QUICKSWITCH® PRODUCTS 2.5V/ 3.3V 20-BIT FLOW-THROUGH PIN OUT, HIGH BANDWIDTH BUS SWITCH

IDTQS3VH16861

FEATURES:

- N channel FET switches with no parasitic diode to Vcc
  - *Isolation under power-off conditions*
  - *No DC path to Vcc 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**
- **Vcc operation: 2.3V to 3.6V**
- **High bandwidth - up to 500 MHz**
- **LVTTL-compatible control Inputs**
- **Undershoot Clamp Diodes on all switch and control Inputs**
- **Low I/O capacitance, 4pF typical**
- **Available in TSSOP package**

APPLICATIONS:

- **Hot-swapping**
- **10/100 Base-T, Ethernet LAN switch**
- **Low distortion analog switch**
- **Replaces mechanical relay**
- **ATM 25/155 switching**

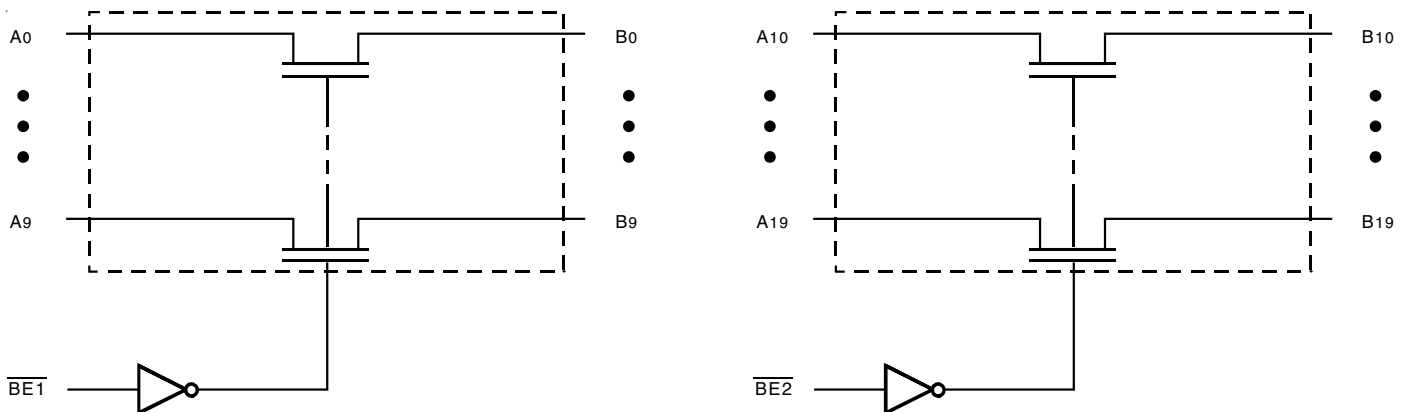## DESCRIPTION:

The QS3VH16861 HotSwitch with 20-bit flow-though pin out is a high bandwidth bus switch. The QS3VH16861 has very low ON resistance, resulting in under 250ps propagation delay through the switch. The switches are controlled by active low enable ($\overline{BE}$x) controls. In the ON state, the switches can pass signals up to 5V. In the OFF state, the switches offer very high impedence at the terminals.

The combination of near-zero propagation delay, high OFF impedance, and over-voltage tolerance makes the QS3VH16861 ideal for high performance communications applications.

