

## LP395 Ultra Reliable Power Transistor

### General Description

The LP395 is a fast monolithic transistor with complete overload protection. This very high gain transistor has included on the chip, current limiting, power limiting, and thermal overload protection, making it difficult to destroy from almost any type of overload. Available in an epoxy TO-92 transistor package this device is guaranteed to deliver 100 mA.

Thermal limiting at the chip level, a feature not available in discrete designs, provides comprehensive protection against overload. Excessive power dissipation or inadequate heat sinking causes the thermal limiting circuitry to turn off the device preventing excessive die temperature.

The LP395 offers a significant increase in reliability while simplifying protection circuitry. It is especially attractive as a small incandescent lamp or solenoid driver because of its low drive requirements and blowout-proof design.

The LP395 is easy to use and only a few precautions need be observed. Excessive collector to emitter voltage can destroy the LP395 as with any transistor. When the device is used as an emitter follower with a low source impedance, it is necessary to insert a 4.7 k $\Omega$  resistor in series with the base lead to prevent possible emitter follower oscillations. Also since it has good high frequency response, supply bypassing is recommended.

Areas where the LP395 differs from a standard NPN transistor are in saturation voltage, leakage (quiescent) current and in base current. Since the internal protection circuitry requires voltage and current to function, the minimum voltage across the device in the on condition (saturated) is typically 1.6 Volts, while in the off condition the quiescent (leakage) current is typically 200  $\mu$ A. Base current in this device flows out of the base lead, rather than into the base as is the case with conventional NPN transistors. Also the base can be driven positive up to 36 Volts without damage, but will draw current if driven negative more than 0.6 Volts. Additionally, if the base lead is left open, the LP395 will turn on.

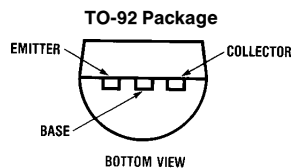
The LP395 is a low-power version of the 1-Amp LM195/LM295/LM395 Ultra Reliable Power Transistor.

The LP395 is rated for operation over a  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  range.

### Features

- Internal thermal limiting
- Internal current and power limiting
- Guaranteed 100 mA output current
- 0.5  $\mu$ A typical base current
- Directly interfaces with TTL or CMOS
- +36 Volts on base causes no damage
- 2  $\mu$ s switching time

### Connection Diagram

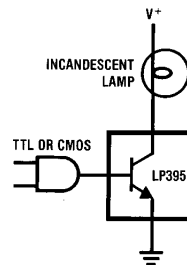


Order Number LP395Z  
See NS Package Z03A

TL/H/5525-1

### Typical Applications

#### Fully Protected Lamp Driver



TL/H/5525-3

## Absolute Maximum Ratings

|                                   |       |                                    |                    |
|-----------------------------------|-------|------------------------------------|--------------------|
| Collector to Emitter Voltage      | 36V   | Collector Current Limit            | Internally Limited |
| Collector to Base Voltage         | 36V   | Power Dissipation                  | Internally Limited |
| Base to Emitter Voltage (Forward) | 36V   | Operating Temperature Range        | −40°C to +125°C    |
| Base to Emitter Voltage (Reverse) | 10V   | Storage Temperature Range          | −65°C to +150°C    |
| Base to Emitter Current (Reverse) | 20 mA | Lead Temp. (Soldering, 10 seconds) | 260°C              |

