# QUICKSWITCH® PRODUCTS 2.5V / 3.3V DUAL 4:1 MUX/DEMUX HIGH BANDWIDTH BUS SWITCH

**IDTQS3VH253**

## FEATURES:

- **N channel FET switches with no parasitic diode to $V_{CC}$**
  - *Isolation under power-off conditions*
  - *No DC path to $V_{CC}$ or GND*
  - *5V tolerant in OFF and ON state*
- **5V tolerant I/Os**
- **Low $R_{ON}$ - 4Ω typical**
- **Flat $R_{ON}$ characteristics over operating range**
- **Rail-to-rail switching 0 - 5V**
- **Bidirectional dataflow with near-zero delay: no added ground bounce**
- **Excellent $R_{ON}$ matching between channels**
- **$V_{CC}$ operation: 2.3V to 3.6V**
- **High bandwidth - up to 500MHz**
- **LVTTL-compatible control Inputs**
- **Undershoot Clamp Diodes on all switch and control Inputs**
- **Low I/O capacitance, 4pF typical**
- **Available in QSOP and TSSOP packages**

## APPLICATIONS:

- **Hot-swapping**
- **Multiplexing/demultiplexing**
- **Low distortion analog switch**
- **Replaces mechanical relay**
- **ATM 25/155 switching**

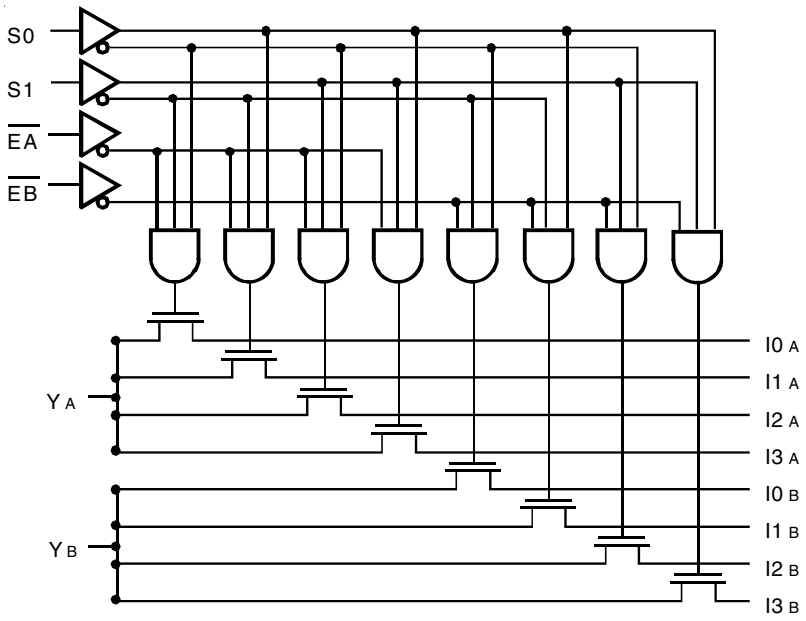
## DESCRIPTION:

The QS3VH253 HotSwitch Dual 4:1 multiplexer/demultiplexer is a high bandwidth bus switch. The QS3VH253 has very low ON resistance, resulting in under 250ps propagation delay through the switch. The Select (Sx) inputs control the data flow. The multiplexers/demultiplexers are enabled when the Enable ($\overline{EA}$, $\overline{EB}$) inputs are low. In the ON state, the switches can pass signals up to 5V. In the OFF state, the switches offer very high impedance at the terminals.

The combination of near-zero propagation delay, high OFF impedance, and over-voltage tolerance makes the QS3VH253 ideal for high performance communication applications.

The QS3VH253 is characterized for operation from -40°C to +85°C.

