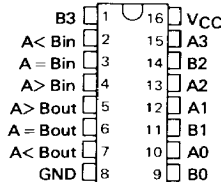


TYPES SN5485, SN54L85, SN54LS85, SN54S85 SN7485, SN74LS85, SN74S85 4-BIT MAGNITUDE COMPARATORS

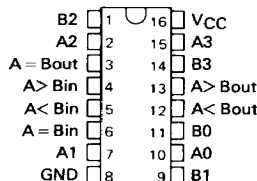
MARCH 1974 — REVISED DECEMBER 1983

TYPE	TYPICAL POWER DISSIPATION	TYPICAL DELAY (4-BIT WORDS)
'85	275 mW	23 ns
'L85	20 mW	90 ns
'LS85	52 mW	24 ns
'S85	365 mW	11 ns

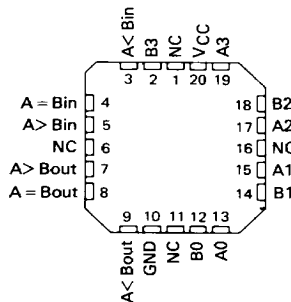
SN5485, SN54LS85, SN54S85 ... J OR W PACKAGE
SN7485 ... J OR N PACKAGE
SN74LS85, SN74S85 ... D, J OR N PACKAGE
(TOP VIEW)



SN54L85 ... J PACKAGE
(TOP VIEW)



SN54LS85, SN54S85 ... FK PACKAGE
SN74LS85, SN74S85 ... FN PACKAGE
(TOP VIEW)



NC - No internal connection

description

These four-bit magnitude comparators perform comparison of straight binary and straight BCD (8-4-2-1) codes. Three fully decoded decisions about two 4-bit words (A, B) are made and are externally available at three outputs. These devices are fully expandable to any number of bits without external gates. Words of greater length may be compared by connecting comparators in cascade. The A > B, A < B, and A = B outputs of a stage handling less-significant bits are connected to the corresponding A > B, A < B, and A = B inputs of the next stage handling more-significant bits. The stage handling the least-significant bits must have a high-level voltage applied to the A = B input and in addition for the '85, low-level voltages applied to the A > B and A < B inputs. The cascading paths of the '85, 'LS85, and 'S85 are implemented with only a two-gate-level delay to reduce overall comparison times for long words. An alternate method of cascading which further reduces the comparison time is shown in the typical application data.

FUNCTION TABLES

COMPARING INPUTS				CASCADING INPUTS			OUTPUTS		
A3, B3	A2, B2	A1, B1	A0, B0	A > B	A < B	A = B	A > B	A < B	A = B
A3 = B3	X	X	X	X	X	X	H	L	L
A3 < B3	X	X	X	X	X	X	L	H	L
A3 = B3	A2 > B2	X	X	X	X	X	H	L	L
A3 = B3	A2 < B2	X	X	X	X	X	L	H	L
A3 = B3	A2 = B2	A1 > B1	X	X	X	X	H	L	L
A3 = B3	A2 = B2	A1 < B1	X	X	X	X	L	H	L
A3 = B3	A2 = B2	A1 = B1	A0 > B0	X	X	X	H	L	L
A3 = B3	A2 = B2	A1 = B1	A0 < B0	X	X	X	L	H	L
A3 = B3	A2 = B2	A1 = B1	A0 = B0	H	L	L	H	L	L
A3 = B3	A2 = B2	A1 = B1	A0 = B0	L	H	L	L	H	L
A3 = B3	A2 = B2	A1 = B1	A0 = B0	L	L	H	L	L	H

'85, 'LS85, 'S85

A3 = B3	A2 = B2	A1 = B1	A0 = B0	X	X	H	L	L	H
A3 = B3	A2 = B2	A1 = B1	A0 = B0	H	H	L	L	L	L
A3 = B3	A2 = B2	A1 = B1	A0 = B0	L	L	L	H	H	L

'L85

A3 = B3	A2 = B2	A1 = B1	A0 = B0	L	H	H	L	H	H
A3 = B3	A2 = B2	A1 = B1	A0 = B0	H	L	H	H	L	H
A3 = B3	A2 = B2	A1 = B1	A0 = B0	H	H	H	H	H	H
A3 = B3	A2 = B2	A1 = B1	A0 = B0	H	H	L	H	H	L
A3 = B3	A2 = B2	A1 = B1	A0 = B0	L	L	L	L	L	L

H = high level, L = low level, X = irrelevant

PRODUCTION DATA

This document contains 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.

