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TP3USB30M10

DPDT ANALOG SWITCH
LOW-POWER, TWO-PORT, HIGH-SPEED, USB2.0 (480Mbps)

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General Description

The TP3USB30 is a Low-Power, Two-Port, High-Speed, USB2.0 (480Mbps) double–pole double-throw (DPDT) Analog Switch featuring an On-Resistance of 4.5Ω at V_{CC}=3V and a Low On Capacitance 3.7pF Typical.

The TP3USB30 is compatible with the requirements of USB2.0 and the wide bandwidth needed to pass the third harmonic, resulting in signals with minimum edge and phase distortion. Superior channel-to channel crosstalk also minimizes interference. Break-before-make function for both parts eliminates signal disruption during switching from preventing both switches being enabled simultaneously.

The TP3USB30 contains special circuitry on the switch I/O pins for applications where the V_{CC} supply is powered-off (V_{CC}=0), which allows the device to withstand an over-voltage condition. This device is designed to minimize current consumption even when the control voltage applied to the Sel pin is lower than the supply voltage (V_{CC}). This feature is especially valuable to ultra-portable applications, such as cell phones, allowing for direct interface with the general purpose I/Os of the baseband processor. Other applications include switching and connector sharing in portable cell phones, PDAs, digital cameras, printers, and notebook computers.

The TP3USB30 is available in TQFN10 (1.8x1.4) and MSOP10 packages.

Applications

- Wide Power Supply Range: 2.3V to 5V
- Low On Capacitance 3.7pF Typical
- Low On Resistance 4.5Ω (typ.) at 3V V_{DD} when V_{SW}=0.4V
- High Bandwidth (-3db): >720MHz without C_L and >550MHz with C_L=5pF
- Low Power Consumption: 1uA Maximum
- ESD: pass 8kV HBM test
- Over voltage tolerance (OVT) on all USB ports up to 5.25V without external components
- TTL/CMOS Compatible
- Break-Before-Make Switching
- Operation Temperature Range: -40℃ to 85℃
- Available in TQFN10 (1.8x1.4) and MSOP10 Packages

Features

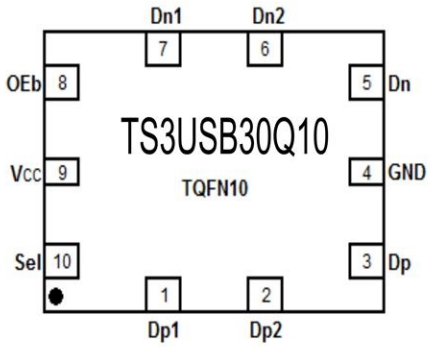
- Cell phone, PDAs, Digital camera, Notebook, LCD Monitor, TV, SET-TOP BOX

