QP1691A / QP2691 /QP3691

QP SEMICONDUCTOR

October 9, 2007

QP1691A/QP2691/QP3691
(RS-422/RS-423) Line Drivers with Tri-State Outputs

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**
- **Outputs will not clamp line with power off or in Tri-State mode**
- **100Ω transmission line drive capability**
- **Low I_{CC} and I_{EE} power consumption**
  - **RS-422: I_{CC} = 9 mA/driver typical**
  - **RS-423: I_{CC} = 4.5 mA/driver typical**
    I_{EE} = 2.5 mA/driver typical
- **Short Circuit protection for both source and sink outputs**
- **Pin Compatible with AM26LS30**
- **EPROM technology 100% programmable**
- **Low current PNP inputs compatible with TTL, MOS and CMOS logic**

General Description

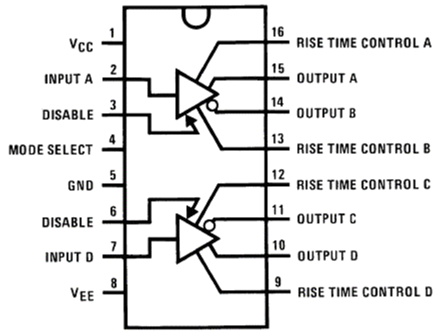
The QP1691A/QP2691/QP3691 are low power Schottky TTL line drivers designed to meet the requirements of EIA standards RS-422 and RS-423. They feature four buffered outputs with high source and sink current capability with internal short circuit protection. A mode control input provides a choice of operation 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 wave shaping output signals in the single-ended driver mode. A multipoint application in differential mode with wave shaping capacitors is not allowed.

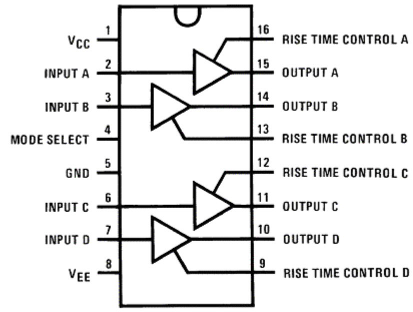
With the mode select pin low, the QP1691A/QP2691/QP3691 are dual-differential line drivers with TRI-STATE outputs. They feature ±10V output common-mode range in Tri-State mode and 0V output unbalance when operated with ±5V supply.

Connection Diagrams

<table>
<tr><th></th><th>With Mode Select LOW
(RS-422 Connection)</th><th>With Mode Select HIGH
(RS-423 Connection)</th></tr>
<tr><td>QP1691A
QP2691
QP3691

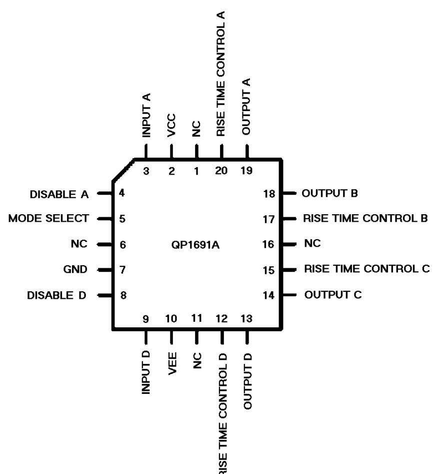
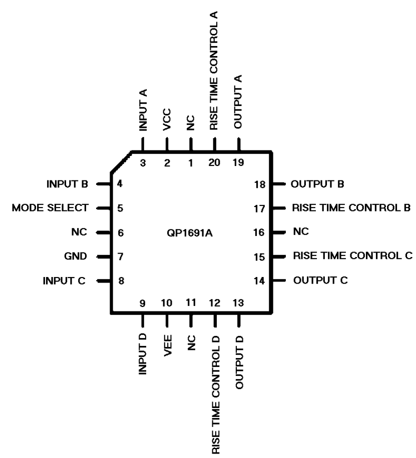
CerDIP
PDIP
Cerpack
SOIC

16 Lead</td><td>

Top View</td><td>

Top View</td></tr>
<tr><td>QP1691A
QP2691
QP3691

LCC

20 Lead</td><td>
</td><td>
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Absolute Maximum Ratings

Stresses above the AMR may cause permanent damage, extended operation at AMR may degrade performance and affect reliability

