Bilateral switch

74HC1G66; 74HCT1G66

FEATURES

- Wide operating voltage range: 2.0 to 9.0 V
- Very low ON resistance
  45 Ω (TYP.) at V_{CC} = 4.5 V
  30 Ω (TYP.) at V_{CC} = 6.0 V
  25 Ω (TYP.) at V_{CC} = 9.0 V
- High noise immunity
- Low power dissipation
- Very small 5 pins package
- Output capability: non standard.

DESCRIPTION

The 74HC1G/HCT1G66 is a high-speed Si-gate CMOS device.

The 74HC1G/HCT1G66 provides an analog switch. The switch has two input/output terminals (Y, Z) and an active HIGH enable input (E). When E is LOW, the analog switch is turned off.

The non standard output currents are equal compared to the 74HC/HCT4066.

FUNCTION TABLE

INPUTS E(1)	SWITCH
L	OFF
H	ON

Note

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

QUICK REFERENCE DATA

GND = 0 V; T_{amb} = 25 °C; $t_r = t_f$ = 6.0 ns.

SYMBOL	PARAMETER	CONDITIONS	TYP.		UNIT
			HC1G	HCT1G	
t_{PZH}/t_{PZL}	turn-on time E to V_{os}	C_L = 15 pF R_L = 1 kΩ V_{CC} = 5 V	11	12	ns
t_{PHZ}/t_{PLZ}	turn-off time E to V_{os}		11	12	ns
C_I	input capacitance		1.5	1.5	pF
C_{PD}	power dissipation capacitance	notes 1 and 2	9	9	pF
C_S	max. switch capacitance		8	8	pF

Notes

1. C_{PD} is used to determine the dynamic power dissipation (P_D in μW).
   $P_D = C_{PD} \times V_{CC}^2 \times f_i + \sum ((C_L + C_S) \times V_{CC}^2 \times f_o)$ where:
   f_i = input frequency in MHz;
   f_o = output frequency in MHz;
   C_L = output load capacitance in pF;
   C_S = max. switch capacitance in pF;
   V_{CC} = supply voltage in V;
   $\sum ((C_L + C_S) \times V_{CC}^2 \times f_o)$ = sum of outputs.
2. For HC1G the condition is V_I = GND to V_{CC}.
   For HCT1G the condition is V_I = GND to V_{CC} − 1.5 V.

PINNING

PIN	SYMBOL	DESCRIPTION
1	Y	independent input/output
2	Z	independent input/output
3	GND	ground (0 V)
4	E	enable input (active HIGH)
5	V_{CC}	DC positive supply voltage

ORDERING INFORMATION

OUTSIDE NORTH AMERICA	PACKAGE					
	TEMPERATURE RANGE	PINS	PACKAGE	MATERIAL	CODE	MARKING
74HC1G66GW	−40 to +125 °C	5	SC-88A	plastic	SOT353	HL
74HCT1G66GW		5	SC-88A	plastic	SOT353	TL

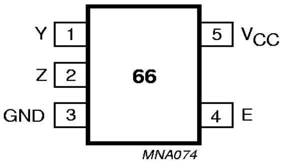


Fig.1 Pin configuration.

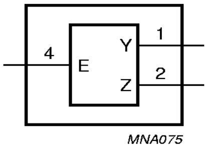


Fig.2 Logic symbol.

Fig.3 IEC logic symbol.

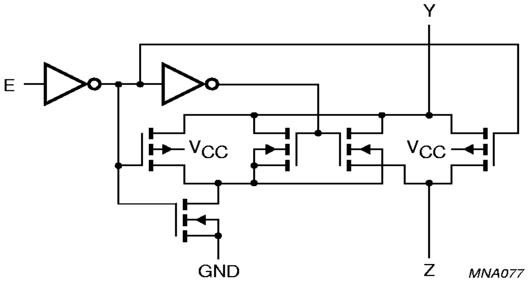


Fig.4 Logic diagram.

RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	74HC1G66			74HCT1G66			UNIT	CONDITIONS
		MIN.	TYP.	MAX.	MIN.	TYP.	MAX.		
V_{CC}	DC supply voltage	2.0	5.0	10.0	4.5	5.0	5.5	V	
V_I	DC input voltage range	GND	–	V_{CC}	GND	–	V_{CC}	V	
V_S	DC switch voltage range	GND	–	V_{CC}	GND	–	V_{CC}	V	
T_{amb}	operating ambient temperature range	–40	–	+125	–40	–	+125	°C	see DC and AC characteristics per device
t_r,t_f	input rise and fall times except for Schmitt-trigger inputs	–	–	1000	–	–	–	ns	V_{CC} = 2.0 V
		–	6.0	500	–	6.0	500	ns	V_{CC} = 4.5 V
		–	–	400	–	–	–	ns	V_{CC} = 6.0 V
		–	–	250	–	–	–	ns	V_{CC} = 10.0 V

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134); voltages are referenced to GND (ground = 0 V); see note 1.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CC}	DC supply voltage		–0.5	11.0	V
$\pm I_{IK}$	DC digital input diode current	$V_I < -0.5$ or $V_I > V_{CC} + 0.5$ V	–	20	mA
$\pm I_{SK}$	DC switch diode current	$V_S < -0.5$ or $V_S > V_{CC} + 0.5$ V	–	20	mA
$\pm I_S$	DC switch output current	$-0.5V < V_S < V_{CC} + 0.5$ V	–	25	mA
$\pm I_{CC}$	DC V_{CC} or GND current		–	50	mA
T_{stg}	storage temperature		–65	+150	°C
P_D	power dissipation per package 5 pins plastic SC88A	for temperature range: –40 to + 125 °C; above +55 °C derate linearly with 2.5 mW/K	–	200	mW
P_S	power dissipation per switch		–	100	mW

Note

1. To avoid drawing V_{CC} current out of terminal Z, when switch current flows in terminal Y, the voltage drop across the bidirectional switch must not exceed 0.4 V. If the switch current flows into terminal Z, no V_{CC} current will flow out of terminal Y. In this case there is no limit for the voltage drop across the switch, but the voltage at Y and Z may not exceed V_{CC} or GND.

DC CHARACTERISTICS FOR THE 74HC1G66

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

SYMBOL	PARAMETER	T_{amb} (°C)					UNIT	TEST CONDITIONS	
		−40 to +85			−40 to +125			V_{CC} (V)	OTHER
		MIN.	TYP.(1)	MAX.	MIN.	MAX.			
V_{IH}	HIGH-level input voltage	1.5	1.2	–	1.5	–	V	2.0	
		3.15	2.4	–	3.15	–	V	4.5	
		4.2	3.2	–	4.2	–	V	6.0	
		6.3	4.7	–	6.3	–	V	9.0	
V_{IL}	LOW-level input voltage	–	0.8	0.5	–	0.5	V	2.0	
		–	2.1	1.35	–	1.35	V	4.5	
		–	2.8	1.8	–	1.8	V	6.0	
		–	4.3	2.7	–	2.7	V	9.0	
$\pm I_I$	input leakage current	–	0.1	1.0	–	1.0	μA	6.0	$V_I = V_{CC}$ or GND
		–	0.2	2.0	–	2.0	μA	10.0	
$\pm I_S$	analog switch OFF-state current	–	0.1	1.0	–	1.0	μA	10.0	$V_I = V_{IH}$ or V_{IL}; $\lvert V_S \rvert = V_{CC} - GND$; see Fig.6
$\pm I_S$	analog switch ON-state current	–	0.1	1.0	–	1.0	μA	10.0	$V_I = V_{IH}$ or V_{IL}; $\lvert V_S \rvert = V_{CC} - GND$; see Fig.7
I_{CC}	quiescent supply current	–	1.0	10	–	20	μA	6.0	$V_I = V_{CC}$ or GND; V_{is} = GND or V_{CC}; $V_{os} = V_{CC}$ or GND
		–	2.0	20	–	40	μA	10.0	

Note

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

DC CHARACTERISTICS FOR 74HC1G/74HCT1G66

For 74HC1G66: V_{CC} = 2.0, 4.5, 6.0, 9.0 V; note 1.

For 74HCT1G66: V_{CC} = 4.5 V.

