

CMOS Quad Bilateral Switch

For Transmission or Multiplexing of Analog or Digital Signals

High-Voltage Types (20-Volt Rating)

CD4016B Series types are quad bilateral switches intended for the transmission or multiplexing of analog or digital signals. Each of the four independent bilateral switches has a single control signal input which simultaneously biases both the p and n device in a given switch on or off.

The CD4016 "B" Series types are supplied in 14-lead hermetic dual-in-line ceramic packages (D and F suffixes), 14-lead dual-in-line plastic packages (E suffix), and in chip form (H suffix).

Features:

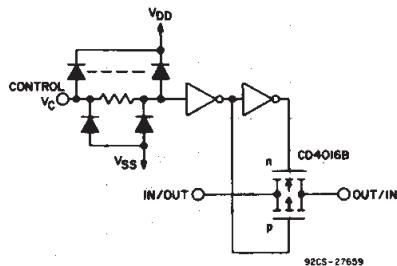
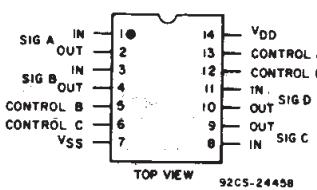
- 20-V digital or ± 10 -V peak-to-peak switching
- 280- Ω typical on-state resistance for 15-V operation
- Switch on-state resistance matched to within 10 Ω typ. over 15-V signal-input range
- High on/off output-voltage ratio: 65 dB typ. @ $f_{IS} = 10$ kHz, $R_L = 10$ k Ω
- High degree of linearity: <0.5% distortion typ. @ $f_{IS} = 1$ kHz, $V_{IS} = 5$ Vp-p, $V_{DD}-V_{SS} \geq 10$ V, $R_L = 10$ k Ω
- Extremely low off-state switch leakage resulting in very low offset current and high effective off-state resistance: 100 pA typ. @ $V_{DD}-V_{SS}=18$ V, $T_A=25^\circ\text{C}$
- Extremely high control input impedance (control circuit isolated from signal circuit: 10^{12} Ω typ.)
- Low crosstalk between switches: -50 dB typ. @ $f_{IS} = 0.9$ MHz, $R_L = 1$ k Ω
- Matched control-input to signal-output capacitance: Reduces output signal transients
- Frequency response, switch on = 40 MHz (typ.)
- 100% tested for quiescent current at 20 V
- Maximum control input current of 1 μA at 18 V over full package temperature range; 100 nA at 18 V at 25°C
- 5-V, 10-V, and 15-V parametric ratings

Applications:

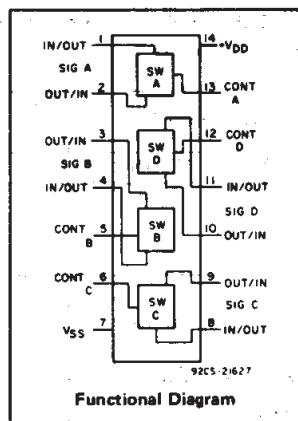
- Analog signal switching/multiplexing
- Signal gating ■ Modulator
- Squelch control ■ Demodulator
- Chopper ■ Commutating switch
- Digital signal switching/multiplexing
- CMOS logic implementation
- Analog-to-digital & digital-to-analog conversion
- Digital control of frequency, impedance, phase, and analog-signal gain

CD4016B Types

Terminal Assignment



Schematic diagram - 1 of 4 identical sections.



Functional Diagram

RECOMMENDED OPERATING CONDITIONS

For maximum reliability, nominal operating conditions should be selected so that operation is always within the following range:

CHARACTERISTIC	LIMITS		UNITS
	Min.	Max.	
Supply Voltage Range (For $T_A =$ Full Package Temperature Range)	3	18	V

MAXIMUM RATINGS, Absolute-Maximum Values:

DC SUPPLY-VOLTAGE RANGE, (V_{DD})

Voltages referenced to V_{SS} Terminal -0.5V to +20V

INPUT VOLTAGE RANGE, ALL INPUTS -0.5V to V_{DD} +0.5V

DC INPUT CURRENT, ANY ONE INPUT ± 10 mA

POWER DISSIPATION PER PACKAGE (P_D):

For $T_A = -55^\circ\text{C}$ to $+100^\circ\text{C}$ 500mW

For $T_A = +100^\circ\text{C}$ to $+125^\circ\text{C}$ Derate Linearity at 12mW/ $^\circ\text{C}$ to 200mW

