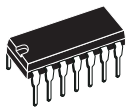
# HCF4093

## QUAD 2-input NAND Schmitt trigger

**Datasheet - production data**



**PDIP-14**

**SO-14**

## Features

- Schmitt trigger action on each input with no external components
- Hysteresis voltage typically 0.9 V at $V_{DD}$ = 5 V and 2.3 V at $V_{DD}$ =10 V
- Noise immunity greater than 50 % of $V_{DD}$ ( typ.)
- No limit on input rise and fall times
- Quiescent current specified up to 20 V
- Standardized symmetrical output characteristics
- 5 V, 10 V, and 15 V parametric ratings
- Input leakage current $I_I$ = 100 nA (max.) at $V_{DD}$ = 18 V and $T_A$ = 25 °C
- 100 % tested for quiescent current

## Applications

- Automotive
- Industrial
- Computer
- Consumer

## Description

The HCF4093 is a monolithic integrated circuit fabricated in metal oxide semiconductor technology available in PDIP-14 and SO-14 packages.

The HCF4093 consists of four Schmitt trigger circuits. Each circuit function has a 2-input NAND gate with Schmitt trigger action on both inputs. The gate switches at different points for positive and negative going signals. The difference between the positive voltage ($V_P$) and the negative voltage ($V_N$) is defined as hysteresis voltage ($V_H$).

**Table 1. Device summary table**

| Order code | Temperature range | Package | Packing | Marking |
|---|---|---|---|---|
| HCF4093M013TR | -55 ° C to +125 ° C | SO-14 | Tape & reel | HCF4093 |
| HCF4093YM013TR (1) | -40 ° C to +125 ° C | SO-14 (automotive grade)(1) | | HCF4093Y |
| HCF4093BEY | -55 ° C to +125 ° C | PDIP-14 | Tube | HCF4093BE |

1. Qualification and characterization according to AEC Q100 and Q003 or equivalent, advanced screening according to AEC Q001 & Q002 or equivalent are ongoing.



