

2-Input NAND Gate with Open Drain Output

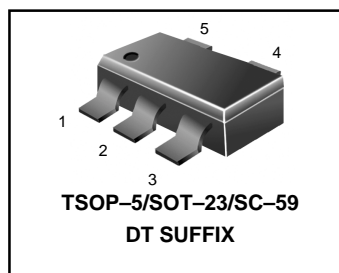
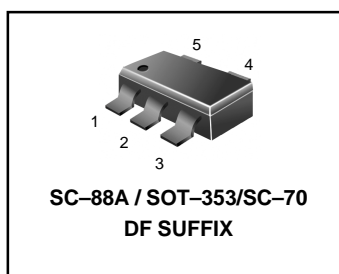
L74VHC1G03

The L74VHC1G03 is an advanced high speed CMOS 2-input NOR gate with an open drain output fabricated with silicon gate CMOS technology. It achieves high speed operation similar to equivalent Bipolar Schottky TTL while maintaining CMOS low power dissipation.

The internal circuit is composed of three stages, including an open drain output which provides the capability to set output switching level. This allows the L74VHC1G03 to be used to interface 5 V circuits to circuits of any voltage between V_{CC} and 7 V using an external resistor and power supply.

The L74VHC1G03 input structure provides protection when voltages up to 7 V are applied, regardless of the supply voltage.

- High Speed: $t_{PD} = 3.6$ ns (Typ) at $V_{CC} = 5$ V
- Low Internal Power Dissipation: $I_{CC} = 2$ mA (Max) at $T_A = 25^\circ\text{C}$
- Power Down Protection Provided on Inputs
- Pin and Function Compatible with Other Standard Logic Families
- Chip Complexity: FETs = 62; Equivalent Gates = 16



MARKING DIAGRAMS

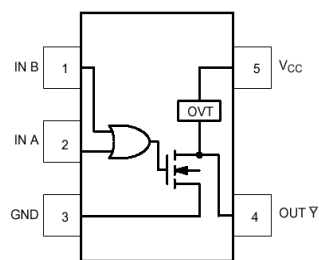
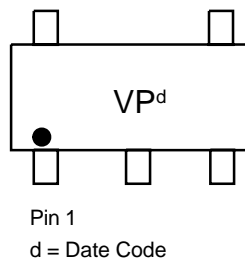
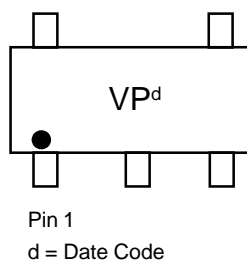


Figure 1. Pinout (Top View)

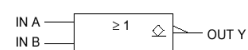


Figure 2. Logic Symbol

| PIN ASSIGNMENT | |
|----------------|---------------|
| 1 | IN B |
| 2 | IN A |
| 3 | GND |
| 4 | OUT \bar{Y} |
| 5 | V_{CC} |

| FUNCTION TABLE | | |
|----------------|---|-----------|
| Inputs | | Output |
| A | B | \bar{Y} |
| L | L | Z |
| L | H | L |
| H | L | L |
| H | H | L |

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 5 of this data sheet.

L74VHC1G03

MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
|-----------------------|--|--|---|
| V _{CC} | DC Supply Voltage | - 0.5 to + 7.0 | V |
| V _{IN} | DC Input Voltage | - 0.5 to 7.0 | V |
| V _{OUT} | DC Output Voltage | V _{CC} =0 High or Low State | - 0.5 to 7.0 -0.5 to V _{CC} + 0.5 |
| I _{IK} | Input Diode Current | -20 | mA |
| I _{OK} | Output Diode Current | V _{OUT} < GND; V _{OUT} > V _{CC} | +20 mA |
| I _{OUT} | DC Output Current, per Pin | + 25 | mA |
| I _{CC} | DC Supply Current, V _{CC} and GND | +50 | mA |
| P _D | Power dissipation in still air | SC-88A, TSOP-5 | 200 mW |
| θ _{JA} | Thermal resistance | SC-88A, TSOP-5 | 333 °C/W |
| T _L | Lead Temperature, 1 mm from Case for 10 s | 260 | °C |
| T _J | Junction Temperature Under Bias | + 150 | °C |
| T _{stg} | Storage temperature | -65 to +150 | °C |
| V _{ESD} | ESD Withstand Voltage | Human Body Model (Note 2) Machine Model (Note 3) Charged Device Model (Note 4) | >2000 > 200 N/A V |
| I _{LATCH-UP} | Latch-Up Performance | Above V _{CC} and Below GND at 125°C (Note 5) | ± 500 mA |

