

# NLAS1053

## 2:1 Mux/Demux Analog Switches

The NLAS1053 is an advanced CMOS analog switch fabricated with silicon gate CMOS technology. It achieves very high speed propagation delays and low ON resistances while maintaining CMOS low power dissipation. The device consists of a single 2:1 Mux/Demux (SPDT), similar to ON Semiconductor's NLAS4053 analog and digital voltages that may vary across the full power supply range (from V<sub>CC</sub> to GND).

The inhibit and select input pins have over voltage protection that allows voltages above V<sub>CC</sub> up to 7.0 V to be present without damage or disruption of operation of the part, regardless of the operating voltage.

- High Speed: t<sub>PD</sub> = 1 ns (Typ) at V<sub>CC</sub> = 5.0 V
- Low Power Dissipation: I<sub>CC</sub> = 2 μA (Max) at T<sub>A</sub> = 25°C
- High Bandwidth, Improved Linearity, and Low R<sub>DS(ON)</sub>
- INH Pin Allows a Both Channels 'OFF' Condition (With a High)
- R<sub>DS(ON)</sub> ≅ 25 Ω, Performance Very Similar to the NLAS4053
- Break Before Make Circuitry, Prevents Inadvertent Shorts
- Useful For Switching Video Frequencies Beyond 50 MHz
- Latch-Up Performance Exceeds 300 mA
- ESD Performance: HBM > 2000 V; MM > 200 V, CDM > 1500 V
- Tiny US8 Package, Only 2.1 X 3.0 mm

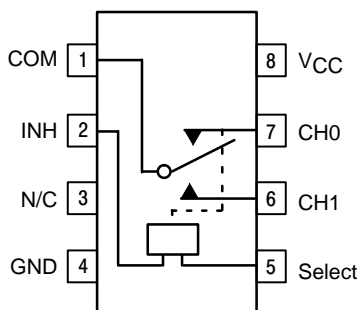


Figure 1. Pin Assignment



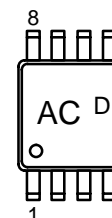
ON Semiconductor™

<http://onsemi.com>

### MARKING DIAGRAMS



US8  
US SUFFIX  
CASE 493-01



AC = Device Code  
D = Date Code

### ORDERING INFORMATION

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

### FUNCTION TABLE

INH	Select	Ch 0	Ch 1
H	X	OFF	OFF
L	L	ON	OFF
L	H	OFF	ON

**MAXIMUM RATINGS**

Symbol	Parameter	Value	Unit
V <sub>CC</sub>	Positive DC Supply Voltage	-0.5 to +7.0	V
V <sub>IN</sub>	Digital Input Voltage (Select and Inhibit)	-0.5 ≤ V is ≤ +7.0	V
V <sub>IS</sub>	Analog Output Voltage (V <sub>CH</sub> or V <sub>COM</sub> )	-0.5 ≤ V is ≤ V <sub>CC</sub> +0.5	V
I <sub>IK</sub>	DC Current, Into or Out of Any Pin	50	mA
T <sub>STG</sub>	Storage Temperature Range	-65 to +150	°C
T <sub>L</sub>	Lead Temperature, 1 mm from Case for 10 Seconds	260	°C
T <sub>J</sub>	Junction Temperature under Bias	+150	°C
θ <sub>JA</sub>	Thermal Resistance	250	°C/W
P <sub>D</sub>	Power Dissipation in Still Air at 85°C	250	mW
MSL	Moisture Sensitivity	Level 1	
FR	Flammability Rating	Oxygen Index: 30% – 35% UL-94-VO (0.125 in)	
V <sub>ESD</sub>	ESD Withstand Voltage	Human Body Model (Note 2) Machine Model (Note 3) Charged Device Model (Note 4)	> 2000 200 N/A
I <sub>Latch-Up</sub>	Latch-Up Performance	Above V <sub>CC</sub> and Below GND at 85°C (Note 5)	±300

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.

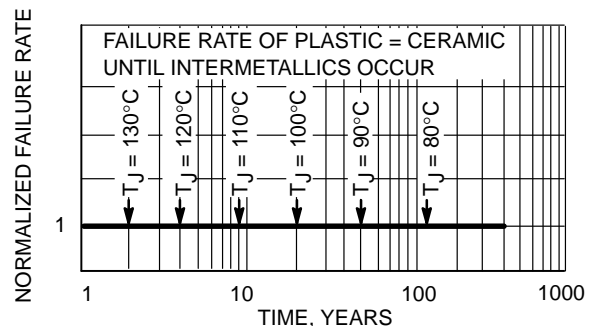
1. Measured with minimum pad spacing on an FR4 board, using 10 mm-by-1 inch, 2-ounce copper trace with no air flow.
2. Tested to EIA/JESD22-A114-A.
3. Tested to EIA/JESD22-A115-A.
4. Tested to JESD22-C101-A.
5. Tested to EIA/JESD78.

**RECOMMENDED OPERATING CONDITIONS**

Symbol	Characteristics	Min	Max	Unit
V <sub>CC</sub>	Positive DC Supply Voltage	2.0	5.5	V
V <sub>IN</sub>	Digital Input Voltage (Select and Inhibit)	GND	5.5	V
V <sub>IO</sub>	Static or Dynamic Voltage Across an Off Switch	GND	V <sub>CC</sub>	V
V <sub>IS</sub>	Analog Input Voltage (CH, COM)	GND	V <sub>CC</sub>	V
T <sub>A</sub>	Operating Temperature Range, All Package Types	-55	+125	°C
t <sub>r</sub> , t <sub>f</sub>	Input Rise or Fall Time, (Enable Input)	V <sub>CC</sub> = 3.3 V ± 0.3 V V <sub>CC</sub> = 5.0 V ± 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 2. Failure Rate versus Time Junction Temperature**

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## DC CHARACTERISTICS – Digital Section (Voltages Referenced to GND)

