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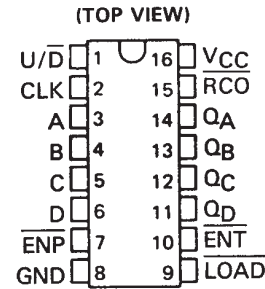
# SN54LS169B, SN54S169 SN74LS169B, SN74S169

## SYNCHRONOUS 4-BIT UP/DOWN BINARY COUNTERS

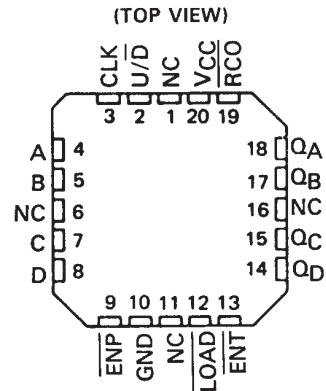
SDLS134 – OCTOBER 1976 – REVISED MARCH 1988

- Programmable Look-Ahead Up/Down Binary Counters
- Fully Synchronous Operation for Counting and Programming
- Internal Look-Ahead for Fast Counting
- Carry Output for n-Bit Cascading
- Fully Independent Clock Circuit

SN54LS169B, SN54S169 . . . J OR W PACKAGE  
SN74LS169B, SN74S169 . . . D OR N PACKAGE



SN54LS169B, SN54S169 . . . FK PACKAGE



NC-No internal connection

### description

These synchronous presettable counters feature an internal carry look-ahead for cascading in high speed counting applications. The 'LS169B and 'S169 are 4-bit binary counters. Synchronous operation is provided by having all flip-flops clocked simultaneously so that the outputs change coincident with each other when so instructed by the count-enable inputs and internal gating. This mode of operation helps eliminate the output counting spikes that are normally associated with asynchronous (ripple-clock) counters. A buffered clock input triggers the four master-slave flip-flops on the rising (positive-going) edge of the clock waveform.

These counters are fully programmable; that is the outputs may each be preset to either level. The load input circuitry allows loading with the carry-enable output of cascaded counters. As loading is synchronous, setting up a low level at the load input disables the counter and causes the outputs to agree with the data inputs after the next clock pulse.

The carry look-ahead circuitry provides for cascading counters for n-bit synchronous applications without additional gating. Instrumental in accomplishing this function are two count-enable inputs and a carry output. Both count enable inputs ( $\overline{ENP}$ ,  $\overline{ENT}$ ) must be low to count. The direction of the count is determined by the level of the up/down input. When the input is high, the counter counts up; when low, it counts down. Input ENT is fed forward to enable the carry output. The carry output thus enabled will produce a low-level output pulse with a duration approximately equal to the high portion of the  $Q_A$  output when counting up and approximately equal to the low portion of the  $Q_A$  output when counting down. This low-level overflow carry pulse can be used to enable successive cascaded stages. Transitions at the  $\overline{ENP}$  or  $\overline{ENT}$  inputs are allowed regardless of the level of the clock input. All inputs are diode-clamped to minimize transmission-line effects, thereby simplifying system design.

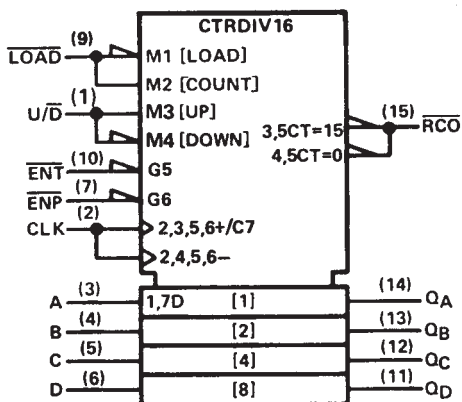
These counters feature a fully independent clock circuit. Changes at control inputs ( $\overline{ENP}$ ,  $\overline{ENT}$ ,  $\overline{LOAD}$ ,  $U/\overline{D}$ ) that will modify the operating mode have no effect until clocking occurs. The function of the counter (whether enabled, disabled, loading, or counting) will be dictated solely by the conditions meeting the stable setup and hold times.

TYPE	TYPICAL MAXIMUM CLOCK FREQUENCY		TYPICAL POWER DISSIPATION
	COUNTING UP	COUNTING DOWN	
'LS169B	35MHz	35MHz	100mW
'S169	70MHz	55MHz	500mW

