

## Quad-SPDT, Clickless Audio Switches with Negative Signal Handling

### General Description

The MAX4910/MAX4911/MAX4912 quad, single-pole/double-throw (SPDT), clickless audio switches feature negative signal capability that allows signals as low as  $V_{CC}-5.5V$  to pass through without distortion. These analog switches have a low on-resistance, low supply current, and operate from a single +1.8V to +5.5V supply.

The MAX4910/MAX4911/MAX4912 have internal shunt resistors that automatically discharge the capacitance at the normally open (NO) and normally closed (NC) terminals when they are not connected. The MAX4910/MAX4911 have shunt resistors on all NO and NC terminals and the MAX4912 has shunt resistors on all NO, NC1, and NC3 terminals. These shunt resistors reduce click-and-pop sounds that occur when switching audio signals between precharged points. A break-before-make feature further reduces popping.

The MAX4910/MAX4912 control the switches in pairs with two control bits CB1 and CB2. The MAX4911 has one control bit to switch all four switches and an enable pin  $\overline{\text{EN}}$  to put the switches in a high-impedance mode. The MAX4912 has two terminals without shunt resistors for switching applications that do not require pre-discharge switching.

The MAX4910/MAX4911/MAX4912 are available in a tiny 16-pin TQFN-EP (3mm x 3mm) package and operate over the -40°C to +85°C extended temperature range.

## Applications

## Cell Phones

## PDAs and Handheld Devices

## Notebook Computers

## MP3 Players

## Features

- ◆ Distortion-Free Negative Signal Throughput Down to  $V_{CC} - 5.5V$
- ◆ Internal Shunt Resistors Reduce Click-and-Pop Sounds
- ◆ High PSRR Reduces Supply Noise
- ◆ Low On-Resistance ( $0.37\Omega$ )
- ◆  $0.1\Omega$  Channel-to-Channel Matching
- ◆  $0.35\Omega$  On-Resistance Flatness
- ◆ +1.8V to +5.5V Single-Supply Voltage
- ◆ -80dB Crosstalk (20kHz)
- ◆ -90dB Off-Isolation (20kHz)
- ◆ 0.05% Total Harmonic Distortion
- ◆ Enable Control (MAX4911)
- ◆ 10nA Leakage Current
- ◆ 150nA Supply Current

## ***Ordering Information***

| PART         | TEMP RANGE     | PIN-PACKAGE  | TOP MARK | PKG CODE |
|--------------|----------------|--------------|----------|----------|
| MAX4910ETE+  | -40°C to +85°C | 16 TQFN-EP** | ADY      | T1633-4  |
| MAX4911ETE+* | -40°C to +85°C | 16 TQFN-EP** | ADZ      | T1633-4  |
| MAX4912ETE+* | -40°C to +85°C | 16 TQFN-EP** | AEA      | T1633-4  |

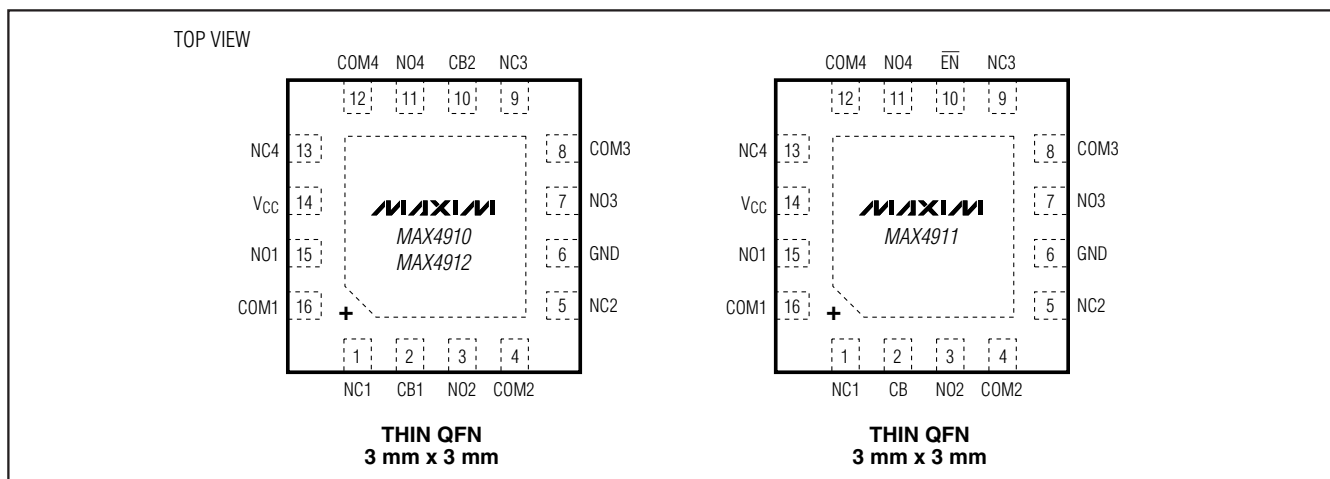
+ Denotes lead-free package.

\*Future product—contact factory for availability.

\*\*EP = Exposed pad.

**Typical Operating Circuit appears at end of data sheet.**

## Pin Configurations



# Quad-SPDT, Clickless Audio Switches with Negative Signal Handling

## ABSOLUTE MAXIMUM RATINGS

(All voltages referenced to GND.)

|                                                                                       |                                          |
|---------------------------------------------------------------------------------------|------------------------------------------|
| $V_{CC}$ , $CB_{-}$ , $\overline{EN}$ .....                                           | -0.3V to +6.0V                           |
| $COM_{-}$ , $NC_{-}$ , $NO_{-}$ .....                                                 | ( $V_{CC} - 6V$ ) to ( $V_{CC} + 0.3V$ ) |
| Continuous Current $NO_{-}$ , $NC_{-}$ , $COM_{-}$ .....                              | $\pm 300mA$                              |
| Peak Current $NO_{-}$ , $NC_{-}$ , $COM_{-}$ (pulsed at 1ms,<br>50% duty cycle) ..... | $\pm 400mA$                              |
| Peak Current $NO_{-}$ , $NC_{-}$ , $COM_{-}$ (pulsed at 1ms,<br>10% duty cycle) ..... | $\pm 500mA$                              |

Continuous Power Dissipation ( $T_A = +70^{\circ}C$ )

|                                                                                             |                                   |
|---------------------------------------------------------------------------------------------|-----------------------------------|
| 16-Pin TQFN, Single-Layer Board<br>(derate 15.6mW/ $^{\circ}C$ above $+70^{\circ}C$ ) ..... | 1250mW                            |
| 16-Pin TQFN, Multilayer Board<br>(derate 20.8mW/ $^{\circ}C$ above $+70^{\circ}C$ ) .....   | 1667mW                            |
| Operating Temperature Range .....                                                           | $-40^{\circ}C$ to $+85^{\circ}C$  |
| Junction Temperature .....                                                                  | $+150^{\circ}C$                   |
| Storage Temperature Range .....                                                             | $-65^{\circ}C$ to $+150^{\circ}C$ |
| Lead Temperature (soldering, 10s) .....                                                     | $+300^{\circ}C$                   |

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## ELECTRICAL CHARACTERISTICS

