

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

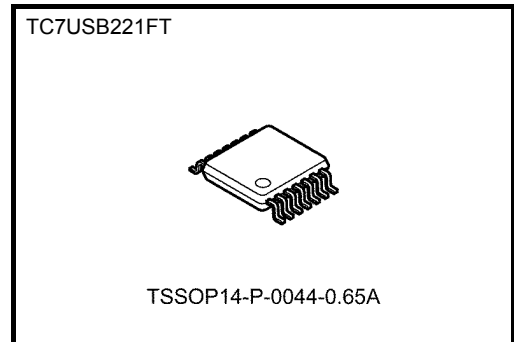
TC7USB221FT

Dual SPDT USB Switch

TC7USB221 is high-speed CMOS dual 1-2 multiplexer/demultiplexer. The low on resistance and the low capacitance of the switch allow connections to USB application.

This device consists of dual individual two-inputs multiplexer/demultiplexer with common select input (S) and output enable (\overline{OE}). The D+/D- inputs is connected to the D1+/D1- or D2+/D2- outputs determined by the combination both the select input (S) and output enable (\overline{OE}). When the output enable (\overline{OE}) input is held "H" level, the switches are open with regardless the state of select inputs and a high-impedance state exists between the switches.

All inputs are equipped with protection circuits against static discharge.



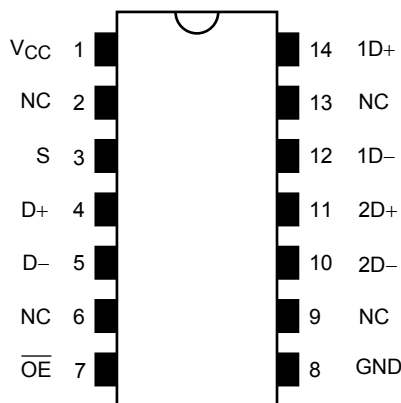
Weight
TSSOP14-P-0044-0.65A: 0.06 g (typ.)

Features

- Operating voltage: $V_{CC} = 2.3$ to 3.6 V
- ON-capacitance: $C_{I/O} = 7$ pF Switch ON (typ.) @ $V_{CC}=3.3$ V
- ON-resistance: $R_{ON} = 6.5 \Omega$ (typ.) @ $V_{CC}=3$ V, $V_{I/O}=0$ V
- R_{ON} Flatness: $R_{ON(Flat)} = 1.6 \Omega$ (typ.) @ $V_{CC}=3$ V
- Delta R_{ON} : $\Delta R_{ON} = 0.5 \Omega$ (typ.) @ $V_{CC}=3$ V
- ESD performance: Machine model $\geq \pm 200$ V
Human body model $\geq \pm 2000$ V
- Power-down protection for inputs (\overline{OE} and S, I/O)
- Package: TSSOP14

Pin Assignment (top view)

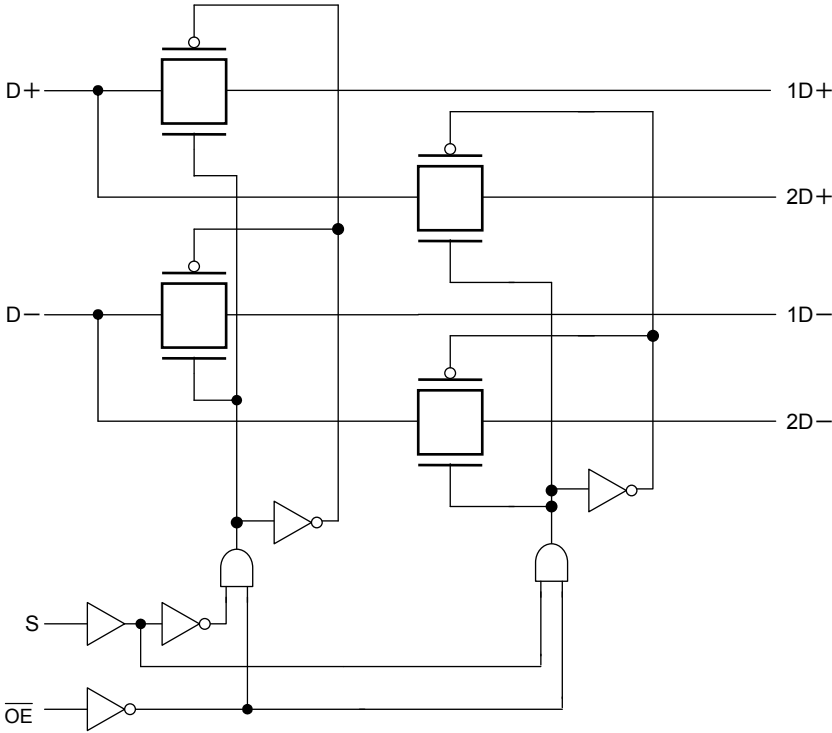
FT (TSSOP14-P-0044-0.65A)



