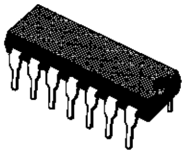
**SGS-THOMSON**
**MICROELECTRONICS**

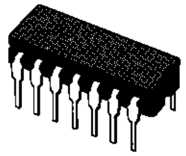
# M54/74HC242
# M54/74HC243

## QUAD BUS TRANSCEIVER (3-STATE)

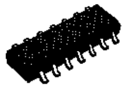
- HIGH SPEED
  $t_{PD}$ = 9 ns (TYP.) AT $V_{CC}$ = 5 V
- LOW POWER DISSIPATION
  $I_{CC}$ = 4 µA (MAX.) AT 25 °C
- OUTPUT DRIVE CAPABILITY
  15 LSTTL LOADS
- BALANCED PROPAGATION DELAYS
  $t_{PLH} = t_{PHL}$
- SYMMETRICAL OUTPUT IMPEDANCE
  $I_{OL} = |I_{OH}|$ = 6 mA (MIN.)
- HIGH NOISE IMMUNITY
  $V_{NIH} = V_{NIL}$ = 28 % $V_{CC}$ (MIN.)
- WIDE OPERATING VOLTAGE RANGE
  $V_{CC}$ (OPR) = 2 V TO 6 V
- PIN AND FUNCTION COMPATIBLE
  WITH 54/74LS242/243



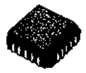
**B1R**
(Plastic Package)



**F1R**
(Ceramic Package)



**M1R**
(Micro Package)



**C1R**
(Chip Carrier)

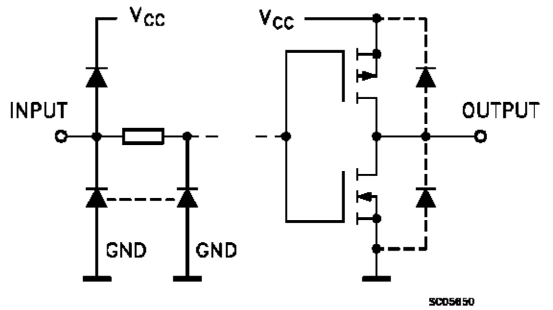
**ORDER CODES :**

M54HCXXXF1R M74HCXXXM1R
M74HCXXXB1R M74HCXXXC1R

### DESCRIPTION

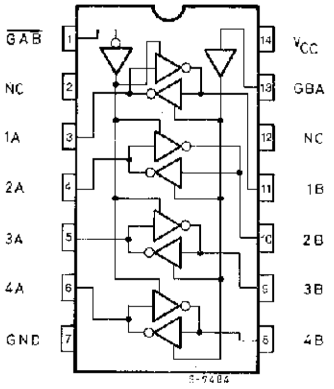
The M54/74HC242/243 are high speed CMOS QUAD BUS TRANSCEIVER (3-STATE) FABRICATED IN SILICON GATE $C^2$MOS technology. They have the same high speed performance of LSTTL combined with true CMOS low power consumption. The HC242/243 are 3 STATE bi-directional inverting and non-inverting buffers and are intended for two-way asynchronous communication between data buses. They are high drive current outputs which enable high speed operation when driving large bus capacitances. Each device has one active high enable (GBA), and one active low enable ($\overline{GAB}$). GBA enables the A outputs and $\overline{GAB}$ enables the B outputs. All inputs are equipped with protection circuits against static discharge and transient excess voltage.

