



0.5Ω, Low-Voltage, Single-Supply SPST Analog Switches

General Description

The MAX4626/MAX4627/MAX4628 are low-on-resistance, low-voltage, single-pole/single-throw (SPST) analog switches that operate from a +1.8V to +5.5V single supply. The MAX4626 is normally open (NO), and the MAX4627 is normally closed (NC). The MAX4628 is normally open (NO) and has two control inputs. These devices also have fast switching speeds ($t_{ON} = 50\text{ns}$ max, $t_{OFF} = 30\text{ns}$ max).

When powered from a +5V supply, the MAX4626/MAX4627/MAX4628 offer 0.5Ω max on-resistance (R_{ON}) with 0.1Ω max R_{ON} flatness, and their digital logic inputs are TTL compatible. These switches also feature overcurrent protection to prevent device damage from short circuits and excessive loads.

The MAX4626 is pin compatible with the MAX4514, and the MAX4627 is pin compatible with the MAX4515. The MAX4626/MAX4627 are available in SOT23-5 packages; the MAX4628 is available in a SOT23-6 package.

Applications

Power Routing
Battery-Operated Equipment
Audio and Video Signal Routing
Low-Voltage Data-Acquisition Systems
Communications Circuits
PCMCIA Cards
Cellular Phones
Modems
Hard Drives

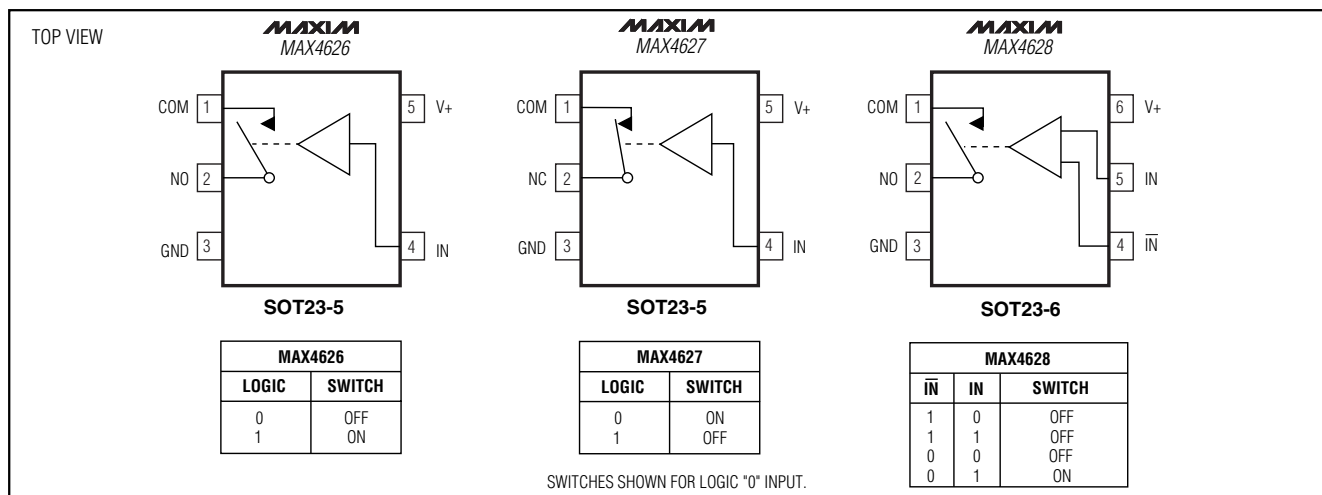
Features

- ◆ Low R_{ON}
0.5Ω max (+5V Supply)
0.9Ω max (+3V Supply)
- ◆ 0.1Ω max R_{ON} Flatness (+5V Supply)
- ◆ Overcurrent Protection
- ◆ Single-Supply Operation (+1.8V to +5.5V)
- ◆ Available in SOT23 Packages
- ◆ Fast Switching: $t_{ON} = 50\text{ns}$ max, $t_{OFF} = 30\text{ns}$ max
- ◆ TTL-Logic Compatible at +5V
- ◆ Pin Compatible with MAX4514 (MAX4626)
Pin Compatible with MAX4515 (MAX4627)

