

# MAXIM

## Dual, 5Ω Analog Switches

MAX4621/MAX4622/MAX4623

### 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 RON 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

# 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 <sub>L</sub> 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 <sub>-</sub> , NO <sub>-</sub> , NC <sub>-</sub> )	±100mA
Peak Current (COM <sub>-</sub> , NO <sub>-</sub> , NC <sub>-</sub> ) (pulsed at 1ms, 10% duty cycle)	±300mA

Continuous Power Dissipation (T<sub>A</sub> = +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<sub>-</sub>, NC<sub>-</sub>, or COM<sub>-</sub> 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<sub>L</sub> = +5V, GND = 0, V<sub>INH</sub> = +2.4V, V<sub>INL</sub> = +0.8V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	
<b>ANALOG SWITCH</b>							
Input Voltage Range (Note 3)	V <sub>COM-</sub> , V <sub>NO-</sub> , V <sub>NC-</sub>		V-		V+	V	
On-Resistance	R <sub>ON</sub>	I <sub>COM-</sub> = 10mA, V <sub>NO-</sub> or V <sub>NC-</sub> = ±10V		3	5	Ω	
			T <sub>A</sub> = +25°C				
			T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>		7		
On-Resistance Match Between Channels (Notes 3, 4)	ΔR <sub>ON</sub>	I <sub>COM-</sub> = 10mA, V <sub>NO-</sub> or V <sub>NC-</sub> = ±10V		0.25	0.5	Ω	
			T <sub>A</sub> = +25°C				
			T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>		0.7		
On-Resistance Flatness (Notes 3, 5)	R <sub>FLAT(ON)</sub>	I <sub>COM-</sub> = 10mA; V <sub>NO-</sub> or V <sub>NC-</sub> = -5V, 0, 5V		0.2	0.5	Ω	
			T <sub>A</sub> = +25°C				
			T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>		0.7		
Off-Leakage Current (NO <sub>-</sub> or NC <sub>-</sub> ) (Note 6)	I <sub>NO-</sub> , I <sub>NC-</sub>	V <sub>NO-</sub> or V <sub>NC-</sub> = ±10V, V <sub>COM-</sub> = ∓10V		-0.5	0.01	0.5	nA
			T <sub>A</sub> = +25°C				
			T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>	-5		5	
COM <sub>-</sub> Off-Leakage Current (Note 6)	I <sub>COM-(OFF)</sub>	V <sub>COM-</sub> = ±10V, V <sub>NO-</sub> or V <sub>NC-</sub> = ∓10V		-0.5	0.01	0.5	nA
			T <sub>A</sub> = +25°C				
			T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>	-5		5	
COM <sub>-</sub> On-Leakage Current (Note 6)	I <sub>COM-(ON)</sub>	V <sub>COM-</sub> = ±10V, V <sub>NO-</sub> or V <sub>NC-</sub> = ∓10V or floating		-1	0.02	1	nA
			T <sub>A</sub> = +25°C				
			T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>	-10		10	
<b>LOGIC INPUT</b>							
Input Current with Input Voltage High	I <sub>INH</sub>	V <sub>IN-</sub> = 2.4V	-0.5	0.001	0.5	μA	
Input Current with Input Voltage Low	I <sub>INL</sub>	V <sub>IN-</sub> = 0.8V	-0.5	0.001	0.5	μA	
Logic Input Voltage High	V <sub>INH</sub>		2.4			V	
Logic Input Voltage Low	V <sub>INL</sub>				0.8	V	

