

# 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  $V_{CC}$  to GND).

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

### Features

- High Speed:  $t_{PD} = 1$  ns (Typ) at  $V_{CC} = 5.0$  V
- Low Power Dissipation:  $I_{CC} = 2$   $\mu$ A (Max) at  $T_A = 25^\circ$ C
- High Bandwidth, Improved Linearity, and Low  $R_{DS_{ON}}$
- INH Pin Allows a Both Channels 'OFF' Condition (With a High)
- $R_{DS_{ON}} \cong 25 \Omega$ , Performance Very Similar to the NLAS4053
- Break Before Make Circuitry, Prevents Inadvertent Shorts
- Useful For Switching Video Frequencies Beyond 50 MHz
- Latchup 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
- Pb-Free Package is Available

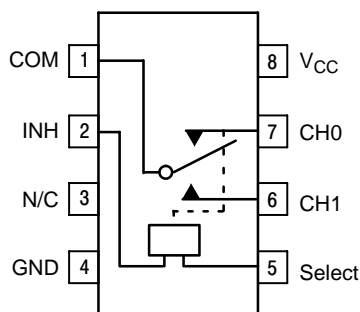
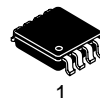


Figure 1. Pin Assignment



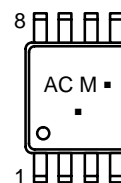
ON Semiconductor®

<http://onsemi.com>



US8  
US SUFFIX  
CASE 493-01

### MARKING DIAGRAMS



AC = Specific Device Code  
M = Date Code\*  
▪ = Pb-Free Package

(Note: Microdot may be in either location)  
\*Date Code orientation may vary depending upon manufacturing location.

### ORDERING INFORMATION

Device	Package	Shipping†
NLAS1053US	US8	3000 / Tape & Reel
NLAS1053USG	US8 (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.

### FUNCTION TABLE

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

**MAXIMUM RATINGS**

Parameter	Symbol	Value	Unit
Positive DC Supply Voltage	$V_{CC}$	-0.5 to +7.0	V
Digital Input Voltage (Select and Inhibit)	$V_{IN}$	$-0.5 \leq V_{is} \leq +7.0$	V
Analog Output Voltage ( $V_{CH}$ or $V_{COM}$ )	$V_{IS}$	$-0.5 \leq V_{is} \leq V_{CC} + 0.5$	V
DC Current, Into or Out of Any Pin	$I_{IK}$	50	mA
Storage Temperature Range	$T_{STG}$	-65 to +150	°C
Lead Temperature, 1 mm from Case for 10 Seconds	$T_L$	260	°C
Junction Temperature under Bias	$T_J$	+150	°C
Thermal Resistance	$\theta_{JA}$	250	°C/W
Power Dissipation in Still Air at 85°C	$P_D$	250	mW
Moisture Sensitivity	MSL	Level 1	
Flammability Rating	Oxygen Index: 30% – 35% $F_R$	UL 94 V-0 @ 0.125 in	
ESD Withstand Voltage	Human Body Model (Note 2) Machine Model (Note 3) Charged Device Model (Note 4) $V_{ESD}$	> 2000 200 N/A	V
Latchup Performance	Above $V_{CC}$ and Below GND at 85°C (Note 5) $I_{LATCHUP}$	$\pm 300$	mA

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

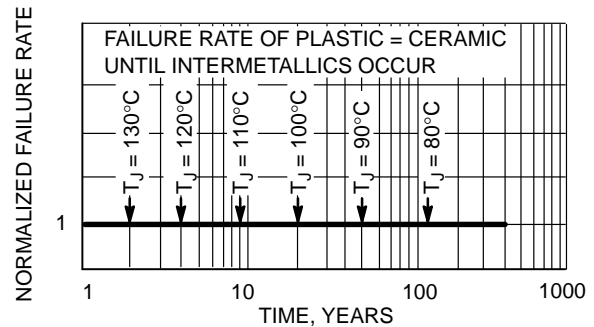
1. Measured with minimum pad spacing on an FR4 board, using 10 mm-by-1 inch, 2-ounce copper trace with no air flow.
2. Tested to EIA/JESD22-A114-A.
3. Tested to EIA/JESD22-A115-A.
4. Tested to JESD22-C101-A.
5. Tested to EIA/JESD78.

