



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

General Description

The DG417L/DG418L/DG419L precision, CMOS analog switches feature low on-resistance ($R_{ON} = 35\Omega$), guaranteed R_{ON} matching between switches (3Ω max), and guaranteed R_{ON} flatness over the signal range (4Ω 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 μ 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

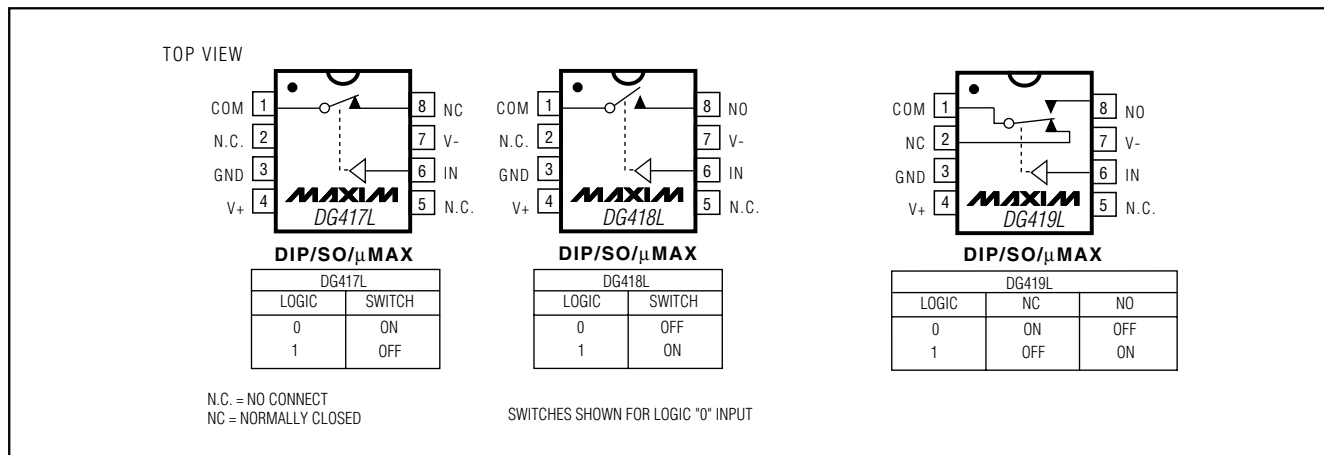
- ◆ +3V Logic-Compatible Digital Inputs
 $V_{IH} = 2.0V$
 $V_{IL} = 0.8V$
- ◆ Plug-In Upgrades for Industry-Standard
DG417/DG418/DG419 and
MAX317/MAX318/MAX319
- ◆ Power-Supply Sequencing-Free Operation
- ◆ Low On-Resistance (35Ω max)
- ◆ Guaranteed Matched On-Resistance Between Channels (3Ω max)
- ◆ Guaranteed On-Resistance Flatness (4Ω 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 μ MAX Package

Ordering Information

PART	TEMP. RANGE	PIN-PACKAGE
DG417LEUA	$-40^\circ C$ to $+85^\circ C$	8 μ 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



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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_A = +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_{IH} = 2.0V, V_{IL} = 0.8V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Notes 2, 3)

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

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ELECTRICAL CHARACTERISTICS—Dual ±15V Supplies (continued)

(V+ = +15V, V- = -15V, V_{IH} = 2.0V, V_{IL} = 0.8V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Notes 2, 3)

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

DG417L/DG418L/DG419L

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ELECTRICAL CHARACTERISTICS—Dual ±15V Supplies (continued)

(V+ = +15V, V- = -15V, V_{IH} = 2.0V, V_{IL} = 0.8V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS	T _A	MIN	TYP	MAX	UNITS
DIGITAL I/O							
Input Logic High Voltage	V _{IH}			2.0			V
Input Logic Low Voltage	V _{IL}					0.8	V
Logic Input Current (Input Voltage Low)	I _{INL}	V _{IN} = 0.8V			0.001	1	μA
Logic Input Current (Input Voltage High)	I _{INH}	V _{IN} = 2.0V			0.001	1	μA
POWER SUPPLY							
Power-Supply Range	V _S	Dual supplies		±4.5		±20	V
Positive Supply Current	I ₊	V ₊ = +16.5V, V ₋ = -16.5V, V _{IN} = 5V	+25°C		26	75	μA
			T _{MIN} to T _{MAX}			125	
		V ₊ = +16.5V, V ₋ = -16.5V, V _{IN} = 0 or V ₊	+25°C		0.01	1	
			T _{MIN} to T _{MAX}			10	
Negative Supply Current	I ₋	V ₊ = +16.5V, V ₋ = -16.5V, V _{IN} = 0, 5V, V ₊	+25°C		0.01	1	μA
			T _{MIN} to T _{MAX}			10	
Ground Current	I _{GND}	V ₊ = +16.5V, V ₋ = -16.5V, V _{IN} = 5V	+25°C		26	75	μA
			T _{MIN} to T _{MAX}			125	
		V ₊ = +16.5V, V ₋ = -16.5V, V _{IN} = 0 or V ₊	+25°C		0.01	1	
			T _{MIN} to T _{MAX}			10	

