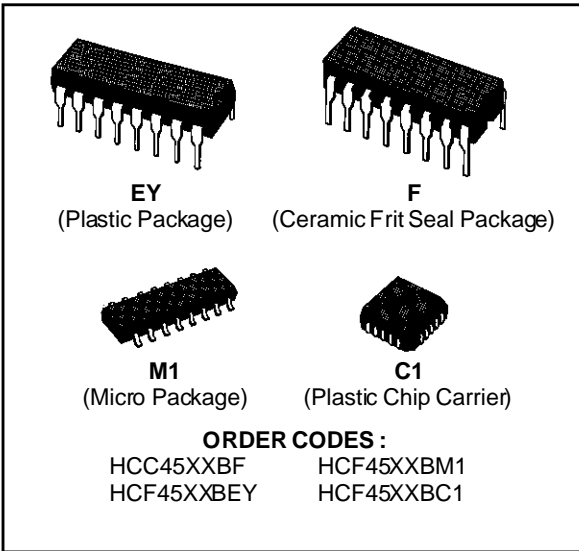


DUAL UP-COUNTERS

HCC/HCF4518B DUAL BCD UP-COUNTER HCC/HCF4520B DUAL BINARY UP-COUNTER

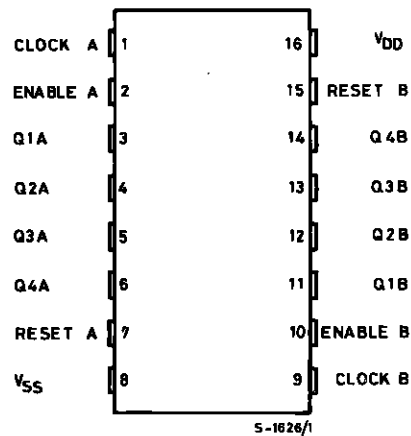
- MEDIUM-SPEED OPERATION – 6MHz TYP. CLOCK FREQUENCY AT 10V
- POSITIVE - OR NEGATIVE - EDGE TRIGGERING
- SYNCHRONOUS INTERNAL CARRY PROPAGATION
- QUIESCENT CURRENT SPECIFIED TO 20V FOR HCC DEVICE
- 5V, 10V, AND 15V PARAMETRIC RATINGS
- INPUT CURRENT OF 100nA AT 18V AND 25°C FOR HCC DEVICE
- 100% TESTED FOR QUIESCENT CURRENT
- MEETS ALL REQUIREMENTS OF JEDEC TENTATIVE STANDARD N° 13A, "STANDARD SPECIFICATIONS FOR DESCRIPTION OF "B" SERIES CMOS DEVICES"



DESCRIPTION

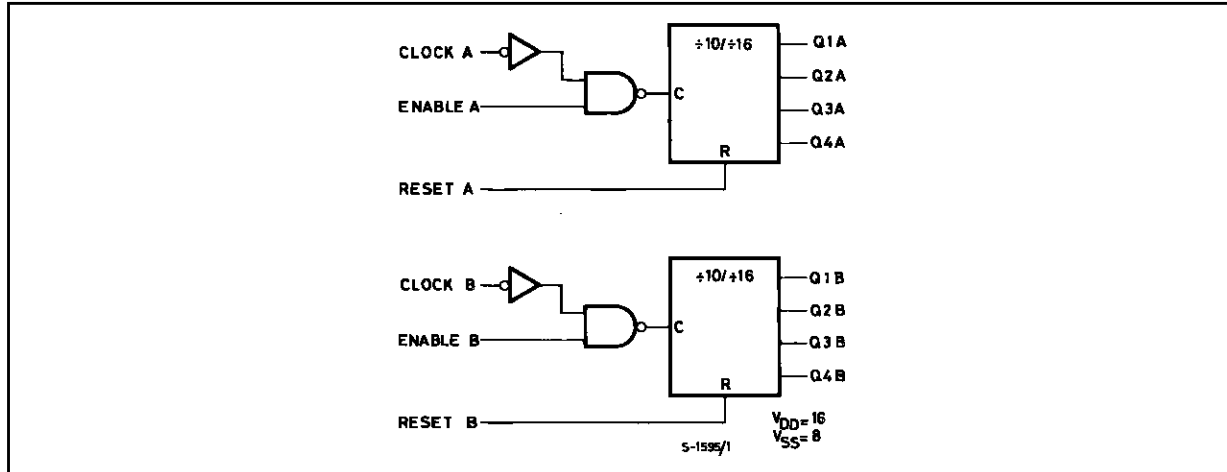
The **HCC4518B/4520B** (extended temperature range) and **HCF4518B/4520B** (intermediate temperature range) are monolithic integrated circuits, available in 16-lead dual in-line plastic or ceramic package and plastic micro package. The **HCC/HCF4518B** Dual BCD Up Counter and **HCC/HCF4520B** Dual Binary Up Counter each consist of two identical, internally synchronous 4-stage counters. The counter stages are D-type flip-flops having interchangeable Clock and Enable lines for incrementing on either the positive-going or negative-going transition. For single-unit operation the Enable input is maintained "high" and the counter advances on each positive-going transition of the Clock. The counters are cleared by high levels on their Reset lines. The counter can be cascaded in the ripple mode by connecting Q4 to the enable input of the subsequent counter while the clock input of the latter is held low.

