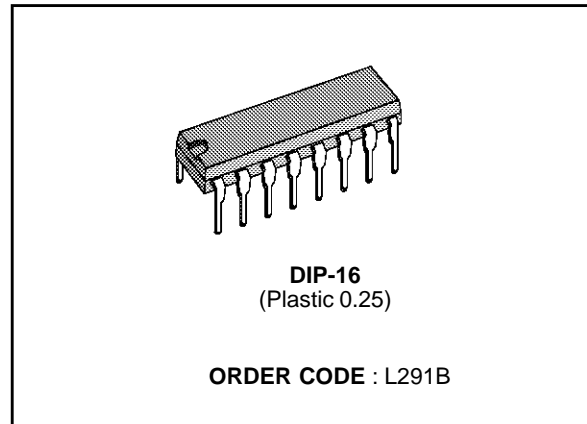


**5 BIT - D/A CONVERTER AND POSITION AMPLIFIER**

- 5 BIT D/A CONVERTER (1/2 LSB MAX LINEARITY ERROR);
- ERROR AMPLIFIER;
- POSITION AMPLIFIER.

**DESCRIPTION**

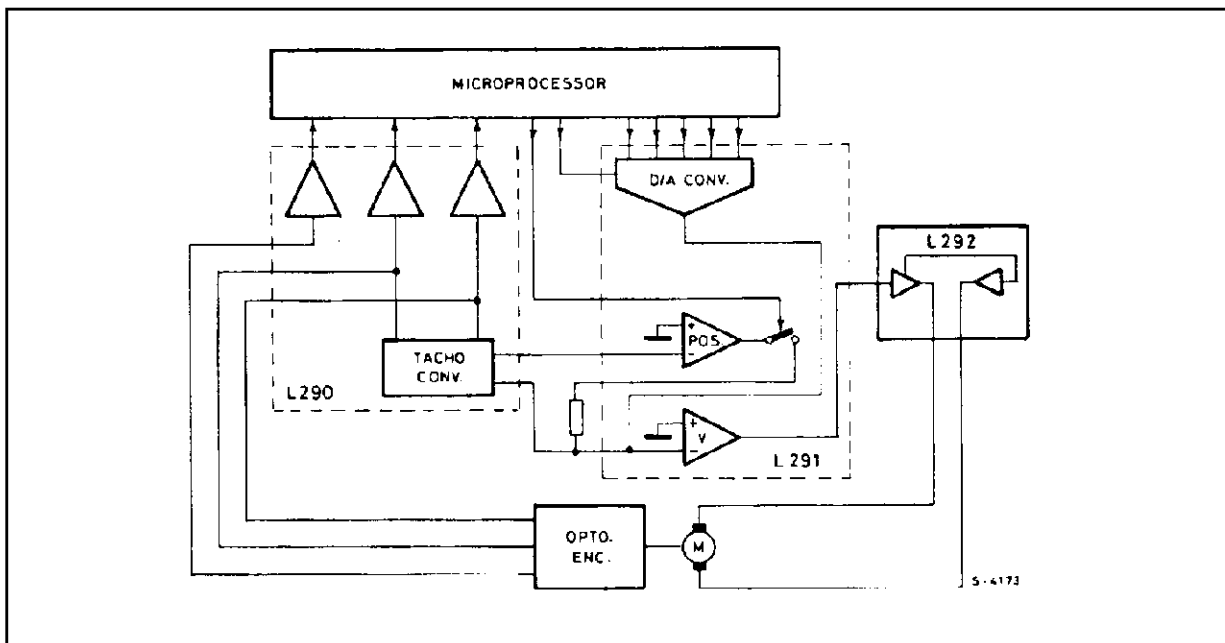
The L291, a monolithic LSI circuit in a 16-lead dual in-line plastic package, is intended for use with the L290 and L292 to form a complete 3 chip DC motor positioning system for applications such as carriage/daisy-wheel position control in typewriters. The L290/291/292 system can be directly controlled by a microprocessor.