**RECOMMENDED OPERATING CONDITIONS**

Characteristics	Symbol	Min	Max	Unit
Positive DC Supply Voltage	$V_{CC}$	2.0	5.5	V
Digital Input Voltage (Select and Inhibit)	$V_{IN}$	GND	5.5	V
Static or Dynamic Voltage Across an Off Switch	$V_{IO}$	GND	$V_{CC}$	V
Analog Input Voltage (CH, COM)	$V_{IS}$	GND	$V_{CC}$	V
Operating Temperature Range, All Package Types	$T_A$	-55	+125	°C
Input Rise or Fall Time (Enable Input)	$t_r, t_f$	$V_{CC} = 3.3 V \pm 0.3 V$ $V_{CC} = 5.0 V \pm 0.5 V$	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)

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

## DC ELECTRICAL CHARACTERISTICS – Analog Section

Parameter	Condition	Symbol	V <sub>CC</sub>	Guaranteed Limit			Unit
				-55 to 25°C	< 85°C	< 125°C	
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	R <sub>ON</sub>	2.5	70	85	105	Ω
			3.0	40	46	52	
			4.5	20	28	34	
			5.5	16	22	28	
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	R <sub>FLAT</sub> (ON)	4.5	4	4	5	Ω
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	ΔR <sub>ON</sub> (ON)	4.5	2	2	3	Ω
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	I <sub>CH0</sub> I <sub>CH1</sub>	5.5	1	10	100	nA
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	I <sub>COM(ON)</sub>	5.5	1	10	100	nA

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

Parameter	Test Conditions	Symbol	V <sub>CC</sub> (V)	Guaranteed Max Limit						Unit	
				-55 to 25°C			< 85°C		< 125°C		
				Min	Typ*	Max	Min	Max	Min		Max
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)	t <sub>ON</sub>	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	
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)	t <sub>OFF</sub>	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	
Transition Time (Channel Selection Time) (Figure ) Select to Output	R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF (Figures and )	t <sub>trans</sub>	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	
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	t <sub>BBM</sub>	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		
			<b>Typical @ 25, V<sub>CC</sub> = 5.0 V</b>								
Maximum Input Capacitance, Select/INH Input Analog I/O (switch off) Common I/O (switch off) Feedthrough (switch on)		C <sub>IN</sub> C <sub>NO</sub> or C <sub>NC</sub> C <sub>COM</sub> C <sub>(ON)</sub>	8 10 10 20							pF	

\*Typical Characteristics are at 25°C.

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

Parameter	Condition	Symbol	V <sub>CC</sub> V	Typical	Unit
				25°C	
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)	BW	3.0	170	MHz
			4.5	200	
			5.5	200	
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)	V <sub>ONL</sub>	3.0	-3	dB
			4.5	-3	
			5.5	-3	
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)	V <sub>ISO</sub>	3.0	-93	dB
			4.5	-93	
			5.5	-93	
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)	Q	3.0	1.5	pC
			5.5	3.0	
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	THD	5.5	0.1	%

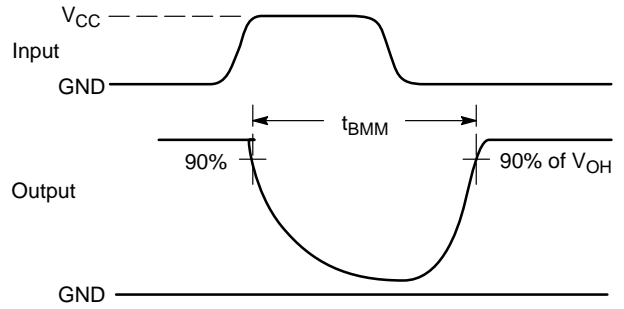
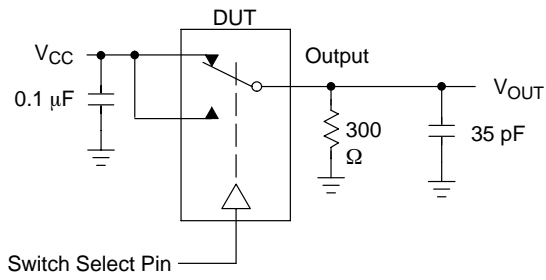


Figure 3.  $t_{BMM}$  (Time Break-Before-Make)

