

SN75ALS194 Quadruple Differential Line Drivers

1 Features

- Meet or exceed the requirements of ANSI standard EIA/TIA-422-B and ITU recommendation V.11
- Designed to operate up to 20 Mbaud
- 3-state TTL-compatible outputs
- Single 5V supply operation
- High output impedance in power-off condition
- Two pairs of drivers, independently enabled
- Designed as improved replacements for the MC3487

2 Applications

- [Factory automation](#)
- ATM and cash counters
- [Smart grid](#)
- AC and [servo motor drives](#)

3 Description

These four differential line drivers are designed for data transmission over twisted-pair or parallel-wire transmission lines. They meet the requirements of ANSI Standard EIA/TIA-422-B and ITU Recommendation V.11 and are compatible with 3-state TTL circuits. Advanced low-power Schottky technology provides high speed without the usual power penalty. Standby supply current is typically only 26mA. Typical propagation delay time is less than 10ns, and enable/disable times are typically less than 16ns.

High-impedance inputs keep input currents low: less than 1µA for a high level and less than 100µA for a low level. The driver circuits can be enabled in pairs by separate active-high enable inputs. The SN75ALS194 is capable of data rates in excess of 20 megabits per second and is designed to operate with the SN75ALS195 quadruple line receiver.

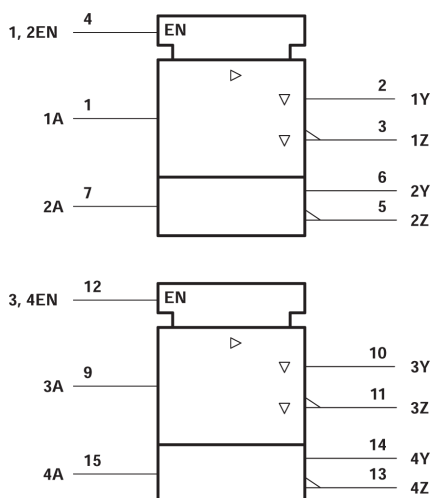
The SN75ALS194 is characterized for operation from 0°C to 70°C.

Package Information

PART NUMBER	PACKAGE ⁽¹⁾	PACKAGE SIZE ⁽²⁾
SN75ALS194	NS (SOP, 16)	10.2mm × 7.8mm
	D (SOIC, 16)	9.9mm × 6mm
	N (PDIP, 16)	19.3mm × 9.4mm

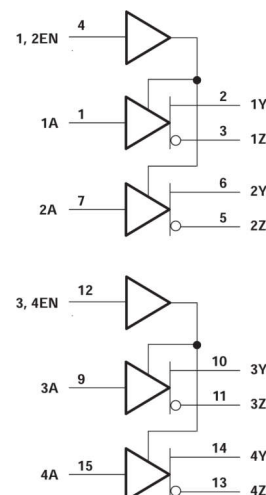
(1) For more information, [Section 10](#).

(2) The package size (length × width) is a nominal value and includes pins, where applicable.



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

Logic Symbol¹



Logic Diagram (Positive Logic)

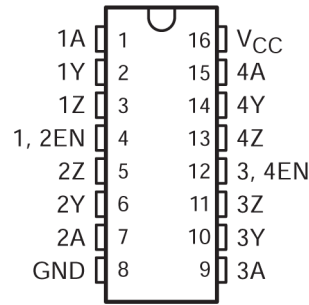
¹ This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.



Table of Contents

1 Features	1	6 Parameter Measurement Information	10
2 Applications	1	7 Detailed Description	12
3 Description	1	7.1 Device Functional Modes.....	12
4 Pin Configuration and Functions	3	8 Device and Documentation Support	13
5 Specifications	4	8.1 Receiving Notification of Documentation Updates....	13
5.1 Absolute Maximum Ratings.....	4	8.2 Support Resources.....	13
5.2 Dissipation Ratings.....	4	8.3 Trademarks.....	13
5.3 Recommended Operating Conditions.....	4	8.4 Electrostatic Discharge Caution.....	13
5.4 Thermal Information.....	4	8.5 Glossary.....	13
5.5 Electrical Characteristics.....	5	9 Revision History	13
5.6 Switching Characteristics.....	5	10 Mechanical, Packaging, and Orderable	
5.7 Typical Characteristics	7	Information	13

