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**
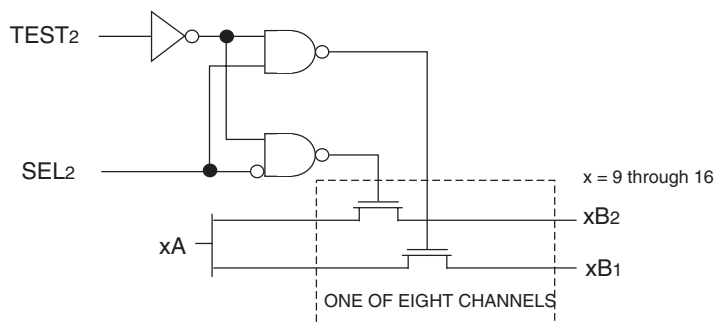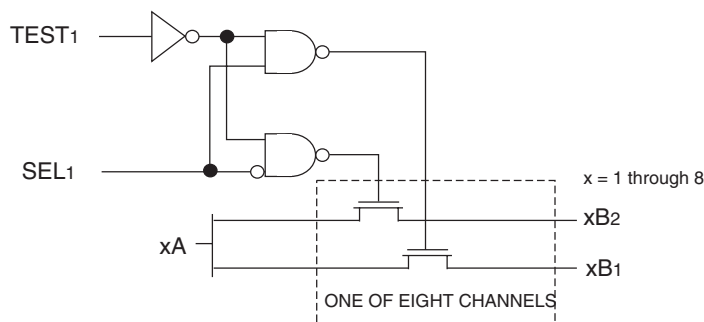- **ATM 25/155 switching**

DESCRIPTION:

The QS3VH16233 HotSwitch is a 32-bit to 16-bit high bandwidth bus switch, which can multiplex or demultiplex data. The QS3VH16233 has very low ON resistance, resulting in under 250ps propagation delay through the switch. This device can be used as two 16-bit to 8-bit multiplexers or as one 32-bit to 16-bit multiplexer. SELx inputs control the data flow. TESTx inputs control either one or two ports connection. In the OFF and ON states, the switches are 5V-tolerant. In the OFF state, the switches offer very high impedance at the terminals.
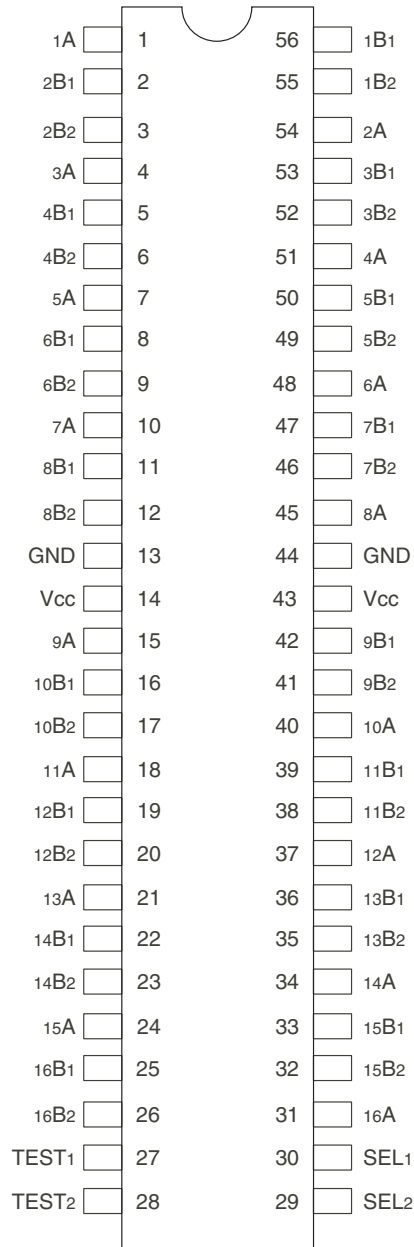
The combination of near-zero propagation delay, high OFF impedance, and over-voltage tolerance also makes the QS3VH16233 ideal for high performance communications applications.