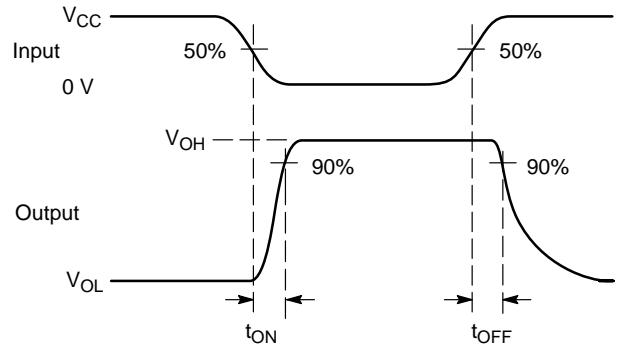
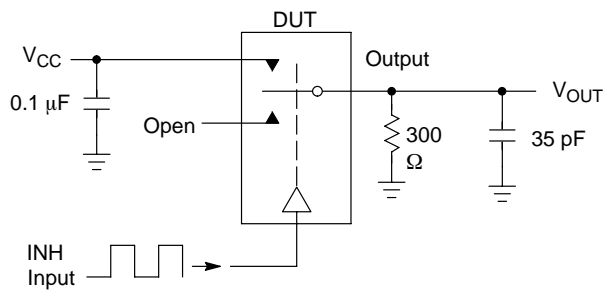


Figure 4.  $t_{ON}/t_{OFF}$

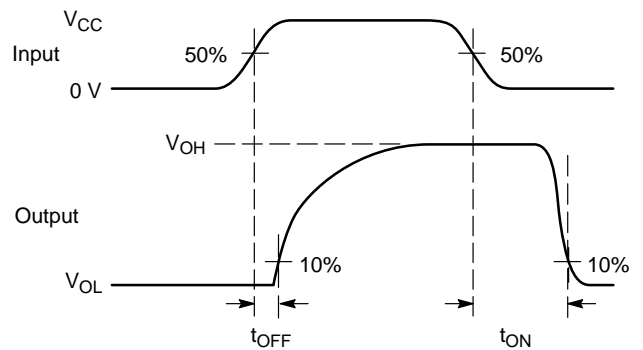
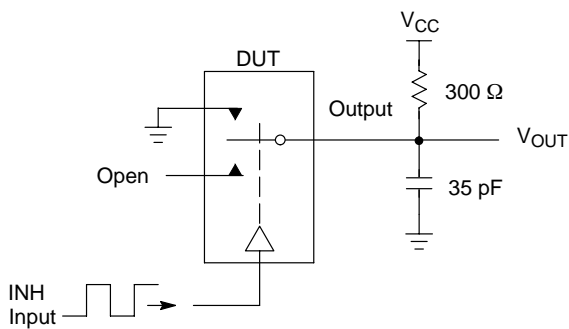
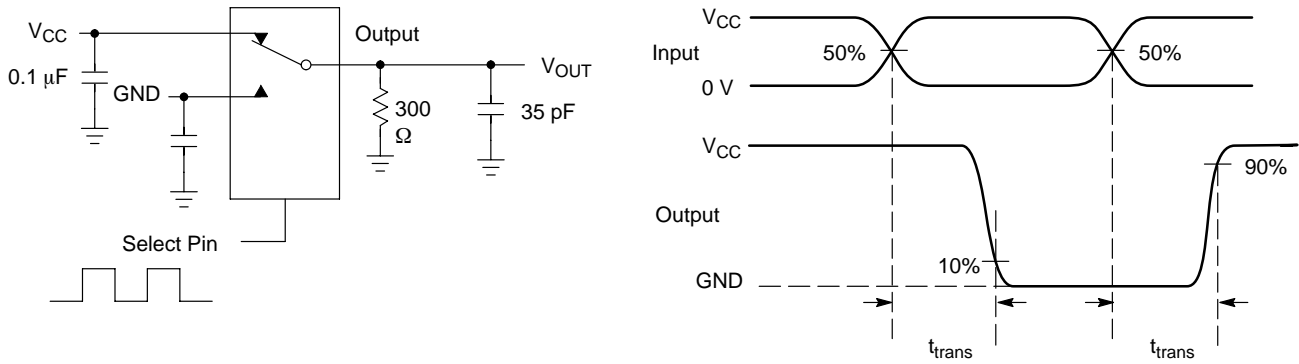
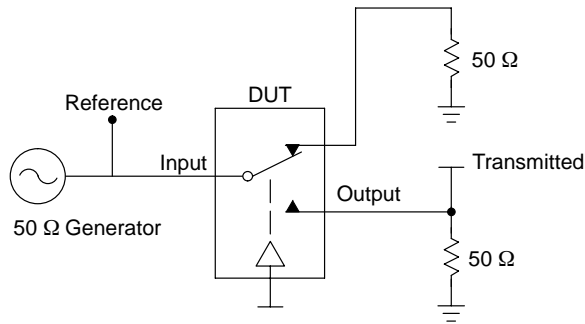


