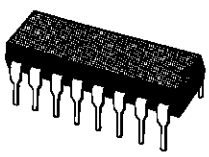
SGS-THOMSON MICROELECTRONICS

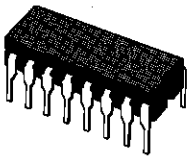
M54HC4316
M74HC4316

QUAD BILATERAL SWITCH

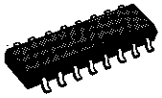
- HIGH SPEED
  t_{PD} = 13 ns (TYP.) AT V_{CC} = 5V
- LOW "ON" RESISTANCE:
  120 Ω TYP. (V_{CC} - V_{EE} = 2 V)
  50 Ω TYP. (V_{CC} - V_{EE} = 4.5 V)
  35 Ω TYP. (V_{CC} - V_{EE} = 9 V)
- WIDE ANALOG INPUT VOLTAGE RANGE: ±6V
- LOW CROSSTALK BETWEEN SWITCHES
- FAST SWITCHING
- SINE WAVE DISTORTION
  0.020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



B1R
(Plastic Package)



F1R
(Ceramic Package)



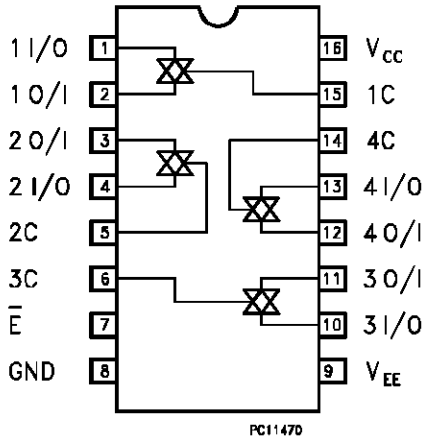
M1R
(Micro Package)

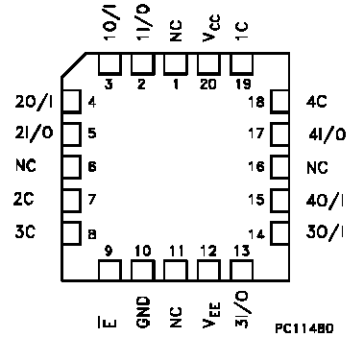
C1R
(Chip Carrier)

ORDER CODES :

M54HC4316F1R M74HC4316M1R
M74HC4316B1R M74HC4316C1R

PIN CONNECTIONS (top view)



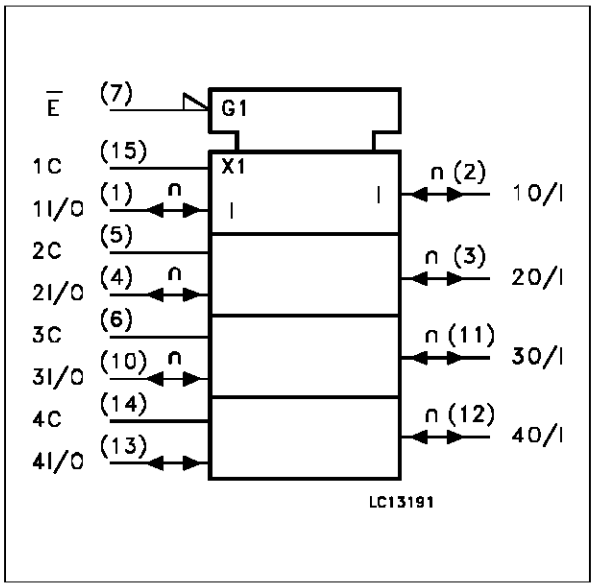


NC =
No Internal
Connection

DESCRIPTION

The M54/74HC4316 is a high speed CMOS QUAD BILATERAL SWITCH fabricated in silicon gate C^2MOS 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_{CC} and GND must be within the range 0 to 6 V. The voltage swing on the analogue Input/Outputs can be between VCC (Positive Limit) and V_{EE} (Negative Limit). The voltage between V_{CC} and V_{EE} must not exceed 12 V.
All input are equipped with protection circuits against static discharge and transient excess voltage.

