

CMOS QUAD ANALOG SWITCH

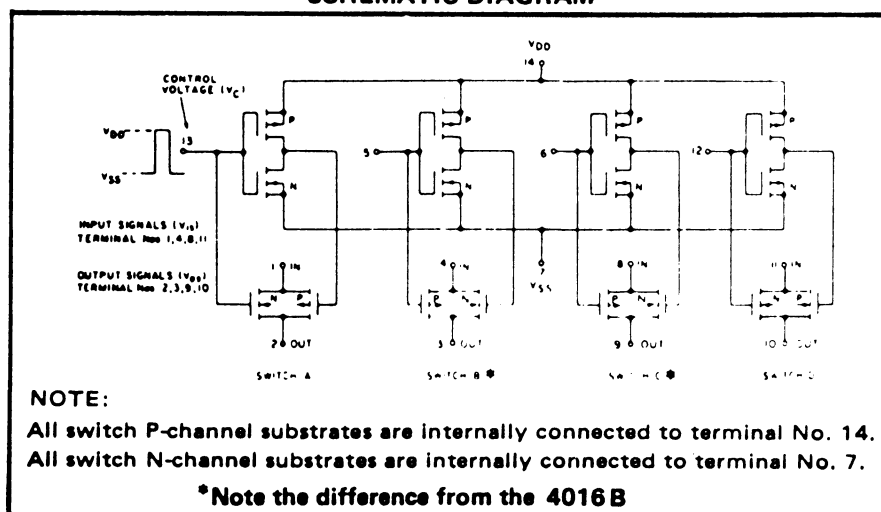
FEATURES

- ◆ 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° C
- ◆ Extremely High Control Input Impedance (Control Circuit Isolated from Signal Circuit) — 10¹² Ω typ.
- ◆ Low Crosstalk Between Switches — -50dB typ. @ f_{is} = 0.9 MHz, R_L = 1k Ω
- ◆ Matched Control-Input to Signal-Output Capacitances - Reduces Output Signal Transients
- ◆ Transmits Frequencies up to 40MHz

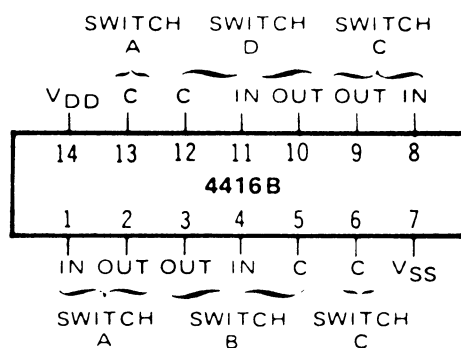
DESCRIPTION

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.

SCHEMATIC DIAGRAM



CONNECTION DIAGRAM (all packages)



Add suffix for package:

C 14-pin Cerdip

E 14-pin Epoxy

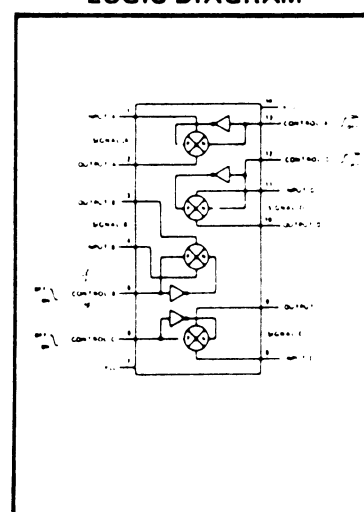
RECOMMENDED OPERATING CONDITIONS

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 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.