SN54LS169B, SN54S169  
 SN74LS169B, SN74S169  
**SYNCHRONOUS 4-BIT UP/DOWN BINARY COUNTERS**

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logic symbol†

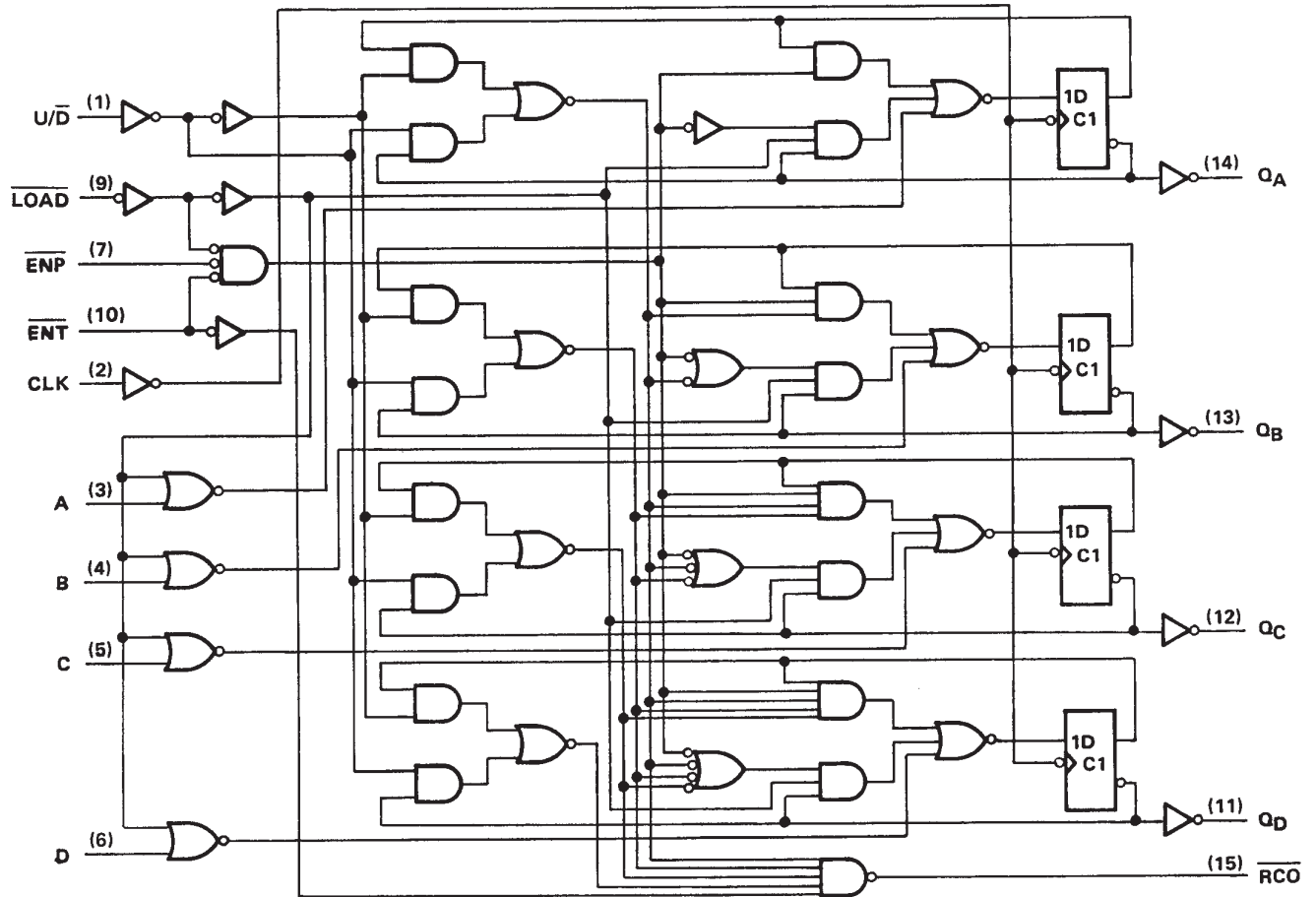


†This symbol is in accordance with ANSI/IEEE Std. 91-1984 and IEC Publication 617-12.  
 Pin numbers shown are for D, J, N, and W packages.

SN54LS169B, SN54S169  
 SN74LS169B, SN74S169  
 SYNCHRONOUS 4-BIT UP/DOWN BINARY COUNTERS

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logic diagram (positive logic)

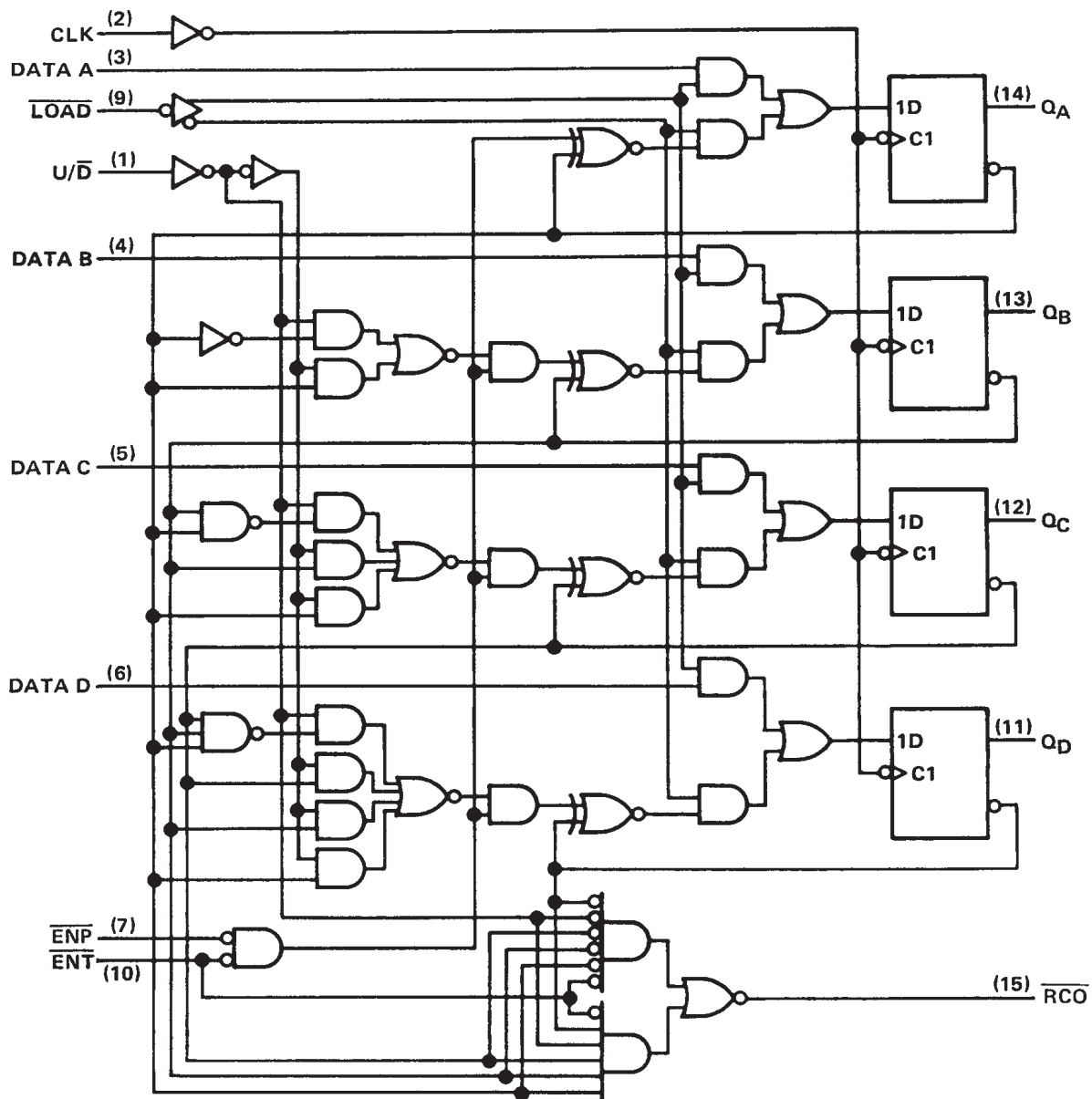


Pin numbers shown are for D, J, N, and W packages.

