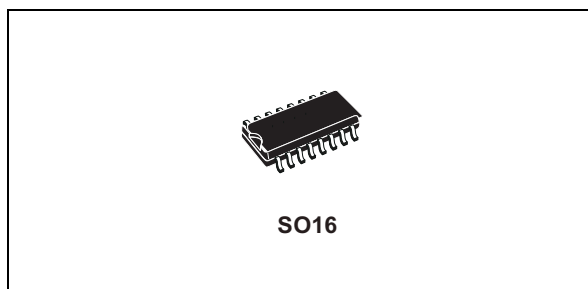


Hex buffer/converter (non-inverting)

Datasheet - production data



Applications

- Automotive
- Industrial
- Computer
- Consumer

Description

The HCF4010 device is a monolithic integrated circuit fabricated in MOS (metal oxide semiconductor) technology available in an SO16 package.

It is a non-inverting hex buffer/converter and can be used as a CMOS to TTL logic level converter, as a current “sink” or “source” driver, or as a multiplexer (1 to 6).

It is the preferred replacement of the HCF4050B in buffer applications.

Features

- Propagation delay time
 - $t_{PD} = 50 \text{ ns}$ (typ.) at $V_{DD} = 10 \text{ V}$, $C_L = 50 \text{ pF}$
- High to low level logic conversion
- Multiplexer: 1 to 6 or 6 to 1
- High “sink” and “source” current capability
- Quiescent current specified up to 20 V
- 5 V, 10 V and 15 V parametric ratings
- Input leakage current
- $I_I = 100 \text{ nA}$ (max.) at $V_{DD} = 18 \text{ V}$, $T_A = 25 \text{ }^\circ\text{C}$
100% tested for quiescent current
- ESD performance
 - CDM: 1 kV
 - HBM: 1 kV
 - MM: 150 V

Table 1. Device summary

| Order code | Temperature range | Package | Packing | Marking |
|-------------------------------|-------------------|-------------------------|---------------|----------|
| HCF4010M013TR | –55 °C to +125 °C | SO16 | Tape and reel | HCF4010 |
| HCF4010YM013TR ⁽¹⁾ | –40 °C to +125 °C | SO16 (automotive grade) | | HCF4010Y |

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

Contents

- 1 Pin information 3**
- 2 Functional description 4**
- 3 Electrical characteristics 5**
- 4 Package information 9**
 - 4.1 SO16 package information 10
- 5 Ordering information 12**
- 6 Revision history 12**

