74AHC1G4212

12-stage divider and oscillator

Rev. 5 — 13 January 2022 | Product data sheet

1. General description

74AHC1G4212 is a 12-stage divider and oscillator. It consists of a chain of 12 flip-flops. Each flip-flop divides the frequency of the previous flip-flop by two, consequently the 74AHC1G4212 counts up to 2^{12} = 4096. The single inverting stage (X1 to X2) functions as a crystal oscillator or an input buffer for an external oscillator. When used as a buffer the output X2 should be left floating. The frequency of the output (Q) is the frequency applied to X1 divided by 4096. The divider advances on the negative-going transition of X1.

The X1 input is overvoltage tolerant. This feature allows the use of this device as a voltage level translator in mixed voltage environments.

2. Features and benefits

- Wide supply voltage range from 2.0 V to 5.5 V
- Overvoltage tolerant inputs to 5.5 V
- High noise immunity
- CMOS low power dissipation
- Latch-up performance exceeds 100 mA per JESD 78 Class II
- ESD protection:
  - HBM JESD22-A114F: exceeds 2000 V
  - CDM JESD22-C101E: exceeds 1000 V
- Specified from -40 °C to +85 °C and from -40 °C to +125 °C

3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74AHC1G4212GW	-40 °C to +125 °C	TSSOP5	plastic thin shrink small outline package; 5 leads; body width 1.25 mm	SOT353-1

4. Marking

Table 2. Marking codes

Type number	Marking[1]
74AHC1G4212GW	C2

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

5. Functional diagram

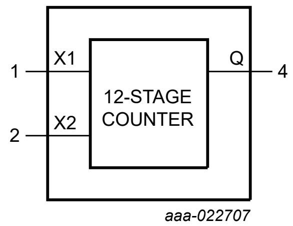


Fig. 1. Logic symbol

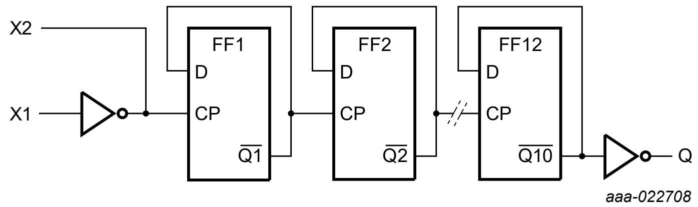


Fig. 2. Logic diagram

6. Pinning information

6.1. Pinning

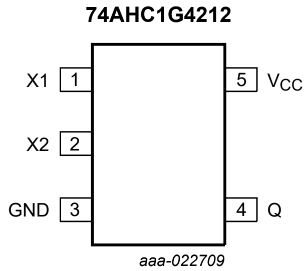


Fig. 3. Pin configuration SOT353-1 (TSSOP5)

6.2. Pin description

Table 3. Pin description

Symbol	Pin	Description
X1	1	clock input/oscillator pin
X2	2	oscillator pin
GND	3	ground (0 V)
Q	4	divider output
V_{CC}	5	supply voltage

7. Functional description

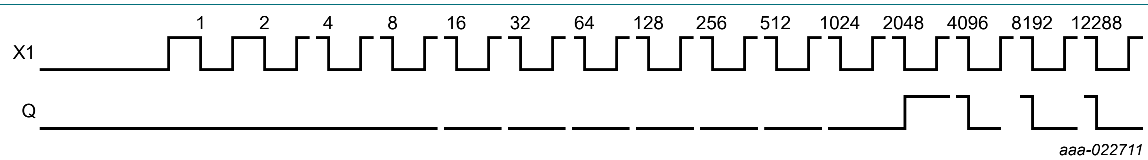


Fig. 4. Timing diagram

8. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	supply voltage		-0.5	+7.0	V
V_I	input voltage		-0.5	+7.0	V
I_{IK}	input clamping current	V_I < -0.5 V	-20	-	mA
I_{OK}	output clamping current	V_O < -0.5 V or V_O > V_{CC} + 0.5 V [1]	-	±20	mA
I_O	output current	-0.5 V < V_O < V_{CC} + 0.5 V	-	±25	mA
I_{CC}	supply current		-	75	mA
I_{GND}	ground current		-75	-	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: P_{tot} derates linearly with 3.3 mW/K above 74 °C.

