TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TCUA221WBG, TCUA2221WBG

TCUA221WBG:USB2.0 High-Speed and Audio Switch with Negative Signal Capability

TCUA2221WBG:USB2.0 High-Speed and Audio Switch with Negative Signal Capability (With Pop Sound Eliminator at Audio Switch)

The TCUA221WBG and TCUA2221WBG are a dual SPDT switch for combined USB2.0 High-Speed and Audio signals.

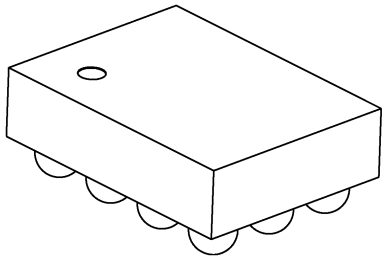
The Audio switch is designed to allow audio signals to swing below ground.

When V_{BUS} is High, the USB switchs (D+, D-) are selected, regardless of the logic level of the Cont inputs. When V_{BUS} is Low or left open and Cont is Low, the Audio switches (R, L) are selected.

The TCUA2221WBG also features shunt resisters on the Audio path to reduce clicks and pop-noises.

All the inputs are protected against electrostatic discharge.

TCUA221WBG, TCUA2221WBG



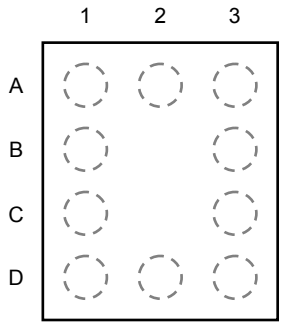
S-UFBGA10-0202-0.40-001

Weight
S-UFBGA10-0202-0.40-001 : 0.0025 g (typ.)

Features

- Operating voltage :V_{CC} = 2.3 ~ 3.6 V
- ON-capacitance (D+, D-) : $C_{I/O}$ = 7pF Switch On (typ.)@ V_{CC} = 3.3 V
- ON-resistance (D+, D-) : R_{ON} = 5.5 Ω (typ.)@V_{CC} = 3 V, V_{IS} = 0 V
- ON-resistance (R, L) : R_{ON} = 4.5 Ω (typ.)@V_{CC} = 3 V, V_{IS} = 0 V
- R_{ON} Flatness(R, L) : R_{ON} Flatness = 2 Ω(typ.)@V_{CC} = 3 V
- ESD performance : Machine model ≥ ± 200V
  Human body model ≥ ± 2000V
- Package : WCSP10B(1.2mm x 1.6mm)

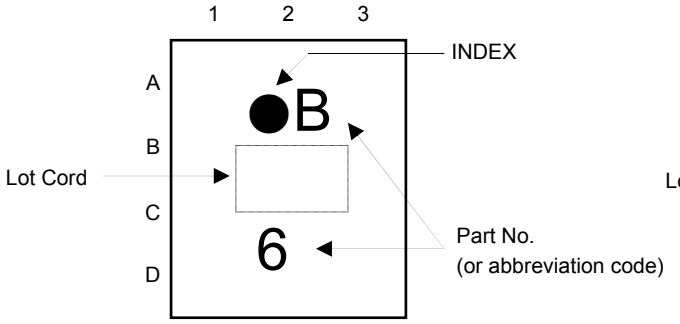
Pin Assignment (top view)



