

SN54390, SN54LS390, SN54393, SN54LS393 SN74390, SN74LS390, SN74393, SN74LS393 DUAL 4-BIT DECADE AND BINARY COUNTERS

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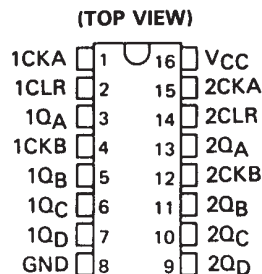
- Dual Versions of the Popular '90A, 'LS90 and '93A, 'LS93
- '390, 'LS390 . . . Individual Clocks for A and B Flip-Flops Provide Dual $\div 2$ and $\div 5$ Counters
- '393, 'LS393 . . . Dual 4-Bit Binary Counter with Individual Clocks
- All Have Direct Clear for Each 4-Bit Counter
- Dual 4-Bit Versions Can Significantly Improve System Densities by Reducing Counter Package Count by 50%
- Typical Maximum Count Frequency . . . 35 MHz
- Buffered Outputs Reduce Possibility of Collector Commutation

description

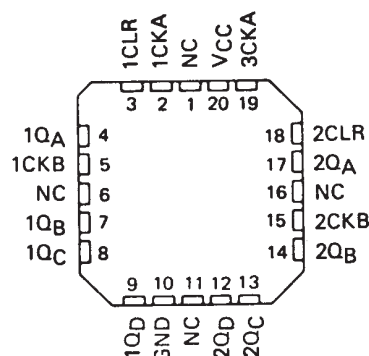
Each of these monolithic circuits contains eight master-slave flip-flops and additional gating to implement two individual four-bit counters in a single package. The '390 and 'LS390 incorporate dual divide-by-two and divide-by-five counters, which can be used to implement cycle lengths equal to any whole and/or cumulative multiples of 2 and/or 5 up to divide-by-100. When connected as a bi-quinary counter, the separate divide-by-two circuit can be used to provide symmetry (a square wave) at the final output stage. The '393 and 'LS393 each comprise two independent four-bit binary counters each having a clear and a clock input. N-bit binary counters can be implemented with each package providing the capability of divide-by-256. The '390, 'LS390, '393, and 'LS393 have parallel outputs from each counter stage so that any submultiple of the input count frequency is available for system-timing signals.

Series 54 and Series 54LS circuits are characterized for operation over the full military temperature range of -55°C to 125°C ; Series 74 and Series 74LS circuits are characterized for operation from 0°C to 70°C .

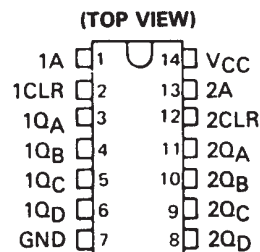
SN54390, SN54LS390 . . . J OR W PACKAGE SN74390 . . . N PACKAGE SN74LS390 . . . D OR N PACKAGE



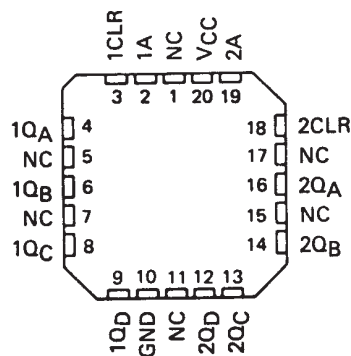
SN54LS390 . . . FK PACKAGE (TOP VIEW)



SN54393, SN54LS393 . . . J OR W PACKAGE SN74393 . . . N PACKAGE SN74LS393 . . . D OR N PACKAGE



SN54LS393 . . . FK PACKAGE (TOP VIEW)



NC - No internal connection

SN54390, SN54LS390, SN54393, SN54LS393
SN74390, SN74LS390, SN74393, SN74LS393
DUAL 4-BIT DECADE AND BINARY COUNTERS

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'390, 'LS390
BCD COUNT SEQUENCE
(EACH COUNTER)
(See Note A)

COUNT	OUTPUT			
	Q _D	Q _C	Q _B	Q _A
0	L	L	L	L
1	L	L	L	H
2	L	L	H	L
3	L	L	H	H
4	L	H	L	L
5	L	H	L	H
6	L	H	H	L
7	L	H	H	H
8	H	L	L	L
9	H	L	L	H

