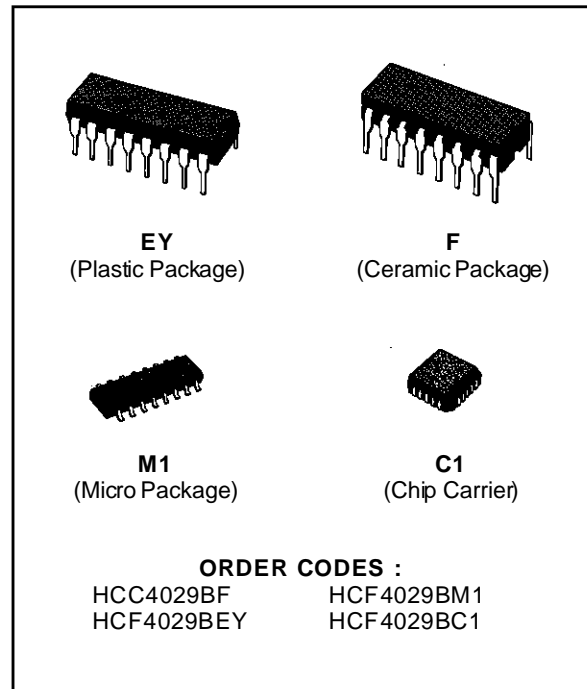


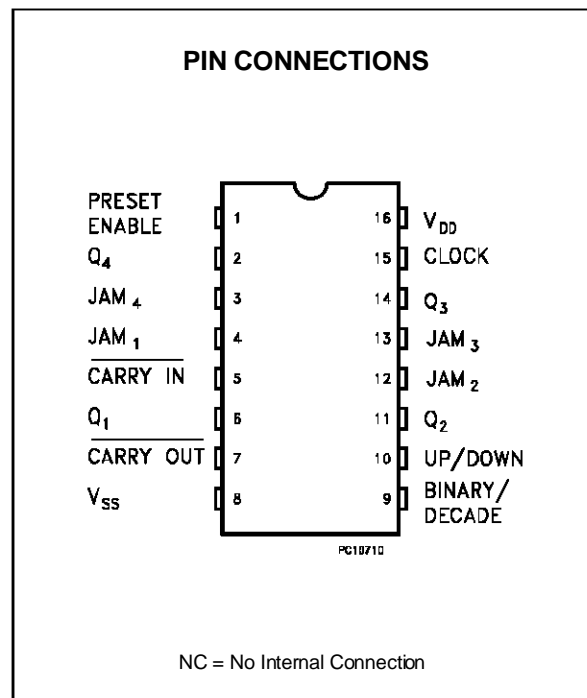
PRESETTABLE UP/DOWN COUNTER BINARY OR BCD DECADE

- MEDIUM SPEED OPERATION - 8MHz (typ.) @ $C_L = 50\text{pF}$ AND $V_{DD}-V_{SS} = 10\text{V}$
- MULTI-PACKAGE PARALLEL CLOCKING FOR SYNCHRONOUS HIGH SPEED OUTPUT RESPONSE OR RIPPLE CLOCKING FOR SLOW CLOCK INPUT RISE AND FALL TIMES
- "PRESET ENABLE" AND INDIVIDUAL "JAM" INPUTS PROVIDED
- BINARY OR DECADE UP/DOWN COUNTING
- BCD OUTPUTS IN DECADE MODE
- STANDARDIZED SYMMETRICAL OUTPUT CHARACTERISTICS
- 5V, 10V, AND 15V PARAMETRIC RATINGS
- INPUT CURRENT OF 100nA AT 18V AND 25°C FOR HCC DEVICE
- QUIESCENT CURRENT SPECIFIED TO 20V FOR HCC DEVICE
- 100% TESTED FOR QUIESCENT CURRENT
- MEETS ALL REQUIREMENTS OF JEDEC TENTATIVE STANDARD N^o. 13A, "STANDARD SPECIFICATIONS FOR DESCRIPTION OF "B" SERIES CMOS DEVICES"



DESCRIPTION

The **HCC4029B** (extended temperature range) and **HCF4029B** (intermediate temperature range) are monolithic integrated circuit, available in 16-lead dual in-line plastic or ceramic package and plastic micro package. The **HCC/HCF4029B** consists of a four-stage binary or BCD-decade up/down counter with provisions for look-ahead carry in both counting modes. The inputs consist of a single CLOCK, CARRY-IN (CLOCK ENABLE), BINARY/DECADE, UP/DOWN, PRESET ENABLE, and four individual JAM signals. Q₁, Q₂, Q₃, Q₄ and a CARRY OUT signal are provided as outputs. A high PRESET ENABLE signal allows information on the JAM INPUTS to preset the counter to any state asynchronously with the clock. A low on each JAM line, when the PRESET-ENABLE signal is high, resets the counter to its zero count. The counter is advanced one count at the positive transition of the clock when the CARRY-IN and PRESET ENABLE signals, are low. Advancement is inhibited when the CARRY-IN or PRESET ENABLE signals are high. The CARRY-OUT signal is normally high and goes low when the

