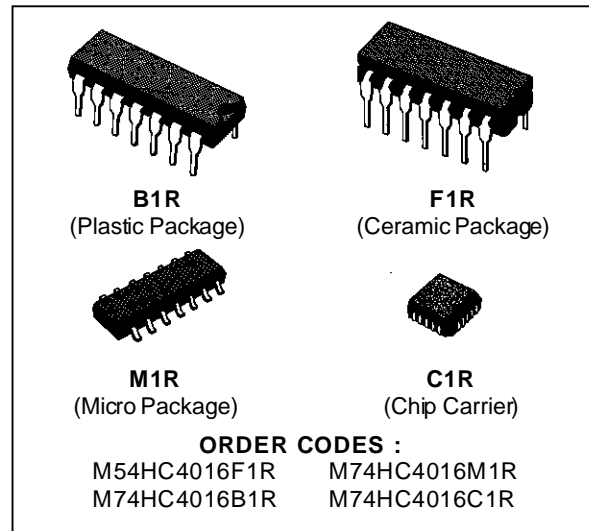


**QUAD BILATERAL SWITCH**

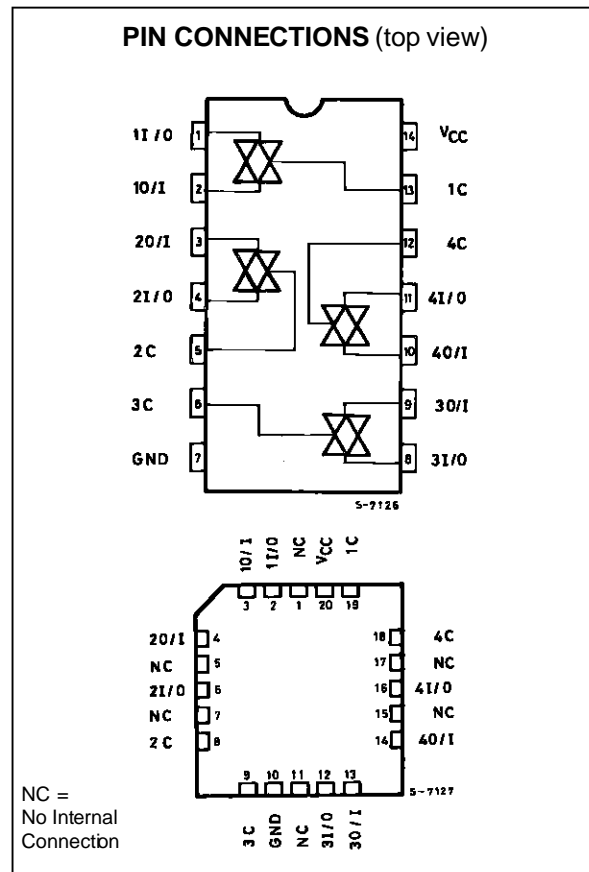
- HIGH SPEED  
 $t_{PD} = 9 \text{ ns}$  (TYP.) AT  $V_{CC} = 5 \text{ V}$
- LOW POWER DISSIPATION  
 $I_{CC} = 1 \mu\text{A}$  (MAX.) AT  $T_A = 25^\circ\text{C}$
- HIGH NOISE IMMUNITY  
 $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (MIN.)
- LOW "ON" RESISTANCE  
 $R_{ON} = 60 \Omega$  (TYP.) AT  $V_{CC} = 9 \text{ V}$ ,  $I_{I/O} = 100 \mu\text{A}$
- SINE WAVE DISTORSION  
 $0.042\%$  (TYP.) AT  $V_{CC} = 9 \text{ V}_{PP}$ ,  $f = 1 \text{ KHz}$
- WIDE OPERATING VOLTAGE RANGE  
 $V_{CC} \text{ (OPR)} = 2 \text{ V TO } 12 \text{ V}$
- PIN AND FUNCTION COMPATIBLE  
 WITH 4016B



