



Quad, SPST, Ultra-Low Leakage, CMOS Analog Switches

General Description

The MAX326/MAX327 quad, single-pole-single-throw (SPST), CMOS analog switches upgrade the DG201A/DG202 and DG211/DG212 with at least 100 times less leakage—the MAX326/MAX327 have 10pA maximum leakage, while the DG201A/DG202 have 1000pA and the DG211/DG212 have 5000pA. Low leakage currents support high system accuracy and make the devices useful for switching into high impedances, such as large-value feedback resistors in closed-loop gain configurations. And the MAX326/MAX327 logic inputs are CMOS and TTL compatible.

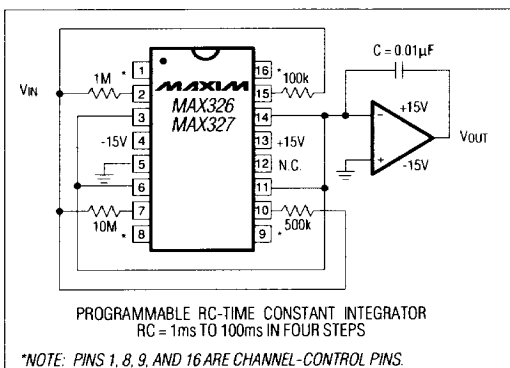
The MAX326/MAX327's low charge injection (3pC typ) minimizes signal error. Operation from single supplies (+10V to +30V), dual supplies ($\pm 5V$ to $\pm 18V$), and unbalanced combinations (i.e. +12V and -5V, or +5V and -15V) maximizes design flexibility. Both parts also feature interchangeable inputs/outputs and Maxim's standard latchup-proof construction.

Extremely low power consumption (5.25mW max) makes the MAX326/MAX327 ideal for portable applications. Other programmable applications include integrators with long RC time constants, current-to-voltage converters, high-gain amplifiers, and voltage dividers.

Applications

PBX, PABX
Military Radios
Sample-and-Hold Circuits
Winchester Disk Drives
Communication Systems
Guidance and Control Systems

Typical Operating Circuit



Features

- ◆ 10pA Max Leakage (<1pA Typ)
- ◆ Plug-In, Low-Leakage Upgrades for DG201A/DG202 and DG211/DG212
- ◆ Interchangeable Inputs/Outputs
- ◆ CMOS and TTL Compatible
- ◆ 3pC Typ Charge Injection
- ◆ Single- (+10V to +30V), Bipolar- ($\pm 5V$ to $\pm 18V$), or Unbalanced- (i.e. +12V and -5V) Supply Operation
- ◆ 5.25mW Max Power Consumption
- ◆ Latchup-Proof Construction

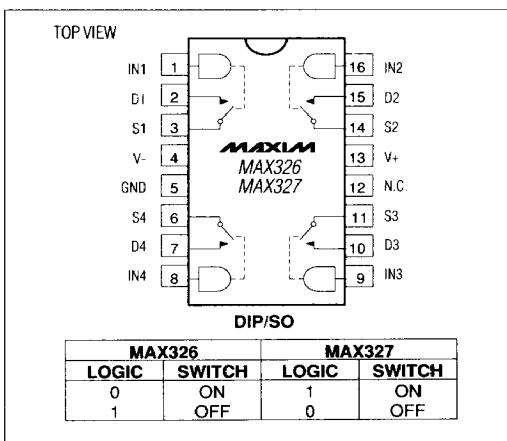
Ordering Information

PART	TEMP. RANGE	PIN-PACKAGE
MAX326CPE	0°C to +70°C	16 Plastic DIP
MAX326CSE	0°C to +70°C	16 Narrow SO
MAX326CJE	0°C to +70°C	16 CERDIP
MAX326C/D	0°C to +70°C	Dice*
MAX326EPE	-40°C to +85°C	16 Plastic DIP
MAX326ESE	-40°C to +85°C	16 Narrow SO
MAX326EJE	-40°C to +85°C	16 CERDIP
MAX326MJE	-55°C to +125°C	16 CERDIP**

* Contact factory for dice specifications.

