Low-power 3-input AND gate Rev. 5 — 20 August 2018

1. General description

The 74AUP1G11 provides a low-power, low-voltage single 3-input AND gate.

Schmitt trigger action at all inputs 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 ensures a very low static and dynamic power consumption 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} . The I_{OFF} circuitry disables the output, preventing the damaging backflow current through the device when it is powered down.

2. Features and benefits

- Wide supply voltage range from 0.8 V to 3.6 V
- High noise immunity
- Complies with JEDEC standards:
 - JESD8-12 (0.8 V to 1.3 V)
 - JESD8-11 (0.9 V to 1.65 V)
 - JESD8-7 (1.2 V to 1.95 V)
 - JESD8-5 (1.8 V to 2.7 V)
 - JESD8-B (2.7 V to 3.6 V)
- ESD protection:
 - HBM JESD22-A114F Class 3A exceeds 5000 V
 - MM JESD22-A115-A exceeds 200 V
 - CDM JESD22-C101E exceeds 1000 V
- Low static power consumption; I_{CC} = 0.9 μA (maximum)
- Latch-up performance exceeds 100 mA per JESD 78 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
- Multiple package options
- Specified from -40 °C to +85 °C and -40 °C to +125 °C

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3. Ordering information

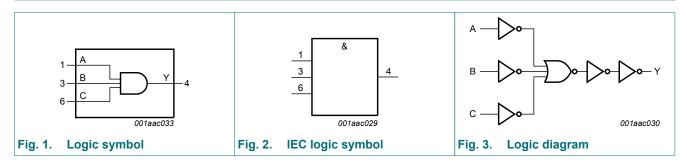
Type number	Package	Package								
	Temperature range	Name	Description	Version						
74AUP1G11GW	-40 °C to +125 °C	SC-88	plastic surface-mounted package; 6 leads	SOT363						
74AUP1G11GM	-40 °C to +125 °C	XSON6	plastic extremely thin small outline package; no leads; 6 terminals; body 1 x 1.45 x 0.5 mm	SOT886						
74AUP1G11GF	-40 °C to +125 °C	XSON6	plastic extremely thin small outline package; no leads; 6 terminals; body 1 x 1 x 0.5 mm	SOT891						
74AUP1G11GN	-40 °C to +125 °C	XSON6	extremely thin small outline package; no leads; 6 terminals; body 0.9 x 1.0 x 0.35 mm	SOT1115						
74AUP1G11GS	-40 °C to +125 °C	XSON6	extremely thin small outline package; no leads; 6 terminals; body 1.0 x 1.0 x 0.35 mm	SOT1202						

4. Marking

Table 2. Marking							
Type number	Marking code[1]						
74AUP1G11GW	pU						
74AUP1G11GM	pU						
74AUP1G11GF	pU						
74AUP1G11GN	pU						
74AUP1G11GS	pU						

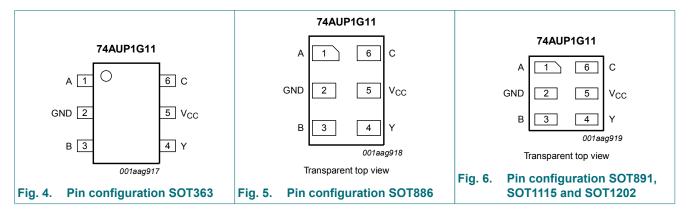
[1] The pin 1 indicator is located on the lower left corner of the device, below the marking code.

5. Functional diagram



6. Pinning information





6.2. Pin description

Table 3. Pin description								
Symbol	Pin	Description						
A	1	data input						
GND	2	ground (0 V)						
В	3	data input						
Y	4	data output						
V _{CC}	5	supply voltage						
С	6	data input						

7. Functional description

Table 4. Function table

H = HIGH voltage level; L = LOW voltage level; X = don't care.

