

MC14175B

Quad Type D Flip-Flop

The MC14175B quad type D flip-flop is constructed with MOS P-channel and N-channel enhancement mode devices in a single monolithic structure. Each of the four flip-flops is positive-edge triggered by a common clock input (C). An active-low reset input (R) asynchronously resets all flip-flops. Each flip-flop has independent Data (D) inputs and complementary outputs (Q and \bar{Q}). These devices may be used as shift register elements or as type T flip-flops for counter and toggle applications.

Features

- Complementary Outputs
- Static Operation
- All Inputs and Outputs Buffered
- Diode Protection on All Inputs
- Supply Voltage Range = 3.0 Vdc to 18 Vdc
- Output Compatible with Two Low-Power TTL Loads or One Low-Power Schottky TTL Load
- Functional Equivalent to TTL 74175
- These Devices are Pb-Free and are RoHS Compliant
- NLV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable*

MAXIMUM RATINGS (Voltages Referenced to V_{SS})

| Parameter | Symbol | Value | Unit |
|---|-------------------|------------------------|--------------------|
| DC Supply Voltage Range | V_{DD} | -0.5 to +18.0 | V |
| Input or Output Voltage Range (DC or Transient) | V_{in}, V_{out} | -0.5 to V_{DD} + 0.5 | V |
| Input or Output Current (DC or Transient) per Pin | I_{in}, I_{out} | ± 10 | mA |
| Power Dissipation per Package (Note 1) | P_D | 500 | mW |
| Ambient Temperature Range | T_A | -55 to +125 | $^{\circ}\text{C}$ |
| Storage Temperature Range | | -65 to +150 | $^{\circ}\text{C}$ |
| Lead Temperature (8-Second Soldering) | | 260 | $^{\circ}\text{C}$ |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Temperature Derating: "D/DW" Packages: -7.0 mW/ $^{\circ}\text{C}$ From 65 $^{\circ}\text{C}$ To 125 $^{\circ}\text{C}$

This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high-impedance circuit. For proper operation, V_{in} and V_{out} should be constrained to the range $V_{SS} \leq (V_{in} \text{ or } V_{out}) \leq V_{DD}$.

Unused inputs must always be tied to an appropriate logic voltage level (e.g., either V_{SS} or V_{DD}). Unused outputs must be left open.

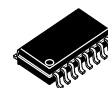


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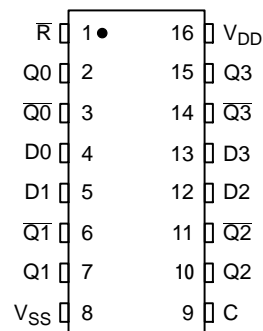


SOIC-16
D SUFFIX
CASE 751B

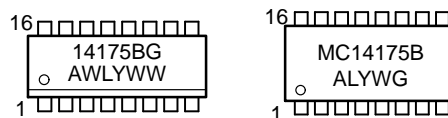


SOEIAJ-16
F SUFFIX
CASE 966

PIN ASSIGNMENT



MARKING DIAGRAMS



SOIC-16

SOEIAJ-16

- A = Assembly Location
- WL, L = Wafer Lot
- YY, Y = Year
- WW, W = Work Week
- G = Pb-Free Package

ORDERING INFORMATION

| Device | Package | Shipping† |
|----------------|---------------------|------------------|
| MC14175BDG | SOIC-16 (Pb-Free) | 48 Units/Rail |
| MC14175BDR2G | SOIC-16 (Pb-Free) | 2500/Tape & Reel |
| NLV14175BDR2G* | SOIC-16 (Pb-Free) | 2500/Tape & Reel |
| MC14175BFELG | SOEIAJ-16 (Pb-Free) | 2000/Tape & Reel |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

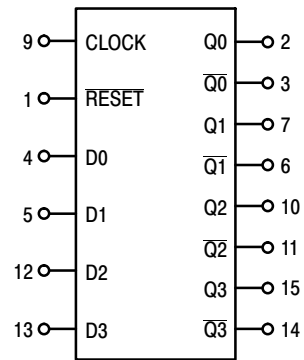
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TRUTH TABLE

| Inputs | | | Outputs | |
|--------|------|-------|---------|-----------|
| Clock | Data | Reset | Q | \bar{Q} |
| | 0 | 1 | 0 | 1 |
| | 1 | 1 | 1 | 0 |
| | X | 1 | Q | \bar{Q} |
| X | X | 0 | 0 | 1 |

