

74LV4051-Q100

8-channel analog multiplexer/demultiplexer

Rev. 1 — 16 July 2021

Product data sheet

1. General description

The 74LV4051-Q100 is an 8-channel analog multiplexer/demultiplexer with three digital select inputs (S0 to S2), an active-LOW enable input (\bar{E}), eight independent inputs/outputs (Y0 to Y7) and a common input/output (Z). It is a low-voltage Si-gate CMOS device that is pin and function compatible with 74HC4051 and 74HCT4051. With \bar{E} LOW, one of the eight switches is selected (low impedance ON-state) by S0 to S2. With \bar{E} HIGH, all switches are in the high-impedance OFF-state, independent of S0 to S2.

V_{CC} and GND are the supply voltage pins for the digital control inputs (S0 to S2, and \bar{E}). The V_{CC} to GND ranges are 1.0 V to 6.0 V. The analog inputs/outputs (Y0 to Y7, and Z) can swing between V_{CC} as a positive limit and V_{EE} as a negative limit. $V_{CC} - V_{EE}$ may not exceed 6.0 V. For operation as a digital multiplexer/demultiplexer, V_{EE} is connected to GND (typically ground).

This product has been qualified to the Automotive Electronics Council (AEC) standard Q100 (Grade 1) and is suitable for use in automotive applications.

2. Features and benefits

- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
 - Specified from -40 °C to +85 °C and from -40 °C to +125 °C
- Optimized for low-voltage applications: 1.0 V to 6.0 V
- Accepts TTL input levels between $V_{CC} = 2.7$ V and $V_{CC} = 3.6$ V
- Low ON resistance:
 - 145 Ω (typical) at $V_{CC} - V_{EE} = 2.0$ V
 - 80 Ω (typical) at $V_{CC} - V_{EE} = 3.0$ V
 - 60 Ω (typical) at $V_{CC} - V_{EE} = 4.5$ V
- Logic level translation:
 - To enable 3 V logic to communicate with ± 3 V analog signals
- Typical 'break before make' built in
- ESD protection:
 - HBM JESD22-A114E exceeds 2000 V
 - MM JESD22-A115-A exceeds 200 V

3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74LV4051PW-Q100	-40 °C to +125 °C	TSSOP16	plastic thin shrink small outline package; 16 leads; body width 4.4 mm	SOT403-1

