

GATE J-K MASTER-SLAVE FLIP-FLOPS

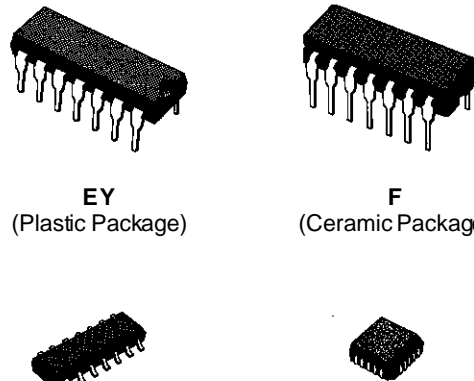
- 16 MHz TOGGLE RATE (typ.) AT $V_{DD} - V_{SS} = 10V$
- GATED INPUTS
- QUIESCENT CURRENT SPECIFIED TO 20v FOR HCC DEVICE
- 5V, 10V AND 15V PARAMETRIC RATINGS
- INPUT CURRENT OF 100nA AT 18V AND 25oC FOR HCC DEVICE
- 100% TESTED FOR QUIESCENT CURRENT
- MEETS ALL REQUIREMENTS OF JEDEC TENTATIVE STANDARD No 13 A, "STANDARD SPECIFICATIONS FOR DESCRIPTION OF B SERIES CMOS DEVICES"

inputs is transferred to the Q and \bar{Q} outputs on the positive edge of the clock pulse. SET and RESET inputs (active high) are provided for asynchronous operation.

DESCRIPTION

The **HCC4095B/4096B** (extended temperature range) and **HCF4095B/4096B** (intermediate temperature range) are monolithic integrated circuits, available in 14 lead dual in-line plastic or ceramic package and plastic micropackage.

The **HCC/HCF4095B** and **HCC/HCF4096B** are J-K Master-Slave Flip-Flops featuring separate AND gating of multiple J and K inputs. The gated J-K input control transfer of information into the master section during clocked operation. Information on the J-K



EY
(Plastic Package)

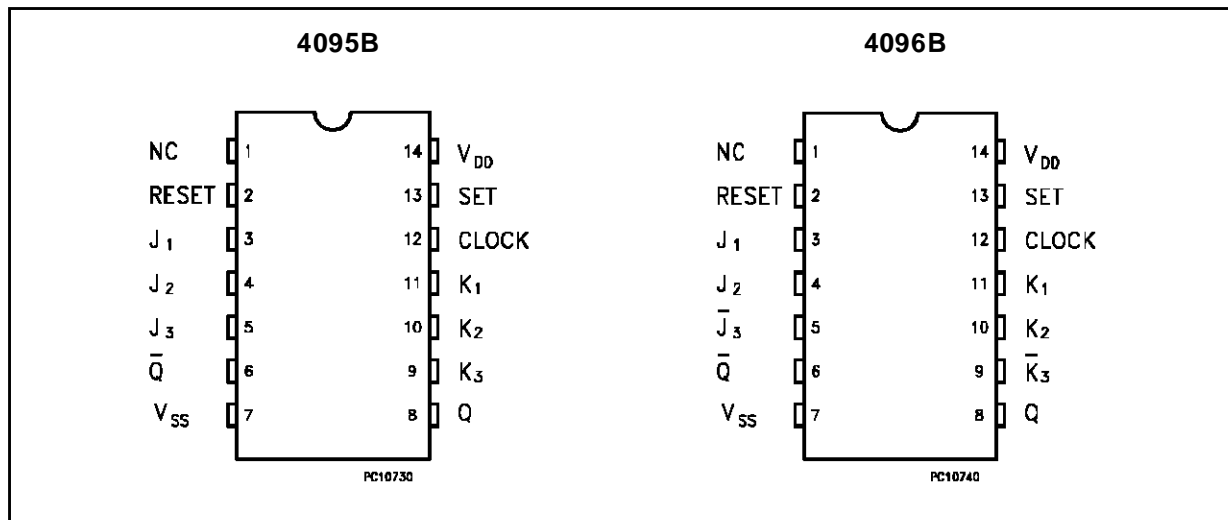
F
(Ceramic Package)

M1
(Micro Package)

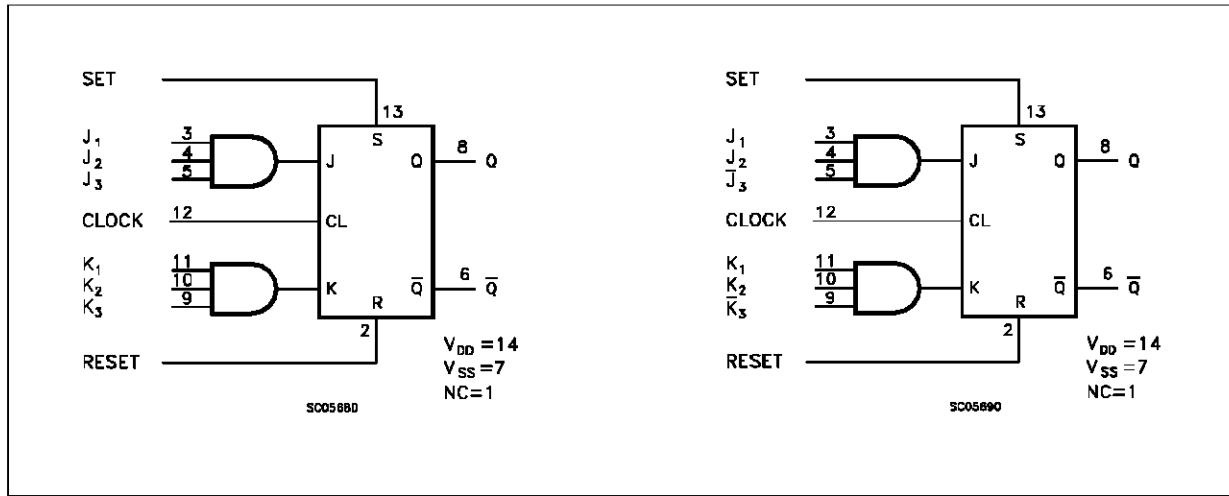
C1
(Chip Carrier)

