

# 74AHC1G4215

## 15-stage divider and oscillator

Rev. 1 — 8 April 2019

Product data sheet

## 1. General description

74AHC1G4215 is a 15-stage divider and oscillator. It consists of a chain of 15 flip-flops. Each flip-flop divides the frequency of the previous flip-flop by two, consequently the 74AHC1G4215 counts up to  $2^{15} = 32768$ . 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 32768. 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
- ESD protection:
  - HBM: ANSI/ESDA/Jedec JS-001 exceeds 2000 V
  - CDM: ANSI/ESDA/Jedec JS-002 exceeds 1000 V
- Latch-up performance exceeds 100 mA per JESD 78 Class II
- 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  |
| 74AHC1G4215GW | -40 °C to +125 °C | TSSOP5 | plastic thin shrink small outline package;<br>5 leads; body width 1.25 mm | SOT353-1 |

## 4. Marking

Table 2. Marking codes

| Type number   | Marking[1] |
|---------------|------------|
| 74AHC1G4215GW | C6         |

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

## 5. Functional diagram

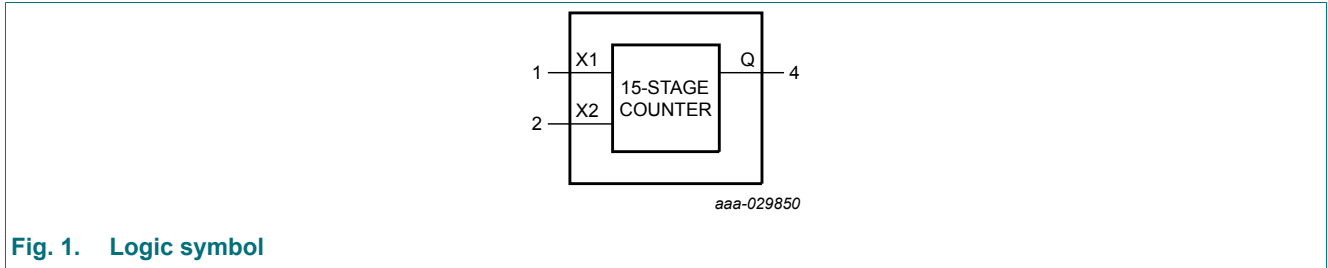


