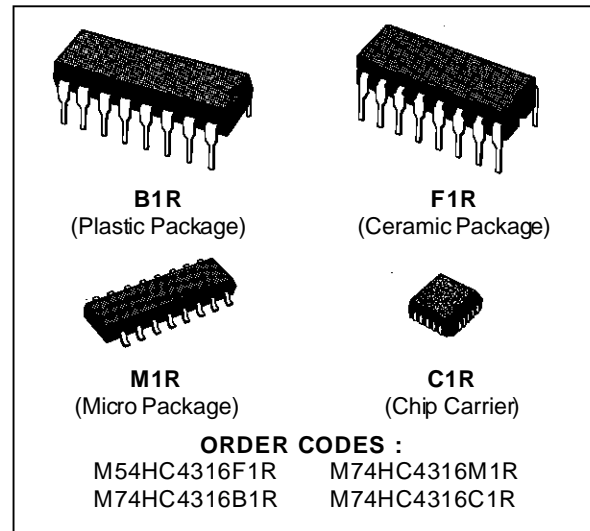


## QUAD BILATERAL SWITCH

- HIGH SPEED  
 $t_{PD} = 13 \text{ ns (TYP.) AT } V_{CC} = 5\text{V}$
- LOW "ON" RESISTANCE:  
 $120 \Omega \text{ TYP. (} V_{CC} - V_{EE} = 2 \text{ V)}$   
 $50 \Omega \text{ TYP. (} V_{CC} - V_{EE} = 4.5 \text{ V)}$   
 $35 \Omega \text{ TYP. (} V_{CC} - V_{EE} = 9 \text{ V)}$
- WIDE ANALOG INPUT VOLTAGE RANGE:  $\pm 6\text{V}$
- LOW CROSSTALK BETWEEN SWITCHES
- FAST SWITCHING
- SINE WAVE DISTORTION  
 $0.020 \text{ (TYP.) AT } V_{CC} - V_{EE} = 9\text{V}$
- HIGH NOISE IMMUNITY  
 $V_{NIH} = V_{NIL} = 28 \% V_{CC} \text{ (MIN.)}$
- LOW POWER DISSIPATION  
 $I_{CC} = 1 \mu\text{A (MAX.) AT } V_{CC} 5\text{V}$
- PIN AND FUNCTION COMPATIBLE WITH 4316B



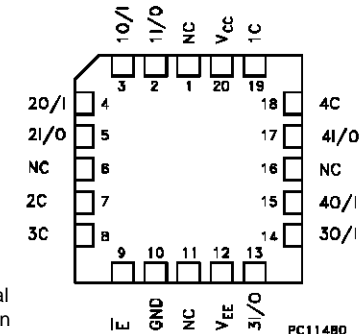
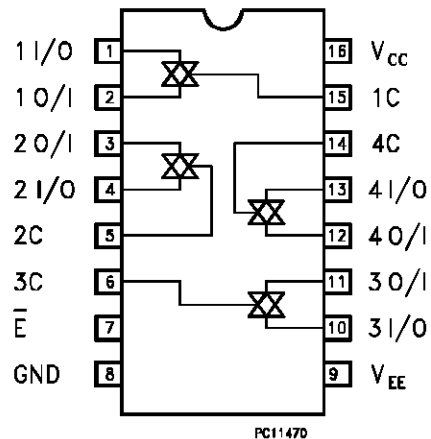
### DESCRIPTION

The M54/74HC4316 is a high speed CMOS QUAD BILATERAL SWITCH fabricated in silicon gate C<sup>2</sup>MOS technology. It has high speed performance combined with true CMOS low power consumption. HC4316 has four independent analogue switches. Each switch has two input/output terminals (nI/O, nO/I) and an active high select input (nC).

When the enable input is high all four analog switches are off. The supply voltage for the digital signals applied to V<sub>CC</sub> and GND must be within the range 0 to 6 V. The voltage swing on the analogue Input/Outputs can be between V<sub>CC</sub> (Positive Limit) and V<sub>EE</sub> (Negative Limit). The voltage between V<sub>CC</sub> and V<sub>EE</sub> must not exceed 12 V.