This is information on a product in full production. www.st.com

# Contents

# 1 Pin information

**Figure 1. Pin connections (top view)**

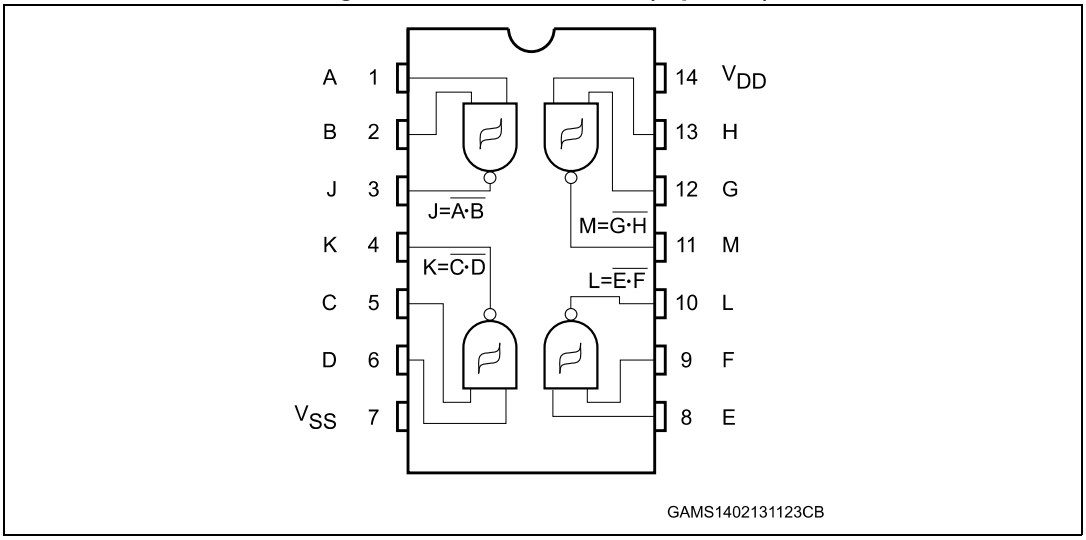



**Table 2. Pin description**

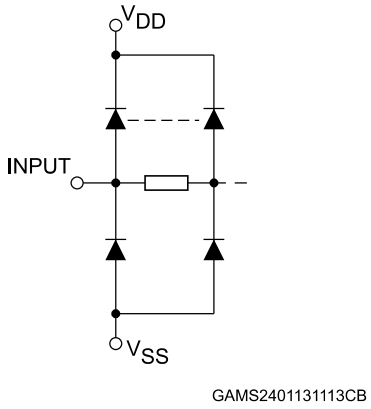
| Pin no | Symbol | Name and function |
|---|---|---|
| 1, 2, 5, 6, 8, 9, 12, 13 | A, B, C, D, E, F, G, H | Data inputs |
| 3, 4, 10, 11 | J, K, L, M | Data outputs |
| 7 | $V_{SS}$ | Negative supply voltage |
| 14 | $V_{DD}$ | Positive supply voltage |

# 2 Functional description

Table 3. Truth table

| Inputs | | Outputs |
|---|---|---|
| A, C, E, G | B, D, F, H | J, K, L, M |
| L | L | H |
| L | H | H |
| H | L | H |
| H | H | L |

Figure 2. Input equivalent circuit



# 3 Electrical characteristics

Stressing the device above the ratings listed in the “Absolute maximum ratings” table may cause permanent damage to the device. These are stress ratings only and operation of the device at these or any other conditions above those indicated in the operating sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Refer also to the STMicroelectronics SURE Program and other relevant quality documents.

**Table 4. Absolute maximum ratings (AMR)**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{DD}$ | Supply voltage | -0.5 to +22 | V |
| $V_I$ | DC input voltage | -0.5 to $V_{DD}$ + 0.5 | |
| $I_I$ | DC input current | ±10 | mA |
| $P_D$ | Power dissipation per package | 200 | mW |
| | Power dissipation per output transistor | 100 | |
| $T_{op}$ | Operating temperature | -55 to +125 | °C |
| $T_{stg}$ | Storage temperature | -65 to +150 | |

**Table 5. Recommended operating conditions**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{DD}$ | Supply voltage | 3 to 20 | V |
| $V_I$ | Input voltage | 0 to $V_{DD}$ | |
| $T_{op}$ | Operating temperature | -55 to 125 | °C |

Table 6. DC specifications(1)

