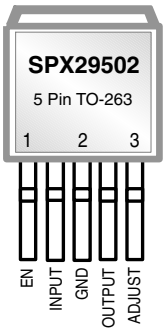
## FEATURES

- Adjustable Output Down to 1.25V
- 1% Output Accuracy
- Output Current of 5A
- Low Dropout Voltage: 420mV @ 5A
- Tight Line Regulation: 0.06%
- Load Regulation: 0.2%
- Fast Transient Response
- Reverse-Battery Protection
- Current Limit and Thermal Protection




## APPLICATIONS

- Powering VGA & Sound Card
- Power PC™ Supplies
- SMPS Post Regulator
- High Efficiency "Green" Computer Systems
- High Efficiency Linear Power Supplies
- Constant Current Regulators
- Adjustable Power Supplies
- Battery Charger

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## DESCRIPTION

The SPX29501/02 are 5A highly accurate voltage regulators with a low dropout voltage of 420mV @ 5A. These regulators are specifically designed for low voltage applications that require a low dropout voltage and a fast transient response. They are fully fault protected against over-current, reverse battery, and positive and negative voltage transients. On-Chip trimming adjusts the reference voltage to 1% initial accuracy. Other features include Enable, and Error Flag.

The SPX295001/02 are offered in 5-pin TO-220 & TO-263 packages. For a 1.5A version, refer to the SPX29150 data sheet. For a 3A version, refer to the SPX29300 datasheet.

## TYPICAL APPLICATION CIRCUITS

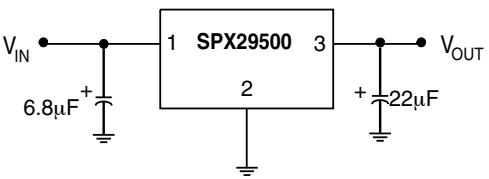



*Figure 1. Fixed Output Linear Regulator*

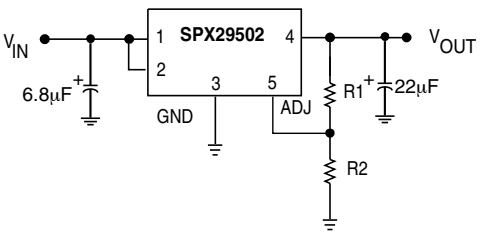



*Figure 2. Adjustable Output Linear Regulator*

## ABSOLUTE MAXIMUM RATINGS

Lead Temperature (soldering, 5 seconds) .....260°C
Storage Temperature Range.....-65°C to +150°C
Operating Junction Temperature Range.....-40°C to +125°C
Input Voltage (Note 1) ..... 20V

## OPERATING RATINGS

Input Voltage ..... 16V

## ELECTRICAL CHARACTERISTICS

Specifications are at $V_{IN} = V_{OUT} + 1V$ and $I_{OUT} = 10mA$, $C_{IN} = 6.8\mu F$, $C_{OUT} = 22\mu F$, $T_A = 25°C$, unless otherwise specified. The ♦ denotes the specifications which apply over the full operating temperature range, unless otherwise specified.

