

74LV4052-Q100

Dual 4-channel analog multiplexer/demultiplexer

Rev. 3 — 22 October 2015

Product data sheet

1. General description

The 74LV4052-Q100 is a dual 4-channel analog multiplexer/demultiplexer with a common select logic. Each multiplexer has four independent inputs/outputs (nY0 to nY3) and a common input/output (nZ). The common channel select logics include two digital select inputs (S0 and S1) and an active LOW enable input (\bar{E}). With \bar{E} LOW, one of the four switches is selected (low impedance ON-state) by S0 and S1. With \bar{E} HIGH, all switches are in the high impedance OFF-state, independent of S0 and S1. V_{CC} and GND are the supply voltage pins for the digital control inputs (S0, S1 and \bar{E}). The V_{CC} to GND ranges are 1.0 V to 6.0 V. The analog inputs/outputs (nY0, to nY3, and nZ) 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 $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$ and from $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$
- Optimized for low-voltage applications: 1.0 V to 6.0 V
- Accepts TTL input levels between $V_{CC} = 2.7\text{ V}$ and $V_{CC} = 3.6\text{ V}$
- Low ON resistance:
 - ◆ $145\ \Omega$ (typical) at $V_{CC} - V_{EE} = 2.0\text{ V}$
 - ◆ $90\ \Omega$ (typical) at $V_{CC} - V_{EE} = 3.0\text{ V}$
 - ◆ $60\ \Omega$ (typical) at $V_{CC} - V_{EE} = 4.5\text{ V}$
- Logic level translation:
 - ◆ To enable 3 V logic to communicate with $\pm 3\text{ V}$ analog signals
- Typical 'break before make' built in
- ESD protection:
 - ◆ MIL-STD-883, method 3015 exceeds 2000 V
 - ◆ HBM JESD22-A114F exceeds 2000 V
 - ◆ MM JESD22-A115-A exceeds 200 V ($C = 200\text{ pF}$, $R = 0\ \Omega$)

3. Ordering information

Table 1. Ordering information

Type number	Package			Version
	Temperature range	Name	Description	
74LV4052D-Q100	-40 °C to +125 °C	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1
74LV4052PW-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

