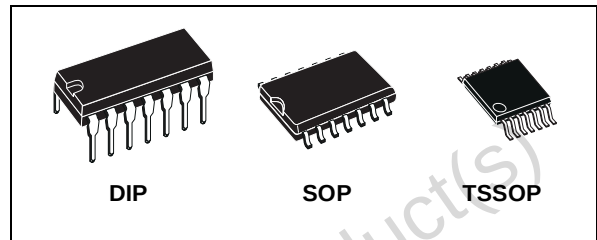




M74HC4016

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 $V_{CC} = 9V$, $I_{I/O} = 100\mu A$
- 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



ORDER CODES

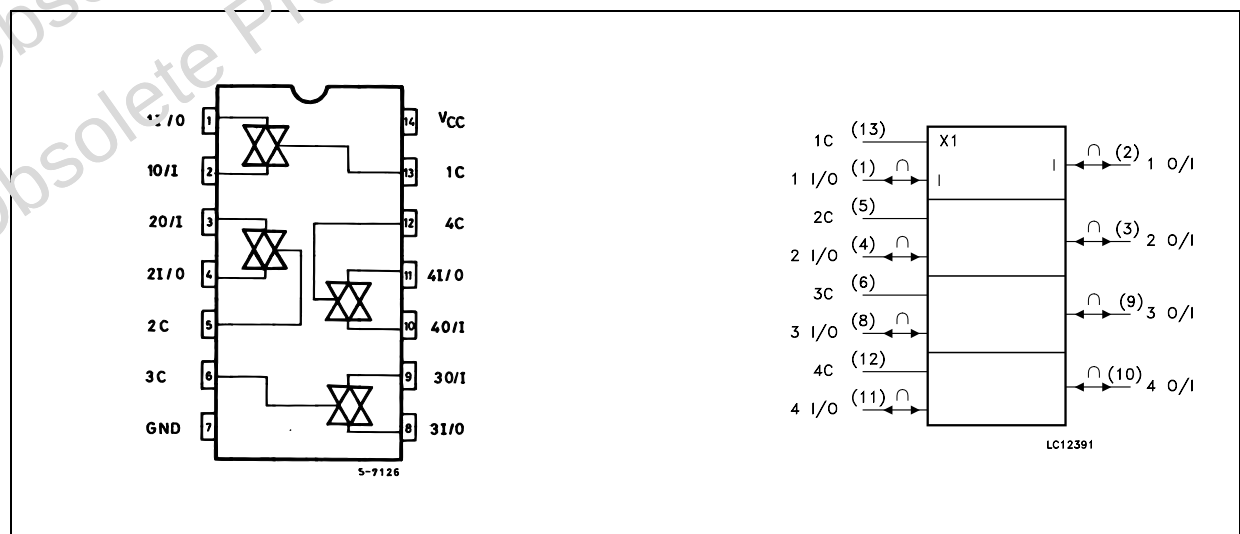
PACKAGE	TUBE	T & R
DIP	M74HC4016B1R	
SOP	M74HC4016M1R	M74HC4016RM13TR
TSSOP		M74HC4016TTR

DESCRIPTION

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

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



The logic diagram for the LC12380 shows three main inputs: **I/O**, **C_{IN}**, and **O/I**. The **I/O** signal is connected to a multiplexer (represented by a diamond with four triangles) and also to an inverter. The output of this inverter is connected to the **C_{IN}** input. The **C_{IN}** input is also connected to a chain of three inverters. The output of the first inverter is connected to the **O/I** input. The output of the second inverter is connected to the **I/O** input. The output of the third inverter is connected to the **O/I** input. The **O/I** input is also connected to the multiplexer. The output of the multiplexer is connected to the **O/I** output.

