

## Dual 2:1 USB2.0 Mux/De-Mux With DC 30V Over-Voltage Protection

### DESCRIPTION

The FSW7227 is a bidirectional low-power dual port, high-speed, USB 2.0 analog switch with integrated protection for USB Type-C™ systems. The device is configured as a dual 2:1 or 1:2 switch. It is optimized for use with the USB 2.0 DP/DM lines in a USB Type-C™ system.

The FSW7227 integrated over-voltage protection on the C0+/- pins can withstand up to DC 30V with automatic shutoff circuitry in order to protect system components behind the switch. GPIO controls of SEL and  $\overline{\text{EN}}$  are 1.8V logic compatible.

The FSW7227 is available in UQFN 1.4x.18-10L and MSOP10 with Pb-free and Halogen-free making it a perfect candidate for mobile and space constrained applications.

### FEATURES

- Supply Range 2.5 V to 5.5 V
- Differential 2:1 or 1:2 Switch/Multiplexer
- Up to DC 30V Overvoltage Protection (OVP) on C0+/- Ports
- IEC 64000-4-5 Surge Protection w/o External TVS onto C0+/- Ports:  $\pm 30\text{V}$
- System Side Clamp Voltage Pulse Less than 9V, Duration Less than 200ns
- Powered Off Protection When VDD = 0 V
- Low R<sub>ON</sub> of 10  $\Omega$  Typical
- Insertion loss: -1dB@200MHz, -2dB@650MHz, -3dB@1GHz
- C<sub>ON</sub> of 4.8 pF
- 1.8-V Compatible Logic Inputs Standard Temperature Range of -40°C to 85°C

### APPLICATIONS

- Anywhere a USB Type-C™ or Micro-B Connector is Used
- USB 2.0 Signal Routing
- Digital Cameras and Camcorders
- Portable Instrumentation
- Set-Top Box
- PADS the withstand USB devices
- Mobile Phones, Tablets and Notebooks

## ORDER INFORMATION

Model	Package	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKING OPTION
FSW7227	UQFN 1.4x1.8-10L	-40°C to +85°C	FSW7227YUWQ10G/TR	Tape and Reel, 3000
	MSOP10	-40°C to +85°C	FSW7227YMS10G/TR	Tape and Reel, 3000