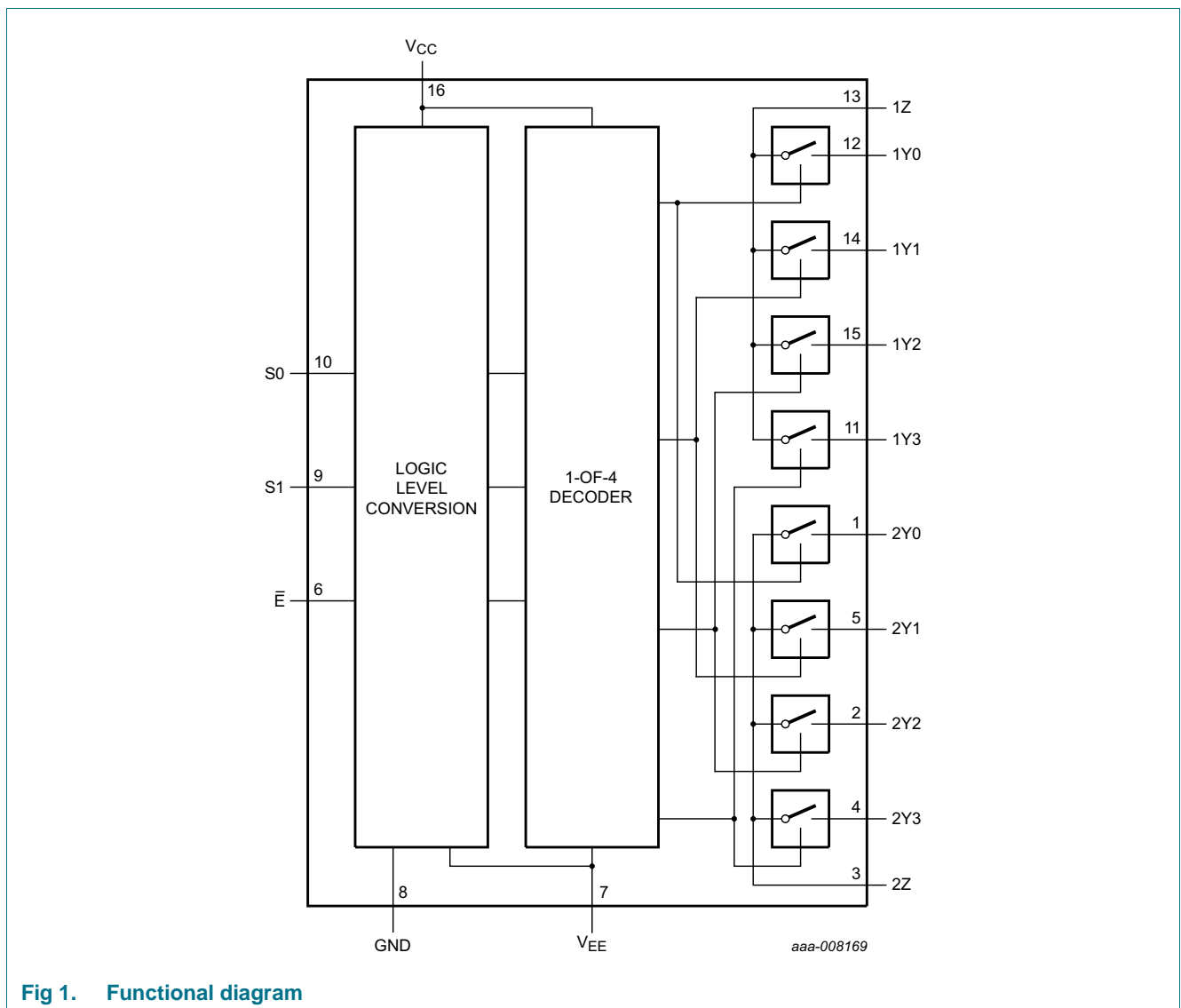


Fig 1. Functional diagram

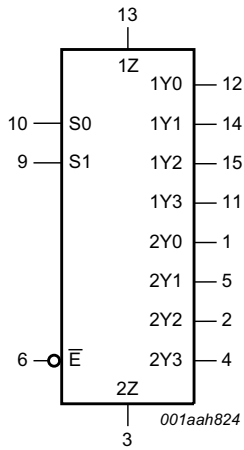


Fig 2. Logic symbol

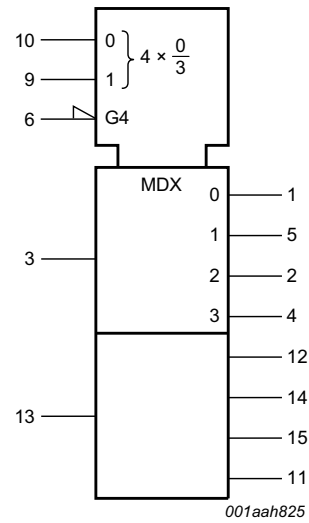


Fig 3. IEC logic symbol

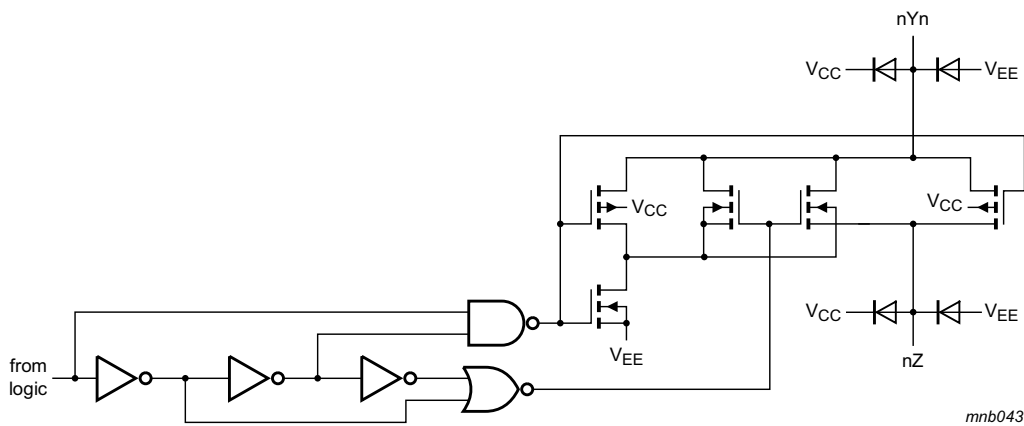
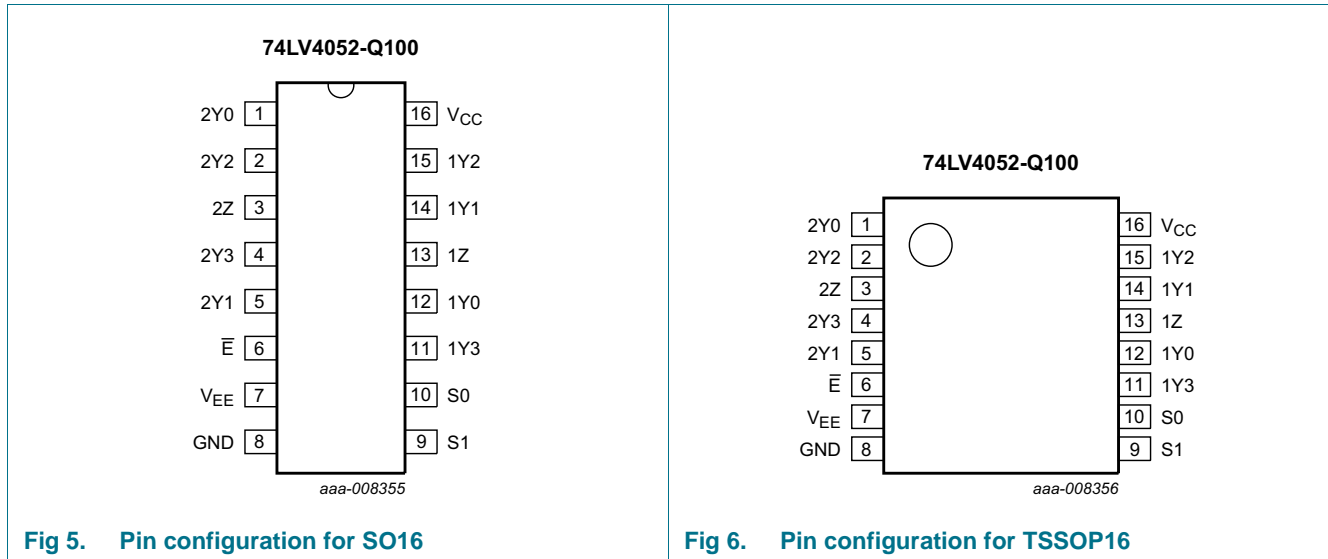