4 Pin Configuration and Functions



**Figure 4-1. D, N, or NS Package
(Top View)**

Table 4-1. Pin Functions

PIN		TYPE ⁽¹⁾	DESCRIPTION
NAME	NO.		
1A	1	I	Single Ended Data Input for Channel 1
1Y	2	O	Non-Inverting Output for Differential Driver on Channel 1
1Z	3	O	Inverting Output of Differential Driver on Channel 1
1, 2EN	4	I	Channel 1 and 2 Enable
2Z	5	O	Inverting Output of Differential Driver on Channel 2
2Y	6	O	Non-Inverting Output for Differential Driver on Channel 2
2A	7	I	Single Ended Data Input for Channel 2
GND	8	GND	Device GND
3A	9	I	Single Ended Data Input for Channel 3
3Y	10	O	Non-Inverting Output for Differential Driver on Channel 3
3Z	11	O	Inverting Output of Differential Driver on Channel 3
3, 4EN	12	I	Channel 3 and 4 Enable
4Z	13	O	Inverting Output of Differential Driver on Channel 4
4Y	14	O	Non-Inverting Output for Differential Driver on Channel 4
4A	15	I	Single Ended Data Input for Channel 4
V _{CC}	16	PWR	Device VCC (4.75V to 5.25V)

(1) Signal Types: I = Input, O = Output, I/O = Input or Output.

5 Specifications

5.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)⁽¹⁾

			MIN	MAX	UNIT
V _{CC}	Supply voltage, (see ⁽²⁾)			7	V
V _I	Input voltage			5.5	V
V _O	Output voltage			7	V
	Continuous total dissipation		See <i>Dissipation Ratings</i> table		
T _A	Operating free-air temperature range:	SN75ALS194	0	70	°C
	Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds:	D or N package		260	°C
T _{stg}	Storage temperature range		-65	150	°C

- (1) Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) All voltage values are with respect to network ground terminal

5.2 Dissipation Ratings

PACKAGE	T _A ≤ 25°C POWER RATING	DERATING FACTOR ABOVE T _A = 25°C	T _A = 70°C POWER RATING	T _A = 125°C POWER RATING
D	950 mW	7.6 mW/°C	608 mW	N/A
N	1150 mW	9.2 mW/°C	736 mW	N/A

5.3 Recommended Operating Conditions

(1)		SN75ALS194			UNIT	
		MIN	NOM	MAX		
Supply voltage, V _{CC}		4.75	5	5.25	V	
High-level input voltage, V _{IH}	All inputs, T _A = 25°C	2				
	A inputs, T _A = Full range	2			V	
	EN inputs, T _A = Full range	2				
Low-level input voltage, V _{IL}					0.8	V
High-level output current, I _{OH}					-20	mA
Low-level output current, I _{OL}	T _A = 25°C				48	mA
	T _A = Full range				48	
Operating free-air temperature, T _A		0		70	°C	

- (1) Full range is T_A = 0°C to 70°C for SN75ALS194.

5.4 Thermal Information

THERMAL METRIC ⁽¹⁾		D (SOIC)	N (PDIP)	NS (SOP)	UNIT
		16-PINS			
R _{θJA}	Junction-to-ambient thermal resistance	84.6	60.6	88.5	°C/W
R _{θJC(top)}	Junction-to-case (top) thermal resistance	43.5	48.1	46.2	°C/W
R _{θJB}	Junction-to-board thermal resistance	43.2	40.6	50.7	°C/W
ψ _{JT}	Junction-to-top characterization parameter	10.4	27.5	13.5	°C/W
ψ _{JB}	Junction-to-board characterization parameter	42.8	40.3	50.3	°C/W
R _{θJC(bot)}	Junction-to-case (bottom) thermal resistance	N/A	N/A	N/A	°C/W

- (1) For more information about traditional and new thermal metrics, see the [Semiconductor and IC package thermal metrics](#) application report.