	1	2	3
A	D+	V_{CC}	V_{BUS}
B	D–	No Ball	COM+
C	R	No Ball	COM–
D	L	GND	Cont

Marking

TCUA221WBG



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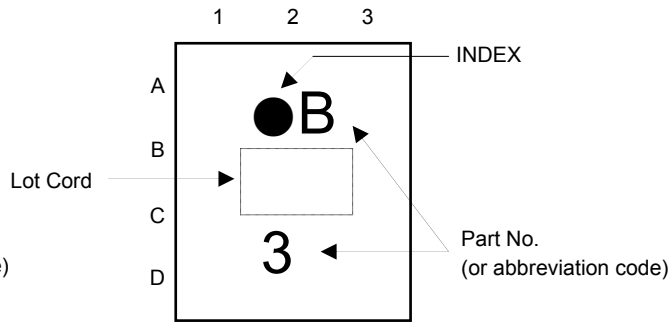
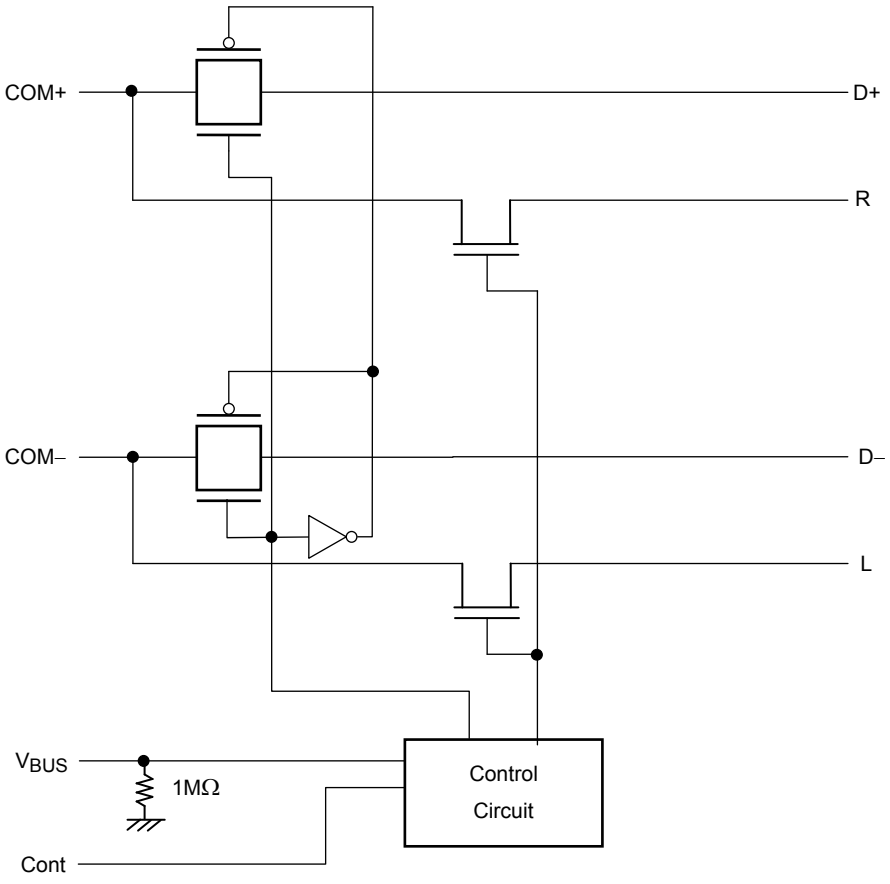


