



HCF40110B

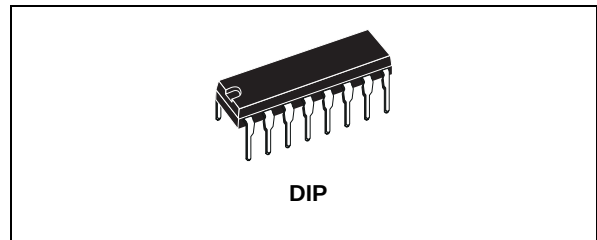
DECADE UP/DOWN COUNTER/DECODER/LATCH/DRIVER

- SEPARATE CLOCK-UP AND CLOCK-DOWN LINES
- CAPABLE OF DRIVING COMMON CATHODE LEDs AND OTHER DISPLAYS DIRECTLY
- ALLOWS CASCADING WITHOUT ANY EXTERNAL CIRCUITRY
- MAXIMUM INPUT CURRENT OF 1 μ A AT 18 V (full package-temperature range)
- QUIESCENT CURRENT SPECIFIED UP TO 20V
- STANDARDIZED, SYMMETRICAL OUTPUT CHARACTERISTICS
- 5V, 10V AND 15V PARAMETRIC RATINGS
- INPUT LEAKAGE CURRENT
 $I_l = 100\text{nA}$ (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

HCF40110B is a monolithic integrated circuit fabricated in Metal Oxide Semiconductor technology available in DIP package.

HCF40110B is a dual-clocked up/down counter with a special preconditioning circuit that allows the counter to be clocked, via positive going inputs, up or down regardless of the states or

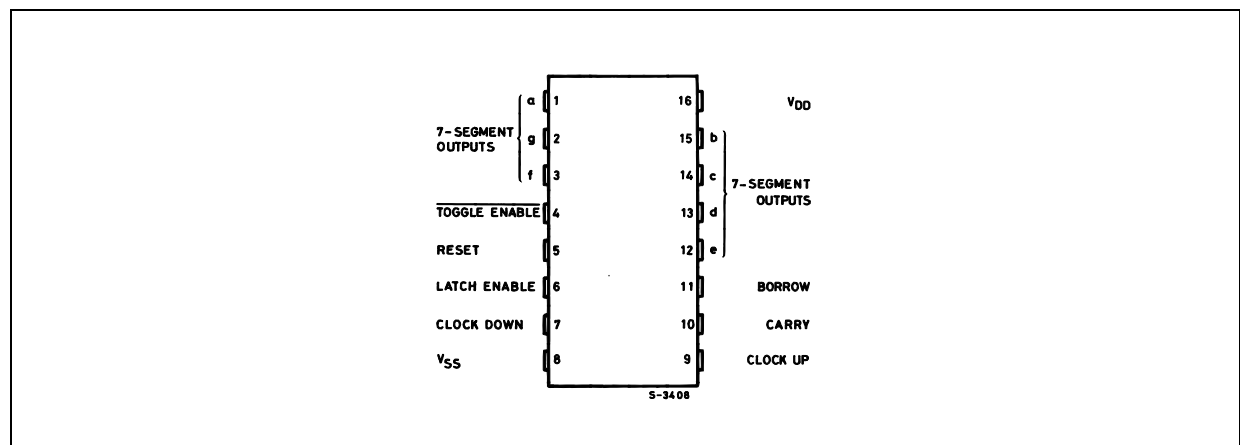


ORDER CODES

PACKAGE	TUBE	T & R
DIP	HCF40110BEY	

timing (within 100 ns typ.) of the other clock line. The clock signal is fed into the control logic and Johnson counter after it is preconditioned. The outputs of the Johnson counter (which include anti-lock gating to avoid being locked at an illegal state) are fed into a latch. This data can be fed directly to the decoder through the latch or can be strobed to hold a particular count while the Johnson counter continues to be clocked. The decoder feeds a seven-segment bipolar output driver which can source up to 25mA to drive LEDs and other displays such as low-voltage fluorescent and incandescent lamps. A short duration negative-going pulse appears on the BORROW output when the count changes from 0

