



**THE DATASHEET OF  
MAX4585EUB+**



# MAXIM

## Serially Controlled Audio/Video Switches

MAX4584/MAX4585

### General Description

The MAX4584/MAX4585 serial-interface, programmable switches are ideal for multimedia applications. Each device contains one normally open (NO) single-pole/single-throw (SPST) switch and one single-pole/double-throw (SPDT) switch. The MAX4584/MAX4585 feature 65Ω on-resistance, 4Ω on-resistance matching between channels, and 5Ω on-resistance flatness. Additionally, they have off-isolation of -83dB at 20kHz and -48dB at 10MHz, with crosstalk of -84dB at 20kHz and -60dB at 10MHz.

The MAX4584 uses a 2-wire I<sup>2</sup>C™-compatible serial interface; the MAX4585 uses a 3-wire SPI™/QSPI™/MICROWIRE™-compatible interface. Both devices are available in a 10-pin μMAX package and are specified for the extended-industrial (-40°C to +85°C) temperature range.

### 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

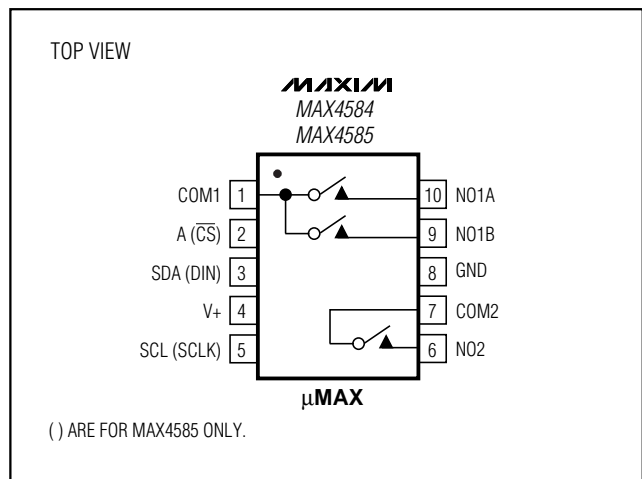
### Features

- ◆ +2.7V to +5.5V Single-Supply Operation
- ◆ SPST and SPDT Switches
- ◆ 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 (MAX4584)
  - 3-Wire SPI/QSPI/MICROWIRE Compatible (MAX4585)

### Ordering Information

| PART       | TEMP. RANGE    | PIN-PACKAGE |
|------------|----------------|-------------|
| MAX4584EUB | -40°C to +85°C | 10 μMAX     |
| MAX4585EUB | -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.

MAXIM

Maxim Integrated Products 1

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# Serially Controlled Audio/Video Switches

## ABSOLUTE MAXIMUM RATINGS

V+ to GND .....-0.3V to +6V  
 COM\_ and NO\_ \_ to GND (Note 1) .....-0.3V to (V+ + 0.3V)  
 A, CS, SDA, DIN, SCL, and SCLK to GND .....-0.3V to +6V  
 Continuous Current into Any Terminal .....±20mA  
 Peak Current into Any Terminal  
 (pulsed at 1ms, 10% duty cycle) .....±40mA  
 ESD per Method 3015.7 .....>2kV

Continuous Power Dissipation (T<sub>A</sub> = +70°C)  
 μMAX (derate 4.1mW/°C above +70°C) .....330mW  
 Operating Temperature Range .....-40°C to +85°C  
 Storage Temperature Range .....-65°C to +150°C  
 Lead Temperature (soldering, 10sec) .....+300°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.

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

## 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 Between Channels (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 (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_ _ Off-Leakage Current (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 (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 (Note 6)              | I <sub>COM_ (ON)</sub>                    | V+ = 5.25V;<br>V <sub>NO_ _</sub> = 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> = 1V <sub>RMS</sub> , f <sub>IN</sub> = 20kHz,<br>R <sub>L</sub> = 600Ω, Figure 8 |   | -83 |       | dB    |    |
| Channel-to-Channel Crosstalk                  | V <sub>CT(A)</sub>                        | V <sub>A</sub> = 1V <sub>RMS</sub> , f <sub>IN</sub> = 20kHz,<br>R <sub>S</sub> = 600Ω, Figure 8 |   | -84 |       | dB    |    |

# Serially Controlled Audio/Video Switches

MAX4584/MAX4585

## 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> = 1V <sub>RMS</sub> , f <sub>IN</sub> = 10MHz,<br>R <sub>L</sub> = 50Ω, Figure 8 |   | -48 |     | dB    |
| Channel-to-Channel Crosstalk                       | V <sub>CT(V)</sub>  | V <sub>A</sub> = 1V <sub>RMS</sub> , f <sub>IN</sub> = 10MHz,<br>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, 11, and Figure 5) |                     |   |   |     |     |       |
| Turn-On Time                                       | t <sub>ON</sub>     | V <sub>NO__</sub> = 2.5V,<br>C <sub>L</sub> = 35pF,<br>R <sub>L</sub> = 5kΩ                     | 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,<br>C <sub>L</sub> = 35pF,<br>R <sub>L</sub> = 300Ω                    | 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 Audio/Video Switches

## ELECTRICAL CHARACTERISTICS—Single +3V Supply

( $V_+ = +3.0V \pm 10\%$ ,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise noted. Typical values are at  $T_A = +25^\circ C$ .)

