



# 35Ω, SPST/SPDT, +3V Logic-Compatible Analog Switches

DG417L/DG418L/DG419L

## General Description

The DG417L/DG418L/DG419L precision, CMOS analog switches feature low on-resistance ( $R_{ON} = 35\Omega$ ), guaranteed  $R_{ON}$  matching between switches ( $3\Omega$  max), and guaranteed  $R_{ON}$  flatness over the signal range ( $4\Omega$  max). These switches are +3V logic-compatible when powered from  $\pm 15V$  or  $\pm 12V$  supplies. The switches conduct equally well in either direction, and feature low charge injection and low power consumption. The DG417L/DG418L/DG419L also offer low off-leakage current over temperature (less than  $5nA$  at  $+85^\circ C$ ).

The DG417L/DG418L are single-pole/single-throw (SPST) switches. The DG417L is normally closed, and the DG418L is normally open. The DG419L is single-pole/double-throw (SPDT) with one normally closed switch and one normally open switch. Switching times are less than  $175ns$  for  $t_{ON}$  and less than  $185ns$  for  $t_{OFF}$ . These devices operate with a single  $+9V$  to  $+36V$  or bipolar  $\pm 4.5V$  to  $\pm 20V$  supplies.

The digital input has a  $+0.8V$  logic-low threshold and a  $+2.0V$  logic-high threshold, ensuring +3V TTL and CMOS-logic compatibility. The DG417L/DG418L/DG419L are available in a tiny 8-pin  $\mu MAX$ , 8-pin SO, or convenient 8-pin plastic DIP. All products are rated at the extended temperature range of  $-40^\circ C$  to  $+85^\circ C$ .

## Applications

- |                              |                          |
|------------------------------|--------------------------|
| Sample-and-Hold Circuits     | Communications Systems   |
| Test Equipment               | Battery-Operated Systems |
| Modems                       | Fax Machines             |
| Guidance and Control Systems | PBX, PABX                |
| Audio Signal Routing         | Military Radios          |

## Features

- ◆ +3V Logic-Compatible Digital Inputs  
 $V_{IH} = 2.0V$   
 $V_{IL} = 0.8V$
- ◆ Plug-In Upgrades for Industry-Standard  
DG417/DG418/DG419 and  
MAX317/MAX318/MAX319
- ◆ Power-Supply Sequencing-Free Operation
- ◆ Low On-Resistance ( $35\Omega$  max)
- ◆ Guaranteed Matched On-Resistance Between Channels ( $3\Omega$  max)
- ◆ Guaranteed On-Resistance Flatness ( $4\Omega$  max)
- ◆ Single-Supply Operation  $+9V$  to  $+36V$   
Dual-Supply Operation  $\pm 4.5V$  to  $\pm 20V$
- ◆ Guaranteed Off-Leakage Current Over Temperature ( $<5nA$  at  $+85^\circ C$ )
- ◆ Rail-to-Rail Analog Signal Handling Capability
- ◆ Tiny 8-Pin  $\mu MAX$  Package

## Ordering Information

PART	TEMP. RANGE	PIN-PACKAGE
DG417LEUA	$-40^\circ C$ to $+85^\circ C$	8 $\mu MAX$
DG417LDY	$-40^\circ C$ to $+85^\circ C$	8 SO
DG417LDJ	$-40^\circ C$ to $+85^\circ C$	8 Plastic DIP

Ordering Information continued at end of data sheet.  
Rail-to-Rail is a registered trademark of Nippon Motorola, Inc.

## Pin Configurations/Functional Diagrams/Truth Tables

TOP VIEW

**DIP/SO/ $\mu MAX$**

DG417L	
LOGIC	SWITCH
0	ON
1	OFF

N.C. = NO CONNECT  
NC = NORMALLY CLOSED

**DIP/SO/ $\mu MAX$**

DG418L	
LOGIC	SWITCH
0	OFF
1	ON

SWITCHES SHOWN FOR LOGIC "0" INPUT

**DIP/SO/ $\mu MAX$**

DG419L		
LOGIC	NC	NO
0	OFF	OFF
1	ON	ON



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## ABSOLUTE MAXIMUM RATINGS

Voltage referenced to V-

V+ .....	44V
GND .....	25V
IN .....	-0.3V to +44V
COM, NC, NO (Note 1) .....	(V- - 0.3V) to (V+ + 0.3V)
Continuous Current (any terminal) (Note 1) .....	±30mA
Peak Current, COM, NO, NC (pulsed at 1ms, 10% duty cycle max) .....	±100mA

Continuous Power Dissipation (T<sub>A</sub> = +70°C)

8-Pin μMAX (derate 4.5mW/°C above +70°C) .....	362mW
8-Pin SO (derate 5.9mW/°C above +70°C) .....	471mW
8-Pin Plastic DIP (derate 9.1mW/°C above +70°C) .....	727mW
Operating Temperature Range .....	-40°C to +85°C
Storage Temperature Range .....	-65°C to +150°C
Lead Temperature (soldering, 10s) .....	+300°C

**Note 1:** Signals on COM, NO, or NC exceeding V+ or V- are clamped by internal diodes. Limit forward current to maximum current ratings.

