1. General Description

The EM74HCS00 is a quad 2-input NAND gate with Schmitt-trigger inputs. Schmitt trigger inputs transform slowly changing input signals into sharply defined jitter-free output signals.

2. Features and Benefits

- Wide supply voltage range from 2.0 V to 6.0 V
- High noise immunity
- CMOS low power dissipation
- Latch-up performance exceeds 250 mA
- Unlimited rise and fall times
- Complies with JEDEC standards:
  - JESD8C (2.7 V to 3.6 V)
  - JESD7A (2.0 V to 6.0 V)
- ESD protection:
  - HBM ANSI/ESDA/JEDEC JS-001 Class 2 exceeds 3500 V
  - CDM ANSI/ESDA/JEDEC JS-002 Class C3 exceeds 2000 V
- Multiple package options

3. Ordering Information

Table 1. Ordering information

Type number	Package		
	Name	Description	Quantity
EM74HCS00D	SOP-14L	plastic small outline package; 14 leads; body width 3.9 mm	3000
EM74HCS00PW	TSSOP-14L	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	3000

4. Function Diagram

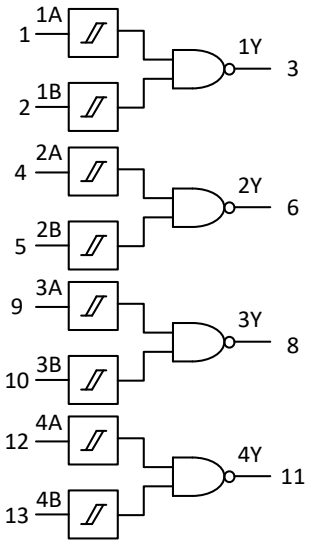


Fig. 1. Logic symbol

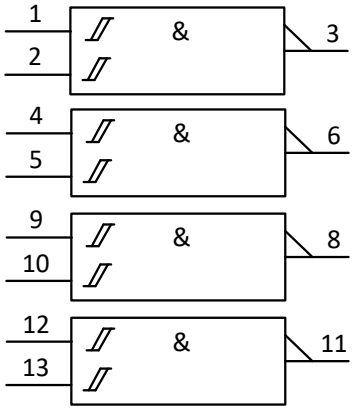


Fig. 2. IEC logic symbol

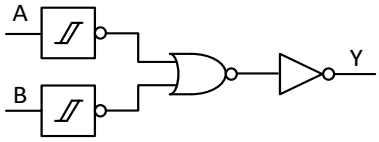


Fig. 3. Logic diagram for one Schmitt trigger

5. Pinning Information

5.1. Pinning

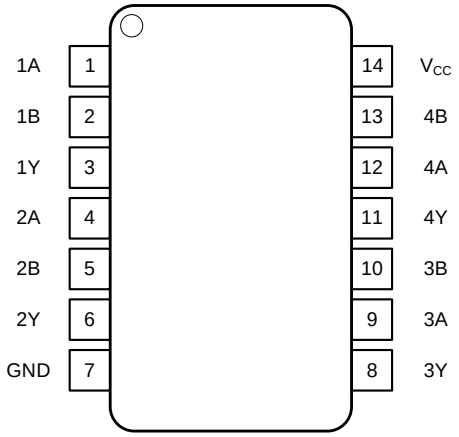


Fig. 4. Top view pin configuration SOP and TSSOP

5.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
1A, 2A, 3A, 4A	1, 4, 9, 12	Data input
1B, 2B, 3B, 4B	2, 5, 10, 13	Data input
1Y, 2Y, 3Y, 4Y	3, 6, 8, 11	Data output
GND	7	Ground (0V)
V_{CC}	14	Supply voltage

6. Functional Description

Table 3. Function table

H = HIGH voltage level; L = LOW voltage level.