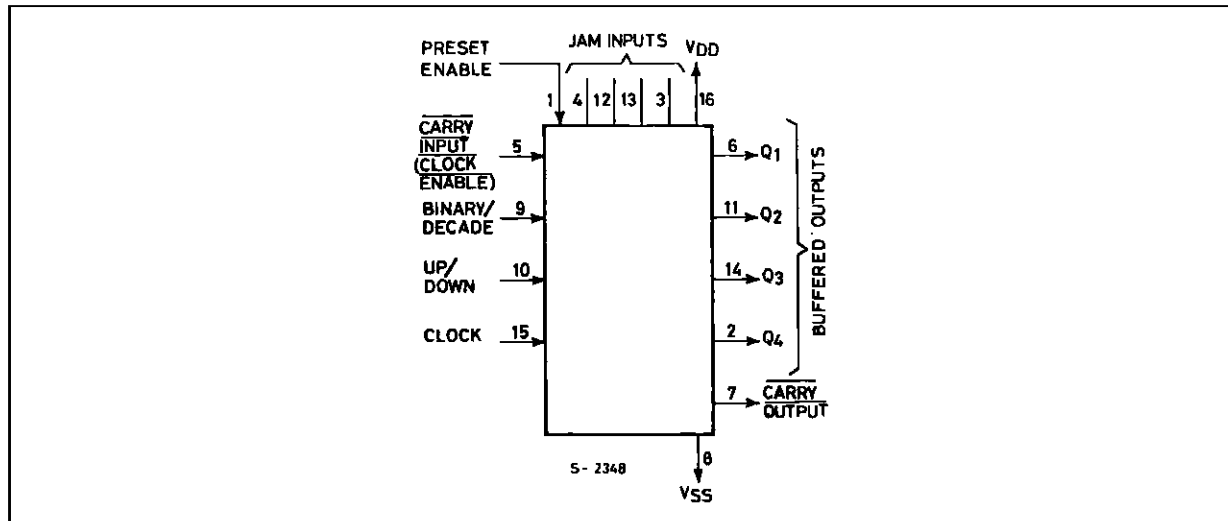


HCC/HCF4029B

counter reaches its maximum count in the UP mode or the minimum count in the DOWN mode provided the CARRY-IN signal is low. The CARRY-IN signal in the low state can thus be considered a CLOCK ENABLE. The CARRY-IN terminal must be connected to V_{SS} when not in use. Binary counting is accomplished when the BINARY/DECADE input is high ; the counter counts in the decade mode when the BINARY/DECADE input is low. The counter

counts Up when to UP/DOWN INPUT is high, and Down when the UP/DOWN INPUT is low. Multiple packages can be connected in either a parallel-clocking or a ripple-clocking arrangement as shown in cascading counter packages. Parallel clocking provides synchronous control and hence faster response from all counting outputs. Ripple-clocking allows for longer clock input rise and fall times.

FUNCTIONAL DIAGRAM



ABSOLUTE MAXIMUM RATING

| 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) | 200 | mW |
| | Dissipation per Output Transistor for Top = Full Package Temperature Range | 100 | mW |
| T _{op} | Operating Temperature: HCC Types HCF Types | -55 to +125 -40 to +85 | °C |
| T _{stg} | Storage Temperature | -65 to +150 | °C |

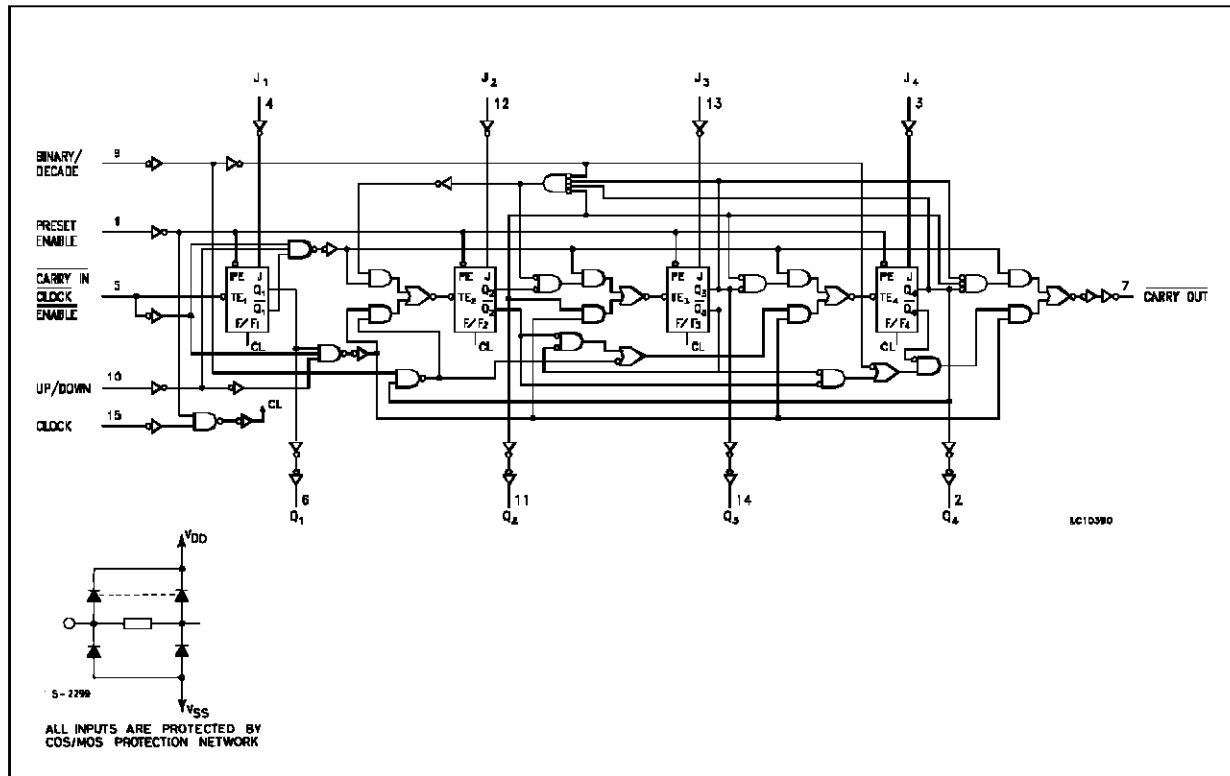
Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for external periods may affect device reliability.

