

High-Speed USB 2.0 480Mbps Switch

General Description

The ET7229 is a double-pole/double-throw (DPDT) switches. Their wide bandwidth and low bit-to-bit skew allow them to pass high-speed differential signals with good signal integrity.

Each switch is bidirectional and offers little or no attenuation of the high-speed signals at the outputs. Industry-leading advantages include a propagation delay of less than 250 ps, resulting from its low channel resistance and low I/O capacitance. Their high channel-to-channel crosstalk rejection results in minimal noise interference. Their bandwidth is wide enough to pass High-Speed USB 2.0 differential signals (480 Mb/s).

ET7229 is offered in a QFN10L package.

Features

- R_{ON} is typically 6.0 Ω @ $V_{CC} = 3.3$ V
- Low Bit-to-Bit skew is typically 50 ps
- Low current consumption is 1.0 μ A typical
- Near-zero propagation delay is typical 250 ps
- Channel on-capacitance is 4.0 pF typical
- V_{CC} operating range from 1.65 V to 4.5 V
- Part No. and package

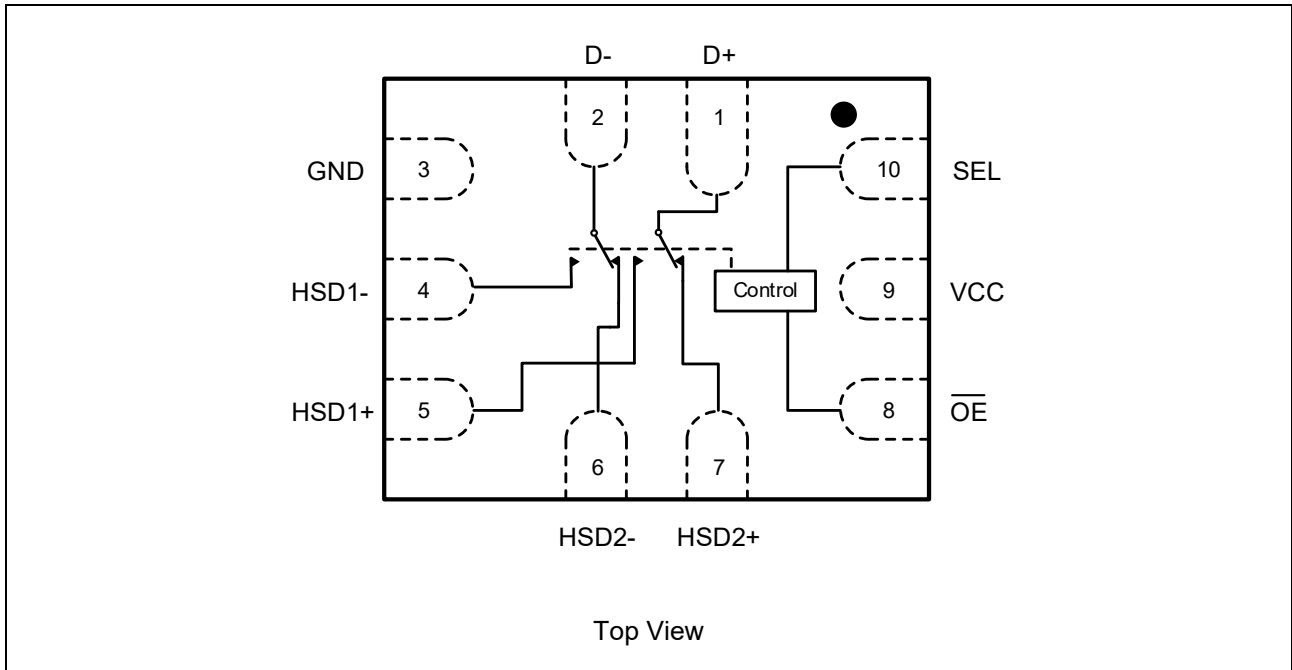
Part No.	Package	Packing Option	MSL
ET7229	QFN10L(1.8 mm×1.4 mm)	Tape and Reel ,3K	Level 1

