19-2170; Rev 0; 10/01

MAXIM

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

General Description

The DG417L/DG418L/DG419L precision, CMOS analog switches feature low on-resistance (R_{ON} = 35Ω), 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 ±15V or ±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°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 ±4.5V to ±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 µMAX, 8-pin SO, or convenient 8-pin plastic DIP. All products are rated at the extended temperature range of -40°C to +85°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 ±4.5V to ±20V
- **Guaranteed Off-Leakage Current Over Temperature (<5nA at +85°C)**
- **Rail-to-Rail Analog Signal Handling Capability**
- **Tiny 8-Pin µMAX Package**

Ordering Information

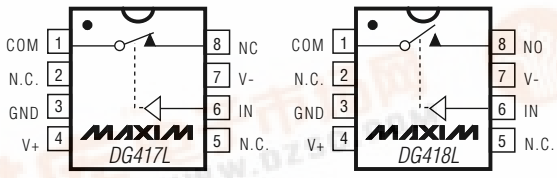
PART	TEMP. RANGE	PIN-PACKAGE
DG417LEUA	-40°C to +85°C	8 µMAX
DG417LDY	-40°C to +85°C	8 SO
DG417LDJ	-40°C to +85°C	8 Plastic DIP

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

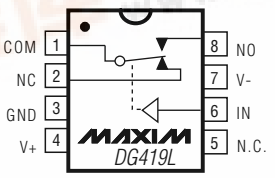


DIP/SO/µMAX

DG417L	
LOGIC	SWITCH
0	ON
1	OFF

DIP/SO/µMAX

DG418L	
LOGIC	SWITCH
0	OFF
1	ON



DIP/SO/µMAX

DG419L		
LOGIC	NC	NO
0	ON	OFF
1	OFF	ON

N.C. = NO CONNECT
NC = NORMALLY CLOSED

SWITCHES SHOWN FOR LOGIC "0" INPUT

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

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	0.25	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 DG418L	+25°C	-0.4	0.01	0.4	nA
				T_{MIN} to T_{MAX}	-10		10	
			DG419L	+25°C	-0.75		0.75	
				T_{MIN} to T_{MAX}	-10		10	

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		

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

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	

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	

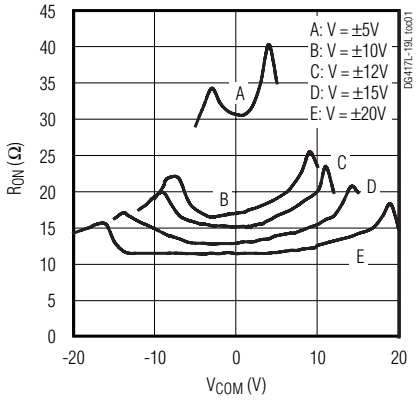
Note 2: The algebraic convention is used in this data sheet; the most negative value is shown in the minimum column.
Note 3: -40°C specifications are guaranteed by design.
Note 4: Flatness is defined as the difference between the maximum and the minimum value of on-resistance as measured at the extremes 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

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

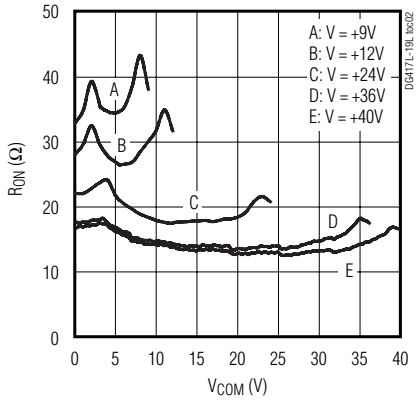
Typical Operating Characteristics

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

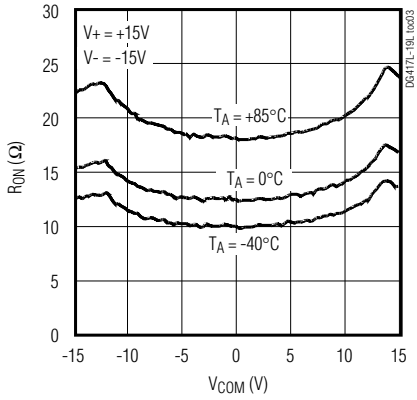
ON-RESISTANCE vs. V_{COM} (DUAL SUPPLIES)



