



**THE DATASHEET OF  
HCF4024M013TR**





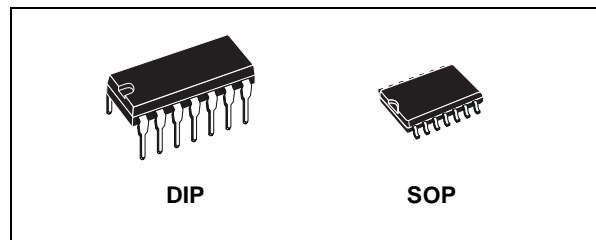
# HCF4024B

## RIPPLE-CARRY BINARY COUNTER/DIVIDERS 7 STAGE

- MEDIUM SPEED OPERATION :  
 $t_{PD} = 80\text{ns}$  (Typ.) at  $V_{DD} = 10\text{V}$
- FULLY STATIC OPERATION
- COMMON RESET
- BUFFERED INPUTS AND OUTPUTS
- STANDARDIZED SYMMETRICAL OUTPUT CHARACTERISTICS
- QUIESCENT CURRENT SPECIFIED UP TO 20V
- 5V, 10V AND 15V PARAMETRIC RATINGS
- INPUT LEAKAGE CURRENT  
 $I_1 = 100\text{nA}$  (MAX) AT  $V_{DD} = 18\text{V}$   $T_A = 25^\circ\text{C}$
- 100% TESTED FOR QUIESCENT CURRENT
- MEETS ALL REQUIREMENTS OF JEDEC JESD13B " STANDARD SPECIFICATIONS FOR DESCRIPTION OF B SERIES CMOS DEVICES"

### DESCRIPTION

The HCF4024B is a monolithic integrated circuit fabricated in Metal Oxide Semiconductor technology available in DIP and SOP packages. The HCF4024B is a ripple carry binary counter. All counter stages are master-slave flip-flops. The



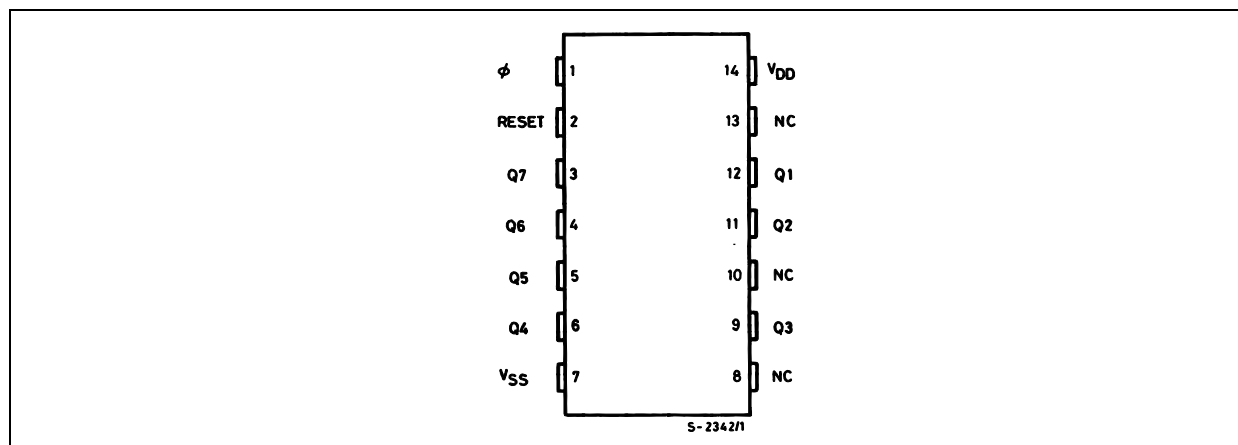
### ORDER CODES

PACKAGE	TUBE	T & R
DIP	HCF4024BEY	
SOP	HCF4024BM1	HCF4024M013TR

state of a counter advances one count on the negative transition of each input pulse; a high level on the RESET line resets the counter to its all zeros stage. Schmitt trigger action on the input pulse line permits unlimited clock rise and fall times.

