19-1497; Rev 0; 8/99

MAXIM

Dual, 5Ω Analog Switches

General Description

The MAX4621/MAX4622/MAX4623 are precision, dual, high-speed analog switches. The single-pole/single-throw (SPST) MAX4621 and double-pole/single-throw (DPST) MAX4623 dual switches are normally open (NO). The single-pole/double-throw (SPDT) MAX4622 has two normally closed (NC) and two NO poles. All three parts offer low 5Ω on-resistance guaranteed to match to within 0.5Ω between channels and to remain flat over the full analog signal range (Δ0.5Ω max). They also offer low leakage (<500pA at +25°C, <5nA at +85°C) and fast switching times (turn-on time <250ns, turn-off time <200ns).

These analog switches are ideal in low-distortion applications and are the preferred solution over mechanical relays in automatic test equipment or applications where current switching is required. They have low power requirements, use less board space, and are more reliable than mechanical relays.

The MAX4621/MAX4622/MAX4623 are pin-compatible replacements for the DG401/DG403/DG405, respectively, offering improved overall performance. These monolithic switches operate from a single positive supply (+4.5V to +36V) or with bipolar supplies (±4.5V to ±18V) while retaining CMOS-logic input compatibility.

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

Features

- **Low On-Resistance: 3Ω (typ), 5Ω (max)**
- **Guaranteed R_{ON} Match Between Channels (0.5Ω max)**
- **Guaranteed Break-Before-Make Operation (MAX4622)**
- **Guaranteed Off-Channel Leakage <5nA at +85°C**
- **Single-Supply Operation (+4.5V to +36V) Bipolar-Supply Operation (±4.5V to ±18V)**
- **TTL/CMOS-Logic Compatible**
- **Rail-to-Rail® Analog Signal Handling Capability**
- **Pin Compatible with DG401/DG403/DG405**

Applications

Reed Relay Replacement	Military Radios
Test Equipment	PBX, PABX Systems
Communication Systems	Audio-Signal Routing
Data-Acquisition Systems	Avionics

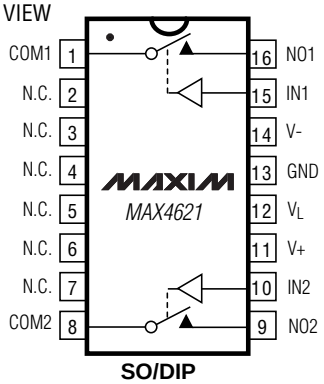
Ordering Information

PART	TEMP. RANGE	PIN-PACKAGE
MAX4621CSE	0°C to +70°C	16 Narrow SO
MAX4621CPE	0°C to +70°C	16 Plastic DIP

Ordering Information continued at end of data sheet.

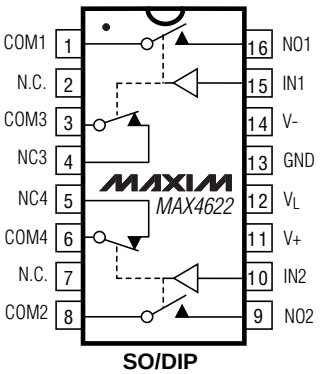
Pin Configurations/Functional Diagrams/Truth Tables

TOP VIEW



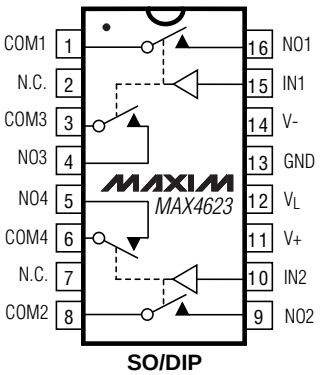
SO/DIP

MAX4621	
LOGIC	SWITCH
0	OFF
1	ON



SO/DIP

MAX4622		
LOGIC	SWITCHES 1, 2	SWITCHES 3, 4
0	OFF	ON
1	ON	OFF



SO/DIP

MAX4623	
LOGIC	SWITCH
0	OFF
1	ON

SWITCHES SHOWN FOR LOGIC "0" INPUT

For free samples & the latest literature: http://www.maxim-ic.com, or phone 1-800-998-8800. For small orders, phone 1-800-835-8769.

Dual, 5Ω Analog Switches

ABSOLUTE MAXIMUM RATINGS

(Voltages Referenced to GND)
V+ to GND .....-0.3V to +44V
V- to GND .....+0.3V to -44V
V+ to V- .....-0.3V to +44V
V_L to GND .....-0.3V to (V+ + 0.3V)
All Other Pins to GND (Note 1) ..... (V- - 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)
Narrow SO (derate 8.70mW/°C above +70°C) 696mW
Narrow DIP (derate 10.53mW/°C above +70°C) 842mW
Operating Temperature Ranges
MAX462_C_ _ .....0°C to +70°C
MAX462_E_ _ .....-40°C to +85°C
Storage Temperature Range .....-65°C to +150°C
Lead Temperature (soldering, 10sec) .....+300°C

Note 1: Signals on NO_, NC_, or COM_ exceeding V+ or V- 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—Dual Supplies

