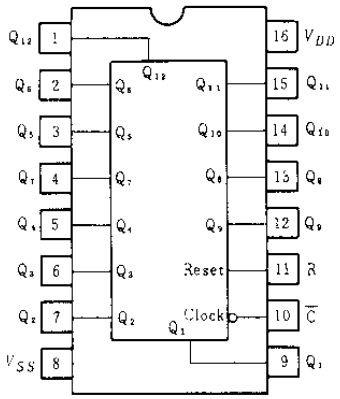
## 12-bit Binary Counter

The HD14040B 12-stages binary counter is designed with an input wave shaping circuit and 12-stages of ripple-carry binary counter. The device advances the count on the negative-going edge of the clock pulse. Applications include time delay circuits, counter controls, and frequency-dividing circuits.

## ■ FEATURES

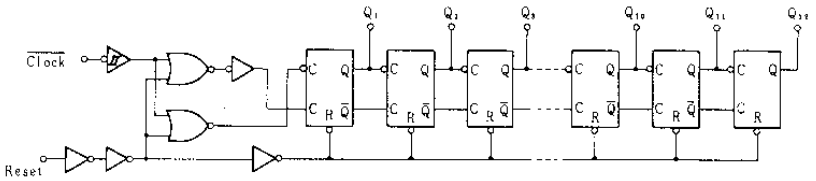
- Fully Static Operation
- Quiescent Current = 5nA/pkg typ. @5V
- Supply Voltage Range = 3 to 18V
- Capable of Driving One Low-power Schottky TTL Load Over the Rated Temperature Range
- Common Reset Line
- 13MHz Typical Counting Rate @15V
- Pin-for-Pin Replacement for CD4040B and MC14040B

## ■ PIN ARRANGEMENT




(Top View)

## ■ LOGIC DIAGRAM

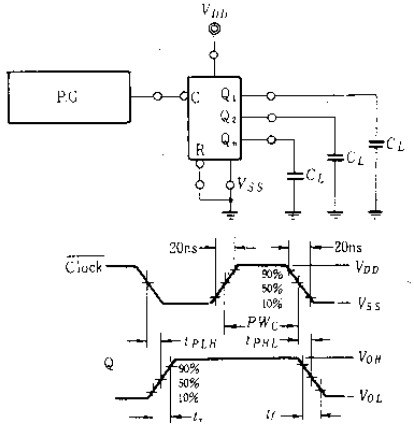



## ■ TRUTH TABLE

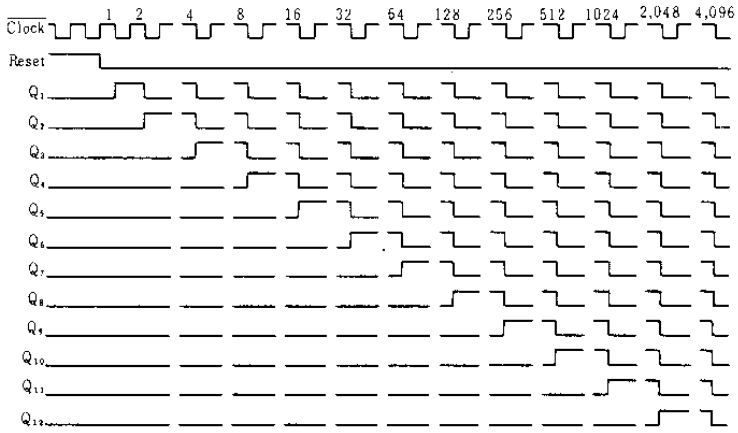
| $\overline{C}$ | Reset | Outputs State |
|---|---|---|
| ⌐ | 0 | No Change |
| ⌐ | 0 | Advance to next state |
| × | 1 | All Outputs are low |

