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maxim integrated™

# MAX4729/MAX4730

# Low-Voltage 3.5Ω, SPDT, CMOS Analog Switches

## General Description

The MAX4729/MAX4730 single-pole/double-throw (SPDT) switches operate from a single supply ranging from +1.8V to +5.5V. These switches provide low 3.5Ω on-resistance ($R_{ON}$), as well as 0.45Ω $R_{ON}$ flatness with a +2.7V supply. These devices typically consume only 1nA of supply current, making them ideal for use in low-power, portable applications. The MAX4729/MAX4730 feature low-leakage currents over the extended temperature range, TTL/CMOS-compatible digital logic, and excellent AC characteristics.

The MAX4729/MAX4730 are available in small 6-pin SC70 and 6-pin µDFN packages. The MAX4729/MAX4730 are offered in three pinout configurations to ease design. The MAX4729/MAX4730 are specified over the extended -40°C to +85°C temperature range.

## Applications

Battery-Operated Equipment

Audio and Video-Signal Routing

Low-Voltage Data-Acquisition Systems

Sample-and-Hold Circuits

Communications Circuits

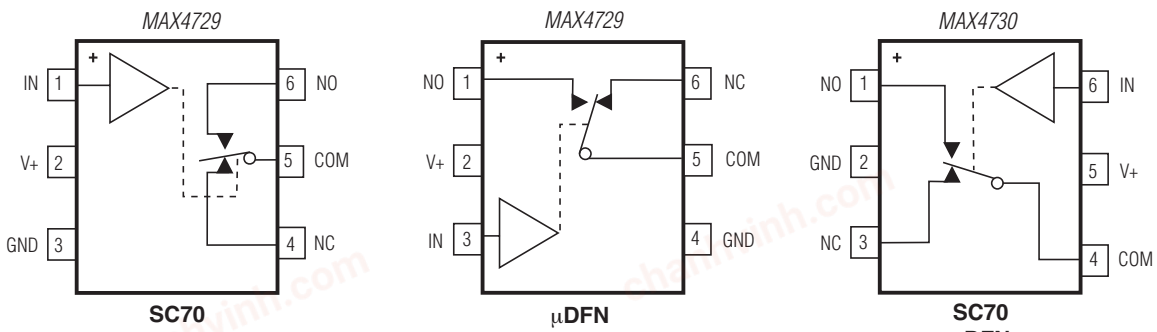
Relay Replacement

## Features

- **Low 3.5Ω $R_{ON}$ (+2.7V Supply)**
- **0.45Ω $R_{ON}$ Flatness (+2.7V Supply)**
- **0.05Ω $R_{ON}$ Match Between Channels (+2.7V Supply)**
- **Tiny SC70 and µDFN Packages**
- **-3dB Bandwidth: 300MHz**
- **Low On-Capacitance: 19.5pF**
- **0.036% Total Harmonic Distortion**
- **Low Supply Current: 1nA**
- **+1.8V to +5.5V Single-Supply Operation**

## Pin Configurations/Functional Diagrams/Truth Table

TOP VIEW




| MAX4729/ MAX4730 | | |
|---|---|---|
| **IN** | **NC** | **NO** |
| 0 | ON | OFF |
| 1 | OFF | ON |

SWITCHES SHOWN FOR LOGIC 0 INPUT.

**For pricing, delivery, and ordering information, please contact Maxim Direct at 1-888-629-4642, or visit Maxim Integrated's website at www.maximintegrated.com.**

*19-3284; Rev 2; 6/14*

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# MAX4729/MAX4730

# Low-Voltage 3.5Ω, SPDT, CMOS Analog Switches

## ABSOLUTE MAXIMUM RATINGS

(All voltages referenced to ground.)
V+, IN .....-0.3V to +6V
COM, NO, NC (Note 1).....-0.3V to (V+ +0.3V)
Continuous Current (IN, V+, GND).....±30mA
Continuous Current (COM, NO, NC).....±80mA
Peak Current COM, NO, NC
(Pulsed at 1ms, 10% Duty Cycle).....±150mA

Continuous Power Dissipation ($T_A$ = +70°C)
µDFN (derate 2.1mW/°C above +70°C).....168mW
SC70 (derate 3.1mW/°C above +70°C).....245mW
Operating Temperature Range .....-40°C to +85°C
Maximum Junction Temperature .....+150°C
Storage Temperature Range .....-65°C to +150°C
Lead Temperature (soldering, 10s).....+300°C
Soldering Temperature (reflow).....+260°C