PIN CONNECTIONS



HCC/HCF4518B/4520B

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 | $^{\circ}C$ |
| T_{stg} | Storage Temperature | - 65 to + 150 | $^{\circ}C$ |

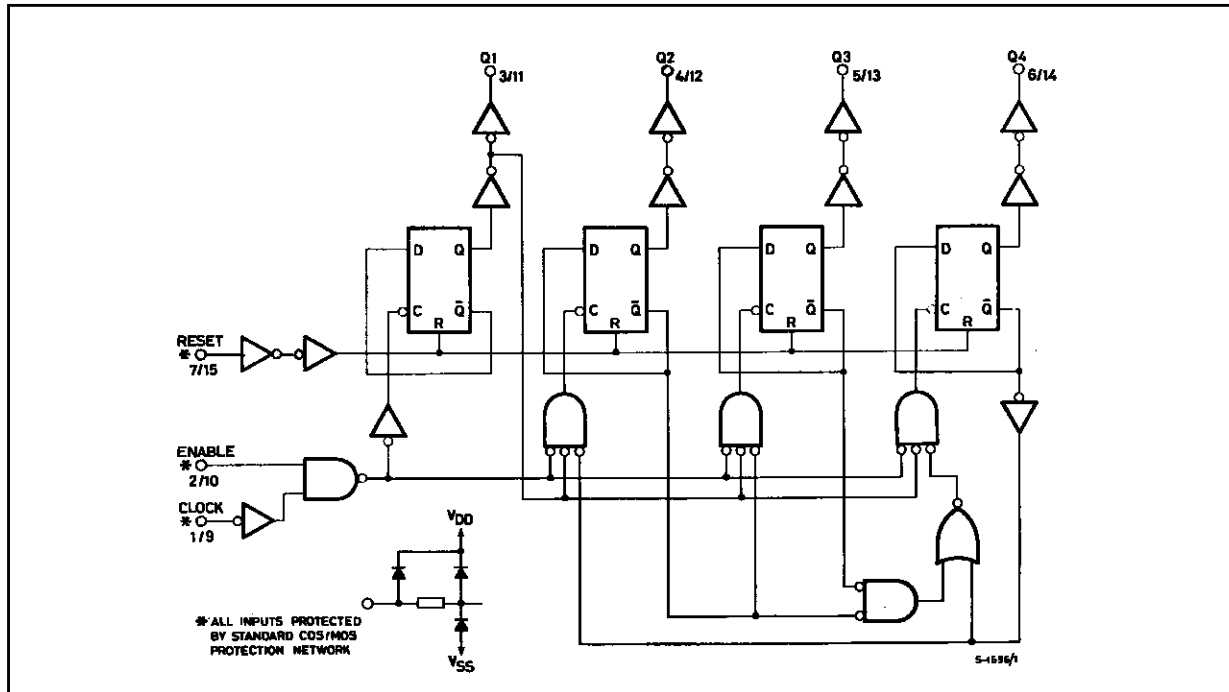
Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure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

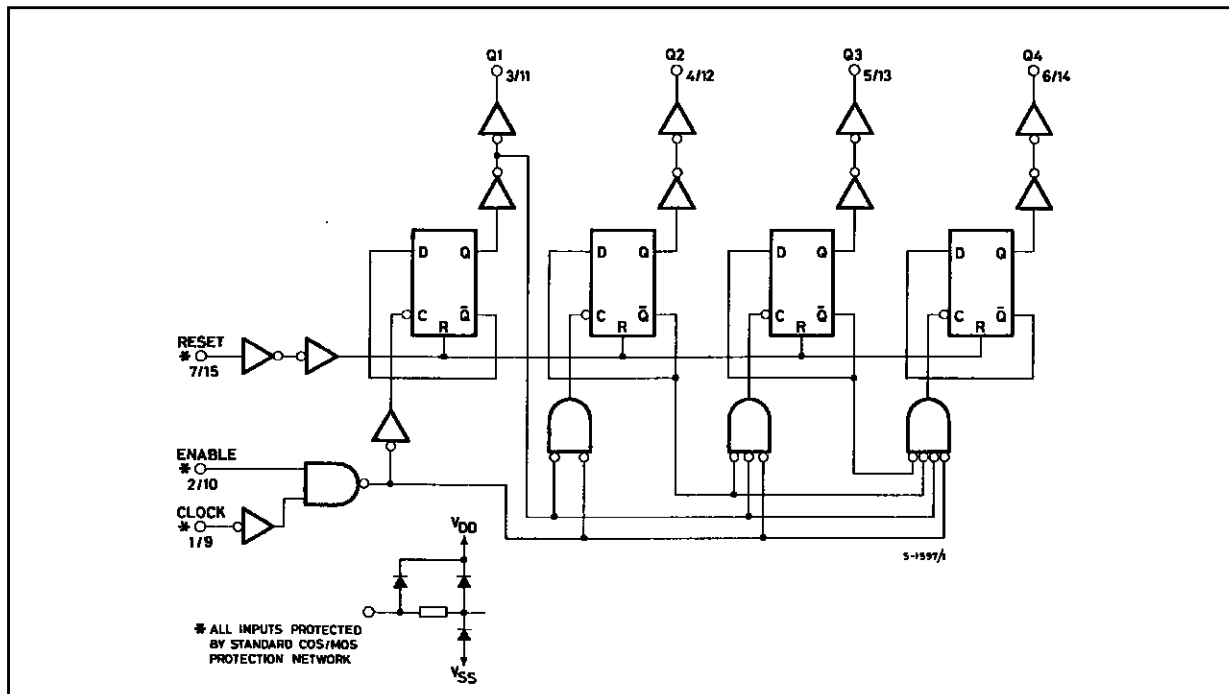
| Symbol | Parameter | Value | Unit |
|----------|--|-------------------------------|-------------|
| V_{DD} | Supply Voltage : HCC Types HCF Types | 3 to 18 3 to 15 | V |
| V_i | Input Voltage | 0 to V_{DD} | V |
| T_{op} | Operating Temperature : HCC Types HCF Types | - 55 to + 125 - 40 to + 85 | $^{\circ}C$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

LOGIC DIAGRAMS (for one of two identical counter)

Decade Counter for 4518B.



Binary Counter for 4520B.



