TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

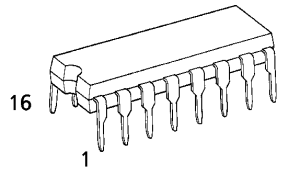
# TC4020BP, TC4020BF, TC4020BFN

## TC4020B 14 STAGE RIPPLE – CARRY BINARY COUNTER / DIVIDERS

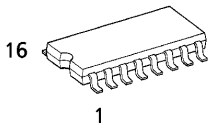
(Note) The JEDEC SOP (FN) is not available in Japan.

TC4020B is 14 stage ripple carry binary counter having asynchronous clear function. The counter advances its counting stage by falling edge of $\overline{CLOCK}$ input. When RESET input is placed "H", all the circuits are reset regardless of $\overline{CLOCK}$ input making all the outputs ( Q1 , Q4 ~ Q14 ) to be "L".

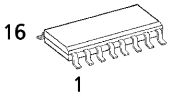
This is most suitable for frequency dividers , control circuits and timing circuits.




P (DIP16-P-300-2.54A)
Weight : 1.00g (Typ.)




F (SOP16-P-300-1.27)
Weight : 0.18g (Typ.)




FN (SOL16-P-150-1.27)
Weight : 0.13g (Typ.)

### MAXIMUM RATINGS

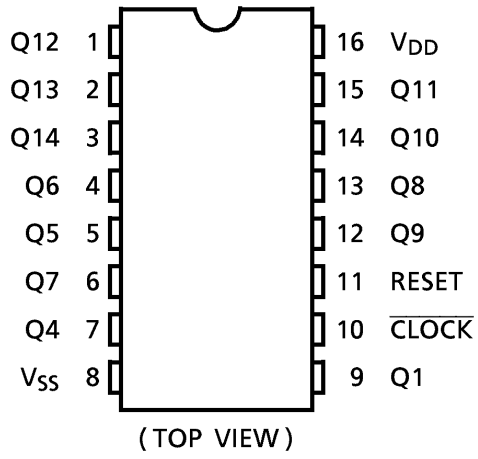
| CHARACTERISTIC | SYMBOL | RATING | UNIT |
|---|---|---|---|
| DC Supply Voltage | $V_{DD}$ | $V_{SS}-0.5 \sim V_{SS}+20$ | V |
| Input Voltage | $V_{IN}$ | $V_{SS}-0.5 \sim V_{DD}+0.5$ | V |
| Output Voltage | $V_{OUT}$ | $V_{SS}-0.5 \sim V_{DD}+0.5$ | V |
| DC Input Current | $I_{IN}$ | ± 10 | mA |
| Power Dissipation | $P_D$ | 300 (DIP) / 180 (SOIC) | mW |
| Operating Temperature Range | $T_{opr}$ | – 40~85 | °C |
| Storage Temperature Range | $T_{stg}$ | – 65~150 | °C |

### TRUTH TABLE

| $\overline{CLOCK}$△ | RESET | OUTPUT STATE |
|---|---|---|
| * | H | ALL OUTPUTS = "L" |
| ⌐↓ | L | NO CHANGE |
| ⌐↓ | L | ADVANCE TO NEXT STATE |

