

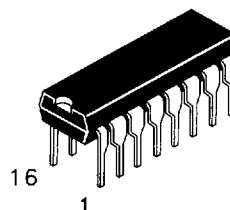
DV74HC163A Available Q2, 1995

4-Bit Presettable Synchronous Counters

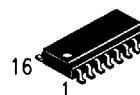
The HC161A is a programmable 4-bit binary counter with Asynchronous reset mode. The HC163A is also a programmable 4-bit binary counter, but with synchronous reset mode.

- **Output Drive Capability:** 10 LSTTL Loads
- **Outputs Directly Interface to** CMOS, NMOS, and TTL
- **Operating Voltage Range:** 2 to 6 V for HC devices
- **Low Input Current:** 1 μ A
- **DC, AC parameters guaranteed from -55°C to 125°C**

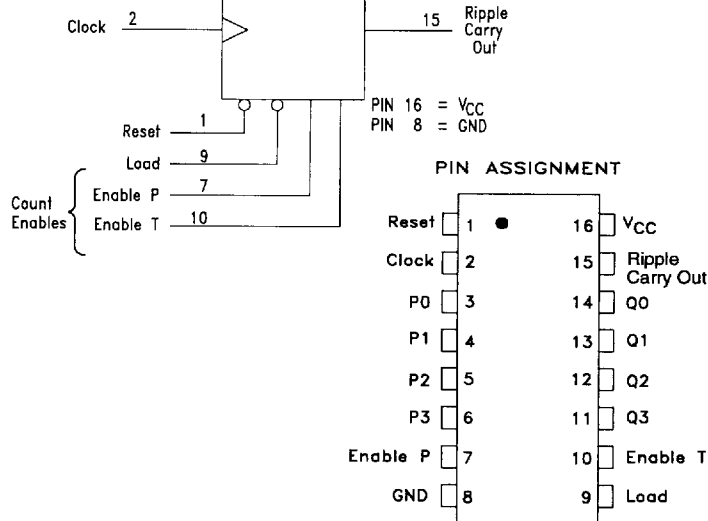
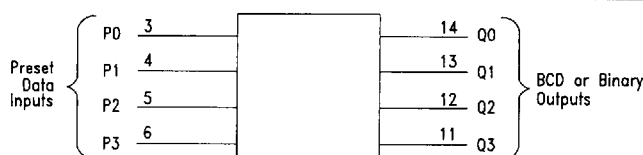
DV74HC161A DV74HC163A



N Suffix
Plastic DIP
AVG-003 Case



D Suffix
Plastic SOP
AVG-004 Case



TRUTH TABLE

Inputs					Output Q
Clock	Reset*	Load	Enable P	Enable T	
↑	L	X	X	X	Reset
↑	H	L	X	X	Load Preset Data
↑	H	H	H	H	Count
↑	H	H	L	X	No Count
↑	H	H	X	L	No Count

H = High Logic Level

L = Low Logic Level

↑ = Rising Edge of Clock

*HC163A only. HC161A is an Asynchronous-Reset Device
Ripple Carry Out = Enable T * Q0 * Q1 * Q2 * Q3

X = Don't Care

ABSOLUTE MAXIMUM RATINGS

Maximum ratings are those values beyond which damage to the device may occur.

Symbol	Parameter	Value	Unit
V _{CC}	DC Supply Voltage (Referenced to GND)	-0.5 to +7.0	V
V _{IN}	DC Input Voltage (Referenced to GND)	-1.5 to V _{CC} + 1.5	V
V _{OUT}	DC Output Voltage (Referenced to GND)	-0.5 to V _{CC} + 0.5	V
I _{IN}	DC Input Current, per Pin	± 20	mA
I _{OUT}	DC Output Current, per Pin	± 25	mA
I _{CC}	DC Supply Current, V _{CC} and GND Pins	± 50	mA
P _D	Power Dissipation in Still Air, Plastic DIP SOP Package	750 500	mW
T _{STG}	Storage Temperature Range	-65 to +150	°C
T _L	Lead Temperature, 1mm from Case for 10 Seconds	260	°C

GUARANTEED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
V _{CC}	DC Supply Voltage Referenced to GND	2.0	6.0	V
V _{IN} , V _{OUT}	DC Input Voltage, Output Voltage (Referenced to GND)	0	V _{CC}	V
T _A	Ambient Temperature	-55	+125	°C
t _r , t _f	Input Rise and Fall Time V _{CC} =2.0V V _{CC} =4.0V V _{CC} =6.0V	0 0 0	1000 500 400	ns