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 ±15V Supplies

(V+ = +15V, V- = -15V, V<sub>IH</sub> = 2.0V, V<sub>IL</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.) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS	T <sub>A</sub>	MIN	TYP	MAX	UNITS	
<b>ANALOG SWITCH</b>								
Analog Signal Range	V <sub>NO</sub> , V <sub>NC</sub> V <sub>COM</sub>			V-		V+	V	
On-Resistance	R <sub>ON</sub>	V+ = +13.5V, V- = -13.5V I <sub>COM</sub> = 10mA V <sub>NO</sub> or V <sub>NC</sub> = ±10V	+25°C		17	35	Ω	
			T <sub>MIN</sub> to T <sub>MAX</sub>			45		
On-Resistance Matching Between Channels (DG419L only)	ΔR <sub>ON</sub>	V+ = +15V, V- = -15V I <sub>COM</sub> = 10mA V <sub>NO</sub> or V <sub>NC</sub> = ±10V	+25°C		0.1	3	Ω	
			T <sub>MIN</sub> to T <sub>MAX</sub>			4		
On-Resistance Flatness (Note 4)	R <sub>FLAT</sub> (ON)	V+ = +15V, V- = -15V I <sub>COM</sub> = 10mA V <sub>NO</sub> or V <sub>NC</sub> = -5V, 0, +5V	+25°C		0.5	4	Ω	
			T <sub>MIN</sub> to T <sub>MAX</sub>			6		
NC or NO Off-Leakage Current (Note 5)	I <sub>NC/NO(OFF)</sub>	V+ = +16.5V, V- = -16.5V V <sub>COM</sub> = ±15.5V V <sub>(NC or NO)</sub> = ∓15.5V	+25°C	-0.25	0.01	0.25	nA	
			T <sub>MIN</sub> to T <sub>MAX</sub>			5		
COM Off-Leakage Current (Note 5)	I <sub>COM(OFF)</sub>	V+ = +16.5V V- = -16.5V V <sub>COM</sub> = ±15.5V V <sub>(NC or NO)</sub> = ∓15.5V	DG417L DG418L	+25°C	-0.25	0.01	0.25	nA
				T <sub>MIN</sub> to T <sub>MAX</sub>			5	
COM On-Leakage Current (Note 5)	I <sub>COM(ON)</sub>	V+ = +16.5V V- = -16.5V V <sub>COM</sub> = ±15.5V V <sub>(NC or NO)</sub> = ±15.5V	DG417L DG418L	+25°C	-0.4	0.01	0.4	nA
				T <sub>MIN</sub> to T <sub>MAX</sub>			10	
			DG419L	+25°C	-0.75		0.75	
				T <sub>MIN</sub> to T <sub>MAX</sub>			10	

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**DG417L/DG418L/DG419L**

## ELECTRICAL CHARACTERISTICS—Dual ±15V Supplies (continued)

(V+ = +15V, V- = -15V, V<sub>IH</sub> = 2.0V, V<sub>IL</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.) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS	T <sub>A</sub>	MIN	TYP	MAX	UNITS
<b>DYNAMIC</b>							
Turn-On Time	t <sub>ON</sub>	V <sub>NO</sub> or V <sub>NC</sub> = ±10V R <sub>L</sub> = 300Ω C <sub>L</sub> = 35pF Figure 1	DG417L	+25°C	110	175	ns
			DG418L	T <sub>MIN</sub> to T <sub>MAX</sub>		250	
Turn-Off Time	t <sub>OFF</sub>	V <sub>NO</sub> or V <sub>NC</sub> = ±10V R <sub>L</sub> = 300Ω C <sub>L</sub> = 35pF Figure 1	DG417L	+25°C	105	185	ns
			DG418L	T <sub>MIN</sub> to T <sub>MAX</sub>		210	
Transition Time	t <sub>TRANS</sub>	V <sub>NO</sub> = ±10V V <sub>NC</sub> = ∓10V R <sub>L</sub> = 300Ω C <sub>L</sub> = 35pF Figure 2	DG419L	+25°C	105	185	ns
				T <sub>MIN</sub> to T <sub>MAX</sub>		250	
Break-Before-Make Delay (Note 6)	t <sub>D</sub>	V <sub>NO</sub> or V <sub>NC</sub> = +10V R <sub>L</sub> = 300Ω C <sub>L</sub> = 35pF Figure 3	DG419L	+25°C	5	25	ns
				T <sub>MIN</sub> to T <sub>MAX</sub>	1		
Charge Injection	Q	V <sub>GEN</sub> = 0, R <sub>GEN</sub> = 0, C <sub>L</sub> = 1nF, Figure 4			15		pC
Off-Isolation (Note 7)	V <sub>ISO</sub>	f = 1MHz, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, Figure 5			-90		dB
Crosstalk (Note 8)	V <sub>CT</sub>	f = 1MHz, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, Figure 6	DG419L			-86	dB
Total Harmonic Distortion	THD	f = 20Hz to 20kHz, 5Vp-p R <sub>L</sub> = 600Ω			0.002		%
NO or NC Off-Capacitance	C <sub>NO(OFF)</sub> C <sub>NC(OFF)</sub>	f = 1MHz, Figure 7			8		pF
COM Off-Capacitance	C <sub>COM(OFF)</sub>	f = 1MHz, Figure 7			8		pF
COM On-Capacitance	C <sub>COM(ON)</sub>	f = 1MHz, Figure 8	DG417L		30		pF
			DG418L				
			DG419L		35		

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## ELECTRICAL CHARACTERISTICS—Dual ±15V Supplies (continued)

(V+ = +15V, V- = -15V, VIH = 2.0V, VIL = 0.8V, 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
<b>DIGITAL I/O</b>							
Input Logic High Voltage	VIH			2.0			V
Input Logic Low Voltage	VIL					0.8	V
Logic Input Current (Input Voltage Low)	IINL	VIN = 0.8V			0.001	1	μA
Logic Input Current (Input Voltage High)	IINH	VIN = 2.0V			0.001	1	μA
<b>POWER SUPPLY</b>							
Power-Supply Range	VS	Dual supplies		±4.5		±20	V
Positive Supply Current	I+	V+ = +16.5V, V- = -16.5V, VIN = 5V	+25°C		26	75	μA
			TMIN to TMAX			125	
Negative Supply Current	I-	V+ = +16.5V, V- = -16.5V, VIN = 0, 5V, V+	+25°C		0.01	1	μA
			TMIN to TMAX			10	
Ground Current	IGND	V+ = +16.5V, V- = -16.5V, VIN = 5V	+25°C		26	75	μA
			TMIN to TMAX			125	
		V+ = +16.5V, V- = -16.5V, VIN = 0 or V+	+25°C		0.01	1	
			TMIN to TMAX			10	

