Precision Monolithic Quad SPST Low-Voltage CMOS Analog Switches

FEATURES

- 2.7- thru 12-V Single Supply or ±3- thru ±6-Dual Supply
- On-Resistance—$r_{DS(on)}$: 17 Ω
- Fast Switching—t_{ON}: 19 ns
  —t_{OFF}: 12 ns
- TTL, CMOS Compatible
- Low Leakage: 0.25 nA
- 2000-V ESD Protection

BENEFITS

- Widest Dynamic Range
- Low Signal Errors and Distortion
- Break-Before-Make Switching Action
- Simple Interfacing

APPLICATIONS

- Precision Automatic Test Equipment
- Precision Data Acquisition
- Communication Systems
- Battery Powered Systems
- Computer Peripherals
- SDSL, DSLAM
- Audio and Video Signal Routing

DESCRIPTION

The DG441L/442L are low voltage pin-for-pin compatible companion devices to the industry standard DG441L/442L with improved performance

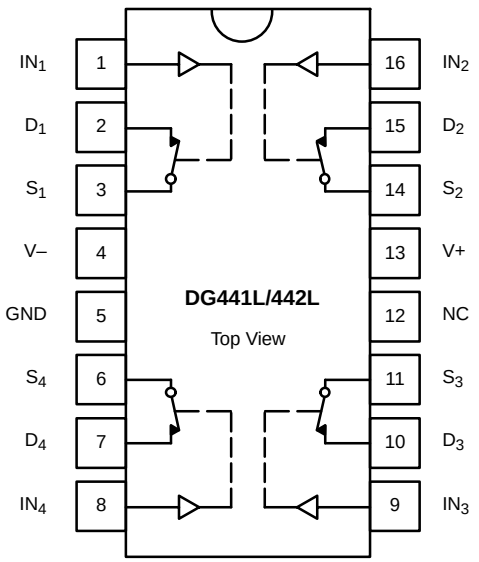
Using BiCMOS wafer fabrication technology allows the DG441L/442L to operate on single and dual supplies. Single supply voltage ranges from 3 to 12 V while dual supply operation is recommended with ±3 to ±6 V.

Combining high speed (t_{ON}: 19 ns), flat $r_{DS(on)}$ over the analog signal range (5 Ω), minimal insertion lose (–3 dB at 280 MHz), and excellent crosstalk and off-isolation performance (–50 dB at 50 MHz), the DG441L/442L are ideally suited for audio and video signal switching.

The DG441L/442L responds to opposite control logic as shown in the Truth Table. open and two normally closed switches.

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION

TSSOP and SOIC



TRUTH TABLE		
Logic	**DG441L**	**DG442L**
0	ON	OFF
1	OFF	ON

Logic "0" ≤ 0.8 V
Logic "1" ≥ 2.4 V

ORDERING INFORMATION		
Temp Range	**Package**	**Part Number**
–40 to 85°C	16-Pin TSSOP	DG441LDQ
		DG442LDQ
	16-Pin Narrow SOIC	DG441LDY
		DG442LDY

ABSOLUTE MAXIMUM RATINGS

V+ to V– ..... –0.3 to 13 V
GND to V– ..... 7 V
Digital Inputs[a] V_S, V_D ..... GND –0.3 to (V+ + 0.3 V)
or 30 mA, whichever occurs first
Continuous Current (Any Terminal) ..... 30 mA
Current, S or D (Pulsed 1 ms, 10% duty cycle) ..... 100 mA
Storage Temperature: (DQ, DY Suffix) ..... –65 to 125°C

Power Dissipation (Package)b
16-Pin TSSOP[c] ..... 450 mW
16-Pin Narrow Body SOIC[d] ..... 650 mW

Notes:
a. Signals on S_X, D_X, or IN_X exceeding V+ or V– will be clamped by internal diodes. Limit forward diode current to maximum current ratings.
b. All leads welded or soldered to PC Board.
c. Derate 7 mW/°C above 75°C
d. Derate 7.6 mW/°C above 75°C

SPECIFICATIONS[a] (SINGLE SUPPLY 12 V)