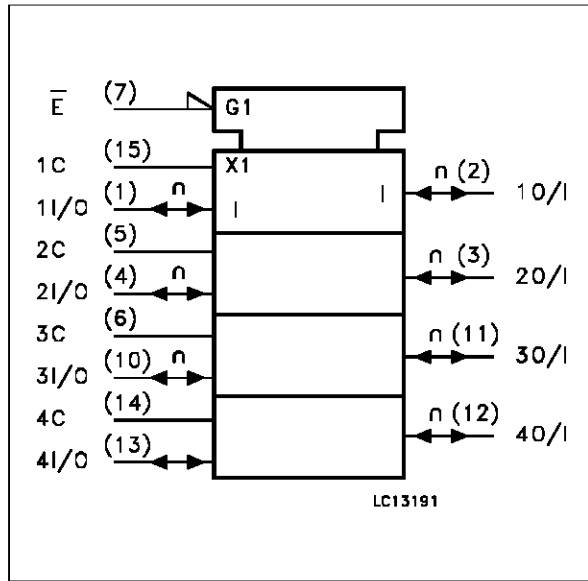
All input are equipped with protection circuits against static discharge and transient excess voltage.

### PIN CONNECTIONS (top view)



NC =  
No Internal  
Connection

IEC LOGIC SYMBOL



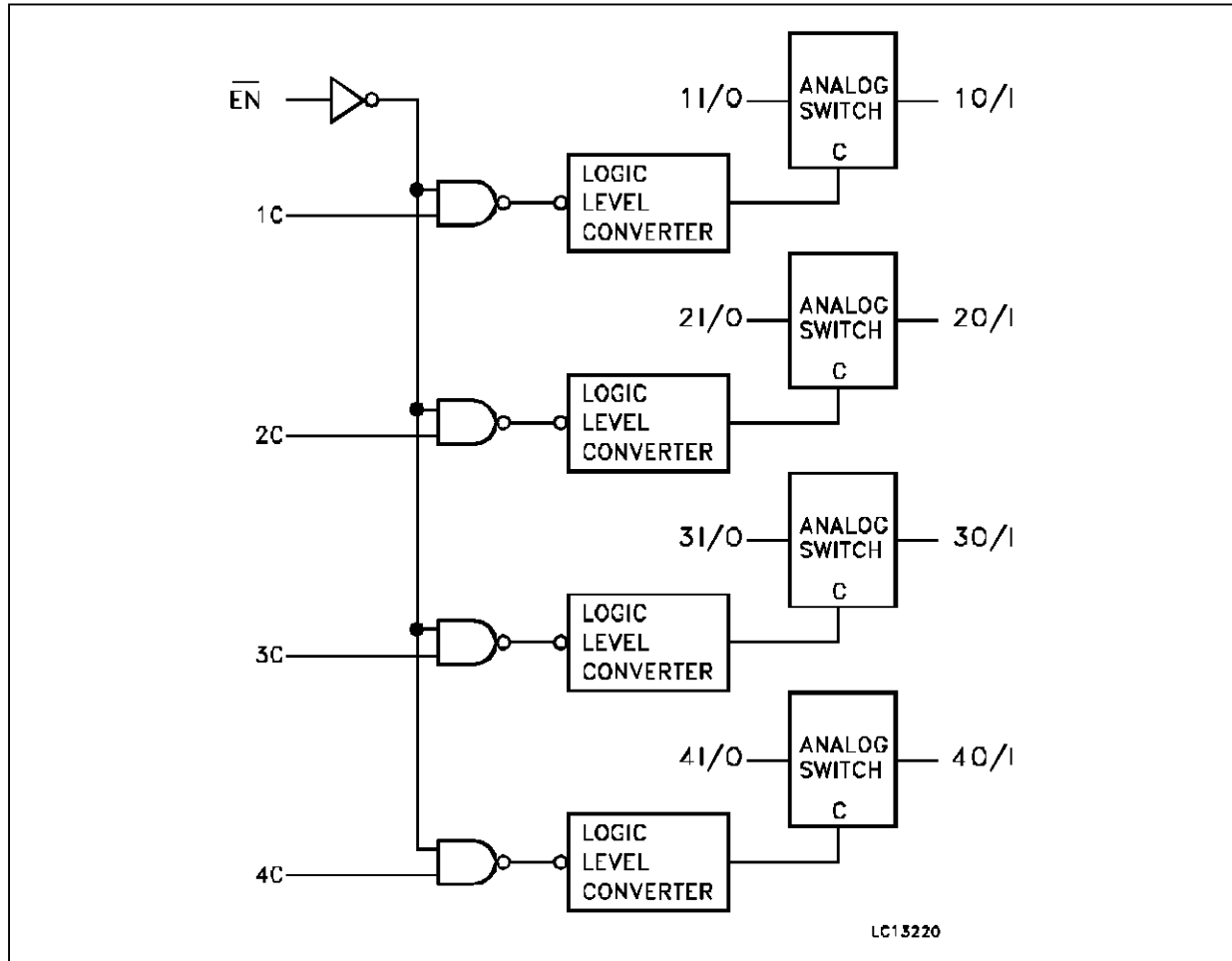
PIN DESCRIPTION

PIN No	SYMBOL	NAME AND FUNCTION
1, 4, 10, 13	1 to 4 I/O	Independent Inputs/Outputs
2, 3, 11, 12	1 to 4 O/I	Independent Outputs/Inputs
7	$\bar{E}$	Enable Inputs (Active LOW)
15, 5, 6, 14	1C to 4C	Enable Inputs (Active HIGH)
9	$V_{EE}$	Negative Supply Voltage
8	GND	Ground (0V)
16	$V_{CC}$	Positive Supply Voltage