## FUNCTIONAL BLOCK DIAGRAM




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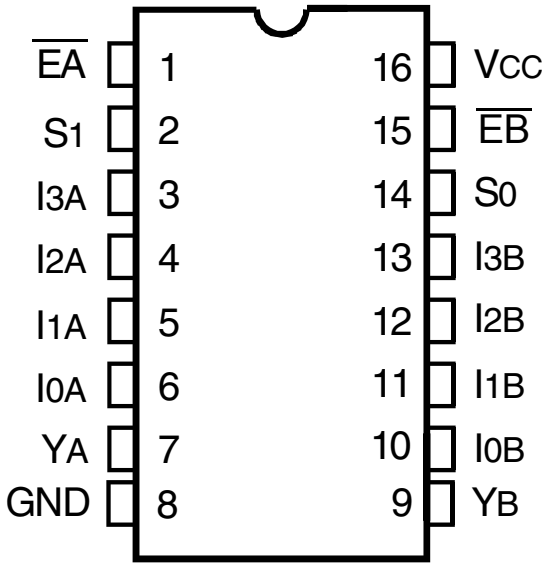


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## PIN CONFIGURATION




QSOP/ TSSOP
TOP VIEW

## ABSOLUTE MAXIMUM RATINGS(1)

| Symbol | Description | Max | Unit |
|---|---|---|---|
| $V_{TERM}$(2) | SupplyVoltage to Ground | –0.5 to +4.6 | V |
| $V_{TERM}$(3) | DC Switch Voltage $V_S$ | –0.5 to +5.5 | V |
| $V_{TERM}$(3) | DC Input Voltage $V_{IN}$ | –0.5 to +5.5 | V |
| $V_{AC}$ | AC Input Voltage (pulse width ≤20ns) | –3 | V |
| $I_{OUT}$ | DC Output Current (max. sink current/pin) | 120 | mA |
| $T_{STG}$ | Storage Temperature | –65 to +150 | °C |

**NOTES:**
1. Stresses greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.
2. $V_{CC}$ terminals.
3. All terminals except $V_{CC}$ .

## CAPACITANCE ($T_A$ = +25°C, F = 1MHz, $V_{IN}$ = 0V, $V_{OUT}$ = 0V)

| Symbol | Parameter(1) | | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| $C_{IN}$ | Control Inputs | | 3 | 5 | pF |
| $C_{I/O}$ | Quickswitch Channels (Switch OFF) | Demux | 4 | 6 | pF |
| | | Mux | 11 | 15 | |
| $C_{I/O}$ | Quickswitch Channels (Switch ON) | Demux | 12 | 16 | pF |
| | | Mux | 12 | 16 | |

**NOTE:**
1. This parameter is guaranteed but not production tested.

## FUNCTION TABLE(1)

| Enable | | Select | | Outputs | | |
|---|---|---|---|---|---|---|
| $\overline{EA}$ | $\overline{EB}$ | $S_1$ | $S_0$ | $Y_A$ | $Y_B$ | Function |
| H | X | X | X | Z | X | Disable A |
| X | H | X | X | X | Z | Disable B |
| L | L | L | L | $I0_A$ | $I0_B$ | S1 - 0 = 0 |
| L | L | L | H | $I1_A$ | $I1_B$ | S1 - 0 = 1 |
| L | L | H | L | $I2_A$ | $I2_B$ | S1 - 0 = 2 |
| L | L | H | H | $I3_A$ | $I3_B$ | S1 - 0 = 3 |

**NOTE:**
1. H = HIGH Voltage Level
   L = LOW Voltage Level
   X = Don't Care
   Z = High-Impedence

## PIN DESCRIPTION

| Pin Names | I/O | Description |
|---|---|---|
| Ixx | I | Data Inputs |
| $S_0$, $S_1$ | I | Select Input |
| $\overline{EA}$, $\overline{EB}$ | I | Enable Input |
| $Y_A$, $Y_B$ | O | Data Outputs |