HC - 161A, HC - 162A**DC ELECTRICAL CHARACTERISTICS**

Symbol	Parameter	Conditions	V _{CC} V	Guaranteed Limits			Unit
				25°C to -55°C	≤85°C	≤125°C	
V _{IH}	Minimum High-Level Input Voltage	V _{OUT} = 0.1 V, I _{OUT} ≤ 20 μA or V _{OUT} = V _{CC} - 0.1 V	2.0 4.5 6.0	1.5 3.15 4.2	1.5 3.15 4.2	1.5 3.15 4.2	V
V _{IL}	Maximum Low-Level Input Voltage	V _{OUT} = 0.1 V, I _{OUT} ≤ 20 μA or V _{OUT} = V _{CC} - 0.1 V	2.0 4.5 6.0	0.50 1.35 1.80	0.50 1.35 1.80	0.50 1.35 1.80	V
V _{OH}	Minimum High-Level Output Voltage	V _{IN} = V _{IH} or V _{IL} I _{OUT} ≤ 20 μA	2.0 4.5 6.0	1.9 4.4 5.9	1.9 4.4 5.9	1.9 4.4 5.9	V
		V _{IN} = V _{IH} or V _{IL} , I _{OUT} ≤ 4.0 mA I _{OUT} ≤ 5.2 mA	4.5 6.0	3.98 5.48	3.84 5.34	3.7 5.2	
V _{OL}	Maximum Low-Level Output Voltage	V _{IN} = V _{IH} or V _{IL} I _{OUT} ≤ 20 μA	2.0 4.5 6.0	0.1 0.1 0.1	0.1 0.1 0.1	0.1 0.1 0.1	V
		V _{IN} = V _{IH} or V _{IL} , I _{OUT} ≤ 6.0 mA I _{OUT} ≤ 7.8 mA	4.5 6.0	0.26 0.26	0.33 0.33	0.40 0.40	
I _{IN}	Maximum Input Leakage Current	V _{IN} = V _{CC} or GND	6.0	± 0.1	± 1.0	± 1.0	μA
I _{CC}	Maximum Quiescent Supply Current	V _{IN} = V _{CC} or GND, I _{OUT} = 0 μA (Per Package)	6.0	4.0	40	160	μA

AC ELECTRICAL CHARACTERISTICS over full operating conditions (C_L = 50 pF, Input t_r = t_f = 6 ns)

Symbol	Parameter	V _{CC} V	Guaranteed Limit			Unit
			25°C to -55°C	≤85°C	≤125°C	
f _{max}	Maximum Clock Frequency (50% Duty Cycle)	2.0 4.5 6.0	6 30 35	5 24 28	4 20 24	MHz
t _{PLH}	Maximum Propagation Delay Time, Clock to Q	2.0 4.5 6.0	120 20 16	160 23 20	200 28 22	ns
t _{PHL}		2.0 4.5 6.0	145 22 18	185 25 20	320 30 23	ns
t _{PHL}	Maximum Propagation Delay Reset to Q (HC161A Only)	2.0 4.5 6.0	145 20 17	185 22 19	220 25 21	ns
t _{PLH}	Maximum Propagation Delay Enable T to Ripple Carry Out	2.0 4.5 6.0	110 16 14	150 18 15	190 20 17	ns
t _{PHL}		2.0 4.5 6.0	135 18 15	175 20 16	210 22 20	ns

Symbol	Parameter	V _{CC} V	Guaranteed Limit			Unit
			25°C to -55°C	≤85°C	≤125°C	
t _{PLH}	Maximum Propagation Delay Time, Clock to Ripple Carry Out	2.0	120	160	200	ns
		4.5	22	27	30	
		6.0	18	22	25	
t _{PHL}		2.0	145	185	220	ns
		4.5	22	28	35	
		6.0	20	24	28	
t _{PHL}	Maximum Propagation Delay Reset to Ripple Carry Out (HC161A Only)	2.0	155	190	230	ns
		4.5	22	26	30	
		6.0	18	22	25	
t _{TLH} , t _{THL}	Maximum Output Transition Time Any Output	2.0	75	95	110	ns
		4.5	15	19	22	
		6.0	13	16	19	
C _{IN}	Maximum Input Capacitance	—	10	10	10	pF

C _{PD}	Power Dissipation Capacitance (Per Gate) Used to determine the no-load dynamic power consumption, $P_D = C_{PD} V_{CC}^2 f + I_{CC} V_{CC}$	Typical @ 25°C. V _{CC} = 5.0 V	pF
		30	

TIMING REQUIREMENTS (C_L=50pF, Input t_r=t_f=6.0 ns)

