# 74AUP1Z125

## Low-power X-tal driver with enable and internal resistor; 3-state

Rev. 5 — 8 August 2012 Product data sheet

## 1. General description

The 74AUP1Z125 combines the functions of the 74AUP1GU04 and 74AUP1G125 with enable circuitry and an internal bias resistor to provide a device optimized for use in crystal oscillator applications.

When not in use the $\overline{EN}$ input can be driven HIGH, pulling up the $\overline{X1}$ input and putting the device in a low-power disable mode. Schmitt trigger action at the $\overline{EN}$ input makes the circuit tolerant to slower input rise and fall times across the entire $V_{CC}$ range from 0.8 V to 3.6 V.

This device is fully specified for partial power-down applications using $I_{OFF}$ at output Y. The $I_{OFF}$ circuitry disables the output Y, preventing the damaging backflow current through the device when it is powered down.

The integration of the two devices into the 74AUP1Z125 produces the benefits of a compact footprint, lower power dissipation and stable operation over a wide range of frequency and temperature.

## 2. Features and benefits

- Wide supply voltage range from 0.8 V to 3.6 V
- High noise immunity
- ESD protection:
  - HBM JESD22-A114F Class 3A exceeds 5000 V
  - MM JESD22-A115-A exceeds 200 V
  - CDM JESD22-C101E exceeds 1000 V
- Latch-up performance exceeds 100 mA per JESD78B Class II
- Inputs accept voltages up to 3.6 V
- Low noise overshoot and undershoot < 10 % of $V_{CC}$
- $I_{OFF}$ circuitry provides partial power-down mode operation at output Y
- Multiple package options
- Specified from –40 °C to +85 °C and –40 °C to +125 °C

## 3. Ordering information

**Table 1. Ordering information**

| Type number | Package | | | |
|---|---|---|---|---|
| | Temperature range | Name | Description | Version |
| 74AUP1Z125GW | –40 °C to +125 °C | SC-88 | plastic surface-mounted package; 6 leads | SOT363 |
| 74AUP1Z125GM | –40 °C to +125 °C | XSON6 | plastic extremely thin small outline package; no leads; 6 terminals; body 1 × 1.45 × 0.5 mm | SOT886 |
| 74AUP1Z125GF | –40 °C to +125 °C | XSON6 | plastic extremely thin small outline package; no leads; 6 terminals; body 1 × 1 × 0.5 mm | SOT891 |
| 74AUP1Z125GN | –40 °C to +125 °C | XSON6 | extremely thin small outline package; no leads; 6 terminals; body 0.9 × 1.0 × 0.35 mm | SOT1115 |
| 74AUP1Z125GS | –40 °C to +125 °C | XSON6 | extremely thin small outline package; no leads; 6 terminals; body 1.0 × 1.0 × 0.35 mm | SOT1202 |

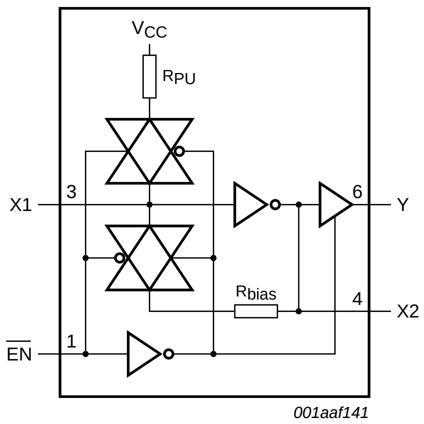
## 4. Marking

**Table 2. Marking**

| Type number | Marking code[1] |
|---|---|
| 74AUP1Z125GW | 55 |
| 74AUP1Z125GM | 55 |
| 74AUP1Z125GF | 55 |
| 74AUP1Z125GN | 55 |
| 74AUP1Z125GS | 55 |

[1] The pin 1 indicator is located on the lower left corner of the device, below the marking code.

## 5. Functional diagram




$R_{PU}$ = pull-up resistance.

$R_{bias}$ = bias resistance.

**Fig 1. Logic symbol**

# 6. Pinning information

## 6.1 Pinning

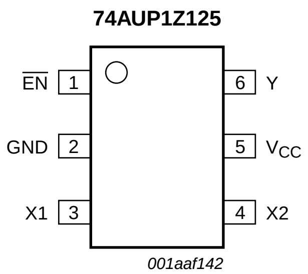



**Fig 2. Pin configuration SOT363**

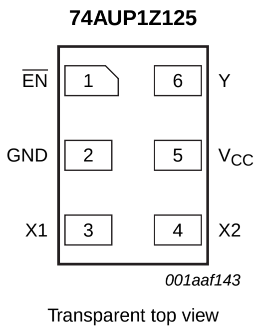



**Fig 3. Pin configuration SOT886**

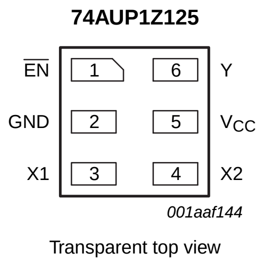



**Fig 4. Pin configuration SOT891, SOT1115 and SOT1202**

## 6.2 Pin description

**Table 3. Pin description**

| Symbol | Pin | Description |
|---|---|---|
| $\overline{EN}$ | 1 | enable input (active LOW) |
| GND | 2 | ground (0 V) |
| X1 | 3 | data input |
| X2 | 4 | unbuffered output |
| $V_{CC}$ | 5 | supply voltage |
| Y | 6 | data output |

# 7. Functional description

**Table 4. Function table[1]**

| Input | | Output | |
|---|---|---|---|
| $\overline{EN}$ | X1 | X2 | Y |
| L | L | H | H |
| L | H | L | L |
| H | L | H | Z |
| H | H | L | Z |

[1] H = HIGH voltage level;
L = LOW voltage level;
Z = high-impedance OFF-state.

## 8. Limiting values

**Table 5. 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 | +4.6 | V |
| $I_{IK}$ | input clamping current | $V_I < 0$ V | | –50 | - | mA |
| $V_I$ | input voltage | | [1] | –0.5 | +4.6 | V |
| $I_{OK}$ | output clamping current | $V_O < 0$ V | | –50 | - | mA |
| $V_O$ | output voltage | Active mode and Power-down mode | [1] | –0.5 | +4.6 | V |
| $I_O$ | output current | $V_O$ = 0 V to $V_{CC}$ | | - | ±20 | mA |
| $I_{CC}$ | supply current | | | - | 50 | mA |
| $I_{GND}$ | ground current | | | –50 | - | mA |
| $T_{stg}$ | storage temperature | | | –65 | +150 | °C |
| $P_{tot}$ | total power dissipation | $T_{amb}$ = –40 °C to +125 °C | [2] | - | 250 | mW |

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

[2] For SC-88 packages: above 87.5 °C the value of $P_{tot}$ derates linearly with 4.0 mW/K.
For XSON6 packages: above 118 °C the value of $P_{tot}$ derates linearly with 7.8 mW/K.

## 9. Recommended operating conditions

**Table 6. Recommended operating conditions**

| Symbol | Parameter | Conditions | Min | Max | Unit |
|---|---|---|---|---|---|
| $V_{CC}$ | supply voltage | | 0.8 | 3.6 | V |
| $V_I$ | input voltage | | 0 | 3.6 | V |
| $V_O$ | output voltage | | 0 | $V_{CC}$ | V |
| $T_{amb}$ | ambient temperature | | –40 | +125 | °C |
| $\Delta t/\Delta V$ | input transition rise and fall rate | $V_{CC}$ = 0.8 V to 3.6 V | - | 200 | ns/V |

## 10. Static characteristics

**Table 7. Static characteristics**

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

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **$T_{amb}$ = 25 °C** | | | | | | |
| $V_{IH}$ | HIGH-level input voltage | X1 input | | | | |
| | | $V_{CC}$ = 0.8 V to 3.6 V | 0.75 × $V_{CC}$ | - | - | V |
| | | $\overline{EN}$ input | | | | |
| | | $V_{CC}$ = 0.8 V | 0.70 × $V_{CC}$ | - | - | V |
| | | $V_{CC}$ = 0.9 V to 1.95 V | 0.65 × $V_{CC}$ | - | - | V |
| | | $V_{CC}$ = 2.3 V to 2.7 V | 1.6 | - | - | V |
| | | $V_{CC}$ = 3.0 V to 3.6 V | 2.0 | - | - | V |
| $V_{IL}$ | LOW-level input voltage | X1 input | | | | |
| | | $V_{CC}$ = 0.8 V to 3.6 V | - | - | 0.25 × $V_{CC}$ | V |
| | | $\overline{EN}$ input | | | | |
| | | $V_{CC}$ = 0.8 V | - | - | 0.30 × $V_{CC}$ | V |
| | | $V_{CC}$ = 0.9 V to 1.95 V | - | - | 0.35 × $V_{CC}$ | V |
| | | $V_{CC}$ = 2.3 V to 2.7 V | - | - | 0.7 | V |
| | | $V_{CC}$ = 3.0 V to 3.6 V | - | - | 0.9 | V |
| $V_{OH}$ | HIGH-level output voltage | Y output; $V_I$ at X1 input = $V_{IH}$ or $V_{IL}$ | | | | |
| | | $I_O$ = −20 μA; $V_{CC}$ = 0.8 V to 3.6 V | $V_{CC}$ − 0.1 | - | - | V |
| | | $I_O$ = −1.1 mA; $V_{CC}$ = 1.1 V | 0.75 × $V_{CC}$ | - | - | V |
| | | $I_O$ = −1.7 mA; $V_{CC}$ = 1.4 V | 1.11 | - | - | V |
| | | $I_O$ = −1.9 mA; $V_{CC}$ = 1.65 V | 1.32 | - | - | V |
| | | $I_O$ = −2.3 mA; $V_{CC}$ = 2.3 V | 2.05 | - | - | V |
| | | $I_O$ = −3.1 mA; $V_{CC}$ = 2.3 V | 1.9 | - | - | V |
| | | $I_O$ = −2.7 mA; $V_{CC}$ = 3.0 V | 2.72 | - | - | V |
| | | $I_O$ = −4.0 mA; $V_{CC}$ = 3.0 V | 2.6 | - | - | V |
| | | X2 output; $V_I$ = GND or $V_{CC}$ | | | | |
| | | $I_O$ = −20 μA; $V_{CC}$ = 0.8 V to 3.6 V | $V_{CC}$ − 0.1 | - | - | V |
| | | $I_O$ = −1.1 mA; $V_{CC}$ = 1.1 V | 0.75 × $V_{CC}$ | - | - | V |
| | | $I_O$ = −1.7 mA; $V_{CC}$ = 1.4 V | 1.11 | - | - | V |
| | | $I_O$ = −1.9 mA; $V_{CC}$ = 1.65 V | 1.32 | - | - | V |
| | | $I_O$ = −2.3 mA; $V_{CC}$ = 2.3 V | 2.05 | - | - | V |
| | | $I_O$ = −3.1 mA; $V_{CC}$ = 2.3 V | 1.9 | - | - | V |
| | | $I_O$ = −2.7 mA; $V_{CC}$ = 3.0 V | 2.72 | - | - | V |
| | | $I_O$ = −4.0 mA; $V_{CC}$ = 3.0 V | 2.6 | - | - | V |

