

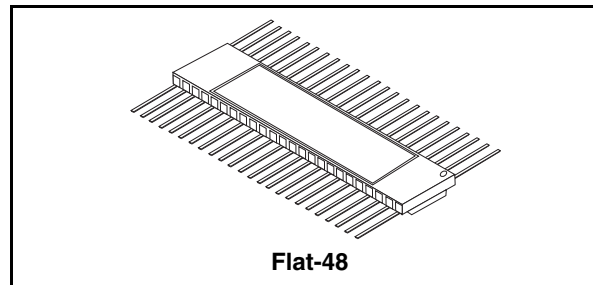


## 54VCXH162245

### Rad hard low voltage CMOS 16-bit bus buffer transceiver (3-state) with 3.6V tolerant inputs and outputs

#### Features

- 1.65 to 3.6V inputs and outputs
- High speed A outputs:
  - $t_{PD} = 3.4\text{ns}$  at  $V_{CC} = 3.0$  to  $3.6\text{V}$
  - $t_{PD} = 4.3\text{ns}$  at  $V_{CC} = 2.3$  to  $2.7\text{V}$
- Symmetrical impedance A output:
  - $I_{OH} = I_{OL} = 12\text{mA}$  (Min) at  $V_{CC} = 3.0\text{V}$
  - $I_{OH} = I_{OL} = 8\text{mA}$  (Min) at  $V_{CC} = 2.3\text{V}$
- High speed B outputs:
  - $t_{PD} = 2.5\text{ns}$  (Max) at  $V_{CC} = 3.0$  to  $3.6\text{V}$
  - $t_{PD} = 3.2\text{ns}$  (Max) at  $V_{CC} = 2.3$  to  $2.7\text{V}$
- Symmetrical impedance A output:
  - $I_{OH} = I_{OL} = 24\text{mA}$  (Min) at  $V_{CC} = 3.0\text{V}$
  - $I_{OH} = I_{OL} = 18\text{mA}$  (Min) at  $V_{CC} = 2.3\text{V}$
- Power down protection on inputs and outputs
- $26\Omega$  serie resistors in A port output
- Operating voltage range:
  - $V_{CC}(\text{Opr}) = 1.65\text{V}$  to  $3.6\text{V}$
- Pin and function compatible with 54 SERIES H162245
- Bus hold provided on both sides
- Cold spare function
- Latch-up performance exceeds  $300\text{mA}$  (JESD 17)
- ESD performance:
  - $\text{HBM} > 2000\text{V}$   
(MIL STD 883 method 3015);  $\text{MM} > 200\text{V}$
- 300KRad Mil1019.6 Condition A, (RHA QML qualification extension undergone)
- No SEL, no SEU under  $72\text{Mev/cm}^2/\text{mg}$  LET heavy ions irradiation
- QML qualified product
- Device fully compliant with DSCC SMD 5962-02508



#### Description

The 54VCXH162245 is a low voltage CMOS 16 bit bus transceiver (3-state) fabricated with sub-micron silicon gate and five-layer metal wiring C<sup>2</sup>MOS technology. It is ideal for low power and very high speed 1.65 to 3.6V applications; it can be interfaced to 3.6V signal environment for both inputs and outputs.

This IC is intended for two-way asynchronous communication between data buses; the direction of data transmission is determined by DIR input.

The two enable inputs  $\overline{nG}$  can be used to disable the device so that the buses are effectively isolated. The device circuits is including  $26\Omega$  series resistance in the A port outputs. These resistors permit to reduce line noise in high speed applications. Bus hold on data inputs is provided in order to eliminate the need for external pull-up or pull-down resistor.

All inputs and outputs are equipped with protection circuits against static discharge, giving them  $2\text{KV}$  ESD immunity and transient excess voltage. All floating bus terminals during High Z State must be held HIGH or LOW.

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# Contents

<b>1</b>	<b>Logic symbols and I/O equivalent circuit</b> .....	<b>3</b>
<b>2</b>	<b>Pin settings</b> .....	<b>4</b>
2.1	Pin connection .....	4
2.2	Pin description .....	5
2.3	Truth table .....	5
<b>3</b>	<b>Maximum rating</b> .....	<b>6</b>
3.1	Recommended operating conditions .....	7
<b>4</b>	<b>Electrical characteristics</b> .....	<b>8</b>
<b>5</b>	<b>Test circuit</b> .....	<b>12</b>
<b>6</b>	<b>Waveforms</b> .....	<b>13</b>
<b>7</b>	<b>Package mechanical data</b> .....	<b>15</b>
<b>8</b>	<b>Order code</b> .....	<b>16</b>
<b>9</b>	<b>Revision history</b> .....	<b>17</b>

