DATA SHEET

74LV132
Quad 2-input NAND Schmitt-trigger

Product specification

IC24 Data Handbook

1997 Feb 04

Philips
Semiconductors

PHILIPS

Quad 2-input NAND Schmitt-trigger 74LV132

FEATURES

- Wide operating voltage: 1.0 to 5.5V
- Optimized for Low Voltage applications: 1.0 to 3.6V
- Accepts TTL input levels between V_{CC} = 2.7V and V_{CC} = 3.6V
- Typical V_{OLP} (output ground bounce) < 0.8V @ V_{CC} = 3.3V, T_{amb} = 25°C
- Typical V_{OHV} (output V_{OH} undershoot) > 2V @ V_{CC} = 3.3V, T_{amb} = 25°C
- Output capability: standard
- I_{CC} category: SSI

APPLICATIONS

- Wave and pulse shapers
- Astable multivibrators
- Monostable multivibrators

DESCRIPTION

The 74LV132 is a low-voltage Si-gate CMOS device and is pin and function compatible with 74HC/HCT132.

The 74LV132 contains four 2-input NAND gates which accept standard input signals. They are capable of transforming slowly changing input signals into sharply defined, jitter-free output signals.

The gate switches at different points for positive and negative-going signals. The difference between the positive voltage V_{T+} and the negative voltage V_{T-} is defined as the hysteresis voltage V_H.

QUICK REFERENCE DATA

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

SYMBOL	PARAMETER	CONDITIONS	TYPICAL	UNIT
t_{PHL}/t_{PLH}	Propagation delay $n\overline{A}$, nB to nY	C_L = 15pF V_{CC} = 3.3V R_{EXT} = 5KΩ C_{EXT} = 0pF	10	ns
C_I	Input capacitance		3.5	pF
C_{PD}	Power dissipation capacitance per gate	Notes 1 and 2	24	pF

NOTES:

1. C_{PD} is used to determine the dynamic power dissipation (P_D in μW)
   $P_D = C_{PD} \times V_{CC}^2 \times f_i + \Sigma (C_L \times V_{CC}^2 \times f_o)$ 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;
   $\Sigma (C_L \times V_{CC}^2 \times f_o)$ = 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. #
14-Pin Plastic DIL	–40°C to +125°C	74LV132 N	74LV132 N	SOT27-1
14-Pin Plastic SO	–40°C to +125°C	74LV132 D	74LV132 D	SOT108-1
14-Pin Plastic SSOP Type II	–40°C to +125°C	74LV132 DB	74LV132 DB	SOT337-1
14-Pin Plastic TSSOP Type I	–40°C to +125°C	74LV132 PW	74LV132PW DH	SOT402-1

PIN CONFIGURATION

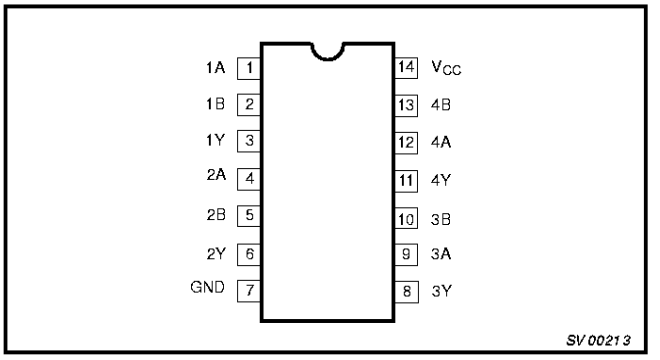


Figure 1. Pin configuration

PIN DESCRIPTION

PIN NUMBER	SYMBOL	FUNCTION
1, 4, 9, 12	1A to 4A	Data inputs
2, 5, 10, 13	1B to 4B	Data inputs
3, 6, 8, 11	1Y to 4Y	Data outputs
7	GND	Ground (0V)
14	V_{CC}	Positive supply voltage

LOGIC SYMBOL (IEEE/IEC)

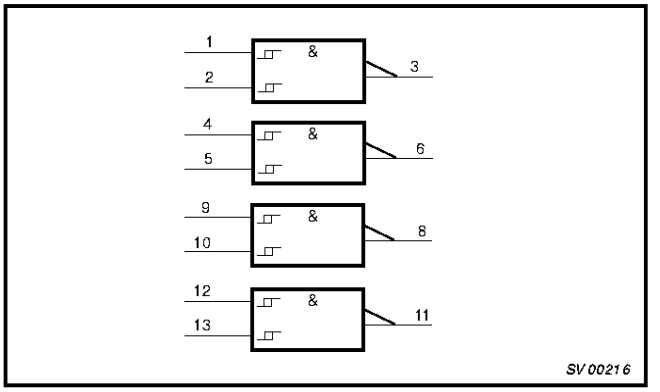


Figure 2. IEC Logic symbol.

