

Features

- Wide VCC Input Voltage Range: 2.3V to 5.5V
- USB Channel: Bandwidth (~3dB): 5.8GHz
RON (Typ.): 4.6Ω; CON (Typ.): 1.2pF
- Mobile High Definition Link (MHL) Channel:
Bandwidth (~3dB): 5.5GHz;
RON (Typ.): 5.7Ω; CON (Typ.): 1.4pF
- Ultra-Low Power Consumption: 20μA (Typ.)
- Power-off Protection: Low Current Leakage in Powered-Down State (VCC = 0V)
Overvoltage Tolerance (OVT) on all I/O Pins up to 5.5V
Overvoltage Protection of 9V Short to Data Pins
- Packaged in QFN2X1.5-10

Applications

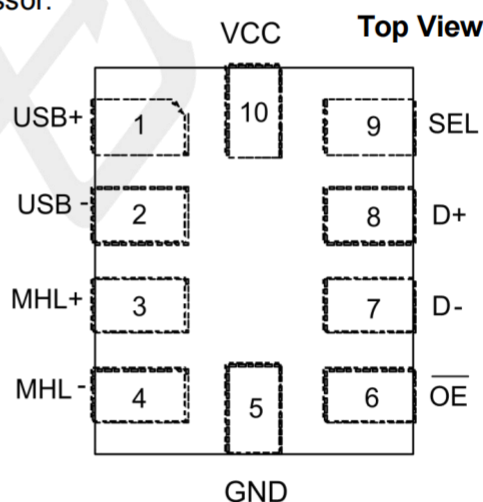
- USB Ports
- Notebook and Desktop Computers
- High-Side Power Protection Switches
- Consumer Electronics
- Telecom Systems
- Digital TV
- USB Device Power Switch
- Motherboard USB Power Switch

Reference: TS3USB3000RSER

General Description

The is a dual single-pole, double throw (SPDT) switch with a Mobile High-Definition Link (MHL) switch and an USB2.0 High-Speed (480Mbps) switch housed in the same package. Wide bandwidth of this product allows the sharing of the USB connector for both MHL video signals and USB data transmission.

The offers wide VCC input voltage range of 2.3V to 5.5V and features overvoltage tolerance (OVT) function, which allows the I/O pins to withstand overvoltage conditions (up to 5.5V). The power-off protection feature forces all I/O pins to be in high-impedance mode when power is not present or 0V without excessive leakage current. 1.8V compatible control logic of allows the direct interface with the General-Purpose I/O (GPIO) of the baseband processor.



Pin Configurations

Pin Number	Pin Name	Pin Function	Pin Number	Pin Name	Pin Function
1	USB+	USB Data Link (Differential+)	6	OE	Output Enable (Active Low)
2	USB-	USB Data Link (Differential-)	7	D-	Switch Output (Differential-)
3	MHL+	MHL Data Link (Differential+)	8	D+	Switch Output (Differential+)
4	MHL-	MHL Data Link (Differential-)	9	SEL	Switch Select (LOW=D+/D- To USB+/USBHIGH=D+/D- To MHL+/MHL-)
5	GND	Ground	10	VCC	Power Supply Pin

Absolute Maximum Ratings

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

Symbol	Parameter	Min	Max	Unit
VCC	Supply Voltage	-0.3	6	V
VI/O	Input-Output DC Voltage	-0.3	6	V
VD-	D- DC Voltage (1)	-0.3	9	V
VI	Digital Input Voltage (SEL, $\overline{OE}$)	-0.3	6	V
IK	Input-Output Port Diode Current (VI/O<0)	-50	--	mA
I _{IK}	Digital Logic Input Clamp Current (Vi<0)	-50	--	mA
ICC	Continuous Current Through VCC	--	100	mA
IGND	Continuous Current Through GND	-100	--	mA
Tstg	Storage Temperature	-65	150	°C
ESD	Human Body Model (HBM)	-5500	5500	V

(1) This rating only applies to the D- pin with respect to GND. VCC must be powered within the recommended operating conditions of 2.3V to 5.5V and the $\overline{OE}$ pin must be logic high for this rating to be applicable. Any condition where VCC is unpowered or the $\overline{OE}$ pin is not high must reference the rest of the Absolute Maximum Ratings Table.

