# TC74LCX02F/FN/FS

## LOW VOLTAGE QUAD 2-INPUT NOR GATE
## WITH 5V TOLERANT INPUTS AND OUTPUTS

The TC74LCX02 is a high performance CMOS 2-INPUT NOR GATE. Designed for use in 3.3 Volt systems, it achieves high speed operation while maintaining the CMOS low power dissipation.

The device is designed for low-voltage (3.3V) $V_{CC}$ applications, but it could be used to interface to 5V supply environment for inputs.

All inputs are equipped with protection circuits against static discharge.

### FEATURES

- Low voltage operation : $V_{CC} = 2.0 \sim 3.6V$
- High speed operation : $t_{pd} = 5.2ns$ (Max.)
  ($V_{CC} = 3.0 \sim 3.6V$)
- Output current : $|I_{OH}| / I_{OL} = 24mA$ (Min.)
  ($V_{CC} = 3.0V$)
- Latch-up performance : $\pm 500mA$
- Available in JEDEC SOP, EIAJ SOP and SSOP
- Power down protection is provided on all inputs and outputs.
- Pin and function compatible with the 74 series (74AC / VHC / HC / F / ALS / LS etc.) 02 type.

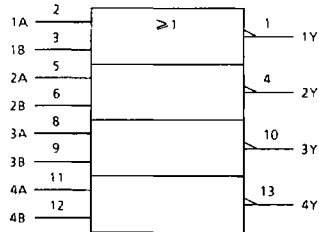TC74LCX02F



SOP14-P-300

TC74LCX02FN



SOL14-P-150

TC74LCX02FS
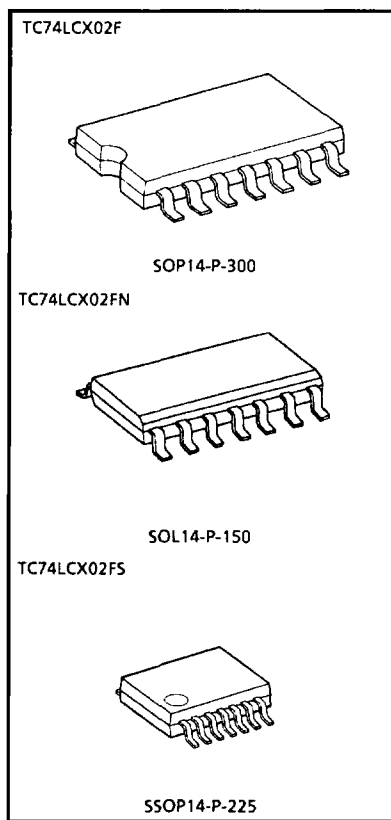


SSOP14-P-225

| Weight | SOP14-P-300 | : 0.18g (Typ.) |
|--------|-------------|----------------|
|        | SOL14-P-150 | : 0.12g (Typ.) |
|        | SSOP14-P-225 | : 0.07g (Typ.) |

PIN ASSIGNMENT



(TOP VIEW)
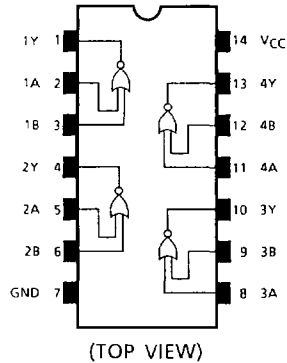
IEC LOGIC SYMBOL



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 | $V_{CC}$ | $-0.5 \sim 7.0$ | V |
| DC Input Voltage | $V_{IN}$ | $-0.5 \sim 7.0$ | V |
| DC Output Voltage | $V_{OUT}$ | $-0.5 \sim 7.0$ (Note 1) | V |
| | | $-0.5 \sim V_{CC} + 0.5$ (Note 2) | |
| Input Diode Current | $I_{IK}$ | $-50$ | mA |
| Output Diode Current | $I_{OK}$ | $\pm 50$ (Note 3) | mA |
| DC Output Current | $I_{OUT}$ | $\pm 50$ | mA |
| Power Dissipation | $P_D$ | 180 | mW |
| DC $V_{CC}$ / Ground Current | $I_{CC}/I_{GND}$ | $\pm 100$ | mA |
| Storage Temperature | $T_{stg}$ | $-65 \sim 150$ | °C |

(Note 1)  $VCC = 0V$

(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 CONDITIONS

| PARAMETER | SYMBOL | RATING | UNIT |
|---|---|---|---|
| Supply Voltage | $V_{CC}$ | 2.0~3.6 | V |
| | | 1.5~3.6 (Note 4) | |
| Input Voltage | $V_{IN}$ | 0~5.5 | V |
| Output Voltage | $V_{OUT}$ | 0~5.5 (Note 5) | V |
| | | 0~$V_{CC}$ (Note 6) | |
| Output Current | $I_{OH}/I_{OL}$ | ±24 (Note 7) | mA |
| | | ±12 (Note 8) | |
| Operating Temperature | $T_{opr}$ | −40~85 | °C |
| Input Rise And Fall Time | dt/dv | 0~10 (Note 9) | ns/V |