Ordering Information

| PART | TEMP. RANGE | PIN-PACKAGE | TOP MARK |
|--------------|----------------|-------------|----------|
| MAX4626EUK-T | -40°C to +85°C | 5 SOT23-5 | ADMJ |
| MAX4627EUK-T | -40°C to +85°C | 5 SOT23-5 | ADMK |
| MAX4628EUT-T | -40°C to +85°C | 6 SOT23-6 | AADN |

Pin Configurations/Functional Diagrams/Truth Tables



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ABSOLUTE MAXIMUM RATINGS

Voltages Referenced to GND

V+, IN, $\overline{\text{IN}}$ -0.3V to +6V

NO, NC, COM (Note 1) -0.3V to (V+ + 0.3V)

Continuous Current NO, NC to COM ±400mA

Peak Switch Current NO, NC to COM

(pulsed at 1ms, 10% duty cycle max) ±800mA

Continuous Power Dissipation (T_A = 70°C)

5-Pin SOT23-5 (derate 7.1mW/°C above +70°C) 571mW

6-Pin SOT23-6 (derate 7.1mW/°C above +70°C) 571mW

Operating Temperature Range

MAX462_EU_ -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 NC, NO, or COM exceeding V+ or GND are clamped by internal diodes.

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+ = +5V ±10%, GND = 0, V_{INH} = 2.4V, V_{INL} = 0.8V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted.) (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, V _{NO} or V _{NC} = 3.5V, I _{COM} = 100mA | T _A = +25°C | | 0.35 | 0.5 | Ω |
| | | | T _A = T _{MIN} to T _{MAX} | | | 0.6 | |
| On-Resistance Flatness (Note 4) | R _{FLAT(ON)} | V+ = 4.5V; V _{COM} = 0, 1V, 2V; I _{COM} = 100mA | T _A = +25°C | | 0.05 | 0.10 | Ω |
| | | | T _A = T _{MIN} to T _{MAX} | | | 0.10 | |
| NO or NC Off-Leakage Current | 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 | -2 | 0.2 | 2 | nA |
| | | | T _A = T _{MIN} to T _{MAX} | -20 | | 20 | |
| COM Off-Leakage Current | I _{COM(OFF)} | V+ = 5.5V; V _{COM} = 1V, 4.5V; V _{NO} or V _{NC} = 4.5V, 1V | T _A = +25°C | -2 | 0.2 | 2 | nA |
| | | | T _A = T _{MIN} to T _{MAX} | -20 | | 20 | |
| COM On-Leakage Current | I _{COM(ON)} | V+ = 5.5V; V _{COM} = 1V, 4.5V; V _{NO} or V _{NC} = 1V, 4.5V, or floating | T _A = +25°C | -4 | 0.3 | 4 | nA |
| | | | T _A = T _{MIN} to T _{MAX} | -40 | | 40 | |
| Overcurrent-Protection Threshold Current | | T _A = +25°C | | | 2.4 | | A |
| DYNAMIC | | | | | | | |
| Turn-On Time | t _{ON} | V _{NO} or V _{NC} = 3V, Figure 2 | T _A = +25°C | | 40 | 50 | ns |
| | | | T _A = T _{MIN} to T _{MAX} | | | 60 | |
| Turn-Off Time | t _{OFF} | V _{NO} or V _{NC} = 3V, Figure 2 | T _A = +25°C | | 18 | 30 | ns |
| | | | T _A = T _{MIN} to T _{MAX} | | | 40 | |
| Charge Injection | Q | C _L = 1.0nF, V _{GEN} = 0, R _{GEN} = 0, T _A = +25°C, Figure 3 | | | 40 | | pC |
| Off-Isolation (Note 5) | OIRR | R _L = 50Ω, C _L = 5pF, f = 1MHz, T _A = +25°C, Figure 4 | | | -51 | | dB |
| COM Off-Capacitance | C _{COM(OFF)} | f = 1MHz, T _A = +25°C, Figure 5 | | | 65 | | pF |
| NC or NO Off-Capacitance | C _{OFF} | f = 1MHz, T _A = +25°C, Figure 5 | | | 65 | | pF |
| COM On-Capacitance | C _{COM(ON)} | f = 1MHz, T _A = +25°C, Figure 5 | | | 130 | | pF |

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MAX4626/MAX4627/MAX4628

ELECTRICAL CHARACTERISTICS—Single +5V Supply (continued)

