

# NL17SG373

## Low-Power D-Type Transparent Latch with 3-State Output

The NL17SG373 MiniGate™ is an advanced high-speed CMOS D-Type Transparent Latch with 3-State Output in ultra-small footprint.

The NL17SG373 input structures provide protection when voltages up to 5.5 V are applied, regardless of the supply voltage.

This device is fully specified for partial power-down applications using I<sub>OFF</sub>. The I<sub>OFF</sub> circuitry disables the output, preventing the damaging backflow current through the device when it is powered down.

### Features

- Wide Operating V<sub>CC</sub> Range: 0.9 V to 3.6 V
- High Speed: t<sub>PD</sub> = 2.4 ns (Typ) @ V<sub>CC</sub> = 3.0 V, C<sub>L</sub> = 15 pF
- Low Power Dissipation: I<sub>CC</sub> = 0.5 μA (Max) at T<sub>A</sub> = 25°C
- 5.5 V Overvoltage Tolerant (OVT) Input Pins
- Ultra-Small Packages
- These Devices are Pb-Free and are RoHS Compliant

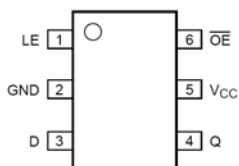


Figure 1. SC88 (Top View)

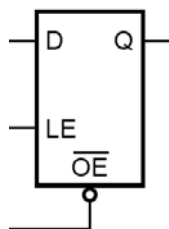


Figure 2. Logic Symbol



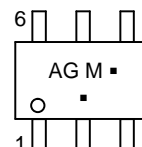
ON Semiconductor®

<http://onsemi.com>

### MARKING DIAGRAMS



SC-88  
DF SUFFIX  
CASE 419B



AG = Device Code  
M = Date Code\*  
■ = Pb-Free Package

(Note: Microdot may be in either location)

\*Date Code orientation and/or position may vary depending upon manufacturing location.

### PIN ASSIGNMENT

Pin	Function
1	LE
2	GND
3	D
4	Q
5	V <sub>CC</sub>
6	$\overline{OE}$

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 9 of this data sheet.

# NL17SG373

## FUNCTION TABLE

Input			Internal Latch	Output	Operating Mode
$\overline{OE}$	LE	D		Q	
L	H	L	L	L	Enable and Read Register
L	H	H	H	H	(Transparent Mode)
L	L	L	L	L	Latch and Read Register
L	L	H	H	H	
H	X	X	X	Z	Latch Register and Disable Output

## MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
$V_{CC}$	DC Supply Voltage	-0.5 to +5.5	V
$V_{IN}$	DC Input Voltage	-0.5 to +5.5	V
$V_{OUT}$	DC Output Voltage	-0.5 to $V_{CC} + 0.5$	V
$I_{IK}$	DC Input Diode Current $V_{IN} < GND$	-50	mA
$I_{OK}$	DC Output Diode Current $V_{OUT} < GND, V_{OUT} > V_{CC}$	$\pm 50$	mA
$I_O$	DC Output Source/Sink Current	$\pm 20$	mA
$I_{CC}$	DC Supply Current Per Supply Pin	$\pm 50$	mA
$I_{GND}$	DC Ground Current per Ground Pin	$\pm 50$	mA
$T_{STG}$	Storage Temperature Range	-65 to +150	$^{\circ}C$
$T_L$	Lead Temperature, 1 mm from Case for 10 Seconds	260	$^{\circ}C$
$T_J$	Junction Temperature Under Bias	150	$^{\circ}C$
MSL	Moisture Sensitivity	Level 1	
$F_R$	Flammability Rating Oxygen Index: 28 to 34	UL 94 V-0 @ 0.125 in	
$V_{ESD}$	ESD Withstand Voltage Human Body Mode (Note 2) Machine Model (Note 3)	> 3000 > 200	V
$I_{LATCHUP}$	Latchup Performance Above $V_{CC}$ and Below GND at 125 $^{\circ}C$ (Note 4)	$\pm 100$	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. Measured with minimum pad spacing on an FR4 board, using 10 mm-by-1 inch, 2 ounce copper trace no air flow.
2. Tested to EIA / JESD22-A114-A.
3. Tested to EIA / JESD22-A115-A.
4. Tested to EIA / JESD78.

