

DATA SHEET

74F373

Octal transparent latch (3-State)

74F374

Octal D flip-flop (3-State)

Product specification

1994 Dec 05

IC15 Data Handbook

Philips Semiconductors



PHILIPS

Latch/flip-flop

74F373/74F374

74F373 Octal transparent latch (3-State)
74F374 Octal D-type flip-flop (3-State)

FEATURES

- 8-bit transparent latch — 74F373
- 8-bit positive edge triggered register — 74F374
- 3-State outputs glitch free during power-up and power-down
- Common 3-State output register
- Independent register and 3-State buffer operation
- SSOP Type II Package

DESCRIPTION

The 74F373 is an octal transparent latch coupled to eight 3-State output devices. The two sections of the device are controlled independently by enable (E) and output enable (\overline{OE}) control gates.

The data on the D inputs is transferred to the latch outputs when the enable (E) input is high. The latch remains transparent to the data input while E is high, and stores the data that is present one setup time before the high-to-low enable transition.

The 3-State output buffers are designed to drive heavily loaded 3-State buses, MOS memories, or MOS microprocessors.

The active low output enable (\overline{OE}) controls all eight 3-State buffers independent of the latch operation. When \overline{OE} is low, latched or transparent data appears at the output.

When \overline{OE} is high, the outputs are in high impedance "off" state, which means they will neither drive nor load the bus.

The 74F374 is an 8-bit edge triggered register coupled to eight 3-State output buffers. The two sections of the device are controlled independently by clock (CP) and output enable (\overline{OE}) control gates.

The register is fully edge triggered. The state of the D input, one setup time before the low-to-high clock transition is transferred to the corresponding flip-flop's Q output.

The 3-State output buffers are designed to drive heavily loaded 3-State buses, MOS memories, or MOS microprocessors.

The active low output enable (\overline{OE}) controls all eight 3-State buffers independent of the register operation. When \overline{OE} is low, the data in the register appears at the outputs. When \overline{OE} is high, the outputs are in high impedance "off" state, which means they will neither drive nor load the bus.

| TYPE | TYPICAL PROPAGATION DELAY | TYPICAL SUPPLY CURRENT (TOTAL) |
|--------|---------------------------|--------------------------------|
| 74F373 | 4.5ns | 35mA |

| TYPE | TYPICAL f_{max} | TYPICAL SUPPLY CURRENT (TOTAL) |
|--------|-------------------|--------------------------------|
| 74F374 | 165MHz | 55mA |

ORDERING INFORMATION

| DESCRIPTION | ORDER CODE | PKG DWG # |
|-----------------------------|---|-----------|
| | COMMERCIAL RANGE $V_{CC} = 5V \pm 10\%$, $T_{amb} = 0^{\circ}C$ to $+70^{\circ}C$ | |
| 20-pin plastic DIP | N74F373N, N74F374N | SOT146-1 |
| 20-pin plastic SOL | N74F373D, N74F374D | SOT163-1 |
| 20-pin plastic SSOP type II | N74F373DB, N74374DB | SOT399-1 |

INPUT AND OUTPUT LOADING AND FAN OUT TABLE

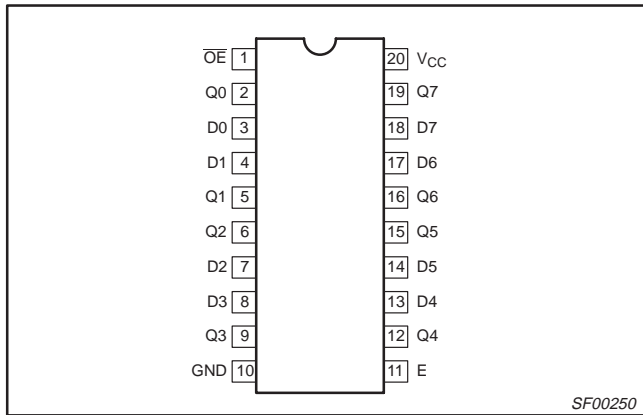
| PINS | DESCRIPTION | 74F (U.L.) HIGH/LOW | LOAD VALUE HIGH/LOW |
|-----------------|--|---------------------|---------------------|
| D0 - D7 | Data inputs | 1.0/1.0 | 20 μ A/0.6mA |
| E (74F373) | Enable input (active high) | 1.0/1.0 | 20 μ A/0.6mA |
| \overline{OE} | Output enable inputs (active low) | 1.0/1.0 | 20 μ A/0.6mA |
| CP (74F374) | Clock pulse input (active rising edge) | 1.0/1.0 | 20 μ A/0.6mA |
| Q0 - Q7 | 3-State outputs | 150/40 | 3.0mA/24mA |

NOTE: One (1.0) FAST unit load is defined as: 20 μ A in the high state and 0.6mA in the low state.