Truth Table

Inputs		Function
\overline{OE}	S	
L	L	D+ port = 1D+ port, D- Port = 1D- Port
L	H	D+ port = 2D+ port, D- Port = 2D- Port
H	X	Disconnect

System Diagram



Absolute Maximum Ratings (Note)

Characteristic		Symbol	Rating	Unit
Power supply range		V_{CC}	-0.5 to 4.6	V
Control pin input voltage (\overline{OE} , S)		V_{IN}	-0.5 to 4.6	V
Switch terminal I/O voltage	$V_{CC}=0$ V or Switch=Off	V_S	-0.5 to 4.6	V
	Switch=On		-0.5 to $V_{CC}+0.5$	
Clump diode current	Control input	I_{IK}	-50	mA
	Switch		± 50	
Switch I/O current		I_S	50	mA
Power dissipation		P_D	180	mW
DC V_{CC}/GND current		I_{CC}/I_{GND}	± 100	mA
Storage temperature		T_{stg}	-65 to 150	$^{\circ}C$

Note: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction. Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc.).

Operating Ranges (Note)

Characteristic		Symbol	Rating	Unit
Power supply voltage		V_{CC}	2.3 to 3.6	V
Control pin input voltage (\overline{OE} , S)		V_{IN}	0 to 3.6	V
Switch I/O voltage	$V_{CC}=0$ V or Switch=Off	V_S	0 to 3.6	V
	Switch=On		0 to V_{CC}	
Operating temperature		T_{opr}	-40 to 85	$^{\circ}C$
Input rise and fall time		dt/dv	0 to 10	ns/V

Note: The operating ranges must be maintained to ensure the normal operation of the device. Unused inputs must be tied to either V_{CC} or GND.

Electrical Characteristics

DC Characteristics (Ta = -40 to 85°C)

Characteristics	Symbol	Test Condition	V _{CC} (V)	Min	Typ.	Max	Unit	
Input voltage (\overline{OE} , S)	"H" level	V _{IH}	—	2.3 to 3.6	0.46 × V _{CC}	—	—	V
	"L" level	V _{IL}	—	2.3 to 3.6	—	—	0.25 × V _{CC}	
Input leakage current (\overline{OE} , S)	I _{IN}	V _{IN} = 0 to 3.6 V	2.3 to 3.6	—	—	±1.0	μA	
Power-off leakage current	I _{OFF}	V _{IN} = 0 to 3.6 V	0	—	—	±5.0	μA	
Off-state leakage current (switch off)	I _{SZ}	D+, D- = 0 to V _{CC} , \overline{OE} = V _{CC}	2.3 to 3.6	—	—	±5.0	μA	
ON resistance (Note2)	R _{ON}	V _{IS} = 0 V, I _{IS} = 30 mA (Note1)	3.0	—	6.5	10	Ω	
		V _{IS} = 0.4 V, I _{IS} = 30 mA (Note1)	3.0	—	7.0	11		
		V _{IS} = 3.0 V, I _{IS} = 30 mA (Note1)	3.0	—	13	19		
Delta R _{ON}	Δ R _{ON}	V _{IS} = 0.4 V, 1.0 V, I _{IS} = 30 mA	3.0	—	0.5	—	Ω	
On-Resistance Flatness	R _{ON(flat)}	V _{IN} = 0 V to 1.0 V, I _{IS} = 30 mA	3.0	—	1.6	—	Ω	
Quiescent supply current	I _{CC}	V _{IN} = V _{CC} or GND, I _{OUT} = 0	3.6	—	—	2.0	μA	
Increase in I _{CC} per input	Δ I _{CC}	V _{IN} = 1.8 V	3.6	—	—	10.0	μA	

