



0.4Ω, Low-Voltage, Single-Supply SPST Analog Switches in SC70

MAX4715/MAX4716

General Description

The MAX4715/MAX4716 are low on-resistance, low-voltage, single-pole/single-throw (SPST) analog switches that operate from a +1.6V to +3.6V single supply. The MAX4715 is normally open (NO), and the MAX4716 is normally closed (NC). These devices also have fast switching speeds ($t_{ON} = 18\text{ns}$ max, $t_{OFF} = 12\text{ns}$ max).

When powered from a +3V supply, the MAX4715/MAX4716 offer 0.4Ω max on-resistance (R_{ON}) with 0.1Ω max R_{ON} flatness. Their digital logic inputs are +1.8V CMOS compatible when using a single +3V supply.

The MAX4715 is pin compatible with the MAX4594, and the MAX4716 is pin compatible with the MAX4595. The MAX4715/MAX4716 are available in SC70-5 packages.

Applications

Power Routing
Battery-Operated Equipment
Audio and Video Signal Routing
Low-Voltage Data-Acquisition Systems
Communications Circuits
PCMCIA Cards
Cellular Phones
Modems
Hard Drives

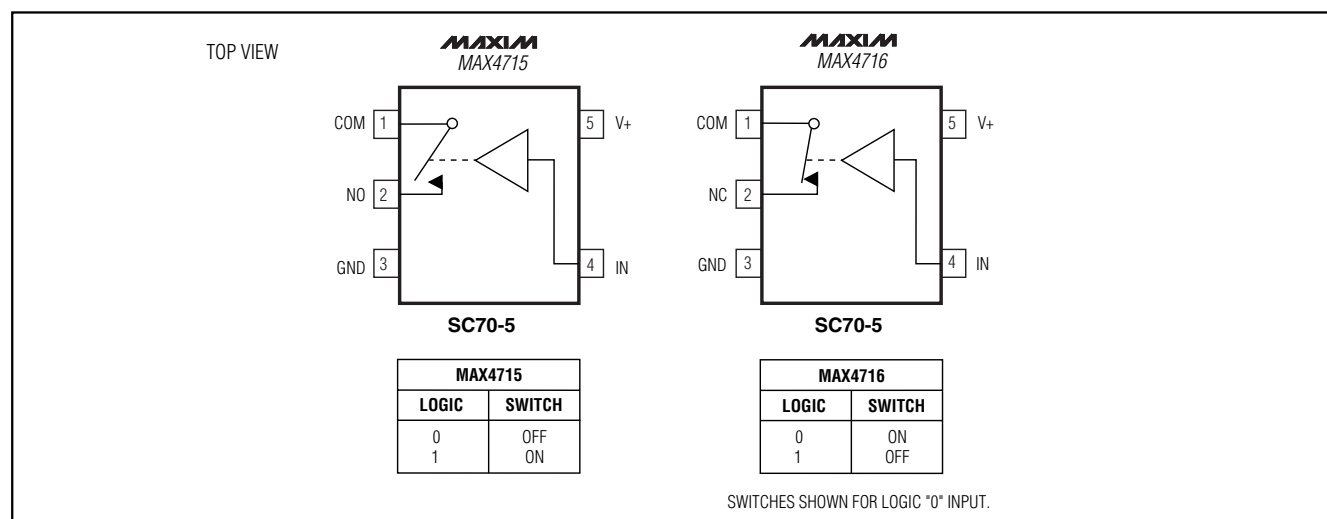
Features

- ◆ Low R_{ON}
 - 0.4Ω max (+3V Supply)
 - 1.2Ω max (+1.8V Supply)
- ◆ 0.1Ω max R_{ON} Flatness (+3V Supply)
- ◆ +1.6V to +3.6V Single-Supply Operation
- ◆ Available in 5-Pin SC70 Packages
- ◆ Fast Switching: $t_{ON} = 18\text{ns}$ max, $t_{OFF} = 12\text{ns}$ max
- ◆ +1.8V CMOS Logic Compatible (+3V Supply)
- ◆ Pin Compatible with MAX4594 (MAX4715)
Pin Compatible with MAX4595 (MAX4716)