**Note 1:** Signals on NO, NC, or COM exceeding V+ or GND are clamped by internal diodes. Signals on IN exceeding GND are clamped by an internal diode. 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

(V+ = +2.7V to +3.6V, $V_{IH}$ = +2.0V, $V_{IL}$ = +0.4V, $T_A$ = -40°C to +85°C, unless otherwise noted. Typical values are at $T_A$ = +25°C.) (Note 2)

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| **ANALOG SWITCH** | | | | | | | |
| Analog Signal Range | $V_{COM}$, $V_{NO}$, $V_{NC}$ | | | 0 | | V+ | V |
| On-Resistance (Note 6) | $R_{ON}$ | V+ = 2.7V, $I_{COM}$ = 10mA, $V_{NO}$ or $V_{NC}$ = 0V to V+ | $T_A$ = +25°C | | 3.5 | 5.5 | Ω |
| | | | $T_A$ = -40°C to +85 | | | 5.7 | |
| On-Resistance Match Between Channels (Notes 3, 6) | $\Delta R_{ON}$ | V+ = 2.7V, $I_{COM}$ = 10mA, $V_{NO}$ or $V_{NC}$ = 0.7V, 1.2V, 2V (MAX4729) | $T_A$ = +25°C | | 0.05 | 0.15 | Ω |
| | | | $T_A$ = -40°C to +85 | | | 0.2 | |
| | | V+ = 2.7V, $I_{COM}$ = 10mA, $V_{NO}$ or $V_{NC}$ = 0.7V, 1.2V, 2V (MAX4730) | $T_A$ = +25°C | | 0.2 | 0.34 | |
| | | | $T_A$ = -40°C to +85 | | | 0.37 | |
| On-Resistance Flatness (Note 4) | $R_{FLAT(ON)}$ | V+ = 2.7V, $I_{COM}$ = 10mA, $V_{NO}$ or $V_{NC}$ = 0.7V, 1.2V, 2V (MAX4729) | $T_A$ = +25°C | | 0.8 | 1.5 | Ω |
| | | | $T_A$ = -40°C to +85 | | | 2.2 | |
| | | V+ = 2.7V, $I_{COM}$ = 10mA, $V_{NO}$ or $V_{NC}$ = 0.7V, 1.2V, 2V (MAX4730) | $T_A$ = +25°C | | 0.45 | 0.95 | |
| | | | $T_A$ = -40°C to +85 | | | 1.3 | |
| NO, NC Off-Leakage Current | $I_{NO (OFF)}$, $I_{NC (OFF)}$ | V+ = 3.3V, $V_{COM}$ = 1V, 3V, $V_{NO}$ or $V_{NC}$ = 3V, 1V | $T_A$ = +25°C | -2 | +0.01 | +2 | nA |
| | | | $T_A$ = -40°C to +85 | -3 | | +3 | |
| COM On-Leakage Current | $I_{COM (ON)}$ | V+ = 3.3V, $V_{COM}$ = 1V or 3V, $V_{NO}$ or $V_{NC}$ = 1V, 3V, or float | $T_A$ = +25°C | -3 | +0.01 | +3 | nA |
| | | | $T_A$ = -40°C to +85 | -4 | | +4 | |
| **DIGITAL INPUTS** | | | | | | | |
| Input Logic High | $V_{IH}$ | | $T_A$ = -40°C to +85 | 2.0 | | | V |
| Input Logic Low | $V_{IL}$ | | $T_A$ = -40°C to +85 | | | 0.4 | V |
| Input Leakage Current | $I_{IN}$ | $V_{IN}$ = 0V or 3.6V | $T_A$ = -40°C to +85 | -1 | +0.005 | +1 | µA |

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## ELECTRICAL CHARACTERISTICS (continued)

(V+ = +2.7V to +3.6V, $V_{IH}$ = +2.0V, $V_{IL}$ = +0.4V, $T_A$ = -40°C to +85°C, unless otherwise noted. Typical values are at $T_A$ = +25°C.) (Note 2)