Parameter	Symbol	Test Conditions Unless Specified V+ = 12 V, V– = 0 V V_L = 5 V, V_{IN} = 2.4 V, 0.8 V[f]	Temp[b]	Limits –40 to 85°C Min[d]	Typ[c]	Max[d]	Unit
Analog Switch							
Analog Signal Range[e]	V_{ANALOG}		Full	0		12	V
Drain-Source On-Resistance	$r_{DS(on)}$	V+ = 10.8 V, V– = 0 V I_S = –10 mA, V_D = 2/9 V	Room Full		20	30 40	Ω
Switch Off Leakage Current	$I_{S(off)}$	V_D = 1/11 V, V_S = 11/1 V	Room Full	–0.25 –5	±0.1	0.25 5	nA
	$I_{D(off)}$		Room Full	–0.25 –5	±0.1	0.25 5	
Channel On Leakage Current	$I_{D(on)}$	V_S = V_D = 11/1 V	Room Full	–0.4 –5	±0.1	0.4 5	
Digital Control							
Input Current, V_{IN} Low	I_{IL}	V_{IN} Under Test = 0.8 V	Full	–1	0.01	1	µA
Input Current, V_{IN} High	I_{IH}	V_{IN} Under Test = 2.4 V	Full	–1		1	
Dynamic Characteristics							
Turn-On Time	t_{ON}	R_L = 300 Ω, C_L = 35 pF V_S = 5 V See Figure 2	Room Full		20	50 60	ns
Turn-Off Time	t_{OFF}		Room Full		12	30 40	
Charge Injection[e]	Q	V_g = 0 V, R_g = 0 Ω, C_L = 10 nF	Room		5		pC
Off Isolation[e]	OIRR	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz	Room		71		dB
Channel-to-Channel Crosstalk[e]	X_{TALK}		Room		95		
Source Off Capacitance[e]	$C_{S(off)}$	f = 1 MHz	Room		5		pF
Drain Off Capacitance[e]	$C_{D(off)}$		Room		6		
Channel On Capacitance[e]	$C_{D(on)}$		Room		15		
Power Supplies							
Positive Supply Current	I+	V_{IN} = 0 or 5 V	Full		10	100	µA
Negative Supply Current	I–		Room Full	–1 –5	–0.002		
Ground Current	I_{GND}		Full	–100	–10		

SPECIFICATIONS[a] (DUAL SUPPLY ±5 V)

Parameter	Symbol	Test Conditions Unless Specified V+ = 5 V, V– = –5 V V_L = 5 V, V_{IN} = 2.4 V, 0.8 V[f]	Temp[b]	Limits –40 to 85°C Min[d]	Typ[c]	Max[d]	Unit
Analog Switch							
Analog Signal Range[e]	V_{ANALOG}		Full	–5		5	V
Drain-Source On-Resistance	$r_{DS(on)}$	V+ = 5 V, V– = –5 V I_S = –10 mA, V_D = ±3.5 V	Room Full		20	30 40	Ω
Switch Off Leakage Current[g]	$I_{S(off)}$	V+ = 5 V, V– = –5 V V_D = ±4.5 V, V_S = ∓4.5 V	Room Full	–0.25 –5	±0.1 ±0.5	0.25 5	nA
	$I_{D(off)}$		Room Full	–0.25 –5	±0.1	0.25 5	
Channel On Leakage Current[g]	$I_{D(on)}$	V+ = 5 V, V– = –5 V V_S = V_D = ±4.5 V	Room Full	–0.4 –5	±0.1 ±0.5	0.4 5	
Digital Control							
Input Current, V_{IN} Low[e]	I_{IL}	V_{IN} Under Test = 0.8 V	Full	–1	0.05	1	µA
Input Current, V_{IN} High[e]	I_{IH}	V_{IN} Under Test = 2.4 V	Full	–1	0.05	1	
Dynamic Characteristics							
Turn-On Time	t_{ON}	R_L = 300 Ω, C_L = 35 pF V_S = ±3.5 V See Figure 2	Room Full		21	50 60	ns
Turn-Off Time	t_{OFF}		Room Full		16	35 40	
Charge Injection[e]	Q	V_g = 0 V, R_g = 0 Ω, C_L = 10 nF	Room		5		pC
Off Isolation[e]	OIRR	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz	Room		68		dB
Channel-to-Channel Crosstalk[e]	X_{TALK}		Room		85		
Source Off Capacitance[e]	$C_{S(off)}$	f = 1 MHz	Room		9		pF
Drain Off Capacitance[e]	$C_{D(off)}$		Room		9		
Channel On Capacitance[e]	$C_{D(on)}$		Room		20		
Power Supplies							
Positive Supply Current[e]	I+	V_{IN} = 0 or 5 V	Full		10	100	µA
Negative Supply Current[e]	I–		Room Full	–1 –5	–0.002		
Ground Current[e]	I_{GND}		Full	–100	–10		

SPECIFICATIONS[a] (SINGLE SUPPLY 5 V)

