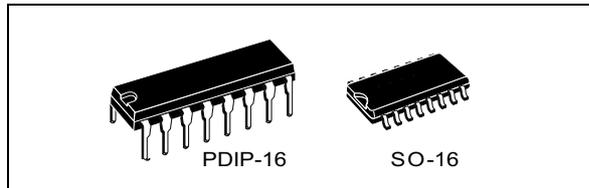


Single 8-channel analog multiplexer/demultiplexer

Datasheet - production data



Features

- Low “ON” resistance: 125 Ω (typ.)
- Over 15 V p.p signal-input range for $V_{DD} - V_{EE} = 15$ V
- High “OFF” resistance, channel leakage: ± 100 pA (typ.) at $V_{DD} - V_{EE} = 18$ V
- Binary address decoding on chip
- High degree of linearity: < 0.5 % distortion typ. at $f_{IS} = 1$ KHz, $V_{IS} = 5$ V_{pp}, $V_{DD} - V_{SS} \geq 10$ V, $R_L = 10$ k Ω
- Very low quiescent power dissipation under all digital control input and supply conditions: 0.2 μ W (typ.) $V_{DD} - V_{SS} = V_{DD} - V_{EE} = 10$ V
- Matched switch characteristics: $R_{ON} = 5$ Ω (typ.) for $V_{DD} - V_{EE} = 15$ V
- Wide range of digital and analog signal levels: digital 3 to 20, analog to 20 V p.p.
- Quiescent current specified up to 20 V
- 5 V, 10 V and 15 V parametric ratings
- ESD performance
 - HBM: 2 kV
 - MM: 200 V
 - CDM: 750 V

- Input leakage current $I_I = 100$ nA (max.) at $V_{DD} = 18$ V, $T_A = 25$ °C
- 100 % tested for quiescent current

Applications

- Automotive
- Industrial
- Computer
- Consumer

Description

The HCF4051 device is a monolithic integrated circuit fabricated in MOS (metal oxide semiconductor) technology available in SO-16 and PDIP-16 packages.

The HCF4051 analog multiplexer/demultiplexer is a digitally controlled analog switch having low ON impedance and very low OFF leakage current. This multiplexer circuit dissipates extremely low quiescent power over the full $V_{DD} - V_{SS}$ and $V_{DD} - V_{EE}$ supply voltage range, independent of the logic state of the control signals.

This device is a single 8-channel multiplexer having three binary control inputs, A, B, and C, and an inhibit input. The three binary signals select 1 of 8 channels to be turned on, and connect one of the 8 inputs to the output. When a logic “1” is present at the inhibit input terminal all channels are off.

Table 1. Device summary

| Order code | Temperature range | Package | Packaging | Marking |
|-------------------------------|-------------------|---------------------------|---------------|-----------|
| HCF4051M013TR | -55/+125 °C | SO-16 | Tape and reel | HCF4051 |
| HCF4051YM013TR ⁽¹⁾ | -40/+125 °C | SO16 (automotive version) | | HCF4051Y |
| HCF4051BEY | -55/+125 °C | PDIP-16 | Tube | HCF4051BE |

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 6**
- 4 Package information 11**
 - 4.1 PDIP-16 (0.25) package information 12
 - 4.2 SO-16 package information 13
- 5 Ordering information 14**
- 6 Revision history 14**

1 Pin information

Figure 1. Pin connections (top view)

