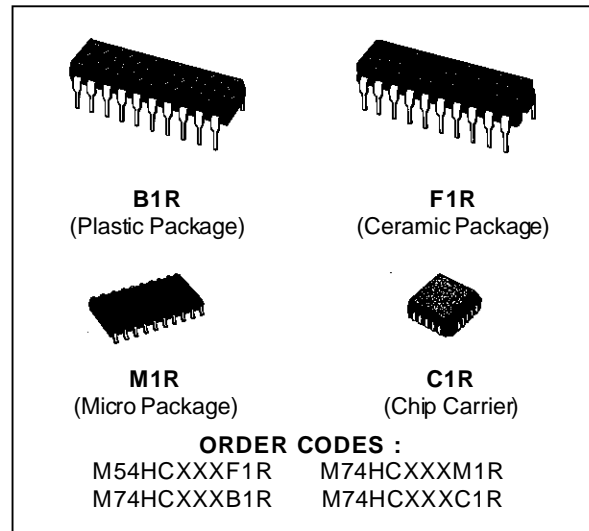


## OCTAL BUS BUFFER WITH 3 STATE OUTPUTS

### HC240: INVERTED - HC241/244 NON INVERTED

- HIGH SPEED  
 $t_{PD} = 10 \text{ ns (TYP.) at } V_{CC} = 5V$
- LOW POWER DISSIPATION  
 $I_{CC} = 4 \mu\text{A (MAX.) at } T_A = 25^\circ\text{C}$
- HIGH NOISE IMMUNITY  
 $V_{NIH} = V_{INL} = 28\% V_{CC} \text{ (MIN.)}$
- OUTPUT DRIVE CAPABILITY  
 15 LSTTL LOADS
- SYMMETRICAL OUTPUT IMPEDANCE  
 $|I_{OH}| = I_{OL} = 6 \text{ mA (MIN)}$
- BALANCED PROPAGATION DELAYS  
 $t_{PLH} = t_{PHL}$
- WIDE OPERATING VOLTAGE RANGE  
 $V_{CC} \text{ (OPR)} = 2V \text{ to } 6V$
- PIN AND FUNCTION COMPATIBLE  
 WITH 54/74LS240/241/244



### DESCRIPTION

The M54/74HC240, HC241 and HC244 are high speed CMOS OCTAL BUS BUFFERS fabricated in silicon gate C<sup>2</sup>MOS technology.

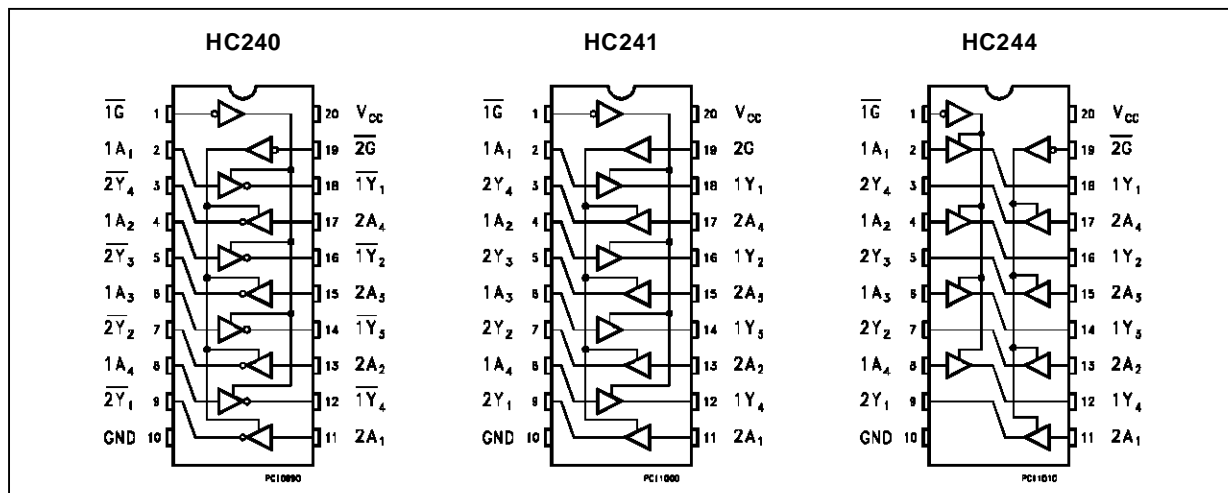
They have the same high speed performance of LSTTL combined with true CMOS low power consumption.

The designer has a choice of select combination of inverting and non-inverting outputs, symmetrical  $\overline{G}$  (active low output control) input, and

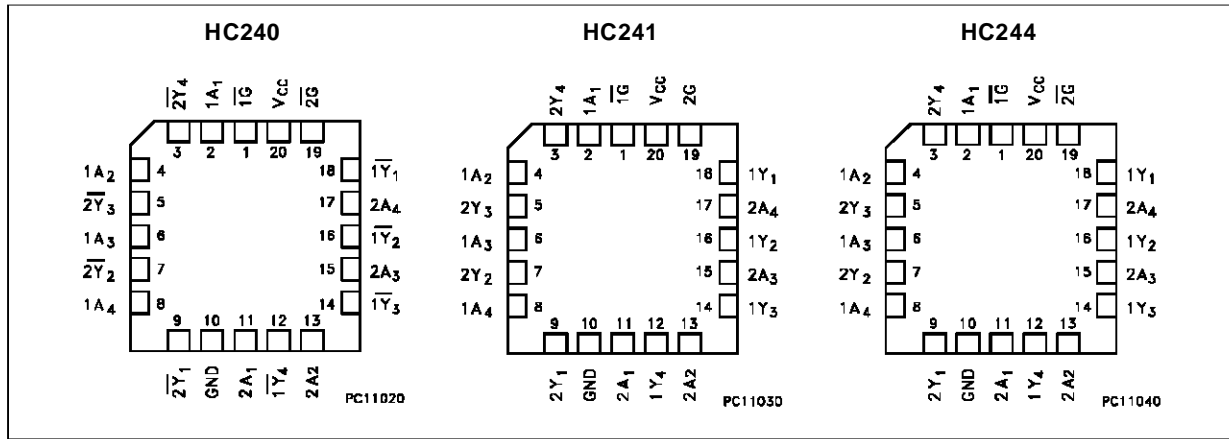
complementary G and  $\overline{G}$  inputs. Each control input governs four BUS BUFFERS.

