19-1713; Rev 0; 4/00

MAXIM

2Ω, Quad, SPST, CMOS Analog Switches

General Description

The MAX4677/MAX4678/MAX4679 quad analog switches feature 1.6Ω max on-resistance (R_{ON}) when operating from a dual ±5V supply. R_{ON} is matched between channels to 0.3Ω max and is flat (0.4Ω max) over the specified signal range. Each switch can handle Rail-to-Rail® analog signals. Off-leakage current is 0.1nA at +25°C. These switches are ideal in low-distortion applications and are the preferred solution over mechanical relays in automated test equipment. They have low power requirements, require less board space, and are more reliable than mechanical relays.

The MAX4677 has four normally closed (NC) switches, and the MAX4678 has four normally open (NO) switches. The MAX4679 has two NC and two NO switches and features guaranteed break-before-make switching.

The MAX4677/MAX4678/MAX4679 operate from either a single +2.7V to +11V or dual ±2.7V to ±5.5V supplies, making them ideal for use in digital card applications and single-ended 75Ω systems.

These devices feature a separate logic supply input that operates from +2.7V to V+, allowing independent logic and analog supplies.

Applications

Reed Relay Replacement	Avionics
Test Equipment	ADC Systems
Communications Systems	Data-Acquisition Systems
Audio Signal Routing	PBX/PABX Systems

Features

- **On-Resistance 1.6Ω max**
- **On-Resistance Flatness 0.4Ω max**
- **On-Resistance Matching 0.3Ω max**
- **Dual ±2.7V to ±5.5V or Single +2.7V to +11V Supply Range**
- **TTL/CMOS-Logic Compatible**
- **Crosstalk -84dB at 1MHz**
- **Off-Isolation -65dB at 1MHz**
- **-3dB Bandwidth: 66MHz**
- **Rail-to-Rail Signal Range**

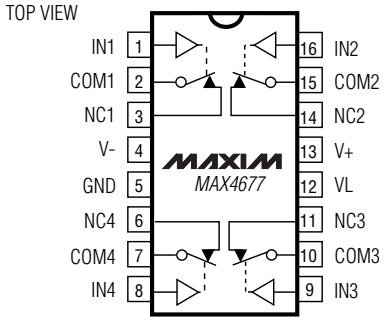
Ordering Information

PART	TEMP. RANGE	PIN-PACKAGE
MAX4677EUE	-40°C to +85°C	16 TSSOP
MAX4677EPE	-40°C to +85°C	16 DIP
MAX4678EUE	-40°C to +85°C	16 TSSOP
MAX4678EPE	-40°C to +85°C	16 DIP
MAX4679EUE	-40°C to +85°C	16 TSSOP
MAX4679EPE	-40°C to +85°C	16 DIP

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

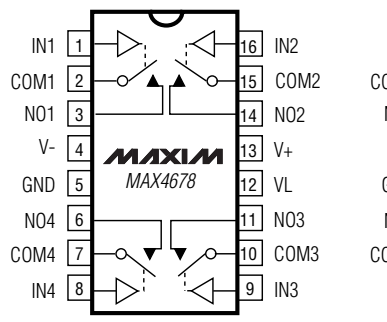
Pin Configurations/Functional Diagrams/Truth Tables

TOP VIEW



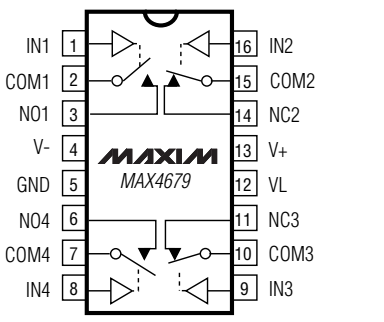
DIP/TSSOP

MAX4677	
LOGIC	SWITCH
0	ON
1	OFF



DIP/TSSOP

MAX4678	
LOGIC	SWITCH
0	OFF
1	ON



DIP/TSSOP

MAX4679		
LOGIC	SWITCHES 1, 4	SWITCHES 2, 3
0	OFF	ON
1	ON	OFF

SWITCHES SHOWN FOR LOGIC "0" INPUT

2Ω, Quad, SPST, CMOS Analog Switches

ABSOLUTE MAXIMUM RATINGS

V+ to GND .....-0.3V to +12V
V- to GND .....+0.3V to -12V
V+ to V- .....+12V
V_L, IN_ to GND (Note 1) .....-0.3V to (V+ + 0.3V)
$V_{COM\_}$, $V_{NC\_}$, $V_{NO\_}$ (Note 1).....V- to V+
Current (any terminal).....±50mA
Continuous Current (COM_, NC_, NO_).....±100mA
Peak Current (COM_, NC_, NO_
pulsed at 1ms 10% duty cycle) .....±200mA

Continuous Power Dissipation (T_A = +70°C)
16-Pin Plastic DIP (derate 10.5mW/°C above +70°C)..842mW
16-Pin TSSOP (derate 5.7mW/°C above +70°C).....457mW
Operating Temperature Range .....-40°C to +85°C
Storage Temperature Range .....-65°C to +150°C
Junction Temperature .....+150°C
Lead Temperature (soldering, 10s) .....+300°C

