



New Product

DG417B/418B/419B  
Vishay Siliconix

## Precision CMOS Analog Switches

### FEATURES

- $\pm 15\text{-V}$  Analog Signal Range
- On-Resistance— $r_{DS(on)}$ :  $15\ \Omega$
- Fast Switching Action— $t_{ON}$ :  $100\ \text{ns}$
- TTL and CMOS Compatible
- MSOP-8 and SOIC-8 Packaging

### BENEFITS

- Wide Dynamic Range
- Low Signal Errors and Distortion
- Break-Before-Make Switching Action
- Simple Interfacing
- Reduced Board Space
- Improved Reliability

### APPLICATIONS

- Precision Test Equipment
- Precision Instrumentation
- Battery Powered Systems
- Sample-and-Hold Circuits
- Military Radios
- Guidance and Control Systems
- Hard Disk Drives

### DESCRIPTION

The DG417B/418B/419B monolithic CMOS analog switches were designed to provide high performance switching of analog signals. Combining low power, low leakages, high speed, low on-resistance and small physical size, the DG417B series is ideally suited for portable and battery powered industrial and military applications requiring high performance and efficient use of board space.

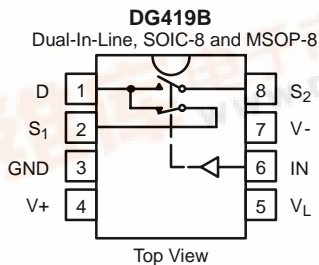
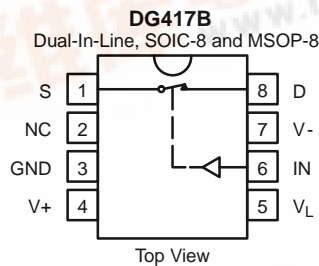
To achieve high-voltage ratings and superior switching performance, the DG417B series is built on Vishay Siliconix's

high voltage silicon gate (HVSG) process. Break-before-make is guaranteed for the DG419B, which is an SPDT configuration. An epitaxial layer prevents latchup.

Each switch conducts equally well in both directions when on, and blocks up to the power supply level when off.

The DG417B and DG418B respond to opposite control logic levels as shown in the Truth Table.

## FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



| TRUTH TABLE |        |        |
|-------------|--------|--------|
| Logic       | DG417B | DG418B |
| 0           | ON     | OFF    |
| 1           | OFF    | ON     |

Logic "0" =  $\leq 0.8\ \text{V}$ , Logic "1" =  $\geq 2.4\ \text{V}$

| TRUTH TABLE—DG419B |                 |                 |
|--------------------|-----------------|-----------------|
| Logic              | SW <sub>1</sub> | SW <sub>2</sub> |
| 0                  | ON              | OFF             |
| 1                  | OFF             | ON              |

Logic "0" =  $\leq 0.8\ \text{V}$ , Logic "1" =  $\geq 2.4\ \text{V}$



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| ORDERING INFORMATION |                       |                        |
|----------------------|-----------------------|------------------------|
| Temp Range           | Package               | Part Number            |
| <b>DG417B/418B</b>   |                       |                        |
| -40 to 85°C          | 8-Pin Plastic MiniDIP | DG417BDJ               |
|                      |                       | DG418BDJ               |
|                      | 8-Pin Narrow SOIC     | DG417BDY               |
|                      |                       | DG418BDY               |
|                      | 8-Pin MSOP            | DG417BDQ               |
|                      |                       | DG418BDQ               |
| -55 to 125°C         | 8-Pin CerDIP          | DG417BAK, DG417BAK/883 |
|                      |                       | DG418BAK, DG418BAK/883 |
| <b>DG419B</b>        |                       |                        |
| -40 to 85°C          | 8-Pin Plastic MiniDIP | DG419BDJ               |
|                      | 8-Pin Narrow SOIC     | DG419BDY               |
|                      | 8-Pin MSOP            | DG419BDQ               |
| -55 to 125°C         | 8-Pin CerDIP          | DG419BAK, DG419BAK/883 |

NOTE: SMD product is dual marked with /883 number.

## ABSOLUTE MAXIMUM RATINGS

|   |   |
|---|---|
| V <sub>-</sub> .....  | -20 V   |
| V <sub>+</sub> .....  | 20 V  |
| GND .....   | 25 V  |
| V <sub>L</sub> .....  | (GND -0.3 V) to (V <sub>+</sub> ) + 0.3 V   |
| Digital Inputs <sup>a</sup> V <sub>S</sub> , V <sub>D</sub> ..... | (V <sub>-</sub> ) -2 V to (V <sub>+</sub> ) + 2 V<br>or 30 mA, whichever occurs first |
| Current, (Any Terminal) Continuous .....                          | 30 mA   |
| Current (S or D) Pulsed 1 ms, 10% duty cycle .....                | 100 mA  |
| Storage Temperature .....   | -65 to 150°C  |
| Power Dissipation (Package) <sup>b</sup>                          |   |

|  |        |
|--|--------|
| 8-Pin Plastic MiniDIP <sup>c</sup> ..... | 400 mW |
| 8-Pin Narrow SOIC <sup>c</sup> .....     | 400 mW |
| 8-Pin MSOP <sup>d</sup> .....            | 400 mW |
| 8-Pin CerDIP <sup>e</sup> .....          | 600 mW |

