

## CMOS LOW VOLTAGE HIGH SPEED QUAD PRECISION ANALOG SWITCHES

### GENERAL DESCRIPTION

The ALD4211/ALD4212/ALD4213 are quad SPST CMOS analog switches specifically designed for low voltage, high speed applications where 0.2pC charge injection, 200pf sampling capacitor, and picoamp leakage current are important analog switch operating characteristics. These analog switches feature fast switching, low on-resistance and micropower consumption.

TheALD4211/4212/4213 are designed for precision applications such as charge amplifiers, sample and hold amplifiers, data converter switches, and programmable gain amplifiers. These switches are also excellent for low voltage micropower general purpose switching applications.

### **APPLICATIONS INFORMATION**

The ALD4211/4212/4213 operate with a standard single power supply from +3V to +12Volts. Functionality extends down to a +2 volt power supply making it suitable for lithium battery or rechargeable battery operated systems where power, efficiency, and performance are important design considerations. Break-before-make switching is guaranteed with single supply operation. The ALD4211/4212/4213 may also be used with dual power supplies from  $\pm 1.5$  to  $\pm 6$  volts.

With special charge balancing and charge cancellation circuitry on chip the ALD4211/ALD4212/ALD4213 were developed for ultra low charge injection applications. Using a 200pF sampling capacitor, very fast precise signal acquisition may be achieved. With ultra low quiescent current, these switches interface directly to CMOS logic levels from microprocessor or logic circuits. On the board level, low charge injection and fast operation may be achieved by using short leads, minimizing input and output capacitances, and by adequate bypass capacitors placed on the board at the supply nodes. For more information, see Application Note AN4200.

The ALD4211/ALD4212/ALD4213 are manufactured with Advanced Linear Devices enhanced ACMOS silicon gate CMOS process. They are designed also as linear cell elements in Advanced Linear Devices' "Function-Specific" ASIC.

### **ORDERING INFORMATION**

Op	Operating Temperature Range											
-55°C to +125°C	-40°C to +85°C	-40°C to +85°C										
16-Pin	16-Pin	16-Pin										
CERDIP	Plastic Dip	SOIC										
Package	Package	Package										
ALD4211 DC	ALD4211 PC	ALD4211 SC										
ALD4212 DC	ALD4212 PC	ALD4212 SC										
ALD4213 DC	ALD4213 PC	ALD4213 SC										

### LOGIC TABLE

Input Logic	Switch State											
	ALD4211	ALD4212	ALD4213									
			Switch 1 / Switch 4	Switch 2 / Switch 3								
0 1	On Off	Off On	Off On	On Off								

\* Contact factory for industrial temperature range.

FEATURES

- 3V, 5V and ±5V supply operation
- 0.2pC charge injection
- 200pF sampling capacitor
- pA leakage current
- 0.1µW power dissipation
- High precision
- Rail to rail signal range
- Low On-resistance
- Break-before-make switching

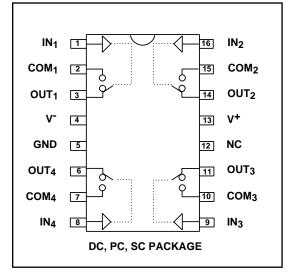
### BENEFITS

- Five times faster signal capture
- Low switching transients
- Low signal loss
- Essentially no DC power consumption
- Full analog signal range from rail to rail
- Flexible power supply range for battery operated systems

### APPLICATIONS

- · Fast sample and hold
- Computer peripherals
- PCMCIA
- Low level signal conditioning circuits
- Portable battery operated systems
- Analog signal multiplexer
- Programmable gain amplifiers
- Switched capacitor circuits
- Micropower based systems
- Video/audio switches
- Feedback control systems

### **PIN CONFIGURATION/ BLOCK DIAGRAM**



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### **ABSOLUTE MAXIMUM RATINGS**

Supply voltage, V+ referenced to V	-0.3V to +13.2V
GND	-0.3V to +13.2V
Terminal voltage range (any terminal) Note 1	(V <sup>-</sup> -0.3)V to (V <sup>+</sup> +0.3)V
Power dissipation	600 mW
Operating temperature range PC, SC package	40°C to +85°C
DC package	55°C to +125°C
Storage temperature range	-65°C to +150°C
Lead temperature, 10 seconds	+260°C
DC current (any terminal)	10mA

### POWER SUPPLY RANGE

		4211/42	212/4213 (I	PC,SC)	4211/	4212/4213	(DC)		
Parameter	Symbol	Min	Тур	Max	Min	Тур	Max	Unit	
Supply Voltage	V <sub>SUPPLY</sub>	±1.5 3.0		±6.0 12.0	±1.5 3.0		±6.0 12.0	V V	Dual Supply Single Supply