Note1: All typical values are at Ta = 25°C.

Note2: Measured by the voltage drop between D+/D- and 1D+/1D-, 2D+/2D- pins at the indicated current through the switch. ON resistance is determined by the lower of the voltages on the two pins.

AC Characteristics $V_{CC}=3.3V \pm 10\%$ ($T_a = -40$ to 85°C)

Characteristics	Symbol	Test Condition	V_{CC} (V)	Min	Typ.	Max	Unit
Propagation Delay Time (Note)	t _{pd}	C _L =5 pF	3.3 ± 0.3	—	0.25	—	ns
Turn ON Time (S, \overline{OE} to Output)	t _{ON}	R _L =50 Ω, C _L =5 pF	3.3 ± 0.3	—	7.5	17	ns
Turn OFF Time (S, \overline{OE} to Output)	t _{OFF}	R _L =50 Ω, C _L =5 pF	3.3 ± 0.3	—	3.3	10	ns
Break Before Make	TBBM	R _L =50 Ω, C _L =5 pF	3.3 ± 0.3	2	—	7.0	ns
Output skew between center port to any other port (Note)	t _{SK(O)}	C _L =5 pF	3.3 ± 0.3	—	0.1	—	ns
Skew of Opposite Transitions of the same output (t _{PHL} - t _{PLH}) (Note)	t _{SK(P)}	C _L =5 pF	3.3 ± 0.3	—	0.1	—	ns
Off Isolation (Non-Adjacent)	OIRR	R _T =50 Ω, f=240 MHz	3.3 ± 0.3	—	-36	—	dB
Crosstalk(Non-Adjacent)	XTalk	R _T =50 Ω, f=240 MHz	3.3 ± 0.3	—	-36	—	dB
-3dB Bandwidth	BW	R _T =50 Ω, C _L =0 pF	3.3 ± 0.3	—	720	—	MHz

Note: This parameter is guaranteed by design.

Capacitive Characteristics ($T_a = 25^\circ\text{C}$)

Characteristics	Symbol	Test Condition	V_{CC} (V)	Typ.	Unit
Control pin input capacitance (\overline{OE} , S)	C _{IN}	V _{IN} = 0 V (Note)	3.3	4	pF
Switch terminal Off capacitance (D+, D-)	C _{I/O}	V _{IS} = 0 V, $\overline{OE} = V_{CC}$ (Note)	3.3	4	pF
Switch terminal Off capacitance (1D+, 1D-, 2D+, 2D-)	C _{I/O}	V _{IS} = 0 V, $\overline{OE} = V_{CC}$ (Note)	3.3	3	pF
Switch terminal On capacitance	C _{I/O}	V _{IS} = 0 V, $\overline{OE} = \text{GND}$ (Note)	3.3	7	pF

Note: This parameter is guaranteed by design.