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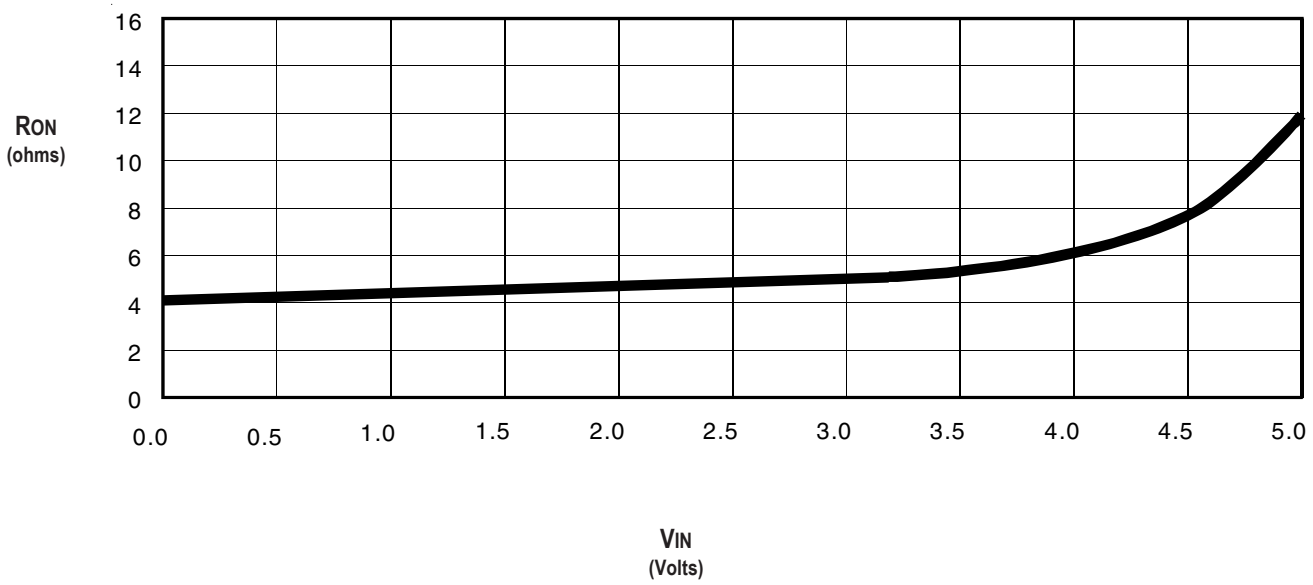
## DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:
Industrial: $T_A$ = –40°C to +85°C, $V_{CC}$ = 3.3V ±0.3V

| Symbol | Parameter | Test Conditions | | | Min. | Typ.(1) | Max. | Unit |
|---|---|---|---|---|---|---|---|---|
| $V_{IH}$ | Input HIGH Voltage | Guaranteed Logic HIGH | $V_{CC}$ = 2.3V to 2.7V | | 1.7 | — | — | V |
| | | for Control Inputs | $V_{CC}$ = 2.7V to 3.6V | | 2 | — | — | |
| $V_{IL}$ | Input LOW Voltage | Guaranteed Logic LOW | $V_{CC}$ = 2.3V to 2.7V | | — | — | 0.7 | V |
| | | for Control Inputs | $V_{CC}$ = 2.7V to 3.6V | | — | — | 0.8 | |
| $I_{IN}$ | Input Leakage Current (Control Inputs) | 0V ≤ $V_{IN}$ ≤ $V_{CC}$ | | | — | — | ±1 | µA |
| $I_{OZ}$ | Off-State Current (Hi-Z) | 0V ≤ $V_{OUT}$ ≤ 5V, Switches OFF | | | — | — | ±1 | µA |
| $I_{OFF}$ | Data Input/Output Power Off Leakage | $V_{IN}$ or $V_{OUT}$ 0V to 5V, $V_{CC}$ = 0V | | | — | — | ±1 | µA |
| $R_{ON}$ | Switch ON Resistance | $V_{CC}$ = 2.3V | $V_{IN}$ = 0V | $I_{ON}$ = 30mA | — | 6 | 8 | Ω |
| | | Typical at $V_{CC}$ = 2.5V | $V_{IN}$ = 1.7V | $I_{ON}$ = 15mA | — | 7 | 9 | |
| | | $V_{CC}$ = 3V | $V_{IN}$ = 0V | $I_{ON}$ = 30mA | — | 4 | 6 | |
| | | | $V_{IN}$ = 2.4V | $I_{ON}$ = 15mA | — | 5 | 8 | |

