# Single 2-Input Exclusive-OR Gate

The NL17SZ86 is a high performance single 2–input Exclusive–OR Gate operating from a 2.3 V to 5.5 V supply.

#### **Features**

- Extremely High Speed:  $t_{PD}$  2.4 ns (typical) at  $V_{CC} = 5.0 \text{ V}$
- Designed for 1.65 V to 5.5 V V<sub>CC</sub> Operation
- Over Voltage Tolerant Inputs
- $L_{VTTL}$  Compatible Interface Capability with 5.0 V TTL Logic with  $V_{CC} = 3$  V
- LVCMOS Compatible
- 24 mA Balanced Output Sink and Source Capability
- Near Zero Static Supply Current Substantially Reduces System Power Requirements
- Replacement for NC7SZ86
- NLV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable
- These Devices are Pb-Free and are RoHS Compliant

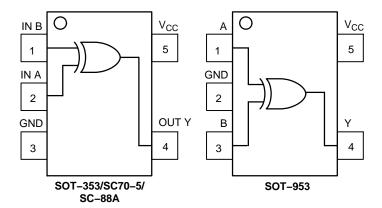


Figure 1. Pinout (Top View)

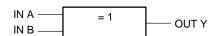


Figure 2. Logic Symbol



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SC-88A / SOT-353 / SC-70 DF SUFFIX CASE 419A



MARKING DIAGRAMS

M = Date Code

A = Assembly Location

Y = Year

W = Work Week

■ = Pb-Free Package

(Note: Microdot may be in either location)



SOT-953 CASE 527AE



E = Specific Device Code

(E with 90 degree clockwise rotation)

M = Month Code

#### **ORDERING INFORMATION**

See detailed ordering and shipping information in the package dimensions section on page 4 of this data sheet.

## **PIN ASSIGNMENT**

(SOT-353/SC70-5/SC-88A)

Pin	Function
1	IN B
2	IN A
3	GND
4	OUT Y
5	V <sub>CC</sub>

#### **PIN ASSIGNMENT (SOT-953)**

Pin	Function
1	IN A
2	GND
3	IN B
4	OUT Y
5	V <sub>CC</sub>

#### **FUNCTION TABLE**

Inp	Output	
Α	В	Υ
L	L	L
L	Н	Н
Н	L	Н
Н	Н	L

#### **MAXIMUM RATINGS**

Symbol	Parameter	Value	Unit
V <sub>CC</sub>	DC Supply Voltage	-0.5  to  +7.0	V
VI	DC Input Voltage	$-0.5 \text{ V} \leq \text{ V}_{\text{I}} \leq +7.0 \text{ V}$	V
Vo	DC Output Voltage Output in High or Low State (Note 1) (SOT-353/SC70-5/SC-88A Packages) Power-Down Mode	-0.5 V to + 7.0	V
Vo	DC Output Voltage (SOT–953 Package)	-0.5 to V <sub>CC</sub> + 0.5	V
I <sub>IK</sub>	DC Input Diode Current V <sub>I</sub> < GND	-50	mA
lok	DC Output Diode Current $V_{OUT} < GND, V_{OUT} > V_{CC}$ (SOT–953 Package)	±50	mA
I <sub>OK</sub>	DC Output Diode Current (SOT-353/SC70-5/SC-88A Packages) V <sub>OUT</sub> < GND	-50	mA
Io	DC Output Sink Current	±50	mA
Icc	DC Supply Current per Supply Pin	±100	mA
I <sub>GND</sub>	DC Ground Current per Ground Pin	±100	mA
T <sub>STG</sub>	Storage Temperature Range	-65 to +150	°C
TL	Lead Temperature, 1 mm from Case for 10 Seconds	260	°C
$T_J$	Junction Temperature under Bias	+150	°C
$\theta_{JA}$	Thermal Resistance (Note 2)	350	°C/W
P <sub>D</sub>	Power Dissipation in Still Air at 85°C	150	mW
MSL	Moisture Sensitivity	Level 1	
F <sub>R</sub>	Flammability Rating Oxygen Index: 28 to 34	UL 94 V-0 @ 0.125 in	
ESD	ESD Classification  Human Body Model (Note 4)  Machine Model (Note 5)  Charge Device Model (Note 6)	Class 1B Class B N/A	
I <sub>LATCHUP</sub>	Latchup Performance Above V <sub>CC</sub> and Below GND at 85°C (Note 3)	±500	mA