Ordering Information

PART	TEMP. RANGE	PIN-PACKAGE	TOP MARK
MAX4715EXK-T	-40°C to +85°C	5 SC70-5	ACJ
MAX4716EXK-T	-40°C to +85°C	5 SC70-5	ACK

Pin Configurations/Functional Diagrams/Truth Tables



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ABSOLUTE MAXIMUM RATINGS

Voltages Referenced to GND

V+, IN-0.3V to +4V
 COM, NO, NC (Note 1).....-0.3V to (V+ + 0.3V)
 Continuous Current NO, NC to COM ± 300 mA
 Peak Switch Current NO, NC to COM
 (pulsed at 1ms, 10% duty cycle max) ± 600 mA
 Continuous Power Dissipation (T_A = +70°C)
 5-Pin SC70 (derate 3.1mW/°C above +70°C).....247mW

Operating Temperature Range

MAX471_EXK.....-40°C to +85°C
 Junction Temperature+150°C
 Storage Temperature Range-65°C to +150°C
 Lead Temperature (soldering, 10s) +300°C

Note 1: Signals on NO, NC, or COM exceeding V+ or GND are clamped by internal diodes.

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—Single +3V Supply

(V+ = +2.7V to +3.6V, V_{IH} = +1.4V, V_{IL} = +0.5V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at V+ = +3.0V and T_A = +25°C.) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS	TA	MIN	TYP	MAX	UNITS
ANALOG SWITCH							
Analog Signal Range	V _{COM} , V _{NO} , V _{NC}			0		V+	V
On-Resistance (Note 6)	R _{ON}	V+ = 2.7V, I _{COM} = 100mA, V _{NO} or V _{NC} = 1.5V	+25°C	0.3	0.4		Ω
			T _{MIN} to T _{MAX}		0.45		
On-Resistance Flatness (Note 4)	R _{FLAT(ON)}	V+ = 2.7V, I _{COM} = 100mA, V _{NO} or V _{NC} = 0.6, 1.5V, 2.1V	+25°C	0.05	0.09		Ω
			T _{MIN} to T _{MAX}		0.1		
NO, NC Off-Leakage Current	I _{NO(OFF)} or I _{NC(OFF)} or	V+ = 3.3V, V _{COM} = 0.3V, 3V V _{NO} or V _{NC} = 3V, 0.3V	+25°C	-1	0.01	1	nA
			T _{MIN} to T _{MAX}	-10		10	
COM Off-Leakage Current	I _{COM(OFF)}	V+ = 3.3V, V _{COM} = 0.3V, 3V V _{NO} or V _{NC} = 3V, 0.3V	+25°C	-1	0.01	1	nA
			T _{MIN} to T _{MAX}	-10		10	
COM On-Leakage Current	I _{COM(ON)}	V+ = 3.3V, V _{COM} = 0.3V, 3V, V _{NO} or V _{NC} = 0.3V, 3V or floating	+25°C	-2		2	nA
			T _{MIN} to T _{MAX}	-10		10	
DYNAMIC							
Turn-On Time	t _{ON}	V _{NO} or V _{NC} = 1.5V, R _L = 50Ω, C _L = 35pF, Figure 1	+25°C	12	18		ns
			T _{MIN} to T _{MAX}		20		
Turn-Off Time	t _{OFF}	V _{NO} or V _{NC} = 1.5V, R _L = 50Ω, C _L = 35pF, Figure 1	+25°C	6	12		ns
			T _{MIN} to T _{MAX}		15		
Charge Injection	Q	V _{GEN} = 0, R _{GEN} = 0, C _L = 1.0nF, Figure 2	+25°C	20			pC
Off-Isolation (Note 5)	V _{ISO}	f = 1MHz, V _{COM} = 1V _{RMS} , R _L = 50Ω, C _L = 5pF, Figure 3	+25°C	-54			dB
Total Harmonic Distortion	THD	f = 20Hz to 20kHz, V _{COM} = 2V _{P-P} , R _L = 32Ω	+25°C	0.01			%
NC or NO Off-Capacitance	C _{NO(OFF)} C _{NC(OFF)}	f = 1MHz, Figure 4	+25°C	55			pF
COM Off-Capacitance	C _{COM(OFF)}	f = 1MHz, Figure 4	+25°C	55			pF
COM On-Capacitance	C _{COM(ON)}	f = 1MHz, Figure 4	+25°C	80			pF