SN54LS169B, SN54S169  
 SN74LS169B, SN74S169  
 SYNCHRONOUS 4-BIT UP/DOWN BINARY COUNTERS

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logic diagram (positive logic)



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

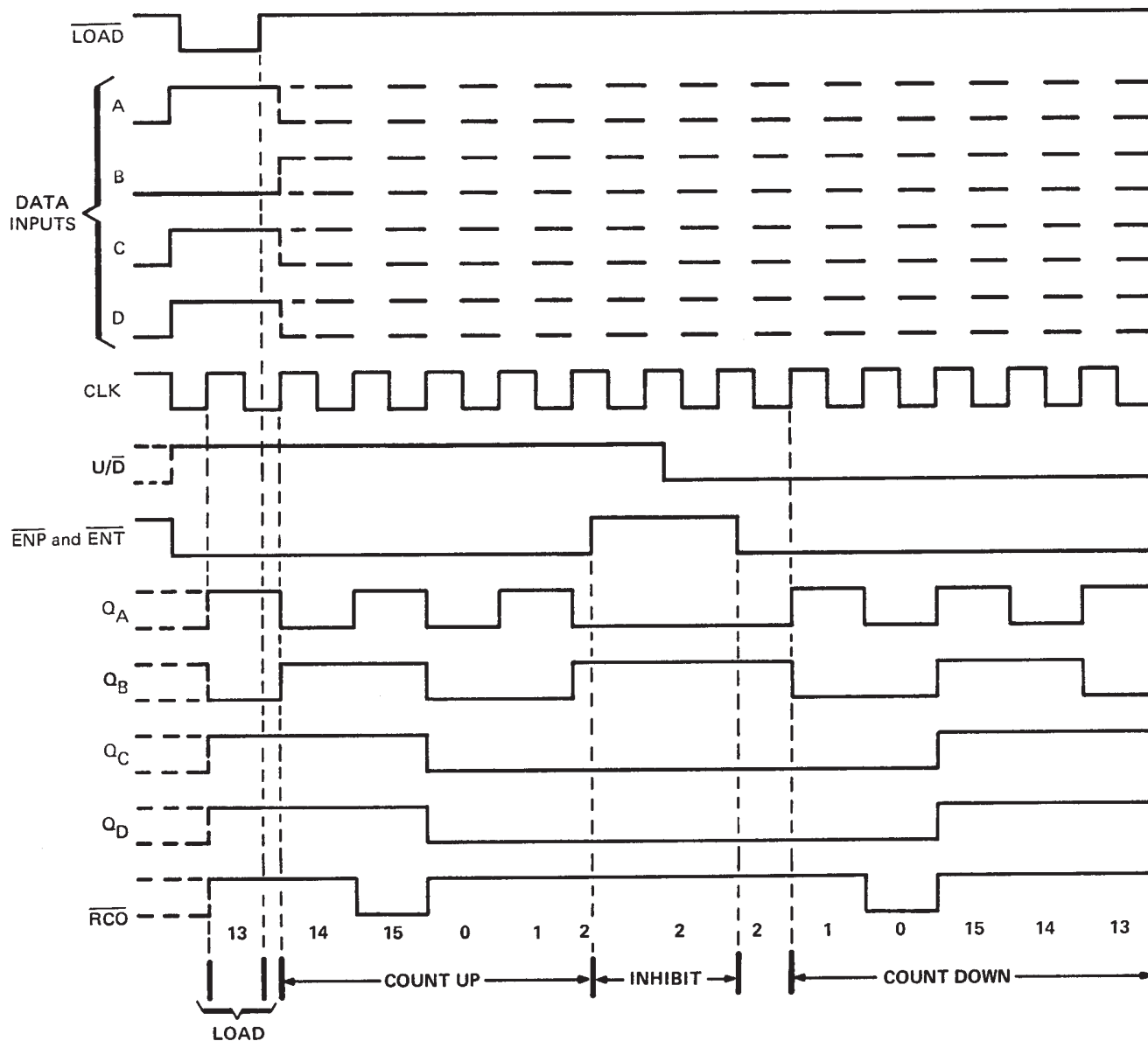


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**typical load, count, and inhibit sequences**

Illustrated below is the following sequence:

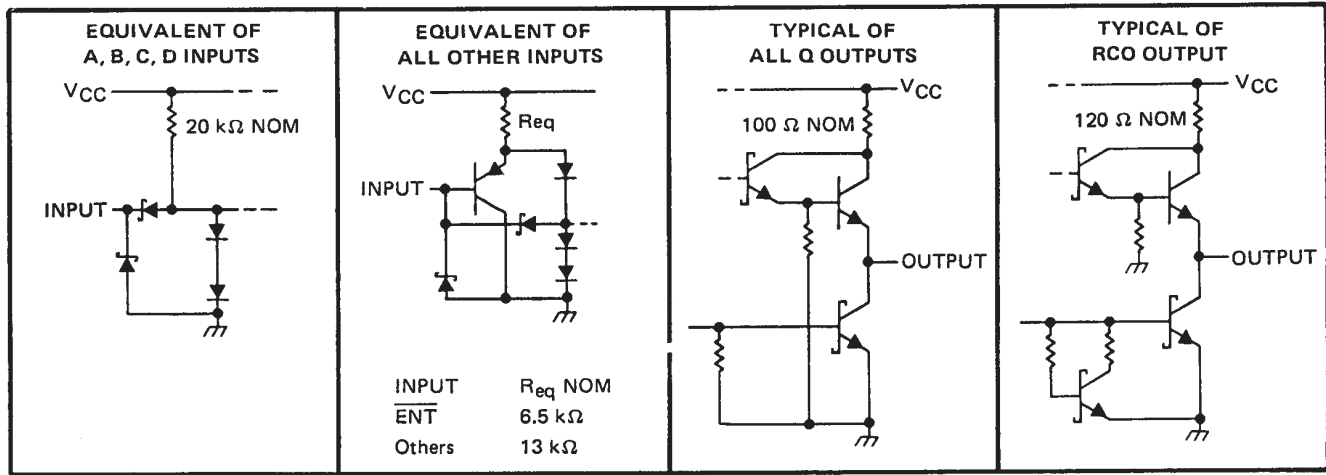
1. Load (preset) to binary thirteen.
2. Count up to fourteen, fifteen (maximum), zero, one, and two.
3. Inhibit
4. Count down to one, zero (minimum), fifteen, fourteen, and thirteen.