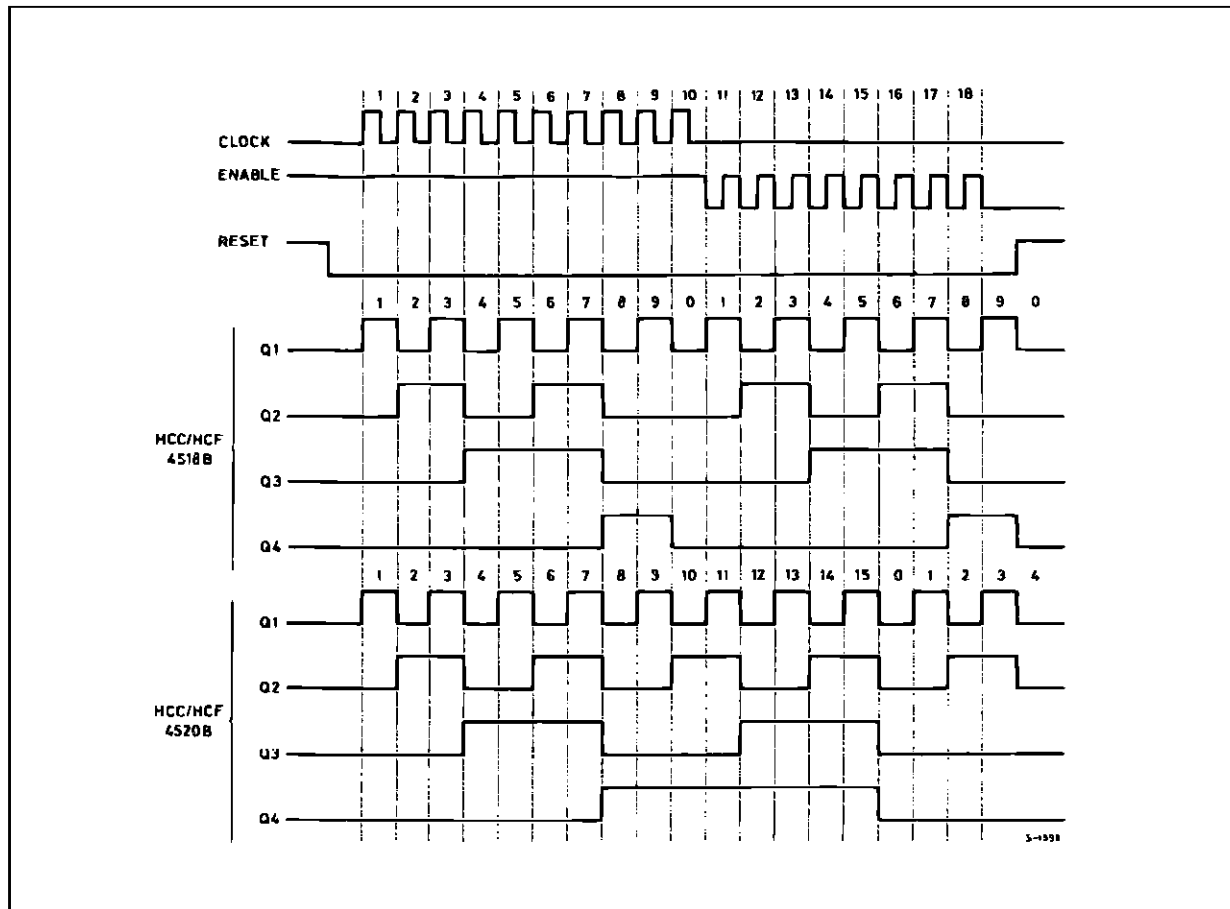
HCC/HCF4518B/4520B

TRUTH TABLE

| Clock | Enable | Reset | Action |
|-------|--------|-------|-------------------|
| | 1 | 0 | Increment Counter |
| 0 | | 0 | Increment Counter |
| | X | 0 | No Change |
| X | | 0 | No Change |
| | 0 | 0 | No Change |
| 1 | | 0 | No Change |
| X | X | 1 | Q1 Thru Q4 = 0 |

X = Don't Care Logic 1 = High State Logic 0 = Low

TIMING DIAGRAM



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 | | V | |
| | | | 10/0 | | < 1 | 10 | | 0.05 | | | 0.05 | | | |
| | | | 15/0 | | < 1 | 15 | | 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 | | V | |
| | | | | 9/1 | < 1 | 10 | | 3 | | | 3 | | | |
| | | | | 13.5/1.5 | < 1 | 15 | | 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} = 15V.

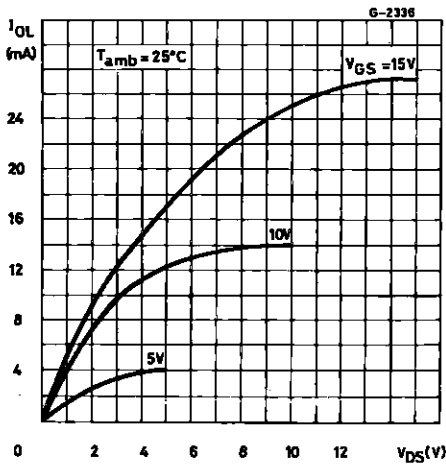
HCC/HCF4518B/4520B

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 $V_{DD} = 0.3\%/^{\circ}\text{C}$ values, all input rise and fall time = 20ns)

