74VCX162245

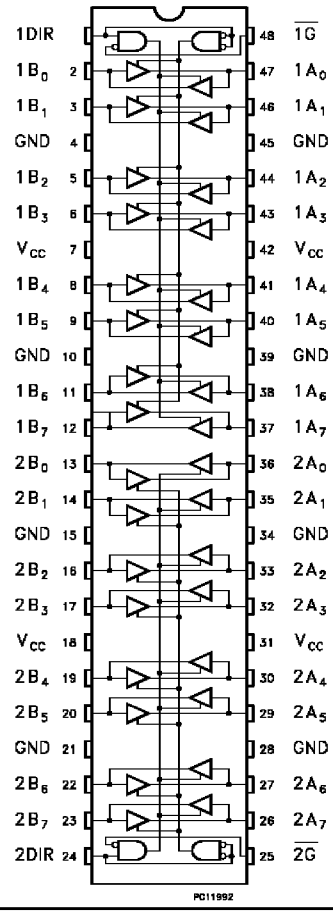
LOW VOLTAGE CMOS 16-BIT BUS TRANSCEIVER (3-STATE) WITH 3.6V TOLERANT INPUTS AND OUTPUTS

- 3.6V TOLERANT INPUTS AND OUTPUTS
- HIGH SPEED A OUTPUTS:
  t_{PD} = 3.4 ns (MAX.) at V_{CC} = 3.0 to 3.6V
  t_{PD} = 4.3 ns (MAX.) at V_{CC} = 2.3 to 2.7V
  t_{PD} = 5.7 ns (MAX.) at V_{CC} = 1.8V
- SYMMETRICAL IMPEDANCE A OUTPUTS:
  $|I_{OH}| = I_{OL}$ = 12 mA (MIN) at V_{CC} = 3.0V
  $|I_{OH}| = I_{OL}$ = 8 mA (MIN) at V_{CC} = 2.3V
  $|I_{OH}| = I_{OL}$ = 4 mA (MIN) at V_{CC} = 1.8V
- HIGH SPEED B OUTPUTS:
  t_{PD} = 2.5 ns (MAX.) at V_{CC} = 3.0 to 3.6V
  t_{PD} = 3.0 ns (MAX.) at V_{CC} = 2.3 to 2.7V
  t_{PD} = 5.0 ns (MAX.) at V_{CC} = 1.8V
- SYMMETRICAL IMPEDANCE B OUTPUTS:
  $|I_{OH}| = I_{OL}$ = 24 mA (MIN) at V_{CC} = 3.0V
  $|I_{OH}| = I_{OL}$ = 18 mA (MIN) at V_{CC} = 2.3V
  $|I_{OH}| = I_{OL}$ = 6 mA (MIN) at V_{CC} = 1.8V
- POWER-DOWN PROTECTION ON INPUTS AND OUTPUTS
- 26Ω SERIE RESITORS IN A PORT OUTPUT
- OPERATING VOLTAGE RANGE:
  V_{CC} (OPR) = 1.8V to 3.6V
- PIN AND FUNCTION COMPATIBLE WITH 74 SERIES 16245
- LATCH-UP PERFORMANCE EXCEEDS 300mA
- ESD PERFORMANCE:
  HBM >2000V; MM > 200V

T
(TSSOP48 Package)

ORDER CODES :
74VCX162245T

PIN CONNECTION



DESCRIPTION

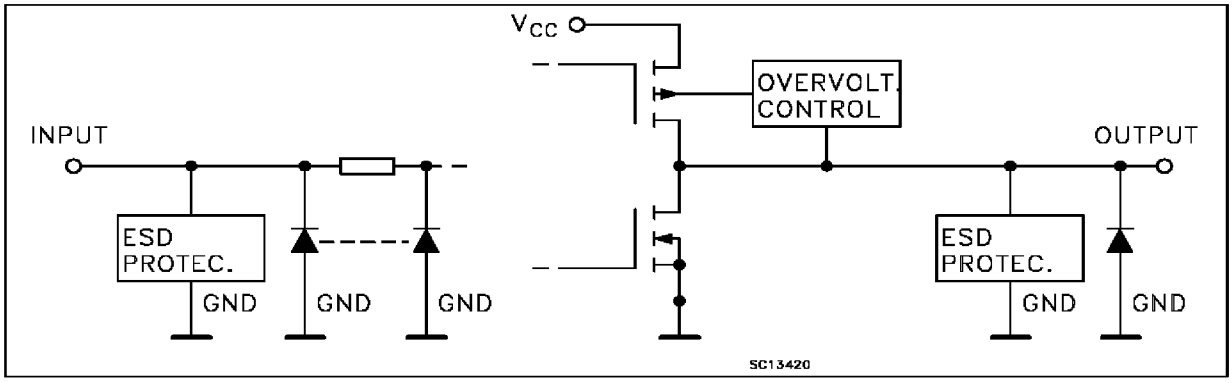
The VCX162245 is a low voltage CMOS 16-BIT BUS TRANSCEIVER (3-STATE) fabricated with sub-micron silicon gate and five layer metal wiring C^2MOS technology. It is ideal for low power and very high speed 1.8 to 3.6V applications; it can be interfaced to 3.6V signal enviroment for both inputs and outputs.

