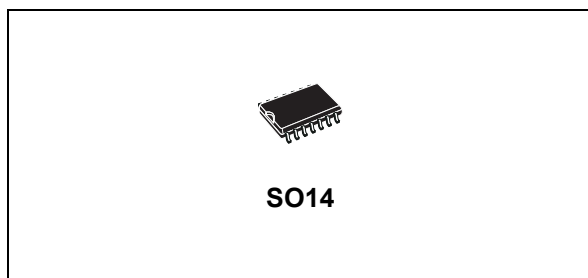


Quad 2-input NAND Schmitt trigger

Datasheet - production data



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

- ESD performance
 - HBM: 2 kV
 - MM: 200 V
 - CDM: 1 kV

Applications

- Automotive
- Industrial
- Computer
- Consumer

Description

The HCF4093 is a monolithic integrated circuit fabricated in metal oxide semiconductor technology available in the SO14 package.

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 | SO14 | Tape and reel | HCF4093 |
| HCF4093YM013TR (1) | -40 °C to +125 °C | SO14 (automotive grade) ⁽¹⁾ | | HCF4093Y |

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

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1 Pin information

Figure 1. Pin connections (top view)

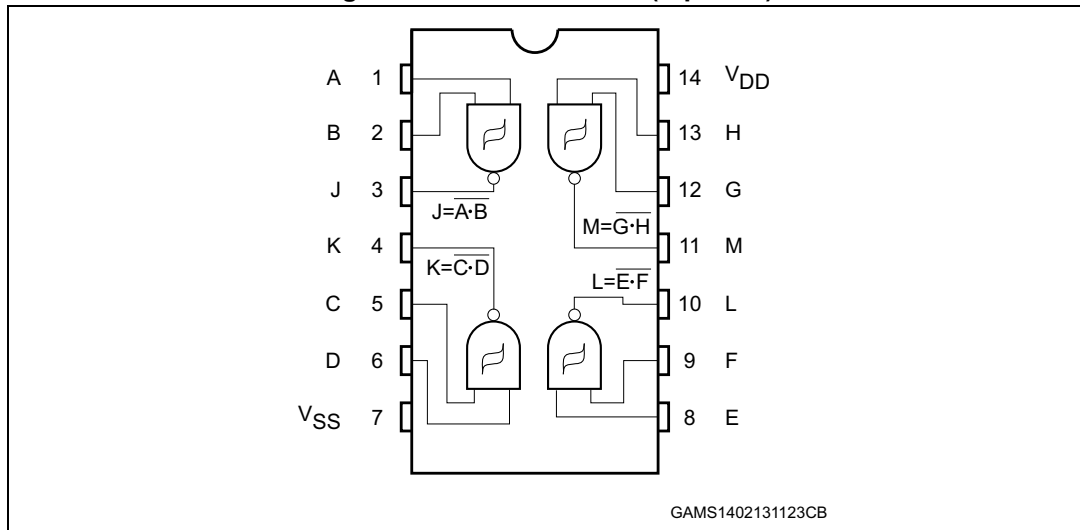


Table 2. Pin description

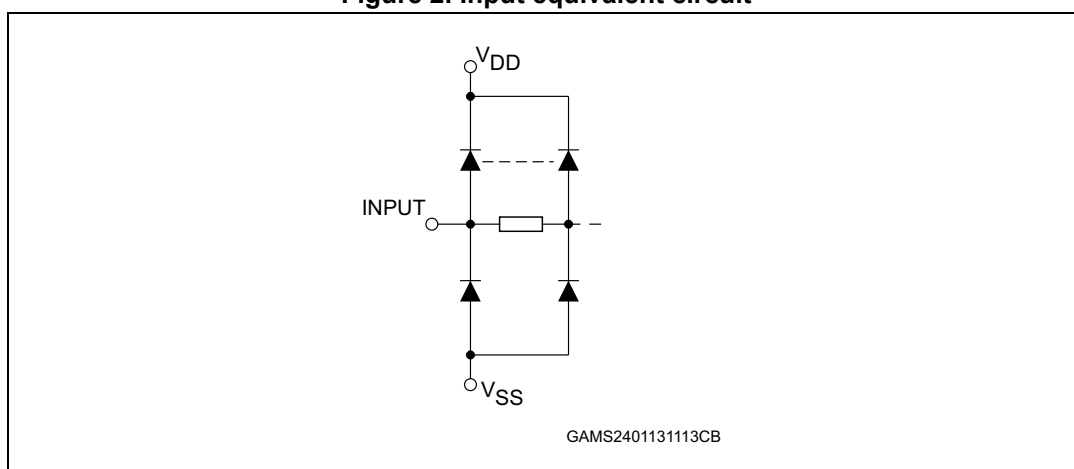
| Pin no | Symbol | Name and function |