ELECTRICAL CHARACTERISTICS—Single +12V Supply

(V₊ = +12V, V₋ = 0, V_{IH} = 2.0V, V_{IL} = 0.8V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS	T _A	MIN	TYP	MAX	UNITS
ANALOG SWITCH							
Analog Signal Range	V _{NO} , V _{NC} V _{COM}			V ₋		V ₊	V
On-Resistance	R _{ON}	V ₊ = +10.8V, I _{COM} = 10mA, V _{NO} or V _{NC} = +3.8V	+25°C		31	100	Ω
			T _{MIN} to T _{MAX}			125	
On-Resistance Matching Between Channels (DG419L Only)	ΔR _{ON}	V ₊ = +10.8V, I _{COM} = 10mA, V _{NO} or V _{NC} = +3.8V	+25°C		0.05	4	Ω
			T _{MIN} to T _{MAX}			6	
On-Resistance Flatness (Note 4)	R _{FLAT} (ON)	V ₊ = +12V, I _{COM} = 10mA V _{NO} or V _{NC} = 2V, 6V, 10V	+25°C		4	9	Ω
			T _{MIN} to T _{MAX}			13	

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DG417L/DG418L/DG419L

ELECTRICAL CHARACTERISTICS—Single +12V Supply (continued)

(V+ = +12V, V- = 0, V_{IH} = 2.0V, V_{IL} = 0.8V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS		T _A	MIN	TYP	MAX	UNITS
DYNAMIC								
Turn-On Time	t _{ON}	V _{NO} or V _{NC} = +10V R _L = 300Ω C _L = 35pF Figure 1	DG417L DG418L	+25°C	150	300	ns	
				T _{MIN} to T _{MAX}	400			
Turn-Off Time	t _{OFF}	V _{NO} or V _{NC} = +10V R _L = 300Ω C _L = 35pF Figure 1	DG417L DG418L	+25°C	110	210	ns	
				T _{MIN} to T _{MAX}	310			
Transition Time	t _{TRANS}	V _{NO} = 0, 10V V _{NC} = 10V, 0 R _L = 300Ω C _L = 35pF Figure 2	DG419L	+25°C	150	300	ns	
				T _{MIN} to T _{MAX}	400			
Break-Before-Make Delay (Note 6)	t _D	V _{NO} , V _{NC} = +10V R _L = 300Ω C _L = 35pF Figure 3	DG419L	+25°C	5	30	ns	
				T _{MIN} to T _{MAX}	1			
Charge Injection	Q	V _{GEN} = 0, R _{GEN} = 0, C _L = 1nF, Figure 4			2.5		pC	
POWER SUPPLY								
Power-Supply Range	V _S	Single supply			9	36	V	
Positive Supply Current	I ₊	V ₊ = +13.2V V _{IN} = 0 or V ₊		+25°C	0.01	1	μA	
				T _{MIN} to T _{MAX}	10			
		V ₊ = +13.2V V _{IN} = 5V		+25°C	15	60		
				T _{MIN} to T _{MAX}	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 T_A = +25°C.

Note 6: Guaranteed by design.

