

## 3A Ultra Low Dropout Voltage Regulator

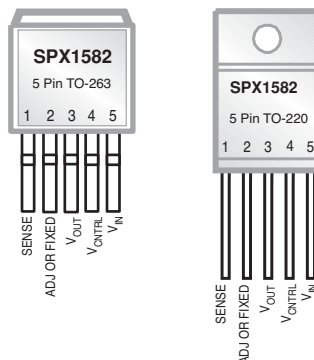
### Fast Response, Adjustable & Fixed

### FEATURES

- Low Dropout Voltage 500mV at 3A Full Load Current
- Adjustable Output Down to 1.25V from ATX Power Supply
- Fixed Output Voltages of 3.3V and 2.5V
- Extremely Tight Load and Line Regulation
- Standard 5-Terminal Low Cost TO-220 and TO-263

### APPLICATIONS

- 3.3V to 2.8V ATX Power Supplies
- 3.3V to 2.9V for Portable PENTIUM™ Processor
- 5V to 3.5V VRE Supply
- High efficiency "Green" Computer Systems



Now Available in Lead Free Packaging

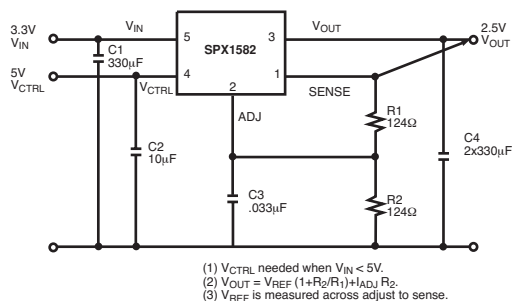
### DESCRIPTION

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 fixed version has a preset output of 3.3V, 2.8V or 2.5V and does not require any external resistors. The SPX1582 features a low dropout of 400mV(Typ.) and offers fast transient response. This device is suitable for Pentium applications requiring 2.8V, 2.5V from 3.3V ATX power supplies, where low current input voltage 1V greater than the output voltage is needed. With an external sense pin the load regulation is less than 1mV. This device is an excellent choice for the use in powering low voltage microprocessors that require a lower dropout, fast transient response to regulate from 3.3V and 5V supplies. The SPX1582 is also an excellent choice as a post regulator for switching supply applications.

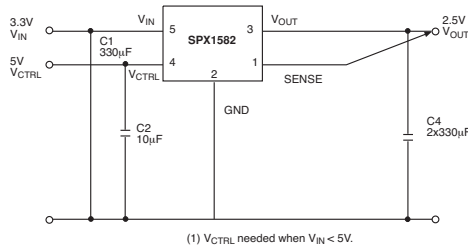
The SPX1582 offers protection against over-current faults, reversed input polarity, over temperature operation and positive or negative transient voltages.

The SPX1582 is offered in a 5 pin TO-220 and TO-263 compatible with industry standard 5-terminal regulators. For 5A, 3A and 1.5A ultra low dropout versions refer to SPX1581, SPX1582 and SPX1583 data sheets respectively.

### TYPICAL APPLICATIONS CIRCUIT



Adjustable Regulator



Typical Fixed Regulator

## ABSOLUTE MAXIMUM RATINGS

Power Dissipation ..... Internally Limited  
 Storage Temperature Range ..... -65°C to +150°C  
 Operating Junction Temperature Range  
 SPX1582 Control Section ..... 0°C to +125°C  
 SPX1582 Power Transistor ..... 0°C to +150°C  
 Input Supply Voltage ..... 6V

$V_{CTRL}$  Input Voltage ..... 13V

## 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 cap unless otherwise specified. The ♦ denotes the specifications which apply over full temperature range -40°C to +85°C, unless otherwise specified.