9. Recommended operating conditions

Table 5. Recommended operating conditions

Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CC}	supply voltage		2.0	5.0	5.5	V
V_I	input voltage		0	-	5.5	V
V_O	output voltage		0	-	V_{CC}	V
T_{amb}	ambient temperature		-40	+25	+125	°C
Δt/ΔV	input transition rise and fall rate	V_{CC} = 3.3 V ± 0.3 V	-	-	100	ns/V
		V_{CC} = 5.0 V ± 0.5 V	-	-	20	ns/V

10. Static characteristics

Table 6. Static characteristics

Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
V_{IH}	HIGH-level input voltage	X1								
		V_{CC} = 2.0 V	1.7	-	-	1.7	-	1.7	-	V
		V_{CC} = 3.0 V	2.4	-	-	2.4	-	2.4	-	V
		V_{CC} = 5.5 V	4.4	-	-	4.4	-	4.4	-	V
V_{IL}	LOW-level input voltage	X1								
		V_{CC} = 2.0 V	-	-	0.3	-	0.3	-	0.3	V
		V_{CC} = 3.0 V	-	-	0.6	-	0.6	-	0.6	V
		V_{CC} = 5.5 V	-	-	1.1	-	1.1	-	1.1	V
V_{OH}	HIGH-level output voltage	Q; V_I = V_{IH} or V_{IL}								
		I_O = -50 μA; V_{CC} = 2.0 V	1.9	2.0	-	1.9	-	1.9	-	V
		I_O = -50 μA; V_{CC} = 3.0 V	2.9	3.0	-	2.9	-	2.9	-	V
		I_O = -50 μA; V_{CC} = 4.5 V	4.4	4.5	-	4.4	-	4.4	-	V
		I_O = -4.0 mA; V_{CC} = 3.0 V	2.58	-	-	2.48	-	2.40	-	V
		I_O = -8.0 mA; V_{CC} = 4.5 V	3.94	-	-	3.8	-	3.70	-	V
		X2; V_I = V_{IH} or V_{IL}								
		I_O = -50 μA; V_{CC} = 2.0 V	1.9	2.0	-	1.9	-	1.9	-	V
		I_O = -50 μA; V_{CC} = 3.0 V	2.9	3.0	-	2.9	-	2.9	-	V
		I_O = -50 μA; V_{CC} = 4.5 V	4.4	4.5	-	4.4	-	4.4	-	V
		I_O = -2.0 mA; V_{CC} = 3.0 V	2.58	-	-	2.48	-	2.40	-	V
		I_O = -3.0 mA; V_{CC} = 4.5 V	3.94	-	-	3.8	-	3.70	-	V
V_{OL}	LOW-level output voltage	Q; V_I = V_{IH} or V_{IL}								
		I_O = 50 μA; V_{CC} = 2.0 V	-	0	0.1	-	0.1	-	0.1	V
		I_O = 50 μA; V_{CC} = 3.0 V	-	0	0.1	-	0.1	-	0.1	V
		I_O = 50 μA; V_{CC} = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I_O = 4.0 mA; V_{CC} = 3.0 V	-	-	0.36	-	0.44	-	0.55	V
		I_O = 8.0 mA; V_{CC} = 4.5 V	-	-	0.36	-	0.44	-	0.55	V
		X2; V_I = V_{IH} or V_{IL}								
		I_O = 50 μA; V_{CC} = 2.0 V	-	0	0.1	-	0.1	-	0.1	V
		I_O = 50 μA; V_{CC} = 3.0 V	-	0	0.1	-	0.1	-	0.1	V
		I_O = 50 μA; V_{CC} = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I_O = 2.0 mA; V_{CC} = 3.0 V	-	-	0.36	-	0.44	-	0.55	V
		I_O = 3.0 mA; V_{CC} = 4.5 V	-	-	0.36	-	0.44	-	0.55	V
I_I	input leakage current	X1; V_I = 5.5 V or GND; V_{CC} = 0 V to 5.5 V	-	-	0.1	-	1.0	-	2.0	μA
I_{CC}	supply current	V_I = V_{CC} or GND; I_O = 0 A; V_{CC} = 5.5 V	-	-	1.0	-	10	-	40	μA
C_I	input capacitance	X1	-	3	8	-	8	-	8	pF

11. Dynamic characteristics

Table 7. Dynamic characteristics

GND = 0 V; t_r = t_f = ≤ 3.0 ns. For test circuit see Fig. 7. For waveforms see Fig. 5 and Fig. 6.