| PARAMETER | SYMBOL | CONDITIONS | $T_A$ | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| **DYNAMIC** | | | | | | | |
| Turn-On Time (Note 5) | $t_{ON}$ | $V_{NO}$, $V_{NC}$ = 2V, $R_L$ = 300Ω, $C_L$ = 35pF, Figure 1 | $T_A$ = +25°C | | 18 | 45 | ns |
| | | | $T_A$ = -40°C to +85 | | | 45 | |
| Turn-Off Time (Note 5) | $t_{OFF}$ | $V_{NO}$, $V_{NC}$ = 2V, $R_L$ = 300Ω, $C_L$ = 35pF, Figure 1 | $T_A$ = +25°C | | 10 | 26 | ns |
| | | | $T_A$ = -40°C to +85 | | | 26 | |
| Break-Before-Make (Note 5) | | $V_{NO}$, $V_{NC}$ = 2V, $R_L$ = 300Ω, $C_L$ = 35pF, Figure 1 | $T_A$ = +25°C | | 5 | | ns |
| | | | $T_A$ = -40°C to +85 | 1 | | | |
| Charge Injection | Q | $V_{GEN}$ = 0V, $R_{GEN}$ = 0, $C_L$ = 1.0nF, Figure 3 | | | 3 | | pC |
| NO, NC Off-Capacitance | $C_{NO(OFF)}$, $C_{NC(OFF)}$ | f = 1MHz, Figure 4 | | | 6.5 | | pF |
| Switch On-Capacitance | $C_{ON}$ | f = 1MHz, Figure 4 | | | 19.5 | | pF |
| Off-Isolation (Note 7) | $V_{ISO}$ | $V_{NO}$ = $V_{NC}$ = 1$V_{RMS}$, $R_L$ = 50Ω, $C_L$ = 5pF, Figure 2 | f = 1MHz | | -67 | | dB |
| | | | f = 10MHz | | -45 | | |
| On-Channel Bandwidth -3dB | BW | Signal = 0dBm, 50Ω in and out, Figure 2 | | | 300 | | MHz |
| Crosstalk (Note 8) | $V_{CT}$ | NO or NC = 1$V_{RMS}$, $C_L$ = 5pF, $R_L$ = 50Ω, Figure 2 | f = 1MHz | | -67 | | dB |
| | | | f = 10MHz | | -52 | | |
| Total Harmonic Distortion | THD | $R_L$ = 600Ω, $V_{NC}$ or $V_{NO}$ = 2$V_{P-P}$, f = 20Hz to 20kHz | +25°C | | 0.035 | | % |
| **POWER SUPPLY** | | | | | | | |
| Power-Supply Range | V+ | | | 1.8 | | 5.5 | V |
| Positive Supply Current | I+ | V+ = 5.5V, $V_{IN}$ = 0V or 5.5V | $T_A$ = +25°C | | 0.001 | | µA |
| | | | $T_A$ = -40°C to +85 | | | 1 | |

**Note 2:** SC70 and µDFN parts are 100% tested at $T_A$ = +25°C. Limits across the full-temperature range are guaranteed by design and correlation.

**Note 3:** $\Delta R_{ON} = R_{ON(MAX)} - R_{ON(MIN)}$.

**Note 4:** $R_{ON}$ 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:** µDFN is guaranteed by design.

**Note 7:** Off-Isolation = 20log10 (VO / VI), where VO is $V_{COM}$ and VI is either $V_{NC}$ or $V_{NO}$ from the network analyzer.

**Note 8:** Crosstalk is measured between the two switches.

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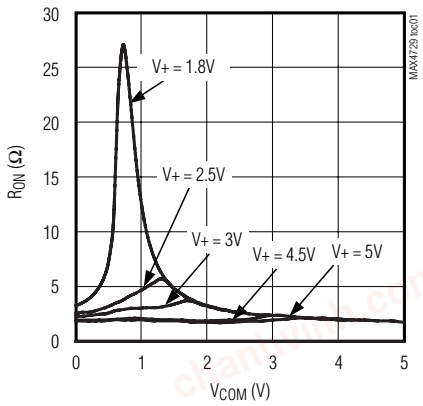
# MAX4729/MAX4730