SYMBOL	PARAMETER	T_{amb} (°C)					UNIT	TEST CONDITIONS		
		−40 to +85			−40 to +125			V_{CC} (V)	I_S (μA)	OTHER
		MIN.	TYP.(2)	MAX.	MIN.	MAX.				
R_{ON}	ON-resistance (peak)	–	–	–	–	–	Ω	2.0	100	V_{is} = V_{CC} to GND; V_I = V_{IH} or V_{IL}; see Fig.5
		–	42	118	–	142	Ω	4.5	1000	
		–	31	105	–	126	Ω	6.0	1000	
		–	23	88	–	105	Ω	9.0	1000	
R_{ON}	ON-resistance (rail)	–	75	–	–	–	Ω	2.0	100	V_{is} = GND; V_I = V_{IH} or V_{IL}; see Fig.5
		–	29	95	–	115	Ω	4.5	1000	
		–	23	82	–	100	Ω	6.0	1000	
		–	18	70	–	80	Ω	9.0	1000	
R_{ON}	ON-resistance (rail)	–	75	–	–	–	Ω	2.0	100	V_{is} = V_{CC}; V_I = V_{IH} or V_{IL}; see Fig.5
		–	35	106	–	128	Ω	4.5	1000	
		–	27	94	–	113	Ω	6.0	1000	
		–	21	78	–	95	Ω	9.0	1000	

Notes

1. At supply voltages approaching 2 V, 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.
2. All typical values are measured at T_{amb} = 25 °C.

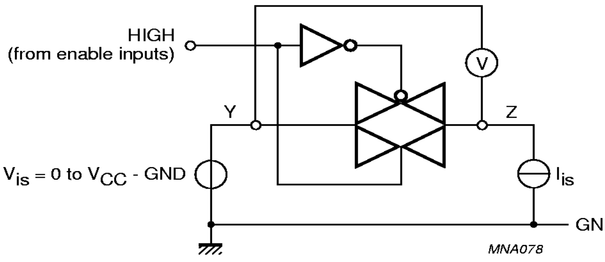


Fig.5 Test circuit for measuring ON-resistance (R_{ON}).

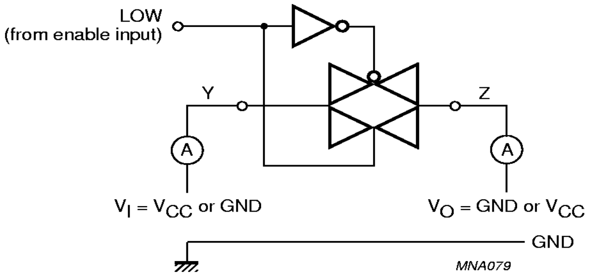


Fig.6 Test circuit for measuring OFF-state current.

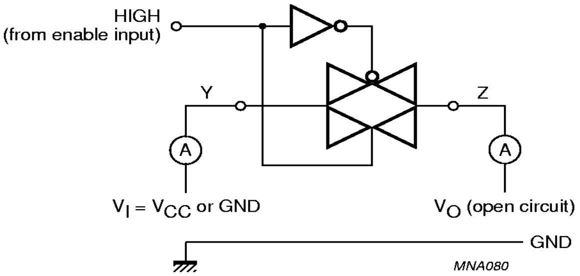


Fig.7 Test circuit for measuring ON-state current.

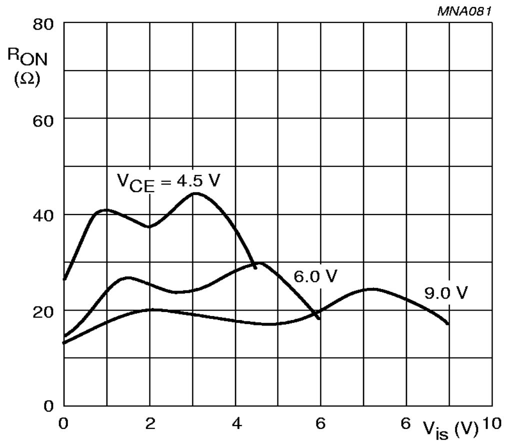


Fig.8 Typical ON-resistance (R_{ON}) as a function of input voltage (V_{is}) for V_{is} = 0 to V_{CC}.