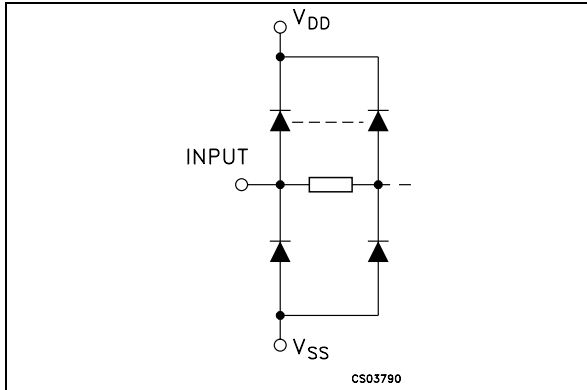
All inputs and outputs are buffered

### PIN CONNECTION



# HCF4024B

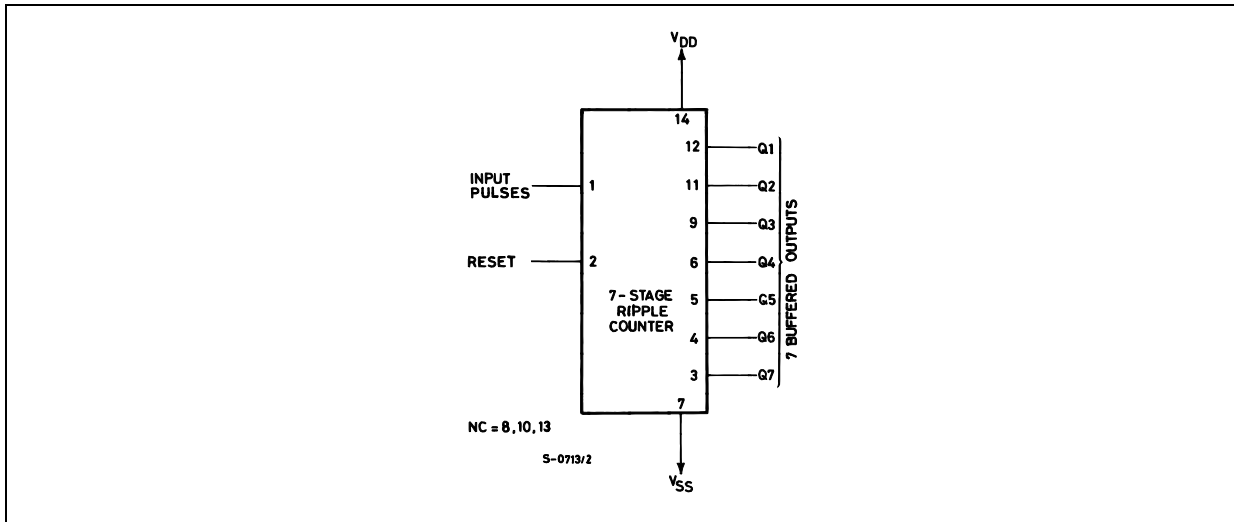
## INPUT EQUIVALENT CIRCUIT



## PIN DESCRIPTION

PIN No	SYMBOL	NAME AND FUNCTION
12, 11, 9, 6, 5, 4, 3	Q1 to Q7	7 Buffered Outputs
8, 10, 13	NC	Not Connected
2	RESET	Reset Input
1	$\Phi$	Input Pulses
7	$V_{SS}$	Negative Supply Voltage
14	$V_{DD}$	Positive Supply Voltage