# Low-Voltage 3.5Ω, SPDT, CMOS Analog Switches

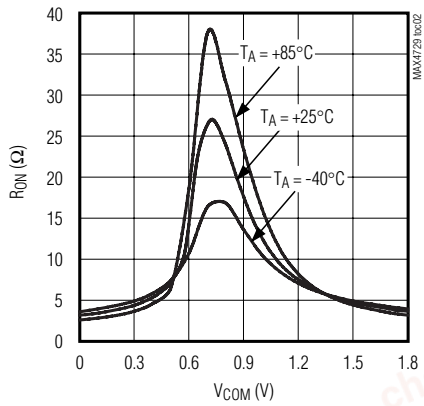
## Typical Operating Characteristics

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

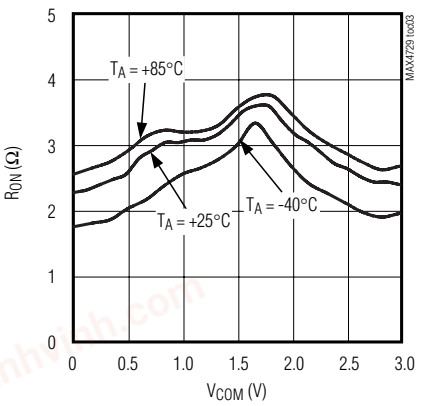
**ON-RESISTANCE vs. $V_{COM}$**



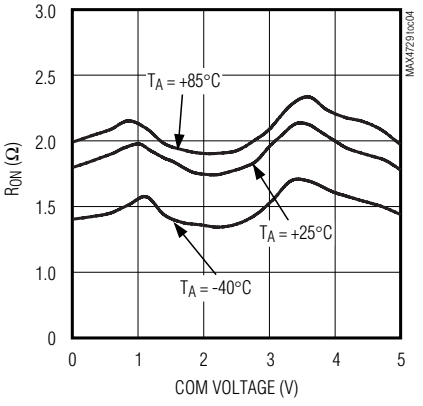

**ON-RESISTANCE vs. $V_{COM}$ (V+ = +1.8V)**



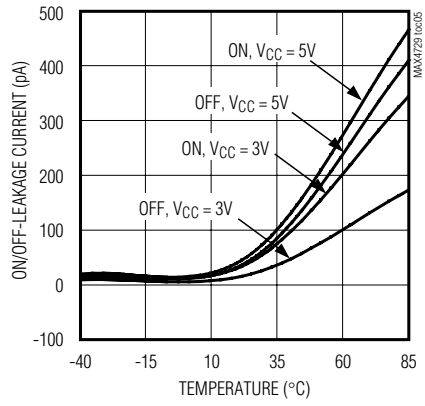

**ON-RESISTANCE vs. $V_{COM}$ (V+ = +3V)**



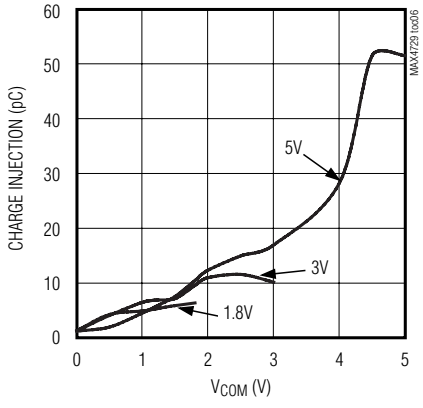

**ON-RESISTANCE vs. $V_{COM}$ (V+ = +5V)**



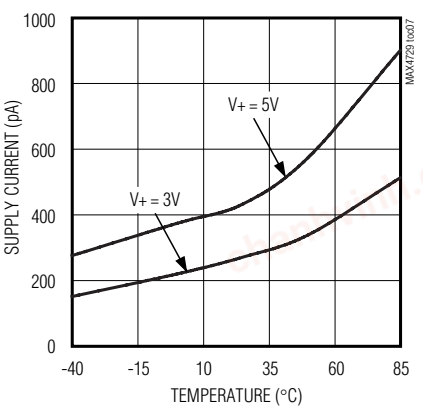

**ON/OFF-LEAKAGE CURRENT vs. TEMPERATURE**



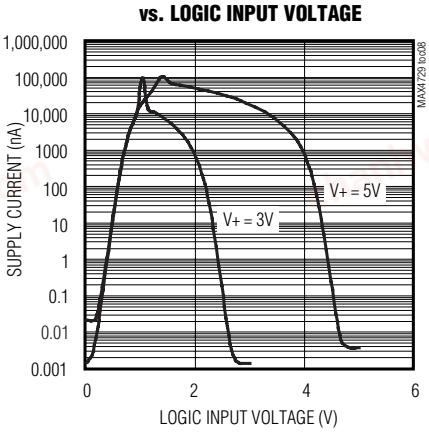

**CHARGE INJECTION vs. $V_{COM}$**



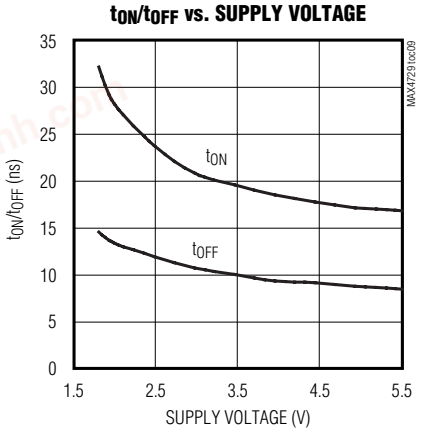

**SUPPLY CURRENT vs. TEMPERATURE**




**SUPPLY CURRENT vs. LOGIC INPUT VOLTAGE**




**$t_{ON}/t_{OFF}$ vs. SUPPLY VOLTAGE**



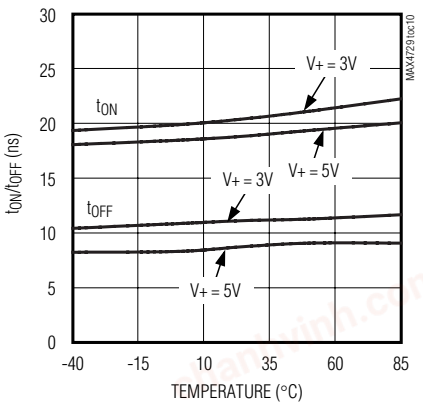
