SN54246, SN54247, SN54LS247, SN54LS248
SN74246, SN74247, SN74LS247, SN74LS248
BCD-TO-SEVEN-SEGMENT DECODERS/DRIVERS

MARCH 1974—REVISED MARCH 1988

'246, '247, 'LS247 feature

- Open-Collector Outputs Drive Indicators Directly
- Lamp-Test Provision
- Leading/Trailing Zero Suppression

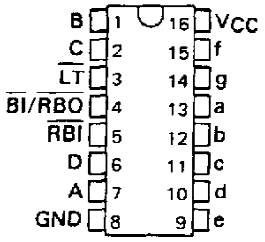
'LS248 feature

- Internal Pull-Ups Eliminate Need for External Resistors
- Lamp-Test Provision
- Leading/Trailing Zero Suppression

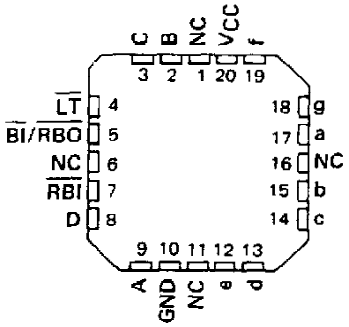
- All Circuit Types Feature Lamp Intensity Modulation Capability

TYPE	DRIVER OUTPUTS				TYPICAL POWER DISSIPATION	PACKAGES
	ACTIVE LEVEL	OUTPUT CONFIGURATION	SINK CURRENT	MAX VOLTAGE		
SN54246	low	open-collector	40 mA	30 V	320 mW	J,W
SN54247	low	open-collector	40 mA	15 V	320 mW	J,W
SN54LS247	low	open-collector	12 mA	15 V	35 mW	J,W
SN54LS248	high	2-kΩ pull-up	2 mA	5.5 V	125 mW	J,W
SN74246	low	open-collector	40 mA	30 V	320 mW	J,N
SN74247	low	open-collector	40 mA	15 V	320 mW	J,N
SN74LS247	low	open-collector	24 mA	15 V	35 mW	J,N
SN74LS248	high	2-kΩ pull-up	6 mA	5.5 V	125 mW	J,N

SN54246, SN54247 . . . J PACKAGE
SN54LS247 THRU SN54LS248 . . . J OR W PACKAGE
SN74246, SN74247 . . . N PACKAGE
SN74LS247, SN74LS248 . . . D OR N PACKAGE
(TOP VIEW)



SN54LS247, SN54LS248 . . . FK PACKAGE
(TOP VIEW)



NC – No internal connection

PRODUCTION DATA documents contain information current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

TEXAS INSTRUMENTS
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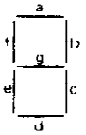
description

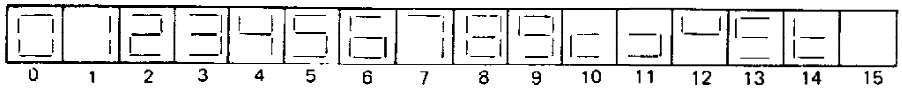
The '246 and '247 are electrically and functionally identical to the SN5446A/SN7446A, and SN5447A/SN7447A respectively, and have the same pin assignments as their equivalents. The 'LS247 and 'LS248 are electrically and functionally identical to the SN54LS47/SN74LS47 and SN54LS48/SN74LS48, respectively, and have the same pin assignments as their equivalents. They can be used interchangeably in present or future designs to offer designers a choice between two indicator fonts. The '46A, '47A, 'LS47, and 'LS48 compose the 6 and the 9 without tails and the '246, '247, 'LS247, and 'LS248 compose the 6 and the 9 with tails. Composition of all other characters, including display patterns for BCD inputs above nine, is identical. The '246, '247, and 'LS247 feature active-low outputs designed for driving indicators directly, and the 'LS248 features active-high outputs for driving lamp buffers. All of the circuits have full ripple-blanking input/output controls and a lamp test input. Segment identification and resultant displays are shown below. Display patterns for BCD input counts above 9 are unique symbols to authenticate input conditions.

All of these circuits incorporate automatic leading and/or trailing-edge zero-blanking control ($\overline{RBI}$ and $\overline{RBO}$). Lamp test ($\overline{LT}$) of these types may be performed at any time when the $\overline{BI}/\overline{RBO}$ node is at a high level. All types contain an overriding blanking input (BI) which can be used to control the lamp intensity by pulsing or to inhibit the outputs. Inputs and outputs are entirely compatible for use with TTL logic outputs.