Figure 5.  $t_{ON}/t_{OFF}$

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



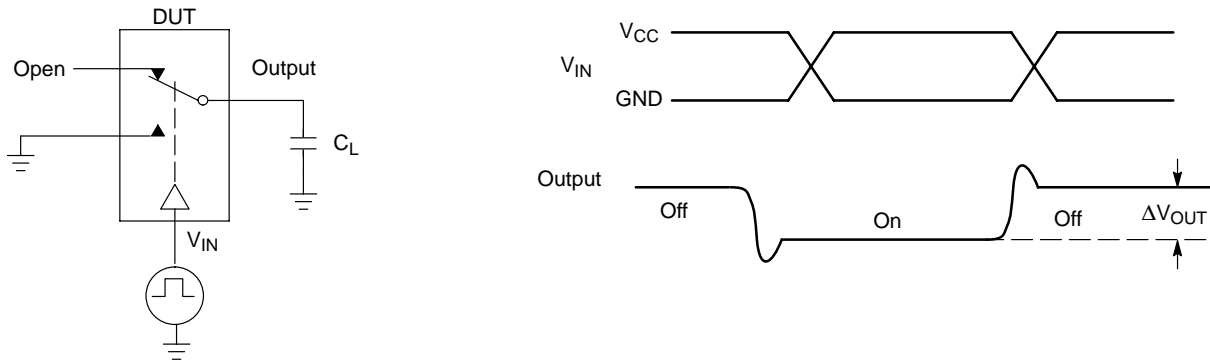
Channel switch control/s test socket is normalized. Off isolation is measured across an off channel. On loss is the bandwidth of an On switch.  $V_{ISO}$ , Bandwidth and  $V_{ONL}$  are independent of the input signal direction.

