✓▲✗IM

Improved, SPST/SPDT Analog Switches

_____General Description

Maxim's redesigned DG417/DG418/DG419 precision, CMOS, monolithic analog switches now feature guaranteed on-resistance matching (3Ω max) between switches and guaranteed on-resistance flatness over the signal range (4Ω max). These switches conduct equally well in either direction and guarantee low charge injection, low power consumption, and an ESD tolerance of 2000V minimum per Method 3015.7. The new design offers low off-leakage current over temperature (less than 5nA at +85°C).

The DG417/DG418 are single-pole/single-throw (SPST) switches. The DG417 is normally closed, and the DG418 is normally open. The DG419 is single-pole/double-throw (SPDT) with one normally closed switch and one normally open switch. Switching times are less than 175ns max for t_{ON} and less than 145ns max for t_{OFF}. Operation is from a single +10V to +30V supply, or bipolar ±4.5V to ±20V supplies. The improved DG417/DG418/DG419 are fabricated with a 44V silicon-gate process.

_____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

_____New Features

♦ **Plug-In Upgrades for Industry-Standard DG417/DG418/DG419**

♦ **Improved $R_{DS(ON)}$ Match Between Channels (3Ω max, DG419 only)**

♦ **Guaranteed $R_{FLAT(ON)}$ Over Signal Range (4Ω max)**

♦ **Improved Charge Injection (10pC max)**

♦ **Improved Off-Leakage Current Over Temperature (<5nA at +85°C)**

♦ **Withstand Electrostatic Discharge (2000V min) per Method 3015.7**

_____Existing Features

♦ **Low $R_{DS(ON)}$ (35Ω max)**

♦ **Single-Supply Operation +10V to +30V Bipolar-Supply Operation ±4.5V to ±20V**

♦ **Low Power Consumption (35µW max)**

♦ **Rail-to-Rail Signal Handling**

♦ **TTL/CMOS-Logic Compatible**

_____Ordering Information

PART	TEMP. RANGE	PIN-PACKAGE
DG417CJ	0°C to +70°C	8 Plastic DIP
DG417CY	0°C to +70°C	8 SO
DG417C/D	0°C to +70°C	Dice*
DG417DJ	-40°C to +85°C	8 Plastic DIP
DG417DY	-40°C to +85°C	8 SO

Ordering Information continued at end of data sheet.

* Contact factory for dice specifications.

_____Pin Configurations/Functional Diagrams/Truth Tables

TOP VIEW

DIP/SO

DG417	
LOGIC	SWITCH
0	ON
1	OFF

DG418	
LOGIC	SWITCH
0	OFF
1	ON

DG419		
LOGIC	SWITCH 1	SWITCH 2
0	ON	OFF
1	OFF	ON

N.C. = NO INTERNAL CONNECTION

SWITCHES SHOWN FOR LOGIC "0" INPUT

_____ ***Maxim Integrated Products* 1**

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ABSOLUTE MAXIMUM RATINGS

Voltage Referenced to V-
   V+ 44V
   GND...25V
   VL ....(GND - 0.3V) to (V+ + 0.3V)
Digital Inputs V_S, V_D (Note 1) ....(V- - 2V) to (V+ + 2V) or 30mA
                  (whichever occurs first)
Continuous Current (any terminal) (Note 1) 30mA
Peak Current, S or D (pulsed at 1ms, 10% duty cycle max)..100mA

Continuous Power Dissipation (T_A = +70°C)
   Plastic DIP (derate 9.09mW/°C above +70°C) 727mW
   SO (derate 5.88mW/°C above +70°C)..........................471mW
   CERDIP (derate 8.00mW/°C above +70°C)..................640mW
Operating Temperature Ranges
   DG41_C_ ....0°C to +70°C
   DG41_D_ ....-40°C to +85°C
   DG41_AK ....-55°C to +125°C
Storage Temperature Range ....-65°C to +150°C
Lead Temperature (soldering, 10sec) ....+300°C

Note 1: Signals on S, D, or IN 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 Supplies

