M74LS85P

4-BIT MAGNITUDE COMPARATOR

DESCRIPTION

The M74LS85P is a semiconductor integrated circuit containing a 4-bit digital comparator.

FEATURES

- Easy expansion of number of bits
- Binary or BCD comparison
- Wide operating temperature range (T_a=–20~+75°C)

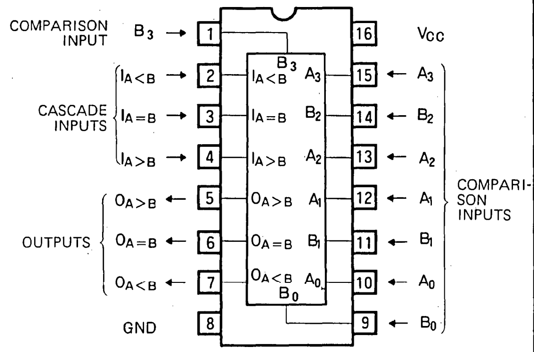
APPLICATION

General purpose, for use in industrial and consumer equipment.

FUNCTIONAL DESCRIPTION

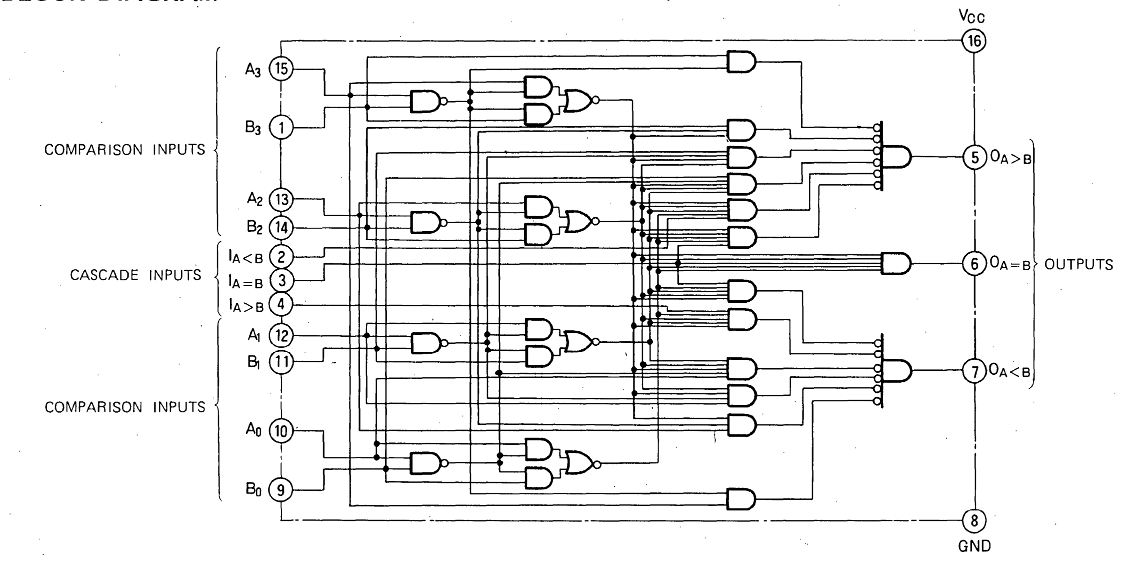
By applying two sets of 4-bit binary numbers A and B to be compared to comparison inputs A_0~A_3 and B_0~B_3 and by setting cascade input $I_{A=B}$ high, high appears in outputs $O_{A>B}$, $O_{A<B}$ and $O_{A=B}$ in accordance with the magnitude. This is used for connecting cascade inputs $I_{A>B}$, $I_{A<B}$ and $I_{A=B}$ and increasing the number of bits.
(Refer to application example)

PIN CONFIGURATION (TOP VIEW)



Outline 16P4

BLOCK DIAGRAM



4-BIT MAGNITUDE COMPARATOR

FUNCTION TABLE (Note 1)