### Notes:

- Signals on S<sub>X</sub>, D<sub>X</sub>, or IN<sub>X</sub> exceeding V<sub>+</sub> or V<sub>-</sub> will be clamped by internal diodes. Limit forward diode current to maximum current ratings.
- All leads welded or soldered to PC Board.
- Derate 5.3 mW/°C above 75°C
- Derate 4 mW/°C above 70°C
- Derate 8 mW/°C above 75°C

## SCHEMATIC DIAGRAM (TYPICAL CHANNEL)

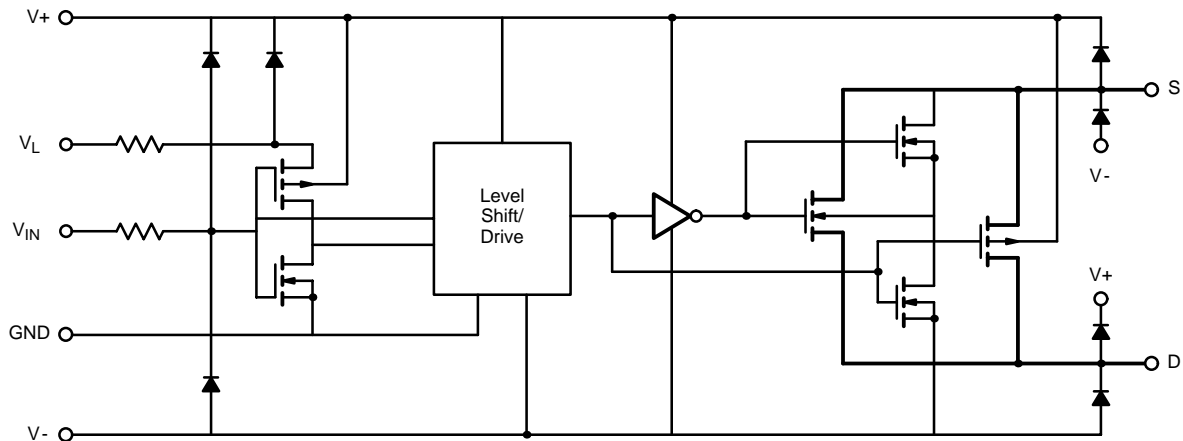


FIGURE 1.