Series 54 and Series 54LS devices are characterized for operation over the full military temperature range of −55°C to 125°C; Series 74 and Series 74LS devices are characterized for operation from 0°C to 70°C.



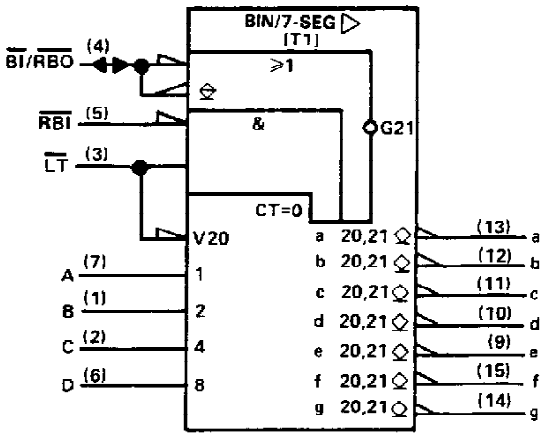
SEGMENT IDENTIFICATION



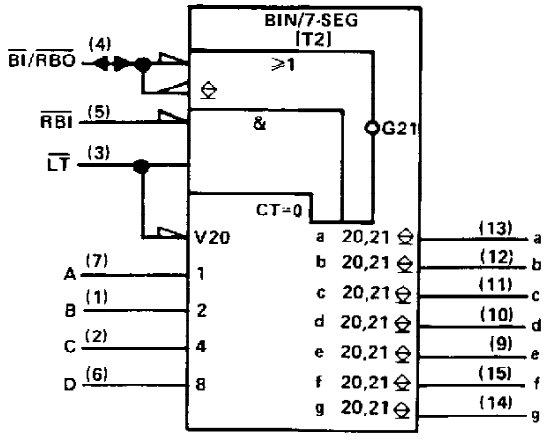
NUMERICAL DESIGNATIONS AND RESULTANT DISPLAYS

logic symbols†

'246, '247, 'LS247



'LS248



†These symbols are in accordance with ANSI/IEEE Std. 91-1984 and IEC Publication 617-12.
Pin numbers shown are for D, J, N, and W packages.

'246, '247, 'LS247 FUNCTION TABLE (T1)

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

'LS248 FUNCTION TABLE (T2)

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

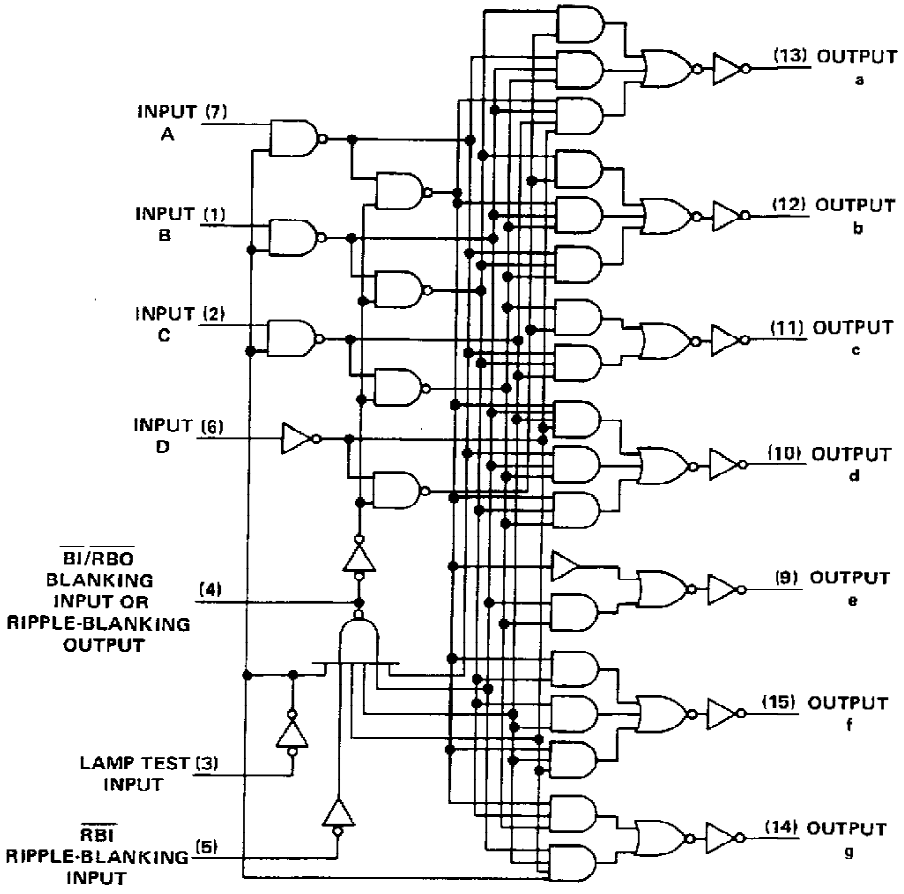
H = high level, L = low level, X = irrelevant