4. Functional diagram

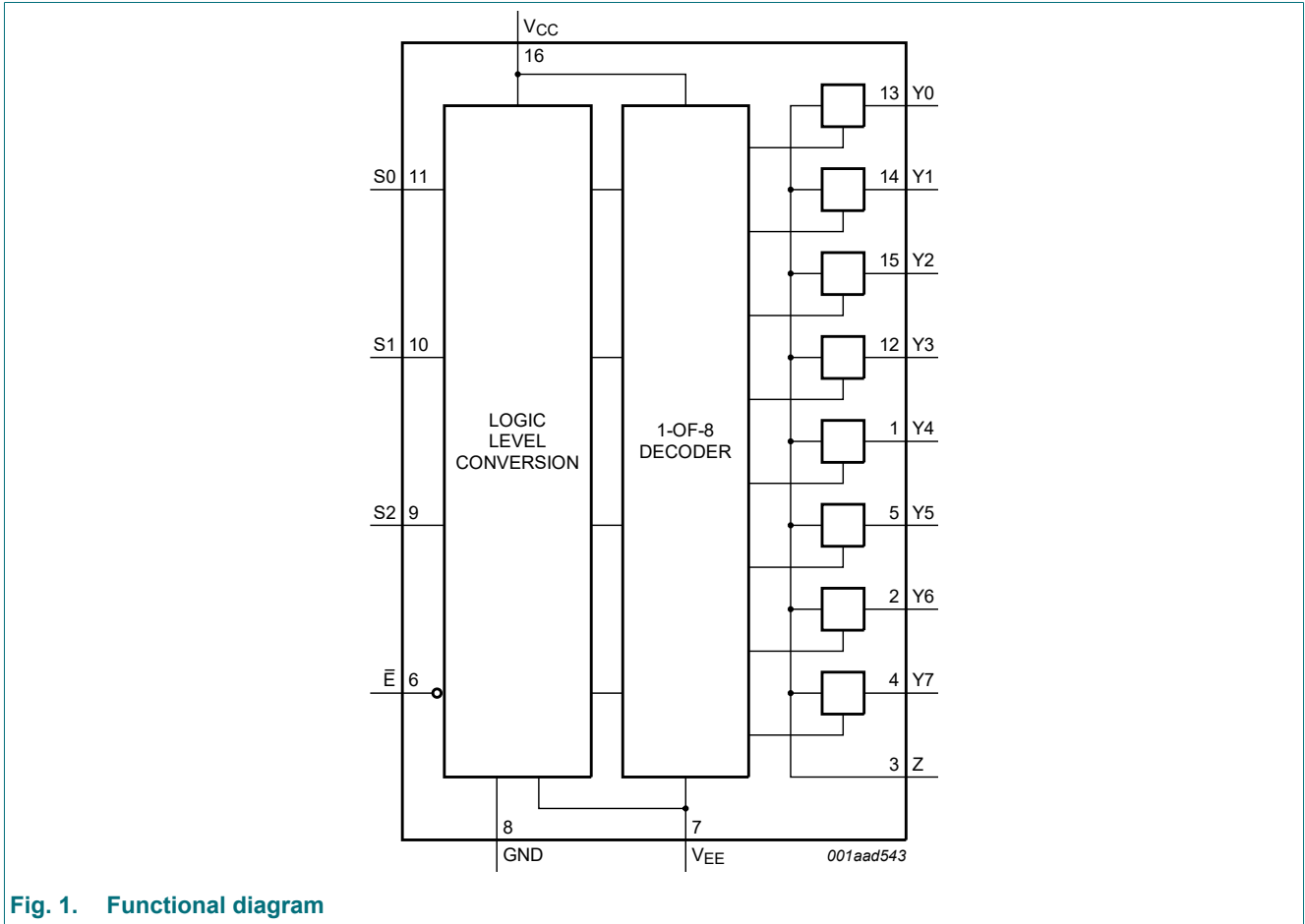


Fig. 1. Functional diagram

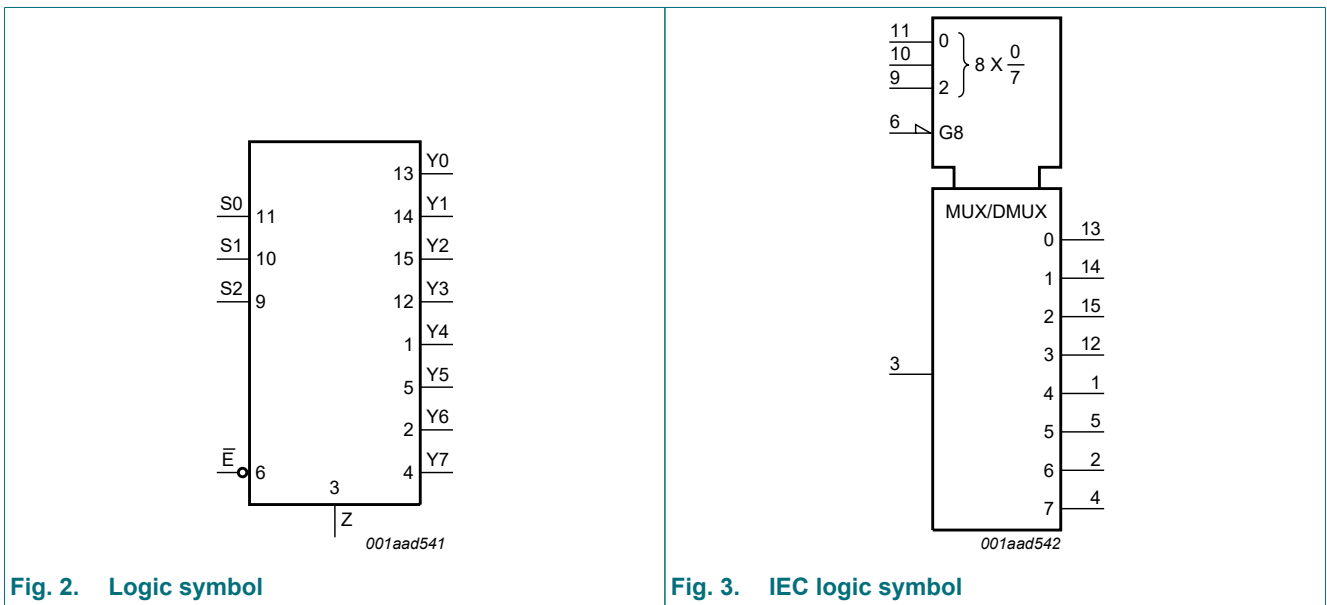


Fig. 2. Logic symbol

Fig. 3. IEC logic symbol

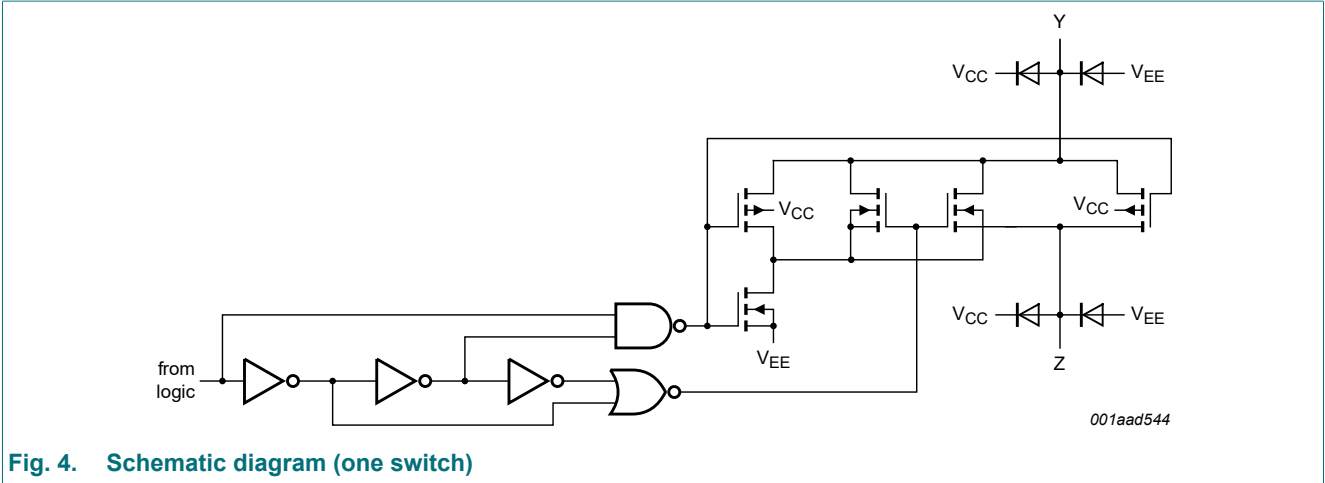


Fig. 4. Schematic diagram (one switch)

5. Pinning information

5.1. Pinning

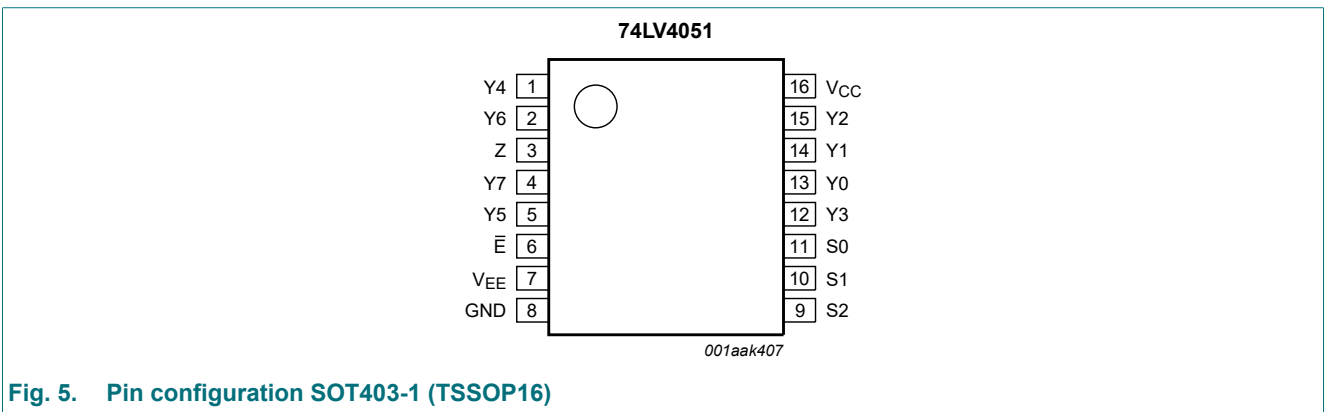


Fig. 5. Pin configuration SOT403-1 (TSSOP16)

5.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
\bar{E}	6	enable input (active LOW)
V_{EE}	7	supply voltage
GND	8	ground supply voltage
S0, S1, S2	11, 10, 9	select input
Y0, Y1, Y2, Y3, Y4, Y5, Y6, Y7	13, 14, 15, 12, 1, 5, 2, 4	independent input or output
Z	3	common output or input
V_{CC}	16	supply voltage

6. Functional description

Table 3. Function table

H = HIGH voltage level; L = LOW voltage level; X = don't care.

Input				Channel ON
E	S2	S1	S0	
L	L	L	L	Y0 to Z
L	L	L	H	Y1 to Z
L	L	H	L	Y2 to Z
L	L	H	H	Y3 to Z
L	H	L	L	Y4 to Z
L	H	L	H	Y5 to Z
L	H	H	L	Y6 to Z
L	H	H	H	Y7 to Z
H	X	X	X	switches off

7. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND = 0 V.

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	supply voltage	[1]	-0.5	+7.0	V
I_{IK}	input clamping current	$V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$ [2]	-	± 20	mA
I_{SK}	switch clamping current	$V_{SW} < -0.5\text{ V}$ or $V_{SW} > V_{CC} + 0.5\text{ V}$ [2]	-	± 20	mA
I_{SW}	switch current	$V_{SW} > -0.5\text{ V}$ or $V_{SW} < V_{CC} + 0.5\text{ V}$; source or sink current [2]	-	± 25	mA
T_{stg}	storage temperature		-65	+150	°C
P_{tot}	total power dissipation	$T_{amb} = -40\text{ °C}$ to $+125\text{ °C}$ [3]	-	500	mW

- [1] To avoid drawing V_{CC} current out of terminal Z, when switch current flows into terminals Y_n , the voltage drop across the bidirectional switch must not exceed 0.4 V. If the switch current flows into terminal Z, no V_{CC} current will flow out of terminals Y_n , and in this case there is no limit for the voltage drop across the switch, but the voltages at Y_n and Z may not exceed V_{CC} or V_{EE} .
- [2] The minimum input voltage rating may be exceeded if the input current rating is observed.
- [3] For SOT403-1 (TSSOP16) package: P_{tot} derates linearly with 8.5 mW/K above 91 °C.