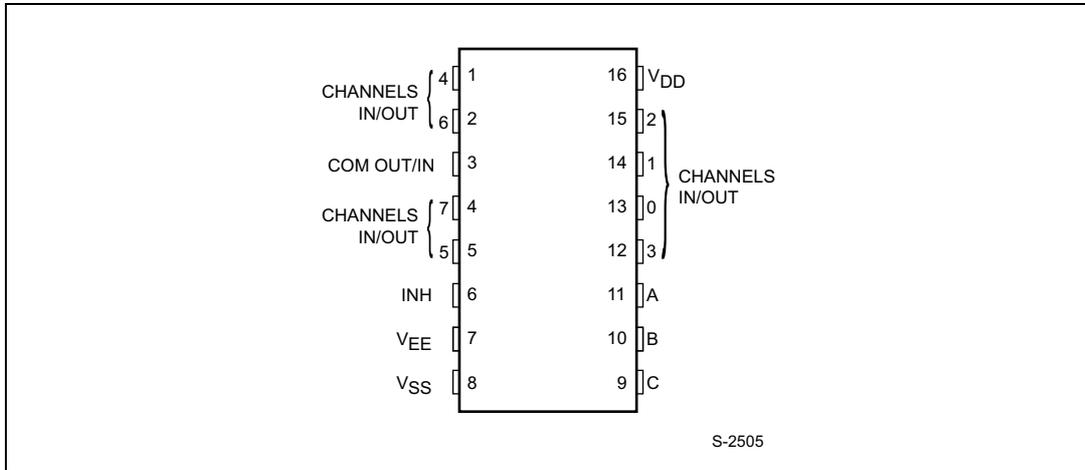


Table 2. Pin description

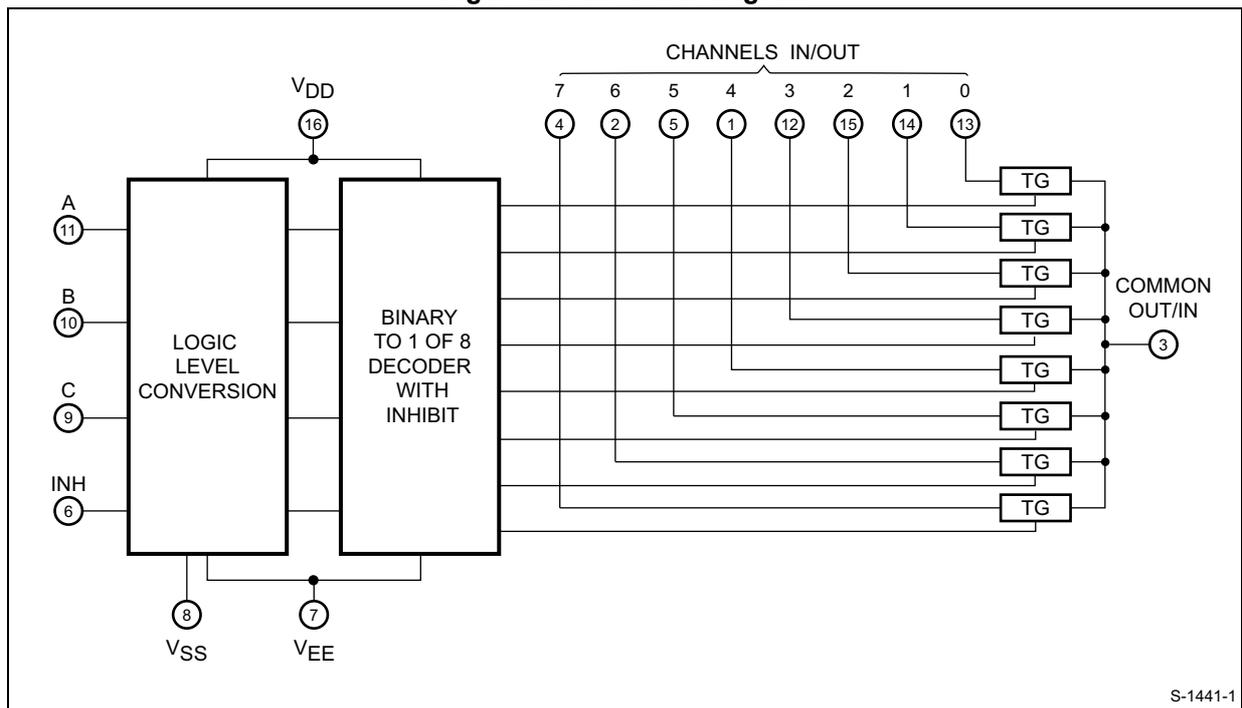
| Pin no. | Symbol | Name and function |
|----------------------------|-----------------------|----------------------------|
| 11, 10, 9 | A, B, C | Binary control inputs |
| 6 | INH | Inhibit inputs |
| 13, 14, 15, 12, 1, 5, 2, 4 | 0 to 7 channel IN/OUT | Independent inputs/outputs |
| 3 | COM OUT/IN | Common output/input |
| 7 | V _{EE} | Supply voltage |
| 8 | V _{SS} | Negative supply voltage |
| 16 | V _{DD} | Positive supply voltage |

