19-1708; Rev 3; 12/06

# 3V/5V, 4Ω, Wideband Quad 2:1 Analog Multiplexer



## General Description

The MAX4674 is a low-voltage CMOS analog switch containing four 2:1 multiplexers/demultiplexer. When powered from a single +5V supply, it features a low 4Ω max on-resistance ($R_{ON}$), 0.4Ω max $R_{ON}$ matching between channels, and 0.8Ω RON flatness over the entire signal range. Off-leakage current is only 0.5nA max at +25°C.

The MAX4674 features fast turn-on ($t_{ON}$) and turn-off ($t_{OFF}$) times of 18ns and 6ns, respectively, and is available in QFN, QSOP, TSSOP, and SO packages.

This low-voltage multiplexer operates with a +1.8V to +5.5V single supply. All digital inputs have +0.8V and +2.4V logic thresholds, ensuring TTL/CMOS-logic compatibility with +5V operation.

## Applications

10/100 Base-T

ATM Switching

Audio and Video Signal Routing

Low-Voltage Data-Acquisition Systems

Communications Circuits

Relay Replacement

## Features

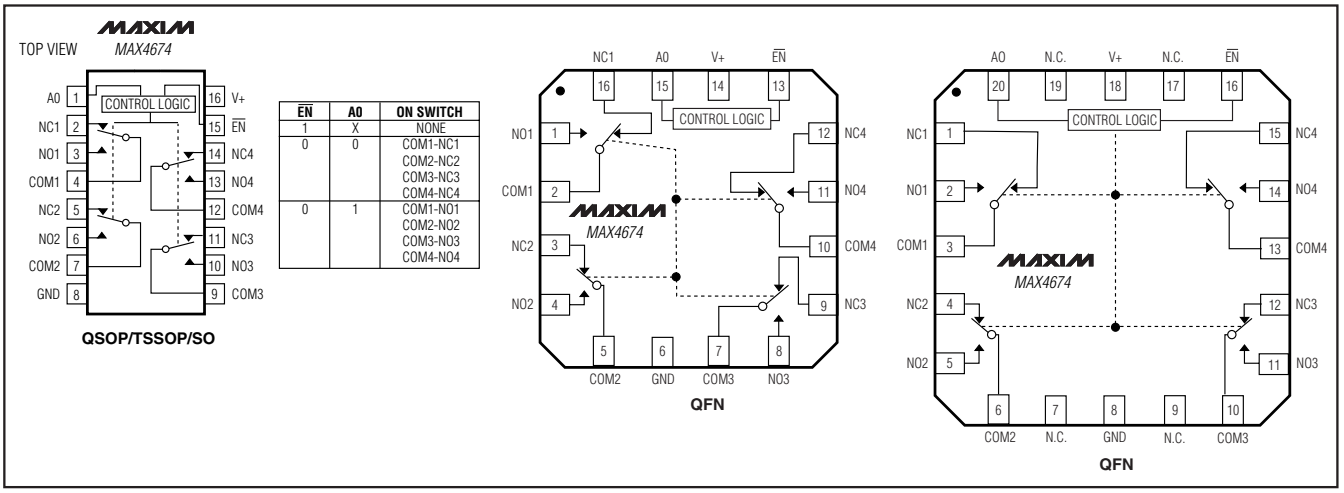
- **Guaranteed On-Resistance**
  **4Ω max (+5V Supply)**
  **6Ω max (+3V Supply)**
- **Guaranteed Match Between Channels**
  **0.4Ω max**
- **Guaranteed Flatness Over Signal Range**
  **0.8Ω max**
- **1.8V Operation**
  **$R_{ON}$ = 100Ω typ Over Temperature**
  **$t_{ON}$ = 51ns typ**
  **$t_{OFF}$ = 13ns typ**
- **Guaranteed Low Leakage Currents**
  **0.5nA max at +25°C**
- **Single-Supply Operation from +1.8V to +5.5V**
- **Rail-to-Rail Signal Handling**
- **TTL/CMOS-Logic Compatible**
- **Crosstalk: -114dB (1MHz)**
- **Off-Isolation: -67dB (1MHz)**
- **4mm × 4mm QFN Package**

## Ordering Information

| PART | TEMP RANGE | PIN-PACKAGE | PKG CODE |
|---|---|---|---|
| MAX4674EEE | -40°C to +85°C | 16 QSOP | E16-4 |
| MAX4674EUE | -40°C to +85°C | 16 TSSOP | U16-2 |
| MAX4674ESE | -40°C to +85°C | 16 Narrow SO | S16-2 |
| MAX4674EGE | -40°C to +85°C | 16 QFN-EP* | G1644-1 |
| MAX4674EGP | -40°C to +85°C | 20 QFN-EP* | G2044-3 |

*EP = Exposed pad.

## Pin Configuration/Functional Diagram/Truth Table



# 3V/5V, 4Ω, Wideband Quad 2:1 Analog Multiplexer

## ABSOLUTE MAXIMUM RATINGS

V+, A0, $\overline{EN}$.....-0.3V to +6V
COM_, NO_, NC_ (Note1).....-0.3V to (V + 0.3V)
Continuous Current COM_, NO_, NC_ .....±100mA
Peak Current (COM_, NO_, NC_)
(pulsed at 1ms, 10% duty cycle) .....±300mA
Continuous Power Dissipation ($T_A$ = +70°C)
16-Pin QSOP (derate 8.3mW/°C above +70°C) ..... 667mW
16-Pin TSSOP (derate 6.7mW/°C above +70°C) .....533mW
16-Pin Narrow SO (derate 8mW/°C above +70°C) ....640mW
16-Pin QFN (derate 18.5mW/°C above +70°C) .....1481mW
20-Pin QFN (derate 20mW/°C above +70°C) .....1600mW
Operating Temperature Range
MAX4674E_E .....-40°C to +85°C
Die Temperature .....+150°C
Storage Temperature Range .....-65°C to +150°C
Lead Temperature (soldering, 10s) .....+300°C

**Note 1:** Signals on NO_, NC_, and COM_ exceeding V+ or GND 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+ = +4.5V to +5.5V, $V_{IH}$ = 2.4V, $V_{IL}$ = 0.8V, $T_A$ = $T_{MIN}$ to $T_{MAX}$, unless otherwise noted. Typical values at $T_A$ = +25°C.) (Notes 2, 3)

