# M74HC4016

QUAD BILATERAL SWITCH

- **HIGH SPEED:**
  t_{PD} = 9ns (TYP.) at V_{CC} = 6V
- **LOW POWER DISSIPATION:**
  I_{CC} = 1μA(MAX.) at T_A=25°C
- **LOW "ON" RESISTANCE:**
  R_{ON} = 60Ω TYP. AT V_{CC} = 9V, $I_{I/O}$ = 100 μA
- **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**

DIP **SOP** **TSSOP**
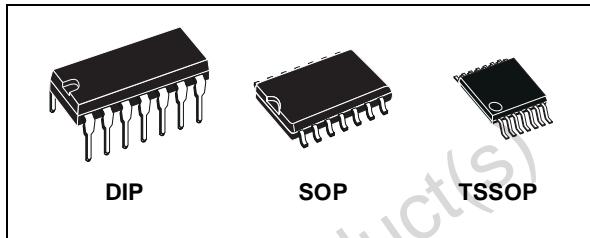
ORDER CODES

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 C^{2}MOS 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

LOGIC DIAGRAM

LC12380
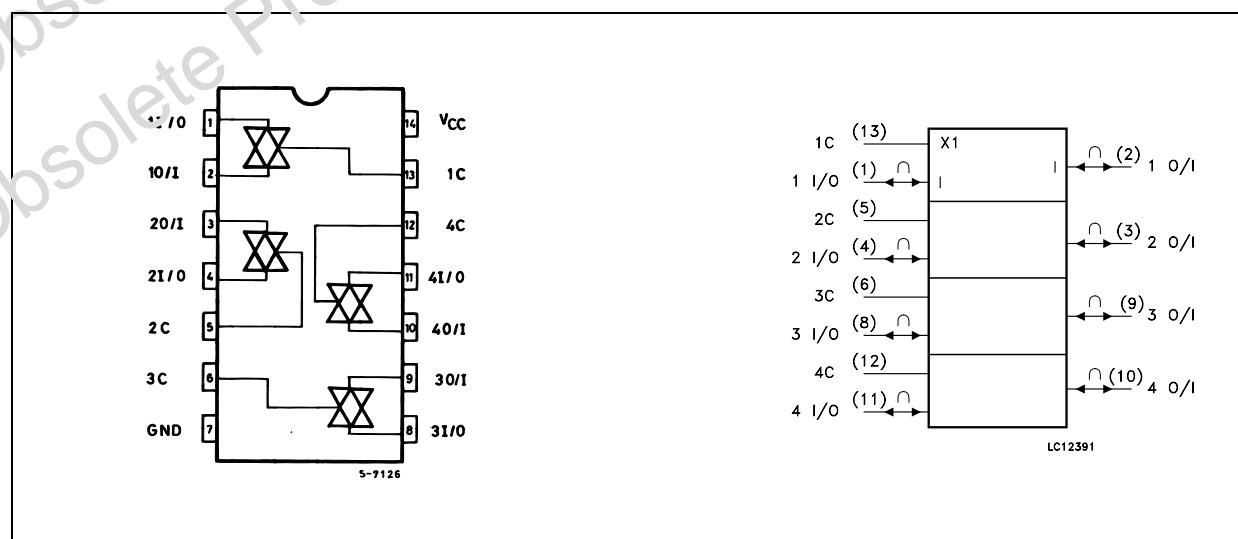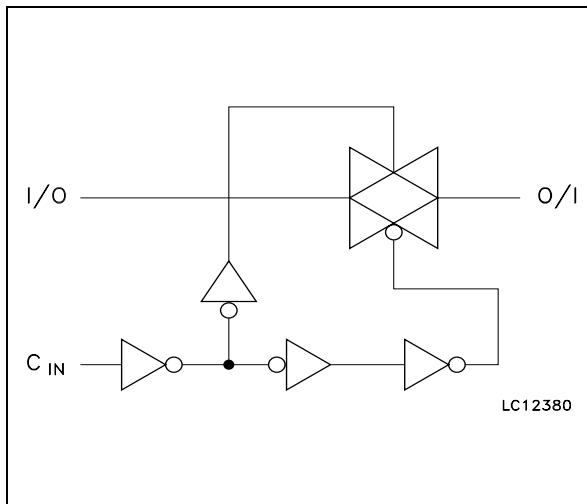
PIN DESCRIPTION

