

DATA SHEET

74AHC377; 74AHCT377

Octal D-type flip-flop with data enable; positive-edge trigger

Product specification
File under Integrated Circuits, IC06

2000 Aug 15

Octal D-type flip-flop with data enable; positive-edge trigger

74AHC377; 74AHCT377

FEATURES

- ESD protection:
HBM EIA/JESD22-A114-A exceeds 2000 V
MM EIA/JESD22-A115-A exceeds 200 V
CDM EIA/JESD22-C101 exceeds 1000 V
- Balanced propagation delays
- All inputs have Schmitt-trigger actions
- Inputs accept voltages higher than V_{CC}
- Ideal for addressable register applications
- Data enable for address and data synchronization
- Eight positive-edge triggered D-type flip-flops
- See “273” for master reset version
- See “373” for transparent latch version
- See “374” for 3-state version
- For AHC only: operates with CMOS input levels
- For AHCT only: operates with TTL input levels
- Specified from -40 to $+85$ and from -40 to $+125$ °C.

DESCRIPTION

The 74AHC/AHCT377 D-type flip-flops are high-speed silicon-gate CMOS devices and are pin compatible with low power Schottky TTL (LSTTL). They are specified in compliance with JEDEC standard No. 7A.

The 74AHC/AHCT377 devices have eight edge-triggered, D-type flip-flops with individual D inputs and Q outputs. A common clock (CP) input loads all flip-flops simultaneously when the data enable (\bar{E}) is LOW. The state of each D input, one set-up time before the LOW-to-HIGH clock transition, is transferred to the corresponding output (Q_n) of the flip-flop.

The \bar{E} input must be stable only one set-up time prior to the LOW-to-HIGH transition for predictable operation.

QUICK REFERENCE DATA

GND = 0 V; $T_{amb} = 25$ °C; $t_r = t_f \leq 3.0$ ns.

| SYMBOL | PARAMETER | CONDITIONS | TYPICAL | | UNIT |
|-------------------|-----------------------------------|--|---------|------|------|
| | | | AHC | AHCT | |
| t_{PHL}/t_{PLH} | propagation delay; CP to Q_n | $C_L = 15$ pF; $V_{CC} = 5$ V | 3.9 | 4.0 | ns |
| f_{max} | maximum clock frequency | $C_L = 15$ pF; $V_{CC} = 5$ V | 175 | 140 | MHz |
| C_I | input capacitance | $V_I = V_{CC}$ or GND | 3.0 | 3.0 | pF |
| C_{PD} | power dissipation capacitance | $C_L = 50$ pF; $f = 1$ MHz; notes 1 and 2 | 20 | 23 | pF |

Notes

1. C_{PD} is used to determine the dynamic power dissipation (P_D in μ W).

$$P_D = C_{PD} \times V_{CC}^2 \times f_i + \sum (C_L \times V_{CC}^2 \times f_o) \text{ where:}$$

f_i = input frequency in MHz;

f_o = output frequency in MHz;

$\sum (C_L \times V_{CC}^2 \times f_o)$ = sum of outputs;

C_L = output load capacitance in pF;

V_{CC} = supply voltage in Volts.

2. The condition is $V_I = \text{GND}$ to V_{CC} .

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FUNCTION TABLE

See note 1.

| OPERATING MODES | INPUTS | | | OUTPUTS |
|-------------------|-----------|----|----------------|----------------|
| | \bar{E} | CP | D _n | Q _n |
| load "1" | L | ↑ | h | H |
| load "0" | L | ↑ | L | L |
| hold (do nothing) | h | ↑ | X | no change |
| | H | X | X | no change |

Note

- H = HIGH voltage level;
h = HIGH voltage level one set-up time prior to the LOW-to-HIGH CP transition;
L = LOW voltage level;
L = LOW voltage level one set-up time prior to the LOW-to-HIGH CP transition;
X = don't care;
↑ = LOW-to-HIGH CP transition.

ORDERING INFORMATION

| TYPE NUMBER | PACKAGES | | | |
|-------------|----------|---------|----------|----------|
| | PINS | PACKAGE | MATERIAL | CODE |
| 74AHC377D | 20 | SO | plastic | SOT163-1 |
| 74AHC377PW | 20 | TSSOP | plastic | SOT360-1 |
| 74AHCT377D | 20 | SO | plastic | SOT163-1 |
| 74AHCT377PW | 20 | TSSOP | plastic | SOT360-1 |

PINNING

| PIN | SYMBOL | DESCRIPTION |
|-------------------------------|----------------------------------|---|
| 1 | \bar{E} | data enable input (active LOW) |
| 2, 5, 6, 9, 12, 15, 16 and 19 | Q ₀ to Q ₇ | flip-flop outputs |
| 3, 4, 7, 8, 13, 14, 17 and 18 | D ₀ to D ₇ | data inputs |
| 10 | GND | ground (0 V) |
| 11 | CP | clock input (LOW-to-HIGH, edge triggered) |
| 20 | V _{CC} | DC supply voltage |

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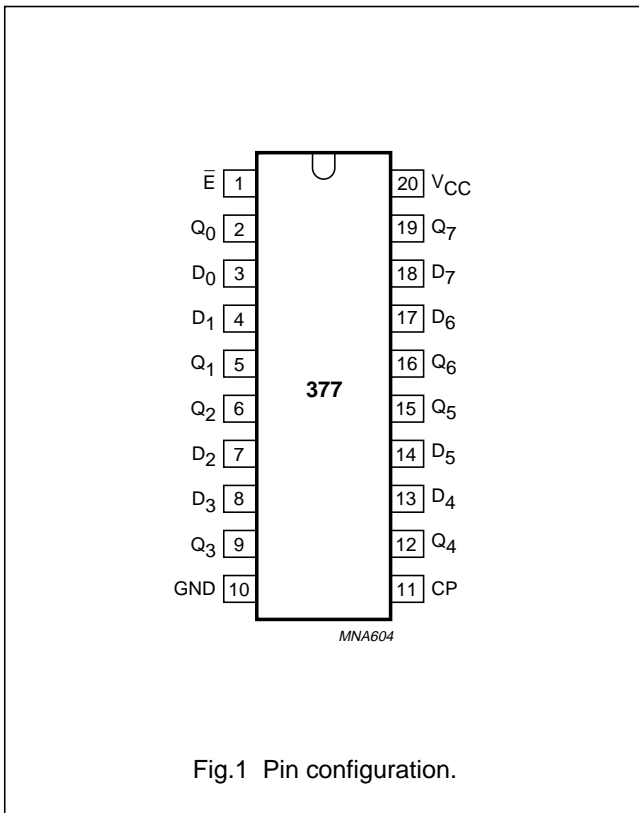


Fig.1 Pin configuration.