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

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

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)**

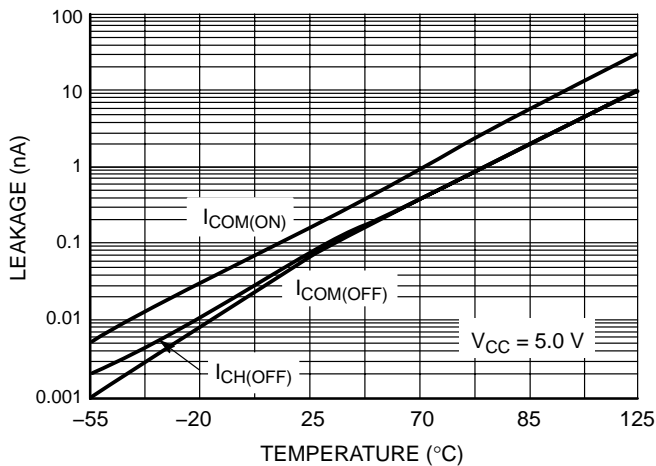


Figure 9. Switch Leakage versus Temperature

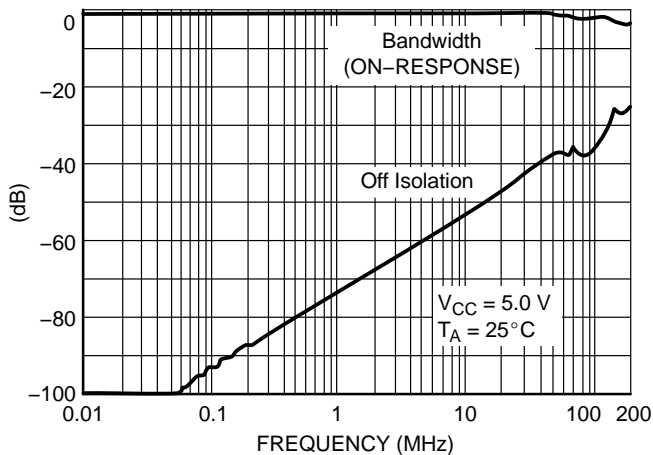


Figure 10. Bandwidth and Off-Channel Isolation

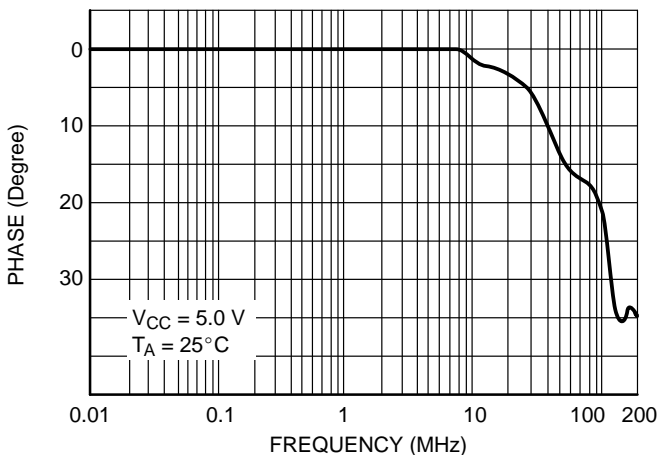


Figure 11. Phase versus Frequency

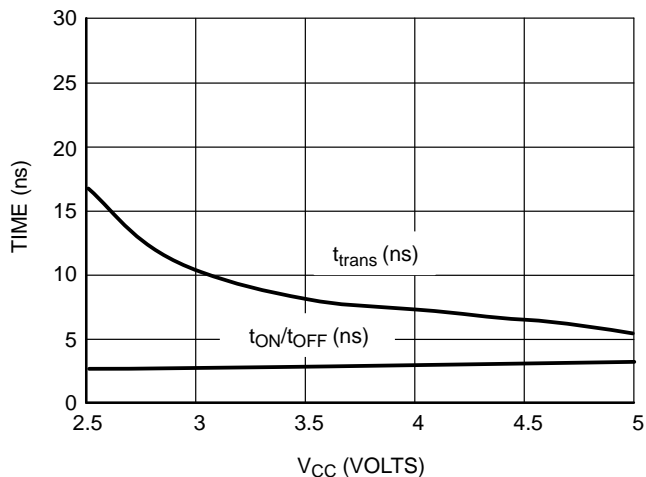


Figure 12.  $t_{ON}$  and  $t_{OFF}$  versus  $V_{CC}$  at 25°C