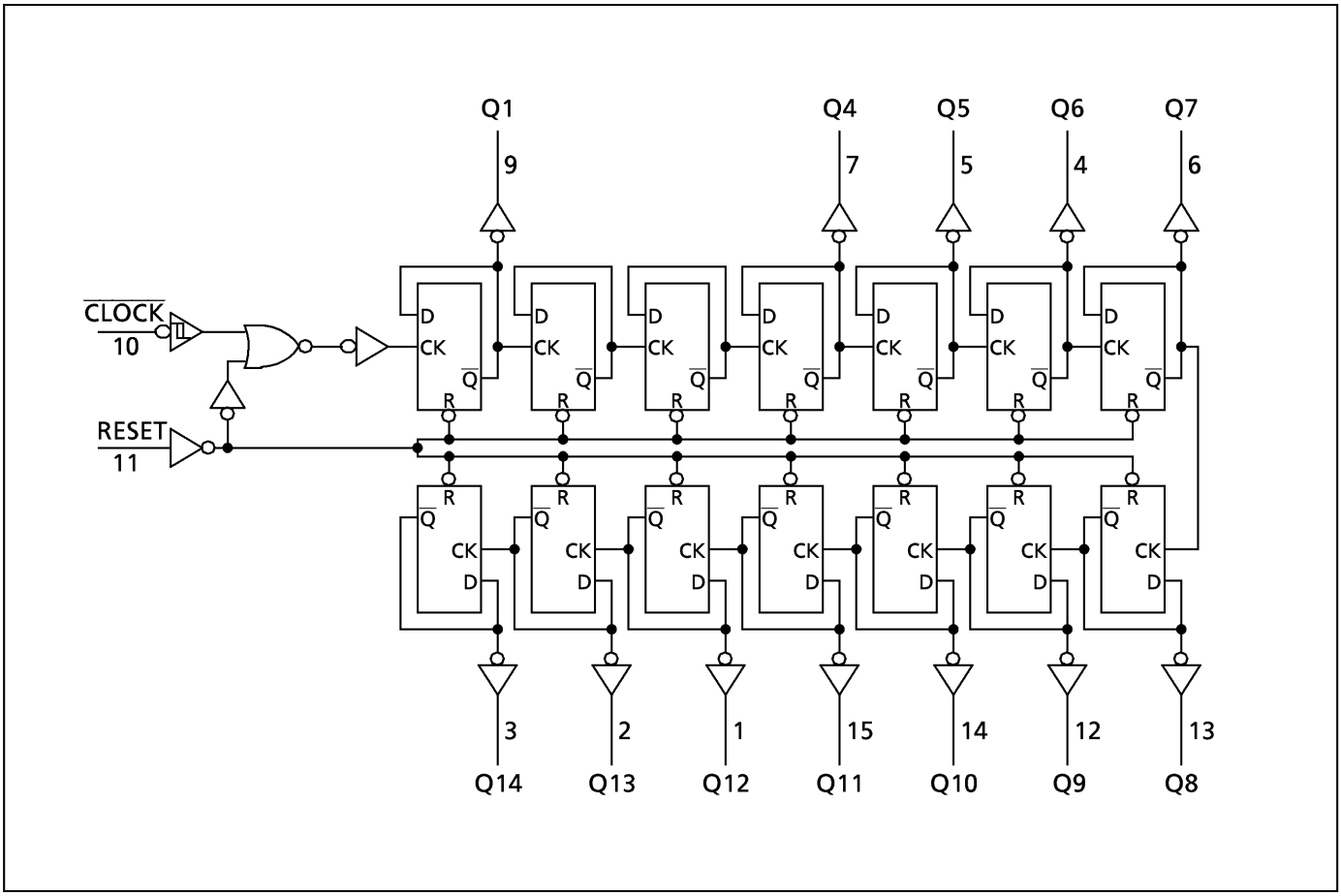
△ : Level Change * : Don't Care

### PIN ASSIGNMENT




( TOP VIEW )

**LOGIC DIAGRAM**



**RECOMMENDED OPERATING CONDITIONS ($V_{SS}$ = 0V)**

| CHARACTERISTIC | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| DC Supply Voltage | $V_{DD}$ | | 3 | — | 18 | V |
| Input Voltage | $V_{IN}$ | | 0 | — | $V_{DD}$ | V |

