M74HC4040

12 STAGE BINARY COUNTER

- HIGH SPEED :
  f_{MAX} = 70 MHz (TYP.) at V_{CC} = 6V
- LOW POWER DISSIPATION:
  I_{CC} =4μA(MAX.) at T_A=25°C
- HIGH NOISE IMMUNITY:
  V_{NIH} = V_{NIL} = 28 % V_{CC} (MIN.)
- SYMMETRICAL OUTPUT IMPEDANCE:
  $|I_{OH}|$ = I_{OL} = 4mA (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 4040

DIP   **SOP**   **TSSOP**

ORDER CODES

PACKAGE	TUBE	T & R
DIP	M74HC4040B1R	
SOP	M74HC4040M1R	M74HC4040RM13TR
TSSOP		M74HC4040TTR

DESCRIPTION

The M74HC4040 is an high speed CMOS 12 STAGE BINARY COUNTER fabricated with silicon gate C^2MOS technology.

A clear input is used to reset the counter to the all low level state. A high level on CLEAR accomplishes the reset function. A negative transition on the CLOCK input increments the counter by one.

For M74HC4040 each division stage has an output; the final frequency is 1/4096 f_{IN}.

All inputs are equipped with protection circuits against static discharge and transient excess voltage.

PIN CONNECTION AND IEC LOGIC SYMBOLS
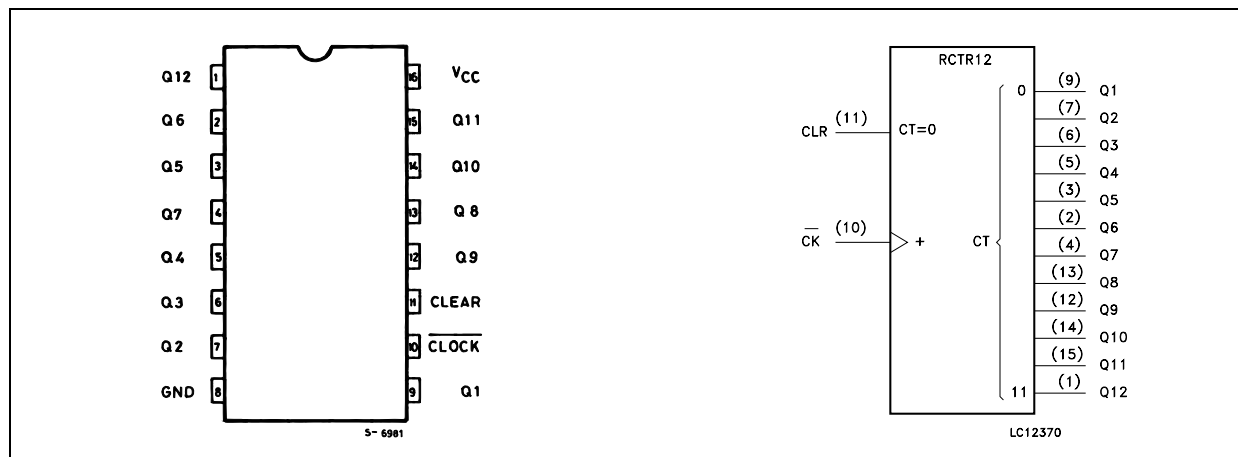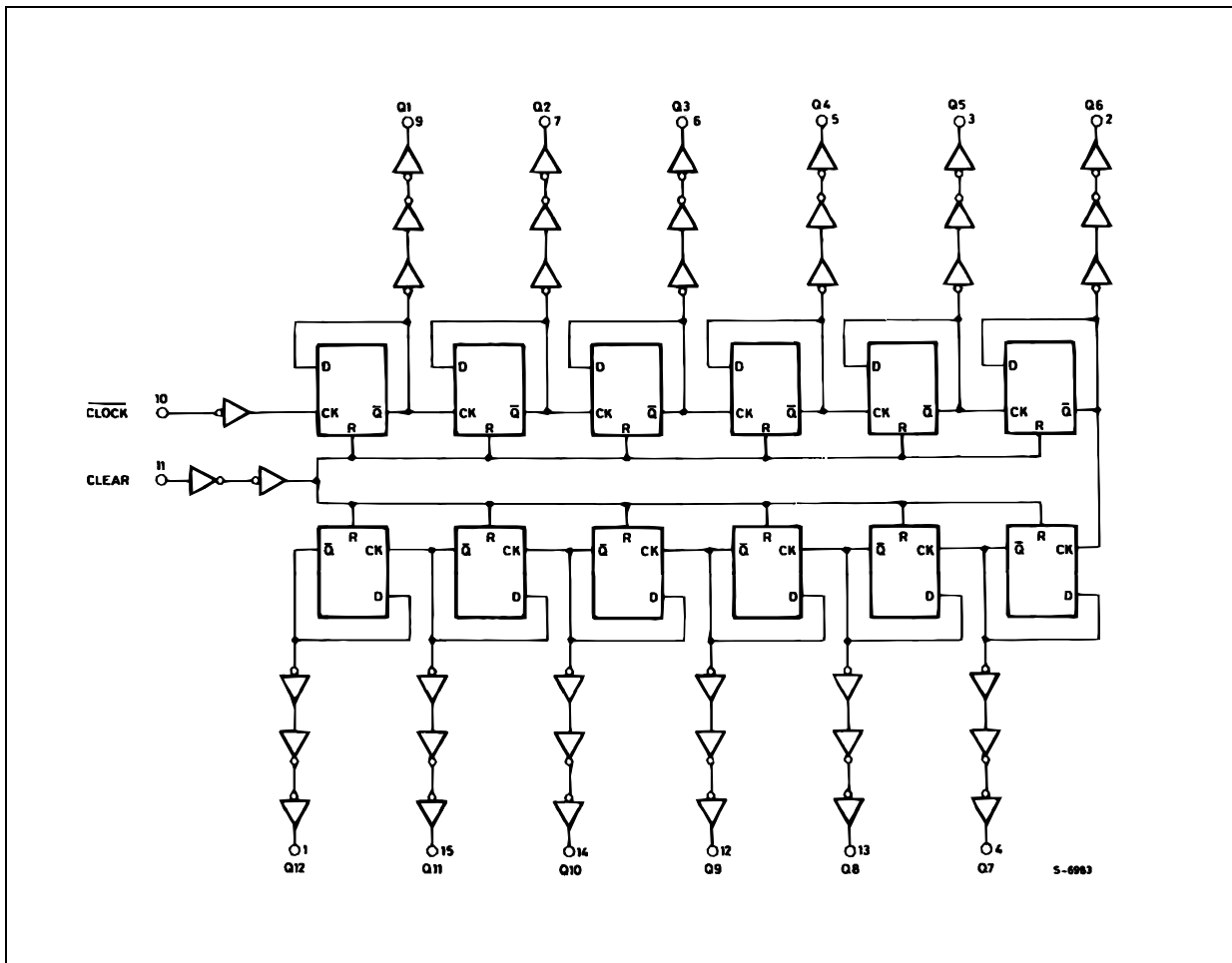
INPUT AND OUTPUT EQUIVALENT CIRCUIT

SC05650

PIN DESCRIPTION

PIN No	SYMBOL	NAME AND FUNCTION
9, 7, 6, 5, 3, 2, 4, 13, 12, 14, 15, 1	Q1 to Q12	Parallel Outputs
10	$\overline{\text{CLOCK}}$	Clock Input (LOW to HIGH, Edge Triggered)
11	CLEAR	Reset Inputs
8	GND	Ground (0V)
16	Vcc	Positive Supply Voltage

