



# Low-Voltage Single Asymmetrical SPDT Analog Switch

## FEATURES

- Low Voltage Operation (2.7 V to 5.5 V)
- Low On-Resistance -  $r_{ON}$ 
  - NO = 0.8  $\Omega$
  - NC = 1.2  $\Omega$
- Low Power Consumption
- TTL/CMOS Compatible
- TSOP-6 Package

## BENEFITS

- Reduced Power Consumption
- Simple Logic Interface
- High Accuracy
- Reduce Board Space

## APPLICATIONS

- Cellular Phones
- Communication Systems
- Portable Test Equipment
- Battery Operated Systems

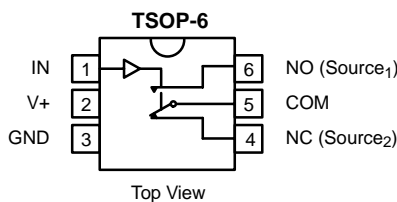
## DESCRIPTION

The DG2020 is a single-pole/double-throw monolithic CMOS analog switch designed for high performance switching of analog signals. Combining low power, high speed, low on-resistance and small physical size, the DG2020 is ideal for portable and battery powered applications requiring high performance and efficient use of board space.

The DG2020 is built on Vishay Siliconix's low voltage J12 process. An epitaxial layer prevents latchup. Break-before-make is guaranteed.

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

## FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



Device Marking: E3xxx

### TRUTH TABLE

Logic	NC	NO
0	ON	OFF
1	OFF	ON

### ORDERING INFORMATION

Temp Range	Package	Part Number
-40 to 85°C	TSOP-6	DG2020DV

**ABSOLUTE MAXIMUM RATINGS**

Reference to GND

V+ .....	-0.3 to +6 V
IN, COM, NC, NO <sup>a</sup> .....	-0.3 to (V+ + 0.3 V)
Continuous Current (Any terminal) .....	±50 mA
Peak Current (Pulsed at 1 ms, 10% duty cycle) .....	±200 mA
Storage Temperature (D Suffix) .....	-65 to 125°C

Power Dissipation (Packages)<sup>b</sup>

TSOP-6 <sup>c</sup> .....	570 mW
---------------------------	--------

- Notes:
- Signals on NC, NO, or COM or IN exceeding V+ will be clamped by internal diodes. Limit forward diode current to maximum current ratings.
  - All leads welded or soldered to PC Board.
  - Derate 7.0 mW/°C above 25°C

SPECIFICATIONS (V+ = 3 V)								
Parameter	Symbol	Test Conditions Otherwise Unless Specified V+ = 3 V, ±10%, V <sub>IN</sub> = 0.4 or 2.0 V <sup>e</sup>	Temp <sup>a</sup>	Limits -40 to 85°C			Unit	
				Min <sup>b</sup>	Typ <sup>c</sup>	Max <sup>b</sup>		
<b>Analog Switch</b>								
Analog Signal Range <sup>d</sup>	V <sub>NO</sub> , V <sub>NC</sub> , V <sub>COM</sub>		Full	0		V+	V	
On-Resistance	r <sub>ON(NO)</sub>	V+ = 2.7 V, V <sub>COM</sub> = 1.5 V, I <sub>NO</sub> , I <sub>NC</sub> = 100 mA	Room		1.4	2.0	Ω	
	r <sub>ON(NC)</sub>		Full		1.5	2.1		
r <sub>ON</sub> Flatness <sup>d</sup>	r <sub>ON(NO)</sub> Flatness	V+ = 2.7 V V <sub>COM</sub> = 0 to V+, I <sub>NO</sub> , I <sub>NC</sub> = 100 mA	Room		0.42			
Switch Off Leakage Current <sup>f</sup>	I <sub>NO(off)</sub> , I <sub>NC(off)</sub>	V+ = 3.3 V, V <sub>NO</sub> , V <sub>NC</sub> = 1 V/3 V V <sub>COM</sub> = 3 V/1 V	Room	-2.3		2.3	nA	
	I <sub>COM(off)</sub>		Full	-60		60		
Channel-On Leakage Current <sup>f</sup>	I <sub>COM(on)</sub>	V+ = 3.3 V, V <sub>NO</sub> , V <sub>NC</sub> = V <sub>COM</sub> = 1 V/3 V	Room	-2.3		2.3	60	
<b>Digital Control</b>								
Input High Voltage	V <sub>INH</sub>		Full	2			V	
Input Low Voltage	V <sub>INL</sub>		Full			0.4		
Input Capacitance	C <sub>in</sub>		Full		3.7		pF	
Input Current	I <sub>INL</sub> or I <sub>INH</sub>	V <sub>IN</sub> = 0 or V+	Full	1		1	μA	
<b>Dynamic Characteristics</b>								
Turn-On Time	t <sub>ON(NO)</sub>	V <sub>NO</sub> or V <sub>NC</sub> = 2.0 V, R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF	Room		6	10	μs	
	t <sub>ON(NC)</sub>		Full		5	7		
Turn-Off Time	t <sub>OFF(NO)</sub>		Room		2	5		5.5
	t <sub>OFF(NC)</sub>		Full		2	4		
Break-Before-Make Time	t <sub>d</sub>	V <sub>NO</sub> or V <sub>NC</sub> = 2.0 V, R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF	Full	1	3			
Charge Injection <sup>d</sup>	Q <sub>INJ</sub>	C <sub>L</sub> = 1 nF, V <sub>GEN</sub> = 0 V, R <sub>GEN</sub> = 0 Ω	Room		1		pC	
Off-Isolation <sup>d</sup>	OIRR	R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 1 MHz	Room		-52		dB	
Crosstalk <sup>d</sup>	X <sub>TALK</sub>		Room		-53			
N <sub>O</sub> , N <sub>C</sub> Off Capacitance <sup>d</sup>	C <sub>NO(off)</sub>	V <sub>IN</sub> = 0 or V+, f = 1 MHz	Room		75		pF	
	C <sub>NC(off)</sub>		Room		34			
Channel-On Capacitance <sup>d</sup>	C <sub>NO(on)</sub>		Room		88			
	C <sub>NC(on)</sub>		Room		95			
<b>Power Supply</b>								
Power Supply Range	V+			2.7		3.3	V	
Power Supply Current	I+	V <sub>IN</sub> = 0 or V+	Full		0.2	1.0	μA	
Power Consumption	P <sub>C</sub>		Full			3.3	μW	