**NOTE:**
1. Typical values are at $V_{CC}$ = 3.3V and $T_A$ = 25°C.

## TYPICAL ON RESISTANCE vs $V_{IN}$ AT $V_{CC}$ = 3.3V





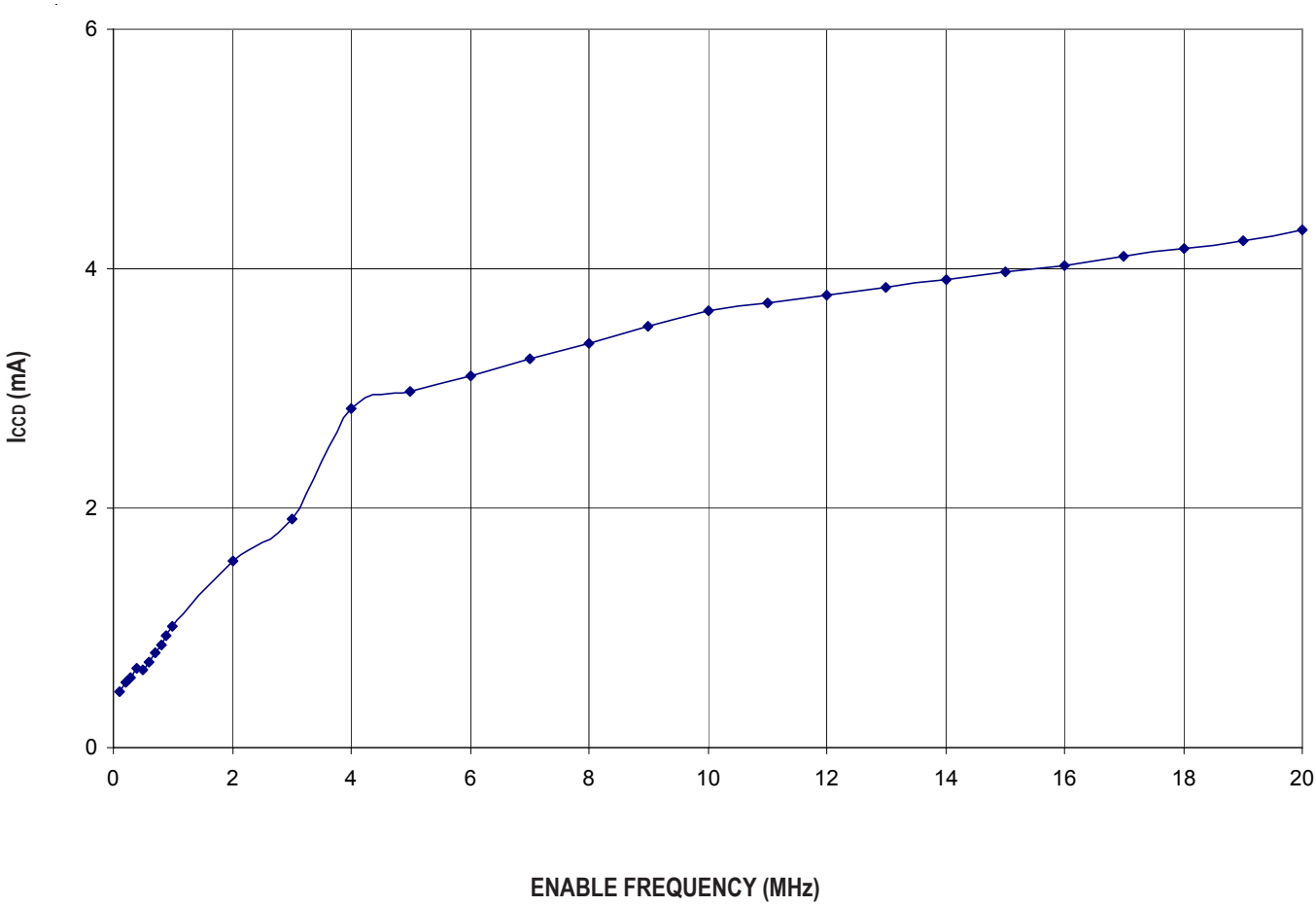

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## POWER SUPPLY CHARACTERISTICS

| Symbol | Parameter | Test Conditions[1] | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{CCQ}$ | Quiescent Power Supply Current | $V_{CC}$ = Max., $V_{IN}$ = GND or $V_{CC}$, f = 0 | — | 2 | 4 | mA |
| $\Delta I_{CC}$ | Power Supply Current [2,3] per Input HIGH | $V_{CC}$ = Max., $V_{IN}$ = 3V, f = 0 per Control Input | — | — | 30 | µA |
| $I_{CCD}$ | Dynamic Power Supply Current[4] | $V_{CC}$ = 3.3V, A and B Pins Open, Control Inputs Toggling @ 50% Duty Cycle | See Typical $I_{CCD}$ vs Enable Frequency graph below | | | |

**NOTES:**
1. For conditions shown as Min. or Max., use the appropriate values specified under DC Electrical Characteristics.
2. Per input driven at the specified level. Mux/demux pins do not contribute to ΔIcc.
3. This parameter is guaranteed but not tested.
4. This parameter represents the current required to switch internal capacitance at the specified frequency. The mux/demux inputs do not contribute to the Dynamic Power Supply Current. This parameter is guaranteed but not production tested.

