1. DESCRIPTION

These monolithic circuits are synchronous reversible (up/down) counters having a complexity of 55 equivalent gates.The 'LS193 is 4-bit binary counters. Synchronous operation is provided by having all flip-flops clocked simultaneously so that the outputs change coincidently with each other when so instructed by the steering logic.This mode of operation eliminates the output counting spikes which are normally associated with asynchronous (ripple-clock) counters.

The outputs of the four master-slave flip-flops are triggered by a low-to-high-level transition of either count (clock) input.The direction of counting is determined by which count input is pulsed while the other count input is high.

All four counters are fully programmable;that is,each output may be preset to either level by entering the desired data at the data inputs while the load input is low.The output will change to agree with the data inputs independently of the count pulses.This feature allows the counters to be used as modulo-N dividers by simply modifying the count length with the preset inputs.

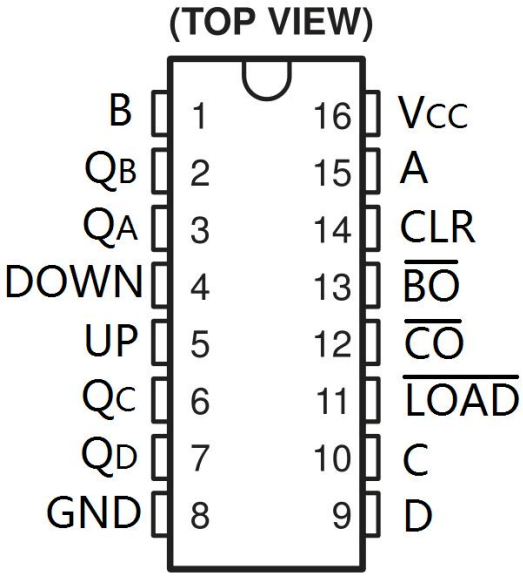
A clear input has been provided which forces all outputs to the low level when a high level is applied.The clear function is independent of the count and load inputs.The clear,count,and load inputs are buffered to lower the drive requirements.This reduces the number of clock drivers,etc.,required for long words.

These counters were designed to be cascaded without the need for external circuitry.Both borrow and carry outputs are available to cascade both the up and down-counting functions.The borrow output produces a pulse equal in width to the count-down input when the counter underflows.Similarly,the carry output produces a pulse equal in width to the count-down input when an overflow condition exists.The counters can then be easily cascaded by feeding the borrow and carry outputs to the count-down and count-up inputs respectively of the succeeding counter.

2. FEATURES

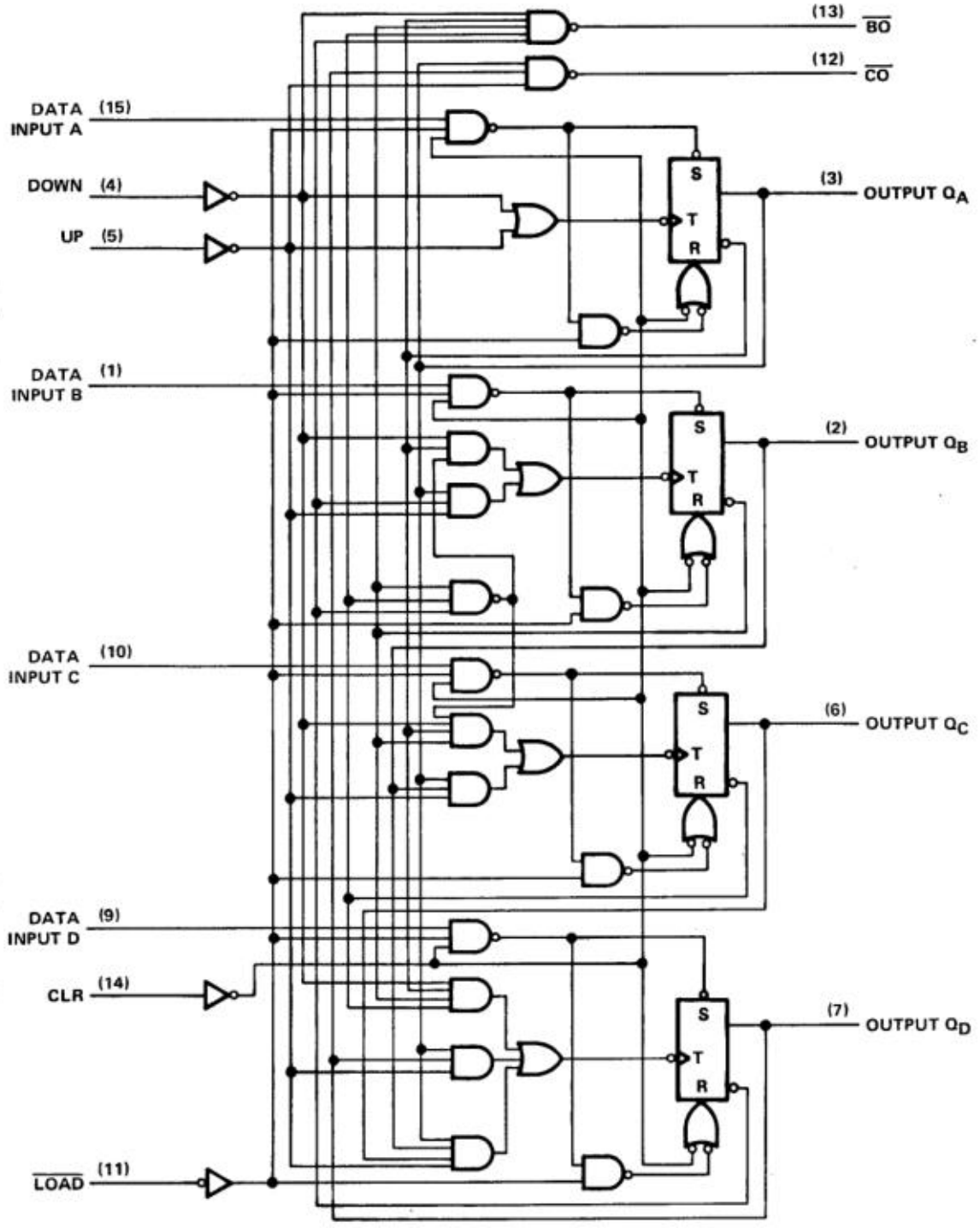
- Cascading Circuitry Provided Internally
- Synchronous Operation
- Individual Preset to Each Flip-Flop
- Fully Independent Clear Input