Note 1: Signals on NC_, NO_, COM_, or IN_ 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+ = +5V ±10%, V- = -5V ±10%, V_L = +2.7V to V+, GND = 0, V_{IH} = +2.4V, V_{IL} = +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	$V_{COM\_}$, $V_{NO\_}$, $V_{NC\_}$			V-		V+	V
On-Resistance	R_{ON}	V+ = 4.5V, V- = -4.5V, $I_{COM\_}$ = 50mA, $V_{NO\_}$ or $V_{NC\_}$ = ±3.3V	T_A = +25°C		1.2	1.6	Ω
			T_A = T_{MIN} to T_{MAX}			2	
On-Resistance Match Between Channels (Note 3)	ΔR_{ON}	V+ = 4.5V, V- = -4.5V, $I_{COM\_}$ = 50mA, $V_{NO\_}$ or $V_{NC\_}$ = ±3.3V	T_A = +25°C		0.2	0.3	Ω
			T_A = T_{MIN} to T_{MAX}			0.5	
On-Resistance Flatness (Note 4)	R_{FLAT}	V+ = 4.5V, V- = -4.5V, $I_{COM\_}$ = 50mA, $V_{NO\_}$ or $V_{NC\_}$ = ±3.3V, 0	T_A = +25°C		0.2	0.4	Ω
			T_A = T_{MIN} to T_{MAX}			0.5	
NC_ or NO_ Off-Leakage Current (Note 5)	$I_{N\_(OFF)}$	V+ = +5.5V, V- = -5.5V, $V_{NO\_}$ or $V_{NC\_}$ = ±4.5V, $V_{COM\_}$ = ∓4.5V	T_A = +25°C	-1	0.1	1	nA
			T_A = T_{MIN} to T_{MAX}	-10		10	
COM_ Off-Leakage Current (Note 5)	$I_{COM\_(OFF)}$	V+ = +5.5V, V- = -5.5V, $V_{NO\_}$ or $V_{NC\_}$ = ±4.5V, $V_{COM\_}$ = ∓4.5V	T_A = +25°C	-1	0.1	1	nA
			T_A = T_{MIN} to T_{MAX}	-10		10	
COM_ On-Leakage Current (Note 5)	$I_{COM\_(ON)}$	V+ = +5.5V, V- = -5.5V, $V_{COM\_}$ = ±4.5V, $V_{NO\_}$ or $V_{NC\_}$ = ±4.5V or floating	T_A = +25°C	-2	0.2	2	nA
			T_A = T_{MIN} to T_{MAX}	-25		25	
LOGIC INPUT							
Input Logic High	V_{IH}	V_L = V+		2.4			V
Input Logic Low	V_{IL}	V_L = V+				0.8	V
Input Leakage Current	I_{IN}	V_L = V+		-1	0.005	1	µA

ELECTRICAL CHARACTERISTICS–Dual Supplies (continued)

(V+ = +5V ±10%, V- = -5V ±10%, V_L = +2.7V to V+, GND = 0, V_{IH} = +2.4V, V_{IL} = +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							
Positive Supply Voltage	V+			+2.7		+5.5	V
Negative Supply Voltage	V-			-2.7		-5.5	V
Logic Supply Voltage	V_L			2.7		V+	V
Positive Supply Current	I+	IN_ = GND or V_L			0.001	1	µA
Negative Supply Current	I-	IN_ = GND or V_L				-1	µA
Logic Supply Current	I_L	IN_ = GND or V_L				1	µA
Ground Current	I_{GND}	IN_ = 0 or V+, V+ = 5.5V, V- = -5.5V				1	µA
DYNAMIC							
Turn-On Time	t_{ON}	V+ = +4.5V, V- = -4.5V, $V_{NC\_}$ or $V_{NO\_}$ = ±3.3V, V_L = V+, Figure 2	T_A = +25°C		200	350	ns
			T_A = T_{MIN} to T_{MAX}			500	
Turn-Off Time	t_{OFF}	V+ = +4.5V, V- = -4.5V, $V_{NC\_}$ or $V_{NO\_}$ = ±3.3V, V_L = V+, Figure 2	T_A = +25°C		110	150	ns
			T_A = T_{MIN} to T_{MAX}			350	
Break-Before-Make Delay	t_{BBM}	Figure 3, MAX4679 only, R_L = 300Ω, C_L = 35pF		5			ns
Charge Injection	Q	R_{GEN} = 0, C_L = 1nF, V_{GEN} = 0, Figure 4			85		pC
Off-Isolation	V_{ISO}	R_L = 50Ω, C_L = 5pF, f = 1MHz, Figure 5a			-65		dB
Crosstalk		R_L = 50Ω, C_L = 5pF, f = 1MHz, Figure 6a			-84		dB
-3dB Bandwidth	BW	R_S = 50Ω, R_L = 50Ω, Figure 7a			66		MHz
NC or NO Off-Capacitance	$C_{(N\_OFF)}$	f = 1MHz, Figure 8			85		pF
COM Off-Capacitance	$C_{(COMOFF)}$	f = 1MHz, Figure 8			85		pF
On-Capacitance	$C_{(ON)}$	f = 1MHz, Figure 8			350		pF

ELECTRICAL CHARACTERISTICS–Single Supply

(V+ = +5V ±10%, V- = 0, V_L = +2.7V to V+, GND = 0, V_{IH} = +2.4V, V_{IL} = +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	$V_{COM\_}$, $V_{NO\_}$, $V_{NC\_}$			0		V+	V
On-Resistance	R_{ON}	V+ = +4.5V, $I_{COM\_}$ = 50mA, $V_{NO\_}$ or $V_{NC\_}$ = 3.3V	T_A = +25°C		1.8	2.7	Ω
			T_A = T_{MIN} to T_{MAX}			3.5	
On-Resistance Match Between Channels (Note 3)	ΔR_{ON}	V+ = +4.5V, $I_{COM\_}$ = 50mA, $V_{NO\_}$ or $V_{NC\_}$ = 3.3V	T_A = +25°C		0.05	0.15	Ω
			T_A = T_{MIN} to T_{MAX}			0.3	
On-Resistance Flatness (Note 4)	R_{FLAT}	V+ = +4.5V, $I_{COM\_}$ = 50mA, $V_{NO\_}$ or $V_{NC\_}$ = 3.3V, 1.5V	T_A = +25°C		0.15	0.25	Ω
			T_A = T_{MIN} to T_{MAX}			0.4	
NC_ or NO_ Off-Leakage Current (Note 5)	$I_{N\_(OFF)}$	V+ = +5.5V; $V_{NO\_}$ or $V_{NC\_}$ = 4.5V, 1V; $V_{COM\_}$ = 1V, 4.5V	T_A = +25°C	-1	0.1	1	nA
			T_A = T_{MIN} to T_{MAX}	-10		10	
COM_ Off-Leakage Current (Note 5)	$I_{COM\_(OFF)}$	V+ = +5.5V; $V_{NO\_}$ or $V_{NC\_}$ = 4.5V, 1V; $V_{COM\_}$ = 1V, 4.5V	T_A = +25°C	-1	0.1	1	nA
			T_A = T_{MIN} to T_{MAX}	-10		10	
COM_ On-Leakage Current (Note 5)	$I_{COM\_(ON)}$	V+ = +5.5V; $V_{COM\_}$ = 1V, 4.5V; $V_{NO\_}$ or $V_{NC\_}$ = 1V, 4.5V, or floating	T_A = +25°C	-2	0.2	2	nA
			T_A = T_{MIN} to T_{MAX}	-25		25	
LOGIC INPUT							
Input Low Voltage	V_{IL}	V_L = V+				0.8	V
Input High Voltage	V_{IH}	V_L = V+		2.4			V
Input Leakage Current	I_{IN}	V_L = V+		-1	0.005	1	µA
POWER SUPPLY							
Positive Supply Voltage	V+			2.7		6	V
Logic Supply Voltage	V_L			2.7		V+	V
Positive Supply Current	I+	$V_{IN\_}$ = 0 or V_L, V_L = V+			1	1	µA
Logic Supply Current	I_L	$V_{IN\_}$ = 0 or V_L, V+ = 5.5V				1	µA
Ground Current	I_{GND}	$V_{IN\_}$ = 0 or V_L, V+ = 5.5V			1	10	µA
DYNAMIC							
Turn-On Time	t_{ON}	V_L = V+, V+ = +4.5V; $V_{NC\_}$ or $V_{NO\_}$ = 3.3V, R_L = 300Ω, C_L = 35pF, Figure 2	T_A = +25°C		600	1000	ns
			T_A = T_{MIN} to T_{MAX}			1400	
Turn-Off Time	t_{OFF}	V_L = V+, V+ = +4.5V; $V_{NC\_}$ or $V_{NO\_}$ = 3.3V, R_L = 300Ω, C_L = 35pF, Figure 2	T_A = +25°C		120	165	ns
			T_A = T_{MIN} to T_{MAX}			400	