ORDER CODES :
HCC40XXBF HCF40XXBM1
HCF40XXBEY HCF40XXBC1

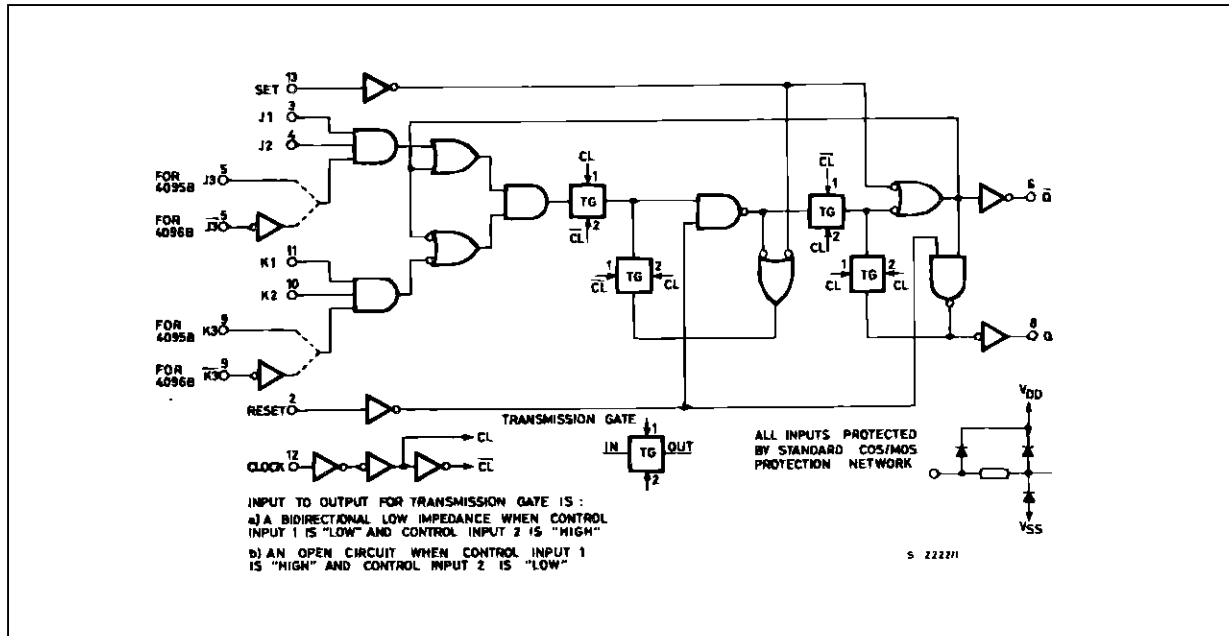
PIN CONNECTIONS



FUNCTIONAL DIAGRAMS



LOGIC DIAGRAM



TRUTH TABLES

SYNCHRONOUS OPERATION (S=0 R=0)

| Inputs Before Positive Clock Transition | | Outputs After Positive Clock Transition | |
|---|-----|---|-----------|
| J * | K * | Q | \bar{Q} |
| 0 | 0 | No Change | |
| 0 | 1 | 0 | 1 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | Toggles | |

* For 4095B J = J1 • J2 • J3, K = K1 • K2 • K3
* For 4096B J = J1 • J2 • J3, K = K1 • K2 • K3

ASYNCHRONOUS OPERATION (J and K DON'T CARE)

| S | R | Q | \bar{Q} |
|---|---|-----------|-----------|
| 0 | 0 | No Change | |
| 0 | 1 | 0 | 1 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 0 |

0 = V_{SS}, 1 = V_{DD}

ABSOLUTE MAXIMUM RATING

| Symbol | Parameter | Value | Unit |
|-------------------|--|-------------------------------|------|
| V _{DD} * | Supply Voltage: HCC Types HCF Types | -0.5 to +20 | V |
| | | -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 Top = Full Package Temperature Range | 200 | mW |
| | | 100 | mW |
| T _{op} | Operating Temperature: HCC Types HCF Types | -55 to +125 | °C |
| | | -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 |

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 | | 1 | | 0.02 | 1 | | 30 | μ A |
| | | | 0/10 | | | 10 | | 2 | | 0.02 | 2 | | 60 | |
| | | | 0/15 | | | 15 | | 4 | | 0.02 | 4 | | 120 | |
| | | 0/20 | | | 20 | | 20 | | 0.04 | 20 | | 600 | | |
| | | HCF Types | 0/5 | | | 5 | | 4 | | 0.02 | 4 | | 30 | |
| | | | 0/10 | | | 10 | | 8 | | 0.02 | 8 | | 60 | |
| 0/15 | | | | 15 | | 16 | | 0.02 | 16 | | 120 | | | |
| 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 | | 4.5 | < 1 | 5 | 3.5 | | 3.5 | | | 3.5 | | V | |
| | | | 9 | < 1 | 10 | 7 | | 7 | | | 7 | | | |
| | | | 13.5 | < 1 | 15 | 11 | | 11 | | | 11 | | | |
| V _{IL} | Input Low Voltage | | 0.5 | < 1 | 5 | | 1.5 | | | 1.5 | | 1.5 | V | |
| | | | 1 | < 1 | 10 | | 3 | | | 3 | | 3 | | |
| | | | 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 | 0/18 | Any Input | | 18 | | \pm 0.1 | | \pm 10 ⁻⁵ | \pm 0.1 | | \pm 1 | μ A | |
| | | 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.