DC CHARACTERISTICS FOR THE 74HCT1G66

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

SYMBOL	PARAMETER	T_{amb} (°C)					UNIT	TEST CONDITIONS	
		−40 to +85			−40 to +125			V_{CC} (V)	OTHER
		MIN.	TYP.(1)	MAX.	MIN.	MAX.			
V_{IH}	HIGH-level input voltage	2.0	1.6	–	2.0	–	V	4.5 to 5.5	
V_{IL}	LOW-level input voltage	0.1	1.2	0.8	–	0.8	V	4.5 to 5.5	
$\pm I_I$	input leakage current	–	0.1	1.0	–	1.0	μA	5.5	$V_I = V_{CC}$ or GND
$\pm I_S$	analog switch OFF-state current	–	0.1	1.0	–	1.0	μA	5.5	$V_I = V_{IH}$ or V_{IL}; $\lvert V_S \rvert = V_{CC} - GND$; see Fig.6
$\pm I_S$	analog switch ON-state current	–	0.1	1.0	–	1.0	μA	5.5	$V_I = V_{IH}$ or V_{IL}; $\lvert V_S \rvert = V_{CC} - GND$; see Fig.7
I_{CC}	quiescent supply current	–	1.0	10.0	–	20	μA	4.5 to 5.5	$V_I = V_{CC}$ or GND; V_{is} = GND or V_{CC}; $V_{os} = V_{CC}$ or GND
ΔI_{CC}	additional supply current per input	–	–	500	–	850	μA	4.5 to 5.5	$V_I = V_{CC} - 2.1$

Note

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

AC CHARACTERISTICS FOR 74HC1G66

GND = 0 V; $t_r = t_f$ = 6.0 ns; C_L = 50 pF.

SYMBOL	PARAMETER	T_{amb} (°C)					UNIT	TEST CONDITIONS	
		−40 to +85			−40 to +125			V_{CC} (V)	WAVEFORMS
		MIN.	TYP.(1)	MAX.	MIN.	MAX.			
t_{PHL}/t_{PLH}	propagation delay V_{is} to V_{os}	–	8	75	–	90	ns	2.0	$R_L = \infty$; C_L = 50 pF; see Fig.12
		–	3	15	–	18	ns	4.5	
		–	2	13	–	15	ns	6.0	
		–	1	10	–	12	ns	9.0	
t_{PZH}/t_{PZL}	turn-on time E to V_{os}	–	50	125	–	150	ns	2.0	R_L = 1; kΩ;C_L = 50 pF; see Figs 13 and 14
		–	16	25	–	30	ns	4.5	
		–	13	21	–	26	ns	6.0	
		–	9	16	–	20	ns	9.0	
t_{PHZ}/t_{PLZ}	turn-off time E to V_{os}	–	27	190	–	225	ns	2.0	R_L = 1 kΩ; C_L = 50 pF: see Figs 13 and 14
		–	16	38	–	45	ns	4.5	
		–	14	33	–	38	ns	6.0	
		–	12	16	–	20	ns	9.0	

Note

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

AC CHARACTERISTICS FOR 74HCT1G66

GND = 0 V; $t_r = t_f = 6.0$ ns; $C_L = 50$ pF. V_{is} is the input voltage at Y or Z terminal, whichever is assigned as an input. V_{os} is the output voltage at Y or Z terminal, whichever is assigned as an output.

SYMBOL	PARAMETER	T_{amb} (°C)					UNIT	TEST CONDITIONS	
		−40 to +85			−40 to +125			V_{CC}(V)	WAVEFORMS
		MIN.	TYP.(1)	MAX.	MIN.	MAX.			
t_{PHL}/t_{PLH}	propagation delay V_{is} to V_{os}	−	3	15	−	18	ns	4.5	$R_L = \infty$; $C_L = 50$ pF; see Fig.12.
t_{PZH}/t_{PZL}	turn-on time E to V_{os}	−	15	30	−	36	ns	4.5	$R_L = 1$ kΩ; $C_L = 50$ pF; see Figs 15 and 16.
t_{PHZ}/t_{PLZ}	turn-off time E to V_{os}	−	13	44	−	53	ns	4.5	$R_L = 1$ kΩ; $C_L = 50$ pF; see Figs 15 and 16.

