

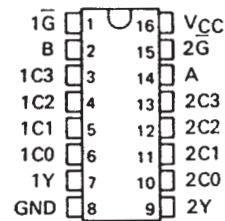
# SN54LS253, SN54S253, SN74LS253, SN74S253 DUAL 4-LINE TO 1-LINE DATA SELECTORS/MULTIPLEXERS WITH 3-STATE OUTPUTS

SDLS147 – SEPTEMBER 1972 – REVISED MARCH 1988

- Three-State Version of SN54/74LS153, SN54/74S153
- Schottky-Diode-Clamped Transistors
- Permits Multiplexing from N Lines to 1 Line
- Performs Parallel-to-Serial Conversion
- Fully Compatible with Most TTL Circuits
- Low Power Dissipation
  - 'LS253 . . . 35 mW Typical
  - 'S253 . . . 225 mW Typical

SN54LS253, SN54S253 . . . J OR W PACKAGE  
SN74LS253, SN74S253 . . . D OR N PACKAGE

(TOP VIEW)



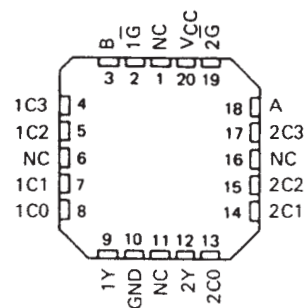
## description

Each of these Schottky-clamped data selectors/multiplexers contains inverters and drivers to supply fully complementary, on-chip, binary decoding data selection to the AND-OR gates. Separate output control inputs are provided for each of the two four-line sections.

The three-state outputs can interface with and drive data lines of bus-organized systems. With all but one of the common outputs disabled (at a high-impedance state) the low-impedance of the single enabled output will drive the bus line to a high or low logic level.

SN54LS253, SN54S253 . . . FK PACKAGE

(TOP VIEW)



NC-No internal connection

FUNCTION TABLE

SELECT INPUTS		DATA INPUTS				OUTPUT CONTROL	OUTPUT
B	A	C0	C1	C2	C3	G	Y
X	X	X	X	X	X	H	Z
L	L	L	X	X	X	L	L
L	L	H	X	X	X	L	H
L	H	X	L	X	X	L	L
L	H	X	H	X	X	L	H
H	L	X	X	L	X	L	L
H	L	X	X	H	X	L	H
H	H	X	X	X	L	L	L
H	H	X	X	X	H	L	H

Address inputs A and B are common to both sections.

H = high level, L = low level, X = irrelevant, Z = high impedance (off)

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

Supply voltage, $V_{CC}$ (see Note 1)	7 V
Input voltage: 'LS253	7 V
'S253	5.5 V
Off-state output voltage	5.5 V
Operating free-air temperature range: SN54LS253, SN54S253	– 55°C to 125°C
SN74LS253, SN74S253	0°C to 70°C
Storage temperature range	– 65°C to 150°C

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

PRODUCTION DATA information is 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.



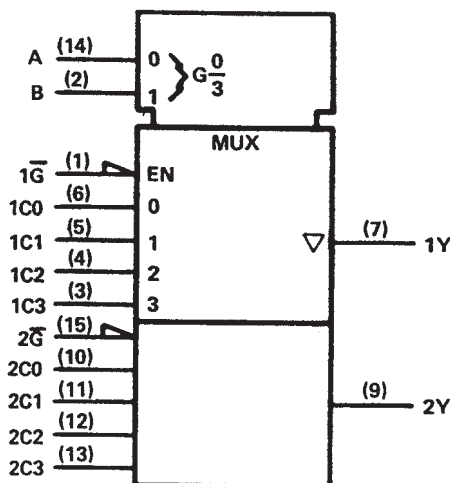
POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 1988, Texas Instruments Incorporated

