

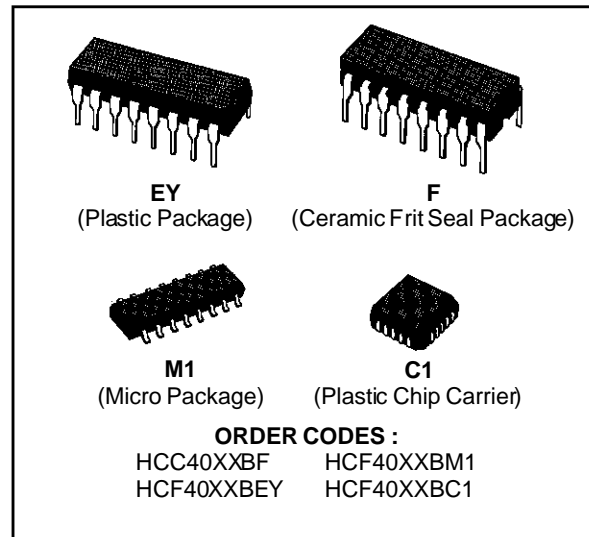
## ANALOG MULTIPLEXERS-DEMULTIPLEXERS

### 4051B - SINGLE 8-CHANNEL

### 4052B - DIFFERENTIAL 4-CHANNEL

### 4053B - TRIPLE 2-CHANNEL

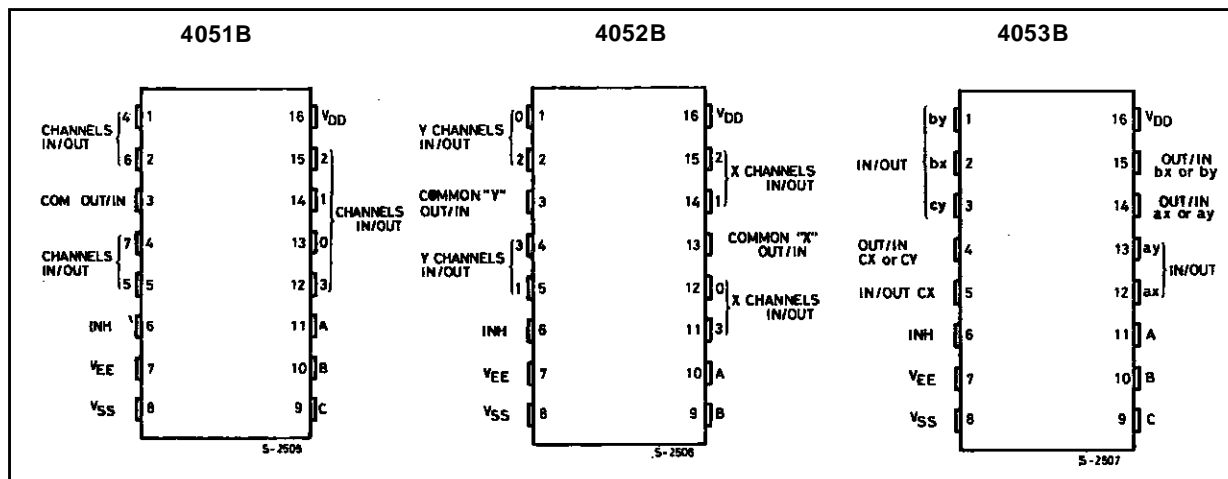
- QUIESCENT CURRENT SPECIFIED TO 20V FOR HCC DEVICE
- LOW "ON" RESISTANCE : 125Ω (typ.) OVER 15V p.p. SIGNAL-INPUT RANGE FOR  $V_{DD} - V_{EE} = 15V$
- HIGH "OFF" RESISTANCE : CHANNEL LEAKAGE  $\pm 100pA$  (typ.)  $V_{DD} - V_{EE} = 18V$
- BINARY ADDRESS DECODING ON CHIP
- VERY LOW QUIESCENT POWER DISSIPATION UNDER ALL DIGITAL CONTROL INPUT AND SUPPLY CONDITIONS : 0.2  $\mu W$  (typ.),  $V_{DD} - V_{SS} = V_{DD} - V_{EE} = 10V$
- MATCHED SWITCH CHARACTERISTICS :  $R_{ON} = 5\Omega$  (typ.) for  $V_{DD} - V_{EE} = 15V$
- WIDE RANGE OF DIGITAL AND ANALOG SIGNAL LEVELS : DIGITAL 3 TO 20V, ANALOG TO 20V p.p.
- 5V, 10V, AND 15V PARAMETRIC RATINGS
- INPUT CURRENT OF 100mA AT 18V AND 25°C FOR HCC DEVICE
- 100% TESTED FOR QUIESCENT CURRENT
- MEETS ALL REQUIREMENTS OF JEDEC TENTATIVE STANDARD N° 13A, "STANDARD SPECIFICATIONS FOR DESCRIPTION OF "B" SERIES CMOS DEVICES"



### DESCRIPTION

The **HCC 4051B, 4052B** and **4053B** (extended temperature range) and **HCF4051B, 4052B** and **4053B** (intermediate temperature range) are monolithic integrated circuits, available in 16-lead dual in-line plastic or ceramic package and plastic micropackage. **HCC/HCF4051B, HCC/HCF4052B,** and **HCC/HCF4053B** analog multiplexers/demultiplexers are digitally controlled analog switches having low ON impedance and very low OFF leakage

### PIN CONNECTIONS



# HCC/HCF4051B/52B/53B

current. These multiplexer circuits dissipate extremely low quiescent power over the full  $V_{DD} - V_{SS}$  and  $V_{DD} - V_{EE}$  supply-voltage ranges, independent of the logic state of the control signals. When a logic "1" is present at the inhibit input all channels are off. The **HCC/HCF4051B** is a single 8-channel multiplexer having three binary control inputs, A, B, and C, and an inhibit input. The three binary signals select 1 of 8 channels to be turned on, and connect one of the 8 inputs to the output. The **HCC/HCF4052B** is a differential 4-channel multi-

plexer having two binary control inputs, A and B, and an inhibit input. The two binary input signals select 1 of 4 pairs of channels to be turned on and connect the analog inputs to the outputs. The **HCC/HCF4053B** is a triple 2-channel multiplexer having three separate digital control inputs, A, B, and C, and an inhibit input. Each control input selects one of a pair of channels which are connected in a singlepole double-throw configuration.

## FUNCTIONAL DIAGRAMS AND TRUTH TABLES

### 4051B

B-14411

Input States				"On" Channel (S)
Inhibit	C	B	A	
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	X	X	X	None

