



## 3.5 $\Omega$ , Single 8:1 and Dual 4:1, Low-Voltage Analog Multiplexers

### General Description

The MAX4638/MAX4639 are single 8:1 and dual 4:1 CMOS analog multiplexers/demultiplexers (muxes/demuxes). Each mux operates from a single +1.8V to +5V supply or dual  $\pm 2.5V$  supplies. These devices feature 3.5 $\Omega$  on-resistance ( $R_{ON}$ ) when powered with a single +5V supply and have -75dB off-isolation and -85dB crosstalk from the output to each off channel. The switching times are 18ns  $t_{ON}$  and 7ns  $t_{OFF}$ . They feature a -3dB 85MHz bandwidth and a guaranteed 0.25nA leakage current at +25°C.

A +1.8V to +5.5V operating range makes the MAX4638/MAX4639 ideal for battery-powered, portable instruments. All channels guarantee break-before-make switching. These parts feature bidirectional operation and can handle Rail-to-Rail® analog signals. All control inputs are TTL/CMOS-logic compatible. Decoding is in standard BCD format, and an enable input is provided to simplify cascading of devices. These devices are available in small 16-pin thin QFN, TSSOP, and SO packages, as well as a 20-pin thin QFN package.

### Applications

Automatic Test Equipment  
Low-Voltage Data-Acquisition Systems  
Audio and Video Signal Routing  
Medical Equipment  
Battery-Powered Equipment  
Relay Replacement

### Features

- ◆ **Guaranteed  $R_{ON}$**   
3.5 $\Omega$  (+5V or  $\pm 2.5V$  Supplies)  
6 $\Omega$  (+3V Supply)
- ◆ **Guaranteed 0.4 $\Omega$   $R_{ON}$  Match Between Channels**
- ◆ **Guaranteed 1 $\Omega$   $R_{ON}$  Flatness Over Signal Range**
- ◆ **Guaranteed Low Leakage Currents**  
0.25nA at +25°C
- ◆ **Switching Times:  $t_{ON}$  = 18ns,  $t_{OFF}$  = 7ns**
- ◆ **+1.8V to +5.5V Single-Supply Operation**  
 **$\pm 2.5V$  Dual-Supply Operation**
- ◆ **Rail-to-Rail Signal Handling**
- ◆ **TTL/CMOS-Logic Compatible**
- ◆ **Crosstalk: -80dB (1MHz)**
- ◆ **Off-Isolation: -60dB (10MHz)**

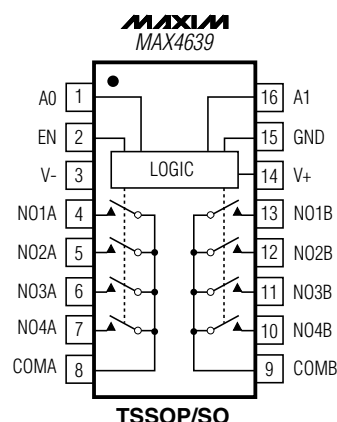
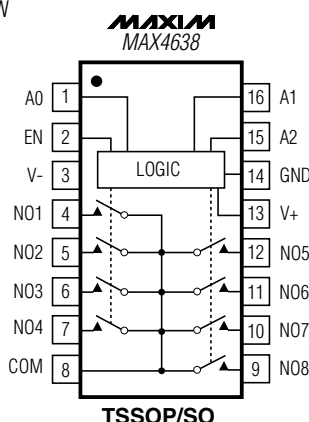
### Ordering Information

| PART       | TEMP RANGE     | PIN-PACKAGE         |
|------------|----------------|---------------------|
| MAX4638ETE | -40°C to +85°C | 16 Thin QFN (4 x 4) |
| MAX4638EUE | -40°C to +85°C | 16 TSSOP            |
| MAX4638ESE | -40°C to +85°C | 16 SO               |
| MAX4638ETP | -40°C to +85°C | 20 Thin QFN (4 x 4) |

Ordering Information continued at end of data sheet.

### Pin Configurations/Functional Diagrams

TOP VIEW



Rail-to-Rail is a registered trademark of Nippon Motorola, Ltd.



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**For pricing, delivery, and ordering information, please contact Maxim/Dallas Direct! at 1-888-629-4642, or visit Maxim's website at [www.maxim-ic.com](http://www.maxim-ic.com).**

MAX4638/MAX4639

# 3.5 $\Omega$ , Single 8:1 and Dual 4:1, Low-Voltage Analog Multiplexers

## ABSOLUTE MAXIMUM RATINGS

(Voltages Referenced to GND)

|                                                                                       |                           |
|---------------------------------------------------------------------------------------|---------------------------|
| V+ to V-                                                                              | .....+6V                  |
| V+, A <sub>-</sub> , EN                                                               | .....-0.3V to +6V         |
| V-                                                                                    | .....+0.3V to -6V         |
| NO <sub>-</sub> , COM <sub>-</sub> (Note 1)                                           | .....-0.3V to (V+ + 0.3V) |
| Continuous Current A <sub>-</sub> , EN                                                | ..... $\pm$ 30mA          |
| Continuous Current NO <sub>-</sub> , COM <sub>-</sub>                                 | ..... $\pm$ 100mA         |
| Peak Current (NO <sub>-</sub> , COM <sub>-</sub> )<br>(pulsed at 1ms, 10% duty cycle) | ..... $\pm$ 200mA         |

Continuous Power Dissipation (T<sub>A</sub> = +70°C)

|                                                |             |
|------------------------------------------------|-------------|
| 16-Pin Thin QFN (derate 16.9mW/°C above +70°C) | .....1349mW |
| 16-Pin TSSOP (derate 5.7mW/°C above +70°C)     | .....457mW  |
| 16-Pin SO (derate 8.70mW/°C above +70°C)       | .....696mW  |
| 20-Pin Thin QFN (derate 16.9mW/°C above +70°C) | .....1349mW |

Operating Temperature Range

|                                   |                      |
|-----------------------------------|----------------------|
| MAX463_E <sub>-</sub> E           | .....-40°C to +85°C  |
| Junction Temperature              | .....+150°C          |
| Storage Temperature Range         | .....-65°C to +150°C |
| Lead Temperature (soldering, 10s) | .....+300°C          |

**Note 1:** Signals on COM<sub>-</sub>, NO<sub>-</sub> exceeding V+ or V- are clamped by internal diodes. A<sub>-</sub> and EN are clamped only to V- and can exceed V+ up to their maximum ratings. 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—+5V Single Supply

(V+ = +5V  $\pm$  10%, V- = 0, V<sub>IH</sub> = +2.4V, V<sub>IL</sub> = +0.8V, 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 9)

| PARAMETER                                            | SYMBOL                                    | CONDITIONS                                                                                                             |                                                       | MIN   |       | TYP<br>(Note 2) | MAX  | UNITS |
|------------------------------------------------------|-------------------------------------------|------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|-------|-------|-----------------|------|-------|
| ANALOG SWITCH                                        |                                           |                                                                                                                        |                                                       |       |       |                 |      |       |
| Analog Signal Range                                  | V <sub>COM_-</sub> ,<br>V <sub>NO_-</sub> |                                                                                                                        |                                                       | 0     |       |                 | V+   | V     |
| On-Resistance                                        | R <sub>ON</sub>                           | V+ = +4.5V, I <sub>COM_-</sub> = 10mA,<br>V <sub>NO_-</sub> = +3.5V                                                    | T <sub>A</sub> = +25°C                                | 2.5   |       |                 | 3.5  | Ω     |
|                                                      |                                           |                                                                                                                        | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |       |       |                 | 4.5  |       |
| On-Resistance Match<br>Between Channels (Notes 3, 8) | ΔR <sub>ON</sub>                          | V+ = +4.5V, I <sub>COM_-</sub> = 10mA,<br>V <sub>NO_-</sub> = +3.5V                                                    | T <sub>A</sub> = +25°C                                | 0.1   |       |                 | 0.4  | Ω     |
|                                                      |                                           |                                                                                                                        | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |       |       |                 | 0.5  |       |
| On-Resistance Flatness (Note 4)                      | R <sub>FLAT(ON)</sub>                     | V+ = +4.5V; I <sub>COM_-</sub> = 10mA;<br>V <sub>NO_-</sub> = +1V, +2V, +3.5V                                          | T <sub>A</sub> = +25°C                                | 0.75  |       |                 | 1    | Ω     |
|                                                      |                                           |                                                                                                                        | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |       |       |                 | 1.2  |       |
| NO_ Off-Leakage Current<br>(Note 5)                  | I <sub>NO_(OFF)</sub>                     | V+ = +5.5V; V <sub>COM_-</sub> = +1V,<br>+4.5V; V <sub>NO_-</sub> = +4.5V, +1V                                         | T <sub>A</sub> = +25°C                                | -0.25 | ±0.01 |                 | 0.25 | nA    |
|                                                      |                                           |                                                                                                                        | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | -0.35 |       |                 | 0.35 |       |
| COM_ Off-Leakage Current<br>(Note 5)                 | I <sub>COM_(OFF)</sub>                    | V+ = +5.5V; V <sub>COM_-</sub> = +1V,<br>+4.5V; V <sub>NO_-</sub> = +4.5V, +1V                                         | T <sub>A</sub> = +25°C                                | -0.25 | ±0.01 |                 | 0.25 | nA    |
|                                                      |                                           |                                                                                                                        | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | -0.75 |       |                 | 0.75 |       |
| COM_ On-Leakage Current<br>(Note 5)                  | I <sub>COM_(ON)</sub>                     | V+ = +5.5V; V <sub>COM_-</sub> = +1V,<br>+4.5V; V <sub>NO_-</sub> = +1V, +4.5V,<br>or floating                         | T <sub>A</sub> = +25°C                                | -0.25 | ±0.01 |                 | 0.25 | nA    |
|                                                      |                                           |                                                                                                                        | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | -0.75 |       |                 | 0.75 |       |
| DIGITAL I/O                                          |                                           |                                                                                                                        |                                                       |       |       |                 |      |       |
| Input Logic High                                     | V <sub>IH</sub>                           |                                                                                                                        |                                                       | 2.4   |       |                 |      | V     |
| Input Logic Low                                      | V <sub>IL</sub>                           |                                                                                                                        |                                                       |       |       |                 | 0.8  | V     |
| Input Leakage Current                                | I <sub>IH</sub> , I <sub>IL</sub>         | V <sub>IN_-</sub> = 0 or V+                                                                                            |                                                       | -0.1  |       | 0.005           | 0.1  | μA    |
| Digital Input Capacitance                            | C <sub>IN</sub>                           |                                                                                                                        |                                                       |       |       | 2               |      | pF    |
| DYNAMIC                                              |                                           |                                                                                                                        |                                                       |       |       |                 |      |       |
| Transition Time (Note 5)                             | t <sub>TRANS</sub>                        | R <sub>L</sub> = 100Ω, C <sub>L</sub> = 35pF,<br>V <sub>NO1</sub> = +3V or 0,<br>V <sub>NO8</sub> = 0 or +3V, Figure 2 | T <sub>A</sub> = +25°C                                | 14    |       |                 | 18   | ns    |
|                                                      |                                           |                                                                                                                        | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |       |       |                 | 20   |       |