No Change

X = Don't Care



V_{DD} = PIN 16
 V_{SS} = PIN 8

Figure 1. Block Diagram

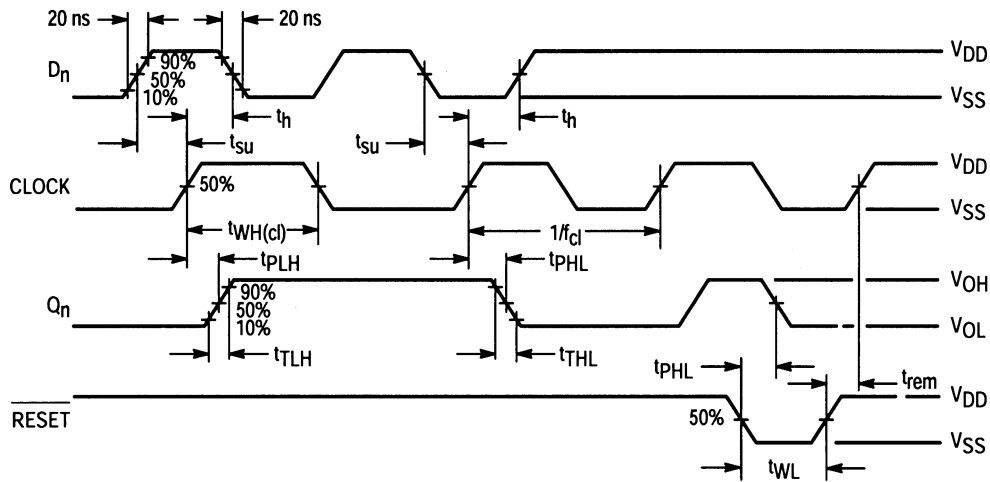


Figure 2. Timing Diagram

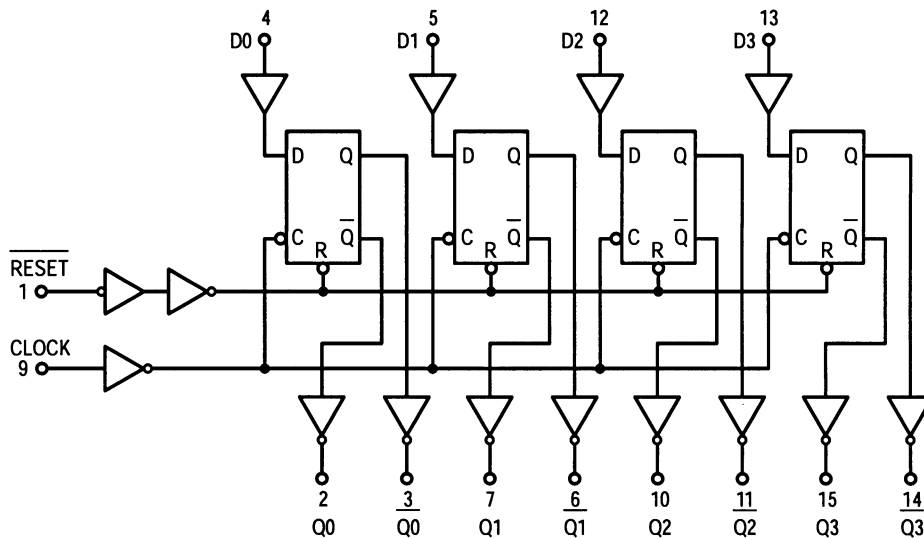


Figure 3. Functional Block Diagram

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ELECTRICAL CHARACTERISTICS (Voltages Referenced to V_{SS})

