



**THE DATASHEET OF
SN74197N**



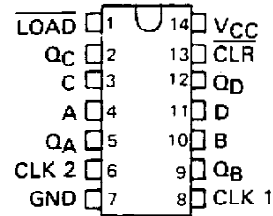
**SN54196, SN54197, SN54LS196, SN54LS197, SN54S196, SN54S197,
SN74196, SN74197, SN74LS196, SN74LS197, SN74S196, SN74S197
50/30/100-MHz PRESETTABLE DECADE OR BINARY COUNTERS/LATCHES**

OCTOBER 1976—REVISED MARCH 1988

- Performs BCD, Bi-Quinary, or Binary Counting
- Fully Programmable
- Fully Independent Clear Input
- Input Clamping Diodes Simplify System Design
- Output QA Maintains Full Fan-out Capability In Addition to Driving Clock-2 Input

SN54196, SN54LS196, SN54S196,
SN54197, SN54LS197, SN54S197 . . . J OR W PACKAGE
SN74196, SN74197 . . . N PACKAGE
SN74LS196, SN74S196,
SN74LS197, SN74S197 . . . D OR N PACKAGE

(TOP VIEW)



TYPES	GUARANTEED COUNT FREQUENCY		TYPICAL POWER DISSIPATION
	CLOCK 1	CLOCK 2	
'196, '197	0-50 MHz	0-25 MHz	240 mW
'LS196, 'LS197	0-30 MHz	0-15 MHz	80 mW
'S196, 'S197	0-100 MHz	0-50 MHz	375 mW

description

These high-speed monolithic counters consist of four d-c coupled, master-slave flip-flops, which are internally interconnected to provide either a divide-by-two and a divide-by-five counter ('196, 'LS196, 'S196) or a divide-by-two and a divide-by-eight counter ('197, 'LS197, 'S197). These four counters are fully programmable; that is, the outputs may be preset to any state by placing a low on the count/load input and entering the desired data at the data inputs. The outputs will change to agree with the data inputs independent of the state of the clocks.

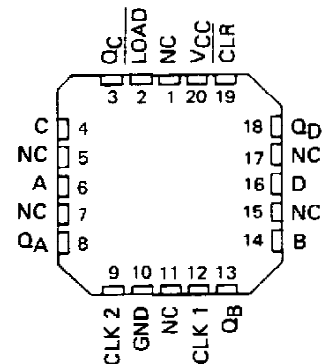
During the count operation, transfer of information to the outputs occurs on the negative-going edge of the clock pulse. These counters feature a direct clear which when taken low sets all outputs low regardless of the states of the clocks.

These counters may also be used as 4-bit latches by using the count/load input as the strobe and entering data at the data inputs. The outputs will directly follow the data inputs when the count/load is low, but will remain unchanged when the count/load is high and the clock inputs are inactive.

All inputs are diode-clamped to minimize transmission-line effects and simplify system design. These circuits are compatible with most TTL logic families. Series 54, 54LS, and 54S circuits are characterized for operation over the full military temperature range of -55°C to 125°C; Series 74, 74LS, and 74S circuits are characterized for operation from 0°C to 70°C.

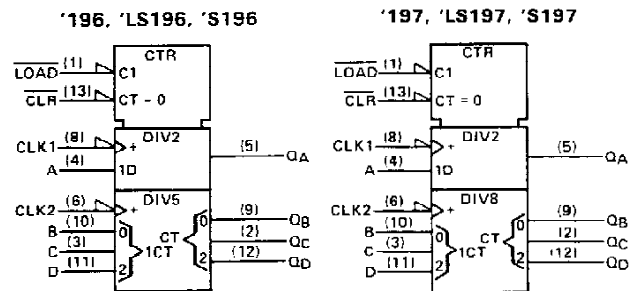
SN54LS196, SN54S196,
SN54LS197, SN54S197 . . . FK PACKAGE

(TOP VIEW)



NC - No internal connection

logic symbols†



† 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.

PRODUCTION DATA documents contain information current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.



