# COS/MOS INTEGRATED CIRCUIT

4045 B

HCC/HCF 4045B

## COS/MOS 21-STAGE COUNTER

- VERY LOW OPERATING DISSIPATION . . . . 1 mW (TYP.); @ $V_{DD}$ = 5V, $f_\phi$ = 1 MHz
- OUTPUT DRIVERS WITH SINCK OR SOURCE CAPABILITY . . . . 7 mA (TYP.) @ $V_{DD}$ = 5V
- MEDIUM SPEED (TYP.) . . . . $f_\phi$ = 16 MHz, @ $V_{DD}$ = 10V
- QUIESCENT CURRENT SPECIFIED TO 20V FOR HCC DEVICE
- 5V, 10V, AND 15V PARAMETRIC RATINGS
- INPUT CURRENT OF 100 nA AT 18V AND 25°C FOR HCC DEVICE
- 100% TESTED FOR QUIESCENT CURRENT
- MEETS ALL REQUIREMENTS OF JEDEC TENTATIVE STANDARD NO. 13A, "STANDARD SPECIFICATIONS FOR DESCRIPTION OF "B" SERIES CMOS DEVICES"

The **HCC 4045B** (extended temperature range) and **HCF 4045B** (intermediate temperature range) are monolithic integrated circuits, available in 16-lead dual in-line plastic or ceramic package and ceramic flat package. The **HCC/HCF 4045B** is a timing circuit consisting of 21 counter stages, two output-shaping flip-flops, two inverter output drivers, and input inverters for use in a crystal oscillator. The **HCC/HCF 4045B** configuration provides 21 flip-flop counting stages, and two flip-flops for shaping the output waveform for a 3.125% duty cycle. Push-pull operation is provided by the inverter output drivers. The first inverter is intended for use as a crystal oscillator-amplifier. However, it may be used as a normal logic inverter if desired. A crystal oscillator circuit can be made less sensitive to voltage-supply variations by the use of source resistors. In this device, the sources of the p and n transistors have been brought out to package terminals. If external resistors are not required, the sources must be shorted to their respective substrates ($S_p$ to $V_{DD}$, $S_n$ to $V_{SS}$).

## ABSOLUTE MAXIMUM RATINGS

| | | | |
|---|---|---|---|
| $V_{DD}$* | Supply voltage: **HCC** types | -0.5 to 20 | V |
| | **HCF** types | -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 $T_{op}$ = full package-temperature range | 100 | mW |
| $T_{op}$ | Operating temperature: **HCC** types | -55 to 125 | °C |
| | **HCF** types | -40 to 85 | °C |
| $T_{stg}$ | Storage temperature | -65 to 150 | °C |

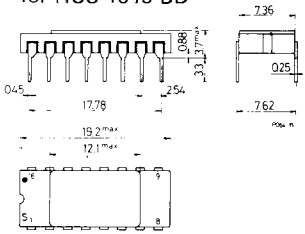
* All voltage values are referred to $V_{SS}$ pin voltage

**ORDERING NUMBERS:**

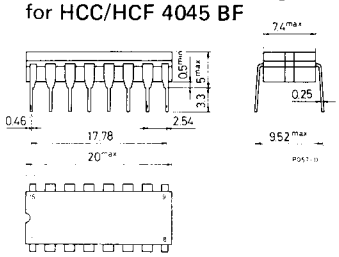
HCC 4045 BD for dual in-line ceramic package
HCC 4045 BF for dual in-line ceramic package, frit seal
HCC 4045 BK for ceramic flat package
HCF 4045 BE for dual in-line plastic package
HCF 4045 BF for dual in-line ceramic package, frit seal

## MECHANICAL DATA (dimensions in mm)

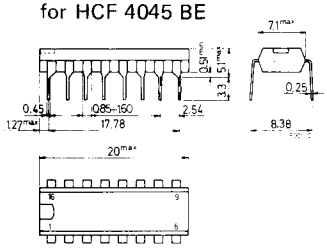
Dual in-line ceramic package for HCC 4045 BD



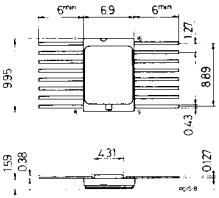
Dual in-line ceramic package for HCC/HCF 4045 BF