### INPUT AND OUTPUT EQUIVALENT CIRCUIT

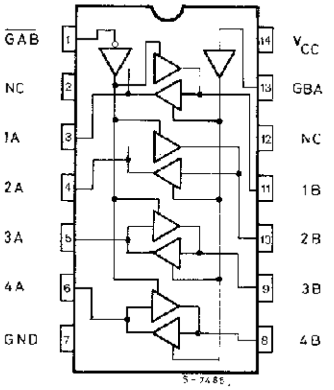


### PIN CONNECTIONS (top view)

**HC242**

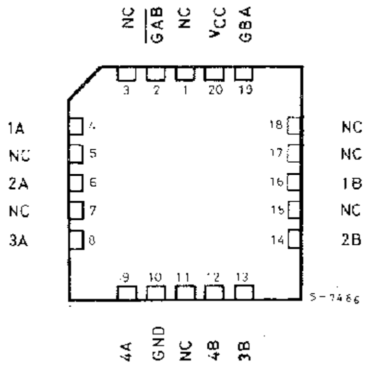


**HC243**



NC =
No Internal
Connection

## CHIP CARRIER



## TRUTH TABLE

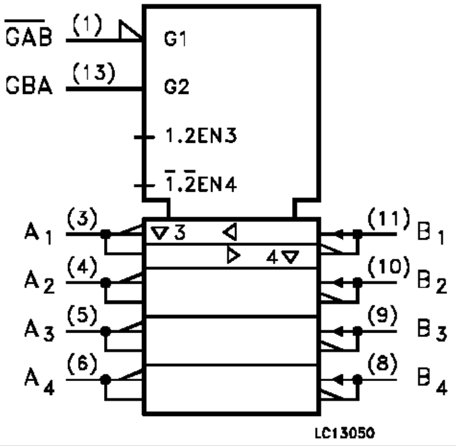
| INPUTS | | FUNCTION | | OUTPUTS | |
|---|---|---|---|---|---|
| $\overline{GAB}$ | GBA | A BUS | B BUS | HC242 | HC243 |
| H | H | OUTPUT | INPUT | A = $\overline{B}$ | A = B |
| L | L | INPUT | OUTPUT | B = $\overline{A}$ | B = A |
| H | L | HIGH IMPEDANCE | | Z | Z |
| L | H | HIGH IMPEDANCE | | Z | Z |

## PIN DESCRIPTION

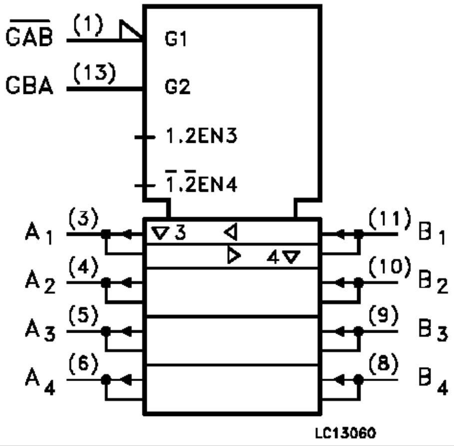
| PIN No | SYMBOL | NAME AND FUNCTION |
|---|---|---|
| 1 | $\overline{GAB}$ | Output Enable Input (active LOW) |
| 2, 12 | NC | Not connected |
| 3, 4, 5, 6 | 1A to 4A | Data Inputs/Outputs |
| 11, 10, 9, 8 | 1B to 4B | Data Inputs/Outputs |
| 13 | GBA | Output Enable Input |
| 7 | GND | Ground (0V) |
| 14 | $V_{CC}$ | Positive Supply Voltage |