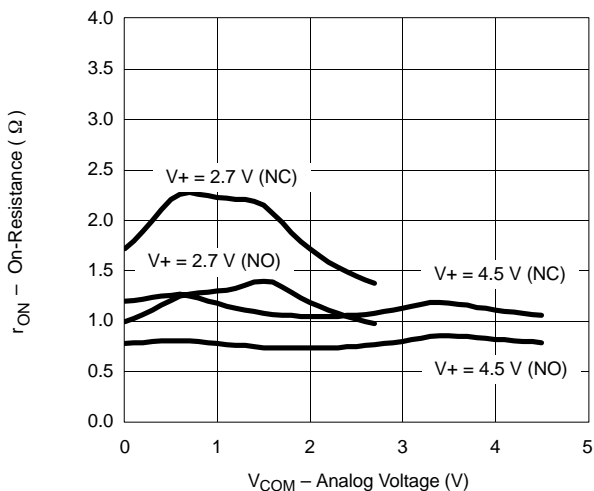
SPECIFICATIONS (V+ = 5 V)								
Parameter	Symbol	Test Conditions Otherwise Unless Specified V+ = 5 V, ±10%, VIN = 0.8 or 2.4 V <sup>e</sup>	Temp <sup>a</sup>	Limits −40 to 85°C			Unit	
				Min <sup>b</sup>	Typ <sup>c</sup>	Max <sup>b</sup>		
<b>Analog Switch</b>								
Analog Signal Range <sup>d</sup>	V <sub>NO</sub> , V <sub>NC</sub> , V <sub>COM</sub>		Full	0		V+	V	
On-Resistance	r <sub>ON</sub> (NO)	V+ = 4.5 V, V <sub>COM</sub> = 3 V, I <sub>NO</sub> , I <sub>NC</sub> = 100 mA	Room		0.8	1.1	Ω	
	r <sub>ON</sub> (NC)		Full		0.9	1.2		
r <sub>ON</sub> Flatness <sup>d</sup>	r <sub>ON</sub> (NO) Flatness	V+ = 4.5 V, V <sub>COM</sub> = 0 to V+, I <sub>NO</sub> , I <sub>NC</sub> = 100 mA	Room		0.13			
Switch Off Leakage Current	I <sub>NO</sub> (off), I <sub>NC</sub> (off)	V+ = 5.5 V V <sub>NO</sub> , V <sub>NC</sub> = 1 V/4.5 V, V <sub>COM</sub> = 4.5 V/1 V	Room	−5.3		5.3	nA	
	I <sub>COM</sub> (off)		Full	−98		98		
Channel-On Leakage Current	I <sub>COM</sub> (on)	V+ = 5.5 V, V <sub>NO</sub> , V <sub>NC</sub> = V <sub>COM</sub> = 1 V/4.5 V	Room	−5.3		5.3		
			Full	−98		98		
<b>Digital Control</b>								
Input High Voltage	V <sub>INH</sub>		Full	2.4			V	
Input Low Voltage	V <sub>INL</sub>		Full			0.8		
Input Capacitance	C <sub>in</sub>		Full		3.5		pF	
Input Current	I <sub>INL</sub> or I <sub>INH</sub>	V <sub>IN</sub> = 0 or V+	Full	1		1	μA	
<b>Dynamic Characteristics</b>								
Turn-On Time	t <sub>ON</sub> (NO)	V <sub>NO</sub> or V <sub>NC</sub> = 3 V, R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF	Room		3	6	μs	
	t <sub>ON</sub> (NC)		Full			6.5		
Turn-Off Time	t <sub>OFF</sub> (NO)		Room		2	5		
	t <sub>OFF</sub> (NC)		Full		1	4		
Break-Before-Make Time	t <sub>d</sub>	V <sub>NO</sub> or V <sub>NC</sub> = 3 V, R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF	Full	0.3	1.5			
Charge Injection <sup>d</sup>	Q <sub>INJ</sub>	C <sub>L</sub> = 1 nF, V <sub>GEN</sub> = 0 V, R <sub>GEN</sub> = 0 Ω	Room		5		pC	
Off-Isolation <sup>d</sup>	OIRR	R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 1 MHz	Room		−53		dB	
Crosstalk <sup>d</sup>	X <sub>TALK</sub>		Room		−54			
Source-Off Capacitance <sup>d</sup>	C <sub>NO</sub> (off)	V <sub>IN</sub> = 0 or V+, f = 1 MHz	Room		65		pF	
	C <sub>NC</sub> (off)		Room		32			
Channel-On Capacitance <sup>d</sup>	C <sub>NO</sub> (on)		Room		90			
	C <sub>NC</sub> (on)		Room		95			
<b>Power Supply</b>								
Power Supply Range	V+			4.5		5.5	V	
Power Supply Current	I+	V <sub>IN</sub> = 0 or V+	Full		0.2	1.0	μA	
Power Consumption	P <sub>C</sub>		Full			5.5	μW	

