

CMOS QUAD ANALOG SWITCH

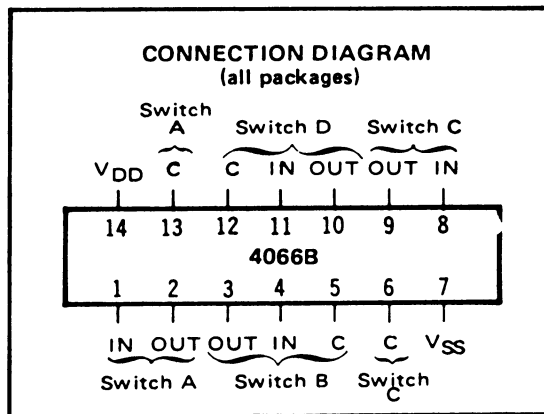
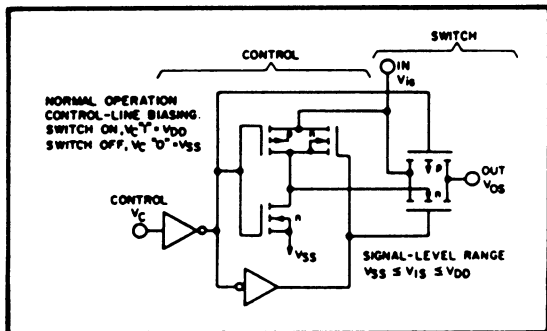
FEATURES

- ◆ Transmission or Multiplexing of Analog or Digital Signals
- ◆ 80Ω Typical ON-Resistance for 15-Volt operation
- ◆ Switch ON-Resistance Matched to within 5Ω over 15-Volt Signal-Input Range
- ◆ ON-Resistance Flat over Full Peak-to-Peak Signal Range
- ◆ High Degree of Linearity:
 - <0.5% Distortion (typ) @ $f_{is} = 1\text{kHz}$, $V_{is} = 5\text{V}_{p-p}$, $V_{DD}-V_{SS} \geq 10\text{V}$, $R_L = 10\text{k}\Omega$
- ◆ Extremely Low OFF switch Leakage Resulting in very Low Offset Current and High Effective OFF Resistance:
 - 10pA (typ) @ $V_{DD}-V_{SS} = 10\text{V}$, $T_A = 25^\circ\text{C}$
- ◆ Extremely High Control Input Impedance (Control Circuit Isolated from Signal Circuit):
 - $10^{12}\Omega$ (typ)
- ◆ Low Crosstalk between Switches:
 - -50dB (typ) @ $f_{is} = 0.9\text{MHz}$, $R_L = 1\text{k}\Omega$
- ◆ Matched Control-Input to Signal-Output Capacitance Reduces Output Signal Transients
- ◆ Frequency Response, Switch ON = 40MHz (typ)

DESCRIPTION

The 4066B is a Quad Bilateral Switch intended for the transmission or multiplexing of analog or digital signals. It is pin-for-pin compatible with the 4016B, but exhibits a much lower ON-resistance. In addition, the ON-resistance is relatively constant over the full input signal range. The 4066 consists of four independent bilateral switches. A single control signal is required per switch. Both the P and the N device in a given switch are biased ON or OFF simultaneously by the control signal. As shown below, the well of the N-channel device on each switch is either tied to the input when the switch is ON or to V_{SS} when the switch is OFF. This configuration minimizes the variation of the switch-transistor threshold voltage with input-signal, and thus keeps the ON-resistance low over the full operating range.