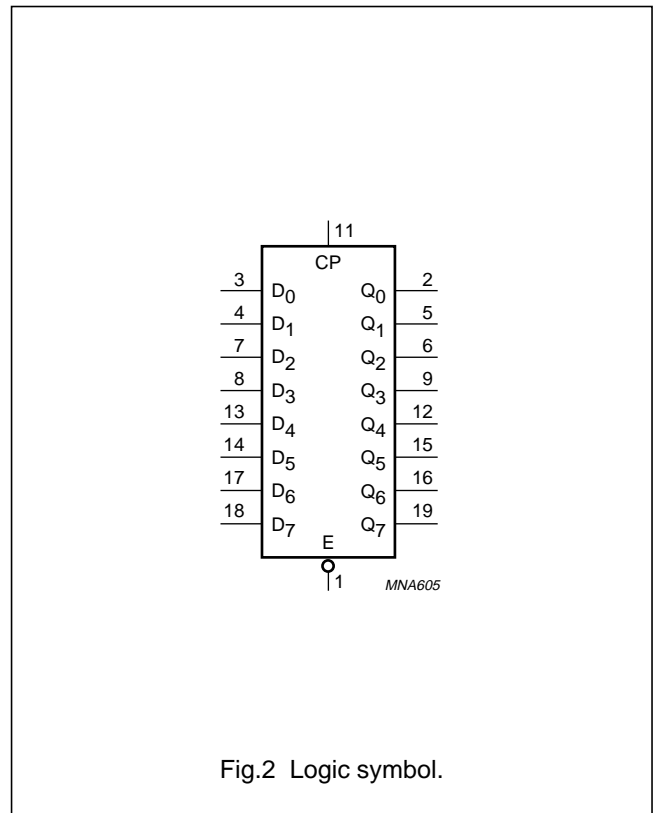


Fig.2 Logic symbol.

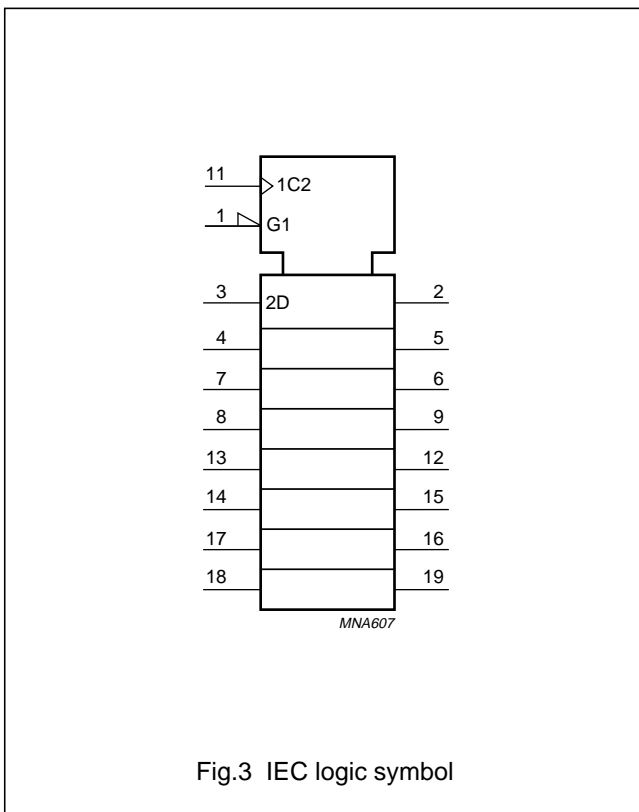


Fig.3 IEC logic symbol

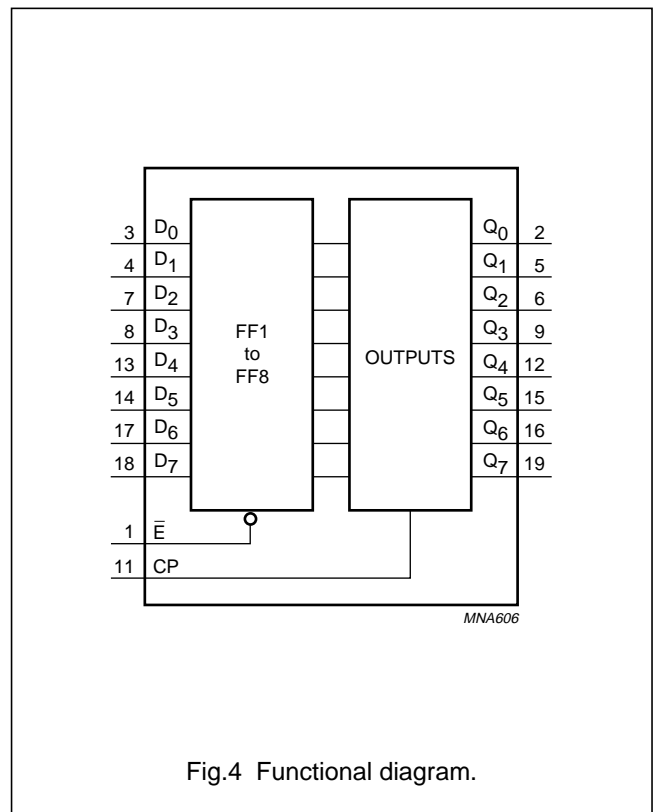


Fig.4 Functional diagram.