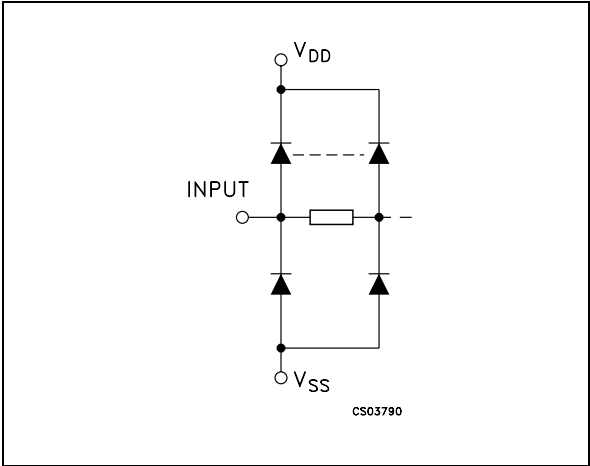
PIN CONNECTION



to 9 or the CARRY output when the count changes from 9 to 0. At other times the BORROW and BORROW outputs can be tied directly to the

clock-up and clock-down lines, respectively, of another HCF40110B for easy cascading of several counters.

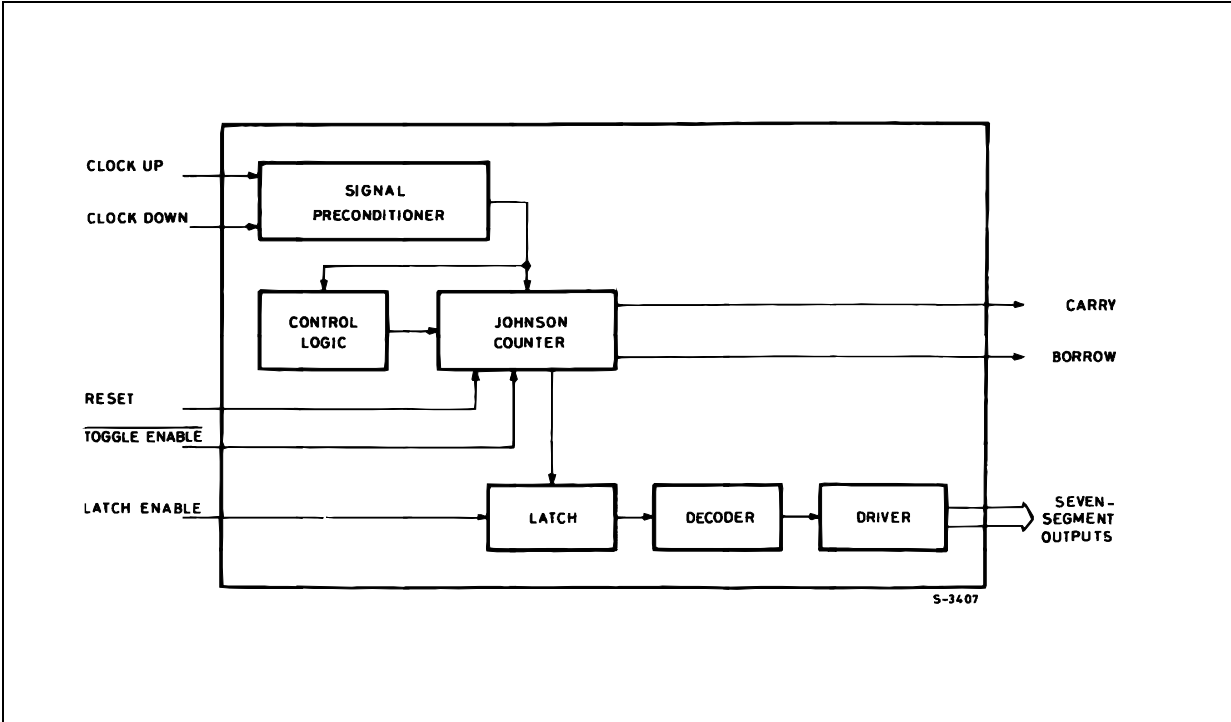
INPUT EQUIVALENT CIRCUIT



PIN DESCRIPTION

PIN No	SYMBOL	NAME AND FUNCTION
1, 15, 14, 13, 12, 3, 2	a, b, c, d, e, f, g	7 Segment Outputs
4	$\overline{\text{Toggle Enable}}$	Enable Johnson Counter
5	Reset	Reset Input
6	Latch Enable	Latch Enable
7	Clock Down	Clock Down
9	Clock Up	Clock Up
10	Carry	Carry Output
11	Borrow	Borrow Output
8	V_{SS}	Negative Supply Voltage
16	V_{DD}	Positive Supply Voltage