Fig 4. Schematic diagram (one switch)

5. Pinning information

5.1 Pinning



5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
2Y0	1	independent input or output
2Y2	2	independent input or output
2Z	3	common input or output
2Y3	4	independent input or output
2Y1	5	independent input or output
\bar{E}	6	enable input (active LOW)
V_{EE}	7	negative supply voltage
GND	8	ground (0 V)
S1	9	select logic input
S0	10	select logic input
1Y3	11	independent input or output
1Y0	12	independent input or output
1Z	13	common input or output
1Y1	14	independent input or output
1Y2	15	independent input or output
V_{CC}	16	positive supply voltage

6. Functional description

Table 3. Function table^[1]

Input			Channel on
\bar{E}	S1	S0	
L	L	L	nY0 and nZ
L	L	H	nY1 and nZ
L	H	L	nY2 and nZ
L	H	H	nY3 and nZ
H	X	X	none

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

7. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to $V_{SS} = 0$ V (ground).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	supply voltage		[1] -0.5	+7.0	V
I_{IK}	input clamping current	$V_I < -0.5$ V or $V_I > V_{CC} + 0.5$ V	[2] -	± 20	mA
I_{SK}	switch clamping current	$V_{SW} < -0.5$ V or $V_{SW} > V_{CC} + 0.5$ V	[2] -	± 20	mA
I_{SW}	switch current	$V_{SW} > -0.5$ V or $V_{SW} < V_{CC} + 0.5$ V; source or sink current	[2] -	± 25	mA
T_{stg}	storage temperature		-65	+150	°C
P_{tot}	total power dissipation	$T_{amb} = -40$ °C to +125 °C	[3]		
		DIP16 package	-	750	mW
		SO16 package	-	500	mW
		SSOP16 and TSSOP16 package	-	400	mW

[1] To avoid drawing V_{CC} current out of terminal nZ, when switch current flows into terminals nYn, the voltage drop across the bidirectional switch must not exceed 0.4 V. If the switch current flows into terminal nZ, no V_{CC} current flows out of terminals nYn. In this case, there is no limit for the voltage drop across the switch, but the voltages at nYn and nZ 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 SO16 package: above 70 °C the value of P_{tot} derates linearly with 8 mW/K.
For TSSOP16 package: above 60 °C the value of P_{tot} derates linearly with 5.5 mW/K.

8. Recommended operating conditions

Table 5. Recommended operating conditions^[1]

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CC}	supply voltage	see Figure 7	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
		$V_{CC} = 2.7\text{ V to }6.0\text{ V}$	-	-	100	ns/V

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



Fig 7. 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 V	0.9	-	-	0.9	-	V
		V _{CC} = 2.0 V	1.4	-	-	1.4	-	V
		V _{CC} = 2.7 V to 3.6 V	2.0	-	-	2.0	-	V
		V _{CC} = 4.5 V	3.15	-	-	3.15	-	V
		V _{CC} = 6.0 V	4.20	-	-	4.20	-	V
V _{IL}	LOW-level input voltage	V _{CC} = 1.2 V	-	-	0.3	-	0.3	V
		V _{CC} = 2.0 V	-	-	0.6	-	0.6	V
		V _{CC} = 2.7 V to 3.6 V	-	-	0.8	-	0.8	V
		V _{CC} = 4.5 V	-	-	1.35	-	1.35	V
		V _{CC} = 6.0 V	-	-	1.80	-	1.80	V
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 Figure 8						
		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 Figure 9						
		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 nYn	-	5	-	-	-	pF
		common pins nZ	-	12	-	-	-	pF

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

9.1 Test circuits

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

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

aaa-008173

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

Fig 9. 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 graphs see [Figure 10](#) and [Figure 11](#).

