



THE DATASHEET OF DS3691N



DS1691A,DS3691

DS1691A/DS3691 (RS-422/RS-423) Line Drivers with TRI-STATE Outputs



Literature Number: SNLS357C

DS1691A/DS3691 (RS-422/RS-423) Line Drivers with TRI-STATE® Outputs

General Description

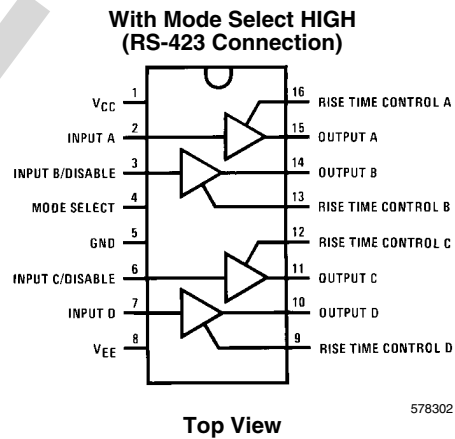
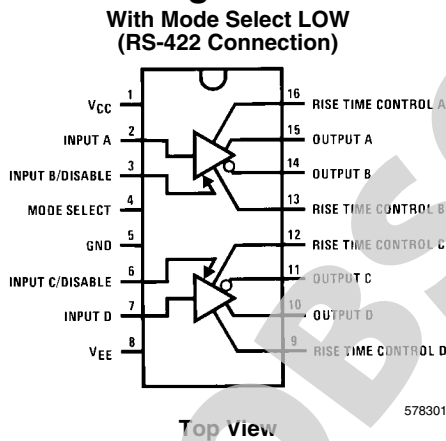
The DS1691A/DS3691 are low power Schottky TTL line drivers designed to meet the requirements of EIA standards RS-422 and RS-423. They feature 4 buffered outputs with high source and sink current capability with internal short circuit protection. A mode control input provides a choice of operation either as 4 single-ended line drivers or 2 differential line drivers. A rise time control pin allows the use of an external capacitor to slow the rise time for suppression of near end crosstalk to other receivers in the cable. Rise time capacitors are primarily intended for waveshaping output signals in the single-ended driver mode. Multipoint applications in differential mode with waveshaping capacitors is not allowed.

With the mode select pin low, the DS1691A/DS3691 are dual-differential line drivers with TRI-STATE outputs. They feature $\pm 10V$ output common-mode range in TRI-STATE mode and 0V output unbalance when operated with $\pm 5V$ supply.

Features

- Dual RS-422 line driver with mode pin low, or quad RS-423 line driver with mode pin high
- TRI-STATE outputs in RS-422 mode
- Short circuit protection for both source and sink outputs
- Outputs will not clamp line with power off or in TRI-STATE
- 100 Ω transmission line drive capability
- Low I_{CC} and I_{EE} power consumption
 RS-422: $I_{CC} = 9 \text{ mA/driver typ}$
 RS-423: $I_{CC} = 4.5 \text{ mA/driver typ}$
 $I_{EE} = 2.5 \text{ mA/driver typ}$
- Low current PNP inputs compatible with TTL, MOS and CMOS
- Pin compatible with AM26LS30

Connection Diagrams



Ordering Information

Order Number	Package Type	NS Package Number
DS3691M	SO Package	M16A
DS3691N	Molded DIP	N16E
For Complete Military Product Specifications, refer to the appropriate SMD or MDS.		
DS1691AJ/883	Ceramic DIP	J16A

Absolute Maximum Ratings (Note 2)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

Supply Voltage	
V_{CC}	7V
V_{EE}	-7V
Maximum Power Dissipation (Note 1) at 25°C	
Cavity Package	1509 mW
Molded DIP Package	1476 mW
SO Package	1051 mW
Input Voltage	15V
Output Voltage (Power OFF)	±15V

Storage Temperature -65°C to +150°C

Lead Temperature (Soldering, 4 seconds) 260°C

Operating Conditions

	Min	Max	Units
Supply Voltage			
DS1691A			
V_{CC}	4.5	5.5	V
V_{EE}	-4.5	-5.5	V
DS3691			
V_{CC}	4.75	5.25	V
V_{EE}	-4.75	-5.25	V
Temperature (T_A)			
DS1691A	-55	+125	°C
DS3691	0	+70	°C

Note 1: Derate cavity package 10.1 mW/°C above 25°C; derate molded DIP package 11.9 mW/°C above 25°C. Derate SO package 8.41 mW/°C above 25°C.

