74AUP1Z125

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

Rev. 6 — 11 December 2020 **Product data sheet**

1. General description

The 74AUP1Z125 is a crystal driver with enable, internal resistor and 3-state output. When not in use the $\overline{EN}$ input can be driven HIGH, putting the device in a low power disable mode with X1 pulled HIGH via R_{PU}, X2 set LOW and Y in the high impedance OFF-state. In disable mode the output Y assumes the high impedance OFF-state. Schmitt trigger action on 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. Schmitt-trigger action at all inputs makes the circuit tolerant of slower input rise and fall times.

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
- Overvoltage tolerant inputs 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
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

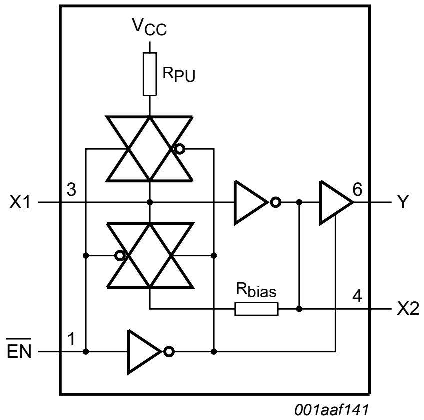
4. Marking

Table 2. Marking

Type number	Marking code [1]
74AUP1Z125GW	55
74AUP1Z125GM	55
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

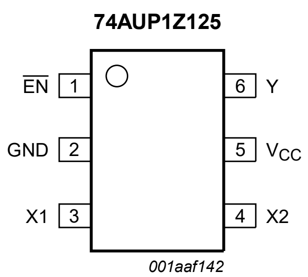


Fig. 2. Pin configuration SOT363

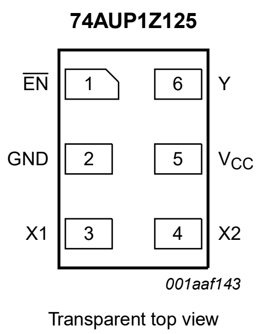


Fig. 3. Pin configuration SOT886

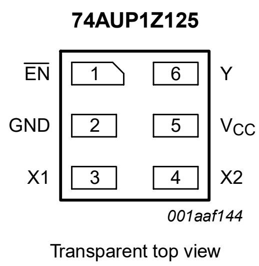


Fig. 4. Pin configuration SOT1115 and SOT1202

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

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

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

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 SOT363 (SC-88) package: P_{tot} derates linearly with 3.7 mW/K above 83 °C.
For SOT886 (XSON6) package: P_{tot} derates linearly with 3.3 mW/K above 74 °C.
For SOT1115 (XSON6) package: P_{tot} derates linearly with 3.2 mW/K above 71 °C.
For SOT1202 (XSON6) package: P_{tot} derates linearly with 3.3 mW/K above 74 °C.

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
Δt/ΔV	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).

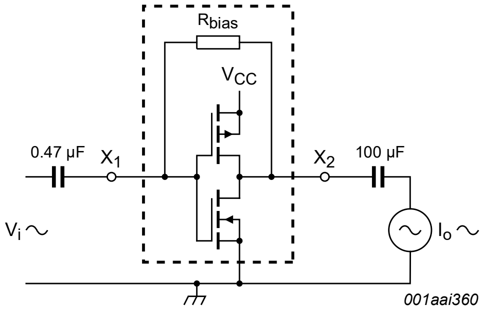
Symbol	Parameter	Conditions	T_{amb} = 25 °C			T_{amb} = -40 °C to +85 °C		T_{amb} = -40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
V_{IH}	HIGH-level input voltage	X1 input; V_{CC} = 0.8 V to 3.6 V	0.75V_{CC}	-	-	0.75V_{CC}	-	0.75V_{CC}	-	V
		$\overline{EN}$ input								
		V_{CC} = 0.8 V	0.70V_{CC}	-	-	0.70V_{CC}	-	0.75V_{CC}	-	V
		V_{CC} = 0.9 V to 1.95 V	0.65V_{CC}	-	-	0.65V_{CC}	-	0.70V_{CC}	-	V
		V_{CC} = 2.3 V to 2.7 V	1.6	-	-	1.6	-	1.6	-	V
		V_{CC} = 3.0 V to 3.6 V	2.0	-	-	2.0	-	2.0	-	V
V_{IL}	LOW-level input voltage	X1 input; V_{CC} = 0.8 V to 3.6 V	-	-	0.25V_{CC}	-	0.25V_{CC}	-	0.25V_{CC}	V
		$\overline{EN}$ input								
		V_{CC} = 0.8 V	-	-	0.30V_{CC}	-	0.30V_{CC}	-	0.25V_{CC}	V
		V_{CC} = 0.9 V to 1.95 V	-	-	0.35V_{CC}	-	0.35V_{CC}	-	0.30V_{CC}	V
		V_{CC} = 2.3 V to 2.7 V	-	-	0.7	-	0.7	-	0.7	V
		V_{CC} = 3.0 V to 3.6 V	-	-	0.9	-	0.9	-	0.9	V

