

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 ± 10 V output common-mode range in Tri-State mode and 0V output unbalance when operated with ± 5 V supply.

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Connection Diagrams

	With Mode Select LOW (RS-422 Connection)	With Mode Select HIGH (RS-423 Connection)
QP1691A QP2691 QP3691 CerDIP PDIP Cerpack SOIC 16 Lead	Top View	Top View
QP1691A QP2691 QP3691 LCC 20 Lead		

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 25°C			
CerDIP	1509	mW/°C	/1
Molded DIP	1476	mW/°C	
SOIC	1051	mW/°C	
DC Input Voltage	15	Volts	
Output Voltage Power Off	±15	Volts	
Storage Temperature	-65 to +155	°C	
Junction Temperature			
Hermetic Packages	175	°C	/2
Molded Packages	160	°C	/2 /3

Recommended Operating Conditions

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

Notes:

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

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

/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 -55°C to +125°C temperature range for the QP1691A, across the -40°C to +85°C temperature range for the QP2691 and across the 0°C to +70°C 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 -55°C, 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 (°C)	Min	Max	Unit
RS-422 Connection		V_{EE} to GND, Mode Select $\leq 0.8V$			
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}	$V_{IN} \leq 15.0V$		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 (°C)	Min	Max	Unit
Differential Output Voltage $V_{A,B}$	V_O	$R_L = \infty$ $V_{IN} = 2.0V$		6.0	V
	$V_{O\overline{B}AR}$	$V_{IN} = 0.8V$		-6.0	V
Differential Output Voltage $V_{A,B}$	V_T	$R_L = 100\Omega$ $V_{IN} = 2.0V$	2		V
	$V_{T\overline{B}AR}$	$V_{CC} \geq 4.75V$ $V_{IN} = 0.8V$	-2		V
Common-Mode Offset Voltage	$V_{OS},$ $V_{OS\overline{B}AR}$	$R_L = 100\Omega$		3	V
Difference in Differential Output Voltage	$ V_T -$ $ V_{T\overline{B}AR} $	$R_L = 100\Omega$		0.4	V
Difference in Common-Mode Offset Voltage	$ V_{OS} -$ $ V_{OS\overline{B}AR} $	$R_L = 100\Omega$		0.4	V
$ V_T - V_{T\overline{B}AR} $	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 Power Off	I_{XA}	$V_{CC} = 0V, V_{CM} = 10V$		100	μA
	I_{XB}	$V_{CC} = 0V, V_{CM} = -10V$		-100	μA
Tri-State Output Current	I_{OX}	$V_{CC} = \text{Max}$ $V_{CM} \leq 10V$		100	μA
		$V_{ee} = 0\&-5V$ $V_{CM} \geq -10V$		-100	μA
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

