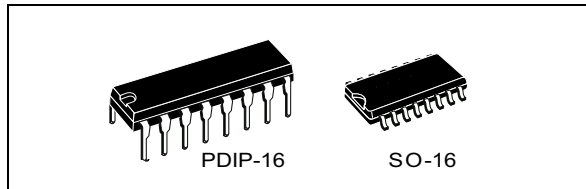


## Single 8-channel analog multiplexer/demultiplexer

Datasheet - production data



### Features

- Low “ON” resistance: 125  $\Omega$  (typ.)
- Over 15 V p.p signal-input range for  $V_{DD} - V_{EE} = 15$  V
- High “OFF” resistance, channel leakage:  $\pm 100$  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<sub>pp</sub>,  $V_{DD} - V_{SS} \geq 10$  V,  $R_L = 10$  k $\Omega$
- Very low quiescent power dissipation under all digital control input and supply conditions: 0.2  $\mu$ W (typ.)  $V_{DD} - V_{SS} = V_{DD} - V_{EE} = 10$  V
- Matched switch characteristics:  $R_{ON} = 5$   $\Omega$  (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 <sup>(1)</sup>	-40/+125 °C	SO16 (automotive version)		HCF4051Y
HCF4051BEY	-55/+125 °C	PDIP-16	Tube	HCF4051BE

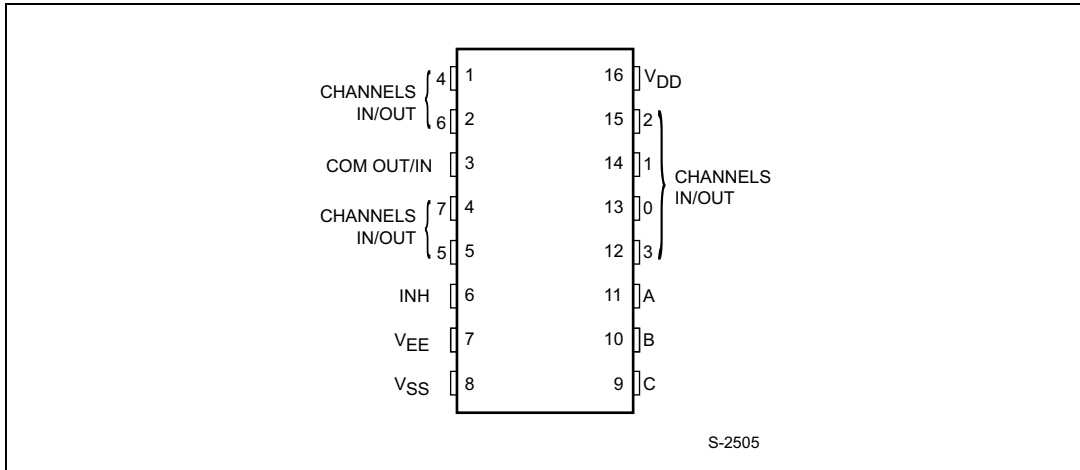
1. Qualification and characterization according to AEC Q100 and Q003 or equivalent, advanced screening according to AEC Q001 and Q002 or equivalent.