1 Pin information

Figure 1. Pin connections

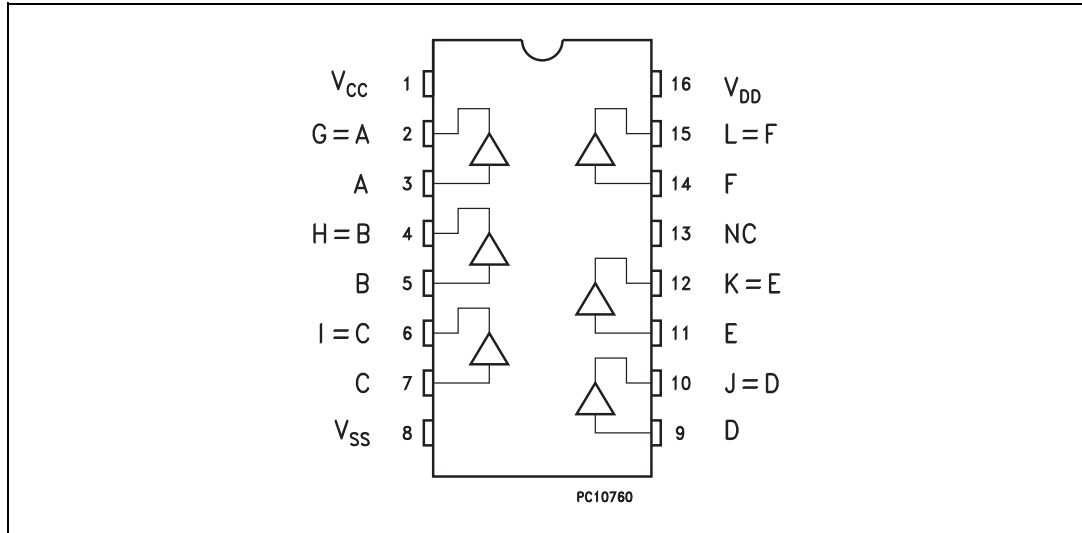


Table 2. Pin description

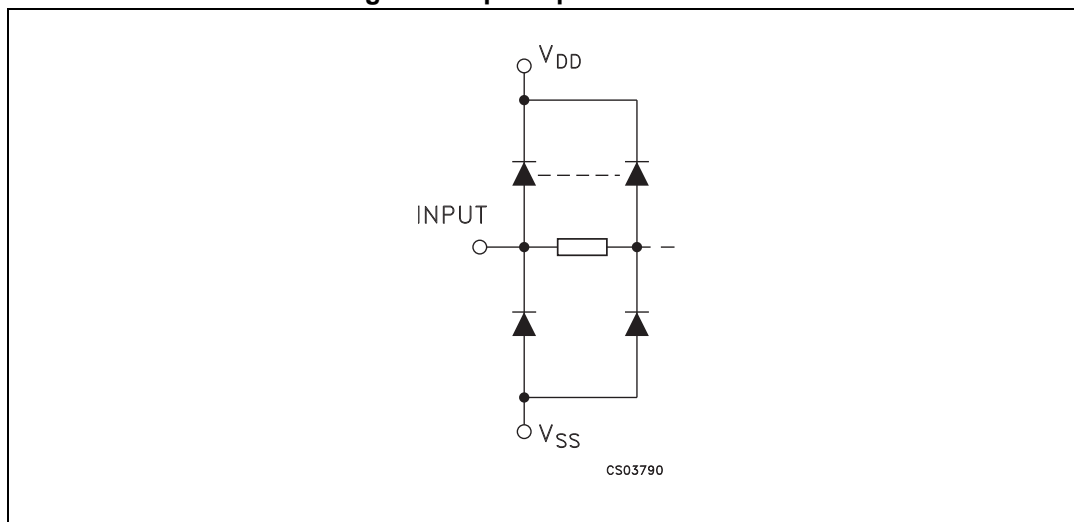
| Pin number | Symbol/name | Function |
|---------------------|------------------|-------------------------|
| 3, 5, 7, 9, 11, 14 | A, B, C, D, E, F | Data inputs |
| 2, 4, 6, 10, 12, 15 | G, H, I, J, K, L | Data outputs |
| 13 | NC | Not connected |
| 1 | V _{CC} | Positive supply voltage |
| 8 | V _{SS} | Negative supply voltage |
| 16 | V _{DD} | Positive supply voltage |

2 Functional description

Table 3. Truth table

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

Figure 2. Input equivalent circuit



3 Electrical characteristics

Absolute maximum ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied. All voltage values are referred to V_{SS} pin voltage.

Table 4. Absolute maximum ratings

| 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 | SO16 | -55 to 125 | °C |
| | | SO16 (automotive grade) | -40 to 125 | |

