INTEGRATED CIRCUITS

DATA SHEET

74HC2G125; 74HCT2G125

Dual buffer/line driver; 3-state

Product specification Supersedes data of 2003 Jan 31 2003 Mar 03





Dual buffer/line driver; 3-state

74HC2G125; 74HCT2G125

FEATURES

- Wide supply voltage range from 2.0 to 6.0 V
- · Symmetrical output impedance
- · High noise immunity
- · Low power dissipation
- · Balanced propagation delays
- · Very small 8 pins package
- · Output capability: bus driver
- ESD protection: HBM EIA/JESD22-A114-A exceeds 2000 V MM EIA/JESD22-A115-A exceeds 200 V.
- Specified from -40 to +85 °C and -40 to +125 °C.

DESCRIPTION

The 74HC2G/HCT2G125 is a high-speed Si-gate CMOS device.

The 74HC2G/HCT2G125 provides one non-inverting buffer/line driver with 3-state output. The 3-state output is controlled by the output enable input pin (\overline{OE}) . A HIGH at pin \overline{OE} causes the output to assume a high-impedance OFF-state.

The bus driver output currents are equal compared to the 74HC/HCT125.

QUICK REFERENCE DATA

GND = 0 V; T_{amb} = 25 °C; t_r = $t_f \le 6.0$ ns.

| SYMBOL | PARAMETER | CONDITIONS | TYP | TYPICAL | | |
|------------------------------------|-----------------------------------|---|------|---------|------|--|
| STIVIBUL | PARAMETER | CONDITIONS | HC2G | HCT2G | UNIT | |
| t _{PHL} /t _{PLH} | propagation delay nA to nY | $C_L = 15 \text{ pF}; V_{CC} = 5 \text{ V}$ | 10 | 12 | ns | |
| C _I | input capacitance | | 1.0 | 1.0 | pF | |
| Co | output capacitance | | 1.5 | 1.5 | pF | |
| C _{PD} | power dissipation capacitance per | output enabled; notes 1 and 2 | 11 | 11 | pF | |
| | buffer | output disabled; notes 1 and 2 | 1 | 1 | pF | |

Notes

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

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

 f_i = input frequency in MHz;

f_o = output frequency in MHz;

C_L = output load capacitance in pF;

 V_{CC} = supply voltage in Volts;

N = total switching outputs;

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

2. For 74HC2G125 the condition is $V_I = GND$ to V_{CC} .

For 74HCT2G125 the condition is $V_I = GND$ to $V_{CC} - 1.5 V$.

Dual buffer/line driver; 3-state

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FUNCTION TABLE

See note 1.

| INF | OUTPUT | |
|-----|--------|----|
| nŌĒ | nA | nY |
| L | L | L |
| L | Н | Н |
| Н | X | Z |

Note

1. H = HIGH voltage level;

L = LOW voltage level;

X = don't care;

Z = high-impedance OFF-state.

ORDERING INFORMATION

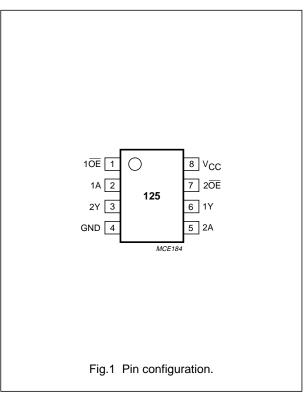
| TYPE NUMBER | TEMPERATURE | | | PACKAGE | | |
|--------------|----------------|------|---------|----------|----------|---------|
| I TPE NUMBER | RANGE | PINS | PACKAGE | MATERIAL | CODE | MARKING |
| 74HC2G125DP | –40 to +125 °C | 8 | TSSOP8 | plastic | SOT505-2 | H25 |
| 74HCT2G125DP | –40 to +125 °C | 8 | TSSOP8 | plastic | SOT505-2 | T25 |
| 74HC2G125DC | –40 to +125 °C | 8 | VSSOP8 | plastic | SOT765-1 | H25 |
| 74HCT2G125DC | –40 to +125 °C | 8 | VSSOP8 | plastic | SOT765-1 | T25 |