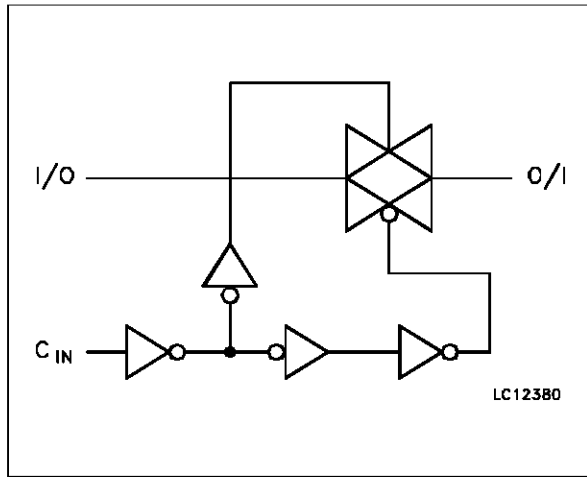
**DESCRIPTION**

The M54/74HC4016 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.

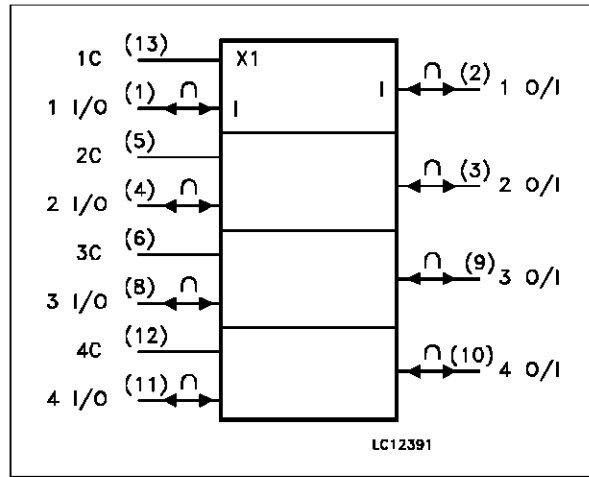
The C input is provided to control the switch ; the switch is ON when the C input is held high and off when C is held low.



**LOGIC DIAGRAM**



**IEC LOGIC SYMBOL**



**PIN DESCRIPTION**

PIN No	SYMBOL	NAME AND FUNCTION
1, 4, 8, 11	1 to 4 I/O	Independent Inputs/Outputs
2, 3, 9, 10	1 to 4 O/I	Independent Outputs/Inputs
13, 5, 6, 12	1C to 4C	Enable Inputs (Active HIGH)
7	GND	Ground (0V)
14	V <sub>CC</sub>	Positive Supply Voltage

**TRUTH TABLE**

CONTROL	SWITCH FUNCTION
H	ON
L	OFF

**ABSOLUTE MAXIMUM RATING**

Symbol	Parameter	Value	Unit
V <sub>CC</sub>	Supply Voltage	-0.5 to +13	V
V <sub>IN</sub>	DC Input Voltage	-0.5 to V <sub>CC</sub> + 0.5	V
V <sub>I/O</sub>	DC Input/Output Voltage	-0.5 to V <sub>CC</sub> + 0.5	V
I <sub>OK</sub>	Control Input DC Diode Current	± 20	mA
I <sub>I/O</sub>	I/O DC Diode Current	± 20	mA
I <sub>O</sub>	DC Output Source Sink Current Per Output Pin	± 25	mA
I <sub>CC</sub> or I <sub>GND</sub>	DC V <sub>CC</sub> or Ground Current	± 50	mA
P <sub>D</sub>	Power Dissipation	500 (*)	mW
T <sub>stg</sub>	Storage Temperature	-65 to +150	°C
T <sub>L</sub>	Lead Temperature (10 sec)	300	°C

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

(\*) 500 mW: ≡ 65 °C derate to 300 mW by 10mW/°C: 65 °C to 85 °C

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Value	Unit	
$V_{CC}$	Supply Voltage	2 to 12	V	
$V_I$	Input Voltage (Control)	0 to $V_{CC}$	V	
$V_{IO}$	Input/Output Voltage	0 to $V_{CC}$	V	
$T_{op}$	Operating Temperature: <b>M54HC Series</b> <b>M74HC Series</b>	-55 to +125 -40 to +85	°C °C	
$t_r, t_f$	Input Rise and Fall Time	$V_{CC} = 2\text{ V}$	0 to 1000	ns
		$V_{CC} = 4.5\text{ V}$	0 to 500	
		$V_{CC} = 6\text{ V}$	0 to 400	
		$V_{CC} = 10\text{ V}$	0 to 250	