## ELECTRICAL CHARACTERISTICS—Single +12V Supply

(V+ = +12V, V- = 0, VIH = 2.0V, VIL = 0.8V, 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
<b>ANALOG SWITCH</b>							
Analog Signal Range	VNO, VNC VCOM			V-		V+	V
On-Resistance	RON	V+ = +10.8V, ICOM = 10mA, VNO or VNC = +3.8V	+25°C		31	100	Ω
			TMIN to TMAX			125	
On-Resistance Matching Between Channels (DG419L Only)	ΔRON	V+ = +10.8V, ICOM = 10mA, VNO or VNC = +3.8V	+25°C		0.05	4	Ω
			TMIN to TMAX			6	
On-Resistance Flatness (Note 4)	RFLAT (ON)	V+ = +12V, ICOM = 10mA VNO or VNC = 2V, 6V, 10V	+25°C		4	9	Ω
			TMIN to TMAX			13	

# 35Ω, SPST/SPDT, +3V Logic-Compatible Analog Switches

**DG417L/DG418L/DG419L**

## ELECTRICAL CHARACTERISTICS—Single +12V Supply (continued)

(V+ = +12V, V- = 0, VIH = 2.0V, VIL = 0.8V, 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
<b>DYNAMIC</b>							
Turn-On Time	tON	VNO or VNC = +10V RL = 300Ω CL = 35pF Figure 1	DG417L DG418L	+25°C	150	300	ns
				TMIN to TMAX		400	
Turn-Off Time	tOFF	VNO or VNC = +10V RL = 300Ω CL = 35pF Figure 1	DG417L DG418L	+25°C	110	210	ns
				TMIN to TMAX		310	
Transition Time	tTRANS	VNO = 0, 10V VNC = 10V, 0 RL = 300Ω CL = 35pF Figure 2	DG419L	+25°C	150	300	ns
				TMIN to TMAX		400	
Break-Before-Make Delay (Note 6)	tD	VNO, VNC = +10V RL = 300Ω CL = 35pF Figure 3	DG419L	+25°C	5	30	ns
				TMIN to TMAX	1		
Charge Injection	Q	VGEN = 0, RGEN = 0, CL = 1nF, Figure 4			2.5		pC
<b>POWER SUPPLY</b>							
Power-Supply Range	Vs	Single supply		9		36	V
Positive Supply Current	I+	V+ = +13.2V VIN = 0 or V+		+25°C	0.01	1	μA
				TMIN to TMAX		10	
		V+ = +13.2V VIN = 5V		+25°C	15	60	
				TMIN to TMAX		110	

**Note 2:** The algebraic convention is used in this data sheet; the most negative value is shown in the minimum column.

**Note 3:** -40°C specifications are guaranteed by design.

**Note 4:** Flatness is defined as the difference between the maximum and the minimum value of on-resistance as measured at the extremes of the specified analog range.

**Note 5:** Leakage parameters are 100% tested at maximum rated hot temperature and guaranteed by correlation at TA = +25°C.

**Note 6:** Guaranteed by design.

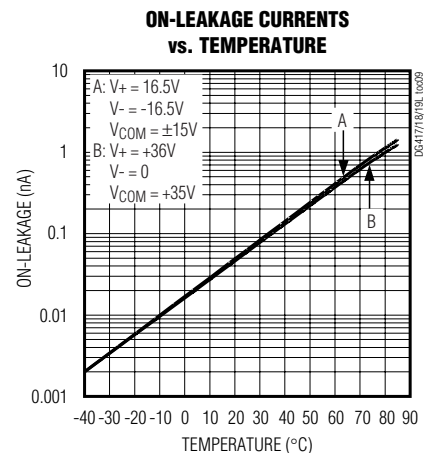
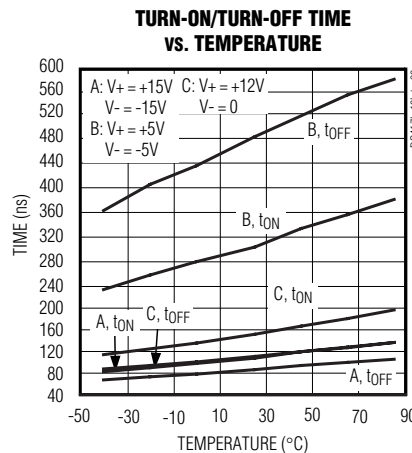
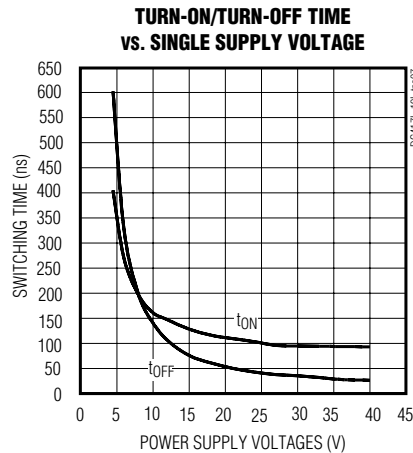
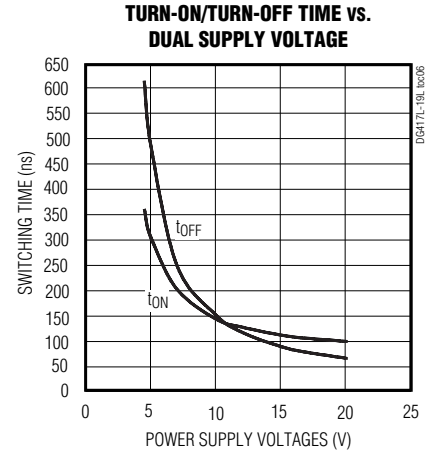
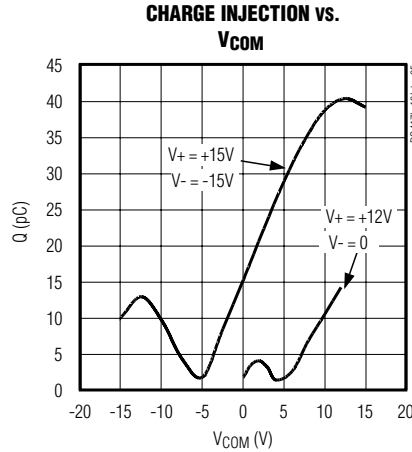
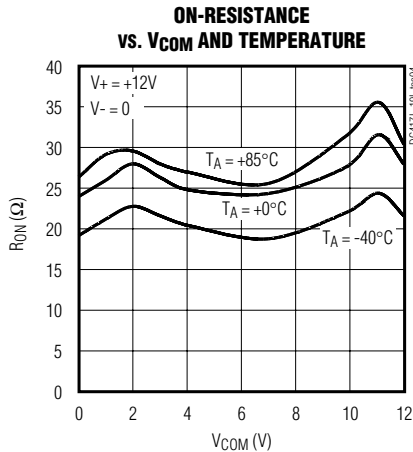
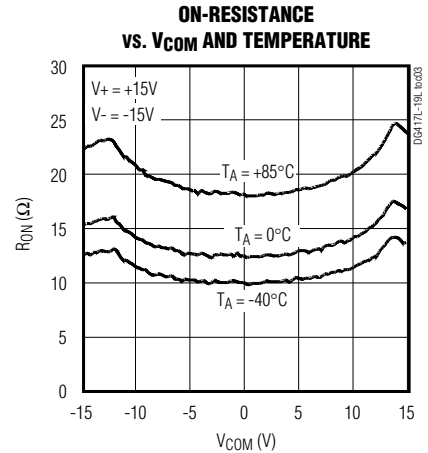
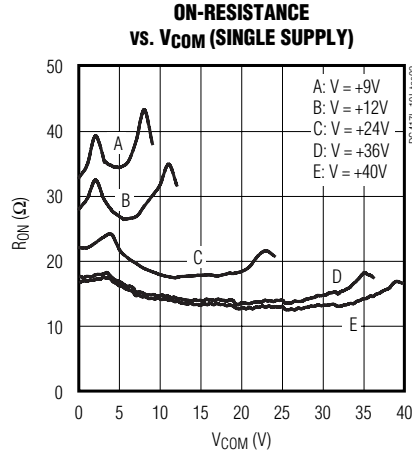
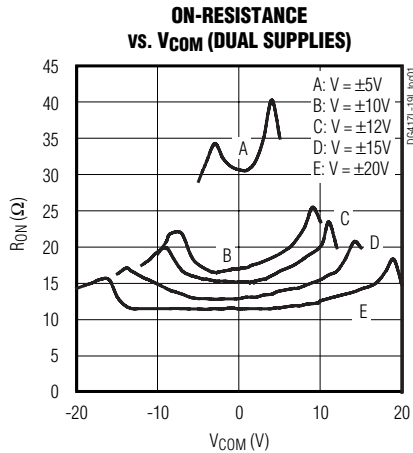
**Note 7:** Off-isolation = 20log10 [VCOM / (VNC or VNO)], VCOM = output, VNC or VNO = input to off switch.

