DATA SHEET

74LV4316
Quad bilateral switches

Product specification
Supersedes data of 1994 Dec 01
IC24 Data Handbook

1998 Jun 23

Philips
Semiconductors

PHILIPS

FEATURES

- Optimized for Low Voltage applications: 1.0V to 6.0V
- Accepts TTL input levels between V_{CC} = 2.7V and V_{CC} = 3.6V
- Low typ “ON” resistance:
  80Ω at V_{CC} – VEE = 4.5V
  120Ω at V_{CC} – VEE = 3.0V
  295Ω at V_{CC} – VEE = 2.0V
- Logic level translation: to enable 3V logic to communicate with ±3V analog signals
- Typical “break before make” built in
- Output capability: non-standard
- I_{CC} category: MSI

DESCRIPTION

The 74LV4316 is a low-voltage CMOS device that is pin and function compatible with 74HC/HCT4316.

The 74LV4316 has four independent analog switches. Each switch has two input/output terminals (nY, nZ) and an active HIGH select input (nS). When the enable input ($\overline{E}$) is HIGH, all four analog switches are turned off.

Current through a switch will not cause additional V_{CC} current provided the voltage at the terminals of the switch is maintained within the supply voltage range; $V_{CC} > (V_Y, V_Z) > V_{EE}$. Inputs nY and nZ are electrically equivalent terminals. V_{CC} and GND are the supply voltage pins for the digital control inputs ($\overline{E}$ and nS). The V_{CC} to GND ranges are 1.0 to 6.0 V.

The analog inputs/outputs (nY 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.

QUICK REFERENCE DATA

GND = 0 V; T_{amb} = 25°C; $t_r = t_f \leq$ 2.5 ns

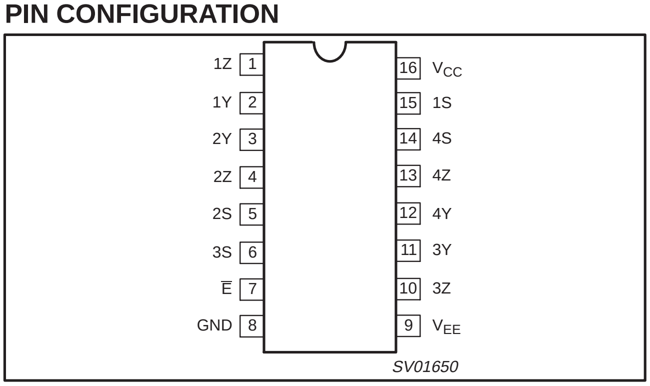
SYMBOL	PARAMETER	CONDITIONS	TYPICAL	UNIT
t_{PZH}/t_{PZL}	Turn “ON” time: $\overline{E}$ to V_{OS} nS to V_{OS}	C_L = 15pF R_L = 1KΩ V_{CC}= 3.3V	19	ns
t_{PHZ}/t_{PLZ}	Turn “OFF” time: $\overline{E}$ to V_{OS} nS to V_{OS}		20	ns
C_I	Input capacitance		3.5	pF
C_{PD}	Power dissipation capacitance per switch	Notes 1, 2	13	pF
C_S	Maximum switch capacitance		5	pF

NOTES:
1. C_{PD} is used to determine the dynamic power dissipation (P_D in μW)
   $P_D = C_{PD} \times V_{CC}^2 \times f_i + \sum (C_L \times V_{CC}^2 \times f_o)$ where:
   f_i = input frequency in MHz; C_L = output load capacity in pF;
   f_o = output frequency in MHz; V_{CC} = supply voltage in V;
   V_{CC} = supply voltage in V:
   $\sum (C_L \times V_{CC}^2 \times f_o)$ = sum of the outputs.
2. The condition is V_I = GND to V_{CC}.

ORDERING INFORMATION

PACKAGES	TEMPERATURE RANGE	OUTSIDE NORTH AMERICA	NORTH AMERICA	PKG. DWG. #
16-Pin Plastic DIL	–40°C to +125°C	74LV4316 N	74LV4316 N	SOT38-4
16-Pin Plastic SO	–40°C to +125°C	74LV4316 D	74LV4316 D	SOT109-1
16-Pin Plastic SSOP Type II	–40°C to +125°C	74LV4316 DB	74LV4316 DB	SOT338-1
16-Pin Plastic TSSOP Type I	–40°C to +125°C	74LV4316 PW	74LV4316PW DH	SOT403-1

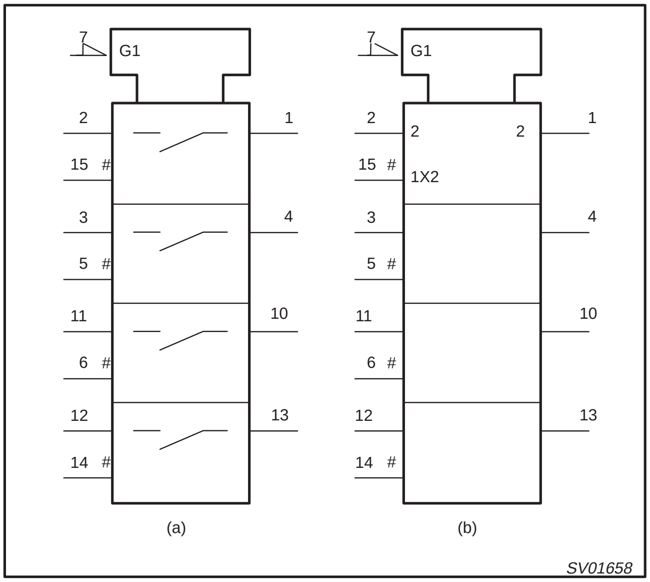
PIN CONFIGURATION



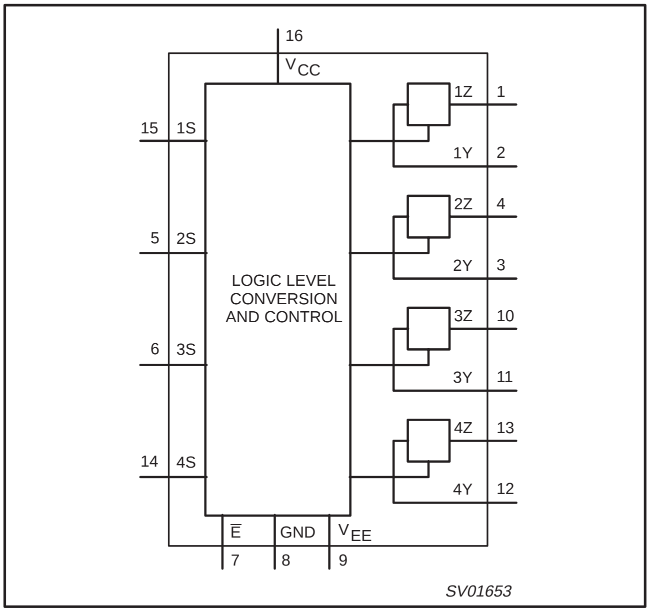
PIN DESCRIPTION

PIN NUMBER	SYMBOL	FUNCTION
1, 4, 10, 13	1Z – 4Z	Independent inputs/outputs
2, 3, 11, 12	1Y – 4Y	Independent inputs/outputs
7	$\overline{E}$	Enable input (active LOW)
8	GND	Ground (0V)
9	V_{EE}	Negative supply voltage
15, 5, 6, 14	1S – 4S	Select inputs (active HIGH)
16	V_{CC}	Positive supply voltage

