## SN54145, SN54LS145, SN74145, SN74LS145 BCD-TO-DECIMAL DECODERS/DRIVERS

SDLS051

#### MARCH 1974 - REVISED MARCH 1988

## FOR USE AS LAMP, RELAY, OR MOS DRIVERS

- Full Decoding of Input Logic
- SN54145, SN74145, and SN74LS145 Have 80-mA Sink-Current Capability
- All Outputs Are Off for Invalid BCD Input Conditions
- Low Power Dissipation of 'LS145 ...
  35 mW Typical

FUNCTION	TABLE

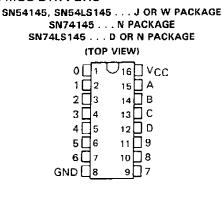
r														
NO.		INP	UTS					0	UT	PUT	S			
1.0.	D	C	8	Α	0	1	2	3	4	5	6	7	8	9
0	L	L	L	L	L	н	н	н	Н	Н	Н	Н	Н	Н
1	L	L	L	н	H	L	н	н	н	Н	н	н	н	н
2	L.	L.	н	L	н	н	L	н	н	н	н	н	н	н
3	L	L	н	н	н	н	н	L	н	Н	н	н	н	н
4	Ł	н	L	L	н	н	Н	Н	L	Н	Н	Н	н	Н
5	Ł	н	L	Η	н	н	н	н	н	L	н	н	н	Ξ
6	L	н	н	L	н	н	н	н	н	н	Ł	н	н	н
7	L	н	н	н	н	н	н	н	н	н	н	L	Н	н
8	н	L	L	L	н	н	н	н	н	н	н	н	L	н
9	н	L	L	н	н	н	н	н	н	н	н	н	н	L
	Н	٦L	Н	L	н	H	Н	Н	Н	Н	Н	Н	Н	Ŧ
	н	L	н	н	н	н	н	н	н	н	н	Н	н	н
Ē	н	н	L	L	н	н	н	н	н	н	н	н	н	н
INVALID	н	н	L	н	н	н	н	н	н	н	н	н	н	н
=	н	Н	н	L	н	н	н	н	н	н	н	н	н	н
	н	н	н	н	н	н	н	н	н	н	н	н	н	н

H = high level (off), L = low level (on)

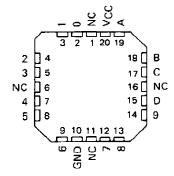
#### description

These monolithic BCD-to-decimal decoder/drivers consist of eight inverters and ten four-input NAND gates. The inverters are connected in pairs to make BCD input data available for decoding by the NAND gates. Full decoding of valid BCD input logic ensures that all outputs remain off for all invalid binary input conditions. These decoders feature high-performance, n-p-n output transistors designed for use as indicator/relay drivers or as open-collector logic-circuit drivers. Each of the highbreakdown output transistors (15 volts) of the SN54145, SN74145, or SN74LS145 will sink up to 80 milliamperes of current. Each input is one Series 54/74 or Series 54LS/74LS standard load, respectively. Inputs and outputs are entirely compatible for use with TTL or DTL logic circuits, and the outputs are compatible for interfacing with most MOS integrated circuits. Power dissipation is typically 215 milliwatts for the '145 and 35 milliwatts for the 'LS145.

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.

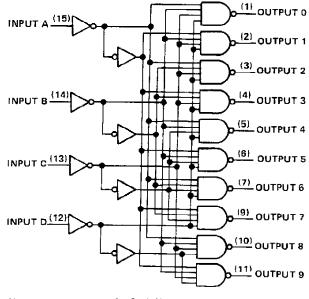






NC - No internal connection





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



# SN54LS145, SN74LS145 **BCD-TO-DECIMAL DECODERS/DRIVERS**

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

Supply voltage, V <sub>CC</sub> (see Note 1)
Input voltage , , , , , , , , , , , , , , , , , , ,
Maximum current into any output (off-state)
Operating free-air temperature range: SN54145
SN74145
Storage temperature range $-65^{\circ}$ C to $150^{\circ}$ C

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

### recommended operating conditions

		SN5414	5	SN74145			
	MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, VCC	4.5	5	5.5	4.75	5	5.25	v
Off-state output voltage, VO(off)			15			15	V
Operating free-air temperature, TA	-55		125	0		70	° C

## electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

	PARAMETER	TEST CONDIT	IONST	MIN	TYPİ	ΜΑΧ	UNIT
VIH	High-level input voltage			2			V
V <sub>IL</sub>	Low-level input voltage					0.8	V
Vik	Input clamp voltage	V <sub>CC</sub> = MIN, I <sub>l</sub> = -12 mA				-1.5	v
IO(off)	Off-state output current	$V_{CC} = MIN, V_{IH} = 2 V,$ $V_{IL} = 0.8 V, V_{O(off)} = 15$	v			250	μA
VOion)	On-state output voltage	V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, V <sub>IL</sub> = 0.8 V	1 <sub>O(on)</sub> = 80 mA		0.5	0.9 0.4	v
1	Input current at maximum input voltage	VCC = MAX, VI = 5.5 V		-		1	mA
Η	High-level input current	V <sub>CC</sub> = MAX, V <sub>1</sub> - 2.4 V				40	μA
<u>۱</u> ι	Low-level input current	V <sub>CC</sub> = MAX, V <sub>1</sub> = 0.4 V	····			-1.6	mA
1	Supply current	Mar MAY Cashier 7	SN54145		43	62	
lcc	Supply current	V <sub>CC</sub> = MAX, See Note 2	SN74145		43	70	mΑ

