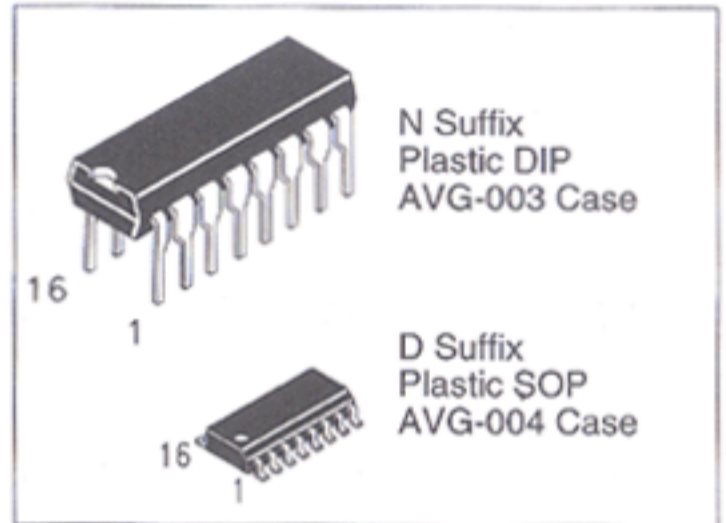


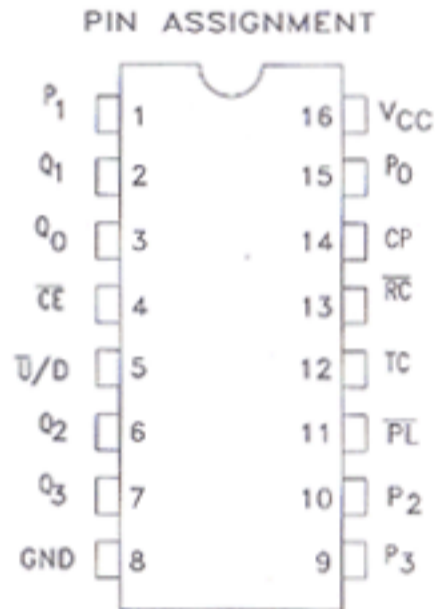
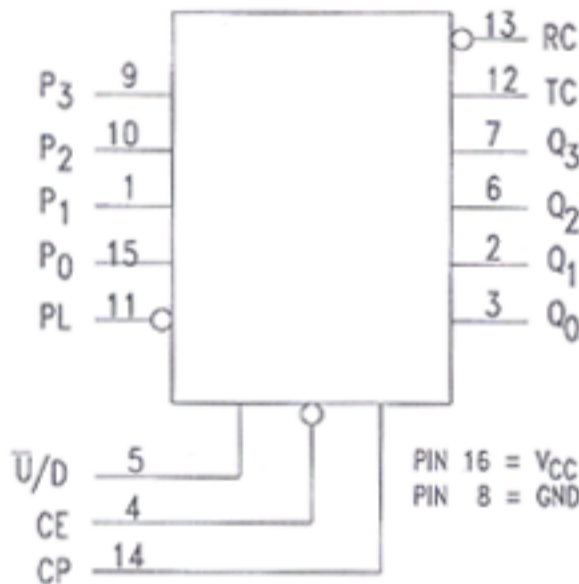
Synchronous Up/Down Decade and Binary Counters

DV74LS190
DV74ALS190
DV74LS191
DV74ALS191

The 74LS/ALS 190 is a synchronous UP/DOWN BCD Decade counter (8421) The 74LS/ALS 191 is a synchronous UP/DOWN Modulo-16 Binary Counter. State changes of the counters are synchronous with the LOW-to-HIGH transition of the Clock Pulse input. An asynchronous Parallel Load (PL) input overrides counting and loads the data present on the P_n inputs into the flip-flops. A Count Enable (CE) input serves as the carry/borrow input in multi-stage counters. An Up/Down Count Control (U/D) input determines whether a circuit counts up or down. A Terminal Count (TC) output and a Ripple Clock (RC) output provide overflow/underflow indication and make possible a variety of methods for generating carry/borrow signals in multi-stage counter applications.



- AVG's LS operates over extended V_{cc} from 4.5 to 5.5 V
- AVG's LS and ALS both have guaranteed DC and AC specification over full temperature and V_{cc} range
- Switching specifications for ALS at 50 pF
- AVG's ALS has the lowest speed power product (4pJ per gate typical) of all logic series



NOTE:

The LS/ALS 190 can be Preset to any state, but will not count beyond 9. If Preset to state 10, 11, 12, 13, 14 or 15, it will follow the sequence 10, 11, 6: 12, 13, 4: 14, 15, 2 if counting Up, and follow the sequence 15, 14, 13, 12, 11, 10, 9 if counting Down.