(V+ = +15V, V- = -15V, V_L = +5V, GND = 0, V_{INH} = +2.4V, V_{INL} = +0.8V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
ANALOG SWITCH							
Input Voltage Range (Note 3)	$V_{COM_}$, $V_{NO_}$, $V_{NC_}$			V-		V+	V
On-Resistance	R_{ON}	$I_{COM_}$ = 10mA, $V_{NO_}$ or $V_{NC_}$ = ±10V	T_A = +25°C		3	5	Ω
			T_A = T_{MIN} to T_{MAX}			7	
On-Resistance Match Between Channels (Notes 3, 4)	ΔR_{ON}	$I_{COM_}$ = 10mA, $V_{NO_}$ or $V_{NC_}$ = ±10V	T_A = +25°C		0.25	0.5	Ω
			T_A = T_{MIN} to T_{MAX}			0.7	
On-Resistance Flatness (Notes 3, 5)	$R_{FLAT(ON)}$	$I_{COM_}$ = 10mA; $V_{NO_}$ or $V_{NC_}$ = -5V, 0, 5V	T_A = +25°C		0.2	0.5	Ω
			T_A = T_{MIN} to T_{MAX}			0.7	
Off-Leakage Current (NO_ or NC_) (Note 6)	$I_{NO_}$, $I_{NC_}$	$V_{NO_}$ or $V_{NC_}$ = ±10V, $V_{COM_}$ = ∓10V	T_A = +25°C	-0.5	0.01	0.5	nA
			T_A = T_{MIN} to T_{MAX}	-5		5	
COM_ Off-Leakage Current (Note 6)	$I_{COM_(OFF)}$	$V_{COM_}$ = ±10V, $V_{NO_}$ or $V_{NC_}$ = ∓10V	T_A = +25°C	-0.5	0.01	0.5	nA
			T_A = T_{MIN} to T_{MAX}	-5		5	
COM_ On-Leakage Current (Note 6)	$I_{COM_(ON)}$	$V_{COM_}$ = ±10V, $V_{NO_}$ or $V_{NC_}$ = ∓10V or floating	T_A = +25°C	-1	0.02	1	nA
			T_A = T_{MIN} to T_{MAX}	-10		10	
LOGIC INPUT							
Input Current with Input Voltage High	I_{INH}	$V_{IN_}$ = 2.4V		-0.5	0.001	0.5	µA
Input Current with Input Voltage Low	I_{INL}	$V_{IN_}$ = 0.8V		-0.5	0.001	0.5	µA
Logic Input Voltage High	V_{INH}			2.4			V
Logic Input Voltage Low	V_{INL}					0.8	V

ELECTRICAL CHARACTERISTICS—Dual Supplies (continued)

(V+ = +15V, V- = -15V, V_L = +5V, GND = 0, V_{INH} = +2.4V, V_{INL} = +0.8V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
POWER SUPPLY							
Power-Supply Range				±4.5		±20.0	V
Positive Supply Current	I+	$V_{IN_}$ = 0 or 5V	T_A = +25°C	-0.5	0.001	0.5	µA
			T_A = T_{MIN} to T_{MAX}	-5		5	
Negative Supply Current	I-	$V_{IN_}$ = 0 or 5V	T_A = +25°C	-0.5	0.001	0.5	µA
			T_A = T_{MIN} to T_{MAX}	-5		5	
Logic Supply Current	I_L	$V_{IN_}$ = 0 or 5V	T_A = +25°C	-0.5	0.001	0.5	µA
			T_A = T_{MIN} to T_{MAX}	-5		5	
Ground Current	I_{GND}	$V_{IN_}$ = 0 or 5V	T_A = +25°C	-0.5	0.001	0.5	µA
			T_A = T_{MIN} to T_{MAX}	-5		5	
SWITCH DYNAMIC CHARACTERISTICS							
Turn-On Time	t_{ON}	$V_{COM_}$ = ±10V, Figure 2	T_A = +25°C		120	250	ns
			T_A = T_{MIN} to T_{MAX}			325	
Turn-Off Time	t_{OFF}	$V_{COM_}$ = ±10V, Figure 2	T_A = +25°C		90	200	ns
			T_A = T_{MIN} to T_{MAX}			275	
Break-Before-Make Time Delay (MAX4622 only)	t_D	$V_{COM_}$ = ±10V, Figure 3, T_A = +25°C		5	25		ns
Charge Injection	Q	C_L = 1.0nF, V_{GEN} = 0, R_{GEN} = 0, Figure 4, T_A = +25°C			480		pC
Off-Isolation (Note 7)	V_{ISO}	R_L = 50Ω, f = 1MHz, Figure 5, T_A = +25°C			-62		dB
Crosstalk (Note 8)	V_{CT}	R_L = 50Ω, f = 1MHz, Figure 6, T_A = +25°C			-60		dB
NC_ or NO_ Capacitance	C_{OFF}	f = 1MHz, Figure 7, T_A = +25°C			34		pF
COM_ Off-Capacitance	C_{COM}	f = 1MHz, Figure 7, T_A = +25°C			34		pF
On-Capacitance	C_{COM}	f = 1MHz, Figure 8, T_A = +25°C			150		pF