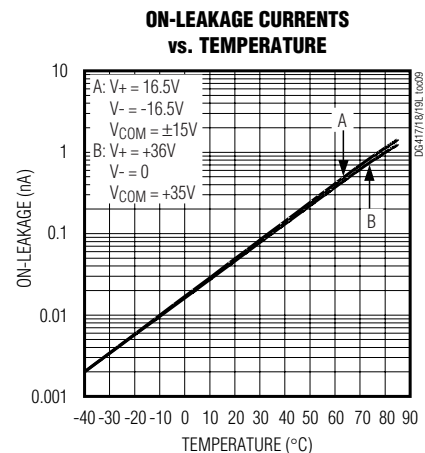
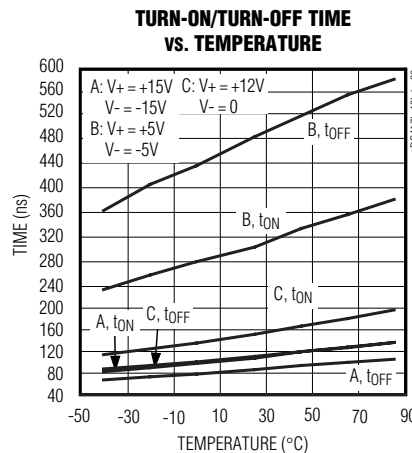
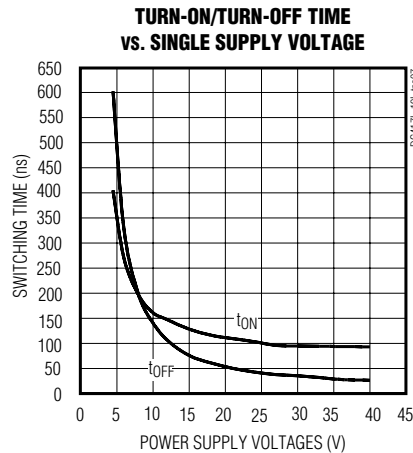
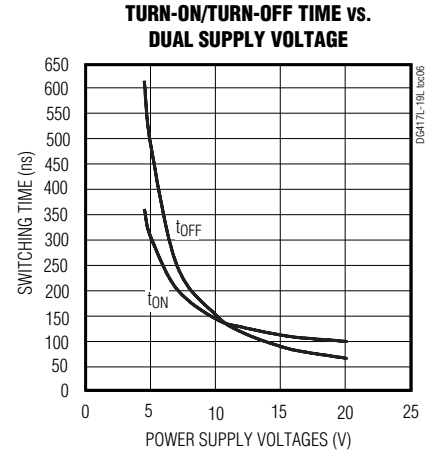
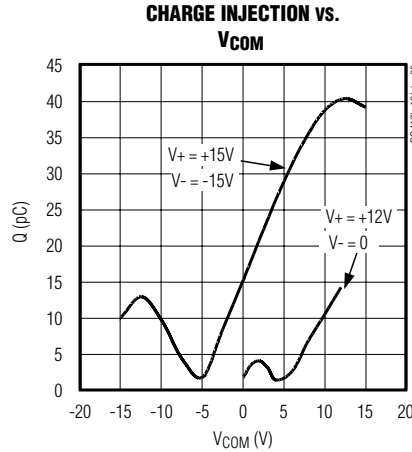
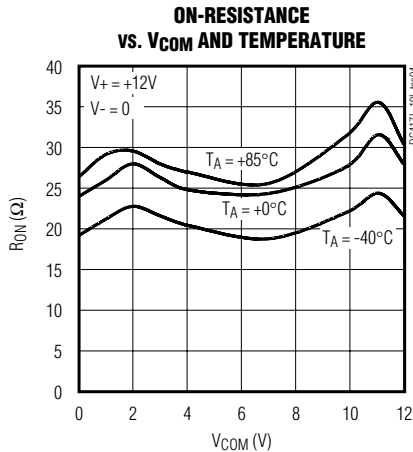
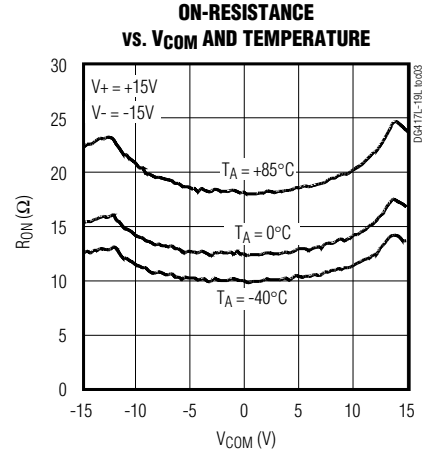
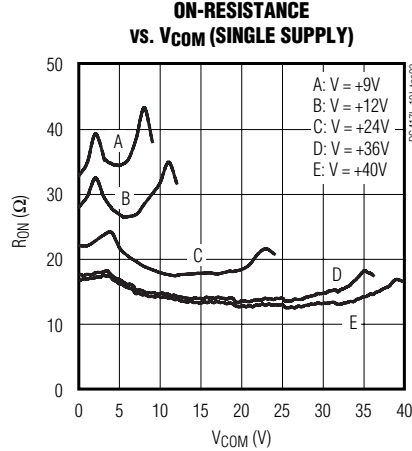
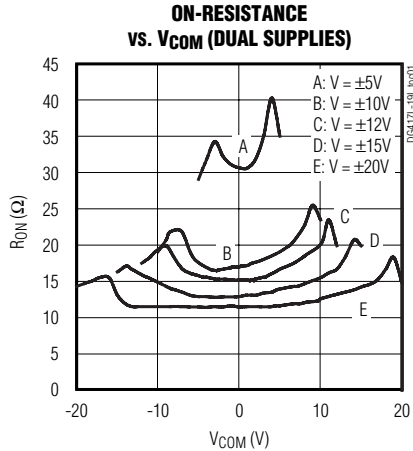
Note 7: Off-isolation = 20log₁₀ [V_{COM} / (V_{NC} or V_{NO})], V_{COM} = output, V_{NC} or V_{NO} = input to off switch.

Note 8: Between Switches

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Typical Operating Characteristics