3. PIN CONFIGURATIONS

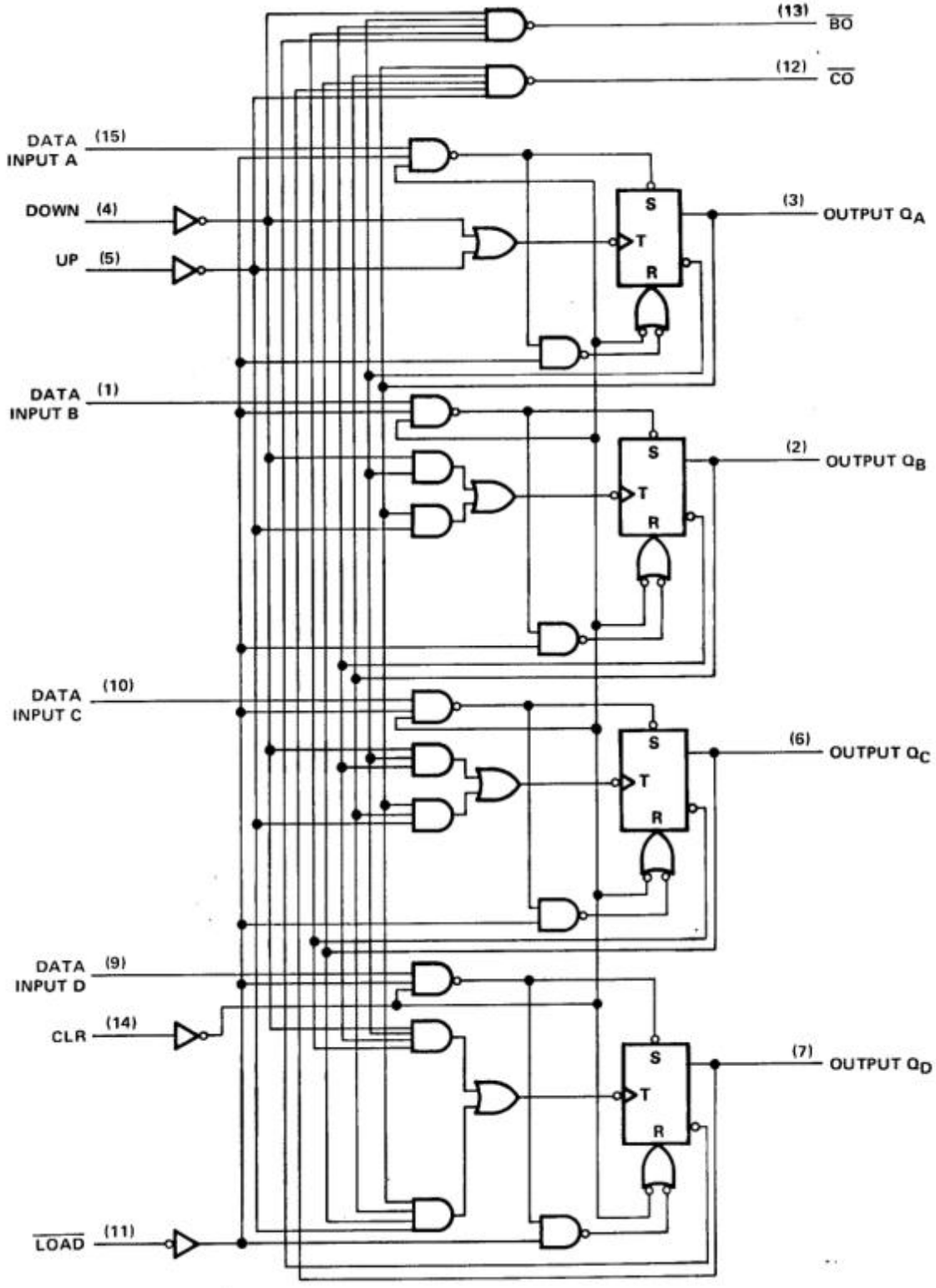


4. LOGIC DIAGRAM

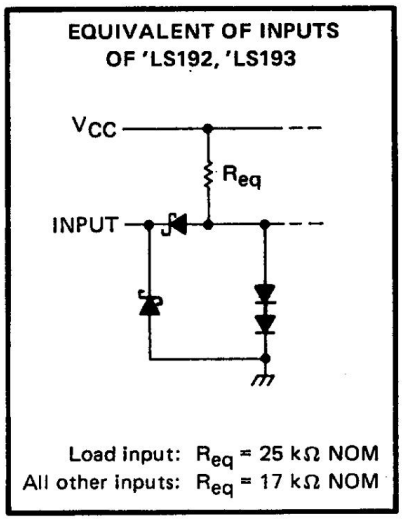
’74LS192

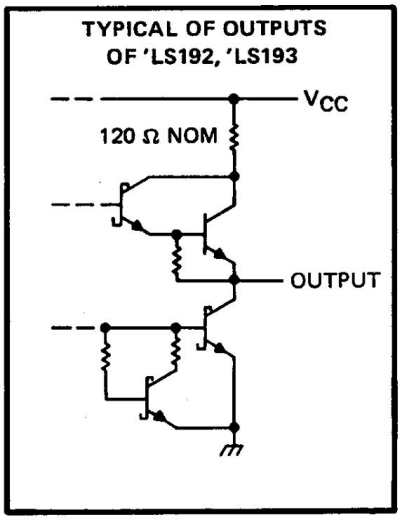


’ 74LS193


(13) $\overline{BO}$
(12) $\overline{CO}$
DATA INPUT A (15)
DOWN (4)
UP (5)
(3) OUTPUT Q_A
DATA INPUT B (1)
(2) OUTPUT Q_B
DATA INPUT C (10)
(6) OUTPUT Q_C
DATA INPUT D (9)
CLR (14)
(7) OUTPUT Q_D
$\overline{LOAD}$ (11)
S
T
R

5. SCHEMATICS OF INPUTS AND OUTPUTS





6. ABSOLUTE MAXIMUM RATINGS OVER OPERATING FREE-AIR TEMPERATURE RANGE (UNLESS OTHERWISE NOTES)

Supply voltage, V_{CC} 7V

Input voltage, VI: 74LS192,74LS193..... 7V

Operating free-air temperature range: DIP package..... 0°C to 70°C

Storage temperature range, Tstg..... −65°C to 150°C

7. RECOMMENDED OPERATING CONDITIONS

		74LS192/193			UNIT
		MIN	NOM	MAX	
V_{CC}	Supply voltage	4.75	5	5.25	V
I_{OH}	High-level output current			−400	μA
I_{OL}	Low-level output current			8	mA
f_{clock}	Clock frequency	0		25	MHz
t_w	Width of any input pulse	20			ns
t_{su}	Clear inactive-state setup time	15			ns
	Load inactive-state setup time	15			ns
	Data setup time	20			ns
t_h	Data hold time	5			ns
T_A	Operating free-air temperature range	0		70	°C