Parameter	Symbol	Test Conditions Unless Specified V+ = 5 V, V– = 0 V V_L = 5 V, V_{IN} = 2.4 V, 0.8 V[f]	Temp[b]	Limits –40 to 85°C Min[d]	Typ[c]	Max[d]	Unit
Analog Switch							
Analog Signal Range[e]	V_{ANALOG}		Full	0		5	V
Drain-Source On-Resistance[e]	$r_{DS(on)}$	V+ = 4.5 V, I_S = –5 mA V_D = 1 V, 3.5 V	Room Full		35	50 75	Ω
Dynamic Characteristics							
Turn-On Time[e]	t_{ON}	R_L = 300 Ω, C_L = 35 pF V_S = 3.5 V, See Figure 2	Room Hot		27	50 60	ns
Turn-Off Time[e]	t_{OFF}		Room Hot		15	30 40	
Charge Injection[e]	Q	V_g = 0 V, R_g = 0 Ω, C_L = 10 nF	Room		0.5		pC

SPECIFICATIONS[a] (SINGLE SUPPLY 5 V)

Parameter	Symbol	Test Conditions Unless Specified V+ = 5 V, V– = 0 V V_L = 5 V, V_{IN} = 2.4 V, 0.8 V[f]	Temp[b]	Limits –40 to 85°C Min[d]	Typ[c]	Max[d]	Unit
Power Supplies							
Positive Supply Current[e]	I+	V_{IN} = 0 or 5 V	Full		10	100	µA
Negative Supply Current[e]	I–		Room Full	–1 –5	–0.002		
Ground Current[e]	I_{GND}		Full	–100	–10		

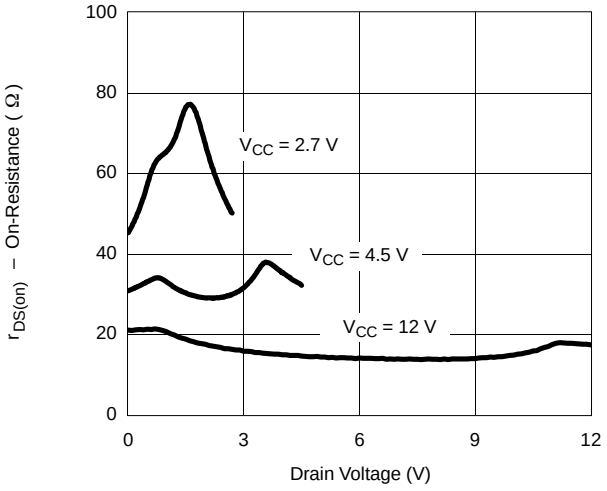
SPECIFICATIONS[a] (SINGLE SUPPLY 3 V)

Parameter	Symbol	Test Conditions Unless Specified V+ = 3 V, V– = 0 V V_L = 3 V, V_{IN} = 0.4 V[f]	Temp[b]	Limits –40 to 85°C Min[d]	Typ[c]	Max[d]	Unit
Analog Switch							
Analog Signal Range[e]	V_{ANALOG}		Full	0		3	V
Drain-Source On-Resistance	$r_{DS(on)}$	V+ = 2.7 V, V– = 0 V I_S = –10 mA, V_D = 0.5, 2.2 V	Room Full		65	80 100	Ω
Switch Off Leakage Current[g]	$I_{S(off)}$	V+ = 3 V, V– = 0 V V_D = 1, 2 V, V_S = 2, 1 V	Room Full	–0.25 –5	±0.1	0.25 5	nA
	$I_{D(off)}$		Room Full	–0.25 –5	±0.1	0.25 5	
Channel On Leakage Current[g]	$I_{D(on)}$	V+ = 3 V, V– = 0 V V_S = V_D = 1, 2 V	Room Full	–0.4 –5	±0.1	0.4 5	
Digital Control							
Input Current, V_{IN} Low	I_{IL}	V_{IN} Under Test = 0.4 V	Full	–1	0.005	1	µA
Input Current, V_{IN} High	I_{IH}	V_{IN} Under Test = 2.4 V	Full	–1	0.005	1	
Dynamic Characteristics							
Turn-On Time	t_{ON}	R_L = 300 Ω, C_L = 35 pF V_S = 1.5 V See Figure 2	Room Full		50	85 110	ns
Turn-Off Time	t_{OFF}		Room Full		30	60 85	
Charge Injection[e]	Q	V_g = 0 V, R_g = 0 Ω, C_L = 10 nF	Room		1		pC
Off Isolation[e]	OIRR	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz	Room		68		dB
Channel-to-Channel Crosstalk[e]	X_{TALK}		Room		85		
Source Off Capacitance[e]	$C_{S(off)}$	f = 1 MHz	Room		6		pF
Drain Off Capacitance[e]	$C_{D(off)}$		Room		6		
Channel On Capacitance[e]	$C_{D(on)}$		Room		20		

