**FAIRCHILD**

SEMICONDUCTOR ™

# MM74HC4020 • MM74HC4040
# 14-Stage Binary Counter • 12-Stage Binary Counter

## General Description

The MM54HC4020/MM74HC4020, MM54HC4040/MM74HC4040, are high speed binary ripple carry counters. These counters are implemented utilizing advanced silicon-gate CMOS technology to achieve speed performance similar to LS-TTL logic while retaining the low power and high noise immunity of CMOS.

The 'HC4020 is a 14 stage counter and the 'HC4040 is a 12-stage counter. Both devices are incremented on the falling edge (negative transition) of the input clock, and all their outputs are reset to a low level by applying a logical high on their reset input.

These devices are pin equivalent to the CD4020 and CD4040 respectively. All inputs are protected from damage due to static discharge by protection diodes to $V_{CC}$ and ground.

## Features

- Typical propagation delay: 16 ns
- Wide operating voltage range: 2–6V
- Low input current: 1 µA maximum
- Low quiescent current: 80 µA maximum (74HC Series)
- Output drive capability: 10 LS-TTL loads

## Connection Diagrams

**Dual-In-Line Packages**
**'HC4020**



TOP VIEW

DS005216-1

**'HC4040**



TOP VIEW
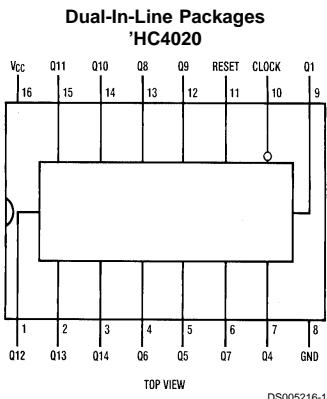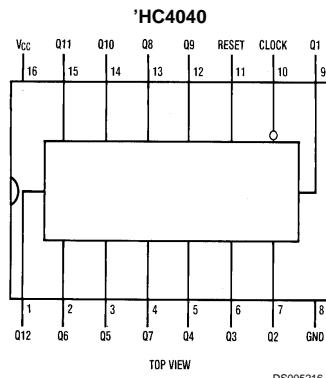
DS005216-3

**Order Number MM54HC4020/4040 or MM74HC4020/4040**

www.fairchildsemi.com

## Absolute Maximum Ratings (Notes 2, 1)

| | |
|---|---|
| Supply Voltage ($V_{CC}$) | −0.5 to +7.0V |
| DC Input Voltage ($V_{IN}$) | −1.5 to $V_{CC}$+1.5V |
| DC Output Voltage ($V_{OUT}$) | −0.5 to $V_{CC}$+0.5V |
| Clamp Diode Current ($I_{CD}$) | ±20 mA |
| DC Output Current, per pin ($I_{OUT}$) | ±25 mA |
| DC $V_{CC}$ or GND Current, per pin ($I_{CC}$) | ±50 mA |
| Storage Temperature Range ($T_{STG}$) | −65˚C to +150˚C |
| Power Dissipation ($P_D$) | |
| (Note 3) | 600 mW |
| S.O. Package only | 500 mW |
| Lead Temperature ($T_L$) | |
| (Soldering 10 seconds) | 260˚C |

## Operating Conditions

| | Min | Max | Units |
|---|---|---|---|
| Supply Voltage ($V_{CC}$) | 2 | 6 | V |
| DC Input or Output Voltage | 0 | $V_{CC}$ | V |
| ($V_{IN}$, $V_{OUT}$) | | | |
| Operating Temp. Range ($T_A$) | | | |
| MM74HC | −40 | +85 | ˚C |
| MM54HC | −55 | +125 | ˚C |
| Input Rise or Fall Times | | | |
| ($t_r$, $t_f$)    $V_{CC}$=2.0V | | 1000 | ns |
| $V_{CC}$=4.5V | | 500 | ns |
| $V_{CC}$=6.0V | | 400 | ns |