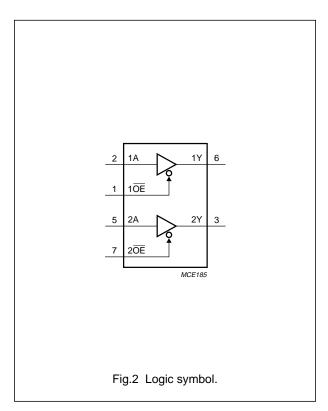
PINNING

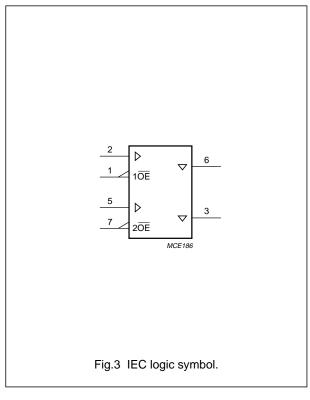
| PIN | SYMBOL | DESCRIPTION |
|-----|-----------------|---------------------|
| 1 | 1 OE | output enable input |
| 2 | 1A | data input |
| 3 | 2Y | data output |
| 4 | GND | ground (0 V) |
| 5 | 2A | data input |
| 6 | 1Y | data output |
| 7 | 2 OE | output enable input |
| 8 | V _{CC} | supply voltage |

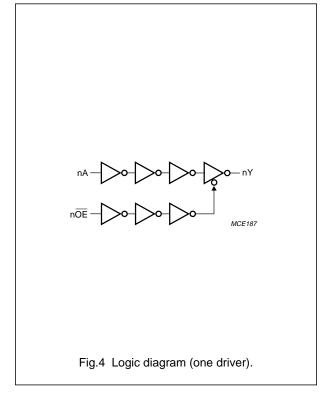
Dual buffer/line driver; 3-state

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Dual buffer/line driver; 3-state

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RECOMMENDED OPERATING CONDITIONS

| SYMBOL | PARAMETER | CONDITIONS | 74 | 4HC2G1 | 25 | 74 | HCT2G1 | 25 | UNIT |
|---------------------------------|-------------------------------|--|------|--------|-----------------|------|--------|-----------------|------|
| STIMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. | UNII |
| V _{CC} | supply voltage | | 2.0 | 5.0 | 6.0 | 4.5 | 5.0 | 5.5 | V |
| V _I | input voltage | | 0 | _ | V _{CC} | 0 | _ | V _{CC} | V |
| Vo | output voltage | | 0 | _ | V _{CC} | 0 | _ | V _{CC} | V |
| T _{amb} | operating ambient temperature | see DC and AC characteristics per device | -40 | +25 | +125 | -40 | +25 | +125 | °C |
| t _r , t _f | input rise and fall times | V _{CC} = 2.0 V | _ | _ | 1000 | _ | _ | _ | ns |
| | | V _{CC} = 4.5 V | _ | 6.0 | 500 | _ | 6.0 | 500 | ns |
| | | V _{CC} = 6.0 V | _ | _ | 400 | _ | _ | _ | ns |

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} | supply voltage | | -0.5 | +7.0 | V |
| I _{IK} | input diode current | $V_I < -0.5 \text{ V or } V_I > V_{CC} + 0.5 \text{ V}; \text{ note 1}$ | _ | ±20 | mA |
| I _{OK} | output diode current | $V_O < -0.5 \text{ V or } V_O > V_{CC} + 0.5 \text{ V}; \text{ note 1}$ | _ | ±20 | mA |
| Io | output source or sink current | $-0.5 \text{ V} < \text{V}_{\text{O}} < \text{V}_{\text{CC}} + 0.5 \text{ V}$; note 1 | _ | 25 | mA |
| I _{CC} , I _{GND} | V _{CC} or GND current | note 1 | _ | 50 | mA |
| T _{stg} | storage temperature | | -65 | +150 | °C |
| P _D | power dissipation per package | for temperature range from –40 to +125 °C; note 2 | _ | 300 | mW |

