# DATA SHEET

## 74F139
## Dual 1-of-4 decoder/demultiplexer

Product specification 1990 Feb 23

IC15 Data Handbook



Philips Semiconductors

# 1-of-4 decoder/demultiplexer 74F139

## FEATURES

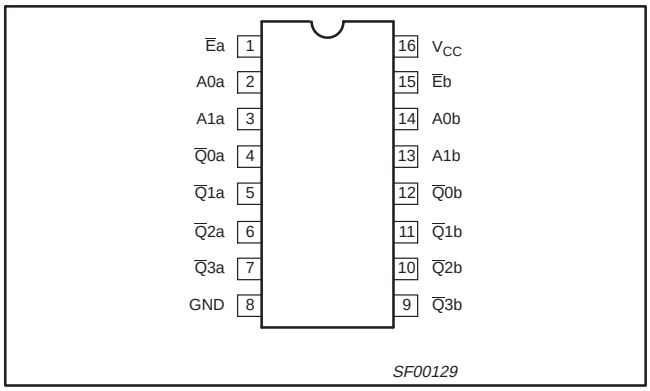
- Demultiplexing capability
- Two independent 1-of-4 decoders
- Multifunction capability

## DESCRIPTION

The 74F139 is a high speed, dual 1-of-4 decoder/demultiplexer. This device has two independent decoders, each accepting two binary weighted inputs (A0n, A1n) and providing four mutually exclusive active-Low outputs ($\overline{Q}$0n–$\overline{Q}$3n). Each decoder has an active-Low Enable ($\overline{E}$). When $\overline{E}$ is High, every output is forced High. The Enable can be used as the Data input for a 1-of-4 demultiplexer application.

| TYPE | TYPICAL PROPAGATION DELAY | TYPICAL SUPPLY CURRENT (TOTAL) |
|---|---|---|
| 74F139 | 5.3ns | 13mA |

## PIN CONFIGURATION




## ORDERING INFORMATION

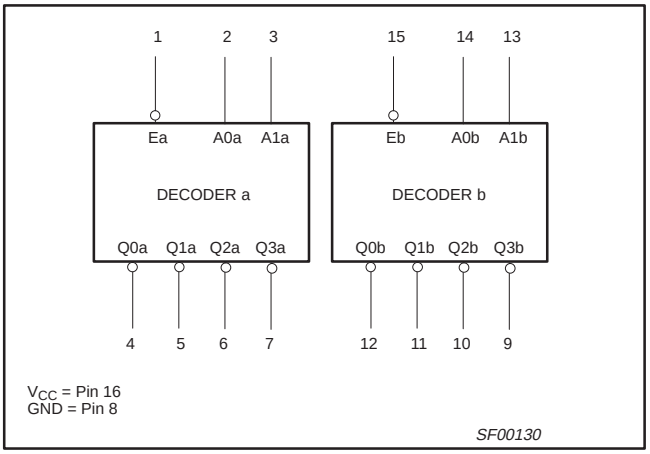
| DESCRIPTION | COMMERCIAL RANGE $V_{CC}$ = 5V ±10%, $T_{amb}$ = 0°C to +70°C | PKG DWG # |
|---|---|---|
| 16-pin plastic DIP | N74F139N | SOT38-4 |
| 16-pin plastic SO | N74F139D | SOT109-1 |

## INPUT AND OUTPUT LOADING AND FAN-OUT TABLE

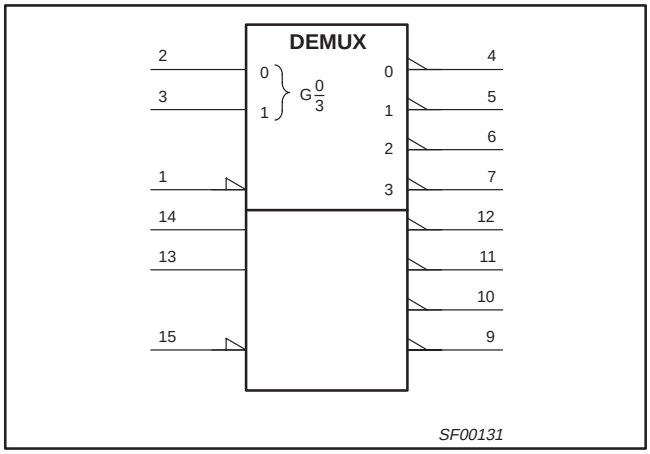
| PINS | DESCRIPTION | 74F (U.L.) HIGH/LOW | LOAD VALUE HIGH/LOW |
|---|---|---|---|
| Ana, Anb | Address inputs | 1.0/1.0 | 20µA/0.6mA |
| $\overline{E}$a, $\overline{E}$b | Enable inputs (active Low) | 1.0/1.0 | 20µA/0.6mA |
| $\overline{Q}$0n–$\overline{Q}$3n | Data outputs (active Low) | 50/33 | 1.0mA/20mA |