LOGIC SYMBOL

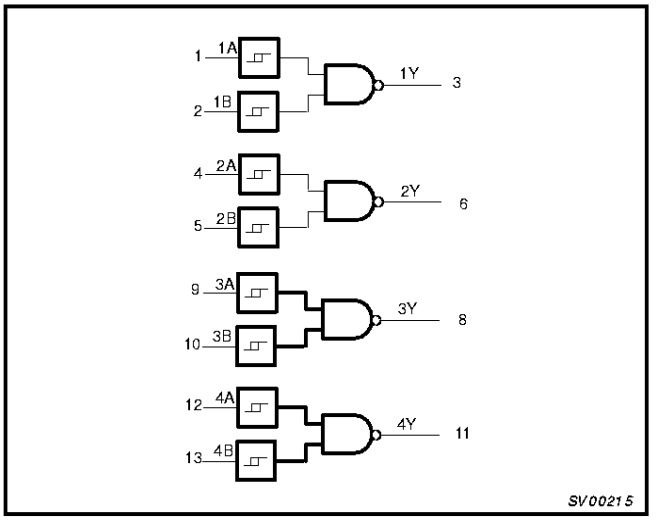


Figure 3. Logic symbol.

LOGIC DIAGRAM

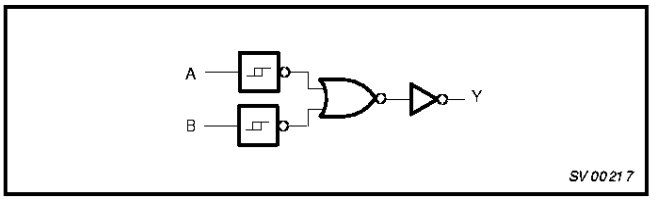


Figure 4. Logic diagram (one Schmitt-trigger)

FUNCTION TABLE

INPUTS		OUTPUT
nA	nB	nY
L	L	H
L	H	H
H	L	H
H	H	L

NOTES:
H = HIGH voltage level
L = LOW voltage level

ABSOLUTE MAXIMUM RATINGS[1, 2]

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

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 $V_O > V_{CC} + 0.5V$	50	mA
$\pm I_O$	DC output source or sink current – standard outputs – bus driver outputs	$-0.5V < V_O < V_{CC} + 0.5V$	 25 35	mA
$\pm I_{GND}$, $\pm I_{CC}$	DC V_{CC} or GND current for types with – standard outputs – bus driver outputs		 50 70	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.

RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
V_{CC}	DC supply voltage	See Note[1]	1.0	3.3	5.5	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 per device	−40 −40		+85 +125	°C
t_r, t_f	Input rise and fall times except for Schmitt-trigger inputs	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.