SCHMATIC DIAGRAM (one of four switches)



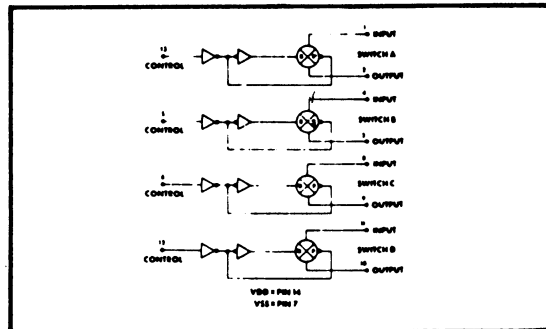
RECOMMENDED OPERATING CONDITIONS

For maximum reliability:

DC Supply Voltage	$V_{DD} - V_{SS}$	3 to 15	Vdc
Operating Temperature	T_A	-55 to +125	°C
		-40 to +85	°C

The advantages over single-channel switches include peak input-signal voltage swings equal to the full supply voltage, and more constant ON-impedance over the input-signal range. For sample-and-hold applications, the 4016 is recommended. When the control input is high the switch will be ON. When the control input is low the switch will be OFF.

LOGIC DIAGRAM



ELECTRICAL CHARACTERISTICS

STATIC CHARACTERISTICS

PARAMETER	CONDITIONS	V _{SS} (Vdc)	V _{DD} (Vdc)	T _{LOW} ²		25°C			T _{HIGH} ²		Units
				Min.	Max.	Min.	Typ.	Max.	Min.	Max.	
QUIESCENT DEVICE CURRENT	I _{DD} V _{IN} = V _{SS} or V _{DD} All valid input combinations	0	5	-	0.05	-	0.0005	0.05	-	1.5	μAdc
		0	10	-	0.1	-	0.001	0.1	-	3.0	
		0	15	-	0.2	-	0.002	0.2	-	6.0	
MINIMUM INPUT HIGH VOLTAGE (Control Input)	V _{IH} V _{IS} = V _{SS} V _{OS} = V _{DD} I _{OS} = 10μA	0	5	-	3.5	-	2.75	3.5	-	3.5	Vdc
		0	10	-	7.0	-	5.5	7.0	-	7.0	
		0	15	-	11.0	-	8.25	11.0	-	11.0	
MAXIMUM INPUT LOW VOLTAGE (Control Input)	V _{IL} V _{IS} = V _{SS} V _{OS} = V _{DD} I _{OS} = 10μA	0	5	1.0	-	1.0	2.25	-	1.0	-	Vdc
		0	10	2.0	-	2.0	4.5	-	2.0	-	
		0	15	3.0	-	3.0	6.75	-	3.0	-	
SWITCH INPUT/OUTPUT LEAKAGE	I _{OFF} V _C = V _{SS} V _{IS} = ±7.5Vdc	-7.5	+7.5	-	±100	-	±0.01	±100	-	±1000	nAdc
ON-RESISTANCE	R _{ON} V _C = V _{DD} V _{IS} = V _{SS} /V _{DD} V _{OS} = $\frac{V_{DD}-V_{SS}}{2}$ R _L = 10kΩ	-7.5	+7.5	-	220	-	80	280	-	320	Ω
		0	+15	-	400	-	120	500	-	550	
		-2.5	+2.5	-	2000	-	270	2500	-	3500	
ON-RESISTANCE MATCH (Same package)	ΔR _{ON} V _C = V _{DD} V _{IS} = V _{SS} /V _{DD} V _{OS} = $\frac{V_{DD}-V_{SS}}{2}$ R _L = 10kΩ	-7.5	+7.5	-	-	-	5	-	-	-	Ω
		0	+15	-	-	-	10	-	-	-	
		-2.5	+2.5	-	-	-	10	-	-	-	

NOTES: ¹ Remaining Static Electrical Characteristics are listed under 4000B Series Family Specifications.