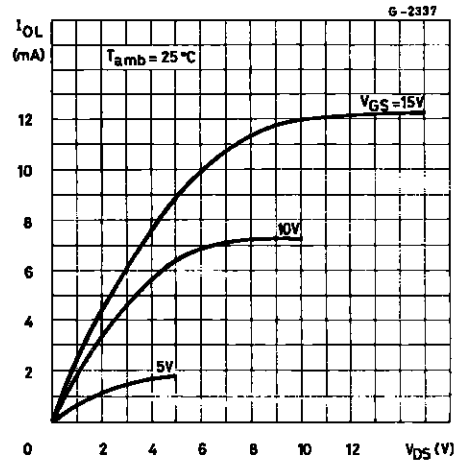
| Symbol | Parameter | Test Conditions | | Value | | | Unit |
|--------------------------|---|-----------------|--------------|-------|------|------|---------------|
| | | | V_{DD} (V) | Min. | Typ. | Max. | |
| t_{PLH} , t_{PHL} | Propagation Delay Time (clock or enable to output) | | 5 | | 280 | 560 | ns |
| | | | 10 | | 115 | 230 | |
| | | | 15 | | 80 | 160 | |
| t_{PLH} , t_{PHL} | Propagation Delay Time (reset to output) | | 5 | | 330 | 650 | ns |
| | | | 10 | | 130 | 225 | |
| | | | 15 | | 90 | 170 | |
| t_{TLH} , t_{THL} | Transition Time | | 5 | | 100 | 200 | ns |
| | | | 10 | | 50 | 100 | |
| | | | 15 | | 40 | 80 | |
| t_W | Clock Pulse Width | | 5 | 200 | 100 | | ns |
| | | | 10 | 100 | 50 | | |
| | | | 15 | 70 | 35 | | |
| t_W | Reset Pulse Width | | 5 | 250 | 125 | | ns |
| | | | 10 | 110 | 55 | | |
| | | | 15 | 80 | 40 | | |
| t_W | Enable Pulse Width | | 5 | 400 | 200 | | ns |
| | | | 10 | 200 | 100 | | |
| | | | 15 | 140 | 70 | | |
| t_r , t_f | Clock or Enable Rise and Fall Time | | 5 | | | 15 | μs |
| | | | 10 | | | 15 | |
| | | | 15 | | | 5 | |
| f_{max} | Maximum Clock Frequency | | 5 | 1.5 | 3 | | MHz |
| | | | 10 | 3 | 6 | | |
| | | | 15 | 4 | 8 | | |
| t_r , t_f | Clock Input Rise or Fall Time | | 5 | | | 15 | μs |
| | | | 10 | | | 5 | |
| | | | 15 | | | 5 | |

Typical Output Low (sink) Current Characteristics.

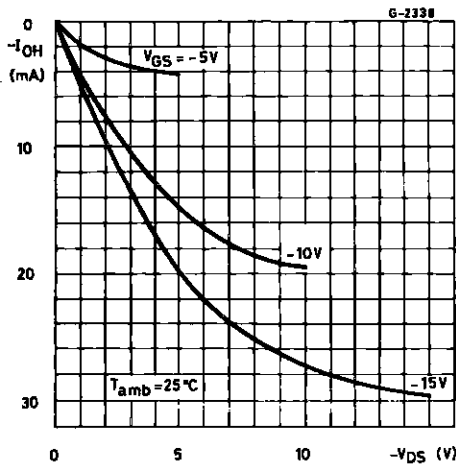
Mini-



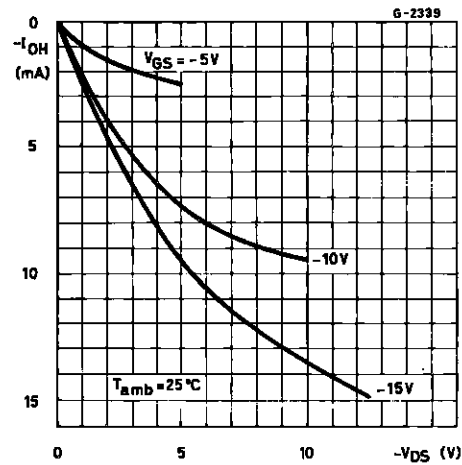
Minimum Output Low (sink) Current Characteristics.



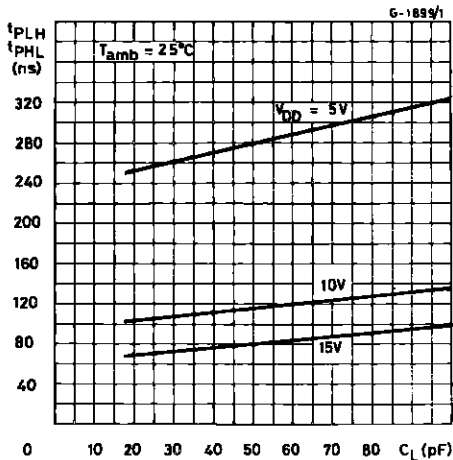
Typical Output High (source) Current Characteristics.



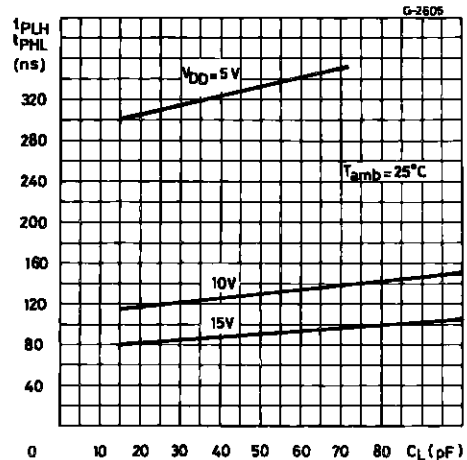
Minimum output High (source) Current Characteristics.



Typical Propagation Delay vs. Load Capacitance, Reset to output.

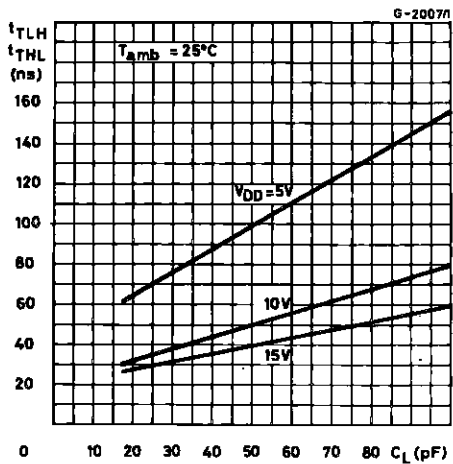


Typical Propagation Delay Time vs. Load Capacitance, Clock or Enable to Output.