DC CHARACTERISTICS FOR THE LV FAMILY

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

SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS					UNIT
			-40°C to +85°C			-40°C to +125°C		
			MIN	TYP[1]	MAX	MIN	MAX	
V_{IH}	HIGH level Input voltage	V_{CC} = 1.2V	0.9			0.9		V
		V_{CC} = 2.0V	1.4			1.4		
		V_{CC} = 2.7 to 3.6V	2.0			2.0		
		V_{CC} = 4.5 to 5.5V	0.7 * V_{CC}			0.7 * V_{CC}		
V_{IL}	LOW level Input voltage	V_{CC} = 1.2V			0.3		0.3	V
		V_{CC} = 2.0V			0.6		0.6	
		V_{CC} = 2.7 to 3.6V			0.8		0.8	
		V_{CC} = 4.5 to 5.5			0.3 * V_{CC}		0.3 * V_{CC}	
V_{OH}	HIGH level output voltage; all outputs	V_{CC} = 1.2V; V_I = V_{IH} or V_{IL}; $-I_O$ = 100µA		1.2				V
		V_{CC} = 2.0V; V_I = V_{IH} or V_{IL}; $-I_O$ = 100µA	1.8	2.0		1.8		
		V_{CC} = 2.7V; V_I = V_{IH} or V_{IL}; $-I_O$ = 100µA	2.5	2.7		2.5		
		V_{CC} = 3.0V; V_I = V_{IH} or V_{IL}; $-I_O$ = 100µA	2.8	3.0		2.8		
		V_{CC} = 4.5V; V_I = V_{IH} or V_{IL}; $-I_O$ = 100µA	4.3	4.5		4.3		
V_{OH}	HIGH level output voltage; STANDARD outputs	V_{CC} = 3.0V; V_I = V_{IH} or V_{IL}; $-I_O$ = 6mA	2.40	2.82		2.20		V
		V_{CC} = 4.5V; V_I = V_{IH} or V_{IL}; $-I_O$ = 12mA	3.60	4.20		3.50		
V_{OH}	HIGH level output voltage; BUS driver outputs	V_{CC} = 3.0V; V_I = V_{IH} or V_{IL}; $-I_O$ = 8mA	2.40	2.82		2.20		V
		V_{CC} = 4.5V; V_I = V_{IH} or V_{IL}; $-I_O$ = 16mA	3.60	4.20		3.50		
V_{OL}	LOW level output voltage; all outputs	V_{CC} = 1.2V; V_I = V_{IH} or V_{IL}; I_O = 100µA		0				V
		V_{CC} = 2.0V; V_I = V_{IH} or V_{IL}; I_O = 100µA		0	0.2		0.2	
		V_{CC} = 2.7V; V_I = V_{IH} or V_{IL}; I_O = 100µA		0	0.2		0.2	
		V_{CC} = 3.0V; V_I = V_{IH} or V_{IL}; I_O = 100µA		0	0.2		0.2	
		V_{CC} = 4.5V; V_I = V_{IH} or V_{IL}; I_O = 100µA		0	0.2		0.2	
V_{OL}	LOW level output voltage; STANDARD outputs	V_{CC} = 3.0V; V_I = V_{IH} or V_{IL}; I_O = 6mA		0.25	0.40		0.50	V
		V_{CC} = 4.5V; V_I = V_{IH} or V_{IL}; I_O = 12mA		0.35	0.55		0.65	
V_{OL}	LOW level output voltage; BUS driver outputs	V_{CC} = 3.0V; V_I = V_{IH} or V_{IL}; I_O = 8mA		0.20	0.40		0.50	V
		V_{CC} = 4.5V; V_I = V_{IH} or V_{IL}; I_O = 16mA		0.35	0.55		0.65	
I_I	Input leakage current	V_{CC} = 5.5V; V_I = V_{CC} or GND			1.0		1.0	µA
I_{OZ}	3-State output OFF-state current	V_{CC} = 5.5V; V_I = V_{IH} or V_{IL}; V_O = V_{CC} or GND			5		10	µA
I_{CC}	Quiescent supply current; SSI	V_{CC} = 5.5V; V_I = V_{CC} or GND; I_O = 0			20.0		40	µA
	Quiescent supply current; flip-flops	V_{CC} = 5.5V; V_I = V_{CC} or GND; I_O = 0			20.0		80	
I_{CC}	Quiescent supply current; MSI	V_{CC} = 5.5V; V_I = V_{CC} or GND; I_O = 0			20.0		160	µA
	Quiescent supply current; LSI	V_{CC} = 5.5V; V_I = V_{CC} or GND; I_O = 0			500		1000	
ΔI_{CC}	Additional quiescent supply current per input	V_{CC} = 2.7V to 3.6V; V_I = V_{CC} − 0.6V			500		850	µA

NOTE:

1. All typical values are measured at T_{amb} = 25°C.

TRANSFER CHARACTERISTICS

Voltages are referenced to GND = 0V.

SYMBOL	PARAMETER	WAVEFORM	CONDITION	LIMITS					UNIT
				−40 to +85°C			−40 to +125°C		
			V_{CC}(V)	MIN	TYP[1]	MAX	MIN	MAX	
V_{T+}	Positive going threshold	Figures 5 and 6	1.2	–	0.70	–	–		V
			2.0	0.8	1.10	1.4	0.8	1.4	
			2.7	1.0	1.45	2.0	1.0	2.0	
			3.0	1.2	1.60	2.2	1.2	2.2	
			3.6	1.5	1.95	2.4	1.5	2.4	
			4.5	1.7	2.50	3.2	1.7	3.2	
			5.5	2.1	3.00	3.9	2.1	3.9	
V_{T-}	Negative going threshold	Figures 5 and 6	1.2	–	0.34	–	–	–	V
			2.0	0.3	0.65	0.9	0.3	0.9	
			2.7	0.4	0.90	1.4	0.4	1.4	
			3.0	0.6	1.05	1.5	0.6	1.5	
			3.6	0.8	1.30	1.8	0.8	1.8	
			4.5	0.9	1.60	2.0	0.9	2.0	
			5.5	1.2	2.00	2.6	1.2	2.6	
V_H	Hysteresis ($V_{T+} - V_{T-}$)	Figures 5 and 6	1.2	–	0.30	–	–	–	V
			2.0	0.2	0.55	0.8	0.2	0.8	
			2.7	0.3	0.60	1.1	0.3	1.1	
			3.0	0.4	0.65	1.2	0.4	1.2	
			3.6	0.4	0.70	1.2	0.4	1.2	
			4.5	0.4	0.80	1.4	0.4	1.4	
			5.5	0.6	1.00	1.5	0.6	1.5	

NOTE:
1. Unless otherwise stated, all typical values are at T_{amb} = 25°C.