( $V_{CC} = +2.7V$  to  $+5.5V$ ,  $T_A = -40^{\circ}C$  to  $+85^{\circ}C$ ,  $\overline{EN} = \text{low}$  (MAX4911 only), unless otherwise noted. Typical values are at  $V_{CC} = +3.0V$ ,  $T_A = +25^{\circ}C$ .) (Note 1)

| PARAMETER                                               | SYMBOL                                                        | CONDITIONS                                                                                                                                                                                   |  | MIN                                                   | TYP | MAX             | UNITS |      |   |
|---------------------------------------------------------|---------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-------------------------------------------------------|-----|-----------------|-------|------|---|
| POWER SUPPLY                                            |                                                               |                                                                                                                                                                                              |  |                                                       |     |                 |       |      |   |
| Supply Voltage                                          | V <sub>CC</sub>                                               |                                                                                                                                                                                              |  | 1.8                                                   |     | 5.5             | V     |      |   |
| Supply Current                                          | I <sub>CC</sub>                                               | V <sub>CC</sub> = +5.5V, V <sub>CB_</sub> = V <sub>EN</sub> = 0V or V <sub>CC</sub>                                                                                                          |  | 0.15                                                  |     | 2               | μA    |      |   |
|                                                         |                                                               | V <sub>CC</sub> = +2.7V, V <sub>CB_</sub> = V <sub>EN</sub> = +0.5V or +1.4V                                                                                                                 |  | 4                                                     |     |                 |       |      |   |
|                                                         |                                                               | V <sub>CC</sub> = +5.5V, V <sub>CB_</sub> = V <sub>EN</sub> = +0.5V or +1.4V                                                                                                                 |  | 8                                                     |     |                 |       |      |   |
| ANALOG SWITCH                                           |                                                               |                                                                                                                                                                                              |  |                                                       |     |                 |       |      |   |
| Analog Signal Range                                     | V <sub>NC_</sub> ,<br>V <sub>NO_</sub> ,<br>V <sub>COM_</sub> | (Note 2)                                                                                                                                                                                     |  | V <sub>CC</sub> - 5.5V                                |     | V <sub>CC</sub> | V     |      |   |
| On-Resistance<br>(Note 3)                               | R <sub>ON</sub>                                               | Channels 1 and 3, V <sub>CC</sub> = +3.3V, V <sub>NC_</sub> or V <sub>NO_</sub> = V <sub>CC</sub> - 5.5V, -1V, 0V, +1V, +2V, V <sub>CC</sub> , I <sub>COM1</sub> = I <sub>COM3</sub> = 100mA |  | T <sub>A</sub> = +25°C                                |     | 0.37            | 0.75  | Ω    |   |
|                                                         |                                                               |                                                                                                                                                                                              |  | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |     | 0.8             |       |      |   |
|                                                         |                                                               | Channels 2 and 4, V <sub>CC</sub> = +3.3V, V <sub>NC_</sub> or V <sub>NO_</sub> = V <sub>CC</sub> - 5.5V, -1V, 0V, +1V, +2V, V <sub>CC</sub> , I <sub>COM2</sub> = I <sub>COM4</sub> = 100mA |  | T <sub>A</sub> = +25°C                                |     | 0.72            |       | 1.45 | Ω |
|                                                         |                                                               |                                                                                                                                                                                              |  | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |     |                 |       | 1.6  |   |
| On-Resistance Match<br>Between Channels<br>(Notes 3, 4) | ΔR <sub>ON</sub>                                              | Channels 1 and 3, V <sub>CC</sub> = +3.3V, V <sub>NC_</sub> or V <sub>NO_</sub> = 0, I <sub>COM_</sub> = 100mA                                                                               |  |                                                       |     | 0.1             |       | Ω    |   |
|                                                         |                                                               | Channels 2 and 4, V <sub>CC</sub> = +3.3V, V <sub>NC_</sub> or V <sub>NO_</sub> = 0, I <sub>COM_</sub> = 100mA                                                                               |  |                                                       |     | 0.1             |       |      |   |
| On-Resistance Flatness<br>(Note 5)                      | R <sub>FLAT</sub>                                             | Channels 1 and 3, V <sub>CC</sub> = +3.3V, V <sub>NC_</sub> = V <sub>NO_</sub> = V <sub>CC</sub> - 5.5V, -1V, 0V, +1V, +2V, V <sub>CC</sub> , I <sub>COM_</sub> = 100mA                      |  |                                                       |     | 0.35            |       | Ω    |   |
|                                                         |                                                               | Channels 2 and 4, V <sub>CC</sub> = +3.3V, V <sub>NC_</sub> = V <sub>NO_</sub> = V <sub>CC</sub> - 5.5V, -1V, 0V, +1V, +2V, V <sub>CC</sub> , I <sub>COM_</sub> = 100mA                      |  |                                                       |     | 0.6             |       |      |   |
| Shunt Switch Resistance                                 | R <sub>SH</sub>                                               |                                                                                                                                                                                              |  | 2                                                     | 3.8 | 6               | kΩ    |      |   |

# Quad-SPDT, Clickless Audio Switches with Negative Signal Handling

## ELECTRICAL CHARACTERISTICS (continued)

( $V_{CC} = +2.7V$  to  $+5.5V$ ,  $T_A = -40^{\circ}C$  to  $+85^{\circ}C$ ,  $\overline{EN} = \text{low}$  (MAX4911 only), unless otherwise noted. Typical values are at  $V_{CC} = +3.0V$ ,  $T_A = +25^{\circ}C$ .) (Note 1)

| PARAMETER                    | SYMBOL                            | CONDITIONS                                                                                                                                                   |                                                       | MIN  | TYP   | MAX  | UNITS |
|------------------------------|-----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|------|-------|------|-------|
| NC_ Off-Leakage Current      | I <sub>NC_(OFF)</sub>             | MAX4912 (NC2 and NC4) only: V <sub>CC</sub> = +2.7V, switch open, V <sub>NC_</sub> = -2.5V or +2.5V, V <sub>COM_</sub> = +2.5V or -2.5V                      | T <sub>A</sub> = +25°C                                | -10  |       | +10  | nA    |
|                              |                                   |                                                                                                                                                              | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | -50  |       | +50  |       |
| COM_ On-Leakage Current      | I <sub>COM_(ON)</sub>             | V <sub>CC</sub> = +2.7V, switch closed; V <sub>NC_</sub> or V <sub>NO_</sub> = -2.5V, +2.5V, or floating; V <sub>COM_</sub> = -2.5V, +2.5V, or floating      | T <sub>A</sub> = +25°C                                | -10  |       | +10  | nA    |
|                              |                                   |                                                                                                                                                              | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | -100 |       | +100 |       |
| DYNAMIC CHARACTERISTICS      |                                   |                                                                                                                                                              |                                                       |      |       |      |       |
| Turn-On Time                 | t <sub>ON</sub>                   | V <sub>CC</sub> = +2.7V, CB_ = low to high, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, V <sub>NO_</sub> = +1.5V, Figure 2                                   |                                                       |      | 0.055 | 0.15 | μs    |
| Turn-Off Time                | t <sub>OFF</sub>                  | V <sub>CC</sub> = +2.7V, CB_ = high to low, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, V <sub>NO_</sub> = +1.5V, Figure 2                                   |                                                       |      | 0.3   | 1.0  | μs    |
| Break-Before-Make Delay Time | t <sub>D</sub>                    | V <sub>CC</sub> = +2.7V, CB_ = low to high or high to low, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, V <sub>NC_</sub> = V <sub>NO_</sub> = +1.5V, Figure 3 |                                                       | 1    | 25    |      | ns    |
| Charge Injection             | Q                                 | V <sub>GEN_</sub> = 0, R <sub>GEN</sub> = 0, C <sub>L</sub> = 1nF, Figure 4                                                                                  |                                                       |      | 300   |      | pC    |
| Power-Supply Rejection Ratio | PSRR                              | f = 20kHz, V <sub>COM_</sub> = 1V <sub>RMS</sub> , R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF                                                                |                                                       |      | 60    |      | dB    |
| Off-Isolation                | V <sub>ISO</sub>                  | f = 20kHz, V <sub>COM_</sub> = 1V <sub>RMS</sub> , R <sub>L</sub> = 50Ω, Figure 5 (Note 6)                                                                   |                                                       |      | -90   |      | dB    |
| Crosstalk                    | V <sub>CT</sub>                   | f = 20kHz, V <sub>COM_</sub> = 1V <sub>RMS</sub> , R <sub>L</sub> = 50Ω, Figure 5                                                                            |                                                       |      | -80   |      | dB    |
| Total Harmonic Distortion    | THD                               | f = 20Hz to 20kHz, V <sub>COM_</sub> = 0.5V <sub>P-P</sub> , R <sub>L</sub> = 50Ω, DC bias = 0                                                               |                                                       |      | 0.05  |      | %     |
| NO_, NC_ Off-Capacitance     | C <sub>NO_(OFF)</sub>             | f = 1MHz, V <sub>COM_</sub> = 0.5V <sub>P-P</sub> , DC bias = 0, Figure 6                                                                                    |                                                       |      | 100   |      | pF    |
| COM On-Capacitance           | C <sub>COM_(ON)</sub>             | f = 1MHz, V <sub>COM_</sub> = 0.5V <sub>P-P</sub> , DC bias = 0, Figure 6                                                                                    |                                                       |      | 200   |      | pF    |
| DIGITAL INPUTS (CB_, EN)     |                                   |                                                                                                                                                              |                                                       |      |       |      |       |
| Input Logic High             | V <sub>IH</sub>                   |                                                                                                                                                              |                                                       | 1.4  |       |      | V     |
| Input Logic Low              | V <sub>IL</sub>                   |                                                                                                                                                              |                                                       |      |       | 0.5  | V     |
| Input Leakage Current        | I <sub>CB</sub> , I <sub>EN</sub> | V <sub>CB_</sub> = V <sub>EN</sub> = 0V or V <sub>CC</sub>                                                                                                   |                                                       | -1   |       | +1   | μA    |