## IEC LOGIC SYMBOLS

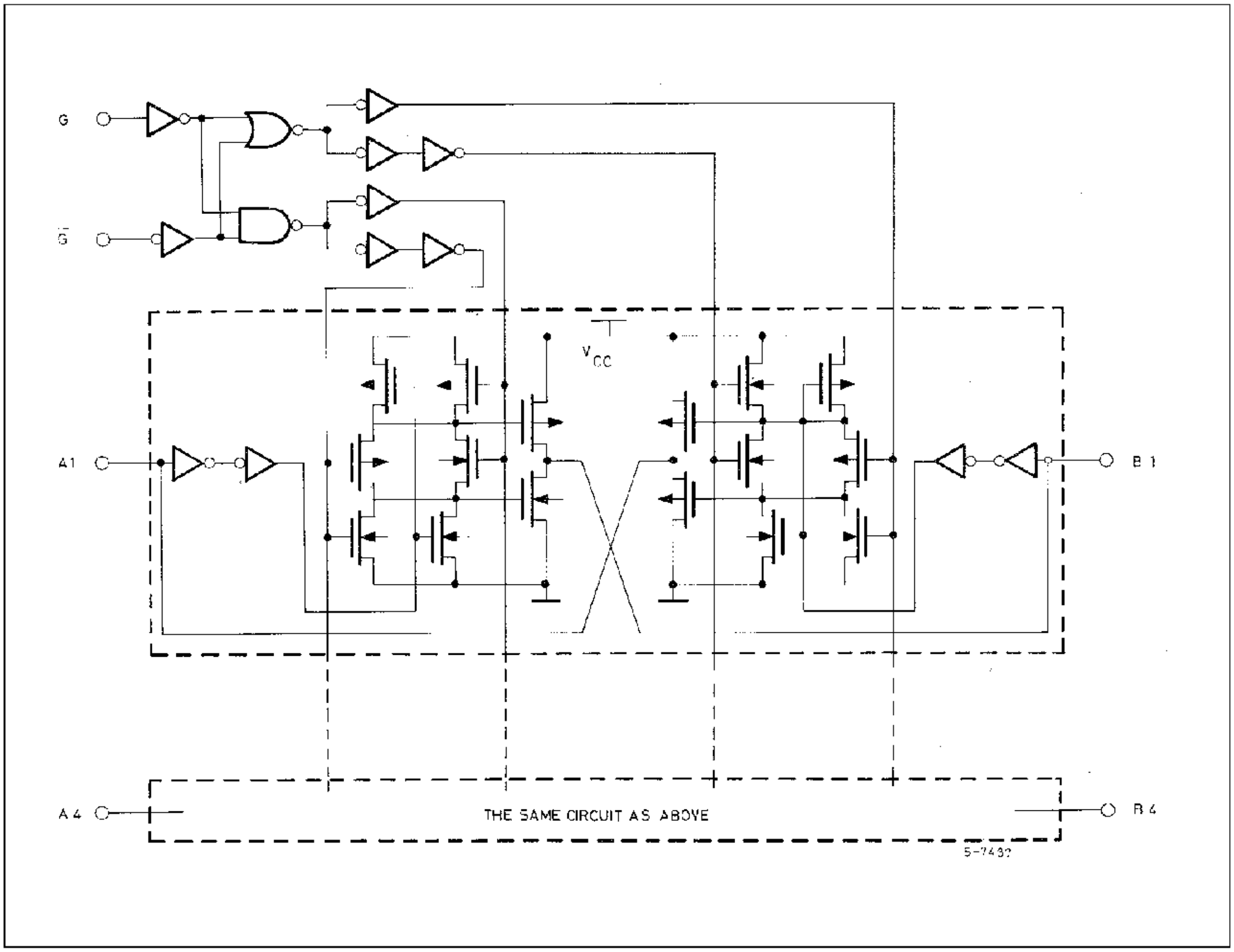
**HC242**



**HC243**



## CIRCUIT DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{CC}$ | Supply Voltage | -0.5 to +7 | V |
| $V_I$ | DC Input Voltage | -0.5 to $V_{CC}$ + 0.5 | V |
| $V_O$ | DC Output Voltage | -0.5 to $V_{CC}$ + 0.5 | V |
| $I_{IK}$ | DC Input Diode Current | ± 20 | mA |
| $I_{OK}$ | DC Output Diode Current | ± 20 | mA |
| $I_O$ | DC Output Source Sink Current Per Output Pin | ± 35 | mA |
| $I_{CC}$ or $I_{GND}$ | DC $V_{CC}$ or Ground Current | ± 70 | mA |
| $P_D$ | Power Dissipation | 500 (*) | mW |
| $T_{stg}$ | Storage Temperature | -65 to +150 | $^oC$ |
| $T_L$ | Lead Temperature (10 sec) | 300 | $^oC$ |

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 $^oC$ derate to 300 mW by 10mW/$^oC$: 65 $^oC$ to 85 $^oC$

## RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | | Value | Unit |
|---|---|---|---|---|
| $V_{CC}$ | Supply Voltage | | 2 to 6 | V |
| $V_I$ | Input Voltage | | 0 to $V_{CC}$ | V |
| $V_O$ | Output Voltage | | 0 to $V_{CC}$ | V |
| $T_{op}$ | Operating Temperature: **M54HC** Series<br>**M74HC** Series | | -55 to +125<br>-40 to +85 | °C<br>°C |
| $t_r$, $t_f$ | Input Rise and Fall Time | $V_{CC}$ = 2 V | 0 to 1000 | ns |
| | | $V_{CC}$ = 4.5 V | 0 to 500 | |
| | | $V_{CC}$ = 6 V | 0 to 400 | |

