19-1362; Rev 1; 9/01

MAXIM

# Quad, SPST Analog Switch



## General Description

The MAX4613 quad analog switch features on-resistance matching (4Ω max) between switches and guarantees on-resistance flatness over the signal range (9Ω max). This low on-resistance switch conducts equally well in either direction. It guarantees low charge injection (10pC max), low power consumption (35µW max), and an electrostatic discharge (ESD) tolerance of 2000V minimum per Method 3015.7. The new design offers lower off leakage current over temperature (less than 5nA at +85°C).

The MAX4613 quad, single-pole/single-throw (SPST) analog switch has two normally closed switches and the two normally open switches. Switching times are less than 250ns for $t_{ON}$ and less than 70ns for $t_{OFF}$. Operation is from a single +4.5V to +40V supply or bipolar ±4.5V to ±20V supplies.

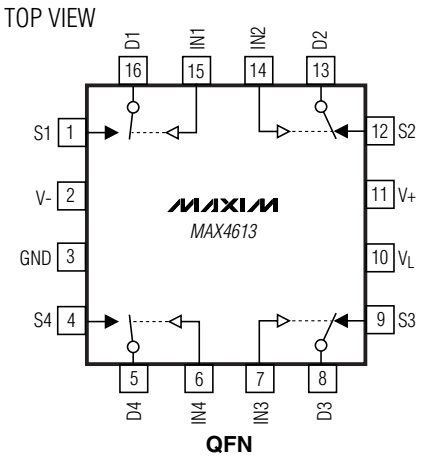
## Applications

| | |
|---|---|
| Sample-and-Hold Circuits | Communication Systems |
| Test Equipment | Battery-Operated Systems |
| Heads-Up Displays | PBX, PABX |
| Guidance and Control Systems | Audio Signal Routing |
| Military Radios | Modems/Faxes |

## Features

- **Pin Compatible with Industry-Standard DG213**
- **Guaranteed $R_{ON}$ Match Between Channels (4Ω max)**
- **Guaranteed $R_{FLAT(ON)}$ Over Signal Range (9Ω max)**
- **Guaranteed Charge Injection (10pC max)**
- **Low Off Leakage Current Over Temperature (<5nA at +85°C)**
- **Withstands 2000V min ESD, per Method 3015.7**
- **Low $R_{DS(ON)}$ (85Ω max)**
- **Single-Supply Operation +4.5V to +40V Bipolar-Supply Operation ±4.5V to ±20V**
- **Low Power Consumption (35µW max)**
- **Rail-to-Rail® Signal Handling**
- **TTL/CMOS-Logic Compatible**

## Pin Configurations/ Functional Diagrams/Truth Table




*Pin Configurations continued at end of data sheet.*

## Ordering Information

| PART | TEMP. RANGE | PIN-PACKAGE |
|---|---|---|
| MAX4613CPE | 0°C to +70°C | 16 Plastic DIP |
| MAX4613CSE | 0°C to +70°C | 16 Narrow SO |
| MAX4613CEE | 0°C to +70°C | 16 QSOP |
| MAX4613CUE | 0°C to +70°C | 16 TSSOP** |
| MAX4613C/D | 0°C to +70°C | Dice* |
| MAX4613EGE | -40°C to +85°C | 16 QFN |
| MAX4613EPE | -40°C to +85°C | 16 Plastic DIP |
| MAX4613ESE | -40°C to +85°C | 16 Narrow SO |
| MAX4613EEE | -40°C to +85°C | 16 QSOP |
| MAX4613EUE | -40°C to +85°C | 16 TSSOP** |

**Contact factory for dice specifications.*
***Contact factory for availability.*

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

# Quad, SPST Analog Switch

## ABSOLUTE MAXIMUM RATINGS

Voltage Referenced to GND
V+ .....+44V
V- .....-44V
V+ to V- .....+44V
$V_L$ .....(GND - 0.3V) to (V+ + 0.3V)
Digital Inputs $V_{S\_}$ $V_{D\_}$ (Note 1) .....(V- - 2V) to (V+ + 2V)
or 30mA (whichever occurs first)
Continuous Current (any terminal) .....30mA
Peak Current, S_ or D_
(pulsed at 1ms, 10% duty cycle max) .....100mA

Continuous Power Dissipation ($T_A$ = +70°C)
Plastic DIP (derate 10.53mW/°C above +70°C) .....842mW
Narrow SO (derate 8.70mW/°C above +70°C) .....696mW
QSOP (derate 8.3mW/°C above +70°C) .....667mW
QFN (derate 19.2mW/C above +70°C) .....1538mW
TSSOP (derate 6.7mW/°C above +70°C) .....457mW
Operating Temperature Ranges
MAX4613C_ _ .....0°C to +70°C
MAX4613E_ _ .....-40°C to +85°C
Storage Temperature Range .....-65°C to +165°C
Lead Temperature (soldering, 10sec) .....+300°C

**Note 1:** Signals on S_, D_, or IN_ exceeding V+ or V- are clamped by internal diodes. Limit forward 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—Dual Supplies

(V+ = 15V, V- = -15V, $V_L$ = 5V, GND = 0V, $V_{INH}$ = 2.4V, $V_{INL}$ = 0.8V, $T_A$ = $T_{MIN}$ to $T_{MAX}$, unless otherwise noted.)

