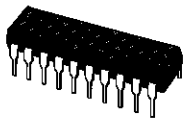
SGS-THOMSON MICROELECTRONICS

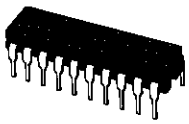
# M54HCT540/541
# M74HCT540/541

## OCTAL BUS BUFFER WITH 3 STATE OUTPUTS
## HCT540: INVERTED - HCT541 NON INVERTED

- HIGH SPEED
  $t_{PD}$ = 10 ns (TYP.) at $V_{CC}$ = 5V
- LOW POWER DISSIPATION
  $I_{CC}$ = 4 µA (MAX.) at $T_A$ = 25 °C
- COMPATIBLE WITH TTL OUTPUTS
  $V_{IH}$ = 2V (MIN.) $V_{IL}$ = 0.8V (MAX.)
- OUTPUT DRIVE CAPABILITY
  15 LSTTL LOADS
- SYMMETRICAL OUTPUT IMPEDANCE
  $|I_{OH}| = I_{OL}$ = 6 mA (MIN)
- BALANCED PROPAGATION DELAYS
  $t_{PLH} = t_{PHL}$
- PIN AND FUNCTION COMPATIBLE
  WITH 54/74LS540/541



**B1R**
(Plastic Package)



**F1R**
(Ceramic Package)

**M1R**
(Micro Package)

**C1R**
(Chip Carrier)

**ORDER CODES :**

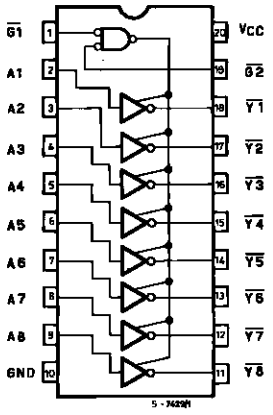
M54HCTXXXF1R M74HCTXXXM1R
M74HCTXXXB1R M74HCTXXXC1R

### DESCRIPTION

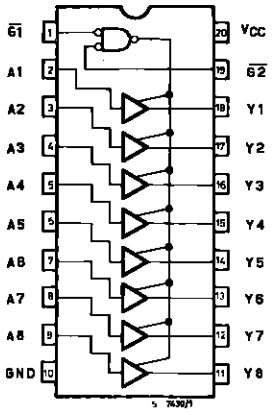
The M54/74HCT540 and HCT541 are high speed CMOS OCTAL BUS BUFFERS (3-STATE) fabricated in silicon gate $C^2MOS$ technology. They have the same high speed performance of LSTTL combined with true CMOS low power consumption. The HCT540 is an inverting buffer and HCT541 is a non inverting buffer.
The 3 STATE control gate operates as a two input AND such that if either $\overline{G1}$ and $\overline{G2}$ are high, all eight outputs are in the high impedance state. In order to enhance PC board layout, the HCT540 and HCT541 offers a pinout having inputs and outputs on opposite sides of the package. All inputs are equipped with protection circuits against static discharge and transient excess voltage.
This integrated circuit has input and output characteristics that are fully compatible with 54/74 LSTTL logic families. M54/74HCT devices are designed to directly interface $HSC^2MOS$ systems with TTL and NMOS components. They are also plug in replacements for LSTTL devices giving a reduction of power consumption.
IT IS PROHIBITED TO APPLY A SIGNAL TO BUS TERMINAL WHEN IT IS IN OUTPUT MODE. 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)

