TS3USB30
HIGH-SPEED USB 2.0 (480-Mbps) 1:2 MULTIPLEXER/DEMULTIPLEXER SWITCH WITH SINGLE ENABLE

SCDS237 – JUNE 2007

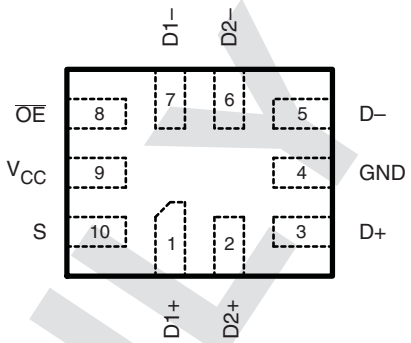
FEATURES

- V_{CC} Operation at 3.0 V and 4.3 V
- 1.8-V Compatible Control-Pin Inputs
- I_{OFF} Supports Partial Power Down Mode Operation
- r_{on} = 10 Ω Max
- Δr_{on} <0.35 Ω Typ
- $C_{io(on)}$ = 7 pF Typ
- Low Power Consumption (1 μA Max)
- 6KV ESD protection
- -3dB Bandwidth = 955-MHz Typ
- Packaged in 10-pin TQFN (1.4mm x 1.8mm)

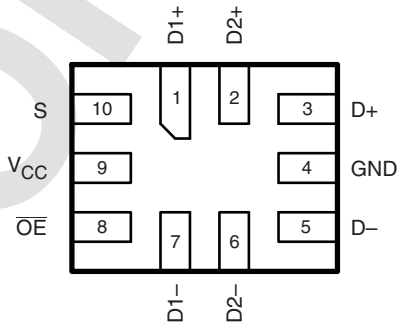
APPLICATIONS

- Routes Signals for USB 1.0, 1.1, and 2.0

RSW PACKAGE
(TOP VIEW)



RSW PACKAGE
(BOTTOM VIEW)



DESCRIPTION/ORDERING INFORMATION

The TS3USB30 is a high-bandwidth switch specially designed for the switching of high-speed USB 2.0 signals in handset and consumer applications, such as cell phones, digital cameras, and notebooks with hubs or controllers with limited USB I/Os. The wide bandwidth (750 MHz) of this switch allows signals to pass with minimum edge and phase distortion. The device multiplexes differential outputs from a USB host device to one of two corresponding outputs. The switch is bidirectional and offers little or no attenuation of the high-speed signals at the outputs. It is designed for low bit-to-bit skew and high channel-to-channel noise isolation, and is compatible with various standards, such as high-speed USB 2.0 (480 Mbps).

ORDERING INFORMATION

T_A	PACKAGE(1)(2)		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	RSW	Tape and reel	TS3USB30RSWR	L6O

(1) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.
(2) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI website at www.ti.com.

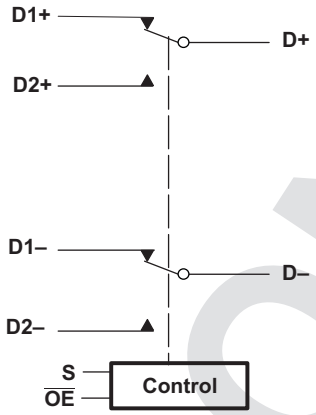
PIN DESCRIPTION

NAME	DESCRIPTION
$\overline{OE}$	Bus-switch enable
S	Select input
D+, D–, Dn+, Dn–	Data ports

TRUTH TABLE

S	$\overline{OE}$	FUNCTION
X	H	Disconnect
L	L	D = $D1_n$
H	L	D = $D2_n$

BLOCK DIAGRAM



Absolute Maximum Ratings(1)

over operating free-air temperature range (unless otherwise noted)

			MIN	MAX	UNIT
V_{CC}	Supply voltage range		–0.5	4.6	V
V_{IN}	Control input voltage range(2)(3)		–0.5	V_{CC}	V
$V_{I/O}$	Switch I/O voltage range(2)(3)(4)		–0.5	V_{CC}	V
I_{IK}	Control input clamp current	V_{IN} < 0		–50	mA
$I_{I/OK}$	I/O port clamp current	$V_{I/O}$ < 0		–50	mA
I_{IO}	ON-state switch current(5)			±64	mA
	Continuous current through V_{CC} or GND			±100	mA
θ_{JA}	Package thermal impedance(6)	RSW package			°C/W
T_{stg}	Storage temperature range		–65	150	°C

(1) Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) All voltages are with respect to ground, unless otherwise specified.
(3) The input and output voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
(4) V_I and V_O are used to denote specific conditions for $V_{I/O}$.
(5) I_I and I_O are used to denote specific conditions for $I_{I/O}$.
(6) The package thermal impedance is calculated in accordance with JESD 51-7.