The QS3VH16233 is characterized for operation from -40°C to +85°C.

FUNCTIONAL BLOCK DIAGRAM

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INDUSTRIAL TEMPERATURE RANGE

FEBRUARY 2013

DSC-5882/9

PIN CONFIGURATION

1A	1	56	1B1
2B1	2	55	1B2
2B2	3	54	2A
3A	4	53	3B1
4B1	5	52	3B2
4B2	6	51	4A
5A	7	50	5B1
6B1	8	49	5B2
6B2	9	48	6A
7A	10	47	7B1
8B1	11	46	7B2
8B2	12	45	8A
GND	13	44	GND
Vcc	14	43	Vcc
9A	15	42	9B1
10B1	16	41	9B2
10B2	17	40	10A
11A	18	39	11B1
12B1	19	38	11B2
12B2	20	37	12A
13A	21	36	13B1
14B1	22	35	13B2
14B2	23	34	14A
15A	24	33	15B1
16B1	25	32	15B2
16B2	26	31	16A
TEST1	27	30	SEL1
TEST2	28	29	SEL2

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	°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)	Mux	8	12	pF
		Demux	4	6	
$C_{I/O}$	Quickswitch Channels (Switch ON)	Mux	16	24	pF
		Demux	8	12	

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

PIN DESCRIPTION

Pin Names	I/O	Description
xA	I/O	Bus A
xBx	I/O	Bus B
SELx	I	Data Select
TESTx	I	Port Select

FUNCTION TABLE[1]

SELx	TESTx	xA	Function
L	L	xB1	xA to xB1
H	L	xB2	xA to xB2
X	H	xB1, xB2	xA to xB1 and xB2

NOTE:
1. H = HIGH Voltage Level
   L = LOW Voltage Level
   X = Don't Care

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 for Control Inputs	V_{CC} = 2.3V to 2.7V		1.7	—	—	V
			V_{CC} = 2.7V to 3.6V		2	—	—	
V_{IL}	Input LOW Voltage	Guaranteed Logic HIGH for Control Inputs	V_{CC} = 2.3V to 2.7V		—	—	0.7	V
			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 (Typ. at V_{CC} = 2.5V)	V_{IN} = 0V	I_{ON} = 30mA	—	6	8	Ω
			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
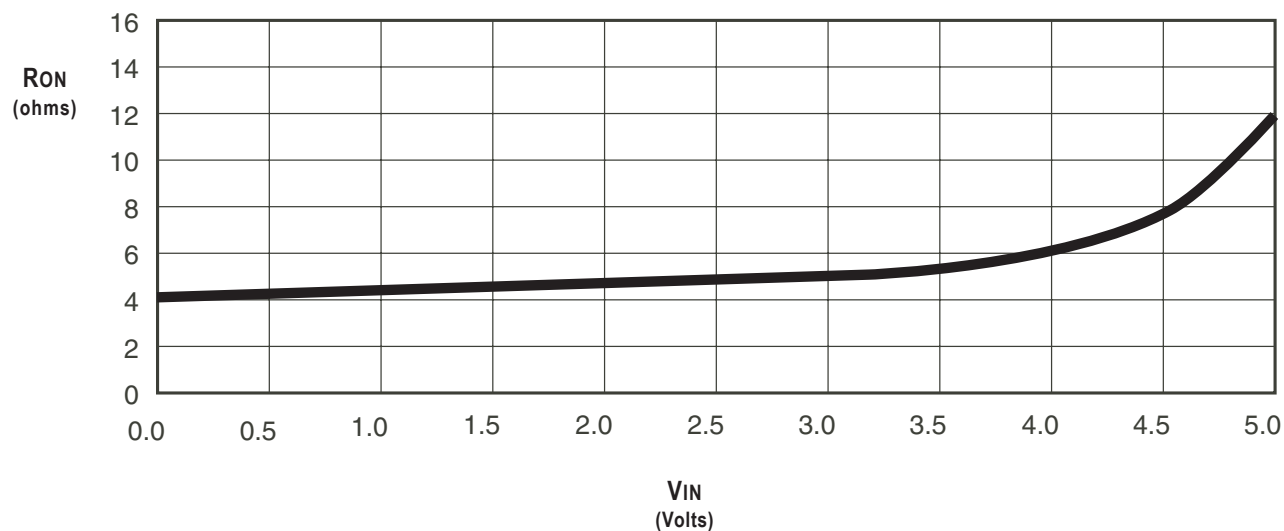
POWER SUPPLY CHARACTERISTICS