Input	Output		
Α	В	С	Y
Н	Н	Н	Н
L	Х	Х	L
Х	L	Х	L
X	Х	L	L

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 ₁ < 0 V	-50	-	mA
VI	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 [1] mode	-0.5	+4.6	V
lo	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 minimum 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 Ptot 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
VI	input voltage		0	3.6	V
Vo	output voltage	Active mode	0	V _{CC}	V
		Power-down mode; V_{CC} = 0 V	0	3.6	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	Min	Тур	Мах	Unit
T _{amb} = 2	5 °C		·			
V _{IH}	HIGH-level input voltage	V _{CC} = 0.8 V	$0.70 \times V_{CC}$	-	-	V
		V _{CC} = 0.9 V to 1.95 V	$0.65 \times V_{CC}$	-	-	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	V _{CC} = 0.8 V	-	-	$0.30 \times V_{CC}$	V
		V _{CC} = 0.9 V to 1.95 V	-	-	$0.35 \times V_{CC}$	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	$V_{I} = V_{IH} \text{ or } V_{IL}$				
		$I_{\rm O}$ = -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	$0.75 \times V_{CC}$	-	-	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
		$I_{\rm O}$ = -2.3 mA; $V_{\rm CC}$ = 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
V _{OL}	LOW-level output voltage	$V_{I} = V_{IH} \text{ or } V_{IL}$				
		$I_{\rm O}$ = 20 µA; $V_{\rm CC}$ = 0.8 V to 3.6 V	-	-	0.1	V
		I _O = 1.1 mA; V _{CC} = 1.1 V	-	-	0.3 x 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
lı	input leakage current	V_{I} = GND to 3.6 V; V_{CC} = 0 V to 3.6 V	-	-	±0.1	μA
I _{OFF}	power-off leakage current	V_{I} or V_{O} = 0 V to 3.6 V; V_{CC} = 0 V	-	-	±0.2	μA
∆I _{OFF}	additional power-off leakage current	$V_{I} \text{ or } V_{O} = 0 \text{ V to } 3.6 \text{ V};$ $V_{CC} = 0 \text{ V to } 0.2 \text{ V}$	-	-	±0.2	μA
I _{CC}	supply current	$V_{I} = GND \text{ or } V_{CC}; I_{O} = 0 \text{ A}; V_{CC} = 0.8 \text{ V to } 3.6 \text{ V}$	-	-	0.5	μA
ΔI _{CC}	additional supply current	$V_1 = V_{CC} - 0.6 \text{ V}; \text{ I}_0 = 0 \text{ A};$ [1] $V_{CC} = 3.3 \text{ V}$	-	-	40	μA
CI	input capacitance	V_{CC} = 0 V to 3.6 V; V _I = GND or V _{CC}	-	0.8	-	pF
Co	output capacitance	$V_0 = GND; V_{CC} = 0 V$	-	1.7	-	pF

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Symbol	Parameter	Conditions	Min	Тур	Max	Unit
T _{amb} = -4	10 °C to +85 °C					
VIH	HIGH-level input voltage	V _{CC} = 0.8 V	0.70 x V _{CC}	-	-	V
		V _{CC} = 0.9 V to 1.95 V	$0.65 \times V_{CC}$	-	-	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	V _{CC} = 0.8 V	-	-	$0.30 \times V_{CC}$	V
		V _{CC} = 0.9 V to 1.95 V	-	-	$0.35 \times V_{CC}$	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	$V_{I} = V_{IH} \text{ or } V_{IL}$				
		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 x 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	$V_{I} = V_{IH} \text{ or } V_{IL}$				
		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 x 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
l _l	input leakage current	V_I = GND to 3.6 V; V_{CC} = 0 V to 3.6 V	-	-	±0.5	μA
I _{OFF}	power-off leakage current	V_1 or V_0 = 0 V to 3.6 V; V_{CC} = 0 V	-	-	±0.5	μA
ΔI _{OFF}	additional power-off leakage current	$V_1 \text{ or } V_0 = 0 \text{ V to } 3.6 \text{ V};$ $V_{CC} = 0 \text{ V to } 0.2 \text{ V}$	-	-	±0.6	μA
l _{cc}	supply current	$V_{I} = GND \text{ or } V_{CC}; I_{O} = 0 \text{ A};$ $V_{CC} = 0.8 \text{ V to } 3.6 \text{ V}$	-	-	0.9	μA
ΔI _{CC}	additional supply current	$V_1 = V_{CC} - 0.6 V; I_0 = 0 A;$ [1] $V_{CC} = 3.3 V$	-	-	50	μA

