Improved Quad SPST CMOS Analog Switches

FEATURES

- Low On-Resistance: 45 Ω
- Low Power Consumption: 1.0 mW
- Fast Switching Action—t_{ON}: 120 ns
- Low Charge Injection—Q: −1 pC
- TTL/CMOS-Compatible Logic
- Single Supply Capability

BENEFITS

- Less Signal Errors and Distortion
- Reduced Power Supply Requirements
- Faster Throughput
- Reduced Pedestal Errors
- Simple Interfacing

APPLICATIONS

- Audio Switching
- Data Acquisition
- Sample-and-Hold Circuits
- Communication Systems
- Automatic Test Equipment
- Medical Instruments

DESCRIPTION

The DG441B/442B are monolithic quad analog switches designed to provide high speed, low error switching of analog and audio signals. The DG441B/442B are upgrades to the original DG441/442.

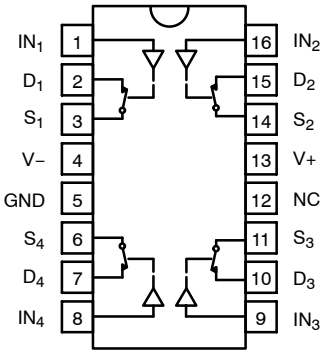
Combing low on-resistance (45 Ω, typ.) with high speed (t_{ON} 120 ns, typ.), the DG441B/442B are ideally suited for Data Acquisition, Communication Systems, Automatic Test Equipment, or Medical Instrumentation. Charge injection has been minimized on the drain for use in sample-and-hold circuits.

The DG441B/442B are built using Vishay Siliconix's high-voltage silicon-gate process. An epitaxial layer prevents latchup.

When on, each switch conducts equally well in both directions and blocks input voltages to the supply levels when off.

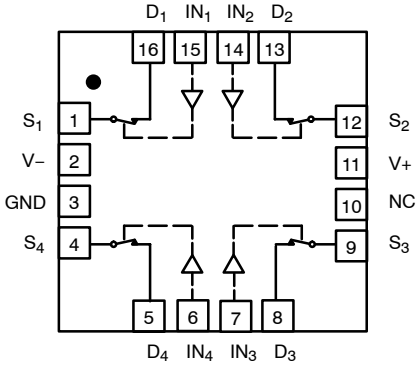
FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION

DG441B
Dual-In-Line and SOIC



Top View

DG441B
QFN16 (4x4 mm)



Top View

TRUTH TABLE		
Logic	**DG441B**	**DG442B**
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 Plastic DIP	DG441BDJ
		DG442BDJ
	16-Pin Narrow SOIC	DG441BDY
		DG442BDY
	16-Pin QFN 4x4 mm	DG441BDN
		DG442BDN

ABSOLUTE MAXIMUM RATINGS

V+ to V– . . . . . 44 V
GND to V– . . . . . 25 V
Digital Inputs[a] V_S, V_D . . . . . (V–) –2 V to (V+) +2 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 . . . . . –65 to 125°C

Power Dissipation (Package)b
16-Pin Plastic DIP[c] . . . . . 470 mW
16-Pin Narrow Body SOIC[d] . . . . . 900 mW
QFN-16[d] . . . . . 850 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 6 mW/°C above 75°C
d. Derate 12 mW/°C above 25°C

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.

