Low-power inverter with open-drain output Rev. 4.1 — 11 July 2023

1. General description

The 74AUP1G06-Q100 is a single inverter with open-drain output. Schmitt-trigger action at all inputs makes the circuit tolerant of slower input rise and fall times. This device ensures 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 potentially damaging backflow current through the device when it is powered down.

This product has been qualified to the Automotive Electronics Council (AEC) standard Q100 (Grade 1) and is suitable for use in automotive applications.

2. Features and benefits

- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
 - Specified from -40 °C to +85 °C and from -40 °C to +125 °C
- Wide supply voltage range from 0.8 V to 3.6 V
- High noise immunity
- CMOS low power dissipation
- Low static power consumption; I_{CC} = 0.9 μA (maximum)
- · Latch-up performance exceeds 100 mA per JESD 78 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
- Complies with JEDEC standards:
 - JESD8-12 (0.8 V to 1.3 V)
 - JESD8-11 (0.9 V to 1.65 V)
 - JESD8-7 (1.65 V to 1.95 V)
 - JESD8-5 (2.3 V to 2.7 V)
 - JESD8C (2.7 V to 3.6 V)
- ESD protection:
 - HBM: ANSI/ESDA/JEDEC JS-001 class 3A exceeds 5000 V
 - CDM: ANSI/ESDA/JEDEC JS-002 class C3 exceeds 1000 V

3. Ordering information

Table 1. Ordering information

Type number	Package								
	emperature range Name Description								
74AUP1G06GW-Q100	-40 °C to +125 °C	TSSOP5	plastic thin shrink small outline package; 5 leads; body width 1.25 mm	<u>SOT353-1</u>					

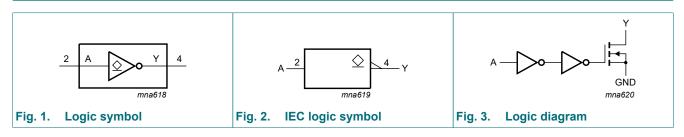
nexperia

4. Marking

Table 2. Marking	
Type number	Marking code [1]
74AUP1G06GW-Q100	pR

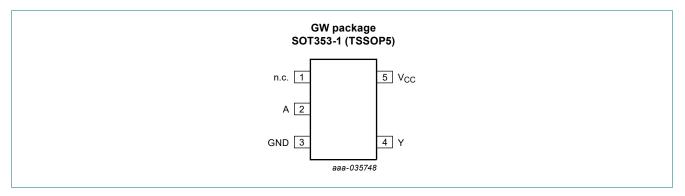
[1] The pin 1 indicator is located on the lower left corner of the device, below the marking code.

5. Functional diagram



6. Pinning information

6.1. Pinning



6.2. Pin description

Symbol	Pin	Description
n.c.	1	not connected
A	2	data input
GND	3	ground (0 V)
Y	4	data output
V _{CC}	5	supply voltage

74AUP1G06_Q100

7. Functional description

Table 4. Function table

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

Input	Output
Α	Y
L	Z
Н	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
Vo	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 SOT353-1 (TSSOP5) package: Ptot derates linearly with 3.3 mW/K above 74 °C.

9. Recommended operating conditions

Table 6. I	Table 6. Recommended operating conditions											
Symbol	Parameter	Conditions	Min	Мах	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	0	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	Max	Unit
T _{amb} = 2	25 °C				1	
V _{IH}	HIGH-level input	V _{CC} = 0.8 V	0.70 × V _{CC}	-	-	V
VIH	voltage	V _{CC} = 0.9 V to 1.95 V	0.65 × V _{CC}	-	-	V
		$V_{CC} = 2.3 V \text{ to } 2.7 V$	1.6	-	-	V
		$V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$	2.0	-	-	V
V _{IL}	LOW-level input voltage		-	-	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 _{OL}	LOW-level output	$V_{I} = V_{IH} \text{ or } V_{IL}$				
	voltage	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
l	input leakage current	V_1 = GND to 3.6 V; V_{CC} = 0 V to 3.6 V	-	-	±0.1	μA
I _{OZ}	OFF-state output current	$V_{I} = V_{IL}; V_{O} = 0 V \text{ to } 3.6 V;$ $V_{CC} = 0 V \text{ to } 3.6 V$	-	-	±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
ΔI _{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	-	-	±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	-	-	0.5	μA
ΔI _{CC}	additional supply current	$V_{I} = V_{CC} - 0.6 V; I_{O} = 0 A; V_{CC} = 3.3 V$	-	-	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	output enabled; V_0 = GND; V_{CC} = 0 V	-	1.7	-	pF
		output disabled; V_0 = GND; V_{CC} = 0 V	-	1.1	-	pF
T _{amb} = -	-40 °C to +85 °C				1	1
VIH	HIGH-level input	V _{CC} = 0.8 V	0.70 × V _{CC}	-	-	V
	voltage	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	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