AC CHARACTERISTICS

GND = 0V; $t_r = t_f$ = 2.5ns; C_L = 50pF; R_L = 1KΩ

SYMBOL	PARAMETER	WAVEFORM	CONDITION	LIMITS					UNIT
				−40 to +85°C			−40 to +125°C		
			V_{CC}(V)	MIN	TYP[1]	MAX	MIN	MAX	
t_{PHL}/t_{PLH}	Propagation delay nA, nB, to nY	Figure 10	1.2	–	65	–	–	–	ns
			2.0	–	18	34	–	43	
			2.7	–	15	24	–	30	
			3.0 to 3.6	–	12[2]	20	–	25	
			4.5 to 5.5	–	9.0[3]	14	–	17	

NOTES:
1. Unless otherwise stated, all typical values are at T_{amb} = 25°C.
2. Typical value measured at V_{CC} = 3.3V.
3. Typical value measured at V_{CC} = 5.0V.

TRANSFER CHARACTERISTIC WAVEFORMS

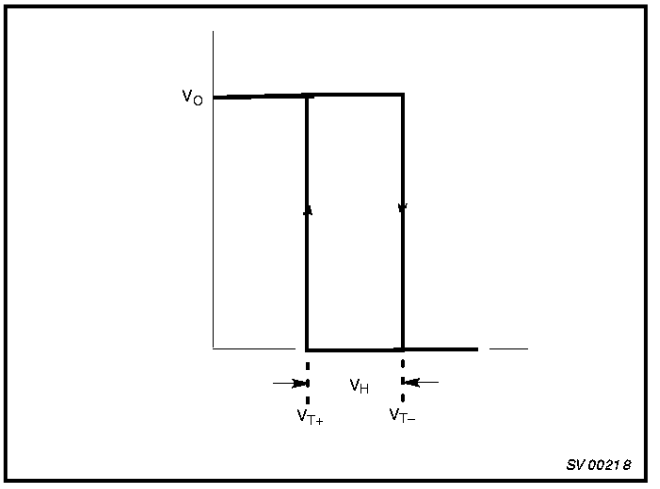


Figure 5. Transfer characteristic.

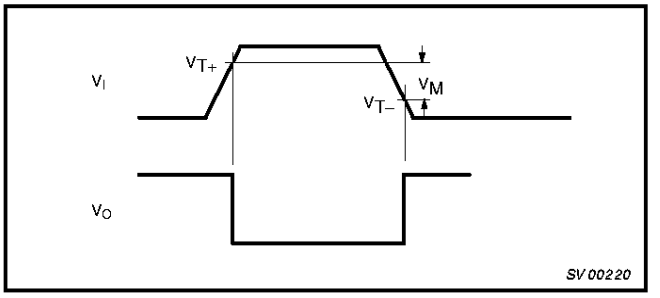


Figure 6. Waveforms showing the definition of V_{T+}, V_{T-} and V_H; where V_{T+} and V_{T-} are between limits of 20% and 70%.

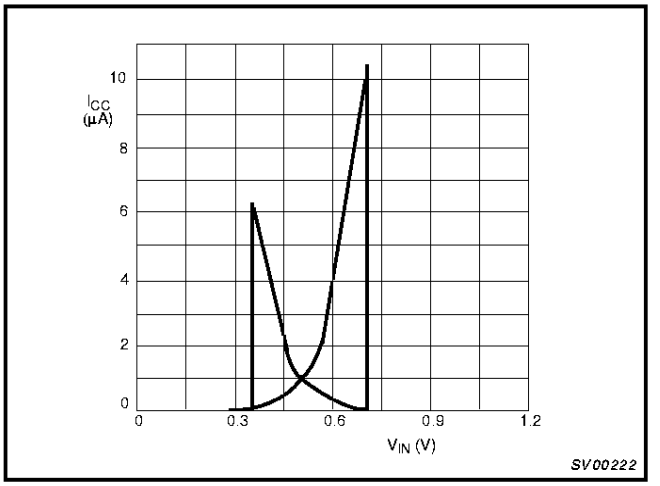


Figure 7. Typical LV132 transfer characteristics; V_{CC} = 1.2V.

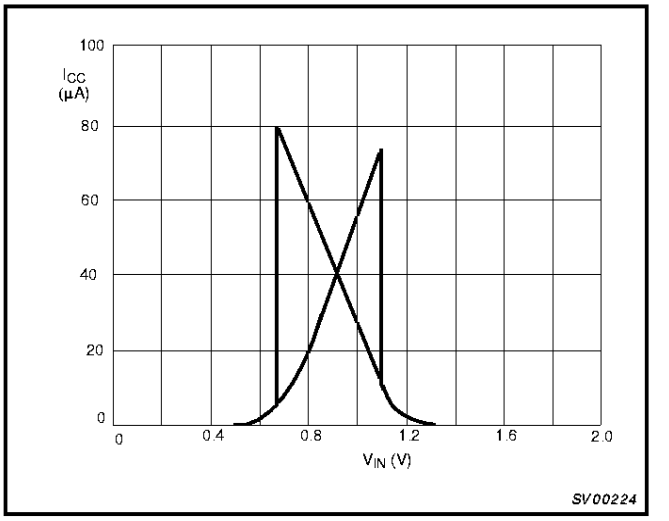


Figure 8. Typical LV132 transfer characteristics; V_{CC} = 2.0V.