| PARAMETER                                                          | MIN            | TYP        | MAX            | UNITS        | CONDITIONS                                                                                                                     |
|--------------------------------------------------------------------|----------------|------------|----------------|--------------|--------------------------------------------------------------------------------------------------------------------------------|
| <b>2.5V Version</b>                                                |                |            |                |              |                                                                                                                                |
| Output Voltage                                                     | 2.450<br>2.400 | 2.5        | 2.550<br>2.600 | V            | $V_{CTRL} = 6.0V$ to 12V, $V_{IN} = 3.0V$ to 5.0V, $I_O = 10mA$<br>♦ $I_O = 10mA$ to 3A                                        |
| <b>2.8V Version</b>                                                |                |            |                |              |                                                                                                                                |
| Output Voltage                                                     | 2.744<br>2.688 | 2.8        | 2.856<br>2.912 | V            | $V_{CTRL} = 6.3V$ to 12V, $V_{IN} = 3.3V + 0.8V$ , $I_O = 10mA$<br>♦ $I_O = 10mA$ to 3A                                        |
| <b>3.3V Version</b>                                                |                |            |                |              |                                                                                                                                |
| Output Voltage                                                     | 3.234<br>3.168 | 3.3<br>3.3 | 3.366<br>3.432 | V            | $V_{CTRL} = 6.3V$ to 12V, $V_{IN} = 3.3V + 0.8V$ , $I_O = 10mA$<br>♦ $I_O = 10mA$ to 3A                                        |
| <b>All Voltage Options</b>                                         |                |            |                |              |                                                                                                                                |
| Reference Voltage                                                  | 1.238          | 1.25       | 1.263          | V            | $V_{CTRL} = 2.75V$ , $V_{IN} = 2.00V$ , $I_O = 10mA$<br>$V_{CTRL} = 2.7V$ to 12V, $V_{IN} = 2.05V$ to 5.5V, $I_O = 10mA$ to 7A |
| Line Regulation                                                    |                | 1.0        | 3.0            | mV           | $V_{CTRL} = 2.5V$ to 12V, $V_{IN} = 1.75$ to 5.5V, $I_O = 10mA$<br>♦ $V_{ADJ} = 0V$                                            |
| Load Regulation (Note 1)<br>0V                                     |                | 1.0        | 5.0            | mV           | ♦ $V_{CTRL} = 2.75V$ , $V_{IN} = V_{OUT} + 1.5V$ , $I_O = 10mA$ to 3A, $V_{ADJ} = 0V$                                          |
| Dropout Voltage Min. $V_{CTRL}$<br>(Note 2) ( $V_{IN} - V_{OUT}$ ) |                | 1.05       | 1.18           | V            | $V_{ADJ} = 0V$<br>$V_{IN} = 2.05V$ , $I_O = 1A$                                                                                |
| Dropout Voltage Min. $V_{IN}$<br>(Note 2) ( $V_{IN} - V_{OUT}$ )   |                | 0.40       | 0.50           | V            | $V_{ADJ} = 0V$<br>$V_{IN} = 2.75V$ , $I_O = 3A$                                                                                |
| Current Limit                                                      | 3.1            |            |                | A            | $V_{CTRL} = 2.75V$ , $V_{IN} = 2.05V$ , $\Delta V_{OUT} = 100mV$ , $V_{ADJ} = 0V$                                              |
| Minimum Load Current                                               |                | 5          | 10             | mA           | ♦ $V_{CTRL} = 5V$ , $V_{IN} = 3.3V$ , $V_{ADJ} = 0V$                                                                           |
| Thermal Regulation                                                 |                | 0.002      | 0.02           | %/W          | 30ms Pulse                                                                                                                     |
| Ripple Rejection                                                   | 60             | 80         |                | dB           | $V_{CTRL} = 3.75V$ , $V_{IN} = 3.75V$ , $I_O = 2.3A$ , $V_{ADJ} = 0V$<br>$T_J = 25$ , $V_{RIPPLE} = 1V_{pp}$ at 120Hz          |
| Control Pin Current                                                |                | 60         | 120            | mA           | ♦ $V_{ADJ} = 0V$<br>$V_{CTRL} = 2.75V$ , $V_{IN} = 2.05V$ , $I_O = 3A$                                                         |
| Adjustble Pin Current                                              |                | 50         | 120            | $\mu A$      | $V_{CTRL} = 2.75V$ , $V_{IN} = 2.05V$ , $V_{ADJ} = 0V$ , $I_O = 10mA$<br>♦                                                     |
| Thermal Resistance<br>TO-220-5                                     |                |            | 3<br>29.3      | $^\circ C/W$ | Junction to Case ( $\theta_{JC}$ )<br>Junction to Ambient ( $\theta_{JA}$ )                                                    |
| Thermal Resistance<br>TO-263-5                                     |                |            | 3<br>31.2      | $^\circ C/W$ | Junction to Case ( $\theta_{JC}$ )<br>Junction to Ambient ( $\theta_{JA}$ )                                                    |