## DC SPECIFICATIONS

Symbol	Parameter	Test Conditions		Value						Unit		
		$V_{CC}$ (V)		$T_A = 25\text{ °C}$ 54HC and 74HC			$-40\text{ to }85\text{ °C}$ 74HC		$-55\text{ to }125\text{ °C}$ 54HC			
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.	
$V_{IHC}$	High Level Control Input Voltage	2.0		1.5			1.5		1.5		V	
		4.5		3.15			3.15		3.15			
		9.0		6.3			6.3		6.3			
		12.0		8.4			8.4		8.4			
$V_{ILC}$	Low Level Control Input Voltage	2.0				0.5		0.5		0.5	V	
		4.5				1.35		1.35		1.35		
		9.0				2.5		2.5		2.5		
		12.0				3.6		3.6		3.6		
$R_{ON}$	ON Resistance	4.5	$V_{IN} = V_{IHC}$ $V_{IO} = V_{CC}$ to GND $I_{IO} = 100\text{ }\mu\text{A}$		160	320		400		450	$\Omega$	
		9.0			85	170		213		260		
		12.0			60	120		150		180		
			4.5	$V_{IN} = V_{IHC}$ $V_{IO} = V_{CC}$ or GND $I_{IO} = 100\text{ }\mu\text{A}$		80	160		200		250	
			9.0			60	120		150		200	
			12.0			50	100		125		150	
$\Delta R_{ON}$	Difference of ON Resistance Between Switches	4.5	$V_{IN} = V_{IHC}$ $V_{IO} = V_{CC}$ or GND $I_{IO} \leq 100\text{ }\mu\text{A}$		16						$\Omega$	
		9.0			9							
		12.0			6							
$I_{OFF}$	Input/Output Leakage Current (SWITCH OFF)	12.0	$V_{OS} = V_{CC}$ or GND $V_{IS} = V_{CC}$ or GND $V_{IN} = V_{ILC}$			$\pm 0.1$		$\pm 1$		$\pm 2$	$\mu\text{A}$	
$I_{IZ}$	Switch Input Leakage Current (SWITCH ON, OUTPUT OPEN)	12.0	$V_{OS} = V_{CC}$ or GND $V_{IN} = V_{IHC}$			$\pm 0.1$		$\pm 1$		$\pm 2$	$\mu\text{A}$	
$I_{IN}$	Control Input Current	6.0	$V_{IN} = V_{CC}$ or GND			$\pm 0.1$		$\pm 1$		$\pm 1$	$\mu\text{A}$	
$I_{CC}$	Quiescent Supply Current	6.0	$V_{IN} = V_{CC}$ or GND		1		10		20		$\mu\text{A}$	
		9.0			4		40		80			
		12.0			8		80		160			

## M54/M74HC4016

### AC ELECTRICAL CHARACTERISTICS ( $C_L = 50$ pF, Input $t_r = t_f = 6$ ns)

Symbol	Parameter	Test Conditions		Value						Unit	
		$V_{CC}$ (V)		$T_A = 25$ °C 54HC and 74HC			$-40$ to $85$ °C 74HC		$-55$ to $125$ °C 54HC		
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.
$\phi_{I/O}$	Phase Difference Between Input and Output	2.0			20	50		65		75	ns
		4.5			5	10		13		15	
		9.0			4	8		10		12	
		12.0			3	7		9		11	
$t_{PZL}$ $t_{PZH}$	Output Enable Time	2.0	$R_L = 1K\Omega$		40	100		125		150	ns
		4.5			10	20		25		30	
		9.0			8	15		20		24	
		12.0			7	14		18		21	
$t_{PLZ}$ $t_{PHZ}$	Output Disable Time	2.0	$R_L = 1K\Omega$		60	150		190		225	ns
		4.5			15	30		38		45	
		9.0			10	26		33		36	
		12.0			8	24		30		32	
$C_{IN}$	Input Capacitance				5	10		10		10	pF
$C_{I/O}$	Switch Terminal Capacitance	9.0			5						pF
$C_{IOS}$	Feed Through Capacitance	9.0			1						pF
$C_{PD} (*)$	Power Dissipation Capacitance	5.0			15						pF