TRUTH TABLE

$\overline{\text{CLOCK}}$	CLEAR	OUTPUT STATE
X	H	ALL OUTPUTS = "L"
⌐	L	NO CHANGE
⌐⌐	L	ADVANCE TO NEXT STATE

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

M74HC4040

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			4		40		80	µA

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.	
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 (Qn - Qn+1)	2.0			20	50		65		75	ns
		4.5			5	10		13		15	
		6.0			4	9		11		13	
t_{PLH} t_{PHL}	Propagation Delay Time ($\overline{CLOCK}$ Q1)	2.0			48	145		180		220	ns
		4.5			17	29		36		44	
		6.0			13	25		31		38	
t_{PHL}	Propagation Delay Time (CLEAR - Qn)	2.0			56	140		175		210	ns
		4.5			18	28		35		42	
		6.0			15	24		30		36	
f_{MAX}	Maximum Clock Frequency	2.0		6.0	15		4.8		4		MHz
		4.5		30	65		24		20		
		6.0		35	70		28		24		
$t_{W(H)}$ $t_{W(L)}$	Minimum Pulse Width (CLOCK)	2.0			40	75		95		110	ns
		4.5			8	15		19		22	
		6.0			7	13		16		19	
$t_{W(H)}$	Minimum Pulse Width (CLEAR)	2.0			70	175		220		265	ns
		4.5			19	35		44		53	
		6.0			16	30		37		45	
t_{REM}	Minimum Removal Time	2.0				25		30		40	ns
		4.5				5		6		8	
		6.0				5		5		7	

