



# Serially Controlled, 4-Channel Audio/Video Multiplexers

MAX4586/MAX4587

## General Description

The MAX4586/MAX4587 serial-interface, programmable, 4-to-1 channel multiplexers are ideal for multimedia applications. They feature 65Ω on-resistance, 4Ω on-resistance matching between channels, and 5Ω on-resistance flatness. Additionally, they feature -83dB off-isolation at 20kHz and -48dB off-isolation at 10MHz, with -84dB crosstalk at 20kHz and -60dB crosstalk at 10MHz.

The MAX4586 uses a 2-wire, I<sup>2</sup>C™-compatible serial interface; the MAX4587 uses a 3-wire, SPI™/QSPI™/MICROWIRE™-compatible interface. Both devices are available in 10-pin μMAX packages and are specified for the extended -40°C to +85°C temperature range.

## Features

- ◆ +2.7V to +5.5V Single-Supply Operation
- ◆ 4-to-1 Channel Multiplexer
- ◆ 65Ω (max) R<sub>ON</sub> with +5V Supply
- ◆ Audio Performance
  - 83dB Off-Isolation at 20kHz
  - 84dB Crosstalk at 20kHz
- ◆ Video Performance
  - 48dB Off-Isolation at 10MHz
  - 60dB Crosstalk at 10MHz
- ◆ Serial Interface
  - 2-Wire, I<sup>2</sup>C Compatible (MAX4586)
  - 3-Wire, SPI/QSPI/MICROWIRE Compatible (MAX4587)

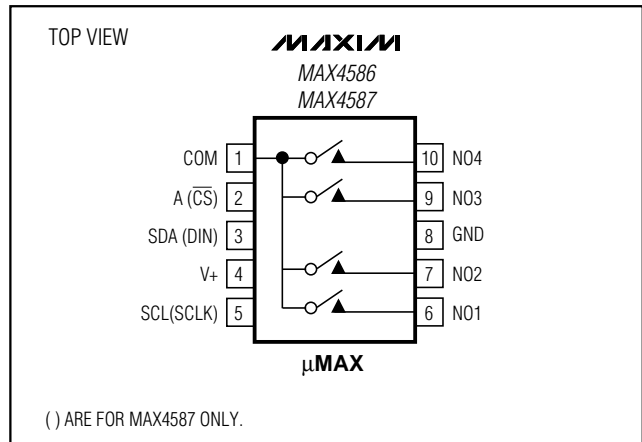
## Applications

- Cellular Phones and Accessories
- Private Mobile Radios (PMRs)
- PC Multimedia Audio/Video Routing
- Industrial Equipment
- Set-Top Boxes
- Video Conferencing
- High-End Audio Equipment

## Ordering Information

| PART       | TEMP. RANGE    | PIN-PACKAGE |
|------------|----------------|-------------|
| MAX4586EUB | -40°C to +85°C | 10 μMAX     |
| MAX4587EUB | -40°C to +85°C | 10 μMAX     |

## Pin Configuration/ Functional Diagram



I<sup>2</sup>C is a trademark of Philips Corp.  
SPI/QSPI are trademarks of Motorola, Inc.  
MICROWIRE is a trademark of National Semiconductor Corp.



# Serially Controlled, 4-Channel Audio/Video Multiplexers

## ABSOLUTE MAXIMUM RATINGS

|                                                           |                      |                                                       |
|-----------------------------------------------------------|----------------------|-------------------------------------------------------|
| V+ to GND .....                                           | -0.3V to +6V         | Continuous Power Dissipation (T <sub>A</sub> = +70°C) |
| COM and NO <sub>-</sub> to GND (Note 1) .....             | -0.3V to (V+ + 0.3V) | 10-Pin μMAX (derate 4.1mW/°C above +70°C) .....       |
| A, $\overline{CS}$ , SDA, DIN, SCL, and SCLK to GND ..... | -0.3V to +6V         | 330mW                                                 |
| Continuous Current into Any Terminal .....                | ±20mA                | Operating Temperature Range .....                     |
| Peak Current into Any Terminal                            |                      | -40°C to +85°C                                        |
| (pulsed at 1ms, 10% duty cycle) .....                     | ±40mA                | Storage Temperature Range .....                       |
| ESD per Method 3015.7 .....                               | >2kV                 | -65°C to +150°C                                       |
|                                                           |                      | Lead Temperature (soldering, 10sec) .....             |
|                                                           |                      | +300°C                                                |

**Note 1:** Signals on NO<sub>-</sub> or COM exceeding V+ or ground are clamped by internal diodes. Limit forward-diode current to maximum current rating.

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—Single +5V Supply

(V+ = +5V ±5%, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.) (Note 2)

| PARAMETER                                           | SYMBOL                                 | CONDITIONS                                                                                         | MIN                                                   | TYP | MAX   | UNITS |    |
|-----------------------------------------------------|----------------------------------------|----------------------------------------------------------------------------------------------------|-------------------------------------------------------|-----|-------|-------|----|
| <b>ANALOG SWITCHES</b>                              |                                        |                                                                                                    |                                                       |     |       |       |    |
| Analog Signal Range (Note 3)                        | V <sub>NO-</sub> ,<br>V <sub>COM</sub> |                                                                                                    | 0                                                     |     | V+    | V     |    |
| On-Resistance                                       | R <sub>ON</sub>                        | V+ = 4.75V,<br>V <sub>NO-</sub> = 3V,<br>I <sub>COM</sub> = 4mA                                    | T <sub>A</sub> = +25°C                                | 45  | 65    | Ω     |    |
|                                                     |                                        |                                                                                                    | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |     | 80    |       |    |
| On-Resistance Match<br>Between Channels<br>(Note 4) | ΔR <sub>ON</sub>                       | V+ = 4.75V,<br>V <sub>NO-</sub> = 3V,<br>I <sub>COM</sub> = 4mA                                    | T <sub>A</sub> = +25°C                                | 2   | 4     | Ω     |    |
|                                                     |                                        |                                                                                                    | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |     | 5     |       |    |
| On-Resistance Flatness<br>(Note 5)                  | R <sub>FLAT</sub>                      | V+ = 4.75V;<br>V <sub>NO-</sub> = 1V, 2V, 3V;<br>I <sub>COM</sub> = 4mA                            | T <sub>A</sub> = +25°C                                | 2   | 5     | Ω     |    |
|                                                     |                                        |                                                                                                    | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |     | 6.5   |       |    |
| NO <sub>-</sub> Off-Leakage Current<br>(Note 6)     | I <sub>NO-(OFF)</sub>                  | V+ = 5.25V;<br>V <sub>NO-</sub> = 1V, 4.5V;<br>V <sub>COM</sub> = 4.5V, 1V                         | T <sub>A</sub> = +25°C                                | -1  | 0.001 | 1     | nA |
|                                                     |                                        |                                                                                                    | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | -10 |       | 10    |    |
| COM Off-Leakage Current<br>(Note 6)                 | I <sub>COM(OFF)</sub>                  | V+ = 5.25V;<br>V <sub>NO-</sub> = 1V, 4.5V;<br>V <sub>COM</sub> = 4.5V, 1V                         | T <sub>A</sub> = +25°C                                | -1  | 0.001 | 1     | nA |
|                                                     |                                        |                                                                                                    | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | -10 |       | 10    |    |
| COM On-Leakage Current<br>(Note 6)                  | I <sub>COM(ON)</sub>                   | V+ = 5.25V; V <sub>NO-</sub> =<br>1V, 4.5V, or floating;<br>V <sub>COM</sub> = 1V, 4.5V            | T <sub>A</sub> = +25°C                                | -1  | 0.002 | 1     | nA |
|                                                     |                                        |                                                                                                    | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | -10 |       | 10    |    |
| <b>AUDIO PERFORMANCE</b>                            |                                        |                                                                                                    |                                                       |     |       |       |    |
| Off-Isolation (Note 7)                              | V <sub>ISO(A)</sub>                    | V <sub>A</sub> = 1.0V <sub>RMS</sub> , f <sub>IN</sub> = 20kHz, R <sub>L</sub> = 600Ω,<br>Figure 8 |                                                       | -83 |       | dB    |    |
| Channel-to-Channel Crosstalk                        | V <sub>CT(A)</sub>                     | V <sub>A</sub> = 1.0V <sub>RMS</sub> , f <sub>IN</sub> = 20kHz, R <sub>S</sub> = 600Ω,<br>Figure 8 |                                                       | -84 |       | dB    |    |