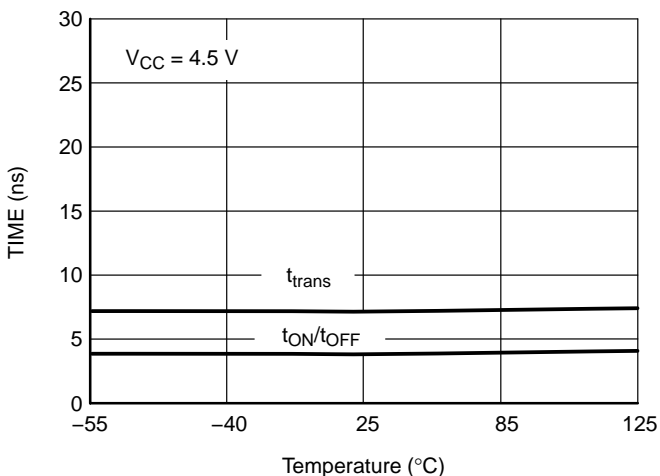


Figure 13.  $t_{ON}$  and  $t_{OFF}$  versus Temp

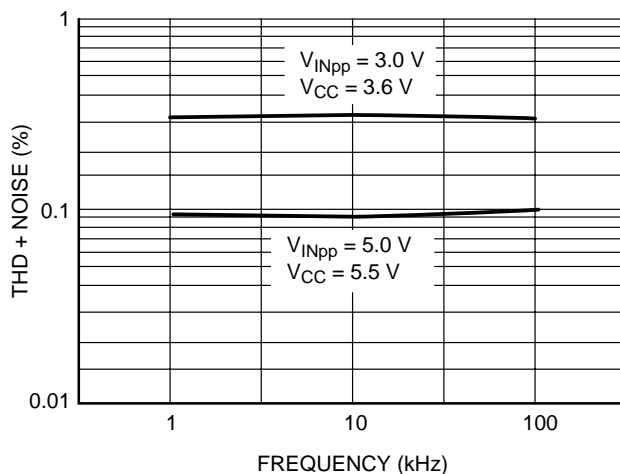


Figure 14. Total Harmonic Distortion Plus Noise versus Frequency

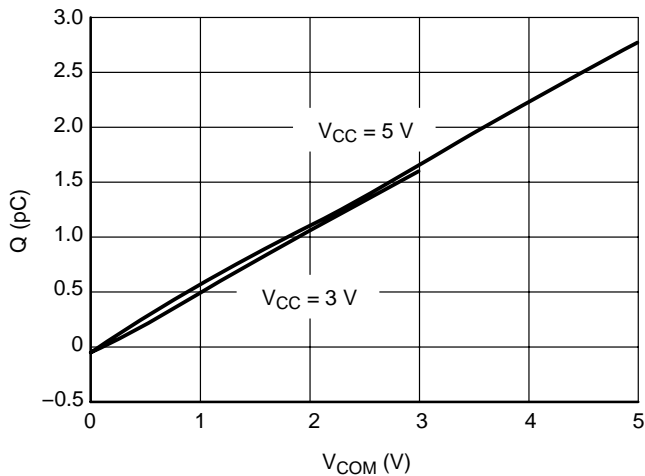


Figure 15. Charge Injection versus COM Voltage

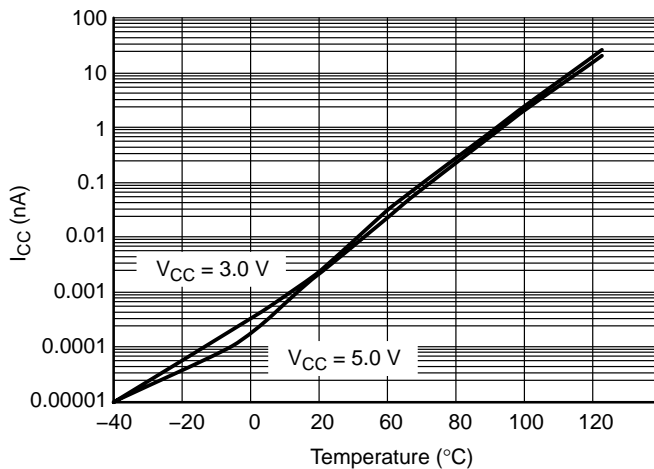


Figure 16.  $I_{CC}$  versus Temp,  $V_{CC} = 3\text{ V}$  &  $5\text{ V}$

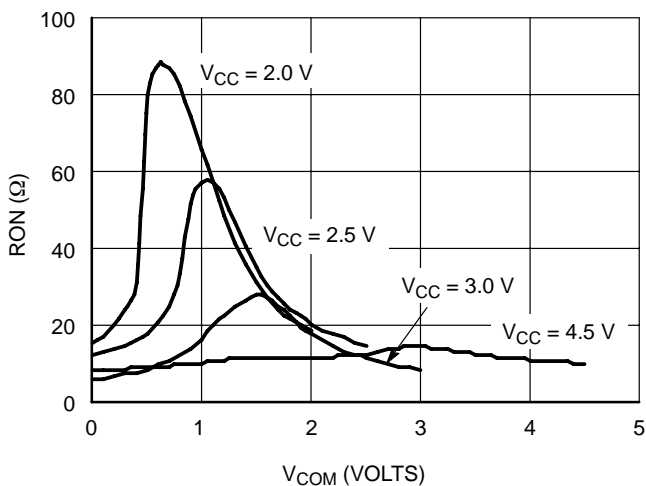


Figure 17.  $R_{ON}$  versus  $V_{COM}$  and  $V_{CC}$  (@  $25^\circ\text{C}$ )