| PARAMETER  | SYMBOL                      | CONDITIONS   |                              | MIN | TYP   | MAX   | UNITS    |
|--|-----------------------------|--|------------------------------|-----|-------|-------|----------|
| <b>ANALOG SWITCHES</b>                             |                             |  |                              |     |       |       |          |
| Analog Signal Range (Note 3)                       | $V_{NO\_}$ ,<br>$V_{COM\_}$ |  |                              | 0   |       | $V_+$ | V        |
| On-Resistance                                      | $R_{ON}$                    | $V_+ = 2.7V$ ,<br>$V_{NO\_} = 1V$ ,<br>$I_{COM\_} = 4mA$                             | $T_A = +25^\circ C$          | 65  | 110   |       | $\Omega$ |
|  |                             |  | $T_A = T_{MIN}$ to $T_{MAX}$ |     |       | 130   |          |
| On-Resistance Match Between Channels (Note 4)      | $\Delta R_{ON}$             | $V_+ = 2.7V$ ,<br>$V_{NO\_} = 1V$ ,<br>$I_{COM\_} = 4mA$                             | $T_A = +25^\circ C$          | 3   | 5     |       | $\Omega$ |
|  |                             |  | $T_A = T_{MIN}$ to $T_{MAX}$ |     |       | 6     |          |
| On-Resistance Flatness (Note 5)                    | $R_{FLAT}$                  | $V_+ = 2.7V$ ;<br>$V_{NO\_} = 1V, 1.5V, 2V$ ;<br>$I_{COM\_} = 4mA$                   | $T_A = +25^\circ C$          | 3   | 10    |       | $\Omega$ |
|  |                             |  | $T_A = T_{MIN}$ to $T_{MAX}$ |     |       | 12    |          |
| NO <sub>__</sub> Off-Leakage Current (Notes 6, 9)  | $I_{NO\_}(OFF)$             | $V_+ = 3.6V$ ;<br>$V_{COM\_} = 0.5V, 3V$ ;<br>$V_{NO\_} = 3V, 0.5V$                  | $T_A = +25^\circ C$          | -1  | 0.001 | 1     | nA       |
|  |                             |  | $T_A = T_{MIN}$ to $T_{MAX}$ | -10 |       | 10    |          |
| COM <sub>__</sub> Off-Leakage Current (Notes 6, 9) | $I_{COM\_}(OFF)$            | $V_+ = 3.6V$ ;<br>$V_{COM\_} = 0.5V, 3V$ ;<br>$V_{NO\_} = 3V, 0.5V$                  | $T_A = +25^\circ C$          | -1  | 0.001 | 1     | nA       |
|  |                             |  | $T_A = T_{MIN}$ to $T_{MAX}$ | -10 |       | 10    |          |
| COM <sub>__</sub> On-Leakage Current (Notes 6, 9)  | $I_{COM\_}(ON)$             | $V_+ = 3.6V$ ;<br>$V_{COM\_} = 0.5V, 3V$ ;<br>$V_{NO\_} = 0.5V, 3V$ ,<br>or floating | $T_A = +25^\circ C$          | -1  | 0.002 | 1     | nA       |
|  |                             |  | $T_A = T_{MIN}$ to $T_{MAX}$ | -10 |       | 10    |          |
| <b>AUDIO PERFORMANCE</b>                           |                             |  |                              |     |       |       |          |
| Off-Isolation (Note 7)                             | $V_{ISO(A)}$                | $V_A = 0.5V_{RMS}$ , $f_{IN} = 20kHz$ , $R_L = 600\Omega$ ,<br>Figure 8              |                              |     | -83   |       | dB       |
| Channel-to-Channel Crosstalk                       | $V_{CT(A)}$                 | $V_A = 0.5V_{RMS}$ , $f_{IN} = 20kHz$ , $R_S = 600\Omega$ ,<br>Figure 8              |                              |     | -84   |       | dB       |
| <b>VIDEO PERFORMANCE</b>                           |                             |  |                              |     |       |       |          |
| Off-Isolation                                      | $V_{ISO(V)}$                | $V_A = 0.5V_{RMS}$ , $f_{IN} = 10MHz$ , $R_L = 50\Omega$ ,<br>Figure 8               |                              |     | -48   |       | dB       |
| Channel-to-Channel Crosstalk                       | $V_{CT(V)}$                 | $V_A = 0.5V_{RMS}$ , $f_{IN} = 10MHz$ , $R_S = 50\Omega$ ,<br>Figure 8               |                              |     | -60   |       | dB       |
| -3dB Bandwidth                                     | BW                          | $R_S = 50\Omega$ , $R_L = 50\Omega$  |                              |     | 200   |       | MHz      |
| NO <sub>__</sub> Off-Capacitance                   | $C_{OFF}$                   | $f_{IN} = 1MHz$  |                              |     | 5     |       | pF       |
| <b>DYNAMIC TIMING</b> (Notes 8, 11, and Figure 5)  |                             |  |                              |     |       |       |          |
| Turn-On Time                                       | $t_{ON}$                    | $V_{NO\_} = 1.5V$ ,<br>$R_L = 5k\Omega$ , $C_L = 35pF$                               | $T_A = +25^\circ C$          | 400 | 800   |       | ns       |
|  |                             |  | $T_A = T_{MIN}$ to $T_{MAX}$ |     |       | 1000  |          |
| Turn-Off Time                                      | $t_{OFF}$                   | $V_{NO\_} = 1.5V$ ,<br>$R_L = 300\Omega$ , $C_L = 35pF$                              | $T_A = +25^\circ C$          | 200 | 350   |       | ns       |
|  |                             |  | $T_A = T_{MIN}$ to $T_{MAX}$ |     |       | 500   |          |
| Break-Before-Make Time                             | $t_{BBM}$                   | $V_{NO\_} = 1.5V$ , Figure 6   |                              | 10  | 100   |       | ns       |