The QS3VH16861 is characterized for operation from -40°C to +85°C.
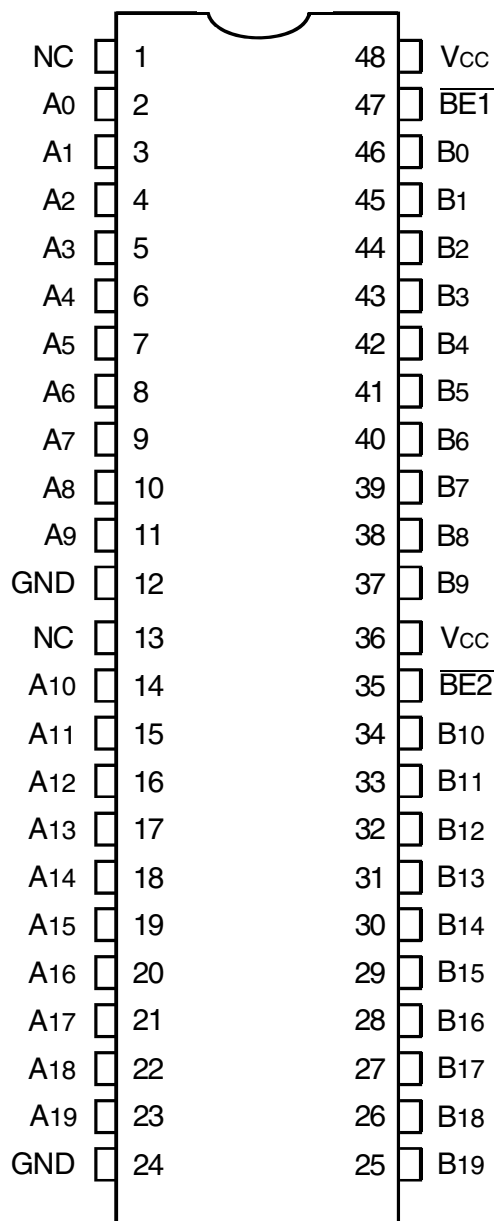
FUNCTIONAL BLOCK DIAGRAM

INDUSTRIAL TEMPERATURE RANGE

JUNE 2013

DSC-5875/6

PIN CONFIGURATION

NC	1		48	V_{CC}
A0	2		47	$\overline{BE1}$
A1	3		46	B0
A2	4		45	B1
A3	5		44	B2
A4	6		43	B3
A5	7		42	B4
A6	8		41	B5
A7	9		40	B6
A8	10		39	B7
A9	11		38	B8
GND	12		37	B9
NC	13		36	V_{CC}
A10	14		35	$\overline{BE2}$
A11	15		34	B10
A12	16		33	B11
A13	17		32	B12
A14	18		31	B13
A15	19		30	B14
A16	20		29	B15
A17	21		28	B16
A18	22		27	B17
A19	23		26	B18
GND	24		25	B19

TSSOP
TOP VIEW

ABSOLUTE MAXIMUM RATINGS[1]

Symbol	Description	Max.	Unit
V_{TERM}[2]	Supply Voltage 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. current/pin)	120	mA
T_{STG}	Storage Temperature	-65 to +150	$^{\circ}C$

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)	4	6	pF
$C_{I/O}$	Quickswitch Channels (Switch ON)	8	12	pF

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

PIN DESCRIPTION

Pin Names	Description
$\overline{BEx}$	Active LOW Bus Enable
A0 - A19	Bus A
B0 - B19	Bus B

FUNCTION TABLE[1]

$\overline{BE1}$	$\overline{BE2}$	A0 - A9	A10 - A19	Function
L	L	B0 - B9	B10 - B19	Connect
L	H	B0 - B9	Z	Connect B0 - B9, Disconnect B10 - B19
H	L	Z	B10 - B19	Disconnect B0 - B9, Connect B10 - B19
H	H	Z	Z	Disconnect

NOTE:
1. H = HIGH Voltage Level
   L = LOW Voltage Level
   Z = High-Impedence

DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE[1]

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 HIGH	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)	$0V \leq V_{IN} \leq V_{CC}$			—	—	±1	µA
I_{OZ}	Off-State Current (Hi-Z)	$0V \leq V_{OUT} \leq 5V$, 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
		(Typ. 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, unless otherwise noted.

