



M74HC113

DUAL J-K FLIP FLOP WITH PRESET

- HIGH SPEED :
 $f_{MAX} = 79\text{MHz}$ (TYP.) at $V_{CC} = 6\text{V}$
- LOW POWER DISSIPATION:
 $I_{CC} = 2\mu\text{A}$ (MAX.) at $T_A = 25^\circ\text{C}$
- HIGH NOISE IMMUNITY:
 $V_{NIH} = V_{NIL} = 28\% V_{CC}$ (MIN.)
- SYMMETRICAL OUTPUT IMPEDANCE:
 $|I_{OH}| = I_{OL} = 4\text{mA}$ (MIN)
- BALANCED PROPAGATION DELAYS:
 $t_{PLH} \cong t_{PHL}$
- WIDE OPERATING VOLTAGE RANGE:
 V_{CC} (OPR) = 2V to 6V
- PIN AND FUNCTION COMPATIBLE WITH
 74 SERIES 113



ORDER CODES

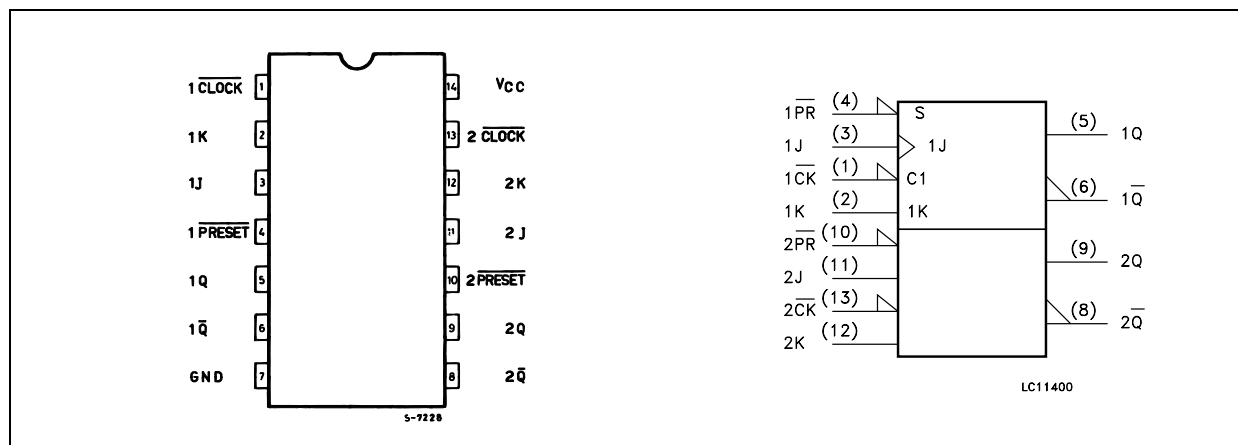
PACKAGE	TUBE	T & R
DIP	M74HC113B1R	
SOP	M74HC113M1R	M74HC113RM13TR
TSSOP		M74HC113TTR

DESCRIPTION

The M74HC113 is an high speed CMOS DUAL J-K FLIP FLOP WITH PRESET fabricated with silicon gate C²MOS technology. This circuit offers individual J, K, set, and clock inputs. These monolithic dual flip-flops are designed so that when the clock goes HIGH, the inputs are enabled and data will be accepted. The logic level of the J and K inputs may be allowed to

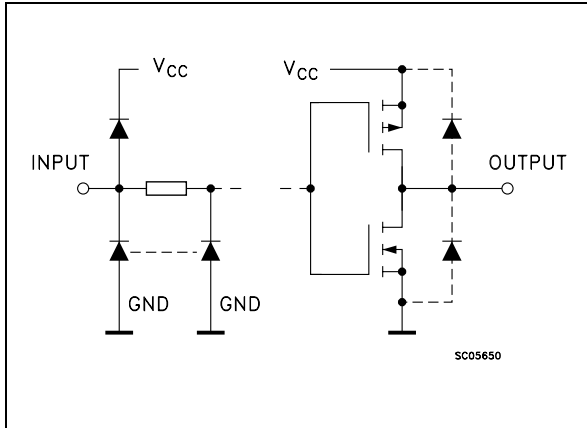
change when the clock pulse is HIGH and the bistable will function as shown in the truth table as long as minimum set-up times are observed. Input data is transferred to the outputs on the negative going edge of the clock pulse. All inputs are equipped with protection circuits against static discharge and transient excess voltage.

