EM74AHC1G14; EM74AHCT1G14

Inverting Schmitt trigger

Product datasheet, Rev. 1.1 Aug 26, 2024

1. General Description

The EM74AHC1G14 and EM74AHCT1G14 are single inverters with Schmitt-trigger inputs. Inputs are overvoltage tolerant.This feature allows the use of these devices as translators in mixed voltage environments.

The AHC device has CMOS input switching levels and supply voltage range 2 V to 5.5 V.

The AHCT device has TTL input switching levels and supply voltage range 4.5 V to 5.5 V.

2. Features and Benefits

- Wide supply voltage range from 2.0 V to 5.5 V
- Overvoltage tolerant inputs to 5.5 V
- High noise immunity
- CMOS low power dissipation
- Latch-up performance exceeds 200 mA
- Symmetrical output impedance
- Balanced propagation delays
- Input levels:
  - For EM74AHC1G14: CMOS level
  - For EM74AHCT1G14: TTL level
- ESD protection:
  - HBM ANSI/ESDA/JEDEC JS-001 Class 3A exceeds 7000 V
  - CDM ANSI/ESDA/JEDEC JS-002 Class C3 exceeds 2000 V
- Multiple package options

3. Ordering Information

Table 1. Ordering information

Type number	Topside marking	Package		
		Name	Description	Quantity
EM74AHC1G14GV	AAYW	SOT23-5L	SOT23 package, 5 pins 2.92 mm × 1.6 mm; 1.25 mm (Max) height	3000
EM74AHCT1G14GV	CAYW			
EM74AHC1G14GW	AAYW	SOT353	SOT353 package, 5 pins 2.1 mm × 1.25 mm; 1.1 mm (Max) height	3000
EM74AHCT1G14GW	CAYW			
EM74AHC1G14DRL	AAYW	SOT553	SOT553 package, 5 pins 1.6 mm × 1.2 mm; 0.6 mm (Max) height	3000
EM74AHCT1G14DRL	CAYW			

4. Function Diagram

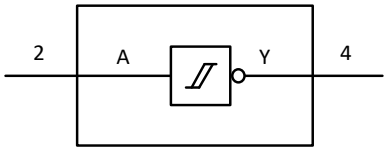


Fig. 1. Logic symbol

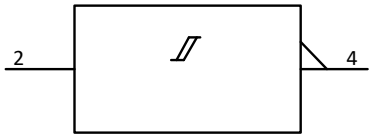


Fig. 2. IEC logic symbol

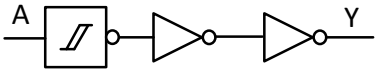


Fig. 3. Logic diagram

5. Pinning Information

5.1. Pinning

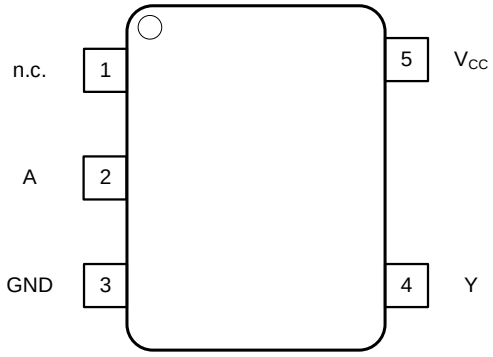


Fig. 4. Top view pin configuration SOT23-5L, SOT353 and SOT553

5.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
n.c.	1	Not connected
A	2	Data input
GND	3	Ground (0V)
Y	4	Data output
V_{CC}	5	Supply voltage

6. Functional Description

Table 3. Function table

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

Input	Output
A	**Y**
L	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
V_I	input voltage		-0.5	7.0	V
I_{IK}	input clamping current	$V_I < -0.5$ V	-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	$-0.5\text{ V} < V_O < V_{CC} + 0.5$ V		±25	mA
I_{CC}	supply current			75	mA
I_{GND}	ground current		-75		mA
P_{tot}	total power dissipation	T_{amb} = -40 °C to + 125 °C		250	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	EM74AHC1G14			EM74AHCT1G14			Unit
			Min	Typ	Max	Min	Typ	Max	
V_{CC}	supply voltage		2.0	5.0	5.5	4.5	5.0	5.5	V
V_I	input voltage		0		5.5	0		5.5	V
V_O	output voltage		0		V_{CC}	0		V_{CC}	V
T_{amb}	ambient temperature		-40	25	125	-40	25	125	°C