Applications

- Differential Signal Data Routing
- USB 2.0 Signal Routing

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Pin Configuration



Pin Function

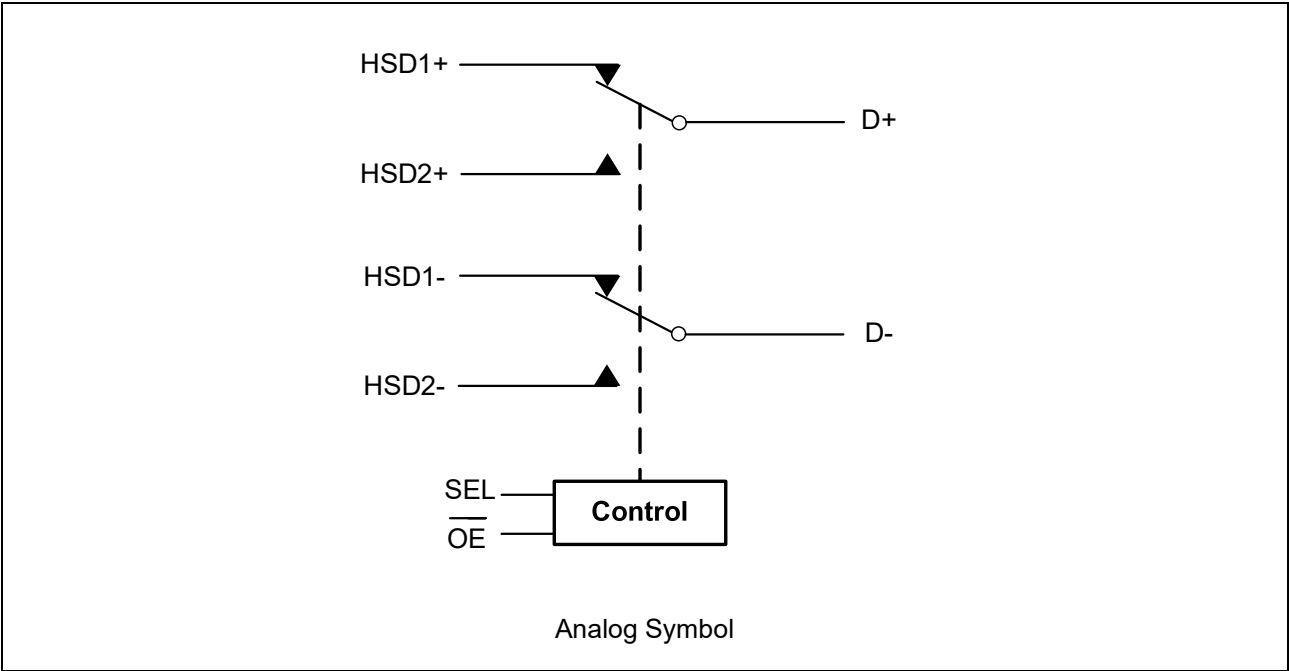
Pin No.	Pin Name	Pin Function
1	D+	Data Ports
2	D-	Data Ports
3	GND	Ground
4	HSD1-	Data Ports
5	HSD1+	Data Ports
6	HSD2-	Data Ports
7	HSD2+	Data Ports
8	$\overline{\text{OE}}$	Output Enable
9	VCC	Power supply
10	SEL	Select Input

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Truth Table

$\overline{\text{OE}}$	SEL	HSD1+ to D+, HSD1- to D-	HSD2+ to D+, HSD2- to D-
1	X	OFF	OFF
0	0	OFF	ON
0	1	ON	OFF

Analog Symbol



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Absolute Maximum Ratings

Symbol	Pins	Parameters	Value	Unit
V _{CC}	VCC	Positive DC Supply Voltage	-0.5 to +6.0	V
V _{IS}	HSD1+,HSD1-,HSD2+,HSD2-	Analog Signal Voltage	-0.5 to V _{CC}	V
	D+,D-		-0.5 to +5.5	
V _{IN}	$\overline{\text{OE}}$	Control Input Voltage	-0.5 to +6.0	V
I _{CC}	VCC	Positive DC Supply Current	50	mA
I _{IS_CON}	HSD1+,HSD1-,HSD2+,HSD2- D+,D-	Analog Signal Continuous Current	± 100	mA
I _{IS_PK}	HSD1+,HSD1-,HSD2+,HSD2- D+,D-	Analog Signal Continuous Current 10% Duty Cycle	± 150	mA
I _{IN}	$\overline{\text{OE}}$	Control Input Current	± 20	mA
T _J		Junction Temperature Range	-40 to +150	°C
T _{STG}		Storage Temperature	-65 to +150	°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

