# Low-Voltage, 0.8-$\Omega$ $r_{ON}$, Dual SPST Analog Switch

## FEATURES

- Low Voltage Operation (1.6 V to 3.6 V)
- Low On-Resistance - $r_{DS(on)}$:
    0.8 $\Omega$ @ 2.7 V
- High Current Handling Capacity:
    150-mA Continuous
- Off-Isolation: −56 dB @ 1 MHz
- Fast Switching: 25 ns $t_{ON}$
- Low Charge Injection—$Q_{INJ}$: 5.8 pC
- Low Power Consumption: < 1 $\mu$W
- ESD Protection > 2,000 V

## BENEFITS

- High Accuracy
- High Bandwidth
- TTL and Low Voltage Logic Compatibility
- Low Power Consumption
- Reduced PCB Space (SOT23-8 and MSOP-8)

## APPLICATIONS

- Mixed Signal Routing
- Portable and Battery Operated Systems
- Low Voltage Data Acquisition
- Modems
- PCMCIA Cards

## DESCRIPTION

The DG2741/2742/2743 are low voltage, single supply, dual SPST analog switches. Designed for high performance switching of analog signals, the DG2741/2742/2743 provide low on-resistance (0.8 $\Omega$ @ +2.7 V), fast speed ($t_{ON}$, $t_{OFF}$ @ 35 ns and 33 ns) and the ability to handle signals over the entire analog voltage range.

When operated on a +3-V supply, control pins are compatible with 1.8-V digital logic. Additionally, on-resistance flatness and matching (0.18 $\Omega$ and 0.08 $\Omega$, respectively) offer high accuracy between channels.

The DG2741 contains two normally open (NO) switches, the DG2742 contains two normally closed (NC) switches, and the DG2743 contains one normally open and one normally closed switch. Break-before-make is guaranteed.

Built on Vishay Siliconix's low voltage submicron CMOS process, the DG2741/2742/2743 were designed to offer solutions that extend beyond audio/video functions, to providing the performance required for today's demanding mixed-signal switching in portable applications.

## FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION—DG2741



DG2741, MSOP-8
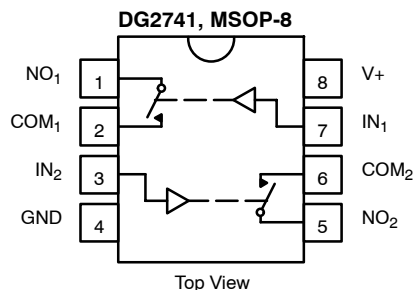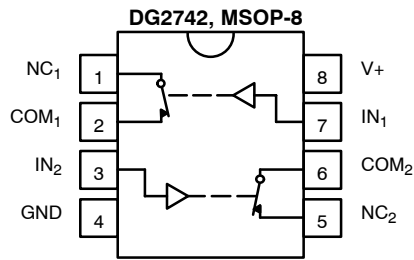
Top View

Device Marking: 2741



DG2741. SOT23-8
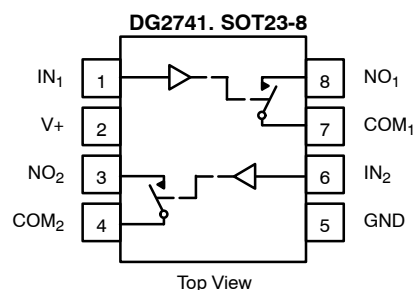
Top View

Device Marking: F3

| TRUTH TABLE - DG2741 | |
|---|---|
| Logic | Switch |
| 0 | Off |
| 1 | On |

## FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION—DG2742/DG2743

**DG2742, MSOP-8**

| | | | |
|---|---|---|---|
| NC₁ | 1 | 8 | V+ |
| COM₁ | 2 | 7 | IN₁ |
| IN₂ | 3 | 6 | COM₂ |
| GND | 4 | 5 | NC₂ |

Top View

Device Marking: 2742

**DG2742. SOT23-8**

| | | | |
|---|---|---|---|
| IN₁ | 1 | 8 | NC₁ |
| V+ | 2 | 7 | COM₁ |
| NC₂ | 3 | 6 | IN₂ |
| COM₂ | 4 | 5 | GND |
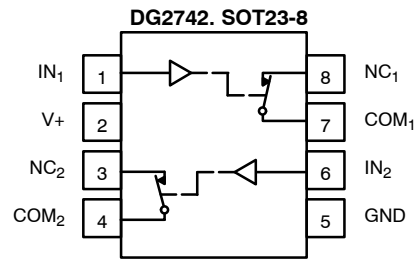
Top View

