DS1691A,DS3691

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

TEXAS INSTRUMENTS

Literature Number: SNLS357C

National Semiconductor

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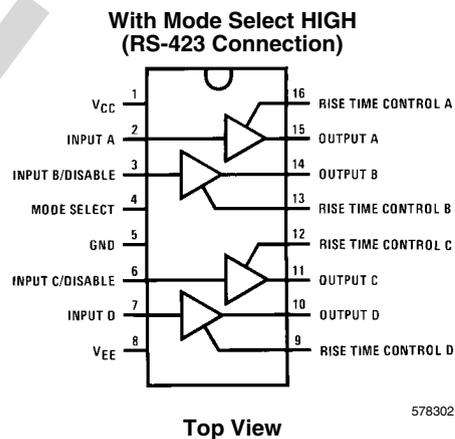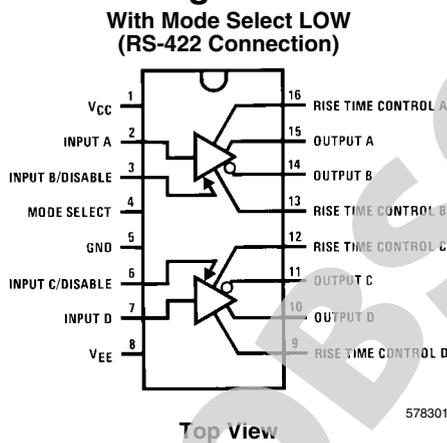
General Description

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 ±10V output common-mode range in TRI-STATE mode and 0V output unbalance when operated with ±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
- 100Ω transmission line drive capability
- Low I_{CC} and I_{EE} power consumption
  RS-422: I_{CC} = 9 mA/driver typ
  RS-423: I_{CC} = 4.5 mA/driver typ:
  I_{EE} = 2.5 mA/driver typ
- Low current PNP inputs compatible with TTL, MOS and CMOS
- Pin compatible with AM26LS30

Connection Diagrams

With Mode Select LOW
(RS-422 Connection)

578301

Top View

With Mode Select HIGH
(RS-423 Connection)

578302

Top View

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

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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
		$V_{IN} ≤ 15V$			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	Differential Output Voltage	$R_L = \infty$	$V_{IN} = 2V$		3.6	6.0	V
$\overline{V_O}$	$V_{A,B}$		$V_{IN} = 0.8V$		−3.6	−6.0	V
V_T	Differential Output Voltage	$R_L = 100Ω$	$V_{IN} = 2V$	2	2.4		V
$\overline{V_T}$	$V_{A,B}$	$V_{CC} ≥ 4.75V$	$V_{IN} = 0.8V$	−2	−2.4		V
$V_{OS}, \overline{V_{OS}}$	Common-Mode Offset Voltage	$R_L = 100Ω$			2.5	3	V
$|V_T| − |\overline{V_T}|$	Difference in Differential Output Voltage	$R_L = 100Ω$			0.05	0.4	V
$|V_{OS}| − |\overline{V_{OS}}|$	Difference in Common-Mode Offset Voltage	$R_L = 100Ω$			0.05	0.4	V
V_{SS}	$|V_T − \overline{V_T}|$	$R_L = 100Ω, V_{CC} ≥ 4.75V$		4.0	4.8		V
V_{CMR}	Output Voltage Common-Mode Range	$V_{DISABLE} = 2.4V$		±10			V
I_{XA}	Output Leakage Current	$V_{CC} = 0V$	$V_{CMR} = 10V$			100	µA
I_{XB}	Power OFF		$V_{CMR} = −10V$			−100	µA
I_{OX}	TRI-STATE Output Current	$V_{CC} = Max$	$V_{CMR} ≤ 10V$			100	µA
		$V_{EE} = 0V$ and −5V	$V_{CMR} ≥ −10V$			−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)

