

1. General Description

EM74AHC1G06 and EM74AHCT1G06 are single inverters with open-drain outputs. 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

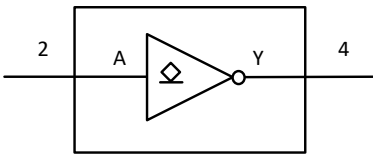
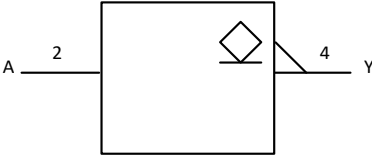
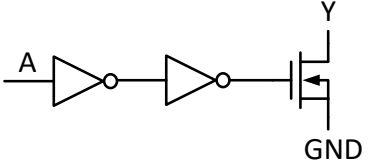
- Wide supply voltage range from 2.0 V to 5.5 V
- Overvoltage tolerant inputs to 5.5 V
- High noise immunity
- CMOS low power dissipation
- Latch-up performance exceeds 200 mA
- Input levels:
 - For EM74AHC1G06: CMOS level
 - For EM74AHCT1G06: TTL level
- ESD protection:
 - HBM ANSI/ESDA/JEDEC JS-001 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

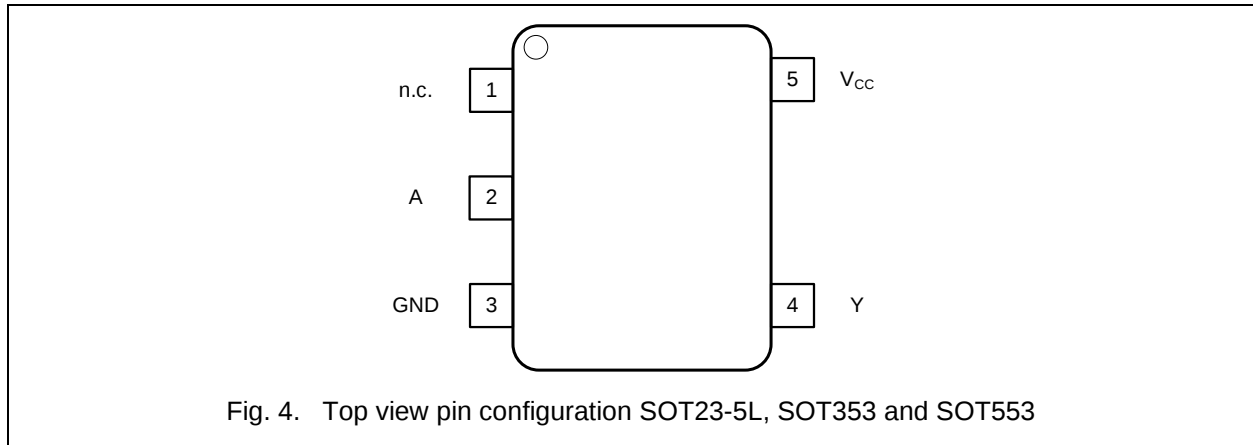
Type number	Topside marking	Package		
		Name	Description	Quantity
EM74AHC1G06GV	A4YW	SOT23-5L	SOT23 package, 5 pins 2.92 mm × 1.6 mm; 1.25 mm (Max) height	3000
EM74AHCT1G06GV	C4YW			
EM74AHC1G06GW	A4YW	SOT353	SOT353 package, 5 pins 2.1 mm × 1.25 mm; 1.1 mm (Max) height	3000
EM74AHCT1G06GW	C4YW			
EM74AHC1G06DRL	A4YW	SOT553	SOT553 package, 5 pins 1.6 mm × 1.2 mm; 0.6 mm (Max) height	3000
EM74AHCT1G06DRL	C4YW			

4. Function Diagram

 Fig. 1. Logic symbol	 Fig. 2. IEC logic symbol	 Fig. 3. Logic diagram
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5. Pinning Information

5.1. Pinning



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; Z = high-impedance OFF-state.