Device Marking: F4

| TRUTH TABLE - DG2742 | |
|---|---|
| Logic | Switch |
| 0 | On |
| 1 | Off |

**DG2743, MSOP-8**

| | | | |
|---|---|---|---|
| NO₁ | 1 | 8 | V+ |
| COM₁ | 2 | 7 | IN₁ |
| IN₂ | 3 | 6 | COM₂ |
| GND | 4 | 5 | NC₂ |

Top View

Device Marking: 2743

**DG2743. SOT23-8**

| | | | |
|---|---|---|---|
| IN₁ | 1 | 8 | NO₁ |
| V+ | 2 | 7 | COM₁ |
| NC₂ | 3 | 6 | IN₂ |
| COM₂ | 4 | 5 | GND |
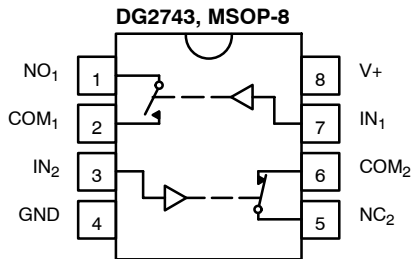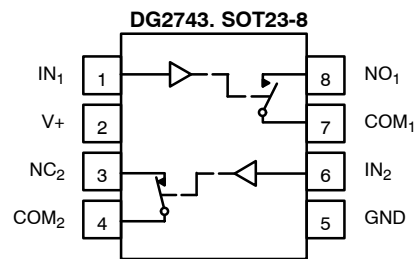
Top View

Device Marking: F5

| TRUTH TABLE - DG2743 | | |
|---|---|---|
| Logic | Switch-1 | Switch-2 |
| 0 | Off | On |
| 1 | On | Off |

| ORDERING INFORMATION | | |
|---|---|---|
| Temp Range | Package | Part Number |
| -40 to 85°C | MSOP-8 | DG2741DQ–T1 |
| | | DG2742DQ–T1 |
| | | DG2743DQ–T1 |
| | SOT23-8 | DG2741DS–T1 |
| | | DG2742DS–T1 |
| | | DG2743DS–T1 |

## ABSOLUTE MAXIMUM RATINGS

Reference to GND

V+ . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . -0.3 to +4 V

IN, COM, NC, NO[a] . . . . . . . . . . . . . . . . . . . . . . . . . . . . -0.3 to (V+ + 0.3 V)

Continuous Current (NO, NC and COM Pins) . . . . . . . . . . . . . . . ± 200 mA

Peak Current . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . ± 300 mA

(Pulsed at 1 ms, 10% duty cycle)

ESD per Method 3015.7 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . > 2 kV

Storage Temperature (D Suffix) . . . . . . . . . . . . . . . . . . . . . . . . . . -65 to 150°C

Power Dissipation (Packages)[c]

6-Pin SC-70[c] . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 250 mW

Notes:
a. Signals on NC, NO, or COM or IN exceeding 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 3.1 mW/°C above 70°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 (V+ = 1.8 V)