Truth Table

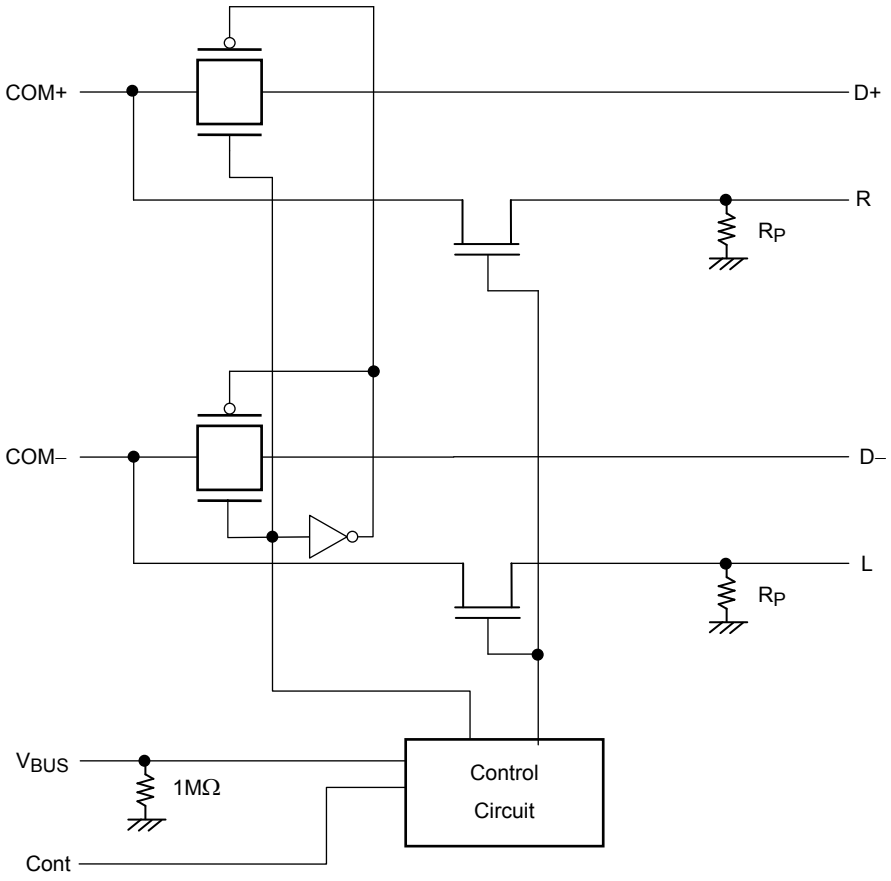
Inputs		Function
Cont	Vbus	
H or L	5V	COM+ port = D+ port, COM– port = D– port
L	L or Open	COM+ port = R port, COM– port = L port
H	L or Open	Disconnnect

System Diagram

TCUA221WBG



TCUA2221WBG



R_P : Pop Sound Eliminator Resistor

Absolute Maximum Ratings (Note)

Characteristic			Symbol	Rating	Unit
Power supply range			V_{CC}	−0.5 to 4.6	V
Control pin input voltage		Cont	V_{IN}	−0.5 to 4.6	V
		V_{BUS}		−0.5 to 6.0	
Switch I/O voltage	Swtich ON	D+,D−	V_S	−0.5 to V_{CC}+0.5	V
		L,R		−2.0 to V_{CC}+0.5 (Note $-0.5 \le V_{CC} - V_S \le 6$)	
		COM+,COM-		−2.0 to V_{CC}+0.5 (Note $-0.5 \le V_{CC} - V_S \le 6$)	
	Swtich OFF or V_{CC}=0V	D+,D−		−0.5 to 4.6	
		L,R		−0.5 to 4.6	
		COM+,COM−		−2.0 to 4.0	
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	°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		Cont	V_{IN}	0 to 3.6	V
		V_{BUS}		0 to 5.5	
Switch I/O voltage	Switch ON	USB(D+/D-)	V_S	0 to V_{CC}	V
		Audio(L/R)		−1.5 to V_{CC}	
		COM+/COM-		−1.5 to V_{CC}	
	Switch OFF or V_{CC} = 0V	USB(D+/D-)		0 to 3.6	
		Audio(L/R)		0 to 3.6	
		COM+/COM-		−1.5 to 3.6	
Operating temperature			T_{opr}	−40 to 85	°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)

