

TC74VCX14FT

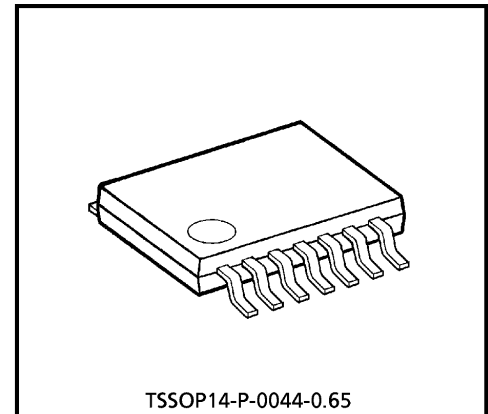
LOW-VOLTAGE HEX SCHMITT INVERTER WITH 3.6 V TOLERANT INPUTS AND OUTPUTS

The TC74VCX14FT is a high performance CMOS schmitt inverter. 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.

Pin configuration and function are the same as the TC74VCX04 but the inputs have hysteresis and with its schmitt trigger function, the TC74VCX14 can be used as a line receivers which will receive slow input signals.

All inputs are equipped with protection circuits against static discharge.



Weight : 0.06 g (Typ.)

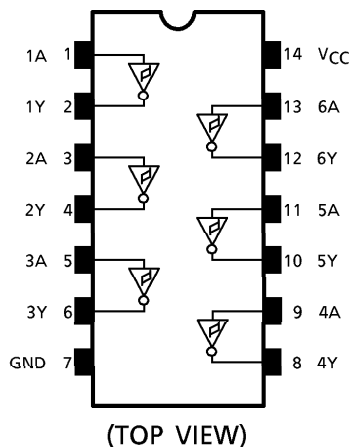
FEATURES

- Low voltage operation : $V_{CC} = 1.8\sim 3.6\text{ V}$
- High speed operation : $t_{pd} = \text{TBD (max) at } V_{CC} = 3.0\sim 3.6\text{ V}$
 $t_{pd} = \text{TBD (max) at } V_{CC} = 2.3\sim 2.7\text{ V}$
 $t_{pd} = \text{TBD (max) at } V_{CC} = 1.8\text{ V}$
- Output current : $I_{OH}/I_{OL} = \pm 24\text{ mA (min) at } V_{CC} = 3.0\text{ V}$
 $I_{OH}/I_{OL} = \pm 18\text{ mA (min) at } V_{CC} = 2.3\text{ V}$
 $I_{OH}/I_{OL} = \pm 6\text{ mA (min) at } V_{CC} = 1.8\text{ V}$
- Latch-up performance : $\pm 300\text{ mA}$
- ESD performance : Human body model $> \pm 2000\text{ V}$
Machine model $> \pm 200\text{ V}$
- Package : TSSOP
(Thin Shrink Small Outline Package)
- Power down protection is provided on all inputs and outputs.

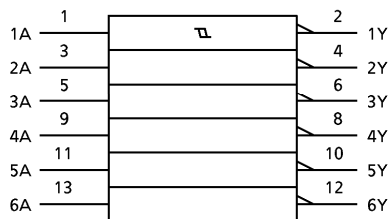
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PIN ASSIGNMENT



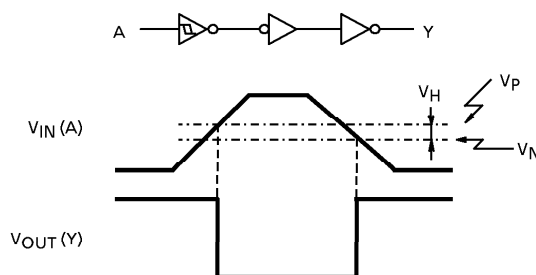
IEC LOGIC SYMBOL



TRUTH TABLE

| INPUTS | OUTPUTS |
|--------|---------|
| A | Y |
| L | H |
| H | L |

SYSTEM DIAGRAM, WAVEFORM



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) : $V_{CC} = 0\text{ V}$

(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 |

- (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

ELECTRICAL CHARACTERISTICS

DC characteristics (T_a = -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 _P | | | 3.6 | — | TBD | V |
| | | | | | 3.0 | — | TBD | |
| | "L" Level | V _{IN} | | | 3.6 | TBD | — | |
| | | | | | 3.0 | TBD | — | |
| Hysteresis Voltage | | V _H | | | 3.6 | TBD | TBD | V |
| | | | | | 3.0 | TBD | TBD | |
| 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} | 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 |