**Note 1:** All parameters are production tested at  $T_A = +85^{\circ}C$  and guaranteed by design over the specified temperature range.

**Note 2:** Signals on  $COM\_$ ,  $NO\_$ , or  $NC\_$  exceeding  $V_{CC}$  are clamped by internal diodes. Limit forward-diode current to maximum current rating.

**Note 3:** Guaranteed by design; not production tested.

**Note 4:**  $\Delta R_{ON} = R_{ON(MAX)} - R_{ON(MIN)}$ .

**Note 5:** Flatness is defined as the difference between the maximum and minimum value of on-resistance as measured over the specified analog signal ranges.

**Note 6:** Off-isolation =  $20\log_{10} [V_{COM\_} / V_{NO\_}]$ ,  $V_{COM\_}$  = output,  $V_{NO\_}$  = input to off switch.

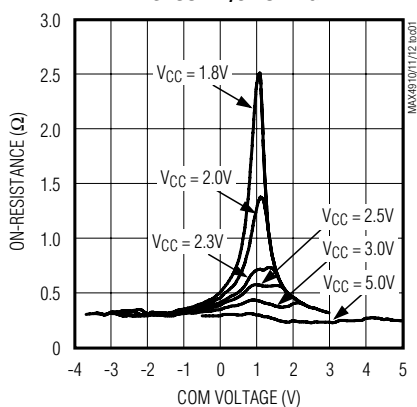
MAX4910/MAX4911/MAX4912

# Quad-SPDT, Clickless Audio Switches with Negative Signal Handling

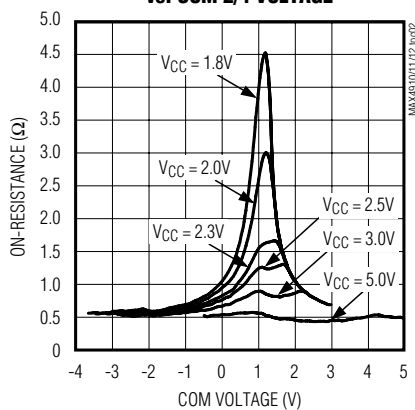
## Typical Operating Characteristics

( $V_{CC} = 3.0V$ ,  $T_A = +25^\circ C$ , unless otherwise noted.)

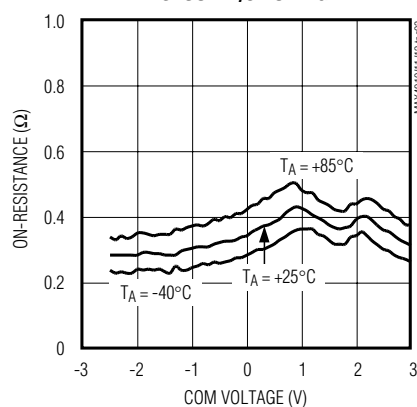
**CHANNEL 1/3 ON-RESISTANCE vs. COM 1/3 VOLTAGE**



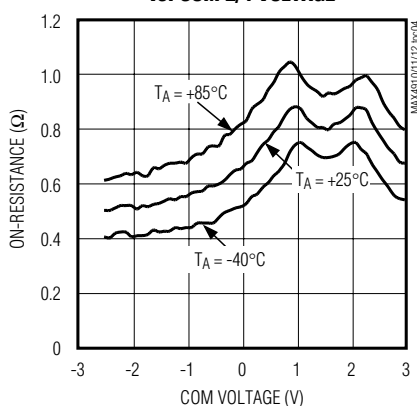
**CHANNEL 2/4 ON-RESISTANCE vs. COM 2/4 VOLTAGE**



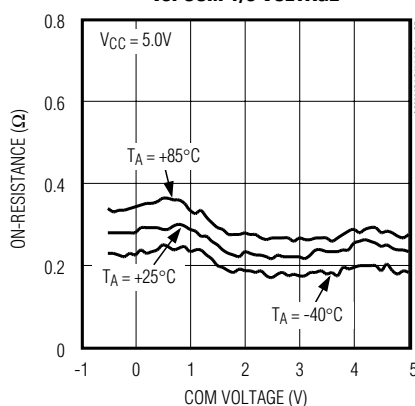
**CHANNEL 1/3 ON-RESISTANCE vs. COM 1/3 VOLTAGE**



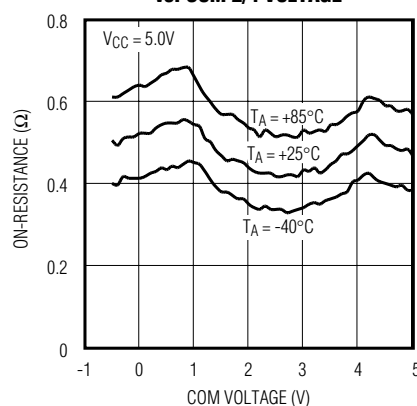
**CHANNEL 2/4 ON-RESISTANCE vs. COM 2/4 VOLTAGE**



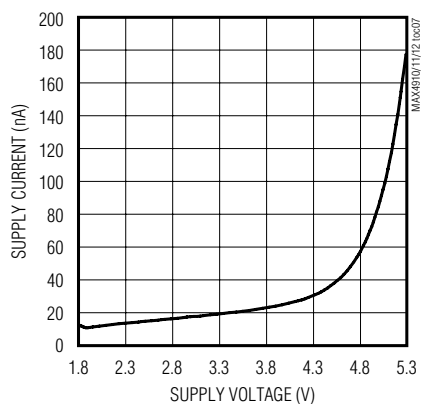
**CHANNEL 1/3 ON-RESISTANCE vs. COM 1/3 VOLTAGE**



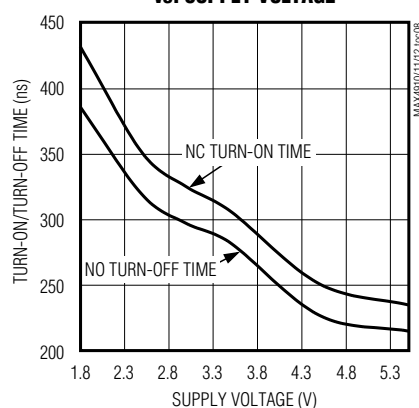
**CHANNEL 2/4 ON-RESISTANCE vs. COM 2/4 VOLTAGE**