# Serially Controlled, 4-Channel Audio/Video Multiplexers

MAX4586/MAX4587

## ELECTRICAL CHARACTERISTICS—Single +5V Supply (continued)

(V+ = +5V ±5%, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.) (Note 2)

| PARAMETER                                        | SYMBOL              | CONDITIONS                                                                                     | MIN                                                   | TYP | MAX | UNITS |
|--------------------------------------------------|---------------------|------------------------------------------------------------------------------------------------|-------------------------------------------------------|-----|-----|-------|
| <b>VIDEO PERFORMANCE</b>                         |                     |                                                                                                |                                                       |     |     |       |
| Off-Isolation (Note 7)                           | V <sub>ISO(V)</sub> | V <sub>A</sub> = 1.0V <sub>RMS</sub> , f <sub>IN</sub> = 10MHz, R <sub>L</sub> = 50Ω, Figure 8 |                                                       | -48 |     | dB    |
| Channel-to-Channel Crosstalk                     | V <sub>CT(V)</sub>  | V <sub>A</sub> = 1.0V <sub>RMS</sub> , f <sub>IN</sub> = 10MHz, R <sub>S</sub> = 50Ω, Figure 8 |                                                       | -60 |     | dB    |
| -0.1dB Bandwidth                                 | BW                  | R <sub>S</sub> = 75Ω, R <sub>L</sub> = 1kΩ                                                     |                                                       | 5   |     | MHz   |
| -3dB Bandwidth                                   | BW                  | R <sub>S</sub> = 50Ω, R <sub>L</sub> = 50Ω                                                     |                                                       | 300 |     | MHz   |
| NO_ Off-Capacitance                              | C <sub>OFF</sub>    | f <sub>IN</sub> = 1MHz                                                                         |                                                       | 5   |     | pF    |
| <b>DYNAMIC TIMING</b> (Notes 8, 9, and Figure 5) |                     |                                                                                                |                                                       |     |     |       |
| Turn-On Time                                     | t <sub>ON</sub>     | V <sub>NO_</sub> = 2.5V, R <sub>L</sub> = 5kΩ, C <sub>L</sub> = 35pF                           | T <sub>A</sub> = +25°C                                | 275 | 400 | ns    |
|                                                  |                     |                                                                                                | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |     | 500 |       |
| Turn-Off Time                                    | t <sub>OFF</sub>    | V <sub>NO_</sub> = 2.5V, R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF                          | T <sub>A</sub> = +25°C                                | 125 | 200 | ns    |
|                                                  |                     |                                                                                                | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |     | 250 |       |
| Break-Before-Make Time                           | t <sub>BBM</sub>    | V <sub>NO_</sub> = 2.5V, Figure 6                                                              | 10                                                    | 50  |     | ns    |
| Charge Injection                                 | Q                   | C <sub>L</sub> = 1.0nF, V <sub>S</sub> = 0, R <sub>S</sub> = 0, Figure 7                       |                                                       | 3   |     | pC    |
| <b>POWER SUPPLY</b>                              |                     |                                                                                                |                                                       |     |     |       |
| Power-Supply Voltage Range                       | V+                  |                                                                                                | 2.7                                                   |     | 5.5 | V     |
| Supply Current                                   | I+                  | All logic inputs = 0 or V+                                                                     |                                                       | 5   | 10  | μA    |

# Serially Controlled, 4-Channel Audio/Video Multiplexers

## ELECTRICAL CHARACTERISTICS—Single +3V Supply

(V+ = +3V ±10%, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.)