AC Test Circuit Load/Waveform

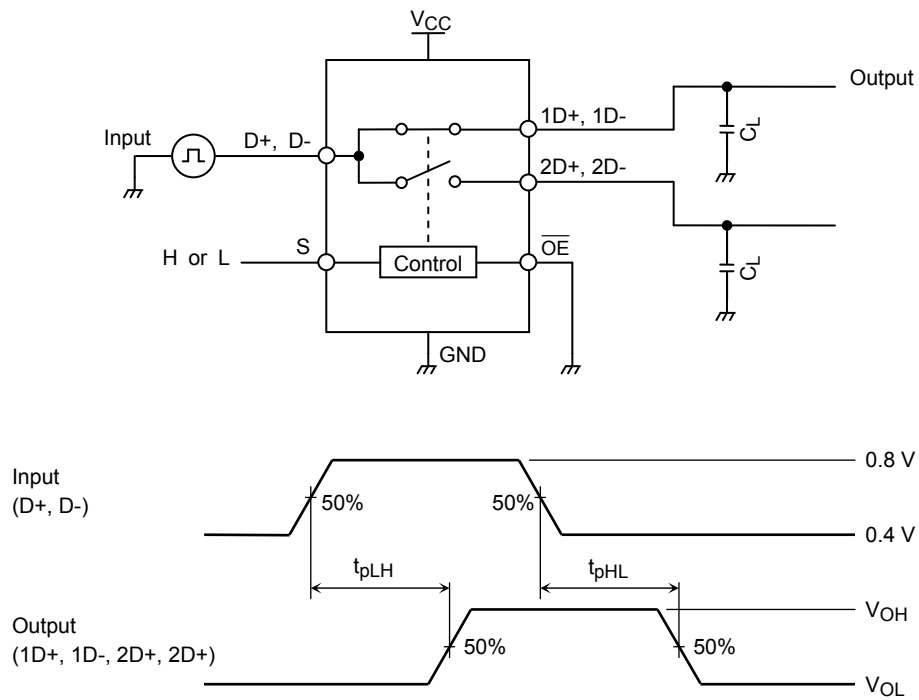


Figure 1 : Propagation Delay Time (t_{pLH} , t_{pHL})

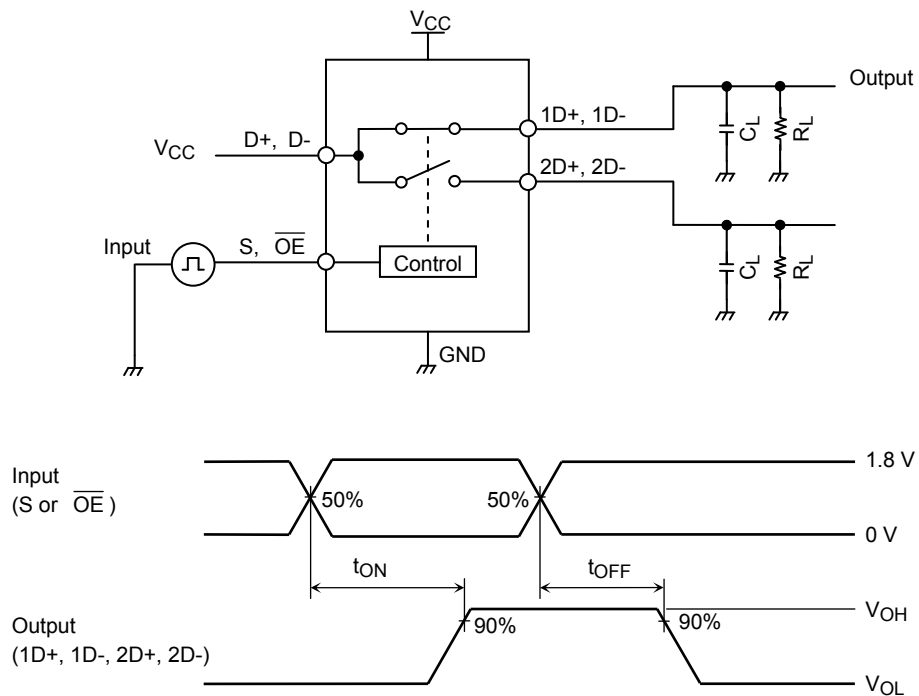


Figure 2 : Turn ON/Turn OFF (t_{ON} , t_{OFF})