### DC ELECTRICAL CHARACTERISTICS

# $T_A = 25^{\circ}C V^{+} = +5.0V$ , $V^{-} = -5.0V GND = 0.0V$ unless otherwise specified

Symbol	4211/4	212/4213	(PC,SC)	4211	/4212/4213	(DC)		Test Conditions
	Min	Тур	Max	Min	Тур	Max	Unit	
VA	-5.0		5.0	-5.0		5.0	V	
R <sub>ON</sub>		90 120	135 190		90	135	Ω	V <sub>A</sub> = 0V I <sub>A</sub> = 1mA -40°C to +85°C
					140	210		-55°C to +125°C
$\Delta R_{ON}$		16			16		%	
$\Delta R_{ON} / \Delta T$		0.43			0.43		%/°C	
		2			2		%	
ICOML		50	100		50	100	pA	V <sub>COM</sub> = ±4.0V,V <sub>OUT</sub> = -/+4.0V -40°C to +85°C
			500			4000	рА pA	-40 C to +83 C -55°C to +125°C
IOUTL		50	100		50	100	pA	V <sub>OUT</sub> = ±4.0V, V <sub>COM</sub> = -/+4.0V -40°C to +85°C
			500			4000	рА pA	-55°C to +125°C
ID(ON)		50	100		50	100	pA	-40°C to +85°C
			500			4000	рА pA	-40°C to +85°C -55°C to +125°C
V <sub>IH</sub>	4.0			4.0				Logic "1"
V <sub>IL</sub>			0.8			0.8	V	Logic "0"
I <sub>H</sub> In			10			10	nA	
		0.01	-		0.01	-		
	V <sub>A</sub> R <sub>ON</sub> ΔR <sub>ON</sub> /ΔT ΔR <sub>ON</sub> /ΔT I <sub>COML</sub> I <sub>OUTL</sub> I <sub>D(ON)</sub> V <sub>IH</sub> V <sub>IL</sub>	Symbol         Min           V <sub>A</sub> -5.0           R <sub>ON</sub> -5.0           R <sub>ON</sub> -5.0           ΔR <sub>ON</sub> -           ΔR <sub>ON</sub> /ΔT         -           I <sub>COML</sub> -           I <sub>OUTL</sub> -           I <sub>D(ON)</sub> -           V <sub>IH</sub> 4.0           V <sub>IL</sub> -	Symbol         Min         Typ $V_A$ -5.0         90 $R_{ON}$ 1         120 $\Delta R_{ON}$ 1         16 $\Delta R_{ON}/\Delta T$ 0.43         16 $\Delta R_{ON}/\Delta T$ 0.43         2 $I_{COML}$ 1         50 $I_{OUTL}$ 50         50 $I_{OUTL}$ 50         50 $V_{IH}$ 4.0         50 $V_{IL}$ 4.0         50	VA       -5.0       5.0         RON       -5.0       5.0         RON       90       135 $\Delta$ RON       16       190 $\Delta$ RON       0.43       - $\Delta$ RON/ $\Delta$ T       0.43       -         ICOML       2       -         IOUTL       50       100         IOUTL       50       100         ID(ON)       50       100         VIH       4.0       -         VIL       0.8       -         IH       10       10	Symbol         Min         Typ         Max         Min $V_A$ -5.0         5.0         -5.0 $R_{ON}$ $1-5.0$ $135$ 190 $\Delta R_{ON}$ $116$ $190$ $1.35$ $\Delta R_{ON}/\Delta T$ $166$ $1.90$ $1.90$ $\Delta R_{ON}/\Delta T$ $0.43$ $1.6$ $1.6$ $\Delta R_{ON}/\Delta T$ $0.43$ $1.6$ $1.6$ $I_{COML}$ $2$ $1.00$ $1.00$ $I_{OUTL}$ $5.0$ $100$ $500$ $1.00$ $I_{OUTL}$ $5.0$ $100$ $500$ $1.00$ $I_{D(ON)}$ $4.0$ $500$ $100$ $500$ $4.0$ $V_{IH}$ $4.0$ $0.8$ $1.00$ <td>Symbol         Min         Typ         Max         Min         Typ           <math>V_A</math>         -5.0         5.0         -5.0         -5.0           <math>R_{ON}</math>         1-5.0         135         190         140           <math>\Delta R_{ON}</math>         16         190         140           <math>\Delta R_{ON}/\Delta T</math>         0.43         16         16         16           <math>\Delta R_{ON}/\Delta T</math>         0.43         16         0.43         2         2           <math>I COML</math>         10.43         100         50         50         50           IOUTL         150         100         500         50         50         50           ID(ON)         14.0         50         100         50         50         50           VIH         4.0         10         4.0         10         10           VIL         10         10         10         10         10</td> <td>Symbol         Min         Typ         Max         Min         Typ         Max           <math>V_A</math>         -5.0         5.0         -5.0         5.0         5.0           <math>R_{ON}</math> <math>2.0</math> <math>135</math>         90         135         90         135           <math>\Delta R_{ON}</math> <math>1.0</math> <math>16</math> <math>1.0</math> <math>140</math>         210           <math>\Delta R_{ON}/\Delta T</math> <math>0.43</math> <math>1.6</math> <math>0.43</math> <math>0.43</math> <math>0.43</math> <math>\Delta R_{ON}/\Delta T</math> <math>0.43</math> <math>0.43</math> <math>0.43</math> <math>0.43</math> <math>0.43</math> <math>I_{COML}</math> <math>0.43</math> <math>0.43</math> <math>0.43</math> <math>0.43</math> <math>0.43</math> <math>0.43</math> <math>I_{COML}</math> <math>0.43</math> <math>0.43</math> <math>0.43</math> <math>0.43</math> <math>0.43</math> <math>0.43</math> <math>I_{OOML}</math> <math>0.43</math> <math>0.43</math> <math>0.43</math> <math>0.43</math> <math>0.43</math> <math>0.43</math> <math>I_{OOML}</math> <math>0.43</math> <math>0.43</math> <math>0.43</math> <math>0.43</math> <math>0.43</math> <math>0.63</math> <math>I_{OOML}</math> <math>50</math> <math>100</math> <math>500</math> <math>100</math> <math>4000</math> <math>4000</math> <math>I_{D(ON)}</math> <math>50</math> <math>100</math> <math>500</math><!