# Dual, 5Ω Analog Switches

MAX4621/MAX4622/MAX4623

## ELECTRICAL CHARACTERISTICS—Dual Supplies (continued)

(V+ = +15V, V- = -15V, VL = +5V, GND = 0, VINH = +2.4V, VINL = +0.8V, TA = TMIN to TMAX, unless otherwise noted. Typical values are at TA = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
<b>POWER SUPPLY</b>							
Power-Supply Range				±4.5		±20.0	V
Positive Supply Current	I+	VIN_ = 0 or 5V	TA = +25°C	-0.5	0.001	0.5	μA
			TA = TMIN to TMAX	-5		5	
Negative Supply Current	I-	VIN_ = 0 or 5V	TA = +25°C	-0.5	0.001	0.5	μA
			TA = TMIN to TMAX	-5		5	
Logic Supply Current	IL	VIN_ = 0 or 5V	TA = +25°C	-0.5	0.001	0.5	μA
			TA = TMIN to TMAX	-5		5	
Ground Current	IGND	VIN_ = 0 or 5V	TA = +25°C	-0.5	0.001	0.5	μA
			TA = TMIN to TMAX	-5		5	
<b>SWITCH DYNAMIC CHARACTERISTICS</b>							
Turn-On Time	tON	VCOM_ = ±10V, Figure 2	TA = +25°C		120	250	ns
			TA = TMIN to TMAX			325	
Turn-Off Time	tOFF	VCOM_ = ±10V, Figure 2	TA = +25°C		90	200	ns
			TA = TMIN to TMAX			275	
Break-Before-Make Time Delay (MAX4622 only)	tD	VCOM_ = ±10V, Figure 3, TA = +25°C		5	25		ns
Charge Injection	Q	CL = 1.0nF, VGEN = 0, RGEN = 0, Figure 4, TA = +25°C			480		pC
Off-Isolation (Note 7)	VISO	RL = 50Ω, f = 1MHz, Figure 5, TA = +25°C			-62		dB
Crosstalk (Note 8)	VCT	RL = 50Ω, f = 1MHz, Figure 6, TA = +25°C			-60		dB
NC_ or NO_ Capacitance	COFF	f = 1MHz, Figure 7, TA = +25°C			34		pF
COM_ Off-Capacitance	CCOM	f = 1MHz, Figure 7, TA = +25°C			34		pF
On-Capacitance	CCOM	f = 1MHz, Figure 8, TA = +25°C			150		pF

# Dual, 5Ω Analog Switches

## ELECTRICAL CHARACTERISTICS—Single Supply

(V+ = +12V, V- = 0, VL = +5V, GND = 0, VINH = +2.4V, VINL = +0.8V, TA = TMIN to TMAX, unless otherwise noted. Typical values are TA = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	
<b>ANALOG SWITCH</b>							
Input Voltage Range (Note 3)	VCOM_, VNO_, VNC_		GND		V+	V	
On-Resistance	RON	ICOM_ = 10mA, VNO_ or VNC_ = 10V	TA = +25°C	5.5	8	Ω	
			TA = TMIN to TMAX		10		
On-Resistance Match Between Channels (Notes 3, 4)	ΔRON	ICOM_ = 10mA, VNO_ or VNC_ = 10V, TA = +25°C		0.2	0.5	Ω	
On-Resistance Flatness (Notes 3, 5)	RFLAT(ON)	ICOM_ = 10mA; VNO_ or VNC_ = 3V, 6V, 9V; TA = +25°C		0.9	1.3	Ω	
NO_ or NC_ Off-Leakage Current (Notes 6, 9)	INO_(OFF), INC_(OFF)	VCOM_ = 1V, 10V; VNO_ or VNC_ = 10V, 1V	TA = +25°C	-0.5	0.01	0.5	nA
			TA = TMIN to TMAX	-5		5	
COM_ Off-Leakage Current (Notes 6, 9)	ICOM_(OFF)	VCOM_ = 10V, 1V; VNO_ or VNC_ = 1V, 10V	TA = +25°C	-0.5	0.01	0.5	nA
			TA = TMIN to TMAX	-5		5	
COM_ On-Leakage Current (Notes 6, 9)	ICOM_(ON)	VCOM_ = 10V, 1V; VNO_ or VNC_ = 10V, 1V, or floating	TA = +25°C	-1	0.02	1	nA
			TA = TMIN to TMAX	-10		10	
<b>LOGIC INPUT</b>							
Input Current with Input Voltage High	IINH	VIN_ = 2.4V	-0.5	0.001	0.5	μA	
Input Current with Input Voltage Low	IINL	VIN_ = 0.8V	-0.5	0.001	0.5	μA	
Logic Input Voltage High	VINH		2.4			V	
Logic Input Voltage Low	VINL				0.8	V	
<b>POWER SUPPLY</b>							
Power-Supply Range			4.5		36.0	V	
Positive Supply Current	I+	VIN_ = 0 or 5V	TA = +25°C	-0.5	0.001	0.5	μA
			TA = TMIN to TMAX	-5		5	
Logic Supply Current	IL	VIN_ = 0 or 5V	TA = +25°C	-0.5	0.001	0.5	μA
			TA = TMIN to TMAX	-5		5	
Ground Current	IGND	VIN_ = 0 or 5V	TA = +25°C	-0.5	0.001	0.5	μA
			TA = TMIN to TMAX	-5		5	

