



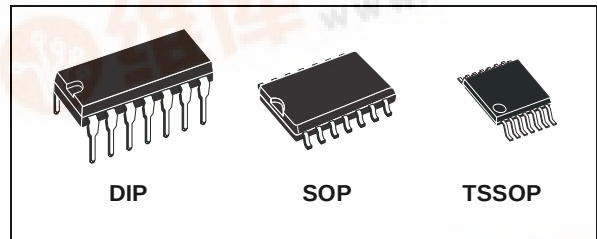
M74HC4016

QUAD BILATERAL SWITCH

- HIGH SPEED:
 $t_{PD} = 9ns$ (TYP.) at $V_{CC} = 6V$
- LOW POWER DISSIPATION:
 $I_{CC} = 1\mu A$ (MAX.) at $T_A = 25^\circ C$
- LOW "ON" RESISTANCE:
 $R_{ON} = 60\Omega$ TYP. AT $V_{CC} = 9V$, $I_{IO} = 100\mu A$
- WIDE OPERATING VOLTAGE RANGE
 V_{CC} (OPR) = 2V TO 12V
- SINE WAVE DISTORTION:
0.042% at $V_{CC} = 9V_{pp}$, $f = 1KHz$
- HIGH NOISE IMMUNITY:
 $V_{NIH} = V_{NIL} = 28\% V_{CC}$ (MIN.)
- PIN AND FUNCTION COMPATIBLE WITH
74 SERIES 4016

DESCRIPTION

The M74HC4016 is a high speed CMOS QUAD BILATERAL SWITCH fabricated with silicon gate C²MOS technology.

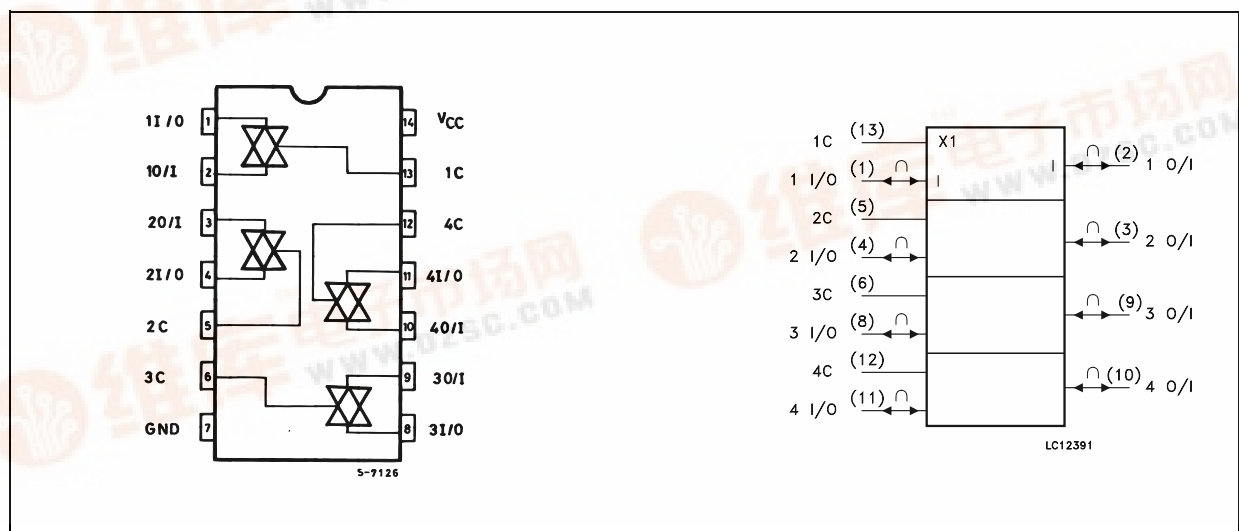


ORDER CODES

PACKAGE	TUBE	T & R
DIP	M74HC4016B1R	
SOP	M74HC4016M1R	M74HC4016RM13TR
TSSOP		M74HC4016TTR

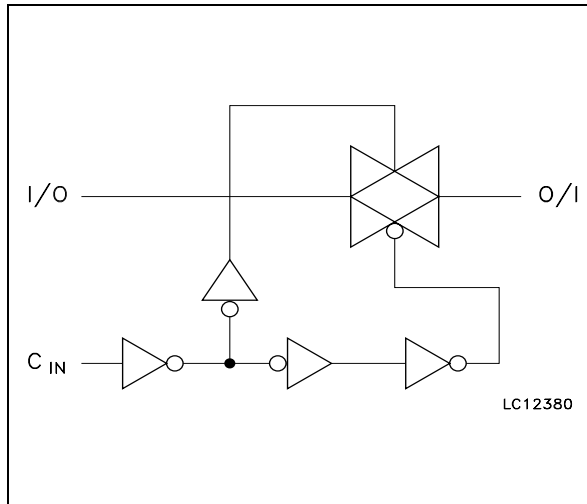
The C input is provided to control the switch; the switch is on when the C input is held high and off when C is held low.

