National Semiconductor

August 1998

# 100304
# Low Power Quint AND/NAND Gate

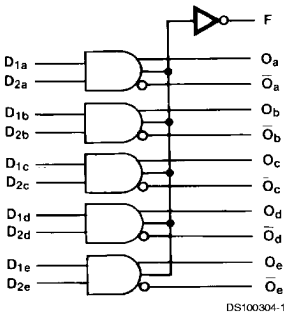
## General Description

The 100304 is monolithic quint AND/NAND gate. The Function output is the wire-NOR of all five AND gate outputs. All inputs have 50 kΩ pull-down resistors.

## Features

- Low Power Operation
- 2000V ESD protection
- Pin/function compatible with 100104
- Voltage compensated operating range = −4.2V to −5.7V
- Available to industrial grade temperature range
- Available to Standard Microcircuit Drawing (SMD) 5962-9153701

## Logic Symbol




## Logic Equation

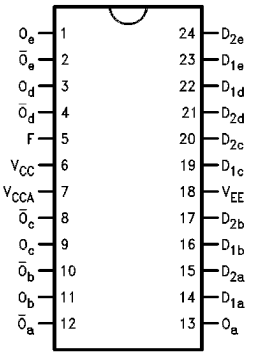
$$F = \overline{(D_{1a} \cdot D_{2a}) + (D_{1b} \cdot D_{2b}) + D_{1c} \cdot D_{2c}) + (D_{1d} \cdot D_{2d}) + (D_{1e} \cdot D_{2e})}.$$

| Pin Names | Description |
|---|---|
| $D_{na}$–$D_{ne}$ | Data Inputs |
| F | Function Output |
| $O_a$–$O_e$ | Data Outputs |
| $\overline{O}_a$–$\overline{O}_e$ | Complementary Data Outputs |

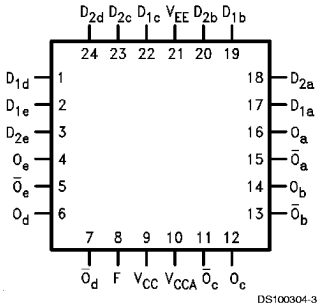
## Connection Diagrams

**24-Pin DIP**




DS100304-2

**24-Pin Quad Cerpak**




DS100304-3

## Absolute Maximum Ratings (Note 1)

**If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.**

| | |
|---|---|
| Above which the useful life may be impaired | |
| Storage Temperature ($T_{STG}$) | −65˚C to +150˚C |
| Maximum Junction Temperature ($T_J$) | |
| Ceramic | +175˚C |
| $V_{EE}$ Pin Potential to Ground Pin | −7.0V to +0.5V |
| Input Voltage (DC) | $V_{EE}$ to +0.5V |
| Output Current (DC Output HIGH) | −50 mA |
| ESD (Note 2) | ≥2000V |

## Recommended Operating Conditions

| | |
|---|---|
| Case Temperature ($T_C$) | |
| Military | −55˚C to +125˚C |
| Supply Voltage ($V_{EE}$) | −5.7V to −4.2V |

**Note 1:** Absolute maximum ratings are those values beyond which the device may be damaged or have its useful life impaired. Functional operation under these conditions is not implied.