| PARAMETER | MIN | TYP | MAX | UNITS | | CONDITIONS |
|---|---|---|---|---|---|---|
| **Fixed Voltage Options** | | **SPX29501** | | | | |
| **1.8V Version** | | | | | | |
| Output Voltage | 1.782<br>1.764 | 1.800<br>1.800 | 1.818<br>1.836 | V | <br>♦ | $I_{OUT}$ = 10mA<br>10mA ≤ $I_{OUT}$ ≤ 5A, 2.8V ≤ $V_{IN}$ ≤ 16V |
| **2.5V Version** | | | | | | |
| Output Voltage | 2.475<br>2.450 | 2.500<br>2.500 | 2.525<br>2.550 | V | <br>♦ | $I_{OUT}$ = 10mA<br>10mA ≤ $I_{OUT}$ ≤ 5A, 3.5V ≤ $V_{IN}$ ≤ 16V |
| **3.3V Version** | | | | | | |
| Output Voltage | 3.267<br>3.234 | 3.300<br>3.300 | 3.333<br>3.366 | V | <br>♦ | $I_{OUT}$ = 10mA<br>10mA ≤ $I_{OUT}$ ≤ 5A, 4.3V ≤ $V_{IN}$ ≤ 16V |
| **5.0V Version** | | | | | | |
| Output Voltage | 4.950<br>4.900 | 5.000<br>5.000 | 5.050<br>5.100 | V | <br>♦ | $I_{OUT}$ = 10mA<br>10mA ≤ $I_{OUT}$ ≤ 5A, 6.0V ≤ $V_{IN}$ ≤ 16V |
| **All Voltage Options** | | **SPX29501/02** | | | | |
| Line Regulation | | 0.06 | 0.5 | % | | $I_{OUT}$=10mA,($V_{OUT}$+1V) ≤ $V_{IN}$ ≤ 16V |
| Load Regulation | | 0.2 | 1 | % | | $V_{IN}$=$V_{OUT}$+2V, 10mA≤ $I_{OUT}$ ≤ $I_{FL}$ (Note 2) |
| ΔV/ΔT | | 20 | 100 | ppm/°C | ♦ | $V_{OUT}$ Temp Coefficient (Note 5) |
| Dropout Voltage, except 1.8V | | 90<br>250<br>420 | 250<br><br>800 | mV | ♦<br><br>♦ | $I_{OUT}$=250mA<br>$I_{OUT}$=2.5A<br>$I_{OUT}$=5A |
| Ground Current (Note 4) | | 20<br>70 | 50 | mA | ♦<br> | $I_{OUT}$=2.5A<br>$I_{OUT}$=5A |
| Ground Pin Current at Dropout | | 3 | | mA | | $V_{IN}$=0.5V less than specified $V_{OUT}$, $I_{OUT}$=10mA |
| Current Limit | | 7.5 | 10 | A | ♦ | (Note 3) |
| Output Noise Voltage (10Hz to 100kHz)<br>$I_L$=100mA | | 425<br><br>350 | | $\mu V_{RMS}$ | | $C_L$=22μF<br><br>$C_L$=33μF |
| Reference Voltage | 1.228<br>1.215 | 1.240 | 1.252<br>1.265 | V | <br>♦ | Adjustable version only |
| Reference Voltage | 1.203 | | 1.277 | V | | Adjustable version only (Note 7) |
| Adjust Pin Bias Current | | 40 | 80<br>120 | nA | <br>♦ | |
| Reference Voltage Temp. Coeff. | | 20 | | ppm/°C | | (Note 6) |
| Adjust Pin Bias Current Temp. Coeff. | | 0.1 | | nA/°C | | |

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## ELECTRICAL CHARACTERISTICS: Continued

Specifications are at $V_{IN} = V_{OUT} + 1V$ and $I_{OUT} = 10mA$, $C_{IN} = 6.8\mu F$, $C_{OUT} = 22\mu F$, $T_A = 25°C$, unless otherwise specified. The ♦ denotes the specifications which apply over the full operating temperature range, unless otherwise specified.

| PARAMETER | MIN | TYP | MAX | UNITS | | CONDITIONS |
|---|---|---|---|---|---|---|
| **Flag Output** (Error Comparator) | | **SPX29501** | | | | |
| Output Leakage Current | | 0.01 | 1<br>2 | µA | <br>♦ | $V_{OH}$=16V |
| Output Low Voltage | | 220 | 300<br>400 | mV | <br>♦ | Device set for 5V,$V_{IN}$=4.5V, $I_{OL}$=250µA |
| Upper Threshold Voltage | 40<br>25 | 60 | | mV | <br>♦ | Device set for 5V, (Note 8) |
| Lower Threshold Voltage | | 75 | 95<br>140 | mV | <br>♦ | Device set for 5V, (Note 8) |
| Hysteresis | | 15 | | mV | | Device set for 5V, (Note 8) |
| **Enable Input** | | **SPX29501/02** | | | | |
| Input Logic Voltage<br>Low (OFF)<br>High (ON) | <br>2.4 | | 0.8 | V | | (Note 10) |
| ENABLE Input Current | | 100<br>0.6 | 600<br>750<br>2<br>4 | µA<br><br>µA<br> | <br>♦<br><br>♦ | $V_{EN}$=16V<br><br>$V_{EN}$=0.8V |
| Regulator Output Current in Shutdown | | 10 | 500 | µA | ♦ | (Note 9) |
| Thermal Resistance | | 2<br>60<br>2<br>60 | | °C/W | | TO-220 Junction to Case, at Tab<br>TO-220 Junction to Ambient<br>TO-263 Junction to Case, at Tab<br>TO-263 Junction to Ambient |

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**NOTES:**

**Note 1:** Maximum positive supply voltage of 20V must be of limited duration (<100ms) and duty cycle of less than 1%. The maximum continuous supply voltage is 16V.

