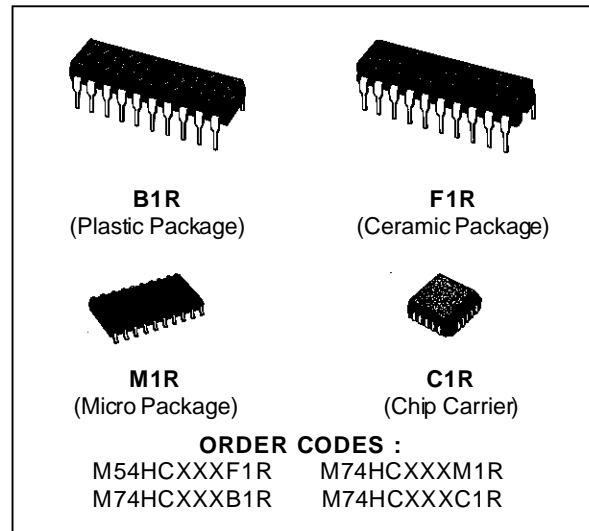


## OCTAL BUS TRANSCEIVER (3-STATE): HC245 NON INVERTING HC640 INVERTING, HC643 INVERTING/NON INVERTING

- HIGH SPEED  
 $t_{PD} = 10 \text{ ns (TYP.) at } V_{CC} = 5V$
- LOW POWER DISSIPATION  
 $I_{CC} = 4 \mu A \text{ (MAX.) at } T_A = 25^\circ C$
- HIGH NOISE IMMUNITY  
 $V_{NIH} = V_{NIL} = 28\% V_{CC} \text{ (MIN.)}$
- 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  
 $V_{CC} \text{ (OPR)} = 2 \text{ V TO } 6 \text{ V}$
- PIN AND FUNCTION COMPATIBLE  
 WITH 54/74LS245/640/643



### DESCRIPTION

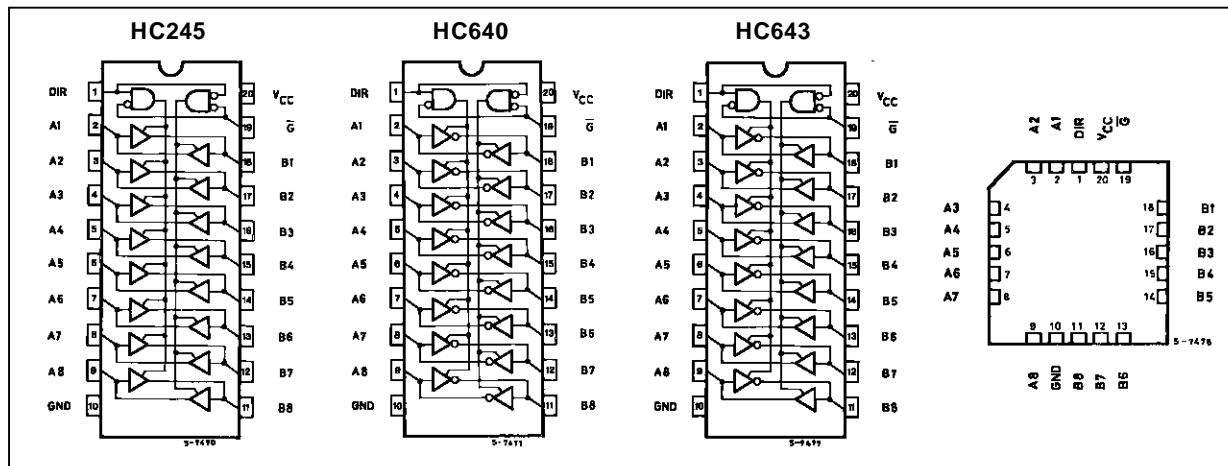
The M54/74HC245, HC640 and HC643 utilise silicon gate C<sup>2</sup>MOS technology to achieve operating speeds equivalent to LSTTL devices.