LOGIC DIAGRAM



ELECTRICAL CHARACTERISTICS

STATIC CHARACTERISTICS¹

PARAMETER		CONDITIONS	V _{SS} (Vdc)	V _{DD} (Vdc)	T _{LOW} ¹		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 0 0	5 10 15	- - -	0.05 0.1 0.2	- - -	0.0005 0.001 0.002	0.05 0.1 0.2	- - -	1.5 3.0 6.0	μAcd
MINIMUM INPUT HIGH VOLTAGE (Control Input)	V _{IH}	V _{IS} = V _{SS} V _{OS} = V _{DD} I _{OS} = 10 μA	0 0 0	5 10 15	- - -	2.9 2.9 2.9	- - -	1.5 1.5 1.5	2.7 2.7 2.7	- - -	2.4 2.4 2.4	Vdco
MAXIMUM INPUT LOW VOLTAGE (Control Input)	V _{IL}	V _{IS} = V _{SS} V _{OS} = V _{DD} I _{OS} = 10 μA	0 0 0	5 10 15	0.9 0.9 0.9	- - -	0.7 0.7 0.7	1.5 1.5 1.5	- - -	0.4 0.4 0.4	- - -	Vdc
SWITCH INPUT/OUTPUT LEAKAGE (Switch off)	I _{OFF}	V _C = V _{SS} ⁴ , V _{IS} ±7.5 ±5	.75 .5	+7.5 +5	- -	±250 ±125	- -	±0.1 ±0.01	±250 ±125	- -	±2500 ±1250	nAdc
ON-RESISTANCE	R _{ON}	V _{IS} (Vdc) V _C = V _{DD} ⁴ R _L = 10kΩ										
		+7.5 -7.5 ±0.25	-7.5	+7.5	- - -	200 200 180	- - -	100 100 80	220 220 200	- - -	450 450 420	Ω
		+5 -5 ±0.25	-5	+5	- - -	260 260 260	- - -	160 ¹ 160 150	300 300 290	- - -	500 500 500	Ω
		+15 +0.25 +9.3	0	+15	- - -	230 100 250	- - -	130 40 150	250 120 270	- - -	500 260 580	Ω
		+10 +0.25 +5.6	0	+10	- - -	220 100 400	- - -	120 60 220	240 130 420	- - -	500 280 900	Ω
ON-RESISTANCE MATCH (Same package)	ΔR _{ON}	V _{IS} (Vdc) V _C = V _{DD} ⁴ R _L = 10kΩ										
		±7.5 ±5	-7.5 -.5	+7.5 +5	- -	- -	- -	10 15	- -	- -	- -	Ω

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

$T_{\text{LOW}} = -55^{\circ}\text{C}$ for C
 $= -40^{\circ}\text{C}$ for E
 $T_{\text{HIGH}} = +125^{\circ}\text{C}$ for C
 $= +85^{\circ}\text{C}$ for E

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

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 _{PC} V _C = V _{DD} V _{IS} = square wave R _L = 10kΩ	0 0 0	5 10 15	— — —	20 10 7.5	40 20 15	ns
BANDWIDTH (-3dB) (Sine Wave)	BW V _C = V _{DD} V _{IS} = 5V _{pp} centered @0.0Vdc	R _L 1kΩ 10kΩ 100kΩ 1MΩ	-5 +5	— — — —	54 40 38 37	— — — —	MHz

ELECTRICAL CHARACTERISTICS (Continued)

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

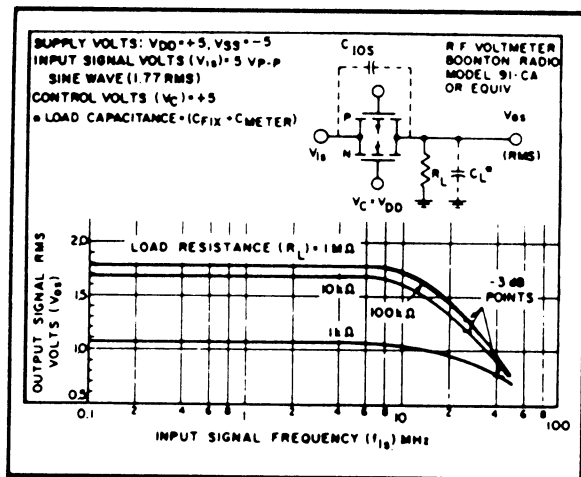
PARAMETER		CONDITIONS		V _{SS} (Vdc)	V _{DD} (Vdc)	Min.	Typ.	Max.	Units
SIGNAL INPUTS (V _{IS}) AND OUTPUTS (V _{OS}) (Continued)									
INSERTION LOSS (= 20 log ₁₀ $\frac{V_{OS}}{V_{IS}}$)		V _C = V _{DD} ¹ V _{IS} = 5V _{pp} centered @0.0Vdc	R _L	-5	+5	-	2.3	-	dB
			1kΩ						
			10kΩ						
			100kΩ						
			1MΩ						
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	-	1250	-	kHz
			1kΩ						
			10kΩ						
			100kΩ						
			1MΩ						
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	C _{IS}	V _C = V _{SS} ¹		-5	+5	-	4	-	pF
	Input								
	Output								
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
MAXIMUM INPUT FREQUENCY	f _C	V _{SS} < V _{IS} < V _{DD} R _L = 1.0kΩ		0	5	-	5	-	MHz
CROSSTALK (To signal port)		V _C = Square wave R _L = 10kΩ R _{IN} = 1.0kΩ		0	5	-	30	-	mV