Ordering Information

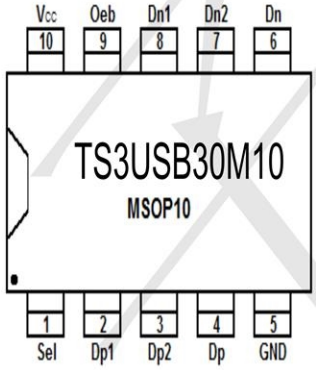
TP3USB30M10

M10:MSOP10 Package
Q10:TQFN10 Package

PIN CONFIGURATION



Top View



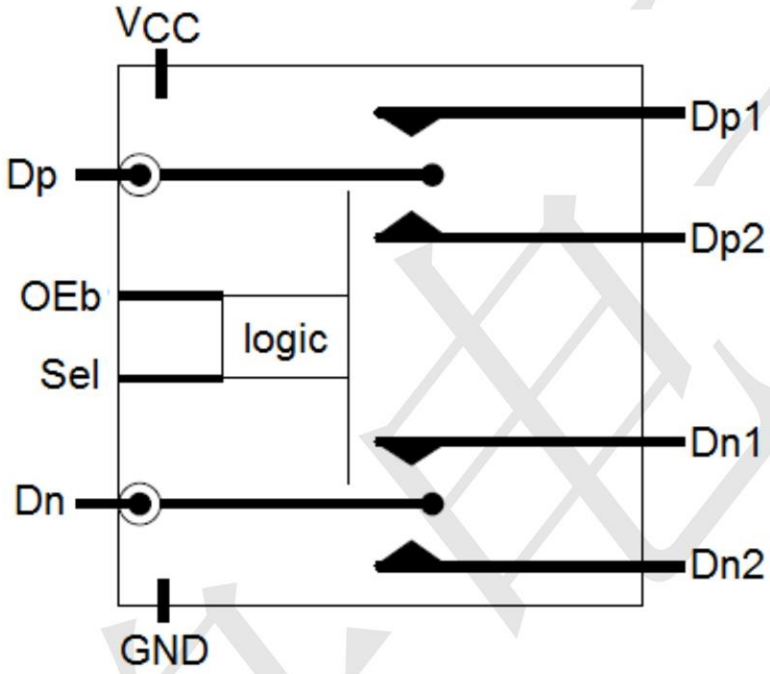
Top View

Pin #		Symbol	Type	Function
TQFN10	MSOP10			
1	2	Dp1	Input / Output	Data Port
2	3	Dp2	Input / Output	Data Port
3	4	Dp	Input / Output	USB Data BUS
4	5	GND	Ground	Ground
5	6	Dn	Input / Output	USB Data BUS
6	7	Dn2	Input / Output	Data Port
7	8	Dn1	Input / Output	Data Port
8	9	OEb	Input	Switch enable
9	10	V_{CC}	PWR	Power Supply
10	1	Sel	Input	Switch select

FUNCTION TABLE

OEb	Sel	Function
1	X	Disconnect
0	0	Dp , Dn=Dp1, Dn1
0	1	Dp , Dn=Dp2, Dn2

BLOCK DIAGRAM



Absolute Maximum Ratings

V_{CC}, DC Supply Voltage	-0.5V~5.5V
Dpn / Dnn / Dp / Dn, DC Switch Voltage	-0.5V~V_{CC}+0.3V
V_{Oeb} / V_{Sel}, DC Input Voltage	-0.5V~V_{CC}
$I_{(Dpn/Dnn/Dp/Dn)}$, Continuous Current	-50mA~+50mA
$I_{PEAK(Dpn/Dnn/Dp/Dn)}$, Peak Current NOTE1	-100mA ~+100mA
T_A, Operating Temperature Range	-40℃~85℃

Stress beyond above listed “Absolute Maximum Ratings” may lead permanent damage to the device. These are stress ratings only and operations of the device at these or any other conditions beyond those indicated in the operational sections of the specifications are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

NOTE1: Pulsed at 1ms, 50% duty circle

Electrical Characteristics

Typical characteristics are at +25°C

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Analog Switch						
Analog Signal Range	$V_{Pn}/V_{Nn}/V_p/V_n$		0		V_{CC}	V
On-Resistance[NOET2]	R_{ON}	V_{CC} = 3V,V_{SW}=0.4V, I_{ON}=-8mA		4.5		Ω
On-Resistance Match Between Channels[NOTE3]	ΔR_{ON}	V_{CC} = 3V,V_{SW}=0.4V, I_{ON}=-8mA		0.1		Ω
Current						
Source Off Leakage Current	$I_{Pn\ /\ Nn\ (OFF)}$	V_{CC}=3.6V,V_p/V_n= 3.6/0.3V, V_{Pn}/V_{Nn}=0.3/3.6V	-1		1	uA
Channel on Leakage Current	$I_{Pn\ /\ Nn\ (ON)}$	V_{CC}=3.6V,V_p/V_n= 3.6/0.3V, V_{Pn}/V_{Nn}=3.6/0.3V	-1		1	uA
POWER OFF leakage current	I_{OFF}	V_{CC} = 0V,V_{SW}=0V to 3.6V, Vcontrol=0 or V_{CC}	-1		1	uA
Quiescent supply current	I_{CC}	V_{CC}=3V, Vcontrol=0 or V_{CC}, I_{OUT}=0			1	uA
Increase in ICC current per control voltage and V_{CC}	I_{CCT}	V_{CC}=3.6V, Vcontrol=2.6V			4	uA
Input Leakage Current	$I_{OEb\ /Sel}$	$V_{OEb\ /\ Sel}$ = 0 or V_{CC}			1	uA
Digital I/O						
Input Voltage High	V_{IH}	V_{CC} = 3.0 to 3.6V	1.6			V
Input Voltage Low	V_{IL}	V_{CC} = 3.0 to 3.6V			0.5	V

NOTE2: Measured by the voltage drop between Dpn/Dnn and Dp/Dn pins at the indicated current through the switch. On resistance is determined by the lower of the voltage on the two (Dpn/Dnn and Dp/Dn ports).

NOTE3: $\Delta R_{ON}= R_{ON(MAX)} - R_{ON(MIN)}$, between Dp and Dn .

