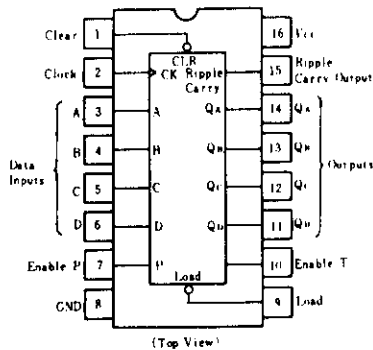


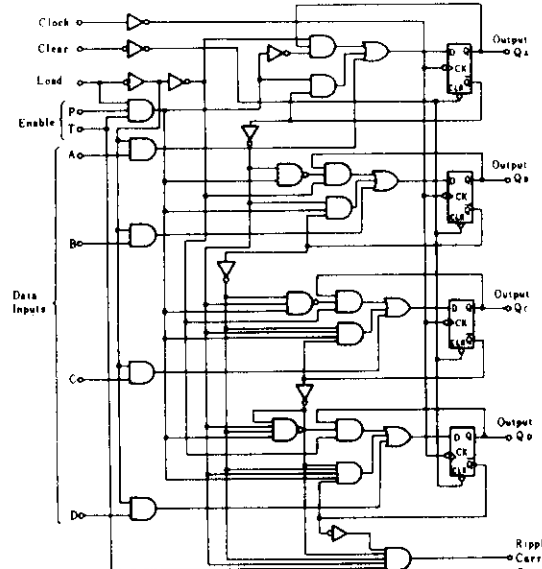
This synchronous 4-bit binary counter features an internal carry look-ahead for application in high speed counting designs. Synchronous operation is provided by having all flip-flops clocked simultaneously so that the outputs changes coincident with each other when so instructed by the count-enable inputs and internal gating. This mode of operation eliminates the output counting spikes that are normally associated with asynchronous (ripple clock) counters. A buffered clock input triggers the four flip-flops on the rising (positive-going) edge of the clock input waveform.

This counter is fully programmable; that is, the outputs may be preset to either level. As presetting is synchronous, setting up a low level at the load input disables the counter and causes the outputs to agree with the setup data after the next clock pulse regardless of the levels of the enable inputs. Low-to-high transitions at the load input should be avoided when the clock is low if the enable inputs are high at or before the transition. The clear function is asynchronous and a low level at the clear input sets all four of the flip-flop outputs low regardless of the levels of clock, load, or enable inputs. The carry look-ahead circuitry provides for cascading counters for n -bit synchronous applications without additional gating. Instrumental in accomplishing this function are two count-enable inputs and a ripple carry output. Both count-enable inputs (P and T) must be high to count, and input T is fed forward to enable the ripple carry output. The ripple carry output thus enabled will produce a high-level output pulse with a duration approximately equal to the high-level portion of the Q_A output. This high-level overflow ripple carry pulse can be used to enable successive cascaded stages. High-to-low level transitions at the enable P or T inputs should occur only when the clock input is high.