FUNCTIONAL DIAGRAM (One Half)



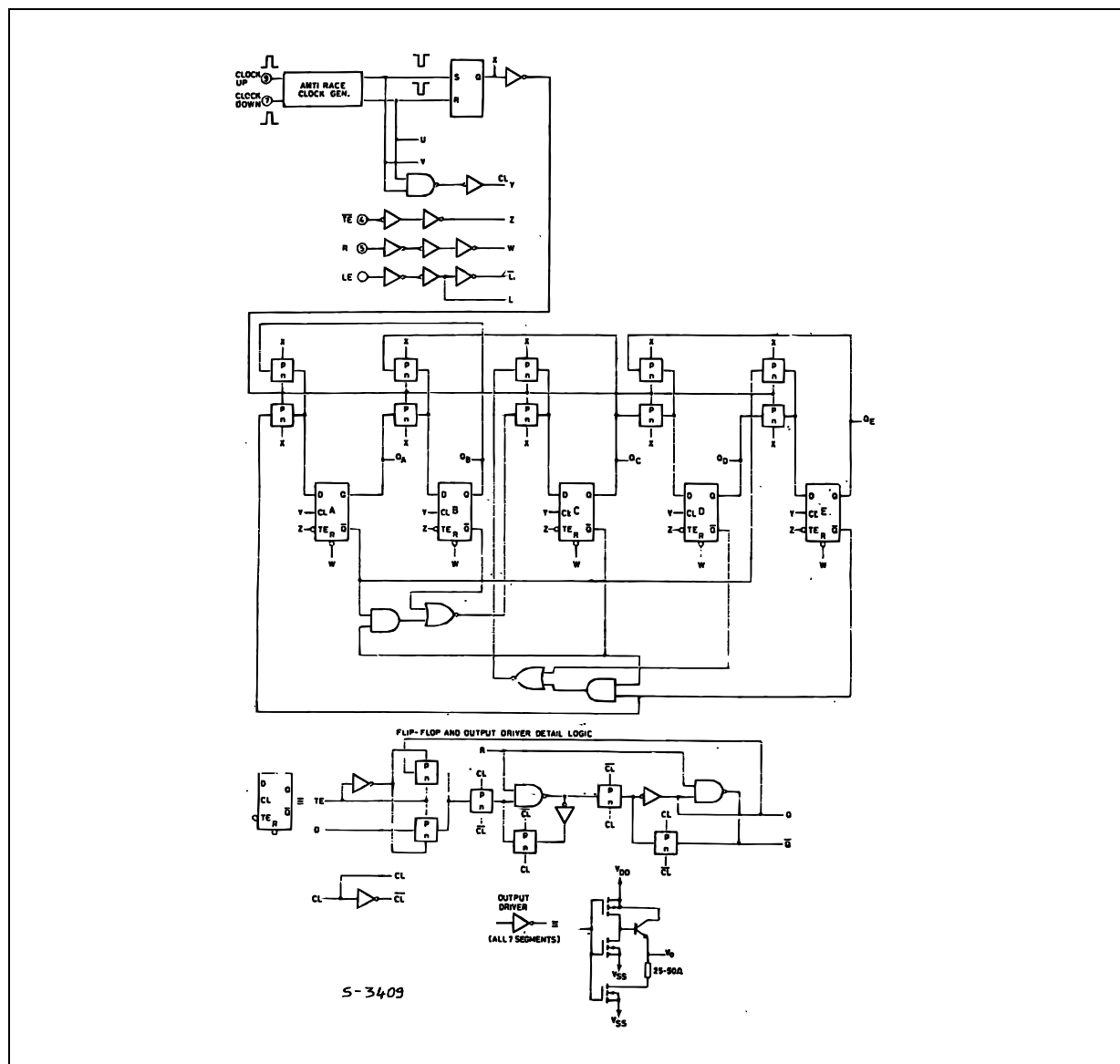
TRUTH TABLES

CLOCK UP*	CLOCK DOWN*	LATCH ENABLE	TOGGLE ENABLE	RESET	COUNTER	DISPLAY
	X	L	L	L	Increments by 1	Follows Counter
X		L	L	L	Decrements by 1	Follows Counter
		X	X	L	No Change	No Change
X	X	X	X	H	Goes to 00000	Follow Counter (Display = 0)
X	X	X	H	L	Inhibited	Remains Fixed
	X	H	L	L	Increments by 1	Remains Fixed
X		H	L	L	Decrements by 1	Remains Fixed