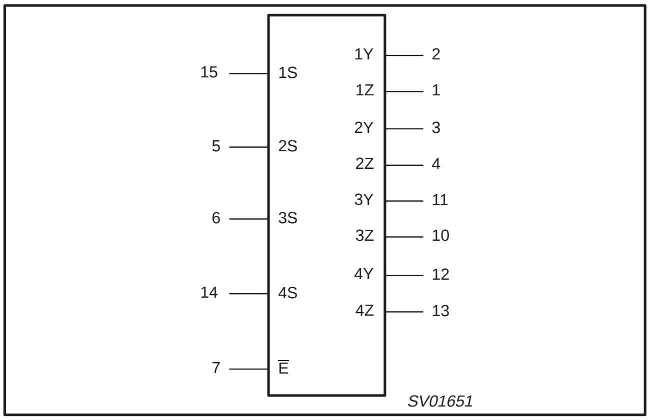
IEC LOGIC SYMBOL



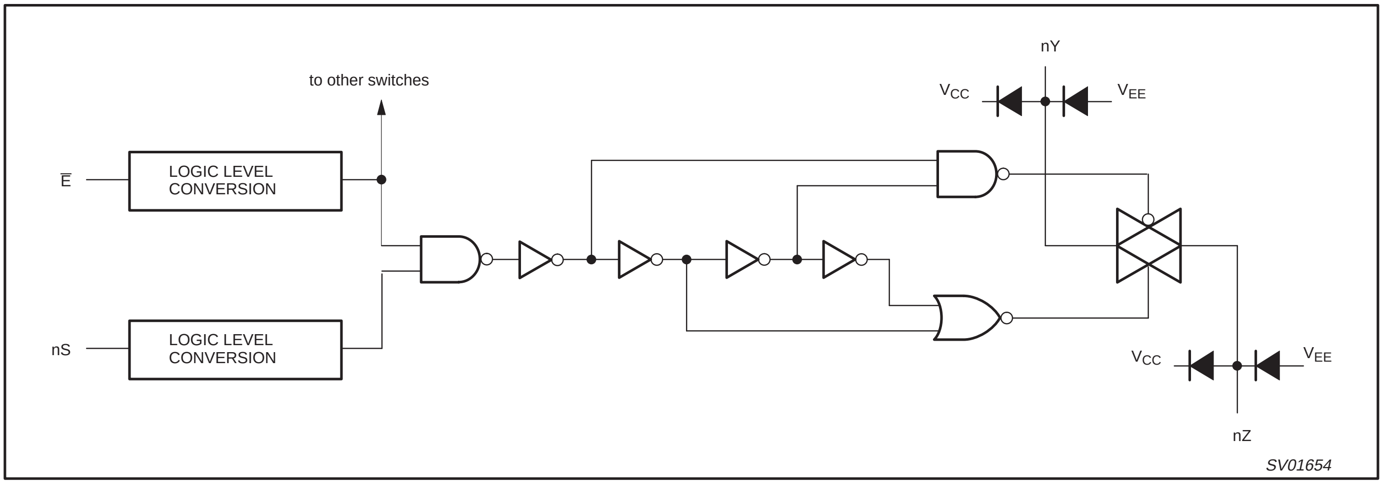
FUNCTIONAL DIAGRAM



LOGIC SYMBOL



SCHEMATIC DIAGRAM (ONE SWITCH)



RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
V_{CC}	DC supply voltage	See Note 1	1.0	3.3	6.0	V
V_I	Input voltage		0	–	V_{CC}	V
V_O	Output voltage		0	–	V_{CC}	V
T_{amb}	Operating ambient temperature range in free air	See DC and AC characteristics	–40 –40		+85 +125	°C
t_r, t_f	Input rise and fall times	V_{CC} = 1.0V to 2.0V V_{CC} = 2.0V to 2.7V V_{CC} = 2.7V to 3.6V V_{CC} = 3.6V to 5.5V	– – – –	– – – –	500 200 100 50	ns/V

NOTE:
1. The LV is guaranteed to function down to V_{CC} = 1.0V (input levels GND or V_{CC}); DC characteristics are guaranteed from V_{CC} = 1.2V to V_{CC} = 5.5V.

ABSOLUTE MAXIMUM RATINGS[1, 2]

In accordance with the Absolute Maximum Rating System (IEC 134).
Voltages are referenced to GND (ground = 0 V).

SYMBOL	PARAMETER	CONDITIONS	RATING	UNIT
V_{CC}	DC supply voltage		–0.5 to +7.0	V
$\pm I_{IK}$	DC input diode current	$V_I < –0.5$ or $V_I > V_{CC} + 0.5V$	20	mA
$\pm I_{OK}$	DC output diode current	$V_O < –0.5$ or $V_O > V_{CC} + 0.5V$	20	mA
$\pm I_O$	DC switch current	$–0.5V < V_O < V_{CC} + 0.5V$	25	mA
T_{stg}	Storage temperature range		–65 to +150	°C
P_{TOT}	Power dissipation per package – plastic DIL – plastic mini-pack (SO) – plastic shrink mini-pack (SSOP and TSSOP)	for temperature range: –40 to +125°C above +70°C derate linearly with 12 mW/K above +70°C derate linearly with 8 mW/K above +60°C derate linearly with 5.5 mW/K	 750 500 400	mW

NOTES:
1. Stresses beyond those listed may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
2. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

