

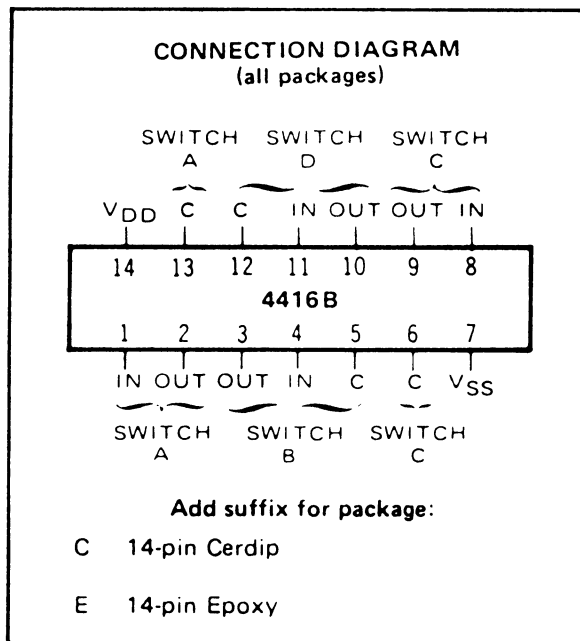
CMOS QUAD ANALOG SWITCH

FEATURES

- ◆ DPDT Switch Operation Without External Logic
- ◆ Wide Range of Digital and Analog Signal Levels — Digital or Analog Signal to 18 Volts peak
- ◆ Low ON Resistance — 200 Ω typ. over 15V_{p-p} Signal Input Range, $V_{DD} - V_{SS} = 15V$
- ◆ Matched Switch Characteristics - 10 Ω typ. Difference Between R_{ON} Values at a Fixed Bias Point over 15 V_{p-p} Signal Input Range, $V_{DD} - V_{SS} = 15V$
- ◆ High "ON/OFF" Output Voltage Ratio — 65 dB typ. @ $f_{is} = 10$ kHz, $R_L = 10$ k Ω
- ◆ High Degree of Linearity — 0.4% Distortion typ. @ $f_{is} = 1$ kHz, $V_{is} = 5$ V_{p-p}, $V_{DD} - V_{SS} = 10V$, $R_L = 10$ k Ω
- ◆ Extremely low OFF Switch Leakage Resulting in Very Low Offset Current and High Effective OFF Switch Resistance — 10 pA typ. @ $V_{DD} - V_{SS} = 10V$, $T_A = 25^\circ C$
- ◆ Extremely High Control Input Impedance (Control Circuit Isolated from Signal Circuit) — $10^{12} \Omega$ typ.
- ◆ Low Crosstalk Between Switches — -50dB typ. @ $f_{is} = 0.9$ MHz, $R_L = 1$ k Ω
- ◆ Matched Control-Input to Signal-Output Capacitances - Reduces Output Signal Transients
- ◆ Transmits Frequencies up to 40MHz

DESCRIPTION

The 4416B is a single-chip monolithic silicon integrated circuit containing eight N-channel and eight P-channel enhancement-mode MOS transistors connected to form four independent bilateral signal switches. Each switch consists of both P- and N-channel devices with common source and drain connections. A single control signal is required per switch. Both P and N devices in a given switch are biased ON or OFF by the control signal.



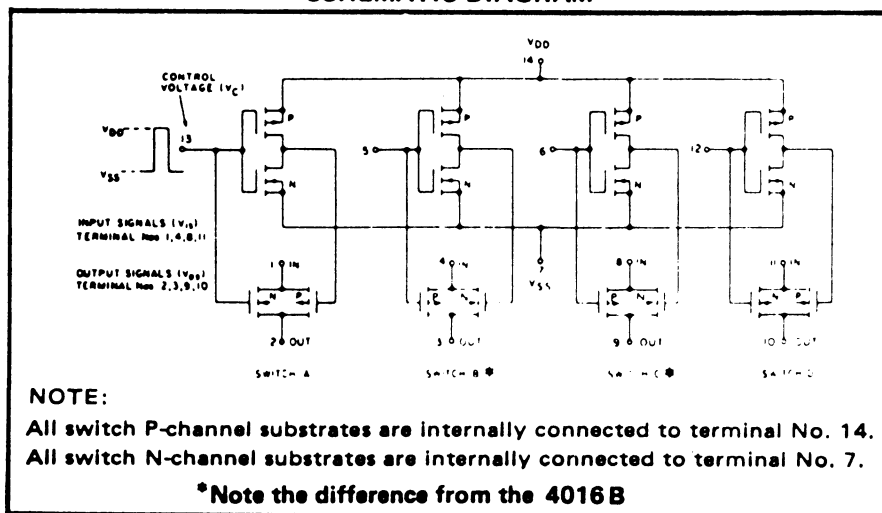
RECOMMENDED OPERATING CONDITIONS

For maximum reliability:

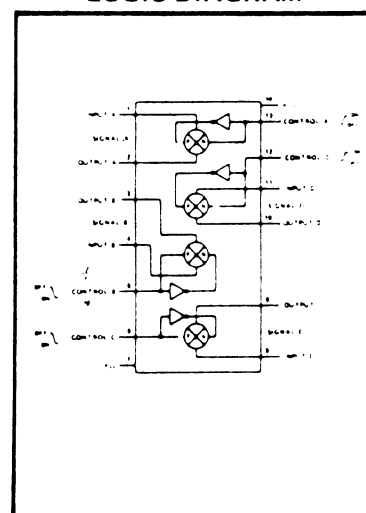
DC Supply Voltage	$V_{DD} - V_{SS}$	3 to 15	Vdc
Operating Temperature	T_A	-55 to +125	$^\circ C$
		-40 to +85	$^\circ C$

The CMOS switch permits peak input-signal voltage swings equal to the full supply voltage, a considerable advantage over single-channel types. When the control input is high the switch will be ON. When the control input is low the switch will be OFF.

SCHMATIC DIAGRAM



LOGIC DIAGRAM



ELECTRICAL CHARACTERISTICS

STATIC CHARACTERISTICS¹

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	μA _{dc}	
		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	-	2.9	-	1.5	2.7	-	2.4	V _{dc}	
		0	10	-	2.9	-	1.5	2.7	-	2.4		
		0	15	-	2.9	-	1.5	2.7	-	2.4		
MAXIMUM INPUT LOW VOLTAGE (Control Input) V _{IL}	V _{IS} = V _{SS} V _{OS} = V _{DD} I _{OS} = 10μA	0	5	0.9	-	0.7	1.5	-	0.4	-	V _{dc}	
		0	10	0.9	-	0.7	1.5	-	0.4	-		
		0	15	0.9	-	0.7	1.5	-	0.4	-		
SWITCH INPUT/OUTPUT LEAKAGE (Switch off) I _{OFF}	V _C = V _{SS} ⁴ V _{IS}	±7.5 -5 ±5	+7.5 +5	-	±250 ±125	-	±0.1 ±0.01	±250 ±125	-	±2500 ±1250	nA _{dc}	
ON-RESISTANCE R _{ON}	V _C = V _{DD} ⁴ R _L = 10kΩ V _{IS} (Vdc)	+7.5 -7.5 ±0.25	+7.5	-	200 200 180	-	100 100 80	220 220 200	-	450 450 420	Ω	
		+5 -5 ±0.25	+5	-	260 260 260	-	160 ¹ 160 150	300 300 290	-	500 500 500	Ω	
		+15 +0.25 +9.3	+15	-	230 100 250	-	130 40 150	250 120 270	-	500 260 580	Ω	
		+10 +0.25 +5.6	+10	-	220 100 400	-	120 60 220	240 130 420	-	500 280 900	Ω	
ON-RESISTANCE MATCH (Same package) ΔR _{ON}	V _C = V _{DD} ⁴ R _L = 10kΩ V _{IS} (Vdc)	±7.5 ±5	+7.5 +5	-	-	-	10 15	-	-	-	Ω	

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

⁴ Reverse polarity of V_C (control input) for switches B and C.

