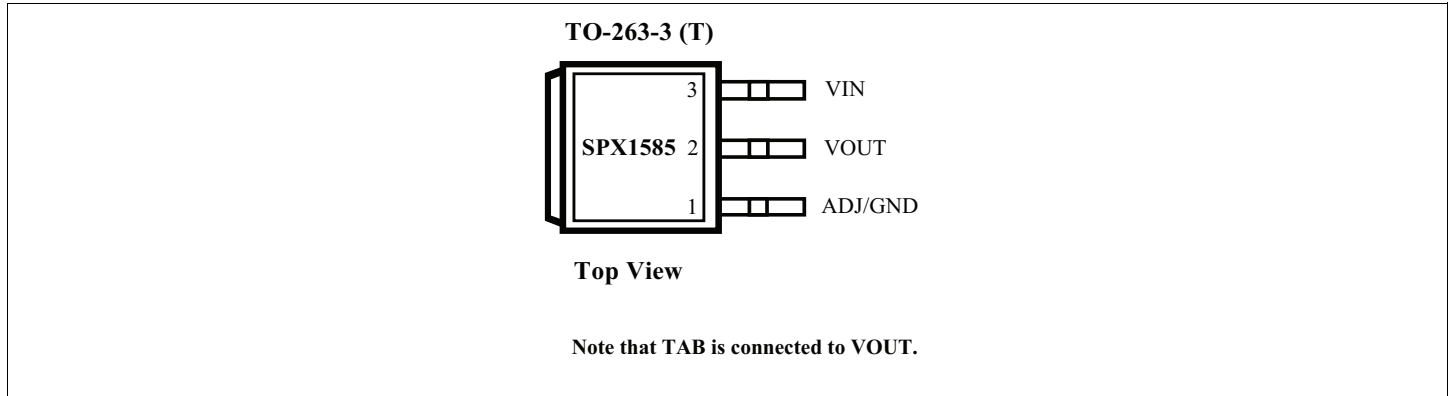


Figure 2: SPX1585 Pinout (Top View)

Pin Description

Table 4: Pin Description

| Pin Number | Pin Name | Description |
|------------|----------|---|
| 1 | ADJ/GND | Output voltage adjust pin. For more information on setting the output voltage, see Figure 3 on page 5. |
| 2 | VOUT | Output voltage pin. Bypass to GND with a 10 μ F capacitor. For more information, see " Stability " on page 4. |
| 3 | VIN | Input voltage pin. Bypass to GND with a 10 μ F capacitor. |

Application Hints

The SPX1585 incorporates protection against overcurrent faults, reversed load insertion, overtemperature operation, and positive and negative transient voltages. However, the use of an output capacitor is required to ensure the stability and performance of the device.

Stability

The output capacitor is part of the regulator's frequency compensation system. Either a 22 μ F aluminum electrolytic capacitor or a 10 μ F solid tantalum capacitor between the output terminal and ground guarantees stable operation for all operating conditions. The recommended value for the equivalent series resistance (ESR) is 0.5 Ω or less.

However, in order to minimize overshoot and undershoot, and therefore optimize the design, see "[Ripple Rejection](#)".

Ripple Rejection

Ripple rejection can be improved by adding a capacitor between the ADJ pin and ground. When the ADJ pin bypassing is used, the value of the output capacitor required increases to its maximum (220 μ F for an aluminum electrolytic capacitor, or 47 μ F for a solid tantalum capacitor). If the ADJ pin is not bypassed, the value of the output capacitor can be lowered to 10 μ F for an electrolytic aluminum capacitor or 4.7 μ F for a solid tantalum capacitor.

However, the value of the ADJ bypass capacitor should be chosen based on the following equation:

$$C = 1 / (6.28 * F_R * R_1)$$

Where C = Value of the capacitor in Farads
(select an equal or larger standard value),

F_R = Ripple frequency in Hz,

R_1 = Value of the resistor R_1 in Ω .

If an ADJ bypass capacitor is used, the amplitude of the output ripple is independent of the output voltage. If an ADJ bypass capacitor is not used, the output ripple is proportional to the ratio of the output voltage to the reference voltage:

$$M = V_{OUT}/V_{REF}$$

Where M = Multiplier for the ripple seen when the ADJ pin is optimally bypassed,

V_{REF} = Reference voltage.