--</td--><td>Symbol         Min         Typ         Max         Min         Typ         Max         Unit           <math>V_A</math>         -5.0         5.0         5.0         -5.0         5.0         V           <math>R_{ON}</math>         90         135         190         140         210         1         <math>\Omega</math> <math>\Delta R_{ON}</math>         16         16         16         16         16         %         <math>\Lambda^{\circ}C</math> <math>\Delta R_{ON/\Delta T}</math>         0.43         2         0.43         0.43         <math>\Lambda^{\circ}C</math> <math>\Lambda^{\circ}C</math> <math>\Delta R_{ON/\Delta T}</math>         0.43         16         100         0.43         <math>\Lambda^{\circ}C</math> <math>\Lambda^{\circ}C</math> <math>\Delta R_{ON/\Delta T}</math>         50         100         500         100         <math>\Lambda^{\circ}A</math> <math>\Lambda^{\circ}C</math> <math>I_{COML}</math> <math>\Lambda^{\circ}D</math>         50         100         500         100         <math>\rho^{A}_{PA}_{PA}_{PA}</math> <math>I_{OUTL}</math> <math>\Lambda^{\circ}O</math>         500         100         500         100         <math>\rho^{A}_{PA}_{PA}_{PA}_{PA}</math> <math>V_{IH}</math> <math>4.0</math> <math>I_{IO}</math> <math>I_{IO}</math></td></td>	Symbol         Min         Typ         Max         Min         Typ $V_A$ -5.0         5.0         -5.0         -5.0 $R_{ON}$ 1-5.0         135         190         140 $\Delta R_{ON}$ 16         190         140 $\Delta R_{ON}/\Delta T$ 0.43         16         16         16 $\Delta R_{ON}/\Delta T$ 0.43         16         0.43         2         2 $I COML$ 10.43         100         50         50         50           IOUTL         150         100         500         50         50         50           ID(ON)         14.0         50         100         50         50         50           VIH         4.0         10         4.0         10         10           VIL         10         10         10         10         10	Symbol         Min         Typ         Max         Min         Typ         Max $V_A$ -5.0         5.0         -5.0         5.0         5.0 $R_{ON}$ $2.0$ $135$ 90         135         90         135 $\Delta R_{ON}$ $1.0$ $16$ $1.0$ $140$ 210 $\Delta R_{ON}/\Delta T$ $0.43$ $1.6$ $0.43$ $0.43$ $0.43$ $\Delta R_{ON}/\Delta T$ $0.43$ $0.43$ $0.43$ $0.43$ $0.43$ $I_{COML}$ $0.43$ $0.43$ $0.43$ $0.43$ $0.43$ $0.43$ $I_{COML}$ $0.43$ $0.43$ $0.43$ $0.43$ $0.43$ $0.43$ $I_{OOML}$ $0.43$ $0.43$ $0.43$ $0.43$ $0.43$ $0.43$ $I_{OOML}$ $0.43$ $0.43$ $0.43$ $0.43$ $0.43$ $0.63$ $I_{OOML}$ $50$ $100$ $500$ $100$ $4000$ $4000$ $I_{D(ON)}$ $50$ $100$ $500$ </td <td>Symbol         Min         Typ         Max         Min         Typ         Max         Unit           <math>V_A</math>         -5.0         5.0         5.0         -5.0         5.0         V           <math>R_{ON}</math>         90         135         190         140         210         1         <math>\Omega</math> <math>\Delta R_{ON}</math>         16         16         16         16         16         %         <math>\Lambda^{\circ}C</math> <math>\Delta R_{ON/\Delta T}</math>         0.43         2         0.43         0.43         <math>\Lambda^{\circ}C</math> <math>\Lambda^{\circ}C</math> <math>\Delta R_{ON/\Delta T}</math>         0.43         16         100         0.43         <math>\Lambda^{\circ}C</math> <math>\Lambda^{\circ}C</math> <math>\Delta R_{ON/\Delta T}</math>         50         100         500         100         <math>\Lambda^{\circ}A</math> <math>\Lambda^{\circ}C</math> <math>I_{COML}</math> <math>\Lambda^{\circ}D</math>         50         100         500         100         <math>\rho^{A}_{PA}_{PA}_{PA}</math> <math>I_{OUTL}</math> <math>\Lambda^{\circ}O</math>         500         100         500         100         <math>\rho^{A}_{PA}_{PA}_{PA}_{PA}</math> <math>V_{IH}</math> <math>4.0</math> <math>I_{IO}</math> <math>I_{IO}</math></td>	Symbol         Min         Typ         Max         Min         Typ         Max         Unit $V_A$ -5.0         5.0         5.0         -5.0         5.0         V $R_{ON}$ 90         135         190         140         210         1 $\Omega$ $\Delta R_{ON}$ 16         16         16         16         16         % $\Lambda^{\circ}C$ $\Delta R_{ON/\Delta T}$ 0.43         2         0.43         0.43 $\Lambda^{\circ}C$ $\Lambda^{\circ}C$ $\Delta R_{ON/\Delta T}$ 0.43         16         100         0.43 $\Lambda^{\circ}C$ $\Lambda^{\circ}C$ $\Delta R_{ON/\Delta T}$ 50         100         500         100 $\Lambda^{\circ}A$ $\Lambda^{\circ}C$ $I_{COML}$ $\Lambda^{\circ}D$ 50         100         500         100 $\rho^{A}_{PA}_{PA}_{PA}$ $I_{OUTL}$ $\Lambda^{\circ}O$ 500         100         500         100 $\rho^{A}_{PA}_{PA}_{PA}_{PA}$ $V_{IH}$ $4.0$ $I_{IO}$