Recommended Operating Conditions

Symbol	Pins	Parameter	Min	Max	Unit
V _{CC}	VCC	Positive DC Supply Voltage	1.65	4.5	V
V _{IS}	HSD1+,HSD1-,HSD2+,HSD2-	Analog Signal Voltage	GND	V _{CC}	V
	D+,D-		GND	4.5	
V _{IN}	$\overline{\text{OE}}$	Digital Select Input Voltage	GND	V _{CC}	V
T _A		Operating Temperature Range	-40	+85	°C

Minimum and maximum values are guaranteed through test or design across the Recommended Operating Conditions, where applicable. Typical values are listed for guidance only and are based on the particular conditions listed for section, where applicable. These conditions are valid for all values found in the characteristics tables unless otherwise specified in the test conditions.

DC Electrical Characteristics

Control Input (Typical: $T_A = 25\text{ }^{\circ}\text{C}$, $V_{CC} = 3.3\text{ V}$)

Symbol	Pins	Parameter	Test Conditions	V_{CC} (V)	-40°C to +85°C			unit
					Min	Typ	Max	
V_{IH}	SEL $\overline{OE}$	Control Input High Voltage ⁽¹⁾		2.7	1.0	-	-	V
				3.4	1.1			
				4.2	1.12			
V_{IL}	SEL $\overline{OE}$	Control Input Low Voltage ⁽¹⁾		2.7	-		0.4	V
				3.4			0.4	
				4.2			0.5	
I_{IN}		Control Input Leakage Current	$0 \leq V_{IS} \leq V_{CC}$	1.65 ~ 4.5	-	-	± 1.0	μA

Note1: V_{IH} level is recommended to be consistent with V_{CC} and V_{IL} level is GND to reduce I_{CC} current.

Supply And Leakage Current (Typical: $T_A = 25\text{ }^{\circ}\text{C}$, $V_{CC} = 3.3\text{ V}$, $\overline{OE} = V_{CC}$ or GND, SEL = V_{CC} or GND)

Symbol	Pins	Parameter	Test Conditions	V_{CC} (V)	-40°C to +85°C		unit
					Min	Max	
I_{CC}	V_{CC}	Quiescent Supply Current	$V_{IS} = V_{CC}$ or GND; $I_{OUT} = 0\text{ A}$	1.65 ~ 4.5	-	1.0	μA
I_{CCT}	V_{CC}	Increase in I_{CC} per Control Voltage	$V_{IN} = 2.6\text{ V}$	3.6	-	10	μA
I_{OZ}	HSD1+ HSD1- HSD2+ HSD2-	OFF Stage Leakage Current	$0 \leq V_{IS} \leq V_{CC}$	1.65 ~ 4.5	-	± 1.0	μA
I_{OFF}	D+, D-	Power OFF Leakage Current	$0 \leq V_{IS} \leq 4.5\text{ V}$	0	-	± 1.0	μA

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High Speed On Resistance (Typical: $T_A = 25^\circ\text{C}$, $V_{CC} = 3.3\text{ V}$)

Symbol	Parameter	Test Conditions	V_{CC} (V)	-40°C to +85°C			unit
				Min	Typ	Max	
R_{ON}	On-Resistance	$V_{IS} = 0.2V, 0.4V$ $I_{ON} = 8\text{mA}$	2.7	-	6.5	12	Ω
			3.3		6.0	10	
			4.2		5.5	8	
R_{FLAT}	On-Resistance Flatness		2.7	-	0.3	1.5	Ω
			3.3		0.2	1	
			4.2		0.1	0.5	
ΔR_{ON}	On-Resistance Matching		2.7	-	0.25	0.5	Ω
			3.3		0.2	0.45	
			4.2		0.15	0.4	

Full Speed On Resistance (Typical: $T_A = 25^\circ\text{C}$, $V_{CC} = 3.3\text{ V}$)

Symbol	Parameter	Test Conditions	V_{CC} (V)	-40°C to +85°C			unit
				Min	Typ	Max	
R_{ON}	On-Resistance	$V_{IS} = 0.2V_{CC}, 0.5V_{CC}, 0.8V_{CC}, V_{CC}$ $I_{ON} = 8\text{mA}$	2.7	-	9.0	13	Ω
			3.3		7.5	11	
			4.2		6.0	9	
ΔR_{ON}	On-Resistance Matching		2.7	-	0.5	0.8	Ω
			3.3		0.4	0.7	
			4.2		0.3	0.6	
R_{FLAT}	On-Resistance Flatness	$V_{IS} = 0.2V, 0.4V, 0.7V, 1.0V$ $I_{ON} = 8\text{mA}$	2.7	-	1.0	3	Ω
			3.3		0.5	1.5	
			4.2		0.4	1.2	