Input	Output
A	Y
L	Z
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 [1]		±20	mA
I _O	output current	V _O > -0.5 V		±25	mA
V _O	output voltage	active mode [1]	-0.5	7.0	V
		high-impedance mode [1]	-0.5	7.0	V
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	EM74AHC1G06			EM74AHCT1G06			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	active mode	0		V _{CC}	0		V _{CC}	V
		high-impedance mode	0		6.0	0		6.0	V
T _{amb}	ambient temperature		-40	25	125	-40	25	125	°C
Δt/ΔV	input transition rise and fall rate	V _{CC} = 3.3 V ± 0.3 V			100				ns/V
		V _{CC} = 5.0 V ± 0.5 V			20			20	ns/V

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Inverter with open-drain output

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	
EM74AHC1G06								
V _{IH}	HIGH-level input voltage	V _{CC} = 2.0 V	1.5			1.5		V
		V _{CC} = 3.0 V	2.1			2.1		V
		V _{CC} = 5.5 V	3.85			3.85		V
V _{IL}	LOW-level input voltage	V _{CC} = 2.0 V			0.5		0.5	V
		V _{CC} = 3.0 V			0.9		0.9	V
		V _{CC} = 5.5 V			1.65		1.65	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL}						
		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 _{OZ}	OFF-state output current	V _I = V _{IH} or V _{IL} ; V _O = V _{CC} or GND; V _{CC} = 5.5 V		±0.01	±2.5		±10.0	μA
I _{CC}	supply current	V _I = V _{CC} or GND ; I _O = 0 A ; V _{CC} = 5.5 V		0.01	10		20	μA
C _I	input capacitance			3.5				pF

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Inverter with open-drain output

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
EM74AHCT1G06								
V _{IH}	HIGH-level input voltage	V _{CC} = 4.5 V to 5.5 V	2.0			2.0		V
V _{IL}	LOW-level input voltage	V _{CC} = 4.5 V to 5.5 V			0.8		0.8	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL} ; 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 _{OZ}	OFF-state output current	V _I = V _{IH} or V _{IL} ; V _O = V _{CC} or GND; V _{CC} = 5.5 V		±0.01	±2.5		±10.0	μA
I _{CC}	supply current	V _I = V _{CC} or GND ; I _O = 0 A ; V _{CC} = 5.5 V		0.01	10		20	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 $T_{amb} = 25^\circ\text{C}$.

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Inverter with open-drain output

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	
EM74AHC1G06								
t _{PZL}	OFF-state to LOW propagation delay	A to Y; see Fig. 5						
		V _{CC} = 3.0 V to 3.6 V, C _L = 15 pF	2.5	5.3	8.5	2.5	9.5	ns
		V _{CC} = 4.5 V to 5.5 V, C _L = 15 pF	1.5	3.5	5.5	1.5	6.0	ns
t _{PLZ}	LOW to OFF-state propagation delay	A to Y; see Fig. 5						
		V _{CC} = 3.0 V to 3.6 V, C _L = 15 pF	2.5	5.8	9.0	2.5	10.0	ns
		V _{CC} = 4.5 V to 5.5 V, C _L = 15 pF	1.5	4.1	6.0	1.5	6.5	ns
C _{PD}	power dissipation capacitance	C _L = 15 pF ; f = 1MHz ; V _I = GND to V _{CC} ; [2]		4				pF
EM74AHCT1G06								
t _{PZL}	OFF-state to LOW propagation delay	A to Y; see Fig. 5						
		V _{CC} = 4.5 V to 5.5 V, C _L = 15 pF	1.5	5.0	7.0	1.5	7.5	ns
t _{PLZ}	LOW to OFF-state propagation delay	A to Y; see Fig. 5						
		V _{CC} = 4.5 V to 5.5 V, C _L = 15 pF	1.5	5.1	7.0	1.5	7.5	ns
C _{PD}	power dissipation capacitance	C _L = 15 pF ; f = 1MHz ; V _I = GND to V _{CC} ; [2]		4				pF

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

[2] 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;

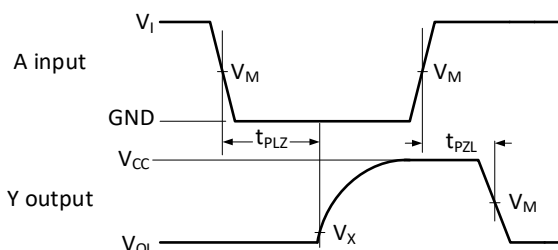
C_L = output load capacitance in pF;

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.