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP (Note 2) | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| **SWITCH** | | | | | | | |
| Analog Signal Range | $V_{ANALOG}$ | (Note 3) | | -15 | | 15 | V |
| Drain-Source On-Resistance | $R_{DS(ON)}$ | $V_D$ = ±10V, $I_S$ = 1mA | $T_A$ = +25°C | | 55 | 70 | Ω |
| | | | $T_A$ = $T_{MIN}$ to $T_{MAX}$ | | | 85 | |
| On-Resistance Match Between Channels (Note 4) | $\Delta R_{DS(ON)}$ | $V_D$ = ±10V, $I_S$ = 1mA | $T_A$ = +25°C | | | 4 | Ω |
| | | | $T_A$ = $T_{MIN}$ to $T_{MAX}$ | | | 5 | |
| On-Resistance Flatness (Note 4) | $R_{FLAT(ON)}$ | $V_D$ = ±5V, $I_S$ = 1mA | $T_A$ = +25°C | | | 9 | Ω |
| | | | $T_A$ = $T_{MIN}$ to $T_{MAX}$ | | | 15 | |
| Source Leakage Current (Note 5) | $I_{S(OFF)}$ | $V_D$ = ±14V, $V_S$ = ∓14V | $T_A$ = +25°C | -0.50 | 0.01 | 0.50 | nA |
| | | | $T_A$ = $T_{MIN}$ to $T_{MAX}$ | -5 | | 5 | |
| Drain-Off Leakage Current (Note 5) | $I_{D(OFF)}$ | $V_D$ = ±14V, $V_S$ = ∓14V | $T_A$ = +25°C | -0.50 | 0.01 | 0.50 | nA |
| | | | $T_A$ = $T_{MIN}$ to $T_{MAX}$ | -5 | | 5 | |
| Drain-On Leakage Current (Note 5) | $I_{D(ON)}$ or $I_{S(ON)}$ | $V_D$ = ±14V, $V_S$ = ±14V | $T_A$ = +25°C | -0.50 | 0.08 | 0.50 | nA |
| | | | $T_A$ = $T_{MIN}$ to $T_{MAX}$ | -10 | | 10 | |
| **INPUT** | | | | | | | |
| Input Current with Input Voltage High | $I_{INH}$ | $V_{IN}$ = 2.4V, all others = 0.8V | | -0.5 | -0.00001 | 0.5 | µA |
| Input Current with Input Voltage Low | $I_{INL}$ | $V_{IN}$ = 0.8V, all others = 2.4V | | -0.5 | -0.00001 | 0.5 | µA |
| **SUPPLY** | | | | | | | |
| Power-Supply Range | V+, V- | | | ±4.5 | | ±20.0 | V |
| Positive Supply Current | I+ | All channels on or off, $V_{IN}$ = 0 or 5V | $T_A$ = +25°C | -1 | 0.001 | 1 | µA |
| | | | $T_A$ = $T_{MIN}$ to $T_{MAX}$ | -5 | | 5 | |
| Negative Supply Current | I- | All channels on or off, $V_{IN}$ = 0 or 5V | $T_A$ = +25°C | -1 | 0.001 | 1 | µA |
| | | | $T_A$ = $T_{MIN}$ to $T_{MAX}$ | -5 | | 5 | |

## ELECTRICAL CHARACTERISTICS—Dual Supplies (continued)

(V+ = 15V, V- = -15V, $V_L$ = 5V, GND = 0V, $V_{INH}$ = 2.4V, $V_{INL}$ = 0.8V, $T_A$ = $T_{MIN}$ to $T_{MAX}$, unless otherwise noted.)

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP (Note 2) | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| Logic Supply Current | $I_L$ | All channels on or off, $V_{IN}$ = 0 or 5V | $T_A$ = +25°C | -1 | 0.001 | 1 | µA |
| | | | $T_A$ = $T_{MIN}$ to $T_{MAX}$ | -5 | | 5 | |
| Ground Current | $I_{GND}$ | All channels on or off, $V_{IN}$ = 0 or 5V | $T_A$ = +25°C | -1 | -0.0001 | 1 | µA |
| | | | $T_A$ = $T_{MIN}$ to $T_{MAX}$ | -5 | | 5 | |
| **DYNAMIC** | | | | | | | |
| Turn-On Time (Note 3) | $t_{ON}$ | $V_S$ = ±10V, Figure 2 | $T_A$ = +25°C | | 150 | 250 | ns |
| Turn-Off Time (Note 3) | $t_{OFF}$ | $V_S$ = ±10V, Figure 2 | $T_A$ = +25°C | | 90 | 120 | ns |
| Break-Before-Make Time Delay (Note 3) | $t_D$ | Figure 3 | $T_A$ = +25°C | 5 | 20 | | ns |
| Charge Injection (Note 3) | Q | $C_L$ = 1nF, $V_{GEN}$ = 0, $R_{GEN}$ = 0, Figure 4 | $T_A$ = +25°C | | 5 | 10 | pC |
| Off-Isolation Rejection Ratio (Note 6) | OIRR | $R_L$ = 50Ω, $C_L$ = 5pF, f = 1MHz, Figure 5 | $T_A$ = +25°C | | 60 | | dB |
| Crosstalk (Note 7) | | $R_L$ = 50Ω, $C_L$ = 5pF, f = 1MHz, Figure 6 | $T_A$ = +25°C | | 100 | | dB |
| Source-Off Capacitance | $C_{S(OFF)}$ | f = 1MHz, Figure 7 | $T_A$ = +25°C | | 4 | | pF |
| Drain-Off Capacitance | $C_{D(OFF)}$ | f = 1MHz, Figure 7 | $T_A$ = +25°C | | 4 | | pF |
| Source-On Capacitance | $C_{S(ON)}$ | f = 1MHz, Figure 8 | $T_A$ = +25°C | | 16 | | pF |
| Drain-On Capacitance | $C_{D(ON)}$ | f = 1MHz, Figure 8 | $T_A$ = +25°C | | 16 | | pF |

## ELECTRICAL CHARACTERISTICS—Single Supply

(V+ = 12V, V- = 0V, $V_L$ = 5V, GND = 0V, $V_{INH}$ = 2.4V, $V_{INL}$ = 0.8V, $T_A$ = $T_{MIN}$ to $T_{MAX}$, unless otherwise noted.)