1. Maximum Ratings are those values beyond which damage to the device may occur. Exposure to these conditions or conditions beyond those indicated may adversely affect device reliability. Functional operation under absolute-maximum-rated conditions is not implied. Functional operation should be restricted to the Recommended Operating Conditions.
2. Tested to EIA/JESD22-A114-A
3. Tested to EIA/JESD22-A115-A
4. Tested to JESD22-C101-A
5. Tested to EIA/JESD78

RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Min | Max | Unit |
|---------------------------------|-----------------------------|--|----------------|------|
| V _{CC} | DC Supply Voltage | 2.0 | 5.5 | V |
| V _{IN} | DC Input Voltage | 0.0 | 5.5 | V |
| V _{OUT} | DC Output Voltage | 0.0 | 7.0 | V |
| T _A | Operating Temperature Range | - 55 | + 125 | °C |
| t _r , t _f | Input Rise and Fall Time | V _{CC} = 3.3 ± 0.3 V V _{CC} = 5.0 ± 0.5 V | 0 100 20 | ns/V |

DEVICE JUNCTION TEMPERATURE VERSUS TIME TO 0.1% BOND FAILURES

| Junction Temperature °C | Time, Hours | Time, Years |
|-------------------------|-------------|-------------|
| 80 | 1,032,200 | 117.8 |
| 90 | 419,300 | 47.9 |
| 100 | 178,700 | 20.4 |
| 110 | 79,600 | 9.4 |
| 120 | 37,000 | 4.2 |
| 130 | 17,800 | 2.0 |
| 140 | 8,900 | 1.0 |