**HCT540**

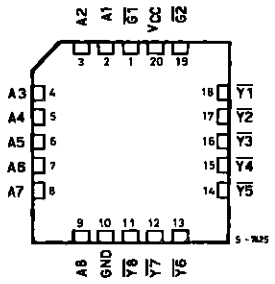



**HCT541**

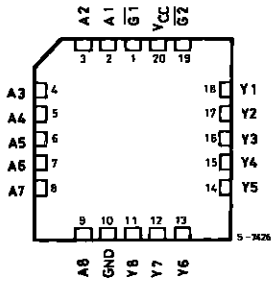


## CHIP CARRIER

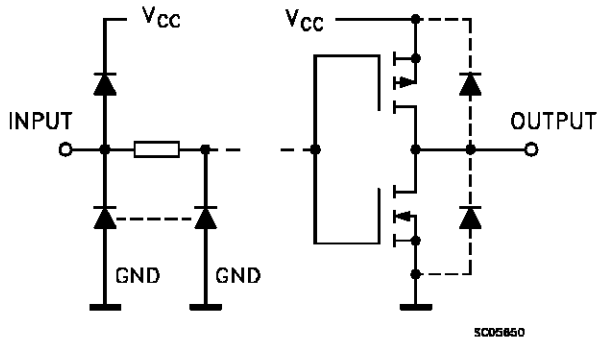
HCT540




HCT541




## INPUT AND OUTPUT EQUIVALENT CIRCUIT



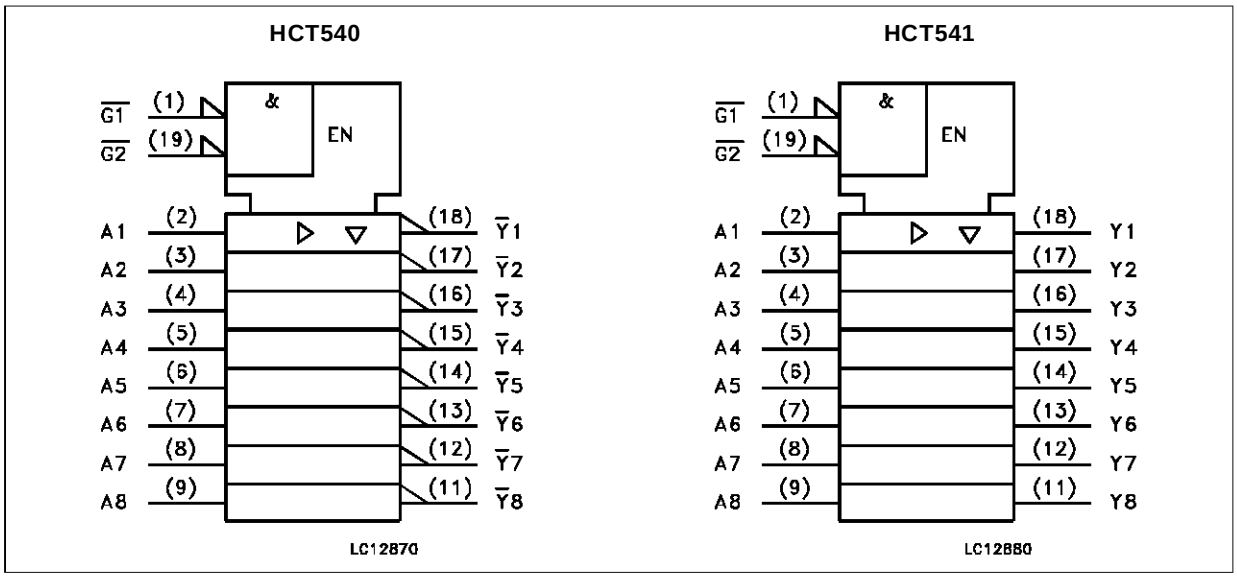

## PIN DESCRIPTION (HCT540)

| PIN No | SYMBOL | NAME AND FUNCTION |
|---|---|---|
| 1, 19 | $\overline{G1}$, $\overline{G2}$ | Output Enable Inputs |
| 2, 3, 4, 5, 6, 7, 8, 9 | A1 to A8 | Data Inputs |
| 18, 17, 16, 15, 14, 13, 11, 12 | $\overline{Y1}$ to $\overline{Y8}$ | Bus Outputs |
| 10 | GND | Ground (0V) |
| 20 | $V_{CC}$ | Positive Supply Voltage |

## PIN DESCRIPTION (HCT541)

| PIN No | SYMBOL | NAME AND FUNCTION |
|---|---|---|
| 1, 19 | $\overline{G1}$, $\overline{G2}$ | Output Enable Inputs |
| 2, 3, 4, 5, 6, 7, 8, 9 | A1 to A8 | Data Inputs |
| 18, 17, 16, 15, 14, 13, 11, 12 | Y1 to Y8 | Bus Outputs |
| 10 | GND | Ground (0V) |
| 20 | $V_{CC}$ | Positive Supply Voltage |