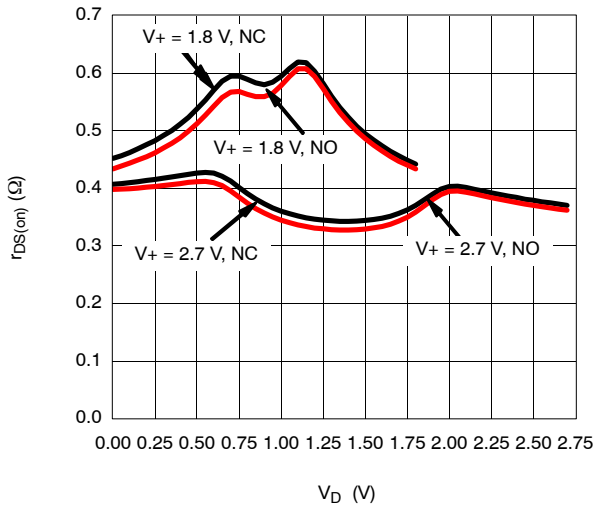| Parameter | Symbol | Test Conditions Otherwise Unless Specified $V+ = 1.8$ V, $\pm$10%, $V_{IN} = 0.4$ or 1.0 V[e] | Temp[a] | Limits −40 to 85°C Min[b] | Typ[c] | Max[b] | Unit |
|---|---|---|---|---|---|---|---|
| **Analog Switch** | | | | | | | |
| Analog Signal Range[d] | $V_{NO}$, $V_{NC}$, $V_{COM}$ | | Full | 0 | | V+ | V |
| On-Resistance | $r_{ON}$ | $V+ = 1.8$ V, $V_{COM} = 0.9$ V $I_{NO}$, $I_{NC} = 10$ mA | Room Full[d] | | 0.9 | 2.5 4.0 | Ω |
| $r_{ON}$ Flatness[d] | $r_{ON}$ Flatness | $V+ = 1.8$ V, $V_{COM} = 0$ to V+, $I_{NO}$, $I_{NC} = 10$ mA | Room | | 0.25 | | |
| $r_{ON}$ Match[d] | $\Delta r_{ON}$ | | Room | | 0.05 | | |
| Switch Off Leakage Current[f] | $I_{NO(off)}$, $I_{NC(off)}$ | $V+ = 1.8$ V $V_{NO}$, $V_{NC} = 0.2$ V/2.0 V, $V_{COM} = 1.5$ V/0.3 V | Room Full[d] | −1 −10 | | 1 10 | nA |
| | $I_{COM(off)}$ | | Room Full[d] | −1 −10 | | 1 10 | |
| Channel-On Leakage Current[f] | $I_{COM(on)}$ | $V+ = 1.8$ V, $V_{NO}$, $V_{NC} = V_{COM} = 0.3$ V/1.5 V | Room Full[d] | −1 −10 | | 1 10 | |
| **Digital Control** | | | | | | | |
| Input High Voltage | $V_{INH}$ | | Full | 1.0 | | | V |
| Input Low Voltage | $V_{INL}$ | | Full | | | 0.4 | |
| Input Capacitance[d] | $C_{in}$ | | Full | | 5.5 | | pF |
| Input Current[f] | $I_{INL}$ or $I_{INH}$ | $V_{IN} = 0$ or V+ | Full | −1 | | 1 | μA |
| **Dynamic Characteristics** | | | | | | | |
| Turn-On Time[d] | $t_{ON}$ | $V_{NO}$ or $V_{NC} = 1.5$ V, $R_L = 50$ Ω, $C_L = 35$ pF Figures 1 and 2 | Room Full[d] | | 33 | 45 50 | ns |
| Turn-Off Time[d] | $t_{OFF}$ | | Room Full[d] | | 27 | 40 45 | |
| Break-Before-Make Time[d] | $t_d$ | | Room | 3 | | | |
| Charge Injection[d] | $Q_{INJ}$ | $C_L = 1$ nF, $V_{GEN} = 0$ V, $R_{GEN} = 0$ Ω, Figure 3 | Room | | 20 | | pC |
| Off-Isolation[d] | OIRR | $R_L = 1$ kΩ, $C_L = 5$ pF, f = 1 MHz | Room | | 55 | | dB |
| Crosstalk[d] | $X_{TALK}$ | | Room | | 91 | | |
| NO, NC Off Capacitance[d] | $C_{NO(off)}$, $C_{NC(off)}$ | $V_{IN} = 0$ or V+, f = 1 MHz | Room | | 88 | | pF |
| Channel-On Capacitance[d] | $C_{ON}$ | | Room | | 105 | | |