# SN54LS253, SN54S253, SN74LS253, SN74S253 DUAL 4-LINE TO 1-LINE DATA SELECTORS/MULTIPLEXERS WITH 3-STATE OUTPUTS

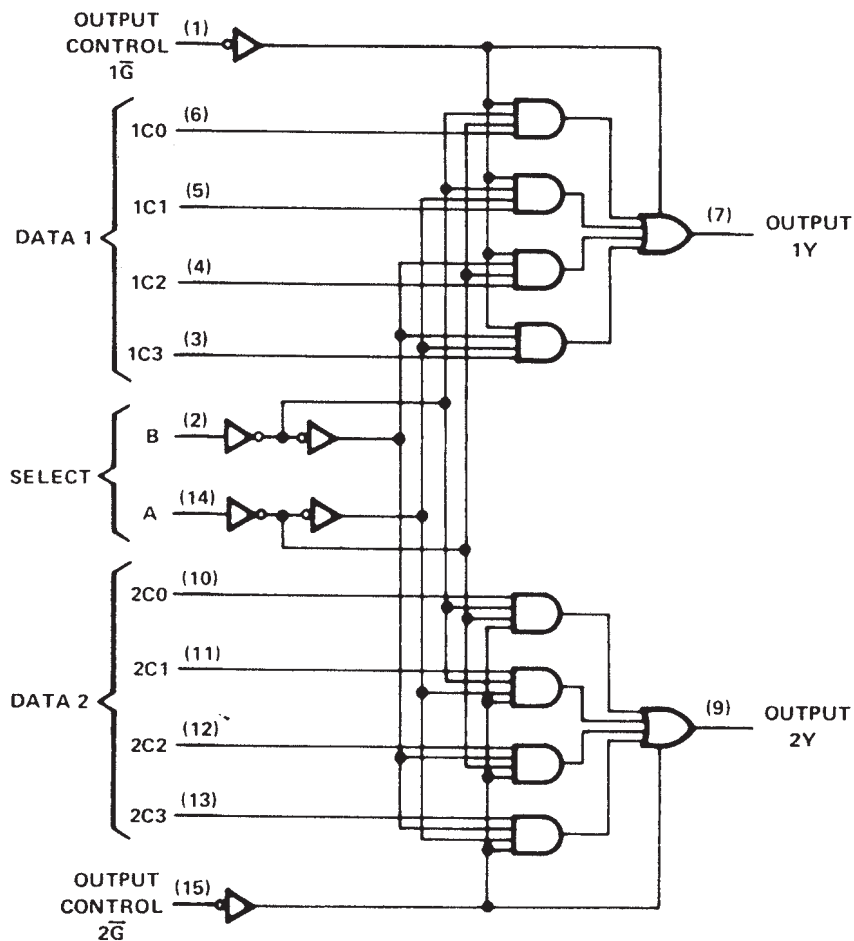
SDLS147 - SEPTEMBER 1972 - REVISED MARCH 1988

logic symbol†



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

logic diagram (positive logic)