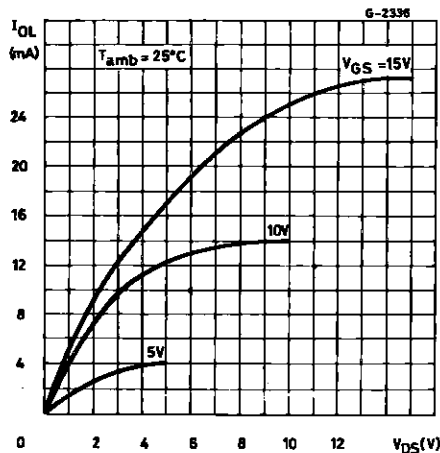
* T_{HIGH} = +125 °C for HCC device; +85 °C for HCF device.

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

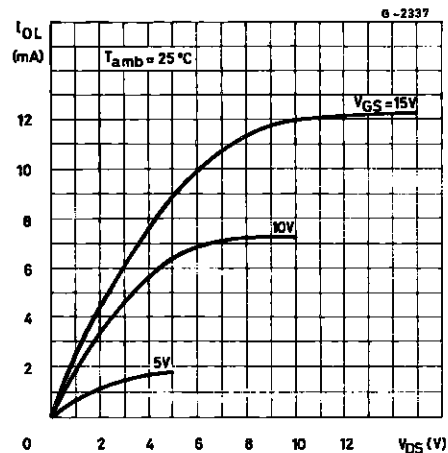
DYNAMIC ELECTRICAL CHARACTERISTICS ($T_{amb} = 25\text{ }^{\circ}\text{C}$, $C_L = 50\text{ pF}$, $R_L = 200\text{ K}\Omega$, typical temperature coefficient for all V_{DD} values is $03\text{ } \%/^{\circ}\text{C}$, all input rise and fall times = 20 ns)

| Symbol | Parameter | Test Conditions | | Value | | | Unit |
|------------------------|---------------------------------------|-----------------|--------------|-------|------|------|---------------|
| | | | V_{DD} (V) | Min. | Typ. | Max. | |
| t_{PLH} t_{PHL} | Propagation Delay Time | | 5 | | 250 | 500 | ns |
| | | | 10 | | 100 | 200 | |
| | | | 15 | | 75 | 150 | |
| t_{PLH} t_{PHL} | Propagation Delay Time (Set or Reset) | | 5 | | 150 | 300 | ns |
| | | | 10 | | 75 | 150 | |
| | | | 15 | | 50 | 100 | |
| t_{THL} t_{TLH} | Transition Time | | 5 | | 100 | 200 | ns |
| | | | 10 | | 50 | 100 | |
| | | | 15 | | 40 | 80 | |
| f_{CL} | Maximum Clock Input Frequency | | 5 | 3.5 | 7 | | MHz |
| | | | 10 | 8 | 16 | | |
| | | | 15 | 12 | 24 | | |
| t_w | Clock Pulse Width | | 5 | 140 | 70 | | ns |
| | | | 10 | 60 | 30 | | |
| | | | 15 | 40 | 20 | | |
| t_r t_f | Clock Input Rise or Fall Time | | 5 | | | 15 | μs |
| | | | 10 | | | 5 | |
| | | | 15 | | | 5 | |
| t_w | Set or Reset Pulse Width | | 5 | 200 | 100 | | ns |
| | | | 10 | 100 | 50 | | |
| | | | 15 | 50 | 25 | | |
| t_{setup} | Data Setup Time | | 5 | 400 | 200 | | ns |
| | | | 10 | 160 | 80 | | |
| | | | 15 | 100 | 50 | | |

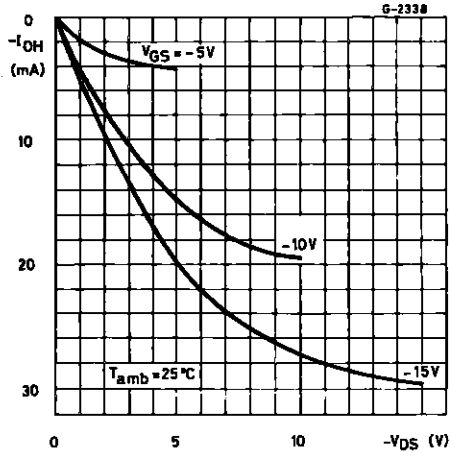
Typical Output Low (sink) Current Characteristics



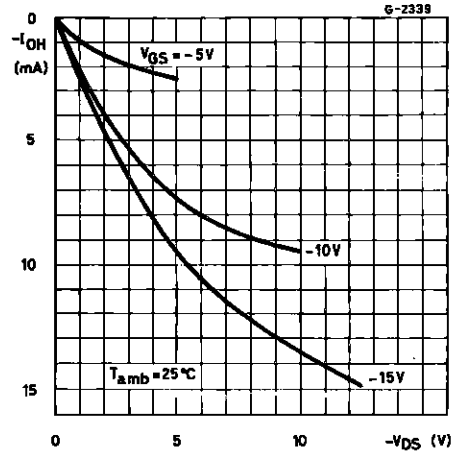
Minimum Output low (sink) Current Characteristics