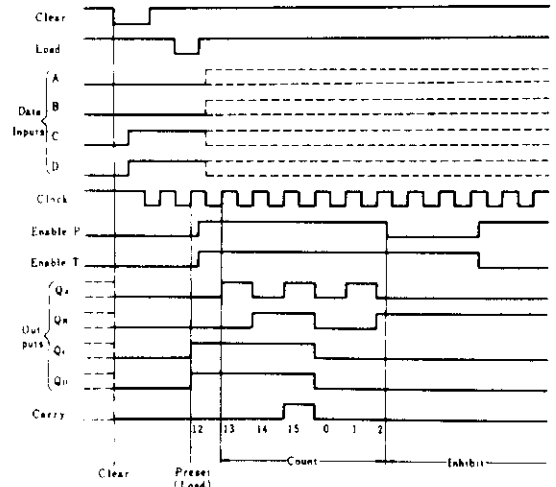
PIN ARRANGEMENT



BLOCK DIAGRAM



TYPICAL CLEAR, PRESET, AND INHIBIT SEQUENCE



RECOMMENDED OPERATING CONDITIONS

Item	Symbol	min	typ	max	Unit
Clock frequency	f_{clock}	0	—	25	MHz
Clock pulse width	$t_w(CK)$	25	—	—	ns
Clear pulse width	$t_w(CLR)$	20	—	—	ns
Setup time	A, B, C, D	20	—	—	ns
	Enable P, T	20	—	—	
	Load	20	—	—	
Hold time	t_h	3	—	—	ns

■ ELECTRICAL CHARACTERISTICS ($T_a = -20 \sim +75^\circ\text{C}$)

Item		Symbol	Test Conditions	min	typ*	max	Unit
Input voltage		V_{IH}		2.0	—	—	V
		V_{IL}		—	—	0.8	V
Output voltage		V_{OH}	$V_{CC}=4.75\text{V}$, $V_{IH}=2\text{V}$, $V_{IL}=0.8\text{V}$, $I_{OH}=-400\mu\text{A}$	2.7	—	—	V
		V_{OL}	$V_{CC}=4.75\text{V}$, $V_{IH}=2\text{V}$	—	—	0.4	V
			$V_{IL}=0.8\text{V}$	—	—	0.5	
Input current	Data, Enable P	I_{IH}	$V_{CC}=5.25\text{V}$, $V_I=2.7\text{V}$	—	—	20	μA
	Load, Clock, Enable T			—	—	40	
	Clear			—	—	20	
	Data, Enable P	I_{IL}	$V_{CC}=5.25\text{V}$, $V_I=0.4\text{V}$	—	—	-0.4	mA
	Load, Clock, Enable T			—	—	-0.8	
	Clear			—	—	-0.4	
	Data, Enable P	I_I	$V_{CC}=5.25\text{V}$, $V_I=7\text{V}$	—	—	0.1	mA
	Load, Clock, Enable T			—	—	0.2	
	Clear			—	—	0.1	
Short-circuit output current		I_{OS}	$V_{CC}=5.25\text{V}$	-20	—	-100	mA
Supply current**		I_{CCH}	$V_{CC}=5.25\text{V}$	—	18	31	mA
		I_{CCL}	$V_{CC}=5.25\text{V}$	—	19	32	mA
Input clamp voltage		V_{IK}	$V_{CC}=4.75\text{V}$, $I_{IN}=-18\text{mA}$	—	—	-1.5	V

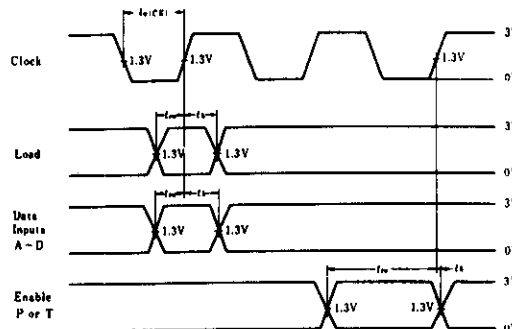
* $V_{CC}=5\text{V}$, $T_a=25^\circ\text{C}$

** I_{CCH} is measured with the load input high, then again with the load input low, with all other inputs high and all outputs open. I_{CCL} is measured with the clock input high, then again with the clock input low, with all other inputs low and all outputs open.

