

MC74HC377A

Octal D Flip-Flop with Common Clock and Enable

High-Performance Silicon-Gate CMOS

The MC74HC377A is identical in pinout to the LS273. The device inputs are compatible with standard CMOS outputs; with pullup resistors, they are compatible with LSTTL outputs.

This device consists of eight D flip-flops with common Clock and Enable (\bar{E}) inputs. Each flip-flop is loaded with a low-to-high transition of the Clock input. Enable (\bar{E}) is active low.

Features

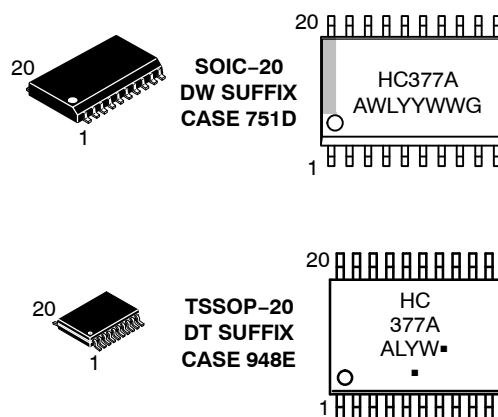
- Output Drive Capability: 10 LSTTL Loads
- Outputs Directly Interface to CMOS, NMOS and TTL
- Operating Voltage Range: 2.0 to 6.0 V
- Low Input Current: 1.0 μ A
- High Noise Immunity Characteristic of CMOS Devices
- In Compliance with the Requirements Defined by JEDEC Standard No. 7A
- Chip Complexity: 264 FETs or 66 Equivalent Gates
- These are Pb-Free Devices



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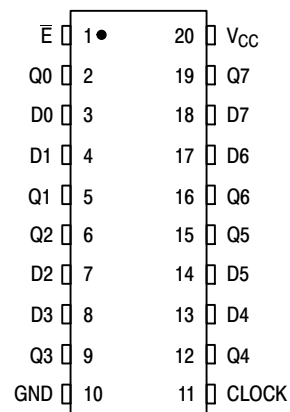
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MARKING DIAGRAMS



A = Assembly Location
WL, L = Wafer Lot
YY, Y = Year
WW, W = Work Week
G = Pb-Free Package
▪ = Pb-Free Package
(Note: Microdot may be in either location)

PIN ASSIGNMENT



ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

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Figure 1. Logic Diagram

FUNCTION TABLE

| Operating Modes | Inputs | | | Outputs |
|-------------------|--------|-----------|--------|------------------------|
| | Clock | \bar{E} | Dn | Qn |
| Load "1" | ↑ | l | h | H |
| Load "0" | ↑ | l | l | L |
| Hold (Do Nothing) | ↑ X | h H | X X | No Change No Change |

H = HIGH voltage level
h = HIGH voltage level one setup time prior to the LOW-to-HIGH CP transition
L = LOW voltage level
l = LOW voltage level one setup time prior to the LOW-to-HIGH CP transition
↑ = LOW-to-HIGH CP transition
X = Don't Care

| Design Criteria | Value | Units |
|---------------------------------|-------|-------|
| Internal Gate Count* | 66 | ea |
| Internal Gate Propagation Delay | 1.5 | ns |
| Internal Gate Power Dissipation | 5.0 | μW |
| Speed Power Product | .0075 | pJ |

*Equivalent to a two-input NAND gate.

ORDERING INFORMATION

| Device | Package | Shipping† |
|-----------------|------------------------|------------------|
| MC74HC377ADWG | SOIC-20 WIDE (Pb-Free) | 38 Units / Rail |
| MC74HC377ADWR2G | SOIC-20 WIDE (Pb-Free) | 1000 Tape & Reel |
| MC74HC377ADTG | TSSOP-20* | 75 Units / Rail |
| MC74HC377ADTR2G | TSSOP-20* | 2500 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.

*This package is inherently Pb-Free.