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

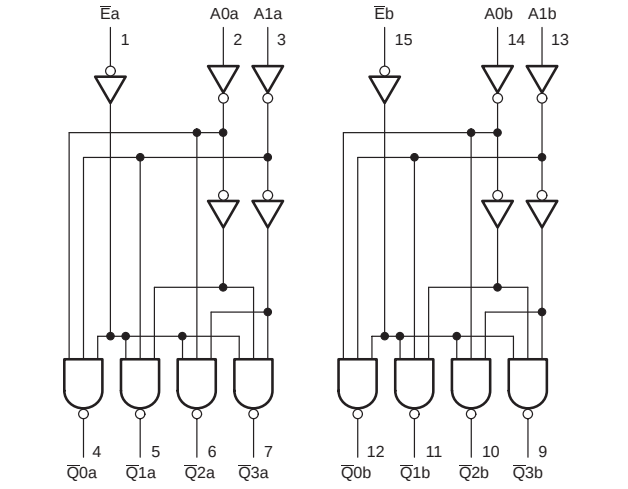
## LOGIC SYMBOL




## IEC/IEEE SYMBOL



## LOGIC DIAGRAM




## FUNCTION TABLE

| INPUTS | | | OUTPUTS | | | |
|---|---|---|---|---|---|---|
| $\overline{E}$ | A0 | A1 | $\overline{Q}$0 | $\overline{Q}$1 | $\overline{Q}$2 | $\overline{Q}$3 |
| H | X | X | H | H | H | H |
| L | L | L | L | H | H | H |
| L | H | L | H | L | H | H |
| L | L | H | H | H | L | H |
| L | H | H | H | H | H | L |

**NOTES:**
H = High voltage level
L = Low voltage level
X = Don't care

## 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 | 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 | | | –1 | mA |
| $I_{OL}$ | Low-level output current | | | 20 | mA |
| $T_{amb}$ | Operating free-air temperature range | 0 | | +70 | °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 |
| $I_{ILL}$ | 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) | $V_{CC}$ = MAX | | | 13 | 20 | mA |

**NOTES:**

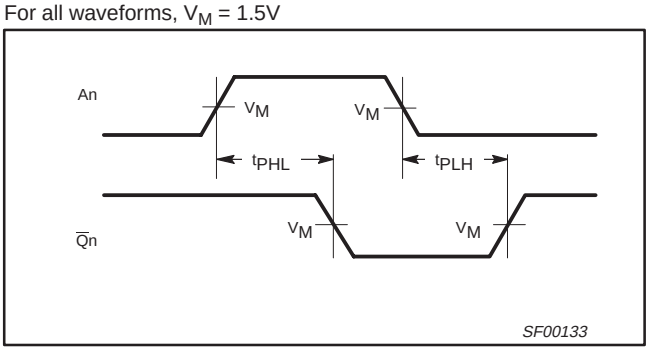
1. For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable type.
2. All typical values are at $V_{CC}$ = 5V, $T_{amb}$ = 25°C.
3. Not more than one output should be shorted at a time. For testing $I_{OS}$, the use of high-speed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

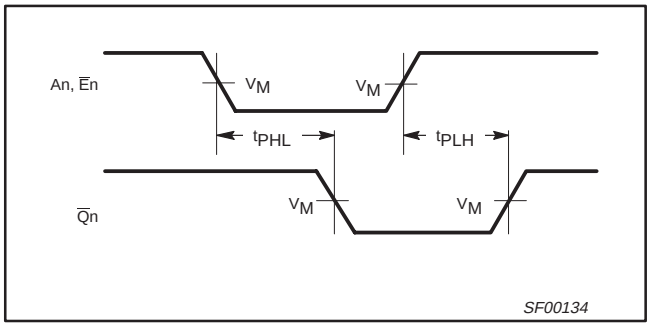
| SYMBOL | PARAMETER | TEST CONDITION | LIMITS | | | | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | | $V_{CC}$ = +5.0V<br>$T_{amb}$ = +25°C<br>$C_L$ = 50pF, $R_L$ = 500Ω | | | $V_{CC}$ = +5.0V ± 10%<br>$T_{amb}$ = 0°C to +70°C<br>$C_L$ = 50pF, $R_L$ = 500Ω | | |
| | | | MIN | TYP | MAX | MIN | MAX | |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation delay<br>A0 ir A1 to $\overline{Q}$na, $\overline{Q}$nb | Waveform 1, 2 | 3.5<br>4.0 | 5.3<br>6.1 | 7.0<br>8.0 | 3.0<br>4.0 | 8.0<br>9.0 | ns |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation delay<br>$\overline{E}$n to $\overline{Q}$na, $\overline{Q}$nb | Waveform 2 | 3.5<br>3.0 | 5.4<br>4.7 | 7.0<br>6.5 | 3.5<br>3.0 | 8.0<br>7.5 | ns |