DC Electrical Characteristics (Notes 3, 4, 5, 6)

Symbol	Parameter	Conditions	Min	Typ	Max	Units	
RS-422 CONNECTION, V_{EE} CONNECTION TO GROUND, MODE SELECT ≤ 0.8V							
V_{IH}	High Level Input Voltage		2			V	
V_{IL}	Low Level Input Voltage				0.8	V	
I_{IH}	High Level Input Current	$V_{IN} = 2.4V$		1	40	μA	
		$V_{IN} \leq 15V$		10	100	μA	
I_{IL}	Low Level Input Current	$V_{IN} = 0.4V$		-30	-200	μA	
V_I	Input Clamp Voltage	$I_{IN} = -12 mA$			-1.5	V	
V_O $\overline{V_O}$	Differential Output Voltage $V_{A,B}$	$R_L = \infty$	$V_{IN} = 2V$		3.6	6.0	V
			$V_{IN} = 0.8V$		-3.6	-6.0	V
V_T $\overline{V_T}$	Differential Output Voltage $V_{A,B}$	$R_L = 100\Omega$ $V_{CC} \geq 4.75V$	$V_{IN} = 2V$	2	2.4		V
			$V_{IN} = 0.8V$	-2	-2.4		V
$V_{OS}, \overline{V_{OS}}$	Common-Mode Offset Voltage	$R_L = 100\Omega$		2.5	3	V	
$ V_T - \overline{V_T} $	Difference in Differential Output Voltage	$R_L = 100\Omega$		0.05	0.4	V	
$ V_{OS} - \overline{V_{OS}} $	Difference in Common-Mode Offset Voltage	$R_L = 100\Omega$		0.05	0.4	V	
V_{SS}	$ V_T - \overline{V_T} $	$R_L = 100\Omega, V_{CC} \geq 4.75V$	4.0	4.8		V	
V_{CMR}	Output Voltage Common-Mode Range	$V_{DISABLE} = 2.4V$	±10			V	
I_{XA} I_{XB}	Output Leakage Current Power OFF	$V_{CC} = 0V$	$V_{CMR} = 10V$			100	μA
			$V_{CMR} = -10V$			-100	μA
I_{OX}	TRI-STATE Output Current	$V_{CC} = \text{Max}$ $V_{EE} = 0V \text{ and } -5V$	$V_{CMR} \leq 10V$			100	μA
			$V_{CMR} \geq -10V$			-100	μA
I_{SA}	Output Short Circuit Current	$V_{IN} = 0.4V$	$V_{OA} = 6V$		80	150	mA
			$V_{OB} = 0V$		-80	-150	mA
I_{SB}	Output Short Circuit Current	$V_{IN} = 2.4V$	$V_{OA} = 0V$		-80	-150	mA
			$V_{OB} = 6V$		80	150	mA
I_{CC}	Supply Current			18	30	mA	

AC Electrical Characteristics (Note 6) $T_A = 25^\circ\text{C}$

Symbol	Parameter	Conditions	Min	Typ	Max	Units
RS-422 CONNECTION, $V_{CC} = 5\text{V}$, MODE SELECT = 0.8V						
t_r	Output Rise Time	$R_L = 100\Omega$, $C_L = 500\text{ pF}$ (Figure 1)		120	200	ns
t_f	Output Fall Time	$R_L = 100\Omega$, $C_L = 500\text{ pF}$ (Figure 1)		120	200	ns
t_{PDH}	Output Propagation Delay	$R_L = 100\Omega$, $C_L = 500\text{ pF}$ (Figure 1)		120	200	ns
t_{PDL}	Output Propagation Delay	$R_L = 100\Omega$, $C_L = 500\text{ pF}$ (Figure 1)		120	200	ns
t_{PZL}	TRI-STATE Delay	$R_L = 450\Omega$, $C_L = 500\text{ pF}$, $C_C = 0\text{ pF}$ (Figure 4)		250	350	ns
t_{PZH}	TRI-STATE Delay	$R_L = 450\Omega$, $C_L = 500\text{ pF}$, $C_C = 0\text{ pF}$ (Figure 4)		180	300	ns
t_{PLZ}	TRI-STATE Delay	$R_L = 450\Omega$, $C_L = 500\text{ pF}$, $C_C = 0\text{ pF}$ (Figure 4)		180	300	ns
t_{PHZ}	TRI-STATE Delay	$R_L = 450\Omega$, $C_L = 500\text{ pF}$, $C_C = 0\text{ pF}$ (Figure 4)		250	350	ns

DC Electrical Characteristics (Notes 3, 4, 5, 6)

