

# 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
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

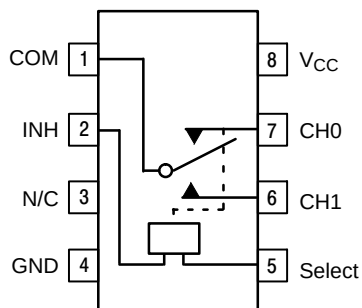


Figure 1. Pin Assignment



**ON Semiconductor®**

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### MARKING DIAGRAM



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

(Note: Microdot may be in either location)

### FUNCTION TABLE

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

### ORDERING INFORMATION

| Device      | Package       | Shipping†          |
|-------------|---------------|--------------------|
| 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.

## 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%<br>$F_R$                                                                  | UL 94 V-0 @ 0.125 in                 |      |
| ESD Withstand Voltage                           | Human Body Model (Note 2)<br>Machine Model (Note 3)<br>Charged Device Model (Note 4)<br>$V_{ESD}$ | > 2000<br>200<br>N/A                 | V    |
| Latchup Performance                             | Above $V_{CC}$ and Below GND at 85°C (Note 5)<br>$I_{LATCHUP}$                                    | $\pm 300$                            | 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 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<br>(Enable Input)      | $t_r, t_f$ | 0<br>0 | 100<br>20 | 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.

## 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         |

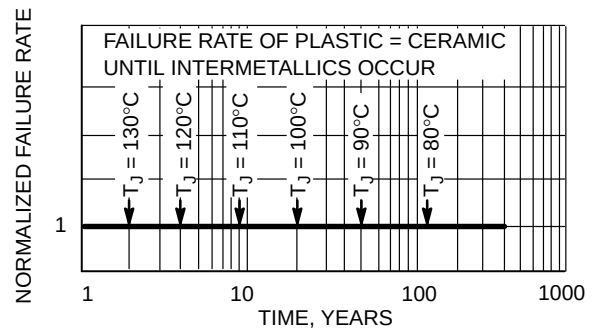


Figure 2. Failure Rate versus Time Junction Temperature

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<br>(Figures 17 – 23) | V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub><br>V <sub>IS</sub> = GND to V <sub>CC</sub><br>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<br>(Figures 17 – 23)  | V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub><br>I <sub>IN</sub> ≤ 10.0 mA<br>V <sub>IS</sub> = 1V, 2V, 3.5V                                                                                                              | R <sub>FLAT</sub><br>(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><br>I <sub>IN</sub> ≤ 10.0 mA<br>V <sub>CH1</sub> or V <sub>CH0</sub> = 3.5 V                                                                                                | ΔR <sub>ON</sub><br>(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><br>V <sub>CH1</sub> or V <sub>CH0</sub> = 1.0 V <sub>COM</sub> 4.5 V                                                                                                        | I <sub>CH0</sub><br>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><br>V <sub>CH1</sub> 1.0 V or 4.5 V with V <sub>CH0</sub> floating or<br>V <sub>CH1</sub> 1.0 V or 4.5 V with V <sub>CH1</sub> floating<br>V <sub>COM</sub> = 1.0 V or 4.5 V | I <sub>COM(ON)</sub>                 | 5.5             | 1                | 10     | 100     | nA   |