2 Functional description

Table 3. Truth table

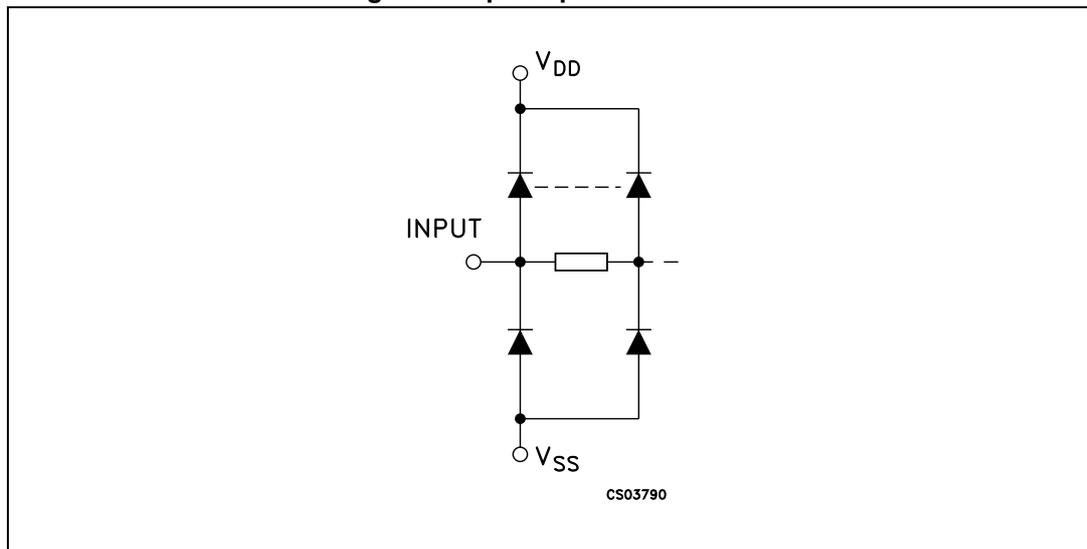
| Input states | | | | "ON" channel (S) |
|--------------|---|---|---|------------------|
| Inhibit | C | B | A | |
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 1 |
| 0 | 0 | 1 | 0 | 2 |
| 0 | 0 | 1 | 1 | 3 |
| 0 | 1 | 0 | 0 | 4 |
| 0 | 1 | 0 | 1 | 5 |
| 0 | 1 | 1 | 0 | 6 |
| 0 | 1 | 1 | 1 | 7 |
| 1 | X | X | X | None |

Figure 2. Functional diagram



S-1441-1

Figure 3. 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 | 500 ⁽¹⁾ | mW |
| | Power dissipation per output transistor | 100 | |
| T_{op} | Operating temperature | -55 to +125 | °C |
| T_{stg} | Storage temperature | -65 to +150 | |

1. 500 mW at 65 °C; derate to 300 mW by 10 mW/°C from 65 °C to 85 °C.