Recommended Operating Conditions(1)

			MIN	MAX	UNIT
V_{CC}	Supply voltage		3.0	4.3	V
V_{IH}	High-level control input voltage	V_{CC} = 3.0 V to 3.6 V	1.3		V
		V_{CC} = 4.3 V	1.7		
V_{IL}	Low-level control input voltage	V_{CC} = 3.0 V to 3.6 V		0.5	V
		V_{CC} = 4.3 V		0.7	
$V_{I/O}$	Data input/output voltage		0	V_{CC}	V
T_A	Operating free-air temperature		–40	85	°C

(1) All unused control inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

Electrical Characteristics[1]

over operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS			MIN	TYP[2]	MAX	UNIT
V_{IK}		V_{CC} = 3.0 V,	I_I = –18 mA				–1.2	V
I_{IN}	Control inputs	V_{CC} = 4.3 V, 0 V	V_{IN} = 0 to 4.3 V				±1	µA
I_{OZ}[3]		V_{CC} = 4.3 V,	V_O = 0 to 3.6 V, V_I = 0,	Switch OFF, V_{IN} = GND			±2	µA
I_{OFF}		V_{CC} = 0 V,	V_O = 0 to 4.3 V, V_I = 0	V_{IN} = V_{CC} or GND			±2	µA
I_{CC}		V_{CC} = 4.3 V,	$I_{I/O}$ = 0, Switch ON or OFF,	V_{IN} = V_{CC} or GND			1	µA
ΔI_{CC}[4]	Control inputs	V_{CC} = 4.3 V,	V_{IN} = 2.6 V				10	µA
C_{in}	Control inputs	V_{CC} = 0 V,	V_{IN} = V_{CC} or GND			1		pF
$C_{io(OFF)}$		V_{CC} = 3.3 V	Switch OFF, V_{IN} = V_{CC}	$V_{I/O}$ = 3.3 V or 0		2		pF
$C_{io(ON)}$		V_{CC} = 3.3 V,	Switch ON, V_{IN} = GND,	$V_{I/O}$ = 3.3 V or 0		7		pF
r_{on}[5]		V_{CC} = 3 V	V_I = 0.4	I_O = -8 mA			10	Ω
Δr_{on}		V_{CC} = 3 V	V_I = 0.4	I_O = -8 mA		0.35		Ω
$r_{on(flat)}$		V_{CC} = 3 V	V_I = 0 V or 1 V	I_O = -8 mA		2		Ω

(1) V_{IN} and I_{IN} refer to control inputs. V_I, V_O, I_I, and I_O refer to data pins.
(2) All typical values are at V_{CC} = 3.3 V (unless otherwise noted), T_A = 25°C.
(3) For I/O ports, the parameter I_{OZ} includes the input leakage current.
(4) This is the increase in supply current for each input that is at the specified TTL voltage level, rather than V_{CC} or GND.
(5) Measured by the voltage drop between the A and B terminals at the indicated current through the switch. ON-state resistance is determined by the lower of the voltages of the two (A or B) terminals.

Dynamic Electrical Characteristics

over operating range, T_A = –40°C to 85°C, V_{CC} = 3.3 V ± 10%, GND = 0 V

PARAMETER		TEST CONDITIONS	MIN	TYP[1]	MAX	UNIT
X_{TALK}	Crosstalk	R_L = 50 Ω, f = 240 MHz, See Figure 9		–56		dB
O_{IRR}	OFF isolation	R_L = 50 Ω, f = 240 MHz, See Figure 8		–39		dB
BW	Bandwidth (–3 dB)	R_L = 50 Ω, C_L = 5 pF, See Figure 10		955		MHz

(1) For Max or Min conditions, use the appropriate value specified under Electrical Characteristics for the applicable device type.

Switching Characteristics

over operating range, T_A = –40°C to 85°C, V_{CC} = 3.3 V ± 10%, GND = 0 V

PARAMETER		TEST CONDITIONS	MIN	TYP(1)	MAX	UNIT
t_{pd}	Propagation delay(2)(3)	R_L = 50 Ω, C_L = 5 pF, See Figure 11		0.25		ns
t_{ON}	Line enable time, SEL to D, nD	R_L = 50 Ω, C_L = 5 pF, See Figure 7			30	ns
t_{OFF}	Line disable time, SEL to D, nD	R_L = 50 Ω, C_L = 5 pF, See Figure 7			25	ns
t_{ON}	Line enable time, $\overline{OE}$ to D, nD	R_L = 50 Ω, C_L = 5 pF, See Figure 7			30	ns
t_{OFF}	Line disable time, $\overline{OE}$ to D, nD	R_L = 50 Ω, C_L = 5 pF, See Figure 7			25	ns
$t_{SK(O)}$	Output skew between center port to any other port(2)	R_L = 50 Ω, C_L = 5 pF, See Figure 12			50	ps
$t_{SK(P)}$	Skew between opposite transitions of the same output ($t_{PHL} – t_{PLH}$)(2)	R_L = 50 Ω, C_L = 5 pF, See Figure 12			20	ps
t_J	Total Jitter(2)	R_L = 50 Ω, C_L = 5 pF, $t_R = t_F$ = 500 ps at 480 Mbps (PRBS = 2^{15} -1)			20	ps

(1) For max or min conditions, use the appropriate value specified under "electrical characteristics" for the applicable device type.
(2) Specified by design
(3) The bus switch contributes no propagational 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 0.25 ns for 10-pF load. Since this time constant is much smaller than the rise/fall times of typical driving signals, it adds very little propagational delay to the system. Propagational 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 interactions with the load on the driven side.