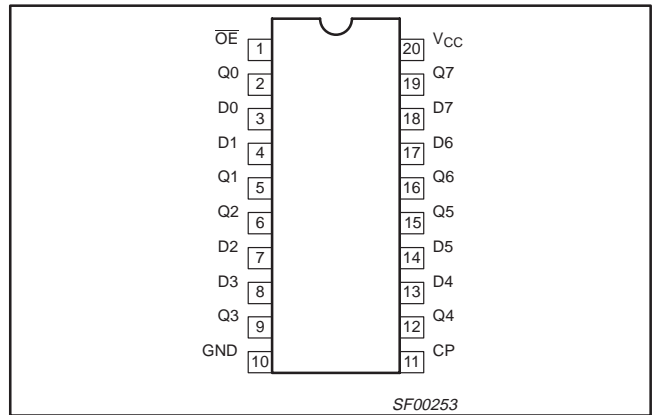
Latch/flip-flop

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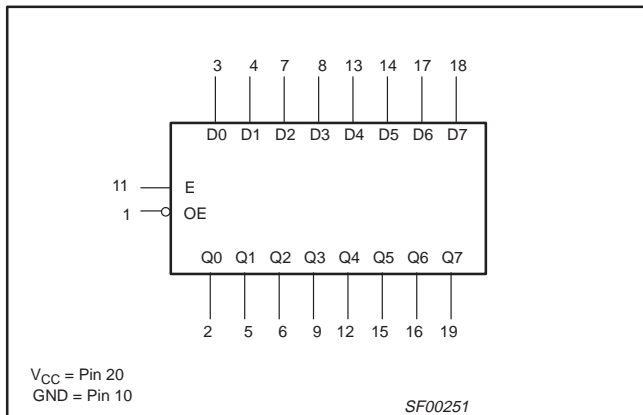
PIN CONFIGURATION – 74F373