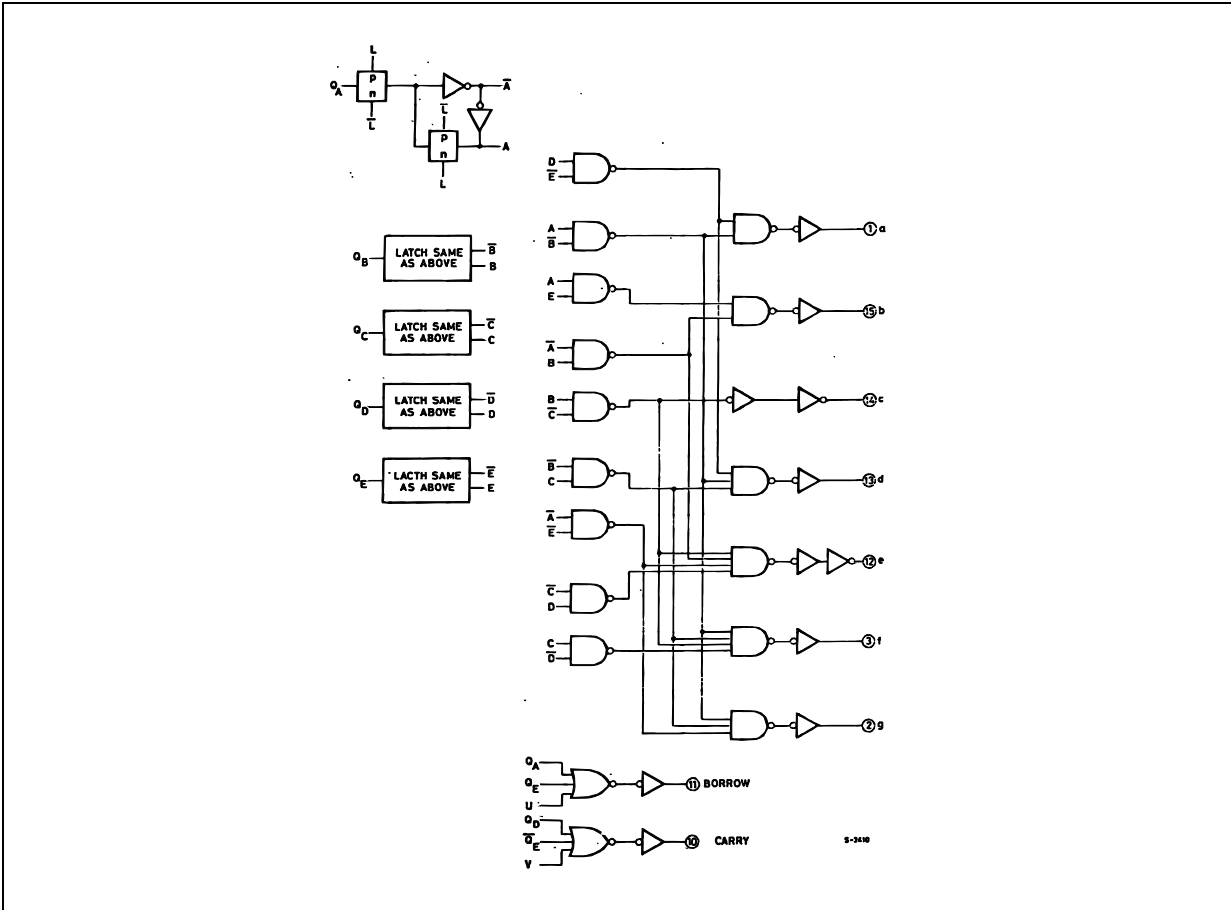
X : Don't Care

* : Typically 100 ns between clock-up and clock-down positive transitions are required to ensure proper counting