DYNAMIC CHARACTERISTICS

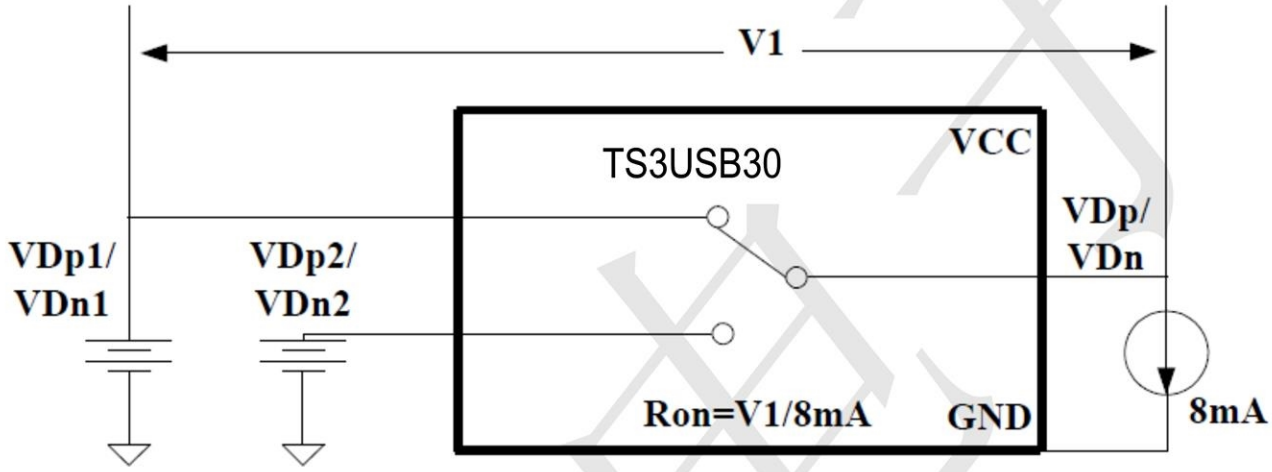
Typical characteristics are at 25°C

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
DRIVER CHARACTERISTICS						
Turn-On Time	t_{ON}	V_{CC}=3.3V, R_L=50Ω, C_L=5pF, V_{SW}=0.8V		10	30	ns
Turn-Off Time	t_{OFF}	V_{CC}=3.3V, R_L=50Ω, C_L=5pF,V_{SW}=0.8V		20	25	ns
Break-Before-Make Time	t_{BBM}	V_{CC}=3.3V, R_L=50Ω, C_L=5pF,$V_{SW1,2}$=0.8V	2.0	3	6.5	ns
Propagation Delay	t_{PD}	V_{CC}=3.3V, R_L=50Ω, C_L=5pF		0.2		ns
CAPACITANCE						
Control Capacitance	C_{IN}	V_{CC}=0V		1.5		pF
ON Capacitance	C_{ON}	V_{CC}=3.3V,OE=0V, f=240MHz		3.7		pF
OFF Capacitance	C_{OFF}	V_{CC}=3.3V,OE=3.3V, f=240MHz		2.0		pF
APPLICATION CHARACTERISTICS						
3dB Bandwidth	f_{3dB}	V_{CC}=3.3V,R_L=50Ω,C_L=0pF		720		MHz
		V_{CC}=3.3V,R_L=50Ω,C_L=5pF		550		MHz
Off Isolation[NOTE4]	V_{Iso}	V_{CC}=3.3V,R_L=50Ω,f=250MHz		-30		dB
Channel crosstalk	XTALK	V_{CC}=3.3V,R_L=50Ω,f=250MHz		-35		dB

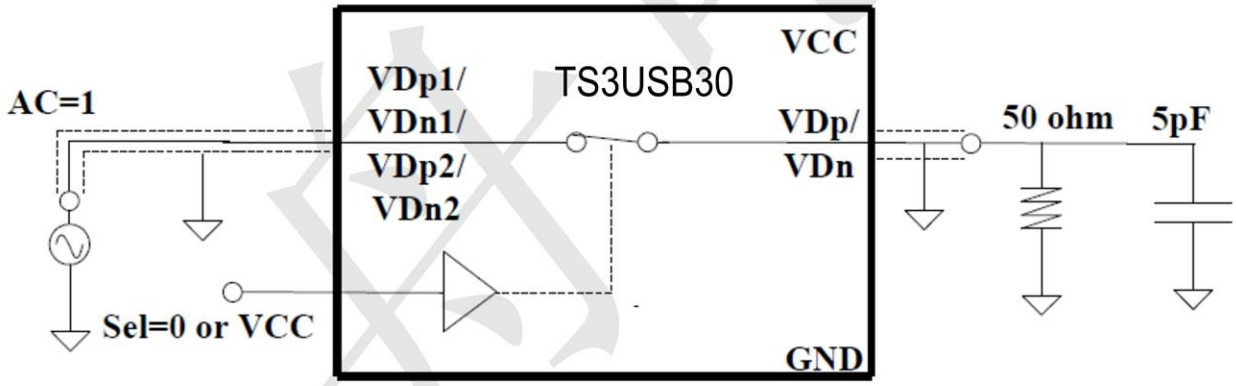
NOTE3: Off Channel Isolation = $20\log_{10}[(V_{P1\backslash P2})/V_P]$ or $20\log_{10}[(V_{N1\backslash N2})/V_N]$