**Note 2:** Full load current ($I_{FL}$) is defined as 5A.

**Note 3:** $V_{IN} = V_{OUT\ (NOMINAL)} + 1V$. For example, use $V_{IN} = 4.3V$ for a 3.3V regulator. Employ pulse-testing procedures to minimize temperature rise.

**Note 4** Ground pin current is the regulator quiescent current. The total current drawn from the source is the sum of the load current plus the ground pin current.

**Note 5:** Output voltage temperature coefficient is defined as the worst case voltage change divided by the total temperature range.

**Note 6:** Thermal regulation is defined as the change in output voltage at time T after a change in power dissipation is applied, excluding load / line regulation effects. Specifications for a 200mA load pulse as $V_{IN} = 20V$ (a 4W pulse) for t = 10ms.

**Note 7:** $V_{REF} \le V_{OUT} \le (V_{IN}-1)$, $2.3V \le V_{IN} \le 16V$, $10mA \le I_L \le I_{FL}$, $T_j < T_{jmax}$.

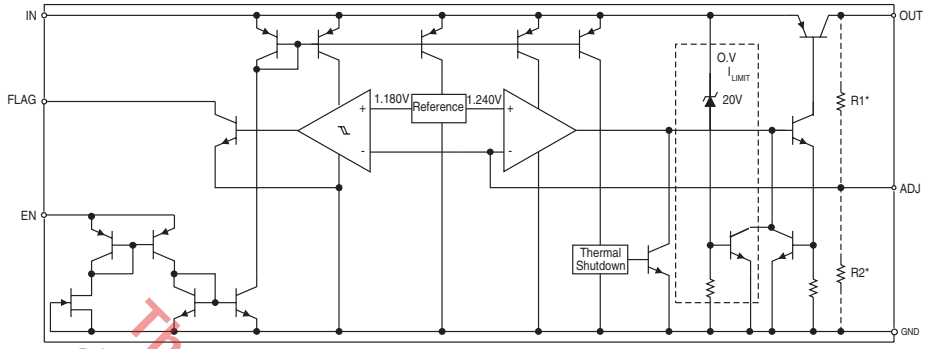
**Note 8:** Comparator threshold is expressed in terms of a voltage differential at the Adjust terminal below the nominal reference voltage measured 6V input. To express these thresholds in terms of output voltage change, multiply the error amplifier gain = $V_{OUT}/V_{REF}$ = (R1 + R2)/R2. For example, at a programmable output voltage of 5V, the Error output is guaranteed to go low when the output drops by 95mVx 5V/ 1.240V = 383mV. Threshold remain constant as a percent of $V_{OUT}$ as $V_{OUT}$ is varied, with the dropout warning occurring at typically 5% below nominal, 7.7% guaranteed.

**Note 9:** $V_{EN} \le 0.4V$ and $V_{IN} \le 16V$, $V_{OUT} = 0$.

**Note 10**: Measured with $I_{OUT} = I_{OUT}$ MIN (10mA).

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## FUNCTIONAL DIAGRAM




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## TYPICAL PERFORMANCE CHARACTERISTICS