All voltage values are referred to V_{SS} pin voltage.

RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Value | Unit |
|-----------------|---|----------------------|------|
| V _{DD} | Supply Voltage: HCC Types HCF Types | 3 to 18 | V |
| | | 3 to 15 | V |
| V _I | Input Voltage | 0 to V _{DD} | V |
| T _{op} | Operating Temperature: HCC Types HCF Types | -55 to +125 | °C |
| | | -40 to +85 | °C |

LOGIC DIAGRAMS



TRUTH TABLES

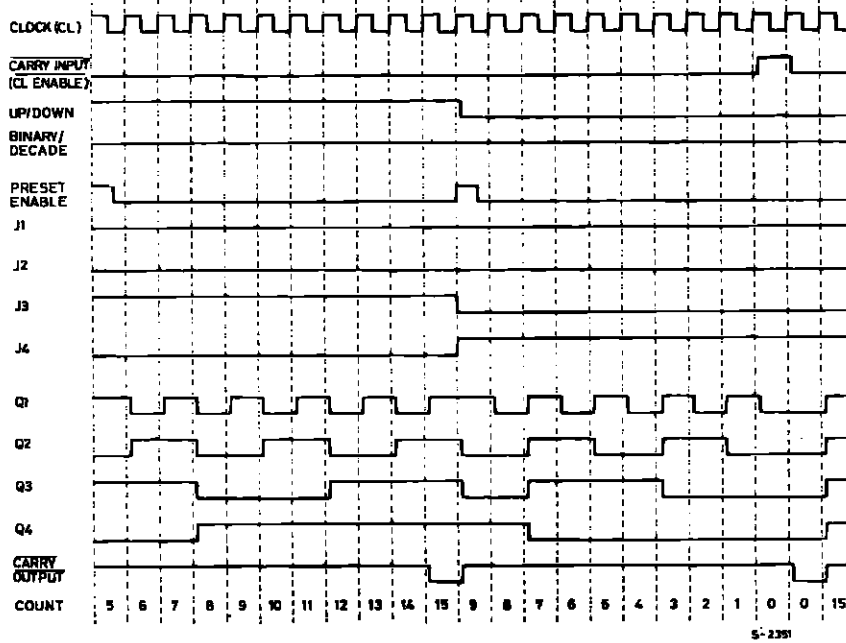
| CLOCK | TE | PE | J | Q | \bar{Q} |
|-----------------------|----|----|---|-----------|--------------|
| X | X | 0 | 0 | 0 | 1 |
| $\overline{\text{L}}$ | 0 | 1 | X | \bar{Q} | Q |
| X | X | 0 | 1 | 1 | 0 |
| $\overline{\text{L}}$ | 1 | 1 | X | Q | \bar{Q} NC |
| $\overline{\text{L}}$ | X | 1 | X | Q | \bar{Q} NC |

X DONT CARE

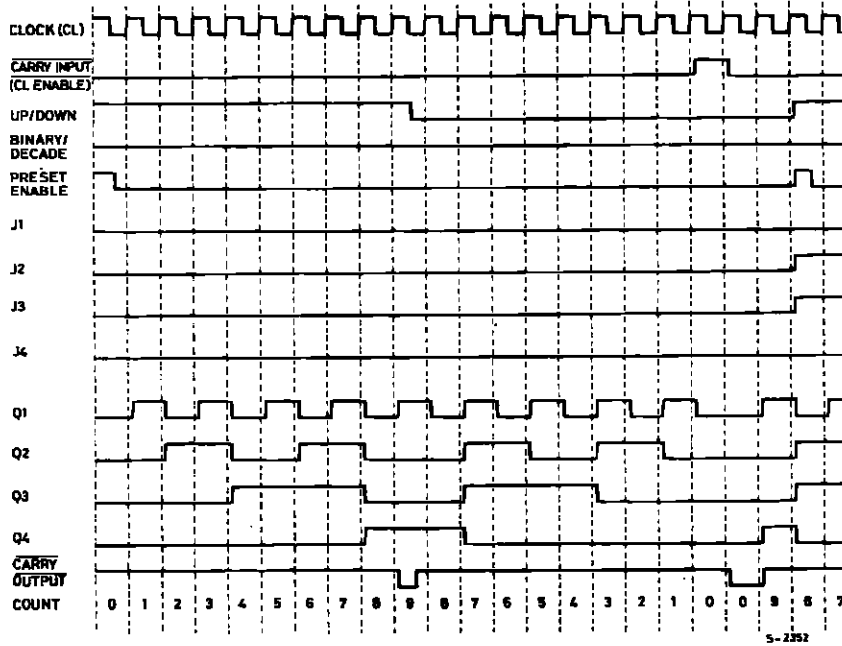
| Control Input | Logic Level | Action |
|------------------------------|-------------|---|
| BIN/DEC (B/D) | 1 | Binary Count |
| | 0 | Decade Count |
| UP/DOWN (U/D) | 1 | Up Count |
| | 0 | Down Count |
| Preset Enable (PE) | 1 | Jam In |
| | 0 | No Jam |
| Carry In (CI) (Clock Enable) | 1 | No Counter Advance at Pos. Clock Transition |
| | 0 | Advance Counter at Pos. Clock Transition |