Along with the low power dissipation and high noise immunity of standard C<sup>2</sup>MOS integrated circuit, it possesses the capability to drive 15 LSTTL loads. These IC's are intended for two-way asynchronous communication between data buses, and the direction of data transmission is determined by DIR input. The enable input ( $\bar{G}$ ) can be used to disable the device so that the buses are effectively isolated.

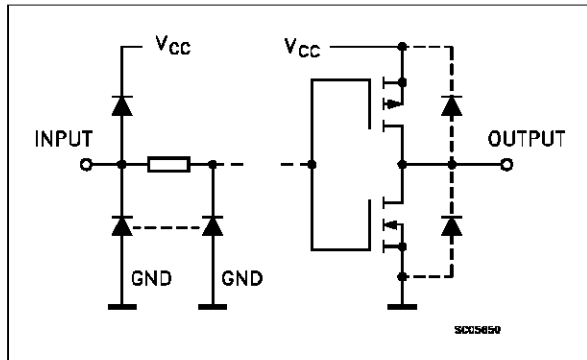
All inputs are equipped with protection circuits against static discharge and transient discharge and transient excess voltage.

IT IS PROHIBITED TO APPLY A SIGNAL TO A BUS TERMINAL WHEN IT IS IN OUTPUT MODE AND WHEN A BUS TERMINAL IS FLOATING (HIGH IMPEDANCE STATE), IT IS REQUESTED TO FIX THE INPUT LEVEL BY MEANS OF EXTERNAL PULL DOWN OR PULL UP RESISTOR.