**Table 7. Static characteristics** *…continued*

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

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{OL}$ | LOW-level output voltage | Y output; $V_I$ at X1 input = $V_{IH}$ or $V_{IL}$ | | | | | |
| | | $I_O$ = 20 μA; $V_{CC}$ = 0.8 V to 3.6 V | | - | - | 0.1 | V |
| | | $I_O$ = 1.1 mA; $V_{CC}$ = 1.1 V | | - | - | 0.3 × $V_{CC}$ | V |
| | | $I_O$ = 1.7 mA; $V_{CC}$ = 1.4 V | | - | - | 0.31 | V |
| | | $I_O$ = 1.9 mA; $V_{CC}$ = 1.65 V | | - | - | 0.31 | V |
| | | $I_O$ = 2.3 mA; $V_{CC}$ = 2.3 V | | - | - | 0.31 | V |
| | | $I_O$ = 3.1 mA; $V_{CC}$ = 2.3 V | | - | - | 0.44 | V |
| | | $I_O$ = 2.7 mA; $V_{CC}$ = 3.0 V | | - | - | 0.31 | V |
| | | $I_O$ = 4.0 mA; $V_{CC}$ = 3.0 V | | - | - | 0.44 | V |
| | | X2 output; $V_I$ = GND or $V_{CC}$ | | | | | |
| | | $I_O$ = 20 μA; $V_{CC}$ = 0.8 V to 3.6 V | | - | - | 0.1 | V |
| | | $I_O$ = 1.1 mA; $V_{CC}$ = 1.1 V | | - | - | 0.3 × $V_{CC}$ | V |
| | | $I_O$ = 1.7 mA; $V_{CC}$ = 1.4 V | | - | - | 0.31 | V |
| | | $I_O$ = 1.9 mA; $V_{CC}$ = 1.65 V | | - | - | 0.31 | V |
| | | $I_O$ = 2.3 mA; $V_{CC}$ = 2.3 V | | - | - | 0.31 | V |
| | | $I_O$ = 3.1 mA; $V_{CC}$ = 2.3 V | | - | - | 0.44 | V |
| | | $I_O$ = 2.7 mA; $V_{CC}$ = 3.0 V | | - | - | 0.31 | V |
| | | $I_O$ = 4.0 mA; $V_{CC}$ = 3.0 V | | - | - | 0.44 | V |
| $I_I$ | input leakage current | X1 input | | | | | |
| | | $V_I = \overline{EN} = V_{CC}$; $V_{CC}$ = 0 V to 3.6 V | | - | - | ±0.1 | μA |
| | | $\overline{EN}$ input | | | | | |
| | | $V_I$ = GND to 3.6 V; $V_{CC}$ = 0 V to 3.6 V | | - | - | ±0.1 | μA |
| $I_{pu}$ | pull-up current | X1 input; $\overline{EN} = V_{CC}$ | | | | | |
| | | $V_I$ = GND; $V_{CC}$ = 0.8 V to 3.6 V | | - | - | 15 | μA |
| $I_{OZ}$ | OFF-state output current | Y output; $V_O$ = 0 V to 3.6 V; $V_{CC}$ = 0 V to 3.6 V; $\overline{EN} = V_{CC}$ | | - | - | ±0.1 | μA |
| $I_{OFF}$ | power-off leakage current | $V_I$ or $V_O$ = 0 V to 3.6 V; $V_{CC}$ = 0 V | [1] | - | - | ±0.2 | μA |
| $\Delta I_{OFF}$ | additional power-off leakage current | $V_I$ or $V_O$ = 0 V to 3.6 V; $V_{CC}$ = 0 V to 0.2 V | [1] | - | - | ±0.2 | μA |
| $I_{CC}$ | supply current | $V_I$ = GND or $V_{CC}$; $I_O$ = 0 A; $V_{CC}$ = 0.8 V to 3.6 V | | - | - | 75 | μA |
| $\Delta I_{CC}$ | additional supply current | $\overline{EN}$ input | | | | | |
| | | $V_I = V_{CC} - 0.6$ V; $I_O$ = 0 A; $V_{CC}$ = 3.3 V | | - | - | 40 | μA |
| $C_I$ | input capacitance | X1 input | | | | | |
| | | $V_{CC}$ = 0 V to 3.6 V; $V_I$ = GND or $V_{CC}$ | | - | 1.3 | - | pF |
| | | $\overline{EN}$ input | | | | | |
| | | $V_{CC}$ = 0 V to 3.6 V; $V_I$ = GND or $V_{CC}$ | | - | 0.8 | - | pF |

**Table 7. Static characteristics** *...continued*

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

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $C_O$ | output capacitance | X2 output | | | | |
| | | $V_O$ = GND; $V_{CC}$ = 0 V | - | 1.5 | - | pF |
| | | Y output | | | | |
| | | $V_O$ = GND; $V_{CC}$ = 0 V | - | 1.7 | - | pF |
| $g_{fs}$ | forward transconductance | see Figure 10 and Figure 11 | | | | |
| | | $V_{CC}$ = 0.8 V | - | - | - | mA/V |
| | | $V_{CC}$ = 1.1 V to 1.3 V | 0.2 | - | 9.9 | mA/V |
| | | $V_{CC}$ = 1.4 V to 1.6 V | 3.9 | - | 17.7 | mA/V |
| | | $V_{CC}$ = 1.65 V to 1.95 V | 7.9 | - | 24.3 | mA/V |
| | | $V_{CC}$ = 2.3 V to 2.7 V | 18 | - | 30.7 | mA/V |
| | | $V_{CC}$ = 3.0 V to 3.6 V | 20.5 | - | 32.4 | mA/V |
| $R_{bias}$ | bias resistance | $\overline{EN}$ = GND; $f_i$ = 0 Hz; $V_I$ = 0 V or $V_{CC}$; See Figure 5; for frequency behavior see Figure 6 | 1.08 | 1.62 | 3.08 | MΩ |
| **$T_{amb}$ = –40 °C to +85 °C** | | | | | | |
| $V_{IH}$ | HIGH-level input voltage | X1 input | | | | |
| | | $V_{CC}$ = 0.8 V to 3.6 V | 0.75 × $V_{CC}$ | - | - | V |
| | | $\overline{EN}$ input | | | | |
| | | $V_{CC}$ = 0.8 V | 0.70 × $V_{CC}$ | - | - | V |
| | | $V_{CC}$ = 0.9 V to 1.95 V | 0.65 × $V_{CC}$ | - | - | V |
| | | $V_{CC}$ = 2.3 V to 2.7 V | 1.6 | - | - | V |
| | | $V_{CC}$ = 3.0 V to 3.6 V | 2.0 | - | - | V |
| $V_{IL}$ | LOW-level input voltage | X1 input | | | | |
| | | $V_{CC}$ = 0.8 V to 3.6 V | - | - | 0.25 × $V_{CC}$ | V |
| | | $\overline{EN}$ input | | | | |
| | | $V_{CC}$ = 0.8 V | - | - | 0.30 × $V_{CC}$ | V |
| | | $V_{CC}$ = 0.9 V to 1.95 V | - | - | 0.35 × $V_{CC}$ | V |
| | | $V_{CC}$ = 2.3 V to 2.7 V | - | - | 0.7 | V |
| | | $V_{CC}$ = 3.0 V to 3.6 V | - | - | 0.9 | V |

**Table 7. Static characteristics** *…continued*

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

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{OH}$ | HIGH-level output voltage | Y output; $V_I$ at X1 input = $V_{IH}$ or $V_{IL}$ | | | | |
| | | $I_O$ = −20 μA; $V_{CC}$ = 0.8 V to 3.6 V | $V_{CC}$ − 0.1 | - | - | V |
| | | $I_O$ = −1.1 mA; $V_{CC}$ = 1.1 V | 0.7 × $V_{CC}$ | - | - | V |
| | | $I_O$ = −1.7 mA; $V_{CC}$ = 1.4 V | 1.03 | - | - | V |
| | | $I_O$ = −1.9 mA; $V_{CC}$ = 1.65 V | 1.30 | - | - | V |
| | | $I_O$ = −2.3 mA; $V_{CC}$ = 2.3 V | 1.97 | - | - | V |
| | | $I_O$ = −3.1 mA; $V_{CC}$ = 2.3 V | 1.85 | - | - | V |
| | | $I_O$ = −2.7 mA; $V_{CC}$ = 3.0 V | 2.67 | - | - | V |
| | | $I_O$ = −4.0 mA; $V_{CC}$ = 3.0 V | 2.55 | - | - | V |
| | | X2 output; $V_I$ = GND or $V_{CC}$ | | | | |
| | | $I_O$ = −20 μA; $V_{CC}$ = 0.8 V to 3.6 V | $V_{CC}$ − 0.1 | - | - | V |
| | | $I_O$ = −1.1 mA; $V_{CC}$ = 1.1 V | 0.7 × $V_{CC}$ | - | - | V |
| | | $I_O$ = −1.7 mA; $V_{CC}$ = 1.4 V | 1.03 | - | - | V |
| | | $I_O$ = −1.9 mA; $V_{CC}$ = 1.65 V | 1.30 | - | - | V |
| | | $I_O$ = −2.3 mA; $V_{CC}$ = 2.3 V | 1.97 | - | - | V |
| | | $I_O$ = −3.1 mA; $V_{CC}$ = 2.3 V | 1.85 | - | - | V |
| | | $I_O$ = −2.7 mA; $V_{CC}$ = 3.0 V | 2.67 | - | - | V |
| | | $I_O$ = −4.0 mA; $V_{CC}$ = 3.0 V | 2.55 | - | - | V |
| $V_{OL}$ | LOW-level output voltage | Y output; $V_I$ at X1 input = $V_{IH}$ or $V_{IL}$ | | | | |
| | | $I_O$ = 20 μA; $V_{CC}$ = 0.8 V to 3.6 V | - | - | 0.1 | V |
| | | $I_O$ = 1.1 mA; $V_{CC}$ = 1.1 V | - | - | 0.3 × $V_{CC}$ | V |
| | | $I_O$ = 1.7 mA; $V_{CC}$ = 1.4 V | - | - | 0.37 | V |
| | | $I_O$ = 1.9 mA; $V_{CC}$ = 1.65 V | - | - | 0.35 | V |
| | | $I_O$ = 2.3 mA; $V_{CC}$ = 2.3 V | - | - | 0.33 | V |
| | | $I_O$ = 3.1 mA; $V_{CC}$ = 2.3 V | - | - | 0.45 | V |
| | | $I_O$ = 2.7 mA; $V_{CC}$ = 3.0 V | - | - | 0.33 | V |
| | | $I_O$ = 4.0 mA; $V_{CC}$ = 3.0 V | - | - | 0.45 | V |
| | | X2 output; $V_I$ = GND or $V_{CC}$ | | | | |
| | | $I_O$ = 20 μA; $V_{CC}$ = 0.8 V to 3.6 V | - | - | 0.1 | V |
| | | $I_O$ = 1.1 mA; $V_{CC}$ = 1.1 V | - | - | 0.3 × $V_{CC}$ | V |
| | | $I_O$ = 1.7 mA; $V_{CC}$ = 1.4 V | - | - | 0.37 | V |
| | | $I_O$ = 1.9 mA; $V_{CC}$ = 1.65 V | - | - | 0.35 | V |
| | | $I_O$ = 2.3 mA; $V_{CC}$ = 2.3 V | - | - | 0.33 | V |
| | | $I_O$ = 3.1 mA; $V_{CC}$ = 2.3 V | - | - | 0.45 | V |
| | | $I_O$ = 2.7 mA; $V_{CC}$ = 3.0 V | - | - | 0.33 | V |
| | | $I_O$ = 4.0 mA; $V_{CC}$ = 3.0 V | - | - | 0.45 | V |