New Product

**DG417B/418B/419B**  
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| <b>SPECIFICATIONS<sup>a</sup></b>         |              |   |  |        |                   |                  |                          |                  |                         |                  |               |            |
|---|--------------|---|--|--------|-------------------|------------------|--------------------------|------------------|-------------------------|------------------|---------------|------------|
| Parameter                                 | Symbol       | Test Conditions<br>Unless Otherwise Specified<br>$V_+ = 15\text{ V}, V_- = -15\text{ V}$<br>$V_L = 5\text{ V}, V_{IN} = 2.4\text{ V}, 0.8\text{ V}^f$ |  |        | Temp <sup>b</sup> | Typ <sup>c</sup> | A Suffix<br>-55 to 125°C |                  | D Suffix<br>-40 to 85°C |                  | Unit          |            |
|   |              |   |  |        |                   |                  | Min <sup>d</sup>         | Max <sup>d</sup> | Min <sup>d</sup>        | Max <sup>d</sup> |               |            |
| <b>Analog Switch</b>                      |              |   |  |        |                   |                  |                          |                  |                         |                  |               |            |
| Analog Signal Range <sup>e</sup>          | $V_{ANALOG}$ |   |  | Full   |                   | -15              | 15                       | -15              | 15                      | V                |               |            |
| Drain-Source On-Resistance                | $r_{DS(on)}$ | $I_S = -10\text{ mA}, V_D = \pm 12.5\text{ V}$<br>$V_+ = 13.5\text{ V}, V_- = -13.5\text{ V}$   |  |        | Room Full         | 15               | 25<br>34                 |                  | 25<br>29                | $\Omega$         |               |            |
| Switch Off Leakage Current                | $I_{S(off)}$ | $V_+ = 16.5\text{ V}, V_- = -16.5\text{ V}$<br>$V_D = \mp 15.5\text{ V}$<br>$V_S = \pm 15.5\text{ V}$   |  |        | Room Full         | -0.1             | -0.25<br>-20             | 0.25<br>20       | -0.25<br>-5             | 0.25<br>5        | nA            |            |
|   | $I_{D(off)}$ |   |  |        | DG417B<br>DG418B  | Room Full        | -0.1                     | -0.25<br>-20     | 0.25<br>20              | -0.25<br>-5      |               | 0.25<br>5  |
|   |              |   |  |        | DG419B            | Room Full        | -0.1                     | -0.75<br>-60     | 0.75<br>60              | -0.75<br>-12     |               | 0.75<br>12 |
| Channel On Leakage Current                | $I_{D(on)}$  | $V_+ = 16.5\text{ V}, V_- = -16.5\text{ V}$<br>$V_S = V_D = \pm 15.5\text{ V}$  |  |        | DG417B<br>DG418B  | Room Full        | -0.4                     | -0.4<br>-40      | 0.4<br>40               | -0.4<br>-10      | 0.4<br>10     |            |
|   |              |   |  |        | DG419B            | Room Full        | -0.4                     | -0.75<br>-60     | 0.75<br>60              | -0.75<br>-12     | 0.75<br>12    |            |
|   |              |   |  |        |                   |                  |                          |                  |                         |                  |               |            |
| <b>Digital Control</b>                    |              |   |  |        |                   |                  |                          |                  |                         |                  |               |            |
| Input Current $V_{IN}$ Low                | $I_{IL}$     |   |  | Full   |                   | -0.5             | 0.5                      | -0.5             | 0.5                     | $\mu\text{A}$    |               |            |
| Input Current $V_{IN}$ High               | $I_{IH}$     |   |  | Full   |                   | -0.5             | 0.5                      | -0.5             | 0.5                     | $\mu\text{A}$    |               |            |
| <b>Dynamic Characteristics</b>            |              |   |  |        |                   |                  |                          |                  |                         |                  |               |            |
| Turn-On Time                              | $t_{ON}$     | $R_L = 300\ \Omega, C_L = 35\text{ pF}$<br>$V_S = \pm 10\text{ V}$<br>See Switching Time Test Circuit   |  |        | DG417B<br>DG418B  | Room Full        | 62                       | 89<br>106        |                         | 89<br>99         | ns            |            |
| Turn-Off Time                             | $t_{OFF}$    |   |  |        | DG417B<br>DG418B  | Room Full        | 53                       | 80<br>88         |                         | 80<br>86         |               |            |
| Transition Time                           | $t_{TRANS}$  | $R_L = 300\ \Omega, C_L = 35\text{ pF}$<br>$V_{S1} = \pm 10\text{ V}, V_{S2} = \mp 10\text{ V}$   |  |        | DG419B            | Room Full        | 60                       | 87<br>96         |                         | 87<br>93         |               |            |
| Break-Before-Make Time Delay              | $t_D$        | $R_L = 300\ \Omega, C_L = 35\text{ pF}$<br>$V_{S1} = V_{S2} = \pm 10\text{ V}$  |  |        | DG419B            | Room             | 16                       | 3                | 3                       |                  |               |            |
| Charge Injection                          | Q            | $C_L = 10\text{ nF}, V_{gen} = 0\text{ V}, R_{gen} = 0\ \Omega$   |  |        | Room              |                  | 4                        |                  |                         |                  | pC            |            |
| Off-Isolation <sup>e</sup>                | OIRR         | $R_L = 50\ \Omega, C_L = 5\text{ nF}, f = 1\text{ MHz}$   |  |        | Room              |                  | -86                      |                  |                         |                  | dB            |            |
| Channel-To-Channel Crosstalk <sup>e</sup> | $X_{TALK}$   |   |  |        | DG419B            | Room             | -87                      |                  |                         |                  | dB            |            |
| Source Off Capacitance                    | $C_{S(off)}$ | $f = 1\text{ MHz}, V_S = 0\text{ V}$  |  |        | Room              |                  | 12                       |                  |                         |                  | pF            |            |
| Drain Off Capacitance                     | $C_{D(off)}$ |   |  |        | DG417B<br>DG418B  | Room             |                          | 12               |                         |                  |               |            |
| Channel On Capacitance                    | $C_{D(on)}$  |   |  |        | DG417B<br>DG418B  | Room             |                          | 50               |                         |                  |               |            |
|   |              |   |  | DG419B | Room              |                  | 57                       |                  |                         |                  |               |            |
| <b>Power Supplies</b>                     |              |   |  |        |                   |                  |                          |                  |                         |                  |               |            |
| Positive Supply Current                   | $I_+$        | $V_+ = 16.5\text{ V}, V_- = -16.5\text{ V}$<br>$V_{IN} = 0\text{ or }5\text{ V}$  |  |        | Room Full         | 0.001            |                          | 1<br>5           |                         | 1<br>5           | $\mu\text{A}$ |            |
| Negative Supply Current                   | $I_-$        |   |  |        | Room Full         | -0.001           | -1<br>-5                 |                  | -1<br>-5                |                  |               |            |
| Logic Supply Current                      | $I_L$        |   |  |        | Room Full         | 0.001            |                          | 1<br>5           |                         | 1<br>5           |               |            |
| Ground Current                            | $I_{GND}$    |   |  |        | Room Full         | -0.000<br>1      | -1<br>-5                 |                  | -1<br>-5                |                  |               |            |

