

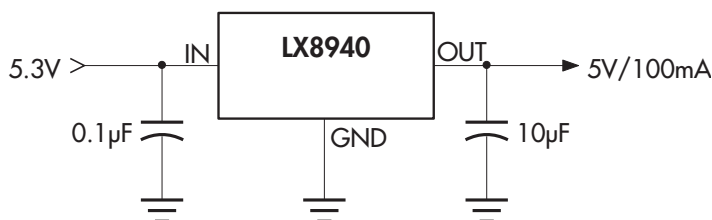
#### DESCRIPTION

The LX8940 is a 5V, low dropout, low quiescent current regulator rated for 1A of output current. It can regulate with as low as 0.4V headroom between the input and output voltages, thus minimizing power dissipation. In addition, it can be used in applications where worst case supplies require a

low input-output differential to maintain regulation. This feature makes it ideal for computer monitors that have to comply with energy-efficient / "Green PC" programs, where the input voltage drops to only a few tenths of a volt above the output when power supply enters sleep-mode operation.

**NOTE:** For current data & package dimensions, visit our web site: <http://www.linfinity.com>.

#### PRODUCT HIGHLIGHT



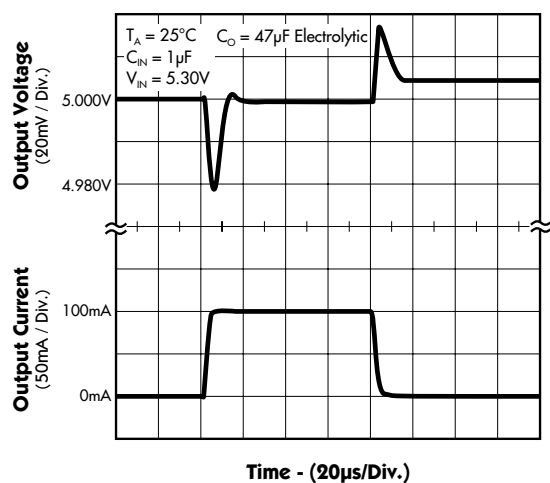
#### KEY FEATURES

- 2% Internally Trimmed Output
- Output Current In Excess Of 1A
- Input-Output Differential Less Than 0.4V At 1A
- Reverse Battery Protection
- 60V Load Dump Protection
- -50V Reverse Transient Protection
- Short Circuit Protection
- Internal Thermal Overload Protection
- Available In 3-Lead Plastic TO-920
- Drops In Most IM2940 Sockets

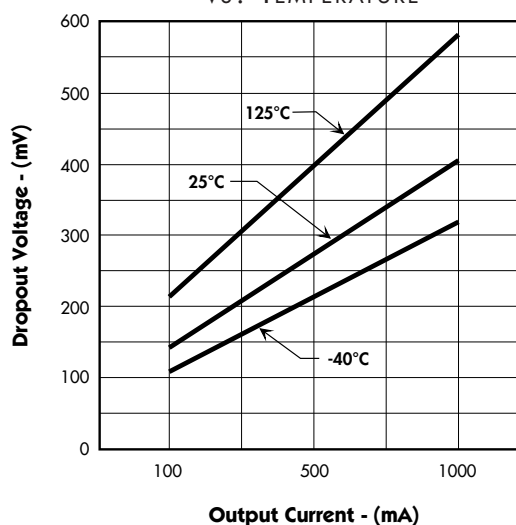
#### APPLICATIONS

- Small Headroom Battery Applications
- High Efficiency Linear Regulators
- Post Regulators For Switching Power Supplies
- Green PC Monitor Applications

#### LOAD TRANSIENT RESPONSE



#### DROPOUT VOLTAGE VS. OUTPUT CURRENT VS. TEMPERATURE



#### PACKAGE ORDER INFO

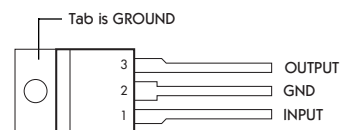
| T <sub>A</sub> (°C) | P                    |
|---------------------|----------------------|
| 0 to 125            | Plastic TO-220 3-pin |
| 0 to 125            | LX8940CP             |
| -40 to 125          | LX8940IP             |

#### ABSOLUTE MAXIMUM RATINGS (Note 1)

Input Voltage ( $V_{IN}$ ) ..... -15V to 26V  
 Operating Junction Temperature  
     Plastic (P Package) ..... 150°C  
 Storage Temperature Range ..... -65°C to 150°C  
 Lead Temperature (Soldering, 10 seconds) ..... 300°C

Note 1. Exceeding these ratings could cause damage to the device. All voltages are with respect to Ground. Currents are positive into, negative out of the specified terminal. Pin numbers refer to DIL packages only.

