

# CD40174B Types

## CMOS Hex 'D'-Type Flip-Flop

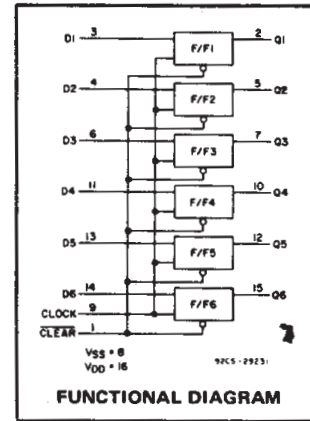
### High-Voltage Types (20-Volt Rating)

■ CD40174B consists of six identical 'D'-type flip-flops having independent DATA inputs. The CLOCK and CLEAR inputs are common to all six units. Data is transferred to the Q outputs on the positive-going transition of the clock pulse. All six flip-flops are simultaneously reset by a low level on the CLEAR input.

The CD40174B types are supplied in 16-lead hermetic dual-in-line ceramic packages (D and F suffixes), 16-lead dual-in-line plastic packages (E suffix), and in chip form (H suffix).

### Features:

- 5-V, 10-V, and 15-V parametric rating
- Standardized symmetrical output characteristics
- 100% tested for quiescent current at 20 V
- Maximum input current of 1  $\mu$ A at 18 V over full package-temperature range; 100 nA at 18 V and 25°C
- Noise margin (over full package-temperature range):
  - 1 V at  $V_{DD} = 5$  V
  - 2 V at  $V_{DD} = 10$  V
  - 2.5 V at  $V_{DD} = 15$  V
- Meets all requirements of JEDEC Tentative Standard No. 13A, "Standard Specifications for Description of 'B' Series CMOS Devices"



### Applications:

- Shift Registers
- Buffer/Storage Registers
- Pattern Generators

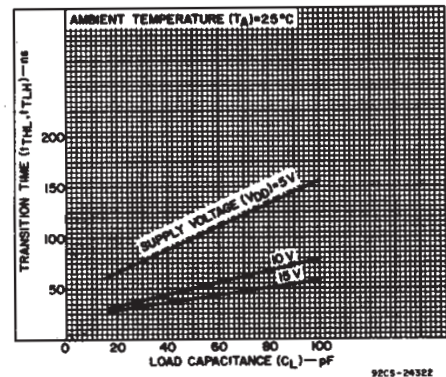
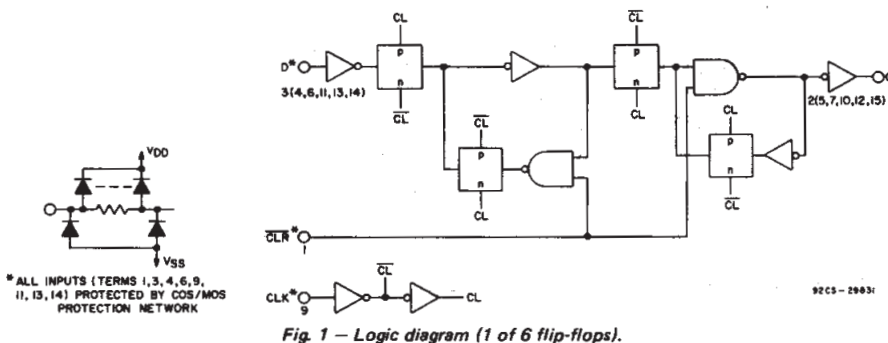
### MAXIMUM RATINGS, Absolute-Maximum Values:

|  |  |
|--|--|
| DC SUPPLY-VOLTAGE RANGE, ( $V_{DD}$ )                                      | -0.5V to +20V                                      |
| Voltages referenced to $V_{SS}$ Terminal)                                  |  |
| INPUT VOLTAGE RANGE, ALL INPUTS  | -0.5V to $V_{DD} + 0.5$ V                          |
| DC INPUT CURRENT, ANY ONE INPUT  | $\pm 10$ mA  |
| POWER DISSIPATION PER PACKAGE ( $P_D$ ):                                   |  |
| For $T_A = -55^\circ\text{C}$ to $+100^\circ\text{C}$                      | 500mW  |
| For $T_A = +100^\circ\text{C}$ to $+125^\circ\text{C}$                     | Derate Linearly at 12mW/ $^\circ\text{C}$ to 200mW |
| DEVICE DISSIPATION PER OUTPUT TRANSISTOR                                   |  |
| FOR $T_A =$ FULL PACKAGE-TEMPERATURE RANGE (All Package Types)             | 100mW  |
| OPERATING-TEMPERATURE RANGE ( $T_A$ )                                      | $-55^\circ\text{C}$ to $+125^\circ\text{C}$        |
| STORAGE TEMPERATURE RANGE ( $T_{stg}$ )                                    | $-65^\circ\text{C}$ to $+150^\circ\text{C}$        |
| LEAD TEMPERATURE (DURING SOLDERING):                                       |  |
| At distance $1/16 \pm 1/32$ inch (1.59 $\pm$ 0.79mm) from case for 10s max | $+265^\circ\text{C}$                               |