FUNCTION TABLES
'390, 'LS390
BI-QUINARY (5-2)
(EACH COUNTER)
(See Note B)

COUNT	OUTPUT			
	Q _A	Q _D	Q _C	Q _B
0	L	L	L	L
1	L	L	L	H
2	L	L	H	L
3	L	L	H	H
4	L	H	L	L
5	H	L	L	L
6	H	L	L	H
7	H	L	H	L
8	H	L	H	H
9	H	H	L	L

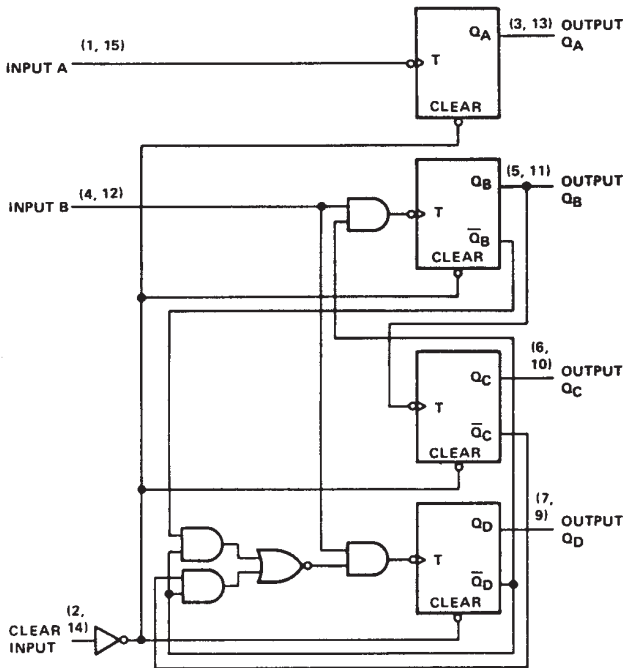
'393, 'LS393
COUNT SEQUENCE
(EACH COUNTER)

COUNT	OUTPUT			
	Q _D	Q _C	Q _B	Q _A
0	L	L	L	L
1	L	L	L	H
2	L	L	H	L
3	L	L	H	H
4	L	H	L	L
5	L	H	L	H
6	L	H	H	L
7	L	H	H	H
8	H	L	L	L
9	H	L	L	H
10	H	L	H	L
11	H	L	H	H
12	H	H	L	L
13	H	H	L	H
14	H	H	H	L
15	H	H	H	H

NOTES: A. Output Q_A is connected to input B for BCD count.
B. Output Q_D is connected to input A for bi-quinary count.
C. H = high level, L = low level.

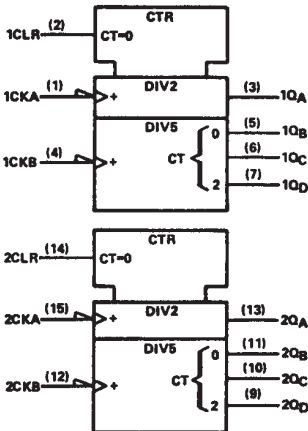
logic diagrams (positive logic)

'390, 'LS390

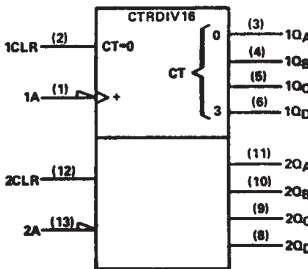


logic symbols†

'390, 'LS390



'393, 'LS393



†These symbols are in accordance with ANSI/IEEE Std. 91-1984 and IEC Publication 617-12.