# 3.5Ω, Single 8:1 and Dual 4:1, Low-Voltage Analog Multiplexers

MAX4638/MAX4639

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

(V+ = +5V ±10%, V- = 0, VIH = +2.4V, VIL = +0.8V, TA = TMIN to TMAX, unless otherwise noted. Typical values are at TA = +25°C.) (Note 9)

| PARAMETER                     | SYMBOL     | CONDITIONS                                                         |                       | MIN   | TYP<br>(Note 2) | MAX | UNITS |
|-------------------------------|------------|--------------------------------------------------------------------|-----------------------|-------|-----------------|-----|-------|
| Break-Before-Make (Note 5)    | tBBM       | RL = 100Ω, CL = 35pF,<br>VNO- = +3V, Figure 3                      | TA = +25°C            |       | 8               |     | ns    |
|                               |            |                                                                    | TA = TMIN to TMAX     | 1     |                 |     |       |
| Enable Turn-On Time (Note 5)  | tON(EN)    | RL = 100Ω, CL = 35pF,<br>VNO1 = +3V, VNO2 to<br>VNO8 = 0, Figure 4 | TA = +25°C            |       | 14              | 18  | ns    |
|                               |            |                                                                    | TA = TMIN to TMAX     |       |                 | 20  |       |
| Enable Turn-Off Time (Note 5) | tOFF(EN)   | RL = 100Ω, CL = 35pF,<br>VNO1 = +3V, VNO2 to<br>VNO8 = 0, Figure 4 | TA = +25°C            |       | 5               | 7   | ns    |
|                               |            |                                                                    | TA = TMIN to TMAX     |       |                 | 8   |       |
| On-Channel -3dB Bandwidth     | BW         | Signal =<br>0dBm,<br>CL = 5pF,<br>50Ω in and<br>out, Figure 6      | MAX4638<br>TA = +25°C |       | 50              |     | MHz   |
|                               |            |                                                                    | MAX4639<br>TA = +25°C |       | 85              |     |       |
| Charge Injection              | Q          | VGEN = +2.5V, RGEN = 0,<br>CL = 1.0nF, Figure 5                    | TA = +25°C            |       | 13              |     | pC    |
| NO- Off-Capacitance           | CNO_(OFF)  | VNO- = 0V, f = 1MHz,<br>Figure 8                                   | TA = +25°C            |       | 9               |     | pF    |
| COM- Off-Capacitance          | CCOM_(OFF) | VCOM- = 0V,<br>f = 1MHz,<br>Figure 8                               | MAX4638<br>TA = +25°C |       | 40              |     | pF    |
|                               |            |                                                                    | MAX4639<br>TA = +25°C |       | 20              |     |       |
| Switch On-Capacitance         | C(ON)      | VCOM- =<br>VNO- = 0V,<br>f = 1MHz,<br>Figure 8                     | MAX4638<br>TA = +25°C |       | 54              |     | pF    |
|                               |            |                                                                    | MAX4639<br>TA = +25°C |       | 34              |     |       |
| Off-Isolation (Note 6)        | VISO       | CL = 5pF, RL = 50Ω,<br>f = 1MHz, VNO- =<br>1VRMS, Figure 6         | TA = +25°C            |       | -55             |     | dB    |
|                               |            | CL = 5pF, RL = 50Ω,<br>f = 10MHz, VNO- =<br>1VRMS, Figure 6        | TA = +25°C            |       | -75             |     |       |
| Crosstalk (Note 7)            | VCT        | CL = 5pF, RL = 50Ω,<br>f = 10MHz, VNO- =<br>1VRMS, Figure 7        | TA = +25°C            |       | -65             |     | dB    |
|                               |            | CL = 5pF, RL = 50Ω,<br>f = 1MHz, VNO- =<br>1VRMS, Figure 7         | TA = +25°C            |       | -85             |     |       |
| Total Harmonic Distortion     | THD        | RL = 600Ω,<br>RFLAT(ON)/RL                                         | TA = +25°C            |       | 0.5             |     | %     |
| <b>SUPPLY</b>                 |            |                                                                    |                       |       |                 |     |       |
| Positive Supply Current       | I+         | V+ = +5.5V, VIN = 0 or V+                                          |                       | 0.001 | 1.0             |     | μA    |

## 3.5Ω, Single 8:1 and Dual 4:1, Low-Voltage Analog Multiplexers

### ELECTRICAL CHARACTERISTICS—+3.0V Single Supply

(V+ = +2.7V to +3.3V, V- = 0, V<sub>IH</sub> = +2.0V, V<sub>IL</sub> = +0.4V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at V+ = +3V and T<sub>A</sub> = +25°C.) (Note 9)

