**Sipex**  *Preliminary*  **SPX2969**

# 150mA Low Dropout Voltage Regulator

## FEATURES
- 5V Fixed Output
- 150mA current capability
- 250mV Dropout
- Programmable Reset Threshold
- 250µA Quiescent Current
- Over Temperature Protection
- Reverse Polarity Protection
- Integrated Pull Up Resistor on Logic Outputs
- -40° to +125°C Operating Range

```
    I  [1]              [8]  Q
   SI  [2]   SPX2969    [7]  SO
 RADJ  [3]  8 Pin NSOIC [6]  RO
    D  [4]              [5]  GND
```

*Available in Lead Free Packaging*
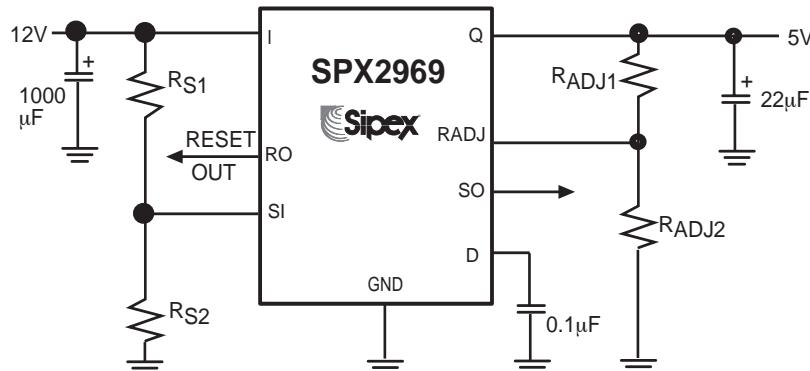
## APPLICATIONS
- Automotive
- Industrial
- Wireless Base Station

## DESCRIPTION

The SPX2969 is a low dropout linear regulator with integrated PNP pass transistor. This part is designed for high voltage applications, which can withstand up to 45V and 125°C. The output voltage is set at a fixed 5V, and the part is guaranteed to deliver at least 150mA. The SPX2969 provides multiple protection mechanisms, including over-temperature and over-current detection. The part has a built-in reset circuit to monitor when the output voltage is below 4.65V. The reset voltage threshold can be programmed down to 3.5V using an external resistor voltage divider, while the reset timing can be programmed via an external capacitor. A built in comparator compares the signal at the pin SI, normally fed by a voltage divider from the input voltage, with the reference and gives an early warning on the pin SO. Both the sense output and the reset output delay signals contain integrated 20kΩ pull up resistors. The part is available in an 8 Pin NSOIC package.

## TYPICAL APPLICATION CIRCUIT

## ABSOLUTE MAXIMUM RATINGS

Input Voltage ................................................................ -40V to 45V
Input Current ........................................................ internally limited
Sense Input Voltage .................................................... -40V to 45V
Sense Input Current ..................................................... -1mA to 1mA
Reset Threshold Voltage .................................................. -0.3 to 7V
Reset Threshold Current ............................................... -10 to 10mA
Reset Delay Voltage ....................................................... -0.3 to 7V
Reset Delay Current .............................................. internally limited
Ground Current ....................................................... 50mA (min)
Reset Output Voltage ..................................................... -0.3 to 7V
Reset Output Current ............................................ internally limited
Sense Output Voltage ..................................................... -0.3 to 7V
Sense Output Current ........................................... internally limited

Output Voltage ............................................................... -0.3 to 7V
Output Current ..................................................... internally limited

Thermal Data
Junction to Ambient (8 Pin NSOIC) ........................................ 163°C/W
Junction to Pin 4, all GND Pins grounded ................................ 30°C/W
Storage Temperature .................................................. -50°C to +150°C
Junction Temperature. (Note 1)....................................-40°C to +150°C

These are stress ratings only and functional operation of the device at these ratings or any other above those indicated in the operation sections of the specifications below is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability.

