NLAS4501

Single SPDT Analog Switch

The NLAS4501 is an analog switch manufactured in sub–micron silicon–gate CMOS technology. It achieves very low R_{ON} while maintaining extremely low power dissipation. The device is a bilateral switch suitable for switching either analog or digital signals, which may vary from zero to full supply voltage.

The NLAS4501 is pin–for–pin compatible with the MAX4501. The NLAS4501 can be used as a direct replacement for the MAX4501 in all 2.0 V to 5.5 V applications where a R_{ON} performance improvement is required.

The Enable pin is compatible with standard CMOS outputs when supply voltage is nominal 5.0 Volts. It is also over–voltage tolerant, making it a very useful logic level translator.

- Guaranteed R_{ON} of 32 Ω at 5.5 V
- Low Power Dissipation: I_{CC} = 2 μA
- Provides Voltage translation for many different voltage levels
  - 3.3 to 5.0 Volts, Enable pin may go as high as +5.5 Volts
  - 1.8 to 3.3 Volts
  - 1.8 to 2.5 Volts
- Improved version of MAX4501 (at any voltage between 2 and 5.5 Volts)
- Chip Complexity: FETs 11

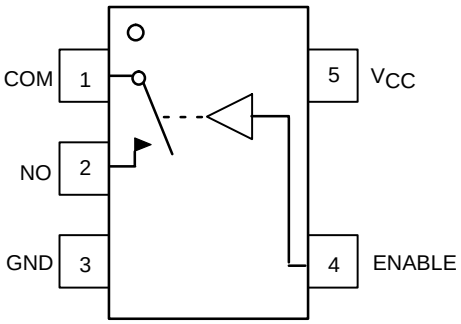

Figure 1. Pinout (Top View)

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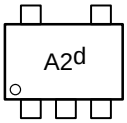
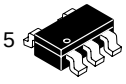
MARKING DIAGRAMS

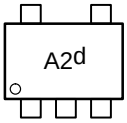
SC70–5/SC–88A/SOT–353
DF SUFFIX
CASE 419A



Pin 1



SOT23–5/TSOP–5/SC59–5
DT SUFFIX
CASE 483



Pin 1

d = Date Code

PIN ASSIGNMENT	
1	COM
2	NO
3	GND
4	ENABLE
5	V_{CC}

FUNCTION TABLE

On/Off Enable Input	State of Analog Switch
L	Off
H	On

ORDERING INFORMATION

See detailed ordering and shipping information on page 8 of this data sheet.

MAXIMUM RATINGS

Symbol	Parameter		Value	Unit
V_{CC}	Positive DC Supply Voltage		−0.5 to +7.0	V
V_{IN}	Digital Input Voltage (Enable)		−0.5 to +7.0	V
V_{IS}	Analog Output Voltage (V_{NO} or V_{COM})		−0.5 to V_{CC} +0.5	V
I_{IK}	DC Current, Into or Out of Any Pin		±20	mA
T_{STG}	Storage Temperature Range		−65 to +150	°C
T_L	Lead Temperature, 1 mm from Case for 10 Seconds		260	°C
T_J	Junction Temperature under Bias		+150	°C
θ_{JA}	Thermal Resistance	SC70–5/SC–88A (Note 1) TSOP–5	350 230	°C/W
P_D	Power Dissipation in Still Air at 85°C	SC70–5/SC–88A TSOP–5	150 200	mW
MSL	Moisture Sensitivity		Level 1	
F_R	Flammability Rating	Oxygen Index: 30% – 35%	UL–94–VO (0.125 in)	
V_{ESD}	ESD Withstand Voltage	Human Body Model (Note 2) Machine Model (Note 3) Charged Device Model (Note 4)	> 2000 > 100 N/A	V
$I_{Latch–Up}$	Latch–Up Performance	Above V_{CC} and Below GND at 85°C (Note 5)	±300	mA

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_{CC}	Positive DC Supply Voltage		2.0	5.5	V
V_{IN}	Digital Input Voltage (Enable)		GND	5.5	V
V_{IO}	Static or Dynamic Voltage Across an Off Switch		GND	V_{CC}	V
V_{IS}	Analog Input Voltage (NO, COM)		GND	V_{CC}	V
T_A	Operating Temperature Range, All Package Types		–55	+125	°C
t_r, t_f	Input Rise or Fall Time, (Enable Input)	V_{CC} = 3.3 V ± 0.3 V V_{CC} = 5.0 V ± 0.5 V	0 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

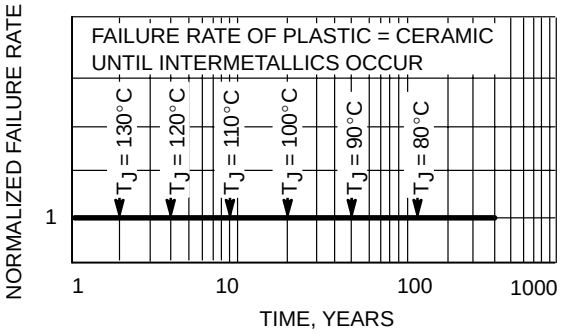


Figure 2. Failure Rate vs. Time Junction Temperature

DC CHARACTERISTICS – Digital Section (Voltages Referenced to GND)

