

High-Speed Drivers with Dual SPST JFET Switches

FEATURES

- Constant On-Resistance Over Entire Analog Range
- Low Leakage
- Low Crosstalk
- Low Rad Hardness

BENEFITS

- Low Distortion
- Eliminates Large Signal Errors
- High Precision
- High Bandwidth Capability
- Fault Protection

APPLICATIONS

- Audio Switching
- Video Switching
- Sample/Hold
- Guidance and Control Systems
- Aerospace

DESCRIPTION

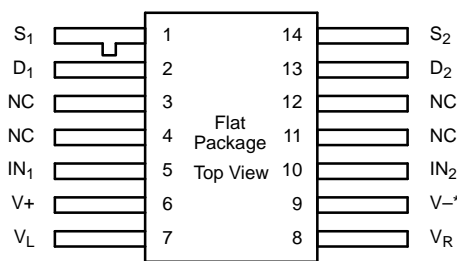
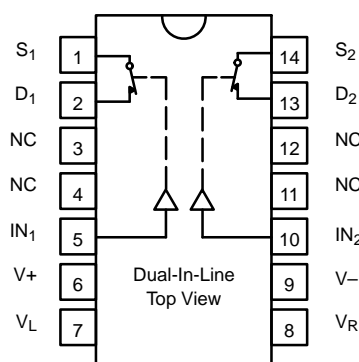
The DG180/181/182 are precision dual single-pole, single-throw (SPST) analog switches designed to provide accurate switching of video and audio signals. This series is ideally suited for applications requiring a constant on-resistance over the entire analog range.

The major difference in the devices is the on-resistance (DG180—10 Ω , DG181—30 Ω , DG182—75 Ω). Reduced errors are achieved through low leakage current ($I_{D(on)}$ < 2 nA). Applications which benefit from the flat JFET

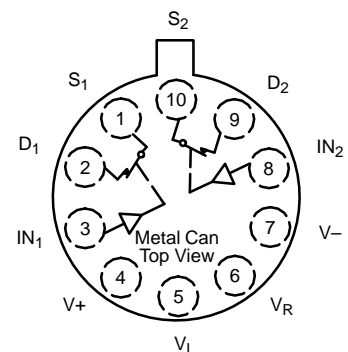
on-resistance include audio switching, video switching, and data acquisition.

To achieve fast and accurate switch performance, each device comprises four n-channel JFET transistors and a TTL compatible bipolar driver. In the on state, each switch conducts current equally well in either direction. In the off condition, the switches will block up to 20 V peak-to-peak, with feedthrough of less than -60 dB at 10 MHz.

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



Refer to JAN38510 Information, Military Section



*Common to Substrate and Case

| TRUTH TABLE | |
|-------------|--------|
| Logic | Switch |
| 0 | ON |
| 1 | OFF |

Logic "0" \leq 0.8 V
 Logic "1" \geq 2.0 V

| ORDERING INFORMATION | | |
|----------------------|-------------------|-------------------------------|
| Temp Range | Package | Part Number |
| -25 to 85°C | 10-Pin Metal Can | DG181BA |
| | 14-Pin Sidebrazed | DG180BP |
| -55 to 125°C | 10-Pin Metal Can | DG180AA/883, 5962-8767301IA |
| | | DG181AA/883, JM38510/11101BIA |
| | | DG182AA/883, JM38510/11102BIA |
| | 14-Pin Sidebrazed | DG180AP/883, 5962-8767301CA |
| | | DG181AP/883, JM38510/11101BCA |
| | | DG182AP/883, JM38510/11102BCA |
| | 14-Pin Flat Pack | 5962-8767301XA |
| | | JM38510/11101BXA |
| | | JM38510/11102BXA |