$T_A = 25°C$

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

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

Symbol	Parameter	Conditions		Min	Typ	Max	Units
RS-423 CONNECTION, $|V_{CC}| = |V_{EE}|$, MODE SELECT ≥ 2V							
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
		$V_{IN} ≤ 15V$			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	Output Voltage	$R_L = ∞$, (Note 7)	$V_{IN} = 2V$	4.0	4.4	6.0	V
$\overline{V_O}$		$V_{CC} ≥ 4.75V$	$V_{IN} = 0.4V$	−4.0	−4.4	−6.0	V
V_T	Output Voltage	$R_L = 450Ω$	$V_{IN} = 2.4V$	3.6	4.1		V
$\overline{V_T}$		$V_{CC} ≥ 4.75V$	$V_{IN} = 0.4V$	−3.6	−4.1		V
$|V_T| - |\overline{V_T}|$	Output Unbalance	$|V_{CC}| = |V_{EE}| = 4.75V$, $R_L = 450Ω$			0.02	0.4	V
I_X^+	Output Leakage Power OFF	$V_{CC} = V_{EE} = 0V$	$V_O = 6V$		2	100	µA
I_X^-	Output Leakage Power OFF	$V_{CC} = V_{EE} = 0V$	$V_O = −6V$		−2	−100	µA
I_S^+	Output Short Circuit Current	$V_O = 0V$	$V_{IN} = 2.4V$		−80	−150	mA
I_S^-	Output Short Circuit Current	$V_O = 0V$	$V_{IN} = 0.4V$		80	150	mA
I_{SLEW}	Slew Control Current				±140		µA
I_{CC}	Positive Supply Current	$V_{IN} = 0.4V$, $R_L = ∞$			18	30	mA
I_{EE}	Negative Supply Current	$V_{IN} = 0.4V$, $R_L = ∞$			−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°C temperature range for the DS1691A and across the 0°C to +70°C range for the DS3691. All typicals are given for $V_{CC} = 5V$ and $T_A = 25°C$. 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 +3.9V minimum and −3.9V minimum.

AC Electrical Characteristics (Note 6)

$T_A = 25°C$

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 = 450Ω, C_L = 500 pF, C_C = 0 (*Figure 2*)		120	300	ns
t_f	Fall Time	R_L = 450Ω, C_L = 500 pF, C_C = 0 (*Figure 2*)		120	300	ns
t_r	Rise Time	R_L = 450Ω, C_L = 500 pF C_C = 50 pF (*Figure 3*)		3.0		µs
t_f	Fall Time	R_L = 450Ω, C_L = 500 pF C_C = 50 pF (*Figure 3*)		3.0		µs
t_{rc}	Rise Time Coefficient	R_L = 450Ω, C_L = 500 pF, C_C = 50 pF (*Figure 3*)		0.06		µs/pF
t_{PDH}	Output Propagation Delay	R_L = 450Ω, C_L = 500 pF, C_C = 0 (*Figure 2*)		180	300	ns
t_{PDL}	Output Propagation Delay	R_L = 450Ω, C_L = 500 pF, C_C = 0 (*Figure 2*)		180	300	ns

AC Test Circuits and Switching Time Waveforms
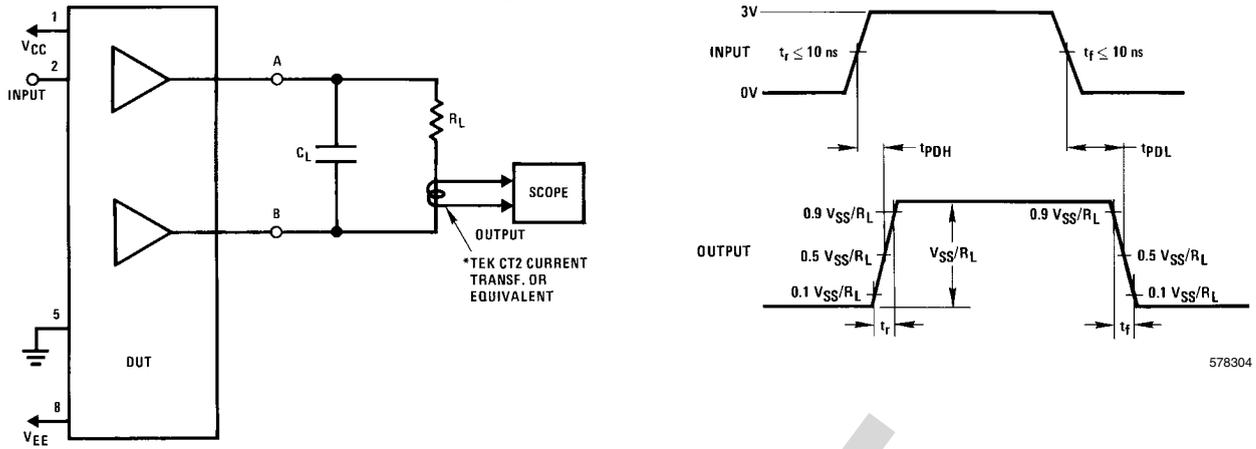
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FIGURE 1. Differential Connection