**Note 8:** Between Switches

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## Typical Operating Characteristics

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

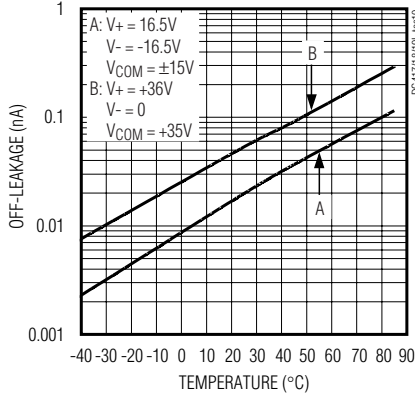


# 35Ω, SPST/SPDT, +3V Logic-Compatible Analog Switches

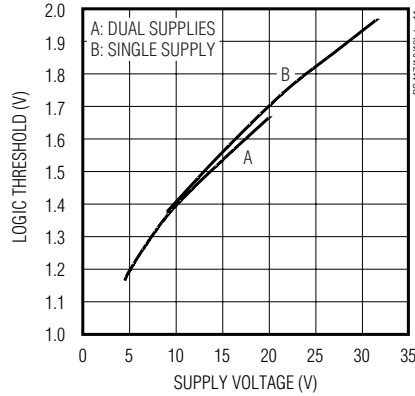
## Typical Operating Characteristics (continued)

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

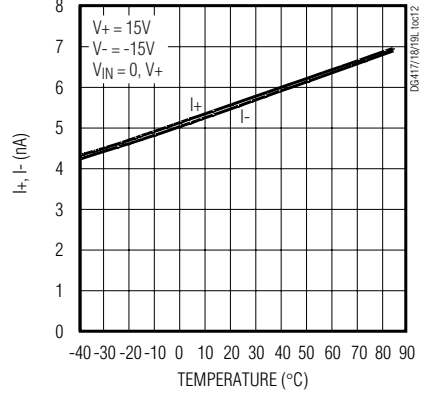
**OFF-LEAKAGE CURRENTS  
vs. TEMPERATURE**



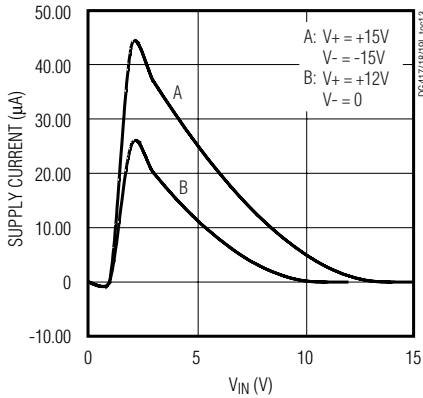
**LOGIC THRESHOLD  
vs. SUPPLY VOLTAGE**