Symbol	Parameter	Condition	V <sub>CC</sub>	Guaranteed Limit			Unit
				-55°C to 25°C	< 85°C	< 125°C	
V <sub>IH</sub>	Minimum High-Level Input Voltage, Select and Inhibit Inputs		2.0	1.5	1.5	1.5	V
			2.5	1.9	1.9	1.9	
			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 <sub>IL</sub>	Maximum Low-Level Input Voltage, Select and Inhibit Inputs		2.0	0.5	0.5	0.5	V
			2.5	0.6	0.6	0.6	
			3.0	0.9	0.9	0.9	
			4.5	1.35	1.35	1.35	
			5.5	1.65	1.65	1.65	
I <sub>IN</sub>	Maximum Input Leakage Current, Select and Inhibit Inputs	V <sub>IN</sub> = 5.5 V or GND	0 V to 5.5 V	±0.1	±1.0	±1.0	µA
I <sub>CC</sub>	Maximum Quiescent Supply Current	Select and Inhibit = V <sub>CC</sub> or GND	5.5	1.0	1.0	2.0	µA

## DC ELECTRICAL CHARACTERISTICS – Analog Section

Symbol	Parameter	Condition	V <sub>CC</sub>	Guaranteed Limit			Unit
				-55 to 25°C	< 85°C	< 125°C	
R <sub>ON</sub>	Maximum "ON" Resistance (Figures 17 – 23)	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> V <sub>IS</sub> = GND to V <sub>CC</sub>  I <sub>IN</sub>   ≤ 10.0 mA	2.5	70	85	105	Ω
			3.0	40	46	52	
			4.5	20	28	34	
			5.5	16	22	28	
R <sub>FLAT</sub> (ON)	ON Resistance Flatness (Figures 17 – 23)	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub>  I <sub>IN</sub>   ≤ 10.0 mA V <sub>IS</sub> = 1V, 2V, 3.5V	4.5	4	4	5	Ω
ΔR <sub>ON</sub> (ON)	ON Resistance Match Between Channels	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub>  I <sub>IN</sub>   ≤ 10.0 mA V <sub>CH1</sub> or V <sub>CH0</sub> = 3.5 V	4.5	2	2	3	Ω
I <sub>CH0</sub> I <sub>CH1</sub>	CH1 or CH0 Off Leakage Current (Figure 9)	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> V <sub>CH1</sub> or V <sub>CH0</sub> = 1.0 V <sub>COM</sub> 4.5 V	5.5	1	10	100	nA
I <sub>COM</sub> (ON)	COM ON Leakage Current (Figure 9)	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> V <sub>CH1</sub> 1.0 V or 4.5 V with V <sub>CH0</sub> floating or V <sub>CH1</sub> 1.0 V or 4.5 V with V <sub>CH1</sub> floating V <sub>COM</sub> = 1.0 V or 4.5 V	5.5	1	10	100	nA

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

Symbol	Parameter	Test Conditions	VCC (V)	Guaranteed Max Limit						Unit	
				-55 to 25°C			< 85°C		< 125°C		
				Min	Typ*	Max	Min	Max	Min		Max
t <sub>ON</sub>	Turn-On Time (Figures 12 and 13) INH to Output	R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF (Figures 4 and 5)	2.5	2	7	12	2	15	2	15	ns
			3.0	2	5	10	2	15	2	15	
			4.5	1	4	9	1	12	1	12	
			5.5	1	3	8	1	12	1	12	
t <sub>OFF</sub>	Turn-Off Time (Figures 12 and 13) INH to Output	R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF (Figures 4 and 5)	2.5	2	7	12	2	15	2	15	ns
			3.0	2	5	10	2	15	2	15	
			4.5	1	4	9	1	12	1	12	
			5.5	1	3	8	1	12	1	12	
t <sub>trans</sub>	Transition Time (Channel Selection Time) (Figure ) Select to Output	R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF (Figures and )	2.5	5	18	28	5	30	5	30	ns
			3.0	5	13	21	5	25	5	25	
			4.5	2	12	16	2	20	2	20	
			5.5	2	9	14	2	20	2	20	
t <sub>BBM</sub>	Minimum Break-Before-Make Time	V <sub>IS</sub> = 3.0 V (Figure 3) R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF	2.5	1	12		1		1		ns
			3.0	1	11		1		1		
			4.5	1	6		1		1		
			5.5	1	5		1		1		

\*Typical Characteristics are at 25°C.

		Typical @ 25, VCC = 5.0 V	
C <sub>IN</sub>	Maximum Input Capacitance, Select/INH Input	8	pF
C <sub>NO</sub> or C <sub>NC</sub>	Analog I/O (switch off)	10	
C <sub>COM</sub>	Common I/O (switch off)	10	
C <sub>(ON)</sub>	Feedthrough (switch on)	20	

## ADDITIONAL APPLICATION CHARACTERISTICS (Voltages Referenced to GND Unless Noted)

Symbol	Parameter	Condition	VCC V	Typical	Unit
				25°C	
BW	Maximum On-Channel -3dB Bandwidth or Minimum Frequency Response (Figure 10)	V <sub>IN</sub> = 0 dBm V <sub>IN</sub> centered between V <sub>CC</sub> and GND (Figure 7)	3.0	170	MHz
			4.5	200	
			5.5	200	
V <sub>ONL</sub>	Maximum Feedthrough On Loss	V <sub>IN</sub> = 0 dBm @ 100 kHz to 50 MHz V <sub>IN</sub> centered between V <sub>CC</sub> and GND (Figure 7)	3.0	-3	dB
			4.5	-3	
			5.5	-3	
V <sub>ISO</sub>	Off-Channel Isolation (Figure 10)	f = 100 kHz; V <sub>IS</sub> = 1 V RMS V <sub>IN</sub> centered between V <sub>CC</sub> and GND (Figure 7)	3.0	-93	dB
			4.5	-93	
			5.5	-93	
Q	Charge Injection Select Input to Common I/O (Figure 15)	V <sub>IN</sub> = V <sub>CC</sub> to GND, F <sub>IS</sub> = 20 kHz t <sub>r</sub> = t <sub>f</sub> = 3 ns R <sub>IS</sub> = 0 Ω, C <sub>L</sub> = 1000 pF Q = C <sub>L</sub> * ΔV <sub>OUT</sub> (Figure 8)	3.0	1.5	pC
			5.5	3.0	
THD	Total Harmonic Distortion THD + Noise (Figure 14)	F <sub>IS</sub> = 20 Hz to 100 kHz, R <sub>L</sub> = R <sub>gen</sub> = 600 Ω, C <sub>L</sub> = 50 pF V <sub>IS</sub> = 5.0 V <sub>pp</sub> sine wave	5.5	0.1	%