These devices are designed to be used with 3 state memory address drivers, etc. All inputs are equipped with protection circuits against static discharge and transient excess voltage.

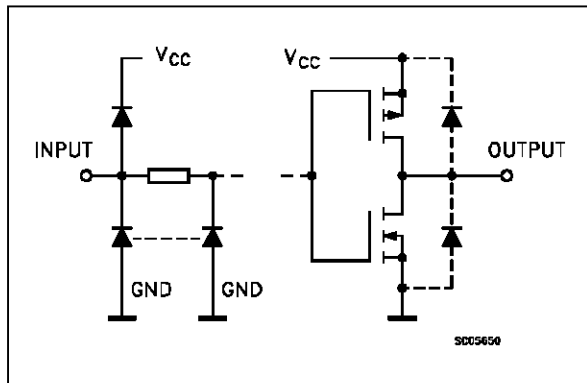
### PIN CONNECTION (top view)



CHIP CARRIER



INPUT AND OUTPUT EQUIVALENT CIRCUIT



PIN DESCRIPTION (HC240)

| PIN No         | SYMBOL                               | NAME AND FUNCTION       |
|----------------|--------------------------------------|-------------------------|
| 1              | $\overline{1G}$                      | Output Enable Input     |
| 2, 4, 6, 8     | 1A1 to 1A4                           | Data Inputs             |
| 9, 7, 5, 3     | $\overline{2Y1}$ to $\overline{2Y4}$ | Data Outputs            |
| 11, 13, 15, 17 | 2A1 to 2A4                           | Data Inputs             |
| 18, 16, 14, 12 | $\overline{1Y1}$ to $\overline{1Y4}$ | Data Outputs            |
| 19             | $\overline{2G}$                      | Output Enabel Input     |
| 10             | GND                                  | Ground (0V)             |
| 20             | Vcc                                  | Positive Supply Voltage |

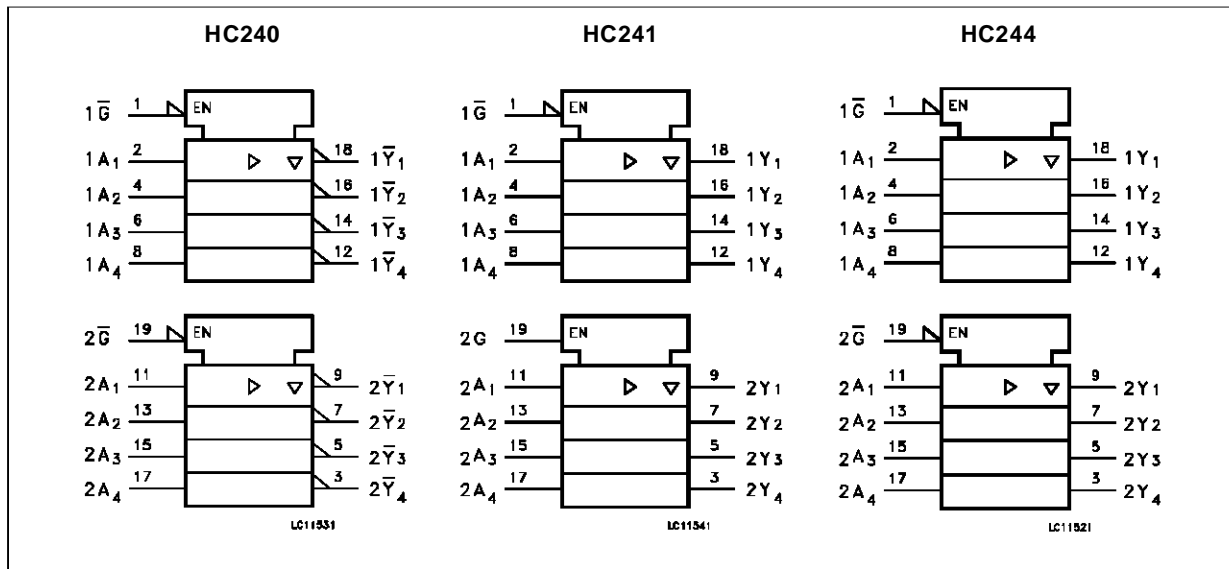
PIN DESCRIPTION (HC241)

| PIN No         | SYMBOL          | NAME AND FUNCTION       |
|----------------|-----------------|-------------------------|
| 1              | $\overline{1G}$ | Output Enable Input     |
| 2, 4, 6, 8     | 1A1 to 1A4      | Data Inputs             |
| 9, 7, 5, 3     | 2Y1 to 2Y4      | Data Outputs            |
| 11, 13, 15, 17 | 2A1 to 2A4      | Data Inputs             |
| 18, 16, 14, 12 | 1Y1 to 1Y4      | Data Outputs            |
| 19             | 2G              | Output Enabel Input     |
| 10             | GND             | Ground (0V)             |
| 20             | Vcc             | Positive Supply Voltage |

PIN DESCRIPTION (HC244)

| PIN No         | SYMBOL          | NAME AND FUNCTION       |
|----------------|-----------------|-------------------------|
| 1              | $\overline{1G}$ | Output Enable Input     |
| 2, 4, 6, 8     | 1A1 to 1A4      | Data Inputs             |
| 9, 7, 5, 3     | 2Y1 to 2Y4      | Data Outputs            |
| 11, 13, 15, 17 | 2A1 to 2A4      | Data Inputs             |
| 18, 16, 14, 12 | 1Y1 to 1Y4      | Data Outputs            |
| 19             | $\overline{2G}$ | Output Enabel Input     |
| 10             | GND             | Ground (0V)             |
| 20             | Vcc             | Positive Supply Voltage |

