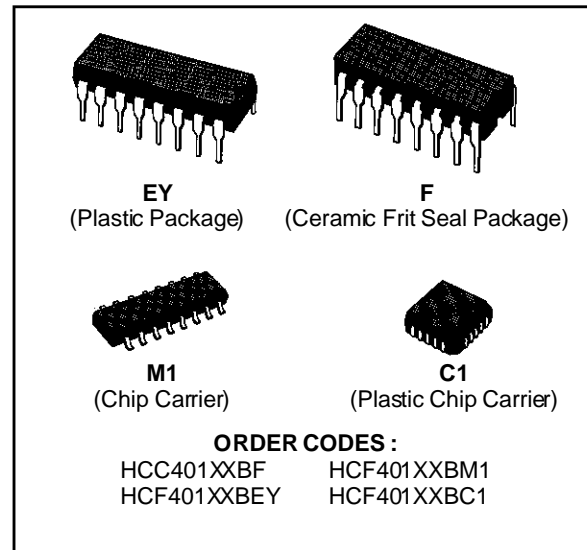


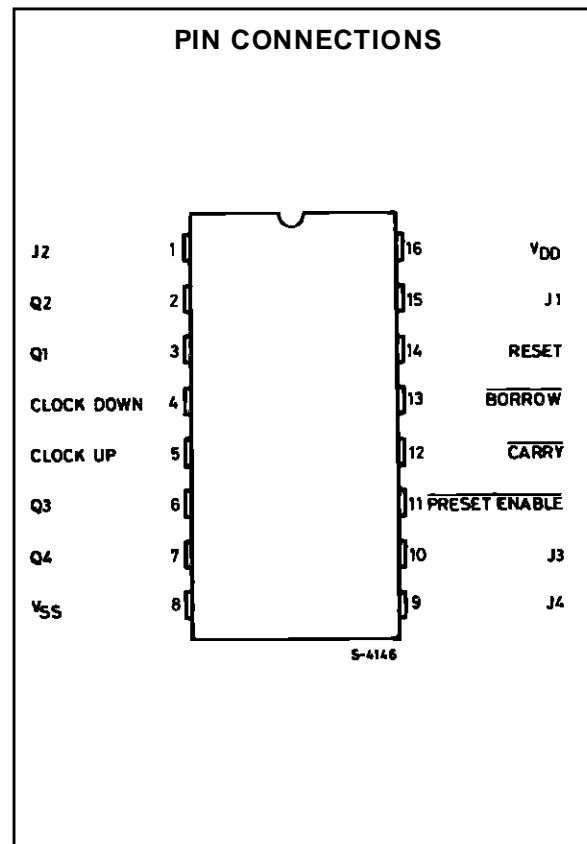
PRESETTABLE UP/DOWN COUNTERS (DUAL CLOCK WITH RESET) 40192B – BCD TYPE 40193B – BINARY TYPE

- INDIVIDUAL CLOCK LINES FOR COUNTING UP OR COUNTING DOWN
- SYNCHRONOUS HIGH-SPEED CARRY AND BORROW PROPAGATION DELAYS FOR CASCADING
- ASYNCHRONOUS RESET AND PRESET CAPABILITY
- MEDIUM-SPEED OPERATION - $f_{CL} = 8\text{MHz}$ (typ.) @ 10V
- STANDARDIZED SYMMETRICAL OUTPUT CHARACTERISTICS
- 5V, 10V, AND 15V PARAMETRIC RATINGS
- INPUT CURRENT OF 100nA AT 18V AND 25°C FOR HCC DEVICE
- 100% TESTED FOR QUIESCENT CURRENT
- MEETS ALL REQUIREMENTS OF JEDEC TENTATIVE STANDARD N° 13A, "STANDARD SPECIFICATIONS FOR DESCRIPTION OF "B" SERIES CMOS DEVICES"



DESCRIPTION

The **HCC40192B**, **HCC40193B**, (extended temperature range) and the **HCF40192B**, **HCF40193B** (intermediate temperature range) are monolithic integrated circuits, available in 16-lead dual in-line plastic or ceramic package and plastic micro package. The **HCC/HCF40192B** Presettable BCD Up/Down Counter and the **HCC/HCF40193B** Presettable Binary Up/Down Counter each consist of 4 synchronously clocked, gated "D" type flip-flops connected as a counter. The inputs consist of 4 individual jam lines, a PRESET ENABLE control, individual CLOCK UP and CLOCK DOWN signals and a master RESET. Four buffered Q signal outputs as well as CARRY and BORROW outputs for multiple-stage counting schemes are provided. The counter is cleared so that all outputs are in a low state by a high on the RESET line. A RESET is accomplished asynchronously with the clock. Each output is individually programmable asynchronously with the clock to the level on the corresponding jam input when the PRESET ENABLE control is low. The counter counts up one count on the positive clock edge of the CLOCK UP signal provided the CLOCK DOWN line is high. The counter counts down one count on the positive clock edge of the CLOCK DOWN signal provided the CLOCK UP line

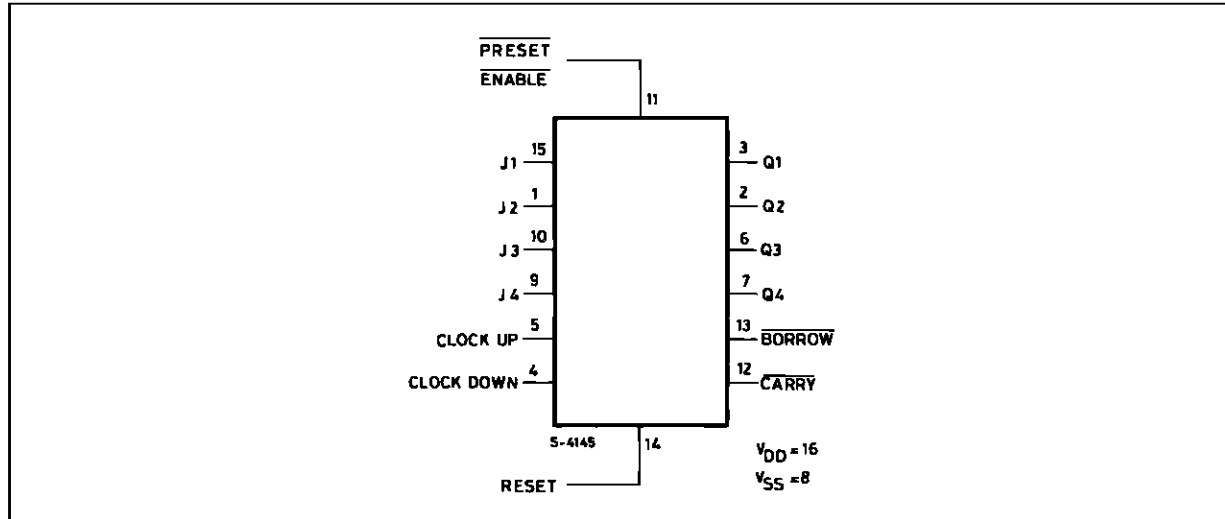


HCC/HCF40192B/193B

is high. The $\overline{\text{CARRY}}$ and $\overline{\text{BORROW}}$ signals are high when the counter is counting up or down. The CARRY signal goes low one-half clock cycle after the counter reaches its maximum count in the count-up mode. The BORROW signal goes low one-half clock cycle after the counter reaches its minimum

count in the count-down mode. Cascading of multiple packages is easily accomplished without the need for additional external circuitry by tying the BORROW and CARRY outputs to the CLOCK DOWN and CLOCK UP inputs, respectively, of the succeeding package.