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	
EM74AHC1G14								
V_{OH}	HIGH-level output voltage	$V_I = V_{T+}$ or V_{T-}						
		I_O = -50 µA; V_{CC} = 2.0 V	1.9	2.0		1.9		V
		I_O = -50 µA; V_{CC} = 3.0 V	2.9	3.0		2.9		V
		I_O = -50 µA; V_{CC} = 4.5 V	4.4	4.5		4.4		V
		I_O = -4.0 mA; V_{CC} = 3.0 V	2.48	2.93		2.40		V
		I_O = -8.0 mA; V_{CC} = 4.5 V	3.80	4.39		3.70		V
V_{OL}	LOW-level output voltage	$V_I = V_{T+}$ or V_{T-}						
		I_O = 50 µA; V_{CC} = 2.0 V		0	0.1		0.1	V
		I_O = 50 µA; V_{CC} = 3.0 V		0	0.1		0.1	V
		I_O = 50 µA; V_{CC} = 4.5 V		0	0.1		0.1	V
		I_O = 4.0 mA; V_{CC} = 3.0 V		0.05	0.44		0.55	V
		I_O = 8.0 mA; V_{CC} = 4.5 V		0.07	0.44		0.55	V
I_I	input leakage current	V_I = 5.5 V or GND ; V_{CC} = 0 V to 5.5 V		±0.01	±1.0		±2.0	µA
I_{CC}	supply current	V_I = V_{CC} or GND ; I_O = 0 A ; V_{CC} = 5.5 V		0.01	10		40	µA
C_I	input capacitance			3.5				pF

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
EM74AHCT1G14								
V_{OH}	HIGH-level output voltage	$V_I = V_{T+}$ or V_{T-}; V_{CC} = 4.5 V						
		I_O = -50 µA;	4.4	4.5		4.4		V
		I_O = -8.0 mA;	3.80	4.39		3.70		V
V_{OL}	LOW-level output voltage	$V_I = V_{T+}$ or V_{T-}; V_{CC} = 4.5 V						
		I_O = 50 µA;		0	0.1		0.1	V
		I_O = 8.0 mA;		0.07	0.44		0.55	V
I_I	input leakage current	V_I = 5.5 V or GND ; V_{CC} = 0 V to 5.5 V		±0.01	±1.0		±2.0	µA
I_{CC}	supply current	$V_I = V_{CC}$ or GND ; I_O = 0 A ; V_{CC} = 5.5 V		0.01	10		40	µA
ΔI_{CC}	additional supply current	per input pin ; V_I = 3.4 V; other inputs at V_{CC} or GND; I_O = 0 A; V_{CC} = 5.5 V		0.23	1.35		1.35	mA
C_I	input capacitance			3.5				pF

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

10. Dynamic Characteristics

Table 7. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 6.

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
EM74AHC1G14								
t_{pd}	propagation delay	A to Y; see Fig. 5 [2]						
		V_{CC} = 3.0 V to 3.6 V, C_L = 15 pF	1.5	6.1	12	1.5	13	ns
		V_{CC} = 4.5 V to 5.5 V, C_L = 15 pF	1.5	3.9	8.5	1.5	9.0	ns
C_{PD}	power dissipation capacitance	C_L = 15 pF ; f = 1MHz ; V_I = GND to V_{CC} ; [3]		20				pF
EM74AHCT1G14								
t_{pd}	propagation delay	A to Y; see Fig. 5 [2]						
		V_{CC} = 4.5 V to 5.5 V, C_L = 15 pF	1.5	5.0	10.0	1.5	10.5	ns
C_{PD}	power dissipation capacitance	C_L = 15 pF ; f = 1MHz ; V_I = GND to V_{CC} ; [3]		21				pF

[1] Typical values are measured at T_{amb} = 25 °C and V_{CC} = 3.3 V and 5.0 V respectively.