# Dual, 5Ω Analog Switches

MAX4621/MAX4622/MAX4623

## ELECTRICAL CHARACTERISTICS—Single Supply (continued)

(V+ = +12V, V- = 0, VL = +5V, GND = 0, VINH = +2.4V, VINL = +0.8V, TA = TMIN to TMAX, unless otherwise noted. Typical values are TA = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
<b>SWITCH DYNAMIC CHARACTERISTICS</b>						
Turn-On Time (Note 3)	tON	VCOM_ = 10V, Figure 2	TA = +25°C	200	350	ns
			TA = TMIN to TMAX		475	
Turn-Off Time (Note 3)	tOFF	VCOM_ = 10V, Figure 2	TA = +25°C	100	200	ns
			TA = TMIN to TMAX		300	
Break-Before-Make Time Delay (MAX4622 only) (Note 3)	tD	RL = 100Ω, CL = 35pF, Figure 3, TA = +25°C	10	75		ns
Charge Injection	Q	CL = 1.0nF, VGEN = 0, RGEN = 0, Figure 4		45		pC
Off-Isolation (Note 7)	VISO	RL = 50Ω, f = 1MHz, Figure 5		-62		dB
Crosstalk (Note 8)	VCT	RL = 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 =  $20\log_{10} [V_{COM\_} / (V_{NC\_} \text{ or } V_{NO\_})]$ . VCOM\_ = output, VNC\_ or VNO\_ = input to off switch.