(V₊ = +5V ±10%, GND = 0, V_{INH} = 2.4V, V_{INL} = 0.8V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted.) (Notes 2, 3)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|-------------------------|------------------|--|-----|-----|-----|-------|
| LOGIC INPUT | | | | | | |
| Input Voltage Low | V _{INL} | | | | 0.8 | V |
| Input Voltage High | V _{INH} | | 2.4 | | | V |
| Logic Input Current | I _{IN} | | -1 | | 1 | μA |
| SUPPLY | | | | | | |
| Power-Supply Range | V ₊ | | 1.8 | | 5.5 | V |
| Positive Supply Current | I ₊ | V ₊ = 5.5V, V _{IN} = 0 or V ₊ | | | 10 | μA |

ELECTRICAL CHARACTERISTICS—Single +3V Supply

(V₊ = +2.7V to +3.6V, GND = 0, V_{INH} = 2.0V, V_{INL} = 0.6V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted.) (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, V _{NO} or V _{NC} = 1.5V, I _{COM} = 100mA | T _A = +25°C | 0.4 | 0.8 | Ω |
| | | | T _A = T _{MIN} to T _{MAX} | | 0.9 | |
| On-Resistance Flatness (Note 4) | R _{FLAT(ON)} | V ₊ = 2.7V; I _{COM} = 100mA; V _{NO} or V _{NC} = 0, 0.75V, 1.5V; T _A = +25°C | | 0.1 | | Ω |
| DYNAMIC | | | | | | |
| Turn-On Time | t _{ON} | V _{NO} or V _{NC} = 1.5V, Figure 2 | T _A = +25°C | 65 | 80 | ns |
| | | | T _A = T _{MIN} to T _{MAX} | | 90 | |
| Turn-Off Time | t _{OFF} | V _{NO} or V _{NC} = 1.5V, Figure 2 | T _A = +25°C | 22 | 40 | ns |
| | | | T _A = T _{MIN} to T _{MAX} | | 50 | |
| Charge Injection | Q | C _L = 1.0nF, Figure 3, V _{GEN} = 0, R _{GEN} = 0, T _A = +25°C | | 30 | | pC |
| LOGIC INPUT | | | | | | |
| Input Voltage Low | V _{INL} | | | | 0.6 | V |
| Input Voltage High | V _{INH} | | 2.0 | | | V |
| Logic Input Current | I _{IN} | | -1 | | 1 | μA |
| SUPPLY | | | | | | |
| Positive Supply Current | I ₊ | V = +3.6V, V _{IN} = 0 | | | 10 | 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: SOT-packaged parts are 100% tested at +25°C. Limits across the full temperature range are guaranteed by design and correlation.

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

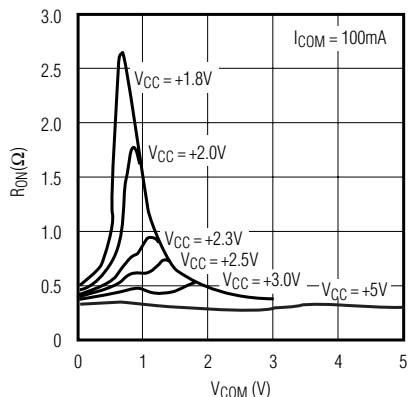
Note 5: Off-Isolation = 20log₁₀ [V_{COM} / (V_{NC} or V_{NO})], V_{COM} = output, V_{NC} or V_{NO} = input to off switch.

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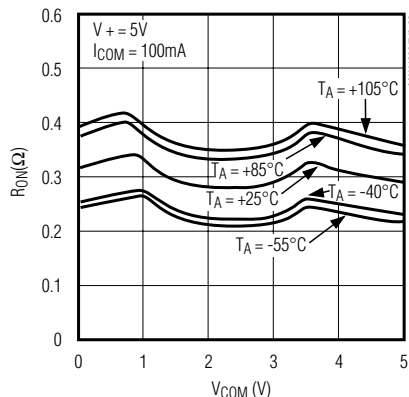
Typical Operating Characteristics

($T_A = +25^\circ\text{C}$, unless otherwise noted.)