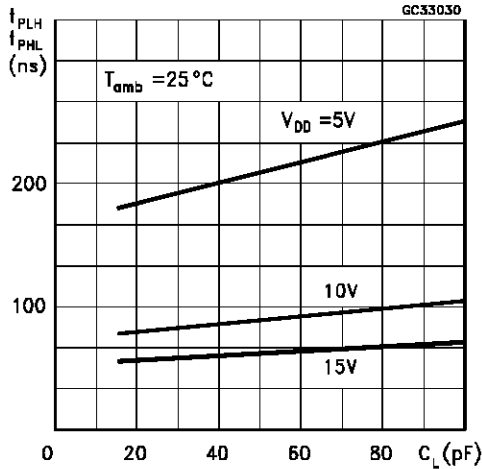
Typical Output High (source) Current Characteristics



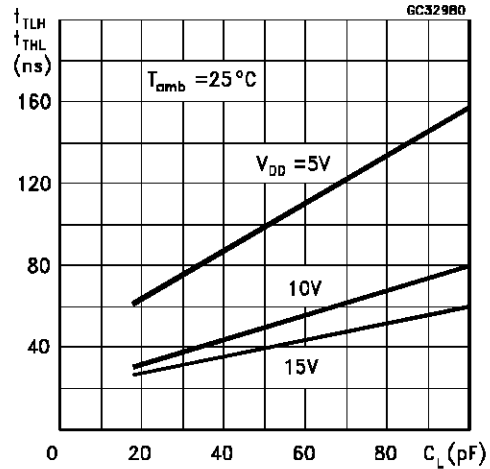
Minimum Output High (source) Current Characteristics



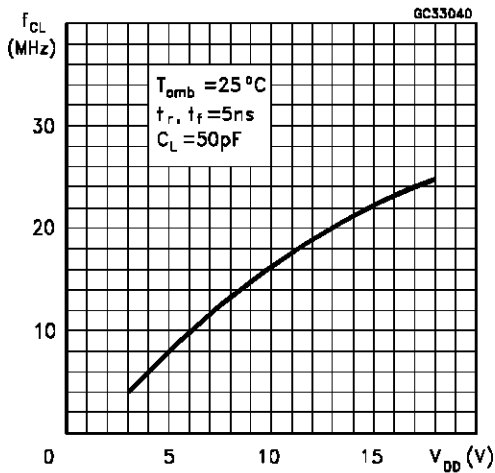
Typical Propagation Delay Time vs Load Capacitance



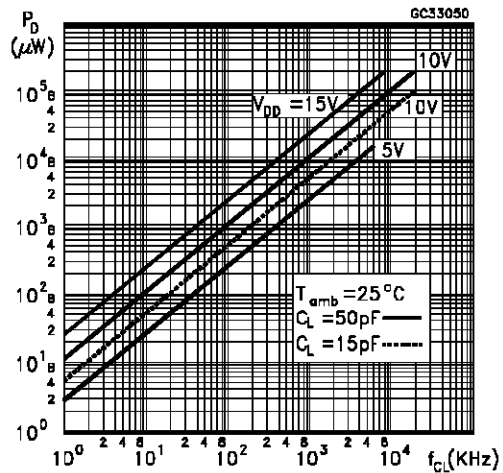
Typical Transition Time vs Load Capacitance



Typical Clock Frequency vs Supply Voltage (Toggle Mode)