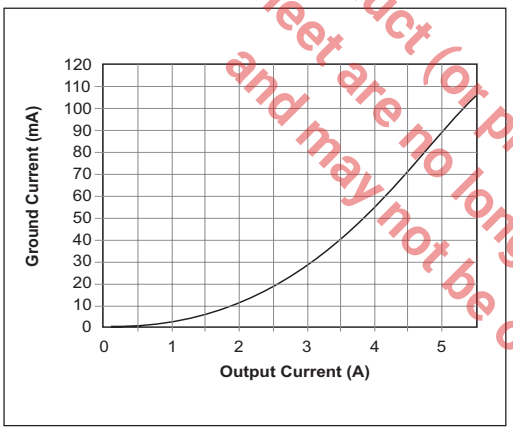



*Figure 3. Ground Current (mA) vs. Output Current (A)*

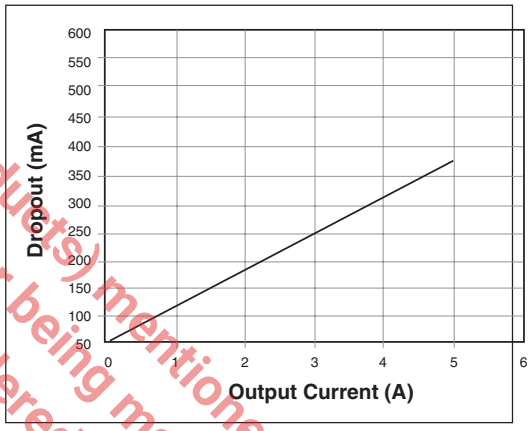



*Figure 4. Dropout (mV) vs. Output Current (A)*

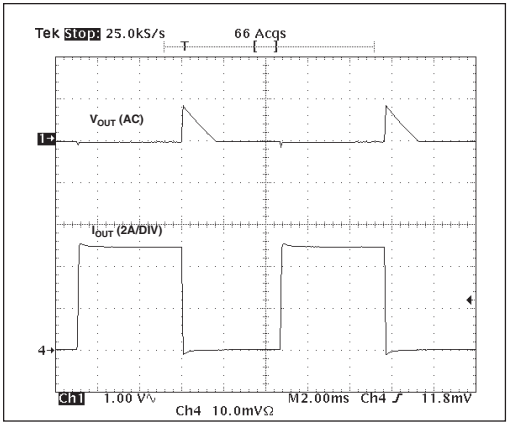



*Figure 5. Load Transient ($V_{IN}$=4V, $V_O$=3.3V, $C_{OUT}$=22µF, 10mA~5A)*

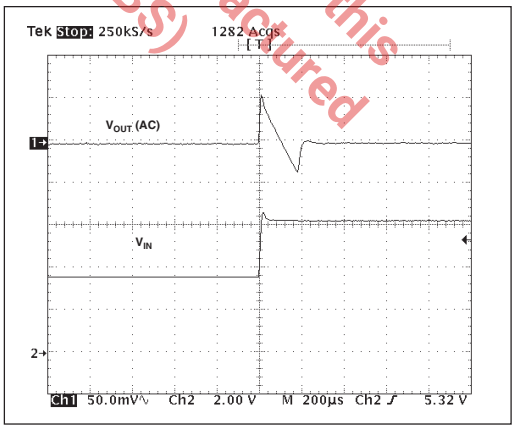



*Figure 6. Line Transient ($C_{OUT}$=22µF, $I_O$=10mA)*

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The SPX29501/02 incorporates protection against over-current faults, reversed load insertion, over temperature operation, and positive and negative transient voltage.

### Thermal Considerations

Although the SPX29501/02 offers limiting circuitry for overload conditions, it is still necessary to insure that the maximum junction temperature is not exceeded in the application. Heat will flow through the lowest resistance path, the junction-to-case path. In order to insure the best thermal flow of the component, proper mounting is required.

### TO-220 Design Example:

Assume that $V_{IN}$ = 8V, $V_{OUT}$ = 5V, $I_{OUT}$ = 5A, $T_A$ = 50°C, $\theta_{HA}$ = 1°C/W, $\theta_{CH}$ = 2°C/W, and $\theta_{JC}$ = 2°C/W, where:

$T_A$ = ambient temperature,
$\theta_{HA}$ = heatsink to ambient thermal resistance
$\theta_{CH}$ = case to heatsink thermal resistance
$\theta_{JC}$ = junction to case thermal resistance

The power calculated under these conditions is:

$$P_D = (V_{IN} - V_{OUT}) * I_{OUT} = 15W.$$

And the junction temperature is calculated as

$$T_J = T_A + P_D * (\theta_{HA} + \theta_{CH} + \theta_{JC}) \text{ or}$$
$$T_J = 50 + 15 * (1+2+2) = 125°C$$

Reliable operation is insured.

### Capacitor Requirements

The output capacitor is needed to insure stability and minimize the output noise. The value of the capacitor varies with the load. However, a minimum value of 22µF aluminum capacitor will guarantee stability over all load conditions. A tantalum capacitor is recommended if a faster load transient response is needed. If the power source has a high AC impedance, a 0.1µF ceramic capacitor between input & ground is recommended.