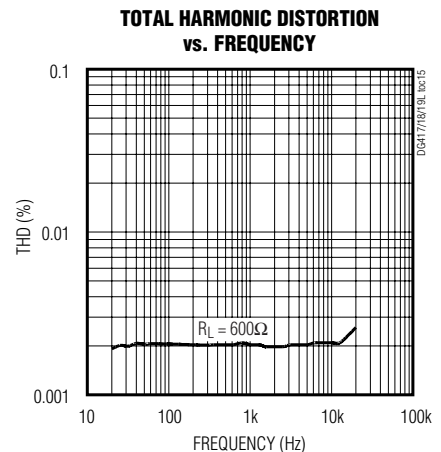
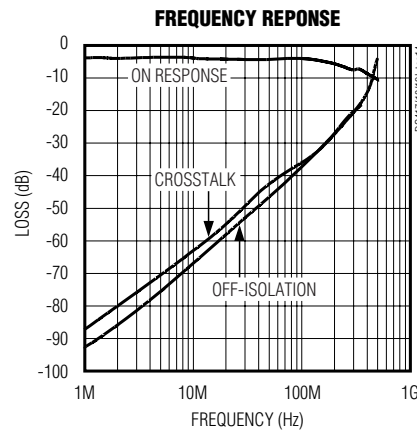
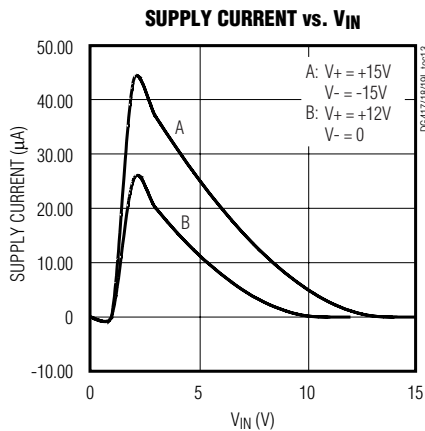
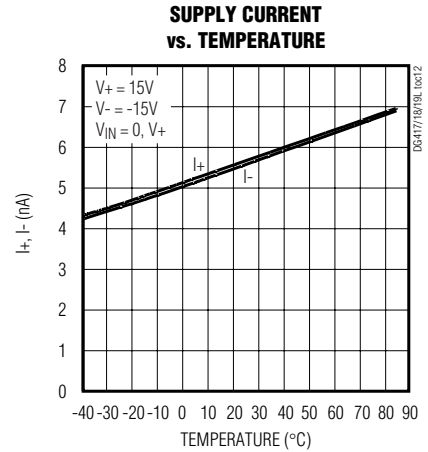
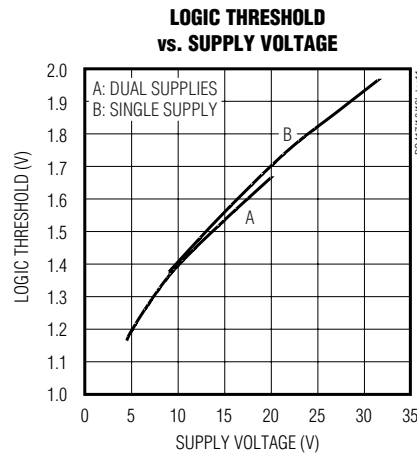
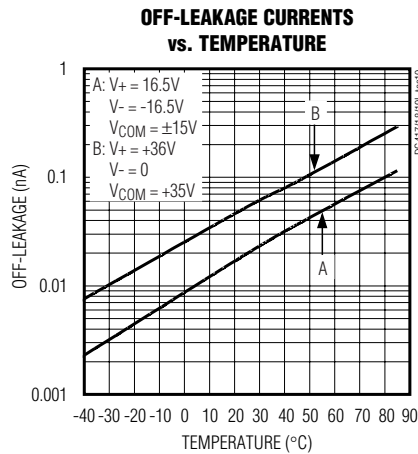
($T_A = +25^\circ\text{C}$, unless otherwise noted.)



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

Typical Operating Characteristics (continued)