PIN CONNECTION AND IEC LOGIC SYMBOLS



M74HC4016

LOGIC DIAGRAM



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 RATINGS

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 _{IOK}	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 conditions is not implied.

(*) 500mW at 65 °C; derate to 300mW by 10mW/°C from 65°C to 85°C

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Value	Unit
V _{CC}	Supply Voltage	2 to 12	V
V _{IN}	Input Voltage (Control)	0 to V _{CC}	V
V _{I/O}	I/O Voltage	0 to V _{CC}	V
T _{op}	Operating Temperature	-55 to 125	°C
t _r , t _f	Input Rise and Fall Time	V _{CC} = 2.0V	0 to 1000
		V _{CC} = 4.5V	0 to 500
		V _{CC} = 6.0V	0 to 400
		V _{CC} = 10.0V	0 to 250

DC SPECIFICATIONS

Symbol	Parameter	Test Condition		Value						Unit	
		V _{CC} (V)		T _A = 25°C			-40 to 85°C		-55 to 125°C		
				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}		160	320		400		450	Ω
		9.0	V _{I/O} = V _{CC} to GND		85	170		213		260	
		12.0	I _{I/O} = 100μA		60	120		150		180	
		4.5	V _{IN} = V _{IHC}		80	160		200		250	
		9.0	V _{I/O} = V _{CC} or GND		60	120		150		200	
		12.0	I _{I/O} = 100μA		50	100		125		150	
ΔR _{ON}	Difference of ON Resistance between switches	4.5	V _{IN} = V _{IHC}		16						Ω
		9.0	V _{I/O} = V _{CC} or GND		9						
		12.0	I _{I/O} ≤ 100μA		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	

M74HC4016

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

Symbol	Parameter	Test Condition		Value						Unit	
		V _{CC} (V)		T _A = 25°C			-40 to 85°C		-55 to 125°C		
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.
Φ _{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	

CAPACITIVE CHARACTERISTICS

Symbol	Parameter	Test Condition		Value						Unit	
		V _{CC} (V)		T _A = 25°C			-40 to 85°C		-55 to 125°C		
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.
C _{IN}	Input Capacitance				5	10		10		10	pF
C _{I/O}	Switch Terminal Capacitance				5						pF
C _{IOS}	Feed Through Capacitance				1						pF
C _{PD}	Power Dissipation Capacitance (note 1)				15						pF

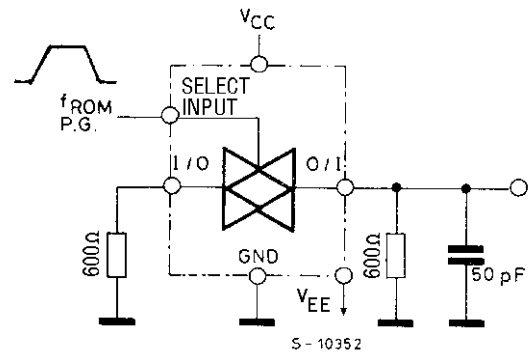
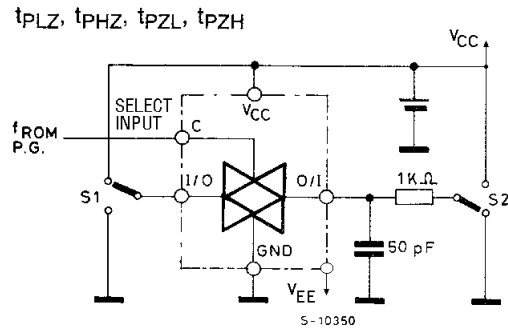
1) C_{PD} is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation. $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}$

ANALOG SWITCH CHARACTERISTICS (GND = 0V; $T_A = 25^\circ\text{C}$)