Parameter		Symbol	Test Condition		V_{CC} (V)	Min.	Typ.	Max.	Unit
High-level input voltage	V_{BUS}	V_{IH}	—		2.3 to 3.6	V_{CC} + 0.6	—	—	V
Low-level input voltage	V_{BUS}	V_{IL}	—		2.3 to 3.6	—	—	V_{CC} – 0.5	V
High-level input voltage	Cont	V_{IH}	—		2.3 to 2.5	0.50 × V_{CC}	—	—	V
					2.7 to 3.0	0.45 × V_{CC}	—	—	V
					3.3 to 3.6	0.40 × V_{CC}	—	—	V
Low-level input voltage	Cont	V_{IL}	—		2.3 to 3.6	—	—	0.15 × V_{CC}	V
Input leakage current	V_{BUS}	I_{IN}	V_{IN} = 0 to 5.5 V		2.3 to 3.6	—	—	±10	μA
	Cont	I_{IN}	V_{IN} = 0 to 3.6 V		2.3 to 3.6	—	—	±1	μA
Power-off leakage current	D+,D–	I_{OFF}	V_{IN} = 0 to 3.6 V		0	—	—	±10	μA
	R,L	I_{OFF}	V_{IN} = 0 to 3.6 V	UA221	0	—	—	±10	μA
				UA2221		-60	—	120	μA
	COM+, COM–	I_{OFF}	V_{IN} = -1.5 to 3.6 V		0	—	—	±10	μA
Off-state leakage current (switch off)	D+,D–	I_{SZ}	V_{IS} = 0 to V_{CC}, Switch OFF		2.3 to 3.6	—	—	±10	μA
	R,L,	I_{SZ}	V_{IS} = 0 to V_{CC}, Switch OFF	UA221	2.3 to 3.6	—	—	±10	μA
				UA2221		-60	—	120	μA
	COM+, COM–	I_{SZ}	V_{IS} = -1.5 to V_{CC}, Switch OFF		2.3 to 3.6	—	—	±10	μA
ON-resistance	D+,D–	R_{ON}	V_{BUS} = 4.25 V, V_{IS} = 0 V, I_{IS} = 30 mA (Note)		3.0	—	5.5	10	Ω
			V_{BUS} = 4.25 V, V_{IS} = 1.0 V, I_{IS} = 30 mA (Note)		3.0	—	6.5	12	Ω
			V_{BUS} = 4.25 V, V_{IS} = 3.0 V, I_{IS} = 30 mA (Note)		3.0	—	22	40	Ω
	R,L	R_{ON}	V_{IS} = –1.0 V, I_{IS} = 30 mA (Note)		3.0	—	4.0	8	Ω
			V_{IS} = 0V, I_{IS} = 30 mA (Note)		3.0	—	4.5	9	Ω
			V_{IS} = 1.0 V, I_{IS} = 30 mA (Note)		3.0	—	6.0	11	Ω
ON-resistance Flatness	R,L	$R_{FLAT(ON)}$	V_{IS} = -1.0V to 1.0V, I_{IS} = 30 mA (Note)		3.0	—	2.0	—	Ω
Quiescent supply current		I_{CC}	V_{IN} (Cont) = V_{CC} or GND, V_{BUS} =0V or 5V , I_{OUT} = 0 A		3.6	—	—	2	μA
		ΔI_{CC}	V_{IN} (Cont) = 1.8V		3.6	—	—	40	μA
					2.7	—	—	10	μA
Pop Sound Elimator Resistor		R_P	V_{IS} = 0 to V_{CC}, I_{IS} = 30 mA (Note)	UA2221	3.6	—	50	—	Ω

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

AC Characteristics (Ta = −40 to 85°C)

Characteristics	Symbol	Test Condition	V_{CC} (V)	Min.	Typ.	Max.	Unit
Propagation Delay Time (Note)	t_{PLH}, t_{PHL}	CL=5pF, See Fig. 1	3.3 ± 0.3	—	0.25	—	ns
Turn ON Time (Cont, V_{BUS} to Output)	t_{on}	RL=50Ω, CL=5pF See Fig. 2	3.3 ± 0.3	—	—	1.0	μs
Turn OFF Time (Cont, V_{BUS} to Output)	t_{off}	RL=50Ω, CL=5pF See Fig. 2	3.3 ± 0.3	—	—	1.0	μs
Break Before Make	TBBM	RL=50Ω, CL=5pF See Fig. 3	3.3 ± 0.3	2.0	—	15	ns

Note: This parameter is guaranteed by design.