Symbol	Parameter	Conditions		25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
				Min	Typ	Max	Min	Max	Min	Max	
t_{pd}	propagation delay	X1 to X2;	[1]								
		V_{CC} = 3.0 V to 3.6 V	[2]								
		C_L = 15 pF		-	3	7	1	11	1	13	ns
		C_L = 50 pF		-	7	13	1	16	1	18	ns
		V_{CC} = 4.5 V to 5.5 V	[3]								
		C_L = 15 pF		-	2	5	1	7	1	9	ns
		C_L = 50 pF		-	6	10	1	11	1	12	ns
		X1 to Q;	[1]								
		V_{CC} = 3.0 V to 3.6 V	[2]								
		C_L = 15 pF		-	28	48	1	59	1	68	ns
		C_L = 50 pF		-	31	52	1	62	1	73	ns
		V_{CC} = 4.5 V to 5.5 V	[3]								
		C_L = 15 pF		-	20	31	1	39	1	45	ns
		C_L = 50 pF		-	22	35	1	45	1	51	ns
t_W	pulse width	X1 HIGH or LOW									
		V_{CC} = 3.0 V to 3.6 V		4	-	-	5	-	7	-	ns
		V_{CC} = 4.5 V to 5.5 V		3	-	-	4	-	5	-	ns
f_{max}	maximum frequency	X1									
		V_{CC} = 3.3 V		125	-	-	100	-	70	-	MHz
		V_{CC} = 5 V		165	-	-	125	-	100	-	MHz
C_{PD}	power dissipation capacitance	C_L = 50 pF; f_i = 1 MHz; V_I = GND to V_{CC}	[4]								
		V_{CC} = 3.3 V		-	4	-	-	-	-	-	pF
		V_{CC} = 5 V		-	5	-	-	-	-	-	pF

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

[2] Typical values are measured at V_{CC} = 3.3 V.

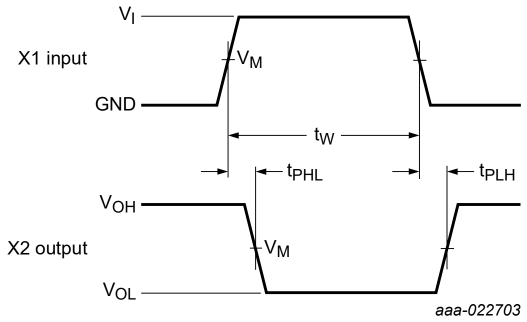
[3] Typical values are measured at V_{CC} = 5.0 V.

[4] C_{PD} is used to determine the dynamic power dissipation P_D (μW).

$P_D = C_{PD} \times V_{CC}^2 \times f_i + C_L \times V_{CC}^2 \times f_i/4096$ where:

f_i = input frequency in MHz; C_L = output load capacitance in pF; V_{CC} = supply voltage in Volt.

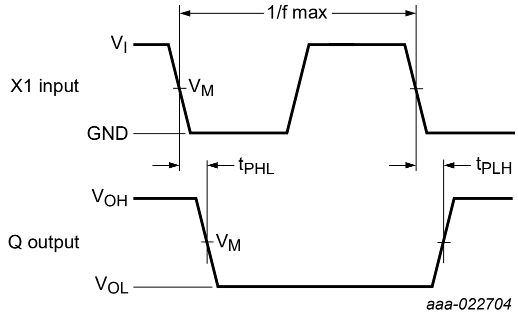
11.1. Waveforms and test circuit



Measurement points are given in Table 8.

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

Fig. 5. Input X1 to output X2 propagation delay times



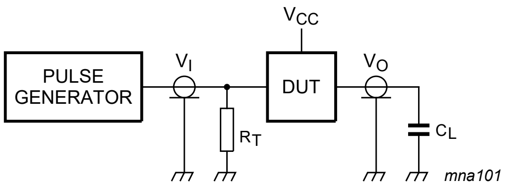
Measurement points are given in Table 8.