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

CONTROL	SWITCH FUNCTION
H	ON
L	OFF

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

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	$V_{CC} = 2.0V$	ns
		$V_{CC} = 4.5V$	
		$V_{CC} = 6.0V$	
		$V_{CC} = 10.0V$	

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				1		10		20	μA
		9.0	V _{IN} = V _{CC} or GND			4		40		80	
		12.0				8		80		160	

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

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

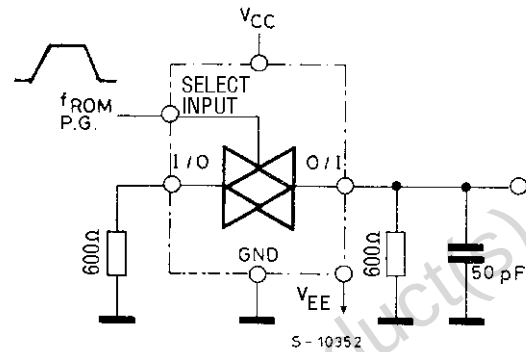
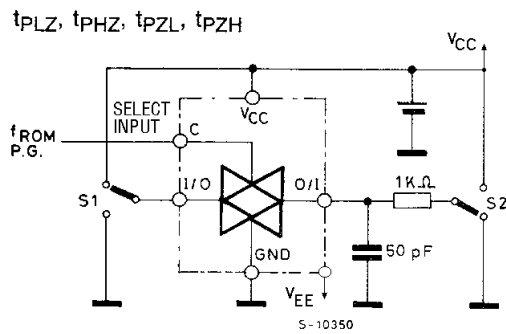
1) C_{PD} is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation. $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}$

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

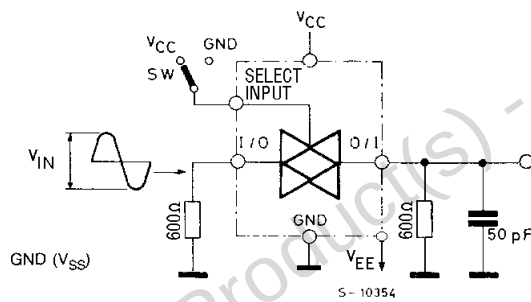
Symbol	Parameter	Test Condition			Value	Unit
		V _{CC} (V)	V _{IN} (V _{p-p})		Typ.	
	Sine Wave Distortion (THD)	4.5	4.5	f _{IN} = 1 KHz R _L = 10 KΩ, C _L = 50 pF	0.118	%
		9.0	9.0		0.042	
		12.0	12.0		0.032	
f _{MAX}	Frequency Response (Switch ON)	4.5	Adjust f _{IN} voltage to obtain 0 dBm at V _{OS} . Increase f _{IN} Frequency until dB meter reads -3dB R _L = 50Ω, 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 = 600Ω C _L = 50 pF, f _{IN} = 1MHz sine wave		-50	dB
		9.0			-50	
		12.0			-50	
	Crosstalk (Control Input to Signal Output)	4.5	R _L = 600Ω, C _L = 50 pF, f _{IN} = 1MHz 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 dBmat input R _L = 600Ω, C _L = 50 pF, f _{IN} = 1MHz sine wave		-50	dB
		9.0			-50	
		12.0			-50	

SWITCHING CHARACTERISTICS TEST CIRCUIT

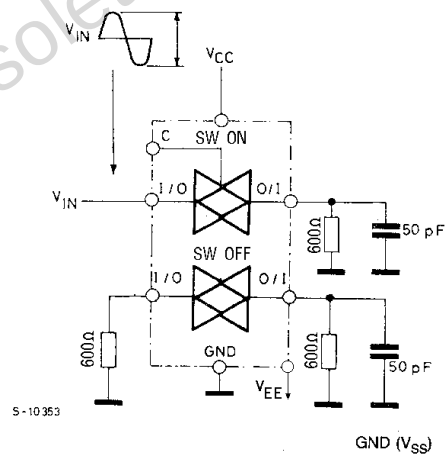
CROSSTALK (control to output)



