

F100307

Low Power Quint Exclusive OR/NOR Gate

General Description

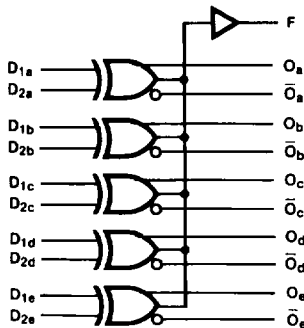
The F100307 is monolithic quint exclusive-OR/NOR gate. The Function output is the wire-OR of all five exclusive-OR outputs. All inputs have 50 kΩ pull-down resistors.

Features

- Low Power Operation
- 2000V ESD protection
- Pin/function compatible with F100107
- Voltage compensated operating range = -4.2V to -5.7V

Ordering Code: See Section 8

Logic Symbol



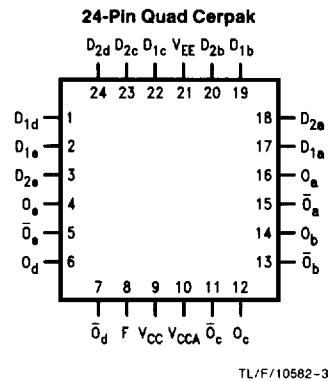
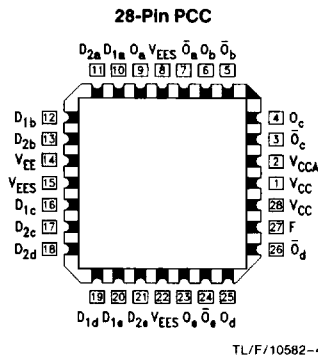
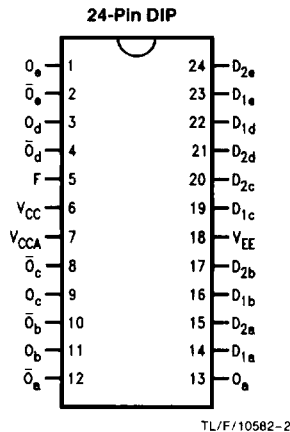
TL/F/10582-1

Logic Equation

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

| Pin Names | Description |
|-----------------------|----------------------------|
| $D_{1a}-D_{2e}$ | Data Inputs |
| F | Function Output |
| O_a-O_e | Data Outputs |
| $\bar{O}_a-\bar{O}_e$ | Complementary Data Outputs |

Connection Diagrams



Absolute Maximum Ratings

Above which the useful life may be impaired. (Note 1)

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

Storage Temperature (T_{STG}) -85°C to $+150^{\circ}\text{C}$

Maximum Junction Temperature (T_J)

Ceramic $+175^{\circ}\text{C}$

Plastic $+150^{\circ}\text{C}$

V_{EE} Pin Potential to Ground Pin -7.0V to $+0.5\text{V}$

Input Voltage (DC) V_{EE} to $+0.5\text{V}$

Output Current (DC Output HIGH) -50 mA

ESD (Note 2) $\geq 2000\text{V}$

Recommended Operating Conditions

Case Temperature (T_C)

Commercial 0°C to $+85^{\circ}\text{C}$

Military -55°C to $+125^{\circ}\text{C}$

Supply Voltage (V_{EE})

Commercial -5.7V to -4.2V

Military -5.7V to -4.2V

Commercial Version

DC Electrical Characteristics

$V_{EE} = -4.2\text{V}$ to -5.7V , $V_{CC} = V_{CCA} = \text{GND}$, $T_C = 0^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ (Note 3)