Symbol	Parameter	V _{CC} V	Guaranteed Limit			Unit
			25°C to -55°C	≤85°C	≤125°C	
t _{su}	Minimum Set up Time Preset Data Inputs to Clock	2.0	40	60	80	ns
		4.5	15	20	30	
		6.0	12	18	20	
t _{su}	Minimum Setup Time, Load to Clock	2.0	60	75	90	ns
		4.5	15	20	30	
		6.0	12	18	20	
t _{su}	Minimum Setup Time, Reset to Clock (HC163A Only)	2.0	60	75	90	ns
		4.5	20	25	35	
		6.0	17	23	25	
t _{su}	Minimum Setup Time Enable T or Enable P to Clock	2.0	80	95	110	ns
		4.5	20	25	35	
		6.0	17	23	25	
t _h	Minimum Hold Time, Clock to Load or Preset Data Inputs	2.0	3	3	3	ns
		4.5	3	3	3	
		6.0	3	3	3	
t _h	Minimum Hold Time, Clock to Reset (HC163A Only)	2.0	3	3	3	ns
		4.5	3	3	3	
		6.0	3	3	3	
t _h	Minimum Hold Time, Clock to Enable T or Enable P	2.0	3	3	3	ns
		4.5	3	3	3	
		6.0	3	3	3	
t _{rec}	Minimum Recovery Time Reset Inactive to Clock (HC161A Only)	2.0	80	95	110	ns
		4.5	15	20	26	
		6.0	12	17	23	
t _{rec}	Minimum Recovery Time Load Inactive to Clock	2.0	80	95	110	ns
		4.5	15	20	26	
		6.0	12	17	23	
t _w	Minimum Pulse Width Clock	2.0	60	75	90	ns
		4.5	12	15	18	
		6.0	10	13	15	
t _w	Minimum Pulse Width Reset	2.0	60	75	90	ns
		4.5	12	15	18	
		6.0	10	13	15	
t _r , t _f	Maximum Input Rise and Fall Times		2.0	1000	1000	ns
			4.5	500	500	
			6.0	400	400	

161, 163

HCT - 161A, HCT - 163A

DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Conditions	V _{CC} V	Guaranteed Limits						Unit
				25°C to -55°C		≤85°C		≤125°C		
				Min	Max	Min	Max	Min	Max	
V _{IH}	Minimum High-Level Input Voltage	V _{OUT} = 0.1 V or V _{CC} -0.1 V I _{OUT} ≤ 20 μA	4.5 5.5	2.00 2.00		2.00 2.00		2.00 2.00		V
V _{IL}	Maximum Low- Level Input Voltage	V _{OUT} =0.1 V or V _{CC} - 0.1 V I _{OUT} ≤ 20 μA	4.5 5.5		0.80 0.80		0.80 0.80		0.80 0.80	V
V _{OH}	Minimum High-Level Output Voltage	V _{IN} = V _{IL} or V _{IH} I _{OUT} ≤ 20 μA	4.5 5.5	4.40 5.40		4.40 5.40		4.40 5.40		V
		V _{IN} =V _{IL} or V _{IH} I _{OUT} ≤4.0 mA	4.5	3.98		3.84		3.70		V
V _{OL}	Maximum Low Level Output Voltage	V _{IN} = V _{IH} or V _{IL} I _{OUT} ≤ 20 μA	4.5 5.5		0.1 0.1		0.1 0.1		0.1 0.1	V
		V _{IN} = V _{IH} or V _{IL} I _{OUT} ≤ 4.0mA	4.5		0.26		0.33		0.40	V
I _{IN}	Maximum Input Leakage Current	V _{IN} = V _{CC} or GND	5.5		± 0.1		± 1.0		± 1.0	μA
I _{CC}	Maximum Quiescent Supply Current	V _{IN} = V _{CC} or GND I _{OUT} = 0 μA	5.5		4.0		40		160	μA

Δ I _{CC}	Additional Quiescent Supply Current	V _{IN} =2.4V, Any One Input V _{IN} =V _{CC} or GND, Other Inputs I _{OUT} =0 μA	5.5	≥ -55°C		25°C to 125°C		mA
				2.9		2.4		

AC ELECTRICAL CHARACTERISTICS over full operating conditions (C_L=50 pF, Input t_r=t_f=6ns)

