

## 8 BIT PISO SHIFT REGISTER

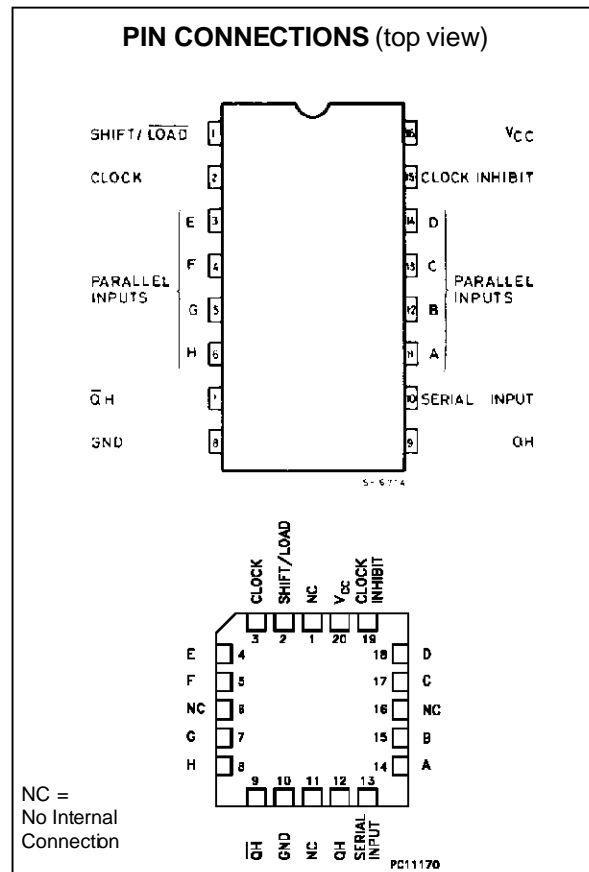
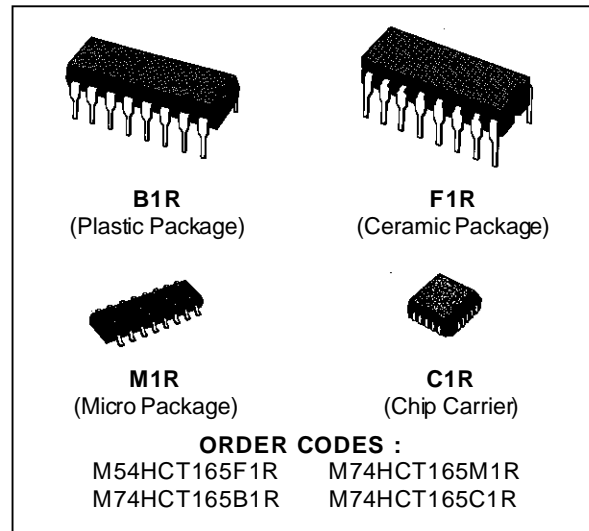
- HIGH SPEED  
 $t_{PD} = 17 \text{ ns (TYP.) AT } V_{CC} = 5 \text{ V}$
- LOW POWER DISSIPATION  
 $I_{CC} = 4 \mu\text{A (MAX.) AT } T_A = 25 \text{ }^\circ\text{C}$
- OUTPUT DRIVE CAPABILITY  
 10 LSTTL LOADS
- BALANCED PROPAGATION DELAYS  
 $t_{PLH} = t_{PHL}$
- SYMMETRICAL OUTPUT IMPEDANCE  
 $I_{OL} = |I_{OH}| = 4 \text{ mA (MIN.)}$
- COMPATIBLE WITH TTL OUTPUTS  
 $V_{IH} = 2 \text{ V (MIN.) } V_{IL} = 0.8 \text{ V (MAX.)}$
- PIN AND FUNCTION COMPATIBLE  
 WITH 54/74LS165

### DESCRIPTION

The M54/74HCT165 is a high speed CMOS 8 BIT PISO SHIFT REGISTER fabricated in silicon gate C<sup>2</sup>MOS technology. It has the same high speed performance of LSTTL combined with true CMOS low power consumption. It achieves the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power dissipation.