Fig. 1. Logic symbol

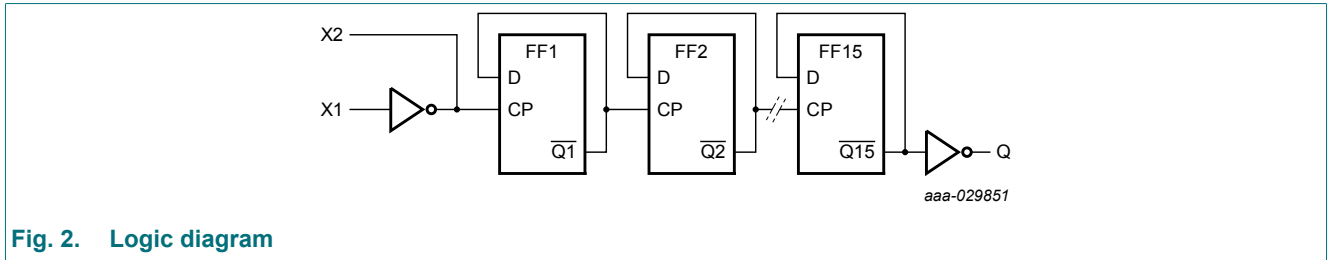


Fig. 2. Logic diagram

## 6. Pinning information

### 6.1. Pinning

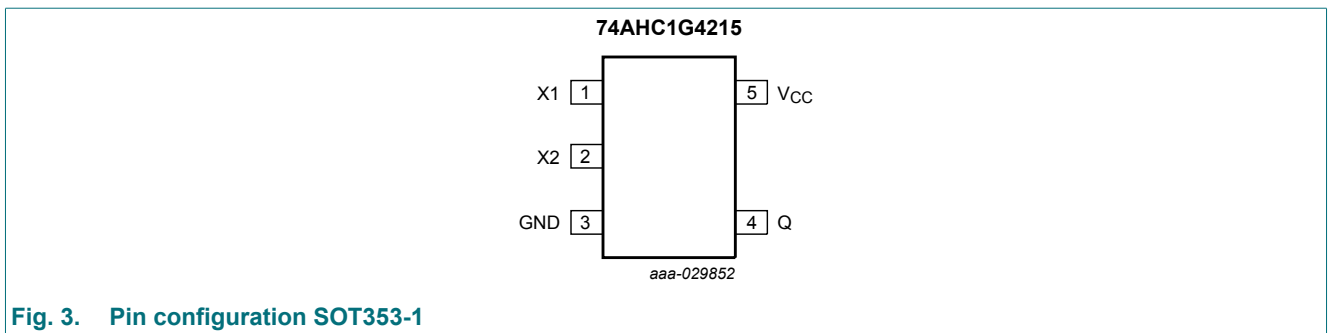


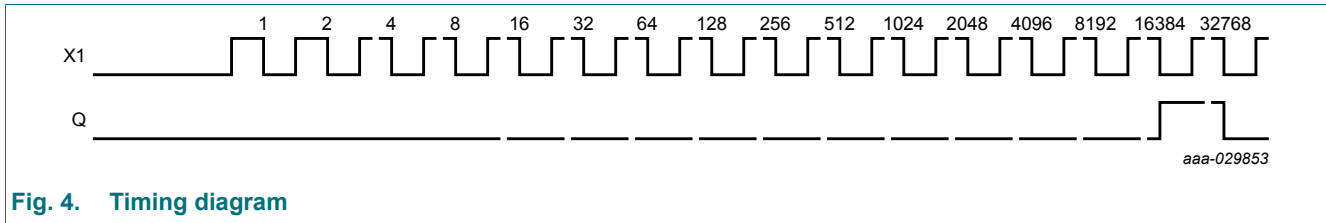
Fig. 3. Pin configuration SOT353-1

### 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 <sub>CC</sub> | 5   | supply voltage             |

## 7. Functional description



## 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  | $V_I < -0.5\text{ V}$                                      | -20  | -    | mA   |
| $I_{OK}$  | output clamping current | $V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$ [1] | -    | ±20  | mA   |
| $I_O$     | output current          | $-0.5\text{ V} < V_O < V_{CC} + 0.5\text{ V}$              | -    | ±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 | $T_{amb} = -40\text{ °C}$ to $+125\text{ °C}$ [2]          | -    | 250  | mW   |

[1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

[2] For TSSOP5 package: above 87.5 °C the value of  $P_{tot}$  derates linearly with 4.0 mW/K.