■ SWITCHING CHARACTERISTICS ($V_{CC}=5\text{V}$, $T_a=25^\circ\text{C}$)

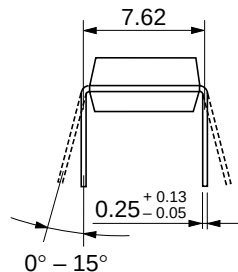
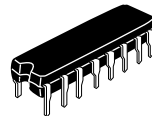
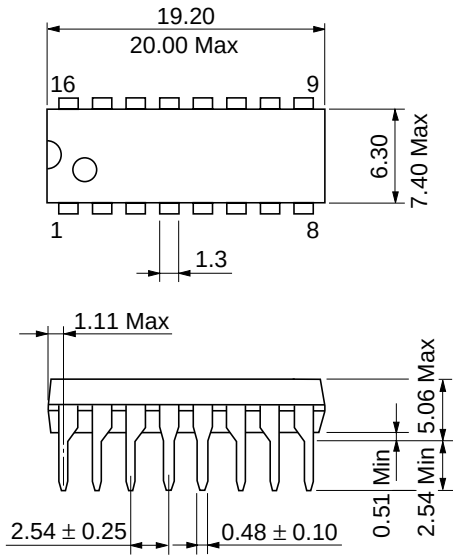
Item	Symbol	Inputs	Outputs	Test Conditions	min	typ	max	Unit
Maximum clock frequency	f_{max}	Clock	$Q_A \sim Q_D$	$C_L=15\text{pF}$, $R_L=2\text{k}\Omega$	25	32	—	MHz
Propagation delay time	t_{PLH}	Clock	Ripple		—	20	35	ns
	t_{PHL}		Carry		—	18	35	ns
	t_{PLH}	Clock (Load=H')	$Q_A \sim Q_D$		—	13	24	ns
	t_{PHL}				—	18	27	ns
	t_{PLH}	Clock (Load=L')	$Q_A \sim Q_D$		—	13	24	ns
	t_{PHL}				—	18	27	ns
	t_{PLH}	Enable T	Ripple		—	9	14	ns
	t_{PHL}		Carry		—	9	14	ns
	t_{PHL}	Clear	$Q_A \sim Q_D$		—	20	28	ns

■ TIMING DEFINITION

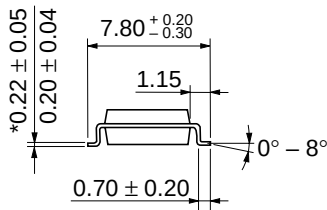
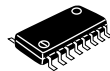
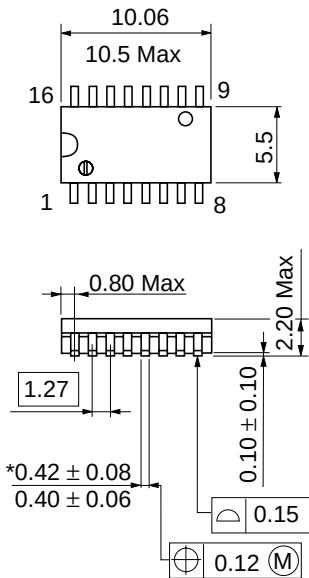


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Unit: mm

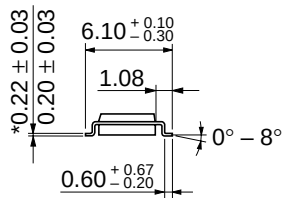
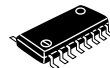
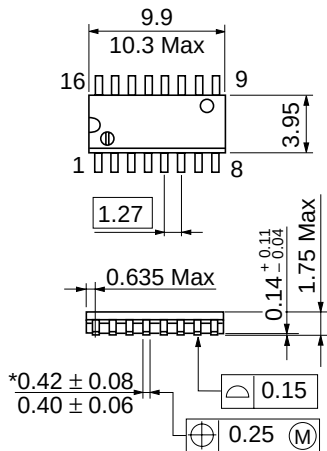


Hitachi Code	DP-16
JEDEC	Conforms
EIAJ	Conforms
Weight (reference value)	1.07 g



*Dimension including the plating thickness
Base material dimension

Hitachi Code	FP-16DA
JEDEC	—
EIAJ	Conforms
Weight (reference value)	0.24 g



*Dimension including the plating thickness
Base material dimension

Hitachi Code	FP-16DN
JEDEC	Conforms
EIAJ	Conforms
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