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

| Parameter                                                                                                                    | Test Conditions                                                                      | Symbol                                                                                         | V <sub>CC</sub><br>(V)                | Guaranteed Max Limit |                     |                      |                  |                      |                  | Unit                 |     |    |
|------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|---------------------------------------|----------------------|---------------------|----------------------|------------------|----------------------|------------------|----------------------|-----|----|
|                                                                                                                              |                                                                                      |                                                                                                |                                       | -55 to 25°C          |                     |                      | < 85°C           |                      | < 125°C          |                      |     |    |
|                                                                                                                              |                                                                                      |                                                                                                |                                       | Min                  | Typ*                | Max                  | Min              | Max                  | Min              |                      | Max |    |
| Turn-On Time<br>(Figures 12 and 13)<br>INH to Output                                                                         | R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF<br>(Figures 4 and 5)                  | t <sub>ON</sub>                                                                                | 2.5<br>3.0<br>4.5<br>5.5              | 2<br>2<br>1<br>1     | 7<br>5<br>4<br>3    | 12<br>10<br>9<br>8   | 2<br>2<br>1<br>1 | 15<br>15<br>12<br>12 | 2<br>2<br>1<br>1 | 15<br>15<br>12<br>12 | ns  |    |
| Turn-Off Time<br>(Figures 12 and 13)<br>INH to Output                                                                        | R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF<br>(Figures 4 and 5)                  | t <sub>OFF</sub>                                                                               | 2.5<br>3.0<br>4.5<br>5.5              | 2<br>2<br>1<br>1     | 7<br>5<br>4<br>3    | 12<br>10<br>9<br>8   | 2<br>2<br>1<br>1 | 15<br>15<br>12<br>12 | 2<br>2<br>1<br>1 | 15<br>15<br>12<br>12 | ns  |    |
| Transition Time (Channel Selec-<br>tion Time)<br>(Figure )<br>Select to Output                                               | R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF<br>(Figures and )                     | t <sub>trans</sub>                                                                             | 2.5<br>3.0<br>4.5<br>5.5              | 5<br>5<br>2<br>2     | 18<br>13<br>12<br>9 | 28<br>21<br>16<br>14 | 5<br>5<br>2<br>2 | 30<br>25<br>20<br>20 | 5<br>5<br>2<br>2 | 30<br>25<br>20<br>20 | ns  |    |
| Minimum<br>Break-Before-Make Time                                                                                            | V <sub>IS</sub> = 3.0 V (Figure 3)<br>R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF | t <sub>BBM</sub>                                                                               | 2.5<br>3.0<br>4.5<br>5.5              | 1<br>1<br>1<br>1     | 12<br>11<br>6<br>5  |                      | 1<br>1<br>1<br>1 |                      | 1<br>1<br>1<br>1 |                      | ns  |    |
|                                                                                                                              |                                                                                      |                                                                                                | Typical @ 25, V <sub>CC</sub> = 5.0 V |                      |                     |                      |                  |                      |                  |                      |     |    |
| Maximum Input Capacitance, Select/INH Input<br>Analog I/O (switch off)<br>Common I/O (switch off)<br>Feedthrough (switch on) |                                                                                      | C <sub>IN</sub><br>C <sub>NO</sub> or C <sub>NC</sub><br>C <sub>COM</sub><br>C <sub>(ON)</sub> | 8<br>10<br>10<br>20                   |                      |                     |                      |                  |                      |                  |                      |     | pF |

\*Typical Characteristics are at 25°C.

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

| Parameter                                                                         | Condition                                                                                                                                                  | Symbol    | $V_{CC}$<br>V     | Typical           | Unit |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-------------------|-------------------|------|
|                                                                                   |                                                                                                                                                            |           |                   | 25°C              |      |
| Maximum On-Channel -3dB Bandwidth or<br>Minimum Frequency Response<br>(Figure 10) | $V_{IN} = 0$ dBm<br>$V_{IN}$ centered between $V_{CC}$ and GND<br>(Figure 7)                                                                               | BW        | 3.0<br>4.5<br>5.5 | 170<br>200<br>200 | MHz  |
| Maximum Feedthrough On Loss                                                       | $V_{IN} = 0$ dBm @ 100 kHz to 50 MHz<br>$V_{IN}$ centered between $V_{CC}$ and GND<br>(Figure 7)                                                           | $V_{ONL}$ | 3.0<br>4.5<br>5.5 | -3<br>-3<br>-3    | dB   |
| Off-Channel Isolation<br>(Figure 10)                                              | $f = 100$ kHz; $V_{IS} = 1$ V RMS<br>$V_{IN}$ centered between $V_{CC}$ and GND<br>(Figure 7)                                                              | $V_{ISO}$ | 3.0<br>4.5<br>5.5 | -93<br>-93<br>-93 | dB   |
| Charge Injection Select Input to<br>Common I/O<br>(Figure 15)                     | $V_{IN} = V_{CC}$ to GND, $F_{IS} = 20$ kHz<br>$t_r = t_f = 3$ ns<br>$R_{IS} = 0 \Omega$ , $C_L = 1000$ pF<br>$Q = C_L \cdot \Delta V_{OUT}$<br>(Figure 8) | Q         | 3.0<br>5.5        | 1.5<br>3.0        | pC   |
| Total Harmonic Distortion<br>THD + Noise<br>(Figure 14)                           | $F_{IS} = 20$ Hz to 100 kHz, $R_L = R_{gen} = 600 \Omega$<br>$C_L = 50$ pF<br>$V_{IS} = 5.0$ V <sub>PP</sub> sine wave                                     | THD       | 5.5               | 0.1               | %    |

