

Precision, Quad, SPDT, CMOS Analog Switch

ABSOLUTE MAXIMUM RATINGS

V+ to V-	44V
VIN, VCOM, VNO, VNC	V- to V+
(VNO - VNC)	32V
V+ to Ground	30V
V- to Ground	30V
Current, Any Terminal Except VCOM, VNO, or VNC	30mA
Continuous Current, VCOM, VNO, or VNC	20mA
Peak Current, VCOM, VNO, or VNC (Pulsed at 1ms, 10% duty cycle max)	70mA
ESD	2000V

Continuous Power Dissipation (TA = +70°C) (Note 1)

Plastic DIP (derate above +70°C by 11.11mW/°C)	889mW
SO (derate above +70°C by 10.00mW/°C)	800mW
CERDIP (derate above +70°C by 11.11mW/°C)	889mW
TSSOP (derate above +70°C by 7mW/°C)	559mW

Operating Temperature Ranges:

MAX333AC	0°C to +70°C
MAX333AE	-40°C to +85°C
MAX333AMJP	-55°C to +125°C
Storage Temperature Range	-65°C to +150°C
Lead Temperature (soldering, 10sec)	+300°C

Note 1: Device mounted with all leads soldered 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—Dual Supplies

(GND = 0V, V+ = +15V, V- = -15V, TA = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP (Notes 2, 3)	MAX	UNITS
POWER REQUIREMENTS							
Positive Supply Current	I+	VIN = 0V/5V, V+ = 16.5V, V- = -16.5V		0.05	0.25		mA
Supply Voltage Range	V+/V-	Dual supply, V+ = V-		±4.5V	±20		V
	V+	Single supply, V- = GND		10	30		
Negative Supply Current	I-	VIN = 0V/5V, V+ = 16.5V, V- = -16.5V		0.01	1		μA
LOGIC INPUT							
Input Voltage Low	VIL			V-	0.8		V
Input Voltage High	VIH			2.4	V+		V
Input Current	IIN	VIN = V-, V+		-1.0	0.0001	1.0	μA
SWITCH							
Analog Signal Range	VCOM, VNO, VNC			V-	V+		V
On Circuit Resistance	RON	VCOM = +10V, I(NC or NO) = 1mA; VCOM = -10V, I(NC or NO) = 1mA		M	20	35	Ω
				C, E		45	
On Resistance Match Between Channels (Note 4)	RON	I(NC or NO) = -10mA, VD = 10V or -10V, V+ = 15V, V- = -15V		TA = +25°C		2	Ω
				TA = TMIN to TMAX		4	
On Resistance Flatness (Note 4)	RON	I(NC or NO) = -10mA, VD = 5V or -5V, V+ = 15V, V- = -15V		TA = +25°C		3	Ω
				TA = TMIN to TMAX		5	
On Circuit Leakage Current	ICOM	VCOM = ±15.5V, VNC or VNO = ±15.5V, V+ = 16.5V, V- = -16.5V		M	-0.75	0.75	nA
				C, E	-1.00	0.20	
Off Circuit Leakage Current	INC or INO	VCOM = ±15.5V VNC or VNO = ±15.5V, V+ = 16.5V, V- = -16.5V		M	-0.25	0.01	nA
				C, E	-0.50	0.02	
DYNAMIC							
Turn-Off Time	tOFF	Figure 1			145		ns
Turn-On Time	tON				175		ns
Break-Before-Make Time	tOPEN			10			ns
Off Capacitance	COFF				5		pF
On Capacitance	CON				5		pF
Charge Injection	Q	CL = 10nF, VGEN = 0V, RGEN = 0Ω, Figure 6	TA = +25°C		2	10	pC
Off Isolation	OIRR	f = 1MHz, RL = 75Ω, VCOM = 2.3VRMS			72		dB
Crosstalk	CCRR				78		dB

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ELECTRICAL CHARACTERISTICS—DUAL SUPPLIES (continued)