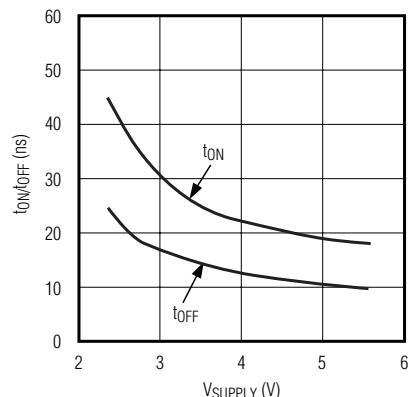
ON-RESISTANCE vs. COM VOLTAGE OVER SUPPLY VOLTAGE



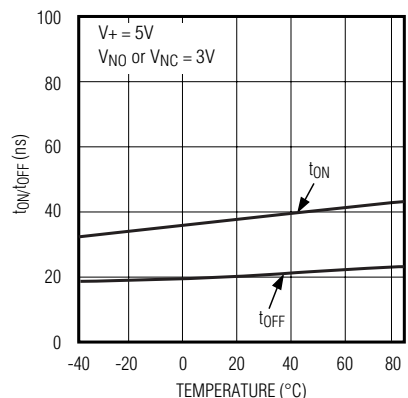
ON-RESISTANCE vs. COM VOLTAGE OVER TEMPERATURE