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

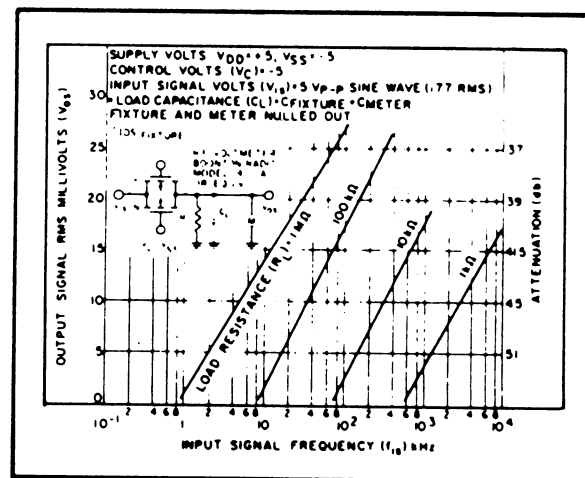
TYPICAL ON-RESISTANCE CHARACTERISTICS

CHARACTERISTIC*	SUPPLY CONDITIONS		LOAD CONDITIONS					
	V_{DD} (V)	V_{SS} (V)	$R_L = 1k\Omega$		$R_L = 10k\Omega$		$R_L = 100k\Omega$	
			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
$R_{ON(max.)}$	+15	0	300	+11	300	+9.3	320	+9.2
R_{ON}	+10	0	280	+10	250	+10	240	+10
$R_{ON(max.)}$	+10	0	280	0	250	0	300	0
R_{ON}	+5	0	880	+5	470	+5	450	+5
$R_{ON(max.)}$	+5	0	800	0	580	0	800	0
R_{ON}	+7.5	-7.5	200	+7.5	200	+7.5	180	+7.5
$R_{ON(max.)}$	+7.5	-7.5	200	-7.5	200	-7.5	180	-7.5
R_{ON}	+5	-5	280	+5	250	+5	240	+5
$R_{ON(max.)}$	+5	-5	310	-5	250	-5	240	-5
R_{ON}	+2.5	-2.5	880	+2.5	450	+2.5	490	+2.5
$R_{ON(max.)}$	+2.5	-2.5	720	-2.5	520	-2.5	520	-2.5
R_{ON}	+2.5	-2.5	232k	+2.5	300k	+2.5	870k	+2.5
$R_{ON(max.)}$	+2.5	-2.5	232k	-2.5	300k	-2.5	870k	-2.5

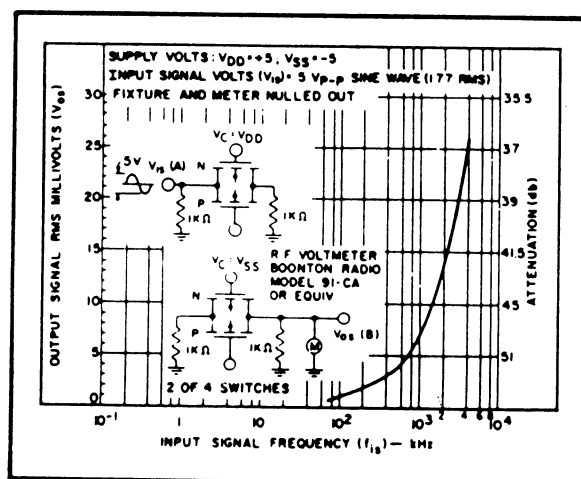
* Variation from a perfect switch; $R_{ON} = 0\Omega$.



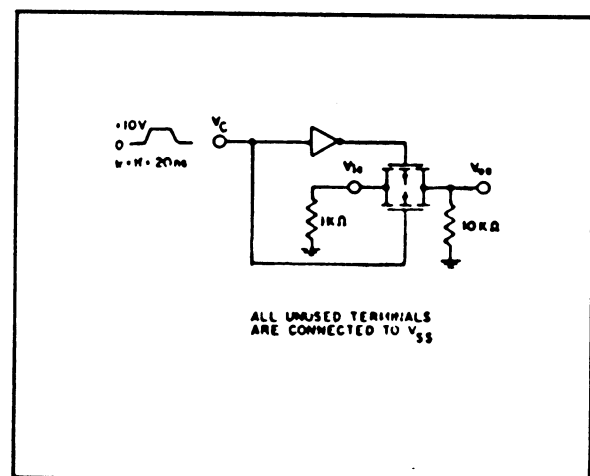
Typ. switch frequency response - switch "ON"



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