# Contents

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# 1 Pin information

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



**Table 2. Pin description**

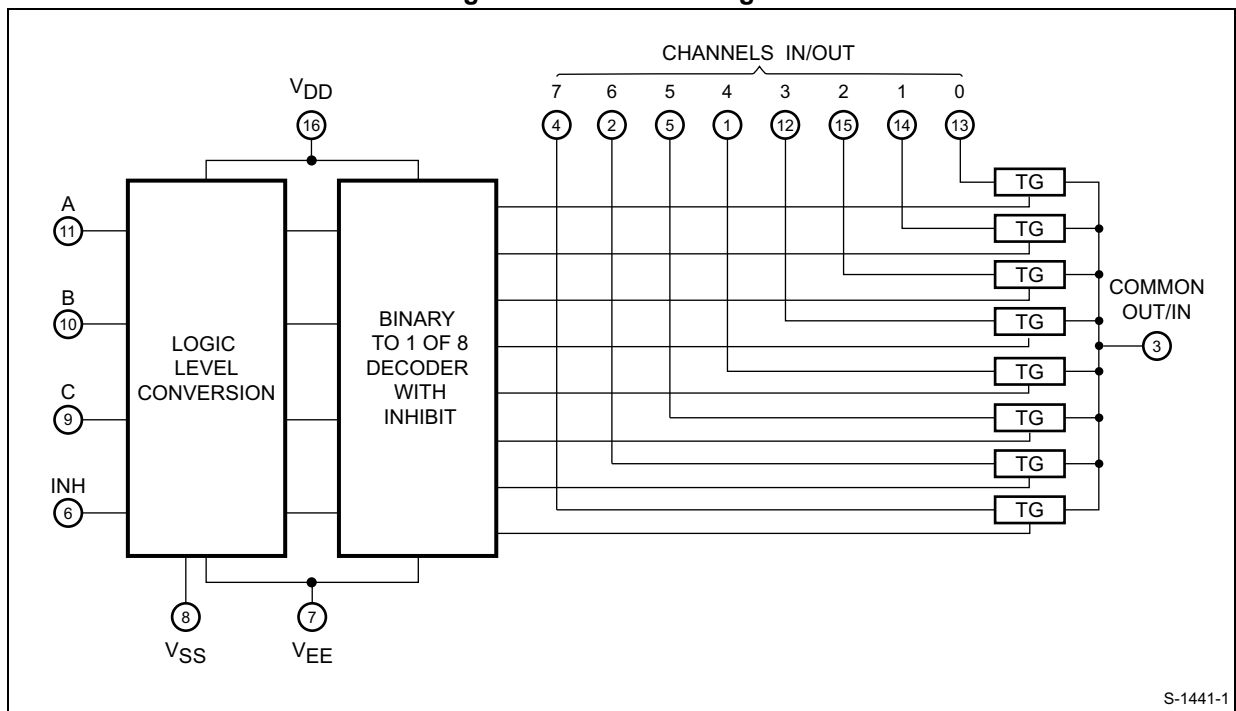
Pin no.	Symbol	Name and function
11, 10, 9	A, B, C	Binary control inputs
6	INH	Inhibit inputs
13, 14, 15, 12, 1, 5, 2, 4	0 to 7 channel IN/OUT	Independent inputs/outputs
3	COM OUT/IN	Common output/input
7	V <sub>EE</sub>	Supply voltage
8	V <sub>SS</sub>	Negative supply voltage
16	V <sub>DD</sub>	Positive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

## 2 Functional description

Table 3. Truth table

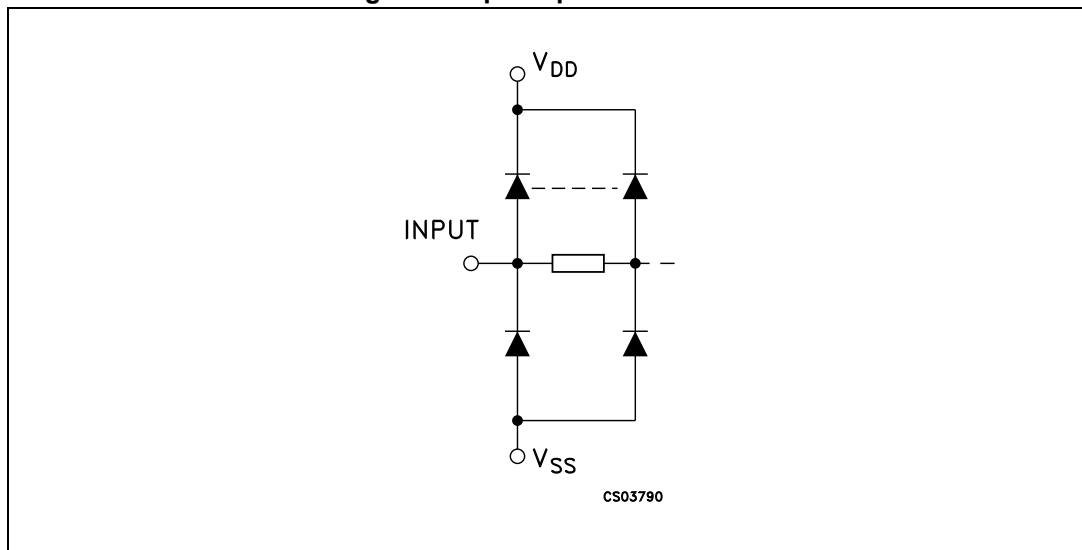
Input states				"ON" channel (S)
Inhibit	C	B	A	
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	X	X	X	None

