

DATA SHEET

74HC2G66; 74HCT2G66 Bilateral switches

Product specification
Supersedes data of 2003 Nov 26

2004 May 19

Bilateral switches

74HC2G66; 74HCT2G66

FEATURES

- Wide supply voltage range from 2.0 V to 9.0 V
- Very low ON-resistance:
 - 41 Ω (typical) at $V_{CC} = 4.5$ V
 - 30 Ω (typical) at $V_{CC} = 6.0$ V
 - 21 Ω (typical) at $V_{CC} = 9.0$ V.
- High noise immunity
- Low power dissipation
- ± 25 mA switch current
- SOT505-2 package
- ESD protection:
HBM EIA/JESD22-A114-A exceeds 2000 V
MM EIA/JESD22-A115-A exceeds 200 V.
- Specified from -40 °C to $+85$ °C and -40 °C to $+125$ °C.

DESCRIPTION

The 74HC2G66/74HCT2G66 is a high-speed Si-gate CMOS device.

The 74HC2G66/74HCT2G66 provides a dual analog switch. Each switch has two pins (nY and nZ) for input or output and an active HIGH enable input (pin E). When pin E is LOW, the belonging analog switch is turned off.

QUICK REFERENCE DATA

$GND = 0$ V; $T_{amb} = 25$ °C; $t_r = t_f = 6.0$ ns; V_{os} is the output voltage at pins nY or nZ, whichever is assigned as an output.

SYMBOL	PARAMETER	CONDITIONS	TYPICAL		UNIT
			HC2G	HCT2G	
t_{PZH}/t_{PZL}	turn-on time nE to V_{os}	$C_L = 50$ pF; $R_L = 1$ k Ω ; $V_{CC} = 4.5$ V	12	13	ns
t_{PHZ}/t_{PLZ}	turn-off time nE to V_{os}	$C_L = 50$ pF; $R_L = 1$ k Ω ; $V_{CC} = 4.5$ V	12	13	ns
C_I	input capacitance		3.5	3.5	pF
C_{PD}	power dissipation capacitance per switch	notes 1 and 2	9	9	pF
C_S	switch capacitance		8	8	pF

Notes

1. C_{PD} is used to determine the dynamic power dissipation (P_D in μ W).

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

f_i = input frequency in MHz;

f_o = output frequency in MHz;

C_L = output load capacitance in pF;

C_S = Switch capacitance in pF;

V_{CC} = supply voltage in Volts.

2. For 74HC2G66 the condition is $V_I = GND$ to V_{CC} .
For 74HCT2G66 the condition is $V_I = GND$ to $V_{CC} - 1.5$ V.

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FUNCTION TABLE

See note 1.

INPUT nE	SWITCH
L	OFF
H	ON

Note

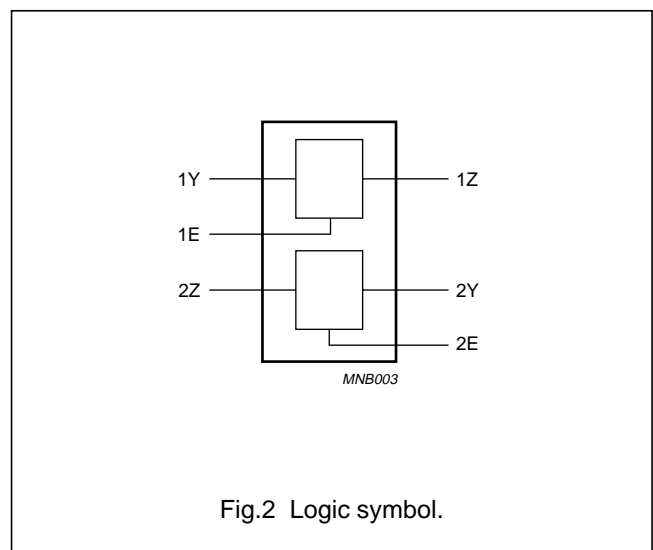
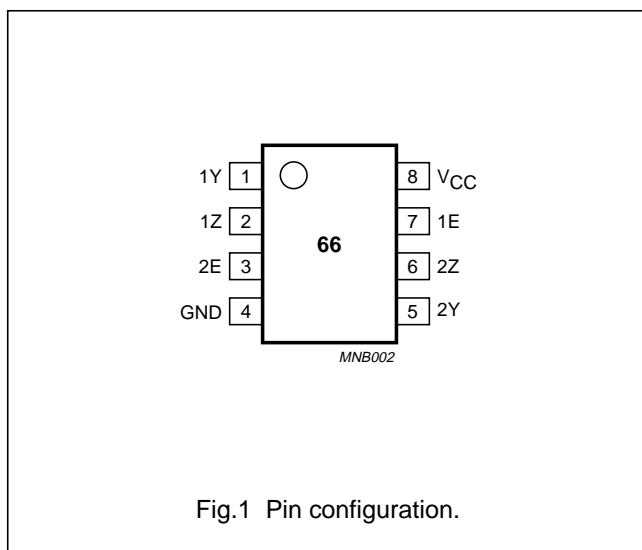
- 1. H = HIGH voltage level;
L = LOW voltage level.

ORDERING INFORMATION

TYPE NUMBER	PACKAGE					
	TEMPERATURE RANGE	PINS	PACKAGE	MATERIAL	OUTLINE VERSION	MARKING
74HC2G66DP	-40 °C to +125 °C	8	TSSOP8	plastic	SOT505-2	H66
74HCT2G66DP	-40 °C to +125 °C	8	TSSOP8	plastic	SOT505-2	T66