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

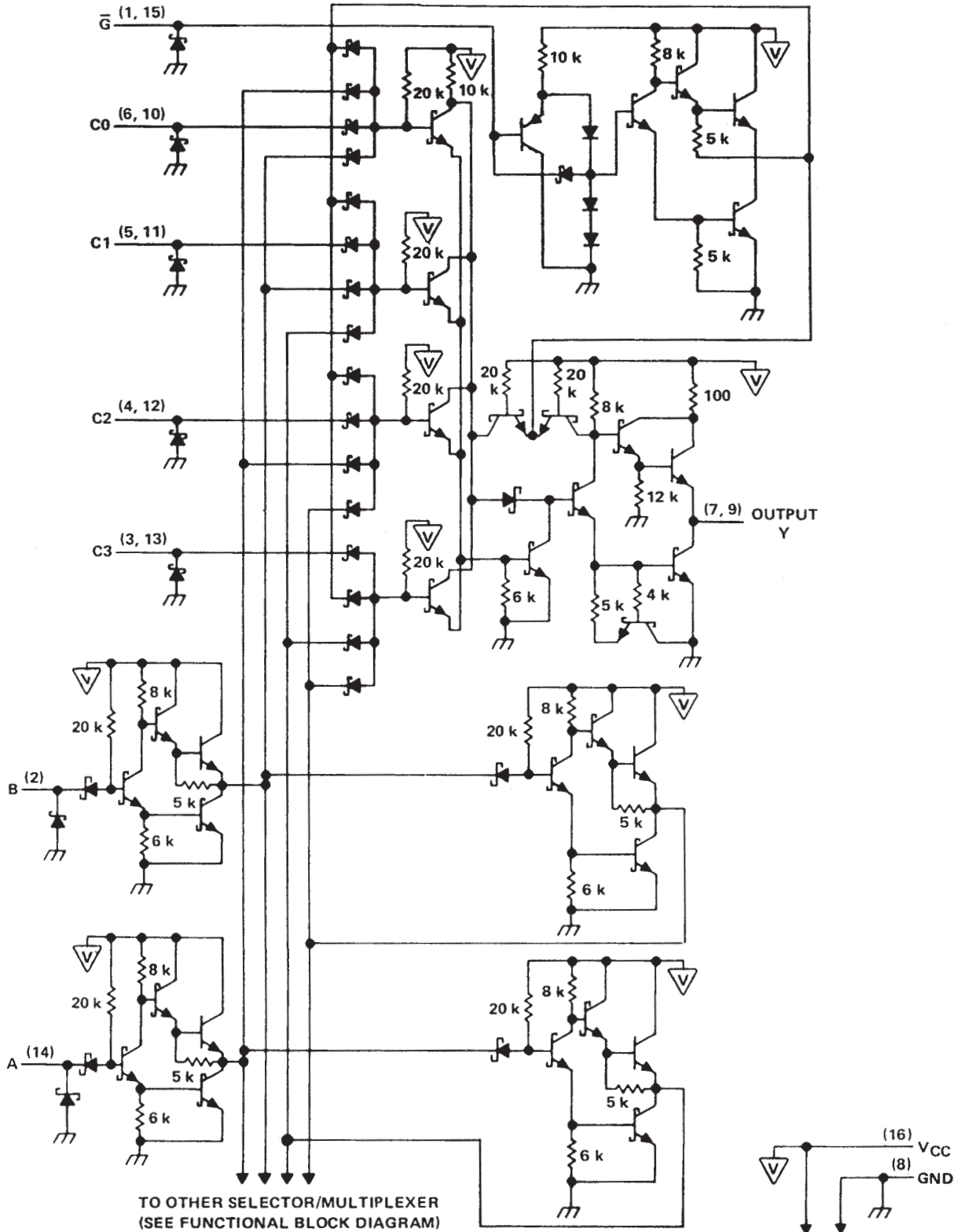


POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

# SN54LS253, SN54S253, SN74LS253, SN74S253 DUAL 4-LINE TO 1-LINE DATA SELECTORS/MULTIPLEXERS WITH 3-STATE OUTPUTS

SDLS147 - SEPTEMBER 1972 - REVISED MARCH 1988

schematic (each selector/multiplexer, and the common select section)



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



# SN54LS253, SN54S253, SN74LS253, SN74S253 DUAL 4-LINE TO 1-LINE DATA SELECTORS/MULTIPLEXERS WITH 3-STATE OUTPUTS

SDLS147 – SEPTEMBER 1972 – REVISED MARCH 1988

## recommended operating conditions

	SN54LS253			SN74LS253			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
V <sub>CC</sub> Supply voltage	4.5	5	5.5	4.75	5	5.25	V
V <sub>IH</sub> High-level input voltage	2			2			V
V <sub>IL</sub> Low-level input voltage	0.7			0.8			V
I <sub>OH</sub> High-level output current	-1			-2.6			mA
I <sub>OL</sub> Low-level output current	4			8			mA
T <sub>A</sub> Operating free-air temperature	-55 125			0 70			°C

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

PARAMETER	TEST CONDITIONS†	SN54LS253		SN74LS253		UNIT
		MIN	TYP ‡	MAX	MIN	
V <sub>IK</sub>	V <sub>CC</sub> = MIN, I <sub>I</sub> = -18 mA	-1.5		-1.5		V
V <sub>OH</sub>	V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, V <sub>IL</sub> = MAX, I <sub>OH</sub> = MAX	2.4	3.4	2.4	3.1	V
V <sub>OL</sub>	V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, V <sub>IL</sub> = MAX	I <sub>OL</sub> = 4 mA		0.25	0.4	V
		I <sub>OL</sub> = 8 mA		0.25 0.5		
I <sub>OZ</sub>	V <sub>CC</sub> = MAX, V <sub>IH</sub> = 2 V	V <sub>O</sub> = 2.7 V		20		μA
		V <sub>O</sub> = 0.4 V		-20		
I <sub>I</sub>	V <sub>CC</sub> = MAX, V <sub>I</sub> = 7 V	0.1		0.1		mA
I <sub>IH</sub>	V <sub>CC</sub> = MAX, V <sub>I</sub> = 2.7 V	20		20		μA
I <sub>IL</sub>	V <sub>CC</sub> = MAX, V <sub>I</sub> = 0.4 V	G̅		-0.2		mA
		All other		-0.4		
I <sub>OS</sub> §	V <sub>CC</sub> = MAX	-30	-130	-30	-130	mA
I <sub>CC</sub>	V <sub>CC</sub> = MAX, See Note 2	Condition A		7	12	mA
		Condition B		8.5	14	

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C.

§ Not more than one output should be shorted at a time, and duration for the short-circuit should exceed one second.

NOTE 2: I<sub>CC</sub> is measured with the outputs open under the following conditions:

- A. All inputs grounded.
- B. Output control at 4.5 V, all inputs grounded.