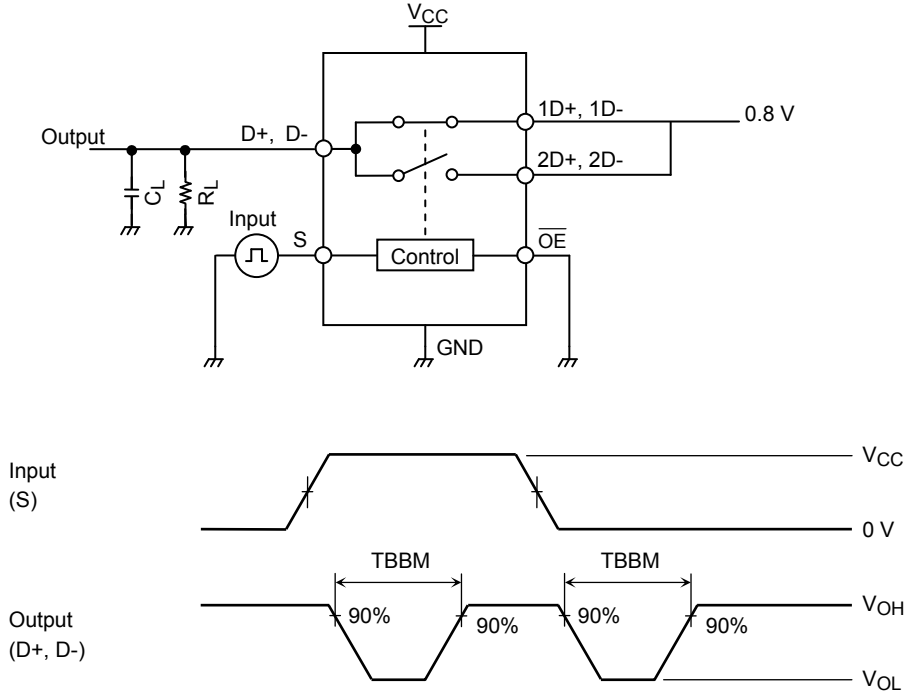


Figure 3 : Break Before Make (TBBM)