## IEC LOGIC SYMBOLS

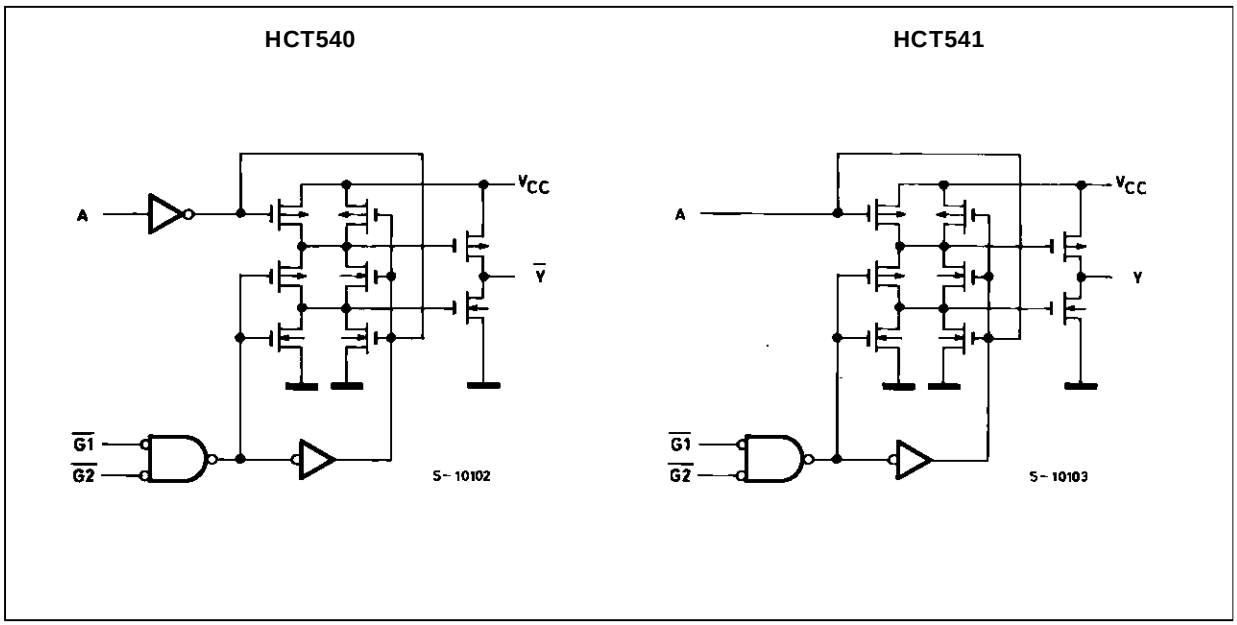



## TRUTH TABLE

| INPUT | | | OUTPUT | |
|---|---|---|---|---|
| $\overline{G1}$ | $\overline{G2}$ | An | $\overline{Yn}$ (HCT540) | Yn (HCT541) |
| H | X | X | Z | Z |
| X | H | X | Z | Z |
| L | L | H | L | H |
| L | L | L | H | L |

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

## CIRCUIT SCHEMATIC (Per Circuit)



## 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 | °C |
| $T_L$ | Lead Temperature (10 sec) | 300 | °C |

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions 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 |
|---|---|---|---|
| $V_{CC}$ | Supply Voltage | 4.5 to 5.5 | 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 ($V_{CC}$ = 4.5 to 5.5V) | 0 to 500 | ns |