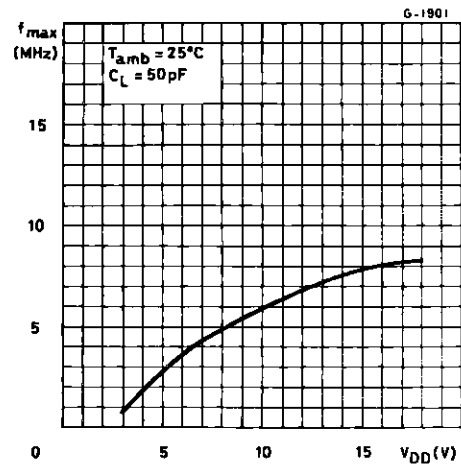


HCC/HCF4518B/4520B

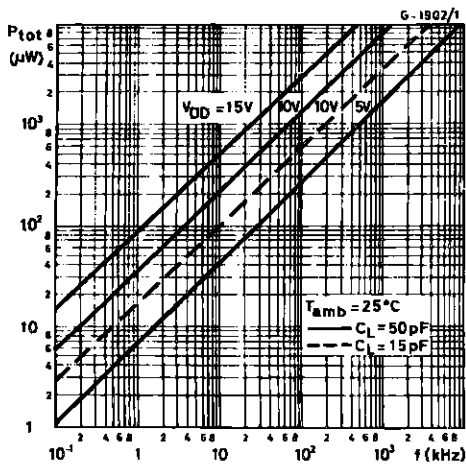
Typical Transition Time vs. load Capacitance.



Typical Maximum-clock Frequency vs. Supply Voltage.

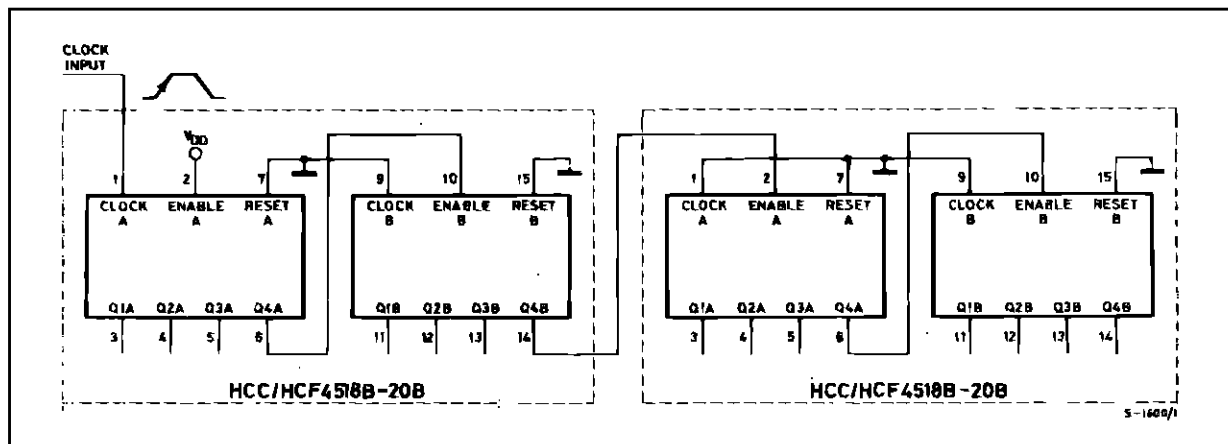


Typical Power Dissipation/Counter vs. Frequency.

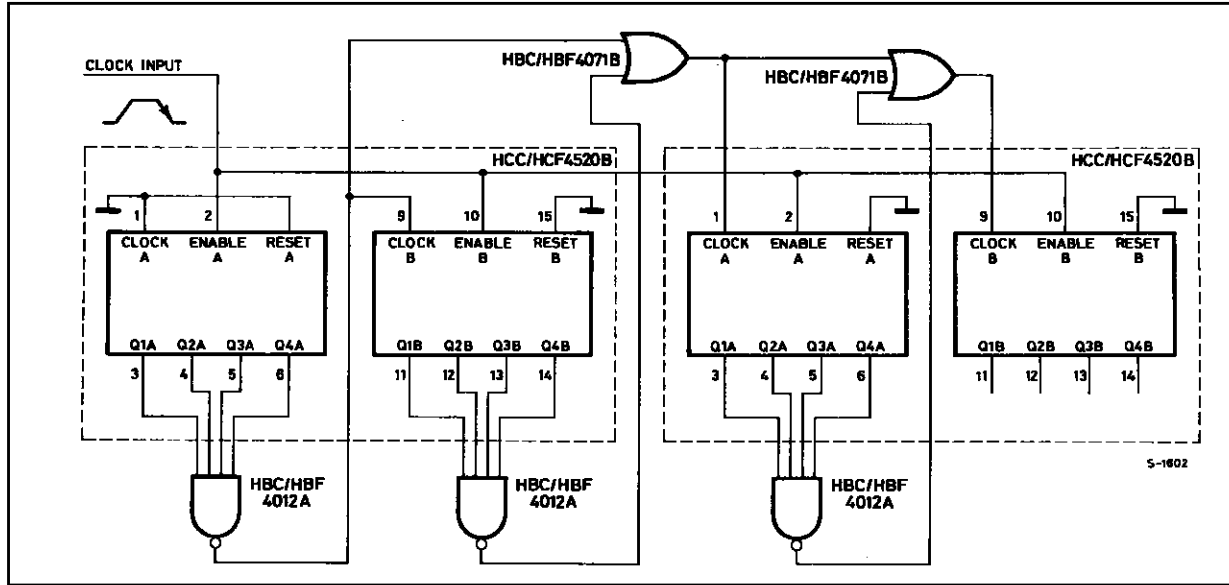


TYPICAL APPLICATIONS

RIPPLE CASCADING OF FOUR COUNTERS WITH POSITIVE-EDGE TRIGGERING.