## PIN CONFIGURATION

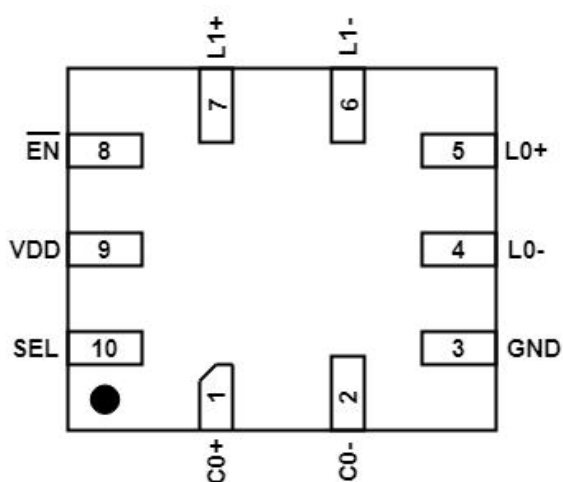


Figure 1. UQFN 1.4x1.8-10L

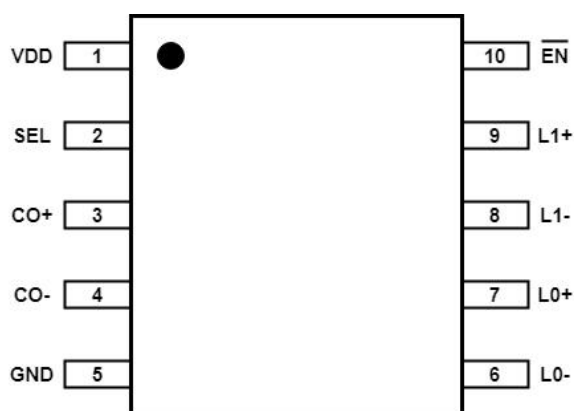


Figure 2. MSOP10

## PIN DESCRIPTION

UQFN1.4x1.8-10L	MSOP10	Pin Name	Signal Type	Description
1	3	C0+	I/O	Signal I/O, Common Port
2	4	C0-	I/O	Signal I/O, Common Port
7	9	L1+	I/O	Signal I/O, Channle 1
6	8	L1-	I/O	Signal I/O, Channle 1
5	7	L0+	I/O	Signal I/O, Channle 0
4	6	L0-	I/O	Signal I/O, Channle 0
10	2	SEL	I	Operation Model Select (when SEL=0: C0→L0, when SEL=1: C0→L1)
8	10	_EN	I	_EN=1, Power Down is Enabled
9	1	VDD	PWR	Positive Supply Voltage
3	5	GND	GND	Power Ground

## TRUTH TABLE

Function	SEL	_EN
C0+/- to L0+/-	L	L
C0+/- to L1+/-	H	L
All Switches Hi-Z	X	H

## Typical Application

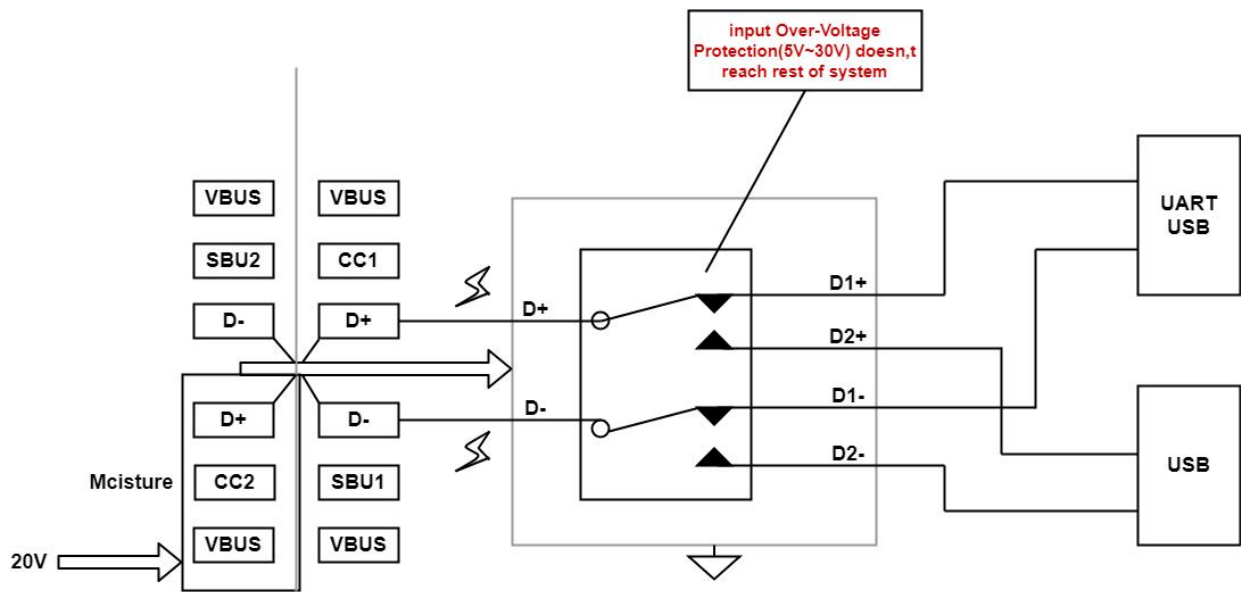


Figure 3. FSW7227 Application circuit

In addition, considering the power consumption requirements of portable products, FSW7227 is designed to minimize static power consumption. As shown in Figure 5 below, FSW7227 integrates pull-down resistance up to 6 MΩ on both SEL and / OE pins. The weak pull-down resistance on the SEL pin saves power and ensures that channel 1 is opened in the default state, and the weak pull-down resistance on the OE pins ensures that the chip can work after power on.