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

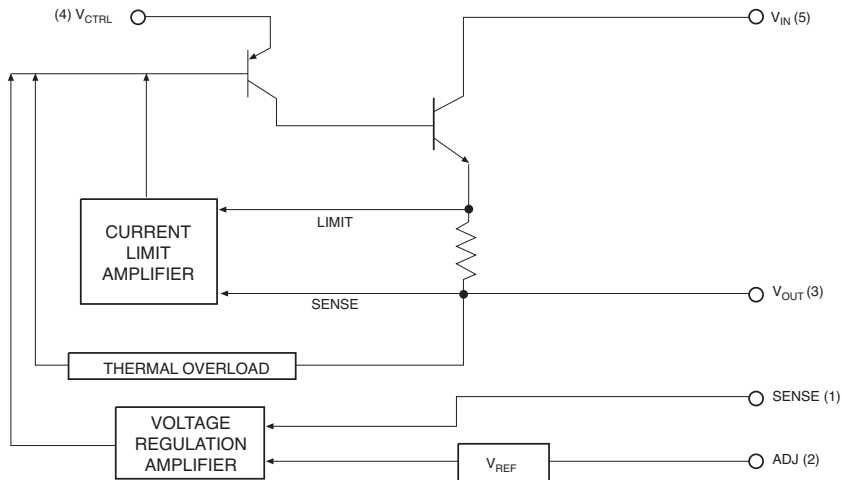
**Note 2:** Dropout voltage is defined as the minimum differential between  $V_{IN}$  and  $V_{OUT}$  or  $V_{CTRL}$  and  $V_{OUT}$  required to maintain regulation at  $V_{OUT}$  95% Nominal  $V_{OUT}$ .

**Note 3:**  $V_{REF}$  is measured across Adjust pin to Sense pin.

| PIN NUMBER | PIN NAME   | DESCRIPTION                                                                                                                                                                                                                     |
|------------|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1          | SENSE      | Allows Kelvin sense of $V_{OUT}$ at the load. (Positive side of the reference voltage of the device).                                                                                                                           |
| 2          | ADJ        | Negative side of the reference voltage for the device. Adding a small bypass capacitor from the ADJ pin to ground will improve the transient response.                                                                          |
| 3          | $V_{OUT}$  | Power output of the device.                                                                                                                                                                                                     |
| 4          | $V_{CTRL}$ | Supply pin for the control circuitry of the device. The current flow into this pin will be about 1% of the output current. $V_{CTRL}$ must be between 1.0V and 1.3V greater than the output voltage for the device to regulate. |
| 5          | $V_{IN}$   | Output load current is supplied through this pin. $V_{IN}$ must be between 0.1V and 0.8V greater than the output voltage for this device to regulate.                                                                           |

Note that TAB is internally connected to Pin 3.

FUNCTIONAL DIAGRAM



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

The SPX1582 uses a separate input voltage  $V_{CTRL}$  ( $V_{CTRL} \geq V_{OUT} + 1.3V$ ) 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 will reduce the heat dissipation\*, and lower heatsink and cooling fan costs.

The SPX1582 can power the 2.5V core voltage for microprocessors such as a PentiumPC™, P55C™, AMD5k86™ and K6™ and the IBM PowerPC™ 603EV and 604EV processors.

A typical application would use 3.3V for  $V_{IN}$  and 5.0V for  $V_{CTRL}$  from a motherboard power supply to provide a nominal 2.5V output. Using the sense pin provides a Kelvin measurement of output for reducing resistance-associated errors.

### Power Up Sequencing

The SPX1582 requires a power up sequence in that  $V_{IN}$  must be applied before  $V_{CTRL}$  to prevent a latchup condition. If this is not possible, then 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

1.25V reference voltage is being developed between the SENSE pin and the ADJ pin of the SPX1582. Adding two external resistors (see fig 1.) will allow 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 formula:

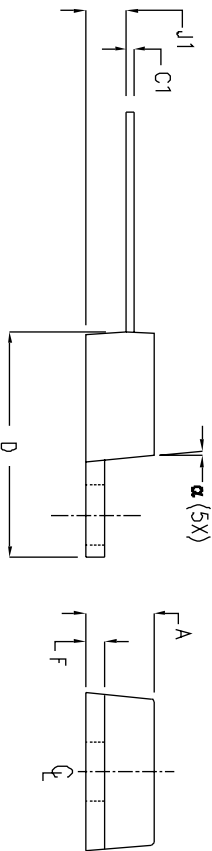
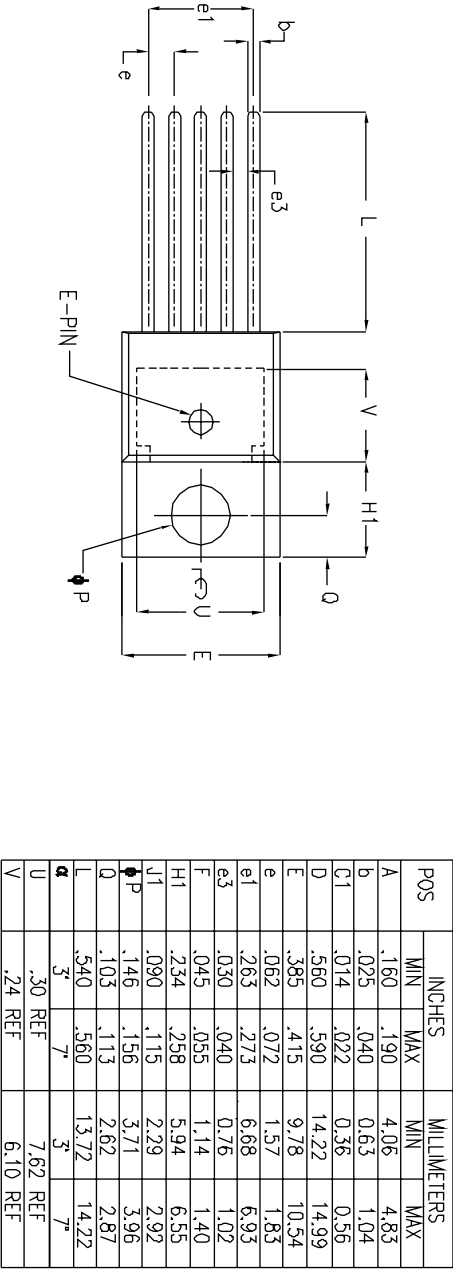
$$V_{OUT} = V_{REF} (1 + R_2/R_1) + I_{ADJ} (R_2).$$

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 will improve load regulation.

### Lowering Noise

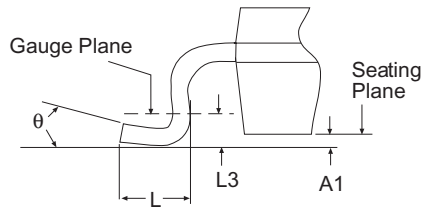
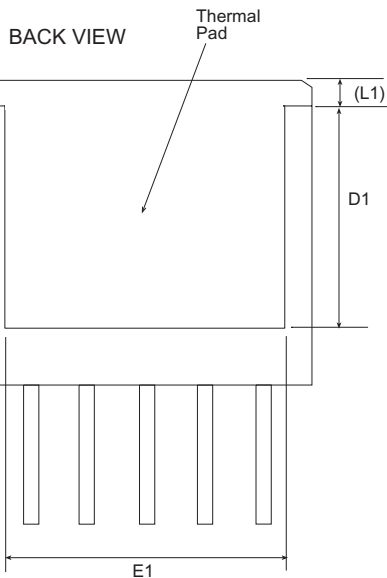
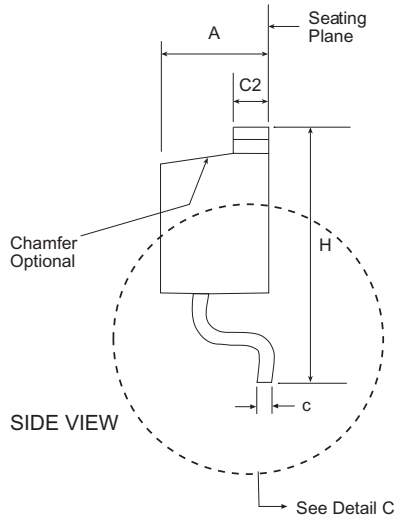
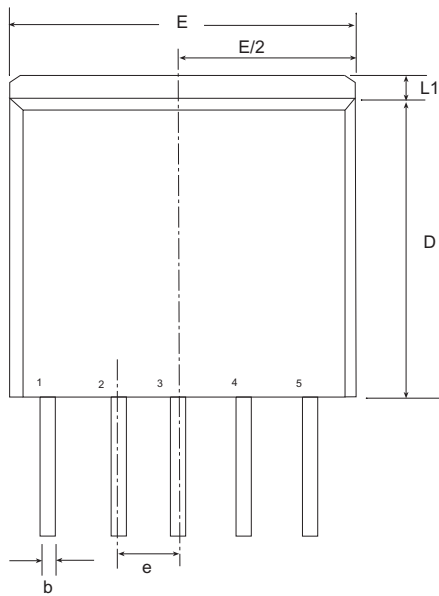
For the fixed voltage device, adding a capacitor at the GND pin will improve transient response. This capacitor is chosen in the range of 1µF to 0.1µF and will depend on the amount of output capacitance in the system.