This IC is intended for two-way asynchronous communication beetwen data buses; the direction of data trasmission is determined by DIR input. The two enable inputs $n\overline{G}$ can be used to disable the device so that the buses are effectively isolated. The device circuits is including 26Ω series resistance in the A port outputs. These resistors permit to reduce line noise in high speed applications. All inputs and outputs are equipped

with protection circuits against static discharge, giving them 2KV ESD immunity and transient excess voltage.

NOTE: IT IS PROHIBITED TO APPLY A SIGNAL TO A TERMINAL WHEN IT IS IN OUTPUT MODE AND WHEN A BUS THERMINAL IS FLOATING (HIGH IMPEDANCE STATE) IT IS REQUESTED TO FIX THE INPUT LEVEL BY MEANS OF EXTERNAL PULL DOWN OR PULL UP RESISTOR.

INPUT AND OUTPUT EQUIVALENT CIRCUIT



PIN DESCRIPTION

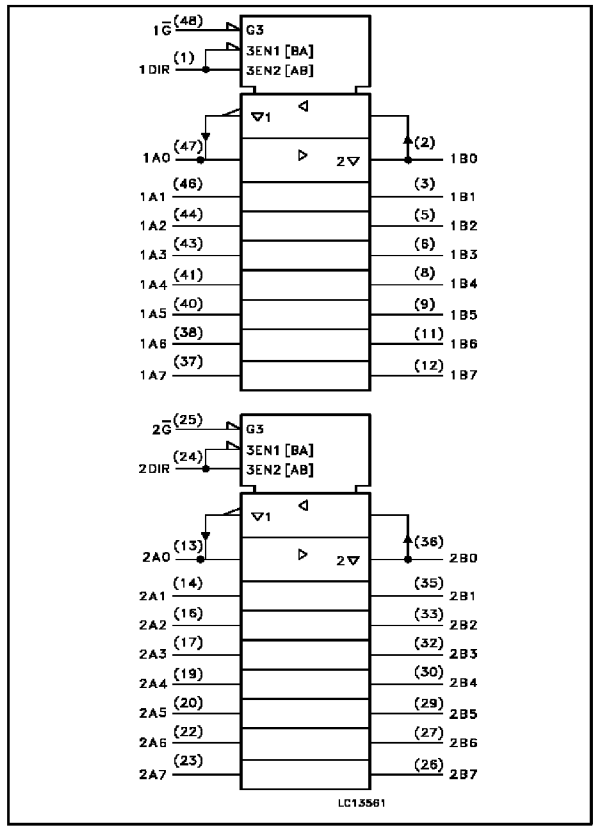
PIN No	SYMBOL	NAME AND FUNCTION
1	1DIR	Directional Control
2, 3, 5, 6, 8, 9, 11, 12	1B0 to 1B7	Data Inputs/Outputs
13, 14, 16, 17, 19, 20, 22, 23	2B0 to 2B7	Data Inputs/Outputs
24	2DIR	Directional Control
25	$\overline{2G}$	Output Enabel Input
36, 35, 33, 32, 30, 29, 27, 26	2A0 to 2A7	Data Inputs/Outputs
47, 46, 44, 43, 41, 40, 38, 37	1A0 to 1A7	Data Inputs/Outputs
48	$\overline{1G}$	Output Enabel Input
4, 10, 15, 21, 28, 34, 39, 45	GND	Ground (0V)
7, 18, 31, 42	V_{CC}	Positive Supply Voltage