FUNCTIONAL DIAGRAM



ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
|------------|---|--------------------------------|--------------------|
| V_{DD}^* | Supply Voltage : HCC Types HCF Types | - 0.5 to + 20 - 0.5 to + 18 | V |
| V_i | Input Voltage | - 0.5 to $V_{DD} + 0.5$ | V |
| I_i | DC Input Current (any one input) | ± 10 | mA |
| P_{tot} | Total Power Dissipation (per package) Dissipation per Output Transistor for T_{op} = Full Package-temperature Range | 200 100 | mW |
| T_{op} | Operating Temperature : HCC Types HCF Types | - 55 to + 125 - 40 to + 85 | $^{\circ}\text{C}$ |
| T_{stg} | Storage Temperature | - 65 to + 150 | $^{\circ}\text{C}$ |

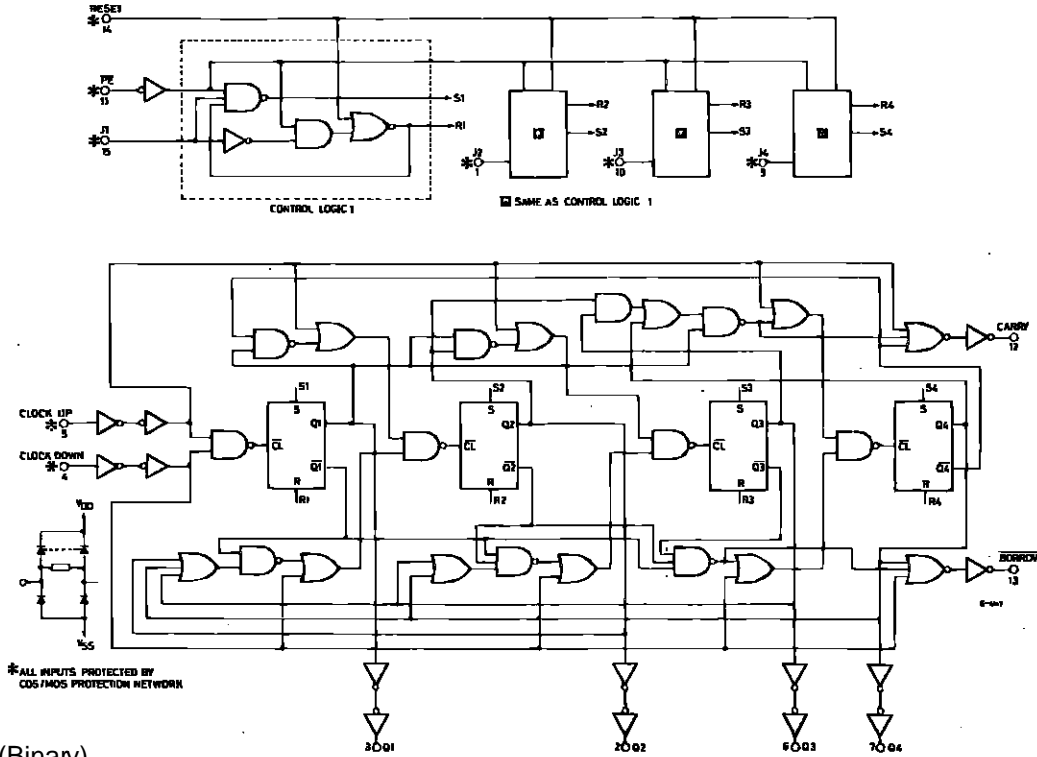
Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for external periods may affect device reliability.
* All voltages are with respect to V_{SS} (GND).

RECOMMENDED OPERATING CONDITIONS

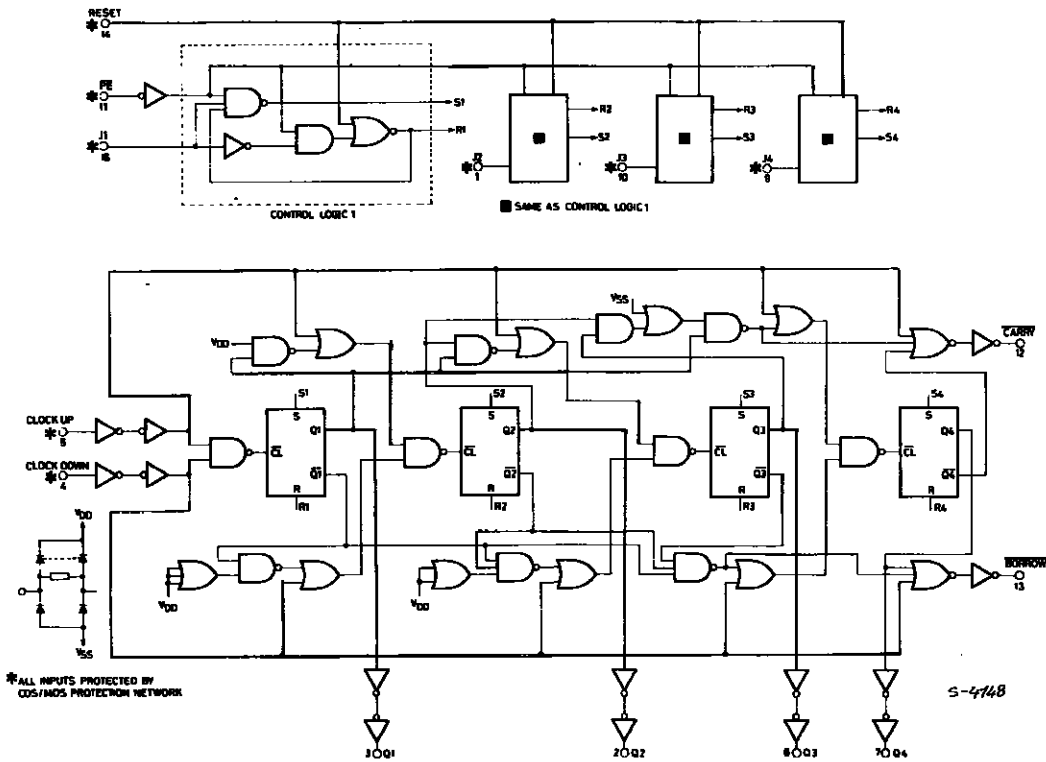
| Symbol | Parameter | Value | Unit |
|----------|--|-------------------------------|--------------------|
| V_{DD} | Supply Voltage : HCC Types HCF Types | 3 to 18 3 to 15 | V |
| V_i | Input Voltage | 0 to V_{DD} | V |
| T_{op} | Operating Temperature : HCC Types HCF Types | - 55 to + 125 - 40 to + 85 | $^{\circ}\text{C}$ |

LOGIC DIAGRAMS

40192B (BCD).