NOTES: 1. The blanking input ($\overline{BI}$) must be open or held at a high logic level when output functions 0 through 15 are desired. The ripple-blanking input ($\overline{RBI}$) must be open or high if blanking of a decimal zero is not desired.
2. When a low logic level is applied directly to the blanking input ($\overline{BI}$), all segment outputs are low regardless of the level of any other input.
3. When ripple-blanking input ($\overline{RBI}$) and inputs A, B, C, and D are at a low level with the lamp test input high, all segment outputs go low and the ripple-blanking output ($\overline{RBO}$) goes to a low level (response condition).
4. When the blanking input/ripple-blanking output ($\overline{BI}/\overline{RBO}$) is open or held high and a low is applied to the lamp-test input, all segment outputs are high.

† $\overline{BI}/\overline{RBO}$ is wire-AND logic serving as blanking input ($\overline{BI}$) and/or ripple-blanking output ($\overline{RBO}$).

logic diagram (positive logic)

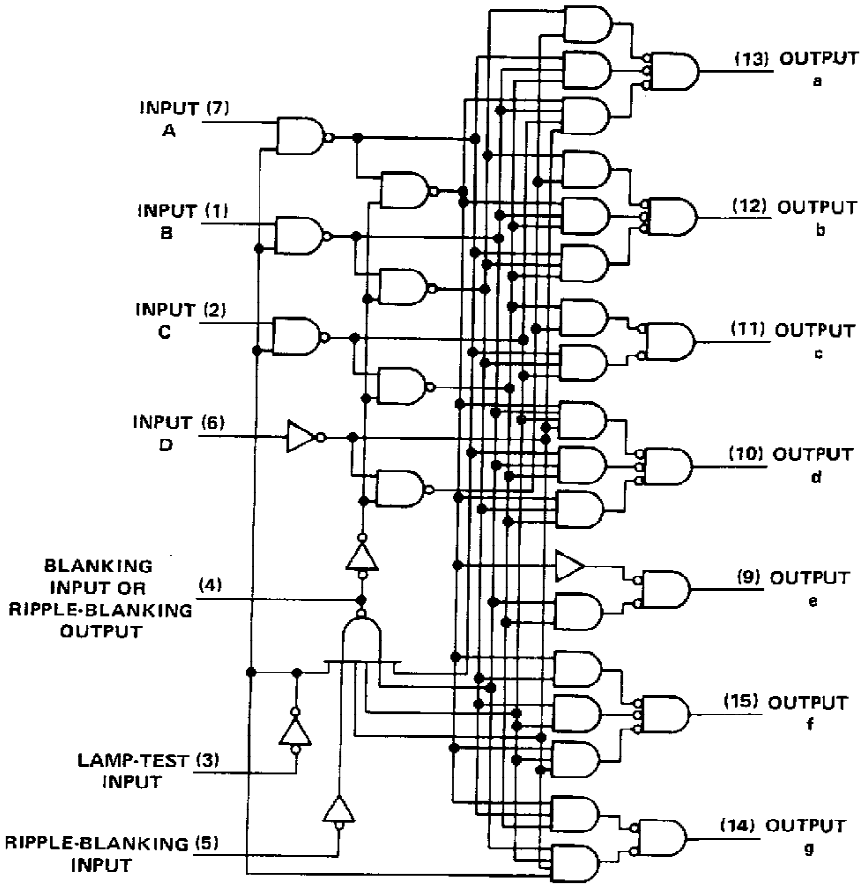
'246, '247, 'LS247



Pin numbers shown are for D, J, N, and W packages.

logic diagram (positive logic)

'LS248

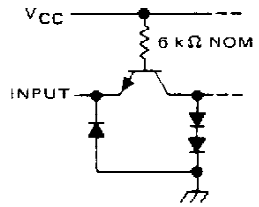


Pin numbers shown are for D, J, N, and W packages.