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Test	Symbol	Conditions /4 /6 /7 /8 /9 Case Operating Range (°C)	Min	Max	Unit
Operating Supply Current	I_{CC}	$V_{CC} = 5.5V$, $I_{OUT} = 0$ mA		30	mA
AC Electrical Characteristics	$T_A = 25^\circ C$	/9			
Output Rise Time	t_r	$R_L = 100\Omega$, $C_L = 500$ pF (Figure 1)		200	ns
Output Fall Time	T_f	$R_L = 100\Omega$, $C_L = 500$ pF (Figure 1)		200	ns
Output Propagation Delay	T_{PDH}	$R_L = 100\Omega$, $C_L = 500$ pF (Figure 1)		200	ns
Output Propagation Delay	T_{PDL}	$R_L = 100\Omega$, $C_L = 500$ pF (Figure 1)		200	ns
Tri-State Delay	T_{PZL}	$R_L = 450\Omega$, $C_L = 500$ pF $C_C = 0$ pF (Figure 4)		350	ns
Tri-State Delay	T_{PZH}	$R_L = 450\Omega$, $C_L = 500$ pF $C_C = 0$ pF (Figure 4)		350	ns
Tri-State Delay	T_{PLZ}	$R_L = 450\Omega$, $C_L = 500$ pF $C_C = 0$ pF (Figure 4)		350	ns
Tri-State Delay	T_{PHZ}	$R_L = 450\Omega$, $C_L = 500$ pF $C_C = 0$ pF (Figure 4)		350	ns
RS-423 Connection		$ V_{CC} = V_{EE} $, Mode Select $\geq 2V$			
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	μA
	I_{IH1}	$V_{IN} \leq 15.0V$		100	μA
Low Level Input Current	I_{IL}	$V_{IN} = 0.4V$		-200	μA
Input Clamp Voltage	V_I	$I_{IN} = -12mA$		-1.5	V
Output Voltage	V_O	$R_L = \infty$ /10 $V_{IN} = 2.0V$	4.0	6.0	V
	$V_{O\overline{BAR}}$	$V_{IN} = 0.4V$	-4.0	-6.0	V
Output Voltage	V_T	$R_L = 450\Omega$ $V_{IN} = 2.0V$	3.6		V
	$V_{T\overline{BAR}}$	$V_{CC} \geq 4.75V$ $V_{IN} = 0.8V$	-3.6		V
Output Unbalance	$ V_T - V_{T\overline{BAR}} $	$ V_{CC} = V_{EE} = 4.75V$, $R_L = 450\Omega$		0.4	V

TABLE I – ELECTRICAL PERFORMANCE CHARACTERISTICS

Test	Symbol	Conditions /4 /6 /7 /8 /9 Case Operating Range (°C)	Min	Max	Unit
Output Leakage Power OFF	I_{X+}	$V_{CC}=V_{EE}= 0V, V_O= 6V$		100	μA
	I_{X+}	$V_{CC}=V_{EE}= 0V, V_O= -6V$		-100	μA
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	μA
Positive Supply Current	I_{CC}	$V_{IN}= 0.4V, R_L= \infty$		30	mA
Negative Supply Current	I_{EE}	$V_{IN}= 0.4V, R_L= \infty$		-22	mA
AC Electrical Characteristics	$T_A=25^{\circ}C$	/9			
Output Rise Time	t_r	$R_L= 450\Omega, C_L= 500\text{ pF}, C_C= 0\text{ pF}$ (Figure 2)		300	ns
Output Fall Time	T_f	$R_L= 450\Omega, C_L= 500\text{ pF}, C_C= 0\text{ pF}$ (Figure 2)		300	ns
Output Rise Time (Typical)	t_{r1}	$R_L= 450\Omega, C_L= 500\text{ pF}, C_C= 50\text{ pF}$ (Figure 3)		3	μs
Output Fall Time (Typical)	T_{f1}	$R_L= 450\Omega, C_L= 500\text{ pF}, C_C= 50\text{ pF}$ (Figure 3)		3	μs
Rise Time Coefficient (Typical)	T_{rc}	$R_L= 450\Omega, C_L= 500\text{ pF}, C_C= 50\text{ pF}$ (Figure 3)		0.06	$\mu s/pF$
Output Propagation Delay	T_{PDH}	$R_L= 450\Omega, C_L= 500\text{ pF}, C_C= 0\text{ pF}$ (Figure 2)		300	ns
Output Propagation Delay	T_{PDL}	$R_L= 450\Omega, C_L= 500\text{ pF}, C_C= 0\text{ pF}$ (Figure 2)		300	ns