ABSOLUTE MAXIMUM RATINGS

| | | | |
|------------------------------|------------|--|--------------|
| V_+ to V_- | 36 V | Current (S or D) DG181, DG182 | 30 mA |
| V_+ to V_D | 33 V | Current (All Other Pins) | 30 mA |
| V_D to V_- | 33 V | Storage Temperature | -65 to 150°C |
| V_D to V_D | ± 22 V | Power Dissipation ^a | |
| V_L to V_- | 36 V | 10-Pin Metal Can ^b | 450 mW |
| V_L to V_{IN} | 8 V | 14-Pin Sidebrazed ^c | 825 mW |
| V_L to V_R | 8 V | 14-Pin Flat Pack ^d | 900 mW |
| V_{IN} to V_R | 8 V | Notes: | |
| V_R to V_- | 27 V | a. All leads welded or soldered to PC Board. | |
| V_R to V_{IN} | 2 V | b. Derate 6 mW/°C above 75°C | |
| Current (S or D) DG180 | 200 mA | c. Derate 11 mW/°C above 75°C | |
| | | d. Derate 10 mW/°C above 75°C | |

SCHEMATIC DIAGRAM (TYPICAL CHANNEL)

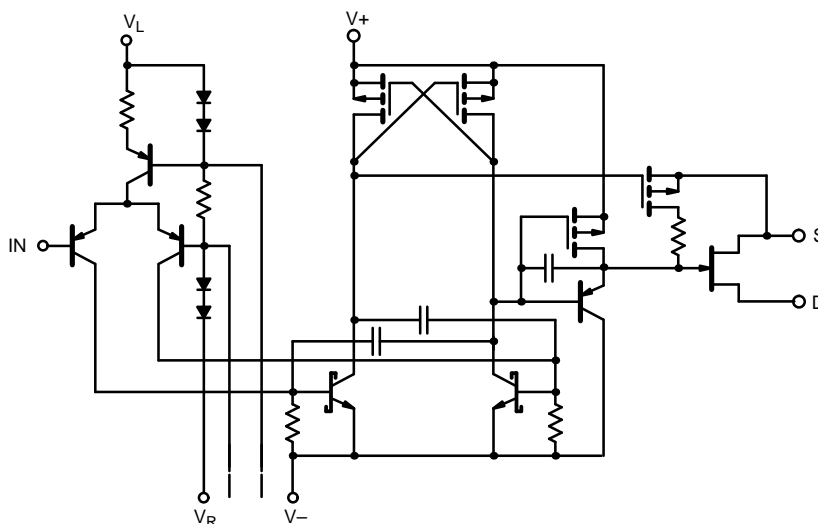


FIGURE 1.