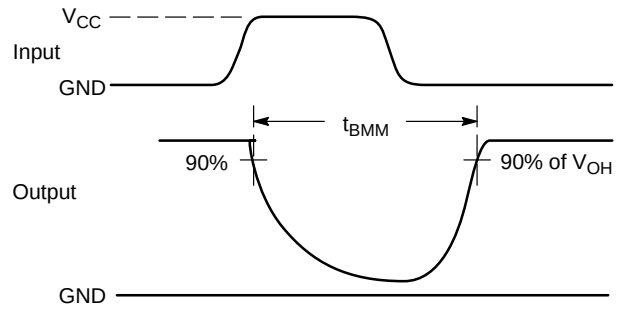
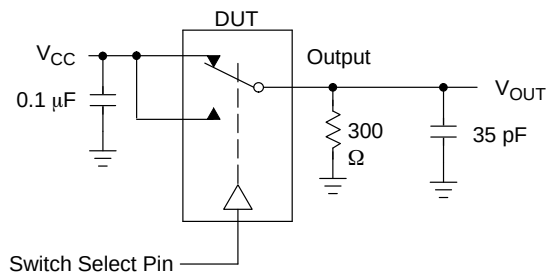


Figure 3.  $t_{BMM}$  (Time Break-Before-Make)

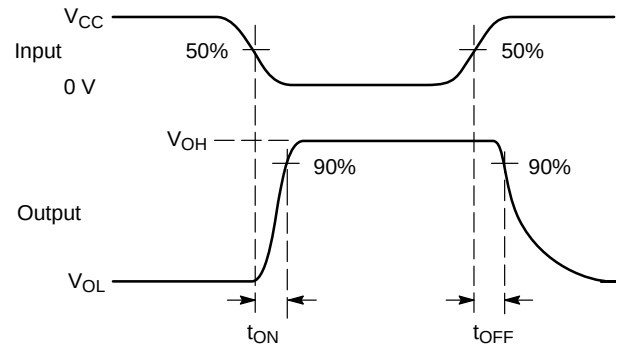
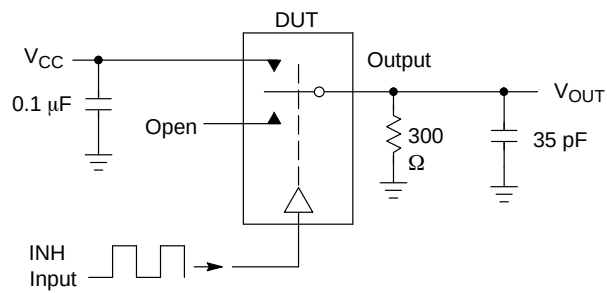


Figure 4.  $t_{ON}/t_{OFF}$

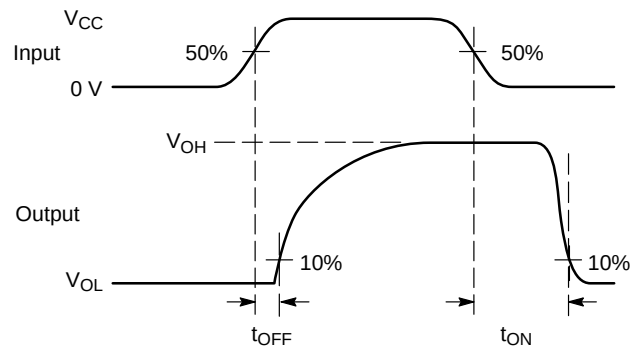
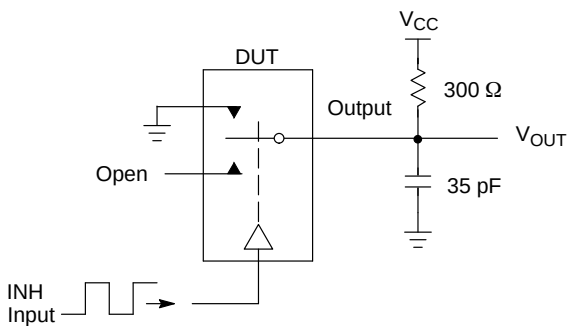


Figure 5.  $t_{ON}/t_{OFF}$

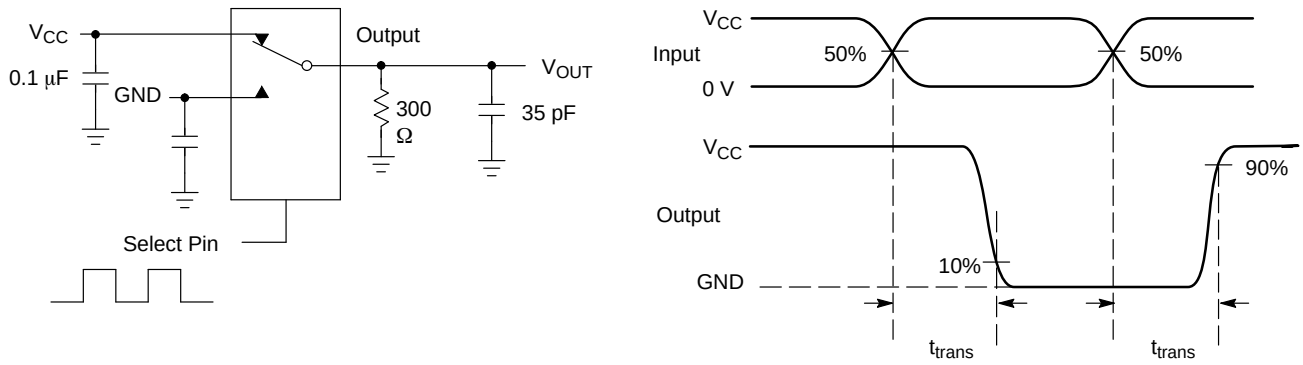
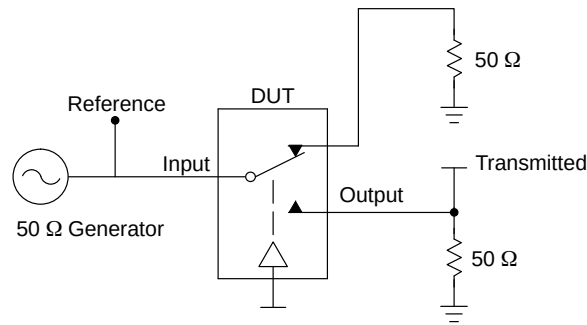