## ELECTRICAL CHARACTERISTICS

$V_{IN}$ = 13.5V; -40°C < $T_J$ < 125°C. The ♦ denotes the specifications which apply over the full operating temperature range, unless otherwise specified.

| PARAMETER | SYMBOL | MIN | TYP | MAX | UNITS | | CONDITIONS |
|-----------|--------|-----|-----|-----|-------|---|-----------|
| Output Voltage | $V_Q$ | 4.90 | 5.00 | 5.10 | V | ♦ | 1mA < $I_Q$ 100mA<br>6V < $V_I$ < 16V |
| Current Limit | $I_Q$ | 150 | 250 | 500 | mA | ♦ | |
| Current Consumption $I_q = I_I - I_Q$ | $I_q$ | - | 240 | 300 | μA | | $I_Q$ < 1 mA, Tj < 85°C |
| Current Consumption $I_q = I_I - I_Q$ | $I_q$ | - | 250 | 700 | μA | ♦ | $I_Q$ = 10mA |
| Current Consumption $I_q = I_I - I_Q$ | $I_q$ | - | 2 | 8 | mA | ♦ | $I_Q$ = 50mA |
| Dropout Voltage | $V_{DR}$ | - | 0.25 | 0.5 | V | ♦ | $I_Q$ = 100mA (Q - I) when output drops below 2% (see note 2) |
| Load Regulation | $V_Q$ | - | 2 | 20 | mV | ♦ | $I_Q$ = 5mA to 100mA |
| Line Regulation | $V_Q$ | - | 1 | 10 | mV | ♦ | $V_I$ = 6V to 26V<br>$I_Q$ = 1 mA |
| **Reset Generator** | | | | | | | |
| Threshold Voltage | $V_{RT}$ | 4.50 | 4.65 | 4.80 | V | ♦ | |
| Reset Adjust | $V_{RADJ, TH}$ | 1.26 | 1.35 | 1.44 | V | ♦ | $V_Q$ = 3.5V (see note 3) |
| Reset Pullup | - | 10 | 20 | 40 | KΩ | ♦ | |
| Saturation Voltage | $V_{RO, SAT}$ | - | 0.1 | 0.4 | V | ♦ | $R_{intern}$ |