|--------------------------|------------------------|-------------------------|
| 1, 2, 5, 6, 8, 9, 12, 13 | A, B, C, D, E, F, G, H | Data inputs |
| 3, 4, 10, 11 | J, K, L, M | Data outputs |
| 7 | V _{SS} | Negative supply voltage |
| 14 | V _{DD} | Positive 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 _{ol} (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 | | 0.05 | | | 0.05 | | 0.05 | |
| | | 10/0 | | | 10 | | | | | | | | |
| | | 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 | V |
| | | | | | 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 | V |
| | | | | | 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 | V |
| | | | | | 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 _{OL} (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 | | ±10 ⁻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}.

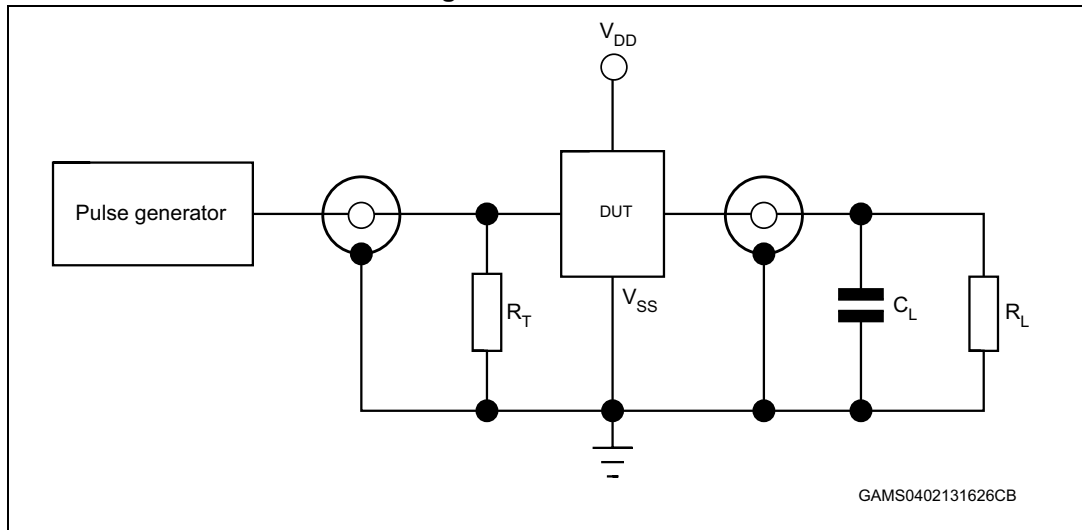
b: Input on terminals 1 and 2, 5 and 6, 8 and 9, or 12 and 13; other inputs to V_{DD}.