Notes

1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

2. Above 110 $^{\circ}$ C the value of P_D derates linearly with 8 mW/K.

Dual buffer/line driver; 3-state

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DC CHARACTERISTICS

Type 74HC2G125

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

| CVMDOL | PARAMETER | TEST CONDITIO | NS | BAINI | TYP.(1) | MAY | LINUT |
|------------------------|----------------------------|---|---------------------|-------|----------|-------|-------|
| SYMBOL | PARAMETER | OTHER | V _{CC} (V) | MIN. | I YP.(1) | MAX. | UNIT |
| T _{amb} = -40 | to +85 °C | | | | • | | |
| V _{IH} | HIGH-level input voltage | | 2.0 | 1.5 | 1.2 | _ | V |
| | | | 4.5 | 3.15 | 2.4 | _ | V |
| | | | 6.0 | 4.2 | 3.2 | _ | V |
| V _{IL} | LOW-level input voltage | | 2.0 | _ | 0.8 | 0.5 | V |
| | | | 4.5 | _ | 2.1 | 1.35 | V |
| | | | 6.0 | _ | 2.8 | 1.8 | V |
| V _{OH} | HIGH-level output voltage | V _I = V _{IH} or V _{IL} | | | | | |
| | | $I_{O} = -20 \mu A$ | 2.0 | 1.9 | 2.0 | _ | V |
| | | $I_{O} = -20 \mu A$ | 4.5 | 4.4 | 4.5 | _ | V |
| | | $I_{O} = -20 \mu A$ | 6.0 | 5.9 | 6.0 | _ | V |
| | | $I_{O} = -6.0 \text{ mA}$ | 4.5 | 4.13 | 4.32 | _ | V |
| | | $I_{O} = -7.8 \text{ mA}$ | 6.0 | 5.63 | 5.81 | _ | V |
| V _{OL} | LOW-level output voltage | $V_I = V_{IH}$ or V_{IL} | | | | | |
| | | I _O = 20 μA | 2.0 | _ | 0 | 0.1 | V |
| | | I _O = 20 μA | 4.5 | _ | 0 | 0.1 | V |
| | | I _O = 20 μA | 6.0 | _ | 0 | 0.1 | V |
| | | $I_{O} = 6.0 \text{ mA}$ | 4.5 | _ | 0.15 | 0.33 | V |
| | | I _O = 7.8 mA | 6.0 | _ | 0.16 | 0.33 | V |
| ILI | input leakage current | $V_I = V_{CC}$ or GND | 6.0 | _ | _ | ±1.0 | μΑ |
| I _{OZ} | 3-state output OFF current | $V_I = V_{IH} \text{ or } V_{IL};$ $V_O = V_{CC} \text{ or GND}$ | 6.0 | _ | _ | ±.5.0 | μΑ |
| I _{CC} | quiescent supply current | $V_I = V_{CC}$ or GND; $I_O = 0$ | 6.0 | _ | _ | 10 | μΑ |

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| 0)/44001 | DADAMETED | TEST CONDITIO | NS | | T)(D(1) | | |
|------------------------|----------------------------|---|---------------------|------|---------------------|-------|------|
| SYMBOL | PARAMETER | OTHER | V _{CC} (V) | MIN. | TYP. ⁽¹⁾ | MAX. | UNIT |
| T _{amb} = -40 | to +125 °C | | | • | • | ' | |
| V _{IH} | HIGH-level input voltage | | 2.0 | 1.5 | _ | _ | V |
| | | | 4.5 | 3.15 | - | _ | V |
| | | | 6.0 | 4.2 | Ī- | _ | V |
| V _{IL} | LOW-level input voltage | | 2.0 | _ | Ī- | 0.5 | V |
| | | | 4.5 | _ | Ī- | 1.35 | V |
| | | | 6.0 | _ | Ī- | 1.8 | V |
| V _{OH} | HIGH-level output voltage | V _I = V _{IH} or V _{IL} | | | | | |
| | | $I_{O} = -20 \mu A$ | 2.0 | 1.9 | _ | _ | V |
| | | $I_{O} = -20 \mu A$ | 4.5 | 4.4 | _ | _ | V |
| | | $I_{O} = -20 \mu A$ | 6.0 | 5.9 | _ | _ | V |
| | | $I_{O} = -6.0 \text{ mA}$ | 4.5 | 3.7 | _ | _ | V |
| | | $I_{O} = -7.8 \text{ mA}$ | 6.0 | 5.2 | _ | _ | V |
| V _{OL} | LOW-level output voltage | $V_I = V_{IH}$ or V_{IL} | | | | | |
| | | I _O = 20 μA | 2.0 | _ | _ | 0.1 | V |
| | | I _O = 20 μA | 4.5 | _ | _ | 0.1 | V |
| | | I _O = 20 μA | 6.0 | _ | _ | 0.1 | V |
| | | $I_{O} = 6.0 \text{ mA}$ | 4.5 | _ | _ | 0.4 | V |
| | | $I_{O} = 7.8 \text{ mA}$ | 6.0 | _ | _ | 0.4 | V |
| I _{LI} | input leakage current | V _I = V _{CC} or GND | 6.0 | _ | Ī- | ±1.0 | μΑ |
| l _{OZ} | 3-state output OFF current | $V_I = V_{IH} \text{ or } V_{IL};$ $V_O = V_{CC} \text{ or GND}$ | 6.0 | _ | _ | ±10.4 | μΑ |
| Icc | quiescent supply current | $V_I = V_{CC}$ or GND; $I_O = 0$ | 6.0 | _ | _ | 20 | μΑ |