**SUPPLY CURRENT vs. SUPPLY VOLTAGE**



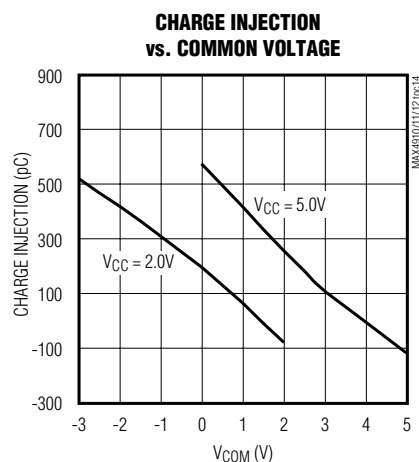
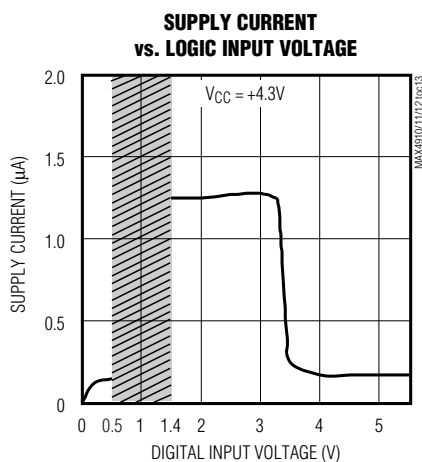
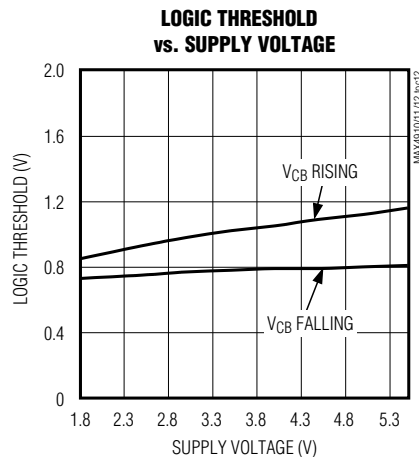
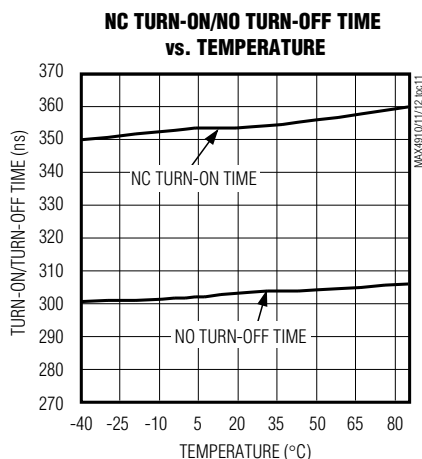
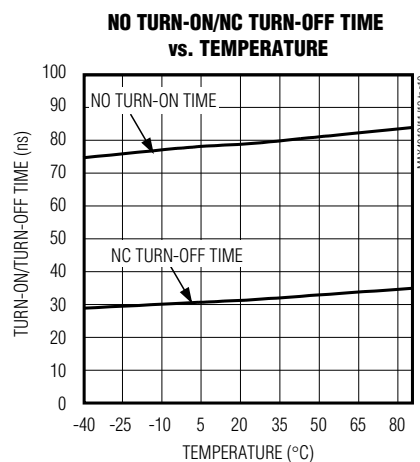
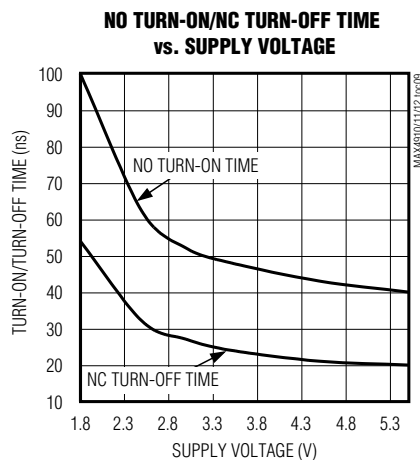
**NC TURN-ON / NO TURN-OFF TIME vs. SUPPLY VOLTAGE**



# Quad-SPDT, Clickless Audio Switches with Negative Signal Handling

## Typical Operating Characteristics (continued)

( $V_{CC} = 3.0V$ ,  $T_A = +25^{\circ}C$ , unless otherwise noted.)

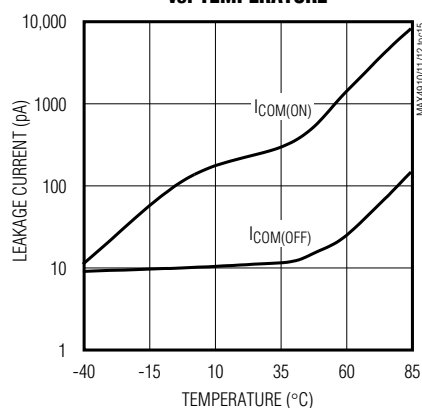


# Quad-SPDT, Clickless Audio Switches with Negative Signal Handling

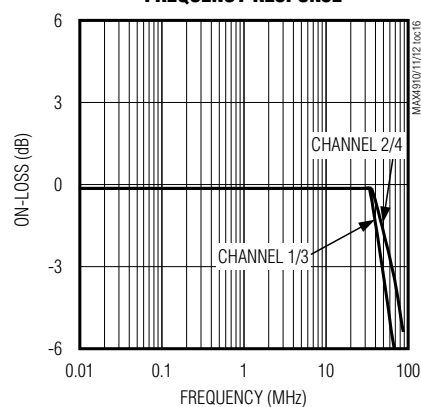
## Typical Operating Characteristics (continued)

( $V_{CC} = 3.0V$ ,  $T_A = +25^\circ C$ , unless otherwise noted.)