Octal D-type flip-flop with data enable;
positive-edge trigger

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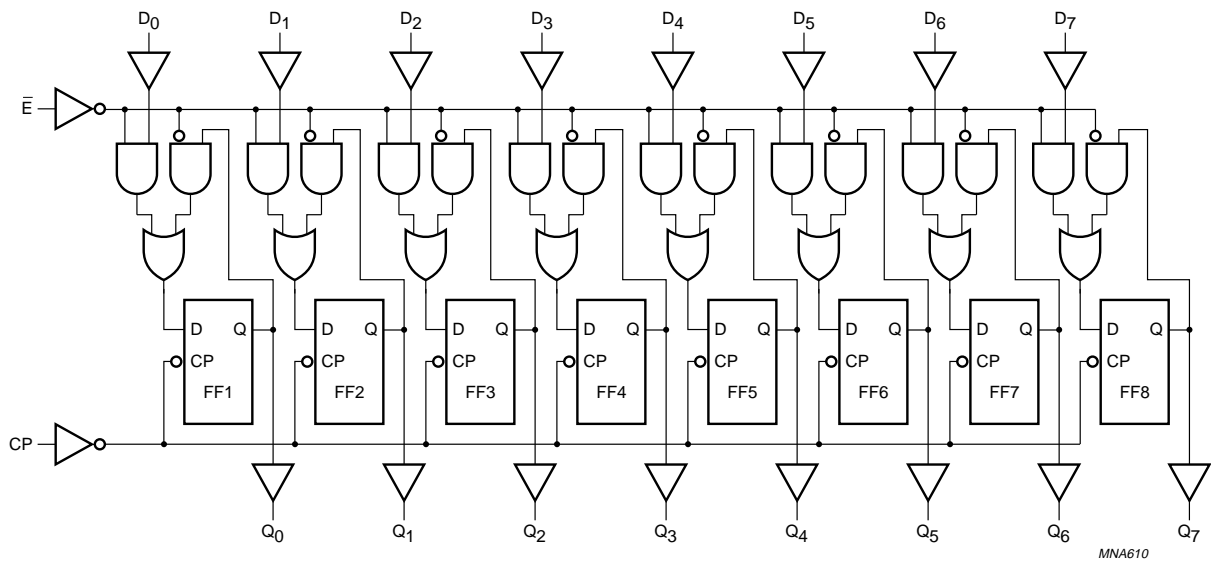


Fig.5 Logic diagram.

Octal D-type flip-flop with data enable; positive-edge trigger

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RECOMMENDED OPERATING CONDITIONS

| SYMBOL | PARAMETER | CONDITIONS | 74AHC | | | 74AHCT | | | UNIT |
|--------------------------------|-------------------------------|--|-------|------|----------|--------|------|----------|------|
| | | | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. | |
| V_{CC} | DC supply voltage | | 2.0 | 5.0 | 5.5 | 4.5 | 5.0 | 5.5 | V |
| V_I | input voltage | | 0 | – | 5.5 | 0 | – | 5.5 | V |
| V_O | output voltage | | 0 | – | V_{CC} | 0 | – | V_{CC} | V |
| T_{amb} | operating ambient temperature | see DC and AC characteristics per device | –40 | +25 | +85 | –40 | +25 | +85 | °C |
| | | | –40 | +25 | +125 | –40 | +25 | +125 | °C |
| $t_r, t_f (\Delta t/\Delta f)$ | input rise and fall rates | $V_{CC} = 3.3 V \pm 0.3 V$ | – | – | 100 | – | – | – | ns/V |
| | | $V_{CC} = 5 V \pm 0.5 V$ | – | – | 20 | – | – | 20 | |

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 60134); voltages are referenced to GND (ground = 0 V).

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|-----------|----------------------------------|---|------|----------|------|
| V_{CC} | DC supply voltage | | –0.5 | +7.0 | V |
| V_I | input voltage range | | –0.5 | +7.0 | V |
| I_{IK} | DC input diode current | $V_I < -0.5 V$; note 1 | – | –20 | mA |
| I_{OK} | DC output diode current | $V_O < -0.5 V$ or $V_O > V_{CC} + 0.5 V$; note 1 | – | ± 20 | mA |
| I_O | DC output source or sink current | $-0.5 V < V_O < V_{CC} + 0.5 V$ | – | ± 25 | mA |
| I_{CC} | DC V_{CC} or GND current | | – | ± 75 | mA |
| T_{stg} | storage temperature range | | –65 | +150 | °C |
| P_D | power dissipation per package | for temperature range: –40 to +125 °C; note 2 | – | 500 | mW |

Notes

- The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
- For SO packages: above 70 °C the value of P_D derates linearly by 8 mW/K.
For TSSOP packages: above 60 °C the value of P_D derates linearly by 5.5 mW/K.

Octal D-type flip-flop with data enable; positive-edge trigger

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DC CHARACTERISTICS

74AHC family

With regard to recommended operating conditions; voltages are referenced to GND (ground = 0 V).