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| **ANALOG SWITCH** | | | | | | | |
| Analog Signal Range | $V_{COM\_}$,$V_{NO\_}$, $V_{NC\_}$ | | | 0 | | V+ | V |
| On-Resistance | $R_{ON}$ | V+ = 4.5V, $I_{COM\_}$ = 10mA, $V_{NO\_}$ or $V_{NC\_}$ = 0 to V+ | $T_A$ = +25°C | | 2.2 | 4 | Ω |
| | | | $T_A$ = $T_{MIN}$ to $T_{MAX}$ | | | 5 | |
| On-Resistance Match Between Channels (Notes 4, 5) | $\Delta R_{ON}$ | V+ = 4.5V, $I_{COM\_}$ = 10mA, $V_{NO\_}$ or $V_{NC\_}$ = 0 to V+ | $T_A$ = +25°C | | 0.15 | 0.4 | Ω |
| | | | $T_A$ = $T_{MIN}$ to $T_{MAX}$ | | | 0.5 | |
| On-Resistance Flatness (Note 6) | $R_{FLAT (ON)}$ | V+ = 4.5V, $I_{COM\_}$ = 10mA, $V_{NO\_}$ or $V_{NC\_}$ = 0 to V+ | $T_A$ = +25°C | | 0.5 | 0.8 | Ω |
| | | | $T_A$ = $T_{MIN}$ to $T_{MAX}$ | | | 1 | |
| NO_, NC_ Off-Leakage Current (Note 7) | $I_{NO\_(OFF)}$, $I_{NC\_(OFF)}$ | V+ = 5.5V; $V_{COM\_}$ = 1V, 4.5V; $V_{NO\_}$ or $V_{NC\_}$ = 4.5V, 1V | $T_A$ = +25°C | -0.5 | ±0.01 | +0.5 | nA |
| | | | $T_A$ = $T_{MIN}$ to $T_{MAX}$ | -1 | | +1 | |
| COM_ Off-Leakage Current (Note 7) | $I_{COM\_(OFF)}$ | V+ = 5.5V; $V_{COM\_}$ = 1V, 4.5V; $V_{NO\_}$ or $V_{NC\_}$ = 4.5V, 1V | $T_A$ = +25°C | -0.5 | ±0.01 | +0.5 | nA |
| | | | $T_A$ = $T_{MIN}$ to $T_{MAX}$ | -1 | | +1 | |
| COM_ On-Leakage Current (Note 7) | $I_{COM\_(ON)}$ | V+ = 5.5V; $V_{COM\_}$ = 1V, 4.5V; $V_{NO\_}$ or $V_{NC\_}$ = 1, 4.5V, or floating | $T_A$ = +25°C | -0.5 | ±0.01 | +0.5 | nA |
| | | | $T_A$ = $T_{MIN}$ to $T_{MAX}$ | -1 | | +1 | |
| **DIGITAL I/O** (A0, $\overline{EN}$) | | | | | | | |
| Input Logic High | $V_{IH}$ | | | 2.4 | | | V |
| Input Logic Low | $V_{IL}$ | | | | | 0.8 | V |
| Input Leakage Current | $I_{IN}$ | $V_{IN}$ = 0 or +5.5V | | -0.5 | ±1 | +0.5 | µA |
| **DYNAMIC** | | | | | | | |
| Turn-On Time (Note 7) | $t_{ON}$ | $V_{NO\_}$ or $V_{NC\_}$ = 3V, $R_L$ = 100Ω, $C_L$ = 35pF, Figure 2 | $T_A$ = +25°C | | 10 | 18 | ns |
| | | | $T_A$ = $T_{MIN}$ to $T_{MAX}$ | | | 20 | |

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

(V+ = +4.5V to +5.5V, $V_{IH}$ = 2.4V, $V_{IL}$ = 0.8V, $T_A$ = $T_{MIN}$ to $T_{MAX}$, unless otherwise noted. Typical values at $T_A$ = +25°C.) (Notes 2, 3)

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| Turn-Off Time (Note 7) | $t_{OFF}$ | $V_{NO\_}$ or $V_{NC\_}$ = 3V, $R_L$ = 100Ω, $C_L$ = 35pF, Figure 2 | $T_A$ = +25°C | | 4 | 6 | ns |
| | | | $T_A$ = $T_{MIN}$ to $T_{MAX}$ | | | 8 | |
| Break-Before-Make (Note 7) | $t_{BBM}$ | $V_{NO\_}$ or $V_{NC\_}$ = 3V, $R_L$ = 100Ω, $C_L$ = 35pF, Figure 3 | $T_A$ = +25°C | | 5 | | ns |
| | | | $T_A$ = $T_{MIN}$ to $T_{MAX}$ | 1 | | | |
| Charge Injection | Q | $V_{GEN}$ = 4V, $R_{GEN}$ = 0, $C_L$ = 1.0nF, Figure 4 | | | 10 | | pC |
| Off-Isolation (Note 8) | $V_{ISO}$ | $C_L$ = 5pF, $R_L$ = 100Ω, f = 10MHz, Figure 5 | f = 10MHz | | -47 | | dB |
| | | | f = 1MHz | | -67 | | |
| Crosstalk (Note 9) | $V_{CT}$ | $C_L$ = 5pF, $R_L$ = 100Ω, f = 10MHz, Figure 5 | f = 10MHz | | -68 | | dB |
| | | | f = 1MHz | | -114 | | |
| Total Harmonic Distortion | THD | $R_L$ = 600Ω, f = 20Hz to 20kHz | | | 0.015 | | % |
| NO_, NC_ Off-Capacitance | $C_{NO\_(OFF)}$, $C_{NC\_(OFF)}$ | $V_{NO\_}$, $V_{NC\_}$ = GND, f = 1MHz, Figure 6 | | | 10 | | pF |
| COM_ Off-Capacitance | $C_{COM\_(OFF)}$ | $V_{COM\_}$ = GND, f = 1MHz, Figure 6 | | | 20 | | pF |
| COM_ On-Capacitance | $C_{(ON)}$ | $V_{COM\_}$ = $V_{NO\_}$, $V_{NC\_}$ = GND, f = 1MHz, Figure 6 | | | 30 | | pF |
| **SUPPLY** | | | | | | | |
| Supply Range | V+ | | | 1.8 | | 5.5 | V |
| Positive Supply Current | I+ | V+ = +5.5V, $V_{IN}$ = 0 or V+ | | | 0.001 | 1.0 | µA |

## ELECTRICAL CHARACTERISTICS—Single +3V Supply

(V+ = +2.7V to +3.3V, $V_{IH}$ = 2.0V, $V_{IL}$ = 0.4V, $T_A$ =$T_{MIN}$ to $T_{MAX}$, unless otherwise noted. Typical values at $T_A$ = +25°C.) (Notes 2, 3)

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| **ANALOG SWITCH** | | | | | | | |
| Analog Signal Range | $V_{COM}$, $V_{NO}$, $V_{NC\_}$ | | | 0 | | V+ | V |
| On-Resistance | $R_{ON}$ | V+ = 2.7V, $I_{COM\_}$ = 10mA, $V_{NO\_}$ or $V_{NC\_}$ = 0 to V+ | $T_A$ = +25°C | | 4 | 6 | Ω |
| | | | $T_A$ = $T_{MIN}$ to $T_{MAX}$ | | | 8 | |
| On-Resistance Match Between Channels (Notes 4, 5) | $\Delta R_{ON}$ | V+ = 2.7V, $I_{COM\_}$ = 10mA, $V_{NO\_}$ or $V_{NC\_}$ = 0 to V+ | $T_A$ = +25°C | | 0.15 | 0.4 | Ω |
| | | | $T_A$ = $T_{MIN}$ to $T_{MAX}$ | | | 0.5 | |
| On-Resistance Flatness (Note 6) | $R_{FLAT(ON)}$ | V+ = 2.7V, $I_{COM\_}$ = 10mA, $V_{NO\_}$ or $V_{NC\_}$ = 0 to V+ | $T_A$ = +25°C | | 2 | 3 | Ω |
| | | | $T_A$ = $T_{MIN}$ to $T_{MAX}$ | | | 4 | |
| NO_, NC_ Off-Leakage Current (Note 7) | $I_{NO\_(OFF)}$, $I_{NC\_(OFF)}$ | V+ = 3.3V; $V_{COM\_}$ = 1V, 3V; $V_{NO\_}$ or $V_{NC\_}$ = 3V, 1V | $T_A$ = +25°C | -0.5 | ±0.01 | +0.5 | nA |
| | | | $T_A$ = $T_{MIN}$ to $T_{MAX}$ | -1 | | +1 | |

# 3V/5V, 4Ω, Wideband Quad 2:1 Analog Multiplexer

## ELECTRICAL CHARACTERISTICS—Single +3V Supply (continued)

(V+ = +2.7V to +3.3V, $V_{IH}$ = 2.0V, $V_{IL}$ = 0.4V, $T_A$ = $T_{MIN}$ to $T_{MAX}$, unless otherwise noted. Typical values at $T_A$ = +25°C.) (Notes 2, 3)