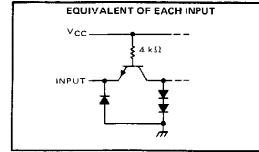
<sup>†</sup>For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions. <sup>‡</sup>All typical values are at  $V_{CC} = 5 V$ ,  $T_A = 25$ °C. NOTE 2: I<sub>CC</sub> is measured with all inputs grounded and outputs open.

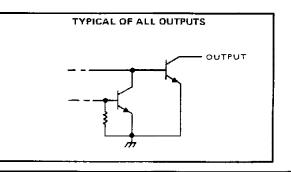
# switching characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = $25^{\circ}$ C

	PARAMETER		TEST CONDITI	MIN	MAX	UNIT	
<b>TPLH</b>	Propagation delay time, low-to-high-level output	$C_{1} = 15  pF_{2}$	R <sub>1</sub> = 100 Ω.	See Note 3		50	ns
<sup>t</sup> PHL	Propagation delay time, high-to-low-level output	ν <u>Γ</u> - 15 μr,	н <u>Г</u> - 10032,	See 1001e S		50	ns

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

#### schematics of inputs and outputs





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## SN54145, SN74145 **BCD-TO-DECIMAL DECODERS/DRIVERS**

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

Supply voltage, V <sub>CC</sub> (see Note 1)													
Input voltage Operating free-air temperature range: SN54LS													
SN74LS													
Storage temperature range				-			-			-65	5°C	to	150°C

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

#### recommended operating conditions

	Sr	SN54LS145				SN74LS145			
	MIN	NOM	MAX	MIN	NOM	MAX	UNIT		
Supply voltage, VCC	4.5	5	5.5	4.75	5	5.25	V		
Off-state output voltage, VO(off)			15			15	V		
Operating free-air temperature, TA	-55		125	0		70	°C		

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

	PARAMETER	TEST CON	DITIONE <sup>†</sup>	SN	154LS1	45	SI			
			MIN	TYP‡	MAX	MIN	TYч	MAX	UNIT	
⊻ін	High-level input voltage			2			2			V
VIL	Low-level input voltage					0.7	†		0.8	V
VIK	Input clamp voltage	V <sub>CC</sub> = MIN,	lı = -18 mA			-1.5	-		-1.5	V
IO(off)	Off-state output current	V <sub>CC</sub> ≠ MIN, V <sub>IL</sub> = V <sub>IL</sub> max,	V <sub>IH</sub> = 2 V, V <sub>OH</sub> = 15 V			250			250	μА
V <sub>O(on)</sub>	On-state output voltage	V <sub>CC</sub> ∸ MIN, V <sub>IH</sub> ≈ 2 V,	I <sub>OL</sub> = 12 mA	L	0,25	0.4		0.25 0.35	0.4 0.5	v
		$V_{1L} = V_{1L} \max$	I <sub>OL</sub> = 80 mA					2.3	3	1
-ų	Input current at maximum input voltage	VCC = MAX,	V <sub>1</sub> = 7 V			0.1			0.1	mA
Чн	High-level input current	V <sub>CC</sub> = MAX,	VI = 2.7 V			20			20	μA
III.	Law-level input current	V <sub>CC</sub> = MAX,	VI = 0.4 V			-0.4			-0.4	mA
'cc	Supply current	V <sub>CC</sub> = MAX,	See Note 2		7	13		7	13	mA

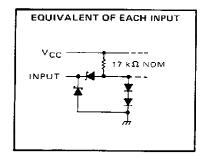
<sup>†</sup>For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.  $\frac{1}{2}$ All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C. NOTE 2: 1<sub>CC</sub> is measured with all inputs grounded and outputs open.

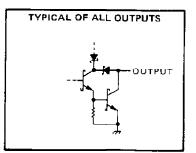
### switching characteristics, VCC = 5 V, TA = 25°C

PARAMETER		TEST CONDITI	IONS	MIN N	MAX	UNIT
tPLH Propagation delay time, iow-to-high-level output	C) = 45 pF,	R <sub>1</sub> = 665 Ω.	See Note 3		50	ns
tPHL Propagation delay time, high-to-low-level output	сц - 45 рг,	ΗL = 665 Ω,	Jee Note 5		50	ns