ELECTRICAL CHARACTERISTICS–Single Supply (continued)

(V+ = +5V ±10%, V- = 0, V_L = +2.7V to V+, GND = 0, V_{IH} = +2.4V, V_{IL} = +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
Break-Before- Make Delay	t_{BBM}	MAX4679 only, R_L = 300Ω, C_L = 35pF, Figure 3	5			ns
Charge Injection	Q	R_{GEN} = 0, C_L = 1nF, V_{GEN} = 0, Figure 4		9		pC
Off-Isolation	V_{ISO}	R_L = 50Ω, C_L = 5pF, f = 1MHz, Figure 5b		-65		dB
Crosstalk		R_L = 50Ω, C_L= 5pF, f = 1MHz, Figure 6b		-84		dB
-3dB Bandwidth	BW	R_S = 50Ω, R_L = 50Ω, Figure 7b		63		MHz
NC or NO Off-Capacitance	$C_{(N\_OFF)}$	f = 1MHz, Figure 8		85		pF
COM Off-Capacitance	$C_{(COMOFF)}$	f = 1MHz, Figure 8		85		pF
On-Capacitance	$C_{(ON)}$	f = 1MHz, Figure 8		350		pF

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: $\Delta R_{ON} = R_{ON(MAX)} - R_{ON(MIN)}$.

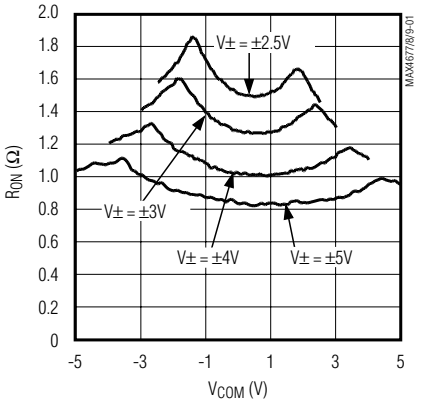
Note 4: Flatness is defined as the difference between the maximum and minimum value of on-resistance as measured over the specified analog signal ranges.

Note 5: Leakage parameters are 100% tested at maximum-rated hot operating temperature and the highest supply voltage, and guaranteed by correlation at +25°C.

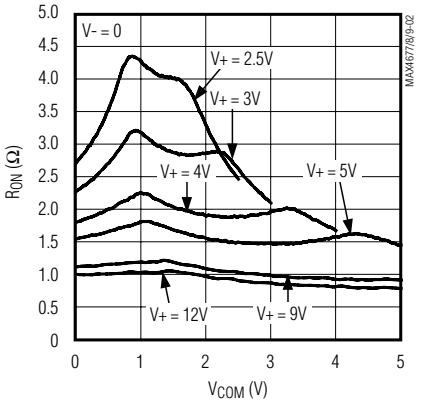
Typical Operating Characteristics

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

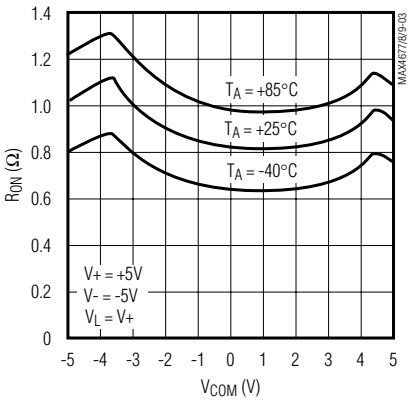
ON-RESISTANCE vs. V_{COM} (DUAL SUPPLY)



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



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

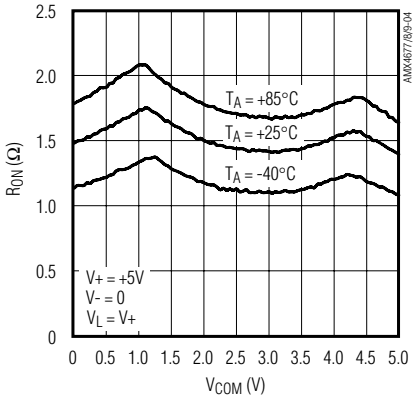


2Ω, Quad, SPST, CMOS Analog Switches

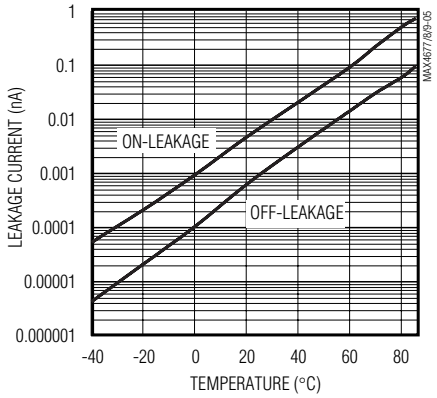
Typical Operating Characteristics (continued)