| Symbol | Parameter | Min | Typ | Max | Units | Conditions | |
|-----------|--|---------|---------|------------|---------------|--|--|
| V_{OH} | Output HIGH Voltage | -1025 | -955 | -870 | mV | $V_{IN} = V_{IH}(\text{Max})$ or $V_{IL}(\text{Min})$ | Loading with 50Ω to -2.0V |
| V_{OL} | Output LOW Voltage | -1830 | -1705 | -1620 | mV | | |
| V_{OHC} | Output HIGH Voltage | -1035 | | | mV | $V_{IN} = V_{IH}(\text{Min})$ or $V_{IL}(\text{Max})$ | Loading with 50Ω to -2.0V |
| V_{OLC} | Output LOW Voltage | | | -1610 | mV | | |
| V_{IH} | Input HIGH Voltage | -1165 | | -870 | mV | Guaranteed HIGH Signal for All Inputs | |
| V_{IL} | Input LOW Voltage | -1830 | | -1475 | mV | Guaranteed LOW Signal for All Inputs | |
| I_{IL} | Input LOW Current | 0.50 | | | μA | $V_{IN} = V_{IL}(\text{Min})$ | |
| I_{IH} | Input HIGH Current $D_{2a}-D_{2e}$ $D_{1a}-D_{1e}$ | | | 250 350 | μA | $V_{IN} = V_{IH}(\text{Max})$ | |
| I_{EE} | Power Supply Current | -69 | -43 | -30 | mA | Inputs Open | |

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.

Note 3: The specified limits represent the "worst case" value for the parameter. Since these values normally occur at the temperature extremes, additional noise immunity and guardbanding can be achieved by decreasing the allowable system operating ranges. Conditions for testing shown in the tables are chosen to guarantee operation under "worst case" conditions.

Ceramic Dual-In-Line Package AC Electrical Characteristics

$V_{EE} = -4.2\text{V}$ to -5.7V , $V_{CC} = V_{CCA} = \text{GND}$

| Symbol | Parameter | $T_C = 0^{\circ}\text{C}$ | | $T_C = +25^{\circ}\text{C}$ | | $T_C = +85^{\circ}\text{C}$ | | Units | Conditions |
|------------------------|--|---------------------------|------|-----------------------------|------|-----------------------------|------|-------|-----------------|
| | | Min | Max | Min | Max | Min | Max | | |
| t_{PLH} t_{PHL} | Propagation Delay $D_{2a}-D_{2e}$ to O, \bar{O} | 0.55 | 1.90 | 0.55 | 1.80 | 0.55 | 1.90 | ns | Figures 1 and 2 |
| t_{PLH} t_{PHL} | Propagation Delay $D_{1a}-D_{1e}$ to O, \bar{O} | 0.55 | 1.70 | 0.55 | 1.60 | 0.55 | 1.70 | ns | |
| t_{PLH} t_{PHL} | Propagation Delay Data to F | 1.15 | 2.75 | 1.15 | 2.75 | 1.15 | 3.00 | ns | |
| t_{TLH} t_{THL} | Transition Time 20% to 80%, 80% to 20% | 0.35 | 1.20 | 0.35 | 1.20 | 0.35 | 1.20 | ns | |

Commercial Version (Continued)

PCC and Cerpak AC Electrical Characteristics

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

| Symbol | Parameter | $T_C = 0^\circ C$ | | $T_C = +25^\circ C$ | | $T_C = +85^\circ C$ | | Units | Conditions |
|------------------------|--|-------------------|------|---------------------|------|---------------------|------|-------|-------------------|
| | | Min | Max | Min | Max | Min | Max | | |
| t_{PLH} t_{PHL} | Propagation Delay $D_{2a}-D_{2e}$ to O, \bar{O} | 0.55 | 1.70 | 0.55 | 1.60 | 0.55 | 1.70 | ns | Figures 1 and 2 |
| t_{PLH} t_{PHL} | Propagation Delay $D_{1a}-D_{1e}$ to O, \bar{O} | 0.55 | 1.50 | 0.55 | 1.40 | 0.55 | 1.50 | ns | |
| t_{PLH} t_{PHL} | Propagation Delay Data to F | 1.15 | 2.55 | 1.15 | 2.55 | 1.15 | 2.80 | ns | |
| t_{TLH} t_{THL} | Transition Time 20% to 80%, 80% to 20% | 0.35 | 1.10 | 0.35 | 1.10 | 0.35 | 1.10 | ns | |
| $t_{S, G-G}$ | Skew, Gate to Gate | TBD | | TBD | | TBD | | ps | PCC Only (Note 1) |

Note 1: Gate to gate skew is defined as the difference in propagation delays between each of the outputs.