| Sym. | Parameter | Test condition | | | | Value | | | | | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $V_I$ (V) | $V_O$ (V) | $\|I_O\|$ (µA) | $V_{DD}$(V) | $T_A$ = 25 °C | | | -40 to 85 °C | | -55 to 125 °C | | |
| | | | | | | Min. | Typ. | Max. | Min. | Max. | Min. | Max. | |
| $I_L$ | Quiescent current | 0/5 | | | 5 | | | 1 | | 30 | | 30 | µA |
| | | 0/10 | | | 10 | | 0.02 | 2 | | 60 | | 60 | |
| | | 0/15 | | | 15 | | | 4 | | 120 | | 120 | |
| | | 0/20 | | | 20 | | 0.04 | 20 | | 600 | | 600 | |
| $V_{OH}$ | High level output voltage | 0/5 | | <1 | 5 | 4.95 | | | 4.95 | | 4.95 | | V |
| | | 0/10 | | | 10 | 9.95 | | | 9.95 | | 9.95 | | |
| | | 0/15 | | | 15 | 14.95 | | | 14.95 | | 14.95 | | |
| $V_{OL}$ | Low level output voltage | 5/0 | | <1 | 5 | | | | | | | | |
| | | 10/0 | | | 10 | | 0.05 | | | 0.05 | | 0.05 | |
| | | 15/0 | | | 15 | | | | | | | | |
| $V_P$ | Positive trigger threshold voltage | a | | | 5 | 2.2 | 2.9 | 3.6 | 2.2 | 3.6 | 2.2 | 3.6 | |
| | | | | | 10 | 4.6 | 5.9 | 7.1 | 4.6 | 7.1 | 4.6 | 7.1 | |
| | | | | | 15 | 6.8 | 8.8 | 10.8 | 6.8 | 10.8 | 6.8 | 10.8 | |
| | | b | | | 5 | 2.6 | 3.3 | 4.0 | 2.6 | 4 | 2.6 | 4 | |
| | | | | | 10 | 5.6 | 7 | 8.2 | 5.6 | 8.2 | 5.6 | 8.2 | |
| | | | | | 15 | 6.3 | 9.4 | 12.7 | 6.3 | 12.7 | 6.3 | 12.7 | |
| $V_N$ | Negative trigger threshold voltage | a | | | 5 | 0.9 | 1.9 | 2.8 | 0.9 | 2.8 | 0.9 | 2.8 | |
| | | | | | 10 | 2.5 | 3.9 | 5.2 | 2.5 | 5.2 | 2.5 | 5.2 | |
| | | | | | 15 | 4 | 5.8 | 7.4 | 4 | 7.4 | 4 | 7.4 | |
| | | b | | | 5 | 1.4 | 2.3 | 3.2 | 1.4 | 3.2 | 1.4 | 3.2 | |
| | | | | | 10 | 3.4 | 5.1 | 6.6 | 3.4 | 6.6 | 3.4 | 6.6 | |
| | | | | | 15 | 4.8 | 7.3 | 9.6 | 4.8 | 9.6 | 4.8 | 9.6 | |
| $V_H$ | Hysteresis voltage | a | | | 5 | 0.3 | 0.9 | 1.6 | 0.3 | 1.6 | 0.3 | 1.6 | |
| | | | | | 10 | 1.2 | 2.3 | 3.4 | 1.2 | 3.4 | 1.2 | 3.4 | |
| | | | | | 15 | 1.6 | 3.5 | 5 | 1.6 | 5 | 1.6 | 5 | |
| | | b | | | 5 | 0.3 | 0.9 | 1.6 | 0.3 | 1.6 | 0.3 | 1.6 | |
| | | | | | 10 | 1.2 | 2.3 | 3.4 | 1.2 | 3.4 | 1.2 | 3.4 | |
| | | | | | 15 | 1.6 | 3.5 | 5 | 1.6 | 5 | 1.6 | 5 | |
| $I_{OH}$ | Output drive current | 0/5 | 2.5 | <1 | 5 | -1.36 | -3.2 | | -1.15 | | -1.1 | | mA |
| | | | 4.6 | | | -0.44 | -1 | | -0.36 | | -0.36 | | |
| | | 0/10 | 9.5 | | 10 | -1.1 | -2.6 | | -0.9 | | -0.9 | | |
| | | 0/15 | 13.5 | | 15 | -3.0 | -6.8 | | -2.4 | | -2.4 | | |

**Table 6. DC specifications[1] (continued)**

| Sym. | Parameter | Test condition | | | | Value | | | | | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $V_I$ (V) | $V_O$ (V) | $\|I_O\|$ (µA) | $V_{DD}$(V) | $T_A$ = 25 °C | | | -40 to 85 °C | | -55 to 125 °C | | |
| | | | | | | Min. | Typ. | Max. | Min. | Max. | Min. | Max. | |
| $I_{OL}$ | Output sink current | 0/5 | 0.4 | <1 | 5 | 0.44 | 1 | | 0.36 | | 0.36 | | mA |
| | | 0/10 | 0.5 | | 10 | 1.1 | 2.6 | | 0.9 | | 0.9 | | |
| | | 0/15 | 1.5 | | 15 | 3.0 | 6.8 | | 2.4 | | 2.4 | | |
| $I_I$ | Input leakage current | 0/18 | Any input | | 18 | | $\pm10^{-5}$ | ±0.1 | | ±1 | | ±1 | µA |
| $C_I$ | Input capacitance | | Any input | | | | 5 | 7.5 | | | | | pF |