### PIN CONNECTION (top view)



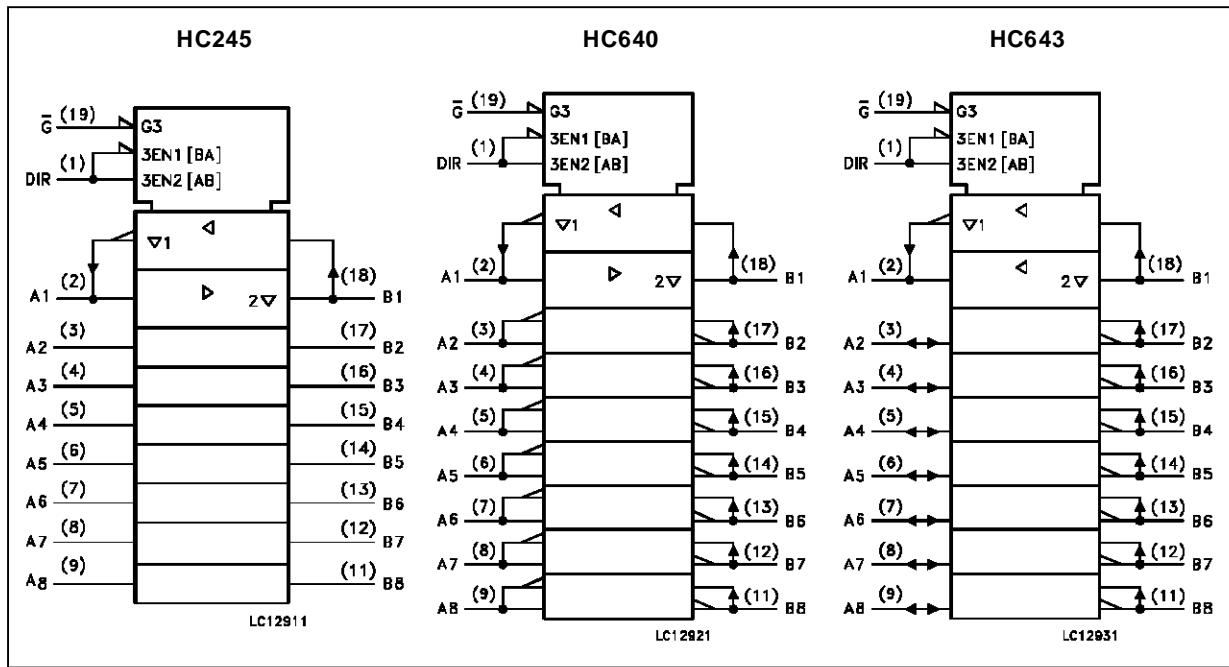
INPUT AND OUTPUT EQUIVALENT CIRCUIT



PIN DESCRIPTION

| PIN No                         | SYMBOL          | NAME AND FUNCTION                |
|--------------------------------|-----------------|----------------------------------|
| 1                              | DIR             | Directional Control              |
| 2, 3, 4, 5, 6, 7, 8, 9         | A1 to A8        | Data Inputs/Outputs              |
| 18, 17, 16, 15, 14, 13, 12, 11 | B1 to B8        | Data Inputs/Outputs              |
| 19                             | $\overline{G}$  | Output Enable Input (Active LOW) |
| 10                             | GND             | Ground (0V)                      |
| 20                             | V <sub>CC</sub> | Positive Supply Voltage          |