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



DG417L/DG418L/DG419L

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

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

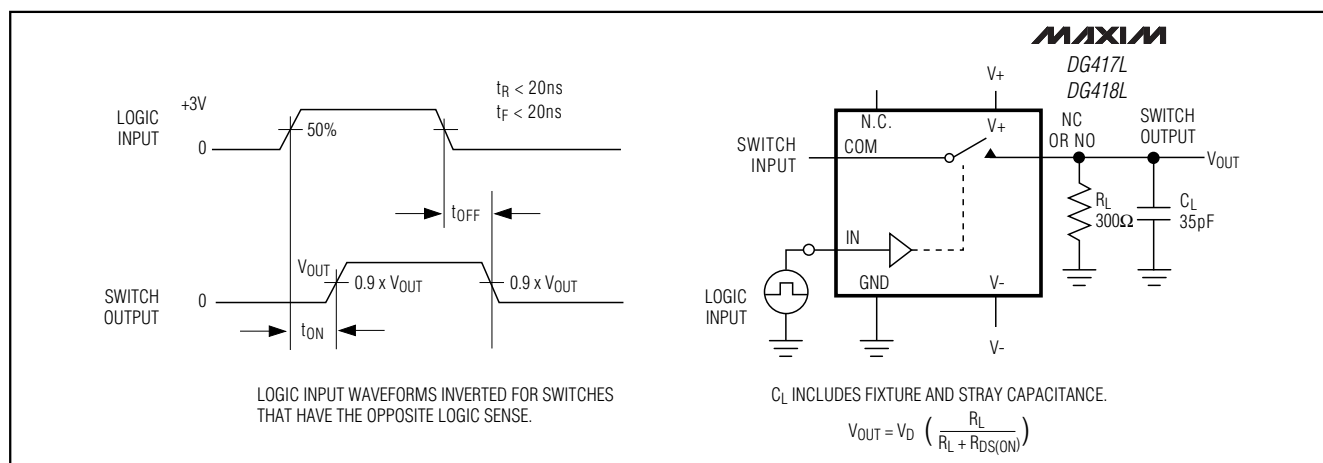


Figure 1. DG417L/DG418L Switching Time

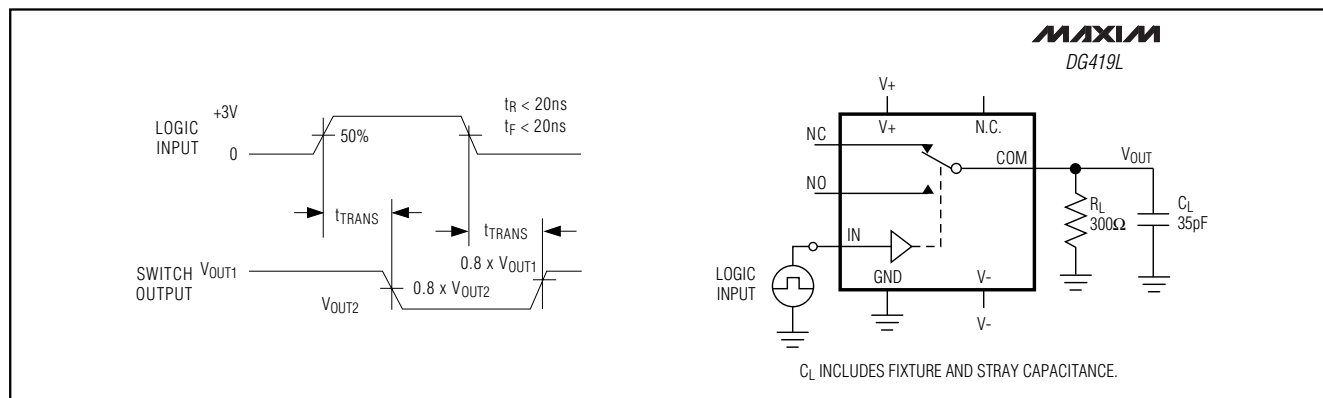


Figure 2. DG419L Transition Time

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

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_L , 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_L 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)