APPLICATION INFORMATION

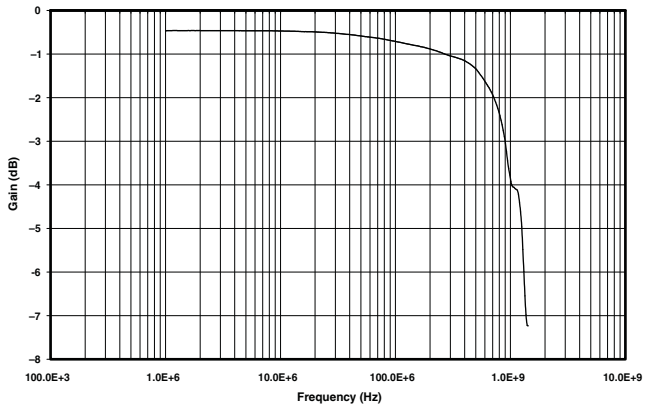


Figure 1. Gain vs Frequency

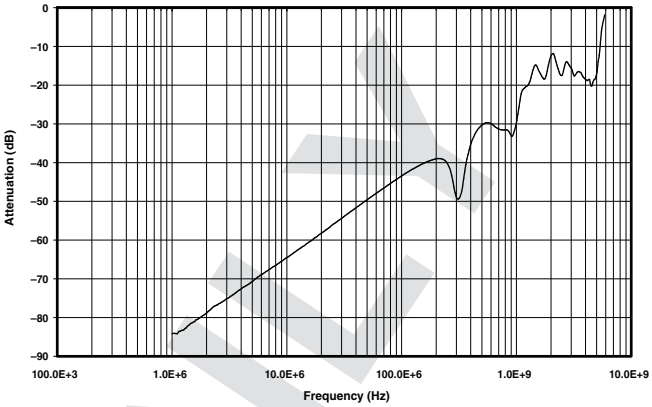


Figure 2. OFF Isolation

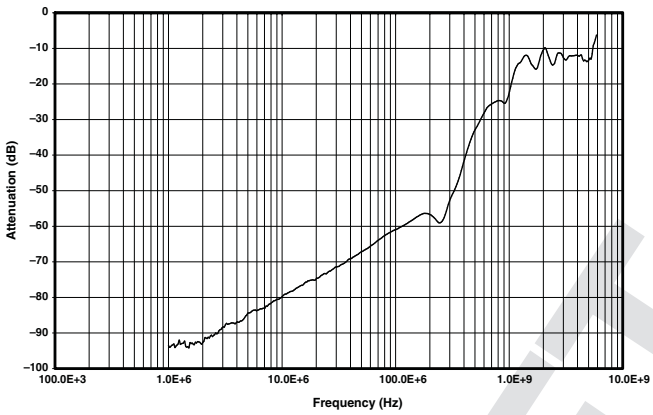


Figure 3. Crosstalk

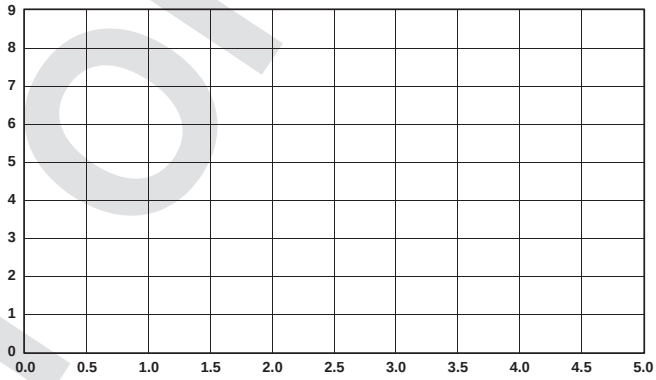


Figure 4. r_{on}

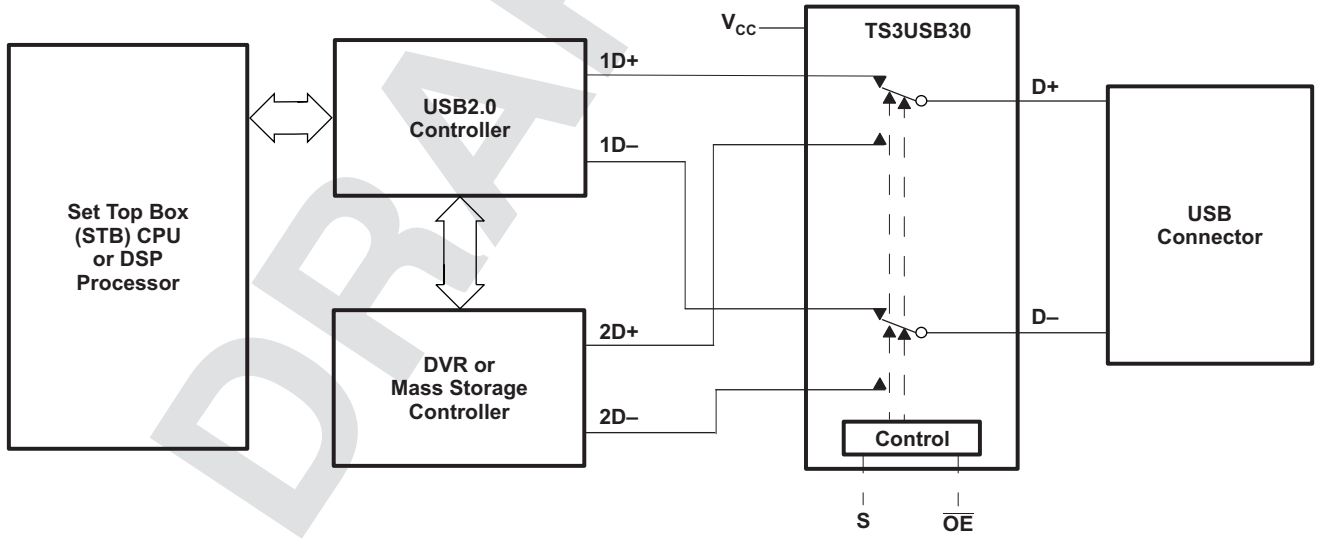
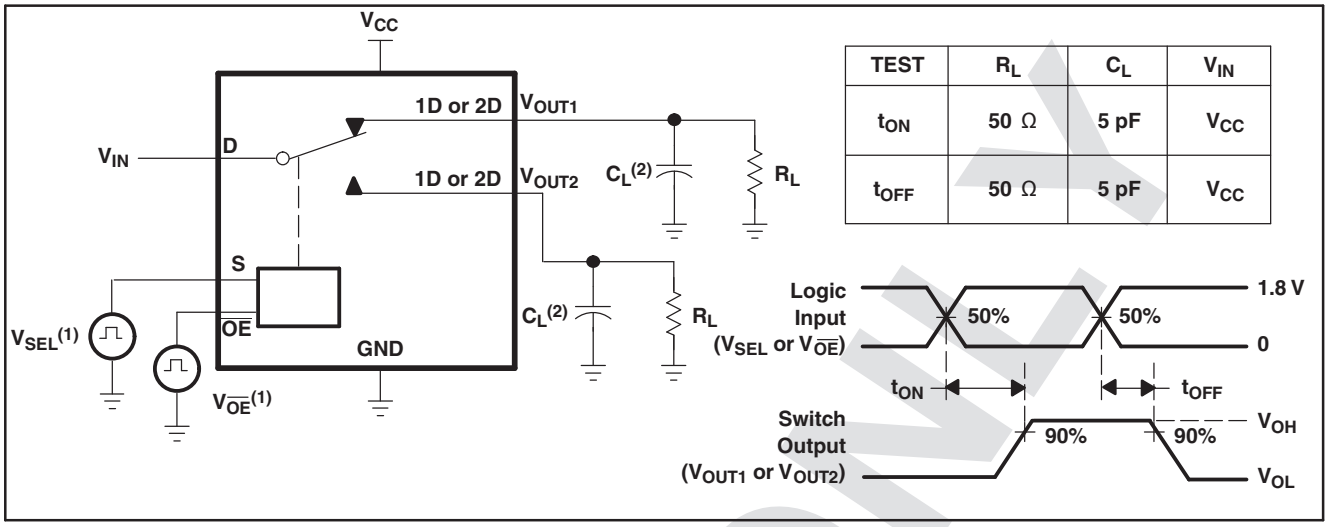


Figure 5. Application Diagram

PARAMETER MEASUREMENT INFORMATION



TEST	R_L	C_L	V_{IN}
t_{ON}	50 Ω	5 pF	V_{CC}
t_{OFF}	50 Ω	5 pF	V_{CC}

(1) All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, Z_O = 50 Ω, t_r < 5 ns, t_f < 5 ns.
(2) C_L includes probe and jig capacitance.

Figure 6. Turn-On (t_{ON}) and Turn-Off Time (t_{OFF})