## DC Electrical Characteristics (Note 4)

| Symbol | Parameter | Conditions | $V_{CC}$ | $T_A$=25˚C | 74HC $T_A$=−40 to 85˚C | 54HC $T_A$=−55 to 125˚C | Units |
|---|---|---|---|---|---|---|---|
| | | | | Typ | Guaranteed Limits | | |
| $V_{IH}$ | Minimum High Level Input Voltage | | 2.0V | | 1.5 | 1.5 | 1.5 | V |
| | | | 4.5V | | 3.15 | 3.15 | 3.15 | V |
| | | | 6.0V | | 4.2 | 4.2 | 4.2 | V |
| $V_{IL}$ | Maximum Low Level Input Voltage (Note 5) | | 2.0V | | 0.5 | 0.5 | 0.5 | V |
| | | | 4.5V | | 1.35 | 1.35 | 1.35 | V |
| | | | 6.0V | | 1.8 | 1.8 | 1.8 | V |
| $V_{OH}$ | Minimum High Level Output Voltage | $V_{IN}$=$V_{IH}$ or $V_{IL}$ $|I_{OUT}|$≤20 µA | 2.0V | 2.0 | 1.9 | 1.9 | 1.9 | V |
| | | | 4.5V | 4.5 | 4.4 | 4.4 | 4.4 | V |
| | | | 6.0V | 6.0 | 5.9 | 5.9 | 5.9 | V |
| | | $V_{IN}$=$V_{IH}$ or $V_{IL}$ $|I_{OUT}|$≤4.0 mA | 4.5V | 4.2 | 3.98 | 3.84 | 3.7 | V |
| | | $|I_{OUT}|$≤5.2 mA | 6.0V | 5.7 | 5.48 | 5.34 | 5.2 | V |
| $V_{OL}$ | Maximum Low Level Output Voltage | $V_{IN}$=$V_{IH}$ or $V_{IL}$ $|I_{OUT}|$≤20 µA | 2.0V | 0 | 0.1 | 0.1 | 0.1 | V |
| | | | 4.5V | 0 | 0.1 | 0.1 | 0.1 | V |
| | | | 6.0V | 0 | 0.1 | 0.1 | 0.1 | V |
| | | $V_{IN}$=$V_{IH}$ or $V_{IL}$ $|I_{OUT}|$≤4.0 mA | 4.5V | 0.2 | .26 | 0.33 | 0.4 | V |
| | | $|I_{OUT}|$≤5.2 mA | 6.0V | 0.2 | .26 | 0.33 | 0.4 | V |
| $I_{IN}$ | Maximum Input Current | $V_{IN}$=$V_{CC}$ or GND | 6.0V | | ±0.1 | ±1.0 | ±1.0 | µA |
| $I_{CC}$ | Maximum Quiescent Supply Current | $V_{IN}$=$V_{CC}$ or GND $I_{OUT}$=0 µA | 6.0V | | 8.0 | 80 | 160 | µA |

**Note 1:** Maximum Ratings are those values beyond which damage to the device may occur.

**Note 2:** Unless otherwise specified all voltages are referenced to ground.

**Note 3:** Power Dissipation temperature derating — plastic "N" package: −12 mW/˚C from 65˚C to 85˚C; ceramic "J" package: −12 mW/˚C from 100˚C to 125˚C.

**Note 4:** For a power supply of 5V ±10% the worst case output voltages ($V_{OH}$, and $V_{OL}$) occur for HC at 4.5V. Thus the 4.5V values should be used when designing with this supply. Worst case $V_{IH}$ and $V_{IL}$ occur at $V_{CC}$=5.5V and 4.5V respectively. (The $V_{IH}$ value at 5.5V is 3.85V.) The worst case leakage current ($I_{IN}$, $I_{CC}$, and $I_{OZ}$) occur for CMOS at the higher voltage and so the 6.0V values should be used.

**Note 5:** $V_{IL}$ limits are currently tested at 20% of $V_{CC}$. The above $V_{IL}$ specification (30% of $V_{CC}$) will be implemented no later than Q1, CY'89.