Symbol	Parameter	Conditions	Min	Typ	Max	Units	
RS-423 CONNECTION, $I_{V_{CC}} = I_{V_{EE}}$, MODE SELECT $\geq 2\text{V}$							
V_{IH}	High Level Input Voltage		2			V	
V_{IL}	Low Level Input Voltage				0.8	V	
I_{IH}	High Level Input Current	$V_{IN} = 2.4\text{V}$		1	40	μA	
		$V_{IN} \leq 15\text{V}$		10	100	μA	
I_{IL}	Low Level Input Current	$V_{IN} = 0.4\text{V}$		-30	-200	μA	
V_I	Input Clamp Voltage	$I_{IN} = -12\text{ mA}$			-1.5	V	
V_O	Output Voltage	$R_L = \infty$, (Note 7) $V_{CC} \geq 4.75\text{V}$	$V_{IN} = 2\text{V}$	4.0	4.4	6.0	V
$\overline{V_O}$			$V_{IN} = 0.4\text{V}$	-4.0	-4.4	-6.0	V
V_T	Output Voltage	$R_L = 450\Omega$ $V_{CC} \geq 4.75\text{V}$	$V_{IN} = 2.4\text{V}$	3.6	4.1		V
$\overline{V_T}$			$V_{IN} = 0.4\text{V}$	-3.6	-4.1		V
$ V_T - \overline{V_T} $	Output Unbalance	$ V_{CC} = V_{EE} = 4.75\text{V}$, $R_L = 450\Omega$		0.02	0.4	V	
I_{X^+}	Output Leakage Power OFF	$V_{CC} = V_{EE} = 0\text{V}$ $V_O = 6\text{V}$		2	100	μA	
I_{X^-}	Output Leakage Power OFF	$V_{CC} = V_{EE} = 0\text{V}$ $V_O = -6\text{V}$		-2	-100	μA	
I_{S^+}	Output Short Circuit Current	$V_O = 0\text{V}$ $V_{IN} = 2.4\text{V}$		-80	-150	mA	
I_{S^-}	Output Short Circuit Current	$V_O = 0\text{V}$ $V_{IN} = 0.4\text{V}$		80	150	mA	
I_{SLEW}	Slew Control Current			± 140		μA	
I_{CC}	Positive Supply Current	$V_{IN} = 0.4\text{V}$, $R_L = \infty$		18	30	mA	
I_{EE}	Negative Supply Current	$V_{IN} = 0.4\text{V}$, $R_L = \infty$		-10	-22	mA	

Note 2: "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the devices should be operated at these limits. The tables of "Electrical Characteristics" provide conditions for actual device operation.

Note 3: Unless otherwise specified, min/max limits apply across the -55°C to $+125^\circ\text{C}$ temperature range for the DS1691A and across the 0°C to $+70^\circ\text{C}$ range for the DS3691. All typicals are given for $V_{CC} = 5\text{V}$ and $T_A = 25^\circ\text{C}$. V_{CC} and V_{EE} as listed in operating conditions.

Note 4: All currents into device pins are positive; all currents out of device pins are negative. All voltages are referenced to ground unless otherwise specified.

Note 5: Only one output at a time should be shorted.

Note 6: Symbols and definitions correspond to EIA RS-422 and/or RS-423 where applicable.

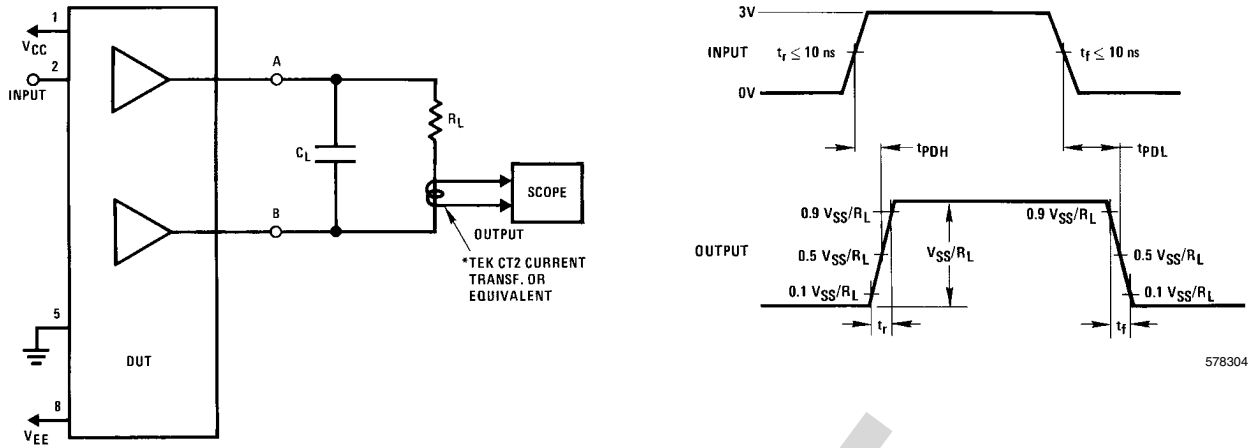
Note 7: At -55°C , the output voltage is $+3.9\text{V}$ minimum and -3.9V minimum.

AC Electrical Characteristics (Note 6) $T_A = 25^\circ\text{C}$

Symbol	Parameter	Conditions	Min	Typ	Max	Units
RS-423 CONNECTION, $V_{CC} = 5V$, $V_{EE} = -5V$, MODE SELECT = 2.4V						
t_r	Rise Time	$R_L = 450\Omega$, $C_L = 500\text{ pF}$, $C_C = 0$ (Figure 2)		120	300	ns
t_f	Fall Time	$R_L = 450\Omega$, $C_L = 500\text{ pF}$, $C_C = 0$ (Figure 2)		120	300	ns
t_r	Rise Time	$R_L = 450\Omega$, $C_L = 500\text{ pF}$, $C_C = 50\text{ pF}$ (Figure 3)		3.0		μs
t_f	Fall Time	$R_L = 450\Omega$, $C_L = 500\text{ pF}$, $C_C = 50\text{ pF}$ (Figure 3)		3.0		μs
t_{rc}	Rise Time Coefficient	$R_L = 450\Omega$, $C_L = 500\text{ pF}$, $C_C = 50\text{ pF}$ (Figure 3)		0.06		$\mu\text{s/pF}$
t_{PDH}	Output Propagation Delay	$R_L = 450\Omega$, $C_L = 500\text{ pF}$, $C_C = 0$ (Figure 2)		180	300	ns
t_{PDL}	Output Propagation Delay	$R_L = 450\Omega$, $C_L = 500\text{ pF}$, $C_C = 0$ (Figure 2)		180	300	ns