8. Recommended operating conditions

Table 5. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CC}	supply voltage	see Fig. 6 [1]	1	3.3	6	V
V_I	input voltage		0	-	V_{CC}	V
V_{SW}	switch voltage		0	-	V_{CC}	V
T_{amb}	ambient temperature	in free air	-40	-	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 1.0\text{ V to }2.0\text{ V}$	-	-	500	ns/V
		$V_{CC} = 2.0\text{ V to }2.7\text{ V}$	-	-	200	ns/V
		$V_{CC} = 2.7\text{ V to }3.6\text{ V}$	-	-	100	ns/V

[1] The static characteristics are guaranteed from $V_{CC} = 1.2\text{ V}$ to 6.0 V , but LV devices are guaranteed to function down to $V_{CC} = 1.0\text{ V}$ (with input levels GND or V_{CC}).

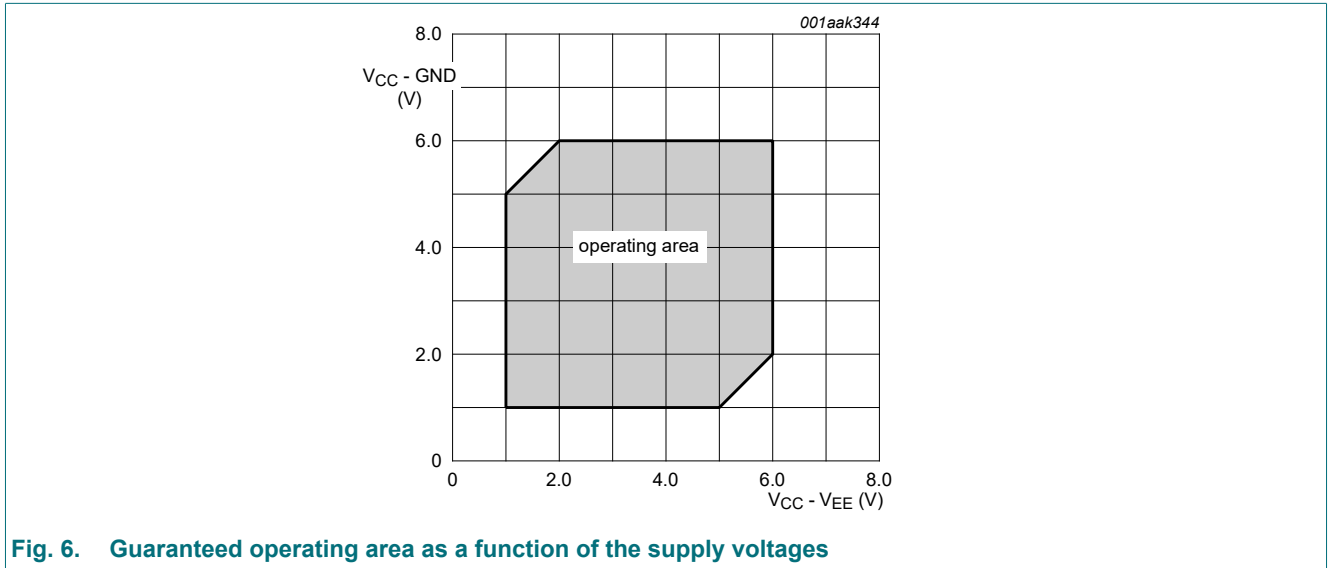


Fig. 6. Guaranteed operating area as a function of the supply voltages

9. Static characteristics

Table 6. Static characteristics

At recommended operating conditions. Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
V_{IH}	HIGH-level input voltage	$V_{CC} = 1.2\text{ V}$	0.9	-	-	0.9	-	V
		$V_{CC} = 2.0\text{ V}$	1.4	-	-	1.4	-	V
		$V_{CC} = 2.7\text{ V to }3.6\text{ V}$	2.0	-	-	2.0	-	V
		$V_{CC} = 4.5\text{ V}$	3.15	-	-	3.15	-	V
		$V_{CC} = 6.0\text{ V}$	4.20	-	-	4.20	-	V
V_{IL}	LOW-level input voltage	$V_{CC} = 1.2\text{ V}$	-	-	0.3	-	0.3	V
		$V_{CC} = 2.0\text{ V}$	-	-	0.6	-	0.6	V
		$V_{CC} = 2.7\text{ V to }3.6\text{ V}$	-	-	0.8	-	0.8	V
		$V_{CC} = 4.5\text{ V}$	-	-	1.35	-	1.35	V
		$V_{CC} = 6.0\text{ V}$	-	-	1.80	-	1.80	V

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
I _I	input leakage current	V _I = V _{CC} or GND						
		V _{CC} = 3.6 V	-	-	1.0	-	1.0	μA
		V _{CC} = 6.0 V	-	-	2.0	-	2.0	μA
I _{S(OFF)}	OFF-state leakage current	V _I = V _{IH} or V _{IL} ; see Fig. 7						
		V _{CC} = 3.6 V	-	-	1.0	-	1.0	μA
		V _{CC} = 6.0 V	-	-	2.0	-	2.0	μA
I _{S(ON)}	ON-state leakage current	V _I = V _{IH} or V _{IL} ; see Fig. 8						
		V _{CC} = 3.6 V	-	-	1.0	-	1.0	μA
		V _{CC} = 6.0 V	-	-	2.0	-	2.0	μA
I _{CC}	supply current	V _I = V _{CC} or GND; I _O = 0 A						
		V _{CC} = 3.6 V	-	-	20	-	40	μA
		V _{CC} = 6.0 V	-	-	40	-	80	μA
ΔI _{CC}	additional supply current	per input; V _I = V _{CC} - 0.6 V; V _{CC} = 2.7 V to 3.6 V	-	-	500	-	850	μA
C _I	input capacitance		-	3.5	-	-	-	pF
C _{sw}	switch capacitance	independent pins Y _n	-	5	-	-	-	pF
		common pin Z	-	25	-	-	-	pF

[1] Typical values are measured at T_{amb} = 25 °C.

9.1. Test circuits

V_I = V_{CC} or V_{EE} and V_O = V_{EE} or V_{CC}.

Fig. 7. Test circuit for measuring OFF-state leakage current

V_I = V_{CC} or V_{EE} and V_O = open circuit.