Symbol	Parameter	Conditions	T_{amb} = 25 °C			T_{amb} = -40 °C to +85 °C		T_{amb} = -40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
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_{CC} - 0.1	-	V_{CC} - 0.11	-	V
		I_O = -1.1 mA; V_{CC} = 1.1 V	$0.75V_{CC}$	-	-	$0.7V_{CC}$	-	$0.6V_{CC}$	-	V
		I_O = -1.7 mA; V_{CC} = 1.4 V	1.11	-	-	1.03	-	0.93	-	V
		I_O = -1.9 mA; V_{CC} = 1.65 V	1.32	-	-	1.30	-	1.17	-	V
		I_O = -2.3 mA; V_{CC} = 2.3 V	2.05	-	-	1.97	-	1.77	-	V
		I_O = -3.1 mA; V_{CC} = 2.3 V	1.9	-	-	1.85	-	1.67	-	V
		I_O = -2.7 mA; V_{CC} = 3.0 V	2.72	-	-	2.67	-	2.40	-	V
		I_O = -4.0 mA; V_{CC} = 3.0 V	2.6	-	-	2.55	-	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} - 0.1	-	-	V_{CC} - 0.1	-	V_{CC} - 0.11	-	V
		I_O = -1.1 mA; V_{CC} = 1.1 V	$0.75V_{CC}$	-	-	$0.7V_{CC}$	-	$0.6V_{CC}$	-	V
		I_O = -1.7 mA; V_{CC} = 1.4 V	1.11	-	-	1.03	-	0.93	-	V
		I_O = -1.9 mA; V_{CC} = 1.65 V	1.32	-	-	1.30	-	1.17	-	V
		I_O = -2.3 mA; V_{CC} = 2.3 V	2.05	-	-	1.97	-	1.77	-	V
		I_O = -3.1 mA; V_{CC} = 2.3 V	1.9	-	-	1.85	-	1.67	-	V
		I_O = -2.7 mA; V_{CC} = 3.0 V	2.72	-	-	2.67	-	2.40	-	V
		I_O = -4.0 mA; V_{CC} = 3.0 V	2.6	-	-	2.55	-	2.30	-	V

Symbol	Parameter	Conditions	T_{amb} = 25 °C			T_{amb} = -40 °C to +85 °C		T_{amb} = -40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
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	-	0.1	-	0.11	V
		I_O = 1.1 mA; V_{CC} = 1.1 V	-	-	$0.3V_{CC}$	-	$0.3V_{CC}$	-	$0.33V_{CC}$	V
		I_O = 1.7 mA; V_{CC} = 1.4 V	-	-	0.31	-	0.37	-	0.41	V
		I_O = 1.9 mA; V_{CC} = 1.65 V	-	-	0.31	-	0.35	-	0.39	V
		I_O = 2.3 mA; V_{CC} = 2.3 V	-	-	0.31	-	0.33	-	0.36	V
		I_O = 3.1 mA; V_{CC} = 2.3 V	-	-	0.44	-	0.45	-	0.50	V
		I_O = 2.7 mA; V_{CC} = 3.0 V	-	-	0.31	-	0.33	-	0.36	V
		I_O = 4.0 mA; V_{CC} = 3.0 V	-	-	0.44	-	0.45	-	0.50	V
		X2 output; V_I = GND or V_{CC}								
		I_O = 20 μA; V_{CC} = 0.8 V to 3.6 V	-	-	0.1	-	0.1	-	0.11	V
		I_O = 1.1 mA; V_{CC} = 1.1 V	-	-	$0.3V_{CC}$	-	$0.3V_{CC}$	-	$0.33V_{CC}$	V
		I_O = 1.7 mA; V_{CC} = 1.4 V	-	-	0.31	-	0.37	-	0.41	V
		I_O = 1.9 mA; V_{CC} = 1.65 V	-	-	0.31	-	0.35	-	0.39	V
		I_O = 2.3 mA; V_{CC} = 2.3 V	-	-	0.31	-	0.33	-	0.36	V
		I_O = 3.1 mA; V_{CC} = 2.3 V	-	-	0.44	-	0.45	-	0.50	V
		I_O = 2.7 mA; V_{CC} = 3.0 V	-	-	0.31	-	0.33	-	0.36	V
		I_O = 4.0 mA; V_{CC} = 3.0 V	-	-	0.44	-	0.45	-	0.50	V
I_I	input leakage current	X1 input; V_I = $\overline{EN}$ = V_{CC}; V_{CC} = 0 V to 3.6 V	-	-	±0.1	-	±0.5	-	±0.75	μA
		$\overline{EN}$ input; V_I = GND to 3.6 V; V_{CC} = 0 V to 3.6 V	-	-	±0.1	-	±0.5	-	±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	-	15	-	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	-	±0.5	-	±0.75	μA
I_{OFF}	power-off leakage current	Only for output Y and input $\overline{EN}$. V_I or V_O = 0 V to 3.6 V; V_{CC} = 0 V	-	-	±0.2	-	±0.5	-	±0.75	μA
ΔI_{OFF}	additional power-off leakage current	Only for output Y and input $\overline{EN}$. V_I or V_O = 0 V to 3.6 V; V_{CC} = 0 V to 0.2 V	-	-	±0.2	-	±0.6	-	±0.75	μA

