

October 1988 Revised March 2000

DM74LS47

BCD to 7-Segment Decoder/Driver with Open-Collector Outputs

General Description

The DM74LS47 accepts four lines of BCD (8421) input data, generates their complements internally and decodes the data with seven AND/OR gates having open-collector outputs to drive indicator segments directly. Each segment output is guaranteed to sink 24 mA in the ON (LOW) state and withstand 15V in the OFF (HIGH) state with a maximum leakage current of 250 μA . Auxiliary inputs provided blanking, lamp test and cascadable zero-suppression functions.

Features

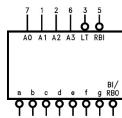
- Open-collector outputs
- Drive indicator segments directly
- Cascadable zero-suppression capability
- Lamp test input

Ordering Code:

Order Number	Package Number	age Number Package Description							
DM74LS47M	M16A	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150 Narrow							
DM74LS47N	N16E	16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300 Wide							

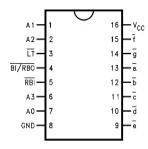
Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

Logic Symbol



V_{CC} = Pin 16 GND = Pin 8

Connection Diagram



Pin Descriptions

Pin Names	Description
A0-A3	BCD Inputs
RBI	Ripple Blanking Input (Active LOW)
ĪŢ	Lamp Test Input (Active LOW)
BI/RBO	Blanking Input (Active LOW) or
	Ripple Blanking Output (Active LOW)
a –g	Segment Outputs (Active LOW) (Note 1)

Note 1: OC—Open Collector

Truth Table

Decimal	-aimal							T							
or	Inputs						Outputs							Note	
Function	LT	RBI	А3	A2	A1	Α0	BI/RBO	a	b	c	d	e	f	g	1
0	Н	Н	L	L	L	L	Н	L	L	L	L	L	L	Н	(Note 2)
1	Н	Х	L	L	L	Н	н	Н	L	L	Н	Н	Н	Н	(Note 2)
2	Н	Х	L	L	Н	L	Н	L	L	Н	L	L	Н	L	
3	Н	Х	L	L	Н	Н	Н	L	L	L	L	Н	Н	L	
4	Н	×	L	Н	L	L	н	Н	L	L	Н	Н	L	L	
5	Н	X	L	Н	L	Н	н	L	Н	L	L	Н	L	L	
6	Н	X	L	Н	Н	L	н	Н	Н	L	L	L	L	L	
7	Н	X	L	Н	Н	Н	н	L	L	L	Н	Н	Н	Н	
8	Н	x	Н	L	L	L	Н	L	L	L	L	L	L	L	
9	Н	X	Н	L	L	Н	н	L	L	L	Н	Н	L	L	
10	Н	X	Н	L	Н	L	н	Н	Н	Н	L	L	Н	L	
11	Н	Х	Н	L	Н	Н	н	Н	Н	L	L	Н	Н	L	
12	Н	Х	н	Н	L	L	н	Н	L	Н	Н	Н	L	L	
13	Н	x	н	Н	L	Н	Н	L	Н	Н	L	Н	L	L	
14	Н	×	Н	Н	Н	L	н	Н	Н	Н	L	L	L	L	
15	Н	X	н	Н	Н	Н	н	Н	Н	Н	Н	Н	Н	Н	
BI	Х	X	X	Х	Х	Х	L	Н	Н	Н	Н	Н	Н	Н	(Note 3)
RBI	Н	L	L	L	L	L	L	Н	Н	Н	Н	Н	Н	Н	(Note 4)
ΙΤ	L	X	X	X	X	Χ	н	L	L	L	L	L	L	L	(Note 5)

Note 2: $\overline{BI/RBO}$ is wire-AND logic serving as blanking input (\overline{BI}) and/or ripple-blanking output (\overline{RBO}) . The blanking out (\overline{BI}) must be open or held at a HIGH level when output functions 0 through 15 are desired, and ripple-blanking input (\overline{RBI}) must be open or at a HIGH level if blanking or a decimal 0 is not desired. X = input may be HIGH or LOW.

