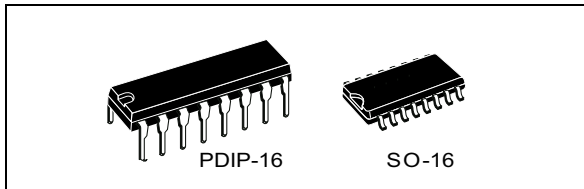


Single 8-channel analog multiplexer/demultiplexer

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)

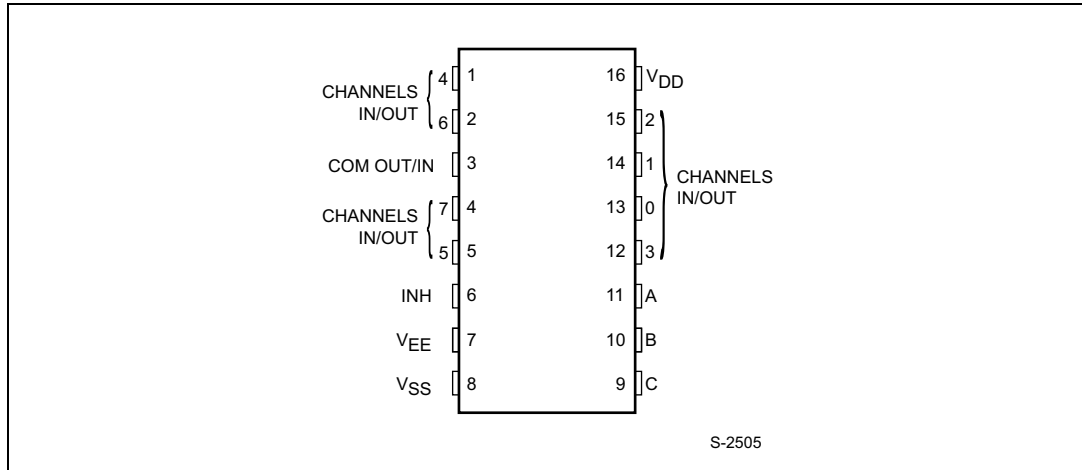


Table 2. Pin description

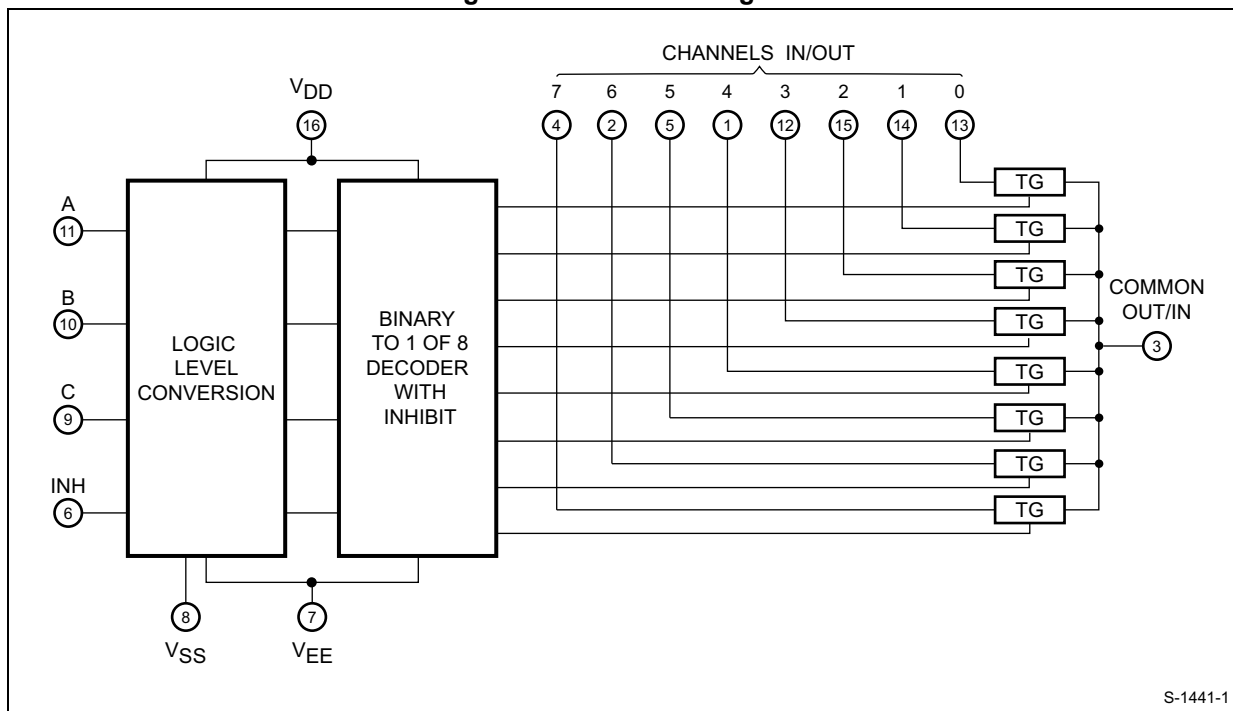
Pin no.	Symbol	Name and function
11, 10, 9	A, B, C	Binary control inputs
6	INH	Inhibit inputs
13, 14, 15, 12, 1, 5, 2, 4	0 to 7 channel IN/OUT	Independent inputs/outputs
3	COM OUT/IN	Common output/input
7	V _{EE}	Supply voltage
8	V _{SS}	Negative supply voltage
16	V _{DD}	Positive supply voltage