### TRUTH TABLE FOR 1 OF 6 FLIP-FLOPS

| INPUTS |      | OUTPUT |    |
|--------|------|--------|----|
| CLOCK  | DATA | CLEAR  | Q  |
|        | 0    | 1      | 0  |
|        | 1    | 1      | 1  |
|        | X    | 1      | NC |
| X      | X    | 0      | 0  |

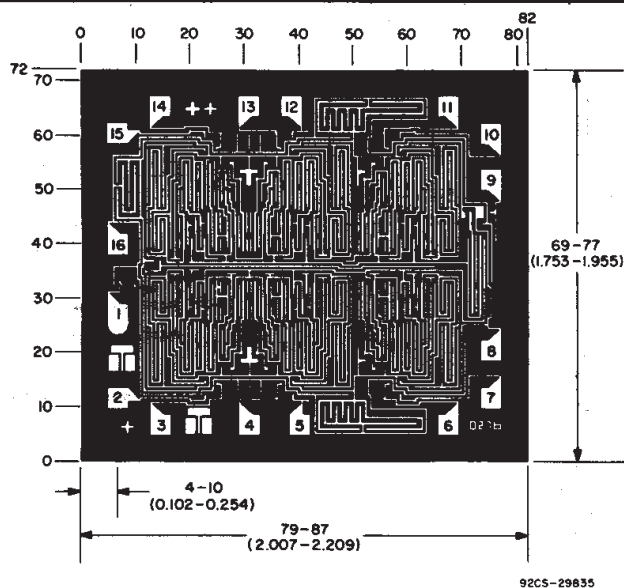
1 = High Level  
0 = Low Level  
X = Don't Care  
NC = No Change



## CD40174B Types

**RECOMMENDED OPERATING CONDITIONS** at  $T_A = 25^\circ\text{C}$ , Except as Noted.  
 For maximum reliability, nominal operating conditions should be selected so that operation is always within the following ranges:

| CHARACTERISTIC  | $V_{DD}$<br>(V) | LIMITS          |                | UNITS         |
|---|-----------------|-----------------|----------------|---------------|
|   |                 | Min.            | Max.           |               |
| Supply-Voltage Range (For $T_A =$ Full Package-Temperature Range) | —               | 3               | 18             | V             |
| Data Setup Time, $t_{SU}$   | 5<br>10<br>15   | 40<br>20<br>10  | —<br>—<br>—    | ns            |
| Data Hold Time, $t_H$   | 5<br>10<br>15   | 80<br>40<br>30  | —<br>—<br>—    | ns            |
| Clock Input Frequency, $f_{CL}$                                   | 5<br>10<br>15   | —<br>dc<br>—    | 3.5<br>6<br>8  | MHz           |
| Clock Input Rise or Fall Time, $t_{rCL}$ , $t_{fCL}$              | 5<br>10<br>15   | —<br>—<br>—     | 15<br>15<br>15 | $\mu\text{s}$ |
| Clock Input Pulse Width, $t_{WL}$ , $t_{WH}$                      | 5<br>10<br>15   | 130<br>60<br>40 | —<br>—<br>—    | ns            |
| Clear Pulse Width, $t_{WL}$                                       | 5<br>10<br>15   | 100<br>50<br>40 | —<br>—<br>—    | ns            |
| Clear Removal Time, $t_{REM}$                                     | 5<br>10<br>15   | 0<br>0<br>0     | —<br>—<br>—    | ns            |



Dimensions and pad layout for CD40174BH.

Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated. Grid graduations are in mils ( $10^{-3}$  inch).

The photographs and dimensions of each CMOS chip represent a chip when it is part of the wafer. When the wafer is separated into individual chips, the angle of cleavage may vary with respect to the chip face for different chips. The actual dimensions of the isolated chip, therefore, may differ slightly from the nominal dimensions shown. The user should consider a tolerance of  $-3$  mils to  $+16$  mils applicable to the nominal dimensions shown.