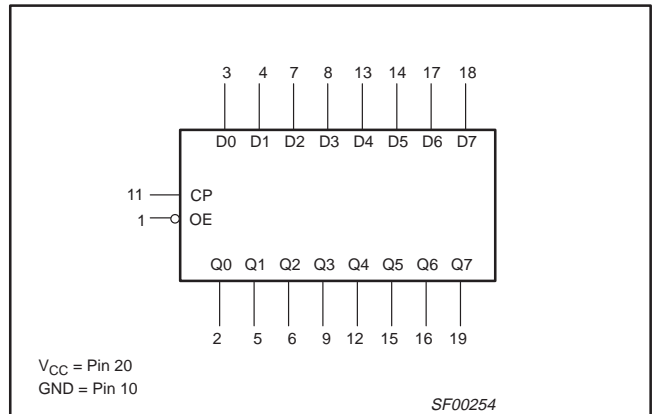
PIN CONFIGURATION – 74F374



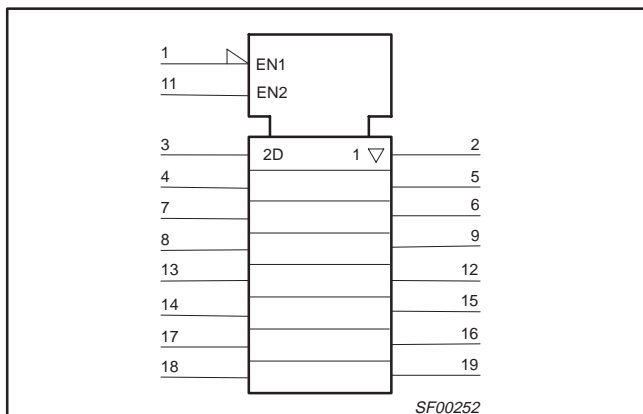
LOGIC SYMBOL – 74F373



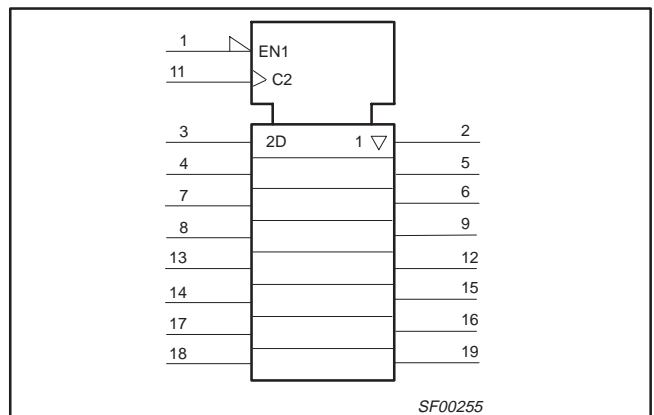
IEC/IEE SYMBOL – 74F374



IEC/IEEE SYMBOL – 74F373



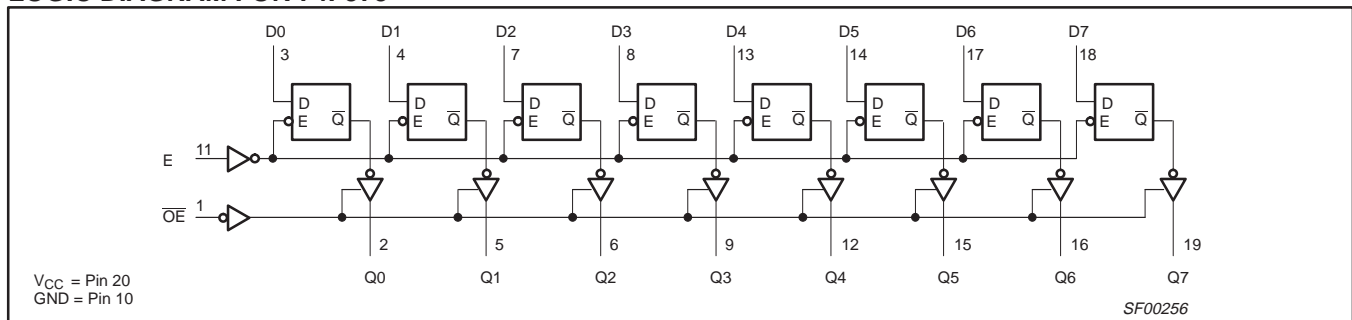
IEC/IEEE SYMBOL – 74F374



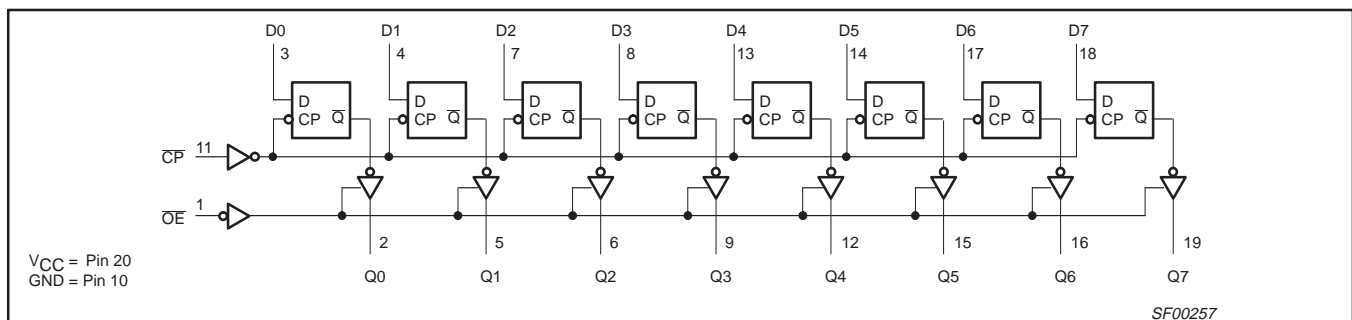
Latch/flip-flop

74F373/74F374

LOGIC DIAGRAM FOR 74F373



LOGIC DIAGRAM FOR 74F374



FUNCTION TABLE FOR 74F373

| INPUTS | | | INTERNAL REGISTER | OUTPUTS | OPERATING MODE |
|--------|---|----|-------------------|---------|--------------------------|
| OE | E | Dn | | Q0 - Q7 | |
| L | H | L | L | L | Enable and read register |
| L | H | H | H | H | |
| L | ↓ | l | L | L | Latch and read register |
| L | ↓ | h | H | H | |
| L | L | X | NC | NC | Hold |
| H | L | X | NC | Z | Disable outputs |
| H | H | Dn | Dn | Z | |

NOTES:

- H = High-voltage level
- h = High state must be present one setup time before the high-to-low enable transition
- L = Low-voltage level
- l = Low state must be present one setup time before the high-to-low enable transition
- NC = No change
- X = Don't care
- Z = High impedance "off" state
- ↓ = High-to-low enable transition

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FUNCTION TABLE FOR 74F374

| INPUTS | | | INTERNAL REGISTER | OUTPUTS | OPERATING MODE |
|-----------------|------------|----|-------------------|---------|------------------------|
| \overline{OE} | CP | Dn | | Q0 - Q7 | |
| L | \uparrow | l | L | L | Load and read register |
| L | \uparrow | h | H | H | |
| L | \uparrow | X | NC | NC | Hold |
| H | \uparrow | X | NC | Z | Disable outputs |
| H | \uparrow | Dn | Dn | Z | |

NOTES:

- H = High-voltage level
 h = High state must be present one setup time before the low-to-high clock transition
 L = Low-voltage level
 l = Low state must be present one setup time before the low-to-high clock transition
 NC = No change
 X = Don't care
 Z = High impedance "off" state
 \uparrow = Low-to-high clock transition
 \uparrow = Not low-to-high clock transition

ABSOLUTE MAXIMUM RATINGS

(Operation beyond the limit set forth in this table may impair the useful life of the device. Unless otherwise noted these limits are over the operating free air temperature range.)

| SYMBOL | PARAMETER | RATING | UNIT |
|-----------|--|------------------|------|
| V_{CC} | Supply voltage | -0.5 to +7.0 | V |
| V_{IN} | Input voltage | -0.5 to +7.0 | V |
| I_{IN} | Input current | -30 to +5 | mA |
| V_{OUT} | Voltage applied to output in high output state | -0.5 to V_{CC} | V |
| I_{OUT} | Current applied to output in low output state | 48 | mA |
| T_{amb} | Operating free air temperature range | 0 to +70 | °C |
| T_{stg} | Storage temperature range | -65 to +150 | °C |

RECOMMENDED OPERATING CONDITIONS

| SYMBOL | PARAMETER | LIMITS | | | UNIT |
|-----------|--------------------------------------|--------|-----|-----|------|
| | | MIN | NOM | MAX | |
| V_{CC} | Supply voltage | 4.5 | 5.0 | 5.5 | V |
| V_{IH} | High-level input voltage | 2.0 | | | V |
| V_{IL} | Low-level input voltage | | | 0.8 | V |
| I_{IK} | Input clamp current | | | -18 | mA |
| I_{OH} | High-level output current | | | -3 | mA |
| I_{OL} | Low-level output current | | | 24 | mA |
| T_{amb} | Operating free air temperature range | 0 | | +70 | °C |

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DC ELECTRICAL CHARACTERISTICS

(Over recommended operating free-air temperature range unless otherwise noted.)

| SYMBOL | PARAMETER | TEST CONDITIONS ¹ | LIMITS | | | UNIT | |
|------------------|--|---|-----------------------|------------------|-----------|------|----|
| | | | MIN | TYP ² | MAX | | |
| V _{OH} | High-level output voltage | V _{CC} = MIN, V _{IL} = MAX, V _{IH} = MIN, I _{OH} = MAX | ±10%V _{CC} | 2.4 | | V | |
| | | | ±5%V _{CC} | 2.7 | 3.4 | V | |
| V _{OL} | Low-level output voltage | V _{CC} = MIN, V _{IL} = MAX, V _{IH} = MIN, I _{OL} = MAX | ±10%V _{CC} | | 0.35 0.50 | V | |
| | | | ±5%V _{CC} | | 0.35 0.50 | V | |
| V _{IK} | Input clamp voltage | V _{CC} = MIN, I _I = I _{IK} | | -0.73 | -1.2 | V | |
| I _I | Input current at maximum input voltage | V _{CC} = MAX, V _I = 7.0V | | | 100 | μA | |
| I _{IH} | High-level input current | V _{CC} = MAX, V _I = 2.7V | | | 20 | μA | |
| I _{IL} | Low-level input current | V _{CC} = MAX, V _I = 0.5V | | | -0.6 | mA | |
| I _{OZH} | Off-state output current, high-level voltage applied | V _{CC} = MAX, V _O = 2.7V | | | 50 | μA | |
| I _{OZL} | Off-state output current, low-level voltage applied | V _{CC} = MAX, V _O = 0.5V | | | -50 | μA | |
| I _{OS} | Short-circuit output current ³ | V _{CC} = MAX | | -60 | -150 | mA | |
| I _{CC} | Supply current (total) | 74F373 | V _{CC} = MAX | | 35 | 60 | mA |
| | | 74F374 | | | 57 | 86 | mA |

NOTES:

1. For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable type.
2. All typical values are at V_{CC} = 5V, T_{amb} = 25°C.
3. Not more than one output should be shorted at a time. For testing I_{OS}, the use of high-speed test apparatus and/or sample-and-hold techniques are preferable in order to minimize internal heating and more accurately reflect operational values. Otherwise, prolonged shorting of a high output may raise the chip temperature well above normal and thereby cause invalid readings in other parameter tests. In any sequence of parameter tests, I_{OS} tests should be performed last.