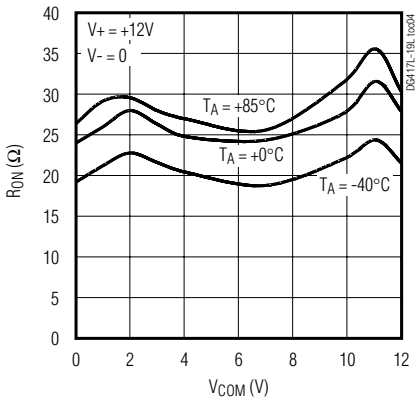
ON-RESISTANCE vs. V_{COM} (SINGLE SUPPLY)



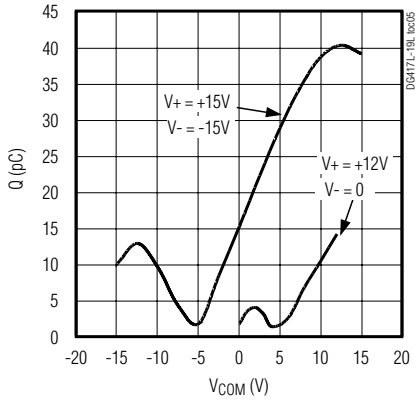
ON-RESISTANCE vs. V_{COM} AND TEMPERATURE



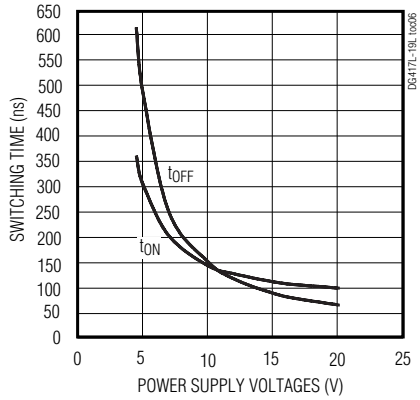
ON-RESISTANCE vs. V_{COM} AND TEMPERATURE



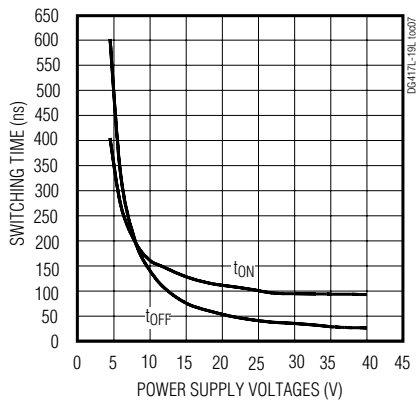
CHARGE INJECTION vs. V_{COM}



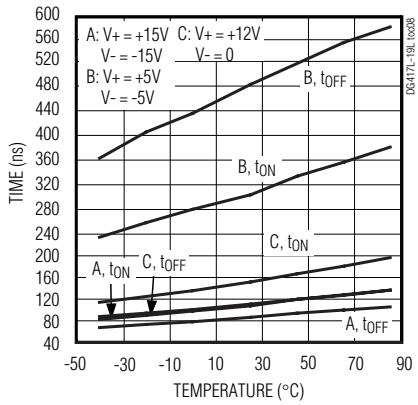
TURN-ON/TURN-OFF TIME vs. DUAL SUPPLY VOLTAGE



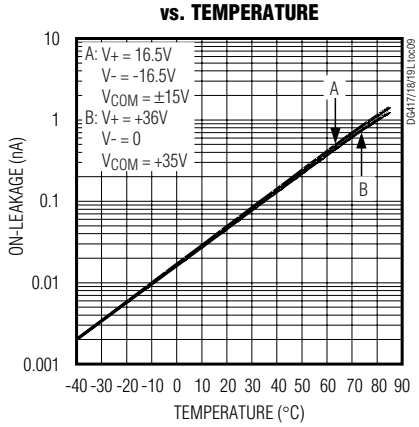
TURN-ON/TURN-OFF TIME vs. SINGLE SUPPLY VOLTAGE