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	5.0			5	10		10		10	pF
C_{PD}	Power Dissipation Capacitance (note 1)	5.0			34						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}/2 (per FLIP/FLOP)
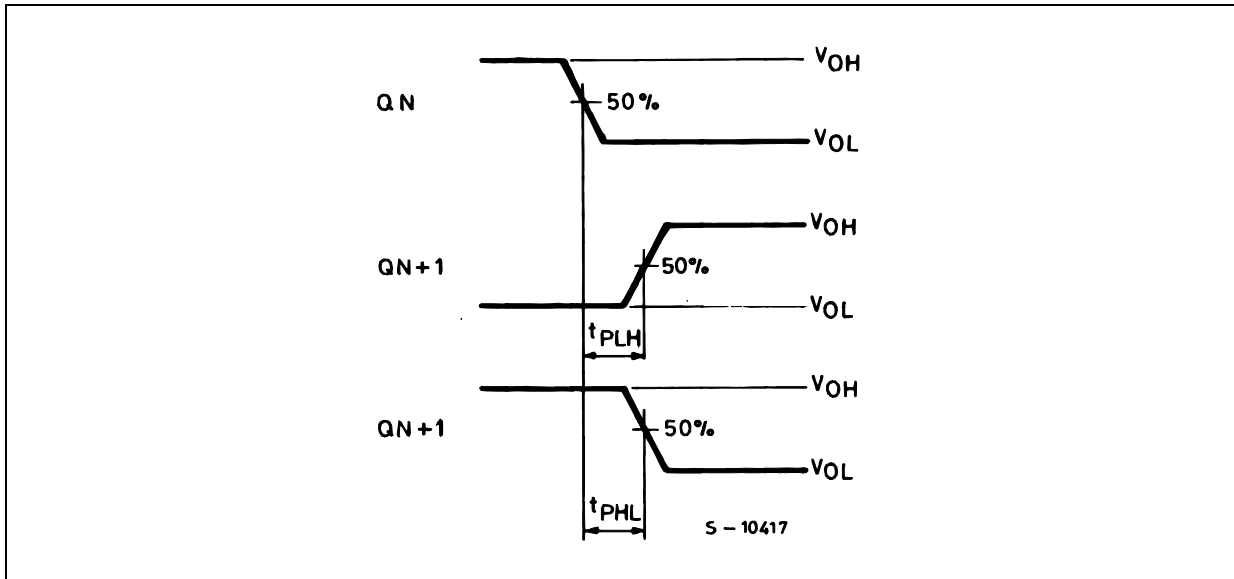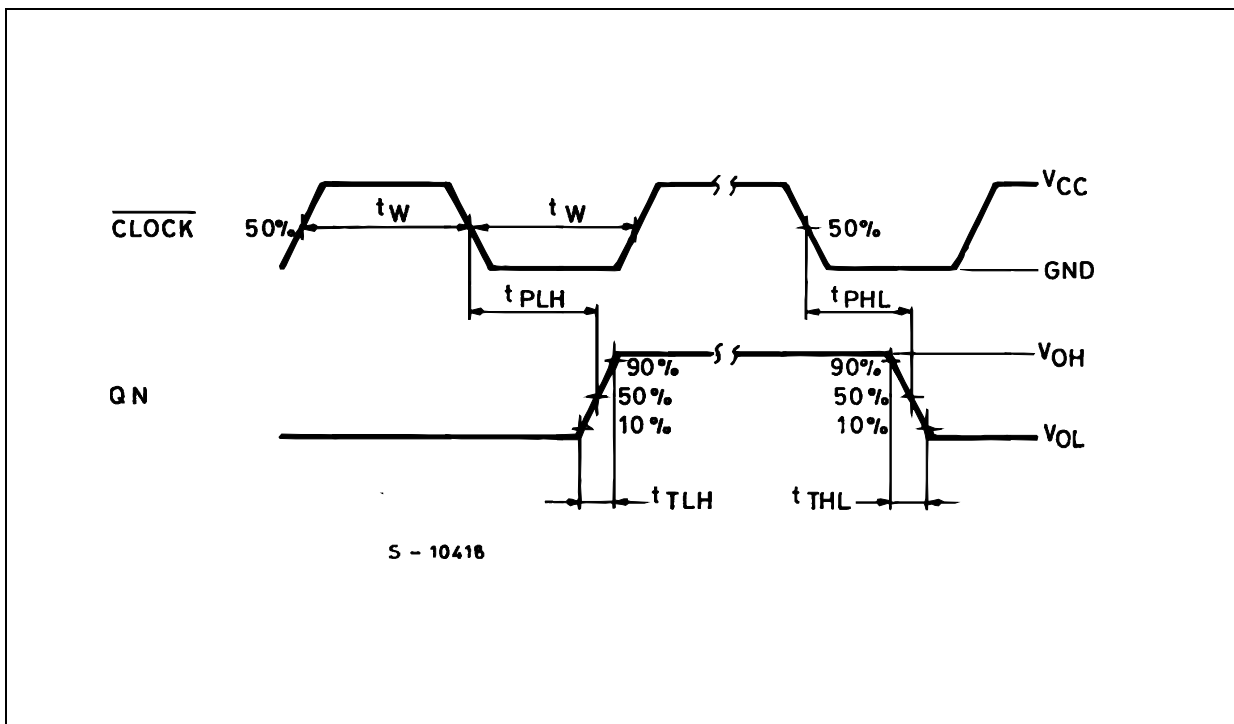
TEST CIRCUIT
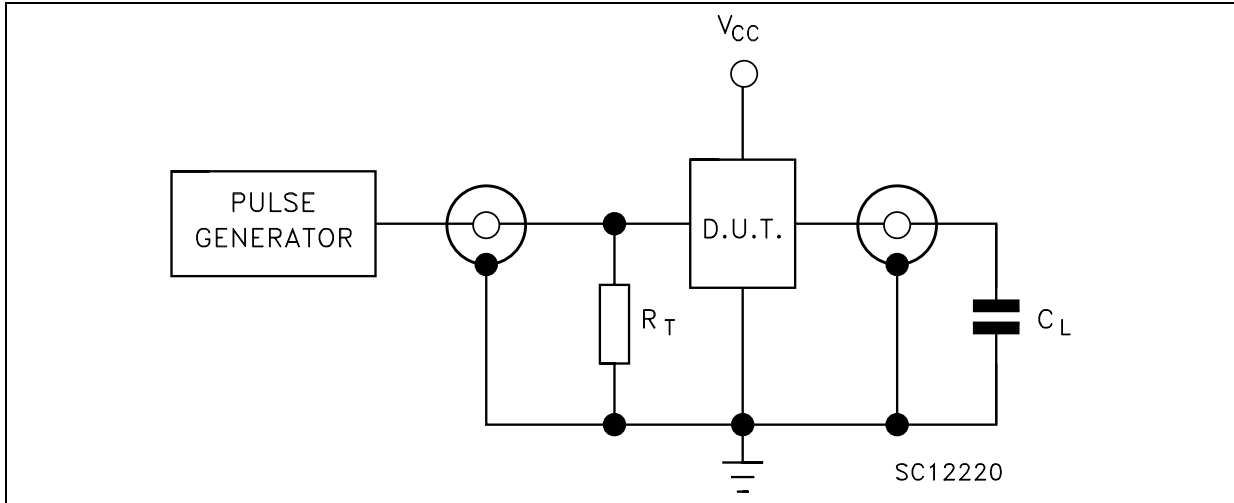
C_L = 50pF or equivalent (includes jig and probe capacitance)
R_T = Z_{OUT} of pulse generator (typically 50Ω)