**FUNCTIONAL DIAGRAM**

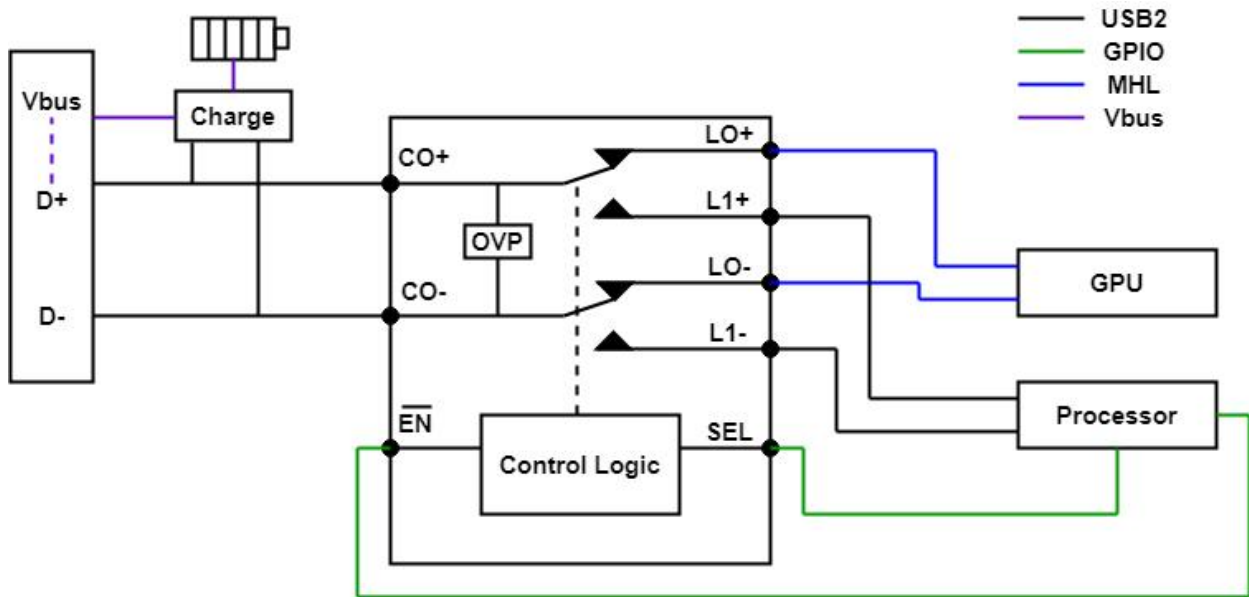


Figure 4. Function Diagram

FSW7227 Is a high-speed, low-power double knife / double throw (DPDT) analog switch with 30V overvoltage protection function, supporting power supply from 2.5V to 5.5V. FSW7227 Designed to switch high-speed USB 2.0 signals in handheld devices (such as mobile phones, digital cameras, and laptops, with hubs or controllers).

Overvoltage protection capability.As shown in Figure 5 below, FSW7227 has a special overvoltage protection circuit on the D + / D-pin. When the USB device is powered off or powered on, this circuit allows the device to withstand the Vbus short circuit to D + or D-up to 30V, ensuring that it is not damaged, and isolating the high voltage from the downstream circuit to protect the downstream circuit.The integration of the OVP circuit into the switch chip also greatly simplifies the design and reduces the size of the solution, solving the pain points in the practical applications of the designers. Please refer to the figure below.