TYPICAL ON RESISTANCE vs V_{IN} AT V_{CC} = 3.3V
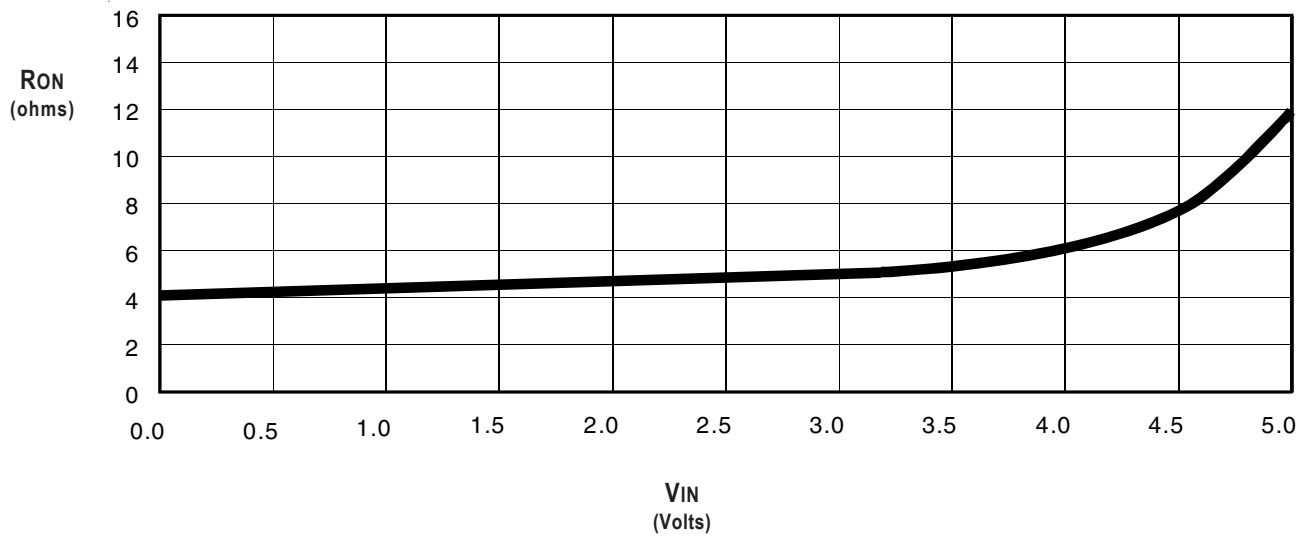
POWER SUPPLY CHARACTERISTICS

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	—	1.5	3	mA
ΔI_{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. A and B pins do not contribute to ΔI_{CC}.
3. This parameter is guaranteed but not tested.
4. This parameter represents the current required to switch internal capacitance at the specified frequency. The A and B 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