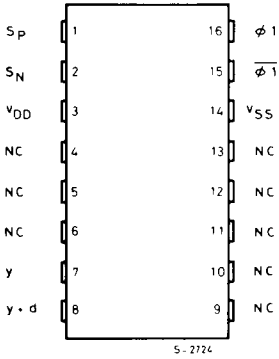
Dual in-line plastic package for HCF 4045 BE



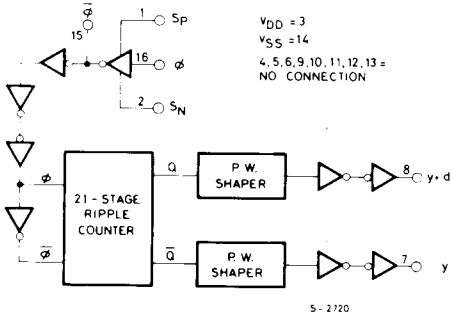
Ceramic flat package for HCC 4045 BK



## CONNECTION DIAGRAM




## LOGIC DIAGRAM

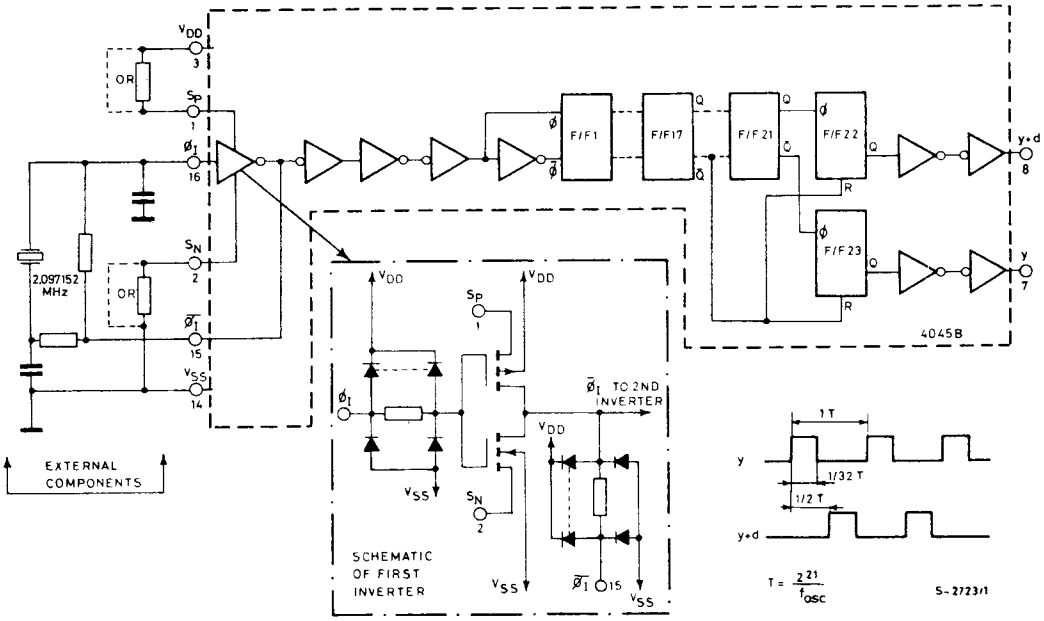



## RECOMMENDED OPERATING CONDITIONS

| | | | |
|---|---|---|---|
| $V_{DD}$ | Supply voltage: **HCC** types | 3 to 18 | V |
| | **HCF** types | 3 to 15 | V |
| $V_I$ | Input voltage | 0 to $V_{DD}$ | V |
| $T_{op}$ | Operating temperature: **HCC** types | -55 to 125 | °C |
| | **HCF** types | -40 to 85 | °C |