TEST CIRCUIT

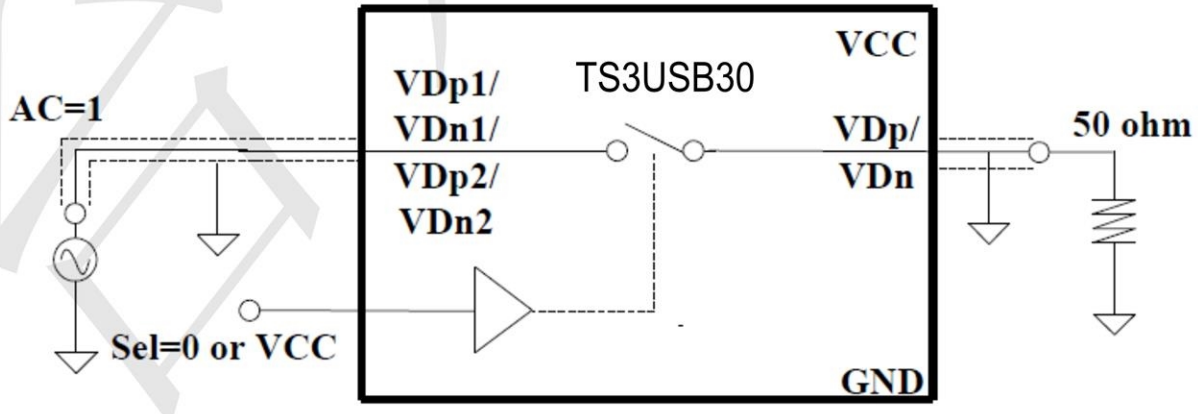
1. Test Circuit for On Resister



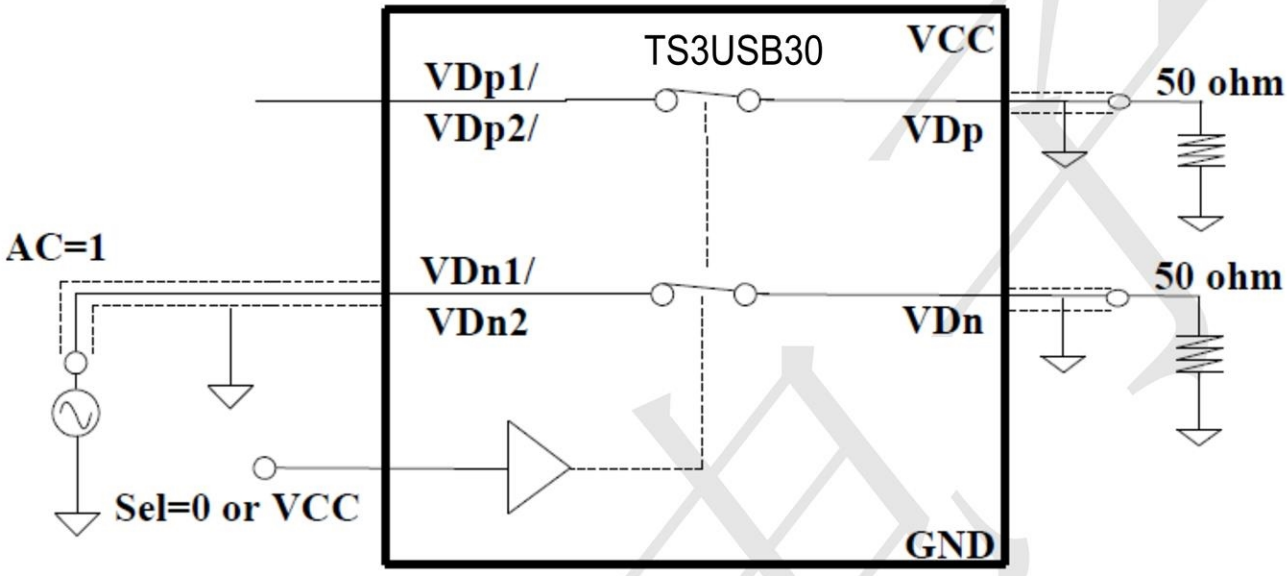
2. Test Circuit for Bandwidth



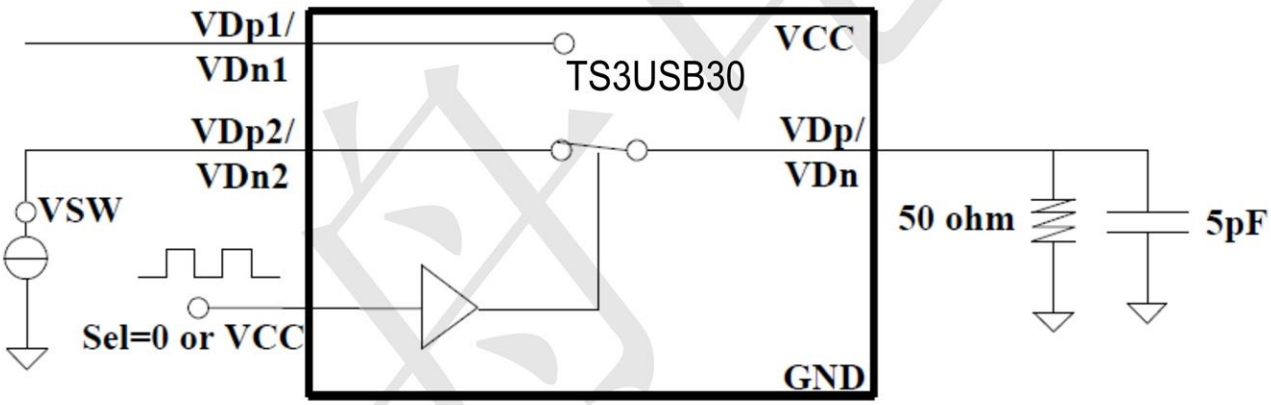
3. Test Circuit for Off Isolation

