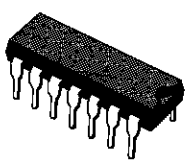
SGS-THOMSON MICROELECTRONICS

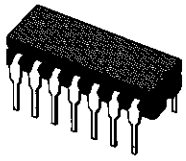
M54HC4016
M74HC4016

QUAD BILATERAL SWITCH

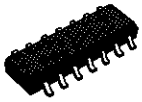
- HIGH SPEED
  t_{PD} = 9 ns (TYP.) AT V_{CC} = 5 V
- LOW POWER DISSIPATION
  I_{CC} = 1 µA (MAX.) AT T_A = 25 °C
- HIGH NOISE IMMUNITY
  $V_{NIH} = V_{NIL}$ = 28 % V_{CC} (MIN.)
- LOW "ON" RESISTANCE
  R_{ON} = 60 Ω (TYP.) AT V_{CC} = 9 V, $I_{I/O}$ = 100 µA
- SINE WAVE DISTORSION
  0.042 % (TYP.) AT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



B1R
(Plastic Package)



F1R
(Ceramic Package)



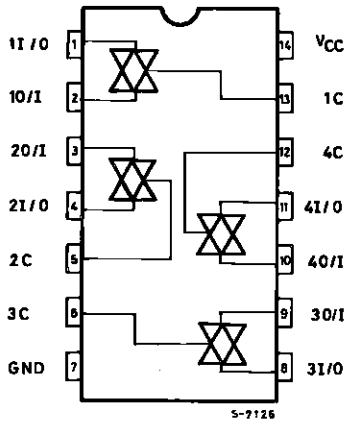
M1R
(Micro Package)

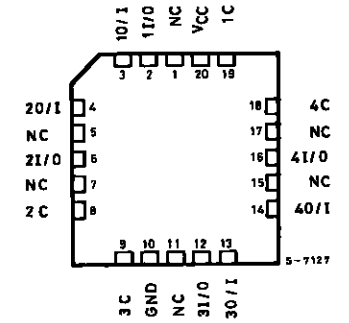
C1R
(Chip Carrier)

ORDER CODES :

M54HC4016F1R M74HC4016M1R
M74HC4016B1R M74HC4016C1R

PIN CONNECTIONS (top view)





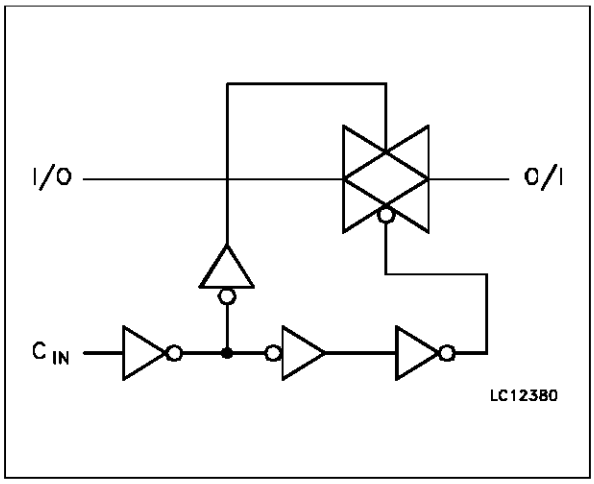
NC =
No Internal
Connection

DESCRIPTION

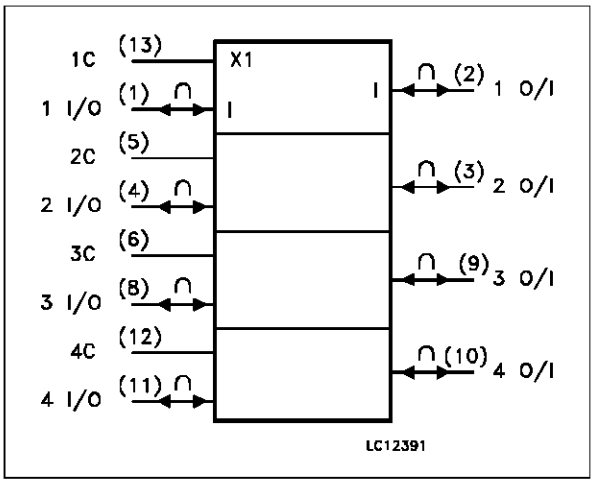
The M54/74HC4016 is a high speed CMOS QUAD BILATERAL SWITCH fabricated in silicon gate C^2MOS technology. It has high speed performance combined with true CMOS low power consumption.

