SN74LS47

BCD to 7-Segment Decoder/Driver

The SN74LS47 are Low Power Schottky BCD to 7-Segment Decoder/Drivers consisting of NAND gates, input buffers and seven AND-OR-INVERT gates. They offer active LOW, high sink current outputs for driving indicators directly. Seven NAND gates and one driver are connected in pairs to make BCD data and its complement available to the seven decoding AND-OR-INVERT gates. The remaining NAND gate and three input buffers provide lamp test, blanking input/ripple-blanking output and ripple-blanking input.

The circuits accept 4-bit binary-coded-decimal (BCD) and, depending on the state of the auxiliary inputs, decodes this data to drive a 7-segment display indicator. The relative positive-logic output levels, as well as conditions required at the auxiliary inputs, are shown in the truth tables. Output configurations of the SN74LS47 are designed to withstand the relatively high voltages required for 7-segment indicators.

These outputs will withstand 15 V with a maximum reverse current of 250 μA. Indicator segments requiring up to 24 mA of current may be driven directly from the SN74LS47 high performance output transistors. Display patterns for BCD input counts above nine are unique symbols to authenticate input conditions.

The SN74LS47 incorporates automatic leading and/or trailing-edge zero-blanking control (RBI and RBO). Lamp test (LT) may be performed at any time which the BI/RBO node is a HIGH level. This device also contains an overriding blanking input (BI) which can be used to control the lamp intensity by varying the frequency and duty cycle of the BI input signal or to inhibit the outputs.

- Lamp Intensity Modulation Capability (BI/RBO)
- Open Collector Outputs
- Lamp Test Provision
- Leading/Trailing Zero Suppression
- Input Clamp Diodes Limit High-Speed Termination Effects

GUARANTEED OPERATING RANGES

Symbol	Parameter	Min	Typ	Max	Unit
V_{CC}	Supply Voltage	4.75	5.0	5.25	V
T_A	Operating Ambient Temperature Range	0	25	70	°C
I_{OH}	Output Current – High $\overline{BI/RBO}$			–50	μA
I_{OL}	Output Current – Low $\overline{BI/RBO}$ $\overline{BI/RBO}$			3.2	mA
$V_{O(off)}$	Off–State Output Voltage a to g			15	V
$I_{O(on)}$	On–State Output Current a to g			24	mA

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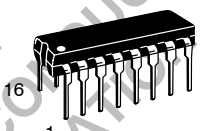
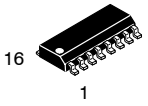
LOW POWER SCHOTTKY



PLASTIC N SUFFIX CASE 648

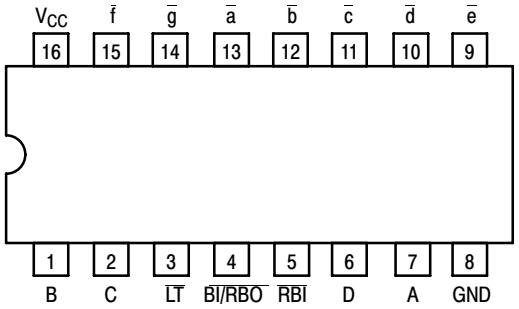


SOIC D SUFFIX CASE 751B

ORDERING INFORMATION

Device	Package	Shipping
SN74LS47N	16 Pin DIP	2000 Units/Box
SN74LS47D	16 Pin	2500/Tape & Reel

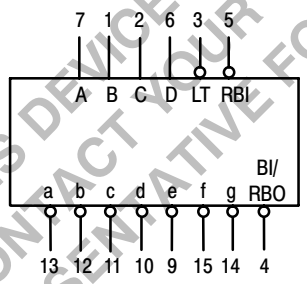
CONNECTION DIAGRAM DIP (TOP VIEW)



PIN NAMES		LOADING (Note a) HIGH	LOW
A, B, C, D	BCD Inputs	0.5 U.L.	0.25 U.L.
$\overline{RBI}$	Ripple-Blanking Input	0.5 U.L.	0.25 U.L.
$\overline{LT}$	Lamp-Test Input	0.5 U.L.	0.25 U.L.
$\overline{BI/RBO}$	Blanking Input or	0.5 U.L.	0.75 U.L.
	Ripple-Blanking Output	1.2 U.L.	2.0 U.L.
$\overline{a}$, to $\overline{g}$	Outputs	Open-Collector	15 U.L.