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Symbol	Parameter	Conditions	Min	Тур	Max	Unit
T _{amb} = -4	10 °C to +125 °C		11			
VIH	HIGH-level input voltage	V _{CC} = 0.8 V	$0.75 ext{ x V}_{CC}$	-	-	V
		V _{CC} = 0.9 V to 1.95 V	$0.70 \times V_{CC}$	-	-	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	V _{CC} = 0.8 V	-	-	$0.25 \times V_{CC}$	V
		V _{CC} = 0.9 V to 1.95 V	-	-	$0.30 \times V_{CC}$	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	$V_{I} = V_{IH} \text{ or } V_{IL}$				
		I_{O} = -20 μ A; 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 x 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
V _{OL}	LOW-level output voltage	$V_{I} = V_{IH} \text{ or } V_{IL}$				
		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 x 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
l _l	input leakage current	V_I = GND to 3.6 V; V_{CC} = 0 V to 3.6 V	-	-	±0.75	μA
I _{OFF}	power-off leakage current	V_{I} or V_{O} = 0 V to 3.6 V; V_{CC} = 0 V	-	-	±0.75	μA
ΔI _{OFF}	additional power-off leakage current	$V_1 \text{ or } V_0 = 0 \text{ V to } 3.6 \text{ V};$ $V_{CC} = 0 \text{ V to } 0.2 \text{ V}$	-	-	±0.75	μA
I _{CC}	supply current	$V_{I} = GND \text{ or } V_{CC}; I_{O} = 0 \text{ A}; V_{CC} = 0.8 \text{ V to } 3.6 \text{ V}$	-	-	1.4	μA
ΔI _{CC}	additional supply current	$V_{I} = V_{CC} - 0.6 V; I_{O} = 0 A;$ [1] $V_{CC} = 3.3 V$	-	-	75	μA

[1] One input at V_{CC} - 0.6 V, other input at V_{CC} or GND.

11. Dynamic characteristics

Table 8. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 8.

