74AHC1G4212-Q100

12-stage divider and oscillator

Rev. 3 — 13 January 2022 Product data sheet

1. General description

74AHC1G4212-Q100 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-Q100 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.

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 2.0 V to 5.5 V
- Overvoltage tolerant inputs to 5.5 V
- High noise immunity
- CMOS low power dissipation
- ESD protection:
  - MIL-STD-883, method 3015 exceeds 2000 V
  - HBM JESD22-A114F: exceeds 2000 V
  - CDM JESD22-C101E: exceeds 1000 V
- Latch-up performance exceeds 100 mA per JESD 78 Class II

3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74AHC1G4212GW-Q100	-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-Q100	C2

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

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5. Functional diagram

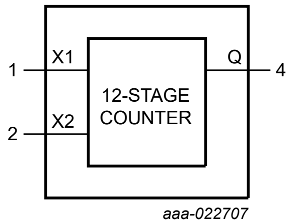


Fig. 1. Logic symbol

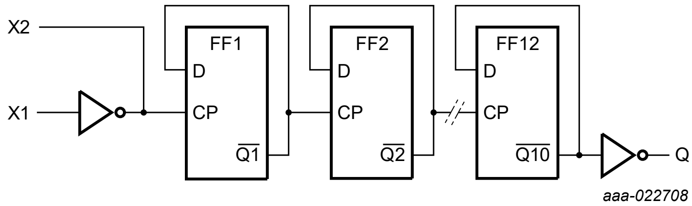


Fig. 2. Logic diagram

6. Pinning information

6.1. Pinning

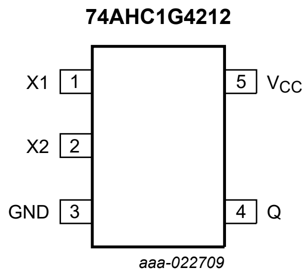


Fig. 3. Pin configuration SOT353-1 (TSSOP5)

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

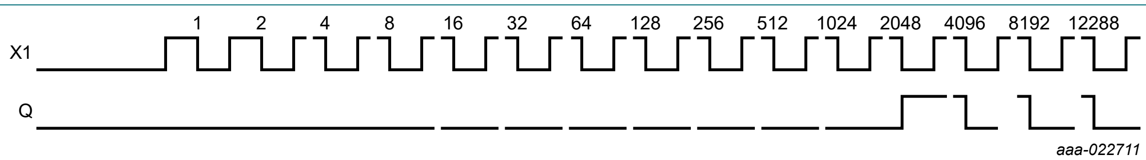


Fig. 4. Timing diagram

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

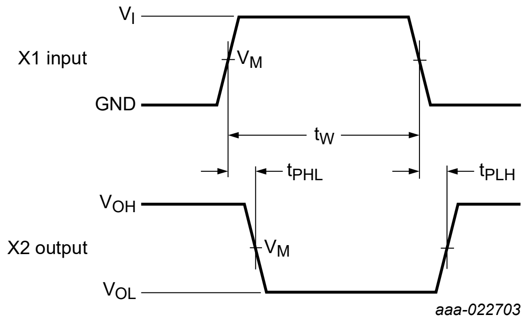
Table 7. Dynamic characteristics

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.

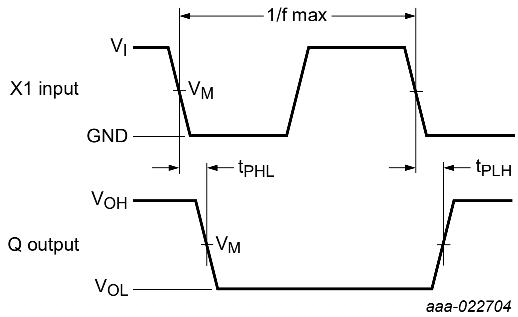
11.1. Waveforms and test circuit



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



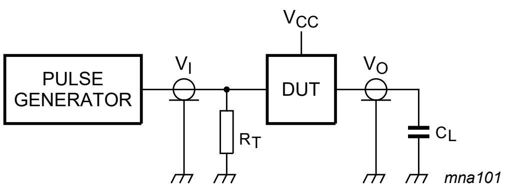
Measurement points are given in Table 8.

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.

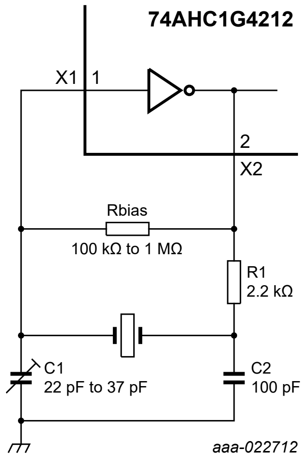
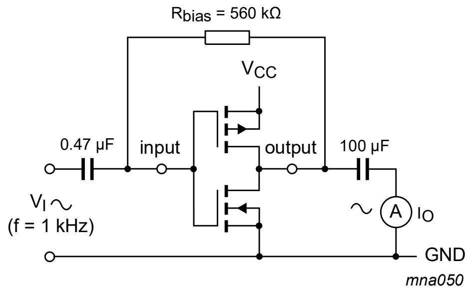