DYNAMIC CHARACTERISTICS (C_L = 50 pF, T_A = 25°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 _{PC}	V _C = V _{DD} ¹ V _{IS} = square wave R _L = 10kΩ	0	5	-	20	40	ns	
		0	10	-	10	20		
		0	15	-	7.5	15		
BANDWIDTH (-3dB) (Sine Wave) BW	V _C = V _{DD} ¹ V _{IS} = 5V _{p-p} centered @0.0Vdc	R _L		-5	+5	-	MHz	
		1kΩ						54
		10kΩ						40
		100kΩ						38
		1MΩ						37

ELECTRICAL CHARACTERISTICS (Continued)

DYNAMIC CHARACTERISTICS (C_L = 50 pF, T_A = 25°C) (Continued)

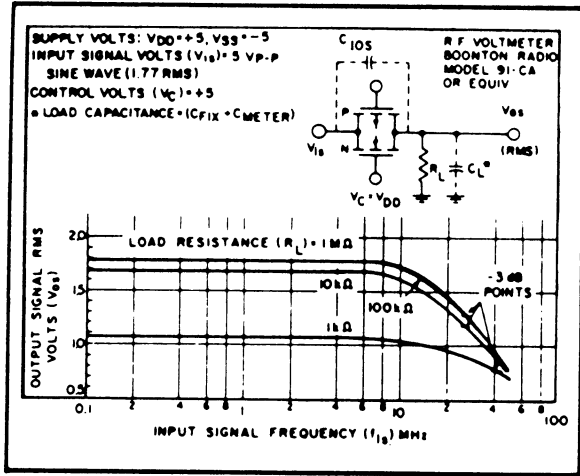
PARAMETER	CONDITIONS	V _{SS} (Vdc)	V _{DD} (Vdc)	Min.	Typ.	Max.	Units		
SIGNAL INPUTS (V_{IS}) AND OUTPUTS (V_{OS}) (Continued)									
INSERTION LOSS (= 20 log ₁₀ $\frac{V_{OL}}{V_{IS}}$)	V _C = V _{DD} ¹ V _{IS} = 5V _{pp} centered @0.0Vdc	R _L		-5	+5	-	dB		
		1kΩ	2.3						
		10kΩ	0.2						
		100kΩ	0.1						
		1MΩ	0.06						
SIGNAL DISTORTION (Sine Wave)	V _C = V _{DD} ¹ V _{IS} = 5V _{pp} centered @0.0Vdc f _{IS} = 1.0kHz R _L = 10kΩ	-5	+5	-	0.4	-	%		
FEEDTHROUGH (-50dB)	V _C = V _{SS} ¹ V _{IS} = 5V _{pp} centered @0.0Vdc	R _L		-5	+5	-	kHz		
		1kΩ	1250						
		10kΩ	140						
		100kΩ	18						
		1MΩ	2						
CROSSTALK (-50dB) (Between two switches)	V _C (A) = V _{DD} ¹ V _C (B) = V _{SS} ¹ V _{IS} (A) = 5V _{pp} centered @0.0Vdc R _L = 1.0k	-5	+5	-	0.9	-	MHz		
CAPACITANCE	V _C = V _{SS} ¹	Input							
		Output	C _{IS}	-5	+5	-	4	-	pF
		Feedthrough	C _{OS}			-	4	-	pF
	C _{IOS}			-	0.2	-	pF		
CONTROL INPUT (V_C)									
PROPAGATION DELAY TIME Turn on	t _{PLH} , t _{PHL} V _{SS} < V _{IS} < V _{DD} R _L = 10kΩ	0	5	-	40	80	ns		
		0	10	-	20	40			
		0	15	-	15	30			
MAXIMUM INPUT FREQUENCY	f _C V _{SS} < V _{IS} < V _{DD} R _L = 1.0kΩ	0	5	-	5	-	MHz		
		0	10	-	10	-			
		0	15	-	12	-			
CROSSTALK (To signal port)	V _C = Square wave R _L = 10kΩ R _{IN} = 1.0kΩ	0	5	-	30	-	mV		
		0	10	-	50	-			
		0	15	-	100	-			

NOTE: ¹ Reverse polarity of V_C (control input) for switches B and C.