TRUTH TABLE

		SWITCH FUNCTION
ENABLE	CONTROL	
L	H	ON
L	L	OFF
H	X	OFF

LOGIC DIAGRAM



**ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter	Value	Unit
$V_{CC}$	Supply Voltage	-0.5 to +7	V
$V_{CC} - V_{EE}$	Supply Voltage	-0.5 to +13	V
$V_I$	Control Input Voltage	-0.5 to $V_{CC} + 0.5$	V
$V_{I/O}$	Switch I/O Voltage	$V_{EE} - 0.5$ to $V_{CC} + 0.5$	V
$I_{IK}$	DC Input Diode Current	$\pm 20$	mA
$I_{OK}$	DC Output Diode Current	$\pm 20$	mA
$I_O$	DC Output Source Sink Current Per Output Pin	$\pm 25$	mA
$I_{CC}$ or $I_{GND}$	DC $V_{CC}$ or Ground Current	$\pm 50$	mA
$P_D$	Power Dissipation	500 (*)	mW
$T_{stg}$	Storage Temperature	-65 to +150	$^{\circ}C$
$T_L$	Lead Temperature (10 sec)	300	$^{\circ}C$

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied.

(\*) 500 mW:  $\equiv 65^{\circ}C$  derate to 300 mW by 10mW/ $^{\circ}C$ :  $65^{\circ}C$  to  $85^{\circ}C$

**RECOMMENDED OPERATING CONDITIONS**

Symbol	Parameter	Value	Unit	
$V_{CC}$	Supply Voltage	2 to 6	V	
$V_{EE}$	Supply Voltage	-6 to 0	V	
$V_{CC} - V_{EE}$	Supply Voltage	2 to 12	V	
$V_I$	Input Voltage	0 to $V_{CC}$	V	
$V_{I/O}$	Switch I/O Voltage	$V_{EE}$ to $V_{CC}$	V	
$T_{op}$	Operating Temperature: <b>M54HC Series</b> <b>M74HC Series</b>	-55 to +125 -40 to +85	$^{\circ}C$ $^{\circ}C$	
$t_r, t_f$	Input Rise and Fall Time	$V_{CC} = 2\text{ V}$ $V_{CC} = 4.5\text{ V}$ $V_{CC} = 6\text{ V}$	0 to 1000 0 to 500 0 to 400	ns

DC SPECIFICATIONS

Symbol	Parameter	Test Conditions		Value						Unit	
		V <sub>CC</sub> (V)	V <sub>EE</sub> (V)	T <sub>A</sub> = 25 °C 54HC and 74HC			-40 to 85 °C 74HC		-55 to 125 °C 54HC		
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.
V <sub>IHC</sub>	High Level Control Input Voltage	2.0		1.5			1.5		1.5	V	
		4.5		3.15			3.15		3.15		
		6.0		4.2			4.2		4.2		
V <sub>ILC</sub>	Low Level Control Input Voltage	2.0				0.5		0.5	0.5	V	
		4.5				1.35		1.35	1.35		
		6.0				1.8		1.8	1.8		
R <sub>ON</sub>	ON Resistance	4.5	GND	V <sub>IN</sub> = V <sub>IHC</sub> V <sub>I/O</sub> = V <sub>CC</sub> to V <sub>EE</sub> I <sub>I/O</sub> = 0.1 mA		70	170		200	Ω	
		4.5	-4.5		50	85		105			
		6.0	-6.0		30	70		85			
		2.0	GND	V <sub>IN</sub> = V <sub>IHC</sub> V <sub>I/O</sub> = V <sub>CC</sub> or V <sub>EE</sub> I <sub>I/O</sub> = 0.1 mA		120	180		215		
		4.5	GND		50	80		100			
		4.5	-4.5		35	60		75			
		6.0	-6.0		20	40		60			
ΔR <sub>ON</sub>	Difference of ON Resistance Between Switches	4.5	GND	V <sub>IN</sub> = V <sub>IHC</sub> or V <sub>ILC</sub> V <sub>I/O</sub> = V <sub>CC</sub> to V <sub>EE</sub> I <sub>I/O</sub> = 0.1 mA		10	15		20	Ω	
		4.5	-4.5		5	10		15			
		6.0	-6.0		5	10		15			
I <sub>OFF</sub>	Input/Output Leakage Current (SWITCH OFF)	6.0	GND	V <sub>OS</sub> = V <sub>CC</sub> or GND V <sub>IS</sub> = V <sub>CC</sub> or GND V <sub>IN</sub> = V <sub>IHC</sub> or V <sub>ILC</sub>		±0.06		±0.6	±2	μA	
		6.0	-6.0		±0.1		±1	±2			
I <sub>IZ</sub>	Switch Input Leakage Current (SWITCH ON, OUTPUT OPEN)	6.0	GND	V <sub>OS</sub> = V <sub>CC</sub> or GND V <sub>IN</sub> = V <sub>ILC</sub> or V <sub>IHC</sub>		±0.06		±0.6	±2	μA	
		6.0	-6.0		±0.1		±1	±2			
I <sub>IN</sub>	Control Input Current	6.0	V <sub>I</sub> = V <sub>CC</sub> or GND		10 <sup>-5</sup>	±0.1		±1	±1	μA	