Dual, 5Ω Analog Switches

ELECTRICAL CHARACTERISTICS—Single Supply

(V+ = +12V, V- = 0, V_L = +5V, GND = 0, V_{INH} = +2.4V, V_{INL} = +0.8V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
ANALOG SWITCH							
Input Voltage Range (Note 3)	$V_{COM_}$, $V_{NO_}$, $V_{NC_}$			GND		V+	V
On-Resistance	R_{ON}	$I_{COM_}$ = 10mA, $V_{NO_}$ or $V_{NC_}$ = 10V	T_A = +25°C		5.5	8	Ω
			T_A = T_{MIN} to T_{MAX}			10	
On-Resistance Match Between Channels (Notes 3, 4)	ΔR_{ON}	$I_{COM_}$ = 10mA, $V_{NO_}$ or $V_{NC_}$ = 10V, T_A = +25°C			0.2	0.5	Ω
On-Resistance Flatness (Notes 3, 5)	$R_{FLAT(ON)}$	$I_{COM_}$ = 10mA; $V_{NO_}$ or $V_{NC_}$ = 3V, 6V, 9V; T_A = +25°C			0.9	1.3	Ω
NO_ or NC_ Off-Leakage Current (Notes 6, 9)	$I_{NO_(OFF)}$, $I_{NC_(OFF)}$	$V_{COM_}$ = 1V, 10V; $V_{NO_}$ or $V_{NC_}$ = 10V, 1V	T_A = +25°C	-0.5	0.01	0.5	nA
			T_A = T_{MIN} to T_{MAX}	-5		5	
COM_ Off-Leakage Current (Notes 6, 9)	$I_{COM_(OFF)}$	$V_{COM_}$ = 10V, 1V; $V_{NO_}$ or $V_{NC_}$ = 1V, 10V	T_A = +25°C	-0.5	0.01	0.5	nA
			T_A = T_{MIN} to T_{MAX}	-5		5	
COM_ On-Leakage Current (Notes 6, 9)	$I_{COM_(ON)}$	$V_{COM_}$ = 10V, 1V; $V_{NO_}$ or $V_{NC_}$ = 10V, 1V, or floating	T_A = +25°C	-1	0.02	1	nA
			T_A = T_{MIN} to T_{MAX}	-10		10	
LOGIC INPUT							
Input Current with Input Voltage High	I_{INH}	$V_{IN_}$ = 2.4V		-0.5	0.001	0.5	µA
Input Current with Input Voltage Low	I_{INL}	$V_{IN_}$ = 0.8V		-0.5	0.001	0.5	µA
Logic Input Voltage High	V_{INH}			2.4			V
Logic Input Voltage Low	V_{INL}					0.8	V
POWER SUPPLY							
Power-Supply Range				4.5		36.0	V
Positive Supply Current	I+	$V_{IN_}$ = 0 or 5V	T_A = +25°C	-0.5	0.001	0.5	µA
			T_A = T_{MIN} to T_{MAX}	-5		5	
Logic Supply Current	I_L	$V_{IN_}$ = 0 or 5V	T_A = +25°C	-0.5	0.001	0.5	µA
			T_A = T_{MIN} to T_{MAX}	-5		5	
Ground Current	I_{GND}	$V_{IN_}$ = 0 or 5V	T_A = +25°C	-0.5	0.001	0.5	µA
			T_A = T_{MIN} to T_{MAX}	-5		5	

ELECTRICAL CHARACTERISTICS—Single Supply (continued)

(V+ = +12V, V- = 0, V_L = +5V, GND = 0, V_{INH} = +2.4V, V_{INL} = +0.8V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
SWITCH DYNAMIC CHARACTERISTICS							
Turn-On Time (Note 3)	t_{ON}	$V_{COM_}$ = 10V, Figure 2	T_A = +25°C		200	350	ns
			T_A = T_{MIN} to T_{MAX}			475	
Turn-Off Time (Note 3)	t_{OFF}	$V_{COM_}$ = 10V, Figure 2	T_A = +25°C		100	200	ns
			T_A = T_{MIN} to T_{MAX}			300	
Break-Before-Make Time Delay (MAX4622 only) (Note 3)	t_D	R_L = 100Ω, C_L = 35pF, Figure 3, T_A = +25°C		10	75		ns
Charge Injection	Q	C_L = 1.0nF, V_{GEN} = 0, R_{GEN} = 0, Figure 4			45		pC
Off-Isolation (Note 7)	V_{ISO}	R_L = 50Ω, f = 1MHz, Figure 5			-62		dB
Crosstalk (Note 8)	V_{CT}	R_L = 50Ω, f = 1MHz, Figure 6			-60		dB

Note 2: The algebraic convention, where the most negative value is a minimum and the most positive value is a maximum, is used in this data sheet.

Note 3: Guaranteed by design.

Note 4: $\Delta R_{ON} = R_{ON_MAX} - R_{ON_MIN}$.

Note 5: Flatness is defined as the difference between the maximum and minimum values of on-resistance as measured over the specified analog signal range.

Note 6: Leakage currents are 100% tested at the maximum-rated hot temperature and guaranteed by correlation at +25°C.

Note 7: Off-isolation = $20\log_{10}$ [$V_{COM_}$ / ($V_{NC_}$ or $V_{NO_}$)]. $V_{COM_}$ = output, $V_{NC_}$ or $V_{NO_}$ = input to off switch.

Note 8: Between any two switches.

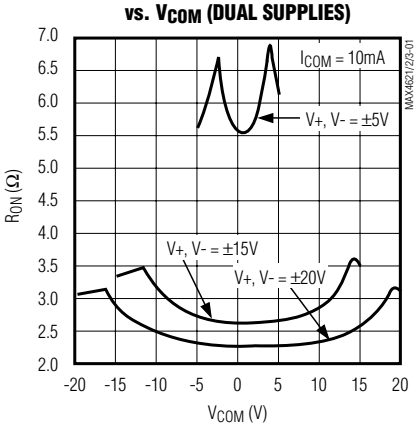
Note 9: Leakage testing for single-supply operation is guaranteed by testing with dual supplies.