SPECIFICATIONS[a] FOR DUAL SUPPLIES

Parameter	Symbol	Test Conditions Unless Otherwise Specified V+ = 15 V, V– = –15 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	–15		15	V
Drain-Source On-Resistance	$r_{DS(on)}$	I_S = 1 mA, V_D = ∓10 V	Room Full		45	80 95	Ω
On-Resistance Match Between Channels[e]	$\Delta r_{DS(on)}$	I_S = 1 mA, V_D = ±10 V	Room Full		2	4 5	Ω
Switch Off Leakage Current	$I_{S(off)}$	V_D = ±14 V, V_S = ∓14 V	Room Full	–0.5 –5	±0.01	0.5 5	nA
	$I_{D(off)}$		Room Full	–0.5 –5	±0.01	0.5 5	nA
Channel On Leakage Current	$I_{D(on)}$	V_S = V_D = ±14 V	Room Full	–0.5 –10	∓0.02	0.5 10	nA
Digital Control							
Input Voltage Low	V_{INL}		Full			0.8	V
Input Voltage High	V_{INH}		Full	2.4			V
Input Current V_{IN} Low	I_{INL}	V_{IN} under test = 0.8 V, All Other = 2.4 V	Full	–1	–0.01	1	µA
Input Current V_{IN} High	I_{INH}	V_{IN} under test = 2.4 V, All Other = 0.8 V	Full	–1	0.01	1	µA
Dynamic Characteristics							
Turn-On Time	t_{ON}	R_L = 1 kΩ, C_L = 35 pF V_S = 10 V, See Figure 2	Room		120	220	ns
Turn-Off Time	t_{OFF}		Room		65	120	ns
Charge Injection[e]	Q	C_L = 1 nF, V_S = 0 V, V_{gen} = 0 V, R_{gen} = 0 Ω	Room		–1		pC
Off Isolation[e]	OIRR	R_L = 50 Ω, C_L = 15 pF, V_S = 1 V_{RMS} f = 100 kHz	Room		90		dB
Crosstalke (Channel-to-Channel)	X_{TALK}		Room		95		dB
Source Off Capacitance[e]	$C_{S(off)}$	f = 1 MHz	Room		4		pF
Drain Off Capacitance[e]	$C_{D(off)}$		Room		4		pF
Channel On Capacitance[e]	$C_{D(on)}$	V_S = V_D = 0 V, f = 1 MHz	Room		16		pF
Power Supplies							
Positive Supply Current	I+	V+ = 16.5 V, V– = –16.5 V V_{IN} = 0 or 5 V	Room Full			1 5	µA
Negative Supply Current	I–		Room Full	–1 –5			µA

SPECIFICATIONS[a] FOR SINGLE SUPPLY

Parameter	Symbol	Test Conditions Otherwise Unless Specified V+ = 12 V, V− = 0 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	$r_{DS(on)}$	I_S = 1 mA, V_D = 3 V, 8 V	Room Full		90	160 200	Ω
Dynamic Characteristics							
Turn-On Time	t_{ON}	R_L = 1 kΩ, C_L = 35 pF V_S = 8 V, See Figure 2	Room		120	300	ns
Turn-Off Time	t_{OFF}		Room		60	200	
Charge Injection	Q	C_L = 1 nF V_{gen} = 6 V, R_{gen} = 0 Ω	Room		4		pC
Power Supplies							
Positive Supply Current	I+	V_{IN} = 0 or 5 V	Room Full			1 5	µA
Negative Supply Current	I−		Room Full	−1 −5			

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.

SCHEMATIC DIAGRAM (TYPICAL CHANNEL)

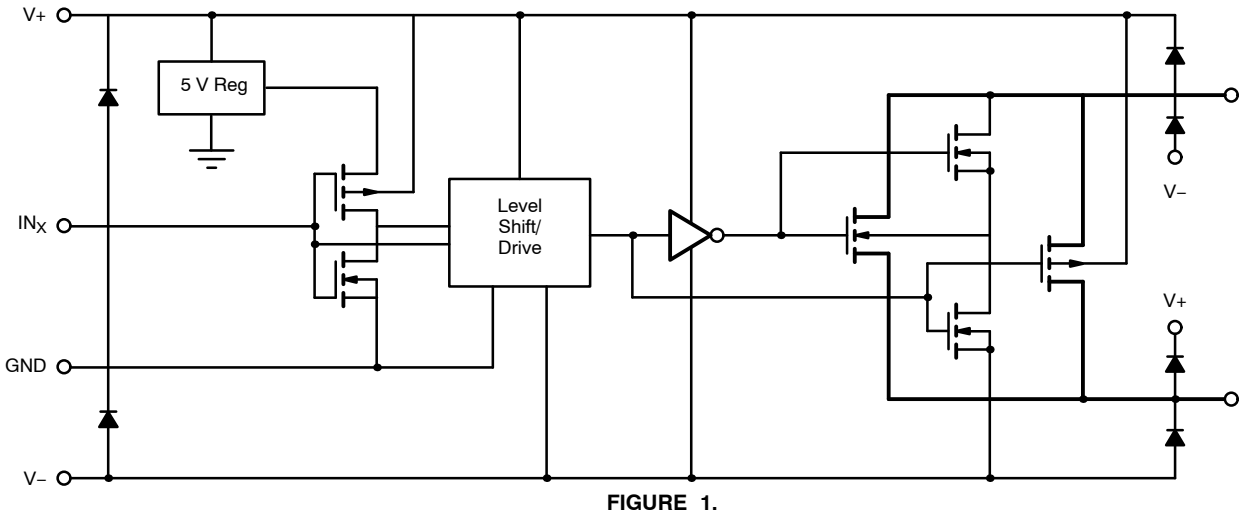
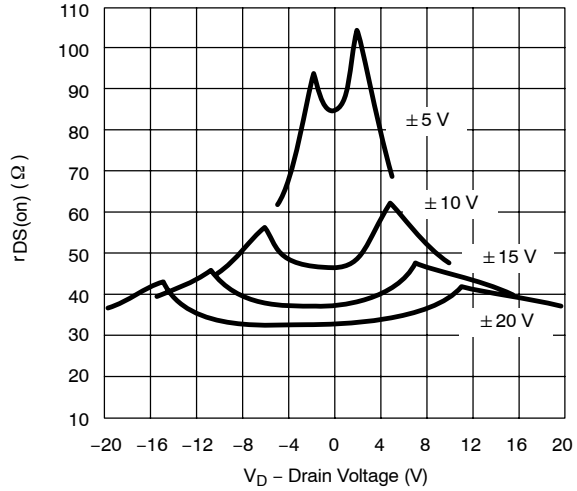