## 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 | 4.5 to 5.5 | | | 2.0 | | | 2.0 | | 2.0 | | V |
| $V_{IL}$ | Low Level Input Voltage | 4.5 to 5.5 | | | | | 0.8 | | 0.8 | | 0.8 | V |
| $V_{OH}$ | High Level Output Voltage | 4.5 | $V_I$ = $V_{IH}$ or $V_{IL}$ | $I_O$=-20 µA | 4.4 | 4.5 | | 4.4 | | 4.4 | | V |
| | | | | $I_O$=-6.0 mA | 4.18 | 4.31 | | 4.13 | | 4.10 | | |
| $V_{OL}$ | Low Level Output Voltage | 4.5 | $V_I$ = $V_{IH}$ or $V_{IL}$ | $I_O$= 20 µA | | 0.0 | 0.1 | | 0.1 | | 0.1 | V |
| | | | | $I_O$= 6.0 mA | | 0.17 | 0.26 | | 0.33 | | 0.4 | |
| $I_I$ | Input Leakage Current | 5.5 | $V_I$ = $V_{CC}$ or GND | | | | ±0.1 | | ±1 | | ±1 | µA |
| $I_{OZ}$ | 3 State Output Off State Current | 5.5 | $V_I$ = $V_{IH}$ or $V_{IL}$ $V_O$ = $V_{CC}$ or GND | | | | ±0.5 | | ±5 | | ±10 | µA |
| $I_{CC}$ | Quiescent Supply Current | 5.5 | $V_I$ = $V_{CC}$ or GND | | | | 4 | | 40 | | 80 | µA |
| $\Delta I_{CC}$ | Additional worst case supply current | 5.5 | Per Input pin $V_I$ = 0.5V or $V_I$ = 2.4V Other Inputs at $V_{CC}$ or GND | | | | 2.0 | | 2.9 | | 3.0 | mA |

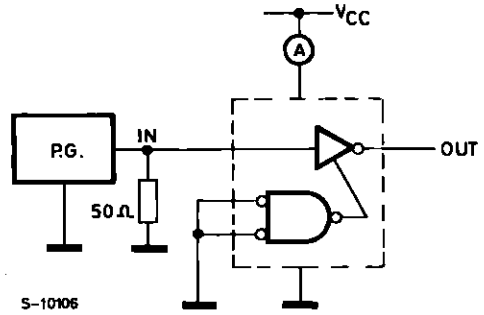
## AC ELECTRICAL CHARACTERISTICS ($C_L$ = 50 pF, Input $t_r = t_f$ = 6 ns)

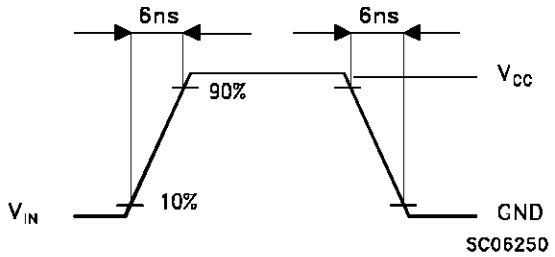
| Symbol | Parameter | Test Conditions | | | Value | | | | | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $V_{CC}$ (V) | $C_L$ (pF) | | $T_A$ = 25 °C 54HC and 74HC | | | -40 to 85 °C 74HC | | -55 to 125 °C 54HC | | |
| | | | | | Min. | Typ. | Max. | Min. | Max. | Min. | Max. | |
| $t_{TLH}$ $t_{THL}$ | Output Transition Time | 4.5 | 50 | | | 6 | 12 | | 15 | | 18 | ns |
| $t_{PLH}$ $t_{PHL}$ | Propagation Delay Time (for HCT540) | 4.5 | 50 | | | 12 | 20 | | 25 | | 30 | ns |
| | | 4.5 | 150 | | | 16 | 25 | | 31 | | 38 | ns |
| $t_{PLH}$ $t_{PHL}$ | Propagation Delay Time (for HCT541) | 4.5 | 50 | | | 14 | 23 | | 29 | | 35 | ns |
| | | 4.5 | 150 | | | 18 | 28 | | 35 | | 42 | ns |
| $t_{PZL}$ $t_{PZH}$ | Output Enable Time | 4.5 | 50 | $R_L$ = 1KΩ | | 18 | 30 | | 38 | | 45 | ns |
| | | 4.5 | 150 | $R_L$ = 1KΩ | | 22 | 34 | | 43 | | 51 | ns |
| $t_{PLZ}$ $t_{PHZ}$ | Output Disable Time | 4.5 | 50 | $R_L$ = 1KΩ | | 19 | 27 | | 34 | | 41 | ns |
| $C_{IN}$ | Input Capacitance | | | | | 5 | 10 | | 10 | | 10 | pF |
| $C_{PD}$ (*) | Power Dissipation Capacitance | | | | | 34 | | | | | | 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. $I_{CC}(opr) = C_{PD} \bullet V_{CC} \bullet f_{IN} + I_{CC}/8$ (per gate)