## 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   |
| $\Delta t/\Delta V$ | input transition rise and fall rate | $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ | -   | -   | 100      | ns/V |
|                     |                                     | $V_{CC} = 5.0\text{ V} \pm 0.5\text{ V}$ | -   | -   | 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 <sub>IH</sub>                                   | HIGH-level input voltage  | X1  |       |     |      |                  |      |                   |      |      |
|   |                           | V <sub>CC</sub> = 2.0 V   | 1.7   | -   | -    | 1.7              | -    | 1.7               | -    | V    |
|   |                           | V <sub>CC</sub> = 3.0 V   | 2.4   | -   | -    | 2.4              | -    | 2.4               | -    | V    |
|   |                           | V <sub>CC</sub> = 5.5 V   | 4.4   | -   | -    | 4.4              | -    | 4.4               | -    | V    |
| V <sub>IL</sub>                                   | LOW-level input voltage   | X1  |       |     |      |                  |      |                   |      |      |
|   |                           | V <sub>CC</sub> = 2.0 V   | -     | -   | 0.3  | -                | 0.3  | -                 | 0.3  | V    |
|   |                           | V <sub>CC</sub> = 3.0 V   | -     | -   | 0.6  | -                | 0.6  | -                 | 0.6  | V    |
|   |                           | V <sub>CC</sub> = 5.5 V   | -     | -   | 1.1  | -                | 1.1  | -                 | 1.1  | V    |
| V <sub>OH</sub>                                   | HIGH-level output voltage | Q; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                    |       |     |      |                  |      |                   |      |      |
|   |                           | I <sub>O</sub> = -50 μA; V <sub>CC</sub> = 2.0 V  | 1.9   | 2.0 | -    | 1.9              | -    | 1.9               | -    | V    |
|   |                           | I <sub>O</sub> = -50 μA; V <sub>CC</sub> = 3.0 V  | 2.9   | 3.0 | -    | 2.9              | -    | 2.9               | -    | V    |
|   |                           | I <sub>O</sub> = -50 μA; V <sub>CC</sub> = 4.5 V  | 4.4   | 4.5 | -    | 4.4              | -    | 4.4               | -    | V    |
|   |                           | I <sub>O</sub> = -4.0 mA; V <sub>CC</sub> = 3.0 V   | 2.58  | -   | -    | 2.48             | -    | 2.40              | -    | V    |
|   |                           | I <sub>O</sub> = -8.0 mA; V <sub>CC</sub> = 4.5 V   | 3.94  | -   | -    | 3.8              | -    | 3.70              | -    | V    |
|   |                           | X2; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                   |       |     |      |                  |      |                   |      |      |
|   |                           | I <sub>O</sub> = -50 μA; V <sub>CC</sub> = 2.0 V  | 1.9   | 2.0 | -    | 1.9              | -    | 1.9               | -    | V    |
|   |                           | I <sub>O</sub> = -50 μA; V <sub>CC</sub> = 3.0 V  | 2.9   | 3.0 | -    | 2.9              | -    | 2.9               | -    | V    |
|   |                           | I <sub>O</sub> = -50 μA; V <sub>CC</sub> = 4.5 V  | 4.4   | 4.5 | -    | 4.4              | -    | 4.4               | -    | V    |
|   |                           | I <sub>O</sub> = -2.0 mA; V <sub>CC</sub> = 3.0 V   | 2.58  | -   | -    | 2.48             | -    | 2.40              | -    | V    |
| I <sub>O</sub> = -3.0 mA; V <sub>CC</sub> = 4.5 V | 3.94                      | -   | -     | 3.8 | -    | 3.70             | -    | V                 |      |      |
| V <sub>OL</sub>                                   | LOW-level output voltage  | Q; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                    |       |     |      |                  |      |                   |      |      |
|   |                           | I <sub>O</sub> = 50 μA; V <sub>CC</sub> = 2.0 V   | -     | 0   | 0.1  | -                | 0.1  | -                 | 0.1  | V    |
|   |                           | I <sub>O</sub> = 50 μA; V <sub>CC</sub> = 3.0 V   | -     | 0   | 0.1  | -                | 0.1  | -                 | 0.1  | V    |
|   |                           | I <sub>O</sub> = 50 μA; V <sub>CC</sub> = 4.5 V   | -     | 0   | 0.1  | -                | 0.1  | -                 | 0.1  | V    |
|   |                           | I <sub>O</sub> = 4.0 mA; V <sub>CC</sub> = 3.0 V  | -     | -   | 0.36 | -                | 0.44 | -                 | 0.55 | V    |
|   |                           | I <sub>O</sub> = 8.0 mA; V <sub>CC</sub> = 4.5 V  | -     | -   | 0.36 | -                | 0.44 | -                 | 0.55 | V    |
|   |                           | X2; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                   |       |     |      |                  |      |                   |      |      |
|   |                           | I <sub>O</sub> = 50 μA; V <sub>CC</sub> = 2.0 V   | -     | 0   | 0.1  | -                | 0.1  | -                 | 0.1  | V    |
|   |                           | I <sub>O</sub> = 50 μA; V <sub>CC</sub> = 3.0 V   | -     | 0   | 0.1  | -                | 0.1  | -                 | 0.1  | V    |
|   |                           | I <sub>O</sub> = 50 μA; V <sub>CC</sub> = 4.5 V   | -     | 0   | 0.1  | -                | 0.1  | -                 | 0.1  | V    |
|   |                           | I <sub>O</sub> = 2.0 mA; V <sub>CC</sub> = 3.0 V  | -     | -   | 0.36 | -                | 0.44 | -                 | 0.55 | V    |
| I <sub>O</sub> = 3.0 mA; V <sub>CC</sub> = 4.5 V  | -                         | -   | 0.36  | -   | 0.44 | -                | 0.55 | V                 |      |      |
| I <sub>I</sub>                                    | input leakage current     | X1; V <sub>I</sub> = 5.5 V or GND;<br>V <sub>CC</sub> = 0 V to 5.5 V                      | -     | -   | 0.1  | -                | 1.0  | -                 | 2.0  | μA   |
| I <sub>CC</sub>                                   | supply current            | V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A;<br>V <sub>CC</sub> = 5.5 V | -     | -   | 1.0  | -                | 10   | -                 | 40   | μA   |
| C <sub>I</sub>                                    | input capacitance         | X1  | -     | 3   | 8    | -                | 8    | -                 | 8    | pF   |