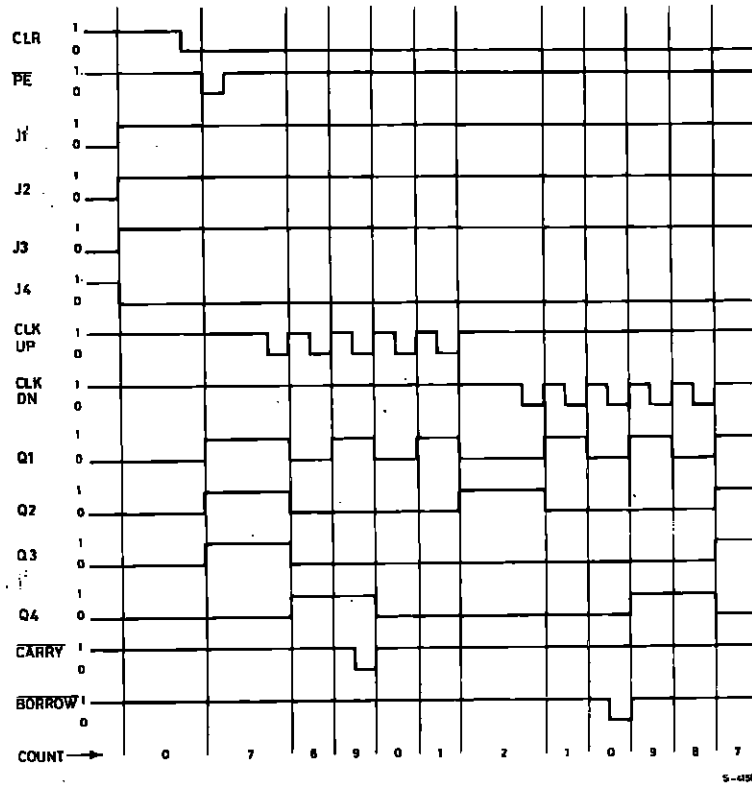


40193B (Binary).

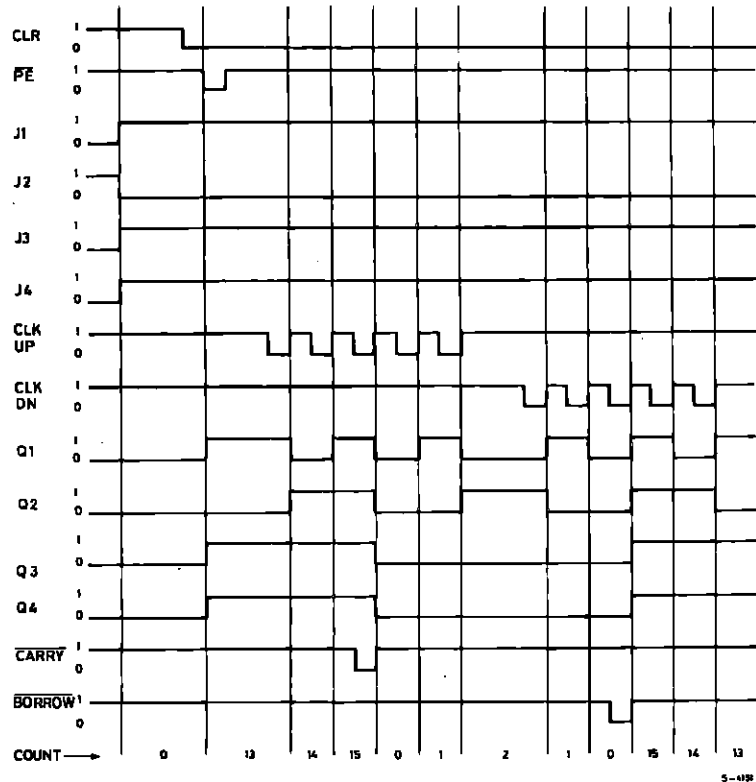


TIMING DIAGRAMS

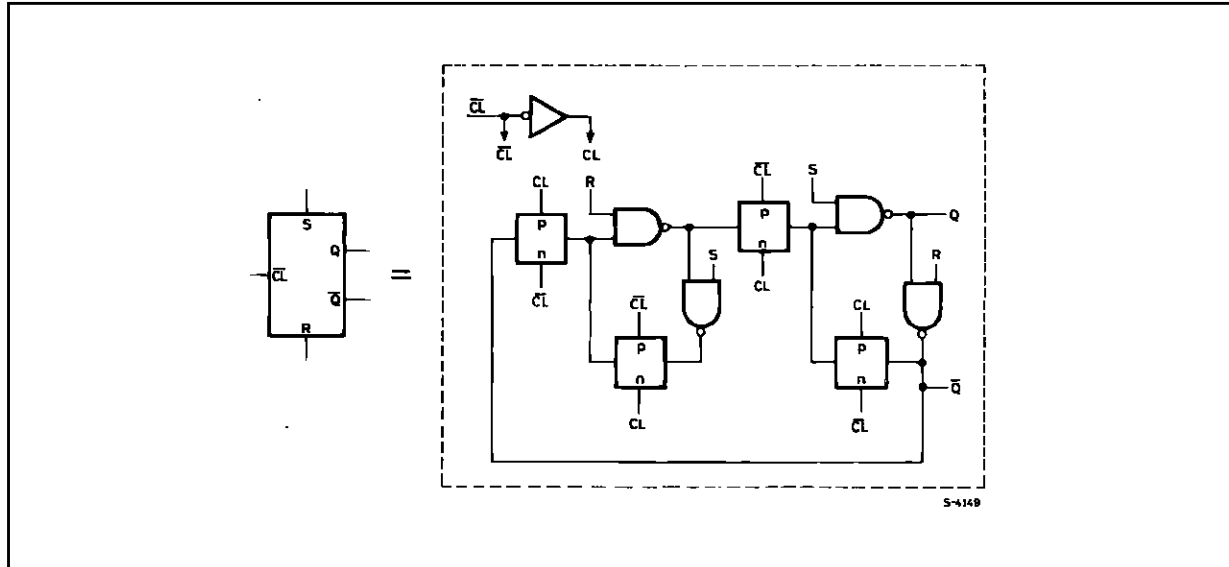
40192B (BCD).