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| SPECIFICATIONS <sup>a</sup> FOR UNIPOLAR SUPPLIES |              |   |        |                   |                  |                          |                  |                         |                  |               |
|---|--------------|---|--------|-------------------|------------------|--------------------------|------------------|-------------------------|------------------|---------------|
| Parameter   | Symbol       | Test Conditions<br>Unless Otherwise Specified<br>$V_+ = 12\text{ V}, V_- = 0\text{ V}$<br>$V_L = 5\text{ V}, V_{IN} = 2.4\text{ V}, 0.8\text{ V}^f$ |        | Temp <sup>b</sup> | Typ <sup>c</sup> | A Suffix<br>-55 to 125°C |                  | D Suffix<br>-40 to 85°C |                  | Unit          |
|   |              |   |        |                   |                  | Min <sup>d</sup>         | Max <sup>d</sup> | Min <sup>d</sup>        | Max <sup>d</sup> |               |
| <b>Analog Switch</b>                              |              |   |        |                   |                  |                          |                  |                         |                  |               |
| Analog Signal Range <sup>e</sup>                  | $V_{ANALOG}$ |   |        | Full              |                  | 0                        | 12               | 0                       | 12               | V             |
| Drain-Source On-Resistance                        | $r_{DS(on)}$ | $I_S = -10\text{ mA}, V_D = 3.8\text{ V}$<br>$V_+ = 10.8\text{ V}$  |        | Room Full         | 26               |                          | 35<br>52         |                         | 35<br>45         | $\Omega$      |
| <b>Dynamic Characteristics</b>                    |              |   |        |                   |                  |                          |                  |                         |                  |               |
| Turn-On Time                                      | $t_{ON}$     | $R_L = 300\ \Omega, C_L = 35\text{ pF}, V_S = 8\text{ V}$<br>See Switching Time Test Circuit  |        | Room Full         | 100              |                          | 125<br>155       |                         | 125<br>143       | ns            |
| Turn-Off Time                                     | $t_{OFF}$    |   |        | Room Full         | 38               |                          | 66<br>73         |                         | 66<br>69         |               |
| Break-Before-Make Time Delay                      | $t_D$        | $R_L = 300\ \Omega, C_L = 35\text{ pF}$   | DG419B | Room              | 62               | 25                       |                  | 25                      |                  |               |
| Transition Time                                   | $t_{TRANS}$  | $R_L = 300\ \Omega, C_L = 35\text{ pF}$<br>$V_{S1} = 0\text{ V}, 8\text{ V}, V_{S2} = 8\text{ V}, 0\text{ V}$                                       |        | Room Full         | 95               |                          | 119<br>153       |                         | 119<br>141       |               |
| Charge Injection                                  | Q            | $C_L = 10\text{ nF}, V_{gen} = 0\text{ V}, R_{gen} = 0\ \Omega$   |        | Room              | 3                |                          |                  |                         |                  | pC            |
| <b>Power Supplies</b>                             |              |   |        |                   |                  |                          |                  |                         |                  |               |
| Positive Supply Current                           | $I_+$        | $V_+ = 13.2\text{ V}, V_L = 5.25\text{ V}$<br>$V_{IN} = 0\text{ or }5\text{ V}$   |        | Room Full         | 0.001            |                          | 1<br>5           |                         | 1<br>5           | $\mu\text{A}$ |
| Negative Supply Current                           | $I_-$        |   |        | Room              | -0.001           | -1<br>-5                 |                  | -1<br>-5                |                  |               |
| Logic Supply Current                              | $I_L$        |   |        | Room              | 0.001            |                          | 1<br>5           |                         | 1<br>5           |               |
| Ground Current                                    | $I_{GND}$    |   |        | Room              | -0.001           | -1<br>-5                 |                  | -1<br>-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.

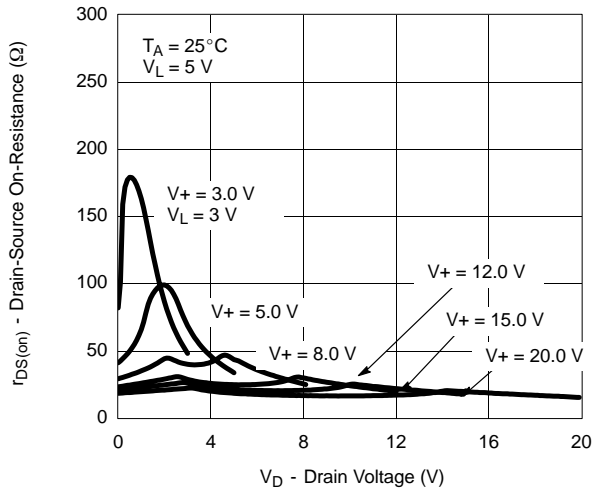


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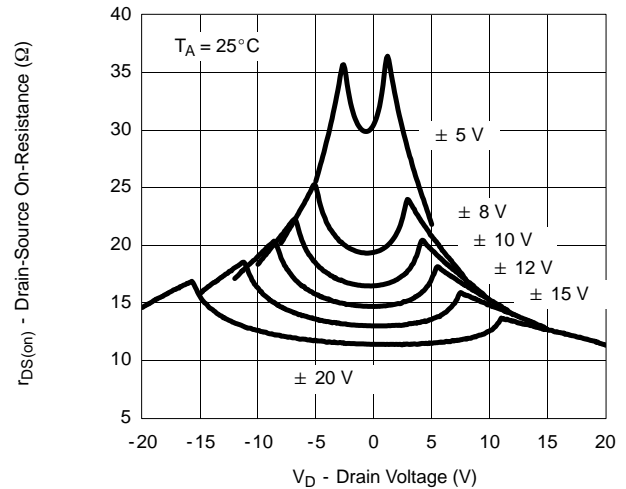
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**TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)**

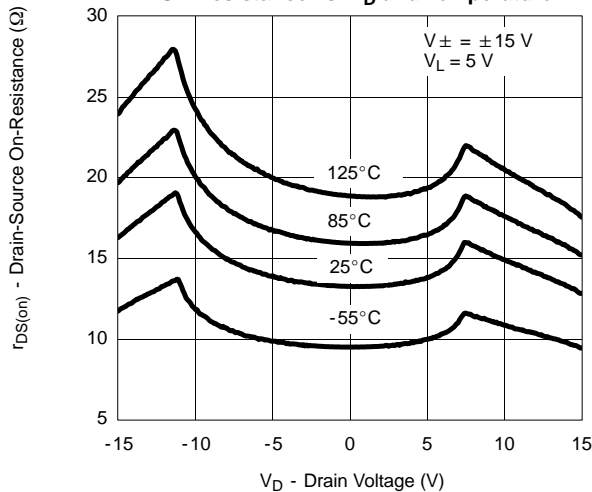
**On-Resistance vs.  $V_D$  and Unipolar Supply Voltage**