TIMING DIAGRAMS

Binary Mode



Decade Mode



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 | | |
| | | | 0/10 | 9.5 | | 10 | -1.3 | | -1.1 | -2.6 | | -0.9 | | |
| | | | 0/15 | 13.5 | | 15 | -3.6 | | -3.0 | -6.8 | | -2.4 | | |
| 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 | | ± 0.1 | | $\pm 10^{-5}$ | ± 0.1 | | ± 1 | μ A |
| | | HCF Types | 0/15 | | | | | | | | | | | |
| 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} = 15V

HCC/HCF4029B

DYNAMIC ELECTRICAL CHARACTERISTICS ($T_{amb} = 25\text{ }^{\circ}\text{C}$, $C_L = 50\text{ pF}$, $R_L = 200\text{ K}\Omega$, typical temperature coefficient for all V_{DD} values is $03\text{ }^{\circ}\text{C}/\text{C}$, all input rise and fall times = 20 ns)

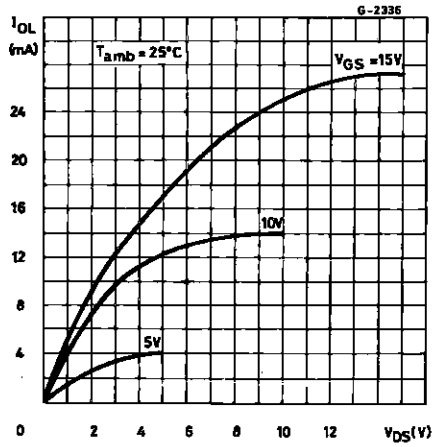
| Symbol | Parameter | Test Conditions | | Value | | | Unit |
|------------------------|---|-----------------|--------------|-------|------|------|---------------|
| | | | V_{DD} (V) | Min. | Typ. | Max. | |
| t_{PLH} t_{PHL} | Propagation Delay Time (Q Outputs) | | 5 | | 250 | 500 | ns |
| | | | 10 | | 120 | 240 | |
| | | | 15 | | 90 | 180 | |
| t_{PLH} t_{PHL} | Propagation Delay Time (Carry Output) | | 5 | | 280 | 560 | ns |
| | | | 10 | | 130 | 260 | |
| | | | 15 | | 95 | 190 | |
| t_{TLH} t_{THL} | Transition Time (Q Outputs, Carry Output) | | 5 | | 100 | 200 | ns |
| | | | 10 | | 50 | 100 | |
| | | | 15 | | 40 | 80 | |
| t_w | Minimum Clock Pulse Width | | 5 | | 90 | 180 | ns |
| | | | 10 | | 45 | 90 | |
| | | | 15 | | 30 | 60 | |
| t_r , t_f^{**} | Clock Rise and Fall Time | | 5 | | | 15 | μs |
| | | | 10 | | | 15 | |
| | | | 15 | | | 15 | |
| t_{setup}^* | Minimum Setup Time (Carry Input) | | 5 | | 30 | 60 | ns |
| | | | 10 | | 10 | 20 | |
| | | | 15 | | 6 | 12 | |
| t_{setup} | Minimum Setup Time (B/D or UD) | | 5 | | 170 | 340 | ns |
| | | | 10 | | 70 | 140 | |
| | | | 15 | | 50 | 100 | |
| f_{max} | Maximum Clock Input Frequency | | 5 | 2 | 4 | | MHz |
| | | | 10 | 4 | 8 | | |
| | | | 15 | 5.5 | 11 | | |
| PRESET ENABLE | | | | | | | |
| t_{PLH} t_{PHL} | Propagation Delay Time (Q Outputs) | | 5 | | 235 | 470 | ns |
| | | | 10 | | 100 | 200 | |
| | | | 15 | | 80 | 160 | |
| t_{PLH} t_{PHL} | Propagation Delay Time (Carry Output) | | 5 | | 320 | 640 | ns |
| | | | 10 | | 145 | 290 | |
| | | | 15 | | 105 | 210 | |
| t_w | Minimum Preset Enable (Pulse Width) | | 5 | | 65 | 130 | ns |
| | | | 10 | | 35 | 70 | |
| | | | 15 | | 25 | 50 | |
| t_{rem}^* | Minimum Preset Enable (Removal Time) | | 5 | | 100 | 200 | ns |
| | | | 10 | | 55 | 110 | |
| | | | 15 | | 40 | 80 | |
| CARRY INPUT | | | | | | | |
| t_{PHL} t_{PLH} | Propagation Delay Time (Carry Output) | | 5 | | 170 | 340 | ns |
| | | | 10 | | 70 | 140 | |
| | | | 15 | | 50 | 100 | |
| t_{setup}^{***} | Minimum Setup Time (Carry In) | | 5 | | 25 | 50 | ns |
| | | | 10 | | 15 | 30 | |
| | | | 15 | | 12 | 25 | |
| t_{hold} | Minimum Hold Time (Carry In) | | 5 | | 100 | 200 | ns |
| | | | 10 | | 35 | 70 | |
| | | | 15 | | 30 | 60 | |