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_{CC}	Positive Supply Voltage

TRUTH TABLE

CONTROL	SWITCH FUNCTION
H	ON
L	OFF

ABSOLUTE MAXIMUM RATING

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	-0.5 to +13	V
V_{IN}	DC Input Voltage	-0.5 to V_{CC} + 0.5	V
$V_{I/O}$	DC Input/Output Voltage	-0.5 to V_{CC} + 0.5	V
I_{OK}	Control Input DC Diode Current	± 20	mA
$I_{I/OK}$	I/O DC 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 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
$V_{I/O}$	Input/Output Voltage		0 to V_{CC}	V
T_{op}	Operating Temperature: **M54HC** Series **M74HC** Series		-55 to +125 -40 to +85	^oC ^oC
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	
		V_{CC} = 10 V	0 to 250	

DC SPECIFICATIONS

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.	
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} $V_{I/O}$ = V_{CC} to GND $I_{I/O}$ = 100 µA		160	320		400		450	Ω
		9.0			85	170		213		260	
		12.0			60	120		150		180	
		4.5	V_{IN} = V_{IHC} $V_{I/O}$ = V_{CC} or GND $I_{I/O}$ = 100 µA		80	160		200		250	
		9.0			60	120		150		200	
		12.0			50	100		125		150	
ΔR_{ON}	Difference of ON Resistance Between Switches	4.5	V_{IN} = V_{IHC} $V_{I/O}$ = V_{CC} or GND $I_{I/O} \leq$ 100 µA		16						Ω
		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}			±0.1		±1		±2	µA
I_{IZ}	Switch Input Leakage Current (SWITCH ON, OUTPUT OPEN)	12.0	V_{OS} = V_{CC} or GND V_{IN} = V_{IHC}			±0.1		±1		±2	µA
I_{IN}	Control Input Current	6.0	V_{IN} = V_{CC} or GND			±0.1		±1		±1	µA
I_{CC}	Quiescent Supply Current	6.0	V_{IN} = V_{CC} or GND			1		10		20	µA
		9.0				4		40		80	
		12.0				8		80		160	

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			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 = 1KΩ		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 = 1KΩ		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

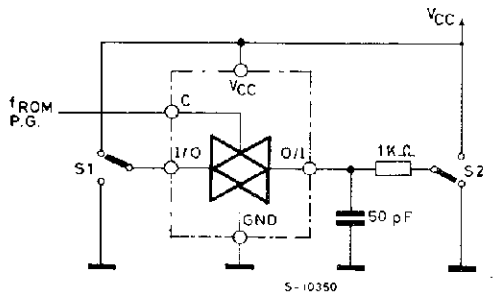
(*) C_{PD} is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operting current can be obtained by the following equation. $I_{CC}(opr) = C_{PD} \bullet V_{CC} \bullet f_{IN} + I_{CC}$

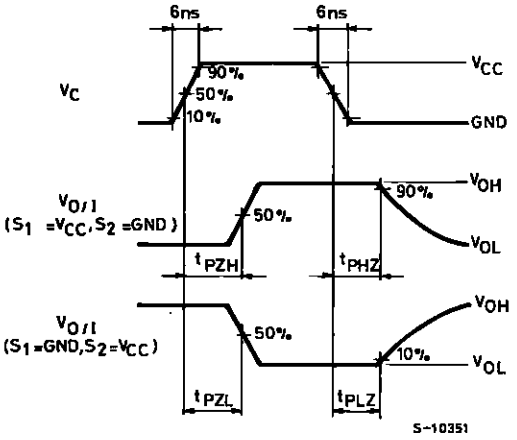
ANALOG SWITCH CHARACTERISTICS (GND = 0 V T_A = 25 °C)