| SYMBOL | PARAMETER | TEST CONDITIONS | | T_{amb} (°C) | | | | | | UNIT | |
|----------|--|---|--------------|----------------|------|------------|------------|-----------|-------------|------------|---------|
| | | OTHER | V_{CC} (V) | 25 | | | -40 to +85 | | -40 to +125 | | |
| | | | | MIN. | TYP. | MAX. | MIN. | MAX. | MIN. | | MAX. |
| V_{IH} | HIGH-level input voltage | | 2.0 | 1.5 | – | – | 1.5 | – | 1.5 | – | V |
| | | | 3.0 | 2.1 | – | – | 2.1 | – | 2.1 | – | |
| | | | 5.5 | 3.85 | – | – | 3.85 | – | 3.85 | – | |
| V_{IL} | LOW-level input voltage | | 2.0 | – | – | 0.5 | – | 0.5 | – | 0.5 | V |
| | | | 3.0 | – | – | 0.9 | – | 0.9 | – | 0.9 | |
| | | | 5.5 | – | – | 1.65 | – | 1.65 | – | 1.65 | |
| V_{OH} | HIGH-level output voltage; all outputs | $V_I = V_{IH}$ or V_{IL} ; $I_O = -50 \mu A$ | 2.0 | 1.9 | 2.0 | – | 1.9 | – | 1.9 | – | V |
| | | | 3.0 | 2.9 | 3.0 | – | 2.9 | – | 2.9 | – | |
| | | | 4.5 | 4.4 | 4.5 | – | 4.4 | – | 4.4 | – | |
| V_{OH} | HIGH-level output voltage | $V_I = V_{IH}$ or V_{IL} ; $I_O = -4.0 \text{ mA}$ | 3.0 | 2.58 | – | – | 2.48 | – | 2.40 | – | V |
| | | | 4.5 | 3.94 | – | – | 3.8 | – | 3.70 | – | |
| | | | | | | | | | | | |
| V_{OL} | LOW-level output voltage; all outputs | $V_I = V_{IH}$ or V_{IL} ; $I_O = 50 \mu A$ | 2.0 | – | 0 | 0.1 | – | 0.1 | – | 0.1 | V |
| | | | 3.0 | – | 0 | 0.1 | – | 0.1 | – | 0.1 | |
| | | | 4.5 | – | 0 | 0.1 | – | 0.1 | – | 0.1 | |
| | LOW-level output voltage | $V_I = V_{IH}$ or V_{IL} ; $I_O = 4 \text{ mA}$ | 3.0 | – | – | 0.36 | – | 0.44 | – | 0.55 | V |
| | | | 4.5 | – | – | 0.36 | – | 0.44 | – | 0.55 | |
| I_I | input leakage current | $V_I = V_{CC}$ or GND | 5.5 | – | – | 0.1 | – | 1.0 | – | 2.0 | μA |
| I_{OZ} | 3-state output OFF current | $V_I = V_{IH}$ or V_{IL} ; $V_O = V_{CC}$ or GND | 5.5 | – | – | ± 0.25 | – | ± 2.5 | – | ± 10.0 | μA |
| I_{CC} | quiescent supply current | $V_I = V_{CC}$ or GND; $I_O = 0$ | 5.5 | – | – | 4.0 | – | 40 | – | 80 | μA |
| C_I | input capacitance | | – | – | 3 | 10 | – | 10 | – | 10 | pF |

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74AHCT family

With regard to recommended operating conditions; voltages are referenced to GND (ground = 0 V).

| SYMBOL | PARAMETER | TEST CONDITIONS | | T _{amb} (°C) | | | | | | UNIT | |
|------------------|---|--|---------------------|-----------------------|------|-------|------------|------|-------------|-------|------|
| | | OTHER | V _{CC} (V) | 25 | | | -40 to +85 | | -40 to +125 | | |
| | | | | MIN. | TYP. | MAX. | MIN. | MAX. | MIN. | | MAX. |
| V _{IH} | HIGH-level input voltage | | 4.5 to 5.5 | 2.0 | – | – | 2.0 | – | 2.0 | – | V |
| V _{IL} | LOW-level input voltage | | 4.5 to 5.5 | – | – | 0.8 | – | 0.8 | – | 0.8 | V |
| V _{OH} | HIGH-level output voltage; all outputs | V _I = V _{IH} or V _{IL} ; I _O = -50 µA | 4.5 | 4.4 | 4.5 | – | 4.4 | – | 4.4 | – | V |
| | HIGH-level output voltage | V _I = V _{IH} or V _{IL} ; I _O = -8.0 mA | 4.5 | 3.94 | – | – | 3.8 | – | 3.70 | – | V |
| V _{OL} | LOW-level output voltage; all outputs | V _I = V _{IH} or V _{IL} ; I _O = 50 µA | 4.5 | – | 0 | 0.1 | – | 0.1 | – | 0.1 | V |
| | LOW-level output voltage | V _I = V _{IH} or V _{IL} ; I _O = 8 mA | 4.5 | – | – | 0.36 | – | 0.44 | – | 0.55 | V |
| I _I | input leakage current | V _I = V _{IH} or V _{IL} | 5.5 | – | – | 0.1 | – | 1.0 | – | 2.0 | µA |
| I _{oz} | 3-state output OFF current | V _I = V _{IH} or V _{IL} ; V _O = V _{CC} or GND per input pin; other inputs at V _{CC} or GND; I _O = 0 | 5.5 | – | – | ±0.25 | – | ±2.5 | – | ±10.0 | µA |
| I _{CC} | quiescent supply current | V _I = V _{CC} or GND; I _O = 0 | 5.5 | – | – | 4.0 | – | 40 | – | 80 | µA |
| ΔI _{CC} | additional quiescent supply current per input pin | V _I = V _{CC} - 2.1 V other inputs at V _{CC} or GND; I _O = 0 | 4.5 to 5.5 | – | – | 1.35 | – | 1.5 | – | 1.5 | mA |
| C _I | input capacitance | | – | – | 3 | 10 | – | 10 | – | 10 | pF |

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AC CHARACTERISTICS

Type 74AHC377

GND = 0 V; $t_r = t_f \leq 3.0$ ns.