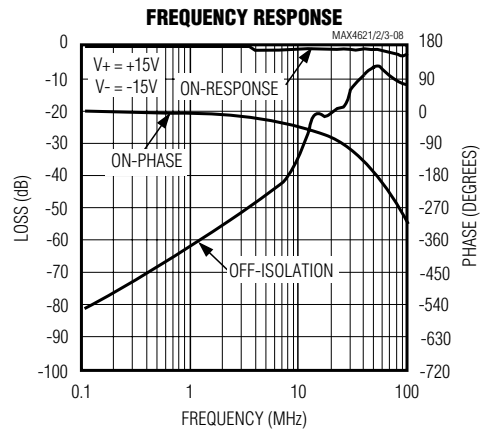
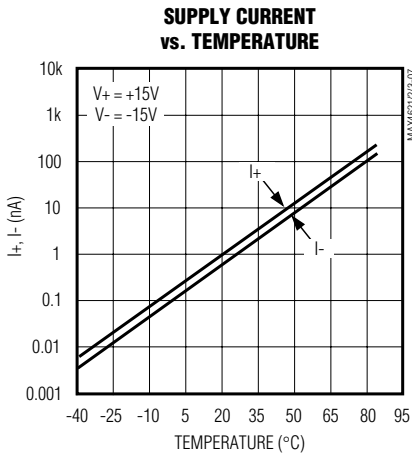
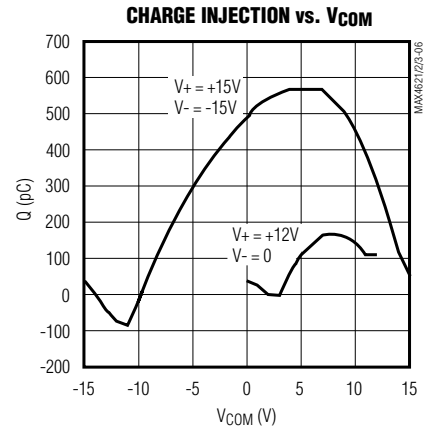
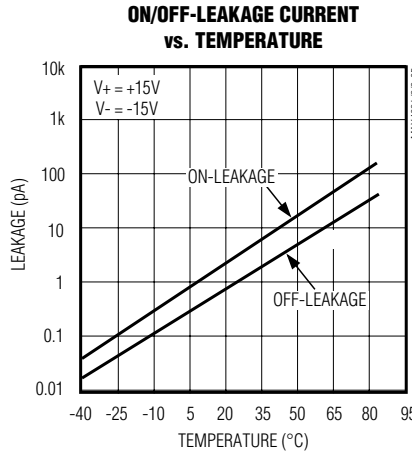
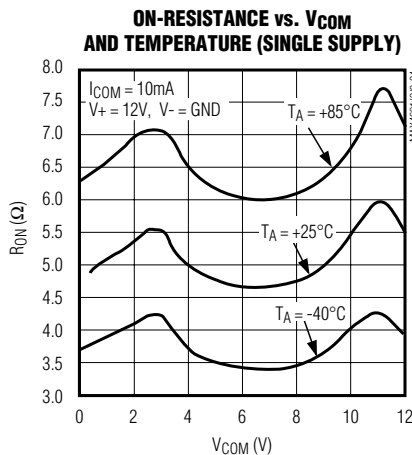
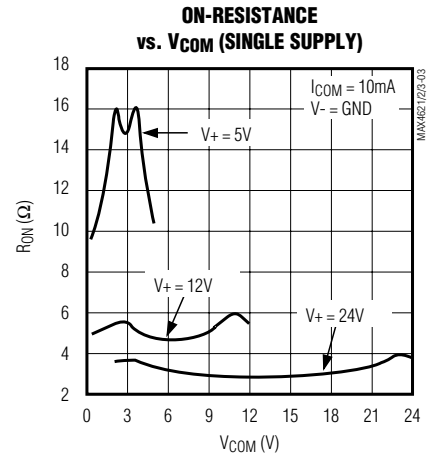
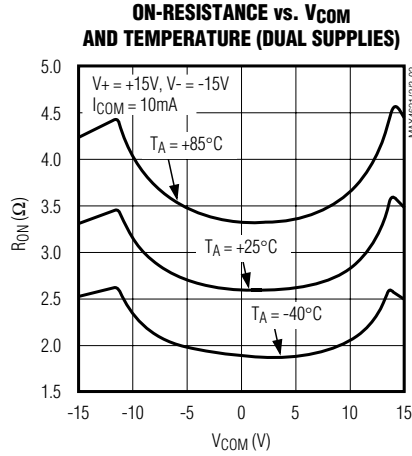
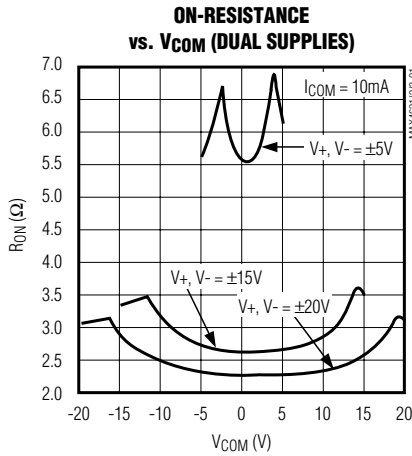
**Note 8:** Between any two switches.

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

# Dual, 5Ω Analog Switches

## Typical Operating Characteristics

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



# Dual, 5Ω Analog Switches

MAX4621/MAX4622/MAX4623

## Pin Description

PIN	NAME	FUNCTION
<b>MAX4621</b>		
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 <sub>L</sub>	Logic Supply-Voltage Input
13	GND	Ground
14	V-	Negative Supply Voltage Input
<b>MAX4622</b>		
1, 3, 6, 8	COM <sub>-</sub>	Switch Common Terminal
2, 7	N.C.	Not internally connected
4, 5, 9, 16	NC <sub>-</sub> , NO <sub>-</sub>	Switch Normally Closed/Open Terminal
10, 15	IN2, IN1	Digital Logic Inputs
11	V+	Positive Supply-Voltage Input
12	V <sub>L</sub>	Logic Supply-Voltage Input
13	GND	Ground
14	V-	Negative Supply Voltage Input
<b>MAX4623</b>		
1, 3, 6, 8	COM <sub>-</sub>	Switch Common Terminal
2, 7	N.C.	Not internally connected
4, 5, 9, 16	NO <sub>-</sub>	Switch Normally Open Terminal
10, 15	IN2, IN1	Digital Logic Inputs
11	V+	Positive Supply-Voltage Input
12	V <sub>L</sub>	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<sub>+</sub> to V<sub>-</sub> 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<sub>+</sub> on first, followed by V<sub>L</sub>, V<sub>-</sub>, 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<sub>+</sub> and V<sub>L</sub> (Figure 1). Adding diodes reduces the analog signal range to 1V below V<sub>+</sub> and 1V above V<sub>-</sub>, but low switch resistance and low leakage characteristics are unaffected. The difference between V<sub>+</sub> and V<sub>-</sub> should not exceed +44V.