This device contains eight clocked master slave RS flip-flops connected as a shift register, with auxiliary gating to provide over-riding asynchronous parallel entry. Parallel data enters when the shift/load input is low. The parallel data can change while shift/load is low, provided that the recommended set-up and hold times are observed. For clocked operation, shift/load must be high. The two clock input perform identically; one can be used as a clock inhibit by applying a high signal; to permit this operation clocking is accomplished through a 2 input nor gates.

To avoid double clocking, however, the inhibit signal should only go high while the clock is high. Otherwise the rising inhibit signal will cause the same response as rising clock edge. This integrated circuit has input and output characteristics that are fully compatible with 54/74 LSTTL logic families. M54/74HCT devices are designed to directly interface HSCMOS systems with TTL and NMOS components. They are also plug in replacements for LSTTL devices giving a reduction of power consumption. All inputs are equipped with protection circuits against static discharge and transient excess voltage.



# M54/M74HCT165

## INPUT AND OUTPUT EQUIVALENT CIRCUIT

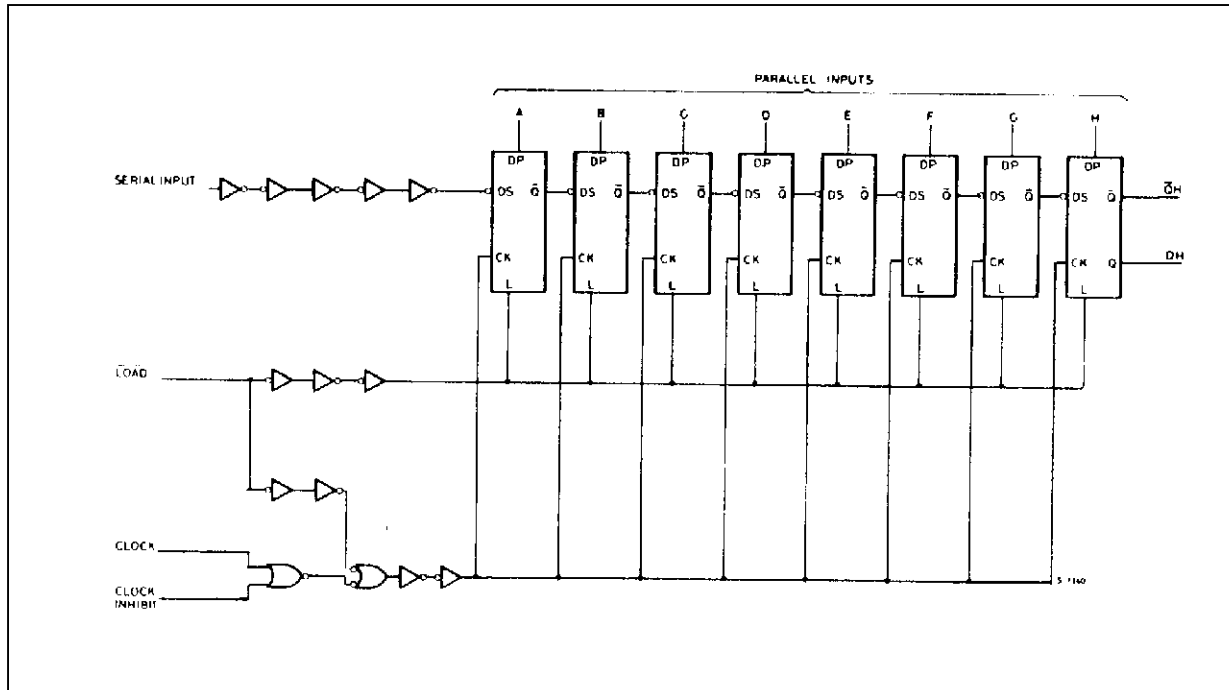


## TRUTH TABLE

INPUTS					INTERNAL OUTPUTS		OUTPUTS	OUTPUTS
SHIFT/LOAD	CLOCK INHIBIT	CLOCK	SERIAL IN	A .....H	QA	QB	QH	$\overline{QH}$
L	X	X	X	a.....h	a	b	h	$\overline{h}$
H	L		H	X	H	QAn	QGn	$\overline{QGn}$
H	L		L	X	L	QAn	QGn	$\overline{QGn}$
H		L	H	X	H	QAn	QGn	$\overline{QGn}$
H		L	L	X	L	QAn	QGn	$\overline{QGn}$
H	X	H	X	X	NO CHANGE			
H	H	X	X	X	NO CHANGE			

a.....h: The level of steady input voltage at inputs A through H respectively  
 QAn - QGn : The level of QA -QG, respectively, before the most-recent transition of the clock.