Symbol	Parameter	Conditions	T_{amb} = 25 °C			T_{amb} = -40 °C to +85 °C		T_{amb} = -40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
I_{CC}	supply current	V_I = GND or V_{CC}; I_O = 0 A; V_{CC} = 0.8 V to 3.6 V	-	-	75	-	75	-	75	µA
ΔI_{CC}	additional supply current	$\overline{EN}$ input; V_I = V_{CC} - 0.6 V; I_O = 0 A; V_{CC} = 3.3 V	-	-	40	-	50	-	75	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
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 Fig. 5 and Fig. 6								
		V_{CC} = 0.8 V	-	-	-	-	-	-	-	mA/V
		V_{CC} = 1.1 V to 1.3 V	0.2	-	9.9	-	10.8	-	10.8	mA/V
		V_{CC} = 1.4 V to 1.6 V	3.9	-	17.7	1.8	21.2	1.8	21.2	mA/V
		V_{CC} = 1.65 V to 1.95 V	7.9	-	24.3	7.5	29.9	6.9	29.9	mA/V
		V_{CC} = 2.3 V to 2.7 V	18	-	30.7	15.0	38.0	13.4	38.0	mA/V
		V_{CC} = 3.0 V to 3.6 V	20.5	-	32.4	17.8	39.2	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 Fig. 7; for frequency behavior see Fig. 8	1.08	1.62	3.08	1.07	3.11	1.07	3.11	MΩ

11. Test circuits and graphs

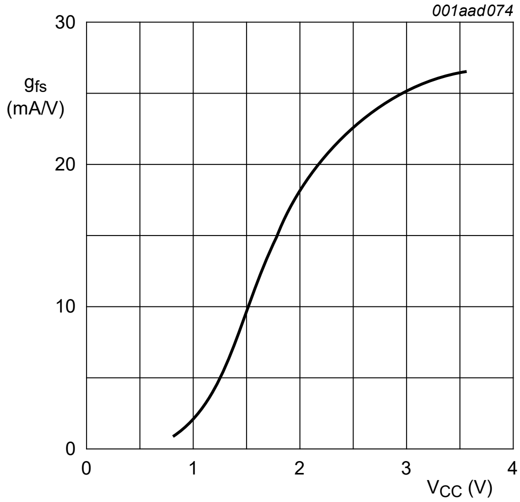


$$g_{fs} = \frac{\Delta I_O}{\Delta V_I}$$

f_i = 1 kHz.

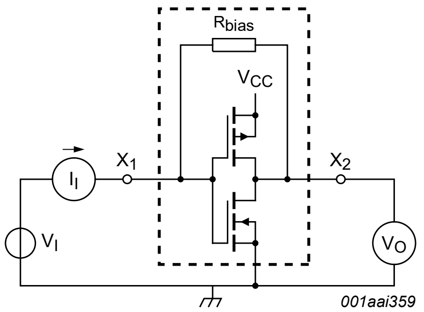
V_O is constant.

Fig. 5. Test set-up for measuring forward transconductance



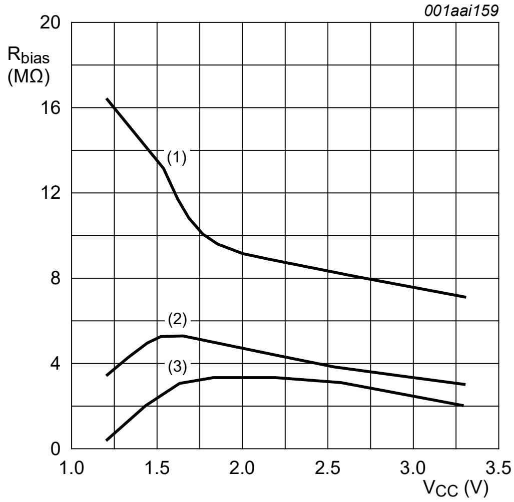
T_{amb} = 25 °C.

Fig. 6. Typical forward transconductance as a function of supply voltage



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

Fig. 7. Test circuit for measuring bias resistance



(1) f_i = 30 kHz.

(2) f_i = 1 MHz

(3) f_i = 10 MHz

Fig. 8. Typical bias resistance versus supply voltage

12. Dynamic characteristics

Table 8. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 11.

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	Min	Max	
C_L = 5 pF										
t_{pd}	propagation delay	X1 to X2; see Fig. 9 [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	0.9	5.3	ns
		V_{CC} = 1.4 V to 1.6 V	0.7	1.7	3.1	0.6	3.4	0.6	3.8	ns
		V_{CC} = 1.65 V to 1.95 V	0.5	1.4	2.6	0.5	2.9	0.5	3.2	ns
		V_{CC} = 2.3 V to 2.7 V	0.4	1.1	2.0	0.4	2.3	0.4	2.6	ns
		V_{CC} = 3.0 V to 3.6 V	0.3	1.0	1.8	0.3	2.1	0.3	2.4	ns
		X1 to Y; see Fig. 9 [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	3.2	16.3	ns
		V_{CC} = 1.4 V to 1.6 V	2.2	4.2	7.7	2.6	9.1	2.6	10.1	ns
		V_{CC} = 1.65 V to 1.95 V	1.9	3.5	6.2	2.2	7.8	2.2	8.6	ns
		V_{CC} = 2.3 V to 2.7 V	1.6	2.9	4.8	1.9	6.2	1.9	6.9	ns
		V_{CC} = 3.0 V to 3.6 V	1.4	2.6	4.1	1.7	4.7	1.7	5.2	ns
t_{en}	enable time	$\overline{EN}$ to Y; see Fig. 10 [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	2.9	18.0	ns
		V_{CC} = 1.4 V to 1.6 V	2.5	4.3	8.2	2.3	9.7	2.3	10.7	ns
		V_{CC} = 1.65 V to 1.95 V	2.1	3.6	6.5	2.0	7.6	2.0	8.4	ns
		V_{CC} = 2.3 V to 2.7 V	1.8	2.9	4.8	1.7	5.8	1.7	6.4	ns
		V_{CC} = 3.0 V to 3.6 V	1.7	2.6	4.1	1.7	4.7	1.7	5.2	ns
t_{dis}	disable time	$\overline{EN}$ to Y; see Fig. 10 [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	2.9	10.4	ns
		V_{CC} = 1.4 V to 1.6 V	2.0	3.3	6.4	2.3	6.7	2.3	7.4	ns
		V_{CC} = 1.65 V to 1.95 V	1.9	3.2	6.0	2.0	6.4	2.0	7.1	ns
		V_{CC} = 2.3 V to 2.7 V	1.4	2.3	4.4	1.7	4.7	1.7	5.2	ns
		V_{CC} = 3.0 V to 3.6 V	1.7	2.6	4.4	1.7	4.9	1.7	5.4	ns