* From Up/Down, Binary/Decade, Carry In or Preset Enable Control Inputs to Clock Edge

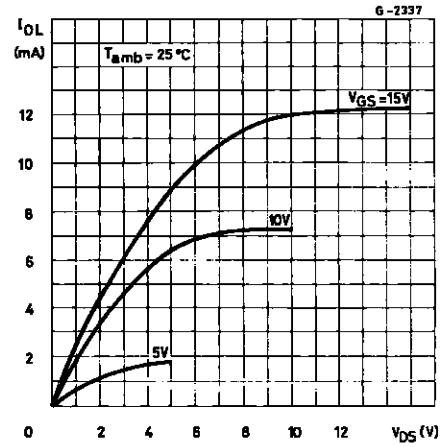
** If more than one unit is cascaded in the parallel clocked application t_r should be made less than or equal to the sum of the fixed propagation delay at 15 pF and the transition time of the carry output driving stage for the estimated capacitance load.

*** From Carry in to Clock Edge.

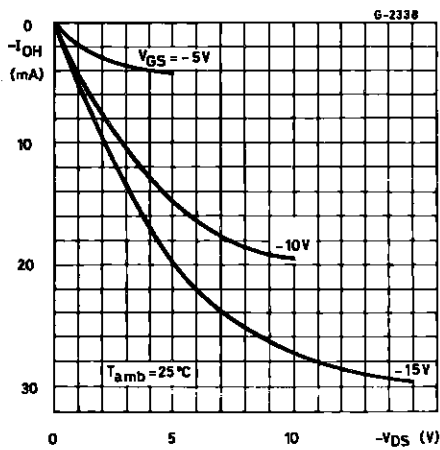
Typical Output Low (sink) Current Characteristics.



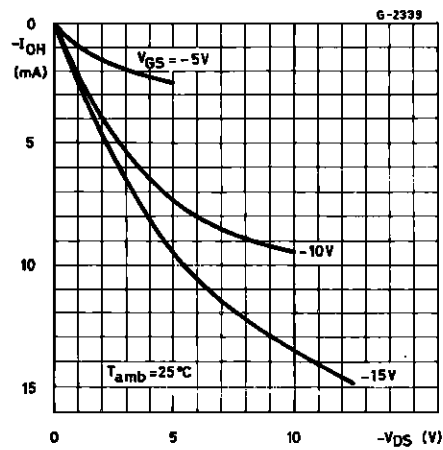
Minimum Output Low (sink) Current Characteristics.



Typical Output High (source) Current Characteristics.



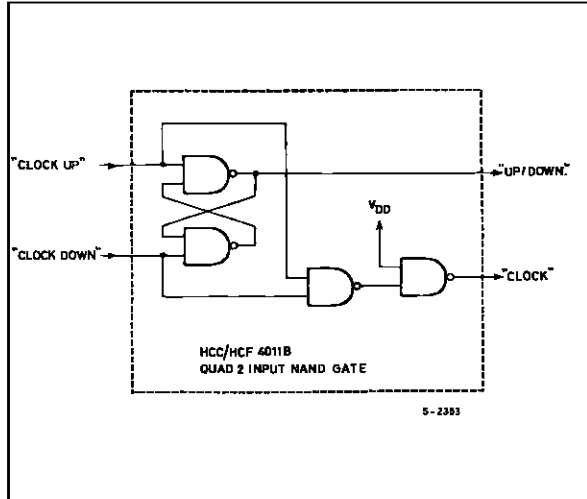
Minimum Output High (source) Current Characteristics.



HCC/HCF4029B

APPLICATIONS

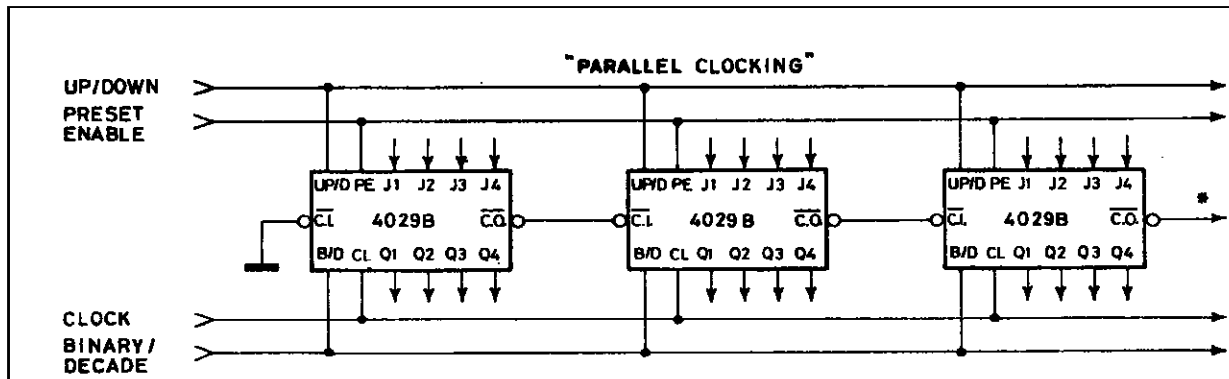
Conversion of Clock up, Clock Down Input Signals to Clock and Up/Down Inputs Signals.