5-2299

ALL INPUTS ARE PROTECTED BY COS/MOS PROTECTION NETWORK

### 4052B

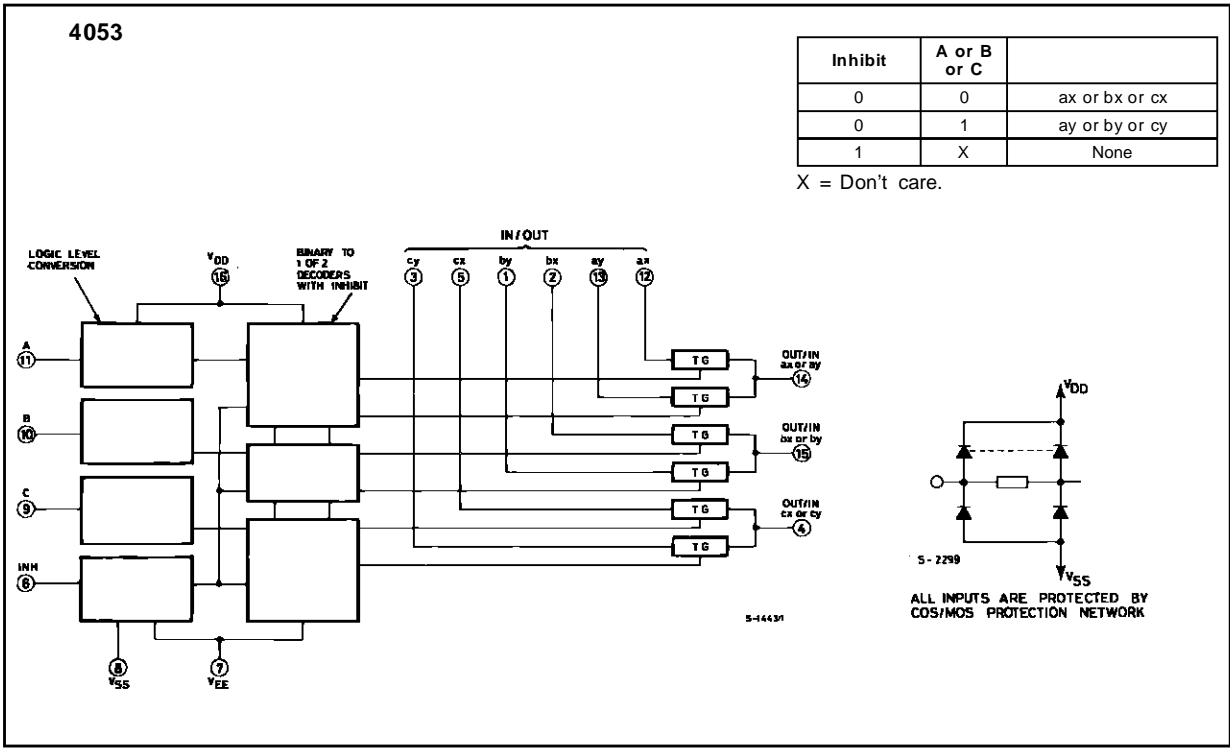
S-144451

Inhibit	B	A	
0	0	0	0x, 0y
0	0	1	1x, 1y
0	1	0	2x, 2y
0	1	1	3x, 3y
1	X	X	None

5-2299

ALL INPUTS ARE PROTECTED BY COS/MOS PROTECTION NETWORK

FUNCTIONAL DIAGRAMS AND TRUTH TABLES (continued)



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
$V_{DD}^*$	Supply Voltage : HCC Types HCF Types	- 0.5 to + 20 - 0.5 to + 18	V V
$V_i$	Input Voltage	- 0.5 to $V_{DD} + 0.5$	V
$I_i$	DC Input Current (any one input)	$\pm 10$	mA
$P_{tot}$	Total Power Dissipation (per package) Dissipation per Output Transistor for $T_{op} =$ Full Package-temperature Range	200 100	mW mW
$T_{op}$	Operating Temperature : HCC Types HCF Types	- 55 to + 125 - 40 to + 85	$^{\circ}C$ $^{\circ}C$
$T_{stg}$	Storage Temperature	- 65 to + 150	$^{\circ}C$

Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for external periods may affect device reliability.

\* All voltage values are referred to  $V_{SS}$  pin voltage.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Value	Unit
$V_{DD}$	Supply Voltage : HCC Types HCF Types	3 to 18 3 to 15	V V
$V_i$	Input Voltage	0 to $V_{DD}$	V
$T_{op}$	Operating Temperature : HCC Types HCF Types	- 55 to + 125 - 40 to + 85	$^{\circ}C$ $^{\circ}C$

# HCC/HCF4051B/52B/53B

## STATIC ELECTRICAL CHARACTERISTICS (over recommended operating conditions)

Symbol	Parameter		Test Conditions				Value						Unit							
			$V_{IS}$ (V)	$V_{EE}$ (V)	$V_{SS}$ (V)	$V_{DD}$ (V)	$T_{Low}^*$		25 °C			$T_{High}^*$								
							Min.	Max.	Min.	Typ.	Max.	Min.		Max.						
$I_L$	Quiescent Device Current	HCC Types					5	5	0.04	5	0.04	150	$\mu A$							
							10	10	0.04	10	300									
							15	20	0.04	20	600									
							20	100	0.08	100	3000									
		HCF Types					5	20	0.04	20	150									
							10	40	0.04	40	300									
							15	80	0.04	80	600									
<b>SWITCH</b>																				
ON	Resistance	HCC Types	$0 \leq V_I \leq V_{DD}$	0	0		5	880	470	1050	1200	$\Omega$								
							10	310	180	400	580									
							15	220	125	280	400									
		HCF Types					5	880	470	1050	1200									
							10	330	180	400	520									
							15	230	125	280	360									
$\Delta ON$	Resistance $\Delta R_{ON}$ (between any 2 channels)			0	0		5		10			$\Omega$								
							10		10											
							15		5											
OFF (●) Channel Leakage Current	Any Channel OFF	HCC Types		0	0	18	100		$\pm 0.1$	100	1000	nA								
		HCF Types																		
	All Channels OFF (common OUT/IN)	HCC Types											0	0	18	100	$\pm 0.1$	100	1000	nA
		HCF Types											0	0	15	300	$\pm 0.1$	300	1000	nA
C Capacitance	Input Output 4051 Output 4052 Output 4053 Feedthrough					5				5		pF								
										30										
										18										
										9										
										0.2										
<b>CONTROL (Address or Inhibit)</b>																				
$V_{IL}$	Input Low Voltage		$= V_{DD}$ Thru 1K $\Omega$	$V_{EE} = V_{SS}$ $R_L = 1K\Omega$ to $V_{SS}$ $I_{IS} < 2\mu A$ (on all off channels)			5	1.5		1.5	1.5	V								
							10	3		3	3									
							15	4		4	4									
							5	3.5	3.5		3.5									
$V_{IH}$	Input High Voltage						10	7	7		7	V								
							15	11	11		11									
$I_{IH}, I_{IL}$	Input Leakage Current	HCC Types	$V_I = 0/18V$			18		$\pm 0.1$		$\pm 10^{-3}$	$\pm 0.1$	$\pm 1$	$\mu A$							
		HCF Types								$V_I = 0/15V$	15	$\pm 0.3$		$\pm 10^{-3}$	$\pm 0.3$	$\pm 1$				
$C_I$	Input Capacitance		Any Address or Inhibit Input							5	7.5		pF							


(●) Determined by minimum feasible leakage measurement for automatic testing.

(\*)  $T_{Low} = -55^\circ C$  for HCC device :  $-40^\circ C$  for HCF device.

(\*)  $T_{High} = +125^\circ C$  for HCC device :  $+85^\circ C$  for HCF device.

**DYNAMIC ELECTRICAL CHARACTERISTICS**

(T<sub>amb</sub> = 25°C, C<sub>L</sub> = 50pF all input square wave rise and fall time = 20ns)