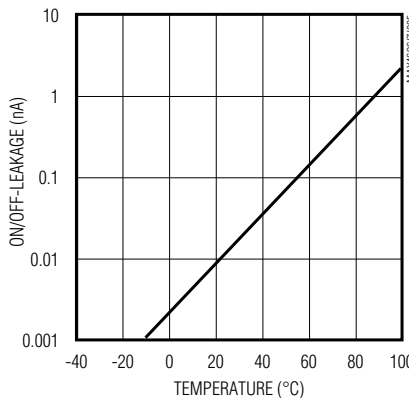
TURN-ON/OFF TIMES vs. SUPPLY VOLTAGE



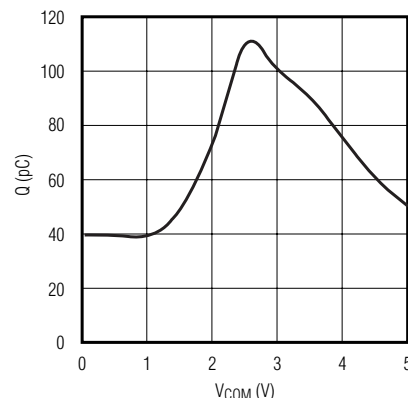
TURN-ON/OFF TIMES vs. TEMPERATURE



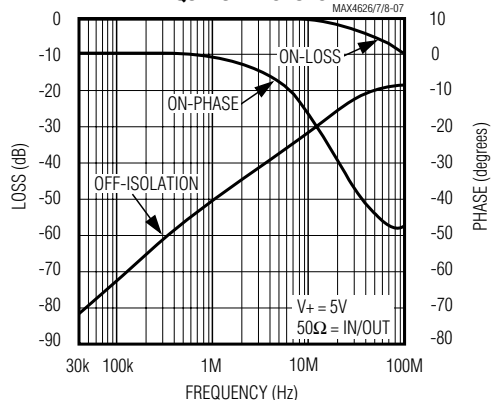
ON/OFF-LEAKAGE CURRENT vs. TEMPERATURE



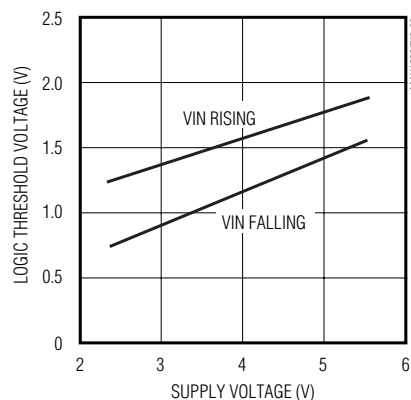
CHARGE INJECTION vs. COM VOLTAGE



FREQUENCY RESPONSE



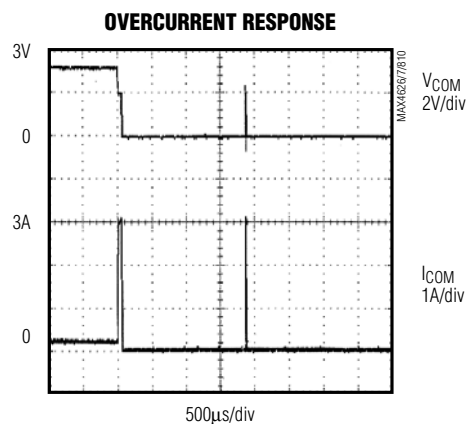
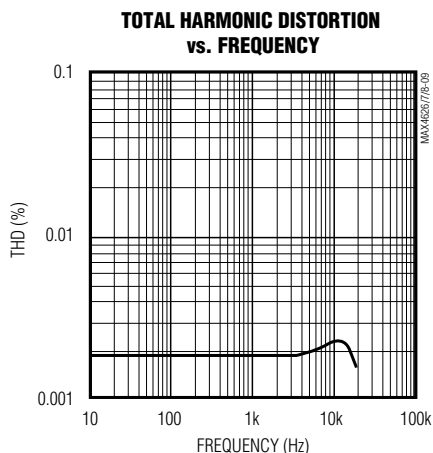
LOGIC THRESHOLD VOLTAGE vs. SUPPLY VOLTAGE



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Typical Operating Characteristics (continued)

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



Pin Description

| PIN | | | NAME | FUNCTION |
|---------|---------|---------|------------------------|--|
| MAX4626 | MAX4627 | MAX4628 | | |
| 1 | 1 | 1 | COM | Analog Switch—Common |
| 2 | — | 2 | NO | Analog Switch—Normally Open |
| 3 | 3 | 3 | GND | Ground |
| 4 | 4 | 5 | IN | Digital Control Input |
| 5 | 5 | 6 | V+ | Positive Supply Input |
| — | 2 | — | NC | Analog Switch—Normally Closed |
| — | — | 4 | $\overline{\text{IN}}$ | Inverted Digital Control Input (see MAX4628 Truth Table) |

MAX4626/MAX4627/MAX4628

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Detailed Description

The MAX4626/MAX4627/MAX4628 are low-on-resistance (R_{ON}), low-voltage, single-pole/single-throw (SPST) analog switches that operate from a +1.8V to +5.5V single supply. The MAX4626 is normally open (NO), and the MAX4627 is normally closed (NC). The MAX4628 is normally open (NO) and has two control inputs.

When powered from a +5V supply, their 0.5 Ω R_{ON} allows high continuous currents to be switched in a variety of applications. In the event of an overcurrent condition, these switches provide both current-limit and thermal-shutdown protection.

Current-Limit Protection

The MAX4626/MAX4627/MAX4628 feature current-limit protection circuitry. When the voltage drop across the on switch reaches 0.6V (typ), the internal circuitry activates. The current limit is not instantaneous, but rather integrates over time so that current limiting will not activate under momentary short-circuit conditions encountered when the switch output charges a small 0.1 μ F capacitor. For sustained overcurrent conditions, the switch turns off (opens). The switch turns on after 5ms and, if the overload condition persists, the switch will cycle off and on to produce a pulsed output. A direct short circuit will be detected immediately, and the switch will pulse on for 1 μ s, then remain off for 5ms.

Applications Information

Logic Inputs

The MAX4626/MAX4627/MAX4628 logic inputs can be driven up to +5.5V regardless of the supply voltage. For example, with a +3.3V supply, \overline{IN} or \overline{IN} may be driven low to 0V and high to 5.5V. Driving \overline{IN} or \overline{IN} Rail-to-Rail® minimizes power consumption.

Analog Signal Levels

Analog signals that range over the entire supply voltage (V_+ to GND) can be passed with very little change in on-resistance (see *Typical Operating Characteristics*). The switches are bidirectional, so the NO, NC, and COM pins can be used as either inputs or outputs.

Power-Supply Sequencing and Overvoltage Protection

Caution: Do not exceed the absolute maximum ratings; stresses beyond the listed ratings may cause permanent damage to the devices.

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. If this sequencing is not possible, and if the analog inputs are not current limited to <20mA, add a small-signal diode (D1) as shown in Figure 1. If the analog signal can dip below GND, add D2. Adding protection diodes reduces the analog range to a diode drop (about 0.7V) below V_+ (for D1), and a diode drop above ground (for D2). On-resistance increases by a small amount at low supply voltages. Maximum supply voltage (V_+) must not exceed +6V.