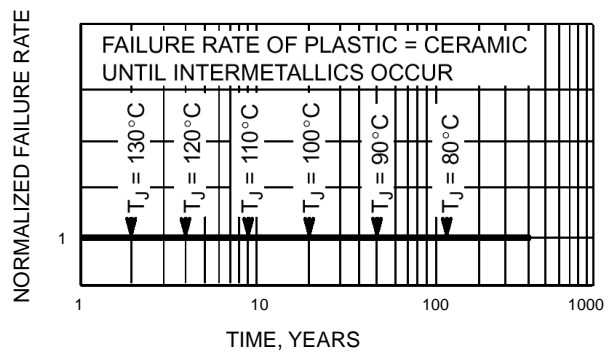


Figure 3. Failure Rate vs. Time Junction Temperature

L74VHC1G03
DC ELECTRICAL CHARACTERISTICS

| Symbol | Parameter | Test Conditions | V _{CC} (V) | T _A = 25°C | | | T _A ≤ 85°C | | -55°C ≤ T _A ≤ 125°C | | Unit |
|------------------|---|--|------------------------|-----------------------|-----|------|-----------------------|------|--------------------------------|------|------|
| | | | | Min | Typ | Max | Min | Max | Min | Max | |
| V _{IH} | Minimum High-Level Input Voltage | | 2.0 | 1.5 | | | 1.5 | | 1.5 | | V |
| | | | 3.0 | 2.1 | | 2.1 | | 2.1 | | | |
| | | | 4.5 | 3.15 | | 3.15 | | 3.15 | | | |
| | | | 5.5 | 3.85 | | 3.85 | | 3.85 | | | |
| V _{IL} | Maximum Low-Level Input Voltage | | 2.0 | | | 0.5 | | 0.5 | | 0.5 | V |
| | | | 3.0 | | | 0.9 | | 0.9 | | 0.9 | |
| | | | 4.5 | | | 1.35 | | 1.35 | | 1.35 | |
| | | | 5.5 | | | 1.65 | | 1.65 | | 1.65 | |
| V _{OH} | Minimum High-Level Output Voltage V _{IN} = V _{IH} or V _{IL} | V _{IN} = V _{IH} or V _{IL} I _{OH} = -50 μA | 2.0 | 1.9 | 2.0 | | 1.9 | | 1.9 | | V |
| | | | 3.0 | 2.9 | 3.0 | | 2.9 | | 2.9 | | |
| | | 4.5 | 4.4 | 4.0 | | 4.4 | | 4.4 | | 4.4 | |
| | | | | | | | | | | | |
| | | V _{IN} = V _{IH} or V _{IL} I _{OH} = -4 mA | 3.0 | 2.58 | | | 2.48 | | 2.34 | | |
| | | I _{OH} = -8 mA | 4.5 | 3.94 | | | 3.80 | | 3.66 | | |
| V _{OL} | Maximum Low-Level Output Voltage V _{IN} = V _{IH} or V _{IL} | V _{IN} = V _{IH} or V _{IL} I _{OL} = 50 μA | 2.0 | | 0.0 | 0.1 | | 0.1 | | 0.1 | V |
| | | | 3.0 | | 0.0 | 0.1 | | 0.1 | | 0.1 | |
| | | 4.5 | | 0.0 | 0.1 | | 0.1 | | 0.1 | | |
| | | | | | | | | | | | |
| | | V _{IN} = V _{IH} or V _{IL} I _{OL} = 4 mA | 3.0 | | | 0.36 | | 0.44 | | 0.52 | |
| | | I _{OL} = 8 mA | 4.5 | | | 0.36 | | 0.44 | | 0.52 | |
| I _{IN} | Maximum Input Leakage Current | V _{IN} = 5.5 V or GND | 0 to 5.5 | | | ±0.1 | | ±1.0 | | ±1.0 | μA |
| I _{CC} | Maximum Quiescent Supply Current | V _{IN} = V _{CC} or GND | 5.5 | | | 2.0 | | 20 | | 40 | μA |
| I _{OPD} | Maximum Off-state Leakage Current | V _{OUT} = 5.5 V | 0 | | | 0.25 | | 2.5 | | 5.0 | μA |

AC ELECTRICAL CHARACTERISTICS C_{load} = 50 pF, Input t_r = t_f = 3.0 ns

| Symbol | Parameter | Test Conditions | T _A = 25°C | | | T _A ≤ 85°C | | -55°C to 125°C | | Unit |
|------------------|--|--|-----------------------|-----|------|-----------------------|------|----------------|------|------|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| t _{PZL} | Maximum Output Enable Time, Input A or B to Y | V _{CC} = 3.3 ± 0.3 V C _L = 15 pF R _L = R _I = 500 Ω C _L = 50 pF | | 5.6 | 7.9 | | 9.5 | | 11.0 | ns |
| | | | | 8.1 | 11.4 | | 13.0 | | 15.5 | |
| t _{PLZ} | Maximum Output Disable Time | V _{CC} = 5.0 ± 0.5 V C _L = 15 pF R _L = R _I = 500 Ω C _L = 50 pF | | 3.6 | 5.5 | | 6.5 | | 8.0 | ns |
| | | | | 5.1 | 7.5 | | 8.5 | | 10.0 | |
| t _{PLZ} | Maximum Output Disable Time | V _{CC} = 3.3 ± 0.3 V C _L = 50 pF R _L = R _I = 500 Ω | | 8.1 | 11.4 | | 13.0 | | 15.5 | ns |
| | | | | 5.1 | 7.5 | | 8.5 | | 10.0 | |
| C _{IN} | Maximum Input Capacitance | | | 4 | 10 | | 10 | | 10 | pF |

| | | | Typical @ 25°C, V _{CC} = 5.0 V | | | |
|-----------------|--|--|---|--|--|----|
| C _{PD} | Power Dissipation Capacitance (Note 6) | | 18 | | | pF |

6. 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} × V_{CC} × f_{in} + I_{CC}. C_{PD} is used to determine the no-load dynamic power consumption; P_D = C_{PD} × V_{CC}² × f_{in} + I_{CC} × V_{CC}.