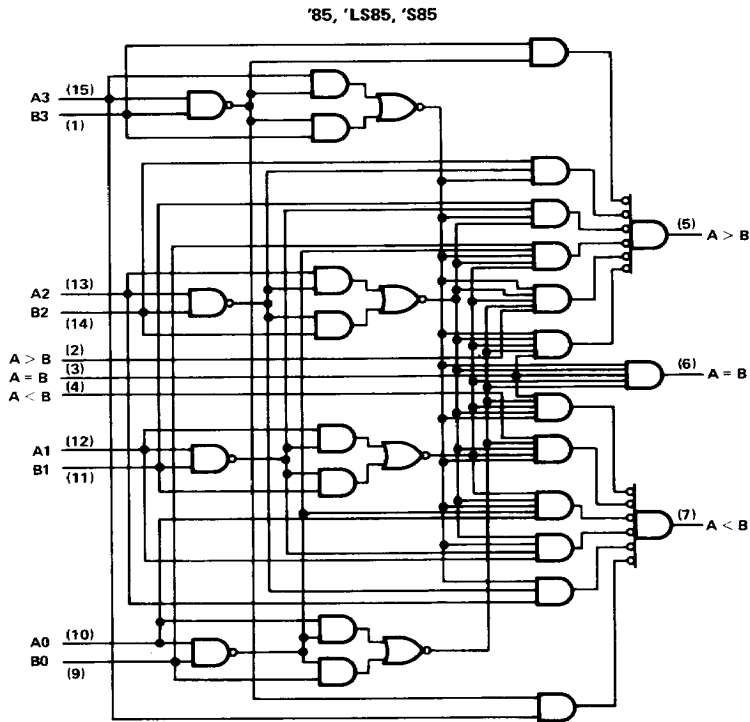
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TTL DEVICES

**TYPES SN5485, SN54LS85, SN54S85,
SN7485, SN74LS85, SN74S85
4-BIT MAGNITUDE COMPARATORS**

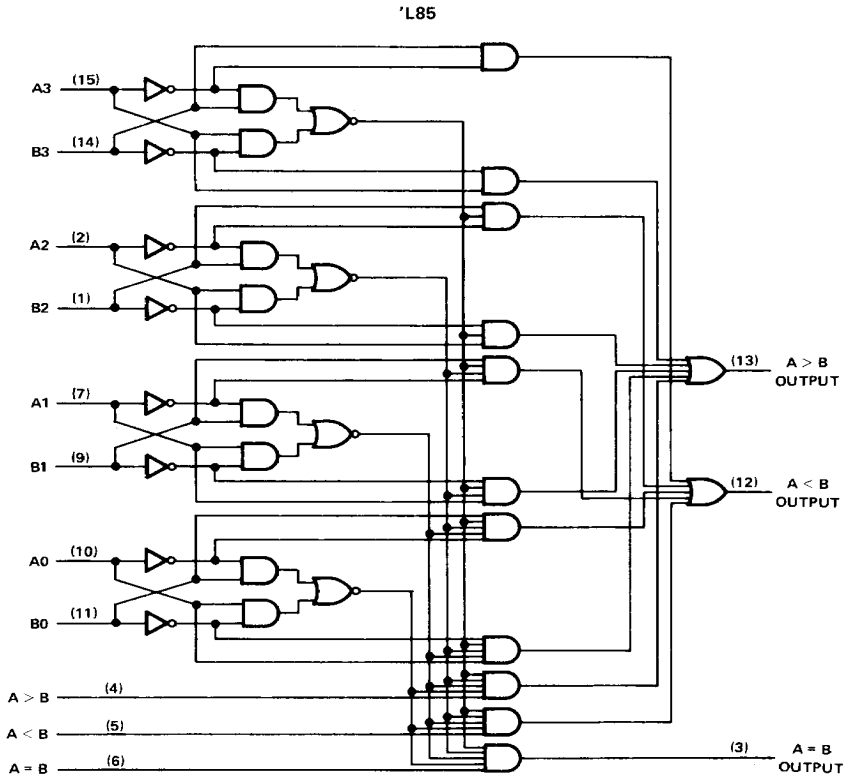
logic diagrams



Pin numbers shown on logic notation are for D, J or N packages.