DC ELECTRICAL CHARACTERISTICS

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

SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS -40°C to +85°C MIN	TYP[1]	MAX	-40°C to +125°C MIN	MAX	UNIT
V_{IH}	HIGH level Input voltage	V_{CC} = 1.2 V	0.90			0.90		V
		V_{CC} = 2.0 V	1.40			1.4		
		V_{CC} = 2.7 to 3.6 V	2.00			2.0		
		V_{CC} = 4.5 V	3.15			3.15		
		V_{CC} = 6.0 V	4.20			4.20		
V_{IL}	LOW level Input voltage	V_{CC} = 1.2 V			0.30		0.30	V
		V_{CC} = 2.0 V			0.60		0.60	
		V_{CC} = 2.7 to 3.6 V			0.80		0.80	
		V_{CC} = 4.5 V			1.35		1.35	
		V_{CC} = 6.0 V			1.80		1.80	
$\pm I_I$	Input leakage current	V_{CC} = 3.6 V; V_I = V_{CC} or GND V_{CC} = 6.0 V; V_I = V_{CC} or GND			1.0 2.0		1.0 2.0	μA
$\pm I_S$	Analog switch OFF-state current per channel	V_{CC} = 3.6 V; V_I = V_{IH} or V_{IL} V_{CC} = 6.0 V; V_I = V_{IH} or V_{IL}			1.0 2.0		1.0 2.0	μA
$\pm I_S$	Analog switch ON-state current per channel	V_{CC} = 3.6 V; V_I = V_{IH} or V_{IL} V_{CC} = 6.0 V; V_I = V_{IH} or V_{IL}			1.0 2.0		1.0 2.0	μA
I_{CC}	Quiescent supply current	V_{CC} = 3.6V; V_I = V_{CC} or GND; I_O = 0 V_{CC} = 6.0V; V_I = V_{CC} or GND; I_O = 0			20 40		40 80	μA
ΔI_{CC}	Additional quiescent supply current per input	V_{CC} = 2.7 V to 3.6 V; V_I = V_{CC} – 0.6 V			500		850	μA
R_{ON}	ON-resistance (peak)	V_{CC} = 1.2 V; V_I = V_{IH} or V_{IL} V_{CC} = 2.0 V; V_I = V_{IH} or V_{IL} V_{CC} = 2.7 V; V_I = V_{IH} or V_{IL} V_{CC} = 3.0 to 3.6 V; V_I = V_{IH} or V_{IL} V_{CC} = 4.5 V; V_I = V_{IH} or V_{IL} V_{CC} = 6.0 V; V_I = V_{IH} or V_{IL}		295 120 110 80 70	– 860 300 270 200 180		– 990 360 325 240 215	Ω
R_{ON}	ON-resistance (rail)	V_{CC} = 1.2 V; V_I = V_{IH} or V_{IL} V_{CC} = 2.0 V; V_I = V_{IH} or V_{IL} V_{CC} = 2.7 V; V_I = V_{IH} or V_{IL} V_{CC} = 3.0 to 3.6 V; V_I = V_{IH} or V_{IL} V_{CC} = 4.5 V; V_I = V_{IH} or V_{IL} V_{CC} = 6.0 V; V_I = V_{IH} or V_{IL}		225 110 85 55 40 35	– 240 150 135 100 90		– 290 180 180 120 110	Ω
R_{ON}	ON-resistance (rail)	V_{CC} = 1.2 V; V_I = V_{IH} or V_{IL} V_{CC} = 2.0 V; V_I = V_{IH} or V_{IL} V_{CC} = 2.7 V; V_I = V_{IH} or V_{IL} V_{CC} = 3.0 to 3.6 V; V_I = V_{IH} or V_{IL} V_{CC} = 4.5 V; V_I = V_{IH} or V_{IL} V_{CC} = 6.0 V; V_I = V_{IH} or V_{IL}		250 120 75 60 45 40	– 270 170 155 115 105		– 325 205 180 135 120	Ω
ΔR_{ON}	Maximum variation of ON-resistance between any two channels	V_{CC} = 1.2 V; V_I = V_{IH} or V_{IL} V_{CC} = 2.0 V; V_I = V_{IH} or V_{IL} V_{CC} = 2.7 V; V_I = V_{IH} or V_{IL} V_{CC} = 3.0 to 3.6 V; V_I = V_{IH} or V_{IL} V_{CC} = 4.5 V; V_I = V_{IH} or V_{IL} V_{CC} = 6.0 V; V_I = V_{IH} or V_{IL}		– 5 4 4 3 2				Ω

NOTE:

1. All typical values are measured at T_{amb} = 25°C.
2. At supply voltage approaching 1.2V, the analog switch ON-resistance becomes extremely non-linear. Therefore it is recommended that these devices be used to transmit digital signals only, when using these supply voltages.

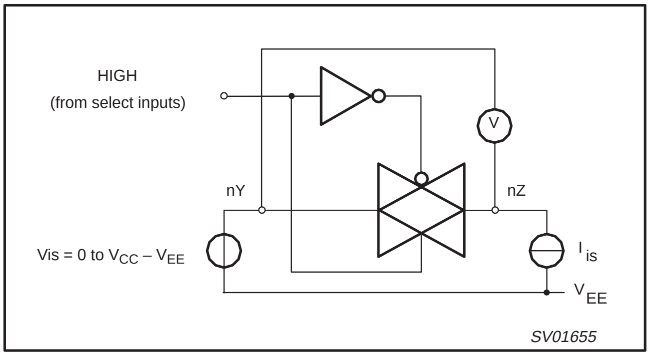


Figure 1. Test circuit for measuring ON-resistance (R_{on}).

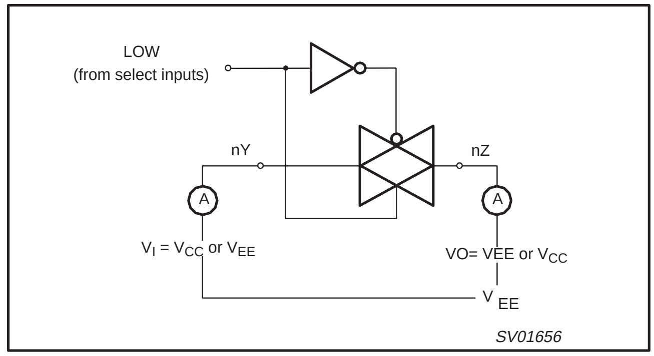


Figure 2. Test circuit for measuring OFF-state current.

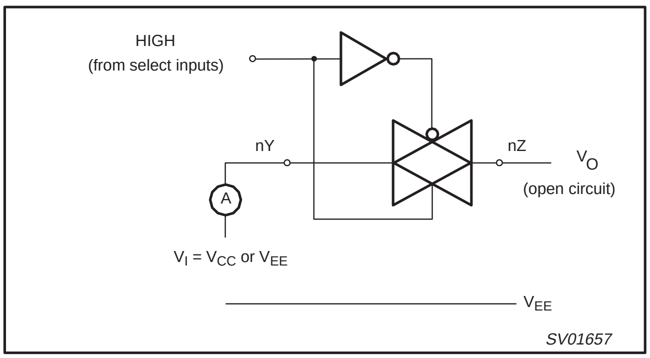


Figure 3. Test circuit for measuring ON-state current.