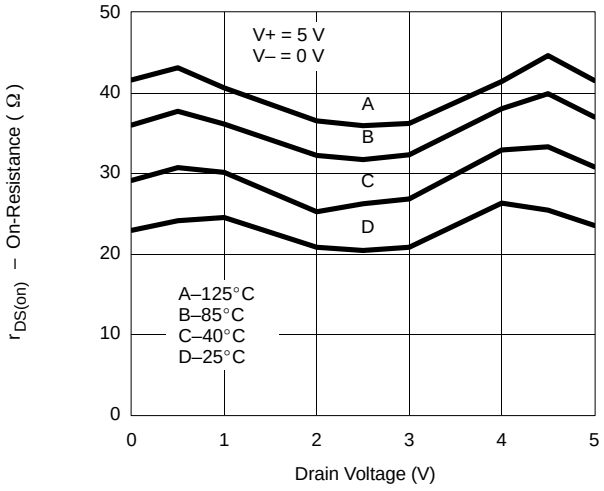
Notes:
a. Refer to PROCESS OPTION FLOWCHART.
b. Room = 25°C, Full = as determined by the operating temperature suffix.
c. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
d. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
e. Guaranteed by design, not subject to production test.
f. V_{IN} = input voltage to perform proper function.
g. Leakage parameters are guaranteed by worst case test conditions and not subject to test.

TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)

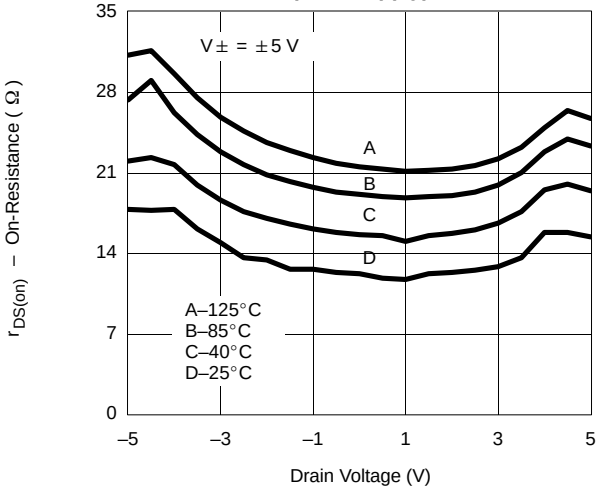
$r_{DS(on)}$ vs. Drain Voltage (Single Supply)



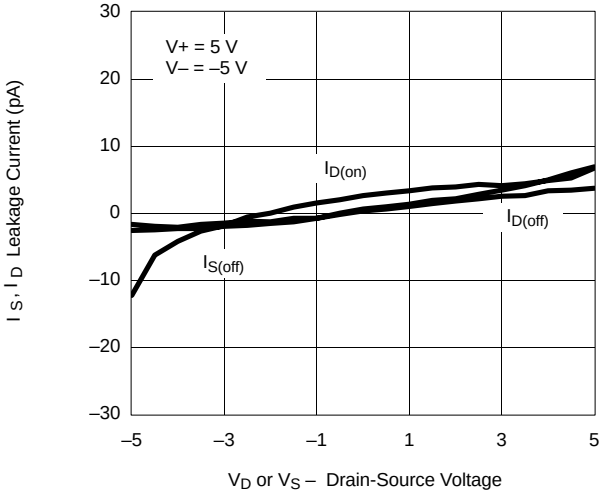
$r_{DS(on)}$ vs. Drain Voltage and Temperature (Single Supply)



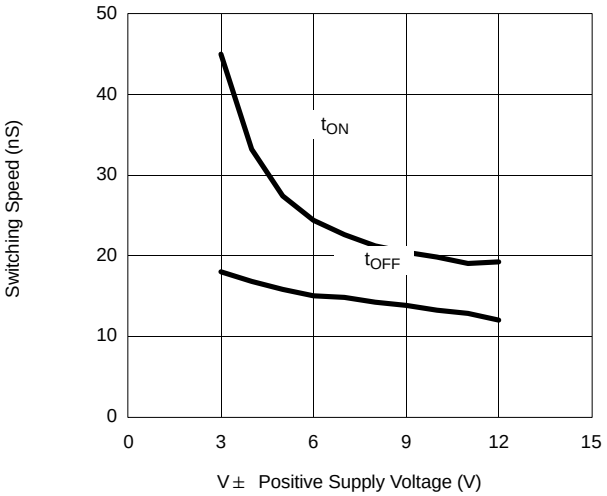
$r_{DS(on)}$ vs. Drain Voltage and Temperature (Dual Supply)