Recommend Operating Conditions

Symbol	Parameter	Rating	Unit
VCC	Supply Voltage	2.3to 5.5	V
VI/O (USB)	Analog Voltage	0 to Vcc	V
VI/O (MHL)			
VI	Digital Input Voltage (SEL, $\overline{OE}$)	0 to VCC	V
TRAM(VCC)	Power Supply Ramp Time Requirement (VCC)	100 to 1000	μs/V
TA	Operating Free-Air Temperature	-40 to 85	°C
RθJA	Junction-To-Ambient Thermal Resistance	193	°C/W
RθJC(top)	Junction-To-Case (Top) Thermal Resistance	96	°C/W
RθJB	Junction-To-Board Thermal Resistance	118	°C/W
θJT	Junction-To-Top Characterization Parameter	7.8	°C/W
θJB	Junction-To-Board Characterization Parameter	118	°C/W

Electrical Characteristics

T_A=-40°C to 85°C, Typical values are at V_{CC}=3.3V, T_A=25°C, (unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
MHL SWITCH						
R _{ON}	ON-State Resistance	V _{CC} =2.7V, V _{I/O} =1.65V, I _{ON} =-8mA	--	5.7	9	Ω
		V _{CC} =2.3V, V _{I/O} =1.65V, I _{ON} =-8mA	--	5.7	9.5	
ΔR _{ON}	ON-State Resistance Match between + and - Paths	V _{CC} =2.3V, V _{I/O} =1.65V, I _{ON} =-8mA	--	0.1	--	Ω
I _{OZ}	OFF Leakage Current	V _{CC} =5V, Switch OFF, V _{MHL±} =1.65V to 3.45V, V _{D±} =0V	-2	--	2	μA
I _{ON}	ON Leakage Current	V _{CC} =5V, Switch ON, V _{MHL±} =1.65V to 3.45V, V _{D±} = NC	-2	--	2	μA
Z _{ON_GND}	ON-State Impedance to GND	V _{I/O} =0V to 1.8V, T _A =-40°C to 85°C	7	--	--	MΩ
USB SWITCH						
R _{ON}	ON-State Resistance	V _{CC} =2.3V, V _{I/O} =0.4V, I _{ON} =-8mA	--	4.6	7.5	Ω
ΔR _{ON}	ON-State Resistance Match between + and - Paths	V _{CC} =2.3V, V _{I/O} =0.4V, I _{ON} =-8mA	--	0.1	--	Ω
I _{OZ}	OFF Leakage Current	V _{CC} =5V, Switch OFF, V _{USB±} =0V to 3.6V, V _{D±} =0V	-2	--	2	μA
I _{ON}	ON Leakage Current	V _{CC} =5V, Switch ON, V _{USB±} =0V to 3.6V, V _{D±} =NC	-2	--	2	μA
Z _{ON_GND}	ON-State Impedance to GND	V _{I/O} =0V to 1.8V, T _A =-40°C to 85°C	7	--	--	MΩ
DIGITAL CONTROL INPUTS (SEL, $\overline{\text{OE}}$)						
V _{IH}	Input Logic High	V _{CC} =2.3V to 5V	1.3	--	--	V
V _{IL}	Input Logic Low	V _{CC} =2.3V to 5V	--	--	0.6	V
I _{IN}	Input Leakage Current	V _{CC} =5V, V _{I/O} =0V to 3.6V, V _{IN} =0 to 5V	-10	--	10	μA