**Table 7. Static characteristics** *…continued*

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

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $I_I$ | input leakage current | X1 input | | | | | |
| | | $V_I$ = $\overline{EN}$ = $V_{CC}$; $V_{CC}$ = 0 V to 3.6 V | | - | - | ±0.5 | µA |
| | | $\overline{EN}$ input | | | | | |
| | | $V_I$ = GND to 3.6 V; $V_{CC}$ = 0 V to 3.6 V | | - | - | ±0.5 | µA |
| $I_{pu}$ | pull-up current | X1 input; $\overline{EN}$ = $V_{CC}$ | | | | | |
| | | $V_I$ = GND; $V_{CC}$ = 0.8 V to 3.6 V | | - | - | 15 | µA |
| $I_{OZ}$ | OFF-state output current | Y output; $V_O$ = 0 V to 3.6 V; $V_{CC}$ = 0 V to 3.6 V; $\overline{EN}$ = $V_{CC}$ | | - | - | ±0.5 | µA |
| $I_{OFF}$ | power-off leakage current | $V_I$ or $V_O$ = 0 V to 3.6 V; $V_{CC}$ = 0 V | [1] | - | - | ±0.5 | µA |
| $\Delta I_{OFF}$ | additional power-off leakage current | $V_I$ or $V_O$ = 0 V to 3.6 V; $V_{CC}$ = 0 V to 0.2 V | [1] | - | - | ±0.6 | µA |
| $I_{CC}$ | supply current | $V_I$ = GND or $V_{CC}$; $I_O$ = 0 A; $V_{CC}$ = 0.8 V to 3.6 V | | - | - | 75 | µA |
| $\Delta I_{CC}$ | additional supply current | $\overline{EN}$ input | | | | | |
| | | $V_I$ = $V_{CC}$ − 0.6 V; $I_O$ = 0 A; $V_{CC}$ = 3.3 V | | - | - | 50 | µA |
| $g_{fs}$ | forward transconductance | see Figure 10 and Figure 11 | | | | | |
| | | $V_{CC}$ = 0.8 V | | - | - | - | mA/V |
| | | $V_{CC}$ = 1.1 V to 1.3 V | | - | - | 10.8 | mA/V |
| | | $V_{CC}$ = 1.4 V to 1.6 V | | 1.8 | - | 21.2 | mA/V |
| | | $V_{CC}$ = 1.65 V to 1.95 V | | 7.5 | - | 29.9 | mA/V |
| | | $V_{CC}$ = 2.3 V to 2.7 V | | 15.0 | - | 38.0 | mA/V |
| | | $V_{CC}$ = 3.0 V to 3.6 V | | 17.8 | - | 39.2 | mA/V |
| $R_{bias}$ | bias resistance | $\overline{EN}$ = GND; $f_i$ = 0 Hz; $V_I$ = 0 V or $V_{CC}$; See Figure 5; for frequency behavior see Figure 6 | | 1.07 | - | 3.11 | MΩ |

**Table 7. Static characteristics** *...continued*

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

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $T_{amb}$ = –40 °C to +125 °C | | | | | | |
| $V_{IH}$ | HIGH-level input voltage | X1 input | | | | |
| | | $V_{CC}$ = 0.8 V to 3.6 V | 0.75 × $V_{CC}$ | - | - | V |
| | | $\overline{EN}$ input | | | | |
| | | $V_{CC}$ = 0.8 V | 0.75 × $V_{CC}$ | - | - | V |
| | | $V_{CC}$ = 0.9 V to 1.95 V | 0.70 × $V_{CC}$ | - | - | V |
| | | $V_{CC}$ = 2.3 V to 2.7 V | 1.6 | - | - | V |
| | | $V_{CC}$ = 3.0 V to 3.6 V | 2.0 | - | - | V |
| $V_{IL}$ | LOW-level input voltage | X1 input | | | | |
| | | $V_{CC}$ = 0.8 V to 3.6 V | - | - | 0.25 × $V_{CC}$ | V |
| | | $\overline{EN}$ input | | | | |
| | | $V_{CC}$ = 0.8 V | - | - | 0.25 × $V_{CC}$ | V |
| | | $V_{CC}$ = 0.9 V to 1.95 V | - | - | 0.30 × $V_{CC}$ | V |
| | | $V_{CC}$ = 2.3 V to 2.7 V | - | - | 0.7 | V |
| | | $V_{CC}$ = 3.0 V to 3.6 V | - | - | 0.9 | V |
| $V_{OH}$ | HIGH-level output voltage | Y output; $V_I$ at X1 input = $V_{IH}$ or $V_{IL}$ | | | | |
| | | $I_O$ = –20 µA; $V_{CC}$ = 0.8 V to 3.6 V | $V_{CC}$ – 0.11 | - | - | V |
| | | $I_O$ = –1.1 mA; $V_{CC}$ = 1.1 V | 0.6 × $V_{CC}$ | - | - | V |
| | | $I_O$ = –1.7 mA; $V_{CC}$ = 1.4 V | 0.93 | - | - | V |
| | | $I_O$ = –1.9 mA; $V_{CC}$ = 1.65 V | 1.17 | - | - | V |
| | | $I_O$ = –2.3 mA; $V_{CC}$ = 2.3 V | 1.77 | - | - | V |
| | | $I_O$ = –3.1 mA; $V_{CC}$ = 2.3 V | 1.67 | - | - | V |
| | | $I_O$ = –2.7 mA; $V_{CC}$ = 3.0 V | 2.40 | - | - | V |
| | | $I_O$ = –4.0 mA; $V_{CC}$ = 3.0 V | 2.30 | - | - | V |
| | | X2 output; $V_I$ = GND or $V_{CC}$ | | | | |
| | | $I_O$ = –20 µA; $V_{CC}$ = 0.8 V to 3.6 V | $V_{CC}$ – 0.11 | - | - | V |
| | | $I_O$ = –1.1 mA; $V_{CC}$ = 1.1 V | 0.6 × $V_{CC}$ | - | - | V |
| | | $I_O$ = –1.7 mA; $V_{CC}$ = 1.4 V | 0.93 | - | - | V |
| | | $I_O$ = –1.9 mA; $V_{CC}$ = 1.65 V | 1.17 | - | - | V |
| | | $I_O$ = –2.3 mA; $V_{CC}$ = 2.3 V | 1.77 | - | - | V |
| | | $I_O$ = –3.1 mA; $V_{CC}$ = 2.3 V | 1.67 | - | - | V |
| | | $I_O$ = –2.7 mA; $V_{CC}$ = 3.0 V | 2.40 | - | - | V |
| | | $I_O$ = –4.0 mA; $V_{CC}$ = 3.0 V | 2.30 | - | - | V |

**Table 7. Static characteristics** *...continued*

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

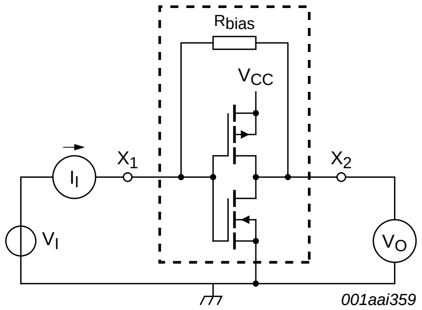
| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{OL}$ | LOW-level output voltage | Y output; $V_I = V_{IH}$ or $V_{IL}$ | | | | | |
| | | $I_O$ = 20 μA; $V_{CC}$ = 0.8 V to 3.6 V | | - | - | 0.11 | V |
| | | $I_O$ = 1.1 mA; $V_{CC}$ = 1.1 V | | - | - | 0.33 × $V_{CC}$ | V |
| | | $I_O$ = 1.7 mA; $V_{CC}$ = 1.4 V | | - | - | 0.41 | V |
| | | $I_O$ = 1.9 mA; $V_{CC}$ = 1.65 V | | - | - | 0.39 | V |
| | | $I_O$ = 2.3 mA; $V_{CC}$ = 2.3 V | | - | - | 0.36 | V |
| | | $I_O$ = 3.1 mA; $V_{CC}$ = 2.3 V | | - | - | 0.50 | V |
| | | $I_O$ = 2.7 mA; $V_{CC}$ = 3.0 V | | - | - | 0.36 | V |
| | | $I_O$ = 4.0 mA; $V_{CC}$ = 3.0 V | | - | - | 0.50 | V |
| | | X2 output; $V_I$ = GND or $V_{CC}$ | | | | | |
| | | $I_O$ = 20 μA; $V_{CC}$ = 0.8 V to 3.6 V | | - | - | 0.11 | V |
| | | $I_O$ = 1.1 mA; $V_{CC}$ = 1.1 V | | - | - | 0.33 × $V_{CC}$ | V |
| | | $I_O$ = 1.7 mA; $V_{CC}$ = 1.4 V | | - | - | 0.41 | V |
| | | $I_O$ = 1.9 mA; $V_{CC}$ = 1.65 V | | - | - | 0.39 | V |
| | | $I_O$ = 2.3 mA; $V_{CC}$ = 2.3 V | | - | - | 0.36 | V |
| | | $I_O$ = 3.1 mA; $V_{CC}$ = 2.3 V | | - | - | 0.50 | V |
| | | $I_O$ = 2.7 mA; $V_{CC}$ = 3.0 V | | - | - | 0.36 | V |
| | | $I_O$ = 4.0 mA; $V_{CC}$ = 3.0 V | | - | - | 0.50 | V |
| $I_I$ | input leakage current | X1 input | | | | | |
| | | $V_I = \overline{EN} = V_{CC}$; $V_{CC}$ = 0 V to 3.6 V | | - | - | ±0.75 | μA |
| | | $\overline{EN}$ input | | | | | |
| | | $V_I$ = GND to 3.6 V; $V_{CC}$ = 0 V to 3.6 V | | - | - | ±0.75 | μA |
| $I_{pu}$ | pull-up current | X1 input; $\overline{EN} = V_{CC}$ | | | | | |
| | | $V_I$ = GND; $V_{CC}$ = 0.8 V to 3.6 V | | - | - | 15 | μA |
| $I_{OZ}$ | OFF-state output current | Y output; $V_O$ = 0 V to 3.6 V; $V_{CC}$ = 0 V to 3.6 V; $\overline{EN} = V_{CC}$ | | - | - | ±0.75 | μA |
| $I_{OFF}$ | power-off leakage current | $V_I$ or $V_O$ = 0 V to 3.6 V; $V_{CC}$ = 0 V | [1] | - | - | ±0.75 | μA |
| $\Delta I_{OFF}$ | additional power-off leakage current | $V_I$ or $V_O$ = 0 V to 3.6 V; $V_{CC}$ = 0 V to 0.2 V | [1] | - | - | ±0.75 | μA |
| $I_{CC}$ | supply current | $V_I$ = GND or $V_{CC}$; $I_O$ = 0 A; $V_{CC}$ = 0.8 V to 3.6 V | | - | - | 75 | μA |
| $\Delta I_{CC}$ | additional supply current | $\overline{EN}$ input | | | | | |
| | | $V_I = V_{CC} - 0.6$ V; $I_O$ = 0 A; $V_{CC}$ = 3.3 V | | - | - | 75 | μA |