## TYPICAL $I_{CCD}$ vs ENABLE FREQUENCY CURVE AT $V_{CC}$ = 3.3V






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# SWITCHING CHARACTERISTICS OVER OPERATING RANGE

$T_A$ = -40°C to +85°C

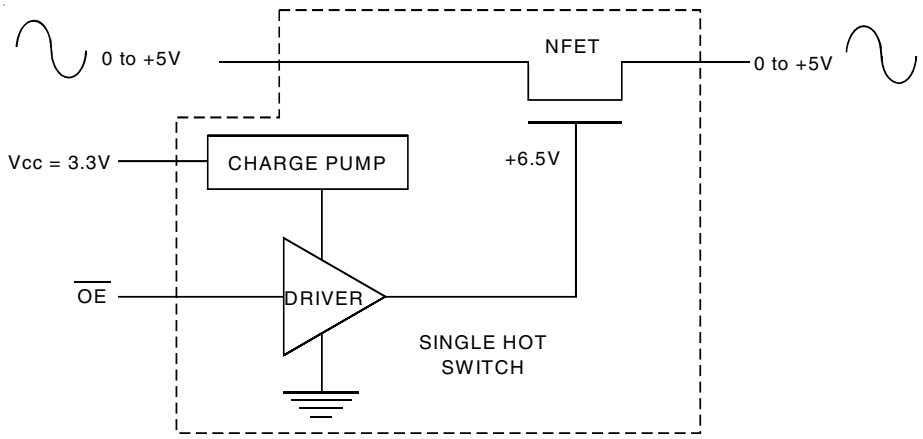
| Symbol | Parameter | $V_{CC}$ = 2.5 ± 0.2V (1) | | $V_{CC}$ = 3.3 ± 0.3V (1) | | Unit |
|---|---|---|---|---|---|---|
| | | Min. (4) | Max. | Min. (4) | Max. | |
| $t_{PLH}$<br>$t_{PHL}$ | Data Propagation Delay(2,3)<br>Yx to Ixx or Ixx to Yx | — | 0.2 | — | 0.2 | ns |
| $t_{SEL}$ | Select Time<br>S to Yx | 1.5 | 9 | 1.5 | 8 | ns |
| $t_{PZH}$<br>$t_{PZL}$ | Enable Time<br>Sx to Ixx | 1.5 | 9 | 1.5 | 9 | ns |
| $t_{PHZ}$<br>$t_{PLZ}$ | Disable Time<br>Sx to Ixx | 1.5 | 8 | 1.5 | 8 | ns |
| $t_{PZH}$<br>$t_{PZL}$ | Enable Time<br>$\overline{Ex}$ to Yx or Ixx | 1.5 | 9 | 1.5 | 8 | ns |
| $t_{PHZ}$<br>$t_{PLZ}$ | Disable Time<br>$\overline{Ex}$ to Yx or Ixx | 1.5 | 8 | 1.5 | 8 | ns |
| $f_{\overline{E}xorSx}$ | Operating Frequency - Enable(2,5) | — | 10 | — | 20 | MHz |

**NOTES:**
1. See Test Conditions under TEST CIRCUITS AND WAVEFORMS.
2. This parameter is guaranteed but not production tested.
3. The bus switch contributes no propagation delay other than the RC delay of the ON resistance of the switch and the load capacitance. The time constant for the switch alone is of the order of 0.2ns at $C_L$ = 50pF. Since this time constant is much smaller than the rise and 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.
4. Minimums are guaranteed but not production tested.
5. Maximum toggle frequency for Sx or $\overline{Ex}$ control input (pass voltage > $V_{CC}$, $V_{IN}$ = 5V, $R_{LOAD} \geq 1M\Omega$, no $C_{LOAD}$).