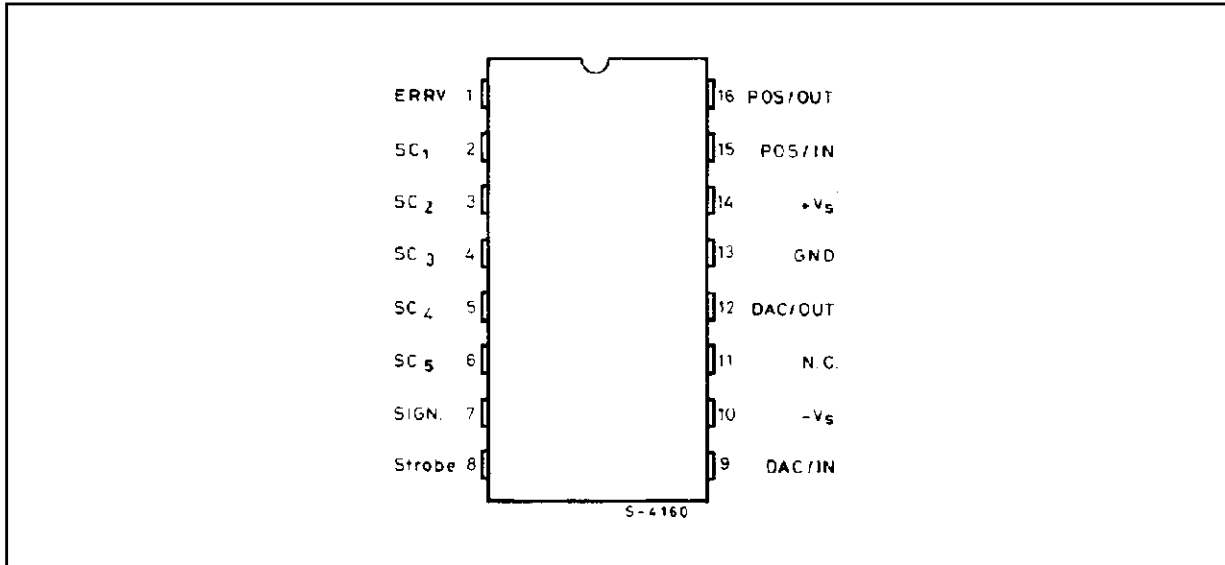
**ABSOLUTE MAXIMUM RATINGS**

| Symbol                            | Parameter  | Value       | Unit |
|-----------------------------------|--|-------------|------|
| V <sub>s</sub>                    | Supply Voltage                                   | ± 15        | V    |
| P <sub>tot</sub>                  | Total Power Dissipation T <sub>amb</sub> = 70 °C | 1           | W    |
| T <sub>stg</sub> , T <sub>j</sub> | Storage and Junction Temperature                 | - 40 to 150 | °C   |