## FUNCTIONAL DIAGRAM

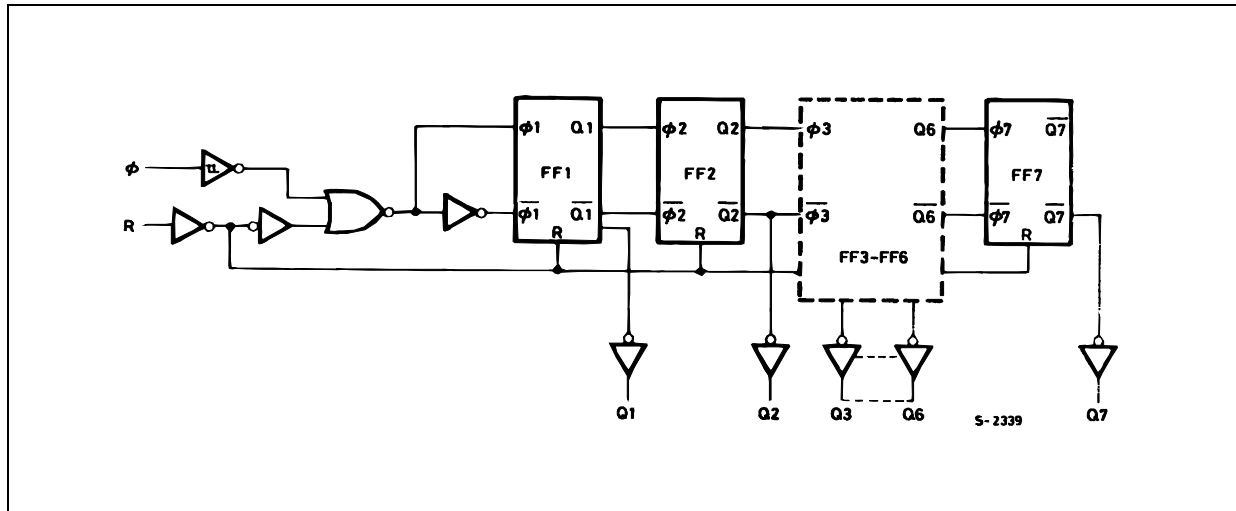


## TRUTH TABLE

$\Phi$	RESET	OUTPUT STATE
X	H	ALL OUTPUTS = "L"
	L	NO CHANGE
	L	ADVANCE TO NEXT STATE

X : Don't Care

## LOGIC DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
$V_{DD}$	Supply Voltage	-0.5 to +22	V
$V_I$	DC Input Voltage	-0.5 to $V_{DD} + 0.5$	V
$I_I$	DC Input Current	$\pm 10$	mA
$P_D$	Power Dissipation per Package	200	mW
	Power Dissipation per Output Transistor	100	mW
$T_{op}$	Operating Temperature	-55 to +125	$^{\circ}\text{C}$
$T_{stg}$	Storage Temperature	-65 to +150	$^{\circ}\text{C}$

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied.

All voltage values are referred to  $V_{SS}$  pin voltage.

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Value	Unit
$V_{DD}$	Supply Voltage	3 to 20	V
$V_I$	Input Voltage	0 to $V_{DD}$	V
$T_{op}$	Operating Temperature	-55 to 125	$^{\circ}\text{C}$

DC SPECIFICATIONS

Symbol	Parameter	Test Condition				Value						Unit	
		V <sub>I</sub> (V)	V <sub>O</sub> (V)	I <sub>OL</sub>   ( $\mu$ A)	V <sub>DD</sub> (V)	T <sub>A</sub> = 25°C			-40 to 85°C		-55 to 125°C		
						Min.	Typ.	Max.	Min.	Max.	Min.		Max.
I <sub>L</sub>	Quiescent Current	0/5			5		0.04	5		150		150	$\mu$ A
		0/10			10		0.04	10		300		300	
		0/15			15		0.04	20		600		600	
		0/20			20		0.08	100		3000		3000	
V <sub>OH</sub>	High Level Output Voltage	0/5		<1	5	4.95			4.95		4.95		V
		0/10		<1	10	9.95			9.95		9.95		
		0/15		<1	15	14.95			14.95		14.95		
V <sub>OL</sub>	Low Level Output Voltage	5/0		<1	5		0.05			0.05		0.05	V
		10/0		<1	10		0.05			0.05		0.05	
		15/0		<1	15		0.05			0.05		0.05	
V <sub>IH</sub>	High Level Input Voltage		0.5/4.5	<1	5	3.5			3.5		3.5		V
			1/9	<1	10	7			7		7		
			1.5/13.5	<1	15	11			11		11		
V <sub>IL</sub>	Low Level Input Voltage		4.5/0.5	<1	5			1.5		1.5		1.5	V
			9/1	<1	10			3		3		3	
			13.5/1.5	<1	15			4		4		4	
I <sub>OH</sub>	Output Drive Current	0/5	2.5	<1	5	-1.36	-3.2		-1.1		-1.1		mA
		0/5	4.6	<1	5	-0.44	-1		-0.36		-0.36		
		0/10	9.5	<1	10	-1.1	-2.6		-0.9		-0.9		
		0/15	13.5	<1	15	-3.0	-6.8		-2.4		-2.4		
I <sub>OL</sub>	Output Sink Current	0/5	0.4	<1	5	0.44	1		0.36		0.36		mA
		0/10	0.5	<1	10	1.1	2.6		0.9		0.9		
		0/15	1.5	<1	15	3.0	6.8		2.4		2.4		
I <sub>I</sub>	Input Leakage Current	0/18	Any Input		18		$\pm 10^{-5}$	$\pm 0.1$		$\pm 1$		$\pm 1$	$\mu$ A
C <sub>I</sub>	Input Capacitance		Any Input				5	7.5					pF