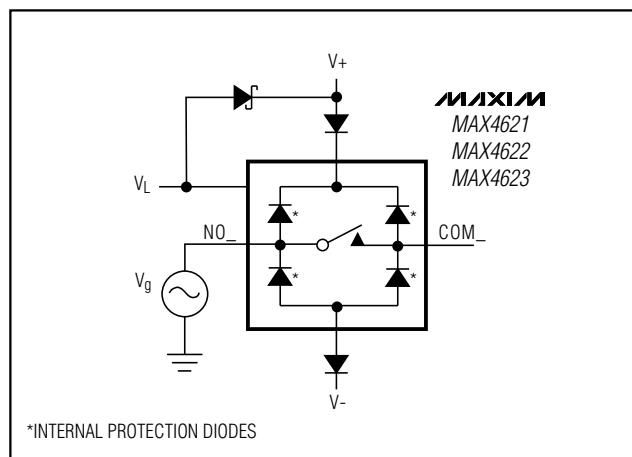


Figure 1. Overvoltage Protection Using Blocking Diodes

# Dual, 5Ω Analog Switches

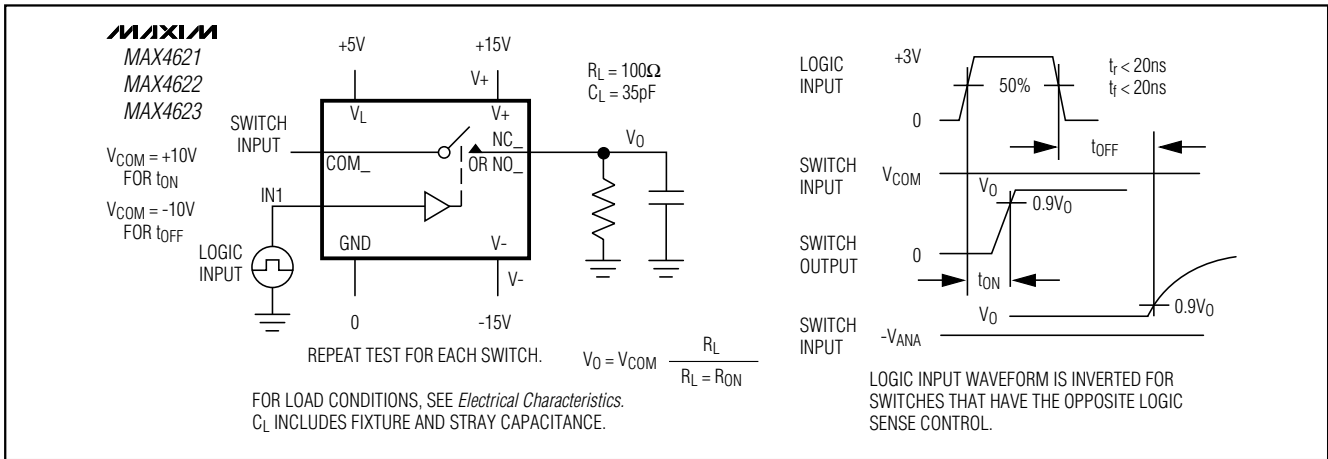


Figure 2. Switching-Time Test Circuit

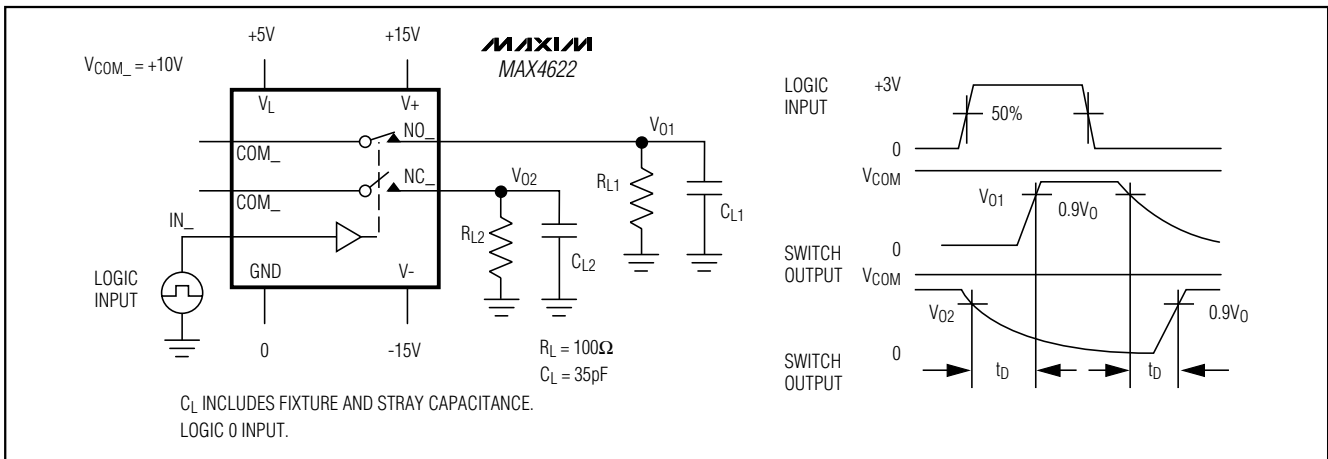


Figure 3. MAX4622 Break-Before-Make Test Circuit

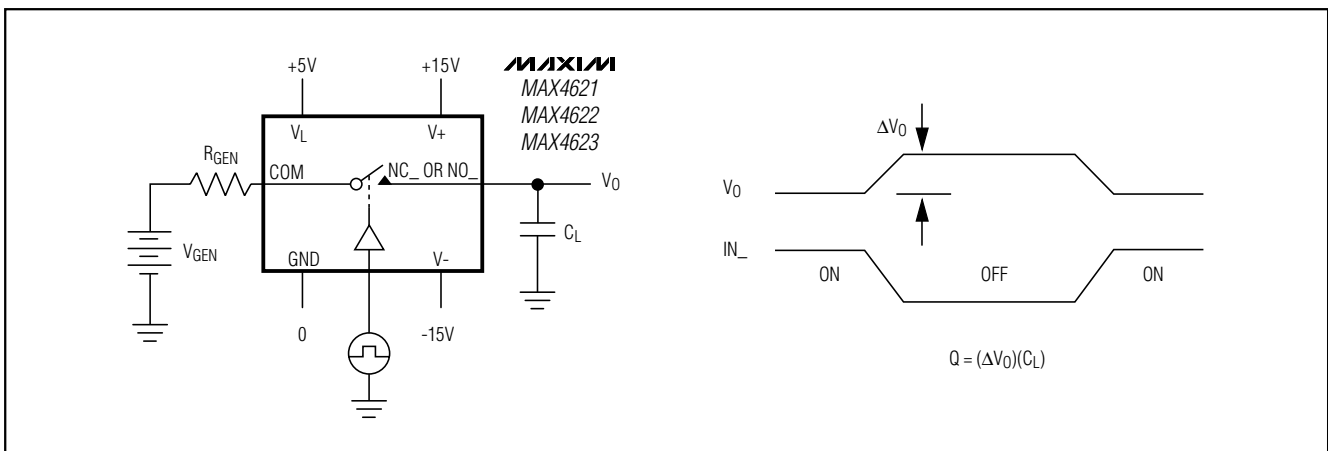


Figure 4. Charge-Injection Test Circuit



# Dual, 5Ω Analog Switches

MAX4621/MAX4622/MAX4623