(V+ = +15V, V- = -15V, VL = 5V, GND = 0V, V_{INL} = 0.8V, V_{INH} = 2.4V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS			MIN	TYP (Note 2)	MAX	UNITS
SWITCH								
Analog Signal Range	$V_{S\_}$, V_D	(Note 3)			-15		15	V
Drain-Source On-Resistance	$R_{DS(ON)}$	V+ = 13.5V, V- = -13.5V, V_D = ±10V, I_S = -10mA	T_A = +25°C	C, D		20	35	Ω
				A		20	30	
			T_A = T_{MIN} to T_{MAX}				45	
On-Resistance Match Between Channels (Note 4)	$\Delta R_{DS(ON)}$	V+ = 15V, V- = -15V, V_D = ±10V, I_S = -10mA	T_A = +25°C				3	Ω
			T_A = T_{MIN} to T_{MAX}				4	
On-Resistance Flatness (Note 4)	$R_{FLAT(ON)}$	V+ = 15V, V- = -15V, V_D = ±5V, I_S = -10mA	T_A = +25°C				4	Ω
			T_A = T_{MIN} to T_{MAX}				6	
Source-Off Leakage Current (Note 5)	$I_{S(OFF)}$	V+ = 16.5V, V- = -16.5V, V_D = ±15.5V, V_S = ∓15.5V	T_A = +25°C		-0.25		0.25	nA
			T_A = T_{MIN} to T_{MAX}	C, D	-5		5	
				A	-20		20	
Drain-Off Leakage Current (Note 5)	$I_{D(OFF)}$	V+ = 16.5V, V- = -16.5V, V_D = ±15.5V, V_S = ∓15.5V	DG417/ DG418	T_A = +25°C	-0.25	0.1	0.25	nA
				T_A = T_{MIN} to T_{MAX}	C, D	-5	5	
					A	-20	20	
			DG419	T_A = +25°C	-0.75	-0.1	0.75	
				T_A = T_{MIN} to T_{MAX}	C, D	-10	10	
					A	-40	40	
Drain-On Leakage Current (Note 5)	$I_{D(ON)}$	V+ = 16.5V, V- = -16.5V, V_D = ±15.5V, V_S = ±15.5V	DG417/ DG418	T_A = +25°C	-0.4		0.4	nA
				T_A = T_{MIN} to T_{MAX}	C, D	-10	10	
					A	-40	40	
			DG419	T_A = +25°C	-0.75		0.75	
				T_A = T_{MIN} to T_{MAX}	C, D	-10	10	
					A	-40	40	

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ELECTRICAL CHARACTERISTICS—Dual Supplies (continued)

(V+ = +15V, V- = -15V, VL = 5V, GND = 0V, V_{INL} = 0.8V, V_{INH} = 2.4V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP (Note 2)	MAX	UNITS
LOGIC INPUT							
Logic Input Current with Input Voltage High	I_{INH}	V_{IN} = 2.4V		-0.5	0.005	0.5	µA
Logic Input Current with Input Voltage Low	I_{INL}	V_{IN} = 0.8V		-0.5	0.005	0.5	µA
DYNAMIC							
Turn-On Time	t_{ON}	DG417/DG418, V_D = ±10V, Figure 2	T_A = +25°C		100	175	ns
			T_A = T_{MIN} to T_{MAX}			250	
Turn-Off Time	t_{OFF}	DG417/DG418, V_D = ±10V, Figure 2	T_A = +25°C		60	145	ns
			T_A = T_{MIN} to T_{MAX}			210	
Transition Time	t_{TRANS}	DG419, V_S = ±10V, Figure 3	T_A = +25°C			175	ns
			T_A = T_{MIN} to T_{MAX}			250	
Break-Before-Make Interval	t_D	DG419, V_{S1} = V_{S2} = ±10V, Figure 4, T_A = +25°C		5	13		ns
Charge Injection (Note 3)	Q	V_{GEN} = 0V, Figure 5, T_A = +25°C			3	10	pC
Off-Isolation Rejection Ratio (Note 6)	OIRR	R_L = 500Ω, C_L = 5pF, f = 1MHz, Figure 6, T_A = +25°C			68		dB
Crosstalk (Note 7)		DG419, R_L = 50Ω, C_L = 5pF, f = 1MHz, Figure 7, T_A = +25°C			85		dB
Drain Off-Capacitance	$C_{D\,(OFF)}$	V_D = 0V, f = 1MHz, Figure 8, T_A = +25°C			8		pF
Source Off-Capacitance	$C_{S\,(OFF)}$	V_D = 0V, f = 1MHz, Figure 8, T_A = +25°C			8		pF
Drain-Source On-Capacitance	$C_{D\,(ON)}$ or $C_{S\,(ON)}$	V_S = 0V, f = 1MHz, Figure 9, T_A = +25°C	DG417/DG418		30		pF
			DG419		35		
SUPPLY							
Positive Supply Current	I+	V+ = 16.5V, V- = -16.5V, V_{IN} = 0V or 5V	T_A = +25°C	-1	-0.0001	1	µA
			T_A = T_{MIN} to T_{MAX}	-5		5	
Negative Supply Current	I-	V+ = 16.5V, V- = -16.5V, V_{IN} = 0V or 5V	T_A = +25°C	-1	-0.0001	1	µA
			T_A = T_{MIN} to T_{MAX}	-5		5	
Logic Supply Current	I_L	V+ = 16.5V, V- = -16.5V, V_{IN} = 0V or 5V	T_A = +25°C	-1	-0.0001	1	µA
			T_A = T_{MIN} to T_{MAX}	-5		5	
Ground Current	I_{GND}	V+ = 16.5V, V- = -16.5V, V_{IN} = 0V or 5V	T_A = +25°C	-1	-0.0001	1	µA
			T_A = T_{MIN} to T_{MAX}	-5		5	