# 1 Logic symbols and I/O equivalent circuit

Figure 1. IEC logic symbols

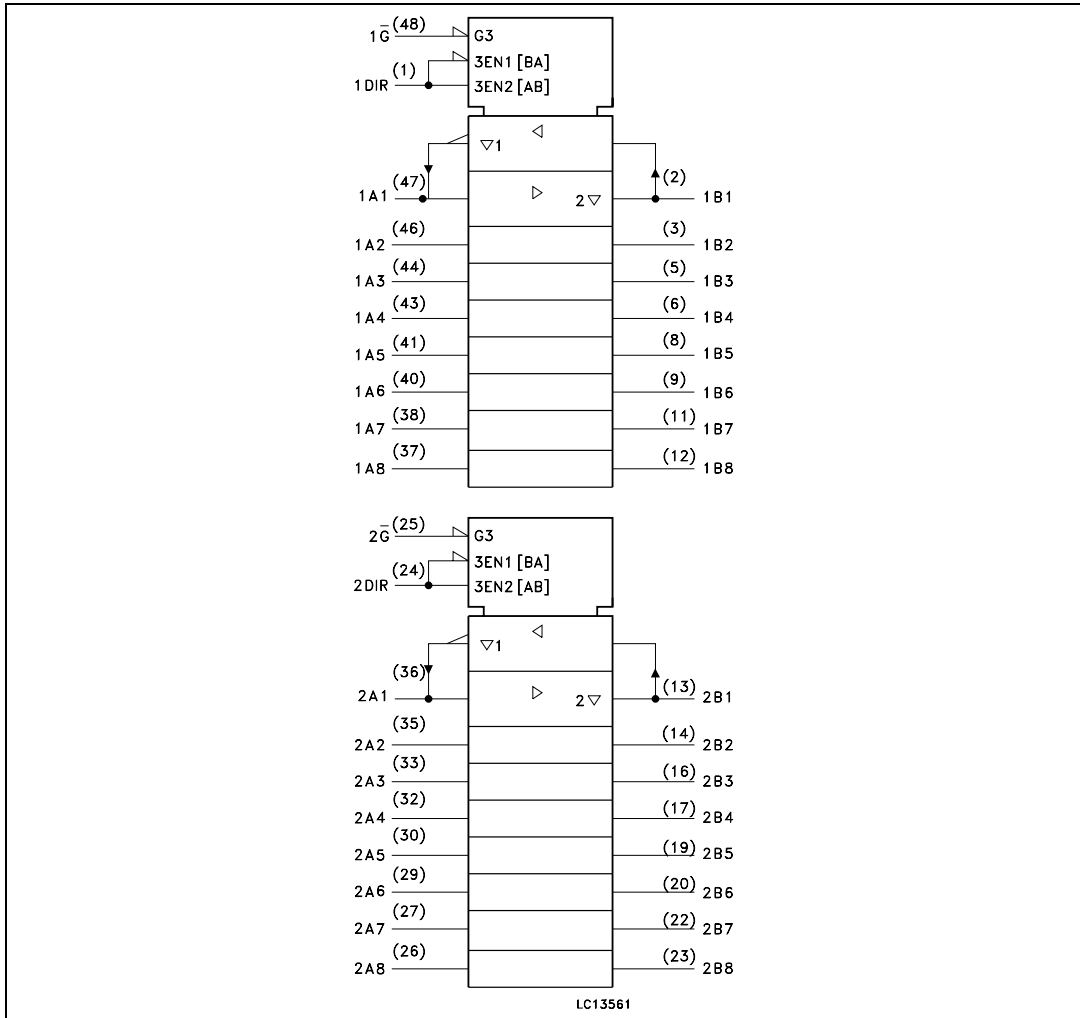
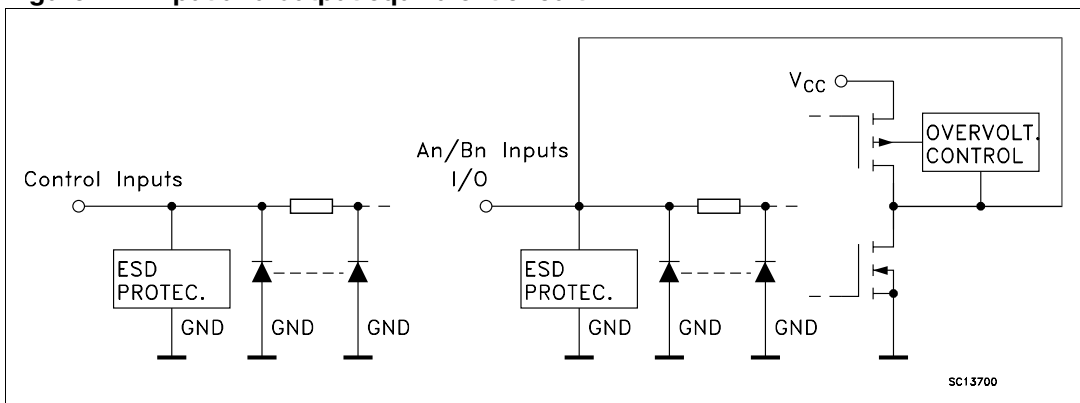