# SN54LS169B, SN54S169 SN74LS169B, SN74S169 SYNCHRONOUS 4-BIT UP/DOWN BINARY COUNTERS

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## 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	.....	7 V
Operating free-air temperature range: SN54LS169B	.....	- 55°C to 125°C
SN74LS169B	.....	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

		SN54LS169B			SN74LS169B			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
$V_{CC}$	Supply voltage	4.5	5	5.5	4.75	5	5.25	V
$V_{IH}$	High-level-input voltage	2			2			V
$V_{IL}$	Low-level input voltage			0.7			0.8	V
$I_{OH}$	High-level output current			$\overline{RCO}$			- 0.4	mA
				Any Q			- 1.2	mA
$I_{OL}$	Low-level output current			$\overline{RCO}$			4	mA
				Any Q			12	mA
$f_{clock}$	Clock frequency	0		20	0		20	MHz
$t_{w(clock)}$	Width of clock pulse (high or low) (see Figure 1)	25			25			ns
$t_{su}$	Setup time, (see Figure 1)			Data inputs A, B, C, D			30	ns
				ENP or ENT			30	
				Load			35	
				U/ $\overline{D}$			35	
$t_h$	Hold time at any input with respect to clock (see Figure 1)	0			0			ns
$T_A$	Operating free-air temperature	- 55		125	0		70	°C



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SN74LS169B, SN74S169  
**SYNCHRONOUS 4-BIT UP/DOWN BINARY COUNTERS**

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

PARAMETER	TEST CONDITIONS†		SN54LS169B			SN74LS169B			UNIT	
			MIN	TYP‡	MAX	MIN	TYP‡	MAX		
V <sub>IK</sub>	V <sub>CC</sub> = MIN, I <sub>I</sub> = -18 mA		-1.5			-1.5			V	
V <sub>OH</sub>	V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, V <sub>IL</sub> = MAX	$\overline{RCO}$	I <sub>OH</sub> = -0.4 mA		2.5	3.4	2.7	3.4	V	
		Any Q	I <sub>OH</sub> = -1.2 mA		2.4	3.2	2.4	3.2		
V <sub>OL</sub>	V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, V <sub>IL</sub> = MAX	$\overline{RCO}$	I <sub>OH</sub> = 4 mA		0.25	0.4	0.25	0.4	V	
			I <sub>OL</sub> = 8 mA				0.35	0.5		
		Any Q	I <sub>OL</sub> = 12 mA		0.25	0.4	0.25	0.4		
			I <sub>OL</sub> = 24 mA				0.35	0.5		
I <sub>I</sub>	V <sub>CC</sub> = MAX, V <sub>I</sub> = 7 V		0.1			0.1			mA	
I <sub>IH</sub>	V <sub>CC</sub> = MAX, V <sub>I</sub> = 2.7 V		20			20			μA	
I <sub>IL</sub>	V <sub>CC</sub> = MAX, V <sub>I</sub> = 0.4 V	U/ $\overline{D}$ , LOAD, $\overline{ENP}$ , CLK		-0.2			-0.2			mA
		All other inputs		-0.4			-0.4			
I <sub>OS</sub> §	V <sub>CC</sub> = MAX, V <sub>O</sub> = 0 V	$\overline{RCO}$		-20	-100	-20	-100	mA		
		Any Q		-30	-130	-30	-130			
I <sub>CC</sub>	V <sub>CC</sub> = MAX, See Note 2		28	45	28	45	mA			

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

‡ All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C.

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

NOTE 2: I<sub>CC</sub> is measured after applying a momentary 4.5 V, then ground, to the clock input with all other inputs grounded and the outputs open.

switching characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C (see note 3)

PARAMETER¶	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	LS169B			UNIT
				MIN	TYP	MAX	
f <sub>max</sub>				20	35		MHz
t <sub>PLH</sub>	CLK	$\overline{RCO}$	R <sub>L</sub> = 2 kΩ, C <sub>L</sub> = 15 pF	26	40		ns
t <sub>PHL</sub>				17	25		
t <sub>PLH</sub>	$\overline{ENT}$	$\overline{RCO}$		15	25		ns
t <sub>PHL</sub>				11	20		
t <sub>PLH</sub>	U/ $\overline{D}$	$\overline{RCO}$		23	35		ns
t <sub>PHL</sub>				15	25		
t <sub>PLH</sub>	CLK	Any Q		16	25		ns
t <sub>PHL</sub>				17	25		

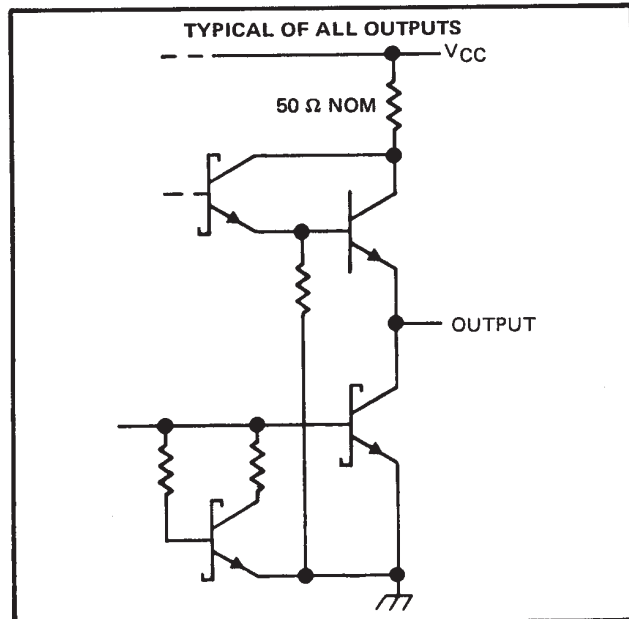
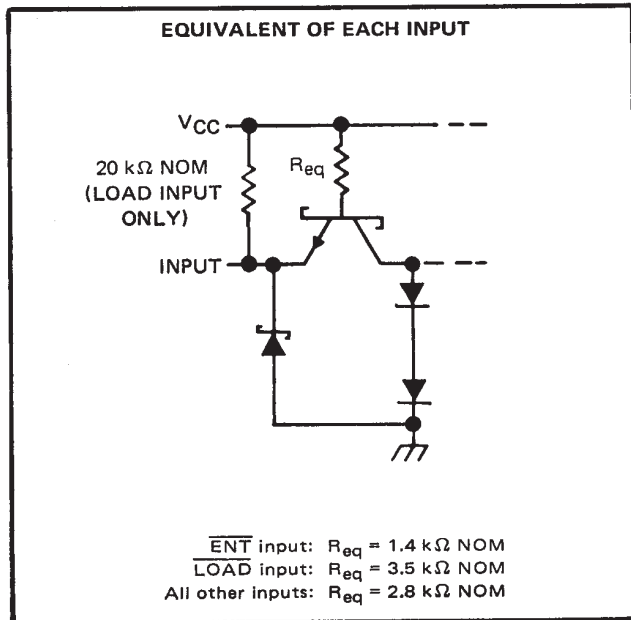
¶ Propagation delay time from up/down to ripple carry must be measured with the counter at either a minimum or a maximum count. As the logic level of the up/down input is changed, the ripple carry output will follow. If the count is minimum (0), the ripple carry output transition will be in phase. If the count is maximum (15), the ripple carry output will be out of phase.

