



# M74HCT138

## 3 TO 8 LINE DECODER (INVERTING)

- HIGH SPEED:  
 $t_{PD} = 16\text{ns}$  (TYP.) at  $V_{CC} = 4.5\text{V}$
- LOW POWER DISSIPATION:  
 $I_{CC} = 4\mu\text{A}$  (MAX.) at  $T_A = 25^\circ\text{C}$
- COMPATIBLE WITH TTL OUTPUTS :  
 $V_{IH} = 2\text{V}$  (MIN.)  $V_{IL} = 0.8\text{V}$  (MAX)
- SYMMETRICAL OUTPUT IMPEDANCE:  
 $|I_{OH}| = I_{OL} = 4\text{mA}$  (MIN)
- BALANCED PROPAGATION DELAYS:  
 $t_{PLH} \cong t_{PHL}$
- PIN AND FUNCTION COMPATIBLE WITH  
 74 SERIES 138



### ORDER CODES

PACKAGE	TUBE	T & R
DIP	M74HCT138B1R	
SOP	M74HCT138M1R	M74HCT138RM13TR
TSSOP		M74HCT138TTR

### DESCRIPTION

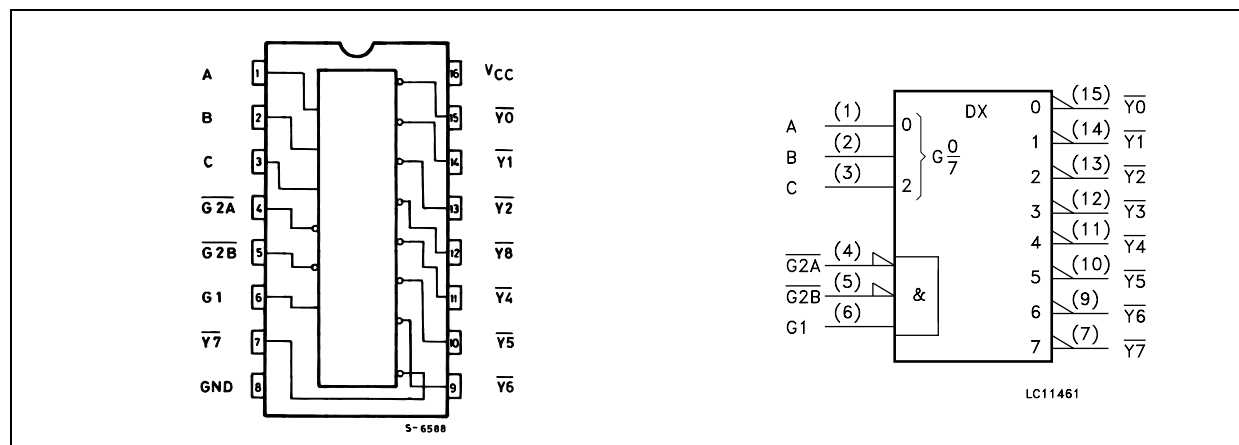
The M74HCT138 is an high speed CMOS 3 TO 8 LINE DECODER fabricated with silicon gate C<sup>2</sup>MOS technology.

If the device is enabled, 3 binary select inputs (A, B, and C) determine which one of the outputs will go low. If enable input G1 is held low or either  $\overline{G2A}$  or  $\overline{G2B}$  is held high, the decoding function is inhibited and all the 8 outputs go high. Three

enable inputs are provided to ease cascade connection and application of address decoders for memory systems.