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578306
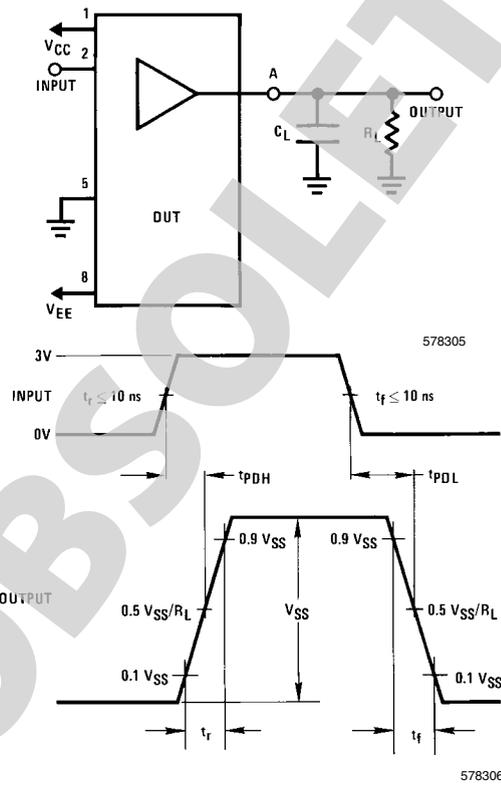
FIGURE 2. RS-423 Connection