Military Version—Preliminary

DC Electrical Characteristics

$V_{EE} = -4.2V$ to $-5.7V$, $V_{CC} = V_{CCA} = GND$, $T_C = -55^\circ C$ to $+125^\circ C$

| Symbol | Parameter | Min | Max | Units | T_C | Conditions | Notes | |
|-----------|--|-------|------------|---------|---------------------------------|--|---------------------------------------|---------|
| V_{OH} | Output HIGH Voltage | -1025 | -870 | mV | $0^\circ C$ to $+125^\circ C$ | $V_{IN} = V_{IH} (Max)$ or $V_{IL} (Min)$ | Loading with 50Ω to $-2.0V$ | 1, 2, 3 |
| | | -1085 | -870 | mV | $-55^\circ C$ | | | |
| V_{OL} | Output LOW Voltage | -1830 | -1620 | mV | $0^\circ C$ to $+125^\circ C$ | | | |
| | | -1830 | -1555 | mV | $-55^\circ C$ | | | |
| V_{OHC} | Output HIGH Voltage | -1035 | | mV | $0^\circ C$ to $+125^\circ C$ | $V_{IN} = V_{IH} (Min)$ or $V_{IL} (Max)$ | Loading with 50Ω to $-2.0V$ | 1, 2, 3 |
| | | -1085 | | mV | $-55^\circ C$ | | | |
| V_{OLC} | Output LOW Voltage | | -1610 | mV | $0^\circ C$ to $+125^\circ C$ | | | |
| | | | -1555 | mV | $-55^\circ C$ | | | |
| V_{IH} | Input HIGH Voltage | -1165 | -870 | mV | $-55^\circ C$ to $+125^\circ C$ | Guaranteed HIGH Signal for All Inputs | 1, 2, 3, 4 | |
| V_{IL} | Input LOW Voltage | -1830 | -1475 | mV | $-55^\circ C$ to $+125^\circ C$ | Guaranteed LOW Signal for All Inputs | 1, 2, 3, 4 | |
| I_{IL} | Input LOW Current | 0.50 | | μA | $-55^\circ C$ to $+125^\circ C$ | $V_{EE} = -4.2V$ $V_{IN} = V_{IL} (Min)$ | 1, 2, 3 | |
| I_{IH} | Input High Current $D_{2a}-D_{2e}$ $D_{1a}-D_{1e}$ | | 250 350 | μA | $0^\circ C$ to $+125^\circ C$ | $V_{EE} = -5.7V$ $V_{IN} = V_{IH} (Max)$ | 1, 2, 3 | |
| | | | 350 500 | μA | $-55^\circ C$ | | | |
| I_{EE} | Power Supply Current | -63 | -30 | mA | $-55^\circ C$ to $+125^\circ C$ | Inputs Open | 1, 2, 3 | |

Note 1: F100K 300 Series cold temperature testing is performed by temperature soaking (to guarantee junction temperature equals $-55^\circ C$), 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 2: Screen tested 100% on each device at $-55^\circ C$, $+25^\circ C$, and $+125^\circ C$, Subgroups 1, 2, 3, 7, and 8.

Note 3: Sample tested (Method 5005, Table I) on each manufactured lot at $-55^\circ C$, $+25^\circ C$, and $+125^\circ C$, Subgroups A1, 2, 3, 7, and 8.

Note 4: Guaranteed by applying specified input condition and testing V_{OH}/V_{OL} .

Military Version—Preliminary (Continued)