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AC Electrical Characteristics⁽²⁾

Timing / Frequency (Typical: $T_A = 25\text{ }^{\circ}\text{C}$, $V_{CC} = 3.3\text{ V}$, $R_L = 50\text{ }\Omega$)

Symbol	Parameter	Test Conditions	V_{CC} (V)	-40°C to +85°C			unit
				Min	Typ	Max	
t_{ON}	Turn-ON Time		2.7 ~ 4.5	-	14	20	ns
t_{OFF}	Turn-OFF Time		2.7 ~ 4.5	-	21	25	ns
t_{BBM}	Break-Before-Make Delay	$V_{IS} = 0\text{ V to } V_{CC}$	2.7 ~ 4.5	2	8	-	ns
BW	-3 dB Bandwidth	$C_L = 5\text{ pF}$	2.7 ~ 4.5	-	550	-	MHz
		$C_L = 0\text{ pF}$		-	900	-	

Isolation (Typical: $T_A = 25\text{ }^{\circ}\text{C}$, $V_{CC} = 3.3\text{ V}$, $R_L = 50\text{ }\Omega$)

Symbol	Pins	Parameter	Conditions	V_{CC} (V)	-40°C to +85°C			unit
					Min	Typ	Max	
O_{IRR}	Open	OFF-Isolation	$f = 250\text{ MHz}$	1.65 ~ 4.5	-	-30	-	dB
X_{TALK}	HSD1+ to HSD1-	Non-Adjacent Channel Crosstalk	$f = 250\text{ MHz}$	1.65 ~ 4.5	-	-45	-	dB

Capacitance (Typical: $T_A = 25\text{ }^{\circ}\text{C}$, $V_{CC} = 3.3\text{ V}$, $R_L = 50\text{ }\Omega$, $f = 1\text{ MHz}$)

Symbol	Pins	Parameter	Conditions	V_{CC} (V)	-40°C to +85°C			unit
					Min	Typ	Max	
C_{IN}	$\overline{OE}$	Control Pin Input Capacitance		0		2.0		pF
C_{ON}	D+ to HSD1/2+	ON Capacitance	$V_{OE} = 0\text{ V}$	3.3		8.0		pF
C_{OFF}	HSD2+, HSD2-	OFF Capacitance	$V_{IS} = 3.3\text{ V}$ $V_{OE} = 3.3\text{ V}$	3.3		3.5		pF

Note2: AC parameter is guaranteed by design.