Dual, 5Ω Analog Switches

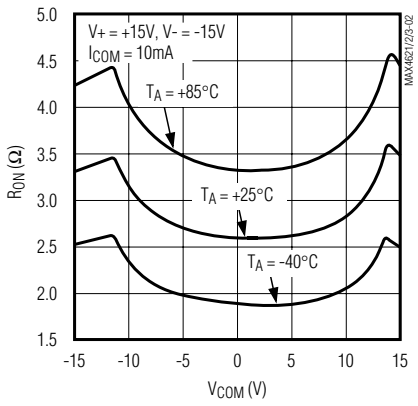
Typical Operating Characteristics

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

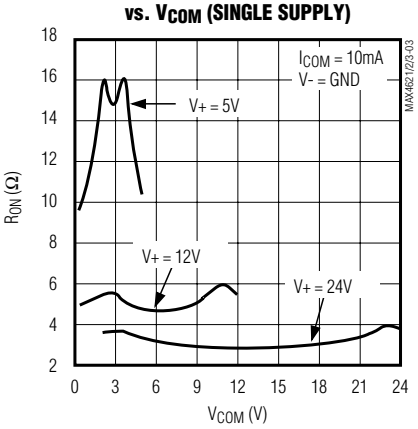
ON-RESISTANCE vs. V_{COM} (DUAL SUPPLIES)



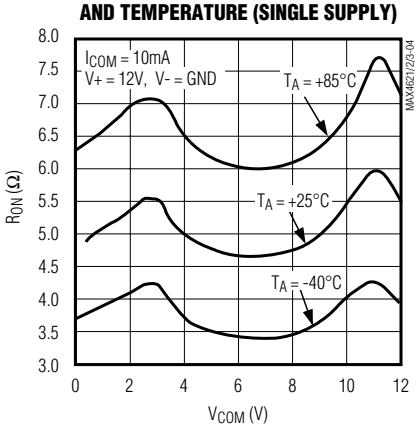
ON-RESISTANCE vs. V_{COM} AND TEMPERATURE (DUAL SUPPLIES)



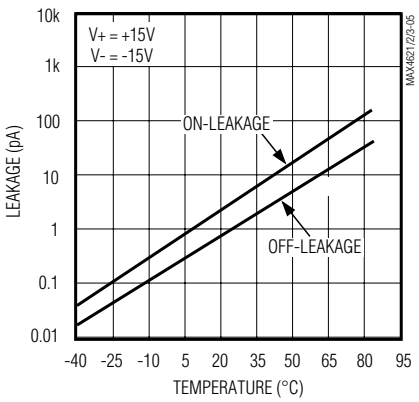
ON-RESISTANCE vs. V_{COM} (SINGLE SUPPLY)



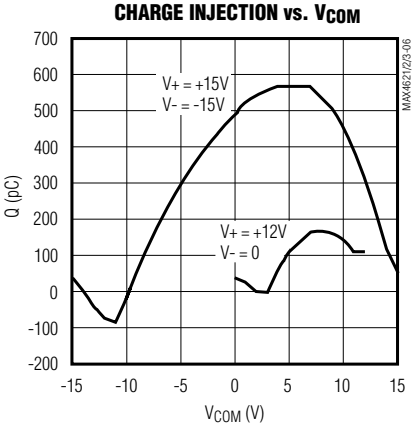
ON-RESISTANCE vs. V_{COM} AND TEMPERATURE (SINGLE SUPPLY)



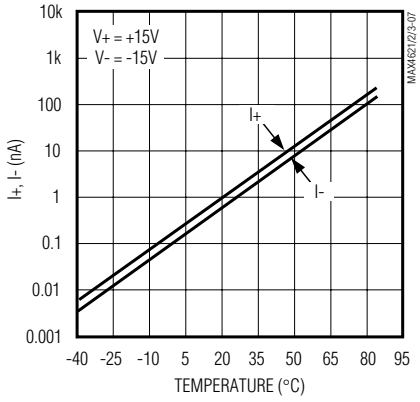
ON/OFF-LEAKAGE CURRENT vs. TEMPERATURE



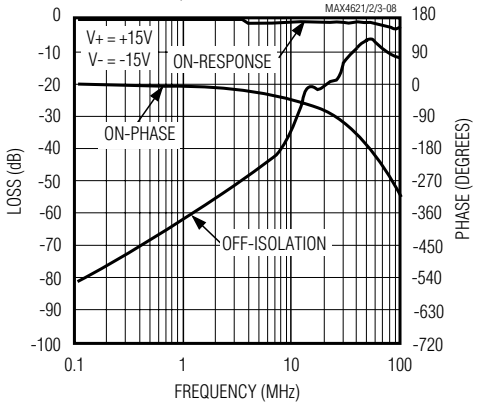
CHARGE INJECTION vs. V_{COM}



SUPPLY CURRENT vs. TEMPERATURE



FREQUENCY RESPONSE



Pin Description

PIN	NAME	FUNCTION
MAX4621		
1, 8	COM1, COM2	Switch Common Terminal
2–7	N.C.	Not internally connected
9, 16	NO2, NO1	Switch Normally Open Terminal
10, 15	IN2, IN1	Digital Logic Inputs
11	V+	Positive Supply-Voltage Input
12	V_L	Logic Supply-Voltage Input
13	GND	Ground
14	V-	Negative Supply Voltage Input
MAX4622		
1, 3, 6, 8	COM_	Switch Common Terminal
2, 7	N.C.	Not internally connected
4, 5, 9, 16	NC_, NO_	Switch Normally Closed/Open Terminal
10, 15	IN2, IN1	Digital Logic Inputs
11	V+	Positive Supply-Voltage Input
12	V_L	Logic Supply-Voltage Input
13	GND	Ground
14	V-	Negative Supply Voltage Input
MAX4623		
1, 3, 6, 8	COM_	Switch Common Terminal
2, 7	N.C.	Not internally connected
4, 5, 9, 16	NO_	Switch Normally Open Terminal
10, 15	IN2, IN1	Digital Logic Inputs
11	V+	Positive Supply-Voltage Input
12	V_L	Logic Supply-Voltage Input
13	GND	Ground
14	V-	Negative Supply Voltage

Applications Information

Operation with Supply Voltages Other than ±15V

The MAX4621/MAX4622/MAX4623 switches operate with ±4.5V to ±18V bipolar supplies and a +4.5V to +36V single supply. In either case, analog signals ranging from V+ to V- can be switched. The *Typical Operating Characteristics* graphs show the typical on-resistance variation with analog signal and supply voltage.