Fig. 8. Test circuit for measuring ON-state leakage current

9.2. ON resistance

Table 7. ON resistance

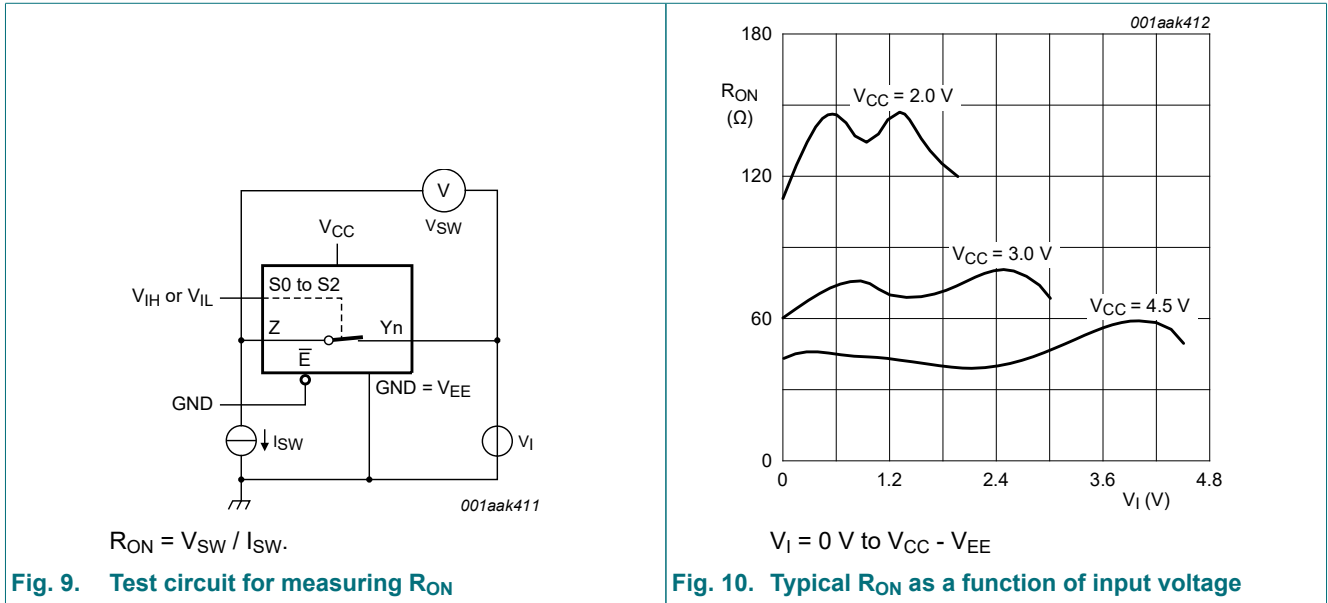
At recommended operating conditions; voltages are referenced to GND (ground = 0 V); for test circuit and graph see Fig. 9 and Fig. 10.

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	
R _{ON(peak)}	ON resistance (peak)	V _I = 0 V to V _{CC} - V _{EE}						
		V _{CC} = 1.2 V; I _{SW} = 100 μA [2]	-	-	-	-	-	Ω
		V _{CC} = 2.0 V; I _{SW} = 1000 μA	-	145	325	-	375	Ω
		V _{CC} = 2.7 V; I _{SW} = 1000 μA	-	90	200	-	235	Ω
		V _{CC} = 3.0 V to 3.6 V; I _{SW} = 1000 μA	-	80	180	-	210	Ω
		V _{CC} = 4.5 V; I _{SW} = 1000 μA	-	60	135	-	160	Ω
		V _{CC} = 6.0 V; I _{SW} = 1000 μA	-	55	125	-	145	Ω
ΔR _{ON}	ON resistance mismatch between channels	V _I = 0 V to V _{CC} - V _{EE}						
		V _{CC} = 1.2 V; I _{SW} = 100 μA [2]	-	-	-	-	-	Ω
		V _{CC} = 2.0 V; I _{SW} = 1000 μA	-	5	-	-	-	Ω
		V _{CC} = 2.7 V; I _{SW} = 1000 μA	-	4	-	-	-	Ω
		V _{CC} = 3.0 V to 3.6 V; I _{SW} = 1000 μA	-	4	-	-	-	Ω
		V _{CC} = 4.5 V; I _{SW} = 1000 μA	-	3	-	-	-	Ω
		V _{CC} = 6.0 V; I _{SW} = 1000 μA	-	2	-	-	-	Ω
R _{ON(rail)}	ON resistance (rail)	V _I = GND						
		V _{CC} = 1.2 V; I _{SW} = 100 μA [2]	-	225	-	-	-	Ω
		V _{CC} = 2.0 V; I _{SW} = 1000 μA	-	110	235	-	270	Ω
		V _{CC} = 2.7 V; I _{SW} = 1000 μA	-	70	145	-	165	Ω
		V _{CC} = 3.0 V to 3.6 V; I _{SW} = 1000 μA	-	60	130	-	150	Ω
		V _{CC} = 4.5 V; I _{SW} = 1000 μA	-	45	100	-	115	Ω
		V _{CC} = 6.0 V; I _{SW} = 1000 μA	-	40	85	-	100	Ω
R _{ON(rail)}	ON resistance (rail)	V _I = V _{CC} - V _{EE}						
		V _{CC} = 1.2 V; I _{SW} = 100 μA [2]	-	250	-	-	-	Ω
		V _{CC} = 2.0 V; I _{SW} = 1000 μA	-	120	320	-	370	Ω
		V _{CC} = 2.7 V; I _{SW} = 1000 μA	-	75	195	-	225	Ω
		V _{CC} = 3.0 V to 3.6 V; I _{SW} = 1000 μA	-	70	175	-	205	Ω
		V _{CC} = 4.5 V; I _{SW} = 1000 μA	-	50	130	-	150	Ω
		V _{CC} = 6.0 V; I _{SW} = 1000 μA	-	45	120	-	135	Ω

[1] All typical values are measured at nominal V_{CC} and at T_{amb} = 25 °C.

[2] When supply voltages (V_{CC} - V_{EE}) near 1.2 V the analog switch ON resistance becomes extremely non-linear. When using a supply of 1.2 V, it is recommended to use these devices only for transmitting digital signals.

9.3. On resistance test circuit and graph



10. Dynamic characteristics

Table 8. Dynamic characteristics

Voltages are referenced to GND (GND = $V_{EE} = 0$ V). For test circuit see Fig. 13.

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	
t_{pd}	propagation delay	Y_n to Z, Z to Y_n ; see Fig. 11 [2]	-	-	-	-	-	-
		$V_{CC} = 1.2$ V	-	25	-	-	-	ns
		$V_{CC} = 2.0$ V	-	9	17	-	20	ns
		$V_{CC} = 2.7$ V	-	6	13	-	15	ns
		$V_{CC} = 3.0$ V to 3.6 V	-	5	10	-	12	ns
		$V_{CC} = 4.5$ V	-	4	9	-	10	ns
$V_{CC} = 6.0$ V	-	3	8	-	8	ns		