IEC LOGIC SYMBOLS

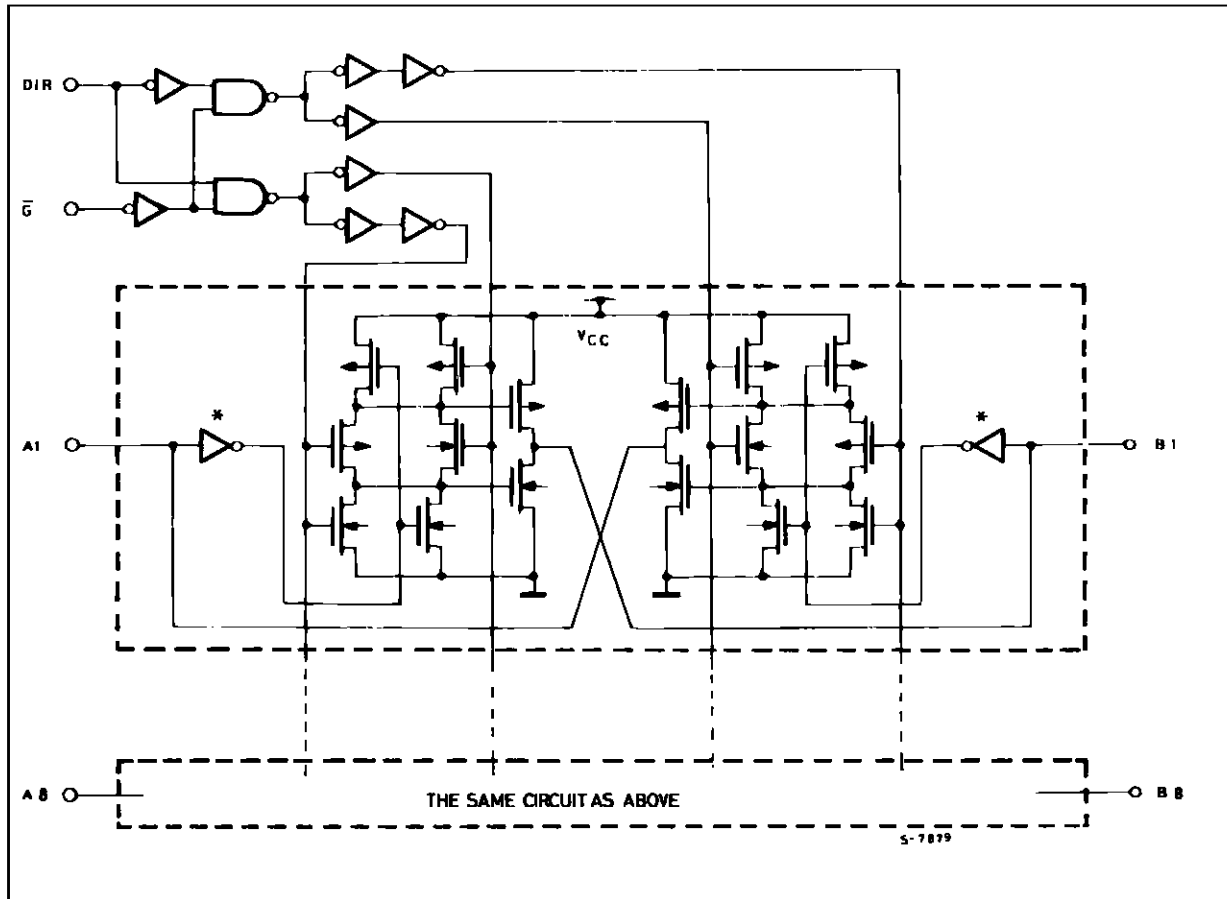


TRUTH TABLE

| INPUT          |     | FUNCTION |        | OUTPUT |                    |                    |
|----------------|-----|----------|--------|--------|--------------------|--------------------|
| $\overline{G}$ | DIR | A BUS    | B BUS  | HC245  | HC640              | HC643              |
| L              | L   | OUTPUT   | INPUT  | A = B  | A = $\overline{B}$ | A = B              |
| L              | H   | INPUT    | OUTPUT | B = A  | B = $\overline{A}$ | B = $\overline{A}$ |
| H              | X   | Z        | Z      | Z      | Z                  | Z                  |

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

LOGIC DIAGRAM (HC640)



NOTE: IN CASE OF HC245 OR HC643, INPUT INVERTERS MARKED\* AT A BUS AND B BUS ARE ELIMINATED RESPECTIVELY

ABSOLUTE MAXIMUM RATING

| 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><br><b>M74HC Series</b> | -55 to +125<br>-40 to +85 | °C<br>°C  |    |
| t <sub>r</sub> , t <sub>f</sub> | Input Rise and Fall Time  | V <sub>CC</sub> = 2 V     | 0 to 1000 | ns |
|                                 |   | V <sub>CC</sub> = 4.5 V   | 0 to 500  |    |