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP (Note 2) | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| **SWITCH** | | | | | | | |
| Analog Signal Range | $V_{ANALOG}$ | | | 0 | | 12 | V |
| Drain-Source On-Resistance | $R_{DS(ON)}$ | $V_L$ = 5V; $V_D$ = 3V, 8V; $I_S$ = 1mA | $T_A$ = +25°C | | 100 | 160 | Ω |
| | | | $T_A$ = $T_{MIN}$ to $T_{MAX}$ | | | 200 | |
| **SUPPLY** | | | | | | | |
| Power-Supply Range | V+, V- | | | 4.5 | | 40 | V |
| Power-Supply Current | I+ | All channels on or off, $V_{IN}$ = 0 or 5V | $T_A$ = +25°C | -1 | 0.001 | 1 | µA |
| | | | $T_A$ = $T_{MIN}$ to $T_{MAX}$ | -5 | | 5 | |
| Negative Supply Current | I- | All channels on or off, $V_{IN}$ = 0 or 5V | $T_A$ = +25°C | -1 | -0.0001 | 1 | µA |
| | | | $T_A$ = $T_{MIN}$ to $T_{MAX}$ | -5 | | 5 | |
| Logic Supply Current | $I_L$ | All channels on or off, $V_{IN}$ = 0 or 5V | $T_A$ = +25°C | -1 | 0.001 | 1 | µA |
| | | | $T_A$ = $T_{MIN}$ to $T_{MAX}$ | -5 | | 5 | |
| Ground Current | $I_{GND}$ | All channels on or off, $V_{IN}$ = 0 or 5V | $T_A$ = +25°C | -1 | -0.0001 | 1 | µA |
| | | | $T_A$ = $T_{MIN}$ to $T_{MAX}$ | -5 | | 5 | |

# Quad, SPST Analog Switch

## ELECTRICAL CHARACTERISTICS—Single Supply (continued)

(V+ = 12V, V- = 0, $V_L$ = 5V, GND = 0V, $V_{INH}$ = 2.4V, $V_{INL}$ = 0.8V, $T_A$ = $T_{MIN}$ to $T_{MAX}$, unless otherwise noted.)

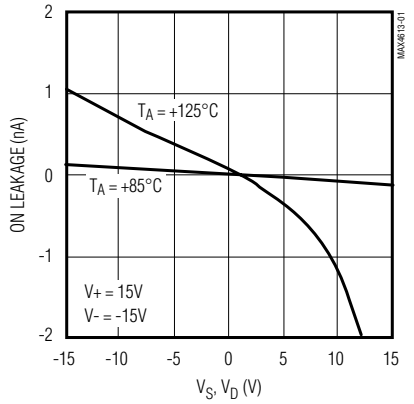
| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP (Note 2) | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| **DYNAMIC** | | | | | | | |
| Turn-On Time (Note 3) | $t_{ON}$ | $V_S$ = 8V, Figure 2 | $T_A$ = +25°C | | 300 | 400 | ns |
| Turn-Off Time (Note 3) | $t_{OFF}$ | $V_S$ = 8V, Figure 2 | $T_A$ = +25°C | | 60 | 200 | ns |
| Charge Injection (Note 3) | Q | $C_L$ = 1nF, $V_{GEN}$ = 0, $R_{GEN}$ = 0, Figure 4 | $T_A$ = +25°C | | 5 | 10 | pC |

**Note 2:** Typical values are for **design aid only,** are not guaranteed and are not subject to production testing. 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:** Guaranteed by design.
**Note 4:** On-resistance match between channels and flatness are guaranteed only with bipolar-supply operation. Flatness is defined as the difference between the maximum and the minimum value of on-resistance as measured at the extremes of the specified analog signal range.
**Note 5:** Leakage parameters $I_{S(OFF)}$, $I_{D(OFF)}$, $I_{D(ON)}$, and $I_{S(ON)}$ are 100% tested at the maximum rated hot temperature and guaranteed at +25°C.
**Note 6:** Off-Isolation Rejection Ratio = 20log ($V_D/V_S$).
**Note 7:** Between any two switches.