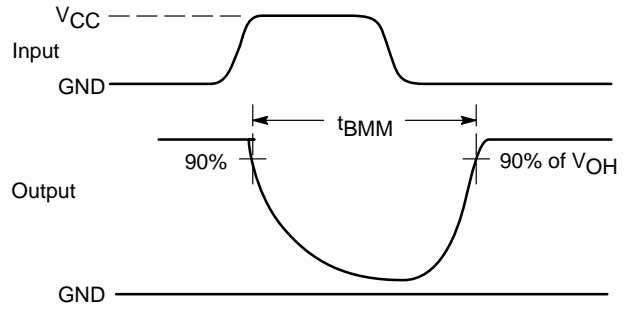
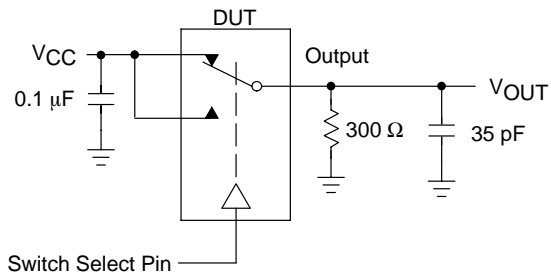


Figure 3. t<sub>BMM</sub> (Time Break-Before-Make)

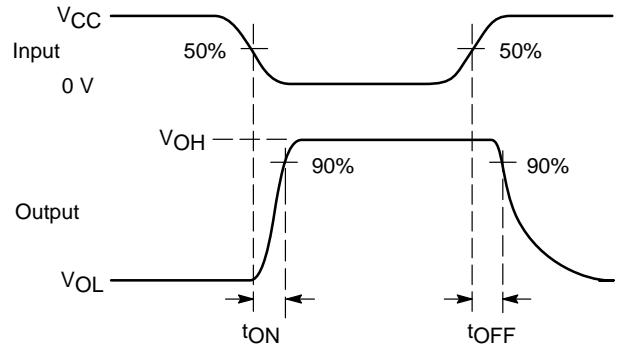
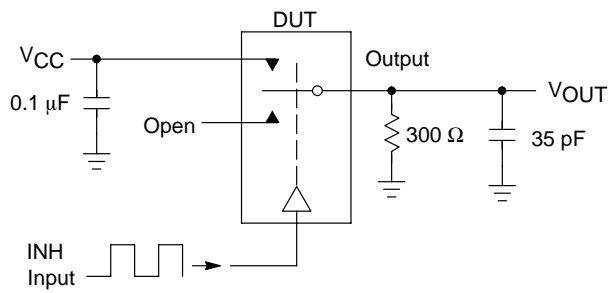


Figure 4. t<sub>ON</sub>/t<sub>OFF</sub>

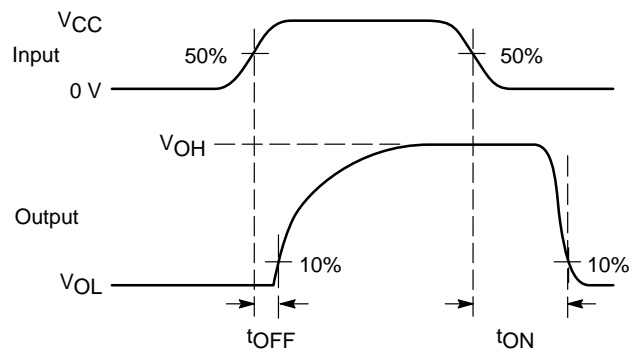
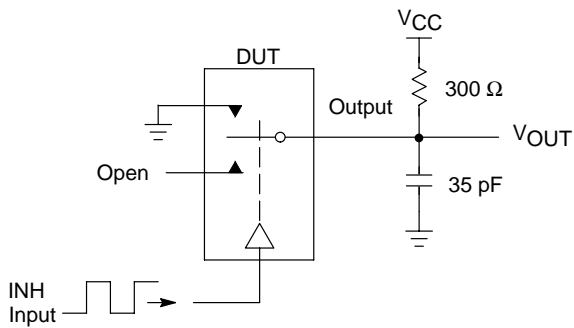
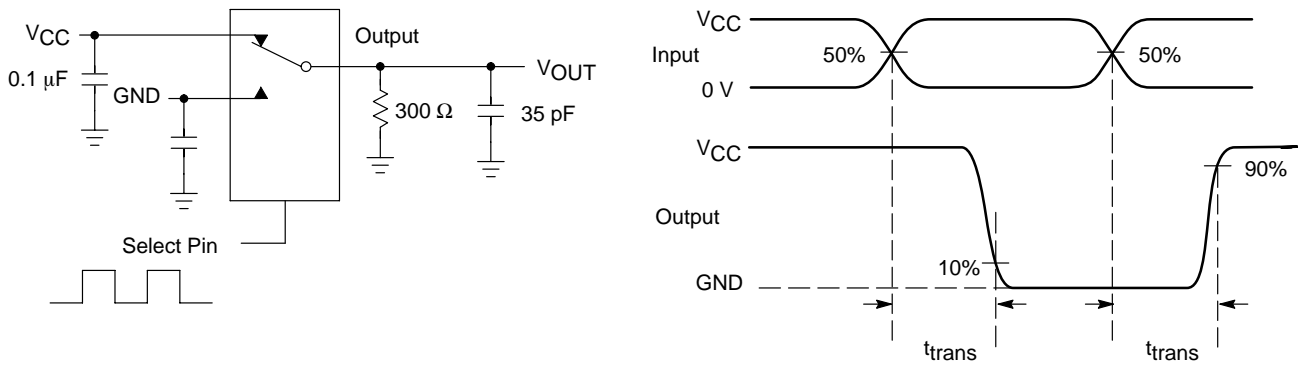
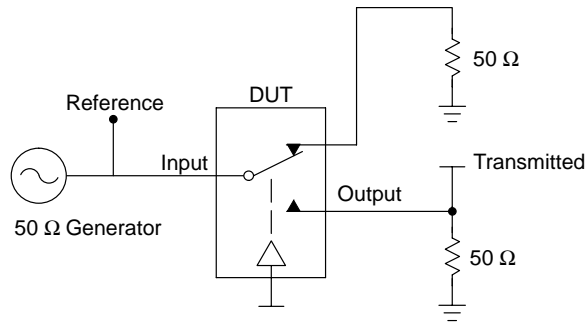