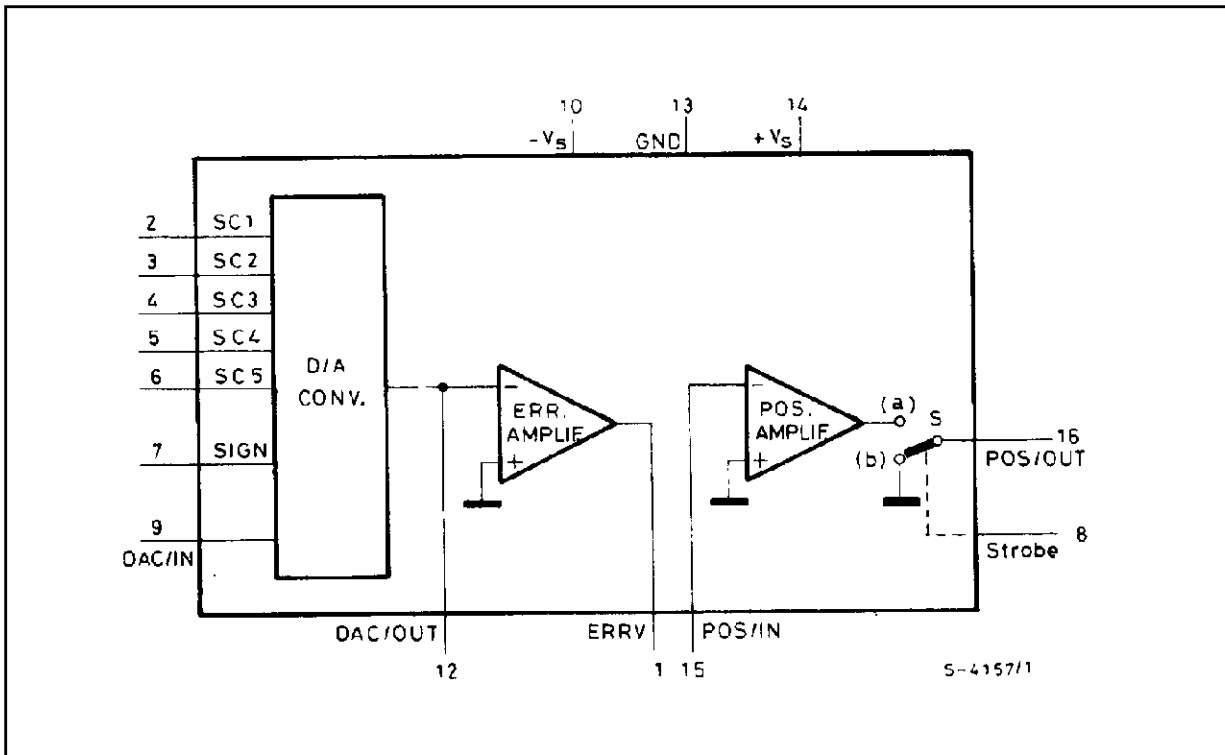
**SYSTEM BLOCK DIAGRAM**



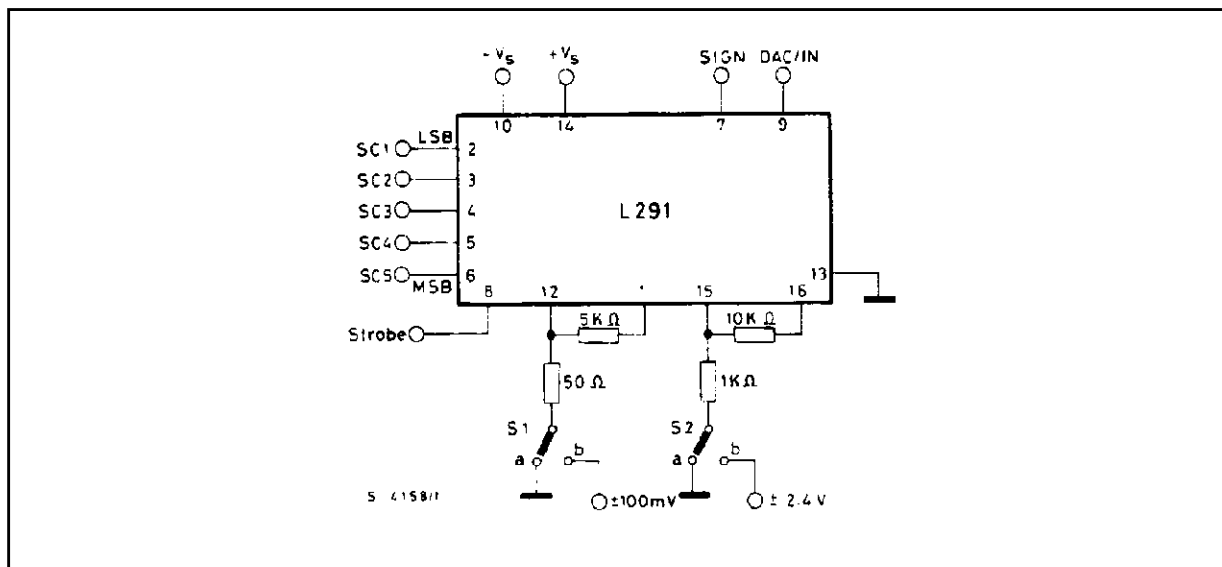
CONNECTION DIAGRAM (top view)



BLOCK DIAGRAM



## TEST CIRCUIT



## THERMAL DATA

| Symbol         | Parameter                           | Value | Unit    |
|----------------|-------------------------------------|-------|---------|
| $R_{th-j-amb}$ | Thermal resistance junction-ambient | Max   | 80 °C/W |

**ELECTRICAL CHARACTERISTICS** (refer to the circuit, S1 and S2 in (a),  $V_s = \pm 12$  V,  $T_{amb} = 25$  °C, unless otherwise specified)

| Symbol | Parameter               | Test conditions | Min.     | Typ. | Max.     | Unit |
|--------|-------------------------|-----------------|----------|------|----------|------|
| $V_s$  | Supply Voltage          |                 | $\pm 10$ |      | $\pm 15$ | V    |
| $I_d$  | Quiescent Drain Current |                 |          | 6.5  | 10       | mA   |