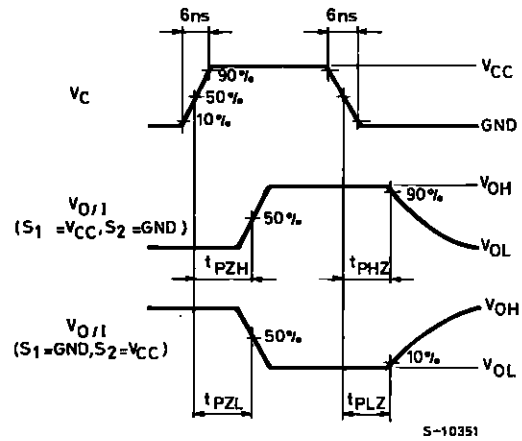
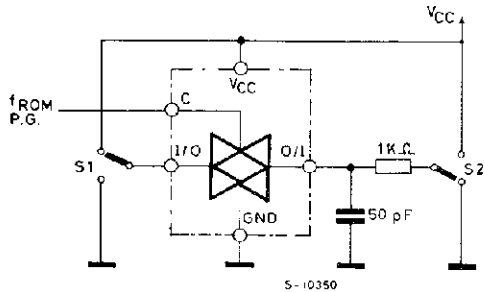
(\*)  $C_{PD}$  is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation.  $I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} +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

### ANALOG SWITCH CHARACTERISTICS (GND = 0 V $T_A = 25$ °C)

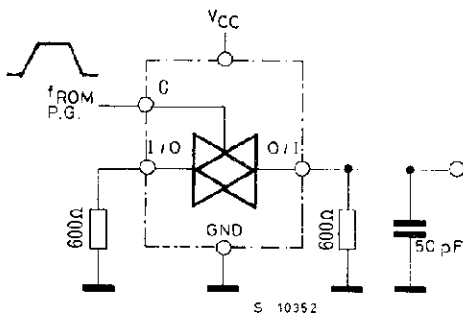
Symbol	Parameter	Test Conditions			Value	Unit
		$V_{CC}$ (V)	$V_{IN}$ (Vp-p)		Typ.	
	Sine Wave Distortion (THD)	4.5	4.5	$f_{IN} = 1$ KHz $R_L = 10$ K $\Omega$ $C_L = 50$ pF	0.118	%
		9.0	9.0		0.042	
		12.0	12.0		0.032	
$f_{MAX}$	Frequency Response (Switch ON)	4.5	Adjust $f_{IN}$ voltage to Obtain 0 dBm at $V_{OS}$ .		23	MHz
		9.0	Increase $f_{IN}$ Frequency until dB Meter reads -3dB		38	
		12.0	$R_L = 50$ $\Omega$ $C_L = 50$ pF		42	
	Feedthrough Attenuation (Switch OFF)	4.5	$V_{IN}$ is centered at $V_{CC}/2$ . Adjust input for 0 dBm		-50	dB
		9.0	$R_L = 600$ $\Omega$ $C_L = 50$ pF $f_{IN} = 1$ MHz sine wave		-50	
		12.0			-50	
	Crosstalk (Control Input to Signal Output)	4.5	$R_L = 600$ $\Omega$ $C_L = 50$ pF		8	mV
		9.0	$f_{IN} = 1$ MHz square wave ( $t_r = t_f = 6$ ns)		23	
		12.0			40	
	Crosstalk (Between Any Switches)	4.5	Adjust $V_{IN}$ to Obtain 0 dBm at input		-50	dB
		9.0	$R_L = 600$ $\Omega$ $C_L = 50$ pF $f_{IN} = 1$ MHz sine wave		-50	
		12.0			-50	

SWITCHING CHARACTERISTICS TEST CIRCUIT

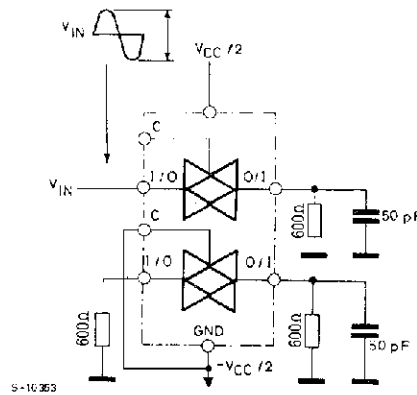
$t_{PLZ}$ ,  $t_{PHZ}$ ,  $t_{PZL}$ ,  $t_{PZH}$ .