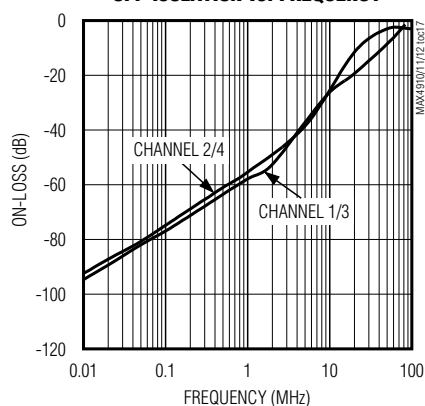
**LEAKAGE CURRENT  
vs. TEMPERATURE**



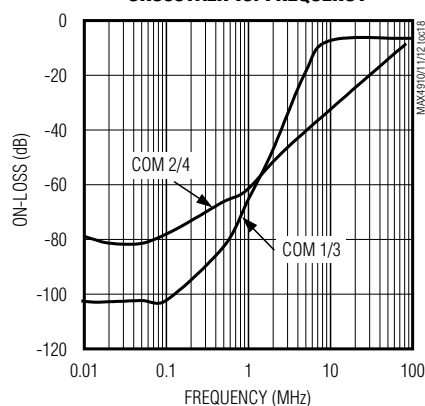
**FREQUENCY RESPONSE**



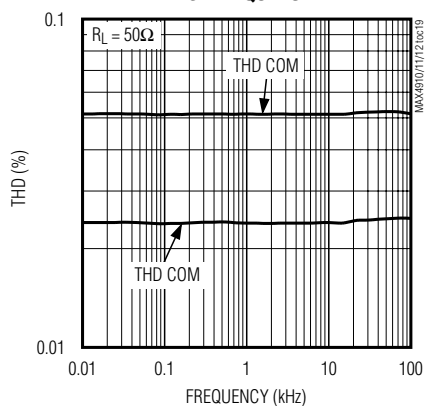
**OFF-ISOLATION vs. FREQUENCY**



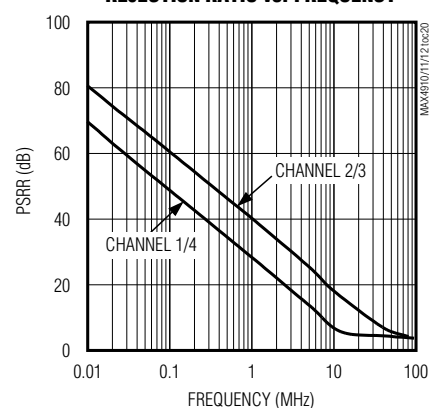
**CROSSTALK vs. FREQUENCY**



**TOTAL HARMONIC DISTORTION  
vs. FREQUENCY**



**CHANNEL 2/3 POWER SUPPLY  
REJECTION RATIO vs. FREQUENCY**



# Quad-SPDT, Clickless Audio Switches with Negative Signal Handling

## Pin Description

| PIN                 |         | NAME                   | FUNCTION                                                                                                                                          |
|---------------------|---------|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| MAX4910/<br>MAX4912 | MAX4911 |                        |                                                                                                                                                   |
| 1                   | 1       | NC1                    | Analog Switch 1—Normally Closed Terminal                                                                                                          |
| 2                   | —       | CB1                    | Digital Control Input for Analog Switch 1 and Analog Switch 3                                                                                     |
| —                   | 2       | CB                     | Digital Control Input for All Analog Switches                                                                                                     |
| 3                   | 3       | NO2                    | Analog Switch 2—Normally Open Terminal                                                                                                            |
| 4                   | 4       | COM2                   | Analog Switch 2—Common Terminal                                                                                                                   |
| 5                   | 5       | NC2                    | Analog Switch 2—Normally Closed Terminal                                                                                                          |
| 6                   | 6       | GND                    | Ground                                                                                                                                            |
| 7                   | 7       | NO3                    | Analog Switch 3—Normally Open Terminal                                                                                                            |
| 8                   | 8       | COM3                   | Analog Switch 3—Common Terminal                                                                                                                   |
| 9                   | 9       | NC3                    | Analog Switch 3—Normally Closed Terminal                                                                                                          |
| 10                  | —       | CB2                    | Digital Control Input for Analog Switch 2 and Analog Switch 4.                                                                                    |
| —                   | 10      | $\overline{\text{EN}}$ | Enable Input. Driving $\overline{\text{EN}}$ high causes all switches to be high impedance. Pull $\overline{\text{EN}}$ low for normal operation. |
| 11                  | 11      | NO4                    | Analog Switch 4—Normally Open Terminal                                                                                                            |
| 12                  | 12      | COM4                   | Analog Switch 4—Common Terminal                                                                                                                   |
| 13                  | 13      | NC4                    | Analog Switch 4—Normally Closed Terminal                                                                                                          |
| 14                  | 14      | V <sub>CC</sub>        | Positive Supply Voltage Input                                                                                                                     |
| 15                  | 15      | NO1                    | Analog Switch 1—Normally Open Terminal                                                                                                            |
| 16                  | 16      | COM1                   | Analog Switch 1—Common Terminal                                                                                                                   |
| —                   | —       | EP                     | Exposed Pad. Connect to Ground                                                                                                                    |

MAX4910/MAX4911/MAX4912

## Detailed Description

The MAX4910/MAX4911/MAX4912 quad SPDT audio switches are low on-resistance, low supply current, high power-supply rejection ratio (PSRR) devices that operate from a +1.8V to +5.5V single supply. These devices feature a negative signal capability that allows signals below GND to pass through without distortion and break-before-make switching.

The MAX4910/MAX4912 have two digital control inputs CB1 and CB2 where each bit controls a pair of switches (see Table 1). The MAX4911 has an active-low enable  $\overline{\text{EN}}$  and a digital control bit CB. Driving  $\overline{\text{EN}}$  low takes the switches out of high impedance and CB controls all four switches (see Table 2). The MAX4910/MAX4911 have shunt resistors on all their NO and NC terminals to suppress click-and-pop sounds that may occur from switching to a precharged terminal. The MAX4912 does not have click-and-pop suppression resistors on NC2 and NC4 for applications that do not require predischarge switching.

Table 1. MAX4910/MAX4912 Truth Tables

| CB1 | NC1 | NO1 | NC3 | NO3 |
|-----|-----|-----|-----|-----|
| 0   | On  | Off | On  | Off |
| 1   | Off | On  | Off | On  |
|     |     |     |     |     |
| CB2 | NC2 | NO2 | NC4 | NO4 |
| 0   | On  | Off | On  | Off |
| 1   | Off | On  | Off | On  |

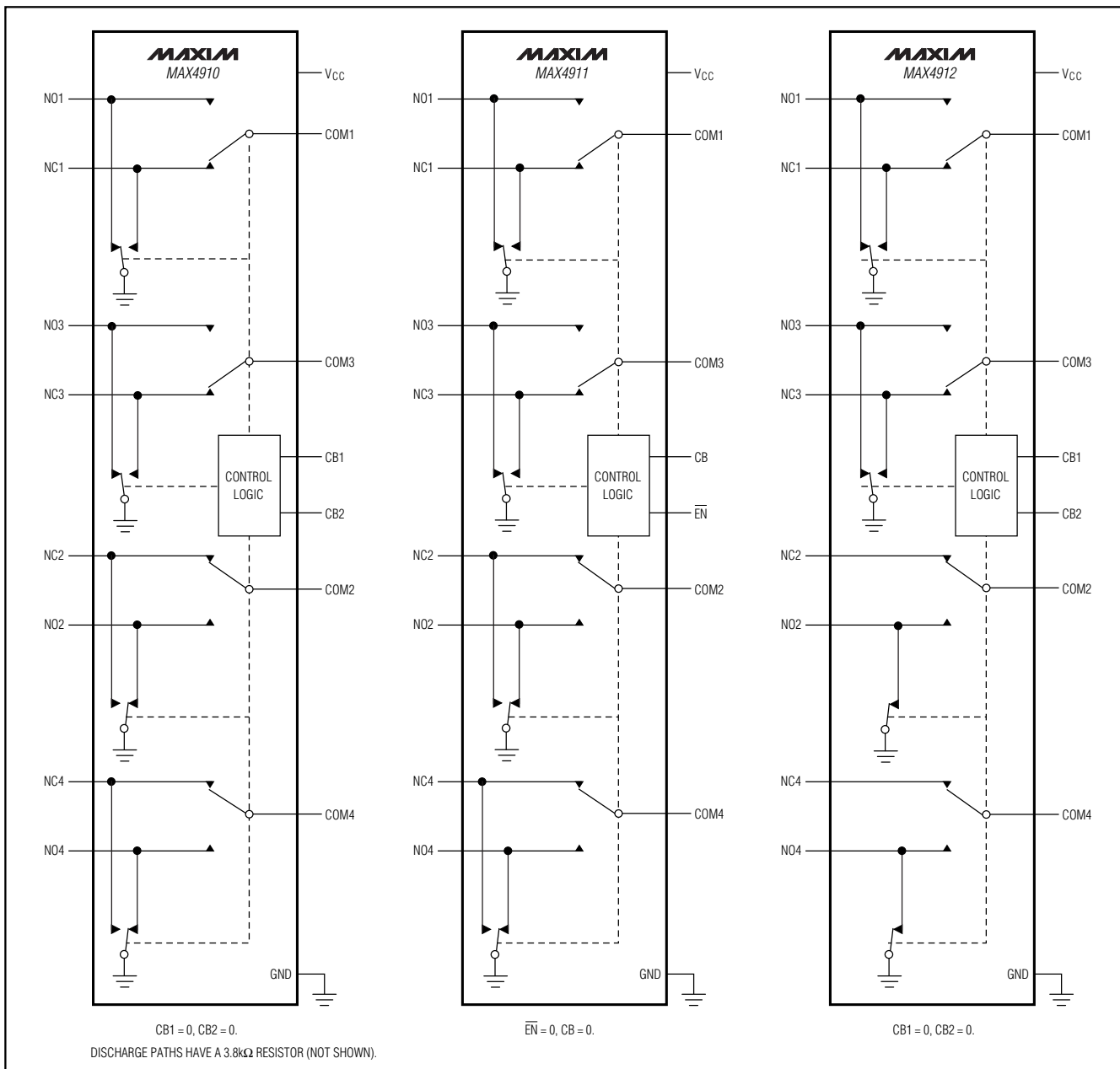
Table 2. MAX4911 Truth Table

| $\overline{\text{EN}}$ | CB | NC <sub>—</sub> | NO <sub>—</sub> |
|------------------------|----|-----------------|-----------------|
| 1                      | X  | Off             | Off             |
| 0                      | 1  | Off             | On              |
| 0                      | 0  | On              | Off             |

X = Don't care.

