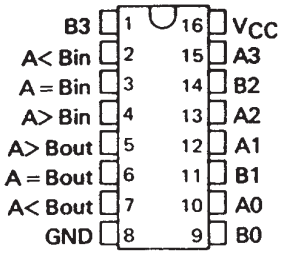
TYPE	TYPICAL POWER DISSIPATION	TYPICAL DELAY (4-BIT WORDS)
'85	275 mW	23 ns
'LS85	52 mW	24 ns
'S85	365 mW	11 ns

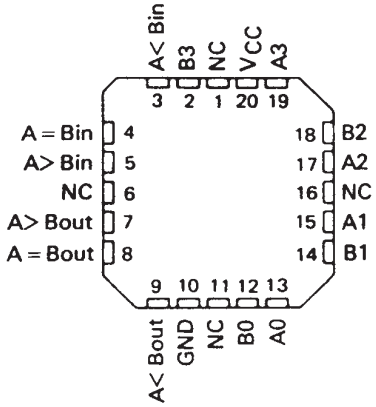
description

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. 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.

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



SN54LS85, SN54S85 . . . FK PACKAGE
(TOP VIEW)

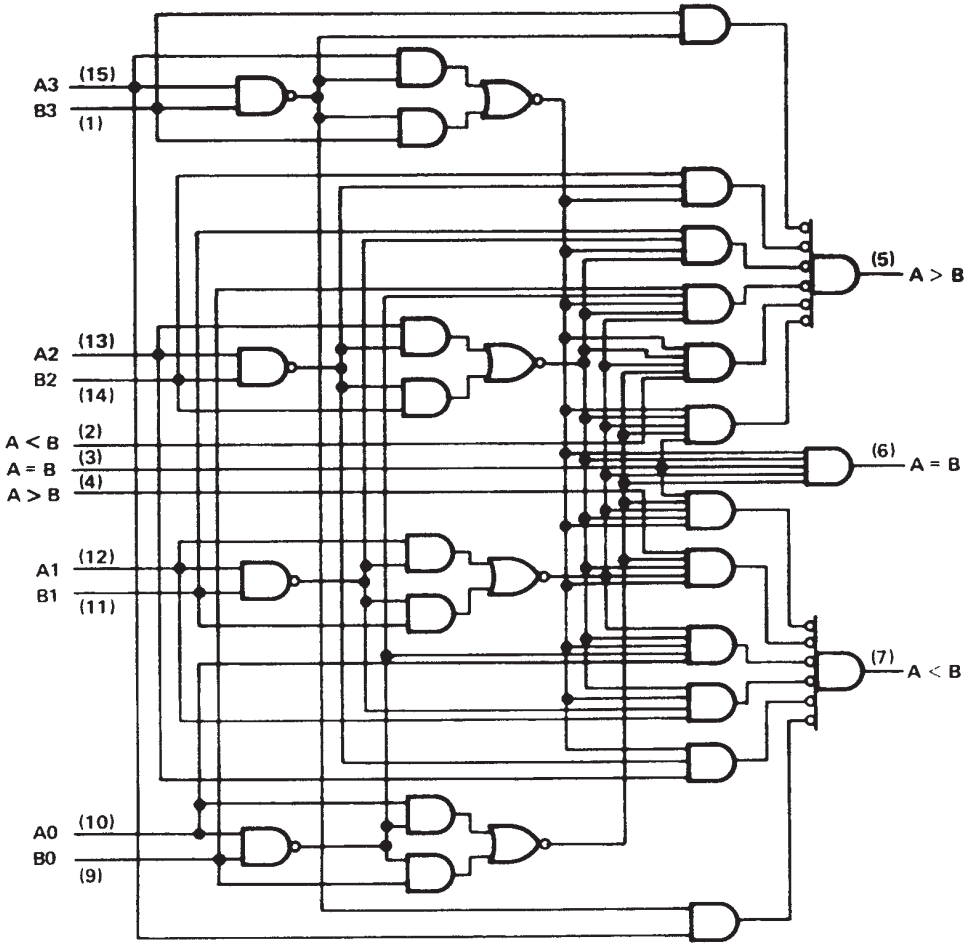


NC - No internal connection

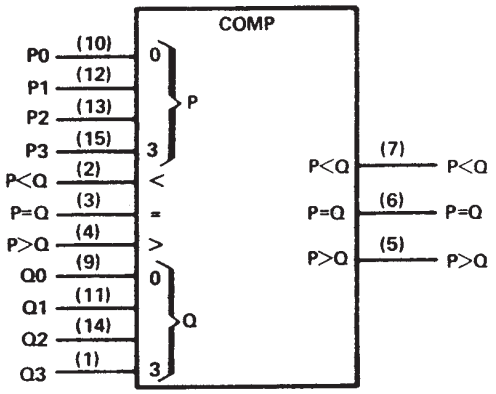
FUNCTION TABLE

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 = B2	A2 = B2	A1 > B1	X	X	X	X	H	L	L