## POSITION AMPLIFIER

|              |                                  |  |         |  |          |         |
|--------------|----------------------------------|--|---------|--|----------|---------|
| $V_{strobe}$ | Enable Voltage Level             | $V_L$ (S in (a)) *                                 | 0       |  | 0.8      | V       |
|              |                                  | $V_H$ (S in (b)) *                                 | 2.4     |  | $+V_s$   | V       |
| $V_{os}$     | Output Offset Voltage (pin 16)   | $V_{strobe} = V_L$ ; $G_v = 20$ dB                 |         |  | $\pm 50$ | mV      |
| $I_b$        | Input Bias Current (pin 15)      | $V_{strobe} = V_L$                                 |         |  | 0.3      | $\mu$ A |
| $V_o$        | Output Voltage Swing (pin 16)    | $V_{strobe} = V_L$ ; S2 in (b); $V_s = \pm 10.8$ V | $\pm 9$ |  |          | V       |
| $V_R$        | Residual Output Voltage (pin 16) | $V_{strobe} = V_H$                                 |         |  | $\pm 20$ | mV      |

\* See block diagram and the note for Position Amplifier.

**ELECTRICAL CHARACTERISTICS** (continued)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|--------|-----------|-----------------|------|------|------|------|
|--------|-----------|-----------------|------|------|------|------|

**D/A CONVERTER**

|              |   |  |        |      |           |         |
|--------------|---|--|--------|------|-----------|---------|
| $I_{ref}$    | Current Reference Input Range (pin 9)                                 |  | 0.3    |      | 1.2       | mA      |
| $V_{os}$     | Current Reference Offset Voltage (pin 9)                              | $I_{ref} = 0.3$ to $1.2$ mA<br>All Inputs High                 |        |      | $\pm 20$  | mV      |
| $I_o$        | Output Current Range (pin 12)   |  |        |      | 1.4       | mA      |
| $I_o$        | Output Current (pin 12)   | $I_{ref} = 0.722$ mA<br>SC1 to SC5 = L<br>SIGN = L( $I_{o1}$ ) | -1.358 | -1.4 | -1.442    | mA      |
|              |   | SIGN = H( $I_{o2}$ )   | +1.358 | +1.4 | +1.442    |         |
| $\Delta I_o$ | Linearity Error   | $I_{o1} + I_{o2}$  | -21    |      | +21       | $\mu$ A |
|              |   | $I_{ref} = 0.722$ mA   |        |      | 1.61      | %FS     |
| $I_{os}$     | Pin 12 Output Offset Current (including Error Amplifier bias current) | All Inputs High  |        |      | $\pm 0.4$ | $\mu$ A |
| $V_L$        | Low Voltage Level (digital inputs)                                    | SC1 = LSB  | 0      |      | 0.8       | V       |
| $V_H$        | High Voltage Level (digital inputs)                                   | SC5 = MSB  | 2.4    |      | $+V_S$    | V       |
| $I_L$        | Digital Input Current (low state)                                     | $V_L = 0.4$ V  |        |      | -50       | $\mu$ A |
| $I_H$        | Digital Inputs Current (high state)                                   | $V_H = +V_S$   |        |      | 1         | $\mu$ A |

**ERROR AMPLIFIER**

|          |                               |  |           |  |           |    |
|----------|-------------------------------|--|-----------|--|-----------|----|
| $V_{os}$ | Output Offset Voltage (pin 1) | $I_{ref} = 0.5$ mA; All Inputs High<br>$G_v = 40$ dB |           |  | $\pm 200$ | mV |
| $I_o$    | Output Current (pin 1)        |  |           |  | $\pm 5$   | mA |
| $V_o$    | Output Voltage Swing (pin 1)  | All Inputs High<br>S1 in (b); $R_L = 10$ K $\Omega$  | $\pm 7.4$ |  | $\pm 8.4$ | Vp |

### D/A CONVERTER

The L291 contains a 5-bit D/A converter accepting a binary code and generating a bipolar output current, the polarity of which depends on the SIGN input. The amplitude of the output current is a multiple of a reference current  $I_{ref}$ .

The maximum output current is

$$I_{FS} = \pm \frac{31}{16} I_{ref}$$

The following table shows the value of  $I_o$  for different input codes. Note that the input bits are active low.

| DIGITAL INPUT WORD |            |     |     |     |            | Output Current<br>$I_o$  |
|--------------------|------------|-----|-----|-----|------------|--------------------------|
| SIGN               | SC5<br>MSB | SC4 | SC3 | SC2 | SC1<br>LSB |                          |
| L                  | L          | L   | L   | L   | L          | $-\frac{31}{16} I_{ref}$ |
| L                  | H          | H   | H   | H   | L          | $-\frac{1}{16} I_{ref}$  |
| X                  | H          | H   | H   | H   | H          | 0                        |
| H                  | H          | H   | H   | H   | L          | $+\frac{1}{16} I_{ref}$  |
| H                  | L          | L   | L   | L   | L          | $+\frac{31}{16} I_{ref}$ |

X = indifferent

L = low

H = High

This D/A converter has a maximum linearity error or equal to  $\pm 1/2$  LSB (or  $\pm 1.61\%$  Full Scale); that guarantees its monotonicity.