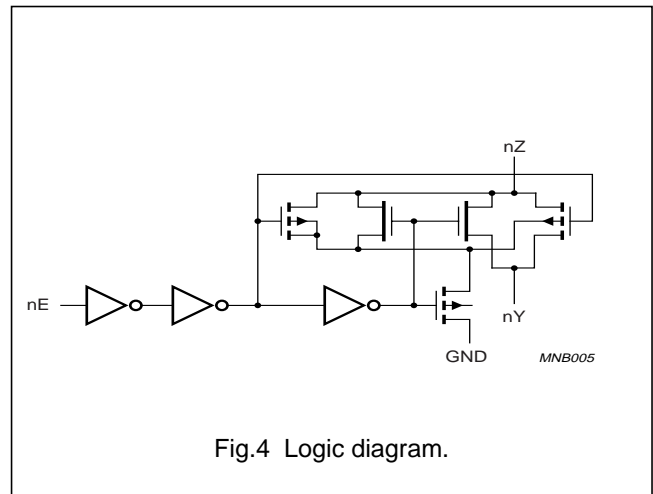
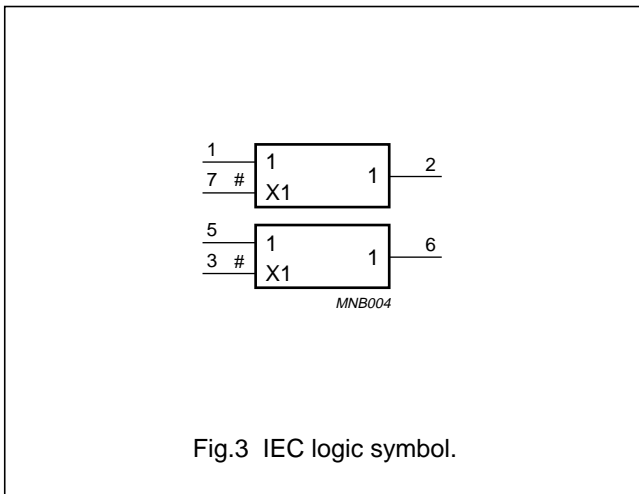
PINNING

PIN	SYMBOL	DESCRIPTION
1	1Y	independent input or output
2	1Z	independent input or output
3	2E	enable input (active HIGH)
4	GND	ground (0 V)
5	2Y	independent input or output
6	2Z	independent input or output
7	1E	enable input (active HIGH)
8	V _{CC}	supply voltage



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RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	CONDITIONS	74HC2G66			74HCT2G66			UNIT
			MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
V _{CC}	supply voltage		2.0	5.0	10.0	4.5	5.0	5.5	V
V _I	input voltage		0	–	V _{CC}	0	–	V _{CC}	V
V _O	output voltage		0	–	V _{CC}	0	–	V _{CC}	V
T _{amb}	ambient temperature	see DC and AC characteristics per device	–40	+25	+125	–40	+25	+125	°C
t _r , t _f	input rise and fall times	V _{CC} = 2.0 V	–	–	1000	–	–	–	ns
		V _{CC} = 4.5 V	–	6.0	500	–	6.0	500	ns
		V _{CC} = 6.0 V	–	–	400	–	–	–	ns
		V _{CC} = 9.0 V	–	–	250	–	–	–	ns

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 60134); voltages are referenced to GND (ground = 0 V).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V _{CC}	supply voltage		–0.5	+11.0	V
I _{IK}	input diode current	V _I < –0.5 V or V _I > V _{CC} + 0.5 V; note 1	–	±20	mA
I _{OK}	output diode current	V _O < –0.5 V or V _O > V _{CC} + 0.5 V; note 1	–	±20	mA
I _O	output source or sink current	–0.5 V < V _O < V _{CC} + 0.5 V; note 1	–	±25	mA
I _{CC} , I _{GND}	V _{CC} or GND current	note 1	–	±30	mA
T _{stg}	storage temperature		–65	+150	°C
P _{tot}	power dissipation of package	T _{amb} = –40 °C to +125 °C; note 2	–	300	mW
P _s	power dissipation per switch		–	100	mW

Notes

1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
2. Above 55 °C the value of P_{tot} derates linearly with 2.5 mW/K.

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DC CHARACTERISTICS

Type 74HC2G66

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

SYMBOL	PARAMETER	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
		OTHER	V _{CC} (V)				
T_{amb} = -40 °C to +85 °C; note1							
V _{IH}	HIGH-level input voltage		2.0	1.5	1.2	–	V
			4.5	3.15	2.4	–	V
			6.0	4.2	3.2	–	V
			9.0	6.3	4.7	–	V
V _{IL}	LOW-level input voltage		2.0	–	0.8	0.5	V
			4.5	–	2.1	1.35	V
			6.0	–	2.8	1.8	V
			9.0	–	4.3	2.7	V
I _{LI}	input leakage current	V _I = V _{CC} or GND	6.0	–	–	±0.1	μA
			9.0	–	–	±0.2	μA
I _{s(OFF)}	analog switch current, OFF-state	V _I = V _{IH} or V _{IL} ; V _S = V _{CC} – GND; see Fig.7	9.0	–	0.1	1.0	μA
I _{s(ON)}	analog switch current, ON-state	V _I = V _{IH} or V _{IL} ; V _S = V _{CC} – GND; see Fig.8	9.0	–	0.1	1.0	μA
I _{CC}	quiescent supply current	V _I = V _{CC} or GND; V _{is} = GND or V _{CC} ; V _{os} = V _{CC} or GND	6.0	–	–	10	μA
			9.0	–	–	20	μA

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SYMBOL	PARAMETER	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
		OTHER	V _{CC} (V)				
T_{amb} = -40 °C to +125 °C							
V _{IH}	HIGH-level input voltage		2.0	1.5	–	–	V
			4.5	3.15	–	–	V
			6.0	4.2	–	–	V
			9.0	6.3	–	–	V
V _{IL}	LOW-level input voltage		2.0	–	–	0.5	V
			4.5	–	–	1.35	V
			6.0	–	–	1.8	V
			9.0	–	–	2.7	V
I _{LI}	input leakage current	V _I = V _{CC} or GND	6.0	–	–	±0.1	µA
			9.0	–	–	±0.2	µA
I _{s(OFF)}	analog switch current, OFF-state	V _I = V _{IH} or V _{IL} ; V _S = V _{CC} – GND; see Fig.7	9.0	–	–	1.0	µA
I _{s(ON)}	analog switch current, ON-state	V _I = V _{IH} or V _{IL} ; V _S = V _{CC} – GND; see Fig.8	9.0	–	–	1.0	µA
I _{CC}	quiescent supply current	V _I = V _{CC} or GND; V _{IS} = GND or V _{CC} ; V _{OS} = V _{CC} or GND	6.0	–	–	20	µA
			9.0	–	–	40	µA

