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# DATA SHEET

## 74F86
## Quad 2-input exclusive-OR gate

Product specification

1990 Feb 09

IC15 Data Handbook

Philips
Semiconductors

PHILIPS

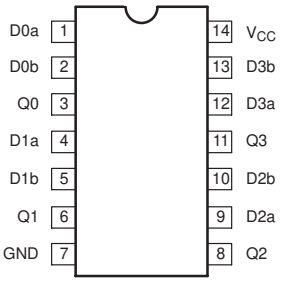
# Quad 2-input Exclusive-OR gate 74F86

## FEATURE

- Industrial temperature range available (–40°C to +85°C)

| TYPE | TYPICAL PROPAGATION DELAY | TYPICAL SUPPLY CURRENT (TOTAL) |
|---|---|---|
| 74F86 | 4.3ns | 16.5mA |

## PIN CONFIGURATION




## ORDERING INFORMATION

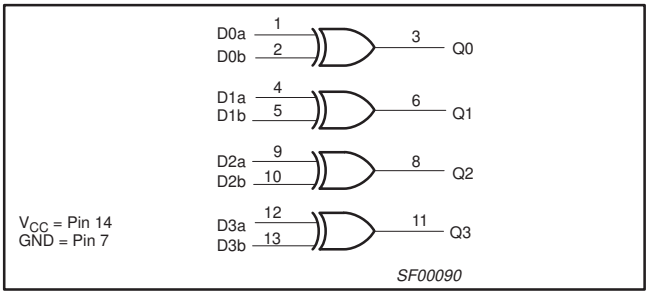
| DESCRIPTION | ORDER CODE | | PKG DWG # |
|---|---|---|---|
| | COMMERCIAL RANGE $V_{CC}$ = 5V ±10%, $T_{amb}$ = 0°C to +70°C | INDUSTRIAL RANGE $V_{CC}$ = 5V ±10%, $T_{amb}$ = –40°C to +85°C | |
| 14-pin plastic DIP | N74F86N | I74F86N | SOT27-1 |
| 14-pin plastic SO | N74F86D | I74F86D | SOT108-1 |

## INPUT AND OUTPUT LOADING AND FAN-OUT TABLE

| PINS | DESCRIPTION | 74F (U.L.) HIGH/LOW | LOAD VALUE HIGH/LOW |
|---|---|---|---|
| Dna, Dnb | Data inputs | 1.0/1.0 | 20µA/0.6mA |
| Qn | Data output | 50/33 | 1.0mA/20mA |

**NOTE:**
1. One (1.0) FAST unit load is defined as: 20µA in the High state and 0.6mA in the Low state.

## LOGIC DIAGRAM

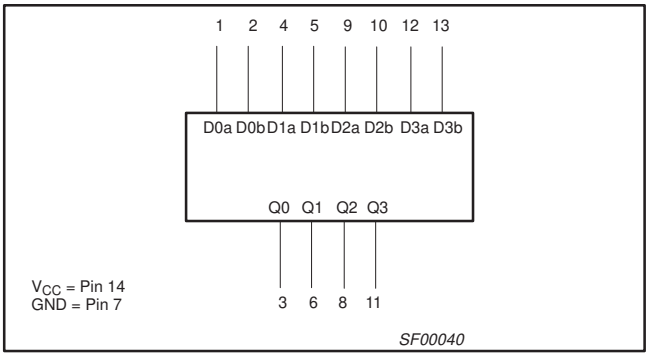



## FUNCTION TABLE

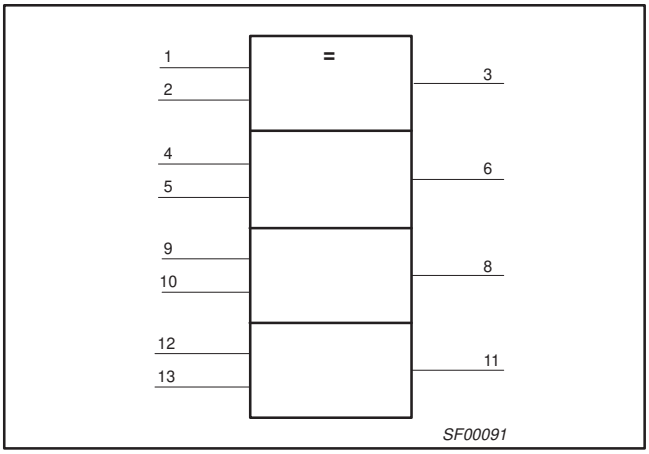
| INPUTS | | OUTPUT |
|---|---|---|
| Dna | Dnb | Qn |
| L | L | L |
| L | H | H |
| H | L | H |
| H | H | L |