Note

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

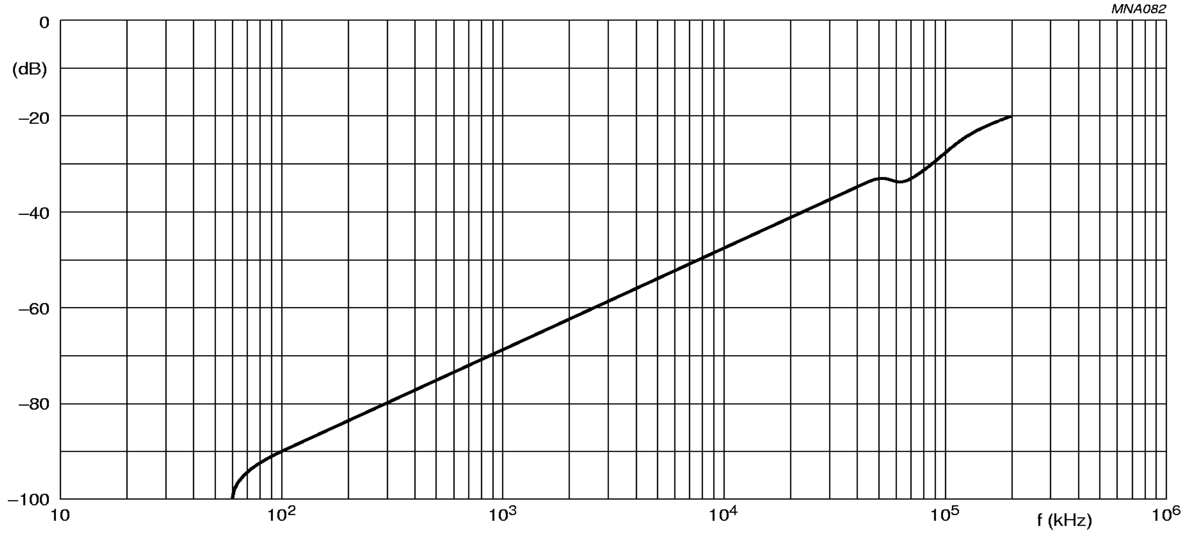
ADDITIONAL AC CHARACTERISTICS FOR THE 74HC1G66/74HCT1G66

Recommended conditions and typical values. GND = 0 V; $t_r = t_f = 6.0$ ns. V_{is} is the input voltage at Y or Z terminal, whichever is assigned as an input. V_{os} is the output voltage at Y or Z terminal, whichever is assigned as an output.

SYMBOL	PARAMETER	TYP.	UNIT	V_{CC} (V)	$V_{is(p-p)}$ (V)	TEST CONDITIONS
	sine-wave distortion f = 1 kHz	0.04 0.02	%	4.5 9.0	4.0 8.0	$R_L = 10$ kΩ; $C_L = 50$ pF; see Fig.12
	sine-wave distortion f = 10 kHz	0.12 0.06	%	4.5 9.0	4.0 8.0	$R_L = 10$ kΩ; $C_L = 50$ pF; see Fig.12
	switch OFF signal feed-through	−50 −50	dB	4.5 9.0	note 1	$R_L = 600$ Ω; $C_L = 50$ pF; f = 1 MHz; see Figs 9 and 13
f_{max}	minimum frequency response (−3 dB)	180 200	MHz	4.5 9.0	note 2	$R_L = 50$ Ω; $C_L = 10$ pF; see Figs 10 and 11
C_S	maximum switch capacitance	8	pF			