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

**SN54LS169B, SN54S169  
SN74LS169B, SN74S169  
SYNCHRONOUS 4-BIT UP/DOWN BINARY COUNTERS**

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**schematics of inputs and outputs**



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

Supply voltage, $V_{CC}$ (See Note 4) .....	7 V
Input voltage .....	5.5 V
Interemitter voltage (see Note 5) .....	5.5 V
Operating free-air temperature range: SN54S169 (see Note 6) .....	-55°C to 125°C
SN74S169 .....	0°C to 70°C
Storage temperature range .....	-65°C to 150°C

**recommended operating conditions**

	SN54S169			SN74S169			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, $f_{clock}$	0		40	0		40	MHz
Width of clock pulse, $t_{w(clock)}$ (high or low) (see Figure 1)	10			10			ns
Setup time, $t_{su}$ (see Figure 1)	Data inputs A, B, C, D			4			ns
	$\overline{ENP}$ or $\overline{ENT}$			14			
	Load			9			
	$U/\overline{D}$			20			
Hold time at any input with respect to clock, $t_w$ (see Figure 1)	1			1			ns
Operating free-air temperature, $T_A$ (see Note 6)	-55		125	0		70	°C

- NOTES: 4. Voltage values, except interemitter voltage, are with respect to network ground terminal.  
 5. This is the voltage between two emitters of a multiple-emitter transistor. For these circuits, this rating applies between the count enable inputs  $\overline{ENP}$  and  $\overline{ENT}$ .  
 6. A SN54S169 in the W package operating at free-air temperatures above 91°C requires a heat sink that provides a thermal resistance from case to free-air,  $R_{\theta CA}$ , of not more than 26°C/W.



SN54LS169B, SN54S169  
SN74LS169B, SN74S169  
**SYNCHRONOUS 4-BIT UP/DOWN BINARY COUNTERS**

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

PARAMETER	TEST CONDITIONS†	SN54S169		SN74S169		UNIT		
		MIN	TYP‡	MAX	MIN		TYP‡	MAX
V <sub>IH</sub> High-level input voltage		2			2	V		
V <sub>IL</sub> Low-level input voltage				0.8		0.8	V	
V <sub>IK</sub> Input clamp voltage	V <sub>CC</sub> = MIN, I <sub>I</sub> = -18 mA			-1.2		-1.2	V	
V <sub>OH</sub> High-level output voltage	V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, V <sub>IL</sub> = 0.8 V, I <sub>OH</sub> = -1 mA	2.5	3.4		2.7	3.4	V	
V <sub>OL</sub> Low-level output voltage	V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, V <sub>IL</sub> = 0.8 V, I <sub>OL</sub> = 20 mA			0.5		0.5	V	
I <sub>I</sub> Input current at maximum input voltage	V <sub>CC</sub> = MAX, V <sub>I</sub> = 5.5 V			1		1	mA	
I <sub>IH</sub> High-level input current	ENT			100		100	μA	
	Load	V <sub>CC</sub> = MAX, V <sub>I</sub> = 2.7 V		-10	-200	-10		-200
	Other inputs			50		50		
I <sub>IL</sub> Low-level input current	ENT	V <sub>CC</sub> = MAX, V <sub>I</sub> = 0.5 V		-4		-4	mA	
	Other inputs			-2		-2		
I <sub>OS</sub> Short-circuit output current <sup>§</sup>	V <sub>CC</sub> = MAX,			-40	-100	-40	-100	mA
I <sub>CC</sub> Supply current	V <sub>CC</sub> = MAX, See Note 2			100	160	100	160	mA

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

‡ All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C.

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

NOTE 2: I<sub>CC</sub> is measured after applying a momentary 4.5 V, then ground, to the clock input with all other inputs grounded and the outputs open.

switching characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C

PARAMETER¶	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	U/D = HIGH			U/D = LOW			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
f <sub>max</sub>			C <sub>L</sub> = 15 pF, R <sub>L</sub> = 280 Ω, See Figures 2 and 3 and Note 3	40	70		40	55		MHz
t <sub>PLH</sub>	CLK	RCO			14	21		14	21	ns
t <sub>PHL</sub>					20	28		20	28	
t <sub>PLH</sub>	CLK	Any Q			8	15		8	15	ns
t <sub>PHL</sub>					11	15		11	15	
t <sub>PLH</sub>	ENT	RCO			7.5	11		6	12	ns
t <sub>PHL</sub>					15	22		15	25	
t <sub>PLH</sub> ◇	U/D	RCO			9	15		8	15	ns
t <sub>PHL</sub> ◇					10	15		16	22	

¶ t<sub>max</sub> = maximum clock frequency

t<sub>PLH</sub> = propagation delay time, low-to-high-level output

t<sub>PHL</sub> = propagation delay time, high-to-low-level output

Propagation delay time from up/down to ripple carry must be measured with the counter at either a minimum or a maximum count. As the logic level of the up/down input is changed, the ripple carry output will follow. If the count is minimum (0), the ripple carry output transition will be in phase. If the count is maximum (15 for 'S169), the ripple carry output will be out of phase.