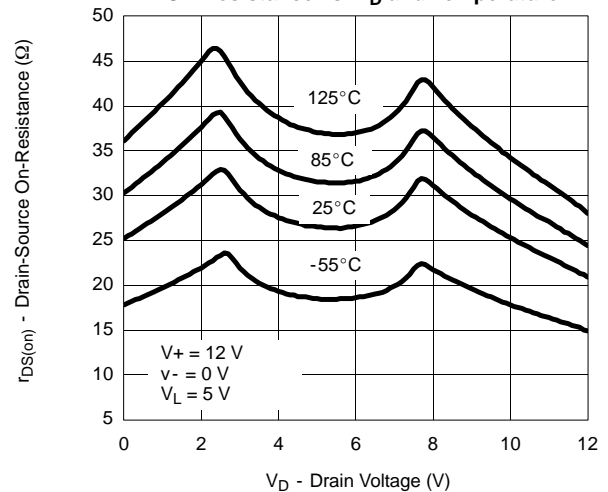
**On-Resistance vs.  $V_D$  and Dual Supply Voltage**



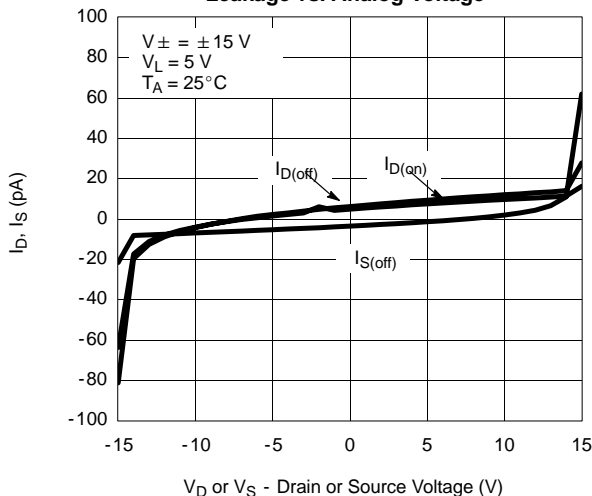
**On-Resistance vs.  $V_D$  and Temperature**



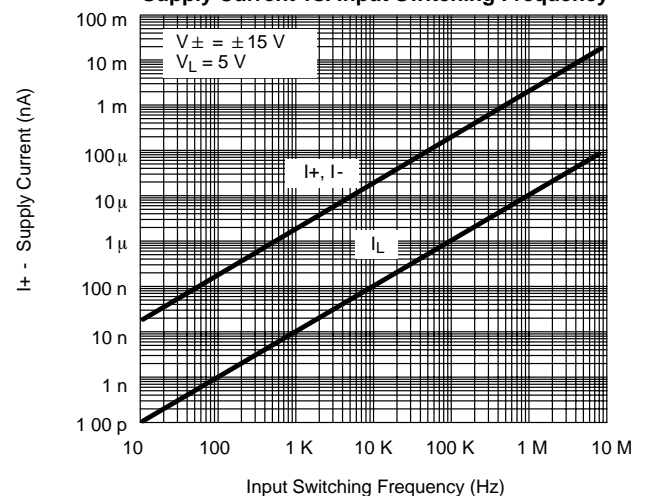
**On-Resistance vs.  $V_D$  and Temperature**