5.5 Electrical Characteristics

over recommended ranges of supply voltage and operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS ⁽¹⁾		MIN	TYP ⁽²⁾	MAX	UNIT
V _{IK}	Input clamp voltage	V _{CC} = MIN,	I _I = -18mA			-1.5	V
V _{OH}	High-level output voltage	V _{CC} = MIN, I _{OH} = -20mA	SN75ALS194	2.5			V
V _{OL}	Low-level output voltage	V _{CC} = MIN,	I _{OL} = MAX			0.5	V
V _O	Output voltage	I _O = 0		0		6	V
V _{OD1}	Differential output voltage	I _O = 0		1.5		6	V
V _{OD2}	Differential output voltage			1/2 V _{OD1} or 2 ⁽³⁾			V
Δ V _{OD}	Change in magnitude of differential output voltage ⁽⁴⁾	R _L = 100Ω,	See Figure 5-1			±0.4	V
V _{OC}	Common-mode output voltage					±3	V
Δ V _{OC}	Change in magnitude of common-mode output voltage ⁽⁴⁾					±0.4	V
I _O	Output current with power off	V _{CC} = 0	V _O = 6V			100	mA
			V _O = -0.25V			-100	
I _{OZ}	High-impedance-state output current	V _{CC} = MAX, Output enables at 0.8V	V _O = 2.7V			100	mA
			V _O = 0.5V			-100	
I _I	Input current at maximum input voltage	V _{CC} = MAX,	V _I = 5.5V			100	mA
I _{IH}	High-level input current	V _{CC} = MAX,	V _I = 2.7V			50	mA
I _{IL}	Low-level input current	V _{CC} = MAX,	V _I = 0.5V			-200	mA
I _{OS}	Short-circuit output current ⁽⁵⁾	V _{CC} = MAX,	V _I = 2V	-40		-140	mA
I _{CC}	Supply current (all drivers)	V _{CC} = MAX,	All outputs disabled		26	45	mA

- (1) For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
- (2) All typical values are at V_{CC} = 5V, T_A = 25°C.
- (3) The minimum V_{OD2} with a 100Ω load is either 1/2V_{OD1} or 2V, whichever is greater.
- (4) Δ|V_{OD}| and Δ|V_{OC}| are the changes in magnitude of V_{OD} and V_{OC}, respectively, that occur when the input is changed from a high level to a low level.
- (5) Not more than one output should be shorted at a time, and duration of the short circuit should not exceed one second.

5.6 Switching Characteristics

V_{CC} = 5V, T_A = 25°C

PARAMETER		TEST CONDITIONS	SN75ALS194			UNIT
			MIN	TYP	MAX	
t _{PLH}	Propagation delay time, low- to high-level output	C _L = 15 pF, L = 15 pF, See Figure 6-1		6	13	ns
t _{PHL}	Propagation delay time, high- to low-level output			9	14	ns
	Output-to-output skew			3.5	6	ns
t _{t(OD)}	Differential output transition time	C _L = 15 pF, See Figure 6-2		8	14	ns
t _{PZH}	Output enable time to high level	C _L = 15 pF, See Figure 6-3		9	12	ns
t _{PZL}	Output enable time to low level			12	20	ns
t _{PHZ}	Output disable time from high level			9	14	ns
t _{PLZ}	Output disable time from low level			12	15	ns

Table 5-1. Symbol Equivalents

DATA SHEET PARAMETER	EIA/TIA-422-B
V_O	V_{oa}, V_{ob}
$ V_{OD1} $	V_o
$ V_{OD2} $	$V_t (R_L = 100 \Omega)$
$\Delta V_{OD} $	$ V_i - \bar{V}_i $
V_{OC}	$ V_{os} $
$\Delta V_{OC} $	$ V_{os} - \bar{V}_{os} $
I_{OS}	$ I_{sa} , I_{sb} $
I_O	$ I_{xa} , I_{xb} $

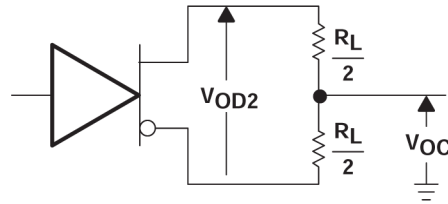


Figure 5-1. Driver V_{OD} And V_{OC}

5.7 Typical Characteristics

Data for temperatures below 0°C and above 70°C are applicable to the SN55ALS194 circuits only.

The A input is connected to V_{CC} during the testing of the Y outputs and to GND during the testing of the Z outputs.

The A input is connected to ground during the testing of the Y outputs and to V_{CC} during the testing of the Z outputs.