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)	$V_I = 0 \text{ V to } V_{CC} - V_{EE}$						
		$V_{CC} = 1.2 \text{ V}; I_{SW} = 100 \mu\text{A}$ ^[2]	-	-	-	-	-	Ω
		$V_{CC} = 2.0 \text{ V}; I_{SW} = 1000 \mu\text{A}$	-	145	325	-	375	Ω
		$V_{CC} = 2.7 \text{ V}; I_{SW} = 1000 \mu\text{A}$	-	90	200	-	235	Ω
		$V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}; I_{SW} = 1000 \mu\text{A}$	-	80	180	-	210	Ω
		$V_{CC} = 4.5 \text{ V}; I_{SW} = 1000 \mu\text{A}$	-	60	135	-	160	Ω
		$V_{CC} = 6.0 \text{ V}; I_{SW} = 1000 \mu\text{A}$	-	55	125	-	145	Ω
ΔR _{ON}	ON resistance mismatch between channels	$V_I = 0 \text{ V to } V_{CC} - V_{EE}$						
		$V_{CC} = 1.2 \text{ V}; I_{SW} = 100 \mu\text{A}$ ^[2]	-	-	-	-	-	Ω
		$V_{CC} = 2.0 \text{ V}; I_{SW} = 1000 \mu\text{A}$	-	5	-	-	-	Ω
		$V_{CC} = 2.7 \text{ V}; I_{SW} = 1000 \mu\text{A}$	-	4	-	-	-	Ω
		$V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}; I_{SW} = 1000 \mu\text{A}$	-	4	-	-	-	Ω
		$V_{CC} = 4.5 \text{ V}; I_{SW} = 1000 \mu\text{A}$	-	3	-	-	-	Ω
		$V_{CC} = 6.0 \text{ V}; I_{SW} = 1000 \mu\text{A}$	-	2	-	-	-	Ω

Table 7. ON resistance ...continued

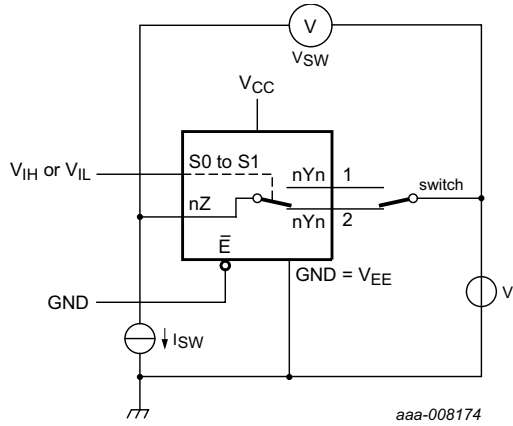
At recommended operating conditions; voltages are referenced to GND (ground = 0 V); for graphs see [Figure 10](#) and [Figure 11](#).

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ ^[1]	Max	Min	Max	
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
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] Typical values are measured at T_{amb} = 25 °C.

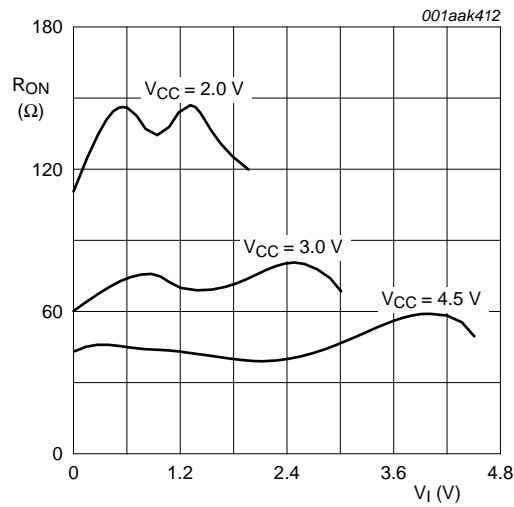
[2] When supply voltages (V_{CC} - V_{EE}) near 1.2 V the analog switch ON resistance becomes extremely non-linear. When using a supply of 1.2 V, use these devices only for transmitting digital signals.

9.3 On resistance waveform and test circuit



$$R_{ON} = V_{SW} / I_{SW}$$

Fig 10. Test circuit for measuring R_{ON}



$V_i = 0$ V to $V_{CC} - V_{EE}$

Fig 11. Typical R_{ON} as a function of input voltage

10. Dynamic characteristics

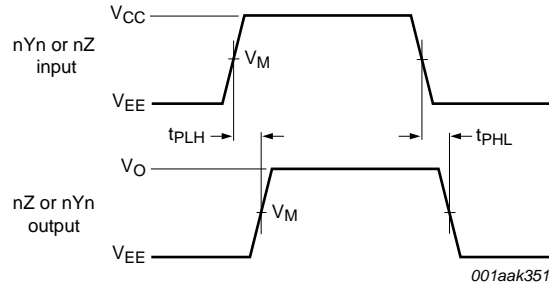
Table 8. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V). For test circuit, see [Figure 14](#).