A3 = B3	A2 = B2	A1 < B1	X	X	X	X	L	H	L
A2 = 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	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

logic diagrams (positive logic)

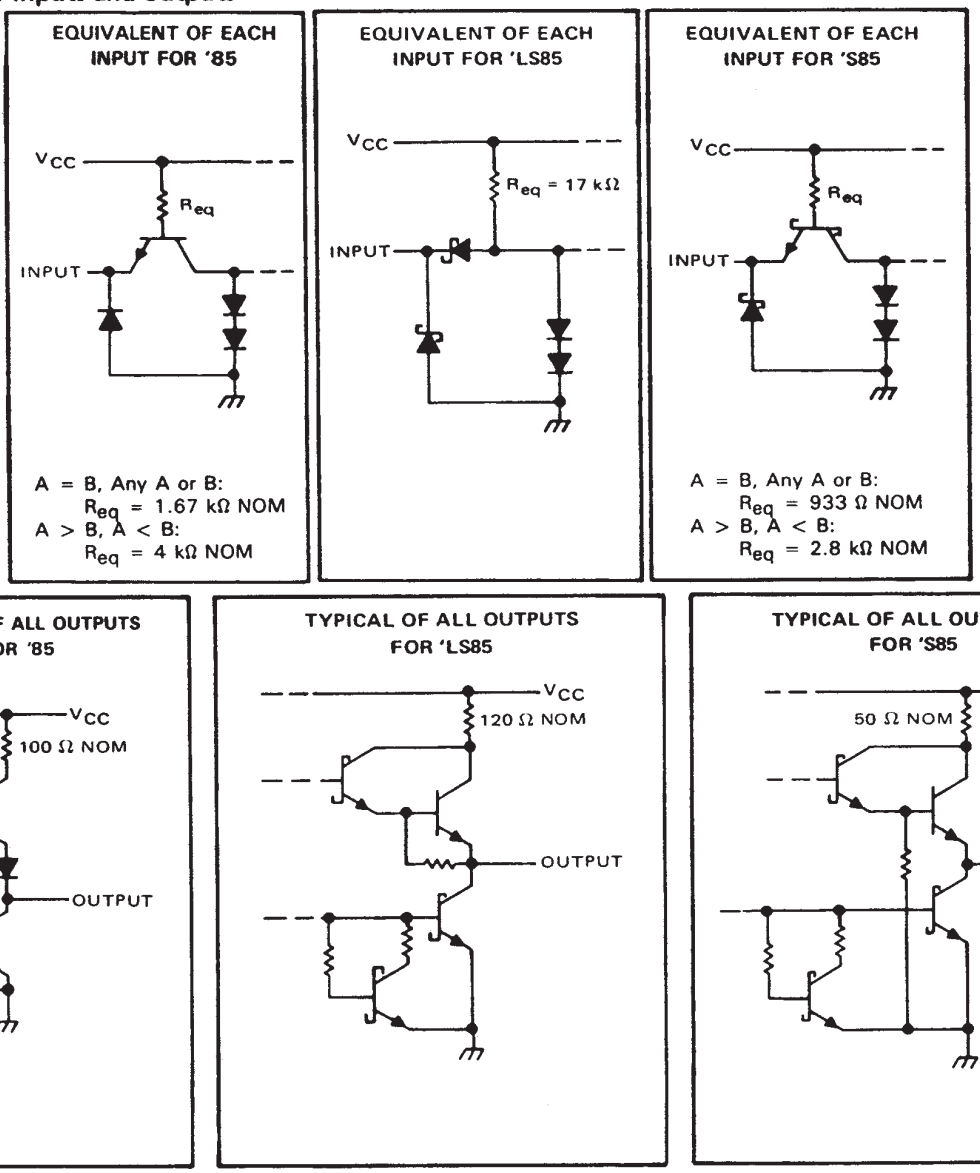


logic symbol†



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

schematics of inputs and outputs



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

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

NOTES: 1. Voltage values, except interemitter voltage, are with respect to network ground terminal.
2. 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.