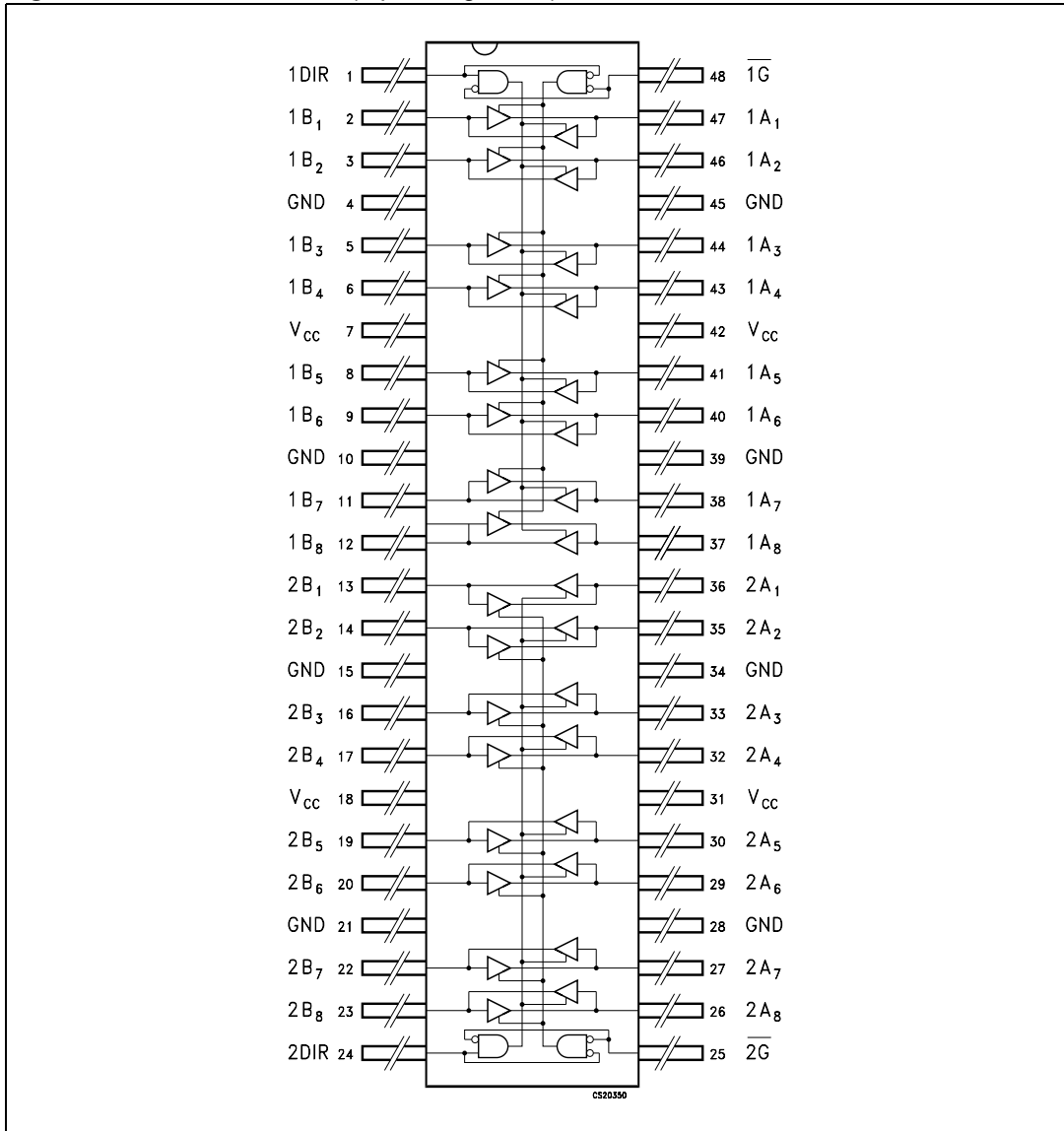
Figure 2. Input and output equivalent circuit



## 2 Pin settings

### 2.1 Pin connection

Figure 3. Pin connection (top through view)



## 2.2 Pin description

Table 1. Pin description

Pin N°	Symbol	Name and function
1	1DIR	Directional control
2, 3, 5, 6, 8, 9, 11, 12	1B1 to 1B8	Data Inputs/Outputs
13, 14, 16, 17, 19, 20, 22, 23	2B1 to 2B8	Data Inputs/Outputs
24	2DIR	Directional Control
25	$2\bar{G}$	Output enable input
36, 35, 33, 32, 30, 29, 27, 26	2A1 to 2A8	Data Inputs/Outputs
47, 46, 44, 43, 41, 40, 38, 38	1A1 to 1A8	Data Inputs/Outputs
48	$1\bar{G}$	Output Enable Input
4, 10, 15, 21, 28, 34, 39, 45	GND	Ground (0V)
7, 18, 31, 42	V <sub>CC</sub>	Positive supply voltage

## 2.3 Truth table

Table 2. Truth table

Inputs		Function		Output
$\bar{G}$	DIR	A BUS	B BUS	Yn
L	L	OUTPUT	INPUT	A = B
L	H	INPUT	OUTPUT	B = A
H	X	Z	Z	Z

Note: X = Do not care; Z = High Impedance

### 3 Maximum rating

Stressing the device above the rating listed in the “Absolute Maximum Ratings” table may cause permanent damage to the device. These are stress ratings only and operation of the device at these or any other conditions above those indicated in the Operating sections of this specification is not implied. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability. Refer also to the STMicroelectronics SURE Program and other relevant quality documents.