# Serially Controlled Audio/Video Switches

MAX4584/MAX4585

## 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>   |                          |     | 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 Conditions | 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 10)                     | t <sub>R</sub>      |   | 20 +<br>0.1C <sub>B</sub> |     | 300 | ns    |
| SCL/SDA Fall Time (Note 10)                     | t <sub>F</sub>      |   | 20 +<br>0.1C <sub>B</sub> |     | 300 | ns    |

# Serially Controlled Audio/Video Switches

## 3-WIRE TIMING CHARACTERISTICS

(Figures 3 and 4,  $V_+ = +2.75V$  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 | 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.

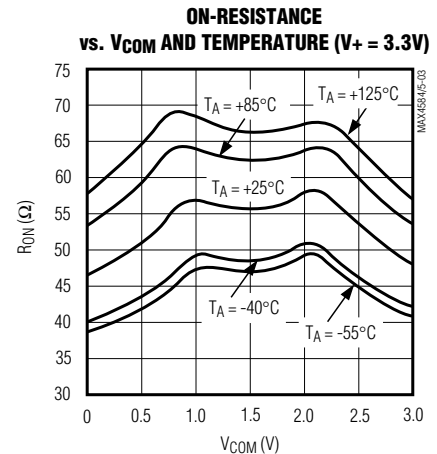
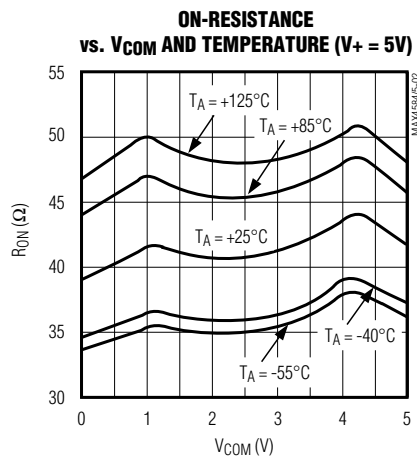
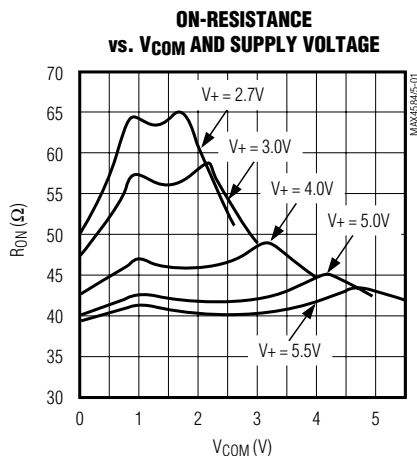
**Note 9:** Leakage testing is guaranteed by testing with a  $+5.25V$  supply.