Figure 6.  $t_{trans}$  (Channel Selection Time)



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.

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

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

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

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

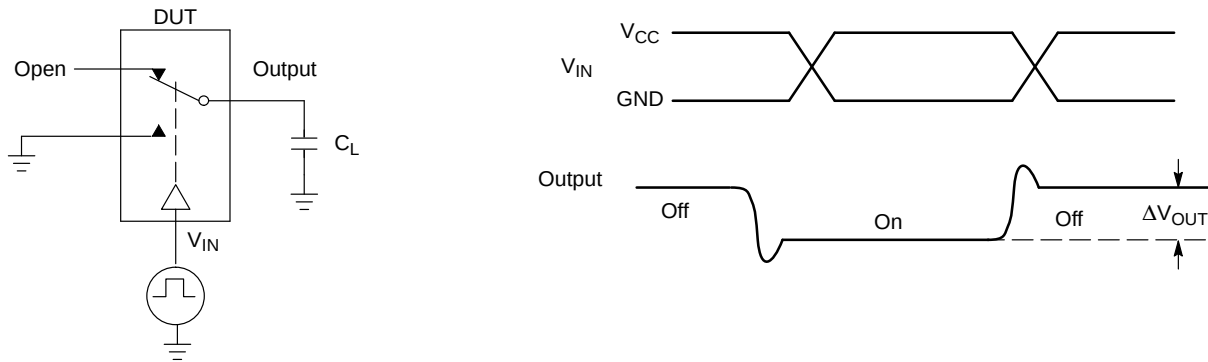


Figure 8. Charge Injection: (Q)