**NOTES:**
H = High voltage level
L = Low voltage level

## LOGIC SYMBOL




## IEC/IEEE SYMBOL



## ABSOLUTE MAXIMUM RATINGS

(Operation beyond the limits 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 | | 40 | mA |
| $T_{amb}$ | Operating free-air temperature range | Commercial range | 0 to +70 | °C |
| | | Industrial range | –40 to +85 | °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 | | | | –1 | mA |
| $I_{OL}$ | Low-level output current | | | | 20 | mA |
| $T_{amb}$ | Operating free-air temperature range | Commercial range | 0 | | +70 | °C |
| | | Industrial range | –40 | | +85 | °C |

## 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 | ±10%$V_{CC}$ | 2.5 | | | V |
| | | | $V_{IH}$ = MIN, $I_{OH}$ = MAX | ±5%$V_{CC}$ | 2.7 | 3.4 | | V |
| $V_{OL}$ | Low-level output voltage | | $V_{CC}$ = MIN, $V_{IL}$ = MAX | ±10%$V_{CC}$ | | 0.30 | 0.50 | V |
| | | | $V_{IH}$ = MIN, $I_{OL}$ = MAX | ±5%$V_{CC}$ | | 0.30 | 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 |
| $I_{OS}$ | Short-circuit output current[3] | | $V_{CC}$ = MAX | | -60 | | –150 | mA |
| $I_{CC}$ | Supply current (total) | $I_{CCH}$ | $V_{CC}$ = MAX | D0a = GND, D0b = 4.5V | | 15 | 23 | mA |
| | | $I_{CCL}$ | $V_{CC}$ = MAX | $V_{IN}$ = 4.5V | | 18 | 28 | mA |

**NOTES:**

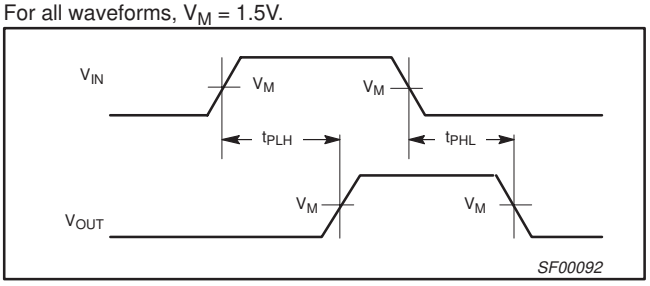
1. For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable type.
2. All typical values are at $V_{CC}$ = 5V, $T_{amb}$ = 25°C.
3. Not more than one output should be shorted at a time. For testing $I_{OS}$, the use of high-speed 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

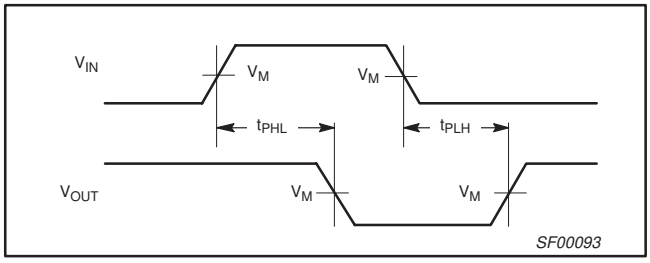
| SYMBOL | PARAMETER | TEST CONDITION | LIMITS | | | | | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $V_{CC}$ = +5.0V<br>$T_{amb}$ = +25°C<br>$C_L$ = 50pF<br>$R_L$ = 500Ω | | | $V_{CC}$ = +5.0V ± 10%<br>$T_{amb}$ = 0°C to +70°C<br>$C_L$ = 50pF<br>$R_L$ = 500Ω | | $V_{CC}$ = +5.0V ± 10%<br>$T_{amb}$ = –40°C to +85°C<br>$C_L$ = 50pF<br>$R_L$ = 500Ω | | |
| | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation delay<br>Dna or Dnb to Qn<br>(other input Low) | Waveform 1 | 3.0<br>3.0 | 4.0<br>4.2 | 5.5<br>5.5 | 3.0<br>3.0 | 6.5<br>6.5 | 3.0<br>2.5 | 7.0<br>8.0 | ns |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation delay<br>Dna or Dnb to Qn<br>(other input High) | Waveform 2 | 3.5<br>3.0 | 5.3<br>4.7 | 7.0<br>6.5 | 3.5<br>3.0 | 8.0<br>7.5 | 3.5<br>3.0 | 10.0<br>8.0 | ns |

## AC WAVEFORMS

For all waveforms, $V_M$ = 1.5V.