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ELECTRICAL CHARACTERISTICS—Single +3V Supply (continued)

(V₊ = +2.7V to +3.6V, V_{IH} = +1.4V, V_{IL} = +0.5V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at V₊ = +3.0V and T_A = +25°C.) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS	T _A	MIN	TYP	MAX	UNITS
LOGIC INPUT							
Input Voltage Low	V _{IL}					0.5	V
Input Voltage High	V _{IH}			1.4			V
Input Leakage Current	I _{IN}	V _{IN} = 0 or V ₊		-1		1	μA
SUPPLY							
Power-Supply Range	V ₊			1.6		3.6	V
Positive Supply Current	I ₊	V ₊ = +3.6V, V _{IN} = 0 or V ₊	+25°C		0.04	0.2	μA
			T _{MIN} to T _{MAX}			2	

ELECTRICAL CHARACTERISTICS—Single +1.8V Supply

(V₊ = +1.8V, V_{IH} = +1V, V_{IL} = +0.4V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS	TA	MIN	TYP	MAX	UNITS
ANALOG SWITCH							
Analog Signal Range	V _{COM} , V _{NO} , V _{NC}			0		V+	V
On-Resistance	R _{ON}	I _{COM} = 10mA, V _{NO} or V _{NC} = 0.9V	+25°C		0.6	1.2	Ω
			T _{MIN} to T _{MAX}			2.5	
NO or NC Off-Leakage Current	I _{NO(OFF)} or I _{NC(OFF)}	V _{COM} = 0.3V, 1.5V, V _{NO} or V _{NC} = 1.5V, 0.3V	+25°C		-1	1	nA
			T _{MIN} to T _{MAX}		-10	10	
COM Off-Leakage Current	I _{COM(OFF)}	V _{COM} = 0.3V, 1.5V, V _{NO} or V _{NC} = 1.5V, 0.3V	+25°C		-1	1	nA
			T _{MIN} to T _{MAX}		-10	10	
COM On-Leakage Current	I _{COM(ON)}	V _{COM} = 1.5V, 0.3V, V _{NO} or V _{NC} = 1.5V, 0.3V, or floating	+25°C		-2	2	nA
			T _{MIN} to T _{MAX}		-10	10	
DYNAMIC							
Turn-On Time	t _{ON}	V _{NO} or V _{NC} = 1.5V, R _L = 50Ω, C _L = 35pF, Figure 1	+25°C		18	25	ns
			T _{MIN} to T _{MAX}			30	
Turn-Off Time	t _{OFF}	V _{NO} or V _{NC} = 1.5V, R _L = 50Ω, C _L = 35pF, Figure 1	+25°C		9	20	ns
			T _{MIN} to T _{MAX}			25	
Charge Injection	Q	V _{GEN} = 0, R _{GEN} = 0, C _L = 1nF, Figure 2	+25°C		40		pC

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ELECTRICAL CHARACTERISTICS—Single +1.8V Supply (continued)