Symbol	Parameter	Conditions		25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
				Min	Typ[1]	Max	Min	Max	Min	Max	
C_L = 10 pF											
t_{pd}	propagation delay	X1 to X2; see Fig. 9	[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	1.2	7.5	ns
		V_{CC} = 1.4 V to 1.6 V		1.0	2.3	4.0	0.9	4.6	0.9	5.1	ns
		V_{CC} = 1.65 V to 1.95 V		0.8	1.9	3.3	0.7	3.8	0.7	4.2	ns
		V_{CC} = 2.3 V to 2.7 V		0.6	1.5	2.7	0.6	3.1	0.6	3.5	ns
		V_{CC} = 3.0 V to 3.6 V		0.5	1.3	2.4	0.5	2.7	0.5	3.0	ns
		X1 to Y; see Fig. 9	[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	3.6	17.9	ns
		V_{CC} = 1.4 V to 1.6 V		2.1	4.9	8.9	3.0	10.1	3.0	11.2	ns
		V_{CC} = 1.65 V to 1.95 V		1.9	4.1	6.9	2.6	8.0	2.6	8.8	ns
		V_{CC} = 2.3 V to 2.7 V		2.1	3.4	5.4	2.3	6.6	2.3	7.3	ns
		V_{CC} = 3.0 V to 3.6 V		1.8	3.1	4.8	2.1	5.6	2.1	6.2	ns
t_{en}	enable time	$\overline{EN}$ to Y; see Fig. 10	[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	3.4	17.6	ns
		V_{CC} = 1.4 V to 1.6 V		2.3	5.0	9.3	2.2	9.6	2.2	10.6	ns
		V_{CC} = 1.65 V to 1.95 V		2.0	4.2	7.2	1.9	7.9	1.9	8.7	ns
		V_{CC} = 2.3 V to 2.7 V		1.8	3.4	5.5	1.7	6.4	1.7	7.1	ns
		V_{CC} = 3.0 V to 3.6 V		1.7	3.2	4.9	1.7	5.5	1.7	6.1	ns
t_{dis}	disable time	$\overline{EN}$ to Y; see Fig. 10	[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	3.4	11.9	ns
		V_{CC} = 1.4 V to 1.6 V		2.1	4.2	7.6	2.2	8.0	2.2	8.8	ns
		V_{CC} = 1.65 V to 1.95 V		2.2	4.3	7.3	1.9	7.6	1.9	8.4	ns
		V_{CC} = 2.3 V to 2.7 V		1.6	3.1	5.3	1.7	5.5	1.7	6.1	ns
		V_{CC} = 3.0 V to 3.6 V		2.1	3.8	6.0	1.7	6.5	1.7	7.2	ns

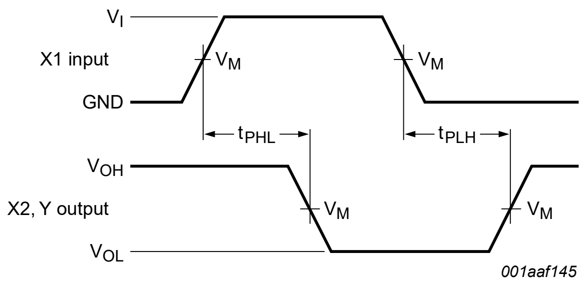
Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	Min	Max	
C_L = 15 pF										
t_{pd}	propagation delay	X1 to X2; see Fig. 9 [2]								
		V_{CC} = 0.8 V	-	13.0	-	-	-	-	-	ns
		V_{CC} = 1.1 V to 1.3 V	1.6	3.8	7.9	1.4	8.8	1.4	9.7	ns
		V_{CC} = 1.4 V to 1.6 V	1.3	2.8	4.9	1.1	5.7	1.1	6.3	ns
		V_{CC} = 1.65 V to 1.95 V	1.0	2.3	4.0	0.9	4.7	0.9	5.2	ns
		V_{CC} = 2.3 V to 2.7 V	0.8	1.9	3.2	0.8	3.7	0.8	4.1	ns
		V_{CC} = 3.0 V to 3.6 V	0.7	1.6	2.9	0.7	3.3	0.7	3.7	ns
		X1 to Y; see Fig. 9 [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	4.0	19.4	ns
		V_{CC} = 1.4 V to 1.6 V	3.0	5.4	9.7	3.3	10.6	3.3	11.7	ns
		V_{CC} = 1.65 V to 1.95 V	2.2	4.6	7.7	2.9	9.0	2.9	9.9	ns
		V_{CC} = 2.3 V to 2.7 V	2.0	3.9	6.1	2.6	7.3	2.6	8.1	ns
		V_{CC} = 3.0 V to 3.6 V	2.0	3.6	5.4	2.3	5.9	2.3	6.5	ns
t_{en}	enable time	$\overline{EN}$ to Y; see Fig. 10 [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	3.7	19.3	ns
		V_{CC} = 1.4 V to 1.6 V	3.0	5.5	10.0	2.5	10.2	2.5	11.3	ns
		V_{CC} = 1.65 V to 1.95 V	2.3	4.7	7.9	2.1	9.2	2.1	10.2	ns
		V_{CC} = 2.3 V to 2.7 V	2.0	3.9	6.2	2.0	7.4	2.0	8.2	ns
		V_{CC} = 3.0 V to 3.6 V	2.0	3.6	5.5	1.9	6.0	1.9	6.6	ns