Control		Output
nA	**nB**	**nY**
L	L	H
L	H	H
H	L	H
H	H	L

7. Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Table 4. Absolute Maximum Ratings

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

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	supply voltage		-0.5	7.0	V
I_{IK}	input clamping current	$V_I < -0.5$ V or $V_I > V_{CC} + 0.5$ V [1]		±20	mA
I_{OK}	output clamping current	$V_O < -0.5$ V or $V_O > V_{CC} + 0.5$ V [1]		±20	mA
I_O	output current	$V_O = -0.5$ V to $(V_{CC} + 0.5$ V)		±35	mA
I_{CC}	supply current			70	mA
I_{GND}	ground current		-70		mA
P_{tot}	total power dissipation			500	mW
T_{stg}	storage temperature		-65	150	°C

[1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

8. Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. EnergyMath does not recommend exceeding them or designing to Absolute Maximum Ratings.

Table 5. Recommended Operating Conditions

Symbol	Parameter	Conditions	EM74HCS00			Unit
			Min	Typ	Max	
V_{CC}	supply voltage		2.0	5.0	6.0	V
V_I	input voltage		0		V_{CC}	V
V_O	output voltage		0		V_{CC}	V
T_{amb}	ambient temperature		-40		125	°C

9.Static Characteristics

Table 6. Static characteristics

At recommended operating conditions. Voltages are referenced to GND (ground = 0 V). Typical values measured at T_{amb} = 25°C (unless otherwise noted).

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	
V_{OH}	HIGH-level output voltage	V_I = V_{T+} or V_{T-}						
		I_O = -20 µA; V_{CC} = 2.0 V	1.9			1.9		V
		I_O = -20 µA; V_{CC} = 4.5 V	4.4			4.4		V
		I_O = -20 µA; V_{CC} = 6.0 V	5.9			5.9		V
		I_O = -6.0 mA; V_{CC} = 4.5 V	3.84			3.7		V
		I_O = -7.8 mA; V_{CC} = 6.0 V	5.34			5.2		V
V_{OL}	LOW-level output voltage	V_I = V_{T+} or V_{T-}						
		I_O = 20 µA; V_{CC} = 2.0 V			0.1		0.1	V
		I_O = 20 µA; V_{CC} = 4.5 V			0.1		0.1	V
		I_O = 20 µA; V_{CC} = 6.0 V			0.1		0.1	V
		I_O = 6.0 mA; V_{CC} = 4.5 V			0.33		0.4	V
		I_O = 7.8 mA; V_{CC} = 6.0 V			0.33		0.4	V
I_I	input leakage current	V_I = V_{CC} or GND ; V_{CC} = 6.0 V			±1		±1	µA
I_{CC}	supply current	V_I = V_{CC} or GND ; I_O = 0 A ; V_{CC} = 6.0 V			1		2	µA
C_I	input capacitance			7				pF

10. Dynamic Characteristics

Table 7. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 6. Typical values measured at T_{amb} = 25°C (unless otherwise noted).

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	
t_{pd}	propagation delay	nA to nY; see Fig. 5 [1]						
		V_{CC} = 2.0 V			35		40	ns
		V_{CC} = 4.5 V			20		25	ns
		V_{CC} = 6.0 V			15		20	ns
t_t	transition time	see Fig. 5 [2]						
		V_{CC} = 2.0 V			9		11	ns
		V_{CC} = 4.5 V			6		8	ns
		V_{CC} = 6.0 V			4		5	ns
C_{PD}	power dissipation capacitance	C_L = 15 pF; f = 1 MHz; V_I = GND to V_{CC} [3]		18				pF

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

[2] t_t is the same as t_{THL} and t_{TLH}.

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

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

f_i = input frequency in MHz;

f_o = output frequency in MHz;