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	$\pm 10$	mA
$P_D$	Power dissipation per package	500 <sup>(1)</sup>	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	$\mu\text{A}$
					10		0.04	10		300	
					15		0.04	20		600	
					20		0.08	100		3000	
<b>Switch</b>											
$R_{ON}$	Resistance	$0 \leq V_I \leq V_{DD}$	0	0	5		470	1050		1200	$\Omega$
					10		180	400		520	
					15		125	280		360	
$D_{ON}$	Resistance $\Delta R_{ON}$ (between any 2 of 4 switches)	$0 \leq V_I \leq V_{DD}$	0	0	5		10				$\Omega$
					10		10				
					15		5				
OFF <sup>(1)</sup>	Channel leakage current (all channels OFF) (COMMON O/I)		0	0	18		$\pm 0.1$	100		1000	$\text{nA}$
OFF <sup>(1)</sup>	Channel leakage current (any channel OFF)		0	0	18		$\pm 0.1$	100		1000	
$C_I$	Input capacitance						5				$\text{pF}$
$C_O$	Output capacitance		-5	-5	5		30				
$C_{IO}$	Feedthrough						0.2				
<b>Control (address or inhibit)</b>											
$V_{IL}$	Input low voltage	$= V_{DD}$ through 1 K $\Omega$	$V_{EE} = V_{SS}$ $R_L = 1\text{K}\Omega$ to $V_{SS}$ $I_{IS} < 2\mu\text{A}$ (on all OFF channels)	5			1.5		1.5	$\text{V}$	
				10			3		3		
				15			4		4		
$V_{IH}$	Input high voltage			5	3.5			3.5			
				10	7			7			
				15	11			11			
$I_{IH}, I_{IL}$	Input leakage current				18		$\pm 10^{-3}$	$\pm 0.1$		$\pm 1$	$\mu\text{A}$
$C_I$	Input capacitance						5	7.5			$\text{pF}$

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

**Table 7. Dynamic electrical characteristics**  
 (T<sub>amb</sub> = 25 °C, C<sub>L</sub> = 50 pF, all input square wave rise and fall time = 20 ns)<sup>(1)</sup>

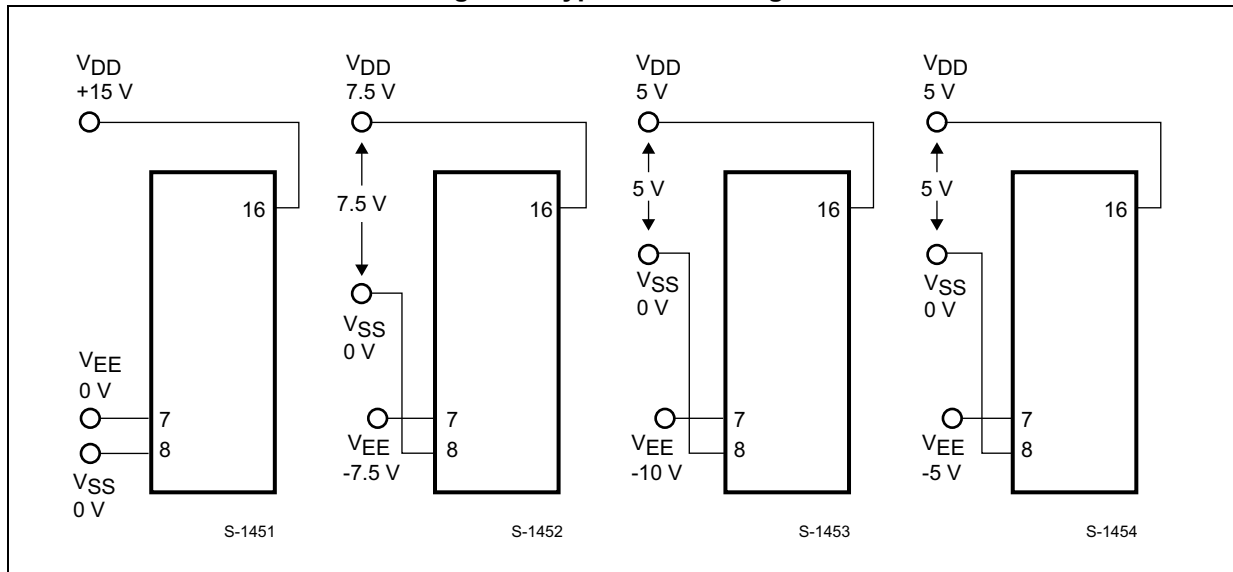
Parameter	Test condition							Value			Unit
	V <sub>EE</sub> (V)	R <sub>L</sub> (KΩ)	f <sub>i</sub> (KHz)	V <sub>I</sub> (V)	V <sub>SS</sub> (V)	V <sub>DD</sub> (V)	Min.	Typ.	Max.		
Propagation delay time (signal input to output)		200		V <sub>DD</sub> 		5			30	60	ns
						10			15	30	
						15			11	20	
Frequency response channel "ON" (sine wave input) at 20 log V <sub>O</sub> /V <sub>I</sub> = -3 dB	=V <sub>SS</sub>	1		5 <sup>(2)</sup>		10	V <sub>O</sub> at common OUT/IN		20		MHz
							V <sub>O</sub> at any channel		60		
Feedthrough (all channels OFF) at 20 log V <sub>O</sub> /V <sub>I</sub> = -40 dB	=V <sub>SS</sub>	1		5 <sup>(2)</sup>		10	V <sub>O</sub> at common OUT/IN		12		MHz
							V <sub>O</sub> at any channel		8		
Frequency signal crosstalk at 20 log V <sub>O</sub> /V <sub>I</sub> = -40 dB	=V <sub>SS</sub>	1		5 <sup>(2)</sup>		10	Between any 2 channels		3		
Sine wave distortion f <sub>IS</sub> = 1 KHz sine wave	=V <sub>SS</sub>	10	1	2 <sup>(2)</sup>		5			0.3		%
				3 <sup>(2)</sup>		10			0.2		
				5 <sup>(2)</sup>		15			0.12		
<b>Control (address or inhibit)</b>											
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 <sup>(1)</sup>			0	10	V <sub>C</sub> = V <sub>DD</sub> - V <sub>SS</sub> (square wave)		65		mV peak