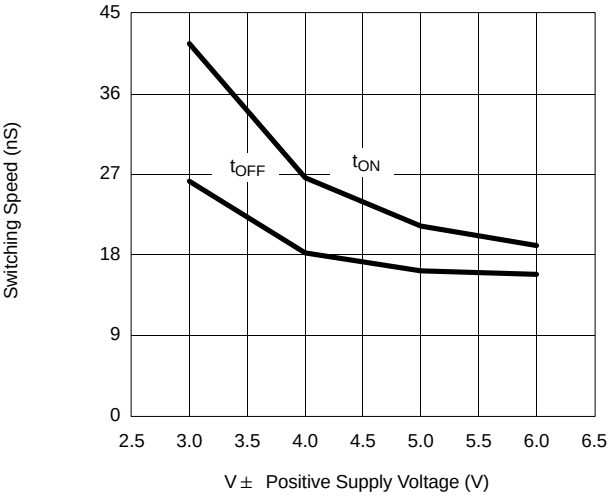
Leakage Current vs. Analog Voltage (Dual Supply)



Switching Time vs. Single Supply

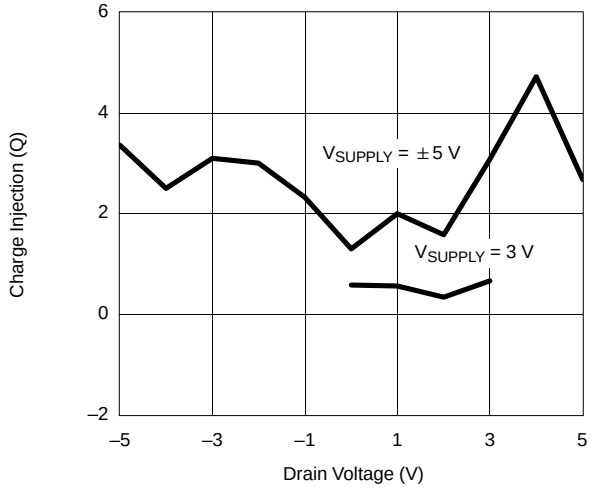


Switching Time vs. Dual Supply

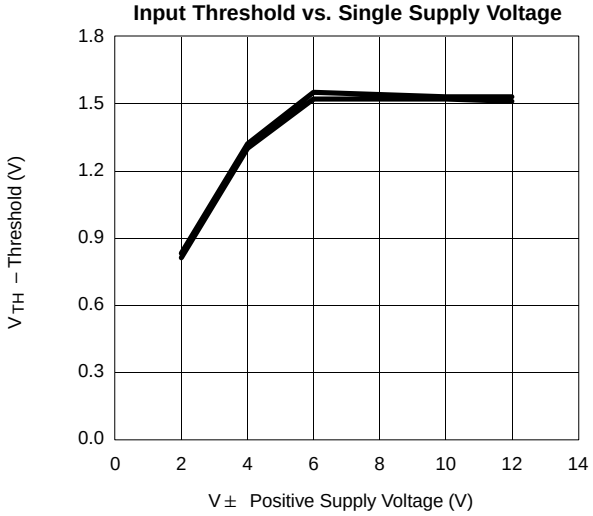


TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)

