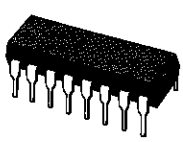
SGS-THOMSON MICROELECTRONICS

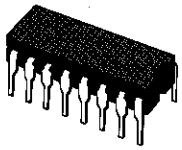
# HCC4060B
# HCF4060B

## 14-STAGE RIPPLE CARRY BINARY COUNTER/DIVIDER AND OSCILLATOR

- MEDIUM-SPEED OPERATION
- COMMON RESET
- FULLY STATIC OPERATION
- BUFFERED INPUTS AND OUTPUTS
- 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
- 1005 TESTED FOR QUIESCENT CURRENT
- MEETS ALL REQUIREMENTS OF JEDEC TENTATIVE STANDARD N. 13A, " STANDARD SPECIFICATIONS FOR DESCRIPTION OF ' B ' SERIES CMOS DEVICES "



**EY**
(Plastic Package)



**F**
(Ceramic Package)

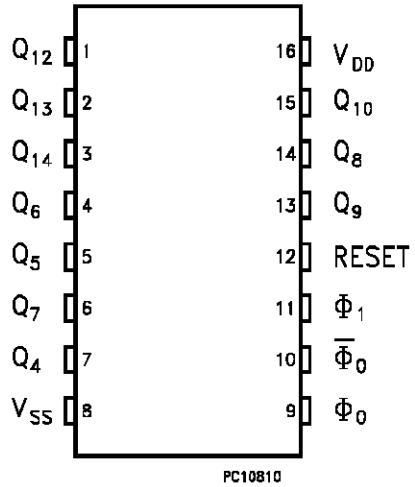
**M1**
(Micro Package)

**C1**
(Chip Carrier)

**ORDER CODES :**

| | |
|---|---|
| HCC4060BF | HCF4060BM1 |
| HCF4060BEY | HCF4060BC1 |

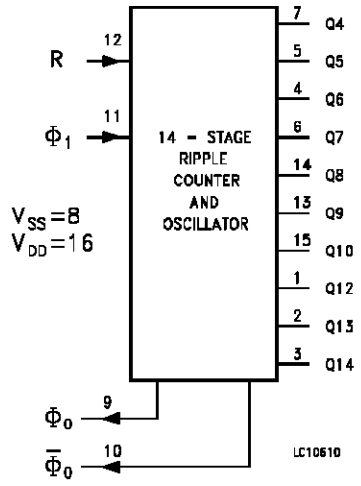
**PIN CONNECTIONS**




### DESCRIPTION

The **HCC4060B** (extended temperature range) and **HCF4060B** (intermediate temperature range) are monolithic integrated circuit, available in 16-lead dual in line plastic or ceramic package and plastic micropackage. The **HCC/HCF4060B** consist of an oscillator section and 14 ripple carry binary counter stages. The oscillator configuration allows design of either RC or crystal oscillator circuits. A RESET input is provided which reset the counter to the all 0's state and disables oscillator. A high level on the RESET line accmplishes the reset function. All counter stages are master slave flip-flops. The state of the counter is advanced one step in binary order on the negative transition of $\phi_1$ (and $\phi_0$). All inputs and outputs are fully buffered. Schmitt trigger action on the clock lin permits unlimited clock rise and fall time.

## FUNCTIONAL DIAGRAM




## ABSOLUTE MAXIMUM RATING

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{DD}$ * | Supply Voltage: **HCC** Types<br>**HCF** Types | -0.5 to +20<br>-0.5 to +18 | V<br>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)<br>Dissipation per Output Transistor<br>for Top = Full Package Temperature Range | 200<br><br>100 | mW<br><br>mW |
| $T_{op}$ | Operating Temperature: **HCC** Types<br>**HCF** Types | -55 to +125<br>-40 to +85 | $^oC$<br>$^oC$ |
| $T_{stg}$ | Storage Temperature | -65 to +150 | $^oC$ |