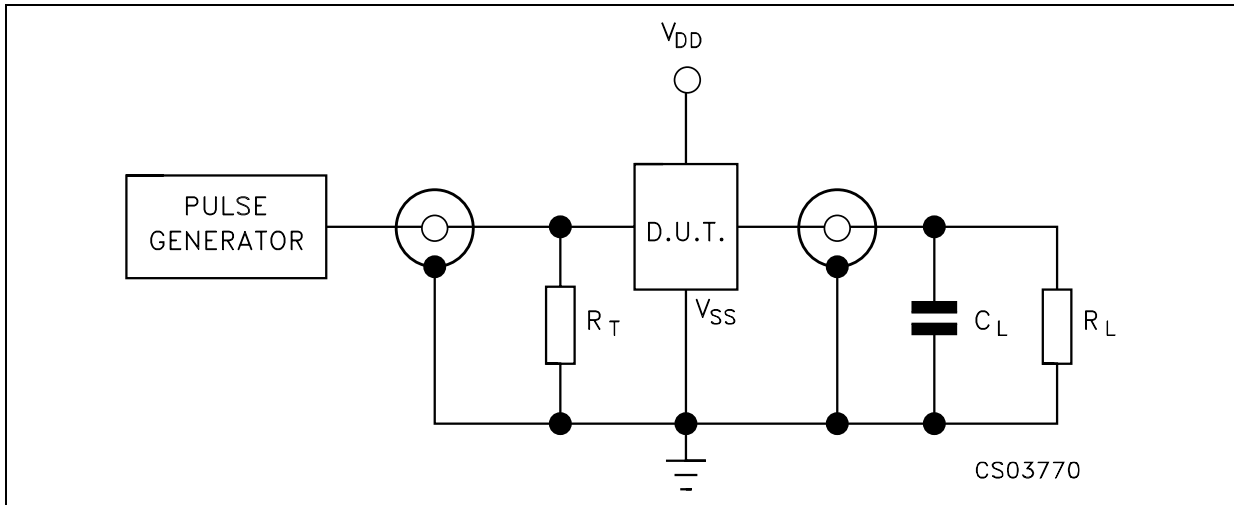
The Noise Margin for both "1" and "0" level is: 1V min. with V<sub>DD</sub>=5V, 2V min. with V<sub>DD</sub>=10V, 2.5V min. with V<sub>DD</sub>=15V

**DYNAMIC ELECTRICAL CHARACTERISTICS** ( $T_{amb} = 25^{\circ}\text{C}$ ,  $C_L = 50\text{pF}$ ,  $R_L = 200\text{K}\Omega$ ,  $t_r = t_f = 20\text{ ns}$ )

Symbol	Parameter	Test Condition		Value (*)			Unit
		$V_{DD}$ (V)		Min.	Typ.	Max.	
<b>INPUT-PULSE OPERATION</b>							
$t_{PLH}$ $t_{PHL}$	Propagation Delay Time ( $\emptyset$ to Q1 Out)	5			180	360	ns
		10			80	160	
		15			65	130	
$t_{PLH}$ $t_{PHL}$	Propagation Delay Time ( $Q_n$ to $Q_{n+1}$ )	5			100	200	ns
		10			40	80	
		15			30	60	
$t_{THL}$ $t_{TLH}$	Transition Time	5			100	200	ns
		10			50	100	
		15			40	80	
$t_W$	Minimum Input Pulse Width	5			70	140	ns
		10			30	60	
		15			20	40	
$t_r$ , $t_f$	Input Pulse Rise and Fall Time	5		unlimited			$\mu\text{s}$
		10					
		15					
$f_{max}$	Maximum Clock Input Frequency	5		3.5	7		MHz
		10		8	16		
		15		12	24		
<b>RESET OPERATION</b>							
$t_{PHL}$	Propagation Delay Time	5			140	280	ns
		10			60	120	
		15			50	100	
$t_W$	Minimum Reset Pulse Width	5			100	200	ns
		10			40	80	
		15			30	60	
$t_{REM}$	Reset Removal Time	5			175	350	ns
		10			75	150	
		15			50	100	