| SYMBOL | PARAMETER | TEST CONDITIONS | | T_{amb} (°C) | | | | | | UNIT | |
|---|----------------------------------|------------------|-------|----------------|------|------|------------|------|-------------|------|------|
| | | WAVEFORMS | C_L | 25 | | | -40 to +85 | | -40 to +125 | | |
| | | | | MIN. | TYP. | MAX. | MIN. | MAX. | MIN. | | MAX. |
| $V_{CC} = 3.0$ to 3.6 V; typical values at $V_{CC} = 3.3$ V | | | | | | | | | | | |
| t_{PHL}/t_{PLH} | propagation delay CP to Q_n | see Figs 6 and 8 | 15 pF | – | 5.6 | 12.8 | 1.0 | 15.0 | 1.0 | 16.0 | ns |
| f_{max} | maximum clock pulse frequency | see Figs 6 and 8 | | 80 | 125 | – | 70 | – | 70 | – | MHz |
| t_{PHL}/t_{PLH} | propagation delay CP to Q_n | see Figs 6 and 8 | 50 pF | – | 8.0 | 16.0 | 1.0 | 18.0 | 1.0 | 20.0 | ns |
| t_W | clock pulse width HIGH or LOW | see Figs 6 and 8 | | 5.0 | – | – | 5.0 | – | 5.0 | – | ns |
| t_{su} | set-up time D_n to CP | see Figs 7 and 8 | | 5.0 | – | – | 5.0 | – | 5.0 | – | ns |
| | set-up time \bar{E} to CP | | | 5.0 | – | – | 5.0 | – | 5.0 | – | ns |
| t_h | hold time D_n to CP | see Figs 7 and 8 | | 1.5 | – | – | 1.5 | – | 1.5 | – | ns |
| | hold time \bar{E} to CP | | | 1.5 | – | – | 1.5 | – | 1.5 | – | ns |
| f_{max} | maximum clock pulse frequency | see Figs 6 and 8 | | 50 | 75 | – | 45 | – | 45 | – | MHz |
| $V_{CC} = 4.5$ to 5.5 V; typical values at $V_{CC} = 5.0$ V | | | | | | | | | | | |
| t_{PHL}/t_{PLH} | propagation delay CP to Q_n | see Figs 6 and 8 | 15 pF | – | 3.9 | 9.0 | 1.0 | 10.5 | 1.0 | 11.5 | ns |
| f_{max} | maximum clock pulse frequency | see Figs 6 and 8 | | 125 | 175 | – | 110 | – | 110 | – | MHz |
| t_{PHL}/t_{PLH} | propagation delay CP to Q_n | see Figs 6 and 8 | 50 pF | – | 5.6 | 10.5 | 1.0 | 12.0 | 1.0 | 13.5 | ns |
| t_W | clock pulse width HIGH or LOW | see Figs 6 and 8 | | 5.0 | – | – | 5.0 | – | 5.0 | – | ns |
| t_{su} | set-up time D_n to CP | see Figs 7 and 8 | | 4.5 | – | – | 4.5 | – | 4.5 | – | ns |
| t_{su} | set-up time \bar{E} to CP | | | 4.5 | – | – | 4.5 | – | 4.5 | – | ns |
| t_h | hold time D_n to CP | see Figs 7 and 8 | | 2.0 | – | – | 2.0 | – | 2.0 | – | ns |
| t_h | hold time \bar{E} to CP | | | 2.0 | – | – | 2.0 | – | 2.0 | – | ns |
| f_{max} | maximum clock pulse frequency | see Figs 6 and 8 | | 85 | 120 | – | 75 | – | 75 | – | MHz |

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Type 74AHCT377

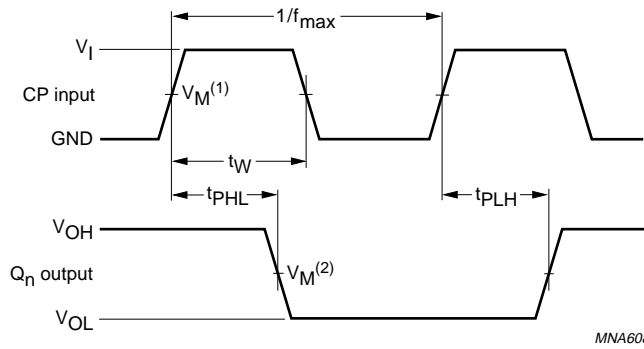
GND = 0 V; $t_r = t_f \leq 3.0$ ns.

| SYMBOL | PARAMETER | TEST CONDITIONS | | T_{amb} (°C) | | | | | | UNIT | |
|---|----------------------------------|------------------|-------|----------------|------|------|------------|------|-------------|------|------|
| | | WAVEFORMS | C_L | 25 | | | -40 to +85 | | -40 to +125 | | |
| | | | | MIN. | TYP. | MAX. | MIN. | MAX. | MIN. | | MAX. |
| $V_{CC} = 4.5$ to 5.5 V; typical values at $V_{CC} = 5.0$ V | | | | | | | | | | | |
| t_{PHL}/t_{PLH} | propagation delay CP to Q_n | see Figs 6 and 8 | 15 pF | – | 4.0 | 9.0 | 1.0 | 10.5 | 1.0 | 11.5 | ns |
| f_{max} | maximum clock pulse frequency | see Figs 6 and 8 | | 90 | 140 | – | 80 | – | 80 | – | MHz |
| t_{PHL}/t_{PLH} | propagation delay CP to Q_n | see Figs 6 and 8 | 50 pF | – | 5.7 | 10.5 | 1.0 | 12.0 | 1.0 | 13.5 | ns |
| t_W | clock pulse width HIGH or LOW | see Figs 6 and 8 | | 5.0 | – | – | 5.0 | – | 5.0 | – | ns |
| t_{su} | set-up time D_n to CP | see Figs 7 and 8 | | 4.5 | – | – | 4.5 | – | 4.5 | – | ns |
| | set-up time \bar{E} to CP | | 4.5 | – | – | 4.5 | – | 4.5 | – | ns | |
| t_h | hold time D_n to CP | | 2.0 | – | – | 2.0 | – | 2.0 | – | ns | |
| | hold time \bar{E} to CP | | 2.0 | – | – | 2.0 | – | 2.0 | – | ns | |
| f_{max} | maximum clock pulse frequency | see Figs 6 and 8 | | 85 | 130 | – | 75 | – | 75 | – | MHz |