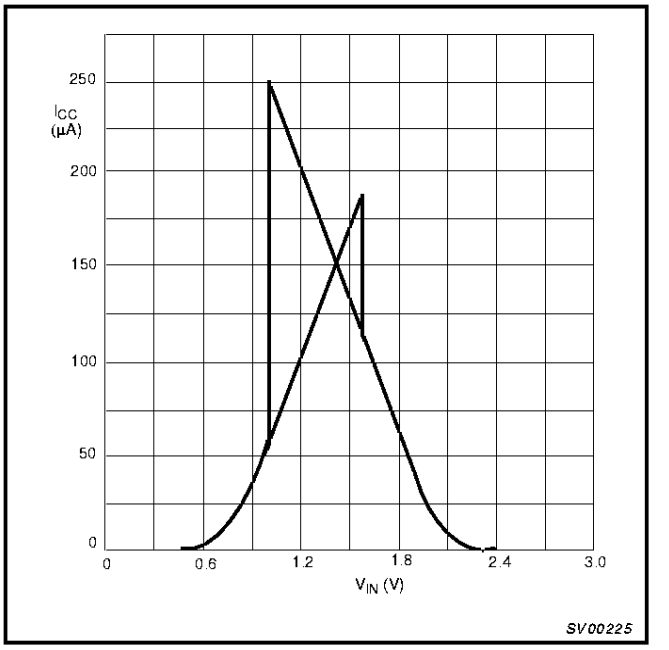


Figure 9. Typical LV132 transfer characteristics; V_{CC} = 3.0V.

AC WAVEFORMS

V_M = 1.5V at V_{CC} ≥ 2.7V ≤ 3.6V
V_M = 0.5V * V_{CC} at V_{CC} < 2.7V and ≥ 4.5V
V_{OL} and V_{OH} are the typical output voltage drop that occur with the output load.

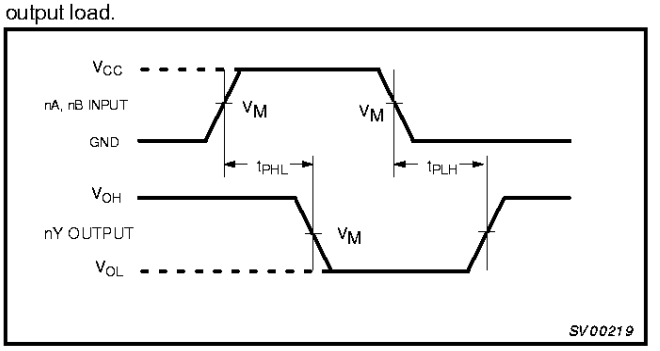
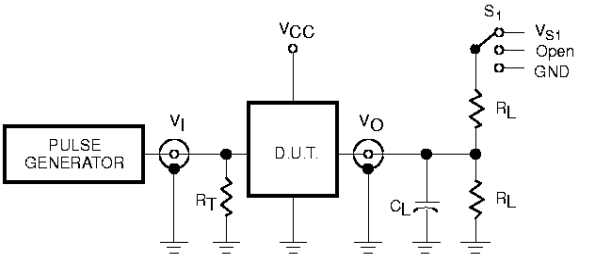


Figure 10. Waveforms showing the input (nA, nB) to output (nY) propagation delays.

TEST CIRCUIT



Test Circuit for switching times

SWITCH POSITION

TEST	S_1
t_{PLH}/t_{PHL}	Open

V_{CC}	V_I	V_{S1}
< 2.7V	V_{CC}	2 * V_{CC}

DEFINITIONS

R_L = Load resistor; see AC CHARACTERISTICS for value.

C_L = Load capacitance includes jig and probe capacitance: See AC CHARACTERISTICS for value.

R_T = Termination resistance should be equal to Z_{OUT} of pulse generators.

SY00076

Figure 11. Load circuitry for switching times

APPLICATION INFORMATION

All values given are typical unless otherwise specified.

The slow input rise and fall times cause additional power dissipation, this can be calculated using the following formula:

$P_{ad} = f_i \times (t_r \times I_{CCa} + t_f \times I_{CCa}) \times V_{CC}$.

WHERE:

P_{ad} = additional power dissipation (μW)
f_i = input frequency (MHz)
t_r = input rise time (ns); 10% – 90%
t_f = input fall time (ns); 10% – 90%
I_{CCa} = average additional supply current (μA)

Average I_{CCa} differs with positive or negative input transitions, as shown in fig.12.