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

[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;

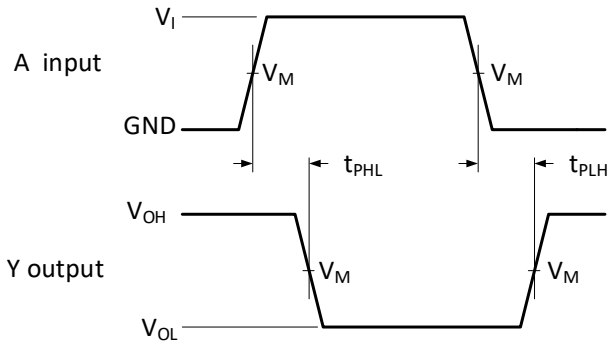
C_L = output load capacitance in pF;

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

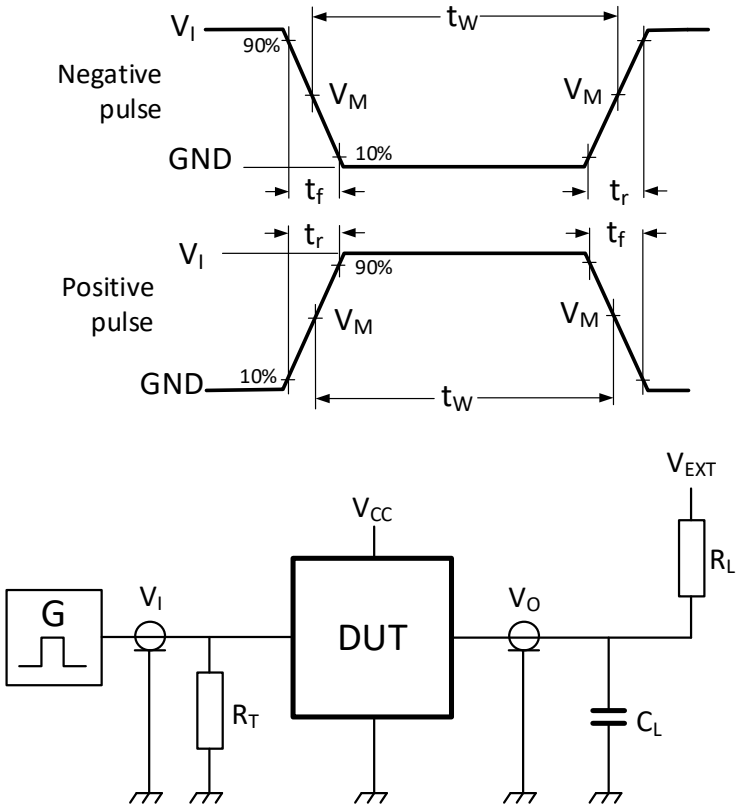


Measurement points are given in Table 8.
V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Fig. 5. The input A to output Y propagation delays

Table 8. Measurement points

Type	Input		Output
	V_I	V_M	V_M
EM74AHC1G14	GND to V_{CC}	0.5 x V_{CC}	0.5 x V_{CC}
EM74AHCT1G14	GND to 3.0 V	1.5 V	0.5 x V_{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_{PD}
EM74AHC1G14	GND to V_{CC}	≤ 2.5 ns	15 pF	500 Ω	open
EM74AHCT1G14	GND to 3.0 V	≤ 2.5 ns	15 pF	500 Ω	open