2 Functional description

Table 3. Truth table

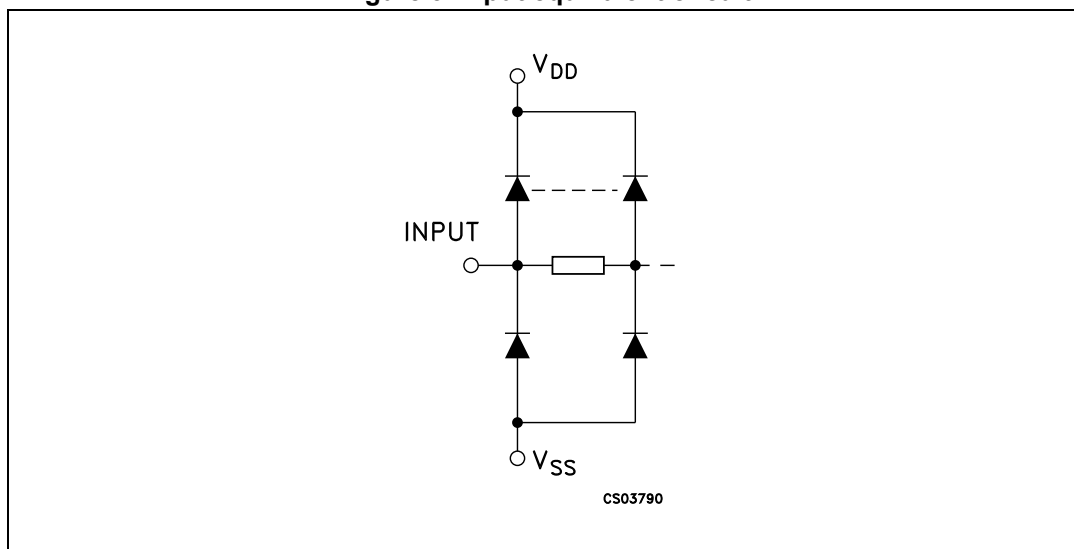
Input states				"ON" channel (S)
Inhibit	C	B	A	
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	X	X	X	None

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.

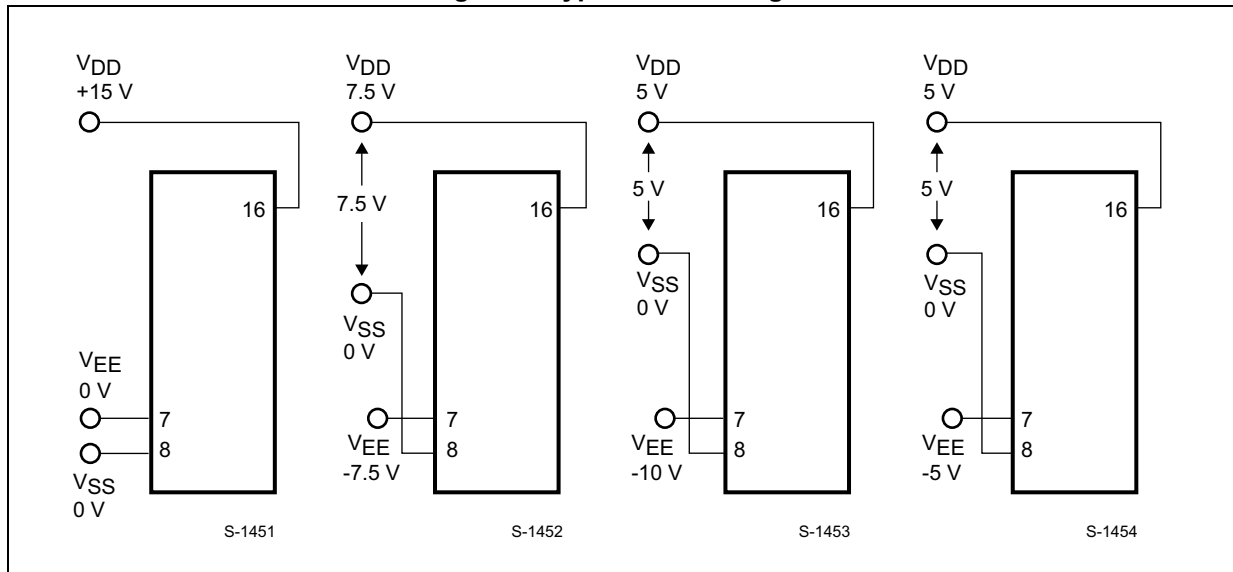
Table 7. Dynamic electrical characteristics
 (T_{amb} = 25 °C, C_L = 50 pF, all input square wave rise and fall time = 20 ns)⁽¹⁾