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

### PIN CONNECTION AND IEC LOGIC SYMBOLS



# M74HCT138

## INPUT AND OUTPUT EQUIVALENT CIRCUIT



## PIN DESCRIPTION

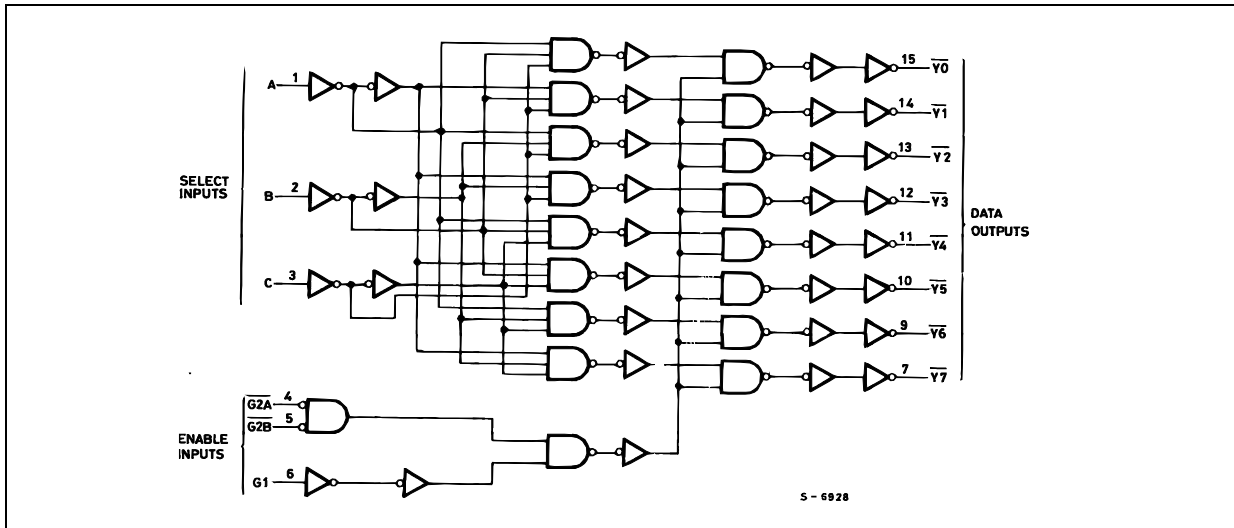
PIN No	SYMBOL	NAME AND FUNCTION
1, 2, 3	A, B, C	Address Inputs
4, 5	$\overline{G2A}$ , $\overline{G2B}$	Enable Inputs
6	G1	Enable Input
9, 10, 11, 12, 13, 14, 15, 7	Y0 to Y7	Data Outputs
8	GND	Ground (0V)
16	V <sub>CC</sub>	Positive Supply Voltage

## TRUTH TABLE

INPUTS						OUTPUTS							
ENABLE			SELECT										
$\overline{G2B}$	$\overline{G2A}$	G1	C	B	A	$\overline{Y0}$	$\overline{Y1}$	$\overline{Y2}$	$\overline{Y3}$	$\overline{Y4}$	$\overline{Y5}$	$\overline{Y6}$	$\overline{Y7}$
X	X	L	X	X	X	H	H	H	H	H	H	H	H
X	H	X	X	X	X	H	H	H	H	H	H	H	H
H	X	X	X	X	X	H	H	H	H	H	H	H	H
L	L	H	L	L	L	L	H	H	H	H	H	H	H
L	L	H	L	L	H	H	L	H	H	H	H	H	H
L	L	H	L	H	L	H	H	L	H	H	H	H	H
L	L	H	L	H	H	H	H	H	L	H	H	H	H
L	L	H	H	L	L	H	H	H	H	L	H	H	H
L	L	H	H	L	H	H	H	H	H	H	L	H	H
L	L	H	H	H	L	H	H	H	H	H	H	L	H
L	L	H	H	H	H	H	H	H	H	H	H	H	L

X : Don't Care

## LOGIC DIAGRAM



This logic diagram has not been 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	$\pm 20$	mA
$I_{OK}$	DC Output Diode Current	$\pm 20$	mA
$I_O$	DC Output Current	$\pm 25$	mA
$I_{CC}$ or $I_{GND}$	DC $V_{CC}$ or Ground Current	$\pm 50$	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	4.5 to 5.5	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 ( $V_{CC} = 4.5$ to $5.5V$ )	0 to 500	ns