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

Fig. 6. Input X1 to output Q propagation delay times

Table 8. Measurement points

Inputs		Output
V_I	V_M	V_M
GND to V_{CC}	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$



Test data is given in Table 7. Definitions for test circuit:

C_L = Load capacitance including jig and probe capacitance.

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

Fig. 7. Test circuit for measuring switching times

12. Crystal oscillator

12.1. Typical crystal oscillator circuit

A typical crystal oscillator schematic is shown in Fig. 8. R1 is the power limiting resistor, its value depends on the frequency and required stability against changes in V_{CC} or average I_{CC}. For starting and maintaining oscillation a minimum transconductance is necessary, so R1 should not be too large. A practical value for R1 is 2.2 kΩ.

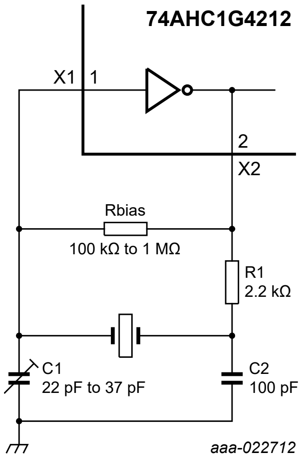
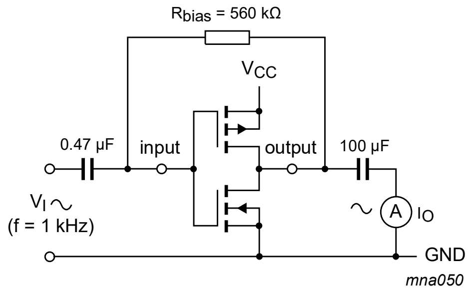


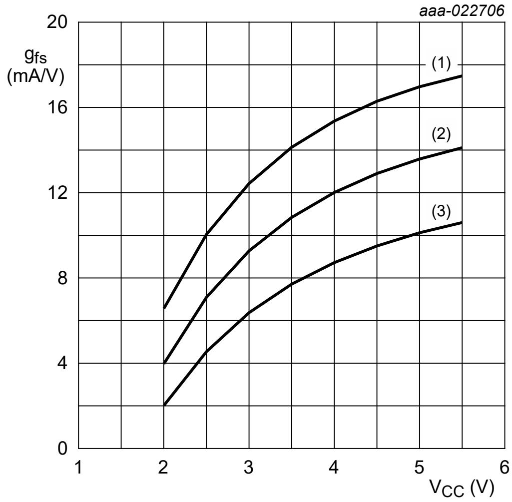
Fig. 8. External component connection for a crystal oscillator



$g_{fs} = \Delta I_O / \Delta V_I$ at V_O is constant.

See also Fig. 10.

Fig. 9. Test set-up for measuring forward transconductance



T_{amb} = 25 °C.

(1) Maximum.