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



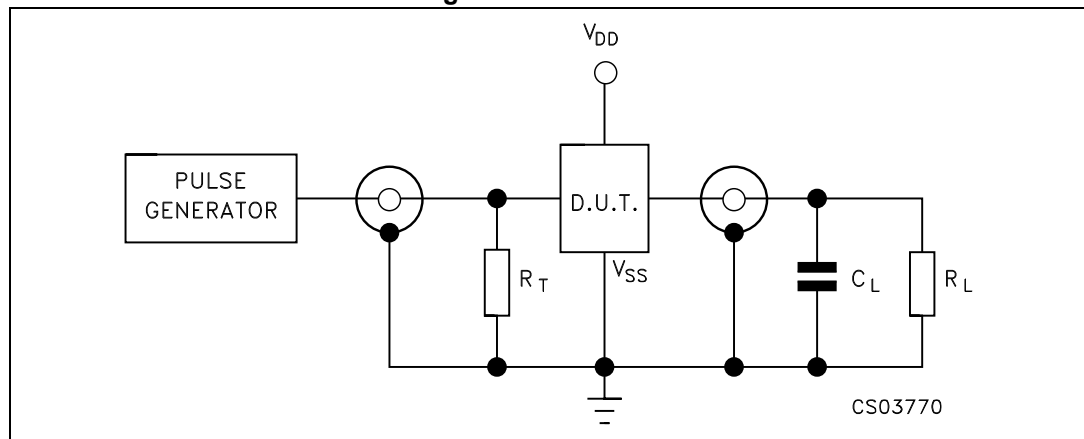
- The ADDRESS (digital-control inputs) and INHIBIT logic levels are : "0" = V_{SS} and "1" = V_{DD} . The analog signal (through the TG) may swing from V_{EE} to V_{DD} .

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)