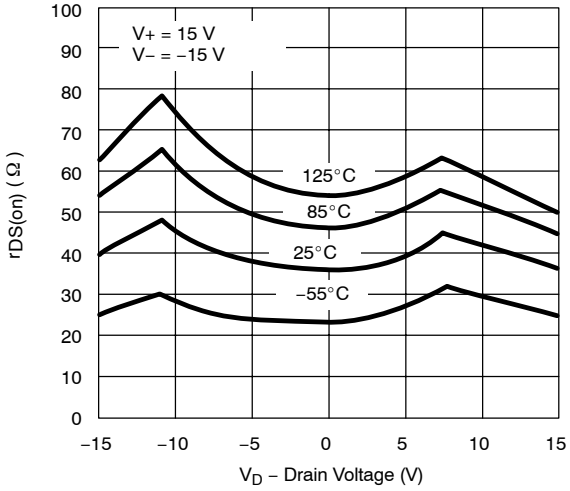
FIGURE 1.

TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)

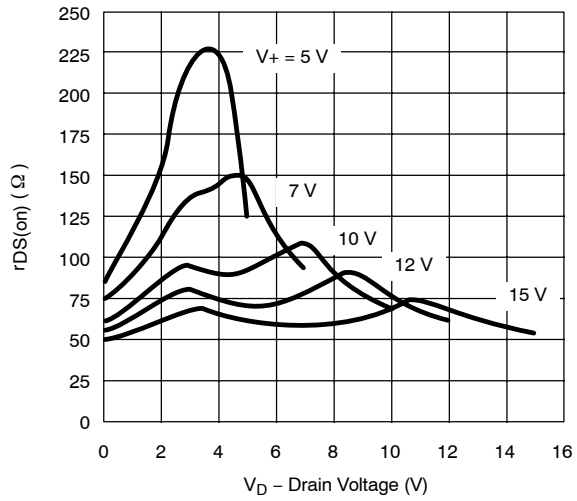
$r_{DS(on)}$ vs. V_D and Power Supply Voltages