Low-power inverter with open-drain output

Symbol	Parameter	Conditions	Min	Тур	Мах	Unit
V _{OL}	LOW-level output	V _I = V _{IH} or V _{IL}				
	voltage	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	-	-	$0.3 \times V_{CC}$	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
I _I	input leakage current	V_I = GND to 3.6 V; V_{CC} = 0 V to 3.6 V	-	-	±0.5	μA
I _{OZ}	OFF-state output current	$V_{I} = V_{IL}; V_{O} = 0 V \text{ to } 3.6 V;$ $V_{CC} = 0 V \text{ to } 3.6 V$	-	-	±0.5	μA
I _{OFF}	power-off leakage current	$V_1 \text{ or } V_0 = 0 \text{ V to } 3.6 \text{ V}; V_{CC} = 0 \text{ V}$	-	-	±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
I _{CC}	supply current	$V_{I} = GND \text{ or } V_{CC}; I_{O} = 0 \text{ A};$ $V_{CC} = 0.8 \text{ V to } 3.6 \text{ V}$	-	-	0.9	μA
ΔI _{CC}	additional supply current	$V_{I} = V_{CC} - 0.6 V; I_{O} = 0 A; V_{CC} = 3.3 V$	-	-	50	μA
T _{amb} = -4	40 °C to +125 °C	I				
VIH	HIGH-level input	V _{CC} = 0.8 V	0.75 × V _{CC}	-	-	V
	voltage	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	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 _{OL}	LOW-level output	V _I = V _{IH} or V _{IL}				
	voltage	I_0 = 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

Low-power inverter with open-drain output

Symbol	Parameter	Conditions	Min	Тур	Max	Unit
I _I	input leakage current	V_{I} = GND to 3.6 V; V_{CC} = 0 V to 3.6 V	-	-	±0.75	μA
I _{OZ}	OFF-state output current	$V_{I} = V_{IL}; V_{O} = 0 V \text{ to } 3.6 V;$ $V_{CC} = 0 V \text{ to } 3.6 V$	-	-	±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_{I} or V_{O} = 0 V to 3.6 V; V_{CC} = 0 V to 0.2 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; V _{CC} = 3.3 V	-	-	75	μA

11. Dynamic characteristics

Table 8. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 5.

Symbol	Parameter	Conditions	25 °C			°C to 5 °C	-40 °C to +125 °C		Unit	
			Min	Typ [1]	Мах	Min	Max	Min	Max	1
C _L = 5 p	F									
t _{pd}	propagation	A to Y; see <u>Fig. 4</u> [2]								
	delay	V _{CC} = 0.8 V	-	12.8	-	-	-	-	-	ns
		V _{CC} = 1.1 V to 1.3 V	2.3	4.3	9.9	2.0	10.9	2.0	12.0	ns
		V _{CC} = 1.4 V to 1.6 V	1.8	3.1	6.1	1.5	7.1	1.5	7.8	ns
		V _{CC} = 1.65 V to 1.95 V	1.5	2.8	4.7	1.2	5.7	1.2	6.3	ns
		V _{CC} = 2.3 V to 2.7 V	1.2	2.2	3.2	1.0	3.9	1.0	4.3	ns
		V _{CC} = 3.0 V to 3.6 V	1.1	2.2	3.3	0.8	3.6	0.8	4.0	ns
C _L = 10	pF									-
t _{pd}	propagation delay	A to Y; see <u>Fig. 4</u> [2]								
		V _{CC} = 0.8 V	-	15.8	-	-	-	-	-	ns
		V _{CC} = 1.1 V to 1.3 V	2.7	5.4	11.2	2.5	13.2	2.5	15.0	ns
		V _{CC} = 1.4 V to 1.6 V	2.2	3.9	7.0	2.0	8.5	2.0	9.4	ns
		V _{CC} = 1.65 V to 1.95 V	1.9	3.6	5.4	1.7	6.7	1.7	7.4	ns
		V _{CC} = 2.3 V to 2.7 V	1.7	2.9	3.8	1.4	4.5	1.4	5.0	ns
		V _{CC} = 3.0 V to 3.6 V	1.6	3.2	4.6	1.2	4.9	1.2	5.4	ns
C _L = 15	pF									
t _{pd}	propagation	A to Y; see <u>Fig. 4</u> [2]								
	delay	V _{CC} = 0.8 V	-	18.8	-	-	-	-	-	ns
		V _{CC} = 1.1 V to 1.3 V	3.2	6.4	12.2	2.9	15.2	2.9	17.0	ns
		V _{CC} = 1.4 V to 1.6 V	2.6	4.6	7.7	2.3	9.4	2.3	10.0	ns
		V _{CC} = 1.65 V to 1.95 V	2.3	4.5	6.6	2.1	7.3	2.1	8.1	ns
		V _{CC} = 2.3 V to 2.7 V	2.1	3.5	4.6	1.7	5.1	1.7	5.7	ns
		V _{CC} = 3.0 V to 3.6 V	2.0	4.0	6.0	1.5	6.5	1.5	7.2	ns