1. Both ends of channel.  
 2. Peak-to-peak voltage symmetrical about (V<sub>DD</sub> - V<sub>EE</sub>) / 2.





Figure 4. Typical bias voltages



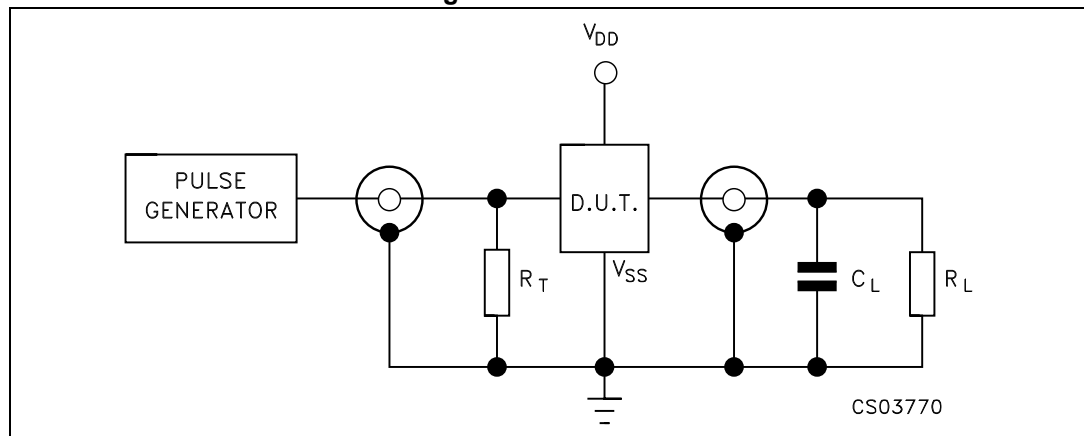
- The ADDRESS (digital-control inputs) and INHIBIT logic levels are : "0" =  $V_{SS}$  and "1" =  $V_{DD}$ . The analog signal (through the TG) may swing from  $V_{EE}$  to  $V_{DD}$ .

