# High-Speed CMOS QuickSwitch® 16 to 8 Multiplexer

QS3390
QS32390

## FEATURES/BENEFITS

- 16:8 multiplexer function with zero delay
- 5Ω switches connect inputs to outputs
- Zero propagation delay
- Low power CMOS proprietary technology
- TTL compatible control inputs
- Direct connection for mux, demux
- QS32390 is 25Ω version for low noise
- Zero ground bounce in flow-through mode
- Available in 28-pin DIP, SOIC (SO) & QSOP

## DESCRIPTION

The QS3390 and QS32390 each provide a 16 to 8 multiplexer logic switch. The low ON resistance (5Ω) of the QS3390 allows inputs to be connected to the output without adding propagation delay and without generating additional ground bounce noise. The QS32390 adds an internal 25Ω resistor to reduce reflection noise in high-speed applications. The select and enable inputs select and connect one of eight inputs to the common I/O pin, respectively. The multiplexer function can be used to select and route logic signals for zero delay, isolate bus capacitance, form crossbar switches, etc.

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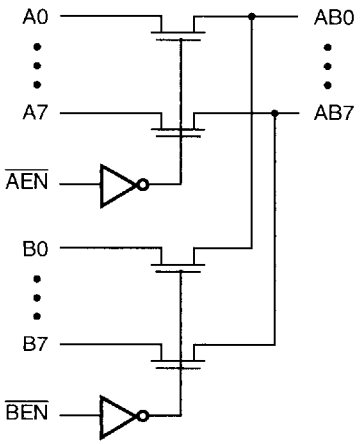
## FUNCTIONAL BLOCK DIAGRAM

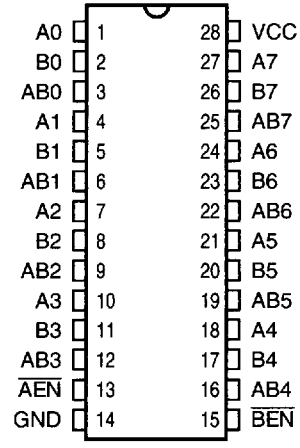


## PIN DESCRIPTION

| Name | I/O | Description |
|---|---|---|
| A9-A0 | I/O | Bus A |
| B9-B0 | I/O | Bus B |
| $\overline{AEN}$, $\overline{BEN}$ | I | Bus Switch Enable |

## PIN CONFIGURATION (All Pins Top View)

**PDIP, SOIC (SO), QSOP**




## FUNCTION TABLE

| $\overline{AEN}$ | $\overline{BEN}$ | A Sw | B Sw | Function |
|---|---|---|---|---|
| H | H | Off | Off | Disconnect |
| L | H | On | Off | A to AB |
| H | L | Off | On | B to AB |
| L | L | On | On | A, B to AB |

## ABSOLUTE MAXIMUM RATINGS

Supply Voltage to Ground ..... –0.5V to +7.0V
DC Switch Voltage Vs ..... –0.5V to +7.0V
DC Input Voltage $V_{IN}$ ..... –0.5V to +7.0V
AC Input Voltage (for a pulse width ≤ 20 ns) ..... –3.0V
DC Output Current Max. Sink Current/Pin ..... 120 mA
Maximum Power Dissipation ..... 0.5 watts
$T_{STG}$ Storage Temperature ..... –65° to +150°C

**Note:** Stresses greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to QSI devices that result in functional or reliability type failures.

## CAPACITANCE

$T_A$ = 25°C, f = 1 MHz, $V_{IN}$ = 0V, $V_{OUT}$ = 0V

| Name | Discription | Conditions | SOIC | QSOP | PDIP | Unit |
|---|---|---|---|---|---|---|
| $C_{IN}$ | Input Capacitance, Controls | $V_{IN}$ = 0V | 6 | 6 | 7 | pF |
| $C_{OFF}$ | A, B, AB I/O Capacitance, Switch Off | $V_{IN}$ = 0V | 8 | 8 | 8 | pF |

**Note:** Capacitance is characterized but not tested and the values are typical.

## DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Commercial: $T_A$ = 0°C to 70°C, $V_{CC}$ = 5.0V ± 5%

| Symbol | Parameter | Test Conditions | | Min | Typ(1) | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{IH}$ | Input HIGH Voltage | Guaranteed Logic HIGH for Control Inputs | | 2.0 | — | — | V |
| $V_{IL}$ | Input LOW Voltage | Guaranteed Logic LOW for Control Inputs | | — | — | 0.8 | V |
| $\lvert I_{IN} \rvert$ | Input Leakage Current | $0 \le V_{IN} \le V_{CC}$ | | — | — | 1 | µA |
| $\lvert I_{OZ} \rvert$ | Off-State Current (Hi-Z)(2) | $0 \le A, B, AB \le V_{CC}$ | | — | — | 1 | µA |
| $R_{ON}$ | Switch ON Resistance(4,5) | $V_{CC}$ = Min., $V_{IN}$ = 0.0V<br>$I_{ON}$ = 30 mA | 3390<br>32390 | —<br>20 | 5<br>28 | 7<br>40 | Ω |
| $R_{ON}$ | Switch ON Resistance(4,5) | $V_{CC}$ = Min., $V_{IN}$ = 2.4V<br>$I_{ON}$ = 15 mA | 3390<br>32390 | —<br>24 | 10<br>35 | 15<br>48 | Ω |