## DC SPECIFICATIONS

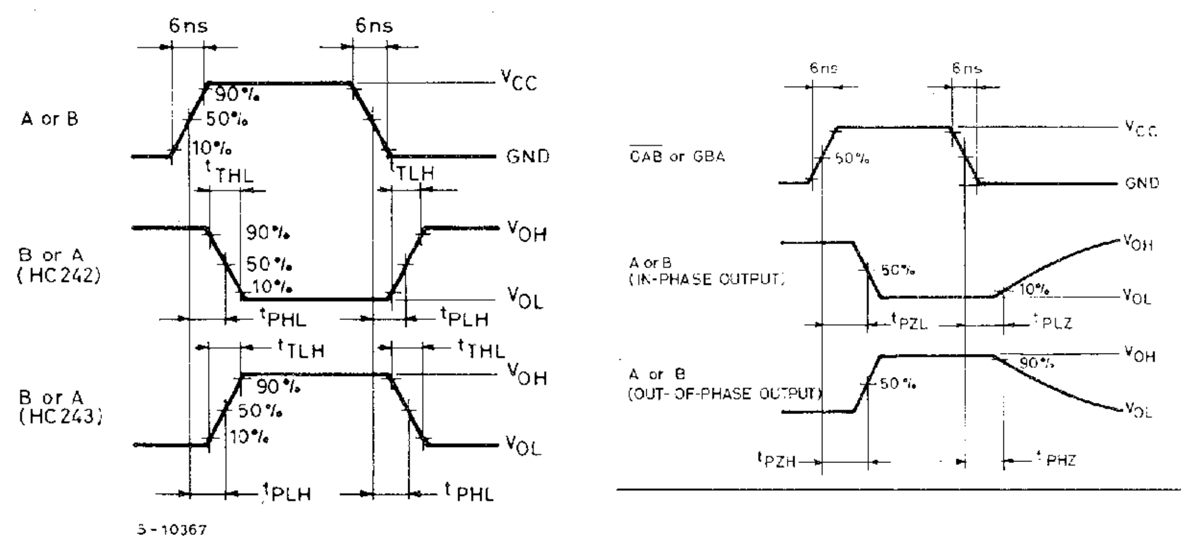
| Symbol | Parameter | Test Conditions | | | Value | | | | | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $V_{CC}$ (V) | | | $T_A$ = 25 °C 54HC and 74HC | | | -40 to 85 °C 74HC | | -55 to 125 °C 54HC | | |
| | | | | | Min. | Typ. | Max. | Min. | Max. | Min. | Max. | |
| $V_{IH}$ | 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 | | |
| $V_{IL}$ | 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 | |
| $V_{OH}$ | High Level Output Voltage | 2.0 | $V_I$ = $V_{IH}$ or $V_{IL}$ | $I_O$=-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 | | $I_O$=-6.0 mA | 4.18 | 4.31 | | 4.13 | | 4.10 | | |
| | | 6.0 | | $I_O$=-7.8 mA | 5.68 | 5.8 | | 5.63 | | 5.60 | | |
| $V_{OL}$ | Low Level Output Voltage | 2.0 | $V_I$ = $V_{IH}$ or $V_{IL}$ | $I_O$= 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 | | $I_O$= 6.0 mA | | 0.17 | 0.26 | | 0.33 | | 0.40 | |
| | | 6.0 | | $I_O$= 7.8 mA | | 0.18 | 0.26 | | 0.33 | | 0.40 | |
| $I_I$ | Input Leakage Current | 6.0 | $V_I$ = $V_{CC}$ or GND | | | | ±0.1 | | ±1 | | ±1 | µA |
| $I_{OZ}$ | 3 State Output Off-state Current | 6.0 | $V_I$ = $V_{IH}$ or $V_{IL}$<br>$V_O$ = $V_{CC}$ or GND | | | | ±0.5 | | ±5 | | ±10 | µA |
| $I_{CC}$ | Quiescent Supply Current | 6.0 | $V_I$ = $V_{CC}$ or GND | | | | 4 | | 40 | | 80 | µA |