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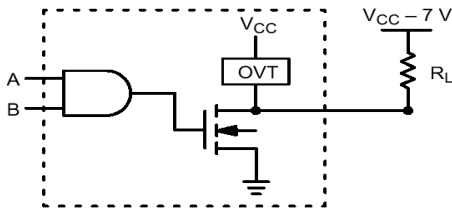


Figure 4. Output Voltage Mismatch Application

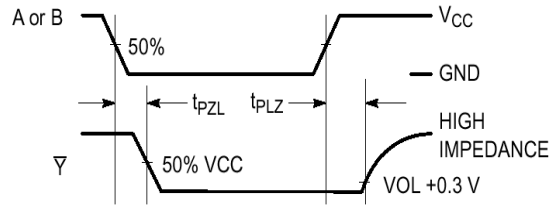
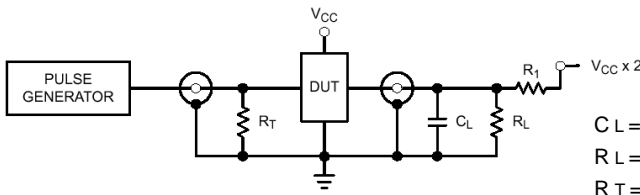


Figure 5. Switching Waveforms



CL = 50 pF equivalent (Includes jig and probe capacitance)
 RL = R1 = 500 Ω or equivalent
 RT = Z OUT of pulse generator (typically 50 Ω)

Figure 6. Test Circuit

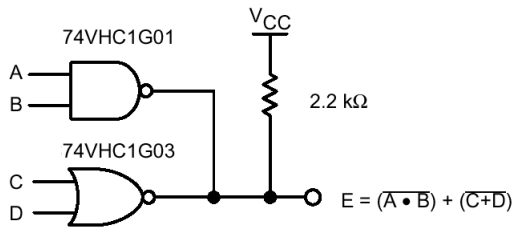


Figure 7. Complex Boolean Functions

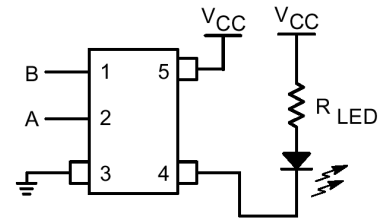


Figure 8. LED Driver

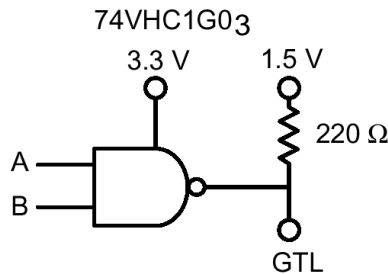


Figure 9. GTL Driver

DEVICE ORDERING INFORMATION

| Device Nomenclature | | | | | | | | |
|---------------------|-------------------------|-----------------------|------------|-----------------|----------------|----------------------|--------------------------------------|-------------------------------|
| Device Order Number | Logic Circuit Indicator | Temp Range Identifier | Technology | Device Function | Package Suffix | Tape and Reel Suffix | Package Type (Name/SOT#/Common Name) | Tape and Reel Size |
| L74VHC1G03DFT1 | L | 74 | VHC1G | 03 | DF | T1 | SC-70/SC-88A/ SOT-353 | 178 mm (7 in) 3000 Unit |
| L74VHC1G03DFT2 | L | 74 | VHC1G | 03 | DF | T2 | SC-70/SC-88A/ SOT-353 | 178 mm (7 in) 3000 Unit |
| L74VHC1G03DFT4 | L | 74 | VHC1G | 03 | DF | T4 | SC-70/SC-88A/ SOT-353 | 330 mm (13 in) 10,000 Unit |
| L74VHC1G03DTT1 | L | 74 | VHC1G | 03 | DT | T1 | SOT-23/TSOPS/ SC-59 | 178 mm (7 in) 3000 Unit |
| L74VHC1G03DTT3 | L | 74 | VHC1G | 03 | DT | T3 | SOT-23/TSOPS/ SC-59 | 330 mm (13 in) 10,000 Unit |