## TEST CIRCUIT Icc (Opr.)

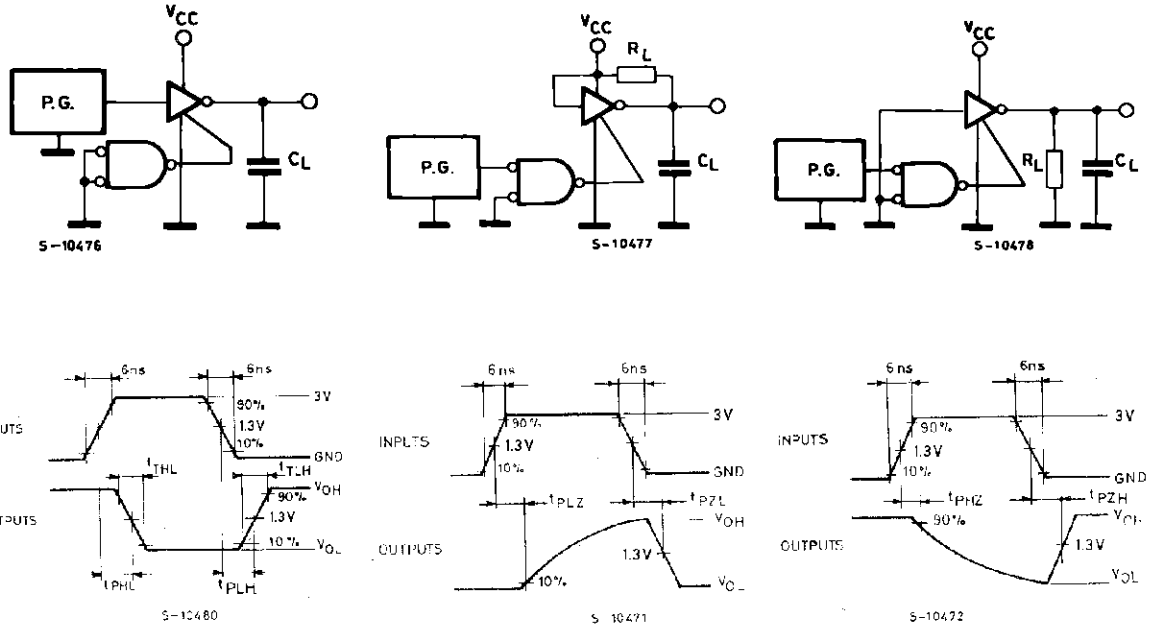
**HCT540**



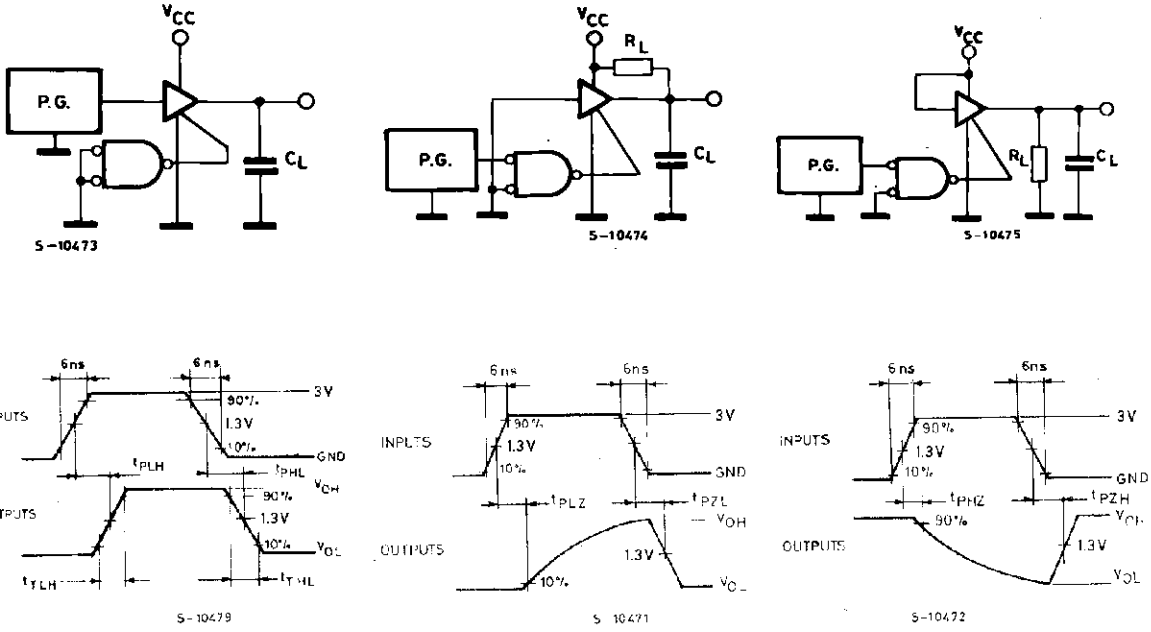



## SWITCHING CHARACTERISTICS TEST CIRCUIT

**HCT540**

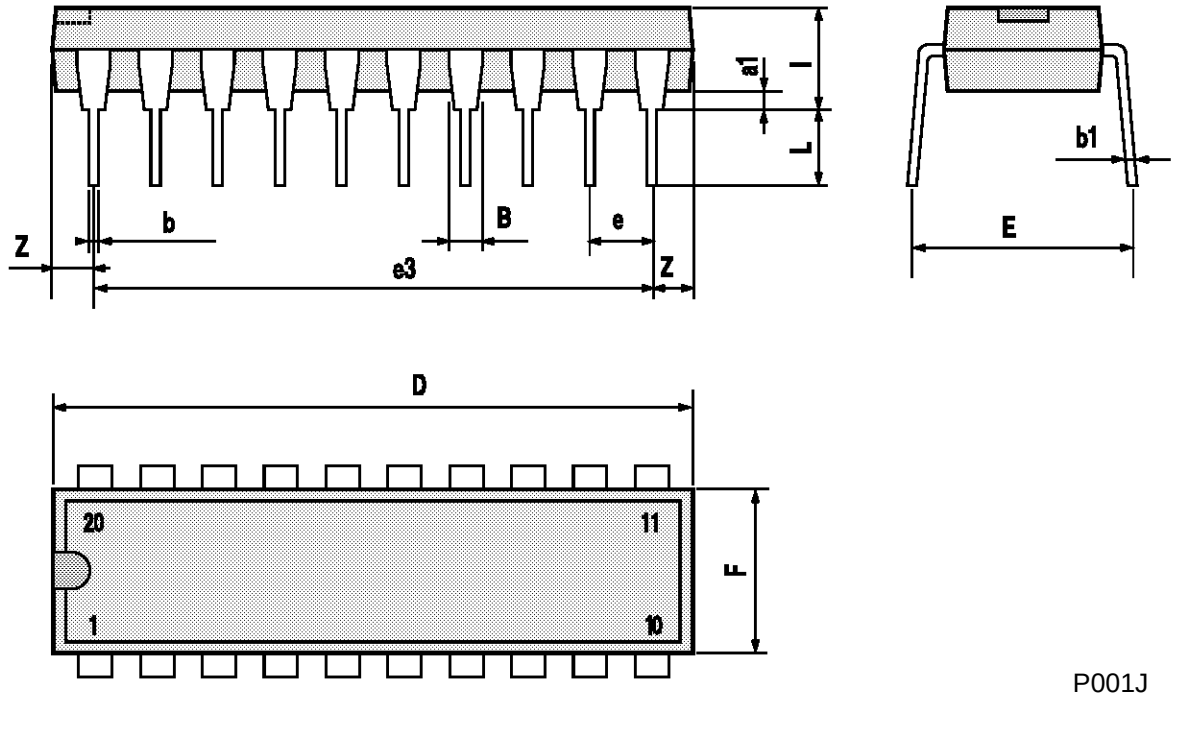



**HCT541**



## Plastic DIP20 (0.25) MECHANICAL DATA

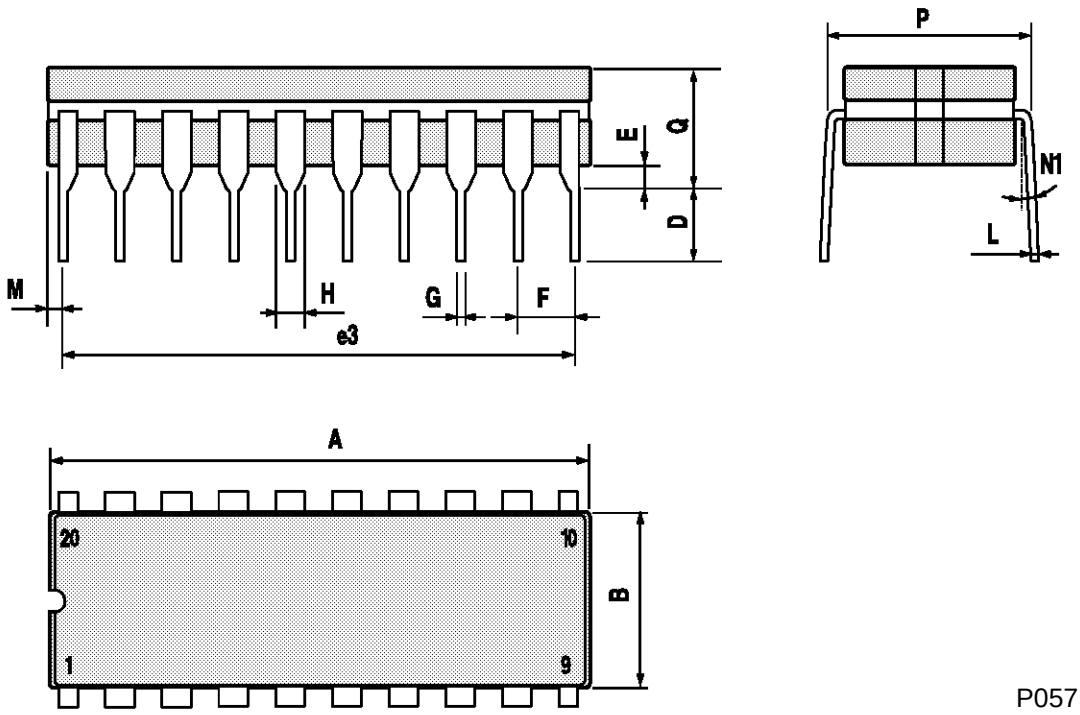
| DIM. | mm | | | inch | | |