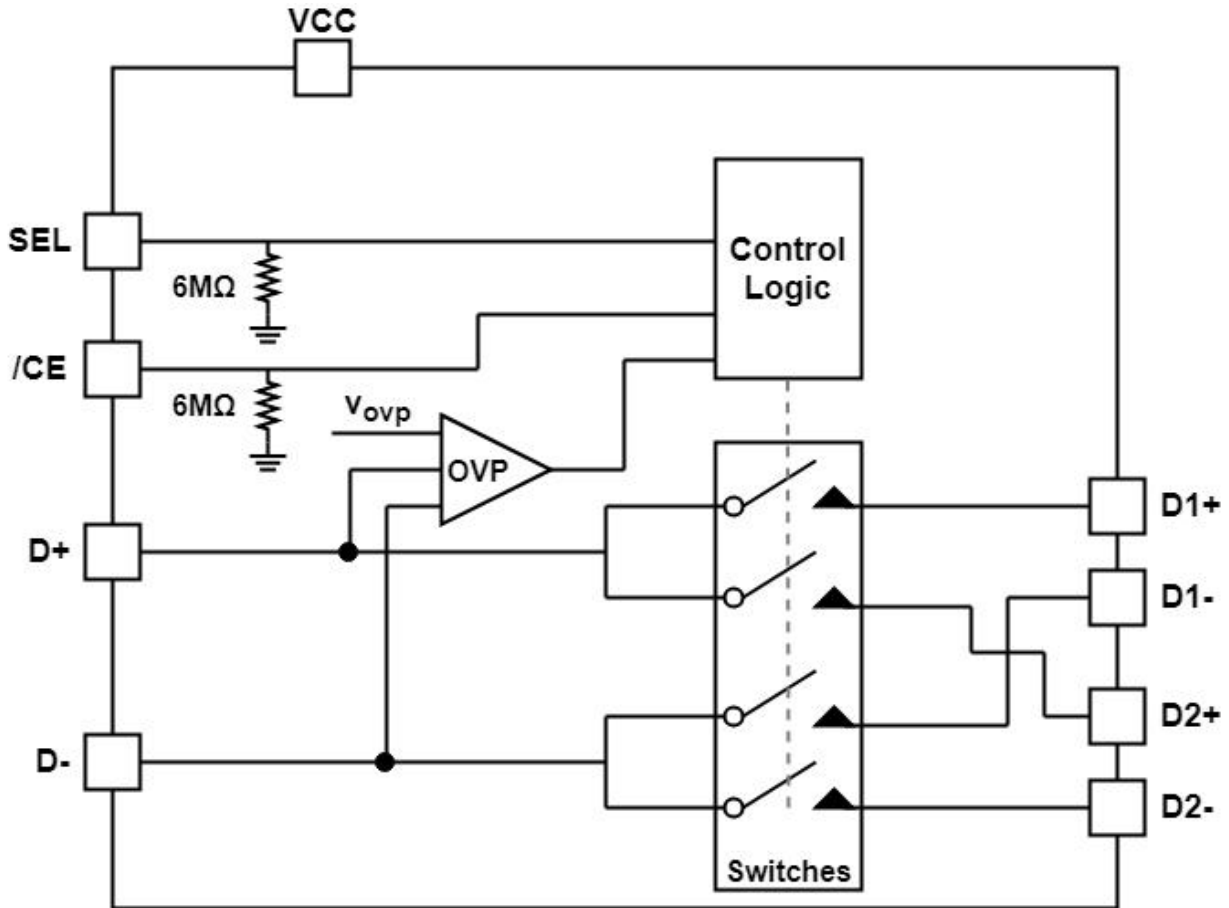
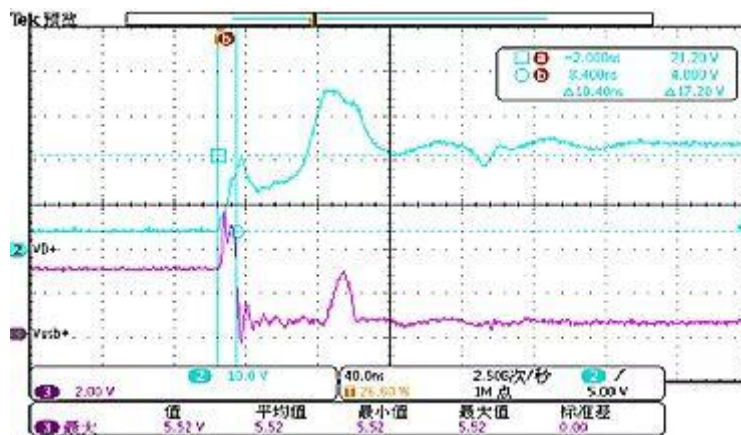


Figure 5. Internal function diagram

As shown in Figure 6 below, when the voltage on the data line is too high, the OVP protection circuit inside FSW7227 starts to work, and the maximum voltage is as high as 5.5V, OVP responds, and the response speed is very fast, the average response time is 10.4nS, which can quickly disconnect, and protect the internal circuit from being damaged by high voltage loading.