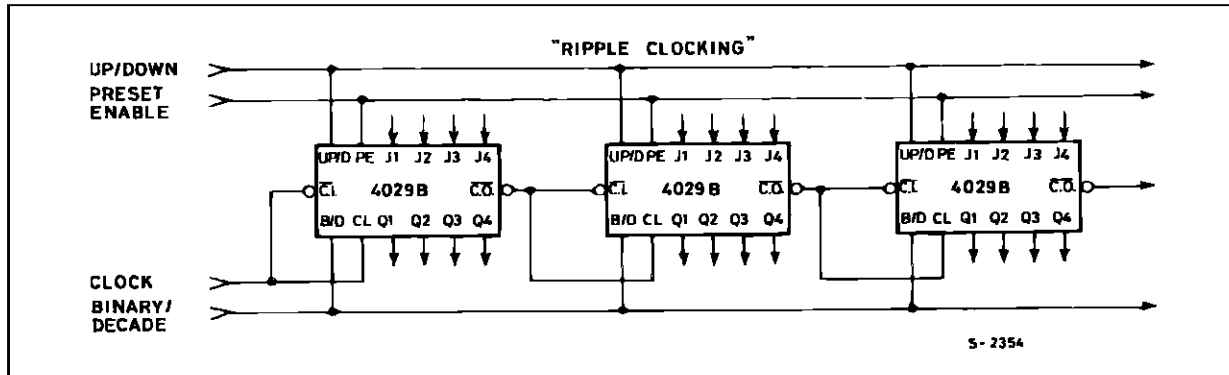
The **HCC/HCF4029B** CLOCK and UP/DOWN inputs are used directly in most applications. In applications where CLOCK UP and CLOCK DOWN inputs are provided, conversion to the **HCC/HCF4029B** CLOCK and UP/DOWN inputs can easily be realized by use of the circuit.

HCC/HCF4029B changes count on positive transitions of CLOCK UP or CLOCK DOWN inputs. For the gate configuration shown below, when counting up the CLOCK DOWN input must be maintained high and conversely when counting down the CLOCK UP input must be maintained high.

Cascading Counter Packages.



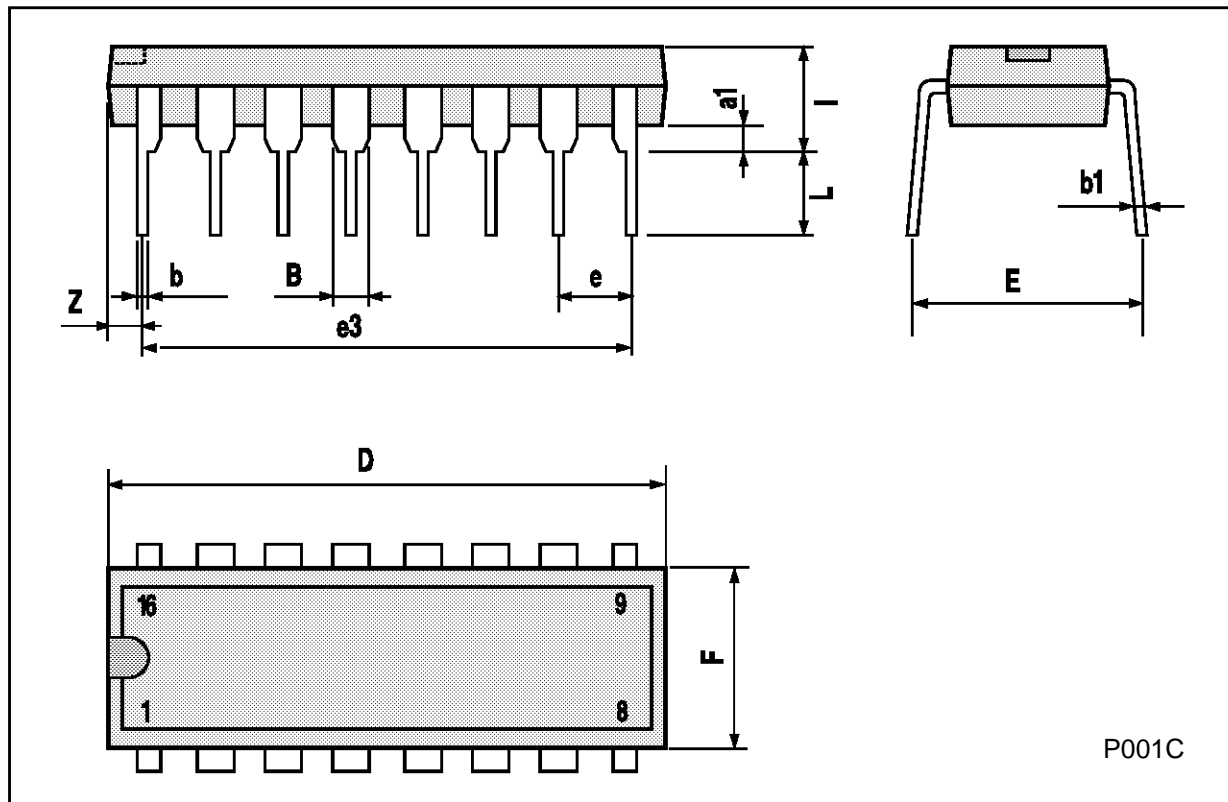
* CARRY-OUT lines at the 2nd, 3rd, etc., stages may have a negative-going glitch pulse resulting from differential delays of different **HCC/HCF4029B** IC's. These negative-going glitches do not affect proper **HCC/HCF4029B** operation. However, if the CARRY-OUT signals are used to trigger other edge-sensitive logic devices, such as FF's or counters, the CARRY-OUT signals should be gated with the clock signal using a 2-input NOR gate such as **HCC/HCF4001B**.