Symbol	Parameter	Condition	V_{CC}	Guaranteed Max Limit			Unit
				–55 to 25°C	<85°C	<125°C	
V_{IH}	Minimum High–Level Input Voltage, Enable Inputs		2.0 3.0 4.5 5.5	1.5 2.1 3.15 3.85	1.5 2.1 3.15 3.85	1.5 2.1 3.15 3.85	V
V_{IL}	Maximum Low–Level Input Voltage, Enable Inputs		2.0 3.0 4.5 5.5	0.5 0.9 1.35 1.65	0.5 0.9 1.35 1.65	0.5 0.9 1.35 1.65	V
I_{IN}	Maximum Input Leakage Current, Enable Inputs	V_{IN} = 5.5 V or GND	0 V to 5.5 V	±0.1	±1.0	±1.0	μA
I_{CC}	Maximum Quiescent Supply Current (per package)	Enable and VIS = VCC or GND	5.5	1.0	1.0	2.0	μA

DC ELECTRICAL CHARACTERISTICS – Analog Section

Symbol	Parameter	Condition	V_{CC}	Guaranteed Max Limit			Unit
				–55 to 25°C	<85°C	<125°C	
R_{ON}	Maximum ON Resistance (Figures 8 – 12)	$V_{IN} = V_{IH}$ $V_{IS} = V_{CC}$ to GND $I_{IS}I = \leq 10.0$mA	3.0 4.5 5.5	45 30 25	50 35 30	55 40 35	Ω
$R_{FLAT(ON)}$	ON Resistance Flatness	$V_{IN} = V_{IH}$ $I_{IS}I = \leq 10.0$mA V_{IS} = 1V, 2V, 3.5V	4.5	4	4	5	Ω
$I_{NO(OFF)}$	Off Leakage Current, Pin 2 (Figure 3)	$V_{IN} = V_{IL}$ V_{NO} = 1.0 V, V_{COM} = 4.5 V or V_{COM} = 1.0 V and V_{NO} 4.5 V	5.5	1	10	100	nA
$I_{COM(OFF)}$	Off Leakage Current, Pin 1 (Figure 3)	$V_{IN} = V_{IL}$ V_{NO} = 4.5 V or 1.0 V V_{COM} = 1.0 V or 4.5 V	5.5	1	10	100	nA

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

Symbol	Parameter	Test Conditions	V_{CC}	Guaranteed Max Limit									Unit
				–55 to 25°C			<85°C			<125°C			
			(V)	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
t_{ON}	Turn–On Time	R_L = 300 Ω, C_L = 35 pF (Figures 4, 5, and 13)	2.0 3.0 4.5 5.5		7.0 5.0 4.5 4.5	14 10 9 9			16 12 11 11			16 12 11 11	ns
t_{OFF}	Turn–Off Time	R_L = 300 Ω, C_L = 35 pF (Figures 4, 5, and 13)	2.0 3.0 4.5 5.5		11.0 7.0 5.0 5.0	22 14 10 10			24 16 12 12			24 16 12 12	ns

		Typical @ 25, VCC = 5.0 V	
C_{IN}	Maximum Input Capacitance, Select Input	8	pF
C_{NO} or C_{NC}	Analog I/O (switch off)	10	
$C_{COM(OFF)}$	Common I/O (switch off)	10	
$C_{COM(ON)}$	Feedthrough (switch on)	20	

ADDITIONAL APPLICATION CHARACTERISTICS (Voltages Referenced to GND Unless Noted)

Symbol	Parameter	Condition	V_{CC} V	Limit 25°C	Unit
BW	Maximum On–Channel –3dB Bandwidth or Minimum Frequency Response	V_{IS} = 0 dBm V_{IS} centered between V_{CC} and GND (Figures 6 and 14)	3.0 4.5 5.5	190 200 220	MHz
V_{ONL}	Maximum Feedthrough On Loss	V_{IS} = 0 dBm @ 10 kHz V_{IS} centered between V_{CC} and GND (Figure 6)	3.0 4.5 5.5	–2 –2 –2	dB
V_{ISO}	Off–Channel Isolation	f = 100 kHz; V_{IS} = 1 V RMS V_{IS} centered between V_{CC} and GND (Figures 6 and 15)	3.0 4.5 5.5	–93	dB
Q	Charge Injection Enable Input to Common I/O	V_{IS} = V_{CC} to GND, F_{IS} = 20 kHz $t_r = t_f$ = 3 ns R_{IS} = 0 Ω, C_L = 1000 pF $Q = C_L * \Delta V_{OUT}$ (Figures 7 and 16)	3.0 5.5	1.5 3.0	pC
THD	Total Harmonic Distortion THD + Noise	F_{IS} = 20 Hz to 1 MHz, R_L = Rgen = 600 Ω, C_L = 50 pF V_{IS} = 3.0 V_{PP} sine wave V_{IS} = 5.0 V_{PP} sine wave (Figure 17)	3.3 5.5	0.3 0.15	%