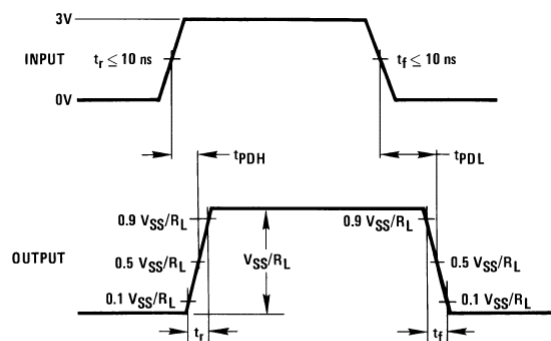
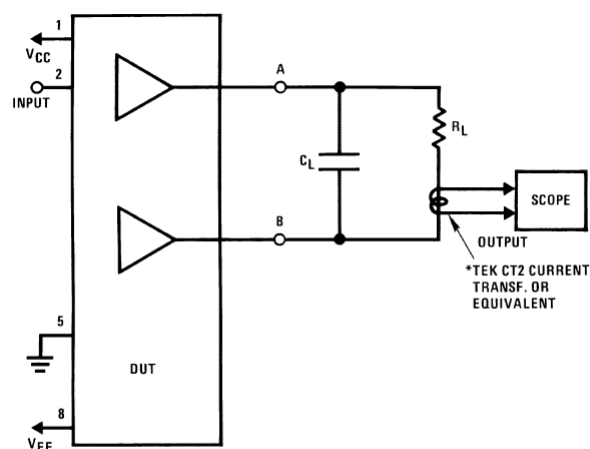
AC Test Loads

FIGURE 1. Differential Connection

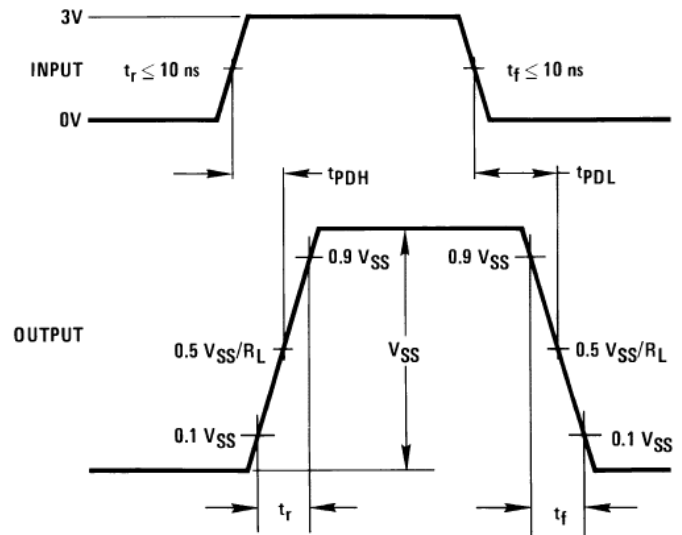
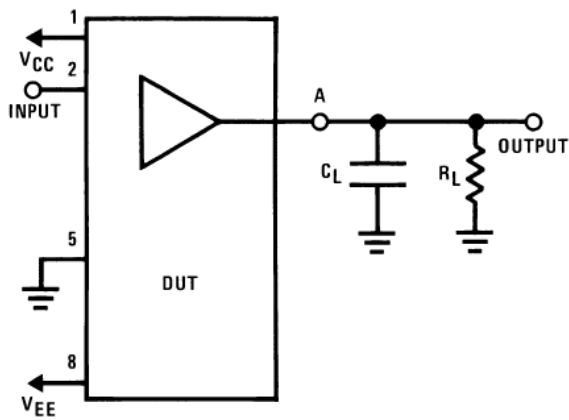