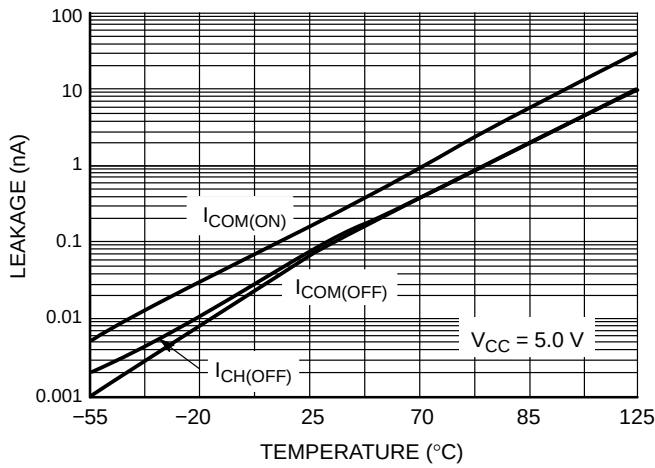


Figure 9. Switch Leakage versus Temperature

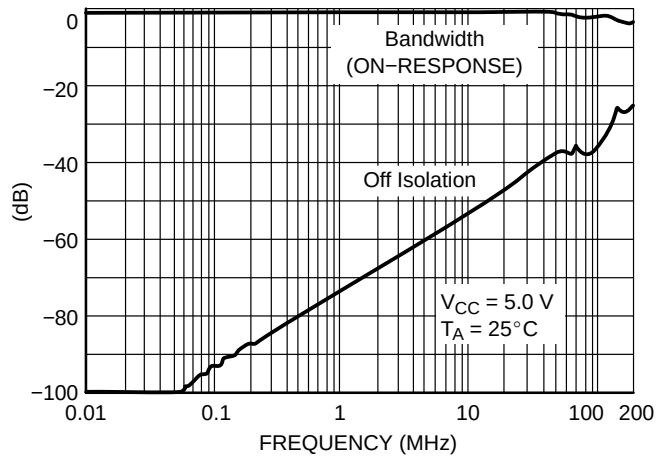


Figure 10. Bandwidth and Off-Channel Isolation

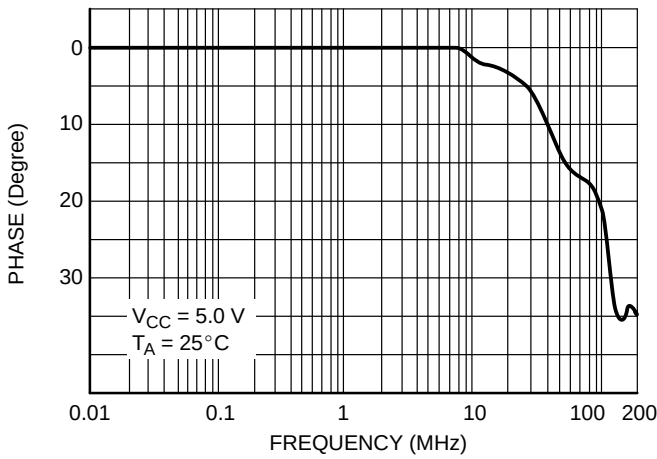


Figure 11. Phase versus Frequency

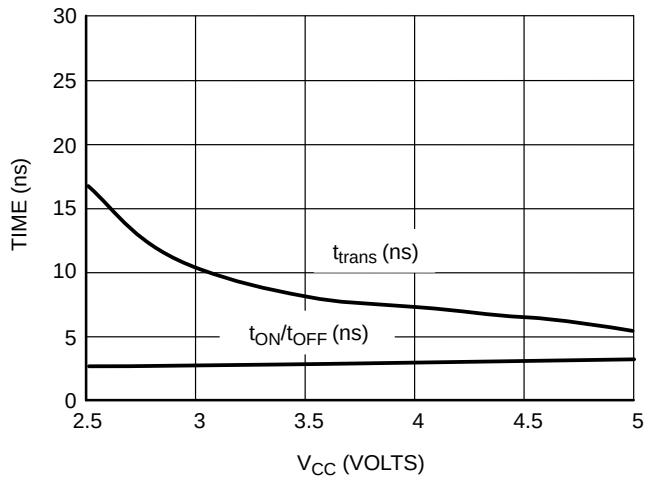


Figure 12.  $t_{ON}$  and  $t_{OFF}$  versus  $V_{CC}$  at 25°C

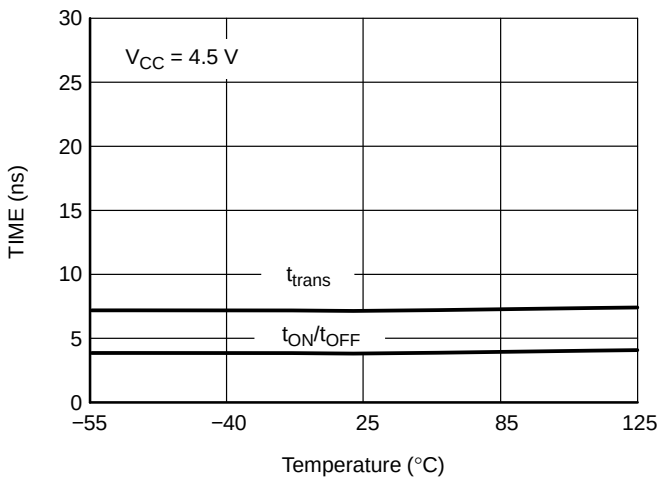


Figure 13.  $t_{ON}$  and  $t_{OFF}$  versus Temp