| PARAMETER                                            | SYMBOL                                  | CONDITIONS                                                                         |                                                                                 | MIN   | TYP<br>(Note 2) | MAX  | UNITS |
|------------------------------------------------------|-----------------------------------------|------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|-------|-----------------|------|-------|
| ANALOG SWITCH                                        |                                         |                                                                                    |                                                                                 |       |                 |      |       |
| Analog Signal Range                                  | V <sub>COM_</sub> ,<br>V <sub>NO_</sub> |                                                                                    |                                                                                 | 0     |                 | V+   | V     |
| On-Resistance                                        | R <sub>ON</sub>                         | I <sub>COM_</sub> = 10mA,<br>V <sub>NO_</sub> = +1.7V                              | T <sub>A</sub> = +25°C<br>T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | 4.5   | 6               | 8    | Ω     |
| On-Resistance Match<br>Between Channels (Notes 3, 8) | ΔR <sub>ON</sub>                        | I <sub>COM_</sub> = 10mA,<br>V <sub>NO_</sub> = +1.7V                              | T <sub>A</sub> = +25°C<br>T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | 0.25  | 0.6             | 0.8  | Ω     |
| On-Resistance Flatness (Note 4)                      | R <sub>FLAT(ON)</sub>                   | I <sub>COM_</sub> = 10mA;<br>V <sub>NO_</sub> = +1.5V, +1.7V,<br>+1.9V             | T <sub>A</sub> = +25°C<br>T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | 1     | 2               | 2.5  | Ω     |
| NO_ Off-Leakage Current<br>(Note 5)                  | I <sub>NO_(OFF)</sub>                   | V+ = +3.3V;<br>V <sub>COM_</sub> = +1V, +3V;<br>V <sub>NO_</sub> = +3V, +1V        | T <sub>A</sub> = +25°C<br>T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | -0.25 | ±0.01           | 0.25 | nA    |
| COM_ Off-Leakage Current<br>(Note 5)                 | I <sub>COM_(OFF)</sub>                  | V+ = +3.3V;<br>V <sub>COM_</sub> = +1V, +3V;<br>V <sub>NO_</sub> = +3V, +1V        | T <sub>A</sub> = +25°C<br>T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | -0.25 | ±0.01           | 0.25 | nA    |
| COM_ On-Leakage Current<br>(Note 5)                  | I <sub>COM_(ON)</sub>                   | V+ = +3.3V; V <sub>COM_</sub> = +1V, +3V; V <sub>NO_</sub> = +1V, +3V, or floating | T <sub>A</sub> = +25°C<br>T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | -0.25 | ±0.01           | 0.25 | nA    |
| DIGITAL I/O                                          |                                         |                                                                                    |                                                                                 |       |                 |      |       |
| Input Logic High                                     | V <sub>IH</sub>                         |                                                                                    |                                                                                 | 2.0   |                 |      | V     |
| Input Logic Low                                      | V <sub>IL</sub>                         |                                                                                    |                                                                                 |       |                 | 0.4  | V     |
| Input Leakage Current                                | I <sub>IH</sub> , I <sub>IL</sub>       | V <sub>IN_</sub> = 0 or V+                                                         |                                                                                 | -0.1  | 0.005           | 0.1  | μA    |
| Digital Input Capacitance                            | C <sub>IN</sub>                         |                                                                                    |                                                                                 |       | 2               |      | pF    |
| DYNAMIC                                              |                                         |                                                                                    |                                                                                 |       |                 |      |       |
| Transition Time (Note 5)                             | t <sub>TRANS</sub>                      | V <sub>NO_</sub> = +2V, C <sub>L</sub> = 35pF,<br>R <sub>L</sub> = 100Ω, Figure 2  | T <sub>A</sub> = +25°C<br>T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | 16    | 20              | 24   | ns    |
| Break-Before-Make (Note 5)                           | t <sub>BBM</sub>                        | V <sub>NO_</sub> = +2V, C <sub>L</sub> = 35pF,<br>R <sub>L</sub> = 100Ω, Figure 3  | T <sub>A</sub> = +25°C<br>T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | 8     | 1               |      | ns    |
| Enable Turn-On Time (Note 5)                         | t <sub>ON(EN)</sub>                     | V <sub>NO_</sub> = +2V, C <sub>L</sub> = 35pF,<br>R <sub>L</sub> = 100Ω, Figure 4  | T <sub>A</sub> = +25°C<br>T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | 15    | 20              | 24   | ns    |
| Enable Turn-Off Time (Note 5)                        | t <sub>OFF(EN)</sub>                    | V <sub>NO_</sub> = +2V, C <sub>L</sub> = 35pF,<br>R <sub>L</sub> = 100Ω, Figure 4  | T <sub>A</sub> = +25°C<br>T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | 5     | 9               | 10   | ns    |

# 3.5Ω, Single 8:1 and Dual 4:1, Low-Voltage Analog Multiplexers

MAX4638/MAX4639

## ELECTRICAL CHARACTERISTICS—+3.0V Single Supply (continued)

(V<sub>+</sub> = +2.7V to +3.3V, V<sub>-</sub> = 0, V<sub>IH</sub> = +2.0V, V<sub>IL</sub> = +0.4V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at V<sub>+</sub> = +3V and T<sub>A</sub> = +25°C.) (Note 9)

| PARAMETER                 | SYMBOL                 | CONDITIONS                                                                                                    |                        | MIN                    | TYP<br>(Note 2) | MAX | UNITS |
|---------------------------|------------------------|---------------------------------------------------------------------------------------------------------------|------------------------|------------------------|-----------------|-----|-------|
| Off-Isolation (Note 6)    | V <sub>ISO</sub>       | C <sub>L</sub> = 5pF, R <sub>L</sub> = 50Ω,<br>f = 10MHz,<br>V <sub>NO_</sub> = +1V <sub>RMS</sub> , Figure 6 | T <sub>A</sub> = +25°C |                        | 55              |     | dB    |
|                           |                        | C <sub>L</sub> = 5pF, R <sub>L</sub> = 50Ω,<br>f = 1MHz, V <sub>NO_</sub> = 1V <sub>RMS</sub> ,<br>Figure 6   | T <sub>A</sub> = +25°C |                        | -75             |     |       |
| Crosstalk (Note 7)        | V <sub>CT</sub>        | C <sub>L</sub> = 5pF, R <sub>L</sub> = 50Ω,<br>f = 10MHz, V <sub>NO_</sub> = 1V <sub>RMS</sub> ,<br>Figure 7  | T <sub>A</sub> = +25°C |                        | -65             |     | dB    |
|                           |                        | C <sub>L</sub> = 5pF, R <sub>L</sub> = 50Ω,<br>f = 1MHz, V <sub>NO_</sub> = 1V <sub>RMS</sub> ,<br>Figure 7   | T <sub>A</sub> = +25°C |                        | -85             |     |       |
| On-Channel -3dB Bandwidth | BW                     | Signal =<br>0dBm, 50Ω in<br>and out,<br>Figure 6                                                              | MAX4638                | T <sub>A</sub> = +25°C |                 | 50  | MHz   |
|                           |                        |                                                                                                               | MAX4639                | T <sub>A</sub> = +25°C |                 | 85  |       |
| NO_ Off-Capacitance       | C <sub>NO_(OFF)</sub>  | V <sub>NO_</sub> = 0V, f = 1MHz,<br>Figure 8                                                                  |                        | T <sub>A</sub> = +25°C |                 | 9   | pF    |
| COM_ Off-Capacitance      | C <sub>COM_(OFF)</sub> | V <sub>COM_</sub> = 0V,<br>f = 1MHz,<br>Figure 8                                                              | MAX4638                | T <sub>A</sub> = +25°C |                 | 40  | pF    |
|                           |                        |                                                                                                               | MAX4639                | T <sub>A</sub> = +25°C |                 | 20  |       |
| Switch On-Capacitance     | C <sub>(ON)</sub>      | V <sub>COM</sub> = V <sub>NO_</sub><br>= 0V,<br>f = 1MHz,<br>Figure 8                                         | MAX4638                | T <sub>A</sub> = +25°C |                 | 54  | pF    |
|                           |                        |                                                                                                               | MAX4639                | T <sub>A</sub> = +25°C |                 | 34  |       |
| SUPPLY                    |                        |                                                                                                               |                        |                        |                 |     |       |
| Positive Supply Current   | I+                     | V+ = +3.3V, V <sub>IN_</sub> = 0 or V+                                                                        |                        |                        | 0.001           | 1   | μA    |

## ELECTRICAL CHARACTERISTICS—±2.5V Dual Supplies

(V<sub>+</sub> = +2.5 ±10%, V<sub>-</sub> = -2.5V ±10%, V<sub>IH</sub> = +2.0V, V<sub>IL</sub> = +0.4V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at V<sub>±</sub> = ±2.5V and T<sub>A</sub> = +25°C.)

| PARAMETER                                            | SYMBOL                                  | CONDITIONS                                                                      |                                                       | MIN | TYP<br>(Note 2) | MAX | UNITS |
|------------------------------------------------------|-----------------------------------------|---------------------------------------------------------------------------------|-------------------------------------------------------|-----|-----------------|-----|-------|
| ANALOG SWITCH                                        |                                         |                                                                                 |                                                       |     |                 |     |       |
| Analog Signal Range                                  | V <sub>COM-</sub> ,<br>V <sub>NO-</sub> |                                                                                 |                                                       | V-  |                 | V+  | V     |
| On-Resistance                                        | R <sub>ON</sub>                         | I <sub>COM-</sub> = 10mA, V <sub>NO-</sub> = ±1.5V,<br>V+ = +2.25V, V- = -2.25V | T <sub>A</sub> = +25°C                                | 2.5 | 3.5             | Ω   |       |
|                                                      |                                         |                                                                                 | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |     | 4.5             |     |       |
| On-Resistance Match<br>Between Channels (Notes 3, 8) | ΔR <sub>ON</sub>                        | I <sub>COM-</sub> = 10mA, V <sub>NO-</sub> = ±1.5V,<br>V+ = +2.25V, V- = -2.25V | T <sub>A</sub> = +25°C                                | 0.2 | 0.4             | Ω   |       |
|                                                      |                                         |                                                                                 | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |     | 0.5             |     |       |

## 3.5Ω, Single 8:1 and Dual 4:1, Low-Voltage Analog Multiplexers

### ELECTRICAL CHARACTERISTICS—±2.5V Dual Supplies (continued)

(V<sub>+</sub> = +2.5 ±10%, V<sub>-</sub> = -2.5V ±10%, V<sub>IH</sub> = +2.0V, V<sub>IL</sub> = +0.4V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at V<sub>±</sub> = ±2.5V and T<sub>A</sub> = +25°C.)