**Note 10:**  $C_B$  = capacitance of one bus line in pF. Tested with  $C_B = 400pF$ .

**Note 11:** Typical values are for MAX4584 devices.

## Typical Operating Characteristics

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

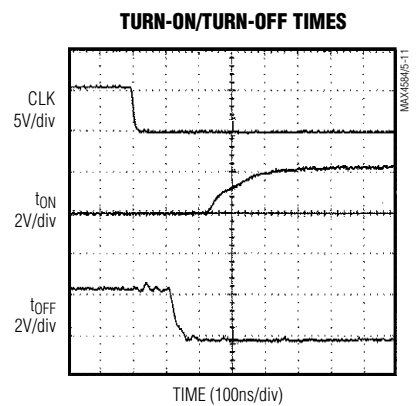
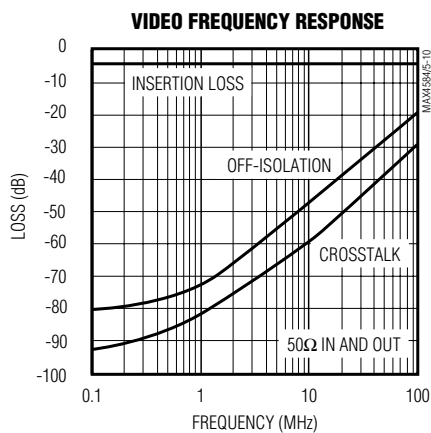
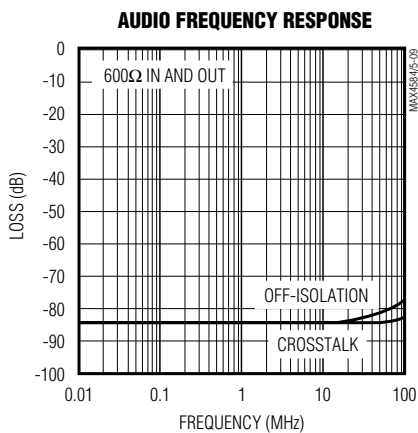
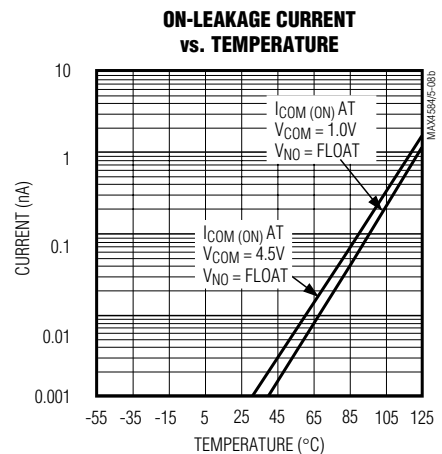
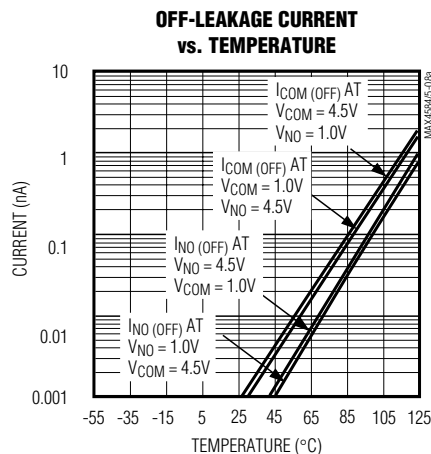
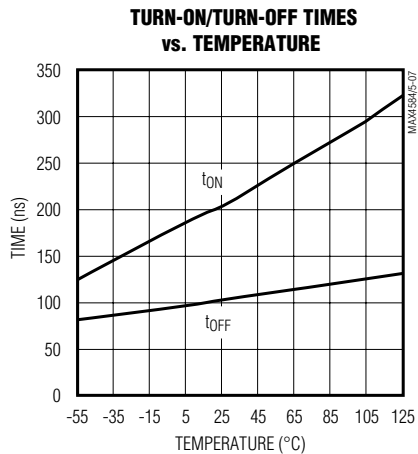
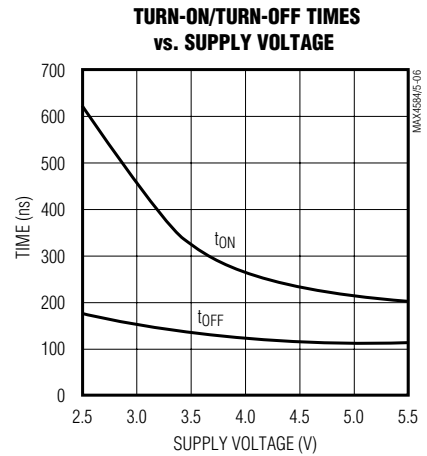
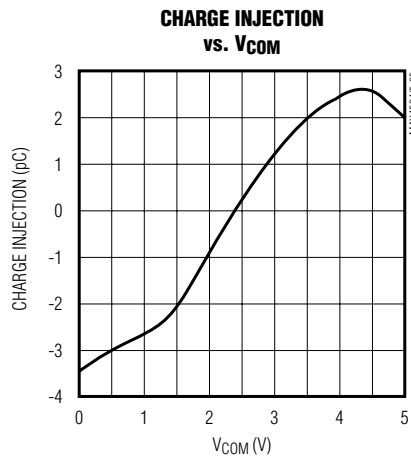
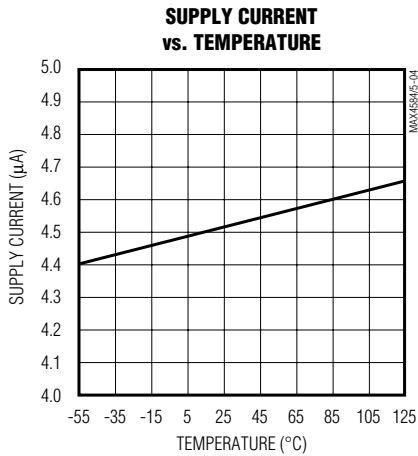


# Serially Controlled Audio/Video Switches

## Typical Operating Characteristics (continued)

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

MAX4584/MAX4585



# Serially Controlled Audio/Video Switches

## Pin Description

| PIN     |         | NAME            | FUNCTION   |
|---------|---------|-----------------|--|
| MAX4584 | MAX4585 |                 |  |
| 1       | 1       | COM1            | Analog Switch SPDT 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 the 2-Wire Serial Interface          |
| —       | 3       | DIN             | Data Input of the 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       | NO2             | Normally Open SPST Terminal                        |
| 7       | 7       | COM2            | Analog Switch SPST Common Terminal                 |
| 8       | 8       | GND             | Ground   |
| 9       | 9       | NO1B            | Normally Open Terminal                             |
| 10      | 10      | NO1A            | Normally Open Terminal                             |