Vcc=3.3V Full bandwidth VD=4.0-21V USB Load=50ohm Cusb += 5 pF



The maximum of 5.5V OVP response time was 10.4nS

Figure 6. FSW7227 High-pressure test

## ELECTRICAL CHARACTERISTICS

( $T_A=25^\circ\text{C}$ ,  $V_{DD}=3.3\text{V}$ , unless otherwise specified)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
<b>POWER SUPPLY</b>						
Supply Voltage Range	VDD		2.5	3.3	5.5	V
Supply Current	I <sub>CC</sub>	$\text{\_EN}=1$ disconnection		0.6	2	uA
		$\text{\_EN}=0$ connection		33		uA
<b>SEL/\_EN DIGITAL INPUT CONTROL</b>						
control input logic high	V <sub>IH</sub>		1.6		5.5	V
control input logic low	V <sub>IL</sub>		-0.1		0.5	V
Internal pull-down resistor	R <sub>PD</sub>			2		MΩ
<b>SWITCH ON RESISTANCE AND OFF LEAKAGE</b>						
On-Resistance	R <sub>ON</sub>	V <sub>IS</sub> = 0V~0.4V I <sub>OUT</sub> =8mA		10	11	Ω
R <sub>ON</sub> Flatness <sup>(1)</sup>	R <sub>FLAT</sub>	V <sub>IS</sub> = 0V~0.4V I <sub>OUT</sub> =8mA		0.3	0.5	Ω
R <sub>ON</sub> Matching Between Channels <sup>(2)</sup>	ΔR <sub>ON</sub>	V <sub>IS</sub> = 0V~0.4V I <sub>OUT</sub> =8mA		0.1	0.2	Ω
OFF Leakage Current	I <sub>LEAK</sub>	V <sub>C0+/-</sub> = 10V V <sub>L1+/-</sub> = V <sub>D2+/-</sub> =0V		31	50	uA
<b>SWITCH DYNAMICS</b>						
On Capacitance	C <sub>ON</sub>	V <sub>C0+/-</sub> = 0.2V, f = 1MHz		4		pF
Off Capacitance	C <sub>OFF</sub>	V <sub>C0+/-</sub> = 0.2V, f = 1MHz		3		pF
Off Isolation	Off	f = 250MHz, R <sub>T</sub> = 50Ω , C <sub>L</sub> = 0pF		-38		dB
Crosstalk <sup>(3)</sup> (Channel-to-Channel)	X <sub>TALK</sub>	f = 250MHz, R <sub>T</sub> = 50Ω , C <sub>L</sub> = 0pF		-41		dB
-3dB Bandwidth	BW	R <sub>T</sub> =50 Ω , C <sub>L</sub> =0pF Signal Power 0dBm	0.9	1		GHz
Break-Before-Make	BBM	V <sub>L1+/-</sub> = V <sub>D2+/-</sub> = 0.4V, R <sub>L</sub> =50Ω		1.5		uS
Turn-on Time	t <sub>ON</sub>	V <sub>C0+/-</sub> = 0.4V, R <sub>L</sub> =50Ω $\text{\_EN}$ switches from High to Low		20		uS
Turn-off Time	t <sub>OFF</sub>	V <sub>C0+/-</sub> = 0.4V, R <sub>L</sub> =50Ω $\text{\_EN}$ switches from Low to High		1.2		uS
Propagation Delay	t <sub>PD</sub>	V <sub>C0+/-</sub> = 0.4V, R <sub>L</sub> =50Ω		200		pS
<b>OVER VOLTAGE PROTECTION</b>						
OVP Lockout Threshold	V <sub>OVP</sub>	V <sub>C0+/-</sub> Rising Edge	4.6	4.9	5.2	V
OVP Hysteresis	V <sub>HYS</sub>	V <sub>C0+/-</sub> Falling Edge		200		mV
Clamp Voltage on L1+/- and D2+/-	V <sub>CLAMP</sub>	10V shorts to C0+/- with R <sub>L</sub> =1KΩ @ L1+/- and D2+/-		6.5	8	V
OVP Response Time	t <sub>FP</sub>	10V shorts to C0+/- with R <sub>L</sub> =1KΩ @ L1+/- and D2+/-		200	300	nS
OVP Recovery Time	t <sub>FPR</sub>	V <sub>C0+/-</sub> jumps from 6V to 1V step	30	45	60	uS