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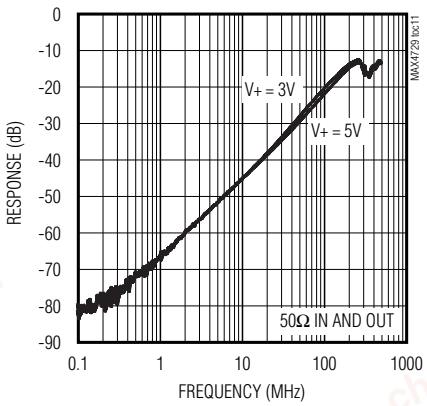
## Typical Operating Characteristics (continued)

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

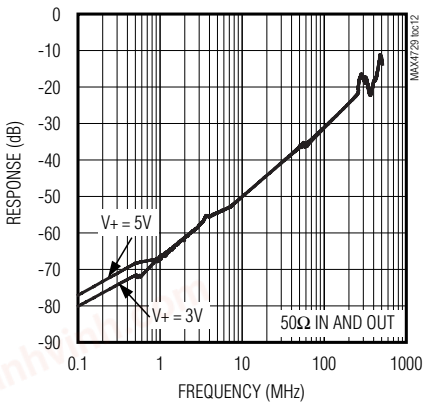
**$t_{ON}/t_{OFF}$ vs. TEMPERATURE**



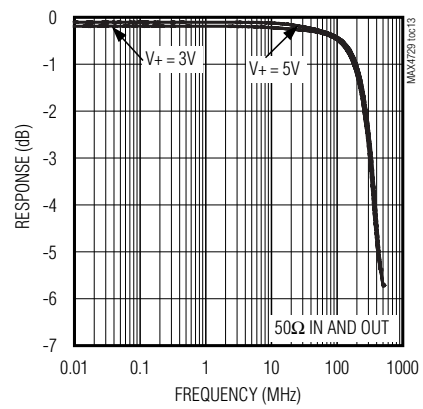

**OFF-ISOLATION**



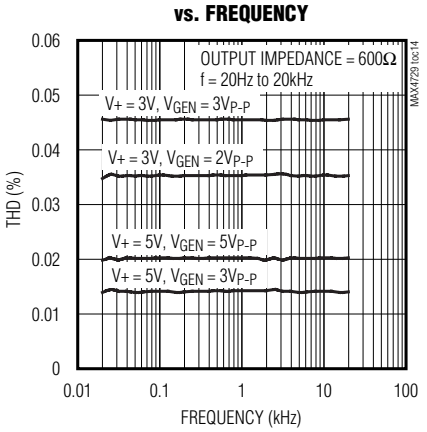

**CROSSTALK**



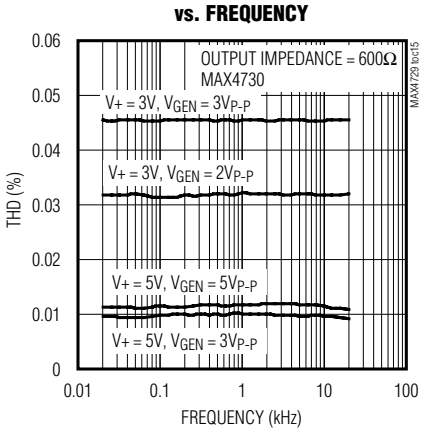

**ON-LOSS BANDWIDTH**




**TOTAL HARMONIC DISTORTION vs. FREQUENCY**




**TOTAL HARMONIC DISTORTION vs. FREQUENCY**




## Pin Description

| PIN | | | NAME | FUNCTION |
|---|---|---|---|---|
| MAX4729 | | MAX4730 | | |
| SC70 | µDFN | SC70/µDFN | | |
| 1 | 3 | 6 | IN | Logic-Control Input |
| 2 | 2 | 5 | V+ | Positive Supply Voltage |
| 3 | 4 | 2 | GND | Ground |
| 4 | 6 | 3 | NC | Analog Switch Normally Closed Terminal |
| 5 | 5 | 4 | COM | Analog Switch Common Terminal |
| 6 | 1 | 1 | NO | Analog Switch Normally Open Terminal |