Figure 5. t<sub>ON</sub>/t<sub>OFF</sub>

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**Figure 6.  $t_{trans}$  (Channel Selection Time)**



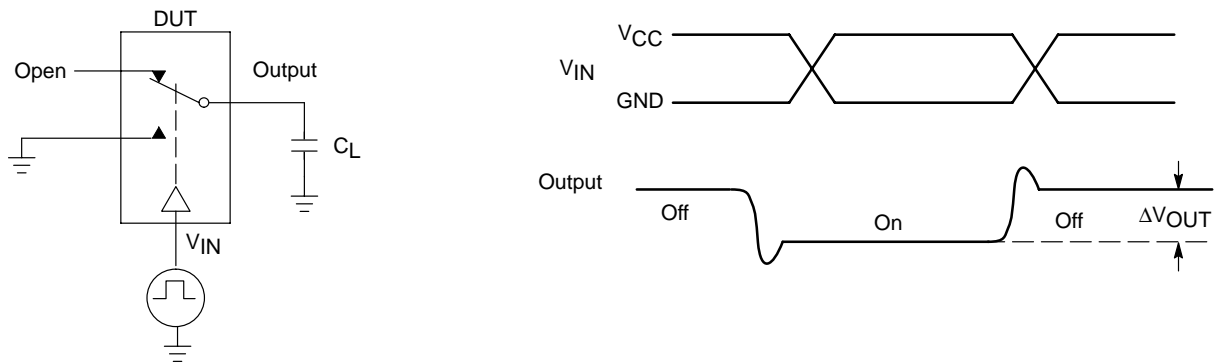
Channel switch control/s test socket is normalized. Off isolation is measured across an off channel. On loss is the bandwidth of an On switch.  $V_{ISO}$ , Bandwidth and  $V_{ONL}$  are independent of the input signal direction.

$$V_{ISO} = \text{Off Channel Isolation} = 20 \text{ Log} \left( \frac{V_{OUT}}{V_{IN}} \right) \text{ for } V_{IN} \text{ at } 100 \text{ kHz}$$

$$V_{ONL} = \text{On Channel Loss} = 20 \text{ Log} \left( \frac{V_{OUT}}{V_{IN}} \right) \text{ for } V_{IN} \text{ at } 100 \text{ kHz to } 50 \text{ MHz}$$

Bandwidth (BW) = the frequency 3 dB below  $V_{ONL}$

**Figure 7. Off Channel Isolation/On Channel Loss (BW)/Crosstalk (On Channel to Off Channel)/ $V_{ONL}$**



**Figure 8. Charge Injection: (Q)**

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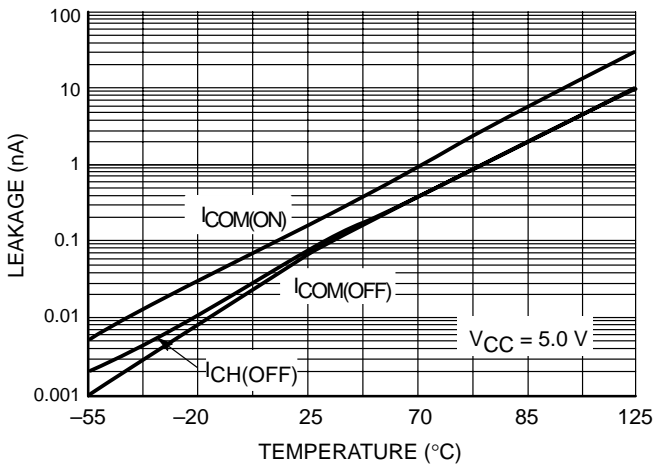