Octal D-type flip-flop with data enable;
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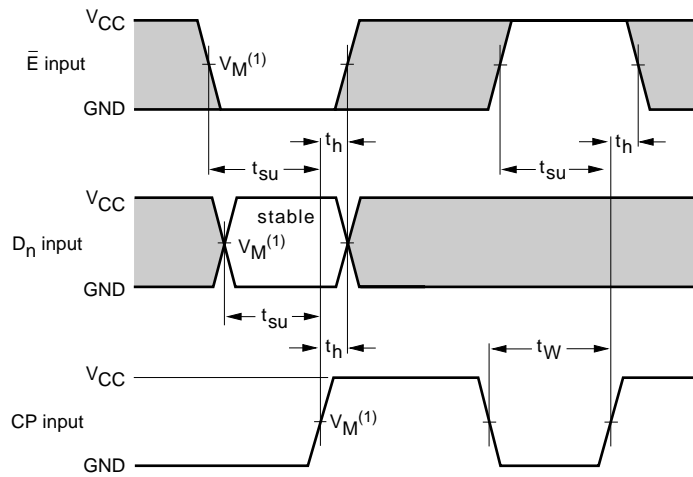
AC WAVEFORMS



MNA608

| FAMILY | V _I INPUT REQUIREMENTS | V _M ⁽¹⁾ INPUT | V _M ⁽²⁾ OUTPUT |
|--------|-----------------------------------|-------------------------------------|--------------------------------------|
| AHC | GND to V _{CC} | 50% V _{CC} | 50% V _{CC} |
| AHCT | GND to 3.0 V | 1.5 V | 50% V _{CC} |

Fig.6 The clock (CP) to output (Q_n) propagation delays.



MNA609

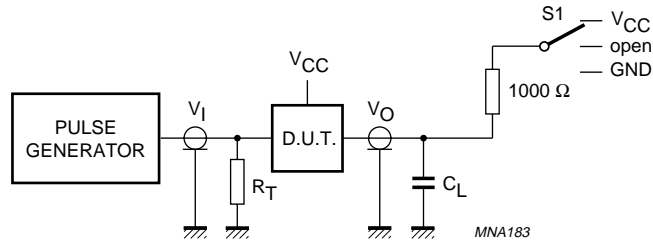
| FAMILY | V _I INPUT REQUIREMENTS | V _M ⁽¹⁾ INPUT |
|--------|-----------------------------------|-------------------------------------|
| AHC | GND to V _{CC} | 50% V _{CC} |
| AHCT | GND to 3.0 V | 1.5 V |

The shaded areas indicate when the input is permitted to change for predictable output performance.

Fig.7 The data set-up and hold times for D_n input

Octal D-type flip-flop with data enable;
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| TEST | S ₁ |
|------------------------------------|-----------------|
| t _{PLH} /t _{PHL} | open |
| t _{PLZ} /t _{PZL} | V _{CC} |
| t _{PHZ} /t _{PZH} | GND |

Fig.8 Load circuit for switching times.

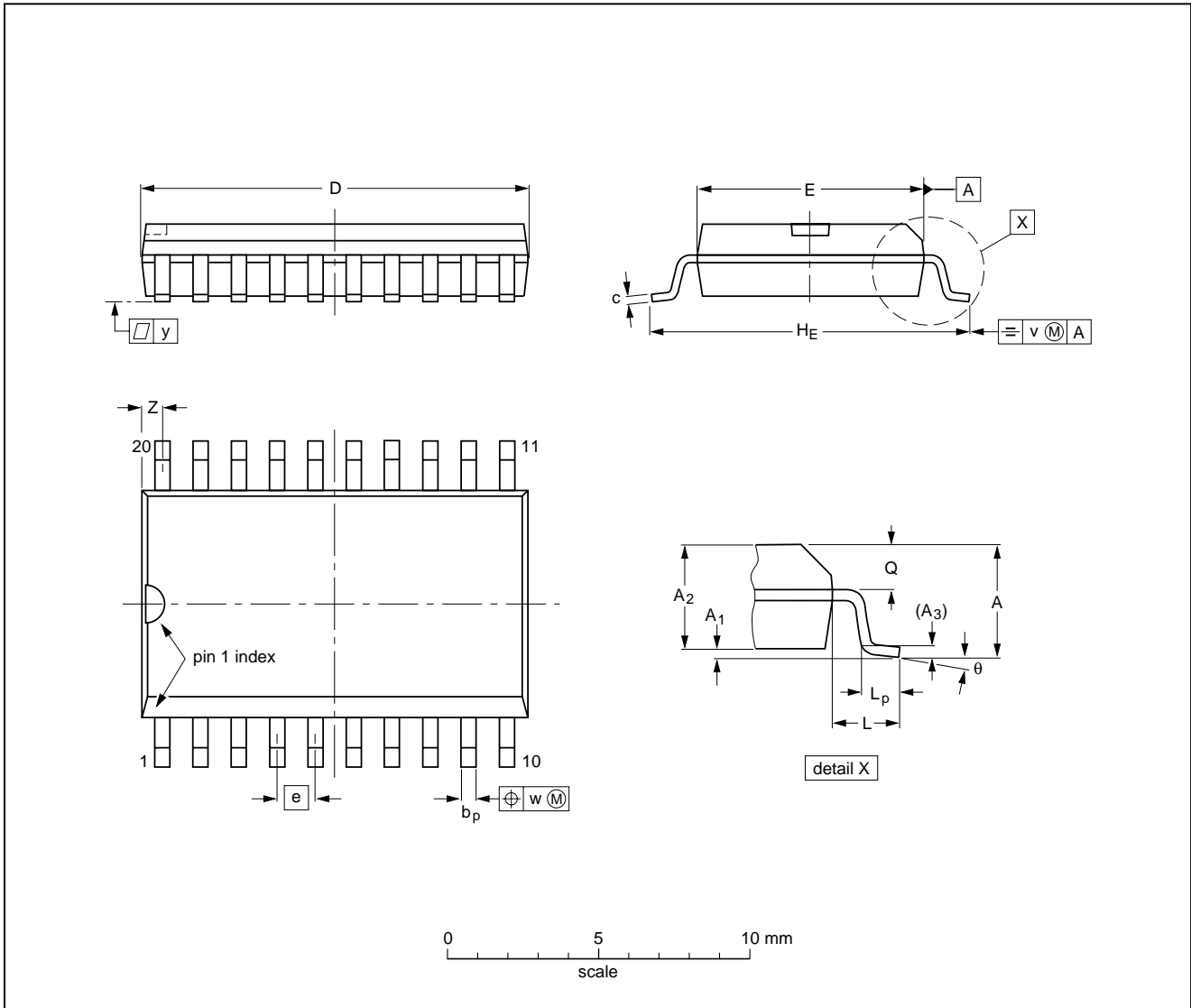
Octal D-type flip-flop with data enable;
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PACKAGE OUTLINES