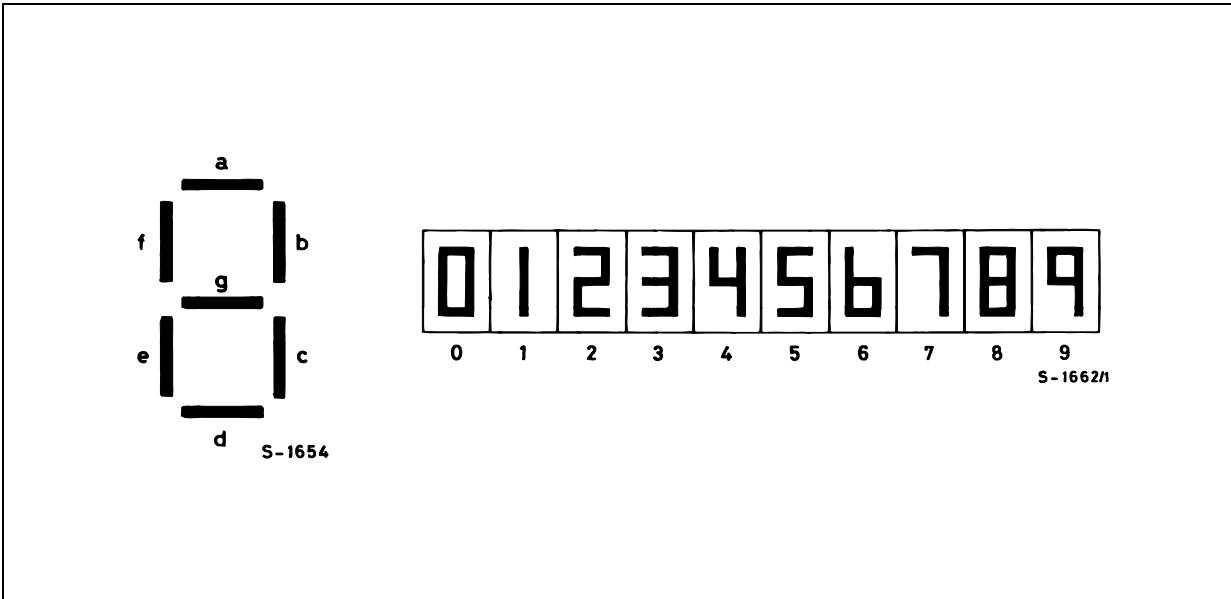
LOGIC DIAGRAM



LOGIC DIAGRAM



DISPLAY SEGMENTS



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	± 10	mA
P_D	Power Dissipation per Package	200	mW
	Power Dissipation per Output Transistor	100	mW
T_{op}	Operating Temperature	-55 to +125	°C
T_{stg}	Storage Temperature	-65 to +150	°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	°C