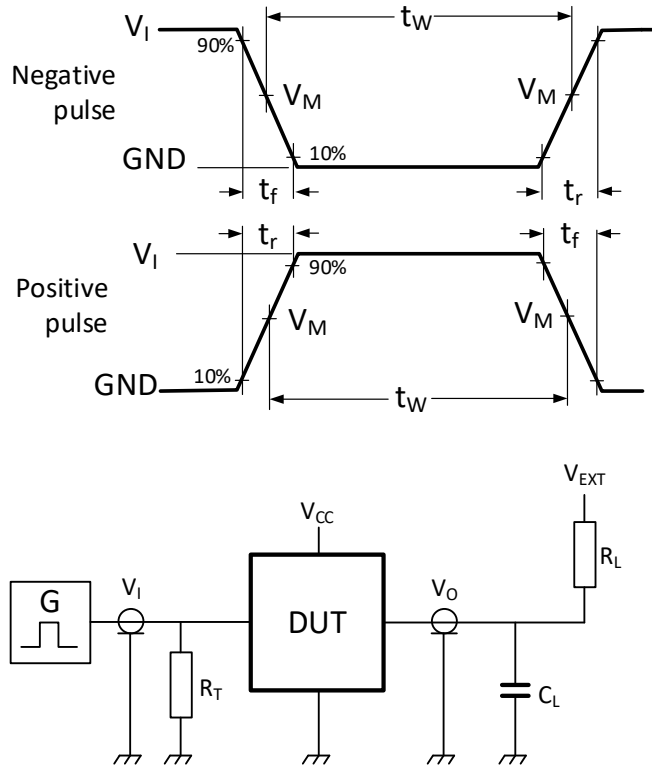
Fig. 5. The input A to output Y propagation delays

Table 8. Measurement points

Type	Input		Output	
	V_I	V_M	V_M	V_X
EM74AHC1G06	GND to V_{CC}	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	$V_{OL} + 0.3V$
EM74AHCT1G06	GND to 3.0 V	1.5 V	$0.5 \times V_{CC}$	$V_{OL} + 0.3V$

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Inverter with open-drain output



Test data is given in Table 9.

Definitions for test circuit:

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.

R_L = Load resistance.

V_{EXT} = External voltage for measuring switching times.