## AC ELECTRICAL CHARACTERISTICS (Input $t_r$ = $t_f$ = 6 ns)

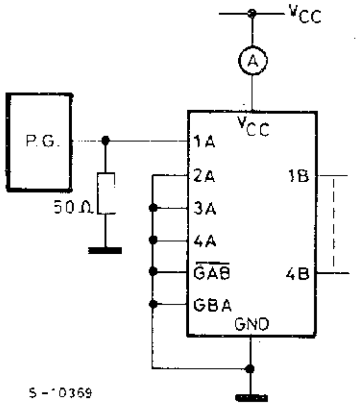
| Symbol | Parameter | Test Conditions | | | Value | | | | | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $V_{CC}$ (V) | $C_L$ (pF) | | $T_A$ = 25 °C 54HC and 74HC | | | -40 to 85 °C 74HC | | -55 to 125 °C 54HC | | |
| | | | | | Min. | Typ. | Max. | Min. | Max. | Min. | Max. | |
| $t_{TLH}$<br>$t_{THL}$ | Output Transition Time | 2.0 | 50 | | | 25 | 60 | | 75 | | 90 | ns |
| | | 4.5 | | | | 7 | 12 | | 15 | | 18 | |
| | | 6.0 | | | | 6 | 10 | | 13 | | 15 | |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay Time | 2.0 | 50 | | | 39 | 90 | | 115 | | 135 | ns |
| | | 4.5 | | | | 13 | 18 | | 23 | | 27 | |
| | | 6.0 | | | | 11 | 15 | | 20 | | 23 | |
| | | 2.0 | 150 | | | 51 | 145 | | 180 | | 220 | ns |
| | | 4.5 | | | | 17 | 29 | | 36 | | 44 | |
| | | 6.0 | | | | 14 | 25 | | 31 | | 37 | |
| $t_{PZL}$<br>$t_{PZH}$ | 3 State Output Enable Time | 2.0 | 50 | $R_L$ = 1 KΩ | | 57 | 145 | | 180 | | 220 | ns |
| | | 4.5 | | | | 18 | 29 | | 36 | | 44 | |
| | | 6.0 | | | | 15 | 25 | | 31 | | 37 | |
| | | 2.0 | 150 | $R_L$ = 1 KΩ | | 70 | 175 | | 220 | | 265 | ns |
| | | 4.5 | | | | 22 | 35 | | 44 | | 53 | |
| | | 6.0 | | | | 19 | 30 | | 37 | | 45 | |
| $t_{PLZ}$<br>$t_{PHZ}$ | 3 State Output Disable Time | 2.0 | 50 | $R_L$ = 1 KΩ | | 45 | 150 | | 190 | | 225 | ns |
| | | 4.5 | | | | 20 | 30 | | 38 | | 45 | |
| | | 6.0 | | | | 17 | 26 | | 32 | | 38 | |
| $C_{IN}$ | Input Capacitance | | | | | 5 | 10 | | 10 | | 10 | pF |
| $C_{PD}$ (*) | Power Dissipation Capacitance | | for HC242<br>for HC243 | | | 30<br>35 | | | | | | pF |

(*) $C_{PD}$ 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 operting current can be obtained by the following equation. $I_{CC}(opr) = C_{PD} \bullet V_{CC} \bullet f_{IN} + I_{CC}$