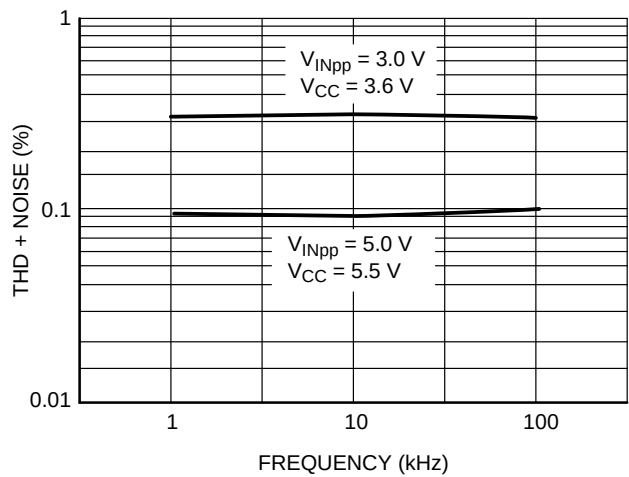


Figure 14. Total Harmonic Distortion Plus Noise versus Frequency

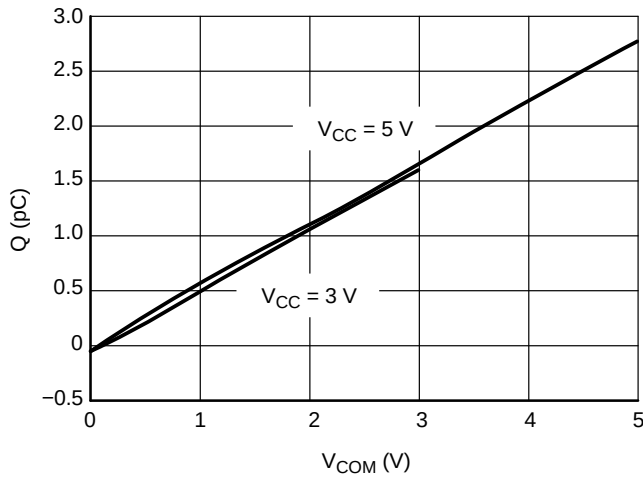


Figure 15. Charge Injection versus COM Voltage

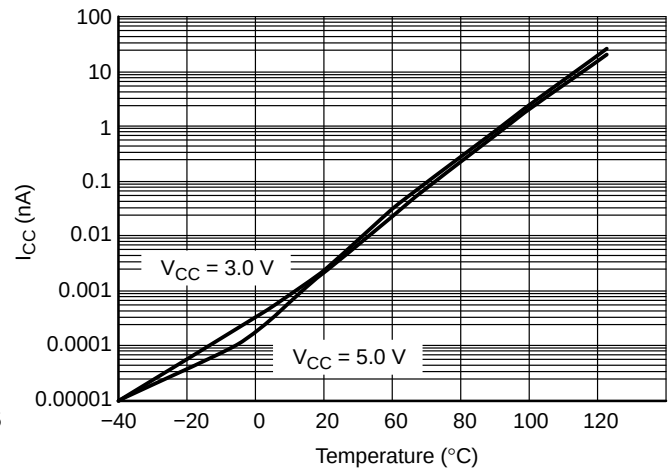


Figure 16.  $I_{CC}$  versus Temp,  $V_{CC} = 3\text{ V}$  &  $5\text{ V}$

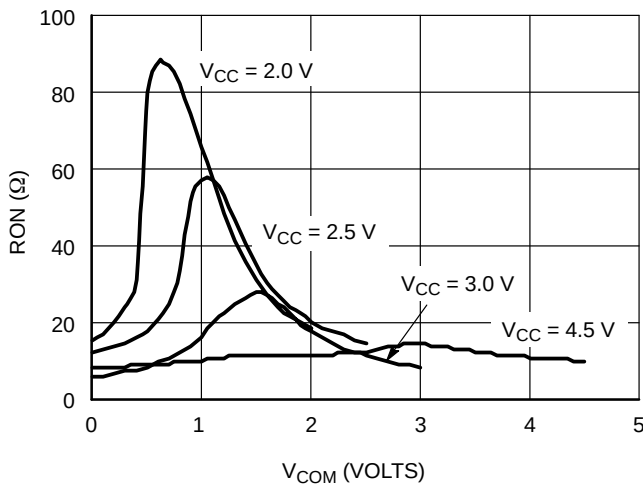


Figure 17.  $R_{ON}$  versus  $V_{COM}$  and  $V_{CC}$  (@  $25^{\circ}\text{C}$ )