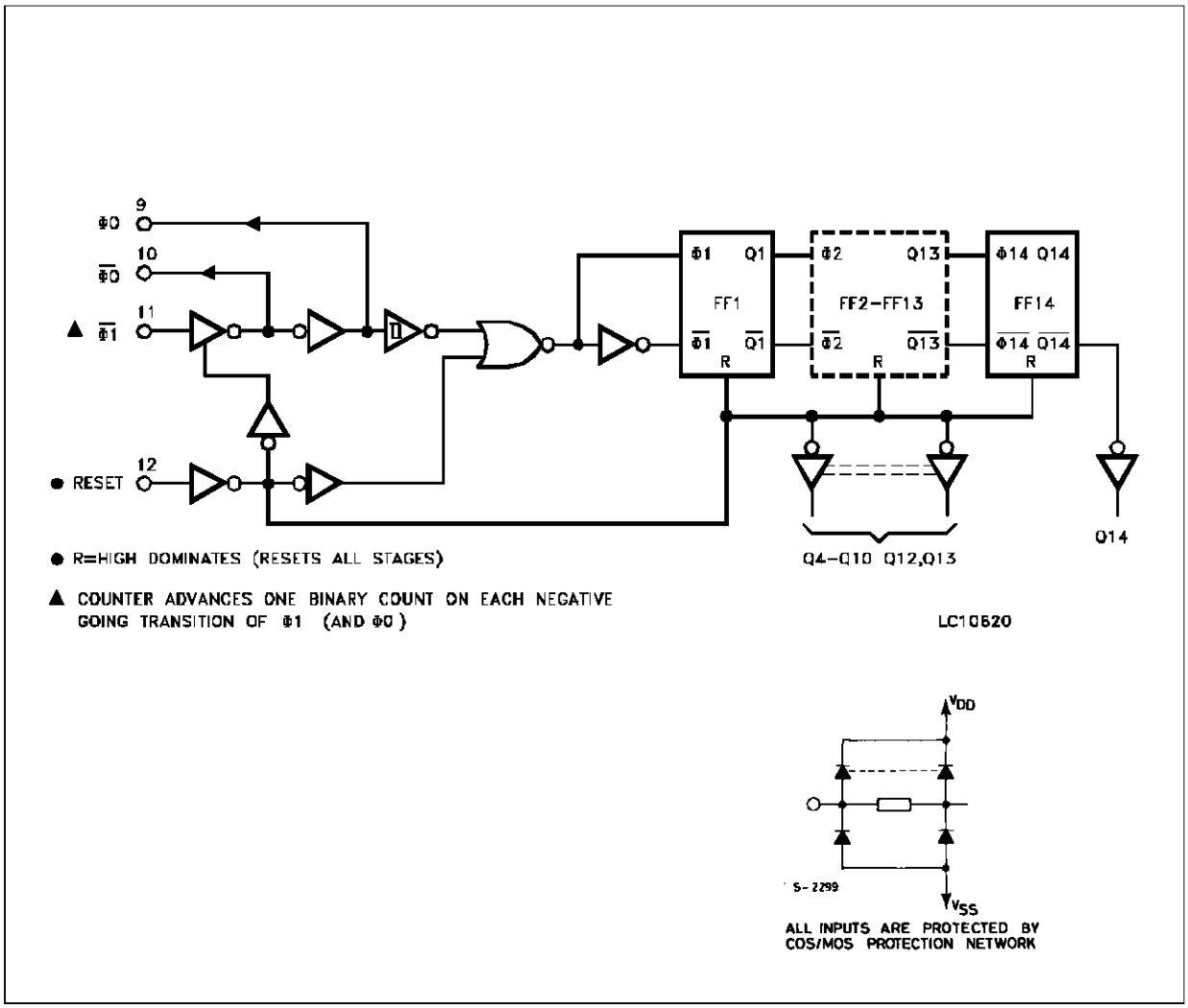
Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure 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<br>**HCF** Types | 3 to 18<br>3 to 15 | V<br>V |
| $V_I$ | Input Voltage | 0 to $V_{DD}$ | V |
| $T_{op}$ | Operating Temperature: **HCC** Types<br>**HCF** Types | -55 to +125<br>-40 to +85 | $^oC$<br>$^oC$ |

## LOGIC DIAGRAM



**STATIC ELECTRICAL CHARACTERISTICS** (over recommended operating conditions)

| Symbol | Parameter | | Test Conditios | | | | Value | | | | | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | $V_I$ (V) | $V_O$ (V) | $\|I_O\|$ (µA) | $V_{DD}$ (V) | $T_{LOW}$ * Min. | $T_{LOW}$ * Max. | 25 °C Min. | 25 °C Typ. | 25 °C Max. | $T_{HIGH}$ * Min. | $T_{HIGH}$ * Max. | |
| $I_L$ | Quiescent Current | HCC Types | 0/5 | | | 5 | | 5 | | 0.04 | 5 | | 150 | µA |
| | | | 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 | |
| | | | 0/15 | | | 15 | | 80 | | 0.04 | 80 | | 600 | |
| $V_{OH}$ | 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 | | 0/18 | Any Input | | 18 | | ±0.1 | | $±10^{-5}$ | ±0.1 | | ±1 | µA |
| | | | 0/15 | | | 15 | | ±0.3 | | $±10^{-5}$ | ±0.3 | | ±1 | µA |
| $C_I$ | 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.