**Table 3. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{CC}$	Supply voltage	-0.5 to +4.6	V
$V_I$	DC input voltage	-0.5 to +4.6	V
$V_O$	DC output voltage (OFF State)	-0.5 to +4.6	V
$V_O$	DC output voltage (High or Low State) <sup>(1)</sup>	-0.5 to $V_{CC} + 0.5$	V
$I_{IK}$	DC input diode current	- 50	mA
$I_{OK}$	DC output diode current <sup>(2)</sup>	- 50	mA
$I_O$	DC output current	$\pm 50$	mA
$I_{CC}$ or $I_{GND}$	DC $V_{CC}$ or ground current per supply pin	$\pm 100$	mA
$P_D$	Power dissipation	400	mW
$T_{stg}$	Storage temperature	-65 to +150	°C
$T_L$	Lead temperature (10 sec)	260	°C

1.  $I_O$  absolute maximum rating must be observed
2.  $V_O < GND$ ,  $V_O > V_{CC}$

### 3.1 Recommended operating conditions

**Table 4. Recommended operating conditions**

Symbol	Parameter	Value	Unit
$V_{CC}$	Supply voltage	1.8 to 3.6	V
$V_I$	Input voltage	-0.3 to 3.6	V
$V_O$	Output voltage (OFF State)	0 to 3.6	V
$V_O$	Output voltage (High or Low State)	0 to $V_{CC}$	V
$I_{OH}, I_{OL}$	High or low level output current - A side ( $V_{CC} = 3.0$ to $3.6V$ )	$\pm 12$	mA
$I_{OH}, I_{OL}$	High or low level output current - A side ( $V_{CC} = 2.3$ to $2.7V$ )	$\pm 8$	mA
$I_{OH}, I_{OL}$	High or low level output current - B side ( $V_{CC} = 3.0$ to $3.6V$ )	$\pm 24$	mA
$I_{OH}, I_{OL}$	High or low level output current - B side ( $V_{CC} = 2.3$ to $2.7V$ )	$\pm 18$	mA
$T_{op}$	Operating temperature	-55 to 125	$^{\circ}C$
dt/dv	Input rise and fall time <sup>(1)</sup>	0 to 10	ns/V

1.  $V_{IN}$  from 0.8V to 2V at  $V_{CC} = 3.0V$

## 4 Electrical characteristics

**Table 5. DC specifications** ( $2.7V < V_{CC} \leq 3.6V$  unless otherwise specified)

Symbol	Parameter	Test condition		Value		Unit
		V <sub>CC</sub> (V)		-55 to 125°C		
				Min	Max	
V <sub>IH</sub>	High level input voltage	2.7 to 3.6		2.0		V
V <sub>IL</sub>	Low level input voltage				0.8	
V <sub>OH</sub>	High level output voltage (A Outputs)	2.7 to 3.6	I <sub>O</sub> =-100 μA	V <sub>CC</sub> -0.2		V
		2.7	I <sub>O</sub> =-6 mA	2.2		
		3.0	I <sub>O</sub> =-8 mA	2.4		
			I <sub>O</sub> =-12 mA	2.2		
V <sub>OH</sub>	High level output voltage (B Outputs)	2.7 to 3.6	I <sub>O</sub> =-100 μA	V <sub>CC</sub> -0.2		V
		2.7	I <sub>O</sub> =-12 mA	2.2		
		3.0	I <sub>O</sub> =-18 mA	2.4		
			I <sub>O</sub> =-24 mA	2.2		
V <sub>OL</sub>	Low level output voltage (A Outputs)	2.7 to 3.6	I <sub>O</sub> =100 μA		0.2	V
		2.7	I <sub>O</sub> =6 mA		0.4	
		3.0	I <sub>O</sub> =8 mA		0.55	
			I <sub>O</sub> =12 mA		0.8	
V <sub>OL</sub>	Low level output voltage (B Outputs)	2.7 to 3.6	I <sub>O</sub> =100 μA		0.2	V
		2.7	I <sub>O</sub> =12 mA		0.4	
		3.0	I <sub>O</sub> =18 mA		0.4	
			I <sub>O</sub> =24 mA		0.55	
I <sub>I</sub>	Input leakage current	2.7 to 3.6	V <sub>I</sub> = 0 to 3.6V		± 5	μA
I <sub>I(HOLD)</sub>	Input hold current	3.0	V <sub>I</sub> = 0.8V	75		μA
			V <sub>I</sub> = 2V	-75		
		3.6	V <sub>I</sub> = 0 to 3.6V		± 500	
I <sub>off</sub>	Power off leakage current	0	V <sub>I</sub> or V <sub>O</sub> = 0 to 3.6V		10	μA
I <sub>OZ</sub>	High impedance output leakage current	2.7 to 3.6	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> V <sub>O</sub> = 0 to 3.6V		± 10	μA
I <sub>CC</sub>	Quiescent supply current	2.7 to 3.6	V <sub>I</sub> = V <sub>CC</sub> or GND		20	μA
			V <sub>I</sub> or V <sub>O</sub> = V <sub>CC</sub> to 3.6V		± 20	
ΔI <sub>CC</sub>	I <sub>CC</sub> incr. per input	2.7 to 3.6	V <sub>IH</sub> = V <sub>CC</sub> - 0.6V		750	μA