| Characteristic | Symbol | V_{DD} Vdc | -55°C | | 25°C | | | 125°C | | Unit |
|---|---------------------------|-----------------|------------------------------------|-----------|-------|-----------------|-----------|-------|-----------|-----------|
| | | | Min | Max | Min | Typ (Note 2) | Max | Min | Max | |
| Output Voltage $V_{in} = V_{DD}$ or 0 $V_{in} = 0$ or V_{DD} | "0" Level V_{OL} | 5.0 | - | 0.05 | - | 0 | 0.05 | - | 0.05 | Vdc |
| | | 10 | - | 0.05 | - | 0 | 0.05 | - | 0.05 | |
| | | 15 | - | 0.05 | - | 0 | 0.05 | - | 0.05 | |
| | "1" Level V_{OH} | 5.0 | 4.95 | - | 4.95 | 5.0 | - | 4.95 | - | Vdc |
| | | 10 | 9.95 | - | 9.95 | 10 | - | 9.95 | - | |
| | | 15 | 14.95 | - | 14.95 | 15 | - | 14.95 | - | |
| Input Voltage ($V_O = 4.5$ or 0.5 Vdc) ($V_O = 9.0$ or 1.0 Vdc) ($V_O = 13.5$ or 1.5 Vdc) ($V_O = 0.5$ or 4.5 Vdc) ($V_O = 1.0$ or 9.0 Vdc) ($V_O = 1.5$ or 13.5 Vdc) | "0" Level V_{IL} | 5.0 | - | 1.5 | - | 2.25 | 1.5 | - | 1.5 | Vdc |
| | | 10 | - | 3.0 | - | 4.50 | 3.0 | - | 3.0 | |
| | | 15 | - | 4.0 | - | 6.75 | 4.0 | - | 4.0 | |
| | "1" Level V_{IH} | 5.0 | 3.5 | - | 3.5 | 2.75 | - | 3.5 | - | Vdc |
| | | 10 | 7.0 | - | 7.0 | 5.50 | - | 7.0 | - | |
| | | 15 | 11 | - | 11 | 8.25 | - | 11 | - | |
| Output Drive Current ($V_{OH} = 2.5$ Vdc) ($V_{OH} = 4.6$ Vdc) ($V_{OH} = 9.5$ Vdc) ($V_{OH} = 13.5$ Vdc) ($V_{OL} = 0.4$ Vdc) ($V_{OL} = 0.5$ Vdc) ($V_{OL} = 1.5$ Vdc) | Source I_{OH} | 5.0 | -3.0 | - | -2.4 | -4.2 | - | -1.7 | - | mAdc |
| | | 5.0 | -0.64 | - | -0.51 | -0.88 | - | -0.36 | - | |
| | | 10 | -1.6 | - | -1.3 | -2.25 | - | -0.9 | - | |
| | | 15 | -4.2 | - | -3.4 | -8.8 | - | -2.4 | - | |
| | Sink I_{OL} | 5.0 | 0.64 | - | 0.51 | 0.88 | - | 0.36 | - | mAdc |
| | | 10 | 1.6 | - | 1.3 | 2.25 | - | 0.9 | - | |
| 15 | | 4.2 | - | 3.4 | 8.8 | - | 2.4 | - | | |
| Input Current | I_{in} | 15 | - | ± 0.1 | - | ± 0.00001 | ± 0.1 | - | ± 1.0 | μ Adc |
| Input Capacitance ($V_{in} = 0$) | C_{in} | - | - | - | - | 5.0 | 7.5 | - | - | pF |
| Quiescent Current (Per Package) | I_{DD} | 5.0 | - | 5.0 | - | 0.005 | 5.0 | - | 150 | μ Adc |
| | | 10 | - | 10 | - | 0.010 | 10 | - | 300 | |
| | | 15 | - | 20 | - | 0.015 | 20 | - | 600 | |
| Total Supply Current (Notes 3 & 4) (Dynamic plus Quiescent, Per Package) ($C_L = 50$ pF on all outputs, all buffers switching) | I_T | 5.0 | $I_T = (1.7 \mu A/kHz) f + I_{DD}$ | | | | | | | μ Adc |
| | | 10 | $I_T = (3.4 \mu A/kHz) f + I_{DD}$ | | | | | | | |
| | | 15 | $I_T = (5.0 \mu A/kHz) f + I_{DD}$ | | | | | | | |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

2. Data labelled "Typ" is not to be used for design purposes but is intended as an indication of the IC's potential performance.