|                                 |   | V <sub>CC</sub> = 6 V     | 0 to 400  |    |

**DC SPECIFICATIONS**

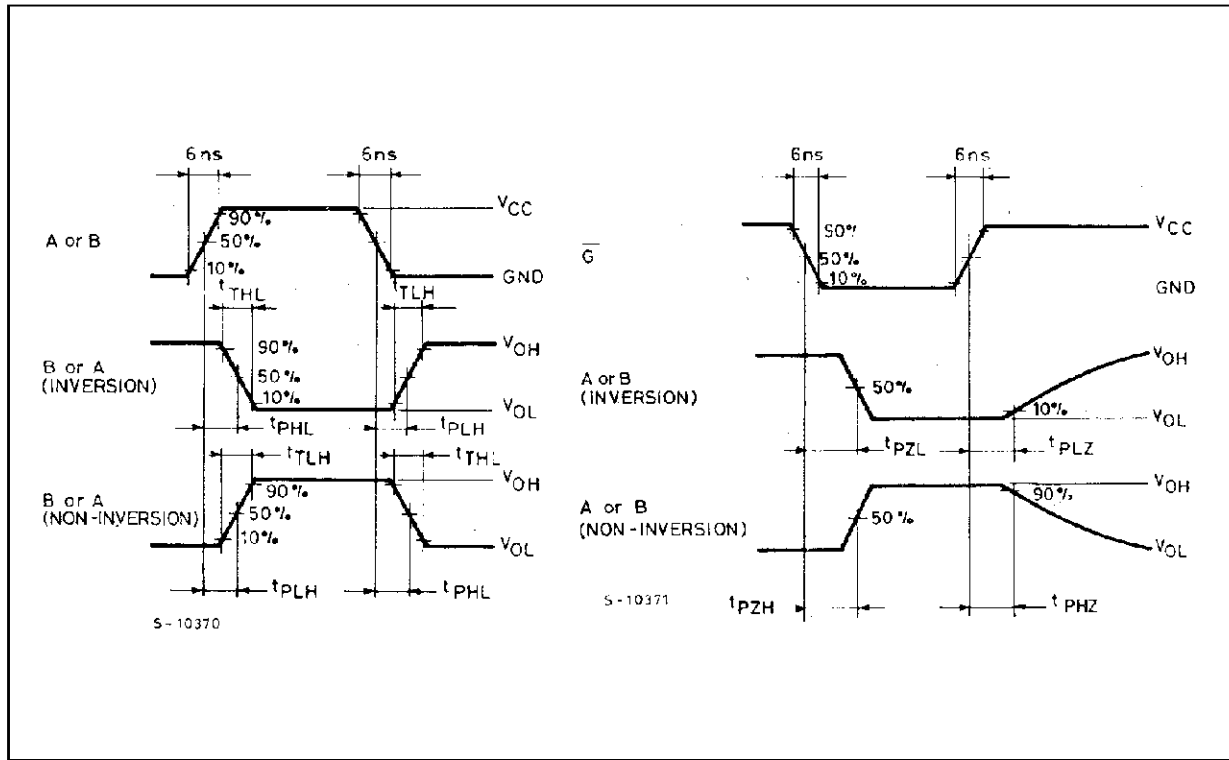
| Symbol          | Parameter                        | Test Conditions        |  | Value                                   |      |      |                      |      |                       | Unit |      |
|-----------------|----------------------------------|------------------------|--|---|------|------|----------------------|------|-----------------------|------|------|
|                 |                                  | 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> = V <sub>IH</sub><br>or<br>V <sub>IL</sub><br>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> = V <sub>IH</sub><br>or<br>V <sub>IL</sub><br>I <sub>O</sub> = 20 μA            |   | 0.0  | 0.1  |                      | 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 |                      | ±5.0 | μA                    |      |      |
| I <sub>CC</sub> | Quiescent Supply Current         | 6.0                    | V <sub>I</sub> = V <sub>CC</sub> or GND  |   |      | 4    |                      | 40   |                       | 80   | μA   |