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

| Symbol | Parameter | Test condition | | | | Value | | | | | Unit |
|-------------------------------------|----------------------------------------------------------------|------------------------------------|-----------------------|-----------------------------------------------------------------------------------------------------------------|-----------------|----------------------------------|---------------|-----------|-------------------------------------------|---------|---------------|
| | | V_{IS} (V) | V_{EE} (V) | V_{SS} (V) | V_{DD} (V) | $T_A = 25\text{ }^\circ\text{C}$ | | | $-55\text{ to }125\text{ }^\circ\text{C}$ | | |
| | | | | | | Min. | Typ. | Max. | Min. | Max. | |
| I_L | Quiescent device current (all switches ON or all switches OFF) | | | | 5 | | 0.04 | 5 | | 150 | μA |
| | | | | | 10 | | 0.04 | 10 | | 300 | |
| | | | | | 15 | | 0.04 | 20 | | 600 | |
| | | | | | 20 | | 0.08 | 100 | | 3000 | |
| Switch | | | | | | | | | | | |
| R_{ON} | Resistance | $0 \leq V_I \leq V_{DD}$ | 0 | 0 | 5 | | 470 | 1050 | | 1200 | Ω |
| | | | | | 10 | | 180 | 400 | | 520 | |
| | | | | | 15 | | 125 | 280 | | 360 | |
| D_{ON} | Resistance ΔR_{ON} (between any 2 of 4 switches) | $0 \leq V_I \leq V_{DD}$ | 0 | 0 | 5 | | 10 | | | | Ω |
| | | | | | 10 | | 10 | | | | |
| | | | | | 15 | | 5 | | | | |
| OFF ⁽¹⁾ | Channel leakage current (all channels OFF) (COMMON O/I) | | 0 | 0 | 18 | | ± 0.1 | 100 | | 1000 | nA |
| OFF ⁽¹⁾ | Channel leakage current (any channel OFF) | | 0 | 0 | 18 | | ± 0.1 | 100 | | 1000 | |
| C_I | Input capacitance | | | | | | 5 | | | | pF |
| C_O | Output capacitance | | -5 | -5 | 5 | | 30 | | | | |
| C_{IO} | Feedthrough | | | | | | 0.2 | | | | |
| Control (address or inhibit) | | | | | | | | | | | |
| V_{IL} | Input low voltage | $= V_{DD}$ through 1 K Ω | | $V_{EE} = V_{SS}$ $R_L = 1\text{K}\Omega$ to V_{SS} $I_{IS} < 2\mu\text{A}$ (on all OFF channels) | 5 | | | 1.5 | | 1.5 | V |
| | | | | | 10 | | | 3 | | 3 | |
| | | | | | 15 | | | 4 | | 4 | |
| V_{IH} | Input high voltage | | | | 5 | 3.5 | | | 3.5 | | V |
| | | | | | 10 | 7 | | | 7 | | |
| | | | | | 15 | 11 | | | 11 | | |
| I_{IH}, I_{IL} | Input leakage current | | $V_I = 0/18\text{ V}$ | | 18 | | $\pm 10^{-3}$ | ± 0.1 | | ± 1 | μA |
| C_I | Input capacitance | | | | | | 5 | 7.5 | | | pF |

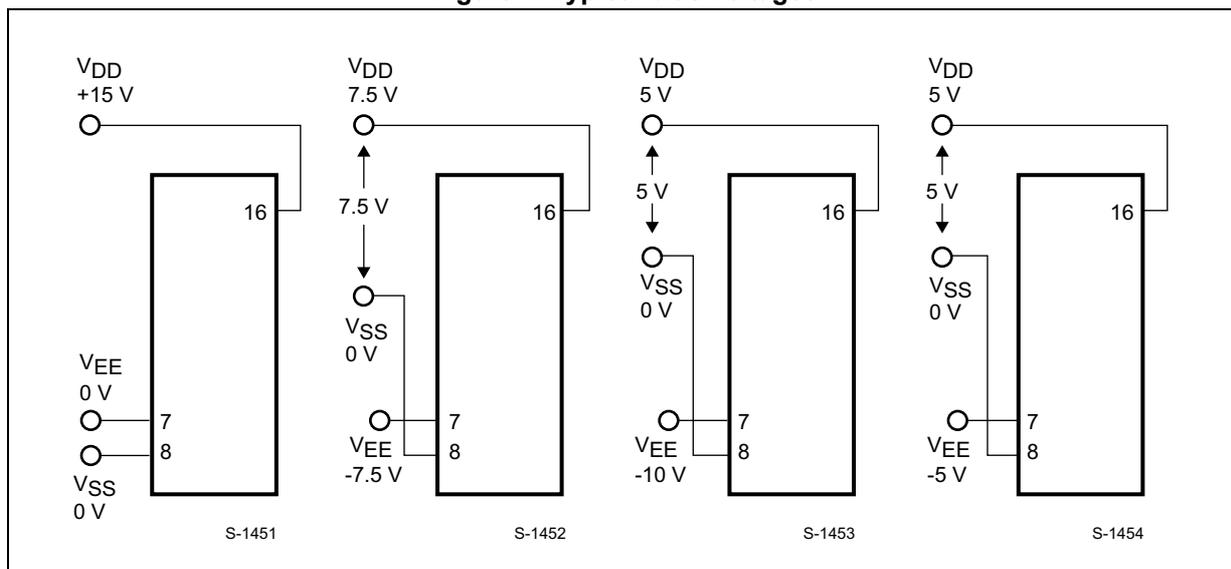
1. Determined by minimum feasible leakage measurement for automating testing.