## SPECIFICATIONS (V+ = 3.0 V)

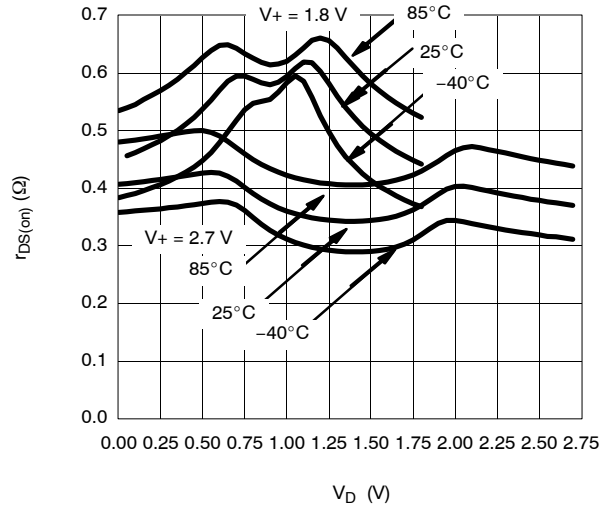| Parameter | Symbol | Test Conditions Otherwise Unless Specified V+ = 3 V, ± 10%, $V_{IN}$ = 0.5 or 1.4 $V^e$ | Temp[a] | Limits −40 to 85°C Min[b] | Typ[c] | Max[b] | Unit |
|---|---|---|---|---|---|---|---|
| **Analog Switch** | | | | | | | |
| Analog Signal Range[d] | $V_{NO}$, $V_{NC}$, $V_{COM}$ | | Full | 0 | | V+ | V |
| On-Resistance | $r_{ON}$ | V+ = 2.7 V, $V_{COM}$ = 0.2 V/1.5 V, $I_{NO}$ $I_{NC}$ = 100 mA | Room Full | | 0.4 | 0.8 0.9 | Ω |
| $r_{ON}$ Flatness | $r_{ON}$ Flatness | V+ = 2.7 V, $V_{COM}$ = 1.5, 2 V, $I_{NO}$, $I_{NC}$ = 100 mA | Room | | 0.08 | 0.18 | |
| $r_{ON}$ MatchFlat | $\Delta r_{ON}$ | | Room | | 0.05 | 0.08 | |
| Switch Off Leakage Current | $I_{NO(off)}$, $I_{NC(off)}$ | V+ = 3.3 V $V_{NO}$, $V_{NC}$ = 0.3 V/3 V, $V_{COM}$ = 3 V/0.3 V | Room Full | −1 −10 | | 1 10 | nA |
| | $I_{COM(off)}$ | | Room Full | −1 −10 | | 1 10 | |
| Channel-On Leakage Current | $I_{COM(on)}$ | V+ = 3.3 V, $V_{NO}$, $V_{NC}$ = $V_{COM}$ = 0.3 V/3 V | Room Full | −1 −10 | | 1 10 | |
| **Digital Control** | | | | | | | |
| Input High Voltage | $V_{INH}$ | | Full | 1.4 | | | V |
| Input Low Voltage | $V_{INL}$ | | Full | | | 0.5 | |
| Input Capacitance[d] | $C_{in}$ | | Full | | 5.5 | | pF |
| Input Current[f] | $I_{INL}$ or $I_{INH}$ | $V_{IN}$ = 0 or V+ | Full | −1 | | 1 | μA |
| **Dynamic Characteristics** | | | | | | | |
| Turn-On Time | $t_{ON}$ | $V_{NO}$ or $V_{NC}$ = 1.5 V, $R_L$ = 50 Ω, $C_L$ = 35 pF V+ = 2.7 V, Figure 1 and 2 | Room Full | | 20 | 30 35 | ns |
| Turn-Off Time | $t_{OFF}$ | | Room Full | | 18 | 28 33 | |
| Break-Before-Make Time | $t_d$ | | Room | 1 | | | |
| Charge Injection[d] | $Q_{INJ}$ | $C_L$ = 1 nF, $V_{GEN}$ = 0 V, $R_{GEN}$ = 0 Ω, Figure 3 | Room | | 5.8 | | pC |
| Off-Isolation[d] | OIRR | $R_L$ = 1 kΩ, $C_L$ = 5 pF, f = 1 MHz | Room | | −56 | | dB |
| Crosstalk[d] | $X_{TALK}$ | | Room | | −89 | | |
| NO, NC Off Capacitance[d] | $C_{NO(off)}$, $C_{NC(off)}$ | V+ = 3.6 V, $V_{IN}$ = 0 or V+, f = 1 MHz | Room | | 81 | | pF |
| Channel-On Capacitance[d] | $C_{ON}$ | | Room | | 103 | | |
| **Power Supply** | | | | | | | |
| Power Supply Range | V+ | | | 1.5 | | 3.6 | V |
| Power Supply Current | I+ | V+ = 3.6 V, $V_{IN}$ = 0 or V+ | | | 0.01 | 1.0 | μA |