**Note 1:** Specifications in the -40°C to 150°C range are guaranteed by design, not production tested.
**Note 2:** Dropout voltage = $V_I$ - $V_Q$ measured when the output voltage has dropped 100mV from the nominal value obtained at 13.5V input.
**Note 3:** The reset threshold $V_{RT}$ can be decreased via an external voltage divider connected to the RADJ. In this case the reset condition is reached if $V_Q$ < $V_{RT}$ and $V_{RADJ}$ < $V_{RADJ, TH}$. Dimensioning the voltage divider according to: $V_{THRES} = V_{RADJ, TH} \times (R_{ADJ1} + R_{ADJ2})/R_{ADJ2}$.
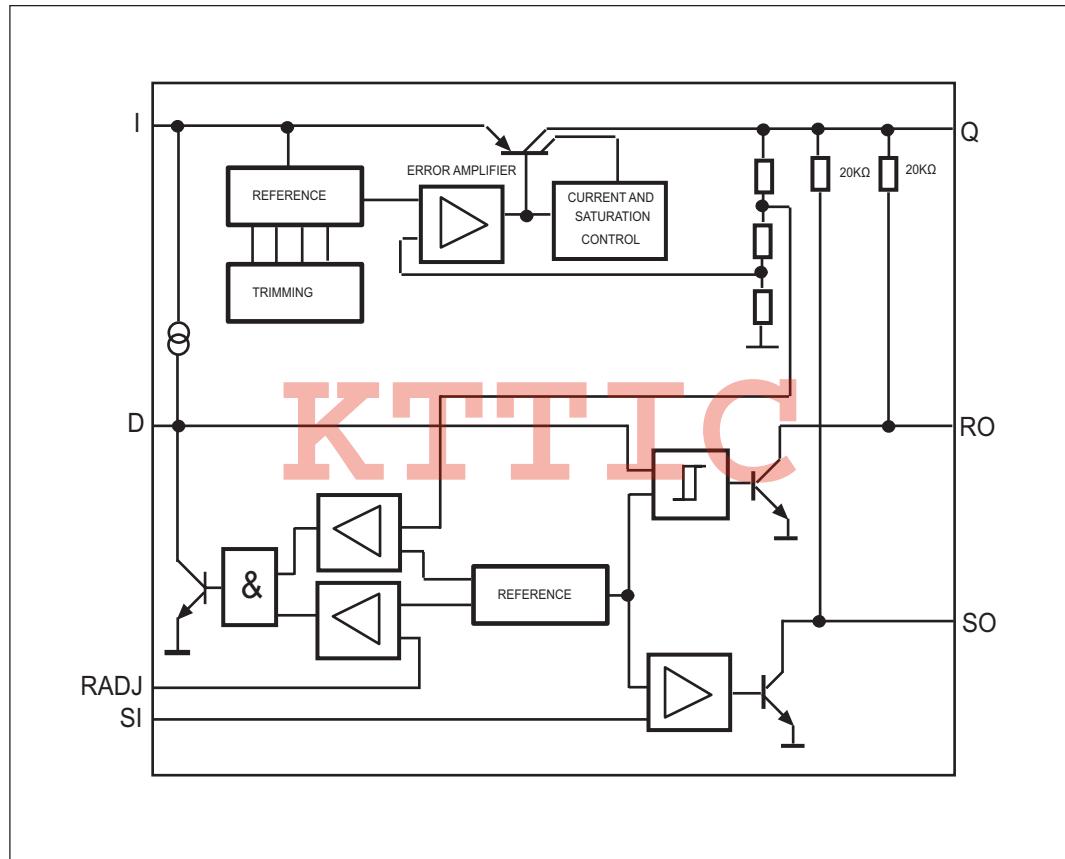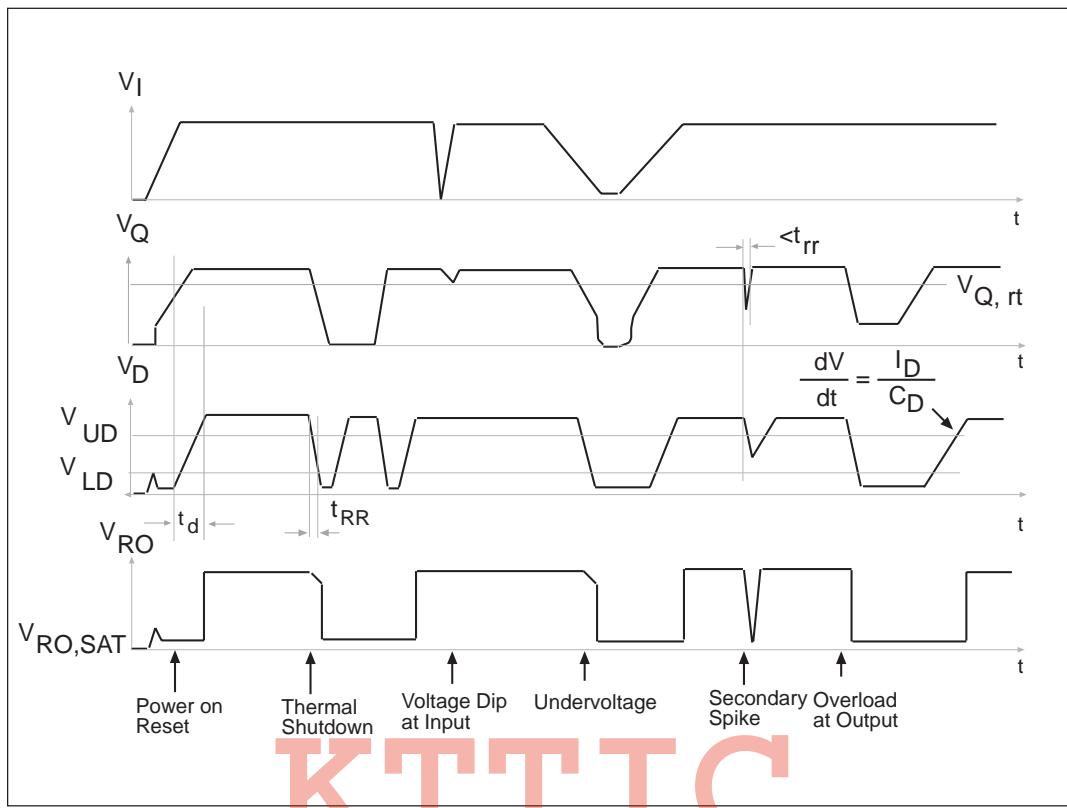
**ELECTRICAL CHARACTERISTICS**