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

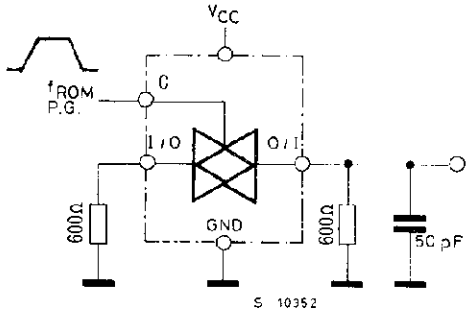
SWITCHING CHARACTERISTICS TEST CIRCUIT

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

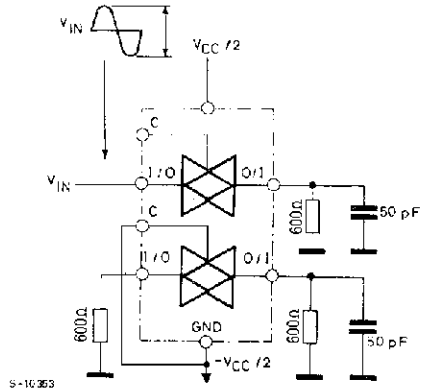




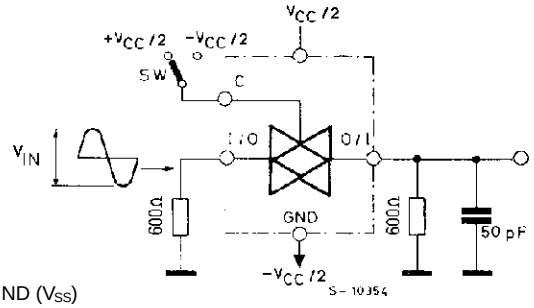
CROSSTALK (control to output)



CROSSTALK BETWEEN ANY TWO SWITCHES

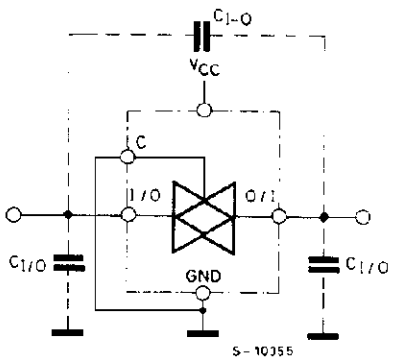


BANDWIDTH AND FEEDTHROUGH ATTENUATION



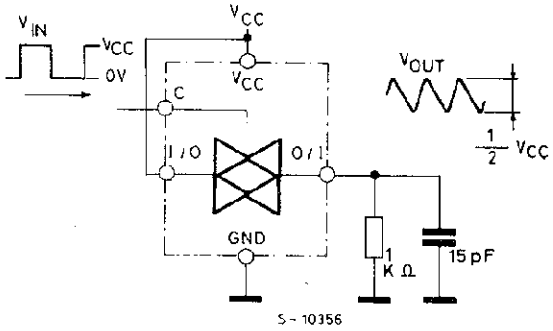
GND (V_{SS})

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

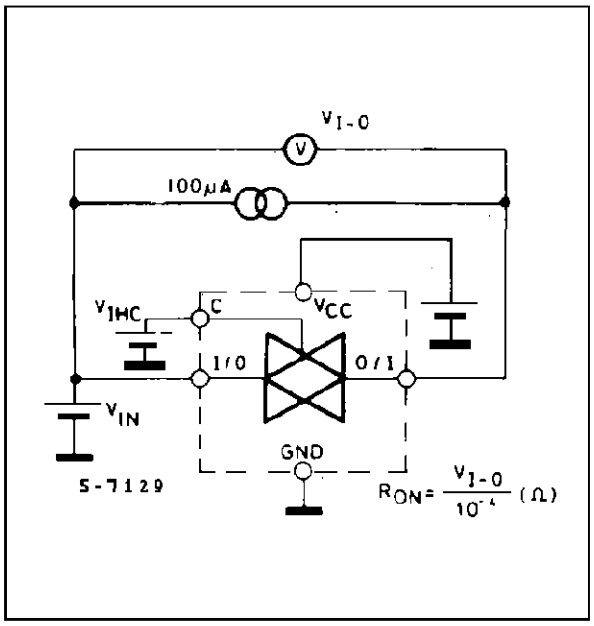


GND (V_{SS})