**Note 2:** ESD testing conforms to MIL-STD-883, Method 3015.

## Military Version DC Electrical Characteristics

$V_{EE}$ = −4.2V to −5.7V, $V_{CC}$ = $V_{CCA}$ = GND, $T_C$ = −55˚C to +125˚C

| Symbol | Parameter | Min | Max | Units | $T_C$ | Conditions | | Notes |
|---|---|---|---|---|---|---|---|---|
| $V_{OH}$ | Output HIGH Voltage | −1025 | −870 | mV | 0˚C to +125˚C | $V_{IN}$ = $V_{IH}$ (Max) or $V_{IL}$ (Min) | Loading with 50Ω0 to −2.0V | (Notes 3, 4, 5) |
| | | −1085 | −870 | mV | −55˚C | | | |
| $V_{OL}$ | Output LOW Voltage | −1830 | −1620 | mV | 0˚C to +125˚C | | | |
| | | −1830 | −1555 | mV | −55˚C | | | |
| $V_{OHC}$ | Output HIGH Voltage | −1035 | | mV | 0˚C to +125˚C | $V_{IN}$ = $V_{IH}$ (Min) or $V_{IL}$ (Max) | Loading with 50Ω to −2.0V | (Notes 3, 4, 5) |
| | | −1085 | | mV | −55˚C | | | |
| $V_{OLC}$ | Output LOW Voltage | | −1610 | mV | 0˚C to +125˚C | | | |
| | | | −1555 | mV | −55˚C | | | |
| $V_{IH}$ | Input HIGH Voltage | −1165 | −870 | mV | −55˚C +125˚C | Guaranteed HIGH Signal for All Inputs | | (Notes 3, 4, 5, 6) |
| $V_{IL}$ | Input LOW Voltage | −1830 | −1475 | mV | −55˚C to +125˚C | Guaranteed LOW Signal for All Inputs | | (Notes 3, 4, 5, 6) |
| $I_{IL}$ | Input LOW Current | 0.50 | | µA | −55˚C to +125˚C | $V_{EE}$ = −4.2V $V_{IN}$ = $V_{IL}$ (Min) | | (Notes 3, 4, 5) |
| $I_{IH}$ | Input High Current | | | | | | | |
| | $D_{2a}$–$D_{2e}$ | | 250 | µA | 0˚C to | $V_{EE}$ = −5.7V $V_{IN}$ = $V_{IH}$ (Max) | | (Notes 3, 4, 5) |
| | $D_{1a}$–$D_{1e}$ | | 350 | | +125˚C | | | |
| | $D_{2a}$–$D_{2e}$ | | 350 | µA | −55˚C | | | |
| | $D_{1a}$–$D_{1e}$ | | 500 | | | | | |
| $I_{EE}$ | Power Supply Current | −75 | −25 | mA | −55˚C to +125˚C | Inputs Open | | (Notes 3, 4, 5) |

**Note 3:** F100K 300 Series cold temperature testing is performed by temperature soaking (to guarantee junction temperature equals −55˚C), then testing immediately without allowing for the junction temperature to stabilize due to heat dissipation after power-up. This provides "cold start" specs which can be considered a worst case condition at cold temperatures.

**Note 4:** Screen tested 100% on each device at −55˚C, +25˚C, and +125˚C, Subgroups, 1, 2 3, 7, and 8.

**Note 5:** Sample tested (Method 5005, Table I) on each manufactured lot at −55˚C, +25˚C, and +125˚C, Subgroups A1, 2, 3, 7, and 8.

**Note 6:** Guaranteed by applying specified input condition and testing $V_{OH}$/$V_{OL}$.

## AC Electrical Characteristics

$V_{EE}$ = −4.2V to −5.7V, $V_{CC}$ = $V_{CCA}$ = GND

| Symbol | Parameter | $T_C$ = −55°C | | $T_C$ = +25°C | | $T_C$ = +125°C | | Units | Conditions | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Min | Max | Min | Max | Min | Max | | | |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay<br>$D_{na}$–$D_{ne}$ to O, $\overline{O}$ | 0.30 | 1.90 | 0.40 | 1.80 | 0.30 | 2.30 | ns | *Figures 1, 2* | (Notes 7, 8, 9) |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay<br>Data to F | 0.80 | 2.90 | 0.90 | 2.80 | 0.90 | 3.40 | ns | | |
| $t_{TLH}$<br>$t_{THL}$ | Transition Time<br>20% to 80%, 80% to 20% | 0.20 | 1.80 | 0.30 | 1.60 | 0.20 | 2.00 | ns | | (Note 10) |

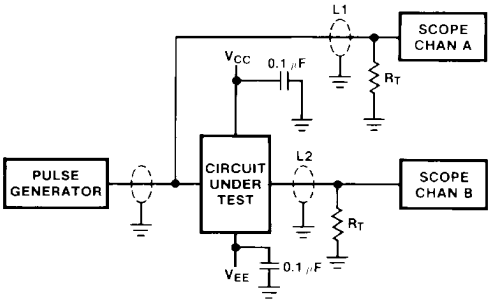
**Note 7:** F100K 300 Series cold temperature testing is performed by temperature soaking (to guarantee junction temperature equals −55°C), then testing immediately after power-up. This provides "cold start" specs which can be considered a worst case condition at cold temperatures.