Ceramic Dual-In-Line Package AC Electrical Characteristics

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

| Symbol | Parameter | $T_C = -55^\circ C$ | | $T_C = +25^\circ C$ | | $T_C = +125^\circ C$ | | Units | Conditions | Notes |
|------------------------|--|---------------------|------|---------------------|------|----------------------|------|-------|-----------------|---------|
| | | Min | Max | Min | Max | Min | Max | | | |
| t_{PLH} t_{PHL} | Propagation Delay $D_{2a}-D_{2e}$ to O, \bar{O} | 0.45 | 2.10 | 0.45 | 2.00 | 0.45 | 2.10 | ns | Figures 1 and 2 | 1, 2, 3 |
| t_{PLH} t_{PHL} | Propagation Delay $D_{1a}-D_{1e}$ to O, \bar{O} | 0.45 | 1.90 | 0.45 | 1.80 | 0.45 | 1.90 | ns | | |
| t_{PLH} t_{PHL} | Propagation Delay Data to F | 1.05 | 2.95 | 1.05 | 2.95 | 1.05 | 3.20 | ns | | |
| t_{TLH} t_{THL} | Transition Time 20% to 80%, 80% to 20% | 0.35 | 1.20 | 0.35 | 1.20 | 0.35 | 1.20 | ns | | 4 |

Cerpak AC Electrical Characteristics

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

| Symbol | Parameter | $T_C = -55^\circ C$ | | $T_C = +25^\circ C$ | | $T_C = +125^\circ C$ | | Units | Conditions | Notes |
|------------------------|--|---------------------|------|---------------------|------|----------------------|------|-------|-----------------|---------|
| | | Min | Max | Min | Max | Min | Max | | | |
| t_{PLH} t_{PHL} | Propagation Delay $D_{2a}-D_{2e}$ to O, \bar{O} | 0.45 | 2.10 | 0.45 | 2.00 | 0.45 | 2.10 | ns | Figures 1 and 2 | 1, 2, 3 |
| t_{PLH} t_{PHL} | Propagation Delay $D_{1a}-D_{1e}$ to O, \bar{O} | 0.45 | 1.90 | 0.45 | 1.80 | 0.45 | 1.90 | ns | | |
| t_{PLH} t_{PHL} | Propagation Delay Data to F | 1.05 | 2.95 | 1.05 | 2.95 | 1.05 | 3.20 | ns | | |
| t_{TLH} t_{THL} | Transition Time 20% to 80%, 80% to 20% | 0.35 | 1.10 | 0.35 | 1.10 | 0.35 | 1.10 | ns | | 4 |

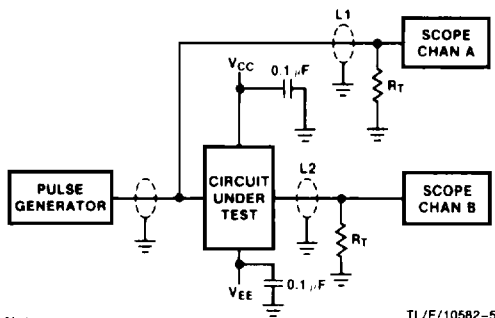
Note 1: F100K 300 Series cold temperature testing is performed by temperature soaking (to guarantee junction temperature equals $-55^\circ C$), then testing immediately after power-up. This provides "cold start" specs which can be considered a worst case condition at cold temperatures.

Note 2: Screen tested 100% on each device at $+25^\circ C$ temperature only, Subgroup A9.

Note 3: Sample tested (Method 5005, Table I) on each mfg. lot at $+25^\circ C$, Subgroup A9, and at $+125^\circ C$ and $-55^\circ C$ temperatures, Subgroups A10 and A11.

Note 4: Not tested at $+25^\circ C$, $+125^\circ C$, and $-55^\circ C$ temperature (design characterization data).

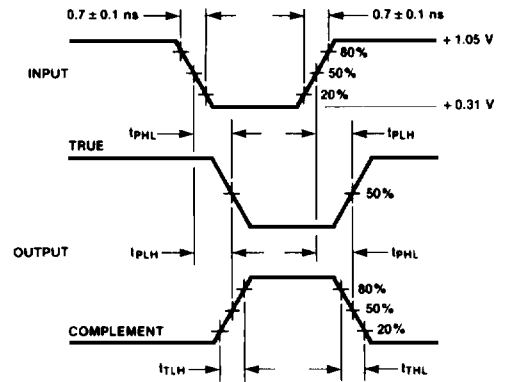
Test Circuitry



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

FIGURE 1. AC Test Circuit

Switching Waveforms



TL/F/10582-6

FIGURE 2. Propagation Delay and Transition Times