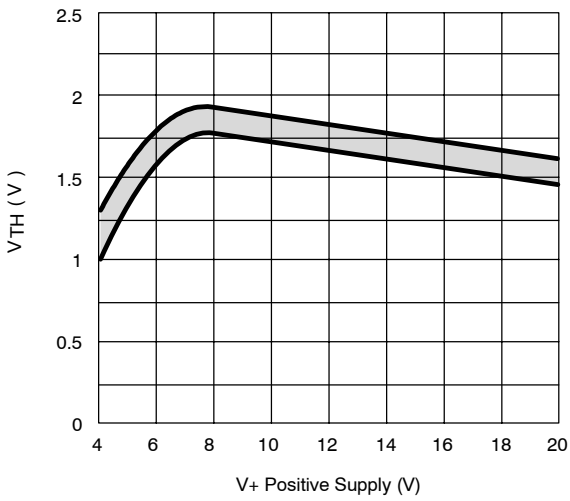
$r_{DS(on)}$ vs. V_D and Temperature



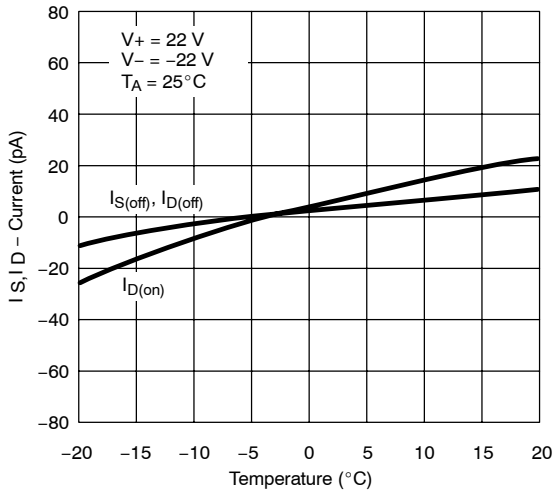
$r_{DS(on)}$ vs. V_D and Single Power Supply Voltages



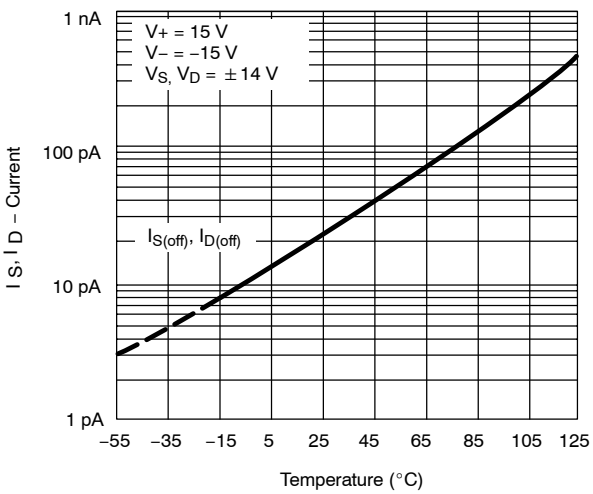
Input Switching Threshold vs. Supply Voltage



Leakage Currents vs. Analog Voltage

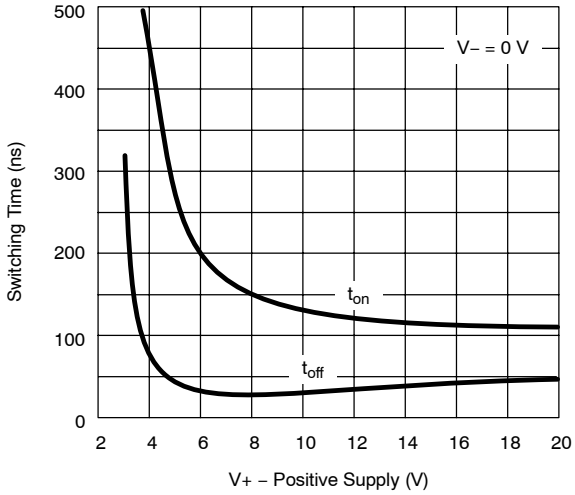


Leakage Currents vs. Temperature

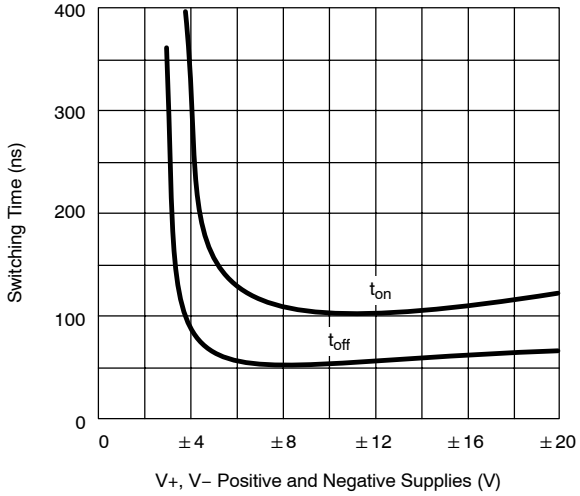


TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)