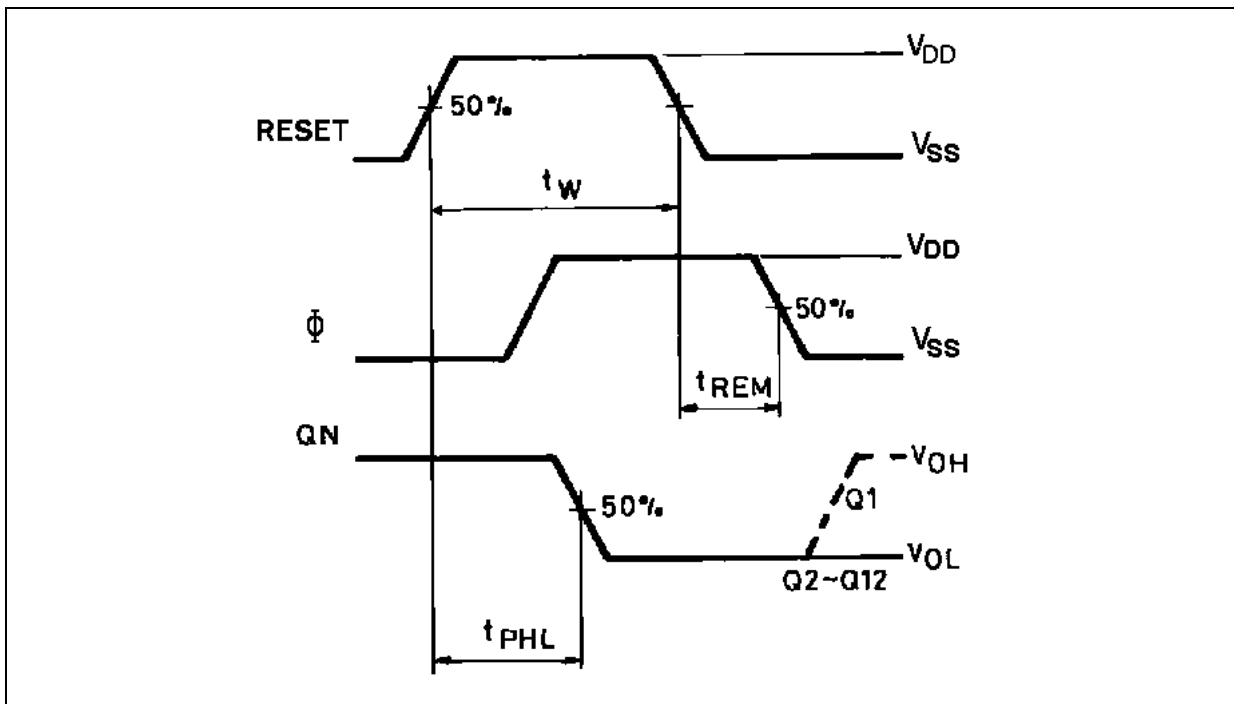
(\*) Typical temperature coefficient for all  $V_{DD}$  value is 0.3 %/°C.