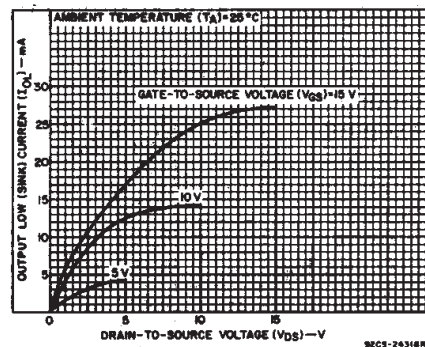


Fig. 3— Typical output low (sink) current characteristics.

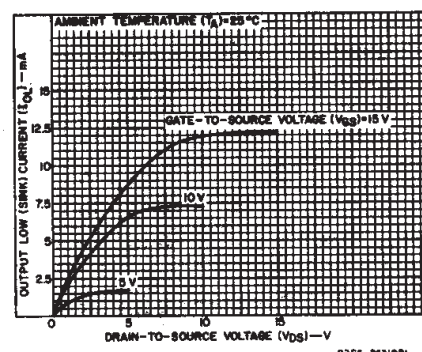


Fig. 4— Minimum output low (sink) current characteristics.

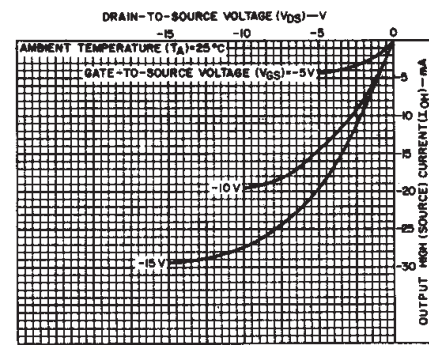


Fig. 5— Typical output high (source) current characteristics.

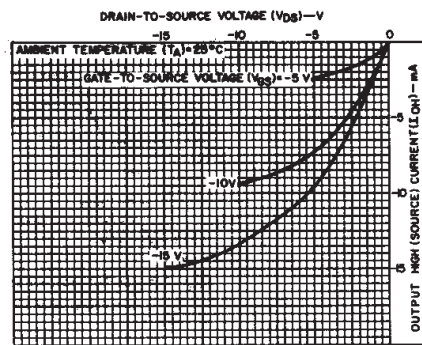


Fig. 6— Minimum output high (source) current characteristics.