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	ns
		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 V_{CC} (V)		Value							Unit
				$T_A = 25°C$			-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	$I_{I/O} = 100\mu A$		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	$I_{I/O} = 100\mu A$		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	$I_{I/O} \leq 100\mu A$		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 pF, Input t_r = t_f = 6ns)

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.	
$\Phi_{I/O}$	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			40	100		125		150	ns
		4.5	R_L = 1KΩ		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			60	150		190		225	ns
		4.5	R_L = 1KΩ		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} x V_{CC} x f_{IN} + I_{CC}

ANALOG SWITCH CHARACTERISTICS (GND = 0V; T_A = 25°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 dBm at input R_L = 600Ω, C_L = 50 pF, f_{IN} = 1MHz sine wave	-50	dB
		9.0			-50	
		12.0			-50	

SWITCHING CARACTERISTICS TEST CIRCUIT

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

CROSSTALK (control to output)

BANDWIDTH AND FEEDTHROUGH ATTENUATION

CROSSTALK BETWEEN ANY TWO SWITCHES

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

MAXIMUM CONTROL FREQUENCY
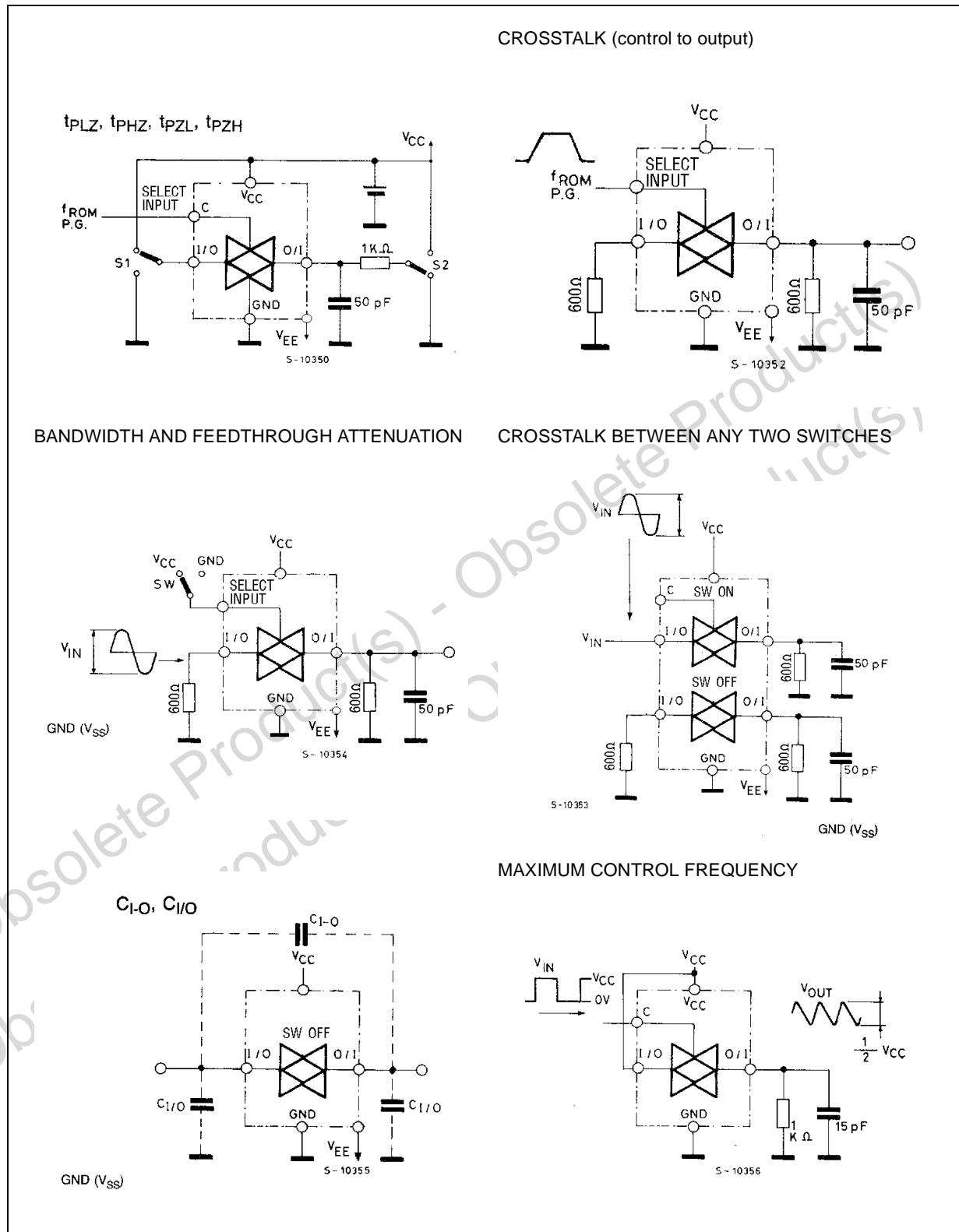
CHANNEL RESISTANCE (R$_{ON}$)