x = Don't Care

## ■ SWITCHING TIME TEST CIRCUIT




## ■ TIMING DIAGRM

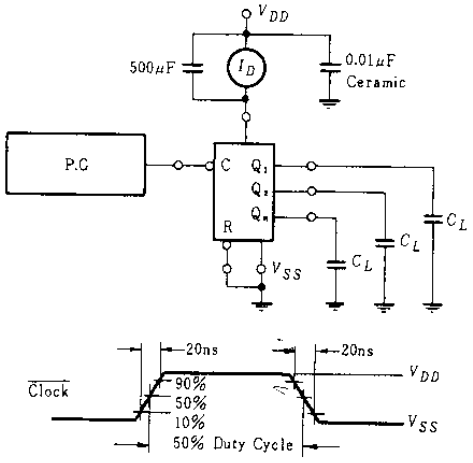


## ■ ELECTRICAL CHARACTERISTICS

| Characteristic | Symbol | $V_{DD}$(V) | Test Conditions | −40°C min | −40°C max | 25°C min | 25°C typ | 25°C max | 85°C min | 85°C max | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Output Voltage | $V_{OL}$ | 5.0 | $V_{in}$ = $V_{DD}$ or 0 | − | 0.05 | − | 0 | 0.05 | − | 0.05 | V |
| | | 10 | | − | 0.05 | − | 0 | 0.05 | − | 0.05 | |
| | | 15 | | − | 0.05 | − | 0 | 0.05 | − | 0.05 | |
| | $V_{OH}$ | 5.0 | $V_{in}$ = 0 or $V_{DD}$ | 4.95 | − | 4.95 | 5.0 | − | 4.95 | − | V |
| | | 10 | | 9.95 | − | 9.95 | 10 | − | 9.95 | − | |
| | | 15 | | 14.95 | − | 14.95 | 15 | − | 14.95 | − | |
| Input Voltage | $V_{IL}$ | 5.0 | $V_{out}$ = 4.5 or 0.5V | − | 1.5 | − | 2.25 | 1.5 | − | 1.5 | V |
| | | 10 | $V_{out}$ = 9.0 or 1.0V | − | 3.0 | − | 4.50 | 3.0 | − | 3.0 | |
| | | 15 | $V_{out}$ = 13.5 or 1.5V | − | 4.0 | − | 6.75 | 4.0 | − | 4.0 | |
| | $V_{IH}$ | 5.0 | $V_{out}$ = 0.5 or 4.5V | 3.5 | − | 3.5 | 2.75 | − | 3.5 | − | V |
| | | 10 | $V_{out}$ = 1.0 or 9.0V | 7.0 | − | 7.0 | 5.50 | − | 7.0 | − | |
| | | 15 | $V_{out}$ = 1.5 or 13.5V | 11.0 | − | 11.0 | 8.25 | − | 11.0 | − | |
| Output Drive Current | $I_{OH}$ | 5.0 | $V_{OH}$ = 2.5V | −1.0 | − | −0.8 | −1.7 | − | −0.6 | − | mA |
| | | 5.0 | $V_{OH}$ = 4.6V | −0.2 | − | −0.16 | −0.36 | − | −0.12 | − | |
| | | 10 | $V_{OH}$ = 9.5V | −0.5 | − | −0.4 | −0.9 | − | −0.3 | − | |
| | | 15 | $V_{OH}$ = 13.5V | −1.4 | − | −1.2 | −3.5 | − | −1.0 | − | |
| | $I_{OL}$ | 5.0 | $V_{OL}$ = 0.4V | 0.52 | − | 0.44 | 0.88 | − | 0.36 | − | mA |
| | | 10 | $V_{OL}$ = 0.5V | 1.3 | − | 1.1 | 2.25 | − | 0.9 | − | |
| | | 15 | $V_{OL}$ = 1.5V | 3.6 | − | 3.0 | 8.8 | − | 2.4 | − | |
| Input Current | $I_{in}$ | 15 | | − | ±0.3 | − | ±0.00001 | ±0.3 | − | ±1.0 | μA |
| Input Capacitance | $C_{in}$ | − | $V_{in}$ = 0 | − | − | − | 5.0 | 7.5 | − | − | pF |
| Quiescent Current | $I_{DD}$ | 5.0 | Zero Signal, per Package | − | 20 | − | 0.005 | 20 | − | 150 | μA |
| | | 10 | | − | 40 | − | 0.010 | 40 | − | 300 | |
| | | 15 | | − | 80 | − | 0.015 | 80 | − | 600 | |
| Total Supply Current* | $I_T$ | 5.0 | Dynamic + $I_{DD}$, $C_L$ = 50pF | − | − | − | 0.42 | − | − | − | μA |
| | | 10 | $f$ = 1kHz, | − | − | − | 0.85 | − | − | − | |
| | | 15 | per Gate | − | − | − | 1.43 | − | − | − | |

* To calculate total supply current at frequency other than 1kHz.
@ $V_{DD}$ = 5.0 V $I_T$ = (0.42μA/kHz) $f$ + $I_{DD}$ @ $V_{DD}$ = 10 V $I_T$ = (0.85μA/kHz) $f$ + $I_{DD}$ @ $V_{DD}$ = 15 V $I_T$ = (1.43μA/kHz) $f$ + $I_{DD}$