## 11. Dynamic characteristics

**Table 7. Dynamic characteristics**

$GND = 0\text{ V}$ ;  $t_r = t_f = \leq 3.0\text{ ns}$ . 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]   |       |     |     |                  |     |                   |     |      |
|           |                               | $V_{CC} = 3.0\text{ V to }3.6\text{ V}$ [2]                                    |       |     |     |                  |     |                   |     |      |
|           |                               | $C_L = 15\text{ pF}$   | -     | 3   | 7   | 1                | 11  | 1                 | 13  | ns   |
|           |                               | $C_L = 50\text{ pF}$   | -     | 7   | 13  | 1                | 16  | 1                 | 18  | ns   |
|           |                               | $V_{CC} = 4.5\text{ V to }5.5\text{ V}$ [3]                                    |       |     |     |                  |     |                   |     |      |
|           |                               | $C_L = 15\text{ pF}$   | -     | 2   | 5   | 1                | 7   | 1                 | 9   | ns   |
|           |                               | $C_L = 50\text{ pF}$   | -     | 6   | 10  | 1                | 11  | 1                 | 12  | ns   |
|           |                               | X1 to Q [1]  |       |     |     |                  |     |                   |     |      |
|           |                               | $V_{CC} = 3.0\text{ V to }3.6\text{ V}$ [2]                                    |       |     |     |                  |     |                   |     |      |
|           |                               | $C_L = 15\text{ pF}$   | -     | 33  | 55  | 1                | 70  | 1                 | 83  | ns   |
|           |                               | $C_L = 50\text{ pF}$   | -     | 35  | 58  | 1                | 75  | 1                 | 88  | ns   |
|           |                               | $V_{CC} = 4.5\text{ V to }5.5\text{ V}$ [3]                                    |       |     |     |                  |     |                   |     |      |
|           |                               | $C_L = 15\text{ pF}$   | -     | 24  | 38  | 1                | 48  | 1                 | 57  | ns   |
|           |                               | $C_L = 50\text{ pF}$   | -     | 26  | 40  | 1                | 52  | 1                 | 61  | ns   |
| $t_W$     | pulse width                   | X1 HIGH or LOW   |       |     |     |                  |     |                   |     |      |
|           |                               | $V_{CC} = 3.0\text{ V to }3.6\text{ V}$  | 4     | -   | -   | 5                | -   | 7                 | -   | ns   |
|           |                               | $V_{CC} = 4.5\text{ V to }5.5\text{ V}$  | 3     | -   | -   | 4                | -   | 5                 | -   | ns   |
| $f_{max}$ | maximum frequency             | X1   |       |     |     |                  |     |                   |     |      |
|           |                               | $V_{CC} = 3.3\text{ V}$  | 125   | -   | -   | 100              | -   | 70                | -   | MHz  |
|           |                               | $V_{CC} = 5\text{ V}$  | 165   | -   | -   | 125              | -   | 100               | -   | MHz  |
| $C_{PD}$  | power dissipation capacitance | $C_L = 50\text{ pF}$ ; $f_i = 1\text{ MHz}$ ; $V_I = GND\text{ to }V_{CC}$ [4] |       |     |     |                  |     |                   |     |      |
|           |                               | $V_{CC} = 3.3\text{ V}$  | -     | 4   | -   | -                | -   | -                 | -   | pF   |
|           |                               | $V_{CC} = 5\text{ V}$  | -     | 5   | -   | -                | -   | -                 | -   | pF   |