Condition	/5	Units	Notes
V_{CC} Supply Voltage	7.0	Volts	
V_{EE} Supply Voltage	-7.0	Volts	
Maximum Power Dissipation at 25ºC			
CerDIP	1509	mW/ºC	/1
Molded DIP	1476	mW/ºC	
SOIC	1051	mW/ºC	
DC Input Voltage	15	Volts	
Output Voltage Power Off	±15	Volts	
Storage Temperature	-65 to +155	ºC	
Junction Temperature			
Hermetic Packages	175	ºC	/2
Molded Packages	160	ºC	/2 /3

Recommended Operating Conditions

Condition		/1 /2 /5	Units	Notes
Supply Voltage Range				
QP1691A				
	V_{CC}	4.5 to 5.5	Volts DC	5V ± 10%
	V_{EE}	-4.5 to –5.5	Volts DC	-5V ± 10%
QP2691/QP3691				
	V_{CC}	4.75 to 5.25	Volts DC	5V ± 5%
	V_{EE}	-4.75 to –5.25	Volts DC	-5V ± 5%
Case Operating Range (T_c) (QP3691)		-0C to +70	ºC	Commercial
Case Operating Range (T_c) (QP2691)		-40C to +85	ºC	Industrial
Case Operating Range (T_c) (QP1691A)		-55 to +125	ºC	Military

Notes:

Apply to Absolute Maximum, Recommended Operating Conditions and Electrical Performance Characteristics.

/1 – Derate CerDIP package 10.1mW/ºC above 25ºC; derate molded DIP package 11.9mW/ºC above 25ºC; derate SO package 8.41mW/ºC above 25ºC.

/2 – Maximum T_j is not to be exceeded.

/3 – Critical for molded plastic products. T_j above listed limits can activate mold compound flame retardant.

/4 – Supply Voltage Range per above table.

/5 – "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. "Electrical Performance Characteristics" provide conditions for actual device operation.

/6 – Unless otherwise specified, min/max limits apply across the –55ºC to +125ºC temperature range for the QP1691A, across the -40ºC to +85ºC temperature range for the QP2691 and across the 0ºC to +70ºC temperature range for the QP3691

/7 – All currents into device pins are positive; all currents out of device pins are negative. All voltages referenced to ground unless otherwise specified.

/8 – Only one output at a time should be shorted.

/9 – Symbols and definitions correspond to EIA RS-422 and/or RS-423 where applicable.

/10 – At -55ºC, the output voltage is +3.9V minimum and –3.9V maximum.

TABLE I – ELECTRICAL PERFORMANCE CHARACTERISTICS

Test	Symbol	Conditions /4 /6 /7 /8 /9 Case Operating Range (ºC)	Min	Max	Unit
RS-422 Connection		V_{EE} to GND, Mode Select ≤ 0.8V			
DC Electrical Characteristics					
Input High Voltage	V_{IH}	Guaranteed Input logical High for all inputs	2.0		V
Input Low Voltage	V_{IL}	Guaranteed Input logical Low for all inputs		0.8	V
High Level Input Current	I_{IH}	V_{IN} = 2.4V		40	uA
	I_{IH1}	V_{IN} ≤ 15.0V		100	uA
Low Level Input Current	I_{IL}	V_{IN} = 0.4V		-200	uA
Input Clamp Voltage	V_I	I_{IN} = -12mA		-1.5	V