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ ^[1]	Max	Min	Max	
t _{pd}	propagation delay	nYn to nZ, nZ to nYn; see Figure 12 ^[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 ^[3]	-	5	10	-	12	ns
		V _{CC} = 4.5 V	-	4	9	-	10	ns
t _{en}	enable time	\bar{E} , Sn to nYn, nZ; see Figure 13 ^[2]						
		V _{CC} = 1.2 V	-	190	-	-	-	ns
		V _{CC} = 2.0 V	-	65	121	-	146	ns
		V _{CC} = 2.7 V	-	48	89	-	108	ns
		V _{CC} = 3.0 V to 3.6 V; C _L = 15 pF ^[3]	-	30	-	-	-	ns
		V _{CC} = 3.0 V to 3.6 V ^[3]	-	36	71	-	86	ns
		V _{CC} = 4.5 V	-	32	60	-	73	ns
t _{dis}	disable time	\bar{E} , Sn to nYn, nZ; see Figure 13 ^[2]						
		V _{CC} = 1.2 V	-	125	-	-	-	ns
		V _{CC} = 2.0 V	-	43	80	-	95	ns
		V _{CC} = 2.7 V	-	33	59	-	71	ns
		V _{CC} = 3.0 V to 3.6 V; C _L = 15 pF ^[3]	-	22	-	-	-	ns
		V _{CC} = 3.0 V to 3.6 V ^[3]	-	26	48	-	57	ns
		V _{CC} = 4.5 V	-	23	41	-	49	ns
C _{PD}	power dissipation capacitance	C _L = 50 pF; f _i = 1 MHz; V _I = GND to V _{CC} ^[4]	-	57	-	-	-	pF

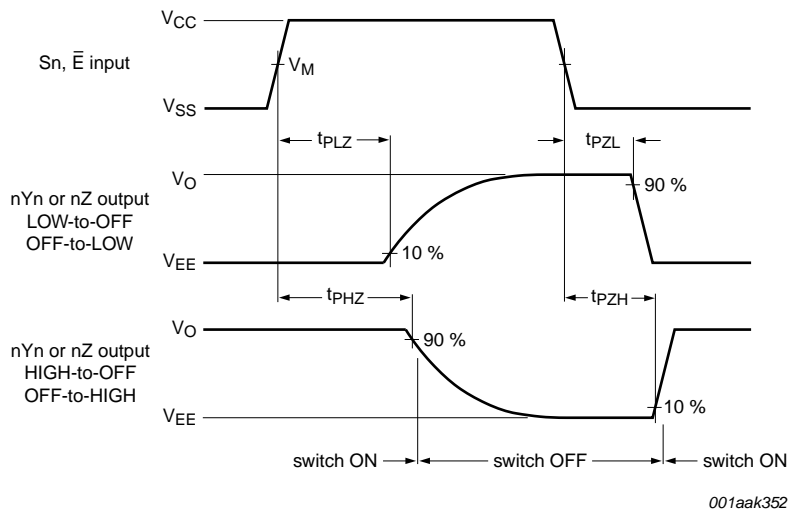
- [1] All typical values are measured at T_{amb} = 25 °C.
- [2] t_{pd} is the same as t_{PLH} and t_{PHL}.
t_{en} is the same as t_{pZL} and t_{pZH}.
t_{dis} is the same as t_{pLZ} and t_{pHZ}.
- [3] Typical values are measured at nominal supply voltage (V_{CC} = 3.3 V).
- [4] C_{PD} is used to determine the dynamic power dissipation (P_D in μW).
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma((C_L + C_{sw}) \times V_{CC}^2 \times f_o)$ 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
 $\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of the outputs.

10.1 Waveforms



Measurement points are given in [Table 9](#).
 V_{OL} and V_{OH} are typical voltage output levels that occur with the output load.

Fig 12. nYn, nZ to nZ, nYn propagation delays

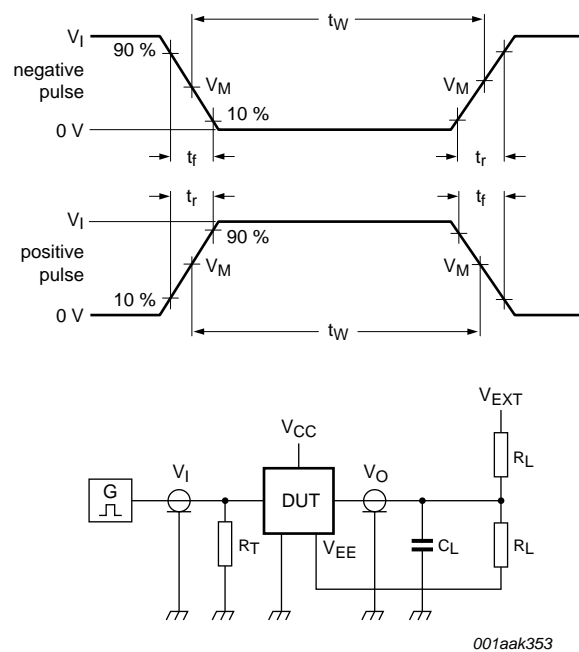


Measurement points are given in [Table 9](#).
 V_{OL} and V_{OH} are typical voltage output levels that occur with the output load.