**Table 6. DC specifications** ( $2.3V < V_{CC} \leq 2.7V$  unless otherwise specified)

Symbol	Parameter	Test condition		Value		Unit
		V <sub>CC</sub> (V)		-55 to 125 °C		
				Min	Max	
V <sub>IH</sub>	High level input voltage	2.3 to 2.7		1.6		V
V <sub>IL</sub>	Low level input voltage				0.7	
V <sub>OH</sub>	High level output voltage	2.3 to 2.7	I <sub>O</sub> =-100 μA	V <sub>CC</sub> -0.2		V
		2.3	I <sub>O</sub> =-4 mA	2.0		
			I <sub>O</sub> =-6 mA	1.8		
			I <sub>O</sub> =-8 mA	1.7		
V <sub>OL</sub>	Low level output voltage	2.3 to 2.7	I <sub>O</sub> =100 μA		0.2	V
		2.3	I <sub>O</sub> =6 mA		0.4	
			I <sub>O</sub> =8 mA		0.6	
I <sub>I</sub>	Input leakage current	2.3 to 2.7	V <sub>I</sub> = V <sub>CC</sub> or GND		± 5	μA
I <sub>I(HOLD)</sub>	Input hold current	2.3	V <sub>I</sub> = 0.7V	45		μA
			V <sub>I</sub> = 1.7V	-45		
I <sub>off</sub>	Power off leakage current	0	V <sub>I</sub> or V <sub>O</sub> = 0 to 3.6V		10	μA
I <sub>OZ</sub>	High impedance output leakage current	2.3 to 2.7	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> V <sub>O</sub> = 0 to 3.6V		± 10	μA
I <sub>CC</sub>	Quiescent supply current	2.3 to 2.7	V <sub>I</sub> = V <sub>CC</sub> or GND		20	μA
			V <sub>I</sub> or V <sub>O</sub> = V <sub>CC</sub> to 3.6V		± 20	

**Table 7. Dynamic switching characteristics**  
 (T<sub>A</sub> = 25°C, Input t<sub>r</sub> = t<sub>f</sub> = 2.0ns, C<sub>L</sub> = 30pF, R<sub>L</sub> = 500Ω)

Symbol	Parameter	Test condition		Value			Unit
		V <sub>CC</sub> (V)		T <sub>A</sub> = 25 °C			
				Min	Typ	Max	
V <sub>OLP</sub>	Dynamic peak low voltage quiet output <sup>(1)</sup> <sup>(2)</sup> (A to B)	2.5	V <sub>IL</sub> = 0V		0.6		V
		3.3	V <sub>IH</sub> = V <sub>CC</sub>		0.8		
V <sub>OLP</sub>	Dynamic peak low voltage quiet output <sup>(1)</sup> <sup>(2)</sup> (B to A)	2.5	V <sub>IL</sub> = 0V		0.25		V
		3.3	V <sub>IH</sub> = V <sub>CC</sub>		0.35		
V <sub>OLV</sub>	Dynamic valley low voltage quiet output <sup>(1)</sup> <sup>(2)</sup> (A to B)	2.5	V <sub>IL</sub> = 0V		-0.6		V
		3.3	V <sub>IH</sub> = V <sub>CC</sub>		-0.8		
V <sub>OLV</sub>	Dynamic valley low voltage quiet output <sup>(1)</sup> <sup>(2)</sup> (B to A)	2.5	V <sub>IL</sub> = 0V		-0.25		V
		3.3	V <sub>IH</sub> = V <sub>CC</sub>		-0.35		
V <sub>OHV</sub>	Dynamic valley high voltage quiet output <sup>(2)</sup> <sup>(3)</sup> (A to B)	2.5	V <sub>IL</sub> = 0V		1.9		V
		3.3	V <sub>IH</sub> = V <sub>CC</sub>		2.2		
V <sub>OHV</sub>	Dynamic valley high voltage quiet output <sup>(2)</sup> <sup>(3)</sup> (B to A)	2.5	V <sub>IL</sub> = 0V		2.05		V
		3.3	V <sub>IH</sub> = V <sub>CC</sub>		2.65		

1. Number of outputs defined as "n". Measured with "n-1" outputs switching from HIGH to LOW or LOW to HIGH. The remaining output is measured in the LOW state.
2. Parameters guaranteed by design.
3. Number of outputs defined as "n". Measured with "n-1" outputs switching from HIGH to LOW or LOW to HIGH. The remaining output is measured in the HIGH state.