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	Min	Max	
t_{dis}	disable time	$\overline{EN}$ to Y; see Fig. 10 [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	3.7	13.7	ns
		V_{CC} = 1.4 V to 1.6 V	3.0	5.1	8.1	2.5	8.9	2.5	9.8	ns
		V_{CC} = 1.65 V to 1.95 V	3.0	5.4	8.0	2.1	9.3	2.1	10.3	ns
		V_{CC} = 2.3 V to 2.7 V	2.1	3.9	6.1	2.0	7.3	2.0	8.1	ns
		V_{CC} = 3.0 V to 3.6 V	2.9	5.1	7.2	1.9	7.9	1.9	8.7	ns
C_L = 30 pF										
t_{pd}	propagation delay	X1 to X2; see Fig. 9 [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	2.2	16.3	ns
		V_{CC} = 1.4 V to 1.6 V	2.0	4.2	7.6	1.8	9.0	1.8	9.9	ns
		V_{CC} = 1.65 V to 1.95 V	1.7	3.6	6.1	1.5	7.2	1.5	8.0	ns
		V_{CC} = 2.3 V to 2.7 V	1.4	2.9	4.8	1.3	5.7	1.3	6.3	ns
		V_{CC} = 3.0 V to 3.6 V	1.2	2.5	4.3	1.1	5.1	1.1	5.7	ns
		X1 to Y; see Fig. 9 [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	5.0	23.9	ns
		V_{CC} = 1.4 V to 1.6 V	4.0	6.9	12.4	4.3	13.5	4.3	14.9	ns
		V_{CC} = 1.65 V to 1.95 V	2.9	5.9	9.8	3.8	10.7	3.8	11.8	ns
		V_{CC} = 2.3 V to 2.7 V	2.7	5.0	7.5	3.3	8.2	3.3	9.1	ns
		V_{CC} = 3.0 V to 3.6 V	2.7	4.7	6.8	3.1	7.7	3.1	8.5	ns
t_{en}	enable time	$\overline{EN}$ to Y; see Fig. 10 [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	4.8	23.9	ns
		V_{CC} = 1.4 V to 1.6 V	4.0	7.1	12.4	3.1	13.5	3.1	14.9	ns
		V_{CC} = 1.65 V to 1.95 V	3.0	6.0	9.9	2.8	10.7	2.8	11.8	ns
		V_{CC} = 2.3 V to 2.7 V	2.7	5.0	7.7	2.6	8.1	2.6	9.0	ns
		V_{CC} = 3.0 V to 3.6 V	2.7	4.8	6.8	2.6	7.7	2.6	8.5	ns
t_{dis}	disable time	$\overline{EN}$ to Y; see Fig. 10 [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	4.8	18.2	ns
		V_{CC} = 1.4 V to 1.6 V	4.4	7.8	11.2	3.1	12.3	3.1	13.6	ns
		V_{CC} = 1.65 V to 1.95 V	5.1	8.8	12.5	2.8	13.3	2.8	14.7	ns
		V_{CC} = 2.3 V to 2.7 V	3.6	6.3	8.6	2.6	9.5	2.6	10.5	ns
		V_{CC} = 3.0 V to 3.6 V	5.2	8.8	11.5	2.6	13.0	2.6	14.3	ns

Symbol	Parameter	Conditions		25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
				Min	Typ[1]	Max	Min	Max	Min	Max	
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}.

12.1. Waveforms and test circuit



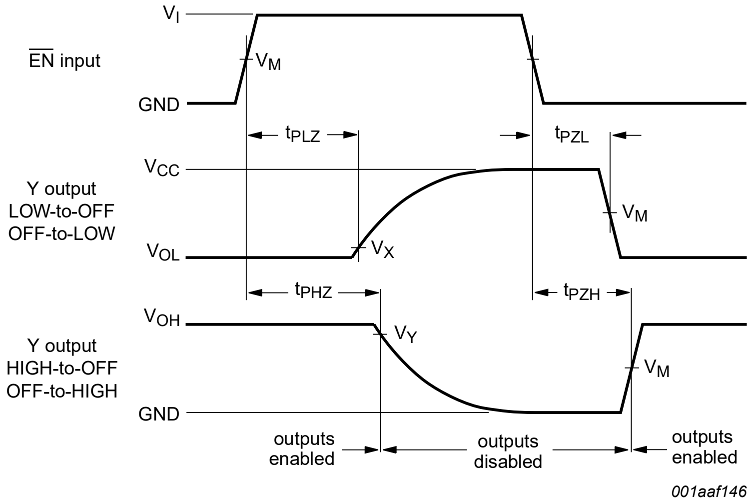
Measurement points are given in Table 9.

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

Fig. 9. 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



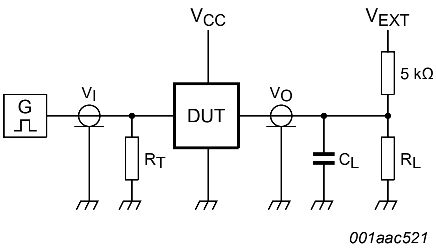
Measurement points are given in Table 10.