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

#### schematic of inputs and outputs









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23-Mar-2012

## **PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/ Ball Finish	MSL Peak Temp <sup>(3)</sup>	Samples (Requires Login)
5962-8508401VEA	ACTIVE	CDIP	J	16	25	TBD	A42	N / A for Pkg Type	
85084012A	ACTIVE	LCCC	FK	20	1	TBD	Call TI	Call TI	
8508401EA	ACTIVE	CDIP	J	16	1	TBD	Call TI	Call TI	
8508401FA	ACTIVE	CFP	W	16	1	TBD	Call TI	Call TI	
SN54LS145J	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	
SN74145N	ACTIVE	PDIP	Ν	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	
SN74145N3	OBSOLETE	PDIP	Ν	16		TBD	Call TI	Call TI	
SN74145NE4	ACTIVE	PDIP	Ν	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	
SN74LS145D	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74LS145DE4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74LS145DG4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74LS145DR	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74LS145DRE4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74LS145DRG4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74LS145N	ACTIVE	PDIP	Ν	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	
SN74LS145N3	OBSOLETE	PDIP	Ν	16		TBD	Call TI	Call TI	
SN74LS145NE4	ACTIVE	PDIP	Ν	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	
SN74LS145NSR	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74LS145NSRE4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74LS145NSRG4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SNJ54145J	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	
SNJ54LS145FK	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type	
SNJ54LS145J	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	



23-Mar-2012

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/ Ball Finish	MSL Peak Temp <sup>(3)</sup>	Samples (Requires Login)
SNJ54LS145W	ACTIVE	CFP	W	16	1	TBD	A42	N / A for Pkg Type	

<sup>(1)</sup> The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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OTHER QUALIFIED VERSIONS OF SN54145, SN54LS145, SN54LS145-SP, SN74145, SN74LS145 :

Catalog: SN74145, SN74LS145, SN54LS145

Military: SN54145, SN54LS145

Space: SN54LS145-SP

NOTE: Qualified Version Definitions:

# PACKAGE OPTION ADDENDUM



23-Mar-2012

- Catalog TI's standard catalog product
- Military QML certified for Military and Defense Applications
- Space Radiation tolerant, ceramic packaging and qualified for use in Space-based application

# PACKAGE MATERIALS INFORMATION

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# TAPE AND REEL INFORMATION

## REEL DIMENSIONS

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TAPE AND REEL INFORMATION

### 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

*A	Il dimensions are nominal												
	Device	Package Type	Package Drawing		SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
	SN74LS145DR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
	SN74LS145NSR	SO	NS	16	2000	330.0	16.4	8.2	10.5	2.5	12.0	16.0	Q1

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# PACKAGE MATERIALS INFORMATION

14-Jul-2012



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74LS145DR	SOIC	D	16	2500	333.2	345.9	28.6
SN74LS145NSR	SO	NS	16	2000	367.0	367.0	38.0

J (R-GDIP-T\*\*) 14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



NOTES: A. All linear dimensions are in inches (millimeters).

- B. This drawing is subject to change without notice.
- C. This package is hermetically sealed with a ceramic lid using glass frit.
- D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
- E. Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

W (R-GDFP-F16)

CERAMIC DUAL FLATPACK



- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. This package can be hermetically sealed with a ceramic lid using glass frit.
  - D. Index point is provided on cap for terminal identification only.
  - E. Falls within MIL STD 1835 GDFP1-F16 and JEDEC MO-092AC



LEADLESS CERAMIC CHIP CARRIER

FK (S-CQCC-N\*\*) 28 TERMINAL SHOWN



NOTES: A. All linear dimensions are in inches (millimeters).

B. This drawing is subject to change without notice.

- C. This package can be hermetically sealed with a metal lid.
- D. Falls within JEDEC MS-004



D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



NOTES: A. All linear dimensions are in inches (millimeters).

- B. This drawing is subject to change without notice.
- Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
- Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
- E. Reference JEDEC MS-012 variation AC.



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# D (R-PDSO-G16) PLASTIC SMALL OUTLINE Stencil Openings (Note D) Example Board Layout (Note C) –16x0,55 -14x1,27 -14x1,27 16x1,50 5,40 5.40 Example Non Soldermask Defined Pad Example Pad Geometry (See Note C) 0,60 .55 Example 1. Solder Mask Opening (See Note E) -0,07 All Around

NOTES: A. All linear dimensions are in millimeters.

- B. This drawing is subject to change without notice.
- C. Publication IPC-7351 is recommended for alternate designs.
- D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
   E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.



# MECHANICAL DATA

## PLASTIC SMALL-OUTLINE PACKAGE

## 0,51 0,35 ⊕0,25⊛ 1,27 8 14 0,15 NOM 5,60 8,20 5,00 7,40 $\bigcirc$ Gage Plane ₽ 0,25 7 1 1,05 0,55 0°-10° Δ 0,15 0,05 Seating Plane — 2,00 MAX 0,10PINS \*\* 14 16 20 24 DIM 10,50 10,50 12,90 15,30 A MAX A MIN 9,90 9,90 12,30 14,70 4040062/C 03/03

NOTES: A. All linear dimensions are in millimeters.

NS (R-PDSO-G\*\*)

**14-PINS SHOWN** 

- B. This drawing is subject to change without notice.
- C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.



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