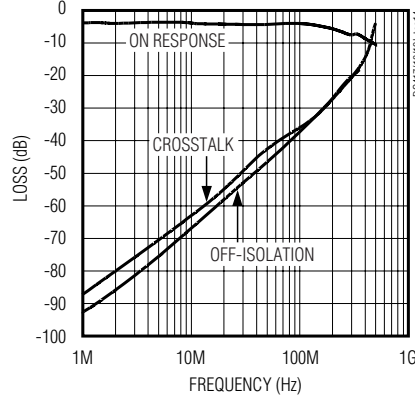
**SUPPLY CURRENT  
vs. TEMPERATURE**



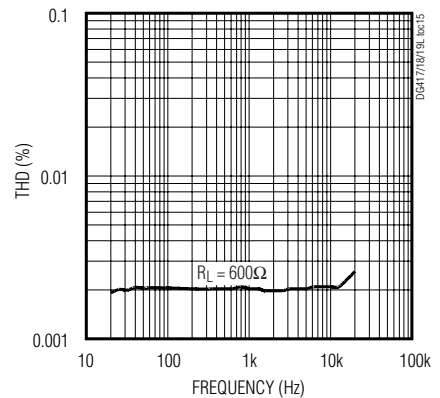
**SUPPLY CURRENT vs.  $V_{\text{IN}}$**



**FREQUENCY REPOSE**



**TOTAL HARMONIC DISTORTION  
vs. FREQUENCY**



DG417L/DG418L/DG419L

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## Pin Description

PIN			NAME	FUNCTION
DG417L	DG418L	DG419L		
1	1	1	COM	Analog Switch Common Terminal
2, 5	2, 5	5	N.C.	No Connection. Not internally connected.
3	3	3	GND	Logic Ground
4	4	4	V+	Analog Signal Positive Supply Input
6	6	6	IN	Logic-Level Input
7	7	7	V-	Analog Signal Negative Supply Input
8	—	2	NC	Analog Switch Normally Closed Terminal
—	8	8	NO	Analog Switch Normally Open Terminal

## Test Circuits/Timing Diagrams

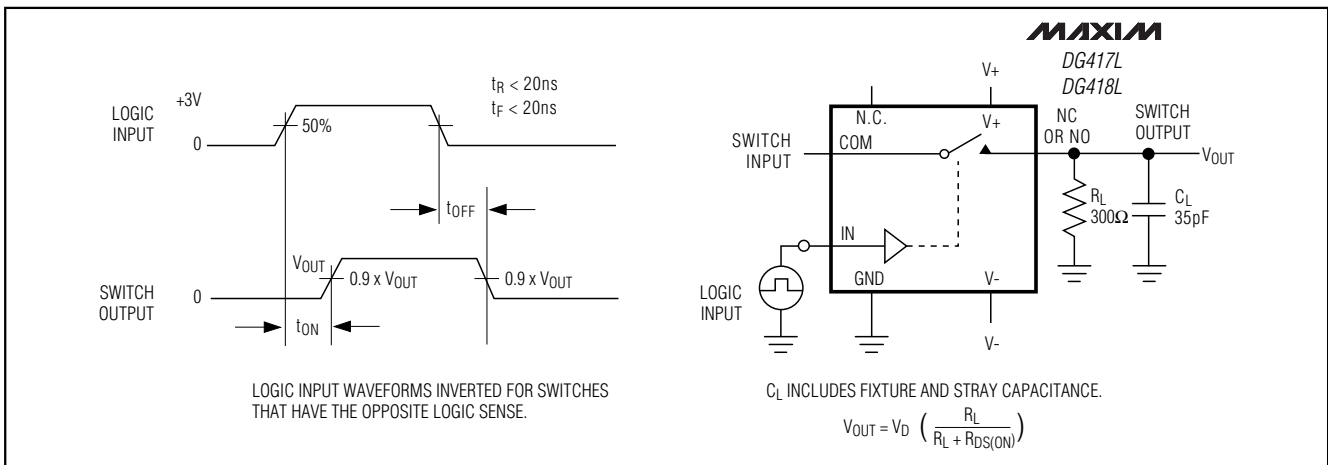


Figure 1. DG417L/DG418L Switching Time

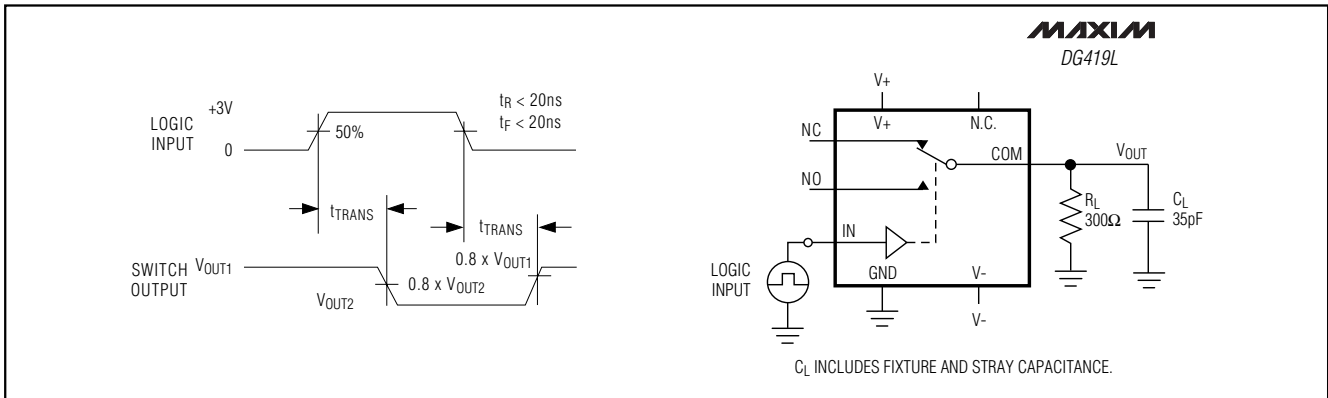


Figure 2. DG419L Transition Time



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## Applications Information

### Power-Supply Sequencing-Free Operation

Most CMOS switches require specific power-supply sequencing in order to prevent device latchup. The older DG417/DG418/DG419 devices require a proper power-supply sequence of V+, V<sub>L</sub>, then V-. Otherwise,

it is necessary to add signal diodes to the circuit in order to prevent potential latchups. The new DG417L/DG418L/DG419L devices eliminate the need for a V<sub>L</sub> input and allow any power-up sequence. Do not exceed the absolute maximum ratings because stresses beyond the listed ratings may cause permanent damage to the devices.