TYPE SN54L85
4-BIT MAGNITUDE COMPARATOR

logic diagrams (continued)

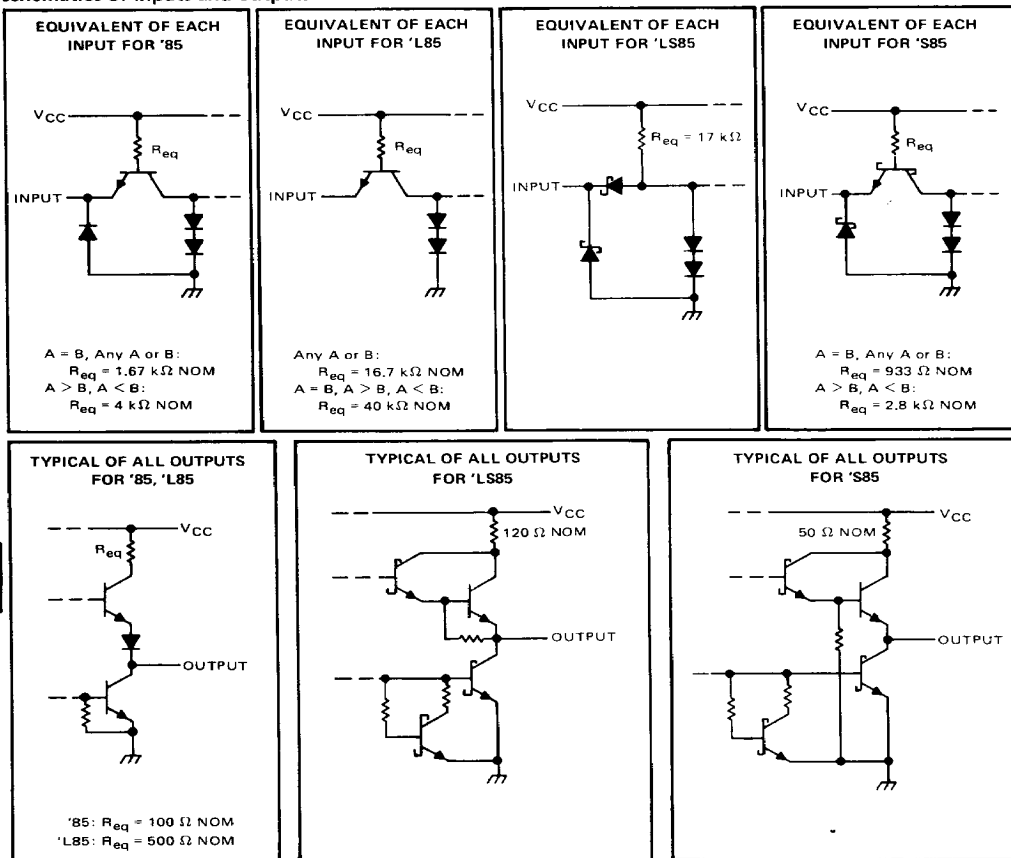


3

TTL DEVICES

TYPES SN5485, SN54L85, SN54LS85, SN54S85, SN7485, SN74LS85, SN74S85 4-BIT MAGNITUDE COMPARATORS

schematics of inputs and outputs



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

	SN54' SN54S'	SN54L'	SN54LS'	SN74' SN74S'	SN74LS'	UNIT
Supply voltage, V_{CC} (see Note 1)	7	8	7	7	7	V
Input voltage (see Note 2)	5.5	5.5	7	5.5	7	V
Interemitter voltage (see Note 3)	5.5			5.5		V
Operating free-air temperature range	- 55 to 125			- 0 to 70		$^{\circ}\text{C}$
Storage temperature range	- 65 to 150			- 65 to 150		$^{\circ}\text{C}$

- NOTES: 1. Voltage values, except interemitter voltage, are with respect to network ground terminal.
2. Input voltages for 'L85 must be zero or positive with respect to network ground terminal.
3. This is the voltage between two emitters of a multiple-emitter input transistor. This rating applies to each A input in conjunction with its respective B input of the '85 and 'S85.