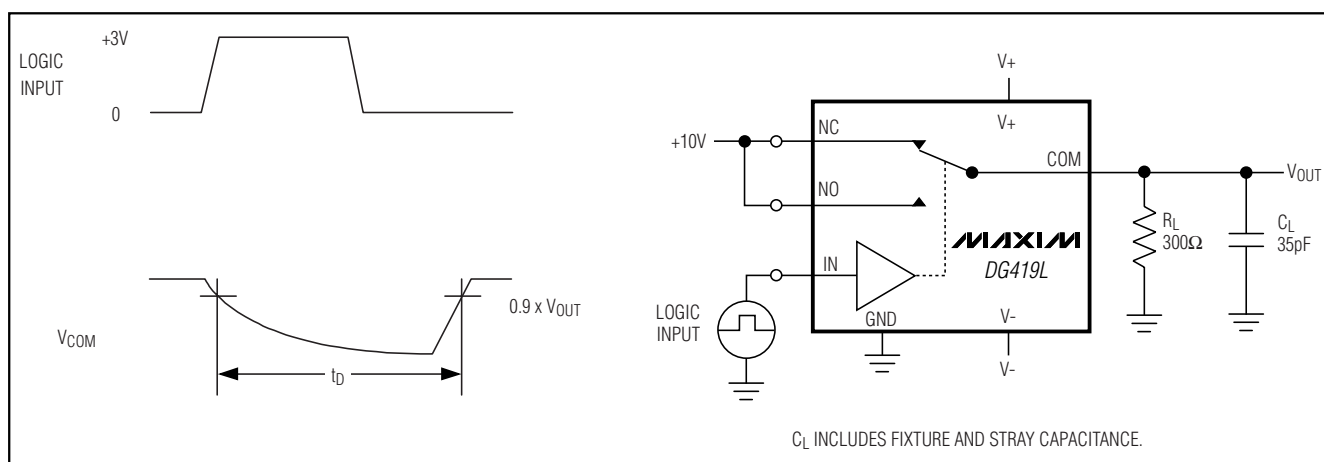


Figure 3. DG419L Break-Before-Make Interval

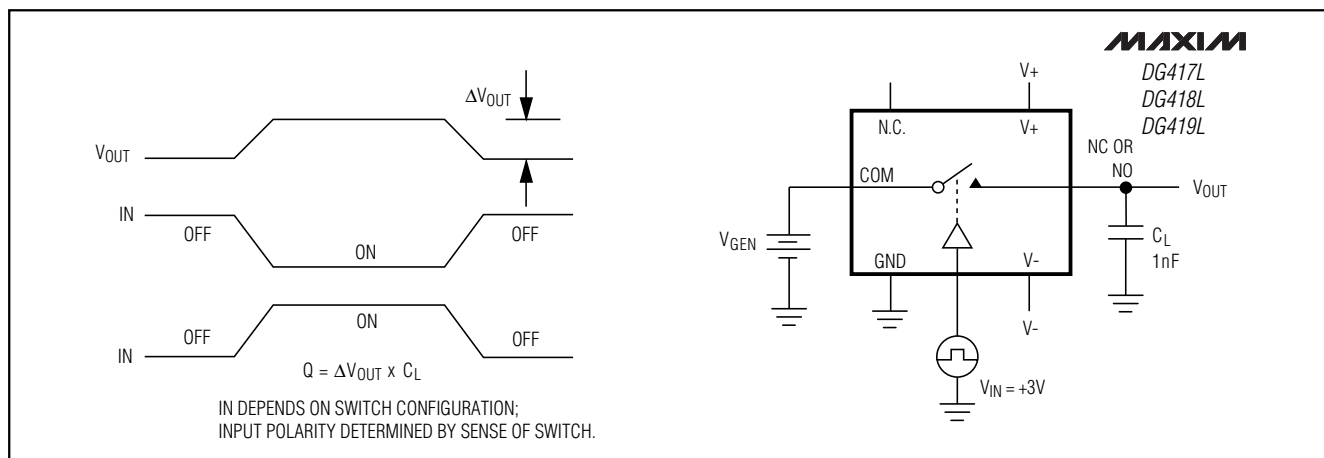


Figure 4. Charge Injection

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Test Circuits/Timing Diagrams (continued)

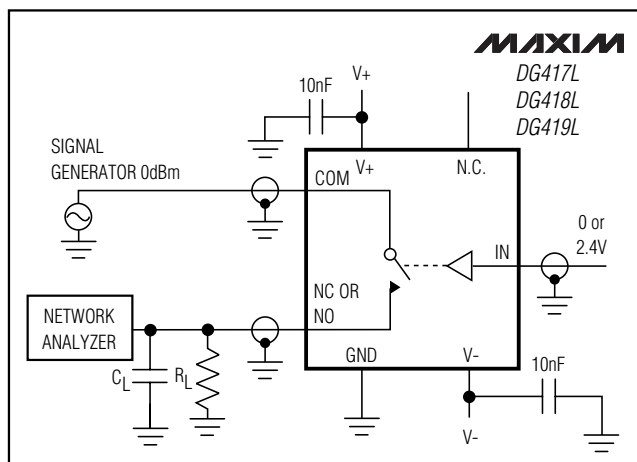


Figure 5. Off-Isolation

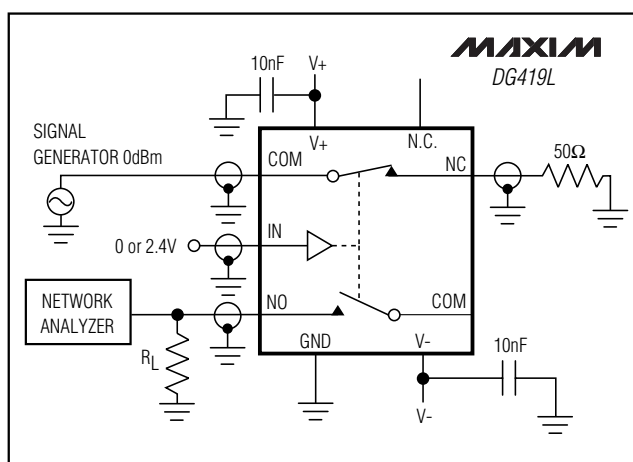


Figure 6. DG419L Crosstalk

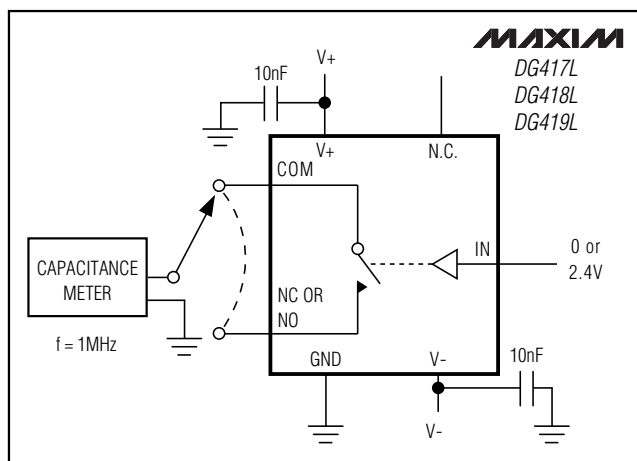


Figure 7. Channel Off-Capacitance

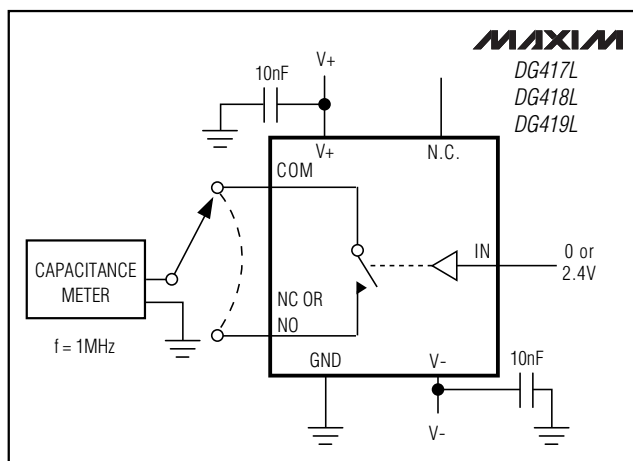


Figure 8. Channel On-Capacitance

Ordering Information (continued)