² T_{LOW} = -55°C for C

= -40°C for E

T_{HIGH} = +125°C for C

= + 85°C for E

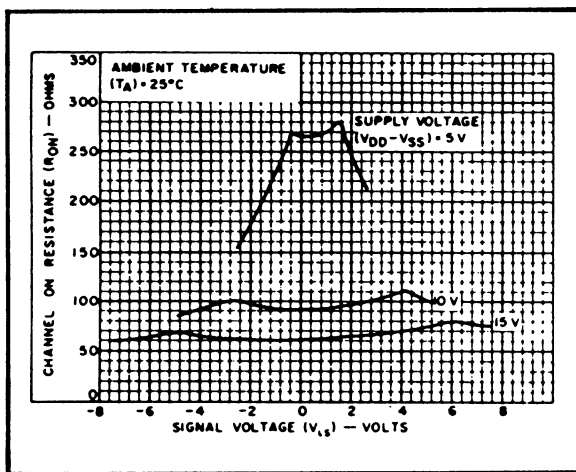
³ Conditions for measuring V_{IH}:

V _{DD}	V _{OS}	V _{IS}	I _{OS}			UNITS
			T _{LOW}	25°C	T _{HIGH}	
5	5	4.6	- .25	- .20	- .14	mA
10	10	9.5	- .62	- .50	- .35	
15	15	13.5	- 1.8	- 1.50	- 1.10	

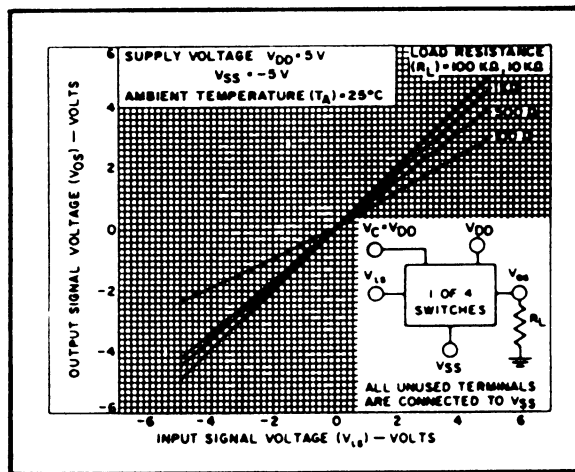
ELECTRICAL CHARACTERISTICS (Continued)

DYNAMIC CHARACTERISTICS ($C_L = 50\text{pF}$, $T_A = 25^\circ\text{C}$)