Ripple Clocking Mode: The Up/Down control can be changed at any count. The only restriction on changing the Up/Down control is that the clock input to the first counting stage must be high.

Plastic DIP16 (0.25) MECHANICAL DATA

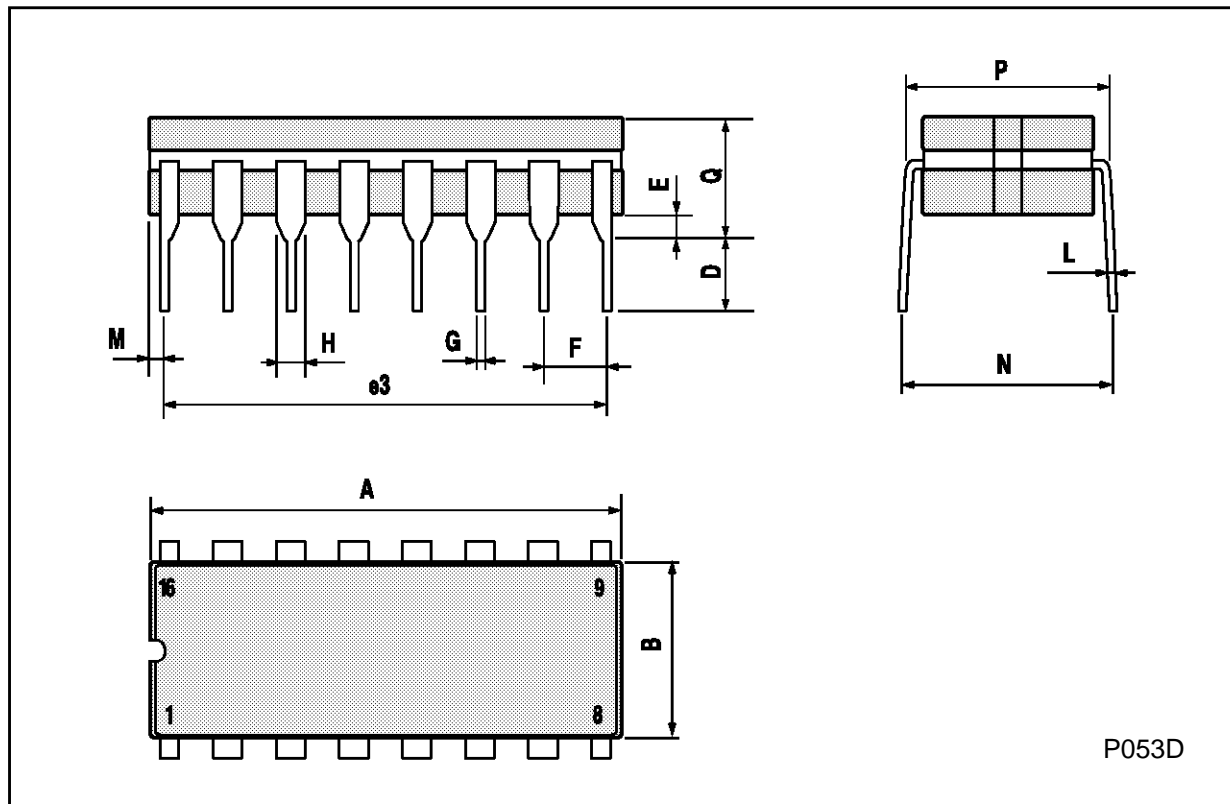
| DIM. | mm | | | inch | | |
|------|------|-------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| a1 | 0.51 | | | 0.020 | | |
| B | 0.77 | | 1.65 | 0.030 | | 0.065 |
| b | | 0.5 | | | 0.020 | |
| b1 | | 0.25 | | | 0.010 | |
| D | | | 20 | | | 0.787 |
| E | | 8.5 | | | 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 |