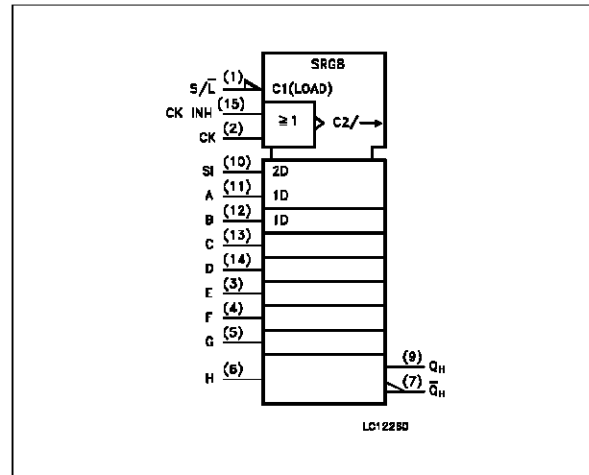
## LOGIC DIAGRAM



**PIN DESCRIPTION**

PIN No	SYMBOL	NAME AND FUNCTION
1	S/L	Asynchronous Parallel Load Input
2	$\overline{QH}$	Complementary Output
7	QH	Serial Output
9	CLOCK	Clock Input (LOW to HIGH edge triggered)
10	SI	Serial Data Input
11, 12, 13, 14, 3, 4, 5, 6	A to H	Parallel Data Inputs
15	CLOCK INH	CLOCK Inhibit
8	GND	Ground (0V)
16	V <sub>CC</sub>	Positive Supply Voltage

**IEC LOGIC SYMBOL**



**ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter	Value	Unit
V <sub>CC</sub>	Supply Voltage	-0.5 to +7	V
V <sub>I</sub>	DC Input Voltage	-0.5 to V <sub>CC</sub> + 0.5	V
V <sub>O</sub>	DC Output Voltage	-0.5 to V <sub>CC</sub> + 0.5	V
I <sub>IK</sub>	DC Input Diode Current	± 20	mA
I <sub>OK</sub>	DC Output Diode Current	± 20	mA
I <sub>O</sub>	DC Output Source Sink Current Per Output Pin	± 25	mA
I <sub>CC</sub> or I <sub>GND</sub>	DC V <sub>CC</sub> or Ground Current	± 50	mA
P <sub>D</sub>	Power Dissipation	500 (*)	mW
T <sub>stg</sub>	Storage Temperature	-65 to +150	°C
T <sub>L</sub>	Lead Temperature (10 sec)	300	°C

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.  
 (\*) 500 mW: ≅ 65 °C derate to 300 mW by 10mW/°C: 65 °C to 85 °C

**RECOMMENDED OPERATING CONDITIONS**

Symbol	Parameter	Value	Unit
V <sub>CC</sub>	Supply Voltage	4.5 to 5.5	V
V <sub>I</sub>	Input Voltage	0 to V <sub>CC</sub>	V
V <sub>O</sub>	Output Voltage	0 to V <sub>CC</sub>	V
T <sub>op</sub>	Operating Temperature: <b>M54HC Series</b> <b>M74HC Series</b>	-55 to +125 -40 to +85	°C °C
t <sub>r</sub> , t <sub>f</sub>	Input Rise and Fall Time (V <sub>CC</sub> = 4.5 to 5.5V)	0 to 500	ns