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	μA
Low-level output current, I_{OL}			16			16	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} = MIN,	I_I = −12 mA				−1.5	V
V_{OH}	High-level output voltage		V_{CC} = MIN, V_{IL} = 0.8 V,	V_{IH} = 2 V, I_{OH} = −400 μA		2.4	3.4		V
V_{OL}	Low-level output voltage		V_{CC} = MIN, V_{IL} = 0.8 V,	V_{IH} = 2 V, I_{OL} = 16 mA			0.2	0.4	V
I_I	Input current at maximum input voltage		V_{CC} = MAX,	V_I = 5.5 V				1	mA
I_{IH}	High-level input current	A < B, A > B inputs	V_{CC} = MAX,	V_I = 2.4 V				40	μA
		all other inputs						120	
I_{IL}	Low-level input current	A < B, A > B inputs	V_{CC} = MAX,	V_I = 0.4 V				−1.6	mA
		all other inputs						−4.8	
I_{OS}	Short-circuit output current§		V_{CC} = MAX,	V_O = 0	SN5485	−20		−55	mA
					SN7485	−18		−55	
I_{CC}	Supply current		V_{CC} = MAX,	See Note 4			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 V, T_A = 25°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 V, T_A = 25°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 pF, R_L = 400 Ω, 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: Load circuits and voltage waveforms are shown in Section 1.

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	μA
Low-level output current, I_{OL}			4			8	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†		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} = MIN,	I_I = −18 mA			−1.5			−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	2.5	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	A < B, A > B inputs	V_{CC} = MAX,	V_I = 7 V			0.1			0.1	mA
		all other inputs					0.3			0.3	
I_{IH}	High-level input current	A < B, A > B inputs	V_{CC} = MAX,	V_I = 2.7 V			20			20	μA
		all other inputs					60			60	
I_{IL}	Low-level input current	A < B, A > B inputs	V_{CC} = MAX,	V_I = 0.4 V			−0.4			−0.4	mA
		all other inputs					−1.2			−1.2	
I_{OS}	Short-circuit output current§		V_{CC} = MAX		−20		−100	−20		−100	mA
I_{CC}	Supply current		V_{CC} = MAX,	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 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.
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 V, T_A = 25°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 pF, R_L = 2 kΩ, 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: Load circuits and voltage waveforms are shown in Section 1.

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} = MIN, I_I = −18 mA				−1.2	V
V_{OH}	High-level output voltage		V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = 0.8 V, I_{OH} = −1 mA	SN54S85	2.5	3.4		V
				SN74S85	2.7	3.4		
V_{OL}	Low-level output voltage		V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = 0.8 V, I_{OL} = 20 mA				0.5	V
I_I	Input current at maximum input voltage		V_{CC} = MAX, V_I = 5.5 V				1	mA
I_{IH}	High-level input current	A < B, A > B inputs	V_{CC} = MAX, V_I = 2.7 V				50	μA
		all other inputs					150	
I_{IL}	Low-level input current	A < B, A > B inputs	V_{CC} = MAX, V_I = 0.5 V				−2	mA
		all other inputs					−6	
I_{OS}	Short-circuit output current§		V_{CC} = MAX		−40		−100	mA
I_{CC}	Supply current		V_{CC} = MAX, See Note 4			73	115	mA
			V_{CC} = MAX, T_A = 125°C, See Note 4	SN54S85W			110	