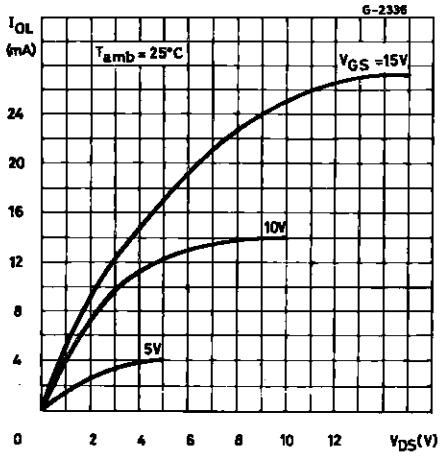
The Noise Margin for both "1" and "0" level is: 1V min. with $V_{DD}$ = 5 V, 2 V min. with $V_{DD}$ = 10 V, 2.5 V min. with $V_{DD}$ = 15 V

**DYNAMIC ELECTRICAL CHARACTERISTICS** ($T_{amb}$ = 25 °C, $C_L$ = 50 pF, $R_L$ = 200 KΩ, typical temperature coefficent for all $V_{DD}$ values is 03 %/°C, all input rise and fall times= 20 ns)

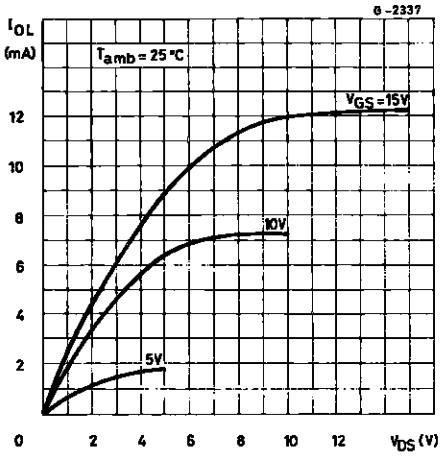
| Symbol | Parameter | Test Conditions | | Value | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | $V_{DD}$ (V) | Min. | Typ. | Max. | |
| $t_{PLH}$ $t_{PHL}$ | Propagation Delay Time ($\phi$ to Q4 out) | | 5 | | 370 | 740 | ns |
| | | | 10 | | 150 | 300 | |
| | | | 15 | | 100 | 200 | |
| $t_{PLH}$ $t_{PHL}$ | Propagation Delay Time (Qn to $Q_{n+1}$) | | 5 | | 100 | 200 | ns |
| | | | 10 | | 50 | 100 | |
| | | | 15 | | 40 | 80 | |
| $t_{TLH}$ $t_{THL}$ | Transition Time | | 5 | | 100 | 200 | ns |
| | | | 10 | | 50 | 100 | |
| | | | 15 | | 40 | 80 | |
| $t_W$ | Input Pulse Width | f = 100KHz | 5 | | 50 | 100 | ns |
| | | | 10 | | 20 | 40 | |
| | | | 15 | | 15 | 30 | |
| $t_r$, $t_f$ | Input Pulse Rise and Fall Time | | 5 | Unlimited | | | µs |
| | | | 10 | | | | |
| | | | 15 | | | | |
| $f_{max}$ | Maximum Clock Input Frequency | | 5 | 3.5 | 7 | | MHz |
| | | | 10 | 8 | 16 | | |
| | | | 15 | 12 | 24 | | |
| **RESET OPERATION** | | | | | | | |
| $t_{PHL}$ | Propagation Delay Time | | 5 | | 180 | 360 | ns |
| | | | 10 | | 80 | 160 | |
| | | | 15 | | 50 | 100 | |
| $t_W$ | Reset Pulse Width | | 5 | | 60 | 120 | ns |
| | | | 10 | | 30 | 60 | |
| | | | 15 | | 20 | 40 | |
| **RC OPERATION** | | | | | | | |
| | Variation of Frequency (Unit-to-Unit) | $C_X$ = 200pF $R_S$ = 560KΩ $R_X$ = 50 KΩ | 5 | 18 | 21.5 | 25 | KHz |
| | | | 10 | 20 | 23 | 26 | |
| | | | 15 | 21.1 | 24 | 27 | |
| | Variation of Frequency With Voltage Change (Same Unit) | $C_X$ = 200pF $R_S$ = 560KΩ $R_X$ = 50 KΩ | 5 to 10 | | | 2 | |
| | | | 10 to 15 | | | 1 | |
| $R_X$ | | $C_X$ = 10µF | 5 | | | 20 | MΩ |
| | | $C_X$ = 50µF | 10 | | | 20 | |
| | | $C_X$ = 10µF | 15 | | | 10 | |
| $C_X$ | | $R_X$ = 500 KΩ | 5 | | | 1000 | mF |
| | | $R_X$ = 300 KΩ | 10 | | | 50 | |
| | | $R_X$ = 300 KΩ | 15 | | | 50 | |
| | Maximum Oscillator Frequency * | $R_X$ = 5KΩ $C_X$ = 15pF | 10 | 530 | 650 | 810 | pF |
| | | | 15 | 690 | 800 | 94 | |