IEC LOGIC SYMBOL



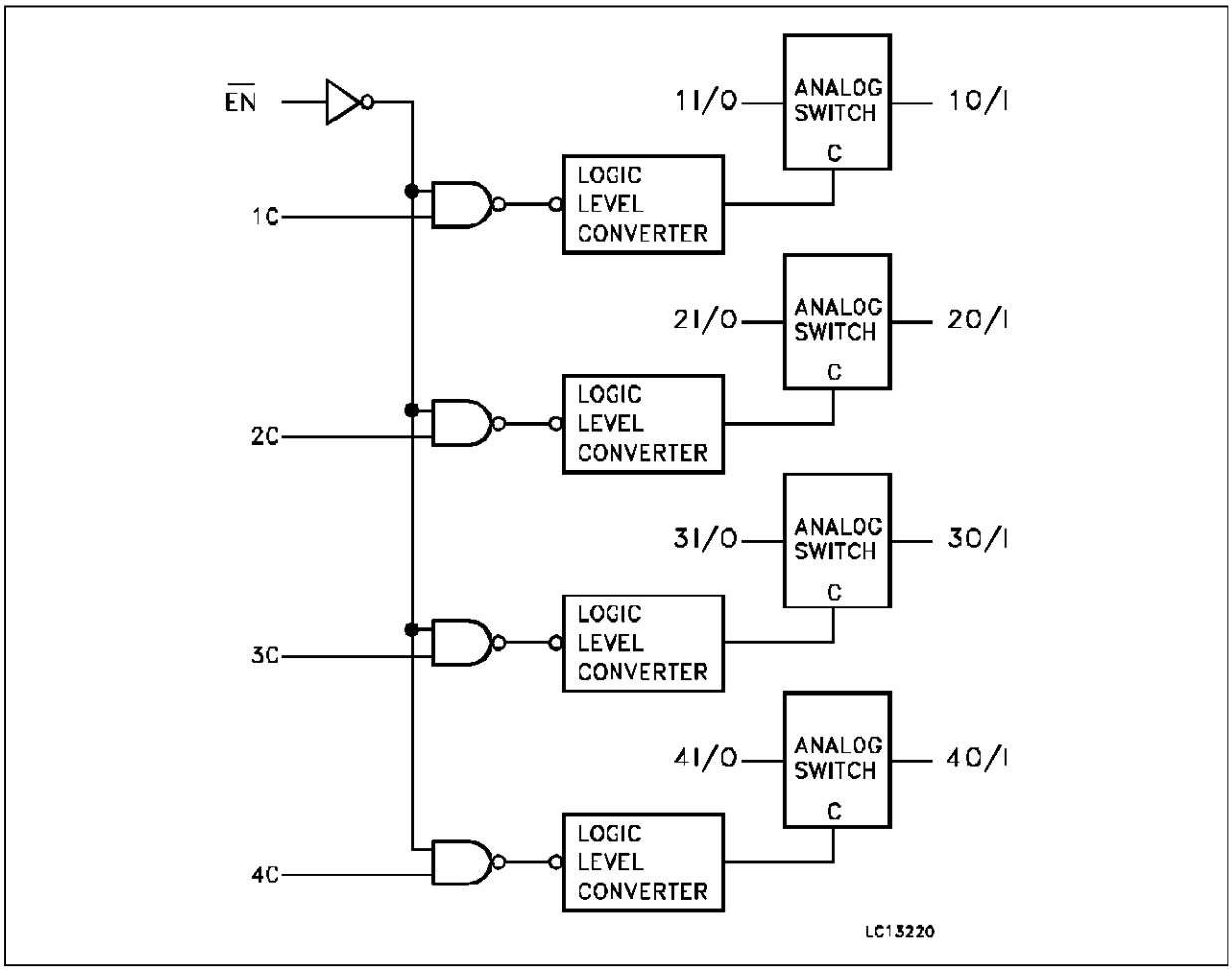
PIN DESCRIPTION

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	$\overline{E}$	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
$\overline{ENABLE}$	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	C0ntrol 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	± 20	mA
I_{OK}	DC Output Diode Current	± 20	mA
I_O	DC Output Source Sink Current Per Output Pin	± 25	mA
I_{CC} or I_{GND}	DC V_{CC} or Ground Current	± 50	mA
P_D	Power Dissipation	500 (*)	mW
T_{stg}	Storage Temperature	-65 to +150	°C
T_L	Lead Temperature (10 sec)	300	°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: ≅ 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 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: **M54HC** Series **M74HC** Series		-55 to +125 -40 to +85	°C °C
t_r, t_f	Input Rise and Fall Time	V_{CC} = 2 V	0 to 1000	ns
		V_{CC} = 4.5 V	0 to 500	
		V_{CC} = 6 V	0 to 400	

DC SPECIFICATIONS

Symbol	Parameter	Test Conditions			Value							Unit
		V_{CC} (V)	V_{EE} (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.	
V_{IHC}	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_{ILC}	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_{ON}	ON Resistance	4.5	GND	$V_{IN} = V_{IHC}$ $V_{I/O} = V_{CC}$ to V_{EE} $I_{I/O}$ = 0.1 mA		70	170		200			Ω
		4.5	-4.5			50	85		105			
		6.0	-6.0			30	70		85			