Note

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

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Type 74HCT2G66

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

SYMBOL	PARAMETER	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
		OTHER	V _{CC} (V)				
T_{amb} = -40 °C to +85 °C; note 1							
V _{IH}	HIGH-level input voltage		4.5 to 5.5	2.0	1.6	–	V
V _{IL}	LOW-level input voltage		4.5 to 5.5	–	1.2	0.8	V
I _{LI}	input leakage current	V _I = V _{CC} or GND	5.5	–	–	±1.0	μA
I _{s(OFF)}	analog switch current, OFF-state	V _I = V _{IH} or V _{IL} ; V _S = V _{CC} – GND; see Fig.7		–	0.1	1.0	μA
I _{s(ON)}	analog switch current, ON-state	V _I = V _{IH} or V _{IL} ; V _S = V _{CC} – GND; see Fig.8		–	0.1	1.0	μA
I _{CC}	quiescent supply current	V _I = V _{CC} or GND; V _{IS} = GND or V _{CC} ; V _{OS} = V _{CC} or GND	4.5 to 5.5	–	–	10	μA
ΔI _{CC}	additional supply current per input	V _I = V _{CC} – 2.1 V; I _O = 0 A	4.5 to 5.5	–	–	375	μA
T_{amb} = -40 °C to +125 °C							
V _{IH}	HIGH-level input voltage		4.5 to 5.5	2.0	–	–	V
V _{IL}	LOW-level input voltage		4.5 to 5.5	–	–	0.8	V
I _{LI}	input leakage current	V _I = V _{CC} or GND	5.5	–	–	±1.0	μA
I _{s(OFF)}	analog switch current, OFF-state	V _I = V _{IH} or V _{IL} ; V _S = V _{CC} – GND; see Fig.7		–	–	1.0	μA
I _{s(ON)}	analog switch current, ON-state	V _I = V _{IH} or V _{IL} ; V _S = V _{CC} – GND; see Fig.8		–	–	1.0	μA
I _{CC}	quiescent supply current	V _I = V _{CC} or GND; V _{IS} = GND or V _{CC} ; V _{OS} = V _{CC} or GND	4.5 to 5.5	–	–	20	μA
ΔI _{CC}	additional supply current per input	V _I = V _{CC} – 2.1 V; I _O = 0 A	4.5 to 5.5	–	–	410	μA

Note1. All typical values are measured at T_{amb} = 25 °C.

Bilateral switches

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Resistance R_{ON} for 74HC2G66 and 74HCT2G66

See notes 1 and 2.

SYMBOL	PARAMETER	TEST CONDITIONS			MIN.	TYP.	MAX.	UNIT
		OTHER	V_{CC} (V)	I_s (μ A)				
$T_{amb} = -40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$; note 3								
$R_{ON(peak)}$	ON-resistance (peak)	$V_{is} = V_{CC}$ to GND; $V_I = V_{IH}$ or V_{IL} ; see Figs 5 and 6	2.0	100	–	250	–	Ω
			4.5	1000	–	41	118	Ω
			6.0	1000	–	30	105	Ω
			9.0	1000	–	21	88	Ω
$R_{ON(rail)}$	ON-resistance (rail)	$V_{is} = \text{GND}$; $V_I = V_{IH}$ or V_{IL} ; see Figs 5 and 6	2.0	100	–	65	–	Ω
			4.5	1000	–	28	95	Ω
			6.0	1000	–	22	82	Ω
			9.0	1000	–	18	70	Ω
	$V_{is} = V_{CC}$; $V_I = V_{IH}$ or V_{IL} ; see Figs 5 and 6	2.0	100	–	65	–	Ω	
		4.5	1000	–	31	106	Ω	
		6.0	1000	–	23	94	Ω	
		9.0	1000	–	19	78	Ω	
ΔR_{ON}	maximum variation of ON-resistance between the two channels	$V_{is} = V_{CC}$ to GND; $V_I = V_{IH}$ or V_{IL} ; see Figs 5 and 6	4.5	–	–	5	–	Ω
			6.0	–	–	4	–	Ω
			9.0	–	–	3	–	Ω
$T_{amb} = -40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$								
$R_{ON(peak)}$	ON-resistance (peak)	$V_{is} = V_{CC}$ to GND; $V_I = V_{IH}$ or V_{IL} ; see Figs 5 and 6	2.0	100	–	–	–	Ω
			4.5	1000	–	–	142	Ω
			6.0	1000	–	–	126	Ω
			9.0	1000	–	–	105	Ω
$R_{ON(rail)}$	ON-resistance (rail)	$V_{is} = \text{GND}$; $V_I = V_{IH}$ or V_{IL} ; see Figs 5 and 6	2.0	100	–	–	–	Ω
			4.5	1000	–	–	115	Ω
			6.0	1000	–	–	100	Ω
			9.0	1000	–	–	80	Ω
	$V_{is} = V_{CC}$; $V_I = V_{IH}$ or V_{IL} ; see Figs 5 and 6	2.0	100	–	–	–	Ω	
		4.5	1000	–	–	128	Ω	
		6.0	1000	–	–	113	Ω	
		9.0	1000	–	–	95	Ω	

Notes

- For 74 HCT2G66 only $V_{CC} = 4.5\text{ V}$ applies; for 74HC2G66 all V_{CC} values apply.
- At supply voltages near 2 V, the analog switch ON-resistance is extremely non linear. When using a supply of 2 V, it is recommended is to use these devices only for digital signals.
- All typical values are measured at $T_{amb} = 25\text{ }^{\circ}\text{C}$.