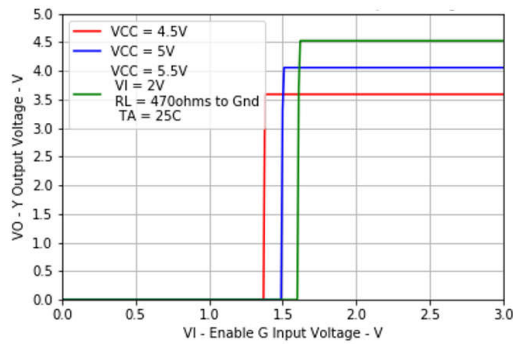


Figure 5-2. Y Output Voltage vs Data Input Voltage

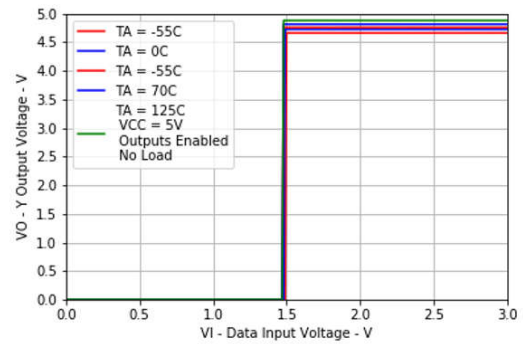


Figure 5-3. Y Output Voltage vs Data Input Voltage

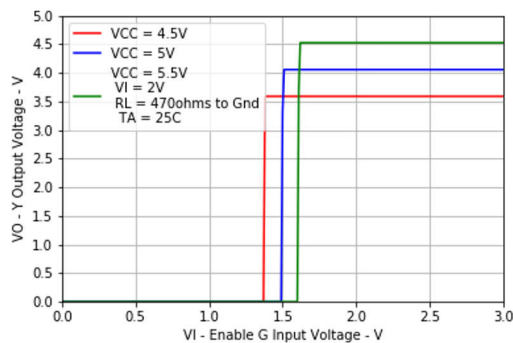


Figure 5-4. Y Output Voltage vs Enable G Input Voltage

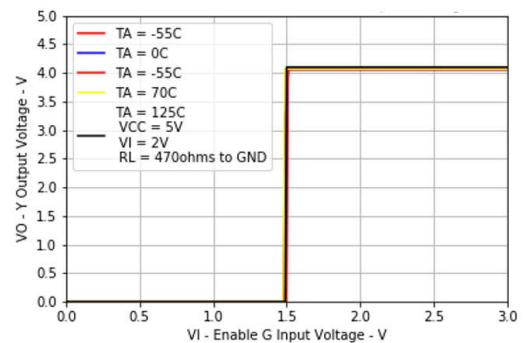


Figure 5-5. Y Output Voltage vs Enable G Input Voltage

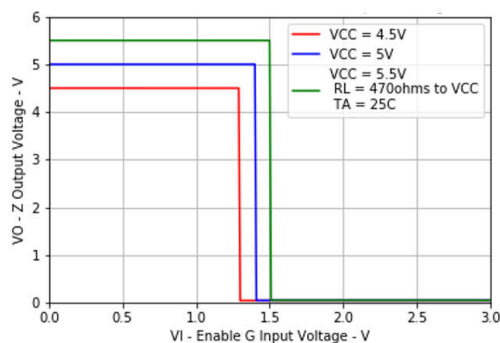


Figure 5-6. Z Output Voltage vs Enable G Input Voltage

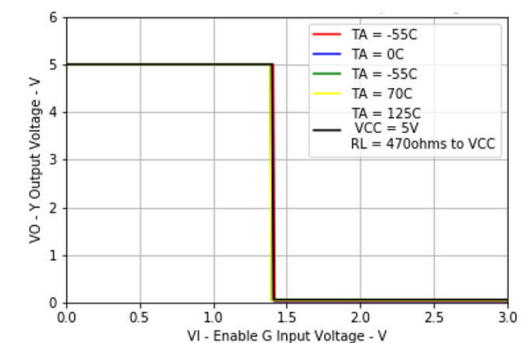


Figure 5-7. Z Output Voltage vs Enable G Input Voltage

5.7 Typical Characteristics (continued)

Data for temperatures below 0°C and above 70°C are applicable to the SN55ALS194 circuits only.

The A input is connected to V_{CC} during the testing of the Y outputs and to GND during the testing of the Z outputs.

The A input is connected to ground during the testing of the Y outputs and to V_{CC} during the testing of the Z outputs.