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

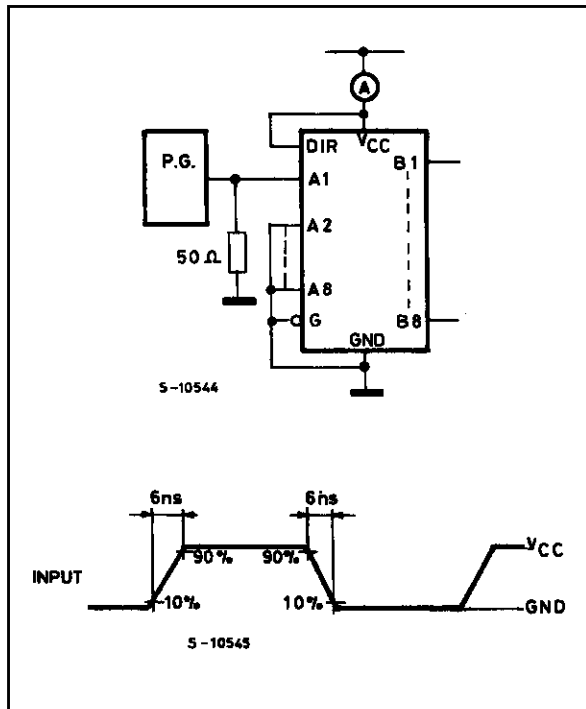
| Symbol                               | Parameter                     | Test Conditions        |                        |                      | Value                                   |          |      |                      |      |                       | Unit |      |    |
|--------------------------------------|-------------------------------|------------------------|------------------------|----------------------|---|----------|------|----------------------|------|-----------------------|------|------|----|
|                                      |                               | 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                     |                      |   | 33       | 90   |                      | 115  |                       | 135  | ns   |    |
|                                      |                               | 4.5                    |                        |                      |   | 12       | 18   |                      | 23   |                       | 27   |      |    |
|                                      |                               | 6.0                    |                        |                      |   | 10       | 15   |                      | 20   |                       | 23   |      |    |
|                                      |                               | 2.0                    | 150                    |                      |   | 48       | 120  |                      | 150  |                       | 180  | ns   |    |
|                                      |                               | 4.5                    |                        |                      |   | 16       | 24   |                      | 30   |                       | 36   |      |    |
|                                      |                               | 6.0                    |                        |                      |   | 14       | 20   |                      | 26   |                       | 31   |      |    |
| t <sub>PZL</sub><br>t <sub>PZH</sub> | Output Enable Time            | 2.0                    | 50                     | R <sub>L</sub> = 1KΩ |   | 48       | 150  |                      | 190  |                       | 225  | ns   |    |
|                                      |                               | 4.5                    |                        |                      |   |          | 16   | 30                   |      | 38                    |      |      | 45 |
|                                      |                               | 6.0                    |                        |                      |   |          | 14   | 26                   |      | 32                    |      |      | 38 |
|                                      |                               | 2.0                    | 150                    | R <sub>L</sub> = 1KΩ |   | 63       | 180  |                      | 225  |                       | 270  | ns   |    |
|                                      |                               | 4.5                    |                        |                      |   |          | 21   | 36                   |      | 45                    |      |      | 54 |
|                                      |                               | 6.0                    |                        |                      |   |          | 18   | 31                   |      | 38                    |      |      | 46 |
| t <sub>PLZ</sub><br>t <sub>PHZ</sub> | Output Disable Time           | 2.0                    | 50                     | R <sub>L</sub> = 1KΩ |   | 37       | 150  |                      | 190  |                       | 225  | ns   |    |
|                                      |                               | 4.5                    |                        |                      |   |          | 17   | 30                   |      | 38                    |      |      | 45 |
|                                      |                               | 6.0                    |                        |                      |   |          | 15   | 26                   |      | 32                    |      |      | 38 |
| C <sub>IN</sub>                      | Input Capacitance             |                        |                        | DIR, $\overline{G}$  |   | 5        | 10   |                      | 10   |                       | 10   | pF   |    |
| C <sub>I/OUT</sub>                   | Output Capacitance            |                        |                        | An, Bn               |   | 13       |      |                      |      |                       |      | pF   |    |
| C <sub>PD</sub> (*)                  | Power Dissipation Capacitance |                        |                        | HC245<br>HC640/643   |   | 39<br>37 |      |                      |      |                       |      | 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)