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| COM_ Off-Leakage Current (Note 7) | $I_{COM\_(OFF)}$ | V+ = 3.3V; $V_{COM\_}$ = 1V, 3V; $V_{NO\_}$ or $V_{NC\_}$ = 3V, 1V | $T_A$ = +25°C | -0.5 | ±0.01 | +0.5 | nA |
| | | | $T_A$ = $T_{MIN}$ to $T_{MAX}$ | -1 | | +1 | |
| COM_ On-Leakage Current (Note 7) | $I_{COM\_(ON)}$ | V+ = 3.3V; $V_{COM\_}$ = 1V, 3V; $V_{NO\_}$ or $V_{NC\_}$ = 1V, 3V, or floating | $T_A$ = +25°C | -0.5 | ±0.01 | +0.5 | nA |
| | | | $T_A$ = $T_{MIN}$ to $T_{MAX}$ | -1 | | +1 | |
| **DIGITAL I/O** (A0, $\overline{EN}$) | | | | | | | |
| Input Logic High | $V_{IH}$ | | | 2.0 | | | V |
| Input Logic Low | $V_{IL}$ | | | | | 0.4 | V |
| Input Leakage Current | $I_{IN}$ | $V_{IN}$ = 0 or +5.5V | | -0.5 | ±1 | +0.5 | µA |
| **DYNAMIC** | | | | | | | |
| Turn-On Time (Note 7) | $t_{ON}$ | $V_{NO\_}$ or $V_{NC\_}$ = 1.5V, $R_L$ = 100Ω, $C_L$ = 35pF, Figure 2 | $T_A$ = +25°C | | 12 | 22 | ns |
| | | | $T_A$ = $T_{MIN}$ to $T_{MAX}$ | | | 25 | |
| Turn-Off Time (Note 7) | $t_{OFF}$ | $V_{NO\_}$ or $V_{NC\_}$ = 1.5V, $R_L$ = 100Ω, $C_L$ = 35pF, Figure 2 | $T_A$ = +25°C | | 5 | 8 | ns |
| | | | $T_A$ = $T_{MIN}$ to $T_{MAX}$ | | | 10 | |
| Break-Before-Make (Note 7) | $t_{BBM}$ | $V_{NO\_}$ or $V_{NC}$ = 1.5V, $R_L$ = 100Ω, $C_L$ = 35pF, Figure 3 | $T_A$ = +25°C | | 5 | | ns |
| | | | $T_A$ = $T_{MIN}$ to $T_{MAX}$ | 1 | | | |
| Charge Injection | Q | $V_{GEN}$ = 2V, $R_{GEN}$ = 0, $C_L$ = 1.0nF, Figure 4 | | | 18 | | pC |
| Off-Isolation (Note 8) | $V_{ISO}$ | $C_L$ = 5pF, $R_L$ = 100Ω, f = 10MHz, Figure 5 | f = 10MHz | | -47 | | dB |
| | | | f = 1MHz | | -67 | | |
| Crosstalk (Note 9) | $V_{CT}$ | $C_L$ = 5pF, $R_L$ = 100Ω, f = 10MHz, Figure 5 | f = 10MHz | | -68 | | dB |
| | | | f = 1MHz | | -114 | | |
| NO_, NC_ Off-Capacitance | $C_{NO\_(OFF)}$, $C_{NC\_(OFF)}$ | $V_{NO\_}$ or $V_{NC\_}$ = GND, f = 1MHz, Figure 6 | | | 10 | | pF |
| COM_ Off-Capacitance | $C_{COM\_(OFF)}$ | $V_{COM\_}$ = GND, f = 1MHz, Figure 6 | | | 20 | | pF |
| COM_ On-Capacitance | $C_{(ON)}$ | $V_{COM\_}$ = $V_{NO\_}$, $V_{NC\_}$ = GND, f = 1MHz, Figure 6 | | | 30 | | pF |
| **SUPPLY** | | | | | | | |
| Positive Supply Current | I+ | V+ = 3.3V, $V_{IN}$ = 0 or V+ | | | 0.001 | 1.0 | µA |

**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:** Parts are tested at the maximum hot-rated temperature. Limits across the entire temperature range are guaranteed by design and correlation.

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

**Note 5:** $\Delta R_{ON}$ matching specifications for QFN packaged parts are guaranteed by design.

**Note 6:** Flatness is defined as the difference between the maximum and minimum value of on-resistance as measured over the specified analog signal range.

**Note 7:** Guaranteed by design.

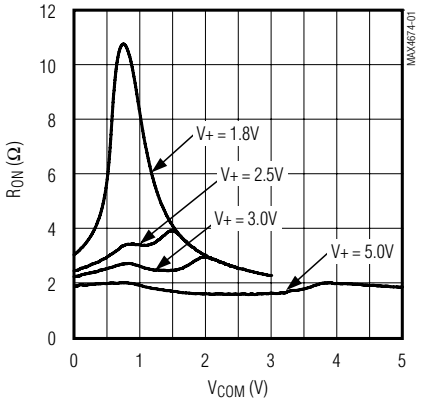
**Note 8:** Off-Isolation = $20\log_{10}(V_{COM}/V_{NO})$, $V_{COM}$ = output, $V_{NO}$ = input to off switch.

**Note 9:** Between any two switches.

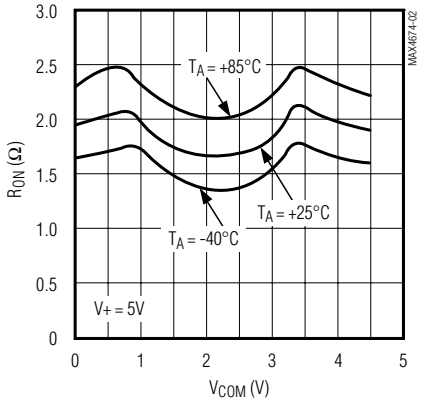
## Typical Operating Characteristics

(V+ = +5V, $T_A$ = +25°C, unless otherwise noted.)