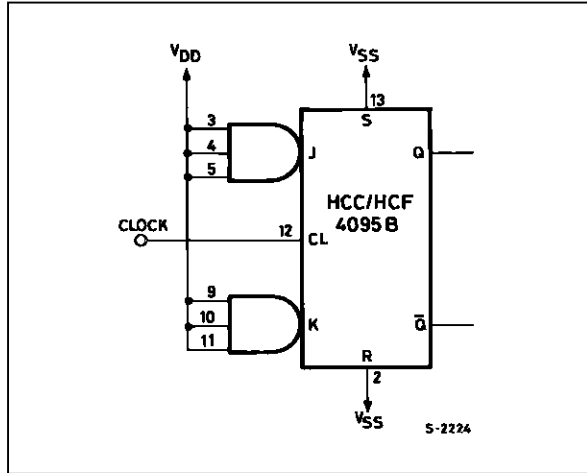


Typical Power Power Dissipation Vs. Input Clock Frequency

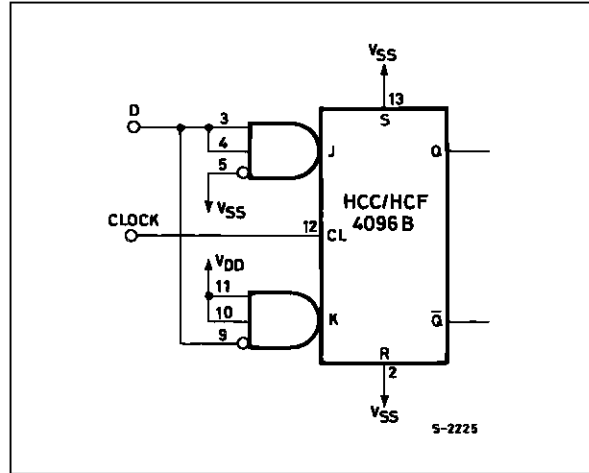


TYPICAL APPLICATIONS

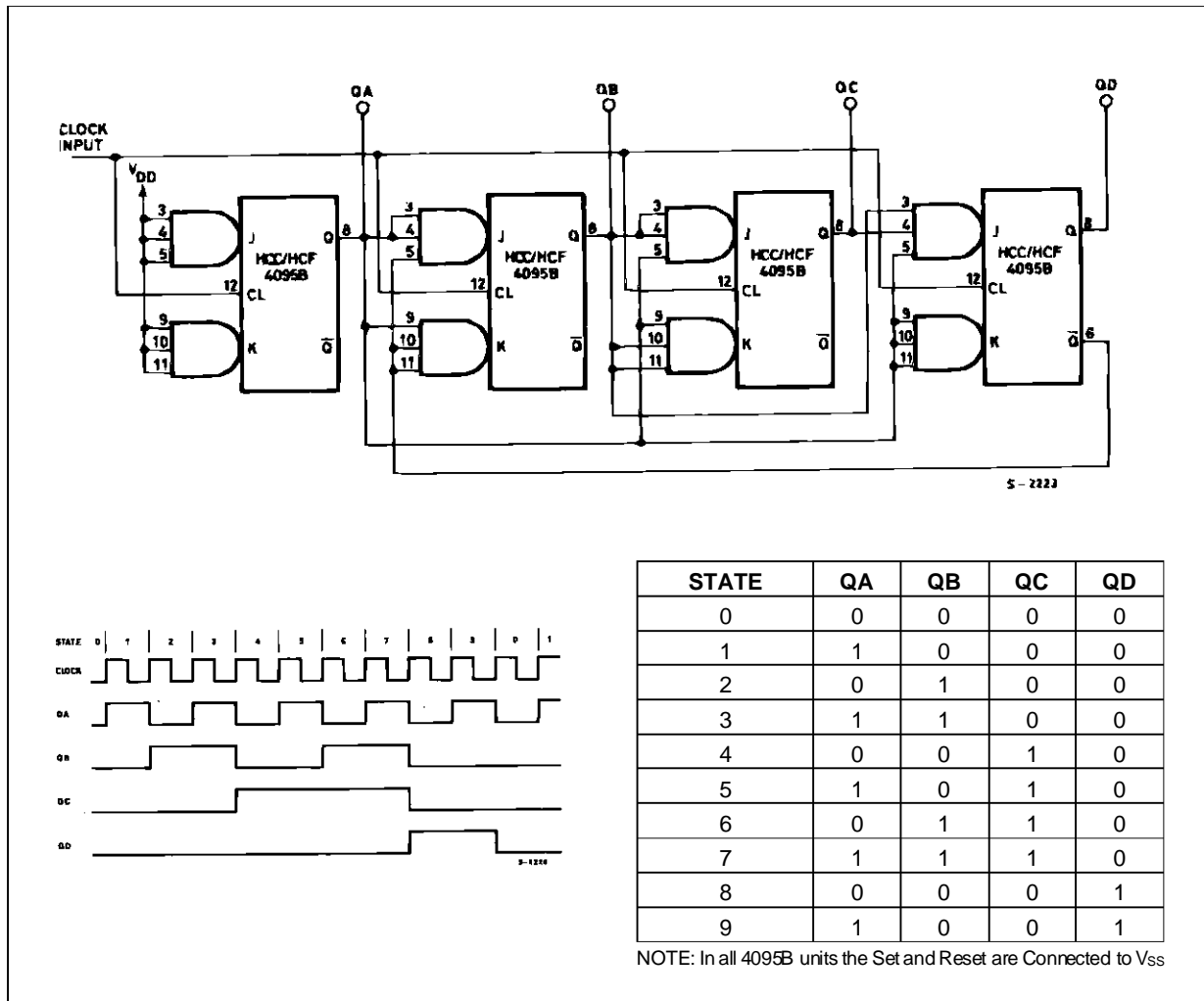
T-type Flip-Flop



D-type Flip-Flop

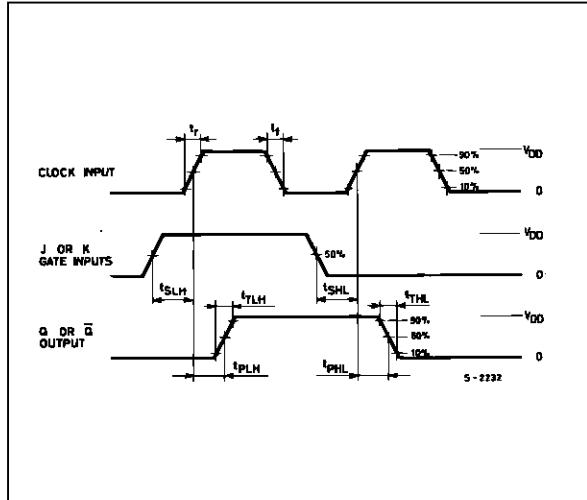


Synchronous Binary Divide by Ten Counter

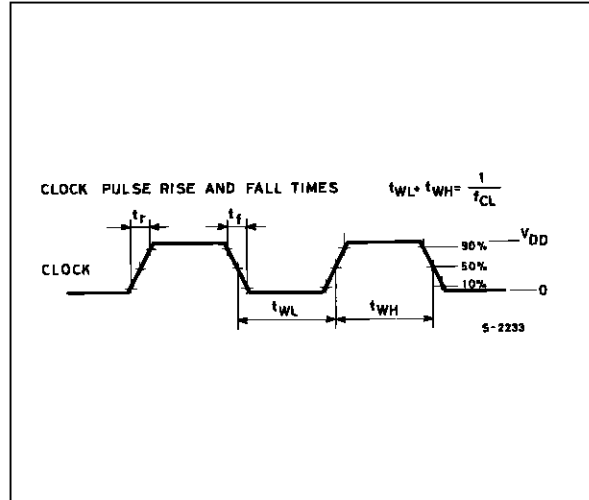