* RC oscillator applications are not recommended at supply voltages below 7V for $R_X$ = 50KΩ

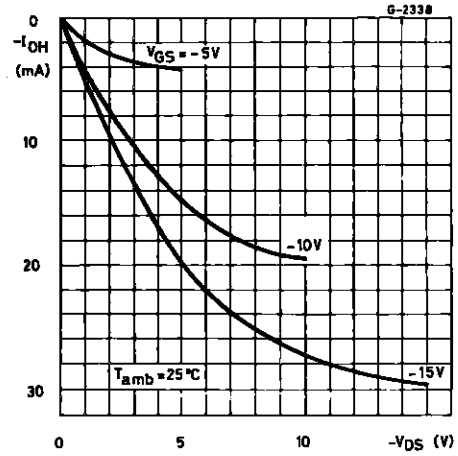
Typical Output Low (sink) Current Characteristics



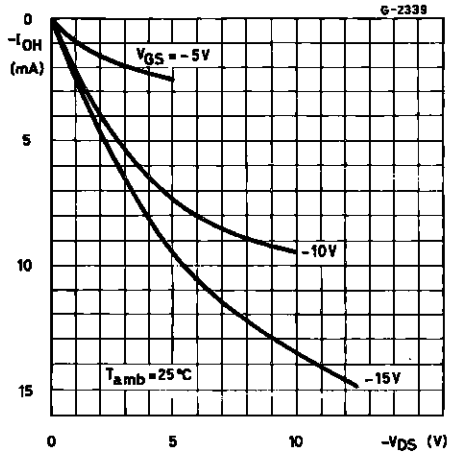

Minimum Output Low (sink) Current Characteristics