TEST CIRCUIT

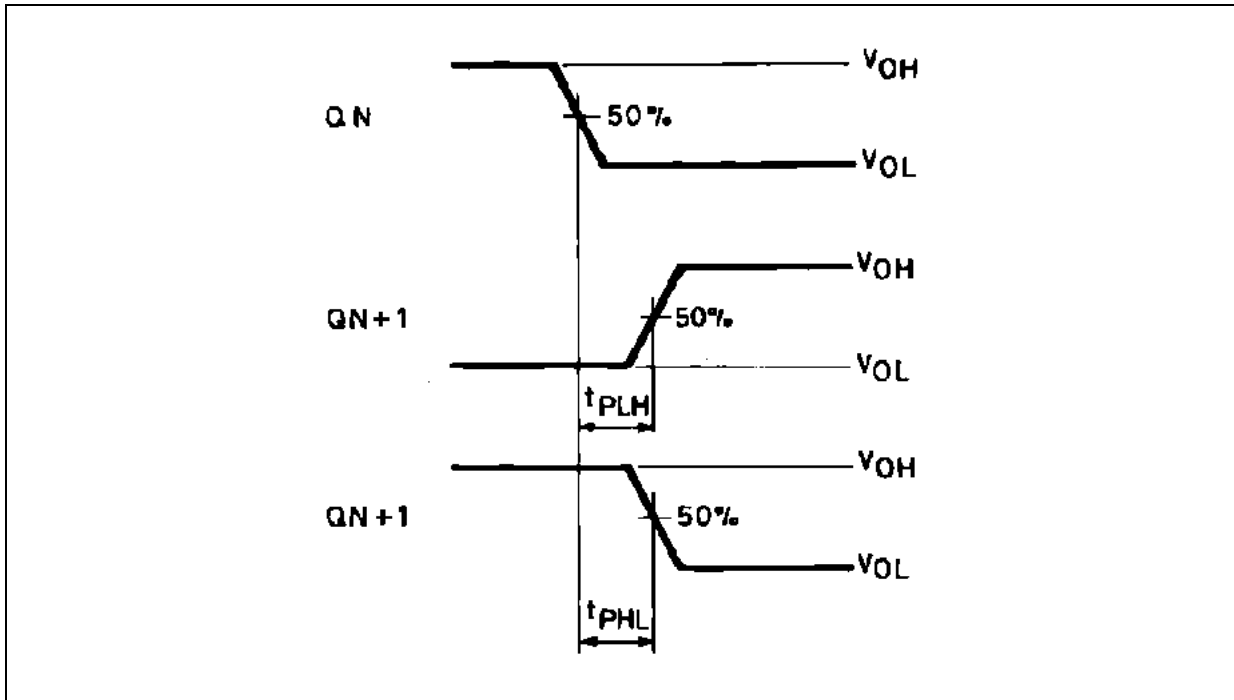


$C_L = 50\text{pF}$  or equivalent (includes jig and probe capacitance)  
 $R_L = 200\text{K}\Omega$   
 $R_T = Z_{\text{OUT}}$  of pulse generator (typically  $50\Omega$ )

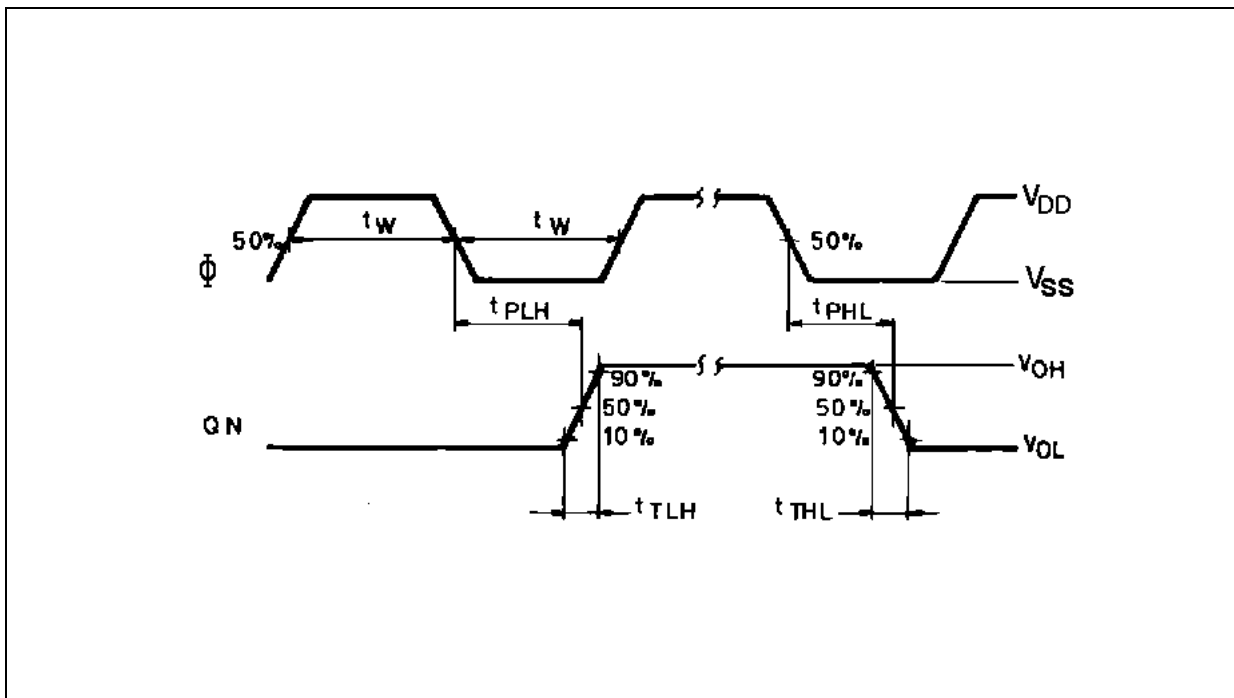
**WAVEFORM 1 : MINIMUM PULSE WIDTH (RESET) AND REMOVAL TIME ( RESET TO  $\Phi$ )** ( $f=1\text{MHz}$ ; 50% duty cycle)