SWITCHING CHARACTERISTICS TEST WAVEFORM



TEST CIRCUIT  $I_{CC}$  (Opr.)



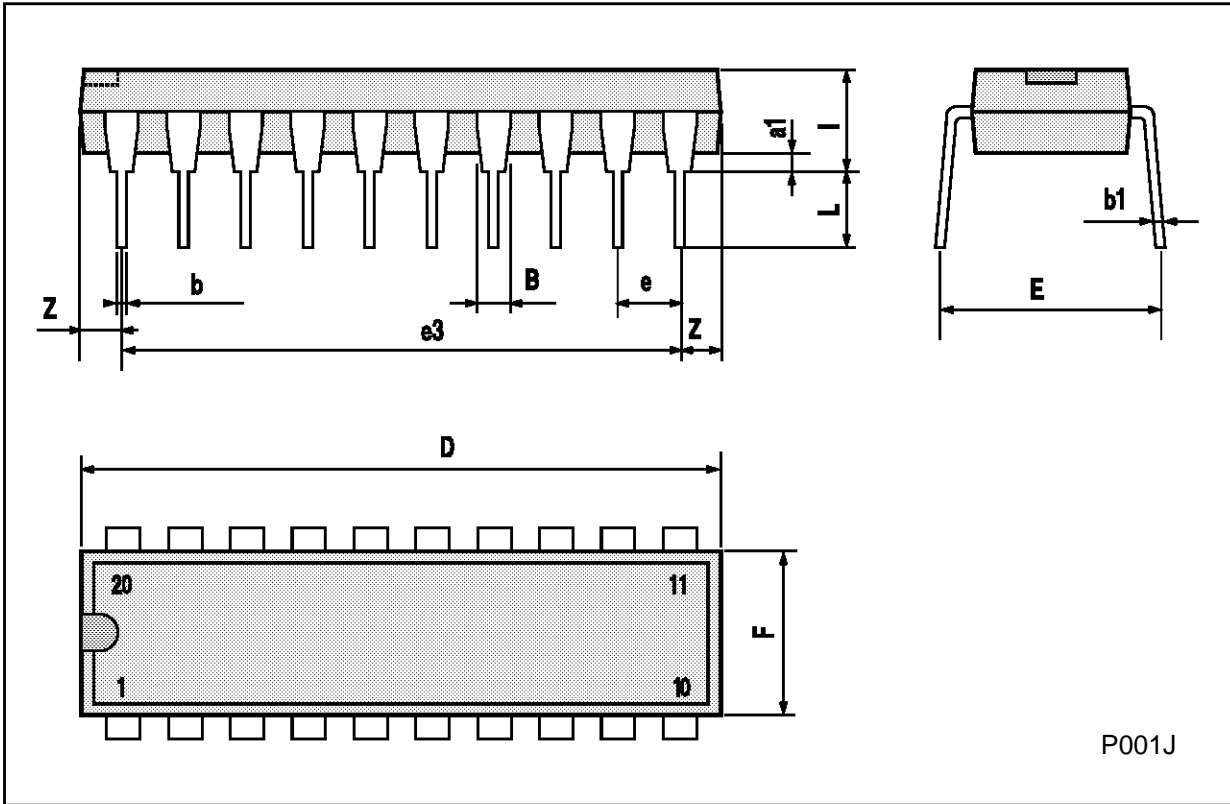
$C_{PD}$  CALCULATION

$C_{PD}$  is to be calculated with the following formula by using the measured value of  $I_{CC}$  (Opr.) in the test circuit opposite.

$$C_{PD} = \frac{I_{CC} (Opr.)}{f_{IN} \times V_{CC}}$$

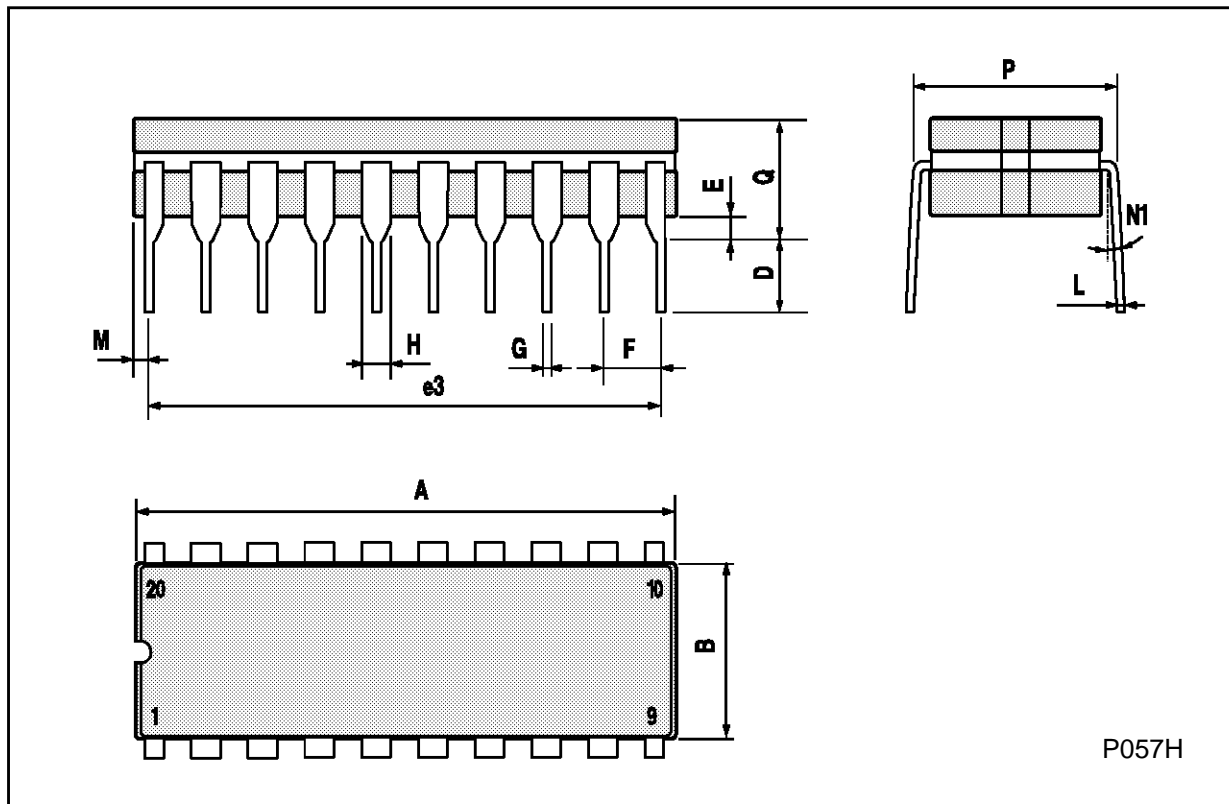
**Plastic DIP20 (0.25) MECHANICAL DATA**