A_3, B_3	A_2, B_2	A_1, B_1	A_0, B_0	$I_{A>B}$	$I_{A<B}$	$I_{A=B}$	$O_{A>B}$	$O_{A<B}$	$O_{A=B}$
$A_3>B_3$	X	X	X	X	X	X	H	L	L
$A_3<B_3$	X	X	X	X	X	X	L	H	L
$A_3=B_3$	$A_2>B_2$	X	X	X	X	X	H	L	L
$A_3=B_3$	$A_2<B_2$	X	X	X	X	X	L	H	L
$A_3=B_3$	$A_2=B_2$	$A_1>B_1$	X	X	X	X	H	L	L
$A_3=B_3$	$A_2=B_2$	$A_1<B_1$	X	X	X	X	L	H	L
$A_3=B_3$	$A_2=B_2$	$A_1=B_1$	$A_0>B_0$	X	X	X	H	L	L
$A_3=B_3$	$A_2=B_2$	$A_1=B_1$	$A_0<B_0$	X	X	X	L	H	L
$A_3=B_3$	$A_2=B_2$	$A_1=B_1$	$A_0=B_0$	H	L	L	H	L	L
$A_3=B_3$	$A_2=B_2$	$A_1=B_1$	$A_0=B_0$	L	H	L	L	H	L
$A_3=B_3$	$A_2=B_2$	$A_1=B_1$	$A_0=B_0$	X	X	H	L	L	H
$A_3=B_3$	$A_2=B_2$	$A_1=B_1$	$A_0=B_0$	H	H	L	L	L	L
$A_3=B_3$	$A_2=B_2$	$A_1=B_1$	$A_0=B_0$	L	L	L	H	H	L

Note 1. X : Irrelevant

ABSOLUTE MAXIMUM RATINGS (Ta = −20 ~ +75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		−0.5 ~ +7	V
V_I	Input voltage		−0.5 ~ +15	V
V_O	Output voltage	High-level state	−0.5 ~ V_{CC}	V
Topr	Operating free-air ambient temperature range		−20 ~ +75	℃
Tstg	Storage temperature range		−65 ~ +150	℃

RECOMMENDED OPERATING CONDITIONS (Ta = −20 ~ +75℃, unless otherwise noted)

Symbol	Parameter		Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage		4.75	5	5.25	V
I_{OH}	High-level output current	$V_{OH} \geqq 2.7V$	0		−400	μA
I_{OL}	Low-level output current	$V_{OL} \leqq 0.4V$	0		4	mA
		$V_{OL} \leqq 0.5V$	0		8	mA

ELECTRICAL CHARACTERISTICS (Ta = −20 ~ +75°C, unless otherwise noted)

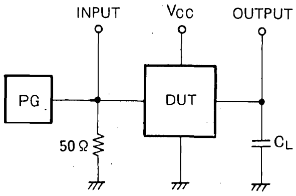
Symbol	Parameter		Test conditions		Limits			Unit
					Min	Typ *	Max	
V_{IH}	High-level input voltage				2			V
V_{IL}	Low-level input voltage						0.8	V
V_{IC}	Input clamp voltage		$V_{CC}=4.75V$, $I_{IC}=-18mA$				−1.5	V
V_{OH}	High-level output voltage		$V_{CC}=4.75V$, $V_I=0.8V$ $V_I=2V$, $I_{OH}=-400\mu A$		2.7	3.4		V
V_{OL}	Low-level output voltage		$V_{CC}=4.75V$	$I_{OL}=4mA$		0.25	0.4	V
			$V_I=0.8V$, $V_I=2V$	$I_{OL}=8mA$		0.35	0.5	V
I_{IH}	High-level input current	$I_{A<B}$, $I_{A>B}$	$V_{CC}=5.25V$				20	μA
		$A_0 \sim A_3, B_0 \sim B_3, I_{A=B}$	$V_I=2.7V$				60	μA
		$I_{A<B}$, $I_{A>B}$	$V_{CC}=5.25V$				0.1	mA
		$A_0 \sim A_3, B_0 \sim B_3, I_{A=B}$	$V_I=10V$				0.3	mA
I_{IL}	Low-level input current	$I_{A<B}$, $I_{A>B}$	$V_{CC}=5.25V$				−0.4	mA
		$A_0 \sim A_3, B_0 \sim B_3, I_{A=B}$	$V_I=0.4V$				−1.2	mA
I_{OS}	Short-circuit output current (Note 2)		$V_{CC}=5.25V$, $V_O=0V$		−20		−100	mA
I_{CC}	Supply current		$V_{CC}=5.25V$ (Note 3)			11	20	mA

* : All typical values are at $V_{CC}=5V$, $T_a=25°C$.
Note 2: All measurements must be done quickly and not more than output should be shorted at a time.
Note 3: I_{CC} is measured with $I_{A=B}$ at 0V and with all other inputs at 4.5V.