**STATIC ELECTRICAL CHARACTERISTICS ($V_{SS}$ = 0V)**

| CHARACTERISTIC | SYMBOL | TEST CONDITION | $V_{DD}$ (V) | −40°C MIN. | −40°C MAX. | 25°C MIN. | 25°C TYP. | 25°C MAX. | 85°C MIN. | 85°C MAX. | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| High-Level Output Voltage | $V_{OH}$ | $\|I_{OUT}\| < 1\mu A$<br>$V_{IN} = V_{SS}, V_{DD}$ | 5<br>10<br>15 | 4.95<br>9.95<br>14.95 | —<br>—<br>— | 4.95<br>9.95<br>14.95 | 5.00<br>10.00<br>15.00 | —<br>—<br>— | 4.95<br>9.95<br>14.95 | —<br>—<br>— | V |
| Low-Level Output Voltage | $V_{OL}$ | $\|I_{OUT}\| < 1\mu A$<br>$V_{IN} = V_{SS}, V_{DD}$ | 5<br>10<br>15 | —<br>—<br>— | 0.05<br>0.05<br>0.05 | —<br>—<br>— | 0.00<br>0.00<br>0.00 | 0.05<br>0.05<br>0.05 | —<br>—<br>— | 0.05<br>0.05<br>0.05 | V |
| Output High Current | $I_{OH}$ | $V_{OH}$ = 4.6V<br>$V_{OH}$ = 2.5V<br>$V_{OH}$ = 9.5V<br>$V_{OH}$ = 13.5V<br>$V_{IN} = V_{SS}, V_{DD}$ | 5<br>5<br>10<br>15 | −0.61<br>−2.50<br>−1.50<br>−4.00 | —<br>—<br>—<br>— | −0.51<br>−2.10<br>−1.30<br>−3.40 | −1.0<br>−4.0<br>−2.2<br>−9.0 | —<br>—<br>—<br>— | −0.42<br>−1.70<br>−1.10<br>−2.80 | —<br>—<br>—<br>— | mA |
| Output Low Current | $I_{OL}$ | $V_{OL}$ = 0.4V<br>$V_{OL}$ = 0.5V<br>$V_{OL}$ = 1.5V<br>$V_{IN} = V_{SS}, V_{DD}$ | 5<br>10<br>15 | 0.61<br>1.50<br>4.00 | —<br>—<br>— | 0.51<br>1.30<br>3.40 | 1.2<br>3.2<br>12.0 | —<br>—<br>— | 0.42<br>1.10<br>2.80 | —<br>—<br>— | mA |
| Input High Voltage | $V_{IH}$ | $V_{OUT}$ = 0.5V, 4.5V<br>$V_{OUT}$ = 1.0V, 9.0V<br>$V_{OUT}$ = 1.5V, 13.5V<br>$\|I_{OUT}\| < 1\mu A$ | 5<br>10<br>15 | 3.5<br>7.0<br>11.0 | —<br>—<br>— | 3.5<br>7.0<br>11.0 | 2.75<br>5.50<br>8.25 | —<br>—<br>— | 3.5<br>7.0<br>11.0 | —<br>—<br>— | V |
| Input Low Voltage | $V_{IL}$ | $V_{OUT}$ = 0.5V, 4.5V<br>$V_{OUT}$ = 1.0V, 9.0V<br>$V_{OUT}$ = 1.5V, 13.5V<br>$\|I_{OUT}\| < 1\mu A$ | 5<br>10<br>15 | —<br>—<br>— | 1.5<br>3.0<br>4.0 | —<br>—<br>— | 2.25<br>4.50<br>6.75 | 1.5<br>3.0<br>4.0 | —<br>—<br>— | 1.5<br>3.0<br>4.0 | V |
| Input Current "H" Level | $I_{IH}$ | $V_{IH}$ = 18V | 18 | — | 0.1 | — | $10^{-5}$ | 0.1 | — | 1.0 | $\mu A$ |
| Input Current "L" Level | $I_{IL}$ | $V_{IL}$ = 0V | 18 | — | −0.1 | — | $-10^{-5}$ | −0.1 | — | −1.0 | $\mu A$ |
| Quiescent Supply Current | $I_{DD}$ | $V_{IN} = V_{SS}, V_{DD}$ * | 5<br>10<br>15 | —<br>—<br>— | 5<br>10<br>20 | —<br>—<br>— | 0.005<br>0.010<br>0.015 | 5<br>10<br>20 | —<br>—<br>— | 150<br>300<br>600 | $\mu A$ |

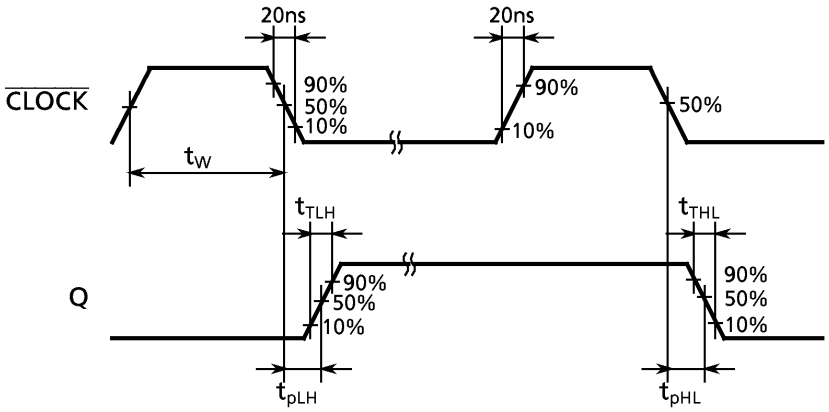
* All valid input combinations.

