

TC4016BP/BF

C²MOS DIGITAL INTEGRATED CIRCUIT
SILICON MONOLITHIC

TC4016BP/TC4016BF QUAD BILATERAL SWITCH

TC4016BP/BF contains four circuits of independent bidirectional switches. When control input CONT is placed at "H" level, the impedance between the input and output of switch becomes low and when CONT is placed at "L" level, it becomes high. This can be used for switching analog and digital signals.

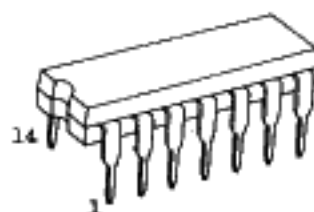
Resistance during ON, R_{ON}

$2.5 \times 10^2 \Omega$ (TYP.) $V_{DD}-V_{SS}=10V$

$1.5 \times 10^2 \Omega$ (TYP.) $V_{DD}-V_{SS}=15V$

Resistance during OFF, R_{OFF}

R_{OFF} (TYP.) $> 10^9 \Omega$

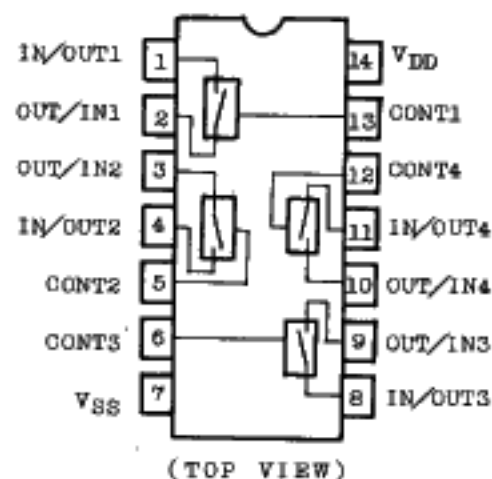


DIP14 (3D14A-P)



MFP14 (F14GB-P)

PIN ASSIGNMENT

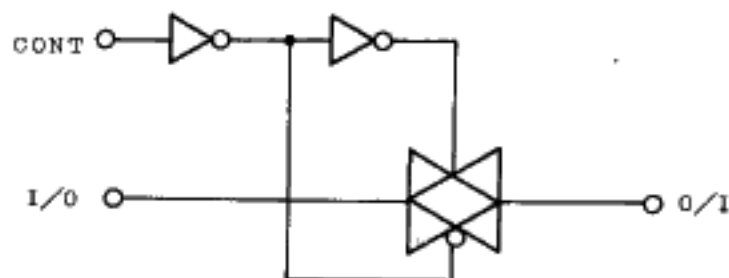


ABSOLUTE MAXIMUM RATINGS

CHARACTERISTIC	SYMBOL	RATING	UNITS
DC Supply Voltage	V_{DD}	$V_{SS}-0.5 \sim V_{SS}+20$	V
Control Input Voltage	V_{CIN}	$V_{SS}-0.5 \sim V_{DD}+0.5$	V
Switch I/O Voltage	$V_{I/O}$	$V_{SS}-0.5 \sim V_{DD}+0.5$	V
Control Input Current	I_C	± 10	mA
Power Dissipation	P_D	300 (DIP) / 180 (MFP)	mW
Operating Temperature Range	T_A	$-40 \sim 85$	$^{\circ}C$
Storage Temperature Range	T_{stg}	$-65 \sim 150$	$^{\circ}C$
Lead Temp./Time	T_{sol}	$260^{\circ}C \cdot 10 \text{ sec}$	

LOGIC DIAGRAM

(1/4 TC4016BP/BF)



TRUTH TABLE

CONTROL	IMPEDANCE BETWEEN IN/OUT - OUT/IN *
H	$1 \sim 20 \times 10^2 \Omega$
L	$> 10^9 \Omega$

* SEE STATIC ELECTRICAL
CHARACTERISTICS

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS
DC Supply Voltage	V_{DD}	3	-	18	V
Input/Output Voltage	V_{IN}/V_{OUT}	0	-	V_{DD}	

STATIC ELECTRICAL CHARACTERISTICS (In case not specifically appointed, $V_{SS}=0V$)