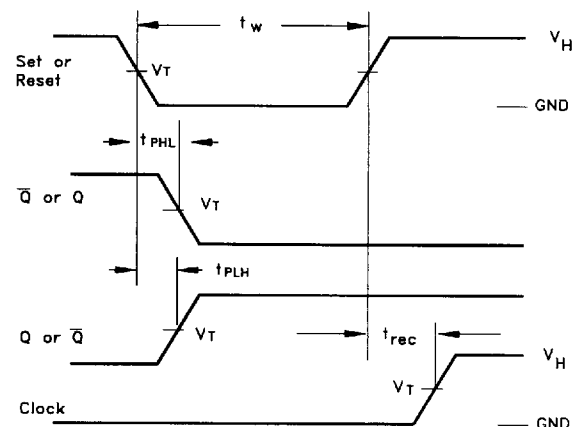
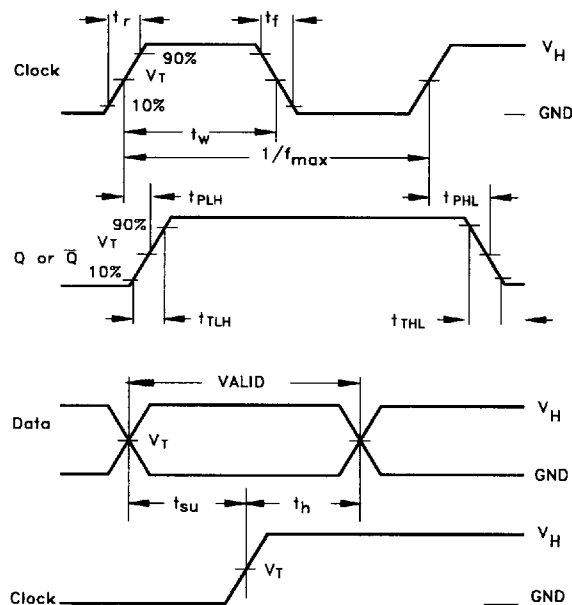
Symbol	Parameter	V _{CC} V	Guaranteed Limit			Unit
			25°C to -55°C	≤85°C	≤125°C	
f _{max}	Maximum Clock Frequency (50% Duty Cycle)	5	30	24	20	MHz
t _{PLH}	Maximum Propagation Delay Time, Clock to Q	5	34	43	51	ns
t _{PHL}		5	41	51	62	ns
t _{PHL}	Maximum Propagation Delay, Reset to Q (HC161A Only)	5	42	53	63	ns
t _{PLH}	Maximum Propagation Delay, Enable T to Ripple Carry Out	5	32	40	48	ns
t _{PHL}		5	39	49	59	ns
t _{PLH}	Maximum Propagation Delay Time, Clock to Ripple Carry Out	5	35	44	53	ns
t _{PHL}		5	43	54	65	ns
t _{PHL}	Maximum Propagation Delay Reset to Ripple Carry Out (HC161A Only)	5	44	55	66	ns
t _{TLH} , t _{THL}	Maximum Output Transition Time, Any Output	5	15	19	22	ns
C _{IN}	Maximum Input Capacitance	—	10	10	10	pF
CPD	Power Dissipation Capacitance (Per Gate) Used to determine the no-load dynamic power consumption, P _D = C _{PD} V _{CC} ² f + I _{CC} V _{CC}	Typical @ 25°C. V _{CC} = 5.0 V				pF
		60				

TIMING REQUIREMENTS (C_L=50pF, Input t_r=t_f=6.0 ns)

Symbol	Parameter	V _{CC} V	Guaranteed Limit			Unit
			25°C to -55°C	≤85°C	≤125°C	
t _{su}	Minimum Set up Time, Preset Data Inputs to Clock	5	30	38	45	ns
t _{su}	Minimum Setup Time, Load to Clock	5	27	34	41	ns

t_{su}	Minimum Setup Time, Reset to Clock (HC163A Only)	5	32	40	48	ns
t_{su}	Minimum Setup Time Enable T or Enable P to Clock	5	40	50	60	ns
t_h	Minimum Hold Time, Clock to Preset Data Inputs	5	10	13	15	ns
t_h	Minimum Hold Time, Clock to Load	5	3	3	3	ns
t_h	Minimum Hold Time, Clock to Reset (HC163A Only)	5	3	3	3	ns
t_h	Minimum Hold Time, Clock to Enable T or Enable P	5	3	3	3	ns
t_{rec}	Minimum Recovery Time Reset Inactive to Clock (HC161A Only)	5	25	31	38	ns
t_{rec}	Minimum Recovery Time Load Inactive to Clock	5	25	31	38	ns
t_w	Minimum Pulse Width Clock	5	16	20	24	ns
t_w	Minimum Pulse Width Reset	5	16	20	24	ns

SWITCHING WAVEFORMS



Input and Output Threshold Voltage:
 $V_T = 50\% V_{CC}$ for HC; 1.3V for HCT
 $V_H = V_{CC}$ for HC, 3V for HCT

161, 163