Adding protection diode D2 causes the logic thresholds to be shifted relative to GND. TTL compatibility is not guaranteed when protection diode D2 is added.

Protection diodes D1 and D2 also protect against some overvoltage situations. With Figure 1's circuit, if the supply voltage is below the absolute maximum rating, and if a fault voltage up to the absolute maximum rating is applied to an analog signal pin, no damage will result.

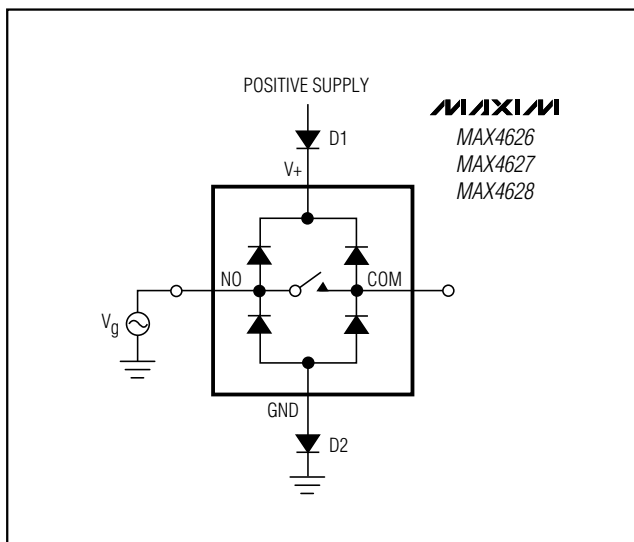


Figure 1. Overvoltage Protection Using Two External Blocking Diodes

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

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Test Circuits/Timing Diagrams