		2.0	GND	$V_{IN} = V_{IHC}$ $V_{I/O} = V_{CC}$ or V_{EE} $I_{I/O}$ = 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_{ON}	Difference of ON Resistance Between Switches	4.5	GND	$V_{IN} = V_{IHC}$ or V_{ILC} $V_{I/O} = V_{CC}$ to V_{EE} $I_{I/O}$ = 0.1 mA		10	15		20			Ω
		4.5	-4.5			5	10		15			
		6.0	-6.0			5	10		15			
I_{OFF}	Input/Output Leakage Current (SWITCH OFF)	6.0	GND	$V_{OS} = V_{CC}$ or GND $V_{IS} = V_{CC}$ or GND $V_{IN} = V_{IHC}$ or V_{ILC}			±0.06		±0.6		±2	µA
		6.0	-6.0				±0.1		±1		±2	
I_{IZ}	Switch Input Leakage Current (SWITCH ON, OUTPUT OPEN)	6.0	GND	$V_{OS} = V_{CC}$ or GND $V_{IN} = V_{ILC}$ or V_{IHC}			±0.06		±0.6		±2	µA
		6.0	-6.0				±0.1		±1		±2	
I_{IN}	Control Input Current	6.0	$V_I = V_{CC}$ or GND			10^{-5}	±0.1		±1		±1	µA

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.	
$ø_{I/O}$	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_{PZL} t_{PZH}	Output Enable Time ($\overline{E}$, C-OUT)	2.0	GND	R_L = 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_{PLZ} t_{PHZ}	Output Disable Time ($\overline{E}$, C-OUT)	2.0	GND	R_L = 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_L = 1KΩ C_L = 15 pF V_{OUT} = 1/2 V_{CC}		2						MHz
		4.5	GND			9						
		6.0	GND			11						
C_{IN}	Input Capacitance					5	10		10		10	pF
$C_{I/O}$	Switch Terminal Capacitance	4.5	-4.5			5						pF
C_{IOS}	Feed Through Capacitance	4.5	-4.5			1						pF
C_{PD} (*)	Power Dissipation Capacitance	5.0	GND			16						pF