## Electrical Characteristics

| Symbol               | Parameter                                   | Conditions   | Typical         | Tested Limit (Note 2) | Design Limit (Note 3)                | Units (Limit)                 |
|----------------------|---|--|-----------------|-----------------------|--------------------------------------|-------------------------------|
| $V_{CE}$             | Collector to Emitter Operating Voltage      | $0.5 \text{ mA} \leq I_C \leq 100 \text{ mA}$  |                 | 36                    | <b>36</b><br>(Note 1)                | V(Max)                        |
| $I_{CL}$             | Collector Current Limit (Note 4)            | $V_{BE} = 2\text{V}, V_{CE} = 36\text{V}$<br>$V_{BE} = 2\text{V}, V_{CE} = 15\text{V}$<br>$V_{BE} = 2\text{V}, 2\text{V} \leq V_{CE} \leq 6\text{V}$ | 45<br>90<br>130 | 25<br>60<br>100       | <b>20</b><br><b>50</b><br><b>100</b> | mA(Min)<br>mA(Min)<br>mA(Min) |
| $I_B$                | Base Current                                | $0 \leq I_C \leq 100 \text{ mA}$   | −0.3            | −2.0                  | − <b>2.5</b>                         | $\mu\text{A}(\text{Max})$     |
| $I_Q$                | Quiescent Current                           | $V_{BE} = 0\text{V}, 0 \leq V_{CE} \leq 36\text{V}$  | 0.24            | 0.50                  | <b>0.60</b>                          | mA(Max)                       |
| $V_{CE(\text{SAT})}$ | Saturation Voltage                          | $V_{BE} = 2\text{V}, I_C = 100 \text{ mA}$   | 1.82            | 2.00                  | <b>2.10</b>                          | V(Max)                        |
| $BV_{BE}$            | Base to Emitter Break-down Voltage (Note 4) | $0 \leq V_{CE} \leq 36\text{V}, I_B = 2 \mu\text{A}$   |                 | 36                    | <b>36</b>                            | V(Min)                        |
| $V_{BE}$             | Base to Emitter Voltage (Note 5)            | $I_C = 5 \text{ mA}$   | 0.69            | 0.79                  | <b>0.90</b>                          | V(Max)                        |
|                      |   | $I_C = 100 \text{ mA}$ (Note 4)  | 1.02            |                       | <b>1.40</b>                          | V (Max)                       |
| $t_S$                | Switching Time                              | $V_{CE} = 20\text{V}, R_L = 200\Omega$<br>$V_{BE} = 0\text{V}, +2\text{V}, 0\text{V}$  | 2               |                       |                                      | $\mu\text{s}$                 |
| $\theta_{JA}$        | Thermal Resistance Junction to Ambient      | 0.4" leads soldered to printed circuit board   | 150             |                       | <b>180</b>                           | °C/W (Max)                    |
|                      |   | 0.125" leads soldered to printed circuit board   | 130             |                       | <b>160</b>                           | °C/W (Max)                    |

**Note 1:** Parameters identified with **boldface type** apply at temp. extremes. All other numbers, unless noted apply at +25°C.

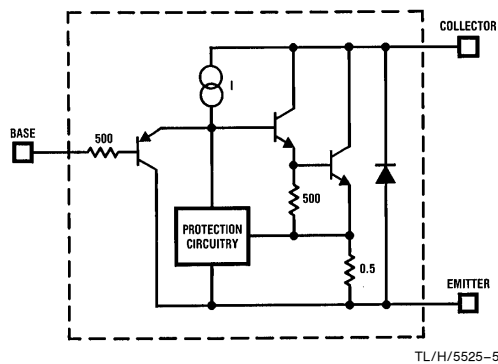
**Note 2:** Guaranteed and 100% production tested.

**Note 3:** Guaranteed (but not 100% production tested) over the operating temperature and supply voltage ranges. These limits are not used to calculate outgoing quality levels.