AC ELECTRICAL CHARACTERISTICS ( $C_L = 50 \text{ pF}$ , Input  $t_r = t_f = 6 \text{ ns}$ )

Symbol	Parameter	Test Conditions			Value						Unit	
		V <sub>CC</sub> (V)			T <sub>A</sub> = 25 °C 54HC and 74HC			-40 to 85 °C 74HC		-55 to 125 °C 54HC		
					Min.	Typ.	Max.	Min.	Max.	Min.		Max.
θ <sub>I/O</sub>	Phase Difference Between Input and Output	2.0	GND			12	30		40			ns
		4.5	GND			3	6		8			
		6.0	GND			3	5		7			
		4.5	-4.5			2	4		5			
		6.0	-6.0			2	4		5			
t <sub>PZL</sub> t <sub>PZH</sub>	Output Enable Time (Ē, C-OUT)	2.0	GND	R <sub>L</sub> = 1KΩ		56	115		145			ns
		4.5	GND			14	23		29			
		6.0	GND			12	20		25			
		4.5	-4.5			13	21		26			
		6.0	-6.0			11	18		23			
t <sub>PLZ</sub> t <sub>PHZ</sub>	Output Disable Time (Ē, C-OUT)	2.0	GND	R <sub>L</sub> = 1KΩ		112	205		255			ns
		4.5	GND			28	41		51			
		6.0	GND			24	35		43			
		4.5	-4.5			24	34		43			
		6.0	-6.0			21	29		36			
	Maximum Control Input Frequency	2.0	GND	R <sub>L</sub> = 1KΩ		2						MHz
		4.5	GND	C <sub>L</sub> = 15 pF		9						
		6.0	GND	V <sub>OUT</sub> = 1/2 V <sub>CC</sub>		11						
C <sub>IN</sub>	Input Capacitance					5	10		10		10	pF
C <sub>I/O</sub>	Switch Terminal Capacitance	4.5		-4.5		5						pF
C <sub>IOS</sub>	Feed Through Capacitance	4.5		-4.5		1						pF
C <sub>PD</sub> (*)	Power Dissipation Capacitance	5.0		GND		16						pF

(\*) C<sub>PD</sub> is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation.  $I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$

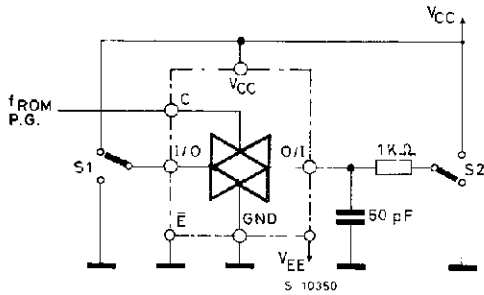
**ANALOG SWITCH CHARACTERISTICS (GND = 0 V T<sub>A</sub> = 25 °C)**