8. ELECTRICAL CHARACTERISTICS OVER RECOMMENDED OPERATING FREE-AIR RANGE (UNLESS OTHERWISE NOTED)

PARAMETER		TEST CONDITIONS†		74LS192/193			UNIT
				MIN	TYP‡	MAX	
V_{IH}	High-level input voltage			2			V
V_{IL}	Low-level input voltage					0.8	V
V_{IK}	Input clamp voltage	V_{CC} = MIN,	I_I = −18 mA			−1.5	V
V_{OH}	High-level output voltage	V_{CC} = MIN, V_{IL} = V_{IL} MAX	V_{IH} = 2 V, I_{OH} = −400 μA	2.7	3.4		V
V_{OL}	Low-level output voltage	V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = V_{IL} MAX	I_{OL} = 4 mA		0.15	0.4	V
			I_{OL} = 8 mA		0.35	0.5	
I_I	Input current at maximum input voltage	V_{CC} = MAX,	V_I = 7 V			0.1	mA
I_{IH}	High-level input current	V_{CC} = MAX,	V_I = 2.7 V			20	μA
I_{IL}	Low-level input current	V_{CC} = MAX,	V_I = 0.4 V			−0.4	mA
I_{OS}	Short-circuit output current§	V_{CC} = MAX		−20		−100	mA
I_{CC}	Supply current	V_{CC} = MAX			19	34	mA

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
‡ All typical values are at V_{CC} = 5 V, T_A = 25°C.
§ Not more than one output should be shorted at a time.

9. SWITCHING CHARACTERISTICS,VCC = 5 V, TA = 25℃

switching characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER†	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{MAX}			C_L = 15 pF, R_L = 2 kΩ	25	32		MHz
t_{PLH}	UP	$\overline{CO}$			17	26	ns
t_{PHL}					18	24	
t_{PLH}	DOWN	$\overline{BO}$			16	24	ns
t_{PHL}					15	24	
t_{PLH}	UP OR DOWN	Q			27	38	ns
t_{PHL}					30	47	
t_{PLH}	$\overline{LOAD}$	Q			24	40	ns
t_{PHL}					25	40	
t_{PHL}	CLR	Q			23	35	ns

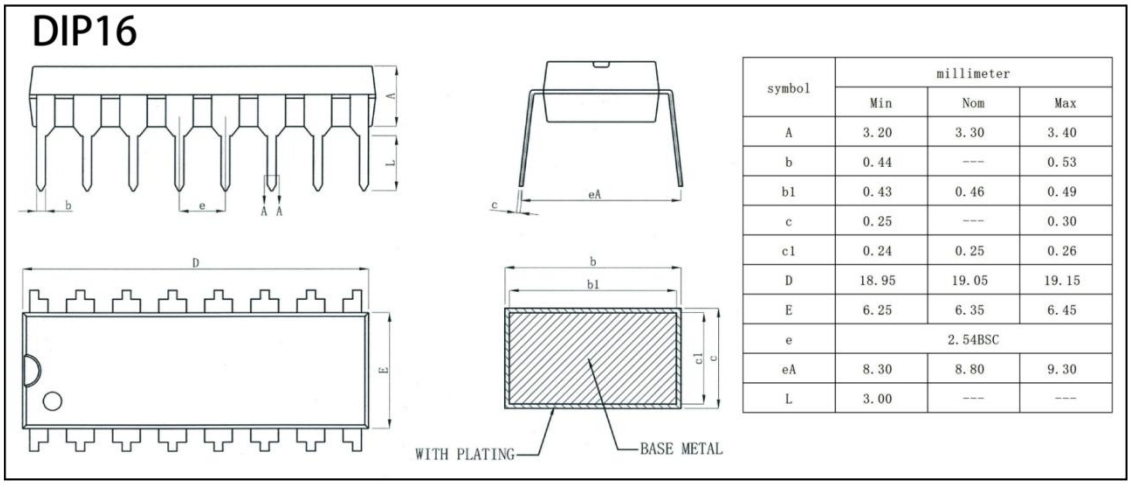
† t_{PLH} = propagation delay time, low-to-high-level output
t_{PHL} = propagation delay time, high-to-low-level output

10. ORDERING INFORMATION

Ordering Information

Part Number	Device Marking	Package Type	Body size (mm)	Temperature (°C)	MSL	Transport Media	Package Quantity
XD74LS192	XD74LS192	DIP16	19.05 * 6.35	-0 to 70	MSL3	Tube 25	1000
XD74LS193	XD74LS193	DIP16	19.05 * 6.35	-0 to 70	MSL3	Tube 25	1000

11. DIMENSIONAL DRAWINGS



symbol	millimeter		
	Min	Nom	Max
A	3.20	3.30	3.40
b	0.44	---	0.53
b1	0.43	0.46	0.49
c	0.25	---	0.30
c1	0.24	0.25	0.26
D	18.95	19.05	19.15
E	6.25	6.35	6.45
e	2.54BSC		
eA	8.30	8.80	9.30
L	3.00	---	---