## AC WAVEFORMS

For all waveforms, $V_M$ = 1.5V

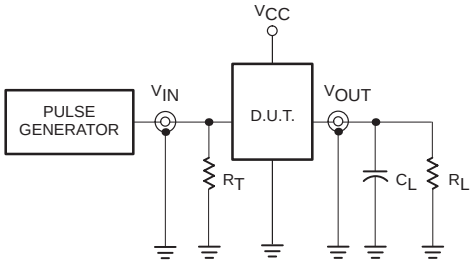



**Waveform 1. Propagation Delay for Inverting Outputs**

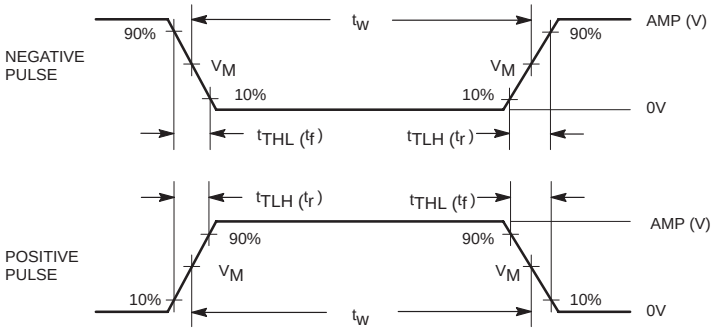



**Waveform 2. Propagation Delay for Non-Inverting Outputs**

## TEST CIRCUIT AND WAVEFORMS




**Test Circuit for Totem-Pole 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.

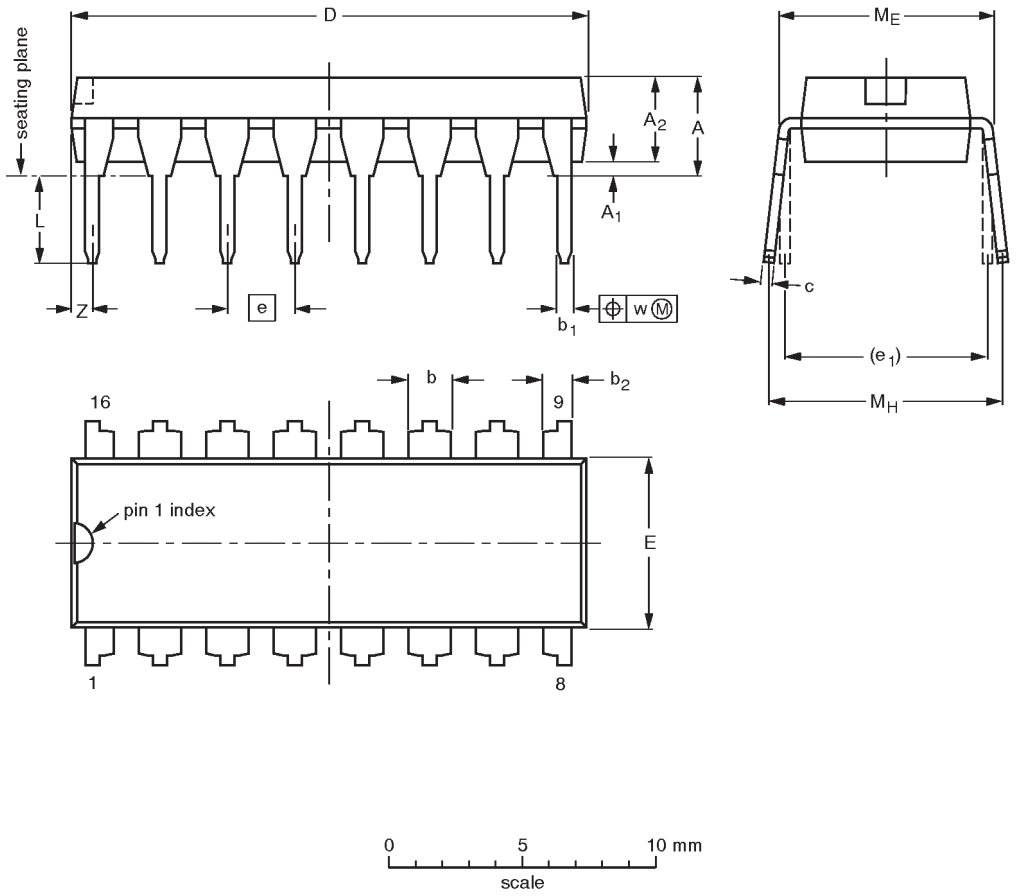
$R_T$ = Termination resistance should be equal to $Z_{OUT}$ of pulse generators.