TYPES SN5485, SN7485 4-BIT MAGNITUDE COMPARATORS

recommended operating conditions

	SN5485			SN7485			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}			16			16	mA
Operating free-air temperature, T_A	-55		125	0		70	$^{\circ}$ C

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

PARAMETER		TEST CONDITIONS†		MIN	TYP‡	MAX	UNIT
V_{IH}	High-level input voltage			2			V
V_{IL}	Low-level input voltage					0.8	V
V_{IK}	Input clamp voltage	$V_{CC} = \text{MIN}$, $I_I = -12 \text{ mA}$				-1.5	V
V_{OH}	High-level output voltage	$V_{CC} = \text{MIN}$, $V_{IL} = 0.8 \text{ V}$, $I_{OH} = -400 \mu\text{A}$	$V_{IH} = 2 \text{ V}$, $I_{OH} = -400 \mu\text{A}$	2.4	3.4		V
V_{OL}	Low-level output voltage	$V_{CC} = \text{MIN}$, $V_{IL} = 0.8 \text{ V}$, $I_{OL} = 16 \text{ mA}$	$V_{IH} = 2 \text{ V}$, $I_{OL} = 16 \text{ mA}$		0.2	0.4	V
I_I	Input current at maximum input voltage	$V_{CC} = \text{MAX}$, $V_I = 5.5 \text{ V}$				1	mA
I_{IH}	High-level input current	$A < B, A > B$ inputs all other inputs	$V_{CC} = \text{MAX}$, $V_I = 2.4 \text{ V}$			40	μ A
						120	
I_{IL}	Low-level input current	$A < B, A > B$ inputs all other inputs	$V_{CC} = \text{MAX}$, $V_I = 0.4 \text{ V}$			-1.6	mA
						-4.8	
I_{OS}	Short-circuit output current§	$V_{CC} = \text{MAX}$, $V_O = 0$		SN5485 -20		-55	mA
I_{CC}	Supply current	$V_{CC} = \text{MAX}$, See Note 4		SN7485 -18		-55	mA
					55	88	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.

NOTE 4: I_{CC} is measured with outputs open, $A = B$ grounded, and all other inputs at 4.5 V.

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

PARAMETER¶	FROM INPUT	TO OUTPUT	NUMBER OF GATE LEVELS	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}	Any A or B data input	$A < B, A > B$	1	$C_L = 15 \text{ pF}$, $R_L = 400 \Omega$, See Note 5		7		ns
			2			12		
			3			17	26	
		$A = B$	4			23	35	
t_{PHL}	Any A or B data input	$A < B, A > B$	1			11		ns
			2			15		
			3			20	30	
		$A = B$	4			20	30	
t_{PLH}	$A < B$ or $A = B$	$A > B$	1			7	11	ns
t_{PHL}	$A < B$ or $A = B$	$A > B$	1			11	17	ns
t_{PLH}	$A = B$	$A = B$	2			13	20	ns
t_{PHL}	$A = B$	$A = B$	2			11	17	ns
t_{PLH}	$A > B$ or $A = B$	$A < B$	1			7	11	ns
t_{PHL}	$A > B$ or $A = B$	$A < B$	1			11	17	ns

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

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

NOTE 5: See General Information Section for load circuits and voltage waveforms.

TYPE SN54L85 4-BIT MAGNITUDE COMPARATOR

recommended operating conditions

	SN54L85			UNIT
	MIN	NOM	MAX	
V_{CC} Supply voltage	4.5	5	5.5	V
V_{IH} High-level input voltage	2			V
V_{IL} Low-level input voltage			0.7	V
I_{OH} High-level output current			-0.1	mA
I_{OL} Low-level output current			2	mA
T_A Operating free-air temperature	-55		125	°C

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

PARAMETER	TEST CONDITIONS†	SN54L85			UNIT
		MIN	TYP‡	MAX	
V_{OH}	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = 0.7 \text{ V}, I_{OH} = -0.1 \text{ mA}$	2.4	3.3		V
V_{OL}	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = 0.7 \text{ V}, I_{OL} = 2 \text{ mA}$		0.15	0.3	V
I_I	A < B, A > B, or A = B			0.1	mA
	A or B inputs			0.3	
I_{IH}	A < B, A > B, or A = B			10	μA
	A or B inputs			30	
I_{IL}	A < B, A > B, or A = B			-0.18	mA
	A or B inputs			-0.54	
$I_{OS}§$	$V_{CC} = \text{MAX}$	-3		-15	mA
I_{CC}	$V_{CC} = \text{MAX}, \text{ See Note 6}$	Condition A		4.0	mA
		Condition B		3.2	

† 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.

NOTE 6: With all outputs open, I_{CC} is measured for Condition A with all inputs at 4.5 V, and for Condition B with all inputs grounded.