# Quad-SPDT, Clickless Audio Switches with Negative Signal Handling

## Functional Diagrams



## Applications Information

### Digital Control Inputs

The MAX4910/MAX4911/MAX4912 logic inputs accept up to +5.5V, regardless of supply voltage. For example, with a +3.3V supply, CB1, CB2, CB, and  $\overline{EN}$  can be driven

low to GND and high to +5.5V, allowing for mixed logic levels in a system. Driving CB, CB1, CB2, and  $\overline{EN}$  rail-to-rail minimizes power consumption. For a +3.3V supply voltage, the logic thresholds are +0.5V (low) and +1.4V (high).

# Quad-SPDT, Clickless Audio Switches with Negative Signal Handling

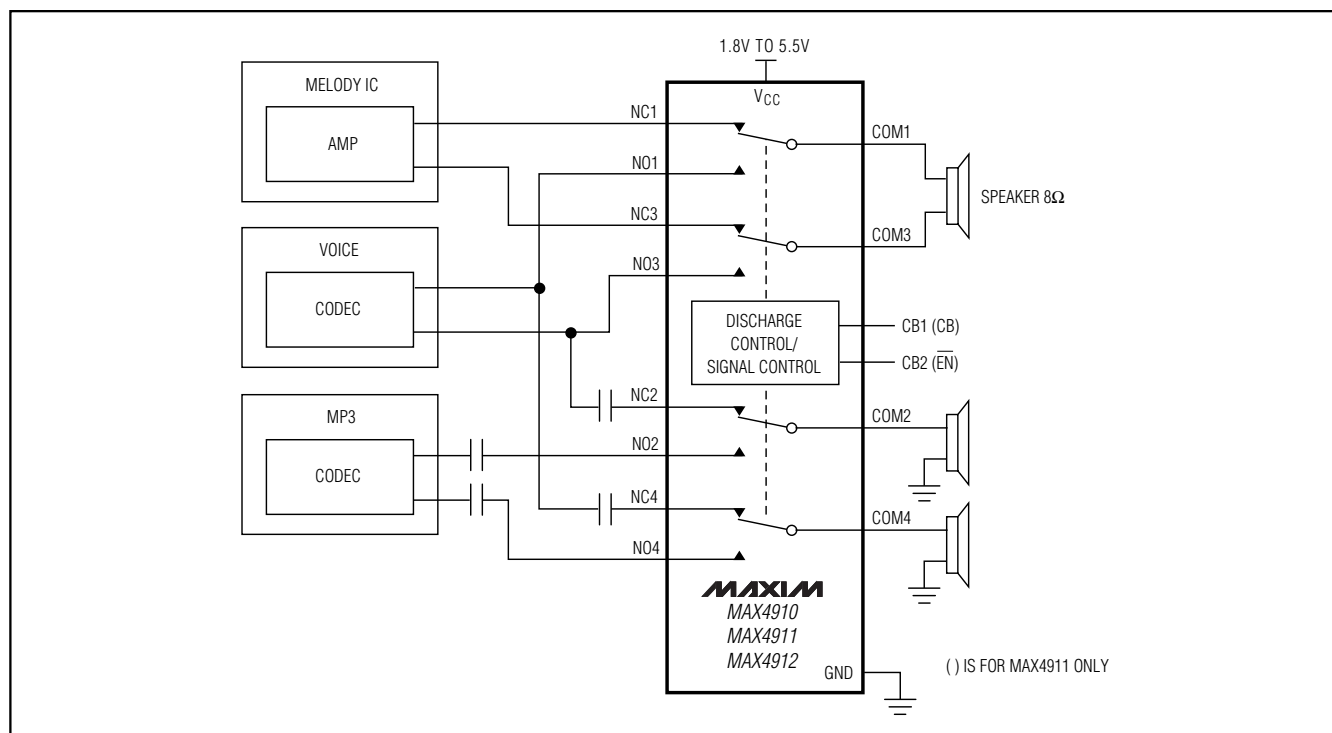


Figure 1. Typical Application Circuit

## Analog Signal Levels

The MAX4910/MAX4911/MAX4912 on-resistance is channel dependant. Channels 1 and 3 have an on-resistance of  $0.37\Omega$  (typ), and channels 2 and 4 have an on-resistance of  $0.72\Omega$  (typ). The on-resistance flatness is guaranteed over temperature and shows minimal variation over the entire voltage supply range (see the *Typical Operating Characteristics*). The on-resistance flatness and low-leakage features make it ideal for bidirectional operation. The switches are bidirectional, so the NO\_, NC\_, and COM\_ pins can be either inputs or outputs.

These devices pass signals as low as  $V_{CC} - 5.5V$ , including signals below ground with minimal distortion.

## Click-and-Pop Suppression

The MAX4910/MAX4911 have a  $3.8k\Omega$  (typ) shunt resistor on all their NO and NC terminals to automatically discharge any capacitance when they are not connected to COM. The MAX4912 has shunt resistors on all NO, NC1, and NC3 terminals. The shunt resistors reduce audible click-and-pop sounds that occur when switching between audio sources.

Audible clicks and pops are caused when a step DC voltage is switched into the speaker. The DC step tran-

sients can be reduced by automatically discharging the side that is not connected to the COM terminal, reducing any residual DC voltage and reducing clicks and pops.

## Break-Before-Make Switching

The MAX4910/MAX4911/MAX4912 feature break-before-make switching, which is configured to break (open) the first set of contacts before engaging (closing) the new contacts. This prevents the momentary connection of the old and new signal paths to the output, reducing click-and-pop sounds.

## Power-Supply Sequencing and Overvoltage Protection

**Caution:** Do not exceed the Absolute Maximum Ratings since stresses beyond the listed ratings may cause permanent damage to the device.

Proper power-supply sequencing is recommended for all CMOS devices. Improper supply sequencing can force the switch into latchup causing it to draw excessive supply current. The only way out of latchup is to recycle the power and properly reapply it. Connect all ground pins first, then apply power to  $V_{CC}$ , and finally apply signals to NO\_, NC\_, and COM\_. Follow the reverse order upon power-down.