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

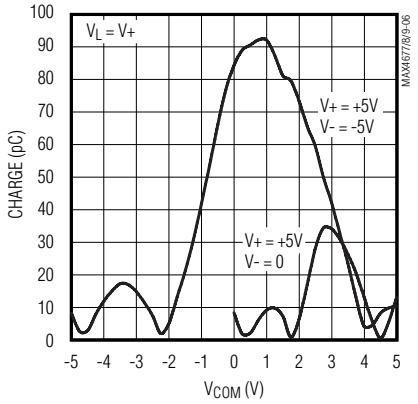
ON-RESISTANCE vs. V_{COM} AND TEMPERATURE (SINGLE SUPPLY)



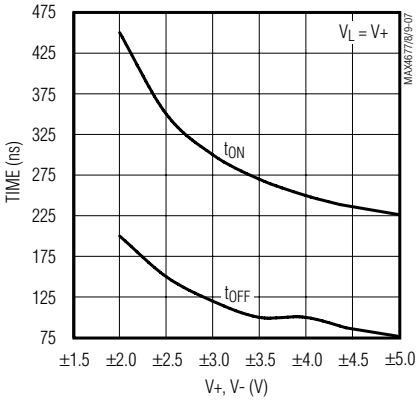
ON-/OFF-LEAKAGE CURRENT vs. TEMPERATURE



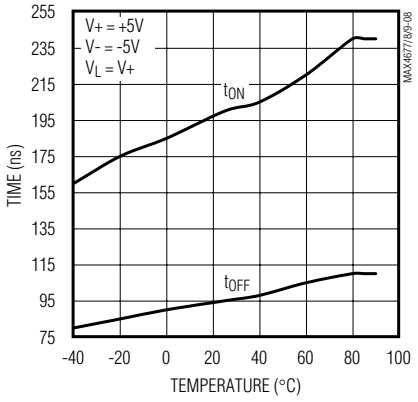
CHARGE INJECTION vs. V_{COM}



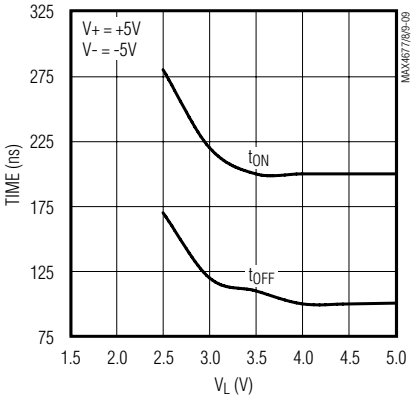
t_{ON}, t_{OFF} vs. SUPPLY VOLTAGE (DUAL SUPPLIES)



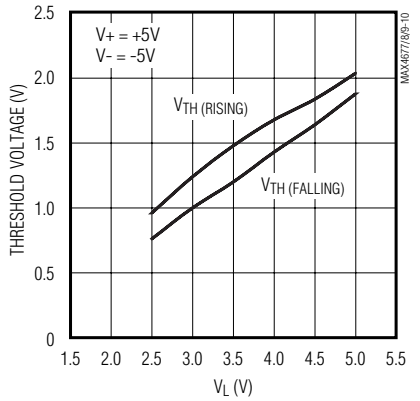
t_{ON}, t_{OFF} vs. TEMPERATURE



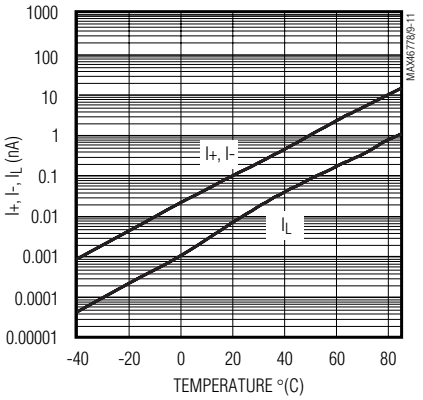
t_{ON}, t_{OFF} vs. LOGIC SUPPLY



INPUT THRESHOLD vs. LOGIC SUPPLY



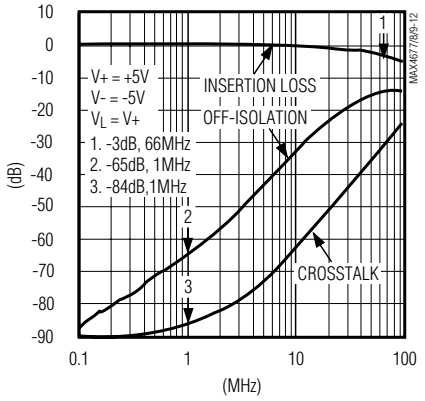
POWER-SUPPLY CURRENT vs. TEMPERATURE



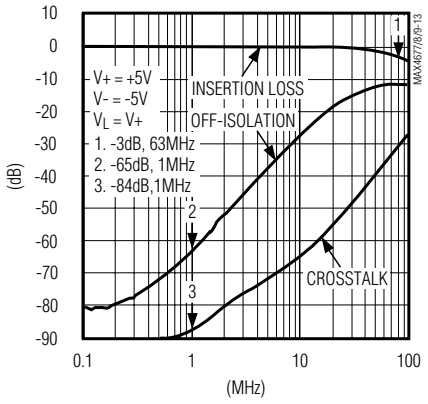
Typical Operating Characteristics (continued)

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

INSERTION LOSS, OFF-ISOLATION, AND CROSSTALK vs. FREQUENCY (DUAL SUPPLIES)



INSERTION LOSS, OFF-ISOLATION, AND CROSSTALK vs. FREQUENCY (SINGLE SUPPLY)