## DC SPECIFICATIONS

Symbol	Parameter	Test Condition		Value						Unit	
		$V_{CC}$ (V)		$T_A = 25^\circ\text{C}$			-40 to 85°C		-55 to 125°C		
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.
$V_{IH}$	High Level Input Voltage	4.5 to 5.5		2.0			2.0		2.0		V
$V_{IL}$	Low Level Input Voltage	4.5 to 5.5				0.8		0.8		0.8	V
$V_{OH}$	High Level Output Voltage	4.5	$I_O = -20 \mu\text{A}$	4.4	4.5		4.4		4.4		V
			$I_O = -4.0 \text{ mA}$	4.18	4.31		4.13		4.10		
$V_{OL}$	Low Level Output Voltage	4.5	$I_O = 20 \mu\text{A}$		0.0	0.1		0.1		0.1	V
			$I_O = 4.0 \text{ mA}$		0.17	0.26		0.33		0.40	
$I_I$	Input Leakage Current	5.5	$V_I = V_{CC}$ or GND			$\pm 0.1$		$\pm 1$		$\pm 1$	$\mu\text{A}$
$I_{CC}$	Quiescent Supply Current	5.5	$V_I = V_{CC}$ or GND			4		40		80	$\mu\text{A}$
$\Delta I_{CC}$	Additional Worst Case Supply Current	5.5	Per Input pin $V_I = 0.5V$ or $V_I = 2.4V$ Other Inputs at $V_{CC}$ or GND $I_O = 0$			2.0		2.9		3.0	mA

## M74HCT138

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

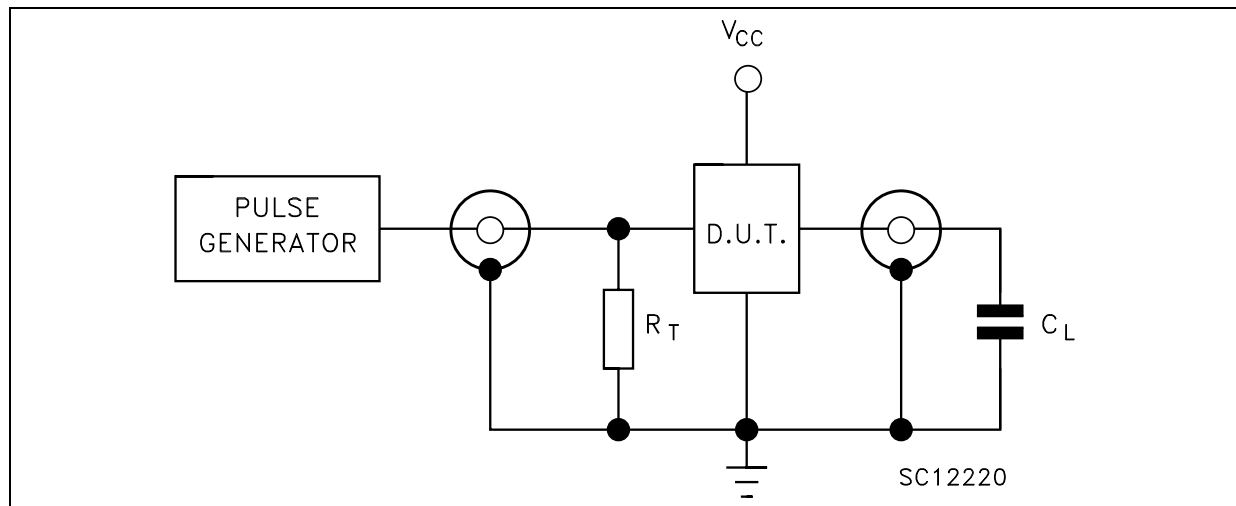
Symbol	Parameter	Test Condition		Value						Unit	
		$V_{CC}$ (V)		$T_A = 25^\circ\text{C}$			$-40 \text{ to } 85^\circ\text{C}$		$-55 \text{ to } 125^\circ\text{C}$		
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.
$t_{TLH} \ t_{THL}$	Output Transition Time	4.5			8	15		19		22	ns
$t_{PLH} \ t_{PHL}$	Propagation Delay Time (A, B, C - Y)	4.5			17	30		38		45	ns
$t_{PLH} \ t_{PHL}$	Propagation Delay Time (G1 - Y)	4.5			16	30		38		45	ns
$t_{PLH} \ t_{PHL}$	Propagation Delay Time (G2 - Y)	4.5			19	30		38		45	ns

### CAPACITIVE CHARACTERISTICS

Symbol	Parameter	Test Condition		Value						Unit	
		$V_{CC}$ (V)		$T_A = 25^\circ\text{C}$			$-40 \text{ to } 85^\circ\text{C}$		$-55 \text{ to } 125^\circ\text{C}$		
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.
$C_{IN}$	Input Capacitance				5	10		10		10	pF
$C_{PD}$	Power Dissipation Capacitance (note 1)				52						pF