Typical Characteristics

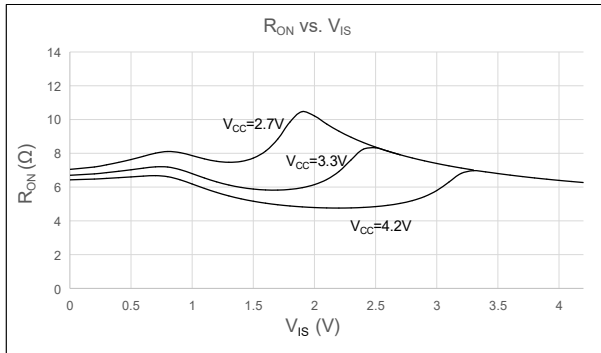


Figure 1. On-Resistance vs. V_{IS}

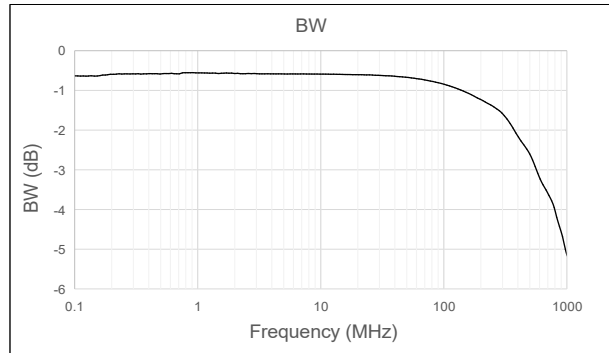


Figure 2. Bandwidth vs. Frequency @V_{CC}=3.3V

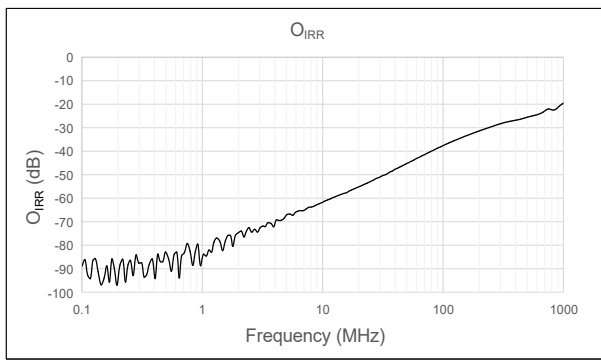


Figure 3. O_{IRR} vs. Frequency @V_{CC}=3.3V

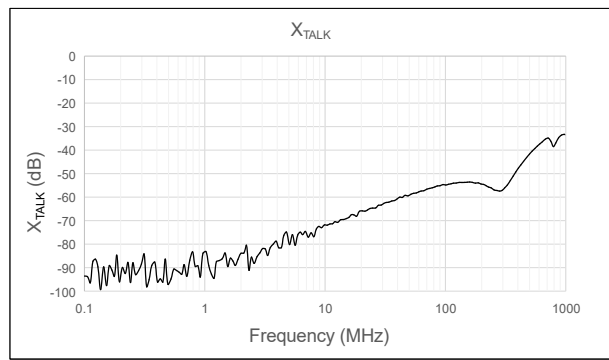
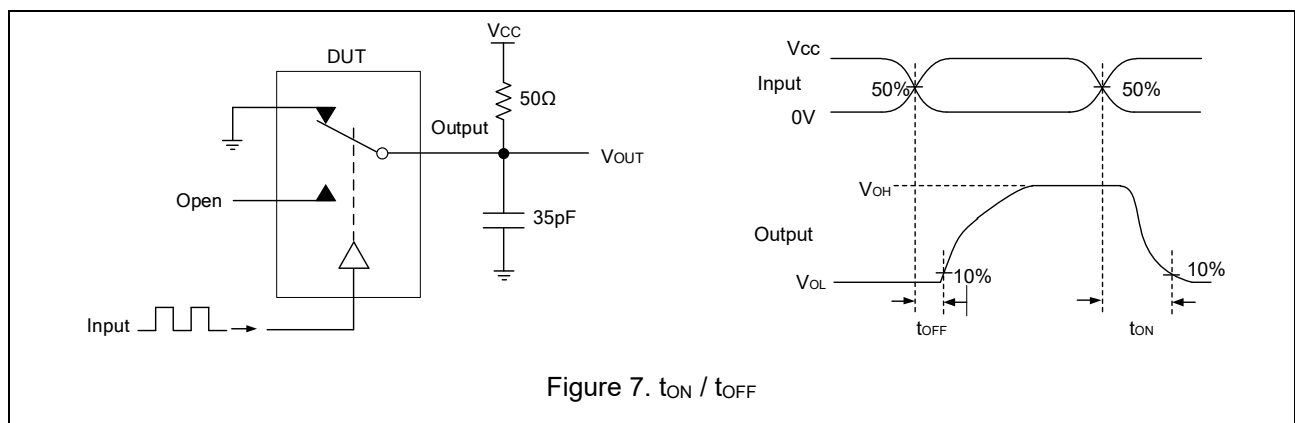
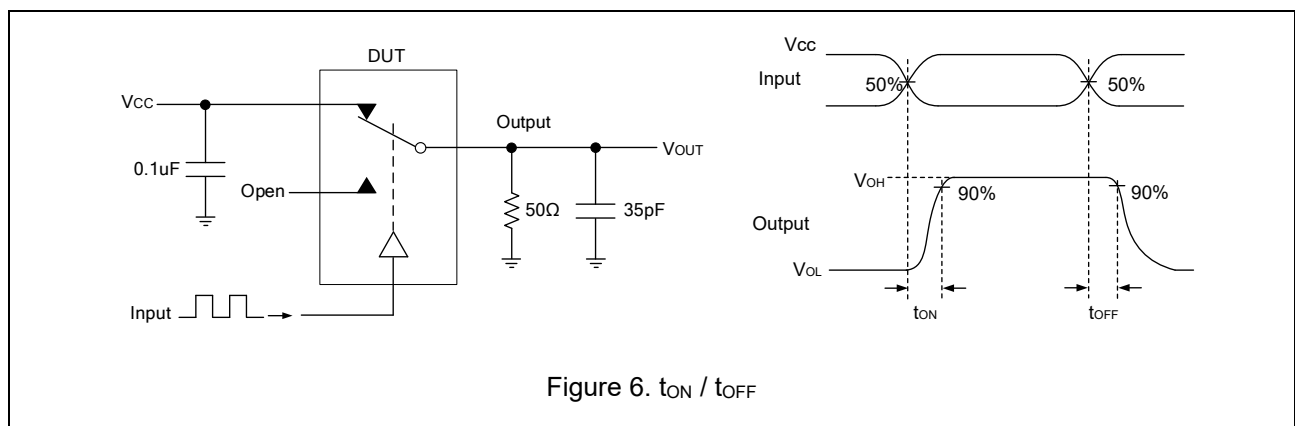
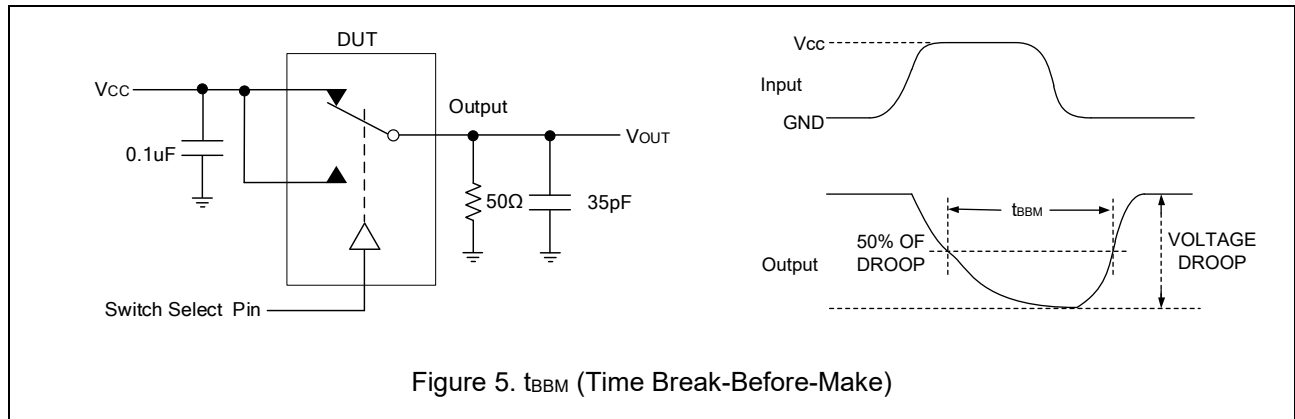