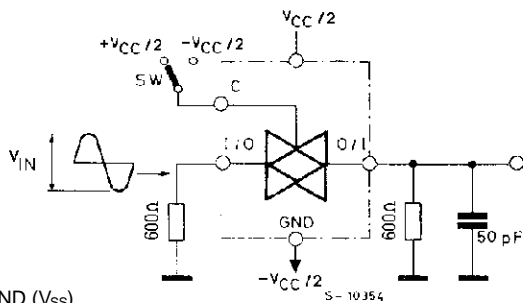
CROSSTALK (control to output)



CROSSTALK BETWEEN ANY TWO SWITCHES

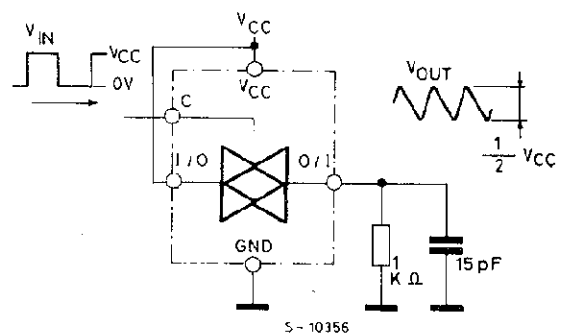


BANDWIDTH AND FEEDTHROUGH ATTENUATION

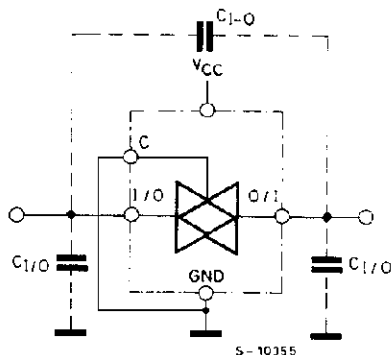


GND (Vss)

