

CMOS LOGIC CIRCUITS

TYPES TF4316A, TP4316A QUAD BILATERAL SWITCHES

SEPTEMBER 1975

- Designed to be Interchangeable with RCA CD4016A
- Difference in r_{on} between Switches in One Package Typically $10\ \Omega$ when $V_I = V_{SS}$ or V_{DD}
- High Degree of Linearity . . . $< 0.5\%$ Distortion Typical at 1 kHz
- Switches Can Transmit Signals in Either Direction at Frequencies of up to 50 MHz Typically
- Extremely Low Off-State Switch Current Resulting in Very High Effective Off-State Resistance . . . 10 pA Typical at $V_{DD} - V_{SS} = 10\text{ V}$
- Maximum Control Input Frequency . . . 10 MHz Typical at $V_{DD} = 10\text{ V}$, $C_L = 15\text{ pF}$, $R_L = 1\text{ k}\Omega$
- High On/Off Output Voltage Ratio . . . 65 dB Typical
- Extremely High Control-Input Impedance (Control Circuit Isolated from Switch Circuit) . . . $10^{12}\ \Omega$ Typical
- Low Crosstalk Between Switches . . . 50 dB Typical at 0.9 MHz, $R_L = 1\text{ k}\Omega$
- Control Input Current . . . $< 10\text{ pA}$ Typical

description

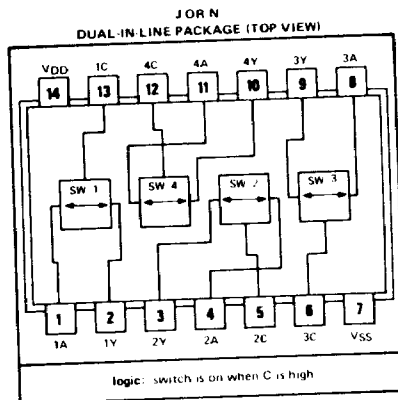
The '4316A is a quadruple bilateral switch constructed with P-channel and N-channel enhancement-type devices in a monolithic structure, and finds primary use where low power dissipation and/or high noise immunity is desired.

Applications include digital switching and multiplexing; analog-to-digital and digital-to-analog conversion; digital control of frequency, impedance, phase and analog-signal gain; signal gating; and use as a squelch control, chopper, modulator, demodulator, or commutating switch.

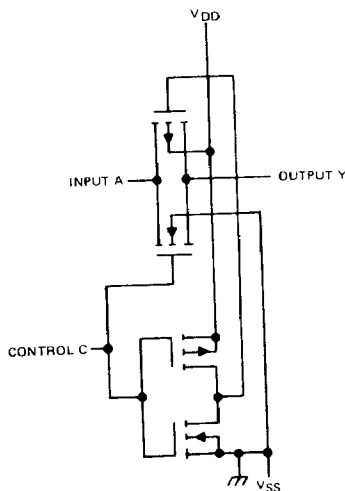
The P^- well is permanently connected to V_{SS} . This results in a higher average on-state resistance than the '4016A has but lower transient current into input A.

specifications

MAXIMUM RATINGS	RECOMMENDED OPERATING CONDITIONS	ELECTRICAL CHARACTERISTICS
Page 62	Page 62	See the following page. Page 63 does not apply.



schematic (each switch)



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electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)
 $V_{DD} = 5\text{ V}$ and 10 V

PARAMETER	TEST CONDITIONS†	$V_{DD} = 5$		TF4316A		TP4316A		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
V_{IH} High-level control input voltage		3		4		4		V
V_{IL} Low-level control input voltage		0.9		0.9		0.9		V
V_{OH} High-level output voltage	A at 0 V, C at V_{IL} max, $I_O = 10\text{ }\mu\text{A}$	4.5		9		9		V
V_{OL} Low-level output voltage	A at 0 V, C at V_{IH} min, $I_O = 10\text{ }\mu\text{A}$	0.5		1		1		V
Input-to-output off-state current	A at 0 V to V_{DD} , C at 0 V, Y at 5 V, $T_A = 25^\circ\text{C}$					± 125	± 125	nA
Total Quiescent Current‡	A at 0 V to V_{DD} , C at 0 V, Y at 0 V to V_{DD} , $T_A = \text{MIN or } 25^\circ\text{C}$					1	1	μA
	$T_A = \text{MAX}$					60	16	
	A = Y = 0 V to V_{DD} , C at V_{DD} , $T_A = \text{MIN or } 25^\circ\text{C}$					1	1	μA
	$T_A = \text{MAX}$					60	16	

$V_{DD} = 15\text{ V}$

PARAMETER	TEST CONDITIONS†	TF4016A		TP4016A		UNIT
		MIN	MAX	MIN	MAX	
I_I Input current	$V_I = 0$ or V_{DD}			± 1	± 1	μA
I_{DD} or $-I_{SS}$ Quiescent supply current	$V_I = V_{DD}$ or 0, No load, $T_A = \text{MIN or } 25^\circ\text{C}$			3	3	μA
	$T_A = \text{MAX}$			180	48	

† $T_A = \text{MIN or MAX}$ refers to the respective values of free-air temperature specified under recommended operating conditions.
‡ This is the total of supply current, control input current, and input-to-output off-state current.