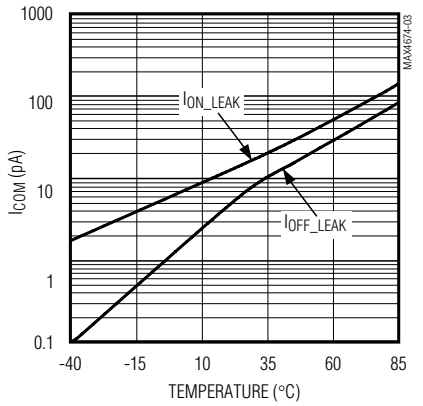
**ON-RESISTANCE vs. $V_{COM}$**



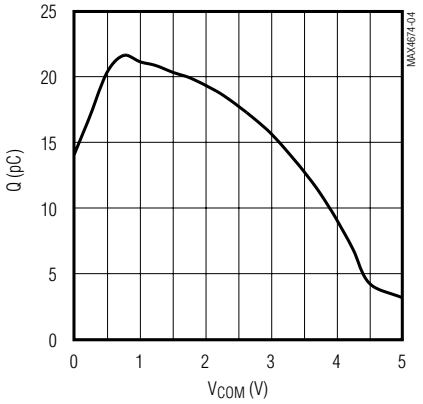

**ON-RESISTANCE vs. $V_{COM}$**



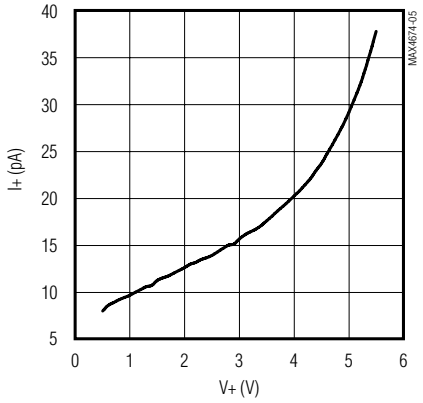

**ON/OFF-LEAKAGE CURRENT vs. TEMPERATURE**



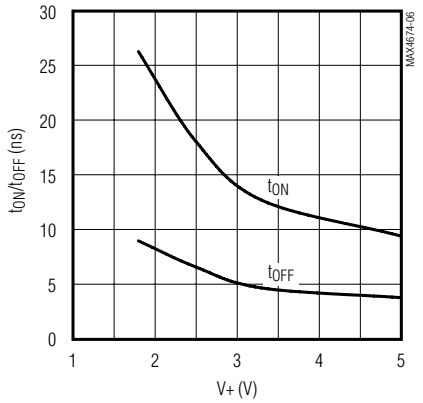

**CHARGE INJECTION vs. $V_{COM}$**



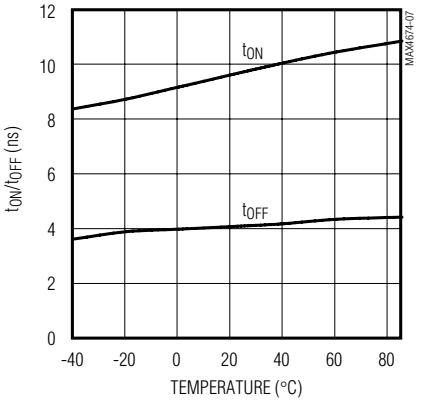

**SUPPLY CURRENT vs. SUPPLY VOLTAGE**



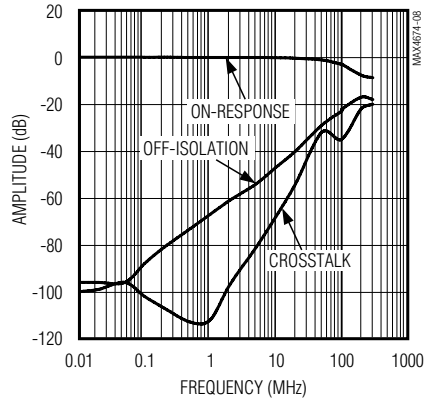

**TURN-ON/-OFF TIME vs. SUPPLY VOLTAGE**



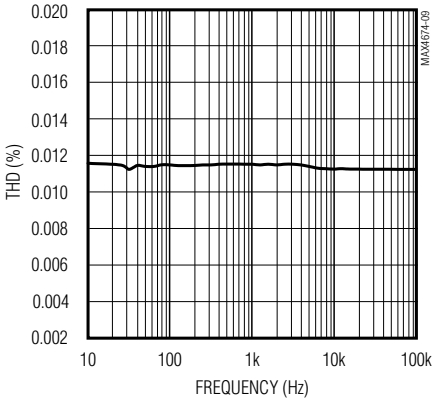

**TURN-ON/-OFF TIME vs. TEMPERATURE**




**OFF-ISOLATION, ON-RESPONSE, AND CROSSTALK vs. FREQUENCY**




**TOTAL HARMONIC DISTORTION vs. FREQUENCY**



# 3V/5V, 4Ω, Wideband Quad 2:1 Analog Multiplexer

## Pin Description

| PIN | | | NAME | FUNCTION |
|---|---|---|---|---|
| QSOP/TSSOP/SO | 20 QFN | 16 QFN | | |
| 1 | 20 | 15 | A0 | Address Input |
| 2 | 1 | 16 | NC1 | Normally Closed Terminal |
| 3 | 2 | 1 | NO1 | Normally Open Terminal |
| 4 | 3 | 2 | COM1 | Analog Switch Common Terminal |
| 5 | 4 | 3 | NC2 | Normally Closed Terminal |
| 6 | 5 | 4 | NO2 | Normally Open Terminal |
| 7 | 6 | 5 | COM2 | Analog Switch Common Terminal |
| — | 7, 9, 17, 19 | — | N.C. | No Connection |
| 8 | 8 | 6 | GND | Ground |
| 9 | 10 | 7 | COM3 | Analog Switch Common Terminal |
| 10 | 11 | 8 | NO3 | Normally Open Terminal |
| 11 | 12 | 9 | NC3 | Normally Closed Terminal |
| 12 | 13 | 10 | COM4 | Analog Switch Common Terminal |
| 13 | 14 | 11 | NO4 | Normally Open Terminal |
| 14 | 15 | 12 | NC4 | Normally Closed Terminal |
| 15 | 16 | 13 | $\overline{EN}$ | Output Enable, Active Low |
| 16 | 18 | 14 | V+ | Positive Supply Voltage |
| — | EP | EP | EP | Exposed Pad. Connect to GND. |

## Detailed Description

The MAX4674 is a low on-resistance ($R_{ON}$), low-voltage, quad 2:1 analog multiplexer/demultiplexer that operates from a +1.8V to +5.5V single supply. The MAX4674 features very fast switching speed ($t_{ON}$ = 18ns max, $t_{OFF}$ = 6ns max) and guaranteed break-before-make switching. Its low $R_{ON}$ allows high continuous currents to be switched in a variety of applications.

### Digital Interface

A0 and $\overline{EN}$ are CMOS digital inputs that meet TTL logic levels when V+ = 5V. Note that A0 and $\overline{EN}$ can exceed the voltage at V+ to a maximum of +5.5V. This feature allows operation of the MAX4674 from a +3.3V supply while controlling it with 5V CMOS logic signals.

The *Pin Configuration/Functional Diagram/Truth Table* located on the first page of this data sheet details the operation of the MAX4674.

## Applications Information

### Power-Supply Considerations

#### Overview

The MAX4674 construction is typical of most CMOS analog switches. It has two supply pins, V+ and GND, used to drive the internal CMOS switches and set the limits of the analog voltage on any switches. Reverse ESD-protection diodes are internally connected between each analog-signal pin and both V+ and GND. If any analog signal exceeds V+ and GND, one of these diodes conducts. During normal operation, these and other reverse-biased ESD diodes leak, forming the only current drawn from $V_{CC}$ or GND.

Virtually all the analog leakage current comes from the ESD diodes. Although the ESD diodes on a given signal pin are identical and therefore fairly well balanced, they are reverse biased differently. Each is biased by either V+ or GND and the analog signal. This means

their leakages will vary as the signal varies. The difference in the two-diode leakages to the V+ and GND pins constitutes the analog-signal-path leakage current. All analog leakage current flows between each pin and one of the supply terminals, not to the other switch terminal, which is why both sides of a given switch can show leakage currents of either the same or opposite polarity.

V+ and GND power the internal logic and set the input logic limits. Logic inputs have ESD-protection diodes to ground.

The logic-level thresholds are TTL/CMOS compatible when V+ is +5V. As V+ rises, the threshold increases; as V+ falls, the threshold decreases. For example, when V+ = +3V, the guaranteed minimum logic-high threshold decreases to 2.0V.

### Low-Voltage Operation

The MAX4674 operates from a single supply between +1.8V and +5.5V. At room temperature, it actually "works" with a single supply near or below +1.7V; as supply voltage decreases, however, switch on-resistance becomes very high.

### 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 device. Always sequence V+ on first, followed by the logic inputs and analog signals. 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 GND, but does not affect the device's low switch resistance and low leakage characteristics. Device operation is unchanged, and the difference between V+ and GND should not exceed 6V. These protection diodes are not recommended if signal levels must extend to ground.

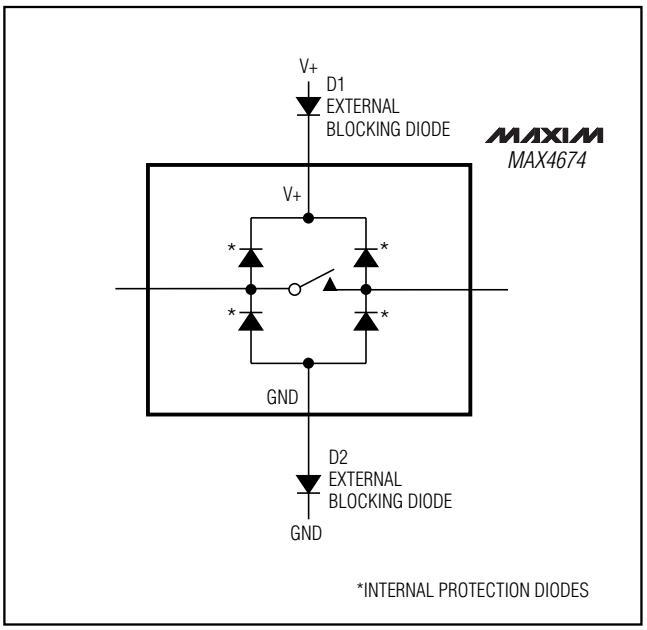



*Figure 1. Overvoltage Protection Using External Blocking Diodes*

### High-Frequency Performance

In 50Ω systems, signal response is reasonably flat up to 50MHz (see the *Typical Operating Characteristics*). Above 20MHz, the on response has several minor peaks that are highly layout dependent. The problem is not turning the switch on, but turning it off. The off-state switch acts like a capacitor and passes higher frequencies with less attenuation. At 10MHz, off-isolation is about -50dB in 50Ω systems, becoming worse (approximately 20dB per decade) as frequency increases. Higher circuit impedances also degrade off-isolation. Adjacent channel attenuation is about 3dB above that of a bare IC socket and is entirely due to capacitive coupling.