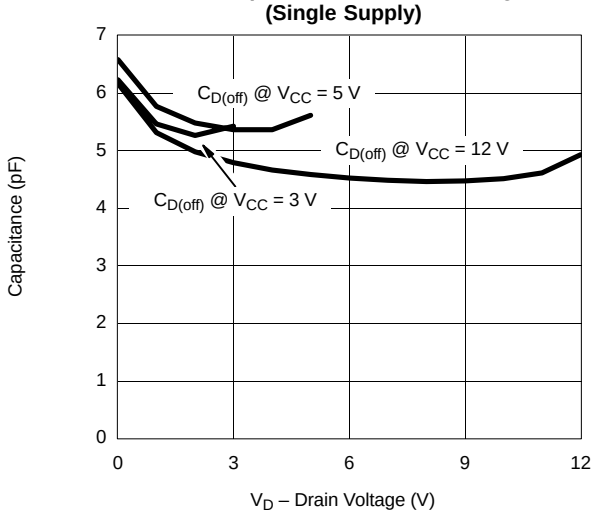
Charge Injection vs. Drain Voltage



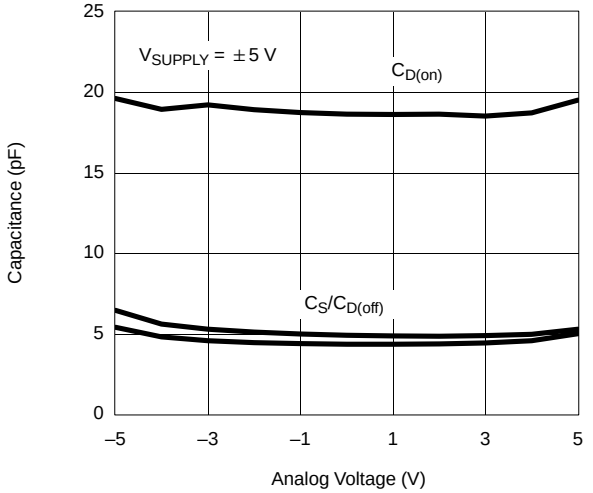
Input Threshold vs. Single Supply Voltage



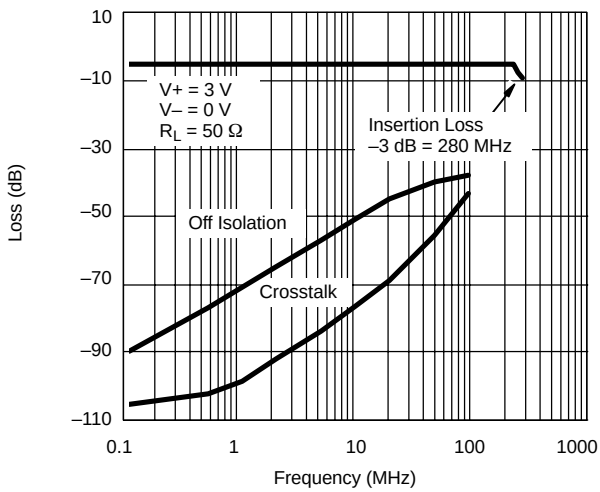
Drain Capacitance vs. Drain Voltage (Single Supply)



Capacitance vs. Analog Signal (Dual Supply)



Insertion Loss, Off Isolation and Crosstalk vs. Frequency (Single Supply)



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SCHEMATIC DIAGRAM (TYPICAL CHANNEL)

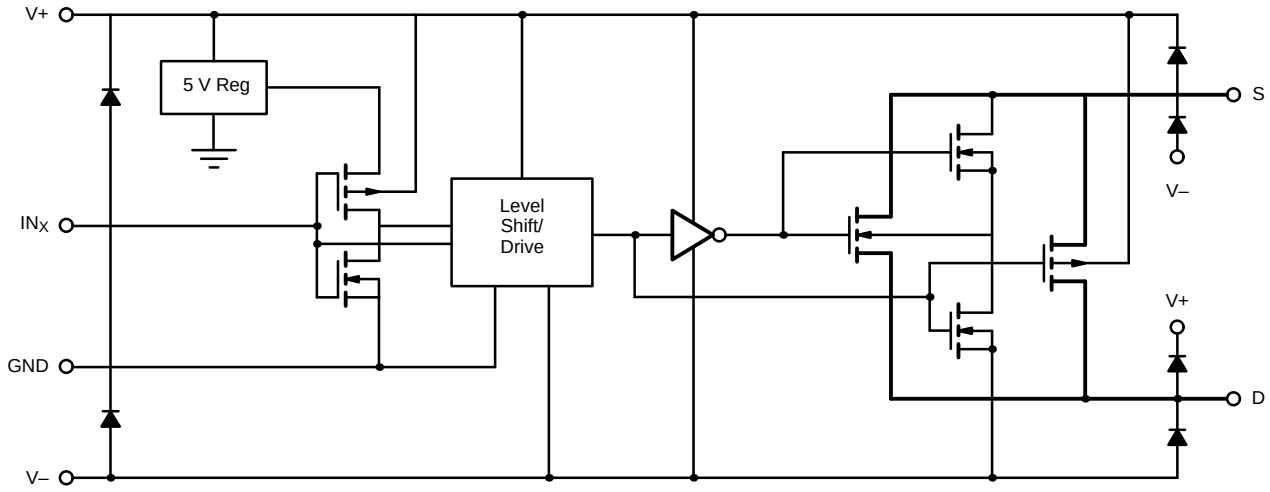
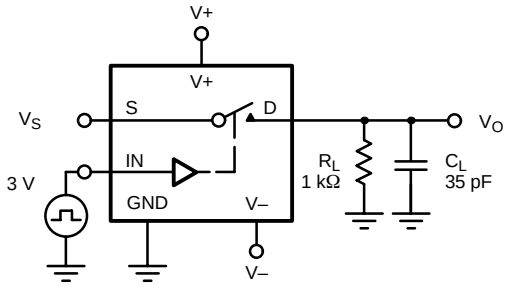
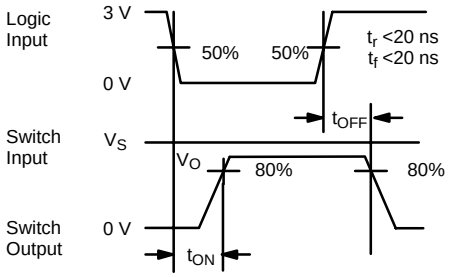