schematics of inputs and outputs

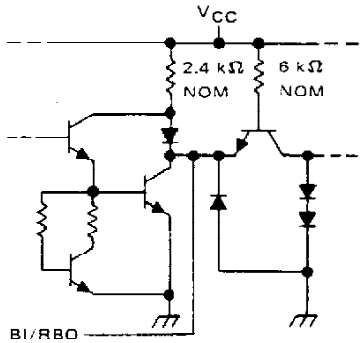
'246, '247

EQUIVALENT OF EACH INPUT EXCEPT $\overline{BI}/\overline{RBO}$



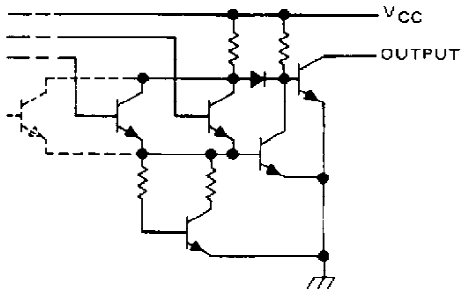
'246, '247

EQUIVALENT OF $\overline{BI}/\overline{RBO}$



'246, '247

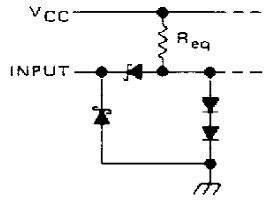
TYPICAL OF OUTPUTS a THRU g



schematics of inputs and outputs

'LS247, 'LS248

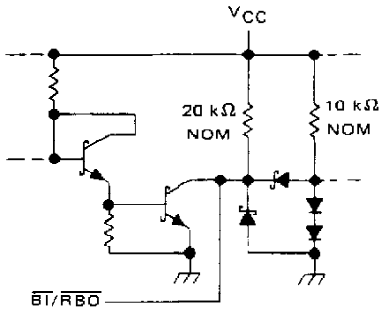
EQUIVALENT OF EACH INPUT EXCEPT $\overline{BI}/\overline{RBO}$



$\overline{LT}$ and $\overline{RBI}$: R_{eq} = 20 kΩ NOM
A, B, C, and D: R_{eq} = 25 kΩ NOM

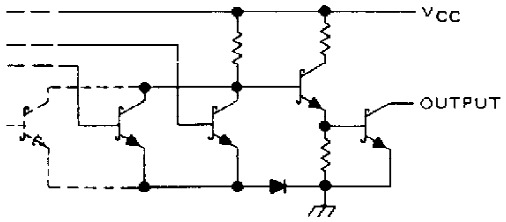
'LS247, 'LS248

EQUIVALENT OF $\overline{BI}/\overline{RBO}$



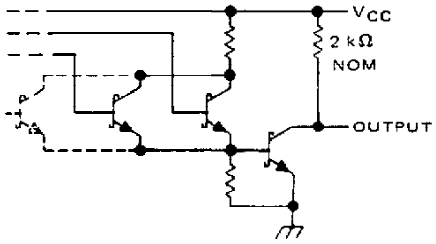
'LS247

TYPICAL OF OUTPUTS a THRU g



'LS248

TYPICAL OF OUTPUTS a THRU g



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

Supply voltage, V_{CC} (see Note 1) . . . . . 7 V
Input voltage . . . . . 5.5 V
Current forced into any output in the off state . . . . . 1 mA
Operating free-air temperature range: SN54246, SN54247 . . . . . −55°C to 125°C
SN74246, SN74247 . . . . . 0°C to 70°C
Storage temperature range . . . . . −65°C to 150°C

NOTE 1: Voltage values are with respect to network ground terminal.