IEC LOGIC SYMBOLS

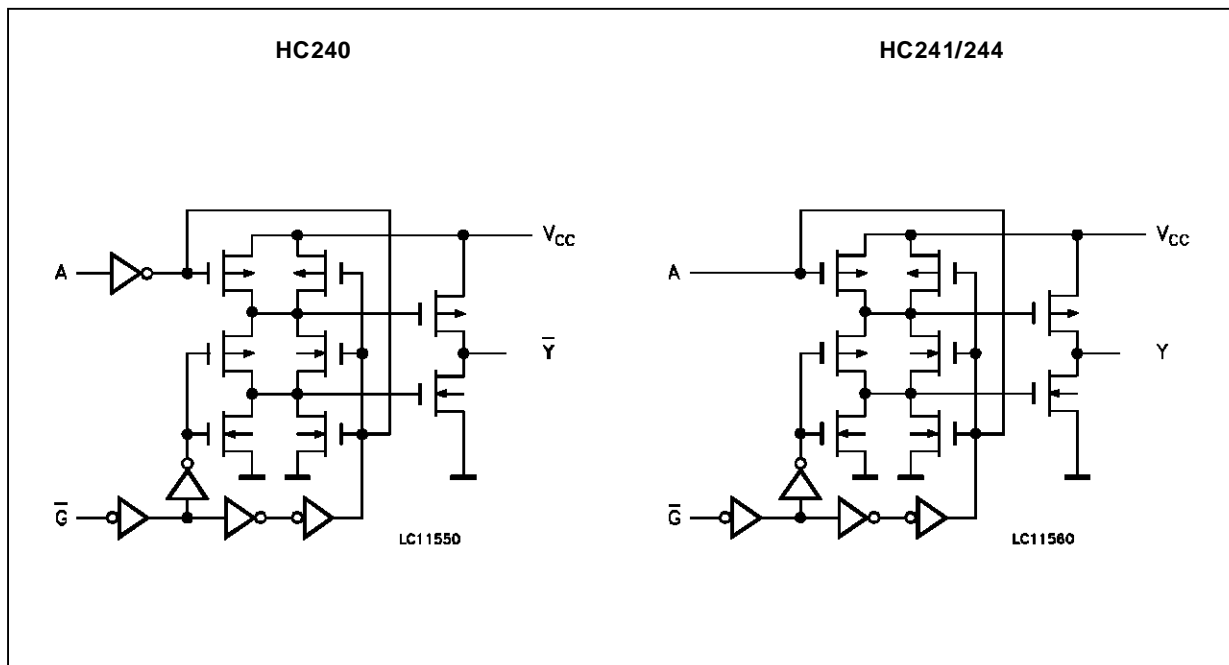


TRUTH TABLE

| INPUT          |           |                | OUTPUT                   |                        |                        |
|----------------|-----------|----------------|--------------------------|------------------------|------------------------|
| $\overline{G}$ | G (HC241) | A <sub>n</sub> | $\overline{Y}_n$ (HC240) | Y <sub>n</sub> (HC241) | Y <sub>n</sub> (HC244) |
| L              | H         | L              | H                        | L                      | L                      |
| L              | H         | H              | L                        | H                      | H                      |
| H              | L         | X              | Z                        | Z                      | Z                      |

X: "H" or "L"  
Z: High impedance

CIRCUIT SCHEMATIC (1/8 PACKAGE)



**ABSOLUTE MAXIMUM RATINGS**

| Symbol                              | Parameter                                    | Value                         | Unit |
|-------------------------------------|--|-------------------------------|------|
| V <sub>CC</sub>                     | Supply Voltage                               | -0.5 to +7                    | V    |
| V <sub>I</sub>                      | DC Input Voltage                             | -0.5 to V <sub>CC</sub> + 0.5 | V    |
| V <sub>O</sub>                      | DC Output Voltage                            | -0.5 to V <sub>CC</sub> + 0.5 | V    |
| I <sub>IK</sub>                     | DC Input Diode Current                       | ± 20                          | mA   |
| I <sub>OK</sub>                     | DC Output Diode Current                      | ± 20                          | mA   |
| I <sub>O</sub>                      | DC Output Source Sink Current Per Output Pin | ± 35                          | mA   |
| I <sub>CC</sub> or I <sub>GND</sub> | DC V <sub>CC</sub> or Ground Current         | ± 70                          | mA   |
| P <sub>D</sub>                      | Power Dissipation                            | 500 (*)                       | mW   |
| T <sub>stg</sub>                    | Storage Temperature                          | -65 to +150                   | °C   |
| T <sub>L</sub>                      | Lead Temperature (10 sec)                    | 300                           | °C   |

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.

(\*) 500 mW: ≡ 65 °C derate to 300 mW by 10mW/°C: 65 °C to 85 °C

**RECOMMENDED OPERATING CONDITIONS**

| Symbol                          | Parameter                                  | Value                               | Unit |
|---------------------------------|--|-------------------------------------|------|
| V <sub>CC</sub>                 | Supply Voltage                             | 2 to 6                              | V    |
| V <sub>I</sub>                  | Input Voltage                              | 0 to V <sub>CC</sub>                | V    |
| V <sub>O</sub>                  | Output Voltage                             | 0 to V <sub>CC</sub>                | V    |
| T <sub>op</sub>                 | Operating Temperature: <b>M54HC Series</b> | -55 to +125                         | °C   |
|                                 | <b>M74HC Series</b>                        | -40 to +85                          | °C   |
| t <sub>r</sub> , t <sub>f</sub> | Input Rise and Fall Time                   | V <sub>CC</sub> = 2 V<br>0 to 1000  | ns   |
|                                 |  | V <sub>CC</sub> = 4.5 V<br>0 to 500 |      |
|                                 |  | V <sub>CC</sub> = 6 V<br>0 to 400   |      |