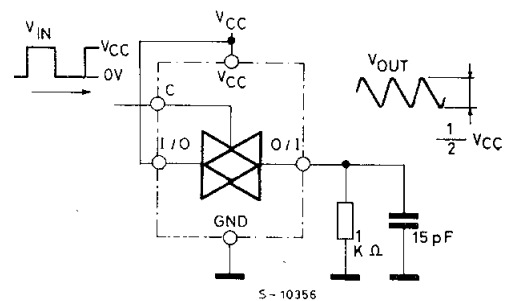
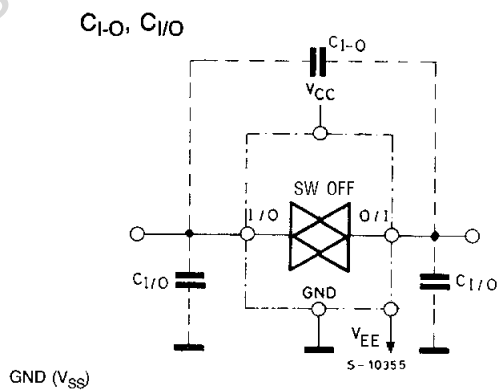
BANDWIDTH AND FEEDTHROUGH ATTENUATION

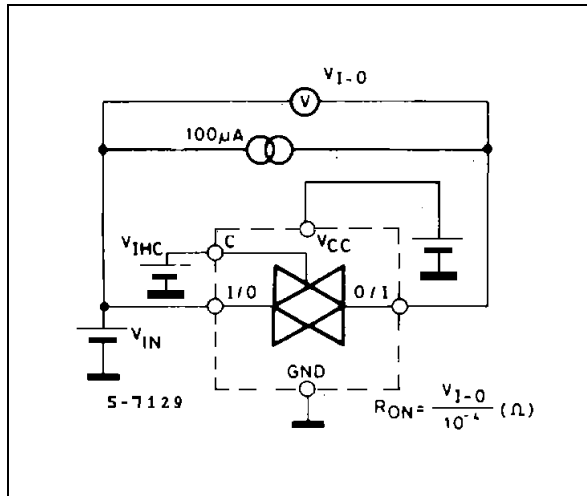
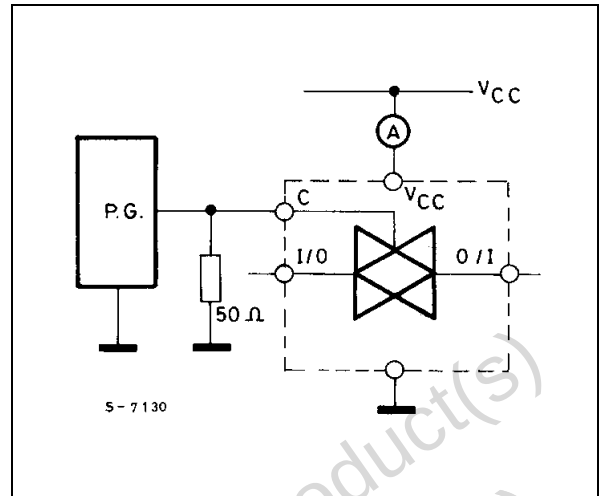