recommended operating conditions

		SN54246			SN54247			SN74246			SN74247			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, V_{CC}		4.5	5	5.5	4.5	5	5.5	4.75	5	5.25	4.75	5	5.25	V
Off-state output voltage, $V_{O(off)}$	a thru g			30			15			30			15	V
On-state output current, $I_{O(on)}$	a thru g			40			40			40			40	mA
High-level output current, I_{OH}	$\overline{BI}/\overline{RBO}$			−200			−200			−200			−200	μA
Low-level output current, I_{OL}	$\overline{BI}/\overline{RBO}$			8			8			8			8	mA
Operating free-air temperature, T_A		−55		125	−55		125	0		70	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
V_{OH}	High-level output voltage	$\overline{BI}/\overline{RBO}$	V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = 0.8 V, I_{OH} = −200 μA	2.4	3.7		V
V_{OL}	Low-level output voltage	$\overline{BI}/\overline{RBO}$	V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = 0.8 V, I_{OL} = 8 mA		0.27	0.4	V
$I_{O(off)}$	Off-state output current	a thru g	V_{CC} = MAX, V_{IH} = 2 V, V_{IL} = 0.8 V, $V_{O(off)}$ = MAX			250	μA
$V_{O(on)}$	On-state output voltage	a thru g	V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = 0.8 V, $I_{O(on)}$ = 40 mA		0.3	0.4	V
I_I	Input current at maximum input voltage	Any input except $\overline{BI}/\overline{RBO}$	V_{CC} = MAX, V_I = 5.5 V			1	mA
I_{IH}	High-level input current	Any input except $\overline{BI}/\overline{RBO}$	V_{CC} = MAX, V_I = 2.4 V			40	μA
I_{IL}	Low-level input current	Any input except $\overline{BI}/\overline{RBO}$	V_{CC} = MAX, V_I = 0.4 V			−1.6	mA
		$\overline{BI}/\overline{RBO}$				−4	
I_{OS}	Short-circuit output current	$\overline{BI}/\overline{RBO}$	V_{CC} = MAX			−4	mA
I_{CC}	Supply current		V_{CC} = MAX, See Note 2		64	103	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.
NOTE 2: I_{CC} is measured with all outputs open and all inputs at 4.5 V.

switching characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{off}	Turn-off time from A input	C_L = 15 pF, R_L = 120 Ω, See Note 3			100	ns
t_{on}	Turn-on time from A input				100	
t_{off}	Turn-off time from $\overline{RBI}$ input				100	ns
t_{on}	Turn-on time from $\overline{RBI}$ input				100	

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

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

Supply voltage, V_{CC} (see Note 1) . . . . . 7 V
Input voltage . . . . . 7 V
Peak output current ($t_w \leq 1$ ms, duty cycle $\leq 10\%$) . . . . . 200 mA
Current forced into any output in the off state . . . . . 1 mA
Operating free-air temperature range: SN54LS247 . . . . . −55°C to 125°C
SN74LS247 . . . . . 0°C to 70°C
Storage temperature range . . . . . −65°C to 150°C

NOTE 1: Voltage values are with respect to network ground terminal.

recommended operating conditions

		SN54LS247			SN74LS247			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, V_{CC}		4.5	5	5.5	4.75	5	5.25	V
Off-state output voltage, $V_{O(off)}$	a thru g			15			15	V
On-state output current, $I_{O(on)}$	a thru g			12			24	mA
High-level output current, I_{OH}	$\overline{BI}/\overline{RBO}$			−50			−50	μA
Low-level output current, I_{OL}	$\overline{BI}/\overline{RBO}$			1.6			3.2	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†		SN54LS247			SN74LS247			UNIT
					MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V_{IH}	High-level input voltage				2			2			V
V_{IL}	Low-level input voltage						0.7			0.8	V
V_{IK}	Input clamp voltage		V_{CC} = MIN,	I_I = −18 mA			−1.5			−1.5	V
V_{OH}	High-level output voltage	$\overline{BI}/\overline{RBO}$	V_{CC} = MIN, V_{IL} = V_{IL} max,	V_{IH} = 2 V, I_{OH} = −50 μA	2.4	4.2		2.4	4.2		V
V_{OL}	Low-level output voltage	$\overline{BI}/\overline{RBO}$	V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = V_{IL} max	I_{OL} = 1.6 mA		0.25	0.4		0.25	0.4	V
				I_{OL} = 3.2 mA					0.35	0.5	
$I_{O(off)}$	Off-state output current	a thru g	V_{CC} = MAX, V_{IL} = V_{IL} max,	V_{IH} = 2 V, $V_{O(off)}$ = 15 V			250			250	μA
$V_{O(on)}$	On-state output voltage	a thru g	V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = V_{IL} max	$I_{O(on)}$ = 12 mA		0.25	0.4		0.25	0.4	V
				$I_{O(on)}$ = 24 mA					0.35	0.5	
I_I	Input current at maximum input voltage		V_{CC} = MAX,	V_I = 7 V			0.1			0.1	mA
I_{IH}	High-level input current		V_{CC} = MAX,	V_I = 2.7 V			20			20	μA
I_{IL}	Low-level input current	Any input except $\overline{BI}/\overline{RBO}$	V_{CC} = MAX,	V_I = 0.4 V			−0.4			−0.4	mA
		$\overline{BI}/\overline{RBO}$					−1.2			−1.2	
I_{OS}	Short-circuit output current	$\overline{BI}/\overline{RBO}$	V_{CC} = MAX		−0.3		−2	−0.3		−2	mA
I_{CC}	Supply current		V_{CC} = MAX,	See Note 2		7	13		7	13	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.
NOTE 2: I_{CC} is measured with all outputs open and all inputs at 4.5 V.