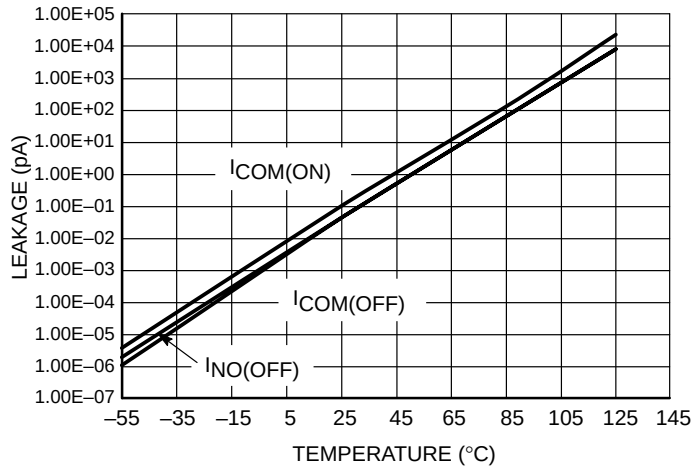


Figure 3. Switch Leakage vs. Temperature

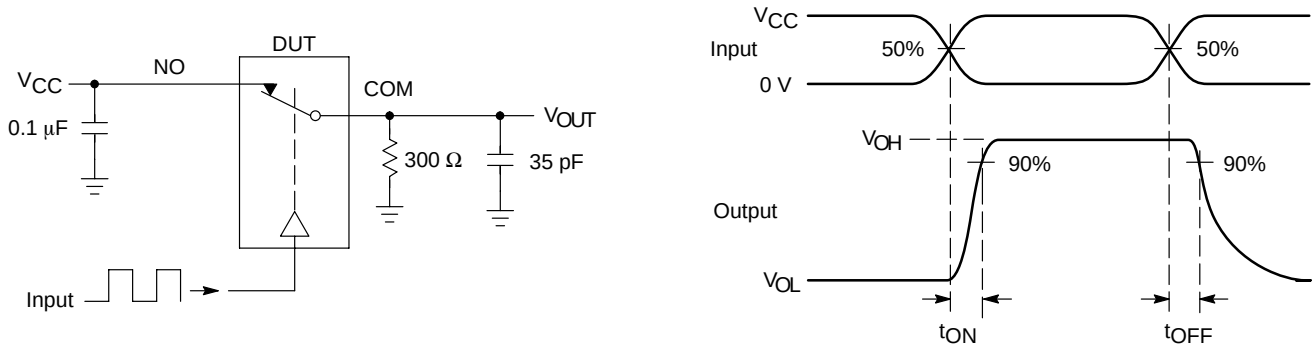


Figure 4. t_{ON}/t_{OFF}

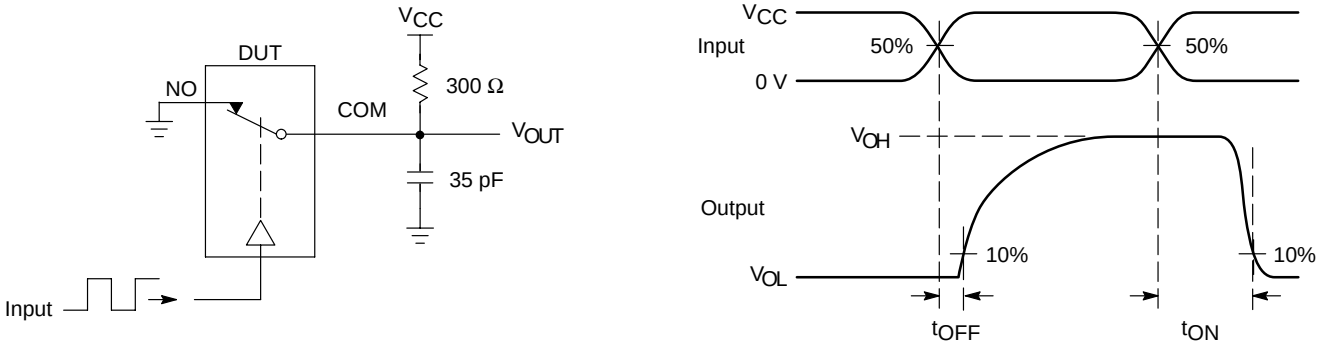
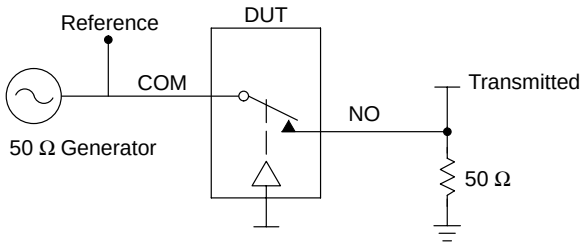