#### PACKAGE PIN OUTS



**P PACKAGE**  
(Top View)

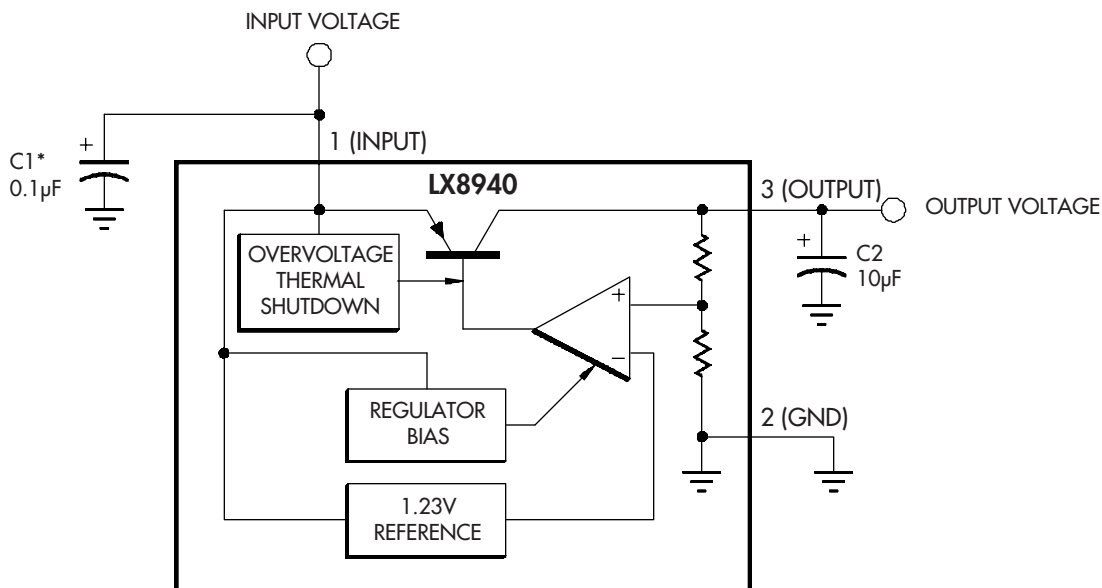
#### THERMAL DATA

##### P PACKAGE:

|                                                       |         |
|-------------------------------------------------------|---------|
| THERMAL RESISTANCE-JUNCTION TO TAB, $\theta_{JT}$     | 3.0°C/W |
| THERMAL RESISTANCE-JUNCTION TO AMBIENT, $\theta_{JA}$ | 60°C/W  |

Junction Temperature Calculation:  $T_J = T_A + (P_D \times \theta_{JA})$ .  
 The  $\theta_{JA}$  numbers are guidelines for the thermal performance of the device/pc-board system.  
 All of the above assume no ambient airflow.

#### BLOCK DIAGRAM



\* Required if regulator is located far from power supply filter.

## 5V LOW DROPOUT REGULATOR

## PRODUCTION DATA SHEET

## RECOMMENDED OPERATING CONDITIONS

| Parameter                                                                           | Symbol   | Recommended Operating Conditions |      |      | Units   |
|-------------------------------------------------------------------------------------|----------|----------------------------------|------|------|---------|
|                                                                                     |          | Min.                             | Typ. | Max. |         |
| Input Voltage                                                                       | $V_{IN}$ | Note 2                           |      | 26   | V       |
| Load Current (with adequate heatsinking)                                            |          | 5                                |      | 1000 | mA      |
| Maximum Line Transient (Load Dump), $V_O \leq 5.5V$                                 |          |                                  |      | 60   | V       |
| Input Capacitor ( $V_{IN}$ to GND)                                                  |          | 0.1                              |      |      | $\mu F$ |
| Output Capacitor with ESR of $10\Omega$ max., ( $V_{OUT}$ to GND & $V_{SB}$ to GND) |          | 10                               |      |      | $\mu F$ |

Note 2.  $V_{IN(MIN)} = 1.2\Delta V_{(MAX)}$ . See Dropout Voltage maximum limit.