** Contact factory for availability and processing to MIL-STD-883. Ordering Information continued on page 6

Pin Configuration



Maxim Integrated Products 1-11

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MAX326/MAX327

1

Quad, SPST, Ultra-Low Leakage, CMOS Analog Switches

ABSOLUTE MAXIMUM RATINGS

V+ to V-	+40V
V _{IN} to GND	V-, V+
V _S , V _D (Note 1)	(V- - 0.3V) to (V+ + 0.3V)
V+ to GND (V- = 0V)	+40V
Current (any terminal, except S or D)	30mA
Continuous Current, S or D	20mA
Peak Current, S or D (pulsed at 1ms, 10% duty cycle max)	70mA
Continuous Total Power Dissipation (Note 2)	
16-Pin Plastic DIP (derate 7.5mW/°C above +70°C)	470mW
16-Pin Narrow SO (derate 10mW/°C above +70°C)	400mW
16-Pin CERDIP (derate 10mW/°C above +70°C)	900mW

Operating Temperature Ranges:

MAX32 _ C _ _	0°C to +70°C
MAX32 _ E _ _	-40°C to +85°C
MAX32 _ MJE	-55°C to +125°C
Storage Temperature Range	-65°C to +150°C
Lead Temperature (soldering, 10 sec)	+300°C

Note 1: Exceeding this limit is acceptable as long as the S or D current is less than 20mA.

Note 2: All leads soldered or welded to PC board.

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+ = 15V, V- = -15V, T_A = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MAX32_M			MAX32_C/E			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
SWITCH									
Analog-Signal Range	VANALOG		TMIN to TMAX	±15		±15		V	
Drain-Source On Resistance	rDS(ON)	VIN = 0.8V (MAX326), VIN = 2.4V (MAX327), VD = ±10V, IS = 100µA	TA = +25°C	1.5	2.5	1.5	3.5	kΩ	
			TMIN to TMAX	2.2	4	1.9	5		
On-Resistance Match			TA = +25°C	5		5		%	
Source-Off Leakage Current (Note 3)	IS(OFF)	VIN = 2.4V (MAX326), VIN = 0.8V (MAX327), VS = 14V, VD = -14V	TA = +25°C	0.1	±10	0.1	±20	pA	
			TMIN to TMAX	±5		±5		nA	
		VIN = 2.4V (MAX326), VIN = 0.8V (MAX327), VS = -14V, VD = 14V	TA = +25°C	0.2	±10	0.2	±20	pA	
			TMIN to TMAX	±5		±5		nA	
Drain-Off Leakage Current (Note 3)	ID(OFF)	VIN = 2.4V (MAX326), VIN = 0.8V (MAX327), VS = 14V, VD = -14V	TA = +25°C	0.1	±10	0.1	±20	pA	
			TMIN to TMAX	±5		±5		nA	
		VIN = 2.4V (MAX326), VIN = 0.8V (MAX327), VS = -14V, VD = 14V	TA = +25°C	0.2	±10	0.2	±20	pA	
			TMIN to TMAX	±5		±5		nA	
Drain-On Leakage Current (Note 3)	ID(ON)	VIN = 0.8V (MAX326), VIN = 2.4V (MAX327), VS = VD = 14V	TA = +25°C	1	±20	1	±50	pA	
			TMIN to TMAX	±10		±10		nA	
		VIN = 0.8V (MAX326), VIN = 2.4V (MAX327), VS = VD = -14V	TA = +25°C	2	±20	2	±50	pA	
			TMIN to TMAX	±10		±10		nA	
INPUT									
Input Current with Input Voltage High	IINH	VIN = 2.4V	TMIN to TMAX	-1 -0.0004		-1 -0.0004		µA	
		VIN = 15V	TMIN to TMAX	0.003 1		0.003 1			
Input Current with Input Voltage Low	IINL	VIN = 0V	TMIN to TMAX	-1 -0.0004		-1 -0.0004		µA	