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. I<sub>O</sub> absolute maximum rating must be observed.

- 2. Measured with minimum pad spacing on an FR4 board, using 10 mm-by-1 inch, 2-ounce copper trace with no air flow.
- Tested to EIA/JESD78
   Tested to EIA/JESD22-A114-A, rated to EIA/JESD22-A114-B.
- 5. Tested to EIA/JESD22-A115-A, rated to EIA/JESD22-A115-B.
- 6. Tested to JESD22-C101-A.

#### **RECOMMENDED OPERATING CONDITIONS**

Symbol	Parameter		Min	Max	Unit
V <sub>CC</sub>	Supply Voltage	Operating Data Retention Only	1.65 1.5	5.5 5.5	V
VI	Input Voltage	(Note 7)	0	5.5	V
Vo	Output Voltage (SOT-353/SC70-5/SC-88A Packages)	(HIGH or LOW State)	0	5.5	V
Vo	Output Voltage (SOT-953 Package)	(HIGH or LOW State)	0	V <sub>CC</sub>	V
T <sub>A</sub>	Operating Free-Air Temperature		-55	+125	°C
Δt/ΔV	Input Transition Rise or Fall Rate	$V_{CC} = 2.5 \text{ V} \pm 0.2 \text{ V}$ $V_{CC} = 3.0 \text{ V} \pm 0.3 \text{ V}$ $V_{CC} = 5.0 \text{ V} \pm 0.5 \text{ V}$	0 0 0	20 10 5	ns/V

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

7. Unused inputs may not be left open. All inputs must be tied to a high- or low-logic input voltage level.

#### DC ELECTRICAL CHARACTERISTICS

			V <sub>CC</sub>	$T_A = 25^{\circ}C$ $-55^{\circ}C \leq T_A$			<sub>4</sub> ≤ 125°C		
Symbol	Parameter	Condition	(V)	Min	Тур	Max	Min	Max	Unit
V <sub>IH</sub>	High-Level Input Voltage		1.65 to 1.95 2.3 to 5.5	0.75 V <sub>CC</sub> 0.7 V <sub>CC</sub>			0.75 V <sub>CC</sub> 0.7 V <sub>CC</sub>		٧
V <sub>IL</sub>	Low-Level Input Voltage		1.65 to 1.95 2.3 to 5.5			0.25 V <sub>CC</sub> 0.3 V <sub>CC</sub>		0.25 V <sub>CC</sub> 0.3 V <sub>CC</sub>	V
V <sub>OH</sub>	High-Level Output Voltage V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IL</sub>	$\begin{split} I_{OH} &= -100 \; \mu A \\ I_{OH} &= -3 \; mA \\ I_{OH} &= -8 \; mA \\ I_{OH} &= -12 \; mA \\ I_{OH} &= -16 \; mA \\ I_{OH} &= -24 \; mA \\ I_{OH} &= -32 \; mA \end{split}$	1.65 to 5.5 1.65 2.3 2.7 3.0 3.0 4.5	V <sub>CC</sub> - 0.1 1.29 1.9 2.2 2.4 2.3 3.8	V <sub>CC</sub> 1.8 2.1 2.4 2.7 2.5 4.0		V <sub>CC</sub> - 0.1 1.29 1.9 2.2 2.4 2.3 3.8		V
V <sub>OL</sub>	Low-Level Output Voltage V <sub>IN</sub> = V <sub>IH</sub>	$\begin{split} I_{OL} &= 100 \; \mu\text{A} \\ I_{OL} &= 3 \; \text{mA} \\ I_{OL} &= 8 \; \text{mA} \\ I_{OL} &= 12 \; \text{mA} \\ I_{OL} &= 16 \; \text{mA} \\ I_{OL} &= 24 \; \text{mA} \\ I_{OL} &= 32 \; \text{mA} \end{split}$	1.65 to 5.5 1.65 2.3 2.7 3.0 3.0 4.5		0.08 0.20 0.22 0.28 0.38 0.42	0.1 0.24 0.3 0.4 0.4 0.55 0.55		0.1 0.24 0.3 0.4 0.4 0.55 0.55	V
I <sub>IN</sub>	Input Leakage Current	V <sub>IN</sub> = 5.5 V or GND	0 to 5.5			± 0.1		±1.0	μΑ
l <sub>OFF</sub>	Power Off Leakage Current (SOT–353/ SC70–5/SC–88A Packages)	V <sub>IN</sub> = 5.5 V or V <sub>OUT</sub> = 5.5 V	0			1		10	μΑ
I <sub>CC</sub>	Quiescent Supply Current	V <sub>IN</sub> = 5.5 V or GND	5.5			1		10	μΑ