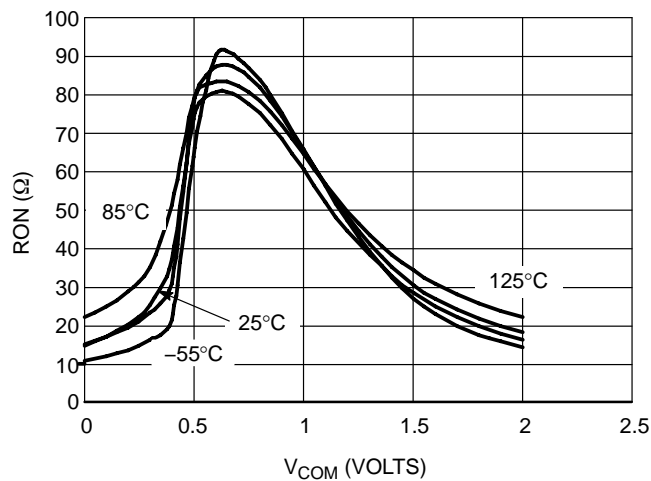


Figure 18.  $R_{ON}$  versus  $V_{COM}$  and Temperature,  $V_{CC} 2.0\text{ V}$

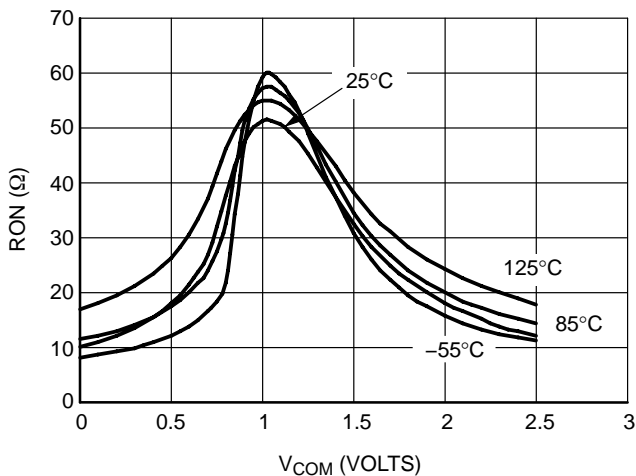


Figure 19.  $R_{ON}$  versus  $V_{COM}$  and Temperature,  $V_{CC} = 2.5\text{ V}$

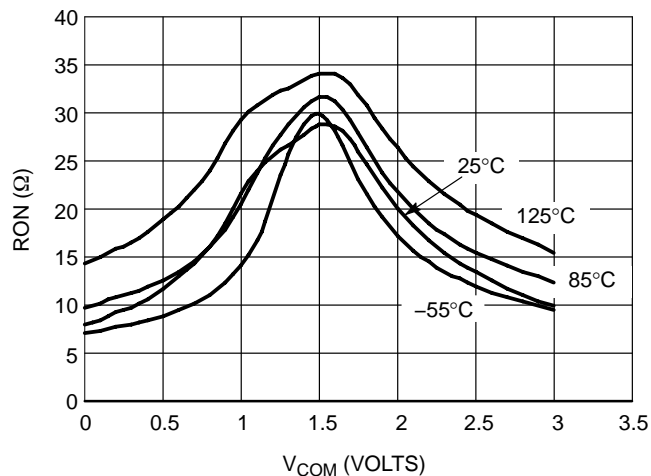


Figure 20.  $R_{ON}$  versus  $V_{COM}$  and Temperature,  $V_{CC} = 3.0\text{ V}$



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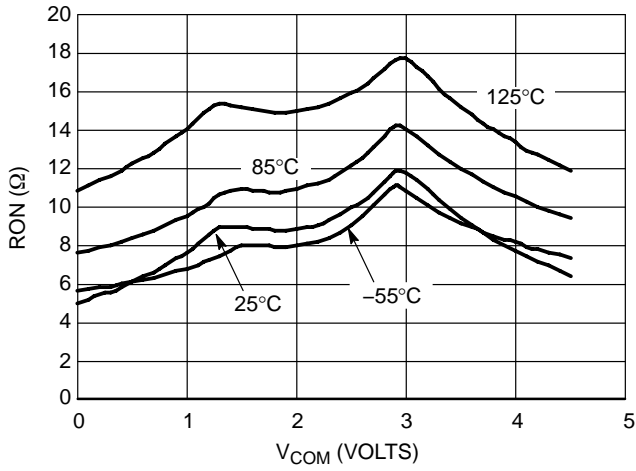


Figure 21. R<sub>ON</sub> versus V<sub>COM</sub> and Temperature, V<sub>CC</sub> = 4.5 V

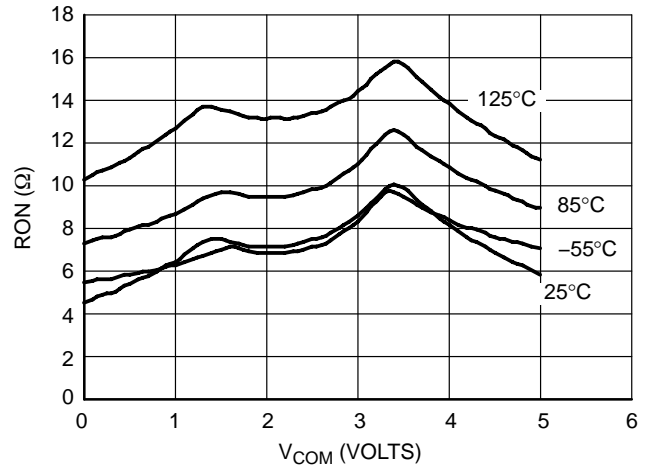


Figure 22. R<sub>ON</sub> versus V<sub>COM</sub> and Temperature, V<sub>CC</sub> = 5.0 V