Symbol	Parameter	Conditions		25 °C		-4	0 °C to +1	25 °C	Unit
				Typ [1]	Мах	Min	Max (85 °C)	Max (125 °C)	
C _L = 5 p	F								
t _{pd}	propagation	A, B and C to Y; see Fig. 7 [2]							
	delay	V _{CC} = 0.8 V	-	18.9	-	-	-	-	ns
		V _{CC} = 1.1 V to 1.3 V	3.0	5.6	9.5	2.8	9.9	10.0	ns
		V _{CC} = 1.4 V to 1.6 V	2.3	3.9	5.9	2.2	6.5	6.8	ns
		V _{CC} = 1.65 V to 1.95 V	1.9	3.1	4.8	1.8	5.3	5.5	ns
		V_{CC} = 2.3 V to 2.7 V	1.6	2.5	3.6	1.4	4.0	4.2	ns
		V _{CC} = 3.0 V to 3.6 V	1.3	2.2	3.2	1.2	3.5	3.7	ns
C _L = 10	pF			-		1			1
t _{pd}	propagation	A, B and C to Y; see Fig. 7 [2]							
	delay	V _{CC} = 0.8 V	-	22.5	-	-	-	-	ns
		V _{CC} = 1.1 V to 1.3 V	3.5	6.5	11.1	3.3	11.6	11.8	ns
		V _{CC} = 1.4 V to 1.6 V	2.8	4.5	6.8	2.6	7.5	7.8	ns
		V _{CC} = 1.65 V to 1.95 V	2.4	3.7	5.6	2.1	6.2	6.4	ns
		V _{CC} = 2.3 V to 2.7 V	1.9	3.0	4.4	1.7	4.8	5.1	ns
		V _{CC} = 3.0 V to 3.6 V	1.7	2.8	4.0	1.5	4.3	4.5	ns
C _L = 15	pF								
t _{pd}	propagation	A, B and C to Y; see Fig. 7 [2]							
	delay	V _{CC} = 0.8 V	-	23.6	-	-	-	-	ns
		V _{CC} = 1.1 V to 1.3 V	3.9	7.3	12.5	3.6	13.3	13.4	ns
		V _{CC} = 1.4 V to 1.6 V	3.2	5.1	7.6	2.9	8.5	8.8	ns
		V _{CC} = 1.65 V to 1.95 V	2.7	4.2	6.3	2.4	6.9	7.3	ns
		V _{CC} = 2.3 V to 2.7 V	2.3	3.5	5.0	2.0	5.5	5.8	ns
		V _{CC} = 3.0 V to 3.6 V	2.0	3.2	4.6	1.8	5.0	5.2	ns
C _L = 30	pF								
t _{pd}	propagation	A, B and C to Y; see Fig. 7 [2]							
	delay	V _{CC} = 0.8 V	-	36.3	-	-	-	-	ns
		V _{CC} = 1.1 V to 1.3 V	5.1	9.5	16.8	4.8	17.9	18.3	ns
		V _{CC} = 1.4 V to 1.6 V	4.2	6.7	10.0	3.8	11.3	11.8	ns
		V _{CC} = 1.65 V to 1.95 V	3.6	5.5	8.1	3.2	9.1	9.7	ns
		V _{CC} = 2.3 V to 2.7 V	3.0	4.6	6.6	2.8	7.2	7.5	ns
		V _{CC} = 3.0 V to 3.6 V	2.7	4.3	6.1	2.5	6.6	6.9	ns

Low-power 3-input AND gate

Symbol	Parameter	Conditions	25 °C			-40 °C to +125 °C			Unit
			Min	Тур [1]	Мах	Min	Max (85 °C)	Max (125 °C)	
C _L = 5 pł	F, 10 pF, 15 pF and	30 pF							
C _{PD}		$f_i = 1 \text{ MHz}; V_I = \text{GND to } V_{CC}$ [3]							
	capacitance	V _{CC} = 0.8 V	-	2.7	-	-	-	-	pF
		V _{CC} = 1.1 V to 1.3 V	-	2.8	-	-	-	-	pF
		V _{CC} = 1.4 V to 1.6 V	-	2.9	-	-	-	-	pF
		V _{CC} = 1.65 V to 1.95 V	-	3.1	-	-	-	-	pF
		V _{CC} = 2.3 V to 2.7 V	-	3.5	-	-	-	-	pF
		V _{CC} = 3.0 V to 3.6 V	-	4.1	-	-	-	-	pF

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

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

[3] \dot{C}_{PD} is used to determine the dynamic power dissipation (P_D in μ W).

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

 f_i = input frequency in MHz;

 f_o = output frequency in MHz;

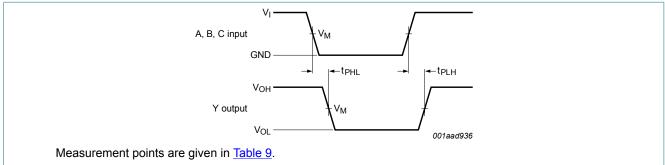
 C_L = load capacitance in pF;

V_{CC} = supply voltage in V;

N = number of inputs switching;

 $\Sigma(C_L \times V_{CC}^2 \times f_0)$ = sum of the outputs.