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	
t _{en}	enable time	\bar{E} to Yn, Z; see Fig. 12 [2]						
		V _{CC} = 1.2 V	-	145	-	-	-	ns
		V _{CC} = 2.0 V	-	49	94	-	112	ns
		V _{CC} = 2.7 V	-	36	69	-	83	ns
		V _{CC} = 3.0 V to 3.6 V; C _L = 15 pF	-	23	-	-	-	ns
		V _{CC} = 3.0 V to 3.6 V	-	28	55	-	66	ns
		V _{CC} = 4.5 V	-	25	47	-	56	ns
		V _{CC} = 6.0 V	-	19	38	-	43	ns
		Sn to Yn; see Fig. 12 [2]						
		V _{CC} = 1.2 V	-	140	-	-	-	ns
		V _{CC} = 2.0 V	-	48	90	-	107	ns
		V _{CC} = 2.7 V	-	35	66	-	79	ns
		V _{CC} = 3.0 V to 3.6 V; C _L = 15 pF	-	22	-	-	-	ns
		V _{CC} = 3.0 V to 3.6 V	-	27	53	-	63	ns
		V _{CC} = 4.5 V	-	24	45	-	54	ns
		V _{CC} = 6.0 V	-	18	34	-	41	ns
t _{dis}	disable time	\bar{E} to Yn, Z; see Fig. 12 [2]						
		V _{CC} = 1.2 V	-	145	-	-	-	ns
		V _{CC} = 2.0 V	-	51	93	-	110	ns
		V _{CC} = 2.7 V	-	38	69	-	82	ns
		V _{CC} = 3.0 V to 3.6 V; C _L = 15 pF	-	25	-	-	-	ns
		V _{CC} = 3.0 V to 3.6 V	-	30	56	-	66	ns
		V _{CC} = 4.5 V	-	29	48	-	56	ns
		V _{CC} = 6.0 V	-	21	37	-	44	ns
		Sn to Yn; see Fig. 12 [2]						
		V _{CC} = 1.2 V	-	115	-	-	-	ns
		V _{CC} = 2.0 V	-	41	73	-	90	ns
		V _{CC} = 2.7 V	-	31	54	-	67	ns
		V _{CC} = 3.0 V to 3.6 V; C _L = 15 pF	-	20	-	-	-	ns
		V _{CC} = 3.0 V to 3.6 V	-	24	44	-	54	ns
		V _{CC} = 4.5 V	-	22	37	-	46	ns
		V _{CC} = 6.0 V	-	17	29	-	36	ns
C _{PD}	power dissipation capacitance	C _L = 50 pF; f _i = 1 MHz; V _I = GND to V _{CC} [3]	-	25	-	-	-	pF

[1] All typical values are measured at nominal V_{CC} and at T_{amb} = 25 °C.

[2] t_{pd} is the same as t_{PLH} and t_{PHL}.

t_{en} is the same as t_{PZL} and t_{PZH}.

t_{dis} is the same as t_{PLZ} and t_{PHZ}.

[3] C_{PD} is used to determine the dynamic power dissipation (P_D in μW).

$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum((C_L + C_{SW}) \times V_{CC}^2 \times f_o)$ where:

f_i = input frequency in MHz, f_o = output frequency in MHz

C_L = output load capacitance in pF

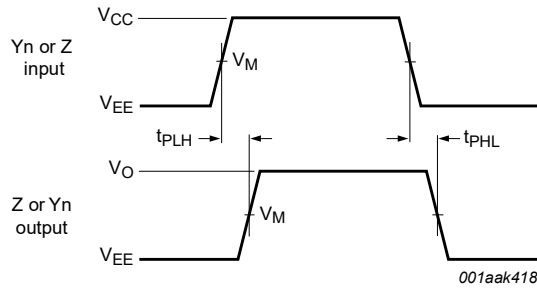
C_{SW} = maximum switch capacitance in pF;

V_{CC} = supply voltage in Volts

N = number of inputs switching

$\sum(C_L \times V_{CC}^2 \times f_o)$ = sum of the outputs.

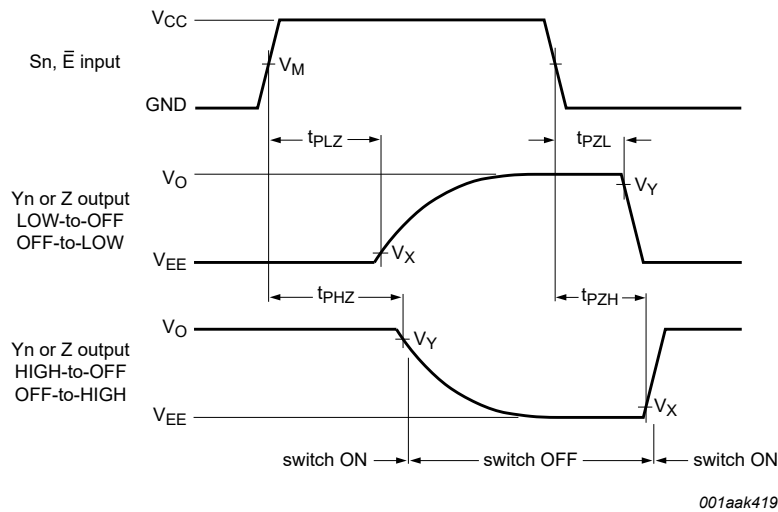
10.1. Waveforms and test circuit



Measurement points are given in [Table 9](#).

V_{EE} and V_O are typical voltage output levels that occur with the output load.

Fig. 11. Propagation delay input (Yn or Z) to output (Z or Yn)



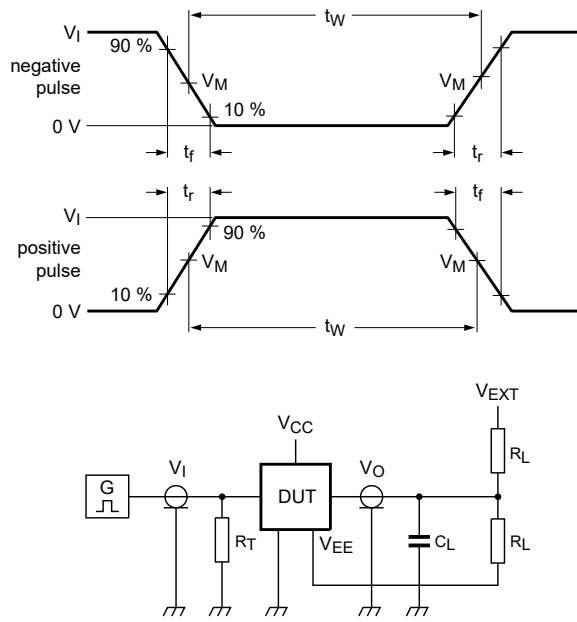
Measurement points are given in [Table 9](#).

V_{EE} and V_O are typical voltage output levels that occur with the output load.

Fig. 12. Enable and disable times

Table 9. Measurement points

Supply voltage	Input	Output		
V_{CC}	V_M	V_M	V_X	V_Y
< 2.7 V	$0.5V_{CC}$	$0.5V_{CC}$	$V_{EE} + 0.1V_{CC}$	$V_O - 0.1V_{CC}$
2.7 V to 3.6 V	1.5 V	1.5 V	$V_{EE} + 0.3 V$	$V_O - 0.3 V$
> 3.6 V	$0.5V_{CC}$	$0.5V_{CC}$	$V_{EE} + 0.1V_{CC}$	$V_O - 0.1V_{CC}$



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Test data is given in [Table 10](#).

Definitions for test circuit:

R_L = Load resistance.

C_L = Load capacitance including jig and probe capacitance.

R_T = Termination resistance should be equal to output impedance Z_o of the pulse generator.

V_{EXT} = External voltage for measuring switching times.