| PARAMETER                            | SYMBOL                            | CONDITIONS                                                                                                   |                                                       | MIN   | TYP<br>(Note 2) | MAX   | UNITS |    |
|--------------------------------------|-----------------------------------|--------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|-------|-----------------|-------|-------|----|
| On-Resistance Flatness<br>(Note 4)   | R <sub>FLAT(ON)</sub>             | I <sub>COM</sub> _ = 10mA; V <sub>NO</sub> _ = ±1.5V,<br>0; V+ = +2.25V; V- = -2.25V                         | T <sub>A</sub> = +25°C                                | 0.75  |                 | 1     | Ω     |    |
|                                      |                                   |                                                                                                              | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | 1.2   |                 |       |       |    |
| NO_ Off-Leakage<br>Current (Note 5)  | I <sub>NO</sub> _ (OFF)           | V+ = +2.75V; V- = -2.75V;<br>V <sub>COM</sub> _ = +1V, +2.5V;<br>V <sub>NO</sub> _ = +2.5V, +1V              | T <sub>A</sub> = +25°C                                | -0.25 | ±0.01           | 0.25  | nA    |    |
|                                      |                                   |                                                                                                              | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | -0.35 | 0.35            |       |       |    |
| COM_ Off-Leakage<br>Current (Note 5) | I <sub>COM</sub> _ (OFF)          | V+ = +2.75V; V- = -2.75;<br>V <sub>COM</sub> _ = +1V, +2.5V;<br>V <sub>NO</sub> _ = +2.5V, +1V               | T <sub>A</sub> = +25°C                                | -0.25 | ±0.01           | 0.25  | nA    |    |
|                                      |                                   |                                                                                                              | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | -0.35 | 0.35            |       |       |    |
| COM_ On-Leakage<br>Current (Note 5)  | I <sub>COM</sub> _ (ON)           | V+ = +2.5V; V- = -2.5;<br>V <sub>COM</sub> _ = +1V, +2.5V;<br>V <sub>NO</sub> _ = +1V, +2.5V, or<br>floating | T <sub>A</sub> = +25°C                                | -0.25 | ±0.01           | 0.25  | nA    |    |
|                                      |                                   |                                                                                                              | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | -0.35 | 0.35            |       |       |    |
| DIGITAL I/O                          |                                   |                                                                                                              |                                                       |       |                 |       |       |    |
| Input Logic High                     | V <sub>IH</sub>                   |                                                                                                              |                                                       | 2.0   |                 |       | V     |    |
| Input Logic Low                      | V <sub>IL</sub>                   |                                                                                                              |                                                       |       |                 | 0.4   | V     |    |
| Input Leakage Current                | I <sub>IH</sub> , I <sub>IL</sub> | V <sub>IN</sub> _ = 0 or V+                                                                                  |                                                       |       | -0.1            | 0.005 | 0.1   | μA |
| Digital Input Capacitance            | C <sub>IN</sub>                   |                                                                                                              |                                                       | 2     |                 |       | pF    |    |
| DYNAMIC                              |                                   |                                                                                                              |                                                       |       |                 |       |       |    |
| Transition Time (Note 5)             | t <sub>TRANS</sub>                | V <sub>NO</sub> _ = +1.2V, C <sub>L</sub> = 35pF,<br>R <sub>L</sub> = 100Ω, Figure 2                         | T <sub>A</sub> = +25°C                                | 16    |                 | 20    | ns    |    |
|                                      |                                   |                                                                                                              | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | 24    |                 |       |       |    |
| Enable Turn-On Time<br>(Note 5)      | t <sub>ON(EN)</sub>               | V <sub>NO</sub> _ = +1.2V, C <sub>L</sub> = 35pF,<br>R <sub>L</sub> = 100Ω, Figure 4                         | T <sub>A</sub> = +25°C                                | 14    |                 | 18    | ns    |    |
|                                      |                                   |                                                                                                              | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | 20    |                 |       |       |    |
| Enable Turn-Off Time<br>(Note 5)     | t <sub>OFF(EN)</sub>              | V <sub>NO</sub> _ = +1.2V, C <sub>L</sub> = 35pF,<br>R <sub>L</sub> = 100Ω, Figure 4                         | T <sub>A</sub> = +25°C                                | 5     |                 | 7     | ns    |    |
|                                      |                                   |                                                                                                              | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | 8     |                 |       |       |    |
| Break-Before-Make (Note 5)           | t <sub>BBM</sub>                  | V <sub>NO</sub> _ = +1.2V, C <sub>L</sub> = 35pF,<br>R <sub>L</sub> = 100Ω, Figure 3                         | T <sub>A</sub> = +25°C                                | 8     |                 |       | ns    |    |
|                                      |                                   |                                                                                                              | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | 1     |                 |       |       |    |

**Note 2:** The algebraic convention, where the most negative value is a minimum and the most positive value a maximum, is used in this data sheet.

**Note 3:** ΔRON = RON(MAX) - RON(MIN).

**Note 4:** Flatness is defined as the difference between the maximum and minimum value of on-resistance as measured over the specified analog signal ranges.

**Note 5:** Guaranteed by design.

**Note 6:** Off-Isolation = 20log<sub>10</sub> (V<sub>COM</sub> / V<sub>NO</sub>), V<sub>COM</sub> = output, V<sub>NO</sub> = input to off switch.

**Note 7:** Between any two switches.

**Note 8:** ΔRON matching specifications for thin QFN packaged parts are guaranteed by design.

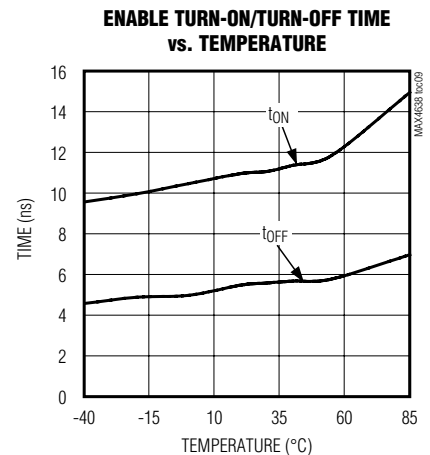
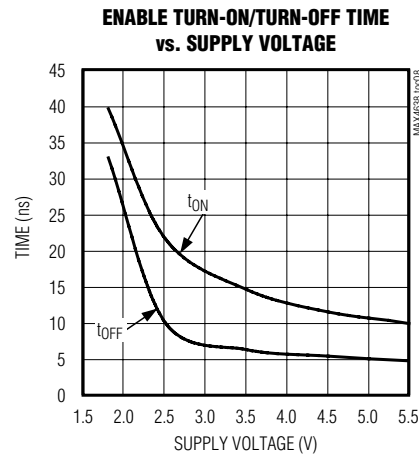
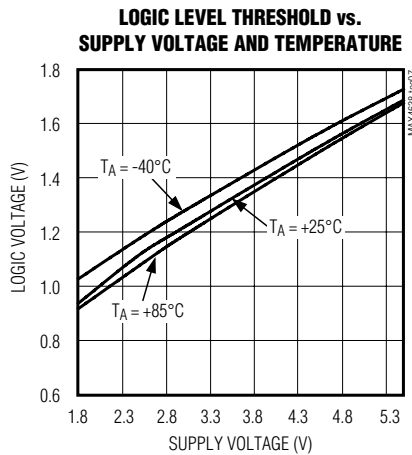
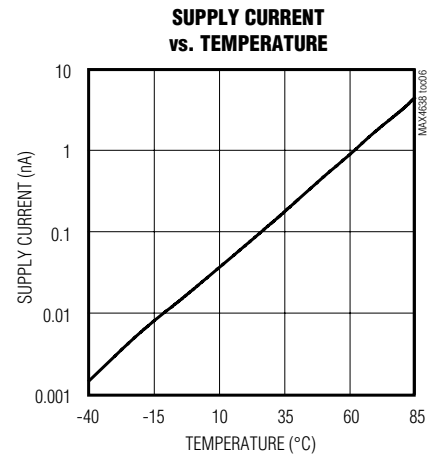
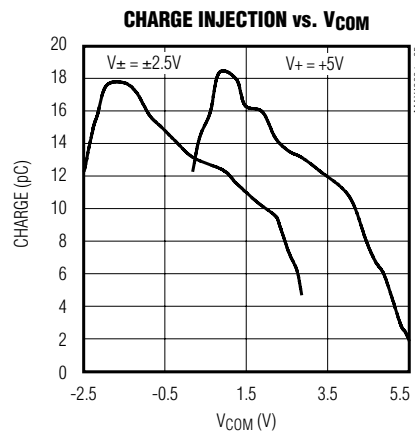
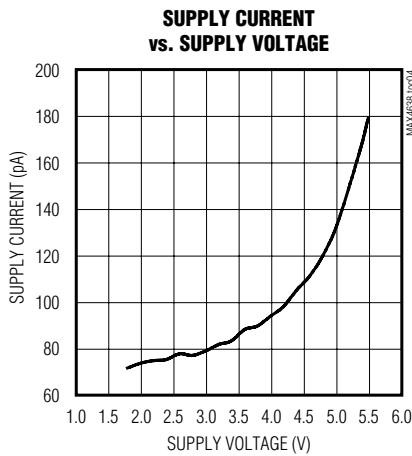
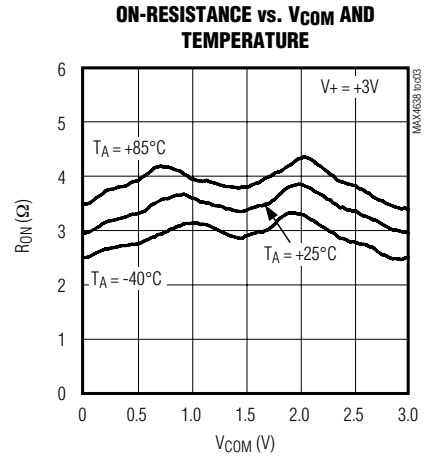
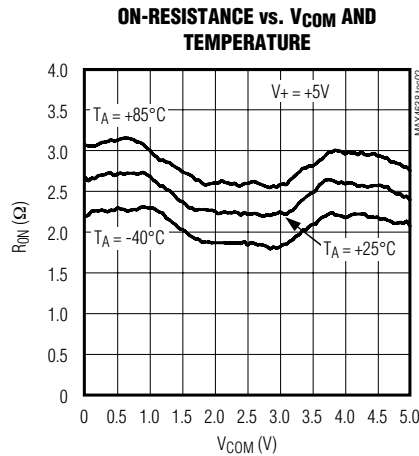
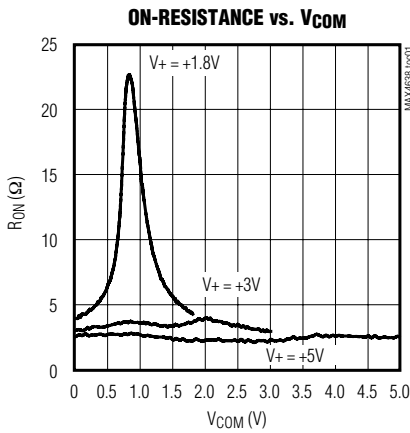
**Note 9:** Parts are tested at +85°C and guaranteed by design over the entire temperature range.