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# CD40174B Types

## STATIC ELECTRICAL CHARACTERISTICS

| CHARACTERISTIC                                     | CONDITIONS         |                     |                     | LIMITS AT INDICATED TEMPERATURES (°C) |       |       |       |       |                   |      | UNITS |
|--|--------------------|---------------------|---------------------|---------------------------------------|-------|-------|-------|-------|-------------------|------|-------|
|  | V <sub>O</sub> (V) | V <sub>IN</sub> (V) | V <sub>DD</sub> (V) | -55                                   | -40   | +85   | +125  | +25   |                   |      |       |
|  |                    |                     |                     |                                       |       |       |       | Min.  | Typ.              | Max. |       |
| Quiescent Device Current, I <sub>DD</sub> Max.     | -                  | 0.5                 | 5                   | 1                                     | 1     | 30    | 30    | -     | 0.02              | 1    | μA    |
|  | -                  | 0.10                | 10                  | 2                                     | 2     | 60    | 60    | -     | 0.02              | 2    |       |
|  | -                  | 0.15                | 15                  | 4                                     | 4     | 120   | 120   | -     | 0.02              | 4    |       |
|  | -                  | 0.20                | 20                  | 20                                    | 20    | 600   | 600   | -     | 0.04              | 20   |       |
| Output Low (Sink) Current I <sub>OL</sub> Min.     | 0.4                | 0.5                 | 5                   | 0.64                                  | 0.61  | 0.42  | 0.36  | 0.51  | 1                 | -    | mA    |
|  | 0.5                | 0.10                | 10                  | 1.6                                   | 1.5   | 1.1   | 0.9   | 1.3   | 2.6               | -    |       |
|  | 1.5                | 0.15                | 15                  | 4.2                                   | 4     | 2.8   | 2.4   | 3.4   | 6.8               | -    |       |
| Output High (Source) Current, I <sub>OH</sub> Min. | 4.6                | 0.5                 | 5                   | -0.64                                 | -0.61 | -0.42 | -0.36 | -0.51 | -1                | -    | mA    |
|  | 2.5                | 0.5                 | 5                   | -2                                    | -1.8  | -1.3  | -1.15 | -1.6  | -3.2              | -    |       |
|  | 9.5                | 0.10                | 10                  | -1.6                                  | -1.5  | -1.1  | -0.9  | -1.3  | -2.6              | -    |       |
| Output Voltage: Low-Level, V <sub>OL</sub> Max.    | -                  | 0.5                 | 5                   | 0.05                                  |       |       |       | -     | 0                 | 0.05 | V     |
|  | -                  | 0.10                | 10                  | 0.05                                  |       |       |       | -     | -                 | 0.05 |       |
|  | -                  | 0.15                | 15                  | 0.05                                  |       |       |       | -     | 0                 | 0.05 |       |
| Output Voltage: High-Level, V <sub>OH</sub> Min.   | -                  | 0.5                 | 5                   | 4.95                                  |       |       |       | 4.95  | 5                 | -    | V     |
|  | -                  | 0.10                | 10                  | 9.95                                  |       |       |       | 9.95  | 10                | -    |       |
|  | -                  | 0.15                | 15                  | 14.95                                 |       |       |       | 14.95 | 15                | -    |       |
| Input Low Voltage, V <sub>IL</sub> Max.            | 0.5, 4.5           | -                   | 5                   | 1.5                                   |       |       |       | -     | -                 | 1.5  | V     |
|  | 1.9                | -                   | 10                  | 3                                     |       |       |       | -     | -                 | 3    |       |
|  | 1.5, 13.5          | -                   | 15                  | 4                                     |       |       |       | -     | -                 | 4    |       |
| Input High Voltage, V <sub>IH</sub> Min.           | 0.5, 4.5           | -                   | 5                   | 3.5                                   |       |       |       | 3.5   | -                 | -    | V     |
|  | 1.9                | -                   | 10                  | 7                                     |       |       |       | 7     | -                 | -    |       |
|  | 1.5, 13.5          | -                   | 15                  | 11                                    |       |       |       | 11    | -                 | -    |       |
| Input Current I <sub>IN</sub> Max.                 | -                  | 0.18                | 18                  | ±0.1                                  | ±0.1  | ±1    | ±1    | -     | ±10 <sup>-5</sup> | ±0.1 | μA    |

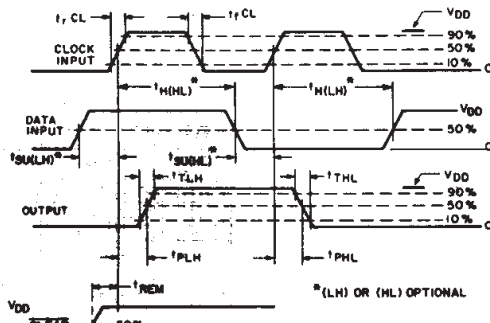


Fig. 10— Definition of setup, hold, propagation delay, and removal times.

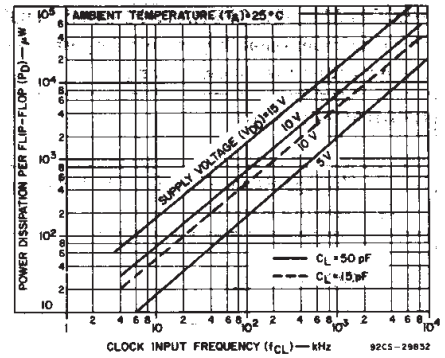


Fig. 7— Typical dynamic power dissipation as a function of CLOCK frequency.

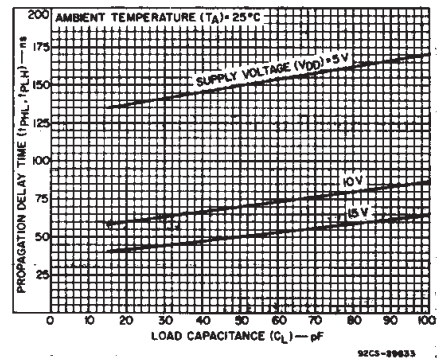


Fig. 8— Typical propagation delay time (CLOCK to OUTPUT) as a function of load capacitance.

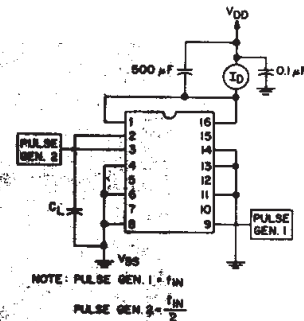


Fig. 9— Dynamic power dissipation test circuit.