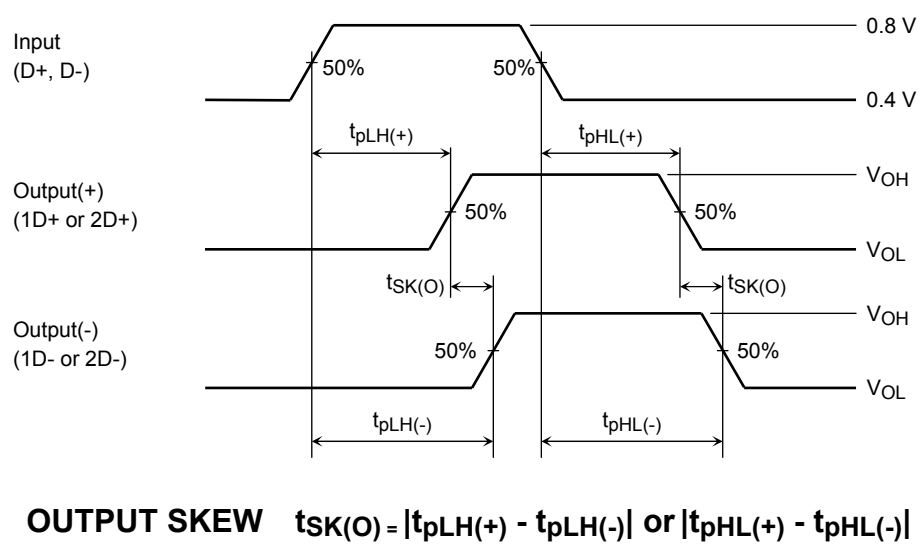
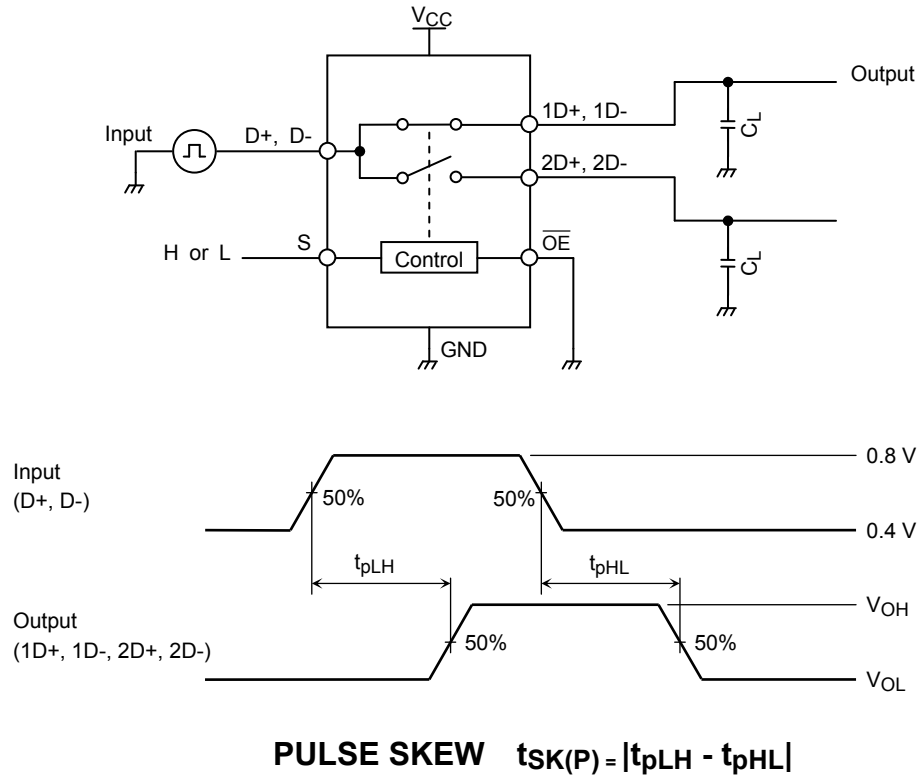