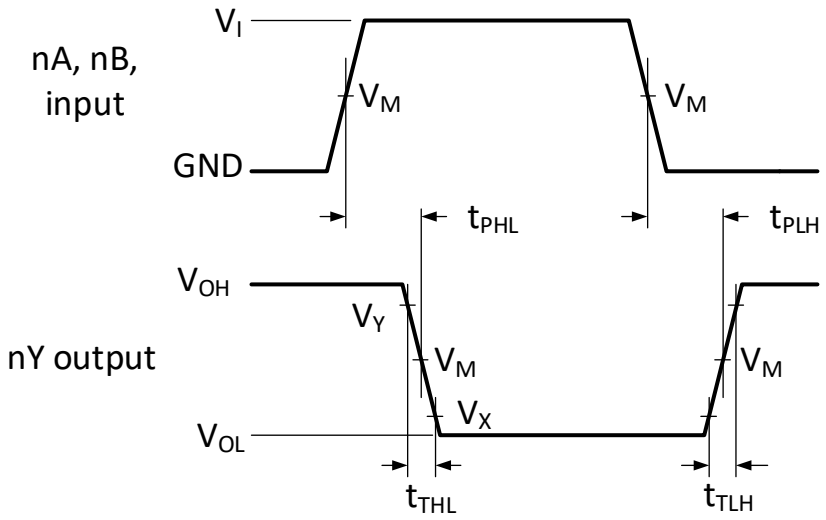
C_L = output load capacitance in pF;

V_{CC} = supply voltage in V;

N = number of inputs switching;

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

10.1. Waveforms and test circuit

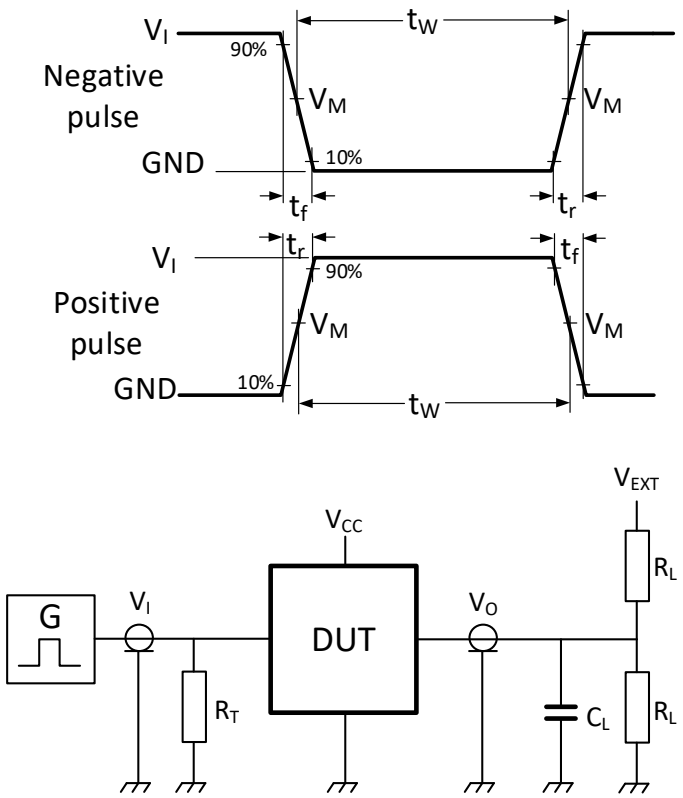


Measurement points are given in Table 8.
V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Fig. 5. The input to output propagation delays

Table 8. Measurement points

Type	Input	Output		
	V_M	V_M	V_X	V_Y
EM74HCS00	$0.5V_{CC}$	$0.5V_{CC}$	$0.1V_{CC}$	$0.9V_{CC}$



Test data is given in Table 9.
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 the output impedance Z_o of the pulse generator.
V_{EXT} = External voltage for measuring switching times.

Fig. 6. Test circuit for measuring switching times

Table 9. Test data

Type	**Input**		**Load**		**V_{EXT}**
	V_I	**$t_r = t_f$**	**C_L**	**R_L**	**t_{PLH}, t_{PHL}**
EM74HCS00	V_{CC}	≤ 2.5 ns	15 pF	500Ω	open

11. Transfer Characteristics

Table 10. Transfer characteristics

At recommended operating conditions. Voltages are referenced to GND (ground = 0 V). Typical values are measured at T_{amb} = 25°C.