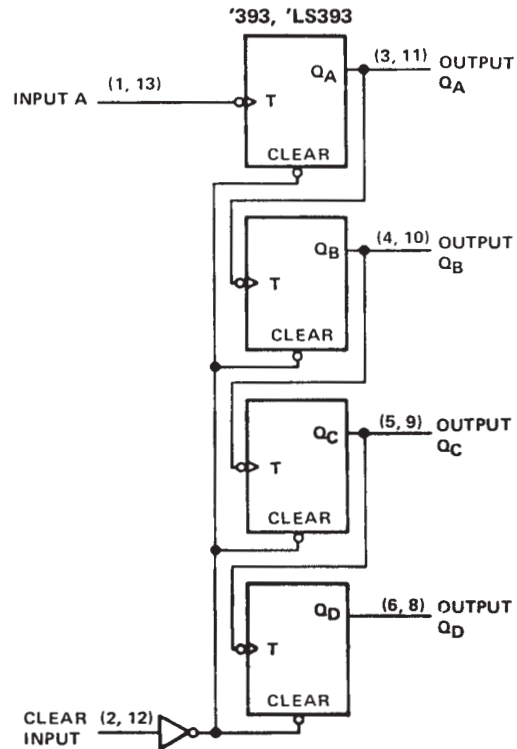
Pin numbers shown are for D, J, N, and W packages.



SN54390, SN54LS390, SN54393, SN54LS393
 SN74390, SN74LS390, SN74393, SN74LS393
 DUAL 4-BIT DECADE AND BINARY COUNTERS

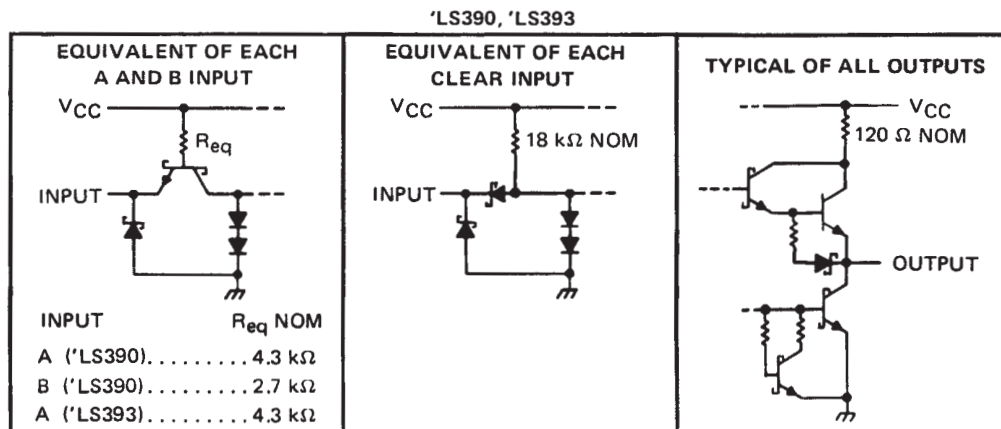
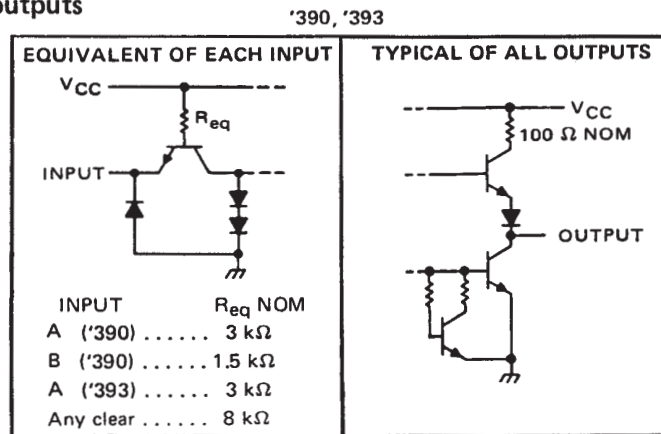
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logic diagrams (continued)



Pin numbers shown are for D, J, N and W packages.

schematics of inputs and outputs



SN54390, SN54LS390, SN54393, SN54LS393 SN74390, SN74LS390, SN74393, SN74LS393 DUAL 4-BIT DECADE AND BINARY COUNTERS

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absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage, V_{CC} (see Note 1)	7 V
Input voltage	5.5 V
Operating free-air temperature range: SN54390, SN54393	–55°C to 125°C
SN74390, SN74393	0°C to 70°C
Storage temperature range	–65°C to 150°C

NOTE 1: Voltage values are with respect to network ground terminal.

recommended operating conditions

		SN54390 SN54393			SN74390 SN74393			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, V_{CC}		4.5	5	5.5	4.75	5	5.25	V
High-level output current, I_{OH}				–800			–800	μ A
Low-level output current, I_{OL}				16			16	mA
Count frequency, f_{count}	A input	0		25	0		25	MHz
	B input	0		20	0		20	
Pulse width, t_w	A input high or low	20			20			ns
	B input high or low	25			25			
	Clear high	20			20			
Clear inactive-state setup time, t_{SU}		25↓			25↓			ns
Operating free-air temperature, T_A		–55		125	0		70	°C

↓ The arrow indicates that the falling edge of the clock pulse is used for reference.