**Table 7. Static characteristics** *…continued*

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

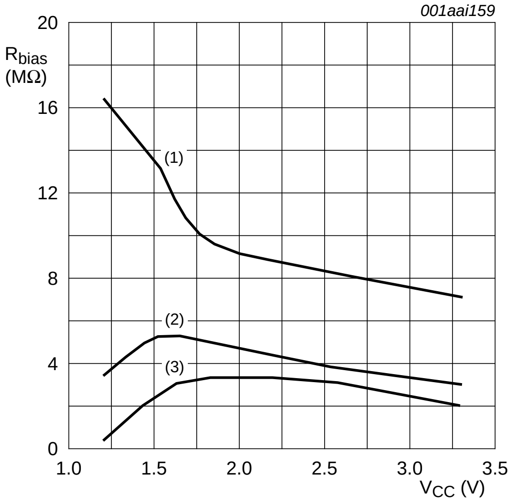
| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $g_{fs}$ | forward transconductance | see Figure 10 and Figure 11 | | | | |
| | | $V_{CC}$ = 0.8 V | - | - | - | mA/V |
| | | $V_{CC}$ = 1.1 V to 1.3 V | - | - | 10.8 | mA/V |
| | | $V_{CC}$ = 1.4 V to 1.6 V | 1.8 | - | 21.2 | mA/V |
| | | $V_{CC}$ = 1.65 V to 1.95 V | 6.9 | - | 29.9 | mA/V |
| | | $V_{CC}$ = 2.3 V to 2.7 V | 13.4 | - | 38.0 | mA/V |
| | | $V_{CC}$ = 3.0 V to 3.6 V | 15.8 | - | 39.2 | mA/V |
| $R_{bias}$ | bias resistance | $\overline{EN}$ = GND; $f_i$ = 0 Hz; $V_I$ = 0 V or $V_{CC}$; See Figure 5; for frequency behavior see Figure 6 | 1.07 | - | 3.11 | MΩ |

[1] Only for output Y and input $\overline{EN}$.




$$R_{bias} = \left|\frac{V_O - V_I}{I_I}\right|$$

**Fig 5. Test circuit for measuring bias resistance**




(1) $f_i$ = 30 kHz.

(2) $f_i$ = 1 MHz.

(3) $f_i$ = 10 MHz.

**Fig 6. Typical bias resistance versus supply voltage**

# 11. Dynamic characteristics

**Table 8. Dynamic characteristics**

*Voltages are referenced to GND (ground = 0 V); for test circuit see Figure 9.*

| Symbol | Parameter | Conditions | | 25 °C | | | –40 °C to +125 °C | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Min | Typ[1] | Max | Min | Max (85 °C) | Max (125 °C) | |
| **$C_L$ = 5 pF** | | | | | | | | | | |
| $t_{pd}$ | propagation delay | X1 to X2; see Figure 7 | [2] | | | | | | | |
| | | $V_{CC}$ = 0.8 V | | - | 6.2 | - | - | - | - | ns |
| | | $V_{CC}$ = 1.1 V to 1.3 V | | 0.9 | 2.3 | 4.4 | 0.9 | 4.8 | 5.3 | ns |
| | | $V_{CC}$ = 1.4 V to 1.6 V | | 0.7 | 1.7 | 3.1 | 0.6 | 3.4 | 3.8 | ns |
| | | $V_{CC}$ = 1.65 V to 1.95 V | | 0.5 | 1.4 | 2.6 | 0.5 | 2.9 | 3.2 | ns |
| | | $V_{CC}$ = 2.3 V to 2.7 V | | 0.4 | 1.1 | 2.0 | 0.4 | 2.3 | 2.6 | ns |
| | | $V_{CC}$ = 3.0 V to 3.6 V | | 0.3 | 1.0 | 1.8 | 0.3 | 2.1 | 2.4 | ns |
| | | X1 to Y; see Figure 7 | [2] | | | | | | | |
| | | $V_{CC}$ = 0.8 V | | - | 18.5 | - | - | - | - | ns |
| | | $V_{CC}$ = 1.1 V to 1.3 V | | 2.8 | 5.9 | 12.5 | 3.2 | 14.8 | 16.3 | ns |
| | | $V_{CC}$ = 1.4 V to 1.6 V | | 2.2 | 4.2 | 7.7 | 2.6 | 9.1 | 10.1 | ns |
| | | $V_{CC}$ = 1.65 V to 1.95 V | | 1.9 | 3.5 | 6.2 | 2.2 | 7.8 | 8.6 | ns |
| | | $V_{CC}$ = 2.3 V to 2.7 V | | 1.6 | 2.9 | 4.8 | 1.9 | 6.2 | 6.9 | ns |
| | | $V_{CC}$ = 3.0 V to 3.6 V | | 1.4 | 2.6 | 4.1 | 1.7 | 4.7 | 5.2 | ns |
| $t_{en}$ | enable time | $\overline{EN}$ to Y; see Figure 8 | [3] | | | | | | | |
| | | $V_{CC}$ = 0.8 V | | - | 31.2 | - | - | - | - | ns |
| | | $V_{CC}$ = 1.1 V to 1.3 V | | 3.1 | 6.1 | 13.8 | 2.9 | 16.3 | 18.0 | ns |
| | | $V_{CC}$ = 1.4 V to 1.6 V | | 2.5 | 4.3 | 8.2 | 2.3 | 9.7 | 10.7 | ns |
| | | $V_{CC}$ = 1.65 V to 1.95 V | | 2.1 | 3.6 | 6.5 | 2.0 | 7.6 | 8.4 | ns |
| | | $V_{CC}$ = 2.3 V to 2.7 V | | 1.8 | 2.9 | 4.8 | 1.7 | 5.8 | 6.4 | ns |
| | | $V_{CC}$ = 3.0 V to 3.6 V | | 1.7 | 2.6 | 4.1 | 1.7 | 4.7 | 5.2 | ns |
| $t_{dis}$ | disable time | $\overline{EN}$ to Y; see Figure 8 | [4] | | | | | | | |
| | | $V_{CC}$ = 0.8 V | | - | 11.1 | - | - | - | - | ns |
| | | $V_{CC}$ = 1.1 V to 1.3 V | | 2.5 | 4.5 | 9.0 | 2.9 | 9.4 | 10.4 | ns |
| | | $V_{CC}$ = 1.4 V to 1.6 V | | 2.0 | 3.3 | 6.4 | 2.3 | 6.7 | 7.4 | ns |
| | | $V_{CC}$ = 1.65 V to 1.95 V | | 1.9 | 3.2 | 6.0 | 2.0 | 6.4 | 7.1 | ns |
| | | $V_{CC}$ = 2.3 V to 2.7 V | | 1.4 | 2.3 | 4.4 | 1.7 | 4.7 | 5.2 | ns |
| | | $V_{CC}$ = 3.0 V to 3.6 V | | 1.7 | 2.6 | 4.4 | 1.7 | 4.9 | 5.4 | ns |

**Table 8. Dynamic characteristics** *...continued*

*Voltages are referenced to GND (ground = 0 V); for test circuit see Figure 9.*

| Symbol | Parameter | Conditions | | 25 °C | | | −40 °C to +125 °C | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Min | Typ[1] | Max | Min | Max (85 °C) | Max (125 °C) | |
| **$C_L$ = 10 pF** | | | | | | | | | | |
| $t_{pd}$ | propagation delay | X1 to X2; see Figure 7 | [2] | | | | | | | |
| | | $V_{CC}$ = 0.8 V | | - | 9.6 | - | - | - | - | ns |
| | | $V_{CC}$ = 1.1 V to 1.3 V | | 1.2 | 3.1 | 6.1 | 1.2 | 6.8 | 7.5 | ns |
| | | $V_{CC}$ = 1.4 V to 1.6 V | | 1.0 | 2.3 | 4.0 | 0.9 | 4.6 | 5.1 | ns |
| | | $V_{CC}$ = 1.65 V to 1.95 V | | 0.8 | 1.9 | 3.3 | 0.7 | 3.8 | 4.2 | ns |
| | | $V_{CC}$ = 2.3 V to 2.7 V | | 0.6 | 1.5 | 2.7 | 0.6 | 3.1 | 3.5 | ns |
| | | $V_{CC}$ = 3.0 V to 3.6 V | | 0.5 | 1.3 | 2.4 | 0.5 | 2.7 | 3.0 | ns |
| | | X1 to Y; see Figure 7 | [2] | | | | | | | |
| | | $V_{CC}$ = 0.8 V | | - | 21.4 | - | - | - | - | ns |
| | | $V_{CC}$ = 1.1 V to 1.3 V | | 3.2 | 6.7 | 14.3 | 3.6 | 16.2 | 17.9 | ns |
| | | $V_{CC}$ = 1.4 V to 1.6 V | | 2.1 | 4.9 | 8.9 | 3.0 | 10.1 | 11.2 | ns |
| | | $V_{CC}$ = 1.65 V to 1.95 V | | 1.9 | 4.1 | 6.9 | 2.6 | 8.0 | 8.8 | ns |
| | | $V_{CC}$ = 2.3 V to 2.7 V | | 2.1 | 3.4 | 5.4 | 2.3 | 6.6 | 7.3 | ns |
| | | $V_{CC}$ = 3.0 V to 3.6 V | | 1.8 | 3.1 | 4.8 | 2.1 | 5.6 | 6.2 | ns |
| $t_{en}$ | enable time | $\overline{EN}$ to Y; see Figure 8 | [3] | | | | | | | |
| | | $V_{CC}$ = 0.8 V | | - | 34.4 | - | - | - | - | ns |
| | | $V_{CC}$ = 1.1 V to 1.3 V | | 3.6 | 6.9 | 15.5 | 3.4 | 16.0 | 17.6 | ns |
| | | $V_{CC}$ = 1.4 V to 1.6 V | | 2.3 | 5.0 | 9.3 | 2.2 | 9.6 | 10.6 | ns |
| | | $V_{CC}$ = 1.65 V to 1.95 V | | 2.0 | 4.2 | 7.2 | 1.9 | 7.9 | 8.7 | ns |
| | | $V_{CC}$ = 2.3 V to 2.7 V | | 1.8 | 3.4 | 5.5 | 1.7 | 6.4 | 7.1 | ns |
| | | $V_{CC}$ = 3.0 V to 3.6 V | | 1.7 | 3.2 | 4.9 | 1.7 | 5.5 | 6.1 | ns |
| $t_{dis}$ | disable time | $\overline{EN}$ to Y; see Figure 8 | [4] | | | | | | | |
| | | $V_{CC}$ = 0.8 V | | - | 13.0 | - | - | - | - | ns |
| | | $V_{CC}$ = 1.1 V to 1.3 V | | 3.4 | 5.7 | 10.4 | 3.4 | 10.8 | 11.9 | ns |
| | | $V_{CC}$ = 1.4 V to 1.6 V | | 2.1 | 4.2 | 7.6 | 2.2 | 8.0 | 8.8 | ns |
| | | $V_{CC}$ = 1.65 V to 1.95 V | | 2.2 | 4.3 | 7.3 | 1.9 | 7.6 | 8.4 | ns |
| | | $V_{CC}$ = 2.3 V to 2.7 V | | 1.6 | 3.1 | 5.3 | 1.7 | 5.5 | 6.1 | ns |
| | | $V_{CC}$ = 3.0 V to 3.6 V | | 2.1 | 3.8 | 6.0 | 1.7 | 6.5 | 7.2 | ns |