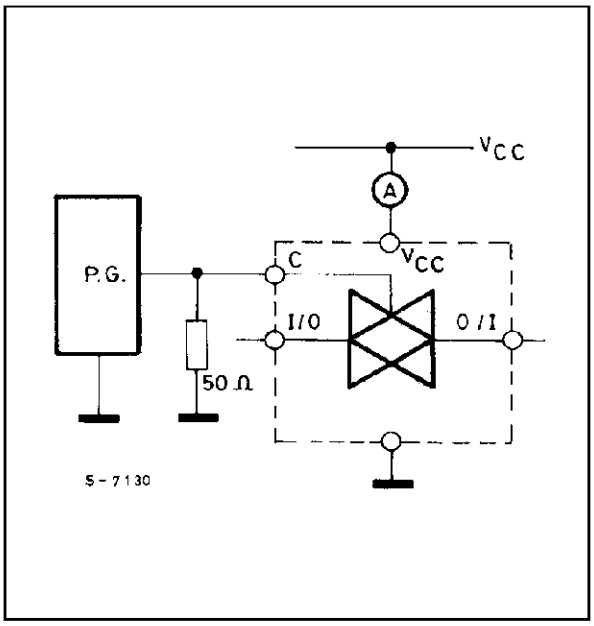
MAXIMUM CONTROL FREQUENCY



CHANNEL RESISTANCE (R_{ON})

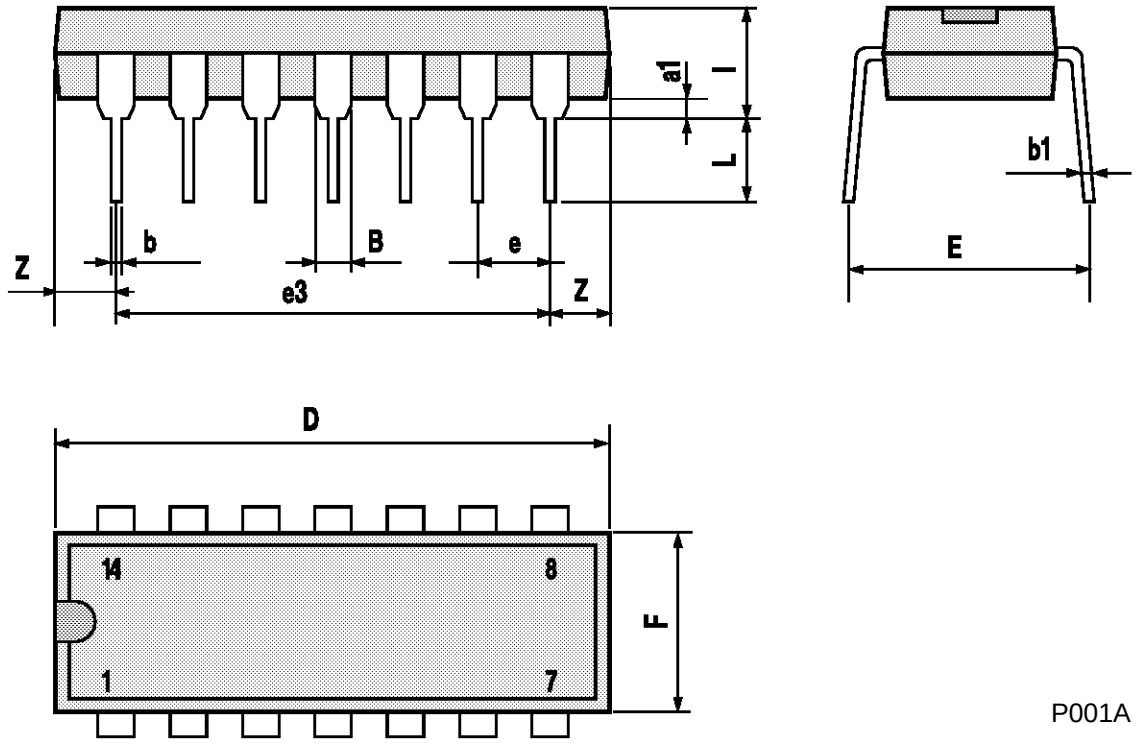


Icc (Opr.)