Analog Switch Characteristics (Ta = 25°C)

Characteristics		Symbol	Test Condition	V_{CC} (V)	Min.	Typ.	Max.	Unit
Off Isolation (Non-Adjacent)	D+,D-	OIRR	RT=50Ω, f=240MHz See Fig. 4	3.3 ± 0.3	—	-36	—	dB
	R,L		RT=50Ω, f=20kHz See Fig. 4	3.3 ± 0.3	—	-72	—	
Crosstalk (Non-Adjacent)	D+,D-	X_{talk}	RT=50Ω, f=240MHz See Fig. 5	3.3 ± 0.3	—	-36	—	dB
	R,L		RT=50Ω, f=20kHz See Fig. 5	3.3 ± 0.3	—	-84	—	
-3dB Bandwidth	D+,D-	BW	RT=50Ω,CL=0pF See Fig. 6	3.3 ± 0.3	—	720	—	MHz
Sine Wave Distortion	R,L	T.H.D	VIN = 2Vp-p, RL = 1kΩ, f = 1kHz	3.3 ± 0.3	—	0.1	—	%

Note: This parameter is guaranteed by design.

Capacitive Characteristics (Ta = 25°C)

Characteristics		Symbol	Test Condition	V_{CC} (V)	Typ.	Unit
Control pin input capaci tance	V_{BUS}	C_{IN}	V_{IN} = 0 V	3.3	20	pF
	Cont			3.3	4	
Switch terminal Off capacitance	D+,D-	$C_{I/O}$	$V_{I/O}$ = 0 V, V_{BUS}=GND or open	3.3	3	pF
	L,R		$V_{I/O}$ = 0 V, Cont=V_{CC}	3.3	3.5	
	COM+,COM-		$V_{I/O}$ = 0 V, V_{BUS}=GND or open, Cont=V_{CC}	3.3	4	
Switch terminal On capacitance	D+,D-	$C_{I/O}$	$V_{I/O}$ = 0 V, V_{BUS}=4.25V	3.3	7	pF
	L,R		$V_{I/O}$ = 0 V, V_{BUS}=GND or open, Cont=GND	3.3	8	

Note: This parameter is guaranteed by design.

ACTEST Circuit Load / Waveform

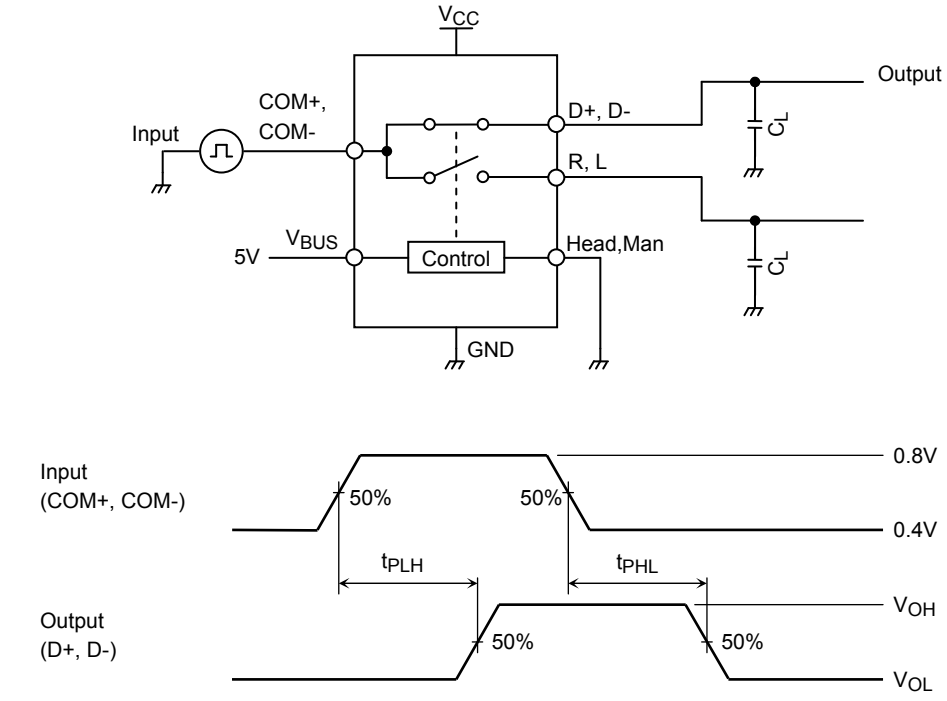


Figure1 Propagation Delay Time (t_{PLH}, t_{PHL})