## AC Electrical Characteristics

$V_{CC}$=5V, $T_A$=25˚C, $C_L$=15 pF, $t_r$=$t_f$=6 ns

| Symbol | Parameter | Conditions | Typ | Guaranteed Limit | Units |
|---|---|---|---|---|---|
| $f_{MAX}$ | Maximum Operating Frequency | | 50 | 30 | MHz |
| $t_{PHL}$, $t_{PLH}$ | Maximum Propagation Delay Clock to Q | (Note 6) | 17 | 35 | ns |
| $t_{PHL}$ | Maximum Propagation Delay Reset to any Q | | 16 | 40 | ns |
| $t_{REM}$ | Minimum Reset Removal Time | | 10 | 20 | ns |
| $t_W$ | Minimum Pulse Width | | 10 | 16 | ns |

## AC Electrical Characteristics

$V_{CC}$=2.0V to 6.0V, $C_L$=50 pF, $t_r$=$t_f$=6 ns (unless otherwise specified)

| Symbol | Parameter | Conditions | $V_{CC}$ | $T_A$=25˚C | 74HC $T_A$=−40 to 85˚C | 54HC $T_A$=−55 to 125˚C | Units |
|---|---|---|---|---|---|---|---|
| | | | | Typ | Guaranteed Limits | | |
| $f_{MAX}$ | Maximum Operating Frequency | | 2.0V | 10 | 6 | 5 | 4 | MHz |
| | | | 4.5V | 40 | 30 | 24 | 20 | MHz |
| | | | 6.0V | 50 | 35 | 28 | 24 | MHz |
| $t_{PHL}$, $t_{PLH}$ | Maximum Propagation Delay Clock to $Q_1$ | | 2.0V | 80 | 210 | 265 | 313 | ns |
| | | | 4.5V | 21 | 42 | 53 | 63 | ns |
| | | | 6.0V | 18 | 36 | 45 | 53 | ns |
| $T_{PHL}$, $t_{PLH}$ | Maximum Propagation Delay Between Stages from $Q_n$ to $Q_{n+1}$ | | 2.0V | 80 | 125 | 156 | 188 | ns |
| | | | 4.5V | 18 | 25 | 31 | 38 | ns |
| | | | 6.0V | 15 | 21 | 26 | 31 | ns |
| $t_{PHL}$ | Maximum Propagation Delay Reset to any Q ('4020 and '4040) | | 2.0V | 72 | 240 | 302 | 358 | ns |
| | | | 4.5V | 24 | 48 | 60 | 72 | ns |
| | | | 6.0V | 20 | 41 | 51 | 61 | ns |
| $t_{REM}$ | Minimum Reset Removal Time | | 2.0V | | 100 | 126 | 149 | ns |
| | | | 4.5V | | 20 | 25 | 50 | ns |
| | | | 6.0V | | 16 | 21 | 25 | ns |
| $t_W$ | Minimum Pulse Width | | 2.0V | | 90 | 100 | 120 | ns |
| | | | 4.5V | | 16 | 20 | 24 | ns |
| | | | 6.0V | | 14 | 18 | 20 | ns |
| $t_{TLH}$, $t_{THL}$ | Maximum Output Rise and Fall Time | | 2.0V | 30 | 75 | 95 | 110 | ns |
| | | | 4.5V | 10 | 15 | 19 | 22 | ns |
| | | | 6.0V | 9 | 13 | 16 | 19 | ns |
| $t_r$, $t_f$ | Maximum Input Rise and Fall Time | | | | 1000 | 1000 | 1000 | ns |
| | | | | | 500 | 500 | 500 | ns |
| | | | | | 400 | 400 | 400 | ns |
| $C_{PD}$ | Power Dissipation Capacitance (Note 7) | (per package) | | 55 | | | | pF |
| $C_{IN}$ | Maximum Input Capacitance | | | 5 | 10 | 10 | 10 | pF |

**Note 6:** Typical Propagation delay time to any output can be calculated using: $t_P$ =17+12(N−1) ns; where N is the number of the output, $Q_W$, at $V_{CC}$=5V.