TURN-ON/TURN-OFF TIME vs. TEMPERATURE



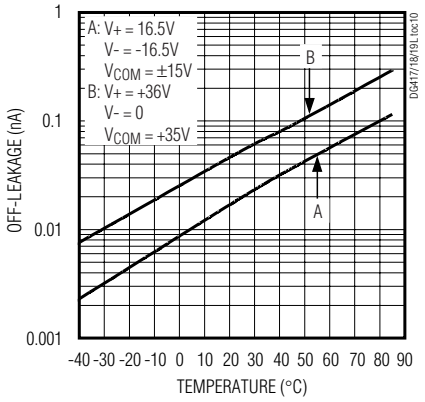
ON-LEAKAGE CURRENTS vs. TEMPERATURE



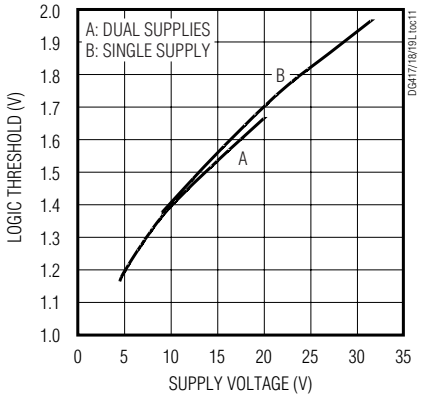
Typical Operating Characteristics (continued)