## switching characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t <sub>PLH</sub>	Data	Y	C <sub>L</sub> = 15 pF, R <sub>L</sub> = 2 kΩ, See Note 3	17	25	ns	
t <sub>PHL</sub>				13	20		
t <sub>PLH</sub>	Select	Y		30	45	ns	
t <sub>PHL</sub>				21	32		
t <sub>PZH</sub>	Output Control	Y		15	28	ns	
t <sub>PZL</sub>				15	23		
t <sub>PHZ</sub>	Output Control	Y	C <sub>L</sub> = 5 pF, R <sub>L</sub> = 2 kΩ, See Note 3	27	41	ns	
t <sub>PLZ</sub>				18	27		

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



# SN54LS253, SN54S253, SN74LS253, SN74S253 DUAL 4-LINE TO 1-LINE DATA SELECTORS/MULTIPLEXERS WITH 3-STATE OUTPUTS

SDLS147 – SEPTEMBER 1972 – REVISED MARCH 1988

## recommended operating conditions

	SN54S253			SN74S253			UNIT	
	MIN	NOM	MAX	MIN	NOM	MAX		
V <sub>CC</sub> Supply voltage	4.5	5	5.5	4.75	5	5.25	V	
V <sub>IH</sub> High-level input voltage	2			2			V	
V <sub>IL</sub> Low-level input voltage	0.8			0.8			V	
I <sub>OH</sub> High-level output current	-2			-6.5			mA	
I <sub>OL</sub> Low-level output current	20			20			mA	
T <sub>A</sub> Operating free-air temperature	-55			0			70	°C

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

PARAMETER	TEST CONDITIONS†	MIN	TYP‡	MAX	UNIT
V <sub>IK</sub>	V <sub>CC</sub> = MIN, I <sub>I</sub> = -18 mA	-1.2			V
V <sub>OH</sub>	V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, V <sub>IL</sub> = 0.8 V, I <sub>OH</sub> = MAX	Series 54S	2.5	3.4	V
		Series 74S	2.7	3.4	
V <sub>OL</sub>	V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, V <sub>IL</sub> = 0.8 V, I <sub>OL</sub> = 20 mA	0.5			V
I <sub>OZ</sub>	V <sub>CC</sub> = MAX, V <sub>IH</sub> = 2 V	V <sub>O</sub> = 2.4 V	50		μA
		V <sub>O</sub> = 0.5 V	-50		
I <sub>I</sub>	V <sub>CC</sub> = MAX, V <sub>I</sub> = 5.5 V	1			mA
I <sub>IH</sub>	V <sub>CC</sub> = MAX, V <sub>I</sub> = 2.7 V	50			μA
I <sub>IL</sub>	V <sub>CC</sub> = MAX, V <sub>I</sub> = 0.5 V	$\bar{G}$ = 0.8 V	-2		mA
		$\bar{G}$ = 2 V	-0.25		
I <sub>OS§</sub>	V <sub>CC</sub> = MAX	-40	-100		mA
I <sub>CC</sub>	V <sub>CC</sub> = MAX, See Note 2	Condition A	45	70	mA
		Condition B	65	85	

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C.

Not more than one output should be shorted at a time and duration of short-circuit should not exceed one second.

NOTE 2: I<sub>CC</sub> is measured with the outputs open under the following conditions:

- A. All inputs grounded.
- B. Output control at 4.5 V, all inputs grounded.

## switching characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t <sub>PLH</sub>	Data	Y	R <sub>L</sub> = 280 Ω, See Note 3	C <sub>L</sub> = 15 pF	6	9	ns
t <sub>PHL</sub>					6	9	
t <sub>PLH</sub>	Select	Y			11.5	18	ns
t <sub>PHL</sub>					12	18	
t <sub>PZH</sub>	Output	Y			11	16.5	ns
t <sub>PZL</sub>	Control				12	18	
t <sub>PHZ</sub>	Output	Y	R <sub>L</sub> = 280 Ω, See Note 3	C <sub>L</sub> = 5 pF	6.5	9.5	ns
t <sub>PLZ</sub>	Control				10	15	