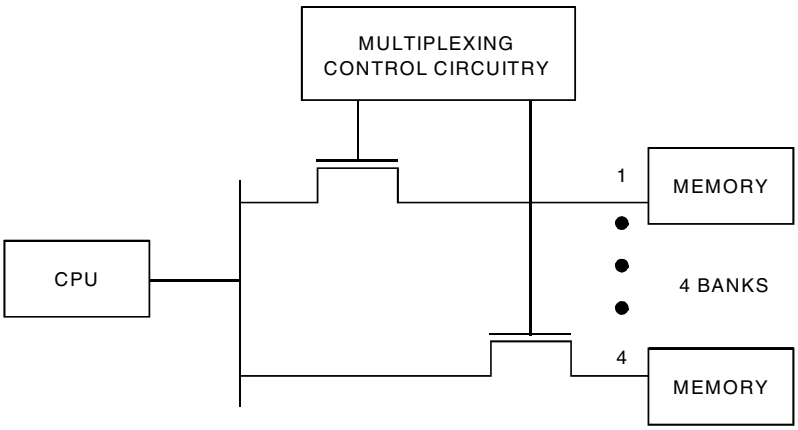


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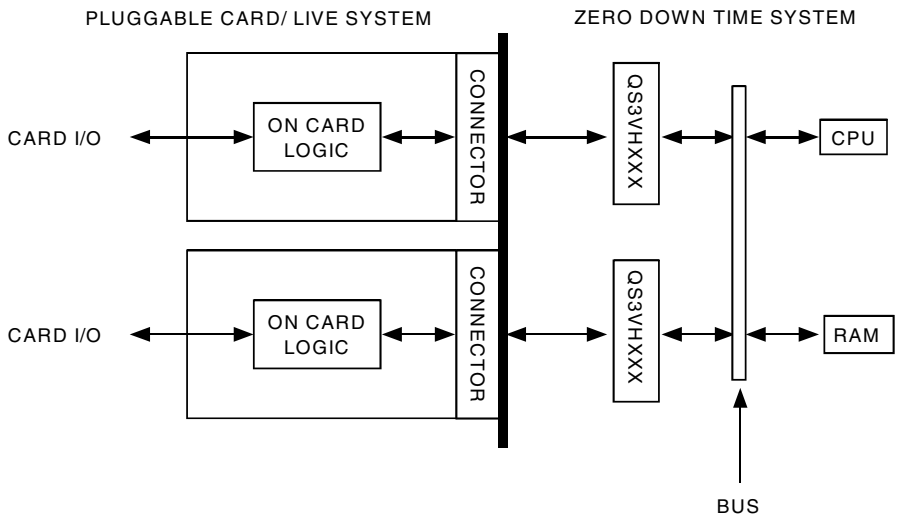
# SOME APPLICATIONS FOR HOTSWITCH PRODUCTS




*Rail-to-Rail Switching*




*Multiplexing/Demultiplexing*




*Hot-Swapping*

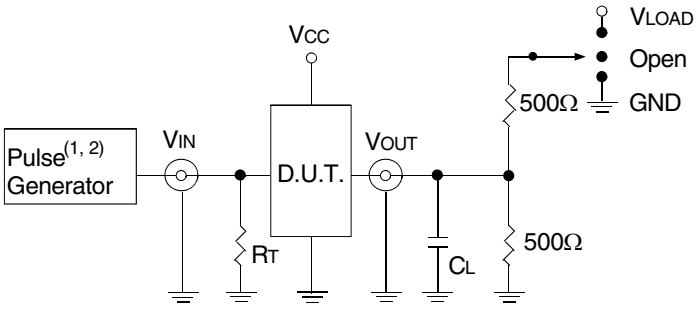


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# TEST CIRCUITS AND WAVEFORMS

## TEST CONDITIONS

| Symbol | $V_{CC}^{(1)}$= 3.3V ± 0.3V | $V_{CC}^{(2)}$= 2.5V ± 0.2V | Unit |
|---|---|---|---|
| $V_{LOAD}$ | 6 | 2 x Vcc | V |
| $V_{IH}$ | 3 | Vcc | V |
| $V_T$ | 1.5 | Vcc/2 | V |
| $V_{LZ}$ | 300 | 150 | mV |
| $V_{HZ}$ | 300 | 150 | mV |
| $C_L$ | 50 | 30 | pF |



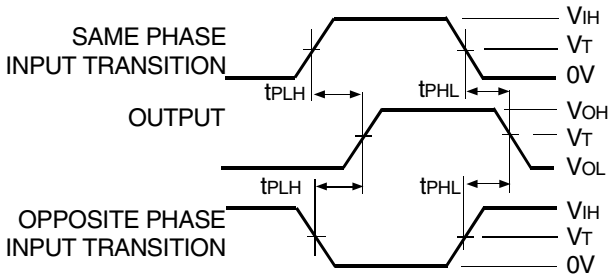

***Test Circuits for All Outputs***

**DEFINITIONS:**
$C_L$ = Load capacitance: includes jig and probe capacitance.
$R_T$ = Termination resistance: should be equal to $Z_{OUT}$ of the Pulse Generator.