**Note 8:** Screen tested 100% on each device at +25°C temperature only, Subgroup A9.

**Note 9:** Sample tested (Method 5005, Table I) on each mfg. lot at +25°C, Subgroup A9, and at +125°C and −55°C temperatures, Subgroups A10 and A11.

**Note 10:** Not tested at +25°C, +125°C, and −55°C temperature (design characterization data).

## Test Circuitry




**Notes:**
$V_{CC}$, $V_{CCA}$ = +2V, $V_{EE}$ = −2.5V
L1 and L2 = equal length 50Ω impedance lines
$R_T$ = 50Ω terminator internal to scope
Decoupling 0.1 µF from GND to $V_{CC}$ and $V_{EE}$
All unused outputs are loaded with 50Ω to GND
$C_L$ = Fixture and stray capacitance ≤ 3 pF

**FIGURE 1. AC Test Circuit**

## Switching Waveforms

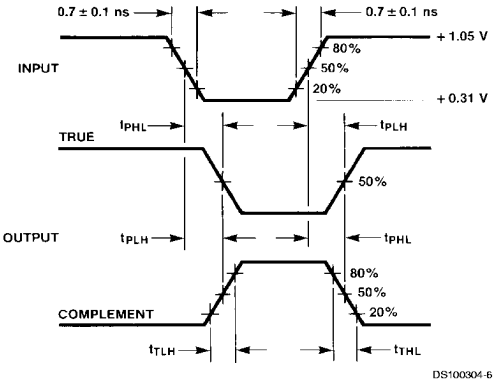
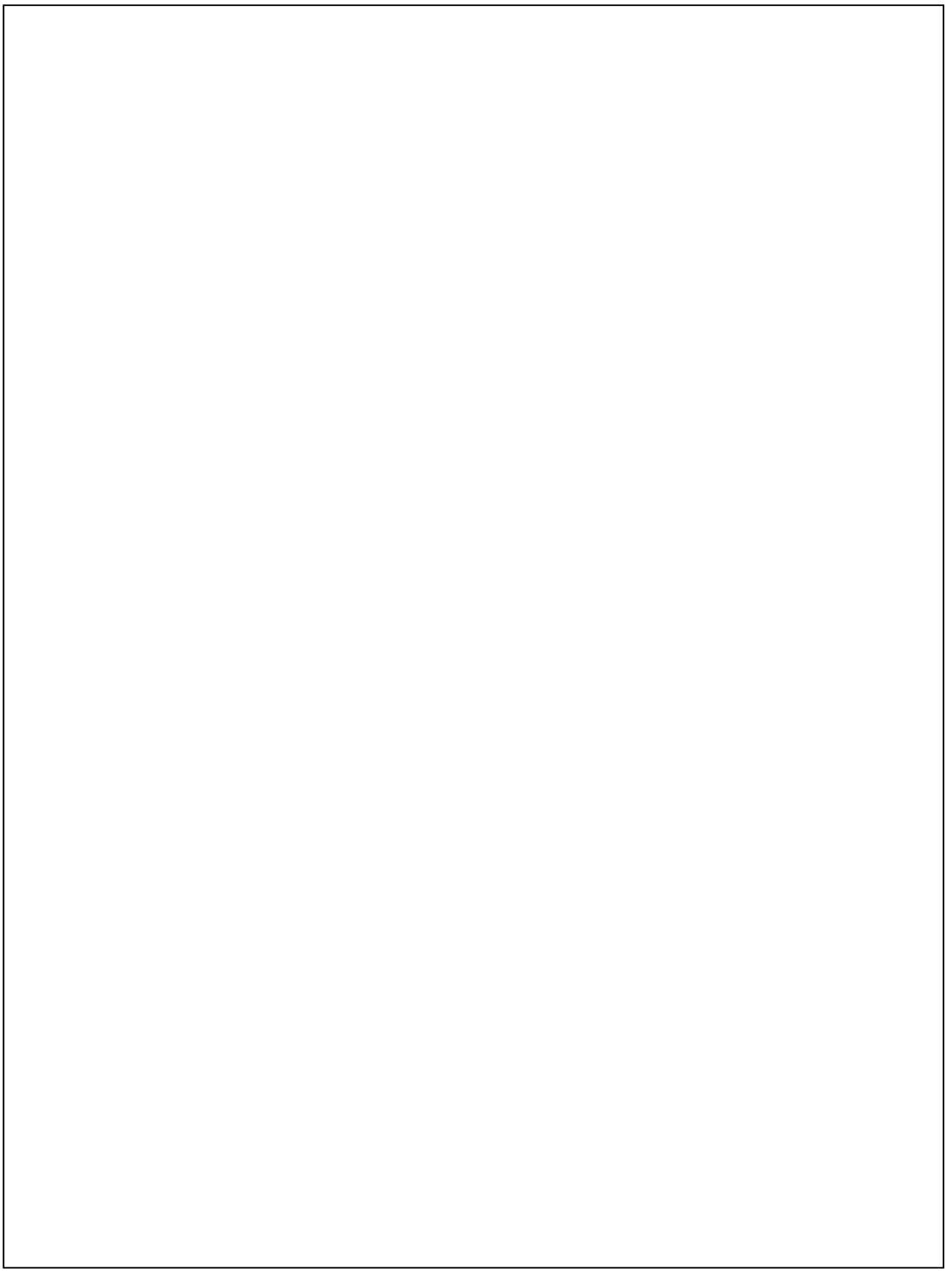
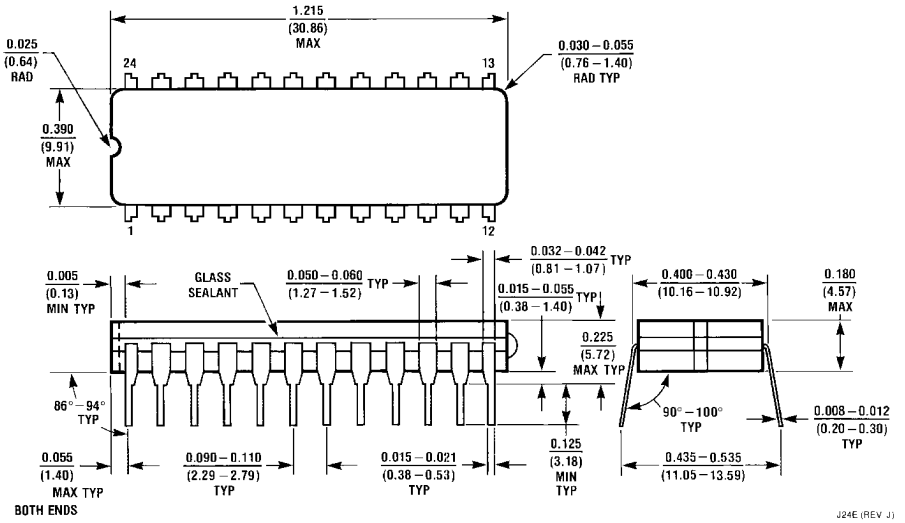