DC characteristics (Ta = -40~85°C, 2.3 V ≤ VCC ≤ 2.7 V)

| PARAMETER | | SYMBOL | TEST CONDITION | | VCC (V) | MIN | MAX | UNIT |
|---------------------------|-----------|------------------|---------------------|---------------|---------|-----------|--------|------|
| Input Voltage | "H" Level | Vp | | | 2.3 | — | TBD | V |
| | "L" Level | VN | | | 2.3 | TBD | — | |
| Hysteresis Voltage | | VH | | | 2.3 | TBD | TBD | V |
| Output Voltage | "H" Level | VOH | VIN = VIL | IOH = -100 μA | 2.3~2.7 | VCC - 0.2 | — | V |
| | | | | IOH = -6 mA | 2.3 | 2.0 | — | |
| | | | | IOH = -12 mA | 2.3 | 1.8 | — | |
| | | | | IOH = -18 mA | 2.3 | 1.7 | — | |
| | "L" Level | VOL | VIN = VIH | IOL = 100 μA | 2.3~2.7 | — | 0.2 | |
| | | | | IOL = 12 mA | 2.3 | — | 0.4 | |
| IOL = 18 mA | | | | 2.3 | — | 0.6 | | |
| Input Leakage Current | | IIN | VIN = 0~3.6 V | | 2.3~2.7 | — | ± 5.0 | μA |
| Power Off Leakage Current | | I _{OFF} | VIN, VOUT = 0~3.6 V | | 0 | — | 10.0 | μA |
| Quiescent Supply Current | | ICC | VIN = VCC or GND | | 2.3~2.7 | — | 20.0 | μA |
| | | | VCC ≤ VIN ≤ 3.6 V | | 2.3~2.7 | — | ± 20.0 | |

DC characteristics (Ta = -40~85°C, 1.8 V ≤ VCC < 2.3 V)

| PARAMETER | | SYMBOL | TEST CONDITION | | VCC (V) | MIN | MAX | UNIT |
|---------------------------|-----------|------------------|---------------------|---------------|---------|-----------|--------|------|
| Input Voltage | "H" Level | Vp | | | 1.8 | — | TBD | V |
| | "L" Level | VN | | | 1.8 | TBD | — | |
| Hysteresis Voltage | | VH | | | 1.8 | TBD | TBD | V |
| Output Voltage | "H" Level | VOH | VIN = VIL | IOH = -100 μA | 1.8 | VCC - 0.2 | — | V |
| | | | | IOH = -6 mA | 1.8 | 1.4 | — | |
| | "L" Level | VOL | VIN = VIH | IOL = 100 μA | 1.8 | — | 0.2 | |
| | | | | IOL = 6 mA | 1.8 | — | 0.3 | |
| Input Leakage Current | | IIN | VIN = 0~3.6 V | | 1.8 | — | ± 5.0 | μA |
| Power Off Leakage Current | | I _{OFF} | VIN, VOUT = 0~3.6 V | | 0 | — | 10.0 | μA |
| Quiescent Supply Current | | ICC | VIN = VCC or GND | | 1.8 | — | 20.0 | μA |
| | | | VCC ≤ VIN ≤ 3.6 V | | 1.8 | — | ± 20.0 | |

AC characteristics (Ta = -40~85°C, Input tr = tf = 2.0 ns, CL = 30 pF, RL = 500 Ω)

| PARAMETER | SYMBOL | TEST CONDITION | VCC (V) | MIN | MAX | UNIT |
|------------------------|----------------|----------------|-----------|-----|-----|------|
| | | | | | | |
| Propagation Delay Time | tpLH tpHL | (Fig. 1, 2) | 1.8 | 1.0 | TBD | ns |
| | | | 2.5 ± 0.2 | 0.8 | TBD | |
| | | | 3.3 ± 0.3 | 0.6 | TBD | |
| Output To Output Skew | tosLH tosHL | (Note 10) | 1.8 | — | 0.5 | ns |
| | | | 2.5 ± 0.2 | — | 0.5 | |
| | | | 3.3 ± 0.3 | — | 0.5 | |

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

(Note 10) : Parameter guaranteed by design.
 (tosLH = |tpLHm - tpLHn|, tosHL = |tpHLm - tpHLn|)