Figure 4. X_{TALK} vs. Frequency @V_{CC}=3.3V

Test Circuit and Waveform



Test Circuit and Waveform (Continued)

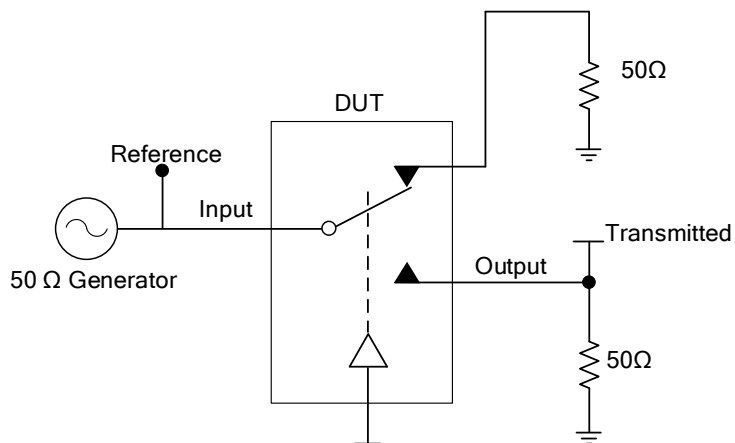


Figure 8. Off Channel Isolation/On Channel Loss(BW)/Crosstalk

(On Channel to Off Channel)/ V_{ONL}

Channel switch control/s test socket is normalized. Off isolation is measured across an off channel. On loss is the bandwidth of an On switch. V_{ISO} , Bandwidth and V_{ONL} are independent of the input signal direction.

V_{ISO} = Off Channel Isolation = $20 \lg(V_{OUT} / V_{IN})$ for V_{IN} at 100 kHz.