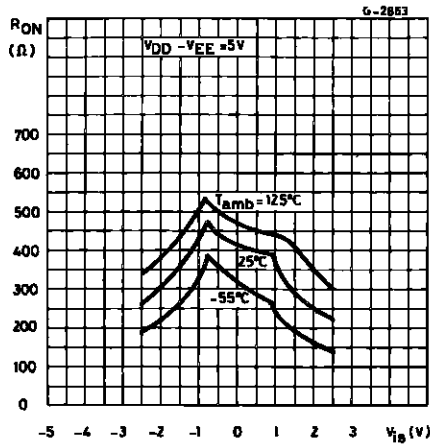
Parameter	Test Conditions						Value		Unit					
	V <sub>EE</sub> (V)	R <sub>L</sub> (kΩ)	f <sub>i</sub> (kHz)	V <sub>IS</sub> (V)	V <sub>SS</sub> (V)	V <sub>DD</sub> (V)	Typ.	Max.						
<b>SWITCH</b>														
t <sub>pd</sub> Propagation Delay Time (signal input to output)		200		10 V 		5		30	30	ns				
						10		15	60					
						15		11	20					
Frequency Response Channel "ON" (sine wave input) at 20 Log $\frac{V_o}{V_i} = -3dB$	= V <sub>SS</sub>	1		5 (●)		10	V <sub>o</sub> at Common OUT/IN	4053B	30	MHz				
								4052B	25					
								4051B	20					
							V <sub>o</sub> at any Channel	60						
Feedthrough (all channels OFF) at 20 Log $\frac{V_o}{V_i} = -40dB$	= V <sub>SS</sub>	1		5 (●)		10	V <sub>o</sub> at Common OUT/IN	4053	8	MHz				
								4052	10					
								4051	12					
							V <sub>o</sub> at any Channel	8						
Frequency Signal Crosstalk at 20 Log $\frac{V_o}{V_i} = -40dB$	= V <sub>SS</sub>	1		5 (●)		10	Between any 2 Channels		3	MHz				
							Between Sections 4052B only	measured on common	6					
								measured on any channel	10					
							Between any 2 Sections 4053B only	in Pin 2 out Pin 14	2.5		MHz			
in Pin 15 out Pin 14	6													
Sine Wave Distortion f <sub>is</sub> = 1kHz Sine Wave	= V <sub>SS</sub>	10	1	2 (●)		5			0.3	%				
							10	1	3 (●)		10			0.2
												10	1	5 (●)
<b>CONTROL (Address or Inhibit)</b>														
Propagation Delay Time : Address-to Signal OUT Channels ON or OFF	0					0	5			360	720	ns		
										160	320			
										120	240			
										225	450			
Propagation Delay Time : Inhibit to Signal OUT (channel turning ON)	0	10				0	5			360	720	ns		
										160	320			
										120	240			
										200	400			
Propagation Delay Time : Inhibit to Signal OUT (channel turning OFF)	0	0.3					5			200	450	ns		
										90	210			
										70	160			
										130	300			
Address or Inhibit to Signal Crosstalk	0	10*				0	10	V <sub>C</sub> = V <sub>DD</sub> -V <sub>SS</sub> (square wave)		65		mV peak		

(●) Peak to peak voltage symmetrical about  $\frac{V_{DD}-V_{EE}}{2}$

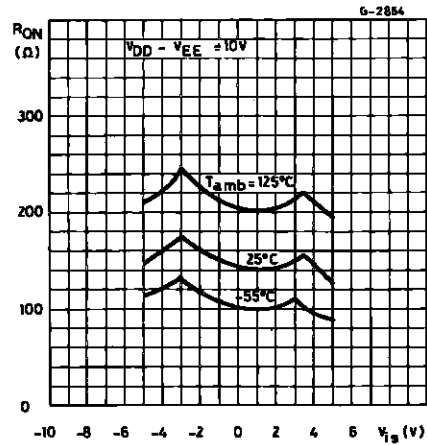
(\*) Both ends of channel.

# HCC/HCF4051B/52B/53B

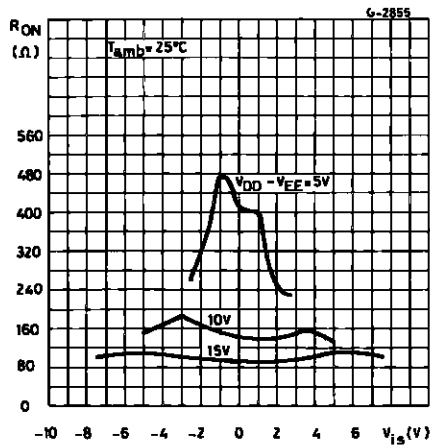
Typical Channel ON Resistance vs. Input Signal Voltage (all types).



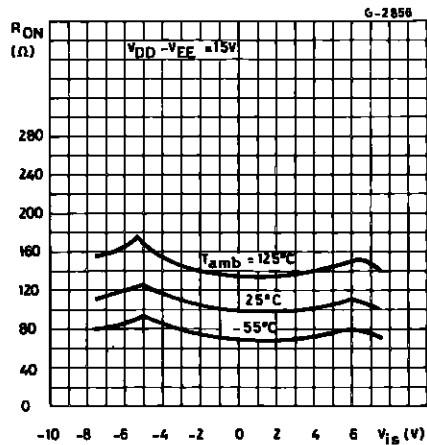
Typical Channel ON Resistance vs. Input Signal Voltage (all types).



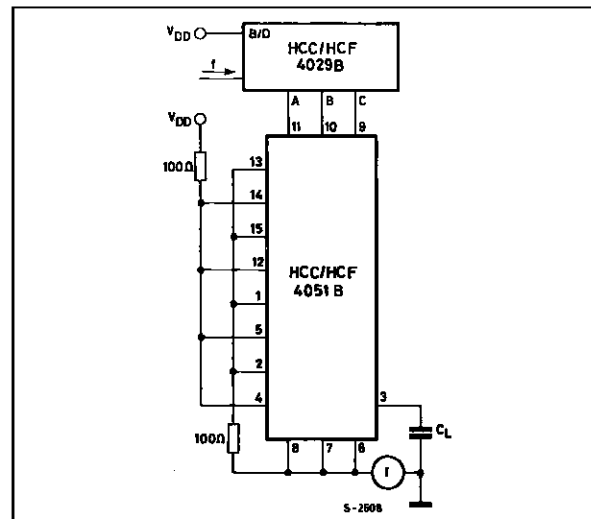
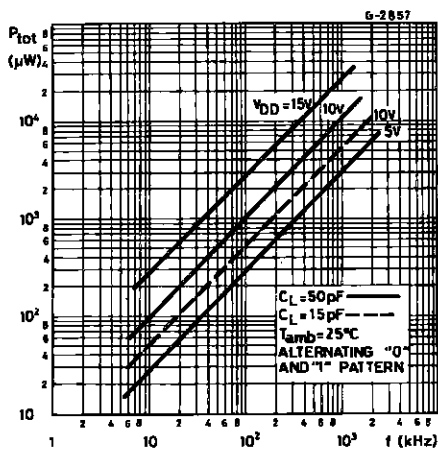
Typical Channel ON Resistance vs. Input Signal Voltage (all types).



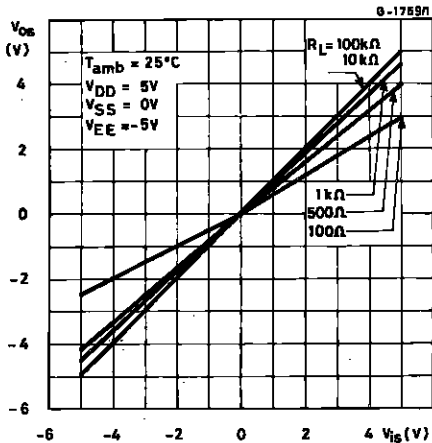
Typical Channel ON Resistance vs. Input Signal Voltage (all types).



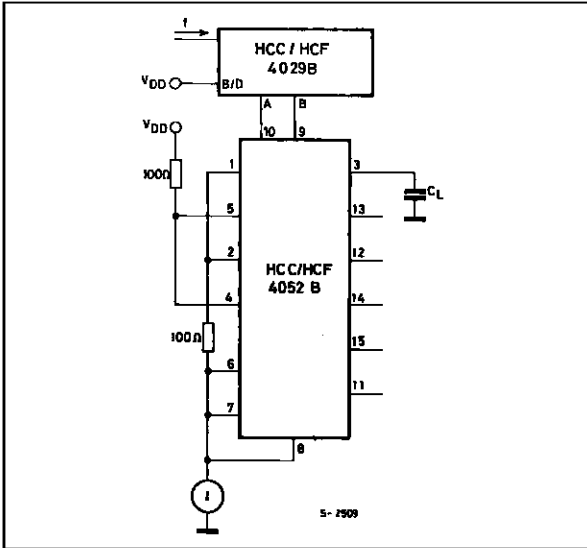
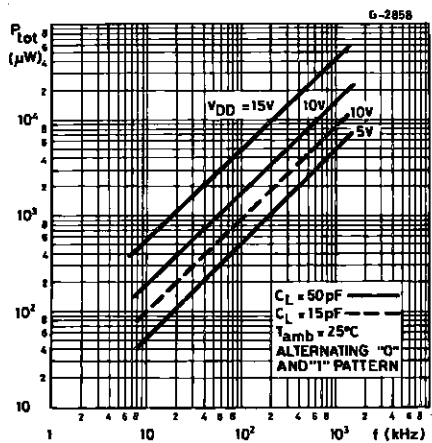
Typical Dynamic Power Dissipation/Package vs. Switching Frequency and Test Circuit (4051B).