**Leakage vs. Analog Voltage**



**Supply Current vs. Input Switching Frequency**



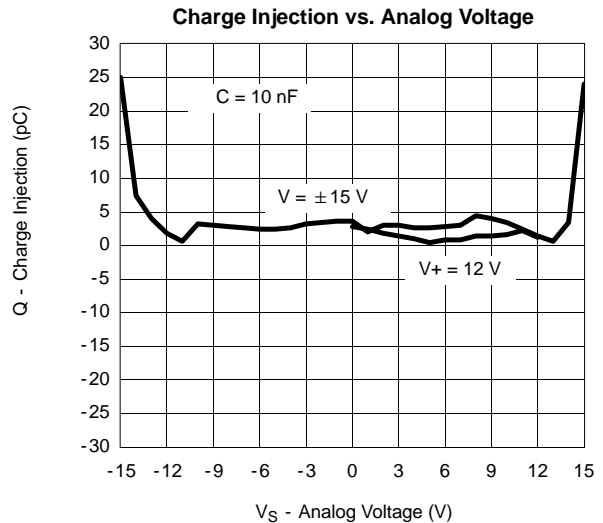
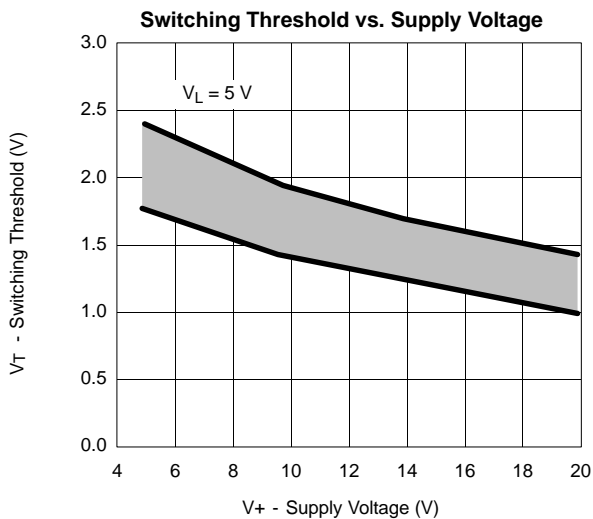
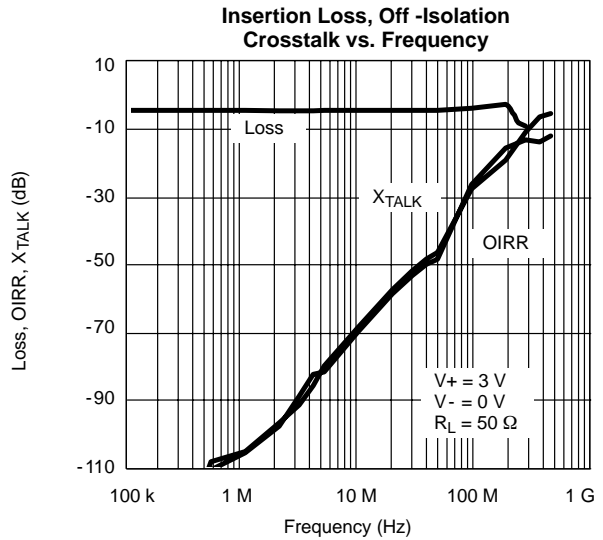
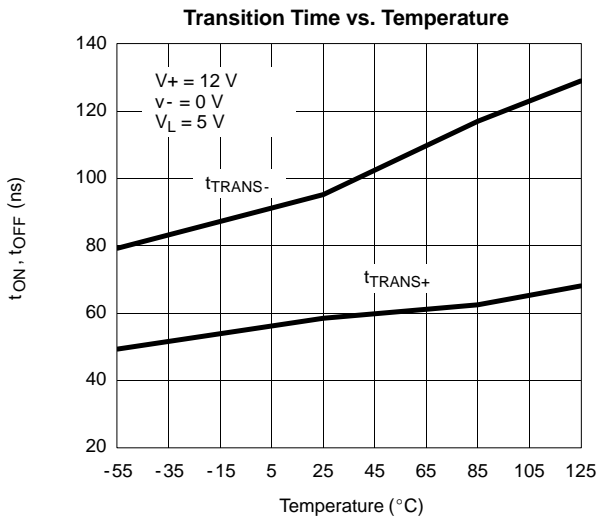
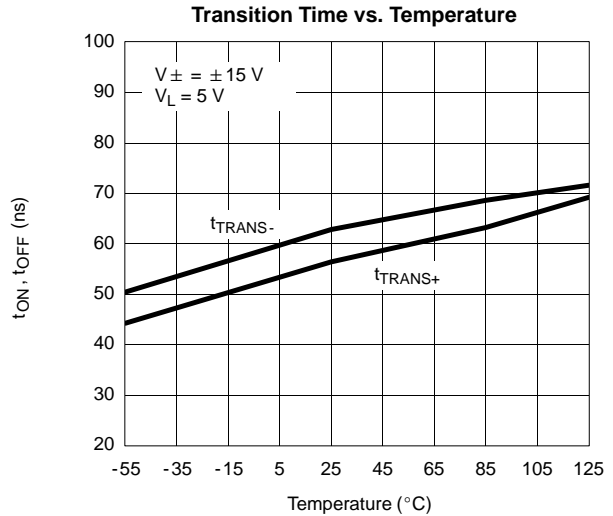
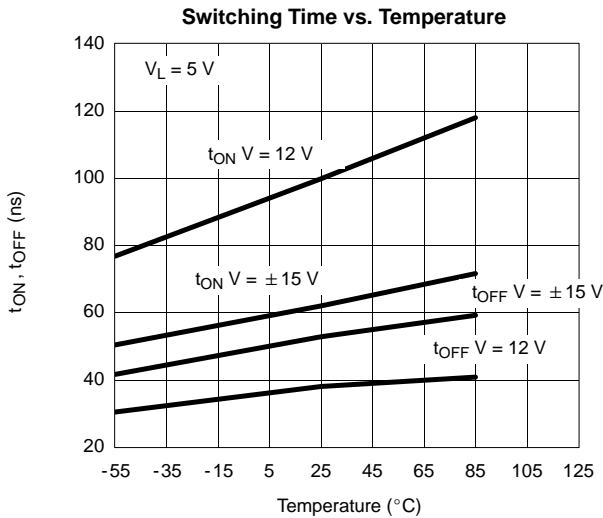
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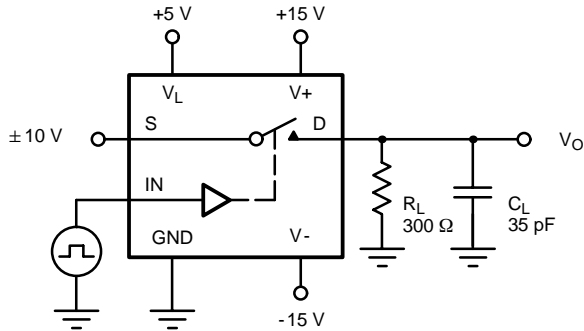