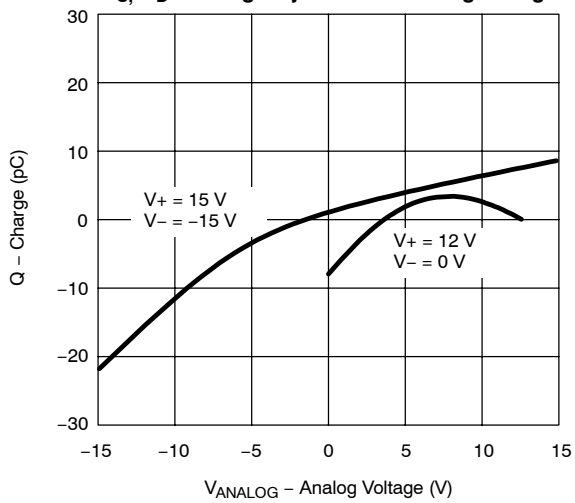
Switching Time vs. Single Supply Voltage



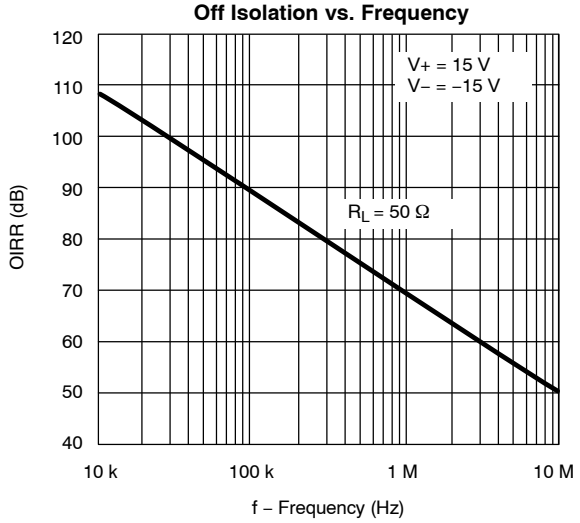
Switching Time vs. Power Supply Voltage



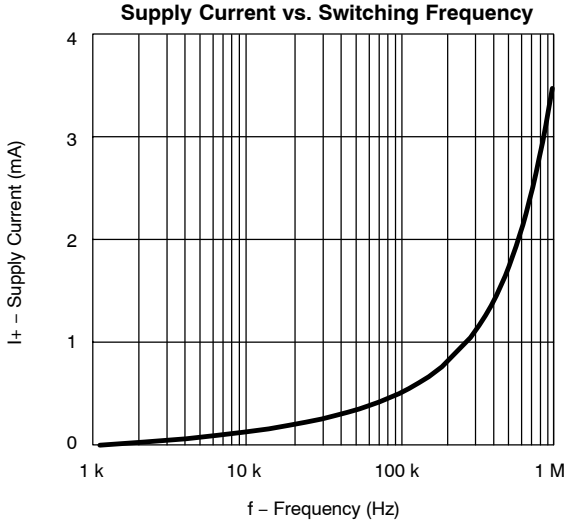
Q_S, Q_D – Charge Injection vs. Analog Voltage



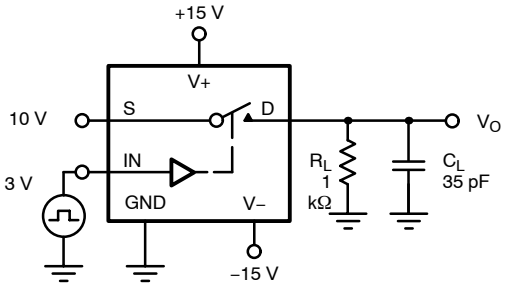
Off Isolation vs. Frequency



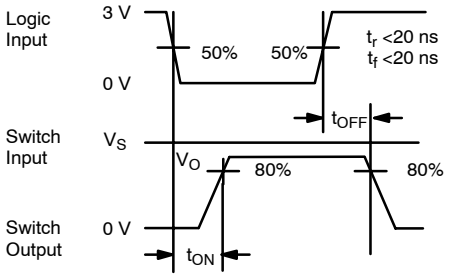
Supply Current vs. Switching Frequency



TEST CIRCUITS

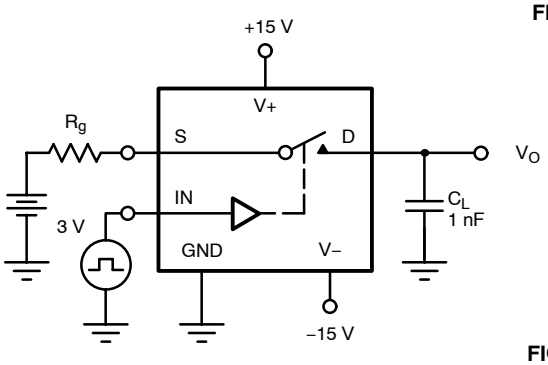


C_L (includes fixture and stray capacitance)



Note: Logic input waveform is inverted for DG442.