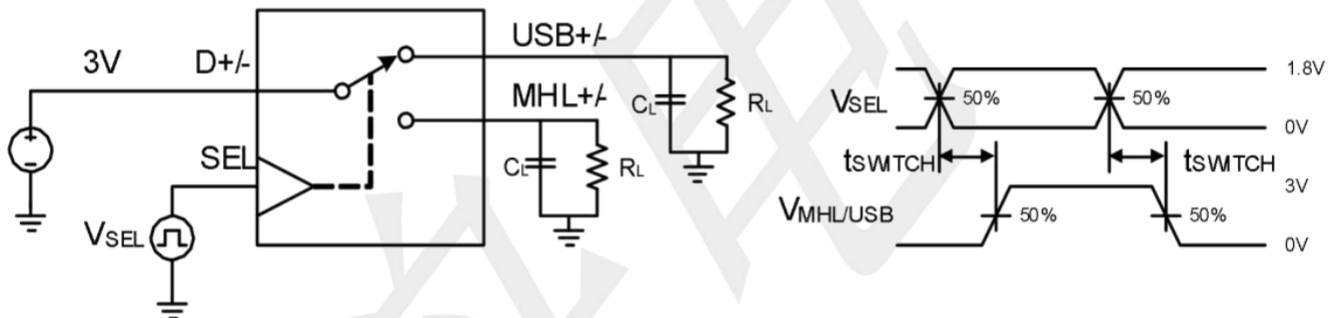
Dynamic Characteristics

Overoperating free-air temperature range (unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
CON(MHL)	MHL Path ON Capacitance	V _{CC} =3.3V, V _{I/O} =0 or 3.3V, f=240MHz, Switch ON	--	1.4	1.8	pF
CON(USB)	USB Path ON Capacitance	V _{CC} =3.3V, V _{I/O} =0 or 3.3V, f=240MHz, Switch ON	--	1.2	1.6	pF
C _I	Digital Input Capacitance	V _{CC} =3.3V, V _I =0 or 2V	--	2.2	--	pF
O _{ISO}	OFF Isolation	V _{CC} =2.3V to 5V, R _L =50Ω, f=240MHz, Switch OFF	--	-36	--	dB
X _{TALK}	Crosstalk	V _{CC} =2.3V to 5V, R _L =50Ω, f=240MHz, Switch ON	--	-42	--	dB
BW(MHL)	MHL Path -3dB Bandwidth	V _{CC} =2.3V to 5V, R _L =50Ω, f=240MHz, Switch ON	--	5.5	--	GHz
BW(USB)	USB Path -3dB Bandwidth	V _{CC} =2.3V to 5V, R _L =50Ω, f=240MHz, Switch ON	--	5.8	--	GHz
SUPPLY						
V _{CC}	Power Supply Voltage		2.3	--	5.5	V
I _{CC}	Positive Supply Current	V _{CC} =5V, V _{IN} =V _{CC} or GND, V _{I/O} =0V, Switch ON or OFF	--	20	40	μA
I _{CC, HZ}	Power Supply Current In High-Z Mode	V _{CC} =5V, V _{IN} =V _{CC} or GND, V _{I/O} =0V, Switch ON or OFF, OE=H	--	1	5	μA

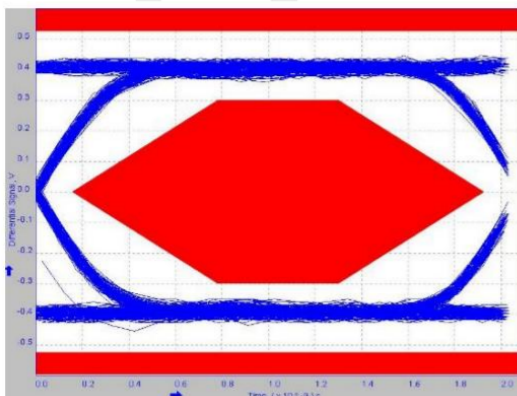
Timing Requirements

Symbol	Conditions		Min	Nom	Max	Unit
t_{switch}	Switching Time (SEL To Output)	See Figure 2	--	60	--	ns
$t_{ZH, ZL(MHL)}$	MHL Enable Time (OE To Output)	$V_{IO}=3.3V$ or $0V$	--	7	--	μs
$t_{HZ, LZ(MHL)}$	MHL Disable Time (OE To Output)		--	22	--	ns
$t_{ZH, ZL(USB)}$	USB Enable Time (OE To Output)	$V_{IO}=0.8V$ or $0V$	--	7	--	μs
$t_{HZ, LZ(USB)}$	USB Disable Time (OE To Output)		--	17	--	ns