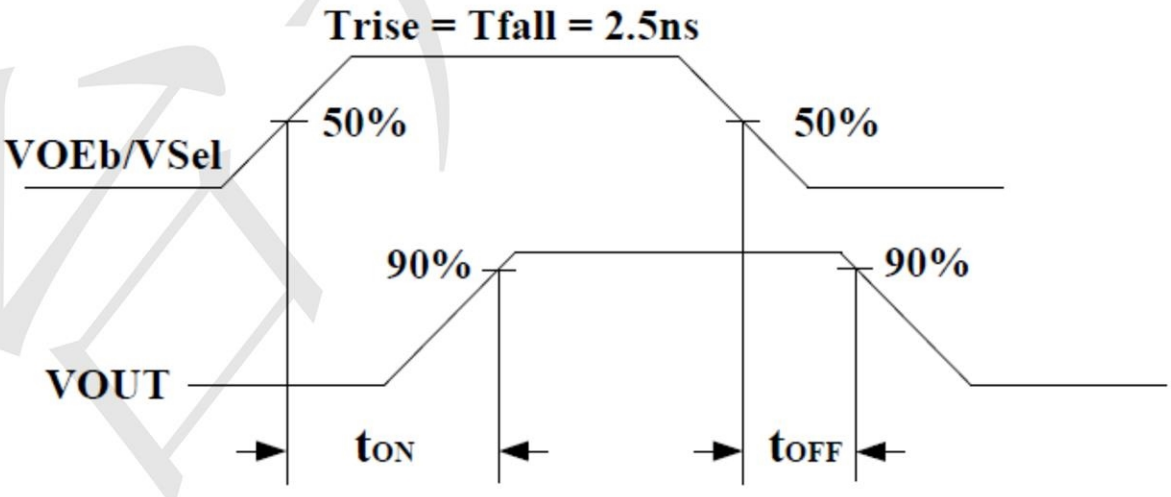


4. Test Circuit for Crosstalk

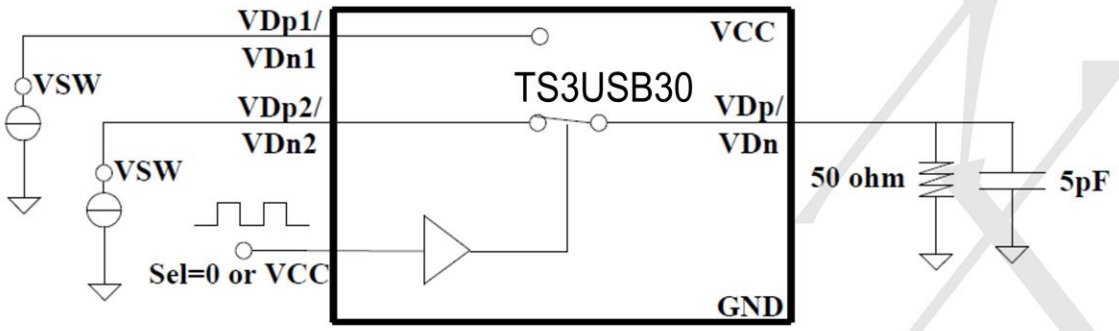


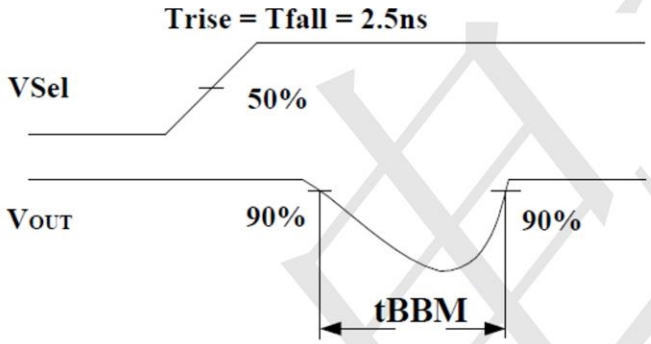
5. Test Circuit for Switch Times



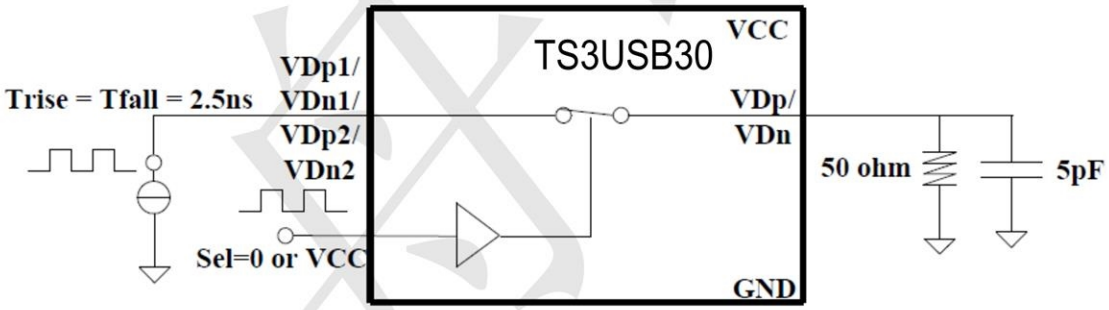