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



**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
76017012A	ACTIVE	LCCC	FK	20	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	76017012A SNJ54LS 253FK	<a href="#">Samples</a>
7601701EA	ACTIVE	CDIP	J	16	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	7601701EA SNJ54LS253J	<a href="#">Samples</a>
7601701EA	ACTIVE	CDIP	J	16	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	7601701EA SNJ54LS253J	<a href="#">Samples</a>
JM38510/30908BEA	ACTIVE	CDIP	J	16	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	JM38510/ 30908BEA	<a href="#">Samples</a>
JM38510/30908BEA	ACTIVE	CDIP	J	16	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	JM38510/ 30908BEA	<a href="#">Samples</a>
JM38510/30908BFA	ACTIVE	CFP	W	16	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	JM38510/ 30908BFA	<a href="#">Samples</a>
JM38510/30908BFA	ACTIVE	CFP	W	16	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	JM38510/ 30908BFA	<a href="#">Samples</a>
M38510/30908BEA	ACTIVE	CDIP	J	16	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	JM38510/ 30908BEA	<a href="#">Samples</a>
M38510/30908BEA	ACTIVE	CDIP	J	16	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	JM38510/ 30908BEA	<a href="#">Samples</a>
M38510/30908BFA	ACTIVE	CFP	W	16	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	JM38510/ 30908BFA	<a href="#">Samples</a>
M38510/30908BFA	ACTIVE	CFP	W	16	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	JM38510/ 30908BFA	<a href="#">Samples</a>
SN54LS253J	ACTIVE	CDIP	J	16	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	SN54LS253J	<a href="#">Samples</a>
SN54LS253J	ACTIVE	CDIP	J	16	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	SN54LS253J	<a href="#">Samples</a>
SN74LS253DR	ACTIVE	SOIC	D	16	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	LS253	<a href="#">Samples</a>
SN74LS253DR	ACTIVE	SOIC	D	16	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	LS253	<a href="#">Samples</a>
SN74LS253N	ACTIVE	PDIP	N	16	25	RoHS & Green	NIPDAU	N / A for Pkg Type	0 to 70	SN74LS253N	<a href="#">Samples</a>
SN74LS253N	ACTIVE	PDIP	N	16	25	RoHS & Green	NIPDAU	N / A for Pkg Type	0 to 70	SN74LS253N	<a href="#">Samples</a>

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
SNJ54LS253FK	ACTIVE	LCCC	FK	20	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	76017012A SNJ54LS 253FK	<a href="#">Samples</a>
SNJ54LS253FK	ACTIVE	LCCC	FK	20	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	76017012A SNJ54LS 253FK	<a href="#">Samples</a>
SNJ54LS253J	ACTIVE	CDIP	J	16	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	7601701EA SNJ54LS253J	<a href="#">Samples</a>
SNJ54LS253J	ACTIVE	CDIP	J	16	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	7601701EA SNJ54LS253J	<a href="#">Samples</a>

(1) 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.

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

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and

continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

**OTHER QUALIFIED VERSIONS OF SN54LS253, SN74LS253 :**

- Catalog: [SN74LS253](#)
- Military: [SN54LS253](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications



## TAPE AND REEL INFORMATION



### 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
SN74LS253DR	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)
SN74LS253DR	SOIC	D	16	2500	333.2	345.9	28.6

FK (S-CQCC-N\*\*)

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



NO. OF TERMINALS **	A		B	
	MIN	MAX	MIN	MAX
20	0.342 (8,69)	0.358 (9,09)	0.307 (7,80)	0.358 (9,09)
28	0.442 (11,23)	0.458 (11,63)	0.406 (10,31)	0.458 (11,63)
44	0.640 (16,26)	0.660 (16,76)	0.495 (12,58)	0.560 (14,22)
52	0.740 (18,78)	0.761 (19,32)	0.495 (12,58)	0.560 (14,22)
68	0.938 (23,83)	0.962 (24,43)	0.850 (21,6)	0.858 (21,8)
84	1.141 (28,99)	1.165 (29,59)	1.047 (26,6)	1.063 (27,0)



4040140/D 01/11

- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - This package can be hermetically sealed with a metal lid.
  - 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.
  - C. 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.
  - D. 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.

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Publication IPC-7351 is recommended for alternate designs.
  - 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.
  - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

N (R-PDIP-T\*\*)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
  - The 20 pin end lead shoulder width is a vendor option, either half or full width.

W (R-GDFP-F16)

CERAMIC DUAL FLATPACK



- 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 ceramic lid using glass frit.
  - D. Index point is provided on cap for terminal identification only.
  - E. Falls within MIL STD 1835 GDFP2-F16

J (R-GDIP-T\*\*)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



DIM \ PINS **	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)



4040083/F 03/03

- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - This package is hermetically sealed with a ceramic lid using glass frit.
  - Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
  - Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.



## IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to TI's Terms of Sale (<https://www.ti.com/legal/termsofsale.html>) or other applicable terms available either on [ti.com](https://www.ti.com) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2021, Texas Instruments Incorporated