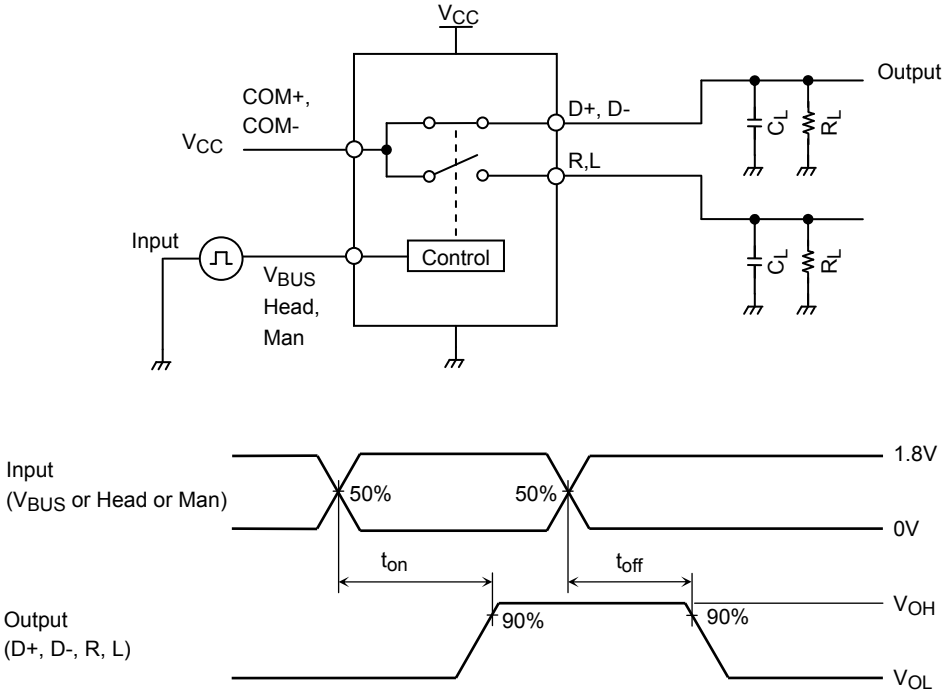


Figure2 Turn ON / Turn OFF (t_{on} t_{off})

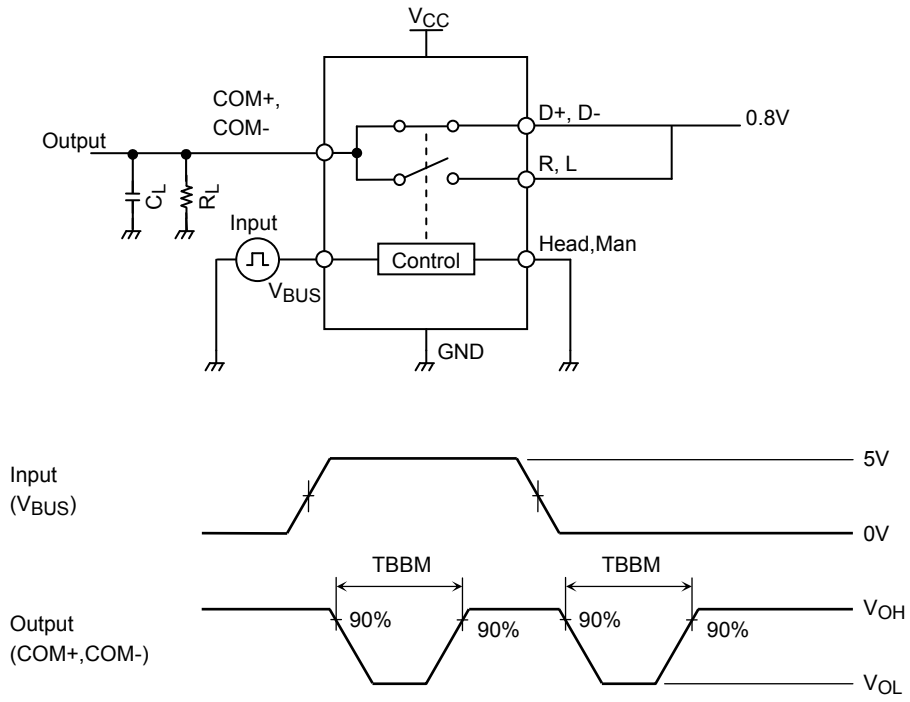


Figure 3 Break Before Make (TBBM)