Pin Description

PIN				
MAX4677	**MAX4678**	**MAX4679**	**NAME**	**FUNCTION**
1, 8, 9, 16	1, 8, 9, 16	1, 8, 9, 16	IN1, IN2, IN3, IN4	Logic Inputs
2, 7, 10, 15	2, 7, 10, 15	2, 7, 10, 15	COM1, COM2, COM3, COM4	Analog Switch Common Terminals
3, 6, 11, 14	—	—	NC1, NC2, NC3, NC4	Analog Switch Normally Closed Terminals
—	3, 6, 11, 14	—	NO1, NO2, NO3, NO4	Analog Switch Normally Open Terminals
—	—	3, 6	NO1, NO4	Analog Switch Normally Open Terminals
—	—	11, 14	NC2, NC3	Analog Switch Normally Closed Terminals
4	4	4	V-	Negative Supply-Voltage Input. Connect to GND for single-supply operation.
5	5	5	GND	Ground
12	12	12	V_L	Logic Supply Input
13	13	13	V+	Positive Supply Input

2Ω, Quad, SPST, CMOS Analog Switches

Applications Information

Overvoltage Protection

Proper power-supply sequencing is recommended for all CMOS devices. Do not exceed the absolute maximum ratings because stresses beyond the listed ratings can cause permanent damage to the devices. Always sequence V+ on first, then V-, then V_L followed by the logic inputs, NO_, NC_, or COM. If proper power-supply sequencing is not possible, add two small signal diodes (D1, D2) in series with the supply pins, and a Schottky diode between V+ and V_L for overvoltage protection (Figure 1). Adding diodes reduces the analog signal range to one diode drop below V+ and one diode drop above V-, but does not affect the devices' low switch resistance and low leakage characteristics. Device operation is unchanged, and the difference between V+ and V- should not exceed 11V.

Power-supply bypassing improves noise margin and prevents switching noise from propagating from the V+ supply to other components. A 0.1µF capacitor connected from V+ to GND is adequate for most applications.

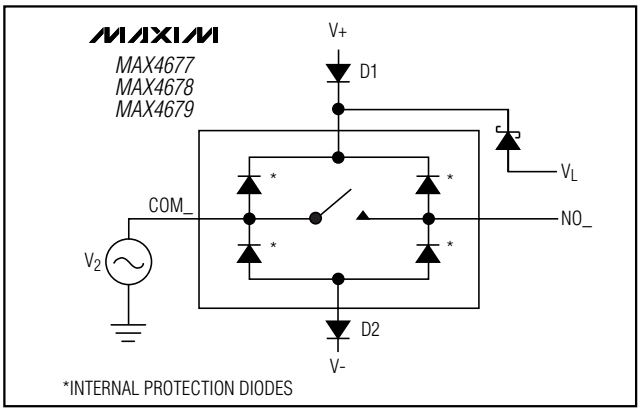


Figure 1. Overvoltage Protection Using External Blocking Diodes

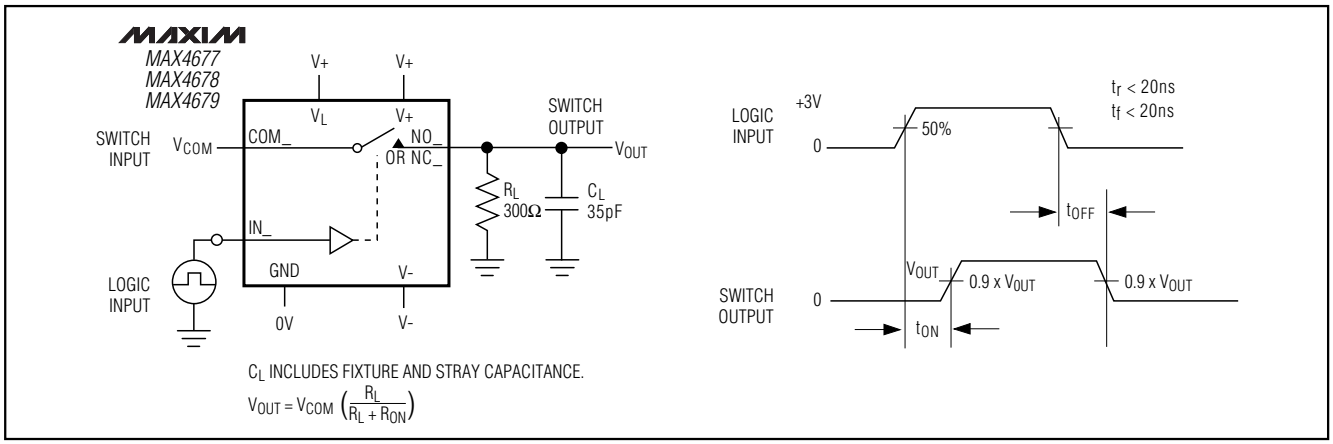


Figure 2. Switching Time

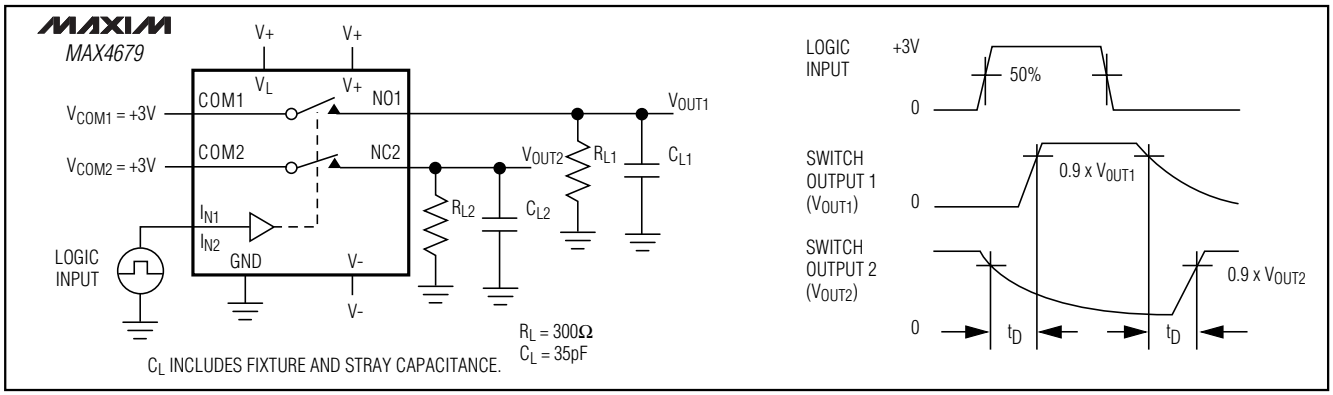


Figure 3. Break-Before-Make Interval (MAX4679 Only)