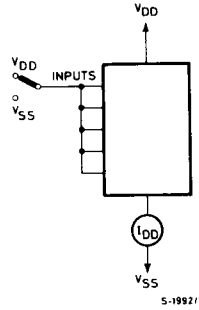
## LOGIC DIAGRAM

4045B and outboard components in a typical 21-stage counter application

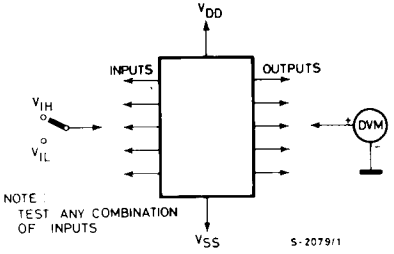



## TEST CIRCUITS

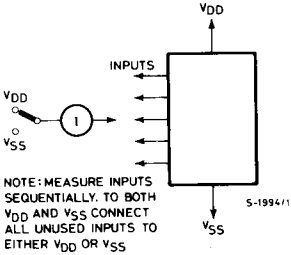
Quiescent device current




Noise immunity




Input leakage current



## STATIC ELECTRICAL CHARACTERISTICS (over recommended operating conditions)

| Parameter | | | Test conditions | | | | Values | | | | | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | $V_I$ (V) | $V_O$ (V) | $\|I_O\|$ ($\mu$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 | $\mu$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 | |
| | | | 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 | 4.6 | | 5 | -4.5 | | -3.6 | -7 | | -2.5 | | mA |
| | | | 0/10 | 9.5 | | 10 | -11.2 | | -9.1 | -18 | | -6.3 | | |
| | | | 0/15 | 13.5 | | 15 | -29.4 | | -23.8 | -47 | | -16.8 | | |
| | | HCF types | 0/ 5 | 4.6 | | 5 | -3.6 | | -3 | -7 | | -2.46 | | |
| | | | 0/10 | 9.5 | | 10 | -8.9 | | -7.7 | -18 | | -6.54 | | |
| | | | 0/15 | 13.5 | | 15 | -23.8 | | -20 | -47 | | -16.6 | | |
| $I_{OL}$ | Output sink current | HCC types | 0/ 5 | 0.4 | | 5 | 4.5 | | 3.6 | 7 | | 2.5 | | mA |
| | | | 0/10 | 0.5 | | 10 | 11.2 | | 9.1 | 18 | | 6.3 | | |
| | | | 0/15 | 1.5 | | 15 | 29.4 | | 23.8 | 47 | | 16.8 | | |
| | | HCF types | 0/ 5 | 0.4 | | 5 | 3.6 | | 3 | 7 | | 2.46 | | |
| | | | 0/10 | 0.5 | | 10 | 8.9 | | 7.7 | 18 | | 6.54 | | |
| | | | 0/15 | 1.5 | | 15 | 23.8 | | 20 | 47 | | 16.6 | | |
| $I_{IH}$, $I_{IL}$ | Input leakage current | HCC types | 0/18 | Any input | | 18 | | ±0.1 | | $\pm 10^{-5}$ | ±0.1 | | ± 1 | |
| | | HCF types | 0/15 | | | 15 | | ±0.3 | | $\pm 10^{-5}$ | ±0.3 | | ± 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

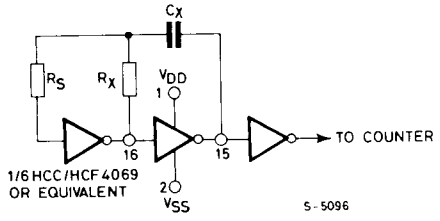
## DYNAMIC ELECTRICAL CHARACTERISTICS ($T_{amb}$ = 25°C, $C_L$ = 50 pF, $R_L$ = 200 kΩ, typical temperature coefficient for all $V_{DD}$ = 0.3%/°C values, all input rise and fall time = 20 ns)

| Parameter | | Test conditions | | Values | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | $V_{DD}$(V) | Min. | Typ. | Max. | |
| $t_{PLH}$, $t_{PHL}$ | Propagation delay time $\phi$ to y or y + d out | | 5 | | 2.2 | 5.5 | μs |
| | | | 10 | | 0.9 | 2.7 | |
| | | | 15 | | 0.65 | 2 | |
| $t_{THL}$, $t_{TLH}$ | Transition time | | 5 | | 25 | 50 | ns |
| | | | 10 | | 13 | 25 | |
| | | | 15 | | 10 | 20 | |
| $f_{max}$ | Maximum input pulse frequency External pulse source | | 5 | 5 | 10 | | MHz |
| | | | 10 | 12 | 25 | | |
| | | | 15 | 15 | 30 | | |
| $t_W$ | Input pulse width | | 5 | | 50 | 100 | ns |
| | | | 10 | | 25 | 50 | |
| | | | 15 | | 20 | 40 | |
| $t_r$, $t_f$ | Clock input rise or fall time | | 5 | | | 500 | μs |
| | | | 10 | | | 500 | |
| | | | 15 | | | 500 | |
| | Variation of output frequency (Unit to unit) | f = 5 MHz | 5 | | 0.05 | | % |
| | | | 10 | | 0.03 | | |
| | | | 15 | | 0.1 | | |
| **RC OSCILLATOR OPERATION** | | | | | | | |
| $f_{osc}$ | Maximum oscillator frequency (see fig. belove left) | $R_X$ = 50 KΩ<br>$R_S$ = 560 KΩ<br>$C_X$ = 50 pF | 5 | 45 | 60 | 75 | KHz |
| | | | 10 | 45 | 60 | 75 | |
| | | | 15 | 45 | 60 | 75 | |