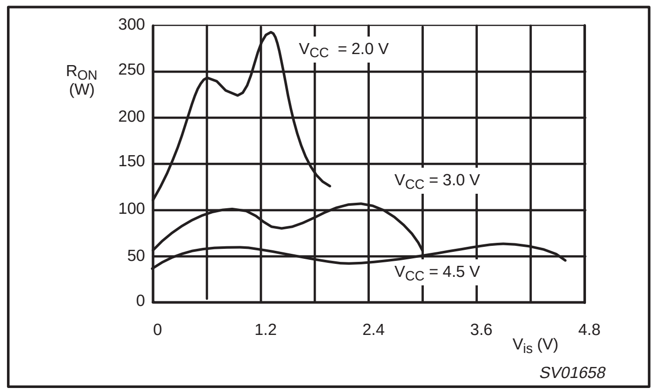


Figure 4. Typical ON-resistance (R_{ON}) as a function of input voltage (V_{is}) for V_{is} = 0 to V_{CC} – V_{EE}.

AC CHARACTERISTICS

GND = 0 V; $t_r = t_f \leq 2.5ns$; C_L = 50pF

SYMBOL	PARAMETER	LIMITS					UNIT	CONDITION	
		–40 to +85 °C			–40 to +125 °C				
		MIN	TYP[1]	MAX	MIN	MAX		V_{CC}(V)	OTHER
t_{PHL}/t_{PLH}	Propagation delay V_{is} to V_{os}		30				ns	1.2	$R_L = \infty$; C_L = 50 pF Figure 12
			10	19		24		2.0	
			8	14		18		2.7	
			6*	11		14		3.0 to 3.6	
			5	9		12		4.5	
			4	7		9		6.0	
t_{PZH}/t_{PZL}	Turn-on time $\overline{E}$ to V_{os}		110				ns	1.2	R_L = 1 kΩ; C_L = 50 pF Figures 13 and 14
			37	70		85		2.0	
			28	51		63		2.7	
			21[2]	41		50		3.0 to 3.6	
			19	35		43		4.5	
			15	27		33		6.0	
t_{PZH}/t_{PZL}	Turn-on time nS to V_{os}		95				ns	1.2	R_L = 1 kΩ; C_L = 50 pF Figures 13 and 14
			32	61		75		2.0	
			24	45		55		2.7	
			18[2]	36		44		3.0 to 3.6	
			16	31		37		4.5	
			12	23		29		6.0	
t_{PHZ}/t_{PLZ}	Turn-off time $\overline{E}$ to V_{os}		105				ns	1.2	R_L = 1 kΩ; C_L = 50 pF Figures 13 and 14
			37	68		80		2.0	
			28	51		59		2.7	
			22[2]	41		48		3.0 to 3.6	
			20	35		41		4.5	
			16	28		32		6.0	
t_{PHZ}/t_{PLZ}	Turn-off time nS to V_{os}		90				ns	1.2	R_L = 1 kΩ; C_L = 50 pF Figures 13 and 14
			32	59		70		2.0	
			24	44		52		2.7	
			19[2]	36		42		3.0 to 3.6	
			17	31		36		4.5	
			14	24		28		6.0	

NOTES:

1. All typical values are measured at T_{amb} = 25°C.
2. All typical values are measured at V_{CC} = 3.3V

ADDITIONAL AC CHARACTERISTICS

GND = 0 V; $t_r = t_f \leq 2.5ns$; $C_L = 50pF$

SYMBOL	PARAMETER	TYP	UNIT	V_{CC} (V)	$V_{IS(P-P)}$ (V)	CONDITIONS
	Sine-wave distortion f = 1 kHz	0.80	%	3.0	2.75	R_L = 10 kΩ; C_L = 50 pF Figure 10
		0.40		6.0	5.50	
	Sine-wave distortion f = 10 kHz	2.40	%	3.0	2.75	R_L = 10 kΩ; C_L = 50 pF Figure 10
		1.20		6.0	5.50	
	Switch “OFF” signal feed through	–50	dB	3.0	Note 1	R_L = 600 kΩ; C_L = 50 pF; f=1 MHz Figures 5 and 11
		–50		6.0		
	Crosstalk between any two switches	–60	dB	3.0	Note 1	R_L = 600 kΩ; C_L = 50 pF; f=1 MHz Figure 7
		–60		6.0		
$V_{(p-p)}$	Crosstalk voltage between enable or address input to any switch (peak-to-peak value)	110	mV	3.0		R_L = 600 kΩ; C_L = 50 pF; f=1 MHz (nS or $\overline{E}$, square wave between V_{CC} and GND, $T_r = t_f$ = 6 ns) Figure 8
		220		6.0		
f_{max}	Minimum frequency response (–3 dB)	180	mHz	3.0	Note 2	R_L = 50 kΩ; C_L = 50 pF Figures 6 and 9
		200		6.0		
C_S	Maximum switch capacitance	5	pF			

GENERAL NOTES:

V_{is} is the input voltage at nY or nZ terminal, whichever is assigned as an input.
V_{os} is the output voltage at nY or nZ terminal, whichever is assigned as an output.

NOTES:

1. Adjust input voltage V_{is} is 0 dBm level (0 dBm = 1 mW into 600 Ω).
2. Adjust input voltage V_{is} is 0 dBm level at V_{os} for 1 MHz (0 dBm = 1 mW into 50 Ω).

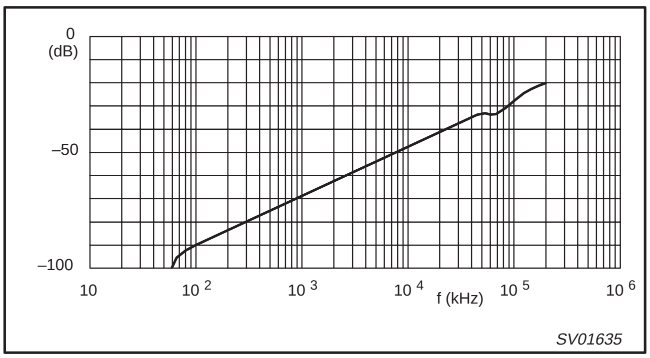


Figure 5. Typical switch “OFF” signal feed-through as a function of frequency.