Notes:

a.   Room = 25°C, Full = as determined by the operating suffix.
b.   The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
c.   Typical values are for design aid only, not guaranteed nor subject to production testing.
d.   Guarantee by design, nor subjected to production test.
e.   $V_{IN}$ = input voltage to perform proper function.
f.   Guaranteed by 3-V leakage testing, not production tested.
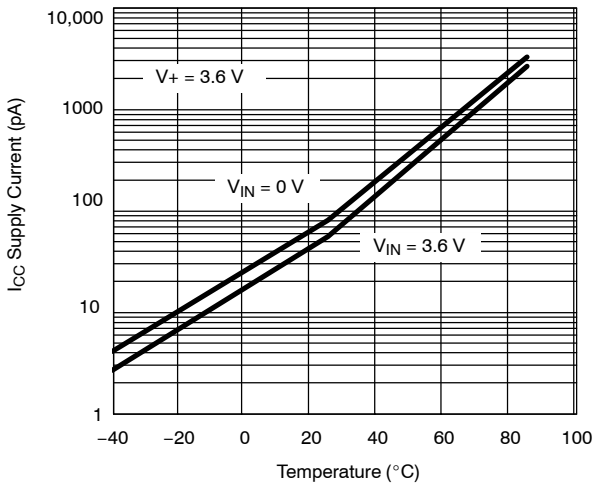
## TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)
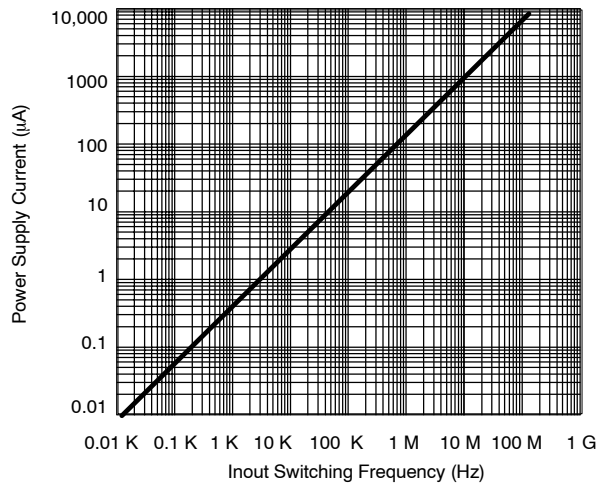
**r$_{DS(on)}$ vs. V$_{COM}$ vs. 1 V$_{CC}$**

r$_{DS(on)}$ (Ω) vs. V$_D$ (V)

V+ = 1.8 V, NC
V+ = 1.8 V, NO
V+ = 2.7 V, NC
V+ = 2.7 V, NO

**r$_{DS(on)}$ vs. V$_D$, V$_{CC}$ and Temperature**

r$_{DS(on)}$ (Ω) vs. V$_D$ (V)

V+ = 1.8 V
85°C
25°C
−40°C
V+ = 2.7 V
85°C
25°C
−40°C

**Supply Current vs. Temperature**

I$_{CC}$ Supply Current (pA) vs. Temperature (°C)

V+ = 3.6 V
V$_{IN}$ = 0 V
V$_{IN}$ = 3.6 V

**Switching Frequency vs. Supply Current**

Power Supply Current (μA) vs. Inout Switching Frequency (Hz)

**Leakage Current vs. Temperature**

Leakage Current (pA) vs. Temperature (°C)