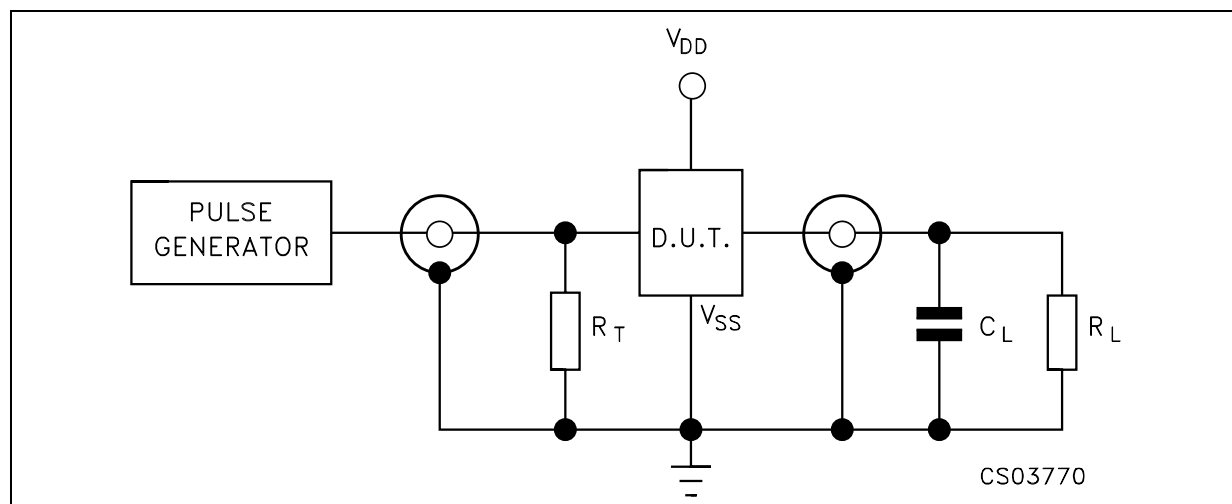
DC SPECIFICATIONS

Symbol	Parameter	Test Condition				Value							Unit
		V _I (V)	V _O (V)	I _O (μA)	V _{DD} (V)	T _A = 25°C			-40 to 85°C		-55 to 125°C		
						Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
I _L	Quiescent Current	0/5			5		0.04	5		150		150	μA
		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 _{OH}	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 _{OL}	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 _{IH}	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 _{IL}	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 _{OH}	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 _{OL}	Output Sink Current Q	0/5	0.4	<1	5	1.74	4		1.43		1.43		mA
		0/10	0.5	<1	10	4.42	10.4		3.74		3.74		
		0/15	1.5	<1	15	11.56	27.2		9.52		9.52		
I _{OL}	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 _I	Input Leakage Current	0/18	Any Input		18		±10 ⁻⁵	±0.1		±1		±1	μA
I _{OZ}	3-State Output Leakage Current	0/18	Any Input		18		±10 ⁻⁴	±0.4		±12		±12	μA
C _I	Input Capacitance		Any Input				5	7.5					pF

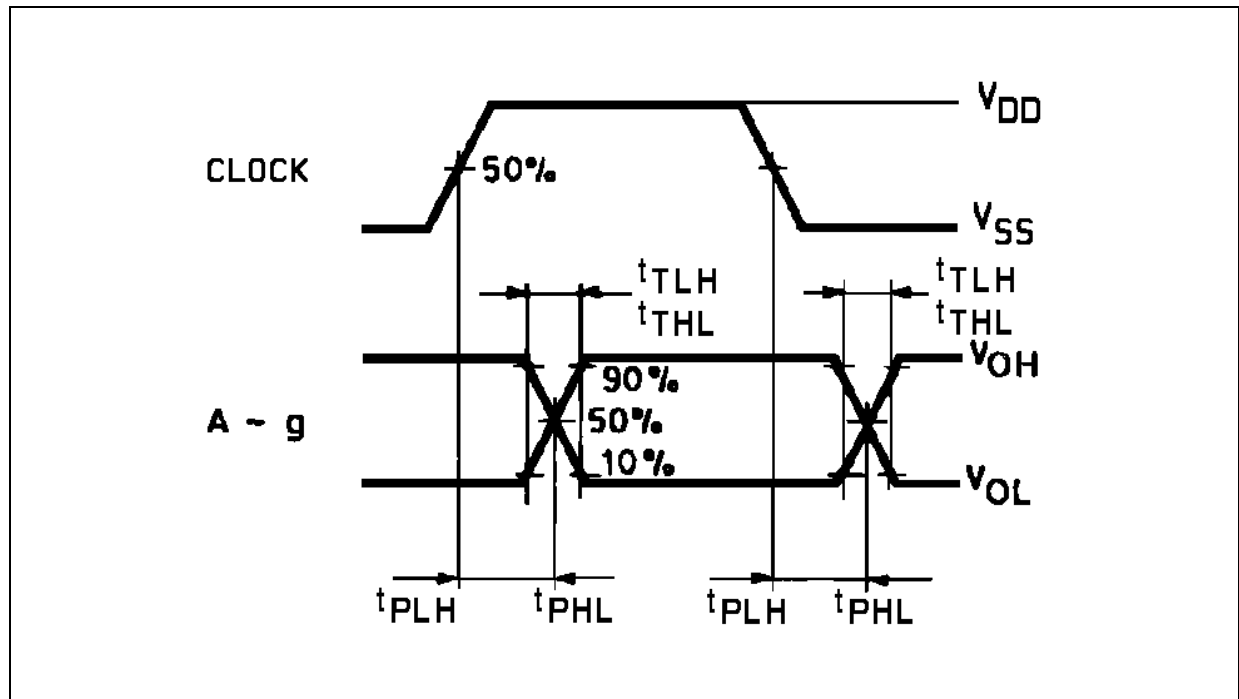
The Noise Margin for both "1" and "0" level is: 1V min. with V_{DD}=5V, 2V min. with V_{DD}=10V, 2.5V min. with V_{DD}=15V