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ELECTRICAL CHARACTERISTICS—Single Supply

(V+ = +12V, V- = 0V, VL = 5V, GND = 0V, V_{INH} = 2.4V, V_{INL} = 0.8V, T_A = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP (Note 2)	MAX	UNITS
SWITCH						
Analog Signal Range	V_{ANALOG}	(Note 3)	0		12	V
Drain-Source On-Resistance	$R_{DS(ON)}$	I_S = -10mA, V_D = 3.8V, V+ = 10.8V		40	100	Ω
DYNAMIC						
Turn-On Time	t_{ON}	DG417/DG418, V_D = 8V, Figure 2		110		ns
Turn-Off Time	t_{OFF}	DG417/DG418, V_D = 8V, Figure 2		40		ns
Break-Before-Make Interval	t_D	DG419, R_L = 1000Ω, C_L = 35pF, Figure 4		60		ns
Charge Injection (Note 3)	Q	C_L = 10nF, V_{GEN} = 0V, R_{GEN} = 0V, Figure 5		2	10	pC
SUPPLY						
Positive Supply Current	I+	All channels on or off, V+ = 13.2V, V_L = 5.25V, V_{IN} = 0V or 5V		-0.0001		µA
Negative Supply Current	I-	All channels on or off, V+ = 13.2V, V_L = 5.25V, V_{IN} = 0V or 5V		-0.0001		µA
Logic Supply Current	I_L	All channels on or off, V_L = 5.25V, V_{IN} = 0V or 5V		-0.0001		µA
Ground Current	I_{GND}	All channels on or off, V_L = 5.25V, V_{IN} = 0V or 5V		-0.0001		µA

Note 2: Typical values are for **design aid only**, are not guaranteed, and are not subject to production testing. 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: Guaranteed by design.

Note 4: On-resistance match between channels and flatness is guaranteed only with bipolar-supply operation. 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 $I_{S(OFF)}$, $I_{D(OFF)}$, and $I_{D(ON)}$ are 100% tested at the maximum rated hot temperature and guaranteed by correlation at +25°C.

Note 6: Off-Isolation Rejection Ratio = 20log (V_D/V_S), V_D = output, V_S = input to off switch.
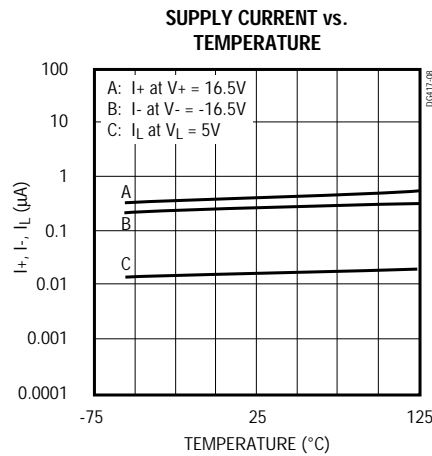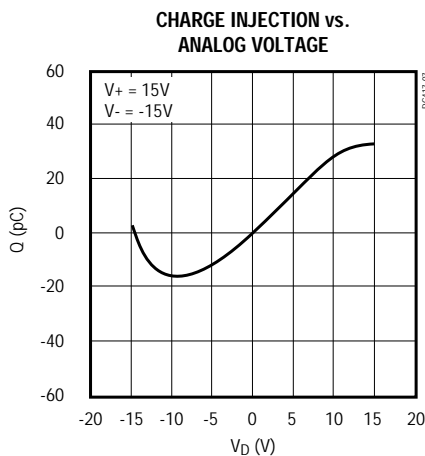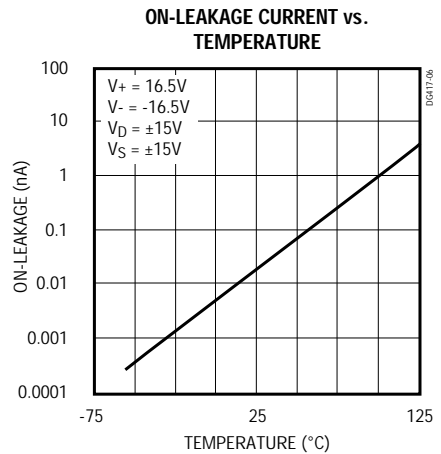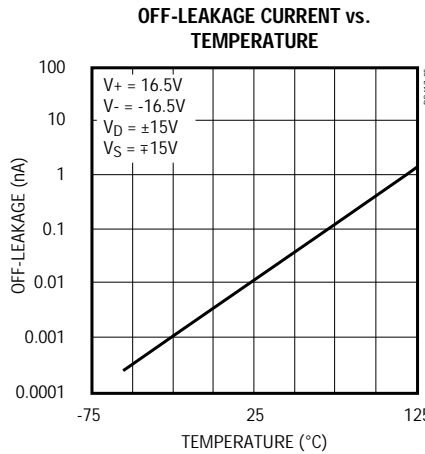
Note 7: Between any two switches.