Table 7. Dynamic electrical characteristics
 (T_{amb} = 25 °C, C_L = 50 pF, all input square wave rise and fall time = 20 ns)⁽¹⁾

| Parameter | Test condition | | | | | | | Value | | | Unit |
|----------------------------------------------------------------------------------------------------|---------------------|---------------------|----------------------|------------------------------------------------------------------------------------------------------|---------------------|---------------------|------------------------------------------------------------------|-------|------|-----|---------|
| | V _{EE} (V) | R _L (KΩ) | f _i (KHz) | V _I (V) | V _{SS} (V) | V _{DD} (V) | Min. | Typ. | Max. | | |
| Propagation delay time (signal input to output) | | 200 | | V _{DD}  | | 5 | | | 30 | 60 | ns |
| | | | | | | 10 | | | 15 | 30 | |
| | | | | | | 15 | | | 11 | 20 | |
| Frequency response channel "ON" (sine wave input) at 20 log V _O /V _I = -3 dB | =V _{SS} | 1 | | 5 ⁽²⁾ | | 10 | V _O at common OUT/IN | | 20 | | MHz |
| | | | | | | | V _O at any channel | | 60 | | |
| Feedthrough (all channels OFF) at 20 log V _O /V _I = -40 dB | =V _{SS} | 1 | | 5 ⁽²⁾ | | 10 | V _O at common OUT/IN | | 12 | | MHz |
| | | | | | | | V _O at any channel | | 8 | | |
| Frequency signal crosstalk at 20 log V _O /V _I = -40 dB | =V _{SS} | 1 | | 5 ⁽²⁾ | | 10 | Between any 2 channels | | 3 | | |
| Sine wave distortion f _{IS} = 1 KHz sine wave | =V _{SS} | 10 | 1 | 2 ⁽²⁾ | | 5 | | | 0.3 | | % |
| | | | | 3 ⁽²⁾ | | 10 | | | 0.2 | | |
| | | | | 5 ⁽²⁾ | | 15 | | | 0.12 | | |
| Control (address or inhibit) | | | | | | | | | | | |
| Propagation delay: address to signal OUT (channels ON or OFF) | 0 | | | | | 0 | 5 | | 360 | 720 | ns |
| | 0 | | | | | 0 | 10 | | 160 | 320 | |
| | 0 | | | | | 0 | 15 | | 120 | 240 | |
| | -5 | | | | | 0 | 5 | | 225 | 450 | |
| Propagation delay: inhibit to signal OUT (channel turning ON) | 0 | 1 | | | | 0 | 5 | | 360 | 720 | ns |
| | 0 | | | | | 0 | 10 | | 160 | 320 | |
| | 0 | | | | | 0 | 15 | | 120 | 240 | |
| | -10 | | | | | 0 | 5 | | 200 | 400 | |
| Propagation delay: inhibit to signal OUT (channel turning OFF) | 0 | 10 | | | | | 5 | | 200 | 450 | ns |
| | 0 | | | | | | 10 | | 90 | 210 | |
| | 0 | | | | | | 15 | | 70 | 160 | |
| | -10 | | | | | | 5 | | 130 | 300 | |
| Address or inhibit to signal crosstalk | 0 | 10 ⁽¹⁾ | | | 0 | 10 | V _C = V _{DD} - V _{SS} (square wave) | | 65 | | mV peak |

1. Both ends of channel.
 2. Peak-to-peak voltage symmetrical about (V_{DD} - V_{EE}) / 2.

Figure 4. Typical bias voltages



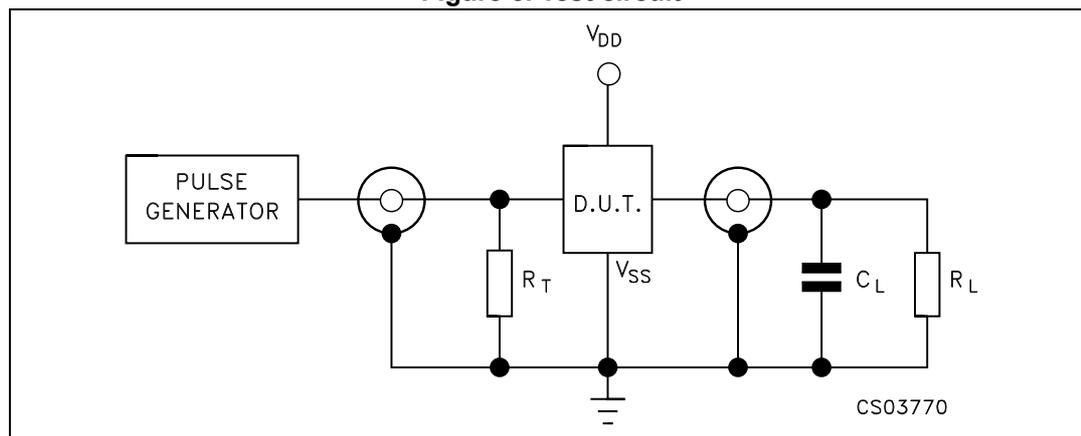
- The ADDRESS (digital-control inputs) and INHIBIT logic levels are : "0" = V_{SS} and "1" = V_{DD} . The analog signal (through the TG) may swing from V_{EE} to V_{DD} .