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS†	'390			'393			UNIT
			MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V _{IH}	High-level input voltage		2			2			V
V _{IL}	Low-level input voltage				0.8			0.8	V
V _{IK}	Input clamp voltage	V _{CC} = MIN, I _I = −12 mA			−1.5			−1.5	V
V _{OH}	High-level output voltage	V _{CC} = MIN, V _{IH} = 2 V, V _{IL} = 0.8 V, I _{OH} = −800 μA	2.4	3.4		2.4	3.4		V
V _{OL}	Low-level output voltage	V _{CC} = MIN, V _{IH} = 2 V, V _{IL} = 0.8 V, I _{OL} = 16 mA¶		0.2	0.4		0.2	0.4	V
I _I	Input current at maximum input voltage	V _{CC} = MAX, V _I = 5.5 V			1			1	mA
I _{IH}	High-level input current	Clear			40			40	μA
		Input A	V _{CC} = MAX, V _I = 2.4 V		80		80		
		Input B			120				
I _{IL}	Low-level input current	Clear	V _{CC} = MAX, V _I = 0.4 V		−1		−1	mA	
		Input A			−3.2		−3.2		
		Input B			−4.8				
I _{OS}	Short-circuit output current§	V _{CC} = MAX	SN54'	−20	−57	−20	−57	mA	
			SN74'	−18	−57	−18	−57		
I _{CC}	Supply current	V _{CC} = MAX, See Note 2		42	69		38	64	mA

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at $V_{CC} = 5 \text{ V}, T_A = 25^\circ\text{C}$.

§ Not more than one output should be shorted at a time.

¶ The Q_A outputs of the '390 are tested at $I_{OL} = 16 \text{ mA}$ plus the limit value for I_{IL} for the B input. This permits driving the B input while maintaining full fan-out capability.

NOTE 2: I_{CC} is measured with all outputs open, both clear inputs grounded following momentary connection to 4.5 V, and all other inputs grounded.



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switching characteristics, $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$