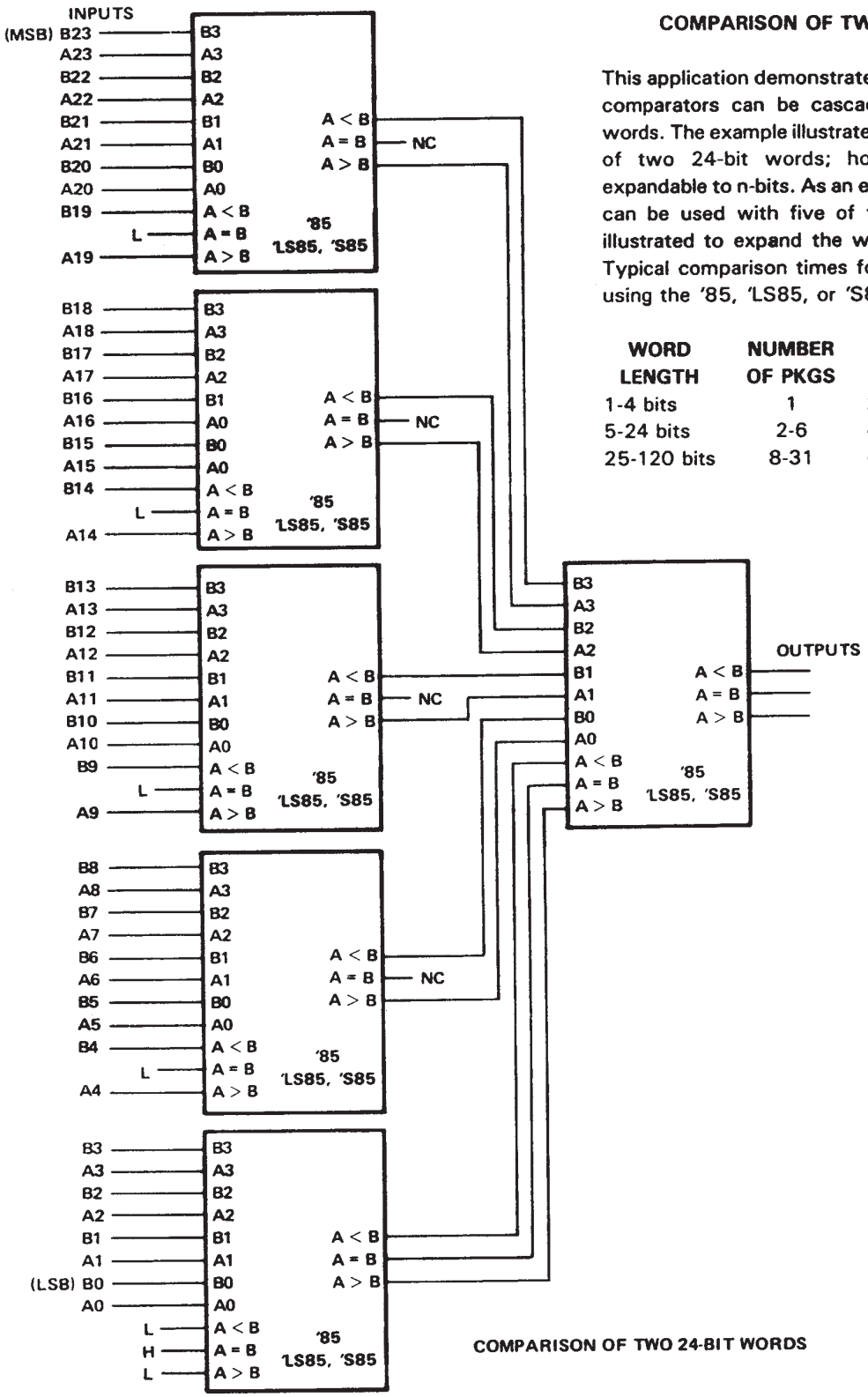
†For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
‡All typical values are at V_{CC} = 5 V, T_A = 25°C.
§Not more than one output should be shorted at a time, and duration of the short-circuit should not exceed one second.
NOTE 4: I_{CC} is measured with outputs open, A = B grounded, and all other inputs at 4.5 V.

switching characteristics, V_{CC} = 5 V, T_A = 25°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 pF, R_L = 280 Ω, See Note 5		5		ns
			2			7.5		
			3			10.5	16	
		A = B	4			12	18	
t_{PHL}	Any A or B data input	A < B, A > B	1			5.5		ns
			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: Load circuits and voltage waveforms are shown in Section 1.

TYPICAL APPLICATION DATA



COMPARISON OF TWO 24-BIT WORDS

COMPARISON OF TWO N-BIT WORDS

This application demonstrates how these magnitude comparators can be cascaded to compare longer words. The example illustrated shows the comparison of two 24-bit words; however, the design is expandable to n-bits. As an example, one comparator can be used with five of the 24-bit comparators illustrated to expand the word length to 120-bits. Typical comparison times for various word lengths using the '85, 'LS85, or 'S85 are:

WORD LENGTH	NUMBER OF PKGS	'85	'LS85	'S85
1-4 bits	1	23 ns	24 ns	11 ns
5-24 bits	2-6	46 ns	48 ns	22 ns
25-120 bits	8-31	69 ns	72 ns	33 ns

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