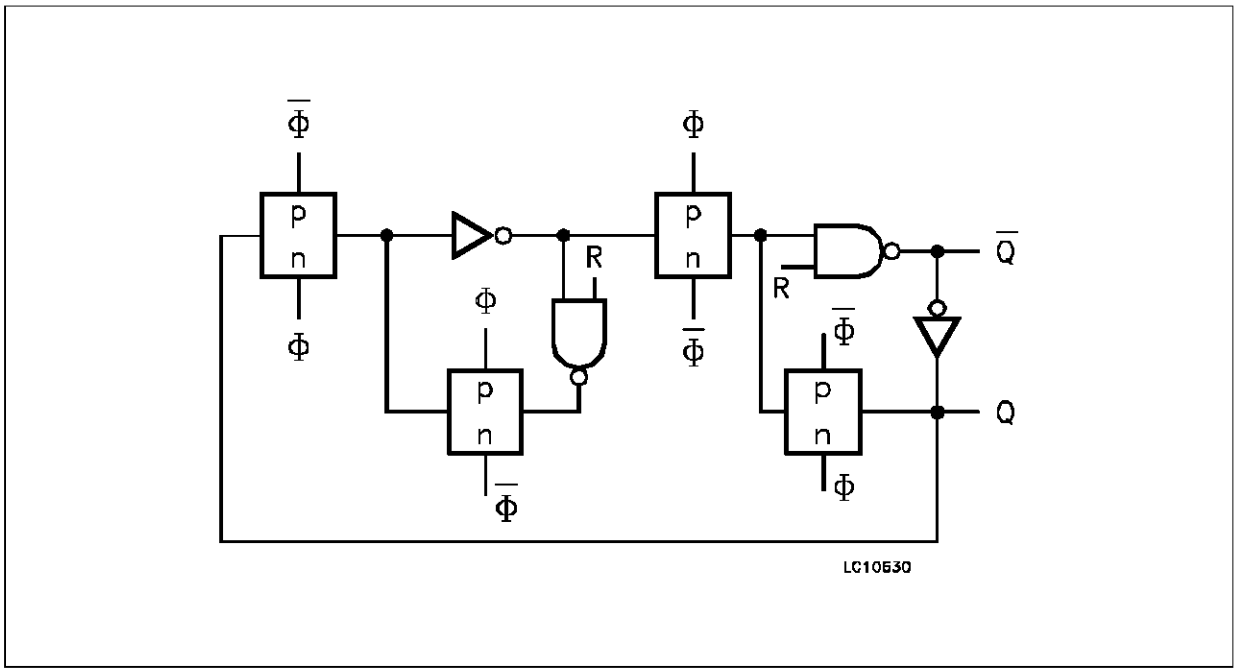

Typical Output High (source) Current Characteristics



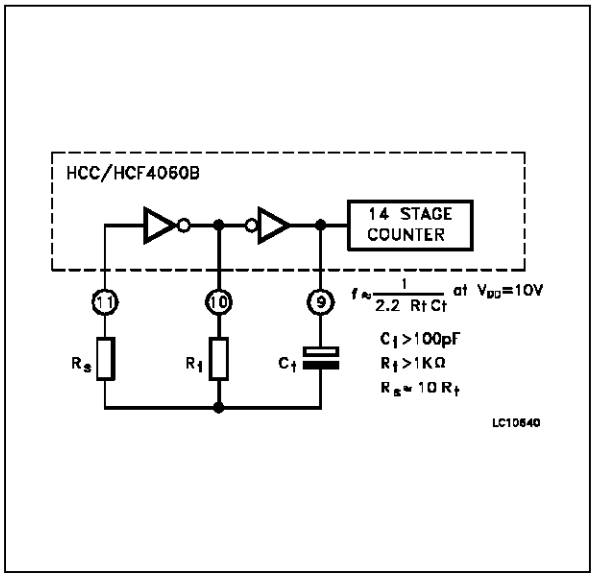

Minimum Output High (source) Current Characteristics



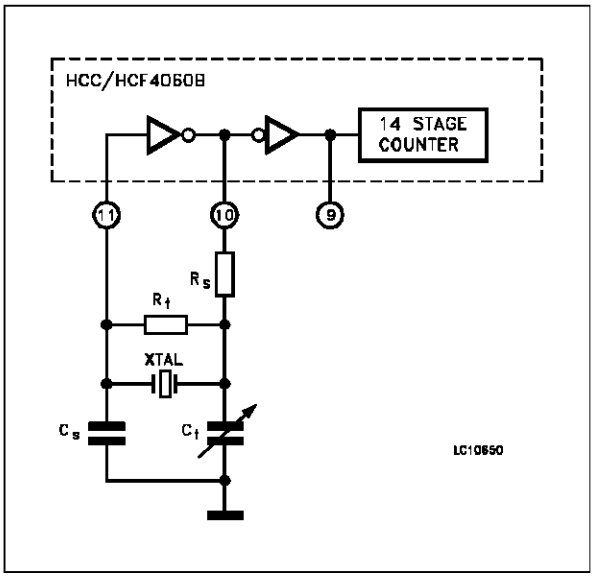
## DETAIL OF TYPICAL FILP-FLOP STAGE




## TYPICAL RC OSILLATOR CIRCUIT

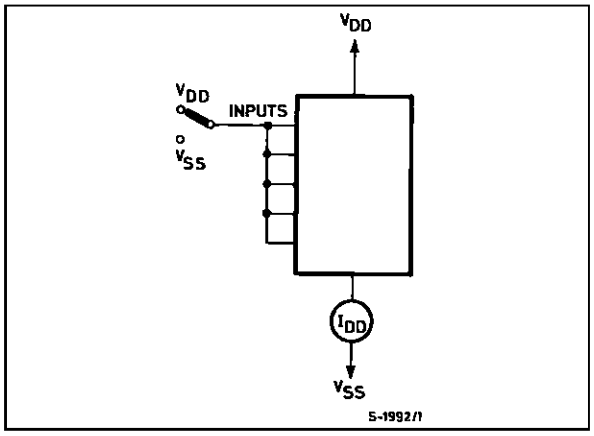