3. The formulas given are for the typical characteristics only at 25°C.

4. To calculate total supply current at loads other than 50 pF: $I_T(C_L) = I_T(50 \text{ pF}) + (C_L - 50) V f k$ where: I_T is in μA (per package), C_L in pF, $V = (V_{DD} - V_{SS})$ in volts, f in kHz is input frequency, and $k = 0.004$.

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SWITCHING CHARACTERISTICS (Note 5) ($C_L = 50 \text{ pF}$, $T_A = 25^\circ\text{C}$)

| Characteristic | Symbol | V_{DD} Vdc | All Types | | | Unit |
|--|-----------------------|-----------------|------------------|-------------------|-------------------|---------------|
| | | | Min | Typ (Note 6) | Max | |
| Output Rise and Fall Time t_{TLH} , $t_{THL} = (1.35 \text{ ns/pF}) C_L + 32 \text{ ns}$ t_{TLH} , $t_{THL} = (0.6 \text{ ns/pF}) C_L + 20 \text{ ns}$ t_{TLH} , $t_{THL} = (0.4 \text{ ns/pF}) C_L + 20 \text{ ns}$ | t_{TLH} , t_{THL} | 5.0 10 15 | – – – | 100 50 40 | 200 100 80 | ns |
| Propagation Delay Time — Clock to Q, Q t_{PLH} , $t_{PHL} = (0.9 \text{ ns/pF}) C_L + 175 \text{ ns}$ t_{PLH} , $t_{PHL} = (0.36 \text{ ns/pF}) C_L + 72 \text{ ns}$ t_{PLH} , $t_{PHL} = (0.26 \text{ ns/pF}) C_L + 57 \text{ ns}$ | t_{PLH} , t_{PHL} | 5.0 10 15 | – – – | 220 90 70 | 400 160 120 | ns |
| Propagation Delay Time — Reset to Q, Q $t_{PHL} = (0.9 \text{ ns/pF}) C_L + 280 \text{ ns}$ $t_{PHL} = (0.36 \text{ ns/pF}) C_L + 112 \text{ ns}$ $t_{PHL} = (0.26 \text{ ns/pF}) C_L + 87 \text{ ns}$ | t_{PHL} , t_{PLH} | 5.0 10 15 | – – – | 325 130 100 | 500 200 150 | ns |
| Clock Pulse Width | t_{WH} | 5.0 10 15 | 250 100 75 | 110 45 35 | – – – | ns |
| Reset Pulse Width | t_{WL} | 5.0 10 15 | 200 80 60 | 100 40 30 | – – – | ns |
| Clock Pulse Frequency | f_{cl} | 5.0 10 15 | – – – | 4.5 11 14 | 2.0 5.0 6.5 | mHz |
| Clock Pulse Rise and Fall Time | t_{TLH} , t_{THL} | 5.0 10 15 | – – – | – – – | 15 5.0 4.0 | μs |
| Data Setup Time | t_{su} | 5.0 10 15 | 120 50 40 | 60 25 20 | – – – | ns |
| Data Hold Time | t_h | 5.0 10 15 | 80 40 30 | 40 20 15 | – – – | ns |
| Reset Removal Time | t_{rem} | 5.0 10 15 | 250 100 80 | 125 50 40 | – – – | ns |

5. The formulas given are for the typical characteristics only at 25°C .

6. Data labelled "Typ" is not to be used for design purposes but is intended as an indication of the IC's potential performance.

MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

ON Semiconductor®



SCALE 1:1

SOIC-16 CASE 751B-05 ISSUE K

DATE 29 DEC 2006



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|-------|-----------|-------|
| | MIN | MAX | MIN | MAX |
| A | 9.80 | 10.00 | 0.386 | 0.393 |
| B | 3.80 | 4.00 | 0.150 | 0.157 |
| C | 1.35 | 1.75 | 0.054 | 0.068 |
| D | 0.35 | 0.49 | 0.014 | 0.019 |
| F | 0.40 | 1.25 | 0.016 | 0.049 |
| G | 1.27 BSC | | 0.050 BSC | |
| J | 0.19 | 0.25 | 0.008 | 0.009 |
| K | 0.10 | 0.25 | 0.004 | 0.009 |
| M | 0° | 7° | 0° | 7° |
| P | 5.80 | 6.20 | 0.229 | 0.244 |
| R | 0.25 | 0.50 | 0.010 | 0.019 |

- | | | | |
|---|---|---|---|
| <p>STYLE 1:</p> <p>PIN 1. COLLECTOR 2. BASE 3. EMITTER 4. NO CONNECTION 5. EMITTER 6. BASE 7. COLLECTOR 8. COLLECTOR 9. BASE 10. EMITTER 11. NO CONNECTION 12. EMITTER 13. BASE 14. COLLECTOR 15. EMITTER 16. COLLECTOR</p> | <p>STYLE 2:</p> <p>PIN 1. CATHODE 2. ANODE 3. NO CONNECTION 4. CATHODE 5. CATHODE 6. NO CONNECTION 7. ANODE 8. CATHODE 9. CATHODE 10. ANODE 11. NO CONNECTION 12. CATHODE 13. CATHODE 14. NO CONNECTION 15. ANODE 16. CATHODE</p> | <p>STYLE 3:</p> <p>PIN 1. COLLECTOR, DYE #1 2. BASE, #1 3. EMITTER, #1 4. COLLECTOR, #1 5. COLLECTOR, #2 6. BASE, #2 7. EMITTER, #2 8. COLLECTOR, #2 9. COLLECTOR, #3 10. BASE, #3 11. EMITTER, #3 12. COLLECTOR, #3 13. COLLECTOR, #4 14. BASE, #4 15. EMITTER, #4 16. COLLECTOR, #4</p> | <p>STYLE 4:</p> <p>PIN 1. COLLECTOR, DYE #1 2. COLLECTOR, #1 3. COLLECTOR, #2 4. COLLECTOR, #2 5. COLLECTOR, #3 6. COLLECTOR, #3 7. COLLECTOR, #4 8. COLLECTOR, #4 9. BASE, #4 10. EMITTER, #4 11. BASE, #3 12. EMITTER, #3 13. BASE, #2 14. EMITTER, #2 15. BASE, #1 16. EMITTER, #1</p> |
| <p>STYLE 5:</p> <p>PIN 1. DRAIN, DYE #1 2. DRAIN, #1 3. DRAIN, #2 4. DRAIN, #2 5. DRAIN, #3 6. DRAIN, #3 7. DRAIN, #4 8. DRAIN, #4 9. GATE, #4 10. SOURCE, #4 11. GATE, #3 12. SOURCE, #3 13. GATE, #2 14. SOURCE, #2 15. GATE, #1 16. SOURCE, #1</p> | <p>STYLE 6:</p> <p>PIN 1. CATHODE 2. CATHODE 3. CATHODE 4. CATHODE 5. CATHODE 6. CATHODE 7. CATHODE 8. CATHODE 9. ANODE 10. ANODE 11. ANODE 12. ANODE 13. ANODE 14. ANODE 15. ANODE 16. ANODE</p> | <p>STYLE 7:</p> <p>PIN 1. SOURCE N-CH 2. COMMON DRAIN (OUTPUT) 3. COMMON DRAIN (OUTPUT) 4. GATE P-CH 5. COMMON DRAIN (OUTPUT) 6. COMMON DRAIN (OUTPUT) 7. COMMON DRAIN (OUTPUT) 8. SOURCE P-CH 9. SOURCE P-CH 10. COMMON DRAIN (OUTPUT) 11. COMMON DRAIN (OUTPUT) 12. COMMON DRAIN (OUTPUT) 13. GATE N-CH 14. COMMON DRAIN (OUTPUT) 15. COMMON DRAIN (OUTPUT) 16. SOURCE N-CH</p> | |

SOLDERING FOOTPRINT



DIMENSIONS: MILLIMETERS

| | | |
|------------------|-------------|---|
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