**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).

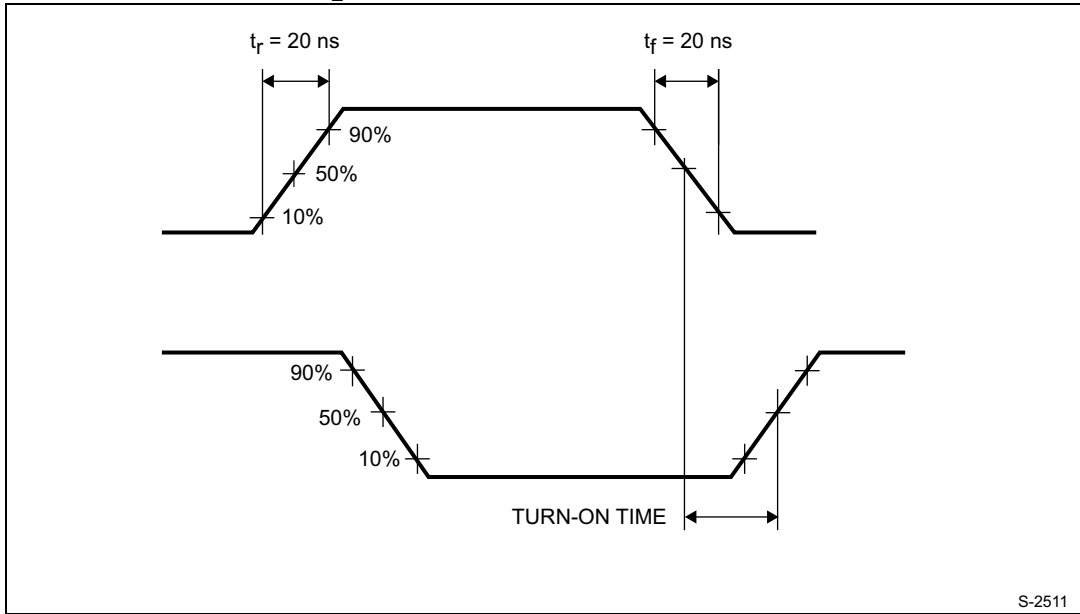
For example, if  $V_{DD} = +5$ ,  $V_{SS} = 0$ , and  $V_{EE} = -13.5$ , analog signals from -13.5 V to 4.5 V can be controlled by digital inputs of 0 to 4.5 V. In certain applications, the external load resistor current may include both  $V_{DD}$  and signal-line components. To avoid drawing  $V_{DD}$  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

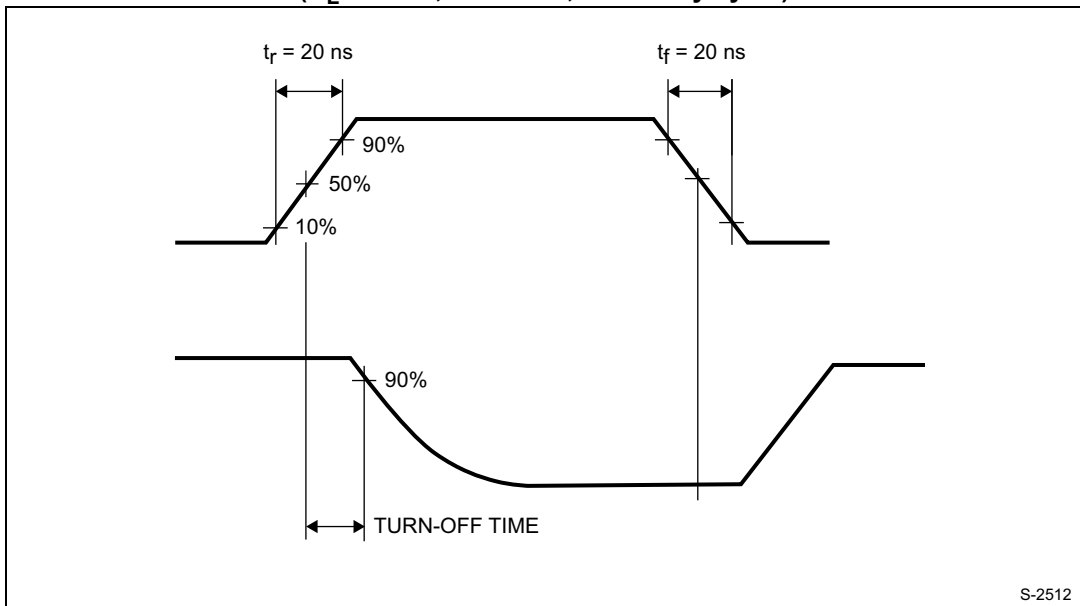


- $C_L = 50$  pF or equivalent (includes jig and probe capacitance)  
 $R_L = 200$  K $\Omega$   
 $R_T = Z_{OUT}$  of pulse generator (typically 50  $\Omega$ ).