WAVEFORMS

Propagation Delay, Transition and Setup Time

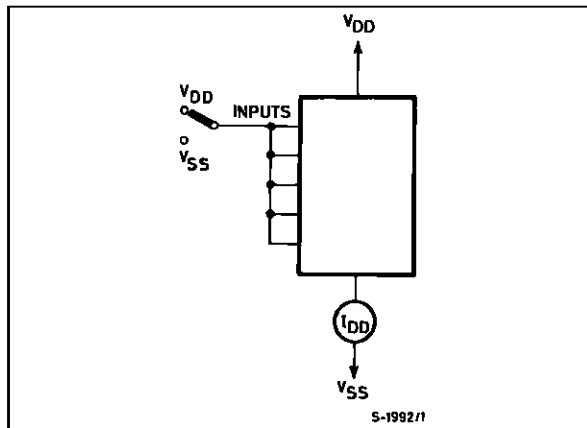


Clock Pulse Rise and Fall Time

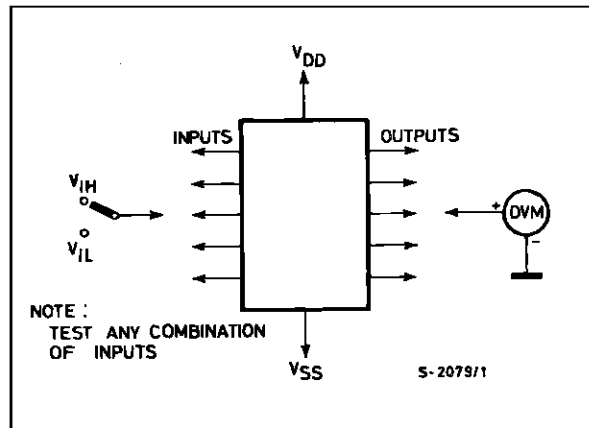


TEST CIRCUITS

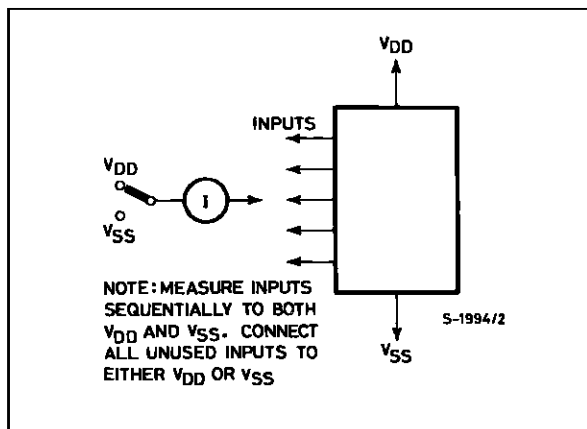
Quiescent Device Current



Noise Immunity.

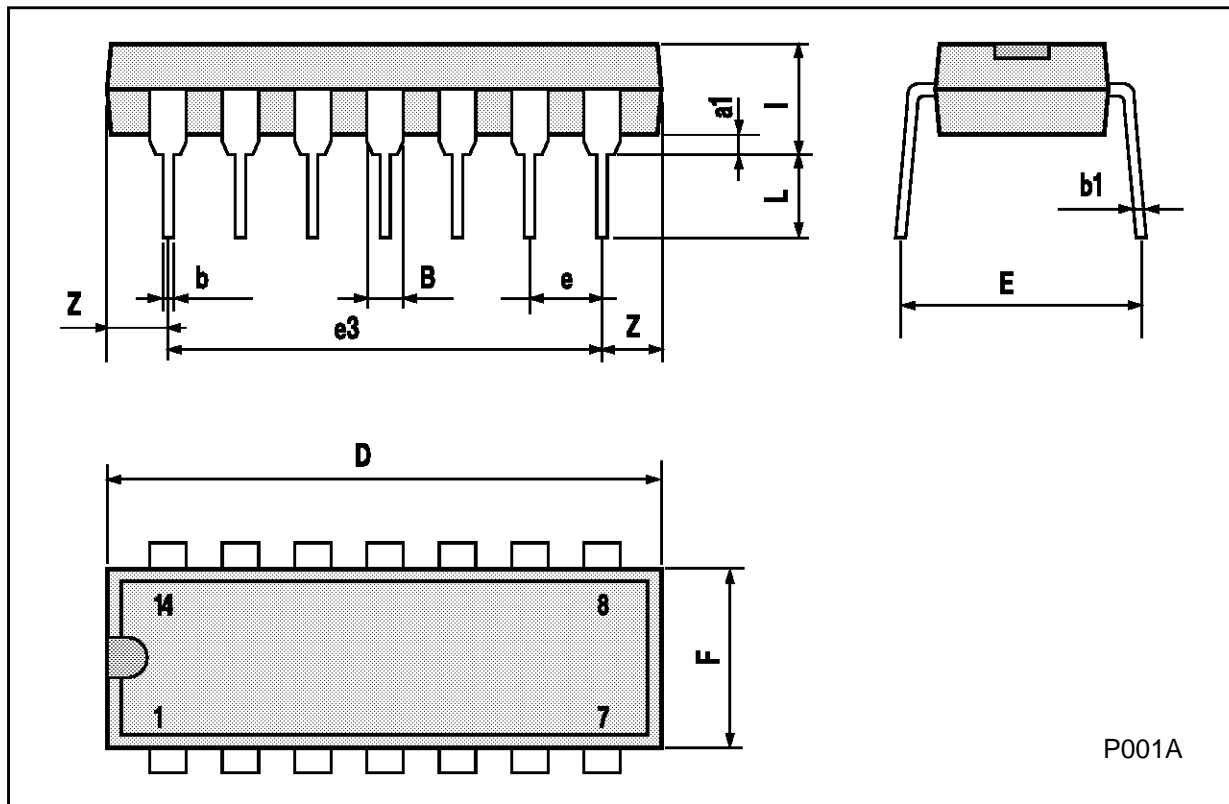


Input Leakage Current.