Special considerations

Control of analog signals up to 20 V peak-to-peak can be achieved by digital signal amplitudes of 4.5 to 20 V (if $V_{DD} - V_{SS} = 3$ V, a $V_{DD} - V_{EE}$ of up to 13 V can be controlled; for $V_{DD} - V_{EE}$ level differences above 13 V, a $V_{DD} - V_{SS}$ of at least 4.5 V is required).

For example, if $V_{DD} = +5$, $V_{SS} = 0$, and $V_{EE} = -13.5$, analog signals from -13.5 V to 4.5 V can be controlled by digital inputs of 0 to 4.5 V. In certain applications, the external load resistor current may include both V_{DD} and signal-line components. To avoid drawing V_{DD} current when switch current flows into the transmission gate inputs, the voltage drop across the bidirectional switch must not exceed 0.8 V (calculated from R_{ON} values shown in [Table 6: DC specifications](#)). No V_{DD} current flows through R_L if the switch current flows into lead 3.

Figure 5. Test circuit



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

Figure 6. Waveform 1: channel turned ON
($R_L = 1\text{ K}\Omega$, $f = 1\text{ MHz}$; 50 % duty cycle)

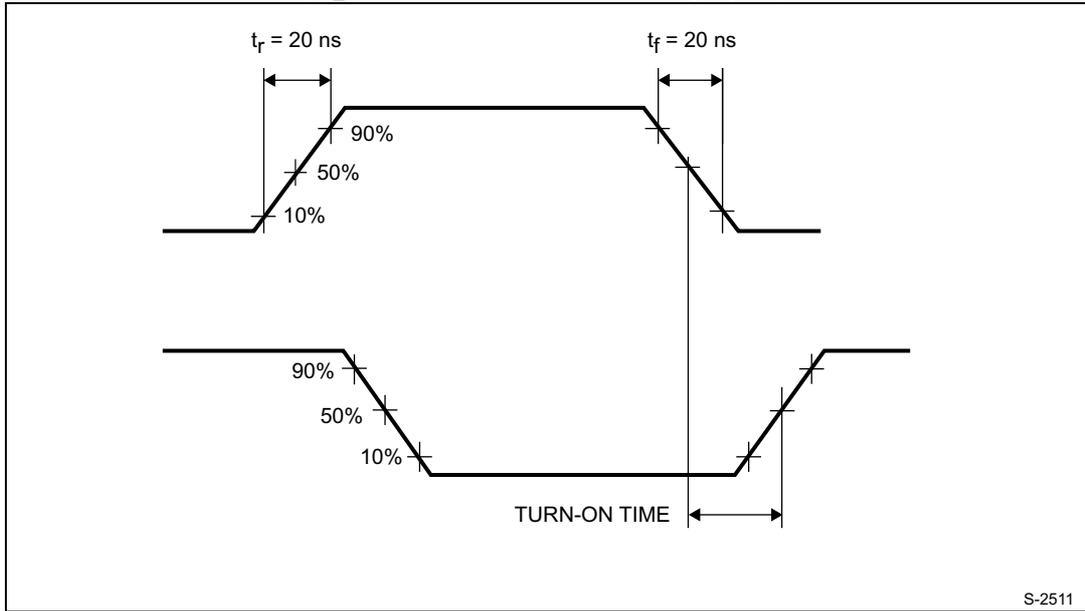
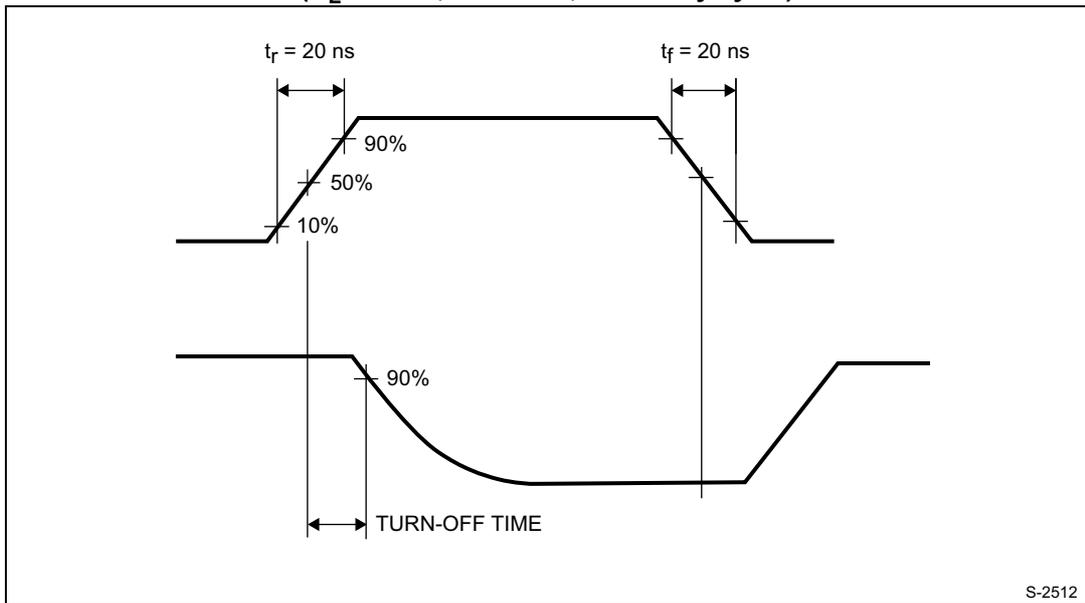