**Note 7:** $C_{PD}$ determines the no load dynamic power consumption, $P_D$=$C_{PD}$ $V_{CC}^2$ f+$I_{CC}$ $V_{CC}$, and the no load dynamic current consumption, $I_S$=$C_{PD}$ $V_{CC}$ f+$I_{CC}$.

# Logic Diagrams

## MM54HC4020/MM74HC4020



DS005216-5

## MM54HC4040/MM74HC4040



DS005216-7
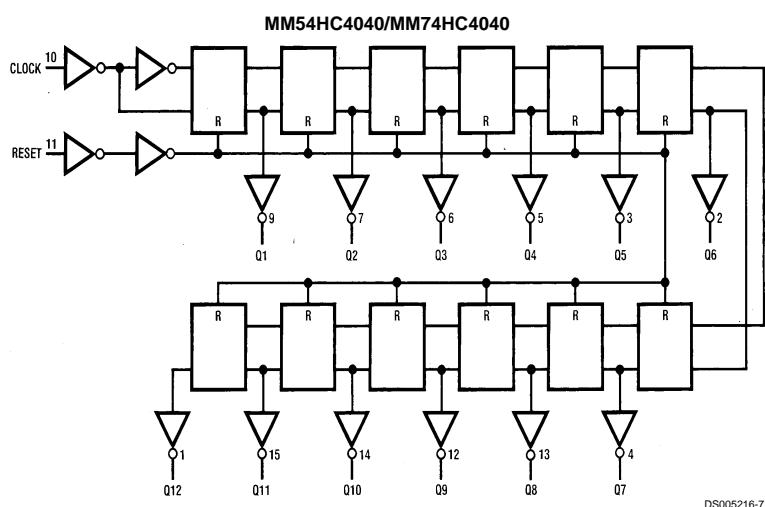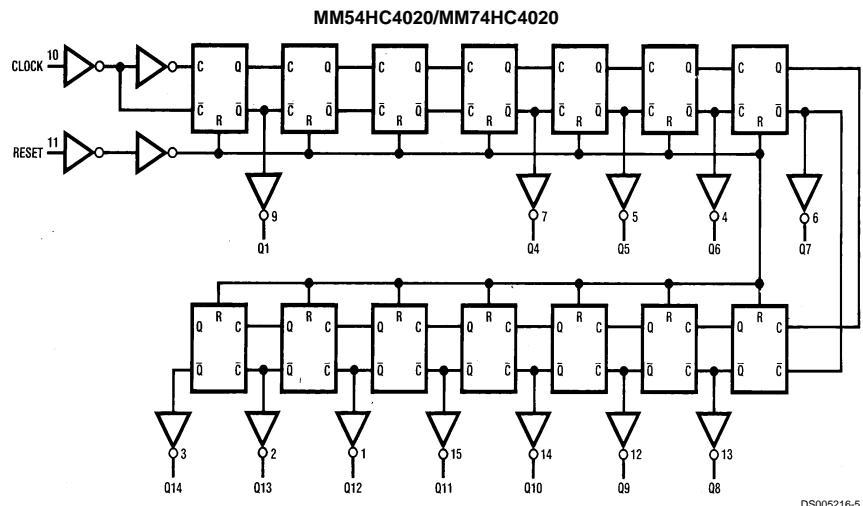
**Timing Diagram**
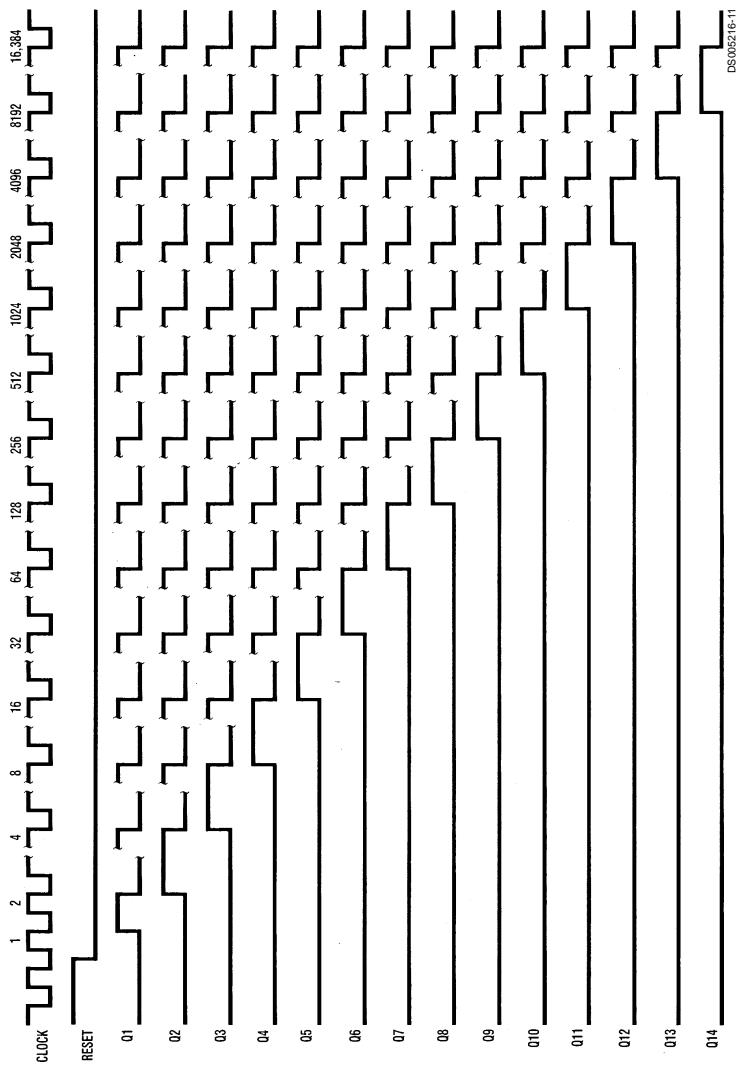