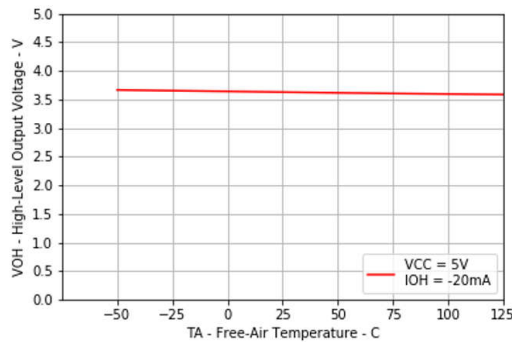


Figure 5-8. High-level Output Voltage vs Free-air Temperature

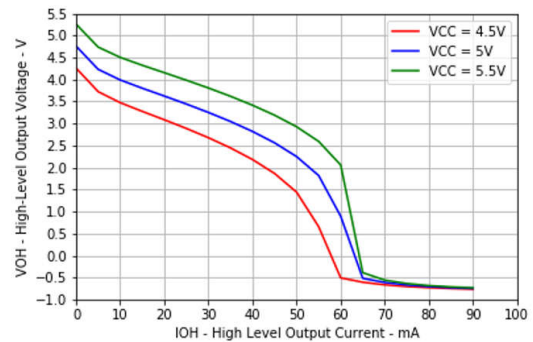


Figure 5-9. High-level Output Voltage vs High-level Output Current

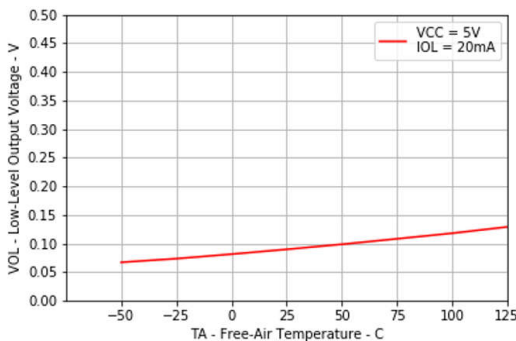


Figure 5-10. Low-level Output Voltage vs Free-air Temperature

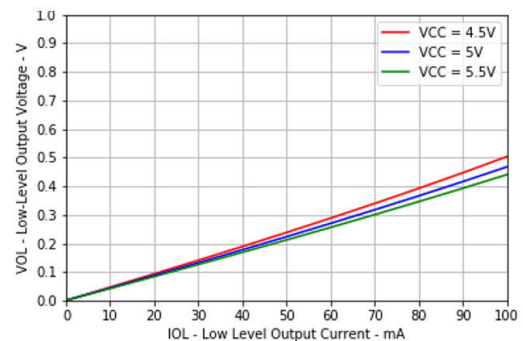


Figure 5-11. Low-level Output Voltage vs Low-level Output Current

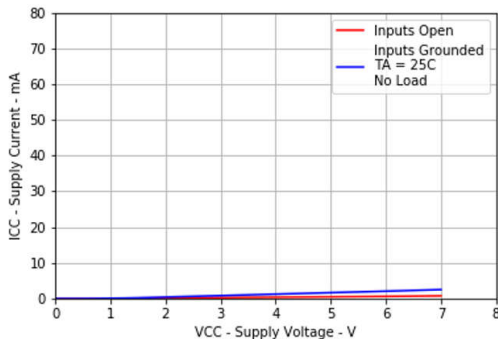


Figure 5-12. Supply Current vs Supply Voltage

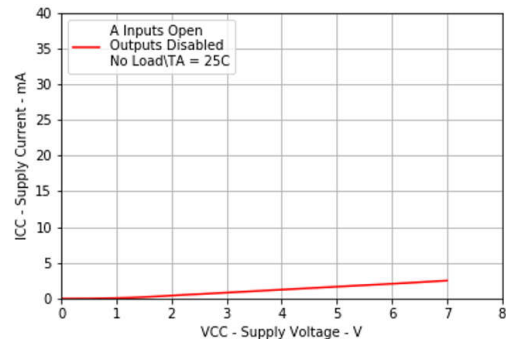


Figure 5-13. Supply Current vs Supply Voltage

5.7 Typical Characteristics (continued)

Data for temperatures below 0°C and above 70°C are applicable to the SN55ALS194 circuits only.
The A input is connected to V_{CC} during the testing of the Y outputs and to GND during the testing of the Z outputs.
The A input is connected to ground during the testing of the Y outputs and to V_{CC} during the testing of the Z outputs.