Dynamic switching characteristics (Ta = 25°C, Input tr = tf = 2.0 ns, CL = 30 pF)

| PARAMETER | SYMBOL | TEST CONDITION | VCC (V) | TYP. | UNIT |
|----------------------------------|--------|----------------------------------|---------|-------|------|
| | | | | | |
| Quiet Output Maximum Dynamic VOL | VOLP | VIH = 1.8 V, VIL = 0 V (Note 11) | 1.8 | 0.25 | V |
| | | VIH = 2.5 V, VIL = 0 V (Note 11) | 2.5 | 0.6 | |
| | | VIH = 3.3 V, VIL = 0 V (Note 11) | 3.3 | 0.8 | |
| Quiet Output Minimum Dynamic VOL | VOLV | VIH = 1.8 V, VIL = 0 V (Note 11) | 1.8 | -0.25 | V |
| | | VIH = 2.5 V, VIL = 0 V (Note 11) | 2.5 | -0.6 | |
| | | VIH = 3.3 V, VIL = 0 V (Note 11) | 3.3 | -0.8 | |
| Quiet Output Minimum Dynamic VOH | VOHV | VIH = 1.8 V, VIL = 0 V (Note 11) | 1.8 | 1.5 | V |
| | | VIH = 2.5 V, VIL = 0 V (Note 11) | 2.5 | 1.9 | |
| | | VIH = 3.3 V, VIL = 0 V (Note 11) | 3.3 | 2.2 | |

(Note 11) : Parameter guaranteed by design.

Capacitive characteristics (Ta = 25°C)

| PARAMETER | SYMBOL | TEST CONDITION | VCC (V) | TYP. | UNIT |
|-------------------------------|--------|------------------------|---------------|------|------|
| | | | | | |
| Input Capacitance | CIN | | 1.8, 2.5, 3.3 | 6 | pF |
| Power Dissipation Capacitance | CpD | fIN = 10 MHz (Note 12) | 1.8, 2.5, 3.3 | 20 | pF |

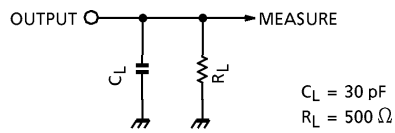
(Note 12) : CpD is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation :

$$I_{CC}(\text{opr.}) = C_{pD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/6 \text{ (Per gate)}$$

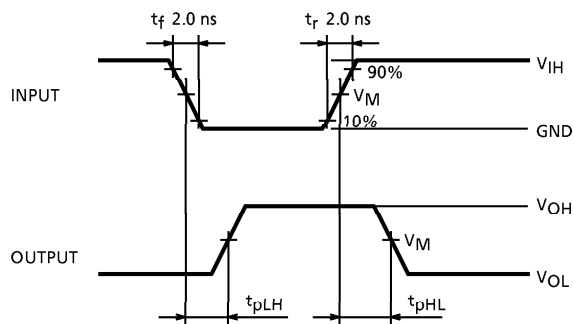
TEST CIRCUIT

Fig.1



AC WAVEFORM

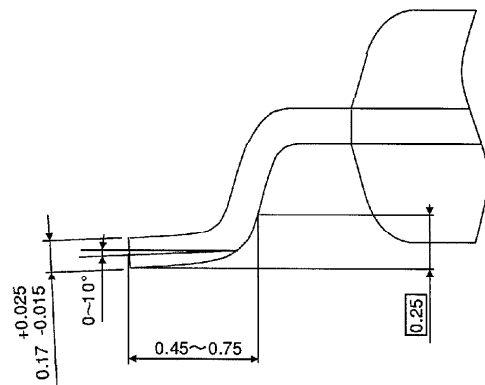
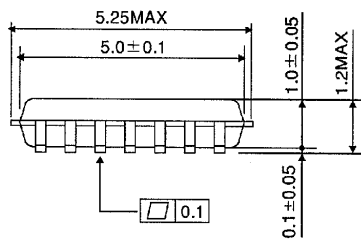
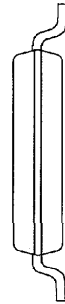
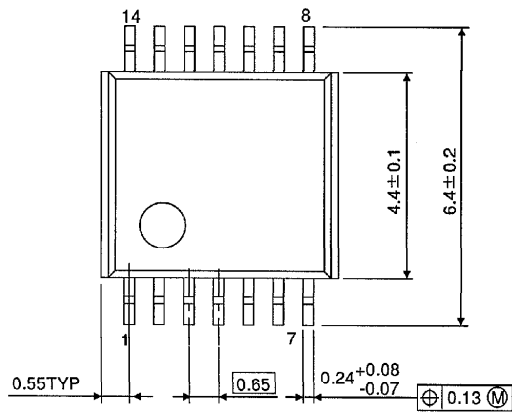
Fig.2 t_{pLH} , t_{pHL}



| SYMBOL | V_{CC} | | |
|----------|-------------------------|-------------------------|------------|
| | $3.3 \pm 0.3 \text{ V}$ | $2.5 \pm 0.2 \text{ V}$ | 1.8 V |
| V_{IH} | 2.7 V | V_{CC} | V_{CC} |
| V_M | 1.5 V | $V_{CC}/2$ | $V_{CC}/2$ |

OUTLINE DRAWING
TSSOP14-P-0044-0.65

Unit : mm



Weight : 0.06 g (Typ.)

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