# AC ELECTRICAL CHARACTERISTICS $T_A = 25^{\circ}C V + = +5.0V, V - = -5.0V, GND = 0.0V$ unless otherwise specified

		4211/	4212/42	13(PC)	4211/4	4212/42 <sup>.</sup>	13(DC)	4211/	4212/42	13(SC)		
Parameter	Symbol	Min	Тур	Max	Min	Тур	Max	Min	Тур	Max	Unit	Test Conditions
Turn On Delay time	t <sub>ON</sub>		60	130		60	130		60	130	ns	(Note 2)
Turn Off Delay time	tOFF		60	130		60	130		60	130	ns	(Note 2)
Charge Injection	Q <sub>INJ</sub>		0.2	1.0		0.2	1.0		0.2	1.0	рС	(Note 3) (Note 4)
Off Isolation			75			75			75		dB	At f = 100KHz, (Note 5)
Crosstalk			90			90			90		dB	At f = 100KHz, (Note 6)
Total Harmonic Distortion	T <sub>HD</sub>		0.05 0.01			0.05 0.01			0.05 0.01		%	R <sub>L</sub> = 10K R <sub>L</sub> = 100K
Com/Out Off Capacitance	COM(OFF) OUT(OFF)		3.0			3.0			3.0		pF	
Channel On Capacitance	C <sub>DS (ON)</sub>		5.7			5.7			5.7		pF	
Pin to Pin Capacitance	С <sub>РР</sub>		0.5			0.6			0.25		pF	