## DC SPECIFICATIONS

| Symbol          | Parameter                        | Test Conditions        |  | Value                                   |      |      |                      |      |                       | Unit |      |      |
|-----------------|----------------------------------|------------------------|--|---|------|------|----------------------|------|-----------------------|------|------|------|
|                 |                                  | V <sub>CC</sub><br>(V) |  | T <sub>A</sub> = 25 °C<br>54HC and 74HC |      |      | -40 to 85 °C<br>74HC |      | -55 to 125 °C<br>54HC |      |      |      |
|                 |                                  |                        |  | Min.                                    | Typ. | Max. | Min.                 | Max. | Min.                  |      | Max. |      |
| V <sub>IH</sub> | High Level Input Voltage         | 2.0                    |  | 1.5                                     |      |      | 1.5                  |      | 1.5                   |      | V    |      |
|                 |                                  | 4.5                    |  | 3.15                                    |      |      | 3.15                 |      | 3.15                  |      |      |      |
|                 |                                  | 6.0                    |  | 4.2                                     |      |      | 4.2                  |      | 4.2                   |      |      |      |
| V <sub>IL</sub> | Low Level Input Voltage          | 2.0                    |  |   |      | 0.5  |                      | 0.5  |                       | 0.5  | V    |      |
|                 |                                  | 4.5                    |  |   |      | 1.35 |                      | 1.35 |                       | 1.35 |      |      |
|                 |                                  | 6.0                    |  |   |      | 1.8  |                      | 1.8  |                       | 1.8  |      |      |
| V <sub>OH</sub> | High Level Output Voltage        | 2.0                    | V <sub>I</sub> =<br>V <sub>IH</sub><br>or<br>V <sub>IL</sub>                                   | I <sub>O</sub> = -20 μA                 | 1.9  | 2.0  |                      | 1.9  |                       | 1.9  | V    |      |
|                 |                                  | 4.5                    |  |   | 4.4  | 4.5  |                      | 4.4  |                       | 4.4  |      |      |
|                 |                                  | 6.0                    |  |   | 5.9  | 6.0  |                      | 5.9  |                       | 5.9  |      |      |
|                 |                                  | 4.5                    | I <sub>O</sub> = -6.0 mA   | 4.18                                    | 4.31 |      | 4.13                 |      | 4.10                  |      |      |      |
|                 |                                  | 6.0                    |  | I <sub>O</sub> = -7.8 mA                | 5.68 | 5.8  |                      | 5.63 |                       | 5.60 |      |      |
| V <sub>OL</sub> | Low Level Output Voltage         | 2.0                    | V <sub>I</sub> =<br>V <sub>IH</sub><br>or<br>V <sub>IL</sub>                                   | I <sub>O</sub> = 20 μA                  |      | 0.0  | 0.1                  |      | 0.1                   |      | V    |      |
|                 |                                  | 4.5                    |  |   |      | 0.0  | 0.1                  |      | 0.1                   |      |      | 0.1  |
|                 |                                  | 6.0                    |  |   |      | 0.0  | 0.1                  |      | 0.1                   |      |      | 0.1  |
|                 |                                  | 4.5                    | I <sub>O</sub> = 6.0 mA  |   | 0.17 | 0.26 |                      | 0.33 |                       | 0.40 |      |      |
|                 |                                  | 6.0                    |  | I <sub>O</sub> = 7.8 mA                 |      | 0.18 | 0.26                 |      | 0.33                  |      |      | 0.40 |
| I <sub>I</sub>  | Input Leakage Current            | 6.0                    | V <sub>I</sub> = V <sub>CC</sub> or GND  |   |      |      | ±0.1                 |      | ±1                    |      | ±1   | μA   |
| I <sub>OZ</sub> | 3 State Output Off State Current | 6.0                    | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>V <sub>O</sub> = V <sub>CC</sub> or GND |   |      |      | ±0.5                 |      | ±5                    |      | ±10  | μA   |
| I <sub>CC</sub> | Quiescent Supply Current         | 6.0                    | V <sub>I</sub> = V <sub>CC</sub> or GND  |   |      |      | 4                    |      | 40                    |      | 80   | μA   |