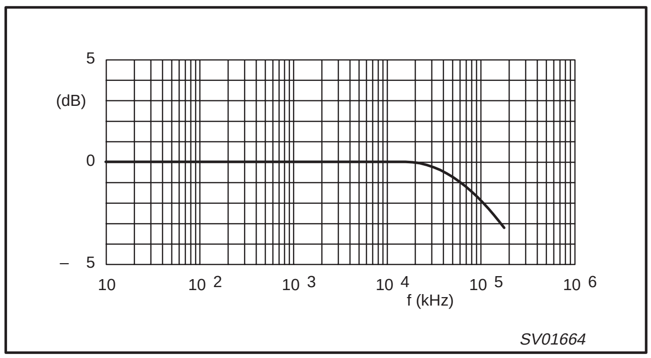


Figure 6. Typical frequency response.

NOTES TO FIGURES 5 AND 6:

Test conditions: V_{CC} = 3.0 V; GND = 0 V; R_L = 50 Ω; R_{SOURCE} = 1kΩ.

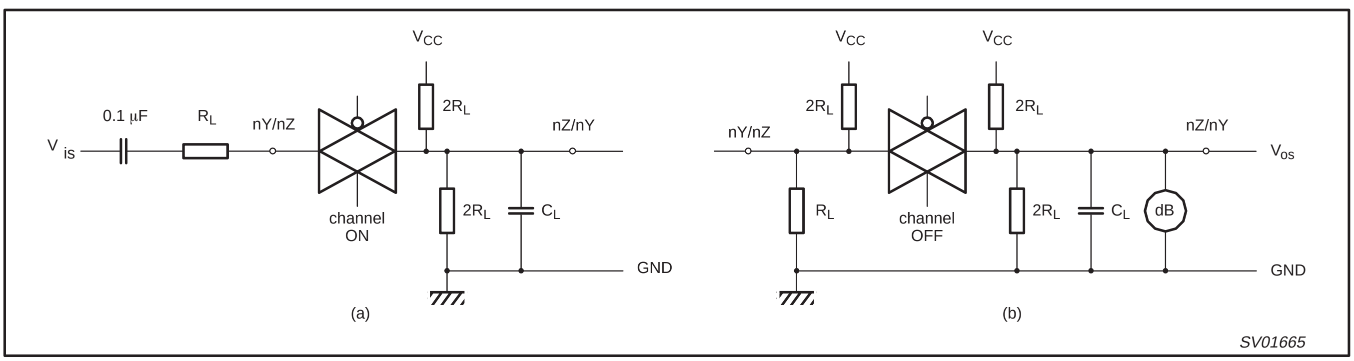


Figure 7. Test circuit for measuring crosstalk between any two switches. (a) channel ON condition; (b) channel OFF condition.

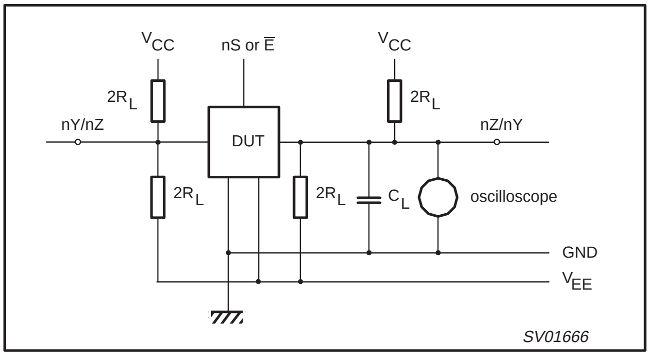
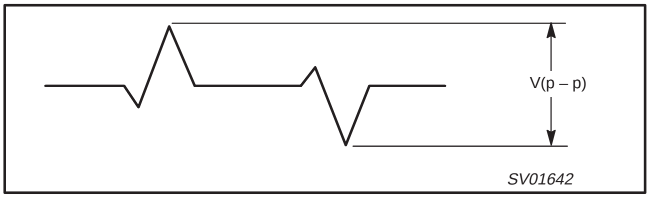


Figure 8. Test circuit for measuring crosstalk between control and any switch.

NOTE TO FIGURE 8:
The crosstalk is defined as follows (oscilloscope output):



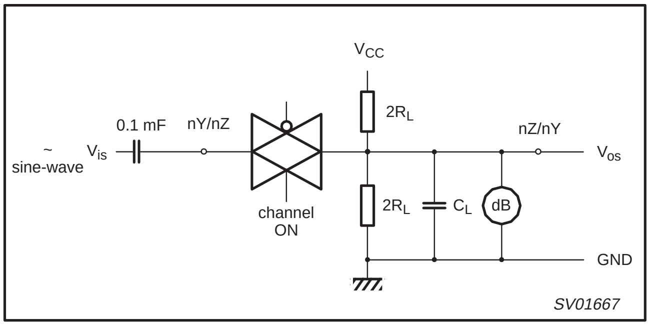


Figure 9. Test circuit for measuring minimum frequency response.

NOTE TO FIGURE 9:
Adjust input voltage to obtain 0 dBm at V_{OS} when F_{in} = 1 MHz. After set-up frequency of f_{in} is increased to obtain a reading of –3 dB at V_{OS}.

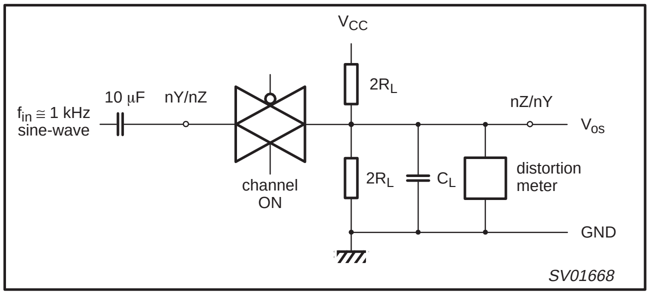


Figure 10. Test circuit for measuring sine-wave distortion.

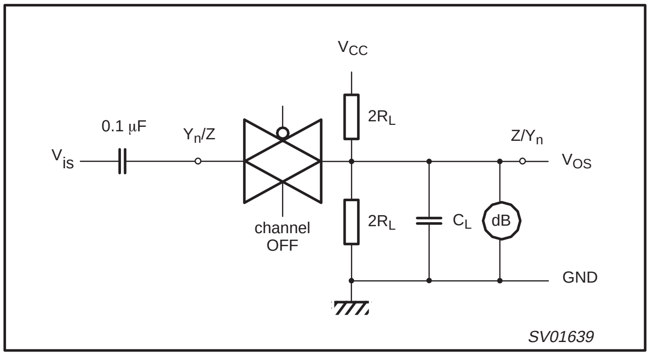


Figure 11. Test circuit for measuring switch "OFF" signal feed-through.