I_{CC} (Opr.)

$$R_{ON} = \frac{V_{I-0}}{10^{-4}} \; (\Omega)$$

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5-7130
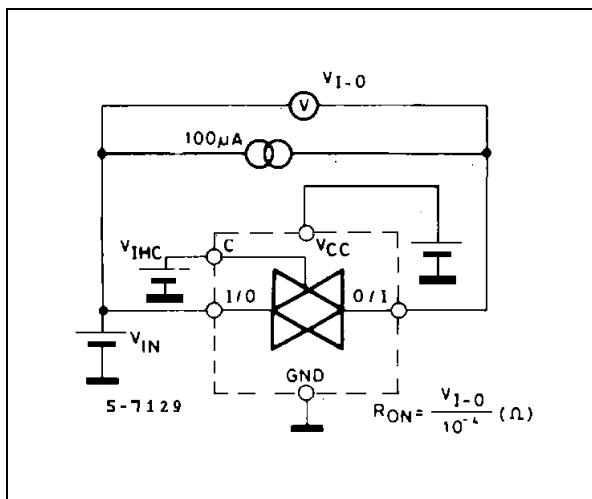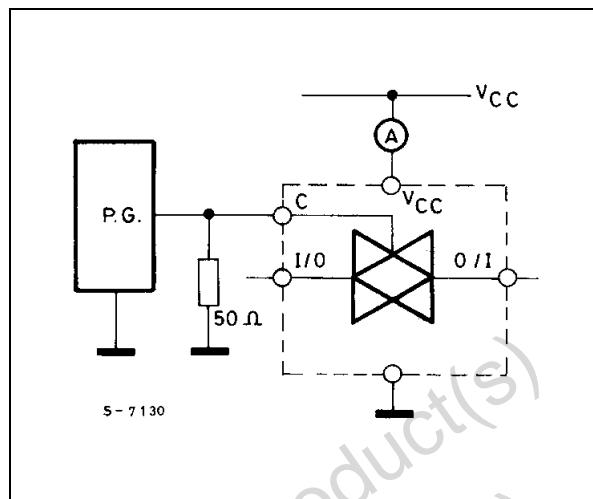
Plastic DIP-14 MECHANICAL DATA