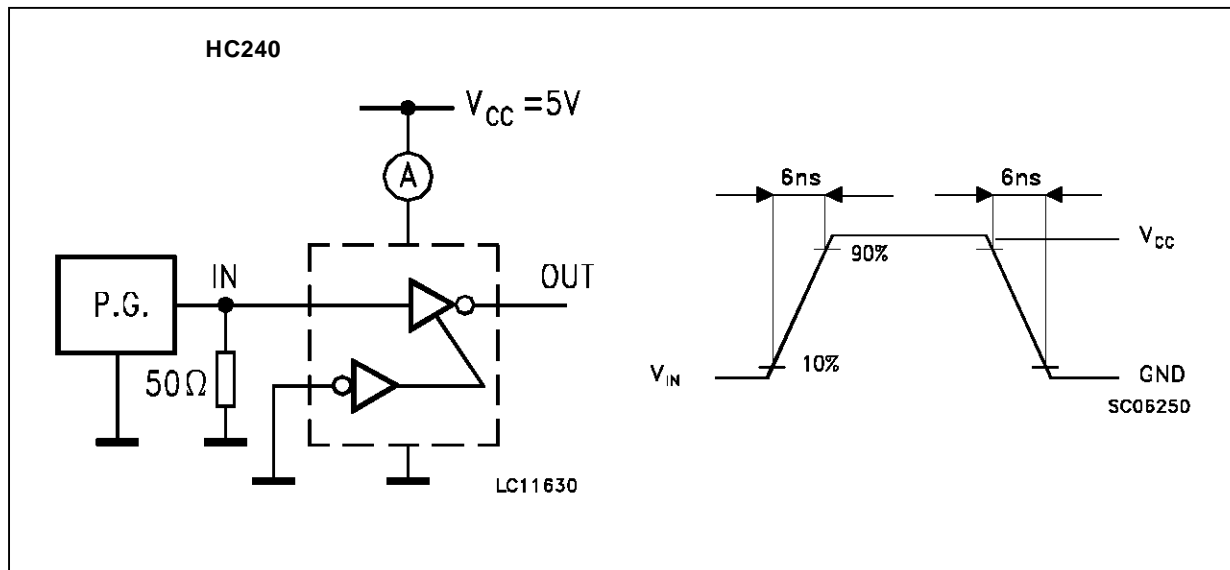
# M54/M74HC240/241/244

## AC ELECTRICAL CHARACTERISTICS (C<sub>L</sub> = 50 pF, Input t<sub>r</sub> = t<sub>f</sub> = 6 ns)

| Symbol                               | Parameter                     | Test Conditions        |                        |                      | Value                                   |          |      |                      |      |                       | Unit |      |    |
|--------------------------------------|-------------------------------|------------------------|------------------------|----------------------|---|----------|------|----------------------|------|-----------------------|------|------|----|
|                                      |                               | V <sub>CC</sub><br>(V) | C <sub>L</sub><br>(pF) |                      | T <sub>A</sub> = 25 °C<br>54HC and 74HC |          |      | -40 to 85 °C<br>74HC |      | -55 to 125 °C<br>54HC |      |      |    |
|                                      |                               |                        |                        |                      | Min.                                    | Typ.     | Max. | Min.                 | Max. | Min.                  |      | Max. |    |
| t <sub>TLH</sub><br>t <sub>THL</sub> | Output Transition Time        | 2.0                    | 50                     |                      |   | 25       | 60   |                      | 75   |                       | 90   | ns   |    |
|                                      |                               | 4.5                    |                        |                      |   | 7        | 12   |                      | 19   |                       | 18   |      |    |
|                                      |                               | 6.0                    |                        |                      |   | 6        | 10   |                      | 13   |                       | 15   |      |    |
| t <sub>PLH</sub><br>t <sub>PHL</sub> | Propagation Delay Time        | 2.0                    | 50                     |                      |   | 36       | 90   |                      | 115  |                       | 135  | ns   |    |
|                                      |                               | 4.5                    |                        |                      |   | 12       | 18   |                      | 23   |                       | 27   |      |    |
|                                      |                               | 6.0                    |                        |                      |   | 10       | 15   |                      | 20   |                       | 23   |      |    |
|                                      |                               | 2.0                    | 150                    |                      |   | 51       | 130  |                      | 165  |                       | 195  | ns   |    |
|                                      |                               | 4.5                    |                        |                      |   | 17       | 26   |                      | 33   |                       | 39   |      |    |
|                                      |                               | 6.0                    |                        |                      |   | 14       | 22   |                      | 28   |                       | 33   |      |    |
| t <sub>PZL</sub><br>t <sub>PZH</sub> | Output Enable Time            | 2.0                    | 50                     | R <sub>L</sub> = 1KΩ |   | 48       | 125  |                      | 155  |                       | 190  | ns   |    |
|                                      |                               | 4.5                    |                        |                      |   |          | 16   | 25                   |      | 31                    |      |      | 38 |
|                                      |                               | 6.0                    |                        |                      |   |          | 14   | 21                   |      | 26                    |      |      | 32 |
|                                      |                               | 2.0                    | 150                    | R <sub>L</sub> = 1KΩ |   | 63       | 165  |                      | 205  |                       | 250  | ns   |    |
|                                      |                               | 4.5                    |                        |                      |   |          | 21   | 33                   |      | 41                    |      |      | 50 |
|                                      |                               | 6.0                    |                        |                      |   |          | 18   | 28                   |      | 35                    |      |      | 43 |
| t <sub>PLZ</sub><br>t <sub>PHZ</sub> | Output Disable Time           | 2.0                    | 50                     | R <sub>L</sub> = 1KΩ |   | 32       | 125  |                      | 155  |                       | 190  | ns   |    |
|                                      |                               | 4.5                    |                        |                      |   |          | 15   | 25                   |      | 31                    |      |      | 38 |
|                                      |                               | 6.0                    |                        |                      |   |          | 14   | 21                   |      | 26                    |      |      | 32 |
| C <sub>IN</sub>                      | Input Capacitance             |                        |                        |                      |   | 5        | 10   |                      | 10   |                       | 10   | pF   |    |
| C <sub>OUT</sub>                     | Output Capacitance            |                        |                        |                      |   | 10       |      |                      |      |                       |      | pF   |    |
| C <sub>PD</sub> (*)                  | Power Dissipation Capacitance |                        |                        | HC240<br>HC241/244   |   | 31<br>33 |      |                      |      |                       |      | pF   |    |

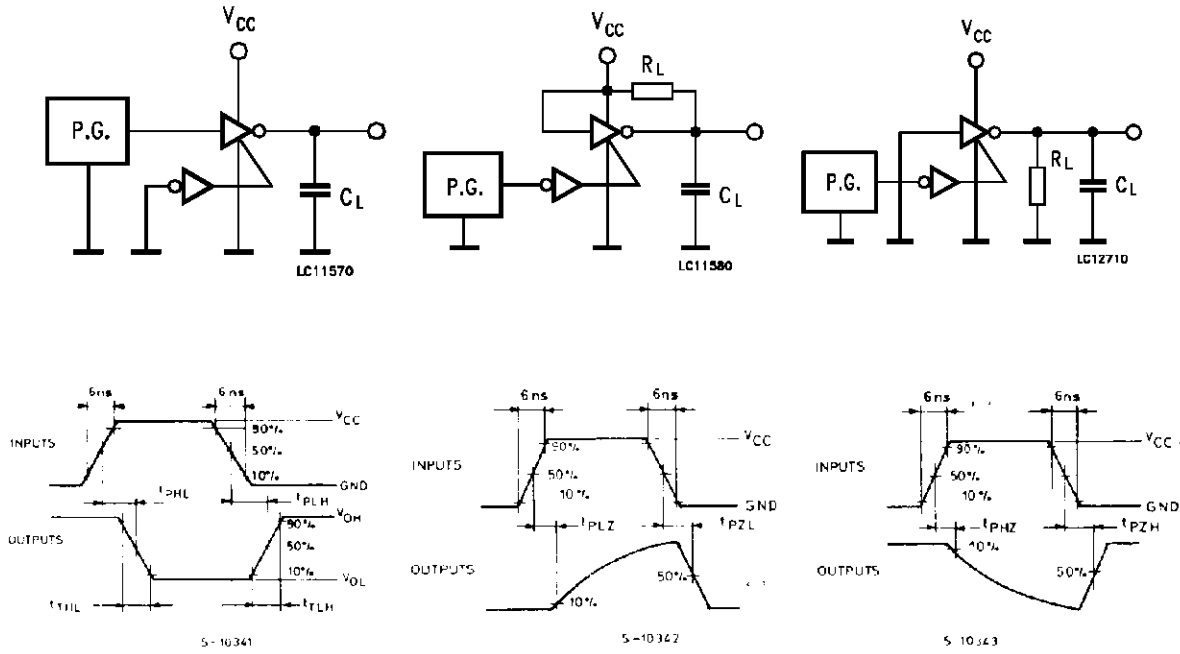
(\*) C<sub>PD</sub> is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation. I<sub>cc(opr)</sub> = C<sub>PD</sub> • V<sub>CC</sub> • f<sub>IN</sub> + I<sub>cc</sub>/8 (per circuit)