**Table 8. Dynamic characteristics** *...continued*
*Voltages are referenced to GND (ground = 0 V); for test circuit see Figure 9.*

| Symbol | Parameter | Conditions | | 25 °C | | | –40 °C to +125 °C | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Min | Typ[1] | Max | Min | Max (85 °C) | Max (125 °C) | |
| **$C_L$ = 15 pF** | | | | | | | | | | |
| $t_{pd}$ | propagation delay | X1 to X2; see Figure 7 | [2] | | | | | | | |
| | | $V_{CC}$ = 0.8 V | | - | 13.0 | - | - | - | - | ns |
| | | $V_{CC}$ = 1.1 V to 1.3 V | | 1.6 | 3.8 | 7.9 | 1.4 | 8.8 | 9.7 | ns |
| | | $V_{CC}$ = 1.4 V to 1.6 V | | 1.3 | 2.8 | 4.9 | 1.1 | 5.7 | 6.3 | ns |
| | | $V_{CC}$ = 1.65 V to 1.95 V | | 1.0 | 2.3 | 4.0 | 0.9 | 4.7 | 5.2 | ns |
| | | $V_{CC}$ = 2.3 V to 2.7 V | | 0.8 | 1.9 | 3.2 | 0.8 | 3.7 | 4.1 | ns |
| | | $V_{CC}$ = 3.0 V to 3.6 V | | 0.7 | 1.6 | 2.9 | 0.7 | 3.3 | 3.7 | ns |
| | | X1 to Y; see Figure 7 | [2] | | | | | | | |
| | | $V_{CC}$ = 0.8 V | | - | 24.2 | - | - | - | - | ns |
| | | $V_{CC}$ = 1.1 V to 1.3 V | | 3.6 | 7.5 | 16.1 | 4.0 | 17.6 | 19.4 | ns |
| | | $V_{CC}$ = 1.4 V to 1.6 V | | 3.0 | 5.4 | 9.7 | 3.3 | 10.6 | 11.7 | ns |
| | | $V_{CC}$ = 1.65 V to 1.95 V | | 2.2 | 4.6 | 7.7 | 2.9 | 9.0 | 9.9 | ns |
| | | $V_{CC}$ = 2.3 V to 2.7 V | | 2.0 | 3.9 | 6.1 | 2.6 | 7.3 | 8.1 | ns |
| | | $V_{CC}$ = 3.0 V to 3.6 V | | 2.0 | 3.6 | 5.4 | 2.3 | 5.9 | 6.5 | ns |
| $t_{en}$ | enable time | $\overline{EN}$ to Y; see Figure 8 | [3] | | | | | | | |
| | | $V_{CC}$ = 0.8 V | | - | 37.5 | - | - | - | - | ns |
| | | $V_{CC}$ = 1.1 V to 1.3 V | | 4.0 | 7.7 | 17.2 | 3.7 | 17.5 | 19.3 | ns |
| | | $V_{CC}$ = 1.4 V to 1.6 V | | 3.0 | 5.5 | 10.0 | 2.5 | 10.2 | 11.3 | ns |
| | | $V_{CC}$ = 1.65 V to 1.95 V | | 2.3 | 4.7 | 7.9 | 2.1 | 9.2 | 10.2 | ns |
| | | $V_{CC}$ = 2.3 V to 2.7 V | | 2.0 | 3.9 | 6.2 | 2.0 | 7.4 | 8.2 | ns |
| | | $V_{CC}$ = 3.0 V to 3.6 V | | 2.0 | 3.6 | 5.5 | 1.9 | 6.0 | 6.6 | ns |
| $t_{dis}$ | disable time | $\overline{EN}$ to Y; see Figure 8 | [4] | | | | | | | |
| | | $V_{CC}$ = 0.8 V | | - | 14.8 | - | - | - | - | ns |
| | | $V_{CC}$ = 1.1 V to 1.3 V | | 4.3 | 6.8 | 11.2 | 3.7 | 12.4 | 13.7 | ns |
| | | $V_{CC}$ = 1.4 V to 1.6 V | | 3.0 | 5.1 | 8.1 | 2.5 | 8.9 | 9.8 | ns |
| | | $V_{CC}$ = 1.65 V to 1.95 V | | 3.0 | 5.4 | 8.0 | 2.1 | 9.3 | 10.3 | ns |
| | | $V_{CC}$ = 2.3 V to 2.7 V | | 2.1 | 3.9 | 6.1 | 2.0 | 7.3 | 8.1 | ns |
| | | $V_{CC}$ = 3.0 V to 3.6 V | | 2.9 | 5.1 | 7.2 | 1.9 | 7.9 | 8.7 | ns |

**Table 8. Dynamic characteristics** *...continued*

*Voltages are referenced to GND (ground = 0 V); for test circuit see Figure 9.*

| Symbol | Parameter | Conditions | 25 °C | | | –40 °C to +125 °C | | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | Min | Typ[1] | Max | Min | Max (85 °C) | Max (125 °C) | |
| $C_L$ = 30 pF | | | | | | | | | |
| $t_{pd}$ | propagation delay | X1 to X2; see Figure 7 [2] | | | | | | | |
| | | $V_{CC}$ = 0.8 V | - | 23.2 | - | - | - | - | ns |
| | | $V_{CC}$ = 1.1 V to 1.3 V | 2.4 | 6.0 | 13.1 | 2.2 | 14.8 | 16.3 | ns |
| | | $V_{CC}$ = 1.4 V to 1.6 V | 2.0 | 4.2 | 7.6 | 1.8 | 9.0 | 9.9 | ns |
| | | $V_{CC}$ = 1.65 V to 1.95 V | 1.7 | 3.6 | 6.1 | 1.5 | 7.2 | 8.0 | ns |
| | | $V_{CC}$ = 2.3 V to 2.7 V | 1.4 | 2.9 | 4.8 | 1.3 | 5.7 | 6.3 | ns |
| | | $V_{CC}$ = 3.0 V to 3.6 V | 1.2 | 2.5 | 4.3 | 1.1 | 5.1 | 5.7 | ns |
| | | X1 to Y; see Figure 7 [2] | | | | | | | |
| | | $V_{CC}$ = 0.8 V | - | 32.6 | - | - | - | - | ns |
| | | $V_{CC}$ = 1.1 V to 1.3 V | 4.8 | 9.6 | 21.0 | 5.0 | 21.7 | 23.9 | ns |
| | | $V_{CC}$ = 1.4 V to 1.6 V | 4.0 | 6.9 | 12.4 | 4.3 | 13.5 | 14.9 | ns |
| | | $V_{CC}$ = 1.65 V to 1.95 V | 2.9 | 5.9 | 9.8 | 3.8 | 10.7 | 11.8 | ns |
| | | $V_{CC}$ = 2.3 V to 2.7 V | 2.7 | 5.0 | 7.5 | 3.3 | 8.2 | 9.1 | ns |
| | | $V_{CC}$ = 3.0 V to 3.6 V | 2.7 | 4.7 | 6.8 | 3.1 | 7.7 | 8.5 | ns |
| $t_{en}$ | enable time | $\overline{EN}$ to Y; see Figure 8 [3] | | | | | | | |
| | | $V_{CC}$ = 0.8 V | - | 47.1 | - | - | - | - | ns |
| | | $V_{CC}$ = 1.1 V to 1.3 V | 5.2 | 9.9 | 21.0 | 4.8 | 21.7 | 23.9 | ns |
| | | $V_{CC}$ = 1.4 V to 1.6 V | 4.0 | 7.1 | 12.4 | 3.1 | 13.5 | 14.9 | ns |
| | | $V_{CC}$ = 1.65 V to 1.95 V | 3.0 | 6.0 | 9.9 | 2.8 | 10.7 | 11.8 | ns |
| | | $V_{CC}$ = 2.3 V to 2.7 V | 2.7 | 5.0 | 7.7 | 2.6 | 8.1 | 9.0 | ns |
| | | $V_{CC}$ = 3.0 V to 3.6 V | 2.7 | 4.8 | 6.8 | 2.6 | 7.7 | 8.5 | ns |
| $t_{dis}$ | disable time | $\overline{EN}$ to Y; see Figure 8 [4] | | | | | | | |
| | | $V_{CC}$ = 0.8 V | - | 20.3 | - | - | - | - | ns |
| | | $V_{CC}$ = 1.1 V to 1.3 V | 6.0 | 10.2 | 15.3 | 4.8 | 16.5 | 18.2 | ns |
| | | $V_{CC}$ = 1.4 V to 1.6 V | 4.4 | 7.8 | 11.2 | 3.1 | 12.3 | 13.6 | ns |
| | | $V_{CC}$ = 1.65 V to 1.95 V | 5.1 | 8.8 | 12.5 | 2.8 | 13.3 | 14.7 | ns |
| | | $V_{CC}$ = 2.3 V to 2.7 V | 3.6 | 6.3 | 8.6 | 2.6 | 9.5 | 10.5 | ns |
| | | $V_{CC}$ = 3.0 V to 3.6 V | 5.2 | 8.8 | 11.5 | 2.6 | 13.0 | 14.3 | ns |

**Table 8. Dynamic characteristics** *...continued*

*Voltages are referenced to GND (ground = 0 V); for test circuit see Figure 9.*

| Symbol | Parameter | Conditions | | 25 °C | | | –40 °C to +125 °C | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Min | Typ[1] | Max | Min | Max (85 °C) | Max (125 °C) | |
| **$C_L$ = 5 pF, 10 pF, 15 pF and 30 pF** | | | | | | | | | | |
| $C_{PD}$ | power dissipation capacitance | $f_i$ = 1 MHz; $\overline{EN}$ = GND; $V_I$ = GND to $V_{CC}$ | [5][6] | | | | | | | |
| | | $V_{CC}$ = 0.8 V | | - | 7.1 | - | - | - | - | pF |
| | | $V_{CC}$ = 1.1 V to 1.3 V | | - | 12.9 | - | - | - | - | pF |
| | | $V_{CC}$ = 1.4 V to 1.6 V | | - | 19.2 | - | - | - | - | pF |
| | | $V_{CC}$ = 1.65 V to 1.95 V | | - | 19.9 | - | - | - | - | pF |
| | | $V_{CC}$ = 2.3 V to 2.7 V | | - | 21.6 | - | - | - | - | pF |
| | | $V_{CC}$ = 3.0 V to 3.6 V | | - | 24.3 | - | - | - | - | pF |

[1] All typical values are measured at nominal $V_{CC}$.

[2] $t_{pd}$ is the same as $t_{PLH}$ and $t_{PHL}$.

[3] $t_{en}$ is the same as $t_{PZH}$ and $t_{PZL}$.

[4] $t_{dis}$ is the same as $t_{PHZ}$ and $t_{PLZ}$.