Table 6. DC specifications⁽¹⁾

| Sym. | Parameter | Test condition | | | | Value | | | | | | Unit | |
|-----------------|---------------------------|-----------------------|-----------------------|---------------------------|--|------------------------|-------------------|------|--------------|------|---------------|------|------|
| | | V _I (V) | V _O (V) | I _{OL} (μA) | V _{DD} = V _{CC} (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 | | 0.02 | 1 | | 30 | | 30 | μA |
| | | 0/10 | | | 10 | | 0.02 | 2 | | 60 | | 60 | |
| | | 0/15 | | | 15 | | 0.02 | 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 | | <1 | 10 | 9.95 | | | 9.95 | | 9.95 | | |
| | | 0/15 | | <1 | 15 | 14.95 | | | 14.95 | | 14.95 | | |
| V _{OL} | Low-level output voltage | 5/0 | | <1 | 5 | | 0.05 | | | 0.05 | | 0.05 | V |
| | | 10/0 | | <1 | 10 | | 0.05 | | | 0.05 | | 0.05 | |
| | | 15/0 | | <1 | 15 | | 0.05 | | | 0.05 | | 0.05 | |
| V _{IH} | High-level input voltage | | 0.5/4.5 | <1 | 5 | 3.5 | | | 3.5 | | 3.5 | | V |
| | | | 1/9 | <1 | 10 | 7 | | | 7 | | 7 | | |
| | | | 1.5/13.5 | <1 | 15 | 11 | | | 11 | | 11 | | |
| V _{IL} | Low-level input voltage | | 4.5/0.5 | <1 | 5 | | | 1.5 | | 1.5 | | 1.5 | V |
| | | | 9/1 | <1 | 10 | | | 3 | | 3 | | 3 | |
| | | | 13.5/1.5 | <1 | 15 | | | 4 | | 4 | | 4 | |
| I _{OH} | Output drive current | 0/5 | 2.5 | <1 | 5 | -0.8 | -1.6 | | -0.65 | | -0.65 | | mA |
| | | 0/5 | 4.6 | <1 | 5 | -0.2 | -0.4 | | -0.18 | | -0.18 | | |
| | | 0/10 | 9.5 | <1 | 10 | -0.45 | -0.9 | | -0.38 | | -0.38 | | |
| | | 0/15 | 13.5 | <1 | 15 | -1.5 | -3 | | -1.25 | | -1.25 | | |
| I _{OL} | Output sink current | 0/5 | 0.4 | <1 | 5 | 3 | 4 | | 2.4 | | 2.4 | | mA |
| | | 0/10 | 0.5 | <1 | 10 | 8 | 10 | | 6.4 | | 6.4 | | |
| | | 0/15 | 1.5 | <1 | 15 | 24 | 36 | | 19 | | 19 | | |
| 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 |

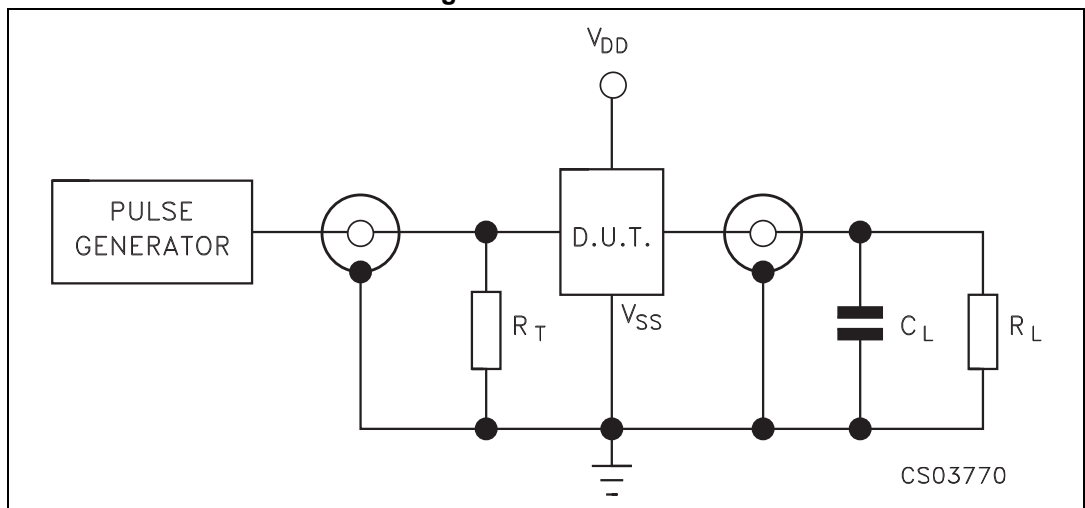
1. The noise margin for both level "1" and "0" is: 1 V min. with V_{DD} = 5 V, 2 V min. with V_{DD} = 10 V, 2.5 V min. with V_{DD} = 15 V.