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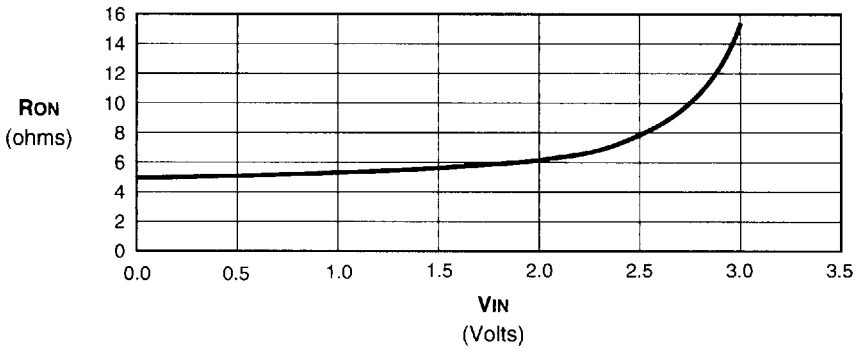
**Notes:**
1. Typical values indicate Vcc = 5.0V and $T_A$ = 25°C.
2. During input/output leakage, testing all pins are at a HIGH or LOW state, and the $\overline{G}$ control is HIGH.
3. Measured by voltage drop between A or B pins to AB pin at indicated current through the switch. ON resistance is determined by the lower of the voltages on the two (A,B) pins.
4. Max. value $R_{ON}$ guaranteed but not tested.

## Typical ON Resistance vs $V_{IN}$ at 4.75 Vcc (3390 Only)



## POWER SUPPLY CHARACTERISTICS

| Symbol | Parameter | Test Conditions[1] | Max | Unit |
|---|---|---|---|---|
| $I_{CCQ}$ | Quiescent Power Supply Current | Vcc = Max., $V_{IN}$ = GND or Vcc, f = 0 | 30 | µA |
| $\Delta I_{CC}$ | Power Supply Current per Input HIGH[2] | Vcc = Max., $V_{IN}$ = 3.4V, f = 0 per Control Input | 3.5 | mA |
| $Q_{CCD}$ | Dynamic Power Supply Current per MHz[3] | Vcc = Max., A, B, AB Pins Open, Control InputsToggling @ 50% Duty Cycle | 0.25 | mA/ MHz |
| Ic | Total Power Supply Current[4,5] | Vcc = Max., A, B, AB Pins at 0.0V, Control InputsToggling @ 50% Duty Cycle Vih = 3.4V, f Clock + MHz | 9.0 | mA |

**Notes:**

1. For conditions shown as Min. or Max., use the appropriate values specified under DC specifications.
2. Per TTL driven input ($V_{IN}$ = 3.4V, control inputs only). A, B, and AB pins do not contribute to Icc.
3. This current applies to the control inputs only and represents the current required to switch internal capacitance at the specified frequency. The A, B, and AB I/Os generate no significant AC or DC currents as they transition. This parameter is guaranteed by design, but not tested.
4. Ic = I Quiescent + I Inputs + I Dynamic.
   $I_C = I_{CC} + \Delta I_{CC} D_H N_T + Q_{CCD} (f_i N_i)$.
   $I_{CC}$ = Power Supply Current for each TTL HIGH input ($V_{IN}$ = 3.4V, control inputs only).
   $D_H$ = Duty Cycle for each TTL input that is HIGH (control inputs only).
   $N_T$ = Number of TTL inputs that are at $D_H$ (control inputs only).
   $f_i$ = frequency that the inputs are toggled (control inputs only).
5. Note that activity on A, B, and AB I/Os do not contribute to Ic if A, B, and AB I/Os are between GND and Vcc. The switches merely connect and pass through activity on these pins. For example: If the control inputs are at 0V and the switches are on, Ic will be equal to Icc only regardless of activity on the A, B, and AB I/Os.

## SWITCHING CHARACTERISTICS OVER OPERATING RANGE

Commercial: $T_A$ = 0°C to 70°C, $V_{CC}$ = 5.0V ± 5%
$C_{LOAD}$ = 50 pF, $R_{LOAD}$ = 500Ω unless otherwise noted.

| Symbol | Description[1] | QS3390 Min | QS3390 Typ | QS3390 Max | QS32390[7] Min | QS32390[7] Typ | QS32390[7] Max | Unit |
|---|---|---|---|---|---|---|---|---|
| $t_{PLH}$<br>$t_{PHL}$ | Data Propagation Delay[2,4]<br>A,B to/from AB | — | 0.25[3] | — | — | 1.25 | — | ns |
| $t_{PZL}$<br>$t_{PZH}$ | Switch Turn-on Delay[1]<br>$\overline{AEN}/\overline{BEN}$ to A, B, AB | 1.5 | — | 6.5 | 1.5 | — | 7.5 | ns |
| $t_{PLZ}$<br>$t_{PHZ}$ | Switch Turn-off Delay[1,2]<br>$\overline{AEN}/\overline{BEN}$ to A, B, AB | 1.5 | — | 5.5 | — | — | 5.5 | ns |
| $\lvert Q_{CI} \rvert$ | Charge Injection[5] | — | 1.5 | — | — | 1.5 | — | pC |

**Notes:**

1. See Test Circuit and Waveforms. Minimums guaranteed but not tested.
2. This parameter is guaranteed by design but not tested.
3. The time constant for the switch alone is of the order of 0.25 ns for 50 pF.
4. The bus switch contributes no propagation delay other than the RC delay of the ON resistance of the switch and the load capacitance. Since this time constant is much smaller than the rise/fall times of typical driving signals, it adds very little propagation delay to the system. Propagation delay of the bus switch when used in a system is determined by the driving circuit on the driving side of the switch and its interaction with the load on the driven side.
5. Measured at switch turn off, A/B to AB, load = 50 pF in parallel with 10 meg scope probe, $V_{IN}$ at $\overline{AEN}/\overline{BEN}$ = 0.0V.
6. Characterized parameter but not tested.
7. Preliminary data, subject to change.