## Chip Information

TRANSISTOR COUNT: 478

# 3V/5V, 4Ω, Wideband Quad 2:1 Analog Multiplexer

## Test Circuits/Timing Diagrams

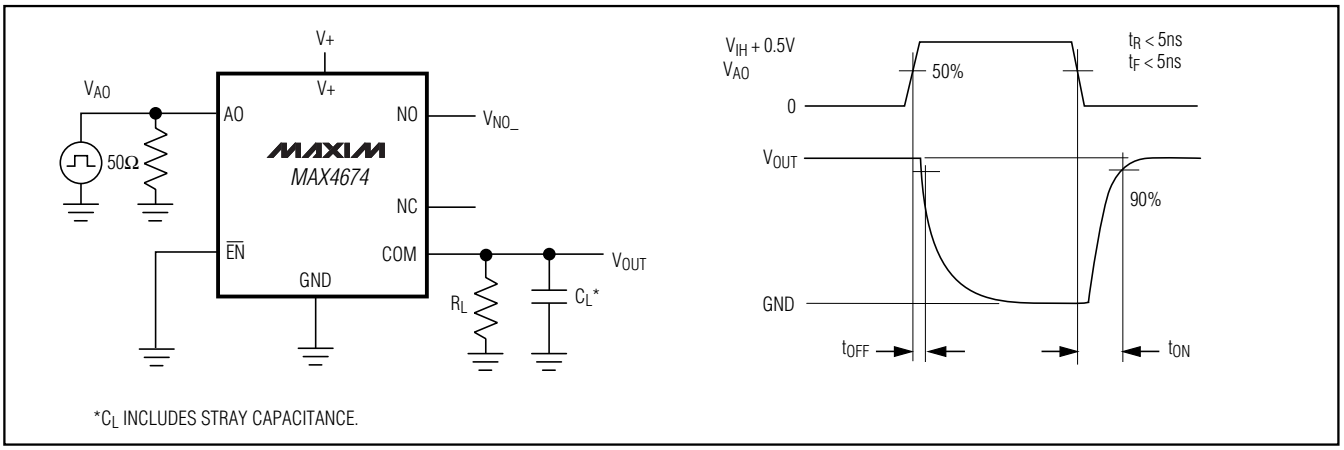



*Figure 2. Turn-On and Turn-Off Times*

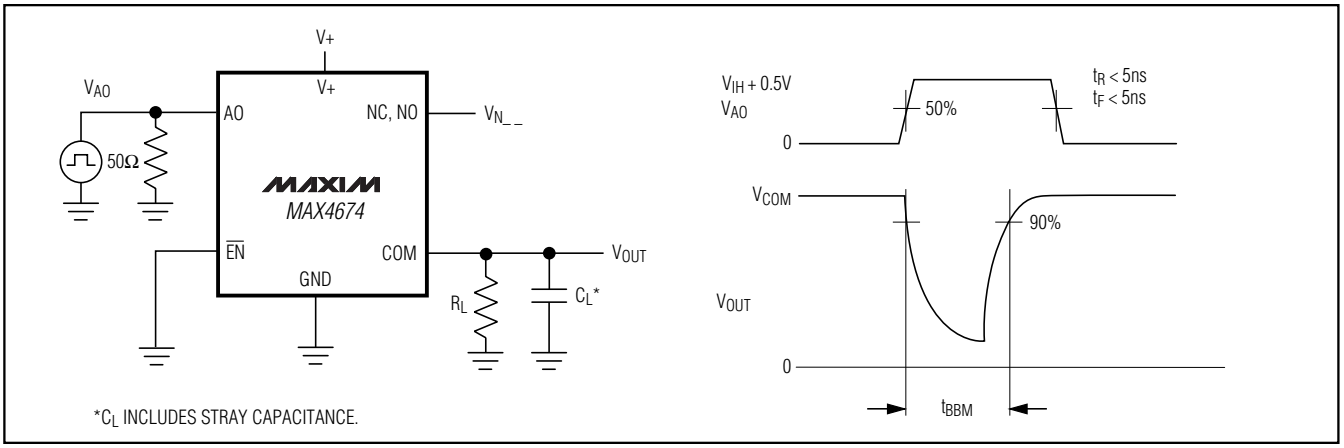



*Figure 3. Break-Before-Make Interval*

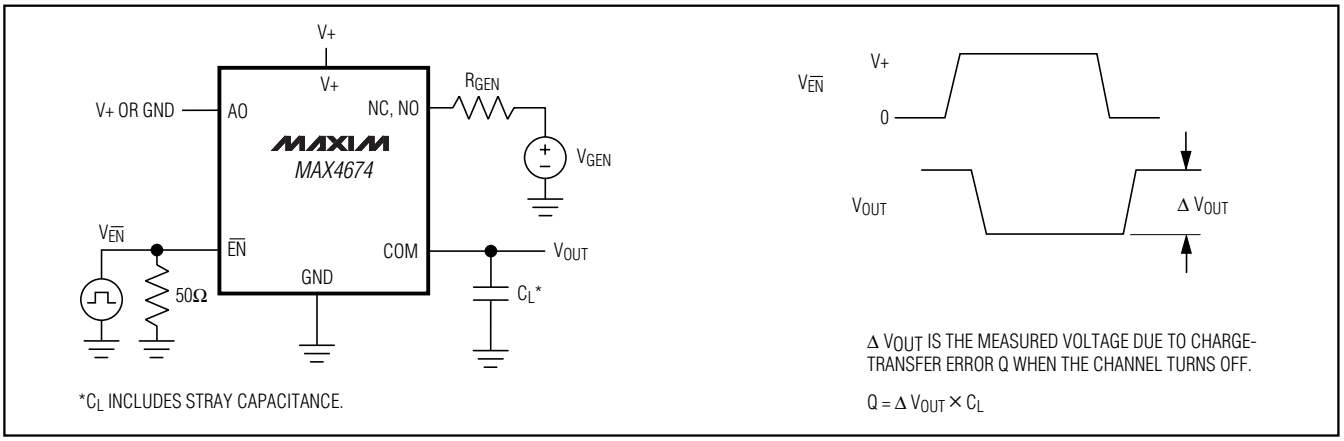
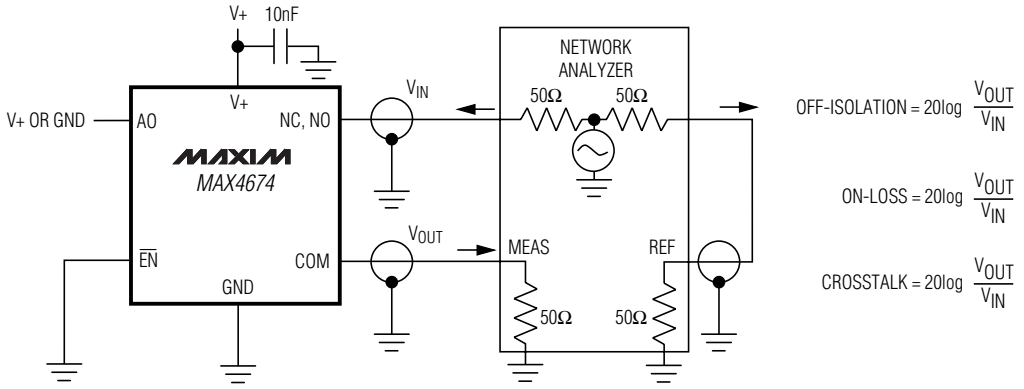