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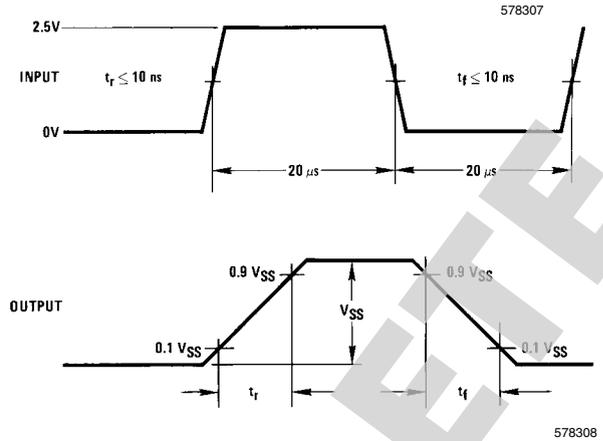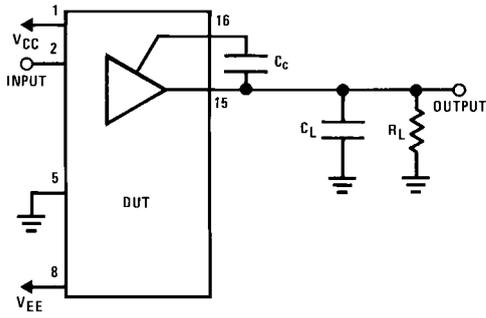
FIGURE 3. Rise Time Control for RS-423
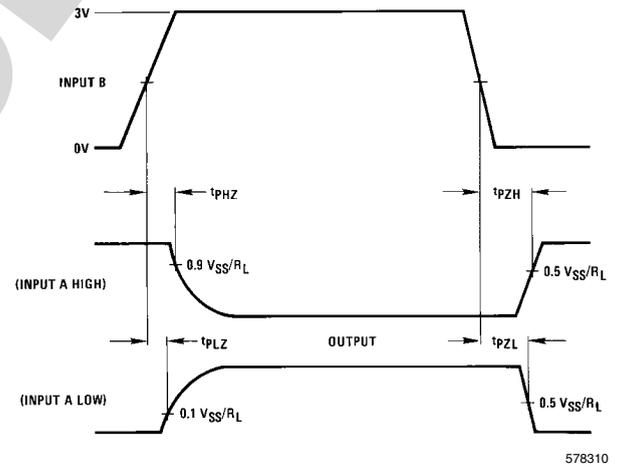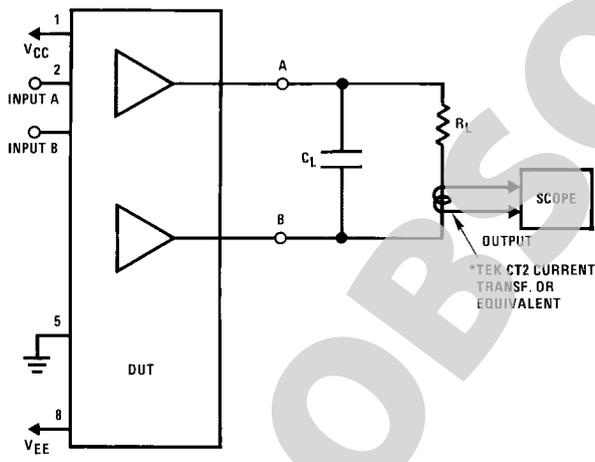
FIGURE 4. TRI-STATE Delays

Switching Waveforms
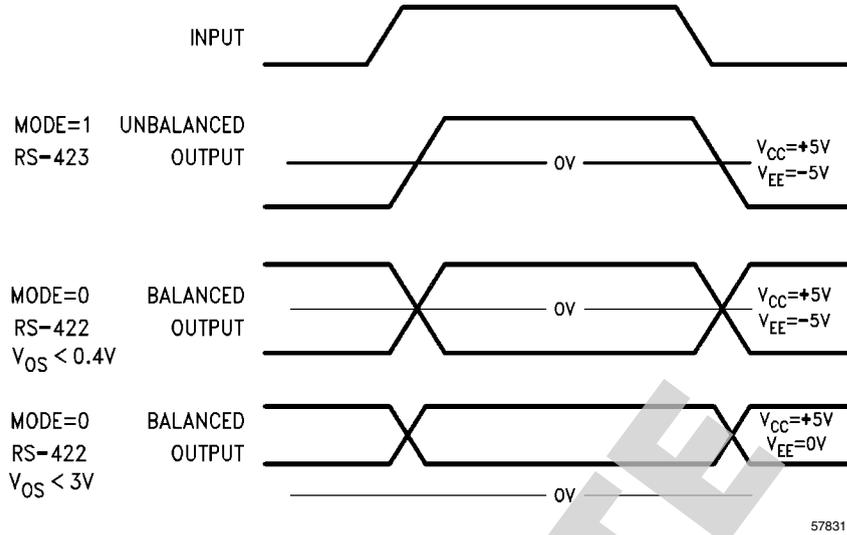
FIGURE 5. Typical Output Voltage