### DC ELECTRICAL CHARACTERISTICS TA = $25^{\circ}$ C Vt = $\pm 5.0$ V, Vc = GND = 0.0V, upless otherwise si

 $T_A$  = 25°C V+ = +5.0V, V- = GND = 0.0V unless otherwise specified

Symbol	4211/421	2/4213 (PC	C,SC)	4211/4	212/4213 (1	DC)		Test Conditions
	Min	Тур	Max	Min	Тур	Max	Unit	
VA	0.0		+5.0	0.0		+5.0	V	
R <sub>ON</sub>		195 250	280 365		195	280	Ω	V <sub>A</sub> = 0V I <sub>A</sub> = 1mA -40°C to +85°C
					270	390		-55°C to +125°C
$\Delta R_{ON}$		20			20		%	
$\Delta R_{ON} / \Delta T$		0.43			0.43		%/°C	
		2			2		%	
ICOML		50	100 500		50	100	pA pA	V <sub>COM</sub> = 1 to 4V,V <sub>OUT</sub> = 4 to 1V -40°C to +85°C
						4000	pА	-55°C to +125°C
IOUTL		50	100 500		50	100	рА pA	V <sub>OUT</sub> = 1 to 4V,V <sub>COM</sub> = 4 to 1V -40°C to +85°C
						4000	pА	-55°C to +125°C
I <sub>D(ON)</sub>		50	100		50	100	pА	4000 10 00500
			500			4000	рА pA	-40°C to +85°C -55°C to +125°C
$V_{\rm IH}$	4.0			4.0				Logic "1"
V <sub>IL</sub>			0.8			0.8	V	Logic "0"
I <sub>IH</sub> I <sub>IL</sub>			10			10	nA	
ISUPPLY		0.01	1		0.01	1	μA	
-	VA           RON           ΔRON           ΔRON/ΔΤ           ICOML           IOUTL           IOUTL           VIH           VIL           IIH           IIL	Symbol         Min           V <sub>A</sub> 0.0           R <sub>ON</sub> 0.0           A <sub>RON</sub>	Symbol         Min         Typ $V_A$ 0.0         195 $R_{ON}$ 195         250 $\Delta R_{ON}$ 20         20 $\Delta R_{ON}/\Delta T$ 0.43         20 $\Delta R_{ON}/\Delta T$ 0.43         20 $I_{COML}$ 2         2 $I_{OUTL}$ 50         50 $I_{D(ON)}$ 50         50 $V_{IH}$ 4.0         50 $V_{IL}$ 1         50	VA       0.0       +5.0         RON       195       280 $\Delta R_{ON}$ 20       20 $\Delta R_{ON}/\Delta T$ 0.43       -         ICOML       20       100         IOUTL       50       100         IOUTL       50       100         IOUTL       50       100         VIH       4.0       50         VIH       4.0       0.8         IIH       10       10	Symbol         Min         Typ         Max         Min $V_A$ 0.0         +5.0         0.0 $R_{ON}$ 195         280         365 $\Delta R_{ON}$ 20         20         365 $\Delta R_{ON}/\Delta T$ 20         20         20 $\Delta R_{ON}/\Delta T$ 0.43         20         20 $ICOML$ 20         100         20           ICOML         50         100         500           IOUTL         50         100         20           ID(ON)         50         100         500           VIH         4.0         50         100           VIL         6.0.8         4.0           IH         10         10	Symbol         Min         Typ         Max         Min         Typ $V_A$ 0.0         +5.0         0.0         195         280         365         195 $R_{ON}$ 195         250         365         120         270 $\Delta R_{ON}$ 2.0         20         1.0         20         20 $\Delta R_{ON}/\Delta T$ 0.43         1.0         0.43         20 $\Delta R_{ON}/\Delta T$ 0.43         1.0         0.43         20 $\Delta R_{ON}/\Delta T$ 0.43         1.0         2.0         20 $\Delta R_{ON}/\Delta T$ 50         100         50         50         50           ICOML         1.0         50         100         50         50           IOUTL         50         50         100         50         50           VIH         4.0         1.0         4.0         1.0         50           VIL         1.0         0.8         1.0         1.0         1.0	Symbol         Min         Typ         Max         Min         Typ         Max $V_A$ 0.0         +5.0         0.0         +5.0         195         280         195         280         365         195         280         390 $\Delta R_{ON}$ 20          210         270         390 $\Delta R_{ON}/\Delta T$ 20          20         20         390 $\Delta R_{ON}/\Delta T$ 0.43          0.43          100 $\Delta R_{ON}/\Delta T$ 0.43          0.43 $\Delta R_{ON}/\Delta T$ 0.43           0.43	Symbol         Min         Typ         Max         Min         Typ         Max         Unit $V_A$ 0.0         +5.0         0.0         +5.0         V $R_{ON}$ 195         280         365         195         280         390 $\Omega$ $\Delta R_{ON}$ 2         20         365         270         390 $\mathcal{I}$ $\Delta R_{ON}$ 2         20         20         20 $\mathcal{I}$