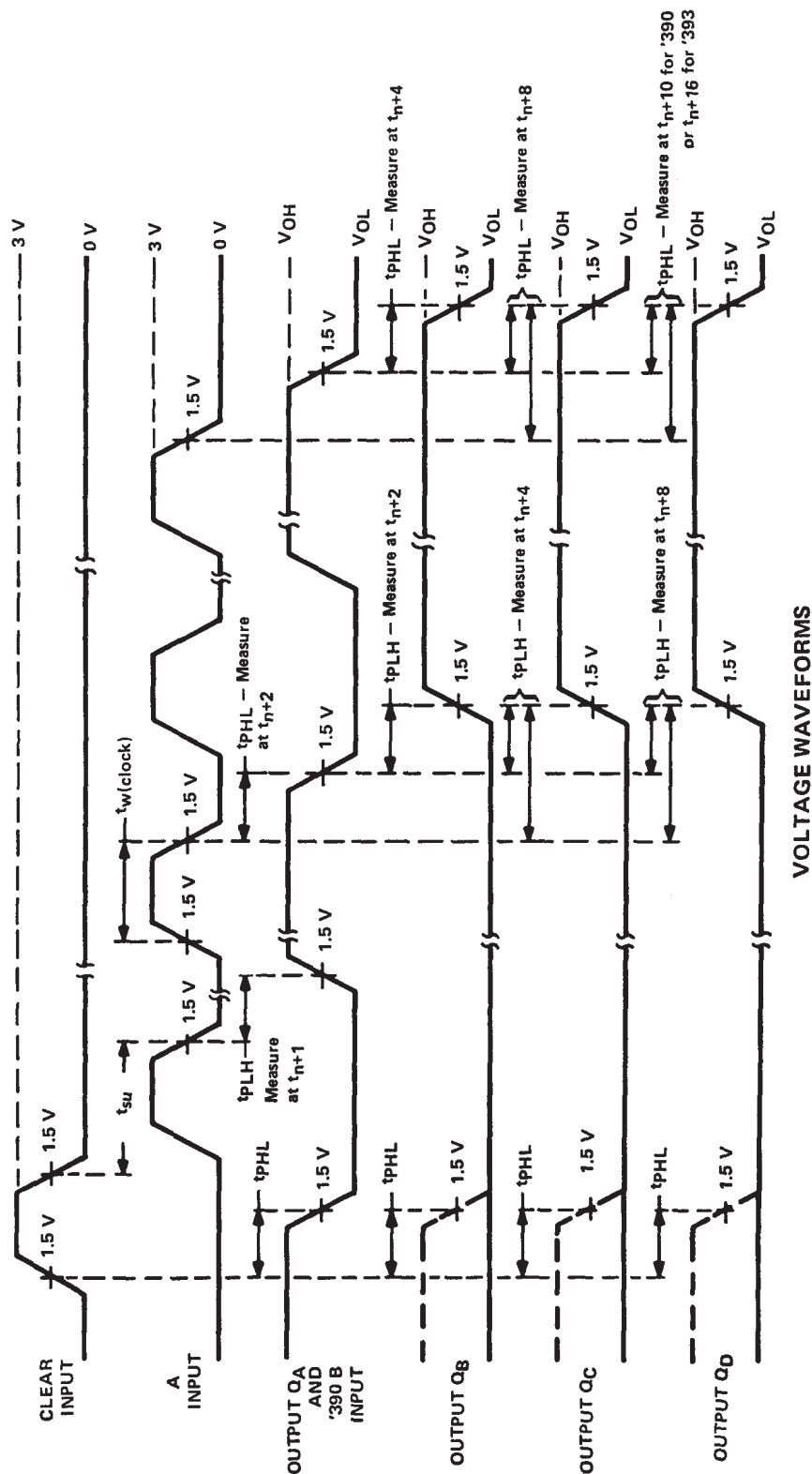
PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	'390			'393			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
f _{max}	A	Q _A	C _L = 15 pF, R _L = 400 Ω, See Note 3 and Figure 1	25	35		25	35		MHz
	B	Q _B		20	30					
t _{PLH}	A	Q _A			12	20		12	20	ns
t _{PHL}					13	20		13	20	
t _{PLH}	A	Q _C of '390 Q _D of '393			37	60		40	60	ns
t _{PHL}					39	60		40	60	
t _{PLH}	B	Q _B			13	21				ns
t _{PHL}					14	21				
t _{PLH}	B	Q _C			24	39				ns
t _{PHL}					26	39				
t _{PLH}	B	Q _D			13	21				ns
t _{PHL}					14	21				
t _{PHL}	Clear	Any			24	39		24	39	ns

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

SN54390, SN54LS390, SN54393, SN54LS393
 SN74390, SN74LS390, SN74393, SN74LS393
 DUAL 4-BIT DECADE AND BINARY COUNTERS

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PARAMETER MEASUREMENT INFORMATION



NOTE A: Input pulses are supplied by a generator having the following characteristics $t_r \leq 5 \text{ ns}$, $t_f \leq 5 \text{ ns}$, $PRR = 1 \text{ MHz}$, duty cycle = 50%, $Z_{out} \approx 50 \text{ ohms}$.