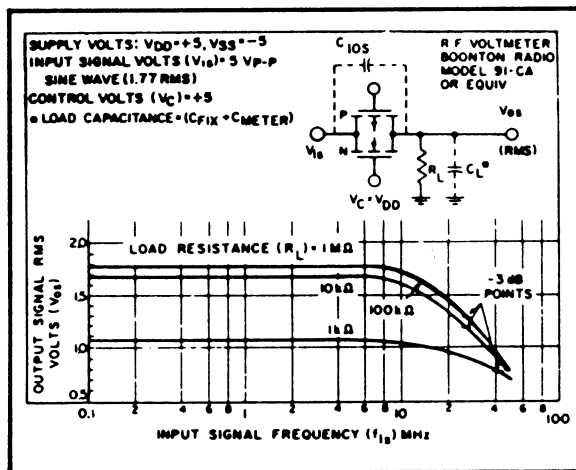
PARAMETER	CONDITIONS	V_{SS} (Vdc)	V_{DD} (Vdc)	Min.	Typ.	Max.	Units	
SIGNAL INPUTS (V_{is}) AND OUTPUTS (V_{os})								
PROPAGATION DELAY TIME Signal Input to Signal Output	t_{PLH} , t_{PHL}	$V_c = V_{DD}$ $V_{is} = \text{Square Wave}$ $R_L = 10\text{k}\Omega$	0	5	—	20	ns	
			0	10	—	10		
			0	15	—	7.5		
BANDWIDTH (-3dB) (Sine Wave)	BW	$V_c = V_{DD}$ $V_{is} = 5V_{p-p}$ centered @ 0.0Vdc R_L	1k Ω	-5	+5	—	54	MHz
			10k Ω	—	—	—	40	
			100k Ω	—	—	—	38	
			1M Ω	—	—	—	37	
INSERTION LOSS ($= 20 \log_{10} \frac{V_{os}}{V_{is}}$)		$V_c = V_{DD}$ $V_{is} = 5V_{p-p}$ centered @ 0.0Vdc R_L	1k Ω	-5	+5	—	2.3	dB
			10k Ω	—	—	—	0.2	
			100k Ω	—	—	—	0.1	
			1M Ω	—	—	—	0.05	
SIGNAL DISTORTION (Sine Wave)		$V_c = V_{DD}$ $V_{is} = 5V_{p-p}$ centered @ 0.0Vdc $f_{is} = 1.0\text{kHz}$ $R_L = 10\text{k}\Omega$	-5	+5	—	0.16	%	
FEEDTHROUGH (-50dB)		$V_c = V_{SS}$ $V_{is} = 5V_{p-p}$ centered @ 0.0Vdc R_L	1k Ω	-5	+5	—	1250	kHz
			10k Ω	—	—	—	140	
			100k Ω	—	—	—	18	
			1M Ω	—	—	—	2	
CROSSTALK (-50dB) Between two switches		$V_c(A) = V_{DD}$ $V_c(B) = V_{SS}$ $V_{is}(A) = 5V_{p-p}$ centered @ 0.0Vdc $R_L = 10\text{k}\Omega$	-5	+5	—	0.9	MHz	
CAPACITANCE	Input Output Feedthrough	$V_c = V_{SS}$	C_{is}	—	—	—	8	pF
			C_{os}	-5	+5	—	8	pF
			C_{ios}	—	—	—	0.5	pF
CONTROL INPUT (V_c)								
PROPAGATION DELAY TIME Turn on	t_{PC}	$V_{SS} \leq V_{is} \leq V_{DD}$ $R_L = 10\text{k}\Omega$	0	5	—	50	100	ns
			0	10	—	25	50	
			0	15	—	20	40	
MAXIMUM INPUT FREQUENCY	f_c	$V_{SS} \leq V_{is} \leq V_{DD}$ $R_L = 1.0\text{k}\Omega$	0	5	—	5	—	MHz
			0	10	—	10	—	
			0	15	—	12	—	
CROSSTALK (To signal port)		$V_c = \text{Square Wave}$ $R_L = 10\text{k}\Omega$ $R_{in} = 1.0\text{k}\Omega$	0	5	—	30	—	mV
			0	10	—	50	—	
			0	15	—	100	—	



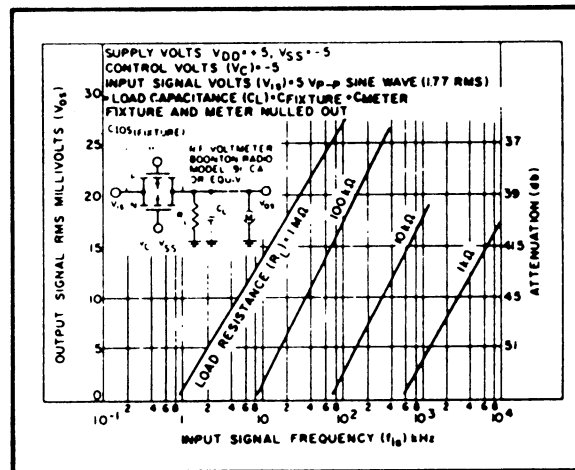
Typical channel ON resistance vs. signal voltage for three values of supply voltage (V_{DD}-V_{SS})



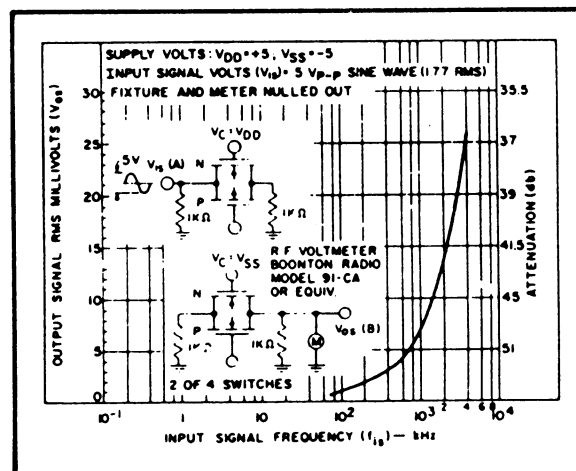
Typical ON characteristics for 1 of 4 channels.