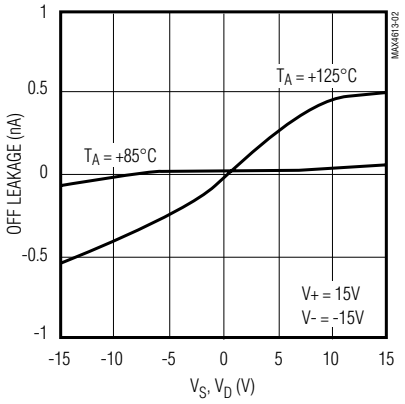
## Typical Operating Characteristics

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

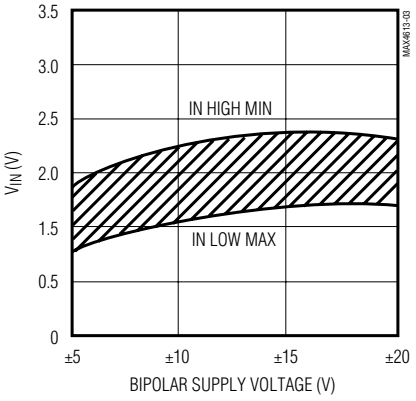
**ON LEAKAGE CURRENTS**



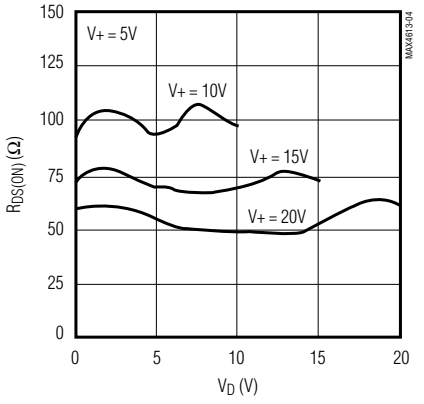

**OFF LEAKAGE CURRENTS**



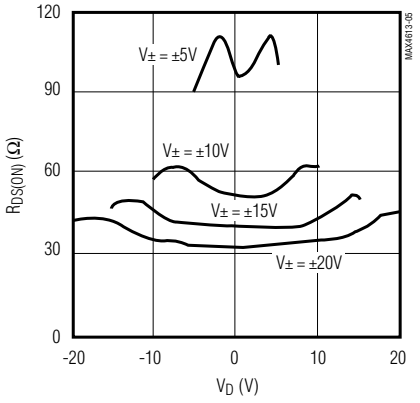

**SWITCHING THRESHOLD vs. BIPOLAR SUPPLY VOLTAGE**



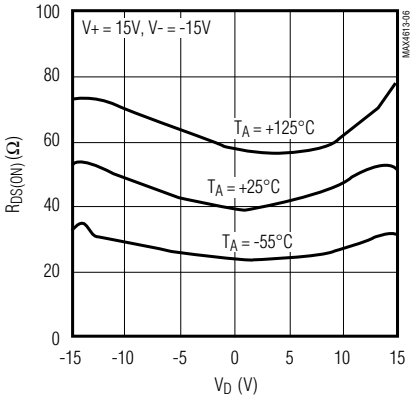

**ON-RESISTANCE vs. $V_D$ (UNIPOLAR SUPPLY VOLTAGE)**




**ON-RESISTANCE vs. $V_D$ (BIPOLAR SUPPLY VOLTAGE)**



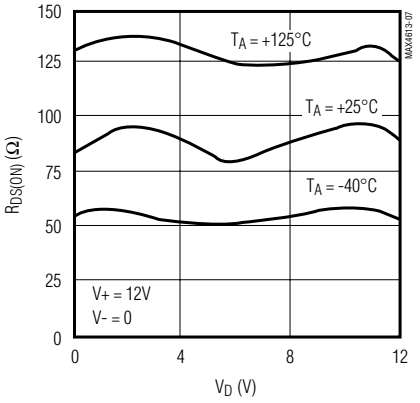

**ON-RESISTANCE vs. $V_D$ (BIPOLAR SUPPLY VOLTAGE AND TEMPERATURE)**



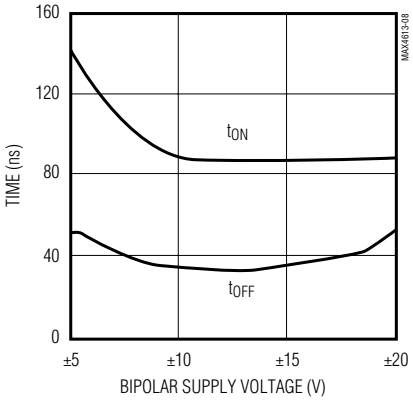
## Typical Operating Characteristics (continued)

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

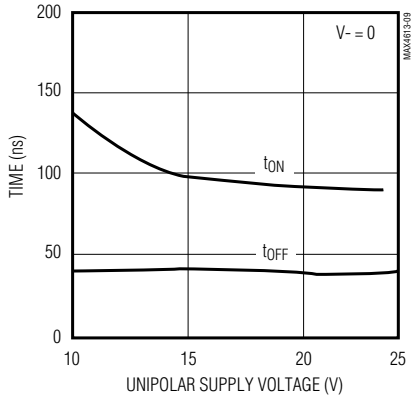
**ON-RESISTANCE vs. $V_D$ (UNIPOLAR SUPPLY VOLTAGE AND TEMPERATURE)**



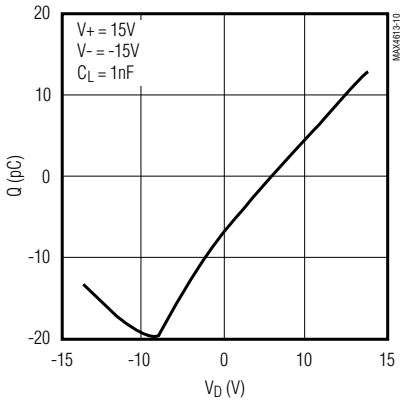

**SWITCHING TIME vs. BIPOLAR SUPPLY VOLTAGE**



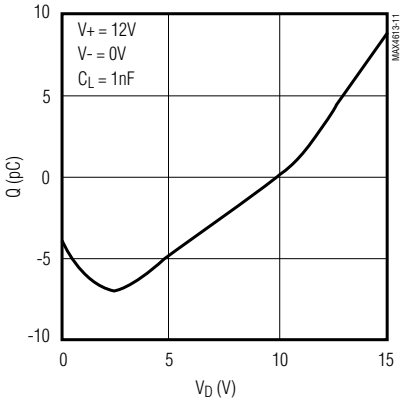

**SWITCHING TIME vs. UNIPOLAR SUPPLY VOLTAGE**




**CHARGE INJECTION vs. $V_D$ VOLTAGE**




**CHARGE INJECTION vs. $V_D$ VOLTAGE**



# Quad, SPST Analog Switch

## Pin Description

| PIN | | NAME | FUNCTION |
|---|---|---|---|
| DIP/SO/TSSOP | QFN | | |
| 1, 8, 9, 16 | 6, 7, 14, 15 | IN1–IN4 | Logic Control Input |
| 2, 7, 10, 15 | 5, 8, 13, 16 | D1–D4 | Analog-Switch Drain Output |
| 3, 6, 11, 14 | 1, 4, 9, 12 | S1–S4 | Analog-Switch Source Output |
| 4 | 2 | V- | Negative-Supply Voltage Input |
| 5 | 3 | GND | Ground |
| 12 | 10 | $V_L$ | Logic-Supply Voltage Input |
| 13 | 11 | V+ | Positive-Supply Voltage Input—Connected to Substrate |

## Applications Information

### General Operation

1) Switches are open when power is off.
2) IN_, D_, and S_ should not exceed V+ or V-, even with the power off.
3) Switch leakage is from each analog switch terminal to V+ or V-, not to other switch terminals.