SWITCHING CHARACTERISTICS (V_{CC}=5V, Ta=25°C, unless otherwise noted)

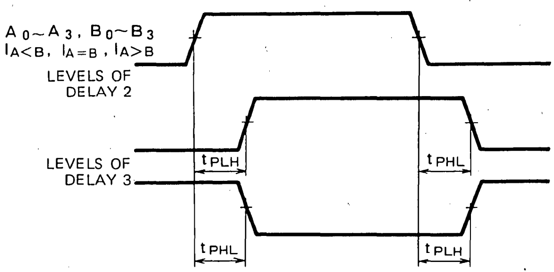
Symbol	Parameter		Test conditions	Limits Min	Limits Typ	Limits Max	Unit
t_{PLH}	Low-to-high-level, high-to-low-level output propagation time, from inputs, $A_0 \sim A_3$, $B_0 \sim B_3$ to outputs $O_{A<B}$, $O_{A=B}$, $O_{A>B}$	Number of delay gate steps 1	C_L = 15pF (Note 4)		6		ns
t_{PHL}					11		ns
t_{PLH}		Number of delay gate steps 2			10		ns
t_{PHL}					18		ns
t_{PLH}		Number of delay gate steps 3			12	36	ns
t_{PHL}					20	30	ns
t_{PLH}	Low-to-high-level, high-to-low-level output propagation time, from inputs $A_0 \sim A_3$, $B_0 \sim B_3$ to outputs $O_{A<B}$, $O_{A=B}$, $O_{A>B}$				16	45	ns
t_{PHL}					20	45	ns
t_{PLH}	Low-to-high-level, high-to-low-level output propagation time, from input $I_{A=B}$ to outputs $O_{A<B}$, $O_{A>B}$				6	22	ns
t_{PHL}					12	17	ns
t_{PLH}	Low-to-high-level, high-to-low-level output propagation time, from input $I_{A=B}$ to output $O_{A=B}$				7	20	ns
t_{PHL}					13	26	ns
t_{PLH}	Low-to-high-level, high-to-low-level output propagation time, from inputs $I_{A<B}$, $I_{A>B}$ to outputs $O_{A<B}$, $O_{A=B}$, $O_{A>B}$				9	22	ns
t_{PHL}					15	17	ns

Note 4: Measurement circuit



(1) The pulse generator (PG) has the following characteristics: PRR = 1MHz, t_r = 6ns, t_f = 6ns, t_w = 500ns, V_P=3V_{P-P}, Z_O = 50Ω.
(2) C_L includes probe and jig capacitance.

TIMING DIAGRAM (Reference level = 1.3V)



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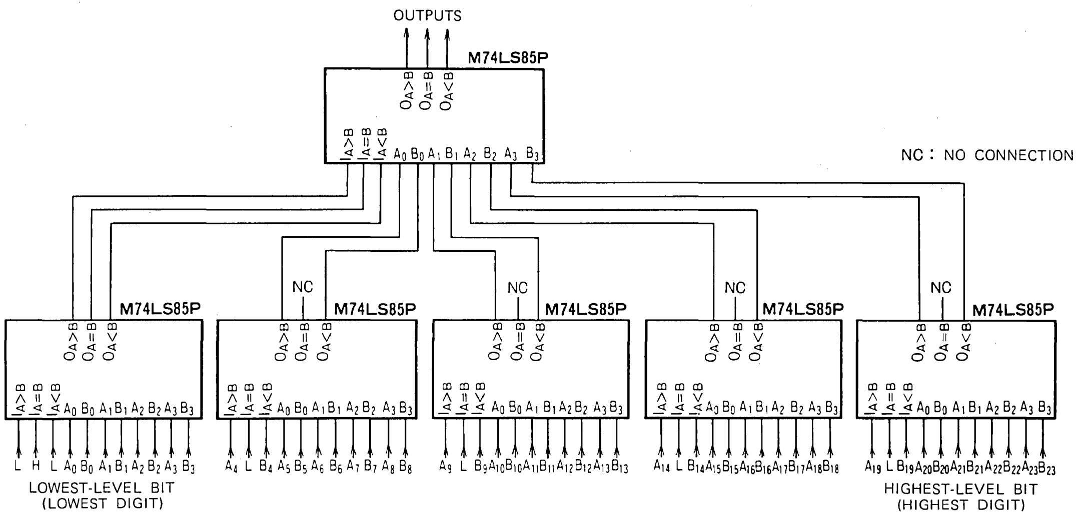
APPLICATION EXAMPLES

(1) Shown below is a 24-bit (digital) comparator using the M74LS85P. Expansion is possible up to n bits using this type of cascade connection.



NC : NO CONNECTION

(2) Shown below is an n-bit comparator using the M74LS85P. The speed is decreases as the number of bits in the configuration below increases. configuration below.