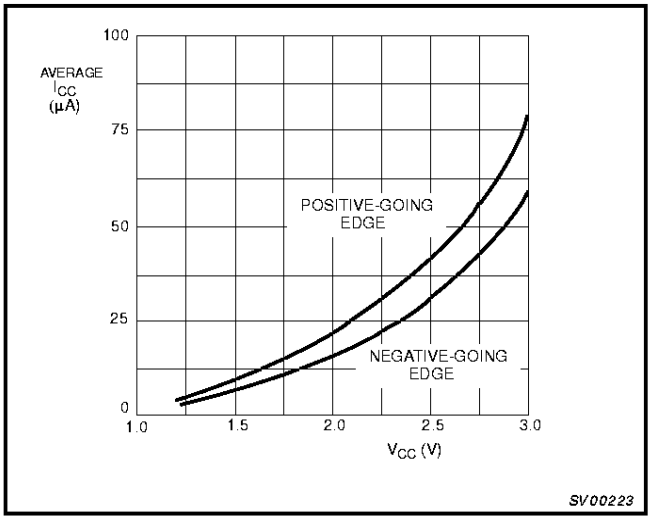


Figure 12. Average I_{CC} for LV Schmitt–trigger devices; linear change of V_I between 0.1 V_{CC} to 0.9 V_{CC}.

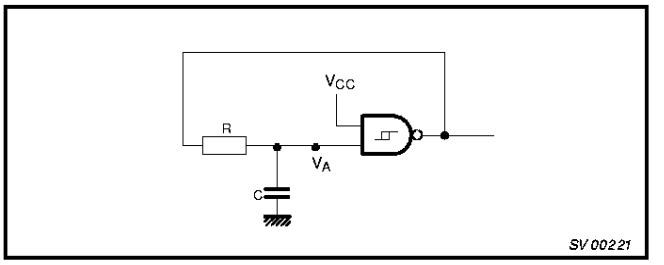
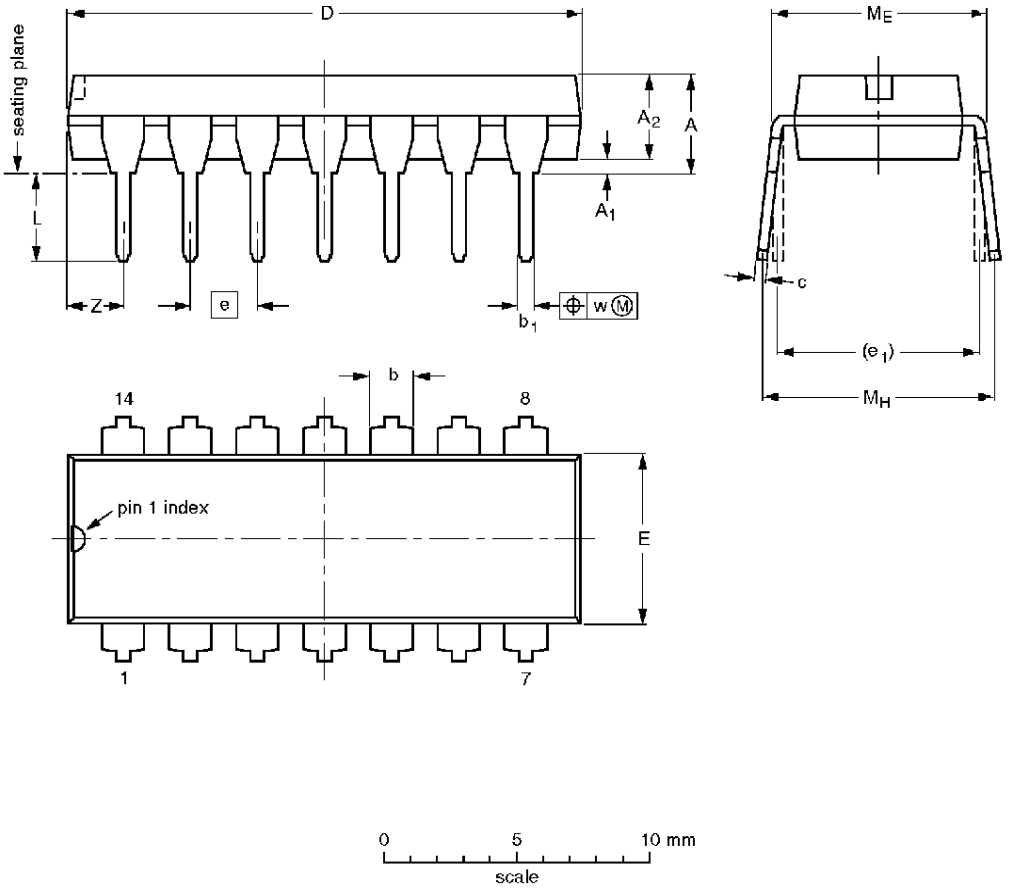