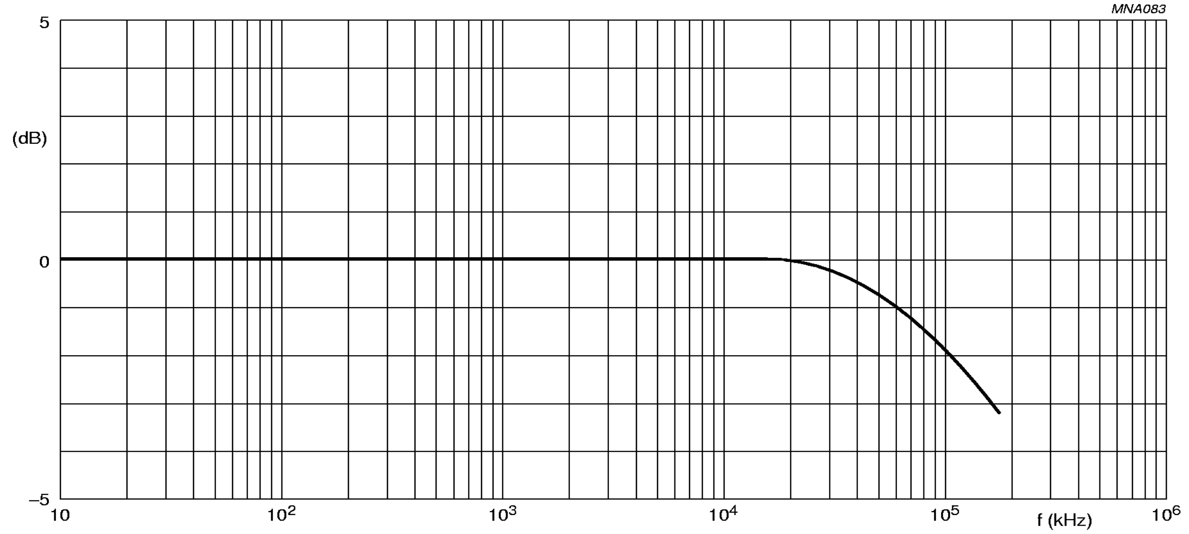
Notes

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).



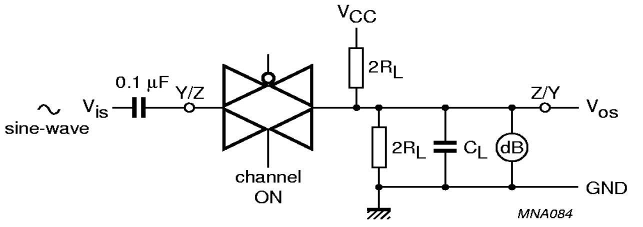
Test conditions: V_{CC} = 4.5 V; GND = 0 V; R_L = 50 Ω; R_{SOURCE} = 1kΩ.

Fig.9 Typical switch OFF signal feed-through as a function of frequency.



Test conditions: V_{CC} = 4.5 V; GND = 0 V; R_L = 50 Ω; R_{SOURCE} = 1kΩ.

Fig.10 Typical frequency response.



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}.

Fig.11 Test circuit for measuring minimum frequency response.

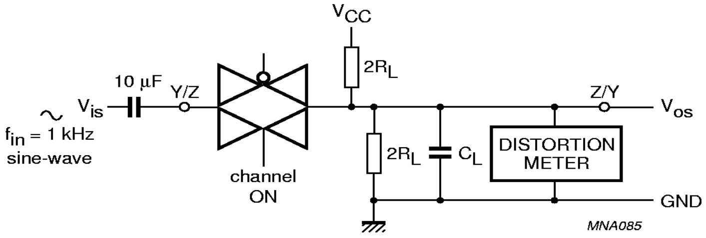


Fig.12 Test circuit for measuring sine-wave distortion.

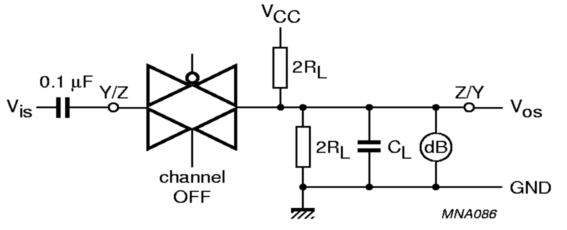
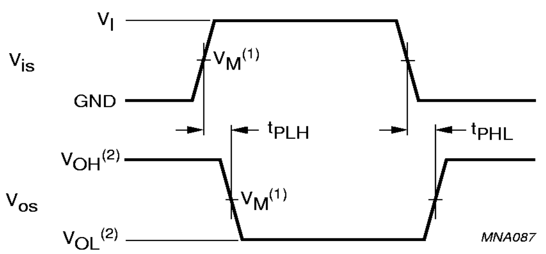


Fig.13 Test circuit for measuring switch OFF signal feed-through.