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

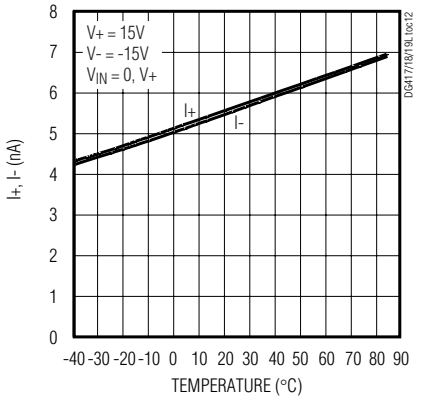
OFF-LEAKAGE CURRENTS vs. TEMPERATURE



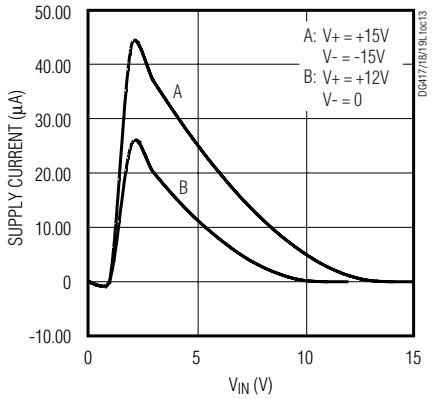
LOGIC THRESHOLD vs. SUPPLY VOLTAGE



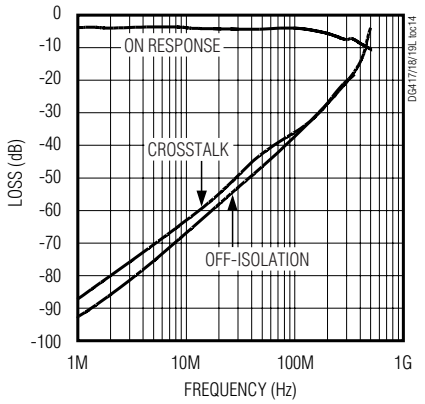
SUPPLY CURRENT vs. TEMPERATURE



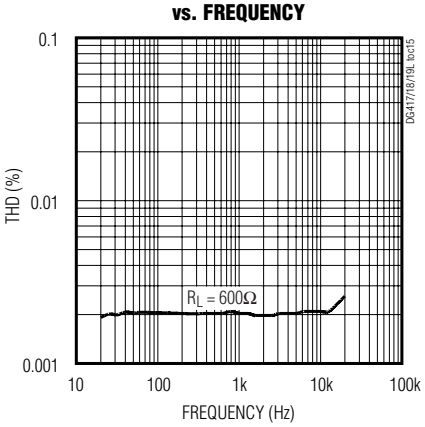
SUPPLY CURRENT vs. V_{IN}



FREQUENCY REPONSE



TOTAL HARMONIC DISTORTION vs. FREQUENCY



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

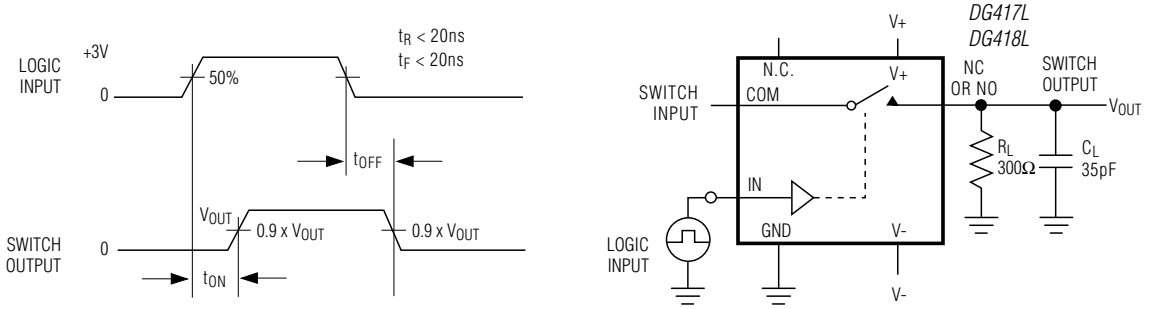


Figure 1. DG417L/DG418L Switching Time

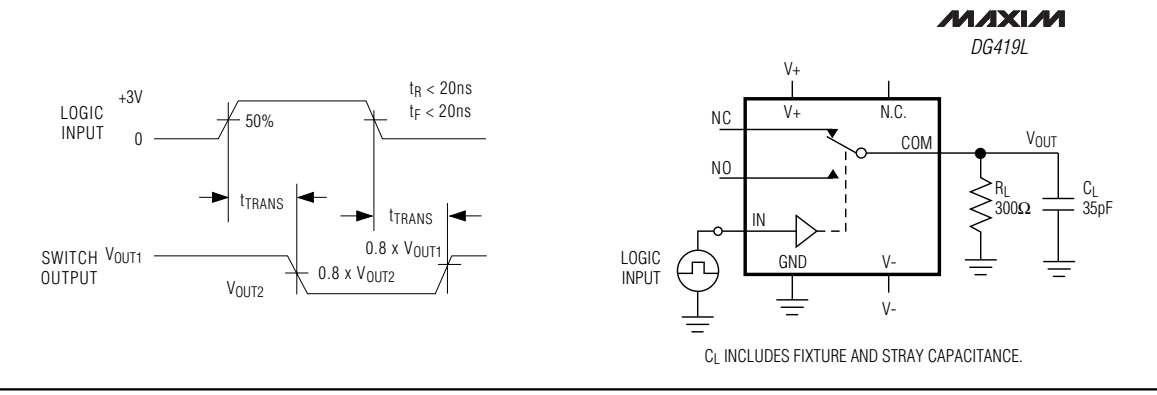


Figure 2. DG419L Transition Time

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)