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
$V_{CC}$	Positive DC Supply Voltage	0.9	3.6	V
$V_{IN}$	Digital Input Voltage	0	3.6	V
$V_{OUT}$	Output Voltage Active Mode	0	$V_{CC}$	V
$T_A$	Operating Free-Air Temperature	-55	+125	$^{\circ}C$
$\Delta t / \Delta V$	Input Transition Rise or Fall Rate $V_{CC} = 3.3 V \pm 0.3 V$	0	10	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.

# NL17SG373

## DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	T <sub>A</sub> = 25°C			T <sub>A</sub> = -55°C to +125°C		Unit
				Min	Typ	Max	Min	Max	
V <sub>IH</sub>	High-Level Input Voltage		0.9	V <sub>CC</sub>			V <sub>CC</sub>		V
			1.1 to 1.3	0.7 x V <sub>CC</sub>			0.7 x V <sub>CC</sub>		
			1.4 to 1.6	0.65 x V <sub>CC</sub>			0.65 x V <sub>CC</sub>		
			1.65 to 1.95	0.65 x V <sub>CC</sub>			0.65 x V <sub>CC</sub>		
			2.3 to 2.7	1.7			1.7		
			3.0 to 3.6	2.0			2.0		
V <sub>IL</sub>	Low-Level Input Voltage		0.9			GND		GND	V
			1.1 to 1.3			0.3 x V <sub>CC</sub>		0.3 x V <sub>CC</sub>	
			1.4 to 1.6			0.35 x V <sub>CC</sub>		0.35 x V <sub>CC</sub>	
			1.65 to 1.95			0.35 x V <sub>CC</sub>		0.35 x V <sub>CC</sub>	
			2.3 to 2.7			0.7		0.7	
			3.0 to 3.6			0.8		0.8	
V <sub>OH</sub>	High-Level Output Voltage	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OH</sub> = -20 μA	0.9	0.75		0.75		V
			I <sub>OH</sub> = -0.3 mA	1.1 to 1.3	0.75 x V <sub>CC</sub>		0.75 x V <sub>CC</sub>		
			I <sub>OH</sub> = -1.7 mA	1.4 to 1.6	0.75 x V <sub>CC</sub>		0.75 x V <sub>CC</sub>		
			I <sub>OH</sub> = -3.0 mA	1.65 to 1.95	V <sub>CC</sub> - 0.45		V <sub>CC</sub> - 0.45		
			I <sub>OH</sub> = -4.0 mA	2.3 to 2.7	2.0		2.0		
			I <sub>OH</sub> = -8.0 mA	3.0 to 3.6	2.48		2.48		
V <sub>OL</sub>	Low-Level Output Voltage	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OL</sub> = 20 μA	0.9		0.1		0.1	V
			I <sub>OL</sub> = 0.3 mA	1.1 to 1.3		0.25 x V <sub>CC</sub>		0.25 x V <sub>CC</sub>	
			I <sub>OL</sub> = 1.7 mA	1.4 to 1.6		0.25 x V <sub>CC</sub>		0.25 x V <sub>CC</sub>	
			I <sub>OL</sub> = 3.0 mA	1.65 to 1.95		0.45		0.45	
			I <sub>OL</sub> = 4.0 mA	2.3 to 2.7		0.4		0.4	
			I <sub>OL</sub> = 8.0 mA	3.0 to 3.6		0.4		0.4	
I <sub>IN</sub>	Input Leakage Current	0 ≤ V <sub>IN</sub> ≤ 3.6 V	0 to 3.6			±0.1		±0.5	μA
I <sub>CC</sub>	Quiescent Supply Current	V <sub>IN</sub> = V <sub>CC</sub> or GND	3.6			0.5		10	μA
I <sub>OZ</sub>	3-State Output Leakage Current	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>OUT</sub> = 0 to 3.6 V	0.9 to 3.6			0.1		1	μA

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.