**DC SPECIFICATIONS**

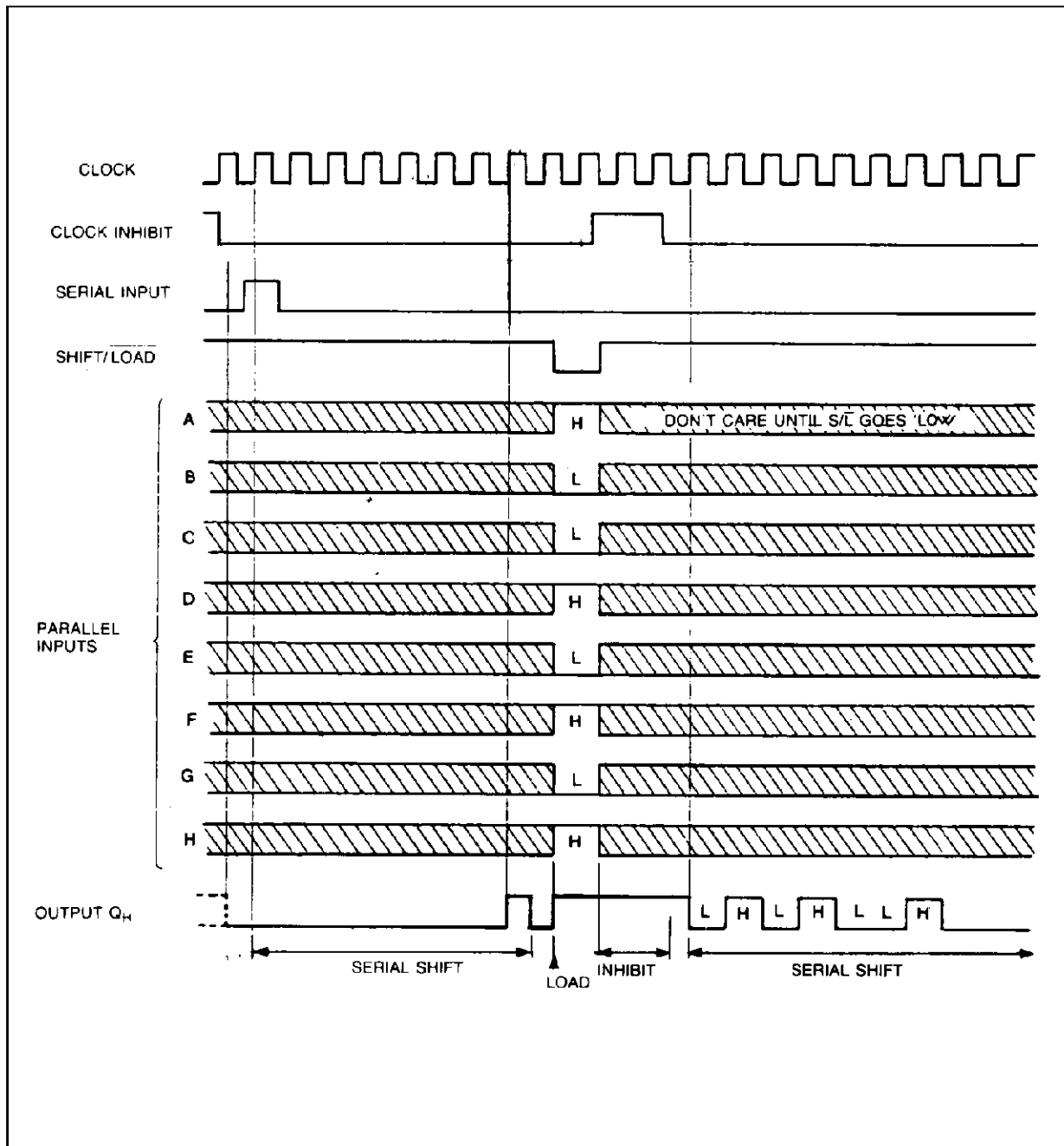
Symbol	Parameter	Test Conditions		Value						Unit		
		V <sub>CC</sub> (V)		T <sub>A</sub> = 25 °C 54HC and 74HC			-40 to 85 °C 74HC		-55 to 125 °C 54HC			
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.	
V <sub>IH</sub>	High Level Input Voltage	4.5 to 5.5		2.0			2.0		2.0		V	
V <sub>IL</sub>	Low Level Input Voltage	4.5 to 5.5				0.8		0.8		0.8	V	
V <sub>OH</sub>	High Level Output Voltage	4.5	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>O</sub> = -20 μA	4.4	4.5		4.4		4.4	V	
				I <sub>O</sub> = -4.0 mA	4.18	4.31		4.13		4.10		
V <sub>OL</sub>	Low Level Output Voltage	4.5	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>O</sub> = 20 μA		0.0	0.1		0.1		0.1	V
				I <sub>O</sub> = 4.0 mA		0.17	0.26		0.33		0.4	
I <sub>I</sub>	Input Leakage Current	5.5	V <sub>I</sub> = V <sub>CC</sub> or GND				±0.1		±1		±1	μA
I <sub>CC</sub>	Quiescent Supply Current	5.5	V <sub>I</sub> = V <sub>CC</sub> or GND				4		40		80	μA
ΔI <sub>CC</sub>	Additional worst case supply current	5.5	Per Input pin V <sub>I</sub> = 0.5V or V <sub>I</sub> = 2.4V Other Inputs at V <sub>CC</sub> or GND I <sub>O</sub> = 0				2.0		2.9		3.0	mA