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**SN54196, SN54197, SN54LS196, SN54LS197, SN54S196, SN54S197,
SN74196, SN74197, SN74LS196, SN74LS197, SN74S196, SN74S197
50/30/100-MHz PRESETTABLE DECADE OR BINARY COUNTERS/LATCHES**

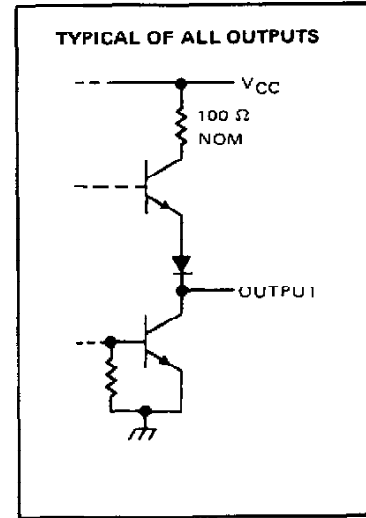
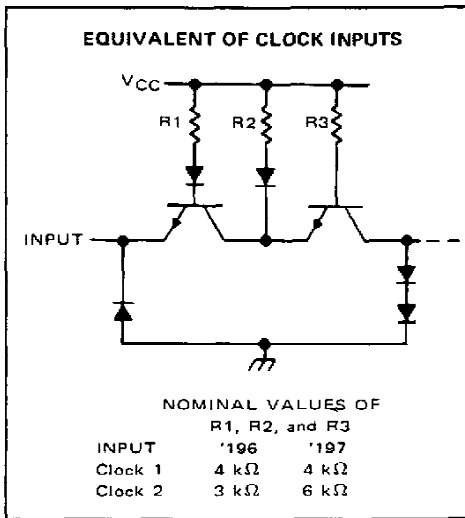
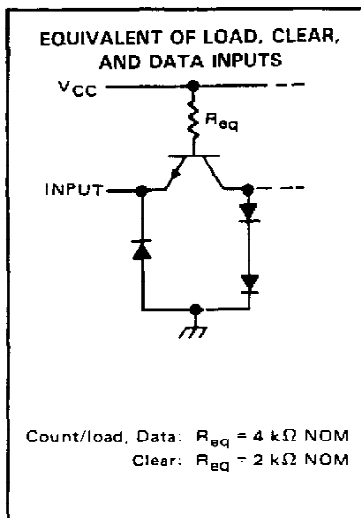
typical count configurations

'196, 'LS196, and 'S196 typical count configurations and function tables are the same as those for '176.
'197, 'LS197, and 'S197 typical count configurations and function tables are the same as those for '177.

logic diagrams

'196, 'LS196, and 'S196 logic diagrams are the same as those for '176.
'197, 'LS197, and 'S197 logic diagrams are the same as those for '177.

schematics of inputs and outputs



SN54196, SN54197, SN74196, SN74197 50-MHz PRESETTABLE DECADE OR BINARY COUNTERS/LATCHES

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
Interemitter voltage (see Note 2)	5.5 V
Operating free-air temperature range: SN54196, SN54197 Circuits	-55°C to 125°C
SN74196, SN74197 Circuits	0°C to 70°C
Storage temperature range	-65°C to 150°C

- NOTES: 1. Voltage values are with respect to network ground terminal.
 2. This is the voltage between two emitters of a multiple-emitter transistor. For this circuit, this rating applies between the Clear and Load inputs.

recommended operating conditions

	SN54196, SN54197			SN74196, SN74197			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	Clock-1 input	0	50	0		50	MHz
	Clock-2 input	0	25	0		25	
Pulse width, t_w	Clock-1 input	10		10			ns
	Clock-2 input	20		20			
	Clear	15		15			
	Load	20		20			
Input hold time, t_H (see Note 3)	High-level data	$t_w(\text{load})$		$t_w(\text{load})$			ns
	Low-level data	$t_w(\text{load})$		$t_w(\text{load})$			
Input setup time, t_{SU} (see Note 3)	High-level data	10		10			ns
	Low-level data	15		15			
Count enable time, t_{EN} (see Note 4)		20		20			ns
Operating free-air temperature, T_A		-55	125	0		70	°C

- NOTES: 3. Setup and hold times are with respect to the falling edge of the load input.
 4. Minimum count enable time is the interval immediately preceding the negative-going edge of the clock pulse during which interval the count/load and clear inputs must both be high to ensure counting.