# NL17SG373

## AC ELECTRICAL CHARACTERISTICS (Input $t_r = t_f = 3.0$ ns)

Symbol	Parameter	Test Condition	$V_{CC}$ (V)	$T_A = 25^\circ\text{C}$			$T_A = -55^\circ\text{C to } +125^\circ\text{C}$		Unit
				Min	Typ	Max	Min	Max	
$t_{PLH}$ , $t_{PHL}$	Propagation Delay, D to Q	$C_L = 10$ pF, $R_L = 1$ M $\Omega$	0.9	–	15.3	–	–	–	ns
			1.1 to 1.3	–	6.3	12.3	1.0	14.4	
			1.4 to 1.6	–	4.4	8.1	1.0	9.4	
			1.65 to 1.95	–	3.6	6.2	0.5	6.7	
			2.3 to 2.7	–	2.6	3.9	0.5	4.4	
			3.0 to 3.6	–	2.1	3.1	0.5	3.7	
		$C_L = 15$ pF, $R_L = 1$ M $\Omega$	0.9	–	17.7	–	–	–	ns
			1.1 to 1.3	–	7.1	13.6	1.0	15.6	
			1.4 to 1.6	–	5.0	9.2	1.0	10.4	
			1.65 to 1.95	–	4.1	6.9	1.0	7.1	
			2.3 to 2.7	–	2.9	4.4	0.5	5.0	
			3.0 to 3.6	–	2.4	3.4	0.5	3.9	
		$C_L = 30$ pF, $R_L = 1$ M $\Omega$	0.9	–	29	–	–	–	ns
			1.1 to 1.3	–	9.3	17.3	1.0	21.2	
			1.4 to 1.6	–	6.4	11.6	1.0	12.6	
			1.65 to 1.95	–	5.3	9.1	1.0	9.6	
			2.3 to 2.7	–	4	5.7	1.0	6.1	
			3.0 to 3.6	–	3.3	4.4	1.0	4.8	
$t_{PLH}$ , $t_{PHL}$	Propagation Delay, LE to Q	$C_L = 10$ pF, $R_L = 1$ M $\Omega$	0.9	–	15.3	–	–	–	ns
			1.1 to 1.3	–	6.3	12.3	1.0	14.4	
			1.4 to 1.6	–	4.4	8.1	1.0	9.4	
			1.65 to 1.95	–	3.6	6.2	0.5	6.7	
			2.3 to 2.7	–	2.6	3.9	0.5	4.4	
			3.0 to 3.6	–	2.1	3.1	0.5	3.7	
		$C_L = 15$ pF, $R_L = 1$ M $\Omega$	0.9	–	17.7	–	–	–	ns
			1.1 to 1.3	–	7.1	13.6	1.0	15.6	
			1.4 to 1.6	–	5.0	9.2	1.0	10.4	
			1.65 to 1.95	–	4.1	6.9	1.0	7.1	
			2.3 to 2.7	–	2.9	4.4	0.5	5.0	
			3.0 to 3.6	–	2.4	3.4	0.5	3.9	
		$C_L = 30$ pF, $R_L = 1$ M $\Omega$	0.9	–	29	–	–	–	ns
			1.1 to 1.3	–	9.3	17.3	1.0	21.2	
			1.4 to 1.6	–	6.4	11.6	1.0	12.6	
			1.65 to 1.95	–	5.3	9.1	1.0	9.6	
			2.3 to 2.7	–	4	5.7	1.0	6.1	
			3.0 to 3.6	–	3.3	4.4	1.0	4.8	