$V_{IN}$ = 13.5V; -40°C < $T_J$ < 125°C. The ♦ denotes the specifications which apply over the full operating temperature range, unless otherwise specified.

| PARAMETER | SYMBOL | MIN | TYP | MAX | UNITS | | CONDITIONS |
|---|---|---|---|---|---|---|---|
| **Reset Generator** | | | | | | | |
| Upper Delay Switching Threshold | $V_{UD}$ | 1.4 | 1.8 | 2.2 | V | ♦ | |
| Lower Delay Switching Threshold | $V_{LD}$ | 0.3 | 0.45 | 0.60 | V | ♦ | |
| Saturation Voltage Delay Capacitor | $V_{D, SAT}$ | - | - | 0.1 | V | ♦ | $V_Q < V_{RT}$ |
| Charge Current | $I_D$ | 3.0 | 6.5 | 9.5 | µA | ♦ | $V_D$ =1V |
| Delay Time L to H | $t_D$ | 17 | 28 | - | ms | ♦ | $C_D$ = 100nF |
| Delay Time H to L | $t_t$ | - | 1 | - | µs | ♦ | $C_D$ = 100nF |
| **Input Voltage Sense** | | | | | | | |
| Sense Threshold High | $V_{SI, high}$ | 1.25 | 1.33 | 1.36 | V | ♦ | |
| Sense Threshold Low | $V_{SI, low}$ | 1.18 | 1.22 | 1.28 | V | ♦ | |
| Sense Output low Voltage | $V_{SO, low}$ | - | 0.1 | 0.4 | V | ♦ | $V_{SI}$ < 1.20V $V_Q$ > 3V $R_{intern}$ |
| Sense Pull up | - | 10 | 20 | 40 | K | ♦ | |
| Sense Input Current | $i_{si}$ | -1 | 0.1 | 1 | µA | ♦ | |
| Sense Response Time | - | | 2 | | µs | ♦ | |

**APPLICATIONS INFORMATION**

The input capacitor $C_I$ is necessary for compensating line influences. Using a resistor of approximately 1Ω in series with $C_I$, the oscillating circuit consisting of input inductance and input capacitance can be damped. The output capacitor $C_Q$ is necessary for the stability of the regulating circuit. Stability is guaranteed at values ≥ 10μF and at an ESR ≤ 10Ω within the operating temperature range. The delay pin capacitor's variation and temperature coefficient may cause a small difference in the reset delay.