### ERROR AMPLIFIER

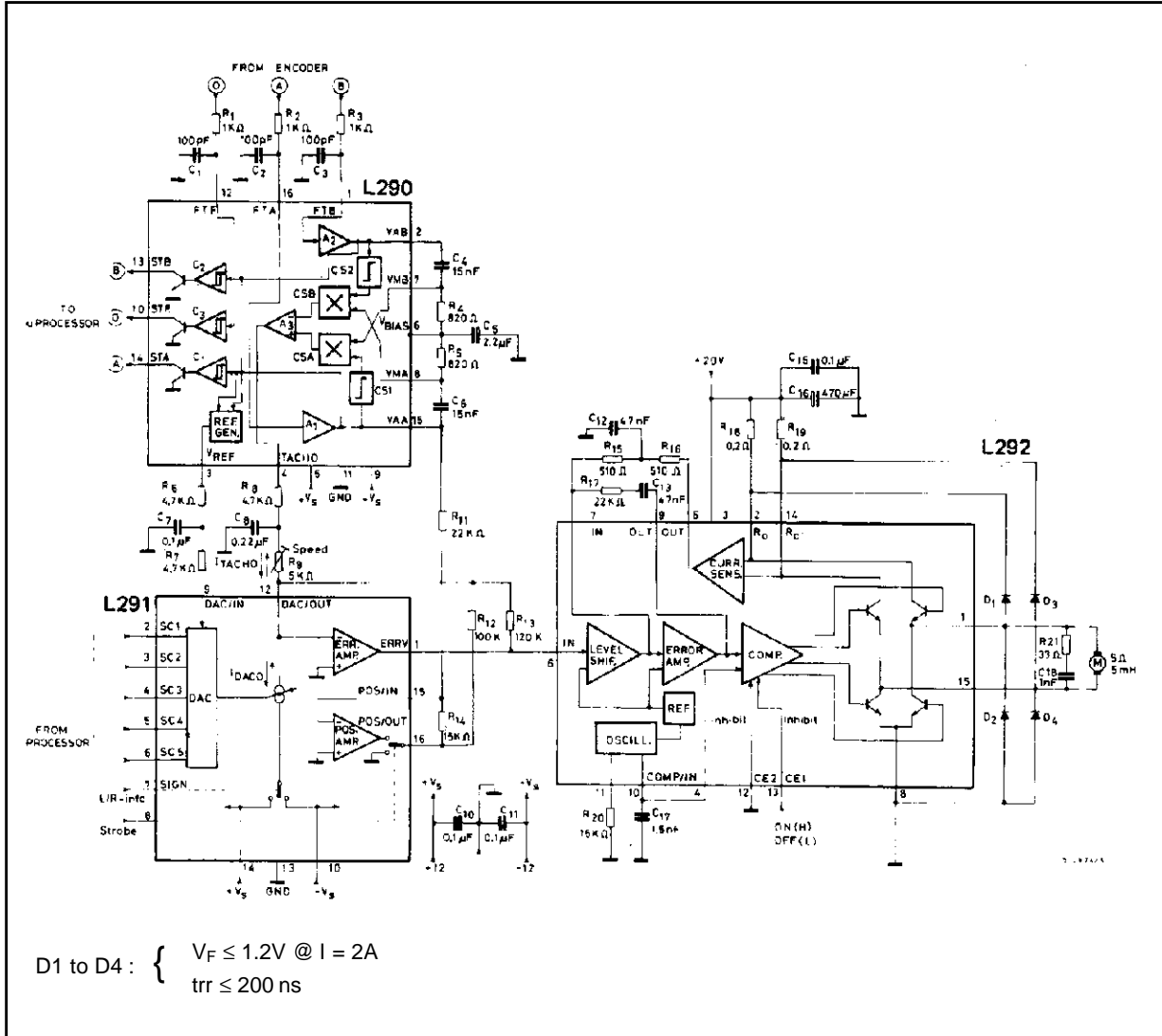
In order to have a good stability, the Error Amplifier must work with a closed loop gain greater or equal than 20 dB.