PIN CONNECTION AND IEC LOGIC SYMBOLS



M74HC113

INPUT AND OUTPUT EQUIVALENT CIRCUIT



PIN DESCRIPTION

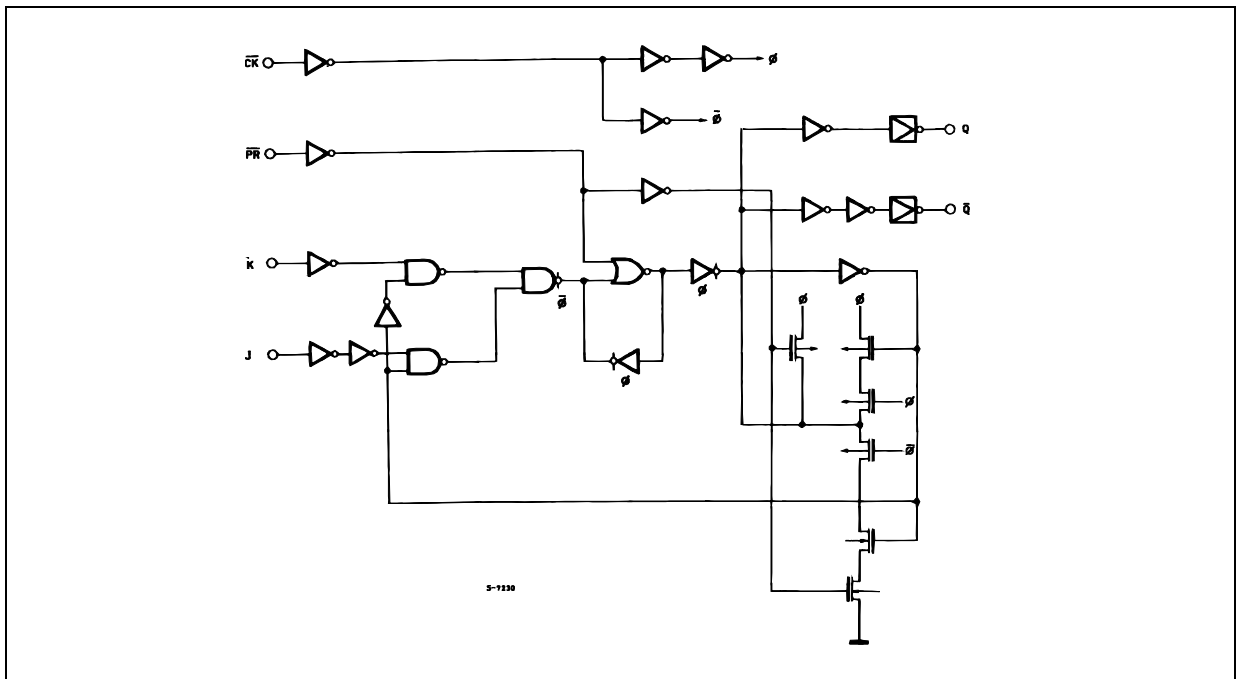
PIN No	SYMBOL	NAME AND FUNCTION
1, 13	$\overline{1CK}, \overline{2CK}$	Clock Input(HIGH to LOW edge triggered)
2, 12	1K, 2K	Data Inputs: Flip-Flop 1 and 2
3, 11	1J, 2J	Data Inputs: Flip-Flop 1 and 2
4, 10	1PR, 2PR	Set Inputs
5, 9	1Q, 2Q	True Flip-Flop Outputs
6, 8	$\overline{1Q}, \overline{2Q}$	Complement Flip-Flop Outputs
7	GND	Ground (0V)
14	Vcc	Positive Supply Voltage

TRUTH TABLE

INPUTS				OUTPUTS		FUNCTION
\overline{PR}	J	K	\overline{CK}	Q	\overline{Q}	
L	X	X	X	H	L	PRESET
H	L	L	\square	Q_n	\overline{Q}_n	NO CHANGE
H	L	H	\square	L	H	----
H	H	L	\square	H	L	----
H	H	H	\square	\overline{Q}_n	Q_n	TOGGLE
H	X	X	\square	Q_n	\overline{Q}_n	NO CHANGE

X : Don't Care

LOGIC DIAGRAM



This logic diagram has not be used to estimate propagation delays

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	-0.5 to +7	V
V_I	DC Input Voltage	-0.5 to $V_{CC} + 0.5$	V
V_O	DC Output Voltage	-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 Current	± 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 6	V	
V_I	Input Voltage	0 to V_{CC}	V	
V_O	Output 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	ns
		$V_{CC} = 6.0V$	0 to 400	ns