## TYPICAL CRYSTAL OSCILLATOR CIRCUIT

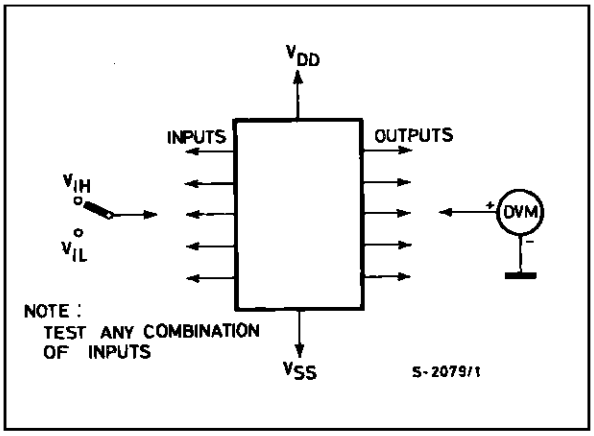


## TEST CIRCUITS

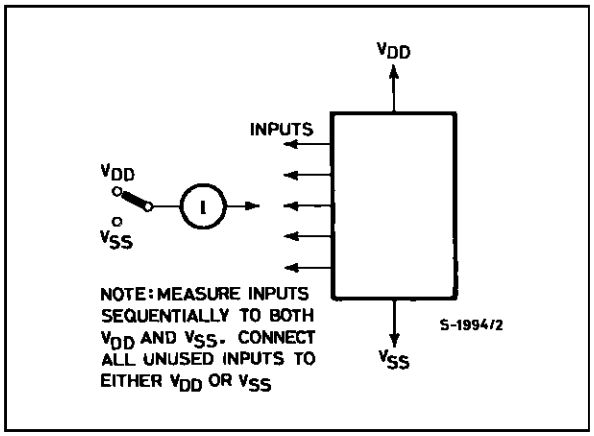
Quiescent Device Current.




Noise Immunity.

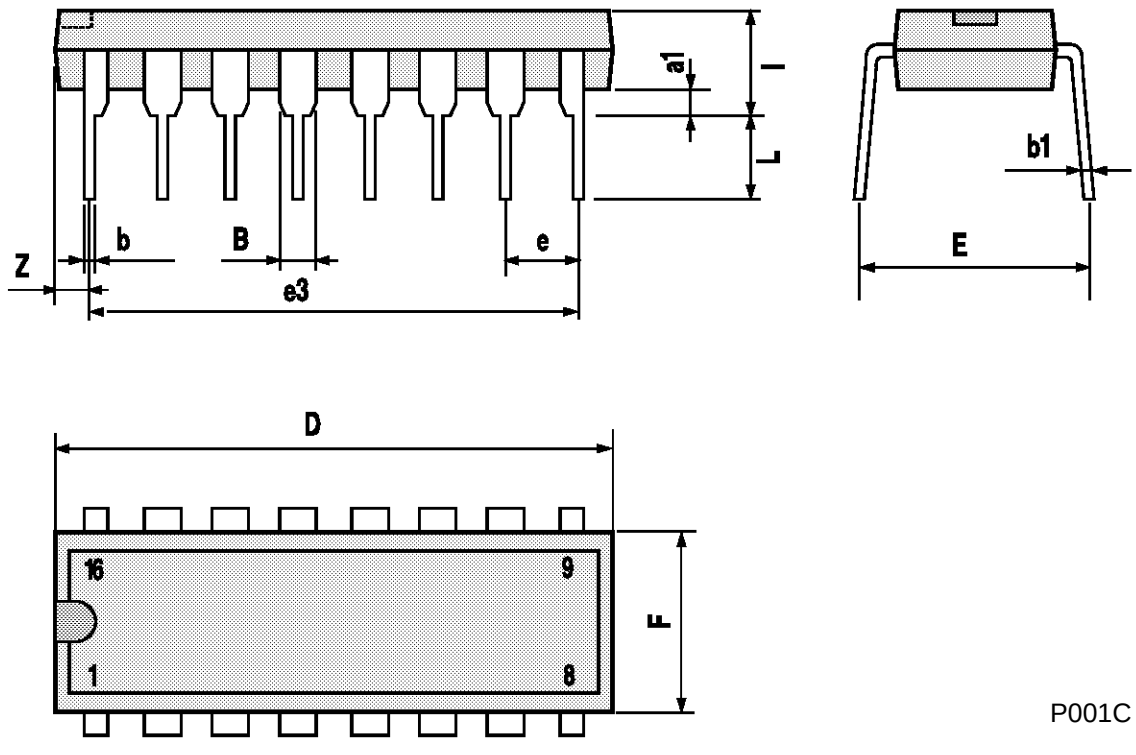



Input Leakage Current.