**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)

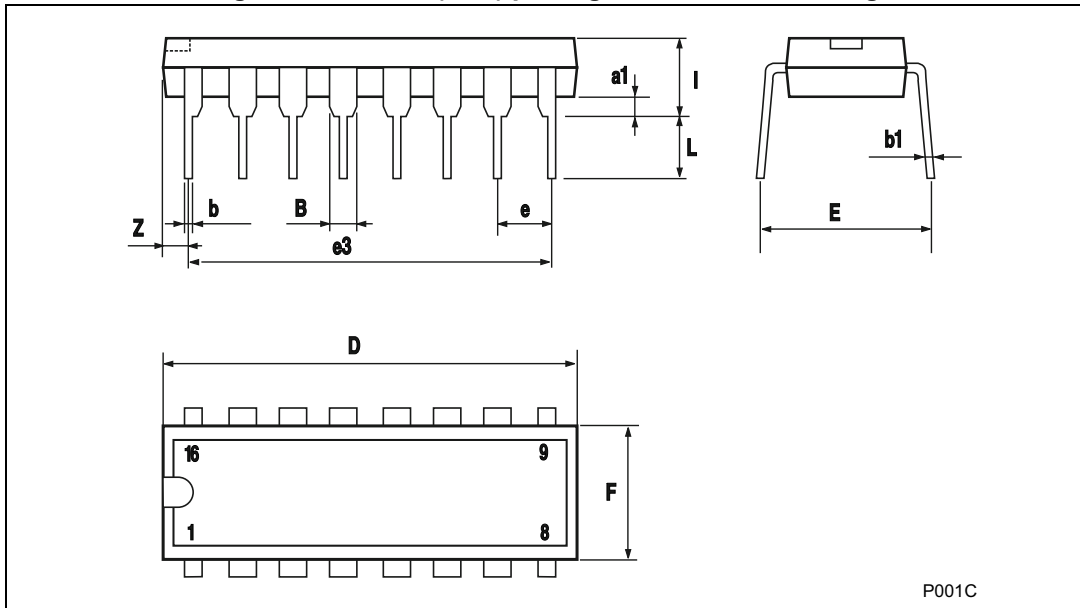


## 4 Package information

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](http://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

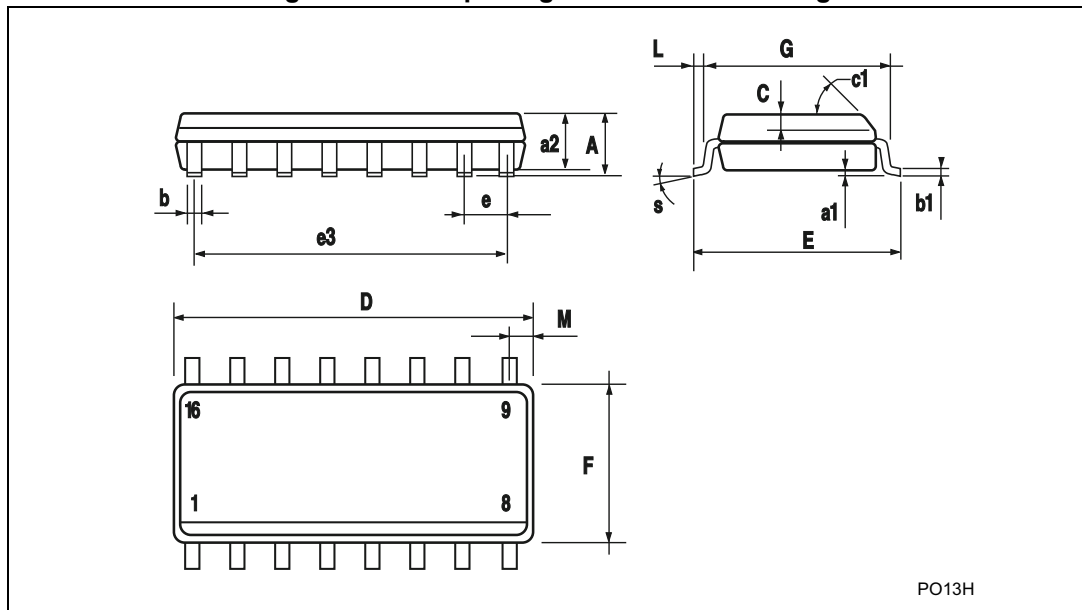


Table 9. SO-16 package mechanical data

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

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