Note 3: When a LOW level is applied to the blanking input (forced condition) all segment outputs go to a HIGH level regardless of the state of any other input condition

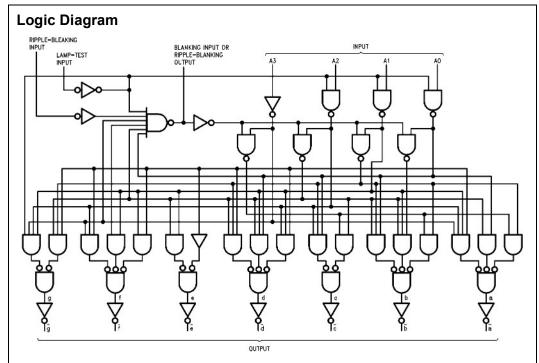
Note 4: When ripple-blanking input (RBI) and inputs A0, A1, A2 and A3 are LOW level, with the lamp test input at HIGH level, all segment outputs go to a HIGH level and the ripple-blanking output (RBO) goes to a LOW level (response condition).

Note 5: When the blanking input/ripple-blanking output (\$\overline{BI/RBO}\$) is OPEN or held at a HIGH level, and a LOW level is applied to lamp test input, all segment outputs go to a LOW level.

Functional Description

The DM74LS47 decodes the input data in the pattern indicated in the Truth Table and the segment identification illustration. If the input data is decimal zero, a LOW signal applied to the $\overline{\text{RBI}}$ blanks the display and causes a multidigit display. For example, by grounding the $\overline{\text{RBI}}$ of the highest order decoder and connecting its $\overline{\text{BI}}/\overline{\text{RBO}}$ to $\overline{\text{RBI}}$ of the next lowest order decoder, etc., leading zeros will be suppressed. Similarly, by grounding $\overline{\text{RBI}}$ of the lowest order decoder and connecting its $\overline{\text{BI}}/\overline{\text{RBO}}$ to $\overline{\text{RBI}}$ of the next highest order decoder, etc., trailing zeros will be suppressed. Leading and trailing zeros can be suppressed $\overline{\text{sim}}$ ultaneously by using external gates, i.e.: by driving $\overline{\text{RBI}}$ of a

intermediate decoder from an OR gate whose inputs are $\overline{BI/RBO}$ of the next highest and lowest order decoders. $\overline{BI/RBO}$ also serves as an unconditional blanking input. The internal NAND gate that generates the \overline{RBO} signal has a resistive pull-up, as opposed to a totem pole, and thus $\overline{BI/RBO}$ can be forced LOW by external means, using wired-collector logic. A LOW signal thus applied to $\overline{BI/RBO}$ turns off all segment outputs. This blanking feature can be used to control display intensity by varying the duty cycle of the blanking signal. A LOW signal applied to \overline{LT} turns on all segment outputs, provided that $\overline{BI/RBO}$ is not forced LOW.



Numerical Designations—Resultant Displays



Absolute Maximum Ratings(Note 6)

Supply Voltage 7V Input Voltage 7V Operating Free Air Temperature Range $0^{\circ}\text{C to } +70^{\circ}\text{C}$ Storage Temperature Range $-65^{\circ}\text{C to } +150^{\circ}\text{C}$

Note 6: 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 tables 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	Parameter	Min	Nom	Max	Units
V _{CC}	Supply Voltage	4.75	5	5.25	V
V _{IH}	HIGH Level Input Voltage	2			V
V _{IL}	LOW Level Input Voltage			0.8	V
I _{OH}	HIGH Level Output Current $\overline{a} - \overline{g}$ @ 15V = V _{OH} (Note 7)			-250	μΑ
I _{OH}	HIGH Level Output Current BI /RBO			-50	μΑ
I _{OL}	LOW Level Output Current			24	mA
T _A	Free Air Operating Temperature	0		70	°C

Note 7: OFF-State at a-g.