## Plastic DIP16 (0.25) MECHANICAL DATA

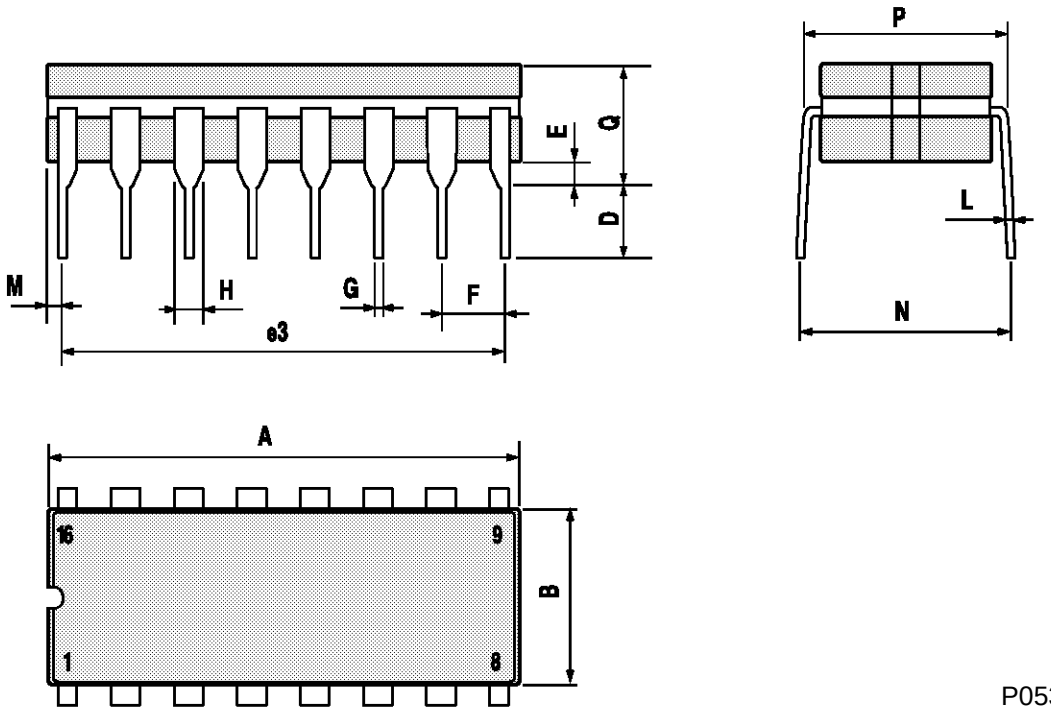
| DIM. | mm | | | inch | | |
|---|---|---|---|---|---|---|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| a1 | 0.51 | | | 0.020 | | |
| B | 0.77 | | 1.65 | 0.030 | | 0.065 |
| b | | 0.5 | | | 0.020 | |
| b1 | | 0.25 | | | 0.010 | |
| D | | | 20 | | | 0.787 |
| E | | 8.5 | | | 0.335 | |
| e | | 2.54 | | | 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

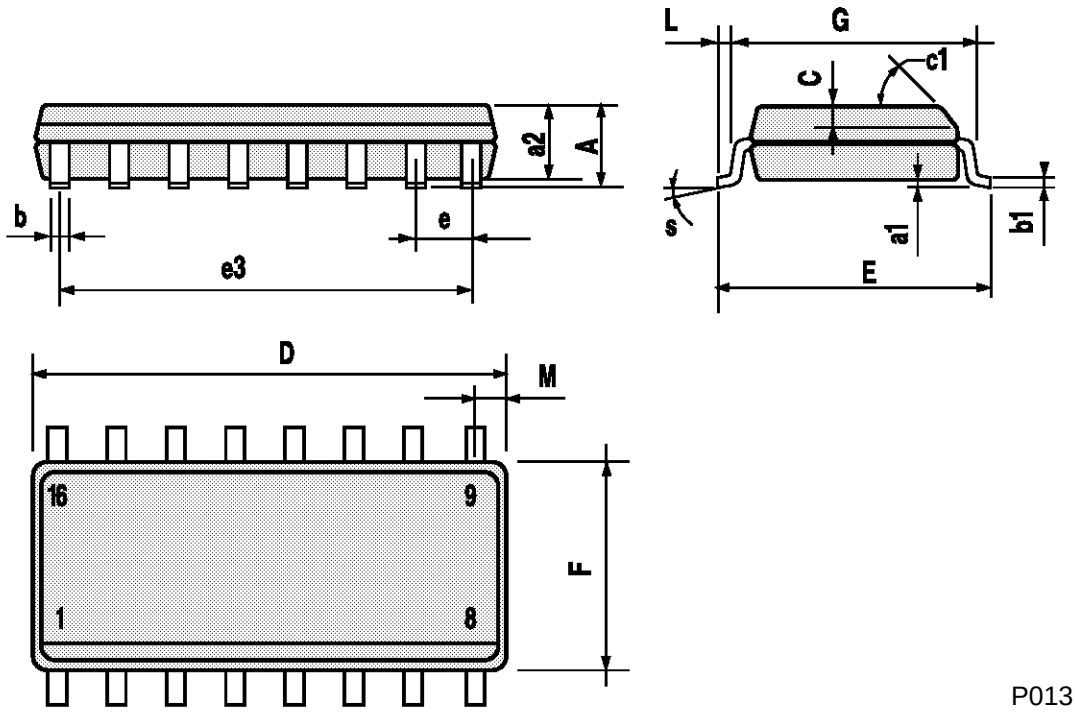
| DIM. | mm | | | inch | | |
|---|---|---|---|---|---|---|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | | 20 | | | 0.787 |
| B | | | 7 | | | 0.276 |
| D | | 3.3 | | | 0.130 | |
| E | 0.38 | | | 0.015 | | |
| e3 | | 17.78 | | | 0.700 | |
| F | 2.29 | | 2.79 | 0.090 | | 0.110 |
| G | 0.4 | | 0.55 | 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 |