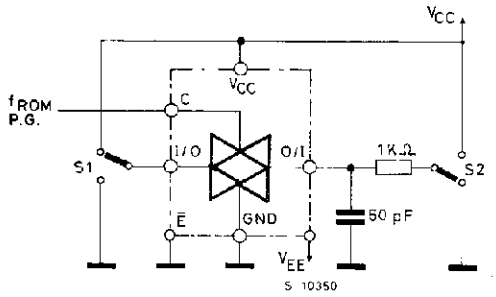
(*) C_{PD} is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operting current can be obtained by the following equation. $I_{CC}(opr) = C_{PD} \bullet V_{CC} \bullet f_{IN} + I_{CC}$

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

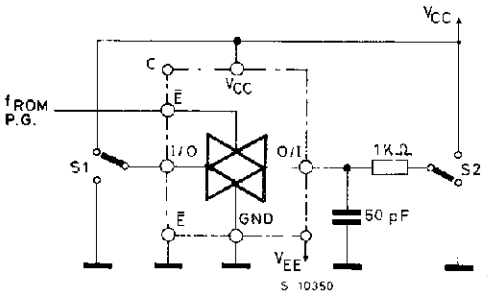
Symbol	Parameter	Test Conditions				Value	Unit
		V_{CC} (V)	V_{EE} (V)	VIN (Vp-p)		Typ.	
	Sine Wave Distortion (THD)	2.25	2.25	4	f_{IN} = 1 KHz R_L = 10 Ω C_L = 50 pF	0.025	%
		4.5	4.5	8		0.020	
		6.0	6.0	11		0.018	
f_{MAX}	Frequency Response (Switch ON)	2.25	2.25	Adjust f_{IN} voltage to Obtain 0 dBm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

SWITCHING CHARACTERISTICS TEST CIRCUIT

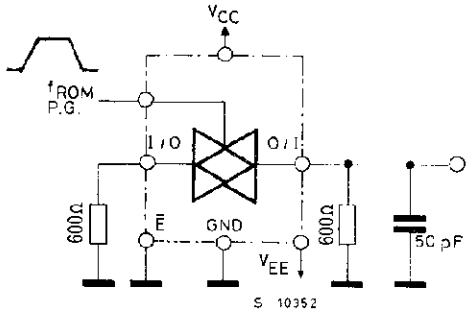
CONTROL
t_{PLZ}, t_{PHZ}, t_{PZL}, t_{PZH}.



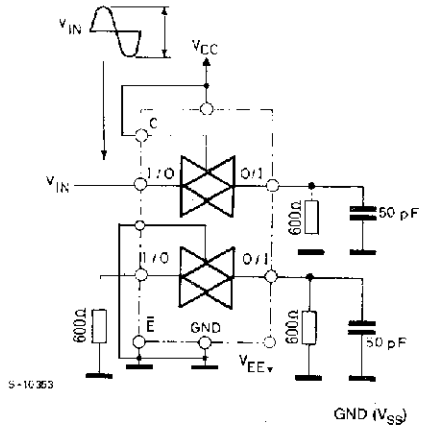
ENABLE
t_{PLZ}, t_{PHZ}, t_{PZL}, t_{PZH}.



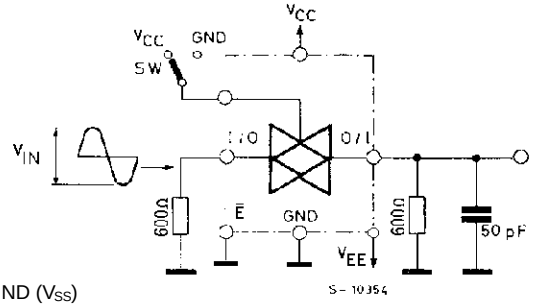
CROSSTALK (control to output)