| SPECIFICATIONS ^a FOR DG180 | | | | | | | | | | |
|---------------------------------------|--------------|---|------------------------------|------------------|--------------------------|------------------|-------------------------|------------------|---------------|--|
| Parameter | Symbol | Test Conditions Unless Specified $V_+ = 15\text{ V}, V_- = -15\text{ V}, V_L = 5\text{ V}$ $V_R = 0\text{ V}, V_{IN} = 2\text{ V}, 0.8\text{ V}^f$ | Temp ^b | Typ ^c | A Suffix -55 to 125°C | | B Suffix -25 to 85°C | | Unit | |
| | | | | | Min ^d | Max ^d | Min ^d | Max ^d | | |
| Analog Switch | | | | | | | | | | |
| Analog Signal Range ^e | V_{ANALOG} | | Full | | -7.5 | 15 | -7.5 | 15 | V | |
| Drain-Source On-Resistance | $r_{DS(on)}$ | $I_S = -10\text{ mA}, V_D = -7.5\text{ V}$ | Room Full | 7.5 | | 10 20 | | 15 25 | Ω | |
| Source Off Leakage Current | $I_{S(off)}$ | $V_S = \pm 10\text{ V}, V_D = \mp 10\text{ V}$ $V_+ = 10\text{ V}, V_- = -20\text{ V}$ | Room Hot | 0.05 | | 10 1000 | | 15 300 | nA | |
| | | $V_S = \pm 7.5\text{ V}, V_D = \mp 7.5\text{ V}$ | Room Hot | 0.05 | | 10 1000 | | 15 300 | | |
| Drain Off Leakage Current | $I_{D(off)}$ | $V_S = \pm 10\text{ V}, V_D = \mp 10\text{ V}$ $V_+ = 10\text{ V}, V_- = -20\text{ V}$ | Room Hot | 0.04 | | 10 1000 | | 15 300 | | |
| | | $V_S = \pm 7.5\text{ V}, V_D = \mp 7.5\text{ V}$ | Room Hot | 0.03 | | 10 1000 | | 15 300 | | |
| Channel On Leakage Current | $I_{D(on)}$ | $V_D = V_S = \pm 7.5\text{ V}$ | Room Hot | -0.1 | -2 -200 | | -10 -200 | | | |
| Saturation Drain Current | I_{DSS} | 2 ms Pulse Duration | Room | 300 | | | | | mA | |
| Digital Input | | | | | | | | | | |
| Input Current with Input Voltage High | I_{INH} | $V_{IN} = 5\text{ V}$ | Room Hot | <0.01 | | 10 20 | | 10 20 | μA | |
| Input Current with Input Voltage Low | I_{INL} | $V_{IN} = 0\text{ V}$ | Full | -30 | -250 | | -250 | | | |
| Dynamic Characteristics | | | | | | | | | | |
| Turn-On Time | t_{on} | See Switching Time Test Circuit | Room | 240 | | 400 | | 600 | ns | |
| Turn-Off Time | t_{off} | | Room | 140 | | 200 | | 250 | | |
| Source-Off Capacitance | $C_{S(off)}$ | $f = 1\text{ MHz}$ | Room | 21 | | | | | pF | |
| Drain-Off Capacitance | $C_{D(off)}$ | | $V_S = -5\text{ V}, I_D = 0$ | Room | 17 | | | | | |
| Channel-On Capacitance | $C_{D(on)}$ | | $V_D = -5\text{ V}, I_S = 0$ | Room | 17 | | | | | |
| Off Isolation | OIRR | $f = 1\text{ MHz}, R_L = 75\ \Omega$ | Room | >55 | | | | | dB | |
| Power Supplies | | | | | | | | | | |
| Positive Supply Current | I_+ | $V_{IN} = 0\text{ V}, \text{ or } 5\text{ V}$ | Room | 0.6 | | 1.5 | | 1.5 | mA | |
| Negative Supply Current | I_- | | Room | -2.7 | -5 | | -5 | | | |
| Logic Supply Current | I_L | | Room | 3 | | 4.5 | | 4.5 | | |
| Reference Supply Current | I_R | | Room | -1 | -2 | | -2 | | | |

Notes:

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



| SPECIFICATIONS ^a FOR DG181 | | | | | | | | | |
|---------------------------------------|--------------|---|------------------------------|------------------|--------------------------|------------------|-------------------------|------------------|---------------|
| Parameter | Symbol | Test Conditions Unless Specified $V_+ = 15\text{ V}, V_- = -15\text{ V}, V_L = 5\text{ V}$ $V_R = 0\text{ V}, V_{IN} = 2\text{ V}, 0.8\text{ V}^f$ | Temp ^b | Typ ^c | A Suffix -55 to 125°C | | B Suffix -25 to 85°C | | Unit |
| | | | | | Min ^d | Max ^d | Min ^d | Max ^d | |
| Analog Switch | | | | | | | | | |
| Analog Signal Range ^e | V_{ANALOG} | | Full | | -7.5 | 15 | -7.5 | 15 | V |
| Drain-Source On-Resistance | $r_{DS(on)}$ | $I_S = -10\text{ mA}, V_D = -7.5\text{ V}$ | Room Full | 18 | | 30 60 | | 50 75 | Ω |
| Source Off Leakage Current | $I_{S(off)}$ | $V_S = \pm 10\text{ V}, V_D = \mp 10\text{ V}$ $V_+ = 10\text{ V}, V_- = -20\text{ V}$ | Room Hot | 0.05 | | 1 100 | | 5 100 | nA |
| | | $V_S = \pm 7.5\text{ V}, V_D = \mp 7.5\text{ V}$ | Room Hot | 0.07 | | 1 100 | | 5 100 | |
| Drain Off Leakage Current | $I_{D(off)}$ | $V_S = \pm 10\text{ V}, V_D = \mp 10\text{ V}$ $V_+ = 10\text{ V}, V_- = -20\text{ V}$ | Room Hot | 0.5 | | 1 100 | | 5 100 | |
| | | $V_S = \pm 7.5\text{ V}, V_D = \mp 7.5\text{ V}$ | Room Hot | 0.6 | | 1 100 | | 5 100 | |
| Channel On Leakage Current | $I_{D(on)}$ | $V_D = V_S = \pm 7.5\text{ V}$ | Room Hot | -0.02 | -2 -200 | | -10 -200 | | |
| Digital Input | | | | | | | | | |
| Input Current with Input Voltage High | I_{INH} | $V_{IN} = 5\text{ V}$ | Room Hot | <0.01 | | 10 20 | | 10 20 | μA |
| Input Current with Input Voltage Low | I_{INL} | $V_{IN} = 0\text{ V}$ | Full | -30 | -250 | | -250 | | |
| Dynamic Characteristics | | | | | | | | | |
| Turn-On Time | t_{on} | See Switching Time Test Circuit | Room | 85 | | 150 | | 180 | ns |
| Turn-Off Time | t_{off} | | Room | 95 | | 130 | | 150 | |
| Source-Off Capacitance | $C_{S(off)}$ | f = 1 MHz | Room | 9 | | | | | pF |
| Drain-Off Capacitance | $C_{D(off)}$ | | $V_S = -5\text{ V}, I_D = 0$ | Room | 6 | | | | |
| Channel-On Capacitance | $C_{D(on)}$ | | $V_D = -5\text{ V}, I_S = 0$ | Room | 14 | | | | |
| Off Isolation | OIRR | f = 1 MHz, $R_L = 75\ \Omega$ | Room | >50 | | | | | dB |
| Power Supplies | | | | | | | | | |
| Positive Supply Current | I_+ | $V_{IN} = 0\text{ V}, \text{ or } 5\text{ V}$ | Room | 0.6 | | 1.5 | | 1.5 | mA |
| Negative Supply Current | I_- | | Room | -2.7 | -5 | | -5 | | |
| Logic Supply Current | I_L | | Room | 3.1 | | 4.5 | | 4.5 | |
| Reference Supply Current | I_R | | Room | -1 | -2 | | -2 | | |

Notes:

- Refer to PROCESS OPTION FLOWCHART.
- Room = 25°C, Full = as determined by the operating temperature suffix.
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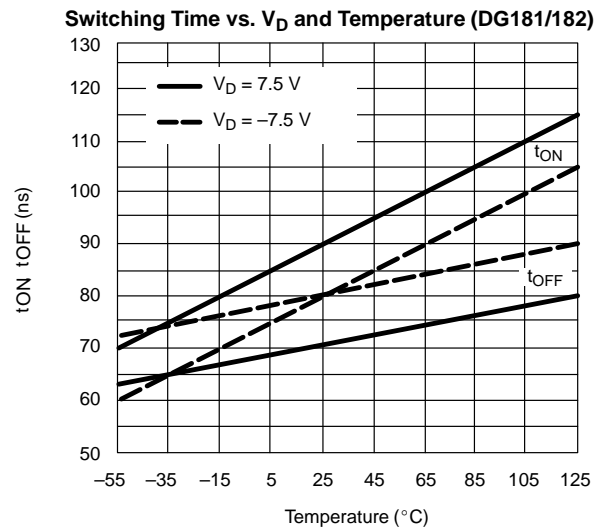
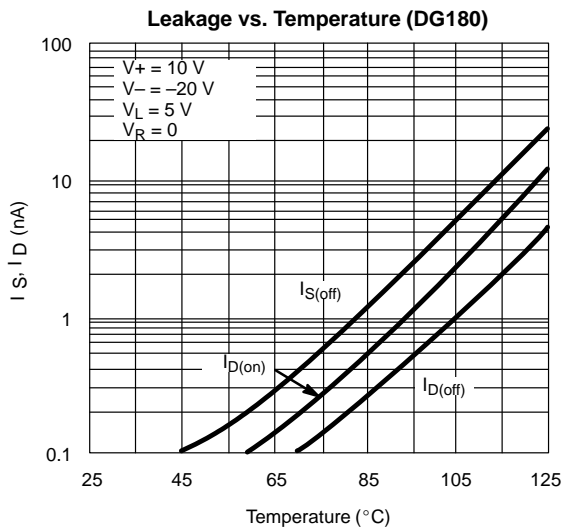
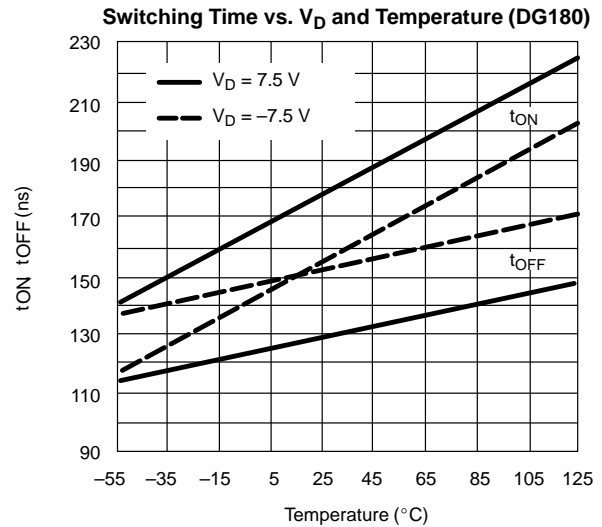
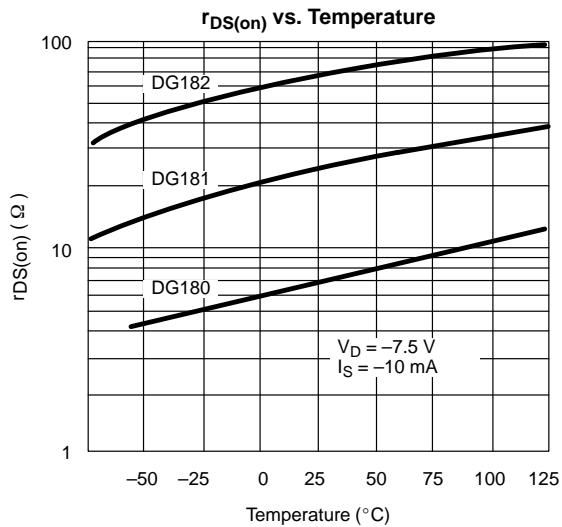
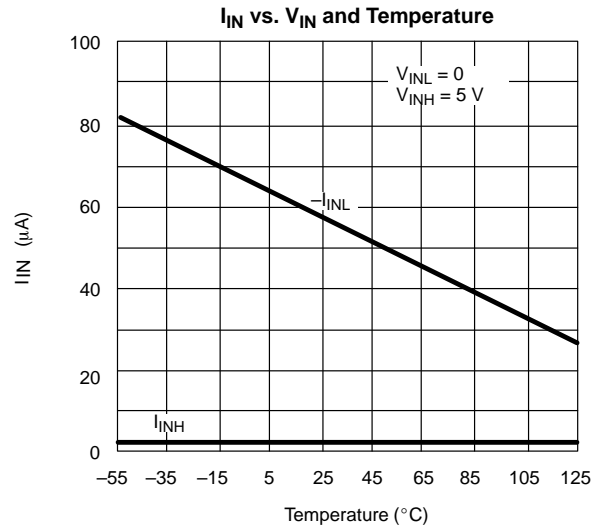
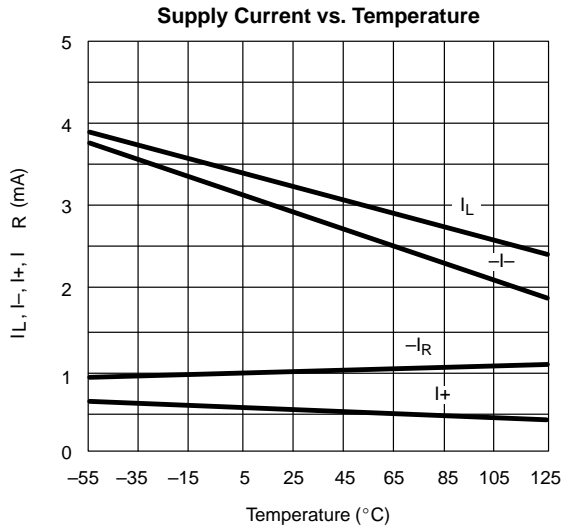
| SPECIFICATIONS ^a FOR DG182 | | | | | | | | | |
|---------------------------------------|--------------|---|------------------------------|------------------|--------------------------|------------------|-------------------------|------------------|---------------|
| Parameter | Symbol | Test Conditions Unless Specified $V_+ = 15\text{ V}, V_- = -15\text{ V}, V_L = 5\text{ V}$ $V_R = 0\text{ V}, V_{IN} = 2\text{ V}, 0.8\text{ V}^f$ | Temp ^b | Typ ^c | A Suffix -55 to 125°C | | B Suffix -25 to 85°C | | Unit |
| | | | | | Min ^d | Max ^d | Min ^d | Max ^d | |
| Analog Switch | | | | | | | | | |
| Analog Signal Range ^e | V_{ANALOG} | | Full | | -10 | 15 | -10 | 15 | V |
| Drain-Source On-Resistance | $r_{DS(on)}$ | $I_S = -10\text{ mA}, V_D = -7.5\text{ V}$ | Room Full | 35 | | 75 150 | | 100 150 | Ω |
| Source Off Leakage Current | $I_{S(off)}$ | $V_S = \pm 10\text{ V}, V_D = \mp 10\text{ V}$ $V_+ = 10\text{ V}, V_- = -20\text{ V}$ | Room Hot | 0.05 | | 1 100 | | 5 100 | nA |
| | | $V_S = \pm 10\text{ V}, V_D = \mp 10\text{ V}$ | Room Hot | 0.07 | | 1 100 | | 5 100 | |