Quad, SPST, Ultra-Low Leakage, CMOS Analog Switches

MAX326/MAX327

1

ELECTRICAL CHARACTERISTICS (continued)

($V_+ = 15V$, $V_- = -15V$, $T_A = +25^\circ C$, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MAX32_M			MAX32_C/E			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
SUPPLY									
Positive Supply Current	I+	V _{IN} = 0V or 5V on all inputs	0.09	0.25		0.09	0.25		mA
Negative Supply Current	I-	V _{IN} = 0V or 5V on all inputs	-0.1	-0.00001		-0.1	-0.00001		mA
Power-Supply Range for Continuous Operation		(Note 4)	±4.5		±18	±4.5		±18	V
DYNAMIC									
Turn-On Time	t _{ON}	V _S = 2V, R _L = 1kΩ, C _L = 35pF (Figure 1)	500	1000		500	1000		ns
Turn-Off Time	t _{OFF}	V _S = 2V, R _L = 1kΩ, C _L = 35pF (Figure 1)	50	500		50	500		ns
Charge Injection	Q	C _L = 0.01μF, V _{GEN} = 0V, R _{GEN} = 0Ω	3			3			pC
Off Isolation (Note 4)	OIRR	V _{IN} = 5V, R _L = 1kΩ, C _L = 15pF, V _S = 1V _{RMS} , f = 100kHz	70			70			dB
Crosstalk (Channel-to-Channel)	CCRR	V _{IN} = 5V, R _L = 1kΩ, C _L = 15pF, V _S = 1V _{RMS} , f = 100kHz	90			90			dB
Source-Off Capacitance	C _{S(OFF)}	V _S = 0V, V _{IN} = 5V, f = 1MHz	1.7			1.7			pF
Drain-Off Capacitance	C _{D(OFF)}	V _S = 0V, V _{IN} = 5V, f = 1MHz	1.7			1.7			pF
Channel-On Capacitance	C _{D(ON)} + C _{S(ON)}	V _D = V _S = 0V, V _{IN} = 0V, f = 1MHz	6			6			pF

Note 3: Leakage parameters $I_{S(OFF)}$, $I_{D(OFF)}$, and $I_{D(ON)}$ are sample tested for M-suffix devices at $+25^\circ C$. E- and C- suffix devices are guaranteed at $+25^\circ C$, but not tested. All leakage parameters are 100% tested at maximum rated operating temperatures, i.e. $+70^\circ C$, $+85^\circ C$, or $+125^\circ C$.

Note 4: Electrical characteristics, such as $r_{DS(ON)}$, will change when power supplies other than $\pm 15V$ are used. Power-supply range is a design characteristic, not production tested.