DS005216-11

## Physical Dimensions inches (millimeters) unless otherwise noted

0.785
(19.939)
MAX

14 13 12 11 10 9 8

0.025
(0.635)
RAD

0.220−0.310
(5.588−7.874)

1 2 3 4 5 6 7

0.290−0.320
(7.366−8.128)

0.180
(4.572) MAX

95° ±5°

10° MAX

0.310−0.410
(7.874−10.41)

0.005
(0.127)
MIN

GLASS
SEALANT

86°94° TYP

0.008−0.012
(0.203−0.305)

0.098
(2.489)
MAX BOTH ENDS

0.060 ±0.005
(1.524 ±0.127)

0.018 ±0.003
(0.457 ±0.076)

0.100 ±0.010
(2.540 ±0.254)

0.200
(5.080)
MAX

0.020−0.060
(0.508−1.524)

0.125−0.200
(3.175−5.080)

0.150
(3.81)
MIN
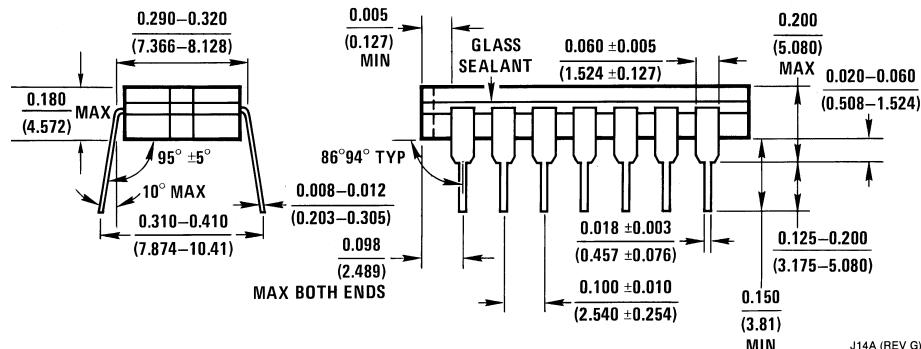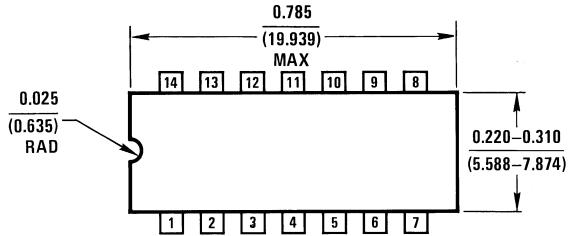
J14A (REV G)