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

### AC ELECTRICAL CHARACTERISTICS $t_R = t_F = 3.0 \text{ ns}$

			V <sub>CC</sub>	•	Γ <sub>A</sub> = 25°C	;	-55°C ≤ T	<sub>A</sub> ≤ 125°C	
Symbol	Parameter	Condition	(V)	Min	Тур	Max	Min	Max	Unit
t <sub>PLH</sub>	Propagation Delay	$R_L = 1 \text{ M}\Omega$ , $C_L = 15 \text{ pF}$	1.65	2.0	6.9	13.8	2.0	14.5	ns
t <sub>PHL</sub>	(Figure 3 and 4)	$R_L = 1 \text{ M}\Omega$ , $C_L = 15 \text{ pF}$	1.8	2.0	5.7	11.5	2.0	12	
		$R_L = 1 \text{ M}\Omega$ , $C_L = 15 \text{ pF}$	$2.5 \pm 0.2$	1.2	4.1	7.0	1.2	7.5	
		$R_L = 1 \text{ M}\Omega, C_L = 15 \text{ pF}$ $R_L = 500 \Omega, C_L = 50 \text{ pF}$	$3.3 \pm 0.3$	0.8 1.2	3.0 3.8	4.8 5.4	0.8 1.2	5.2 5.9	
		$\begin{aligned} R_L &= 1 \text{ M}\Omega, C_L = 15 \text{ pF} \\ R_L &= 500 \ \Omega, C_L = 50 \text{ pF} \end{aligned}$	$5.0 \pm 0.5$	0.5 0.8	2.2 2.9	3.5 4.2	0.5 1.0	3.8 4.6	

#### **CAPACITIVE CHARACTERISTICS**

Symbol	Parameter Condition		Typical	Unit
C <sub>IN</sub>	Input Capacitance	$V_{CC} = 5.5 \text{ V}, V_I = 0 \text{ V or } V_{CC}$	7.0	pF
C <sub>PD</sub>	Power Dissipation Capacitance (Note 8)	10 MHz, $V_{CC} = 3.3 \text{ V}$ , $V_I = 0 \text{ V or } V_{CC}$ 10 MHz, $V_{CC} = 5.5 \text{ V}$ , $V_I = 0 \text{ V or } V_{CC}$	9 11	pF

<sup>8.</sup> C<sub>PD</sub> 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<sub>CC(OPR)</sub> = C<sub>PD</sub> • V<sub>CC</sub> • f<sub>in</sub> + I<sub>CC</sub>. C<sub>PD</sub> is used to determine the no–load dynamic power consumption; P<sub>D</sub> = C<sub>PD</sub> • V<sub>CC</sub><sup>2</sup> • f<sub>in</sub> + I<sub>CC</sub> • V<sub>CC</sub>.