11.1. Waveforms and test circuit



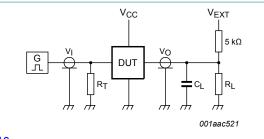
Logic levels: V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Fig. 7. Input A, B and C to output Y propagation delay times

Table 9. Measurement points

Supply voltage	Output	Input					
V _{cc}	V _M	V _M	VI	t _r = t _f			
0.8 V to 3.6 V	0.5 x V _{CC}	0.5 x V _{CC}	V _{CC}	≤ 3.0 ns			

Low-power 3-input AND gate



Test data is given in <u>Table 10</u>.

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. 8. Test circuit for measuring switching times

Table 10. Test data

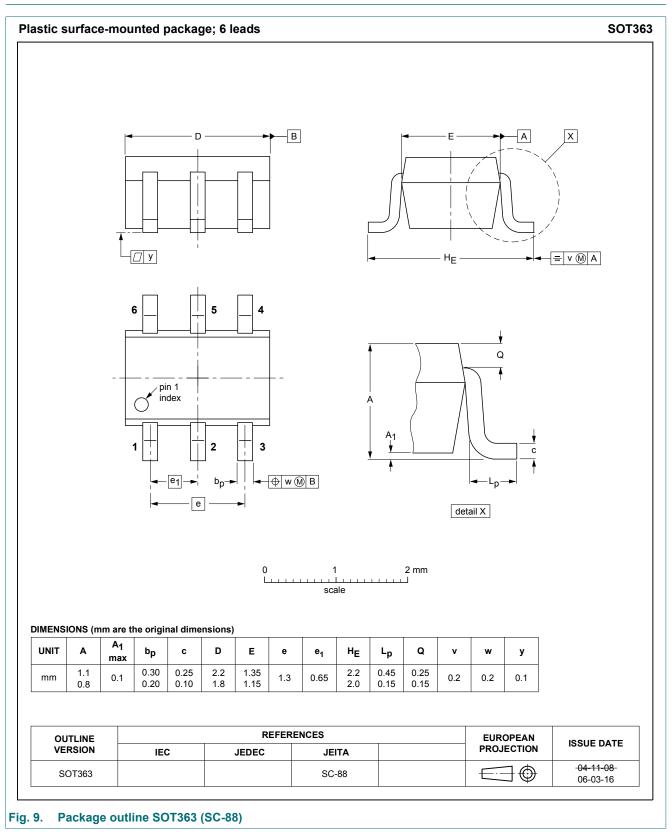
Supply voltage	Load		V _{EXT}		
V _{cc}	CL	R _L [1]	t _{PLH} , t _{PHL}	t _{PZH} , t _{PHZ}	t _{PZL} , t _{PLZ}
0.8 V to 3.6 V	5 pF, 10 pF, 15 pF and 30 pF	5 kΩ or 1 MΩ	open	GND	2 x V _{CC}