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# MAX4729/MAX4730

# Low-Voltage 3.5Ω, SPDT, CMOS Analog Switches

## Detailed Description

The MAX4729/MAX4730 single-pole/double-throw (SPDT) switches operate from a single supply ranging from +1.8V to +5.5V. These switches provide low 3.5Ω on-resistance ($R_{ON}$), as well as 0.45Ω $R_{ON}$ flatness with a 2.7V supply. These devices typically consume only 1nA of supply current, making them suitable for use in low-power, portable applications. The MAX4729/MAX4730 feature low-leakage currents over the entire temperature range, TTL/CMOS-compatible digital logic, and excellent AC characteristics.

## Applications Information

### Digital Control Inputs

The MAX4729/MAX4730 logic inputs accept up to +5.5V, regardless of supply voltage. For example, with a +3.3V supply, IN can be driven low to GND and high to +5.5V, allowing for mixing of logic levels in a system. With a 2.7V to 3.6V power-supply voltage range, the logic thresholds are set so $V_{IL}$ = 0.4V (max) and $V_{IH}$ = 2V (min).

### Power-Supply Sequencing and Overvoltage Protection

**Caution:** Do not exceed the absolute maximum ratings because stresses beyond the listed ratings can cause permanent damage to the device. Proper power-supply sequencing is recommended for all CMOS devices. Always apply V+ before applying analog signals, especially if the analog signal is not current limited.