## TYPICAL CHARACTERISTICS (25 °C UNLESS NOTED)



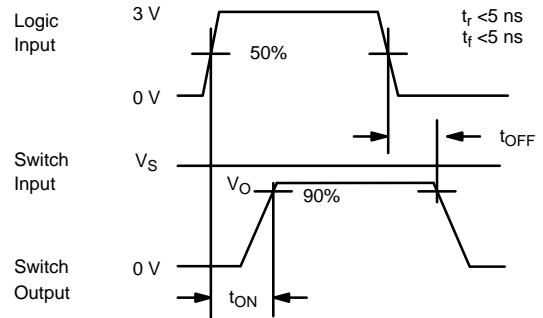
**TEST CIRCUITS**

$V_O$  is the steady state output with the switch on.



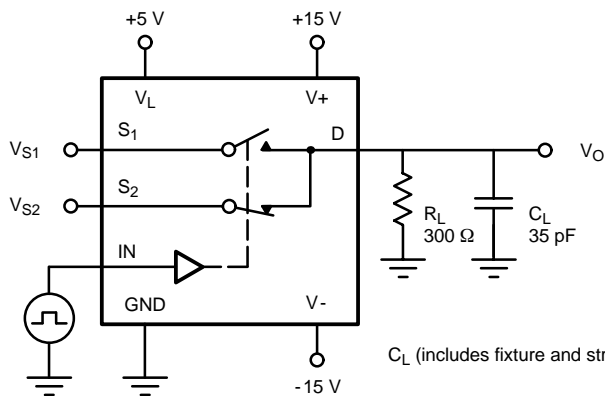
$C_L$  (includes fixture and stray capacitance)

$$V_O = V_S \frac{R_L}{R_L + r_{DS(on)}}$$

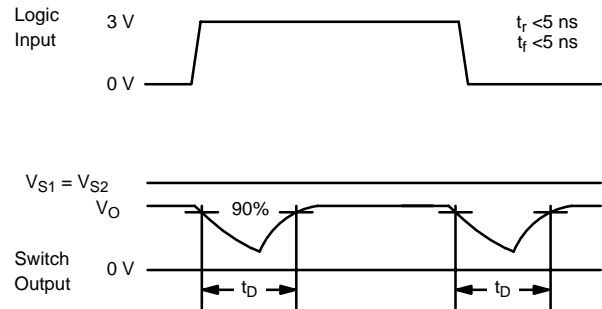


Note: Logic input waveform is inverted for switches that have the opposite logic sense.

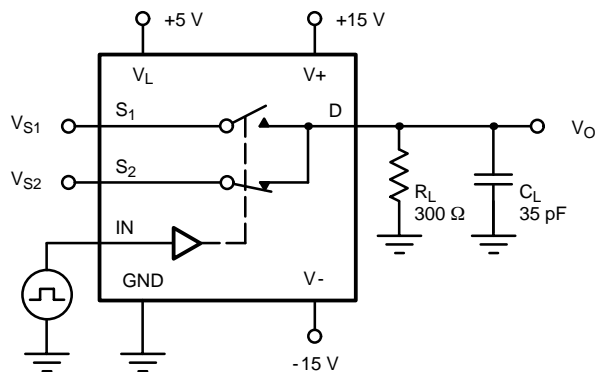
**FIGURE 2. Switching Time (DG417B/418B)**



$C_L$  (includes fixture and stray capacitance)

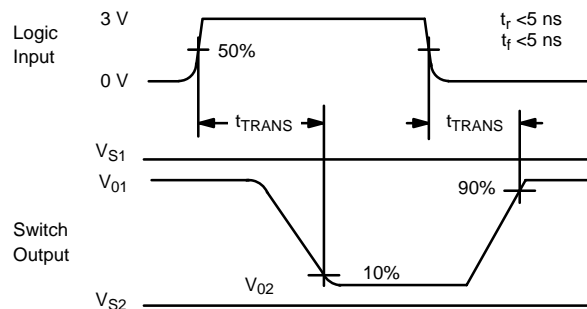


**FIGURE 3. Break-Before-Make (DG419B)**



$C_L$  (includes fixture and stray capacitance)

$$V_O = V_S \frac{R_L}{R_L + r_{DS(on)}}$$



**FIGURE 4. Transition Time (DG419B)**

TEST CIRCUITS

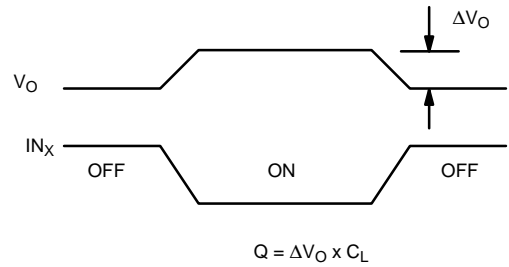
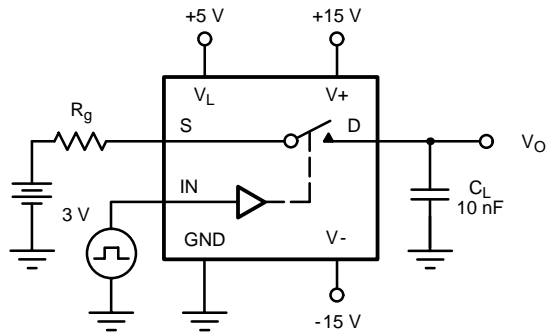