OBSOLETE

AC Test Circuits and Switching Time Waveforms



578303
FIGURE 1. Differential Connection

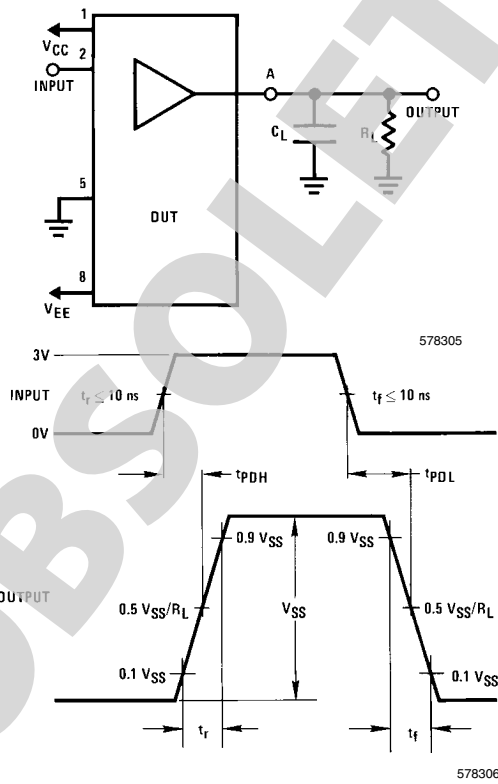


FIGURE 2. RS-423 Connection

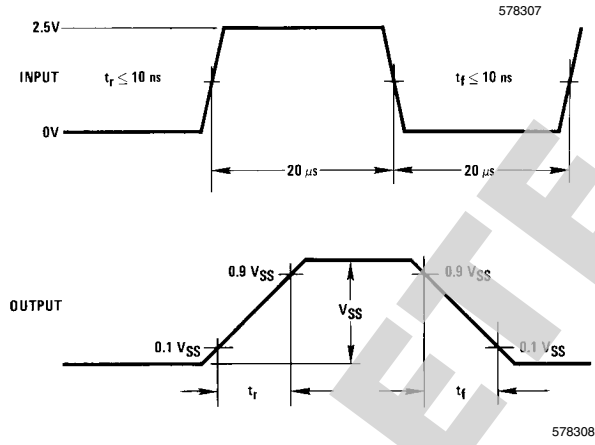
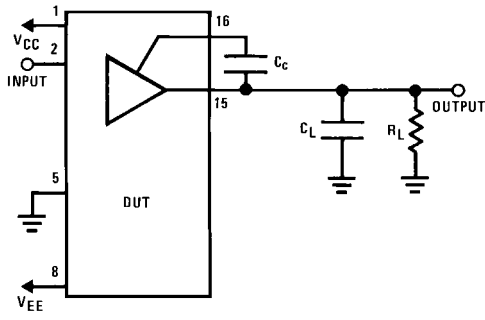


FIGURE 3. Rise Time Control for RS-423

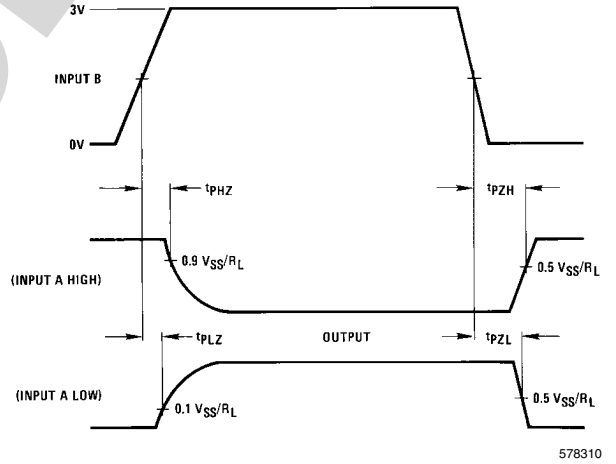
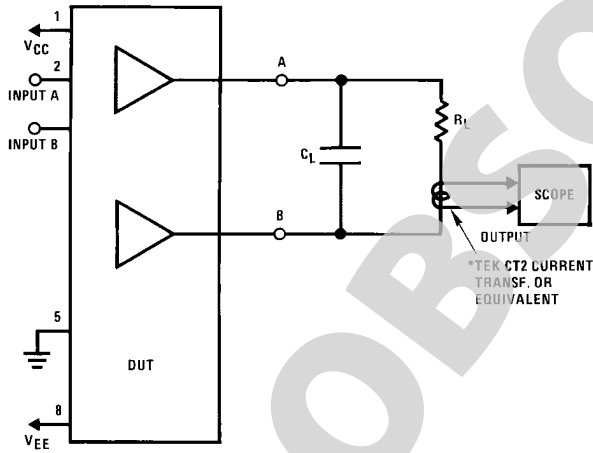