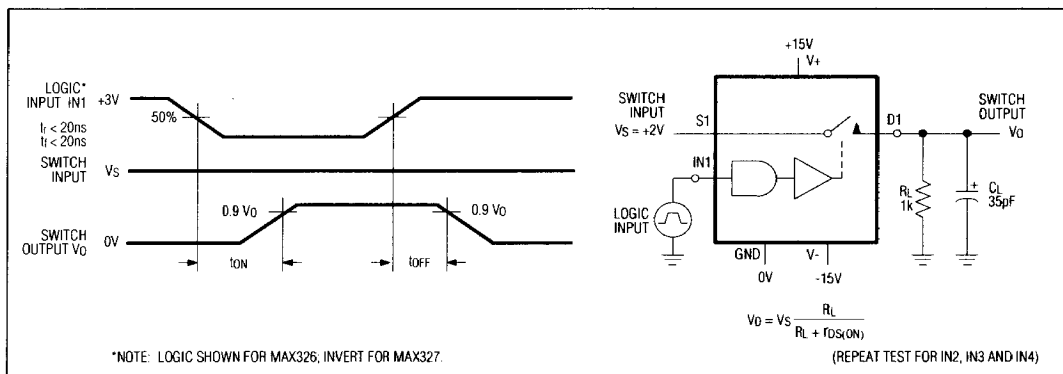


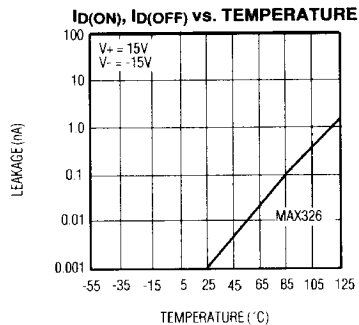
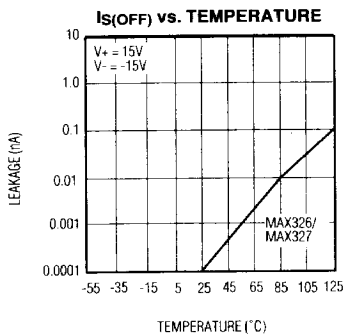
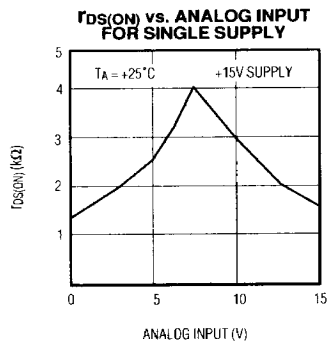
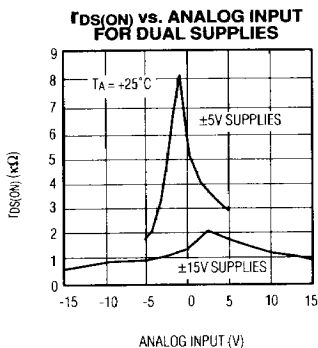
Figure 1. Switching-Time Test Circuit. Switch-output waveform shown for $V_S = \text{constant}$ with logic-input waveform as shown. Note: V_S may be positive or negative as per switching-time test circuit. V_O is the steady-state output with switch on. Feedthrough via gate capacitance may result in spikes at leading and trailing edge of output waveform.

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1-13

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Typical Operating Characteristics



Quad, SPST, Ultra-Low Leakage, CMOS Analog Switches

Application Hints

The MAX326/MAX327 are pin-compatible upgrades for the DG201A/DG202 and DG211/DG212. The MAX326/MAX327 feature significantly lower leakages (at least 100 times less at +25°C), but with higher on resistance. Low leakage minimizes signal error in most applications that require signal switching into high-impedance inputs of A/Ds or op amps. Switching times are virtually identical, as shown in Table 1.

Table 1. Switching Speeds with Various Power-Supply Combinations

POWER SUPPLY (V)	t _{ON} (μs)	t _{OFF} (ns)
±15	0.5	50
±10	1	80
±5	2.5	200
+10	2.5	200
+15	1.5	100

The MAX326/MAX327 work well in single-supply applications from +10V to +30V. For these applications, V₋ should be connected to ground, and signal levels equal to the rail can be switched. ±5V to ±18V dual supplies can also be used to increase design flexibility.

Channel-to-channel on-resistance matching is typically better than 95% for a given analog input level. *Typical Operating Characteristics* show how r_{DS(ON)} changes with various analog inputs and power-supply combinations.

While specified at TTL threshold levels, the logic threshold is roughly 1.5V ±0.2V and switches properly with CMOS input levels from -15V to +15V. Logic input levels should never be allowed to exceed the supply rails.

Protecting Against Fault Conditions

Fault conditions develop when power supplies are turned off with input signals still present, or when overvoltages occur at the inputs during normal operation. In either case, source-to-body diodes can be forward biased to conduct current from the signal source. If low current levels are required, the addition of external protection diodes is recommended (Figure 2).

To provide protection for overvoltages up to 20V above the supply rails, a 1N4001 or 1N914 diode should be placed in series with the positive and negative supplies (Figure 2). The addition of these diodes will reduce the analog signal range to 1V below the positive supply and 1V above the negative supply.