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-422 Interface

RS-422 Point to Point Application
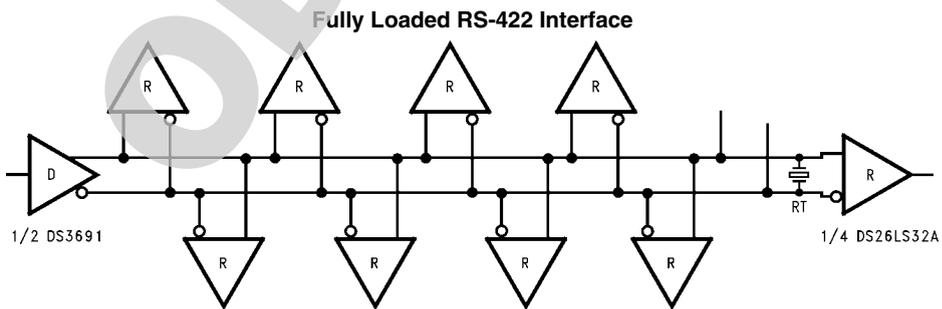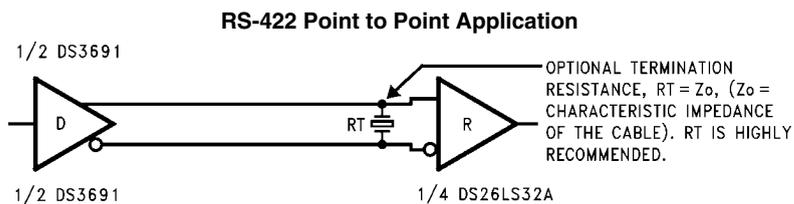
Fully Loaded RS-423 Interface
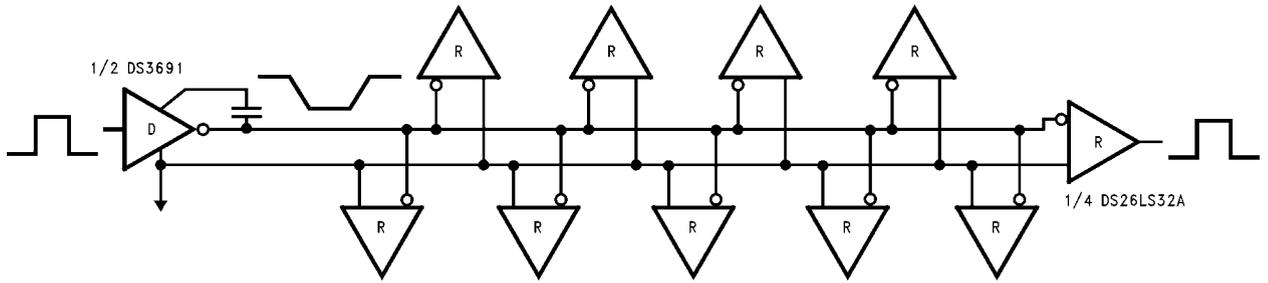
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Differential Application with Rise Time Control
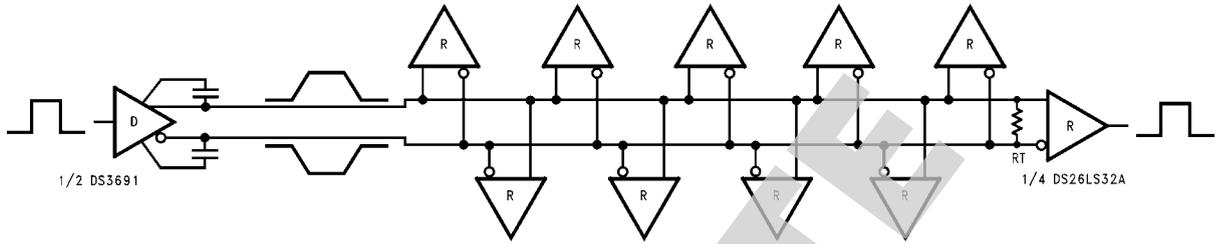
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*Note: Controlled edge allows longer stub lengths. Multiple Drivers are NOT allowed.