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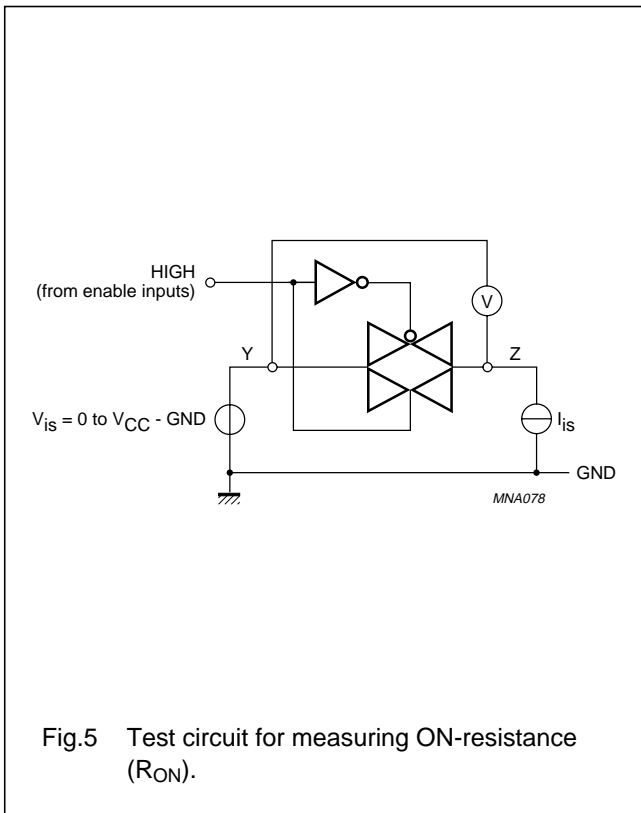
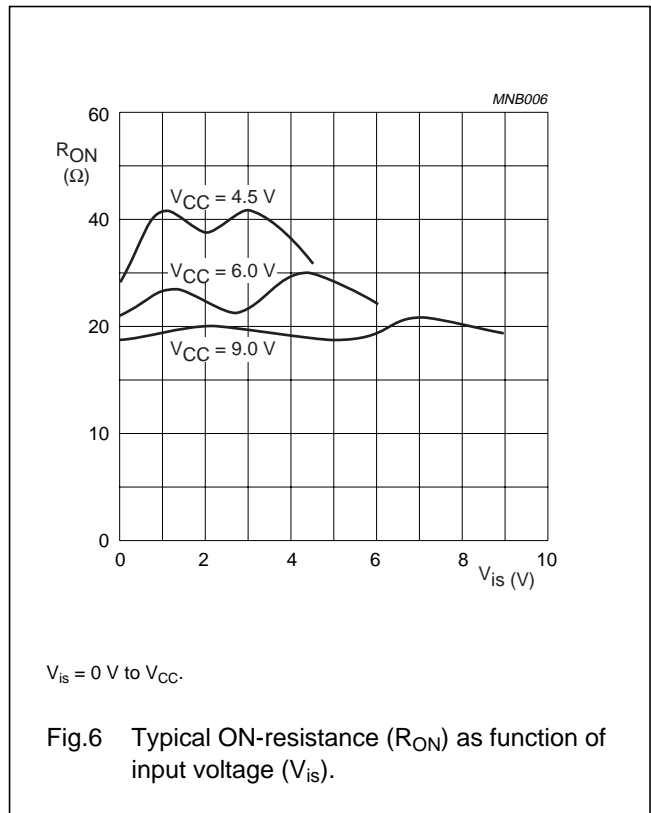


Fig.5 Test circuit for measuring ON-resistance (R_{ON}).



$V_{is} = 0 \text{ V to } V_{CC}$.

Fig.6 Typical ON-resistance (R_{ON}) as function of input voltage (V_{is}).

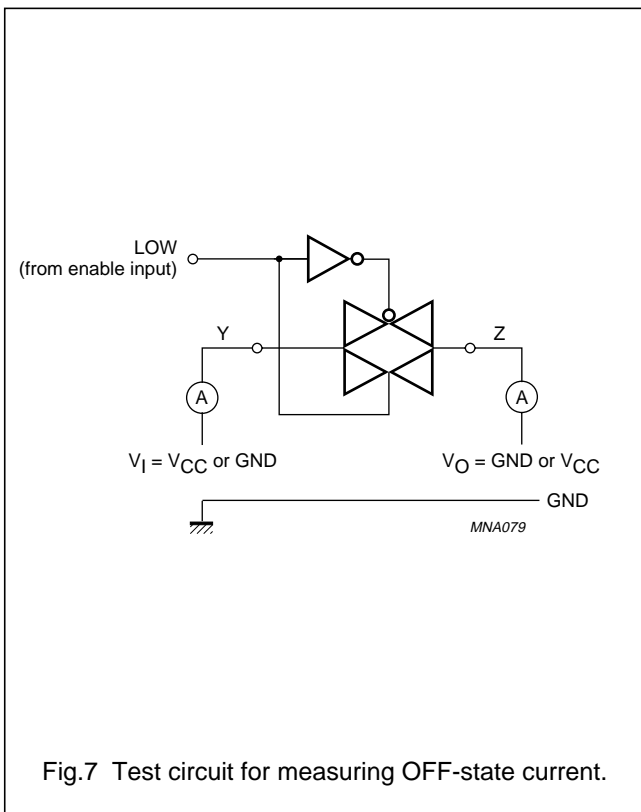


Fig.7 Test circuit for measuring OFF-state current.

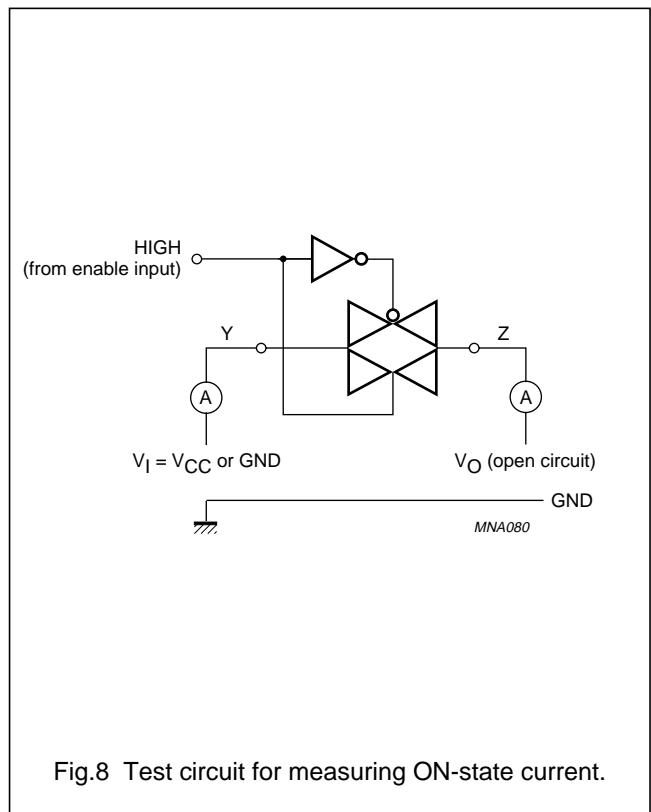


Fig.8 Test circuit for measuring ON-state current.