| PARAMETER                                        | SYMBOL                                 | CONDITIONS                                                                                      |                                                       | MIN | TYP   | MAX  | UNITS |
|--------------------------------------------------|----------------------------------------|-------------------------------------------------------------------------------------------------|-------------------------------------------------------|-----|-------|------|-------|
| <b>ANALOG SWITCHES</b>                           |                                        |                                                                                                 |                                                       |     |       |      |       |
| Analog Signal Range (Note 3)                     | V <sub>NO_</sub> ,<br>V <sub>COM</sub> |                                                                                                 |                                                       | 0   |       | V+   | V     |
| On-Resistance                                    | R <sub>ON</sub>                        | V+ = 2.7V,<br>V <sub>NO_</sub> = 1V,<br>I <sub>COM</sub> = 4mA                                  | T <sub>A</sub> = +25°C                                | 65  | 110   |      | Ω     |
|                                                  |                                        |                                                                                                 | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |     |       | 130  |       |
| On-Resistance Match Between Channels (Note 4)    | ΔR <sub>ON</sub>                       | V+ = 2.7V,<br>V <sub>NO_</sub> = 1V,<br>I <sub>COM</sub> = 4mA                                  | T <sub>A</sub> = +25°C                                | 3   | 5     |      | Ω     |
|                                                  |                                        |                                                                                                 | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |     |       | 6    |       |
| On-Resistance Flatness (Note 5)                  | R <sub>FLAT</sub>                      | V+ = 2.7V;<br>V <sub>NO_</sub> = 1V, 1.5V, 2V;<br>I <sub>COM</sub> = 4mA                        | T <sub>A</sub> = +25°C                                | 3   | 10    |      | Ω     |
|                                                  |                                        |                                                                                                 | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |     |       | 12   |       |
| NO_ Off-Leakage Current (Notes 6, 10)            | I <sub>NO_(OFF)</sub>                  | V+ = 3.6V;<br>V <sub>NO_</sub> = 0.5V, 3V;<br>V <sub>COM</sub> = 3V, 0.5V                       | T <sub>A</sub> = +25°C                                | -1  | 0.001 | 1    | nA    |
|                                                  |                                        |                                                                                                 | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | -10 |       | 10   |       |
| COM Off-Leakage Current (Notes 6, 10)            | I <sub>COM(OFF)</sub>                  | V+ = 3.6V;<br>V <sub>NO_</sub> = 0.5V, 3V;<br>V <sub>COM</sub> = 3V, 0.5V                       | T <sub>A</sub> = +25°C                                | -1  | 0.001 | 1    | nA    |
|                                                  |                                        |                                                                                                 | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | -10 |       | 10   |       |
| COM On-Leakage Current (Notes 6, 10)             | I <sub>COM(ON)</sub>                   | V+ = 3.6V; V <sub>NO_</sub> = 0.5V, 3V, or floating;<br>V <sub>COM</sub> = 0.5V, 3V             | T <sub>A</sub> = +25°C                                | -1  | 0.002 | 1    | nA    |
|                                                  |                                        |                                                                                                 | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | -10 |       | 10   |       |
| <b>AUDIO PERFORMANCE</b>                         |                                        |                                                                                                 |                                                       |     |       |      |       |
| Off-Isolation (Note 7)                           | V <sub>ISO(A)</sub>                    | V <sub>A</sub> = 0.5V <sub>RMS</sub> , f <sub>IN</sub> = 20kHz, R <sub>L</sub> = 600Ω, Figure 8 |                                                       |     | -83   |      | dB    |
| Channel-to-Channel Crosstalk                     | V <sub>CT(A)</sub>                     | V <sub>A</sub> = 0.5V <sub>RMS</sub> , f <sub>IN</sub> = 20kHz, R <sub>S</sub> = 600Ω, Figure 8 |                                                       |     | -84   |      | dB    |
| <b>VIDEO PERFORMANCE</b>                         |                                        |                                                                                                 |                                                       |     |       |      |       |
| Off-Isolation (Note 7)                           | V <sub>ISO(V)</sub>                    | V <sub>A</sub> = 0.5V <sub>RMS</sub> , f <sub>IN</sub> = 10MHz, R <sub>L</sub> = 50Ω, Figure 8  |                                                       |     | -48   |      | dB    |
| Channel-to-Channel Crosstalk                     | V <sub>CT(V)</sub>                     | V <sub>A</sub> = 0.5V <sub>RMS</sub> , f <sub>IN</sub> = 10MHz, R <sub>S</sub> = 50Ω, Figure 8  |                                                       |     | -60   |      | dB    |
| -3dB Bandwidth                                   | BW                                     | R <sub>S</sub> = 50Ω, R <sub>L</sub> = 50Ω                                                      |                                                       |     | 200   |      | MHz   |
| NO_ Off-Capacitance                              | C <sub>OFF</sub>                       | f <sub>IN</sub> = 1MHz                                                                          |                                                       |     | 5     |      | pF    |
| <b>DYNAMIC TIMING</b> (Notes 8, 9, and Figure 5) |                                        |                                                                                                 |                                                       |     |       |      |       |
| Turn-On Time                                     | t <sub>ON</sub>                        | V <sub>NO_</sub> = 1.5V,<br>R <sub>L</sub> = 5kΩ, C <sub>L</sub> = 35pF                         | T <sub>A</sub> = +25°C                                | 400 | 800   |      | ns    |
|                                                  |                                        |                                                                                                 | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |     |       | 1000 |       |
| Turn-Off Time                                    | t <sub>OFF</sub>                       | V <sub>NO_</sub> = 1.5V,<br>R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF                        | T <sub>A</sub> = +25°C                                | 200 | 350   |      | ns    |
|                                                  |                                        |                                                                                                 | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |     |       | 500  |       |
| Break-Before-Make Time                           | t <sub>BBM</sub>                       | V <sub>NO_</sub> = 1.5V, Figure 6                                                               |                                                       | 10  | 100   |      | ns    |

# Serially Controlled, 4-Channel Audio/Video Multiplexers

MAX4586/MAX4587

## I/O INTERFACE CHARACTERISTICS

(V+ = +2.7V to +5.25V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.)

| PARAMETER                                                                         | SYMBOL            | CONDITIONS               | MIN | TYP  | MAX | UNITS |
|-----------------------------------------------------------------------------------|-------------------|--------------------------|-----|------|-----|-------|
| <b>DIGITAL INPUTS (SCLK, DIN, <math>\overline{\text{CS}}</math>, SCL, SDA, A)</b> |                   |                          |     |      |     |       |
| Input Low Voltage                                                                 | V <sub>IL</sub>   | V+ = 5V                  |     |      | 0.8 | V     |
|                                                                                   |                   | V+ = 3V                  |     |      | 0.6 |       |
| Input High Voltage                                                                | V <sub>IH</sub>   | V+ = 5V                  | 3   |      |     | V     |
|                                                                                   |                   | V+ = 3V                  | 2   |      |     |       |
| Input Hysteresis                                                                  | V <sub>HYST</sub> |                          |     | 0.2  |     | V     |
| Input Leakage Current                                                             | I <sub>LEAK</sub> | Digital inputs = 0 or V+ | -1  | 0.01 | 1   | μA    |
| Input Capacitance                                                                 | C <sub>IN</sub>   | f = 1MHz                 |     | 5    |     | pF    |
| <b>DIGITAL OUTPUT (SDA)</b>                                                       |                   |                          |     |      |     |       |
| Output Low Voltage                                                                | V <sub>OL</sub>   | I <sub>SINK</sub> = 6mA  |     |      | 0.4 | V     |

## 2-WIRE TIMING CHARACTERISTICS

(Figures 1 and 2, V+ = +2.7V to +5.25V, f<sub>SCL</sub> = 100kHz, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.)

| PARAMETER                                      | SYMBOL              | CONDITIONS                                      | MIN                       | TYP | MAX | UNITS |
|------------------------------------------------|---------------------|-------------------------------------------------|---------------------------|-----|-----|-------|
| SCL Clock Frequency                            | f <sub>SCL</sub>    | V+ = 2.7V to 5.25V                              | 0                         |     | 100 | kHz   |
|                                                |                     | V+ = 4.75V to 5.25V                             |                           |     | 400 |       |
| Bus Free Time Between Stop and Start Condition | t <sub>BUF</sub>    |                                                 | 4.7                       |     |     | μs    |
| Hold Time After Start Condition                | t <sub>HD:STA</sub> | The first clock is generated after this period. | 4.0                       |     |     | μs    |
| Stop Condition Setup Time                      | t <sub>SU:STO</sub> |                                                 | 4.0                       |     |     | μs    |
| Data Hold Time                                 | t <sub>HD:DAT</sub> |                                                 | 0                         |     |     | μs    |
| Data Setup Time                                | t <sub>SU:DAT</sub> |                                                 | 250                       |     |     | ns    |
| Clock Low Period                               | t <sub>LOW</sub>    |                                                 | 4.7                       |     |     | μs    |
| Clock High Period                              | t <sub>HIGH</sub>   |                                                 | 4.0                       |     |     | μs    |
| SCL/SDA Rise Time (Note 11)                    | t <sub>R</sub>      |                                                 | 20 +<br>0.1C <sub>B</sub> |     | 300 | ns    |
| SCL/SDA Fall Time (Note 11)                    | t <sub>F</sub>      |                                                 | 20 +<br>0.1C <sub>B</sub> |     | 300 | ns    |