Reducing Parasitic Resistance and Inductance

One solution to minimize parasitic resistance and inductance is to connect capacitors in parallel. This arrangement improves the transient response of the power supply if your system requires rapidly changing current load condition.

Thermal Consideration

Although the SPX1585 offers limiting circuitry for overload conditions, it is necessary not to exceed the maximum junction temperature, and therefore to be careful about thermal resistance. The heat flow follows the lowest resistance path, which is the junction-to-case thermal resistance. To ensure the best thermal flow of the component, a proper mounting is required. Note that the case of the device is electrically connected to the output. If the case must be electrically isolated, a thermally conductive spacer can be used. However, do not forget to consider its contribution to thermal resistance.

Assuming:

$$V_{IN} = 10V, V_{OUT} = 5V, I_{OUT} = 1.5A, T_A = 50^\circ C/W, \\ \theta_{Heatsink\ Case} = 6^\circ C/W, \theta_{Heatsink\ Case} = 0.5^\circ C/W, \theta_{JC} = 3^\circ C/W$$

Power dissipation under this condition

$$P_D = (V_{IN} - V_{OUT}) * I_{OUT} = 7.5W$$

Junction temperature

$$T_J = T_A + P_D * (\theta_{Case - HS} + \theta_{HS} \theta_{JC})$$

For the control section

$$T_J = 50 + 7.5 * (0.5 + 6 = 3) = 121.25^\circ C$$

121.25 $^\circ$ C < $T_{J(max)}$ for the control and power sections.

In both conditions, reliable operation is ensured by an adequate junction temperature.

Basic Adjustable Regulator

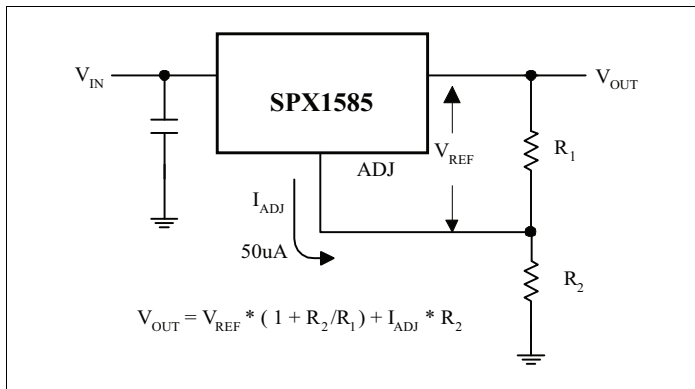


Figure 3: Basic Adjustable Regulator

Output Voltage

In [Figure 3](#), the resistor R_1 generates a constant current flow, normally the specified load current of 10mA. This current goes through the resistor R_2 to set the overall output voltage. The current I_{ADJ} is very small and constant. Therefore, its contribution to the overall output voltage is very small and can generally be ignored.

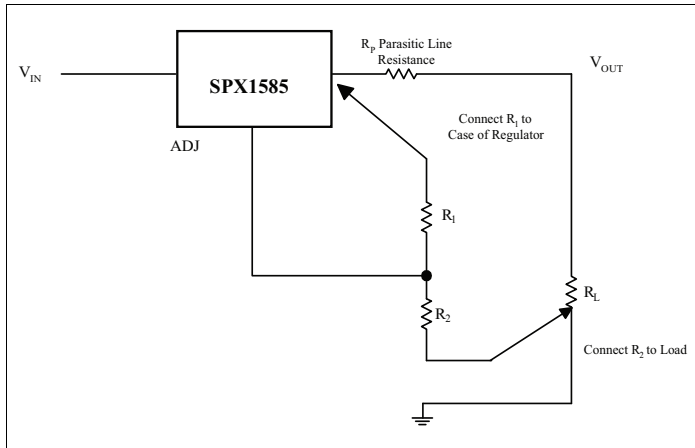


Figure 4: Adjustable Regulator Best Practices

Load Regulation

Parasitic line resistance can degrade load regulation. In order not to affect the behavior of the regulator, it is better to connect the resistor R_1 from the resistor divider directly to the case, and not to the load, as shown in [Figure 4](#). For the same reason, it is better to connect the resistor R_2 to the negative side of the load.