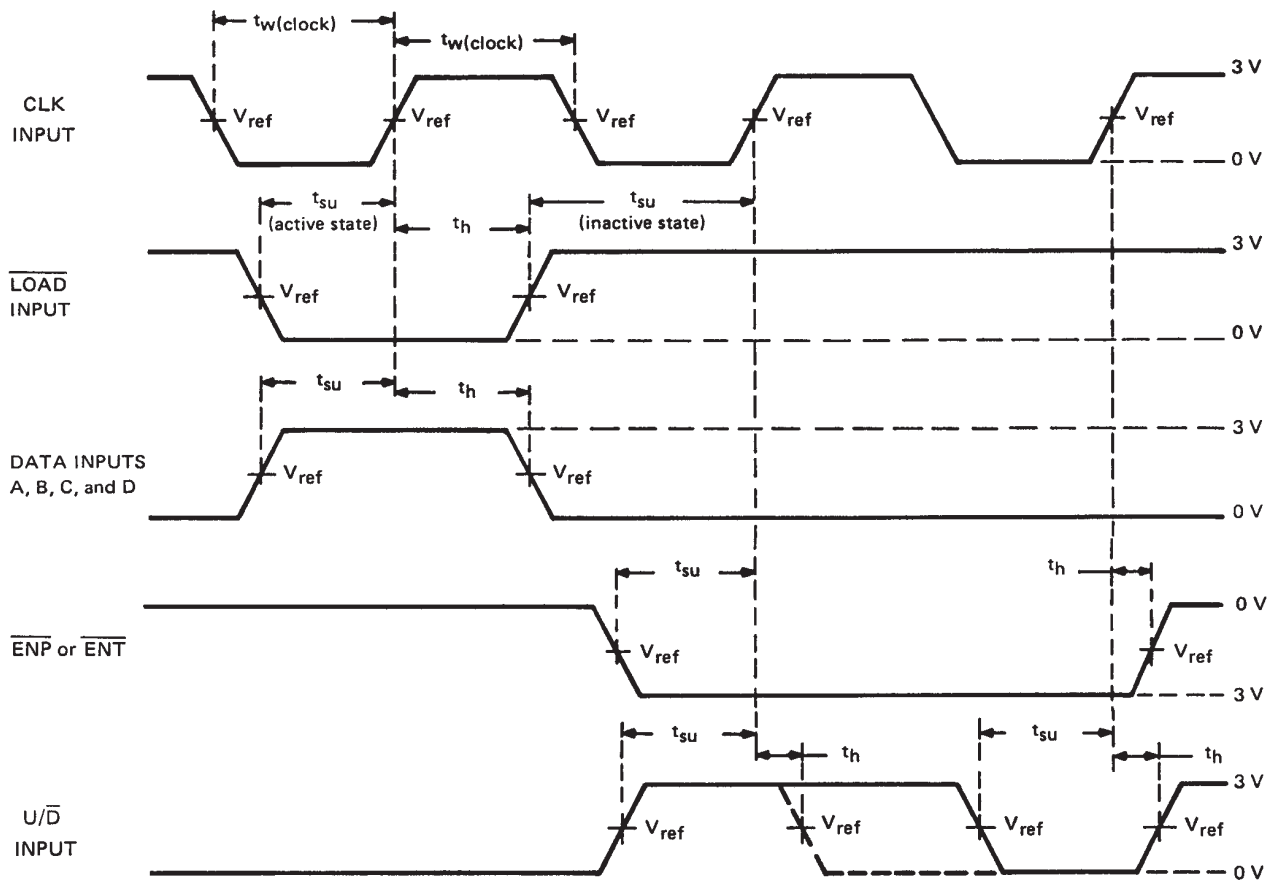
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**SN54LS169B, SN54S169  
SN74LS169B, SN74S169  
SYNCHRONOUS 4-BIT UP/DOWN BINARY COUNTERS**

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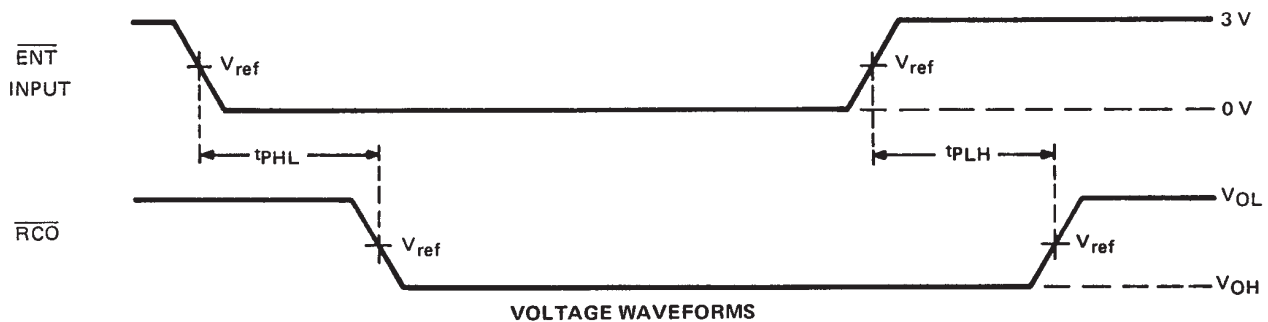
**PARAMETER MEASUREMENT INFORMATION**



**VOLTAGE WAVEFORMS**

- NOTES: A. The input pulses are supplied by a generator having the following characteristics: PRR  $\leq$  1 MHz, duty cycle  $\leq$  50%,  $Z_{out} \approx 50 \Omega$ ; for 'LS169B,  $t_r \leq 15$  ns,  $t_f \leq 6$  ns, and for 'S169,  $t_r \leq 2.5$  ns,  $t_f \leq 2.5$  ns.  
B. For 'LS169B,  $V_{ref} = 1.3$  V; for 'S168 and 'S169,  $V_{ref} = 1.5$  V.

**FIGURE 1—PULSE WIDTHS, SETUP TIMES, HOLD TIMES**



**VOLTAGE WAVEFORMS**

- NOTES: A. The input pulses are supplied by a generator having the following characteristics: PRR  $\leq$  MHz, duty cycle  $\leq$  50%,  $Z_{out} \approx 50 \Omega$ ; for 'LS169B,  $t_r \leq 15$  ns,  $t_f \leq 5$  ns; and for 'S169,  $t_r \leq 2.5$  ns,  $t_f \leq 2.5$  ns.  
B.  $t_{PLH}$  and  $t_{PHL}$  from enable T input to ripple carry output assume that the counter is at the maximum count, all Q outputs high.  
C. For 'LS169B,  $V_{ref} = 1.3$  V; for 'S169,  $V_{ref} = 1.5$  V.  
D. Propagation delay time from up/down to ripple carry must be measured with the counter at either a minimum or a maximum count. As the logic level of the up/down input is changed, the ripple carry output will follow. If the count is minimum (0) the ripple carry output transition will be in phase. If the count is maximum (15), the ripple carry output will be out of phase.