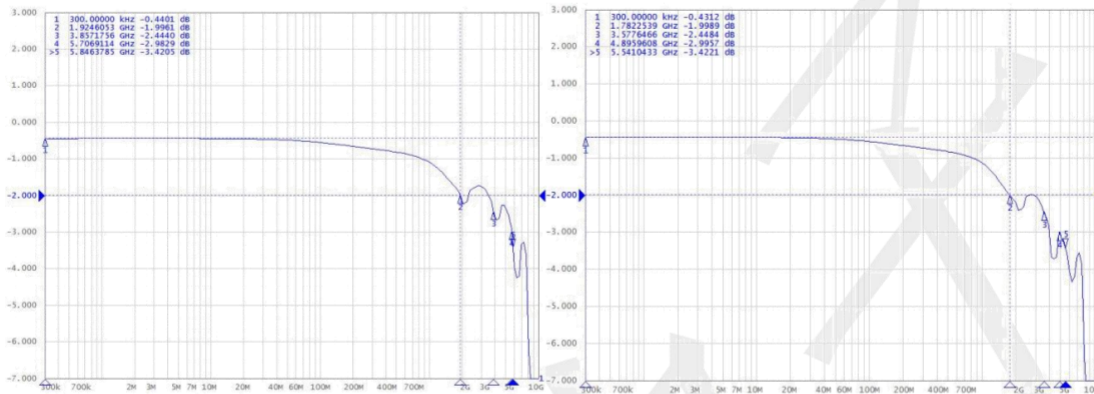
- (1) All input pulses are supplied by generators having the following characteristics: $PRR \leq 10MHz$, $Z_O = 50\Omega$, $t_r < 5ns$, $t_f < 5ns$.
- (2) C_L includes probe and jig capacitance.

Typical Performance Characteristics



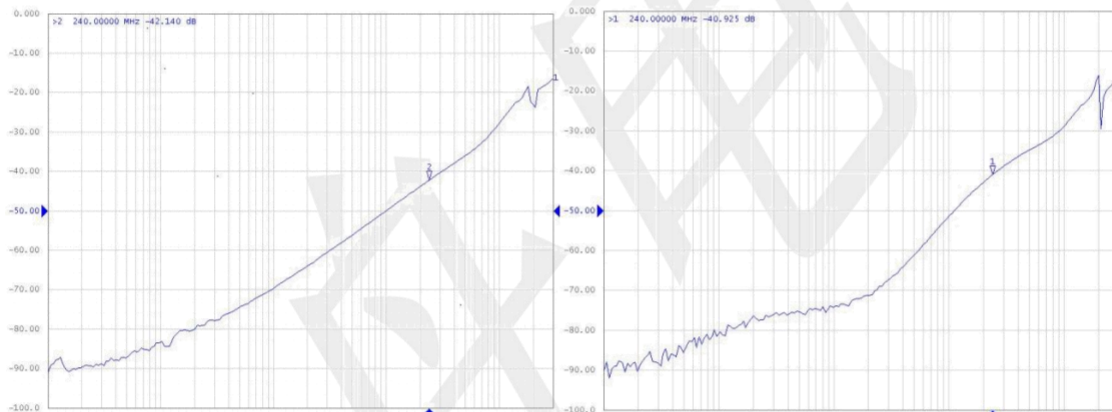
480-Mbps USB2.0 Eye Pattern for USB Switch With

Typical Performance Characteristics



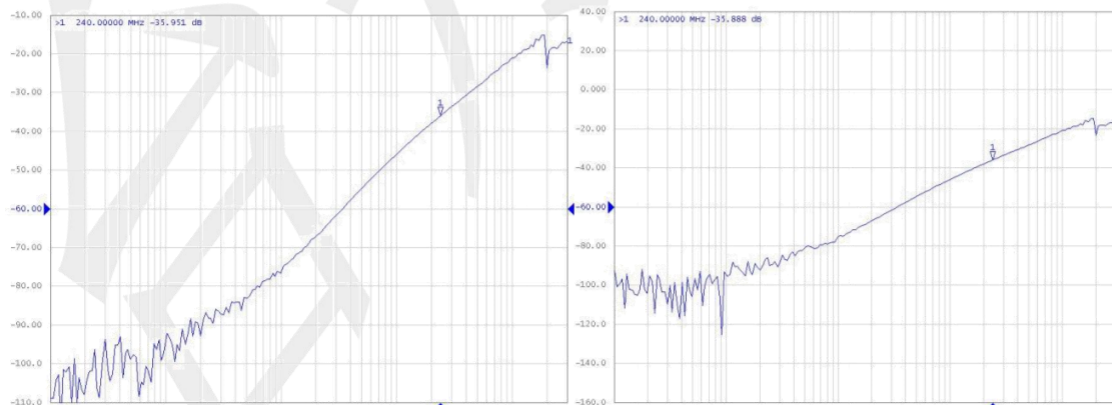
Differential S21 vs Frequency USB Switch