Note

^{1.} All typical values are measured at $T_{amb} = 25$ °C.

Dual buffer/line driver; 3-state

74HC2G125; 74HCT2G125

Type 74HCT2G125

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

| CVMDOL | DADAMETED | TEST CONDI | TIONS | MINI | TVD (1) | MAY | LINUT |
|------------------------|-------------------------------------|---|---------------------|------|---------|-------|-------|
| SYMBOL | PARAMETER | OTHER | V _{CC} (V) | MIN. | TYP.(1) | MAX. | UNIT |
| T _{amb} = -40 | to +85 °C | | 1 | | | | ·! |
| V _{IH} | HIGH-level input voltage | | 4.5 to 5.5 | 2.0 | 1.6 | _ | ٧ |
| V _{IL} | LOW-level input voltage | | 4.5 to 5.5 | _ | 1.2 | 0.8 | V |
| V _{OH} | HIGH-level output voltage | $V_I = V_{IH} \text{ or } V_{IL}$ | | | | | |
| | | $I_{O} = -20 \mu A$ | 4.5 | 4.4 | 4.5 | - | V |
| | | $I_{O} = -6.0 \text{ mA}$ | 4.5 | 4.13 | 4.32 | - | V |
| V _{OL} | LOW-level output voltage | $V_I = V_{IH} \text{ or } V_{IL}$ | | | | | |
| | | $I_0 = 20 \mu A$ | 4.5 | _ | 0 | 0.1 | V |
| | | $I_{O} = 6.0 \text{ mA}$ | 4.5 | _ | 0.15 | 0.33 | V |
| ILI | input leakage current | $V_I = V_{CC}$ or GND | 5.5 | _ | _ | ±1.0 | μΑ |
| I _{OZ} | 3-state output OFF current | $V_I = V_{IH} \text{ or } V_{IL};$ $V_O = V_{CC} \text{ or GND}$ | 5.5 | _ | _ | ±5.0 | μА |
| I _{CC} | quiescent supply current | $V_I = V_{CC}$ or GND; $I_O = 0$ | 5.5 | - | - | 10 | μА |
| ΔI_{CC} | additional supply current per input | $V_I = V_{CC} - 2.1 \text{ V};$ $I_O = 0$ | 4.5 to 5.5 | - | _ | 375 | μΑ |
| T _{amb} = -40 | to +125 °C | • | | | | | ·! |
| V _{IH} | HIGH-level input voltage | | 4.5 to 5.5 | 2.0 | T- | _ | ٧ |
| V _{IL} | LOW-level input voltage | | 4.5 to 5.5 | _ | _ | 0.8 | V |
| V _{OH} | HIGH-level output voltage | $V_I = V_{IH}$ or V_{IL} | | | | | |
| | | $I_{O} = -20 \mu A$ | 4.5 | 4.4 | _ | _ | V |
| | | $I_{O} = -6.0 \text{ mA}$ | 4.5 | 3.7 | _ | _ | V |
| V _{OL} | LOW-level output voltage | $V_I = V_{IH}$ or V_{IL} | | | | | |
| | | $I_0 = 20 \mu A$ | 4.5 | _ | _ | 0.1 | V |
| | | $I_0 = 6.0 \text{ mA}$ | 4.5 | _ | _ | 0.4 | V |
| ILI | input leakage current | $V_I = V_{CC}$ or GND | 5.5 | _ | - | ±1.0 | μΑ |
| l _{OZ} | 3-state output OFF current | $V_I = V_{IH} \text{ or } V_{IL};$ $V_O = V_{CC} \text{ or GND}$ | 5.5 | _ | _ | ±10.4 | μА |
| I _{CC} | quiescent supply current | $V_I = V_{CC}$ or GND; $I_O = 0$ | 5.5 | _ | - | 20 | μА |
| ΔI_{CC} | additional supply current per input | $V_I = V_{CC} - 2.1 \text{ V};$ $I_O = 0$ | 4.5 to 5.5 | _ | _ | 410 | μА |