Symbol	Parameter	Test Conditions				Value	Unit
		V <sub>CC</sub> (V)	V <sub>EE</sub> (V)	V <sub>IN</sub> (Vp-p)		Typ.	
	Sine Wave Distortion (THD)	2.25	2.25	4	f <sub>IN</sub> = 1 KHz R <sub>L</sub> = 10 Ω C <sub>L</sub> = 50 pF	0.025	%
		4.5	4.5	8		0.020	
		6.0	6.0	11		0.018	
f <sub>MAX</sub>	Frequency Response (Switch ON)	2.25	2.25	Adjust f <sub>IN</sub> voltage to Obtain 0 dBm at V <sub>OS</sub> .		28	MHz
		4.5	4.5	Increase f <sub>IN</sub> Frequency until dB Meter reads -3dB		42	
		6.0	6.0	R <sub>L</sub> = 50 Ω C <sub>L</sub> = 10 pF f <sub>IN</sub> = 1 KHz sine wave		43	
	Feedthrough Attenuation (Switch OFF)	2.25	2.25	V <sub>IN</sub> is centered at V <sub>CC</sub> /2. Adjust input for 0 dBm		-50	dB
		4.5	4.5	R <sub>L</sub> = 600 Ω C <sub>L</sub> = 50 pF f <sub>IN</sub> = 1 MHz sine wave		-50	
		6.0	6.0			-50	
	Crosstalk (Control Input to Signal Output)	2.25	2.25	R <sub>L</sub> = 600 Ω C <sub>L</sub> = 50 pF			mV
		4.5	4.5	f <sub>IN</sub> = 1 KHz square wave (t <sub>r</sub> = t <sub>f</sub> = 6ns)		5	
		6.0	6.0				
	Crosstalk (Between Any Switches)	2.25	2.25	Adjust V <sub>IN</sub> to Obtain 0 dBm at input		-50	dB
		4.5	4.5	R <sub>L</sub> = 600 Ω C <sub>L</sub> = 50 pF f <sub>IN</sub> = 1 MHz sine wave		-50	
		6.0	6.0			-50	

**SWITCHING CHARACTERISTICS TEST CIRCUIT**

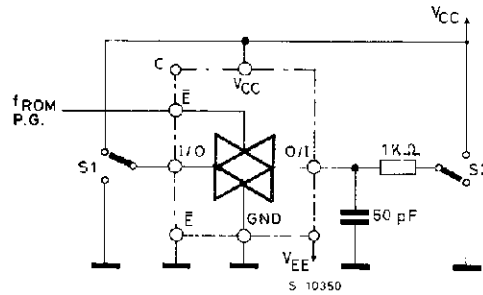
**CONTROL**

$t_{PLZ}$ ,  $t_{PHZ}$ ,  $t_{PZL}$ ,  $t_{PZH}$ .

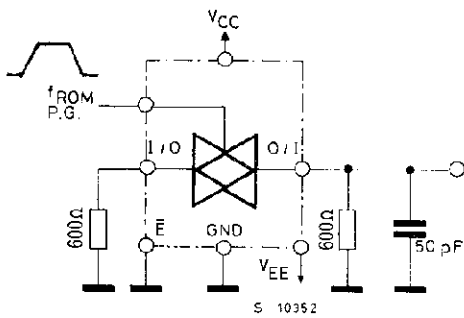


**ENABLE**

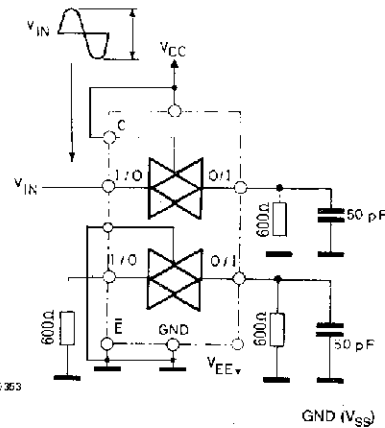
$t_{PLZ}$ ,  $t_{PHZ}$ ,  $t_{PZL}$ ,  $t_{PZH}$ .