## SWITCHING CHARACTERISTICS TEST WAVEFORM



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



## $C_{CP}$ CALCULATION

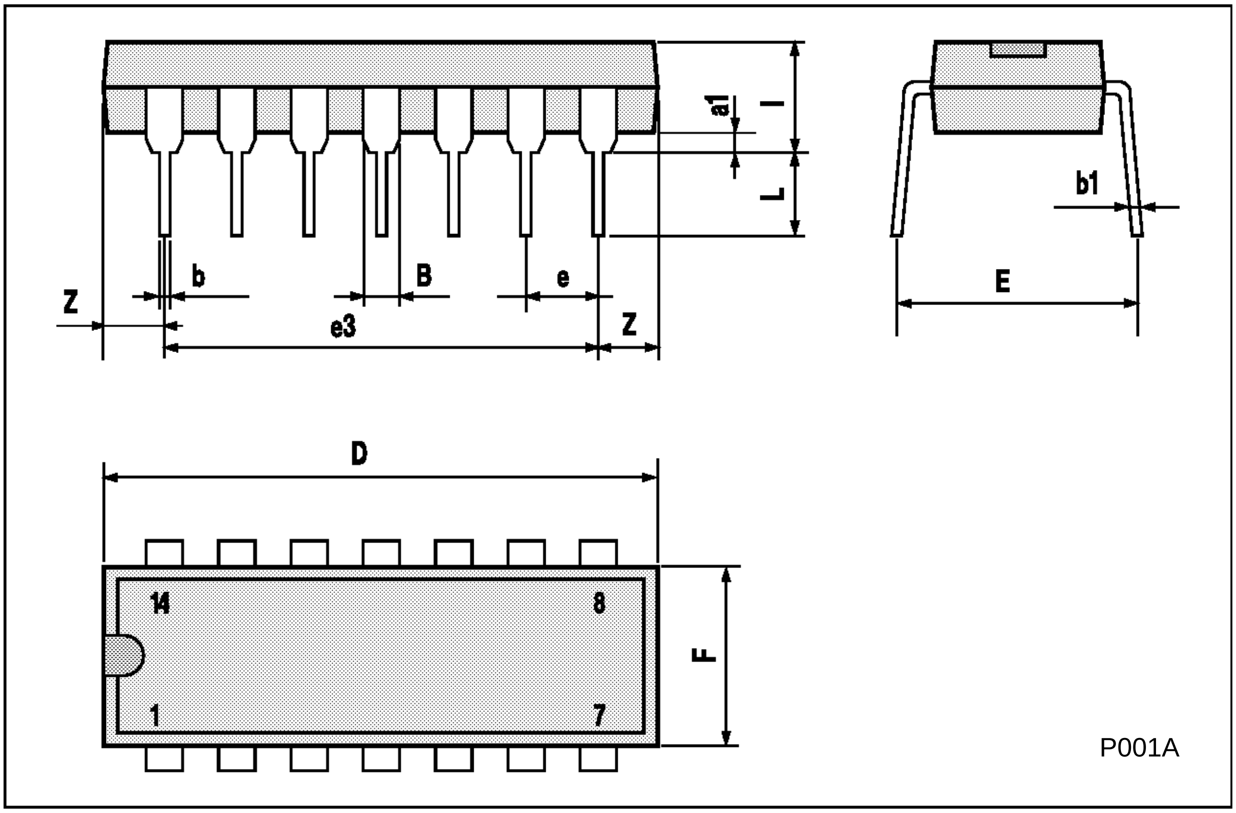
$C_{PD}$ is to be calculated with the following formula by using the measured value of ICC (Opr.) in the test circuit opposite

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

In determining the typical value of CPD, a relatively high frequency of 1MHz was applied to fIN, in order to eliminate any error caused by the quiescent supply current.