### Operation with Supply Voltages Other than ±15V

Using supply voltages less than ±15V will reduce the analog signal range. The MAX4613 operates with ±4.5V to ±20V bipolar supplies or with a +4.5V to +40V single supply; connect V- to GND when operating with a single supply. Also, all device types can operate with unbalanced supplies such as +24V and -5V. $V_L$ must be connected to +5V to be TTL compatible, or to V+ for CMOS-logic level inputs. The *Typical Operating Characteristics* graphs show typical on-resistance with ±20V, ±15V, ±10V, and ±5V supplies. (Switching times increase by a factor of two or more for operation at ±5V.)

### 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 may cause permanent damage to the devices. Always sequence V+ on first, followed by $V_L$, V-, and logic inputs. If power-supply sequencing is not possible, add two small, external signal diodes in series with supply pins for overvoltage protection (Figure 1). Adding diodes reduces the analog signal range to 1V below V+ and 1V above V-, but low switch resistance and low leakage characteristics are unaffected. Device operation is unchanged, and the difference between V+ and V- should not exceed +44V.

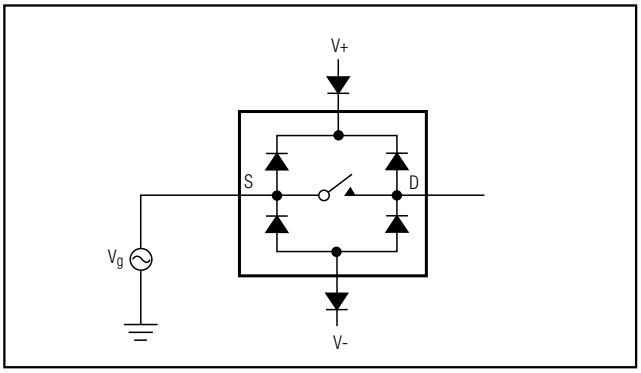



*Figure 1. Overvoltage Protection Using External Blocking Diodes*

## Timing Diagrams/Test Circuits

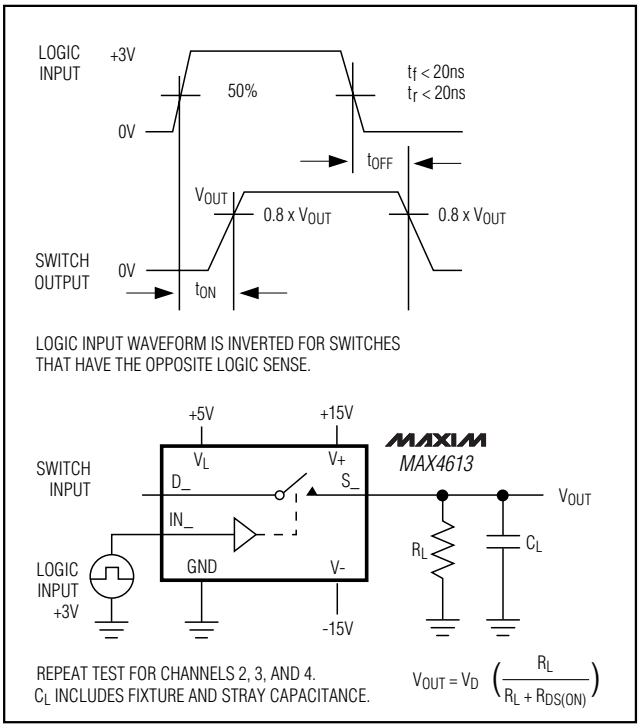



*Figure 2. Switching Time*

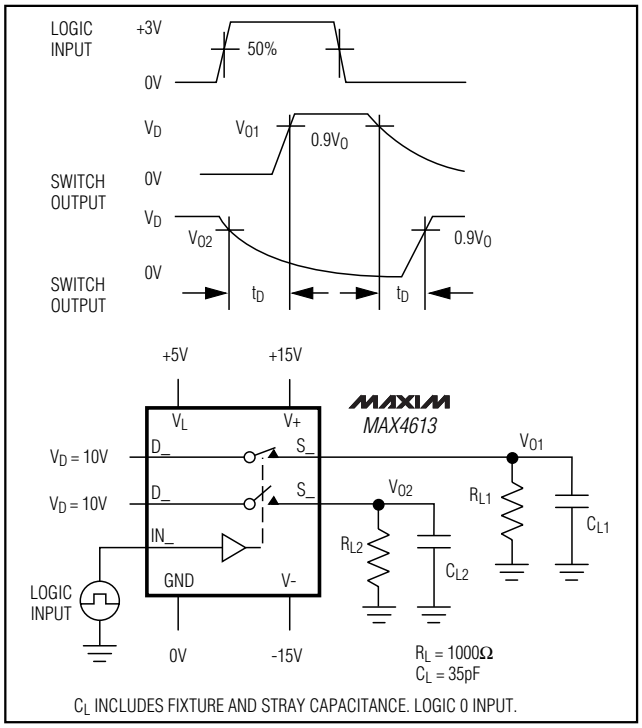



*Figure 3. Break-Before-Make Test Circuit*

# Quad, SPST Analog Switch

## Timing Diagrams/Test Circuits (continued)

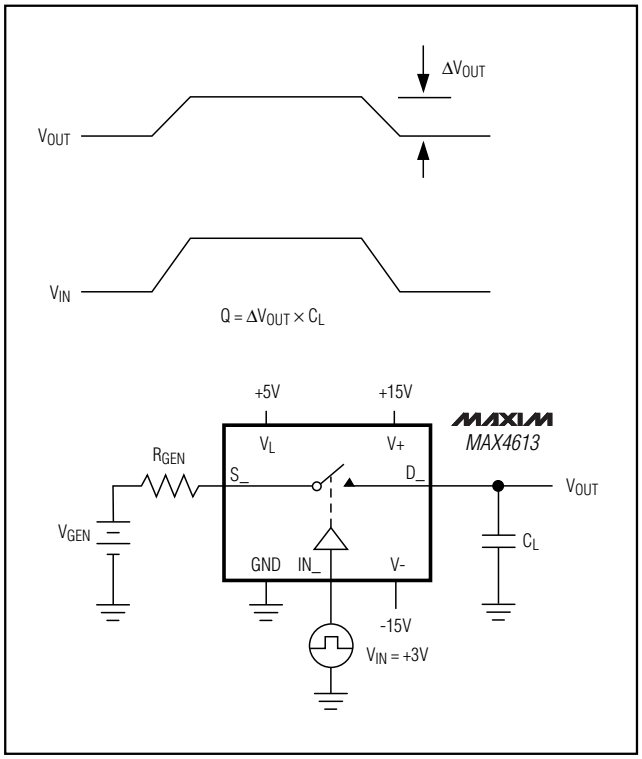



*Figure 4. Charge Injection*

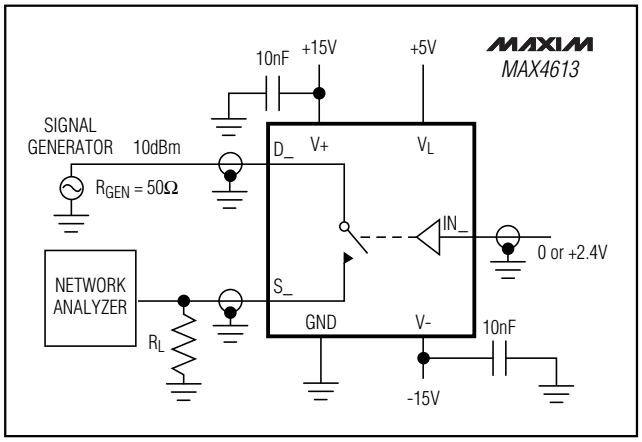



*Figure 5. Off-Isolation Rejection Ratio*

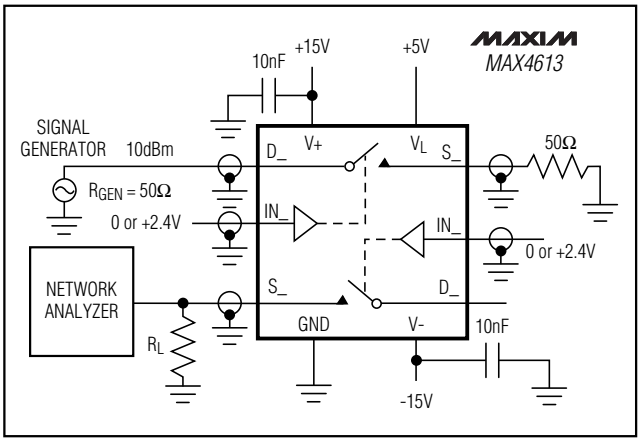



*Figure 6. Crosstalk*

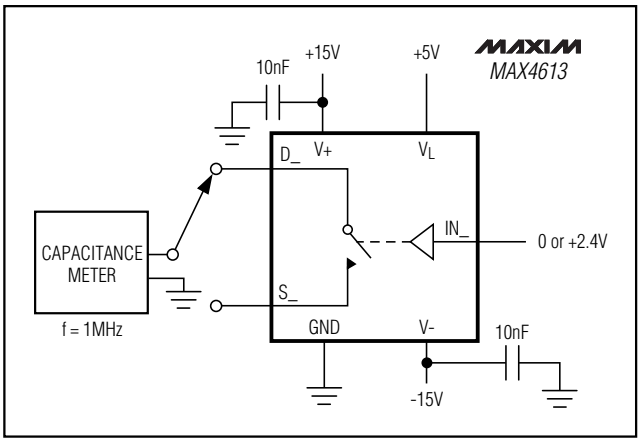



*Figure 7. Source/Drain-Off Capacitance*

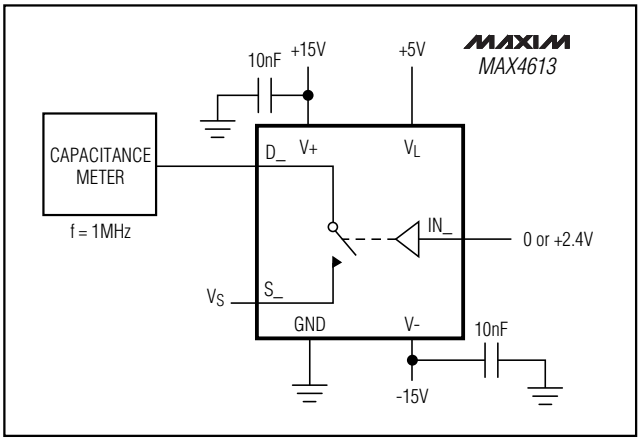
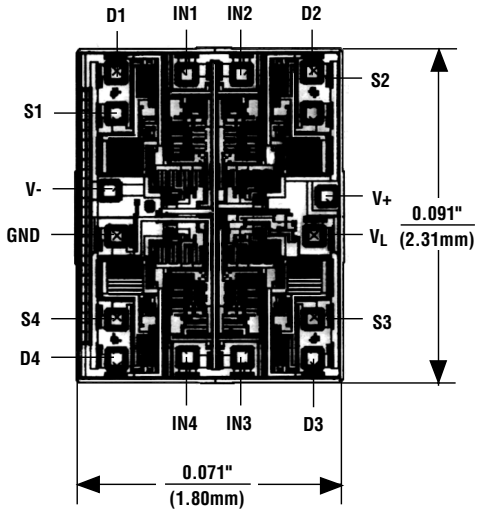