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)
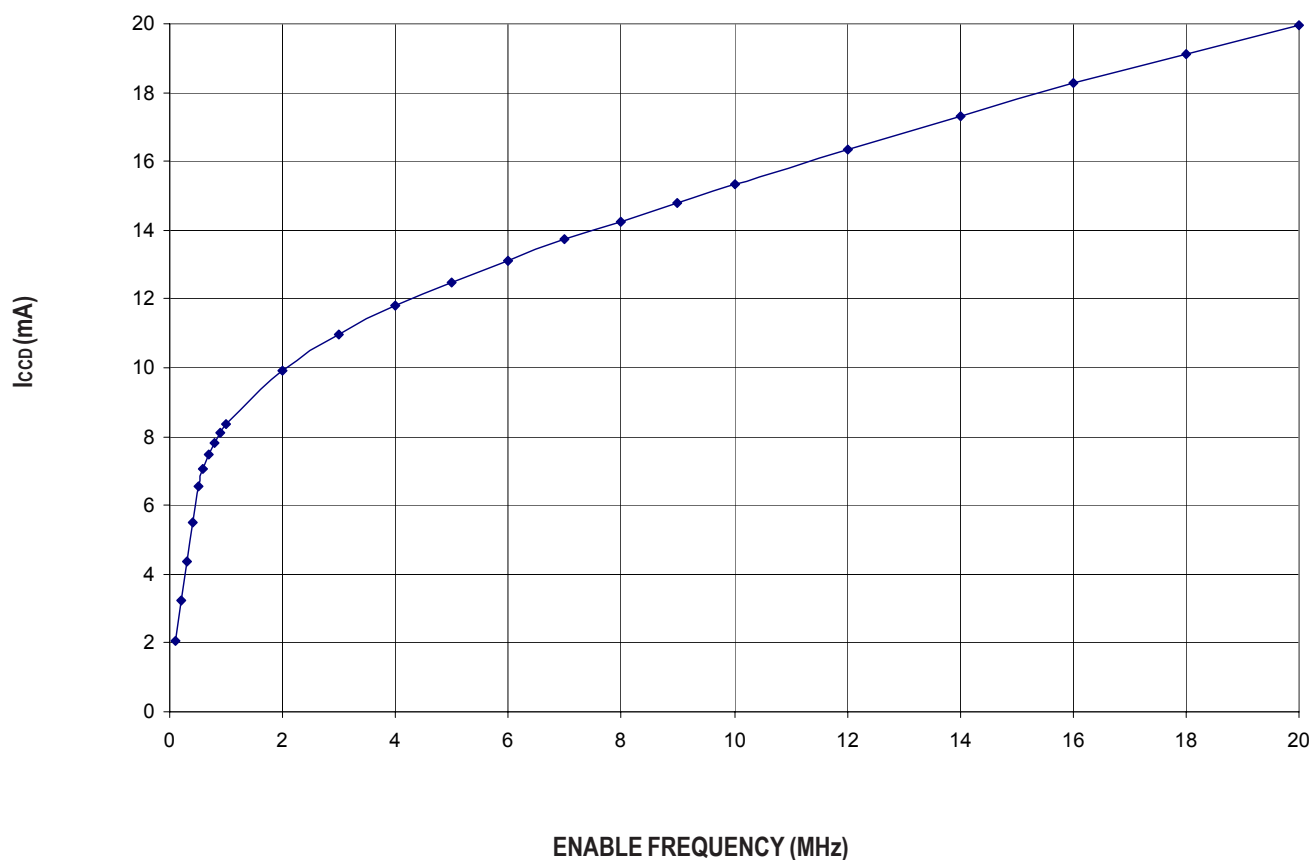
SWITCHING CHARACTERISTICS OVER OPERATING RANGE