### TEST CIRCUIT I<sub>cc</sub> (Opr.)

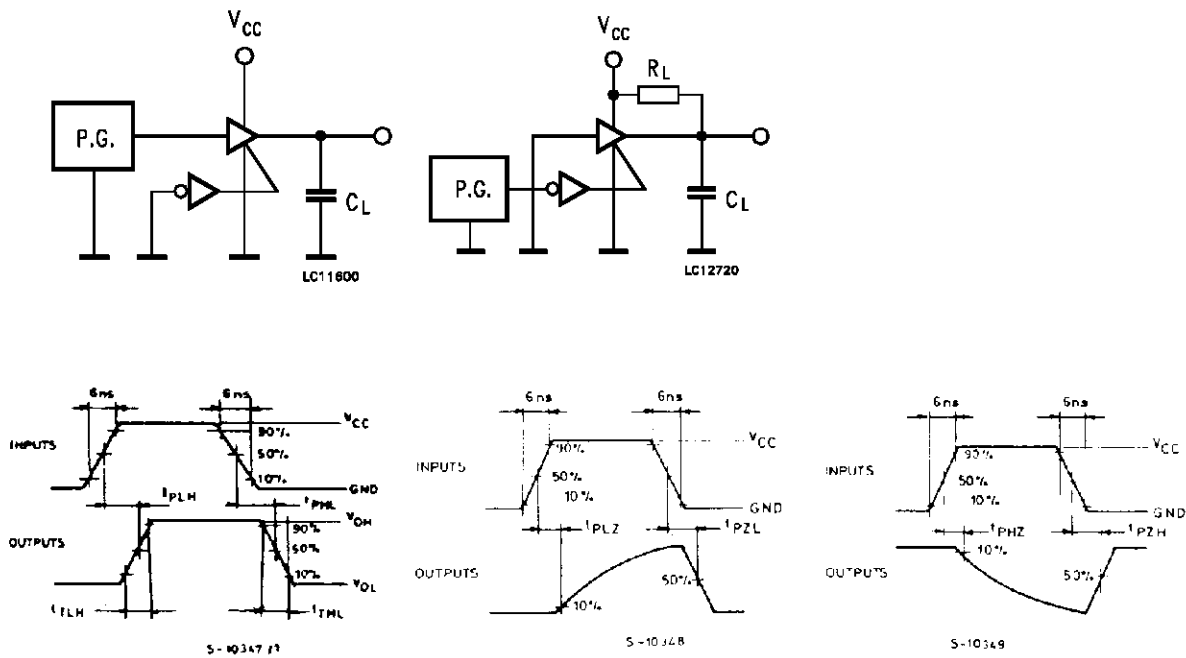


SWITCHING CHARACTERISTICS TEST CIRCUIT

HC240

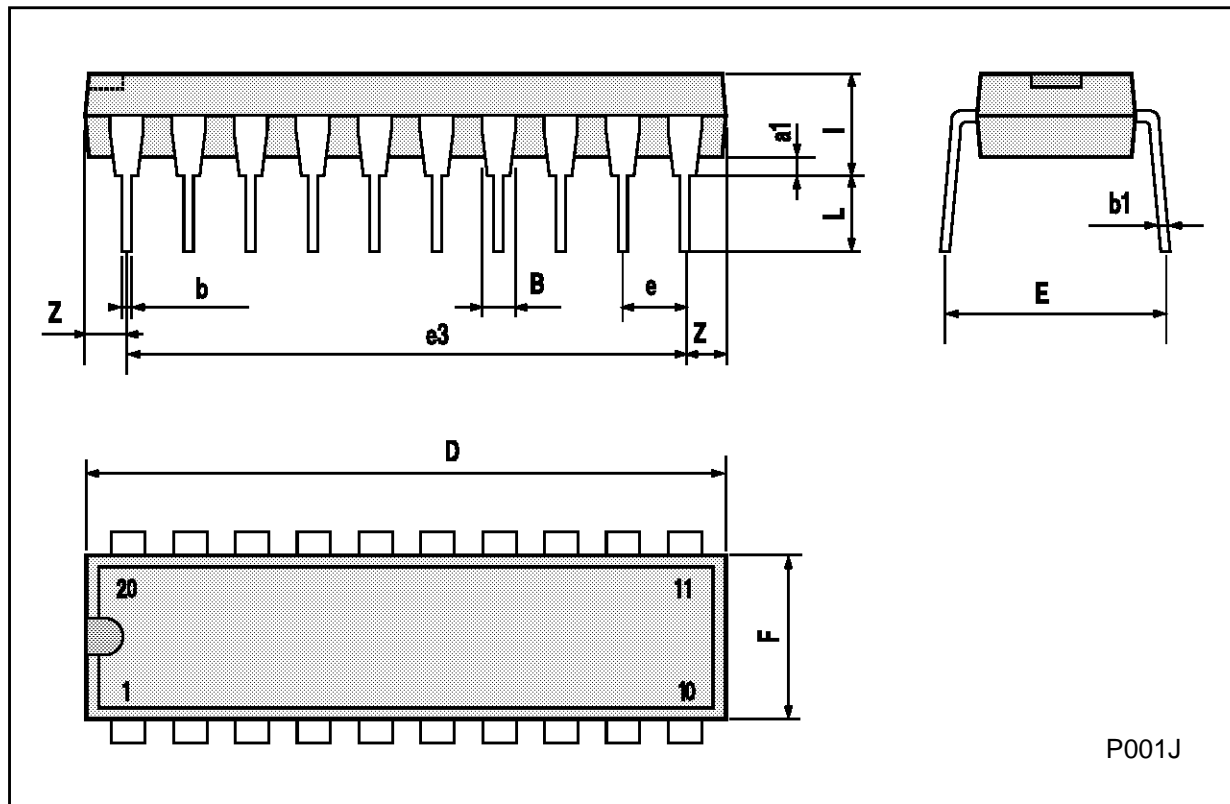


HC241/HC244



**Plastic DIP20 (0.25) MECHANICAL DATA**

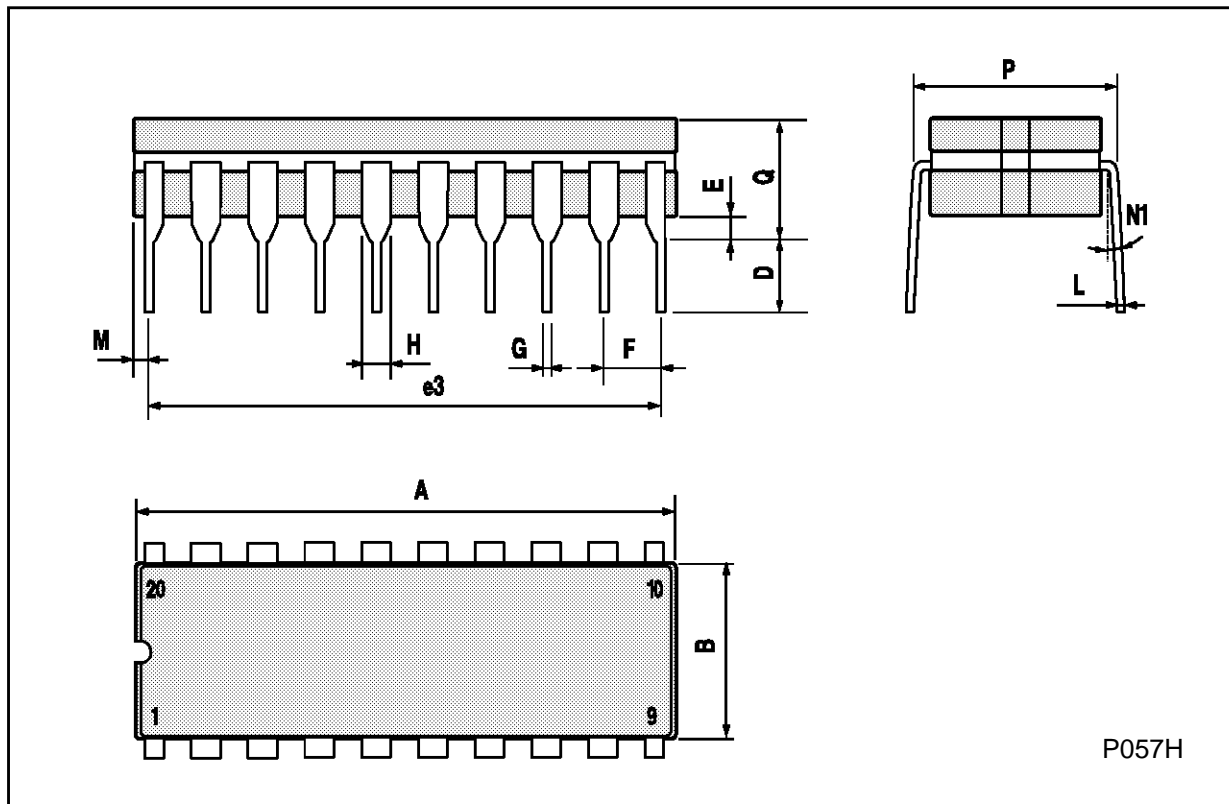
| DIM. | mm    |       |      | inch  |       |       |
|------|-------|-------|------|-------|-------|-------|
|      | MIN.  | TYP.  | MAX. | MIN.  | TYP.  | MAX.  |
| a1   | 0.254 |       |      | 0.010 |       |       |
| B    | 1.39  |       | 1.65 | 0.055 |       | 0.065 |
| b    |       | 0.45  |      |       | 0.018 |       |
| b1   |       | 0.25  |      |       | 0.010 |       |
| D    |       |       | 25.4 |       |       | 1.000 |
| E    |       | 8.5   |      |       | 0.335 |       |
| e    |       | 2.54  |      |       | 0.100 |       |
| e3   |       | 22.86 |      |       | 0.900 |       |
| F    |       |       | 7.1  |       |       | 0.280 |
| I    |       |       | 3.93 |       |       | 0.155 |
| L    |       | 3.3   |      |       | 0.130 |       |
| Z    |       |       | 1.34 |       |       | 0.053 |