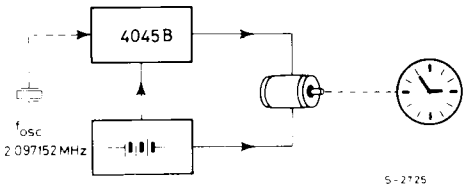
## TYPICAL APPLICATIONS

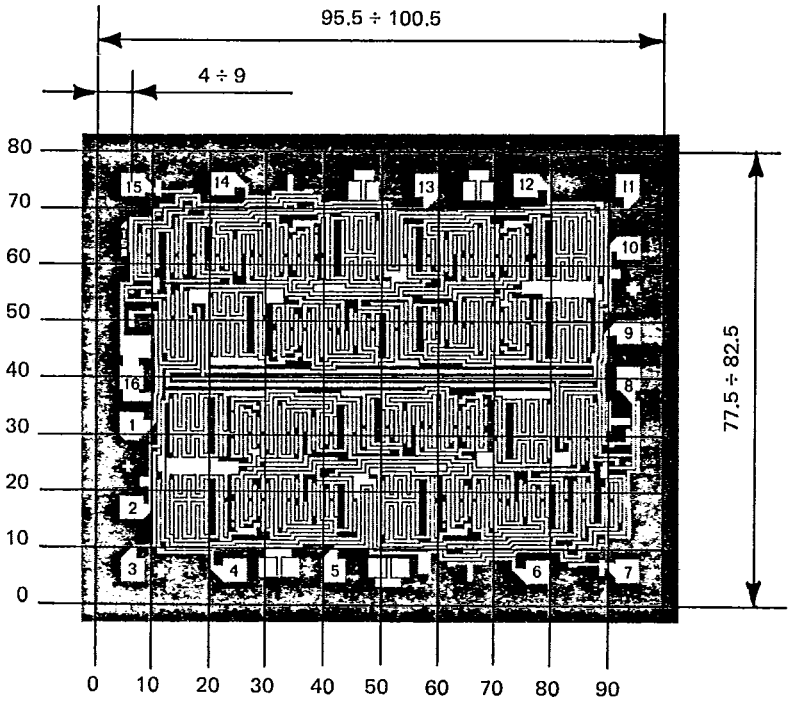
Digital equipment in which ultra-low dissipation and/or operation using a battery source are primary design requirements.
Accurate timing from a crystal oscillator for timing applications such as wall clocks, table clocks, automobile clocks, and digital timing references in any circuit requiring accurately timed outputs at various intervals in the counting sequence.
Driving miniature synchronous motors, stepping motors, or external bipolar transistors in push-pull fashion.

Typical RC circuit

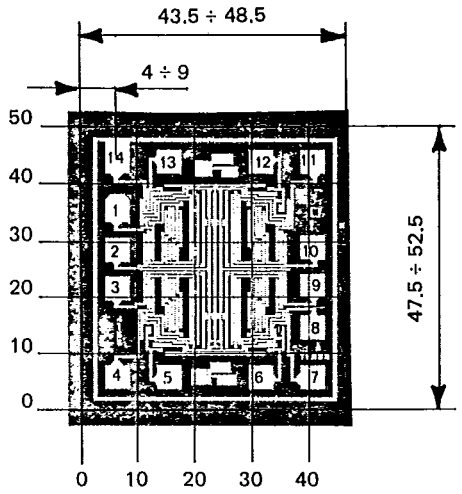



Electronic watch application circuit




95.5 ÷ 100.5
4 ÷ 9
77.5 ÷ 82.5
80
70
60
50
40
30
20
10
0
0 10 20 30 40 50 60 70 80 90
15 14 13 12 11 10 9 8 16 1 2 3 4 5 6 7

**4015B**


43.5 ÷ 48.5
4 ÷ 9
47.5 ÷ 52.5
50
40
30
20
10
0
0 10 20 30 40
14 13 12 11 1 2 3 10 9 8 4 5 6 7

**4016B**