Dual RS-423 Inverting Driver
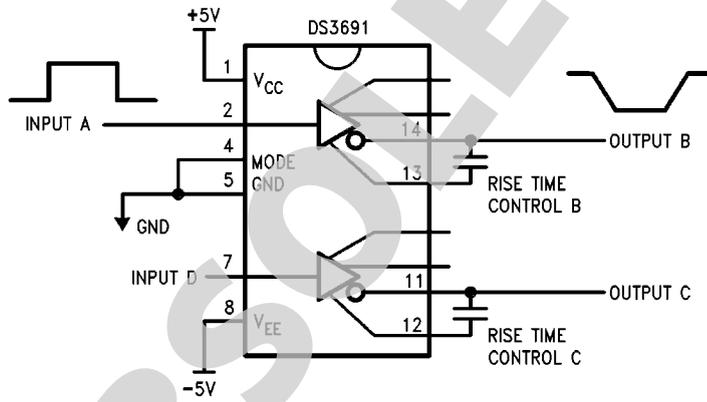
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Typical Rise Time Control Characteristics

(RS-423 Mode)

Rise Time vs External Capacitor

Physical Dimensions inches (millimeters) unless otherwise noted

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

J16A (REV L)

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

M16A (REV H)

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OPTION 01

OPTION 02

PIN NO. 1
IDENT

PIN NO. 1
IDENT

INDEX
AREA
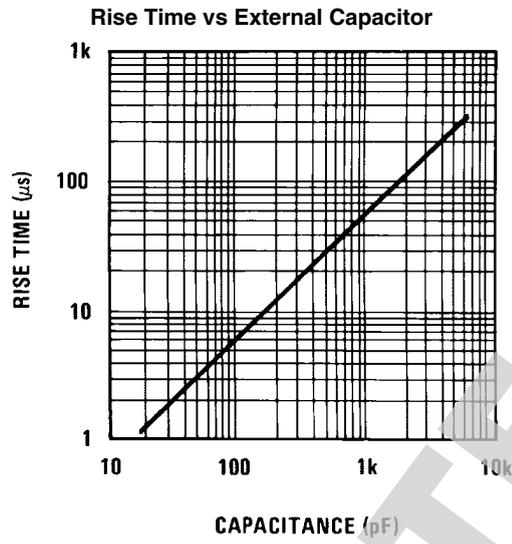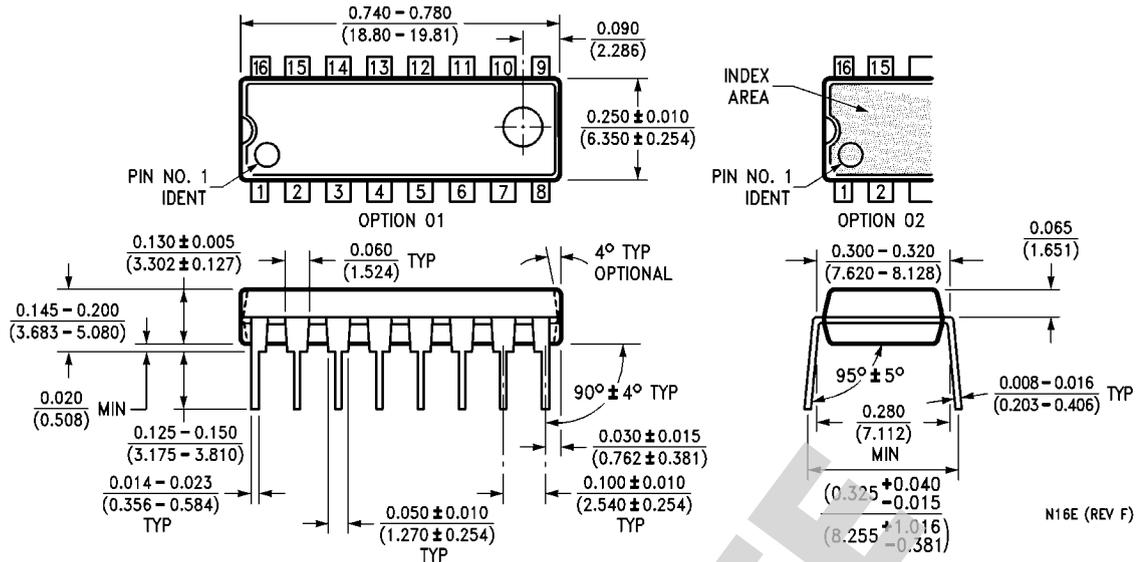
N16E (REV F)

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

Notes

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