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 | |

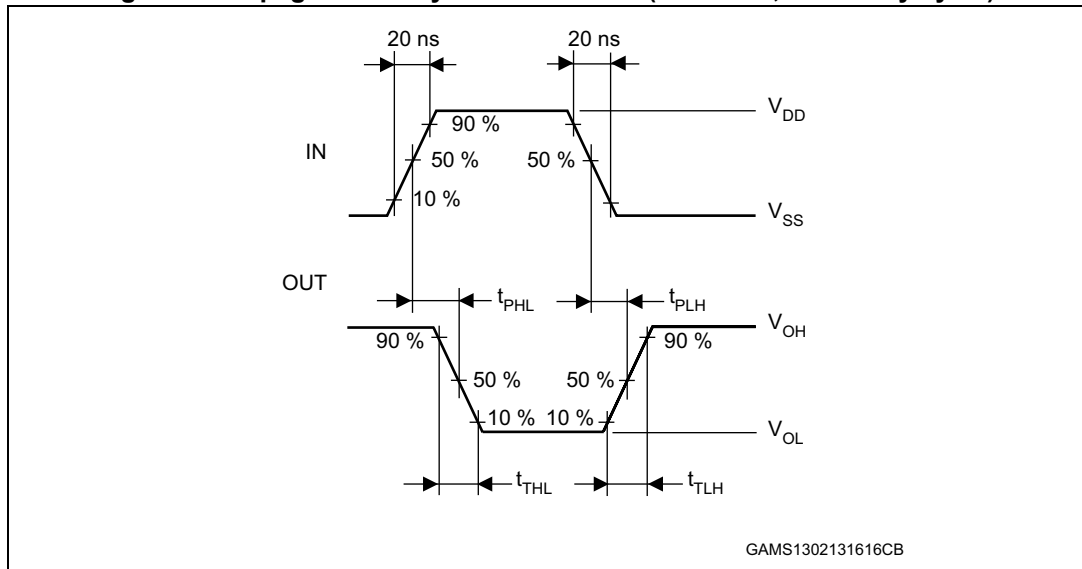
1. The typical temperature coefficient for all V_{DD} values is 0.3 %/°C.

Figure 3. Test circuit



- Legend: $C_L = 50 \text{ pF}$ or equivalent (includes jig and probe capacitance), $R_L = 200 \text{ K}\Omega$, $R_T = Z_{OUT}$ of pulse generator (typically 50Ω)

Figure 4. Propagation delay time waveform ($f = 1 \text{ MHz}$; 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 SO14 package information

Figure 5. SO14 package mechanical drawing

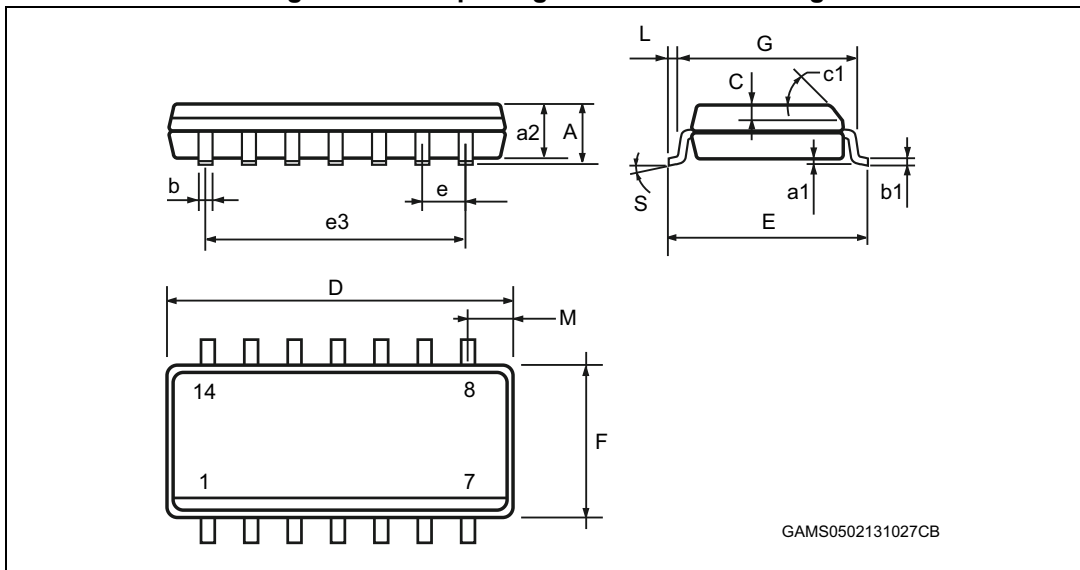
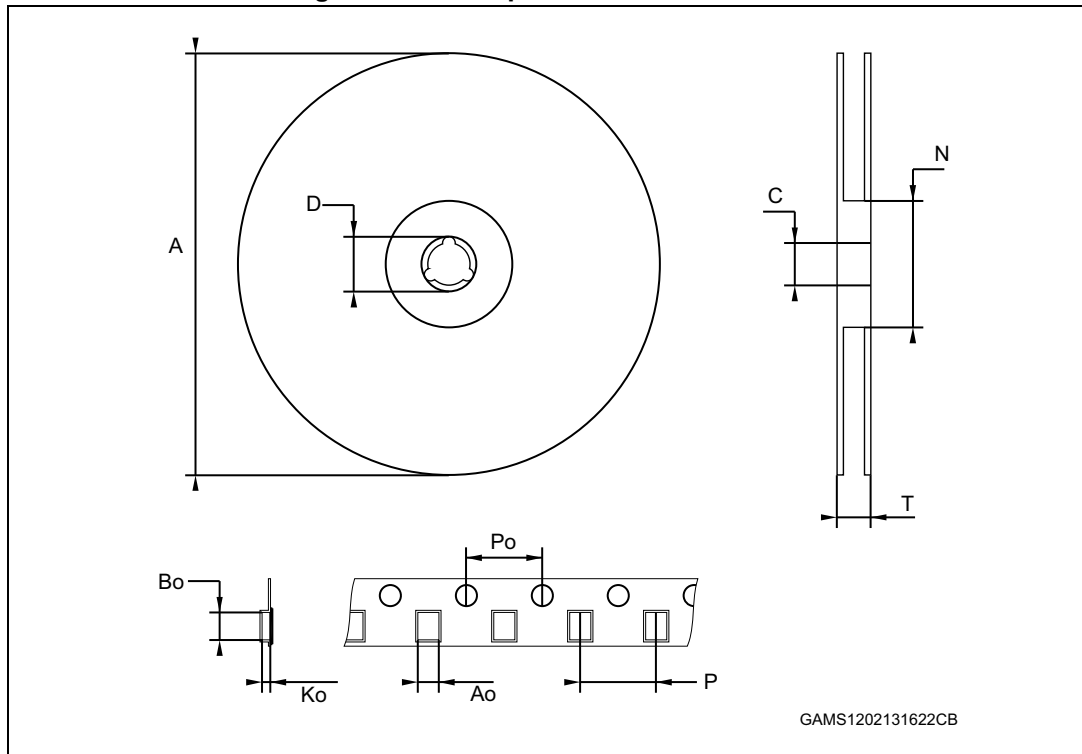