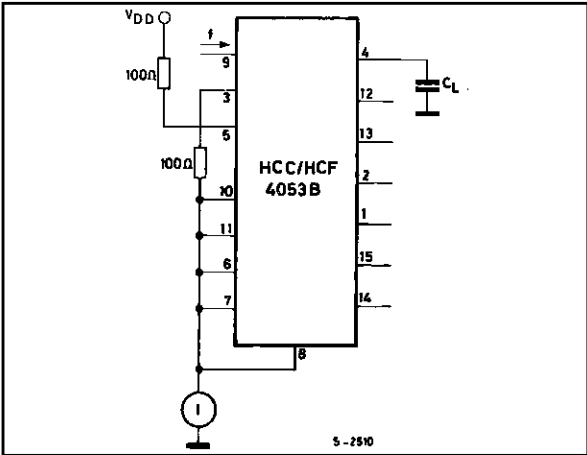
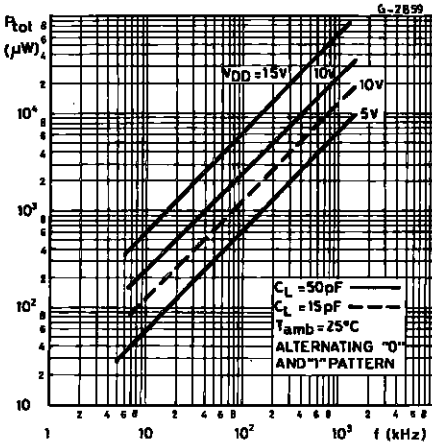
Typical ON Characteristics for 1 of 8 Channels (4051B).



Typical Dynamic Power Dissipation/Package vs. Switching Frequency and Test Circuit (4052B).

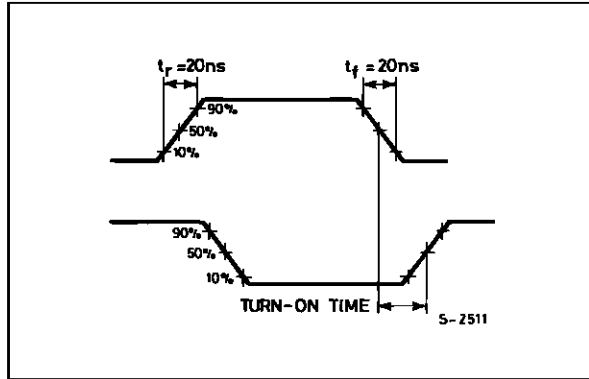


Typical Dynamic Power Dissipation/Package vs. Switching Frequency and Test Circuit (4053B).

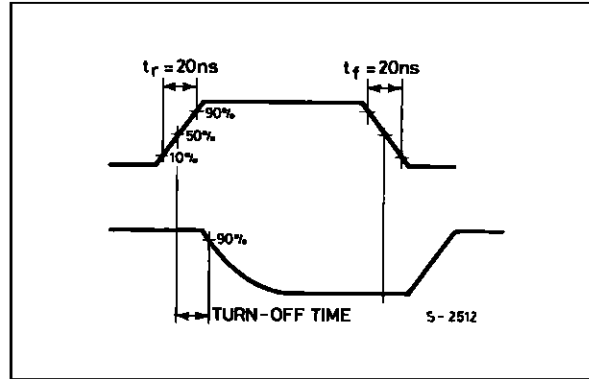


WAVEFORMS

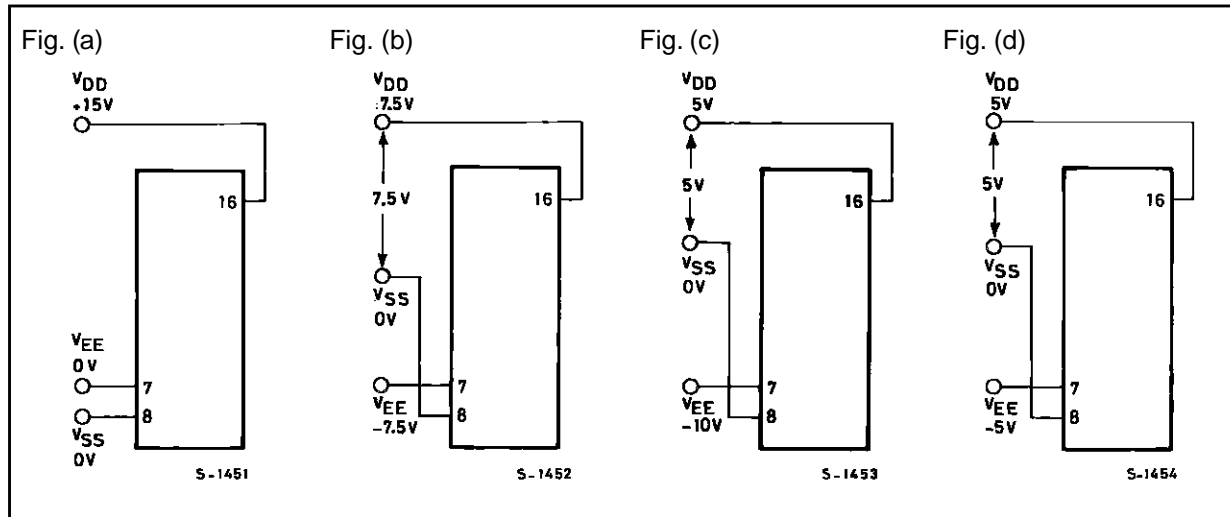
Channel Being Turned ON ( $R_L = 10K\Omega$ ).



Channel Being Turned OFF ( $R_L = 300K\Omega$ ).



TYPICAL BIAS VOLTAGES

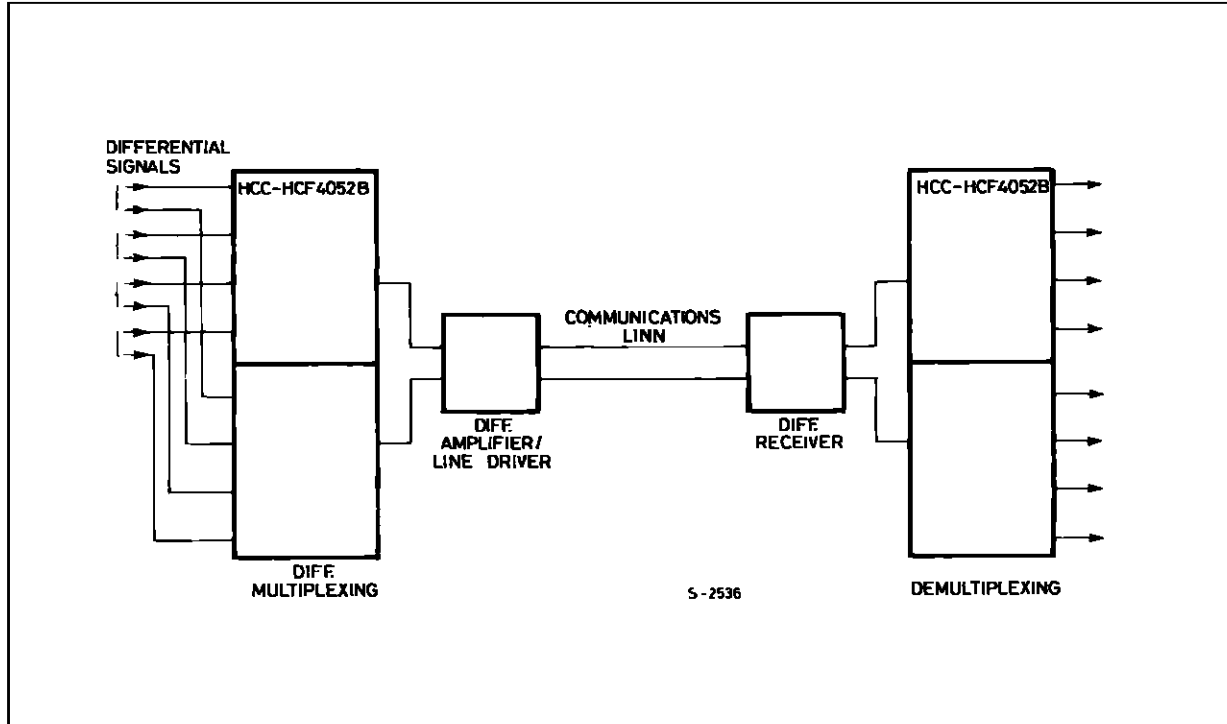


The ADDRESS (digital-control inputs) and INHIBIT logic levels are : "0"= $V_{SS}$  and "1"= $V_{DD}$ . The analog signal (through the TG) may swing from  $V_{EE}$  to  $V_{DD}$ .