Bilateral switches

74HC2G66; 74HCT2G66

AC CHARACTERISTICS

Type 74HC2G66

GND = 0 V; $t_r = t_f = 6.0$ ns; V_{is} is the input voltage at pins nY or nZ, whichever is assigned as an input; V_{os} is the output voltage at pins nY or nZ, whichever is assigned as an output.

SYMBOL	PARAMETER	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
		WAVEFORMS	V_{CC} (V)				
$T_{amb} = -40$ °C to $+85$ °C; note 1							
t_{PHL}/t_{PLH}	propagation delay V_{is} to V_{os}	$R_L = \infty$; see Figs 16 and 18	2.0	–	6.5	65	ns
			4.5	–	2.0	13	ns
			6.0	–	1.5	11	ns
			9.0	–	1.2	10	ns
t_{PZH}/t_{PZL}	turn-on time nE to V_{os}	$R_L = 1$ k Ω ; see Figs 17 and 18	2.0	–	40	125	ns
			4.5	–	12	25	ns
			6.0	–	10	21	ns
			9.0	–	7	16	ns
t_{PHZ}/t_{PLZ}	turn-off time nE to V_{os}	$R_L = 1$ k Ω ; see Figs 17 and 18	2.0	–	21	145	ns
			4.5	–	12	29	ns
			6.0	–	11	28	ns
			9.0	–	10	23	ns
$T_{amb} = -40$ °C to $+125$ °C							
t_{PHL}/t_{PLH}	propagation delay V_{is} to V_{os}	$R_L = \infty$; see Figs 16 and 18	2.0	–	–	80	ns
			4.5	–	–	15	ns
			6.0	–	–	14	ns
			9.0	–	–	12	ns
t_{PZH}/t_{PZL}	turn-on time nE to V_{os}	$R_L = 1$ k Ω ; see Figs 17 and 18	2.0	–	–	150	ns
			4.5	–	–	30	ns
			6.0	–	–	26	ns
			9.0	–	–	20	ns
t_{PHZ}/t_{PLZ}	turn-off time nE to V_{os}	$R_L = 1$ k Ω ; see Figs 17 and 18	2.0	–	–	175	ns
			4.5	–	–	35	ns
			6.0	–	–	33	ns
			9.0	–	–	27	ns

Note

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

Bilateral switches

74HC2G66; 74HCT2G66

Type 74HCT2G66

GND = 0 V; $t_r = t_f = 6.0$ ns; V_{is} is the input voltage at pins nY or nZ, whichever is assigned as an input; V_{os} is the output voltage at pins nY or nZ, whichever is assigned as an output.

SYMBOL	PARAMETER	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
		WAVEFORMS	V_{CC} (V)				
$T_{amb} = -40$ °C to $+85$ °C; note 1							
t_{PHL}/t_{PLH}	propagation delay V_{is} to V_{os}	$R_L = \infty$; see Figs 16 and 18	4.5	–	2.0	15	ns
t_{PZH}/t_{PZL}	turn-on time nE to V_{os}	$R_L = 1$ k Ω ; see Figs 17 and 18	4.5	–	13	30	ns
t_{PHZ}/t_{PLZ}	turn-off time nE to V_{os}	$R_L = 1$ k Ω ; see Figs 17 and 18	4.5	–	13	44	ns
$T_{amb} = -40$ °C to $+125$ °C							
t_{PHL}/t_{PLH}	propagation delay V_{is} to V_{os}	$R_L = \infty$; see Figs 16 and 18	4.5	–	–	18	ns
t_{PZH}/t_{PZL}	turn-on time nE to V_{os}	$R_L = 1$ k Ω ; see Figs 17 and 18	4.5	–	–	36	ns
t_{PHZ}/t_{PLZ}	turn-off time nE to V_{os}	$R_L = 1$ k Ω ; see Figs 17 and 18	4.5	–	–	53	ns

Note

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

Bilateral switches

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Type 74HC2G66 and 74HCT2G66

At recommended conditions and typical values; GND = 0 V; $t_r = t_f = 6.0$ ns; V_{is} is the input voltage at pins nY or nZ, whichever is assigned as an input; V_{os} is the output voltage at pins nY or nZ, whichever is assigned as an output.