TABLE I – ELECTRICAL PERFORMANCE CHARACTERISTICS

Test	Symbol	Conditions /4 /6 /7 /8 /9 Case Operating Range (ºC)	Min	Max	Unit
Differential Output Voltage $V_{A,B}$	V_O	$R_L = \infty$ $V_{IN} = 2.0V$		6.0	V
	V_{OBAR}	$V_{IN} = 0.8V$		-6.0	V
Differential Output Voltage $V_{A,B}$	V_T	$R_L = 100\Omega$ $V_{IN} = 2.0V$	2		V
	V_{TBAR}	$V_{CC} \geq 4.75V$ $V_{IN} = 0.8V$	-2		V
Common-Mode Offset Voltage	V_{OS}, V_{OSBAR}	$R_L = 100\Omega$		3	V
Difference in Differential Output Voltage	$\|V_T\|-\|V_{TBAR}\|$	$R_L = 100\Omega$		0.4	V
Difference in Common-Mode Offset Voltage	$\|V_{OS}\| - \|V_{OSBAR}\|$	$R_L = 100\Omega$		0.4	V
$\|V_T - V_{TBAR}\|$	V_{SS}	$R_L = 100\Omega$, $V_{CC} \geq 4.75V$	4.0		V
Output Voltage Common-Mode Range	V_{CMR}	$V_{DISABLE} = 2.4V$	±10		V
Output Leakage Current	I_{XA}	$V_{CC} = 0V$, $V_{CM} = 10V$		100	uA
Power Off	I_{XB}	$V_{CC} = 0V$, $V_{CM} = -10V$		-100	uA
Tri-State Output Current	I_{OX}	$V_{CC} = Max$ $V_{CM} \leq 10V$		100	uA
		$V_{ee} = 0\&-5V$ $V_{CM} \geq -10V$		-100	uA
Output Short Circuit Current	I_{SA}	$V_{IN} = 0.4V$, $V_{OA} = 6V$	80	150	mA
		$V_{IN} = 0.4V$, $V_{OB} = 0V$	-80	-150	mA
Output Short Circuit Current	I_{SB}	$V_{IN} = 2.4V$, $V_{OA} = 0V$	-80	-150	mA
		$V_{IN} = 2.4V$, $V_{OB} = 6V$	80	150	mA

TABLE I – ELECTRICAL PERFORMANCE CHARACTERISTICS

Test	Symbol	Conditions /4 /6 /7 /8 /9 Case Operating Range (ºC)	Min	Max	Unit
Operating Supply Current	I_{CC}	V_{CC}= 5.5V, I_{OUT}=0 mA		30	mA
AC Electrical Characteristics	T_A=25ºC	/9			
Output Rise Time	t_r	R_L= 100Ω, C_L = 500 pF (Figure 1)		200	ns
Output Fall Time	T_f	R_L= 100Ω, C_L = 500 pF (Figure 1)		200	ns
Output Propagation Delay	T_{PDH}	R_L= 100Ω, C_L = 500 pF (Figure 1)		200	ns
Output Propagation Delay	T_{PDL}	R_L= 100Ω, C_L = 500 pF (Figure 1)		200	ns
Tri-State Delay	T_{PZL}	R_L= 450Ω, C_L = 500 pF C_C = 0 pF (Figure 4)		350	ns
Tri-State Delay	T_{PZH}	R_L= 450Ω, C_L = 500 pF C_C = 0 pF (Figure 4)		350	ns
Tri-State Delay	T_{PLZ}	R_L= 450Ω, C_L = 500 pF C_C = 0 pF (Figure 4)		350	ns
Tri-State Delay	T_{PHZ}	R_L= 450Ω, C_L = 500 pF C_C = 0 pF (Figure 4)		350	ns
RS-423 Connection		$\| V_{CC} \| = \|V_{EE}\|$, Mode Select ≥ 2V			
DC Electrical Characteristics					
Input High Voltage	V_{IH}	Guaranteed Input logical High for all inputs	2.0		V
Input Low Voltage	V_{IL}	Guaranteed Input logical Low for all inputs		0.8	V
High Level Input Current	I_{IH}	V_{IN} = 2.4V		40	uA
	I_{IH1}	V_{IN} ≤ 15.0V		100	uA
Low Level Input Current	I_{IL}	V_{IN} = 0.4V		-200	uA
Input Clamp Voltage	V_I	I_{IN} = -12mA		-1.5	V
Output Voltage	V_O	R_L= ∞ /10 V_{IN} = 2.0V	4.0	6.0	V
	V_{OBAR}	V_{IN} = 0.4V	-4.0	-6.0	V
Output Voltage	V_T	R_L= 450Ω V_{IN} = 2.0V	3.6		V
	V_{TBAR}	V_{CC}≥4.75V V_{IN} = 0.8V	-3.6		V
Output Unbalance	$\|V_T\|-\|V_{TBAR}\|$	$\| V_{CC} \| = \|V_{EE}\|$=4.75V, R_L= 450Ω		0.4	V

