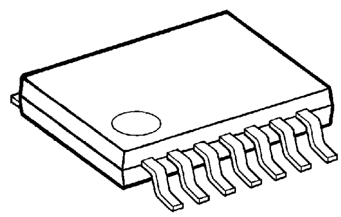
TENTATIVE TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TC74VCX02FT

LOW-VOLTAGE QUAD 2-INPUT NOR GATE WITH 3.6 V TOLERANT INPUTS AND OUTPUTS

The TC74VCX02FT is a high performance CMOS 2-input NOR gate. Designed for use in 1.8, 2.5 or 3.3 Volt systems, it achieves high speed operation while maintaining the CMOS low power dissipation.
It is also designed with over voltage tolerant inputs and outputs up to 3.6 V.
All inputs are equipped with protection circuits against static discharge.



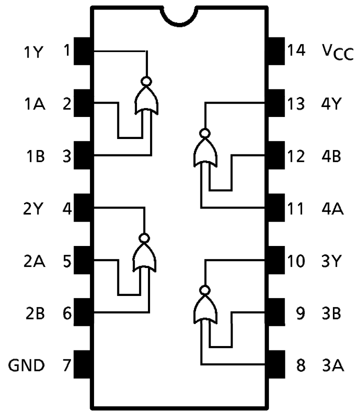
TSSOP14-P-0044-0.65

Weight : 0.06 g (Typ.)

FEATURES

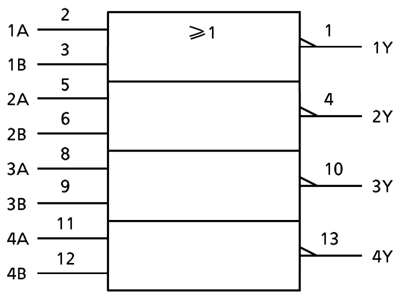
- Low Voltage Operation: V_{CC} = 1.8~3.6 V
- High Speed Operation : t_{pd} = 2.8 ns (max) at V_{CC} = 3.0~3.6 V
  t_{pd} = 3.7 ns (max) at V_{CC} = 2.3~2.7 V
  t_{pd} = 7.4 ns (max) at V_{CC} = 1.8 V
- Output Current : I_{OH} / I_{OL} = ±24 mA (min) at V_{CC} = 3.0 V
  I_{OH} / I_{OL} = ±18 mA (min) at V_{CC} = 2.3 V
  I_{OH} / I_{OL} = ±6 mA (min) at V_{CC} = 1.8 V
- Latch-up Performance : ±300 mA
- ESD Performance : Human body model > ±2000 V
  Machine model > ±200 V
- Package : TSSOP (Thin Shrink Small Outline Package)
- Power down protection is provided on all inputs and outputs.

PIN ASSIGNMENT



(TOP VIEW)

IEC LOGIC SYMBOL



TRUTH TABLE

INPUTS		OUTPUTS
A	B	Y
L	L	H
L	H	L
H	L	L
H	H	L

MAXIMUM RATINGS

PARAMETER	SYMBOL	RATING	UNIT
Power Supply Voltage	V_{CC}	−0.5~4.6	V
DC Input Voltage	V_{IN}	−0.5~4.6	V
DC Output Voltage	V_{OUT}	−0.5~4.6 (Note 1)	V
		−0.5~V_{CC} + 0.5 (Note 2)	
Input Diode Current	I_{IK}	−50	mA
Output Diode Current	I_{OK}	±50 (Note 3)	mA
DC Output Current	I_{OUT}	±50	mA
Power Dissipation	P_D	180	mW
DC V_{CC}/Ground Current	I_{CC}/I_{GND}	±100	mA
Storage Temperature	T_{stg}	−65~150	°C

(Note 1) : $V_{CC} = 0$ V
(Note 2) : High or Low State. I_{OUT} absolute maximum rating must be observed.
(Note 3) : $V_{OUT} < GND$, $V_{OUT} > V_{CC}$