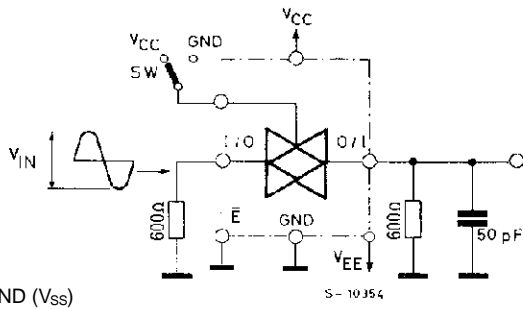
**CROSSTALK (control to output)**



**CROSSTALK BETWEEN ANY TWO SWITCHES**

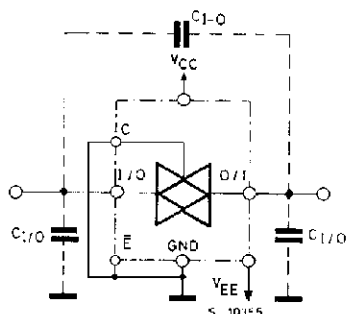


**BANDWIDTH AND FEEDTHROUGH ATTENUATION**



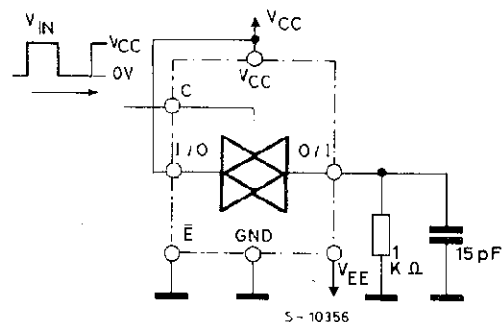
GND (Vss)

**C<sub>I-O</sub> C<sub>I/O</sub>**

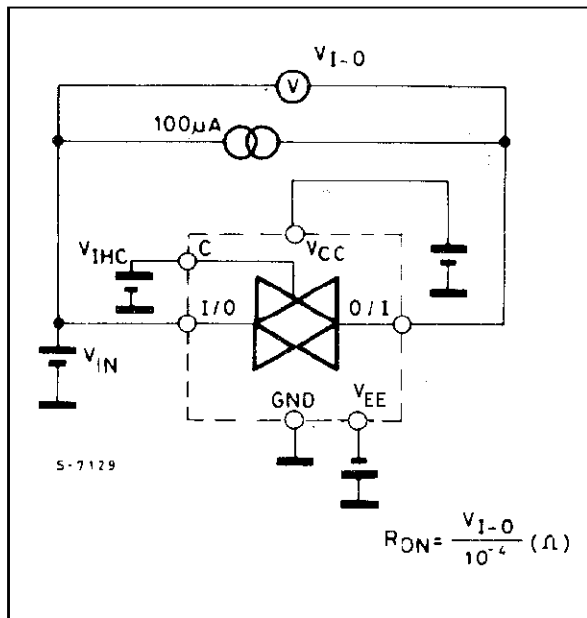


GND (Vss)

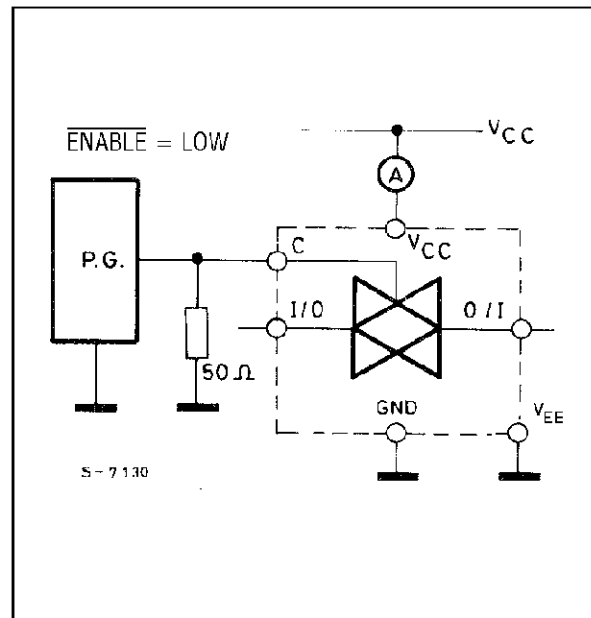
**MAXIMUM CONTROL FREQUENCY**



CHANNEL RESISTANCE (RON)