Notes:

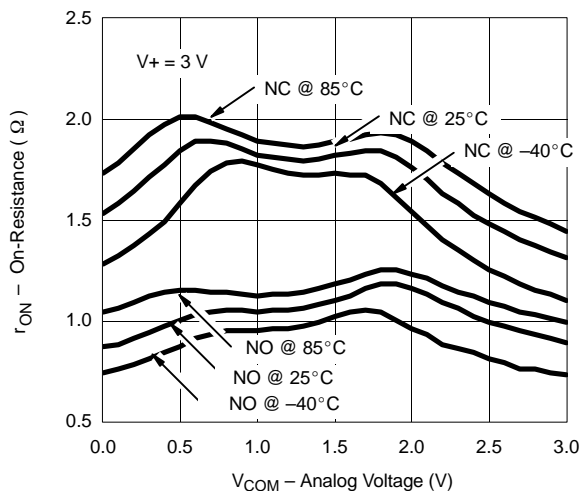
- Room = 25°C, Full = as determined by the operating suffix.
- Typical values are for design aid only, not guaranteed nor subject to production testing.
- The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
- Guarantee by design, nor subjected to production test.
- V<sub>IN</sub> = input voltage to perform proper function.
- Guaranteed by 5-V leakage testing, not production tested.

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

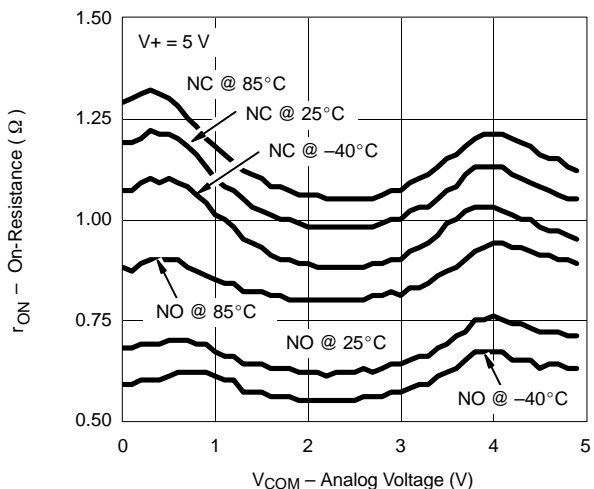
**$r_{ON}$  vs.  $V_{COM}$  and Supply Voltage**