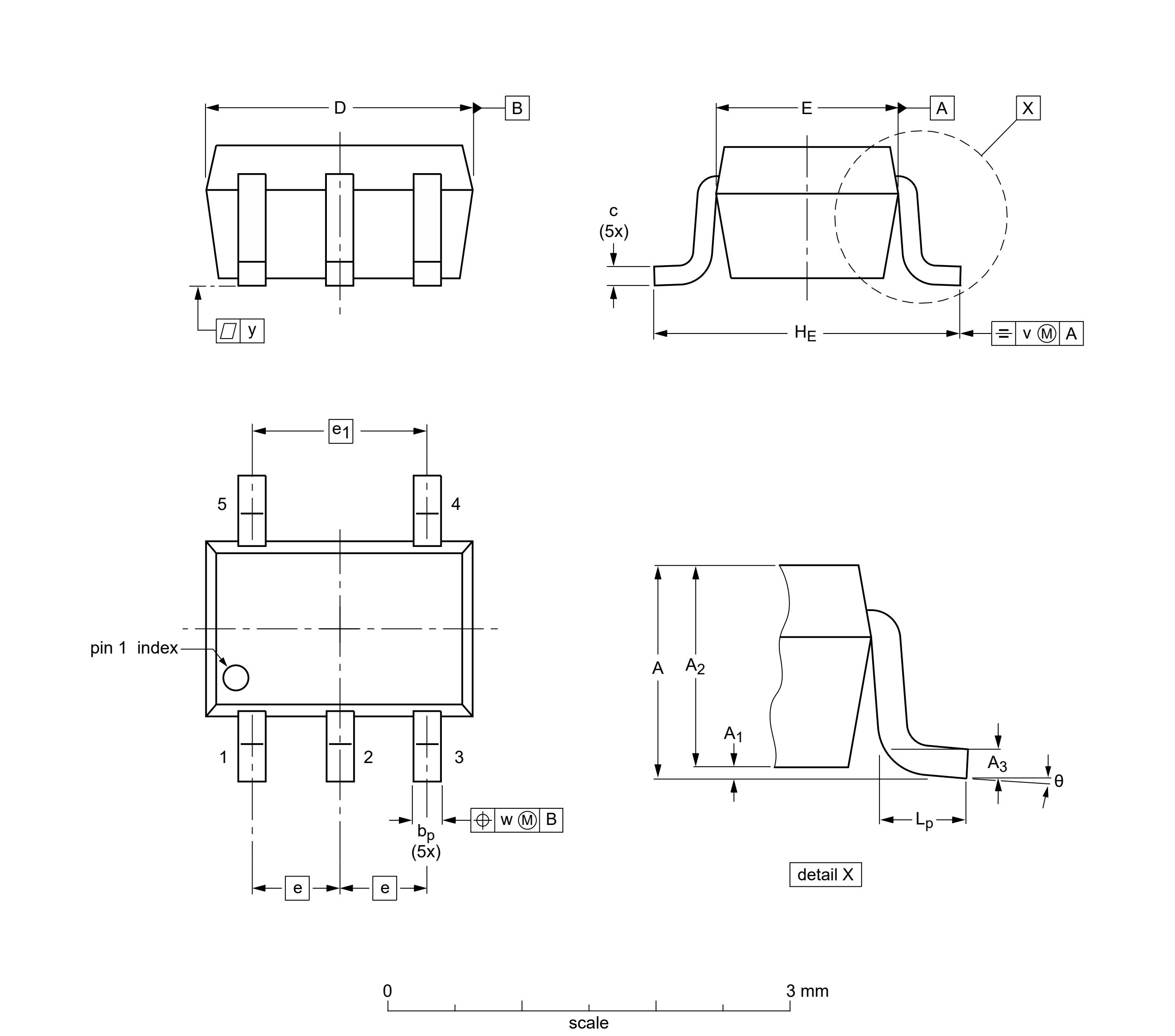
(2) Typical.

(3) Minimum.

Fig. 10. Typical forward transconductance as function of the supply voltage

13. Package outline

TSSOP5: plastic thin shrink small outline package; 5 leads; body width 1.25 mm **SOT353-1**



Dimensions (mm are the original dimensions)

Unit		A	A_1	A_2	A_3	b_p	c	D[1]	E[1]	e	e_1	H_E	L_p	v	w	y	θ
mm	max	1.1	0.1	1.0	0.15	0.30	0.25	2.2	1.35	0.65	1.3	2.4	0.46	0.3	0.1	0.1	8°
	min	0.8	0	0.8		0.15	0.08	1.8	1.15			1.8	0.26				0°

Note
1. Plastic or metal protrusions of 0.2 mm maximum per side are not included.

sot353-1_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT353-1		MO-203	SC-88A			~~21-12-15~~ 21-12-16

Fig. 11. Package outline SOT353-1 (TSSOP5)

14. Abbreviations

Table 9. Abbreviations

Acronym	Description
CDM	Charged Device Model
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model

15. Revision history

Table 10. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74AHC1G4212 v.5	20220113	Product data sheet	-	74AHC1G4212 v.4
Modifications:	• Fig. 11: Package outline drawing SOT353-1 (TSSOP5) updated.			
74AHC1G4212 v.4	20190627	Product data sheet	-	74AHC1G4212 v.3
Modifications:	• Typo corrected in Fig. 4.			
74AHC1G4212 v.3	20180425	Product data sheet	-	74AHC1G4212 v.2
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.			
74AHC1G4212 v.2	20161026	Product data sheet	-	74AHC1G4212 v.1
Modifications:	• Type number 74AHC1G4212GM removed.			
74AHC1G4212 v.1	20160415	Product data sheet	-	-

16. 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.