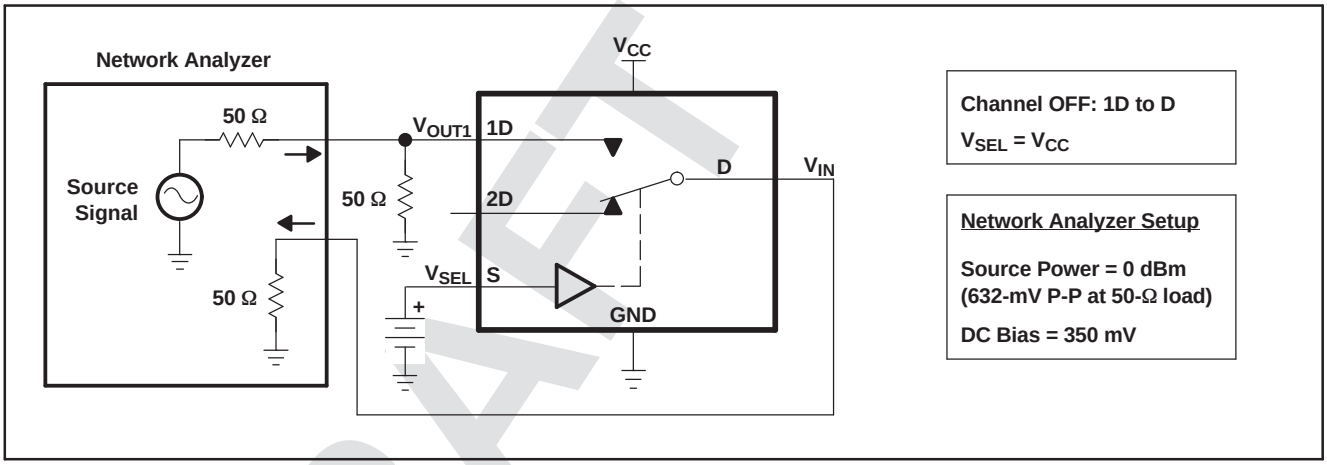


Figure 7. OFF Isolation (O_{ISO})

PARAMETER MEASUREMENT INFORMATION (continued)

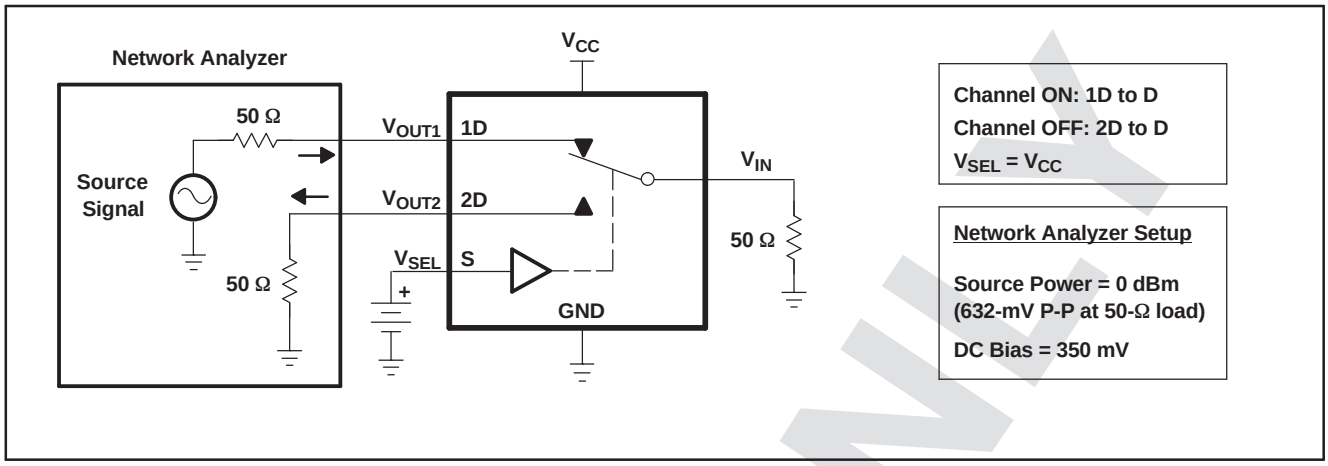


Figure 8. Crosstalk (X_{TALK})

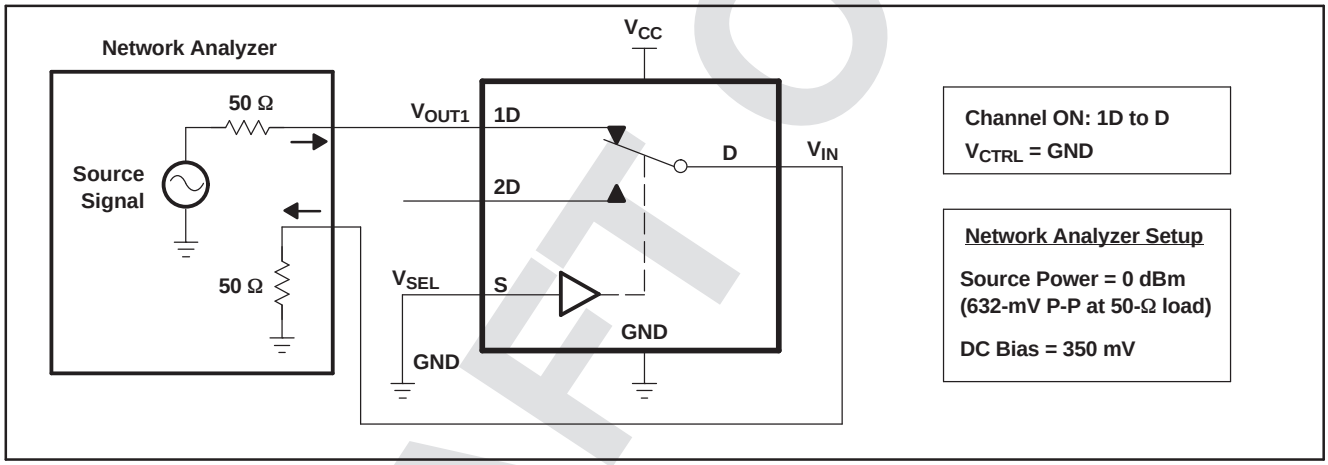


Figure 9. Bandwidth (BW)