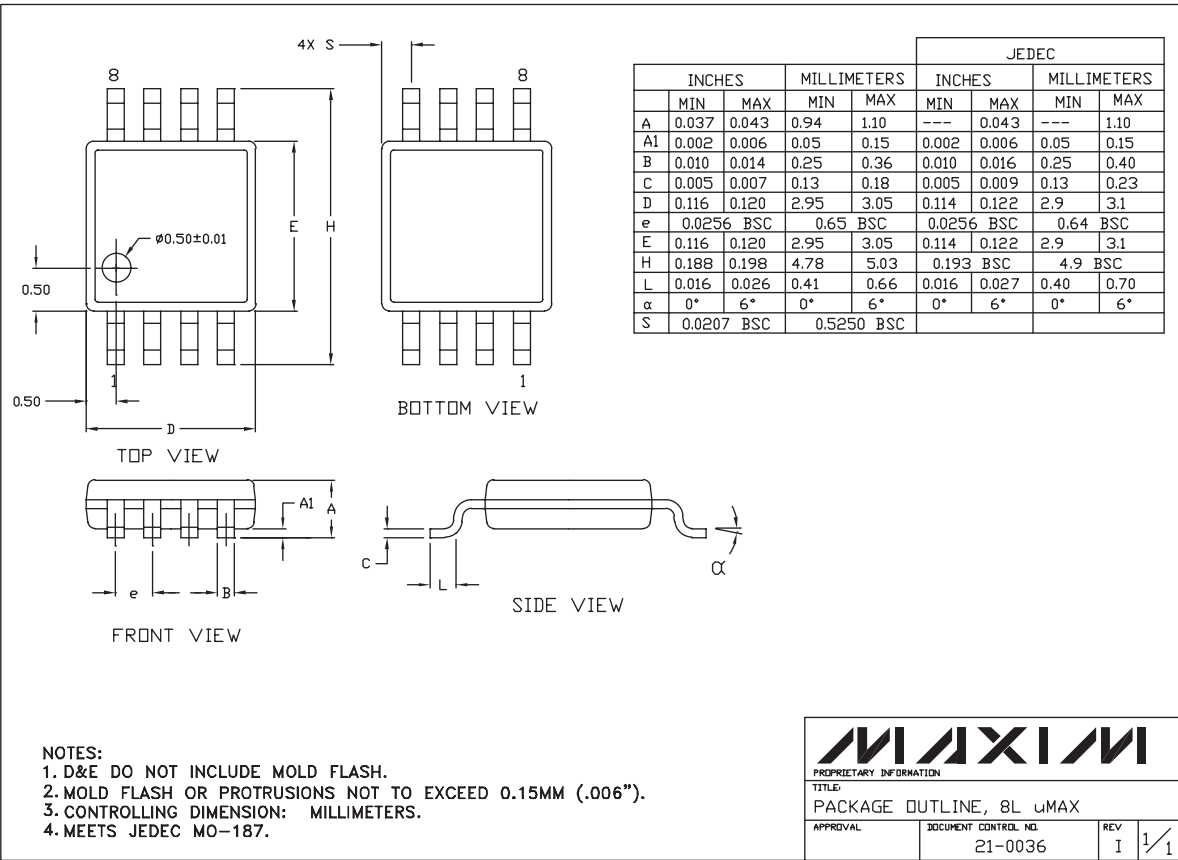
PART	TEMP. RANGE	PIN-PACKAGE
DG418LEUA	-40°C to +85°C	8 μMAX
DG418LDY	-40°C to +85°C	8 SO
DG418LDJ	-40°C to +85°C	8 Plastic DIP
DG419LEUA	-40°C to +85°C	8 μMAX
DG419LDY	-40°C to +85°C	8 SO
DG419LDJ	-40°C to +85°C	8 Plastic DIP