MAX4626/MAX4627/MAX4628

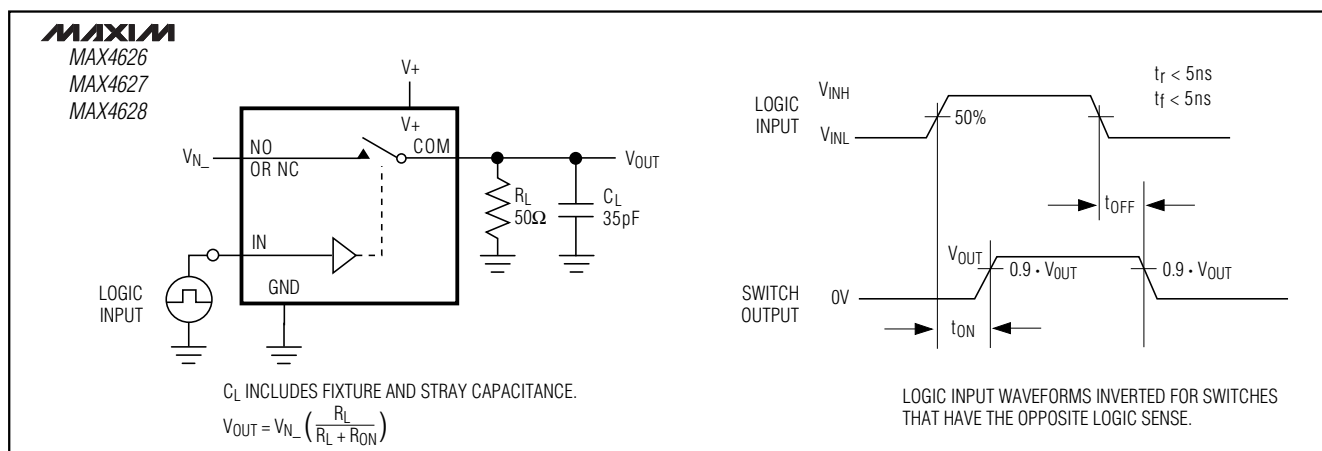


Figure 2. Switching Time

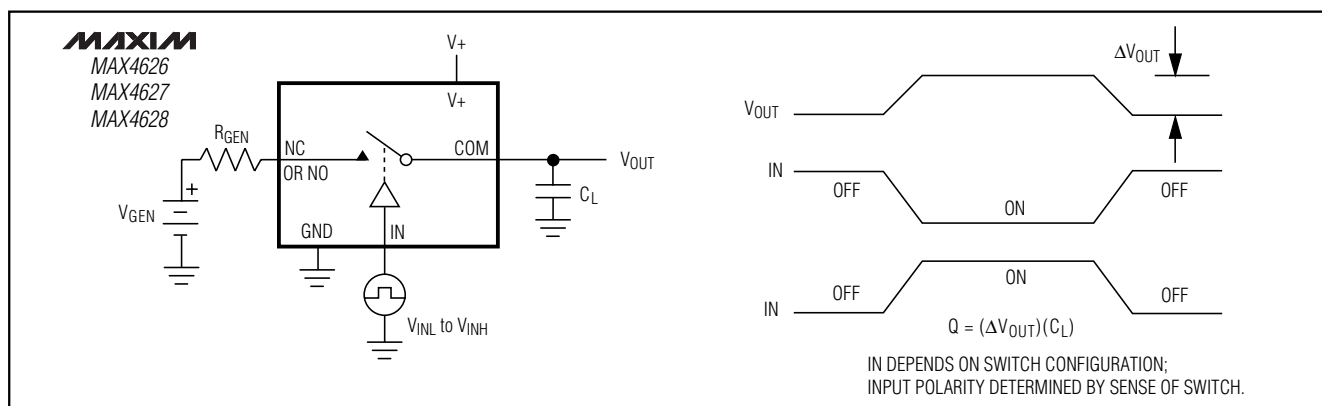


Figure 3. Charge Injection

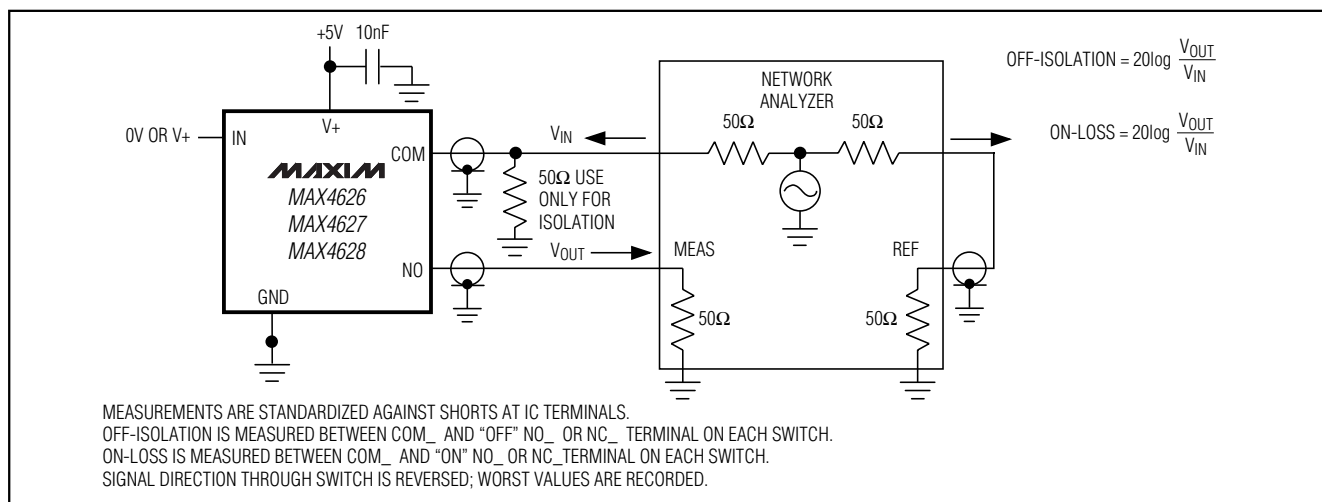


Figure 4. On-Loss and Off-Isolation

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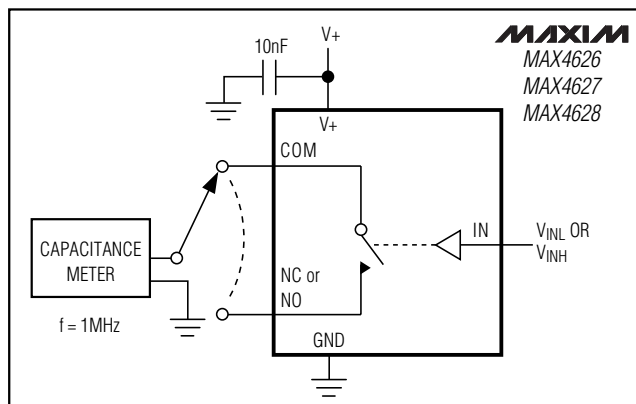