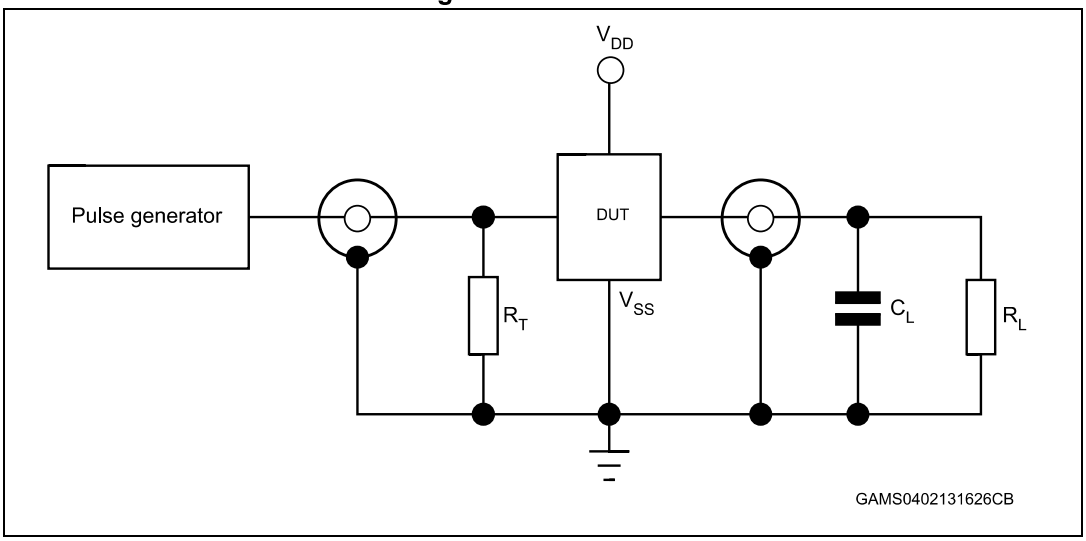
1. The noise margin for both level "1" and "0" is: 1 V min. with $V_{DD}$ = 5 V, 2 V min. with $V_{DD}$ = 10 V, and 2.5 V min. with $V_{DD}$ = 15 V.
   a: Input on terminals 1, 5, 8, 12 or 2, 6, 9, 13; other inputs to $V_{DD}$.
   b: Input on terminals 1 and 2, 5 and 6, 8 and 9, or 12 and 13; other inputs to $V_{DD}$.

**Table 7. Dynamic electrical characteristics**
**($T_{amb}$ = 25 °C, $C_L$ = 50 pF, $R_L$ = 200 kΩ, $t_r = t_f$ = 20 ns)**

| Symbol | Parameter | Test condition | Value[1] | | Unit |
|---|---|---|---|---|---|
| | | $V_{DD}$ (V) | Typ. | Max. | |
| $t_{PLH}$, $t_{PHL}$ | Propagation delay time | 5 | 190 | 380 | ns |
| | | 10 | 90 | 180 | |
| | | 15 | 65 | 130 | |
| $t_{TLH}$, $t_{THL}$ | Output transition time | 5 | 100 | 200 | |
| | | 10 | 50 | 100 | |
| | | 15 | 40 | 80 | |