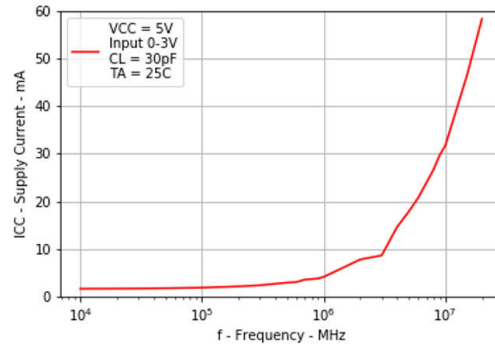
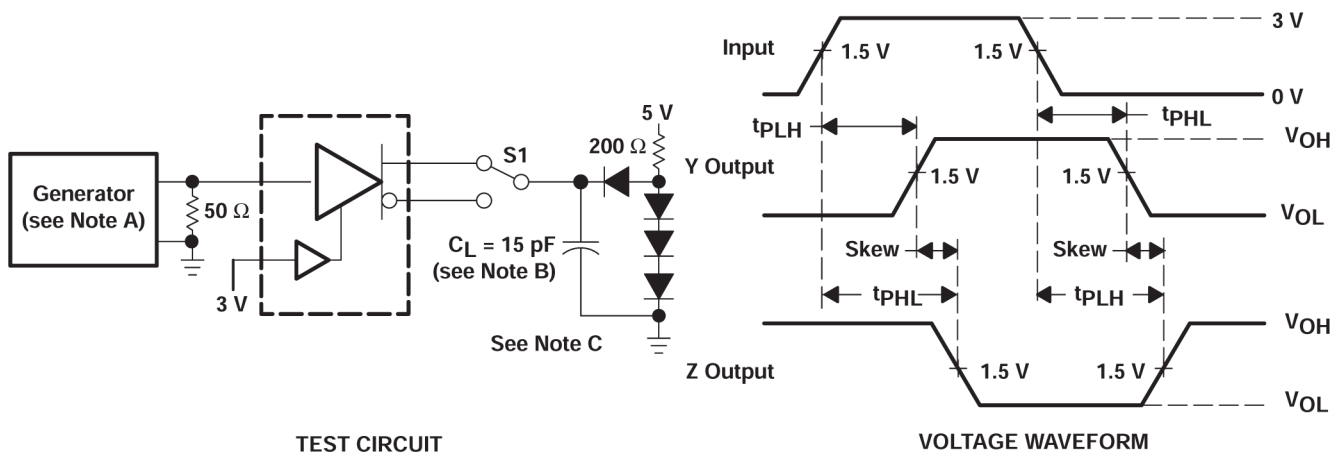


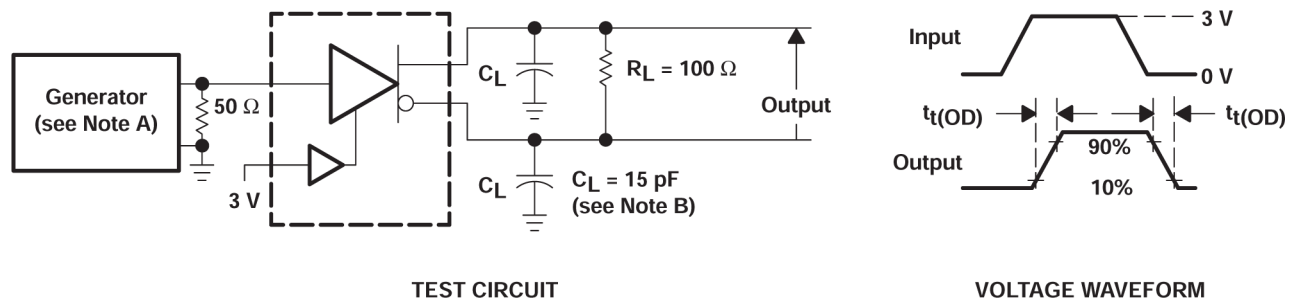
Figure 5-14. Supply Current vs Frequency