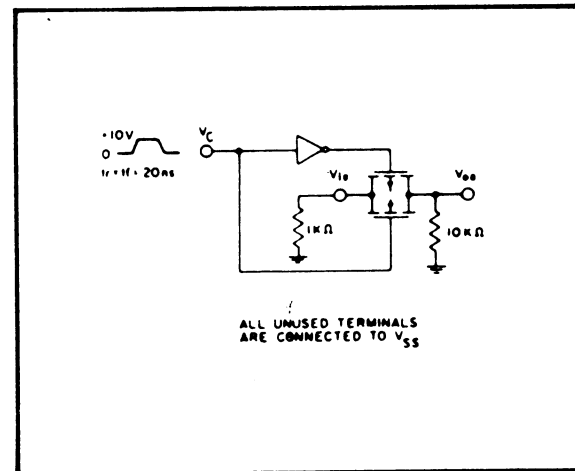
Typ. switch frequency response - switch "ON"



Typ. feedthru vs. freq. - switch "OFF"



Typ. crosstalk between switch circuits in the same package

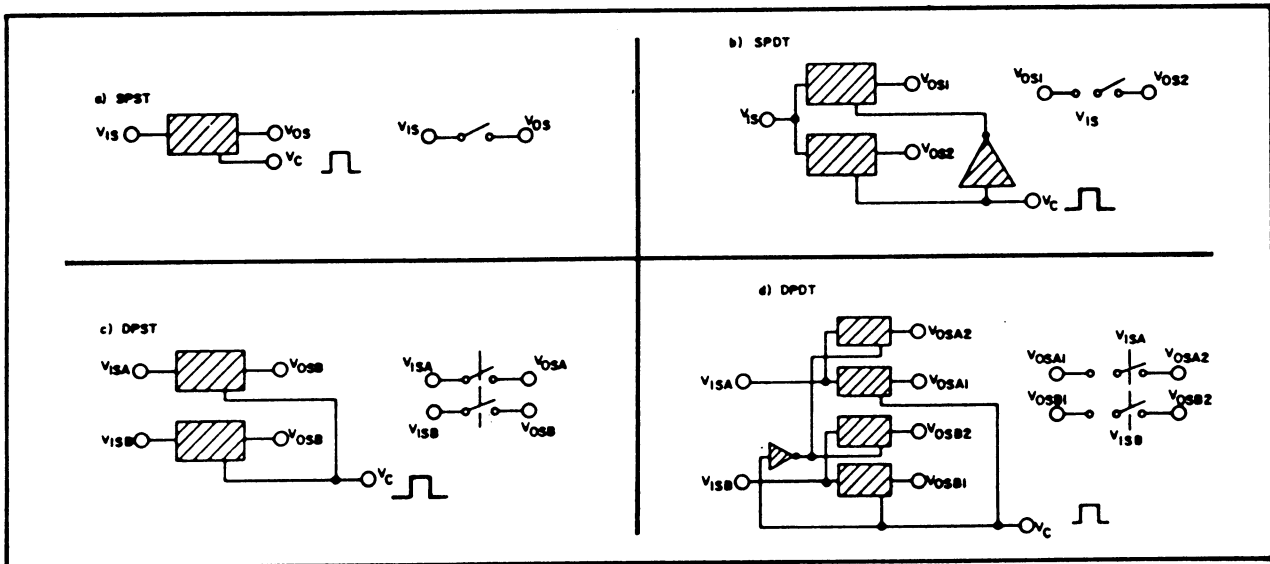


Test circuit, crosstalk-control input to signal output

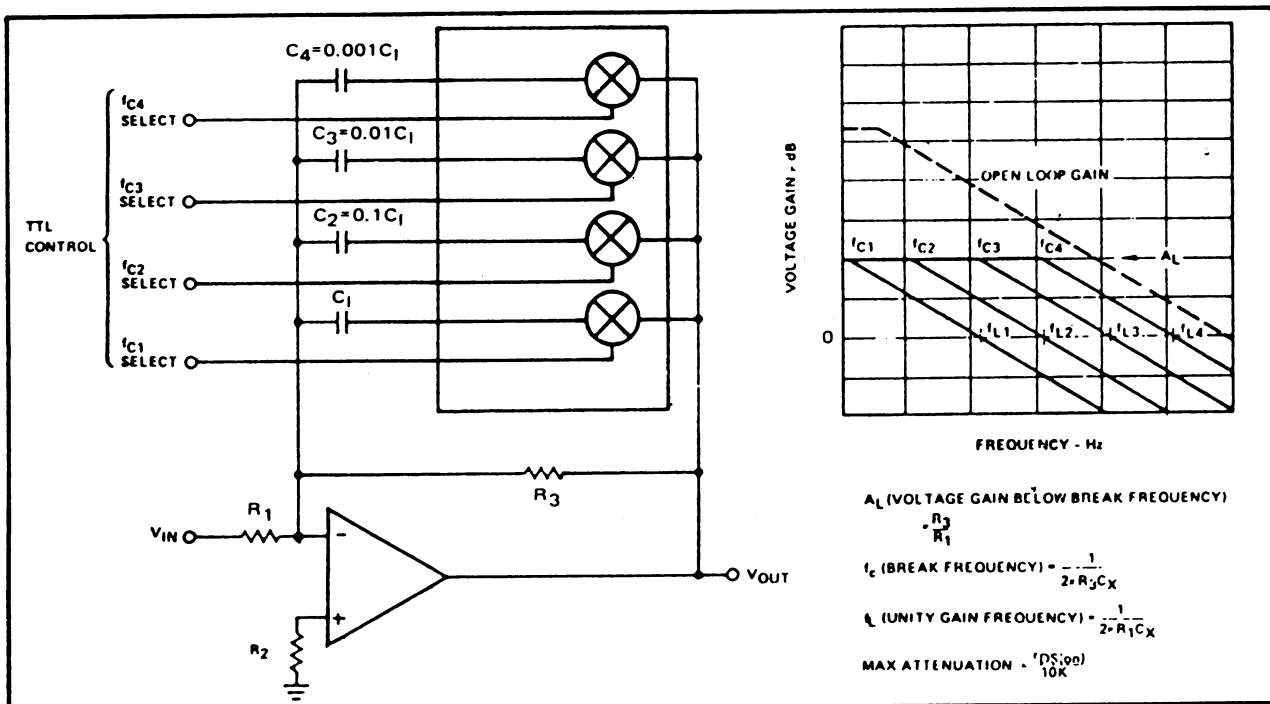
SPECIAL CONSIDERATIONS – 4066B

1. In applications where separate power sources are used to drive V_{DD} and the signal inputs, the V_{DD} current capability should exceed V_{DD}/R_L (R_L = effective external load of the 4 4066B bilateral switches). This provision avoids any permanent current flow or clamp action on the V_{DD} supply when power is applied or removed from 4066B.
2. In certain applications, the external load-resistor current may include both V_{DD} and signal-line components. To avoid drawing V_{DD} current when switch current flows into terminals 1, 4, 8, or 11, the voltage drop across the bidirectional switch must not exceed 0.8 volt (calculated from R_{ON} values shown). No V_{DD} current will flow through R_L if the switch current flows into terminals 2, 3, 9, or 10. Failure to observe this condition may result in distortion of the signal.

APPLICATIONS INFORMATION



Basic Switch Functions using the 4066B



Active Low Pass Filter with Digitally Selected Break Frequency