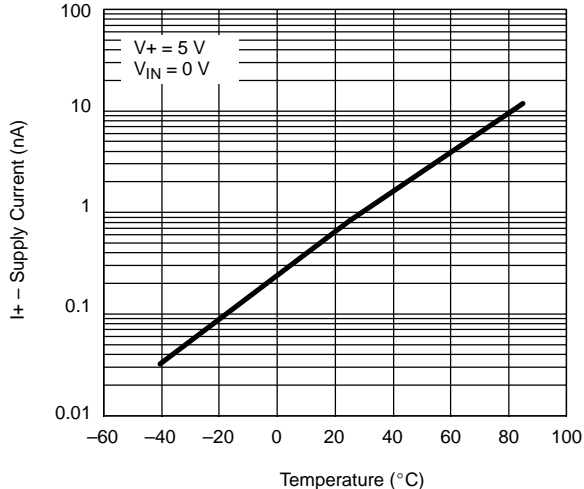
**$r_{ON}$  vs. Analog Voltage and Temperature**



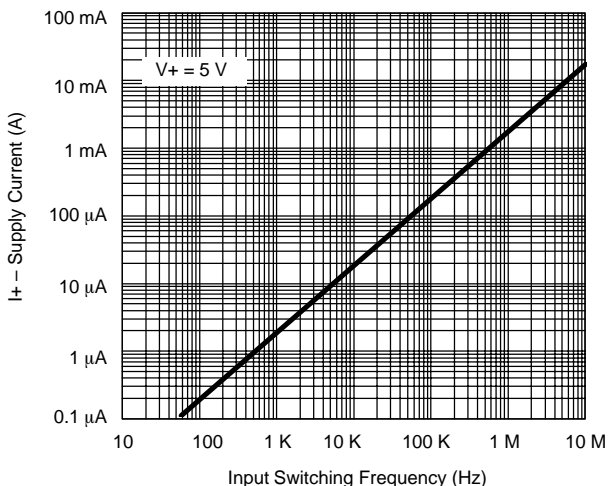
**$r_{ON}$  vs. Analog Voltage and Temperature**