Fig. 13. Test circuit for measuring switching times

Table 10. Test data

Supply voltage	Input		Load		V_{EXT}		
V_{CC}	V_I	t_r, t_f	C_L	R_L	t_{PHL}, t_{PLH}	t_{PZH}, t_{PHZ}	t_{PZL}, t_{PLZ}
< 2.7 V	V_{CC}	≤ 6 ns	50 pF	1 k Ω	open	V_{EE}	$2V_{CC}$
2.7 V to 3.6 V	2.7 V	≤ 6 ns	15 pF, 50 pF	1 k Ω	open	V_{EE}	$2V_{CC}$
> 3.6 V	V_{CC}	≤ 6 ns	50 pF	1 k Ω	open	V_{EE}	$2V_{CC}$

10.2. Additional dynamic parameters

Table 11. Additional dynamic characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); $V_I = \text{GND}$ or V_{CC} (unless otherwise specified); $t_r = t_f \leq 6.0 \text{ ns}$; $T_{amb} = 25 \text{ }^\circ\text{C}$.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
THD	total harmonic distortion	$f_i = 1 \text{ kHz}$; $C_L = 50 \text{ pF}$; $R_L = 10 \text{ k}\Omega$; see Fig. 18				
		$V_{CC} = 3.0 \text{ V}$; $V_I = 2.75 \text{ V (p-p)}$	-	0.8	-	%
		$V_{CC} = 6.0 \text{ V}$; $V_I = 5.5 \text{ V (p-p)}$	-	0.4	-	%
		$f_i = 10 \text{ kHz}$; $C_L = 50 \text{ pF}$; $R_L = 10 \text{ k}\Omega$; see Fig. 18				
		$V_{CC} = 3.0 \text{ V}$; $V_I = 2.75 \text{ V (p-p)}$	-	2.4	-	%
		$V_{CC} = 6.0 \text{ V}$; $V_I = 5.5 \text{ V (p-p)}$	-	1.2	-	%
$f_{(-3\text{dB})}$	-3 dB frequency response	$C_L = 50 \text{ pF}$; $R_L = 50 \text{ }\Omega$; see Fig. 14 [1]				
		$V_{CC} = 3.0 \text{ V}$	-	180	-	MHz
		$V_{CC} = 6.0 \text{ V}$	-	200	-	MHz
α_{iso}	isolation (OFF-state)	$f_i = 1 \text{ MHz}$; $C_L = 50 \text{ pF}$; $R_L = 600 \text{ }\Omega$; see Fig. 16 [2]				
		$V_{CC} = 3.0 \text{ V}$	-	-50	-	dB
		$V_{CC} = 6.0 \text{ V}$	-	-50	-	dB
V_{ct}	crosstalk voltage	between digital inputs and switch; $f_i = 1 \text{ MHz}$; $C_L = 50 \text{ pF}$; $R_L = 600 \text{ }\Omega$; see Fig. 19 [2]				
		$V_{CC} = 3.0 \text{ V}$	-	0.11	-	V
		$V_{CC} = 6.0 \text{ V}$	-	0.12	-	V
Xtalk	crosstalk	between switches; $f_i = 1 \text{ MHz}$; $C_L = 50 \text{ pF}$; $R_L = 600 \text{ }\Omega$; see Fig. 20				
		$V_{CC} = 3.0 \text{ V}$	-	-60	-	dB
		$V_{CC} = 6.0 \text{ V}$	-	-60	-	dB

[1] Adjust f_i voltage to obtain 0 dBm level at output for 1 MHz (0 dBm = 1 mW into 50 Ω).

[2] Adjust f_i voltage to obtain 0 dBm level at output for 1 MHz (0 dBm = 1 mW into 600 Ω).

10.3. Test circuits

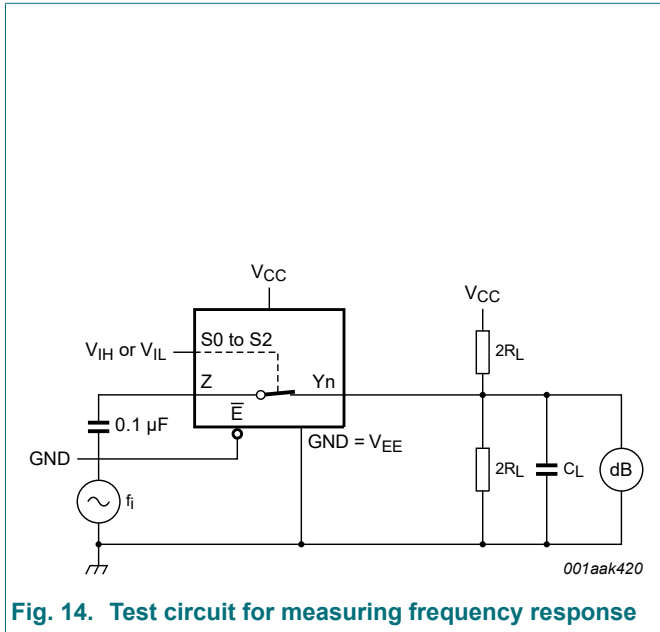


Fig. 14. Test circuit for measuring frequency response

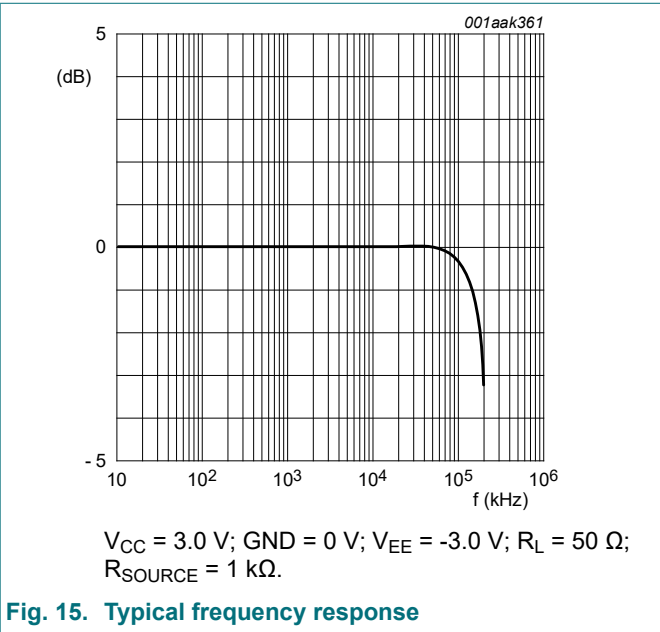


Fig. 15. Typical frequency response

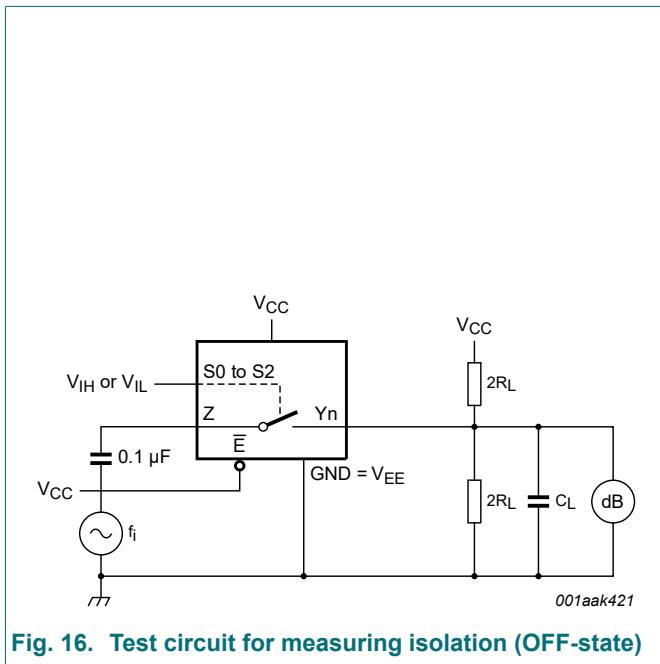


Fig. 16. Test circuit for measuring isolation (OFF-state)