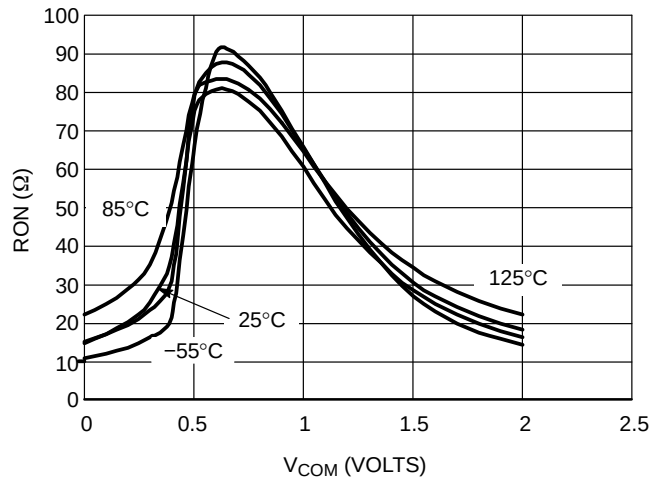


Figure 18.  $R_{ON}$  versus  $V_{COM}$  and Temperature,  $V_{CC} 2.0\text{ V}$

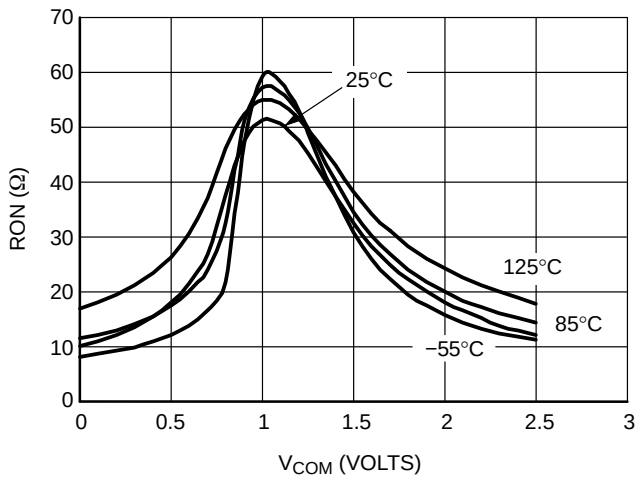


Figure 19.  $R_{ON}$  versus  $V_{COM}$  and Temperature,  $V_{CC} = 2.5\text{ V}$

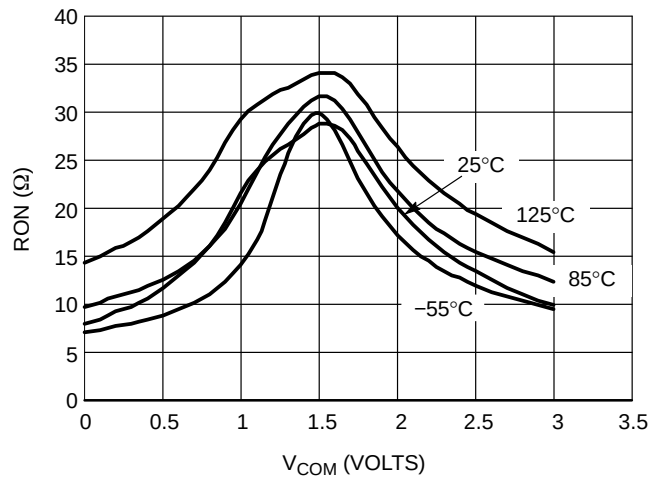


Figure 20.  $R_{ON}$  versus  $V_{COM}$  and Temperature,  $V_{CC} = 3.0\text{ V}$



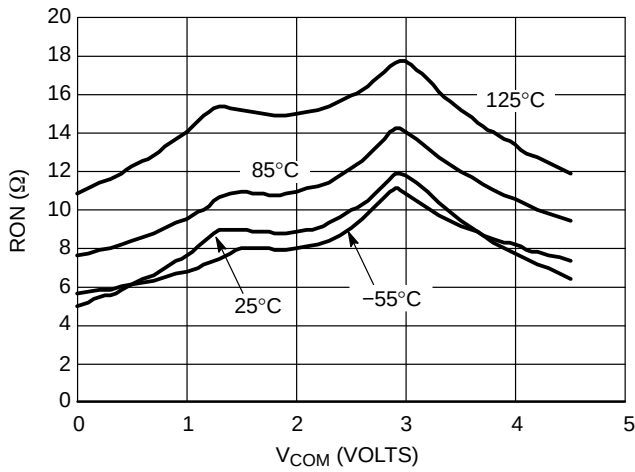


Figure 21.  $R_{ON}$  versus  $V_{COM}$  and Temperature,  $V_{CC} = 4.5\text{ V}$

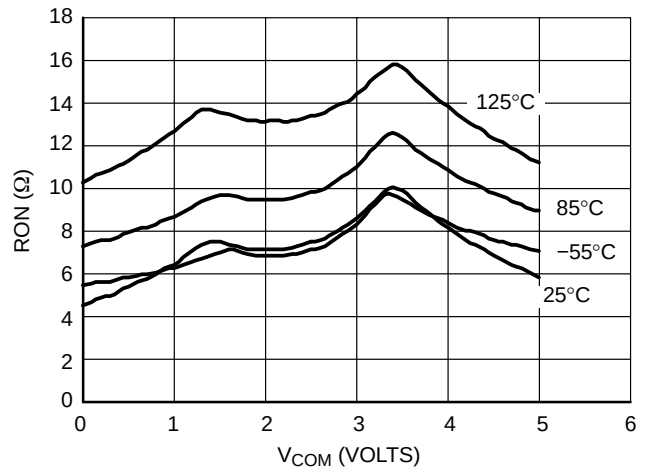


Figure 22.  $R_{ON}$  versus  $V_{COM}$  and Temperature,  $V_{CC} = 5.0\text{ V}$