# 3.5 $\Omega$ , Single 8:1 and Dual 4:1, Low-Voltage Analog Multiplexers

## Typical Operating Characteristics

( $V_+ = +5V$ ,  $V_- = 0$ ,  $T_A = +25^\circ C$ , unless otherwise noted.)

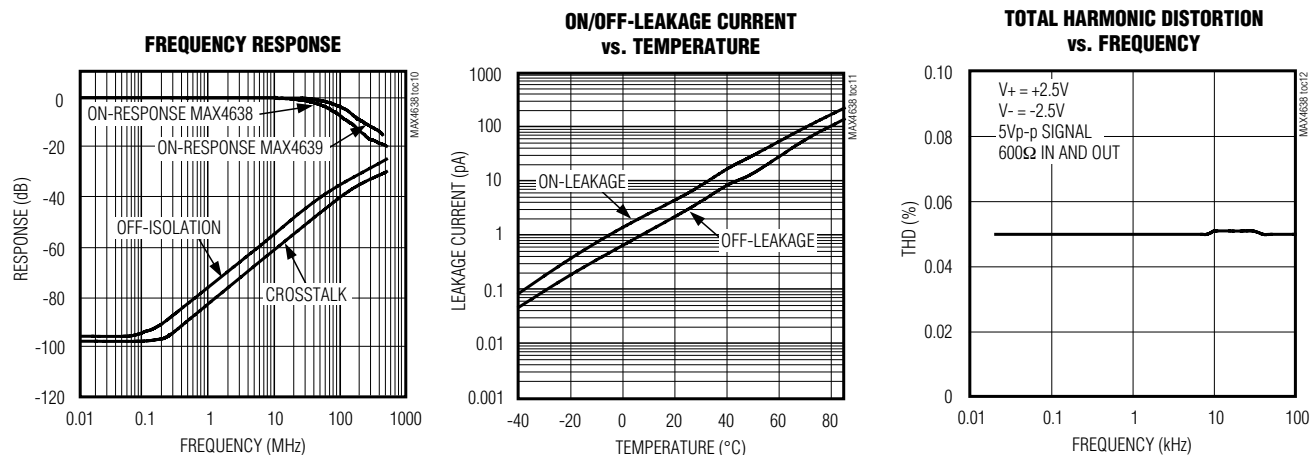
MAX4638/MAX4639



# 3.5Ω, Single 8:1 and Dual 4:1, Low-Voltage Analog Multiplexers

## Typical Operating Characteristics (continued)

(V<sub>+</sub> = +5V, V<sub>-</sub> = 0, T<sub>A</sub> = +25°C, unless otherwise noted.)



## Pin Description

| PIN       |            |              |         |          |               | NAME       | FUNCTION                                 |
|-----------|------------|--------------|---------|----------|---------------|------------|------------------------------------------|
| MAX4638   |            |              | MAX4639 |          |               |            |                                          |
| DIP/SO    | THIN QFN   |              | DIP/SO  | THIN QFN |               |            |                                          |
|           | 16-PIN     | 20-PIN       |         | 16-PIN   | 20-PIN        |            |                                          |
| 1, 15, 16 | 15, 14, 13 | 19, 18, 17   | —       | —        | —             | A0, A2, A1 | Address Inputs                           |
| —         | —          | —            | 1, 16   | 15, 14   | 19, 17        | A0, A1     | Address Inputs                           |
| 2         | 16         | 1            | 2       | 16       | 1             | EN         | Enable                                   |
| 3         | 1          | 2            | 3       | 1        | 2             | V-         | Negative-Supply Voltage Input            |
| 4–7       | 2–5        | 3–6          | —       | —        | —             | NO1–NO4    | Bidirectional Analog Inputs              |
| —         | —          | —            | 4–7     | 2–5      | 3–6           | NO1A–NO4A  | Bidirectional Analog Inputs              |
| 8         | 6          | 7            | —       | —        | —             | COM        | Bidirectional Analog outputs             |
| —         | —          | —            | 8, 9    | 6, 7     | 7, 9          | COMA, COMB | Bidirectional Analog outputs             |
| 9–12      | 7–10       | 10–13        | —       | —        | —             | NO8–NO5    | Bidirectional Analog Inputs              |
| —         | —          | —            | 10–13   | 8–11     | 10–13         | NO4B–NO1B  | Bidirectional Analog Inputs              |
| 13        | 11         | 14           | 14      | 12       | 14            | V+         | Positive-Supply Voltage Input            |
| 14        | 12         | 15           | 15      | 13       | 15            | GND        | Ground                                   |
| —         | —          | 8, 9, 16, 20 | —       | —        | 8, 16, 18, 20 | N.C.       | No Connection. Not internally connected. |
| —         | EP         | EP           | —       | EP       | EP            | PAD        | Exposed Pad. Connect to V-.              |

# 3.5Ω, Single 8:1 and Dual 4:1, Low-Voltage Analog Multiplexers

## Detailed Description

The MAX4638/MAX4639 are low-voltage, CMOS analog muxes. The MAX4638 is an 8:1 mux that switches one of eight inputs (NO1–NO8) to a common output (COM) as determined by the 3-bit binary inputs A0, A1, and A2. The MAX4639 is a 4:1 dual mux that switches one of four differential inputs to a common differential output as determined by the 2-bit binary inputs A0 and A1. Both the MAX4638/MAX4639 have an EN input that can be used to enable or disable the device. When disabled, all channels are switched off. See Truth Tables.

## Applications Information

### Overvoltage Protection

Proper power-supply sequencing is recommended for all CMOS devices. Do not exceed the absolute maximum ratings because stresses beyond the listed ratings can cause permanent damage to the devices. Always sequence V+ on first, then V-, followed by the logic inputs. If power-supply sequencing is not possible, add two small-signal diodes (D1, D2) in series with the supply pins for overvoltage protection (Figure 1). Adding diodes reduces the analog signal range to one diode drop below V+ and one diode drop above V-, but does not affect the devices' low switch resistance. Device operation is unchanged, and the difference between V+ and V- should not exceed 6V. These protection diodes are not recommended when using a single supply. For single-supply operation, V- should be connected to GND as close to the device as possible.