FIGURE 1.

TEST CIRCUITS

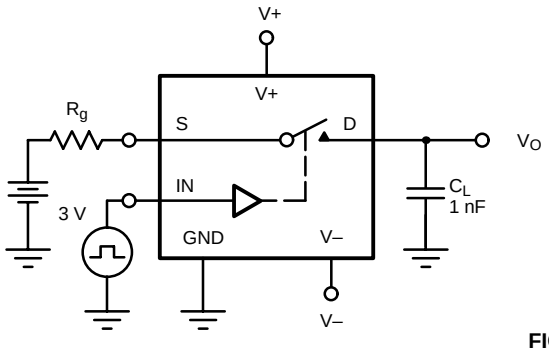


C$_L$ (includes fixture and stray capacitance)



Note: Logic input waveform is inverted for DG442.

FIGURE 2. Switching Time



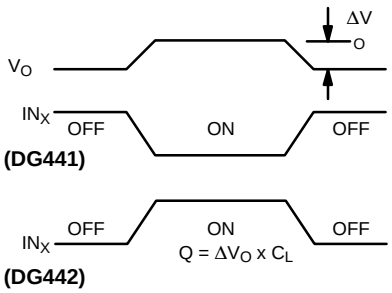


FIGURE 3. Charge Injection

TEST CIRCUITS

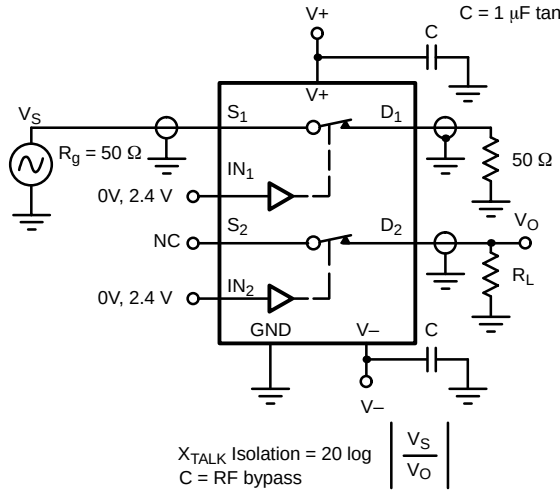


FIGURE 4. Crosstalk

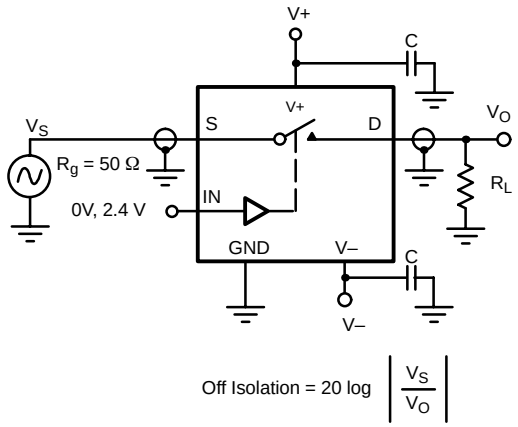