TRUTH TABLE

INPUT		FUNCTION		OUTPUT
$\overline{G}$	DIR	A BUS	B BUS	
L	L	OUTPUT	INPUT	A = B
L	H	INPUT	OUTPUT	B = A
H	X	Z	Z	Z

X: "H" or "L"
Z: High impedance

IEC LOGIC SYMBOLS



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) (note1)	-0.5 to V_{CC} + 0.5	V
I_{IK}	DC Input Diode Current	- 50	mA
I_{OK}	DC Output Diode Current (note2)	±50	mA
I_O	DC Output Source/Sink Current	±50	mA
I_{CC} or I_{GND}	DC V_{CC} or Ground Current Per Supply Pin	±100	mA
P_D	Power Dissipation	400	mW
T_{stg}	Storage Temperature	-65 to +150	°C
T_L	Lead Temperature (10 sec)	300	°C

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.
1) I_O absolute maximum rating must be observed
2) $V_O < GND$, $V_O > V_{CC}$

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)	±12	mA
I_{OH}, I_{OL}	High or Low Level Output Current - A side (V_{CC}=2.3 to 2.7V)	±8	mA
I_{OH}, I_{OL}	High or Low Level Output Current - A side (V_{CC} = 1.8V)	±4	mA
I_{OH}, I_{OL}	High or Low Level Output Current - B side (V_{CC}=3.0 to 3.6V)	±24	mA
I_{OH}, I_{OL}	High or Low Level Output Current - B side (V_{CC}=2.3 to 2.7V)	±18	mA
I_{OH}, I_{OL}	High or Low Level Output Current - B side (V_{CC} = 1.8V)	±6	mA
T_{op}	Operating Temperature:	-40 to +85	°C
dt/dv	Input Transition Rise or Fall Rate (V_{CC} = 3.0V) (note 1)	0 to 10	ns/V

1) V_{IN} from 0.8V to 2.0V, V_{CC} = 3.0V

DC SPECIFICATIONS (2.7V < V_{CC} ≤ 3.6V unless otherwise specified)

Symbol	Parameter	Test Conditions			Value		Unit
		V_{CC} (V)			-40 to 85 °C		
					Min.	Max.	
V_{IH}	High Level Input Voltage	2.7 to 3.6			2.0		V
V_{IL}	Low Level Input Voltage					0.8	V
V_{OH}	High Level Output Voltage (A Outputs)	2.7 to 3.6	$V_I = V_{IH}$ or V_{IL}	I_O=-100 µA	V_{CC}-0.2		V
		2.7		I_O=-6 mA	2.2		
		3.0		I_O=-8 mA	2.4		
		3.0		I_O=-12 mA	2.2		
V_{OH}	High Level Output Voltage (B Outputs)	2.7 to 3.6	$V_I = V_{IH}$ or V_{IL}	I_O=-100 µA	V_{CC}-0.2		V
		2.7		I_O=-12 mA	2.2		
		3.0		I_O=-18 mA	2.4		
		3.0		I_O=-24 mA	2.2		
V_{OL}	Low Level Output Voltage (A Outputs)	2.7 to 3.6	$V_I = V_{IH}$ or V_{IL}	I_O=100 µA		0.2	V
		2.7		I_O=6 mA		0.4	
		3.0		I_O=8 mA		0.5	
		3.0		I_O=12 mA		0.8	
V_{OL}	Low Level Output Voltage (B Outputs)	2.7 to 3.6	$V_I = V_{IH}$ or V_{IL}	I_O=100 µA		0.2	V
		2.7		I_O=12 mA		0.4	
		3.0		I_O=18 mA		0.4	
		3.0		I_O=24 mA		0.55	
I_I	Input Leakage Current	2.7 to 3.6	V_I = 0 to 3.6 V			±5	µA
I_{OZ}	3 State Output Leakage Current	2.7 to 3.6	$V_I = V_{IH}$ or V_{IL} V_O = 0 to 3.6V			±10	µA
I_{off}	Power Off Leakage Current	0	V_I or V_O = 0 to 3.6V			10	µA
I_{CC}	Quiescent Supply Current	2.7 to 3.6	$V_I = V_{CC}$ or GND			20	µA
			V_I or $V_O = V_{CC}$ to 3.6 V			±20	
ΔI_{CC}	ICC incr. per input	2.7 to 3.6	$V_{IH} = V_{CC}$ -0.6V			750	µA

DC SPECIFICATIONS (2.3V < V_{CC} ≤ 2.7V unless otherwise specified)