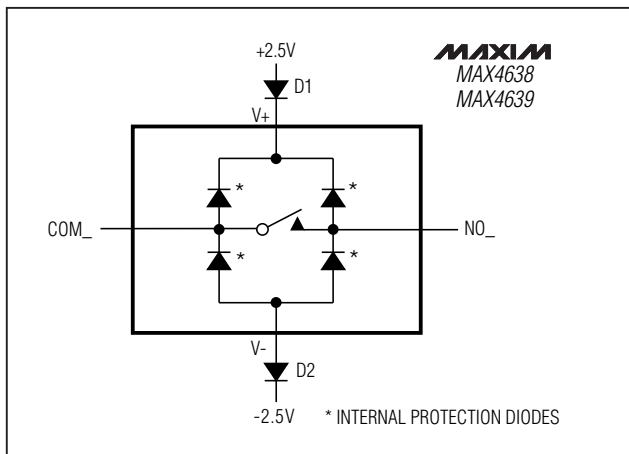


Figure 1. Overvoltage Protection Using External Blocking Diodes

## Ordering Information (continued)

| PART       | TEMP RANGE     | PIN-PACKAGE         |
|------------|----------------|---------------------|
| MAX4639ETE | -40°C to +85°C | 16 Thin QFN (4 × 4) |
| MAX4639EUE | -40°C to +85°C | 16 TSSOP            |
| MAX4639ESE | -40°C to +85°C | 16 SO               |
| MAX4639ETP | -40°C to +85°C | 20 Thin QFN (4 × 4) |

## Truth Tables

### MAX4638 (Single 8-to-1 Mux)

| A2 | A1 | A0 | EN | ON SWITCH |
|----|----|----|----|-----------|
| X  | X  | X  | 0  | None      |
| 0  | 0  | 0  | 1  | NO1       |
| 0  | 0  | 1  | 1  | NO2       |
| 0  | 1  | 0  | 1  | NO3       |
| 0  | 1  | 1  | 1  | NO4       |
| 1  | 0  | 0  | 1  | NO5       |
| 1  | 0  | 1  | 1  | NO6       |
| 1  | 1  | 0  | 1  | NO7       |
| 1  | 1  | 1  | 1  | NO8       |

### MAX4639 (Dual 4-to-1 Mux)

| A1 | A0 | EN | COMA | COMB |
|----|----|----|------|------|
| X  | X  | 0  | None | None |
| 0  | 0  | 1  | NO1A | NO1B |
| 0  | 1  | 1  | NO2A | NO2B |
| 1  | 0  | 1  | NO3A | NO3B |
| 1  | 1  | 1  | NO4A | NO4B |