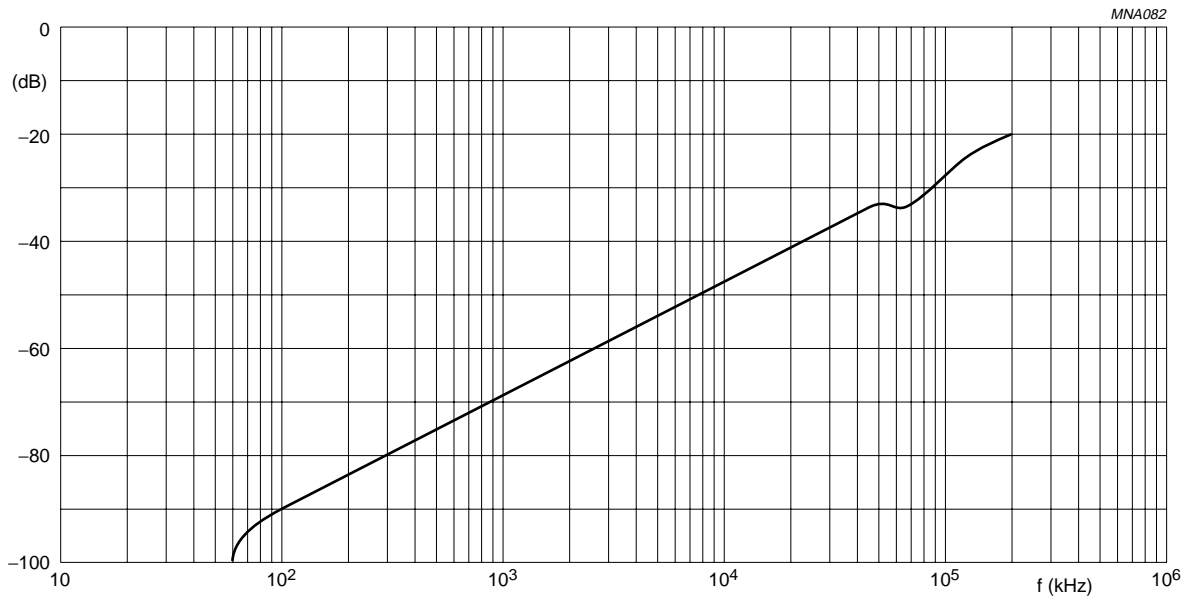
SYMBOL	PARAMETER	TEST CONDITIONS			TYP.	UNIT
		OTHER	$V_{is(p-p)}$ (V)	V_{CC} (V)		
d_{sin}	sine-wave distortion	$f = 1$ kHz; $R_L = 10$ k Ω ; $C_L = 50$ pF; see Fig.14	4.0	4.5	0.04	%
			8.0	9.0	0.02	%
		$f = 10$ kHz; $R_L = 10$ k Ω ; $C_L = 50$ pF; see Fig.14	4.0	4.5	0.12	%
			8.0	9.0	0.06	%
$\alpha_{OFF(feedthru)}$	switch OFF signal feed-through	$R_L = 600$ Ω ; $C_L = 50$ pF; $f = 1$ MHz; see Figs 9 and 15	note 1	4.5	-50	dB
				9.0	-50	dB
$\alpha_{ct(s)}$	crosstalk between the two switches	$R_L = 600$ Ω ; $C_L = 50$ pF; $f = 1$ MHz; see Fig 11	note 1	4.5	-60	dB
				9.0	-60	dB
$V_{ct(E-S)(p-p)}$	crosstalk voltage between enable input to the switches (peak-to-peak value)	$R_L = 600$ Ω ; $C_L = 50$ pF; $f = 1$ MHz (nE, square wave between V_{CC} and GND, $t_r = t_f = 6.0$ ns); see Fig 12	note 1	4.5	110	mV
				9.0	220	mV
f_{max}	frequency response (-3 dB)	$R_L = 50$ Ω ; $C_L = 10$ pF; see Figs 10 and 13	note 2	4.5	180	MHz
				9.0	200	MHz
C_S	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).

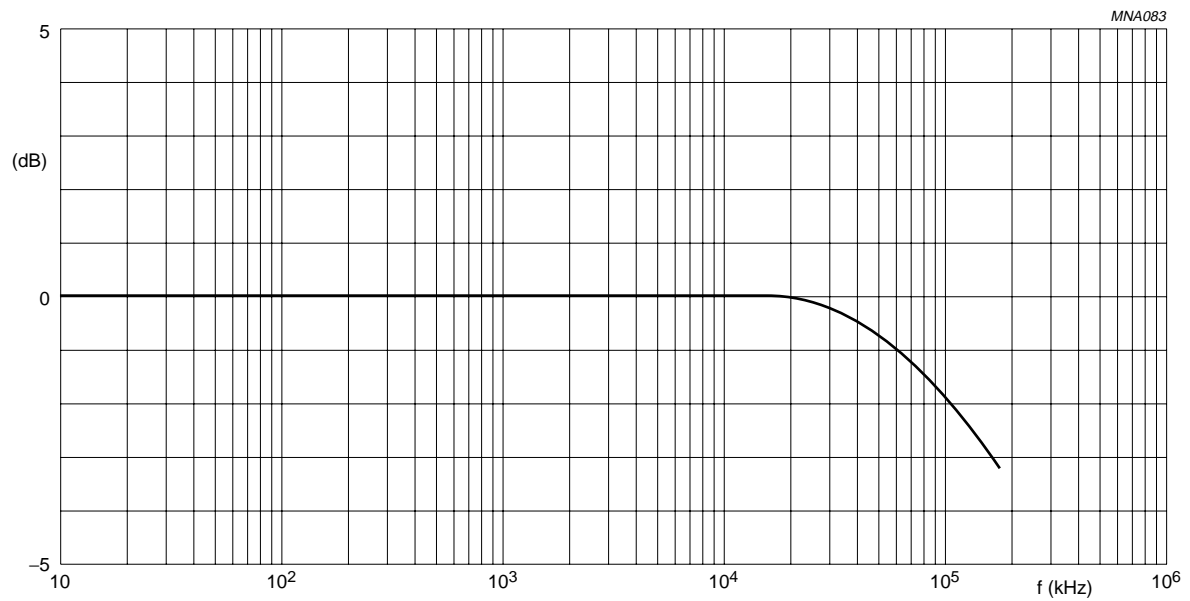
Bilateral switches

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Test conditions: $V_{CC} = 4.5\text{ V}$; $GND = 0\text{ V}$; $R_L = 50\ \Omega$; $R_{SOURCE} = 1\text{ k}\Omega$.

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

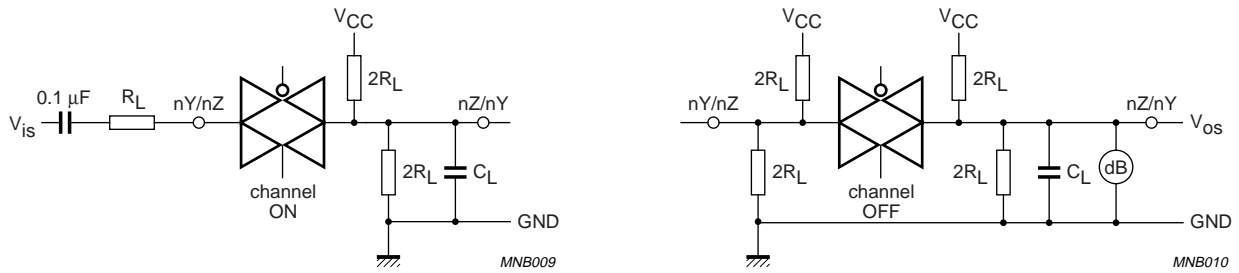


Test conditions: $V_{CC} = 4.5\text{ V}$; $GND = 0\text{ V}$; $R_L = 50\ \Omega$; $R_{SOURCE} = 1\text{ k}\Omega$.