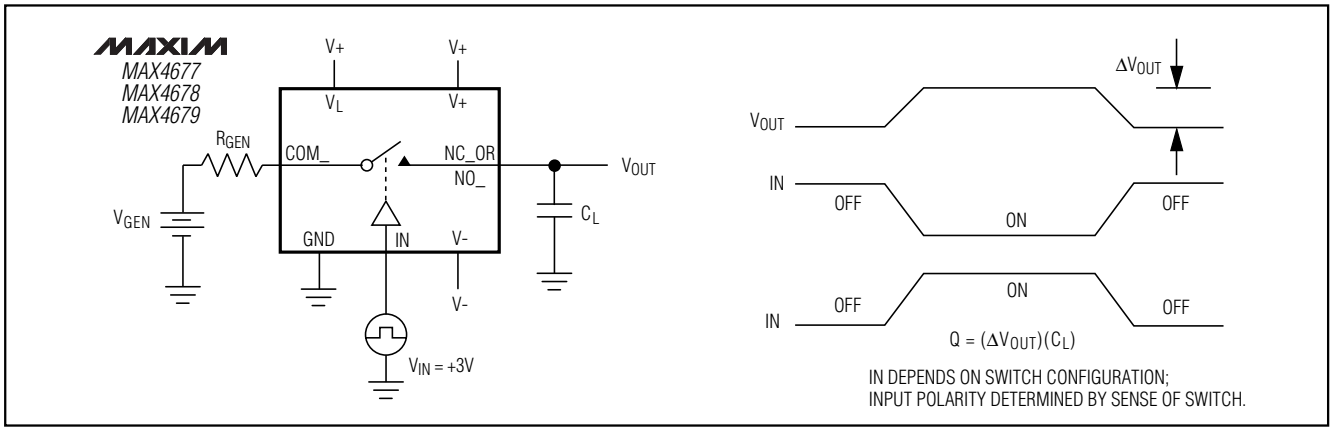


Figure 4. Charge Injection

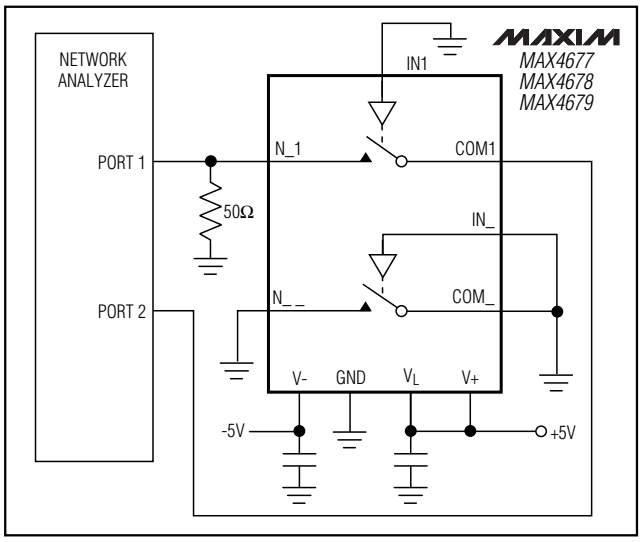


Figure 5a. Off-Isolation Test Circuit, Dual Supplies

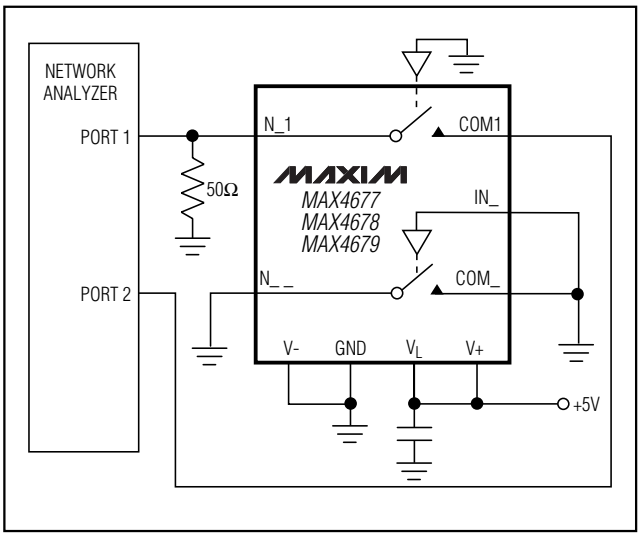


Figure 5b. Off-Isolation Test Circuit, Single Supply

2Ω, Quad, SPST, CMOS Analog Switches

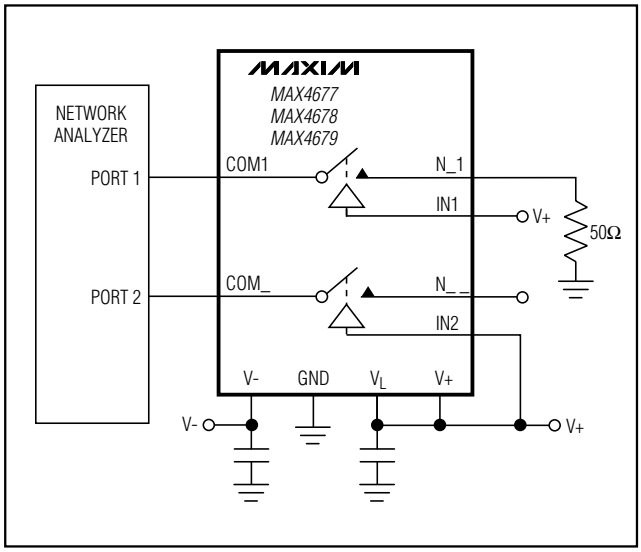


Figure 6a. Crosstalk Test Circuit, Dual Supplies

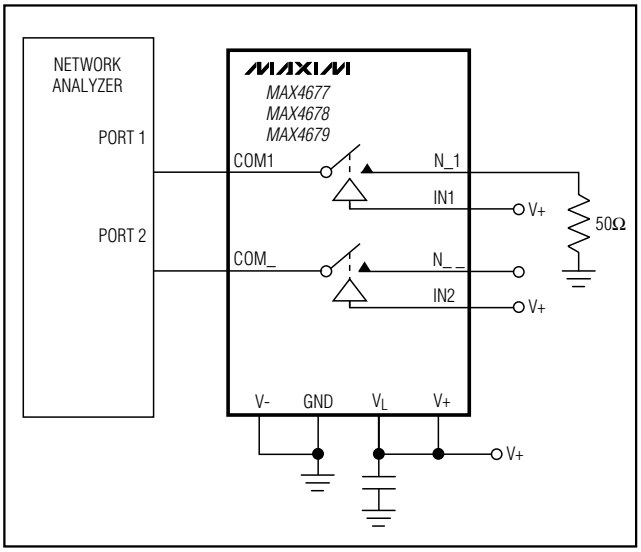


Figure 6b. Crosstalk Test Circuit, Single Supply

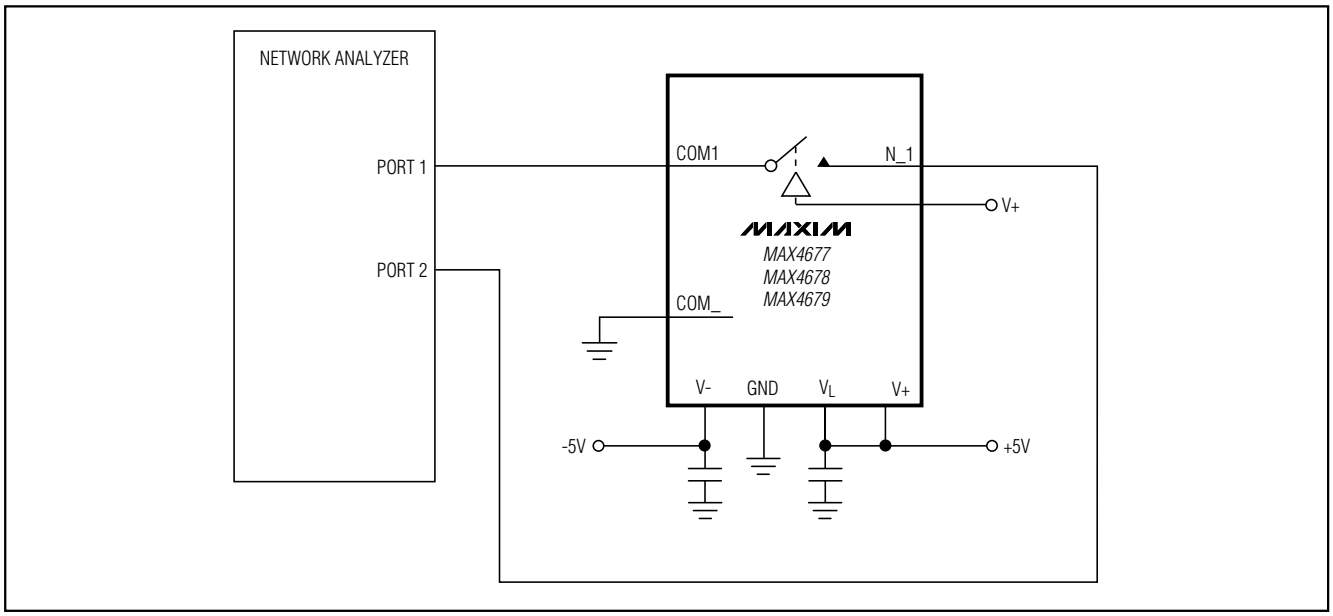


Figure 7a. Insertion Loss Test Circuit, Dual Supplies

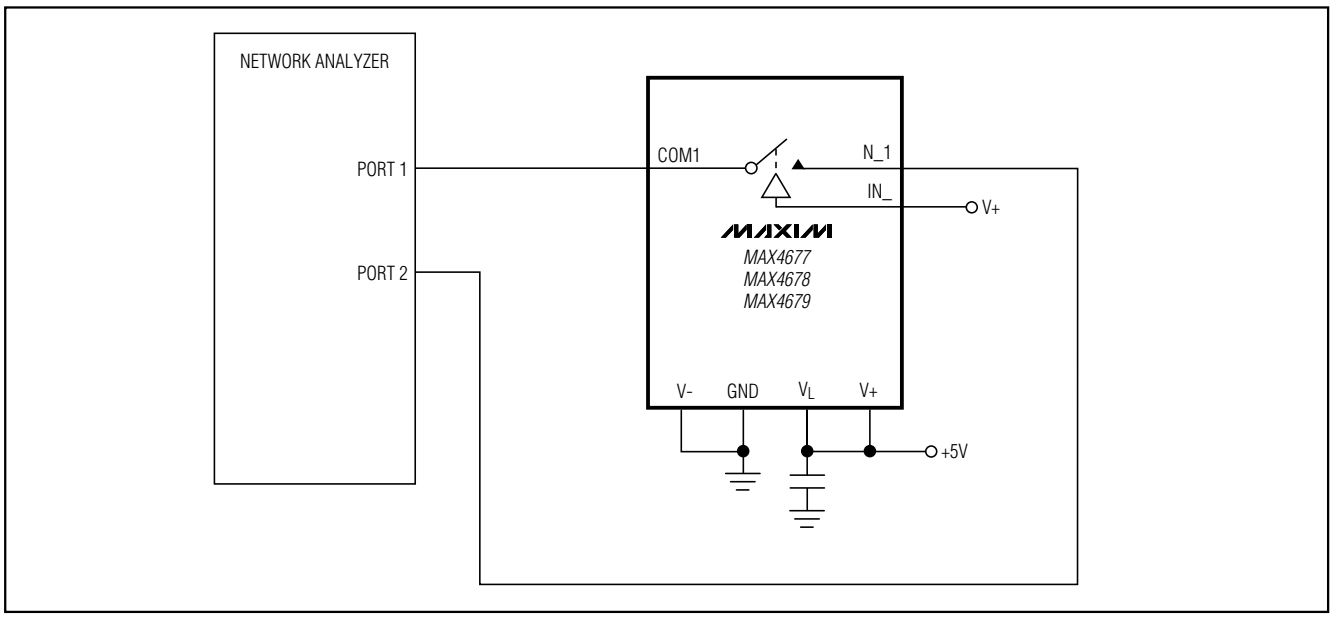


Figure 7b. Insertion Loss Test Circuit, Single Supply

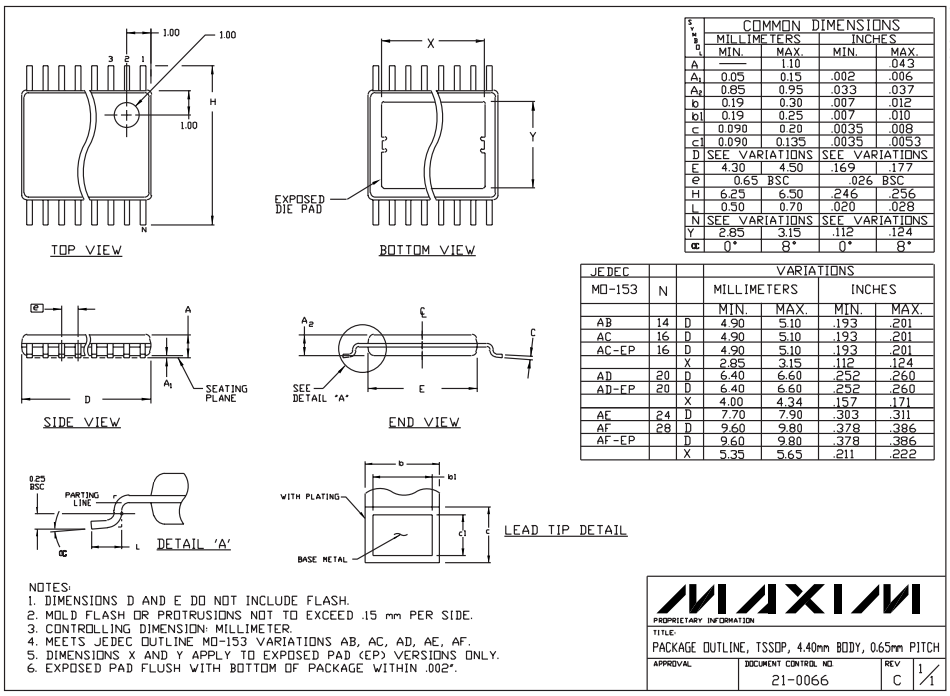
Chip Information

TRANSISTOR COUNT: 240

PROCESS: CMOS

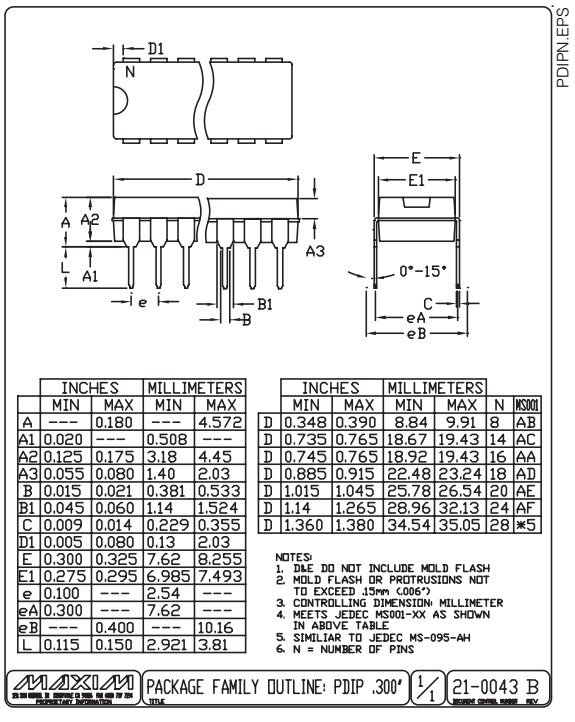
2Ω, Quad, SPST, CMOS Analog Switches

