## 54LS85/DM54LS85/DM74LS85 4-Bit Magnitude Comparators

## **General Description**

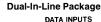
These 4-bit magnitude comparators perform comparison of straight binary or BCD codes. Three fully-decoded decisions about two, 4-bit words (A, B) are made and are externally available at three outputs. These devices are fully expandable to any number of bits without external gates. Words of greater length 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 inputs of the next stage handling more-significant bits. The stage handling the least-significant bits must

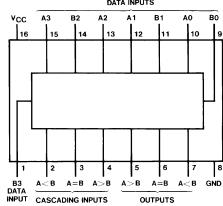
have a high-level voltage applied to the A = B input. The cascading path is implemented with only a two-gate-level delay to reduce overall comparison times for long words.

#### **Features**

- Typical power dissipation 52 mW
- Typical delay (4-bit words) 24 ns
- Alternate Military/Aerospace device (54LS85) is available. Contact a National Semiconductor Sales Office/ Distributor for specifications.

#### **Connection Diagram**





Order Number 54LS85DMQB, 54LS85FMQB, 54LS85LMQB, DM54LS85J, DM54LS85W, DM74LS85M or DM74LS85N See NS Package Number E20A, J16A, M16A, N16E or W16A

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## **Function Table**

Comparing Inputs				Cascading Inputs			Outputs		
A3, B3	A2, B2	A1, B1	A0, B0	<b>A</b> > <b>B</b>	$\mathbf{A} < \mathbf{B}$	$\mathbf{A} = \mathbf{B}$	<b>A</b> > <b>B</b>	$\mathbf{A} < \mathbf{B}$	$\mathbf{A} = \mathbf{B}$
A3 > B3	X	×	X	Х	Χ	Χ	Н	L	L
A3 < B3	X	X	X	Х	Χ	X	L	Н	L
A3 = B3	A2 > B2	X	X	Х	Χ	X	Н	L	L
A3 = B3	A2 < B2	X	X	Х	Χ	X	L	Н	L
A3 = B3	A2 = B2	A1 > B1	X	Х	Χ	X	Н	L	L
A3 = B3	A2 = B2	A1 < B1	X	Х	Χ	X	L	Н	L
A3 = B3	A2 = B2	A1 = B1	A0 > B0	Х	Χ	X	Н	L	L
A3 = B3	A2 = B2	A1 = B1	A0 < B0	Х	Χ	X	L	Н	L
A3 = B3	A2 = B2	A1 = B1	A0 = B0	Н	L	L	Н	L	L
A3 = B3	A2 = B2	A1 = B1	A0 = B0	L	Н	L	L	Н	L
A3 = B3	A2 = B2	A1 = B1	A0 = B0	L	L	Н	L	L	Н
A3 = B3	A2 = B2	A1 = B1	A0 = B0	Х	Χ	Н	L	L	Н
A3 = B3	A2 = B2	A1 = B1	A0 = B0	Н	Н	L	L	L	L
A3 = B3	A2 = B2	A1 = B1	A0 = B0	L	L	L	Н	Н	L

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54LS85/DM54LS85/DM74LS85 4-Bit Magnitude Comparators

## **Absolute Maximum Ratings (Note)**

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Voltage 7V
Input Voltage 7V
Operating Free Air Temperature Range

 $\begin{array}{ccc} {\rm DM54LS~and~54LS} & & -55^{\circ}{\rm C~to} + 125^{\circ}{\rm C} \\ {\rm DM74LS} & & 0^{\circ}{\rm C~to} + 70^{\circ}{\rm C} \end{array}$ 

Storage Temperature Range  $-65^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$ 

Note: The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the "Electrical Characteristics" table are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

## **Recommended Operating Conditions**

Symbol 4U.com	Parameter	DM54LS85				Units		
	i didilictei	Min	Nom	Max	Min	Nom	Max	
V <sub>CC</sub>	Supply Voltage	4.5	5	5.5	4.75	5	5.25	٧
V <sub>IH</sub>	High Level Input Voltage	2			2			٧
V <sub>IL</sub>	Low Level Input Voltage			0.7			0.8	٧
Іон	High Level Output Current			-0.4			-0.4	mA
l <sub>OL</sub>	Low Level Output Current			4			8	mA
T <sub>A</sub>	Free Air Operating Temperature	-55		125	0		70	°C