Fig 13. Enable and disable times

Table 9. Measurement points

Supply voltage	Input	Output
V_{CC}	V_M	V_M
< 2.7 V	$0.5V_{CC}$	$0.5V_{CC}$
2.7 V to 3.6 V	1.5 V	1.5 V
> 3.6 V	$0.5V_{CC}$	$0.5V_{CC}$



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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 14. 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); $V_I = GND$ or V_{CC} (unless otherwise specified); $t_r = t_f \leq 6.0$ ns; $T_{amb} = 25$ °C.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
THD	total harmonic distortion	$f_i = 1$ kHz; $C_L = 50$ pF; $R_L = 10$ k Ω ; see Figure 19				
		$V_{CC} = 3.0$ V; $V_I = 2.75$ V (p-p)	-	0.8	-	%
		$V_{CC} = 6.0$ V; $V_I = 5.5$ V (p-p)	-	0.4	-	%
		$f_i = 10$ kHz; $C_L = 50$ pF; $R_L = 10$ k Ω ; see Figure 19				
		$V_{CC} = 3.0$ V; $V_I = 2.75$ V (p-p)	-	2.4	-	%
		$V_{CC} = 6.0$ V; $V_I = 5.5$ V (p-p)	-	1.2	-	%
$f_{(-3dB)}$	-3 dB frequency response	$C_L = 50$ pF; $R_L = 50$ Ω ; see Figure 15	[1]			
		$V_{CC} = 3.0$ V	-	180	-	MHz
		$V_{CC} = 6.0$ V	-	200	-	MHz
α_{iso}	isolation (OFF-state)	$f_i = 1$ MHz; $C_L = 50$ pF; $R_L = 600$ Ω ; see Figure 17	[2]			
		$V_{CC} = 3.0$ V	-	-50	-	dB
		$V_{CC} = 6.0$ V	-	-50	-	dB
V_{ct}	crosstalk voltage	between digital inputs and switch; $f_i = 1$ MHz; $C_L = 50$ pF; $R_L = 600$ Ω ; see Figure 20				
		$V_{CC} = 3.0$ V	-	0.11	-	V
		$V_{CC} = 6.0$ V	-	0.12	-	V
Xtalk	crosstalk	between switches; $f_i = 1$ MHz; $C_L = 50$ pF; $R_L = 600$ Ω ; see Figure 21	[2]			
		$V_{CC} = 3.0$ V	-	-60	-	dB
		$V_{CC} = 6.0$ V	-	-60	-	dB

- [1] To obtain 0 dBm level at output for 1 MHz, adjust f_i voltage (0 dBm = 1 mW into 50 Ω).
- [2] To obtain 0 dBm level at output for 1 MHz, adjust f_i voltage (0 dBm = 1 mW into 600 Ω).

10.2.1 Test circuits

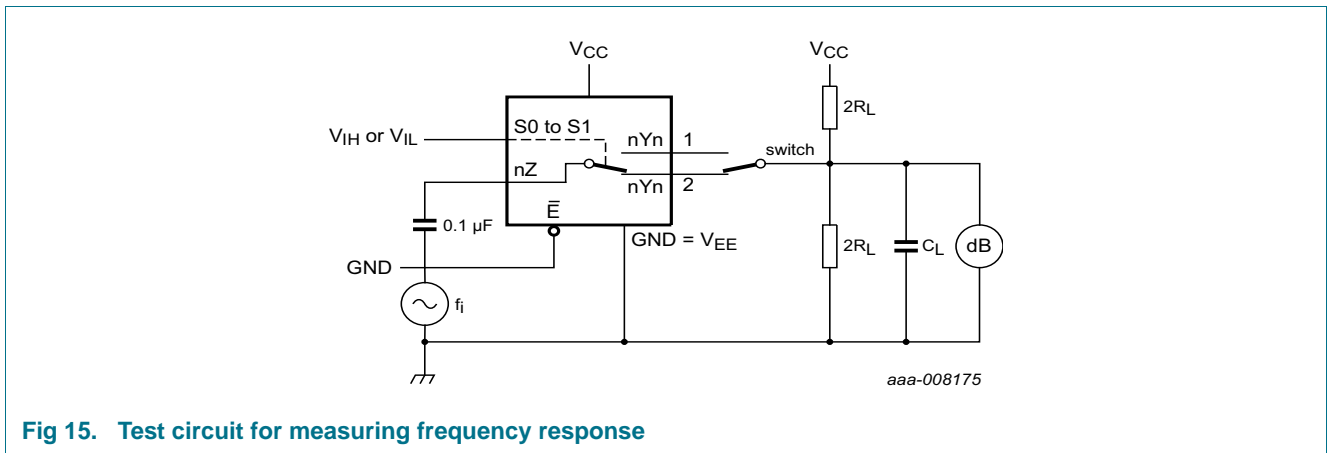
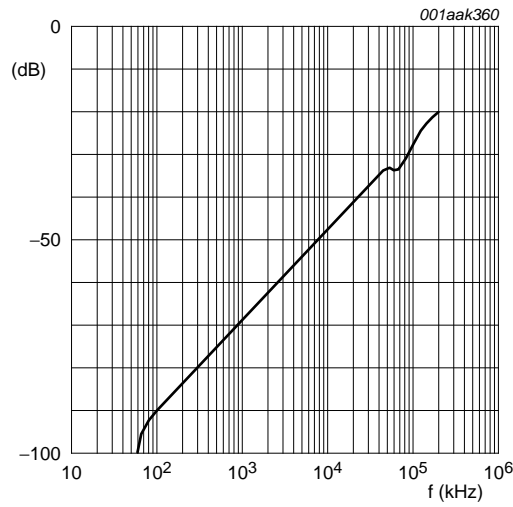