V+ = 3.5 V
I$_{D(off)}$
I$_{S(off)}$
I$_{D(on)}$
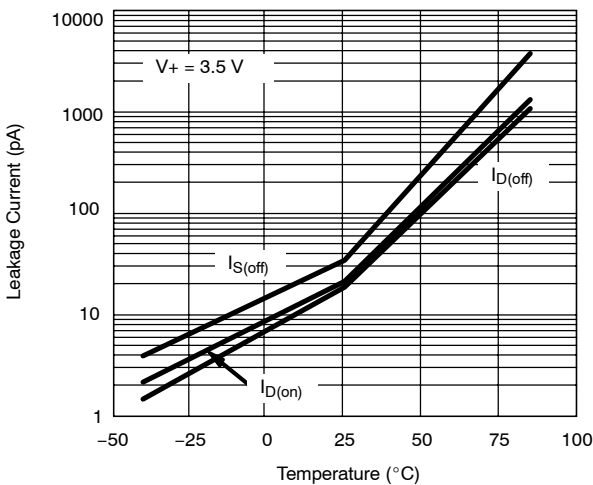
**Leakage Current vs. Analog Voltage**

Leakage Current (pA) vs. V$_D$ (V)

V+ = 3.3 V
I$_{S(off)}$
I$_{D(on)}$
I$_{D(off)}$

# DG2741/2742/2743

## Vishay Siliconix
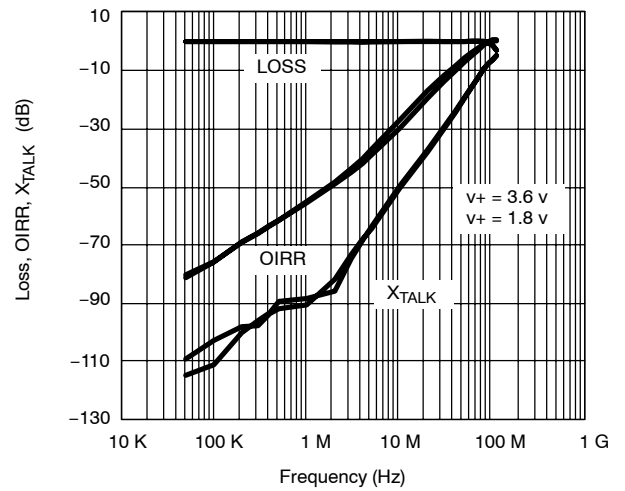
*New Product*

VISHAY
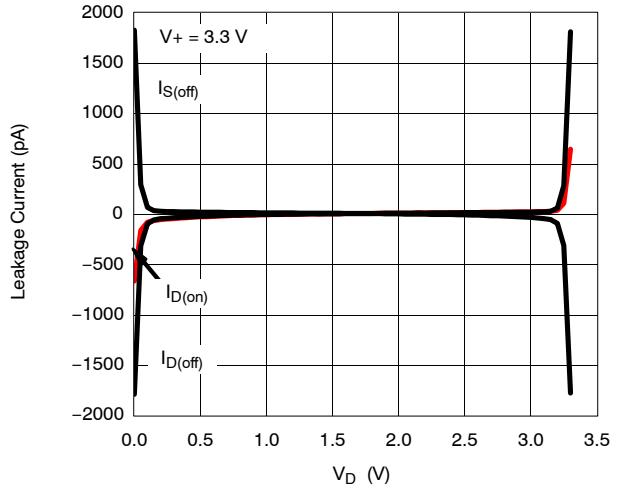
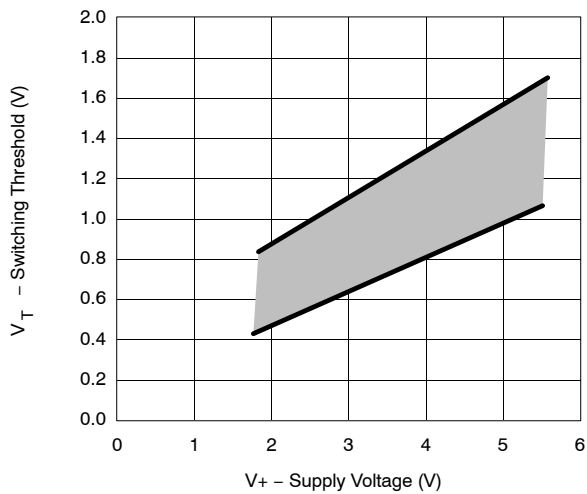## TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)