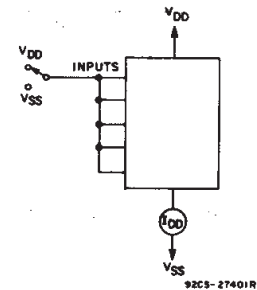


Fig. 11— Quiescent device current test circuit.

# CD40174B Types

DYNAMIC ELECTRICAL CHARACTERISTICS at  $T_A = 25^\circ\text{C}$ ;  
 Input  $t_r, t_f = 20\text{ ns}$ ,  $C_L = 50\text{ pF}$ ,  $R_L = 200\text{ k}\Omega$

| CHARACTERISTIC  | TEST CONDITIONS<br>$V_{DD}$ (V) | LIMITS |      |      | UNITS         |
|---|---------------------------------|--------|------|------|---------------|
|   |                                 | Min.   | Typ. | Max. |               |
| Propagation Delay Time<br>Clock to Output, $t_{PHL}, t_{PLH}$ | 5                               | —      | 150  | 300  | ns            |
|   | 10                              | —      | 70   | 140  |               |
|   | 15                              | —      | 50   | 100  |               |
| Clear to Output, $t_{PHL}$                                    | 5                               | —      | 100  | 200  | ns            |
|   | 10                              | —      | 50   | 100  |               |
|   | 15                              | —      | 40   | 80   |               |
| Transition Time, $t_{THL}, t_{TLH}$                           | 5                               | —      | 100  | 200  | ns            |
|   | 10                              | —      | 50   | 100  |               |
|   | 15                              | —      | 40   | 80   |               |
| Minimum Pulse Width,<br>Clock, $t_{WL}, t_{WH}$               | 5                               | —      | 65   | 130  | ns            |
|   | 10                              | —      | 30   | 60   |               |
|   | 15                              | —      | 20   | 40   |               |
| Clear, $t_{WL}$   | 5                               | —      | 50   | 100  | ns            |
|   | 10                              | —      | 25   | 50   |               |
|   | 15                              | —      | 20   | 40   |               |
| Minimum Data Setup Time, $t_{SU}$                             | 5                               | —      | 20   | 40   | ns            |
|   | 10                              | —      | 10   | 20   |               |
|   | 15                              | —      | 0    | 10   |               |
| Minimum Data Hold Time, $t_H$                                 | 5                               | —      | 40   | 80   | ns            |
|   | 10                              | —      | 20   | 40   |               |
|   | 15                              | —      | 15   | 30   |               |
| Maximum Clock Frequency, $f_{CL}$                             | 5                               | 3.5    | 7    | —    | MHz           |
|   | 10                              | 6      | 12   | —    |               |
|   | 15                              | 8      | 16   | —    |               |
| Maximum Clock Rise or Fall<br>Time, $t_{rCL}, t_{fCL}$        | 5                               | 15     | —    | —    | $\mu\text{s}$ |
|   | 10                              | 15     | —    | —    |               |
|   | 15                              | 15     | —    | —    |               |
| Input Capacitance, $C_{IN}$                                   | Clear                           | —      | 25   | 40   | pF            |
|   | All other                       | —      | 5    | 7.5  |               |
| Minimum Clear Removal<br>Time, $t_{REM}$                      | 5                               | —      | -40  | 0    | ns            |
|   | 10                              | —      | -15  | 0    |               |
|   | 15                              | —      | -10  | 0    |               |

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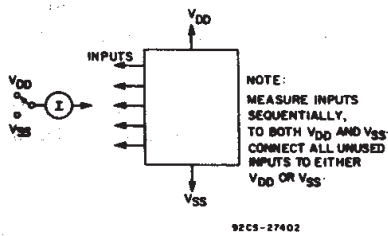


Fig. 12 - Input current test circuit.

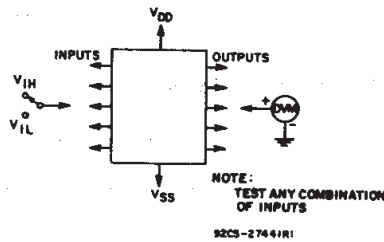
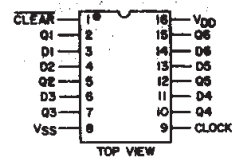


Fig. 13 - Input voltage test circuit.

### TERMINAL ASSIGNMENT



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