11. Transfer Characteristics

Table 10. Transfer 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	
EM74AHC1G14								
V_{T+}	positive-going threshold voltage	V_{CC} = 3.0 V			2.2		2.2	V
		V_{CC} = 4.5 V			3.15		3.15	V
		V_{CC} = 5.5 V			3.85		3.85	V
V_{T-}	negative-going threshold voltage	V_{CC} = 3.0 V	0.85			0.85		V
		V_{CC} = 4.5 V	1.35			1.35		V
		V_{CC} = 5.5 V	1.65			1.65		V
V_H	hysteresis voltage	V_{CC} = 3.0 V	0.3		1.2	0.25	1.2	V
		V_{CC} = 4.5 V	0.4		1.4	0.35	1.4	V
		V_{CC} = 5.5 V	0.5		1.6	0.45	1.6	V
EM74AHCT1G14								
V_{T+}	positive-going threshold voltage	V_{CC} = 4.5 V			2.0		2.0	V
		V_{CC} = 5.5 V			2.0		2.0	V
V_{T-}	negative-going threshold voltage	V_{CC} = 4.5 V	0.5			0.5		V
		V_{CC} = 5.5 V	0.6			0.6		V
V_H	hysteresis voltage	V_{CC} = 4.5 V	0.4		1.4	0.35	1.4	V
		V_{CC} = 5.5 V	0.4		1.6	0.35	1.6	V

[1] Typical values are measured at Tamb = 25 °C.

11.1. Waveforms transfer characteristics

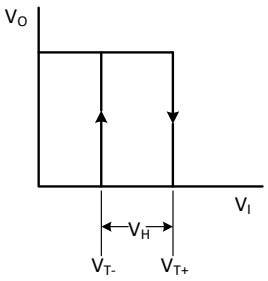


Fig. 7. Transfer characteristic

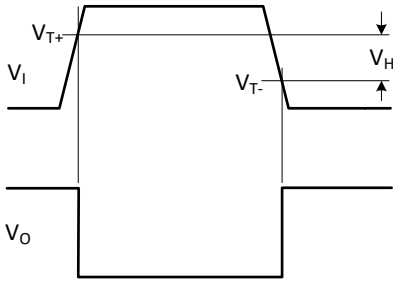
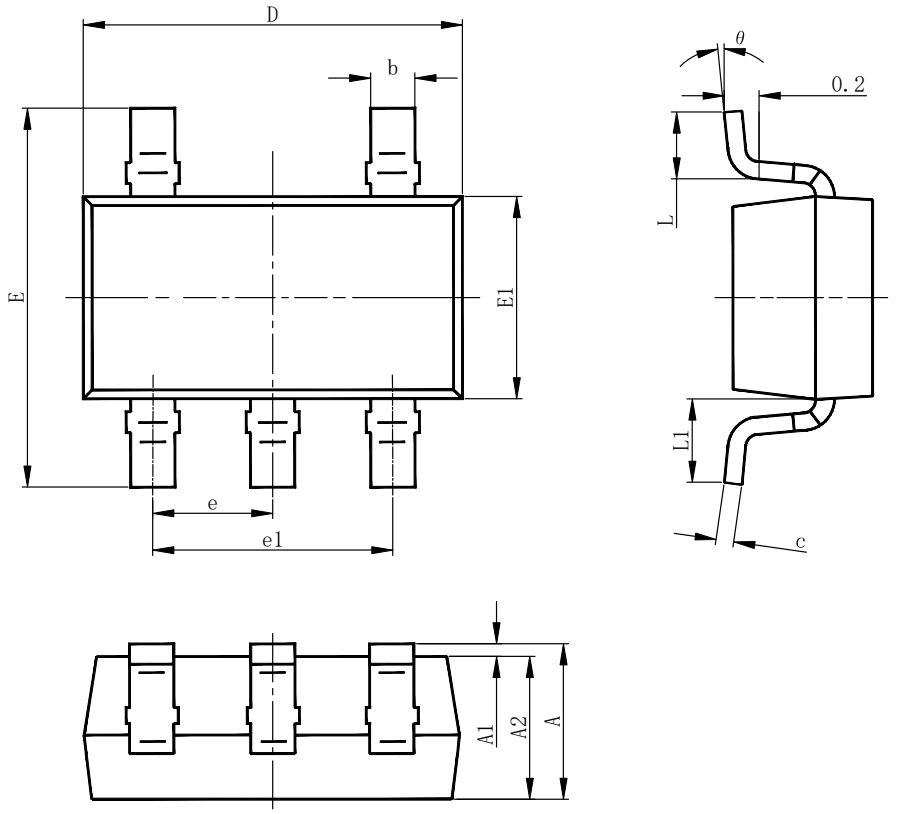