AC ELECTRICAL CHARACTERISTICS

| SYMBOL | PARAMETER | TEST CONDITION | LIMITS | | | | | UNIT | |
|--------------------------------------|---|----------------|---|-----|------|--|------|------|------|
| | | | T _{amb} = +25°C V _{CC} = +5.0V C _L = 50pF, R _L = 500Ω | | | T _{amb} = 0°C to +70°C V _{CC} = +5.0V ± 10% C _L = 50pF, R _L = 500Ω | | | |
| | | | MIN | TYP | MAX | MIN | MAX | | |
| t _{PLH} t _{PHL} | Propagation delay Dn to Qn | Waveform 3 | 3.0 | 5.3 | 7.0 | 3.0 | 8.0 | ns | |
| | | | 2.0 | 3.7 | 5.0 | 2.0 | 6.0 | | |
| t _{PLH} t _{PHL} | Propagation delay E to Qn | | 74F373 | 5.0 | 9.0 | 11.5 | 5.0 | | 12.0 |
| | | | | 3.0 | 4.0 | 7.0 | 3.0 | | 8.0 |
| t _{PZH} t _{PZL} | Output enable time to high or low level | 74F373 | 2.0 | 5.0 | 11.0 | 2.0 | 11.5 | ns | |
| | | | 2.0 | 5.6 | 7.5 | 2.0 | 8.5 | | |
| t _{PHZ} t _{PLZ} | Output disable time from high or low level | 74F373 | 2.0 | 4.5 | 6.5 | 2.0 | 7.0 | ns | |
| | | | 2.0 | 3.8 | 5.0 | 2.0 | 6.0 | | |
| f _{max} | Maximum clock frequency | Waveform 1 | 150 | 165 | | 140 | | ns | |
| t _{PLH} t _{PHL} | Propagation delay CP to Qn | 74F374 | 3.5 | 5.0 | 7.5 | 3.0 | 8.5 | ns | |
| | | | 3.5 | 5.0 | 7.5 | 3.0 | 8.5 | | |
| t _{PZH} t _{PZL} | Output enable time to high or low level | 74F374 | 2.0 | 9.0 | 11.0 | 2.0 | 12.0 | ns | |
| | | | 2.0 | 5.3 | 7.5 | 2.0 | 8.5 | | |
| t _{PHZ} t _{PLZ} | Output disable time from high or low level | 74F374 | 2.0 | 5.3 | 6.0 | 2.0 | 7.0 | ns | |
| | | | 2.0 | 4.3 | 5.5 | 2.0 | 6.5 | | |

Latch/flip-flop

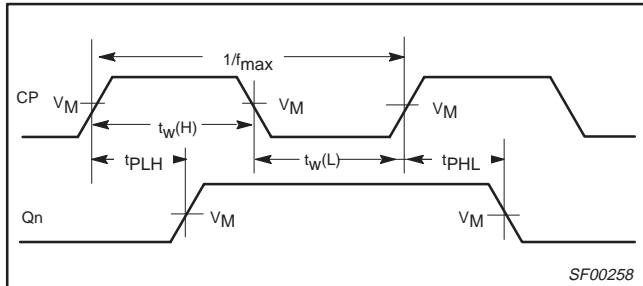
74F373/74F374

AC SETUP REQUIREMENTS

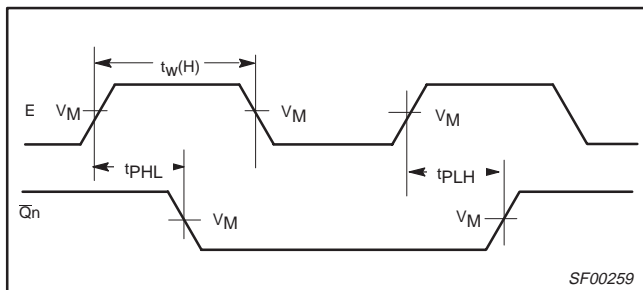
| SYMBOL | PARAMETER | TEST CONDITION | LIMITS | | | | | UNIT | |
|--|---|----------------|---|------------|-----|--|------------|------|----|
| | | | T _{amb} = +25°C V _{CC} = +5.0V C _L = 50pF, R _L = 500Ω | | | T _{amb} = 0°C to +70°C V _{CC} = +5.0V ± 10% C _L = 50pF, R _L = 500Ω | | | |
| | | | MIN | TYP | MAX | MIN | MAX | | |
| t _{SU} (H) t _{SU} (L) | Setup time, high or low level Dn to E | 74F373 | Waveform 4 | 0 1.0 | | | 0 1.0 | | ns |
| t _H (H) t _H (L) | Hold time, high or low level Dn to E | | Waveform 4 | 3.0 3.0 | | | 3.0 3.0 | | ns |
| t _W (H) | E Pulse width, high | | Waveform 1 | 3.5 | | | 4.0 | | ns |
| t _{SU} (H) t _{SU} (L) | Setup time, high or low level Dn to CP | 74F374 | Waveform 5 | 2.0 2.0 | | | 2.0 2.0 | | ns |
| t _H (H) t _H (L) | Hold time, high or low level Dn to CP | | Waveform 5 | 0 0 | | | 0 0 | | ns |
| t _W (H) t _W (L) | CP Pulse width, high or low | | Waveform 5 | 3.5 4.0 | | | 3.5 4.0 | | ns |