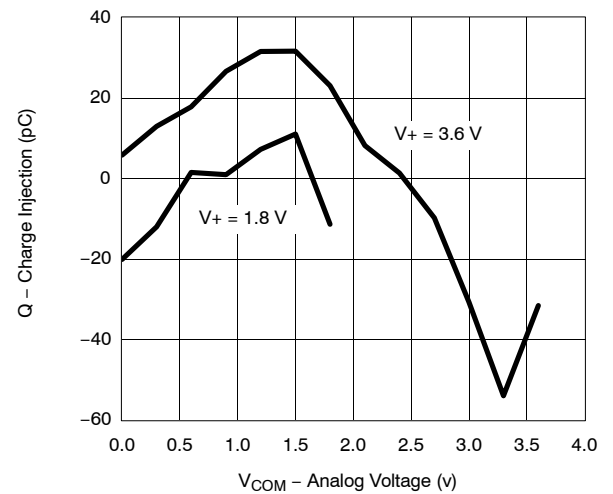**Switching Time vs. V$_{CC}$ and Temperature**
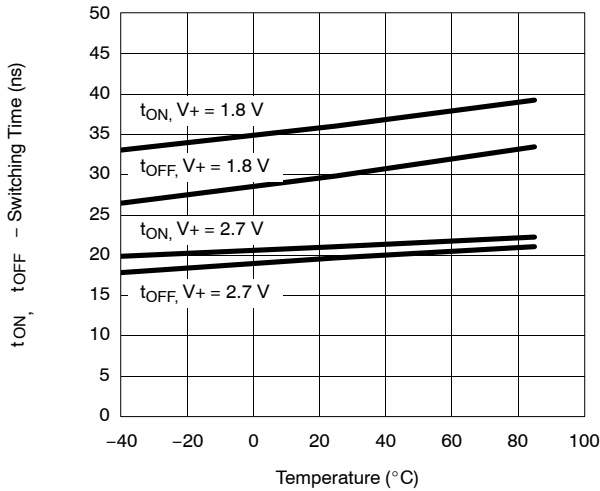
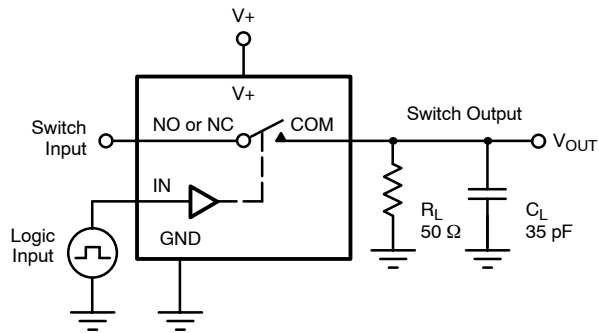**Insertion Loss, Off-Isolation, Crosstalk vs. Frequency**
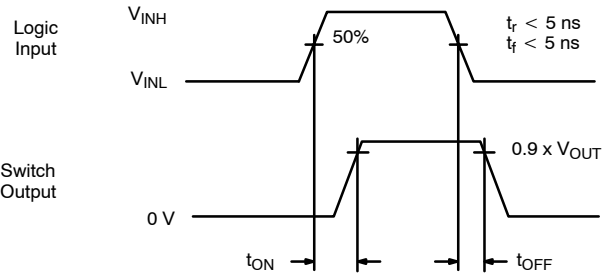
**Switching Threshold vs. Supply Voltage**
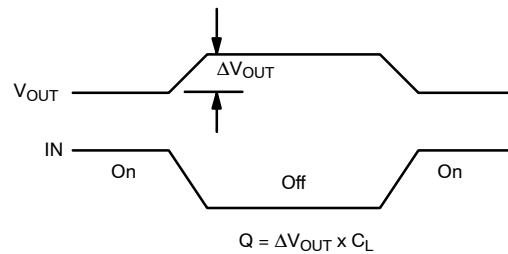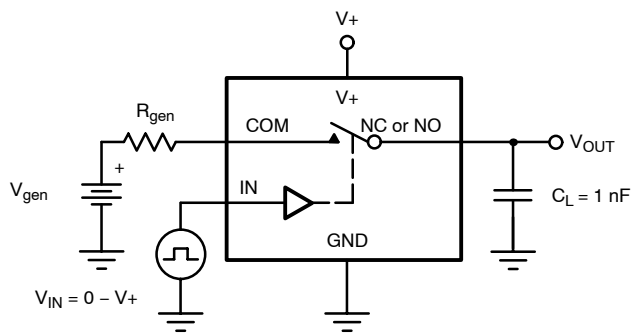
**Charge Injection vs. Analog Voltage**