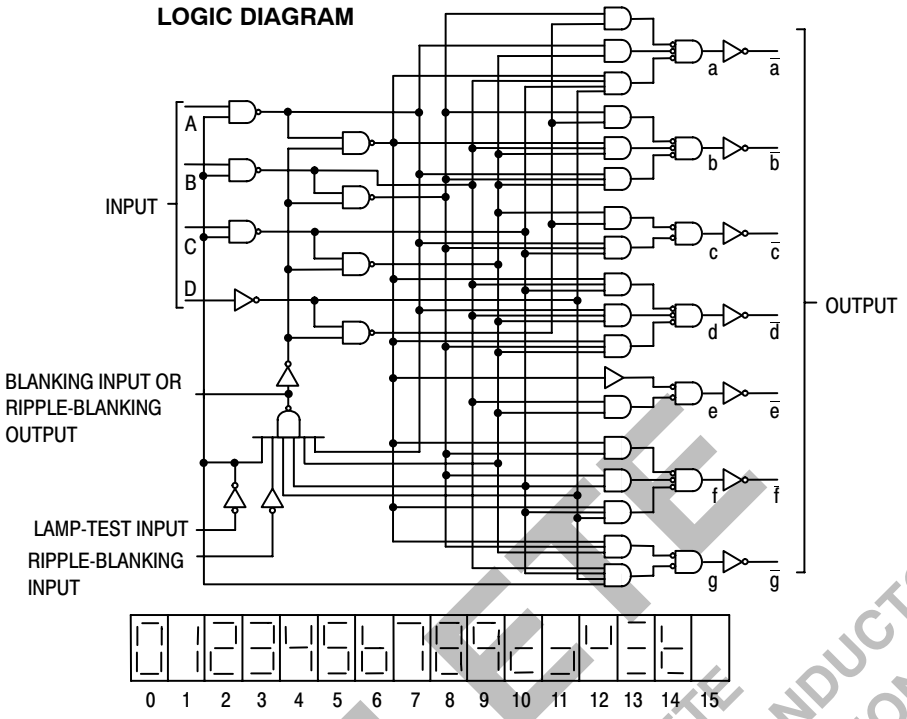
NOTES:
a) 1 Unit Load (U.L.) = 40 μA HIGH, 1.6 mA LOW.
b) Output current measured at V_{OUT} = 0.5 V
The Output LOW drive factor is 15 U.L. for Commercial (74) Temperature Ranges.

LOGIC SYMBOL



V_{CC} = PIN 16
GND = PIN 8

LOGIC DIAGRAM



NUMERICAL DESIGNATIONS — RESULTANT DISPLAYS

TRUTH TABLE

DECIMAL OR FUNCTION	INPUTS							OUTPUTS							NOTE
	$\overline{LT}$	$\overline{RBI}$	D	C	B	A	$\overline{BI/RBO}$	$\overline{a}$	$\overline{b}$	$\overline{c}$	$\overline{d}$	$\overline{e}$	$\overline{f}$	$\overline{g}$	
0	H	H	L	L	L	L	H	L	L	L	L	L	L	H	A
1	H	X	L	L	L	H	H	H	L	L	H	H	H	H	A
2	H	X	L	L	H	L	H	L	L	H	L	L	H	L	
3	H	X	L	L	H	H	H	L	L	L	L	H	H	L	
4	H	X	L	H	L	L	H	H	L	L	H	H	L	L	
5	H	X	L	H	L	H	H	L	H	L	L	H	L	L	
6	H	X	L	H	H	L	H	H	H	L	L	L	L	L	
7	H	X	L	H	H	H	H	L	L	L	H	H	H	H	
8	H	X	H	L	L	L	H	L	L	L	L	L	L	L	
9	H	X	H	L	L	H	H	L	L	L	H	H	L	L	
10	H	X	H	L	H	L	H	H	H	H	L	L	H	L	
11	H	X	H	L	H	H	H	H	H	L	L	H	H	L	
12	H	X	H	H	L	L	H	H	L	H	H	H	L	L	
13	H	X	H	H	L	H	H	L	H	H	L	H	L	L	
14	H	X	H	H	H	L	H	H	H	H	L	L	L	L	
15	H	X	H	H	H	H	H	H	H	H	H	H	H	H	
$\overline{BI}$	X	X	X	X	X	X	L	H	H	H	H	H	H	H	B
$\overline{RBI}$	H	L	L	L	L	L	L	H	H	H	H	H	H	H	C
$\overline{LT}$	L	X	X	X	X	X	H	L	L	L	L	L	L	L	D