## TYPICAL APPLICATIONS

### TYPICAL TIME-DIVISION APPLICATION OF THE 4052B



## SPECIAL CONSIDERATIONS

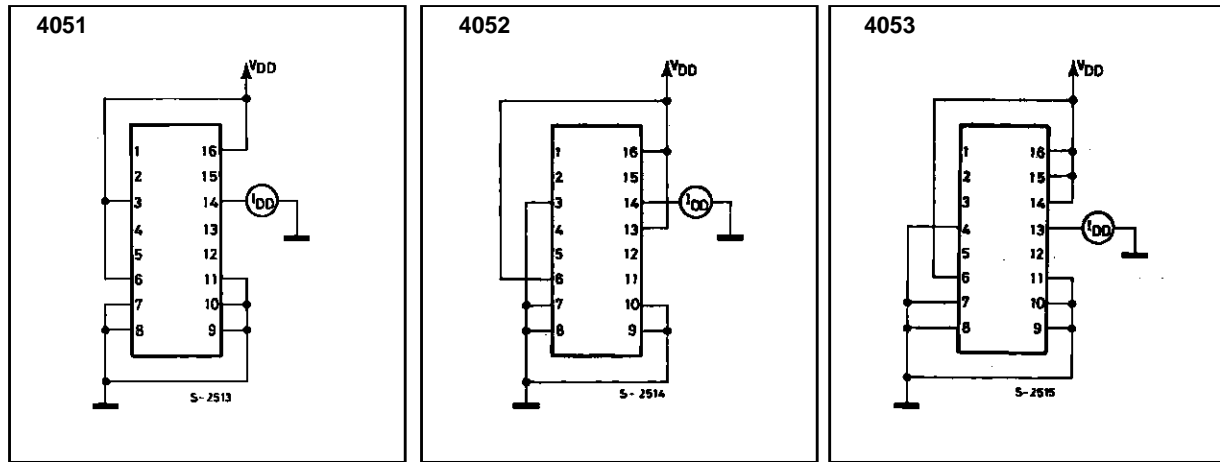
Control of analog signals up to 20V peak-to-peak can be achieved by digital signal amplitudes of 4.5 to 20V (if  $V_{DD} - V_{SS} = 3V$ , a  $V_{DD} - V_{EE}$  of up to 13V can be controlled ; for  $V_{DD} - V_{EE}$  level differences above 13V, a  $V_{DD} - V_{SS}$  of at least 4.5V is required). For example, if  $V_{DD} = +5V$ ,  $V_{SS} = 0$ , and  $V_{EE} = -13.5V$ , analog signals from  $-13.5V$  to  $+4.5V$  can be controlled by digital inputs of 0 to 4.5V. 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 the transmission gate inputs, the voltage drop across the bidirectional switch must not exceed 0,8 volt (valculated from  $R_{ON}$  values shown in ELECTRICAL CHARACTERISTICS CHART). No  $V_{DD}$  current will flow through  $R_L$  if the switch current flows into lead 3 on the **HCC/HCF4051** ; leads 3 and 13 on the **HCC/HCF4052** ; leads 4, 14, and 15 on the **HCC/HCF4053**.

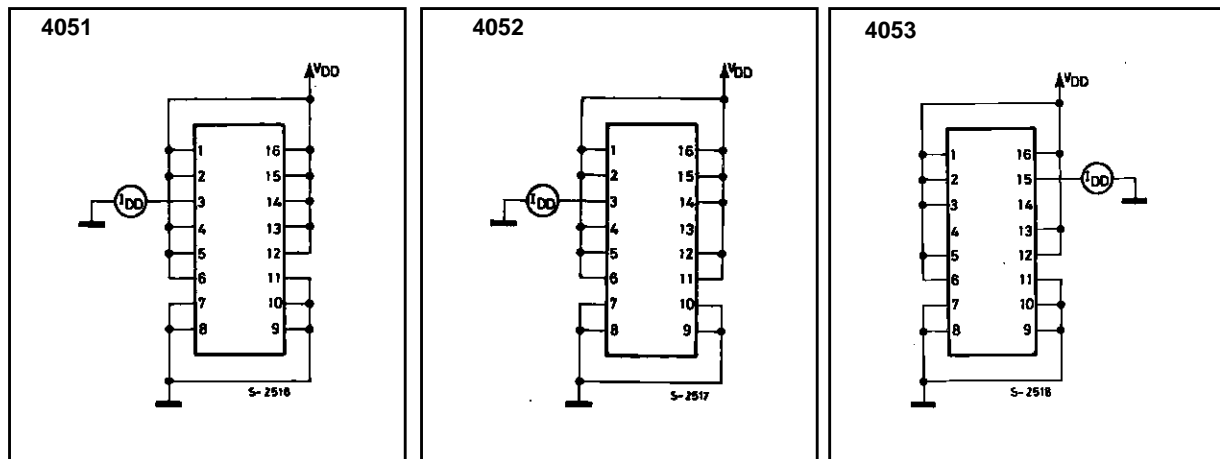
# HCC/HCF4051B/52B/53B

## TEST CIRCUITS

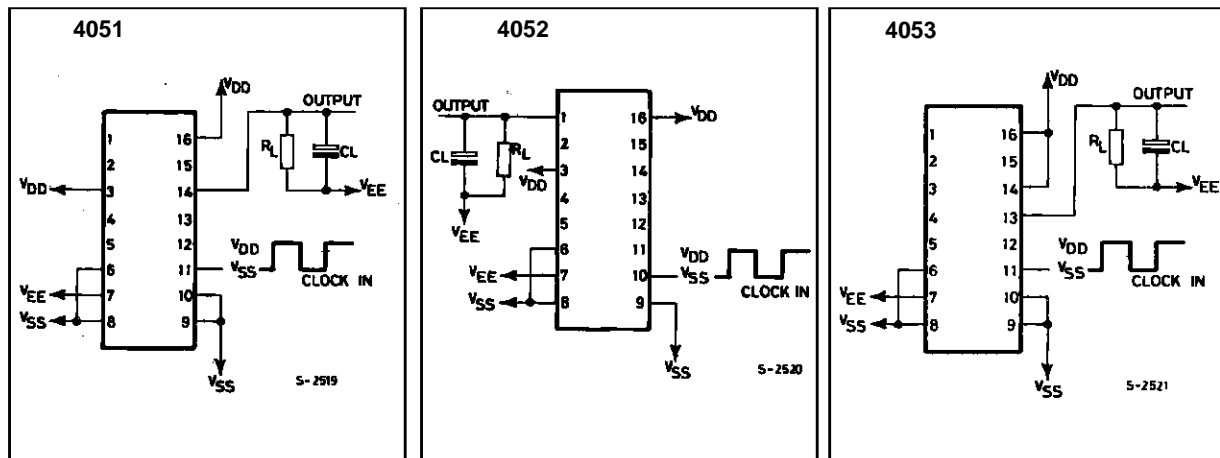
Off Channel Leakage Current-any Channel OFF.



Off Channel Leakage Current-all Channel OFF.