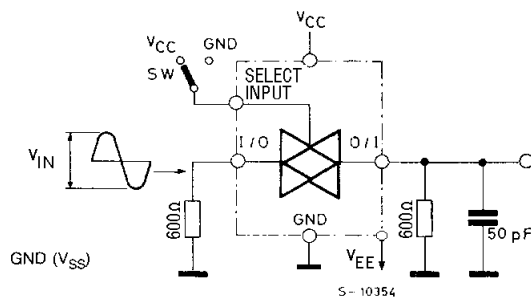
Symbol	Parameter	Test Condition		Value	Unit
		V_{CC} (V)	V_{IN} (V_{p-p})	Typ.	
	Sine Wave Distortion (THD)	4.5	4.5	0.118	%
		9.0	9.0	0.042	
		12.0	12.0	0.032	
f_{MAX}	Frequency Response (Switch ON)	4.5	Adjust f_{IN} voltage to obtain 0 dBm at V_{OS} . Increase f_{IN} Frequency until dB meter reads -3dB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

SWITCHING CHARACTERISTICS TEST CIRCUIT

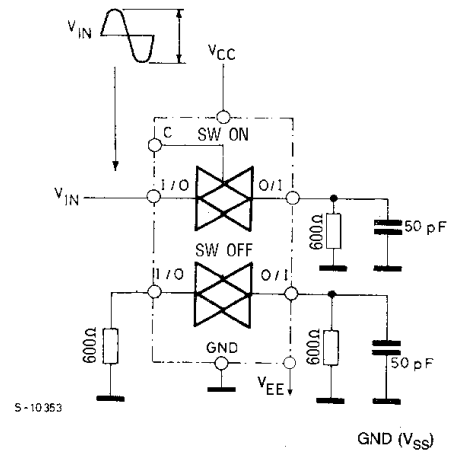
CROSSTALK (control to output)



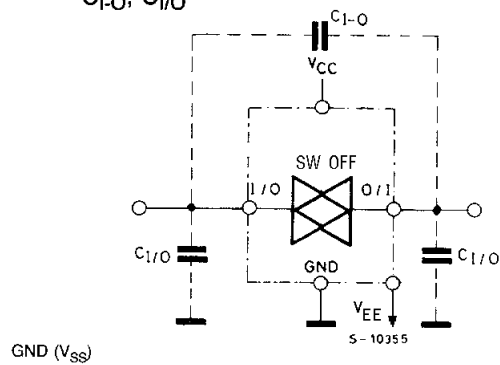
BANDWIDTH AND FEEDTHROUGH ATTENUATION



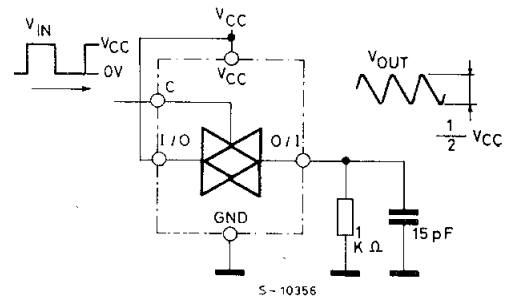
CROSSTALK BETWEEN ANY TWO SWITCHES

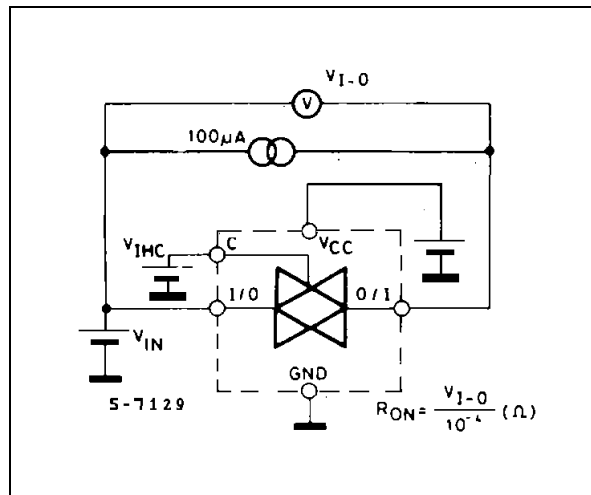
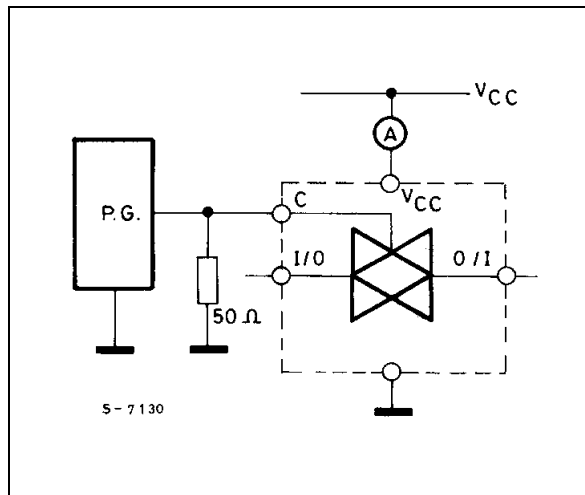