### POSITION AMPLIFIER

It is inserted by means of the strobe signal, TTI and microprocessor compatible. Its output is connected to pin 16 when  $V_{strobe} = \text{Low}$  ; pin 16 grounded for  $V_{strobe} = \text{High}$ .

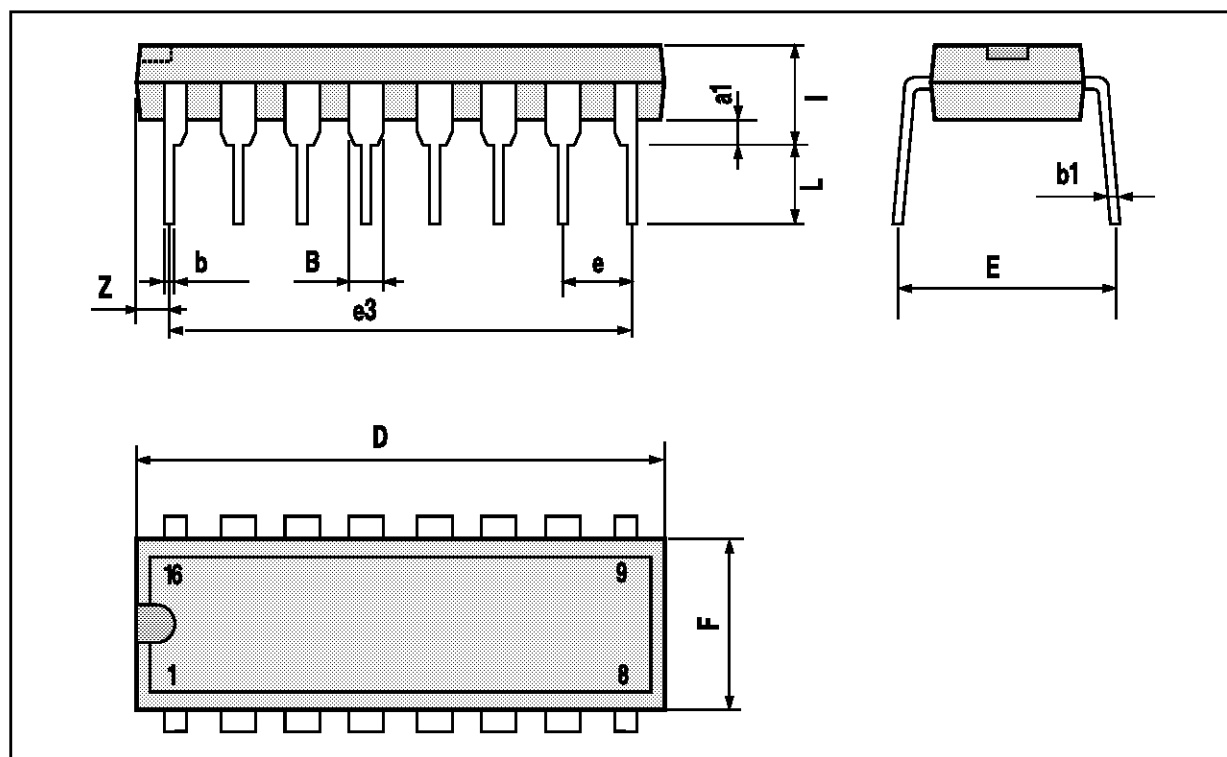
**SYSTEM DESCRIPTION** : refer to the L292 data sheet.

Figure 1. Complete Application Circuit.



## DIP-16 PACKAGE MECHANICAL DATA

| DIM. | mm   |       |      | inch  |       |       |
|------|------|-------|------|-------|-------|-------|
|      | MIN. | TYP.  | MAX. | MIN.  | TYP.  | MAX.  |
| a1   | 0.51 |       |      | 0.020 |       |       |
| B    | 0.77 |       | 1.65 | 0.030 |       | 0.065 |
| b    |      | 0.5   |      |       | 0.020 |       |
| b1   |      | 0.25  |      |       | 0.010 |       |
| D    |      |       | 20   |       |       | 0.787 |
| E    |      | 8.5   |      |       | 0.335 |       |
| e    |      | 2.54  |      |       | 0.100 |       |
| e3   |      | 17.78 |      |       | 0.700 |       |
| F    |      |       | 7.1  |       |       | 0.280 |
| I    |      |       | 5.1  |       |       | 0.201 |
| L    |      | 3.3   |      |       | 0.130 |       |
| Z    |      |       | 1.27 |       |       | 0.050 |



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