Definitions

Draft — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. Nexperia does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

Short data sheet — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local Nexperia sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

Product specification — The information and data provided in a Product data sheet shall define the specification of the product as agreed between Nexperia and its customer, unless Nexperia and customer have explicitly agreed otherwise in writing. In no event however, shall an agreement be valid in which the Nexperia product is deemed to offer functions and qualities beyond those described in the Product data sheet.

Disclaimers

Limited warranty and liability — Information in this document is believed to be accurate and reliable. However, Nexperia does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information. Nexperia takes no responsibility for the content in this document if provided by an information source outside of Nexperia.

In no event shall Nexperia be liable for any indirect, incidental, punitive, special or consequential damages (including - without limitation - lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory.

Notwithstanding any damages that customer might incur for any reason whatsoever, Nexperia's aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the Terms and conditions of commercial sale of Nexperia.

Right to make changes — Nexperia reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

Suitability for use — Nexperia products are not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical systems or equipment, nor in applications where failure or malfunction of an Nexperia product can reasonably be expected to result in personal injury, death or severe property or environmental damage. Nexperia and its suppliers accept no liability for inclusion and/or use of Nexperia products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

Quick reference data — The Quick reference data is an extract of the product data given in the Limiting values and Characteristics sections of this document, and as such is not complete, exhaustive or legally binding.

Applications — Applications that are described herein for any of these products are for illustrative purposes only. Nexperia makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Customers are responsible for the design and operation of their applications and products using Nexperia products, and Nexperia accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the Nexperia product is suitable and fit for the customer's applications and products planned, as well as for the planned application and use of customer's third party customer(s). Customers should provide appropriate design and operating safeguards to minimize the risks associated with their applications and products.

Nexperia does not accept any liability related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products, or the application or use by customer's third party customer(s). Customer is responsible for doing all necessary testing for the customer's applications and products using Nexperia products in order to avoid a default of the applications and the products or of the application or use by customer's third party customer(s). Nexperia does not accept any liability in this respect.

Limiting values — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) will cause permanent damage to the device. Limiting values are stress ratings only and (proper) operation of the device at these or any other conditions above those given in the Recommended operating conditions section (if present) or the Characteristics sections of this document is not warranted. Constant or repeated exposure to limiting values will permanently and irreversibly affect the quality and reliability of the device.

Terms and conditions of commercial sale — Nexperia products are sold subject to the general terms and conditions of commercial sale, as published at http://www.nexperia.com/profile/terms, unless otherwise agreed in a valid written individual agreement. In case an individual agreement is concluded only the terms and conditions of the respective agreement shall apply. Nexperia hereby expressly objects to applying the customer's general terms and conditions with regard to the purchase of Nexperia products by customer.

No offer to sell or license — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

Export control — This document as well as the item(s) described herein may be subject to export control regulations. Export might require a prior authorization from competent authorities.

Non-automotive qualified products — Unless this data sheet expressly states that this specific Nexperia product is automotive qualified, the product is not suitable for automotive use. It is neither qualified nor tested in accordance with automotive testing or application requirements. Nexperia accepts no liability for inclusion and/or use of non-automotive qualified products in automotive equipment or applications.

In the event that customer uses the product for design-in and use in automotive applications to automotive specifications and standards, customer (a) shall use the product without Nexperia's warranty of the product for such automotive applications, use and specifications, and (b) whenever customer uses the product for automotive applications beyond Nexperia's specifications such use shall be solely at customer's own risk, and (c) customer fully indemnifies Nexperia for any liability, damages or failed product claims resulting from customer design and use of the product for automotive applications beyond Nexperia's standard warranty and Nexperia's product specifications.

Translations — A non-English (translated) version of a document is for reference only. The English version shall prevail in case of any discrepancy between the translated and English versions.

Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

Contents

For more information, please visit: http://www.nexperia.com
For sales office addresses, please send an email to: salesaddresses@nexperia.com
Date of release: 13 January 2022