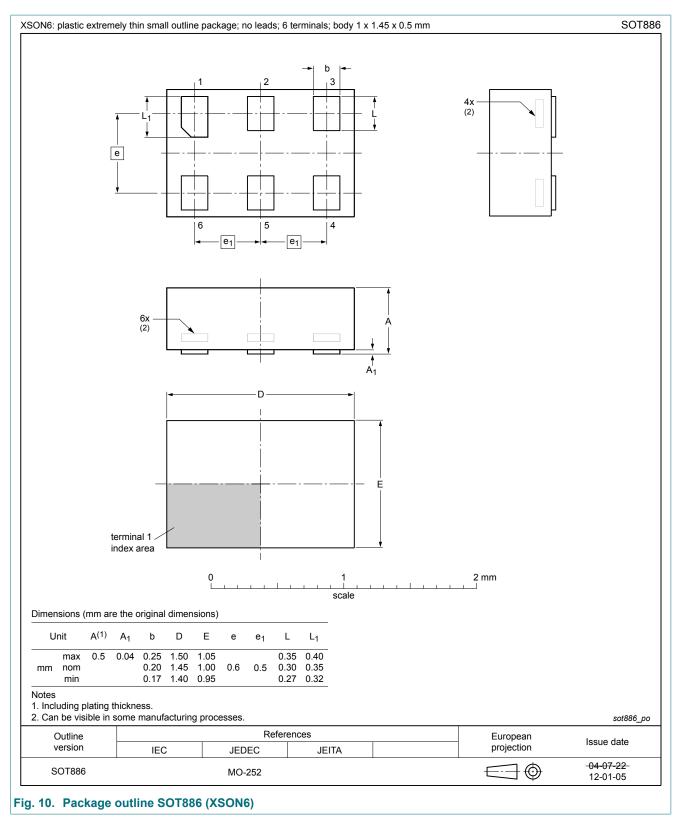
[1] For measuring enable and disable times $R_L = 5 k\Omega$.

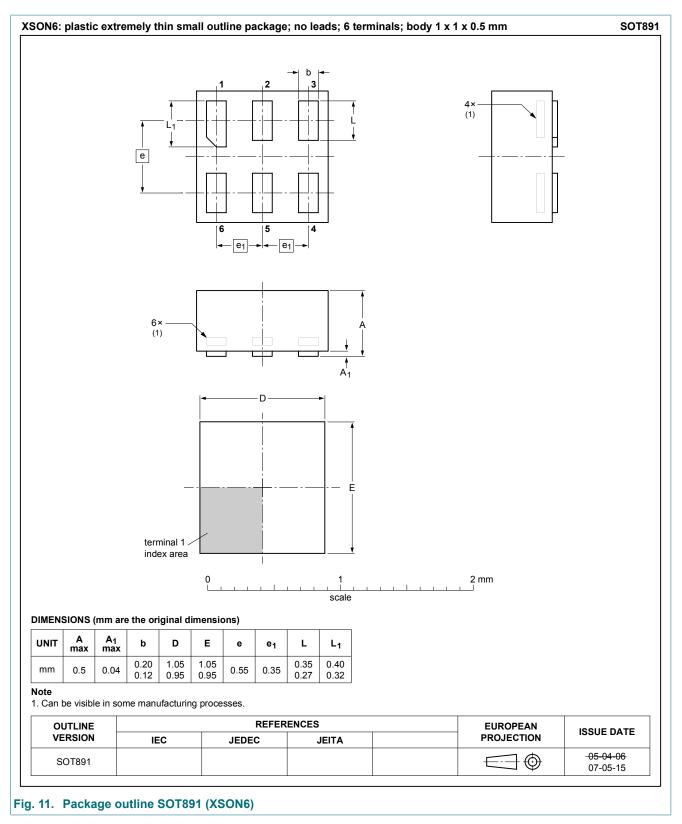
For measuring propagation delay, setup and hold times and pulse width R_L = 1 M Ω .