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	V_{SS} (V)	V_{DD} (V)	-40°C		25°C			85°C		UNITS
					MIN.	MAX.	MIN.	TYP.	MAX.	MIN.	MAX.	
Control Input High Voltage	V_{IH}	$ I_{IS} =10\mu A$	5	5	3.5	-	3.5	2.4	-	3.5	-	V
				10	7.0	-	7.0	4.8	-	7.0	-	
				15	11.0	-	11.0	7.2	-	11.0	-	
Control Input Low Voltage	V_{IL}	$ I_{IS} =10\mu A$	5	5	-	1.0	-	1.7	1.0	-	1.0	V
				10	-	1.0	-	1.7	1.0	-	1.0	
				15	-	1.0	-	1.7	1.0	-	1.0	
On-State Resistance	R_{ON}	$V_{IN}=5V$	5	5	-	-	-	300	-	-	-	Ω
		$V_{IN}=2.5V$		5	-	-	-	2000	-	-	-	
		$V_{IN}=0.25V$		5	-	-	-	300	-	-	-	
		$V_{IN}=10V$	10	10	-	600	-	180	660	-	840	
		$V_{IN}=5V$		10	-	600	-	300	660	-	840	
		$V_{IN}=0.25V$		10	-	600	-	130	660	-	840	
		$V_{IN}=15V$	15	15	-	370	-	140	400	-	520	
		$V_{IN}=7.5V$		15	-	370	-	160	400	-	520	
		$V_{IN}=0.25V$		15	-	370	-	100	400	-	520	
		$V_{IN}=5V$	-5	5	-	600	-	180	660	-	840	
		$V_{IN}=\pm 0.25V$		5	-	600	-	300	660	-	840	
		$V_{IN}=-5V$		5	-	600	-	130	660	-	840	
Δ On-State Resistance (Between Any 2 Switches)	$R_{ON\Delta}$	$V_{IN}=7.5V$	-7.5	7.5	-	370	-	140	400	-	520	Ω
		$V_{IN}=\pm 0.25V$		7.5	-	370	-	160	400	-	520	
		$V_{IN}=-7.5V$		7.5	-	370	-	100	400	-	520	
Input/Output Leakage Current	I_{OFF}	$V_{IN}=18V, V_{OUT}=0V$	18	18	-	± 100	-	± 0.1	± 100	-	± 1000	nA
		$V_{IN}=0V, V_{OUT}=18V$		18	-	± 100	-	± 0.1	± 100	-	± 1000	
Quiescent Device Current	I_{DD}	$V_{IN}=V_{DD}, V_{SS}$ *	5	5	-	0.25	-	0.001	0.25	-	7.5	μA
			10	10	-	0.5	-	0.001	0.5	-	15	
			15	15	-	1.0	-	0.002	1.0	-	30	
Input Current	I_{IH}	$V_{IH}=18V$	18	18	-	0.1	-	10^{-5}	0.1	-	1.0	μA
	I_{IL}	$V_{IL}=0V$		18	-	-0.1	-	-10^{-5}	-0.1	-	-1.0	

* All valid input combinations.

DYNAMIC ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	V _{SS} (V)	V _{DD} (V)	MIN.	TYP.	MAX.	UNITS
Propagation Delay Time (IN - OUT)	t _{pLH}	C _L =50pF	0	5	-	24	45	ns
	t _{pHL}		0	10	-	11	15	
	t _{pHL}		0	15	-	8	12	
Propagation Delay Time (CONTROL - OUT)	t _{pLH}	R _L =1kΩ	0	5	-	35	70	
	t _{pHL}	C _L =50pF	0	10	-	20	40	
	t _{pHL}		0	15	-	17	30	
Max. Control Input Repetition Rate	f _{MAX} (CONT)	R _L =1kΩ	0	5	-	10	-	
		C _L =50pF	0	10	-	12	-	
			0	15	-	12	-	
-3dB Cutoff Frequency	f _{MAX} (I - O)	R _L =1kΩ	-5	5	-	24	-	MHz
		R _L =2kΩ			-	23	-	
		R _L =10kΩ			-	22	-	
		R _L =100kΩ			-	22	-	
		R _L =1MΩ C _L =15pF (*1)			-	22	-	
Total Harmonic Distortion	-	R _L =10kΩ f=1MHz (*2)	-5	5	-	0.16	-	%
-50dB Feedthrough Frequency	-	R _L =1kΩ (*3)	-5	5	-	600	-	kHz
-50dB Crosstalk Frequency	-	R _L =1kΩ (*4)	-5	5	-	1	-	MHz
Crosstalk (CONTROL - OUT)	-	R _{IN} =1kΩ	0	5	-	50	-	mV
		R _{OUT} =10kΩ	0	10	-	100	-	
		C _L =15pF	0	15	-	150	-	
Input Capacitance	C _{IN}	Control Input			-	5	7.5	pF
		Switch I/O			-	5	-	
Feed through Capacitance	C _{IN-OUT}				-	0.5	-	

*1 Sine wave of ±2.5Vp-p shall be used for V_{is} and the frequency of $20 \log_{10} \frac{V_{os}}{V_{is}} = -3\text{dB}$ shall be f_{MAX}.

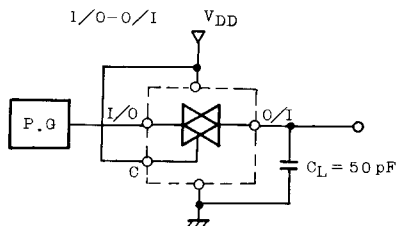
*2 V_{is} shall be sine wave of ±2.5Vp-p.

*3 Sine wave of ±2.5Vp-p shall be used for V_{is} and the frequency of $20 \log_{10} \frac{V_{os}}{V_{is}} = -50\text{dB}$ shall be feed-through.