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MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
|-----------|---|------------------------|------|
| V_{CC} | DC Supply Voltage (Referenced to GND) | -0.5 to +7.0 | V |
| V_{in} | DC Input Voltage (Referenced to GND) | -0.5 to $V_{CC} + 0.5$ | V |
| V_{out} | DC Output Voltage (Referenced to GND) | -0.5 to $V_{CC} + 0.5$ | V |
| I_{in} | DC Input Current, per Pin | ± 20 | mA |
| I_{out} | DC Output Current, per Pin | ± 25 | mA |
| I_{CC} | DC Supply Current, V_{CC} and GND Pins | ± 50 | mA |
| P_D | Power Dissipation in Still Air SOIC Package [†] TSSOP Package [†] | 500 450 | mW |
| T_{stg} | Storage Temperature | -65 to +150 | °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 $GND \leq (V_{in} \text{ or } V_{out}) \leq V_{CC}$.
Unused inputs must always be tied to an appropriate logic voltage level (e.g., either GND or V_{CC}). Unused outputs must be left open.

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

[†]Derating - SOIC Package: - 7 mW/°C from 65° to 125°C
TSSOP Package: - 6.1 mW/°C from 65° to 125°C

RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Min | Max | Unit | |
|-------------------|--|--|-------------|--------------------|----|
| V_{CC} | DC Supply Voltage (Referenced to GND) | 2.0 | 6.0 | V | |
| V_{in}, V_{out} | DC Input Voltage, Output Voltage (Referenced to GND) | 0 | V_{CC} | V | |
| T_A | Operating Temperature, All Package Types | -55 | +125 | °C | |
| t_r, t_f | Input Rise and Fall Time (Figure 2) | $V_{CC} = 2.0 \text{ V}$ $V_{CC} = 4.5 \text{ V}$ $V_{CC} = 6.0 \text{ V}$ | 0 0 0 | 1000 500 400 | ns |

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DC ELECTRICAL CHARACTERISTICS (Voltages Referenced to GND)

| Symbol | Parameter | Test Conditions | V _{CC} V | Guaranteed Limit | | | Unit |
|-----------------|--|---|----------------------|------------------|--------|---------|------|
| | | | | -55 to 25°C | ≤ 85°C | ≤ 125°C | |
| V _{IH} | Minimum High-Level Input Voltage | V _{out} = V _{CC} - 0.1 V I _{out} ≤ 20 μA | 2.0 | 1.5 | 1.5 | 1.5 | V |
| | | | 3.0 | 2.1 | 2.1 | 2.1 | |
| | | | 4.5 | 3.15 | 3.15 | 3.15 | |
| | | | 6.0 | 4.2 | 4.2 | 4.2 | |
| V _{IL} | Maximum Low-Level Input Voltage | V _{out} = 0.1 V I _{out} ≤ 20 μA | 2.0 | 0.5 | 0.5 | 0.5 | V |
| | | | 3.0 | 0.9 | 0.9 | 0.9 | |
| | | | 4.5 | 1.35 | 1.35 | 1.35 | |
| | | | 6.0 | 1.8 | 1.8 | 1.8 | |
| V _{OH} | Minimum High-Level Output Voltage | V _{in} = V _{IH} I _{out} ≤ 20 μA | 2.0 | 1.9 | 1.9 | 1.9 | V |
| | | | 4.5 | 4.4 | 4.4 | 4.4 | |
| | | V _{in} = V _{IH} I _{out} ≤ 4.0 mA I _{out} ≤ 5.2 mA | 4.5 | 3.98 | 3.84 | 3.7 | |
| | | | 6.0 | 5.48 | 5.34 | 5.2 | |
| V _{OL} | Maximum Low-Level Output Voltage | V _{in} = V _{IL} I _{out} ≤ 20 μA | 2.0 | 0.1 | 0.1 | 0.1 | V |
| | | | 4.5 | 0.1 | 0.1 | 0.1 | |
| | | V _{in} = V _{IL} I _{out} ≤ 4.0 mA I _{out} ≤ 5.2 mA | 4.5 | 0.26 | 0.33 | 0.4 | |
| | | | 6.0 | 0.26 | 0.33 | 0.4 | |
| I _{in} | Maximum Input Leakage Current | V _{in} = V _{CC} or GND | 6.0 | ±0.1 | ±1.0 | ±1.0 | μA |
| I _{CC} | Maximum Quiescent Supply Current (per Package) | V _{in} = V _{CC} or GND I _{out} = 0 μA | 6.0 | 4.0 | 40 | 160 | μA |