Differential S21 vs Frequency MHL Switch



CrossTalk Vs Frequency for USB Path

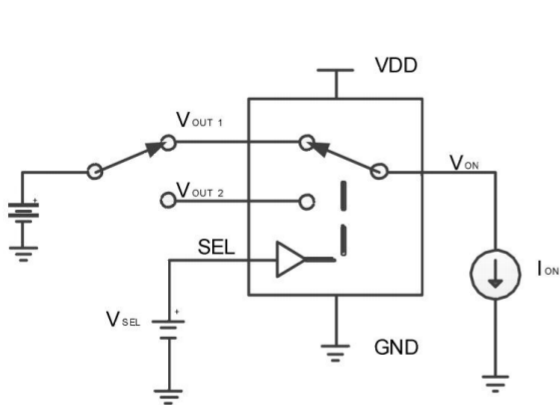
CrossTalk Vs Frequency for MHL Path



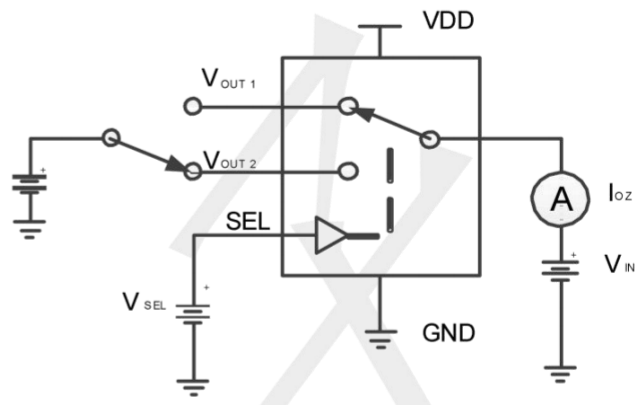
Off Isolation Vs Frequency for USB Path

Off Isolation Vs Frequency for MHL Path

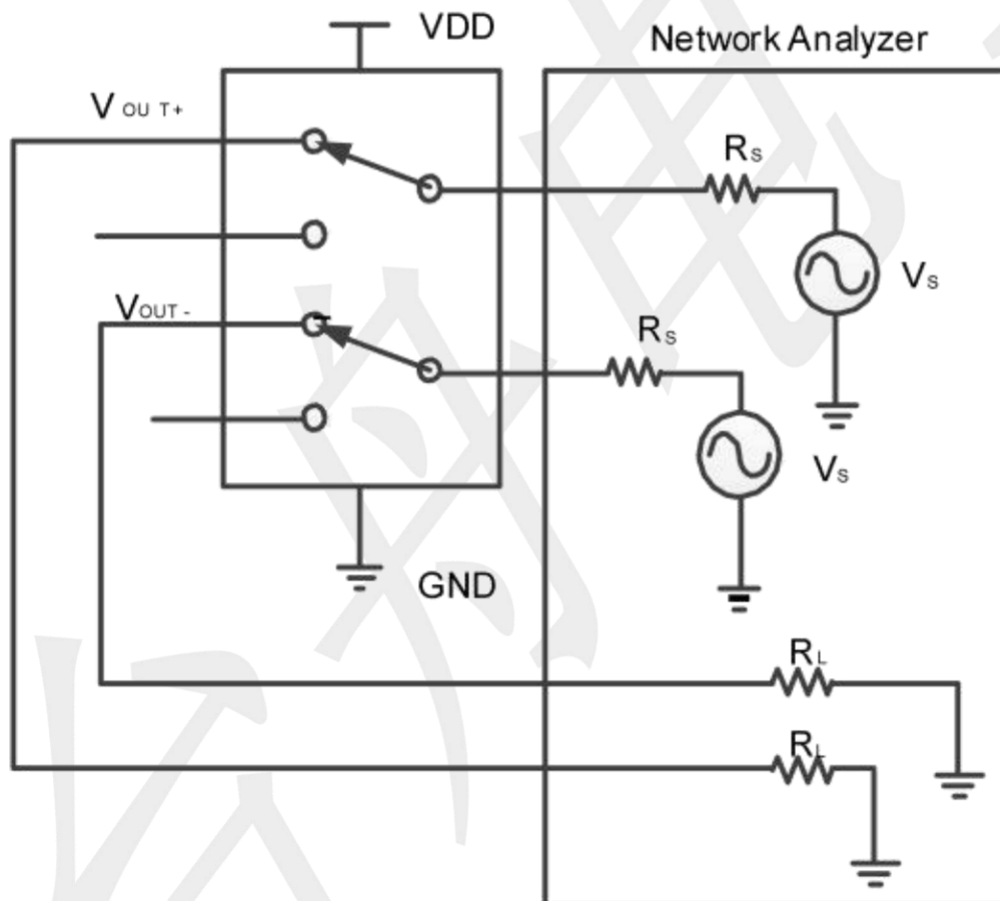