ENABLE FREQUENCY (MHz)
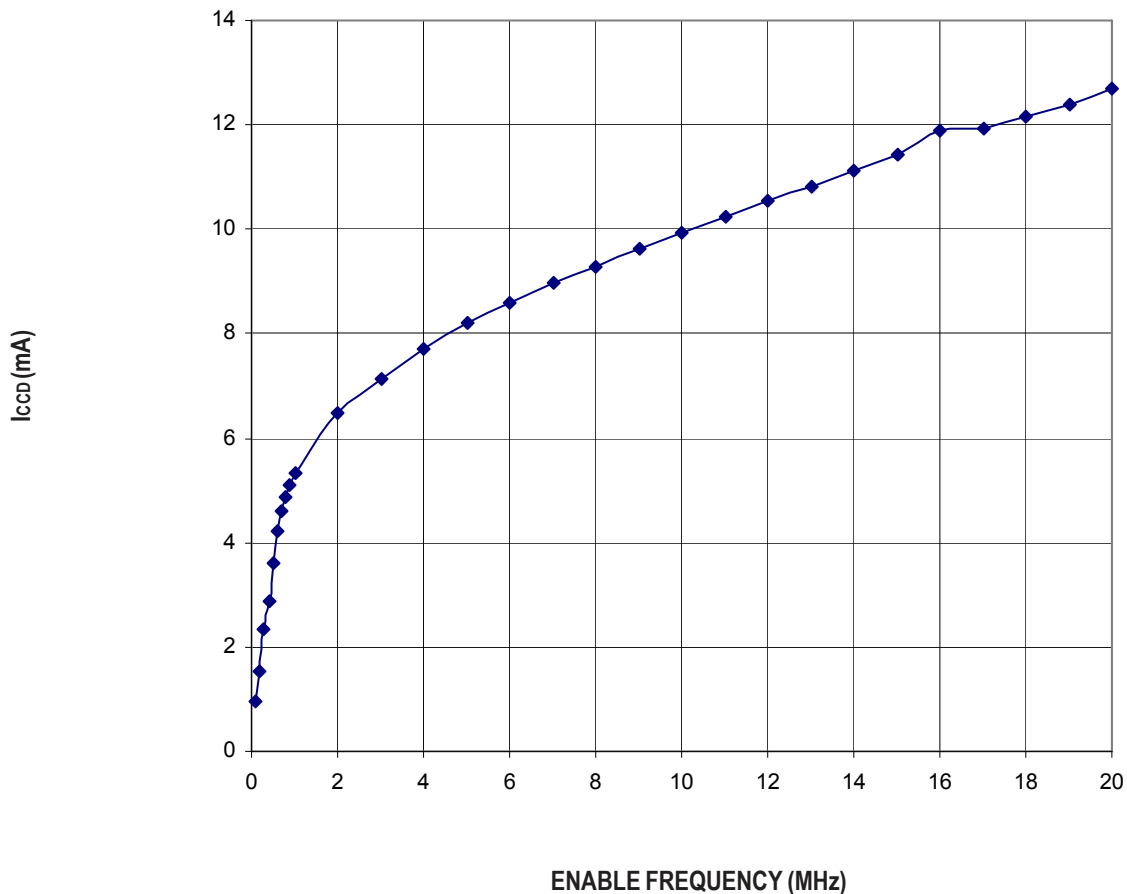
SWITCHING CHARACTERISTICS OVER OPERATING RANGE

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}	Data Propagation Delay[2,3]	——	0.2	——	0.2	ns
t_{PHL}	A to B or B to A					
t_{PZH}	Switch Turn-On Delay	1.5	8.5	1.5	8	ns
t_{PZL}	$\overline{BEx}$ to xA or xB					
t_{PHZ}	Switch Turn-Off Delay	1.5	7.5	1.5	7.5	ns
t_{PLZ}	$\overline{BEx}$ to xA or xB					