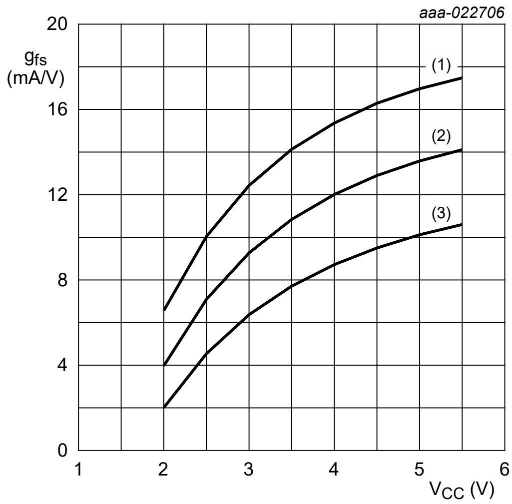
Fig. 8. External component connection for a crystal oscillator



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

See also Fig. 10.

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



T_{amb} = 25 °C.

(1) Maximum.

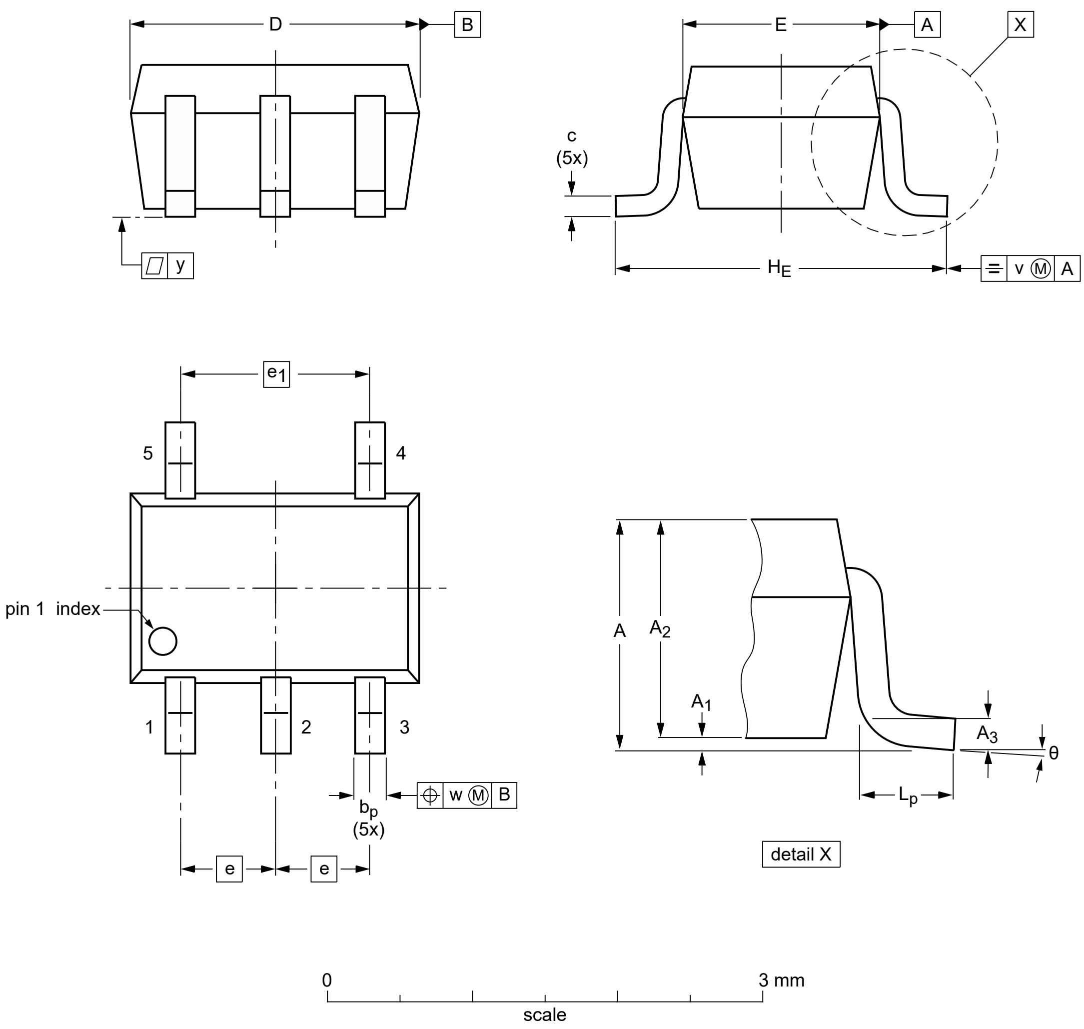
(2) Typical.

(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
MIL	Military

15. Revision history

Table 10. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74AHC1G4212_Q100 v.3	20220113	Product data sheet	-	74AHC1G4212_Q100 v.2
Modifications:	• Fig. 11: Package outline drawing SOT353-1 (TSSOP5) updated.			
74AHC1G4212_Q100 v.2	20190627	Product data sheet	-	74AHC1G4212_Q100 v.1
Modifications:	• Typo corrected in Fig. 4.			
74AHC1G4212_Q100 v.1	20190208	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".
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Date of release: 13 January 2022