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
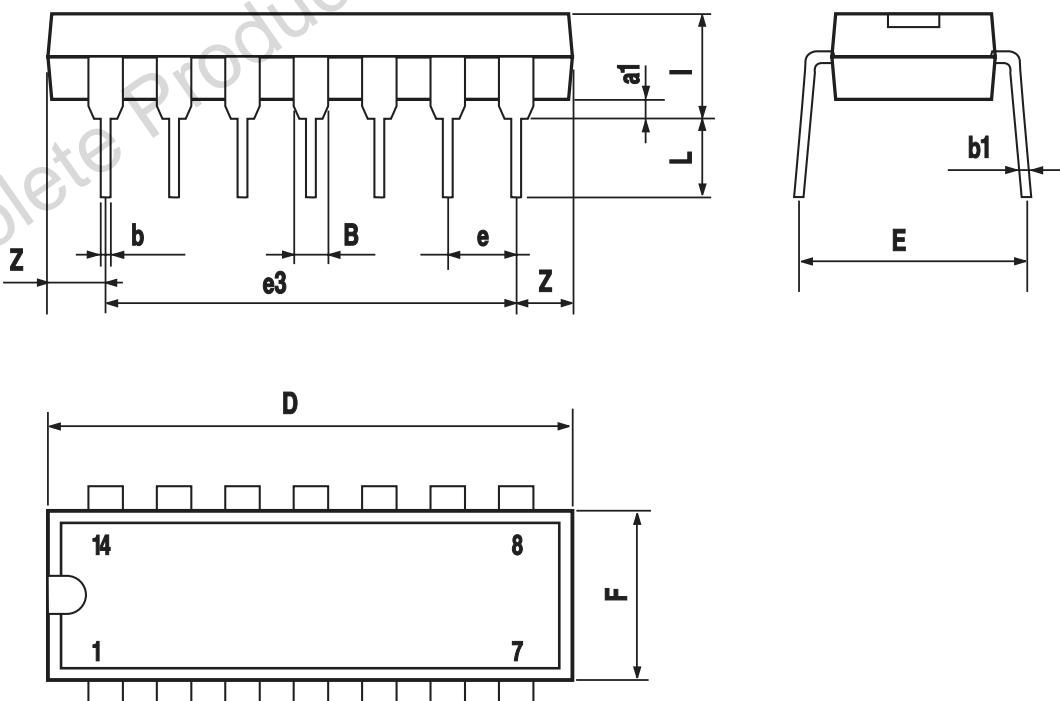
P001A

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

9/11
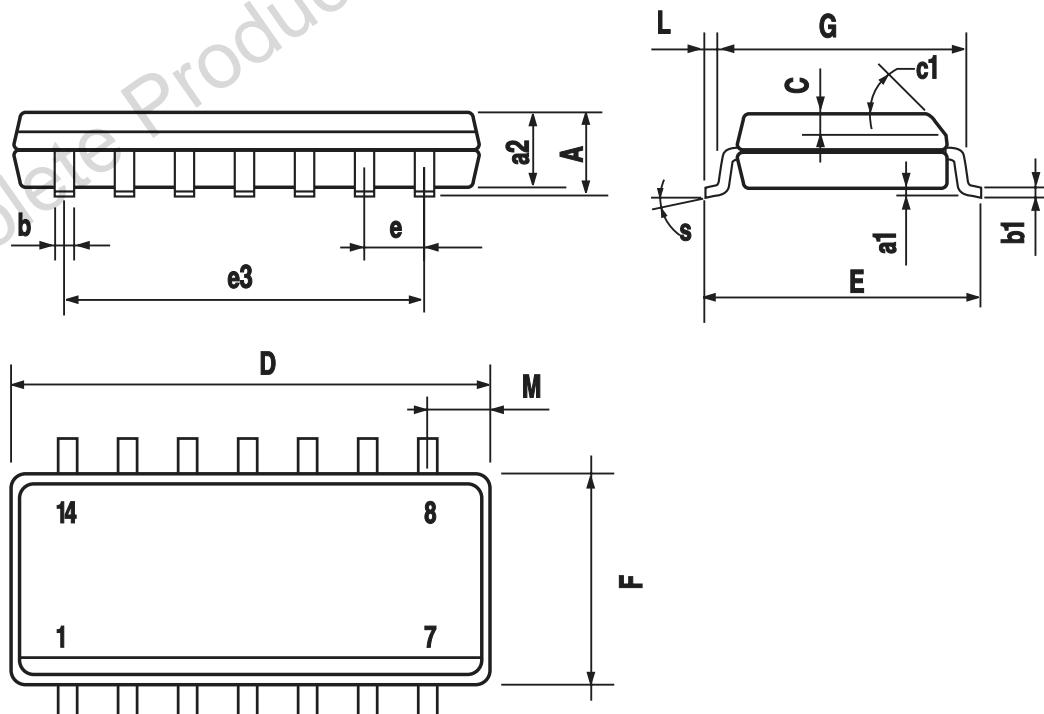
TSSOP14 MECHANICAL DATA

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

PIN 1 IDENTIFICATION

0080337D