Overvoltage Protection

Proper power-supply sequencing is recommended for all CMOS devices. It is important not to 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 signal diodes in series with the supply pins and a Schottky diode between V+ and V_L (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. The difference between V+ and V- should not exceed +44V.

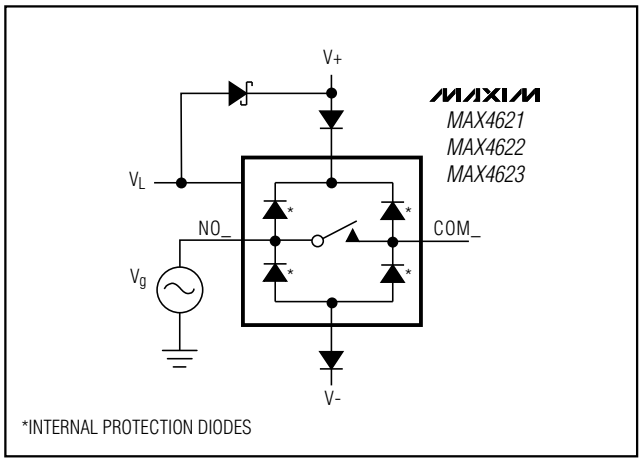


Figure 1. Overvoltage Protection Using Blocking Diodes

Dual, 5Ω Analog Switches

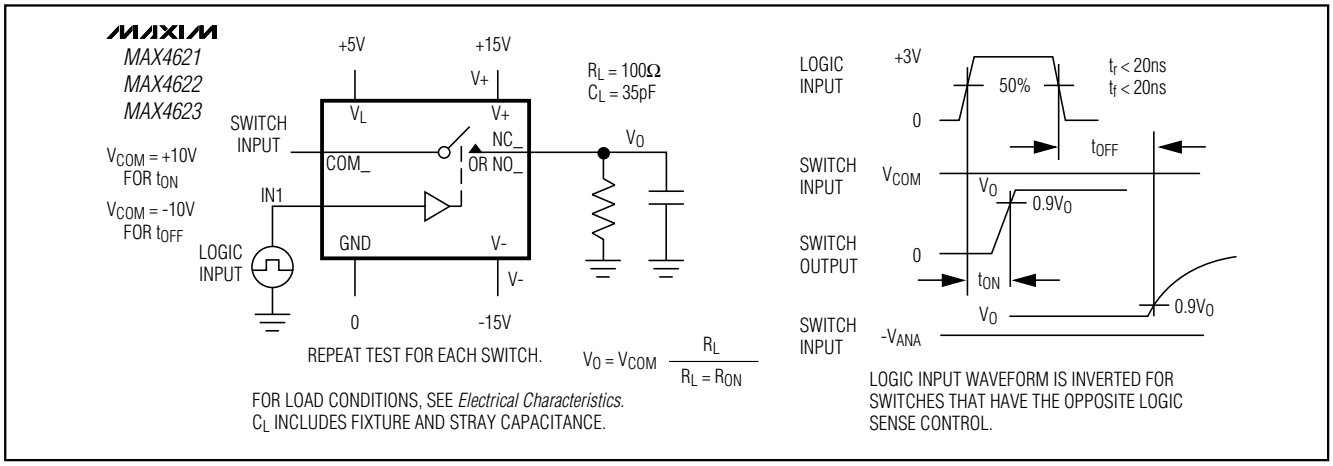


Figure 2. Switching-Time Test Circuit

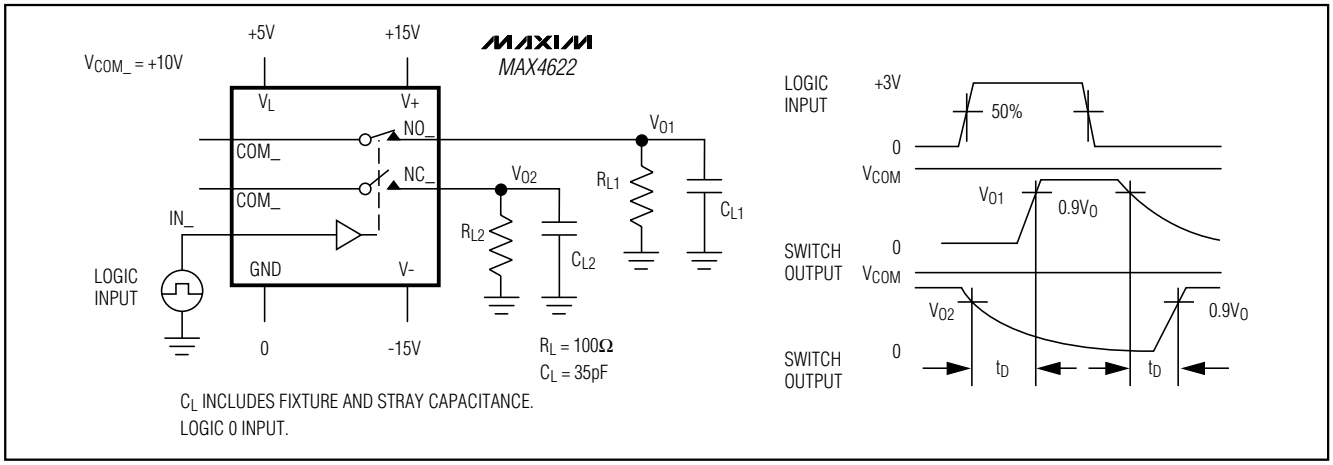


Figure 3. MAX4622 Break-Before-Make Test Circuit

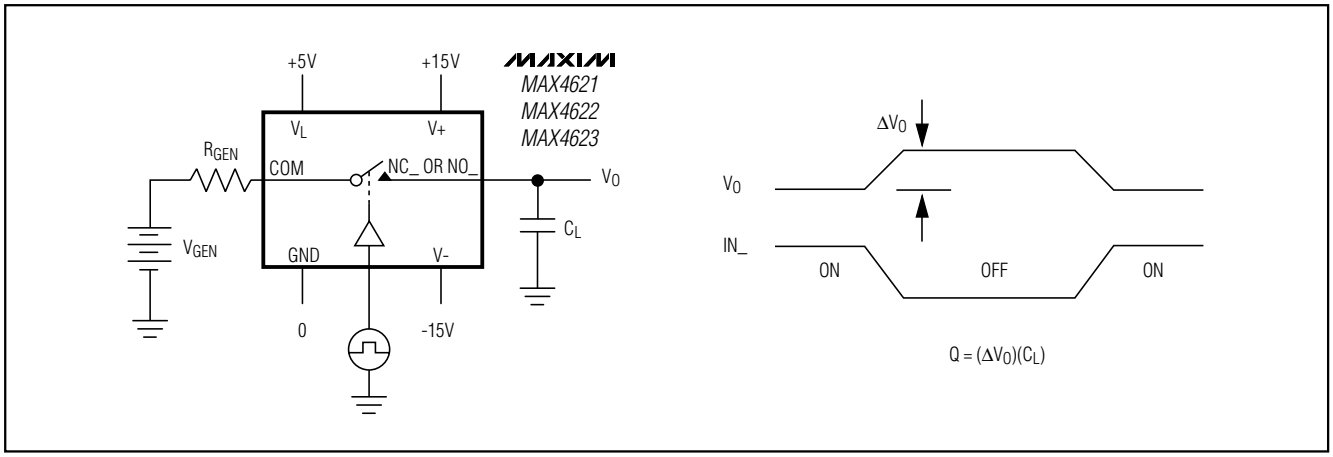
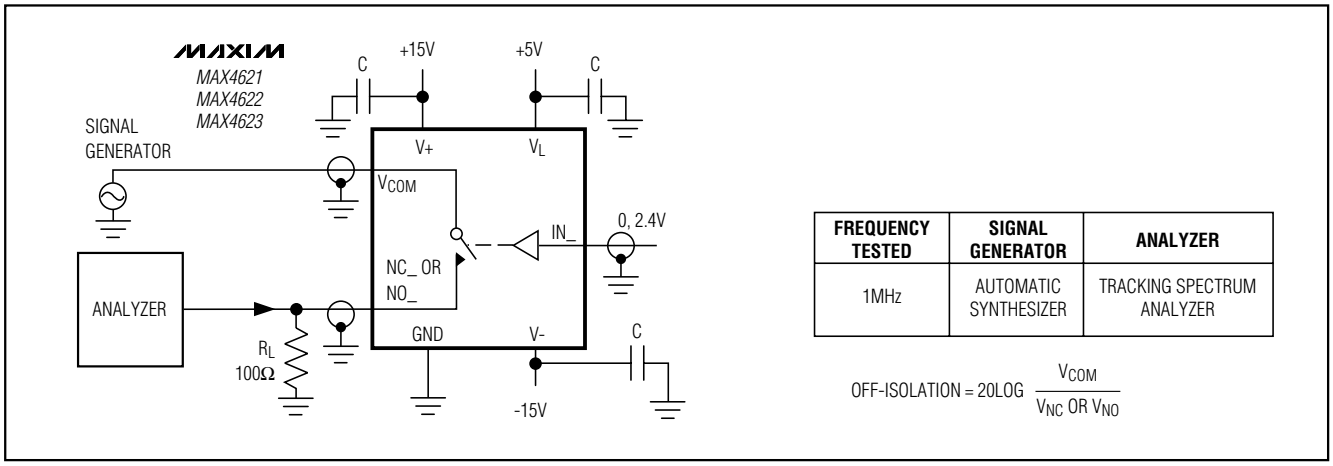
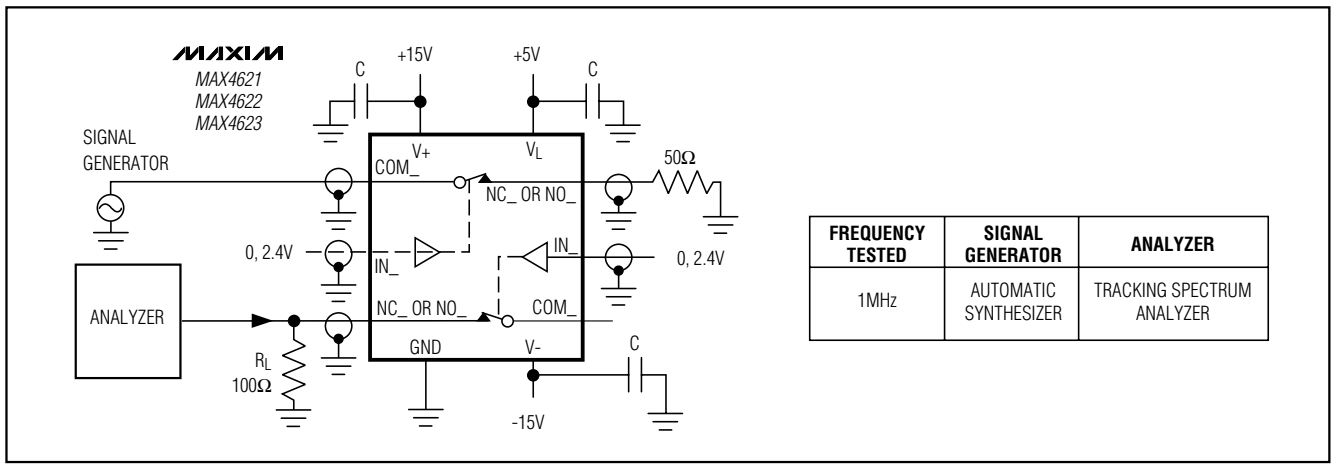