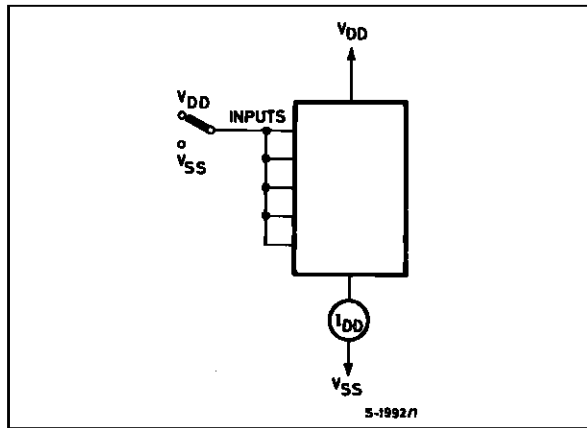


SYNCHRONOUS CASCADING OF FOUR BINARY COUNTERS WITH NEGATIVE-EDGE TRIGGERING.

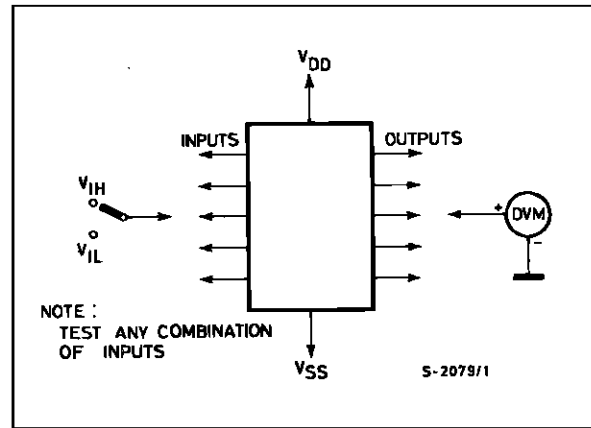


TEST CIRCUITS

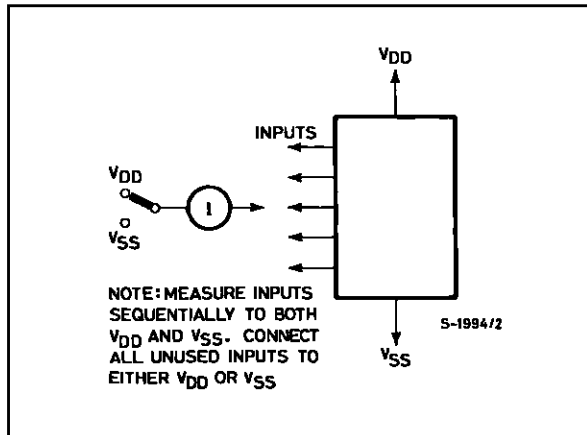
Quiescent Device Current.



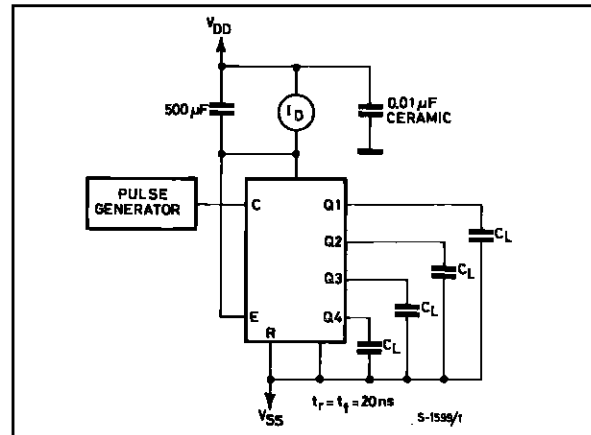
Noise Immunity.



Input Leakage Current.