C_{I-O} , $C_{I/O}$



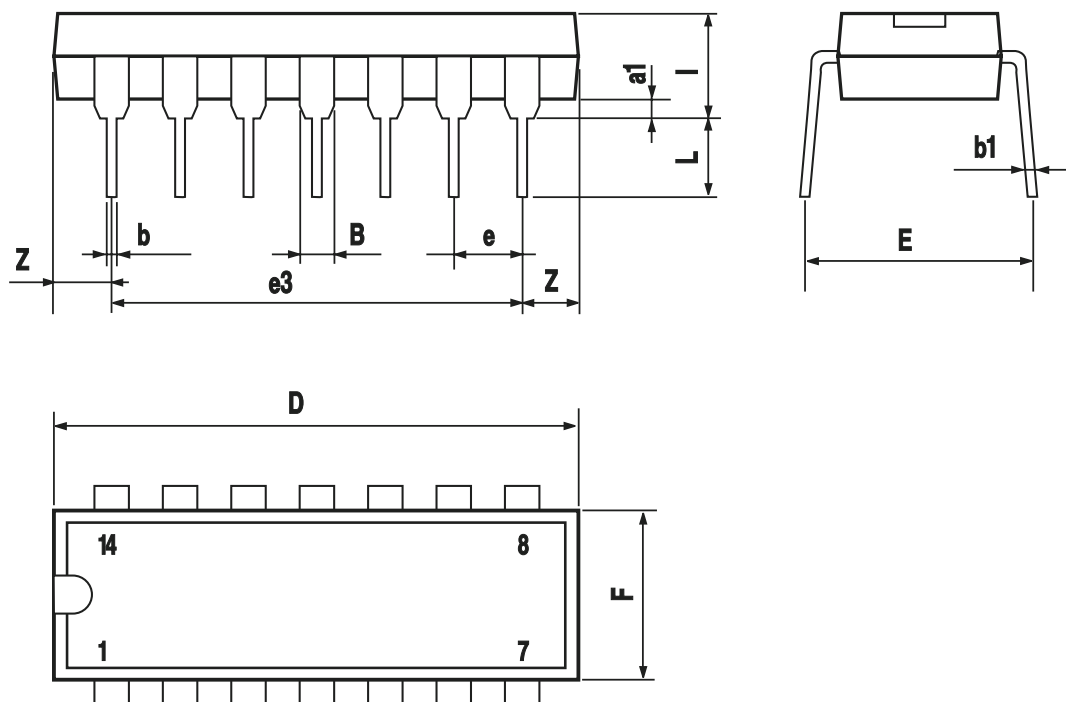
MAXIMUM CONTROL FREQUENCY



CHANNEL RESISTANCE (R_{ON}) I_{CC} (Opr.)

Plastic DIP-14 MECHANICAL DATA

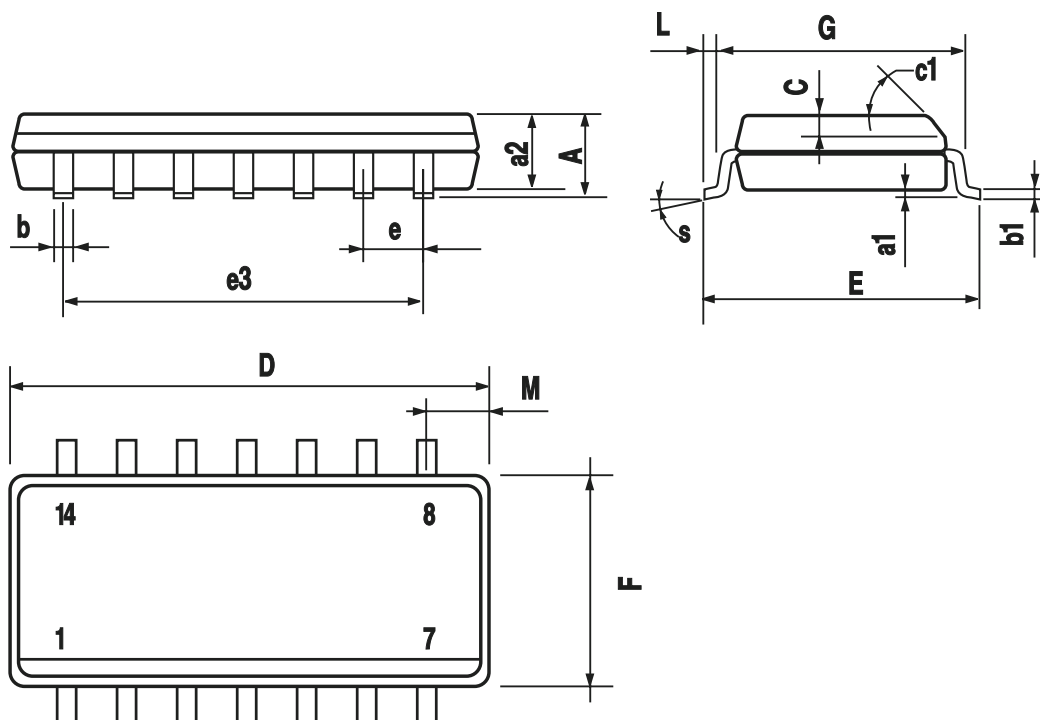
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	1.39		1.65	0.055		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		15.24			0.600	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z	1.27		2.54	0.050		0.100