40193B (Binary).



Internal Logic of Flip-flop.



TRUTH TABLE

| Clock Up | Clock Down | <u>Preset Enable</u> | Reset | Action |
|----------|------------|----------------------|-------|------------|
| | 1 | 1 | 0 | Count Up |
| | 1 | 1 | 0 | No Count |
| 1 | | 1 | 0 | Count Down |
| 1 | | 1 | 0 | No Count |
| X | X | 0 | 0 | Preset |
| X | X | X | 1 | Reset |

1 = High Level 0 = Low Level X = Don't Care.

STATIC ELECTRICAL CHARACTERISTICS (over recommended operating conditions)

| Symbol | Parameter | | Test Conditions | | | | Value | | | | | | Unit | |
|-----------------------------------|-----------------------|-----------|-----------------------|-----------------------|--------------------------------|------------------------|--------------------|-----------|--------|------------------------|-----------|---------------------|---------|---------|
| | | | V _I (V) | V _O (V) | I _O (μ A) | V _{DD} (V) | T _{Low} * | | 25°C | | | T _{High} * | | |
| | | | | | | | Min. | Max. | Min. | Typ. | Max. | Min. | | Max. |
| I _L | Quiescent Current | HCC Types | 0/ 5 | | | 5 | | 5 | | 0.04 | 5 | | 150 | μ A |
| | | | 0/10 | | | 10 | | 10 | | 0.04 | 10 | | 300 | |
| | | | 0/15 | | | 15 | | 20 | | 0.04 | 20 | | 600 | |
| | | | 0/20 | | | 20 | | 100 | | 0.08 | 100 | | 3000 | |
| | | HCF Types | 0/ 5 | | | 5 | | 20 | | 0.04 | 20 | | 150 | |
| | | | 0/10 | | | 10 | | 40 | | 0.04 | 40 | | 300 | |
| V _{OH} | Output High Voltage | | 0/ 5 | | < 1 | 5 | | 4.95 | | 4.95 | | 4.95 | V | |
| | | | 0/10 | | < 1 | 10 | | 9.95 | | 9.95 | | 9.95 | | |
| | | | 0/15 | | < 1 | 15 | | 14.95 | | 14.95 | | 14.95 | | |
| V _{OL} | Output Low Voltage | | 5/0 | | < 1 | 5 | | 0.05 | | 0.05 | | 0.05 | V | |
| | | | 10/0 | | < 1 | 10 | | 0.05 | | 0.05 | | 0.05 | | |
| | | | 15/0 | | < 1 | 15 | | 0.05 | | 0.05 | | 0.05 | | |
| V _{IH} | Input High Voltage | | | 0.5/4.5 | < 1 | 5 | | 3.5 | | 3.5 | | 3.5 | V | |
| | | | | 1/9 | < 1 | 10 | | 7 | | 7 | | 7 | | |
| | | | | 1.5/13.5 | < 1 | 15 | | 11 | | 11 | | 11 | | |
| V _{IL} | Input Low Voltage | | | 4.5/0.5 | < 1 | 5 | | 1.5 | | 1.5 | | 1.5 | V | |
| | | | | 9/1 | < 1 | 10 | | 3 | | 3 | | 3 | | |
| | | | | 13.5/1.5 | < 1 | 15 | | 4 | | 4 | | 4 | | |
| I _{OH} | Output Drive Current | HCC Types | 0/ 5 | 2.5 | | 5 | - 2 | | - 1.6 | - 3.2 | | - 1.15 | mA | |
| | | | 0/ 5 | 4.6 | | 5 | - 0.64 | | - 0.51 | - 1 | | - 0.36 | | |
| | | | 0/10 | 9.5 | | 10 | - 1.6 | | - 1.3 | - 2.6 | | - 0.9 | | |
| | | | 0/15 | 13.5 | | 15 | - 4.2 | | - 3.4 | - 6.8 | | - 2.4 | | |
| | | HCF Types | 0/ 5 | 2.5 | | 5 | - 1.53 | | - 1.36 | - 3.2 | | - 1.1 | | |
| | | | 0/ 5 | 4.6 | | 5 | - 0.52 | | - 0.44 | - 1 | | - 0.36 | | |
| I _{OL} | Output Sink Current | HCC Types | 0/ 5 | 0.4 | | 5 | 0.64 | | 0.51 | 1 | | 0.36 | mA | |
| | | | 0/10 | 0.5 | | 10 | 1.6 | | 1.3 | 2.6 | | 0.9 | | |
| | | | 0/15 | 1.5 | | 15 | 4.2 | | 3.4 | 6.8 | | 2.4 | | |
| | | HCF Types | 0/ 5 | 0.4 | | 5 | 0.52 | | 0.44 | 1 | | 0.36 | | |
| | | | 0/10 | 0.5 | | 10 | 1.3 | | 1.1 | 2.6 | | 0.9 | | |
| | | | 0/15 | 1.5 | | 15 | 3.6 | | 3.0 | 6.8 | | 2.4 | | |
| I _{IH} , I _{IL} | Input Leakage Current | HCC Types | 0/18 | Any Input | | 18 | | \pm 0.1 | | \pm 10 ⁻⁵ | \pm 0.1 | | \pm 1 | μ A |
| | | HCF Types | 0/15 | Any Input | | 15 | | \pm 0.3 | | \pm 10 ⁻⁵ | \pm 0.3 | | \pm 1 | |
| C _I | Input Capacitance | | Any Input | | | | | | 5 | 7.5 | | | pF | |

* T_{Low} = - 55°C for HCC device : - 40°C for HCF device.

* T_{High} = + 125°C for HCC device : + 85°C for HCF device.

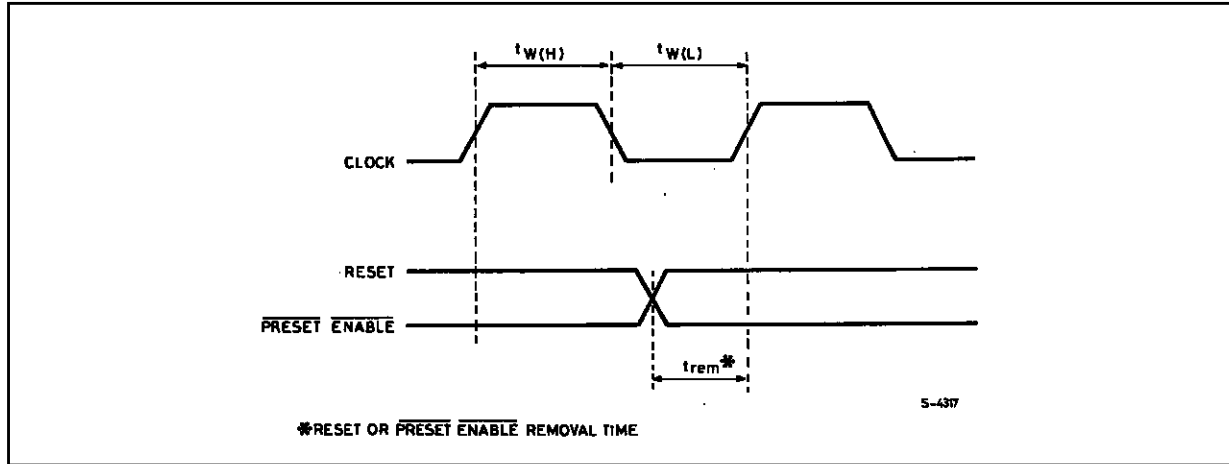
The Noise Margin for both "1" and "0" level is : 1V min. with V_{DD} = 5V, 2V min. with V_{DD} = 10V, 2.5V min. with V_{DD} =