SN54196, SN54197, SN74196, SN74197

50-MHz PRESETTABLE DECADE OR BINARY COUNTERS/LATCHES

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

PARAMETER	TEST CONDITIONS†	SN54196, SN74196			SN54197, SN74197			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	Data, Load	40			40			µA
	Clear, clock 1	80			80			
	Clock 2	120			80			
I _{IL} Low-level input current	Data, Load	-1.6			-1.6			mA
	Clear	-3.2			-3.2			
	Clock 1	-4.8			-4.8			
	Clock 2	-6.4			-3.2			
I _{OS} Short-circuit output current §	V _{CC} = MAX	SN64'	-20	-57	-20	-57	mA	
		SN74'	-18	-57	-18	-57		
I _{CC} Supply current	V _{CC} = MAX, See Note 5	48	59		48	59	mA	

NOTE 5: I_{CC} is measured with all inputs grounded and all outputs open.

†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.

¶Q_A outputs are tested at I_{OL} = 16 mA plus the limit value of I_{IL} for the clock-2 input. This permits driving the clock-2 input while fanning out to 10 Series 54/74 loads.

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

PARAMETER #	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	SN54196			SN54197			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
f _{max}	Clock 1	Q _A	C _L = 15 pF, R _L = 400 Ω, See Note 6	50	70		50	70		MHz
t _{PLH}	Clock 1	Q _A		7	12		7	12		ns
t _{PHL}				10	15		10	15		
t _{PLH}	Clock 2	Q _B		12	18		12	18		ns
t _{PHL}				14	21		14	21		
t _{PLH}	Clock 2	Q _C		24	36		24	36		ns
t _{PHL}				28	42		28	42		
t _{PLH}	Clock 2	Q _D		14	21		36	54		ns
t _{PHL}				12	18		42	63		
t _{PLH}	A, B, C, D	Q _A , Q _B , Q _C , Q _D		16	24		16	24		ns
t _{PHL}				25	38		25	38		
t _{PLH}	Load	Any		22	33		22	33		ns
t _{PHL}				24	36		24	36		
t _{PHL}	Clear	Any		25	37		25	37		ns

#f_{max} = maximum count frequency.

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

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

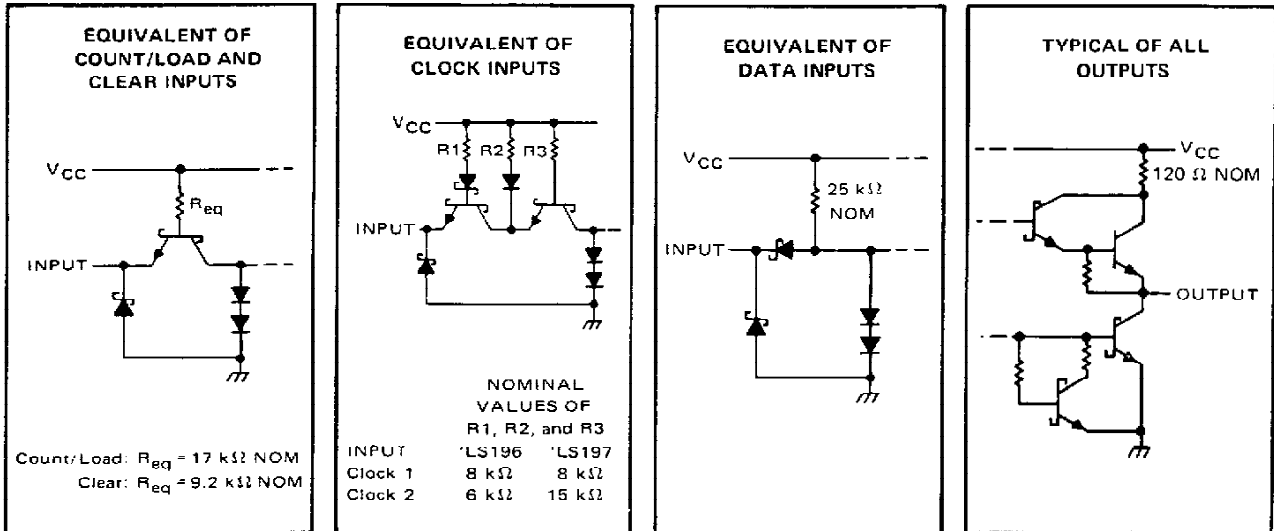
NOTE 6: Load circuit, input conditions, and voltage waveforms are the same as those shown for the '176, '177 except that testing f_{max}, V_{IL} = 0.3 V.