SO20: plastic small outline package; 20 leads; body width 7.5 mm

SOT163-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

| UNIT | A max. | A ₁ | A ₂ | A ₃ | b _p | c | D ⁽¹⁾ | E ⁽¹⁾ | e | H _E | L | L _p | Q | v | w | y | z ⁽¹⁾ | θ |
|--------|--------|----------------|----------------|----------------|----------------|----------------|------------------|------------------|-------|----------------|-------|----------------|----------------|------|------|-------|------------------|----------|
| mm | 2.65 | 0.30 0.10 | 2.45 2.25 | 0.25 | 0.49 0.36 | 0.32 0.23 | 13.0 12.6 | 7.6 7.4 | 1.27 | 10.65 10.00 | 1.4 | 1.1 0.4 | 1.1 1.0 | 0.25 | 0.25 | 0.1 | 0.9 0.4 | 8° 0° |
| inches | 0.10 | 0.012 0.004 | 0.096 0.089 | 0.01 | 0.019 0.014 | 0.013 0.009 | 0.51 0.49 | 0.30 0.29 | 0.050 | 0.419 0.394 | 0.055 | 0.043 0.016 | 0.043 0.039 | 0.01 | 0.01 | 0.004 | 0.035 0.016 | |

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

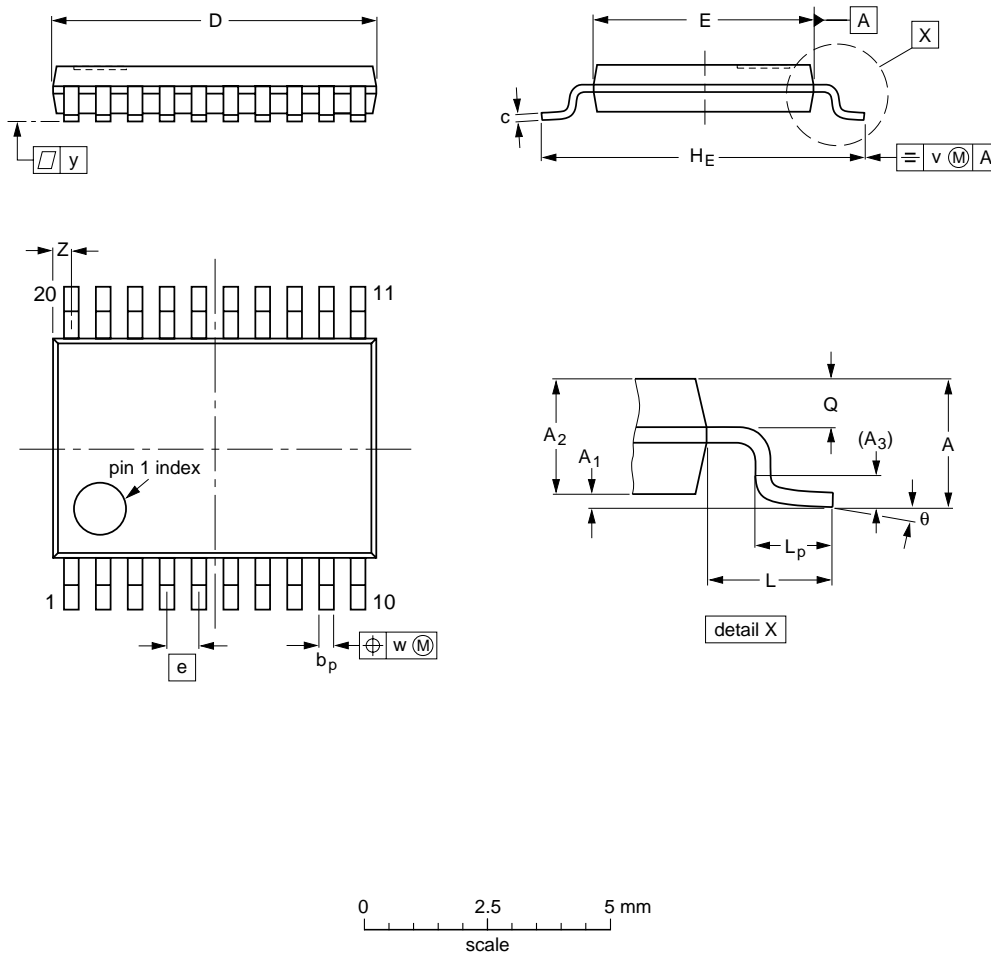
| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|-----------------|------------|--------|------|--|---------------------|----------------------|
| | IEC | JEDEC | EIAJ | | | |
| SOT163-1 | 075E04 | MS-013 | | | | 97-05-22 99-12-27 |

Octal D-type flip-flop with data enable;
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TSSOP20: plastic thin shrink small outline package; 20 leads; body width 4.4 mm