Figure 5. t_{ON}/t_{OFF}



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

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

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

Figure 6. Off Channel Isolation/On Channel Loss (BW)/Crosstalk (On Channel to Off Channel)/V_{ONL}

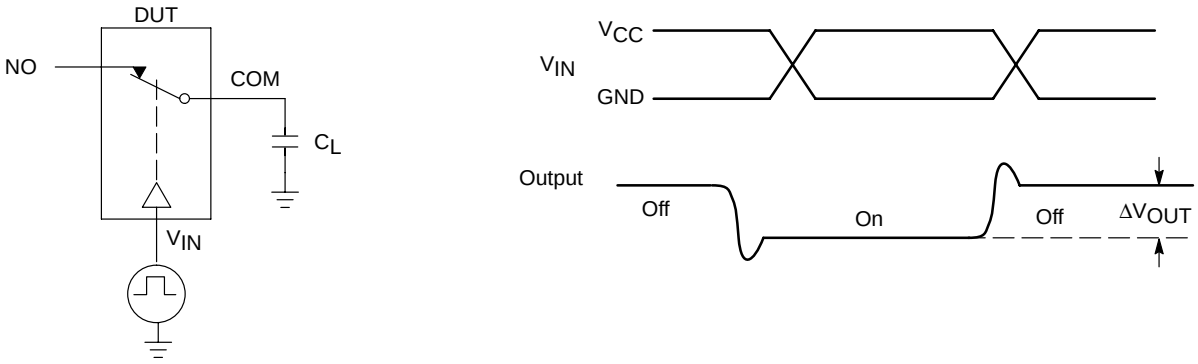


Figure 7. Charge Injection: (Q)

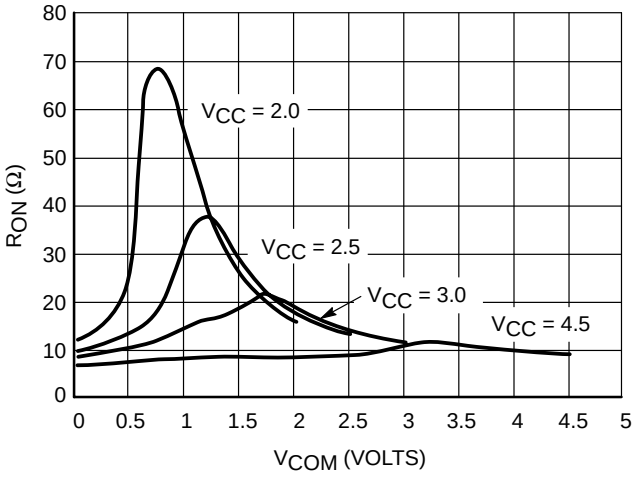


Figure 8. R_{ON} vs. V_{COM} and V_{CC} (@25°C)