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 _{IH}	High Level 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 _{IL}	Low Level 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	
V _{OH}	High Level Output Voltage	2.0	I _O =-20 μA	1.9	2.0		1.9		1.9		V
		4.5	I _O =-20 μA	4.4	4.5		4.4		4.4		
		6.0	I _O =-20 μA	5.9	6.0		5.9		5.9		
		4.5	I _O =-4.0 mA	4.18	4.31		4.13		4.10		
		6.0	I _O =-5.2 mA	5.68	5.8		5.63		5.60		
V _{OL}	Low Level Output Voltage	2.0	I _O =20 μA		0.0	0.1		0.1		0.1	V
		4.5	I _O =20 μA		0.0	0.1		0.1		0.1	
		6.0	I _O =20 μA		0.0	0.1		0.1		0.1	
		4.5	I _O =4.0 mA		0.17	0.26		0.33		0.40	
		6.0	I _O =5.2 mA		0.18	0.26		0.33		0.40	
I _I	Input Leakage Current	6.0	V _I = V _{CC} or GND			± 0.1		± 1		± 1	μA
I _{CC}	Quiescent Supply Current	6.0	V _I = V _{CC} or GND			2		20		40	μA

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

Symbol	Parameter	Test Condition		Value						Unit	
				$T_A = 25^\circ\text{C}$			$-40 \text{ to } 85^\circ\text{C}$		$-55 \text{ to } 125^\circ\text{C}$		
				V_{CC} (V)	Min.	Typ.	Max.	Min.	Max.		Min.
t_{TLH} t_{THL}	Output Transition Time	2.0			30	75		95		110	ns
		4.5			8	15		19		22	
		6.0			7	13		16		19	
t_{PLH} t_{PHL}	Propagation Delay Time ($\overline{CK} - Q, \overline{Q}$)	2.0			46	125		155		190	ns
		4.5			16	25		31		38	
		6.0			12	21		26		32	
t_{PLH} t_{PHL}	Propagation Delay Time (PRESET - Q, Q)	2.0			48	125		155		190	ns
		4.5			16	25		31		38	
		6.0			13	21		26		32	
f_{MAX}	Maximum Clock Frequency	2.0			8	16		6.4		5.4	MHz
		4.5			40	63		32		27	
		6.0			47	79		38		32	
$t_{W(H)}$ $t_{W(L)}$	Minimum Pulse Width (CLOCK)	2.0			16	75		95		110	ns
		4.5			4	15		19		22	
		6.0			3	13		16		19	
$t_{W(L)}$	Minimum Pulse Width (PRESET)	2.0			16	75		95		110	ns
		4.5			4	15		19		22	
		6.0			3	13		16		19	
t_s	Minimum Set-up Time	2.0			16	50		65		75	ns
		4.5			4	10		13		15	
		6.0			3	9		11		13	
t_h	Minimum Hold Time	2.0				0		0		0	ns
		4.5				0		0		0	
		6.0					0		0	0	
t_{REM}	Minimum Removal Time (PRESET)	2.0				5		5		5	ns
		4.5				5		5		5	
		6.0					5		5		

CAPACITIVE CHARACTERISTICS

Symbol	Parameter	Test Condition		Value						Unit	
				$T_A = 25^\circ\text{C}$			$-40 \text{ to } 85^\circ\text{C}$		$-55 \text{ to } 125^\circ\text{C}$		
				V_{CC} (V)	Min.	Typ.	Max.	Min.	Max.		Min.
C_{IN}	Input Capacitance	5.0			5	10		10		10	pF
C_{PD}	Power Dissipation Capacitance (note 1)	5.0			37						pF