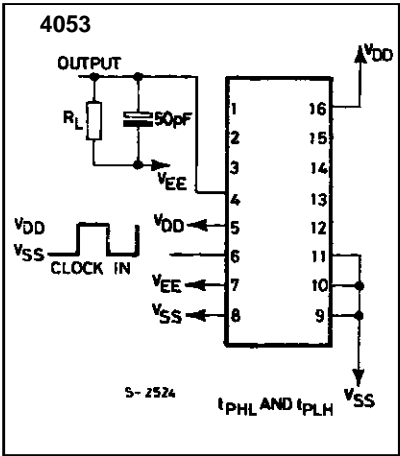
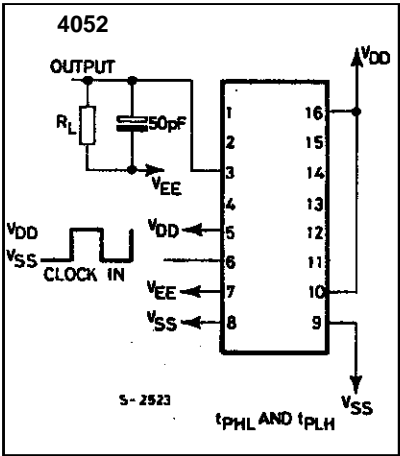
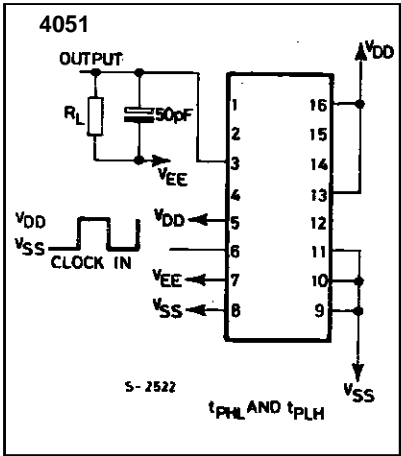


Propagation Delay-address Input to Signal Output.

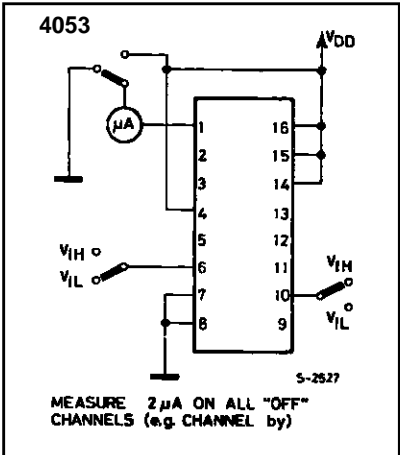
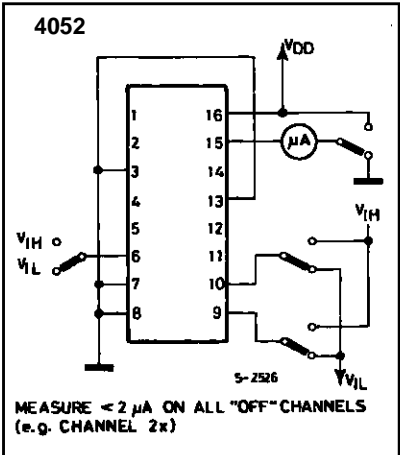
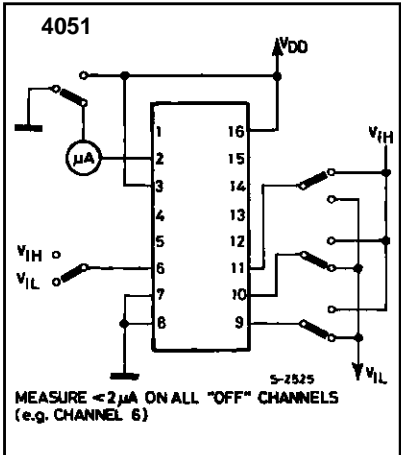


TEST CIRCUITS (continued)

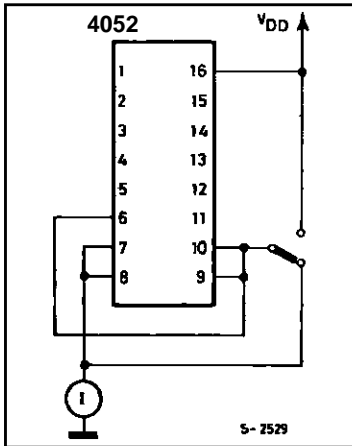
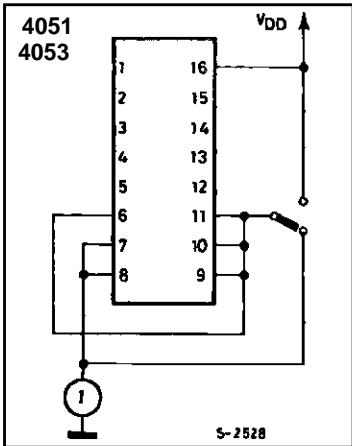
Propagation Delay-Inhibit Input to Signal Output.



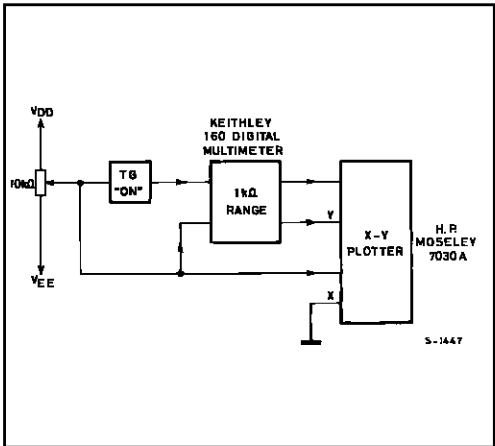
Input Voltage.



Quiescent Device Current.

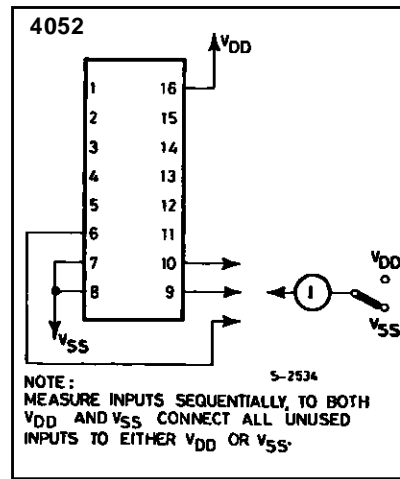
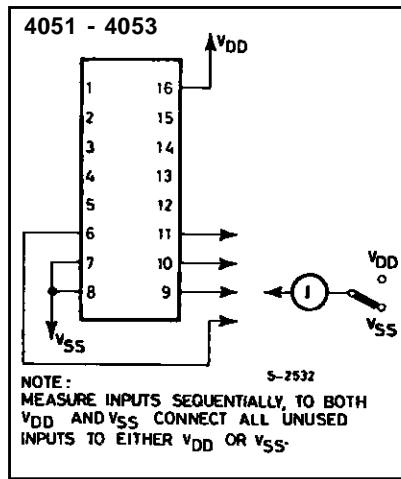


Channel ON Resistance Measurement Circuit.