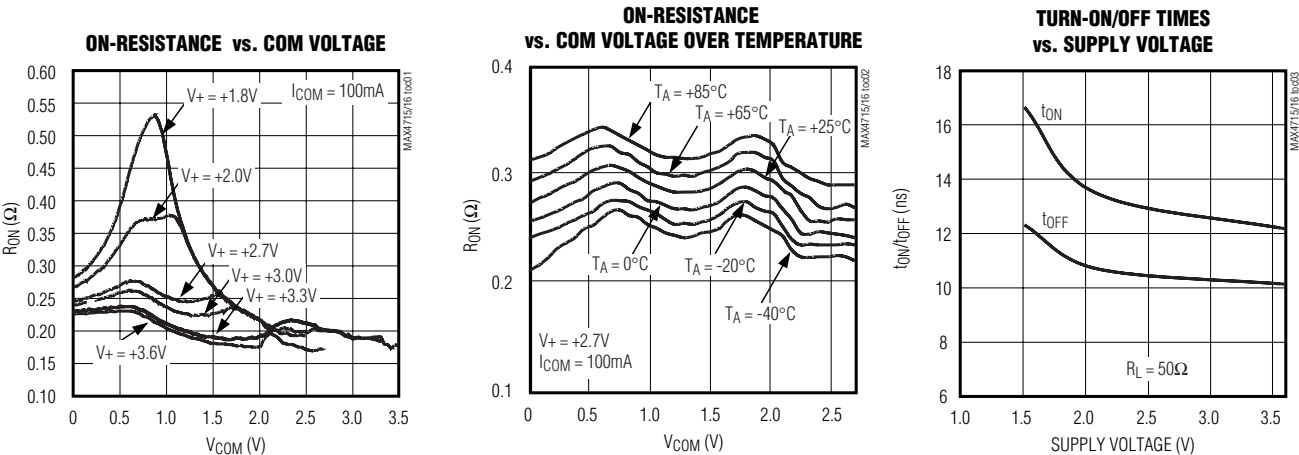
(V+ = +1.8V, VIH = +1V, VIL = +0.4V, TA = TMIN to TMAX, unless otherwise noted. Typical values are at TA = +25°C.) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS	TA	MIN	TYP	MAX	UNITS
LOGIC INPUT							
Input Voltage Low	VIL					0.4	V
Input Voltage High	VIH			1			V
Input Leakage Current	IIN	VIN = 0 or V+				1	μA
SUPPLY							
Positive Supply Current	I+	VIN = 0 or V+	+25°C		0.04	0.2	μA
			TMIN to TMAX			2	

- 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:** SC70-packaged parts are 100% tested at +25°C. Limits across the full temperature range are guaranteed by design and correlation.
- Note 4:** Flatness is defined as the difference between the maximum and minimum values of on-resistance as measured over the specified analog signal range.
- Note 5:** Off-Isolation = 20log10 [VCOM / (VNC or VNO)], VCOM = output, VNC or VNO = input to off switch.
- Note 6:** Guaranteed by design.

Typical Operating Characteristics

(TA = +25°C, unless otherwise noted.)

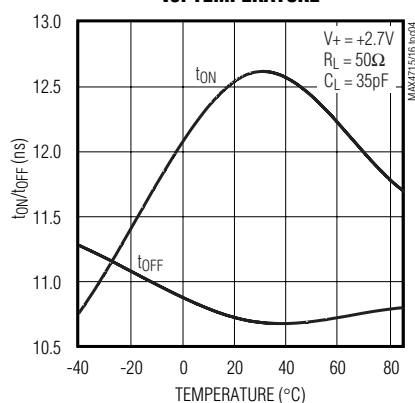


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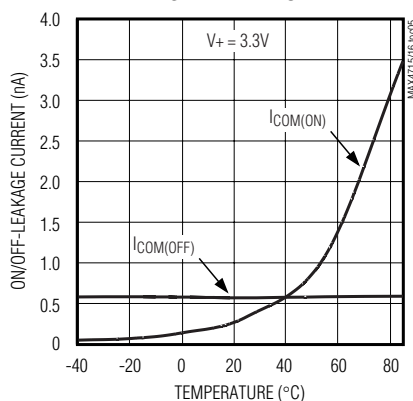
Typical Operating Characteristics (continued)