DYNAMIC ELECTRICAL CHARACTERISTICS ($T_{amb} = 25^{\circ}\text{C}$, $C_L = 50\text{pF}$, $R_L = 200\text{k}\Omega$, typical temperature coefficient for all V_{DD} values is $0.3\%/^{\circ}\text{C}$, all input rise and fall time = 20ns)

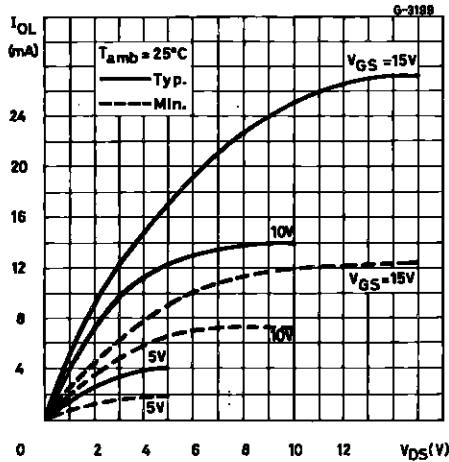
| Symbol | Parameter | Test Conditions | | Value | | | Unit | |
|--------------------------|--|-------------------------------|--------------|-------|------|------|------|---------------|
| | | | V_{DD} (V) | Min. | Typ. | Max. | | |
| t_{PHL} , t_{PLH} | Propagation Delay Time Clock Up or Clock Down to Q Reset to Q | | 5 | | 250 | 500 | ns | |
| | | | 10 | | 120 | 240 | | |
| | | | 15 | | 90 | 180 | | |
| | \overline{PE} to Q | | 5 | | 200 | 400 | ns | |
| | | | 10 | | 100 | 200 | | |
| | | | 15 | | 70 | 140 | | |
| | Clock Up to \overline{Carry} Clock Down to \overline{Borrow} | | 5 | | 160 | 320 | ns | |
| | | | 10 | | 80 | 160 | | |
| | | | 15 | | 60 | 120 | | |
| | \overline{Reset} or \overline{PR} to \overline{Borrow} or \overline{Carry} | | 5 | | 300 | 600 | ns | |
| | | | 10 | | 150 | 300 | | |
| | | | 15 | | 110 | 220 | | |
| t_{THL} , t_{TLH} | Transition Time | | 5 | | 100 | 200 | ns | |
| | | | 10 | | 50 | 100 | | |
| | | | 15 | | 40 | 80 | | |
| t_{rem}^* | Removal Time Reset or \overline{PE} | | 5 | 80 | 40 | | ns | |
| | | | 10 | 40 | 20 | | | |
| | | | 15 | 30 | 15 | | | |
| t_w | Clock Input Pulse Width Reset | | 5 | 480 | 240 | | ns | |
| | | | 10 | 300 | 150 | | | |
| | | | 15 | 260 | 130 | | | |
| | \overline{PE} | | 5 | | 120 | 240 | ns | |
| | | | 10 | | 85 | 170 | | |
| | | | 15 | | 70 | 140 | | |
| | Clock | | 5 | | 90 | 180 | ns | |
| | | | 10 | | 45 | 90 | | |
| | | | 15 | | 30 | 60 | | |
| | t_r , t_f | Clock Input Rise or Fall Time | | 5 | | | 15 | μs |
| | | | | 10 | | | 15 | |
| | | | | 15 | | | 5 | |
| f_{CL} | Maximum Clock Input Frequency | | 5 | 2 | 4 | | MHz | |
| | | | 10 | 5 | 8 | | | |
| | | | 15 | 5.5 | 11 | | | |

* The time required for Reset or Preset Enable control to be removed before clocking (see timing diagram).

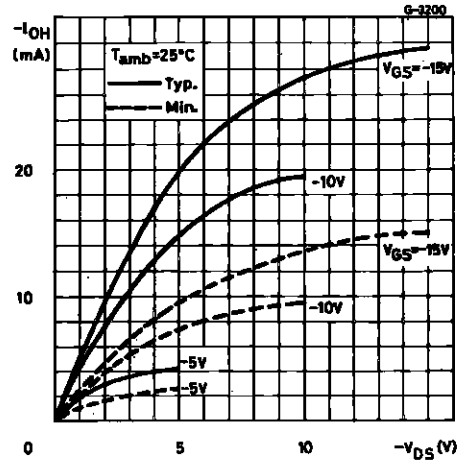
Timing Diagram Defining t_{rem} .



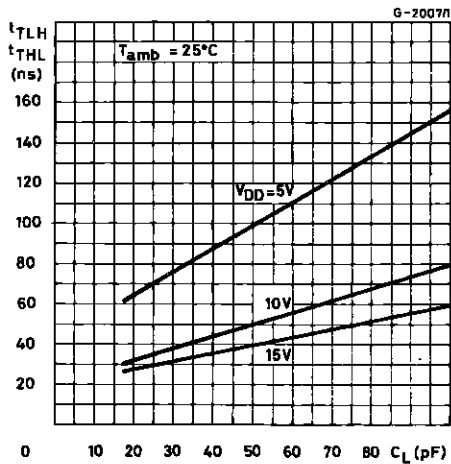
Output Low (sink) Current Characteristics.



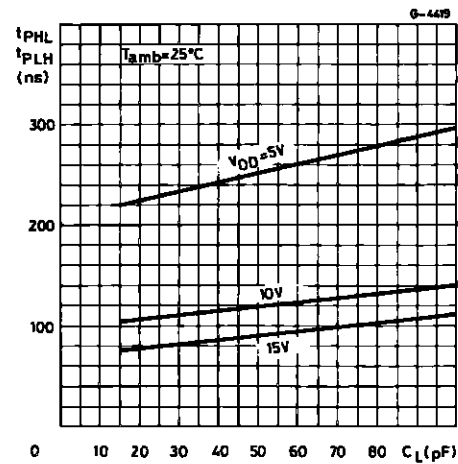
Output high (source) Current Characteristics.