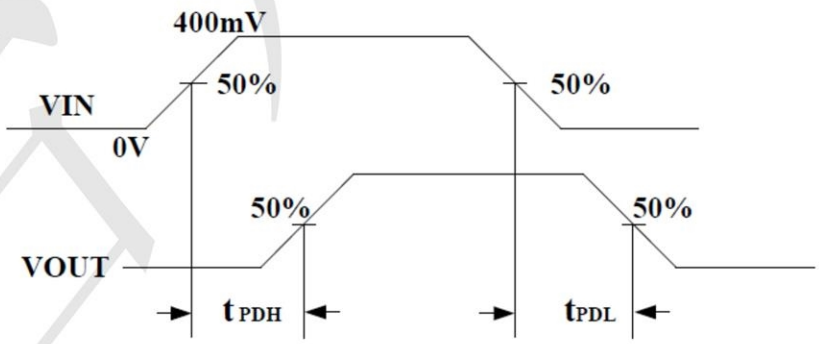
6. Test Circuit for Break-Before-Make Time Delay, t_{BBM}



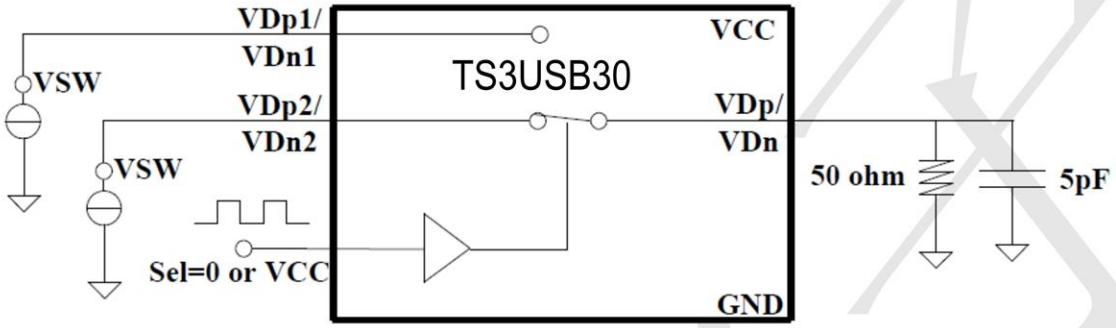


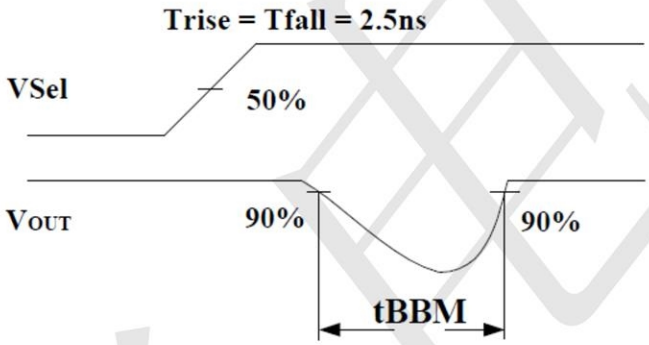
7. Test Circuit for Propagation Delay, T_{PD}