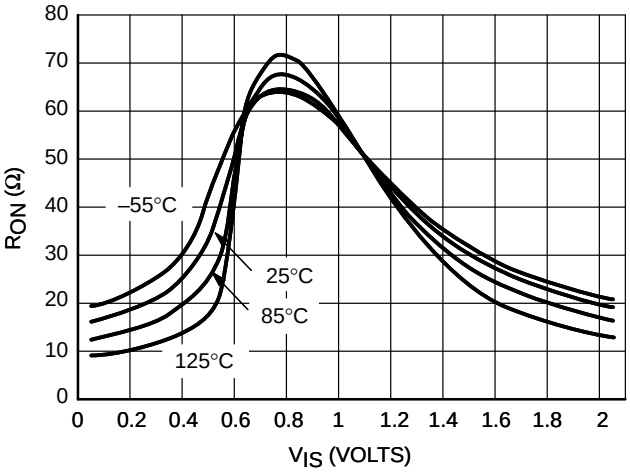


Figure 9. R_{ON} vs. V_{COM} and Temperature, V_{CC} = 2.0 V

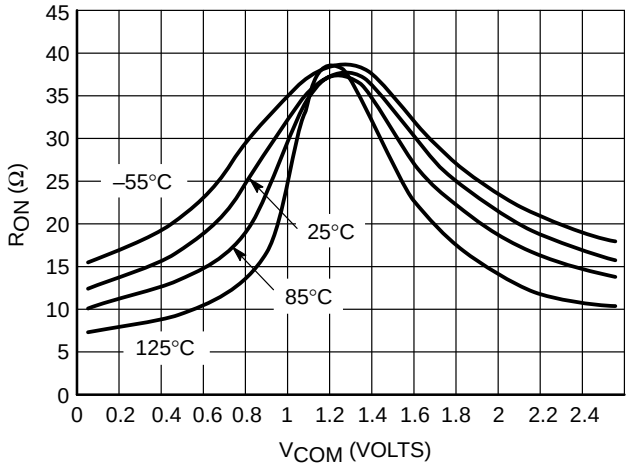


Figure 10. R_{ON} vs. V_{COM} and Temperature, V_{CC} = 2.5 V

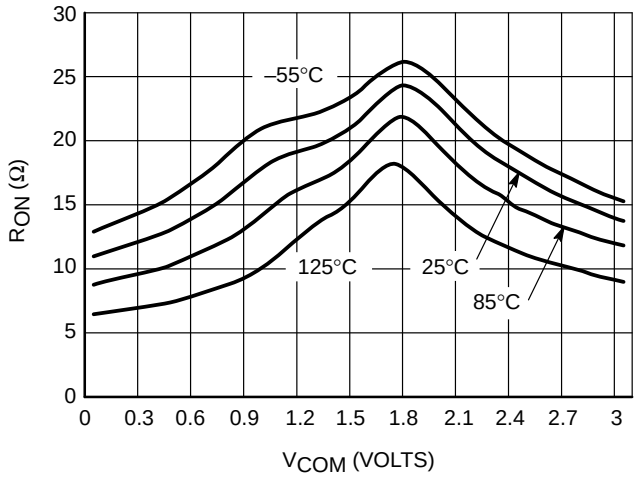


Figure 11. R_{ON} vs. V_{COM} and Temperature, V_{CC} = 3.0 V

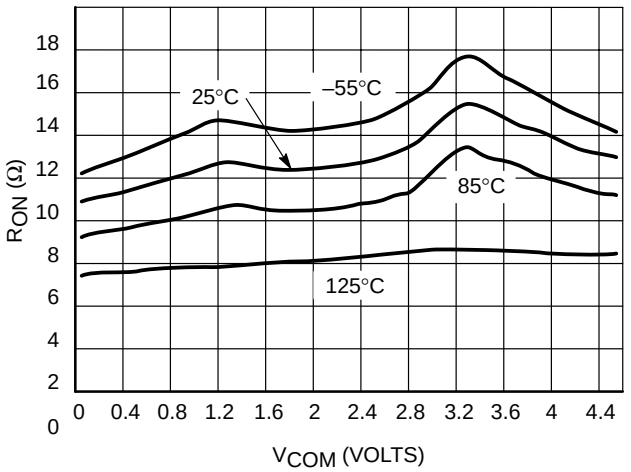


Figure 12. R_{ON} vs. V_{COM} and Temperature, V_{CC} = 4.5 V

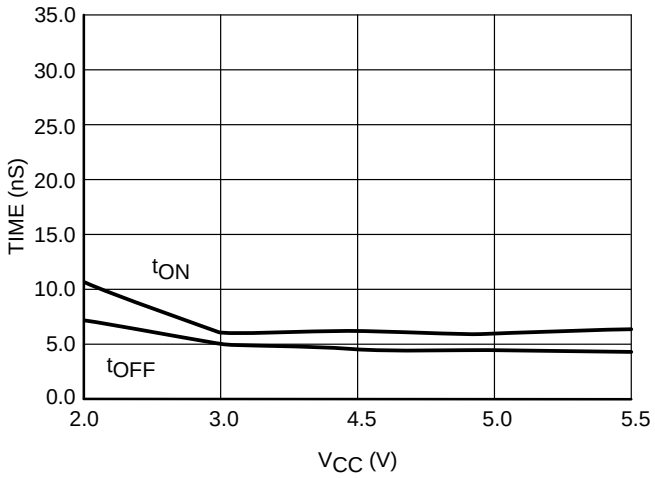


Figure 13. Switching Time vs. Supply Voltage, T = 25°C

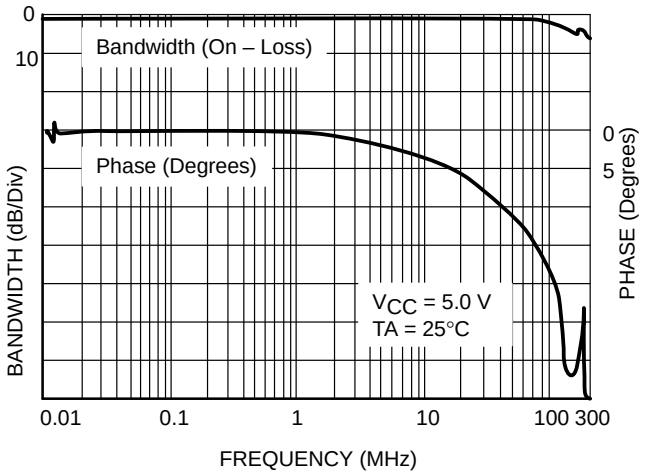


Figure 14. ON Channel Bandwidth and Phase Shift Over Frequency