WAVEFORMS

V_M = 1.5 V at 2.7 V ≤ V_{CC} ≤ 3.6 V
V_M = 0.5 × V_{CC} at 2.7 V > V_{CC} > 3.6 V
V_{OL} and V_{OH} are the typical output voltage drop that occur with the output load
V_X = V_{OL} + 0.3 V at 2.7 V ≤ V_{CC} ≤ 3.6 V
V_X = V_{OL} + 0.1 × V_{CC} at 2.7 V >V_{CC} > 3.6 V
V_Y = V_{OH} – 0.3 V at 2.7 V ≤ V_{CC} ≤ 3.6 V
V_Y = V_{OH} – 0.1 × V_{CC} at 2.7 V >V_{CC} > 3.6 V

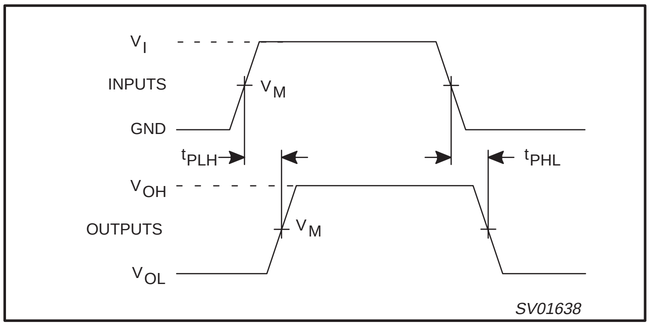


Figure 12. Input (V_{is}) to output (V_{os}) propagation delays.

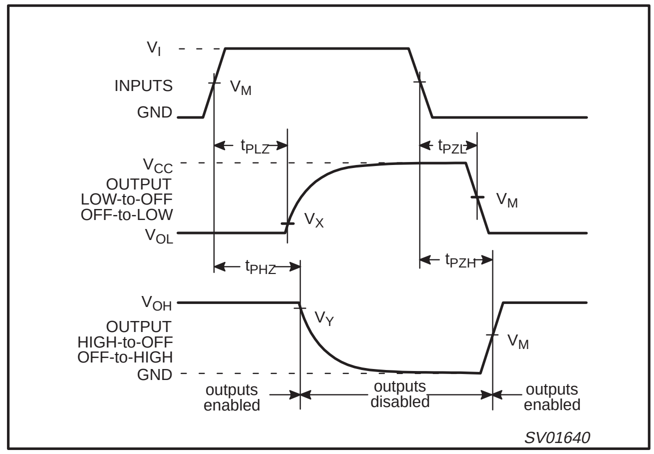
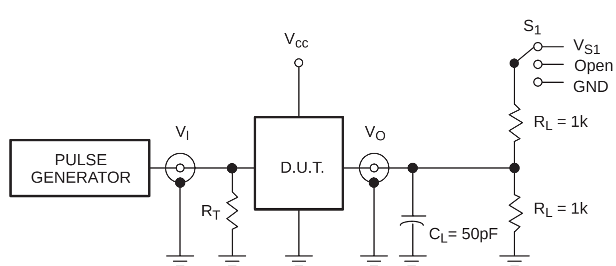
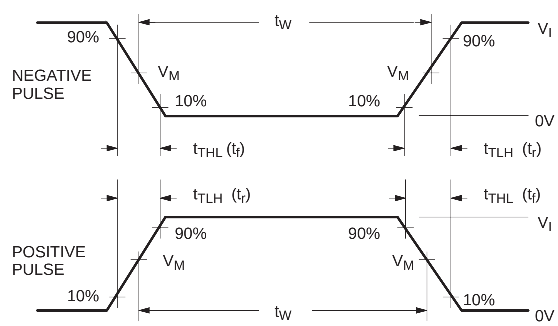


Figure 13. Turn-on and turn-off times for the inputs (nS, $\overline{E}$) to the output (V_{os}).

TEST CIRCUIT



Test Circuit for Outputs



V_M = 1.5V
Input Pulse Definition

SWITCH POSITION

TEST	S_1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	V_{S1}
t_{PHZ}/t_{PZH}	GND