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AC Electrical Characteristics ($C_L = 50$ pF, Input $t_r, t_f = 6.0$ ns)

| Symbol | Parameter | Test Conditions | V_{CC} (V) | Guaranteed Limits | | | Unit |
|--------------------|--|-----------------|--------------|-------------------|--------|---------|------|
| | | | | -55°C to 25° | ≤ 85°C | ≤ 125°C | |
| t_{PHL}, t_{PLH} | Maximum Propagation Delay Clock to Qn | Figures 2, 4 | 2.0 | 160 | 200 | 240 | ns |
| | | | 4.5 | 32 | 40 | 48 | |
| | | | 6.0 | 27 | 34 | 41 | |
| t_{THL}, t_{TLH} | Maximum Output Transition Time | Figures 2, 4 | 2.0 | 75 | 95 | 110 | ns |
| | | | 4.5 | 15 | 19 | 22 | |
| | | | 6.0 | 13 | 16 | 19 | |
| t_W | Minimum Clock Pulse Width High or Low | Figure 2 | 2.0 | 80 | 100 | 120 | ns |
| | | | 4.5 | 16 | 20 | 24 | |
| | | | 6.0 | 4 | 17 | 20 | |
| t_{su} | Minimum Set-up Time D_n to Clock | Figure 3 | 2.0 | 60 | 75 | 90 | ns |
| | | | 4.5 | 12 | 15 | 18 | |
| | | | 6.0 | 10 | 13 | 15 | |
| t_{su} | Minimum Set-up Time Enable to Clock | Figure 3 | 2.0 | 60 | 75 | 90 | ns |
| | | | 4.5 | 12 | 15 | 18 | |
| | | | 6.0 | 10 | 13 | 15 | |
| t_h | Minimum Hold Time D_n to Clock | Figure 3 | 2.0 | 3 | 3 | 3 | ns |
| | | | 4.5 | 3 | 3 | 3 | |
| | | | 6.0 | 3 | 3 | 3 | |
| t_h | Minimum Hold Time Enable to Clock | Figure 3 | 2.0 | 4 | 4 | 4 | ns |
| | | | 4.5 | 4 | 4 | 4 | |
| | | | 6.0 | 4 | 4 | 4 | |
| f_{max} | Maximum Clock Pulse Frequency (50% duty cycle) | Figures 2, 4 | 2.0 | 6 | 5 | 4 | ns |
| | | | 4.5 | 30 | 24 | 20 | |
| | | | 6.0 | 35 | 28 | 24 | |
| C_{in} | Maximum Input Capacitance | | - | 10 | 10 | 10 | pF |

| | | | |
|----------------------|-------------------------------|--|----|
| C_{PD} (Note 1) | | Typical @ 25°C, $V_{CC} = 5.0$ V | pF |
| | Power Dissipation Capacitance | 35 | |

1. C_{PD} is defined as the value of the IC's equivalent capacitance from which the operating current can be calculated from:
 $I_{CC(operating)} \approx C_{PD} \times V_{CC} \times f_{IN} \times N_{SW}$ where N_{SW} = total number of outputs switching and f_{IN} = switching frequency.