Figure 4 : Skew of Opposite Transitions of the same output, Output skew

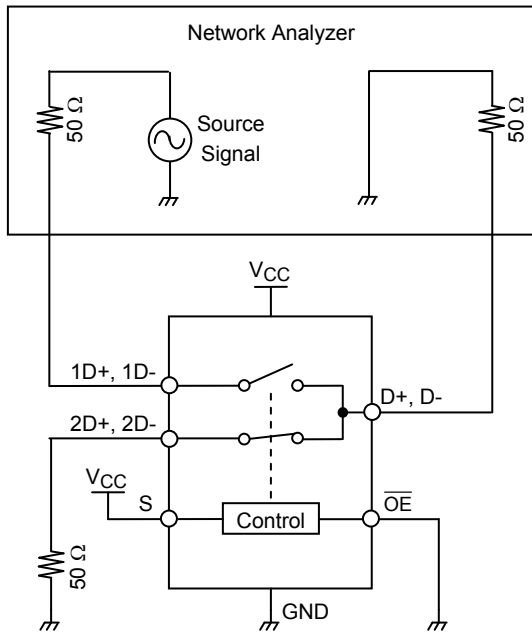


Figure 5 : Channel OFF Isolation

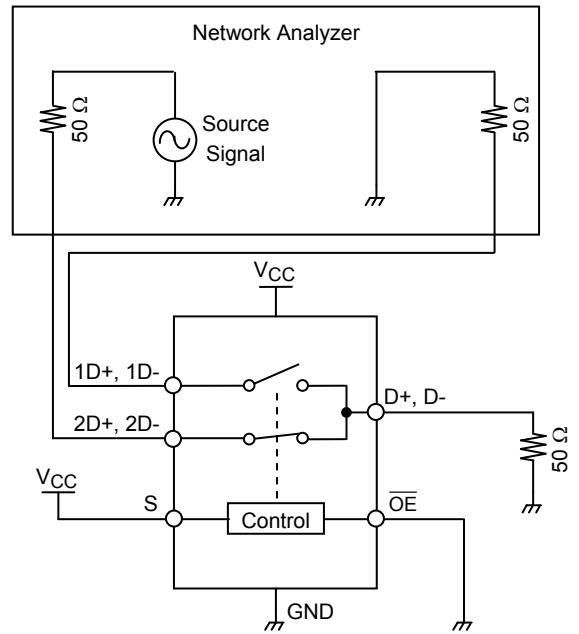


Figure 6 : Crosstalk

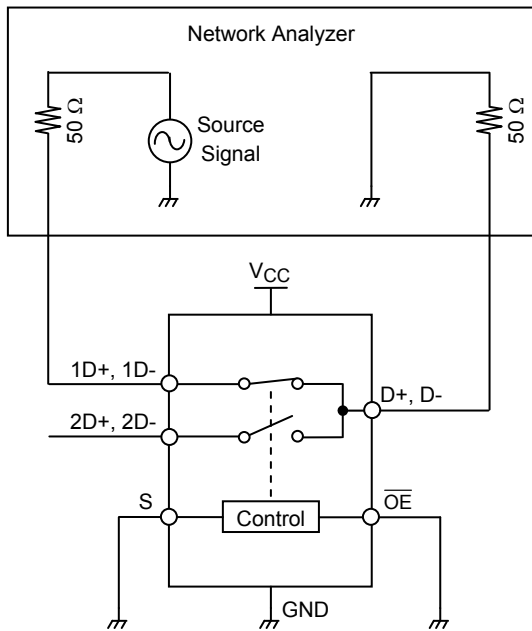


Figure 7 : -3dB Bandwidth

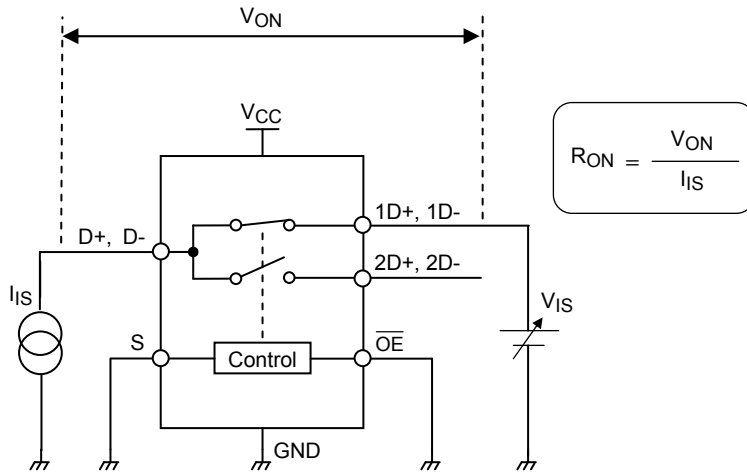


Figure 8 : ON Resistance