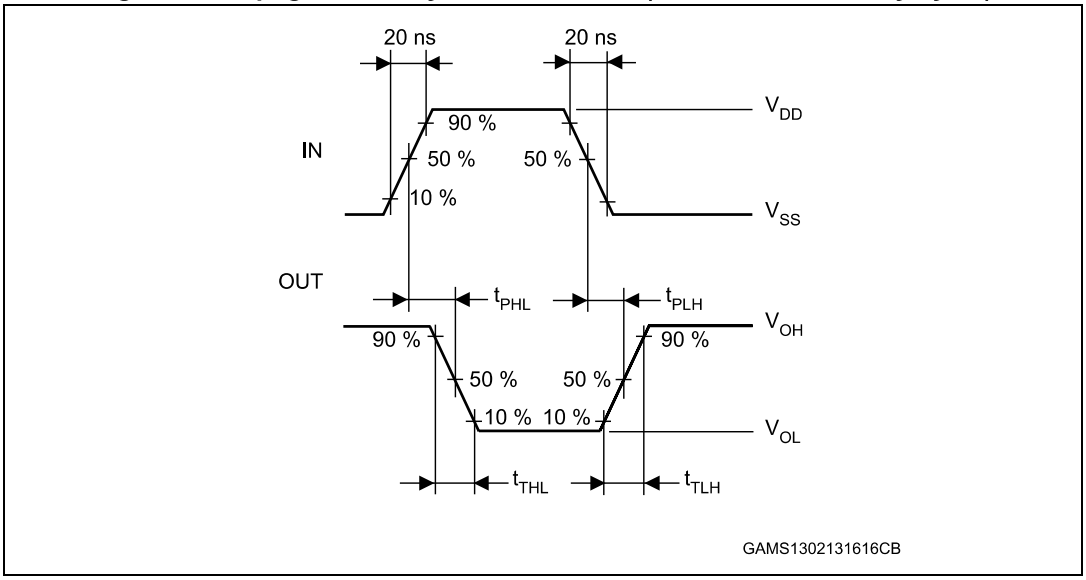
1. The typical temperature coefficient for all $V_{DD}$ values is 0.3 %/°C.

**Figure 3. Test circuit**




1. Legend: $C_L$ = 50 pF or equivalent (includes jig and probe capacitance), $R_L$ = 200 KΩ, $R_T = Z_{OUT}$ of pulse generator (typically 50 Ω)