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}	Any A or B	Any	$R_L = 4 \text{ k}\Omega, C_L = 50 \text{ pF}$		90	150	ns
t_{PHL}					75	150	ns
t_{PLH}	A > B, A < B				75	150	ns
t_{PHL}	or A = B				55	100	ns

NOTE 5: See General Information Section for load circuits and voltage waveforms.

TYPES SN54LS85, SN74LS85 4-BIT MAGNITUDE COMPARATORS

recommended operating conditions

	SN54LS85			SN74LS85			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
Operating free-air temperature, T_A	-55		125	0		70	$^{\circ}$ C

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

PARAMETER		TEST CONDITIONS [†]	SN54LS85			SN74LS85			UNIT
			MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	
V_{IH}	High-level input voltage		2			2			V
V_{IL}	Low-level input voltage			0.7			0.7		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	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = V_{IL \text{ max}}, I_{OL} = 4 \text{ mA}$		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	A < B, A > B inputs		0.1			0.1		mA
		all other inputs		0.3			0.3		
I_{IH}	High-level input current	A < B, A > B inputs		20			20		μ A
		all other inputs		60			60		
I_{IL}	Low-level input current	A < B, A > B inputs		-0.4			-0.4		mA
		all other inputs		-1.2			-1.2		
I_{OS}	Short-circuit output current [§]	$V_{CC} = \text{MAX}$	-20	-100		-20	-100		mA
I_{CC}	Supply current	$V_{CC} = \text{MAX}, \text{ See Note 4}$	10.4	20		10.4	20		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, and duration of the short-circuit should not exceed one second.

NOTE 4: I_{CC} is measured with outputs open, A = B grounded, and all other inputs at 4.5 V.

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

PARAMETER [¶]	FROM INPUT	TO OUTPUT	NUMBER OF GATE LEVELS	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}	Any A or B data input	A < B, A > B	1	$C_L = 15 \text{ pF}, R_L = 2 \text{ k}\Omega, \text{ See Note 5}$		14		ns
			2			19		
			3			24	36	
		A = B	4			27	45	
t_{PHL}	Any A or B data input	A < B, A > B	1			11		ns
			2			15		
			3			20	30	
		A = B	4			23	45	
t_{PLH}	A < B or A = B	A > B	1			14	22	ns
t_{PHL}	A < B or A = B	A > B	1			11	17	ns
t_{PLH}	A = B	A = B	2			13	20	ns
t_{PHL}	A = B	A = B	2			13	26	ns
t_{PLH}	A > B or A = B	A < B	1			14	22	ns
t_{PHL}	A > B or A = B	A < B	1			11	17	ns

[¶] t_{PLH} = propagation delay time, low-to-high-level output

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

NOTE 5: See General Information Section for load circuits and voltage waveforms.

TYPES SN54S85, SN74S85 4-BIT MAGNITUDE COMPARATORS

recommended operating conditions

	SN54S85			SN74S85			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
Operating free-air temperature, T_A	-55		125	0		70	°C

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

PARAMETER		TEST CONDITIONS [†]		MIN	TYP [‡]	MAX	UNIT
V_{IH}	High-level input voltage			2			V
V_{IL}	Low-level input voltage					0.8	V
V_{IK}	Input clamp voltage	$V_{CC} = \text{MIN}, I_I = -18 \text{ mA}$				-1.2	V
V_{OH}	High-level output voltage	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V},$ $V_{IL} = 0.8 \text{ V}, I_{OH} = -1 \text{ mA}$	SN54S85 SN74S85	2.5 2.7	3.4 3.4		V
V_{OL}	Low-level output voltage	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V},$ $V_{IL} = 0.8 \text{ V}, I_{OL} = 20 \text{ mA}$				0.5	V
I_I	Input current at maximum input voltage	$V_{CC} = \text{MAX}, V_I = 5.5 \text{ V}$				1	mA
I_{IH}	High-level input current	A < B, A > B inputs all other inputs	$V_{CC} = \text{MAX}, V_I = 2.7 \text{ V}$			50 150	μA
I_{IL}	Low-level input current	A < B, A > B inputs all other inputs	$V_{CC} = \text{MAX}, V_I = 0.5 \text{ V}$			-2 -6	mA
I_{OS}	Short-circuit output current [§]	$-V_{EC} = \text{MAX}$		-40		-100	mA
I_{CC}	Supply current	$V_{CC} = \text{MAX},$ See Note 4			73	115	mA
		$V_{CC} = \text{MAX}, T_A = 125^\circ\text{C},$ See Note 4	SN54S85W			110	

[†]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.