|---|---|---|---|---|---|---|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| a1 | 0.254 | | | 0.010 | | |
| B | 1.39 | | 1.65 | 0.055 | | 0.065 |
| b | | 0.45 | | | 0.018 | |
| b1 | | 0.25 | | | 0.010 | |
| D | | | 25.4 | | | 1.000 |
| E | | 8.5 | | | 0.335 | |
| e | | 2.54 | | | 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 |




P001J

## Ceramic DIP20 MECHANICAL DATA

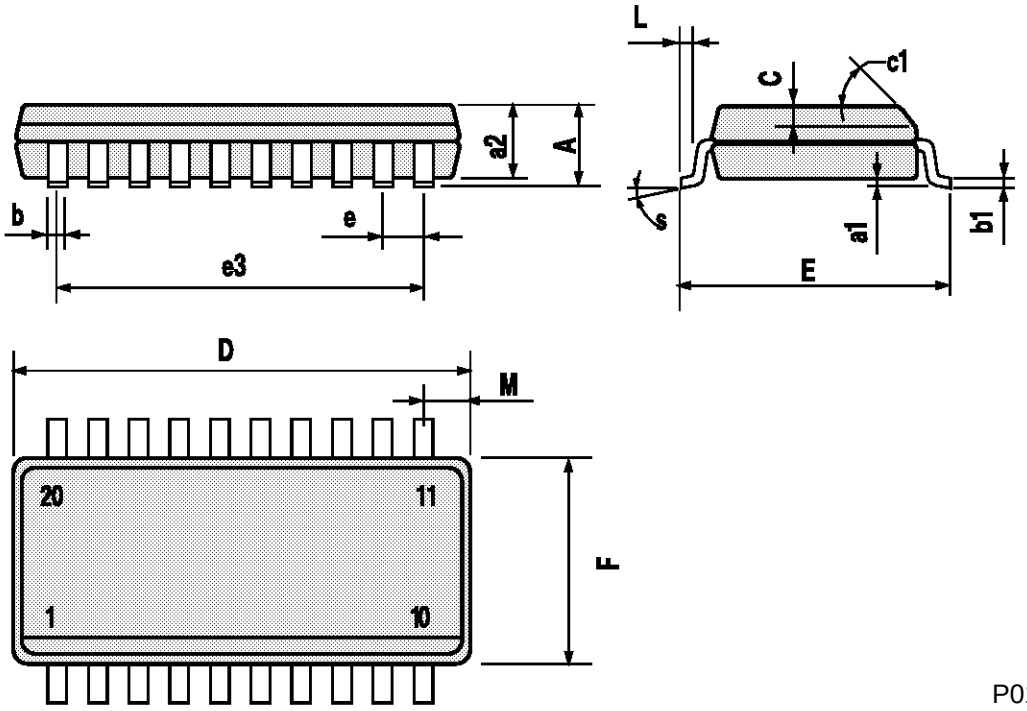
| DIM. | mm | | | inch | | |
|---|---|---|---|---|---|---|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | | 25 | | | 0.984 |
| B | | | 7.8 | | | 0.307 |
| D | | 3.3 | | | 0.130 | |
| E | 0.5 | | 1.78 | 0.020 | | 0.070 |
| e3 | | 22.86 | | | 0.900 | |
| F | 2.29 | | 2.79 | 0.090 | | 0.110 |
| G | 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 |