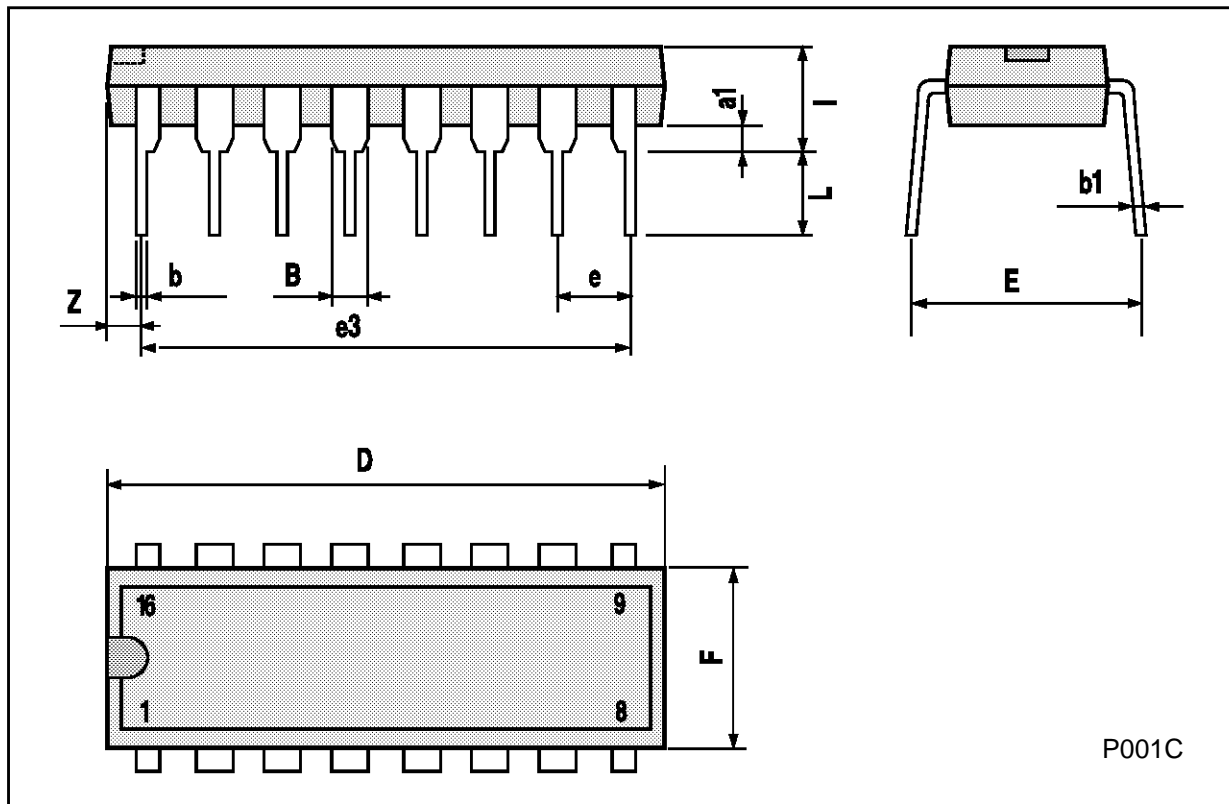


Dynamic Power Dissipation.



Plastic DIP16 (0.25) MECHANICAL DATA

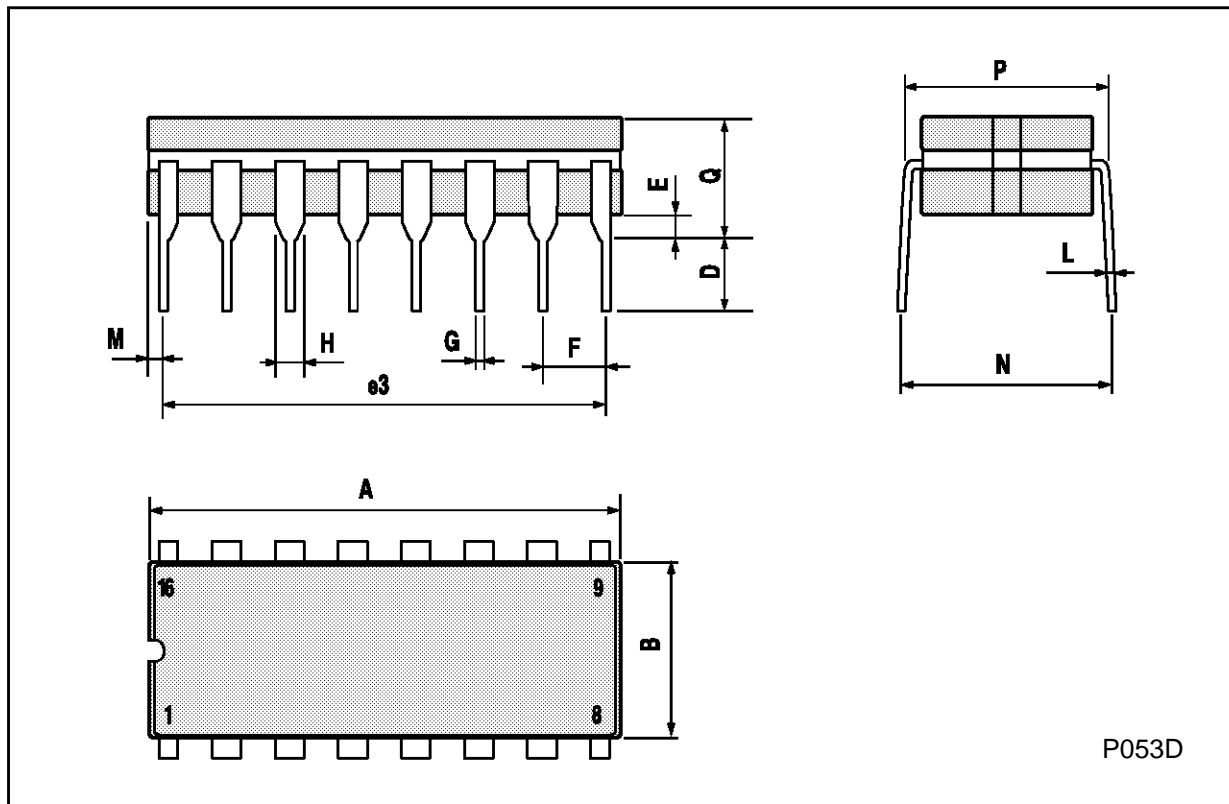
| DIM. | mm | | | inch | | |
|------|------|-------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| a1 | 0.51 | | | 0.020 | | |
| B | 0.77 | | 1.65 | 0.030 | | 0.065 |
| b | | 0.5 | | | 0.020 | |
| b1 | | 0.25 | | | 0.010 | |
| D | | | 20 | | | 0.787 |
| E | | 8.5 | |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