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

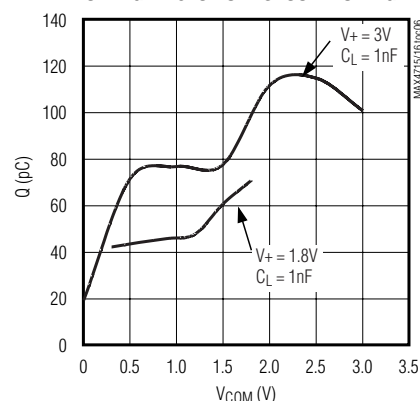
**TURN-ON/OFF TIMES
vs. TEMPERATURE**



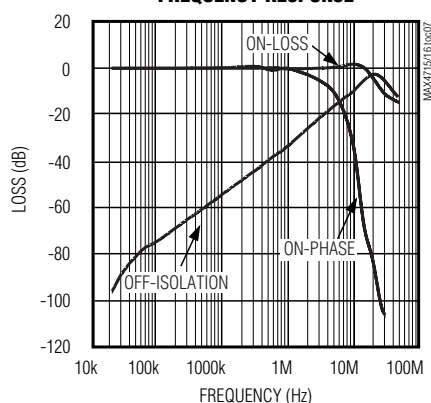
**ON/OFF-LEAKAGE CURRENT
vs. TEMPERATURE**



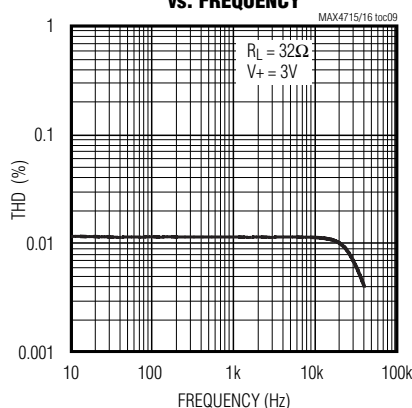
CHARGE INJECTION vs. COM VOLTAGE



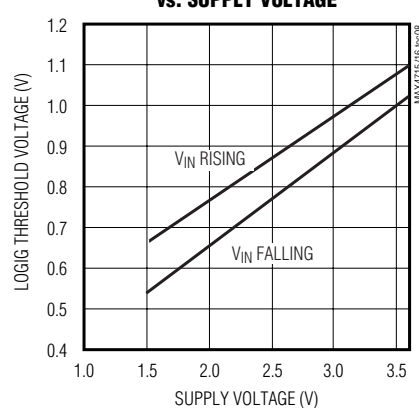
FREQUENCY RESPONSE



**TOTAL HARMONIC DISTORTION
vs. FREQUENCY**



**LOGIC THRESHOLD VOLTAGE
vs. SUPPLY VOLTAGE**



Pin Description

PIN		NAME	FUNCTION
MAX4715	MAX4716		
1	1	COM	Analog Switch—Common
2	—	NO	Analog Switch—Normally Open
—	2	NC	Analog Switch—Normally Closed
3	3	GND	Ground
4	4	IN	Digital Control Input
5	5	V+	Positive Supply Input

0.4Ω, Low-Voltage, Single-Supply SPST Analog Switches in SC70

Detailed Description

The MAX4715/MAX4716 are low on-resistance (R_{ON}), low-voltage, single-pole/single-throw (SPST) analog switches that operate from a +1.6V to +3.6V single supply. The MAX4715 is normally open (NO), and the MAX4716 is normally closed (NC).

When powered from a +3V supply, their 0.4Ω R_{ON} allows high continuous currents to be switched in a variety of applications.

Applications Information

Logic Inputs

The MAX4715/MAX4716 logic inputs can be driven up to +3.6V regardless of the supply voltage. For example,

with a +3.3V supply, IN may be driven low to GND and high to +3.6V. Driving IN Rail-to-Rail® minimizes power consumption.

Analog Signal Levels

Analog signals that range over the entire supply voltage (V_+ to GND) can be passed with very little change in on-resistance (see *Typical Operating Characteristics*). The switches are bidirectional, so the NO, NC, and COM pins can be used as either inputs or outputs.