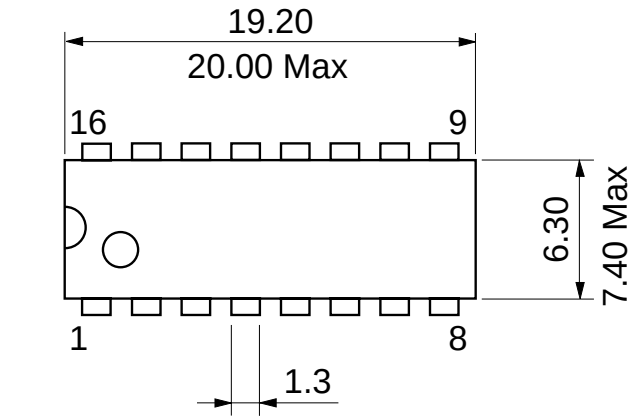
## ■ POWER DISSIPATION TEST CIRCUIT AND WAVEFORM

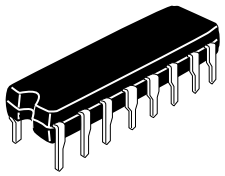


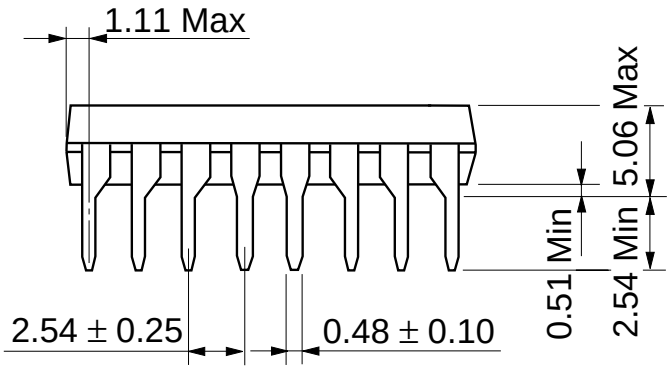
## ■SWITCHING CHARACTERISTICS ($C_L$=50pF, $Ta$=25℃)

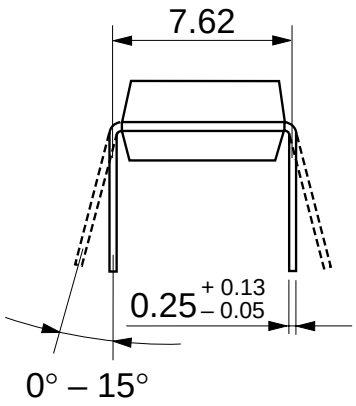
| Characteristic | | Symbol | $V_{DD}$(V) | min | typ | max | Unit |
|---|---|---|---|---|---|---|---|
| Output Rise Time | | $t_r$ | 5.0 | — | 180 | 400 | ns |
| | | | 10 | — | 90 | 200 | |
| | | | 15 | — | 65 | 160 | |
| Output Fall Time | | $t_f$ | 5.0 | — | 100 | 200 | ns |
| | | | 10 | — | 50 | 100 | |
| | | | 15 | — | 37 | 80 | |
| Propagation Delay Time | $\overline{\text{Clock}}$-to-$Q_1$ | $t_{PLH}$, $t_{PHL}$ | 5.0 | — | 400 | 1050 | ns |
| | | | 10 | — | 170 | 420 | |
| | | | 15 | — | 120 | 320 | |
| | $\overline{\text{Clock}}$-to-$Q_{12}$ | | 5.0 | — | 2.5 | 7.5 | μs |
| | | | 10 | — | 0.9 | 2.7 | |
| | | | 15 | — | 0.5 | 2.1 | |
| | Reset-to-Qn | $t_{PHL}$ | 5.0 | — | 570 | 1620 | ns |
| | | | 10 | — | 215 | 600 | |
| | | | 15 | — | 170 | 450 | |
| Clock Pulse Width | | $PW_C$ | 5.0 | 385 | 140 | — | ns |
| | | | 10 | 150 | 55 | — | |
| | | | 15 | 115 | 38 | — | |
| Clock Frequency | | $PRF$ | 5.0 | — | 3.5 | 1.5 | MHz |
| | | | 10 | — | 9.0 | 3.5 | |
| | | | 15 | — | 13 | 4.5 | |
| Clock Pulse Rise and Fall Time | | $t_r$, $t_f$ | 5.0 | No Limit | | | |
| | | | 10 | | | | |
| | | | 15 | | | | |
| Reset Pulse Width | | $PW_R$ | 5.0 | 960 | 320 | — | ns |
| | | | 10 | 360 | 120 | — | |
| | | | 15 | 270 | 80 | — | |