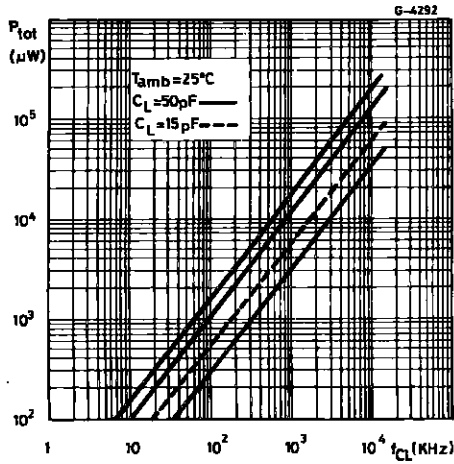
Typical Transition Time vs. Load Capacitance.



Typical Propagation Delay Time vs. Load Capacitance.

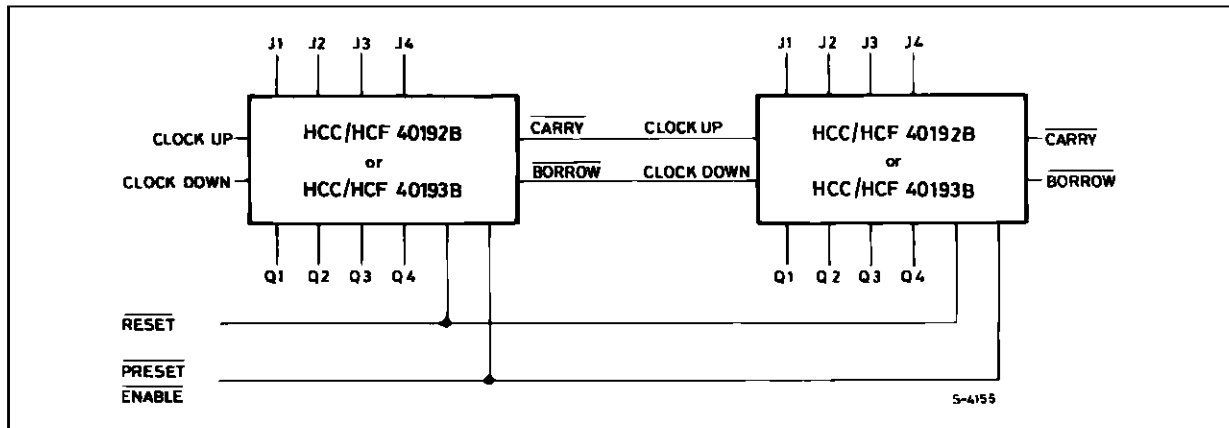


Typical Dynamic Power Dissipation.



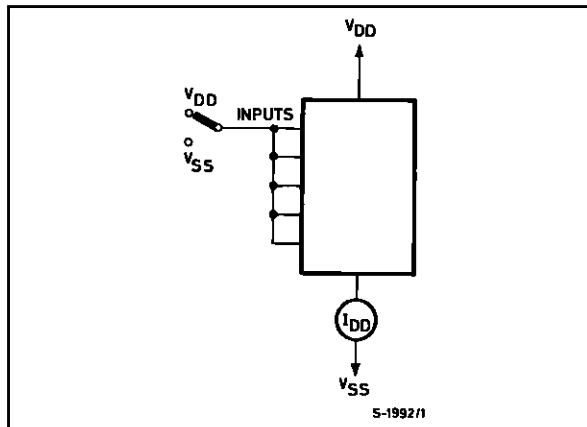
TYPICAL APPLICATION

CASCADED COUNTER PACKAGES

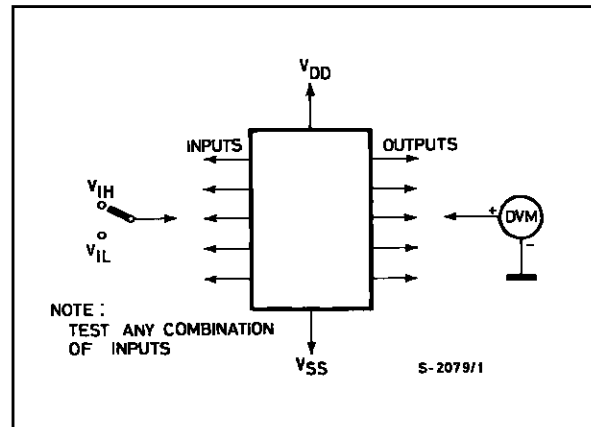


TEST CIRCUITS

Quiescent Device Current

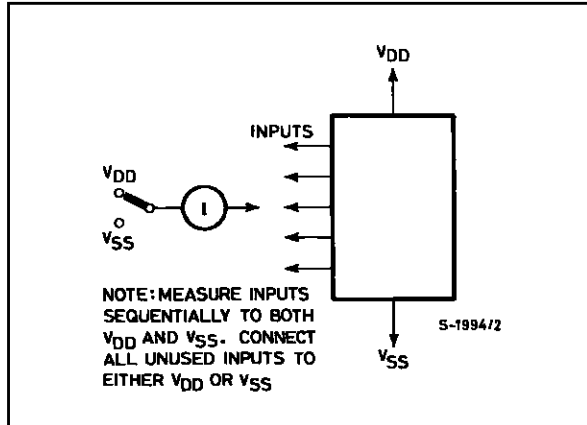


Input Voltage

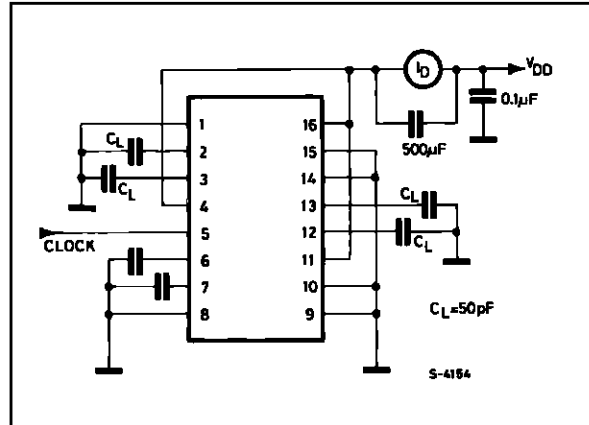


TEST CIRCUITS (continued)

Input Leakage Current.