**Table 8. AC electrical characteristics** ( $C_L = 30\text{pF}$ ,  $R_L = 500\Omega$ , Input  $t_r = t_f = 2.0\text{ns}$ )

Symbol	Parameter	Test condition		Value		Unit
		$V_{CC}$ (V)		-55 to 125 °C		
				Min	Max	
$t_{PLH}$ $t_{PHL}$	Propagation delay time (A to B)	2.3 to 2.7		1.0	4.0	ns
		3.0 to 3.6		0.8	3.6	
$t_{PLH}$ $t_{PHL}$	Propagation delay time (B to A)	2.3 to 2.7		1.0	4.9	ns
		3.0 to 3.6		0.8	4.0	
$t_{PZL}$ $t_{PZH}$	Output enable time (A to B)	2.3 to 2.7		1.0	5.8	ns
		3.0 to 3.6		0.8	4.3	
$t_{PZL}$ $t_{PZH}$	Output enable time (B to A)	2.3 to 2.7		1.0	6.8	ns
		3.0 to 3.6		0.8	4.8	
$t_{PLZ}$ $t_{PHZ}$	Output disable time (A to B)	2.3 to 2.7		1.0	4.8	ns
		3.0 to 3.6		0.8	5.6	
$t_{PLZ}$ $t_{PHZ}$	Output disable time (B to A)	2.3 to 2.7		1.0	5.7	ns
		3.0 to 3.6		0.8	7.0	
$t_{OSLH}$ $t_{OSHL}$	Output to output skew time (1) (2)	2.3 to 2.7			0.5	ns
		3.0 to 3.6			0.5	

1. Skew is defined as the absolute value of the difference between the actual propagation delay for any two outputs of the same device switching in the same direction, either HIGH or LOW ( $t_{OSLH} = |t_{PLHm} - t_{PLHn}|$ ,  $t_{OSHL} = |t_{PHLm} - t_{PHLn}|$ )

2. Parameter guaranteed by design

**Table 9. Capacitive characteristics**

Symbol	Parameter	Test condition		Value			Unit
		$V_{CC}$ (V)		$T_A = 25\text{ °C}$			
				Min	Typ	Max	
$C_{IN}$	Input capacitance	2.5 or 3.3	$V_{IN} = 0$ or $V_{CC}$		4		pF
$C_{OUT}$	Output capacitance	2.5 or 3.3	$V_{IN} = 0$ or $V_{CC}$		8		pF
$C_{PD}$	Power dissipation capacitance (1)	2.5 or 3.3	$f_{IN} = 10\text{MHz}$ $V_{IN} = 0$ or $V_{CC}$		28		pF

1.  $C_{PD}$  is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation.  $I_{CC(oper)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/16$  (per circuit)

## 5 Test circuit

Figure 4. Test circuit

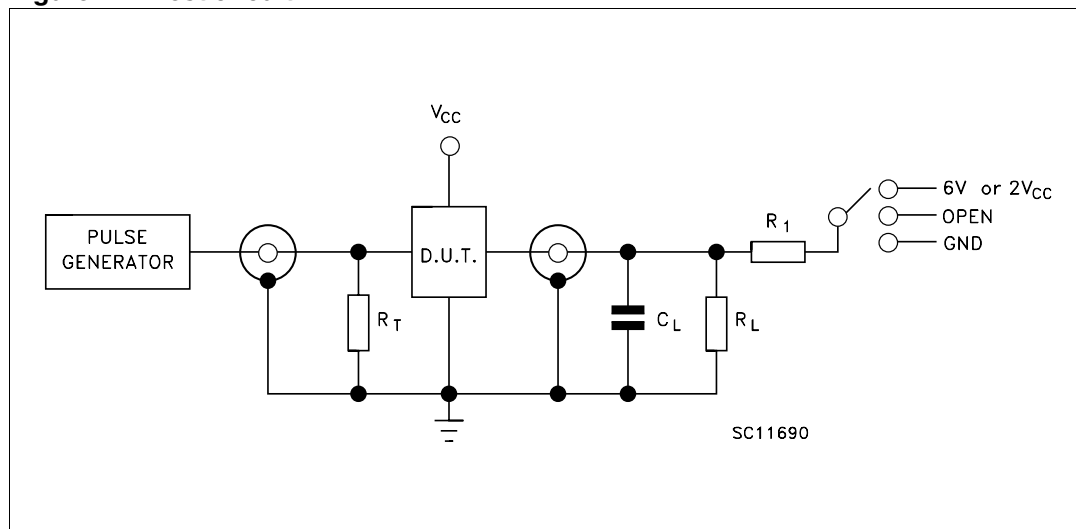


Table 10. Test circuit

Test	Switch
$t_{PLH}$ , $t_{PHL}$	Open
$t_{PZL}$ , $t_{PLZ}$ ( $V_{CC} = 3.0$ to $3.6V$ )	6V
$t_{PZL}$ , $t_{PLZ}$ ( $V_{CC} = 2.3$ to $2.7V$ )	$2V_{CC}$
$t_{PZH}$ , $t_{PHZ}$	GND

$C_L = 30pF$  or equivalent (includes jig and probe capacitance)

$R_L = R_1 = 500\Omega$  or equivalent

$R_T = Z_{OUT}$  of pulse generator (typically  $50\Omega$ )