[5] $C_{PD}$ 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;

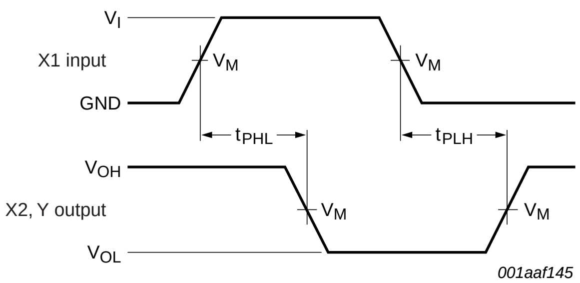
$V_{CC}$ = supply voltage in V;

N = number of inputs switching;

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

[6] Feedback current is included in $C_{PD}$.

## 12. Waveforms



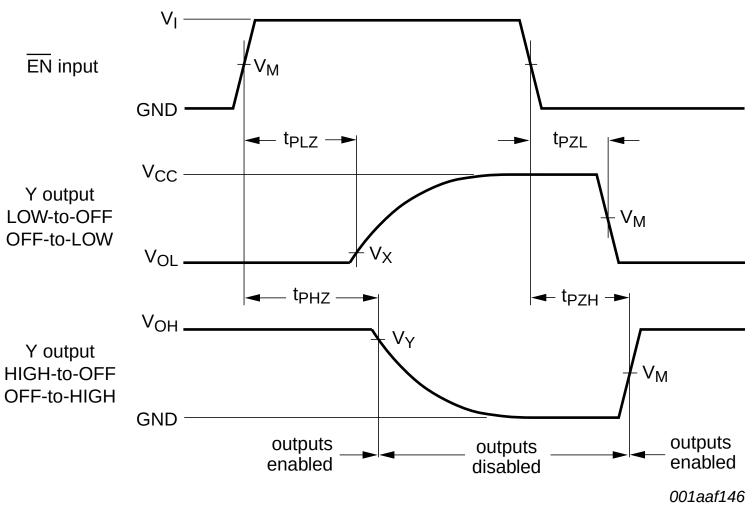

Measurement points are given in Table 9.

Logic levels: $V_{OL}$ and $V_{OH}$ are typical output voltage levels that occur with the output load.

**Fig 7. The input (X1) to output (X2, Y) propagation delays**

**Table 9. Measurement points**

| Supply voltage | Output | Input | | |
|---|---|---|---|---|
| $V_{CC}$ | $V_M$ | $V_M$ | $V_I$ | $t_r = t_f$ |
| 0.8 V to 3.6 V | 0.5 × $V_{CC}$ | 0.5 × $V_{CC}$ | $V_{CC}$ | ≤ 3.0 ns |



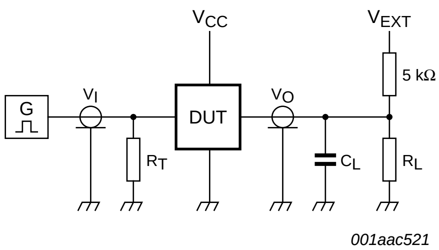

Measurement points are given in Table 10.

Logic levels: $V_{OL}$ and $V_{OH}$ are typical output voltage levels that occur with the output load.

**Fig 8. Enable and disable times**

**Table 10. Measurement points**

| Supply voltage | Input | Output | | |
|---|---|---|---|---|
| $V_{CC}$ | $V_M$ | $V_M$ | $V_X$ | $V_Y$ |
| 0.8 V to 1.6 V | 0.5 × $V_{CC}$ | 0.5 × $V_{CC}$ | $V_{OL}$ + 0.1 V | $V_{OH}$ − 0.1 V |
| 1.65 V to 2.7 V | 0.5 × $V_{CC}$ | 0.5 × $V_{CC}$ | $V_{OL}$ + 0.15 V | $V_{OH}$ − 0.15 V |
| 3.0 V to 3.6 V | 0.5 × $V_{CC}$ | 0.5 × $V_{CC}$ | $V_{OL}$ + 0.3 V | $V_{OH}$ − 0.3 V |




Test data is given in Table 11.

Definitions for test circuit:

$R_L$ = Load resistance.

$C_L$ = Load capacitance including jig and probe capacitance.

$R_T$ = Termination resistance should be equal to the output impedance $Z_o$ of the pulse generator.

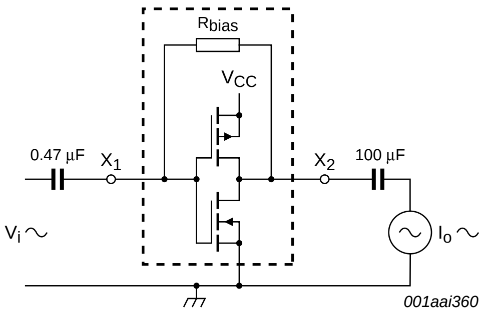
$V_{EXT}$ = External voltage for measuring switching times.

**Fig 9. Test circuit for measuring switching times**

**Table 11. Test data**

| Supply voltage | Load | | $V_{EXT}$ | | |
|---|---|---|---|---|---|
| $V_{CC}$ | $C_L$ | $R_L$ [1] | $t_{PLH}$, $t_{PHL}$ | $t_{PZH}$, $t_{PHZ}$ | $t_{PZL}$, $t_{PLZ}$ |
| 0.8 V to 3.6 V | 5 pF, 10 pF, 15 pF and 30 pF | 5 kΩ or 1 MΩ | open | GND | 2 × $V_{CC}$ |

[1] For measuring enable and disable times $R_L$ = 5 kΩ, for measuring propagation delays, setup and hold times and pulse width $R_L$ = 1 MΩ.

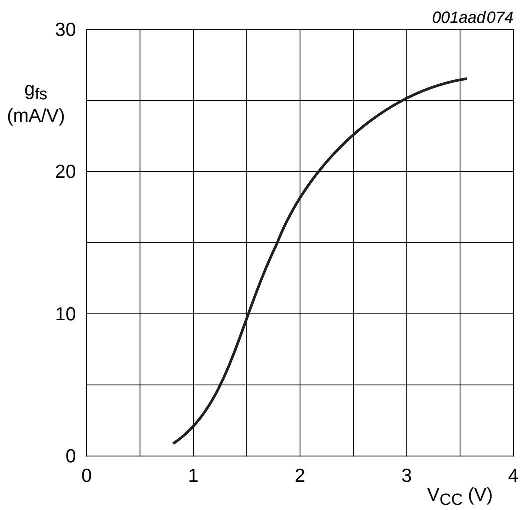



$$g_{fs} = \frac{\Delta I_O}{\Delta V_I}$$

$f_i$ = 1 kHz.

$V_O$ is constant.

**Fig 10. Test set-up for measuring forward transconductance**




$T_{amb}$ = 25 °C.

**Fig 11. Typical forward transconductance as a function of supply voltage**

# 13. Application information

Crystal controlled oscillator circuits are widely used in clock pulse generators because of their excellent frequency stability and wide operating frequency range. The use of the 74AUP1Z125 provides the additional advantages of low power dissipation, stable operation over a wide range of frequency and temperature and a very small footprint. This application information describes crystal characteristics, design and testing of crystal oscillator circuits based on the 74AUP1Z125.

## 13.1 Crystal characteristics

Figure 12 is the equivalent circuit of a quartz crystal.

The reactive and resistive components of the impedance of the crystal alone, and the crystal with a series and a parallel capacitance, is shown in Figure 13.

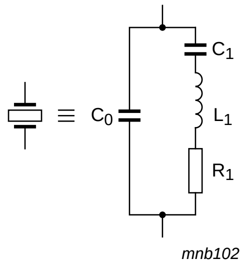
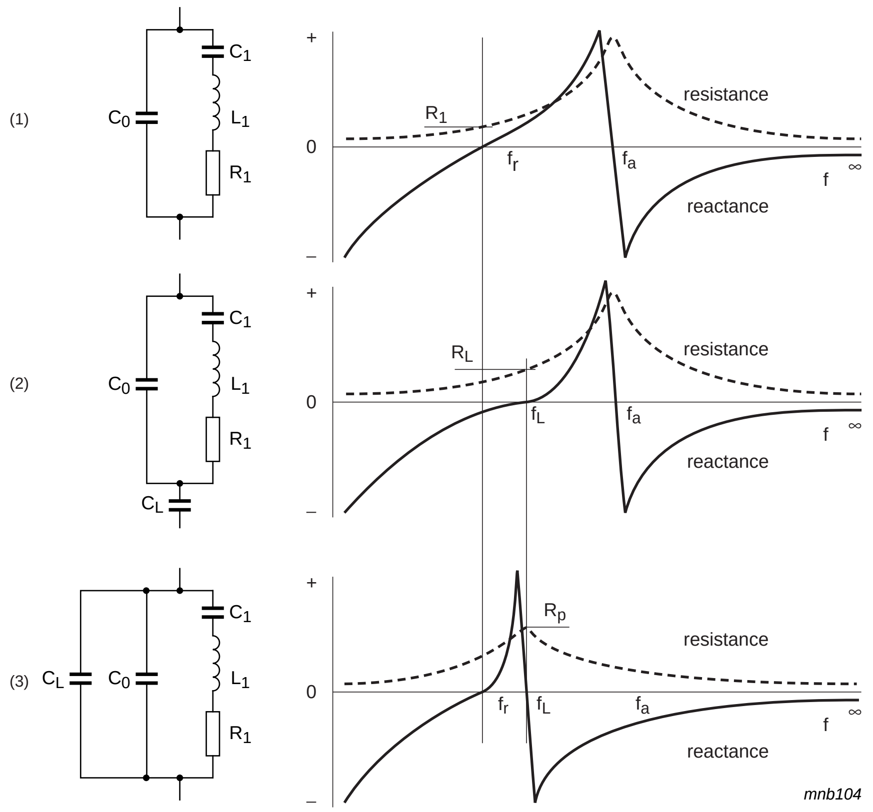



**Fig 12. Equivalent circuit of a crystal**




(1) (a) = resonance

(2) (b) = anti-resonance

(3) (c) = load resonance

**Fig 13. Reactance and resistance characteristics of a crystal**

### 13.1.1 Design

Figure 14 shows the recommended way to connect a crystal to the 74AUP1Z125. This circuit is basically a Pierce oscillator circuit in which the crystal is operating at its fundamental frequency and tuned by the parallel load capacitance of $C_1$ and $C_2$. $C_1$ and $C_2$ are in series with the crystal. They should be approximately equal. $R_1$ is the drive-limiting resistor and is set to approximately the same value as the reactance of $C_1$ at the crystal frequency ($R_1 = X_{C1}$). This results in an input to the crystal of 50 % of the rail-to-rail output of X2. This keeps the drive level into the crystal within drive specifications (the designer should verify this). Overdriving the crystal can cause damage.

The internal bias resistor provides negative feedback and sets a bias point of the inverter near mid-supply, operating the 74AUP1GU04 in the high gain linear region.

To calculate the values of $C_1$ and $C_2$, the designer can use the formula:

$$C_L = \frac{C_1 \times C_2}{C_1 + C_2} + C_s$$

$C_L$ is the load capacitance as specified by the crystal manufacturer. $C_s$ is the stray capacitance of the circuit and for 74AUP1Z125, $C_s$ is equal to an input capacitance of 1.5 pF.