FIGURE 4. TRI-STATE Delays

Switching Waveforms

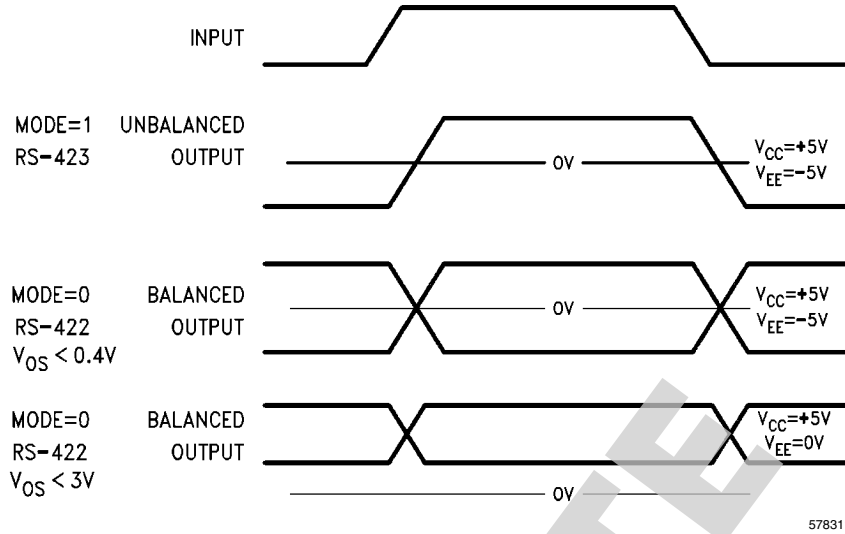
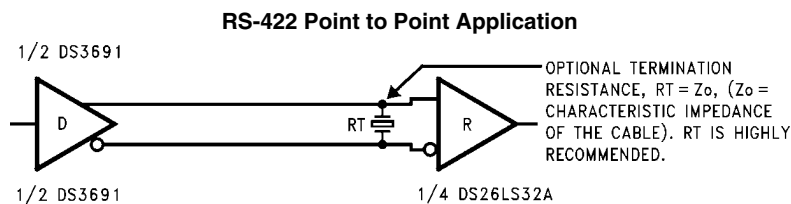
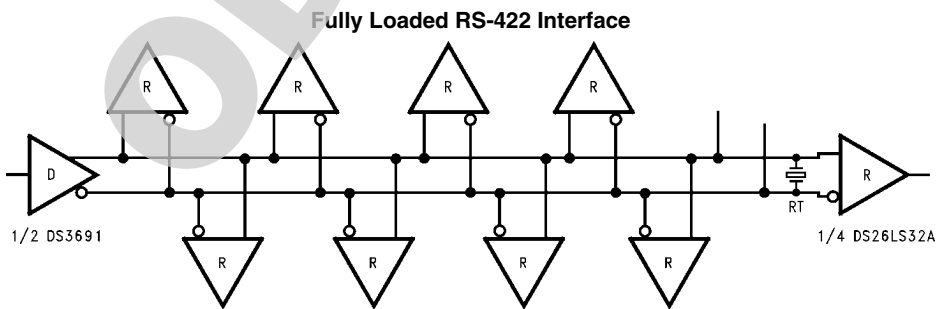


FIGURE 5. Typical Output Voltage

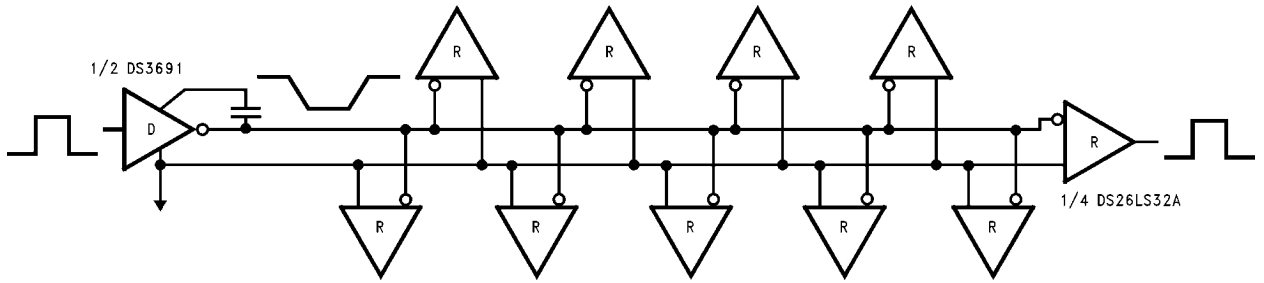
Truth Table

Operation	Inputs			Outputs	
	Mode	A (D)	B (C)	A (D)	B (C)
RS-422	0	0	0	0	1
	0	0	1	TRI-STATE	TRI-STATE
	0	1	0	1	0
	0	1	1	TRI-STATE	TRI-STATE
RS-423	1	0	0	0	0
	1	0	1	0	1
	1	1	0	1	0
	1	1	1	1	1