## Test Circuits/Timing Diagrams (continued)

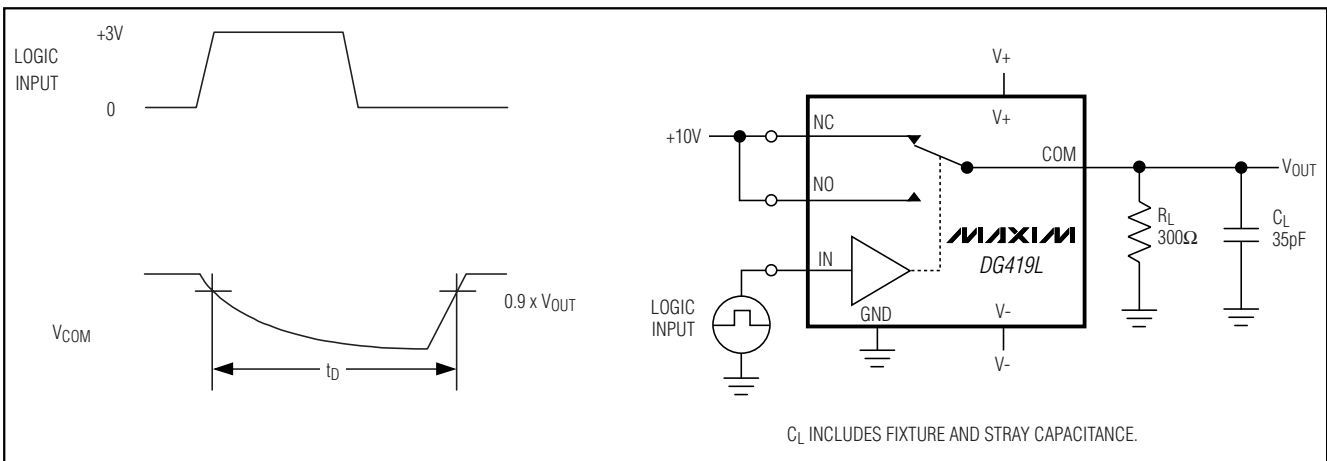


Figure 3. DG419L Break-Before-Make Interval

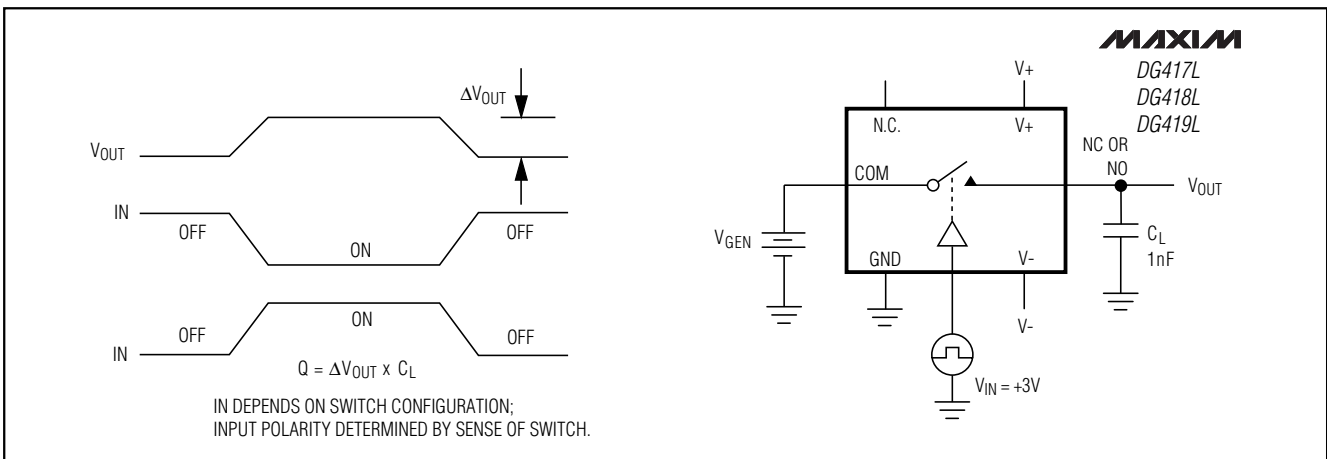


Figure 4. Charge Injection

# 35Ω, SPST/SPDT, +3V Logic-Compatible Analog Switches

## Test Circuits/Timing Diagrams (continued)

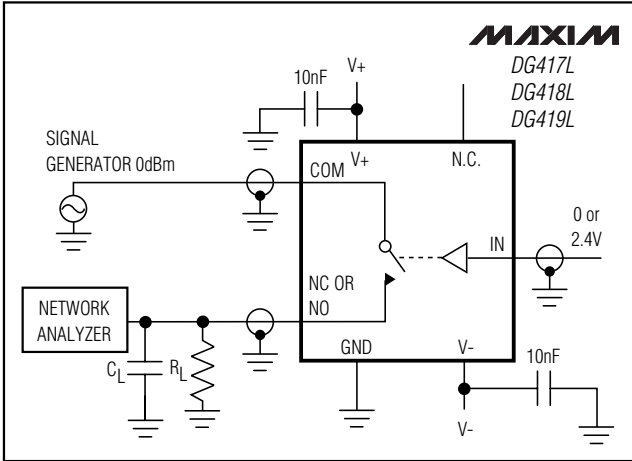


Figure 5. Off-Isolation

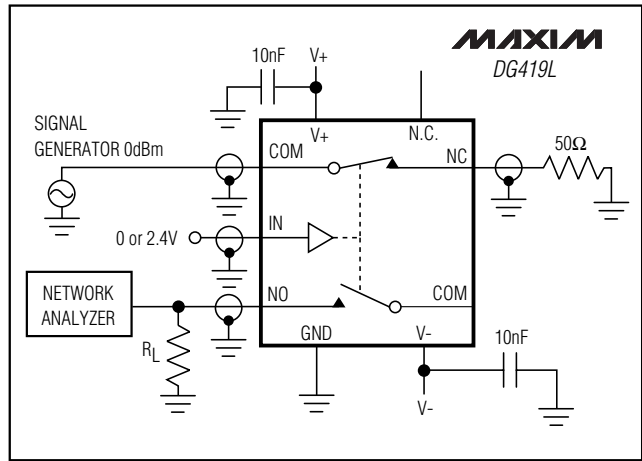


Figure 6. DG419L Crosstalk

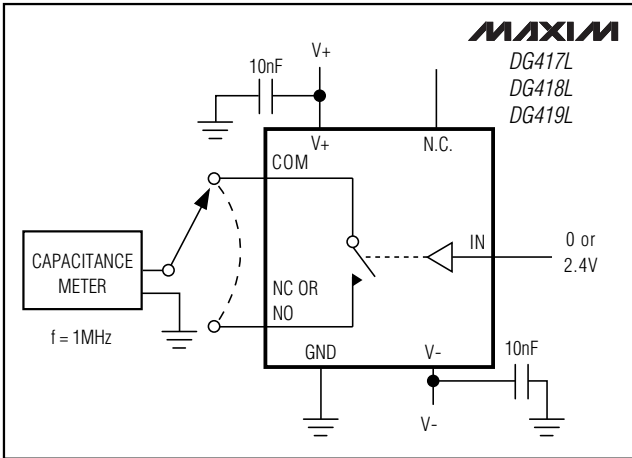


Figure 7. Channel Off-Capacitance

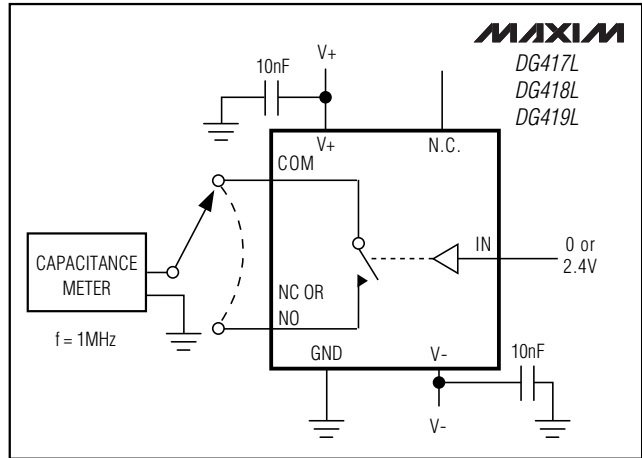


Figure 8. Channel On-Capacitance

### Ordering Information (continued)

PART	TEMP. RANGE	PIN-PACKAGE
DG418LEUA	-40°C to +85°C	8 μMAX
DG418LDY	-40°C to +85°C	8 SO
DG418LDJ	-40°C to +85°C	8 Plastic DIP
DG419LEUA	-40°C to +85°C	8 μMAX
DG419LDY	-40°C to +85°C	8 SO
DG419LDJ	-40°C to +85°C	8 Plastic DIP