CROSSTALK BETWEEN ANY TWO SWITCHES



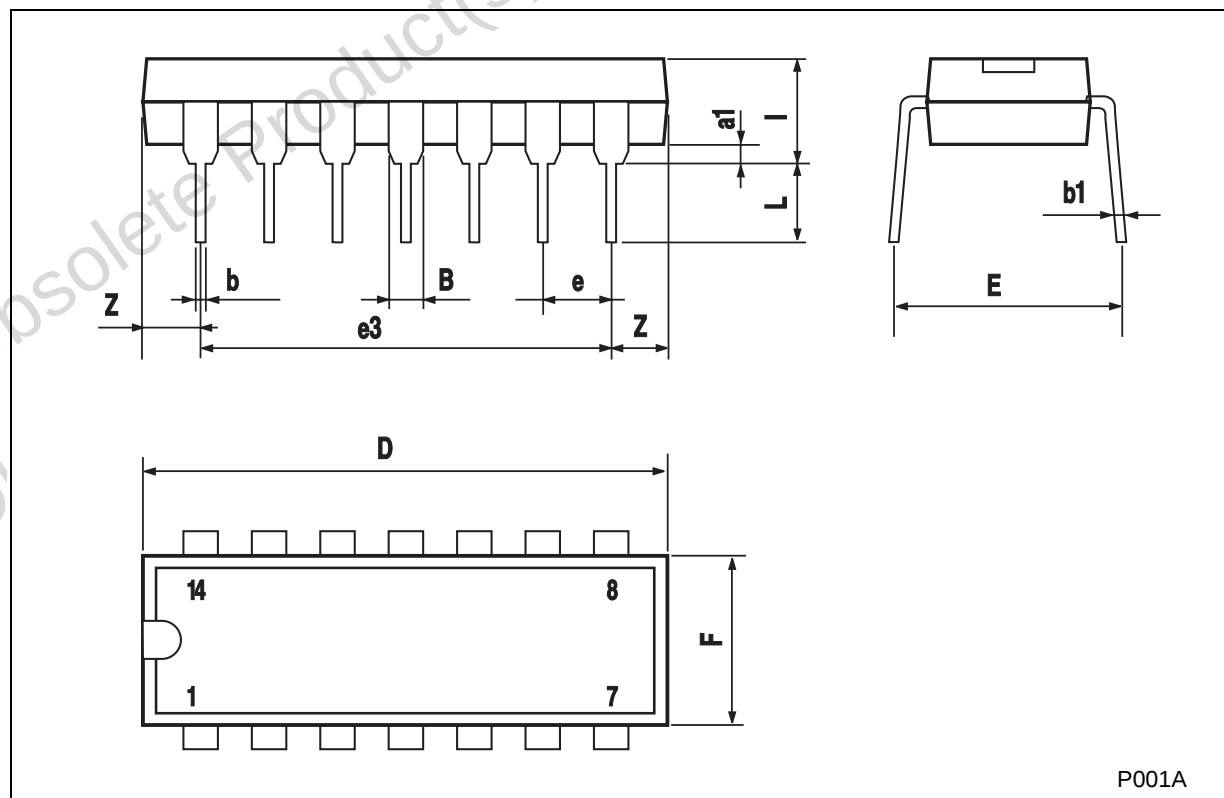
MAXIMUM CONTROL FREQUENCY



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

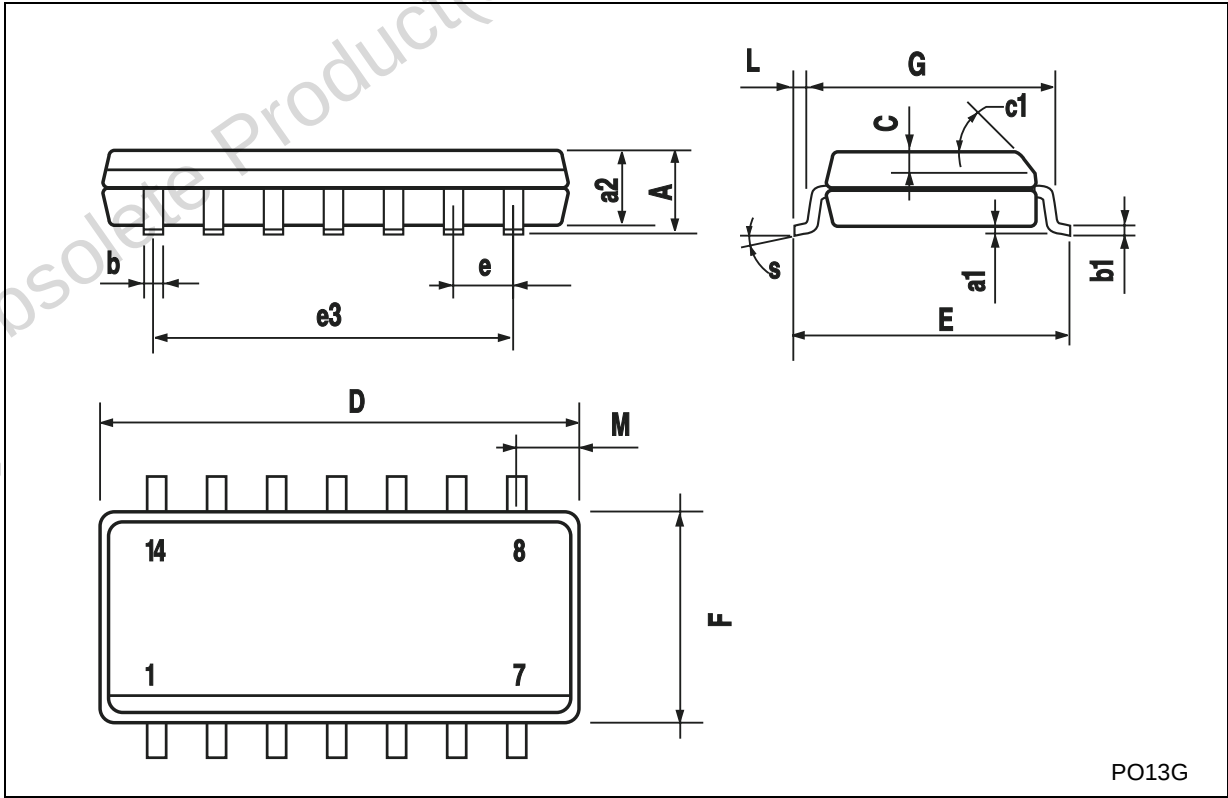
Plastic DIP-14 MECHANICAL DATA