6 Parameter Measurement Information



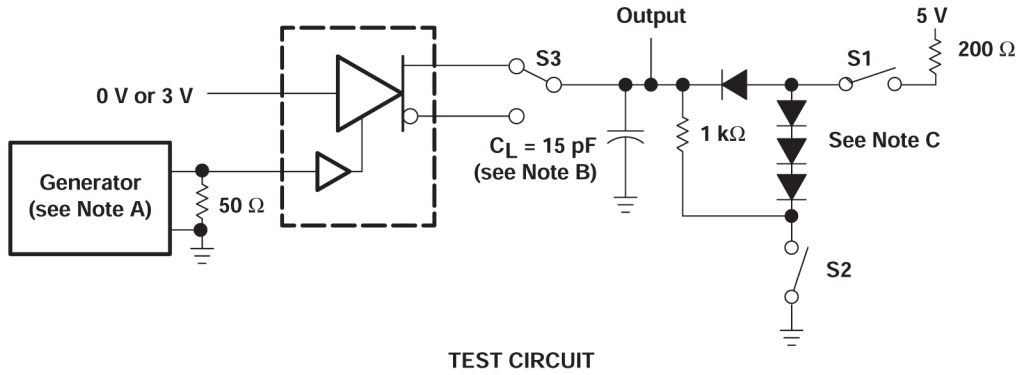
- A. The input pulse is supplied by a generator having the following characteristics: $t_r \leq 5\text{ns}$, $t_f \leq 5\text{ns}$, $\text{PRR} \leq 1\text{MHz}$, duty cycle $\leq 50\%$, $Z_O \approx 50\Omega$.
- B. C_L includes probe and stray capacitance.
- C. All diodes are 1N916 or 1N3064.

Figure 6-1. Test Circuit and Voltage Waveform

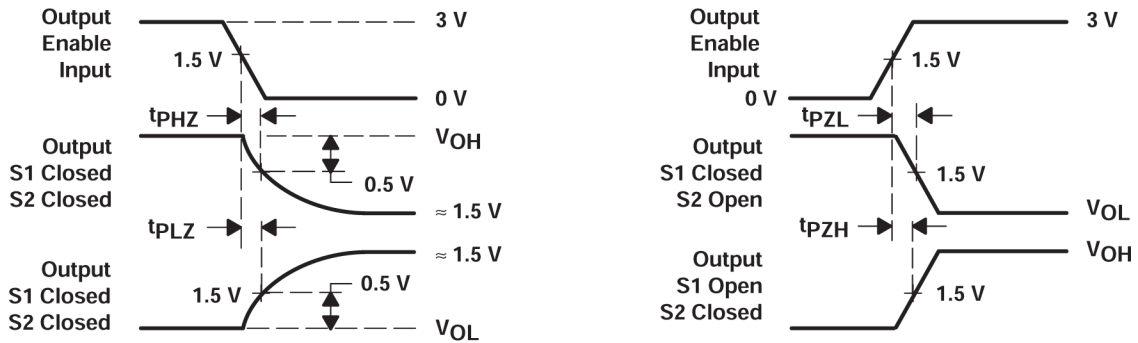


- A. The input pulse is supplied by a generator having the following characteristics: $t_r \leq 5\text{ns}$, $t_f \leq 5\text{ns}$, $\text{PRR} \leq 1\text{MHz}$, duty cycle $\leq 50\%$, $Z_O \approx 50\Omega$.
- B. C_L includes probe and stray capacitance.

Figure 6-2. Differential-Output Test Circuit and Voltage Waveform



TEST CIRCUIT



VOLTAGE WAVEFORMS

- A. The input pulse is supplied by a generator having the following characteristics: $t_r \leq 5 \text{ ns}$, $t_f \leq 5 \text{ ns}$, $\text{PRR} \leq 1 \text{ MHz}$, duty cycle $\leq 50\%$, $Z_o \approx 50 \Omega$.
- B. C_L includes probe and stray capacitance.
- C. All diodes are 1N916 or 1N3064.