Chip Information

TRANSISTOR COUNT: 40
PROCESS: CMOS

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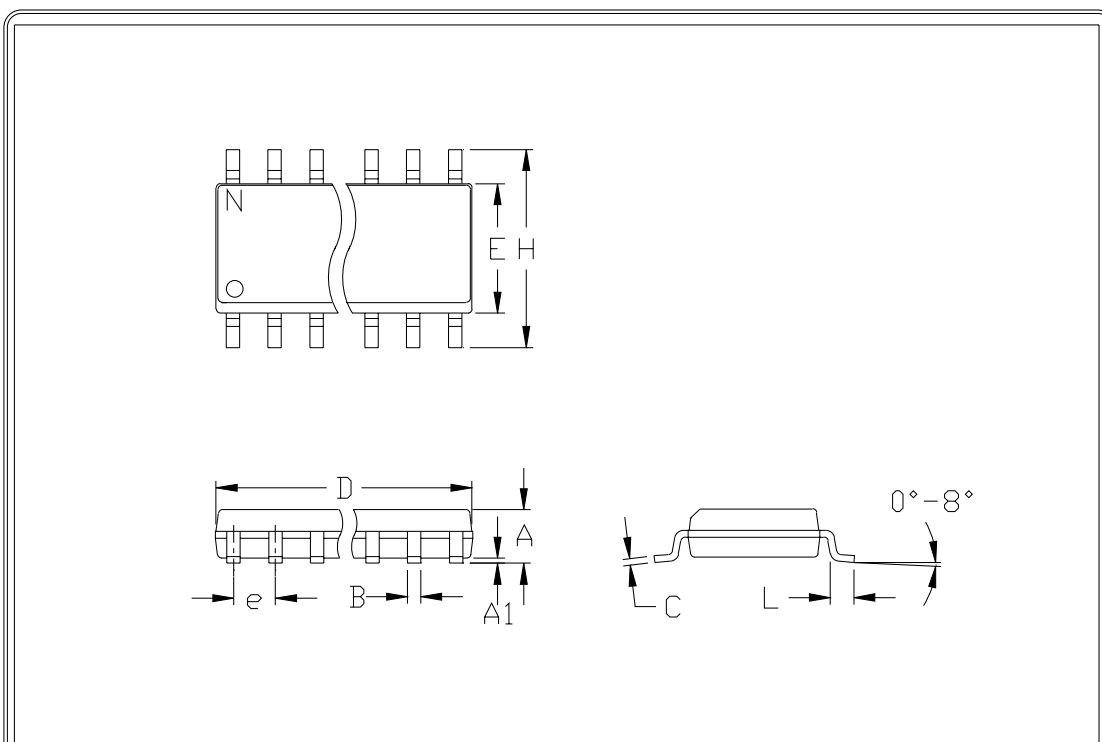
Package Information



DG417L/DG418L/DG419L

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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			
	MIN	MAX	MIN	MAX	N	MS012
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

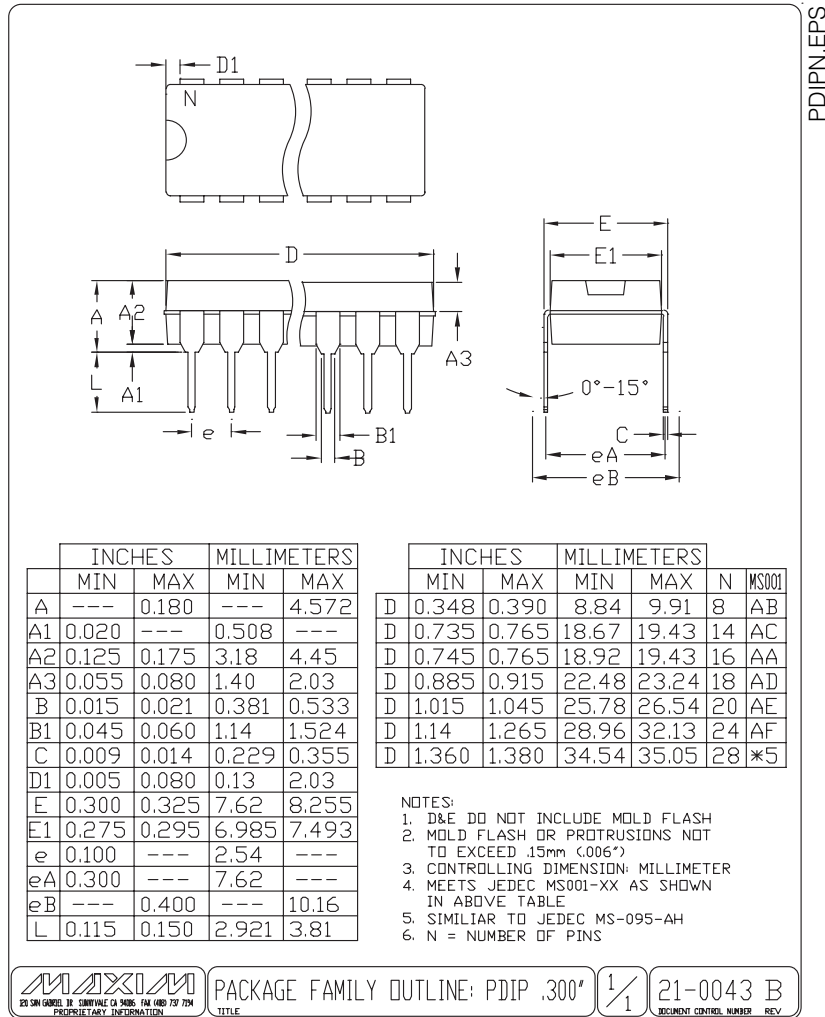
NOTES:

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

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Package Information (continued)

DG417L/DG418L/DG419L



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