**BLOCK DIAGRAM**

$V_I$

$V_Q$

$<t_{rr}$

$V_{Q, rt}$

$V_D$

$V_{UD}$

$V_{LD}$

$$\frac{dV}{dt} = \frac{I_D}{C_D}$$

$t_d$

$t_{RR}$

$V_{RO}$

$V_{RO,SAT}$

Power on Reset | Thermal Shutdown | Voltage Dip at Input | Undervoltage | Secondary Spike | Overload at Output
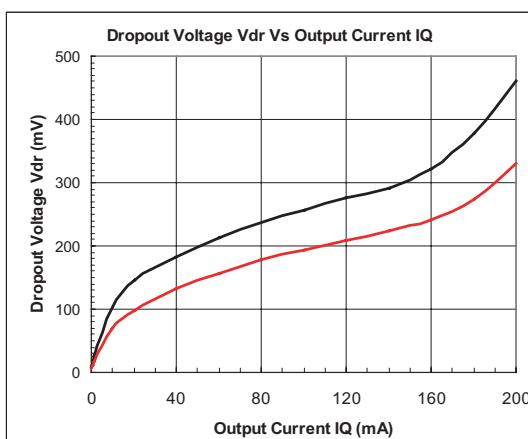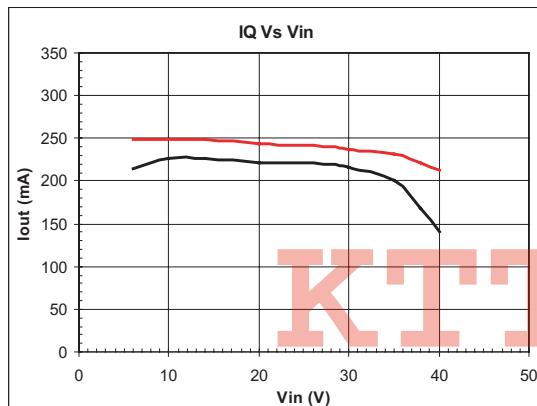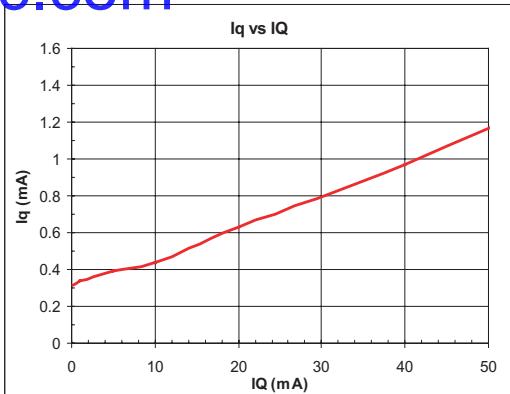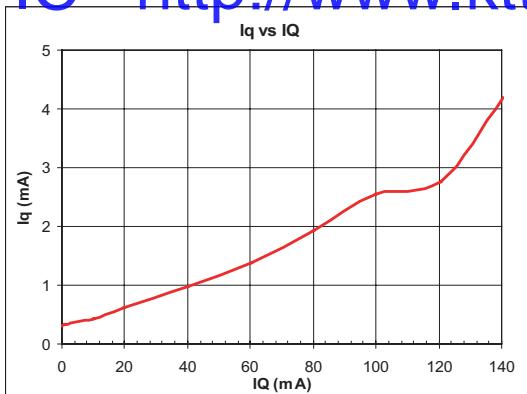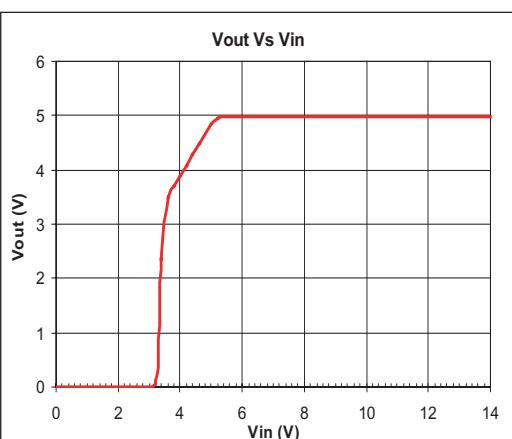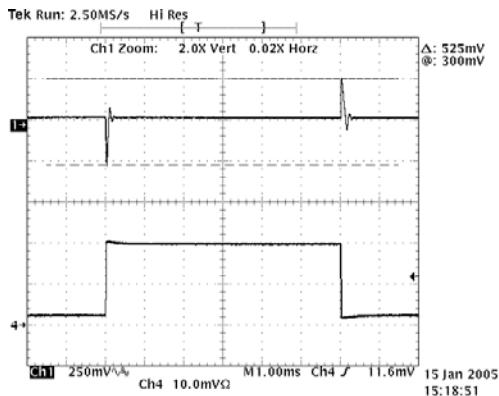
**PIN DESCRIPTION**