SOT360-1



DIMENSIONS (mm are the original dimensions)

| UNIT | A max. | A ₁ | A ₂ | A ₃ | b _p | c | D ⁽¹⁾ | E ⁽²⁾ | e | H _E | L | L _p | Q | v | w | y | z ⁽¹⁾ | θ |
|------|--------|----------------|----------------|----------------|----------------|------------|------------------|------------------|------|----------------|-----|----------------|------------|-----|------|-----|------------------|----------|
| mm | 1.10 | 0.15 0.05 | 0.95 0.80 | 0.25 | 0.30 0.19 | 0.2 0.1 | 6.6 6.4 | 4.5 4.3 | 0.65 | 6.6 6.2 | 1.0 | 0.75 0.50 | 0.4 0.3 | 0.2 | 0.13 | 0.1 | 0.5 0.2 | 8° 0° |

Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|-----------------|------------|--------|------|--|---------------------|----------------------|
| | IEC | JEDEC | EIAJ | | | |
| SOT360-1 | | MO-153 | | | | 95-02-04 99-12-27 |

Octal D-type flip-flop with data enable; positive-edge trigger

74AHC377; 74AHCT377

SOLDERING

Introduction to soldering surface mount packages

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our *"Data Handbook IC26; Integrated Circuit Packages"* (document order number 9398 652 90011).

There is no soldering method that is ideal for all surface mount IC packages. Wave soldering is not always suitable for surface mount ICs, or for printed-circuit boards with high population densities. In these situations reflow soldering is often used.

Reflow soldering

Reflow soldering requires solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the printed-circuit board by screen printing, stencilling or pressure-syringe dispensing before package placement.

Several methods exist for reflowing; for example, infrared/convection heating in a conveyor type oven. Throughput times (preheating, soldering and cooling) vary between 100 and 200 seconds depending on heating method.

Typical reflow peak temperatures range from 215 to 250 °C. The top-surface temperature of the packages should preferably be kept below 230 °C.

Wave soldering

Conventional single wave soldering is not recommended for surface mount devices (SMDs) or printed-circuit boards with a high component density, as solder bridging and non-wetting can present major problems.

To overcome these problems the double-wave soldering method was specifically developed.

If wave soldering is used the following conditions must be observed for optimal results:

- Use a double-wave soldering method comprising a turbulent wave with high upward pressure followed by a smooth laminar wave.
- For packages with leads on two sides and a pitch (e):
 - larger than or equal to 1.27 mm, the footprint longitudinal axis is **preferred** to be parallel to the transport direction of the printed-circuit board;
 - smaller than 1.27 mm, the footprint longitudinal axis **must** be parallel to the transport direction of the printed-circuit board.

The footprint must incorporate solder thieves at the downstream end.

- For packages with leads on four sides, the footprint must be placed at a 45° angle to the transport direction of the printed-circuit board. The footprint must incorporate solder thieves downstream and at the side corners.

During placement and before soldering, the package must be fixed with a droplet of adhesive. The adhesive can be applied by screen printing, pin transfer or syringe dispensing. The package can be soldered after the adhesive is cured.

Typical dwell time is 4 seconds at 250 °C.

A mildly-activated flux will eliminate the need for removal of corrosive residues in most applications.

Manual soldering

Fix the component by first soldering two diagonally-opposite end leads. Use a low voltage (24 V or less) soldering iron applied to the flat part of the lead. Contact time must be limited to 10 seconds at up to 300 °C.

When using a dedicated tool, all other leads can be soldered in one operation within 2 to 5 seconds between 270 and 320 °C.

Octal D-type flip-flop with data enable; positive-edge trigger

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Suitability of surface mount IC packages for wave and reflow soldering methods

| PACKAGE | SOLDERING METHOD | |
|--|-----------------------------------|-----------------------|
| | WAVE | REFLOW ⁽¹⁾ |
| BGA, SQFP | not suitable | suitable |
| HLQFP, HSQFP, HSOP, HTQFP, HTSSOP, SMS | not suitable ⁽²⁾ | suitable |
| PLCC ⁽³⁾ , SO, SOJ | suitable | suitable |
| LQFP, QFP, TQFP | not recommended ⁽³⁾⁽⁴⁾ | suitable |
| SSOP, TSSOP, VSO | not recommended ⁽⁵⁾ | suitable |

Notes

- All surface mount (SMD) packages are moisture sensitive. Depending upon the moisture content, the maximum temperature (with respect to time) and body size of the package, there is a risk that internal or external package cracks may occur due to vaporization of the moisture in them (the so called popcorn effect). For details, refer to the Drypack information in the *"Data Handbook IC26; Integrated Circuit Packages; Section: Packing Methods"*.
- These packages are not suitable for wave soldering as a solder joint between the printed-circuit board and heatsink (at bottom version) can not be achieved, and as solder may stick to the heatsink (on top version).
- If wave soldering is considered, then the package must be placed at a 45° angle to the solder wave direction. The package footprint must incorporate solder thieves downstream and at the side corners.
- Wave soldering is only suitable for LQFP, TQFP and QFP packages with a pitch (e) equal to or larger than 0.8 mm; it is definitely not suitable for packages with a pitch (e) equal to or smaller than 0.65 mm.
- Wave soldering is only suitable for SSOP and TSSOP packages with a pitch (e) equal to or larger than 0.65 mm; it is definitely not suitable for packages with a pitch (e) equal to or smaller than 0.5 mm.

Octal D-type flip-flop with data enable; positive-edge trigger

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DATA SHEET STATUS

| DATA SHEET STATUS | PRODUCT STATUS | DEFINITIONS ⁽¹⁾ |
|---------------------------|----------------|--|
| Objective specification | Development | This data sheet contains the design target or goal specifications for product development. Specification may change in any manner without notice. |
| Preliminary specification | Qualification | This data sheet contains preliminary data, and supplementary data will be published at a later date. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product. |
| Product specification | Production | This data sheet contains final specifications. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product. |

Note

1. Please consult the most recently issued data sheet before initiating or completing a design.

DEFINITIONS

Short-form specification — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

Limiting values definition — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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NOTES

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NOTES

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