Low-power inverter with open-drain output

Symbol	Parameter	arameter Conditions		25 °C		-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	Min	Мах	1
C _L = 30	pF									
t _{pd}	propagation	A to Y; see <u>Fig. 4</u> [2]								
	delay	V _{CC} = 0.8 V	-	27.8	-	-	-	-	-	ns
		V _{CC} = 1.1 V to 1.3 V	4.4	9.3	16.5	3.9	19.3	3.9	21.3	ns
		V _{CC} = 1.4 V to 1.6 V	3.6	6.8	10.1	3.2	12.0	3.2	13.2	ns
		V _{CC} = 1.65 V to 1.95 V	3.2	6.8	10.7	2.9	11.0	2.9	12.1	ns
		V _{CC} = 2.3 V to 2.7 V	2.9	5.3	7.2	2.6	7.8	2.6	8.6	ns
		V _{CC} = 3.0 V to 3.6 V	2.9	6.5	10.5	2.5	10.8	2.5	11.9	ns
C _L = 5 p	F, 10 pF, 15 p	F and 30 pF								
C _{PD}	power	$f_i = 1 \text{ MHz}; V_I = \text{GND to } V_{\text{CC}}$ [3]								
	dissipation capacitance	V _{CC} = 0.8 V	-	0.5	-	-	-	-	-	pF
	Capacitance	V _{CC} = 1.1 V to 1.3 V	-	0.6	-	-	-	-	-	pF
		V _{CC} = 1.4 V to 1.6 V	-	0.7	-	-	-	-	-	pF
		V _{CC} = 1.65 V to 1.95 V	-	0.7	-	-	-	-	-	pF
		V _{CC} = 2.3 V to 2.7 V	-	1.0	-	-	-	-	-	pF
		V _{CC} = 3.0 V to 3.6 V	-	1.2	-	-	-	-	-	pF

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

[2]

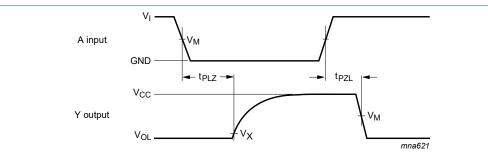
 t_{pd} is the same as t_{PZL} and t_{PLZ} . C_{PD} is used to determine the dynamic power dissipation (P_D in μ W). $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N$ where: [3]

 f_i = input frequency in MHz;

V_{CC} = supply voltage in V;

N = number of inputs switching.

11.1. Waveforms and test circuit



Measurement points are given in Table 9.

Logic level: V_{OL} is the typical output voltage level that occurs at the output load.

The data input (A) to output (Y) propagation delays Fig. 4.