| PIN NUMBER | PIN NAME | DESCRIPTION (8 PIN NSOIC) |
|---|---|---|
| 1 | $V_{IN}$ | Input. Decouple to GND with a Ceramic capacitor. |
| 2 | SENSE IN | Sense Input. If not needed, connect to Q. |
| 3 | $R_{ADJ}$ | Reset Threshold Adj. If not needed, connect to GND. |
| 4 | DELAY | Reset Delay. To select delay time, connect to GND via capacitor. |
| 5 | GND | Ground |
| 6 | RESET | Reset Output. The open-collector output is internally linked to Q via a resistor. Leave open if not needed. |
| 7 | SENSE OUT | Sense Output. The open-collector output is internally linked to Q via a resistor. Leave open if not needed. |
| 8 | $V_{OUT}$ | 5V Output. Connect to GND with a 10μF capacitor, ESR<10. |

**Iq vs IQ**

**Iq vs IQ**

**IQ Vs Vin**

**Dropout Voltage Vdr Vs Output Current IQ**

**Vout Vs Vin**

Red:  T$_J$ = 125°C; Black:T$_J$ = 125°C
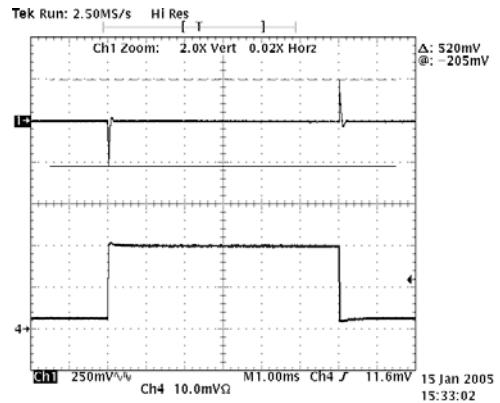
RL = 50 Ohms
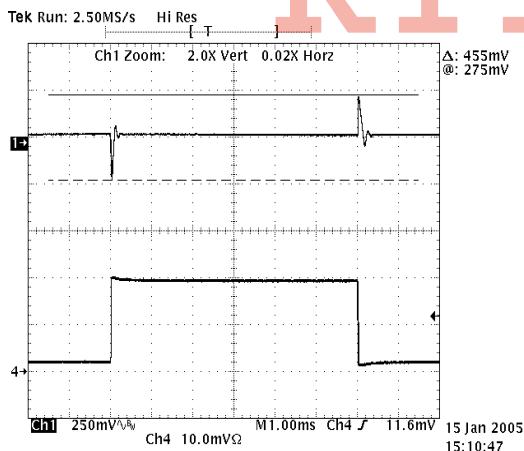
**Load Transient Response:**
**Vin = 13.5V  25˚C, 10 uF Ceramic,**
**Ch1 = Vout, Ch2 = Iout (100mA/div)**
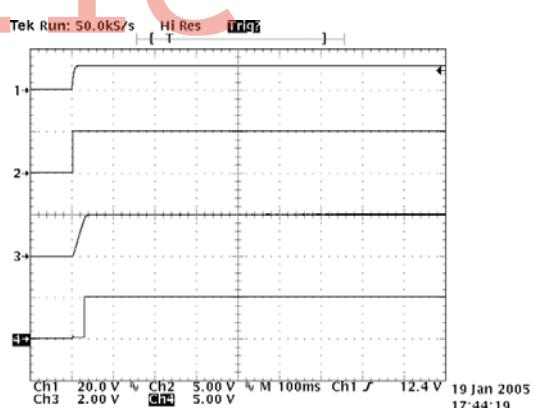
**Load Transient Response:**
**Vin = 13.5V  25˚C, 10 uF Aluminum,**
**Ch1 = Vout, Ch2 = Iout (100mA/div)**
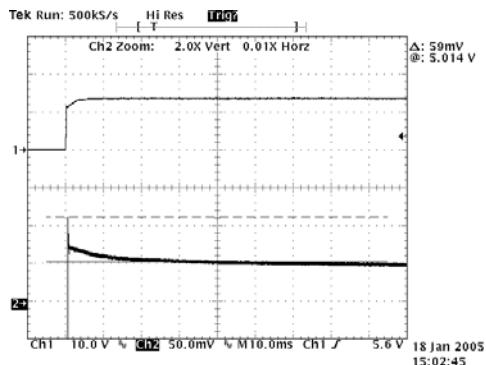
**Load Transient Response:**
**Vin = 13.5V  25C, 10 uF Tantalum, Ch1**
**= Vout, Ch2 = Iout (100mA/div)**
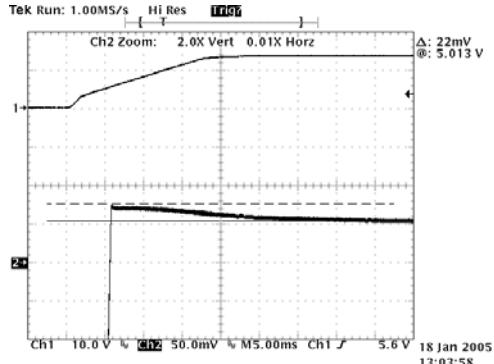
**Reset Output Startup:**
**CH1=Vin, CH2=Vout**
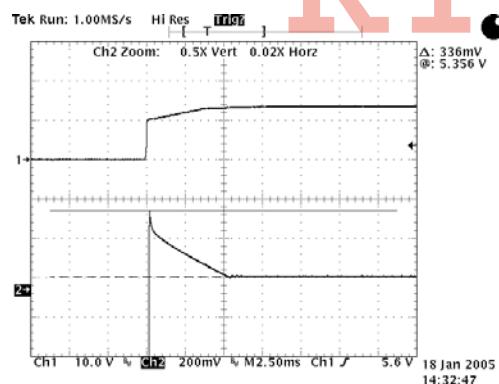
**CH3=VD, CH4=VRO**
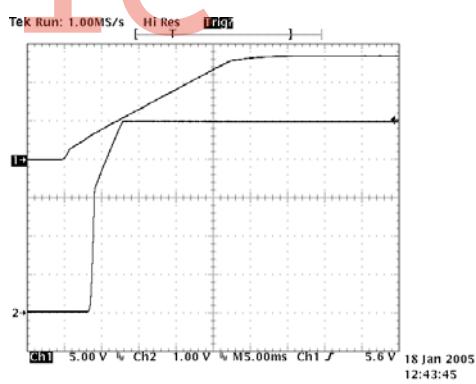
**Fast Start up,:**
**Vin=13.5V, 200mA Load, 85˚C,**
**Ch1 = Vin, Ch2 = Vout**
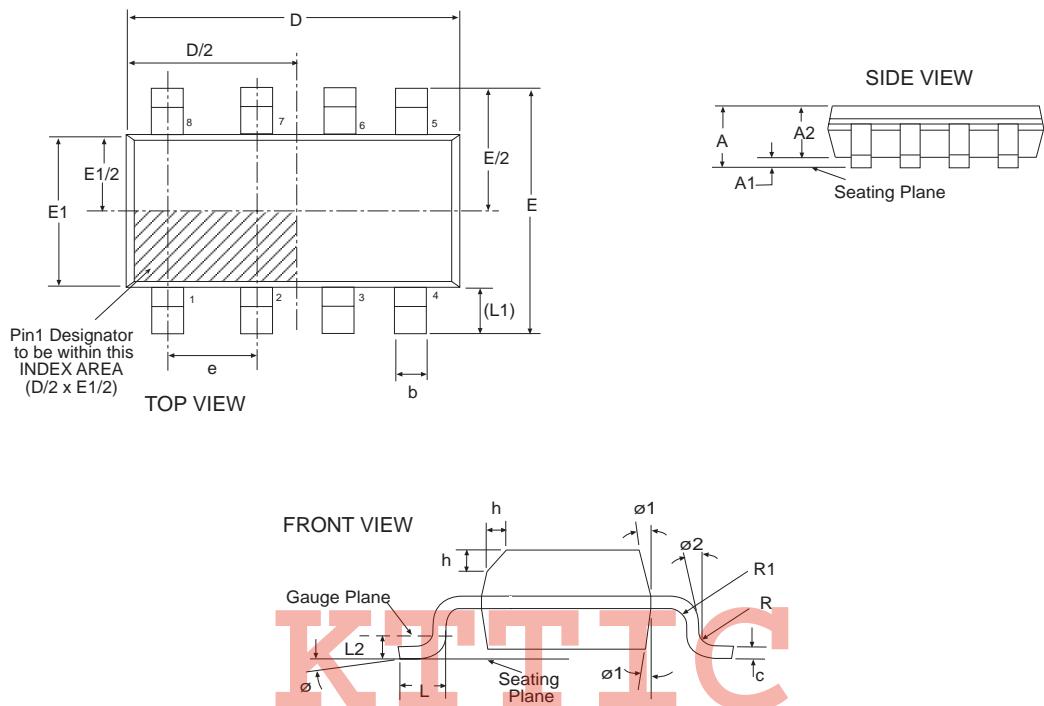