Figure 7. Waveform 2: channel turned OFF
($R_L = 1\text{ KW}$, $f = 1\text{ MHz}$; 50 % duty cycle)

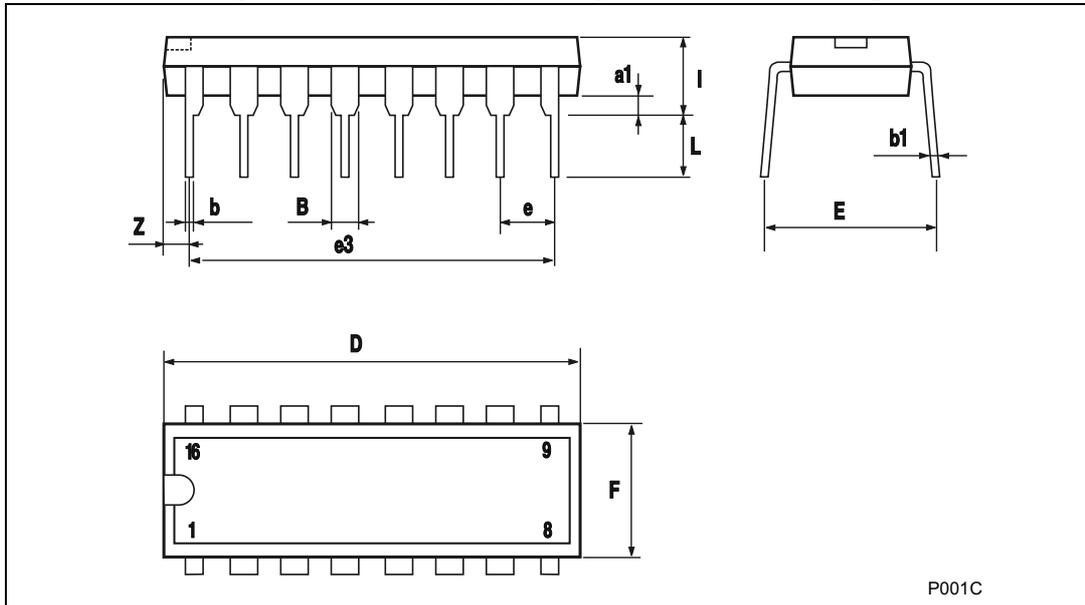


4 Package information

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 PDIP-16 (0.25) package information