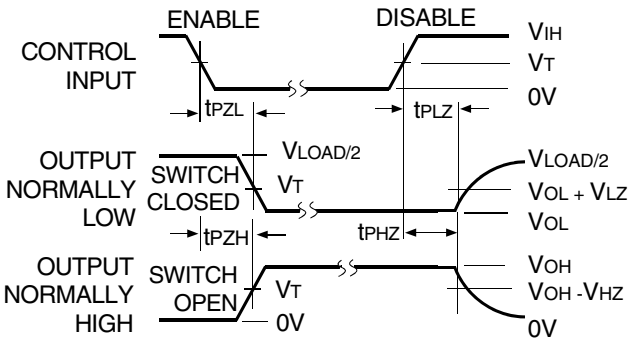
**NOTES:**
1. Pulse Generator for All Pulses: Rate ≤ 10MHz; $t_F$ ≤ 2.5ns; $t_R$ ≤ 2.5ns.
2. Pulse Generator for All Pulses: Rate ≤ 10MHz; $t_F$ ≤ 2ns; $t_R$ ≤ 2ns.

## SWITCH POSITION

| Test | Switch |
|---|---|
| $t_{PLZ}/t_{PZL}$ | $V_{LOAD}$ |
| $t_{PHZ}/t_{PZH}$ | GND |
| $t_{PD}$ | Open |




***Propagation Delay***



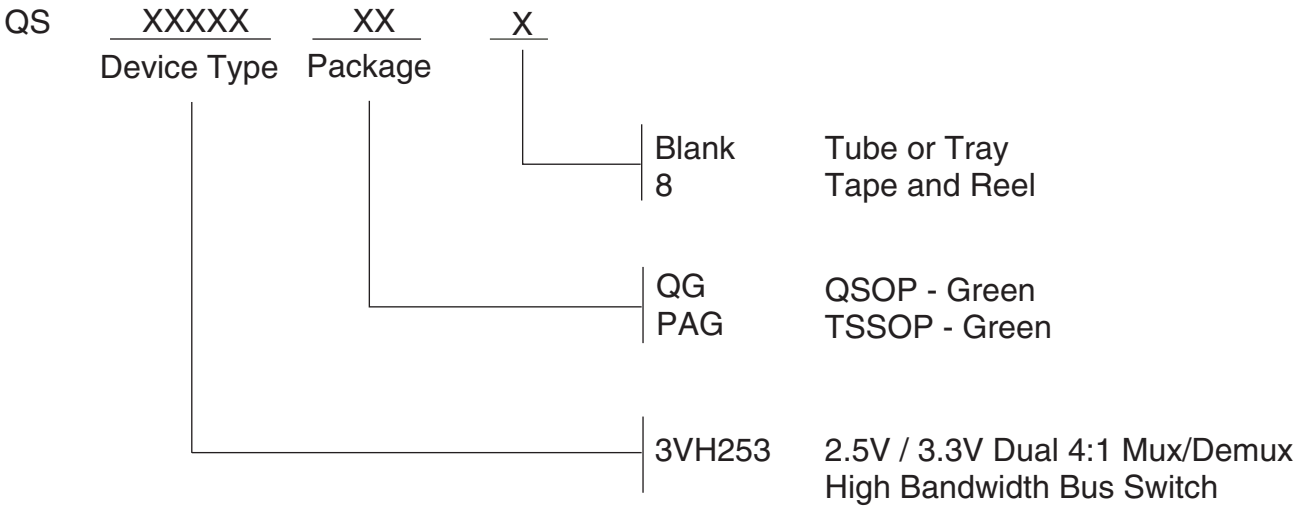

**NOTE:**
1. Diagram shown for input Control Enable-LOW and input Control Disable-HIGH.

***Enable and Disable Times***



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