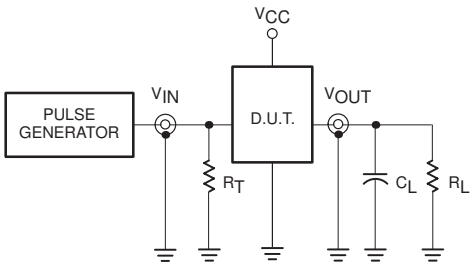



**Waveform 1. Propagation Delay for Non-Inverting Outputs**

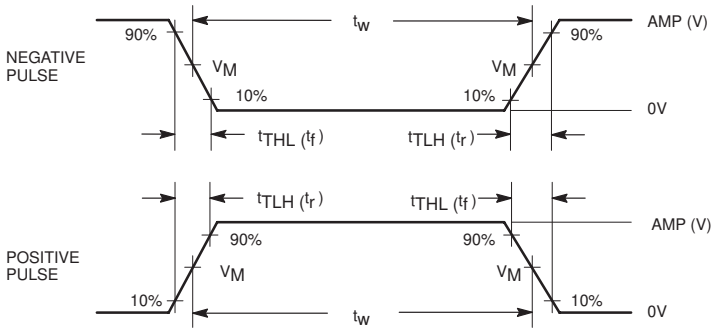



**Waveform 2. Propagation Delay for Inverting Outputs**

## TEST CIRCUIT AND WAVEFORMS




**Test Circuit for Totem-Pole Outputs**




**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 |

**DEFINITIONS:**

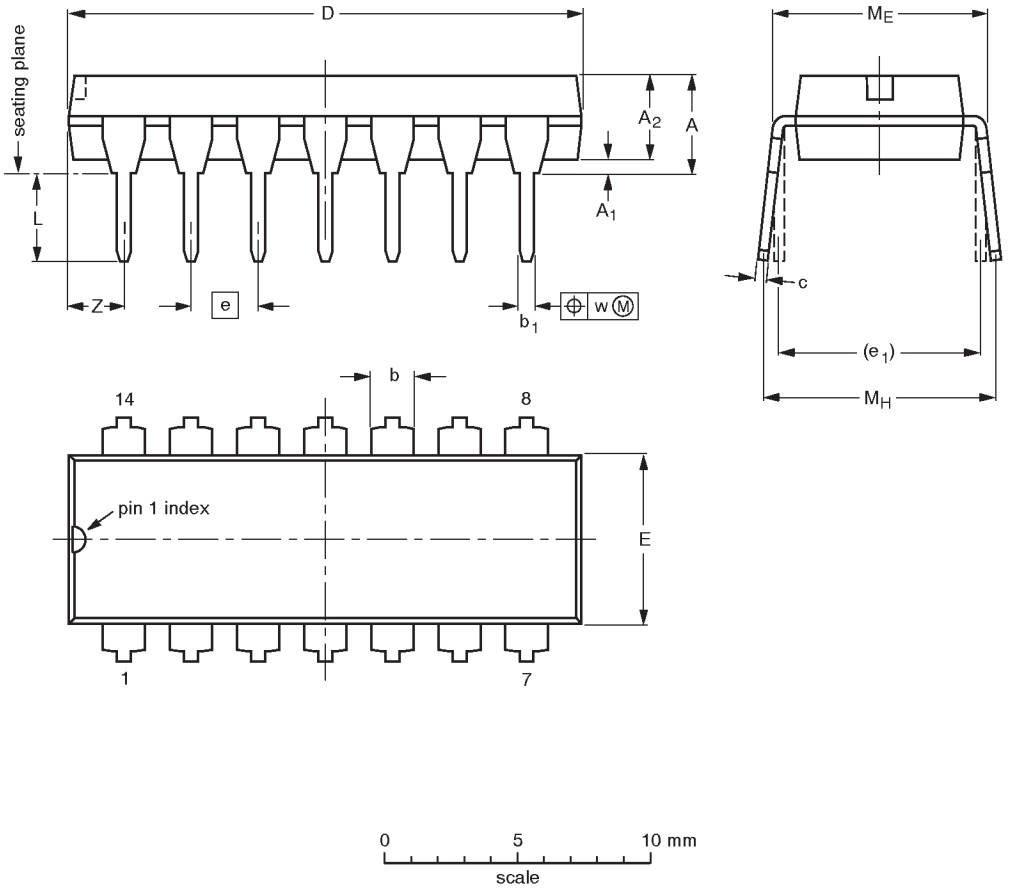
$R_L$ = Load resistor; see AC ELECTRICAL CHARACTERISTICS for value.

$C_L$ = 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.