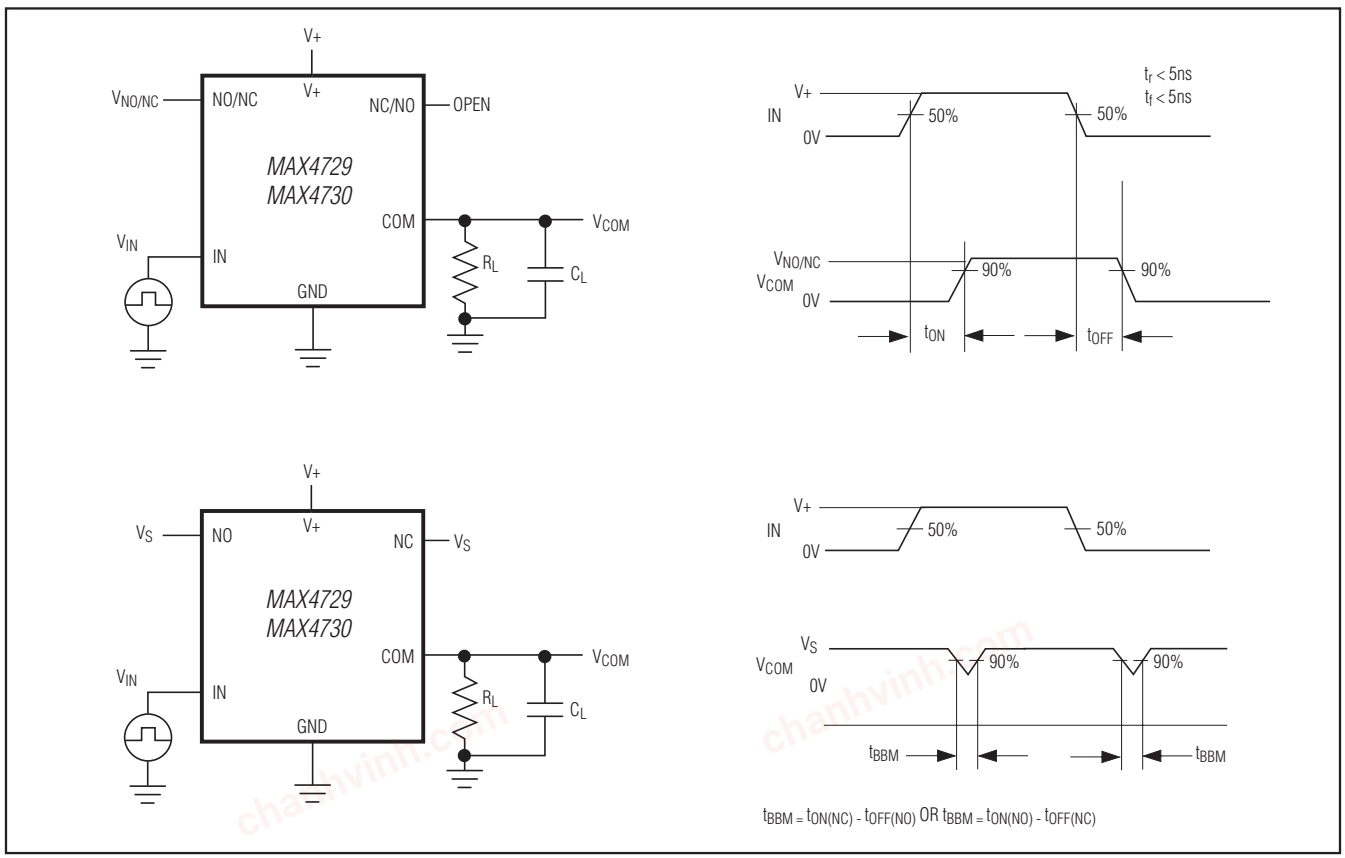



*Figure 1. Switching Times*

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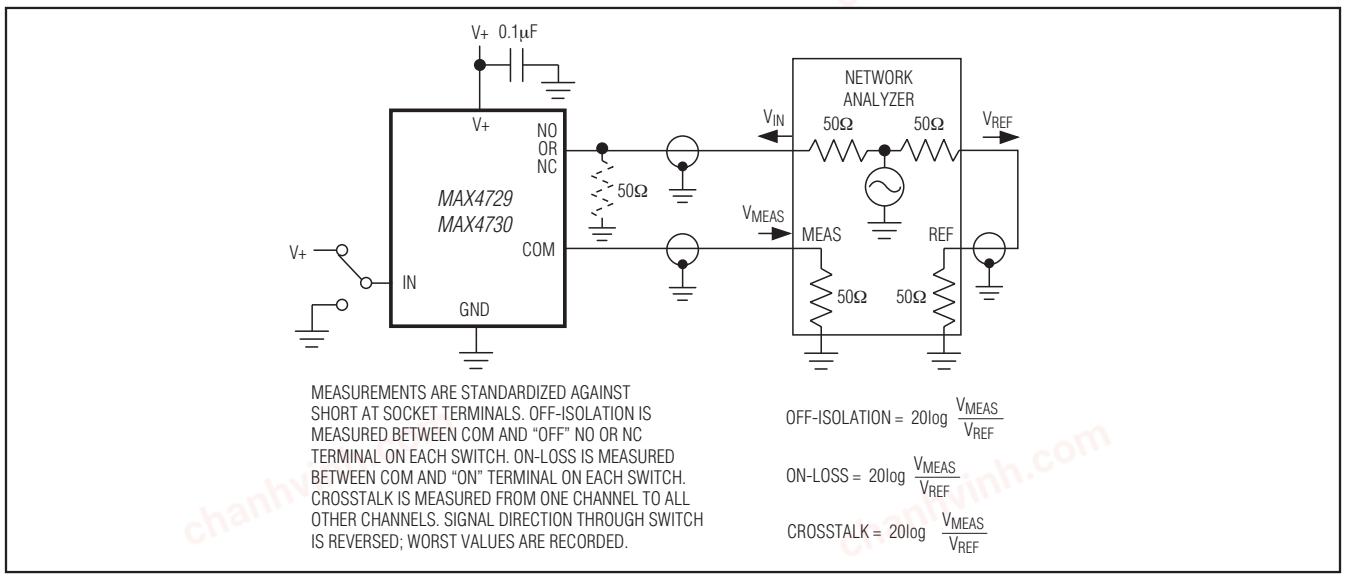