FIGURE 2. RS-423 Connection

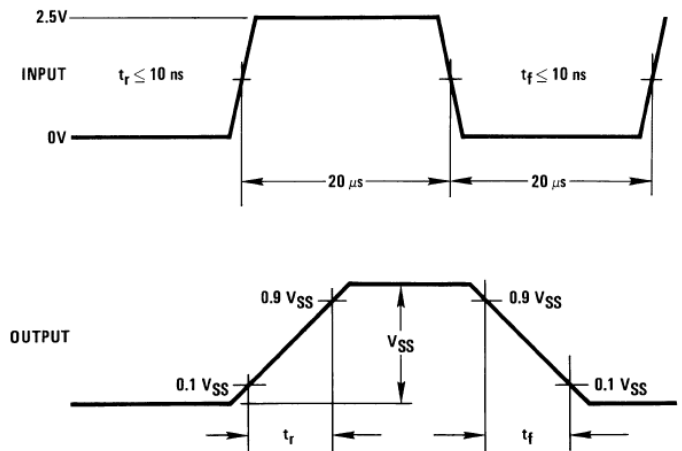
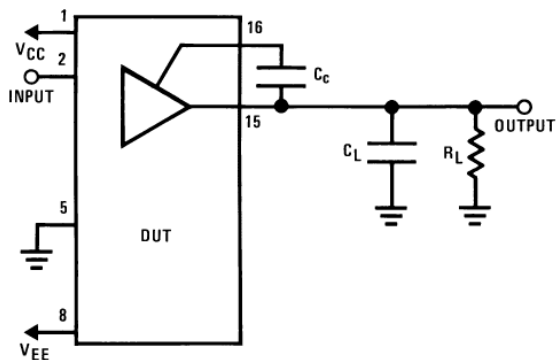


FIGURE 3. Rise Time Control for RS-423

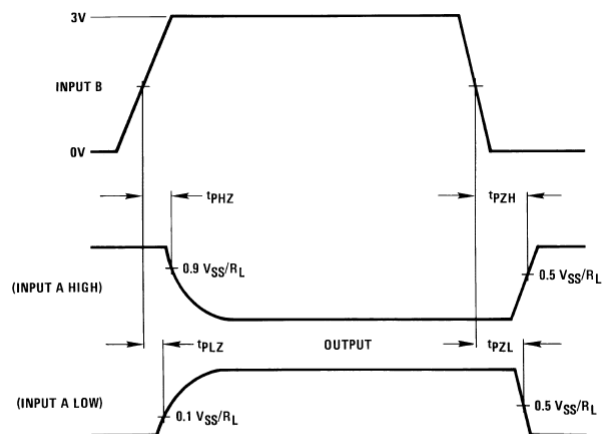
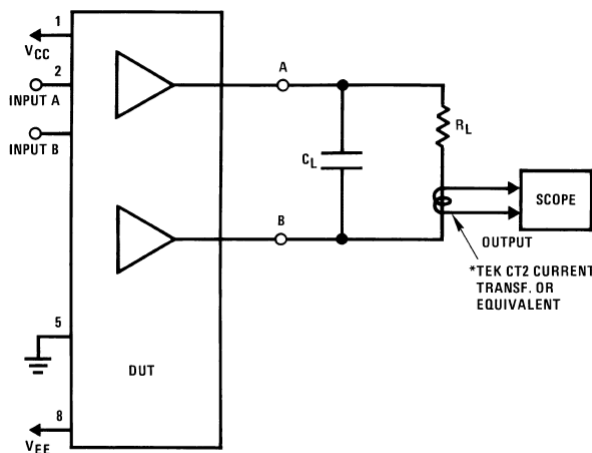