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SWITCHING WAVEFORMS

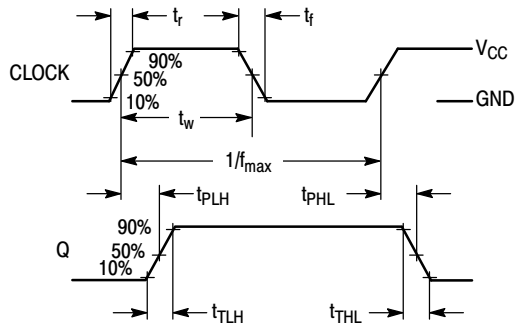
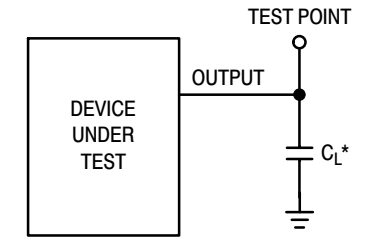


Figure 2.



Figure 3.



*Includes all probe and jig capacitance

Figure 4. Test Circuit

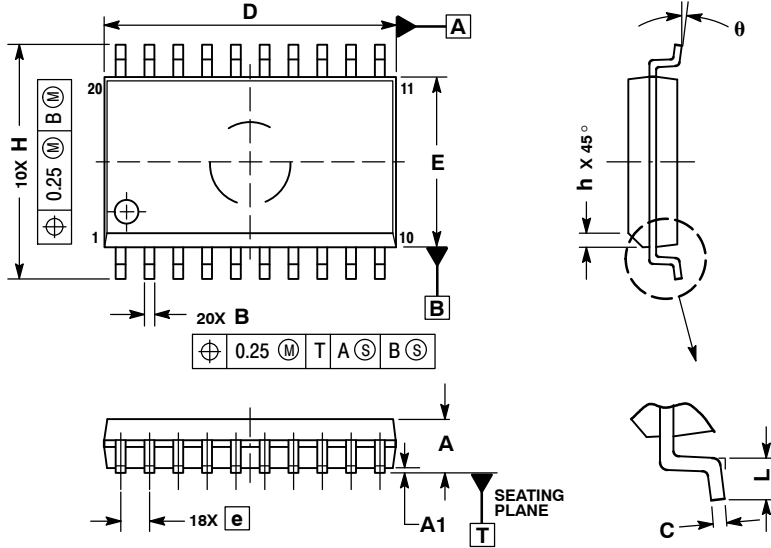


Figure 5. Expanded Logic Diagram

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PACKAGE DIMENSIONS

SOIC-20
DW SUFFIX
CASE 751D-05
ISSUE G



NOTES:

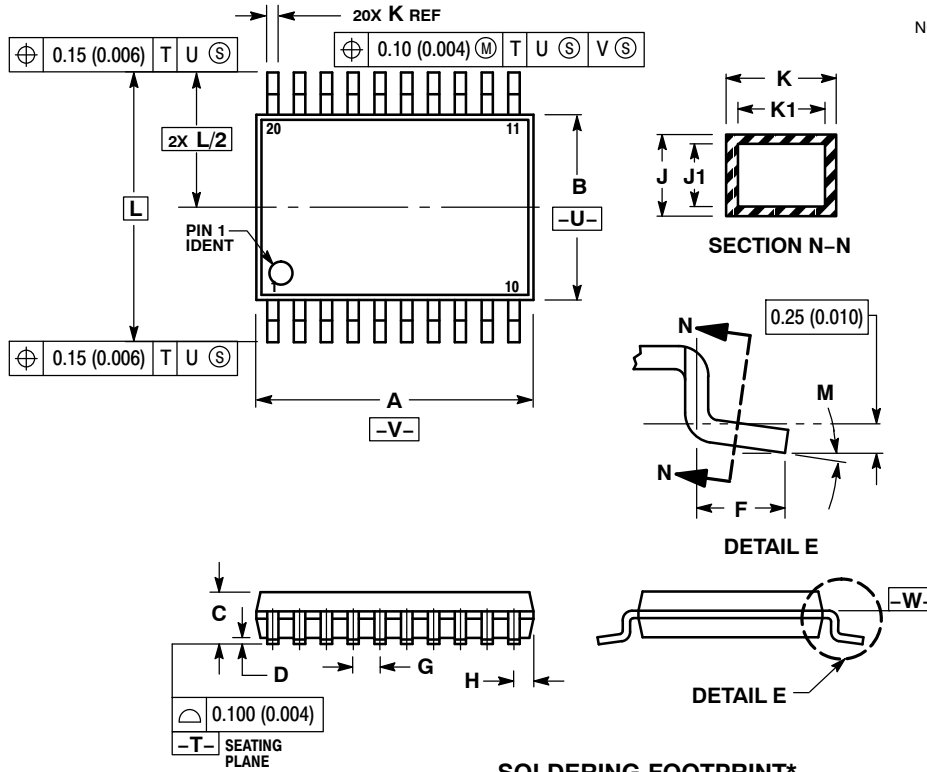
1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF B DIMENSION AT MAXIMUM MATERIAL CONDITION.