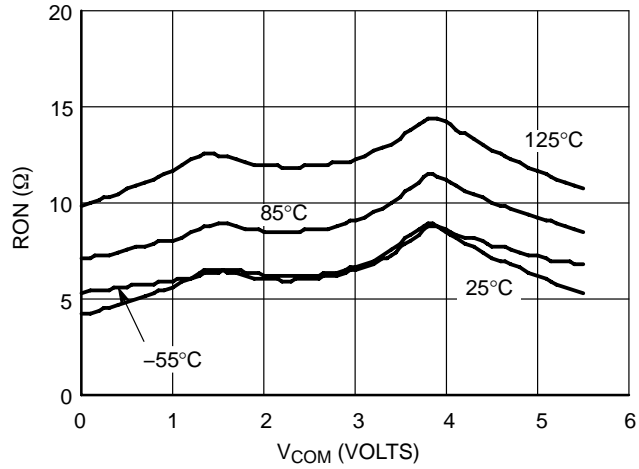
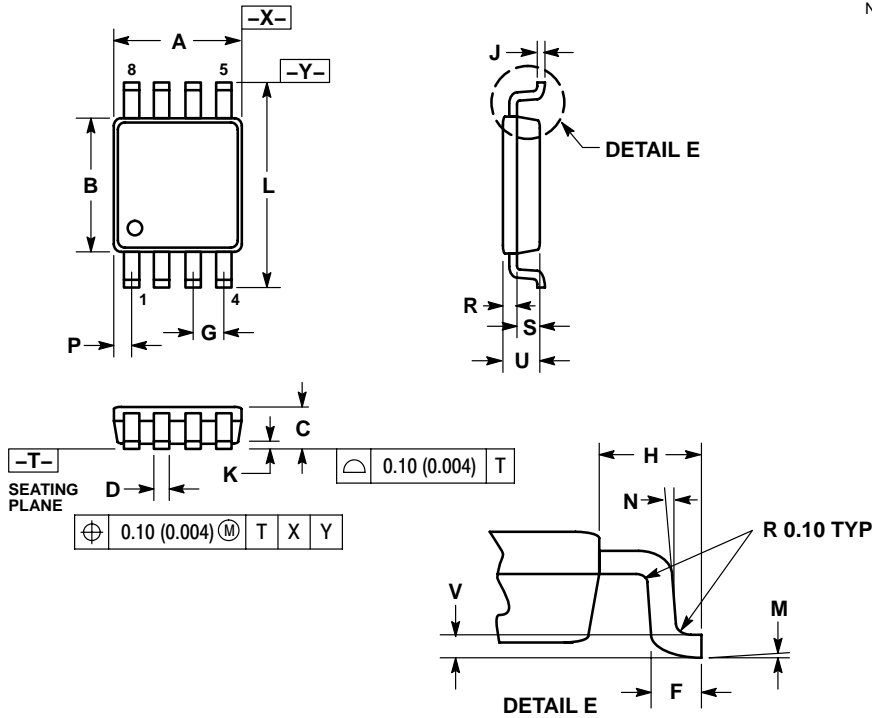


Figure 23. R<sub>ON</sub> versus V<sub>COM</sub> and Temperature, V<sub>CC</sub> = 5.5 V

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## PACKAGE DIMENSIONS

US8  
CASE 493-02  
ISSUE B

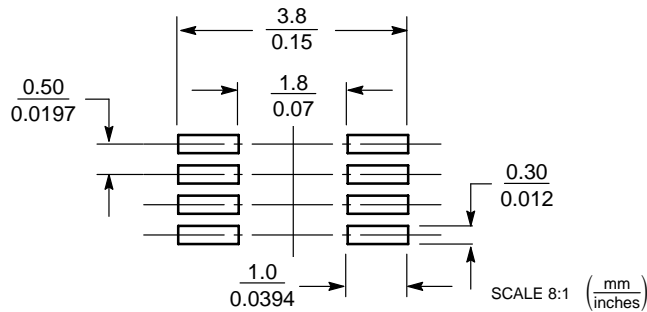


### NOTES:

- 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 °).
- 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	0.23	0.34	0.010	0.013
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	

### 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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