H = HIGH Voltage Level
L = LOW Voltage Level
X = Immaterial

NOTES:

(A) $\overline{BI/RBO}$ is wire-AND logic serving as blanking Input (BI) and/or ripple-blanking output ($\overline{RBO}$). The blanking out (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 of a decimal 0 is not desired. X = input may be HIGH or LOW.

(B) When a LOW level is applied to the blanking input (forced condition) all segment outputs go to a LOW level regardless of the state of any other input condition.

(C) When ripple-blanking input ($\overline{RBI}$) and inputs A, B, C, and D are at 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).

(D) 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.

DC CHARACTERISTICS OVER OPERATING TEMPERATURE RANGE (unless otherwise specified)

Symbol	Parameter	Limits			Unit	Test Conditions	
		Min	Typ	Max			
V_{IH}	Input HIGH Voltage	2.0			V	Guaranteed Input HIGH Theshold Voltage for All Inputs	
V_{IL}	Input LOW Voltage			0.8	V	Guaranteed Input LOW Threshold Voltage for All Inputs	
V_{IK}	Input Clamp Diode Voltage		−0.65	−1.5	V	V_{CC} = MIN, I_{IN} = −18 mA	
V_{OH}	Output HIGH Voltage, $\overline{BI}/\overline{RBO}$	2.4	4.2		V	V_{CC} = MIN, I_{OH} = −50 μA, V_{IN} = V_{IN} or V_{IL} per Truth Table	
V_{OL}	Output LOW Voltage $\overline{BI}/\overline{RBO}$		0.25	0.4	V	I_{OL} = 1.6 mA	V_{CC} = MIN, V_{IN} = V_{IN} or V_{IL} per Truth Table
			0.35	0.5	V	I_{OL} = 3.2 mA	
$I_{O\ (off)}$	Off-State Output Current $\overline{a}$ thru $\overline{g}$			250	μA	V_{CC} = MAX, V_{IN} = V_{IN} or V_{IL} per Truth Table, $V_{O\ (off)}$ = 15 V	
$V_{O\ (on)}$	On-State Output Voltage $\overline{a}$ thru $\overline{g}$		0.25	0.4	V	$I_{O\ (on)}$ = 12 mA	V_{CC} = MAX, V_{IN} = V_{IH} or V_{IL} per Truth Table
			0.35	0.5	V	$I_{O\ (on)}$ = 24 mA	
I_{IH}	Input HIGH Current			20	μA	V_{CC} = MAX, V_{IN} = 2.7 V	
				0.1	mA	V_{CC} = MAX, V_{IN} = 7.0 V	
I_{IL}	Input LOW Current $\overline{BI}/\overline{RBO}$ Any Input except $\overline{BI}/\overline{RBO}$			−1.2 −0.4	mA	V_{CC} = MAX, V_{IN} = 0.4 V	
I_{OS} $\overline{BI}/\overline{RBO}$	Output Short Circuit Current (Note 1)	−0.3		−2.0	mA	V_{CC} = MAX, V_{OUT} = 0 V	
I_{CC}	Power Supply Current		7.0	13	mA	V_{CC} = MAX	

Note 1: Not more than one output should be shorted at a time, nor for more than 1 second.

AC CHARACTERISTICS (T_A = 25°C)

Symbol	Parameter	Limits			Unit	Test Conditions
		Min	Typ	Max		
t_{PHL} t_{PLH}	Propagation Delay, Address Input to Segment Output			100 100	ns ns	V_{CC} = 5.0 V C_L = 15 pF
t_{PHL} t_{PLH}	Propagation Delay, $\overline{RBI}$ Input To Segment Output			100 100	ns ns	

AC WAVEFORMS

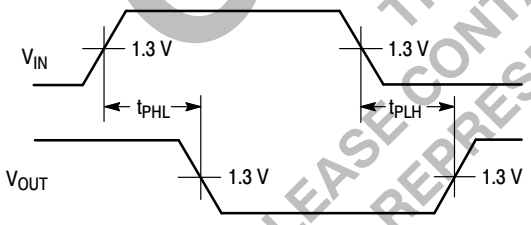


Figure 1.