Application Information



Channel ON, $R_{ON} = (V_{ON} - V_{I/O1}) / I_{ON}$ or $(V_{ON} - V_{I/O2}) / I_{ON}$, $V_{SEL} = H$ or L
ON-State Resistance (R_{ON})



Channel OFF, $V_{SEL} = H$ or L
OFF Leakage Current (I_{OZ})

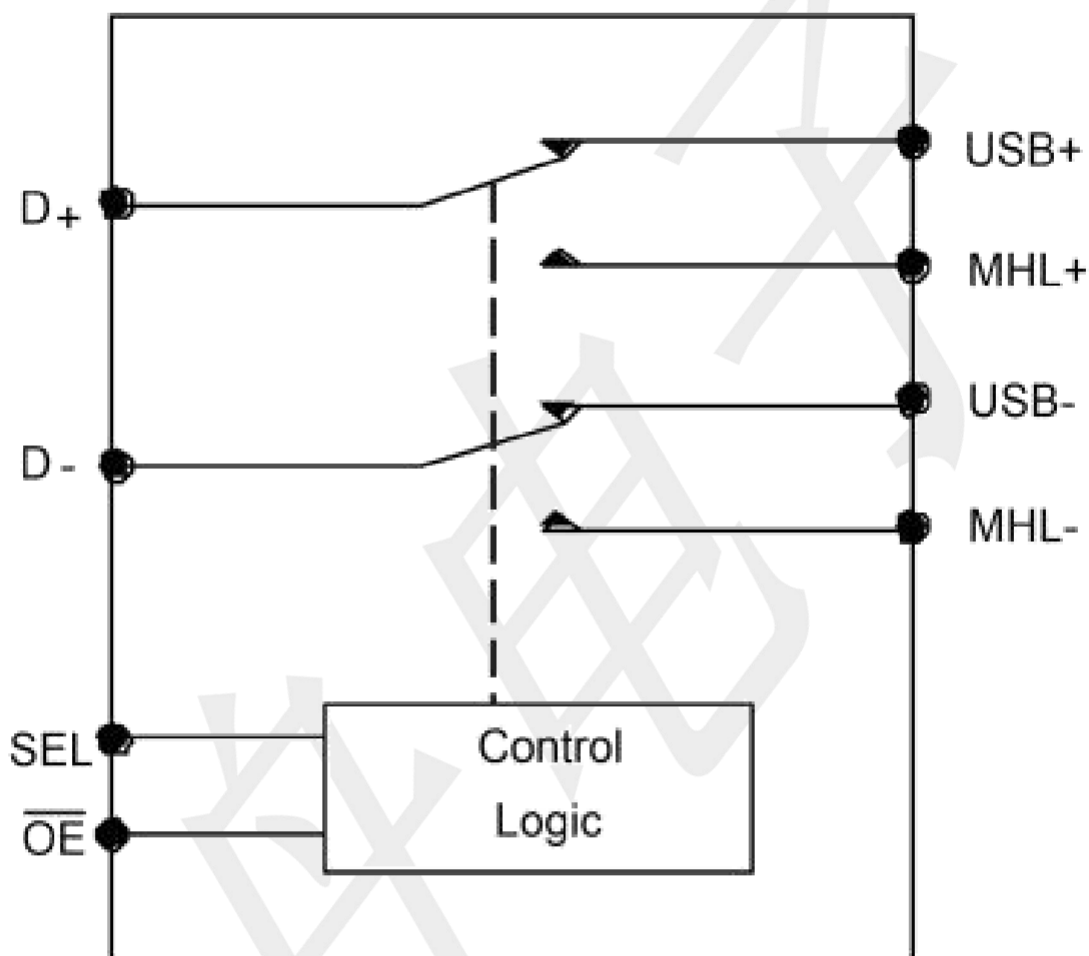


Channel ON, $V_{SEL} = H$ or L , $R_S = R_L = 50\Omega$

Bandwidth (BW)