Note

1. All typical values are measured at $T_{amb} = 25$ °C.

Dual buffer/line driver; 3-state

74HC2G125; 74HCT2G125

AC CHARACTERISTICS

Type 74HC2G125

GND = 0 V; $t_r = t_f \le 6.0$ ns; $C_L = 50$ pF.

| OVMDOL | DADAMETED | TEST CONDIT | TIONS | 84181 | TVD (1) | MAY | LINUT |
|------------------------------------|---------------------------------------|------------------|---------------------|-------|---------|------|-------|
| SYMBOL | PARAMETER | WAVEFORMS | V _{CC} (V) | MIN. | TYP.(1) | MAX. | UNIT |
| T _{amb} = -40 t | to +85 °C | | • | | | • | 1 |
| t _{PHL} /t _{PLH} | propagation delay nA to nY | see Figs 5 and 7 | 2.0 | _ | 35 | 115 | ns |
| | | | 4.5 | _ | 11 | 23 | ns |
| | | | 6.0 | _ | 8 | 20 | ns |
| t _{PZH} /t _{PZL} | 3-state output enable time nOE to nY | see Figs 6 and 7 | 2.0 | _ | 40 | 115 | ns |
| | | | 4.5 | _ | 11 | 23 | ns |
| | | | 6.0 | _ | 8 | 20 | ns |
| t _{PHZ} /t _{PLZ} | 3-state output disable time nOE to nY | see Figs 6 and 7 | 2.0 | _ | 24 | 125 | ns |
| | | | 4.5 | _ | 12 | 25 | ns |
| | | | 6.0 | _ | 10 | 21 | ns |
| t _{THL} /t _{TLH} | output transition time | see Figs 5 and 7 | 2.0 | _ | 18 | 75 | ns |
| | | | 4.5 | _ | 6 | 15 | ns |
| | | | 6.0 | _ | 5 | 13 | ns |
| T _{amb} = -40 1 | to +125 °C | | • | • | • | | |
| t _{PHL} /t _{PLH} | propagation delay nA to nY | see Figs 5 and 7 | 2.0 | _ | _ | 135 | ns |
| | | | 4.5 | _ | _ | 27 | ns |
| | | | 6.0 | _ | _ | 23 | ns |
| t _{PZH} /t _{PZL} | 3-state output enable time nOE to nY | see Figs 6 and 7 | 2.0 | _ | _ | 135 | ns |
| | | | 4.5 | _ | _ | 27 | ns |
| | | | 6.0 | _ | _ | 23 | ns |
| t _{PHZ} /t _{PLZ} | 3-state output disable time nOE to nY | see Figs 6 and 7 | 2.0 | _ | _ | 150 | ns |
| | | | 4.5 | _ | _ | 30 | ns |
| | | | 6.0 | _ | _ | 26 | ns |
| t _{THL} /t _{TLH} | output transition time | see Figs 5 and 7 | 2.0 | _ | _ | 90 | ns |
| | | | 4.5 | _ | _ | 18 | ns |
| | | | 6.0 | _ | _ | 15 | ns |