Table 8. SO14 package mechanical data

| 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 ° |

Figure 6. SO14 tape and reel information



1. Drawing is not to scale.

Table 9. SO14 tape and reel information

| Ref | Dimensions | | | | | |
|-----|-------------|------|------|--------|------|--------|
| | Millimeters | | | Inches | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | | | 330 | | | 12.992 |
| C | 12.8 | | 13.2 | 0.504 | | 0.519 |
| D | 20.2 | | | 0.795 | | |
| N | 60 | | | 2.362 | | |
| T | | | 22.4 | | | 0.882 |
| Ao | 6.4 | | 6.6 | 0.252 | | 0.260 |
| Bo | 9 | | 9.2 | 0.354 | | 0.362 |
| Ko | 2.1 | | 2.3 | 0.082 | | 0.090 |
| Po | 3.9 | | 4.1 | 0.153 | | 0.161 |
| P | 7.9 | | 8.1 | 0.311 | | 0.319 |

5 Ordering information

Table 10. Order codes

| Order code | Temperature range | Package | Packing | Marking |
|--------------------|---------------------|---|---------------|----------|
| HCF4093M013TR | -55 ° C to +125 ° C | SO14 | Tape and reel | HCF4093 |
| HCF4093YM013TR (1) | -40 ° C to +125 ° C | SO14 (automotive grade) ⁽¹⁾ | | HCF4093Y |

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

6 Revision history

Table 11. Document revision history

| Date | Revision | Changes |
|-------------|----------|---|
| Sept-2001 | 1 | Initial release. |
| 16-Aug-2007 | 2 | Document converted to new ST template, added Figure 6: SO14 tape and reel information on page 11 and Table 9: SO14 tape and reel information on page 11 , small text changes. |
| 18-Feb-2013 | 3 | Document template and layout updated Updated package names (PDIP-14 and SO-14 instead of DIP-14 and SOP-14). Updated Features Added Applications Updated Device summary table Small correction to inches min value of Ao in Table 9 Added Section 5: Ordering information |
| 13-Jan-2014 | 4 | Removed PDIP14 package Added ESD data to Features Table 1: Device summary table : updated footnote 1. Table 10: Order codes : updated footnote 1. |

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