# Serially Controlled, 4-Channel Audio/Video Multiplexers

## 3-WIRE TIMING CHARACTERISTICS

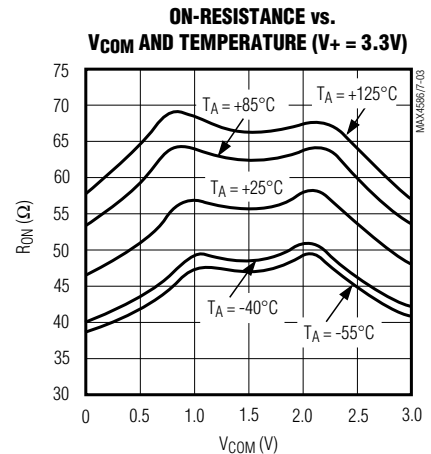
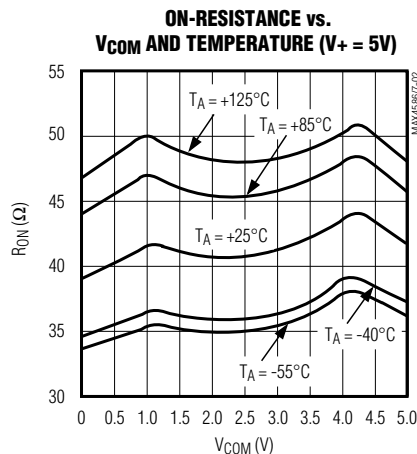
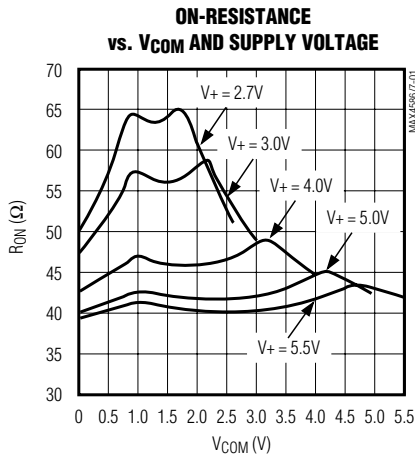
(Figures 3 and 4,  $V_+ = +2.7V$  to  $+5.25V$ ,  $f_{OP} = 2.1MHz$ ,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise noted. Typical values are at  $T_A = +25^\circ C$ .)

| PARAMETER                               | SYMBOL    | CONDITIONS               | MIN | TYP | MAX | UNITS   |
|-----------------------------------------|-----------|--------------------------|-----|-----|-----|---------|
| Operating Frequency                     | $f_{OP}$  | $V_+ = 2.7V$ to $5.25V$  | 0   | 2.1 | 2.1 | MHz     |
|                                         |           | $V_+ = 4.75V$ to $5.25V$ |     |     | 10  |         |
| DIN to SCLK Setup                       | $t_{DS}$  |                          | 100 |     |     | ns      |
| DIN to SCLK Hold                        | $t_{DH}$  |                          | 0   |     |     | ns      |
| $\overline{CS}$ Fall to SCLK Rise Setup | $t_{CSS}$ |                          | 100 |     |     | ns      |
| $\overline{CS}$ Rise to SCLK Hold       | $t_{CSH}$ |                          | 0   |     |     | ns      |
| SCLK Pulse Width Low                    | $t_{CL}$  |                          | 200 |     |     | ns      |
| SCLK Pulse Width High                   | $t_{CH}$  |                          | 200 |     |     | ns      |
| Rise Time (SCLK, DIN, $\overline{CS}$ ) | $t_R$     |                          |     |     | 2   | $\mu s$ |
| Fall Time (SCLK, DIN, $\overline{CS}$ ) | $t_F$     |                          |     |     | 2   | $\mu s$ |
| $\overline{CS}$ Pulse Width High        | $t_{CSW}$ |                          |     | 40  |     | ns      |

- Note 2:** Algebraic convention is used in this data sheet; the most negative value is shown in the minimum column.
- Note 3:** Guaranteed by design. Not subject to production testing.
- Note 4:**  $\Delta R_{ON} = R_{ON(MAX)} - R_{ON(MIN)}$ .
- Note 5:** Resistance flatness is defined as the difference between the maximum and minimum on-resistance values, as measured over the specified analog signal range.
- Note 6:** Leakage parameters are 100% tested at maximum rated temperature and guaranteed by correlation at  $T_A = +25^\circ C$ .
- Note 7:** Off-isolation =  $20 \log(V_{COM} / V_{NO-})$ ,  $V_{COM}$  = output,  $V_{NO-}$  = input to off switch.
- Note 8:** All timing is measured from the clock's falling edge preceding the ACK signal for 2-wire and from the rising edge of  $\overline{CS}$  for 3-wire. Turn-off time is defined at the output of the switch for a 0.5V change, tested with a  $300\Omega$  load to ground. Turn-on time is defined at the output of the switch for a 0.5V change and measured with a  $5k\Omega$  load resistor to GND. All timing is shown with respect to 20%  $V_+$  and 70%  $V_+$ , unless otherwise noted.
- Note 9:** Typical values are for MAX4586 devices.
- Note 10:** Leakage testing is guaranteed by testing with a  $+5.25V$  supply.
- Note 11:**  $C_B$  = capacitance of one bus line in pF. Tested with  $C_B = 400pF$ .

## Typical Operating Characteristics

( $V_+ = +5V$ ,  $T_A = +25^\circ C$ , unless otherwise noted.)