Symbol	Parameter	Test Conditions			Value		Unit
		V_{CC} (V)			-40 to 85 °C		
					Min.	Max.	
V_{IH}	High Level Input Voltage	2.3 to 2.7			1.6		V
V_{IL}	Low Level Input Voltage					0.7	V
V_{OH}	High Level Output Voltage (A Outputs)	2.3 to 2.7	$V_I = V_{IH}$ or V_{IL}	I_O=-100 µA	V_{CC}-0.2		V
		2.3		I_O=-4 mA	2.0		
		2.3		I_O=-6 mA	1.8		
		2.3		I_O=-8 mA	1.7		
V_{OH}	High Level Output Voltage (B Outputs)	2.3 to 2.7	$V_I = V_{IH}$ or V_{IL}	I_O=-100 µA	V_{CC}-0.2		V
		2.3		I_O=-6 mA	2.0		
		2.3		I_O=-12 mA	1.8		
		2.3		I_O=-18 mA	1.7		
V_{OL}	Low Level Output Voltage (A Outputs)	2.3 to 2.7	$V_I = V_{IH}$ or V_{IL}	I_O=100 µA		0.2	V
		2.3		I_O=6 mA		0.4	
		2.3		I_O=8 mA		0.6	
V_{OL}	Low Level Output Voltage (B Outputs)	2.3 to 2.7	$V_I = V_{IH}$ or V_{IL}	I_O=100 µA		0.2	V
		2.3		I_O=12 mA		0.4	
		2.3		I_O=18 mA		0.6	
I_I	Input Leakage Current	2.3 to 2.7	V_I = 0 to 3.6 V			±5	µA
I_{OZ}	3 State Output Leakage Current	2.3 to 2.7	$V_I = V_{IH}$ or V_{IL} V_O = 0 to 3.6V			±10	µA
I_{off}	Power Off Leakage Current	0	V_I or V_O = 0 to 3.6V			10	µA
I_{CC}	Quiescent Supply Current	2.3 to 2.7	$V_I = V_{CC}$ or GND			20	µA
			V_I or V_O = V_{CC} to 3.6 V			±20	

DC SPECIFICATIONS (1.8V ≤ V_{CC} ≤ 2.3V unless otherwise specified)

Symbol	Parameter	Test Conditions			Value		Unit
		V_{CC} (V)			-40 to 85 °C		
					Min.	Max.	
V_{IH}	High Level Input Voltage	1.8 to 2.3			0.7V_{CC}		V
V_{IL}	Low Level Input Voltage					0.2V_{CC}	V
V_{OH}	High Level Output Voltage (A Outputs)	1.8	$V_I = V_{IH}$ or V_{IL}	I_O=-100 µA	V_{CC}-0.2		V
		1.8		I_O=-4 mA	1.4		
V_{OH}	High Level Output Voltage (B Outputs)	1.8	$V_I = V_{IH}$ or V_{IL}	I_O=-100 µA	V_{CC}-0.2		V
		1.8		I_O=-6 mA	1.4		
V_{OL}	Low Level Output Voltage (A Outputs)	1.8	$V_I = V_{IH}$ or V_{IL}	I_O=100 µA		0.2	V
		1.8		I_O=4 mA		0.3	
V_{OL}	Low Level Output Voltage (B Outputs)	1.8	$V_I = V_{IH}$ or V_{IL}	I_O=100 µA		0.2	V
		1.8		I_O=6 mA		0.3	
I_I	Input Leakage Current	1.8	V_I = 0 to 3.6 V			±5	µA
I_{OZ}	3 State Output Leakage Current	1.8	$V_I = V_{IH}$ or V_{IL} V_O = 0 to 3.6V			±10	µA
I_{off}	Power Off Leakage Current	0	V_I or V_O = 0 to 3.6V			10	µA
I_{CC}	Quiescent Supply Current	1.8	$V_I = V_{CC}$ or GND			20	µA
			V_I or $V_O = V_{CC}$ to 3.6 V			±20	

DYNAMIC SWITCHING CHARACTERISTICS (T_a = 25°C, Input $t_r = t_f$ = 2.0ns, C_L = 30pF)