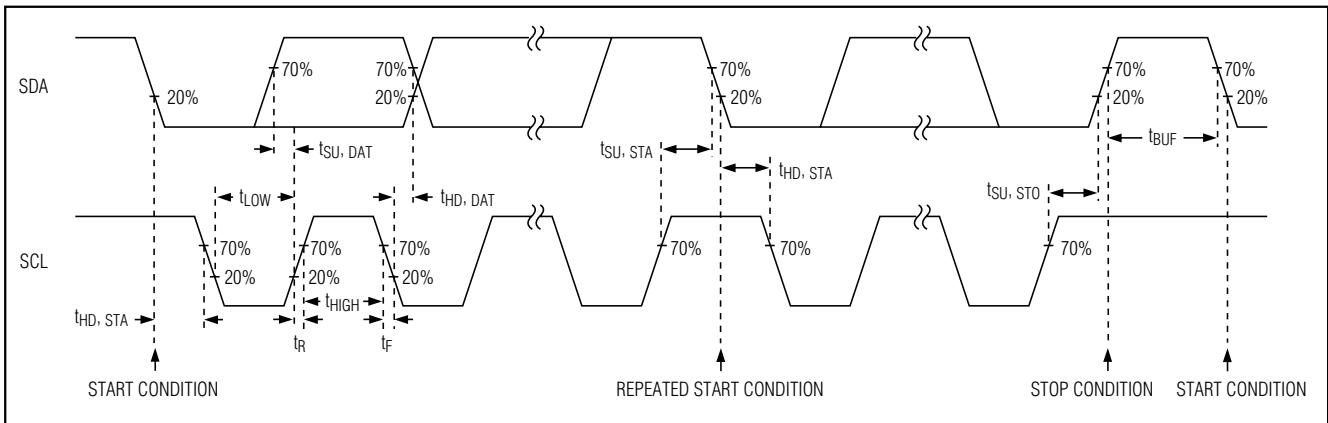


Figure 1. 2-Wire Serial-Interface Timing Diagram

### Detailed Description

The MAX4584/MAX4585 are serial-interface, programmable switches. Each device contains one normally open (NO) single-pole/single-throw (SPST) switch and one single-pole/double-throw (SPDT) switch. The switches are independently controlled through the on-chip serial interface. The MAX4584 uses a 2-wire I<sup>2</sup>C-compatible serial communications protocol; the MAX4585 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 of 20kHz and video frequencies up to 10MHz. They feature 65Ω on-resistance, 4Ω on-resistance matching between channels, and 5Ω on-resistance flat-

ness. Audio off-isolation is -83dB at 20kHz, and crosstalk is at least -84dB at 20kHz. Video off-isolation is -48dB at 10MHz, and crosstalk is at least -60dB at 10MHz.

### Applications Information

#### Switch Control

The MAX4584/MAX4585 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

# Serially Controlled Audio/Video Switches

**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          | X            | —         | X              |
| D2          | NO2 to COM2  | 6, 7      | 0 (Open)       |
| D1          | NO1B to COM1 | 9, 1      | 1 (Closed)     |
| D0 (LSB)    | NO1A to COM1 | 10, 1     | 0 (Open)       |

X = Don't care

**Table 2. Truth Table**

| LOGIC | NO1_ AND NO2 |
|-------|--------------|
| 0     | OPEN         |
| 1     | CLOSED       |

**Table 3. Address Bit Map**

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

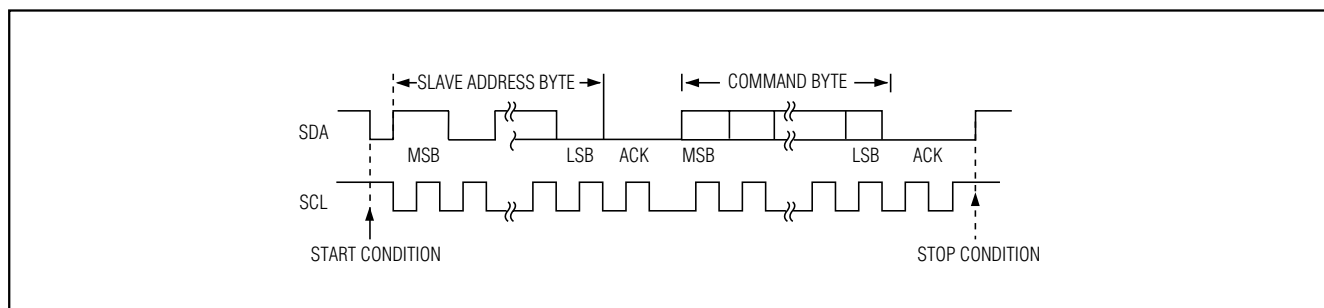


Figure 2. A Complete 2-Wire Serial-Interface Transmission

es the associated switch (Table 2). A logic “0” in any data-bit location opens the associated switch.

### 2-Wire Serial Interface

The MAX4584 uses a 2-wire I<sup>2</sup>C-compatible serial interface. The COM\_ register uses the “SendByte” protocol, which consists of an address byte followed by a command byte (Table 1).

To address a given IC, bit A in the address byte must duplicate the value present at the A pin of that IC. 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 (μP) 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 MAX4584 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.

### 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 is then free for another transmission.

### Slave Address (Address Byte)

The MAX4584 uses an 8-bit-long slave address. To select a slave address, connect A to V+ or GND. The MAX4584 has two possible slave addresses, so a maximum of two of these devices may share the same address line. The slave device MAX4584 monitors the serial bus continuously, waiting for a start condition followed by an address byte. When a slave device recognizes its address (01101A10), it acknowledges that it is ready for further communication by pulling the SDA line low for one clock period.