DEVICE DISSIPATION PER OUTPUT TRANSISTOR

FOR $T_A =$ FULL PACKAGE-TEMPERATURE RANGE (All Package Types) 100mW

OPERATING-TEMPERATURE RANGE (T_A) -55°C to $+125^\circ\text{C}$

STORAGE TEMPERATURE RANGE (T_{STG}) -65°C to $+150^\circ\text{C}$

LEAD TEMPERATURE (DURING SOLDERING):

At distance $1/16 \pm 1/32$ inch (1.59 \pm 0.79mm) from case for 10s max $+265^\circ\text{C}$

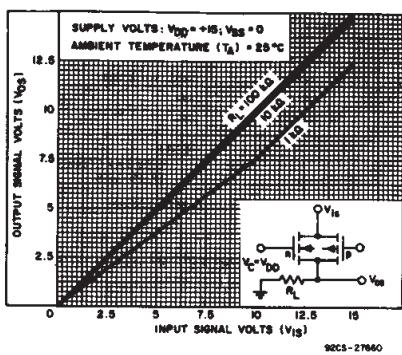


Fig. 1—Typ. on-state characteristics for 1 of 4 switches with $V_{DD} = +15$ V, $V_{SS} = 0$ V.

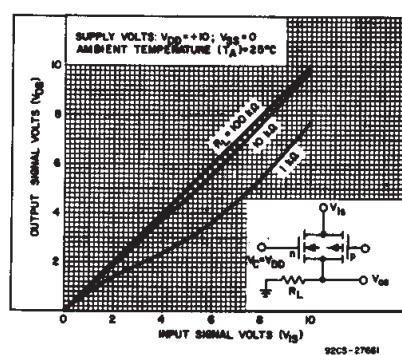


Fig. 2—Typ. on-state characteristics for 1 of 4 switches with $V_{DD} = +10$ V, $V_{SS} = 0$ V.

CD4016B Types

ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	TEST CONDITIONS		LIMITS AT INDICATED TEMPERATURES (°C)						UNITS	
			+25				μA			
	V _{IN} (V)	V _{DD} (V)	-55	-40	+85	+125	Typ.	Max.		
Quiescent Device Current, I _{DD}		0.5	5	0.25	0.25	7.5	7.5	0.01	0.25	
		0.10	10	0.5	0.5	15	15	0.01	0.5	
		0.15	15	1	1	30	30	0.01	1	
		0.20	20	5	5	150	150	0.02	5	
Signal Inputs (V _{is}) and Output (V _{os})										
On-State Resistance, r _{on} Max.	V _C = V _{DD} , R _L = 10 kΩ, Returned to V _{DD} - V _{SS}	V _{is} = V _{DD} or V _{SS}	10	600	610	840	960	—	660	Ω
		V _{is} = 4.75 to 5.75 V	10	1870	1900	2380	2600	—	2000	
		V _{is} = V _{DD} or V _{SS}	15	360	370	520	600	—	400	
		V _{is} = 7.25 to 7.75 V	15	775	790	1080	1230	—	850	
Δ On-State Resistance Between Any 2 Switches, Δr _{on}	R _L = 10 kΩ, V _C = V _{DD}	5	—	—	—	—	15	—	Ω	
		10	—	—	—	—	10	—		
		15	—	—	—	—	5	—		
Total Harmonic Distortion, THD	V _C = V _{DD} = 5 V, V _{SS} = -5 V, V _{is} (p-p) = 5 V (Sine wave centered on 0 V) R _L = 10 kΩ, f _{is} = 1 kHz sine wave	—	—	—	—	0.4	—	%		
-3dB Cutoff Frequency (Switch on)	V _C = V _{DD} = 5 V, V _{SS} = -5 V, V _{is} (p-p) = 5 V (Sine wave centered on 0 V) R _L = 1 kΩ,	—	—	—	—	40	—	MHz		
-50dB Feed-through Frequency (Switch off)	V _C = V _{SS} = -5 V, V _{is} (p-p) = 5 V (Sine wave centered on 0 V) R _L = 1 kΩ	—	—	—	—	1.25	—	MHz		
Input/Output Leakage Current (Switch off) I _{is} Max.	V _C = 0 V V _{is} = 18 V, V _{os} = 0 V; V _{is} = 0 V, V _{os} = 18 V	18	±0.1	±0.1	±1	±1	10 ⁻⁴	±0.1	μA	
-50 dB Crosstalk Frequency	V _{C(A)} = V _{DD} = +5 V, V _{C(B)} = V _{SS} = -5 V, V _{is(A)} = 5 V p-p 50 Ω source R _L = 1 kΩ	—	—	—	—	0.9	—	MHz		
Propagation Delay (Signal Input to Signal Output) t _{pd}	R _L = 200 kΩ V _C = V _{DD} , V _{SS} = GND, CL = 50 pF V _{is} = Square Wave 0 to V _{DD} t _r , t _f = 20 ns	5	—	—	—	—	40	100	ns	
Capacitance: Input, C _{is} Output, C _{os} Feedthrough, C _{ios}	V _{DD} = +5 V V _C = V _{SS} = -5 V	—	—	—	—	—	4	—	pF	
		—	—	—	—	—	4	—		
		—	—	—	—	—	0.2	—		