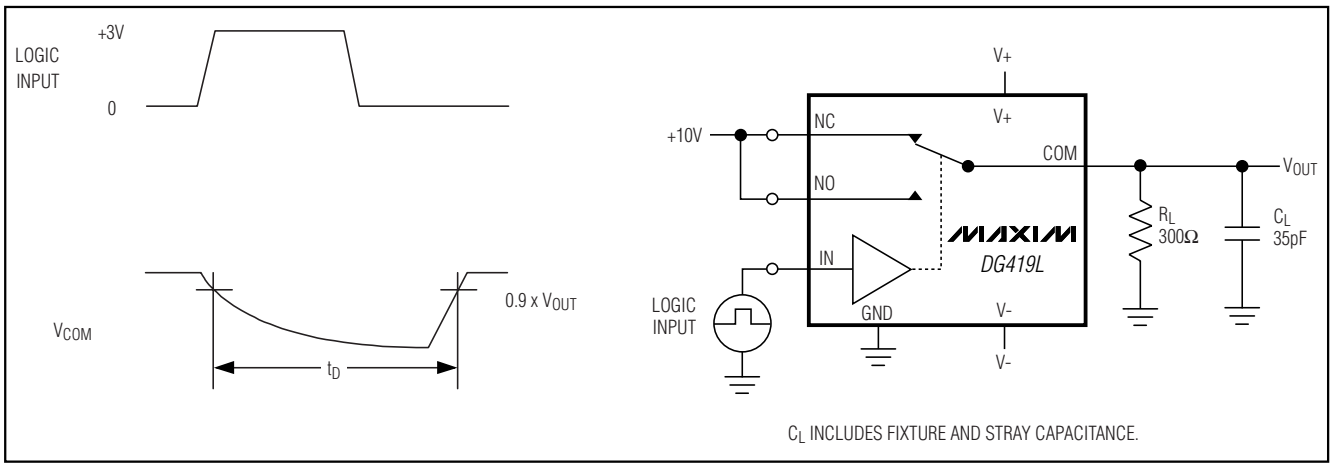


Figure 3. DG419L Break-Before-Make Interval

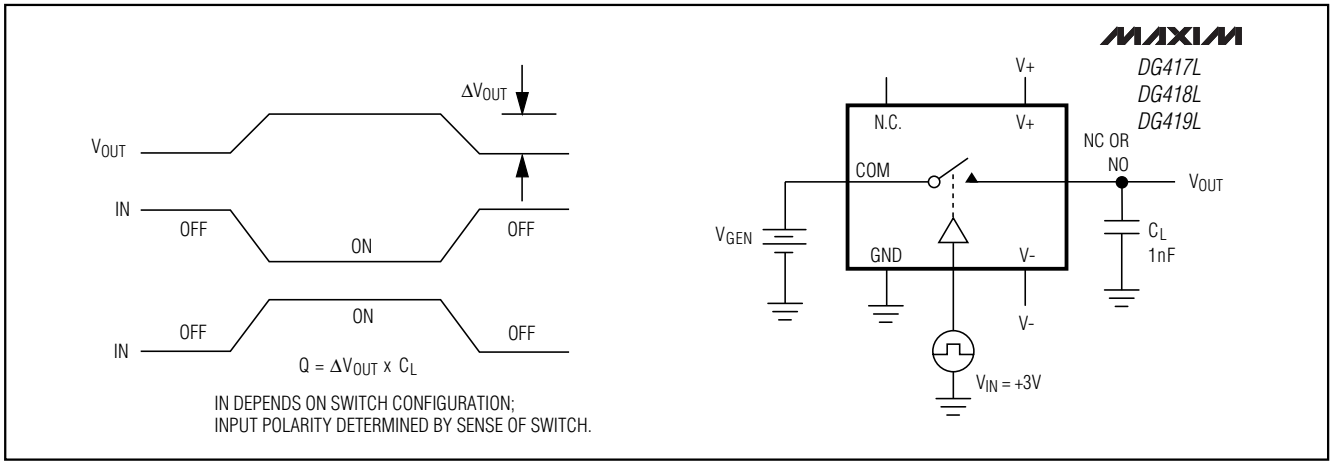


Figure 4. Charge Injection

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

Test Circuits/Timing Diagrams (continued)