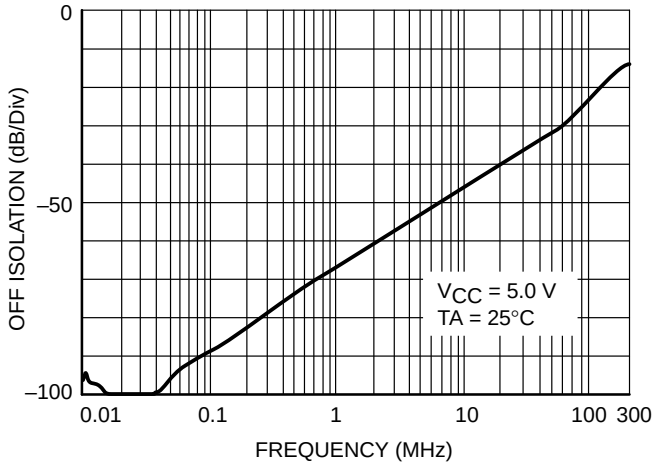


Figure 15. Off Channel Isolation

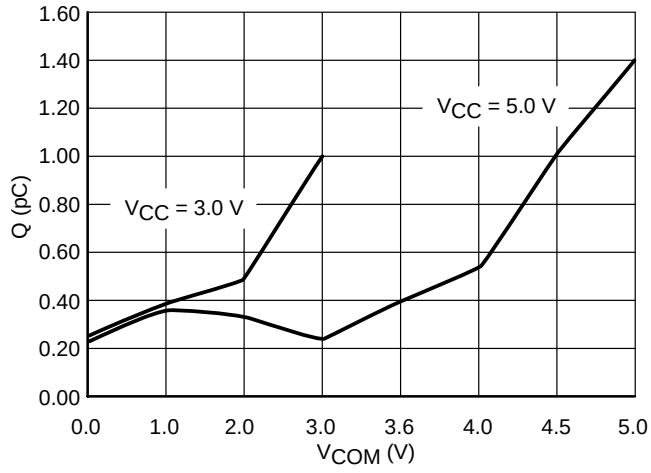


Figure 16. Charge Injection vs. V_{COM}

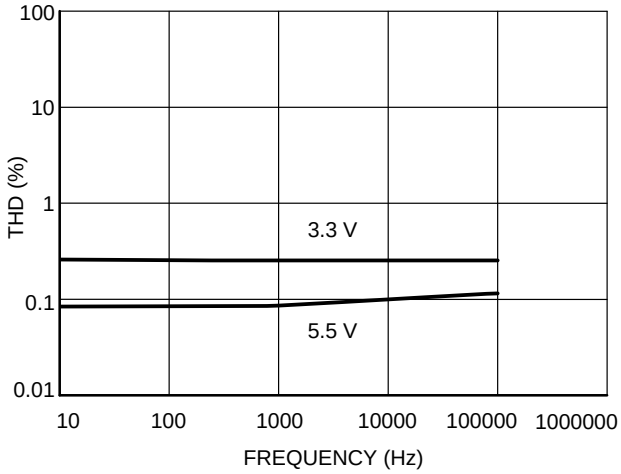


Figure 17. THD vs. Frequency

DEVICE ORDERING INFORMATION

Device Order Number	Device Nomenclature					Package Type (Name/SOT#/ Common Name)	Tape and Reel Size
	Circuit Indicator	Technology	Device Function	Package Suffix	Tape & Reel Suffix		
NLAS4501DFT2	NL	AS	4501	DF	T2	SC–88A / SOT–353 / SC70–5	178 mm (7”) 3000 Unit
NLAS4501DTT1	NL	AS	4501	DT	T1	TSOP–5 / SOT23–5 / SC59–5	178 mm (7”) 3000 Unit