Note

1. All typical values are measured at T_{amb} = 25°C.

Dual buffer/line driver; 3-state

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Type 74HCT2G125

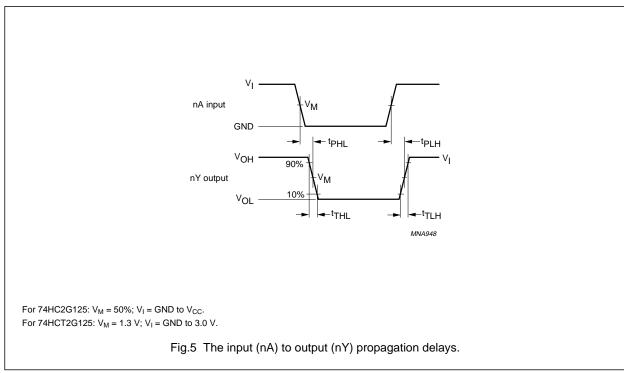
GND = 0 V; $t_r = t_f \le 6.0$ ns; $C_L = 50$ pF.

| SYMBOL | DADAMETED | TEST CONDITIONS | | MINI | TYP.(1) | MAX. | UNIT |
|------------------------------------|---------------------------------------|------------------|---------------------|------|---------|--------|------|
| STIVIBUL | | | V _{CC} (V) | MIN. | 1111.00 | IVIAA. | UNII |
| T _{amb} = -40 t | o +85 °C | | • | • | | • | |
| t _{PHL} /t _{PLH} | propagation delay nA to nY | see Figs 5 and 7 | 4.5 | _ | 15 | 31 | ns |
| t _{PZH} /t _{PZL} | 3-state output enable time nOE to nY | see Figs 6 and 7 | 4.5 | _ | 15 | 35 | ns |
| t _{PHZ} /t _{PLZ} | 3-state output disable time nOE to nY | see Figs 6 and 7 | 4.5 | _ | 15 | 31 | ns |
| t _{THL} /t _{TLH} | output transition time | see Figs 5 and 7 | 4.5 | _ | 6 | 15 | ns |
| T _{amb} = -40 t | o +125 °C | | | | | | |
| t _{PHL} /t _{PLH} | propagation delay nA to nY | see Figs 5 and 7 | 4.5 | _ | _ | 38 | ns |
| t _{PZH} /t _{PZL} | 3-state output enable time nOE to nY | see Figs 6 and 7 | 4.5 | _ | _ | 42 | ns |
| t _{PHZ} /t _{PLZ} | 3-state output disable time nOE to nY | see Figs 6 and 7 | 4.5 | _ | _ | 38 | ns |
| t _{THL} /t _{TLH} | output transition time | see Figs 5 and 7 | 4.5 | _ | _ | 18 | ns |

Note

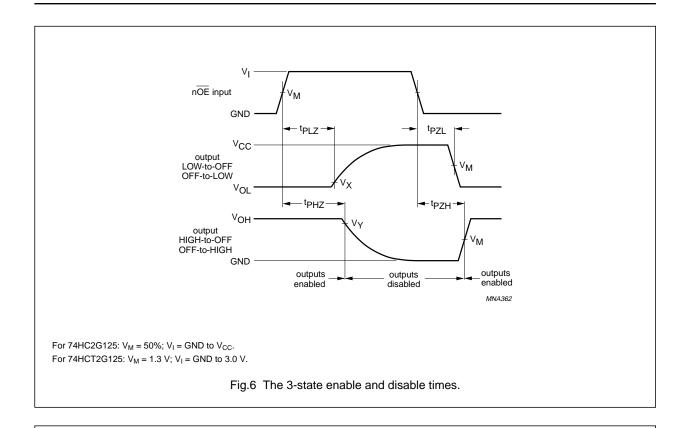
1. All typical values are measured at T_{amb} = 25°C.