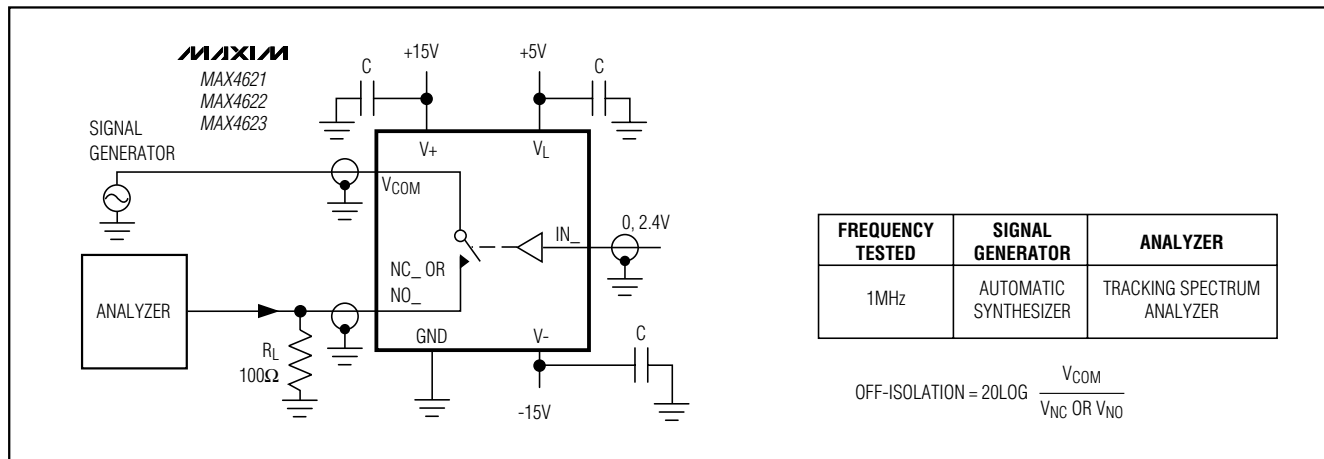


Figure 5. Off-Isolation

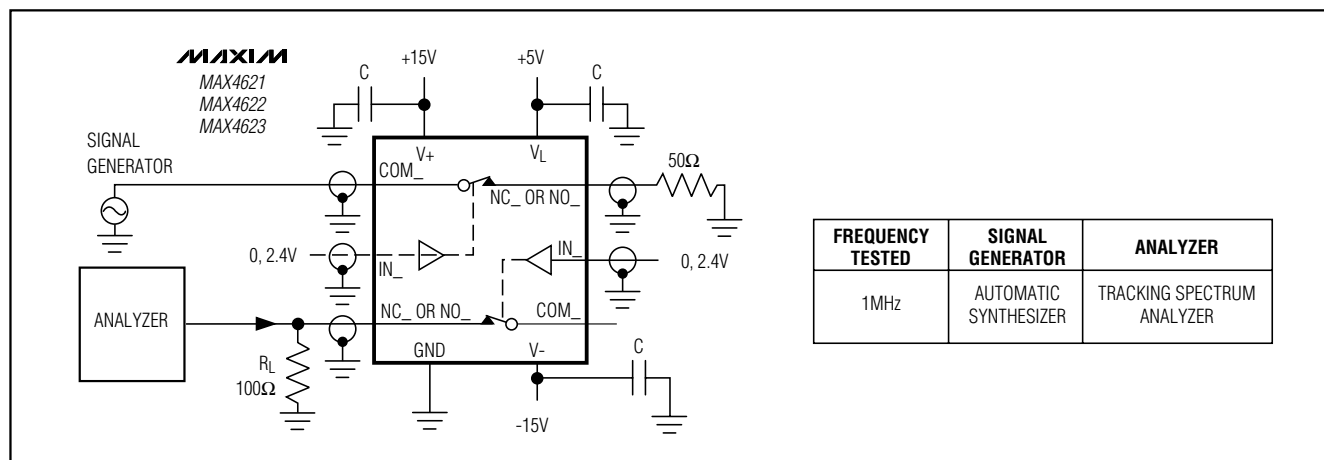


Figure 6. Crosstalk Test Circuit

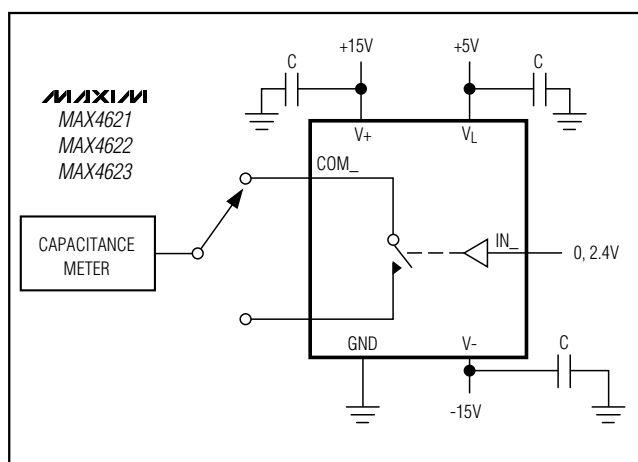


Figure 7. Channel-On Capacitance

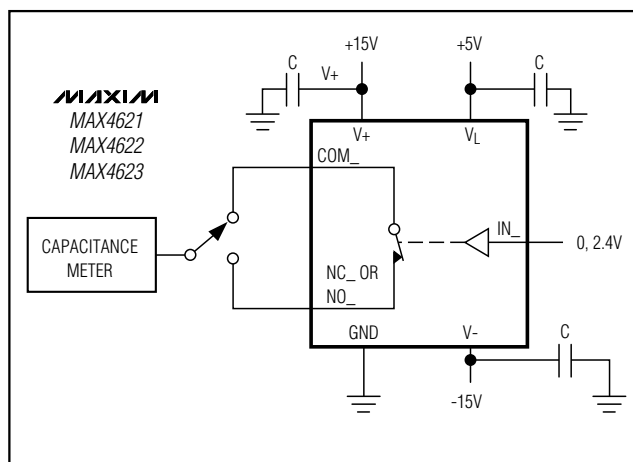


Figure 8. Channel-Off Capacitance

# 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
<b>MAX4622CSE</b>	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