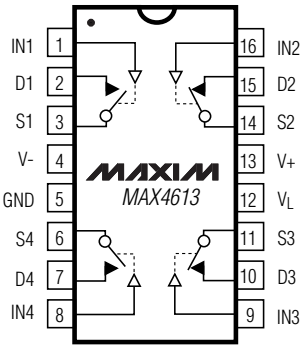

*Figure 8. Source/Drain-On Capacitance*

## Chip Topography




TRANSISTOR COUNT: 126
SUBSTRATE CONNECTED TO V+

## Pin Configurations (continued)

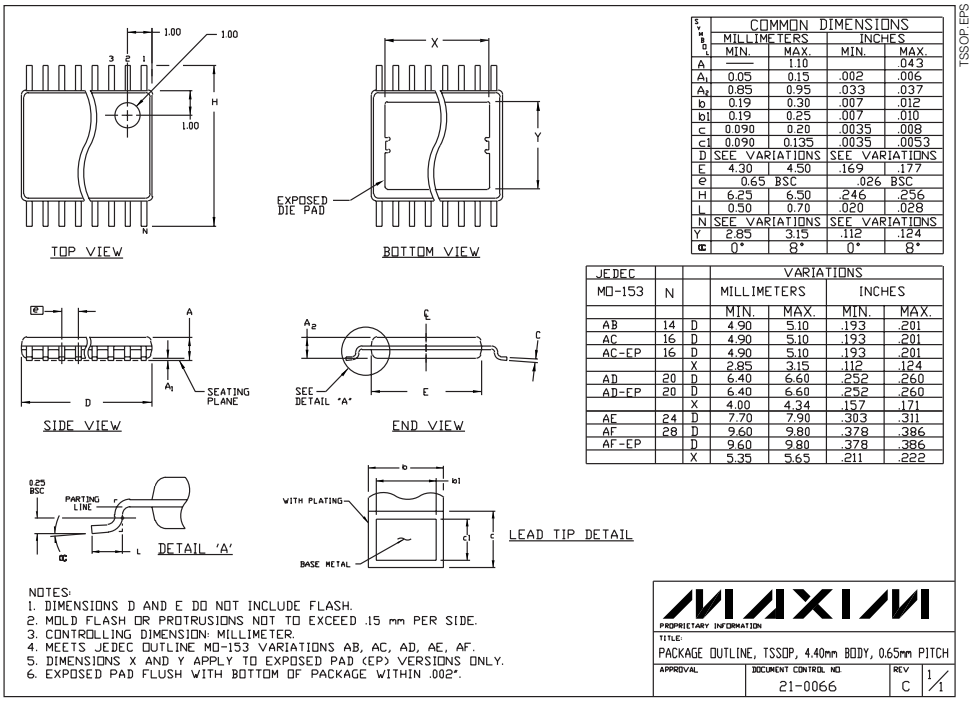



DIP/SO/QSOP/TSSOP

| LOGIC | $SW_1$, $SW_4$ | $SW_2$, $SW_3$ |
|---|---|---|
| 0 | OFF | ON |
| 1 | ON | OFF |

SWITCHES SHOWN FOR LOGIC "0" INPUT

## Package Information




| COMMON DIMENSIONS | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| SYMBOL | MIN. | MAX. | MIN. | 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 |
| b1 | 0.19 | 0.25 | .007 | .010 |
| c | 0.090 | 0.20 | .0035 | .008 |
| c1 | 0.090 | 0.135 | .0035 | .0053 |
| D | SEE VARIATIONS | | SEE VARIATIONS | |
| E | 4.30 | 4.50 | .169 | .177 |
| e | 0.65 BSC | | .026 BSC | |
| H | 6.25 | 6.50 | .246 | .256 |
| L | 0.50 | 0.70 | .020 | .028 |
| N | SEE VARIATIONS | | SEE VARIATIONS | |
| Y | 2.85 | 3.15 | .112 | .124 |
| α | 0° | 8° | 0° | 8° |

| JEDEC | | | VARIATIONS | | | |
|---|---|---|---|---|---|---|
| MO-153 | N | | MILLIMETERS | | INCHES | |
| | | | MIN. | MAX. | MIN. | MAX. |
| AB | 14 | D | 4.90 | 5.10 | .193 | .201 |
| AC | 16 | D | 4.90 | 5.10 | .193 | .201 |
| AC-EP | 16 | D | 4.90 | 5.10 | .193 | .201 |
| | | X | 2.85 | 3.15 | .112 | .124 |
| AD | 20 | D | 6.40 | 6.60 | .252 | .260 |
| AD-EP | 20 | D | 6.40 | 6.60 | .252 | .260 |
| | | X | 4.00 | 4.34 | .157 | .171 |
| AE | 24 | D | 7.70 | 7.90 | .303 | .311 |
| AF | 28 | D | 9.60 | 9.80 | .378 | .386 |
| AF-EP | | D | 9.60 | 9.80 | .378 | .386 |
| | | X | 5.35 | 5.65 | .211 | .222 |