Fig 15. Test circuit for measuring frequency response



$V_{CC} = 3.0\text{ V}$; $GND = 0\text{ V}$; $V_{EE} = -3.0\text{ V}$; $R_L = 50\ \Omega$; $R_{SOURCE} = 1\text{ k}\Omega$.

Fig 18. Typical isolation (OFF-state) as function of frequency

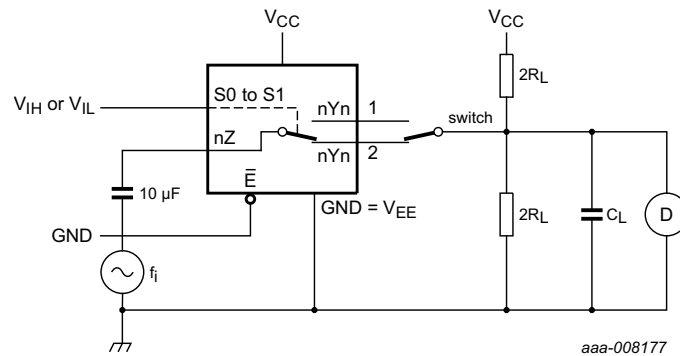
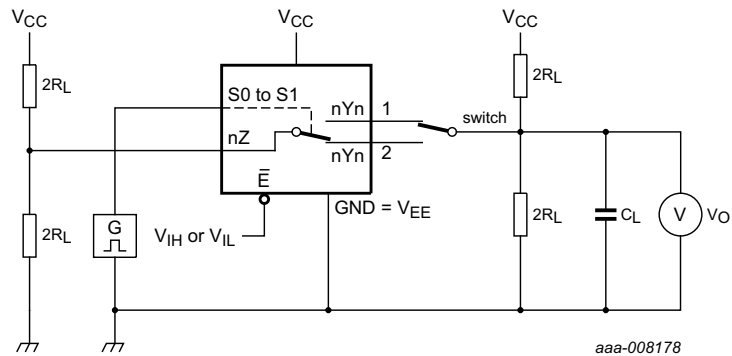
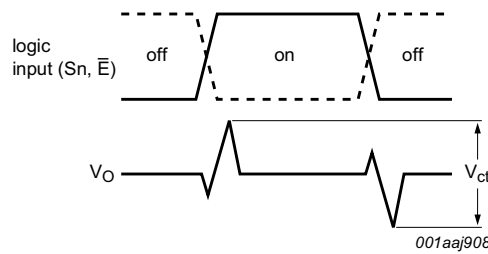


Fig 19. Test circuit for measuring total harmonic distortion



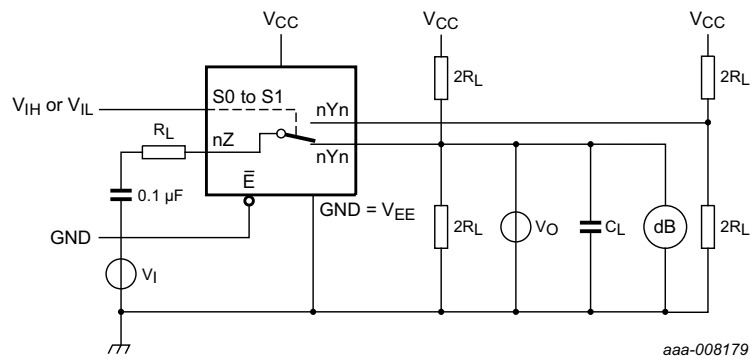
a. Test circuit



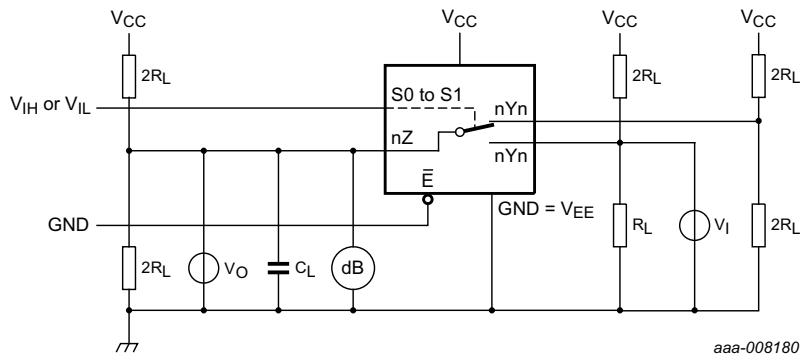
b. Input and output pulse definitions

V_I may be connected to S_n or \bar{E} .