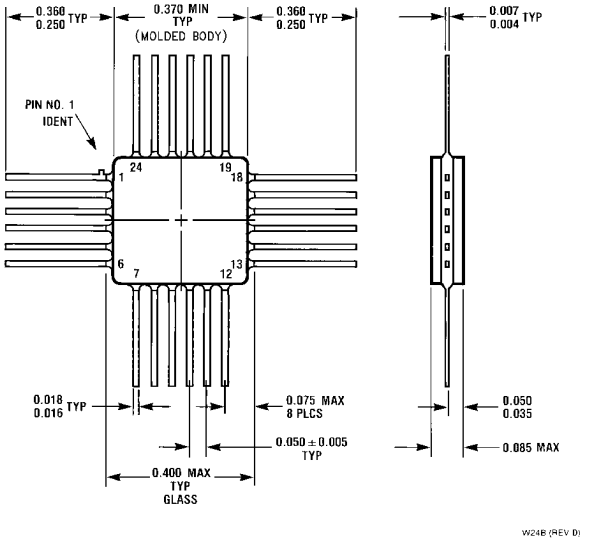

**FIGURE 2. Propagation Delay and Transition Times**



## Physical Dimensions inches (millimeters) unless otherwise noted




**24-Pin Ceramic Dual-In-Line Package (D)**
**NS Package Number J24E**




**24-Pin Quad Cerpak (F)**
**NS Package Number W24B**