P057H

## SO20 MECHANICAL DATA

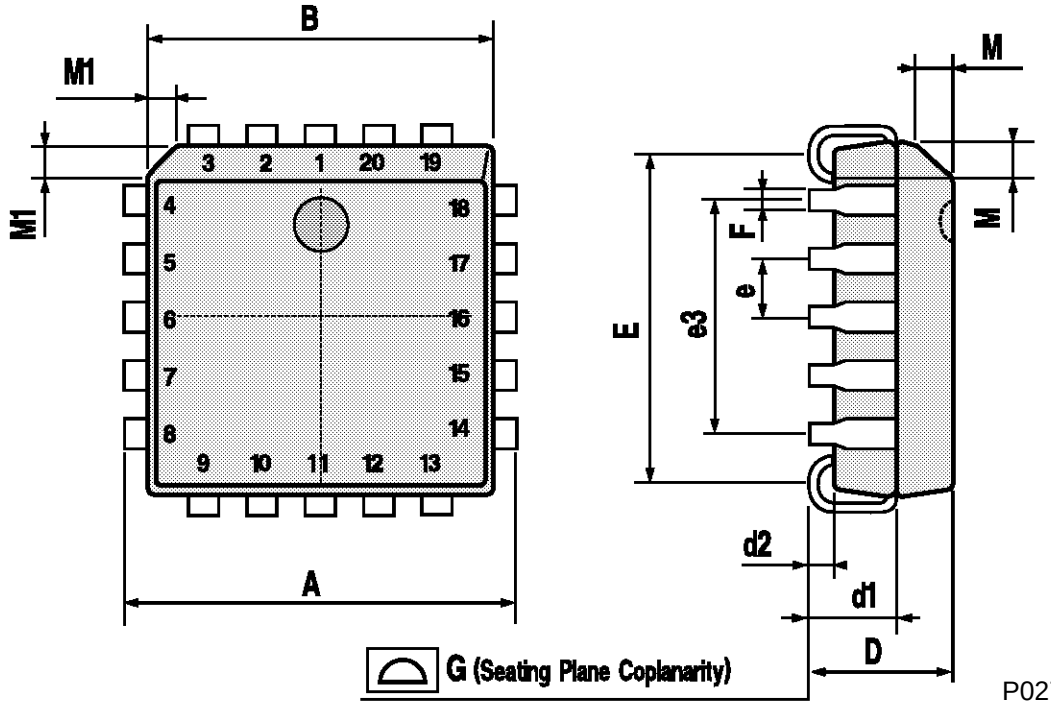
| DIM. | mm | | | inch | | |
|---|---|---|---|---|---|---|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | | 2.65 | | | 0.104 |
| a1 | 0.10 | | 0.20 | 0.004 | | 0.007 |
| a2 | | | 2.45 | | | 0.096 |
| b | 0.35 | | 0.49 | 0.013 | | 0.019 |
| b1 | 0.23 | | 0.32 | 0.009 | | 0.012 |
| C | | 0.50 | | | 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 | |




P027A

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