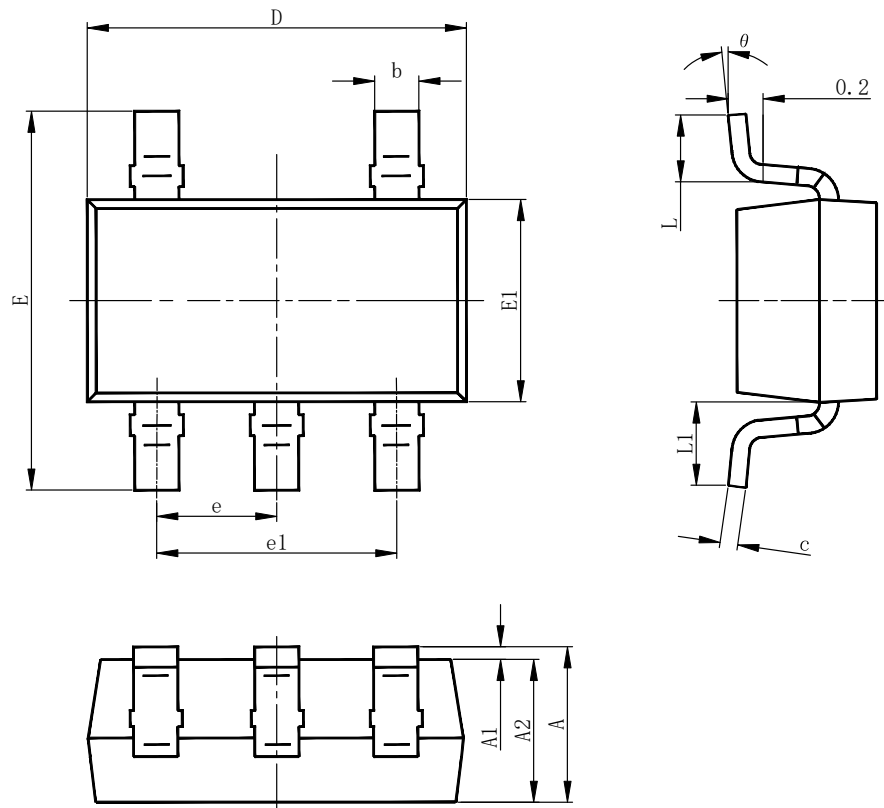
Fig. 6. Test circuit for measuring switching times

Table 9. Test data

Type	Input		Load		
	V_I	$t_r = t_f$	C_L	R_L	t_{PZL}, t_{PLZ}
EM74AHC1G06	GND to V_{CC}	≤ 2.5 ns	15 pF	500 Ω	V_{CC}
EM74AHCT1G06	GND to 3.0 V	≤ 2.5 ns	15 pF	500 Ω	V_{CC}