Notes: 1. Voltage on any terminal must be less than (V+) + 0.3V and greater than (V-) - 0.3V, at all times including before power is applied and V+=V-=0.0V. Vsupply power supply needs to be sequenced on first on power turn-on and sequenced off last during power turn-off. 2. See Switching Time Test Circuit. Break-before-make time is not guaranteed. Turn on and turn off time may overlap. 3. Guaranteed by design. 4. See Charge Injection Test Circuit 5. See Off Isolation Test Circuit 6. See Crosstalk Test Circuit. 7. See switching time test circuit.

ALD4211/ALD4212 ALD4213

		4211/4	212/421	3 (PC)	4211/4	212/42	13 (DC)	4211/	4212/42			
Parameter	Symbol	Min	Тур	Max	Min	Тур	Max	Min	Тур	Max	Unit	Test Conditions
Turn On Delay time	t <sub>ON</sub>		85	170		85	170		85	170	ns	(Note 7)
Turn Off Delay time	tOFF		46	90		46	90		46	90	ns	(Note 7)
Break-Before-Make Delay Time	t <sub>BD</sub>	15	40		15	40		15	40		ns	
Charge Injection	Q <sub>INJ</sub>		0.2	1.0		0.2	1.0		0.2	1.0	рС	(Note 3) (Note 4)
Off Isolation			75			75			75		dB	At f = 100KHz, (Note 5)
Crosstalk			90			90			90		dB	At f = 100KHz, (Note 6)
Total Harmonic Distortion	T <sub>HD</sub>		0.05 0.01			0.05 0.01			0.05 0.01		%	R <sub>L</sub> = 10K R <sub>L</sub> = 100K
Com/Out Off Capacitance	COM(OFF) OUT(OFF)		3.0			3.0			3.0		pF	
Channel On Capacitance	C <sub>DS (ON)</sub>		5.7			5.7			5.7		pF	
Pin to Pin Capacitance	C <sub>PP</sub>		0.5			0.6			0.25		pF	

### AC ELECTRICAL CHARACTERISTICS T<sub>A</sub> = $25^{\circ}$ C V+ = +5.0V, V- = GND = 0.0V unless otherwise specified

The ALD4211/ALD4212/ALD4213 feature very high precision due to these factors:

- 1. The analog switch has ultra low capacitive charge coupling so that the charge stored on a 200pF sampling capacitor is minimally affected.
- 2. With special charge balancing and charge cancellation circuitry designed on chip, the ALD4211/ALD4212/ ALD4213 achieves ultra low charge injection of typically only 0.2pC resulting in extremely low signal distortion to the external circuit.
- 3. The analog switch switching transistors have pA leakage currents minimizing the droop rate of the sampling circuit.
- 4. The internal switch timing allows for the analog switch to turn off internally without producing any residual transistor channel charge injection, which may affect external circuits. With a low loss polystyrene or polypropylene sampling capacitor, long data retention times are possible without significant signal loss.

The ALD4211/ALD4212/ALD4213 CMOS analog switches, when used with industry standard pinout connection, have the input and output pins reversed with the signal source input connected to OUT pins and COM pins used as output pins. In this connection and when used with 1,000pF or greater value capacitors, or when connected to a DC current or resistive load, the switch would not be operating in an ultra low charge injection mode. Typical charge injection, in this case, would be 5pC as the pin to pin capacitive coupling effect would dominate. In this connection, all the other characteristics of the ALD4211/ALD4212/ALD4213 CMOS analog switches remain the same.