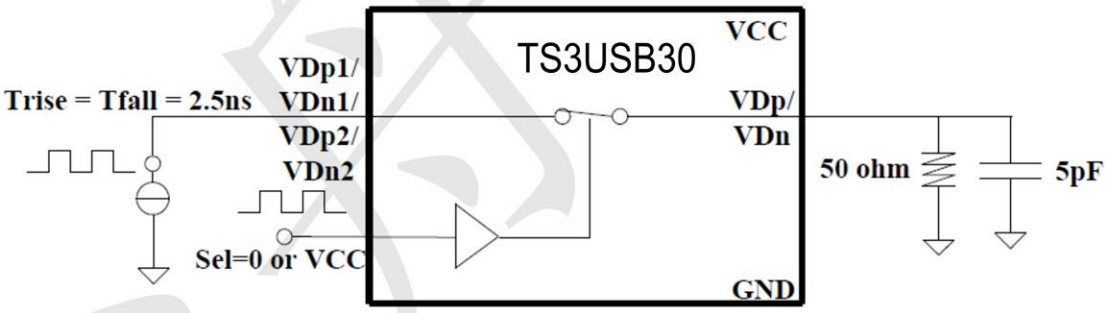


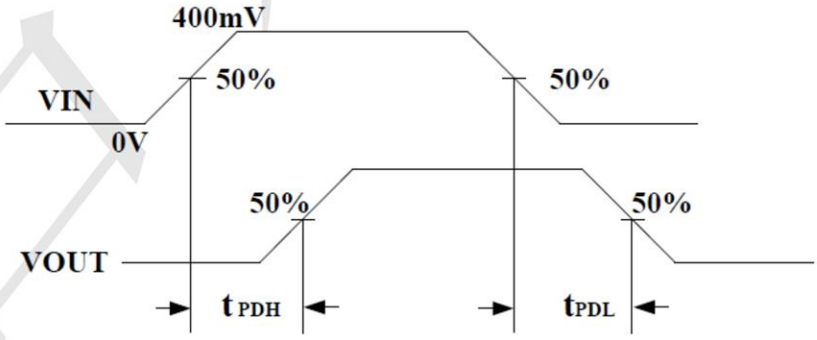
6. Test Circuit for Break-Before-Make Time Delay, t_{BBM}



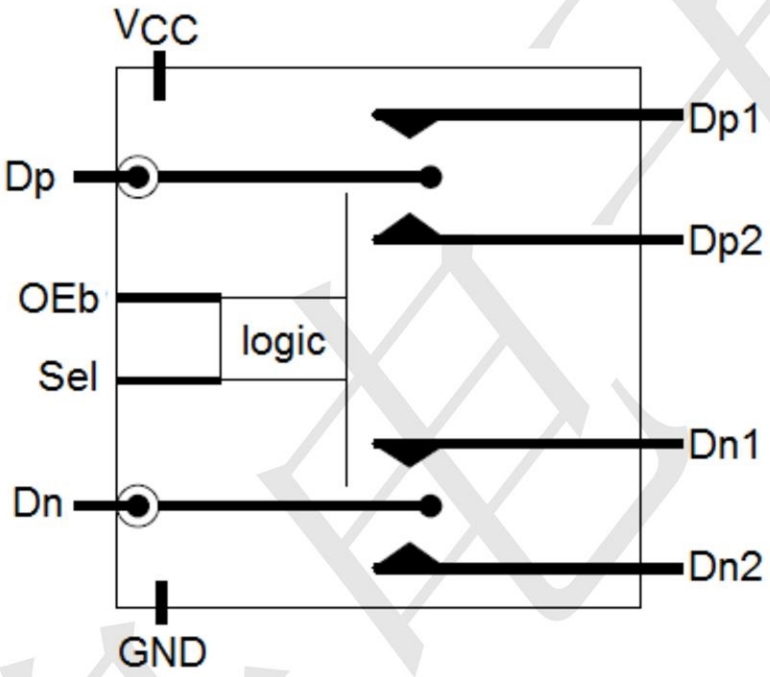


7. Test Circuit for Propagation Delay, T_{PD}





BLOCK DIAGRAM



DETAILED INFORMATION

APPLICATION NOTE

Meeting USB 2.0 V_{BUS} Short Requirements

Power-Off Protection

For a V_{BUS} short circuit the switch is expected to withstand such a condition for at least 24 hours. The TS3USB30 has the specially designed circuit which prevents unintended signal bleed through as well as guaranteed system reliability during a power-down, over-voltage condition. The protection has been added to the common pins (Dp, Dn).