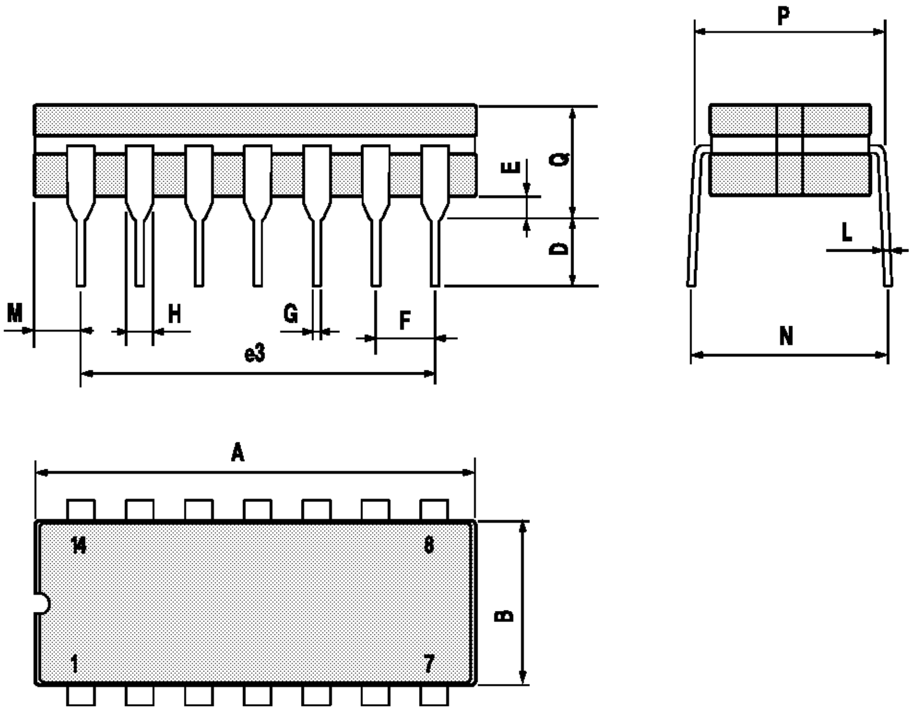
## Plastic DIP14 MECHANICAL DATA

| DIM. | mm | | | inch | | |
|---|---|---|---|---|---|---|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| a1 | 0.51 | | | 0.020 | | |
| B | 1.39 | | 1.65 | 0.055 | | 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 | | 15.24 | | | 0.600 | |
| F | | | 7.1 | | | 0.280 |
| I | | | 5.1 | | | 0.201 |
| L | | 3.3 | | | 0.130 | |
| Z | 1.27 | | 2.54 | 0.050 | | 0.100 |



## Ceramic DIP14/1 MECHANICAL DATA

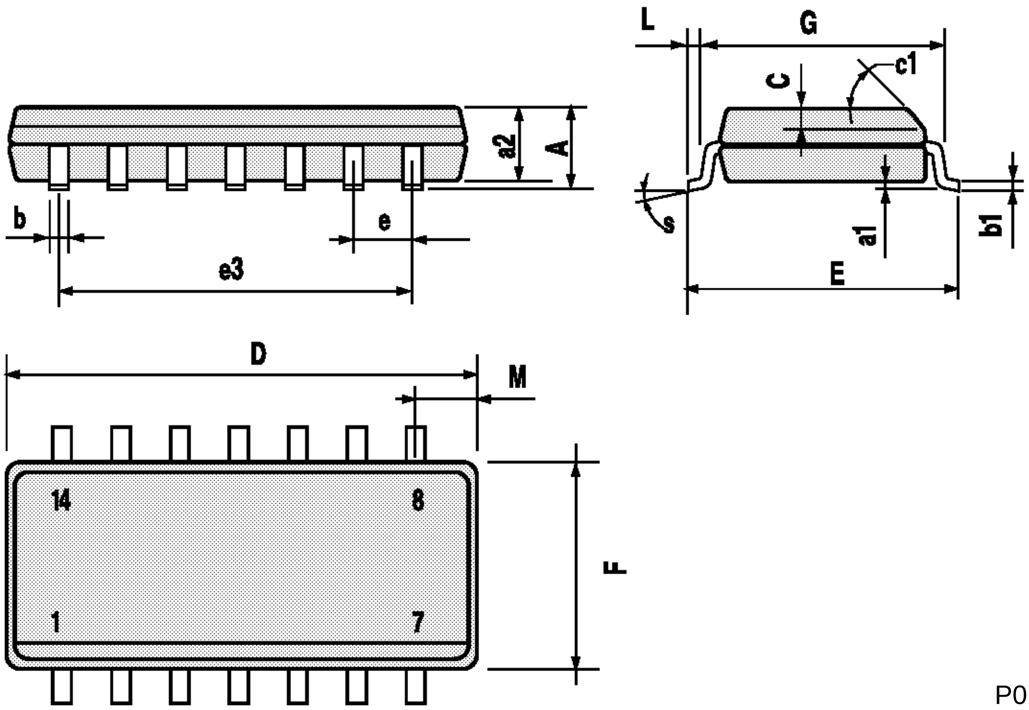
| DIM. | mm |  |  | inch |  |  |
|---|---|---|---|---|---|---|
|  | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A |  |  | 20 |  |  | 0.787 |
| B |  |  | 7.0 |  |  | 0.276 |
| D |  | 3.3 |  |  | 0.130 |  |
| E | 0.38 |  |  | 0.015 |  |  |
| e3 |  | 15.24 |  |  | 0.600 |  |
| F | 2.29 |  | 2.79 | 0.090 |  | 0.110 |
| G | 0.4 |  | 0.55 | 0.016 |  | 0.022 |
| H | 1.17 |  | 1.52 | 0.046 |  | 0.060 |
| L | 0.22 |  | 0.31 | 0.009 |  | 0.012 |
| M | 1.52 |  | 2.54 | 0.060 |  | 0.100 |
| N |  |  | 10.3 |  |  | 0.406 |
| P | 7.8 |  | 8.05 | 0.307 |  | 0.317 |
| Q |  |  | 5.08 |  |  | 0.200 |