FIGURE 4. TRI-STATE Delays

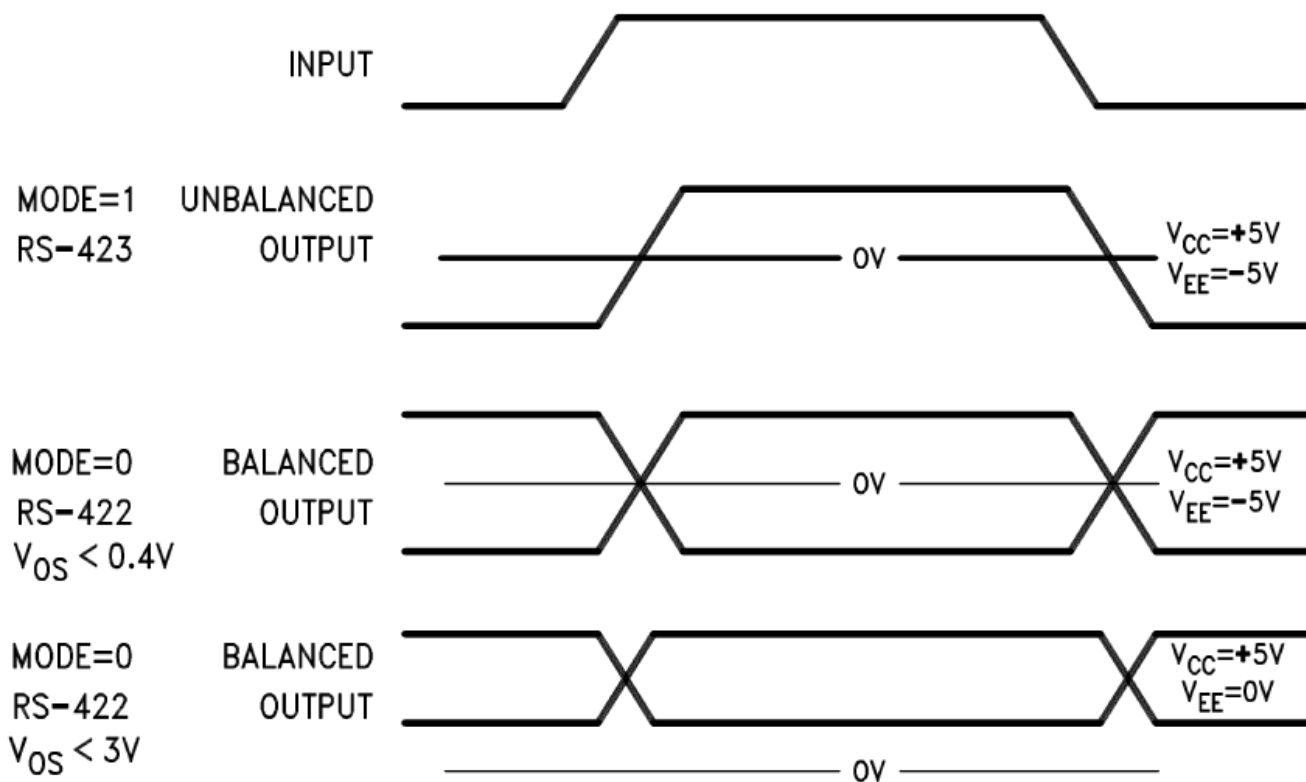


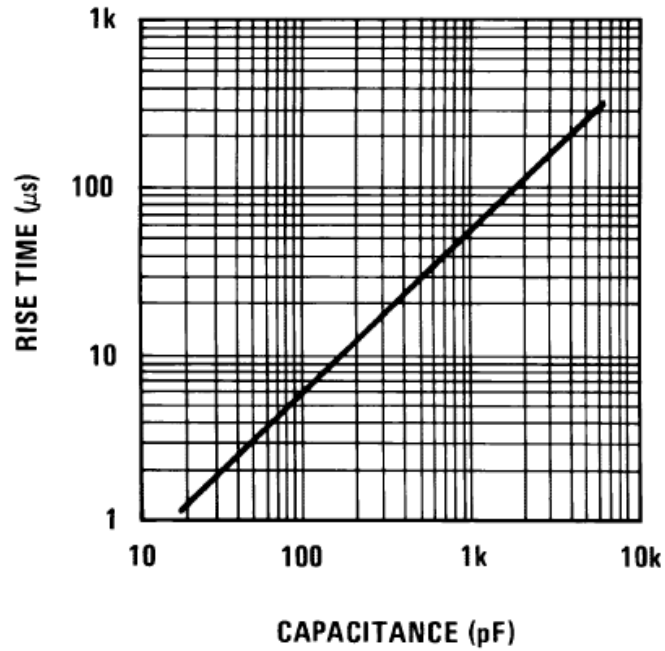
FIGURE 5. Typical Output Voltage

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>