Power-On Protection

The USB 2.0 specification also notes that the USB device should be capable of withstanding a V_{BUS} short during transmission of data. This modification works by limiting current flow back into the V_{CC} rail during the over-voltage event so current remains within the safe operating range.

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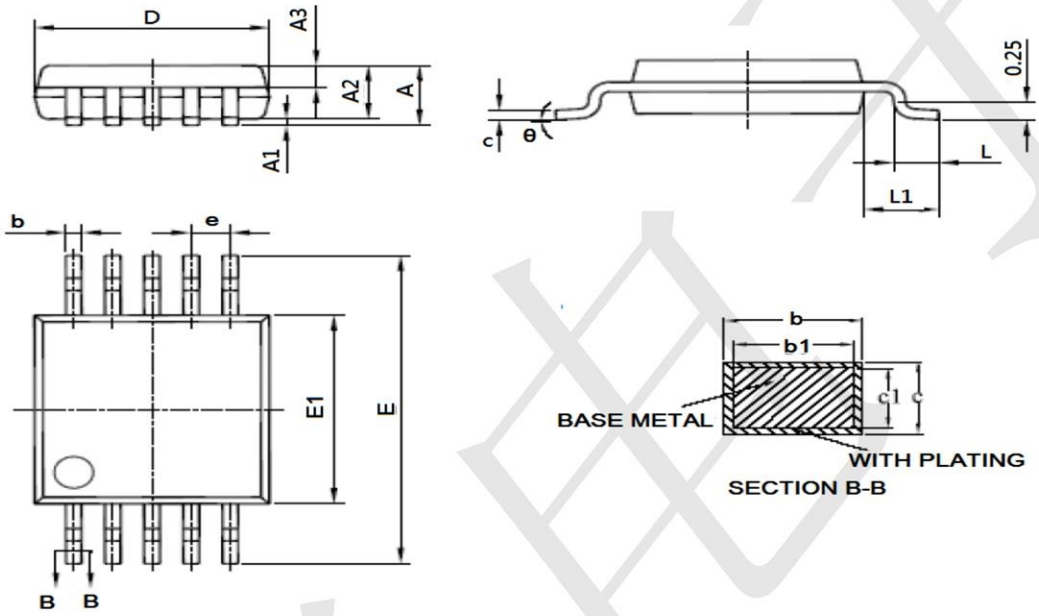
Time (250μs/Div)

Time (10μs/Div)

Package informantion

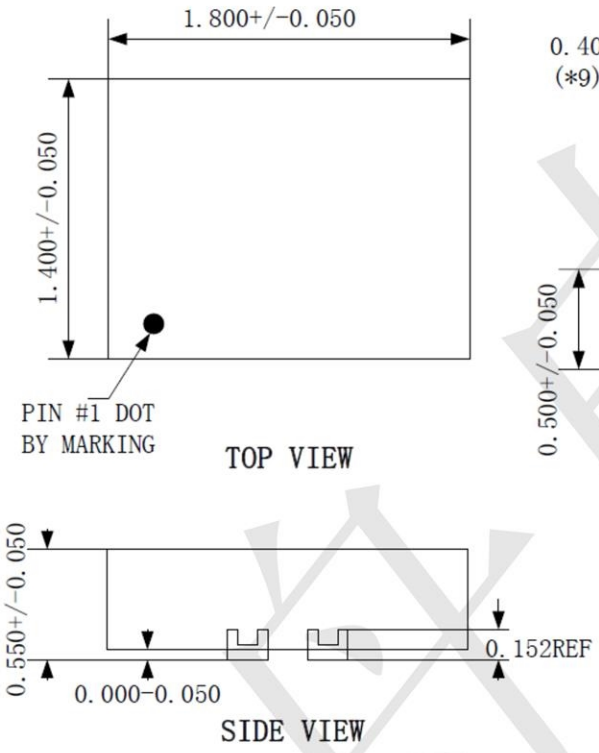
Dimension in MSOP10 (1.8x1.4) (Unit: mm)



Symbol	Min	Max
A	-	1.100
A1	0.050	0.150
A2	0.750	0.950
A3	0.300	0.400
b	0.190	0.280
b1	0.180	0.230
c	0.150	0.200
c1	0.140	0.160
D	2.900	3.100
E	4.700	5.100
E1	2.900	3.100
e	0.500(BSC)	
L	0.400	0.700
L1	0.950(BSC)	
θ	0°	8°

Package informantion

Dimension in TQFN10 (Unit: mm)



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