FIGURE 1

SN54390, SN54LS390, SN54393, SN54LS393
SN74390, SN74LS390, SN74393, SN74LS393
DUAL 4-BIT DECADE AND BINARY COUNTERS

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absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage, V_{CC} (see Note 1)	7 V
Clear input voltage	7 V
Any A or B clock input voltage	5.5 V
Operating free-air temperature range: SN54LS390, SN54LS393	–55°C to 125°C
SN74LS390, SN74LS393	0°C to 70°C
Storage temperature range	–65°C to 150°C

NOTE 1: Voltage values are with respect to network ground terminal.

recommended operating conditions

		SN54LS390 SN54LS393			SN74LS390 SN74LS393			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, V_{CC}		4.5	5	5.5	4.75	5	5.25	V
High-level output current, I_{OH}		–400			–400			μ A
Low-level output current, I_{OL}		4			8			mA
Count frequency, f_{count}	A input	0		25	0		25	MHz
	B input	0		12.5	0		12.5	
Pulse width, t_w	A input high or low	20			20			ns
	B input high or low	40			40			
	Clear high	20			20			
Clear inactive-state setup time, t_{su}		25↓			25↓			ns
Operating free-air temperature, T_A		–55		125	0		70	°C

↓ The arrow indicates that the falling edge of the clock pulse is used for reference.

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS†		SN54LS'			SN74LS'			UNIT
				MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V_{IH}	High-level input voltage			2			2			V
V_{IL}	Low-level input voltage					0.7			0.8	V
V_{IK}	Input clamp voltage	$V_{CC} = \text{MIN}, I_I = -18 \text{ mA}$				–1.5			–1.5	V
V_{OH}	High-level output voltage	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = V_{IL \text{ max}}, I_{OH} = -400 \mu\text{A}$		2.5	3.4		2.7	3.4		V
V_{OL}	Low-level output voltage	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = 0.8 \text{ V},$	$I_{OL} = 4 \text{ mA}¶$	0.25	0.4		0.25	0.4		V
			$I_{OL} = 8 \text{ mA}¶$				0.35	0.5		
I_I	Input current at maximum input voltage	Clear Input A Input B $V_{CC} = \text{MAX}$	$V_I = 7 \text{ V}$			0.1			0.1	mA
			$V_I = 5.5 \text{ V}$			0.2			0.2	
						0.4			0.4	
I_{IH}	High-level input current	Clear Input A Input B $V_{CC} = \text{MAX}, V_I = 2.7 \text{ V}$				0.02			0.02	mA
						0.1			0.1	
						0.2			0.2	
I_{IL}	Low-level input current	Clear Input A Input B $V_{CC} = \text{MAX}, V_I = 0.4 \text{ V}$				–0.4			–0.4	mA
						–1.6			–1.6	
						–2.4			–2.4	
I_{OS}	Short-circuit output current§	$V_{CC} = \text{MAX}$		–20		–100	–20		–100	mA
I_{CC}	Supply current	$V_{CC} = \text{MAX},$ See Note 2	'LS390	15		26	15		26	mA
			'LS393	15		26	15		26	

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at $V_{CC} = 5 \text{ V}, T_A = 25^\circ\text{C}$.

§ Not more than one output should be shorted at a time, and duration of the short-circuit should not exceed one second.

¶ The Q_A outputs of the 'LS390 are tested at $I_{OL} = \text{MAX}$ plus the limit value for I_{IL} for the clock B input. This permits driving the clock B input while maintaining full fan-out capability.

NOTE 2: I_{CC} is measured with all outputs open, both clear inputs grounded following momentary connection to 4.5 V, and all other inputs grounded.



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SN74390, SN74LS390, SN74393, SN74LS393
DUAL 4-BIT DECADE AND BINARY COUNTERS