Package Information



SYMBOL	COMMON DIMENSIONS			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	----	1.10		.043
A_1	0.05	0.15	.002	.006
A_2	0.85	0.95	.033	.037
b	0.19	0.30	.007	.012
b1	0.19	0.25	.007	.010
c	0.090	0.20	.0035	.008
c1	0.090	0.135	.0035	.0053
D	SEE VARIATIONS		SEE VARIATIONS	
E	4.30	4.50	.169	.177
e	0.65 BSC		.026 BSC	
H	6.25	6.50	.246	.256
L	0.50	0.70	.020	.028
N	SEE VARIATIONS		SEE VARIATIONS	
Y	2.85	3.15	.112	.124
α	0°	8°	0°	8°

JEDEC			VARIATIONS			
MO-153	N		MILLIMETERS		INCHES	
			MIN.	MAX.	MIN.	MAX.
AB	14	D	4.90	5.10	.193	.201
AC	16	D	4.90	5.10	.193	.201
AC-EP	16	D	4.90	5.10	.193	.201
		X	2.85	3.15	.112	.124
AD	20	D	6.40	6.60	.252	.260
AD-EP	20	D	6.40	6.60	.252	.260
		X	4.00	4.34	.157	.171
AE	24	D	7.70	7.90	.303	.311
AF	28	D	9.60	9.80	.378	.386
AF-EP		D	9.60	9.80	.378	.386
		X	5.35	5.65	.211	.222



	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	---	0.180	---	4.572
A1	0.020	---	0.508	---
A2	0.125	0.175	3.18	4.45
A3	0.055	0.080	1.40	2.03
B	0.015	0.021	0.381	0.533
B1	0.045	0.060	1.14	1.524
C	0.009	0.014	0.229	0.355
D1	0.005	0.080	0.13	2.03
E	0.300	0.325	7.62	8.255
E1	0.275	0.295	6.985	7.493
e	0.100	---	2.54	---
eA	0.300	---	7.62	---
eB	---	0.400	---	10.16
L	0.115	0.150	2.921	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

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Поставка электронных компонентов

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- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
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- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

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AVIC JONHON

«JONHON» (основан в 1970 г.)

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