# NL17SG373

## AC ELECTRICAL CHARACTERISTICS (Input $t_r = t_f = 3.0$ ns)

Symbol	Parameter	Test Condition	$V_{CC}$ (V)	$T_A = 25^\circ\text{C}$			$T_A = -55^\circ\text{C to } +125^\circ\text{C}$		Unit
				Min	Typ	Max	Min	Max	
$t_{pZH}$ , $t_{pZL}$	Output Enable Time, OE to Q	$C_L = 10$ pF, $R_L = 5$ k $\Omega$	0.9	-	18.9	-	-	-	ns
			1.1 to 1.3	-	6.0	10.2	1	10.6	
			1.4 to 1.6	-	4.5	6.5	1	7.0	
			1.65 to 1.95	-	3.9	5.4	1	5.8	
			2.3 to 2.7	-	2.5	3.5	1	3.8	
			3.0 to 3.6	-	2.1	2.7	1	3	
		$C_L = 15$ pF, $R_L = 5$ k $\Omega$	0.9	-	22	-	-	-	ns
			1.1 to 1.3	-	6.8	11.6	1	12.1	
			1.4 to 1.6	-	5.1	7.2	1	7.9	
			1.65 to 1.95	-	4.4	6.1	1	6.5	
			2.3 to 2.7	-	2.9	3.9	1	4.2	
			3.0 to 3.6	-	2.3	3	1	3.3	
		$C_L = 30$ pF, $R_L = 5$ k $\Omega$	0.9	-	31.8	-	-	-	ns
			1.1 to 1.3	-	9.1	15.7	1	16.2	
			1.4 to 1.6	-	6.7	9.5	1	10.5	
			1.65 to 1.95	-	5.7	7.9	1	8.6	
			2.3 to 2.7	-	3.8	5	1	5.5	
			3.0 to 3.6	-	2.9	3.8	1	4.2	
$t_{pHZ}$ , $t_{pLZ}$	Output Disable Time, OE to Q	$C_L = 10$ pF, $R_L = 5$ k $\Omega$	0.9	-	11.3	-	-	-	ns
			1.1 to 1.3	-	5.3	8.3	1	8.4	
			1.4 to 1.6	-	4.1	5.8	1	6.1	
			1.65 to 1.95	-	4.2	5.7	1	5.9	
			2.3 to 2.7	-	3.0	4	1	4.2	
			3.0 to 3.6	-	3.4	4.7	1	5	
		$C_L = 15$ pF, $R_L = 5$ k $\Omega$	0.9	-	11	-	-	-	ns
			1.1 to 1.3	-	5.8	8.2	1	11	
			1.4 to 1.6	-	3.9	5.9	1	8	
			1.65 to 1.95	-	4.5	6.6	1	7.4	
			2.3 to 2.7	-	3.2	4.3	1	5.1	
			3.0 to 3.6	-	4.8	6.2	1	6.7	
		$C_L = 30$ pF, $R_L = 5$ k $\Omega$	0.9	-	17.7	-	-	-	ns
			1.1 to 1.3	-	9.9	15.7	1	16	
			1.4 to 1.6	-	7.7	10.8	1	11.6	
			1.65 to 1.95	-	6	12.9	1	12.9	
			2.3 to 2.7	-	5	9.1	1	9.5	
			3.0 to 3.6	-	4	12.5	1	13	

# NL17SG373

## AC ELECTRICAL CHARACTERISTICS (Input $t_r = t_f = 3.0$ ns)

Symbol	Parameter	Test Condition	V <sub>CC</sub> (V)	T <sub>A</sub> = 25 °C			T <sub>A</sub> = -55°C to +125°C		Unit
				Min	Typ	Max	Min	Max	
C <sub>IN</sub>	Input Capacitance		0 to 3.6		1.5	-	-	-	pF
C <sub>O</sub>	Output Capacitance	V <sub>O</sub> = GND	0		3	-	-	-	pF
C <sub>PD</sub>	Power dissipation Capacitance (Note 5)	f = 10 MHz; V <sub>I</sub> = GND to V <sub>CC</sub>	0.9	-	1.6	-	-	-	pF
			1.1 to 1.3	-	1.7	-	-	-	
			1.4 to 1.6	-	1.8	-	-	-	
			1.65 to 1.95	-	1.9	-	-	-	
			2.3 to 2.7	-	2.2	-	-	-	
			3.0 to 3.6	-	2.7	-	-	-	

5. C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the dynamic operating current consumption without load. Average operating current can be obtained by the equation  $I_{CC(OPR)} = C_{PD} \cdot V_{CC} \cdot f_{in} + I_{CC}$ . C<sub>PD</sub> is used to determine the no-load dynamic power consumption:  $P_D = C_{PD} \cdot V_{CC}^2 \cdot f_{in} + I_{CC} \cdot V_{CC}$ .