### DC ELECTRICAL CHARACTERISTICS $T_A = 25^{\circ}C V + = +3.0V$ , V<sup>-</sup> = GND = 0.0V unless otherwise specified

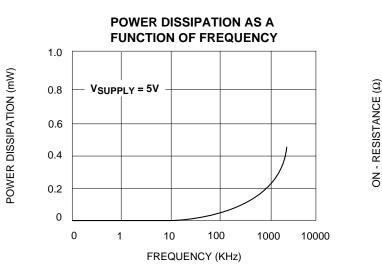
		4211/4	212/4213	(PC,SC)	4211/	/4212/4213	(DC)		
Parameter	Symbol	Min	Тур	Max	Min	Тур	Max	Unit	Test Conditions
Analog Signal Range	VA	0.0		3.0	0.0		3.0	V	
On - Resistance	R <sub>ON</sub>		500 620	700 880		500 680	700 1000	Ω	$V_A = 0V I_A = 1mA$ -40°C to +85°C -55°C to +125°C
Change of On-Resistance from -VS to +VS	ΔR <sub>ON</sub>		43			43	1000	%	
Change of On-Resistance with Temperature	ΔR <sub>ON</sub> /ΔT		0.27			0.27		%/°C	
R <sub>ON</sub> Match Between Switches			2			2		%	
Off Com Leakage Current	ICOML		50	100 500		50	100 4000	pA pA pA	V <sub>COM</sub> = 1 to 2V,V <sub>OUT</sub> = 2 to 1V -40°C to +85°C -55°C to +125°C
Off Out Leakage Current	Ioutl		50	100 500		50	100 4000	pA pA pA	V <sub>OUT</sub> = 1 to 2V,V <sub>COM</sub> = 2 to 1V -40°C to +85°C -55°C to +125°C
Channel On Leakage Current	I <sub>D(ON)</sub>		50	100 500		50	100 4000	pA pA pA	-40°C to +85°C -55°C to +125°C
Input High Voltage	V <sub>IH</sub>	2.4			2.4				Logic "1"
Input Low Voltage	V <sub>IL</sub>			0.8			0.8	V	Logic "0"
Input High or Input Low Current	I <sub>IH</sub> I <sub>IL</sub>			10			10	nA	
Supply Current	ISUPPLY		0.01	1		0.01	1	μA	

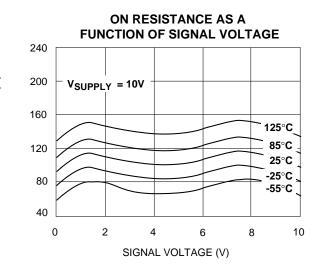
AC ELECTRICAL CHARACTERISTICS  $T_A$  = 25°C V+ = +3.0V, V- = GND = 0.0V unless otherwise specified

		4211/	4212/42	13 (PC)	4211/4	4212/42	13 (DC)	4211/4	4212/42	13 (SC)		
Parameter	Symbol	Min	Тур	Max	Min	Тур	Max	Min	Тур	Max	Unit	Test Conditions
Turn On Delay time	t <sub>ON</sub>		160	300		160	300		160	300	ns	(Note 7)
Turn Off Delay time	tOFF		78	1500		78	150		78	150	ns	(Note 7)
Break-Before-Make Delay Time	t <sub>BD</sub>	20	82		20	82		20	82		ns	
Charge Injection	Q <sub>INJ</sub>		0.2	0.5		0.2	0.5		0.2	0.5	рС	(Note 3) (Note 4)
Off Isolation			75			75			75			dB At f = 100KHz, (Note 5)
Crosstalk			90			90			90			dB At f = 100KHz, (Note 6)
Total Harmonic Distortion	T <sub>HD</sub>		0.05 0.01			0.05 0.01			0.05 0.01		%	R <sub>L</sub> = 10K R <sub>L</sub> = 100K
Com/Out Off Capacitance	COM(OFF) OUT(OFF)		3.0			3.0			3.0		pF	
Channel On Capacitance	C <sub>DS (ON)</sub>		5.7			5.7			5.7		pF	
Pin to Pin Capacitance	Срр		0.5			0.6			0.25		pF	

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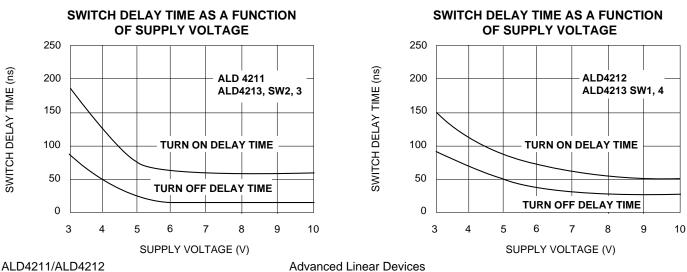
### **TYPICAL PERFORMANCE CHARACTERISTICS**





**ON RESISTANCE AS A** FUNCTION OF SIGNAL VOLTAGE 500 400  $V_{SUPPLY} = 5V$ 300 125°C 85°C 200 25°C 25°C 55°C 100 0 1 2 0 3 4 5 SIGNAL VOLTAGE (V)