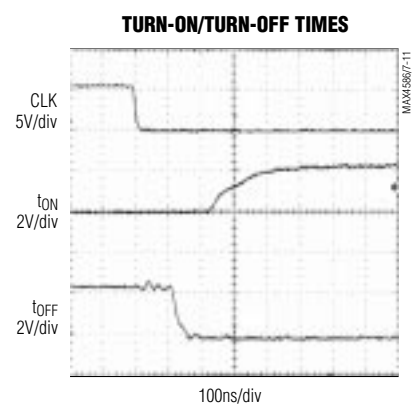
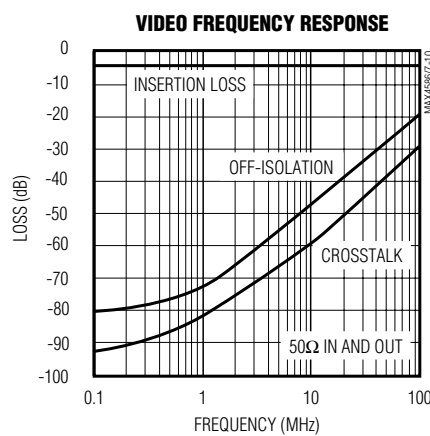
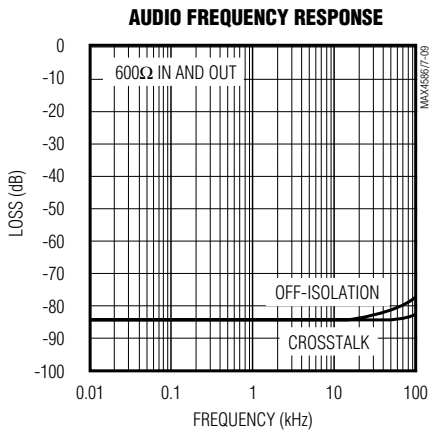
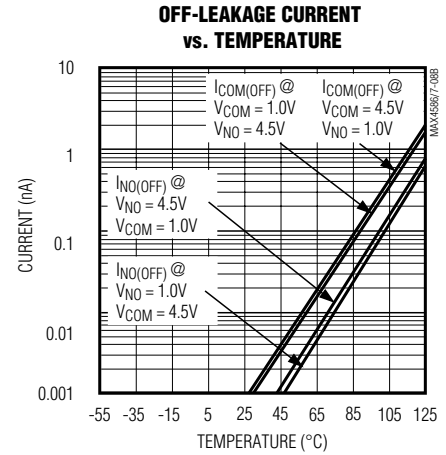
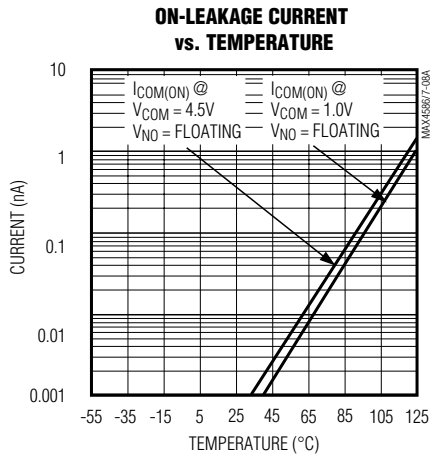
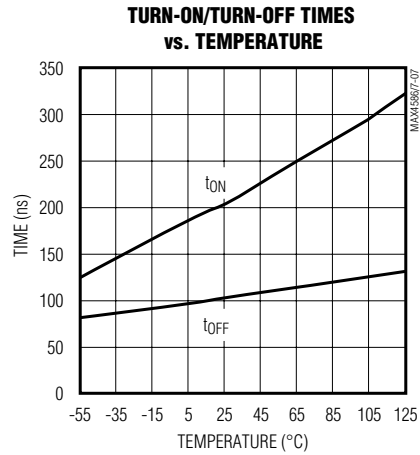
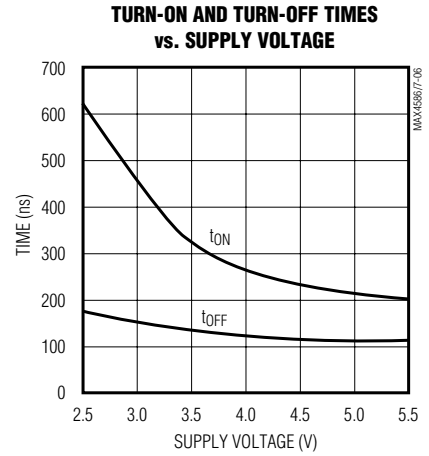
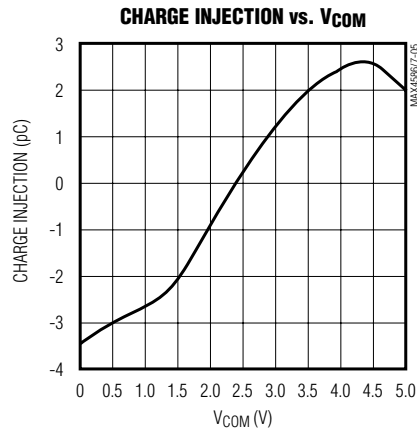
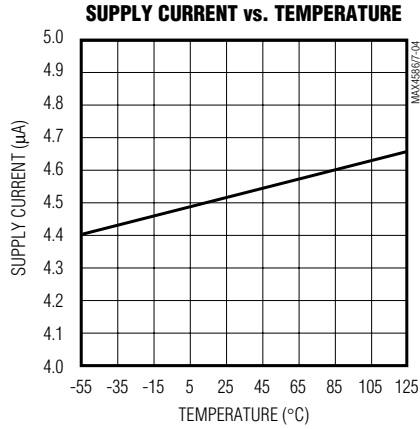


# Serially Controlled, 4-Channel Audio/Video Multiplexers

## Typical Operating Characteristics (continued)

( $V_+ = +5V$ ,  $T_A = +25^\circ C$ , unless otherwise noted.)

MAX4586/MAX4587



# Serially Controlled, 4-Channel Audio/Video Multiplexers

## Pin Description

| PIN     |         | NAME            | FUNCTION                                             |
|---------|---------|-----------------|------------------------------------------------------|
| MAX4586 | MAX4587 |                 |                                                      |
| 1       | 1       | COM             | Analog Switch Common Terminal                        |
| 2       | —       | A               | LSB + 2 of the 2-Wire Serial-Interface Address Field |
| —       | 2       | $\overline{CS}$ | Chip Select of the 3-Wire Serial Interface           |
| 3       | —       | SDA             | Data Input of 2-Wire Serial Interface                |
| —       | 3       | DIN             | Data Input of 3-Wire Serial Interface                |
| 4       | 4       | V+              | Supply Voltage                                       |
| 5       | —       | SCL             | Clock Input of the 2-Wire Serial Interface           |
| —       | 5       | SCLK            | Clock Input of the 3-Wire Serial Interface           |
| 6       | 6       | NO1             | Mux Normally Open Output 1                           |
| 7       | 7       | NO2             | Mux Normally Open Output 2                           |
| 8       | 8       | GND             | Ground                                               |
| 9       | 9       | NO3             | Mux Normally Open Output 3                           |
| 10      | 10      | NO4             | Mux Normally Open Output 4                           |

## Detailed Description

The MAX4586/MAX4587 are serial-interface, programmable multiplexers. Each device contains a 4-to-1 normally open (NO) multiplexer. Each switch is independently controlled through the on-chip serial interface. The MAX4586 uses a 2-wire, I<sup>2</sup>C-compatible serial communications protocol, and the MAX4587 uses a 3-wire, SPI/QSPI/MICROWIRE-compatible serial communications protocol.

These devices operate from a single +2.7V to +5.5V supply and are optimized for use with an audio frequency at 20kHz and video frequencies up to 10MHz. They feature 65 $\Omega$  on-resistance, 4 $\Omega$  on-resistance matching between channels, and 5 $\Omega$  on-resistance flatness. Audio off-isolation is -83dB at 20kHz and crosstalk is at least -84dB at 20kHz, while video off-isolation is -48dB at 10MHz and crosstalk is at least -60dB at 10MHz.

## Applications Information

### Multiplexer Control

The MAX4586/MAX4587 have a common command-bit structure; the only difference between them is the interface type (2-wire or 3-wire, respectively).

The command controls the open/closed states of the various switches. Table 1 shows the configuration of the data bits and their related switches. After a command is issued, a logic “1” in any data-bit location closes the associated switch, while a logic “0” opens it (Table 2).

### 2-Wire Serial Interface

The MAX4586 uses a 2-wire, I<sup>2</sup>C-compatible serial interface. The COM\_ register uses the “SendByte” protocol that consists of an address byte followed by a command byte (Table 1).

To address a given chip, the A bit in the address byte must duplicate the value present at the A pin of that chip. The rest of the address bits must match those shown in Table 3. The command byte details are described in the *Switch Control* section.