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

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

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

[4]  $C_{PD}$  is used to determine the dynamic power dissipation  $P_D$  ( $\mu\text{W}$ ).

$P_D = C_{PD} \times V_{CC}^2 \times f_i + C_L \times V_{CC}^2 \times f_i / 32768$  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

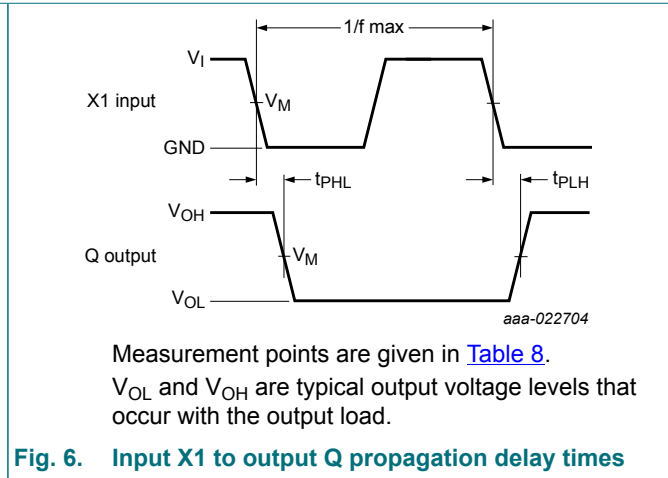
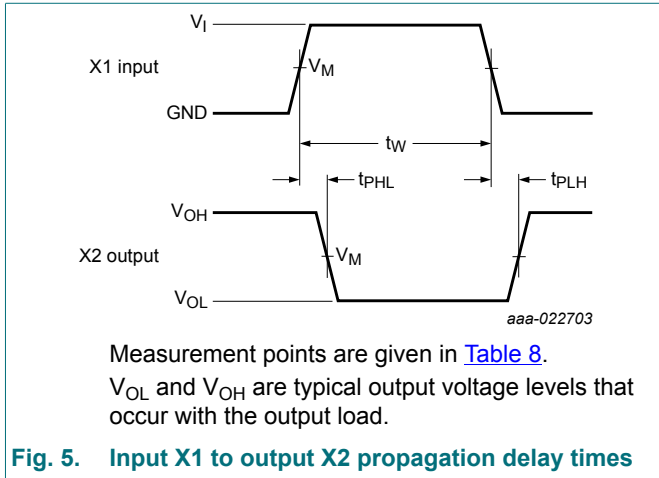
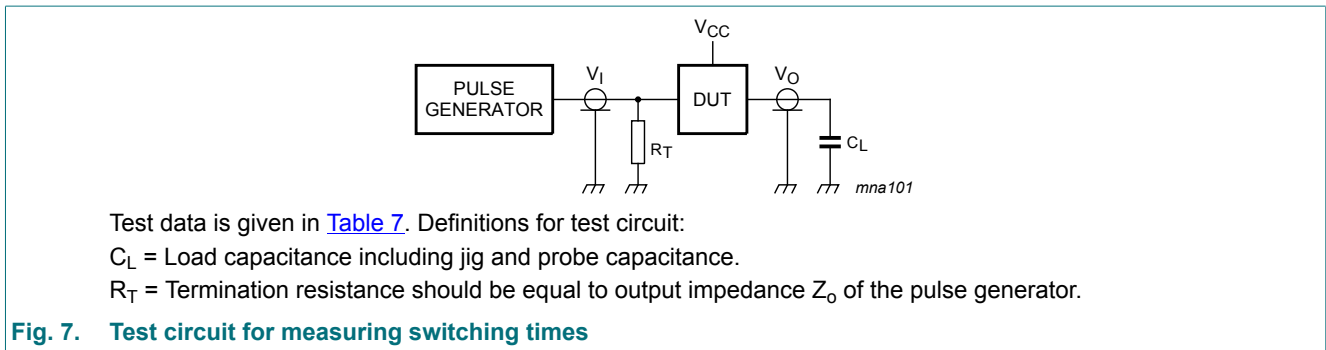