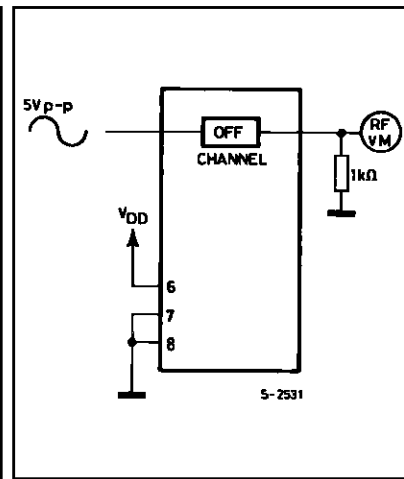


TEST CIRCUITS (continued)

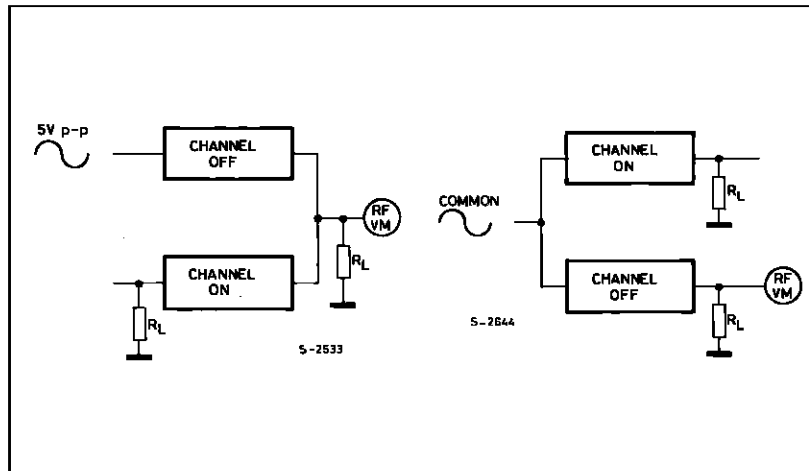
Input Current.



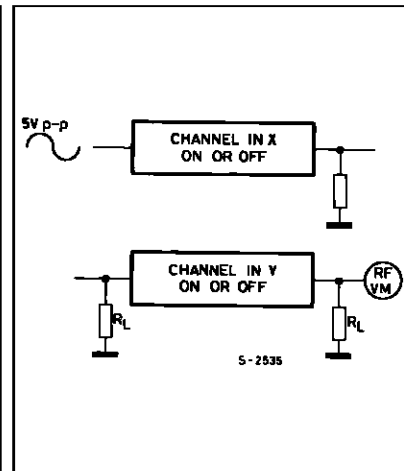
Feedthrough (All Types).



Crosstalk Between any two Channels (All Types).

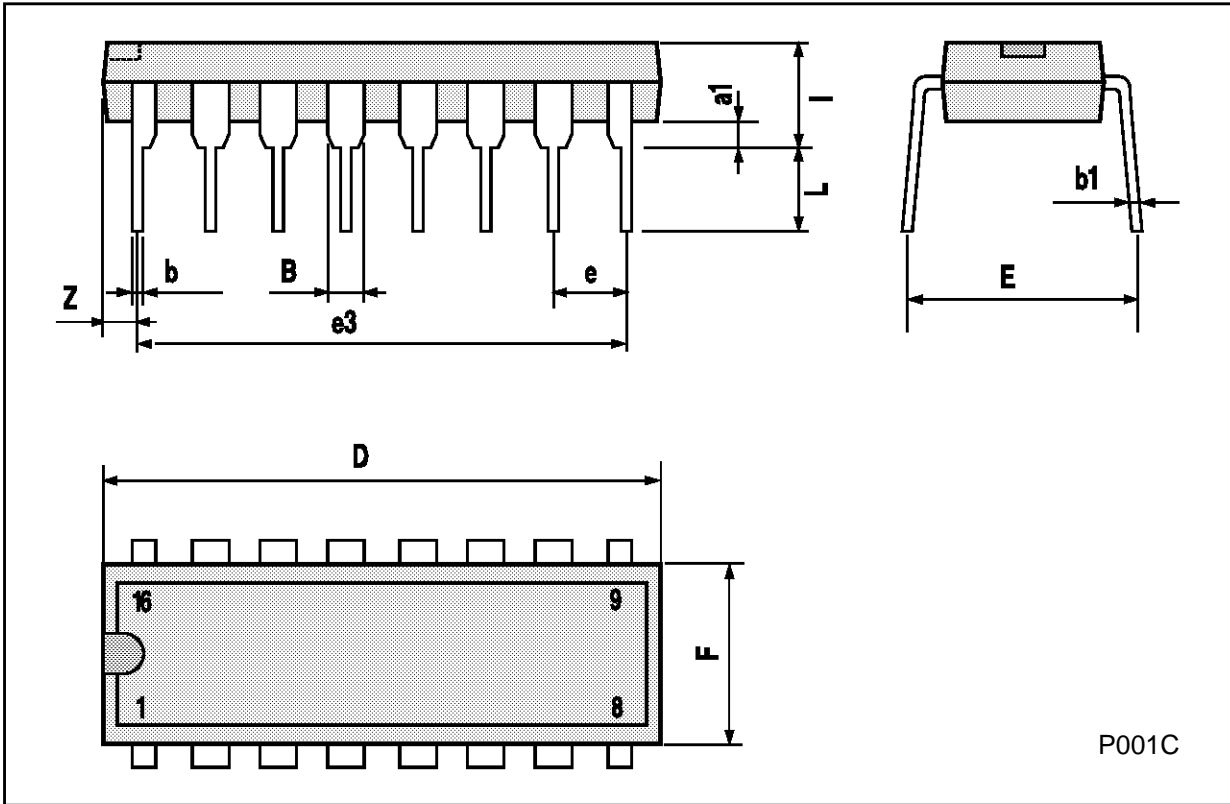


Crosstalk Between Duals or Triplets (4052-4053).



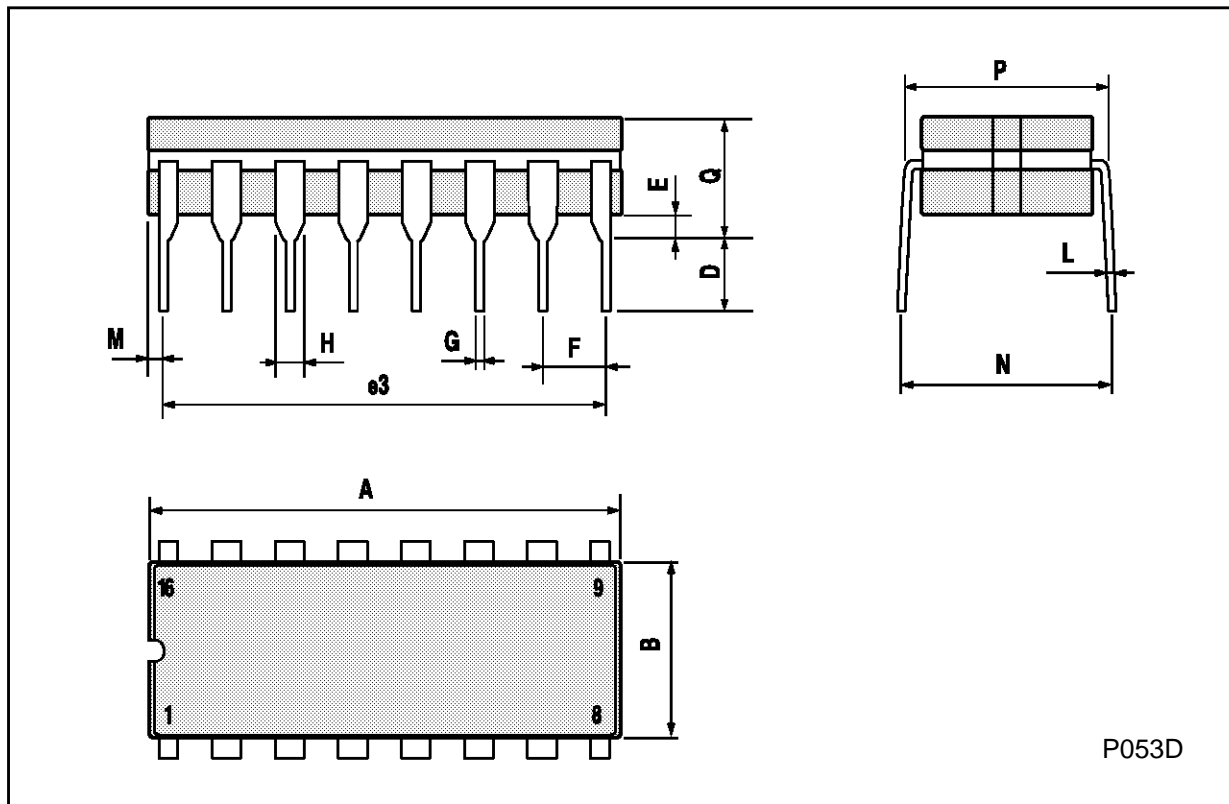
**Plastic DIP16 (0.25) MECHANICAL DATA**