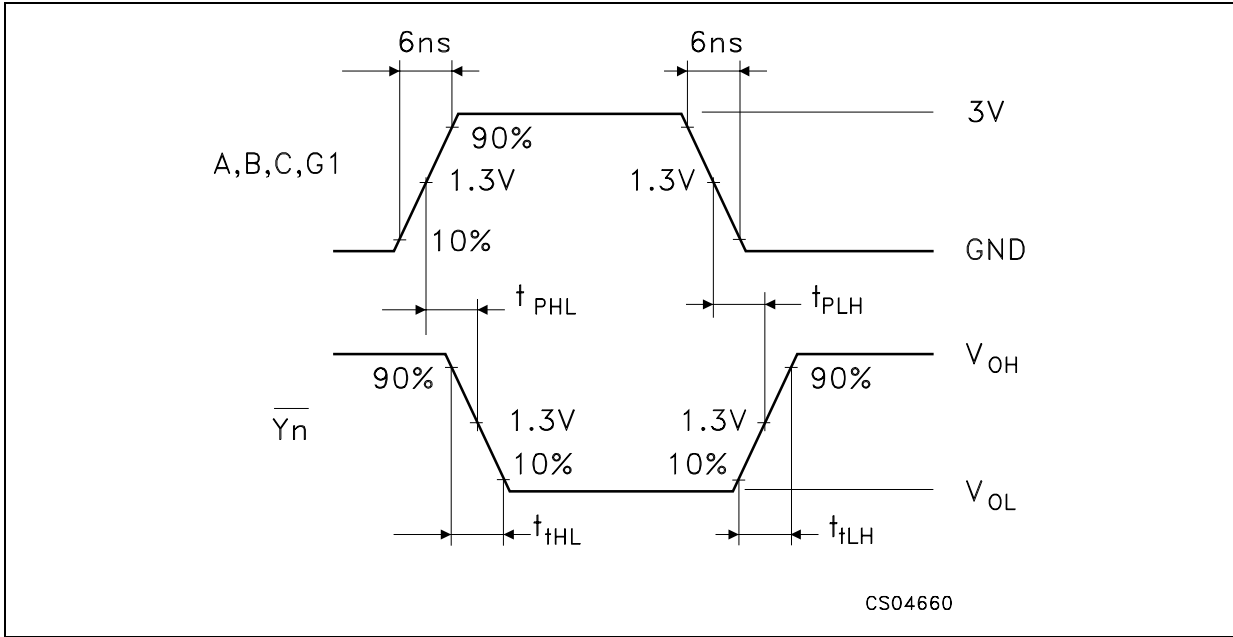
1)  $C_{PD}$  is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation.  $I_{CC(oper)} = C_{PD} \times V_{CC} \times f_{IN}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