**Order Number MM54HC4020J, MM54HC4024J, MM54HC4040J,
MM74HC4020J, MM74HC4024J, or MM74HC4040J
Package J14A**

0.785
[19.94] MAX

16                    9

0.220−0.310
[5.59−7.87]

R 0.025
[0.64]

1                     8

R 0.005−0.020 TYP
[0.13−0.51]

0.037 ± 0.005 TYP
[0.94 ± 0.13]

0.005
[0.13]
MIN TYP

0.055 ± 0.005 TYP
[1.40 ± 0.13]

0.200
[5.08]
MAX TYP

0.020−0.060 TYP
[0.51−1.52]

0.150
[3.81] MIN TYP

0.125−0.200 TYP
[3.18−5.08]

0.080
[2.03] MAX
BOTH ENDS

0.100 ± 0.010 TYP
[2.54 ± 0.25]

90° ± 4°
TYP

0.018 ± 0.003 TYP
[0.46 ± 0.08]

0.290−0.320
[7.37−8.13]

GLASS SEALANT

0.180
[4.57] MAX

0.010 ± 0.002 TYP
[0.25 ± 0.05]

95° ± 5°
TYP

0.310−0.410
[7.87−10.41]
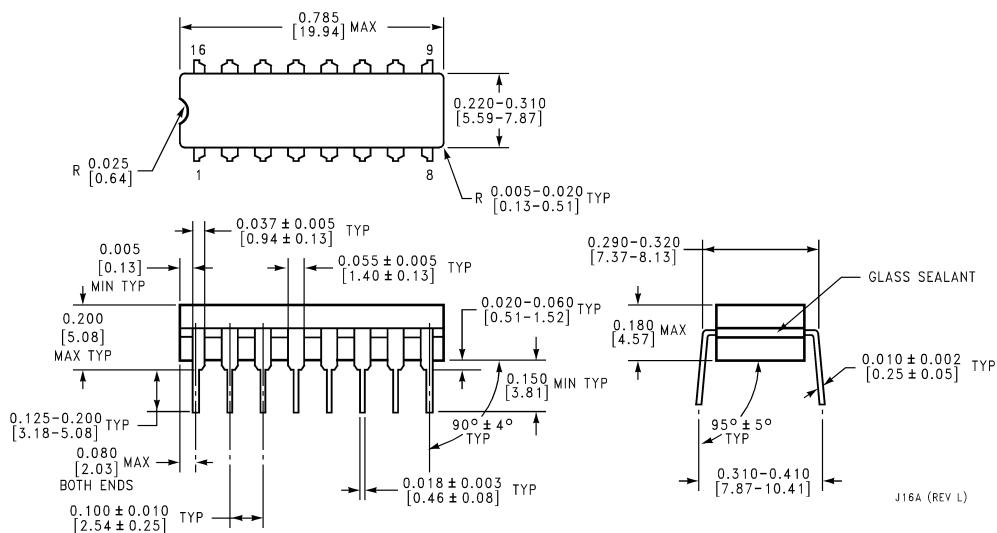
J16A (REV L)