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

Symbol	Parameter	Test Conditions		Value						Unit	
		V <sub>CC</sub> (V)		T <sub>A</sub> = 25 °C 54HC and 74HC			-40 to 85 °C 74HC		-55 to 125 °C 54HC		
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.
t <sub>TLH</sub> t <sub>THL</sub>	Output Transition Time	4.5			8	15		19		22	ns
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay Time (CK - QH, $\overline{QH}$ )	4.5			24	37		46		56	ns
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay Time (CKINH - QH, $\overline{QH}$ )	4.5			24	37		46		56	ns
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay Time (S/L - QH, $\overline{QH}$ )	4.5			26	40		50		60	ns
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay Time (H - QH, $\overline{QH}$ )	4.5			22	34		43		51	ns
f <sub>MAX</sub>	Maximum Clock Frequency	4.5		30	46		24				MHz
t <sub>W(H)</sub> t <sub>W(L)</sub>	Minimum Pulse Width (CK, CKINH)	4.5			8	15		19		22	ns
t <sub>W(H)</sub> t <sub>W(L)</sub>	Minimum Pulse Width (S/L)	4.5			8	15		19			ns
t <sub>s</sub>	Minimum Set-up Time (PI - S/L)	4.5			7	15		19		22	ns
t <sub>s</sub>	Minimum Set-up Time (S/L - CK, CHINH)	4.5			7	15		19		22	ns
t <sub>s</sub>	Minimum Set-up Time (S - CK, CHINH)	4.5			7	15		19		22	ns
t <sub>h</sub>	Minimum Hold Time (PI - S/L) (S/L - CK, CHINH)	4.5				0		0		0	ns
t <sub>REM</sub>	Minimum Removal Time (CK - CKINH) (CKINH - CK)	4.5			5	15		19		22	ns
C <sub>IN</sub>	Input Capacitance				5	10		10		10	pF
C <sub>PD</sub> (*)	Power Dissipation Capacitance				96						pF

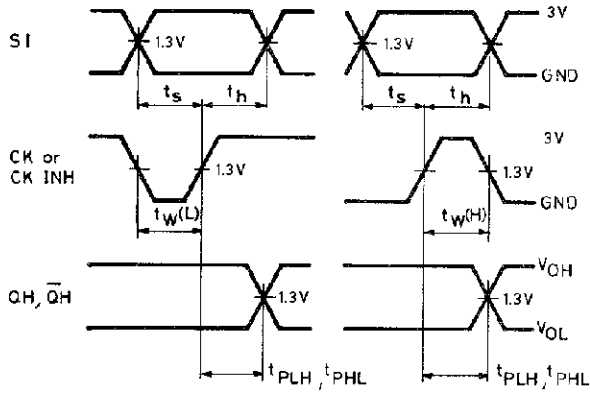
(\*) C<sub>PD</sub> is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation.  $I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN}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