# Quad-SPDT, Clickless Audio Switches with Negative Signal Handling

## Test Circuits/Timing Diagrams

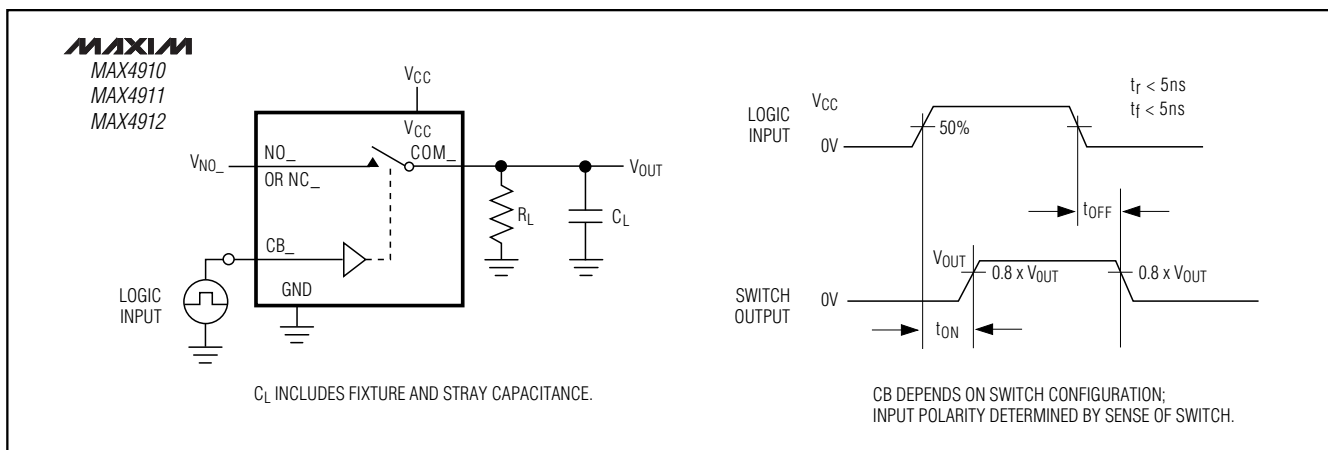


Figure 2. Switching Time

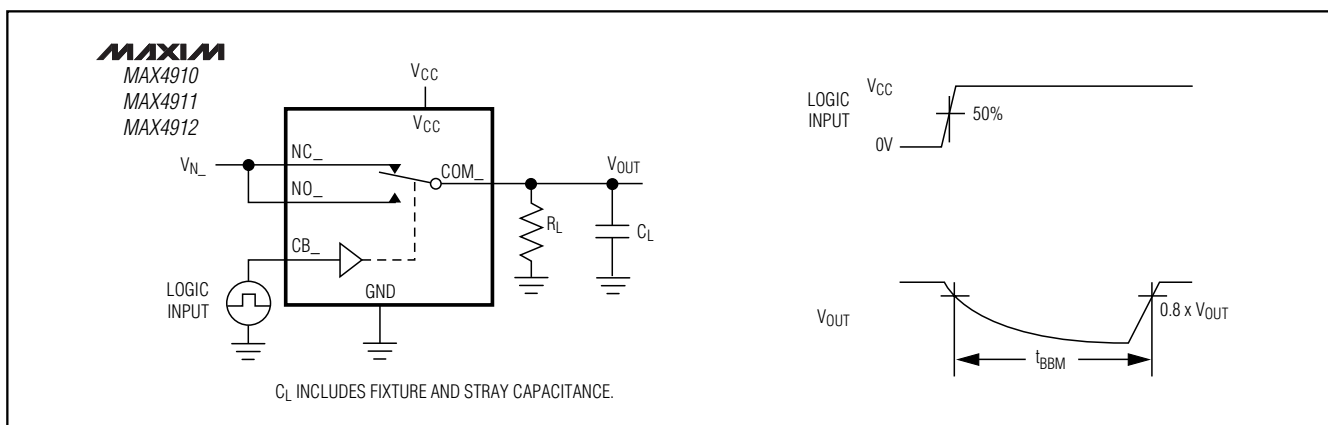


Figure 3. Break-Before-Make Interval

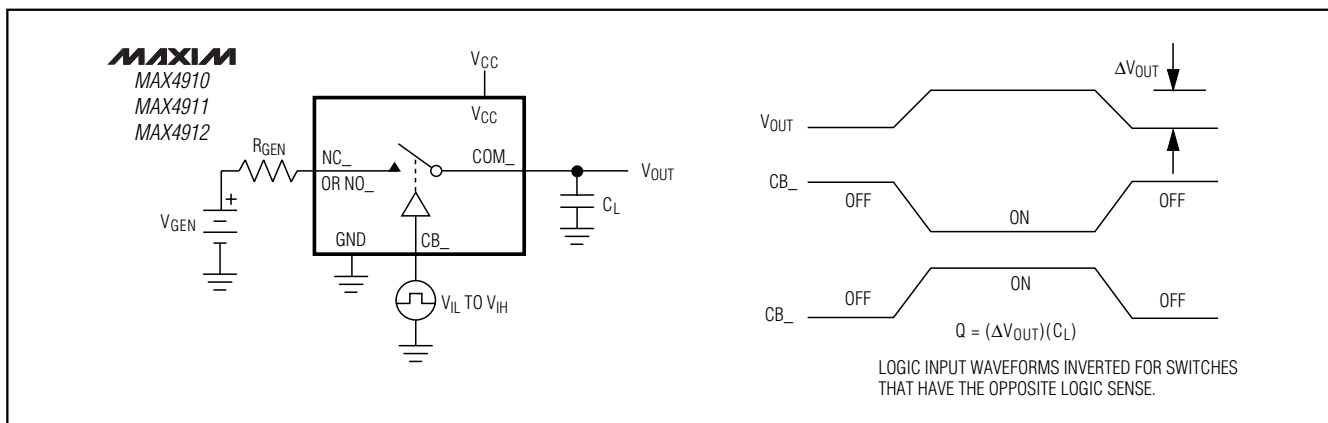


Figure 4. Charge Injection

# Quad-SPDT, Clickless Audio Switches with Negative Signal Handling

## Test Circuits/Timing Diagrams (continued)

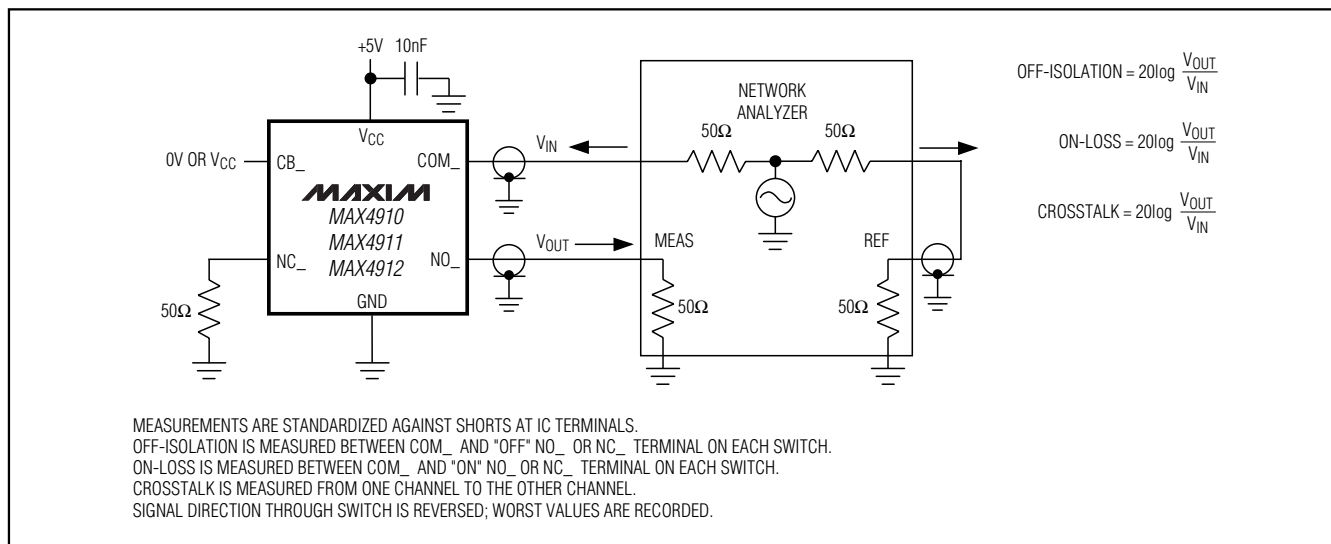


Figure 5. On-Loss, Off-Isolation, and Crosstalk

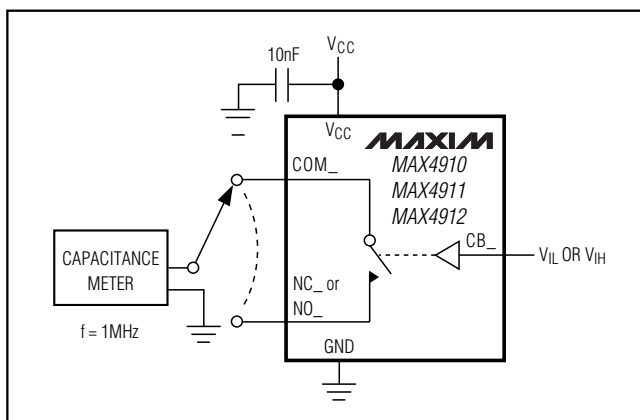