WAVEFORM 1: MINIMUM PULSE WIDTH (CLEAR) AND REMOVAL TIME (CLEAR TO $\overline{\text{CLOCK}}$)
(f=1MHz; 50% duty cycle)
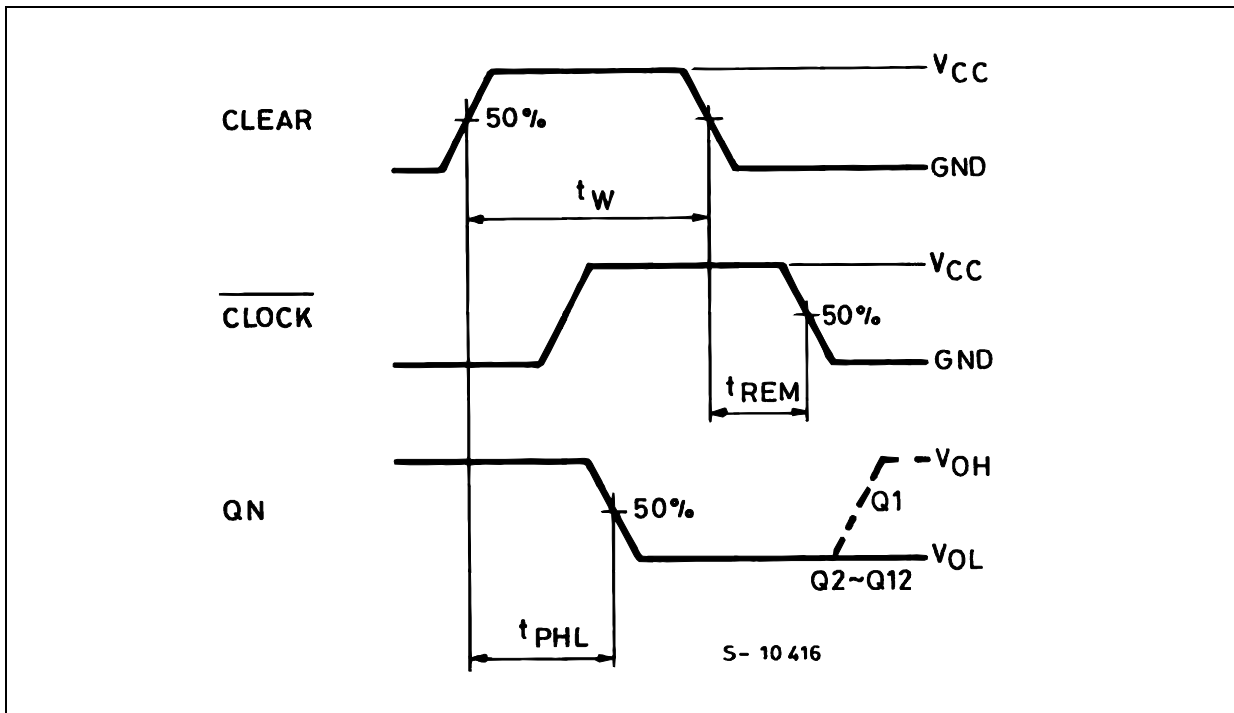
WAVEFORM 2 : PROPAGATION DELAY TIME (f=1MHz; 50% duty cycle)

WAVEFORM 3 : PROPAGATION DELAY TIME, MINIMUM PULSE WIDTH ($\overline{CLOCK}$)(f=1MHz; 50% duty cycle)

Plastic DIP-16 (0.25) MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	0.77		1.65	0.030		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		17.78			0.700	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z			1.27			0.050

P001C

SO-16 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	9.8		10	0.385		0.393
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		8.89			0.350	
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			0.62			0.024
S	8° (max.)					

PO13H

TSSOP16 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

0080338D