# Serially Controlled Audio/Video Switches

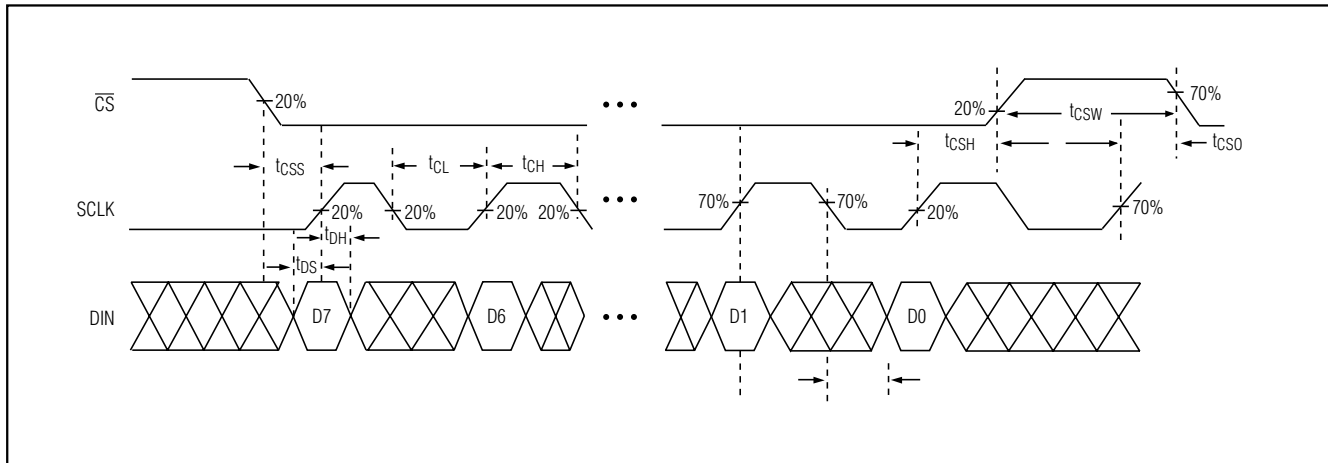


Figure 3. 3-Wire Serial-Interface Timing Diagram

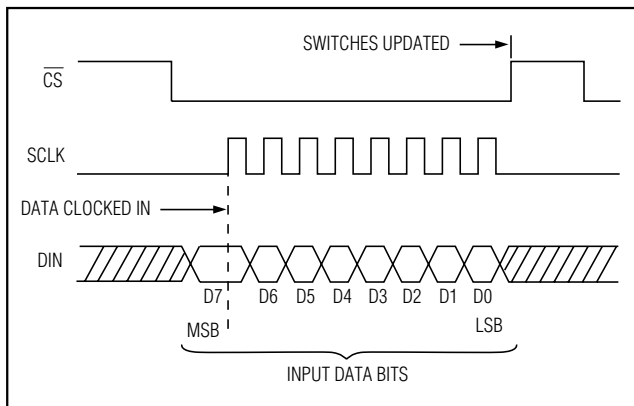


Figure 4. A Complete 3-Wire Serial Transmission

### 3-Wire Serial Interface

The MAX4585 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 are needed in each write cycle. The first bit clocked into the MAX4585 is the command byte's MSB; the last bit clocked in is the data byte's LSB. The first 5 bits of the command byte are "don't care." While shifting data, the device remains in its original configuration. After all 8 bits are clocked into the input shift register, a rising edge on  $\overline{CS}$  latches the data into the MAX4585's 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 MAX4585s individually using a single  $\mu P$ , connect DIN of each MAX4585 together and control  $\overline{CS}$  on each MAX4585 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 MAX4585 is addressed at a time.

### Power-Up State

The MAX4584/MAX4585 feature a preset power-up state. See Table 1 to determine the power-up state of these devices.