## TIMING REQUIREMENTS (Input $t_r = t_f = 3.0$ ns; C<sub>L</sub> = 5 pF, 10 pF, 15 pF and 20 pF)

Symbol	Parameter	Test Condition	V <sub>CC</sub> (V)	T <sub>A</sub> = 25 °C			T <sub>A</sub> = -55°C to +125°C		Unit
				Min	Typ	Max	Min	Max	
t <sub>w</sub>	Pulse Width, LE	High	0.9	-	4.0	-	-	-	ns
			1.1 to 1.3	-	0.7	-	2.1	-	
			1.4 to 1.6	-	0.5	-	1.3	-	
			1.65 to 1.95	-	0.4	-	1.0	-	
			2.3 to 2.7	-	0.3	-	0.8	-	
			3.0 to 3.6	-	0.2	-	0.8	-	
t <sub>SU</sub>	Set-Up Time, D to LE	High or Low	0.9	-	2.1	-	-	-	ns
			1.1 to 1.3	-	0.5	-	2.7	-	
			1.4 to 1.6	-	0.3	-	1.5	-	
			1.65 to 1.95	-	0.3	-	1.2	-	
			2.3 to 2.7	-	0.2	-	0.9	-	
			3.0 to 3.6	-	0.2	-	0.7	-	
t <sub>H</sub>	Hold Time D to LE	High or Low	0.9	-	-2.8	-	-	-	ns
			1.1 to 1.3	-	-0.7	-	-0.1	-	
			1.4 to 1.6	-	-0.4	-	-0.1	-	
			1.65 to 1.95	-	-0.4	-	0	-	
			2.3 to 2.7	-	-0.3	-	0.2	-	
			3.0 to 3.6	-	-0.4	-	0.3	-	

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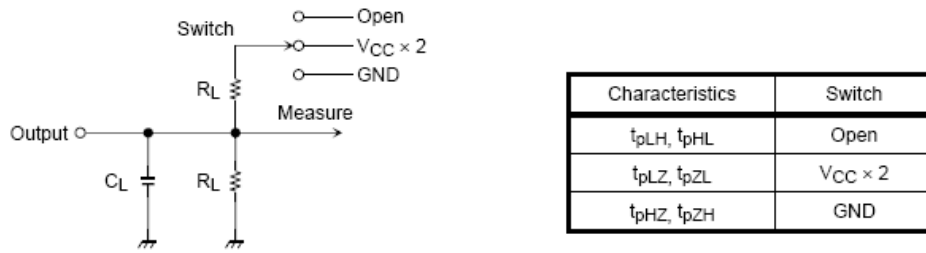
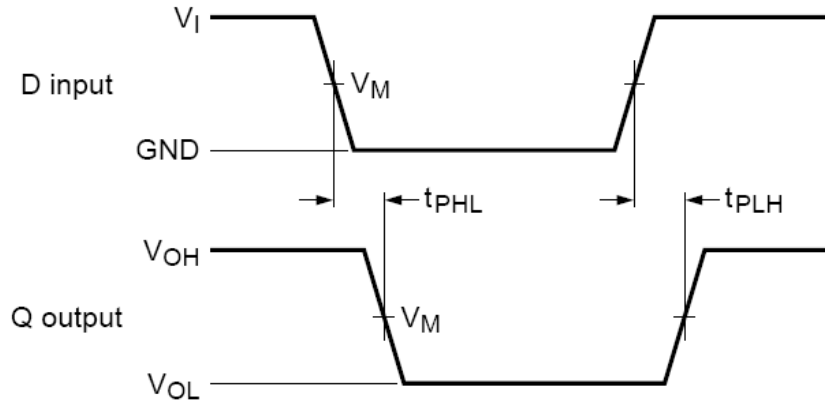
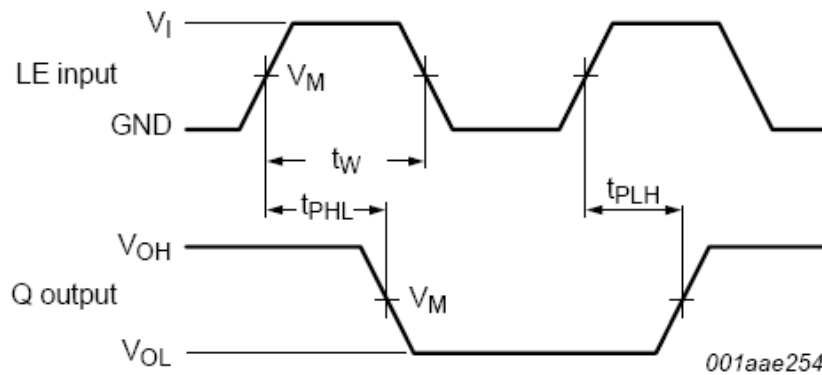


Figure 3. Test Circuit



Logic levels:  $V_{OL}$  and  $V_{OH}$  are typical output voltage levels that occur with the output load.