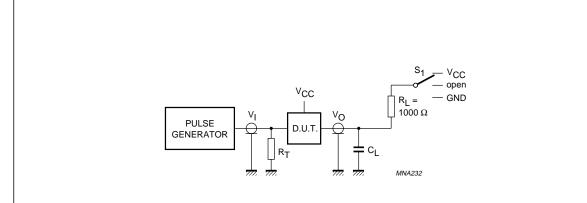
AC WAVEFORMS



Dual buffer/line driver; 3-state

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| TEST | S ₁ |
|------------------------------------|-----------------|
| t _{PLH} /t _{PHL} | open |
| t _{PLZ} /t _{PZL} | V _{CC} |
| t _{PHZ} /t _{PZH} | GND |

Definitions for test circuit:

C_L = load capacitance including jig and probe capacitance (see "AC characteristics").

 R_L = Load resistance.

 $R_{T} = \mbox{termination}$ resistance should be equal to the output impedance Z_{o} of the pulse generator.

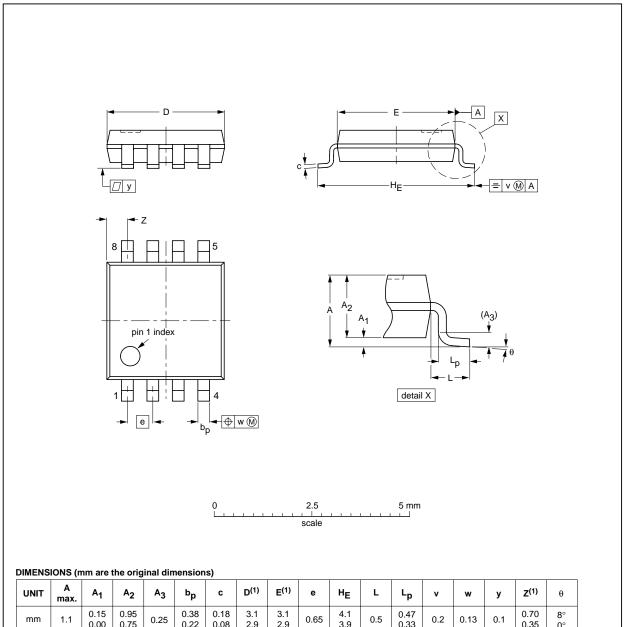
Fig.7 Load circuitry for switching times.

Dual buffer/line driver; 3-state

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PACKAGE OUTLINES

TSSOP8: plastic thin shrink small outline package; 8 leads; body width 3 mm; lead length 0.5 mm SOT505-2



| UNIT | A max. | A ₁ | A ₂ | A ₃ | bp | С | D ⁽¹⁾ | E ⁽¹⁾ | е | HE | L | Lр | v | w | у | Z ⁽¹⁾ | θ |
|------|-----------|----------------|----------------|----------------|--------------|--------------|------------------|------------------|------|------------|-----|--------------|-----|------|-----|------------------|----------|
| mm | 1.1 | 0.15 0.00 | 0.95 0.75 | 0.25 | 0.38 0.22 | 0.18 0.08 | 3.1 2.9 | 3.1 2.9 | 0.65 | 4.1 3.9 | 0.5 | 0.47 0.33 | 0.2 | 0.13 | 0.1 | 0.70 0.35 | 8° 0° |

Note

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

| OUTLINE | | REFER | EUROPEAN | ISSUE DATE | | | |
|----------|-----|-------|----------|------------|------------|------------|--|
| VERSION | IEC | JEDEC | JEITA | | PROJECTION | ISSUE DATE | |
| SOT505-2 | | | | | | 02-01-16 | |

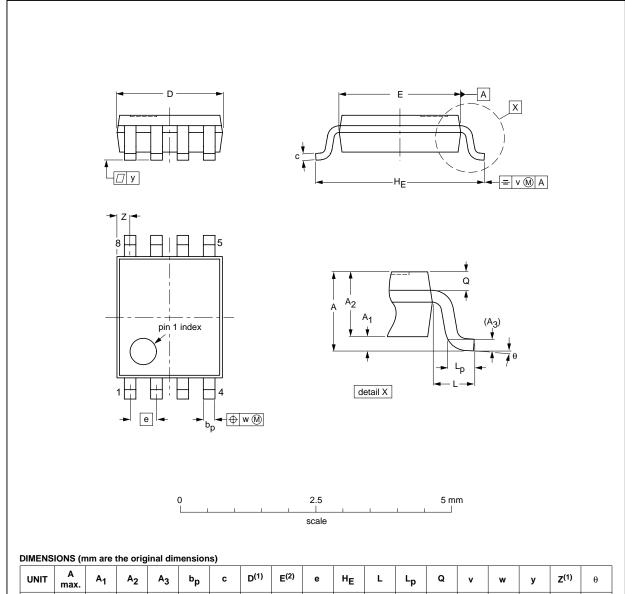
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Dual buffer/line driver; 3-state