## TEST CIRCUITS

V+

V+

Switch Input — NO or NC — COM — Switch Output — $V_{OUT}$

IN

Logic Input

GND

$R_L$ 50 Ω

$C_L$ 35 pF

$C_L$ (includes fixture and stray capacitance)

$$V_{OUT} = V_{COM} \left( \frac{R_L}{R_L + R_{ON}} \right)$$

Logic Input: $V_{INH}$, $V_{INL}$, 50%, $t_r < 5$ ns, $t_f < 5$ ns

Switch Output: $0.9 \times V_{OUT}$, 0 V

$t_{ON}$, $t_{OFF}$

Logic "1" = Switch On
Logic input waveforms inverted for switches that have the opposite logic sense.

**FIGURE 1.** Switching Time

V+

V+

$R_{gen}$ — COM — NC or NO — $V_{OUT}$

$V_{gen}$

IN

GND

$C_L$ = 1 nF

$V_{IN}$ = 0 – V+

$V_{OUT}$, $\Delta V_{OUT}$

IN: On, Off, On

$Q = \Delta V_{OUT} \times C_L$

IN depends on switch configuration: input polarity determined by sense of switch.

**FIGURE 2.** Charge Injection

V+

10 nF

V+

NC or NO

COM

IN

0 V, 2.4 V

$R_L$

GND

Analyzer

Off Isolation $= 20 \log \dfrac{V_{COM}}{V_{NO/NC}}$

**FIGURE 3.** Off-Isolation

V+

10 nF

V+

COM

IN

0 V, 2.4 V

NC or NO

GND

Meter
HP4192A Impedance Analyzer or Equivalent

f = 1 MHz
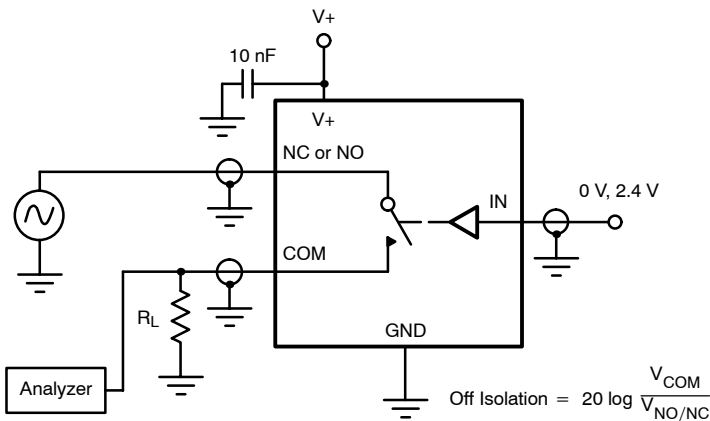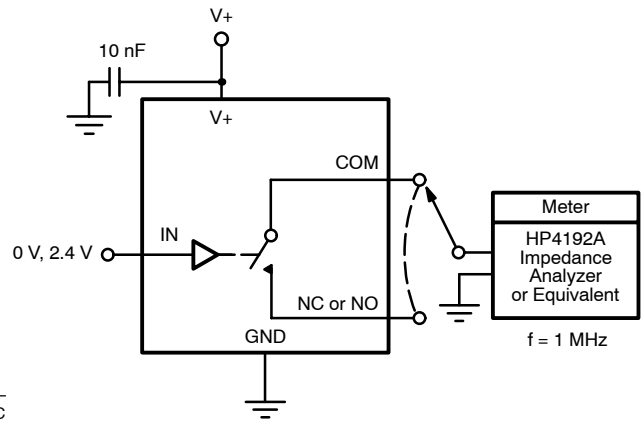
**FIGURE 4.** Channel Off/On Capacitance