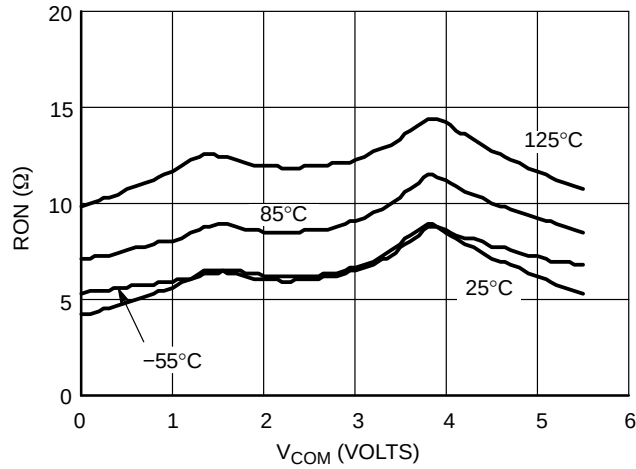


Figure 23.  $R_{ON}$  versus  $V_{COM}$  and Temperature,  $V_{CC} = 5.5\text{ V}$

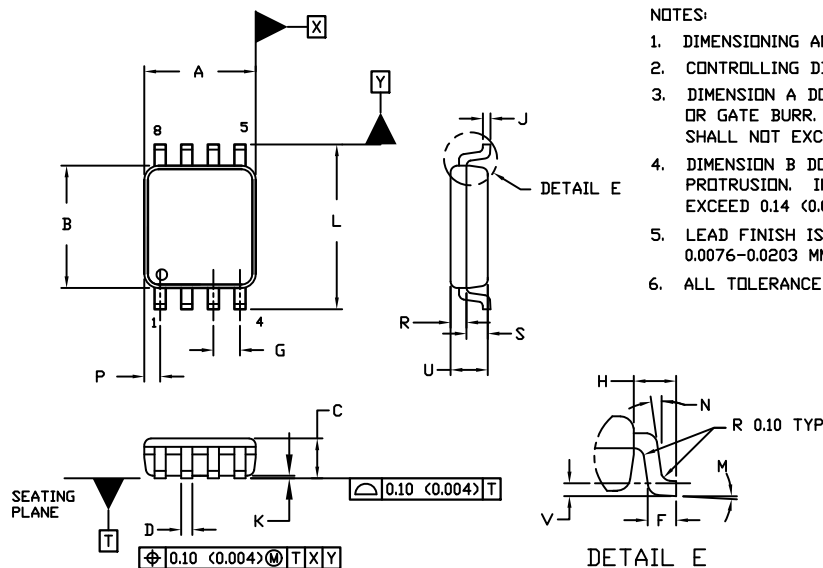
# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



SCALE 4:1

**US8**  
CASE 493  
ISSUE F

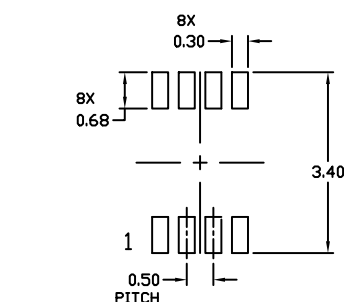
DATE 01 SEP 2021



## NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSION, OR GATE BURR. MOLD FLASH, PROTRUSION, OR GATE BURR SHALL NOT EXCEED 0.14 (0.0055") PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH AND PROTRUSION SHALL NOT EXCEED 0.14 (0.0055") PER SIDE.
5. LEAD FINISH IS SOLDER PLATING WITH THICKNESS OF 0.0076-0.0203 MM (0.003-0.008").
6. ALL TOLERANCE UNLESS OTHERWISE SPECIFIED ±0.0508 MM (0.002").

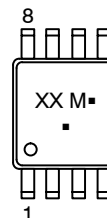
| DIM | MILLIMETERS |      | INCHES    |       |
|-----|-------------|------|-----------|-------|
|     | MIN.        | MAX. | MIN.      | MAX.  |
| A   | 1.90        | 2.10 | 0.075     | 0.083 |
| B   | 2.20        | 2.40 | 0.087     | 0.094 |
| C   | 0.60        | 0.90 | 0.024     | 0.035 |
| D   | 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        | 3.25 | 0.118     | 0.128 |
| M   | 0°          | 6°   | 0°        | 6°    |
| N   | 0°          | 10°  | 0°        | 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 |       |



## RECOMMENDED \* MOUNTING FOOTPRINT

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

## GENERIC MARKING DIAGRAM\*



XX = Specific Device Code  
M = Date Code  
■ = Pb-Free Package

(Note: Microdot may be in either location)

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "■", may or may not be present. Some products may not follow the Generic Marking.

|                  |             |                                                                                                                                                                                  |
|------------------|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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