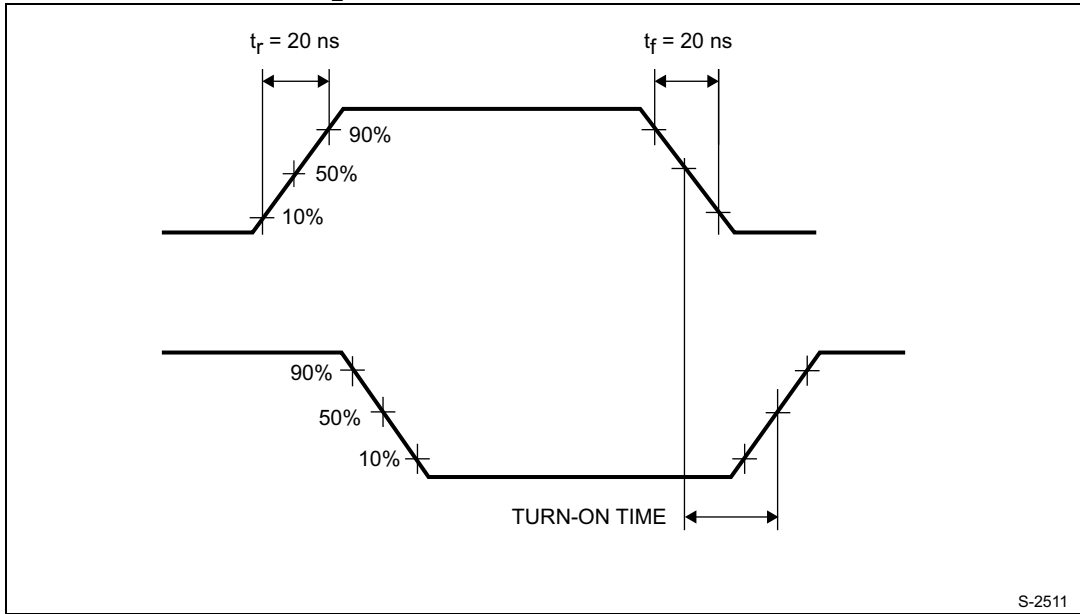
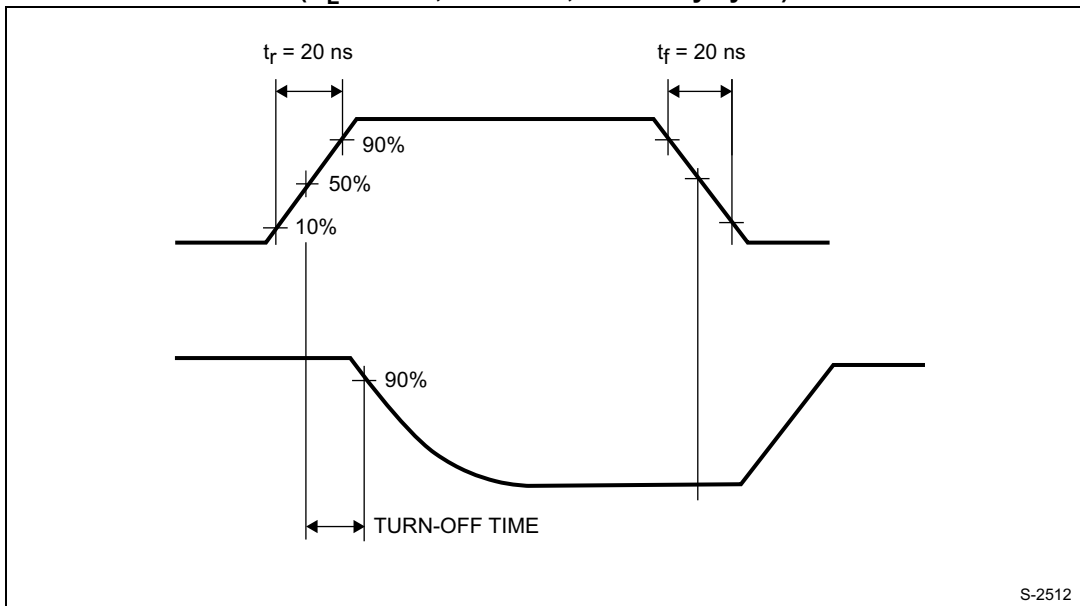


Figure 7. Waveform 2: channel turned OFF
($R_L = 1\text{ KW}$, $f = 1\text{ MHz}$; 50 % duty cycle)