The 2-wire serial interface requires only two I/O lines of a standard microprocessor ( $\mu$ P) port. Figures 1 and 2 detail the timing diagram for signals on the 2-wire bus, and Tables 1 and 3 detail the format of the signals. The MAX4586 is a receive-only device and must be controlled by the bus master device. A bus master device communicates by transmitting the address byte of the slave device over the bus and then transmitting the desired information. Each transmission consists of a start condition, an address byte, a command byte, and finally a stop condition. The slave device acknowledges the recognition of its address by pulling the SDA line low for one clock period after the address byte is transmitted. The slave device also issues a similar acknowledgment after the command byte.



# Serially Controlled, 4-Channel Audio/Video Multiplexers

MAX4586/MAX4587

**Table 1. Command-Bit Mapping**

| COMMAND BIT | SWITCH     | TERMINALS | POWER-UP STATE |
|-------------|------------|-----------|----------------|
| D7 (MSB)    | x          |           | x              |
| D6          | x          |           | x              |
| D5          | x          |           | x              |
| D4          | x          |           | x              |
| D3          | NO4 to COM | 10, 1     | 0 (Open)       |
| D2          | NO3 to COM | 9, 1      | 0 (Open)       |
| D1          | NO2 to COM | 7, 1      | 0 (Open)       |
| D0 (LSB)    | NO1 to COM | 6, 1      | 0 (Open)       |

X = Don't care

**Table 2. Truth Table**

| LOGIC | NO_SWITCH |
|-------|-----------|
| 0     | OPEN      |
| 1     | CLOSED    |

**Table 3. Address Bit Map**

| ADDRESS BIT (A) | ADDRESS   |
|-----------------|-----------|
| 0               | 0110 1010 |
| 1               | 0110 1110 |

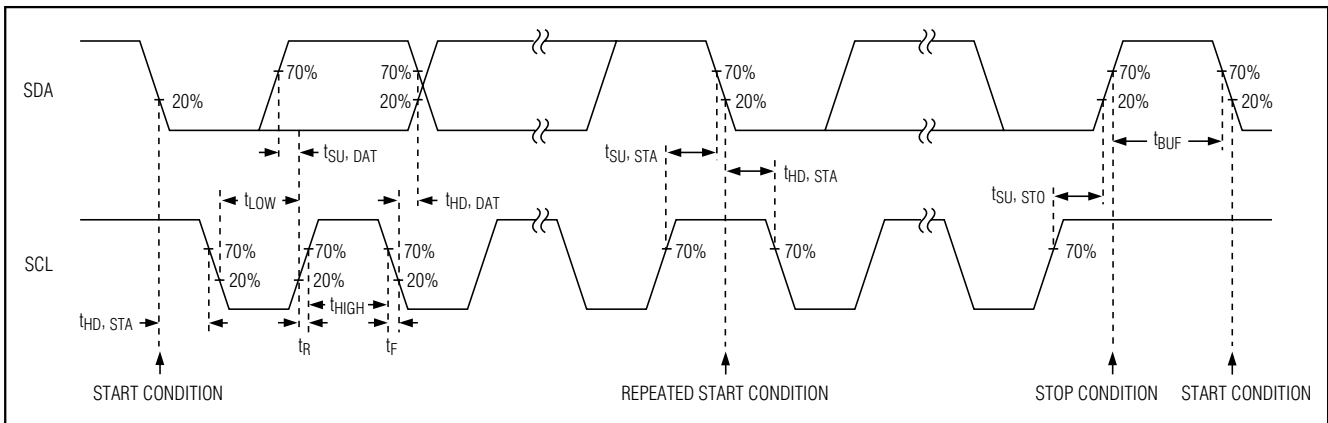


Figure 1. 2-Wire Serial-Interface Timing Diagram

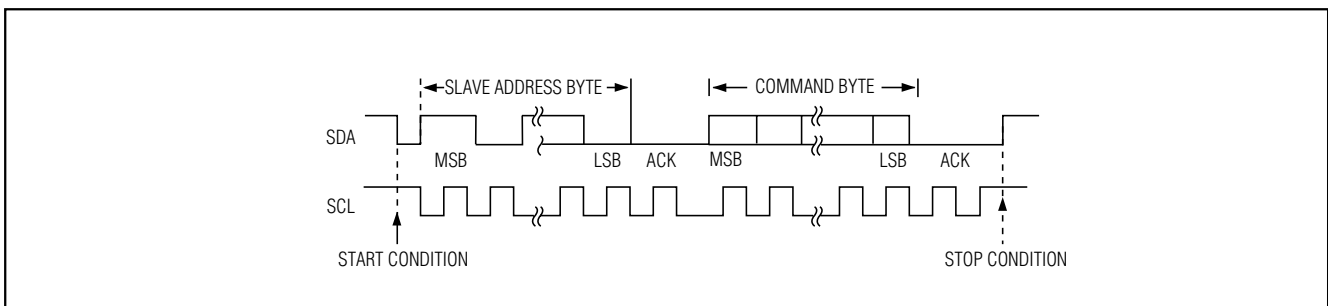


Figure 2. Complete 2-Wire Serial-Interface Transmission

### Start and Stop Conditions

The bus master signals the beginning of a transmission with a start condition by transitioning SDA from high to low while SCL is high. When the bus master has finished communicating with the slave device, it issues a stop condition by transitioning SDA from low to high while SCL is high. The bus master is then free for another transmission.

### Slave Address (Address Byte)

The MAX4586 uses an 8-bit-long slave address. To select a slave address, connect A to V+ or GND. The MAX4586 has two possible slave addresses, so a maximum of two of these devices may share the same address line. The slave device MAX4586 monitors the serial bus continuously, waiting for a start condition followed by an address byte. When a slave device recog-