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	0.77		1.65	0.030		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		17.78			0.700	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z			1.27			0.050



**Ceramic DIP16/1 MECHANICAL DATA**

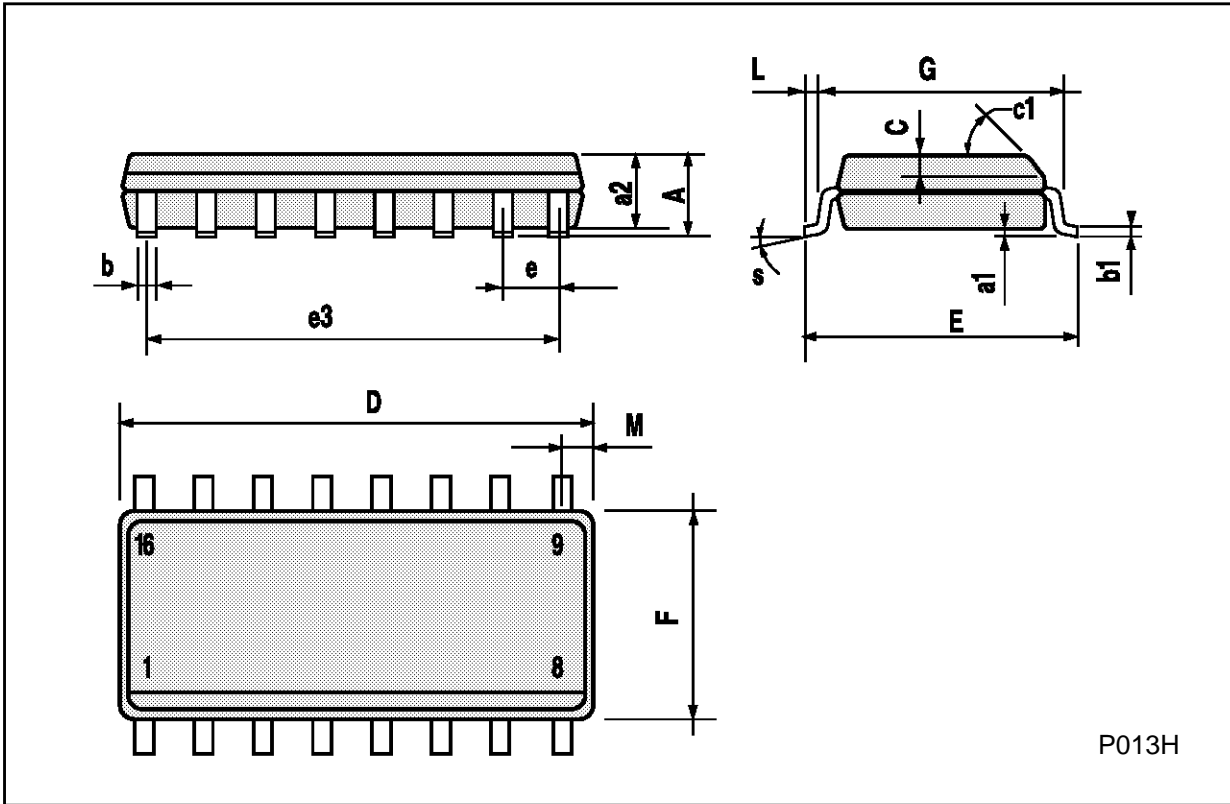
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			20			0.787
B			7			0.276
D		3.3			0.130	
E	0.38			0.015		
e3		17.78			0.700	
F	2.29		2.79	0.090		0.110
G	0.4		0.55	0.016		0.022
H	1.17		1.52	0.046		0.060
L	0.22		0.31	0.009		0.012
M	0.51		1.27	0.020		0.050
N			10.3			0.406
P	7.8		8.05	0.307		0.317
Q			5.08			0.200



P053D

**SO16 (Narrow) MECHANICAL DATA**

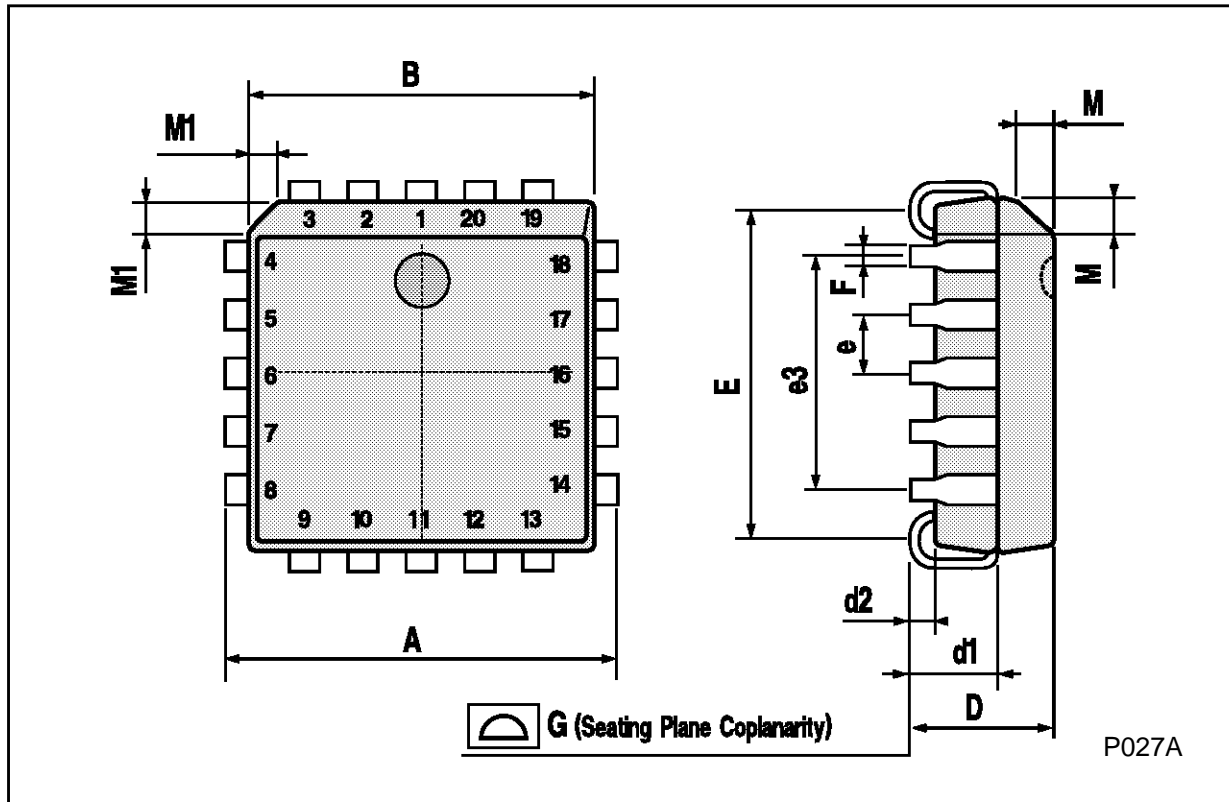
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.2	0.004		0.007
a2			1.65			0.064
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45° (typ.)					
D	9.8		10	0.385		0.393
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		8.89			0.350	
F	3.8		4.0	0.149		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.019		0.050
M			0.62			0.024
S	8° (max.)					



P013H

**PLCC20 MECHANICAL DATA**

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	9.78		10.03	0.385		0.395
B	8.89		9.04	0.350		0.356
D	4.2		4.57	0.165		0.180
d1		2.54			0.100	
d2		0.56			0.022	
E	7.37		8.38	0.290		0.330
e		1.27			0.050	
e3		5.08			0.200	
F		0.38			0.015	
G			0.101			0.004
M		1.27			0.050	
M1		1.14			0.045	





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