T_A = -40°C to +85°C

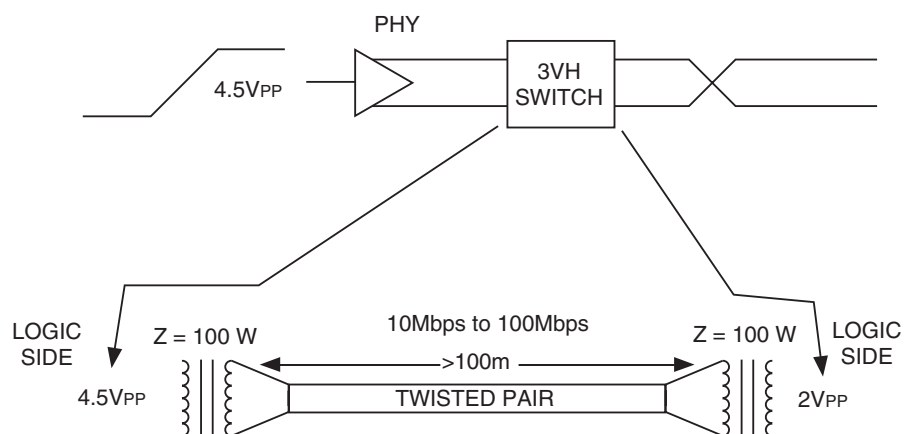| Symbol	Parameter	Vcc = 2.5 ± 0.2V [1]		Vcc = 3.3 ± 0.3V [1]		Unit
		Min. [4]	Max.	Min. [4]	Max.	
t_{PLH} t_{PHL}	Data Propagation Delay [2,3] A to B or B to A	—	0.2	—	0.2	ns
t_{BX}	Switch Multiplex Delay SEL to xA	1.5	9	1.5	7.5	ns
t_{PZH} t_{PZL}	Switch Turn-On Delay SEL to xBx	1.5	9	1.5	8	ns
t_{PHZ} t_{PLZ}	Switch Turn-Off Delay SEL to xBx	1.5	7.5	1.5	7.5	ns
t_{PZH} t_{PZL}	Switch Turn-On Delay TEST to xBx	1.5	8.5	1.5	9	ns
t_{PHZ} t_{PLZ}	Switch Turn-Off Delay TEST to xBx	1.5	8.5	1.5	8.5	ns
f_{Sx}	Operating Frequency - Enable [2,5]	—	7.5	—	15	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 control input (pass voltage > V_{CC}, V_{IN} = 5V, R_{LOAD} ≥ 1MΩ, no C_{LOAD}).
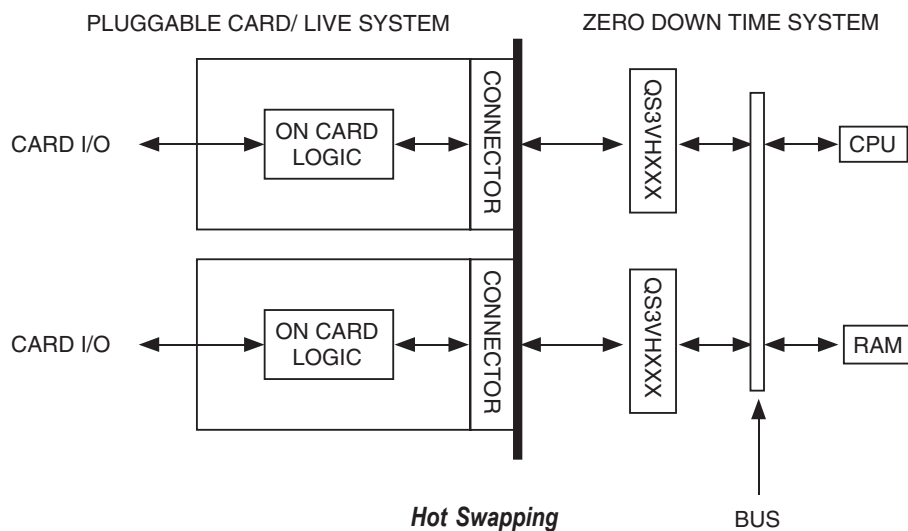
SOME APPLICATIONS FOR HOTSWITCH PRODUCTS