## Electrical Characteristics over recommended operating free air temperature range (unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ (Note 1)	<b>Max</b> −1.5	Units V	
VI	Input Clamp Voltage	$V_{CC} = Min, I_I = -18 \text{ mA}$					
V <sub>OH</sub>	High Level Output	$V_{CC} = Min, I_{OH} = Max$	DM54	2.5	3.4		V
	Voltage	$V_{IL} = Max, V_{IH} = Min$	DM74	2.7	3.4		
V <sub>OL</sub>	Low Level Output	V <sub>CC</sub> = Min, I <sub>OL</sub> = Max	DM54		0.25	0.4	V
	Voltage	$V_{IL} = Max, V_{IH} = Min$	DM74		0.35	0.5	
		$I_{OL} = 4 \text{ mA}, V_{CC} = \text{Min}$	DM74		0.25	0.4	
I <sub>I</sub>	Input Current @ Max	V <sub>CC</sub> = Max	A < B			0.1	mA
	Input Voltage	$V_I = 7V$	A > B			0.1	
			Others			0.3	
I <sub>IH</sub>	High Level Input	V <sub>CC</sub> = Max	A < B			20	μΑ
	Current	$V_I = 2.7V$	A > B			20	
			Others			60	
I <sub>IL</sub>	Low Level Input	V <sub>CC</sub> = Max	A < B			-0.4	mA
	Current	$V_I = 0.4V$	A > B			-0.4	
			Others			-1.2	
los	Short Circuit	V <sub>CC</sub> = Max	DM54	-20		-100	mA
	Output Current	(Note 2)	DM74	-20		-100	
Icc	Supply Current	V <sub>CC</sub> = Max (Note 3)	•		10	20	mA

Note 1: All typicals are at  $V_{CC} = 5V$ ,  $T_A = 25^{\circ}C$ .

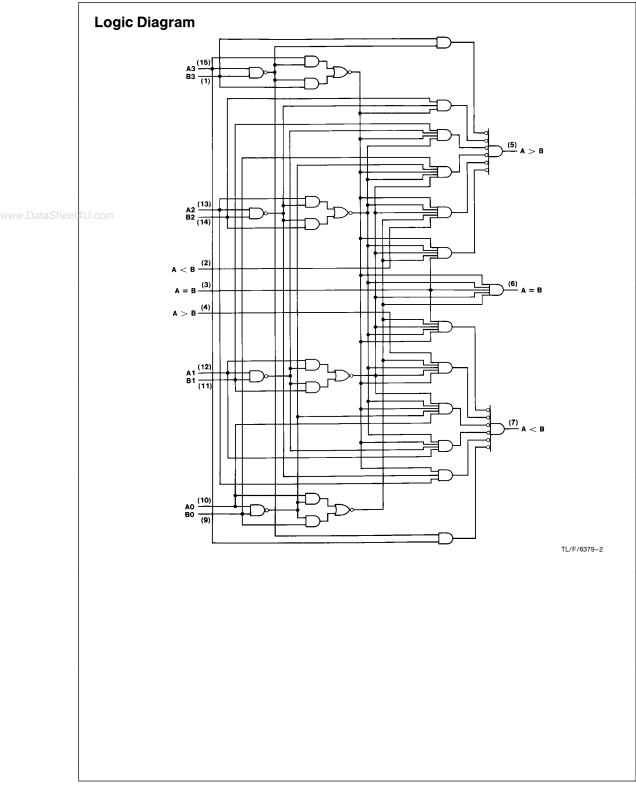
Note 2: Not more than one output should be shorted at a time, and the duration should not exceed one second.

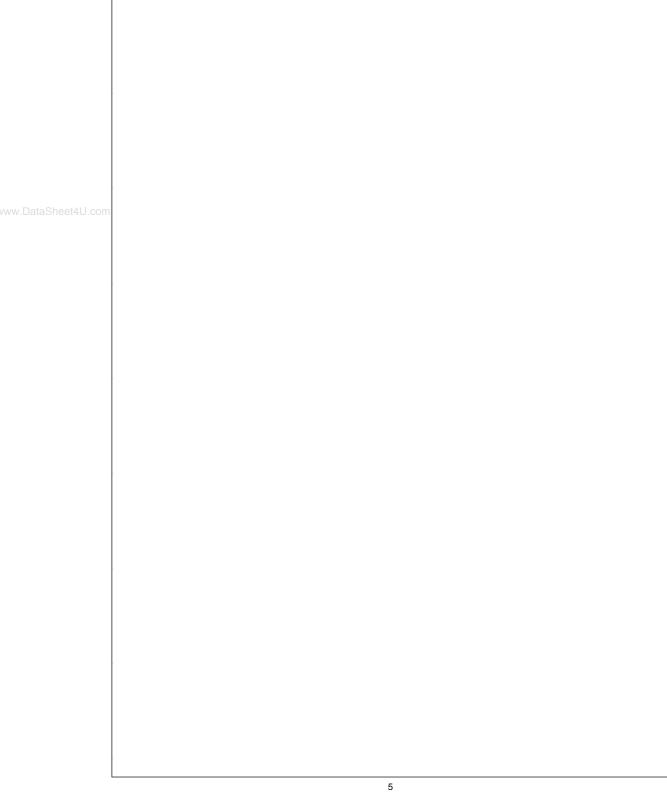
Note 3:  $I_{CC}$  is measured with all outputs open, A = B grounded and all other inputs at 4.5V.