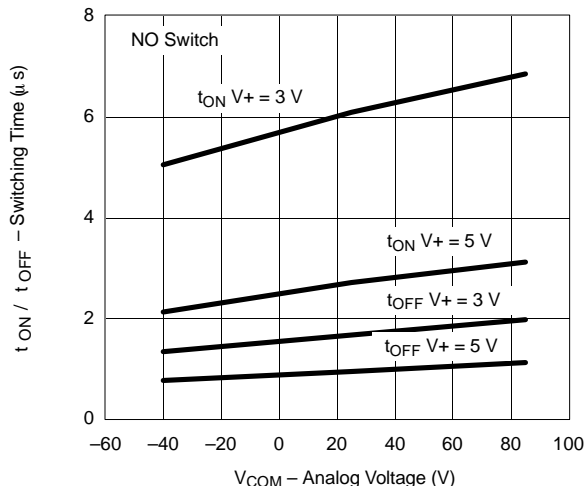
**Supply Current vs. Temperature**



**Supply Current vs. Input Switching Frequency**

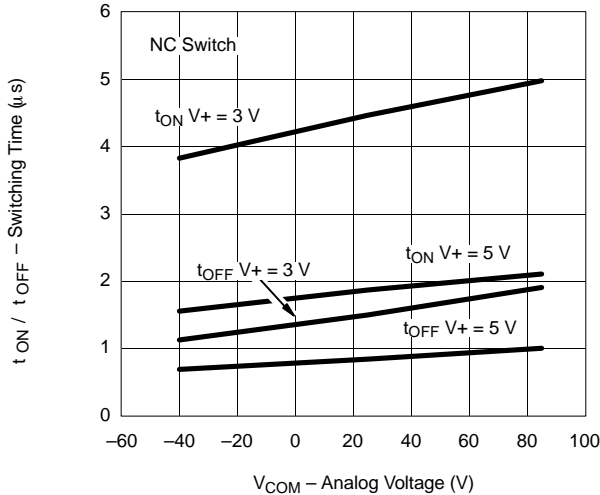


**Switching Time vs. Temperature and Supply Voltage**

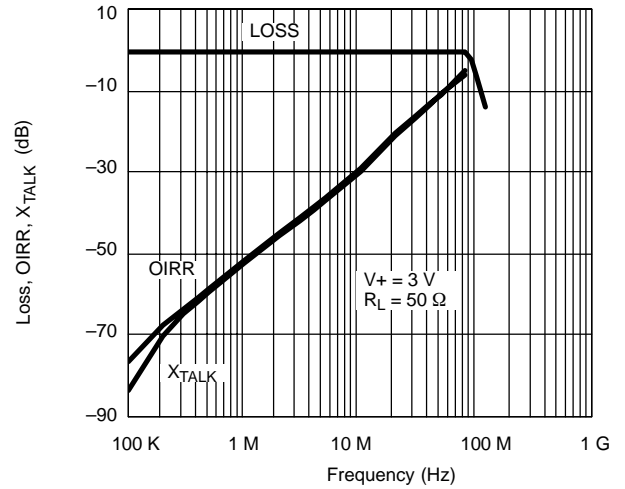


**TYPICAL CHARACTERISTICS (25 °C UNLESS NOTED)**

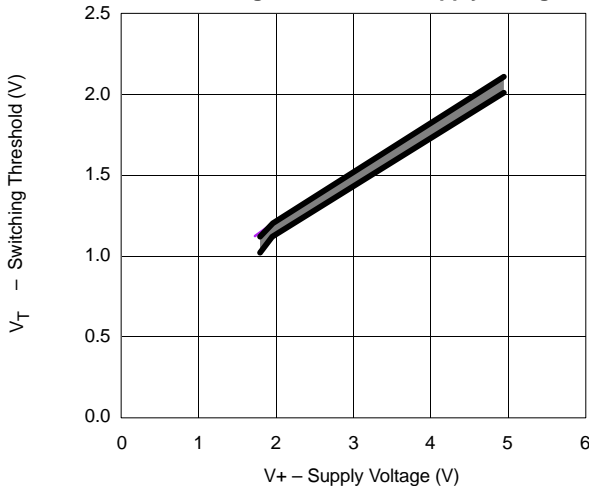
**Switching Time vs. Temperature and Supply Voltage**



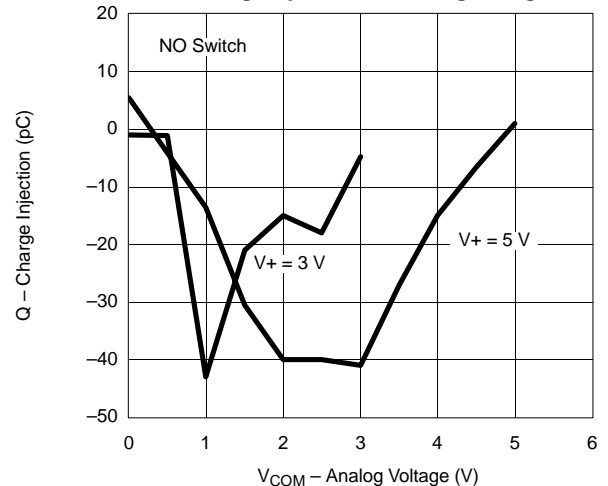
**Insertion Loss, Off-Isolation Crosstalk vs. Frequency**



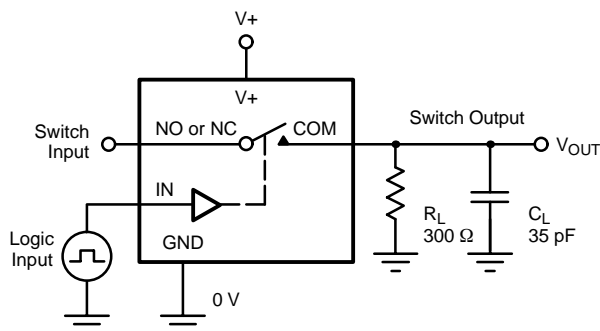
**Switching Threshold vs. Supply Voltage**



**Charge Injection vs. Analog Voltage**

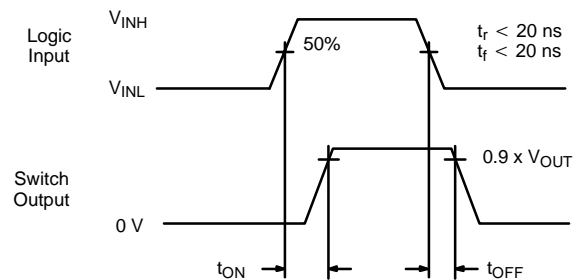


**TEST CIRCUITS**



C<sub>L</sub> (includes fixture and stray capacitance)

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



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

**FIGURE 1. Switching Time**