Controlling Dimension is Inches



- NOTE:
1. DIMENSION C1 APPLY FOR TIN PLATE FINISH.
  2. FOR SOLDER DIP LEAD FINISH, DIMENSION C1 SHOULD BE .015"-.027" (0.38-0.69MM).
  3. J1 DIMENSION TO BE COVERED BY FINAL VISUAL OUTGOING SPEC, CSM-220-017 (i.e. Y-AXIS BEND LEAD ALLOWED FOR 1 LEAD THICKNESS.

TO220 5L PKG OUTLINE



| 5 Pin TO-263 JEDEC TO-263 Variation BA |                                                |     |       |                                                                      |     |       |
|----------------------------------------|------------------------------------------------|-----|-------|----------------------------------------------------------------------|-----|-------|
| SYMBOL                                 | Dimensions in Inches:<br>Controlling Dimension |     |       | Dimensions in Millimeters<br>Conversion Factor:<br>1 Inch = 25.40 mm |     |       |
|                                        | 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                                      | .067 BSC                                       |     |       | 1.702 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                                     | .010 BSC                                       |     |       | 0.254 BSC                                                            |     |       |
| Θ                                      | 0°                                             | -   | 8°    | 0°                                                                   | -   | 8°    |
| SIPEX Pkg Signoff Date/Rev:            |                                                |     |       | JL Jun12-06 / Rev B                                                  |     |       |

| <b>Part Number</b>     | <b>Accuracy</b> | <b>Output Voltage</b> | <b>Packages</b> |
|------------------------|-----------------|-----------------------|-----------------|
| SPX1582U5 .....        | 2.0% .....      | Adj .....             | 5-Pin TO-220    |
| SPX1582U5-2-5 .....    | 2.0% .....      | 2.5V .....            | 5-Pin TO-220    |
| SPX1582U5-2-8 .....    | 2.0% .....      | 2.8V .....            | 5-Pin TO-220    |
| SPX1582U5-3-3 .....    | 2.0% .....      | 3.3V .....            | 5-Pin TO-220    |
| SPX1582T5 .....        | 2.0% .....      | Adj .....             | 5-Pin TO-263    |
| SPX1582T5/TR .....     | 2.0% .....      | Adj .....             | 5-Pin TO-263    |
| SPX1582T5-1-5 .....    | 2.0% .....      | 2.5V .....            | 5-Pin TO-263    |
| SPX1582T5-1-5/TR.....  | 2.0% .....      | 2.5V .....            | 5-Pin TO-263    |
| SPX1582T5-1-8 .....    | 2.0% .....      | 2.5V .....            | 5-Pin TO-263    |
| SPX1582T5-1-8/TR.....  | 2.0% .....      | 2.5V .....            | 5-Pin TO-263    |
| SPX1582T5-2-5 .....    | 2.0% .....      | 2.5V .....            | 5-Pin TO-263    |
| SPX1582T5-2-5/TR ..... | 2.0% .....      | 2.5V .....            | 5-Pin TO-263    |
| SPX1582T5-2-8 .....    | 2.0% .....      | 2.8V .....            | 5-Pin TO-263    |
| SPX1582T5-2-8/TR ..... | 2.0% .....      | 2.8V .....            | 5-Pin TO-263    |
| SPX1582T5-3-3 .....    | 2.0% .....      | 3.3V .....            | 5-Pin TO-263    |
| SPX1582T5-3-3/TR ..... | 2.0% .....      | 3.3V .....            | 5-Pin TO-263    |

Available in lead free packaging. To order add "-L" suffix to part number.

Example: SPX1582T5-3-3/TR = standard; SPX1582T5-L-3-3/TR = lead free.

/TR = Tape and Reel

Pack quantity is 500 for TO-263.



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