| Drain Off Leakage Current | $I_{D(off)}$ | $V_S = \pm 10\text{ V}, V_D = \mp 10\text{ V}$ $V_+ = 10\text{ V}, V_- = -20\text{ V}$ | Room Hot | 0.4 | | 1 100 | | 5 100 | |
| | | $V_S = \pm 10\text{ V}, V_D = \mp 10\text{ V}$ | Room Hot | 0.5 | | 1 100 | | 5 100 | |
| Channel On Leakage Current | $I_{D(on)}$ | $V_D = V_S = \pm 10\text{ V}$ | Room Hot | -0.02 | -2 -200 | | -10 -200 | | |
| Digital Input | | | | | | | | | |
| Input Current with Input Voltage High | I_{INH} | $V_{IN} = 5\text{ V}$ | Room Hot | <0.01 | | 10 20 | | 10 20 | μA |
| Input Current with Input Voltage Low | I_{INL} | $V_{IN} = 0\text{ V}$ | Full | -30 | -250 | | -250 | | |
| Dynamic Characteristics | | | | | | | | | |
| Turn-On Time | t_{on} | See Switching Time Test Circuit | Room | 120 | | 250 | | 300 | ns |
| Turn-Off Time | t_{off} | | Room | 100 | | 130 | | 150 | |
| Source-Off Capacitance | $C_{S(off)}$ | f = 1 MHz | Room | 9 | | | | | pF |
| Drain-Off Capacitance | $C_{D(off)}$ | | $V_D = -5\text{ V}, I_S = 0$ | Room | 6 | | | | |
| Channel-On Capacitance | $C_{D(on)}$ | | $V_D = V_S = 0\text{ V}$ | Room | 14 | | | | |
| Off Isolation | OIRR | f = 1 MHz, $R_L = 75\ \Omega$ | Room | >50 | | | | | dB |
| Power Supplies | | | | | | | | | |
| Positive Supply Current | I_+ | $V_{IN} = 0\text{ V}, \text{ or } 5\text{ V}$ | Room | 0.6 | | 1.5 | | 1.5 | mA |
| Negative Supply Current | I_- | | Room | -2.7 | -5 | | -5 | | |
| Logic Supply Current | I_L | | Room | 3.1 | | 4.5 | | 4.5 | |
| Reference Supply Current | I_R | | Room | -1 | -2 | | -2 | | |