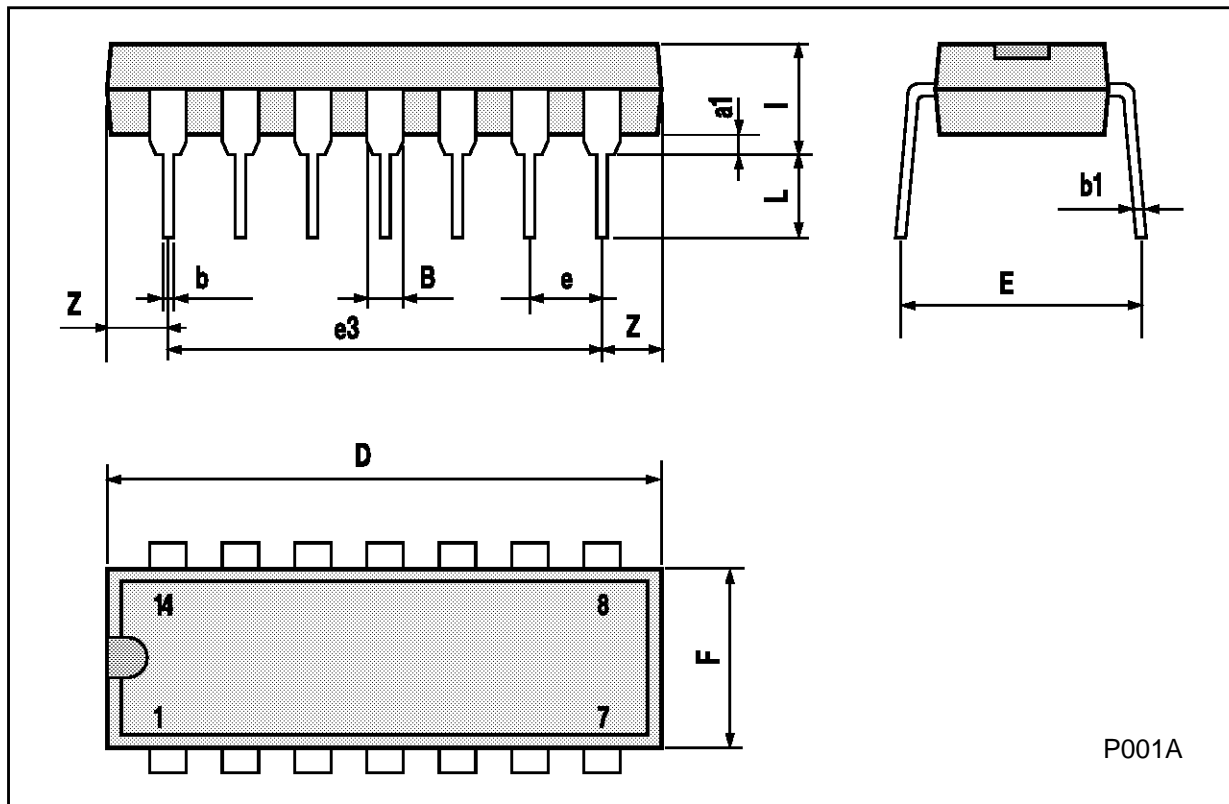
Icc (Opr.)