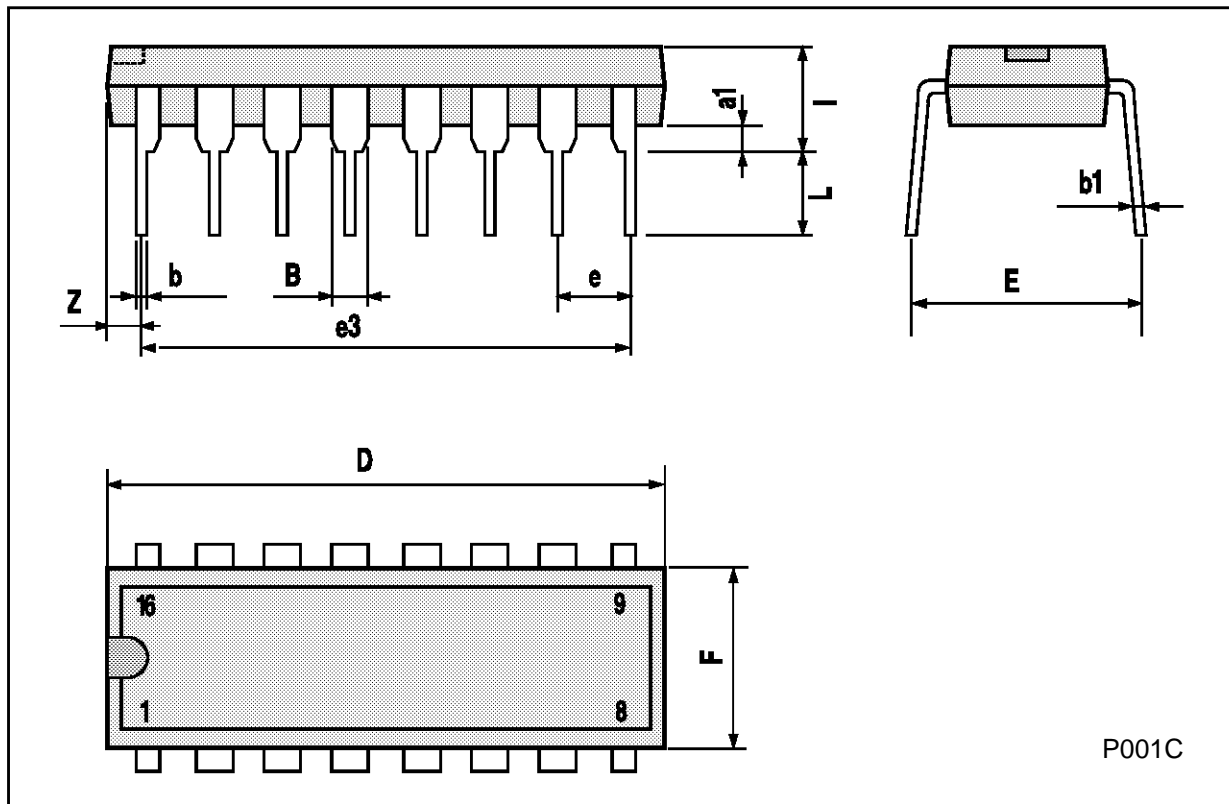


Dynamic Power Dissipation.