TABLE I – ELECTRICAL PERFORMANCE CHARACTERISTICS

Test	Symbol	Conditions /4 /6 /7 /8 /9 Case Operating Range (ºC)	Min	Max	Unit
Output Leakage Power OFF	I_{X+}	V_{CC}=V_{EE}= 0V, V_O= 6V		100	uA
	I_{X+}	V_{CC}=V_{EE}= 0V, V_O= -6V		-100	uA
Output Short Circuit Current	I_{S+}	V_{IN}= 2.4V, V_O= 0V		-150	mA
	I_{S-}	V_{IN}= 0.4V, V_O= 0V		150	mA
Slew Control Current	I_{SLEW}	Typical	-140	140	uA
Positive Supply Current	I_{CC}	V_{IN}= 0.4V, R_L= ∞		30	mA
Negative Supply Current	I_{EE}	V_{IN}= 0.4V, R_L= ∞		-22	mA
AC Electrical Characteristics	T_A=25ºC	/9			
Output Rise Time	t_r	R_L= 450Ω, C_L= 500 pF, C_C= 0 pF (Figure 2)		300	ns
Output Fall Time	T_f	R_L= 450Ω, C_L= 500 pF, C_C= 0 pF (Figure 2)		300	ns
Output Rise Time (Typical)	t_{r1}	R_L= 450Ω, C_L= 500 pF, C_C= 50 pF (Figure 3)		3	us
Output Fall Time (Typical)	T_{f1}	R_L= 450Ω, C_L= 500 pF, C_C= 50 pF (Figure 3)		3	us
Rise Time Coefficient (Typical)	T_{rc}	R_L= 450Ω, C_L= 500 pF, C_C= 50 pF (Figure 3)		0.06	us/pF
Output Propagation Delay	T_{PDH}	R_L= 450Ω, C_L= 500 pF, C_C= 0 pF (Figure 2)		300	ns
Output Propagation Delay	T_{PDL}	R_L= 450Ω, C_L= 500 pF, C_C= 0 pF (Figure 2)		300	ns