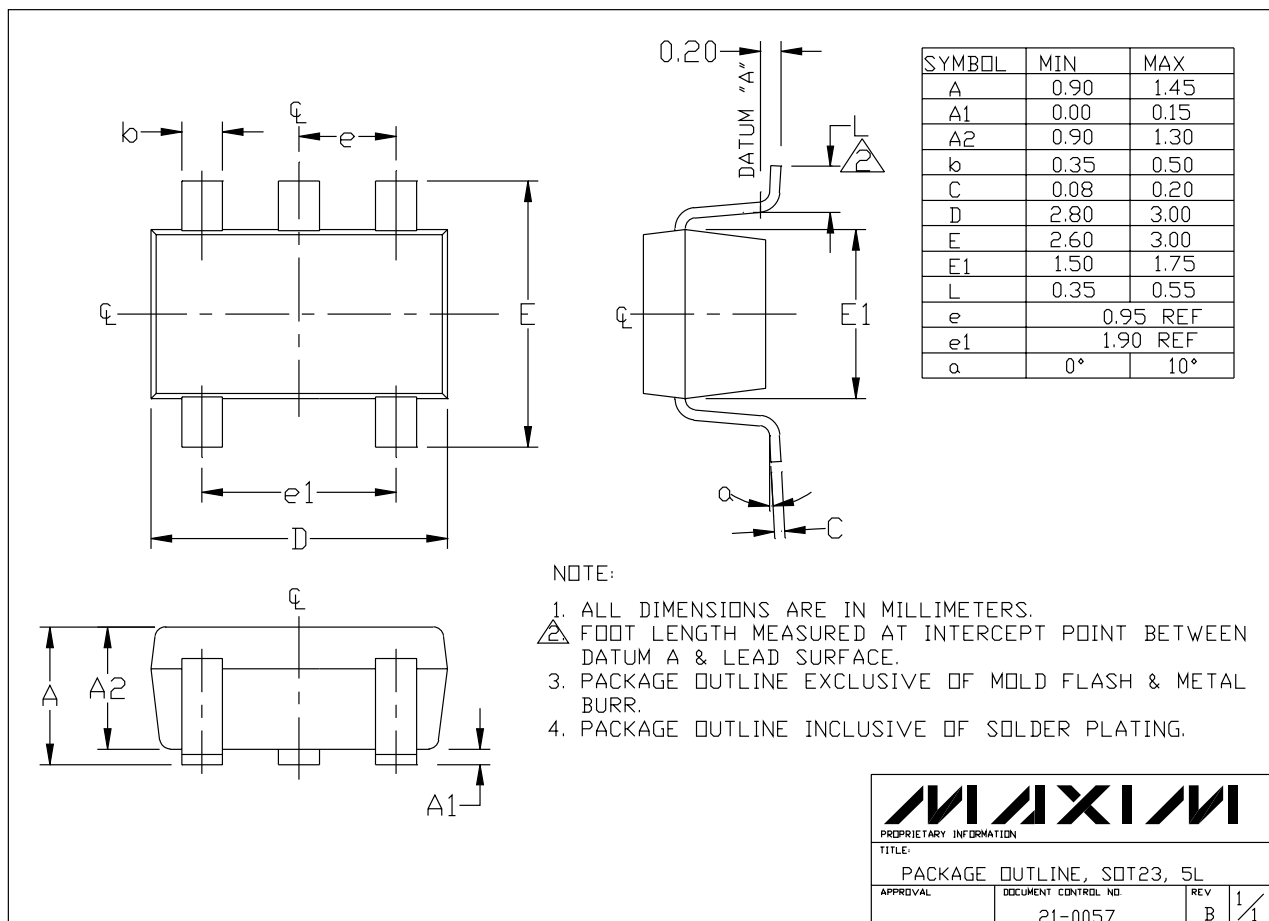


Figure 5. Channel Off/On-Capacitance

Chip Information

TRANSISTOR COUNT: 186

Package Information



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.

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