Fig. 8. Definition of VT+, VT- and VH

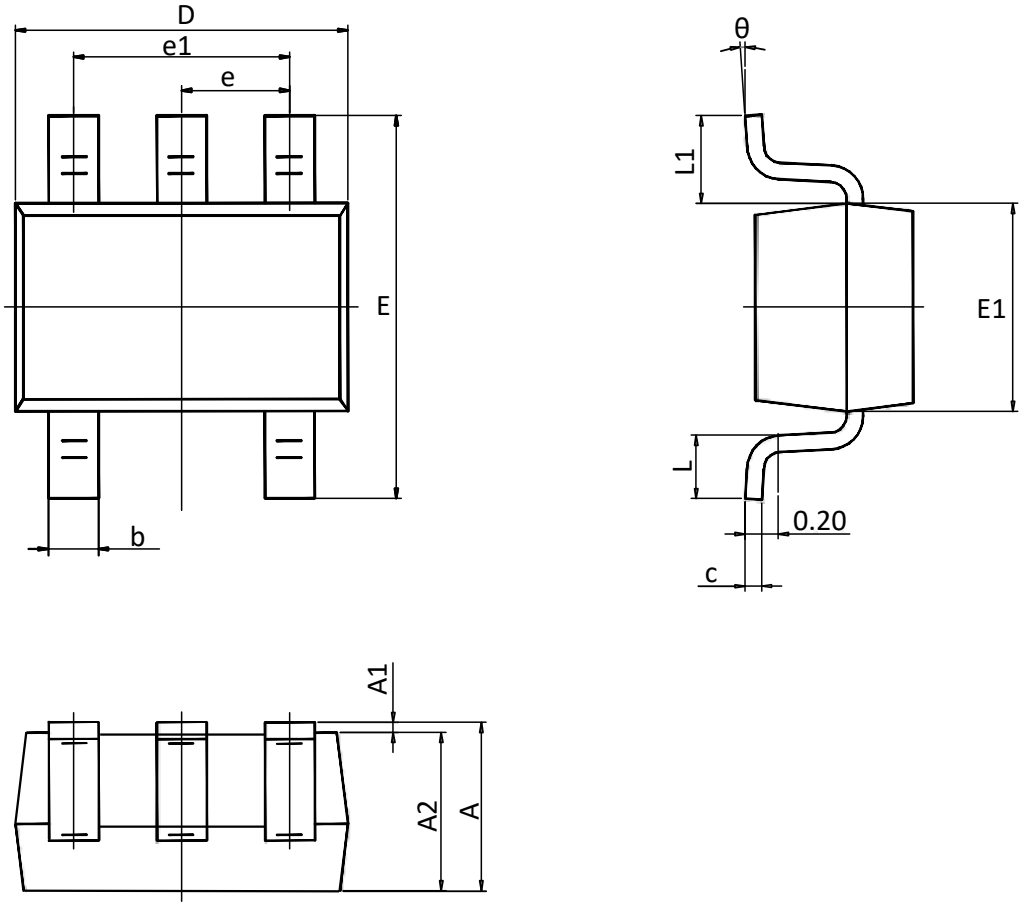
12. Package Outline

SOT23-5L



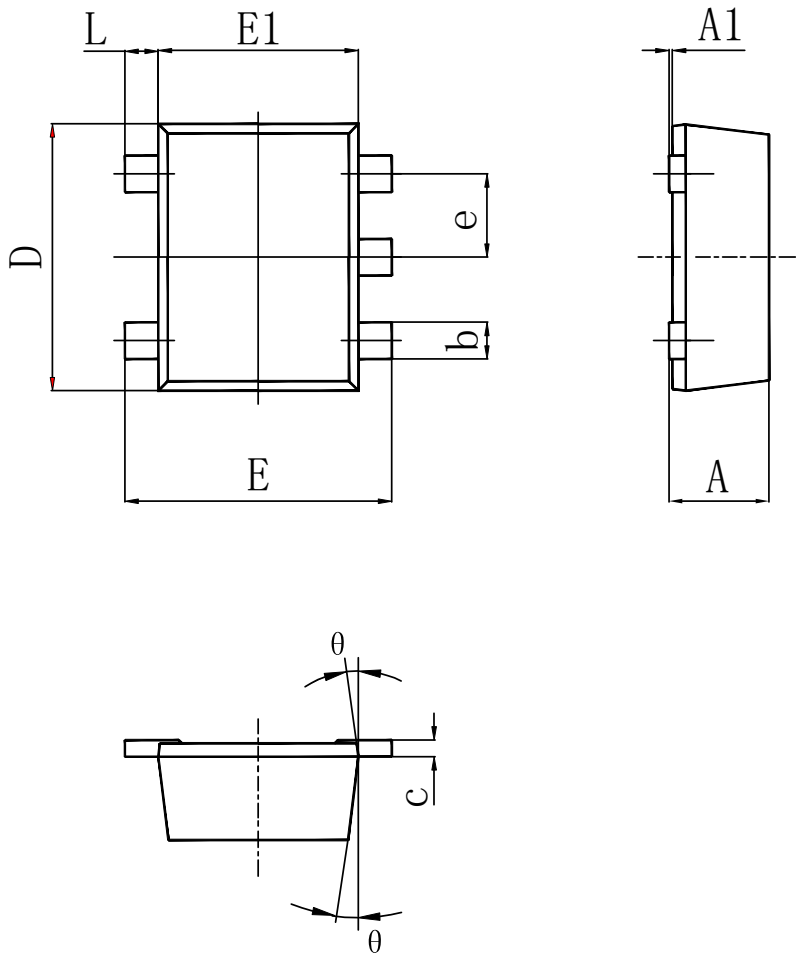
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E1	1.500	1.700	0.059	0.067
E	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
L1	0.600REF.		0.024REF.	
θ	0°	8°	0°	8°

SOT353



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.900	1.100	0.035	0.043
A1	0.000	0.100	0.000	0.004
A2	0.900	1.000	0.035	0.039
b	0.150	0.350	0.006	0.014
c	0.110	0.175	0.004	0.007
D	2.000	2.200	0.079	0.087
E	2.150	2.450	0.085	0.096
E1	1.150	1.350	0.045	0.053
e	0.650 TYP.		0.026 TYP.	
e1	1.200	1.400	0.047	0.055
L	0.260	0.460	0.010	0.018
L1	0.525 REF.		0.021 REF.	
θ	0°	8°	0°	8°

SOT553



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.525	0.600	0.021	0.024
A1	0.000	0.050	0.000	0.002
e	0.450	0.550	0.018	0.022
c	0.090	0.160	0.004	0.006
D	1.500	1.700	0.059	0.067
b	0.170	0.270	0.007	0.011
E1	1.100	1.300	0.043	0.051
E	1.500	1.700	0.059	0.067
L	0.100	0.300	0.004	0.012
θ	7 °REF.		7 °REF.	

13. Abbreviations

Table 10. Abbreviations

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

14. Revision History

Table 11. Revision history

Document ID	Release Date	Data sheet status	Change notice	Supersedes
EM74AHC_AHCT1G14 Rev. 1.1	Aug 26, 2024	Product datasheet		EM74AHC_AHCT1G14 Rev. 1.0
Modifications:	• Section 2: ESD protection HBM updated. • Table 6: C_I Updated. • Table 7: t_{pd} and C_{pd} updated.			
EM74AHC_AHCT1G14 Rev. 1.0	Apr 20, 2024	Product datasheet		