Figure 9. Switch Leakage versus Temperature

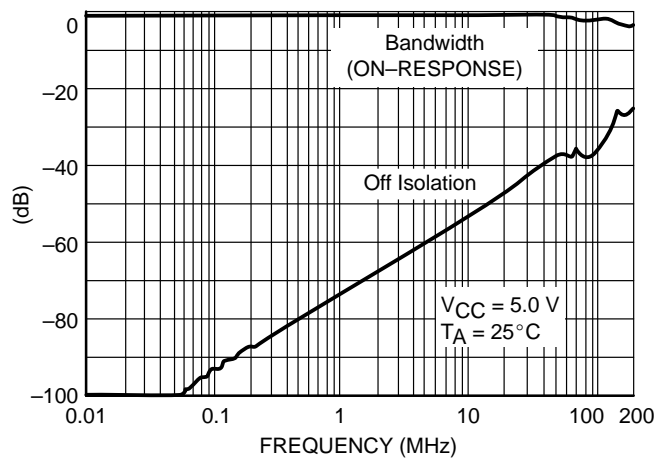


Figure 10. Bandwidth and Off-Channel Isolation

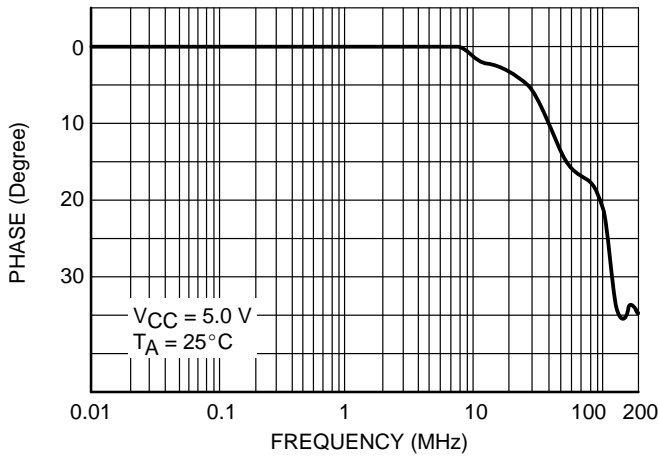


Figure 11. Phase versus Frequency

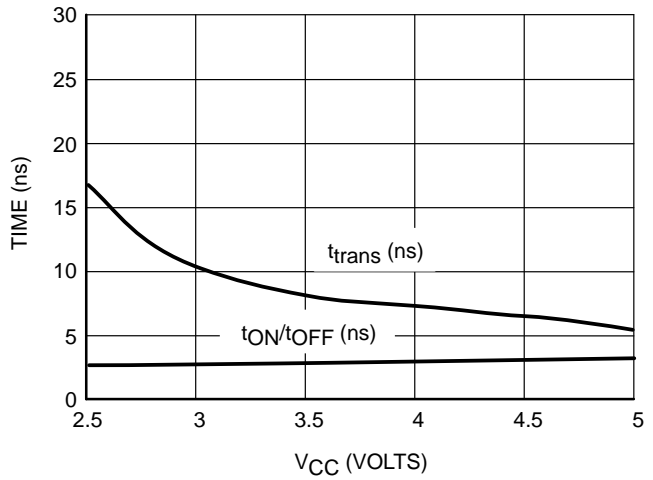


Figure 12.  $t_{ON}$  and  $t_{OFF}$  versus  $V_{CC}$  at 25°C

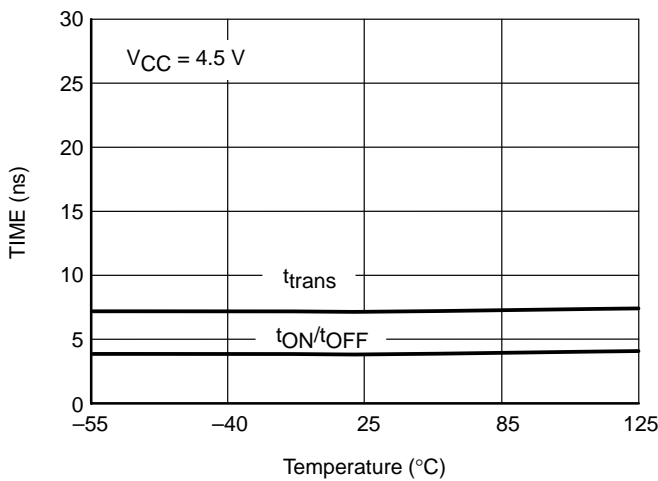


Figure 13.  $t_{ON}$  and  $t_{OFF}$  versus Temp

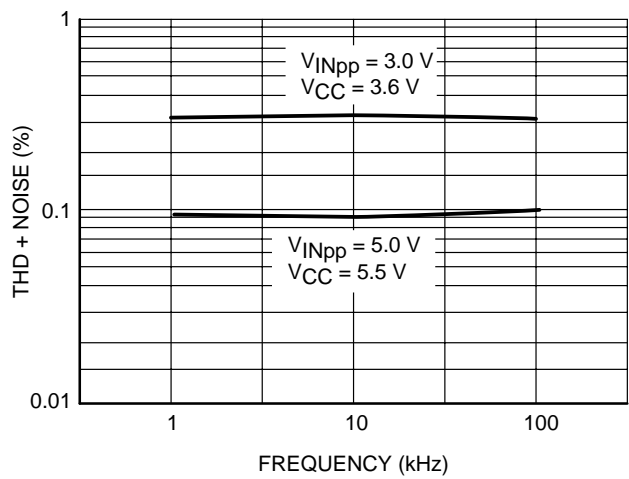


Figure 14. Total Harmonic Distortion Plus Noise versus Frequency

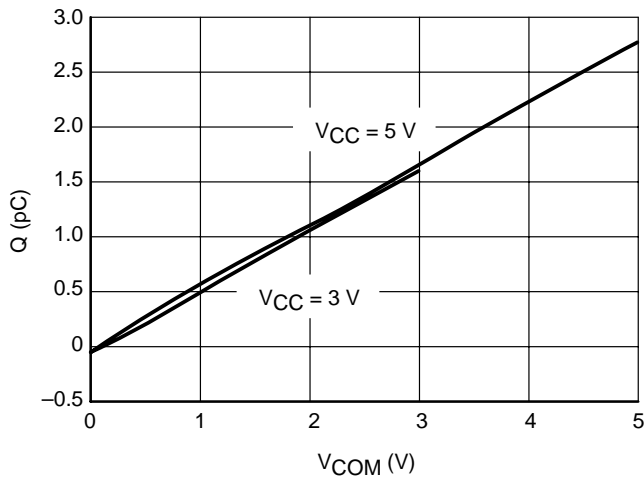


Figure 15. Charge Injection versus COM Voltage

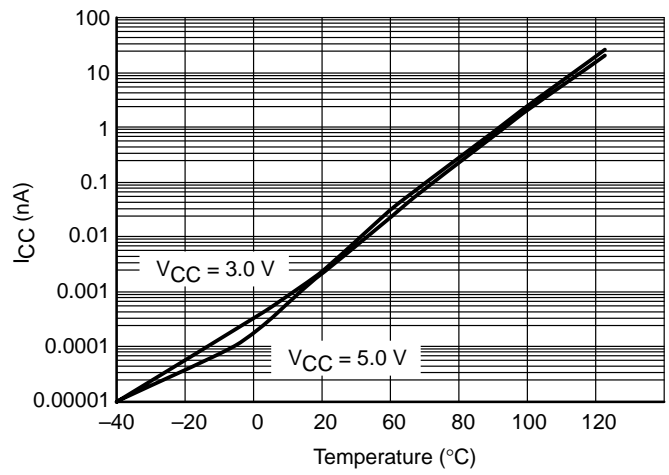


Figure 16. ICC versus Temp, VCC = 3 V & 5 V

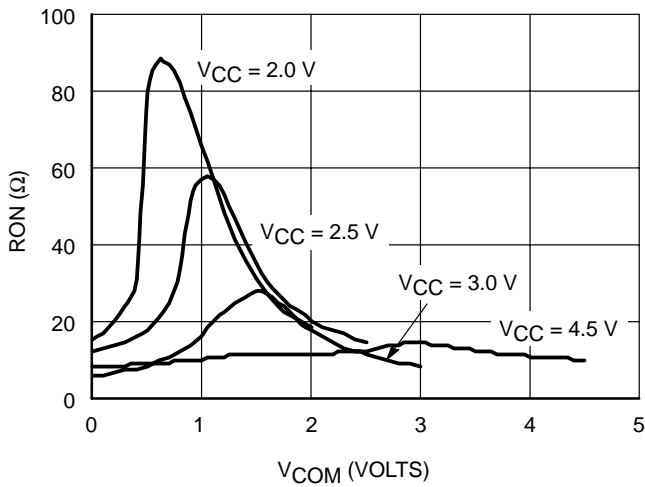


Figure 17. RON versus VCOM and VCC (@ 25°C)