Figure 8. PDIP-16 (0.25) package mechanical drawing



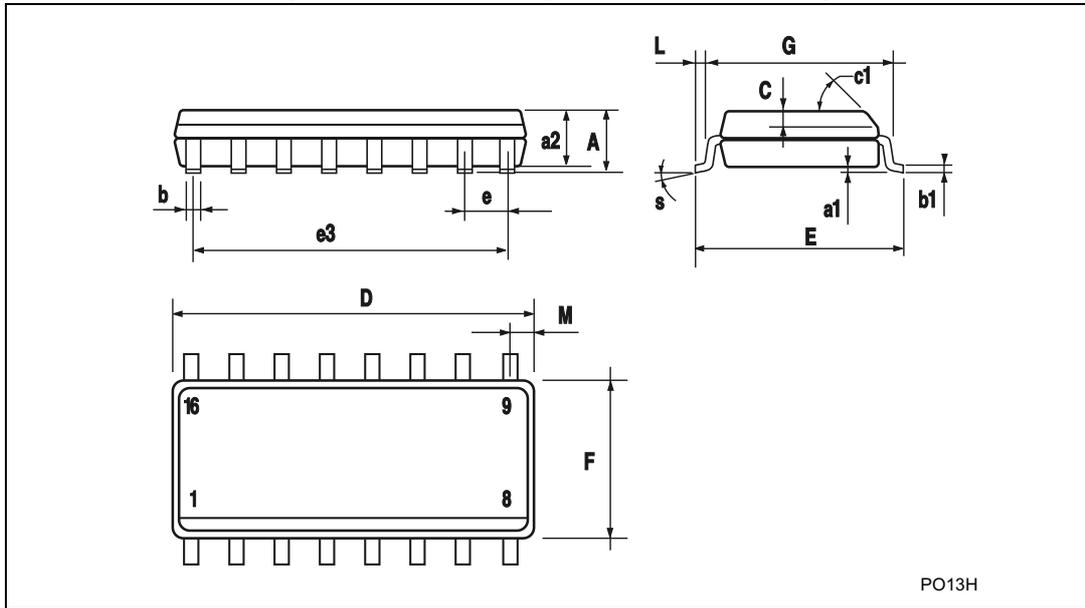
P001C

Table 8. PDIP-16 (0.25) package mechanical data

| Symbol | Dimensions | | | | | |
|--------|------------|-------|------|-------|-------|-------|
| | mm | | | inch | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| a1 | 0.51 | | | 0.020 | | |
| B | 0.77 | | 1.65 | 0.030 | | 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 | | 17.78 | | | 0.700 | |
| F | | | 7.1 | | | 0.280 |
| I | | | 5.1 | | | 0.201 |
| L | | 3.3 | | | 0.130 | |
| Z | | | 1.27 | | | 0.050 |

4.2 SO-16 package information

Figure 9. SO-16 package mechanical drawing



PO13H

Table 9. SO-16 package mechanical data

| Symbol | Dimensions | | | | | |
|--------|------------|------|------|-------|-------|-------|
| | mm | | | inch | | |
| | 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° (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.) | | | | | |

5 Ordering information

Table 10. Order codes

| Order code | Temperature range | Package | Packaging | Marking |
|-------------------------------|-------------------|------------------------------|---------------|-----------|
| HCF4051M013TR | -55/+125 °C | SO-16 | Tape and reel | HCF4051 |
| HCF4051YM013TR ⁽¹⁾ | -40/+125 °C | SO16 (automotive version) | | HCF4051Y |
| HCF4051BEY | -55/+125 °C | PDIP-16 | Tube | HCF4051BE |

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 |
|-------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 26-Oct-2012 | 2 | Updated Features (added ESD values), added Applications . Updated Table 1 (reformatted table, added order codes, temperature range, marking, updated package and packaging). Updated Description (unified part numbers, moved to page 2). Updated Section 2 to Section 4 (added titles and numbering). Updated Table 6 (removed -40/+85° temperature range). Reformatted Section 4 (added ECOPACK text, Figure 8 , Figure 9 , Table 8 , and Table 9). Minor corrections throughout document. |
| 30-Apr-2013 | 3 | Updated Features (ESD values) Added Section 5: Ordering information |

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