Table 8. Measurement points

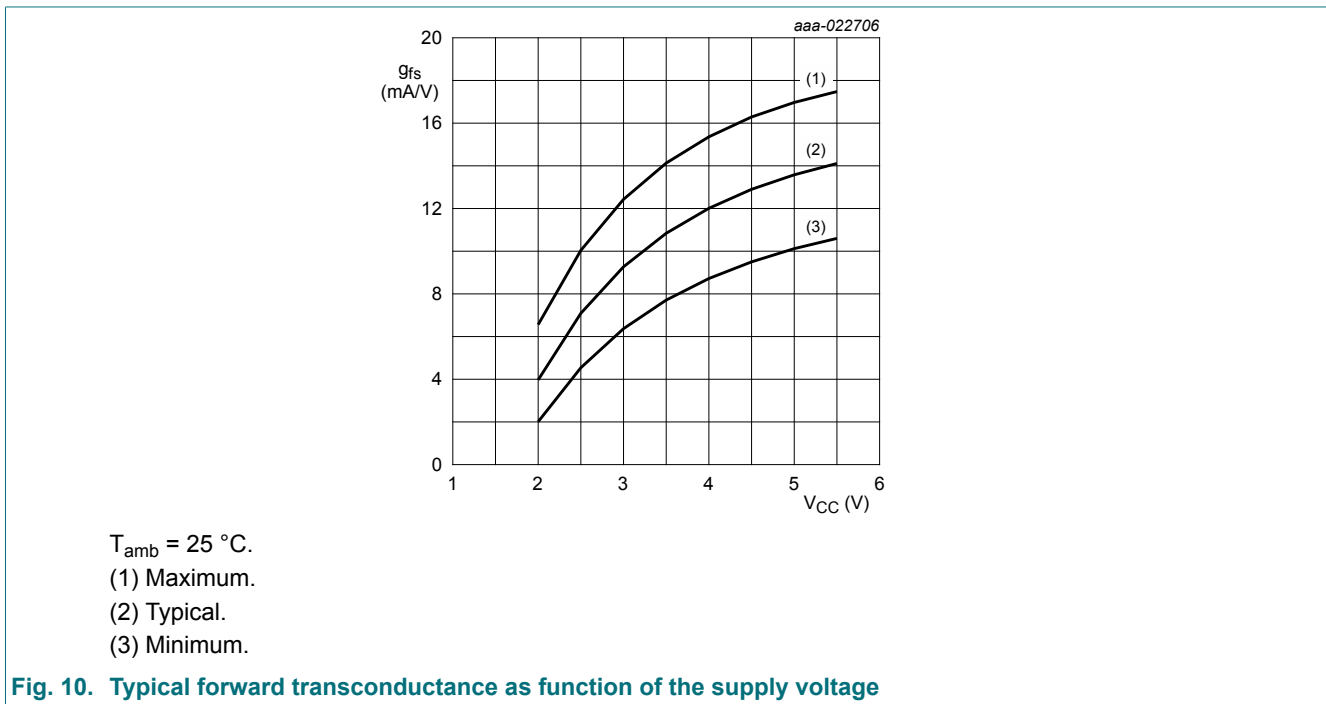
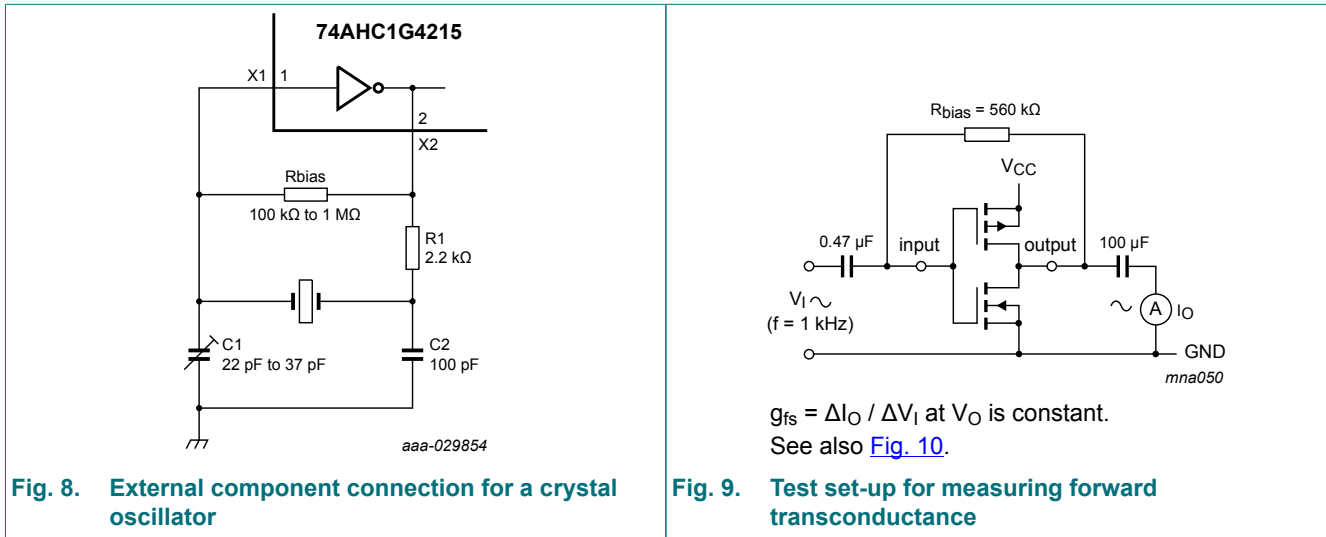
| Inputs          |                     | Output              |
|-----------------|---------------------|---------------------|
| $V_I$           | $V_M$               | $V_M$               |
| GND to $V_{CC}$ | $0.5 \times V_{CC}$ | $0.5 \times V_{CC}$ |