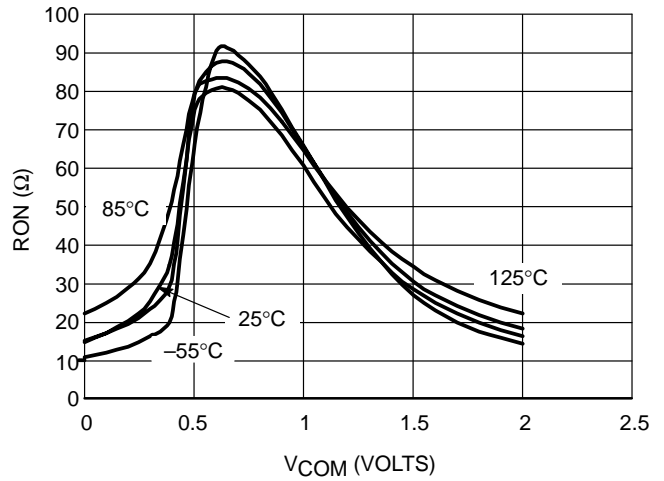


Figure 18. RON versus VCOM and Temperature, VCC 2.0 V

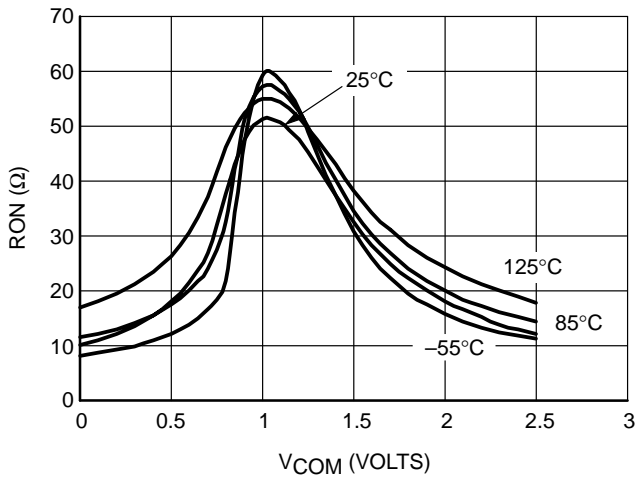


Figure 19. RON versus VCOM and Temperature, VCC = 2.5 V

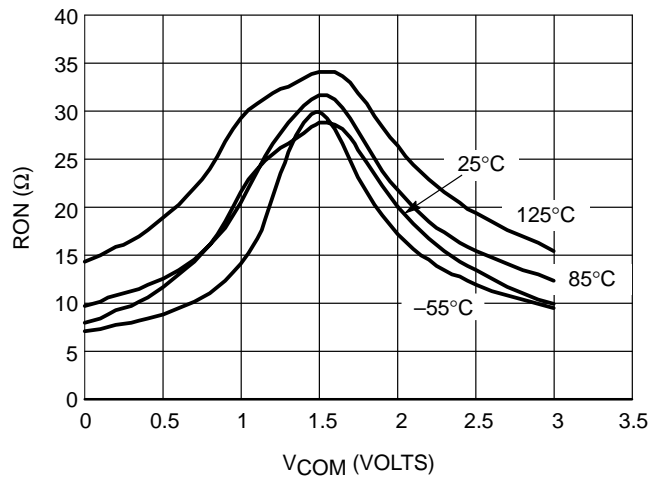


Figure 20. RON versus VCOM and Temperature, VCC = 3.0 V



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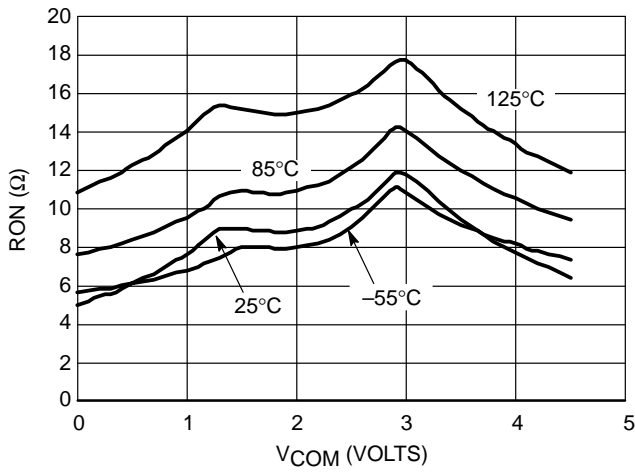