Fig 20. Test circuit for measuring crosstalk voltage between digital inputs and switch



a. Switch-on channel.



b. Switch-off channel.

Fig 21. Test circuit for measuring crosstalk between switches

11. Package outline

SO16: plastic small outline package; 16 leads; body width 3.9 mm

SOT109-1



Fig 22. Package outline SOT109-1 (SO16)

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

SOT403-1

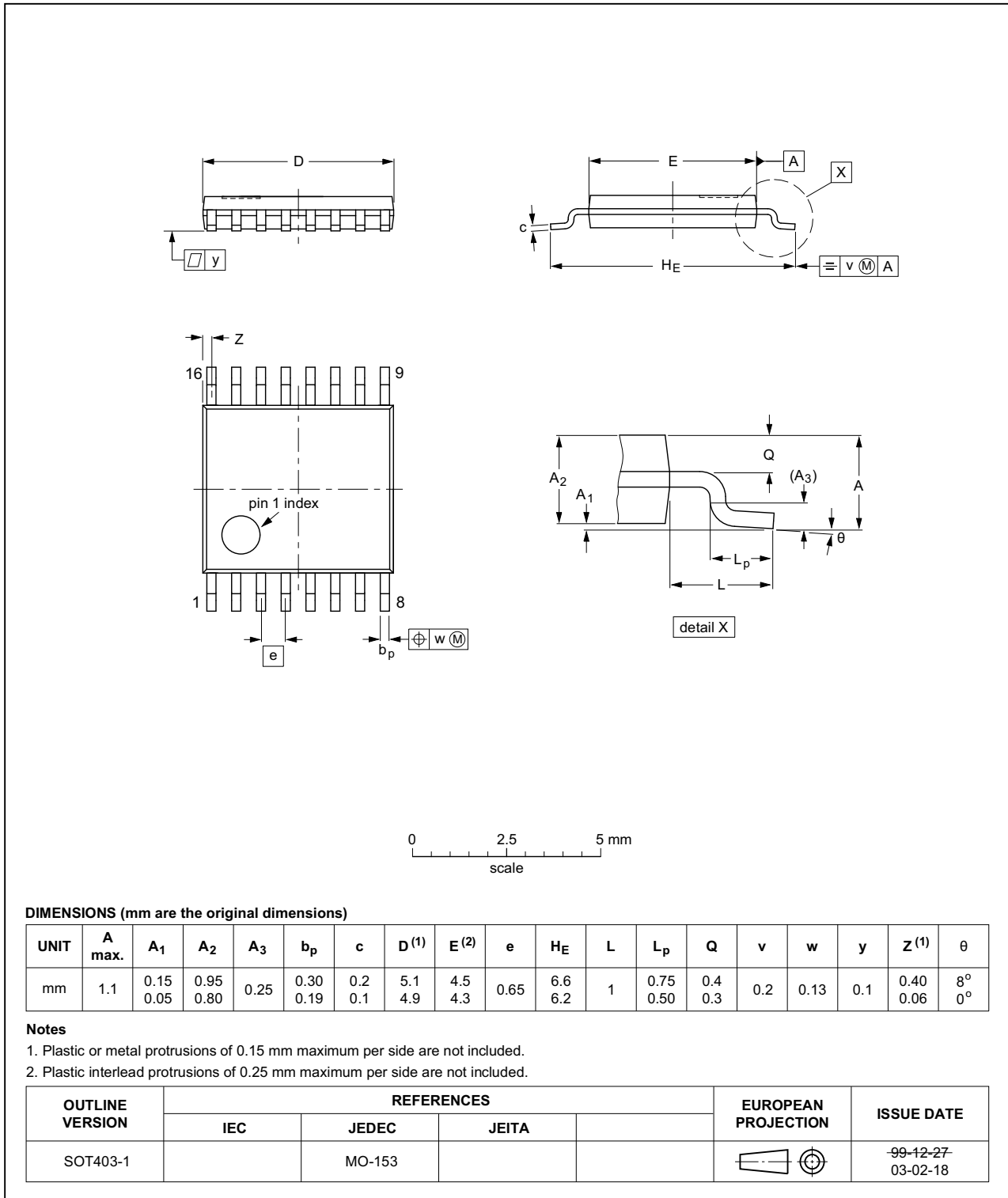


Fig 23. Package outline SOT403-1 (TSSOP16)

12. Abbreviations

Table 12. Abbreviations

Acronym	Description
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
74LV4052_Q100 v.3	20151022	Product data sheet	-	74LV4052_Q100 v.2
Modifications:	<ul style="list-style-type: none"> Descriptive title corrected (errata) 			
74LV4052_Q100 v.2	20140915	Product data sheet	-	74LV4052_Q100 v.1
Modifications:	<ul style="list-style-type: none"> Section 2: ESD protection: MIL-STD-833 changed to MIL-STD883 Table 1: Typo in type number corrected. 			
74LV4052_Q100 v.1	20130722	Product data sheet	-	-

14. Legal information

14.1 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 URL <http://www.nexperia.com>.

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