### TEST CIRCUIT

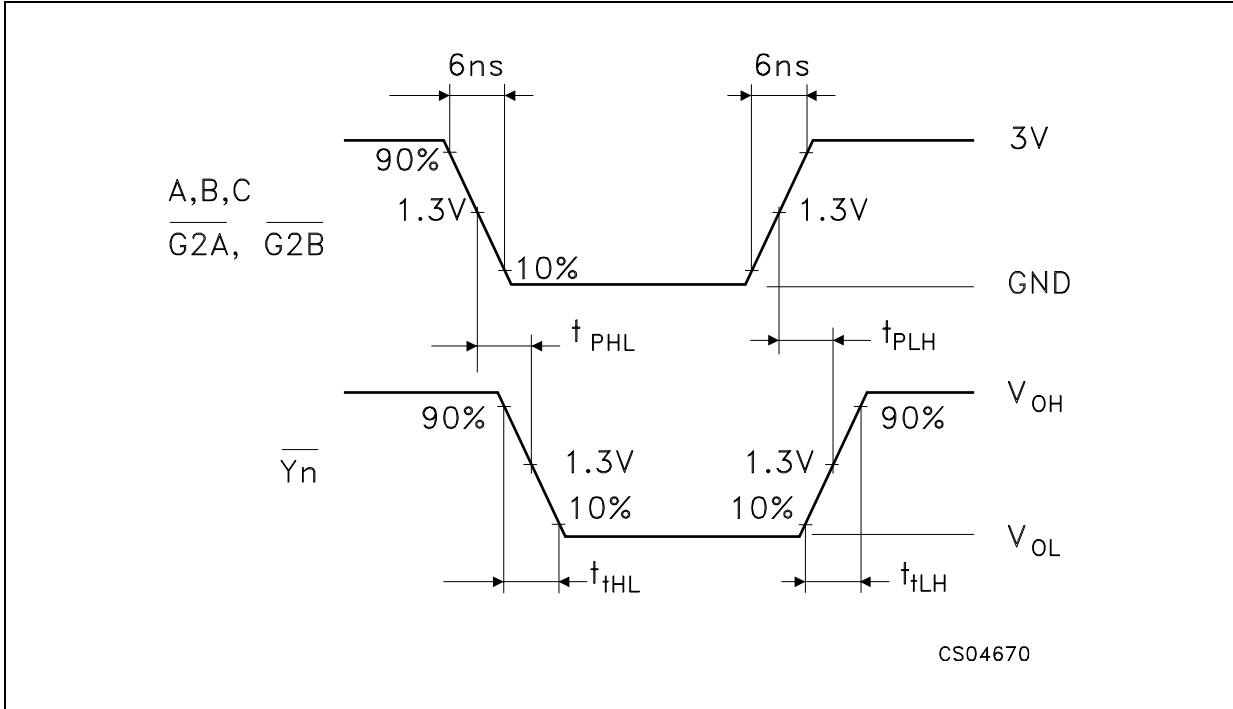


$C_L = 50 \text{ pF}$  or equivalent (includes jig and probe capacitance)  
 $R_T = Z_{OUT}$  of pulse generator (typically  $50 \Omega$ )

WAVEFORM 1: PROPAGATION DELAYS FOR INVERTING OUTPUTS (f=1MHz; 50% duty cycle)