WAVEFORM 2 : PROPAGATION DELAY TIME (f=1MHz; 50% duty cycle)

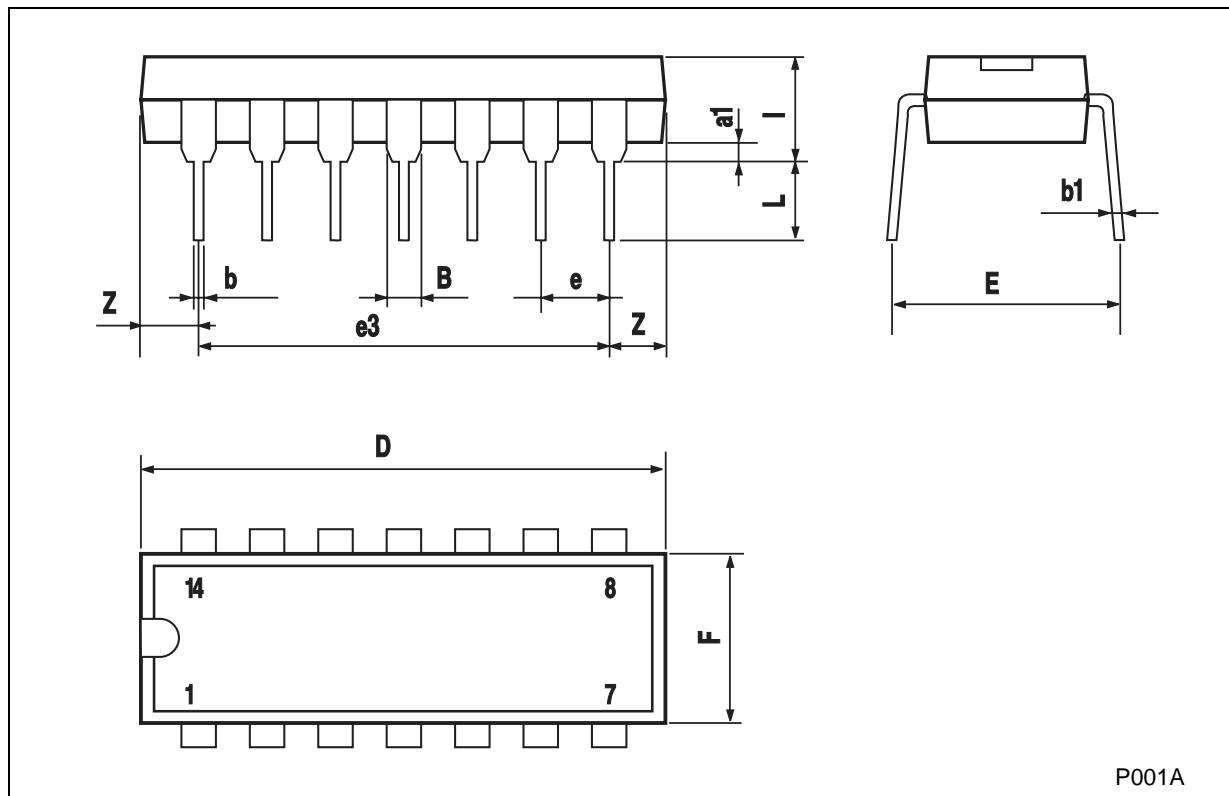


WAVEFORM 3 : PROPAGATION DELAY TIME, MINIMUM PULSE WIDTH ( $\Phi$ ) (f=1MHz; 50% duty cycle)



**Plastic DIP-14 MECHANICAL DATA**

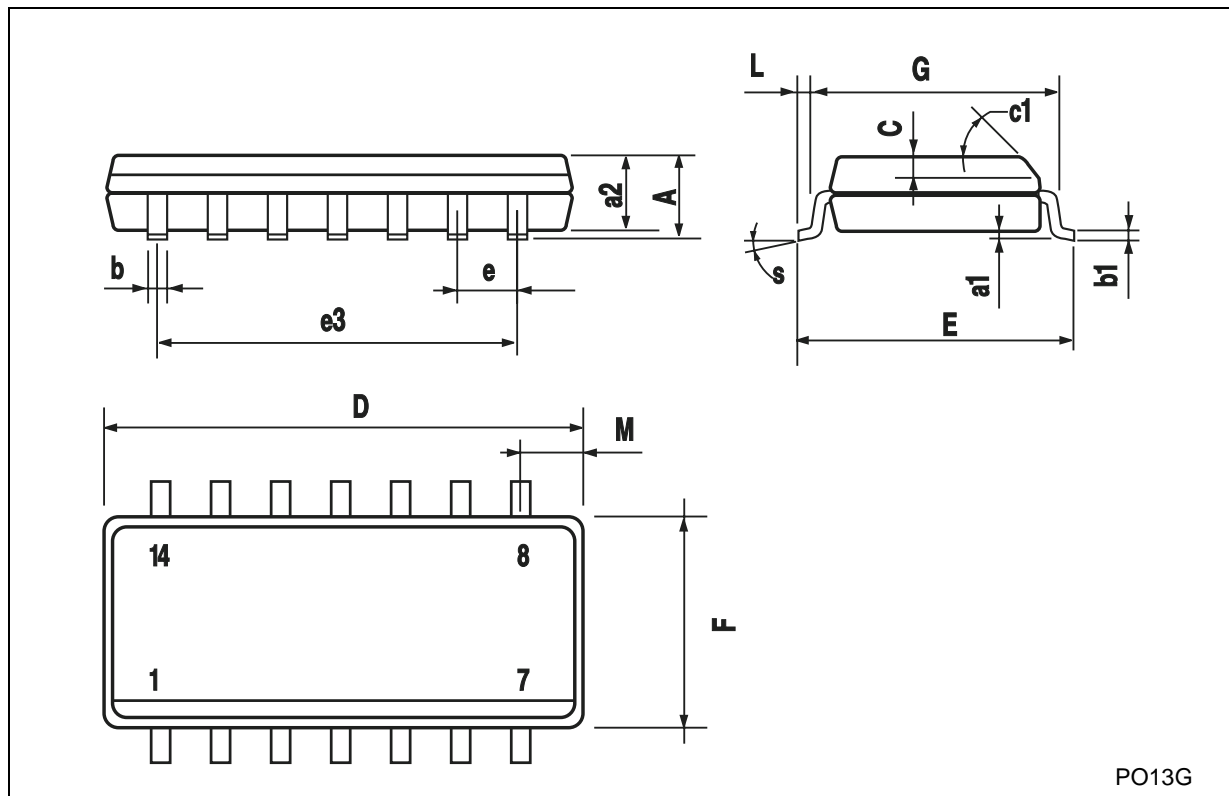
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	1.39		1.65	0.055		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		15.24			0.600	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z	1.27		2.54	0.050		0.100



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.)					



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