# Serially Controlled, 4-Channel Audio/Video Multiplexers

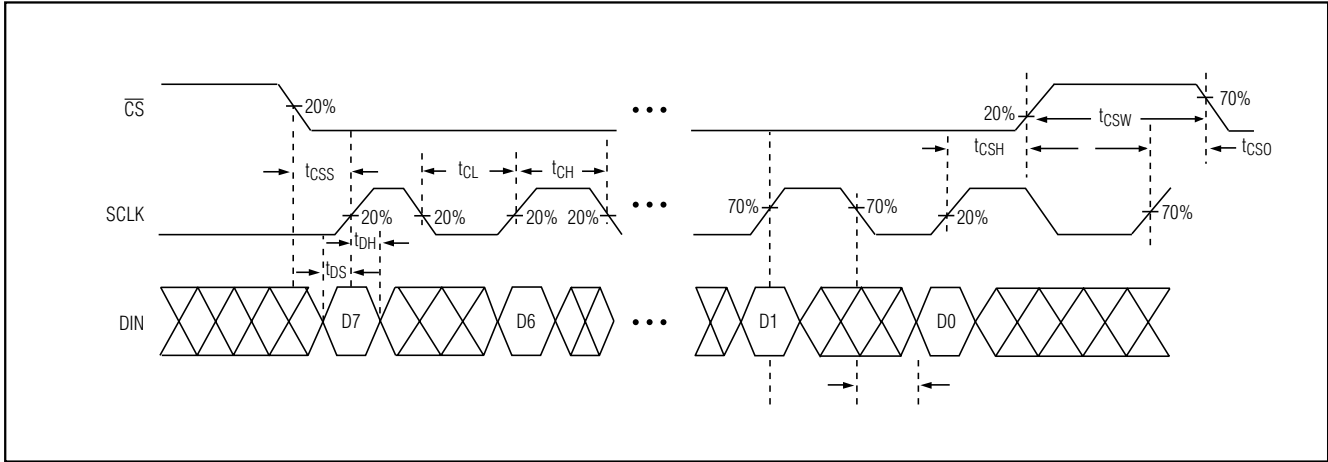


Figure 3. 3-Wire Serial-Interface Timing Diagram

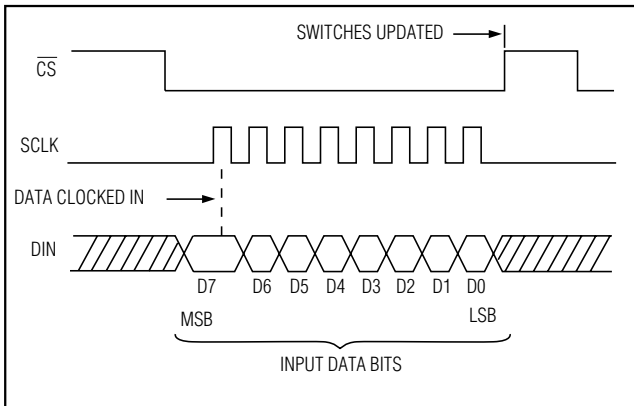


Figure 4. Complete 3-Wire Serial Transmission

nizes its address (01101A10), it acknowledges that it is ready for further communication by pulling the SDA line low for one clock period.

### 3-Wire Serial Interface

The MAX4587 3-wire serial interface is SPI/QSPI/MICROWIRE compatible. An active-low chip-select ( $\overline{CS}$ ) input enables the device to receive data for the serial input (DIN). Data is clocked in on the rising edge of the serial-clock (SCLK) signal. A total of 8 bits is needed in each write cycle. The first bit clocked into the MAX4587 is the command byte's MSB, and the last bit clocked in is the data byte's LSB. The first four bits

of the command byte are "don't care." While shifting data, the device remains in its original configuration. After all eight bits are clocked into the input shift register, a rising edge on  $\overline{CS}$  latches the data into the MAX4587 internal registers, initiating the device's change of state. Figures 3 and 4 detail the 3-wire protocol, and Table 1 details the command byte format.

### Addressable Serial Interface

To program several MAX4587s individually using a single processor, connect DIN of each MAX4587 together and control  $\overline{CS}$  on each MAX4587 separately. To select a particular device, drive the corresponding  $\overline{CS}$  low, clock in the 8-bit command, then drive  $\overline{CS}$  high to execute the command. Typically, only one MAX4587 is addressed at a time.

### Power-Up State

The MAX4586/MAX4587 feature a preset power-up state. See Table 1 to determine the power-up state of the devices.