Symbol	Parameter	Test Conditions		Value			Unit
		V_{CC} (V)		T_A = 25 °C			
				Min.	Typ.	Max.	
V_{OLP}	Dynamic Peak Low Voltage Quiet Output (note 1, 3), A to B	1.8	V_{IL} = 0 V $V_{IH} = V_{CC}$		0.25		V
		2.5			0.6		
		3.3			0.8		
V_{OLP}	Dynamic Peak Low Voltage Quiet Output (note 1, 3) B to A	1.8	V_{IL} = 0 V $V_{IH} = V_{CC}$		0.15		V
		2.5			0.25		
		3.3			0.35		
V_{OLV}	Dynamic Valley Low Voltage Quiet Output (note 1, 3) A to B	1.8	V_{IL} = 0 V $V_{IH} = V_{CC}$		-0.25		V
		2.5			-0.6		
		3.3			-0.8		
V_{OLV}	Dynamic Valley Low Voltage Quiet Output (note 1, 3) B to A	1.8	V_{IL} = 0 V $V_{IH} = V_{CC}$		-0.15		V
		2.5			-0.25		
		3.3			-0.35		
V_{OHV}	Dynamic Valley High Voltage Quiet Output (note 2, 3) A to B	1.8	V_{IL} = 0 V $V_{IH} = V_{CC}$		1.5		V
		2.5			1.9		
		3.3			2.2		
V_{OHV}	Dynamic Valley High Voltage Quiet Output (note 2, 3) B to A	1.8	V_{IL} = 0 V $V_{IH} = V_{CC}$		1.55		V
		2.5			2.05		
		3.3			2.65		

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

AC ELECTRICAL CHARACTERISTICS (C_L = 30 pF, R_L = 500 Ω, Input t_r = t_f = 2.0 ns)

Symbol	Parameter	Test Condition		Value		Unit
		V_{CC} (V)	Waveform	-40 to 85 °C		
				Min.	Max.	
t_{PLH} t_{PHL}	Propagation Delay Time A to B	1.8	1	1.5	5.0	ns
		2.3 to 2.7		1.0	3.0	
		3.0 to 3.6		0.8	2.5	
t_{PLH} t_{PHL}	Propagation Delay Time B to A	1.8	1	1.5	5.7	ns
		2.3 to 2.7		1.0	4.3	
		3.0 to 3.6		0.8	3.4	
t_{PZL} t_{PZH}	Output Enable Time A to B	1.8	2	1.5	7.5	ns
		2.3 to 2.7		1.0	4.9	
		3.0 to 3.6		0.8	3.8	
t_{PZL} t_{PZH}	Output Enable Time B to A	1.8	2	1.5	7.6	ns
		2.3 to 2.7		1.0	5.7	
		3.0 to 3.6		0.8	4.2	
t_{PLZ} t_{PHZ}	Output Disable Time A to B	1.8	2	1.5	5.5	ns
		2.3 to 2.7		1.0	4.2	
		3.0 to 3.6		0.8	3.7	
t_{PLZ} t_{PHZ}	Output Disable Time B to A	1.8	2	1.5	5.7	ns
		2.3 to 2.7		1.0	4.8	
		3.0 to 3.6		0.8	4.1	
t_{OSLH} t_{OSHL}	Output to Output Skew Time (note 1, 2)	1.8			0.5	ns
		2.3 to 2.7			0.5	
		3.0 to 3.6			0.5	

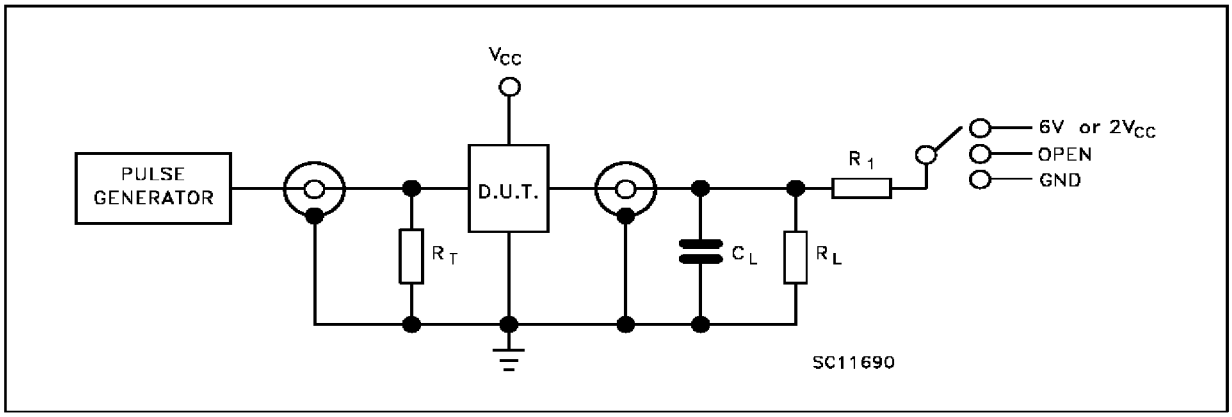
1) Skew is defined as the absolute value of the difference between the actual propagation delay for any two outputs of the same device switching in the same direction, either HIGH or LOW ($t_{OSLH} = |t_{PLHm} - t_{PLHn}|$, $t_{OSHL} = |t_{PHLm} - t_{PHLn}|$)
2) Parameter guaranteed by design