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SN54LS196, SN54LS197, SN74LS196, SN74LS197 30-MHz PRESETTABLE DECADE OR BINARY COUNTERS/LATCHES

schematics of inputs and outputs



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: SN54LS196, SN54LS197 Circuits	-55°C to 125°C
SN74LS196, SN74LS197 Circuits	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

		SN54LS196, SN54LS197			SN74LS196, SN74LS197			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
V_{CC}	Supply voltage	4.5	5	5.5	4.75	5	5.25	V
I_{OH}	High-level output current			-400			-400	μA
I_{OL}	Low-level output current			4			8	mA
Count frequency	Clock-1 input	0		30	0		30	MHz
	Clock-2 input	0		15	0		15	
t_w	Pulse width	Clock-1 input	20		20			ns
		Clock-2 input	30		30			
		Clear	15		15			
		Load	20		20			
t_h	Input hold time, (see Note 3)	High-level data	$t_w(\text{load})$		$t_w(\text{load})$			ns
		Low-level data	$t_w(\text{load})$		$t_w(\text{load})$			
t_{su}	Input setup time, (see Note 3)	High-level data	10		10			ns
		Low-level data	15		15			
t_{enable}	Count enable time, (see Note 4)	Clock 1	30		30			ns
		Clock 2	50		50			
T_A	Operating free-air temperature	-55		125	0		70	°C

NOTES: 3. Setup and hold times are with respect to the falling edge of the load input.

4. Minimum count enable time is the interval immediately preceding the negative-going edge of the clock pulse during which interval the count/load and clear inputs must both be high to ensure counting.

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SN54LS196, SN54LS197, SN74LS196, SN74LS197

30-MHz PRESETTABLE DECADE OR BINARY COUNTERS/LATCHES

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

PARAMETER	TEST CONDITIONS†	SN54LS196		SN74LS196		UNIT		
		SN54LS197	MIN	TYP‡	MAX		MIN	TYP‡
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} = MIN, I _I = -18 mA		-1.5			-1.5	V	
V _{OH} High-level output voltage	V _{CC} = MIN, V _{IH} = 2 V, V _{IL} = V _{IL max} , I _{OH} = -400 µA	2.5	3.4		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‡	0.25	0.4	0.25	0.4	V	
		I _{OL} = 8 mA‡			0.35	0.5		
I _I Input current at maximum input voltage	Data, Load		0.1			0.1	mA	
	Clear, clock 1		0.2			0.2		
	Clock 2 of 'LS196		0.4			0.4		
	Clock 2 of 'LS197		0.2			0.2		
I _{IH} High-level input current	Data, Load		20			20	µA	
	Clear, clock 1		40			40		
	Clock 2 of 'LS196		80			80		
	Clock 2 of 'LS197		40			40		
I _{IL} Low-level input current	Data, Load		-0.4			-0.4	mA	
	Clear		-0.8			-0.8		
	Clock 1		-2.4			-2.4		
	Clock 2 of 'LS196		-2.8			-2.8		
	Clock 2 of 'LS197		-1.3			-1.3		
I _{OS} Short-circuit output current§	V _{CC} = MAX	-20		-100	-20		-100	mA
I _{CC} Supply current	V _{CC} = MAX, See Note 5	16		27	16		27	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, and duration of the short-circuit should not exceed one second.

* Q_A outputs are tested at specified I_{OL} plus the limit value of I_{IL} for the clock-2 input. This permits driving the clock-2 input while maintaining full fan-out capability.

NOTE 5. I_{CC} is measured with all inputs grounded and all outputs open.