(GND = 0V, V+ = +15V, V- = -15V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP (Notes 2, 3)	MAX	UNITS
LOGIC INPUT						
Input Voltage Low	V _{IL}		V-		0.8	V
Input Voltage High	V _{IH}		2.4		V+	V
Input Current	I _{IN}	V _{IN} = V-, V+	-1.0	0.0001	1.0	μA
SWITCH						
Analog Signal Range	V _{COM}		V-		V+	V
On Circuit Resistance	R _{ON}	V _{COM} = 10V, I _(NC or NO) = 1mA; V _{COM} = -10V, I _(NC or NO) = 1mA	C, E		45	Ω
			M		45	
On Circuit Leakage Current	I _{COM}	V _{COM} = ±15V, V _{NC} or V _{NO} = -15V, V+ = 16.5V, V- = -16.5V	C, E	-10	10	nA
			M	-60	60	
On Circuit Leakage Current	I _{NC} or I _{NO}	V _{COM} = ±15V, V _{NC} or V _{NO} = -15V, V+ = 16.5V, V- = -16.5V	C, E	-6	6	nA
			M			

ELECTRICAL CHARACTERISTICS—Single Supply

(GND = 0V, V+ = +12V, V- = 0V, T_A = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP (Notes 2, 3)	MAX	UNITS
SUPPLY						
Supply Voltage Range	V+	Single supply, V- = GND	10		30	V
Positive Supply Current	I+				0.25	mA
INPUT						
Input Voltage Low	V _{INLO}		0		0.8	V
Input Voltage High	V _{INHI}		2.4		V+	V
Input Current	I _{IN}	V _{IN} = V+, 0V			1	μA
SWITCH						
Analog Signal Range	V _{COM} , V _{NO} , V _{NC}		V-		V+	V
On Circuit Resistance	r _{ON}	V _{COM} = 10V, I _(NC or NO) = 1mA, V _{COM} = 1V, I _(NC or NO) = 1mA		35	75	Ω
On Circuit Leakage Current	I _{COM}	V _{COM} = 11V, V _{NC} or V _{NO} = 0V V _{COM} = 1V, V _{NC} or V _{NO} = V+			0.75	nA
Off Circuit Leakage Current	I _{NC} or I _{NO}	V _{COM} = 11V V _{NC} or V _{NO} = 1V			0.25	nA
DYNAMIC						
Turn-Off Time	t _{OFF}	Figure 1		45		ns
Turn-On Time	t _{ON}			90		ns
Break-Before-Make Time	t _{OPEN}		5	10		ns
Off Isolation	OIRR	f = 1MHz, R _L = 75Ω, V _{COM} = 2.3V _{RMS}		70		dB
Crosstalk	CCRR			72		dB

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

Note 3: Typical values are for design aid only, not guaranteed or subject to production testing.

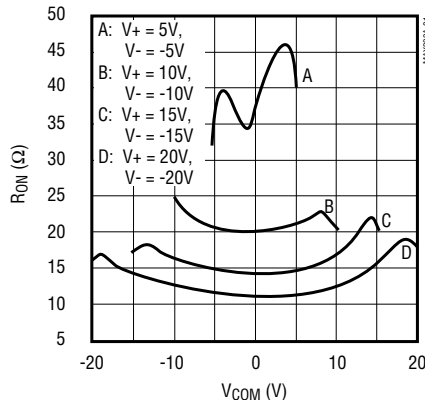
Note 4: On resistance match between channels and flatness are guaranteed only with bipolar-supply operation.

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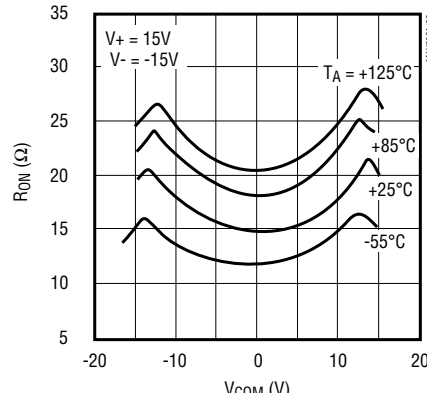
Typical Operating Characteristics

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

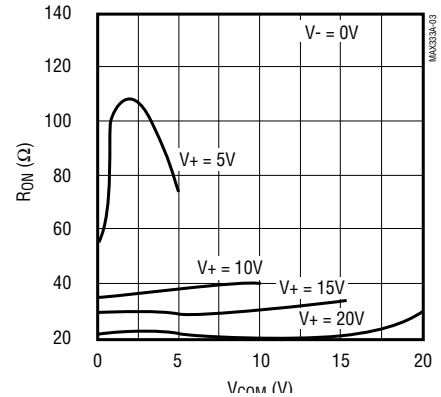
**ON RESISTANCE
vs. V_{COM} AND POWER SUPPLY VOLTAGE**