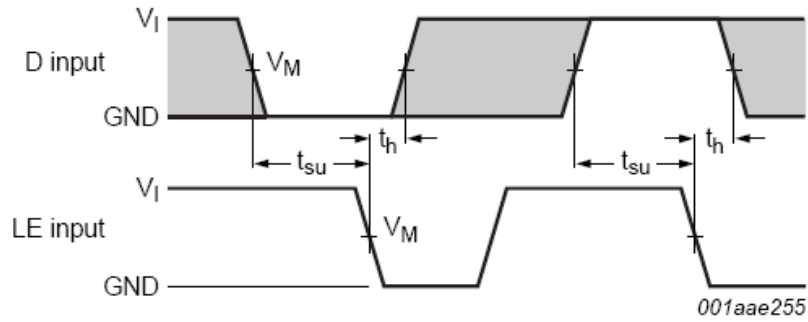
Figure 4.  $t_{pLH}$ ,  $t_{pHL}$  Waveforms (D to Q)



Logic levels:  $V_{OL}$  and  $V_{OH}$  are typical output voltage levels that occur with the output load.

Figure 5.  $t_{pLH}$ ,  $t_{pHL}$ ,  $t_W$  Waveforms (LE to Q)

# NL17SG373

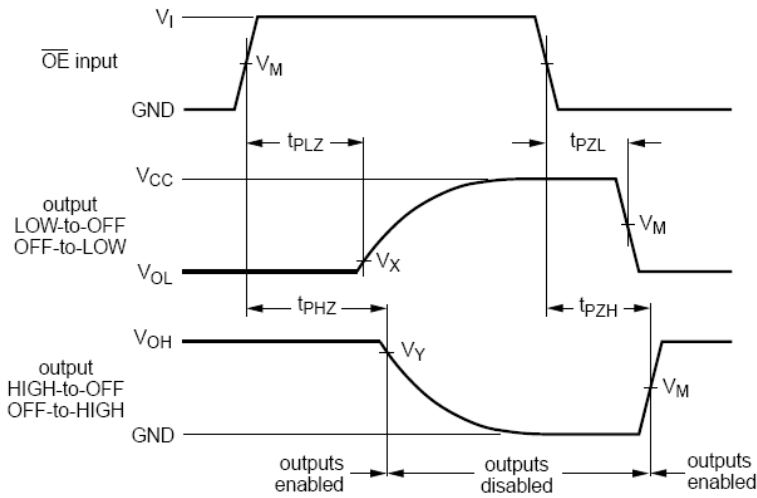


Logic levels:  $V_{OL}$  and  $V_{OH}$  are typical output voltage levels that occur with the output load.

**Figure 6.  $t_{SU}$ ,  $t_H$  Waveforms (D to LE)**

## MEASUREMENT POINTS FOR FIGURES 4, 5 AND 6

Supply Voltage	Input			Output
$V_{CC}$	$V_M$	$V_I$	$t_r = t_f$	$V_M$
0.9 V to 3.6 V	$0.5 \times V_{CC}$	$V_{CC}$	$\leq 3.0$ ns	$0.5 \times V_{CC}$



Logic levels:  $V_{OL}$  and  $V_{OH}$  are typical output voltage levels that occur with the output load.

**Figure 7.  $t_{PLZ}$ ,  $t_{PHZ}$ ,  $t_{PZH}$ ,  $t_{PZL}$  Waveforms ( $\overline{OE}$  to Q)**

## MEASUREMENT POINTS FOR FIGURE 7

Supply Voltage	Input			Output		
$V_{CC}$	$V_M$	$V_I$	$t_r = t_f$	$V_M$	$V_X$	$V_Y$
0.9 V	$0.5 \times V_{CC}$	$V_{CC}$	$\leq 3.0$ ns	$0.5 \times V_{CC}$	$V_{OL} + 0.1$ V	$V_{OH} - 0.1$ V
1.1 V to 1.3 V	$0.5 \times V_{CC}$	$V_{CC}$	$\leq 3.0$ ns	$0.5 \times V_{CC}$	$V_{OL} + 0.1$ V	$V_{OH} - 0.1$ V
1.4 V to 1.6 V	$0.5 \times V_{CC}$	$V_{CC}$	$\leq 3.0$ ns	$0.5 \times V_{CC}$	$V_{OL} + 0.1$ V	$V_{OH} - 0.1$ V
1.65 V to 1.95 V	$0.5 \times V_{CC}$	$V_{CC}$	$\leq 3.0$ ns	$0.5 \times V_{CC}$	$V_{OL} + 0.15$ V	$V_{OH} - 0.15$ V
2.3 V to 2.7 V	$0.5 \times V_{CC}$	$V_{CC}$	$\leq 3.0$ ns	$0.5 \times V_{CC}$	$V_{OL} + 0.15$ V	$V_{OH} - 0.15$ V
3.0 V to 3.6 V	$0.5 \times V_{CC}$	$V_{CC}$	$\leq 3.0$ ns	$0.5 \times V_{CC}$	$V_{OL} + 0.3$ V	$V_{OH} - 0.3$ V