**Note 4:** These numbers apply for pulse testing with a low duty cycle.

**Note 5:** Base positive with respect to emitter.

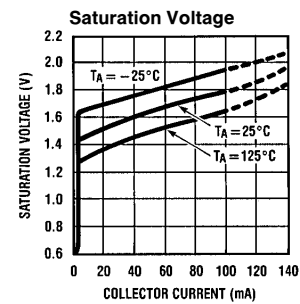
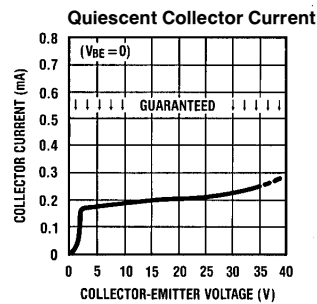
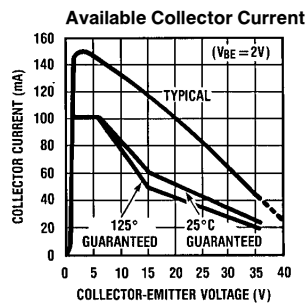
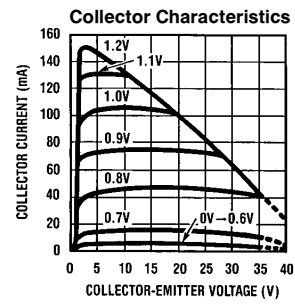
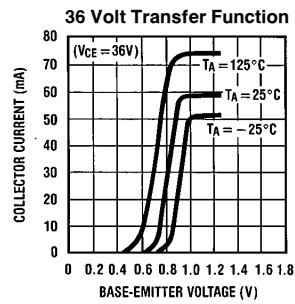
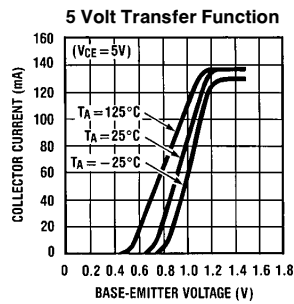
## Simplified Circuit



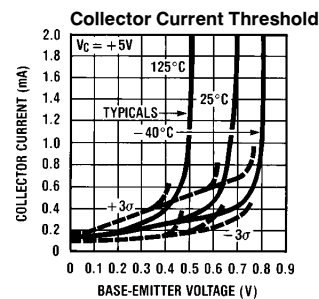
## Applications Information

One failure mode incandescent lamps may experience is one in which the filament resistance drops to a very low value before it actually blows out. This is especially rough on most solid-state lamp drivers and in most cases a lamp failure of this type will also cause the lamp driver to fail. Because of its high gain and blowout-proof design, the LP395 is an ideal candidate for reliably driving small incandescent lamps. Additionally, the current limiting characteristics of the LP395 are advantageous as it serves to limit the cold filament inrush current, thus increasing lamp life.

## Typical Performance Characteristics



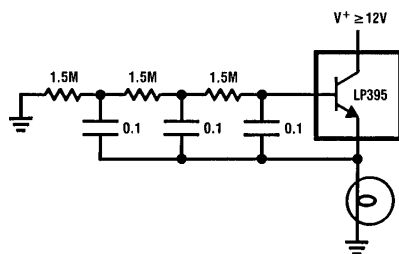
TL/H/5525-4



TL/H/5525-9

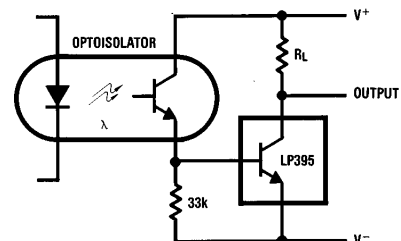
## Typical Applications (Continued)

### Lamp Flasher (Short Circuit Proof)



TL/H/5525-6

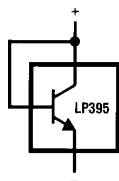
### Optically Isolated Switch



TL/H/5525-7

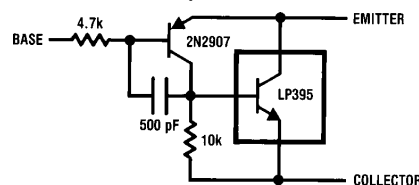
## Typical Applications (Continued)

### Two Terminal Current Limiter



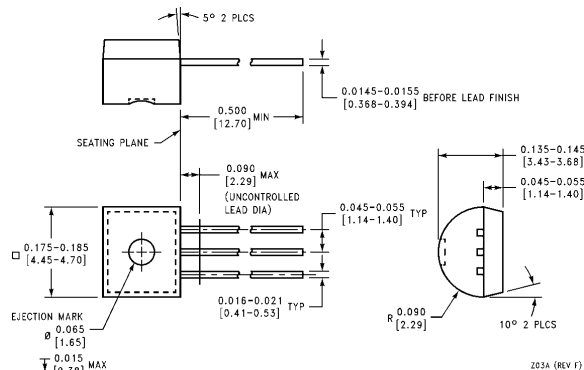
TL/H/5525-8

### Composite PNP



TL/H/5525-2

## Physical Dimensions inches (millimeters)



Order Number LP395Z  
NS Package Z03A

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