RECOMMENDED OPERATING RANGE

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	1.8~3.6	V
		1.2~3.6 (Note 4)	
Input Voltage	V_{IN}	−0.3~3.6	V
Output Voltage	V_{OUT}	0~3.6 (Note 5)	V
		0~ V_{CC} (Note 6)	
Output Current	I_{OH} / I_{OL}	±24 (Note 7)	mA
		±18 (Note 8)	
		±6 (Note 9)	
Operating Temperature	T_{opr}	−40~85	°C
Input Rise And Fall Time	dt / dv	0~10 (Note 10)	ns / V

(Note 4) : Data Retention Only
(Note 5) : V_{CC} = 0 V
(Note 6) : High or Low State
(Note 7) : V_{CC} = 3.0~3.6 V
(Note 8) : V_{CC} = 2.3~2.7 V
(Note 9) : V_{CC} = 1.8 V
(Note 10) : V_{IN} = 0.8~2.0 V, V_{CC} = 3.0 V

ELECTRICAL CHARACTERISTICS

DC characteristics (Ta = −40~85°C, 2.7 V < V_{CC} ≦ 3.6 V)

PARAMETER		SYMBOL	TEST CONDITION		V_{CC} (V)	Min	Max	UNIT
Input Voltage	"H" Level	V_{IH}			2.7~3.6	2.0	—	V
	"L" Level	V_{IL}			2.7~3.6	—	0.8	
Output Voltage	"H" Level	V_{OH}	V_{IN} = V_{IL}	I_{OH} = −100 μA	2.7~3.6	V_{CC} − 0.2	—	V
				I_{OH} = −12 mA	2.7	2.2	—	
				I_{OH} = −18 mA	3.0	2.4	—	
				I_{OH} = −24 mA	3.0	2.2	—	
	"L" Level	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 100 μA	2.7~3.6	—	0.2	
				I_{OL} = 12 mA	2.7	—	0.4	
				I_{OL} = 18 mA	3.0	—	0.4	
				I_{OL} = 24 mA	3.0	—	0.55	
Input Leakage Current		I_{IN}	V_{IN} = 0~3.6 V		2.7~3.6	—	±5.0	μA
Power Off Leakage Current		I_{OFF}	V_{IN}, V_{OUT} = 0~3.6 V		0	—	10.0	μA
Quiescent Supply Current		I_{CC}	V_{IN} = V_{CC} or GND		2.7~3.6	—	20.0	μA
			V_{CC} ≦ V_{IN} ≦ 3.6 V		2.7~3.6	—	±20.0	
Increase In I_{CC} Per Input		ΔI_{CC}	V_{IH} = V_{CC} − 0.6 V		2.7~3.6	—	750	μA

ELECTRICAL CHARACTERISTICS

DC characteristics (Ta = −40~85°C, 2.3 V ≦ V_{CC} ≦ 2.7 V)

PARAMETER		SYMBOL	TEST CONDITION		V_{CC} (V)	Min	Max	UNIT
Input Voltage	"H" Level	V_{IH}			2.3~2.7	1.6	—	V
	"L" Level	V_{IL}			2.3~2.7	—	0.7	
Output Voltage	"H" Level	V_{OH}	V_{IN} = V_{IL}	I_{OH} = −100 μA	2.3~2.7	V_{CC} − 0.2	—	V
				I_{OH} = −6 mA	2.3	2.0	—	
				I_{OH} = −12 mA	2.3	1.8	—	
				I_{OH} = −18 mA	2.3	1.7	—	
	"L" Level	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 100 μA	2.3~2.7	—	0.2	
				I_{OL} = 12 mA	2.3	—	0.4	
				I_{OL} = 18 mA	2.3	—	0.6	
Input Leakage Current		I_{IN}	V_{IN} = 0~3.6 V		2.3~2.7	—	±5.0	μA
Power Off Leakage Current		I_{OFF}	V_{IN}, V_{OUT} = 0~3.6 V		0	—	10.0	μA
Quiescent Supply Current		I_{CC}	V_{IN} = V_{CC} or GND		2.3~2.7	—	20.0	μA
			V_{CC} ≦ V_{IN} ≦ 3.6 V		2.3~2.7	—	±20.0	