SF00006

**DIP14: plastic dual in-line package; 14 leads (300 mil)** **SOT27-1**




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

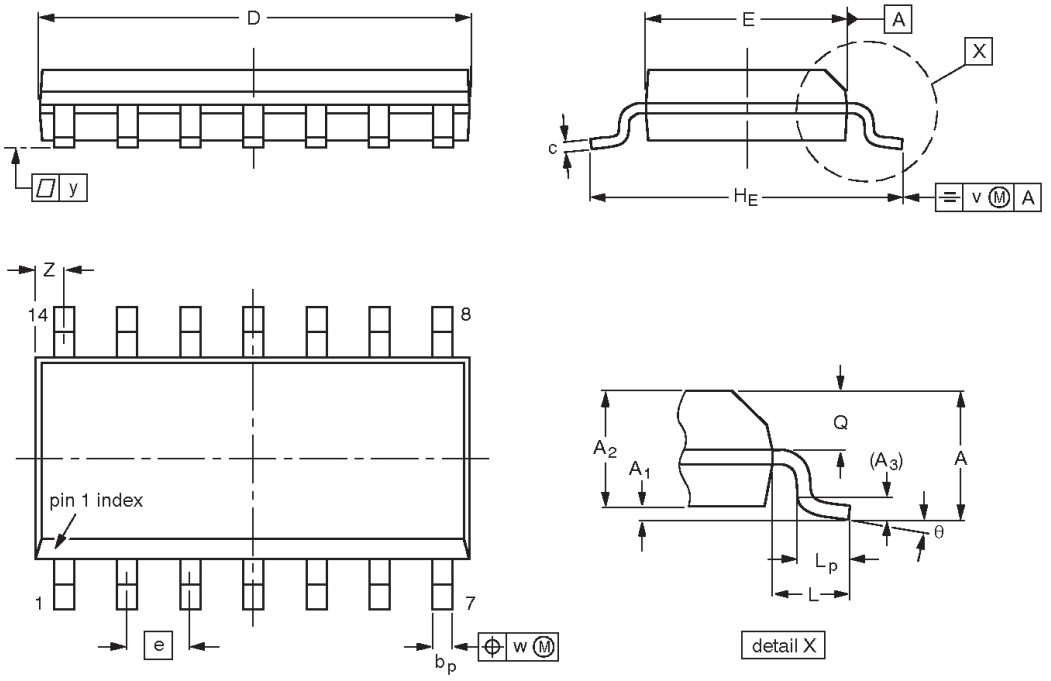
| UNIT | A max. | $A_1$ min. | $A_2$ max. | b | $b_1$ | c | D (1) | E (1) | e | $e_1$ | L | $M_E$ | $M_H$ | w | Z (1) max. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 4.2 | 0.51 | 3.2 | 1.73<br>1.13 | 0.53<br>0.38 | 0.36<br>0.23 | 19.50<br>18.55 | 6.48<br>6.20 | 2.54 | 7.62 | 3.60<br>3.05 | 8.25<br>7.80 | 10.0<br>8.3 | 0.254 | 2.2 |
| inches | 0.17 | 0.020 | 0.13 | 0.068<br>0.044 | 0.021<br>0.015 | 0.014<br>0.009 | 0.77<br>0.73 | 0.26<br>0.24 | 0.10 | 0.30 | 0.14<br>0.12 | 0.32<br>0.31 | 0.39<br>0.33 | 0.01 | 0.087 |

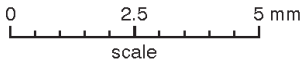
**Note**

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 | | | |
| SOT27-1 | 050G04 | MO-001AA | | | | ~~92-11-17~~<br>95-03-11 |

## SO14: plastic small outline package; 14 leads; body width 3.9 mm SOT108-1




**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 | 1.75 | 0.25<br>0.10 | 1.45<br>1.25 | 0.25 | 0.49<br>0.36 | 0.25<br>0.19 | 8.75<br>8.55 | 4.0<br>3.8 | 1.27 | 6.2<br>5.8 | 1.05 | 1.0<br>0.4 | 0.7<br>0.6 | 0.25 | 0.25 | 0.1 | 0.7<br>0.3 | $8^o$<br>$0^o$ |
| inches | 0.069 | 0.010<br>0.004 | 0.057<br>0.049 | 0.01 | 0.019<br>0.014 | 0.0100<br>0.0075 | 0.35<br>0.34 | 0.16<br>0.15 | 0.050 | 0.244<br>0.228 | 0.041 | 0.039<br>0.016 | 0.028<br>0.024 | 0.01 | 0.01 | 0.004 | 0.028<br>0.012 | |

**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 | | | |
| SOT108-1 | 076E06S | MS-012AB | | | | ~~95-01-23~~<br>97-05-22 |

**NOTES**

## Data sheet status

| Data sheet status | Product status | Definition [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 chages at any time without notice in order to improve design and supply the best possible product. |
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[1] Please consult the most recently issued datasheet before initiating or completing a design.

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**Limiting values definition —** Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). 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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