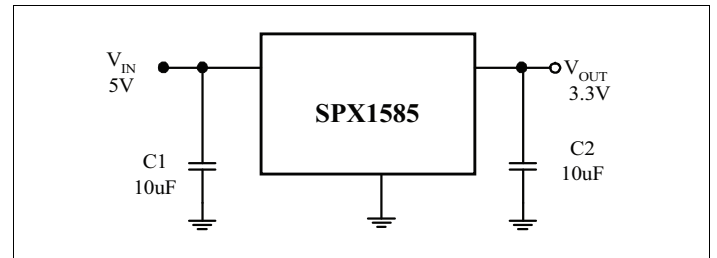


Figure 5: Basic Fixed Regulator

Output Voltage

The fixed-voltage LDO voltage regulators are easy-to-use regulators since the V_{OUT} is preset to the specifications. It is important, however, to provide the appropriate output capacitance for stability and improvement. For most operating conditions, a capacitance of 22 μ F tantalum or 100 μ F electrolytic ensures stability and prevents oscillation.

Typical Applications Circuits

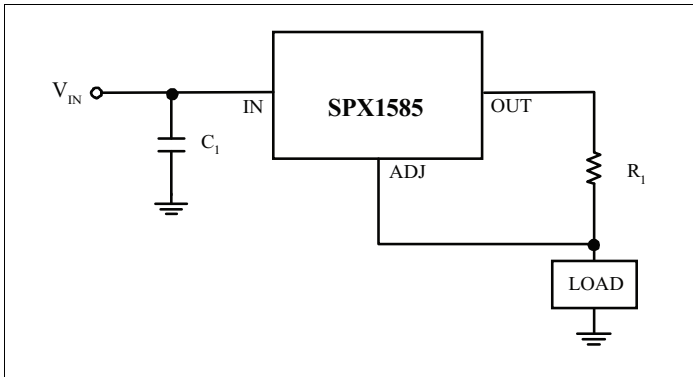


Figure 6: Current Output Regulator

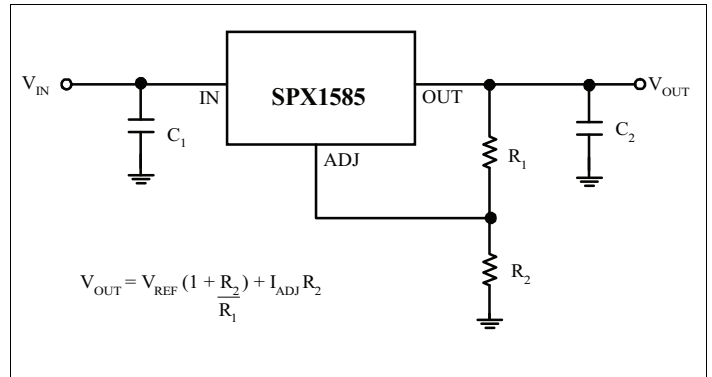


Figure 7: Typical Adjustable Regulator

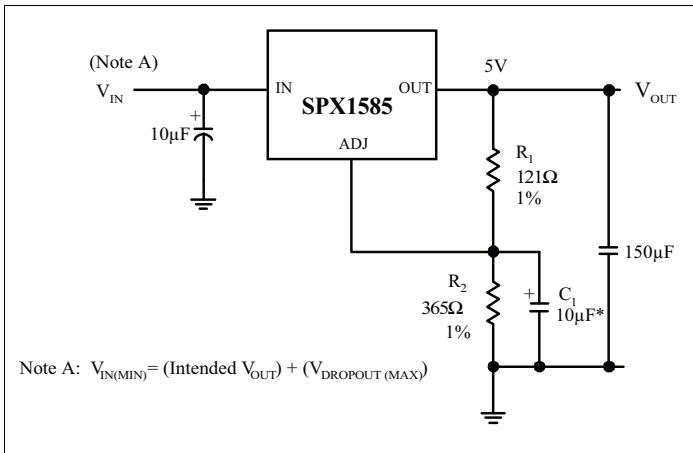


Figure 8: Improving Ripple Rejection

Note: For more information on how to calculate C_1 , see “Ripple Rejection” on page 4.