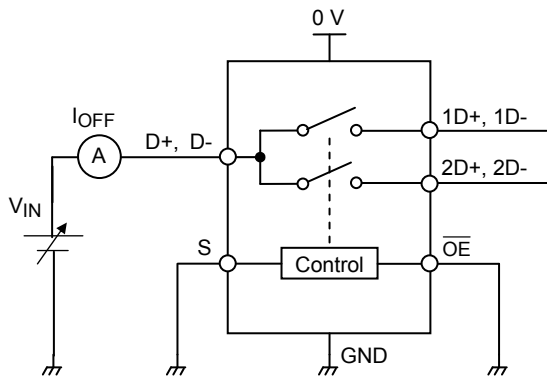


Figure 9 : Power off Leakage Current

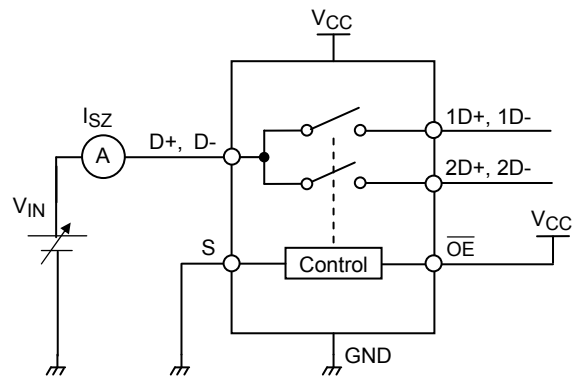
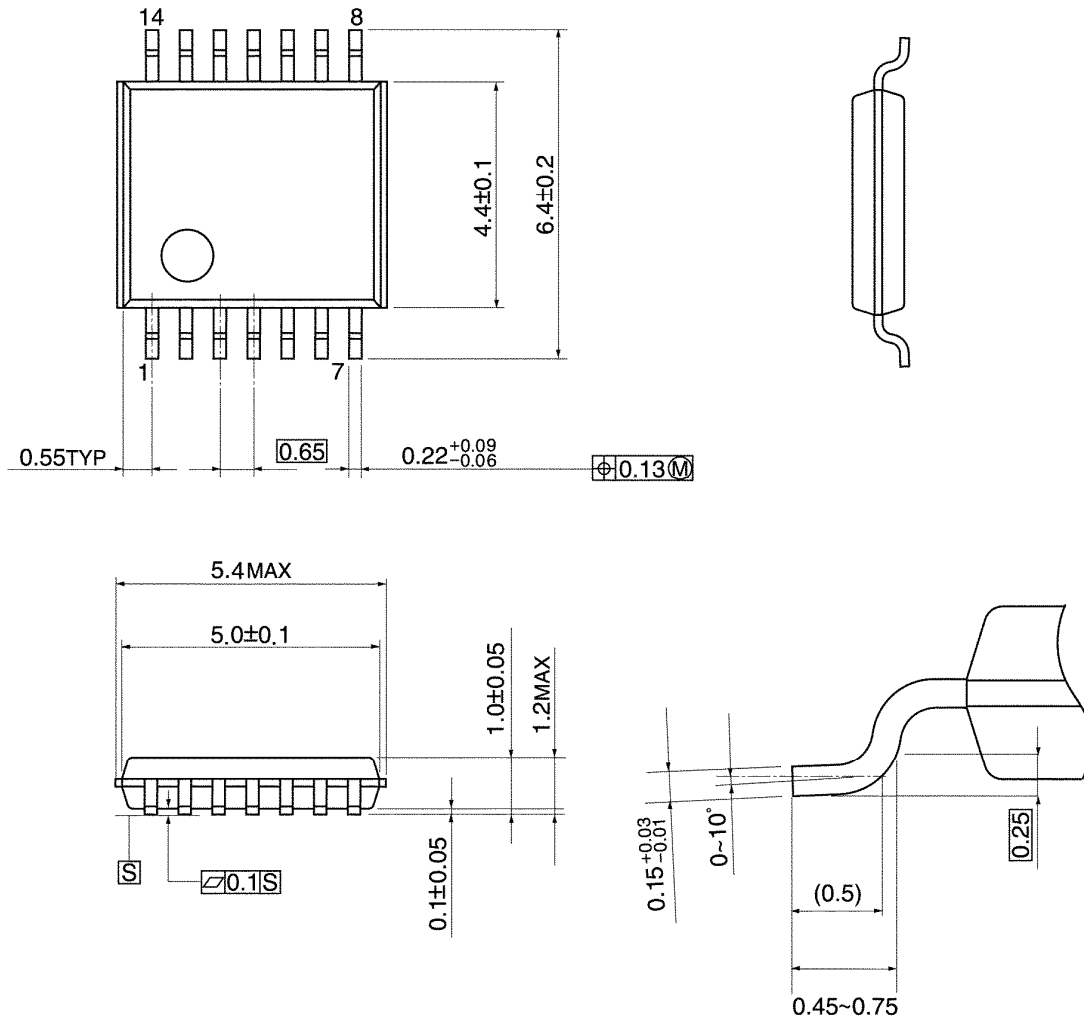


Figure 10 : Off-State Leakage current

Package Dimension

TSSOP14-P-0044-0.65A

Unit: mm



Weight: 0.06 g (Typ.)

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