**Order Number MM54HC4020J, MM54HC4024J, MM54HC4040J,
MM74HC4020J, MM74HC4024J, or MM74HC4040J
Package J16A**

## Physical Dimensions inches (millimeters) unless otherwise noted (Continued)
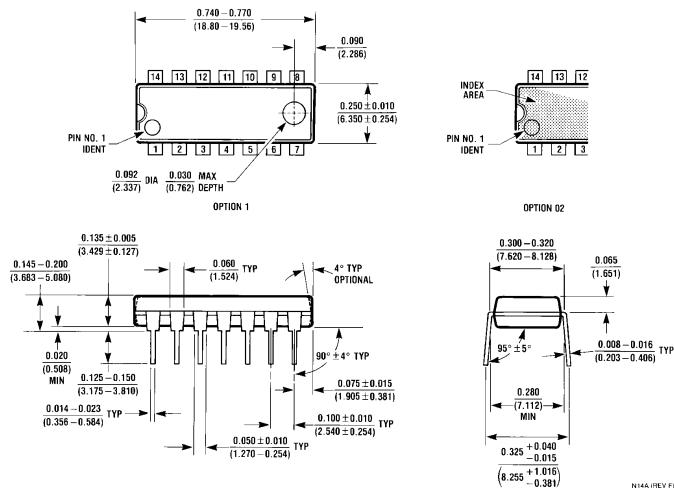


**Order Number MM74HC4020N, MM74HC4024N or MM74HC4040N**
**Package N14A**
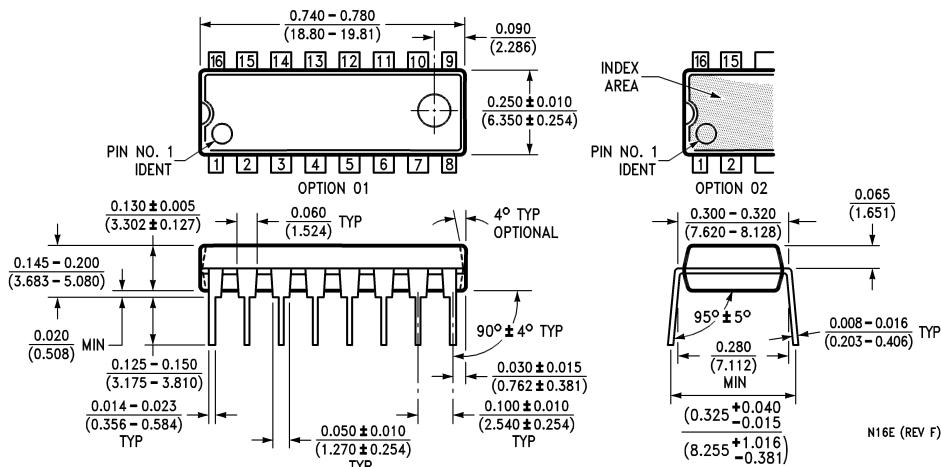


**Order Number MM74HC4020N, MM74HC4024N or MM74HC4040N**
**Package N16E**

**LIFE SUPPORT POLICY**

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DE-
VICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF FAIRCHILD SEMI-
CONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or sys-
tems which, (a) are intended for surgical implant into
the body, or (b) support or sustain life, and (c) whose
failure to perform when properly used in accordance
with instructions for use provided in the labeling, can
be reasonably expected to result in a significant injury
to the user.

2. A critical component in any component of a life support
device or system whose failure to perform can be rea-
sonably expected to cause the failure of the life support
device or system, or to affect its safety or effectiveness.

| Fairchild Semiconductor Corporation Americas | Fairchild Semiconductor Europe | Fairchild Semiconductor Hong Kong Ltd. | National Semiconductor Japan Ltd. |
|---|---|---|---|
| Customer Response Center Tel: 1-888-522-5372 | Fax: +49 (0) 1 80-530 85 86 Email: europe.support@nsc.com Deutsch Tel: +49 (0) 8 141-35-0 English Tel: +44 (0) 1 793-85-68-56 Italy Tel: +39 (0) 2 57 5631 | 13th Floor, Straight Block, Ocean Centre, 5 Canton Rd. Tsimshatsui, Kowloon Hong Kong Tel: +852 2737-7200 Fax: +852 2314-0061 | Tel: 81-3-5620-6175 Fax: 81-3-5620-6179 |

www.fairchildsemi.com