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.
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- e. Guaranteed by design, not subject to production test.
- f. V_{IN} = input voltage to perform proper function.

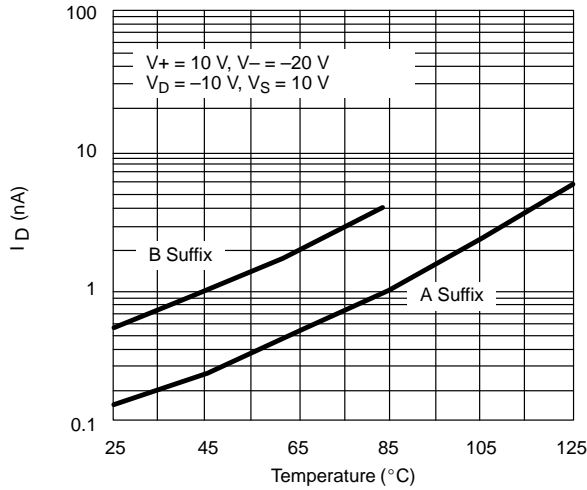


TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)

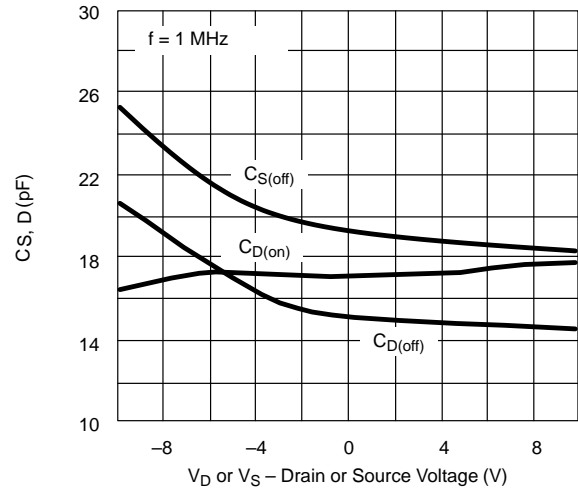


TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)

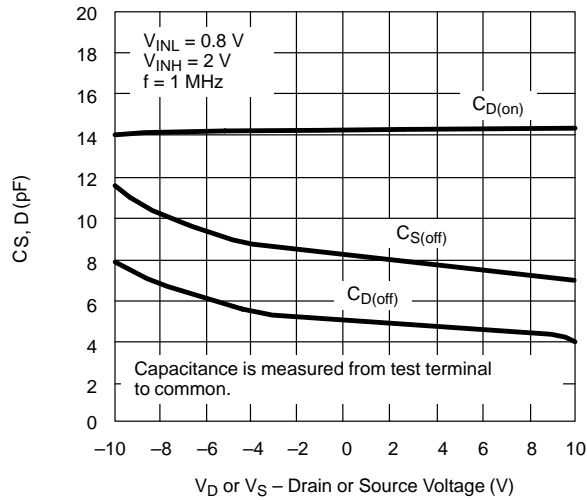
$I_{D(off)}$ vs. Temperature (DG181/182)