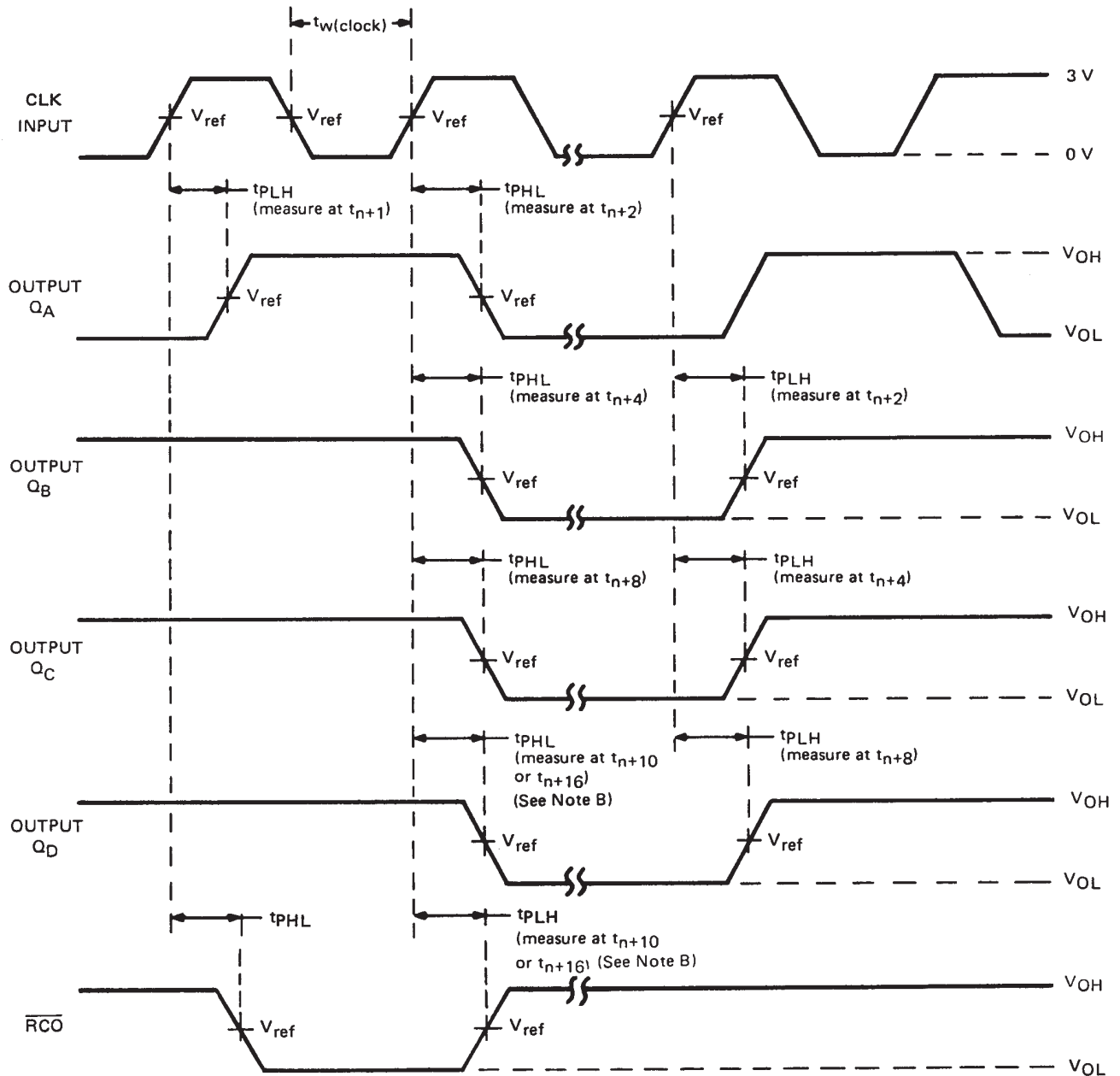
**FIGURE 2—PROPAGATION DELAY TIMES TO CARRY OUTPUT**



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SN74LS169B, SN74S169  
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**PARAMETER MEASUREMENT INFORMATION**



**UP-COUNT VOLTAGE WAVEFORMS**

- NOTES: A. The input pulses are supplied by a generator having the following characteristics: PRR  $\leq$  1 MHz, duty cycle  $\leq$  50%,  $Z_{out} \approx 50 \Omega$ ; for 'LS169B,  $t_r \leq 15$  ns;  $t_f \leq 6$  ns, and 'S169,  $t_r \leq 2.5$  ns,  $t_f \leq 2.5$  ns. Vary PRR to measure  $f_{max}$ .  
 B. Outputs  $Q_D$  and carry are tested at  $t_{n+16}$ , where  $t_n$  is the bit-time when all outputs are low.  
 C. For 'LS169B,  $V_{ref} = 1.3$  V; for 'S169,  $V_{ref} = 1.5$  V.