Detailed Description

Functional Block Diagram

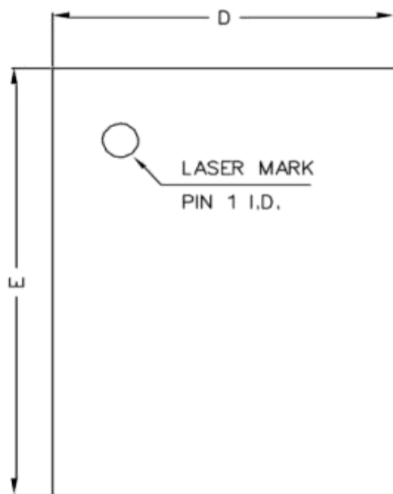


Function Table

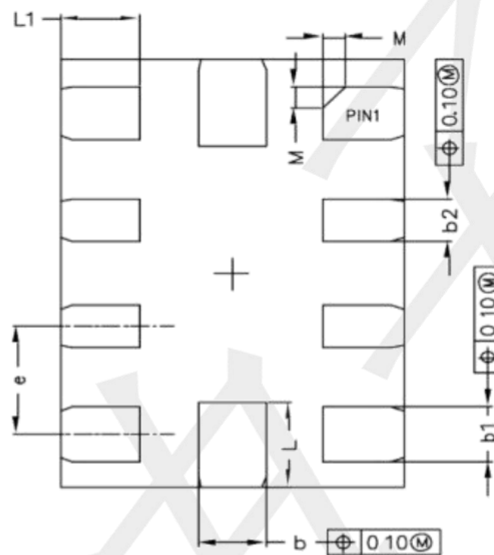
SEL	$\overline{\text{OE}}$	SWITCH STATUS
X	High	Both USB and MHL switches in High-Z
Low	Low	D+/D- to USB+/USB-
High	Low	D+/D- to MHL+/MHL-

Package information (unit: mm)

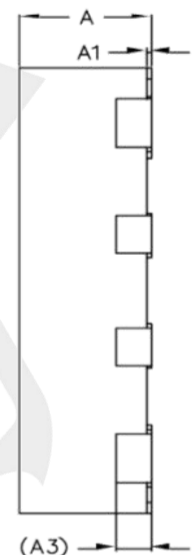
QFN2X1.5-10



TOP VIEW

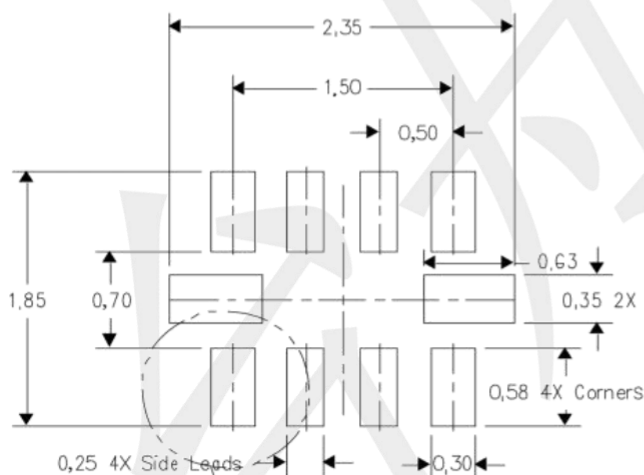


BOTTOM VIEW



SIDE VIEW

Mounting Pad Layout (unit: mm)



COMMON DIMENSIONS (UNITS OF MEASURE=MILLIMETER)			
Symbol	MIN	NOM	MAX
A	0.50	0.55	0.60
A1	0	0.02	0.05
A3	0.152REF		
b	0.25	0.30	0.35
b1	0.20	0.25	0.30
b2	0.15	0.20	0.25
D	1.45	1.50	1.55
E	1.95	2.00	2.05
e	0.40	0.50	0.60
L	0.35	0.40	0.45
L1	0.30	0.35	0.40
M	0.10REF		