## 6 Waveforms

Table 11. Waveform symbol value

Symbol	$V_{CC}$	
	3.0 to 3.6V	2.3 to 2.7V
$V_{IH}$	2.7V	$V_{CC}$
$V_M$	1.5V	$V_{CC}/2$
$V_X$	$V_{OL} + 0.3V$	$V_{OL} + 0.15V$
$V_Y$	$V_{OH} - 0.3V$	$V_{OH} - 0.15V$

Figure 5. Waveform - propagation delay ( $f = 1\text{MHz}$ ; 50% duty cycle)

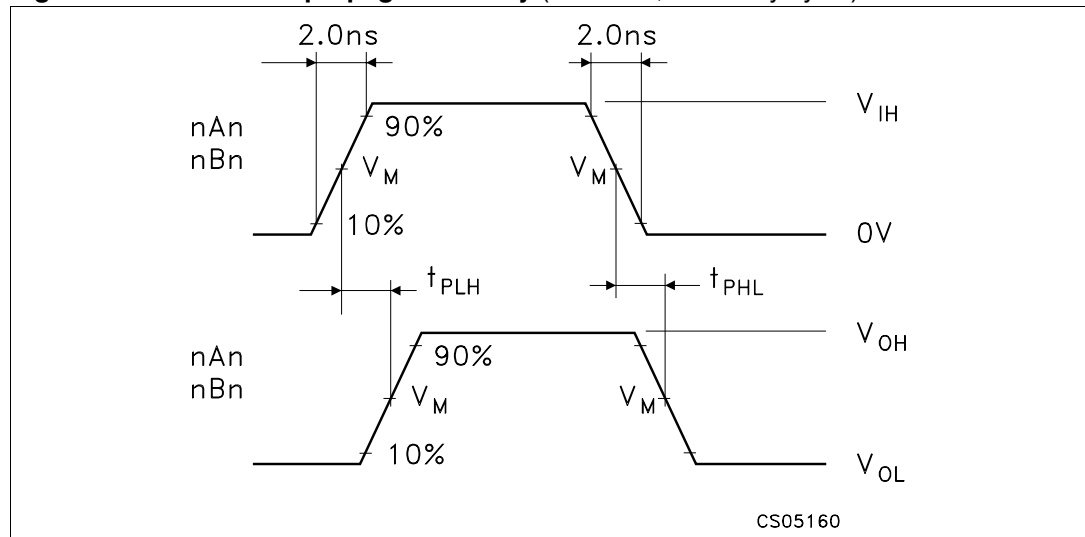
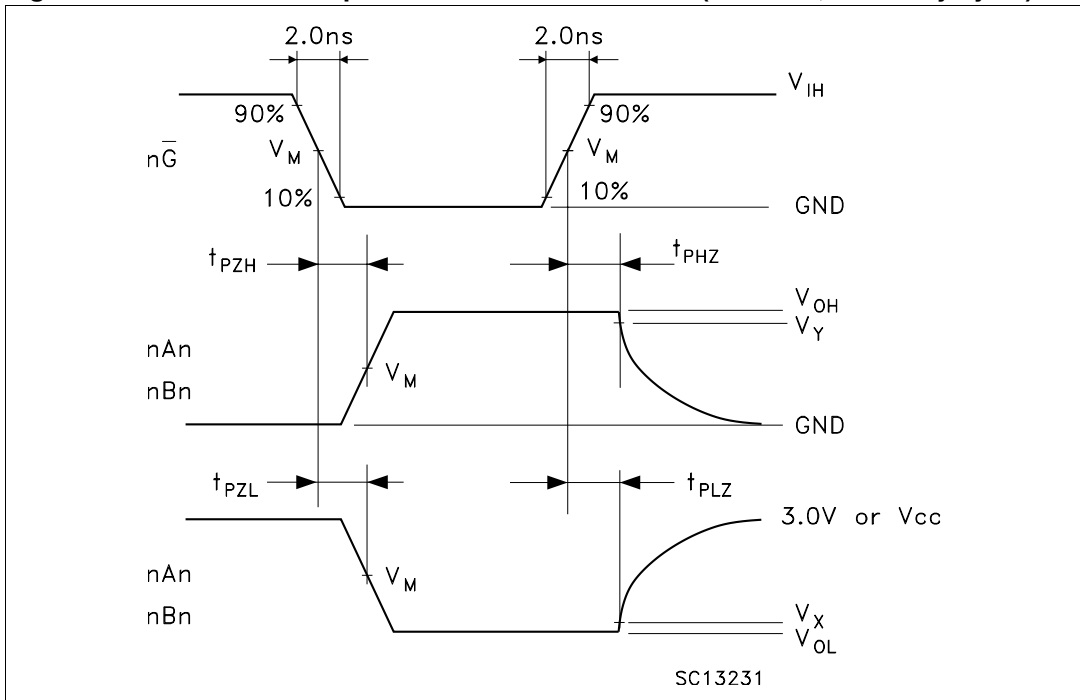


Figure 6. Waveform - output enable and disable time (f = 1MHz; 50% duty cycle)