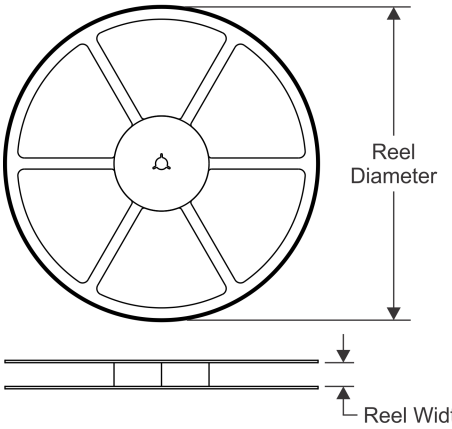
switching characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{off}	Turn-off time from A input	C_L = 15 pF, R_L = 665 Ω, See Note 3			100	ns
t_{on}	Turn-on time from A input				100	
t_{off}	Turn-off time from $\overline{RBI}$ input				100	ns
t_{on}	Turn-on time from $\overline{RBI}$ input				100	

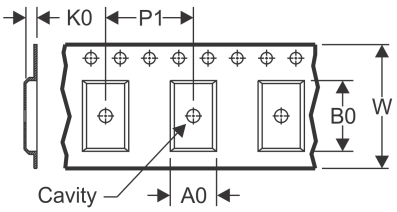
NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

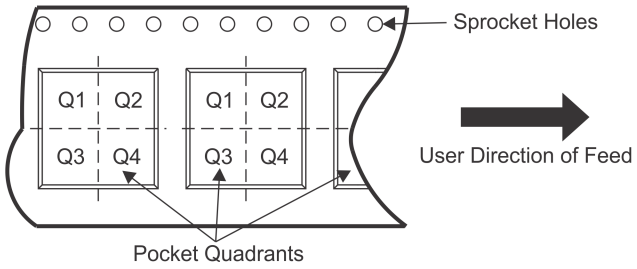


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

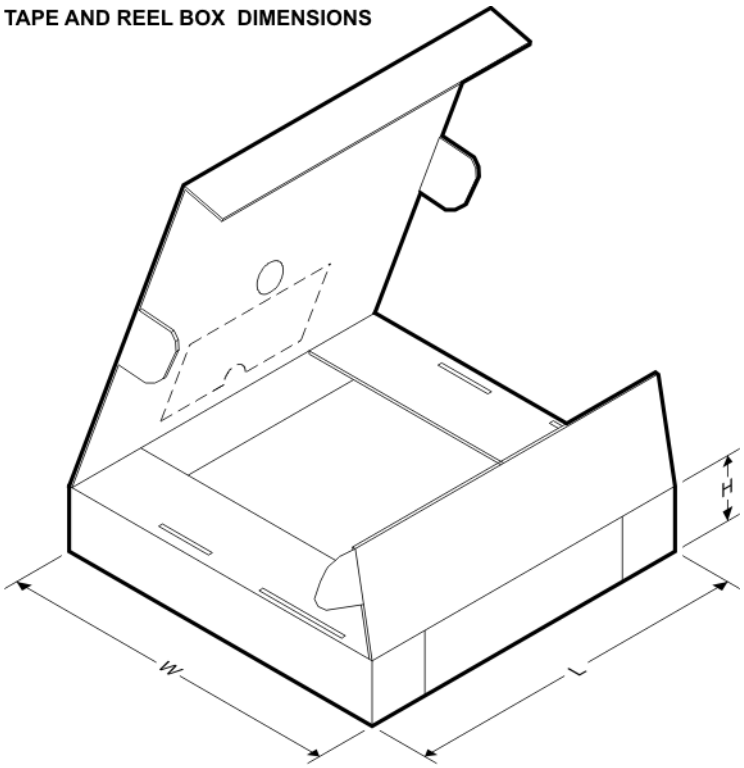
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN74LS247DR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74LS247DR	SOIC	D	16	2500	333.2	345.9	28.6

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