CROSSTALK BETWEEN ANY TWO SWITCHES

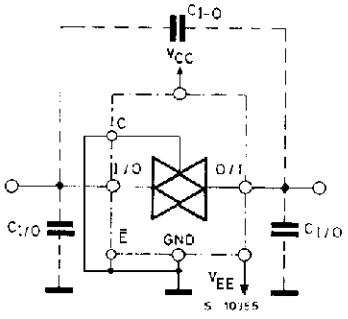


BANDWIDTH AND FEEDTHROUGH ATTENUATION



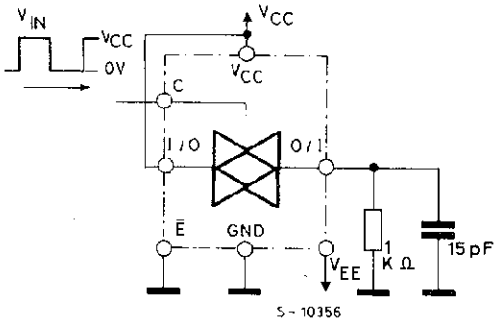
GND (V_{SS})

C_{I-O} $C_{I/O}$

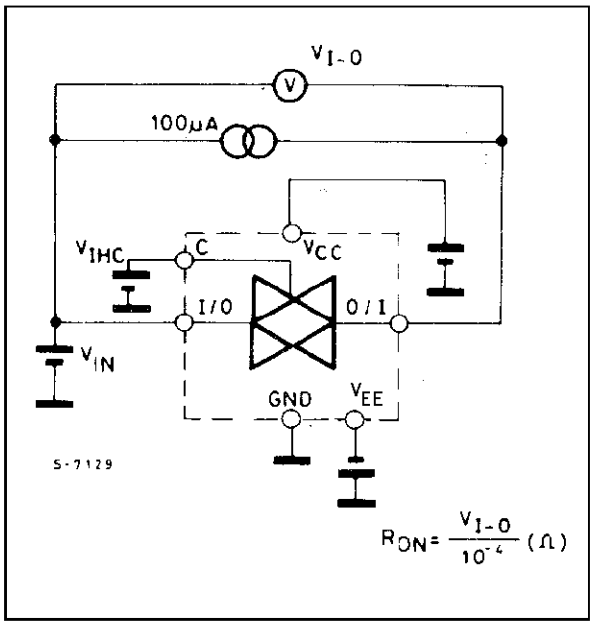


GND (V_{SS})

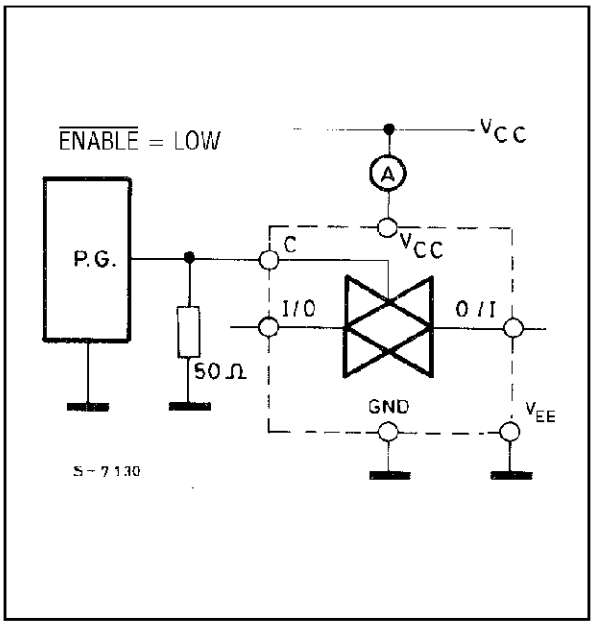
MAXIMUM CONTROL FREQUENCY



CHANNEL RESISTANCE (R_{ON})