Table 7. Dynamic electrical characteristics
 ($T_{amb} = 25\text{ }^{\circ}\text{C}$, $C_L = 50\text{ pF}$, $R_L = 200\text{ k}\Omega$, $t_r = t_f = 20\text{ ns}$)

| Symbol | Parameter | Test condition | | | Value ⁽¹⁾ | | | Unit |
|------------------|------------------------|---------------------|--------------------|---------------------|----------------------|------|------|------|
| | | V _{DD} (V) | V _I (V) | V _{CC} (V) | Min. | Typ. | Max. | |
| t _{TLH} | Output transition time | 5 | 5 | 5 | | 150 | 350 | ns |
| | | 10 | 10 | 10 | | 75 | 15 | |
| | | 15 | 15 | 15 | | 55 | 110 | |
| t _{THL} | Output transition time | 5 | 5 | 5 | | 35 | 70 | |
| | | 10 | 10 | 10 | | 20 | 40 | |
| | | 15 | 15 | 15 | | 15 | 30 | |
| t _{PLH} | Propagation delay time | 5 | 5 | 5 | | 100 | 200 | |
| | | 10 | 10 | 10 | | 50 | 100 | |
| | | 10 | 10 | 5 | | 50 | 100 | |
| | | 15 | 15 | 15 | | 35 | 70 | |
| | | 15 | 15 | 5 | | 35 | 70 | |
| t _{PHL} | Propagation delay time | 5 | 5 | 5 | | 65 | 130 | |
| | | 10 | 10 | 10 | | 35 | 70 | |
| | | 10 | 10 | 5 | | 30 | 70 | |
| | | 15 | 15 | 15 | | 25 | 50 | |
| | | 15 | 15 | 5 | | 20 | 40 | |

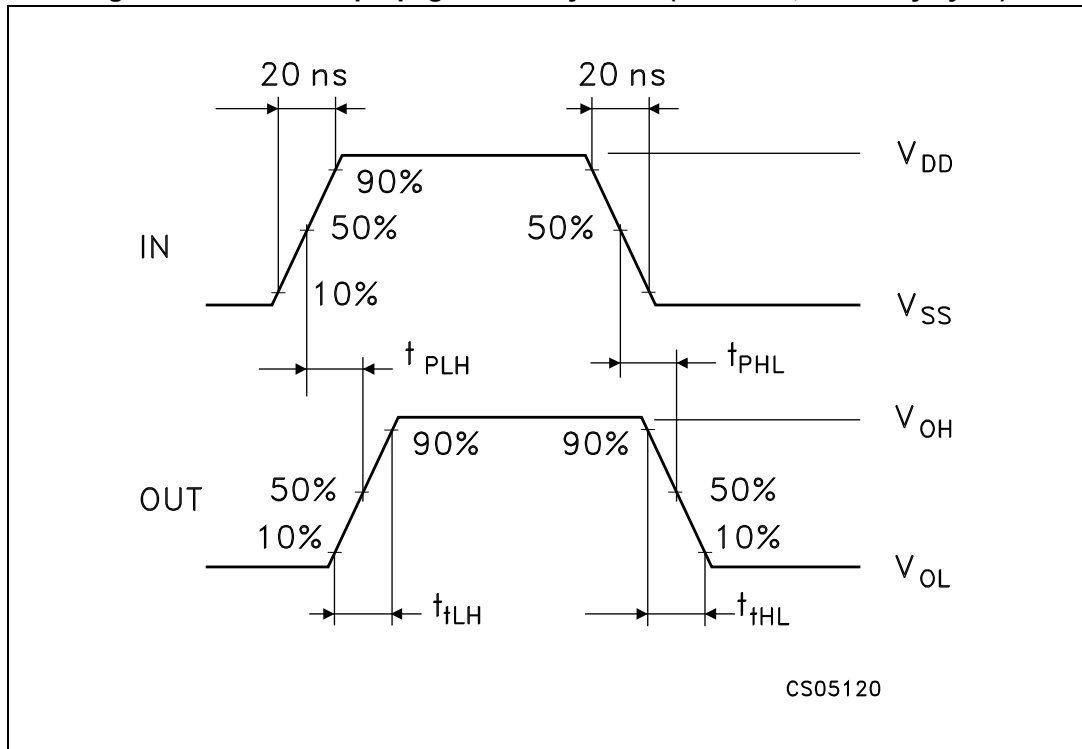
1. Typical temperature coefficient for all V_{DD} values is 0.3%/°C.