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

Test Circuits/Timing Diagrams

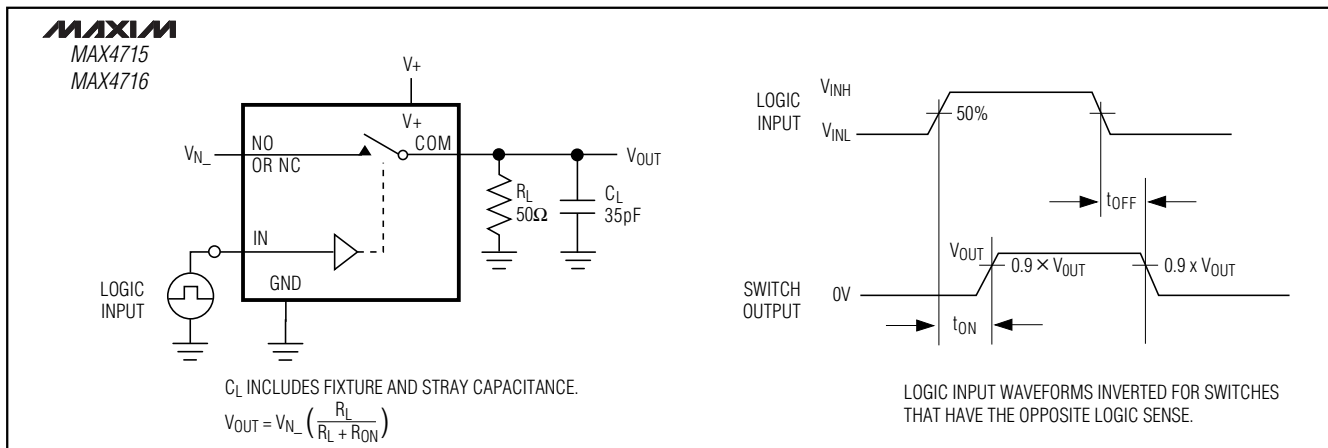


Figure 1. Switching Time

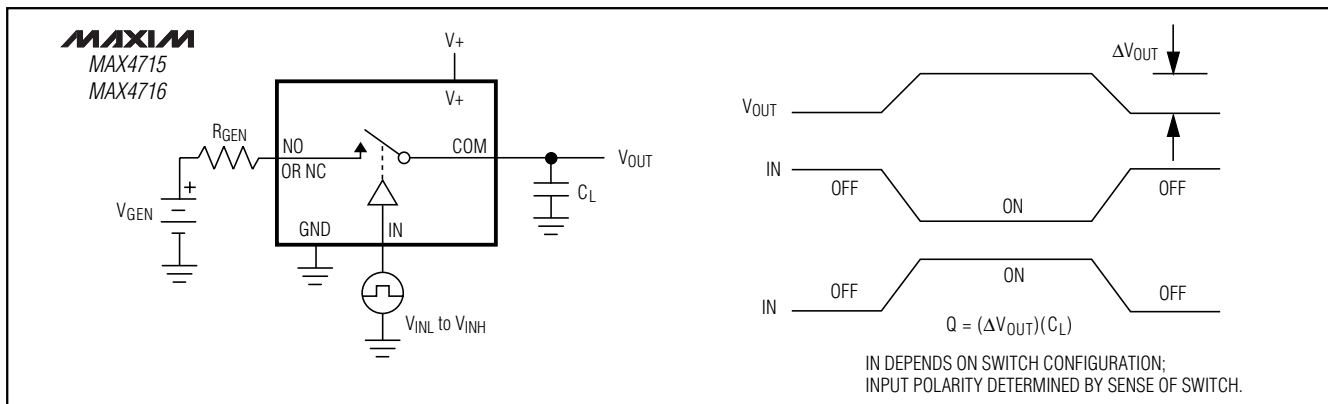


Figure 2. Charge Injection

MAX4715/MAX4716

MEASUREMENTS ARE STANDARDIZED AGAINST SHORTS AT IC TERMINALS.
 OFF-ISOLATION IS MEASURED BETWEEN COM_ AND "OFF" NO_ OR NC_ TERMINAL ON EACH SWITCH.
 ON-LOSS IS MEASURED BETWEEN COM_ AND "ON" NO_ OR NC_ TERMINAL ON EACH SWITCH.
 SIGNAL DIRECTION THROUGH SWITCH IS REVERSED; WORST VALUES ARE RECORDED.