For signals that can be momentarily shorted to the 110VAC line, the addition of a 47kΩ, 1/2W resistor in series with the channel input is recommended. This will protect the switch and allow normal operation to continue once the fault condition abates. The throughput resistance will then be 47kΩ plus r_{DS(ON)}, but low switch leakage will reduce the error while maintaining superior system reliability.

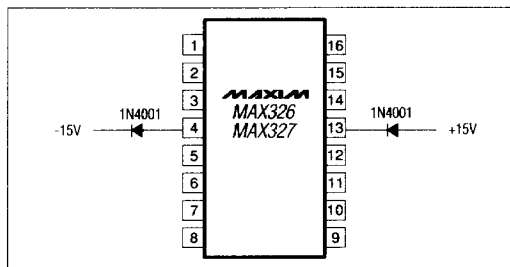


Figure 2. Protection Against Fault Conditions

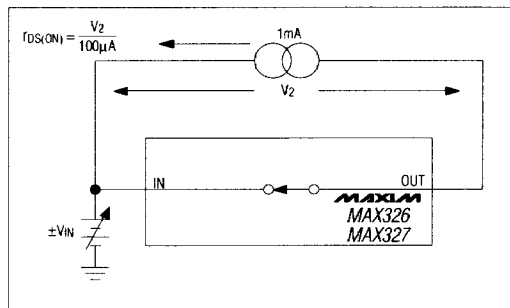


Figure 3. On Resistance vs. Analog-Signal Level Supply Voltage

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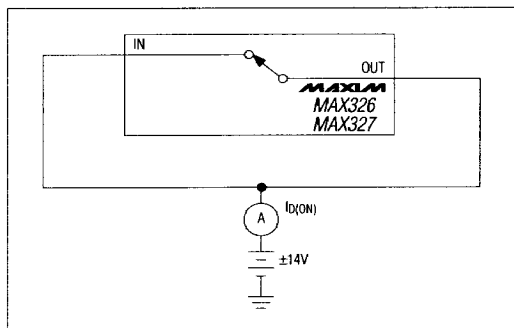


Figure 4. On Leakage Current Test Circuit

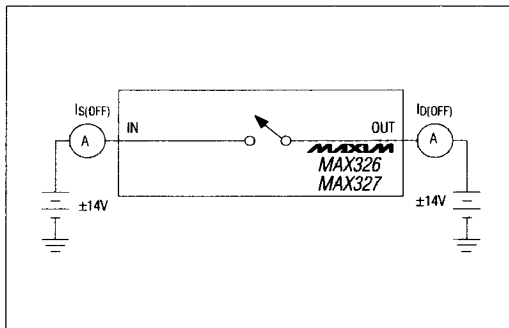


Figure 5. Off Leakage Current Test Circuit

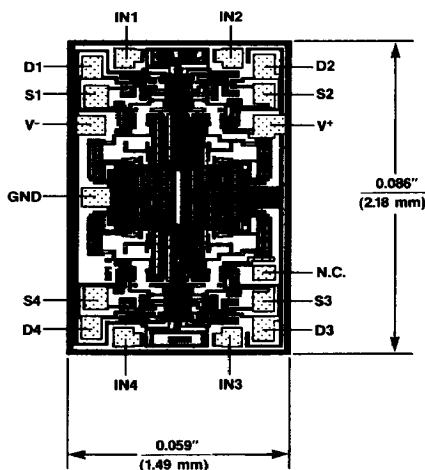
Ordering Information (continued)

PART	TEMP. RANGE	PIN-PACKAGE
MAX327CPE	0°C to +70°C	16 Plastic DIP
MAX327CSE	0°C to +70°C	16 Narrow SO
MAX327CJE	0°C to +70°C	16 CERDIP
MAX327C/D	0°C to +70°C	Dice*
MAX327EPE	-40°C to +85°C	16 Plastic DIP
MAX327ESE	-40°C to +85°C	16 Narrow SO
MAX327EJE	-40°C to +85°C	16 CERDIP
MAX327MJE	-55°C to +125°C	16 CERDIP**

* Contact factory for dice specifications.

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Chip Topography



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