Fig.10 Typical frequency response.

Bilateral switches

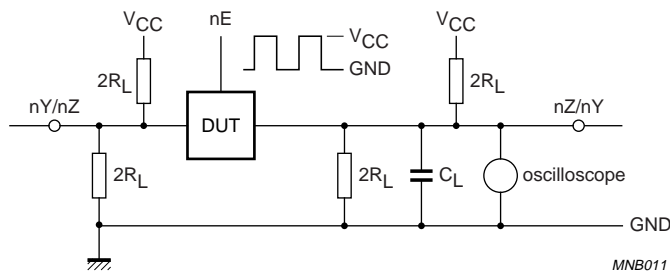
74HC2G66; 74HCT2G66



a. Channel ON condition.

b. Channel OFF condition.

Fig.11 Test circuit for measuring crosstalk between any two switches.



The crosstalk is defined as follows (oscilloscope output):

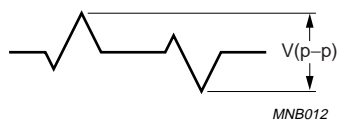
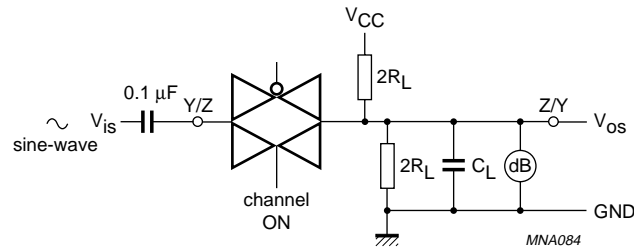


Fig.12 Test circuit for measuring crosstalk between control and any switch.

Bilateral switches

74HC2G66; 74HCT2G66



Adjust input voltage to obtain 0 dBm at V_{os} when $f_i = 1$ MHz.
 After set-up, frequency of f_i is increased to obtain a reading of -3 dB at V_{os} .

Fig.13 Test circuit for measuring minimum frequency response.

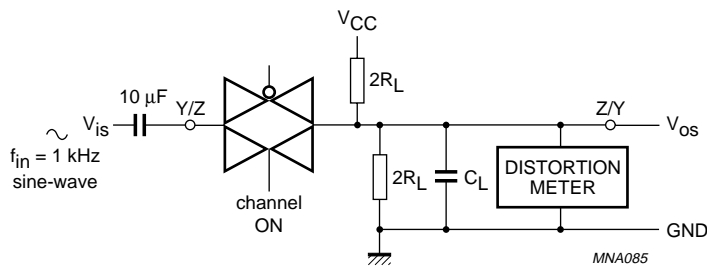


Fig.14 Test circuit for measuring sine-wave distortion.

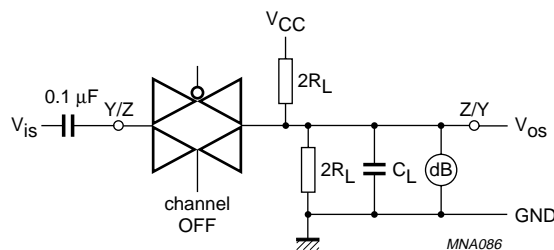
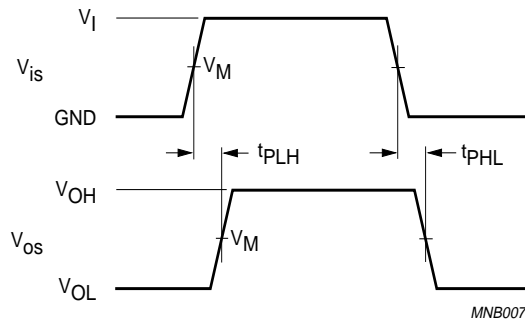


Fig.15 Test circuit for measuring switch OFF signal feed-through.

Bilateral switches

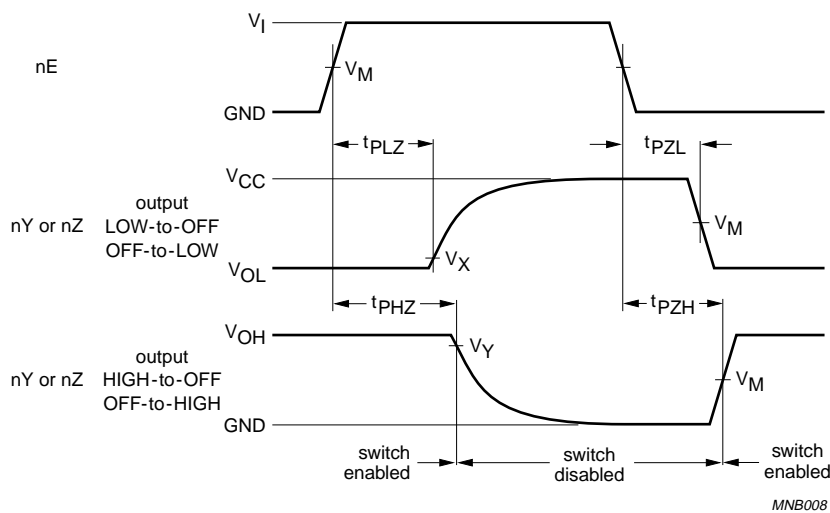
74HC2G66; 74HCT2G66

AC WAVEFORMS



74HC2G66: $V_M = 50\%$; $V_I = \text{GND to } V_{CC}$.
 74HCT2G66: $V_M = 1.3 \text{ V}$; $V_I = \text{GND to } 3.0 \text{ V}$.

Fig.16 Waveforms showing input (V_{is}) to output (V_{os}) propagation delay and the output transition time.