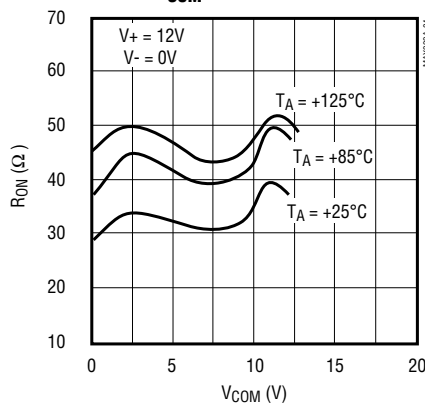
**ON RESISTANCE
vs. V_{COM} AND TEMPERATURE**



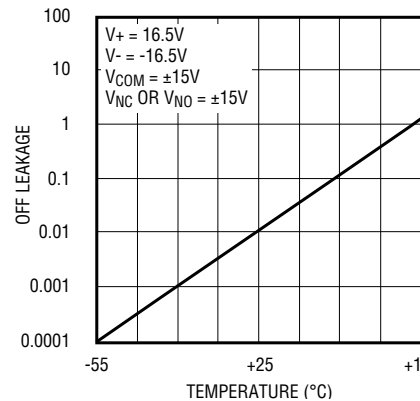
**ON RESISTANCE
vs. V_{COM} AND TEMPERATURE**



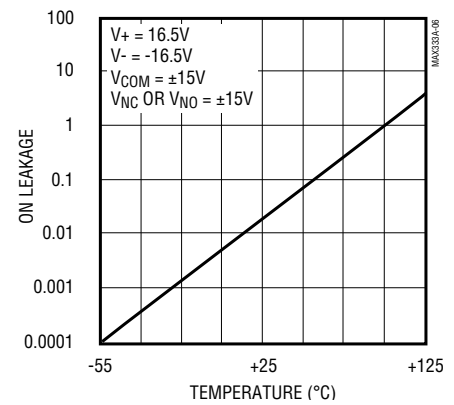
**ON RESISTANCE
vs. V_{COM} AND SINGLE SUPPLY**



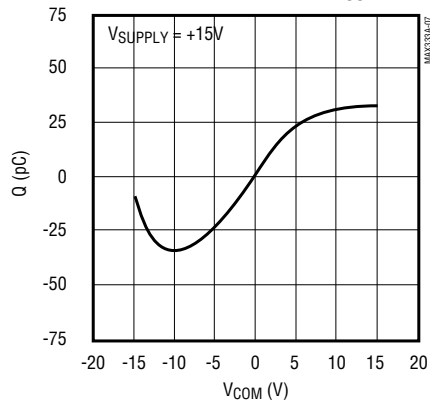
**OFF LEAKAGE CURRENTS
vs. TEMPERATURE**



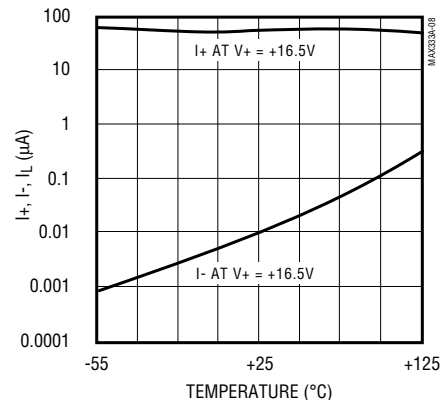
**ON LEAKAGE CURRENTS
vs. TEMPERATURE**



CHARGE INJECTION vs. V_{COM}



SUPPLY CURRENT vs. TEMPERATURE



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Pin Description

PIN	NAME	FUNCTION
1, 10, 11, 20	IN1-IN4	Logic-Level Inputs
2, 9, 12, 19	NO1-NO4	Normally Open Switches
3, 8, 13, 18	COM1-COM4	Common Switch Poles
4, 7, 14, 17	NC1-NC4	Normally Closed Switches
5	V-	Negative Power Supply
6	GND	Ground
15	N.C.	Not Internally Connected
16	V+	Positive Power Supply

Applications Information

Operation with Supply Voltages Other than $\pm 15V$

The main limitation of supply voltages other than $\pm 15V$ is a reduction in the analog signal range. The MAX333A operates with $\pm 5V$ to $\pm 20V$ bipolar supplies. The *Typical Operating Characteristics* and graphs show typical on resistance for $\pm 15V$, $\pm 10V$, $\pm 5V$ supplies. Switching times increase by a factor of two or more for $\pm 5V$ operation. The MAX333A can operate from $+10V$ to $+24V$ unipolar supplies. It can be powered from a single $+10V$ to $+24V$ supply, as well as from unbalanced supplies such as $+24V$ and $-5V$. Connect $V-$ to $0V$ when operating with a single supply.