**DYNAMIC ELECTRICAL CHARACTERISTICS (Ta = 25°C, Vss = 0V, $C_L$ = 50pF)**

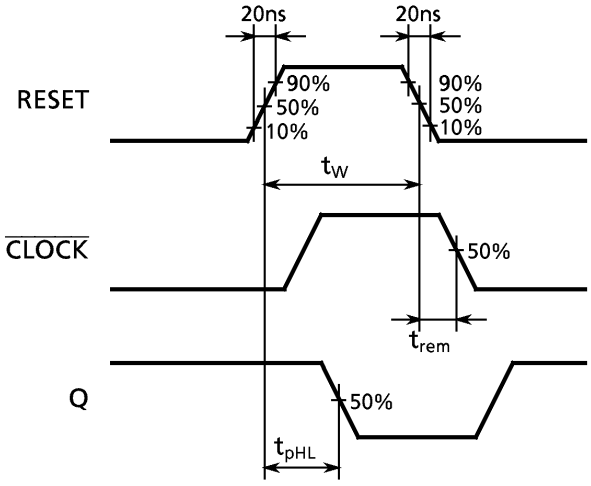
| CHARACTERISTIC | SYMBOL | TEST CONDITION $V_{DD}$(V) | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Output Transition Time (Low to High) | $t_{TLH}$ | 5 | — | 70 | 200 | ns |
| | | 10 | — | 35 | 100 | |
| | | 15 | — | 30 | 80 | |
| Output Transition Time (High to Low) | $t_{THL}$ | 5 | — | 70 | 200 | |
| | | 10 | — | 35 | 100 | |
| | | 15 | — | 30 | 80 | |
| Propagation Delay Time ($\overline{CLOCK}$ - Q1) | $t_{pLH}$ | 5 | — | 160 | 360 | |
| | | 10 | — | 80 | 160 | |
| | | 15 | — | 65 | 130 | |
| Propagation Delay Time ($\overline{CLOCK}$ - Q1) | $t_{pHL}$ | 5 | — | 160 | 360 | |
| | | 10 | — | 80 | 160 | |
| | | 15 | — | 65 | 130 | |
| Propagation Delay Time ($\overline{CLOCK}$ - Q14) | $t_{pLH}$ | 5 | — | 1000 | 2000 | |
| | | 10 | — | 500 | 1000 | |
| | | 15 | — | 400 | 800 | |
| Propagation Delay Time ($\overline{CLOCK}$ - Q14) | $t_{pHL}$ | 5 | — | 1000 | 2000 | |
| | | 10 | — | 500 | 1000 | |
| | | 15 | — | 400 | 800 | |
| Propagation Delay Time (RESET - Q) | $t_{pHL}$ | 5 | — | 150 | 280 | |
| | | 10 | — | 70 | 120 | |
| | | 15 | — | 50 | 100 | |
| Max. Clock Frequency | $f_{CL}$ | 5 | 3.5 | 10 | — | MHz |
| | | 10 | 8.0 | 20 | — | |
| | | 15 | 12.0 | 25 | — | |
| Min. Clock Pulse Width (RESET) | $t_W$ | 5 | — | 50 | 140 | ns |
| | | 10 | — | 20 | 60 | |
| | | 15 | — | 15 | 40 | |
| Min. Pulse Width | $t_W$ | 5 | — | 100 | 200 | |
| | | 10 | — | 40 | 80 | |
| | | 15 | — | 30 | 60 | |
| Min. Removal Time (RESET - $\overline{CLOCK}$) | $t_{rem}$ | 5 | — | — | 350 | |
| | | 10 | — | — | 150 | |
| | | 15 | — | — | 100 | |
| Max. Clock Input Rise Time<br>Max. Clock Input Fall Time | $t_{rCL}$<br>$t_{fCL}$ | 5<br>10<br>15 | No Limit | | | $\mu$s |
| Input Capacitance | $C_{IN}$ | | — | 5 | 7.5 | pF |