| DIM | MILLIMETERS | |
|-------|-------------|-------|
| | MIN | MAX |
| A | 2.35 | 2.65 |
| A1 | 0.10 | 0.25 |
| B | 0.35 | 0.49 |
| C | 0.23 | 0.32 |
| D | 12.65 | 12.95 |
| E | 7.40 | 7.60 |
| e | 1.27 BSC | |
| H | 10.05 | 10.55 |
| h | 0.25 | 0.75 |
| L | 0.50 | 0.90 |
| theta | 0° | 7° |

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PACKAGE DIMENSIONS

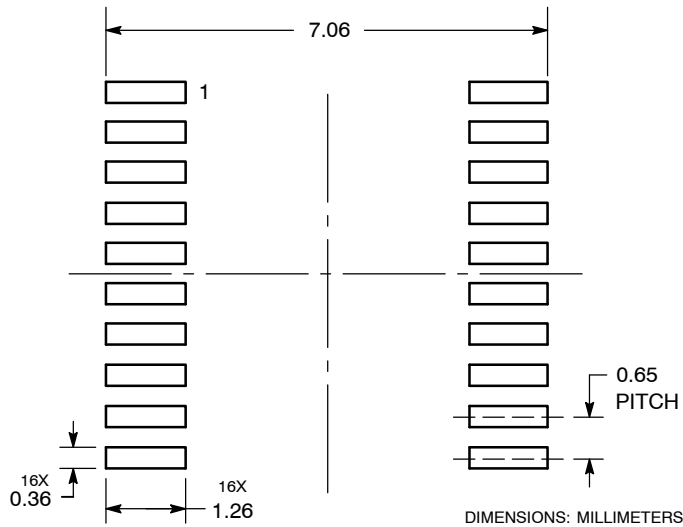
TSSOP-20
DT SUFFIX
CASE 948E-02
ISSUE C



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: MILLIMETER.
 3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
 4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
 5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
 6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
 7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE -W-.


| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|------|-----------|-------|
| | MIN | MAX | MIN | MAX |
| A | 6.40 | 6.60 | 0.252 | 0.260 |
| B | 4.30 | 4.50 | 0.169 | 0.177 |
| C | --- | 1.20 | --- | 0.047 |
| D | 0.05 | 0.15 | 0.002 | 0.006 |
| F | 0.50 | 0.75 | 0.020 | 0.030 |
| G | 0.65 BSC | | 0.026 BSC | |
| H | 0.27 | 0.37 | 0.011 | 0.015 |
| J | 0.09 | 0.20 | 0.004 | 0.008 |
| J1 | 0.09 | 0.16 | 0.004 | 0.006 |
| K | 0.19 | 0.30 | 0.007 | 0.012 |
| K1 | 0.19 | 0.25 | 0.007 | 0.010 |
| L | 6.40 BSC | | 0.252 BSC | |
| M | 0° | 8° | 0° | 8° |

SOLDERING FOOTPRINT*



*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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