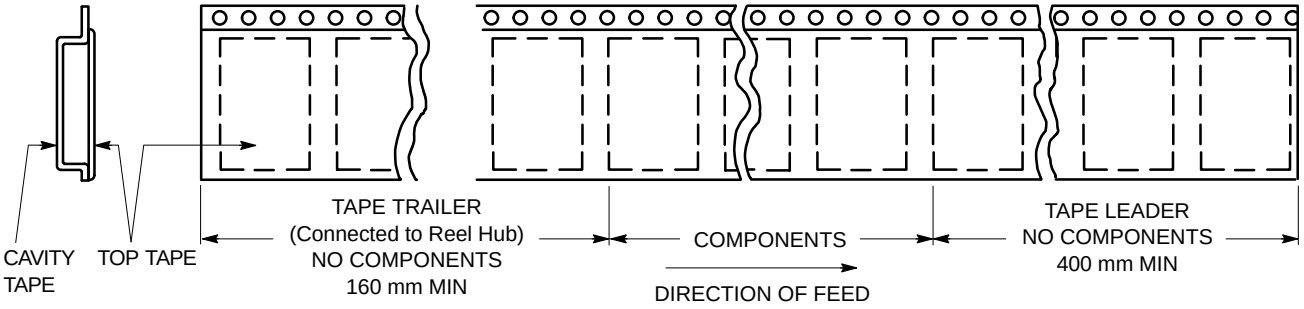


Figure 18. Tape Ends for Finished Goods

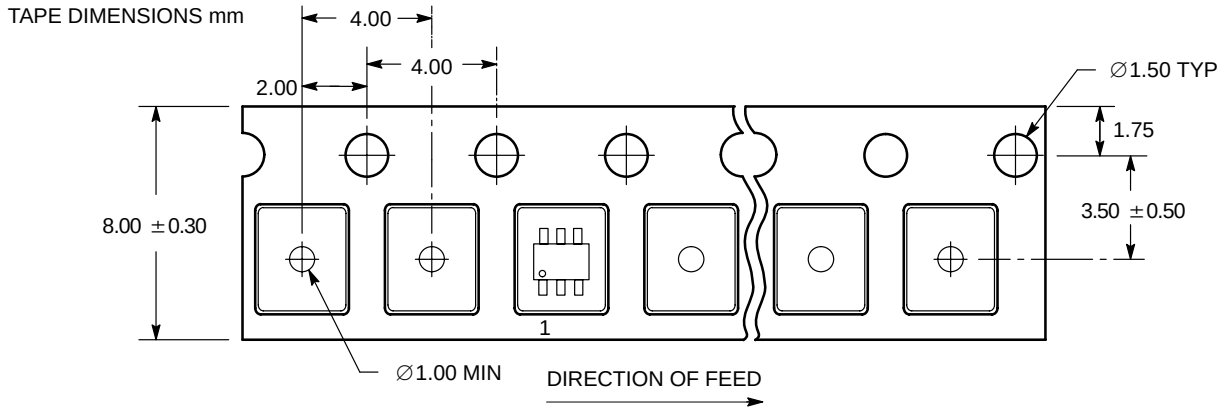


Figure 19. SC70−6/SC−88/SOT−363 DFT2 and SOT23−6/TSOP−6/SC59−6 DTT1 Reel Configuration/Orientation

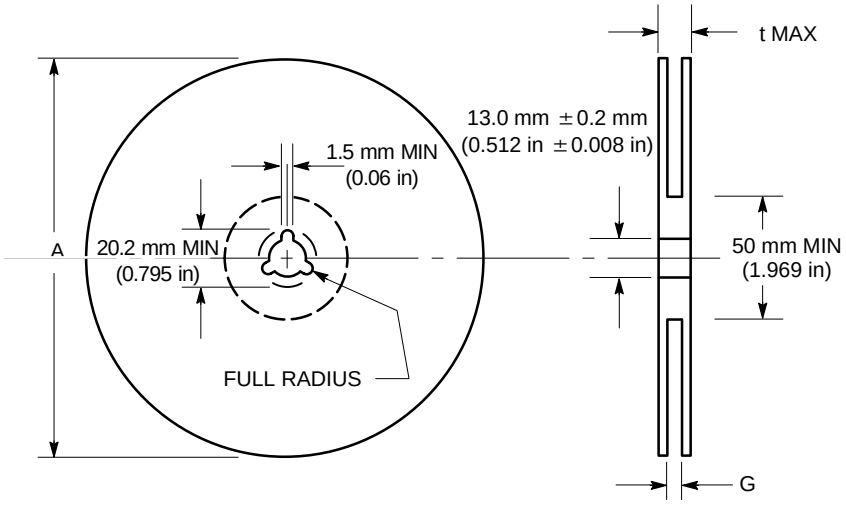


Figure 20. Reel Dimensions

REEL DIMENSIONS

Tape Size	T and R Suffix	A Max	G	t Max
8 mm	T1, T2	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)