AC Test Loads

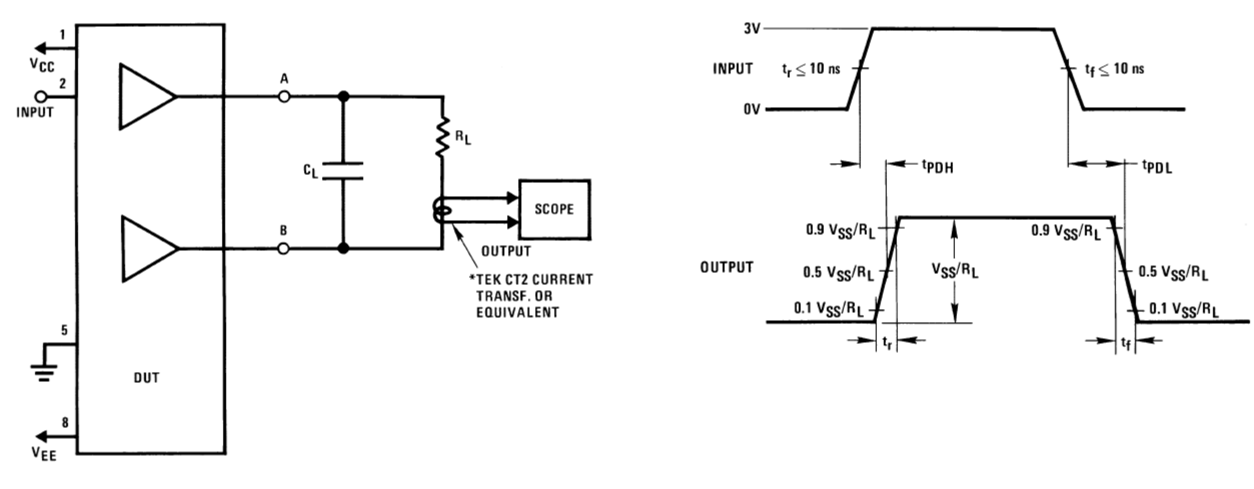


FIGURE 1. Differential Connection

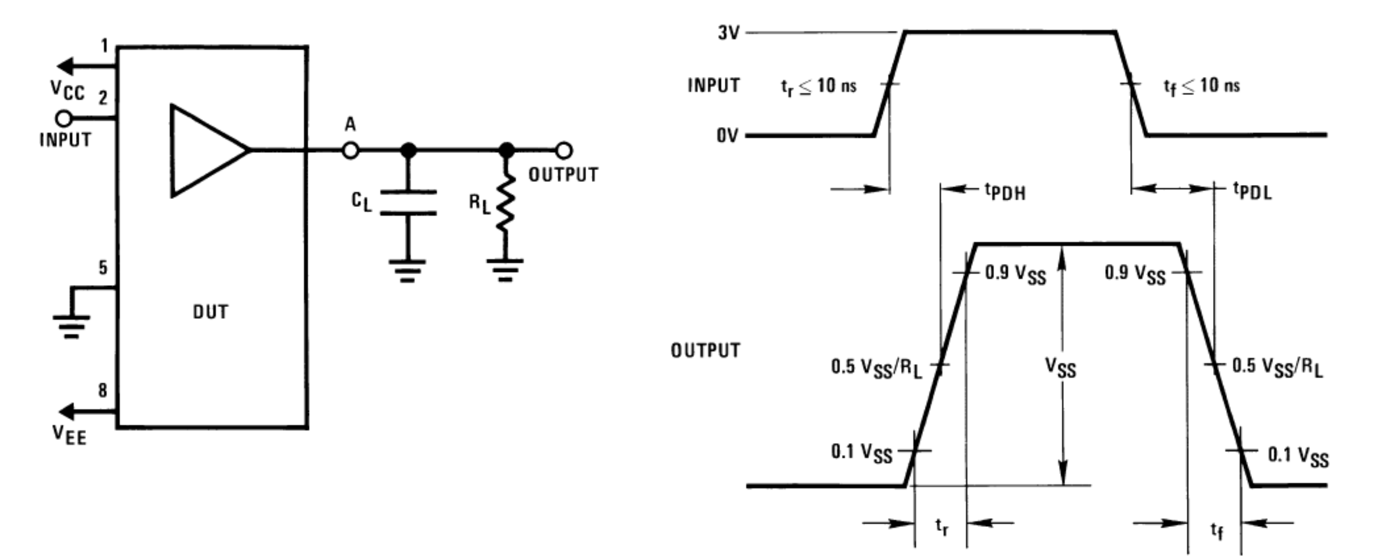


FIGURE 2. RS-423 Connection

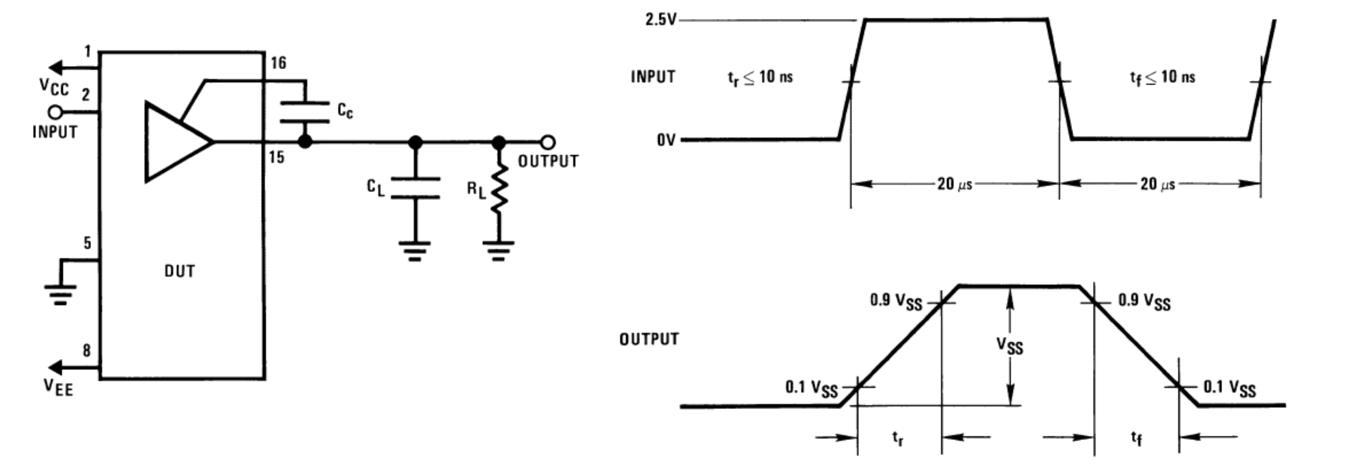


FIGURE 3. Rise Time Control for RS-423

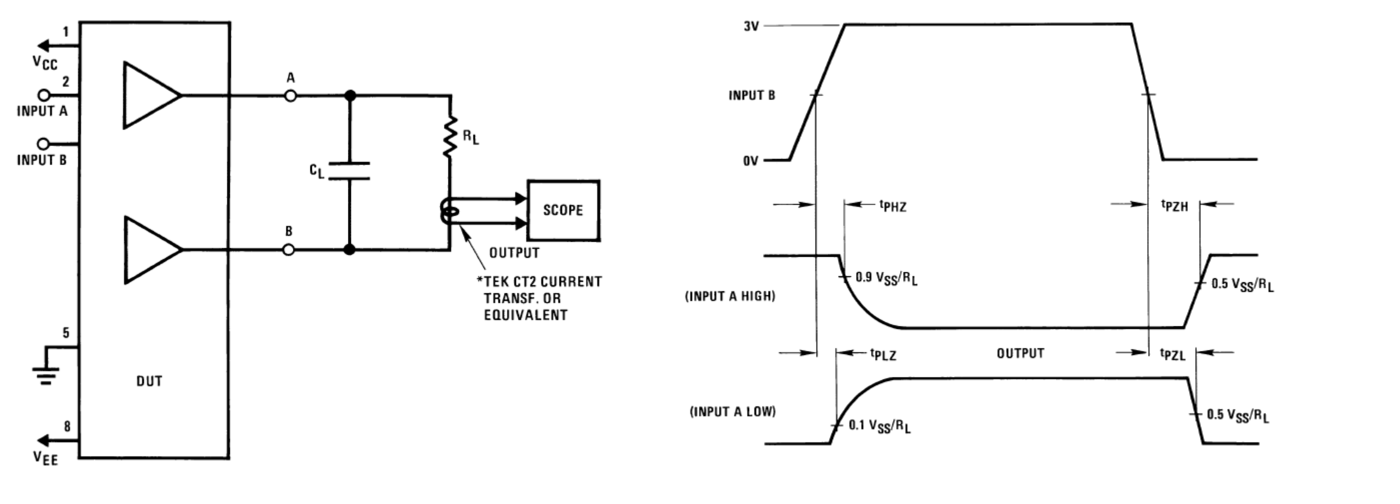


FIGURE 4. TRI-STATE Delays

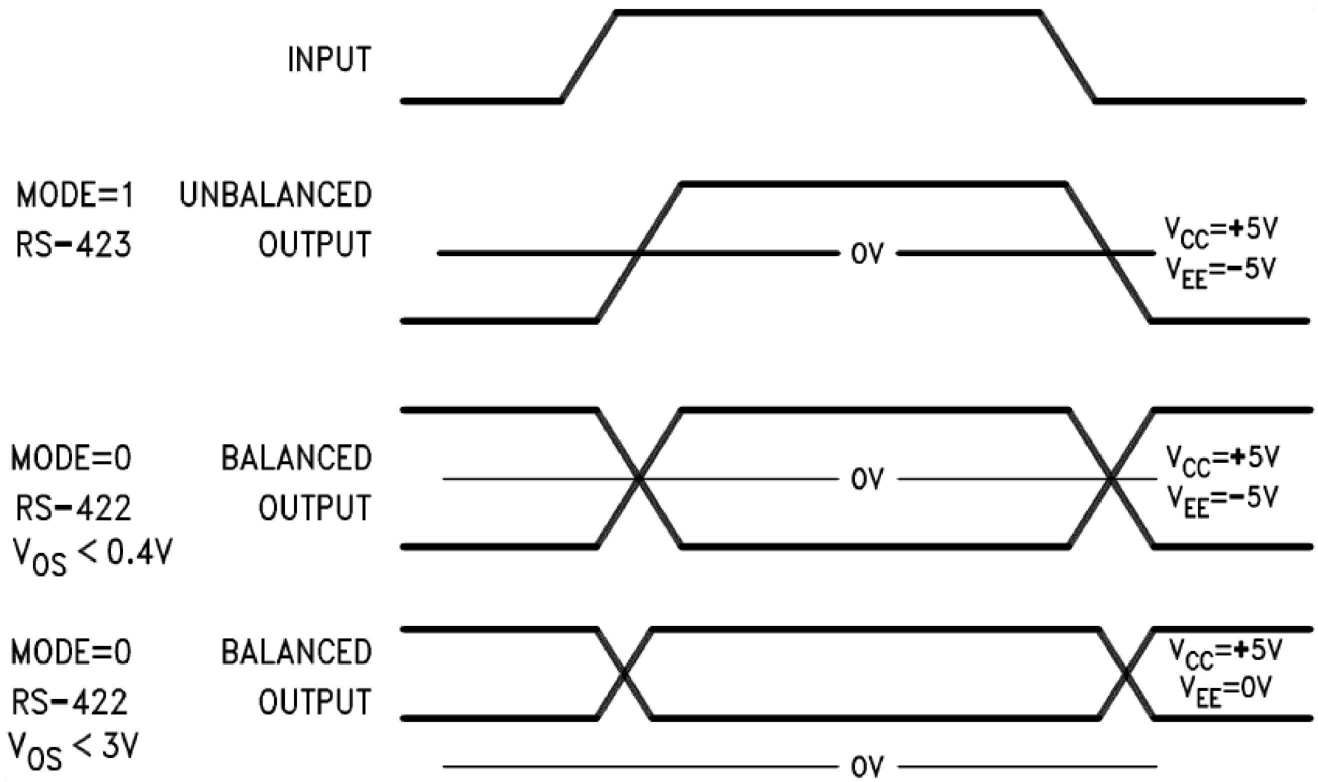


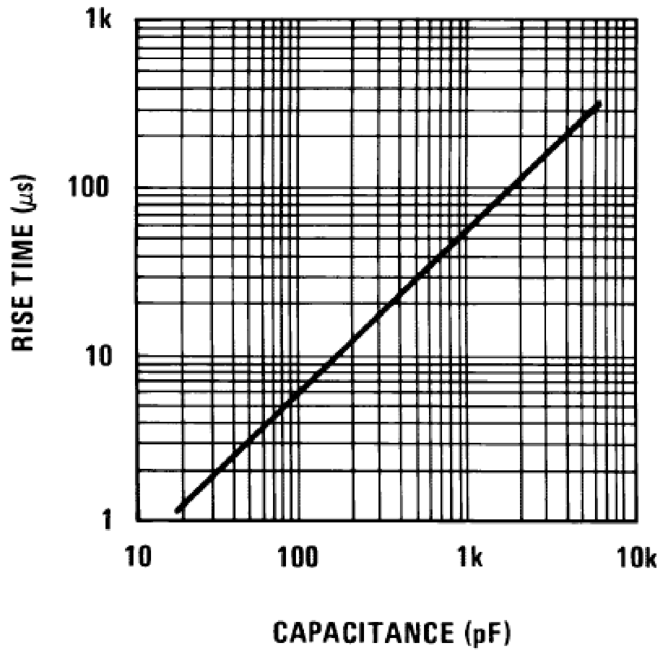
FIGURE 5. Typical Output Voltage

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 Rise Time Control Characteristics (RS-423 Mode)

Rise Time vs External Capacitor



Ordering Information

Temp Range	Part Number	Package	Mil-Std-1835	Generic
Military	5962-86721012A	20-Lead LCC	CQCC1-N20	1691A