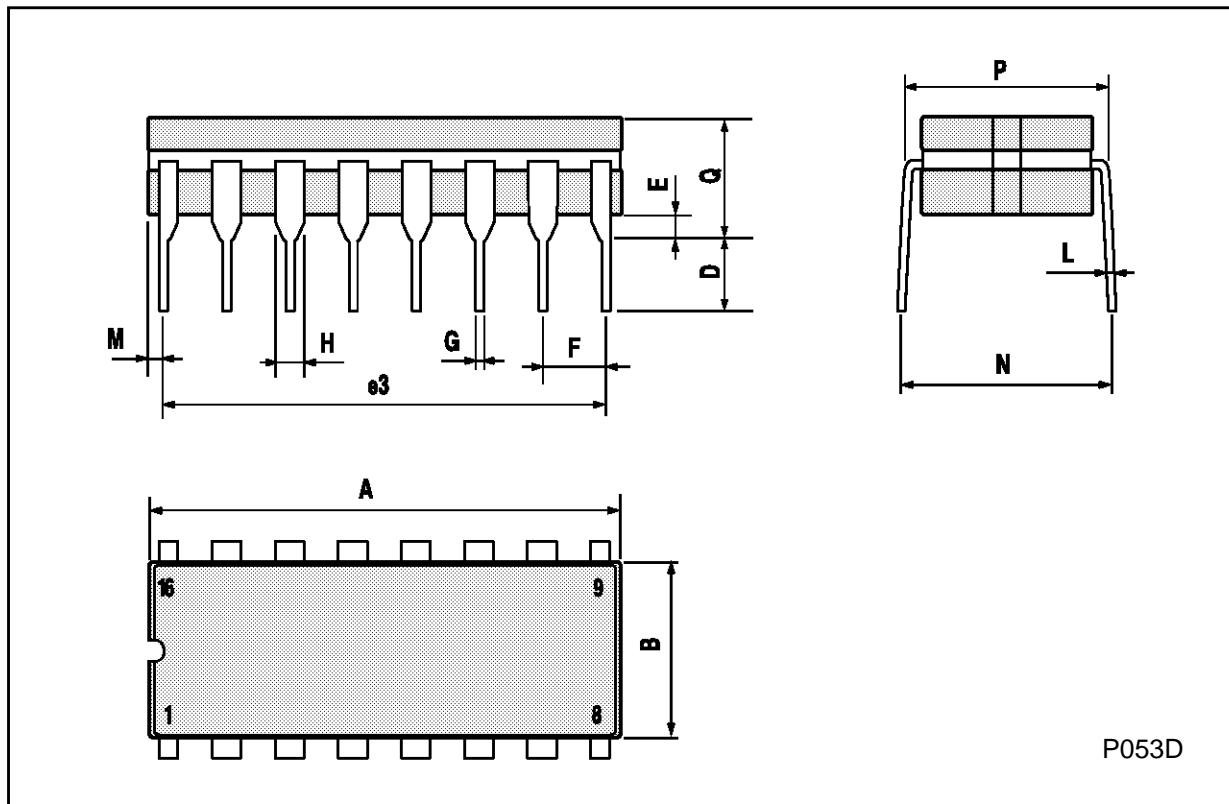
Plastic DIP16 (0.25) MECHANICAL DATA

| 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 |



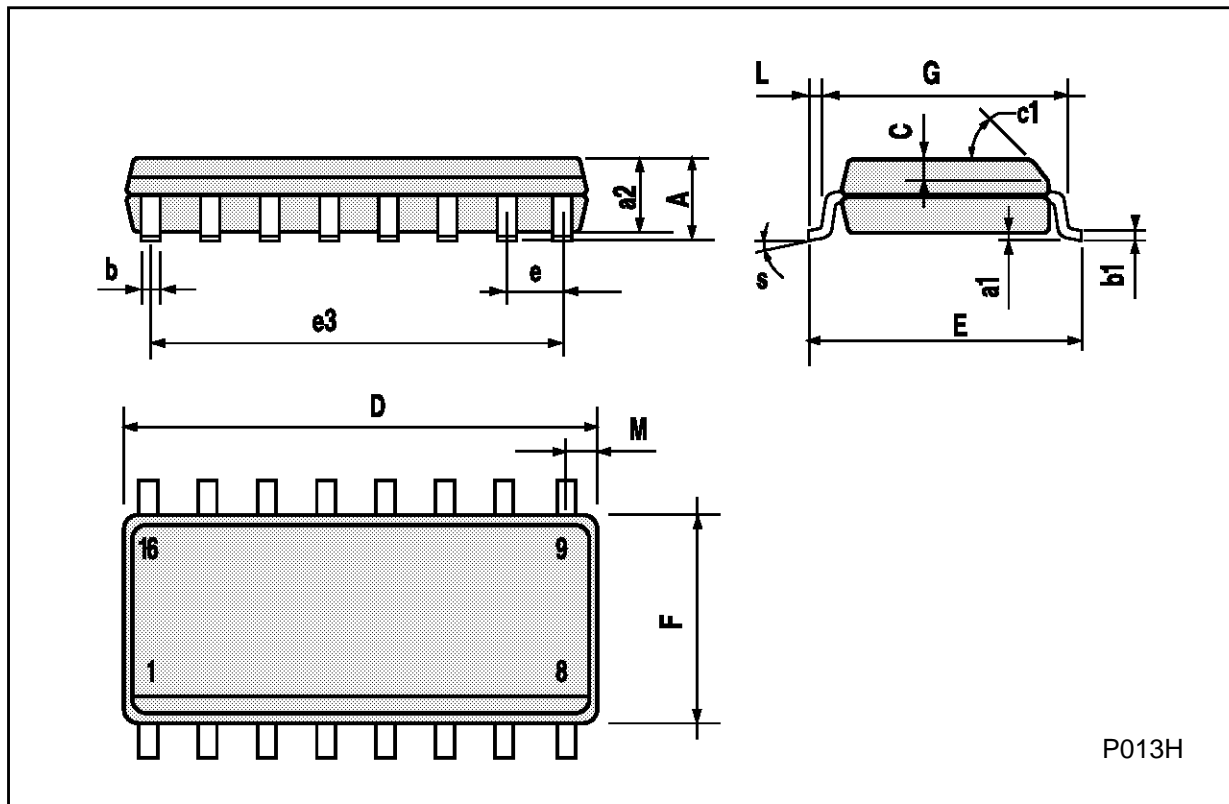
Ceramic DIP16/1 MECHANICAL DATA

| DIM. | mm | | | inch | | |
|------|------|-------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | | 20 | | | 0.787 |
| B | | | 7 | | | 0.276 |
| D | | 3.3 | | | 0.130 | |
| E | 0.38 | | | 0.015 | | |
| e3 | | 17.78 | | | 0.700 | |
| 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 | 0.51 | | 1.27 | 0.020 | | 0.050 |
| N | | | 10.3 | | | 0.406 |
| P | 7.8 | | 8.05 | 0.307 | | 0.317 |
| Q | | | 5.08 | | | 0.200 |



SO16 (Narrow) MECHANICAL DATA

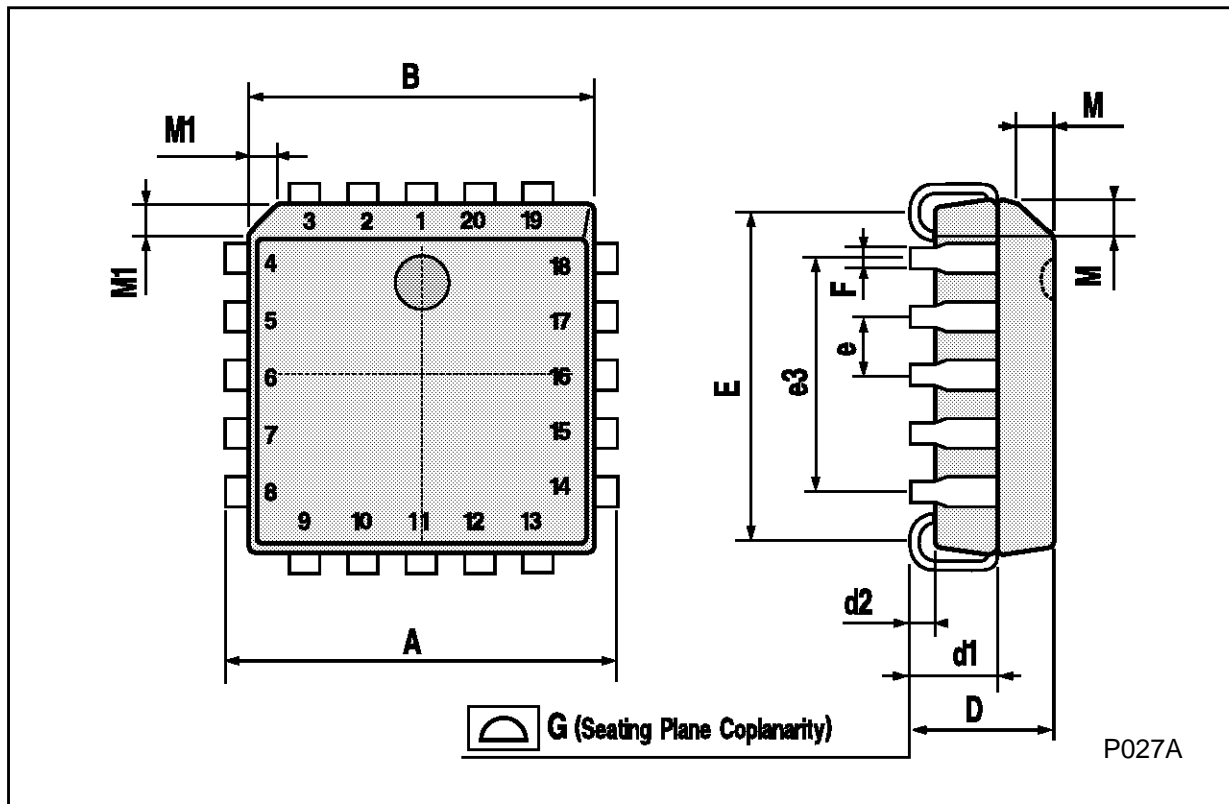
| DIM. | mm | | | inch | | |
|------|------------|------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | | 1.75 | | | 0.068 |
| a1 | 0.1 | | 0.2 | 0.004 | | 0.007 |
| a2 | | | 1.65 | | | 0.064 |
| b | 0.35 | | 0.46 | 0.013 | | 0.018 |
| b1 | 0.19 | | 0.25 | 0.007 | | 0.010 |
| C | | 0.5 | | | 0.019 | |
| c1 | 45° (typ.) | | | | | |
| D | 9.8 | | 10 | 0.385 | | 0.393 |
| E | 5.8 | | 6.2 | 0.228 | | 0.244 |
| e | | 1.27 | | | 0.050 | |
| e3 | | 8.89 | | | 0.350 | |
| 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 | | | 0.62 | | | 0.024 |
| S | 8° (max.) | | | | | |



P013H

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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