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

Fig. 10. 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. 11. 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.

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

Fig. 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 Fig. 13.

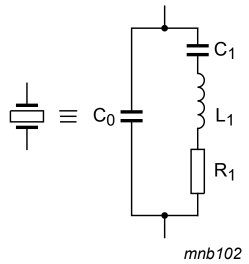
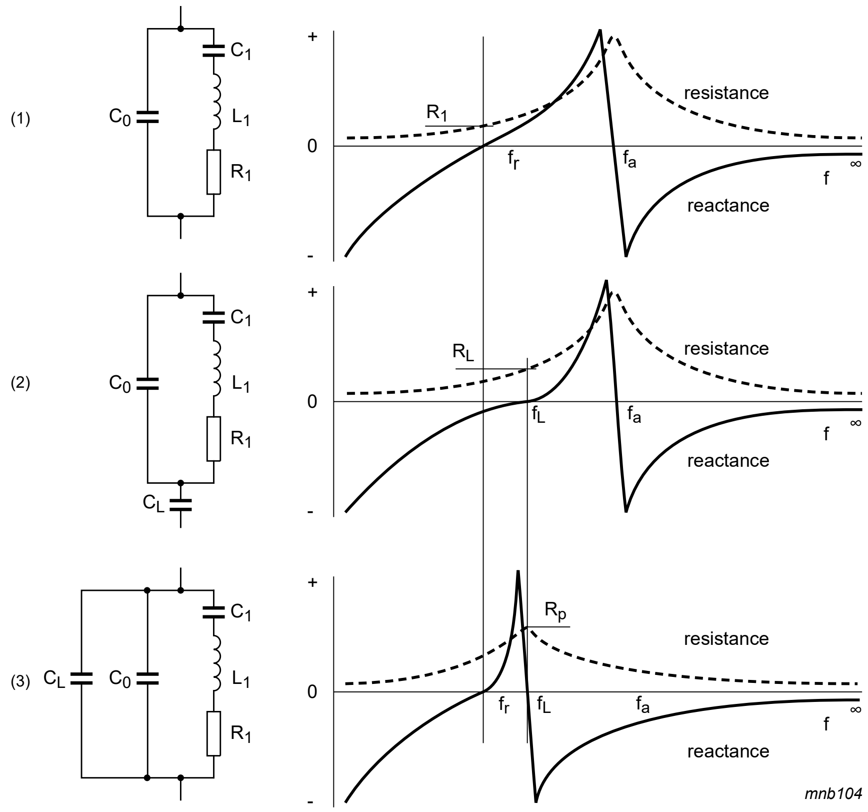


Fig. 12. Equivalent circuit of a crystal



(1) = resonance
(2) = anti-resonance
(3) = load resonance

Fig. 13. Reactance and resistance characteristics of a crystal

13.1.1. Design

Fig. 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.

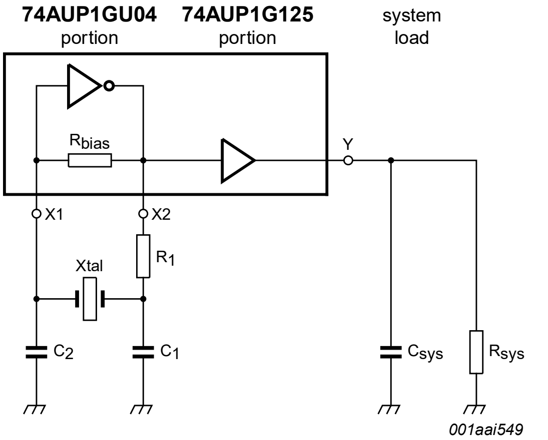


Fig. 14. Crystal oscillator configuration

13.1.2. Testing

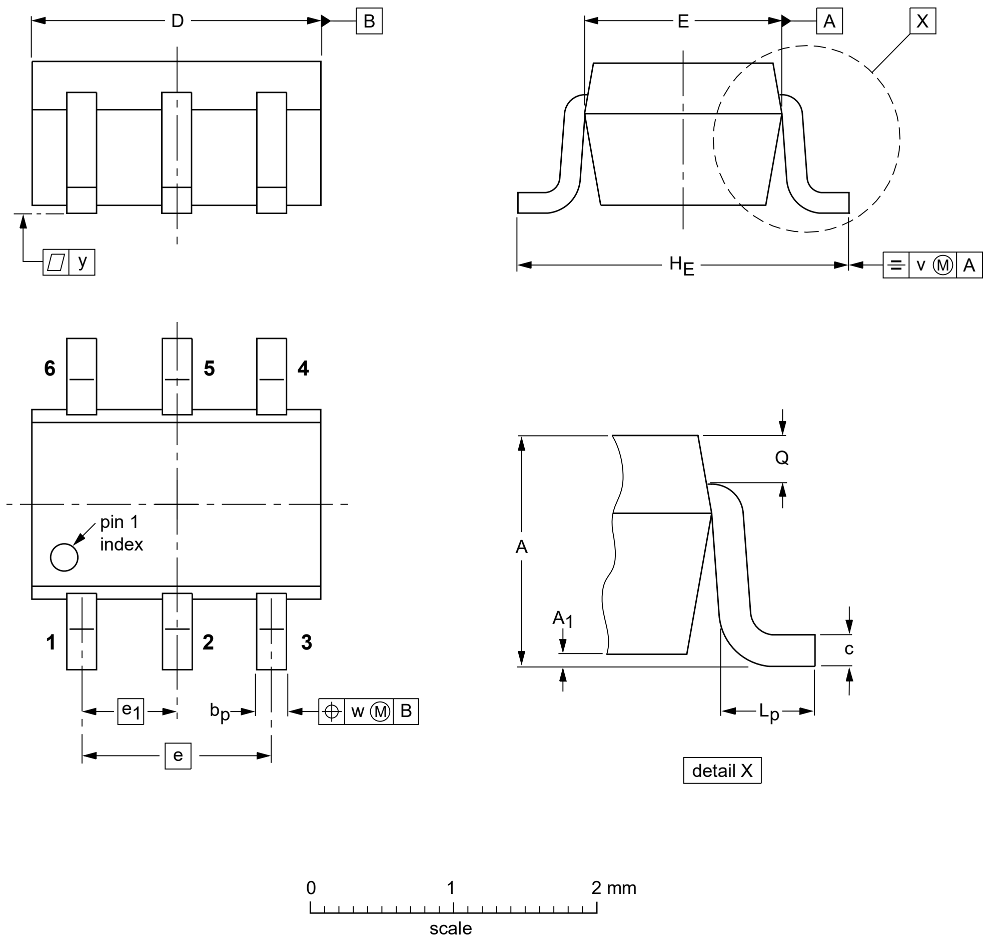
After the calculations are performed for a particular crystal, the oscillator circuit should be tested. The following simple checks verify the prototype design of a crystal controlled oscillator circuit. Perform the checks after laying out the board:

- 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)

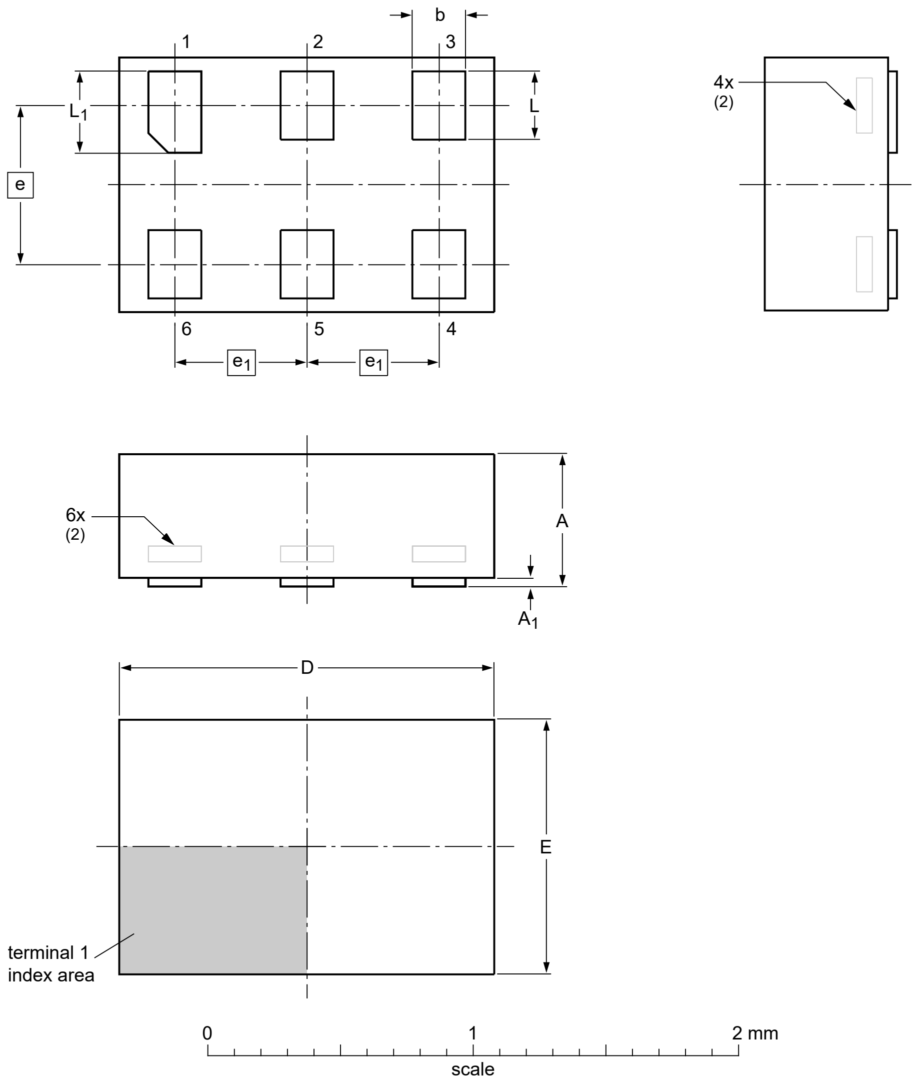
UNIT	A	A_1 max	b_p	c	D	E	e	e_1	H_E	L_p	Q	v	w	y
mm	1.1 0.8	0.1	0.30 0.20	0.25 0.10	2.2 1.8	1.35 1.15	1.3	0.65	2.2 2.0	0.45 0.15	0.25 0.15	0.2	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT363			SC-88			~~04-11-08~~ 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
	max	0.5	0.04	0.25	1.50	1.05			0.35	0.40
mm	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