Figure 13. Relaxation oscillator using the LV132

NOTE:

$$f = \frac{1}{T} = \frac{1}{0.8RC}$$

DIP14: plastic dual in-line package; 14 leads (300 mil) **SOT27-1**



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

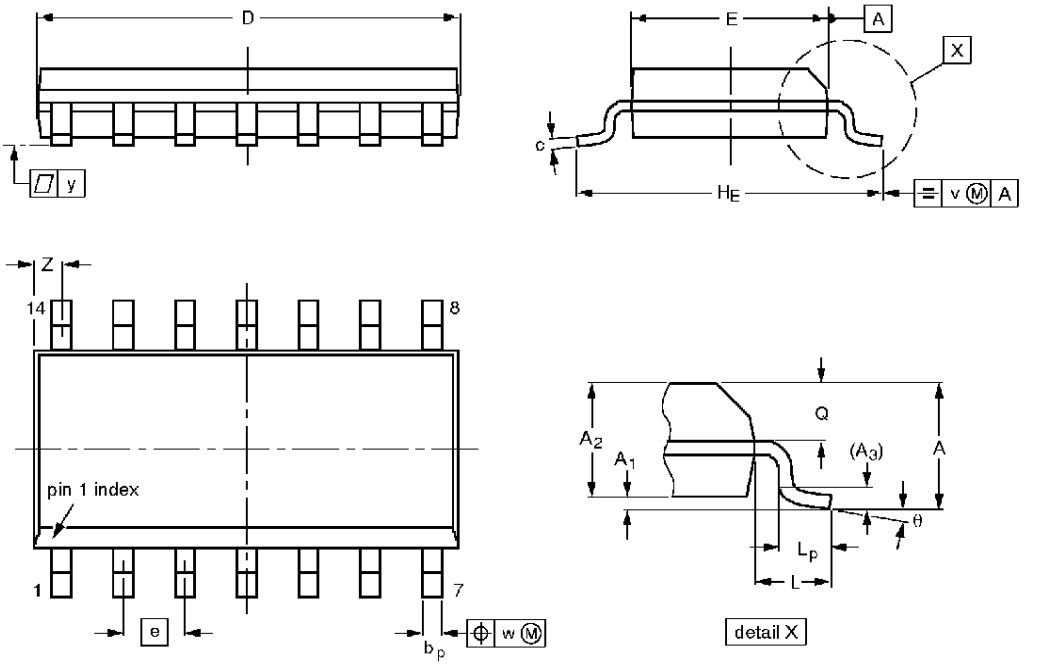
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.2	0.51	3.2	1.73 1.13	0.53 0.38	0.36 0.23	19.50 18.55	6.48 6.20	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	2.2
inches	0.17	0.020	0.13	0.068 0.044	0.021 0.015	0.014 0.009	0.77 0.73	0.26 0.24	0.10	0.30	0.14 0.12	0.32 0.31	0.39 0.33	0.01	0.087

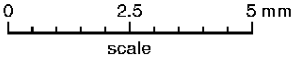
Note

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			
SOT27-1	050G04	MO-001AA				~~92-11-17~~ 95-03-11

SO14: plastic small outline package; 14 leads; body width 3.9 mm **SOT108-1**





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

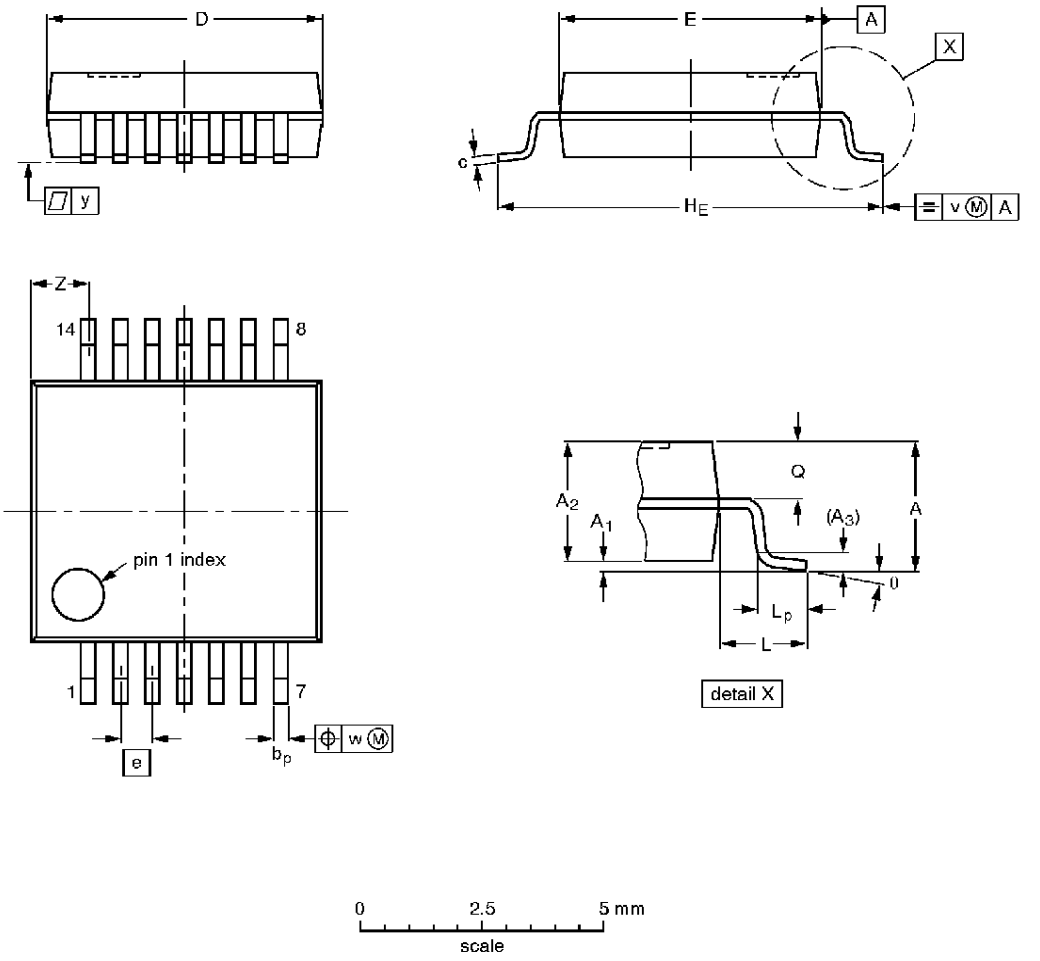
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	8.75 8.55	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.0098 0.0039	0.057 0.049	0.01	0.019 0.014	0.0098 0.0075	0.35 0.34	0.16 0.15	0.050	0.24 0.23	0.041	0.039 0.016	0.028 0.024	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			
SOT108-1	076E06S	MS-012AB				~~91-08-13~~ 95-01-23