**Figure 4. Propagation delay time waveform (f = 1 MHz; 50 % duty cycle)**



# 4 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: *www.st.com*. ECOPACK® is an ST trademark.

## 4.1 PDIP-14 package information

**Figure 5. PDIP-14 package mechanical drawing**

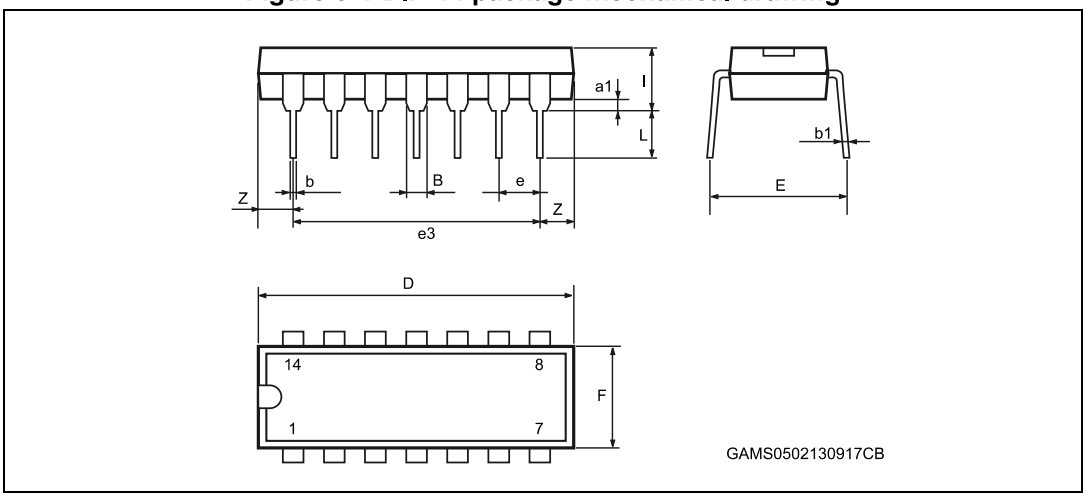



**Table 8. PDIP-14 package mechanical data**

| Ref | Dimensions | | | | | |
|---|---|---|---|---|---|---|
| | Millimeters | | | Inches | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| a1 | 0.51 | | | 0.020 | | |
| B | 1.39 | | 1.65 | 0.055 | | 0.065 |
| b | | 0.5 | | | 0.020 | |
| b1 | | 0.25 | | | 0.010 | |
| D | | | 20 | | | 0.787 |
| E | | 8.5 | | | 0.335 | |
| e | | 2.54 | | | 0.100 | |
| e3 | | 15.24 | | | 0.600 | |
| F | | | 7.1 | | | 0.280 |
| I | | | 5.1 | | | 0.201 |
| L | | 3.3 | | | 0.130 | |
| Z | 1.27 | | 2.54 | 0.050 | | 0.100 |

## 4.2 SO-14 package information

Figure 6. SO-14 package mechanical drawing

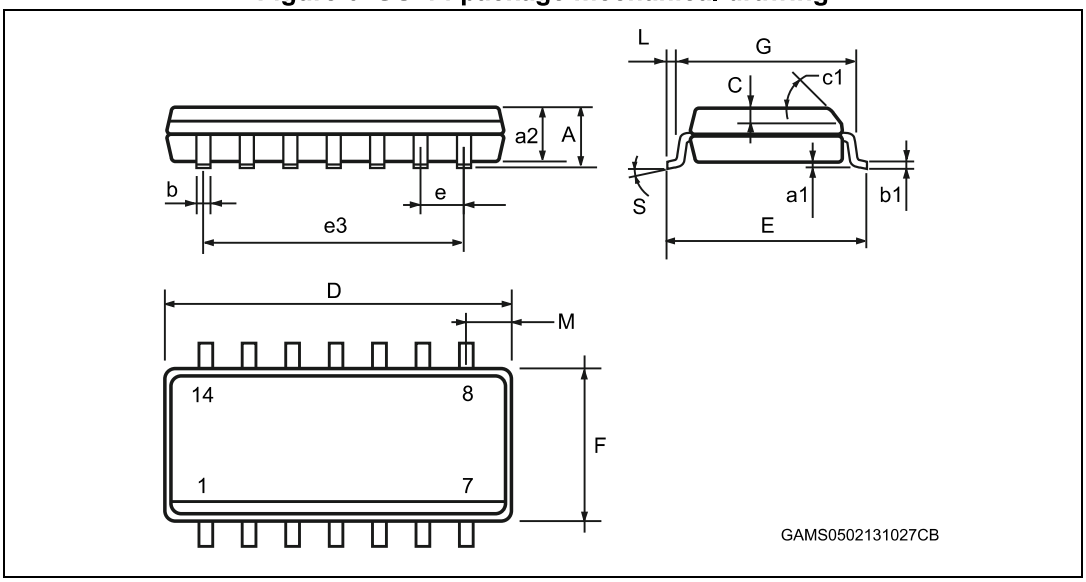



Table 9. SO-14 package mechanical data

| Ref | Dimensions | | | | | |
|---|---|---|---|---|---|---|
| | Millimeters | | | Inches | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | | | 1.75 | | | 0.068 |
| a1 | 0.1 | | 0.2 | 0.003 | | 0.007 |
| a2 | | | 1.65 | | | 0.064 |
| b | 0.35 | | 0.46 | 0.013 | | 0.018 |
| b1 | 0.19 | | 0.25 | 0.007 | | 0.010 |
| C | | 0.5 | | | 0.019 | |
| c1 | | 45 ° | | | 45 ° | |
| D | 8.55 | | 8.75 | 0.336 | | 0.344 |
| E | 5.8 | | 6.2 | 0.228 | | 0.244 |
| e | | 1.27 | | | 0.050 | |
| e3 | | 7.62 | | | 0.300 | |
| F | 3.8 | | 4.0 | 0.149 | | 0.157 |
| G | 4.6 | | 5.3 | 0.181 | | 0.208 |
| L | 0.5 | | 1.27 | 0.019 | | 0.050 |
| M | | | 0.68 | | | 0.026 |
| S | | | 8 ° | | | 8 ° |