P053C

## SO14 MECHANICAL DATA

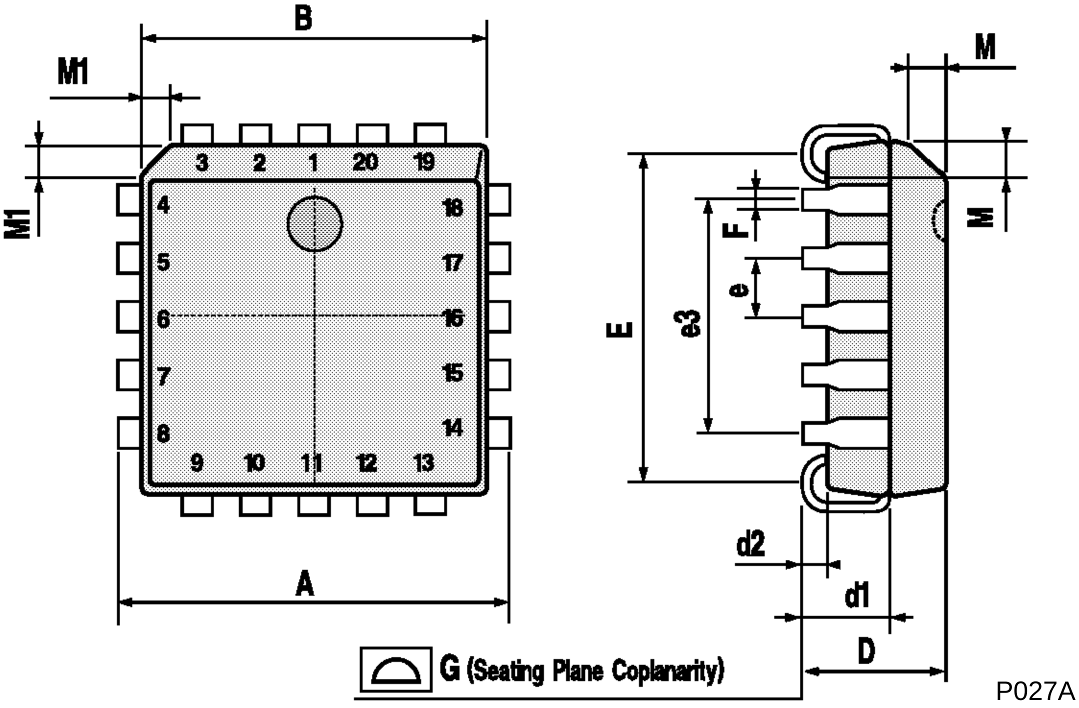
| DIM. | mm | | | inch | | |
|---|---|---|---|---|---|---|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | | 1.75 | | | 0.068 |
| a1 | 0.1 | | 0.2 | 0.003 | | 0.007 |
| a2 | | | 1.65 | | | 0.064 |
| b | 0.35 | | 0.46 | 0.013 | | 0.018 |
| b1 | 0.19 | | 0.25 | 0.007 | | 0.010 |
| C | | 0.5 | | | 0.019 | |
| c1 | 45° (typ.) | | | | | |
| D | 8.55 | | 8.75 | 0.336 | | 0.344 |
| E | 5.8 | | 6.2 | 0.228 | | 0.244 |
| e | | 1.27 | | | 0.050 | |
| e3 | | 7.62 | | | 0.300 | |
| F | 3.8 | | 4.0 | 0.149 | | 0.157 |
| G | 4.6 | | 5.3 | 0.181 | | 0.208 |
| L | 0.5 | | 1.27 | 0.019 | | 0.050 |
| M | | | 0.68 | | | 0.026 |
| S | 8° (max.) | | | | | |



P013G

## 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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