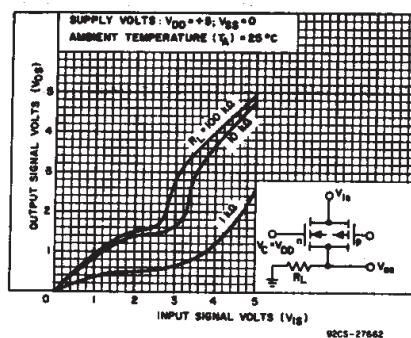


Fig. 3—Typ. on-state characteristics for 1 of 4 switches with V_{DD} = +5 V, V_{SS} = 0 V.

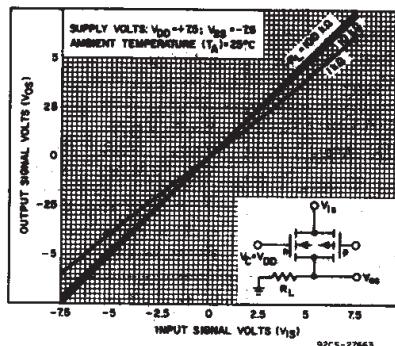


Fig. 4—Typ. on-state characteristics for 1 of 4 switches with V_{DD} = +7.5 V, V_{SS} = -7.5 V.

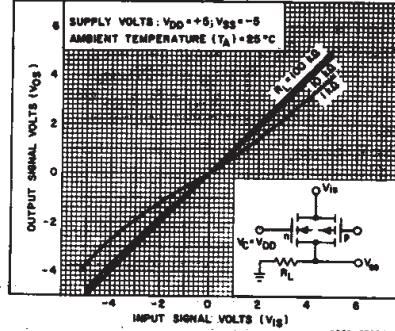


Fig. 5—Typ. on-state characteristics for 1 of 4 switches with V_{DD} = +5 V, V_{SS} = -5 V.

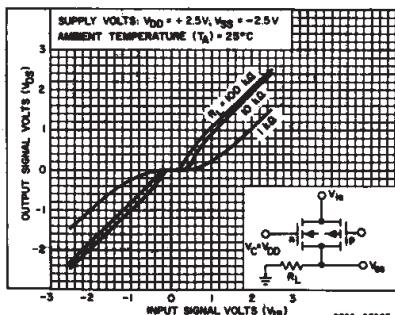


Fig. 6—Typ. on-state characteristics for 1 of 4 switches with V_{DD} = +2.5 V, V_{SS} = -2.5 V.

CD4016B Types

ELECTRICAL CHARACTERISTICS (cont'd)