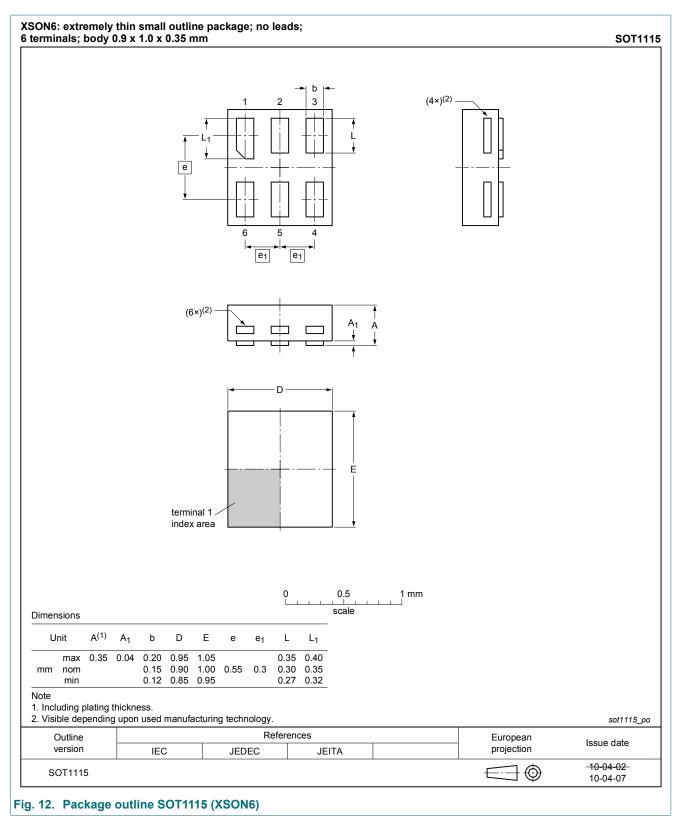
Low-power 3-input AND gate

12. Package outline

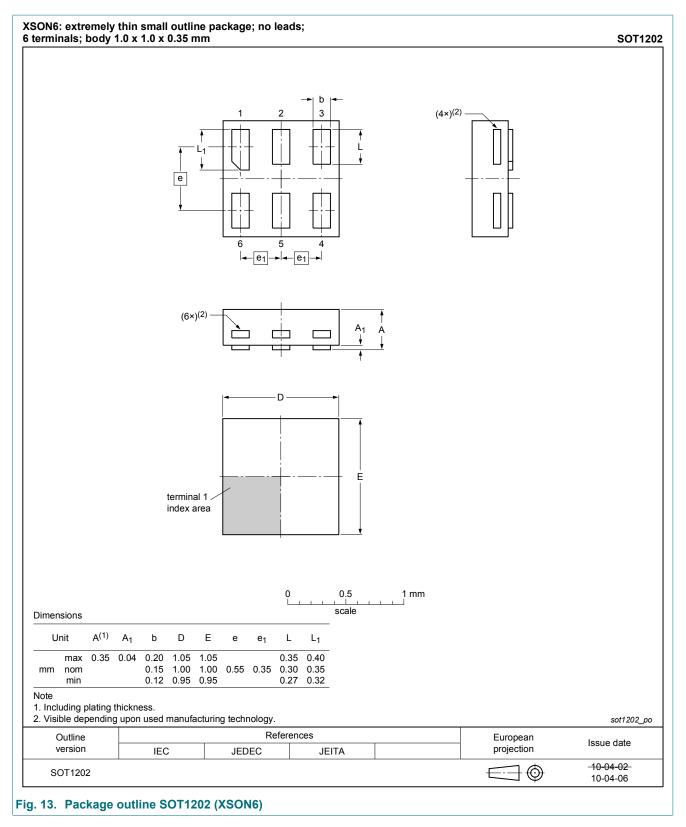








Low-power 3-input AND gate



Product data sheet

13. Abbreviations

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

14. Revision history

Table 12. Revision history						
Document ID	Release date	Data sheet status	Change notice	Supersedes		
74AUP1G11 v.5	20180820	Product data sheet	-	74AUP1G11 v.4		
Modifications:	Nexperia.					
74AUP1G11 v.4	20120803	Product data sheet	-	74AUP1G11 v.3		
Modifications:	Package outline drawing of SOT886 (Fig. 10) modified.					
74AUP1G11 v.3	20111124	Product data sheet	-	74AUP1G11 v.2		
Modifications:	Legal pages updated.					
74AUP1G11 v.2	20101020	Product data sheet	-	74AUP1G11 v.1		
74AUP1G11 v.1	20070904	Product data sheet	-	-		

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15. 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.

 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 <u>https://www.nexperia.com</u>.

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