0 to +5V

NFET

0 to +5V

Vcc = 3.3V — CHARGE PUMP

+6.5V

OE — DRIVER

SINGLE HOT SWITCH

Rail-to-Rail Switching

PHY

4.5V$_{PP}$

3VH SWITCH

LOGIC SIDE

Z = 100 W

10Mbps to 100Mbps

Z = 100 W

LOGIC SIDE

4.5V$_{PP}$

>100m

TWISTED PAIR

2V$_{PP}$
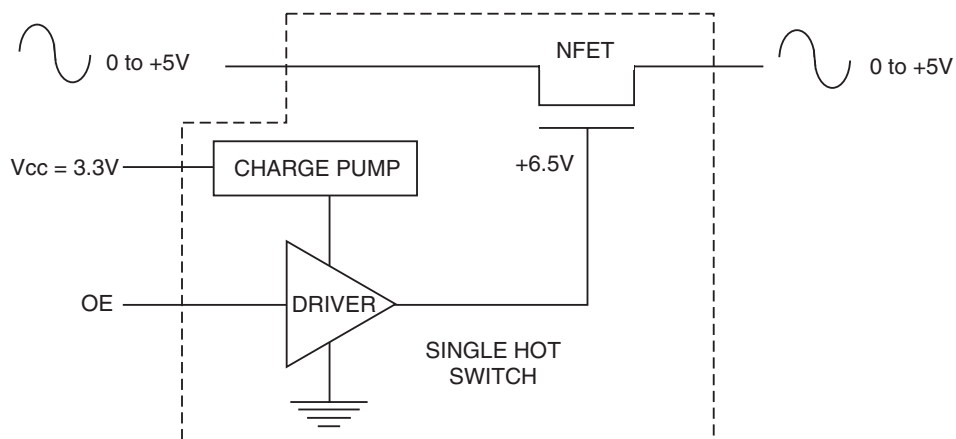
Fast Ethernet Data Switching (LAN Switch)

PLUGGABLE CARD/ LIVE SYSTEM

ZERO DOWN TIME SYSTEM

CARD I/O

ON CARD LOGIC

CONNECTOR

QS3VHXXX

CPU

CARD I/O

ON CARD LOGIC

CONNECTOR

QS3VHXXX

RAM

Hot Swapping

BUS

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 V_{CC}	V
V_{IH}	3	V_{CC}	V
V_T	1.5	$V_{CC}/2$	V
V_{LZ}	300	150	mV
V_{HZ}	300	150	mV
C_L	50	30	pF
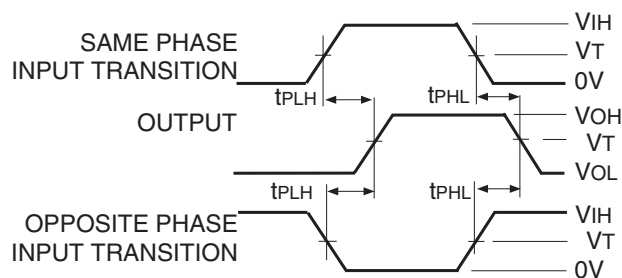
Propagation Delay
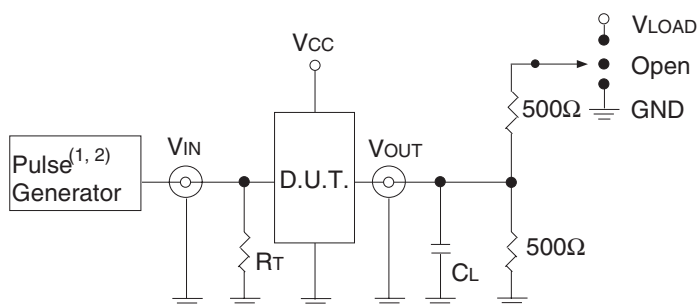
Test Circuits for All Outputs