ELECTRICAL CHARACTERISTICS

DC characteristics (Ta = −40~85°C, 1.8 V ≦ V_{CC} < 2.3 V)

PARAMETER		SYMBOL	TEST CONDITION		V_{CC} (V)	Min	Max	UNIT
Input Voltage	"H" Level	V_{IH}			1.8~2.3	0.7 × V_{CC}	—	V
	"L" Level	V_{IL}			1.8~2.3	—	0.2 × V_{CC}	
Output Voltage	"H" Level	V_{OH}	V_{IN} = V_{IL}	I_{OH} = −100 μA	1.8	V_{CC} − 0.2	—	V
				I_{OH} = −6 mA	1.8	1.4	—	
	"L" Level	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 100 μA	1.8	—	0.2	
				I_{OL} = 6 mA	1.8	—	0.3	
Input Leakage Current		I_{IN}	V_{IN} = 0~3.6 V		1.8	—	±5.0	μA
Power Off Leakage Current		I_{OFF}	V_{IN}, V_{OUT} = 0~3.6 V		0	—	10.0	μA
Quiescent Supply Current		I_{CC}	V_{IN} = V_{CC} or GND		1.8	—	20.0	μA
			V_{CC} ≦ V_{IN} ≦ 3.6 V		1.8	—	±20.0	

AC characteristics (Ta = −40~85°C, Input t_r = t_f = 2.0 ns, C_L = 30 pF, R_L = 500 Ω)

PARAMETER	SYMBOL	TEST CONDITION	V_{CC} (V)	Min	Max	UNIT
Propagation Delay Time	t_{pLH} t_{pHL}	(Fig.1, 2)	1.8	1.0	7.4	ns
			2.5 ± 0.2	0.8	3.7	
			3.3 ± 0.3	0.6	2.8	
Output To Output Skew	t_{osLH} t_{osHL}	(Note 11)	1.8	—	0.5	ns
			2.5 ± 0.2	—	0.5	
			3.3 ± 0.3	—	0.5	

For C_L = 50 pF, add approximately 300 ps to the AC maximum specification.

(Note 11) : Parameter guaranteed by design.
($t_{osLH} = |t_{pLHm} - t_{pLHn}|$, $t_{osHL} = |t_{pHLm} - t_{pHLn}|$)

Dynamic switching characteristics (Ta = 25°C, Input $t_r = t_f = 2.0$ ns, $C_L = 30$ pF)

PARAMETER	SYMBOL	TEST CONDITION	V_{CC} (V)	Typ.	UNIT
Quiet Output Maximum Dynamic V_{OL}	V_{OLP}	$V_{IH} = 1.8$ V, $V_{IL} = 0$ V (Note 12)	1.8	0.25	V
		$V_{IH} = 2.5$ V, $V_{IL} = 0$ V (Note 12)	2.5	0.6	
		$V_{IH} = 3.3$ V, $V_{IL} = 0$ V (Note 12)	3.3	0.8	
Quiet Output Minimum Dynamic V_{OL}	V_{OLV}	$V_{IH} = 1.8$ V, $V_{IL} = 0$ V (Note 12)	1.8	−0.25	V
		$V_{IH} = 2.5$ V, $V_{IL} = 0$ V (Note 12)	2.5	−0.6	
		$V_{IH} = 3.3$ V, $V_{IL} = 0$ V (Note 12)	3.3	−0.8	
Quiet Output Minimum Dynamic V_{OH}	V_{OHV}	$V_{IH} = 1.8$ V, $V_{IL} = 0$ V (Note 12)	1.8	1.5	V
		$V_{IH} = 2.5$ V, $V_{IL} = 0$ V (Note 12)	2.5	1.9	
		$V_{IH} = 3.3$ V, $V_{IL} = 0$ V (Note 12)	3.3	2.2	

(Note 12) : Parameter guaranteed by design.