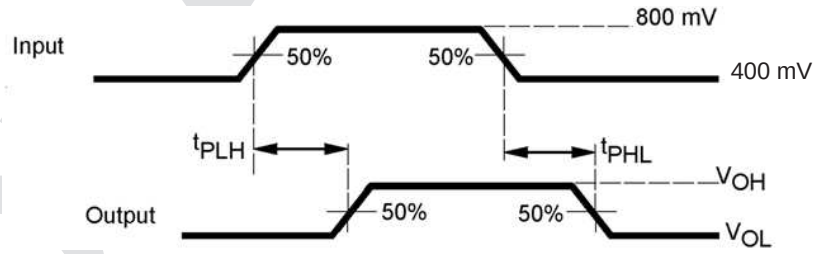
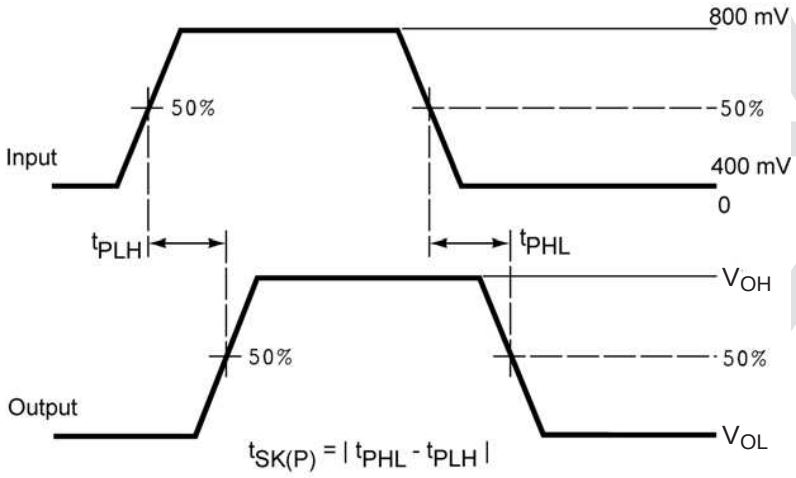
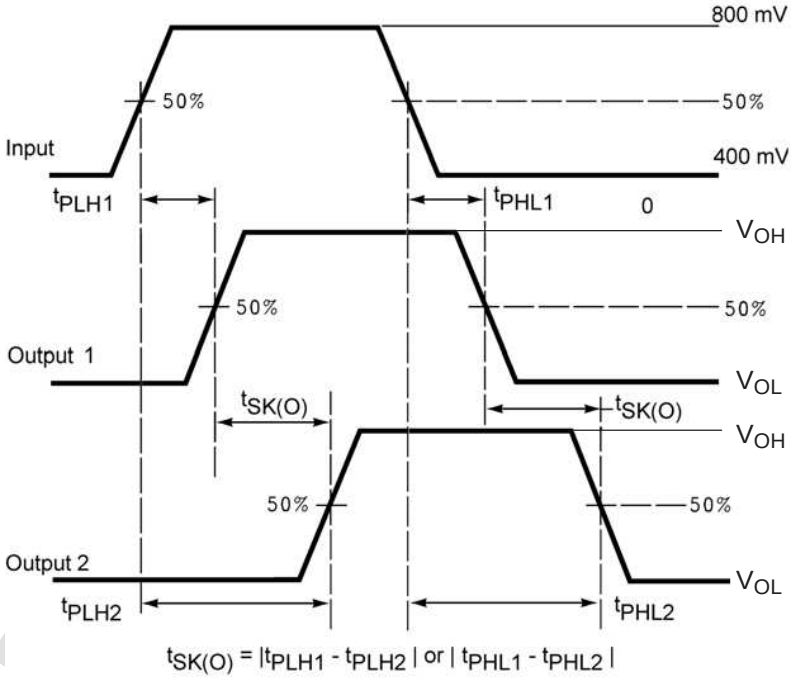


Figure 10. Propagation Delay

PARAMETER MEASUREMENT INFORMATION (continued)



Pulse Skew $t_{SK(P)}$



Output Skew $t_{SK(P)}$

Figure 11. Skew Test

PARAMETER MEASUREMENT INFORMATION (continued)