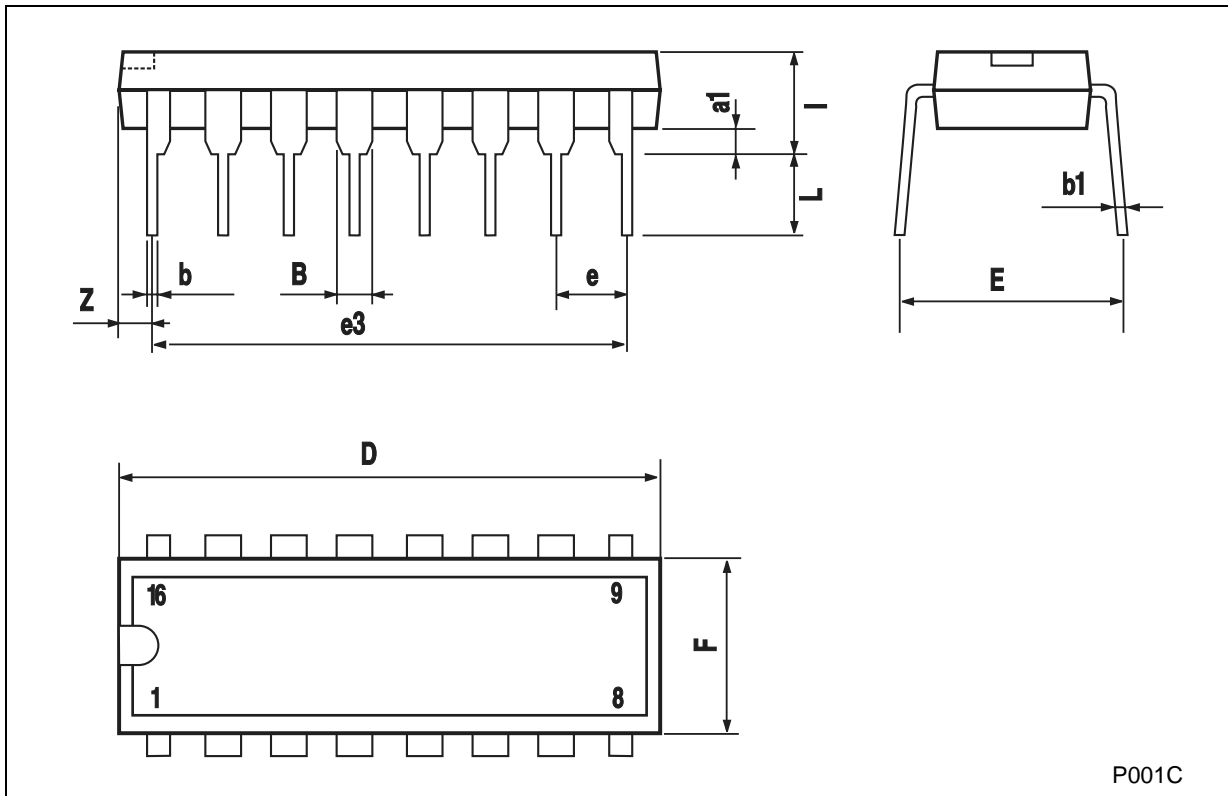


WAVEFORM 2: PROPAGATION DELAYS FOR NON-INVERTING OUTPUTS (f=1MHz; 50% duty cycle)



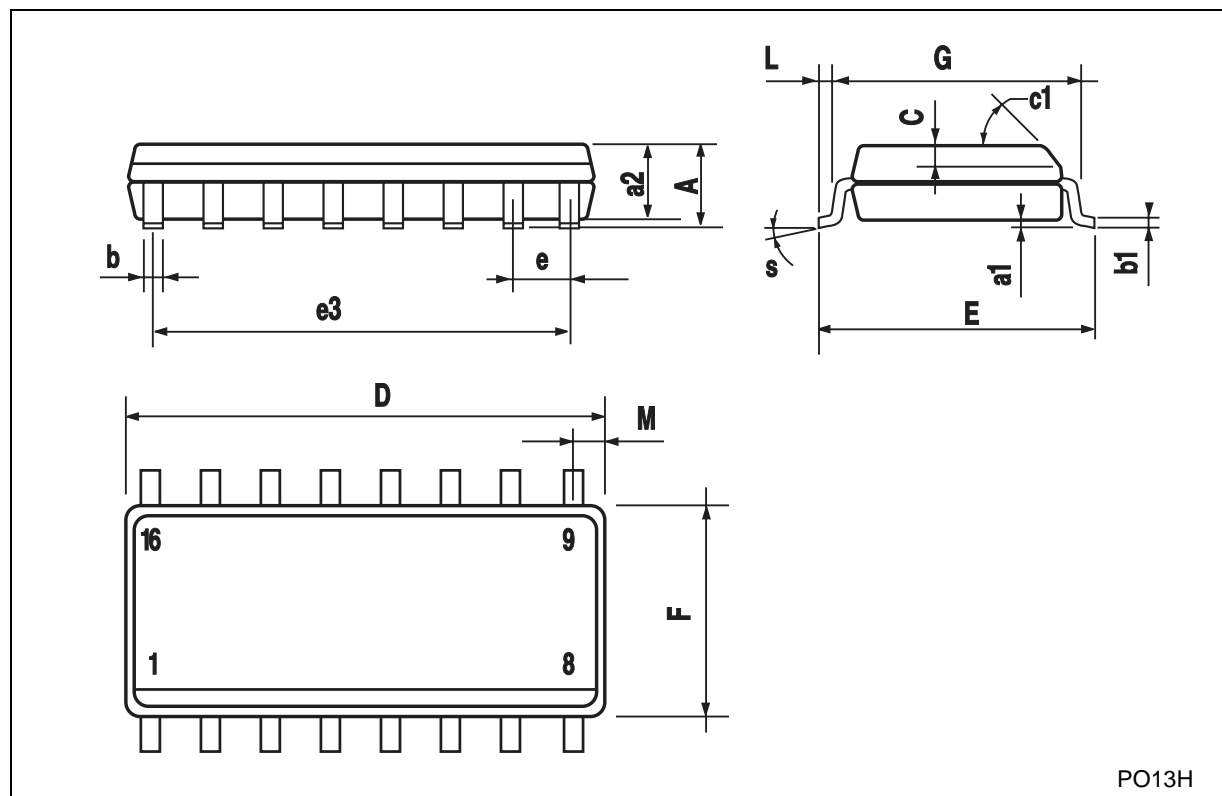
**Plastic DIP-16 (0.25) MECHANICAL DATA**

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



## 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





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