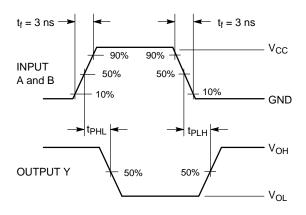
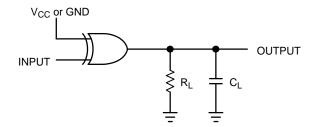


Figure 3. Switching Waveform



A 1–MHz square input wave is recommended for propagation delay tests.

Figure 4. Test Circuit

#### **DEVICE ORDERING INFORMATION**

Device	Package	Shipping <sup>†</sup>
NL17SZ86DFT2G	SC70-5/SC-88A/SOT-353 (Pb-Free)	3000 / Tape & Reel
NLV17SZ86DFT2G*	SC70-5/SC-88A/SOT-353 (Pb-Free)	3000 / Tape & Reel
NL17SZ86P5T5G	SOT-953 (Pb-Free)	8000 / Tape & Reel

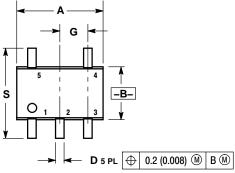
<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

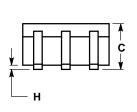
<sup>\*</sup>NLV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable.

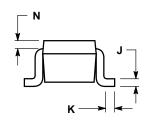
#### **PACKAGE DIMENSIONS**

# SC-88A (SC-70-5/SOT-353) CASE 419A-02

**ISSUE L** 



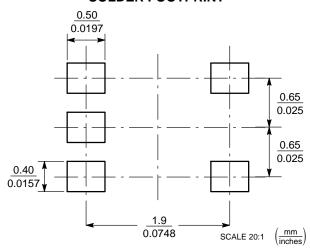




- NOTES:
  1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. 419A-01 OBSOLETE. NEW STANDARD 419A-02.
  4. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

	INC	HES	MILLIN	IETERS
DIM	MIN	MAX	MIN	MAX
Α	0.071	0.087	1.80	2.20
В	0.045	0.053	1.15	1.35
С	0.031	0.043	0.80	1.10
D	0.004	0.012	0.10	0.30
G	0.026	BSC	0.65 BSC	
Н		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

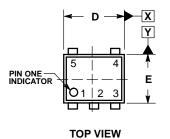
#### **SOLDER FOOTPRINT\***

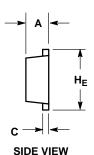


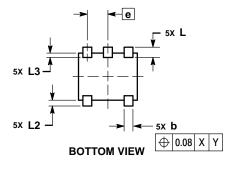
\*For additional information on our Pb–Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

#### PACKAGE DIMENSIONS

#### SOT-953 CASE 527AE ISSUE E





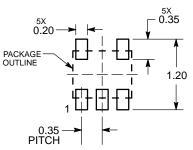


#### NOTES

- DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994. CONTROLLING DIMENSION: MILLIMETERS
- MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF THE BASE MATERIAL DIMENSIONS D AND E DO NOT INCLUDE MOLD
- FLASH, PROTRUSIONS, OR GATE BURRS.

	MILLIMETERS						
DIM	MIN	NOM	MAX				
Α	0.34	0.37	0.40				
b	0.10	0.15	0.20				
С	0.07	0.12	0.17				
D	0.95	1.00	1.05				
Е	0.75	0.80	0.85				
е		0.35 BS	С				
HE	0.95	1.00	1.05				
L	0.175 REF						
L2	0.05	0.10	0.15				
L3			0.15				

#### **SOLDERING FOOTPRINT\***



**DIMENSIONS: MILLIMETERS** 

\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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