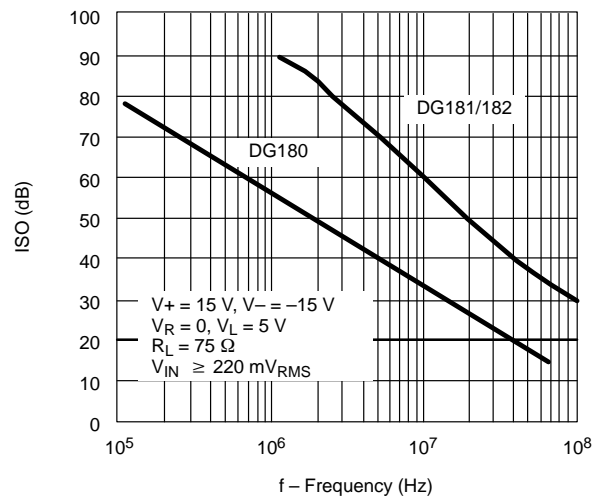
Capacitance vs. V_D or V_S (DG180)



Capacitance vs. V_D or V_S (DG181/182)



Off Isolation vs. Frequency



TEST CIRCUITS

Feedthrough due to charge injection may result in spikes at the leading and trailing edge of the output waveform.

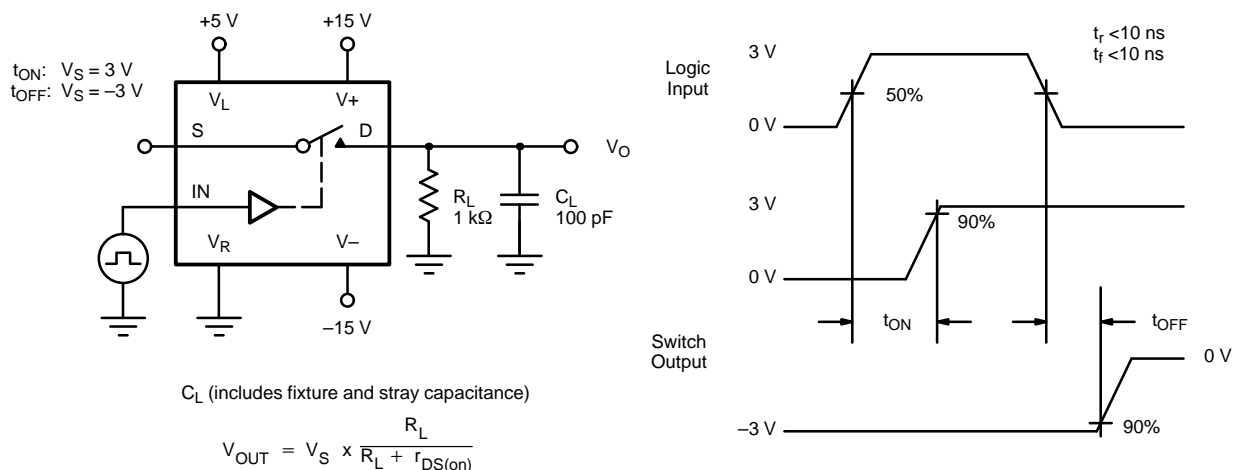


FIGURE 2. Switching Time

APPLICATION HINTS^a

| Switch | V+ Positive Supply Voltage (V) | V- Negative Supply Voltage (V) | V _L Logic Supply Voltage (V) | V _R Reference Supply Voltage (V) | V _{IN} Logic Input Voltage V _{INH(min)} /V _{INL(max)} (V) | V _S Analog Voltage Range (V) |
|----------------|--------------------------------|--------------------------------|---|---|--|---|
| DG180 DG181 | 15 ^b | -15 | 5 | GND | 2.0/0.8 | -7.5 to 15 |
| | 10 | -20 | 5 | GND | 2.0/0.8 | -12.5 to 10 |
| | 12 | -12 | 5 | GND | 2.0/0.8 | -4.5 to 12 |
| DG182 | 15 ^b | -15 | 5 | GND | 2.0/0.8 | -10 to 15 |
| | 10 | -20 | 5 | GND | 2.0/0.8 | -15 to 10 |
| | 12 | -12 | 5 | GND | 2.0/0.8 | -7 to 12 |

Notes:

- a. Application Hints are for DESIGN AID ONLY, not guaranteed and not subject to production testing.
- b. Electrical Parameter Chart based on V+ = 15 V, V_L = 5 V, V_R = GND



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