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 $V-$, V_L , and logic inputs. If power-supply sequencing is not possible, add two small signal diodes in series with the supply pins (Figure 1). Adding the diodes reduces the analog signal range to $1V$ below $V+$ and $1V$ below $V-$, but low switch resistance and low leakage characteristics are unaffected.

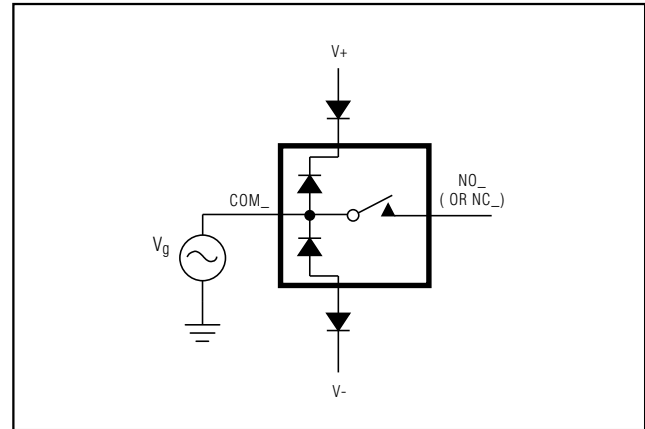


Figure 1. Overvoltage Protection Using Blocking Diodes

Test Circuits/Timing Diagrams

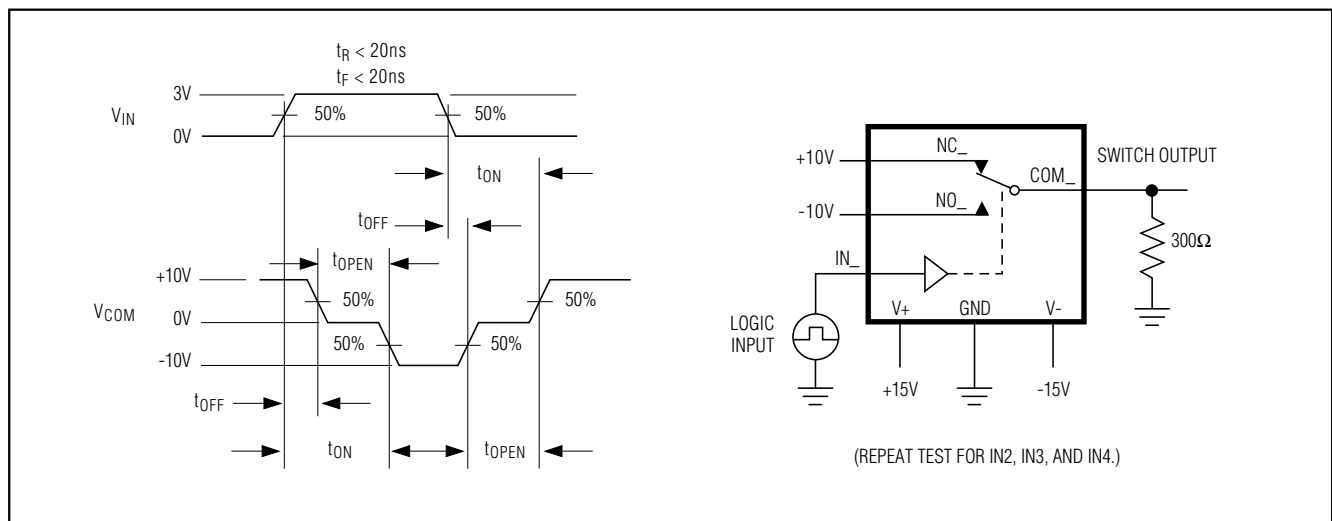


Figure 2. Switching-Time Test Circuit

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Test Circuits/Timing Diagrams