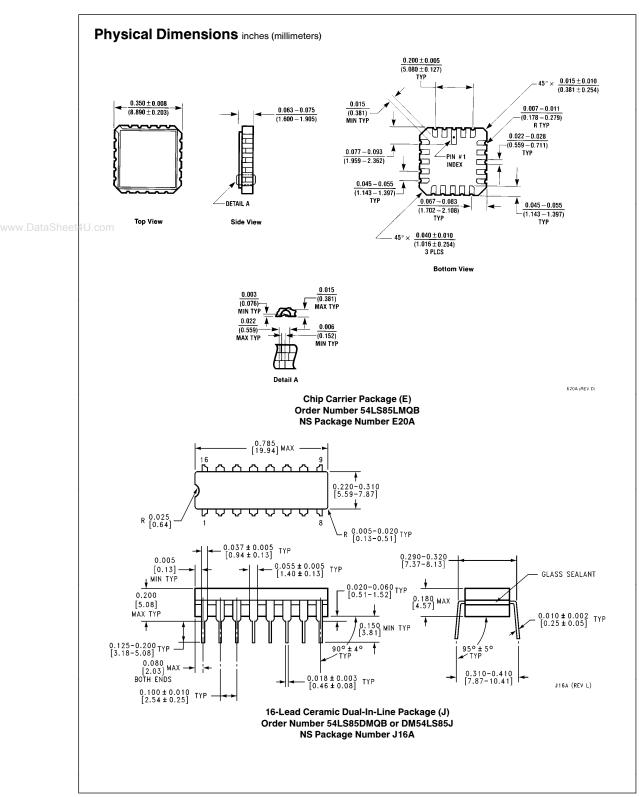
# $\textbf{Switching Characteristics} \text{ at V}_{CC} = 5 \text{V and T}_{A} = 25^{\circ}\text{C (See Section 1 for Test Waveforms and Output Load)}$

		From Input	To Output	Number of Gate Levels					
Symbol	Parameter				C <sub>L</sub> = 15 pF		C <sub>L</sub> = 50 pF		Units
					Min	Max	Min	Max	
t <sub>PLH</sub>	Propagation Delay Time Low-to-High Level Output	Any A or B Data Input	A < B, A > B	3		36		42	ns
			A = B	4		40		40	
t <sub>PHL</sub>	Propagation Delay Time High-to-Low Level Output	Any A or B Data Input	A < B, A > B	3		30		40	ns
			A = B	4		30		40	
t <sub>PLH</sub>	Propagation Delay Time Low-to-High Level Output	A < B or A = B	A > B	1		22		26	ns
t <sub>PHL</sub>	Propagation Delay Time High-to-Low Level Output	A < B or A = B	A > B	1		17		26	ns
t <sub>PLH</sub>	Propagation Delay Time Low-to-High Level Output	A = B	A = B	2		20		25	ns
t <sub>PHL</sub>	Propagation Delay Time High-to-Low Level Output	A = B	A = B	2		17		26	ns
t <sub>PLH</sub>	Propagation Delay Time Low-to-High Level Output	A > B or A = B	A < B	1		22		26	ns
t <sub>PHL</sub>	Propagation Delay Time High-to-Low Level Output	A > B or A = B	A < B	1		17		26	ns

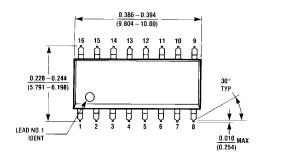
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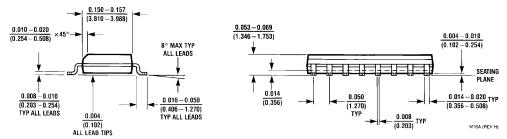




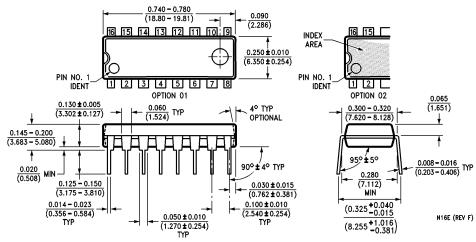
## Physical Dimensions inches (millimeters) (Continued)



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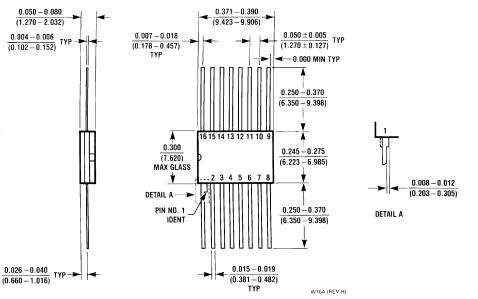


16-Lead Small Outline Molded Package (M) Order Number DM74LS85M NS Package Number M16A



16-Lead Molded Dual-In-Line Package (N) Order Number DM74LS85N NS Package Number N16E

## Physical Dimensions inches (millimeters) (Continued)



16-Lead Ceramic Flat Package (W) Order Number 54LS85FMQB or DM54LS85W NS Package Number W16A

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