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	
V_{T+}	positive-going threshold voltage	see Fig. 7 and Fig. 8						
		V_{CC} = 2.0 V	0.7	1.21	1.5	0.7	1.5	V
		V_{CC} = 4.5 V	1.7	2.39	3.15	1.7	3.15	V
		V_{CC} = 6.0 V	2.1	3.05	4.2	2.1	4.2	V
V_{T-}	negative-going threshold voltage	see Fig. 7 and Fig. 8						
		V_{CC} = 2.0 V	0.3	0.6	0.9	0.3	0.9	V
		V_{CC} = 4.5 V	0.9	1.41	2.0	0.9	2.0	V
		V_{CC} = 6.0 V	1.2	1.9	2.6	1.2	2.6	V
V_H	hysteresis voltage	see Fig. 7 and Fig. 8						
		V_{CC} = 2.0 V	0.2	0.61	1.0	0.2	1.0	V
		V_{CC} = 4.5 V	0.4	0.97	1.4	0.4	1.4	V
		V_{CC} = 6.0 V	0.6	1.16	1.6	0.6	1.6	V

11.1. Waveforms transfer characteristics

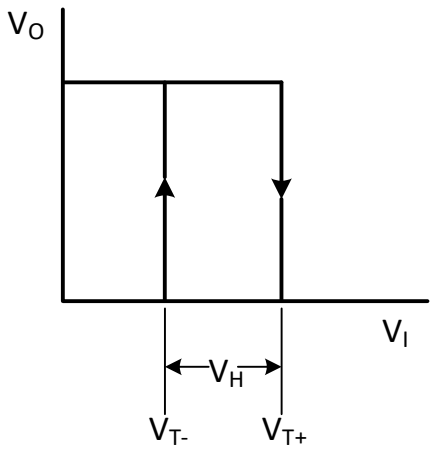
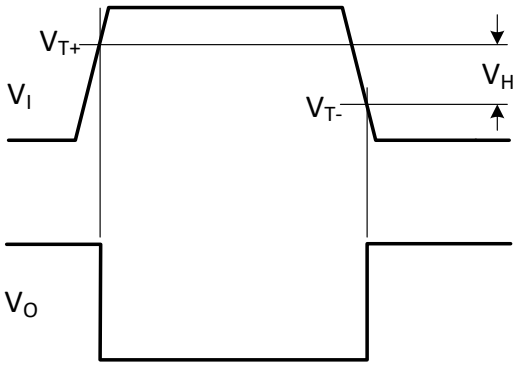


Fig. 7. Transfer characteristic

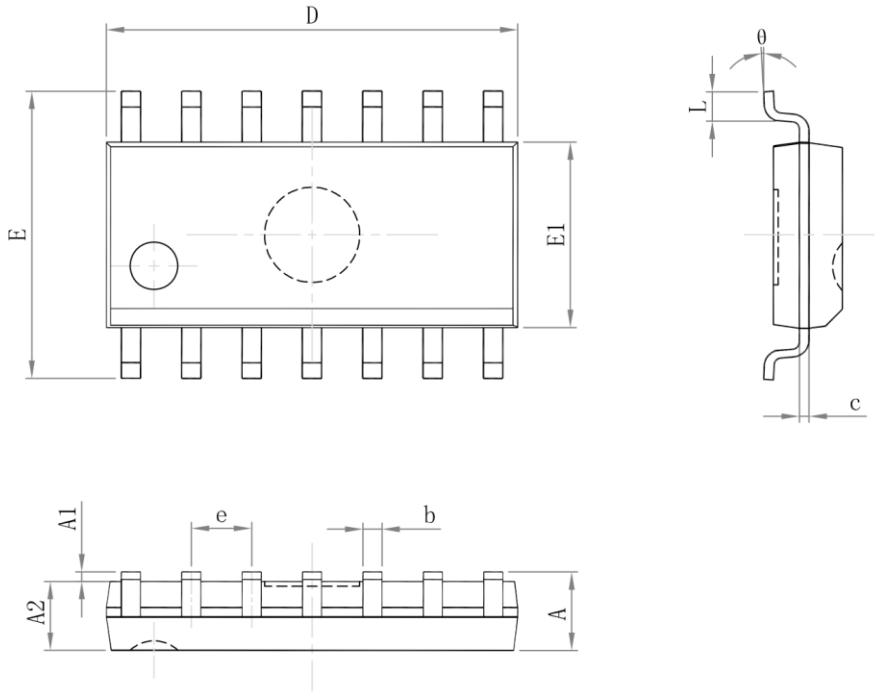


V_{T+} and V_{T-} limits at 70% and 20%.