AC WAVEFORMS

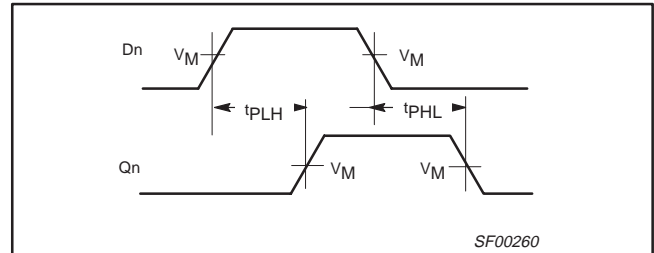
For all waveforms, V_M = 1.5V.
The shaded areas indicate when the input is permitted to change for predictable output performance.



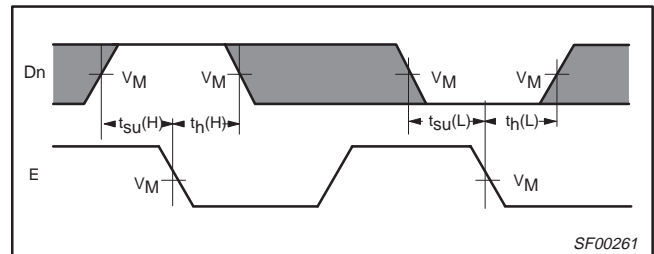
Waveform 1. Propagation delay for clock input to output, clock pulse widths, and maximum clock frequency



Waveform 2. Propagation delay for enable to output and enable pulse width



Waveform 3. Propagation delay for data to output



Waveform 4. Data setup time and hold times

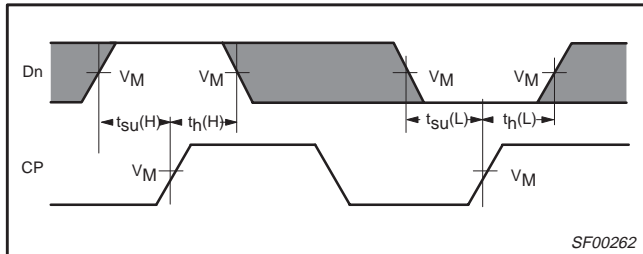
Latch/flip-flop

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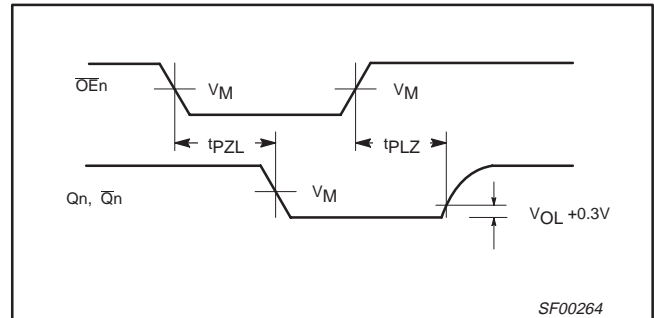
AC WAVEFORMS (Continued)

For all waveforms, $V_M = 1.5V$.

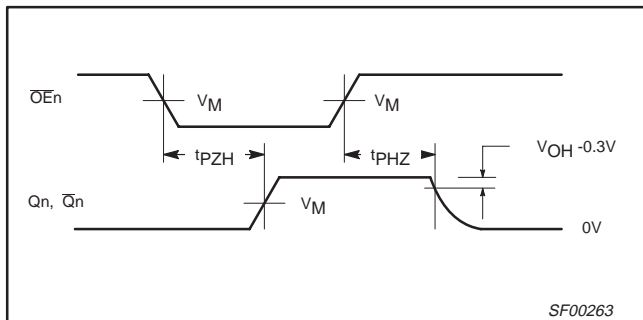
The shaded areas indicate when the input is permitted to change for predictable output performance.



Waveform 5. Data setup time and hold times



Waveform 7. 3-State output enable time to low level and output disable time from low level



Waveform 6. 3-State output enable time to high level and output disable time from high level

TEST CIRCUIT AND WAVEFORMS

| SWITCH POSITION | |
|--------------------|--------|
| TEST | SWITCH |
| t_{pLZ}, t_{pZL} | closed |
| All other | open |

Test circuit for 3-state outputs

DEFINITIONS:

R_L = Load resistor; see AC electrical characteristics for value.

C_L = Load capacitance includes jig and probe capacitance; see AC electrical characteristics for value.