### Minimum Load Current

To ensure a proper behavior of the regulator under light load, a minimum load of 10mA for SPX29501/02 is required.

### Adjustable Regulator Design

The SPX29502 is an adjustable regulator that can be programmed to any value between 1.24V and 16V using 2 resistors, R1 and R2. The relationship between the resistors is:

$$R1 = R2(V_{OUT}/1.24-1).$$

### Error Flag

The SPX29501 features an error flag that indicates either an over current or under voltage condition. The flag output goes low, sinking 10mA when either condition occurs.

### Enable Input

The SPX29501/02 have an Enable function that switches the regulator on and off. Their thresholds are TTL compatible. Enabling the regulator requires approximately 20µA of current.

### Typical Application Circuits

Figure 1 represents at typical fixed output regulator. Figure 2 represents an adjustable output regulator. The values of R1 and R2 set the output voltage value as follows:

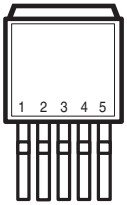
$$V_{OUT} = V_{REF} * [1 + (R1/R2)].$$

For best results, the total series resistance should guarantee a minimum regulator load current of 10mA.

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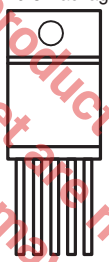
TO-263-5 Package (T5)




Top View

| SPX29501 | SPX29502 |
|---|---|
| 1)ENABLE | 1) ENABLE |
| 2)INPUT | 2) INPUT |
| 3)GND | 3) GND |
| 4)OUTPUT | 4) OUTPUT |
| 5)FLAG | 5) ADJUST |

TO-220-5 Package (U5)



1 2 3 4 5

Top View

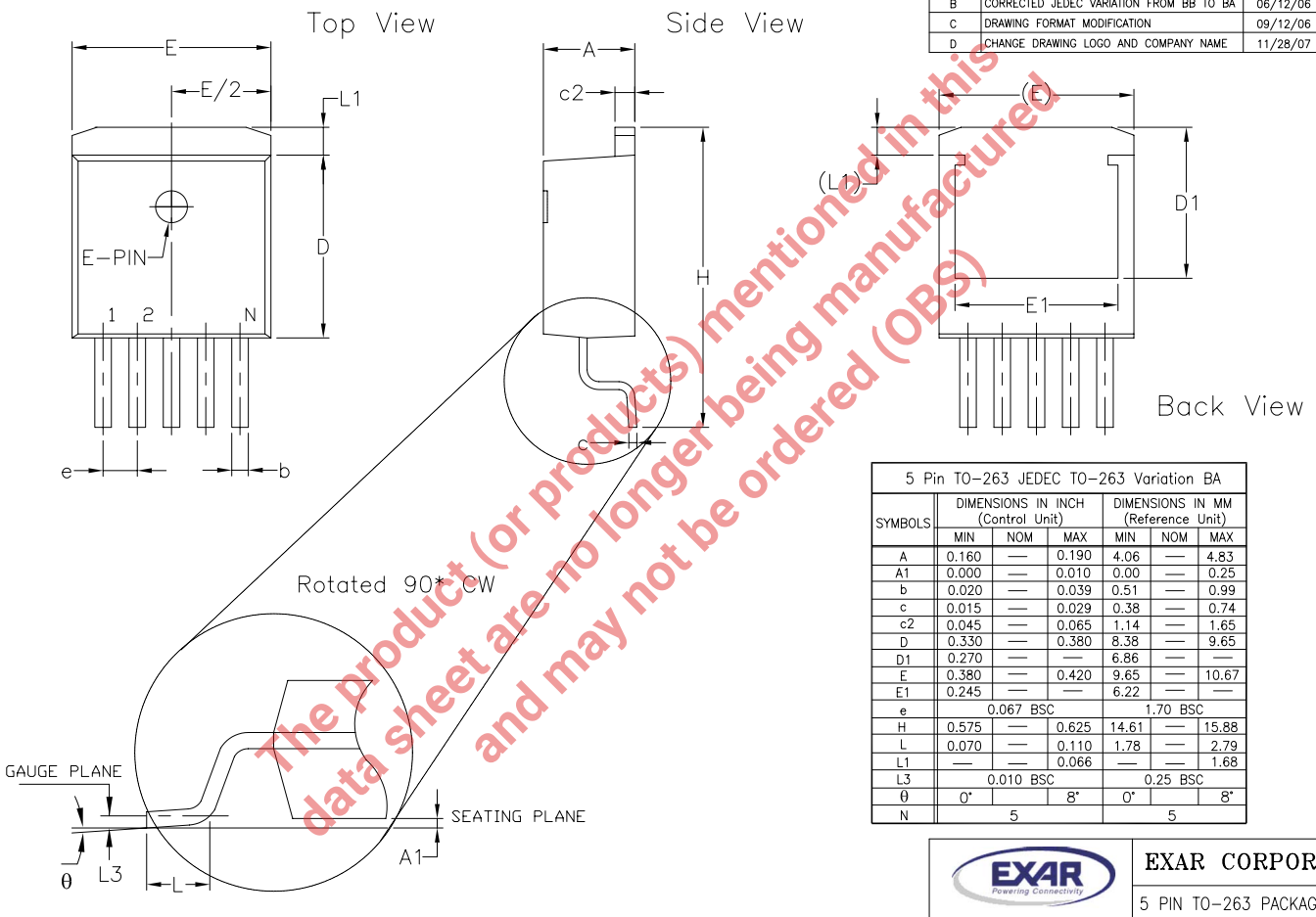
| SPX29501 | SPX29502 |
|---|---|
| 1)ENABLE | 1) ENABLE |
| 2)INPUT | 2) INPUT |
| 3)GND | 3) GND |
| 4)OUTPUT | 4) OUTPUT |
| 5)FLAG | 5) ADJUST |