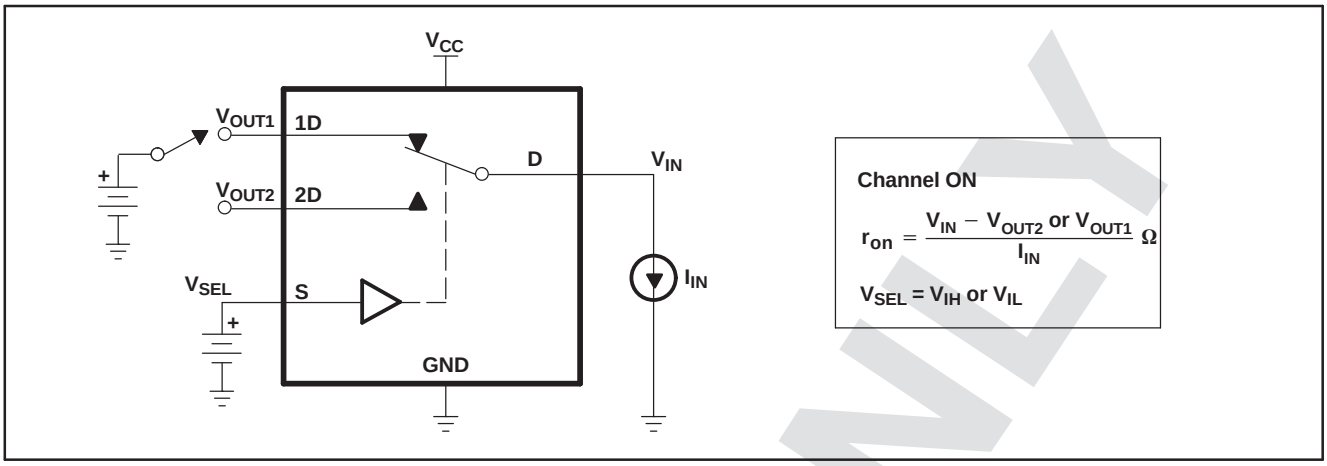


Figure 12. ON-State Resistance ®$_{on}$)