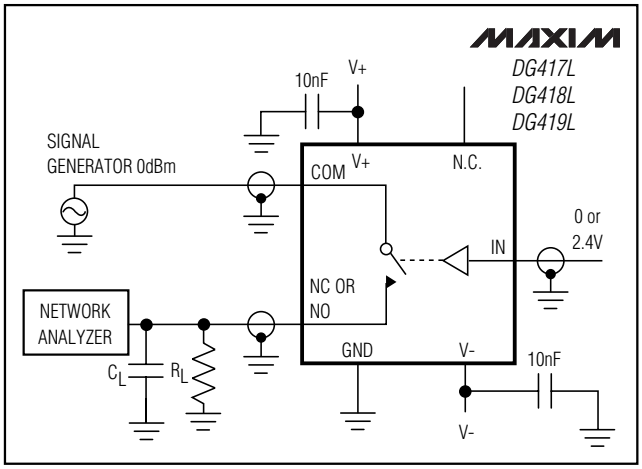


Figure 5. Off-Isolation

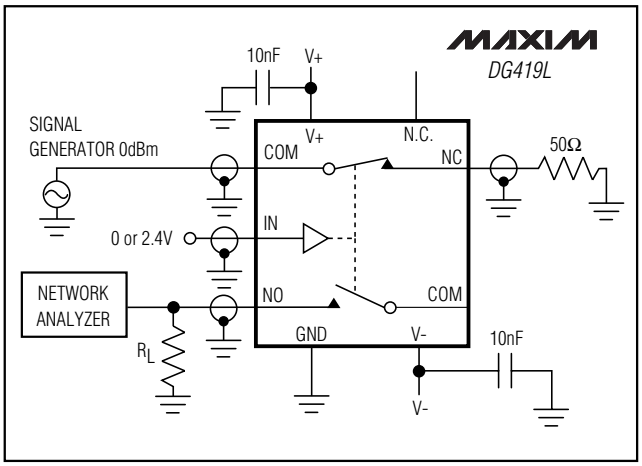


Figure 6. DG419L Crosstalk

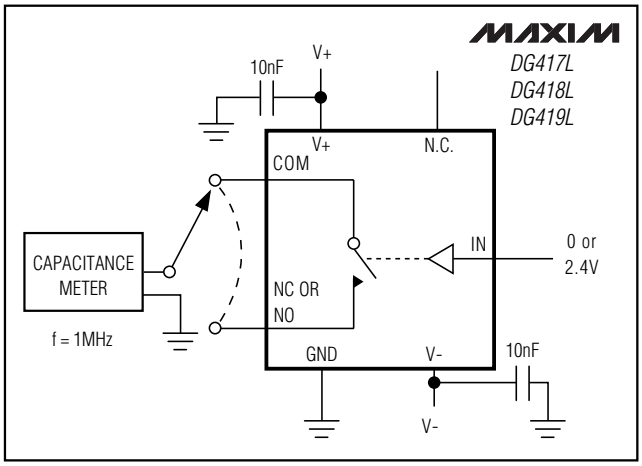


Figure 7. Channel Off-Capacitance

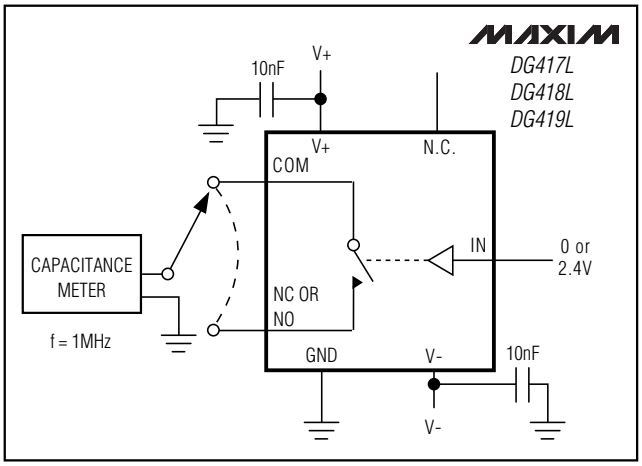


Figure 8. Channel On-Capacitance

Ordering Information (continued)