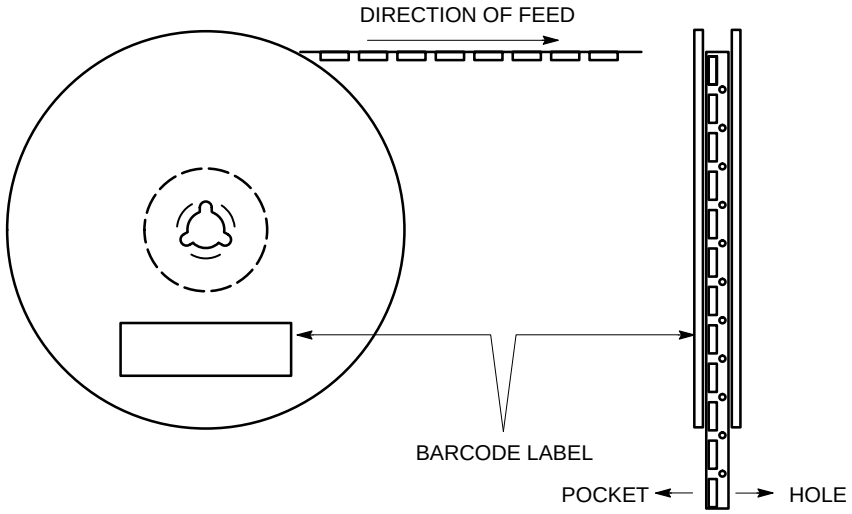
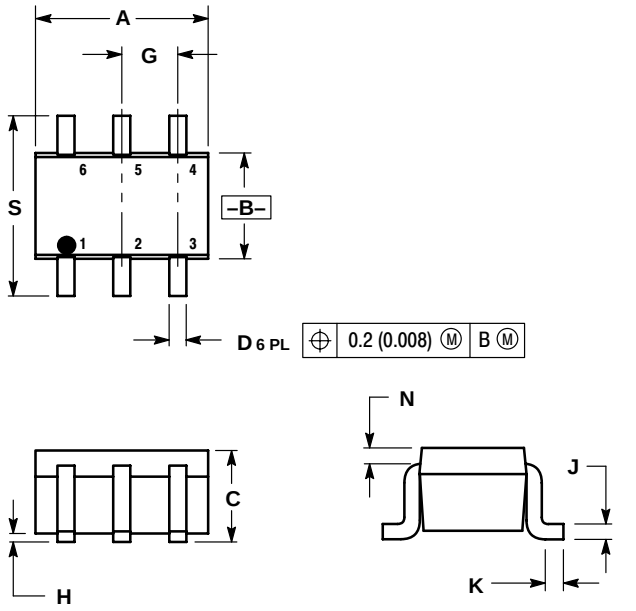


Figure 21. Reel Winding Direction

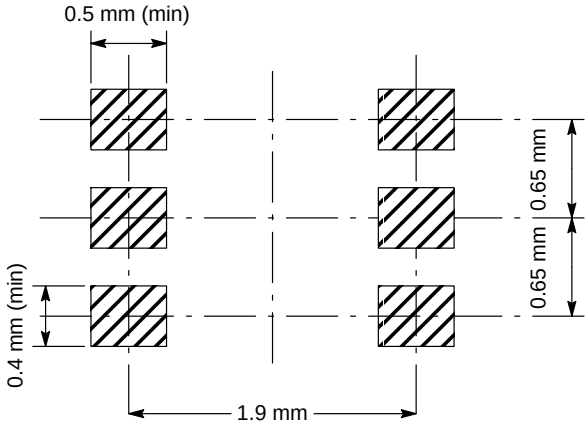
PACKAGE DIMENSIONS

SC70−6/SC−88/SOT−363
DF SUFFIX
CASE 419B−02
ISSUE H



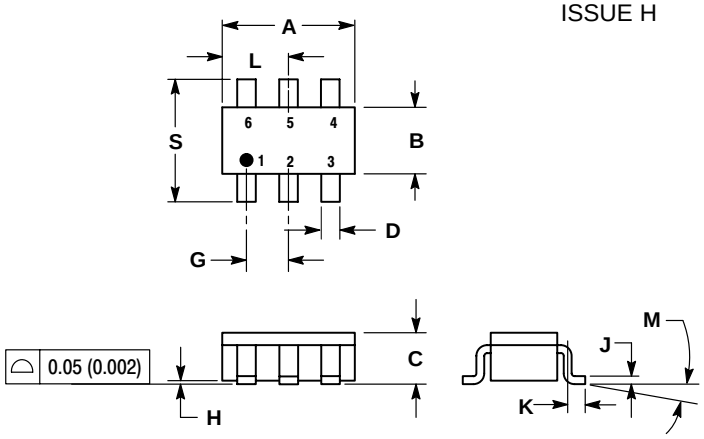
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	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



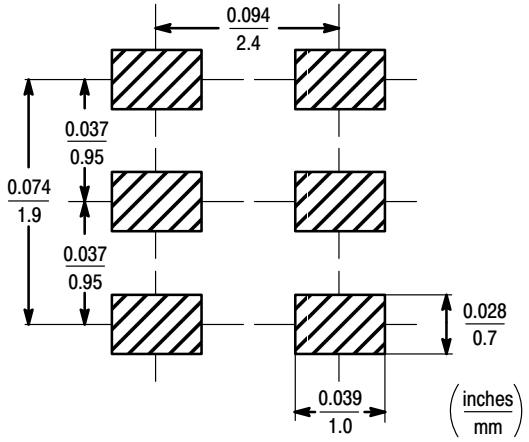
PACKAGE DIMENSIONS

SOT23–6/TSOP–6/SC59–6
DT SUFFIX
CASE 318G–02
ISSUE H



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.

	MILLIMETERS		INCHES	
DIM	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



PUBLICATION ORDERING INFORMATION

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