### Chip Information

TRANSISTOR COUNT: 2259

# Serially Controlled Audio/Video Switches

## Test Circuits/Timing Diagrams

MAX4584/MAX4585

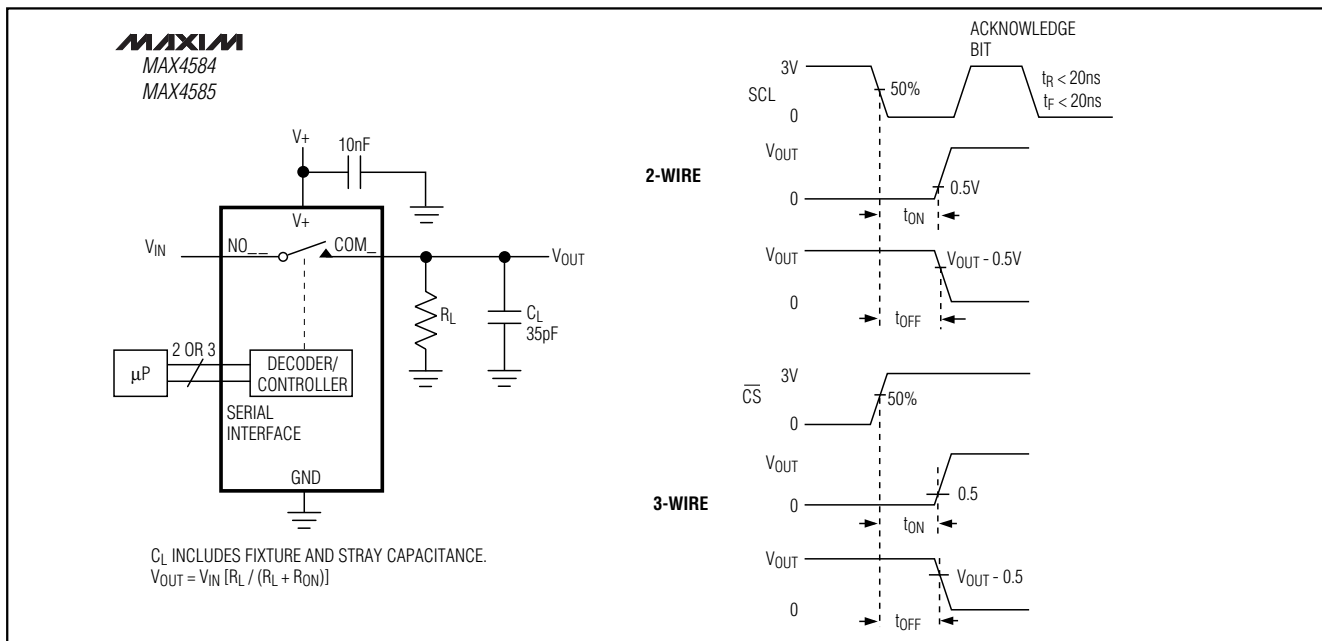


Figure 5. Switching Time

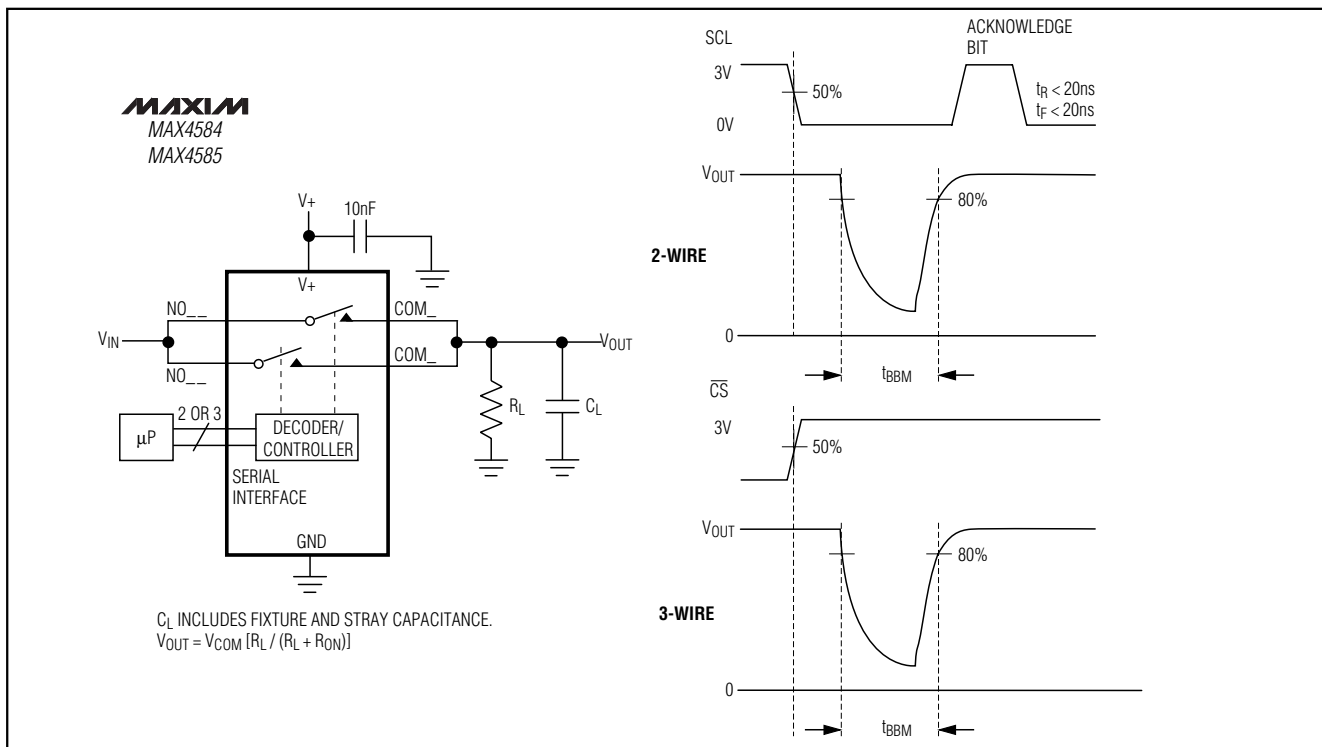


Figure 6. Break-Before-Make Interval