## 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 k $\Omega$ .



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 max. | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | b <sub>p</sub> | c            | D <sup>(1)</sup> | E <sup>(1)</sup> | e    | e <sub>1</sub> | H <sub>E</sub> | L     | L <sub>p</sub> | v   | w   | y   | Z <sup>(1)</sup> | θ        |
|------|--------|----------------|----------------|----------------|----------------|--------------|------------------|------------------|------|----------------|----------------|-------|----------------|-----|-----|-----|------------------|----------|
| mm   | 1.1    | 0.1<br>0       | 1.0<br>0.8     | 0.15           | 0.30<br>0.15   | 0.25<br>0.08 | 2.25<br>1.85     | 1.35<br>1.15     | 0.65 | 1.3            | 2.25<br>2.0    | 0.425 | 0.46<br>0.21   | 0.3 | 0.1 | 0.1 | 0.60<br>0.15     | 7°<br>0° |

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES |        |        |  | EUROPEAN PROJECTION | ISSUE DATE           |
|-----------------|------------|--------|--------|--|---------------------|----------------------|
|                 | IEC        | JEDEC  | JEITA  |  |                     |                      |
| SOT353-1        |            | MO-203 | SC-88A |  |                     | 00-09-01<br>03-02-19 |

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



## 14. Abbreviations

**Table 9. Abbreviations**

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

## 15. Revision history

**Table 10. Revision history**

| Document ID     | Release date | Data sheet status  | Change notice | Supersedes |
|-----------------|--------------|--------------------|---------------|------------|
| 74AHC1G4215 v.1 | 20190408     | 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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