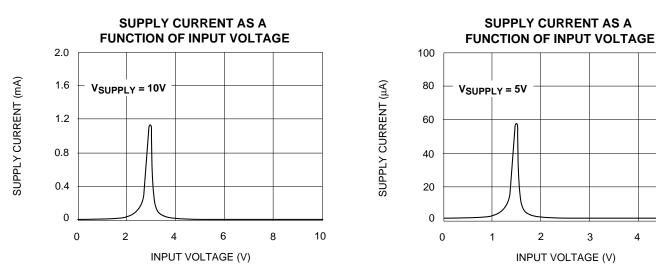
**ON RESISTANCE AS A** FUNCTION OF SIGNAL VOLTAGE 850 V<sub>SUPPLY</sub> = 3V 700 550 125°C 400 85°C 25°C 250 25°C 55°C 100 0 0.6 1.2 1.8 2.4 3.0 SIGNAL VOLTAGE (V)

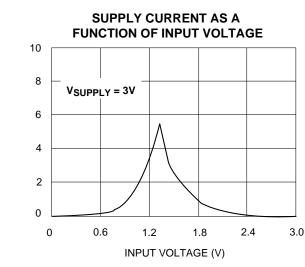


ON - RESISTANCE (Ω)

ON - RESISTANCE (Ω)

### **TYPICAL PERFORMANCE CHARACTERISTICS**



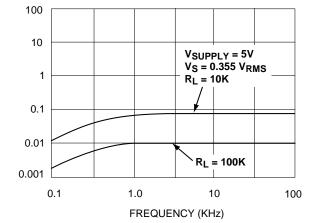


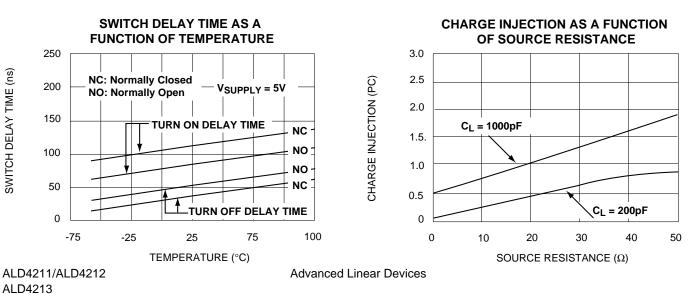
SUPPLY CURRENT (µA)

TOTAL HARMONIC DISTORTION AS A FUNCTION OF FREQUENCY

4

5



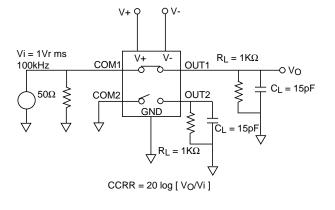


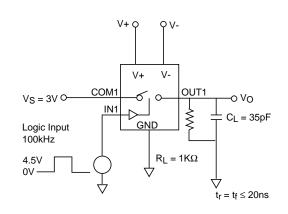
TOTAL HARMONIC DISTORTION (%)

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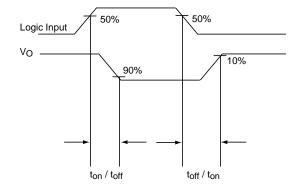
### **TEST CIRCUITS**

### **CROSSTALK TEST CIRCUIT**

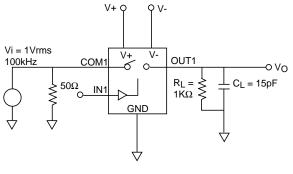




SWITCHING TIME TEST CIRCUIT

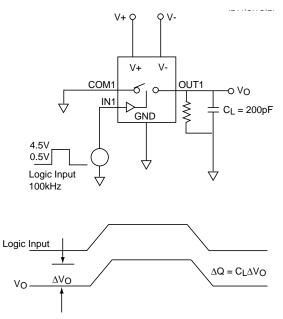


OFF ISOLATION TEST CIRCUIT

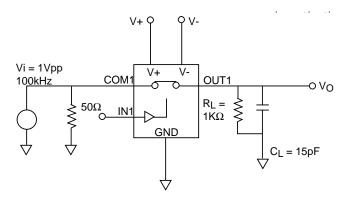


 $Q_{IRR} = 20 \log (V_O/V_i)$ 

### CHARGE INJECTION TEST CIRCUIT



### TOTAL HARMONIC DISTORTION TEST CIRCUIT



ALD4211/ALD4212 ALD4213

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