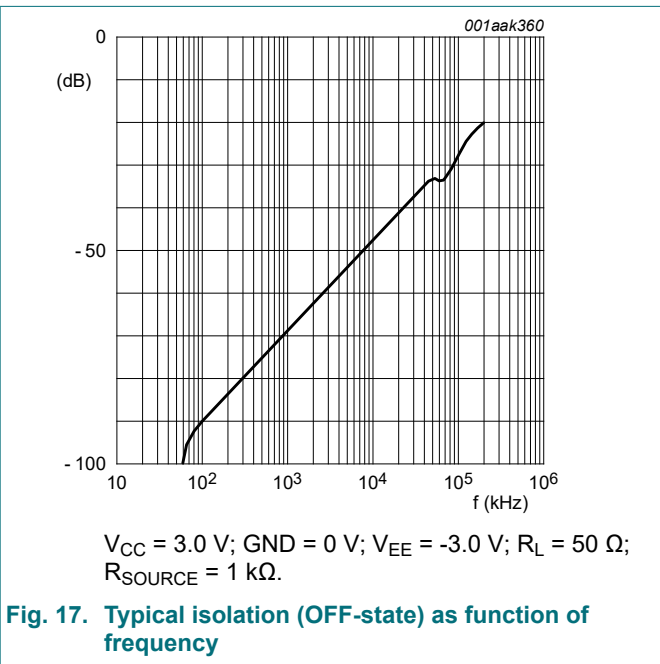


Fig. 17. Typical isolation (OFF-state) as function of frequency

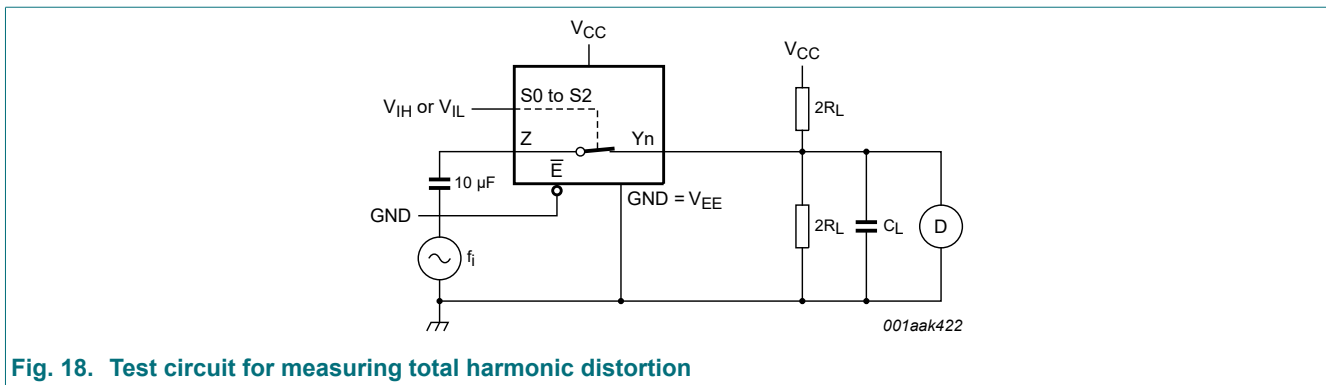
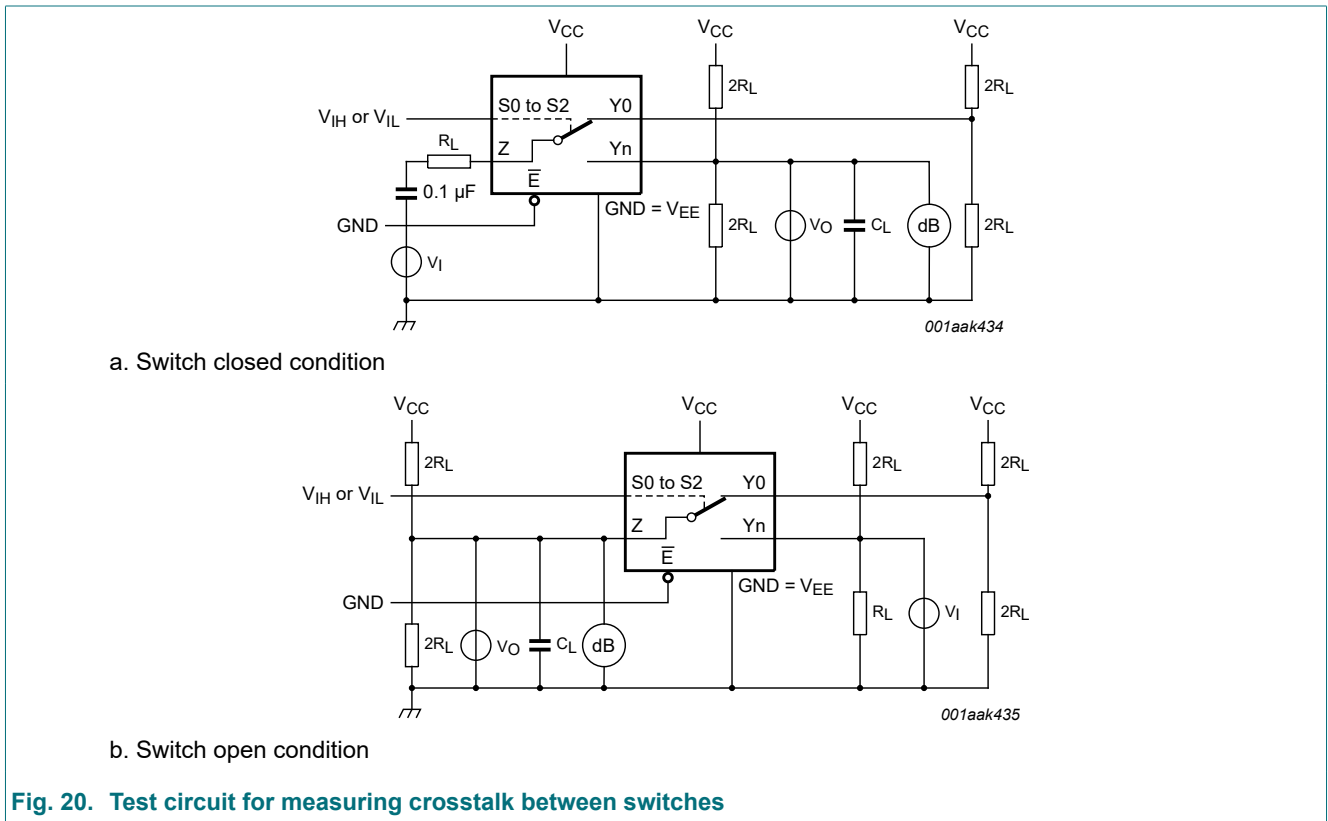
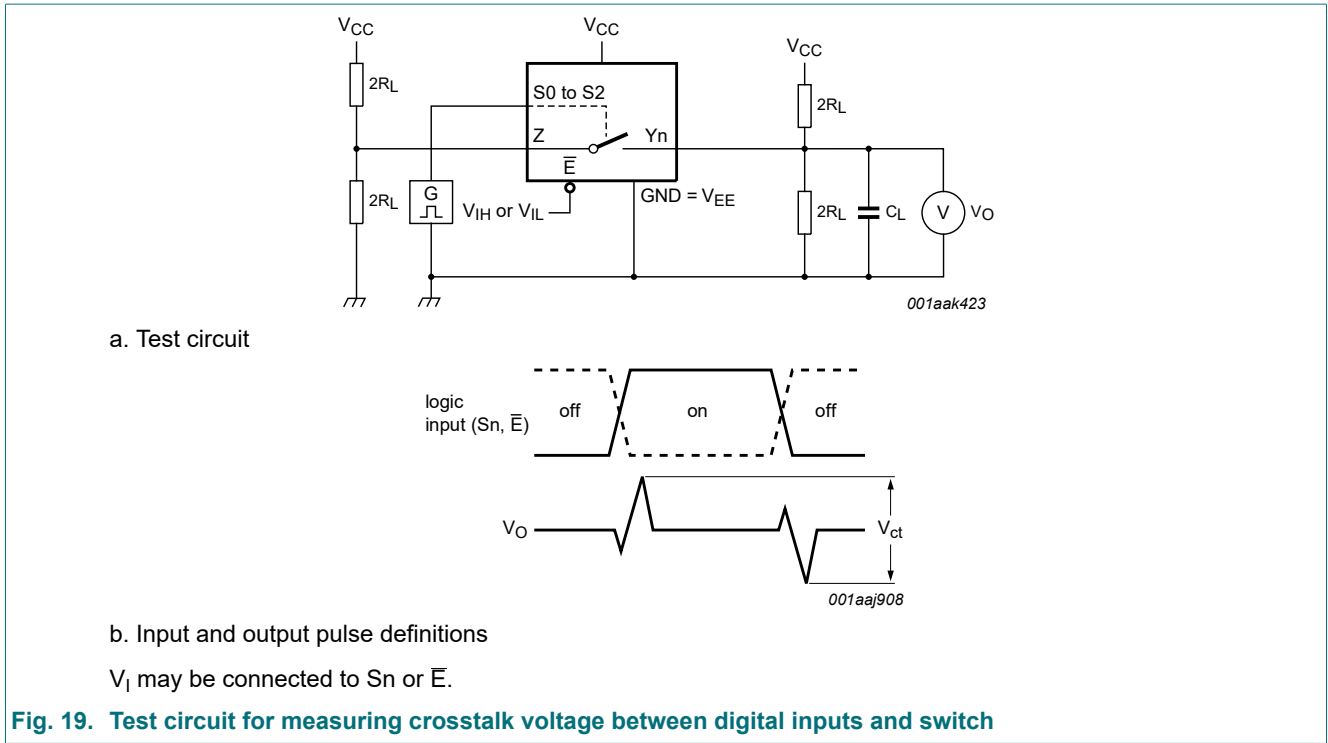