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

PARAMETER #	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	SN54LS196		SN54LS197		UNIT	
				SN74LS196	MIN	TYP	MAX		MIN
f _{max}	Clock 1	Q _A	C _L = 15 pF, R _L = 2 kΩ, See Note 6	30	40		30	40	MHz
t _{PLH}	Clock 1	Q _A		8	15		8	15	ns
t _{PHL}				13	20		14	21	
t _{PLH}	Clock 2	Q _B		16	24		12	19	ns
t _{PHL}				22	33		23	35	
t _{PLH}	Clock 2	Q _C		38	57		34	51	ns
t _{PHL}				41	62		42	63	
t _{PLH}	Clock 2	Q _D		12	18		55	78	ns
t _{PHL}				30	45		63	95	
t _{PLH}	A, B, C, D	Q _A , Q _B , Q _C , Q _D		20	30		18	27	ns
t _{PHL}				29	44		29	44	
t _{PLH}	Load	Any		27	41		26	39	ns
t _{PHL}				30	45		30	45	
t _{PHL}	Clear	Any		34	51		34	51	ns

#f_{max} ≡ maximum count frequency.

t_{PLH} ≡ propagation delay time, low-to-high-level output, t_{PHL} ≡ propagation delay time, high-to-low-level output.

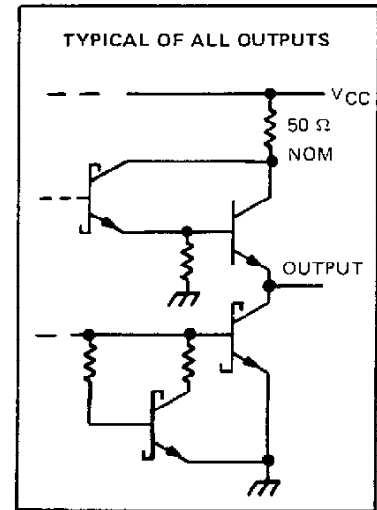
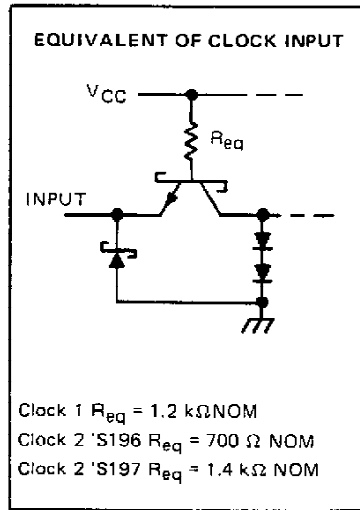
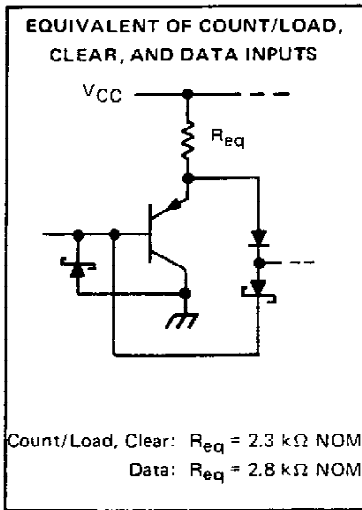
NOTE 6: Load circuit, input conditions, and voltage waveforms are the same as those shown for the '176, '177 except that t_r ≤ 15 ns, t_f ≤ 6 ns, and V_{ref} = 1.3 V (as opposed to 1.5 V).

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SN54S196, SN54S197, SN74S196, SN74S197 100-MHz PRESETTABLE DECADE OR BINARY COUNTERS/LATCHES

schematics of inputs and outputs



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: SN54S196, SN54S197 Circuits	-55°C to 125°C
SN74S196, SN74S197 Circuits	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

		SN54S196, SN54S197			SN74S196, SN74S197			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}		-1			-1			mA
Low-level output current, I_{OL}		20			20			mA
Clock frequency	Clock-1 input	0		100	0		100	MHz
	Clock-2 input	0		50	0		50	
Pulse width, t_w	Clock-1 input	5			5			ns
	Clock-2 input	10			10			
	Clear	30			30			
	Load	5			5			
Input hold time, t_H (see Note 3)	High-level data	31			31			ns
	Low-level data	31			31			
Input setup time, t_{SU} (see Note 3)	High-level data	61			61			ns
	Low-level data	61			61			
Count enable time, t_{EN} (see Note 4)		12			12			ns
Operating free-air temperature, T_A		-55		125	0		70	°C

NOTES: 3. Setup and hold times are with respect to the falling edge of the load input.

4. Minimum count enable time is the interval immediately preceding the negative-going edge of the clock pulse during which interval the count/load and clear inputs must both be high to ensure counting.