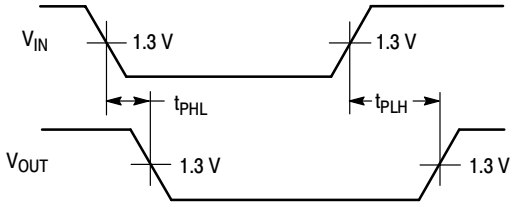
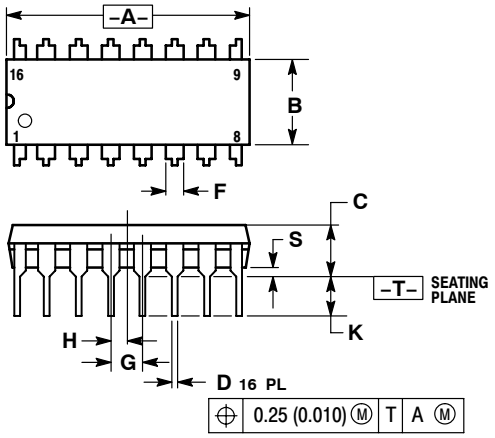


Figure 2.

PACKAGE DIMENSIONS

N SUFFIX
PLASTIC PACKAGE
CASE 648−08
ISSUE R

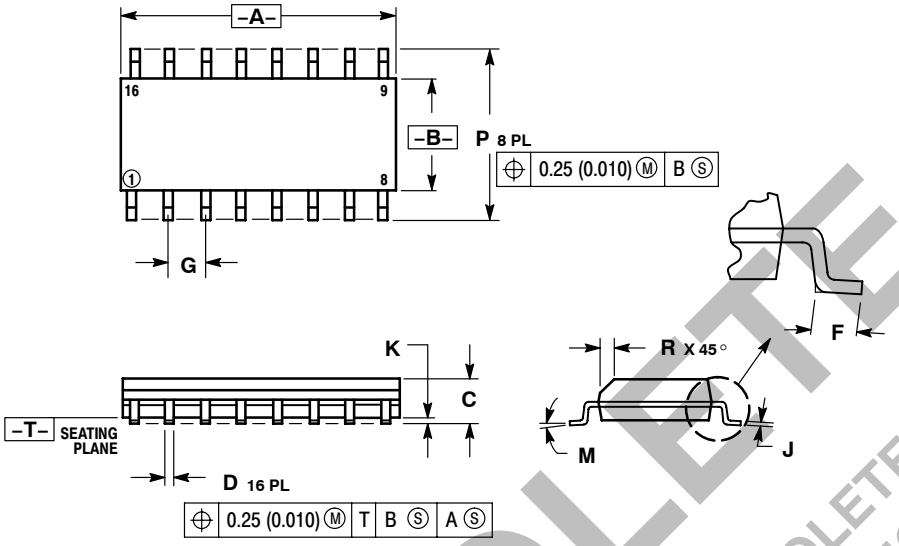


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.740	0.770	18.80	19.55
B	0.250	0.270	6.35	6.85
C	0.145	0.175	3.69	4.44
D	0.015	0.021	0.39	0.53
F	0.040	0.70	1.02	1.77
G	0.100 BSC		2.54 BSC	
H	0.050 BSC		1.27 BSC	
J	0.008	0.015	0.21	0.38
K	0.110	0.130	2.80	3.30
L	0.295	0.305	7.50	7.74
M	0 °	10 °	0 °	10 °
S	0.020	0.040	0.51	1.01

PACKAGE DIMENSIONS

D SUFFIX
PLASTIC SOIC PACKAGE
CASE 751B–05
ISSUE J



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	9.80	10.00	0.386	0.393
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 BSC		0.050 BSC	
J	0.19	0.25	0.008	0.009
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	5.80	6.20	0.229	0.244
R	0.25	0.50	0.010	0.019

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