NOTE 4: I_{CC} is measured with outputs open, A = B grounded, and all other inputs at 4.5 V.

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

PARAMETER [¶]	FROM INPUT	TO OUTPUT	NUMBER OF GATE LEVELS	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}	Any A or B data input	A < B, A > B	1	$C_L = 15 \text{ pF},$ $R_L = 280 \Omega,$ See Note 5		5		ns
			2			7.5		
			3			10.5	16	
		A = B	4			12	18	ns
t_{PHL}	Any A or B data input	A < B, A > B	1			5.5		
			2			7		
			3			11	16.5	
		A = B	4			11	16.5	
t_{PLH}	A < B or A = B	A > B	1			5	7.5	ns
t_{PHL}	A < B or A = B	A > B	1			5.5	8.5	ns
t_{PLH}	A = B	A = B	2			7	10.5	ns
t_{PHL}	A = B	A = B	2			5	7.5	ns
t_{PLH}	A > B or A = B	A < B	1			5	7.5	ns
t_{PHL}	A > B or A = B	A < B	1			5.5	8.5	ns

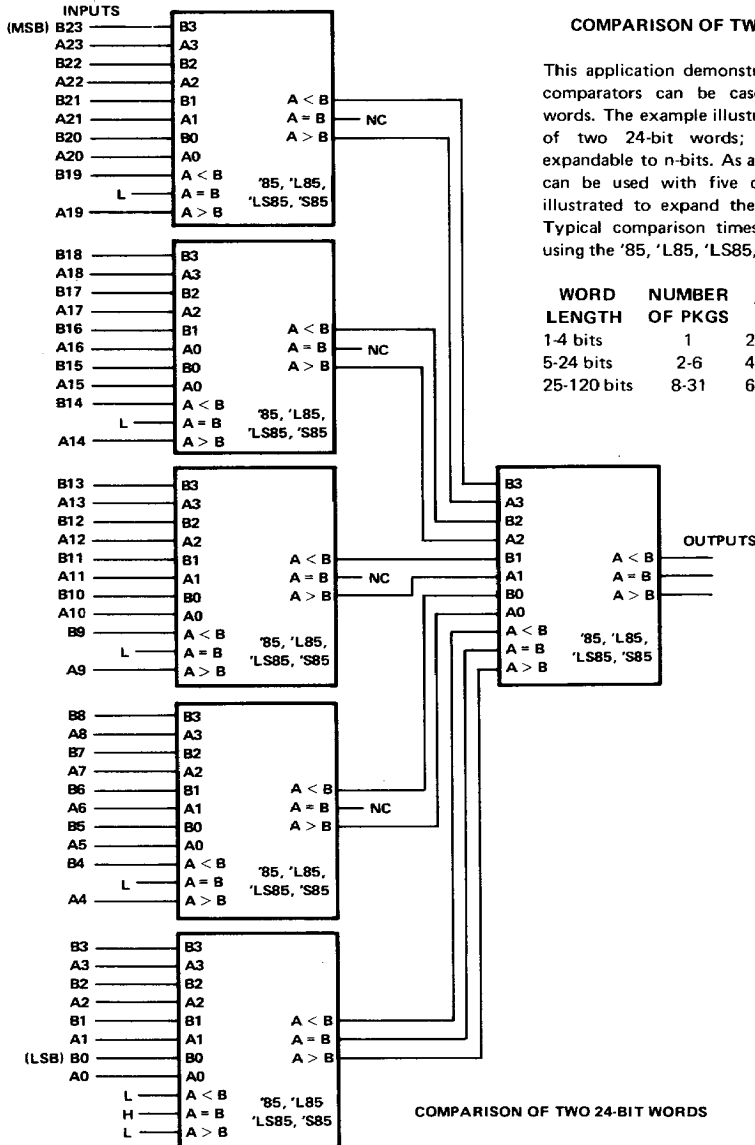
[¶] t_{PLH} = propagation delay time, low-to-high-level output

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

NOTE 5: See General Information Section for load circuits and voltage waveforms.

**TYPES SN5485, SN54L85, SN54LS85, SN54S85,
SN7485, SN74LS85, SN74S85
4-BIT MAGNITUDE COMPARATORS**

TYPICAL APPLICATION DATA



3

TTL DEVICES