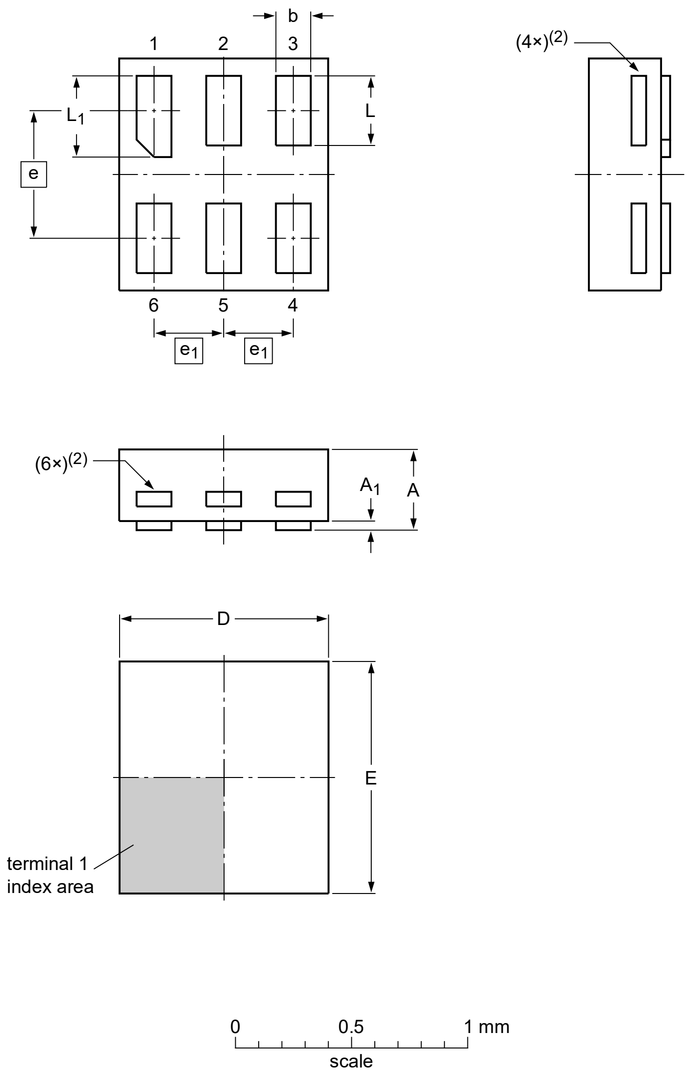
1. Including plating thickness.
2. Can be visible in some manufacturing processes.

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: 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
mm	max	0.35	0.04	0.20	0.95	1.05			0.35	0.40
	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

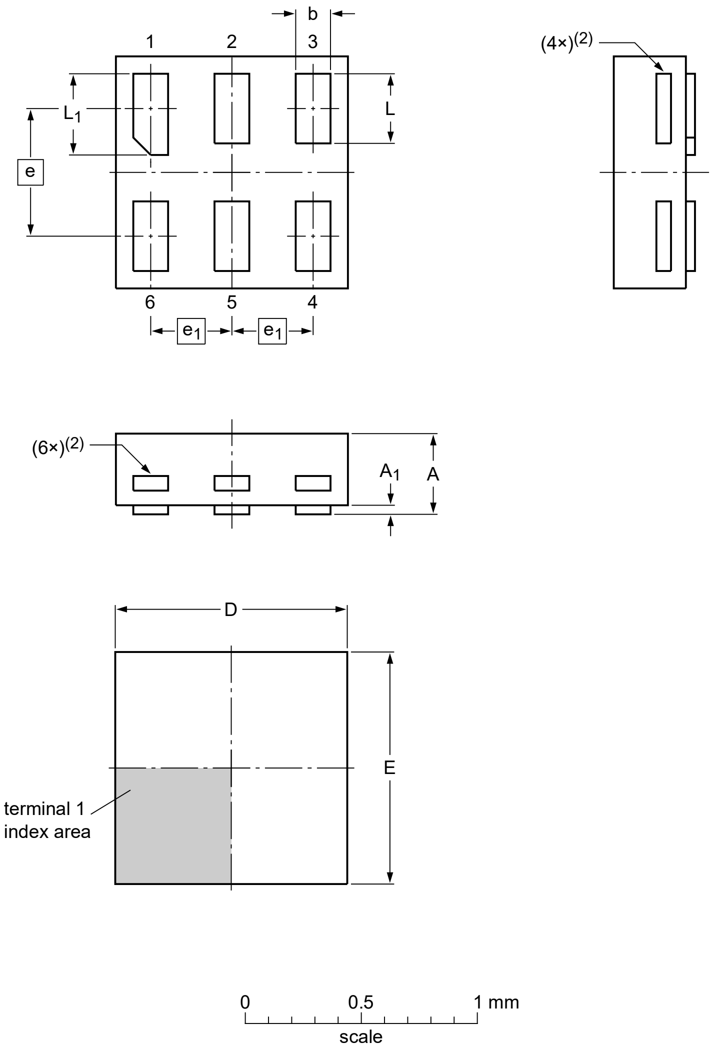
Note
1. Including plating thickness.
2. Visible depending upon used manufacturing technology.

sot1115_po

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

Fig. 17. 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

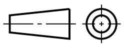
Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT1202						~~10-04-02~~ 10-04-06

Fig. 18. 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.6	20201211	Product data sheet	-	74AUP1Z125 v.5
Modifications:	• The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia. • Legal texts have been adapted to the new company name where appropriate. • Type number 74AUP1Z125GF (SOT891 / XSON6) removed. • Section 1 updated. • Table 5: Derating values for P_{tot} total power dissipation updated.			
74AUP1Z125 v.5	20120808	Product data sheet	-	74AUP1Z125 v.4
Modifications:	• Package outline drawing of SOT886 (Fig. 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

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".
[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the internet at https://www.nexperia.com.

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