P001C

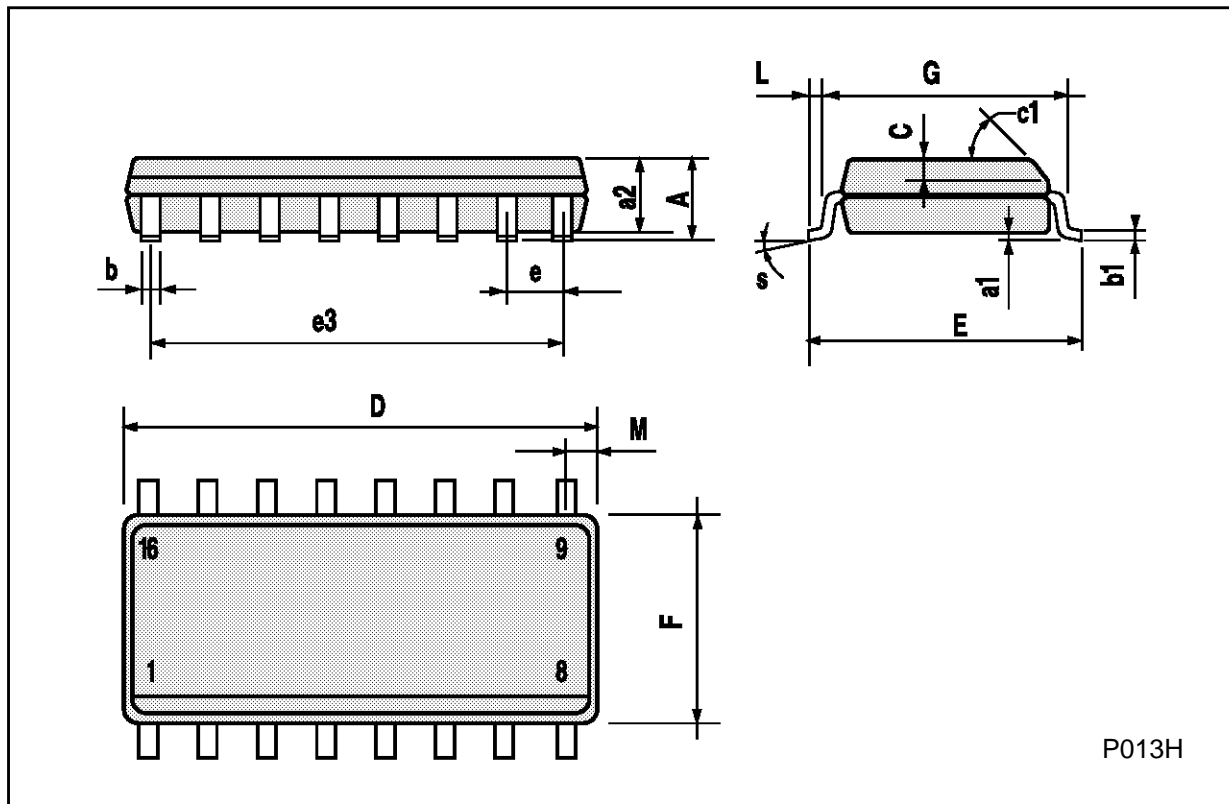
Ceramic DIP16/1 MECHANICAL DATA

| 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

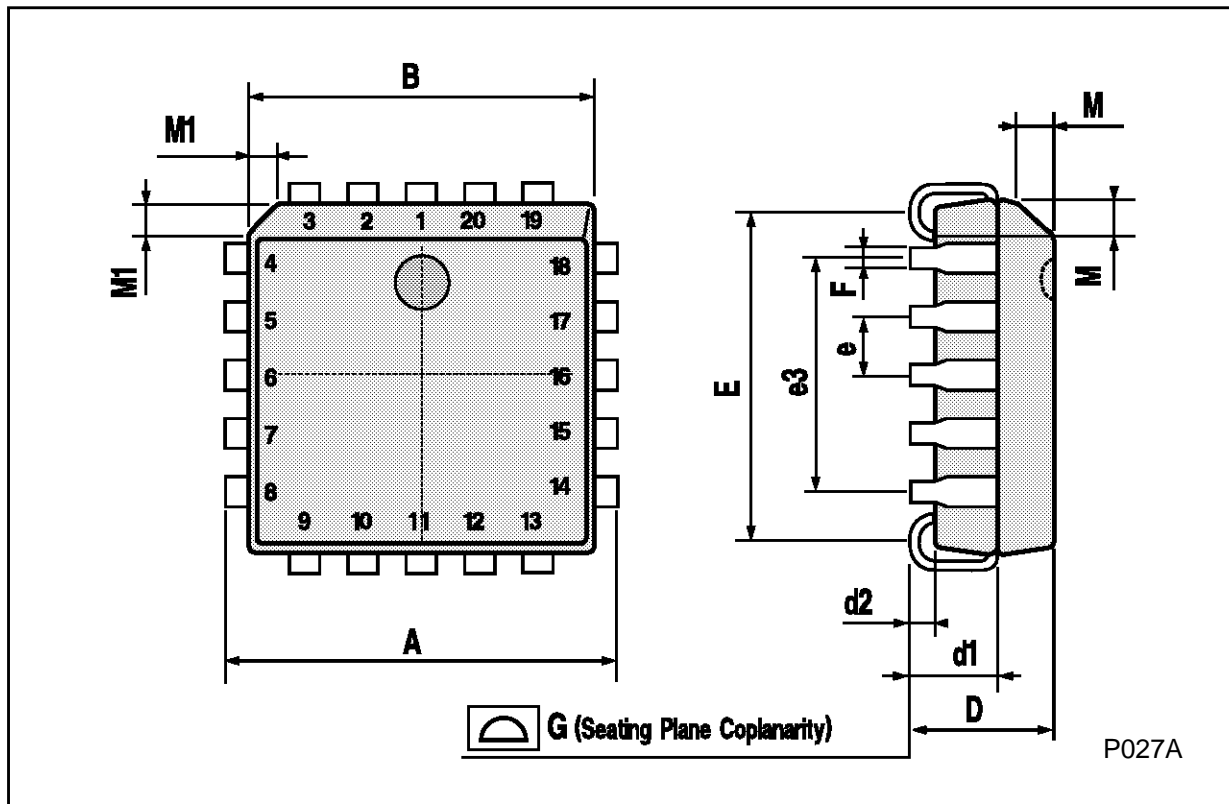
| DIM. | mm | | | inch | | |
|------|------------|------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | | 1.75 | | | 0.068 |
| a1 | 0.1 | | 0.2 | 0.004 | | 0.007 |
| a2 | | | 1.65 | | | 0.064 |
| b | 0.35 | | 0.46 | 0.013 | | 0.018 |
| b1 | 0.19 | | 0.25 | 0.007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