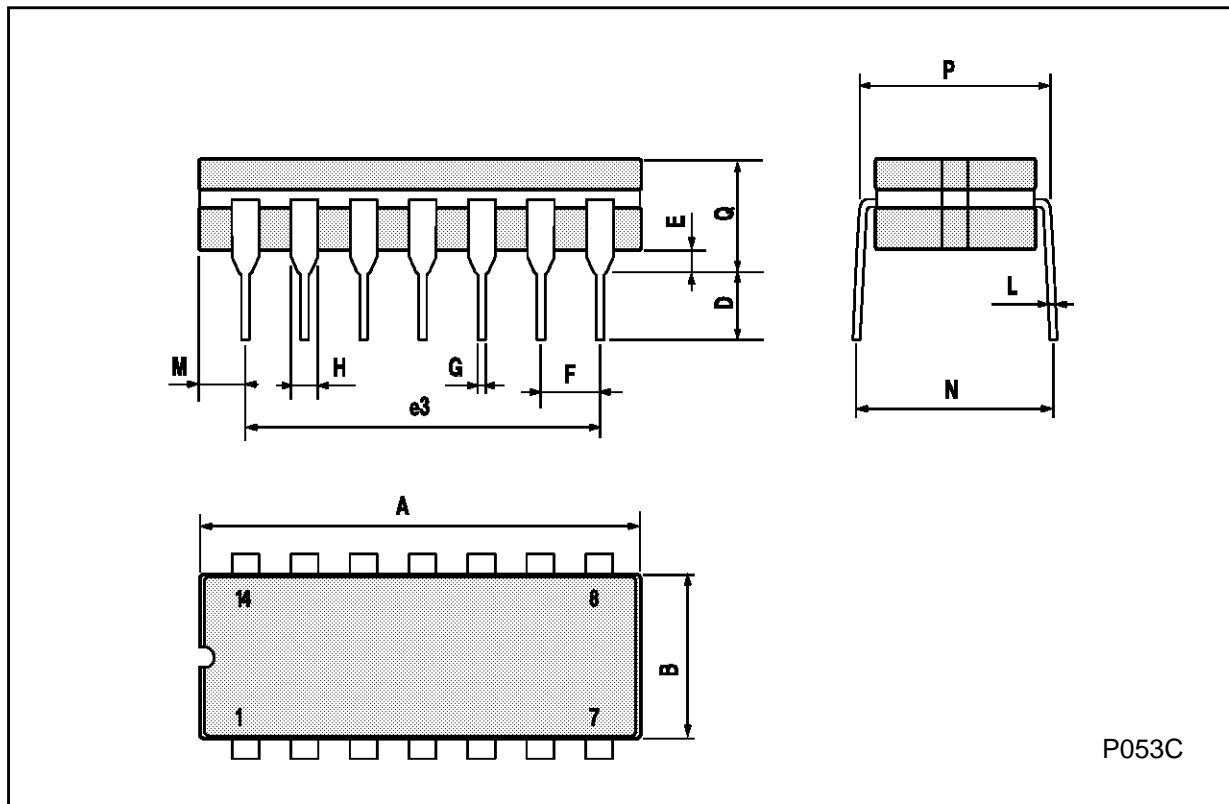
**Plastic DIP14 MECHANICAL DATA**

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	1.39		1.65	0.055		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		15.24			0.600	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z	1.27		2.54	0.050		0.100



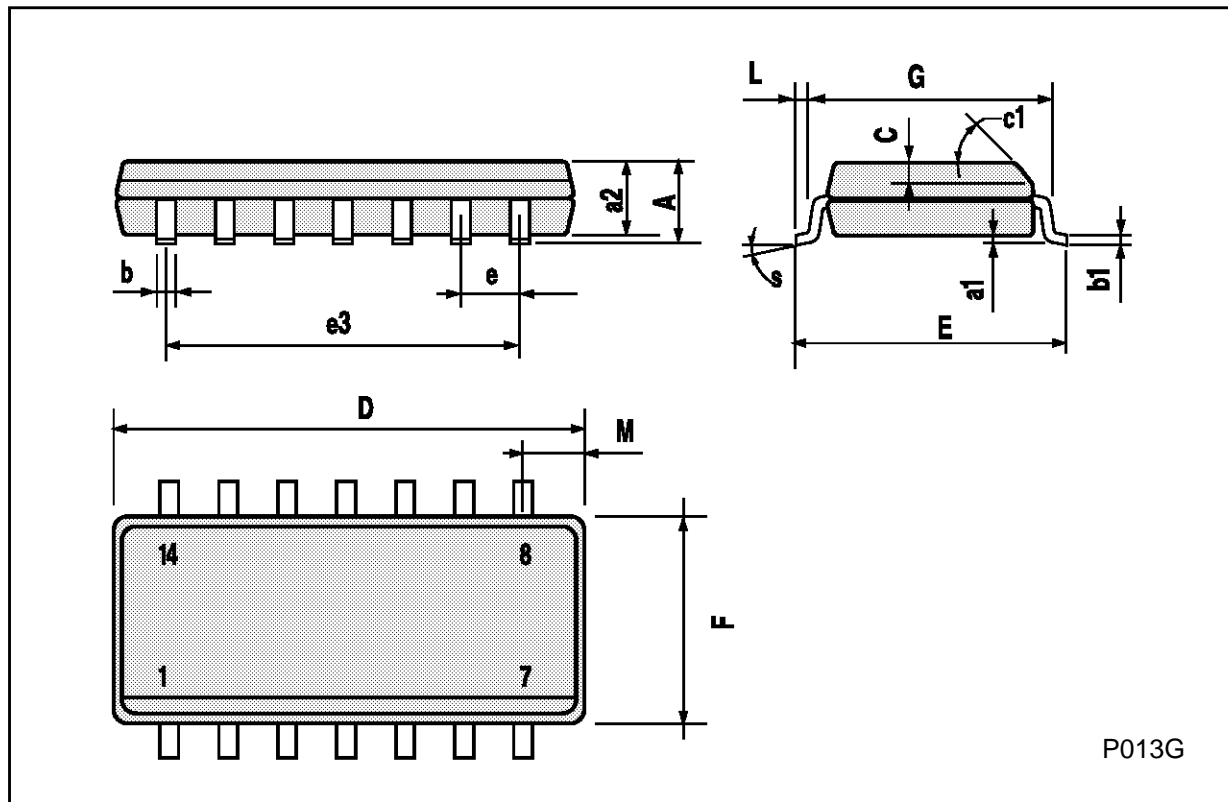
**Ceramic DIP14/1 MECHANICAL DATA**

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			20			0.787
B			7.0			0.276
D		3.3			0.130	
E	0.38			0.015		
e3		15.24			0.600	
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	1.52		2.54	0.060		0.100
N			10.3			0.406
P	7.8		8.05	0.307		0.317
Q			5.08			0.200



## SO14 MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.2	0.003		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	8.55		8.75	0.336		0.344
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		7.62			0.300	
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			0.68			0.026
S	8° (max.)					



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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