$f_{\overline{BEx}}$	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 $\overline{BEx}$ control input (pass voltage > V_{CC}, V_{IN} = 5V, $R_{LOAD} \geq$ 1MΩ, no C_{LOAD}).
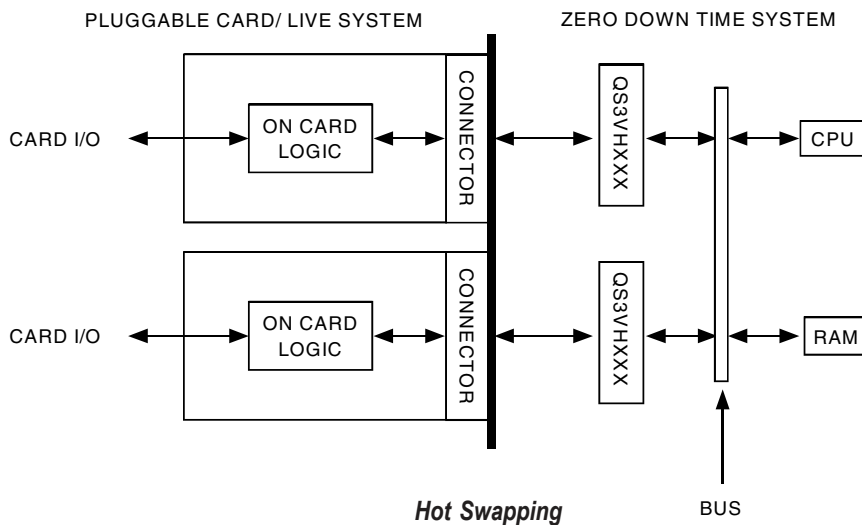
SOME APPLICATIONS FOR HOTSWITCH PRODUCTS
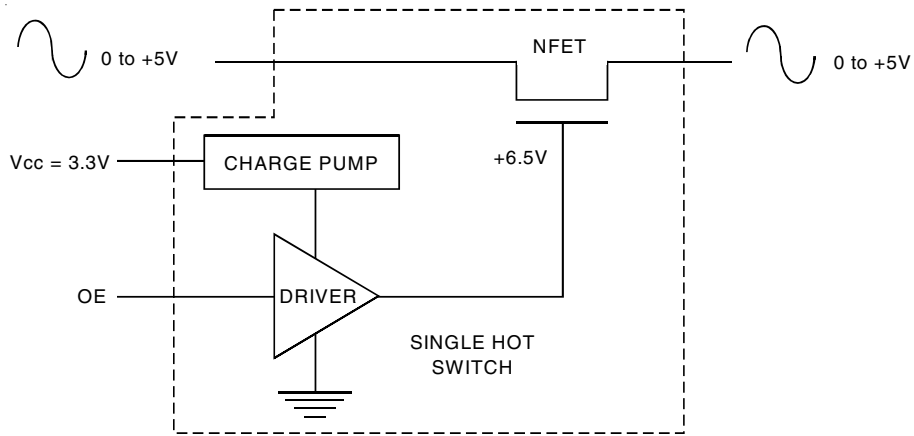
Rail-to-Rail Switching
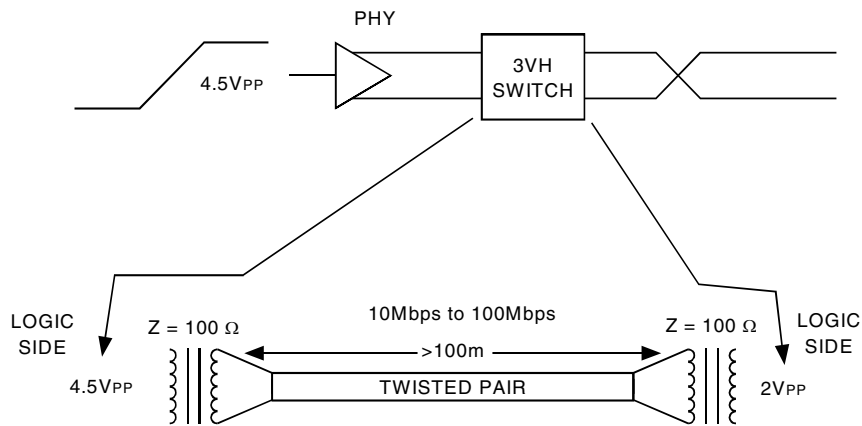
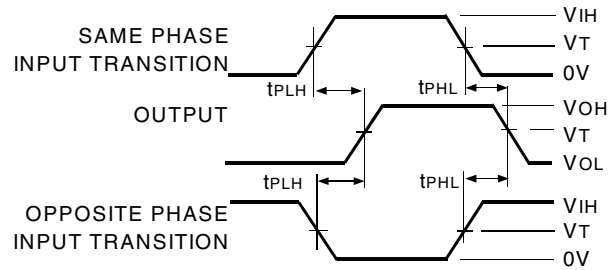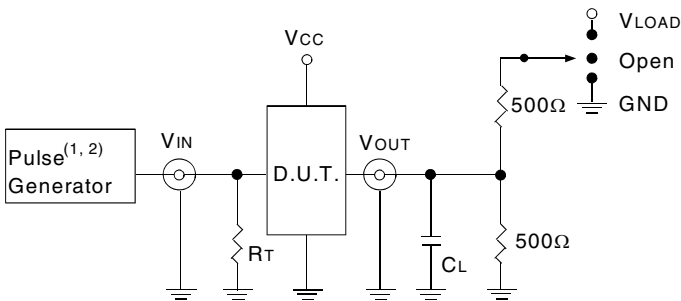*Fast Ethernet Data Switching (LAN Switch)*
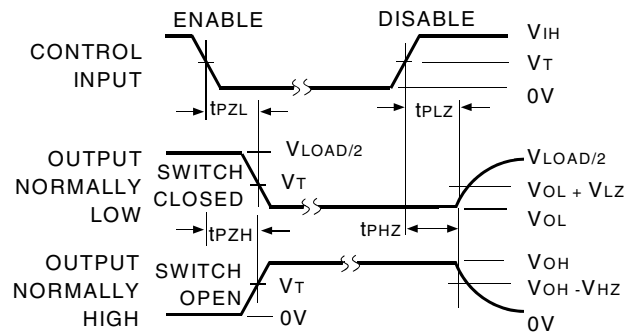
Hot Swapping