MAXIMUM CONTROL FREQUENCY

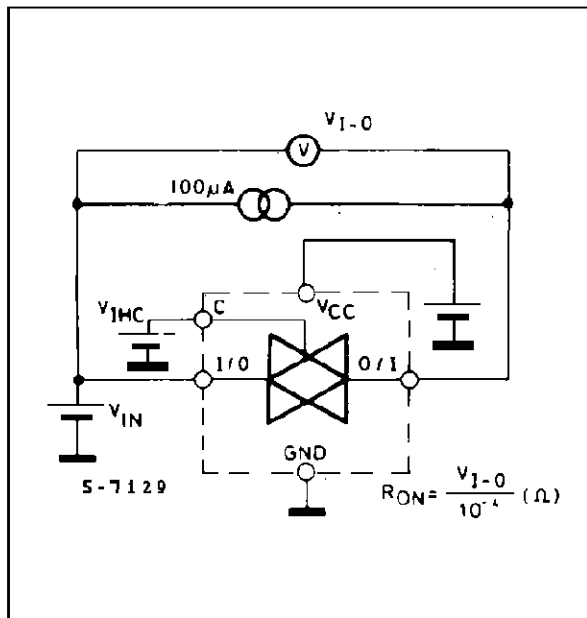


C<sub>I-O</sub> C<sub>I/O</sub>

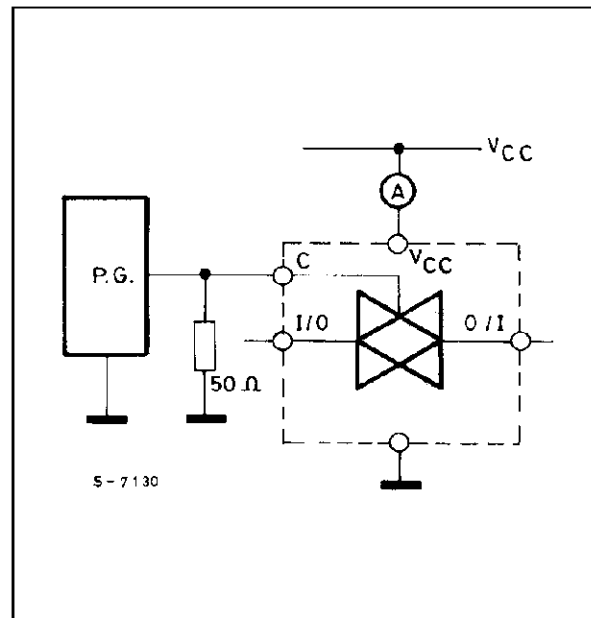


GND (Vss)

CHANNEL RESISTANCE ( $R_{ON}$ )

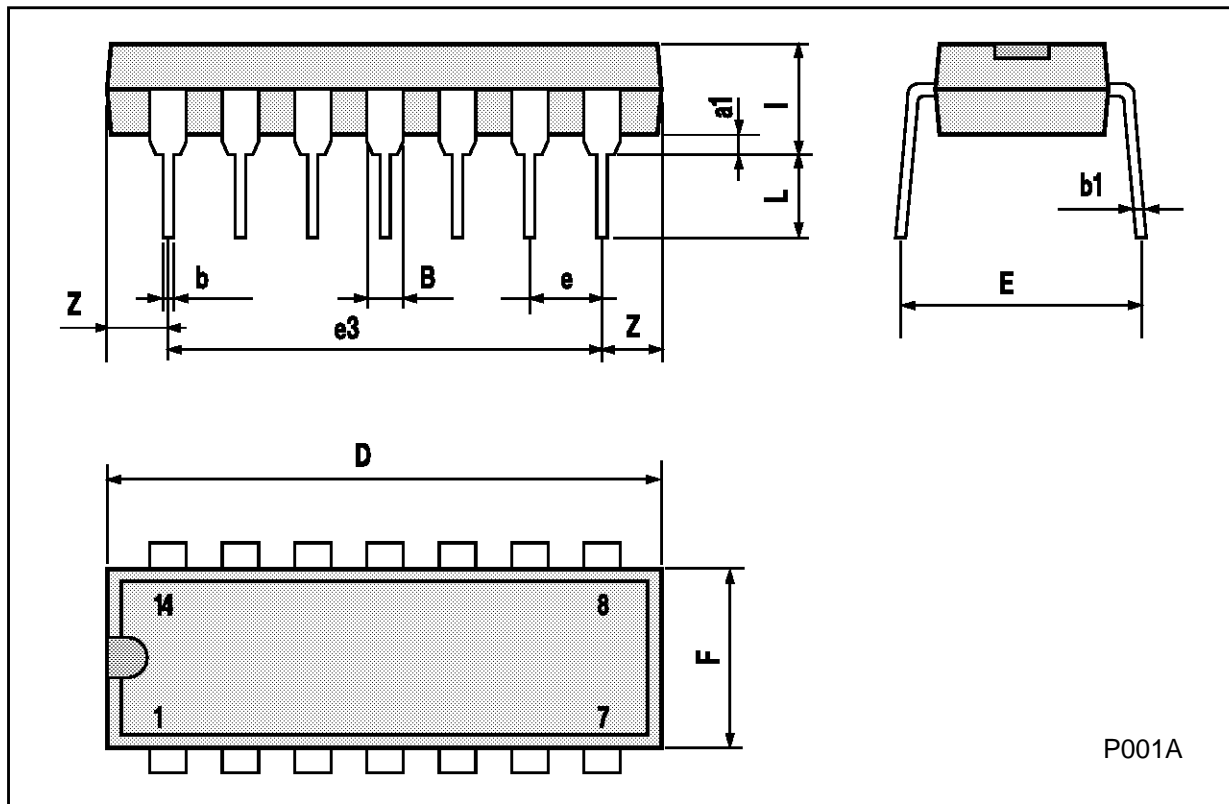


$I_{CC}$  (Opr.)



**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



P053C



## 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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