CAPACITIVE CHARACTERISTICS

Symbol	Parameter	Test Conditions		Value			Unit
		V_{CC} (V)		T_A = 25 °C			
				Min.	Typ.	Max.	
C_{IN}	Input Capacitance	1.8, 2.5 or 3.3	V_{IN} = 0V or V_{CC}		4		pF
C_{OUT}	Output Capacitance	1.8, 2.5 or 3.3	V_{IN} = 0V or V_{CC}		8		pF
C_{PD}	Power Dissipation Capacitance (note 1)	1.8, 2.5 or 3.3	f_{IN} = 10MHz V_{IN} = 0V 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. Average operting current can be obtained by the following equation. $I_{CC}(opr) = C_{PD} \bullet V_{CC} \bullet f_{IN} + I_{CC}/16$ (per circuit)

TEST CIRCUIT



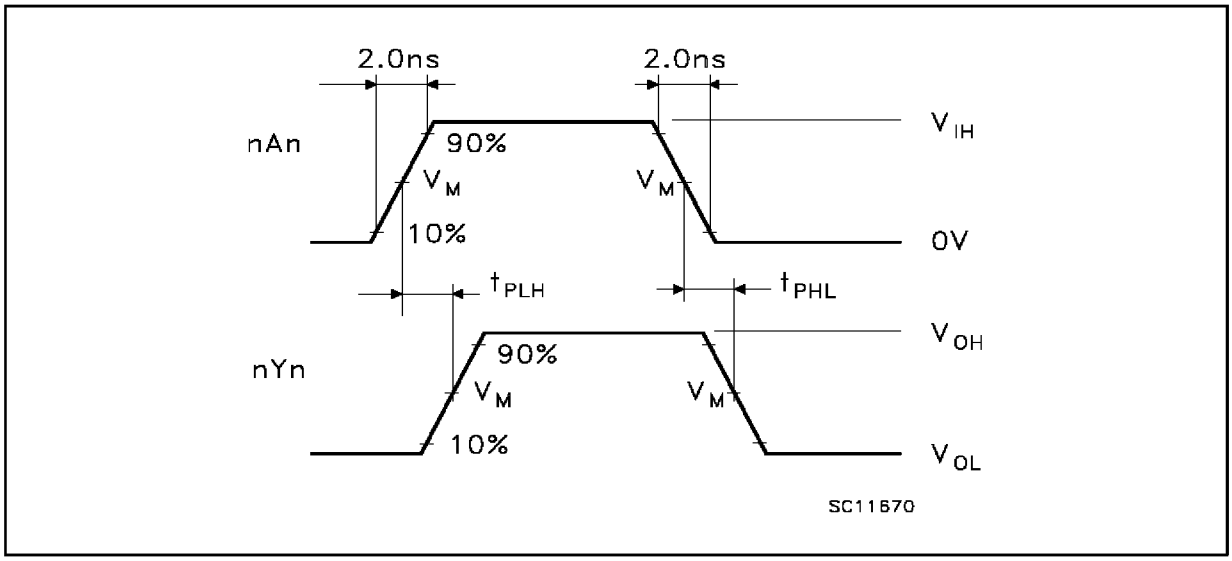
TEST	SWITCH
t_{PLH}, t_{PHL}	Open
t_{PZL}, t_{PLZ} (V_{CC} = 3.0 to 3.6V)	6V
t_{PZL}, t_{PLZ} (V_{CC} = 2.3 to 2.7V or 1.8V)	$2V_{CC}$
t_{PZH}, t_{PHZ}	GND