# NL17SG373

## ORDERING INFORMATION

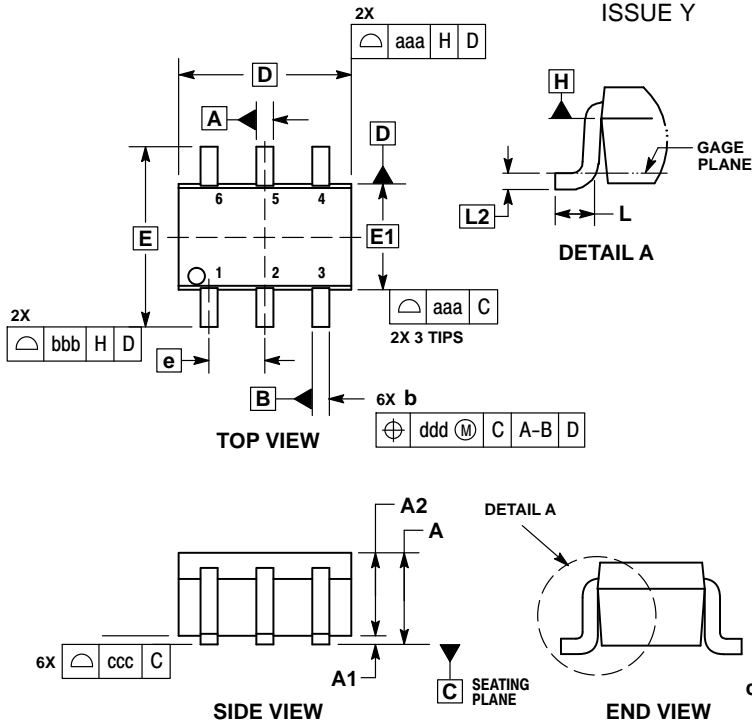
Device	Package	Shipping†
NL17SG373DFT2G	SC-88 / SOT-363 / SC-70-6 (Pb-Free)	3000 / Tape & Reel

†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.

# NL17SG373

## PACKAGE DIMENSIONS

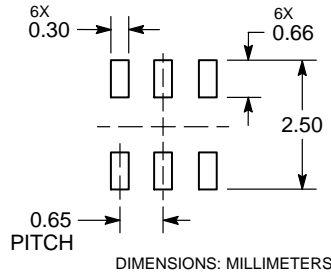
SC-88/SC70-6/SOT-363  
CASE 419B-02  
ISSUE Y



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
  2. CONTROLLING DIMENSION: MILLIMETERS.
  3. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GAGE BURRS SHALL NOT EXCEED 0.20 PER END.
  4. DIMENSIONS D AND E1 AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY AND DATUM H.
  5. DATUMS A AND B ARE DETERMINED AT DATUM H.
  6. DIMENSIONS b AND c APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.08 AND 0.15 FROM THE TIP.
  7. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 TOTAL IN EXCESS OF DIMENSION b AT MAXIMUM MATERIAL CONDITION. THE DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OF THE FOOT.

DIM	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	---	---	1.10	---	---	0.043
A1	0.00	---	0.10	0.000	---	0.004
A2	0.70	0.90	1.00	0.027	0.035	0.039
b	0.15	0.20	0.25	0.006	0.008	0.010
C	0.08	0.15	0.22	0.003	0.006	0.009
D	1.80	2.00	2.20	0.070	0.078	0.086
E	2.00	2.10	2.20	0.078	0.082	0.086
E1	1.15	1.25	1.35	0.045	0.049	0.053
e	0.65 BSC			0.026 BSC		
L	0.26	0.36	0.46	0.010	0.014	0.018
L2	0.15 BSC			0.006 BSC		
aaa	0.15			0.006		
bbb	0.30			0.012		
ccc	0.10			0.004		
ddd	0.10			0.004		

### RECOMMENDED SOLDERING 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.

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