FIGURE 2. Switching Time



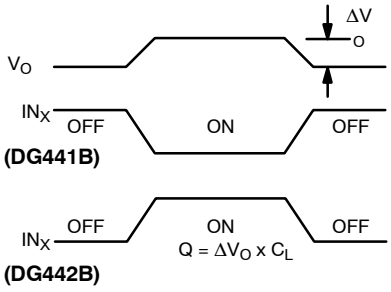
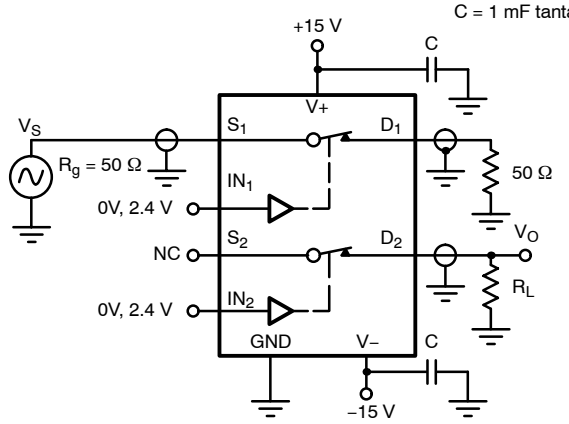


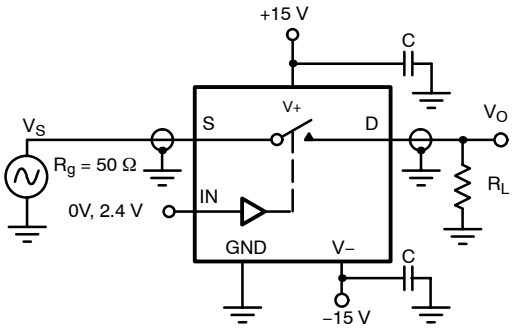
FIGURE 3. Charge Injection

C = 1 mF tantalum in parallel with 0.01 mF ceramic



X_{TALK} Isolation = 20 log $\left|\frac{V_S}{V_O}\right|$
C = RF bypass

FIGURE 4. Crosstalk



Off Isolation = 20 log $\left|\frac{V_S}{V_O}\right|$

FIGURE 5. Off Isolation

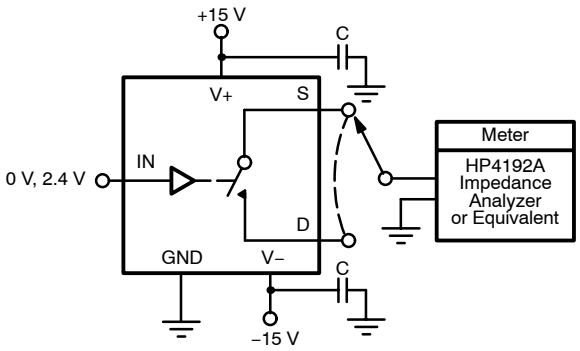


FIGURE 6. Source/Drain Capacitances

APPLICATIONS

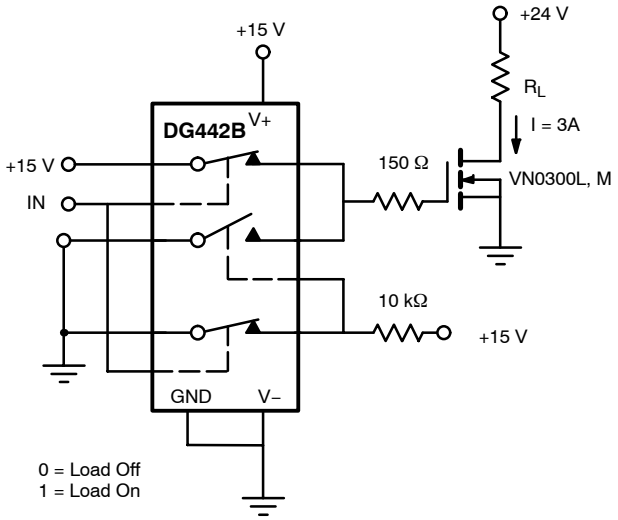


FIGURE 7. Power MOSFET Driver

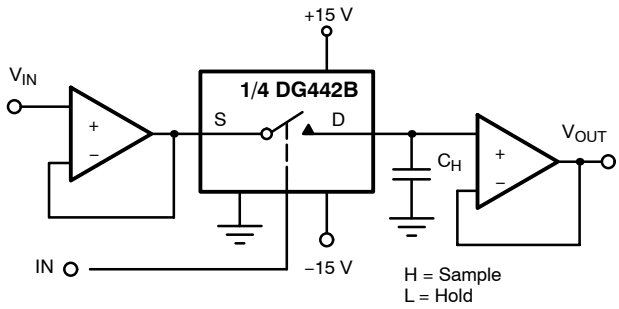


FIGURE 8. Open Loop Sample-and-Hold

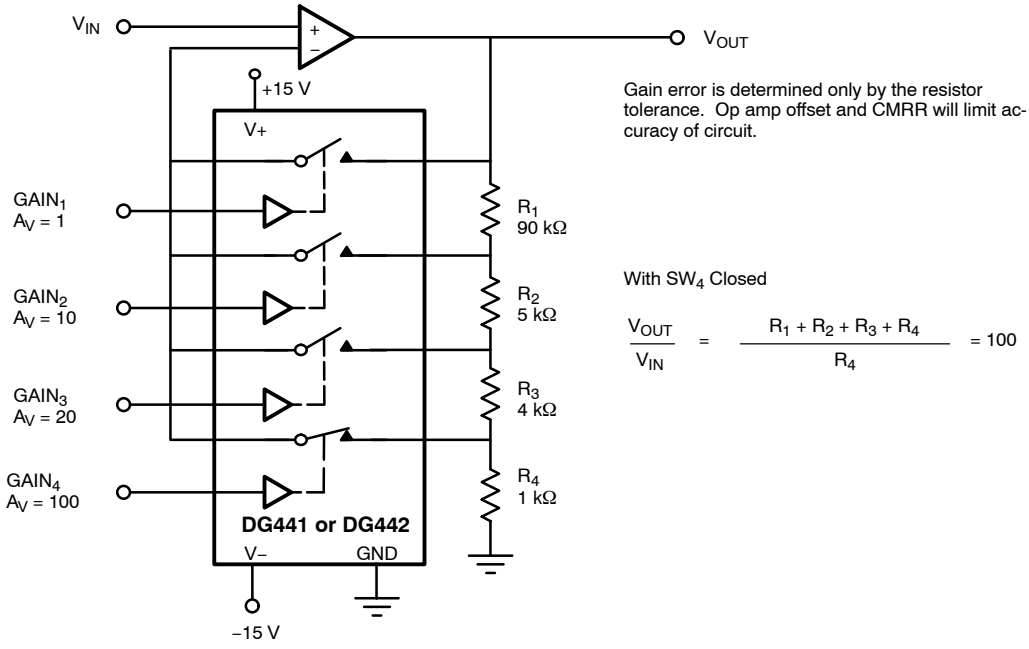


FIGURE 9. Precision-Weighted Resistor Programmable-Gain Amplifier

Disclaimer

All product specifications and data are subject to change without notice.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, “Vishay”), disclaim any and all liability for any errors, inaccuracies or incompleteness contained herein or in any other disclosure relating to any product.

Vishay disclaims any and all liability arising out of the use or application of any product described herein or of any information provided herein to the maximum extent permitted by law. The product specifications do not expand or otherwise modify Vishay’s terms and conditions of purchase, including but not limited to the warranty expressed therein, which apply to these products.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay.

The products shown herein are not designed for use in medical, life-saving, or life-sustaining applications unless otherwise expressly indicated. Customers using or selling Vishay products not expressly indicated for use in such applications do so entirely at their own risk and agree to fully indemnify Vishay for any damages arising or resulting from such use or sale. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

Product names and markings noted herein may be trademarks of their respective owners.