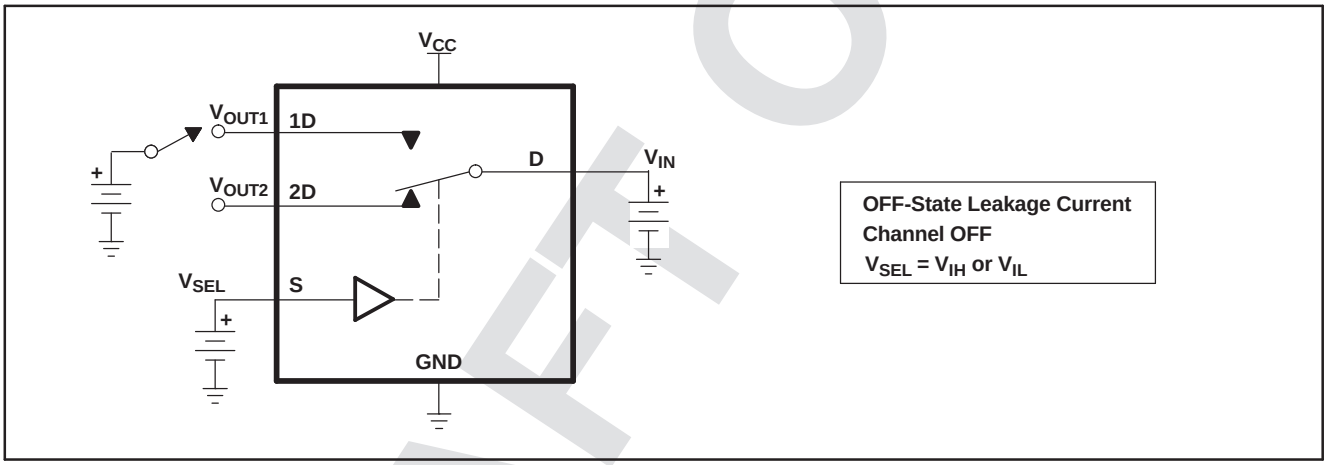


Figure 13. OFF-State Leakage Current

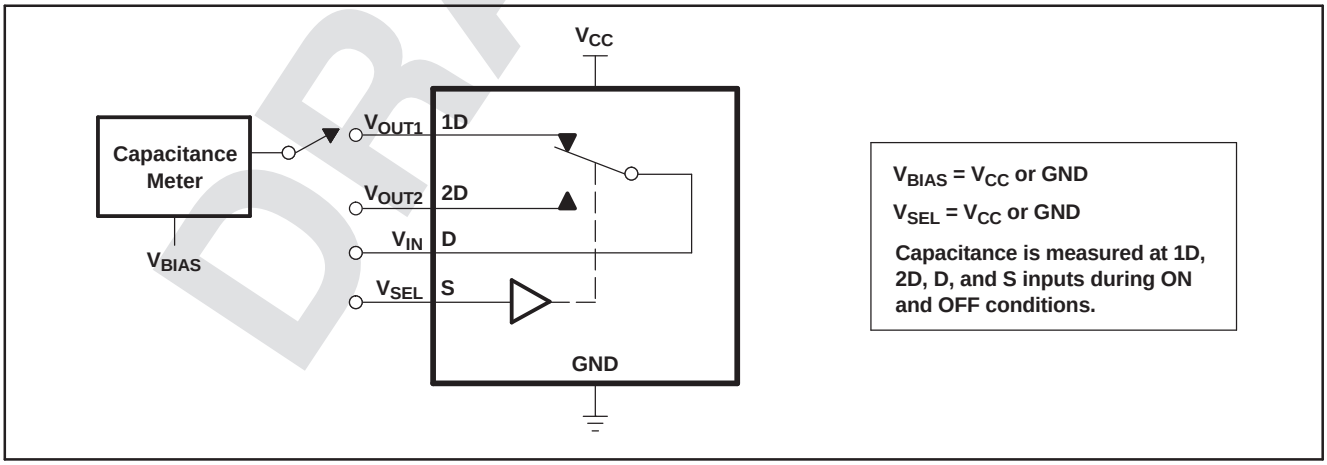
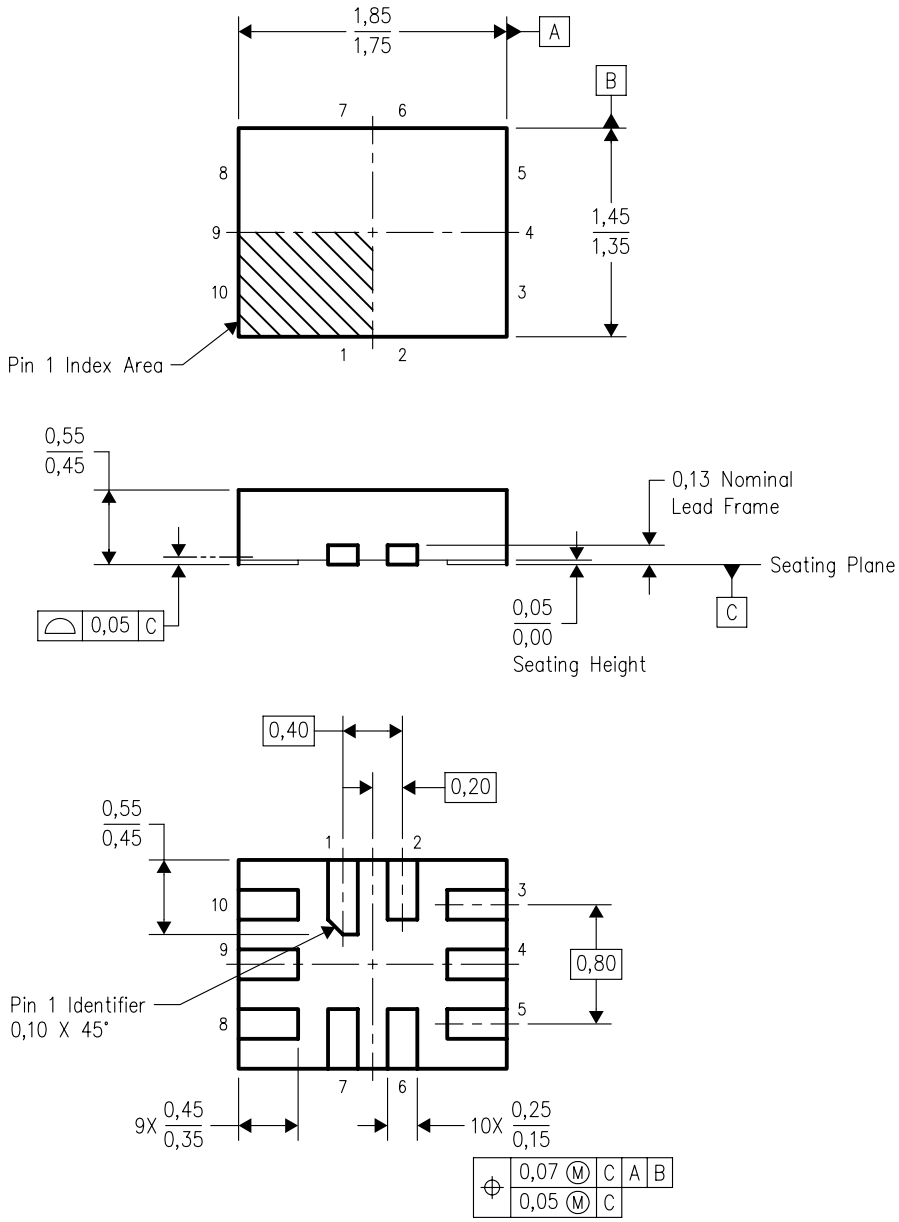


Figure 14. Capacitance

RSW (R–PQFP–N10) PLASTIC QUAD FLATPACK



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NOTES:
A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M–1994.
B. This drawing is subject to change without notice.
C. QFN (Quad Flatpack No–lead) package configuration.

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