# Serially Controlled Audio/Video Switches

## Test Circuits/Timing Diagrams (continued)

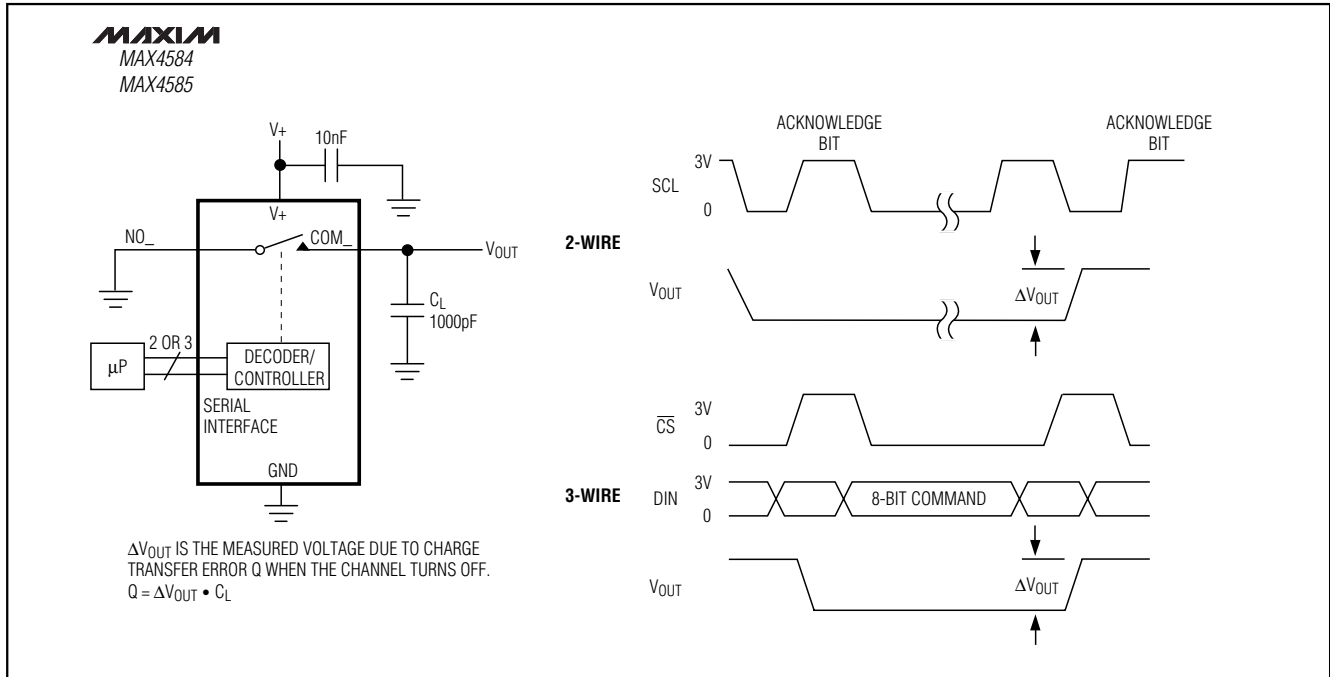


Figure 7. Charge Injection

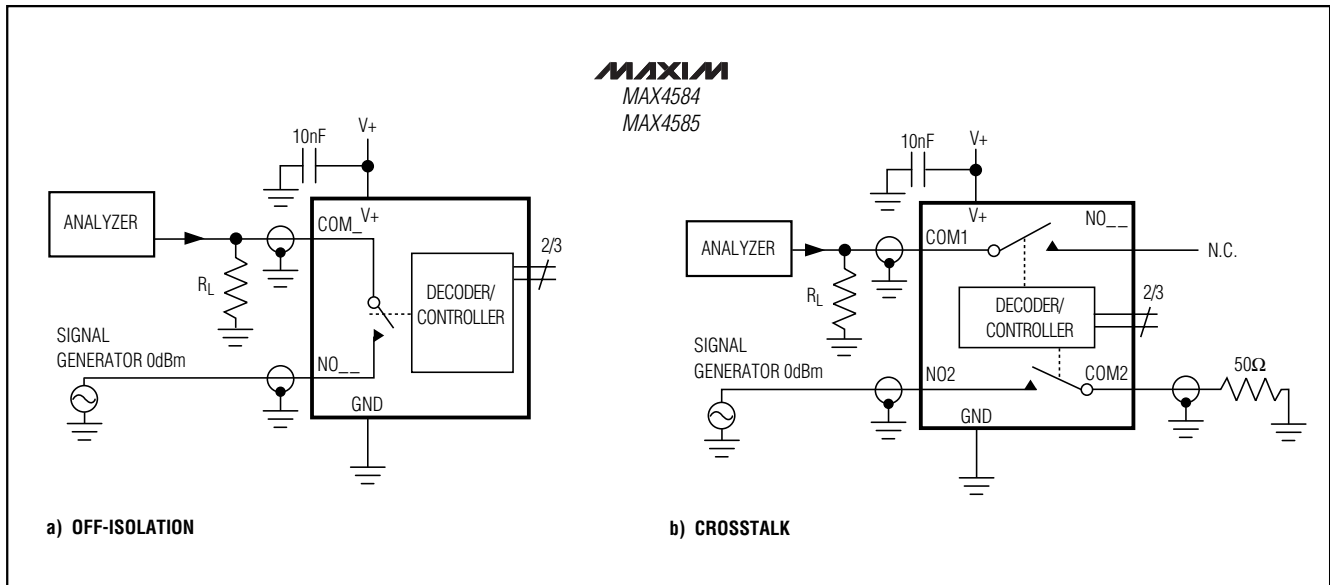


Figure 8. Off-Isolation and Crosstalk

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