*Figure 4. Charge Injection*

## Test Circuits/Timing Diagrams (continued)




**NOTES:** MEASUREMENTS ARE STANDARDIZED AGAINST SHORTS AT SOCKET TERMINALS.
OFF-ISOLATION IS MEASURED BETWEEN COM AND "OFF" NO TERMINAL ON EACH SWITCH.
ON-LOSS IS MEASURED BETWEEN COM AND "ON" NO TERMINAL ON EACH SWITCH.
CROSSTALK IS MEASURED FROM ONE CHANNEL TO ALL OTHER CHANNELS.
SIGNAL DIRECTION THROUGH SWITCH IS REVERSED; WORST VALUES ARE RECORDED.

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

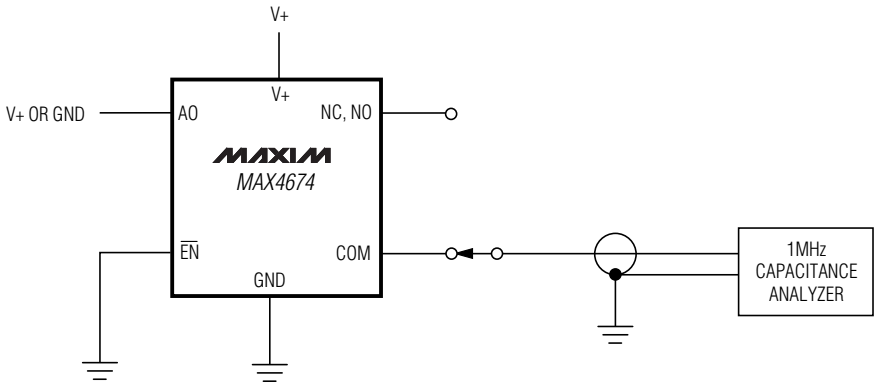


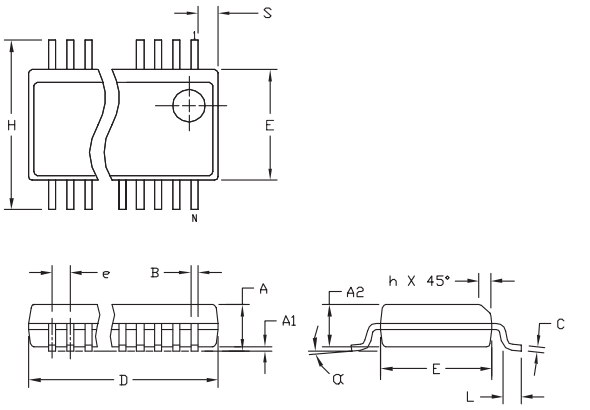

*Figure 6. Capacitance*

# 3V/5V, 4Ω, Wideband Quad 2:1 Analog Multiplexer

## 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**.)

QSOP.EPS




| DIM | INCHES MIN | INCHES MAX | MILLIMETERS MIN | MILLIMETERS MAX |
|---|---|---|---|---|
| A | .053 | .069 | 1.35 | 1.75 |
| A1 | .004 | .010 | .102 | .254 |
| A2 | .049 | .065 | 1.245 | 1.651 |
| B | .008 | .012 | 0.20 | 0.30 |
| C | .0075 | .0098 | 0.191 | 0.249 |
| D | SEE VARIATIONS | | | |
| E | .150 | .157 | 3.81 | 3.99 |
| e | .025 BSC | | 0.635 BSC | |
| H | .230 | .244 | 5.84 | 6.20 |
| h | .010 | .016 | 0.25 | 0.41 |
| L | .016 | .035 | 0.41 | 0.89 |
| N | SEE VARIATIONS | | | |
| α | 0° | 8° | 0° | 8° |

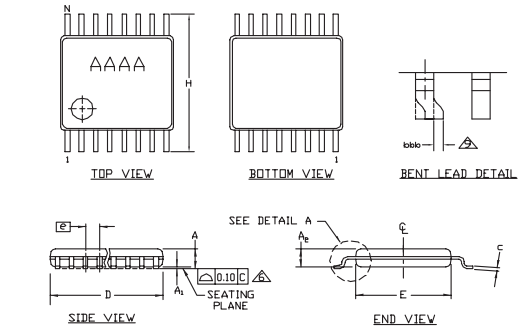
VARIATIONS:

| | INCHES MIN. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS MAX. | N | |
|---|---|---|---|---|---|---|
| D | .189 | .196 | 4.80 | 4.98 | 16 | AB |
| S | .0020 | .0070 | 0.05 | 0.18 | | |
| D | .337 | .344 | 8.56 | 8.74 | 20 | AD |
| S | .0500 | .0550 | 1.270 | 1.397 | | |
| D | .337 | .344 | 8.56 | 8.74 | 24 | AE |
| S | .0250 | .0300 | 0.635 | 0.762 | | |
| D | .386 | .393 | 9.80 | 9.98 | 28 | AF |
| S | .0250 | .0300 | 0.635 | 0.762 | | |

NOTES:
1). D & E DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
2). MOLD FLASH OR PROTRUSIONS NOT TO EXCEED .006" PER SIDE.
3). CONTROLLING DIMENSIONS: INCHES.
4). MEETS JEDEC MO137.

DALLAS SEMICONDUCTOR MAXIM
PROPRIETARY INFORMATION
TITLE: PACKAGE OUTLINE, QSOP .150", .025" LEAD PITCH
APPROVAL | DOCUMENT CONTROL NO. 21-0055 | REV. F | 1/1

TSSOP4.40mm.EPS




| SYMBOL | COMMON DIMENSIONS MILLIMETERS MIN. | MILLIMETERS MAX. | INCHES MIN. | INCHES MAX. |
|---|---|---|---|---|
| A | —— | 1.10 | | .043 |
| $A_1$ | 0.05 | 0.15 | .002 | .006 |
| $A_2$ | 0.85 | 0.95 | .033 | .037 |
| b | 0.19 | 0.30 | .007 | .012 |
| $b_1$ | 0.19 | 0.25 | .007 | .010 |
| c | 0.09 | 0.20 | .004 | .008 |
| $c_1$ | 0.09 | 0.14 | .004 | .006 |
| D | SEE VARIATIONS | | SEE VARIATIONS | |
| E | 4.30 | 4.50 | .169 | .177 |
| e | 0.65 BSC | | .026 BSC | |
| H | 6.25 | 6.55 | .246 | .258 |
| L | 0.50 | 0.70 | .020 | .028 |
| N | SEE VARIATIONS | | SEE VARIATIONS | |
| α | 0° | 8° | 0° | 8° |
| aaa | 0.10 MAX | | | |

| JEDEC MO-153 | N | | PKG. CODES | VARIATIONS MILLIMETERS MIN. | VARIATIONS MILLIMETERS MAX. | VARIATIONS INCHES MIN. | VARIATIONS INCHES MAX. |
|---|---|---|---|---|---|---|---|
| AB-1 | 14 | D | U14-1, U14-2 | 4.90 | 5.10 | .193 | .201 |
| AB | 16 | D | U16-1, U16-2 | 4.90 | 5.10 | .193 | .201 |
| AC | 20 | D | U20-2, U20-3 | 6.40 | 6.60 | .252 | .260 |
| AD | 24 | D | U24-1 | 7.70 | 7.90 | .303 | .311 |
| AE | 28 | D | U28-1, U28-2, U28-3 | 9.60 | 9.80 | .378 | .386 |

NOTES
1. DIMENSIONS D AND E DO NOT INCLUDE FLASH
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED 0.15mm PER SIDE
3. CONTROLLING DIMENSION: MILLIMETER
4. MEETS JEDEC OUTLINE MO-153. SEE JEDEC VARIATIONS TABLE
5. "N" REFERS TO NUMBER OF LEADS
6. LEAD COPLANARITY 0.10 MM MAX.
7. NUMBER OF LEADS SHOWN ARE FOR REFERENCE ONLY
8. MARKING IS FOR PACKAGE ORIENTATION REFERENCE ONLY
9. BENT LEAD 0.10 MM MAX.