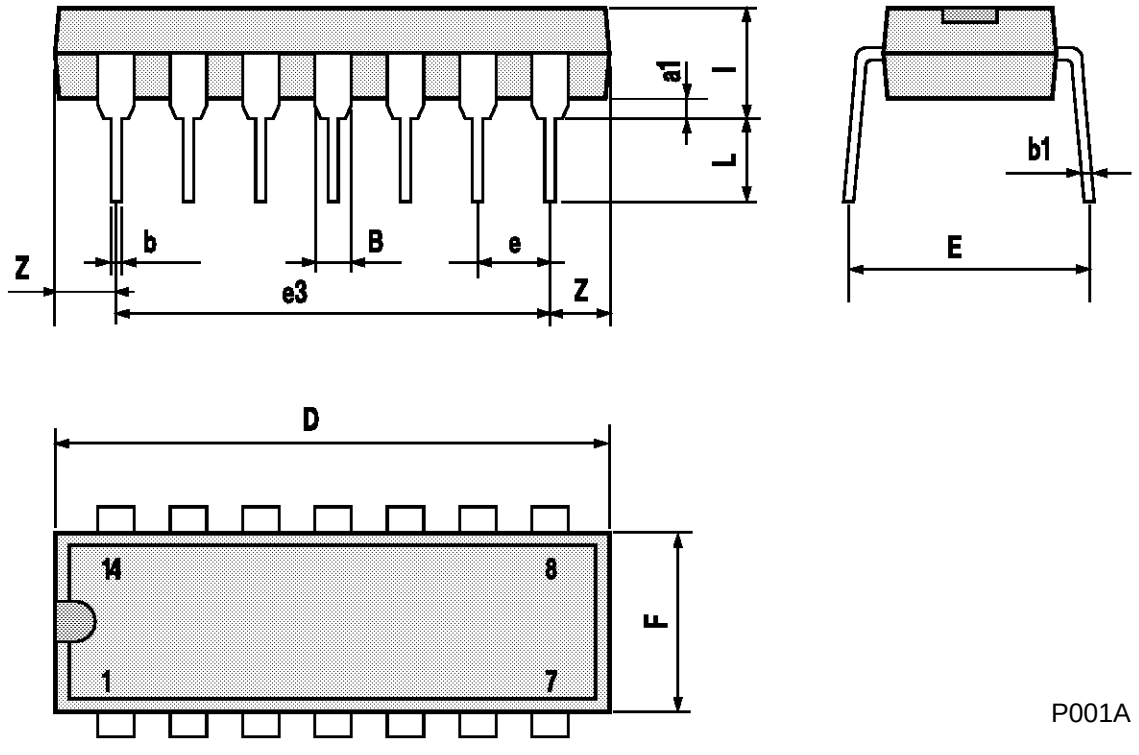


Icc (Opr.)



Plastic DIP14 MECHANICAL DATA

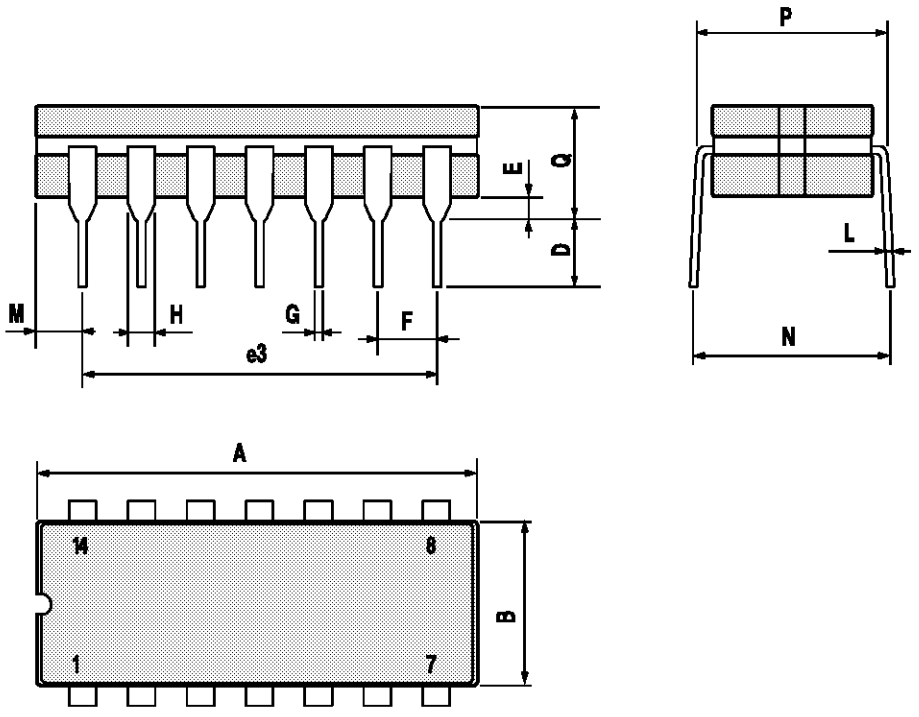
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	1.39		1.65	0.055		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		15.24			0.600	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z	1.27		2.54	0.050		0.100