**OPERATING SUPPLY CURRENT TEST CIRCUIT**

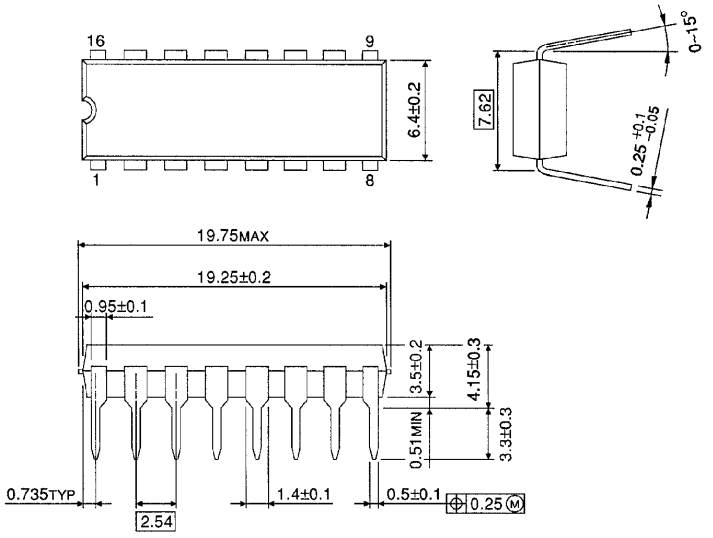
WAVEFORM 1




WAVEFORM 2

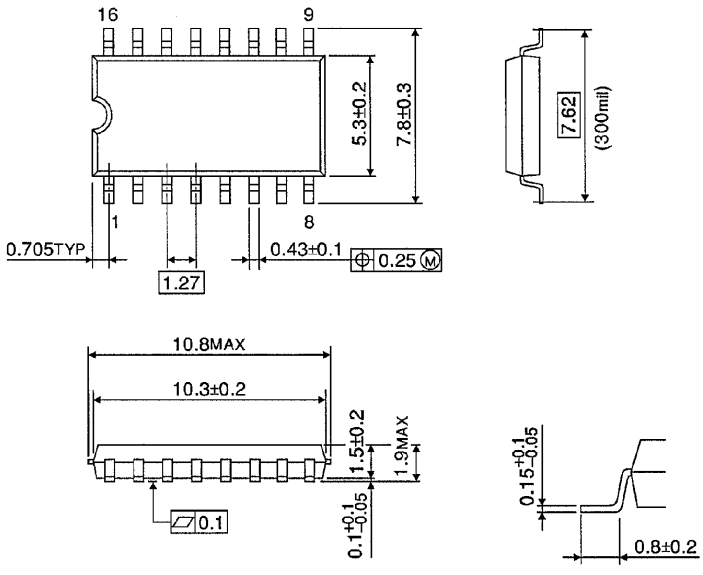


**DIP 16PIN PACKAGE DIMENSIONS (DIP16-P-300-2.54A)** Unit in mm




Weight : 1.00g (Typ.)

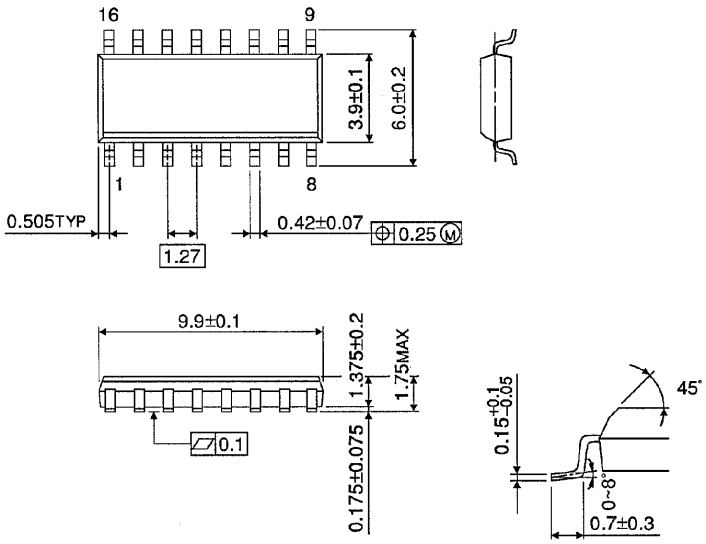
**SOP 16PIN (200mil BODY) PACKAGE DIMENSIONS (SOP16-P-300-1.27)** Unit in mm




Weight : 0.18g (Typ.)

**SOP 16PIN (150mil BODY) PACKAGE DIMENSIONS (SOL16-P-150 -1.27)** Unit in mm

(Note) This package is not available in Japan.




Weight : 0.13g (Typ.)

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