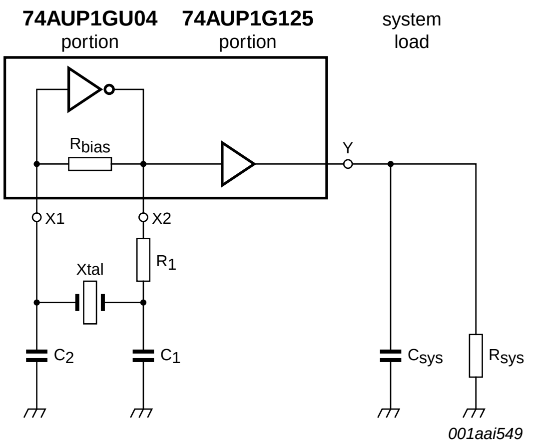



**Fig 14. Crystal oscillator configuration**

### 13.1.2 Testing

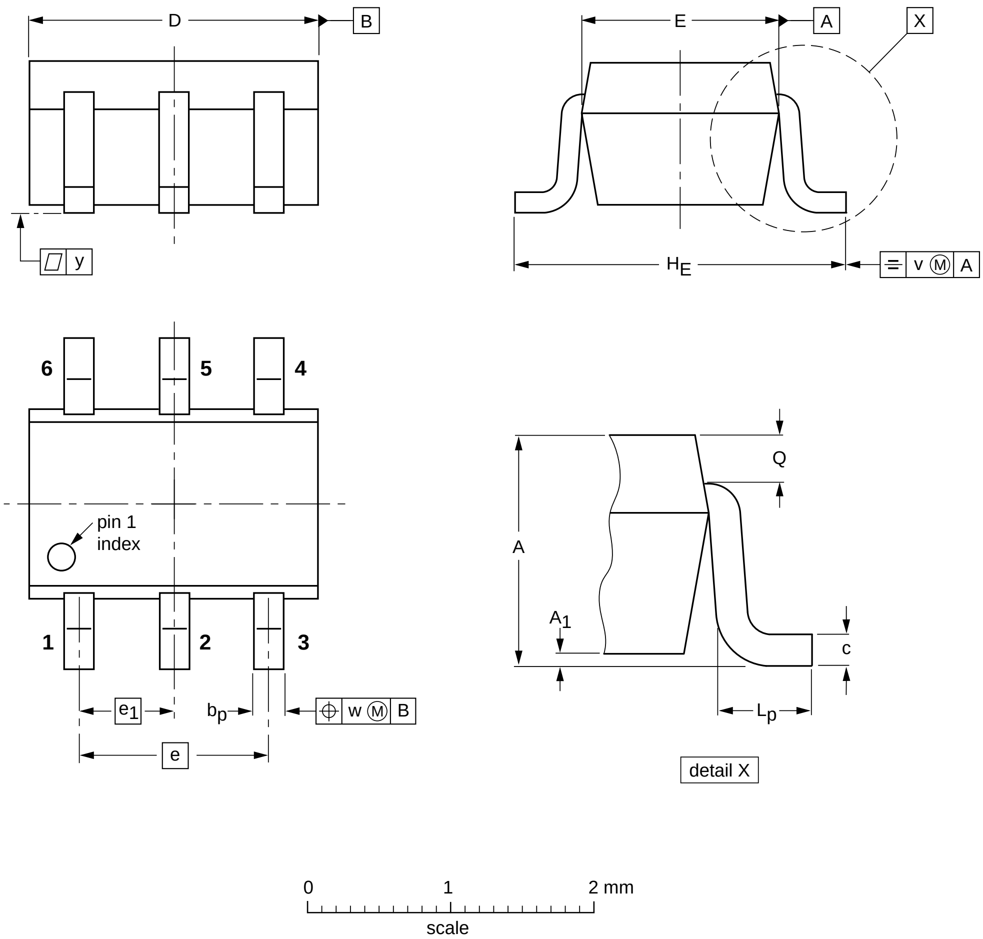
After the calculations are performed for a particular crystal, the oscillator circuit should be tested. The following simple checks verify the prototype design of a crystal controlled oscillator circuit. Perform the checks after laying out the board:

- Test the oscillator over worst-case conditions (lowest supply voltage, worst-case crystal and highest operating temperature). Adding series and parallel resistors can simulate a worse case crystal.
- Insure that the circuit does not oscillate without the crystal.
- Check the frequency stability over a supply range greater than that which is likely to occur during normal operation.
- Check that the start-up time is within system requirements.

As the 74AUP1Z125 isolates the system loading, once the design is optimized, the single layout may work in multiple applications for any given crystal.

## 14. Package outline

**Plastic surface-mounted package; 6 leads** **SOT363**



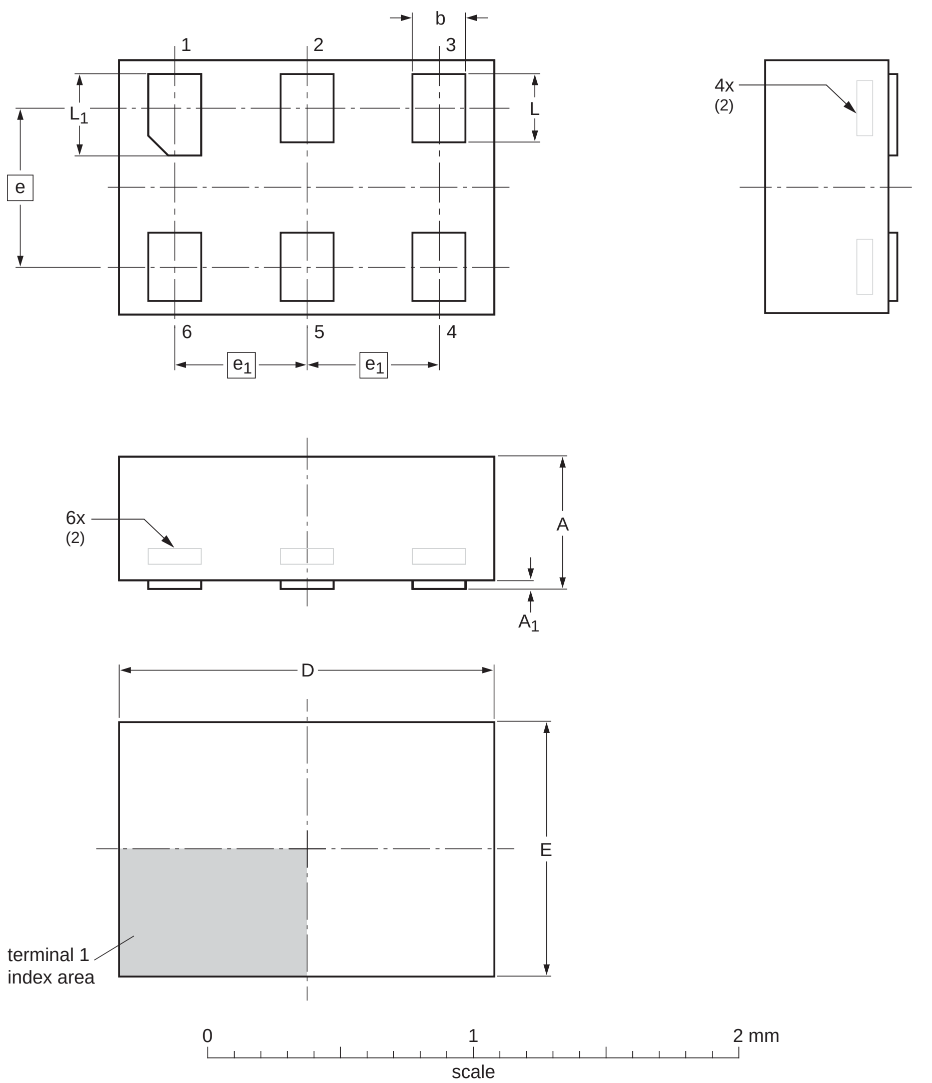

**DIMENSIONS (mm are the original dimensions)**

| UNIT | A | $A_1$ max | $b_p$ | c | D | E | e | $e_1$ | $H_E$ | $L_p$ | Q | v | w | y |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.1<br>0.8 | 0.1 | 0.30<br>0.20 | 0.25<br>0.10 | 2.2<br>1.8 | 1.35<br>1.15 | 1.3 | 0.65 | 2.2<br>2.0 | 0.45<br>0.15 | 0.25<br>0.15 | 0.2 | 0.2 | 0.1 |

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT363 | | | SC-88 | | | ~~04-11-08~~<br>06-03-16 |

**Fig 15. Package outline SOT363 (SC-88)**

XSON6: plastic extremely thin small outline package; no leads; 6 terminals; body 1 x 1.45 x 0.5 mm SOT886




Dimensions (mm are the original dimensions)

| Unit | | A(1) | $A_1$ | b | D | E | e | $e_1$ | L | $L_1$ |
|---|---|---|---|---|---|---|---|---|---|---|
| mm | max | 0.5 | 0.04 | 0.25 | 1.50 | 1.05 | | | 0.35 | 0.40 |
| | nom | | | 0.20 | 1.45 | 1.00 | 0.6 | 0.5 | 0.30 | 0.35 |
| | min | | | 0.17 | 1.40 | 0.95 | | | 0.27 | 0.32 |

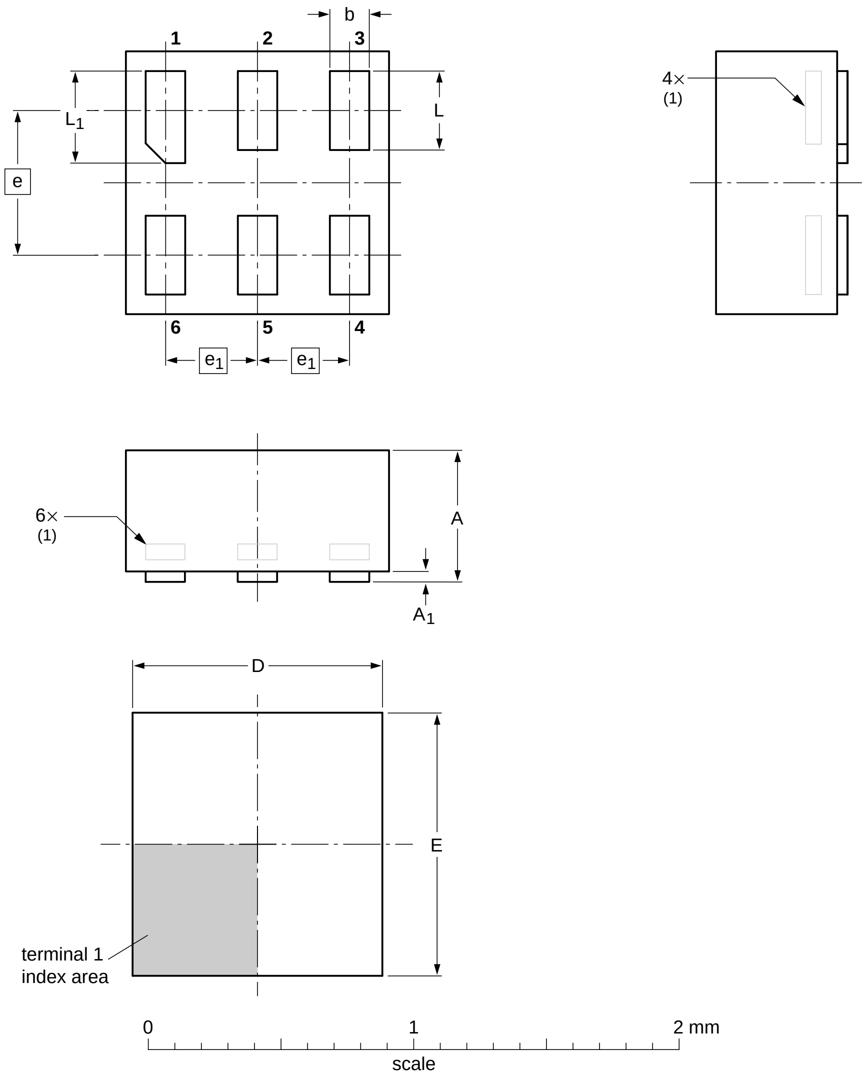
Notes
1. Including plating thickness.
2. Can be visible in some manufacturing processes.