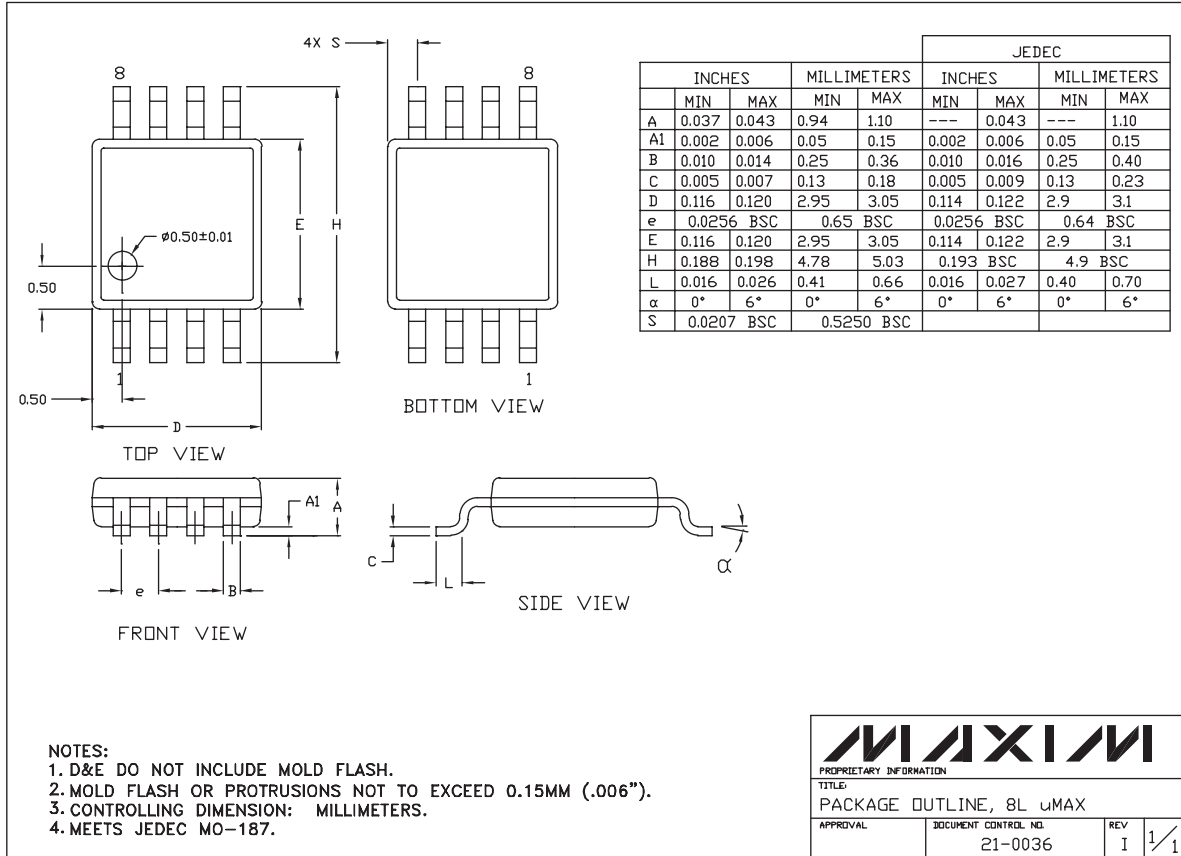
### Chip Information

TRANSISTOR COUNT: 40  
PROCESS: CMOS

# 35Ω, SPST/SPDT, +3V Logic-Compatible Analog Switches

## Package Information

DG417L/DG418L/DG419L

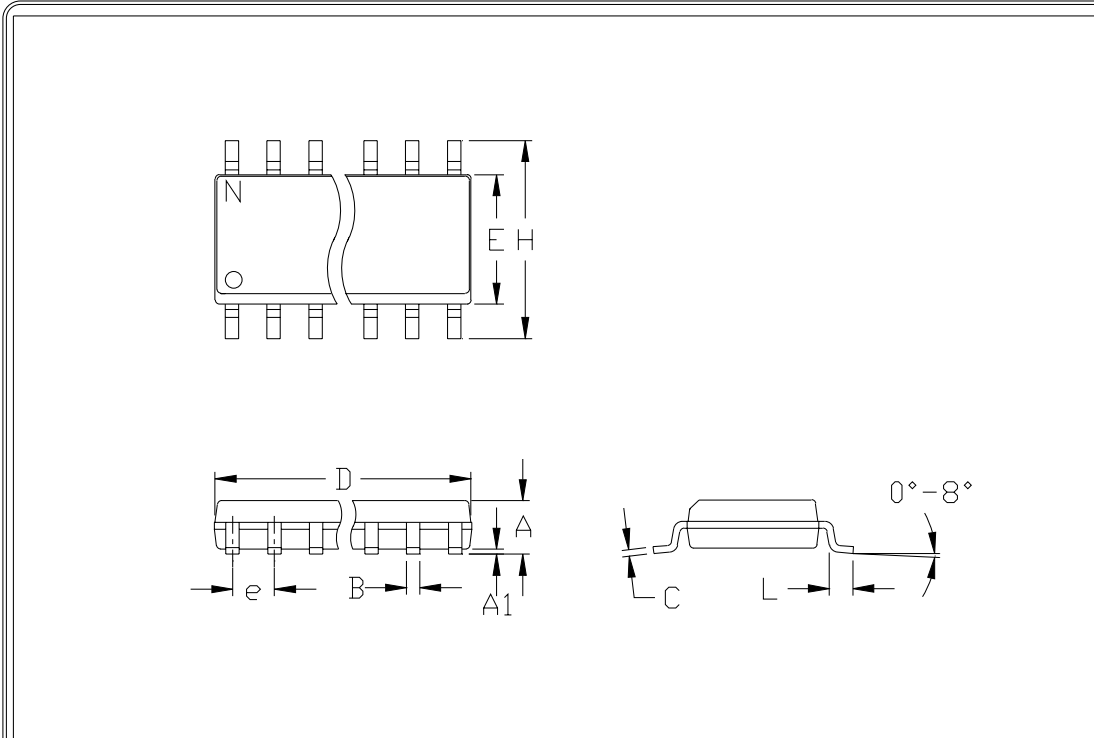


8LUMAXD.EPS

PROPRIETARY INFORMATION  
 TITLE: PACKAGE OUTLINE, 8L uMAX  
 APPROVAL: \_\_\_\_\_ DOCUMENT CONTROL NO. 21-0036 REV I 1/1