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VSSOP8: plastic very thin shrink small outline package; 8 leads; body width 2.3 mm

SOT765-1



| UNI | т , | A max. | A ₁ | A ₂ | A ₃ | bp | С | D ⁽¹⁾ | E ⁽²⁾ | е | HE | L | Lp | Q | v | w | у | Z ⁽¹⁾ | θ |
|-----|-----|-----------|----------------|----------------|----------------|--------------|--------------|------------------|------------------|-----|------------|-----|--------------|--------------|-----|------|-----|------------------|----------|
| mn | 1 | 1 | 0.15 0.00 | 0.85 0.60 | 0.12 | 0.27 0.17 | 0.23 0.08 | 2.1 1.9 | 2.4 2.2 | 0.5 | 3.2 3.0 | 0.4 | 0.40 0.15 | 0.21 0.19 | 0.2 | 0.13 | 0.1 | 0.4 0.1 | 8° 0° |

- Plastic or metal protrusions of 0.15 mm maximum per side are not included.
 Plastic or metal protrusions of 0.25 mm maximum per side are not included.

| OUTLINE | | REFER | EUROPEAN | ISSUE DATE | | |
|----------|-----|--------|----------|------------|------------|--|
| VERSION | IEC | JEDEC | JEITA | PROJECTION | ISSUE DATE | |
| SOT765-1 | | MO-187 | | | 02-06-07 | |
| | | | | | | |

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Dual buffer/line driver; 3-state

74HC2G125; 74HCT2G125

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 can still be used for certain surface mount ICs, but it is not suitable for fine pitch SMDs. In these situations reflow soldering is recommended.

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, convection or convection/infrared 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 220 °C for all the BGA packages and packages with a thickness ≥2.5 mm and packages with a thickness <2.5 mm and a volume ≥350 mm³ so called thick/large packages
- below 235 °C for packages with a thickness <2.5 mm and a volume <350 mm³ so called small/thin packages.

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.

Dual buffer/line driver; 3-state

74HC2G125; 74HCT2G125

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

| PACKAGE ⁽¹⁾ | SOLDERING METHOD | | | | | |
|--|-----------------------------------|-----------------------|--|--|--|--|
| PACKAGE | WAVE | REFLOW ⁽²⁾ | | | | |
| BGA, LBGA, LFBGA, SQFP, TFBGA, VFBGA | not suitable | suitable | | | | |
| DHVQFN, HBCC, HBGA, HLQFP, HSQFP, HSOP, HTQFP, HTSSOP, HVQFN, HVSON, SMS | not suitable ⁽³⁾ | suitable | | | | |
| PLCC ⁽⁴⁾ , SO, SOJ | suitable | suitable | | | | |
| LQFP, QFP, TQFP | not recommended ⁽⁴⁾⁽⁵⁾ | suitable | | | | |
| SSOP, TSSOP, VSO, VSSOP | not recommended ⁽⁶⁾ | suitable | | | | |

Notes

- For more detailed information on the BGA packages refer to the "(LF)BGA Application Note" (AN01026); order a copy from your Philips Semiconductors sales office.
- 2. 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".
- 3. These packages are not suitable for wave soldering. On versions with the heatsink on the bottom side, the solder cannot penetrate between the printed-circuit board and the heatsink. On versions with the heatsink on the top side, the solder might be deposited on the heatsink surface.
- 4. 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.
- 5. Wave soldering is suitable for LQFP, TQFP and QFP packages with a pitch (e) larger than 0.8 mm; it is definitely not suitable for packages with a pitch (e) equal to or smaller than 0.65 mm.
- 6. Wave soldering is suitable for SSOP, TSSOP, VSO and VSSOP 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.

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|-------|-------------------------------------|-------------------------------------|--|
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