on-state resistance at specified free-air temperature, C at V_{DD} , $R_L = 10\text{ k}\Omega$ to 0 V

TEST CONDITIONS†				TF4316A		TP4316A		UNIT
				MIN	MAX	MIN	MAX	
$V_{DD} = 5\text{ V}, V_{SS} = -5\text{ V}$	A at 5 V or -5 V	$T_A = \text{MIN}$		600		610		Ω
		$T_A = 25^\circ\text{C}$		660		660		
		$T_A = \text{MAX}$		960		840		
	A at 0.25 V or -0.25 V	$T_A = \text{MIN}$		1870		1900		Ω
		$T_A = 25^\circ\text{C}$		2000		2000		
		$T_A = \text{MAX}$		2600		2380		
$V_{DD} = 7.5\text{ V}, V_{SS} = -7.5\text{ V}$	A at 7.5 V or -7.5 V	$T_A = \text{MIN}$		360		370		Ω
		$T_A = 25^\circ\text{C}$		400		400		
		$T_A = \text{MAX}$		600		520		
	A at 0.25 V or -0.25 V	$T_A = \text{MIN}$		775		790		Ω
		$T_A = 25^\circ\text{C}$		850		850		
		$T_A = \text{MAX}$		1230		1080		
$V_{DD} = 10\text{ V}, V_{SS} = 0\text{ V}$	A at 10 V or 0.25 V	$T_A = \text{MIN}$		600		610		Ω
		$T_A = 25^\circ\text{C}$		660		660		
		$T_A = \text{MAX}$		960		840		
	A at 5.6 V	$T_A = \text{MIN}$		1870		1900		Ω
		$T_A = 25^\circ\text{C}$		2000		2000		
		$T_A = \text{MAX}$		2600		2380		
$V_{DD} = 15\text{ V}, V_{SS} = 0\text{ V}$	A at 15 V or 0.25 V	$T_A = \text{MIN}$		360		370		Ω
		$T_A = 25^\circ\text{C}$		400		400		
		$T_A = \text{MAX}$		600		520		
	A at 9.3 V	$T_A = \text{MIN}$		775		790		Ω
		$T_A = 25^\circ\text{C}$		850		850		
		$T_A = \text{MAX}$		1230		1080		

† $T_A = \text{MIN or MAX}$ refers to the respective values of free-air temperature specified under recommended operating conditions.

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switching characteristics at 25°C free-air temperature

PARAMETER†	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	V _{DD} = 5 V	V _{DD} = 10 V	UNIT
				TYP	MAX	
t _{PLH}	A	Y	R _L = 10 kΩ, C _L = 50 pF, C at V _{DD} , See Figure 1	30	15	ns
t _{PHL}	A	Y	C _L = 50 pF, See Figure 2	80	30	ns
t _{PLH}	C	Y	R _L = 10 kΩ to 0 V	80	30	ns
t _{PHL}	C	Y	R _L = 10 kΩ to V _{DD}	80	30	ns

†t_{PLH} = Propagation delay time, low-to-high-level output
†t_{PHL} = Propagation delay time, high-to-low-level output

PARAMETER MEASUREMENT INFORMATION

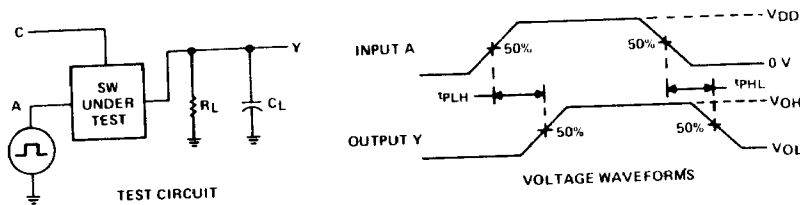


FIGURE 1—PROPAGATION DELAY TIME, SWITCH INPUT A TO OUTPUT Y

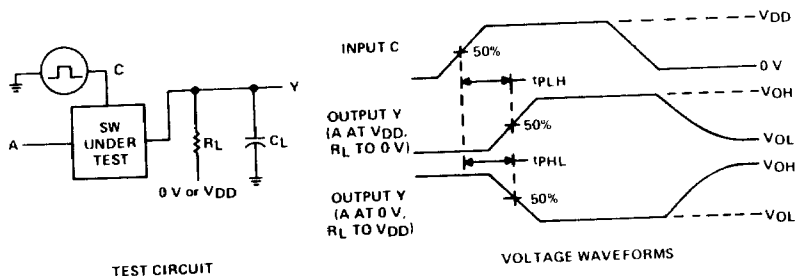


FIGURE 2—PROPAGATION DELAY TIMES, CONTROL INPUT C TO OUTPUT Y

NOTES: A. Input pulses are supplied by generators having the following characteristics: $Z_{out} = 50 \Omega$, PRF = 10 kHz, $t_r \approx 20$ ns, $t_f \approx 20$ ns.
B. C_L includes probe and jig capacitance.
C. The waveforms are monitored on an oscilloscope with the following characteristics: $t_r \approx 10$ ns, $R_{in} \approx 1$ MΩ.