*Figure 2. Off-Isolation/On-Loss Bandwidth, Crosstalk*

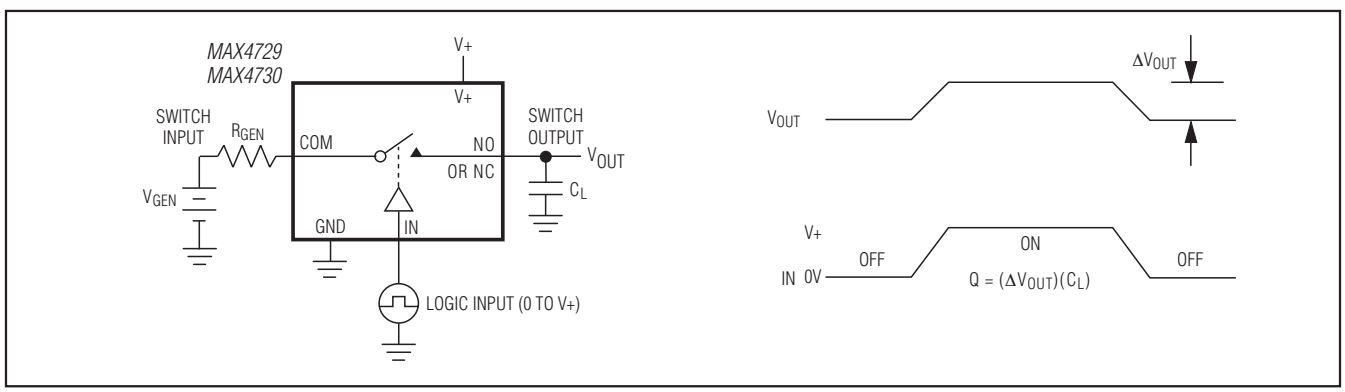



*Figure 3. Charge Injection*

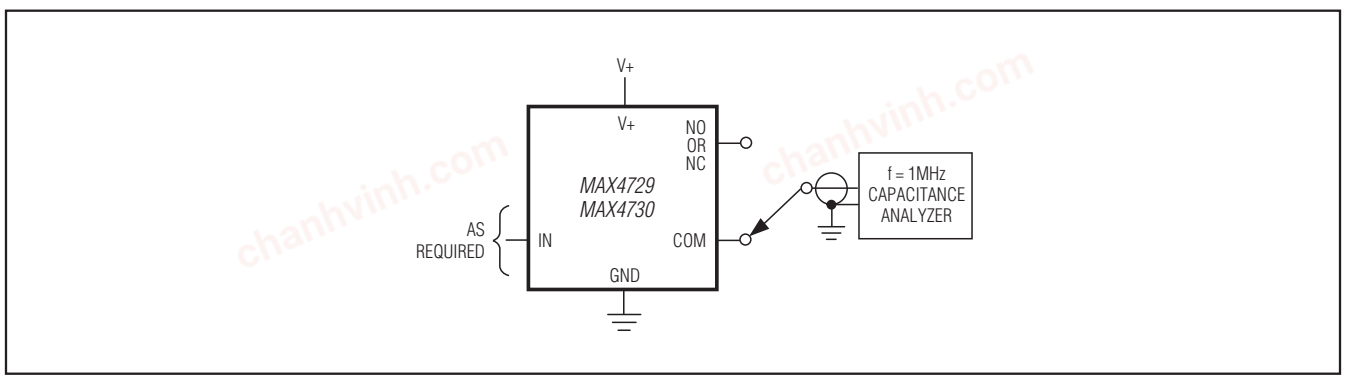



*Figure 4. NO, NC, and COM Capacitance*

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# MAX4729/MAX4730

# Low-Voltage 3.5Ω, SPDT, CMOS Analog Switches

## Chip Information

PROCESS: CMOS

## Ordering Information

| PART | TEMP RANGE | PIN-PACKAGE |
|---|---|---|
| **MAX4729**EXT+T | -40°C to +85°C | 6 SC70 |
| MAX4729ELT+T | -40°C to +85°C | 6 µDFN |
| **MAX4730**EXT+T | -40°C to +85°C | 6 SC70 |
| MAX4730ELT+T | -40°C to +85°C | 6 µDFN |

*+Denotes lead(Pb)-free/RoHS-compliant package.*

## Package Information

For the latest package outline information and land patterns (footprints), go to **www.maximintegrated.com/packages**. Note that a "+", "#", or "-" in the package code indicates RoHS status only. Package drawings may show a different suffix character, but the drawing pertains to the package regardless of RoHS status.

| PACKAGE TYPE | PACKAGE CODE | OUTLINE NO. | LAND PATTERN NO. |
|---|---|---|---|
| 6 SC70 | X6SN+1 | 21-0077 | 90-0189 |
| 6 µDFN | L611+1 | 21-0147 | 90-0080 |

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## Revision History

| REVISION NUMBER | REVISION DATE | DESCRIPTION | PAGES CHANGED |
|---|---|---|---|
| 2 | 6/14 | ELT+ production status corrected | — |

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