Fig. 18. Test circuit for measuring total harmonic distortion



11. Package outline

TSSOP16: plastic thin shrink small outline package; 16 leads; body width 4.4 mm

SOT403-1

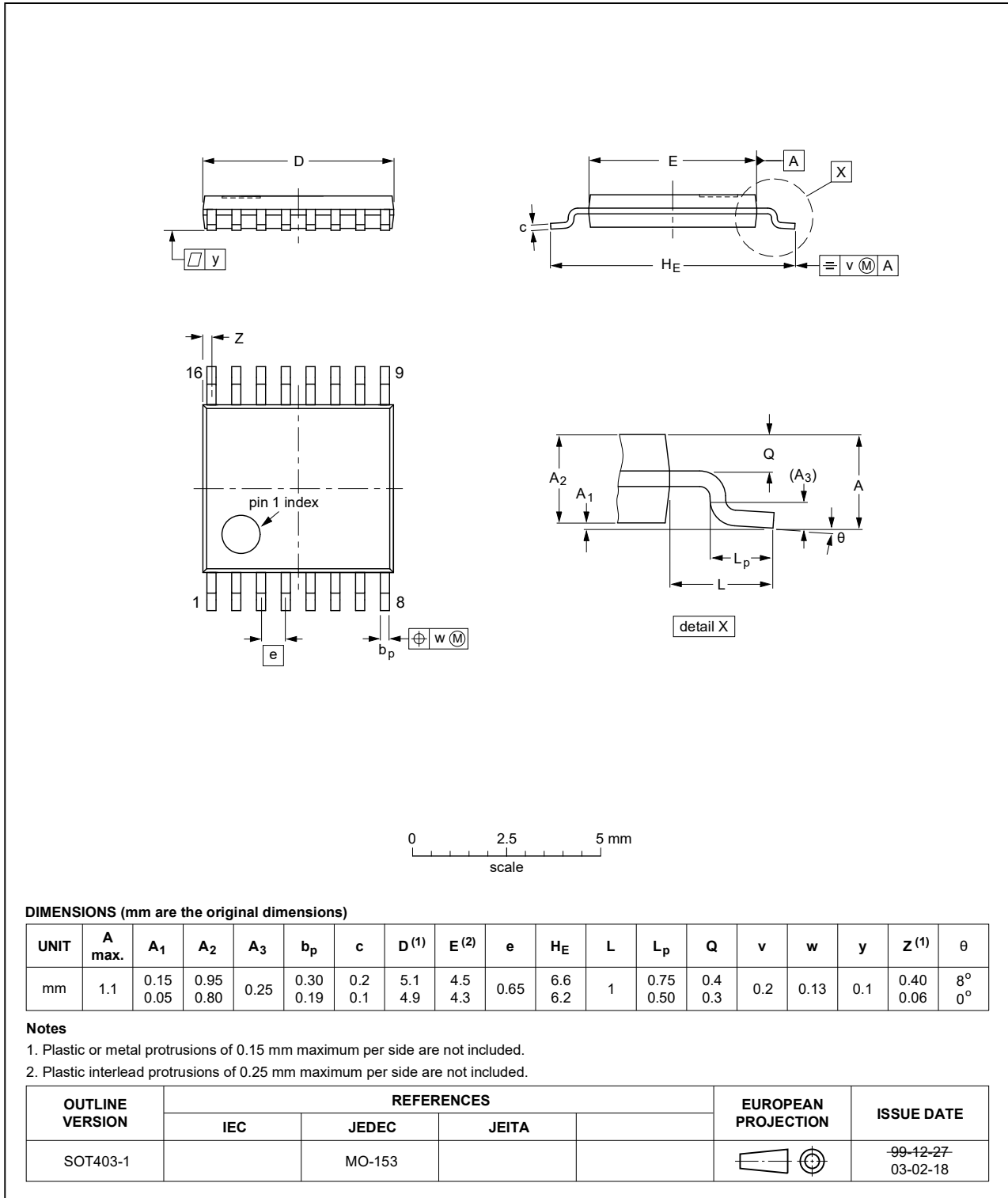


Fig. 21. Package outline SOT403-1 (TSSOP16)

12. Abbreviations

Table 12. Abbreviations

Acronym	Description
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model
TTL	Transistor-Transistor Logic

13. Revision history

Table 13. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LV4051_Q100 v.1	20210716	Product data sheet	-	-

14. Legal information

Data sheet status

Document status [1][2]	Product status [3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

- [1] Please consult the most recently issued document before initiating or completing a design.
- [2] The term 'short data sheet' is explained in section "Definitions".
- [3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the internet at <https://www.nexperia.com>.

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