Figure 4. Charge-Injection Test Circuit



FREQUENCY TESTED	SIGNAL GENERATOR	ANALYZER
1MHz	AUTOMATIC SYNTHESIZER	TRACKING SPECTRUM ANALYZER

Figure 5. Off-Isolation



FREQUENCY TESTED	SIGNAL GENERATOR	ANALYZER
1MHz	AUTOMATIC SYNTHESIZER	TRACKING SPECTRUM ANALYZER

Figure 6. Crosstalk Test Circuit

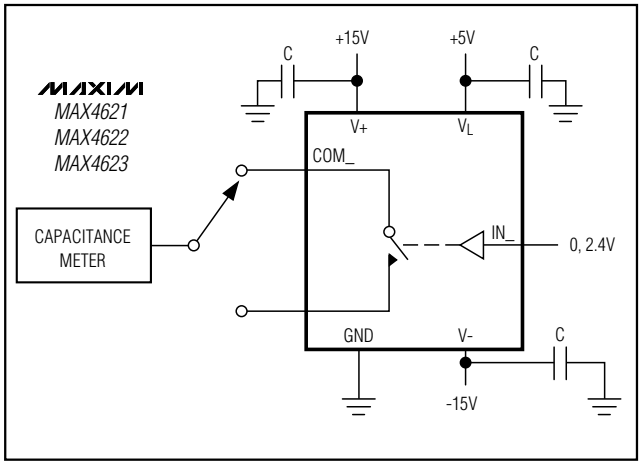


Figure 7. Channel-On Capacitance

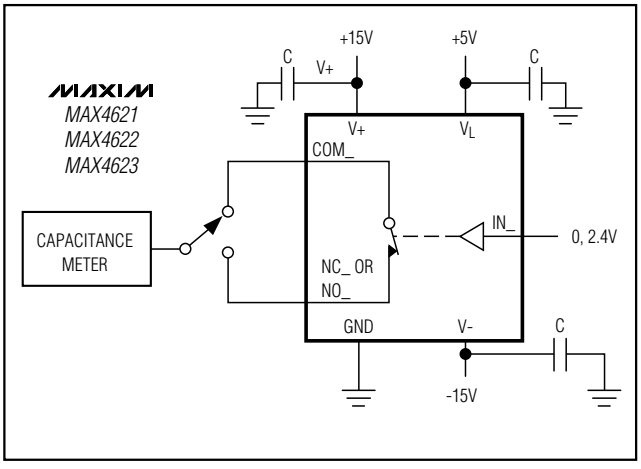


Figure 8. Channel-Off Capacitance

Dual, 5Ω Analog Switches

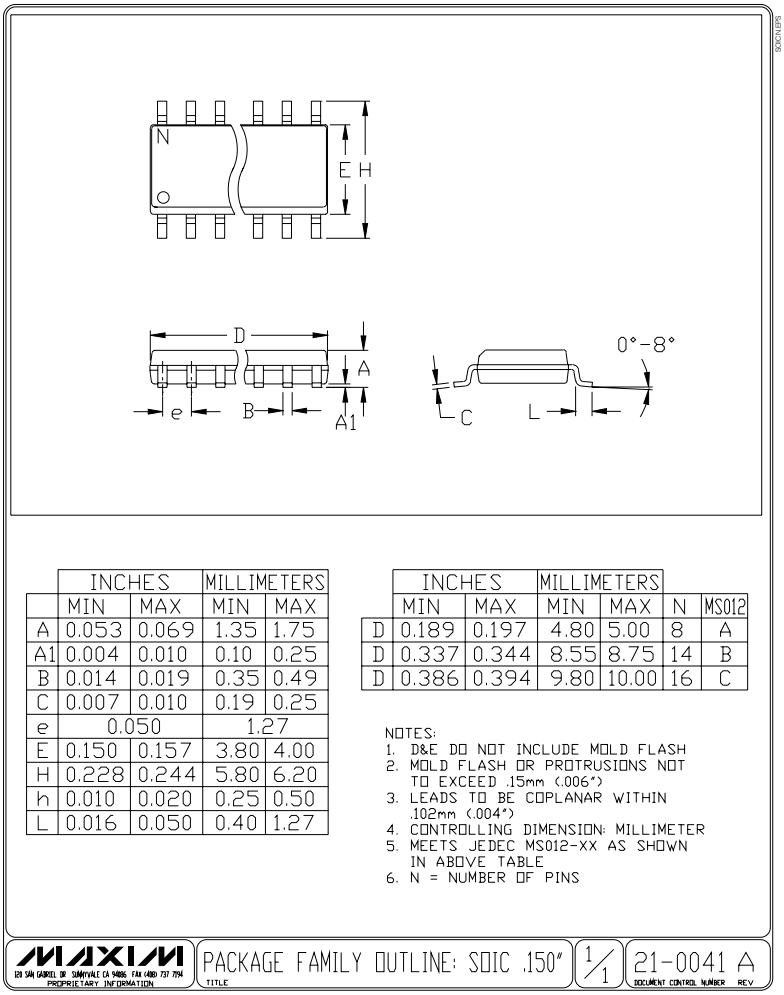
Ordering Information (continued)