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.	
CLOCK UP/CLOCK DOWN							
t _W	Pulse Width	5			85		ns
		10			35		
		15			15		
f _{CL}	Maximum Frequency	5			2.5		MHz
		10			5		
		15			8		
t _{WC}	Carry Pulse Width	5			225		ns
		10			100		
		15			70		
t _{WB}	Borrow Pulse Width	5			260		ns
		10			110		
		15			80		
RESET							
t _{PLH} t _{PHL}	Propagation Delay Time Reset to Clock	5			750		ns
		10			285		
		15			200		
	Delay from Reset to First Allowable Clock	5			300		ns
		10			125		
		15			75		
t _W	Pulse Width	5			150		ns
		10			60		
		15			40		

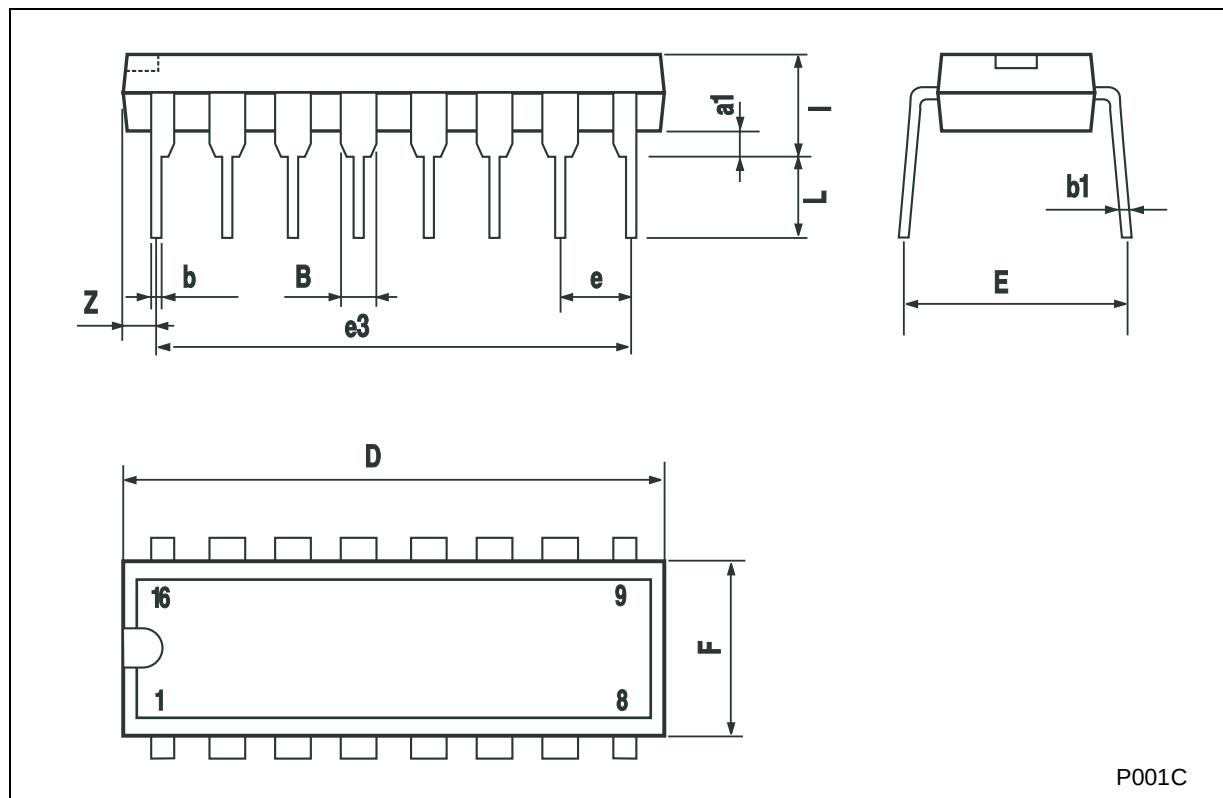
(*) Typical temperature coefficient for all V_{DD} value is 0.3 %/°C.NOTE : Measured at the point of 10% change in output load of 50pF, $R_L = 1\text{K}\Omega$ to V_{DD} for t_{PZL} , t_{PLZ} and $R_L = 1\text{K}\Omega$ to V_{SS} for t_{PHZ} **TEST CIRCUIT** $C_L = 50\text{pF}$ or equivalent (includes jig and probe capacitance) $R_L = 200\text{K}\Omega$ $R_T = Z_{OUT}$ of pulse generator (typically 50Ω)

WAVEFORM : PROPAGATION DELAY TIMES ($f=1\text{MHz}$; 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



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