11. Package Outline

SOT23-5L

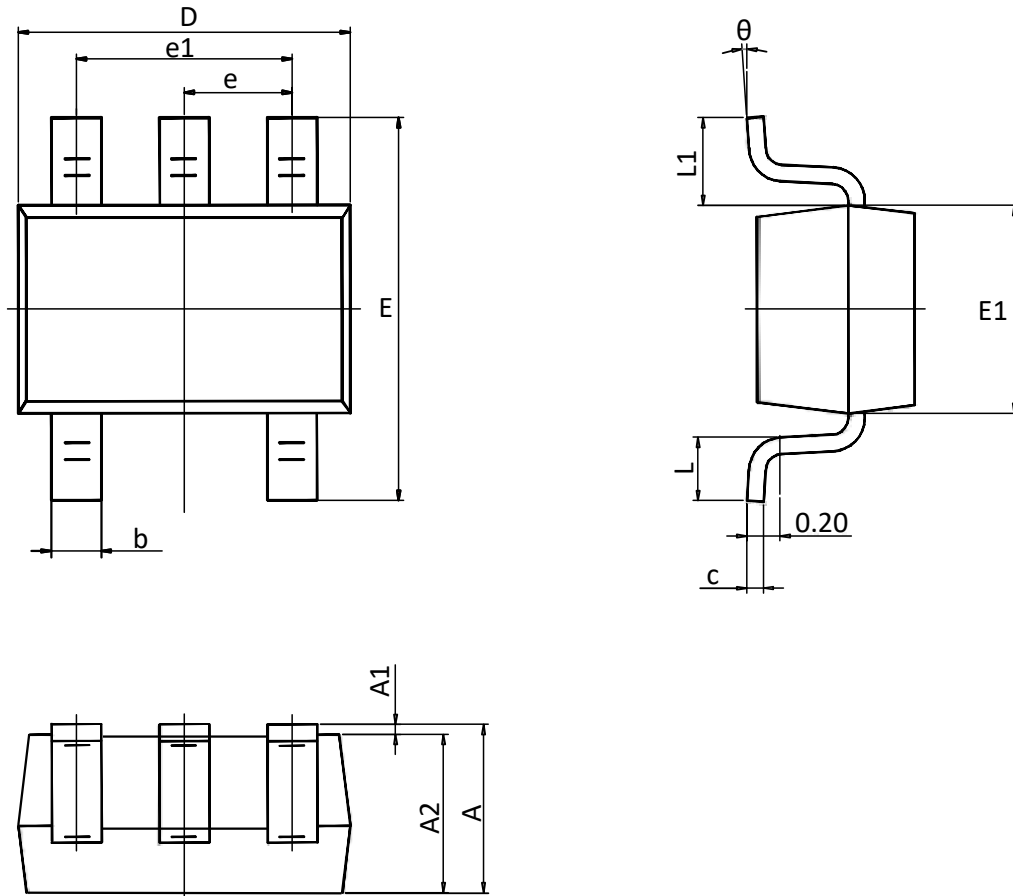


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E1	1.500	1.700	0.059	0.067
E	2.650	2.950	0.104	0.116
e	0.950(BSC)		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°

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Inverter with open-drain output

SOT353

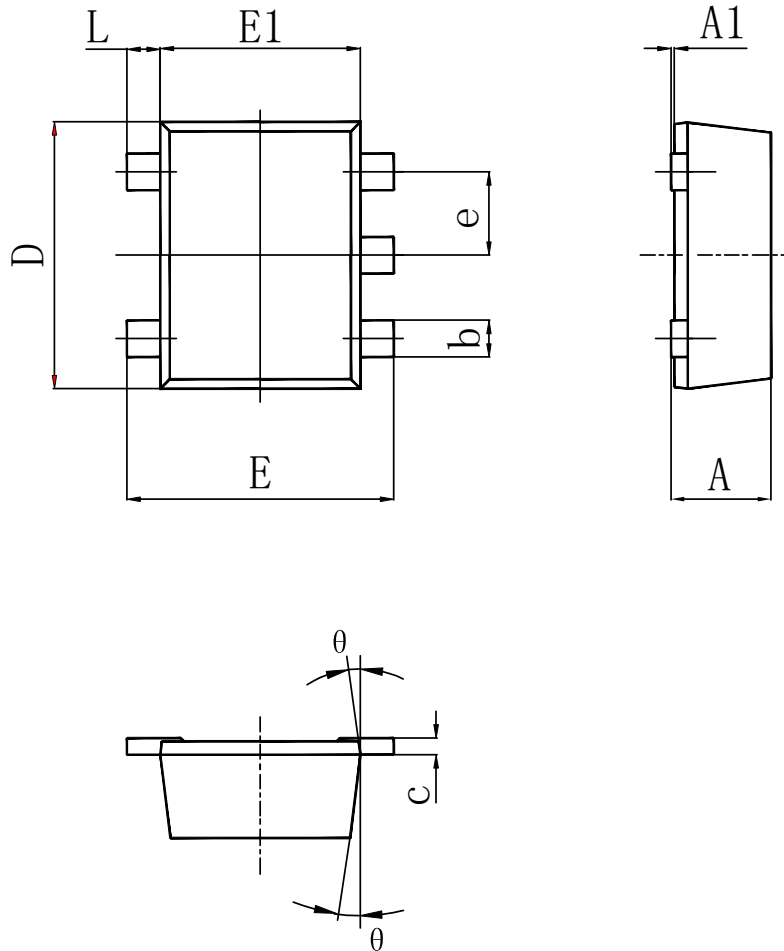


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.900	1.100	0.035	0.043
A1	0.000	0.100	0.000	0.004
A2	0.900	1.000	0.035	0.039
b	0.150	0.350	0.006	0.014
c	0.110	0.175	0.004	0.007
D	2.000	2.200	0.079	0.087
E	2.150	2.450	0.085	0.096
E1	1.150	1.350	0.045	0.053
e	0.650 TYP.		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°

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Inverter with open-drain output

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.	

12. 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

13. Revision History

Table 11. Revision history

Document ID	Release Date	Data sheet status	Change notice	Supersedes
EM74AHC_AHCT1G06 Rev. 1.0	Aug 26, 2024	Product datasheet		