L74VHC1G03

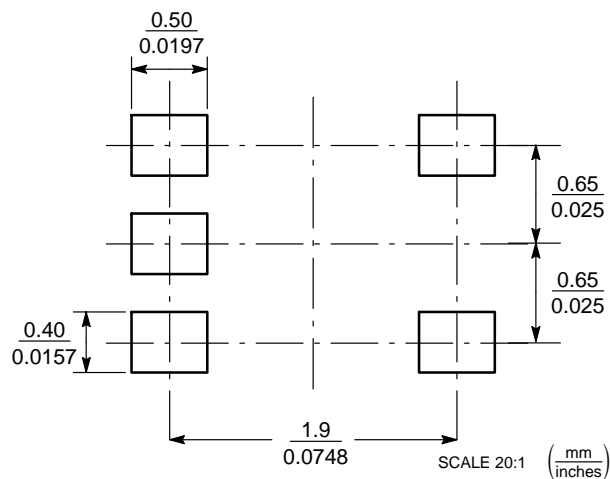
PACKAGE DIMENSIONS SC70-5/SC-88A/SOT-353 DF SUFFIX



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: INCH.
 3. 419A-01 OBSOLETE. NEW STANDARD 419A-02.
 4. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

| DIM | INCHES | | MILLIMETERS | |
|-----|-----------|-------|-------------|------|
| | MIN | MAX | MIN | MAX |
| A | 0.071 | 0.087 | 1.80 | 2.20 |
| B | 0.045 | 0.053 | 1.15 | 1.35 |
| C | 0.031 | 0.043 | 0.80 | 1.10 |
| D | 0.004 | 0.012 | 0.10 | 0.30 |
| G | 0.026 BSC | | 0.65 BSC | |
| H | --- | 0.004 | --- | 0.10 |
| J | 0.004 | 0.010 | 0.10 | 0.25 |
| K | 0.004 | 0.012 | 0.10 | 0.30 |
| N | 0.008 REF | | 0.20 REF | |
| S | 0.079 | 0.087 | 2.00 | 2.20 |

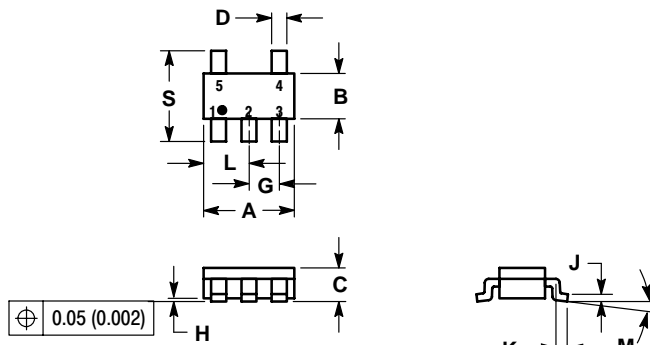
SOLDERING FOOTPRINT*



L74VHC1G03

PACKAGE DIMENSIONS

SOT23-5/TSOP-5/SC59-5
DT SUFFIX



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. A AND B DIMENSIONS DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|-------|--------|--------|
| | MIN | MAX | MIN | MAX |
| A | 2.90 | 3.10 | 0.1142 | 0.1220 |
| B | 1.30 | 1.70 | 0.0512 | 0.0669 |
| C | 0.90 | 1.10 | 0.0354 | 0.0433 |
| D | 0.25 | 0.50 | 0.0098 | 0.0197 |
| G | 0.85 | 1.05 | 0.0335 | 0.0413 |
| H | 0.013 | 0.100 | 0.0005 | 0.0040 |
| J | 0.10 | 0.26 | 0.0040 | 0.0102 |
| K | 0.20 | 0.60 | 0.0079 | 0.0236 |
| L | 1.25 | 1.55 | 0.0493 | 0.0610 |
| M | 0 | 10 | 0 | 10 |
| S | 2.50 | 3.00 | 0.0985 | 0.1181 |

SOLDERING FOOTPRINT*