-DRAWING NOT TO SCALE-

DALLAS SEMICONDUCTOR MAXIM
TITLE: PACKAGE OUTLINE, TSSOP 4.40mm BODY
APPROVAL | DOCUMENT CONTROL NO. 21-0066 | REV. I | 1/1

## Package Information (continued)

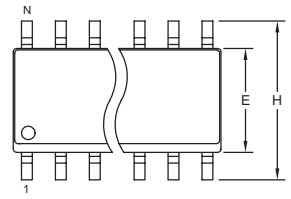
(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to **www.maxim-ic.com/packages**.)

SOICN .EPS

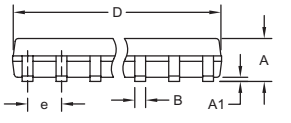
| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 0.053 | 0.069 | 1.35 | 1.75 |
| A1 | 0.004 | 0.010 | 0.10 | 0.25 |
| B | 0.014 | 0.019 | 0.35 | 0.49 |
| C | 0.007 | 0.010 | 0.19 | 0.25 |
| e | 0.050 BSC | | 1.27 BSC | |
| E | 0.150 | 0.157 | 3.80 | 4.00 |
|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

VARIATIONS:

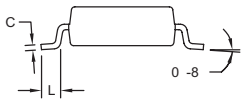
| | INCHES | | MILLIMETERS | | | |
|---|---|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX | N | MS012 |
| D | 0.189 | 0.197 | 4.80 | 5.00 | 8 | AA |
| D | 0.337 | 0.344 | 8.55 | 8.75 | 14 | AB |
| D | 0.386 | 0.394 | 9.80 | 10.00 | 16 | AC |




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.

DALLAS SEMICONDUCTOR MAXIM

PROPRIETARY INFORMATION

TITLE: PACKAGE OUTLINE, .150" SOIC

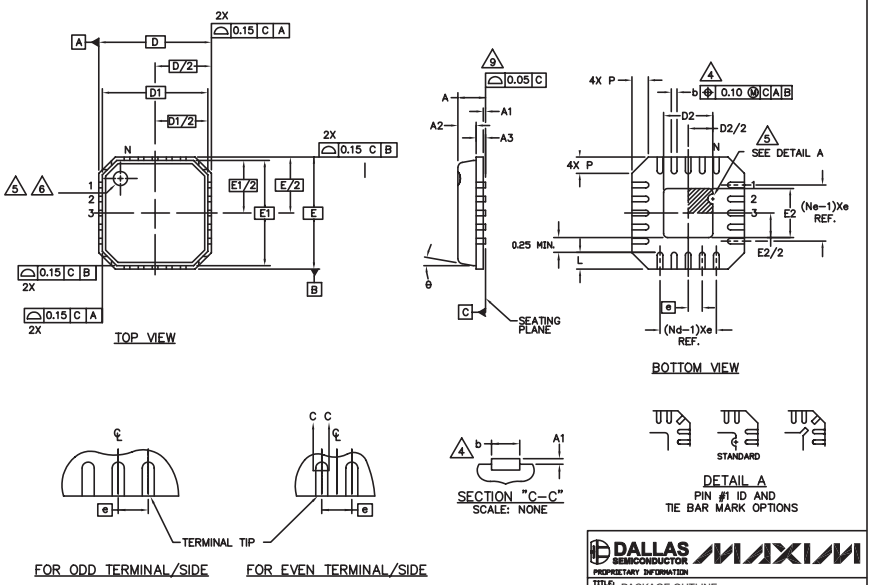
| APPROVAL | DOCUMENT CONTROL NO. | REV. | |
|---|---|---|---|
| | 21-0041 | B | 1/1 |

# 3V/5V, 4Ω, Wideband Quad 2:1 Analog Multiplexer

## 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**.)

12,16,20, 24L QFN.EPS




DALLAS SEMICONDUCTOR MAXIM
PROPRIETARY INFORMATION

TITLE: PACKAGE OUTLINE 12,16,20,24L QFN, 4x4x0.90 MM

APPROVAL | DOCUMENT CONTROL NO. 21-0106 | REV. E | 1/2

NOTES:

1. DIE THICKNESS ALLOWABLE IS 0.305mm MAXIMUM (.012 INCHES MAXIMUM).
2. DIMENSIONING & TOLERANCES CONFORM MUST TO ASME Y14.5M. – 1994.
3. N IS THE NUMBER OF TERMINALS.
   Nd IS THE NUMBER OF TERMINALS IN X-DIRECTION &
   Ne IS THE NUMBER OF TERMINALS IN Y-DIRECTION.
4. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.20 AND 0.25mm FROM TERMINAL TIP.
5. THE PIN #1 IDENTIFIER MUST BE EXISTED ON THE TOP SURFACE OF THE PACKAGE BY USING INDENTATION MARK OR INK/LASER MARKED. DETAILS OF PIN #1 IDENTIFIER IS OPTIONAL, BUT MUST BE LOCATED WITHIN ZONE INDICATED.
6. EXACT SHAPE AND SIZE OF THIS FEATURE IS OPTIONAL.
7. ALL DIMENSIONS ARE IN MILLIMETERS.
8. PACKAGE WARPAGE MAX 0.05mm.
9. APPLIED FOR EXPOSED PAD AND TERMINALS.
   EXCLUDE EMBEDDING PART OF EXPOSED PAD FROM MEASURING.
10. MEETS JEDEC MO220; EXCEPT DIMENSION "b".
11. THIS PACKAGE OUTLINE APPLIES TO PUNCHED QFN (STEPPED SIDES).

| SYMBOL | COMMON DIMENSIONS MIN. | NOM. | MAX. | NOTE |
|---|---|---|---|---|
| A | 0.80 | 0.90 | 1.00 | |
| A1 | 0.00 | 0.01 | 0.05 | |
| A2 | 0.00 | 0.65 | 0.80 | |
| A3 | | 0.20 REF. | | |
| D | | 4.00 BSC | | |
| D1 | | 3.75 BSC | | |
| E | | 4.00 BSC | | |
| E1 | | 3.75 BSC | | |
| θ | 0° | – | 12° | |
| P | 0.24 | 0.42 | 0.60 | |

| SYMBOL | PITCH VARIATION A MIN. | NOM. | MAX. | NOTE | SYMBOL | PITCH VARIATION B MIN. | NOM. | MAX. | NOTE | SYMBOL | PITCH VARIATION C MIN. | NOM. | MAX. | NOTE | SYMBOL | PITCH VARIATION D MIN. | NOM. | MAX. | NOTE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| e | | 0.80 BSC | | | e | | 0.65 BSC | | | e | | 0.50 BSC | | | e | | 0.50 BSC | | |
| N | | 12 | | 3 | N | | 16 | | 3 | N | | 20 | | 3 | N | | 24 | | 3 |
| Nd | | 3 | | 3 | Nd | | 4 | | 3 | Nd | | 5 | | 3 | Nd | | 6 | | 3 |
| Ne | | 3 | | 3 | Ne | | 4 | | 3 | Ne | | 5 | | 3 | Ne | | 6 | | 3 |
| L | 0.50 | 0.60 | 0.75 | | L | 0.50 | 0.60 | 0.75 | | L | 0.50 | 0.60 | 0.75 | | L | 0.30 | 0.40 | 0.50 | |
| b | 0.28 | 0.33 | 0.40 | 4 | b | 0.23 | 0.28 | 0.35 | 4 | b | 0.18 | 0.23 | 0.30 | 4 | b | 0.18 | 0.23 | 0.30 | 4 |

| PKG. CODE | EXPOSED PAD VARIATION D2 MIN. | NOM. | MAX. | E2 MIN. | NOM. | MAX. |
|---|---|---|---|---|---|---|
| G1244-2 | 1.95 | 2.10 | 2.25 | 1.95 | 2.10 | 2.25 |
| G1644-1 | 1.95 | 2.10 | 2.25 | 1.95 | 2.10 | 2.25 |
| G2044-3 | 1.95 | 2.10 | 2.25 | 1.95 | 2.10 | 2.25 |
| G2044-4 | 1.55 | 1.70 | 1.85 | 1.55 | 1.70 | 1.85 |
| G2444-1 | 1.95 | 2.10 | 2.25 | 1.95 | 2.10 | 2.25 |