# 35Ω, SPST/SPDT, +3V Logic-Compatible Analog Switches

## Package Information (continued)



	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

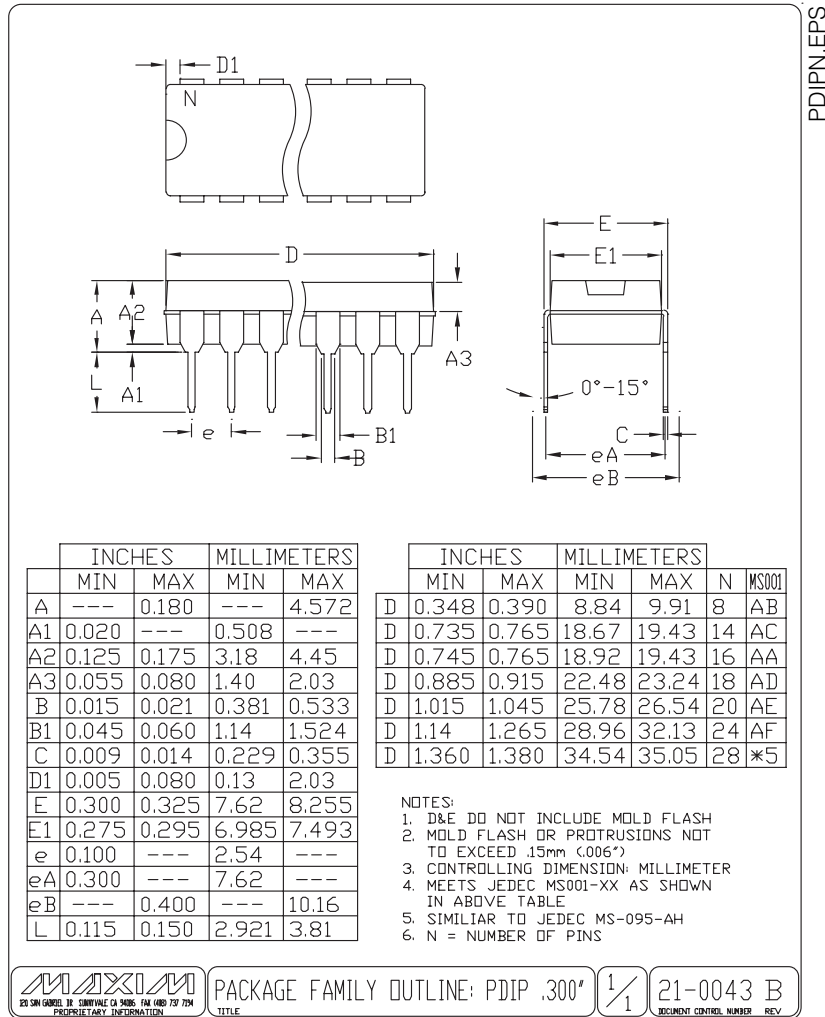
NOTES:

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

# 35Ω, SPST/SPDT, +3V Logic Compatible Analog Switches

## Package Information (continued)

DG417L/DG418L/DG419L



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