Unit: mm



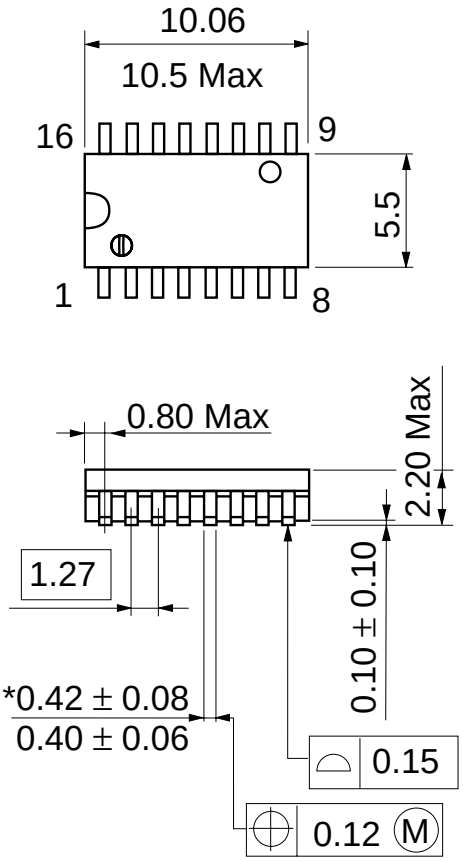



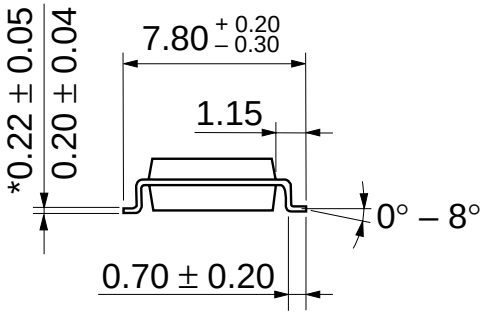


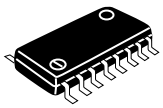




| | |
|---|---|
| Hitachi Code | DP-16 |
| JEDEC | Conforms |
| EIAJ | Conforms |
| Weight (reference value) | 1.07 g |

Unit: mm



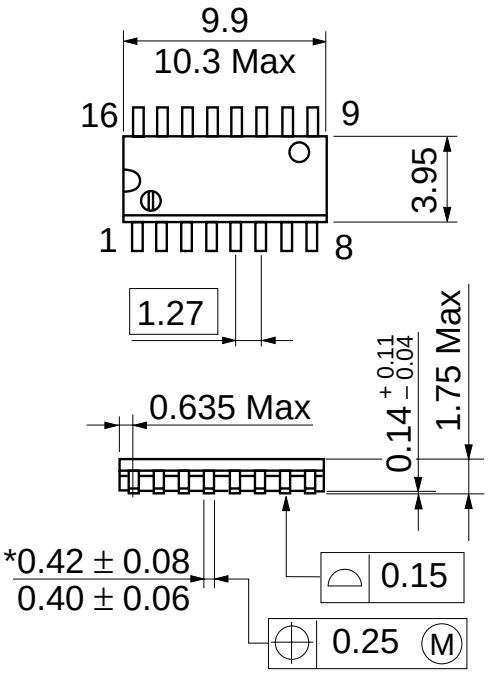



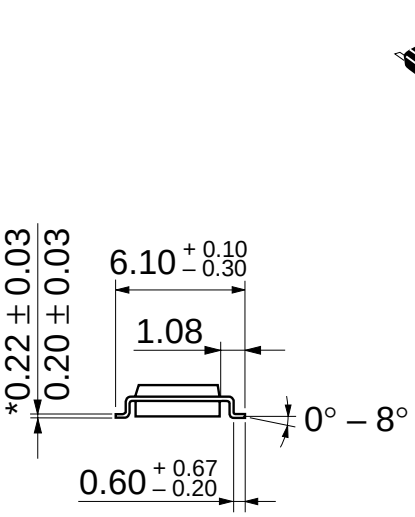



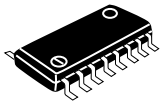
*Dimension including the plating thickness
Base material dimension

| | |
|---|---|
| Hitachi Code | FP-16DA |
| JEDEC | — |
| EIAJ | Conforms |
| Weight (reference value) | 0.24 g |

Unit: mm



*Dimension including the plating thickness
Base material dimension

| | |
|---|---|
| Hitachi Code | FP-16DN |
| JEDEC | Conforms |
| EIAJ | Conforms |
| Weight (reference value) | 0.15 g |

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