## ELECTRICAL CHARACTERISTICS

Unless otherwise specified, these specifications apply over the operating ambient temperatures of  $-40^{\circ}C$  to  $+125^{\circ}C$  for LX8940IP, and  $0^{\circ}C$  to  $+125^{\circ}C$  for LX8940CP;  $V_{IN} = 10V$ ,  $I_O = 1A$ ,  $C_{OUT} = 22\mu F$ , and are for DC characteristics only. (Low duty cycle pulse testing techniques are used which maintains junction and case temperatures equal to the ambient temperature.)

| Parameter                         | Symbol          | Test Conditions                               | LX8940 |      |      | Units         |
|-----------------------------------|-----------------|-----------------------------------------------|--------|------|------|---------------|
|                                   |                 |                                               | Min.   | Typ. | Max. |               |
| Output Voltage                    | $V_O$           | $I_O = 0A$ , $T_A = 25^{\circ}C$              | 4.85   | 5    | 5.15 | V             |
| Line Regulation                   | $\Delta V_{OL}$ | $7V \leq V_{IN} \leq 26V$ , $I_O = 5mA$       |        | 1    | 50   | mV            |
| Load Regulation                   | $\Delta V_{OL}$ | $50mA \leq I_O \leq 1A$                       |        | 10   | 50   | mV            |
| Output Impedance (Note 3)         | $r_O$           | $100mA_{DC}$ and $20mA_{RMS}$ , $f_O = 120Hz$ |        | 200  |      | $m\Omega$     |
| Quiescent Current                 | $I_Q$           | $I_O \leq 5mA$ , $7 \leq V_{IN} \leq 26V$     |        | 3    | 15   | mA            |
|                                   |                 | $I_O = 500mA$                                 |        | 30   | 50   | mA            |
|                                   |                 | $I_O = 1000mA$                                |        | 115  | 180  | mA            |
| Output Noise Voltage (Note 3)     | $V_{O(RMS)}$    | $10Hz - 100kHz$ , $I_O = 5mA$                 |        | 150  |      | $\mu V_{RMS}$ |
| Long Term Stability (Note 3)      |                 |                                               |        | 20   |      | mV/1000hr     |
| Ripple Rejection (Note 3)         | $R_R$           | $f_O = 120Hz$ , $1V_{RMS}$ , $I_O = 100mA$    |        | 66   |      | dB            |
| Dropout Voltage                   | $\Delta V$      | $I_O = 100mA$                                 |        | 150  | 300  | mV            |
|                                   |                 | $I_O = 500mA$                                 |        | 275  | 500  | mV            |
|                                   |                 | $I_O = 1A$                                    |        | 400  | 800  | mV            |
| Current Limit                     | $I_{CL}$        | $V_{IN} = 26V$                                | 1      | 1.2  |      | A             |
| Maximum Operational Input Voltage | $V_{IN(MAX)}$   |                                               | 26     | 31   |      | V             |
| Maximum Line Transient            | $V_{IN(TR)}$    | $R_O = 100\Omega$ , $T \leq 100ms$            |        | 60   |      | V             |

Note 3. These parameters, although guaranteed, are not tested in production.

#### APPLICATION NOTES

The advantages of using a low-dropout regulator such as the LX8940 is the need for less "headroom" for full regulation, and the inherent reverse polarity protection provided by the PNP output device. A typical NPN regulator design requires an input to output differential of approximately two volts minimum. This is due to the  $2V_{be} + V_{cesat}$  of the NPN Darlington used in the output, coupled with the voltage drop across the current limit resistor. In contrast, the "PNP Regulator" uses a single series pass transistor with its single  $V_{cesat}$ , thus the lower input to output voltage differential or dropout voltage.

In some applications the regulator output voltage is used not only as a power supply but also as a voltage reference for control systems. In such cases not just the temperature stability of the output is important but also the initial accuracy. LX8940 fills this need as the internal bandgap reference is trimmed allowing a typical output voltage tolerance of  $\pm 1\%$ .

#### EXTERNAL CAPACITORS

To stabilize the outputs and prevent oscillation (perhaps by many volts) external capacitors are required. The minimum recommended value for the output capacitors is  $10\mu F$ , although the actual size and type will likely vary according to the particular application, e.g., operating temperature range and load. Another consideration is the effective series resistance (ESR) of the

capacitor. Capacitor ESR will vary by manufacturer. Consequently, some evaluation may be required to determine the minimum value of the output capacitors. Generally worst case occurs at the maximum load and minimum ambient temperature.

The size of the output capacitor can be increased to any value above the minimum. One possible advantage of this would be to maintain the output voltage during brief periods of negative input transients

The output capacitors chosen should be rated for the full range of ambient temperature over which the circuit will be exposed and expected to operate. For example, many aluminum type electrolytic capacitors change values at cold temperatures. The effective capacitance is reduced and regulator stability is effected. Tantalum capacitors are a good choice for these types of environments.

#### OUTPUT PROTECTION

The output features fault protection against overvoltage as well as a thermal shutdown feature. If the input voltage rises above 33V (load dump), the output shuts down automatically. The internal circuitry is thus protected and the IC is able to survive higher voltage transients than might otherwise be expected. The thermal shutdown output effectively guards against overheating of the die and protects the device from being damaged.

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