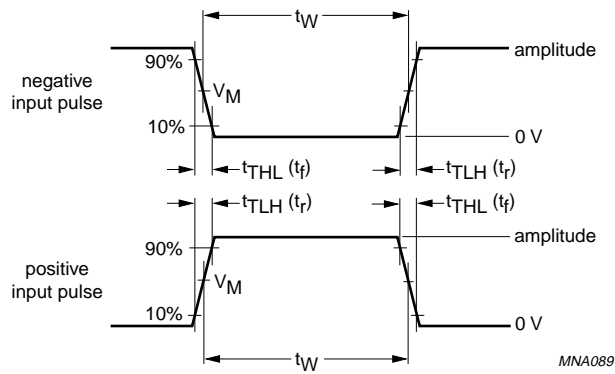


$V_X = 10\%$ of signal amplitude.
 $V_Y = 90\%$ of signal amplitude.
 74HC2G66: $V_M = 50\%$; $V_I = \text{GND to } V_{CC}$.
 74HCT2G66: $V_M = 1.3 \text{ V}$; $V_I = \text{GND to } 3.0 \text{ V}$.

Fig.17 Waveforms showing turn-on and turn-off times.

Bilateral switches

74HC2G66; 74HCT2G66

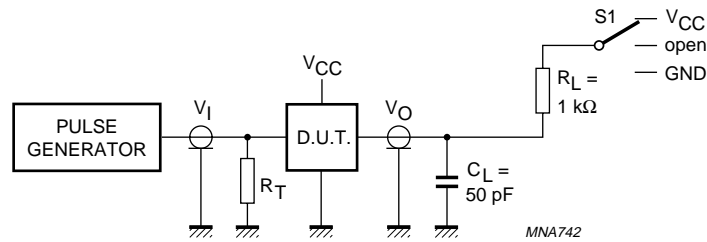


Input pulse definition:

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

74HC2G66: $V_M = 50\%$; $V_I = \text{GND to } V_{CC}$.

74HCT2G66: $V_M = 1.3$ V; $V_I = \text{GND to } 3.0$ V.



TEST	S1
t_{PLH}/t_{PHL}	open
t_{PLZ}/t_{PZL}	V_{CC}
t_{PHZ}/t_{PZH}	GND

Definitions for test circuit:

R_L = Load resistor.

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.

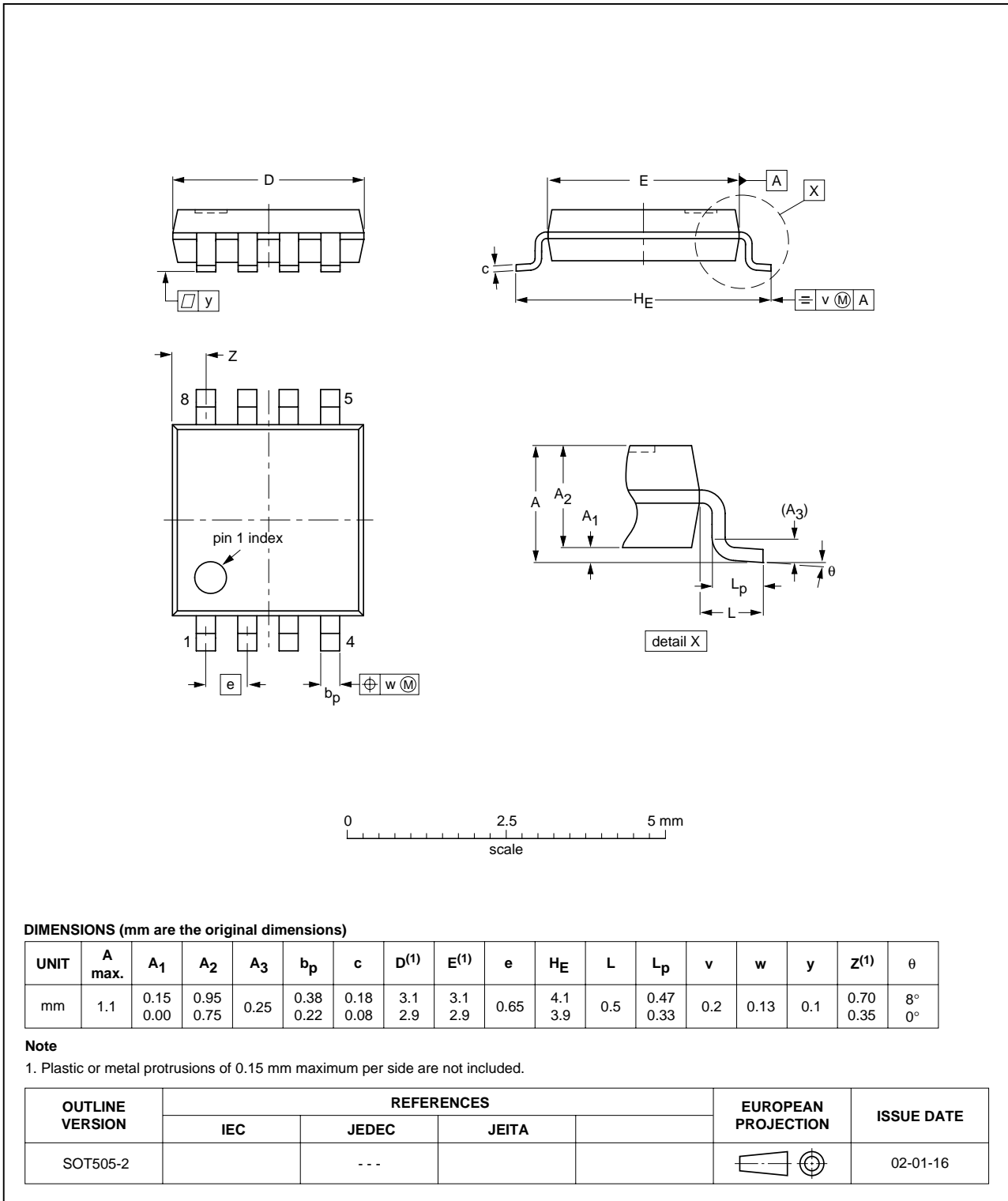
Fig.18 Load circuitry for switching times.

Bilateral switches

74HC2G66; 74HCT2G66

PACKAGE OUTLINE

TSSOP8: plastic thin shrink small outline package; 8 leads; body width 3 mm; lead length 0.5 mm SOT505-2



Bilateral switches

74HC2G66; 74HCT2G66

DATA SHEET STATUS

LEVEL	DATA SHEET STATUS ⁽¹⁾	PRODUCT STATUS ⁽²⁾⁽³⁾	DEFINITION
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