# 3.5Ω, Single 8:1 and Dual 4:1, Low-Voltage Analog Multiplexers

## Test Circuits/Timing Diagrams

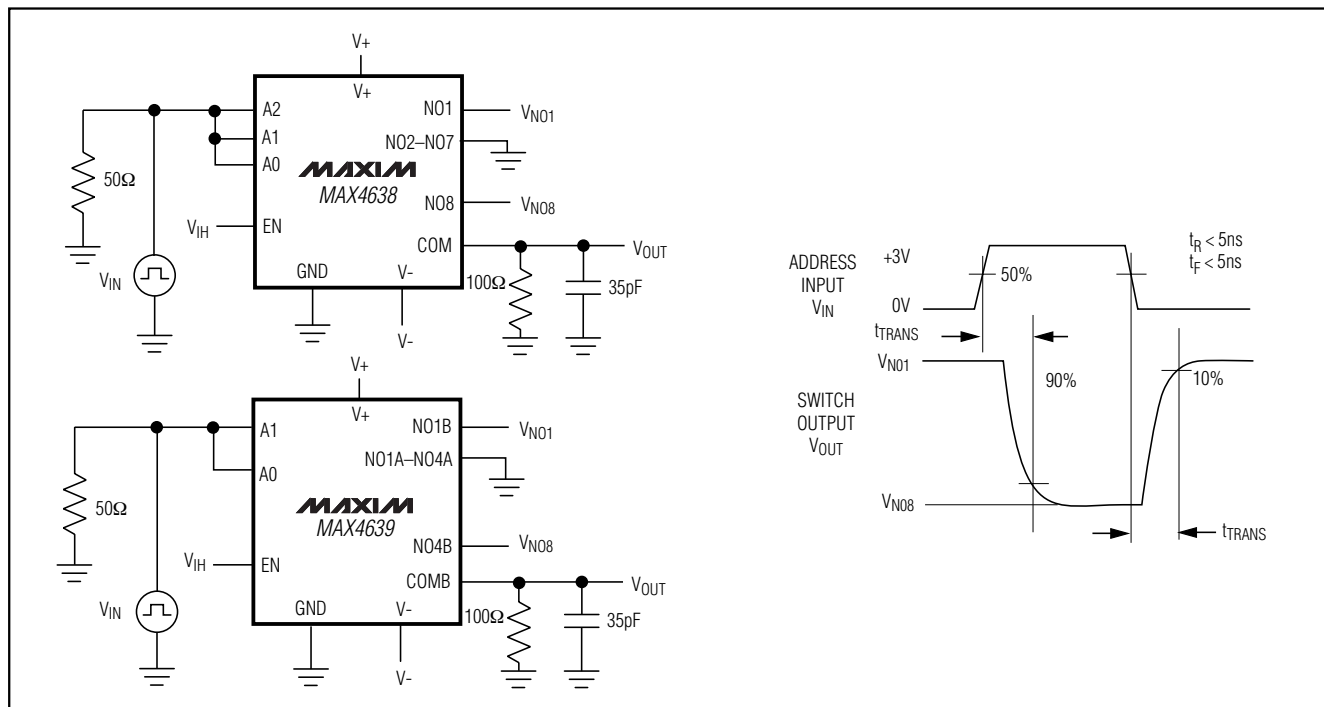


Figure 2. Transition Time

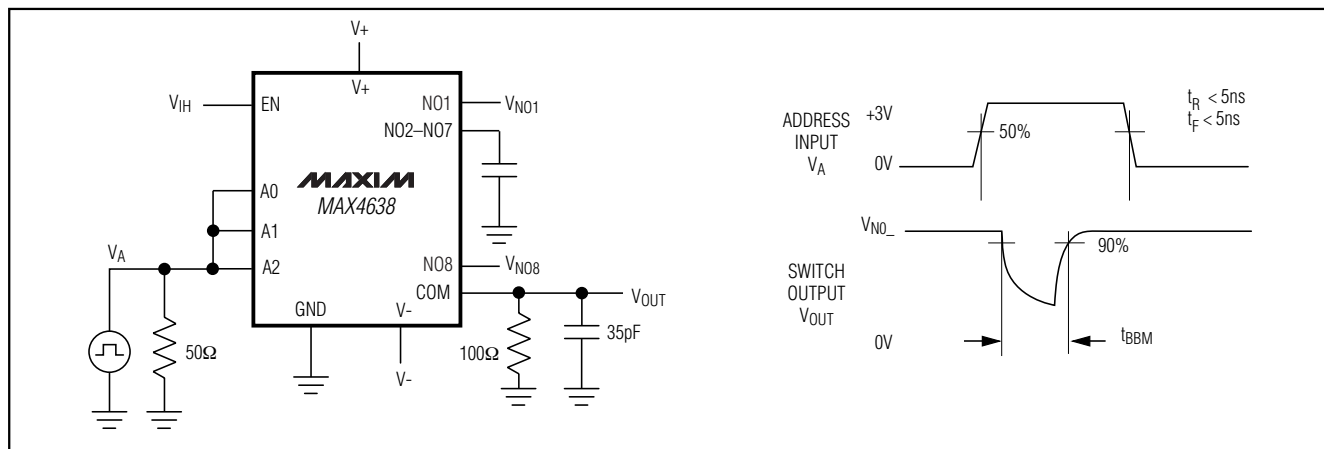


Figure 3. MAX4638 Break-Before-Make Interval

# 3.5Ω, Single 8:1 and Dual 4:1, Low-Voltage Analog Multiplexers

## Test Circuits/Timing Diagrams (continued)

MAX4638/MAX4639

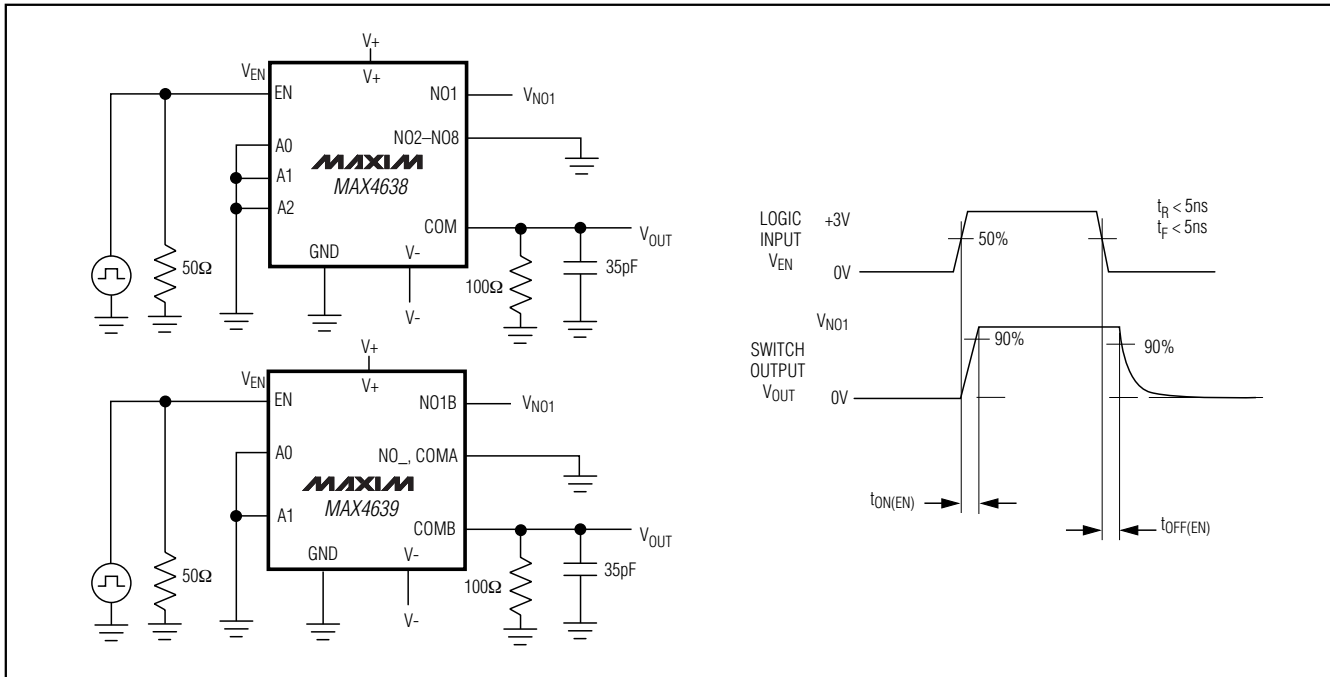


Figure 4. Enable Switching Time

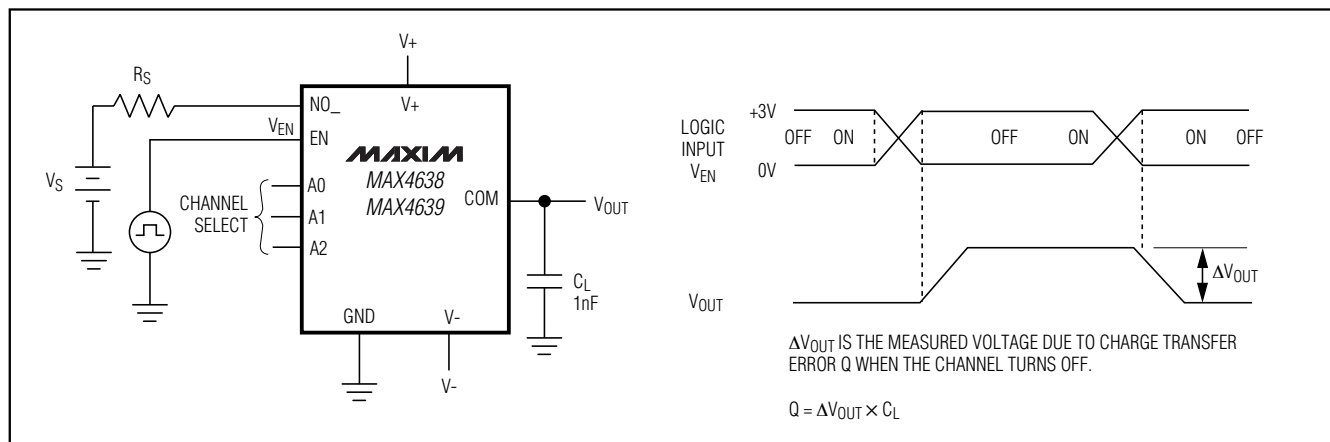


Figure 5. Charge Injection

# 3.5Ω, Single 8:1 and Dual 4:1, Low-Voltage Analog Multiplexers

## Test Circuits/Timing Diagrams (continued)

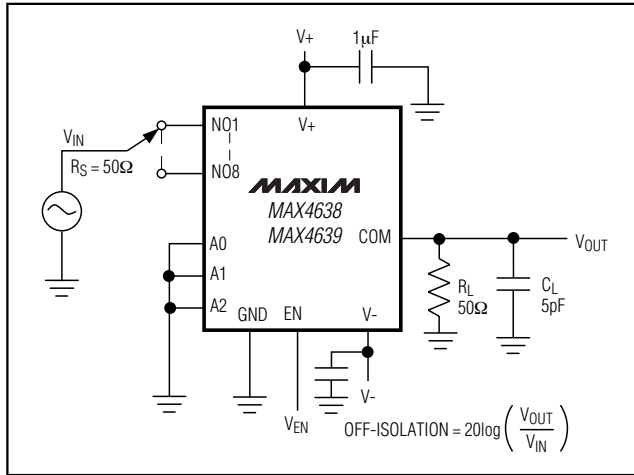


Figure 6. Off-Isolation/On-Channel Bandwidth

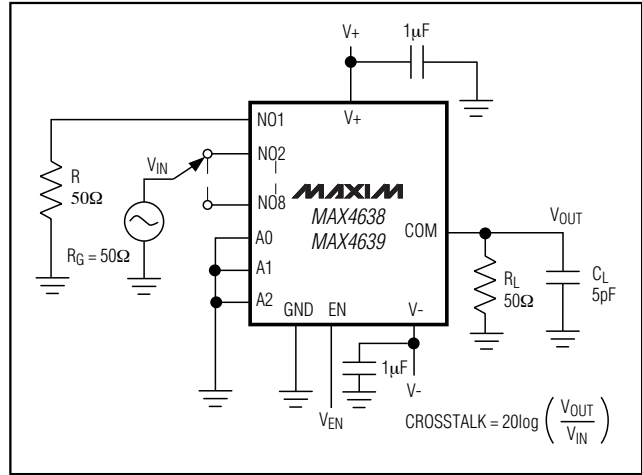


Figure 7. Crosstalk

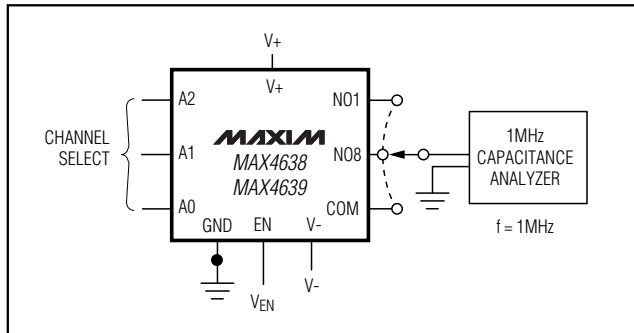


Figure 8. Channel Off/On-Capacitance

## Chip Information

TRANSISTOR COUNT: 632

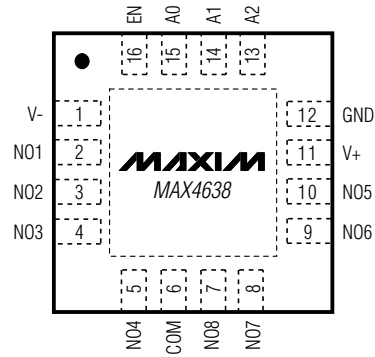
**Note:** Exposed pad on thin QFN packages is connected to V-.

# 3.5Ω, Single 8:1 and Dual 4:1, Low-Voltage Analog Multiplexers

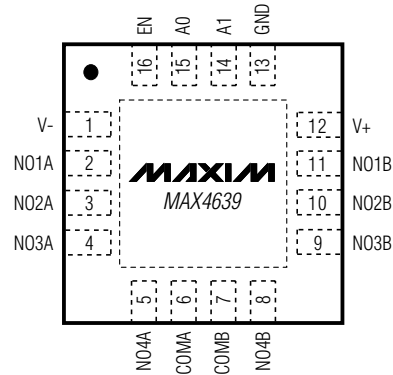
## Pin Configurations (continued)