CHARACTERISTIC	TEST CONDITIONS	LIMITS AT INDICATED TEMPERATURES (°C)							U N I T S
		V_{DD} (V)	-55	-40	+85	+125	Typ.	+25	
Control (V_C)									
Control Input Low Voltage, V_{ILC} (Max.)	$ I_{IS} < 10 \mu A$ $V_{IS} = V_{SS}$, $V_{OS} = V_{DD}$ and $V_{IS} = V_{DD}$, $V_{OS} = V_{SS}$	5, 10, 15	0.9	0.9	0.4	0.4	—	0.7	V
Control Input High Voltage, V_{IHC}	See Fig. 10	5 10 15			3.5 (Min.)	7 (Min.)			V
Input Current, I_{IN} (Max.)	$V_{IS} \leq V_{DD}$ $V_{DD} - V_{SS} = 18 V$ $V_{CC} \leq V_{DD} - V_{SS}$	18	± 0.1	± 0.1	± 1	± 1	$\pm 10^{-5}$	± 0.1	μA
Crosstalk (Control Input to Signal Output)	$V_C = 10 V$ (Sq. Wave) $t_r, t_f = 20 ns$ $R_L = 10 k\Omega$	10 10 15	—	—	—	—	50	—	mV
Turn-On Propagation Delay	$t_r, t_f = 20 ns$ $C_L = 50 pF$ $R_L = 1 k\Omega$	5 10 15	—	—	—	—	35 20 15	70 40 30	ns
Maximum Control Input Repetition Rate	$V_{IS} = V_{DD}$, $V_{SS} = GND$, $R_L = 1 k\Omega$ to gnd, $C_L = 50 pF$, $V_C = 10 V$ (Square wave centered on 5 V) $t_r, t_f = 20 ns$, $V_{OS} = \frac{1}{2} V_{OS}$ @ 1 kHz	10	—	—	—	—	10	—	MHz
Input Capacitance, C_{IN}			—	—	—	—	5	7.5	μF

V_{DD} (V)	V_{IS} (V)	Switch Input						Switch Output V_{OS} (V)
		I_{IS} (mA)						
5	0	0.25	0.2	0.2	0.16	0.12	0.14	—
5	5	-0.25	-0.2	-0.2	-0.16	-0.12	-0.14	4.6
10	0	0.62	0.5	0.5	0.4	0.3	0.35	—
10	10	-0.62	-0.5	-0.5	-0.4	-0.3	-0.35	9.5
15	0	1.8	1.4	1.5	1.2	1	1.1	—
15	15	-1.8	-1.4	-1.5	-1.2	-1	-1.1	13.5

* Plastic package

▲ Ceramic package

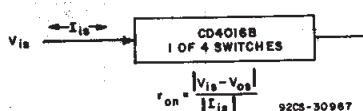


Fig. 10—Determination of r_{on} as a test condition for control input high voltage (V_{IHC}) specification.

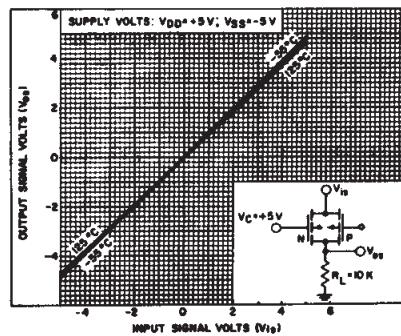


Fig. 7—Typ. on-state characteristics as a function of temp. for 1 of 4 switches with $V_{DD} = +5 V$, $V_{SS} = -5 V$.

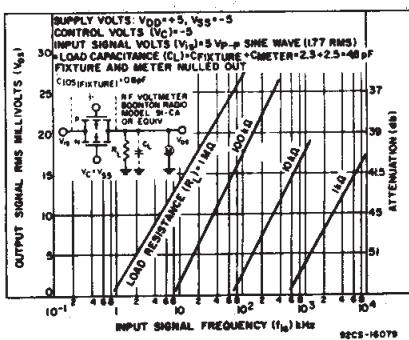


Fig. 8—Typ. feedthru vs. frequency—switch off.

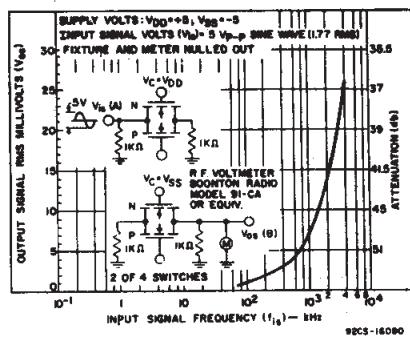


Fig. 9—Typical crosstalk between switch circuits in the same package.

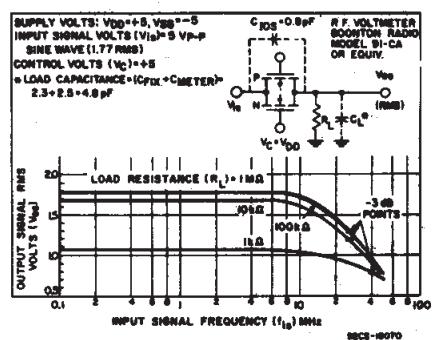


Fig. 11—Typical frequency response—switch on.