Figure 21. RON versus VCOM and Temperature, VCC = 4.5 V

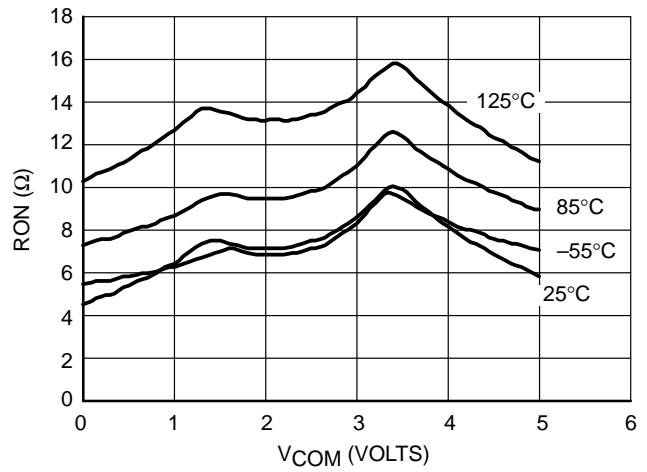


Figure 22. RON versus VCOM and Temperature, VCC = 5.0 V

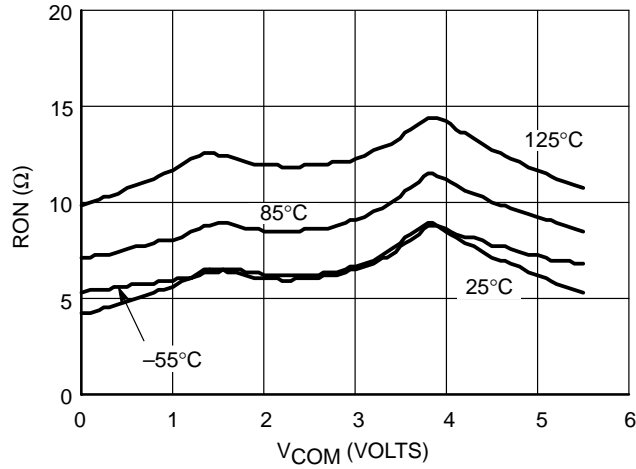


Figure 23. RON versus VCOM and Temperature, VCC = 5.5 V

## DEVICE ORDERING INFORMATION

Device Order Number	Device Nomenclature				Package Type	Tape and Reel Size
	Circuit Indicator	Technology	Device Function	Package Suffix		
NLAS1053US	NL	AS	1053	US	US8	178 mm (7") 3000 Unit

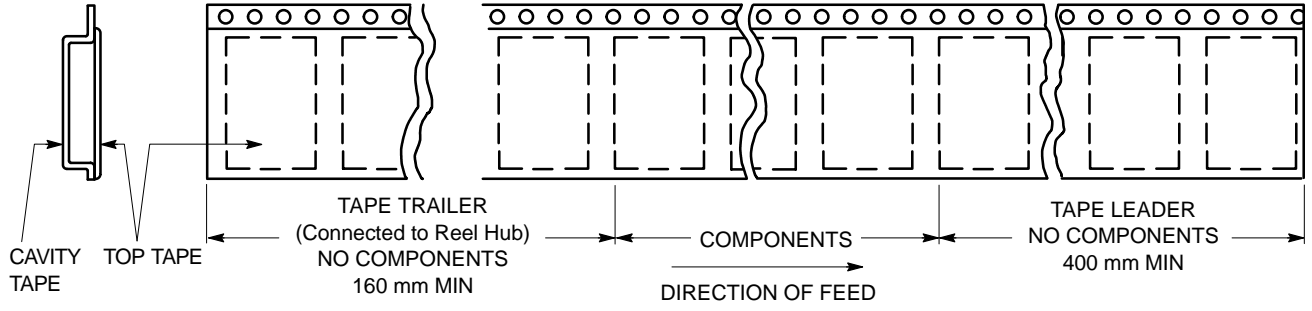


Figure 24. Tape Ends for Finished Goods

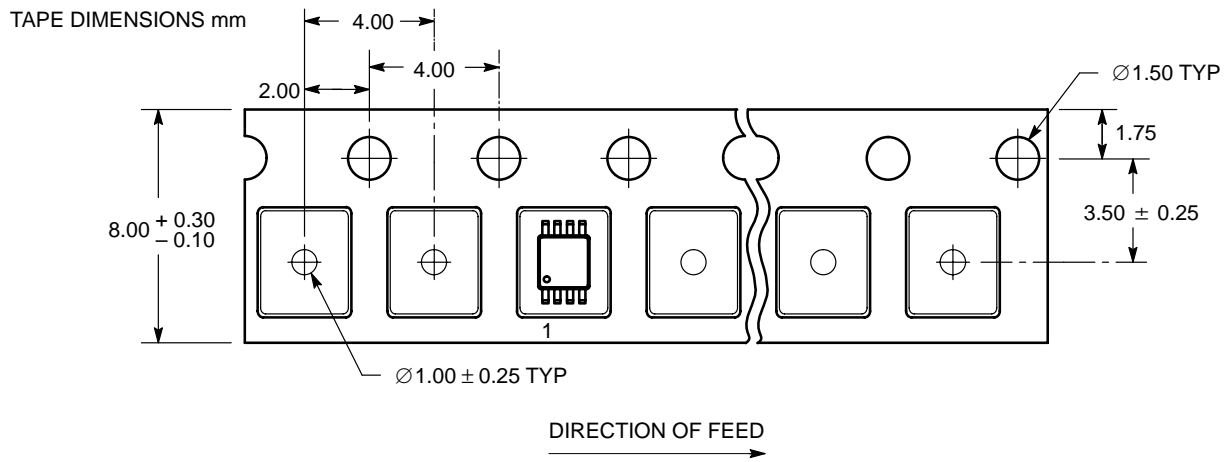


Figure 25. US8 Reel Configuration/Orientation

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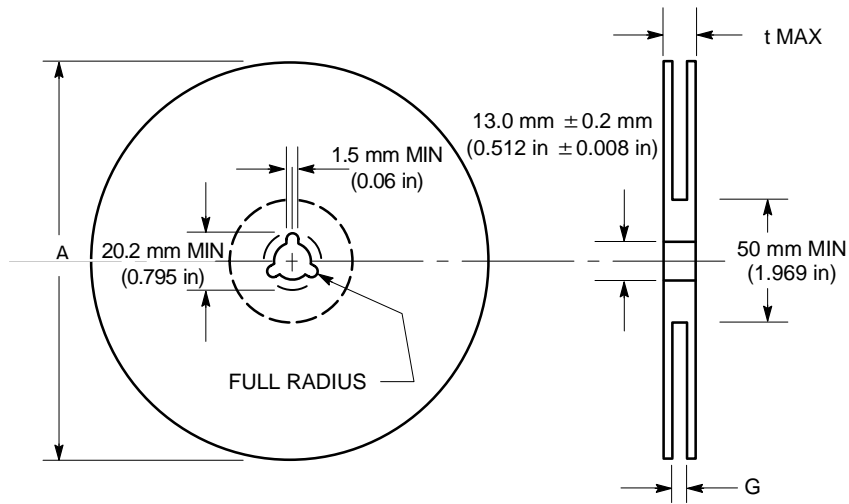


Figure 26. Reel Dimensions

## REEL DIMENSIONS

Tape Size	T and R Suffix	A Max	G	t Max
8 mm	US	178 mm (7 in)	8.4 mm, + 1.5 mm, -0.0 (0.33 in + 0.059 in, -0.00)	14.4 mm (0.56 in)