Figure 6-3. Driver Test Circuit and Voltage Waveforms

7 Detailed Description

7.1 Device Functional Modes

Function Table (Each Driver)

INPUTS A ⁽¹⁾	OUTPUT EN	OUTPUTS	
		Y	Z
H	H	H	L
L	H	L	H
X	L	Z	Z

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

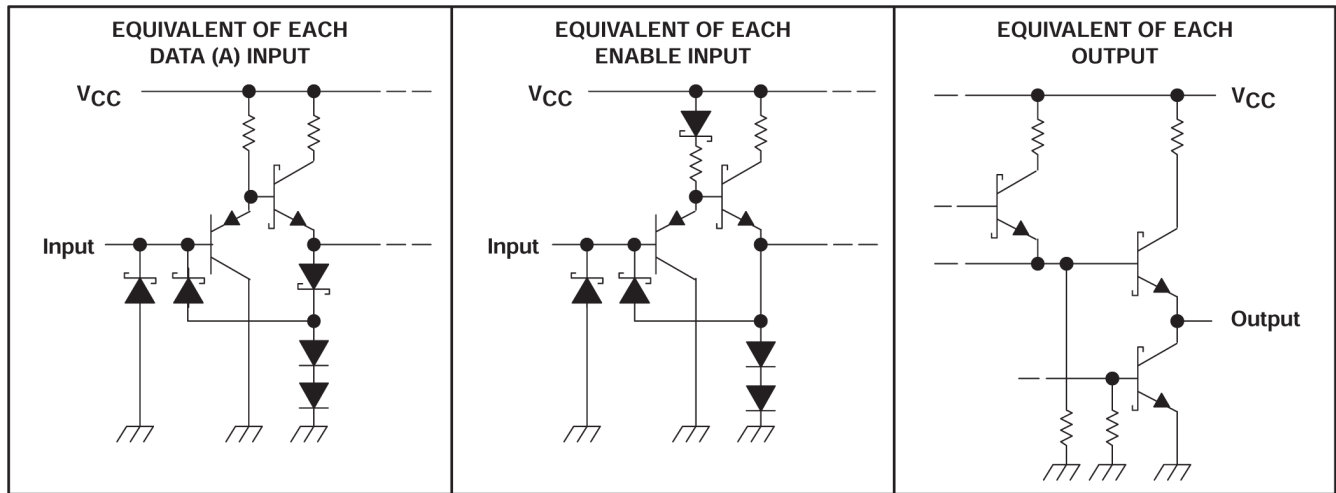


Figure 7-1. Schematics of Inputs and Outputs

8 Device and Documentation Support

TI offers an extensive line of development tools. Tools and software to evaluate the performance of the device, generate code, and develop solutions are listed below.

8.1 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. Click on *Notifications* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

8.2 Support Resources

[TI E2E™ support forums](#) are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

Linked content is provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

8.3 Trademarks

TI E2E™ is a trademark of Texas Instruments.
All trademarks are the property of their respective owners.

8.4 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

8.5 Glossary

[TI Glossary](#) This glossary lists and explains terms, acronyms, and definitions.

9 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision D (May 1995) to Revision E (March 2024)	Page
• Changed the numbering format for tables, figures, and cross-references throughout the document.....	1

10 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

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
SN75ALS194DR	ACTIVE	SOIC	D	16	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	75ALS194	Samples
SN75ALS194N	ACTIVE	PDIP	N	16	25	RoHS & Green	NIPDAU	N / A for Pkg Type	0 to 70	SN75ALS194N	Samples
SN75ALS194NSR	ACTIVE	SO	NS	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	75ALS194	Samples

(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.

OBSOLETE: 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.

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
SN75ALS194DR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
SN75ALS194NSR	SO	NS	16	2000	330.0	16.4	8.2	10.5	2.5	12.0	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)
SN75ALS194DR	SOIC	D	16	2500	340.5	336.1	32.0
SN75ALS194NSR	SO	NS	16	2000	356.0	356.0	35.0

TUBE


*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
SN75ALS194D	D	SOIC	16	40	507	8	3940	4.32
SN75ALS194N	N	PDIP	16	25	506	13.97	11230	4.32



PACKAGE OUTLINE

NS0016A

SOP - 2.00 mm max height

SOP



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NOTES:

1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm, per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm, per side.

EXAMPLE BOARD LAYOUT

NS0016A

SOP - 2.00 mm max height

SOP



4220735/A 12/2021

NOTES: (continued)

5. Publication IPC-7351 may have alternate designs.
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

NS0016A

SOP - 2.00 mm max height

SOP



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:7X

4220735/A 12/2021

NOTES: (continued)

7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
8. Board assembly site may have different recommendations for stencil design.

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



4211283-4/E 08/12

- 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.

MECHANICAL DATA

NS (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

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.

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