Typical Application Information

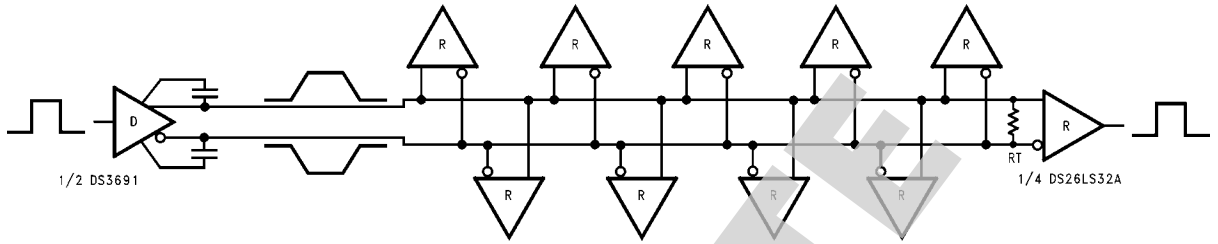


Fully Loaded RS-423 Interface



578315

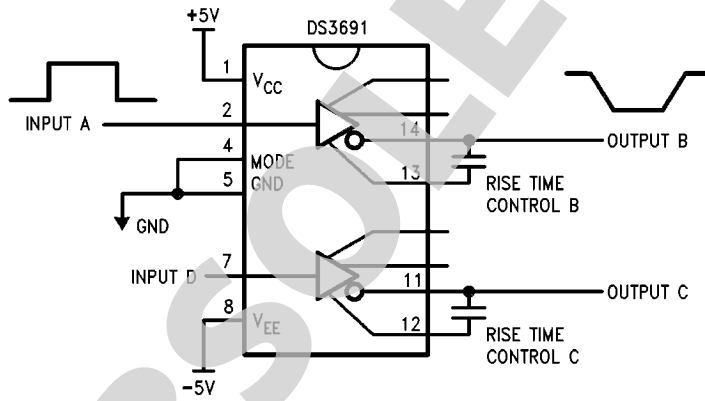
Differential Application with Rise Time Control



578316

*Note: Controlled edge allows longer stub lengths. Multiple Drivers are NOT allowed.

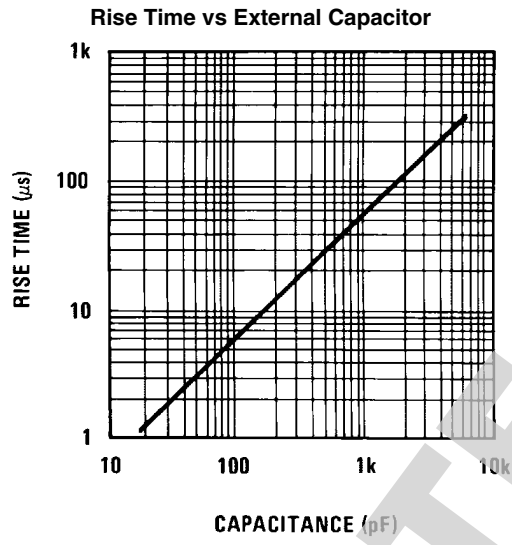
Dual RS-423 Inverting Driver



578317

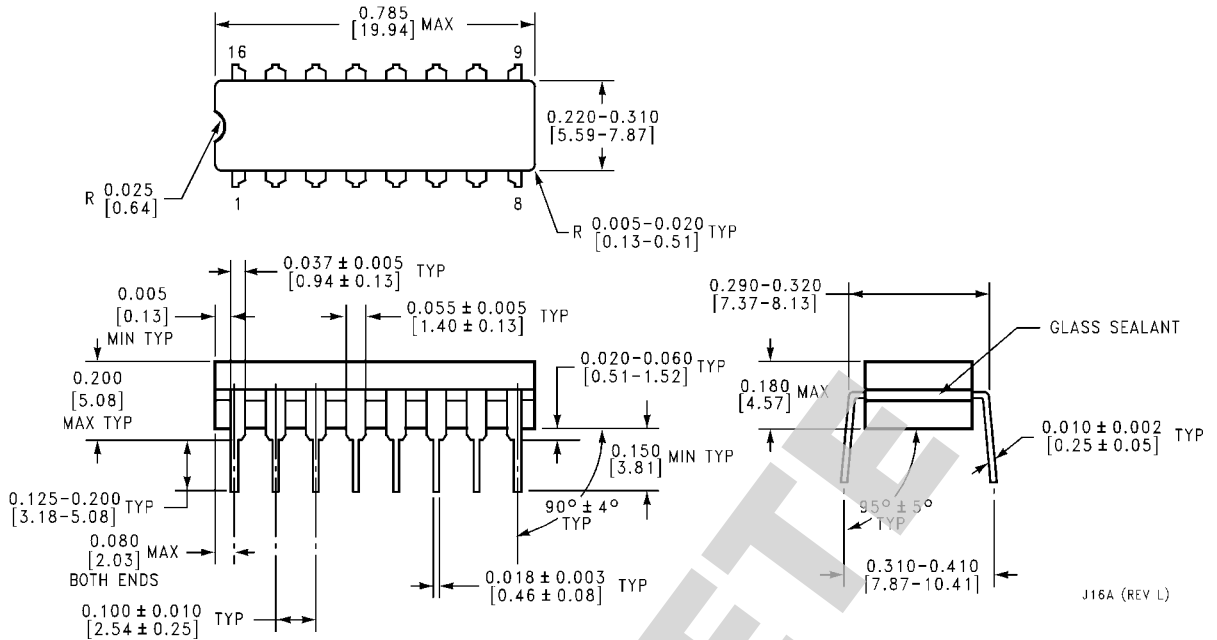
Typical Rise Time Control Characteristics