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 ≤ 1.0MHz; t_F ≤ 2.5ns; t_R ≤ 2.5ns.
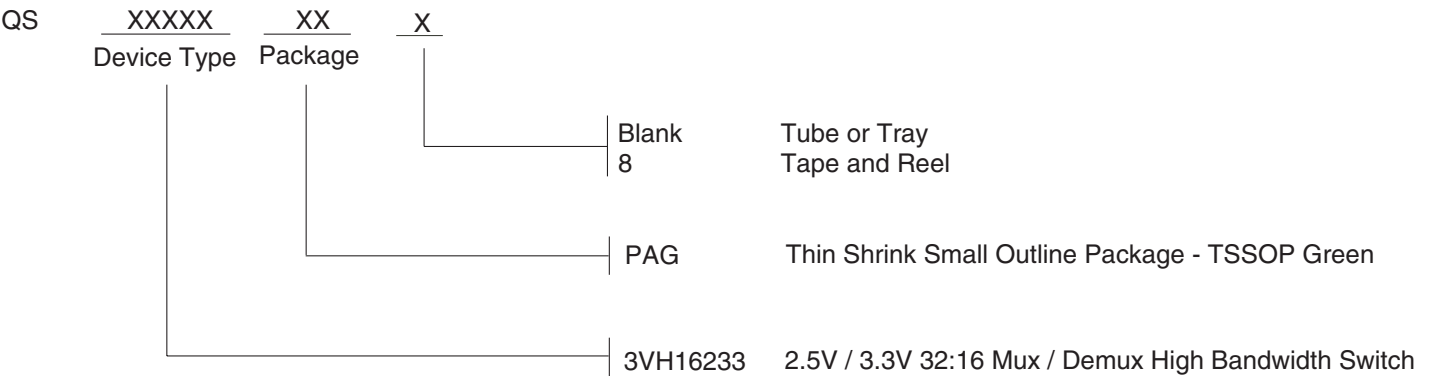2. Pulse Generator for All Pulses: Rate ≤ 1.0MHz; t_F ≤ 2ns; t_R ≤ 2ns.
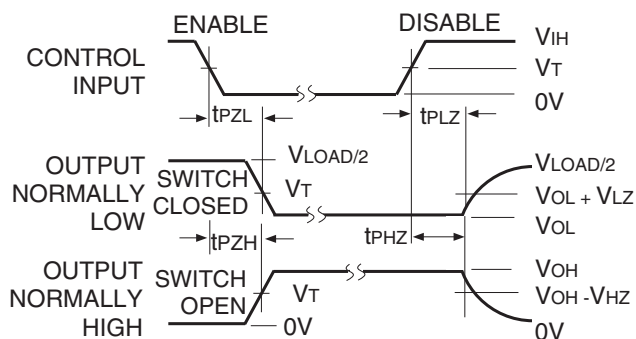
NOTE:
1. Diagram shown for input Control Enable-LOW and input Control Disable-HIGH.

Enable and Disable Times

SWITCH POSITION

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

ORDERING INFORMATION

QS   XXXXX   XX   X
      Device Type Package

Blank   Tube or Tray
8   Tape and Reel

PAG   Thin Shrink Small Outline Package - TSSOP Green

3VH16233   2.5V / 3.3V 32:16 Mux / Demux High Bandwidth Switch

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