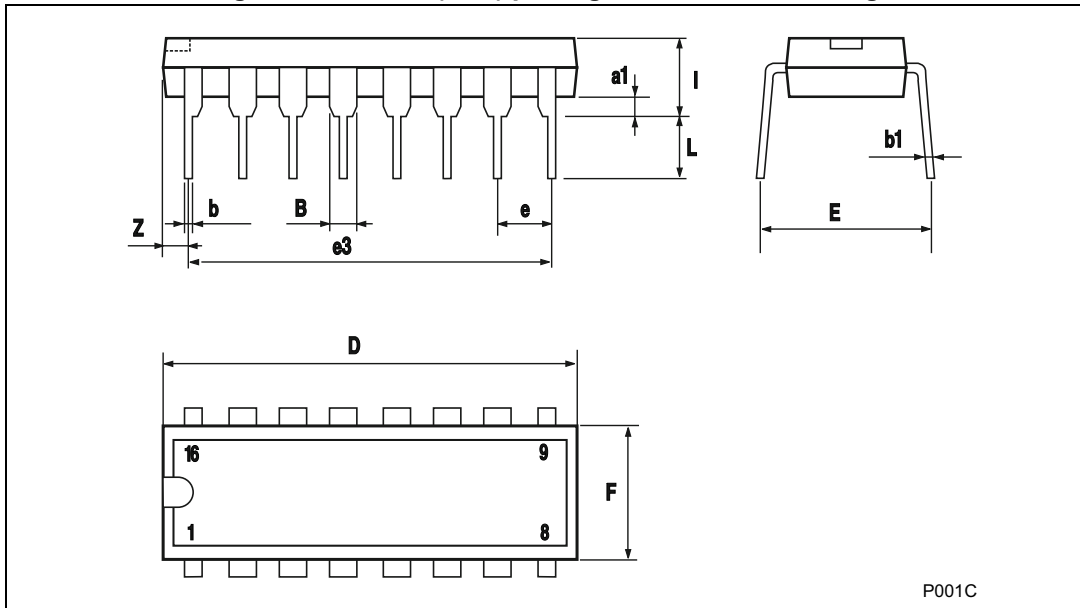


4 Package information

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

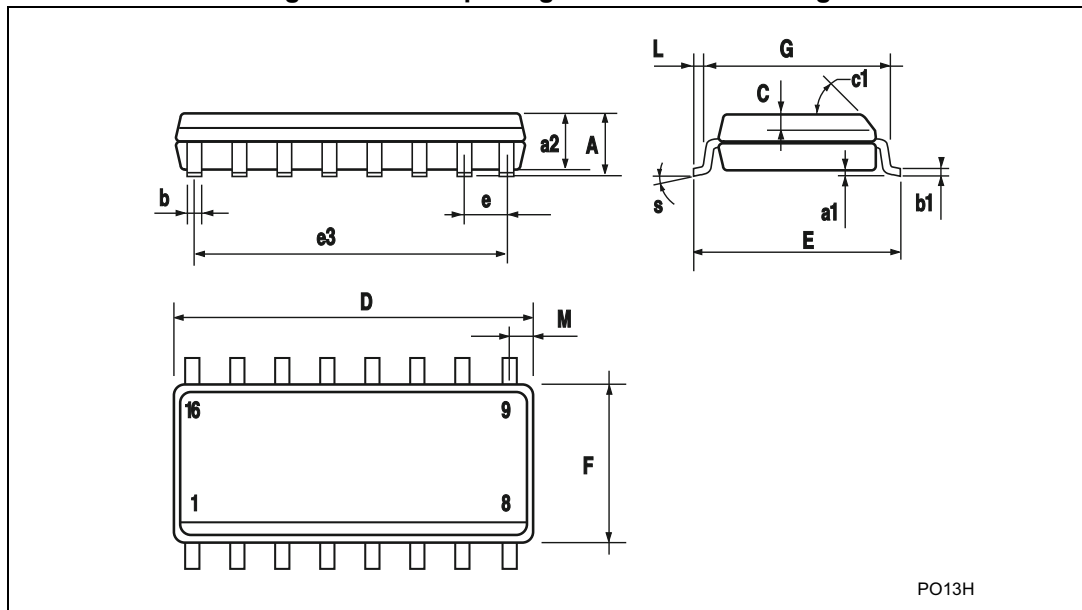


Table 9. SO-16 package mechanical data

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

Please Read Carefully:

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

ST PRODUCTS ARE NOT AUTHORIZED FOR USE IN WEAPONS. NOR ARE ST PRODUCTS DESIGNED OR AUTHORIZED FOR USE IN: (A) SAFETY CRITICAL APPLICATIONS SUCH AS LIFE SUPPORTING, ACTIVE IMPLANTED DEVICES OR SYSTEMS WITH PRODUCT FUNCTIONAL SAFETY REQUIREMENTS; (B) AERONAUTIC APPLICATIONS; (C) AUTOMOTIVE APPLICATIONS OR ENVIRONMENTS, AND/OR (D) AEROSPACE APPLICATIONS OR ENVIRONMENTS. WHERE ST PRODUCTS ARE NOT DESIGNED FOR SUCH USE, THE PURCHASER SHALL USE PRODUCTS AT PURCHASER'S SOLE RISK, EVEN IF ST HAS BEEN INFORMED IN WRITING OF SUCH USAGE, UNLESS A PRODUCT IS EXPRESSLY DESIGNATED BY ST AS BEING INTENDED FOR "AUTOMOTIVE, AUTOMOTIVE SAFETY OR MEDICAL" INDUSTRY DOMAINS ACCORDING TO ST PRODUCT DESIGN SPECIFICATIONS. PRODUCTS FORMALLY ESCC, QML OR JAN QUALIFIED ARE DEEMED SUITABLE FOR USE IN AEROSPACE BY THE CORRESPONDING GOVERNMENTAL AGENCY.

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2013 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Philippines - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

www.st.com