Electrical Characteristics

Over recommended operating free air temperature range (unless otherwise noted)

Symbol	Parameter Parameter	Conditions	Min	Typ (Note 8)	Max	Units	
V _I	Input Clamp Voltage	V _{CC} = Min, I _I = -18 mA		· ·	-1.5	V	
V _{OH}	HIGH Level Output Voltage	$V_{CC} = Min, I_{OH} = Max,$ $V_{II} = Max, \overline{BI} / \overline{RBO}$	2.7	3.4		V	
I _{OFF}	Output HIGH Current Segment Outputs	$V_{CC} = 5.5V, V_O = 15V \overline{a} - \overline{g}$			250	μА	
V _{OL}	LOW Level Output Voltage	$V_{CC} = Min, I_{OL} = Max,$ $V_{IH} = Min, \overline{a} - \overline{g}$		0.35	0.5		
		I _{OL} = 3.2 mA, BI /RBO			0.5	V	
		$I_{OL} = 12 \text{ mA}, \overline{a} - \overline{g}$		0.25	0.4		
		I _{OL} = 1.6 mA, BI /RBO			0.4		
l _l	Input Current @ Max Input Voltage	$V_{CC} = Max, V_I = 7V$ $V_{CC} = Max, V_I = 10V$			100	μА	
I _{IH}	HIGH Level Input Current	V _{CC} = Max, V _I = 2.7V			20	μА	
I _{IL}	LOW Level Input Current	V _{CC} = Max, V _I = 0.4V			-0.4	mA	
los	Short Circuit	V _{CC} = Max (Note 9),				mA	
	Output Current	I _{OS} at BI/RBO	-0.3		-2.0	"	
I _{CC}	Supply Current	V _{CC} = Max			13	mA	

Note 8: All typicals are at $V_{CC} = 5V$, $T_A = 25^{\circ}C$.

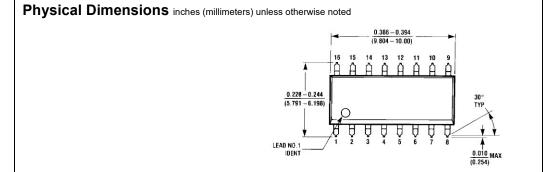
Note 9: Not more than one output should be shorted at a time, and the duration should not exceed one second.

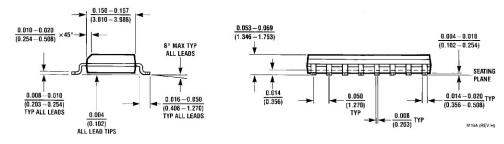
Switching Characteristics

at $V_{CC} = +5.0V$, $T_A = +25^{\circ}C$

	Parameter	Conditions	R _L =	Units		
Symbol			C _L =			
			Min	Max		
t _{PLH}	Propagation Delay			100	no	
t_{PHL}	An to a –g			100	ns	
t _{PLH}	Propagation Delay			100		
t _{PHL}	RBI to a -g (Note 10)			100	ns	

Note 10: $\overline{\text{LT}} = \text{HIGH}$, A0–A3 = LOW





16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150 Narrow Package Number M16A

Physical Dimensions inches (millimeters) unless otherwise noted (Continued) 0.740 - 0.780 0.090 (18.80 - 19.81)(2.286)**16 15 14 13 12 11 10 9** 16 [15] INDEX AREA 0.250 ± 0.010 (6.350 ± 0.254) PIN NO. 1 PIN NO. 1 1 2 3 4 5 6 7 8 1 2 IDENT OPTION 01 OPTION 02 0.065 (1.651) $\frac{0.130 \pm 0.005}{(3.302 \pm 0.127)}$ $\frac{0.060}{(1.524)}$ TYP 4° TYP OPTIONAL 0.300 - 0.320 (7.620 - 8.128)0.145 - 0.200 $\overline{(3.683 - 5.080)}$ 95° ± 5° $\frac{0.008 - 0.016}{(0.203 - 0.406)}$ TYP $\frac{0.020}{(0.508)}$ $\frac{0.280}{(7.112)}$ 0.125 - 0.150 (3.175 - 3.810) $\frac{0.030 \pm 0.015}{(0.762 \pm 0.381)}$ 0.014 = 0.023 (0.356 = 0.584) 0.100 ± 0.010 (0.325 +0.040 -0.015 0.050 ± 0.010 (2.540 ± 0.254) N16E (REV F) TYP (1.270 ± 0.254)

16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300 Wide Package Number N16E

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