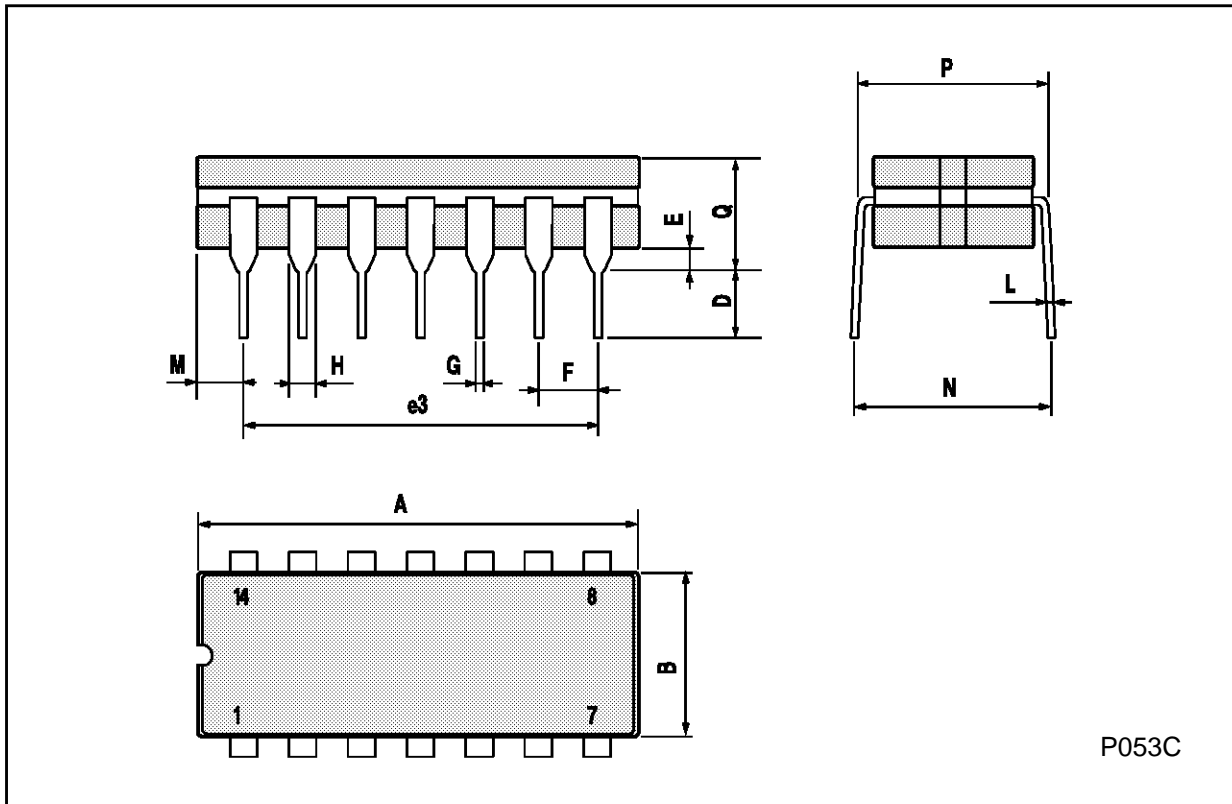
Plastic DIP14 MECHANICAL DATA

| 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 |



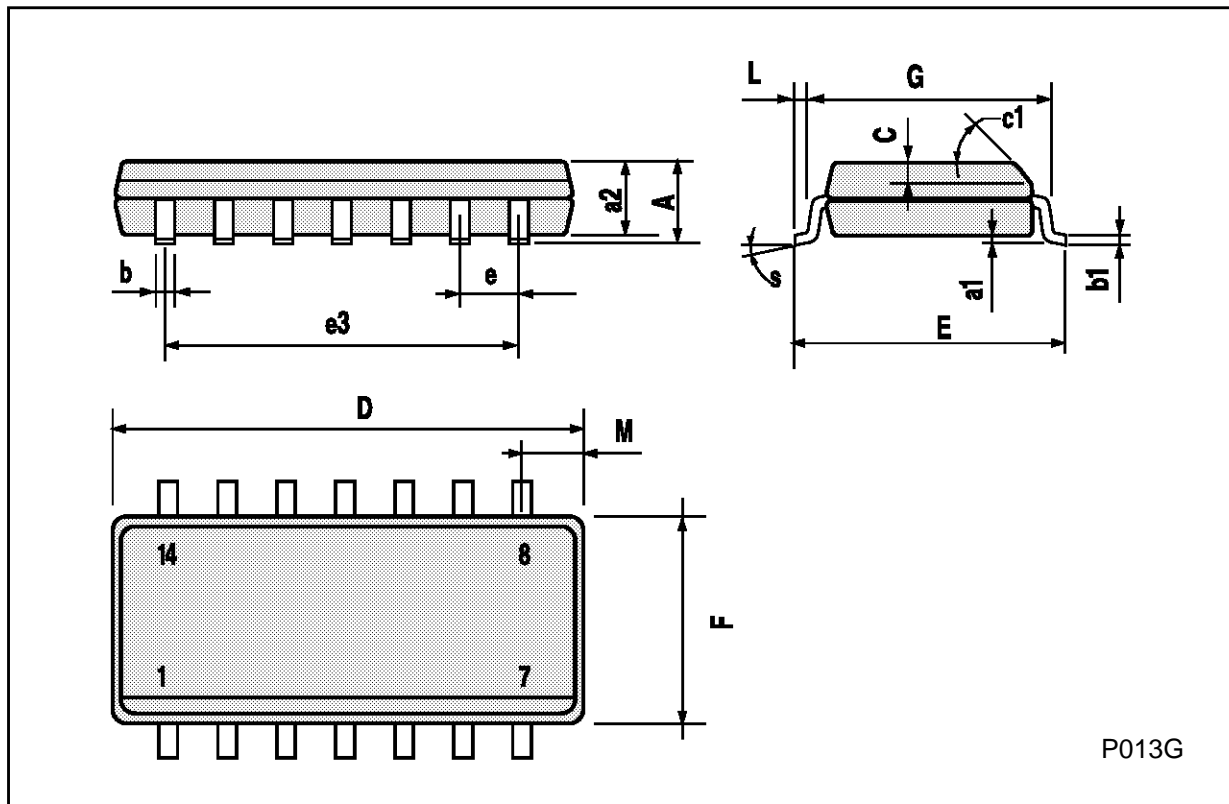
Ceramic DIP14/1 MECHANICAL DATA

| 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 |



SO14 MECHANICAL DATA

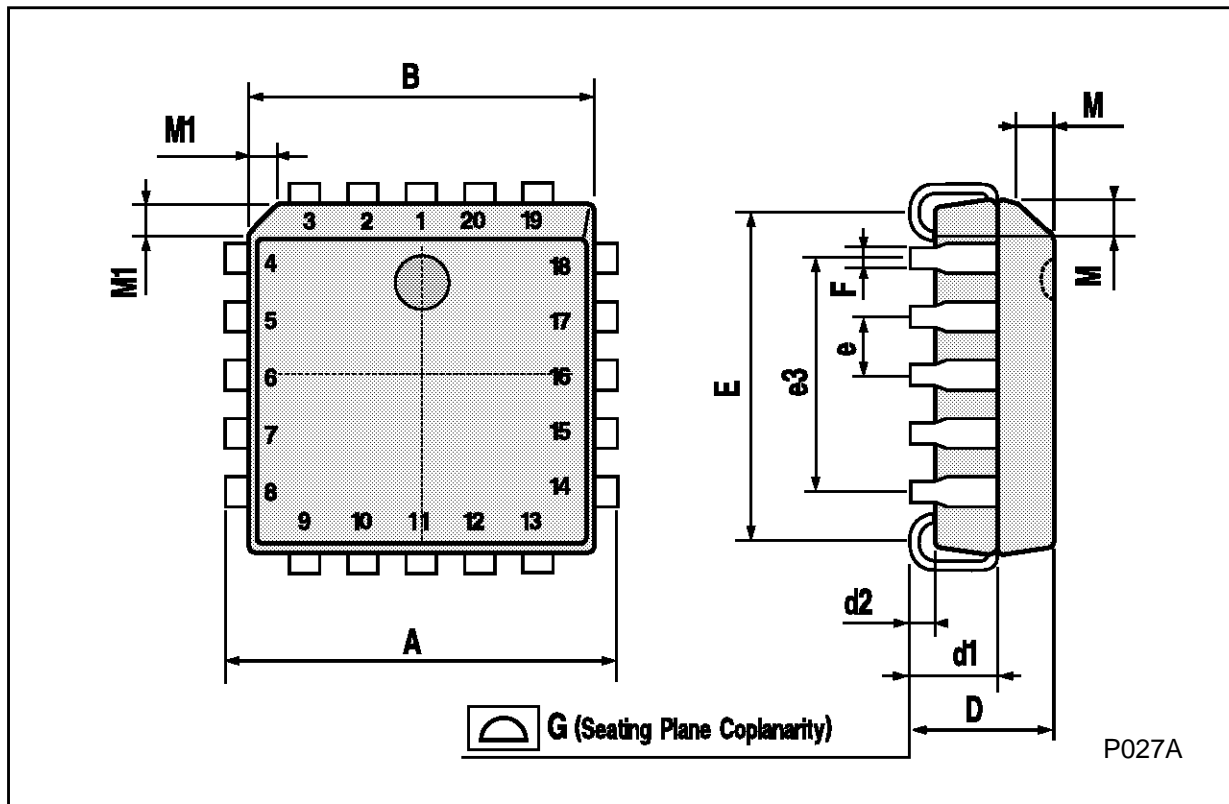
| DIM. | mm | | | inch | | |
|------|------------|------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | | 1.75 | | | 0.068 |
| a1 | 0.1 | | 0.2 | 0.003 | | 0.007 |
| a2 | | | 1.65 | | | 0.064 |
| b | 0.35 | | 0.46 | 0.013 | | 0.018 |
| b1 | 0.19 | | 0.25 | 0.007 | | 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 | |



Information furnished is believed to be accurate and reliable. However, SGS-THOMSON Microelectronics assumes no responsibility for the consequences of use of such information nor for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of SGS-THOMSON Microelectronics. Specifications mentioned in this publication are subject to change without notice. This publication supersedes and replaces all information previously supplied. SGS-THOMSON Microelectronics products are not authorized for use as critical components in life support devices or systems without express written approval of SGS-THOMSON Microelectronics.

© 1994 SGS-THOMSON Microelectronics - All Rights Reserved

SGS-THOMSON Microelectronics GROUP OF COMPANIES
Australia - Brazil - France - Germany - Hong Kong - Italy - Japan - Korea - Malaysia - Malta - Morocco - The Netherlands -
Singapore - Spain - Sweden - Switzerland - Taiwan - Thailand - United Kingdom - U.S.A