DALLAS SEMICONDUCTOR MAXIM
PROPRIETARY INFORMATION

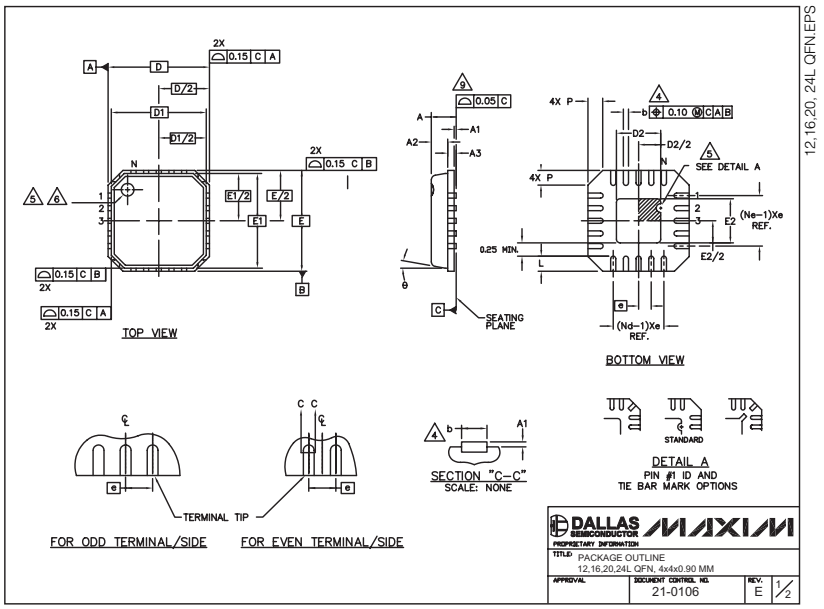
TITLE: PACKAGE OUTLINE 12,16,20,24L QFN, 4x4x0.90 MM

APPROVAL | DOCUMENT CONTROL NO. 21-0106 | REV. E | 2/2

# 3V/5V, 4Ω, Wideband Quad 2:1 Analog Multiplexer

## 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**.)




NOTES:

1. DIE THICKNESS ALLOWABLE IS 0.305mm MAXIMUM (.012 INCHES MAXIMUM).
2. DIMENSIONING & TOLERANCES CONFORM MUST TO ASME Y14.5M. – 1994.
3. N IS THE NUMBER OF TERMINALS.
   Nd IS THE NUMBER OF TERMINALS IN X–DIRECTION &
   Ne IS THE NUMBER OF TERMINALS IN Y–DIRECTION.
4. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.20 AND 0.25mm FROM TERMINAL TIP.
5. THE PIN #1 IDENTIFIER MUST BE EXISTED ON THE TOP SURFACE OF THE PACKAGE BY USING INDENTATION MARK OR INK/LASER MARKED. DETAILS OF PIN #1 IDENTIFIER IS OPTIONAL, BUT MUST BE LOCATED WITHIN ZONE INDICATED.
6. EXACT SHAPE AND SIZE OF THIS FEATURE IS OPTIONAL.
7. ALL DIMENSIONS ARE IN MILLIMETERS.
8. PACKAGE WARPAGE MAX 0.05mm.
9. APPLIED FOR EXPOSED PAD AND TERMINALS.
   EXCLUDE EMBEDDING PART OF EXPOSED PAD FROM MEASURING.
10. MEETS JEDEC MO220; EXCEPT DIMENSION "b".
11. THIS PACKAGE OUTLINE APPLIES TO PUNCHED QFN (STEPPED SIDES).

| SYMBOL | COMMON DIMENSIONS MIN. | NOM. | MAX. | NOTE |
|---|---|---|---|---|
| A | 0.80 | 0.90 | 1.00 | |
| A1 | 0.00 | 0.01 | 0.05 | |
| A2 | 0.00 | 0.65 | 0.80 | |
| A3 | | 0.20 REF. | | |
| D | | 4.00 BSC | | |
| D1 | | 3.75 BSC | | |
| E | | 4.00 BSC | | |
| E1 | | 3.75 BSC | | |
| θ | 0° | – | 12° | |
| P | 0.24 | 0.42 | 0.60 | |

| SYMBOL | PITCH VARIATION A MIN. | NOM. | MAX. | NOTE | SYMBOL | PITCH VARIATION B MIN. | NOM. | MAX. | NOTE | SYMBOL | PITCH VARIATION C MIN. | NOM. | MAX. | NOTE | SYMBOL | PITCH VARIATION D MIN. | NOM. | MAX. | NOTE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| e | | 0.80 BSC | | | e | | 0.65 BSC | | | e | | 0.50 BSC | | | e | | 0.50 BSC | | |
| N | | 12 | | 3 | N | | 16 | | 3 | N | | 20 | | 3 | N | | 24 | | 3 |
| Nd | | 3 | | 3 | Nd | | 4 | | 3 | Nd | | 5 | | 3 | Nd | | 6 | | 3 |
| Ne | | 3 | | 3 | Ne | | 4 | | 3 | Ne | | 5 | | 3 | Ne | | 6 | | 3 |
| L | 0.50 | 0.60 | 0.75 | | L | 0.50 | 0.60 | 0.75 | | L | 0.50 | 0.60 | 0.75 | | L | 0.30 | 0.40 | 0.50 | |
| b | 0.28 | 0.33 | 0.40 | 4 | b | 0.23 | 0.28 | 0.35 | 4 | b | 0.18 | 0.23 | 0.30 | 4 | b | 0.18 | 0.23 | 0.30 | 4 |

| PKG. CODE | EXPOSED PAD VARIATION D2 MIN. | NOM. | MAX. | E2 MIN. | NOM. | MAX. |
|---|---|---|---|---|---|---|
| G1244-2 | 1.95 | 2.10 | 2.25 | 1.95 | 2.10 | 2.25 |
| G1644-1 | 1.95 | 2.10 | 2.25 | 1.95 | 2.10 | 2.25 |
| G2044-3 | 1.95 | 2.10 | 2.25 | 1.95 | 2.10 | 2.25 |
| G2044-4 | 1.55 | 1.70 | 1.85 | 1.55 | 1.70 | 1.85 |
| G2444-1 | 1.95 | 2.10 | 2.25 | 1.95 | 2.10 | 2.25 |

DALLAS SEMICONDUCTOR MAXIM
PROPRIETARY INFORMATION
TITLE: PACKAGE OUTLINE
12,16,20,24L QFN, 4x4x0.90 MM
APPROVAL
DOCUMENT CONTROL NO. 21-0106
REV. E 2/2

## Revision History

Pages changed at Rev 3: 1–7, 10–13

*Maxim cannot assume responsibility for use of any circuitry other than circuitry entirely embodied in a Maxim product. No circuit patent licenses are implied. Maxim reserves the right to change the circuitry and specifications without notice at any time.*

# Mouser Electronics

Authorized Distributor

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