**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 |

*SF00006*

**DIP16: plastic dual in-line package; 16 leads (300 mil)** **SOT38-4**




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

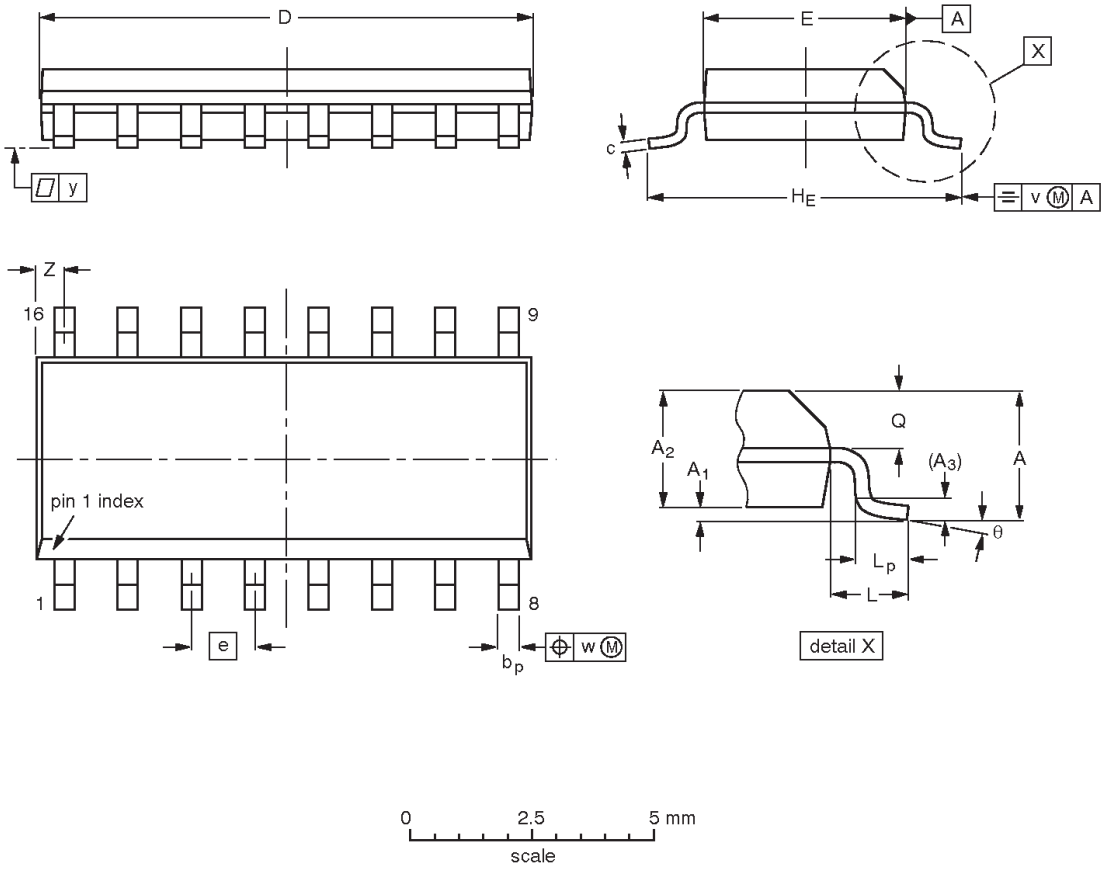
| UNIT | A max. | $A_1$ min. | $A_2$ max. | b | $b_1$ | $b_2$ | c | D (1) | E (1) | e | $e_1$ | L | $M_E$ | $M_H$ | w | Z (1) max. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 4.2 | 0.51 | 3.2 | 1.73<br>1.30 | 0.53<br>0.38 | 1.25<br>0.85 | 0.36<br>0.23 | 19.50<br>18.55 | 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 | 0.76 |
| inches | 0.17 | 0.020 | 0.13 | 0.068<br>0.051 | 0.021<br>0.015 | 0.049<br>0.033 | 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 | 0.030 |

**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 | | | |
| SOT38-4 | | | | | | ~~92-11-17~~<br>95-01-14 |

**SO16: plastic small outline package; 16 leads; body width 3.9 mm** **SOT109-1**




**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 | 10.0<br>9.8 | 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 | 0.39<br>0.38 | 0.16<br>0.15 | 0.050 | 0.244<br>0.228 | 0.041 | 0.039<br>0.016 | 0.028<br>0.020 | 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 | | | |
| SOT109-1 | 076E07S | MS-012AC | | | | ~~95-01-23~~<br>97-05-22 |

## 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. |
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| 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. |

[1] Please consult the most recently issued datasheet before initiating or completing a design.

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