SSOP14: plastic shrink small outline package; 14 leads; body width 5.3 mm **SOT337-1**



DIMENSIONS (mm are the original dimensions)

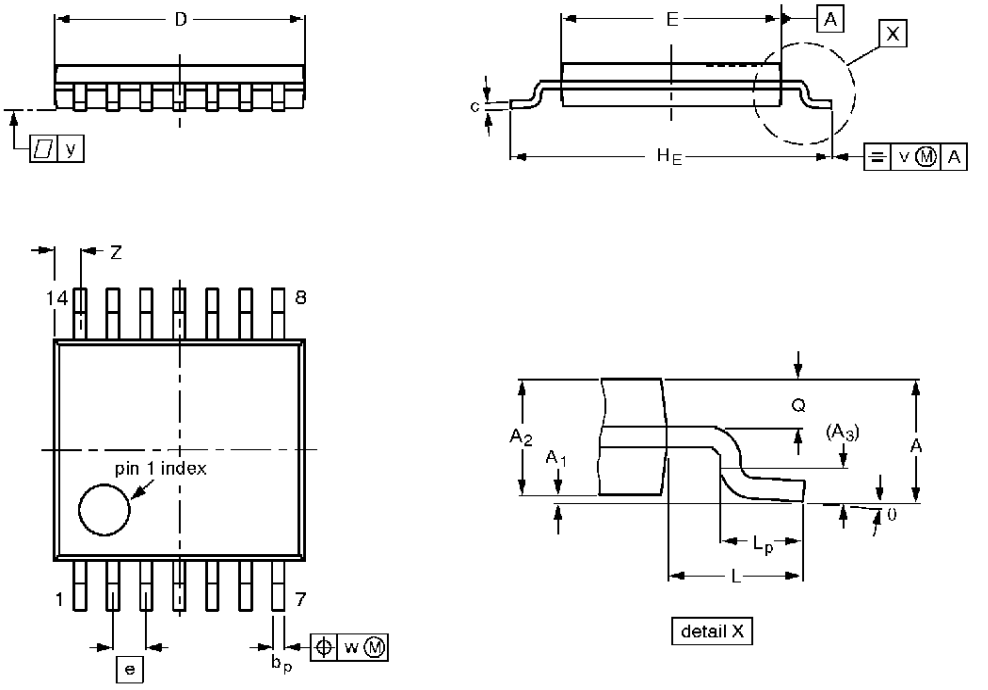
UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (1)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	2.0	0.21 0.05	1.80 1.65	0.25	0.38 0.25	0.20 0.09	6.4 6.0	5.4 5.2	0.65	7.9 7.6	1.25	1.03 0.63	0.9 0.7	0.2	0.13	0.1	1.4 0.9	8° 0°

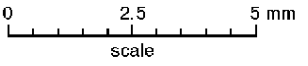
Note

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		
SOT337-1		MO-150AB			~~95-02-04~~ 96-01-18

TSSOP14: plastic thin shrink small outline package; 14 leads; body width 4.4 mm **SOT402-1**





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	0.72 0.38	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			
SOT402-1		MO-153				~~94-07-12~~ 95-04-04

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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