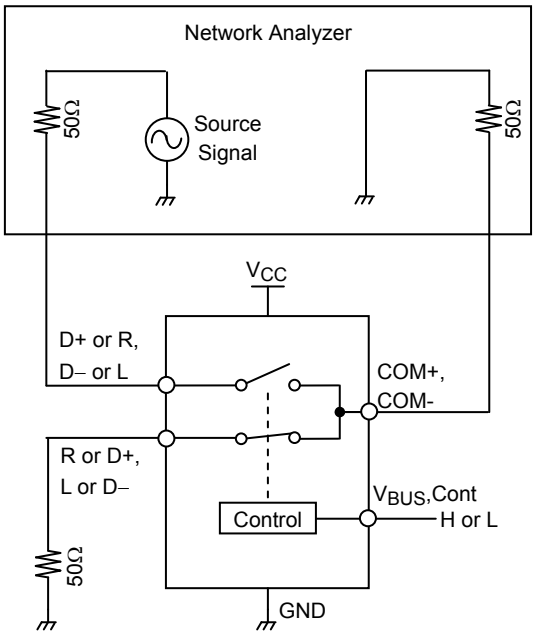


Figure4 OFF Isolation

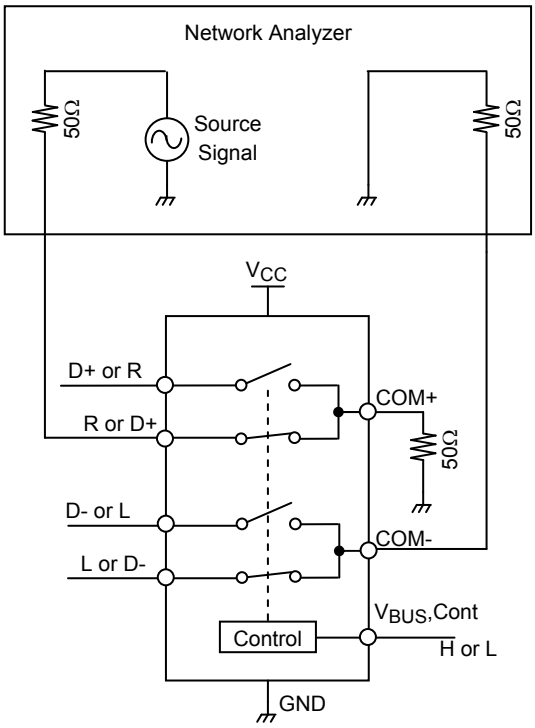


Figure5 Crosstalk

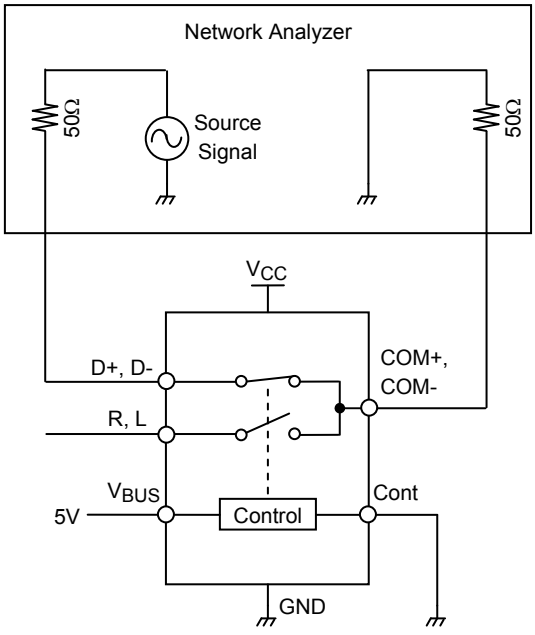
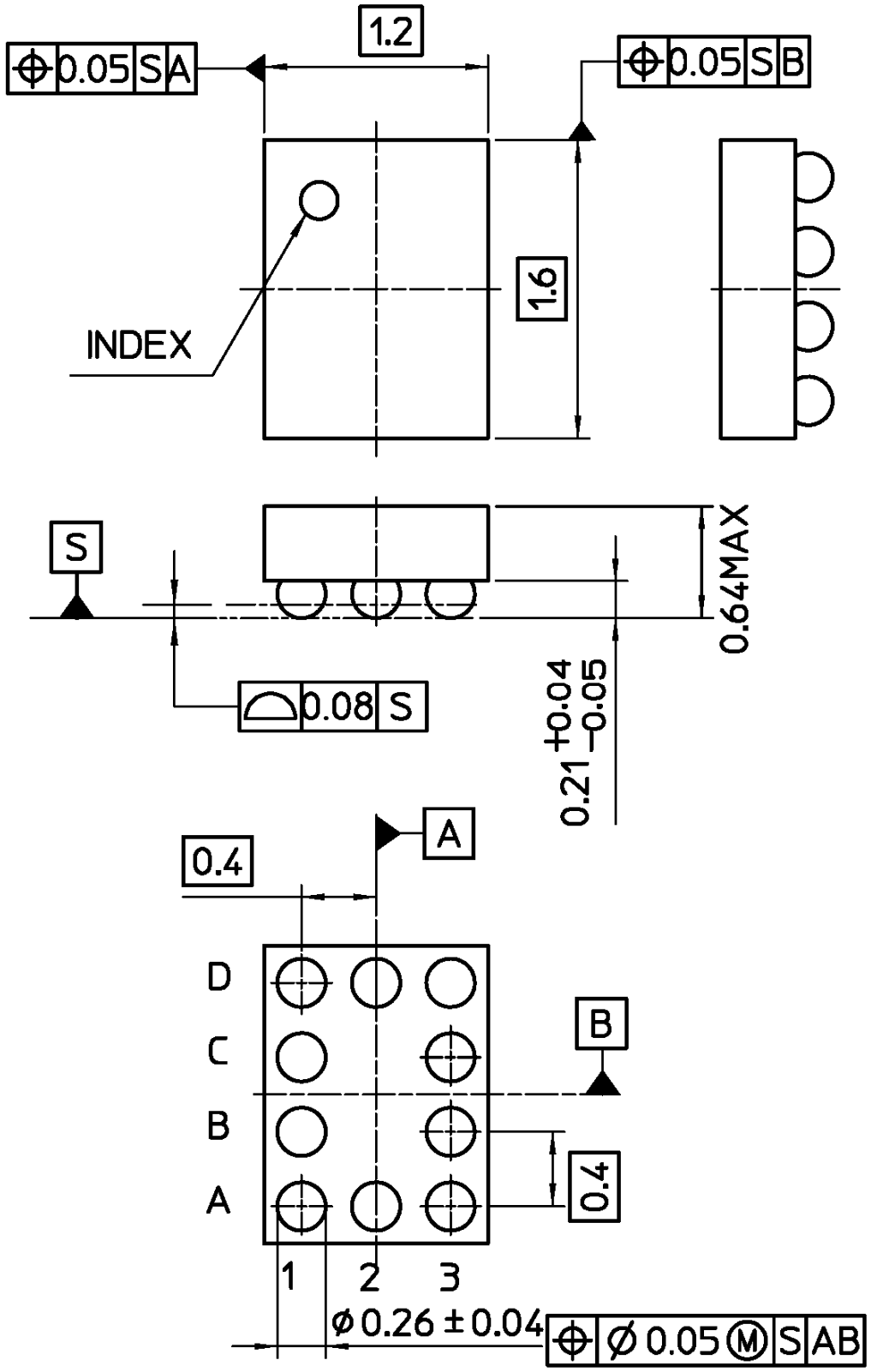


Figure6 -3dB BandWidth

Package Dimension

S-UFBGA10-0202-0.40-001

Unit:mm



The resin used in this product includes no flame retardants.

Weight: 0.0025g (Typ.)

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