P053D

## SO16 (Narrow) MECHANICAL DATA

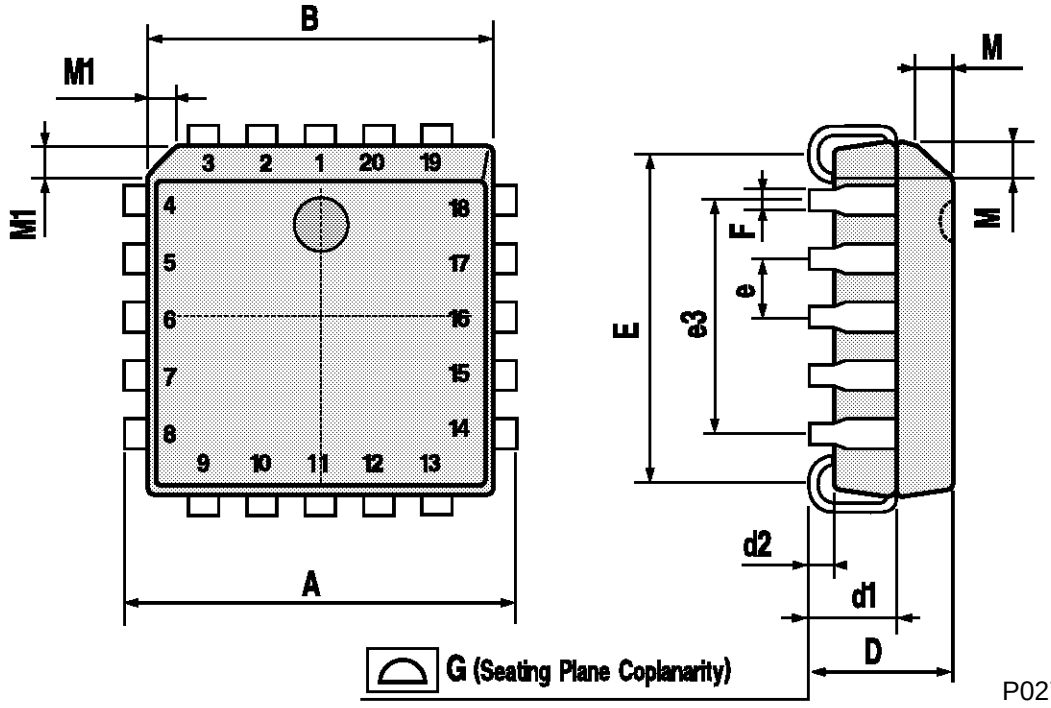
| DIM. | mm | | | inch | | |
|---|---|---|---|---|---|---|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | | 1.75 | | | 0.068 |
| a1 | 0.1 | | 0.2 | 0.004 | | 0.007 |
| a2 | | | 1.65 | | | 0.064 |
| b | 0.35 | | 0.46 | 0.013 | | 0.018 |
| b1 | 0.19 | | 0.25 | 0.007 | | 0.010 |
| C | | 0.5 | | | 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 | |




P027A