V_{CC}	V_I	V_{S1}
< 2.7V	V_{CC}	2 * V_{CC}
2.7–3.6V	2.7V	2 * V_{CC}
≥ 4.5 V	V_{CC}	2 * V_{CC}

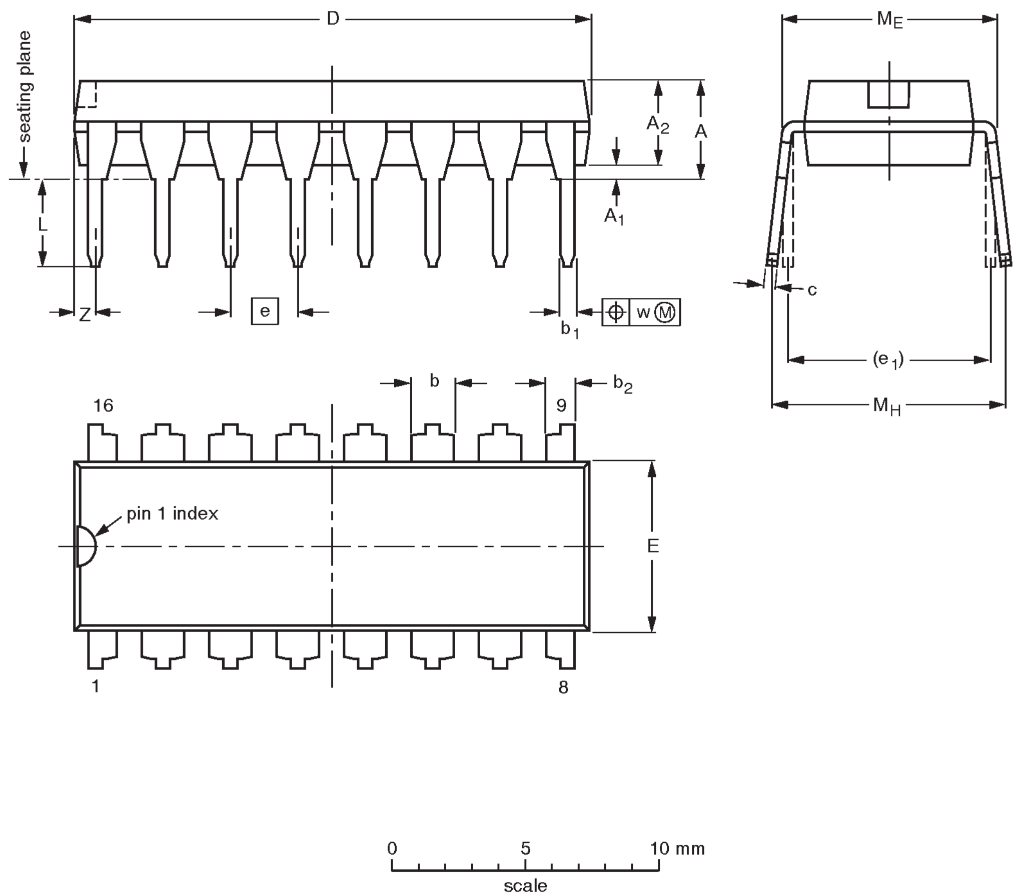
DEFINITIONS

R_L = Load resistor
C_L = Load capacitance includes jig and probe capacitance
R_T = Termination resistance should be equal to Z_{OUT} of pulse generators.

SY00044

Figure 14. Load circuitry for switching times.

DIP16: plastic dual in-line package; 16 leads (300 mil) SOT38-4



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

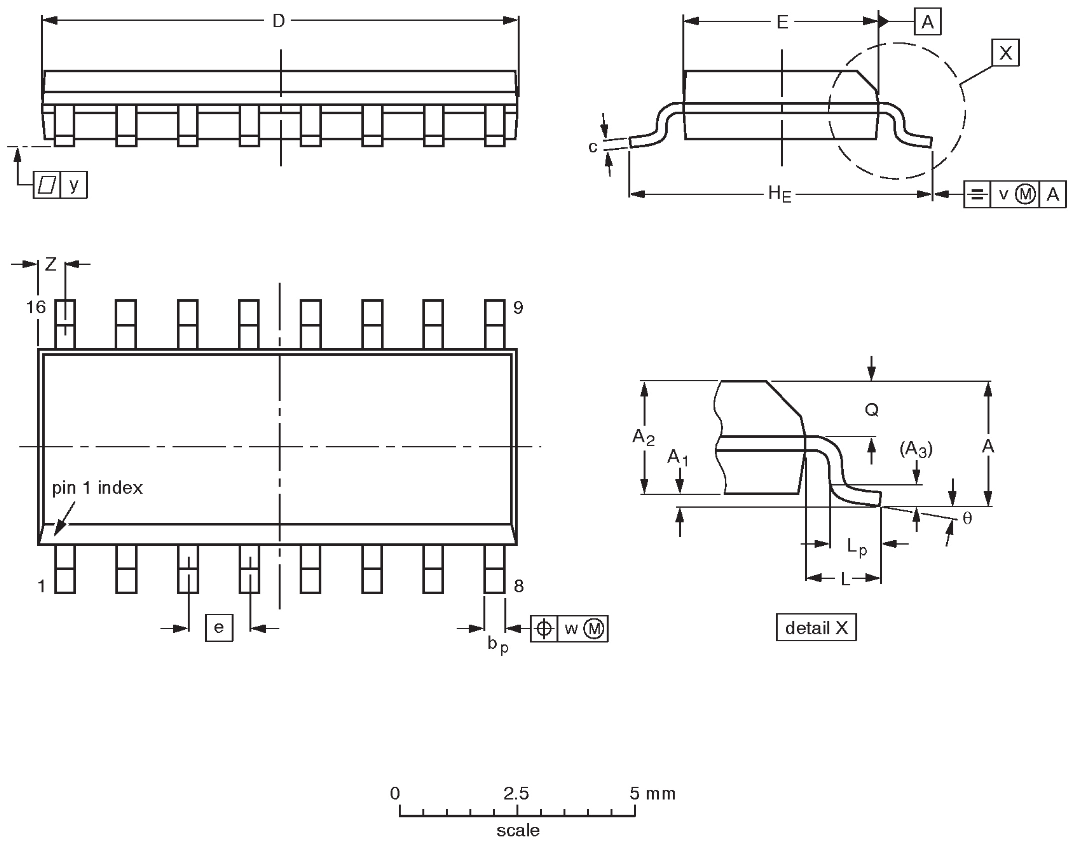
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	b_2	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.2	0.51	3.2	1.73 1.30	0.53 0.38	1.25 0.85	0.36 0.23	19.50 18.55	6.48 6.20	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	0.76
inches	0.17	0.020	0.13	0.068 0.051	0.021 0.015	0.049 0.033	0.014 0.009	0.77 0.73	0.26 0.24	0.10	0.30	0.14 0.12	0.32 0.31	0.39 0.33	0.01	0.030

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT38-4						~~92-11-17~~ 95-01-14

SO16: plastic small outline package; 16 leads; body width 3.9 mm SOT109-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