FIGURE 5. Charge Injection

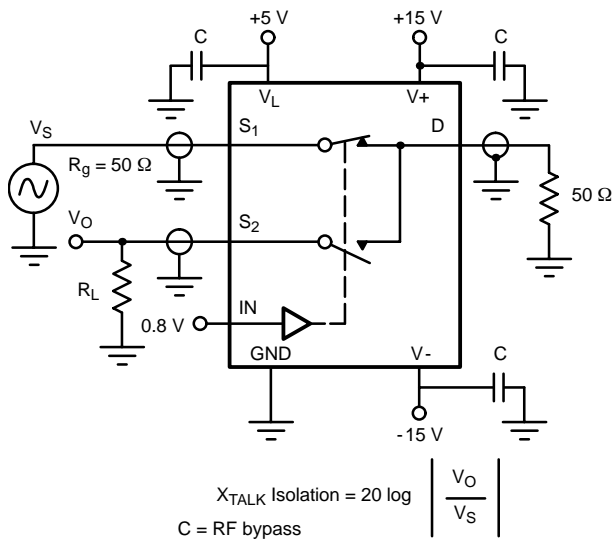


FIGURE 6. Crosstalk (DG419B)

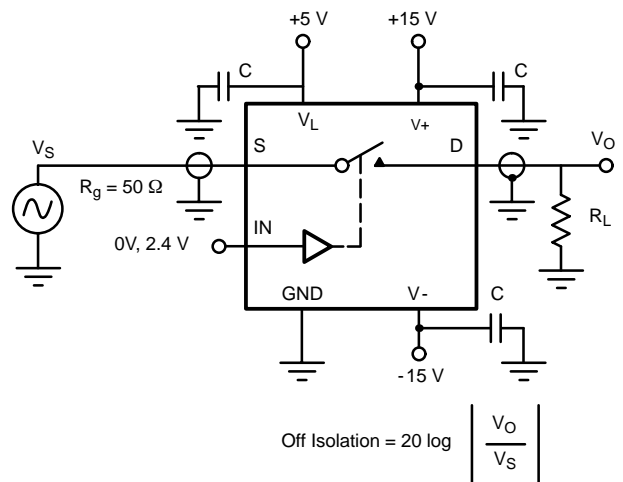


FIGURE 7. Off Isolation

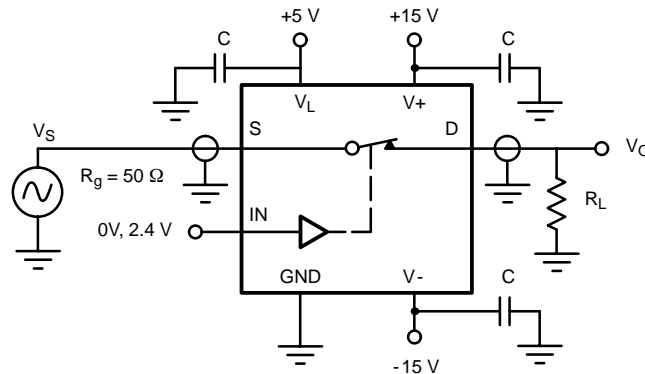


FIGURE 8. Insertion Loss





TEST CIRCUITS

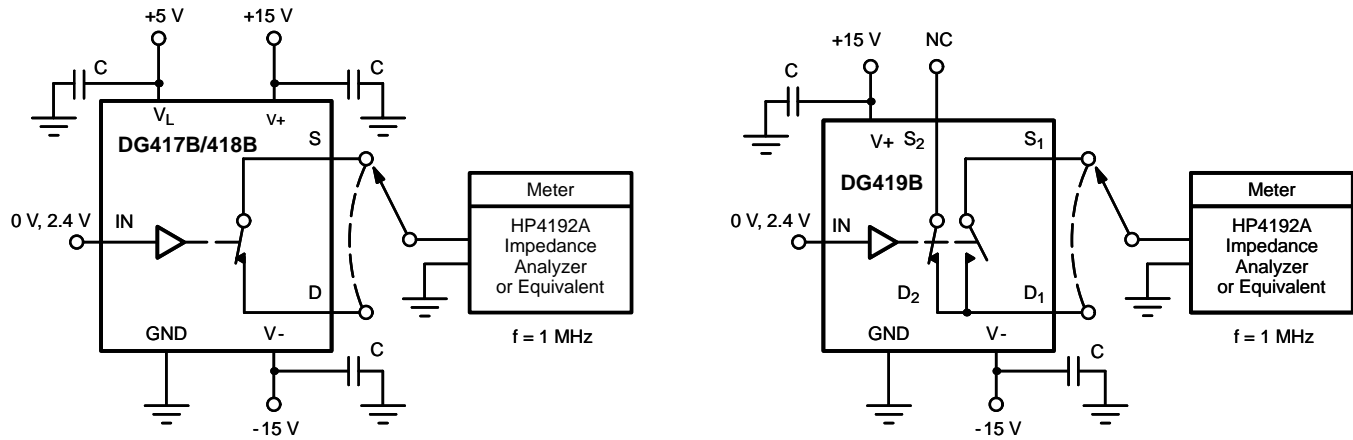


FIGURE 9. Source/Drain Capacitances