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SN54S196, SN54S197, SN74S196, SN74S197

100-MHz PRESETTABLE DECADE OR BINARY COUNTERS/LATCHES

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

PARAMETER	TEST CONDITIONS †	SN54S196, SN74S196			SN54S197, SN74S197			UNIT
		MIN	TYP ‡	MAX	MIN	TYP ‡	MAX	
V _{IH}		2			2			V
V _{IL}		0.8			0.8			V
V _{IK}	V _{CC} = MIN, I _I = -18 mA	-1.2			-1.2			V
V _{OH}	V _{CC} = MIN, V _{IH} = 2 V, V _{IL} = 0.8 V, I _{OH} = -1 mA	54S	2.5	3.4	2.5	3.4	V	
		74S	2.7	3.4	2.7	3.4		
V _{OL}	V _{CC} = MIN, V _{IH} = 2 V, V _{IL} = 0.8 V, I _{OL} = 20 mA †	0.5			0.5			V
I _I	V _{CC} = MAX, V _I = 5.5 V	1			1			mA
I _{IH}	Clock 1, clock 2	150			150			μA
	All other inputs	50			50			
I _{IL}	Data, Load Clear	-0.75			-0.75			mA
	Clock 1	-8			-8			
	Clock 2	-10			-6			
I _{OS} §	V _{CC} = MAX	-30	-110	-30	-110		mA	
I _{CC}	V _{CC} = MAX, See Note 5	54S	75	110	75	110	mA	
		74S	75	120	75	120		

† 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.

†† Q_A outputs are tested at I_{OL} = 20 mA plus the limit value of I_{IL} for the clock-2 input. This permits driving the clock-2 input while fanning out to 10 Series 54S/74S loads.

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

NOTE 5: I_{CC} is measured with all input grounded and all outputs open.

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

PARAMETER #	(FROM INPUT)	TO (OUTPUT)	TEST CONDITIONS	SN54S196, SN74S196			SN54S197, SN74S197			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
f _{max}	Clock 1	Q _A	R _L = 280 Ω, C _L = 15 pF, See Note 7	100	140		100	140		MHz
t _{PLH}	Clock 1	Q _A		5	10		5	10		ns
t _{PHL}				6	10		6	10		
t _{PLH}	Clock 2	Q _B		5	10		5	10		ns
t _{PHL}				8	12		8	12		
t _{PLH}	Clock 2	Q _C		12	18		12	18		ns
t _{PHL}				16	24		15	22		
t _{PLH}	Clock 2	Q _D		5	10		18	27		ns
t _{PHL}				8	12		22	33		
t _{PLH}	A, B, C, D	Q _A , Q _B , Q _C , Q _D		7	12		7	12		ns
t _{PHL}				12	18		12	18		
t _{PLH}	Load	Any		10	18		10	18		ns
t _{PHL}				12	18		12	18		
t _{PHL}	Clear	Any		26	37		26	37		ns

#f_{max} = maximum count frequency.

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

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

NOTE 7: Load circuit, input conditions, and voltage waveforms are the same as those shown in Section 1.

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PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
SN54196J	ACTIVE	CDIP	J	14	25	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	SN54196J	Samples
SN54197J	ACTIVE	CDIP	J	14	25	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	SN54197J	Samples
SNJ54196J	ACTIVE	CDIP	J	14	25	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	SNJ54196J	Samples
SNJ54197J	ACTIVE	CDIP	J	14	25	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	SNJ54197J	Samples

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSELETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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J 14

GENERIC PACKAGE VIEW
CDIP - 5.08 mm max height
CERAMIC DUAL IN LINE PACKAGE



Images above are just a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.

4040083-5/G

J0014A



PACKAGE OUTLINE

CDIP - 5.08 mm max height

CERAMIC DUAL IN LINE PACKAGE



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NOTES:

1. All controlling linear dimensions are in inches. Dimensions in brackets are in millimeters. Any dimension in brackets or parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This package is hermetically sealed with a ceramic lid using glass frit.
4. Index point is provided on cap for terminal identification only and on press ceramic glass frit seal only.
5. Falls within MIL-STD-1835 and GDIP1-T14.

EXAMPLE BOARD LAYOUT

J0014A

CDIP - 5.08 mm max height

CERAMIC DUAL IN LINE PACKAGE



LAND PATTERN EXAMPLE
NON-SOLDER MASK DEFINED
SCALE: 5X



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