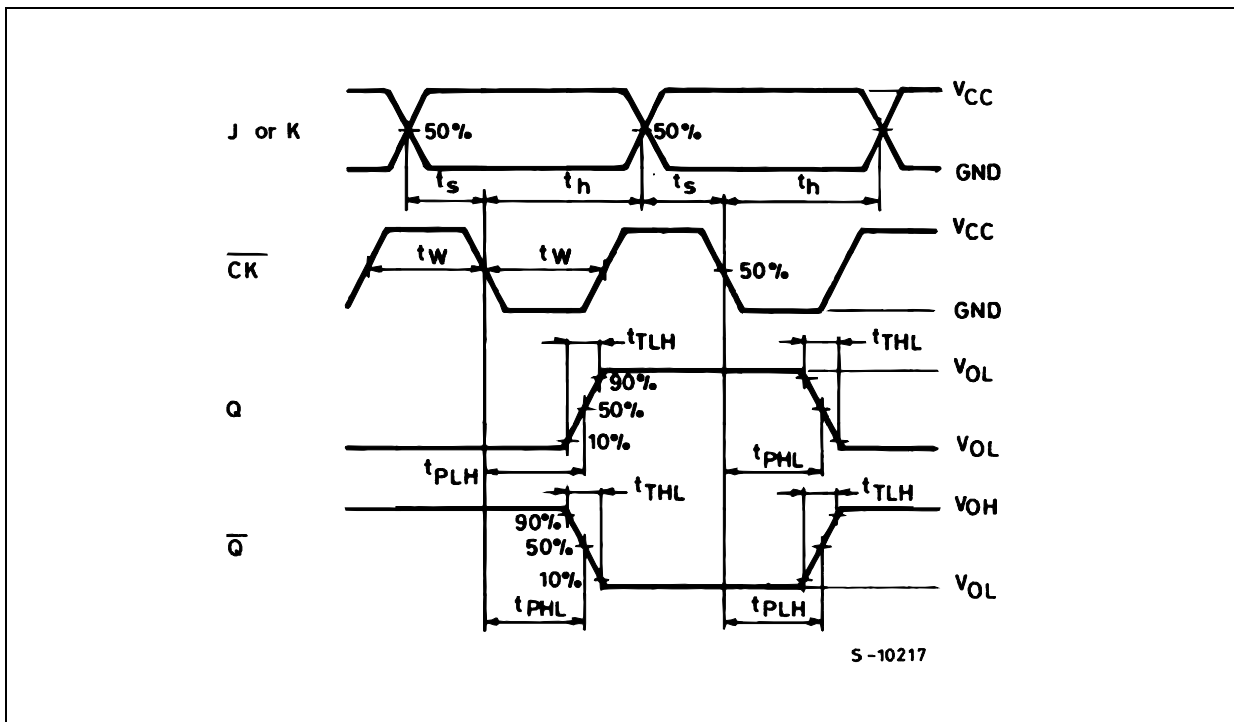
1) C_{PD} is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation. $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/2$ (per FLIP/FLOP)