<b>MAX4623CSE</b>	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		N	MS012
	MIN	MAX	MIN	MAX		
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  
 IN AN AREA OF SIMILAR TO THIS FAMILY OF PARTS  
 PROPRIETARY INFORMATION

PACKAGE FAMILY OUTLINE: SOIC .150"

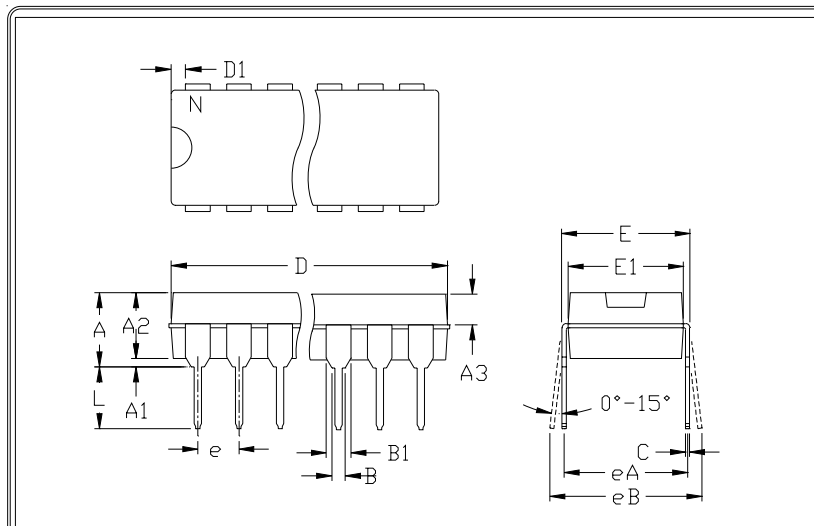
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21-0041 A  
 DOCUMENT CONTROL NUMBER REV

# Dual, 5Ω Analog Switches

## Package Information (continued)

MAX4621/MAX4622/MAX4623



	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		N	MS001
	MIN	MAX	MIN	MAX		
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. SIMILAR TO JEDEC MO-058AB
6. N = NUMBER OF PINS



PACKAGE FAMILY OUTLINE: PDIP .300"

1/1

21-0043 A  
DOCUMENT CONTROL NUMBER REV

# Dual, 5Ω Analog Switches

MAX4621/MAX4622/MAX4623

## NOTES

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