Figure 3. Test circuit



1. C_L = 50 pF or equivalent (includes jig and probe capacitance).
2. R_L = 200 kΩ.
3. R_T = Z_{OUT} of pulse generator (typically 50 Ω).

Figure 4. Waveform - propagation delay times (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 SO16 package information

Figure 5. SO16 package outline

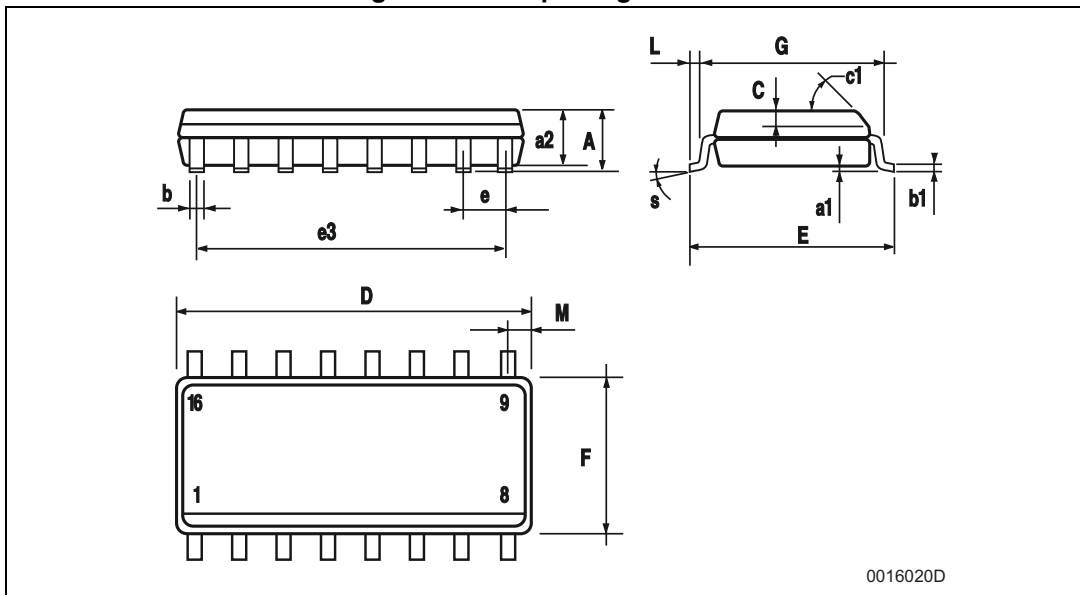
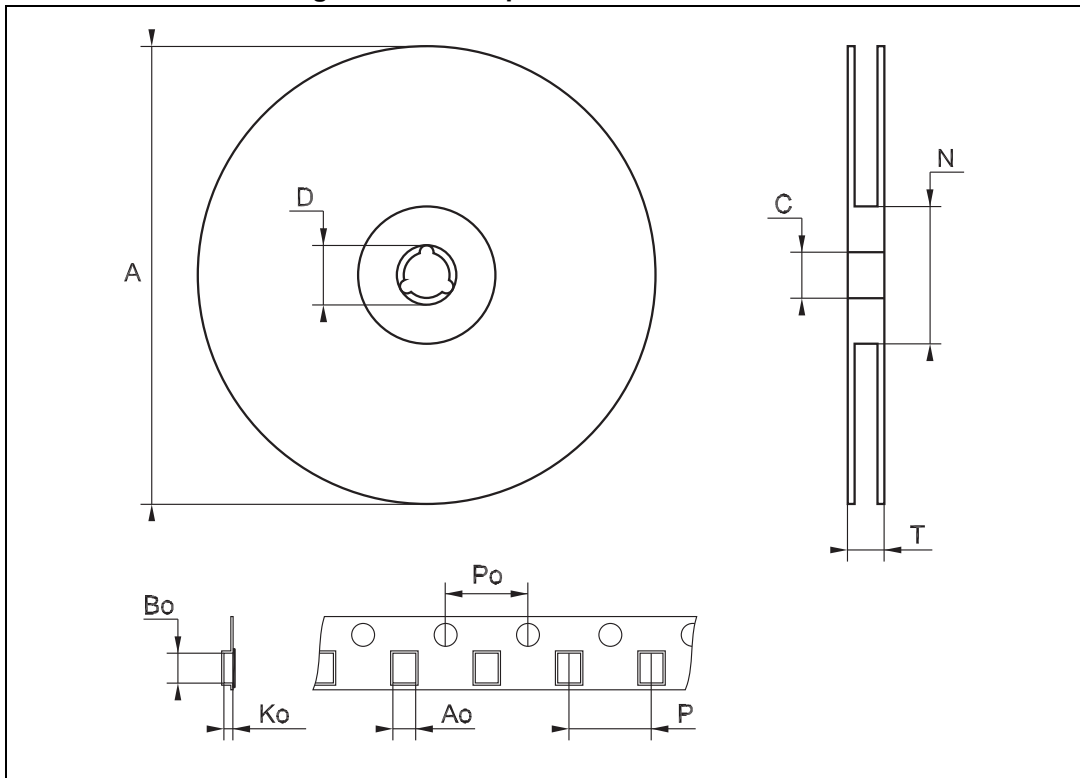