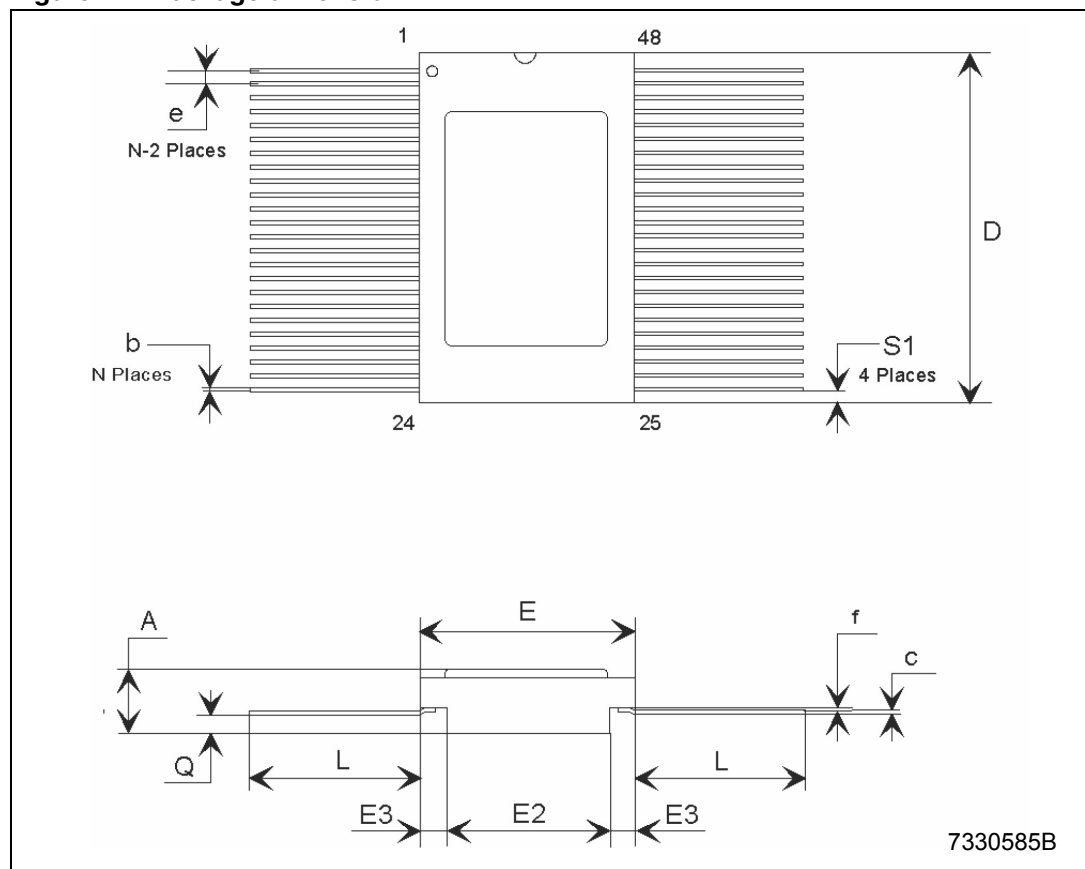
## 7 Package mechanical data

54VCXH162245 Products are supplied into ceramic body / metal lid hermetic Flat 48-pin space package

**Table 12. Flat-48 (MIL-STD-1835) mechanical data**

Dim.	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A	2.18	2.47	2.72	0.086	0.097	0.107
b	0.20	0.254	0.30	0.008	0.010	0.012
c	0.12	0.15	0.18	0.005	0.006	0.007
D	15.57	15.75	15.92	0.613	0.620	0.627
E	9.52	9.65	9.78	0.375	0.380	0.385
E2	6.22	6.35	6.48	0.245	0.250	0.255
E3	1.52	1.65	1.78	0.060	0.065	0.070
e		0.635			0.025	
f		0.20			0.008	
L	6.85	8.38	9.40	0.270	0.330	0.370
Q	0.66	0.79	0.92	0.026	0.031	0.036
S1	0.25	0.43	0.61	0.010	0.017	0.024

**Figure 7. Package dimension**



## 8 Order code

**Table 13. Order code**

Package	Lead finish	Radiation level	Flight model		Engineering model
			QML-V	QML-Q	
Flat-48	Gold	300kRad	RHFXH162245K-01V	RHFXH162245K-01Q	RHRXH162245K1
	Gold	100kRad	RHRXH162245K-01V	RHRXH162245K-01Q	RHRXH162245K1
	Solder dip	100kRad	RHRXH162245K-02V	RHRXH162245K-02Q	Use the above one



## 9 Revision history

Table 14. Revision history

Date	Revision	Changes
06-Jul-2004	1	First release
19-Jul-2004	2	Data on Range -40 to 85°C Removed on Tables 6, 7, 8, 9.
17-May-2005	3	Mechanical Data has been updated.
19-Jun-2006	4	300Krad bullet updated, new template, mechanical data updated
11-Apr-2007	5	Updated coverpage features
27-Jul-2007	6	Typo in <a href="#">Table 12 on page 15</a>

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