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

## ELECTRICAL CHARACTERISTICS
DC characteristics (Ta = −40~85°C)

| 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 | $V_{OH}$ | $V_{IN} = V_{IL}$ | $I_{OH} = -100\mu A$ | 2.7~3.6 | $V_{CC}$ −0.2 | — | V |
| | | | | $I_{OH} = -12mA$ | 2.7 | 2.2 | — | |
| | | | | $I_{OH} = -18mA$ | 3.0 | 2.4 | — | |
| | | | | $I_{OH} = -24mA$ | 3.0 | 2.2 | — | |
| | "L" Level | $V_{OL}$ | $V_{IN} = V_{IH}$ or $V_{IL}$ | $I_{OL} = 100\mu A$ | 2.7~3.6 | — | 0.2 | |
| | | | | $I_{OL} = 12mA$ | 2.7 | — | 0.4 | |
| | | | | $I_{OL} = 16mA$ | 3.0 | — | 0.4 | |
| | | | | $I_{OL} = 24mA$ | 3.0 | — | 0.55 | |
| Input Leakage Current | | $I_{IN}$ | $V_{IN} = 0~5.5V$ | | 2.7~3.6 | — | ±5.0 | $\mu A$ |
| Power Off Leakage Cuurent | | $I_{OFF}$ | $V_{IN}/V_{OUT} = 5.5V$ | | 0 | — | 10.0 | $\mu A$ |
| Quiescent Supply Current | | $I_{CC}$ | $V_{IN} = V_{CC}$ or GND | | 2.7~3.6 | — | 10.0 | $\mu A$ |
| | | | $V_{IN}/V_{OUT} = 3.6~5.5V$ | | 2.7~3.6 | — | ±10.0 | |
| Increase In $I_{CC}$ Per Input | | $\Delta I_{CC}$ | $V_{IH} = V_{CC} - 0.6V$ | | 2.7~3.6 | — | 500 | $\mu A$ |

AC characteristics (Ta = − 40~85°C)

| PARAMETER | SYMBOL | TEST CONDITION | | MIN. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| | | | $V_{CC}$ (V) | | | |
| Propagation Delay Time | $t_{pLH}$ $t_{pHL}$ | (Fig.1, 2) | 2.7 | — | 6.0 | ns |
| | | | 3.3 ± 0.3 | 1.5 | 5.2 | |
| Output To Output Skew | $t_{osLH}$ $t_{osHL}$ | (Note 10) | 2.7 | — | — | ns |
| | | | 3.3 ± 0.3 | — | 1.0 | |

(Note 10) Parameter guaranteed by design.
$$(t_{osLH} = |t_{pLHm} - t_{pLHn}|, \ t_{osHL} = |t_{pHLm} - t_{pHLn}|)$$

**DYNAMIC SWITCHING CHARACTERISTICS** (Ta = 25°C, Input $t_r = t_f = 2.5$ns, $C_L = 50$pF, $R_L = 500\Omega$)

| PARAMETER | SYMBOL | TEST CONDITION | | TYP | UNIT |
|---|---|---|---|---|---|
| | | | $V_{CC}$ (V) | | |
| Quiet Output Maximum Dynamic $V_{OL}$ | $V_{OLP}$ | $V_{IH} = 3.3$V, $V_{IL} = 0$V | 3.3 | TBD | V |
| Quiet Output Minimum Dynamic $V_{OL}$ | $|V_{OLV}|$ | $V_{IH} = 3.3$V, $V_{IL} = 0$V | 3.3 | TBD | V |

**CAPACITIVE CHARACTERISTICS** (Ta = 25°C)

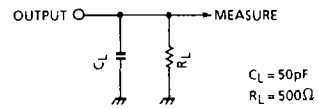| PARAMETER | SYMBOL | TEST CONDITION | | TYP | UNIT |
|---|---|---|---|---|---|
| | | | $V_{CC}$ (V) | | |
| Input Capacitance | $C_{IN}$ | — | 3.3 | TBD | pF |
| Power Dissipation Capacitance | $C_{PD}$ | $f_{IN} = 10$MHz (Note 11) | 3.3 | TBD | pF |

(Note 11) $C_{PD}$ 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 :
$$I_{CC} \text{(opr.)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC} / 4 \text{ (Per gate)}$$

## TEST CIRCUIT

Fig.1

```
OUTPUT O─────●────────●───────►MEASURE

              C_L ═╪═   ⧙ R_L        C_L = 50pF
                 ╧       ╧           R_L = 500Ω
```

## AC WAVEFORM

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

```
      t_f   2 5ns      t_r   2 5ns
                              ┌── 90%              2 7V
INPUT                         ┤  1.5V
                              └── 10%              GND

                     ┌──────────┐                 V_OH
OUTPUT               │          │   1.5V
          ───────────┘          └──────────       V_OL
             t_pLH                  t_pHL
```