Table 8. SO16 package mechanical data

| Symbol | Dimensions | | | | | |
|--------|------------|------|------|-------|-------|-------|
| | mm | | | inch | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | | | 1.75 | | | 0.068 |
| a1 | 0.1 | | 0.25 | 0.004 | | 0.010 |
| a2 | | | 1.64 | | | 0.063 |
| 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° (typ.) | | | | | |
| D | 9.8 | | 10 | 0.385 | | 0.393 |
| E | 5.8 | | 6.2 | 0.228 | | 0.244 |
| e | | 1.27 | | | 0.050 | |
| e3 | | 8.89 | | | 0.350 | |
| 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 | | | 0.62 | | | 0.024 |
| S | 8° (max.) | | | | | |

Figure 6. SO16 tape and reel information



1. Drawing not in scale.

Table 9. SO16 tape and reel information

| Symbol | Dimensions | | | | | |
|--------|------------|------|------|-------|------|--------|
| | mm | | | inch | | |
| | 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 | 6.45 | | 6.65 | 0.254 | | 0.262 |
| Bo | 10.3 | | 10.5 | 0.406 | | 0.414 |
| 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 |
|-------------------------------|-------------------|-------------------------|---------------|----------|
| HCF4010M013TR | –55 °C to +125 °C | SO16 | Tape and reel | HCF4010 |
| HCF4010YM013TR ⁽¹⁾ | –40 °C to +125 °C | SO16 (automotive grade) | | HCF4010Y |

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

6 Revision history

Table 11. Document revision history

| Date | Revision | Changes |
|-------------|----------|---|
| 16-Mar-2005 | 3 | Add V _{CC} on Table 6 |
| 11-Jun-2012 | 4 | Added Applications on page 1 Updated Table 1: Device summary Removed DIP16 package from document Revised document presentation, minor textual updates |
| 15-Jun-2012 | 5 | Updated temperature range in Table 1 Updated T _{op} in Table 5 |
| 19-Oct-2012 | 6 | Updated Features (added ESD data). Updated Table 1 (added Marking, updated note 1.) Reformatted Section 4 (added Figure 5 and Figure 6 , Table 8 and Table 9). Minor corrections throughout document. |
| 25-Apr-2013 | 7 | Updated Features : ESD data modified, removed information regarding B series CMOS devices. Added Section 5: Ordering information |
| 13-Jan-2014 | 8 | Table 1: Device summary : added "Packing" |

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