**Slow Start up:**
 **Vin=13.5V, 200mA Load, 25˚C,**
**Ch1 = Vin, Ch2 = Vout**



**Fast Start up:**
**Vin=13.5V, No Load, 25˚C,**
**Ch1 = Vin, Ch2 = Vout**



**Slow Start up:**
**Vin=13.5V, 200mA Load, 25˚C,**
**Ch1 = Vin, Ch2 = Vout**

**TOP VIEW**

Pin1 Designator to be within this INDEX AREA (D/2 x E1/2)

**SIDE VIEW**

Seating Plane

**FRONT VIEW**

Gauge Plane

Seating Plane

| 8 Pin NSOIC | | JEDEC MS-012 | | Variation AA | |
|---|---|---|---|---|---|
| SYMBOL | Dimensions in Millimeters: Controlling Dimension | | | Dimensions in Inches Conversion Factor: 1 Inch = 25.40 mm | | |
| | MIN | NOM | MAX | MIN | NOM | MAX |
| A | 1.35 | - | 1.75 | 0.053 | - | 0.069 |
| A1 | 0.10 | - | 0.25 | 0.004 | - | 0.010 |
| A2 | 1.25 | - | 1.65 | 0.049 | - | 0.065 |
| b | 0.31 | - | 0.51 | 0.012 | - | 0.020 |
| c | 0.17 | - | 0.25 | 0.007 | - | 0.010 |
| E | 6.00 BSC | | | 0.236 BSC | | |
| E1 | 3.90 BSC | | | 0.154 BSC | | |
| e | 1.27 BSC | | | 0.050 BSC | | |
| h | 0.25 | | 0.50 | 0.010 | - | 0.020 |
| L | 0.40 | - | 1.27 | 0.016 | - | 0.050 |
| L1 | 1.04 REF | | | 0.041 REF | | |
| L2 | 0.25 BSC | | | 0.010 BSC | | |
| R | 0.07 | - | - | 0.003 | - | - |
| R1 | 0.07 | - | - | 0.003 | - | - |
| ø | 0º | - | 8º | 0º | - | 8º |
| ø1 | 5º | - | 15º | 5º | - | 15º |
| ø2 | 0º | - | - | 0º | - | - |
| D | 4.90 BSC | | | 0.193 BSC | | |
| SIPEX Pkg  Signoff Date/Rev: | | | | JL Aug16-05 / Rev A | | |

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| Part number | Output Voltage | Package Type |
|---|---|---|
| SPX2969CS .... ......................................5.0V ......................................... 8 Pin NSOIC | | |
| SPX2969CS/TR......................................5.0V ......................................... 8 Pin NSOIC | | |

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

Example: SPX2969CS/TR = standard; SPX2969CS-L/TR = lead free

/TR = Tape and Reel

Pack quantity is 2,500 for NSOIC.

*CLICK HERE TO ORDER SAMPLES*

KTTIC

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