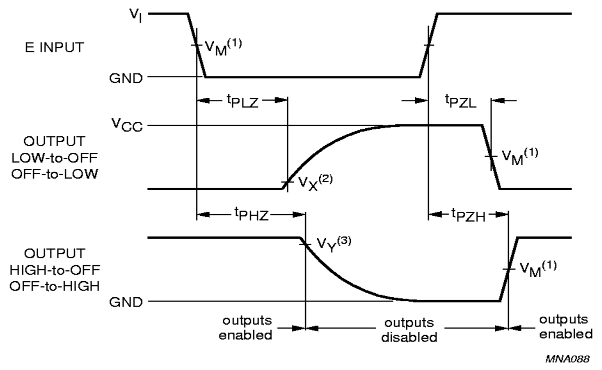
AC WAVEFORMS



(1) HC1G $V_M = 50\%$
HCT1G $V_M = 1.3$ V.

(2) V_{OL} and V_{OH} are the typical output voltage drop that occur with the output load.

Fig.14 The input (V_{is}) to output (V_{os}) propagation delays.

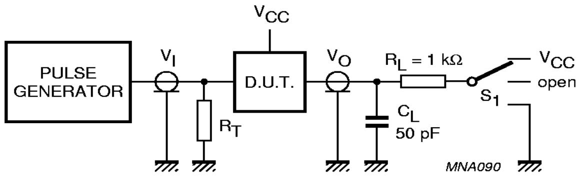


(1) HC1G $V_M = 50\%$; V_I = GND to V_{CC}
HCT1G $V_M = 1.3$ V; V_I = GND to 3.0 V.

(2) $V_X = 10\%$ of signal amplitude.

(3) $V_Y = 90\%$ of signal amplitude.

Fig.15 The turn-on and turn-off times.

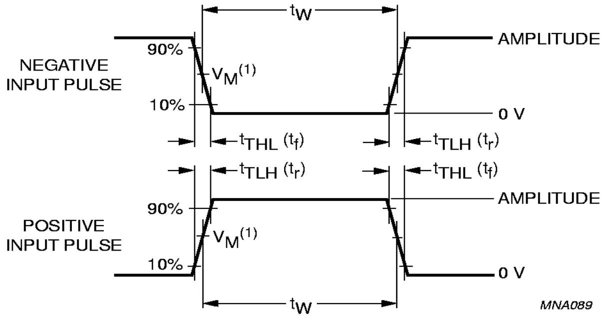


C_L = load capacitance including jig and probe capacitance (see AC CHARACTERISTICS for values)

R_T = termination resistance should be equal to the output impedance Z_O of the pulse generator.

TEST	S_1
t_{PLH}/t_{PHL}	open
t_{PLZ}/t_{PZL}	V_{CC}
t_{PHZ}/t_{PZH}	GND

Fig.16 Test circuit for measuring AC performance.