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



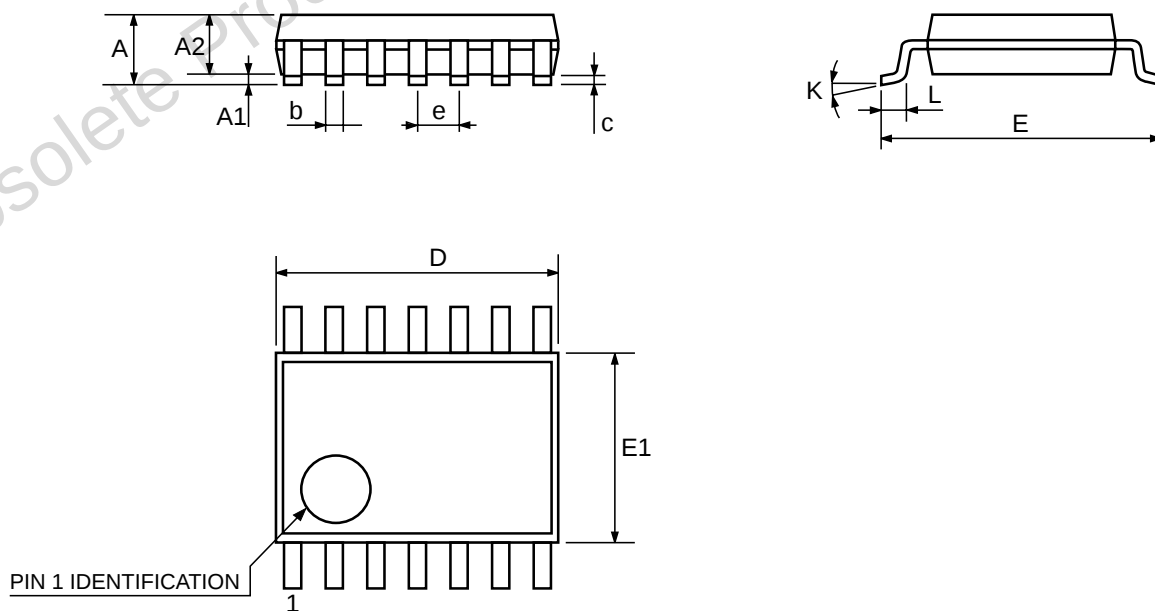
SO-14 MECHANICAL DATA

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.)					



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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