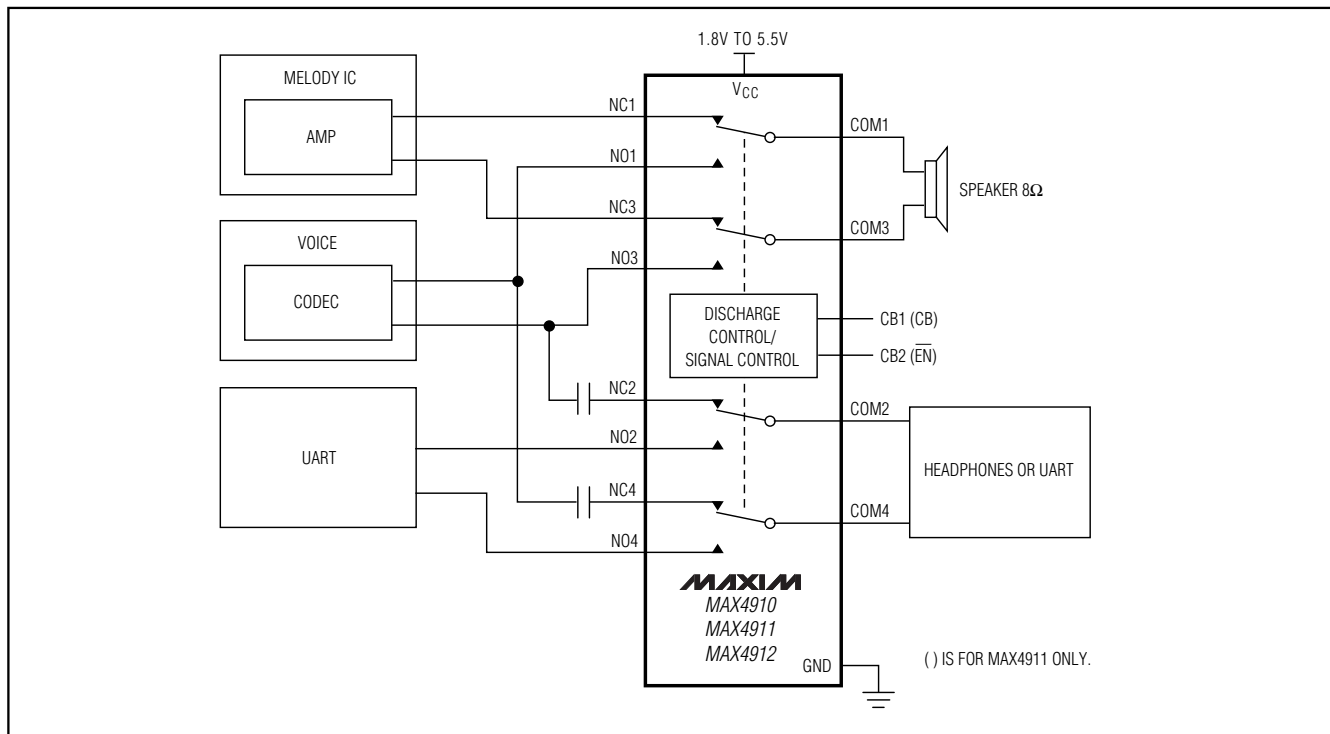


Figure 6. Channel Off-/On-Capacitance

# Quad-SPDT, Clickless Audio Switches with Negative Signal Handling

## Typical Operating Circuit



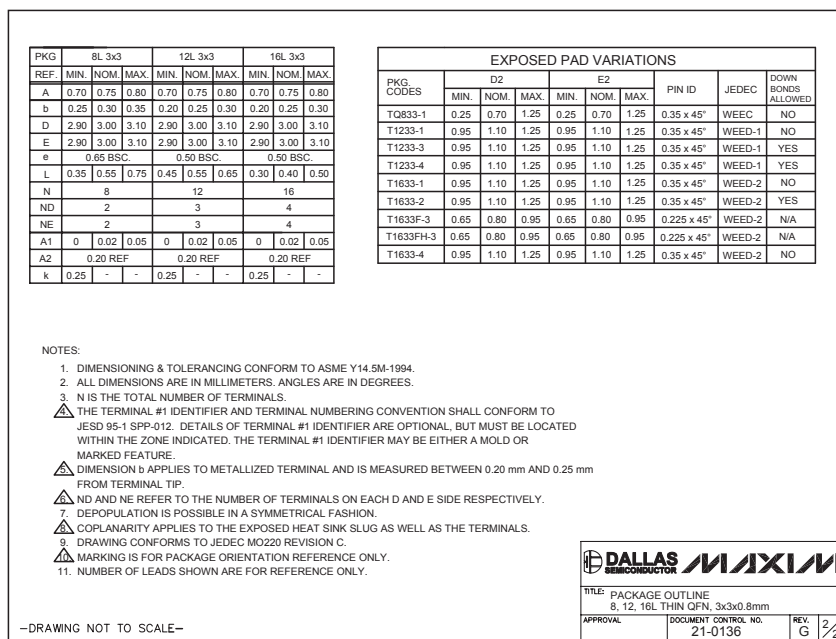
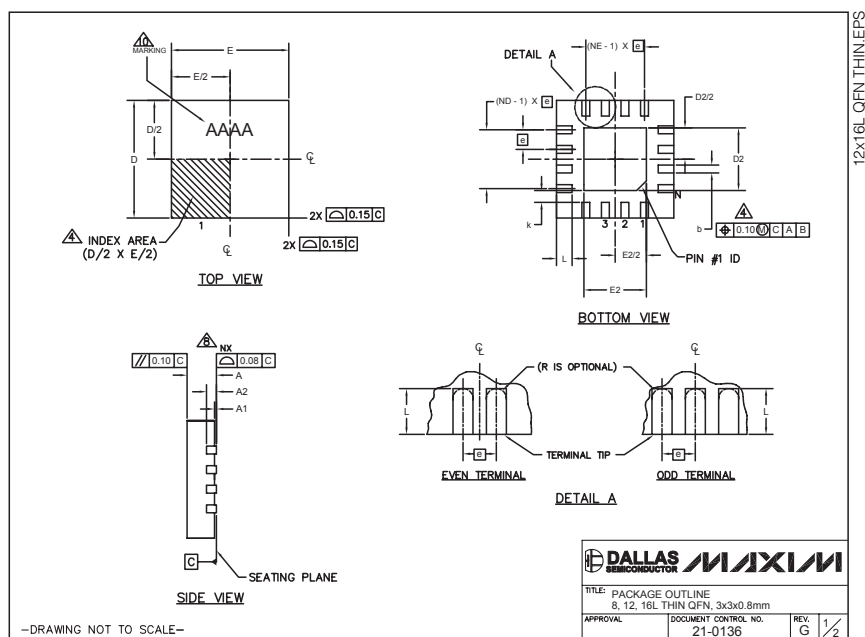
## Chip Information

PROCESS: BiCMOS

# Quad-SPDT, Clickless Audio Switches with Negative Signal Handling

## Package Information

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to [www.maxim-ic.com/packages](http://www.maxim-ic.com/packages).)



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