Military	5962-8672101EA	16-Lead 300-mil CerDIP	GDIP3-T16	1691A
Military	5962-8672101FA	16-Lead Flatpack	GDFP2-F16	1691A
Military	QP1691AE/883	20-Lead LCC	CQCC1-N20	1691A
Military	QP1691AJ/883	16-Lead 300-mil CerDIP	GDIP3-T16	1691A
Military	QP1691AW/883	16-Lead Flatpack	GDFP2-F16	1691A
Industrial	QP2691E	20-Lead LCC	CQCC1-N20	2691
Industrial	QP2691J	16-Lead 300-mil CerDIP	GDIP3-T16	2691
Industrial	QP2691W	16-Lead Flatpack	GDFP2-F16	2691
Commercial	QP3691J	16-Lead 300-mil CerDIP	GDIP3-T16	3691
Commercial	QP3691N	16-Lead 300-mil Plastic DIP		3691
Commercial	QP3691M	16-Lead SOIC		3691

* denotes Lead Free Lead Finish
In addition to those products listed above, QP Semiconductor supports Industrial Temperature Range, Source Control Drawing SCD, and custom package development for this product family.

Notes:

Hermetic Package outline information and specifications are defined by Mil-Std-1835 package dimension requirements.

Military Products manufactured by QP Semiconductor are compliant to the assembly, burn-in, test and quality conformance requirements of Test Methods 5004 & 5005 of Mil-Std-883 for Class B or Q devices as appropriate. The appropriate DSCC Detail Specifications define the electrical test requirements for each device.

The listed drawings, Mil-PRF-38535, Mil-Std-883 and Mil-Std-1835 are available online at http://www.dscc.dla.mil/

Additional information is available at our website http://www.qpsemi.com