MODE SELECT TABLE

Inputs				Mode
PL	CE	U/D	Clock	
H	L	L	↑	Count UP
H	L	H	↑	Count DOWN
L	X	X	X	Preset (Async)
H	H	X	X	No Change (Hold)

RC TRUTH TABLE

Inputs			RC Output
CE	TC	CP	
L	H	↓↑	↓↑
H	X	X	H
X	L	X	H

H=High Logic Level
 L=Low Logic Level
 X=Don't Care
 ↑= Low to High Transition
 ↓↑=Low Pulse

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	LS190, 91	ALS190, 91	Unit
V _{CC}	Supply Voltage	7.0	7.0	V
V _{IN}	Input Voltage	7.0	7.0	V
T _{STG}	Storage Temperature Range	-65 to +150	-65 to +150	°C

GUARANTEED OPERATING CONDITIONS

Symbol	Parameter	LS190, 91		ALS190, 91		Unit
		Min	Max	Min	Max	
V _{CC}	Supply Voltage	4.5	5.5	4.5	5.5	V
V _{IH}	High Level Input Voltage	2.0		2.0		V
V _{IL}	Low Level Input Voltage		0.8		0.8	V
I _{OL}	Low Level Output Current		8.0		8.0	mA
I _{OH}	High Level Output Current		-0.4		-0.4	mA
T _A	Ambient Temperature Range	-10 to +70		-10 to +70		°C

DC ELECTRICAL CHARACTERISTICS over full operating conditions

Symbol	Parameter		Conditions	LS190, 191			ALS190, 191			Unit
				Min	Typ	Max	Min	Typ	Max	
V _{IK}	Input Clamp Voltage		V _{CC} = min, I _{IN} = -18 mA			-1.5			-1.5	V
V _{OH}	High Level Output Voltage		V _{CC} = min, I _{OH} = -0.4 mA	V _{CC} -2		3.5	V _{CC} -2			V
V _{OL}	Low Level Output Voltage		V _{CC} = min; I _{OL} = 4.0 mA		0.25	0.4		0.25	0.4	V
			V _{CC} = min; I _{OL} = 8.0 mA		0.35	0.5		0.35	0.5	V
I _{IH}	High Level Input Current	Other Inputs \overline{CE}	V _{CC} = max, V _{IH} = 2.7V			20 60			20 20	μA
		Other Inputs \overline{CE}	V _{CC} = max, V _{IH} = 7.0V			0.1 0.3			0.1 0.1	mA
I _{IL}	Low Level Input Current	Other Inputs \overline{Clock} \overline{CE}	V _{CC} = max, V _{IN} = 0.4V			-0.4 -0.4 -1.2			-0.1 -0.2 -0.2	mA
I _O	Short Circuit Current		V _{CC} = max, V _O = 2.25 V	-20		-110	-30		-112	mA
I _{CC}	Supply Current		V _{CC} = max			35		12	22	mA

SWITCHING CHARACTERISTICS over full operating conditions

Symbol	Parameter		LS190, 191		ALS190, 191		Unit
			C _L = 15pF		C _L = 50 pF R _L = 500Ω		
			Min	Max	Min	Max	
f _{MAX}	Maximum Clock Frequency	190 191	20 20		25 30		MHz
t _{PLH}	Propagation Delay, \overline{PL} to Output Q			33	8	30	ns
t _{PHL}				50	8	30	
t _{PLH}	Propagation Delay, Data to Output Q			32	4	21	ns
t _{PHL}				40	4	21	
t _{PLH}	Propagation Delay, Clock to \overline{RC}			20	5	20	ns
t _{PHL}				24	5	20	
t _{PLH}	Propagation Delay, Clock to Output Q			24	3	18	ns
t _{PHL}				36	3	18	
t _{PLH}	Propagation Delay, Clock to TC			42	8	31	ns
t _{PHL}				52	8	31	
t _{PLH}	Propagation Delay, $\overline{U/D}$ to \overline{RC}			45	15	37	ns
t _{PHL}				45	10	28	

Symbol	Parameter	LS190, 191 $C_L=15\text{pF}$		ALS190, 191 $C_L=50\text{pF}$ $R_L=500\Omega$		Unit
		Min	Max	Min	Max	
t_{PLH}	Propagation Delay, \bar{U}/D to TC		33	8	25	ns
t_{PHL}			33	8	25	
t_{PLH}	Propagation Delay, \bar{CE} to \bar{RC}		33	4	18	ns
t_{PHL}			33	4	18	

AC SETUP REQUIREMENTS over full operating conditions

Symbol	Parameter		LS190, 191		ALS190, 191		Unit
			Min	Max	Min	Max	
t_w	Pulse Width, Clock	190 191	25		20	16.5	ns
t_w	Pulse Width, \bar{PL}		35		20		ns
t_s	Data, CE, \bar{U}/D Setup Time		20		20		ns
t_h	Hold Time	Data	5.0		5.0		ns
t_{rec}	Recovery Time, \bar{PL} to Clock		40		5		ns

SWITCHING WAVEFORMS