*Tab is internally connected to GND

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| REVISION HISTORY | | | |
|---|---|---|---|
| REV. | DISCRIPTION | DATE | APP'D |
| A | DRAWING ORIGINATION | 01/18/06 | JL |
| B | CORRECTED JEDEC VARIATION FROM BB TO BA | 06/12/06 | JL |
| C | DRAWING FORMAT MODIFICATION | 09/12/06 | JL |
| D | CHANGE DRAWING LOGO AND COMPANY NAME | 11/28/07 | JL |




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| 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 | | |
| θ | 0° | | 8° | 0° | | 8° |
| N | 5 | | | 5 | | |

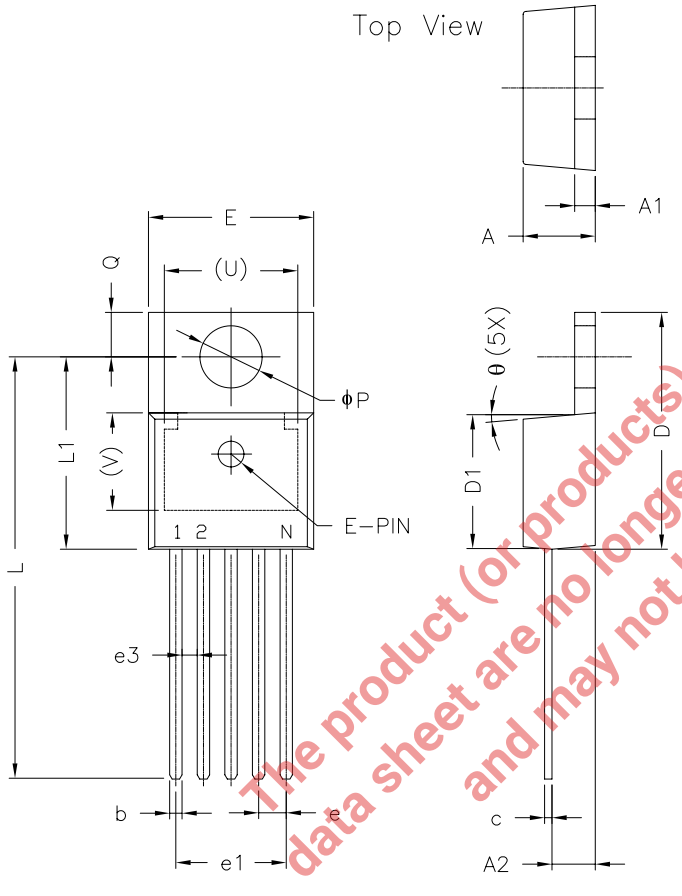
EXAR CORPORATION

5 PIN TO-263 PACKAGE OUTLINE

| Packaging Approval: | | Drawing No: | 5-PIN TO-263 |
|---|---|---|---|
| By: JL | Date: 11/28/07 | Revision: D | Sheet: 1 OF 1 |