### Chip Information

TRANSISTOR COUNT: 2259

# Serially Controlled, 4-Channel Audio/Video Multiplexers

## Test Circuits/Timing Diagrams

MAX4586/MAX4587

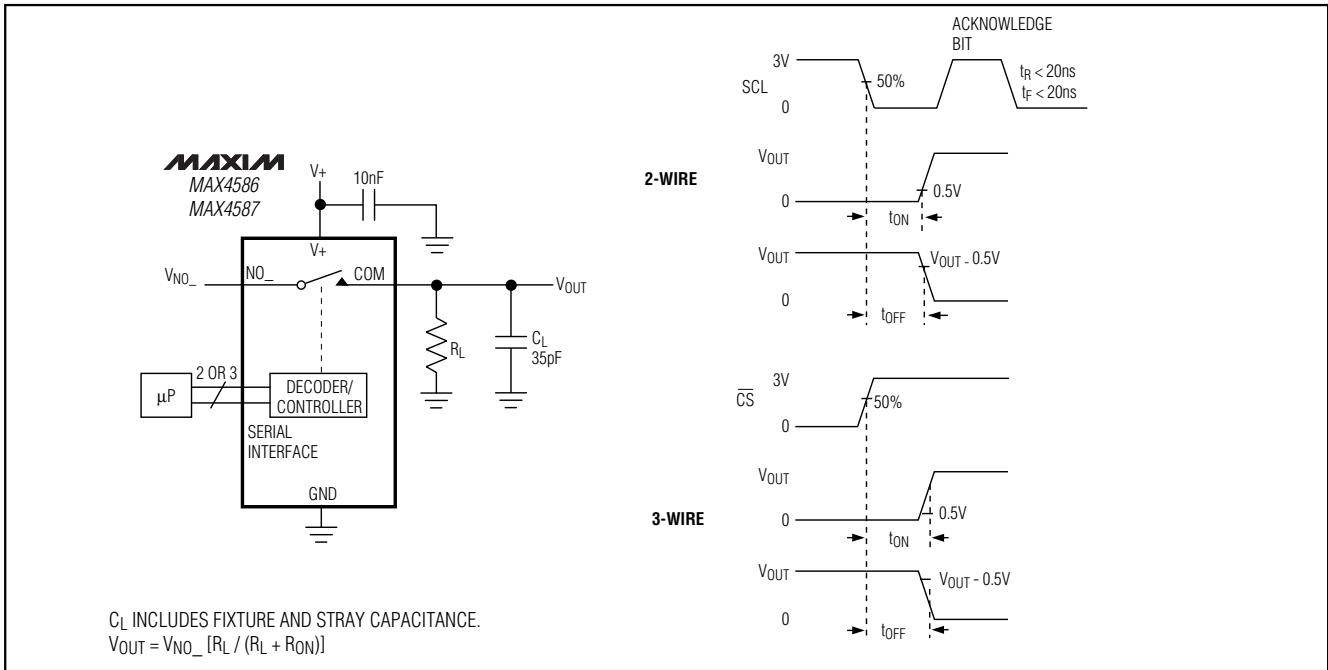


Figure 5. Switching Time

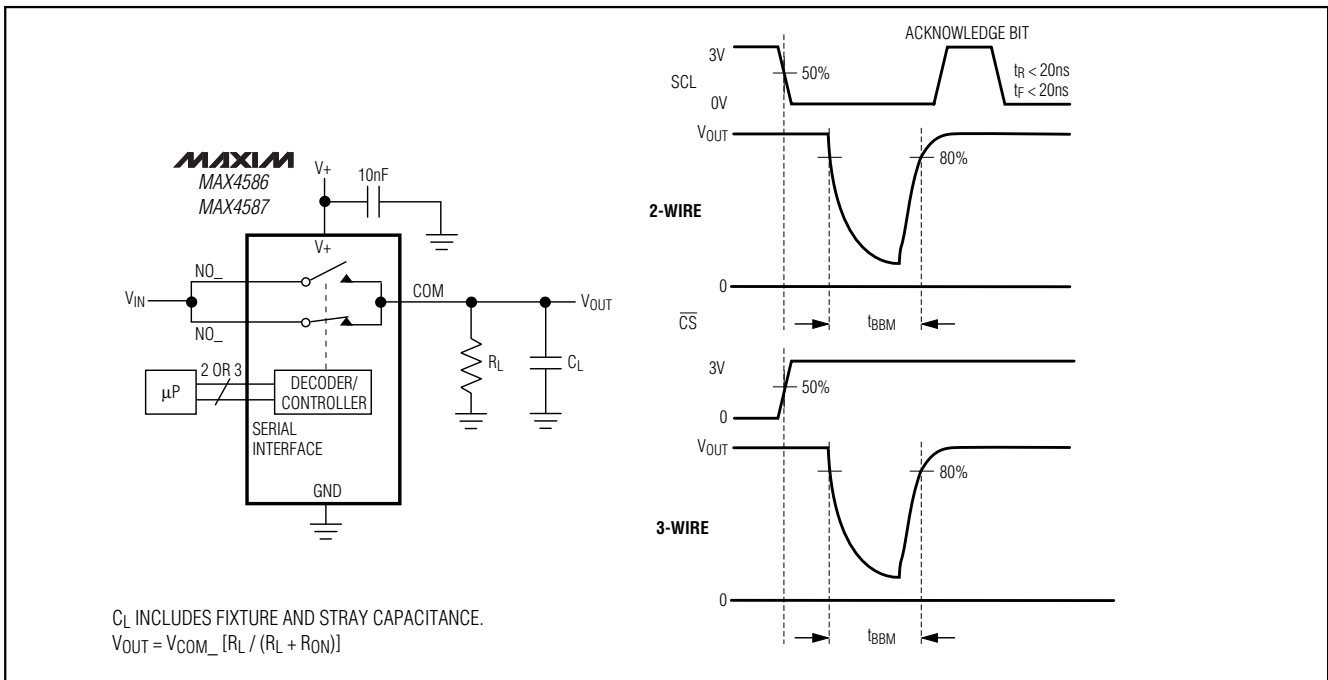


Figure 6. Break-Before-Make Interval

# Serially Controlled, 4-Channel Audio/Video Multiplexers

## Test Circuits/Timing Diagrams (continued)

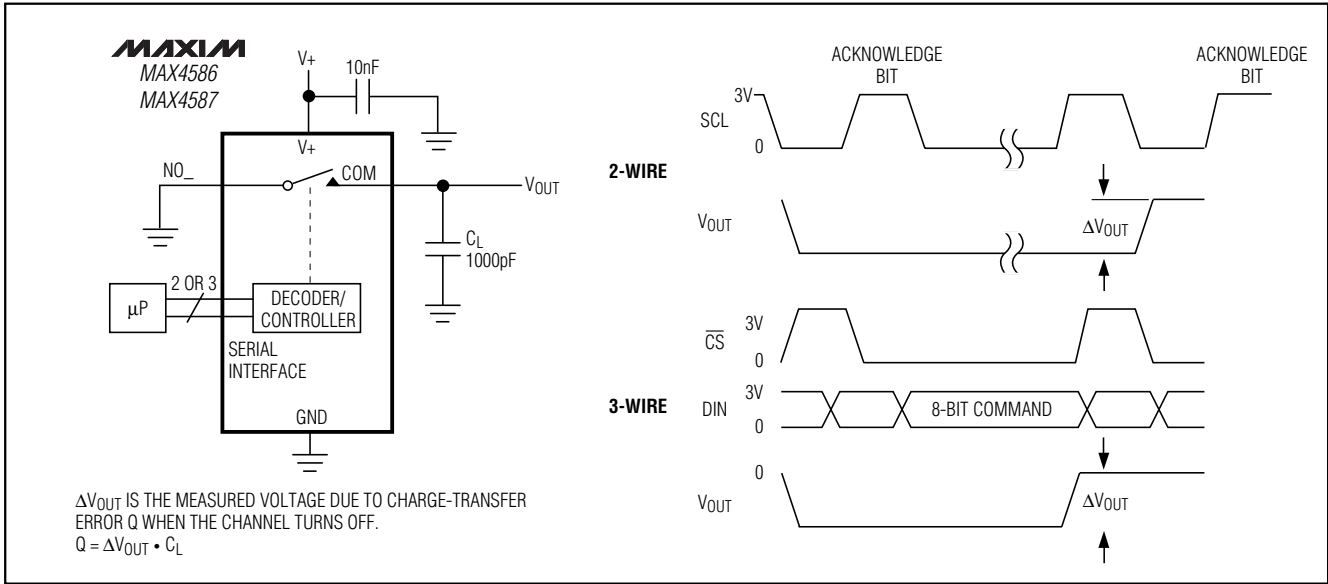


Figure 7. Charge Injection

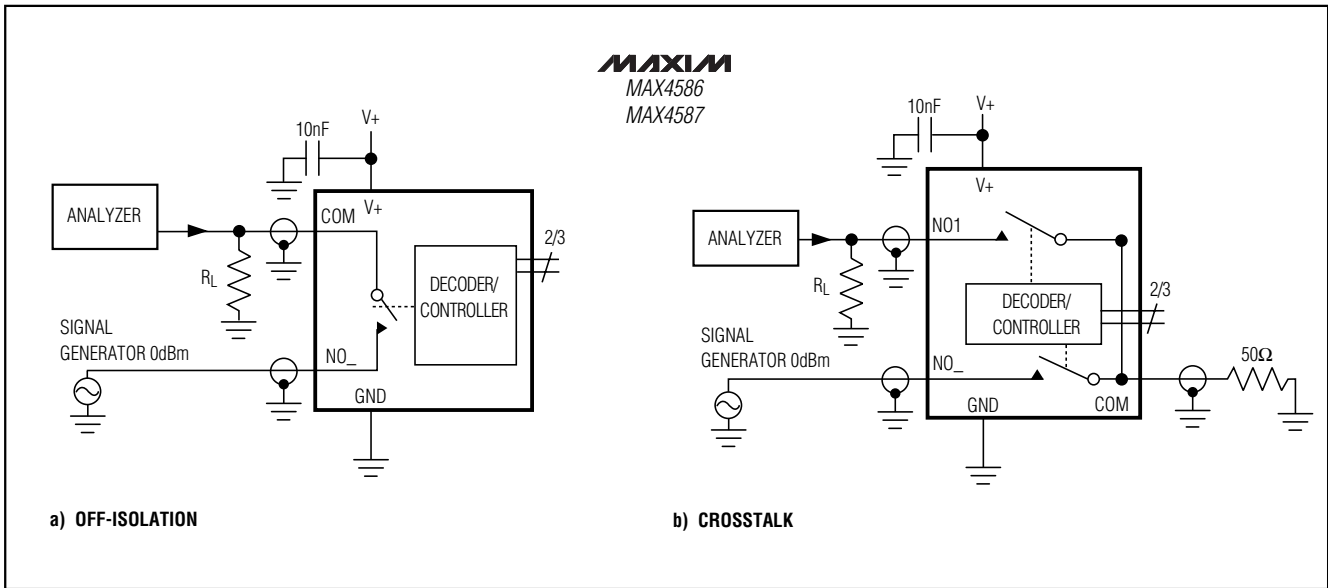


Figure 8. Off-Isolation and Crosstalk

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