TEST CIRCUITS AND WAVEFORMS

TEST CONDITIONS

Symbol	Vcc[(1)]= 3.3V ± 0.3V	Vcc[(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

Propagation Delay

Test Circuits for All Outputs

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

Enable and Disable Times

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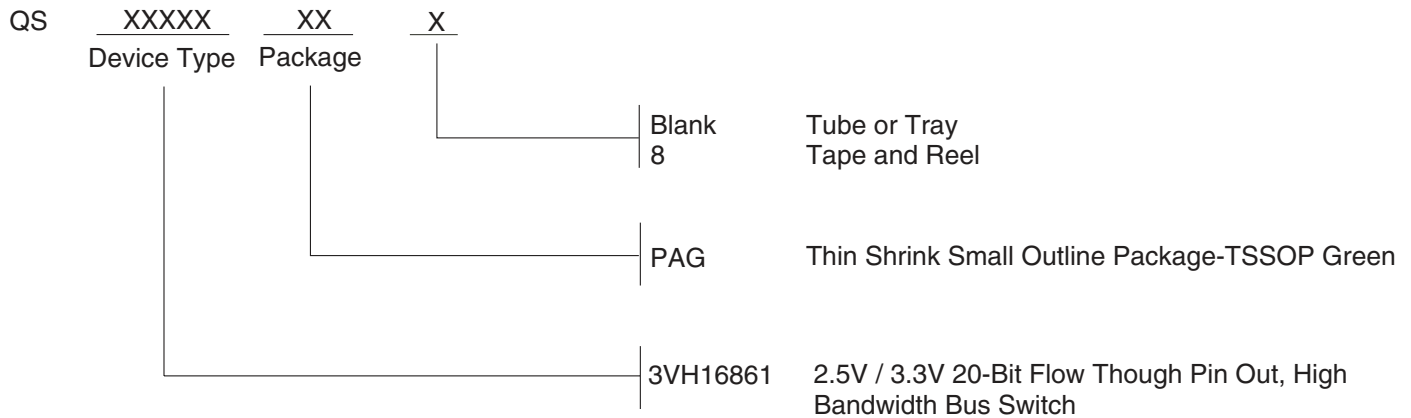R_T = Termination resistance: should be equal to Z_{OUT} of the Pulse Generator.

NOTES:
1. Pulse Generator for All Pulses: Rate ≤ 1.0MHz; t_F ≤ 2.5ns; t_R ≤ 2.5ns.
2. Pulse Generator for All Pulses: Rate ≤ 1.0MHz; t_F ≤ 2ns; t_R ≤ 2ns.

SWITCH POSITION

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

ORDERING INFORMATION

QS   <u>XXXXX</u>   <u>XX</u>   <u>X</u>
      Device Type   Package

Blank   Tube or Tray
8   Tape and Reel

PAG   Thin Shrink Small Outline Package-TSSOP Green

3VH16861   2.5V / 3.3V 20-Bit Flow Though Pin Out, High Bandwidth Bus Switch

Datasheet Document History

06/10/2013   Pg. 1, 8   Updated the Ordering Information by removing non green package version, the "IDT" notation and Adding Tape and Reel information.