P001A

Ceramic DIP14/1 MECHANICAL DATA

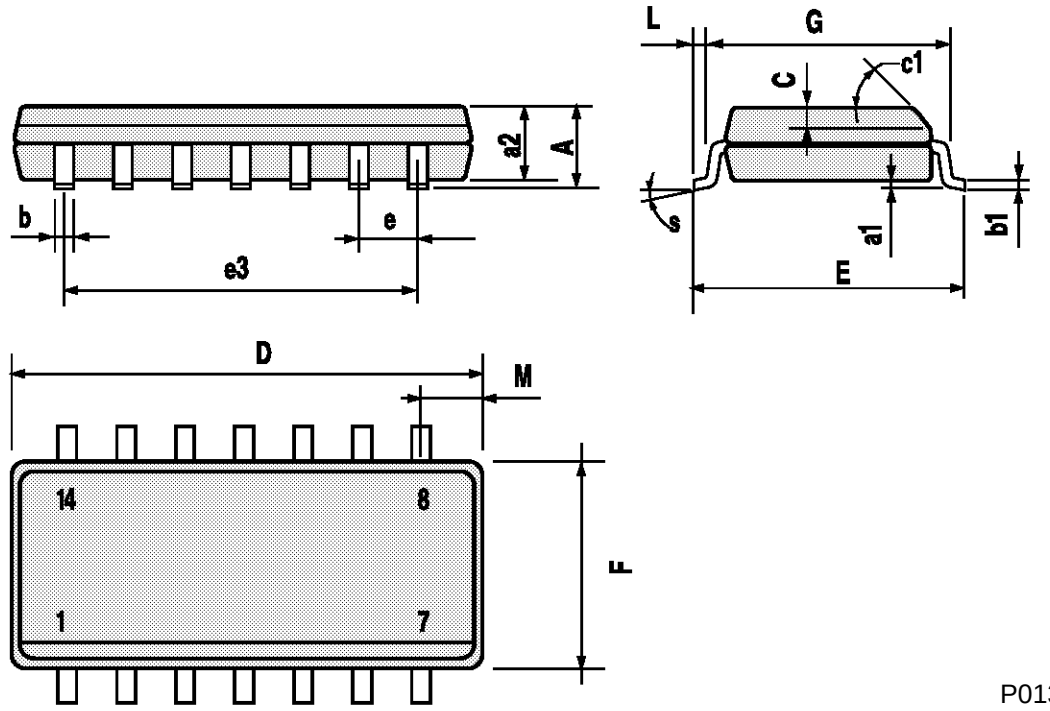
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			20			0.787
B			7.0			0.276
D		3.3			0.130	
E	0.38			0.015		
e3		15.24			0.600	
F	2.29		2.79	0.090		0.110
G	0.4		0.55	0.016		0.022
H	1.17		1.52	0.046		0.060
L	0.22		0.31	0.009		0.012
M	1.52		2.54	0.060		0.100
N			10.3			0.406
P	7.8		8.05	0.307		0.317
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.)					



P013G

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