V_{ONL} = On Channel Loss = $20 \lg(V_{OUT} / V_{IN})$ for V_{IN} at 100 kHz to 50 MHz.

Bandwidth (BW) = the frequency 3 dB below V_{ONL} .

V_{CT} = Use V_{ISO} setup and test to all other switch analog input/outputs terminated with 50 Ω .

Typical Performance Curves

$T_A = +25\text{ }^{\circ}\text{C}$, Unless Otherwise Specified

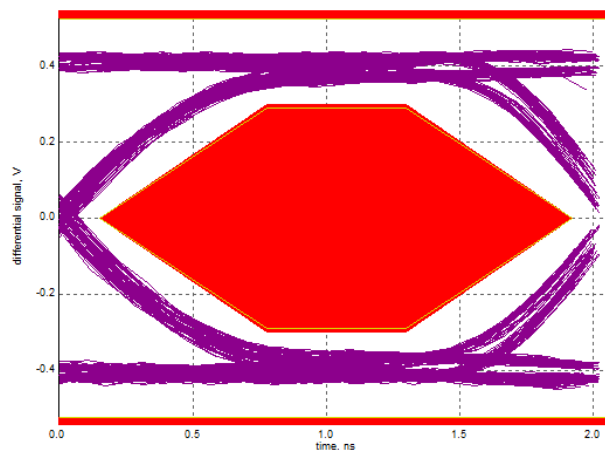
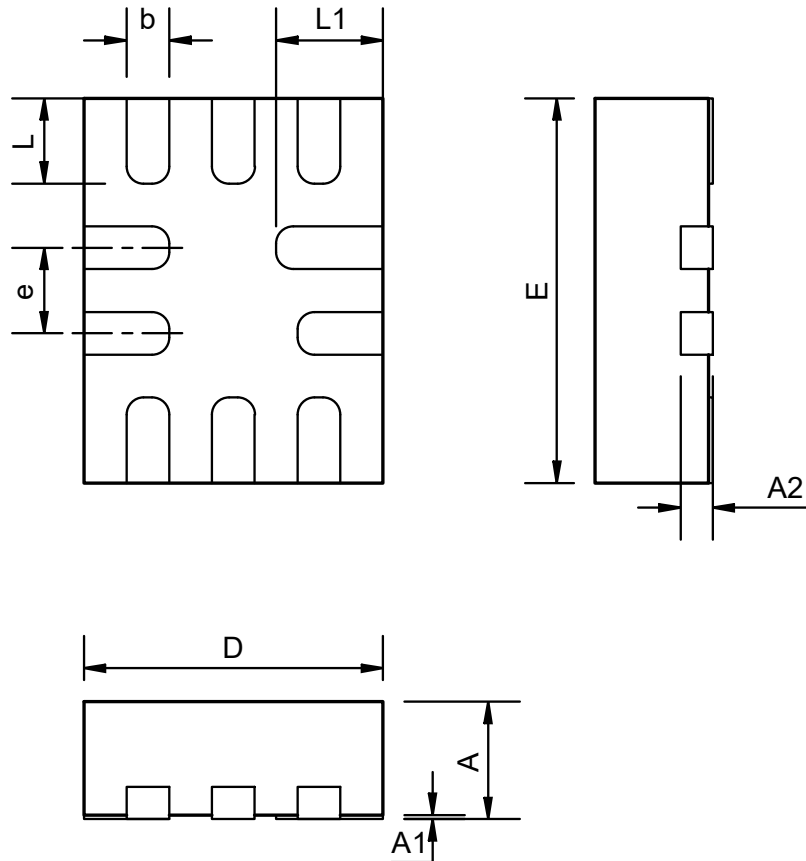


Figure 9. Eye Pattern : 480 Mbps with USB Switches in the Signal Path (near end mask)

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Package Dimension

QFN10L



COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	0.50	0.55	0.60
A1	0	0.02	0.05
A2	0.15 REF		
b	0.15	0.20	0.25
D	1.35	1.40	1.45
E	1.75	1.80	1.85
e	0.40 BSC		
L	0.30	0.40	0.50
L1	0.40	0.50	0.60

Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
0.0	2022-09-23	Preliminary Version	Luh	Luh	Liujiy
1.0	2022-12-15	Update Typeset	Shib	Shib	Liujiy
1.1	2024-01-03	Add Tj	Shib	Shib	Liujiy
1.2	2025-07-22	Update Typical Characteristics and Eye Pattern	Yinp	Yinp	Liujiy