Table 9. Measurement points										
Supply voltage	upply voltage Input			Output						
V _{cc}	V _M	VI	t _r = t _f	V _M	V _X					
0.8 V to 1.6 V	$0.5 \times V_{CC}$	V _{CC}	≤ 3.0 ns	0.5 × V _{CC}	V _{OL} + 0.1 V					
1.65 V to 2.7 V	$0.5 \times V_{CC}$	V _{CC}	≤ 3.0 ns	0.5 × V _{CC}	V _{OL} + 0.15 V					
3.0 V to 3.6 V	$0.5 \times V_{CC}$	V _{CC}	≤ 3.0 ns	0.5 × V _{CC}	V _{OL} + 0.3 V					

Low-power inverter with open-drain output

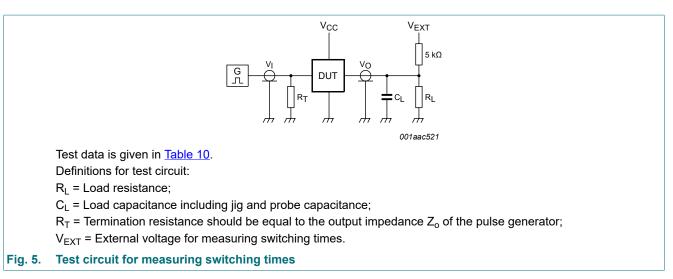


Table 10. Test data

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 k Ω or 1 M Ω	open	GND	$2 \times V_{CC}$

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

For measuring propagation delays, setup and hold times and pulse width R_L = 1 $M\Omega.$

74AUP1G06_Q100

Low-power inverter with open-drain output

12. Package outline

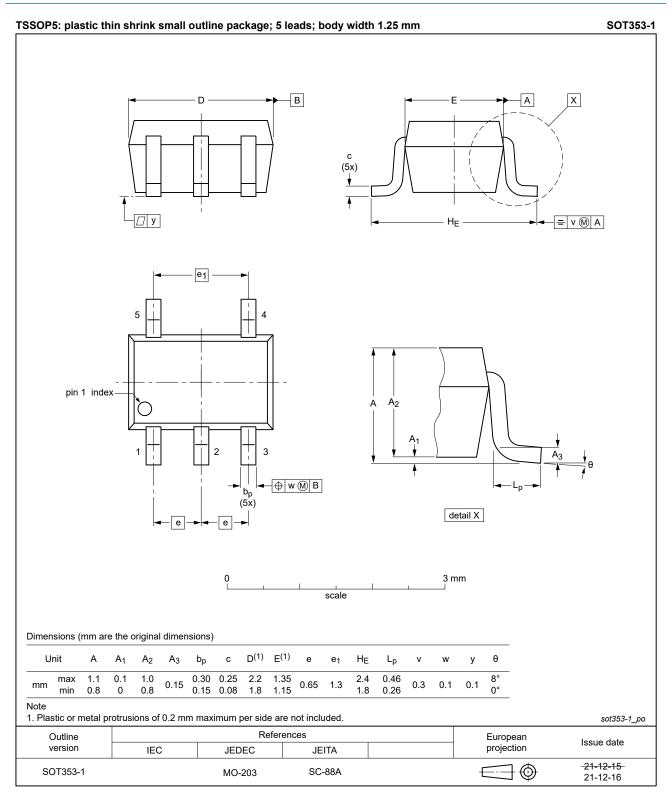


Fig. 6. Package outline SOT353-1 (TSSOP5)

13. Abbreviations

Table 11. Abbreviations				
Acronym	Description			
CMOS	Complementary Metal-Oxide Semiconductor			
DUT	Device Under Test			
ESD	ElectroStatic Discharge			
HBM	Human Body Model			

14. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes		
74AUP1G06_Q100 v.4.1	20230711	Product data sheet	-	74AUP1G06_Q100 v.3		
Modifications:	• <u>Section 2</u> : E	• <u>Section 2</u> : ESD specification updated according to the latest JEDEC standard.				
74AUP1G06_Q100 v.3	20220113	Product data sheet	-	74AUP1G06_Q100 v.2		
Modifications:		 <u>Section 1</u> and <u>Section 2</u> updated. <u>Fig. 6</u>: Package outline drawing for SOT353-1 (TSSOP5) has changed. 				
74AUP1G06_Q100 v.2	20210706	Product data sheet	-	74AUP1G06_Q100 v.1		
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. <u>Section 1</u> and <u>Section 2</u> updated. <u>Table 5</u>: Derating values for P_{tot} total power dissipation have been updated. 					
74AUP1G06_Q100 v.1	20130131	Product data sheet	-	-		

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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