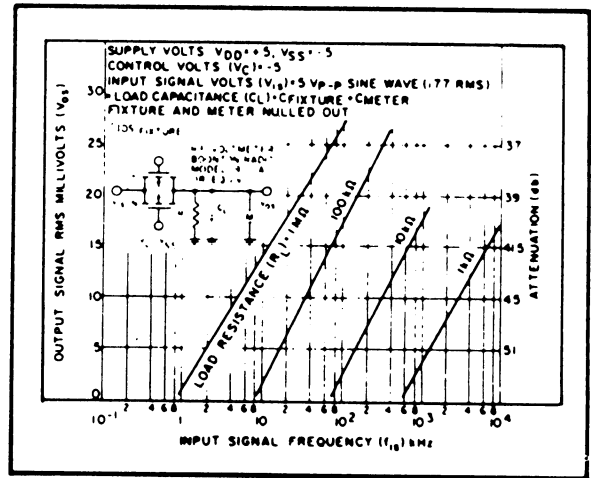
TYPICAL ON-RESISTANCE CHARACTERISTICS

CHARAC- TERISTIC*	SUPPLY CONDITIONS		LOAD CONDITIONS					
	V _{DD} (V)	V _{SS} (V)	R _L = 1kΩ		R _L = 10kΩ		R _L = 100kΩ	
			VALUE (Ω)	V _{IS} (V)	VALUE (Ω)	V _{IS} (V)	VALUE (Ω)	V _{IS} (V)
R _{ON}	+15	0	200	+15	200	+15	180	+15
			200	0	200	0	200	0
R _{ON(max.)}	+15	0	300	+11	300	+9.3	320	+9.2
R _{ON}	+10	0	280	+10	250	+10	240	+10
			280	0	250	0	300	0
R _{ON(max.)}	+10	0	500	+7.4	580	+6.6	610	+5.5
R _{ON}	+5	0	880	+5	470	+5	450	+5
			800	0	580	0	800	0
R _{ON(max.)}	+5	0	1.7k	+4.2	7k	+2.9	33k	+2.7
R _{ON}	+7.5	-7.5	200	+7.5	200	+7.5	180	+7.5
			200	-7.5	200	-7.5	180	-7.5
R _{ON(max.)}	+7.5	-7.5	280	±0.25	280	±25	400	±0.25
R _{ON}	+5	-5	280	+5	250	+5	240	+5
			310	-5	250	-5	240	-5
R _{ON(max.)}	+5	-5	800	±0.25	580	±0.25	760	±0.25
R _{ON}	+2.5	-2.5	580	+2.5	450	+2.5	490	+2.5
			720	-2.5	520	-2.5	520	-2.5
R _{ON(max.)}	+2.5	-2.5	232k	±0.25	300k	±0.25	870k	±0.25

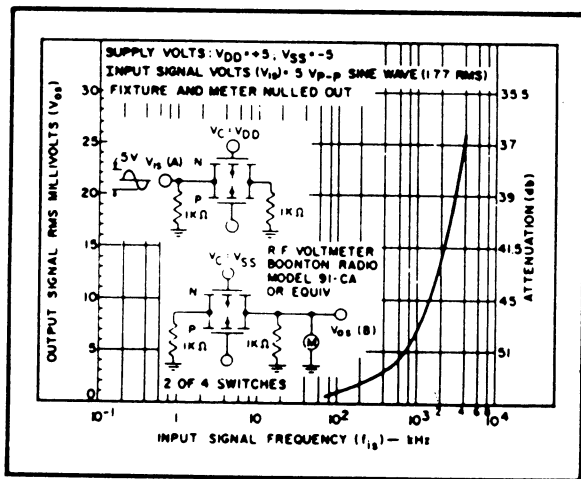
* Variation from a perfect switch; R_{ON} = 0Ω.



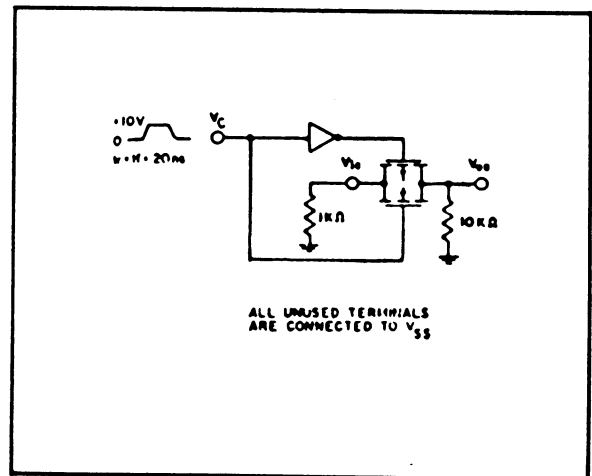
Typ. switch frequency response - switch "ON"



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



Typ. crosstalk between switch circuits in the same package



Test circuit, Crosstalk-control input to signal output.

APPLICATIONS INFORMATION

4416B connected as a DPDT Switch