**FIGURE 3—PROPAGATION DELAY TIMES FROM CLOCK**



**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
80018022A	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type
8001802EA	ACTIVE	CDIP	J	16	1	TBD	A42 SNPB	N / A for Pkg Type
8001802EA	ACTIVE	CDIP	J	16	1	TBD	A42 SNPB	N / A for Pkg Type
8001802FA	ACTIVE	CFP	W	16	1	TBD	A42	N / A for Pkg Type
8001802FA	ACTIVE	CFP	W	16	1	TBD	A42	N / A for Pkg Type
SN54LS169BJ	ACTIVE	CDIP	J	16	1	TBD	A42 SNPB	N / A for Pkg Type
SN54LS169BJ	ACTIVE	CDIP	J	16	1	TBD	A42 SNPB	N / A for Pkg Type
SN54S169J	ACTIVE	CDIP	J	16	1	TBD	A42 SNPB	N / A for Pkg Type
SN54S169J	ACTIVE	CDIP	J	16	1	TBD	A42 SNPB	N / A for Pkg Type
SN74LS169BD	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS169BD	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS169BDE4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS169BDE4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS169BN	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74LS169BN	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74LS169BNE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74LS169BNE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74LS169BNSR	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS169BNSR	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS169BNSRE4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS169BNSRE4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74S169J	OBSOLETE	CDIP	J	16		TBD	Call TI	Call TI
SN74S169J	OBSOLETE	CDIP	J	16		TBD	Call TI	Call TI
SN74S169N	OBSOLETE	PDIP	N	16		TBD	Call TI	Call TI
SN74S169N	OBSOLETE	PDIP	N	16		TBD	Call TI	Call TI
SN74S169N3	OBSOLETE	PDIP	N	16		TBD	Call TI	Call TI
SN74S169N3	OBSOLETE	PDIP	N	16		TBD	Call TI	Call TI
SNJ54LS169BFBK	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type
SNJ54LS169BFBK	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type
SNJ54LS169BJ	ACTIVE	CDIP	J	16	1	TBD	A42 SNPB	N / A for Pkg Type
SNJ54LS169BJ	ACTIVE	CDIP	J	16	1	TBD	A42 SNPB	N / A for Pkg Type
SNJ54LS169BW	ACTIVE	CFP	W	16	1	TBD	A42	N / A for Pkg Type
SNJ54LS169BW	ACTIVE	CFP	W	16	1	TBD	A42	N / A for Pkg Type
SNJ54S169FBK	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
SNJ54S169FK	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type
SNJ54S169J	ACTIVE	CDIP	J	16	1	TBD	A42 SNPB	N / A for Pkg Type
SNJ54S169J	ACTIVE	CDIP	J	16	1	TBD	A42 SNPB	N / A for Pkg Type
SNJ54S169W	ACTIVE	CFP	W	16	1	TBD	A42	N / A for Pkg Type
SNJ54S169W	ACTIVE	CFP	W	16	1	TBD	A42	N / A for Pkg Type

<sup>(1)</sup> 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.

**OBSOLETE:** TI has discontinued the production of the device.

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

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J (R-GDIP-T\*\*)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



DIM \ PINS **	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)



4040083/F 03/03

- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - This package is hermetically sealed with a ceramic lid using glass frit.
  - Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
  - Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.



FK (S-CQCC-N\*\*)

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



4040140/D 10/96

- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. This package can be hermetically sealed with a metal lid.
  - D. The terminals are gold plated.
  - E. Falls within JEDEC MS-004

N (R-PDIP-T\*\*)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN

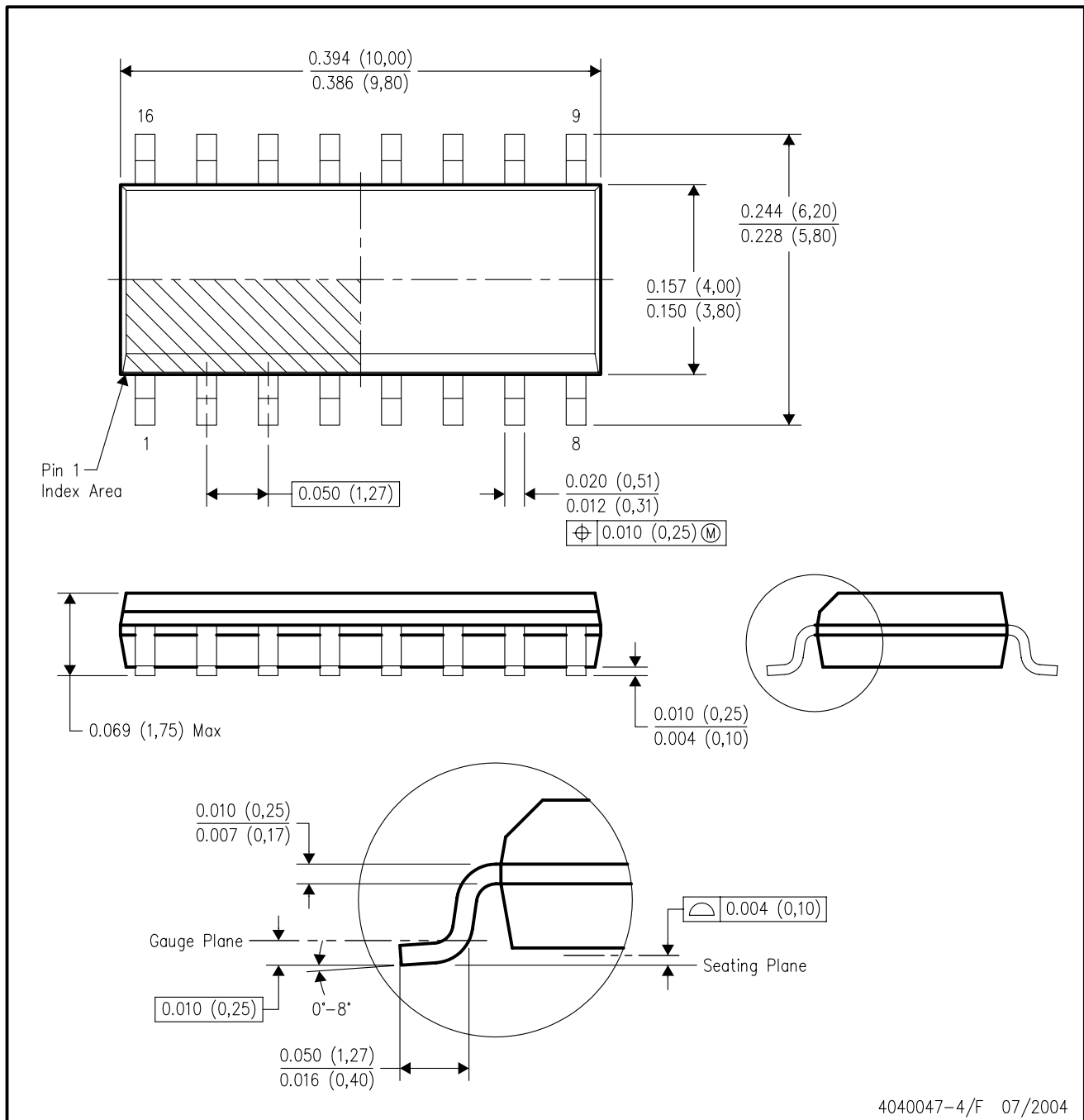


- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - $\triangle C$  Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
  - $\triangle D$  The 20 pin end lead shoulder width is a vendor option, either half or full width.

4040049/E 12/2002

D (R-PDSO-G16)

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
  - D. Falls within JEDEC MS-012 variation AC.

# MECHANICAL DATA

NS (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

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Mailing Address: Texas Instruments  
Post Office Box 655303 Dallas, Texas 75265