Fig. 8. Definition of V_{T+}, V_{T-} and V_H

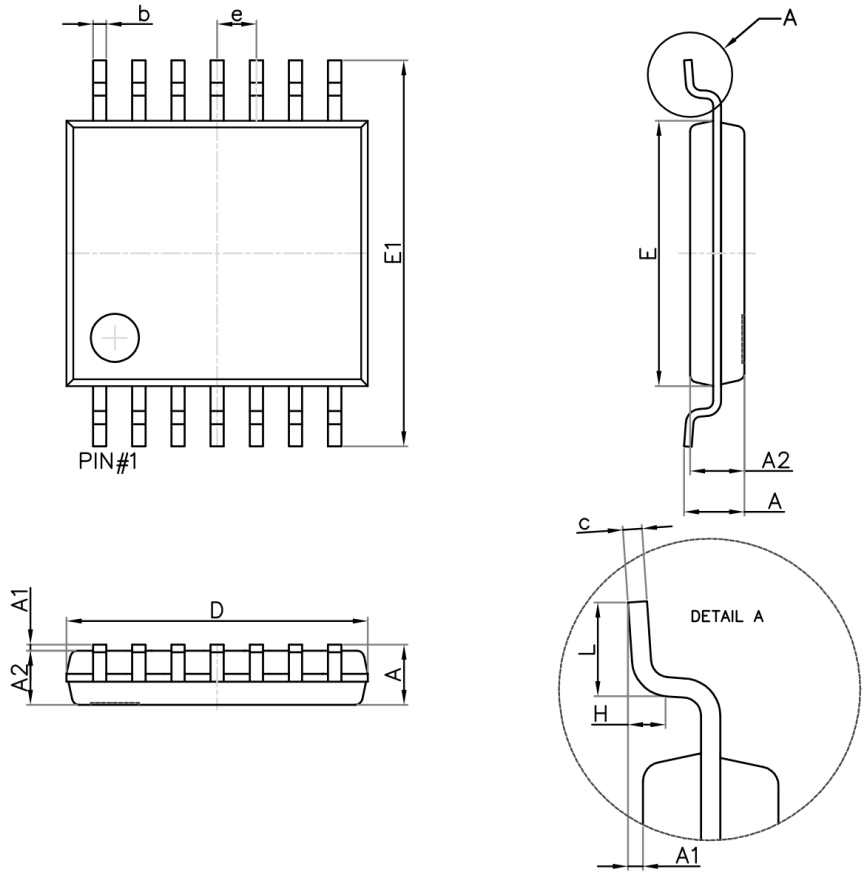
12. Package Outline

SOP-14L



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	— —	1.750	— —	0.069
A1	0.100	0.250	0.004	0.010
A2	1.250	— —	0.049	— —
b	0.310	0.510	0.012	0.020
c	0.100	0.250	0.004	0.010
D	8.450	8.850	0.333	0.348
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
e	1.270(BSC)		0.050(BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

TSSOP-14L



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
D	4.900	5.100	0.193	0.201
E	4.300	4.500	0.169	0.177
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
E1	6.250	6.550	0.246	0.258
A	—	1.200	—	0.047
A2	0.800	1.000	0.031	0.039
A1	0.050	0.150	0.002	0.006
e	0.65 (BSC)		0.026 (BSC)	
L	0.500	0.700	0.020	0.028
H	0.25(TYP)		0.01(TYP)	
θ	1°	7°	1°	7°

13. Abbreviations

Table 11. Abbreviations

Acronym	Description
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
CDM	Charged Device Model

14. Revision History

Table 12. Revision history

Document ID	Release Date	Data sheet status	Change notice	Supersedes
EM74HCS00 Rev. 1.0	Aug 30, 2024	Product datasheet		