TIMING CHART



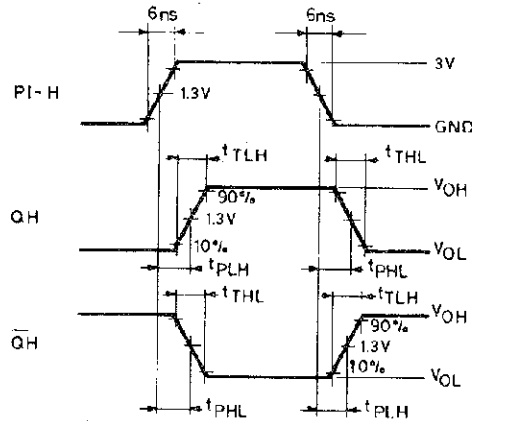
SWITCHING CHARACTERISTICS TEST WAVEFORM

SERIAL MODE



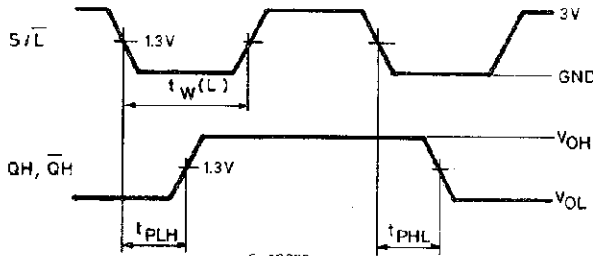
S-10327

PARALLEL MODE



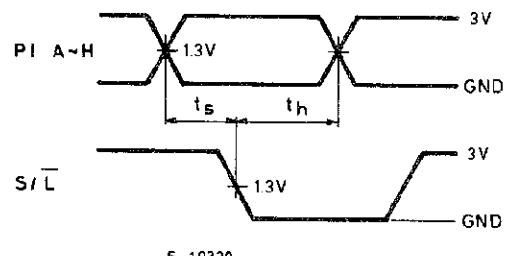
S-10328

PARALLEL MODE



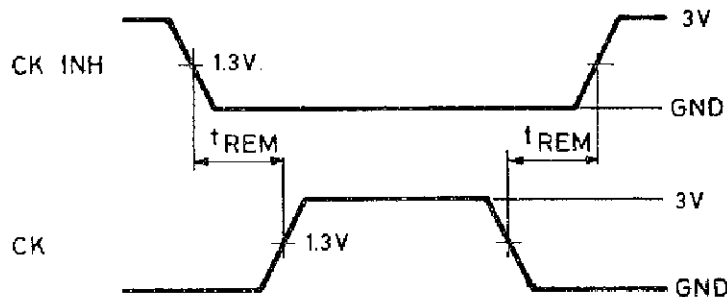
S-10329

PARALLEL MODE



S-10330

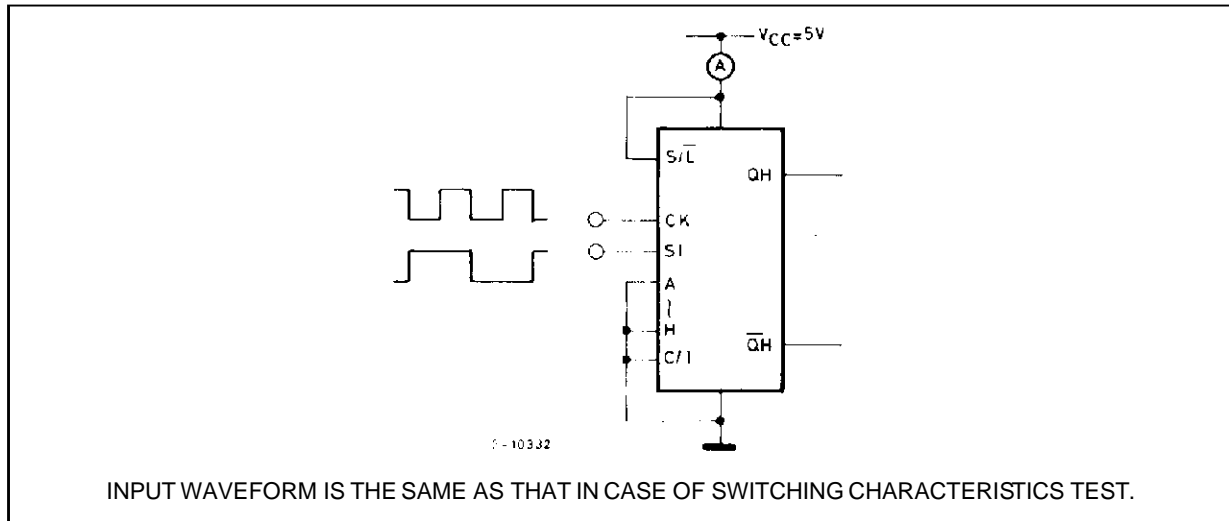
PARALLEL MODE



S-10331

## M54/M74HCT165

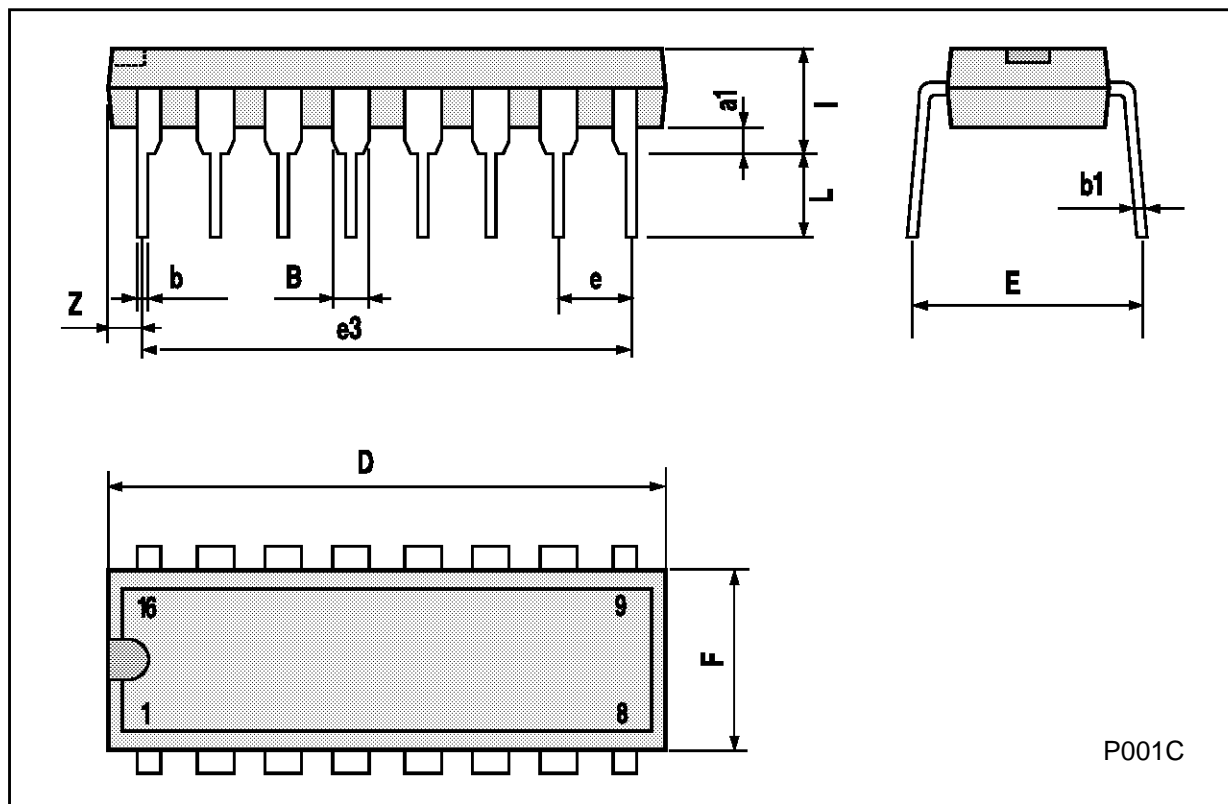
### TEST CIRCUIT $I_{CC}$ (Opr.)





## Plastic DIP16 (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



**Ceramic DIP16/1 MECHANICAL DATA**

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			20			0.787
B			7			0.276
D		3.3			0.130	
E	0.38			0.015		
e3		17.78			0.700	
F	2.29		2.79	0.090		0.110
G	0.4		0.55	0.016		0.022
H	1.17		1.52	0.046		0.060
L	0.22		0.31	0.009		0.012
M	0.51		1.27	0.020		0.050
N			10.3			0.406
P	7.8		8.05	0.307		0.317
Q			5.08			0.200



## SO16 (Narrow) MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.2	0.004		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.)					



P013H

PLCC20 MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	9.78		10.03	0.385		0.395
B	8.89		9.04	0.350		0.356
D	4.2		4.57	0.165		0.180
d1		2.54			0.100	
d2		0.56			0.022	
E	7.37		8.38	0.290		0.330
e		1.27			0.050	
e3		5.08			0.200	
F		0.38			0.015	
G			0.101			0.004
M		1.27			0.050	
M1		1.14			0.045	



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