TEST CIRCUIT

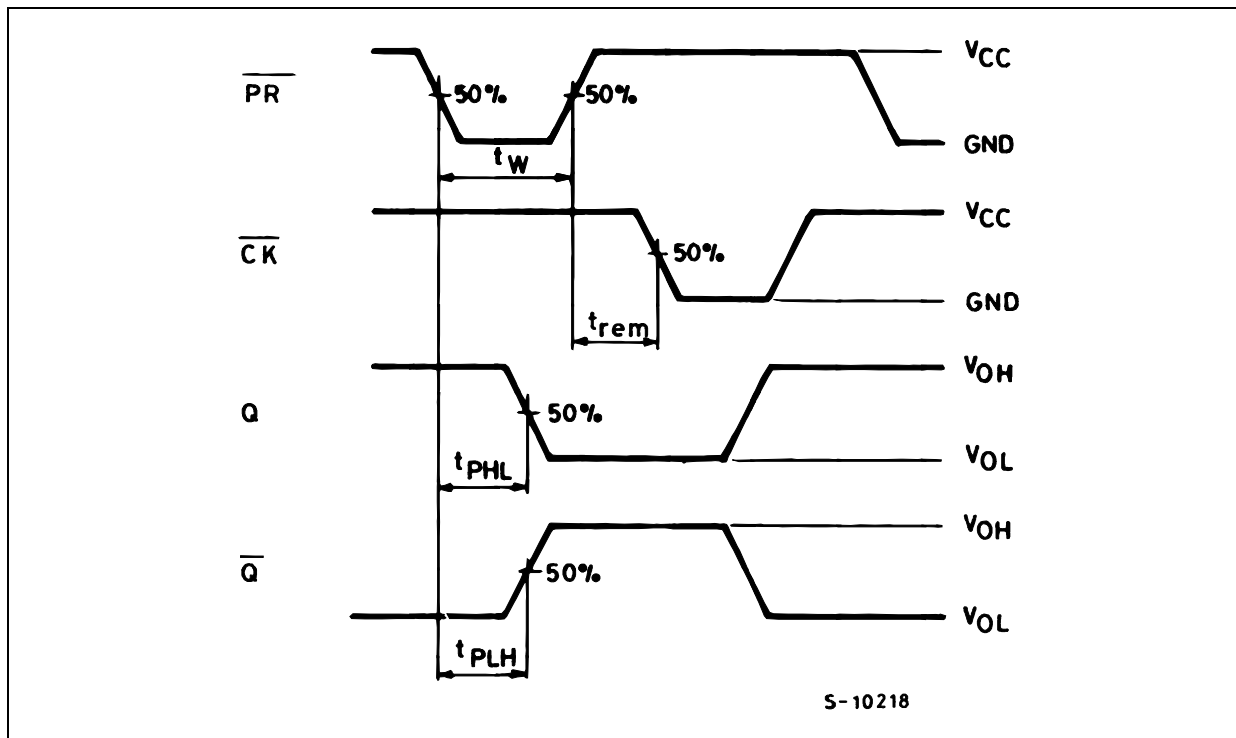


$C_L = 50\text{pF}$ or equivalent (includes jig and probe capacitance)
 $R_T = Z_{OUT}$ of pulse generator (typically 50Ω)

WAVEFORM 1 : PROPAGATION DELAY TIMES, MINIMUM PULSE WIDTH (CK), SETUP AND HOLD TIME (J or K to CK) ($f=1\text{MHz}$; 50% duty cycle)

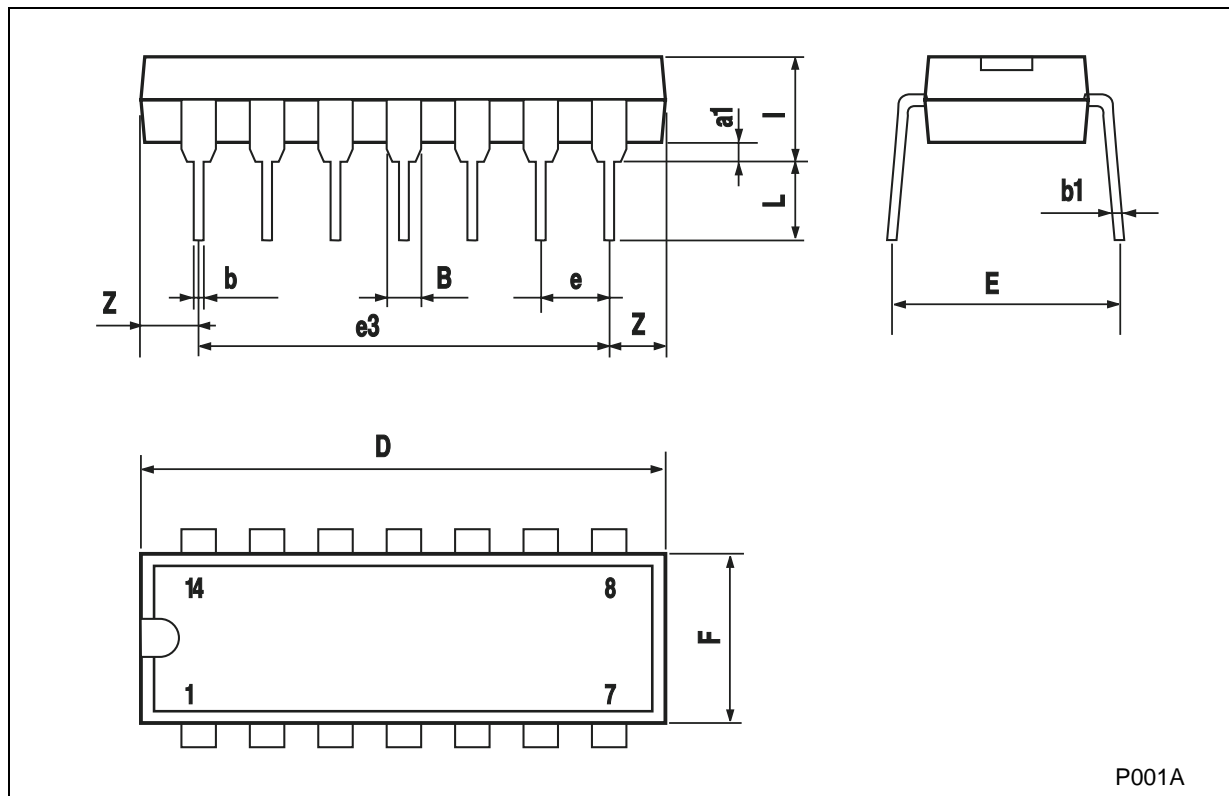


WAVEFORM 2 : MINIMUM PULSE WIDTH (\overline{PR}), REMOVAL TIME (\overline{PR} to \overline{CK})
(f=1MHz; 50% duty cycle)



Plastic DIP-14 MECHANICAL DATA						
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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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