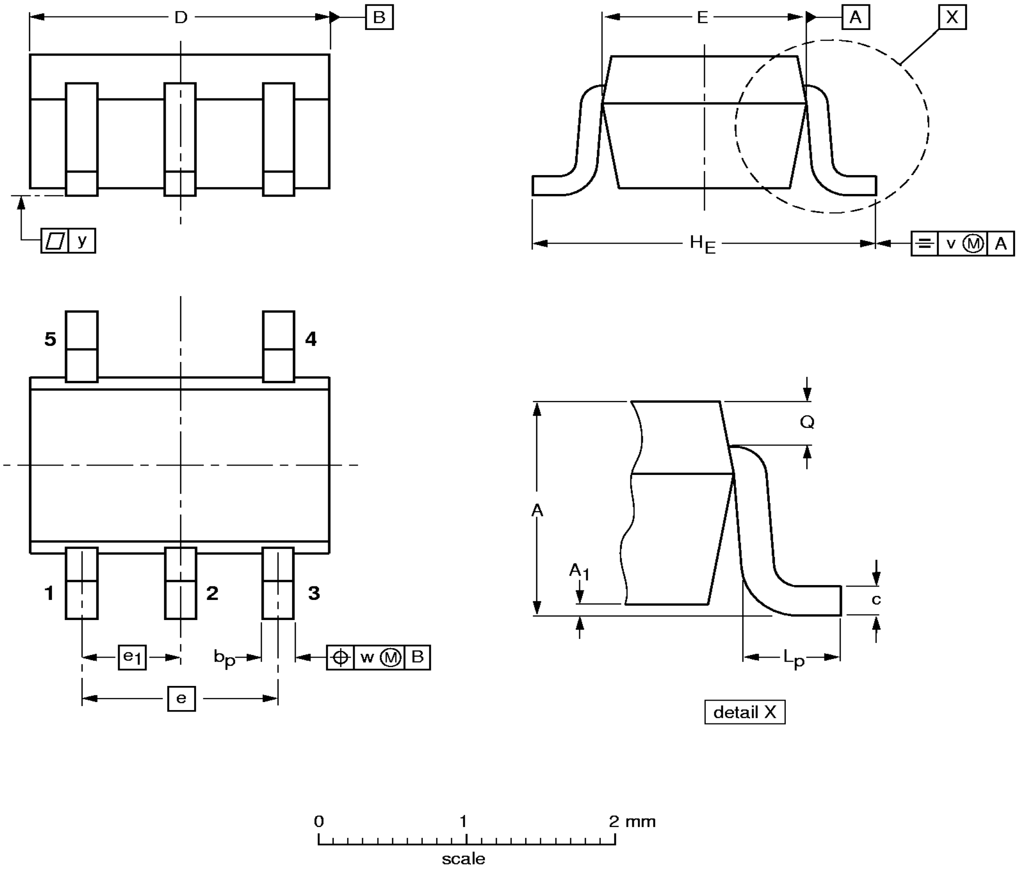
$t_r = t_f = 6$ ns, when measuring f_{max}, there is no constraint on t_r, t_f with 50% duty factor.

(1) HC1G: $V_M = 50\%$; V_I = GND to V_{CC}
HCT1G: $V_M = 1.3$ V; V_I = GND to 3.0 V.

Fig.17 Input pulse definitions.

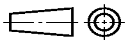
PACKAGE OUTLINE

Plastic surface mounted package; 5 leads **SOT353**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max	b_p	c	D	E (2)	e	e_1	H_E	L_p	Q	v	w	y
mm	1.1 0.8	0.1	0.30 0.20	0.25 0.10	2.2 1.8	1.35 1.15	1.3	0.65	2.2 2.0	0.45 0.15	0.25 0.15	0.2	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT353			SC-88A			97-02-28

SOLDERING

Introduction

There is no soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and surface mounted components are mixed on one printed-circuit board. However, wave soldering is not always suitable for surface mounted ICs, or for printed-circuits with high population densities. In these situations reflow soldering is often used.

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our *“Data Handbook IC26; Integrated Circuit Packages”* (order code 9398 652 90011).

Reflow soldering

Reflow soldering techniques are suitable for all SO packages.

Reflow soldering requires solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the printed-circuit board by screen printing, stencilling or pressure-syringe dispensing before package placement.

Several techniques exist for reflowing; for example, thermal conduction by heated belt. Dwell times vary between 50 and 300 seconds depending on heating method. Typical reflow temperatures range from 215 to 250 °C.

Preheating is necessary to dry the paste and evaporate the binding agent. Preheating duration: 45 minutes at 45 °C.

Wave soldering

Wave soldering techniques can be used for all SO packages if the following conditions are observed:

- A double-wave (a turbulent wave with high upward pressure followed by a smooth laminar wave) soldering technique should be used.
- The longitudinal axis of the package footprint must be parallel to the solder flow.
- The package footprint must incorporate solder thieves at the downstream end.

During placement and before soldering, the package must be fixed with a droplet of adhesive. The adhesive can be applied by screen printing, pin transfer or syringe dispensing. The package can be soldered after the adhesive is cured.

Maximum permissible solder temperature is 260 °C, and maximum duration of package immersion in solder is 10 seconds, if cooled to less than 150 °C within 6 seconds. Typical dwell time is 4 seconds at 250 °C.

A mildly-activated flux will eliminate the need for removal of corrosive residues in most applications.

Repairing soldered joints

Fix the component by first soldering two diagonally-opposite end leads. Use only a low voltage soldering iron (less than 24 V) applied to the flat part of the lead. Contact time must be limited to 10 seconds at up to 300 °C. When using a dedicated tool, all other leads can be soldered in one operation within 2 to 5 seconds between 270 and 320 °C.