*sot886_po*

| Outline version | References | | | | European projection | Issue date |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT886 | | MO-252 | | | | ~~04-07-22~~ 12-01-05 |

## Fig 16. Package outline SOT886 (XSON6)

**XSON6: plastic extremely thin small outline package; no leads; 6 terminals; body 1 x 1 x 0.5 mm** **SOT891**




**DIMENSIONS (mm are the original dimensions)**

| UNIT | A max | $A_1$ max | b | D | E | e | $e_1$ | L | $L_1$ |
|---|---|---|---|---|---|---|---|---|---|
| mm | 0.5 | 0.04 | 0.20<br>0.12 | 1.05<br>0.95 | 1.05<br>0.95 | 0.55 | 0.35 | 0.35<br>0.27 | 0.40<br>0.32 |

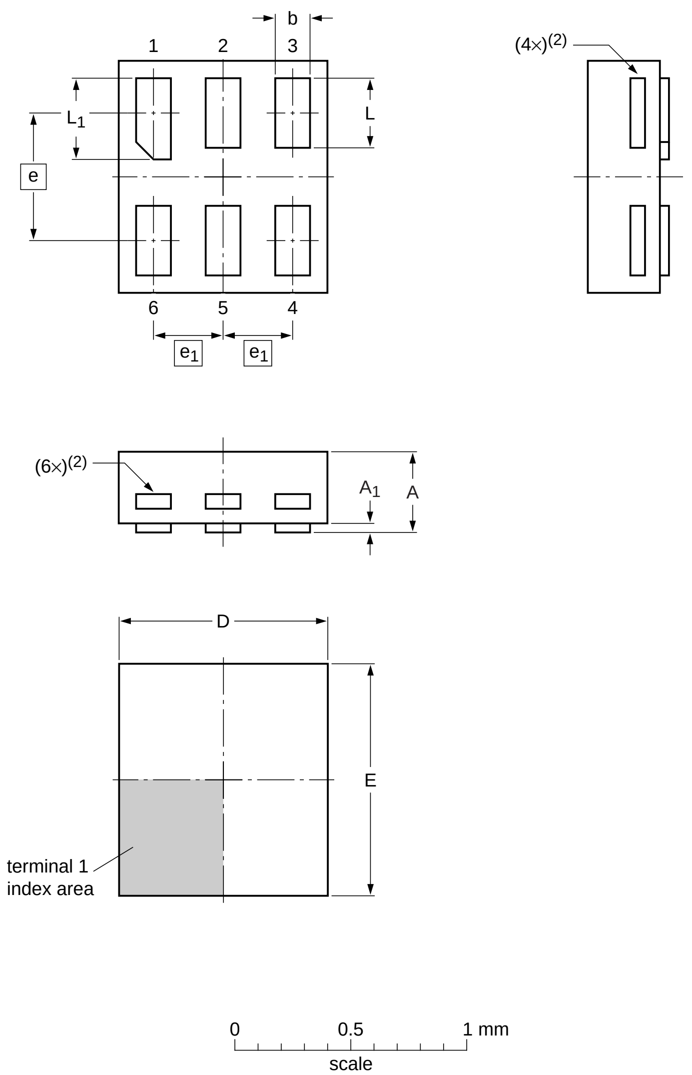
**Note**

1. Can be visible in some manufacturing processes.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT891 | | | | | | ~~05-04-06~~<br>07-05-15 |

**Fig 17. Package outline SOT891 (XSON6)**

**XSON6: extremely thin small outline package; no leads;
6 terminals; body 0.9 x 1.0 x 0.35 mm** **SOT1115**




Dimensions

| Unit | | $A^{(1)}$ | $A_1$ | b | D | E | e | $e_1$ | L | $L_1$ |
|---|---|---|---|---|---|---|---|---|---|---|
| | max | 0.35 | 0.04 | 0.20 | 0.95 | 1.05 | | | 0.35 | 0.40 |
| mm | nom | | | 0.15 | 0.90 | 1.00 | 0.55 | 0.3 | 0.30 | 0.35 |
| | min | | | 0.12 | 0.85 | 0.95 | | | 0.27 | 0.32 |

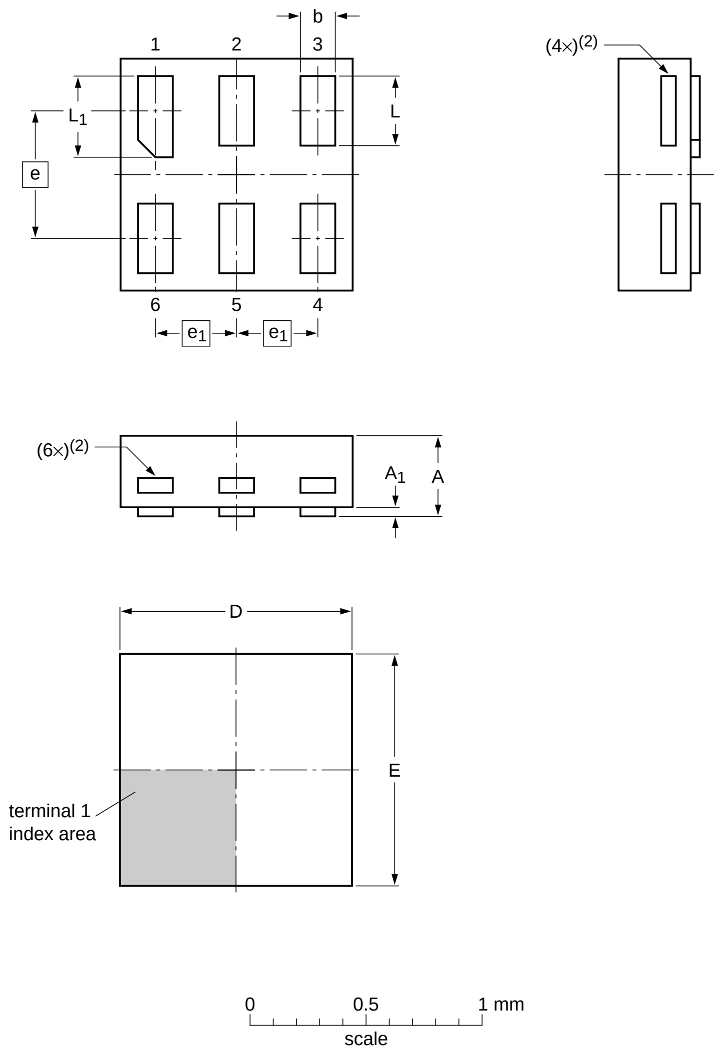
Note
1. Including plating thickness.
2. Visible depending upon used manufacturing technology.

*sot1115_po*

| Outline version | References | | | | European projection | Issue date |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT1115 | | | | | | ~~10-04-02~~ 10-04-07 |

**Fig 18. Package outline SOT1115 (XSON6)**

**XSON6: extremely thin small outline package; no leads;**
**6 terminals; body 1.0 x 1.0 x 0.35 mm** **SOT1202**




Dimensions

| Unit | | A(1) | $A_1$ | b | D | E | e | $e_1$ | L | $L_1$ |
|---|---|---|---|---|---|---|---|---|---|---|
| | max | 0.35 | 0.04 | 0.20 | 1.05 | 1.05 | | | 0.35 | 0.40 |
| mm | nom | | | 0.15 | 1.00 | 1.00 | 0.55 | 0.35 | 0.30 | 0.35 |
| | min | | | 0.12 | 0.95 | 0.95 | | | 0.27 | 0.32 |

Note
1. Including plating thickness.
2. Visible depending upon used manufacturing technology.

*sot1202_po*

| Outline version | References | | | | European projection | Issue date |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT1202 | | | | | | ~~10-04-02~~<br>10-04-06 |

**Fig 19. Package outline SOT1202 (XSON6)**

## 15. Abbreviations

**Table 12. Abbreviations**

| Acronym | Description |
|---|---|
| CDM | Charged Device Model |
| DUT | Device Under Test |
| ESD | ElectroStatic Discharge |
| HBM | Human Body Model |
| MM | Machine Model |

## 16. Revision history

**Table 13. Revision history**

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| 74AUP1Z125 v.5 | 20120808 | Product data sheet | - | 74AUP1Z125 v.4 |
| Modifications: | • Package outline drawing of SOT886 (Figure 16) modified. | | | |
| 74AUP1Z125 v.4 | 20111201 | Product data sheet | - | 74AUP1Z125 v.3 |
| Modifications: | • Legal pages updated. | | | |
| 74AUP1Z125 v.3 | 20100909 | Product data sheet | - | 74AUP1Z125 v.2 |
| 74AUP1Z125 v.2 | 20080807 | Product data sheet | - | 74AUP1Z125 v.1 |
| 74AUP1Z125 v.1 | 20060803 | Product data sheet | - | - |

# 17. Legal information

## 17.1 Data sheet status

| Document status[1][2] | Product status[3] | Definition |
|---|---|---|
| Objective [short] data sheet | Development | This document contains data from the objective specification for product development. |
| Preliminary [short] data sheet | Qualification | This document contains data from the preliminary specification. |
| Product [short] data sheet | Production | This document contains the product specification. |

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

[2] The term 'short data sheet' is explained in section "Definitions".

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## 19. Contents





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Общество с ограниченной ответственностью «МосЧип» ИНН 7719860671 / КПП 771901001
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**Данный компонент на территории Российской Федерации**

**Вы можете приобрести в компании MosChip.**

Для оперативного оформления запроса Вам необходимо перейти по данной ссылке:

http://moschip.ru/get-element

Вы можете разместить у нас заказ для любого Вашего проекта, будь то серийное производство или разработка единичного прибора.

В нашем ассортименте представлены ведущие мировые производители активных и пассивных электронных компонентов.

Нашей специализацией является поставка электронной компонентной базы двойного назначения, продукции таких производителей как XILINX, Intel (ex.ALTERA), Vicor, Microchip, Texas Instruments, Analog Devices, Mini-Circuits, Amphenol, Glenair.

Сотрудничество с глобальными дистрибьюторами электронных компонентов, предоставляет возможность заказывать и получать с международных складов практически любой перечень компонентов в оптимальные для Вас сроки.

На всех этапах разработки и производства наши партнеры могут получить квалифицированную поддержку опытных инженеров.

Система менеджмента качества компании отвечает требованиям в соответствии с ГОСТ Р ИСО 9001, ГОСТ РВ 0015-002 и ЭС РД 009

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