PART	TEMP. RANGE	PIN-PACKAGE
MAX4621ESE	-40°C to +85°C	16 Narrow SO
MAX4621EPE	-40°C to +85°C	16 Plastic DIP
MAX4622CSE	0°C to +70°C	16 Narrow SO
MAX4622CPE	0°C to +70°C	16 Plastic DIP
MAX4622ESE	-40°C to +85°C	16 Narrow SO
MAX4622EPE	-40°C to +85°C	16 Plastic DIP
MAX4623CSE	0°C to +70°C	16 Narrow SO
MAX4623CPE	0°C to +70°C	16 Plastic DIP
MAX4623ESE	-40°C to +85°C	16 Narrow SO
MAX4623EPE	-40°C to +85°C	16 Plastic DIP

Chip Information

TRANSISTOR COUNT: 82

Package Information



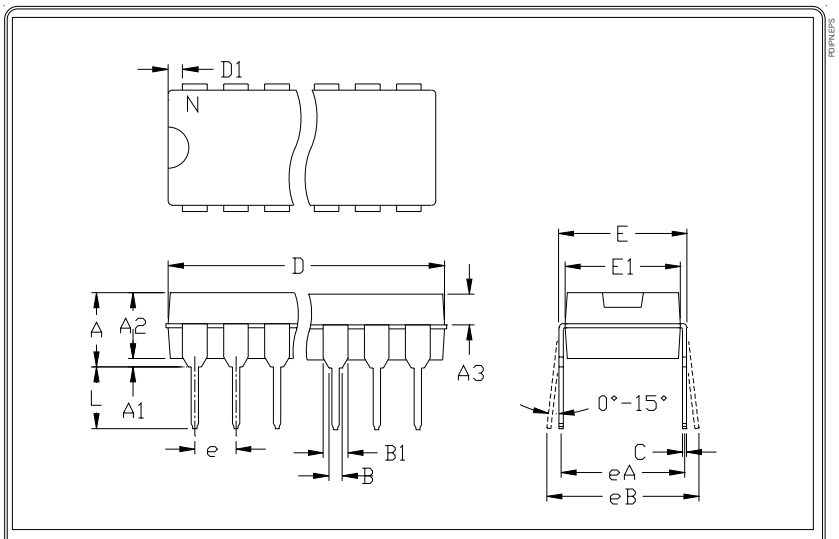
	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.053	0.069	1.35	1.75
A1	0.004	0.010	0.10	0.25
B	0.014	0.019	0.35	0.49
C	0.007	0.010	0.19	0.25
e	0.050		1.27	
E	0.150	0.157	3.80	4.00
H	0.228	0.244	5.80	6.20
h	0.010	0.020	0.25	0.50
L	0.016	0.050	0.40	1.27

	INCHES		MILLIMETERS			
	MIN	MAX	MIN	MAX	N	MS012
D	0.189	0.197	4.80	5.00	8	A
D	0.337	0.344	8.55	8.75	14	B
D	0.386	0.394	9.80	10.00	16	C

NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED .15mm (.006")
3. LEADS TO BE COPLANAR WITHIN .102mm (.004")
4. CONTROLLING DIMENSION: MILLIMETER
5. MEETS JEDEC MS012-XX AS SHOWN IN ABOVE TABLE
6. N = NUMBER OF PINS

MAXIM 120 SAN GABRIEL DR. SUNNYVALE CA 94086 FAX (408) 737 7194 PROPRIETARY INFORMATION | PACKAGE FAMILY OUTLINE: SOIC .150" TITLE | 1/1 | 21-0041 A DOCUMENT CONTROL NUMBER REV

Package Information (continued)



	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	---	0.200	---	5.08
A1	0.015	---	0.38	---
A2	0.125	0.175	3.18	4.45
A3	0.055	0.080	1.40	2.03
B	0.016	0.022	0.41	0.56
B1	0.045	0.065	1.14	1.65
C	0.008	0.012	0.20	0.30
D1	0.005	0.080	0.13	2.03
E	0.300	0.325	7.62	8.26
E1	0.240	0.310	6.10	7.87
e	0.100	---	2.54	---
eA	0.300	---	7.62	---
eB	---	0.400	---	10.16
L	0.115	0.150	2.92	3.81

	INCHES		MILLIMETERS			
	MIN	MAX	MIN	MAX	N	MS001
D	0.348	0.390	8.84	9.91	8	AB
D	0.735	0.765	18.67	19.43	14	AC
D	0.745	0.765	18.92	19.43	16	AA
D	0.885	0.915	22.48	23.24	18	AD
D	1.015	1.045	25.78	26.54	20	AE
D	1.14	1.265	28.96	32.13	24	AF
D	1.360	1.380	34.54	35.05	28	*5

NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED .15mm (.006")
3. CONTROLLING DIMENSION: MILLIMETER
4. MEETS JEDEC MS001-XX AS SHOWN IN ABOVE TABLE
5. SIMILIAR TO JEDEC MO-058AB
6. N = NUMBER OF PINS

MAXIM — 120 SAN GABRIEL DR SUNNYVALE CA 94086 FAX (408) 737 7194 PROPRIETARY INFORMATION
TITLE: PACKAGE FAMILY OUTLINE: PDIP .300" | 1/1 | 21-0043 A DOCUMENT CONTROL NUMBER REV

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