**MAX4638/MAX4639**

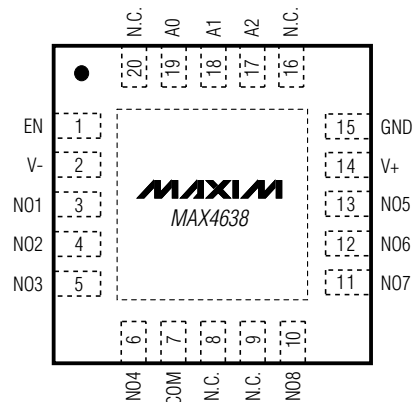
TOP VIEW



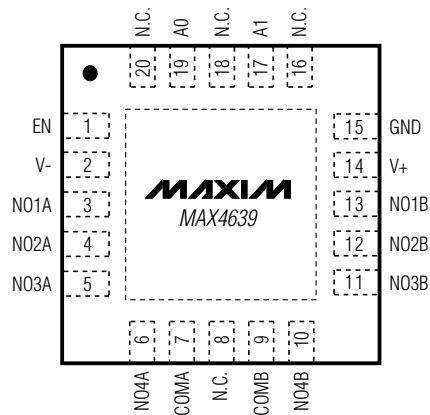
THIN QFN



THIN QFN



THIN QFN

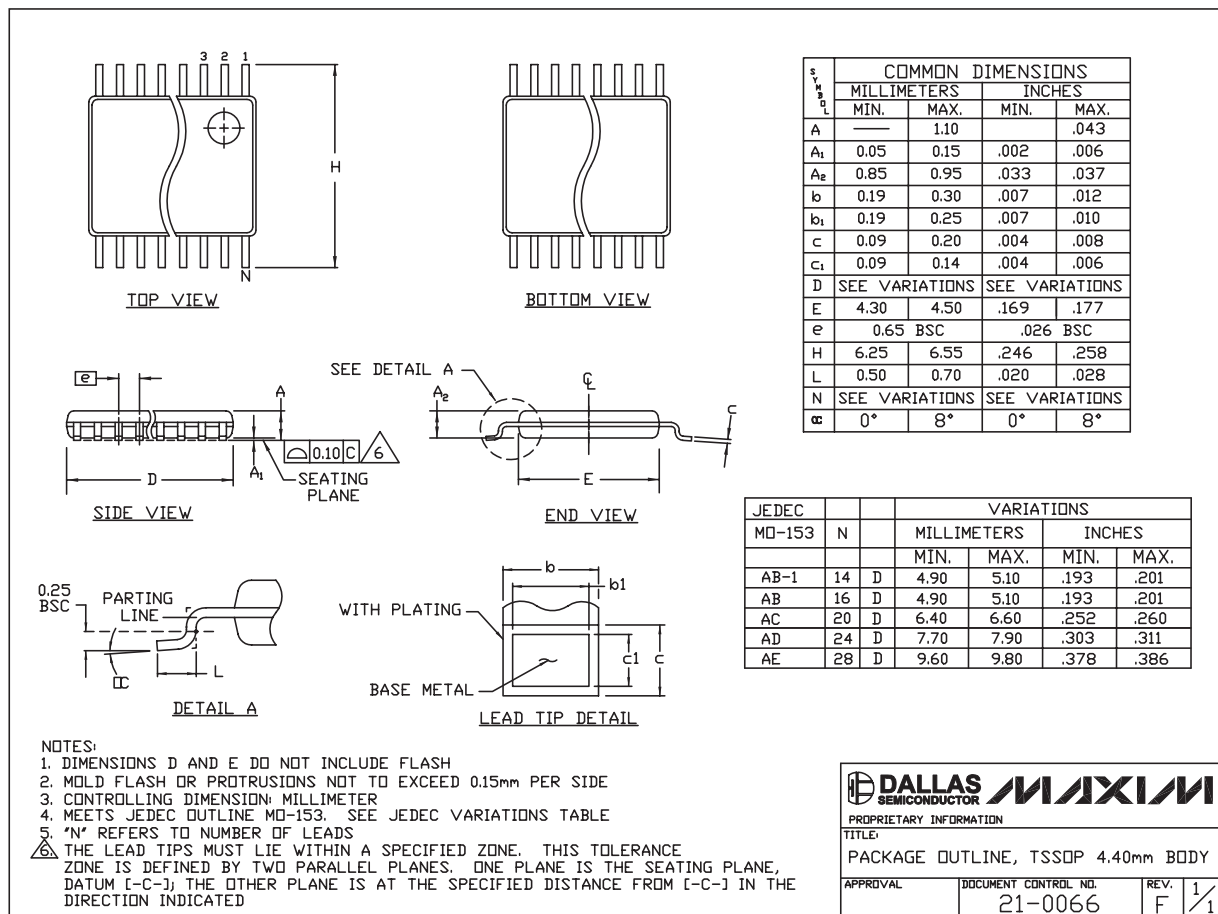


THIN QFN

# 3.5Ω, Single 8:1 and Dual 4:1, Low-Voltage Analog Multiplexers

## Package Information

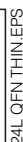
(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to [www.maxim-ic.com/packages](http://www.maxim-ic.com/packages).)



TSSOP4.40mm.EPS

**MAX4638/MAX4639**

(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).)



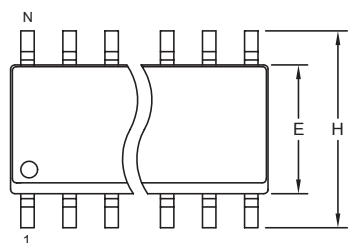
| PKG.<br>CODES | EXPPOSED PAD VARIATIONS |      |      |      |      |      | HVN<br>INDV.<br>CODE |
|---------------|-------------------------|------|------|------|------|------|----------------------|
|               | D2                      |      |      | E2   |      |      |                      |
|               | MIN.                    | NOM. | MAX. | MIN. | NOM. | MAX. |                      |
| T1244-2       | 1.95                    | 2.30 | 2.25 | 1.95 | 2.10 | 2.25 | NO                   |
| T1244-3       | 1.95                    | 2.30 | 2.25 | 1.95 | 2.10 | 2.25 | YES                  |
| T1244-4       | 1.95                    | 2.30 | 2.25 | 1.95 | 2.10 | 2.25 | NO                   |
| T1644-2       | 1.95                    | 2.30 | 2.25 | 1.95 | 2.10 | 2.25 | NO                   |
| T1644-3       | 1.95                    | 2.30 | 2.25 | 1.95 | 2.10 | 2.25 | YES                  |
| T1644-4       | 1.95                    | 2.30 | 2.25 | 1.95 | 2.10 | 2.25 | NO                   |
| T2044-1       | 1.95                    | 2.30 | 2.25 | 1.95 | 2.10 | 2.25 | NO                   |
| T2044-2       | 1.95                    | 2.30 | 2.25 | 1.95 | 2.10 | 2.25 | YES                  |
| T2044-3       | 1.95                    | 2.30 | 2.25 | 1.95 | 2.10 | 2.25 | NO                   |
| T2444-1       | 2.45                    | 2.60 | 2.63 | 2.45 | 2.60 | 2.63 | YES                  |
| T2444-2       | 1.95                    | 2.30 | 2.25 | 1.95 | 2.10 | 2.25 | YES                  |
| T2444-3       | 2.45                    | 2.60 | 2.63 | 2.45 | 2.60 | 2.63 | YES                  |
| T2444-4       | 2.45                    | 2.60 | 2.63 | 2.45 | 2.60 | 2.63 | NO                   |



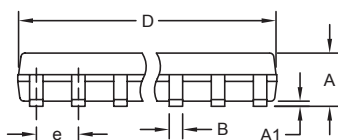
# 3.5Ω, Single 8:1 and Dual 4:1, Low-Voltage Analog Multiplexers

## Package Information (continued)

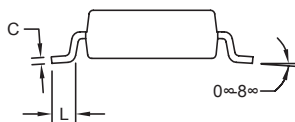
(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to [www.maxim-ic.com/packages](http://www.maxim-ic.com/packages).)



TOP VIEW



FRONT VIEW



SIDE VIEW

### NOTES:

1. D&E DO NOT INCLUDE MOLD FLASH.
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED 0.15mm (.006").
3. LEADS TO BE COPLANAR WITHIN 0.10mm (.004").
4. CONTROLLING DIMENSION: MILLIMETERS.
5. MEETS JEDEC MS012.
6. N = NUMBER OF PINS.

| DIM | INCHES    |       | MILLIMETERS |      |
|-----|-----------|-------|-------------|------|
|     | MIN       | MAX   | MIN         | MAX  |
| A   | 0.053     | 0.069 | 1.35        | 1.75 |
| A1  | 0.004     | 0.010 | 0.10        | 0.25 |
| B   | 0.014     | 0.019 | 0.35        | 0.49 |
| C   | 0.007     | 0.010 | 0.19        | 0.25 |
| e   | 0.050 BSC |       | 1.27 BSC    |      |
| E   | 0.150     | 0.157 | 3.80        | 4.00 |
| H   | 0.228     | 0.244 | 5.80        | 6.20 |
| L   | 0.016     | 0.050 | 0.40        | 1.27 |

### VARIATIONS:

| DIM | INCHES |       | MILLIMETERS |       | N  | MS012 |
|-----|--------|-------|-------------|-------|----|-------|
|     | MIN    | MAX   | MIN         | MAX   |    |       |
| D   | 0.189  | 0.197 | 4.80        | 5.00  | 8  | AA    |
| D   | 0.337  | 0.344 | 8.55        | 8.75  | 14 | AB    |
| D   | 0.386  | 0.394 | 9.80        | 10.00 | 16 | AC    |

SOICN .EPS

|                                                             |                                                       |
|-------------------------------------------------------------|-------------------------------------------------------|
|                                                             |                                                       |
| <small>PROPRIETARY INFORMATION</small>                      |                                                       |
| <small>TITLE:</small><br><b>PACKAGE OUTLINE, .150" SOIC</b> |                                                       |
| <small>APPROVAL</small>                                     | <small>DOCUMENT CONTROL NO.</small><br><b>21-0041</b> |
| <small>REV.</small><br><b>B</b>                             | <small>1/1</small>                                    |

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