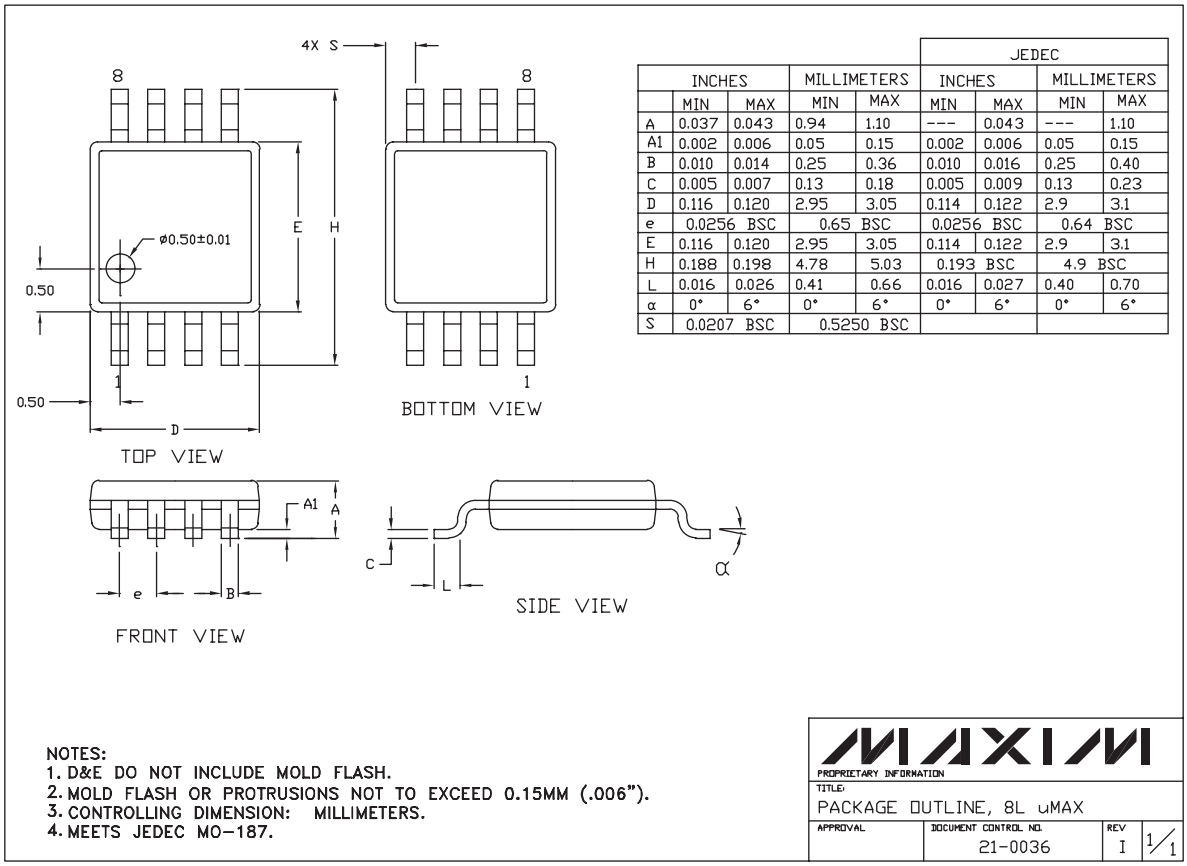
PART	TEMP. RANGE	PIN-PACKAGE
DG418LEUA	-40°C to +85°C	8 µMAX
DG418LDY	-40°C to +85°C	8 SO
DG418LDJ	-40°C to +85°C	8 Plastic DIP
DG419LEUA	-40°C to +85°C	8 µMAX
DG419LDY	-40°C to +85°C	8 SO
DG419LDJ	-40°C to +85°C	8 Plastic DIP