(RS-423 Mode)

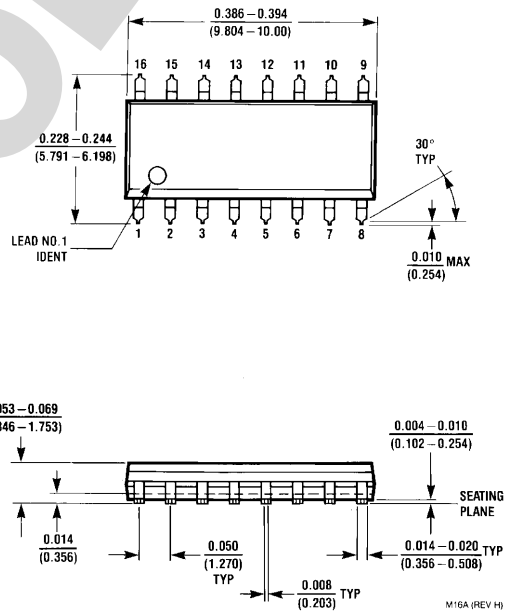


OBSOLETE

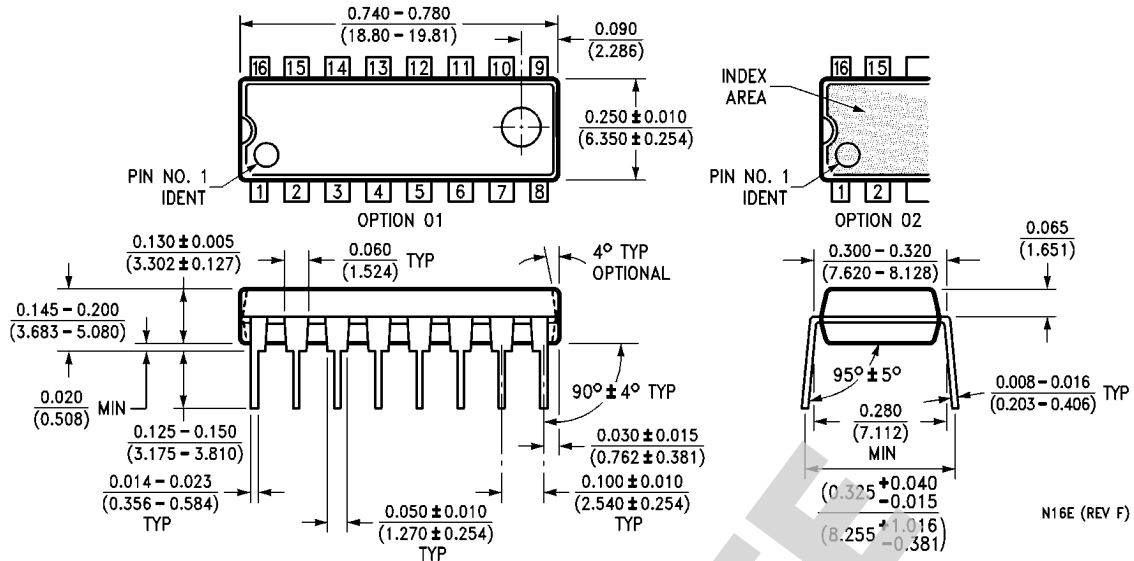
Physical Dimensions inches (millimeters) unless otherwise noted



Ceramic Dual-In-Line Package (J)
Order Number DS1691AJ/883
NS Package Number J16A



SO Package (M)
Order Number DS3691M
NS Package Number M16A



Molded Dual-In-Line Package (N)
Order Number DS3691N
NS Package Number N16E

N16E (REV F)

OBSOLETE

Notes

For more National Semiconductor product information and proven design tools, visit the following Web sites at:

Products		Design Support	
Amplifiers	www.national.com/amplifiers	WEBENCH	www.national.com/webench
Audio	www.national.com/audio	Analog University	www.national.com/AU
Clock Conditioners	www.national.com/timing	App Notes	www.national.com/appnotes
Data Converters	www.national.com/adc	Distributors	www.national.com/contacts
Displays	www.national.com/displays	Green Compliance	www.national.com/quality/green
Ethernet	www.national.com/ethernet	Packaging	www.national.com/packaging
Interface	www.national.com/interface	Quality and Reliability	www.national.com/quality
LVDS	www.national.com/lvds	Reference Designs	www.national.com/refdesigns
Power Management	www.national.com/power	Feedback	www.national.com/feedback
Switching Regulators	www.national.com/switchers		
LDOs	www.national.com/lido		
LED Lighting	www.national.com/led		
PowerWise	www.national.com/powerwise		
Serial Digital Interface (SDI)	www.national.com/sdi		
Temperature Sensors	www.national.com/tempsensors		
Wireless (PLL/VCO)	www.national.com/wireless		

THE CONTENTS OF THIS DOCUMENT ARE PROVIDED IN CONNECTION WITH NATIONAL SEMICONDUCTOR CORPORATION ("NATIONAL") PRODUCTS. NATIONAL MAKES NO REPRESENTATIONS OR WARRANTIES WITH RESPECT TO THE ACCURACY OR COMPLETENESS OF THE CONTENTS OF THIS PUBLICATION AND RESERVES THE RIGHT TO MAKE CHANGES TO SPECIFICATIONS AND PRODUCT DESCRIPTIONS AT ANY TIME WITHOUT NOTICE. NO LICENSE, WHETHER EXPRESS, IMPLIED, ARISING BY ESTOPPEL OR OTHERWISE, TO ANY INTELLECTUAL PROPERTY RIGHTS IS GRANTED BY THIS DOCUMENT.

TESTING AND OTHER QUALITY CONTROLS ARE USED TO THE EXTENT NATIONAL DEEMS NECESSARY TO SUPPORT NATIONAL'S PRODUCT WARRANTY. EXCEPT WHERE MANDATED BY GOVERNMENT REQUIREMENTS, TESTING OF ALL PARAMETERS OF EACH PRODUCT IS NOT NECESSARILY PERFORMED. NATIONAL ASSUMES NO LIABILITY FOR APPLICATIONS ASSISTANCE OR BUYER PRODUCT DESIGN. BUYERS ARE RESPONSIBLE FOR THEIR PRODUCTS AND APPLICATIONS USING NATIONAL COMPONENTS. PRIOR TO USING OR DISTRIBUTING ANY PRODUCTS THAT INCLUDE NATIONAL COMPONENTS, BUYERS SHOULD PROVIDE ADEQUATE DESIGN, TESTING AND OPERATING SAFEGUARDS.

EXCEPT AS PROVIDED IN NATIONAL'S TERMS AND CONDITIONS OF SALE FOR SUCH PRODUCTS, NATIONAL ASSUMES NO LIABILITY WHATSOEVER, AND NATIONAL DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY RELATING TO THE SALE AND/OR USE OF NATIONAL PRODUCTS INCLUDING LIABILITY OR WARRANTIES RELATING TO FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

LIFE SUPPORT POLICY


NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS PRIOR WRITTEN APPROVAL OF THE CHIEF EXECUTIVE OFFICER AND GENERAL COUNSEL OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

Life support devices or systems are devices which (a) are intended for surgical implant into the body, or (b) support or sustain life and whose failure to perform when properly used in accordance with instructions for use provided in the labeling can be reasonably expected to result in a significant injury to the user. A critical component is any component in a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system or to affect its safety or effectiveness.

National Semiconductor and the National Semiconductor logo are registered trademarks of National Semiconductor Corporation. All other brand or product names may be trademarks or registered trademarks of their respective holders.

Copyright© 2008 National Semiconductor Corporation

For the most current product information visit us at www.national.com

 **National Semiconductor Americas Technical Support Center**
 Email: support@nsc.com
 Tel: 1-800-272-9959

National Semiconductor Europe Technical Support Center
 Email: europe.support@nsc.com
 German Tel: +49 (0) 180 5010 771
 English Tel: +44 (0) 870 850 4288

National Semiconductor Asia Pacific Technical Support Center
 Email: ap.support@nsc.com

National Semiconductor Japan Technical Support Center
 Email: jpn.feedback@nsc.com

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Mobile Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Transportation and Automotive	www.ti.com/automotive
Video and Imaging	www.ti.com/video

TI E2E Community Home Page

e2e.ti.com

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2011, Texas Instruments Incorporated







Looking for pricing, stock, or lifecycle information?

Click below to explore more details on WIN SOURCE:

 [View DS3691N](#) on WIN SOURCE

 [Texas Instruments](#) Information

Optimize Your Supply Chain with WIN SOURCE Solutions

-  Global Sourcing Solution
-  Obsolete Management
-  Cost Control Management
-  Shortage Management
-  Alternative Solution
-  Excess Inventory Management