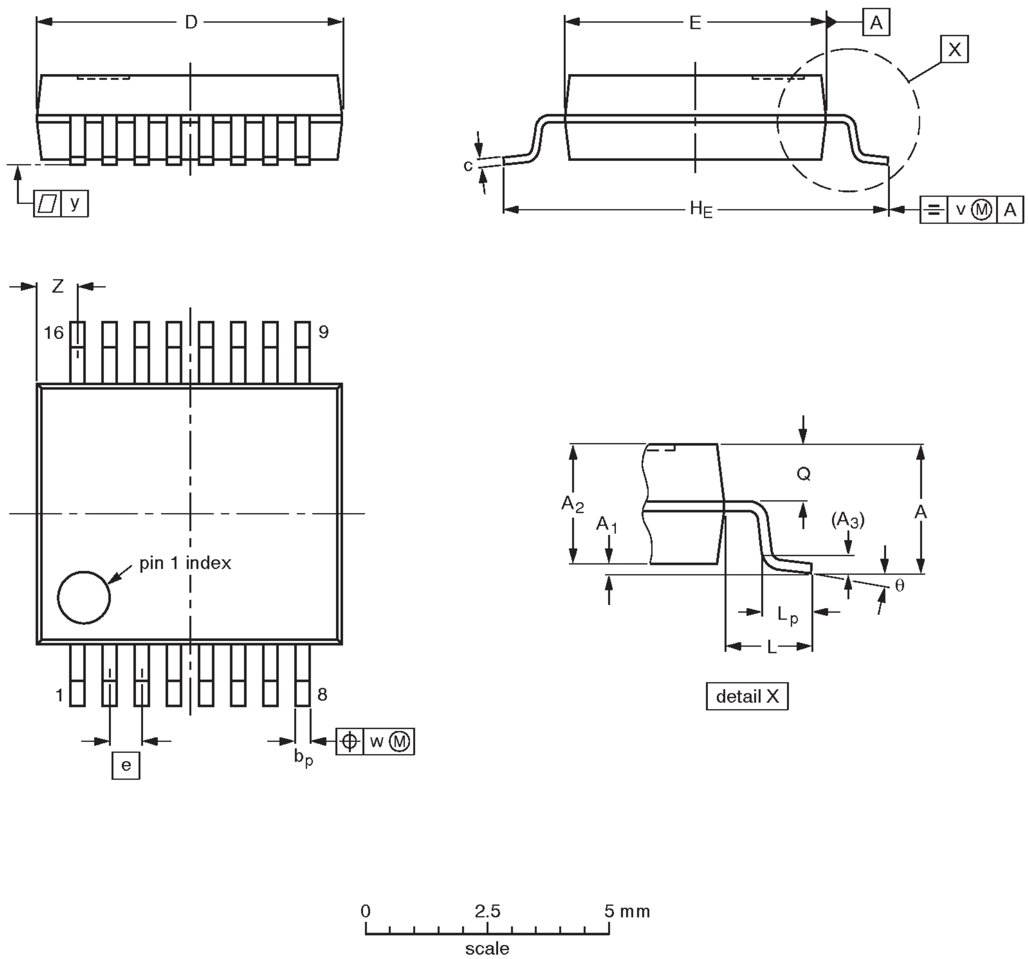
UNIT	A max.	A_1	A_2	A_3	b_p	c	D[(1)]	E[(1)]	e	H_E	L	L_p	Q	v	w	y	Z[(1)]	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	10.0 9.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.0098 0.0039	0.057 0.049	0.01	0.019 0.014	0.0098 0.0075	0.39 0.38	0.16 0.15	0.050	0.24 0.23	0.041	0.039 0.016	0.028 0.020	0.01	0.01	0.004	0.028 0.012	

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT109-1	076E07S	MS-012AC				~~91-08-13~~ 95-01-23

SSOP16: plastic shrink small outline package; 16 leads; body width 5.3 mm — SOT338-1



DIMENSIONS (mm are the original dimensions)

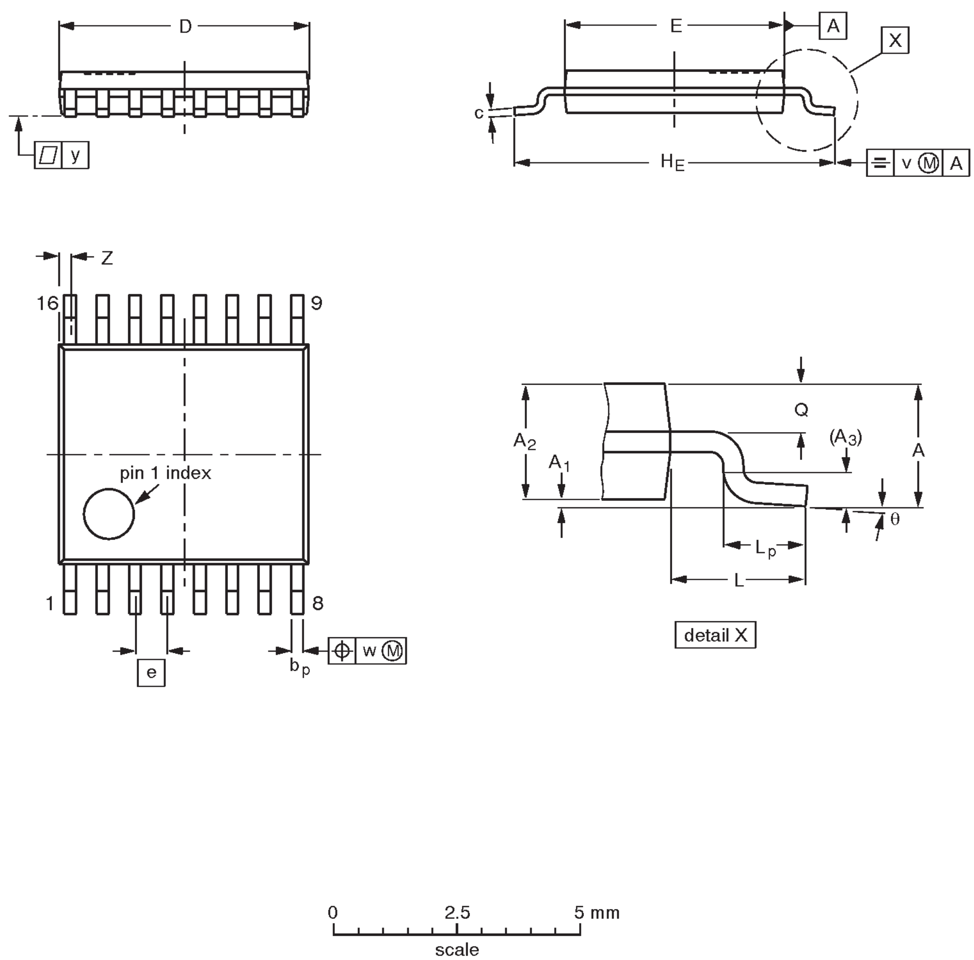
UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (1)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	2.0	0.21 0.05	1.80 1.65	0.25	0.38 0.25	0.20 0.09	6.4 6.0	5.4 5.2	0.65	7.9 7.6	1.25	1.03 0.63	0.9 0.7	0.2	0.13	0.1	1.00 0.55	8° 0°

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT338-1		MO-150AC				~~94-01-14~~ 95-02-04

TSSOP16: plastic thin shrink small outline package; 16 leads; body width 4.4 mm SOT403-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (2)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	1.10	0.15 0.05	0.95 0.80	0.25	0.30 0.19	0.2 0.1	5.1 4.9	4.5 4.3	0.65	6.6 6.2	1.0	0.75 0.50	0.4 0.3	0.2	0.13	0.1	0.40 0.06	8° 0°

Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT403-1		MO-153				~~94-07-12~~ 95-04-04

NOTES

Quad bilateral switches 74LV4316

DEFINITIONS

Data Sheet Identification	Product Status	Definition
Objective Specification	Formative or in Design	This data sheet contains the design target or goal specifications for product development. Specifications may change in any manner without notice.
Preliminary Specification	Preproduction Product	This data sheet contains preliminary data, and supplementary data will be published at a later date. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product.
Product Specification	Full Production	This data sheet contains Final Specifications. Philips Semiconductors reserves the right to make changes at any time without notice, in order to improve design and supply the best possible product.

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