P001A

SO-14 MECHANICAL DATA

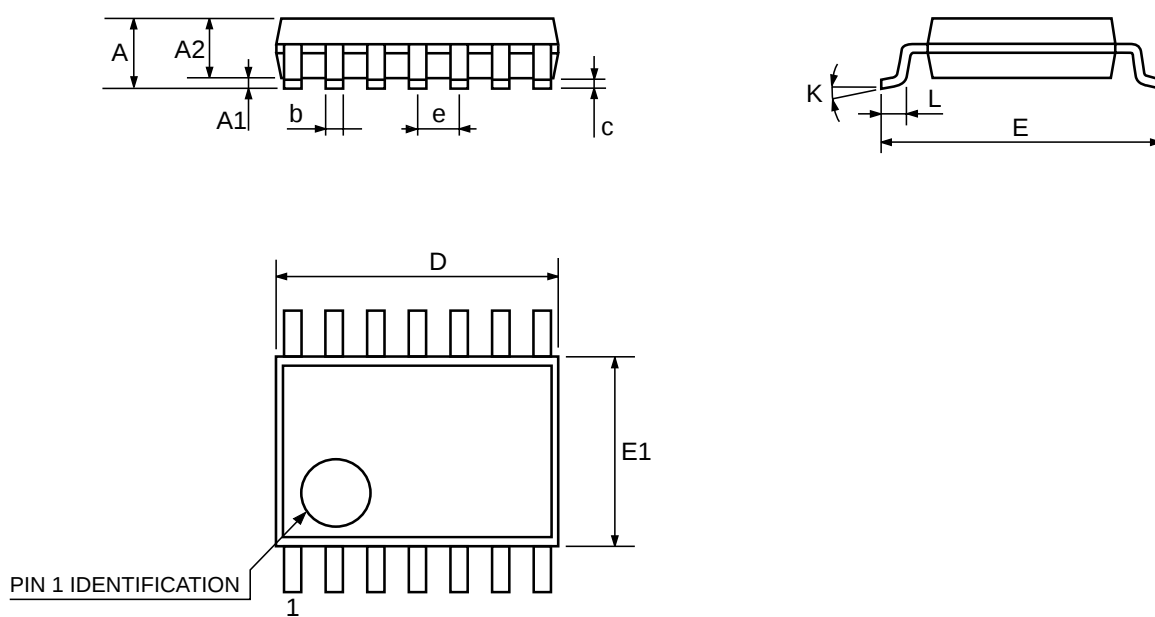
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.2	0.003		0.007
a2			1.65			0.064
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45° (typ.)					
D	8.55		8.75	0.336		0.344
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		7.62			0.300	
F	3.8		4.0	0.149		0.157
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.)					



PO13G

TSSOP14 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.2			0.047
A1	0.05		0.15	0.002	0.004	0.006
A2	0.8	1	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.012
c	0.09		0.20	0.004		0.0089
D	4.9	5	5.1	0.193	0.197	0.201
E	6.2	6.4	6.6	0.244	0.252	0.260
E1	4.3	4.4	4.48	0.169	0.173	0.176
e		0.65 BSC			0.0256 BSC	
K	0°		8°	0°		8°
L	0.45	0.60	0.75	0.018	0.024	0.030



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