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| REVISION HISTORY | | | |
|---|---|---|---|
| REV. | DISCRIPTION | DATE | APP'D |
| A | DRAWING ORIGINATION | 06/30/05 | JL |
| B | DRAWING FORMAT MODIFICATION | 05/09/06 | JL |
| C | CHANGE DRAWING LOGO AND COMPANY NAME | 11/28/07 | JL |




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| 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 | |
| θ | 3° | 7° | 3° | 7° |
| N | 5 | | 5 | |

| | | | |
|---|---|---|---|
| EXAR Powering Connectivity | EXAR CORPORATION | | |
| | 5 PIN TO-220 PACKAGE OUTLINE | | |
| Packaging Approval: | Drawing No: | 5-PIN TO-220 | |
| By: JL / Date: 11/28/07 | Revision: C | Sheet: 1 OF 1 | |

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## ORDERING INFORMATION

| PART NUMBER | ACCURACY | OUTPUT VOLTAGE | PACKAGE |
|---|---|---|---|
| SPX29500U-L-1-8 | EOL | | |
| SPX29500U-L-2-5 | EOL | | |
| SPX29500U-L-3-3 | EOL | | |
| SPX29500U-L-5-0 | EOL | | |
| SPX29500T-L-1-8 | EOL | | |
| SPX29500T-L-2-5 | EOL | | |
| SPX29500T-L-3-3 | EOL | | |
| SPX29500T-L-5-0 | EOL | | |
| SPX29501U5-L-1-8 | EOL | | |
| SPX29501U5-L-2-5 | EOL | | |
| SPX29501U5-L-3-3 | EOL | | |
| SPX29501U5-L-5-0 | EOL | | |
| SPX29501T5-L-1-8 | 1.0% | 1.8V | 5 lead TO-263 |
| SPX29501T5-L-2-5 | 1.0% | 2.5V | 5 lead TO-263 |
| SPX29501T5-L-3-3 | 1.0% | 3.3V | 5 lead TO-263 |
| SPX29501T5-L-5-0 | 1.0% | 5.0V | 5 lead TO-263 |
| SPX29502T5-L | 1.0% | Adj | 5 lead TO-263 |
| SPX29502U5-L | 1.0% | Adj | 5 lead TO-220 |
| SPX29503T5-L | EOL | | |
| SPX29503U5-L | EOL | | |

Please consult the factory for pricing and availability on a Tape-On-Reel option.

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## FOR FURTHER ASSISTANCE

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Exar Technical Documentation: http://www.exar.com/TechDoc/default.aspx?

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# Elektronik komponent tedarikinde Entegreci

Entegreci, Eskişehir merkezli, Türkiye geneline satış yapan bir elektronik komponent mağazasıdır. Entegreler (IC), mikrodenetleyiciler, transistörler, diyotlar, pasif elemanlar, konnektörler, modüller ve geliştirme kartları tek adetten seri üretim adetlerine kadar satılır. Ürün sayfalarında güncel stok durumunu, fiyatı ve datasheet bağlantısını bulabilirsiniz.

### Parça koduyla arama

Üretici parça numarasını yazın; stok ve fiyatı hemen görün.

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### Ürün kategorileri

Entegreden kapasitöre tüm elektronik komponent kategorileri.

**Kategorilere göz atın**

### Üreticiler

Aradığınız üreticinin ürünlerini tek sayfada inceleyin.

**Üreticileri görün**

### Toplu alım ve teklif

Listede olmayan ya da yüksek adetli parçalar için teklif isteyin.

**Teklif isteyin**

**www.entegreci.com** | **destek@entegreci.com** | **0850 305 90 34**

Entegreci is an online electronic components store based in Türkiye. Search by manufacturer part number to see stock, prices and datasheets for integrated circuits, microcontrollers, transistors, passive components and connectors, or request a quote for parts that are not listed.

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