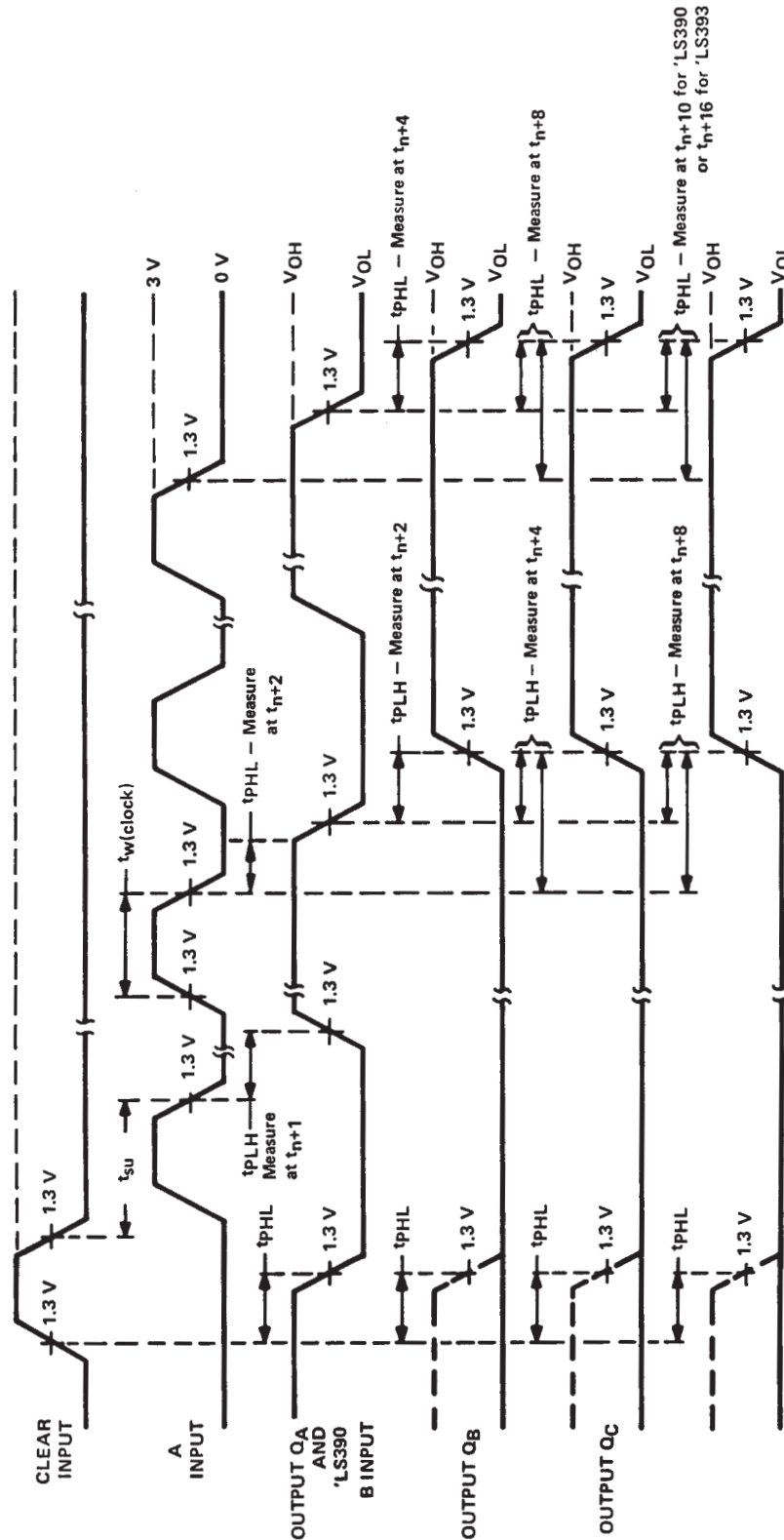
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switching characteristics, $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	'LS390			'LS393			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
f _{max}	A	Q _A	C _L = 15 pF, R _L = 2 kΩ, See Note 4 and Figure 2	25	35		25	35		MHz
	B	Q _B		12.5	20					
t _{PLH}	A	Q _A			12	20		12	20	ns
t _{PHL}					13	20		13	20	
t _{PLH}	A	Q _C of 'LS390 Q _D of 'LS393			37	60		40	60	ns
t _{PHL}					39	60		40	60	
t _{PLH}	B	Q _B			13	21				ns
t _{PHL}					14	21				
t _{PLH}	B	Q _C			24	39				ns
t _{PHL}					26	39				
t _{PLH}	B	Q _D			13	21				ns
t _{PHL}					14	21				
t _{PHL}	Clear	Any			24	39		24	39	ns

NOTE 4: Load circuits and voltage waveforms are shown in Section 1.

PARAMETER MEASUREMENT INFORMATION



VOLTAGE WAVEFORMS

NOTE A: Input pulses are supplied by a generator having the following characteristics $t_r \leq 15$ ns, $t_f \leq 6$ ns, PRR = 1 MHz, duty cycle = 50 %, $Z_{out} \approx 50$ ohms.

FIGURE 2

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