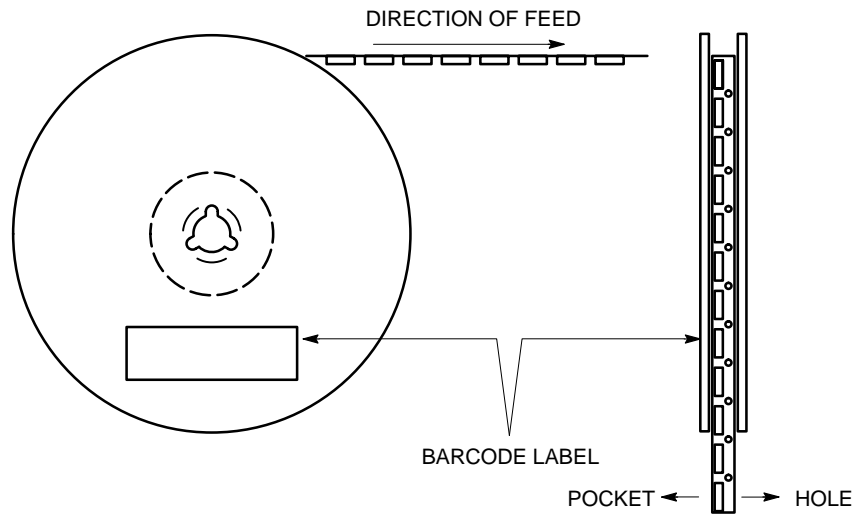
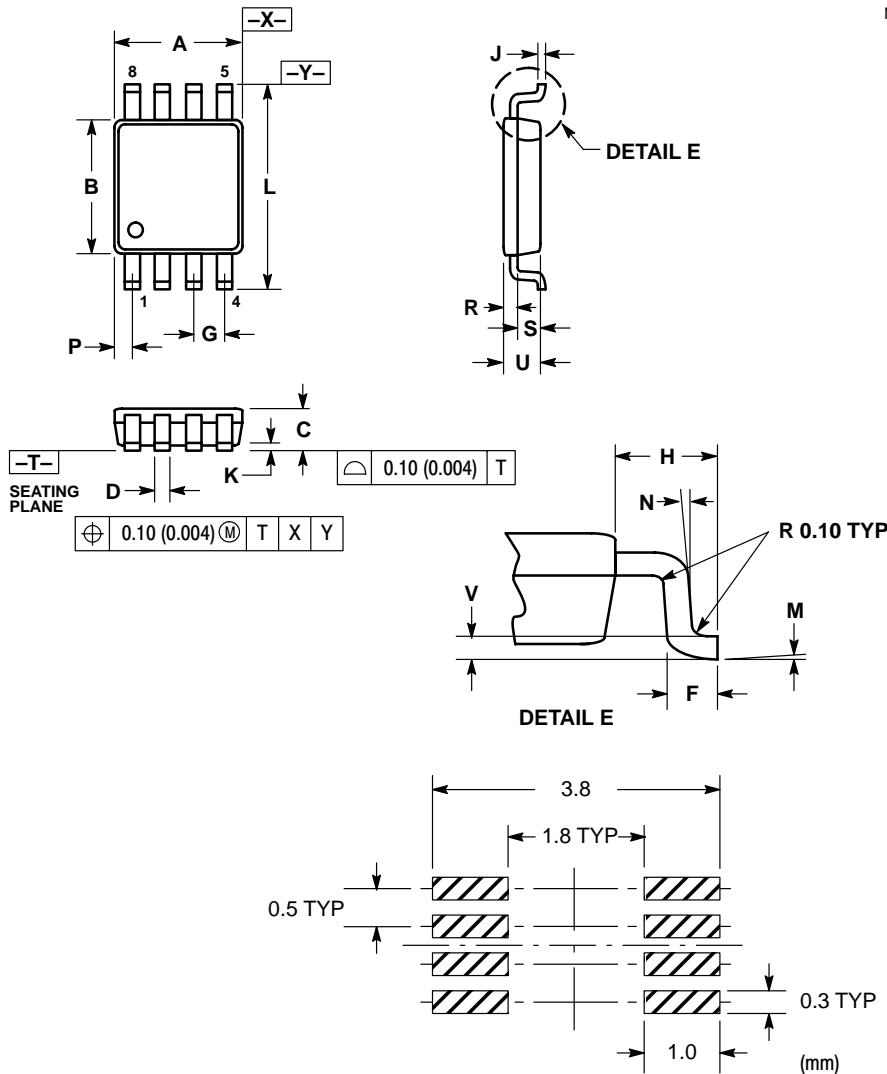


Figure 27. Reel Winding Direction

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## PACKAGE DIMENSIONS


US8  
US SUFFIX  
CASE 493-01  
ISSUE O



### NOTES:

- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- CONTROLLING DIMENSION: MILLIMETERS
- DIMENSION "A" DOES NOT INCLUDE MOLD FLASH, PROTRUSION OR GATE BURR. MOLD FLASH, PROTRUSION AND GATE BURR SHALL NOT EXCEED 0.140 MM (0.0055") PER SIDE.
- DIMENSION "B" DOES NOT INCLUDE INTER-LEAD FLASH OR PROTRUSION. INTER-LEAD FLASH AND PROTRUSION SHALL NOT EXCEED 0.140 (0.0055") PER SIDE.
- LEAD FINISH IS SOLDER PLATING WITH THICKNESS OF 0.0076-0.0203 MM. (300-800 INCH).
- ALL TOLERANCE UNLESS OTHERWISE SPECIFIED ±0.0508 (0.0002").

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	1.90	2.10	0.075	0.083
B	2.20	2.40	0.087	0.094
C	0.60	0.90	0.024	0.035
D	0.17	0.25	0.007	0.010
F	0.20	0.35	0.008	0.014
G	0.50 BSC		0.020 BSC	
H	0.40 REF		0.016 REF	
J	0.10	0.18	0.004	0.007
K	0.00	0.10	0.000	0.004
L	3.00	3.20	0.118	0.126
M	0°	6°	0°	6°
N	5°	10°	5°	10°
P	0.28	0.44	0.011	0.017
R	0.23	0.33	0.009	0.013
S	0.37	0.47	0.015	0.019
U	0.60	0.80	0.024	0.031
V	0.12 BSC		0.005 BSC	

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