Capacitive characteristics (Ta = 25°C)

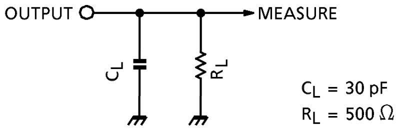
PARAMETER	SYMBOL	TEST CONDITION	V_{CC} (V)	Typ.	UNIT
Input Capacitance	C_{IN}		1.8, 2.5, 3.3	6	pF
Power Dissipation Capacitance	C_{PD}	$f_{IN} = 10$ MHz (Note 13)	1.8, 2.5, 3.3	20	pF

(Note 13) : C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.
Average operating current can be obtained by the equation :

$$I_{CC\,(opr.)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/4 \text{ (per gate)}$$

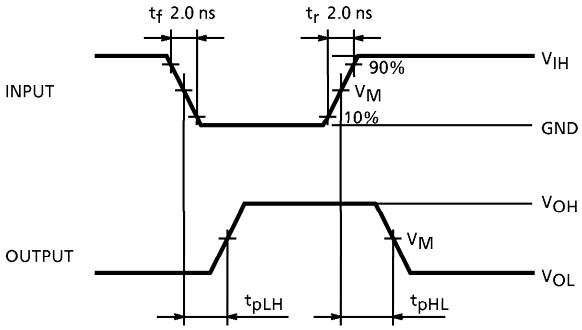
TEST CIRCUIT

Fig.1



AC WAVEFORM

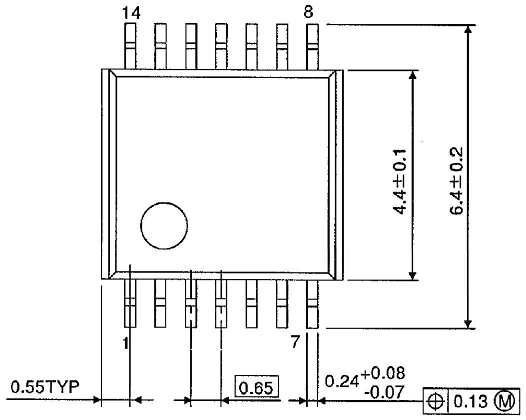
Fig.2 t_{pLH}, t_{pHL}

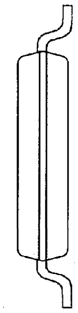


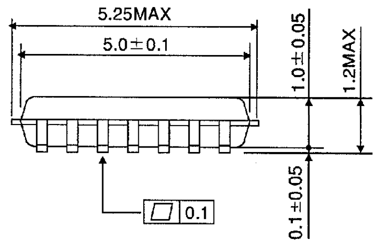
SYMBOL	V_{CC}		
	3.3 ± 0.3 V	2.5 ± 0.2 V	1.8 V
V_{IH}	2.7 V	V_{CC}	V_{CC}
V_M	1.5 V	$V_{CC}/2$	$V_{CC}/2$

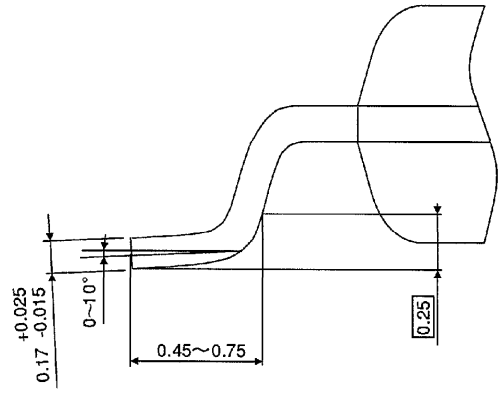
PACKAGE DIMENSIONS

TSSOP14-P-0044-0.65 Unit : mm









Weight : 0.06 g (Typ.)

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