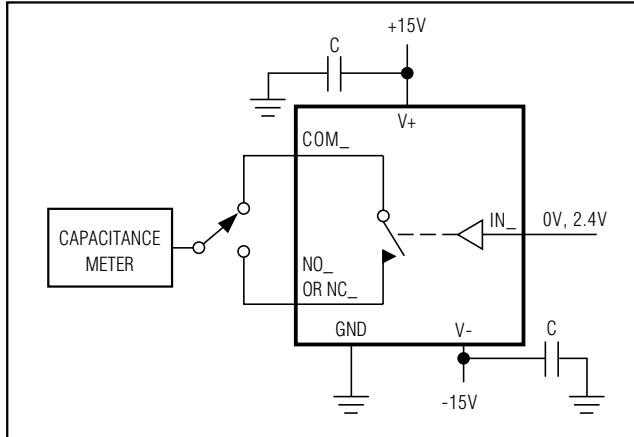


Figure 3. Channel-Off Capacitance

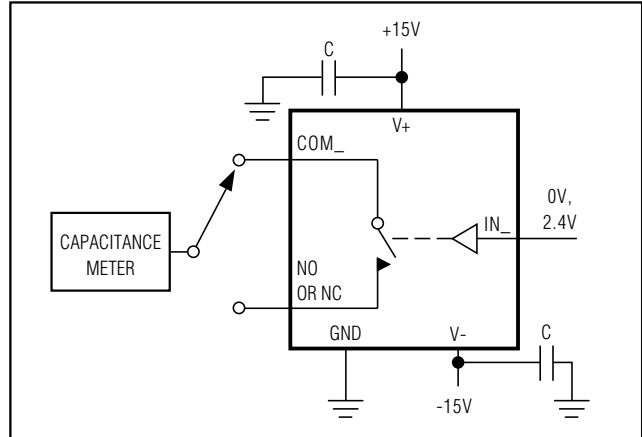


Figure 4. Channel-On Capacitance

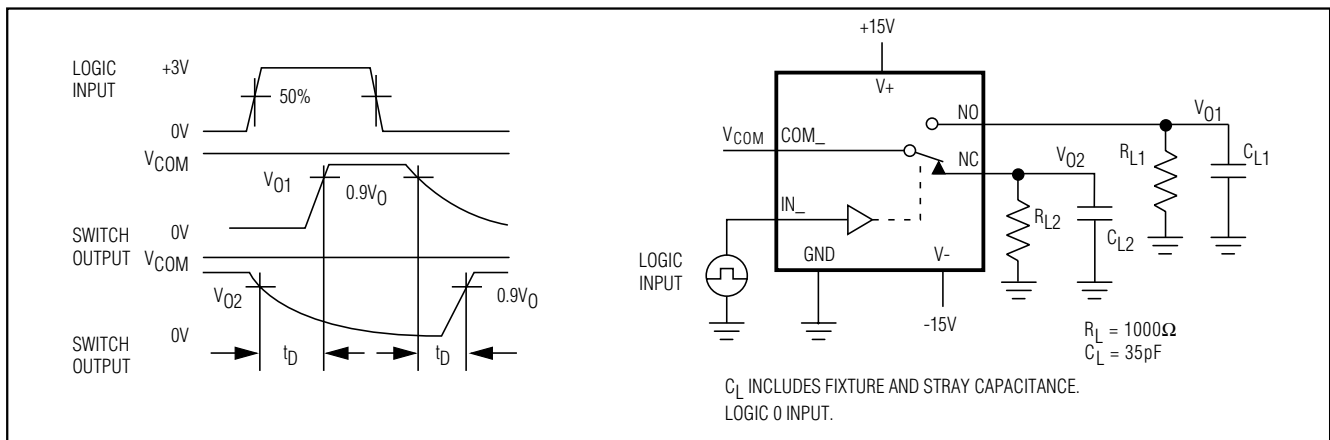


Figure 5. Break-Before-Make

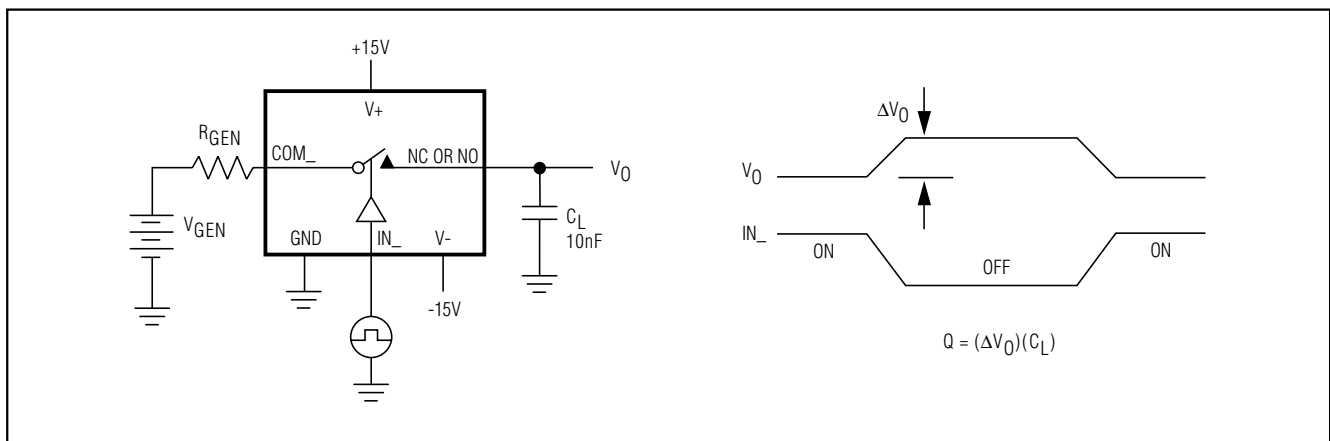


Figure 6. Charge Injection

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The circuit diagram shows a noise source setup. A signal generator is connected to the COM_ pin of a device. The device's V+ pin is connected to +15V through a capacitor C. The V- pin is connected to -15V through a capacitor C. The IN_ pin is connected to a 0V, 2.4V source. The NC_ OR NO_ pin is connected to a 100 ohm resistor (R_L) in series with a 100 ohm resistor. The output of the noise source is connected to the ANALYZER CH A and CH B. The ANALYZER is set to 1 MHz. The test conditions are summarized in the table below:

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

OFF ISOLATION = $20 \log \frac{V_{COM}}{V_{NC \text{ OR } NO}}$

The circuit diagram shows a 741 op-amp configured as a voltage follower. The op-amp is powered by +15V and -15V supplies, with decoupling capacitors C. The non-inverting input (IN1) is connected to a signal generator through a 50Ω resistor and to an analyzer (CH A) through a 100Ω resistor. The inverting input (IN2) is connected to the output (V-) via a feedback loop. The output (V-) is also connected to the analyzer (CH B). The op-amp is labeled with pins COM, IN-, NC1 OR NO1, GND, and V-.

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

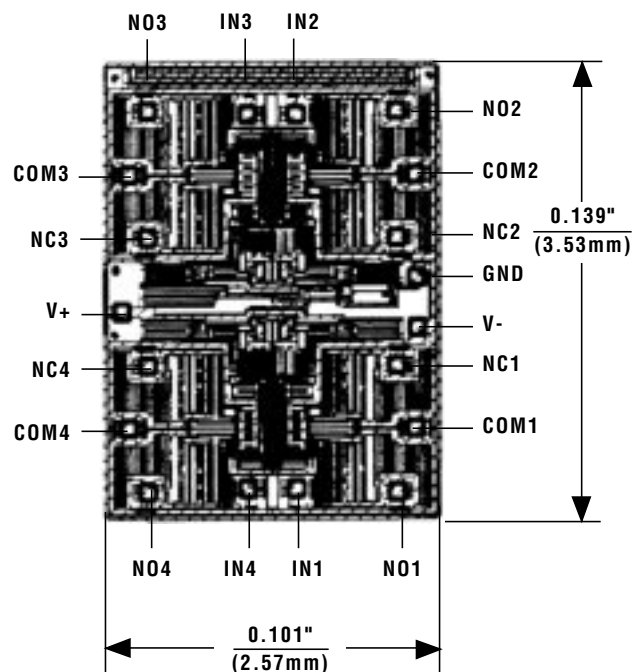
REPEAT TESTS FOR OTHER CHANNELS

MAXIM

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Chip Topography



TRANSISTOR COUNT: 145;
SUBSTRATE CONNECTED TO V+.

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