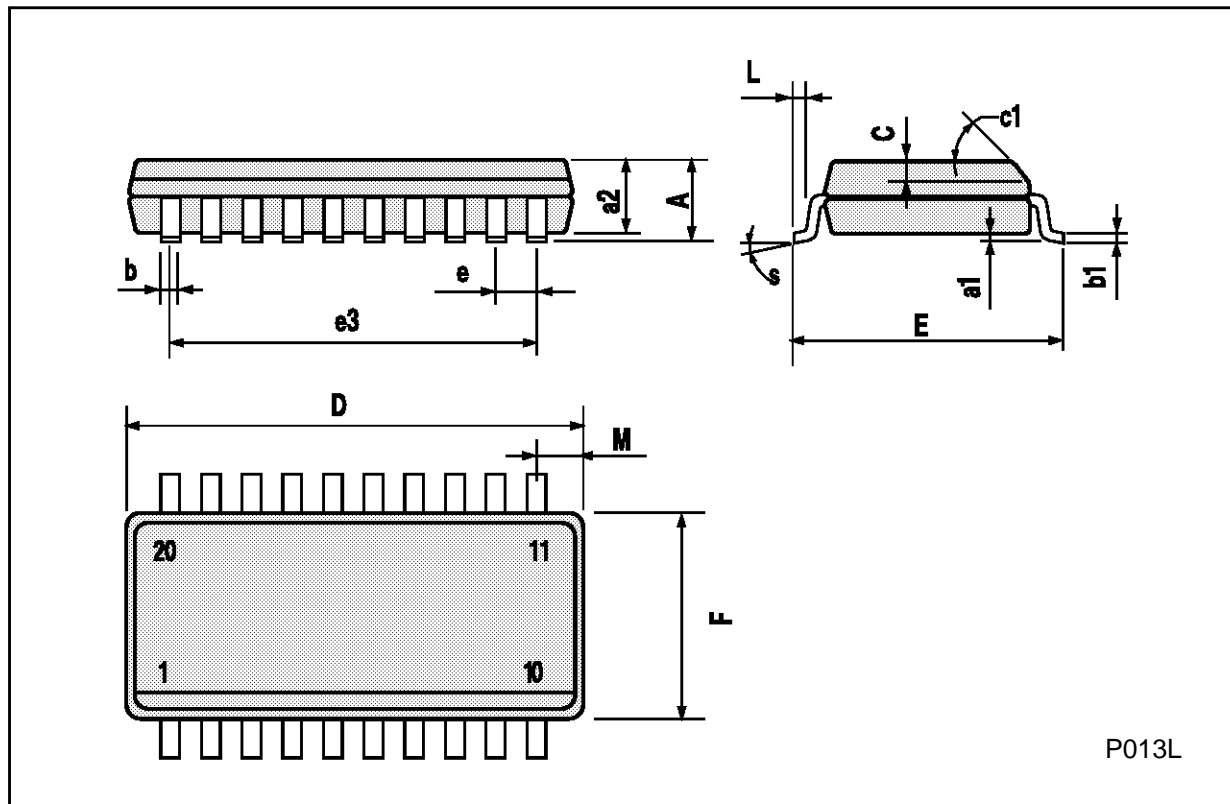
**Ceramic DIP20 MECHANICAL DATA**

| DIM. | mm                    |       |      | inch  |       |       |
|------|-----------------------|-------|------|-------|-------|-------|
|      | MIN.                  | TYP.  | MAX. | MIN.  | TYP.  | MAX.  |
| A    |                       |       | 25   |       |       | 0.984 |
| B    |                       |       | 7.8  |       |       | 0.307 |
| D    |                       | 3.3   |      |       | 0.130 |       |
| E    | 0.5                   |       | 1.78 | 0.020 |       | 0.070 |
| e3   |                       | 22.86 |      |       | 0.900 |       |
| F    | 2.29                  |       | 2.79 | 0.090 |       | 0.110 |
| G    | 0.4                   |       | 0.55 | 0.016 |       | 0.022 |
| I    | 1.27                  |       | 1.52 | 0.050 |       | 0.060 |
| L    | 0.22                  |       | 0.31 | 0.009 |       | 0.012 |
| M    | 0.51                  |       | 1.27 | 0.020 |       | 0.050 |
| N1   | 4° (min.), 15° (max.) |       |      |       |       |       |
| P    | 7.9                   |       | 8.13 | 0.311 |       | 0.320 |
| Q    |                       |       | 5.71 |       |       | 0.225 |



**SO20 MECHANICAL DATA**

| DIM. | mm         |       |       | inch  |       |       |
|------|------------|-------|-------|-------|-------|-------|
|      | MIN.       | TYP.  | MAX.  | MIN.  | TYP.  | MAX.  |
| A    |            |       | 2.65  |       |       | 0.104 |
| a1   | 0.10       |       | 0.20  | 0.004 |       | 0.007 |
| a2   |            |       | 2.45  |       |       | 0.096 |
| b    | 0.35       |       | 0.49  | 0.013 |       | 0.019 |
| b1   | 0.23       |       | 0.32  | 0.009 |       | 0.012 |
| C    |            | 0.50  |       |       | 0.020 |       |
| c1   | 45° (typ.) |       |       |       |       |       |
| D    | 12.60      |       | 13.00 | 0.496 |       | 0.512 |
| E    | 10.00      |       | 10.65 | 0.393 |       | 0.419 |
| e    |            | 1.27  |       |       | 0.050 |       |
| e3   |            | 11.43 |       |       | 0.450 |       |
| F    | 7.40       |       | 7.60  | 0.291 |       | 0.299 |
| L    | 0.50       |       | 1.27  | 0.19  |       | 0.050 |
| M    |            |       | 0.75  |       |       | 0.029 |
| S    | 8° (max.)  |       |       |       |       |       |



P013L

**PLCC20 MECHANICAL DATA**

| DIM. | mm   |      |       | inch  |       |       |
|------|------|------|-------|-------|-------|-------|
|      | MIN. | TYP. | MAX.  | MIN.  | TYP.  | MAX.  |
| A    | 9.78 |      | 10.03 | 0.385 |       | 0.395 |
| B    | 8.89 |      | 9.04  | 0.350 |       | 0.356 |
| D    | 4.2  |      | 4.57  | 0.165 |       | 0.180 |
| d1   |      | 2.54 |       |       | 0.100 |       |
| d2   |      | 0.56 |       |       | 0.022 |       |
| E    | 7.37 |      | 8.38  | 0.290 |       | 0.330 |
| e    |      | 1.27 |       |       | 0.050 |       |
| e3   |      | 5.08 |       |       | 0.200 |       |
| F    |      | 0.38 |       |       | 0.015 |       |
| G    |      |      | 0.101 |       |       | 0.004 |
| M    |      | 1.27 |       |       | 0.050 |       |
| M1   |      | 1.14 |       |       | 0.045 |       |



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