Plastic DIP14 MECHANICAL DATA

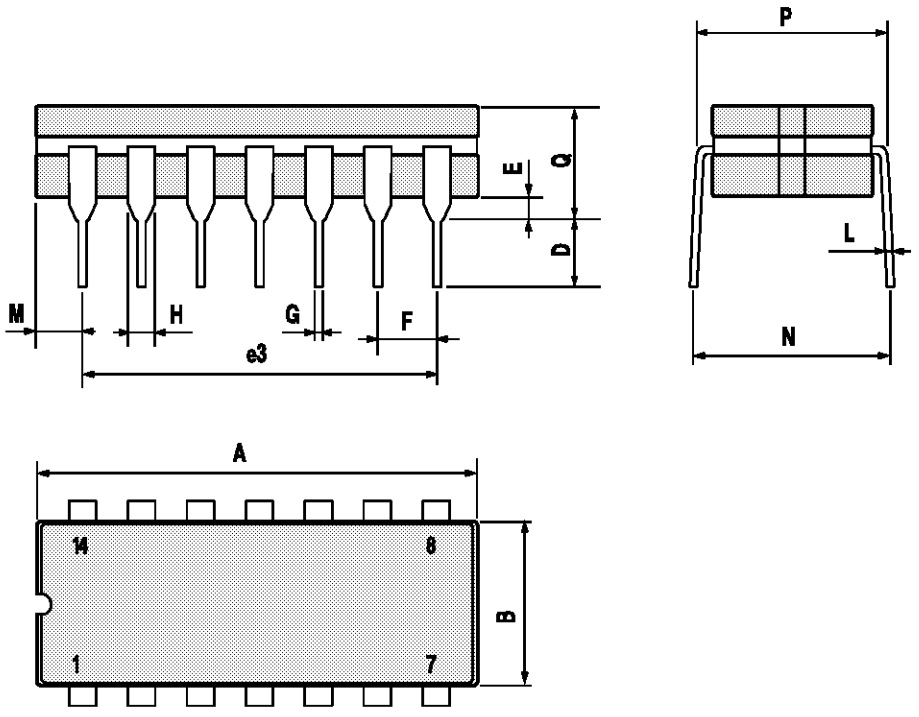
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	1.39		1.65	0.055		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		15.24			0.600	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z	1.27		2.54	0.050		0.100



P001A

Ceramic DIP14/1 MECHANICAL DATA

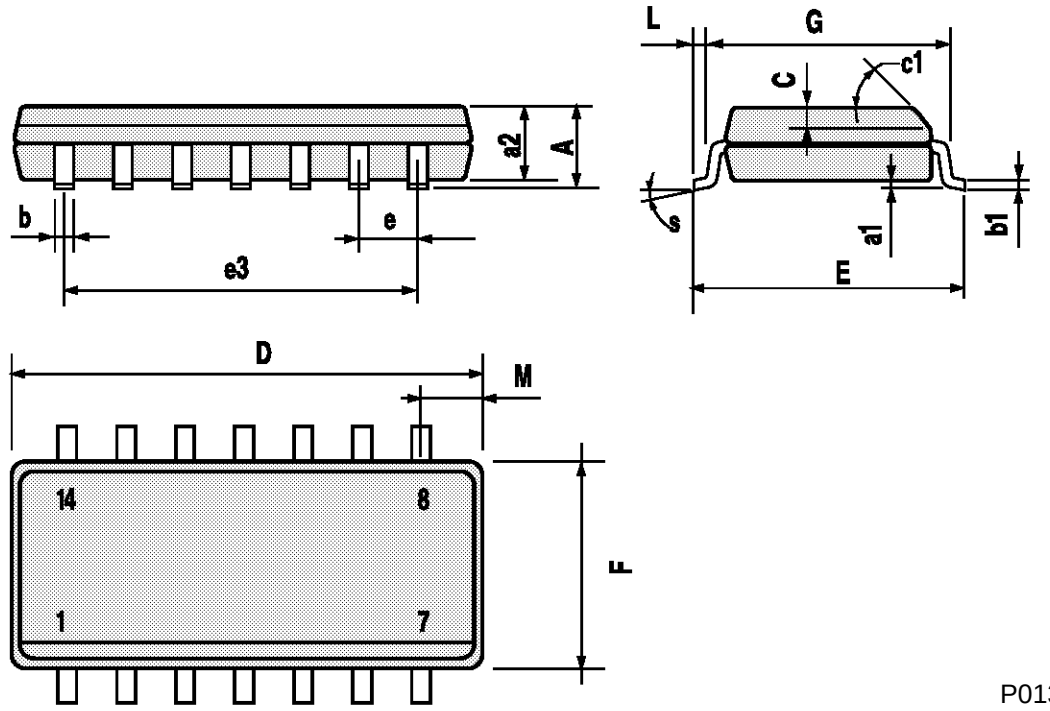
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			20			0.787
B			7.0			0.276
D		3.3			0.130	
E	0.38			0.015		
e3		15.24			0.600	
F	2.29		2.79	0.090		0.110
G	0.4		0.55	0.016		0.022
H	1.17		1.52	0.046		0.060
L	0.22		0.31	0.009		0.012
M	1.52		2.54	0.060		0.100
N			10.3			0.406
P	7.8		8.05	0.307		0.317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