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(T$_A$ = +25°C, unless otherwise noted.)

ON-RESISTANCE vs. V$_D$ AND POWER-SUPPLY VOLTAGE

ON-RESISTANCE vs. V$_D$ AND TEMPERATURE

ON-RESISTANCE vs. V$_D$ (SINGLE SUPPLY)

ON-RESISTANCE vs. V$_D$ AND TEMPERATURE

OFF-LEAKAGE CURRENT vs. TEMPERATURE

ON-LEAKAGE CURRENT vs. TEMPERATURE

CHARGE INJECTION vs. ANALOG VOLTAGE

SUPPLY CURRENT vs. TEMPERATURE
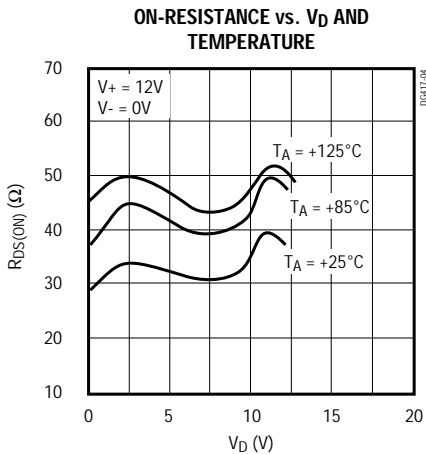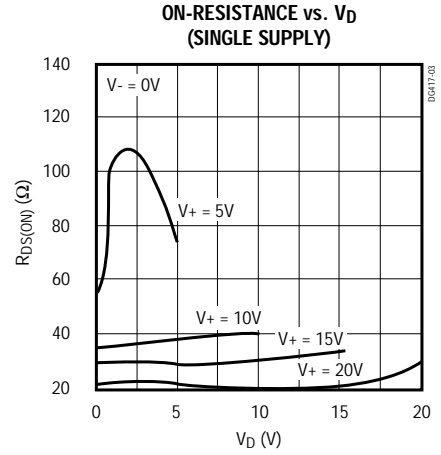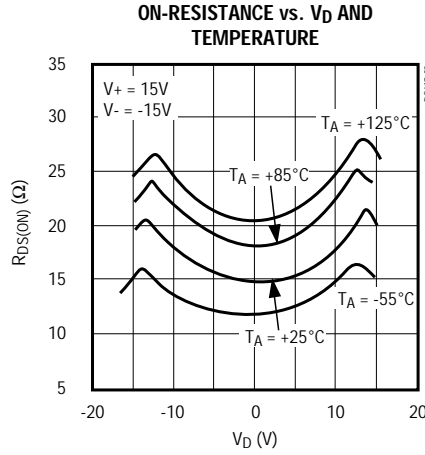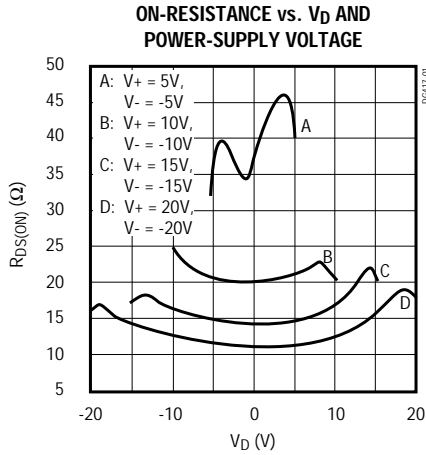
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