R_T = Termination resistance should be equal to Z_{OUT} of pulse generators.

Input pulse definition

| family | INPUT PULSE REQUIREMENTS | | | | | |
|--------|--------------------------|-------|-----------|-------|-----------|-----------|
| | amplitude | V_M | rep. rate | t_w | t_{TLH} | t_{THL} |
| 74F | 3.0V | 1.5V | 1MHz | 500ns | 2.5ns | 2.5ns |

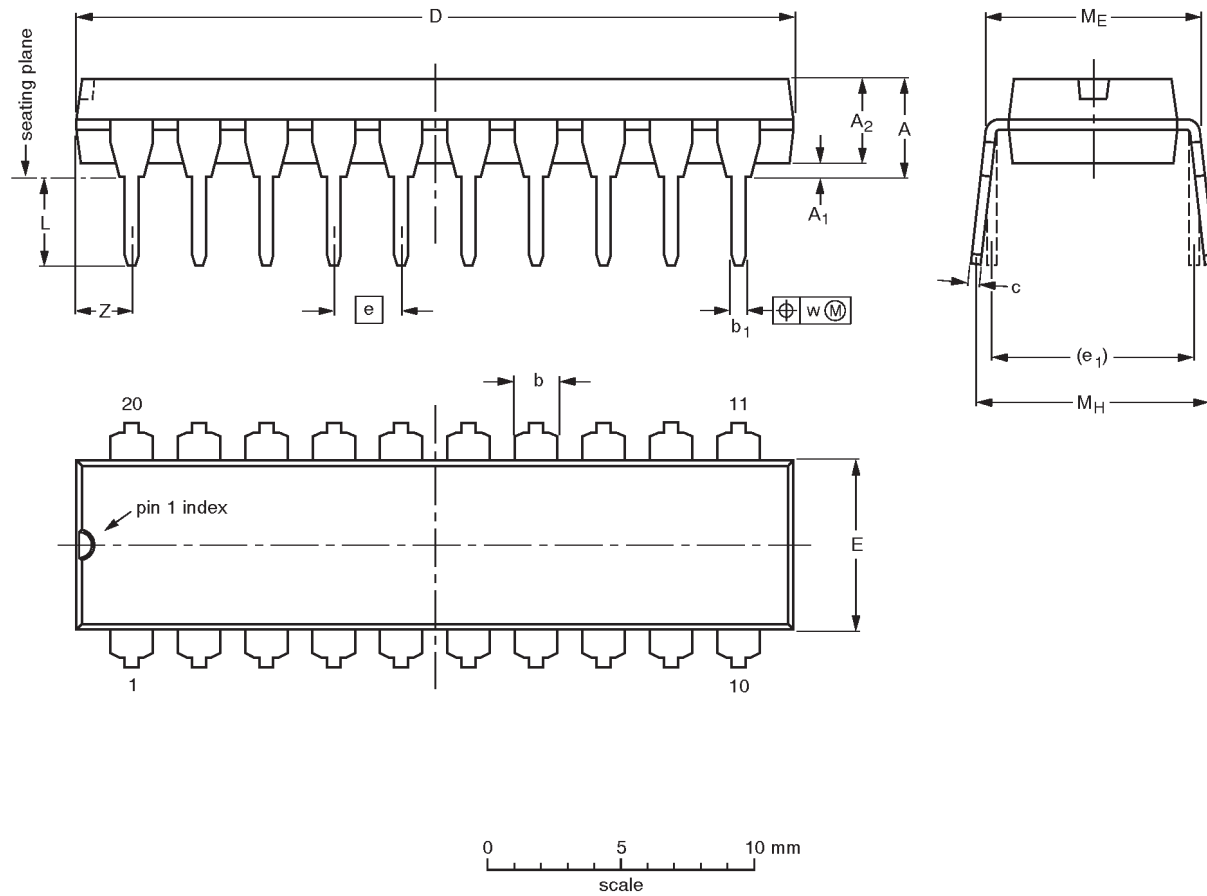
SF00265

Latch/flip-flop

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DIP20: plastic dual in-line package; 20 leads (300 mil)

SOT146-1



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

| UNIT | A max. | A ₁ min. | A ₂ max. | b | b ₁ | c | D ⁽¹⁾ | E ⁽¹⁾ | e | e ₁ | L | M _E | M _H | w | Z ⁽¹⁾ max. |
|--------|--------|---------------------|---------------------|----------------|----------------|----------------|------------------|------------------|------|----------------|--------------|----------------|----------------|-------|-----------------------|
| mm | 4.2 | 0.51 | 3.2 | 1.73 1.30 | 0.53 0.38 | 0.36 0.23 | 26.92 26.54 | 6.40 6.22 | 2.54 | 7.62 | 3.60 3.05 | 8.25 7.80 | 10.0 8.3 | 0.254 | 2.0 |
| inches | 0.17 | 0.020 | 0.13 | 0.068 0.051 | 0.021 0.015 | 0.014 0.009 | 1.060 1.045 | 0.25 0.24 | 0.10 | 0.30 | 0.14 0.12 | 0.32 0.31 | 0.39 0.33 | 0.01 | 0.078 |