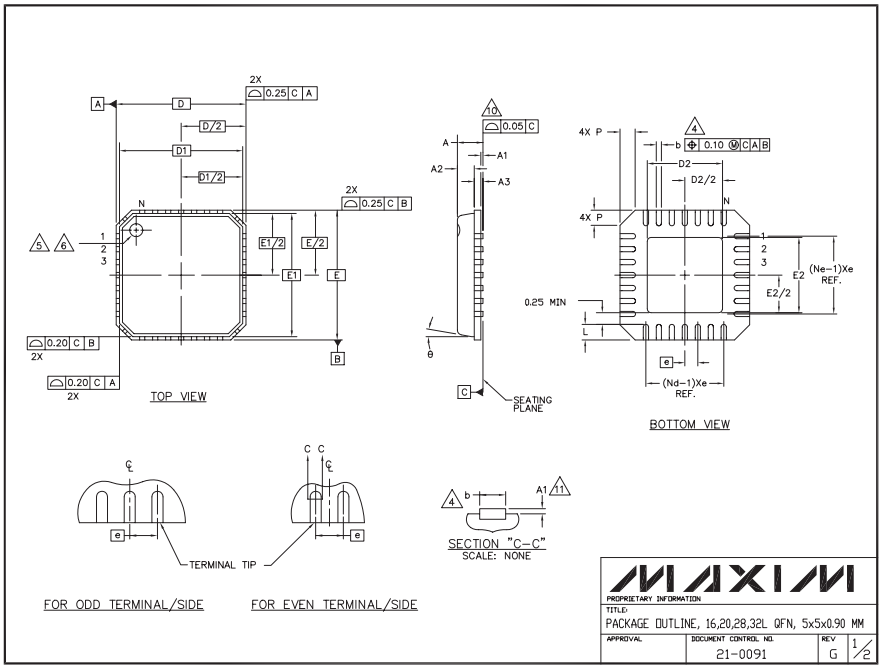
NOTES:
1. DIMENSIONS D AND E DO NOT INCLUDE FLASH.
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED .15 mm PER SIDE.
3. CONTROLLING DIMENSION: MILLIMETER.
4. MEETS JEDEC OUTLINE MO-153 VARIATIONS AB, AC, AD, AE, AF.
5. DIMENSIONS X AND Y APPLY TO EXPOSED PAD (EP) VERSIONS ONLY.
6. EXPOSED PAD FLUSH WITH BOTTOM OF PACKAGE WITHIN .002".

MAXIM
PROPRIETARY INFORMATION
TITLE: PACKAGE OUTLINE, TSSOP, 4.40mm BODY, 0.65mm PITCH
APPROVAL | DOCUMENT CONTROL NO. 21-0066 | REV. C | 1/1

TSSOP EPS

# Quad, SPST Analog Switch

## Package Information (continued)




NOTES:

1. DIE THICKNESS ALLOWABLE IS 0.305mm MAXIMUM (.012 INCHES MAXIMUM)
2. DIMENSIONING & TOLERANCES CONFORM 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.
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 EMBEDDED PART OF EXPOSED PAD FROM MEASURING.
10. MEETS JEDEC MO220.
11. THIS PACKAGE OUTLINE APPLIES TO ANVIL SINGULATION (STEPPED SIDES) AND TO SAW SINGULATION (STRAIGHT SIDES) QFN STYLES.

| SYMBOL | COMMON DIMENSIONS | | | NOTE |
|---|---|---|---|---|
| | MIN. | NOM. | MAX. | |
| A | 0.80 | 0.90 | 1.00 | |
| A1 | 0.00 | 0.01 | 0.05 | |
| A2 | 0.00 | 0.65 | 1.00 | |
| A3 | | 0.20 REF. | | |
| D | | 5.00 BSC | | |
| D1 | | 4.75 BSC | | |
| E | | 5.00 BSC | | |
| E1 | | 4.75 BSC | | |
| θ | 0° | – | 12° | |
| P | 0 | | 0.60 | |
| D2 | 1.25 | – | 3.25 | |
| E2 | 1.25 | – | 3.25 | |

| SYMBOL | PITCH VARIATION B | | | NOTE |
|---|---|---|---|---|
| | MIN. | NOM. | MAX. | |
| e | | 0.80 BSC | | |
| N | | 16 | | 3 |
| Nd | | 4 | | 3 |
| Ne | | 4 | | 3 |
| L | 0.35 | 0.55 | 0.75 | |
| b | 0.28 | 0.33 | 0.40 | 4 |

| SYMBOL | PITCH VARIATION B | | | NOTE |
|---|---|---|---|---|
| | MIN. | NOM. | MAX. | |
| e | | 0.65 BSC | | |
| N | | 20 | | 3 |
| Nd | | 5 | | 3 |
| Ne | | 5 | | 3 |
| L | 0.35 | 0.55 | 0.75 | |
| b | 0.23 | 0.28 | 0.35 | 4 |

| SYMBOL | PITCH VARIATION C | | | NOTE |
|---|---|---|---|---|
| | MIN. | NOM. | MAX. | |
| e | | 0.50 BSC | | |
| N | | 28 | | 3 |
| Nd | | 7 | | 3 |
| Ne | | 7 | | 3 |
| L | 0.35 | 0.55 | 0.75 | |
| b | 0.18 | 0.23 | 0.30 | 4 |

| SYMBOL | PITCH VARIATION D | | | NOTE |
|---|---|---|---|---|
| | MIN. | NOM. | MAX. | |
| e | | 0.50 BSC | | |
| N | | 32 | | 3 |
| Nd | | 8 | | 3 |
| Ne | | 8 | | 3 |
| L | 0.30 | 0.40 | 0.50 | |
| b | 0.18 | 0.23 | 0.30 | 4 |

PROPRIETARY INFORMATION
TITLE:
PACKAGE OUTLINE, 16,20,28,32L QFN, 5x5x0.90 MM
APPROVAL
DOCUMENT CONTROL NO.
21-0091
REV
G
2/2