P001C

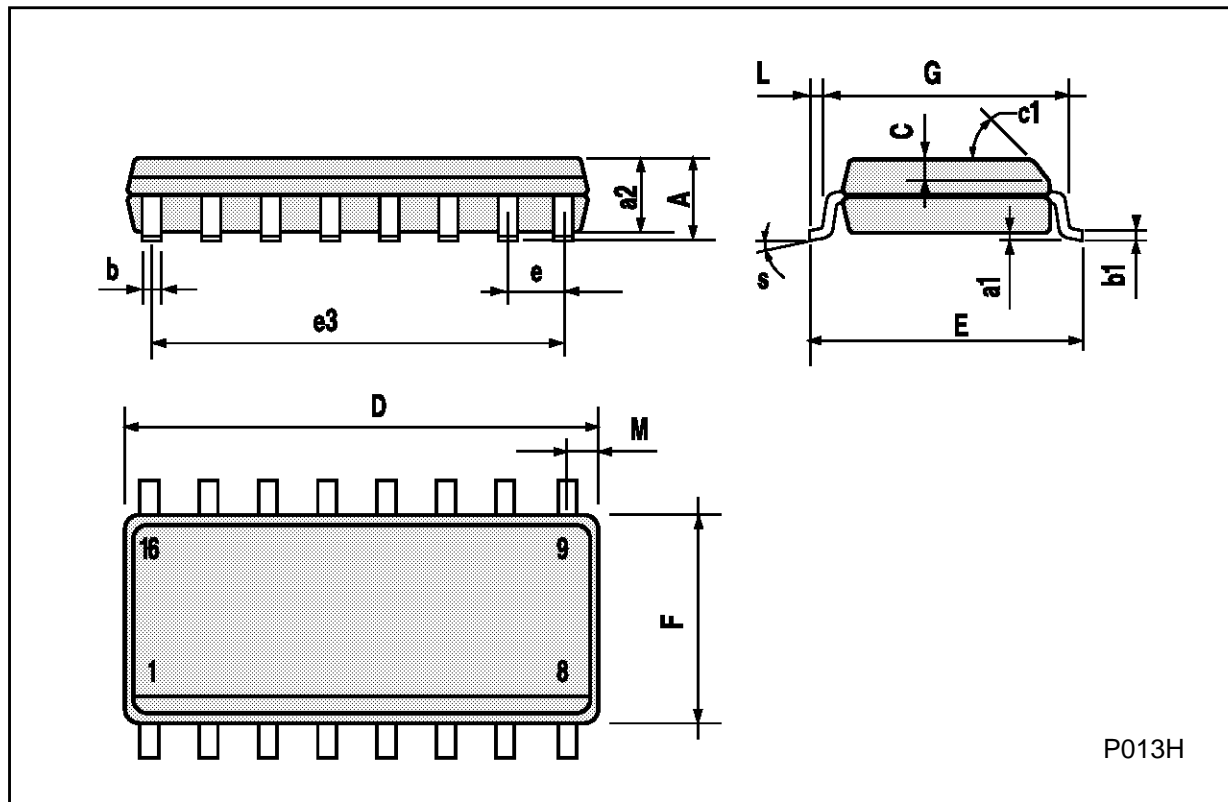
Ceramic DIP16/1 MECHANICAL DATA

| 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

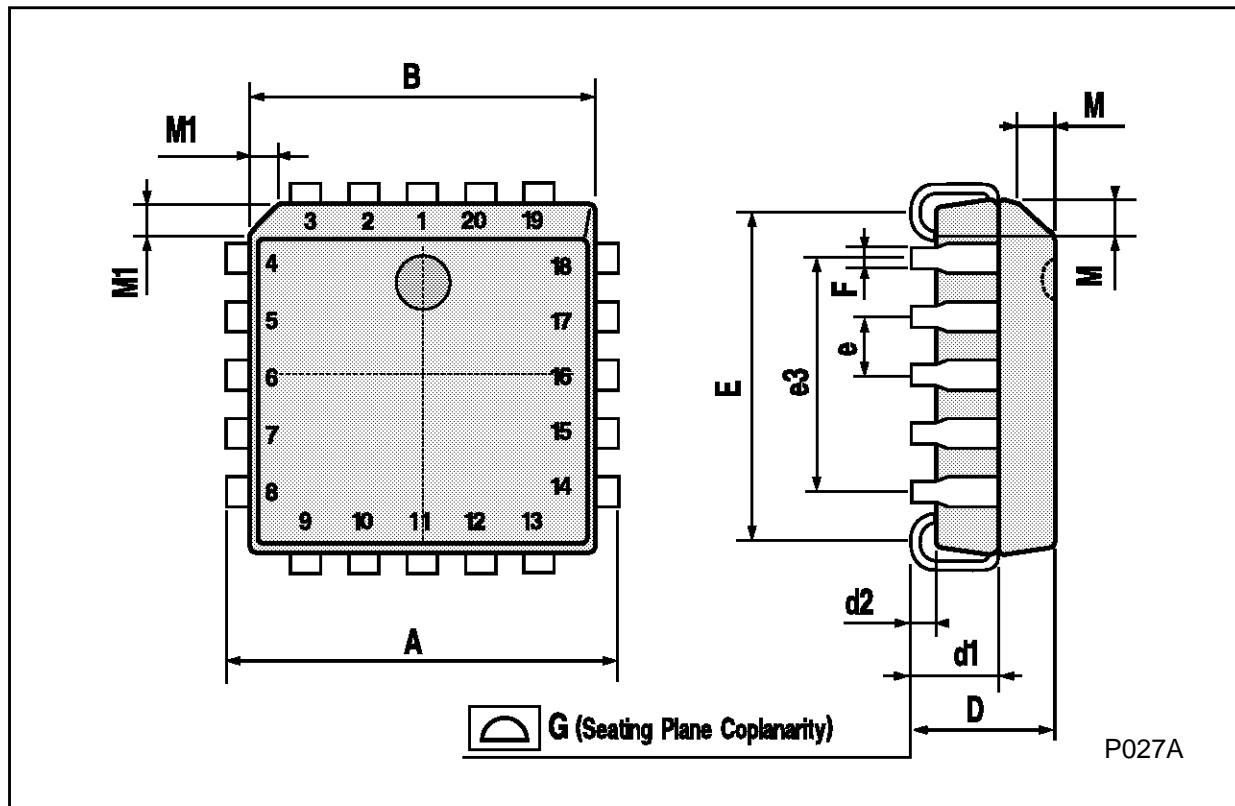
| DIM. | mm | | | inch | | |
|------|------------|------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | | 1.75 | | | 0.068 |
| a1 | 0.1 | | 0.2 | 0.004 | | 0.007 |
| a2 | | | 1.65 | | | 0.064 |
| b | 0.35 | | 0.46 | 0.013 | | 0.018 |
| b1 | 0.19 | | 0.25 | 0.007 | | 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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