FIGURE 5. Off Isolation

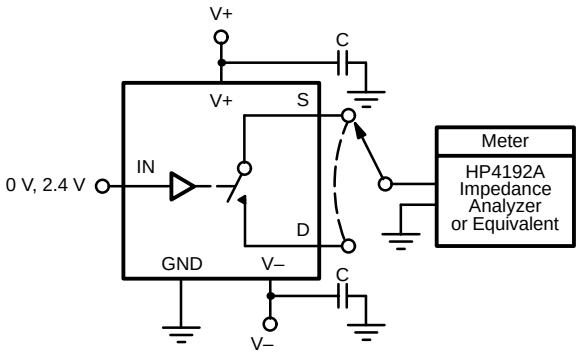


FIGURE 6. Source/Drain Capacitances

APPLICATIONS

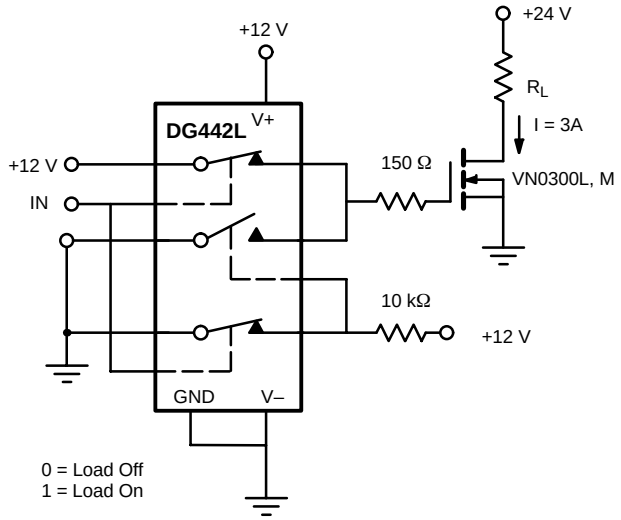


FIGURE 7. Power MOSFET Driver

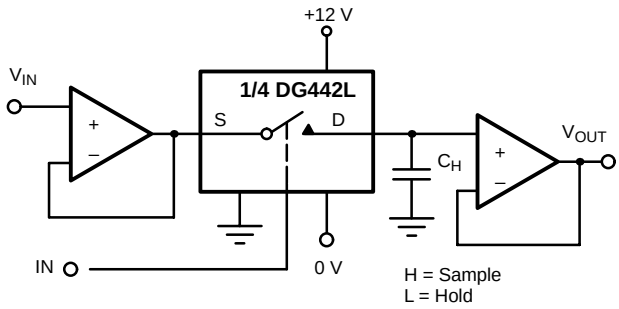


FIGURE 8. Open Loop Sample-and-Hold

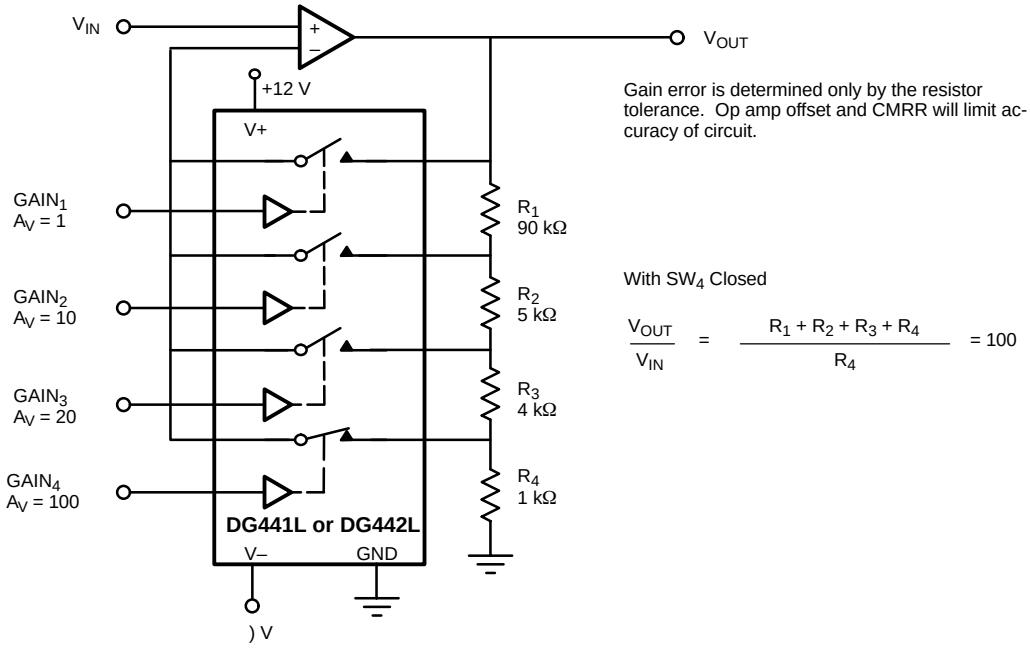


FIGURE 9. Precision-Weighted Resistor Programmable-Gain Amplifier