C_L = 30 pF or equivalent (includes jig and probe capacitance)
$R_L = R_1$ = 500Ω or equivalent
$R_T = Z_{OUT}$ of pulse generator (typically 50Ω)

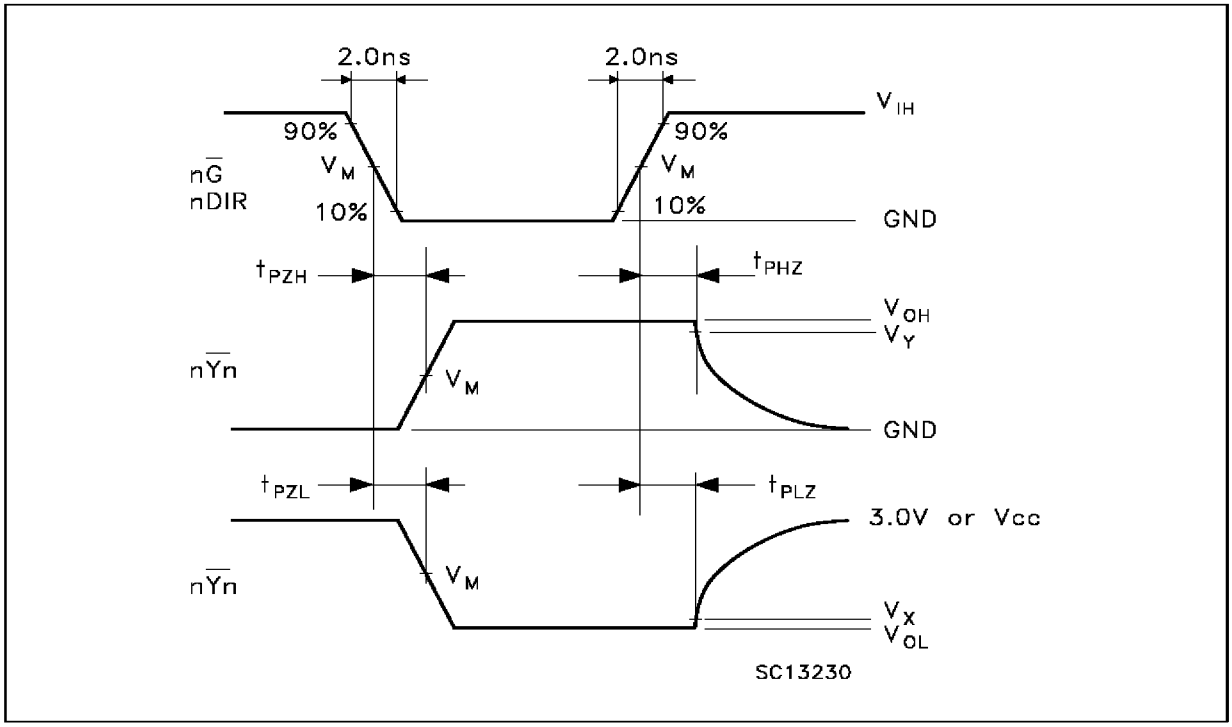
WAVEFORM SYMBOL VALUES

Symbol	V_{CC}		
	3.0 to 3.6V	2.3 to 2.7V	1.8V
V_{IH}	2.7V	V_{CC}	V_{CC}
V_M	1.5V	$V_{CC}/2$	$V_{CC}/2$
V_X	V_{OL} + 0.3V	V_{OL} + 0.15V	V_{OL} + 0.15V
V_Y	V_{OH} - 0.3V	V_{OH} - 0.15V	V_{OH} - 0.15V

WAVEFORM 1: PROPAGATION DELAYS (f=1MHz; 50% duty cicle)



WAVEFORM 2: OUTPUT ENABLE AND DISABLE TIME (f=1MHz; 50% duty cicle)



TSSOP48 MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.1			0.433
A1	0.05	0.10	0.15	0.002	0.004	0.006
A2	0.85	0.9	0.95	0.335	0.354	0.374
b	0.17		0.27	0.0067		0.011
c	0.09		0.20	0.0035		0.0079
D	12.4	12.5	12.6	0.408	0.492	0.496
E	7.95	8.1	8.25	0.313	0.319	0.325
E1	6.0	6.1	6.2	0.236	0.240	0.244
e		0.5 BSC			0.0197 BSC	
K	0^o	4^o	8^o	0^o	4^o	8^o
L	0.50	0.60	0.70	0.020	0.024	0.028