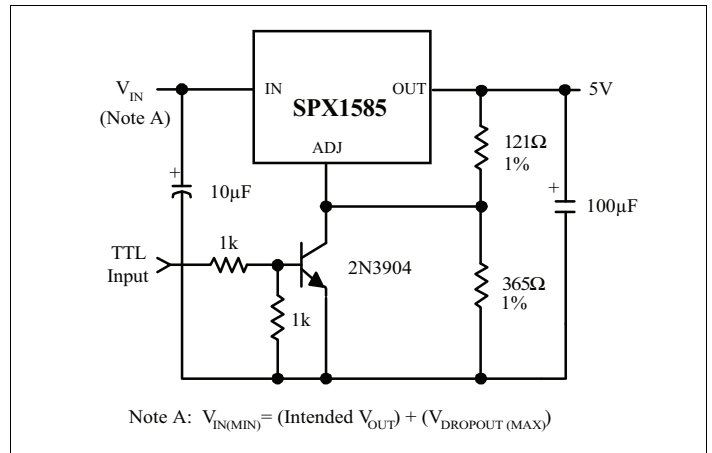


Figure 9: 5V Regulator with Shutdown

Typical Performance Characteristics

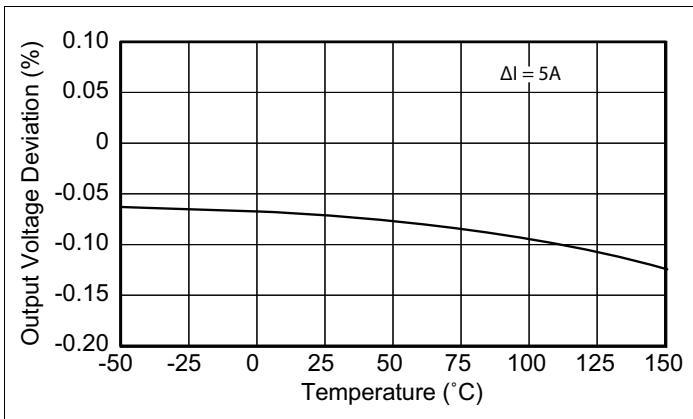


Figure 10: Load Regulation

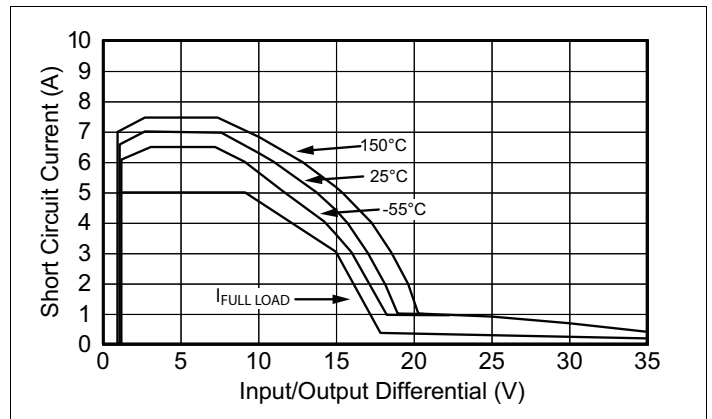


Figure 11: Short Circuit Current

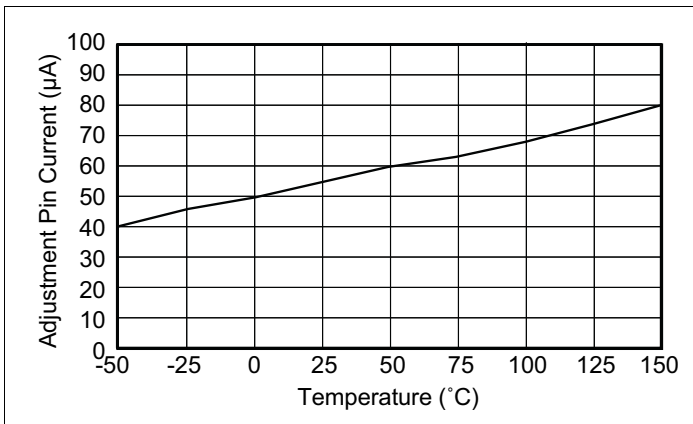


Figure 12: Adjustment Pin Current

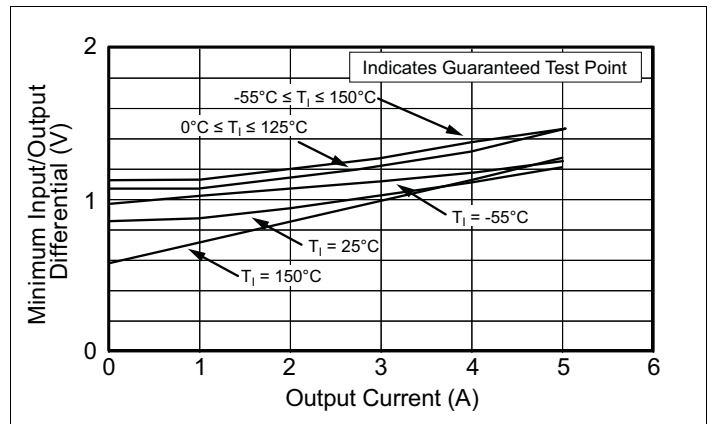


Figure 13: Dropout Voltage

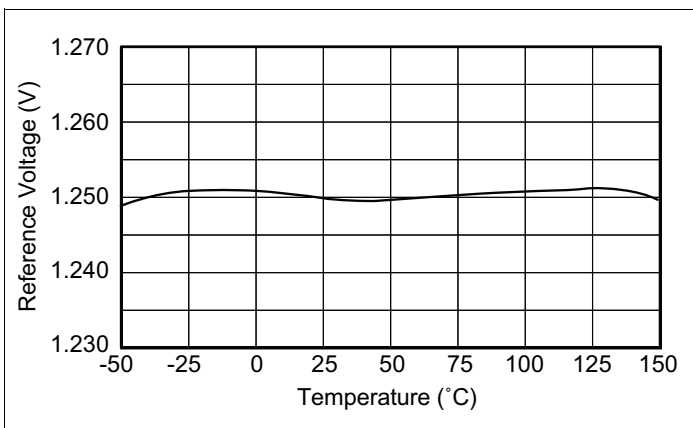


Figure 14: Temperature Stability

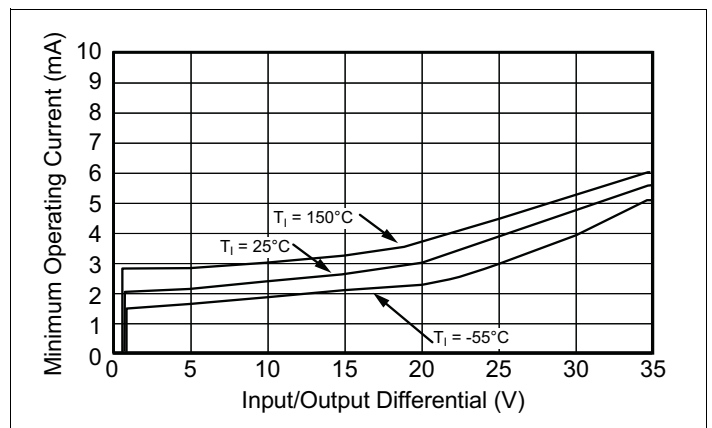


Figure 15: Minimum Operating Current

Ordering Information

Table 5: Ordering Information

| Ordering Part Number | Operating Temperature Range | Accuracy | Output Voltage | Package | Packaging |
|----------------------|---|----------|----------------|---------------|---------------|
| SPX1585AT-L/TR | $-45^{\circ}\text{C} \leq T_J \leq 125^{\circ}\text{C}$ | 1% | ADJ | 3 Lead 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/SPX1585.



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