Note

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

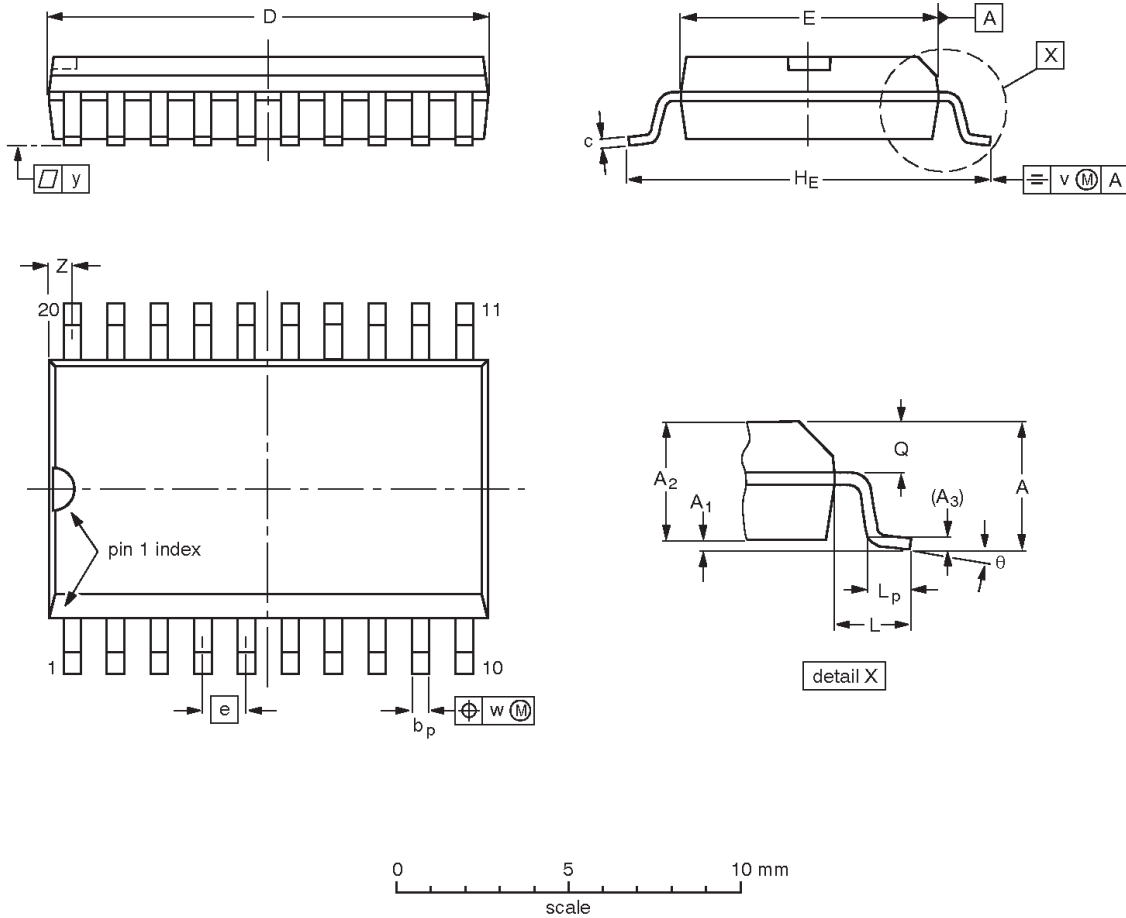
| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|-----------------|------------|-------|-------|--|---------------------|----------------------|
| | IEC | JEDEC | EIAJ | | | |
| SOT146-1 | | | SC603 | | | 92-11-17 95-05-24 |

Latch/flip-flop

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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-013AC | | | | 95-01-24 97-05-22 |

Latch/flip-flop

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NOTES

Latch/flip-flop

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DEFINITIONS

| Data Sheet Identification | Product Status | Definition |
|----------------------------------|-------------------------------|--|
| <i>Objective Specification</i> | Formative or in Design | This data sheet contains the design target or goal specifications for product development. Specifications may change in any manner without notice. |
| <i>Preliminary Specification</i> | Preproduction Product | 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. |
| <i>Product Specification</i> | Full 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. |

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811 East Arques Avenue
P.O. Box 3409
Sunnyvale, California 94088-3409
Telephone 800-234-7381

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