| 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

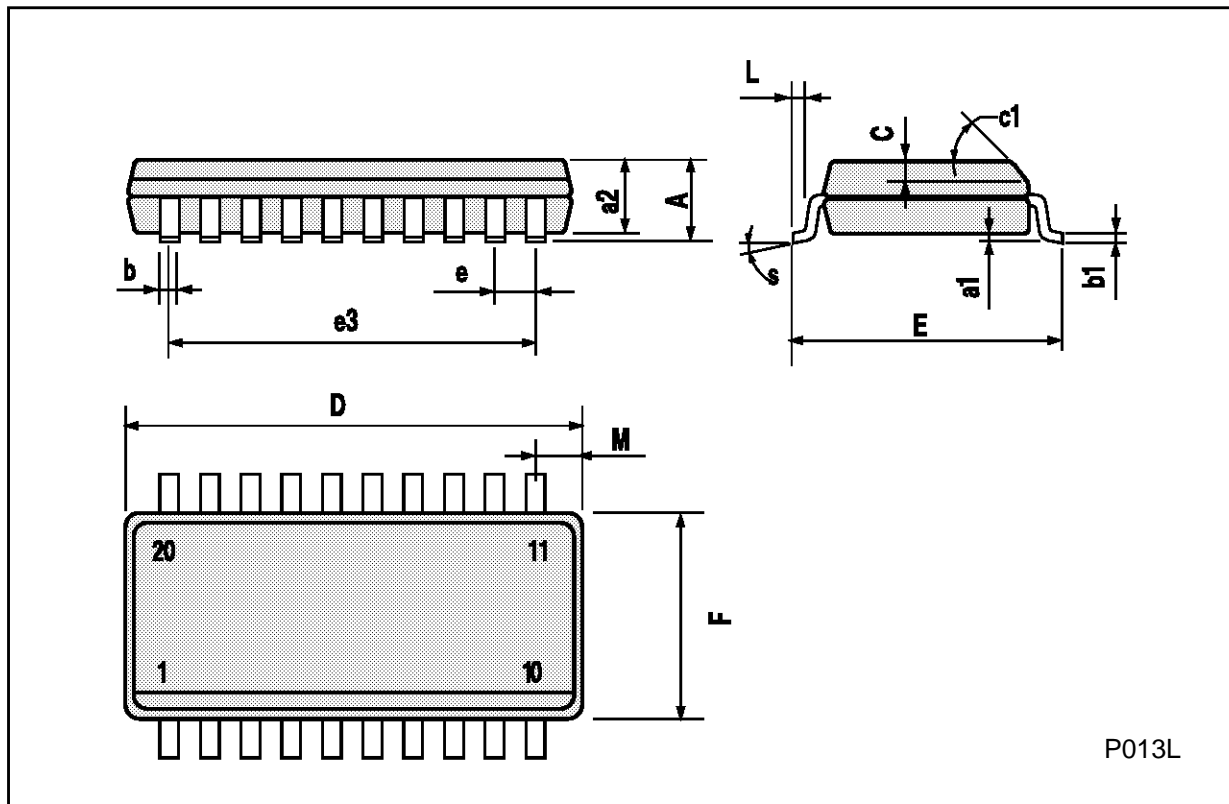
| DIM. | mm                    |       |      | inch  |       |       |
|------|-----------------------|-------|------|-------|-------|-------|
|      | MIN.                  | TYP.  | MAX. | MIN.  | TYP.  | MAX.  |
| A    |                       |       | 25   |       |       | 0.984 |
| B    |                       |       | 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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