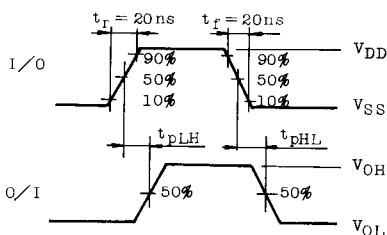
*4 Sine wave of ±2.5Vp-p shall be used for V_{is} and the frequency of $20 \log_{10} \frac{V_{os}}{V_{is}} = -50\text{dB}$ shall be crosstalk.

CIRCUIT FOR MEASUREMENT OF ELECTRICAL CHARACTERISTICS

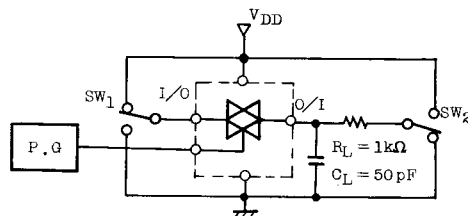
1. t_{pLH} , t_{pHL}



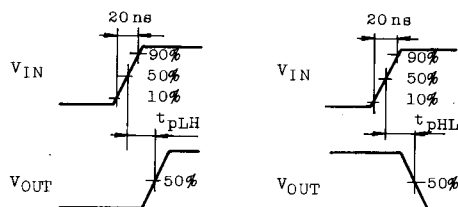
WAVEFORM



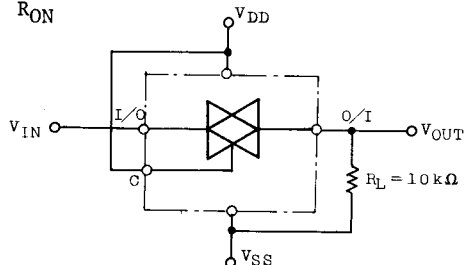
2. t_{pLH} , t_{pHL} (CONTROL - OUT)



WAVEFORM

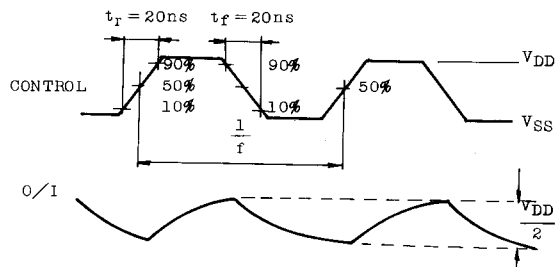
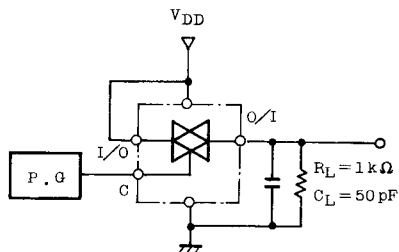


3. R_{ON}



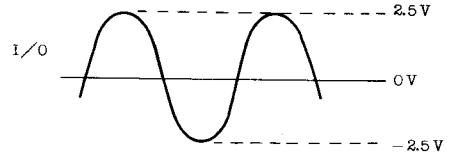
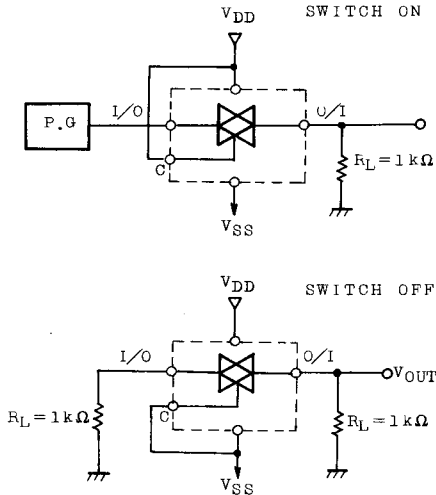
$$R_{ON} = 10 \times \frac{(V_{IN} - V_{OUT})}{V_{OUT}} \text{ (k}\Omega\text{)}$$

4. $f_{MAX}(C)$

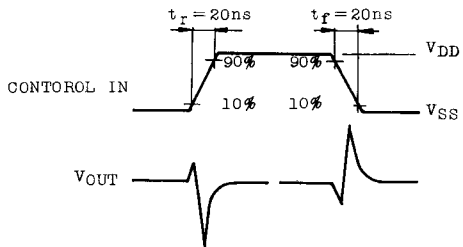
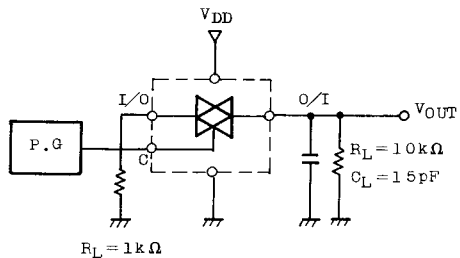


CIRCUIT FOR MEASUREMENT OF ELECTRICAL CHARACTERISTICS

5. CROSSTALK BETWEEN ANY TWO SWITCHES



6. CROSSTALK, CONTROL TO INPUT



7. TOTAL HARMONIC DISTORTION, $f_{MAX}(I-O)$, FEEDTHROUGH