MAXIM
MAX4715
MAX4716

10nF

V+

V+

COM

NC or NO

GND

CAPACITANCE METER

f = 1MHz

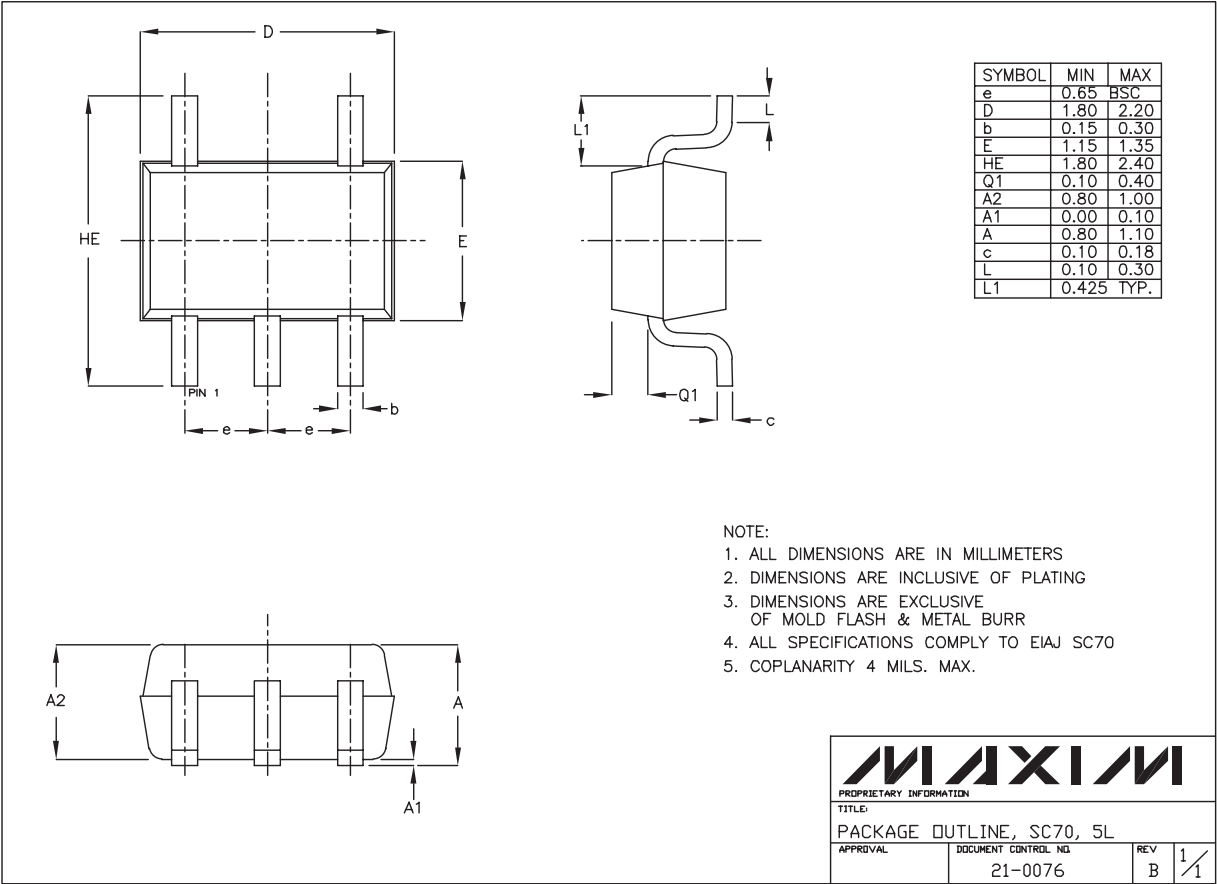
IN

V_{INL} OR V_{INH}

TRANSISTOR COUNT: 135
PROCESS: CMOS

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SPST Analog Switches in SC70

Package Information



Maxim cannot assume responsibility for use of any circuitry other than circuitry entirely embodied in a Maxim product. No circuit patent licenses are implied. Maxim reserves the right to change the circuitry and specifications without notice at any time.

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