Chip Information

TRANSISTOR COUNT: 40

PROCESS: CMOS

Package Information



	INCHES		MILLIMETERS		JEDEC INCHES		JEDEC MILLIMETERS	
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
A	0.037	0.043	0.94	1.10	---	0.043	---	1.10
A1	0.002	0.006	0.05	0.15	0.002	0.006	0.05	0.15
B	0.010	0.014	0.25	0.36	0.010	0.016	0.25	0.40
C	0.005	0.007	0.13	0.18	0.005	0.009	0.13	0.23
D	0.116	0.120	2.95	3.05	0.114	0.122	2.9	3.1
e	0.0256 BSC		0.65 BSC		0.0256 BSC		0.64 BSC	
E	0.116	0.120	2.95	3.05	0.114	0.122	2.9	3.1
H	0.188	0.198	4.78	5.03	0.193 BSC		4.9 BSC	
L	0.016	0.026	0.41	0.66	0.016	0.027	0.40	0.70
α	0°	6°	0°	6°	0°	6°	0°	6°
S	0.0207 BSC		0.5250 BSC					

NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH.
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED 0.15MM (.006").
3. CONTROLLING DIMENSION: MILLIMETERS.
4. MEETS JEDEC MO-187.

MAXIM
PROPRIETARY INFORMATION

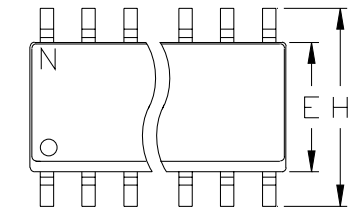
TITLE: PACKAGE OUTLINE, 8L uMAX

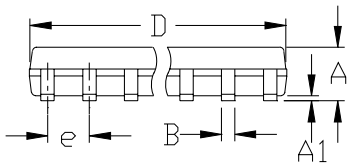
APPROVAL	DOCUMENT CONTROL NO.	REV	
	21-0036	I	1/1

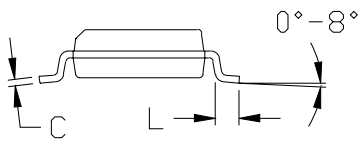
35Ω, SPST/SPDT, +3V Logic-Compatible Analog Switches

Package Information (continued)

SOICN.EPS







	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

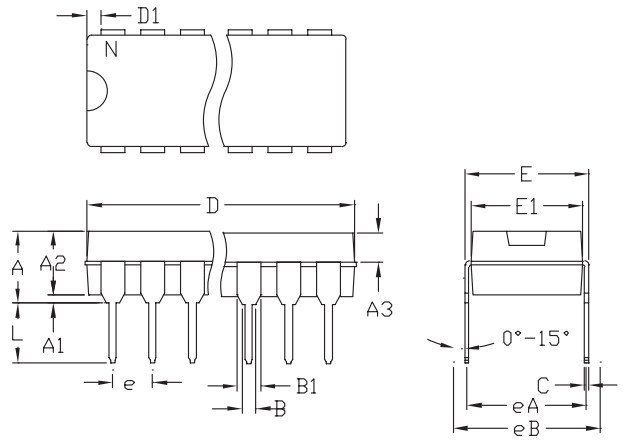
	INCHES		MILLIMETERS			
	MIN	MAX	MIN	MAX	N	MS012
D	0.189	0.197	4.80	5.00	8	A
D	0.337	0.344	8.55	8.75	14	B
D	0.386	0.394	9.80	10.00	16	C

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

MAXIM	PACKAGE FAMILY OUTLINE: SOIC .150"	1/1	21-0041 A
120 SAN GABRIEL DR SUNNYVALE CA 94086 FAX (408) 737 7194 PROPRIETARY INFORMATION	TITLE		DOCUMENT CONTROL NUMBER REV

Package Information (continued)

PDIPN.EPS



	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

NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED .15mm (.006")
3. CONTROLLING DIMENSION: MILLIMETER
4. MEETS JEDEC MS001-XX AS SHOWN IN ABOVE TABLE
5. SIMILIAR TO JEDEC MS-095-AH
6. N = NUMBER OF PINS

MAXIM 120 SAN GABRIEL DR SUNNYVALE CA 94086 FAX (408) 737 7194 PROPRIETARY INFORMATION

TITLE: PACKAGE FAMILY OUTLINE: PDIP .300" | 1/1 | 21-0043 B (DOCUMENT CONTROL NUMBER REV)