Note:

- (1) Flatness is defined as the difference between maximum and minimum value of ON-resistance at the specified analog signal voltage points.
- (2)  $R_{ON}$  matching between channels is calculated by subtracting the channel with the lowest max  $R_{ON}$  value from the channel with the highest max  $R_{ON}$  value.
- (3) Crosstalk is inversely proportional to source impedance

## TYPICAL PERFORMANCE CURVES

$T_A=25^{\circ}\text{C}$ ,  $V_{DD}=3.0\text{V}$ ,  $CAP=0.1\mu\text{F}$ , unless otherwise noted

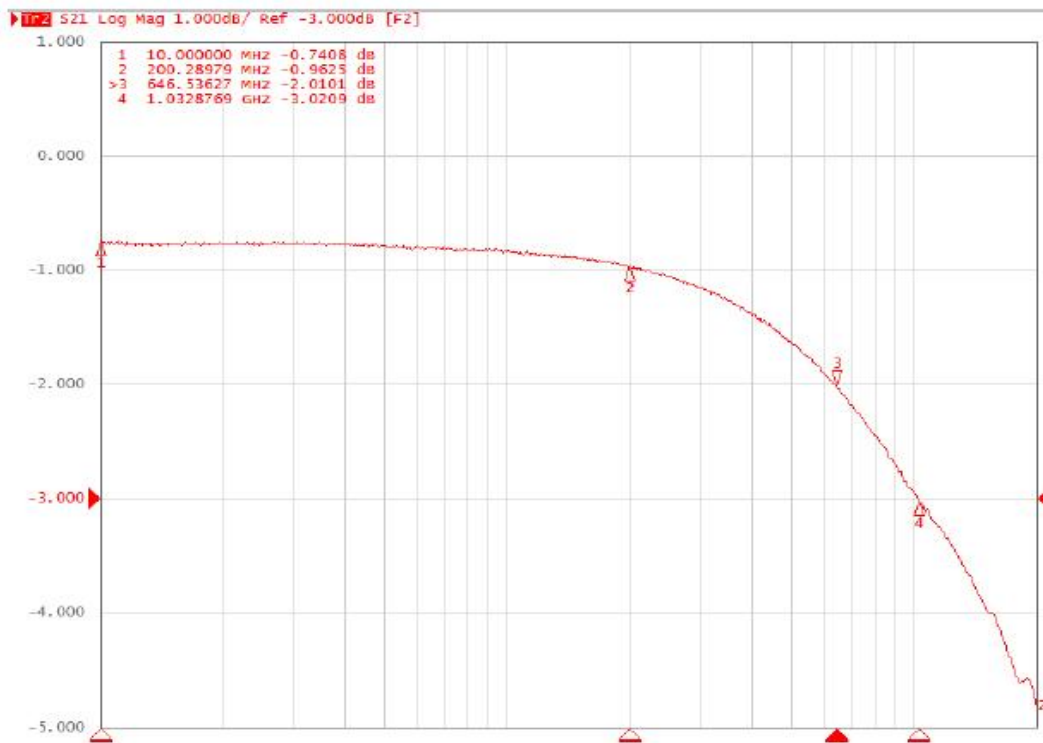


Fig 7. Switch Bandwidth or Insertion Loss

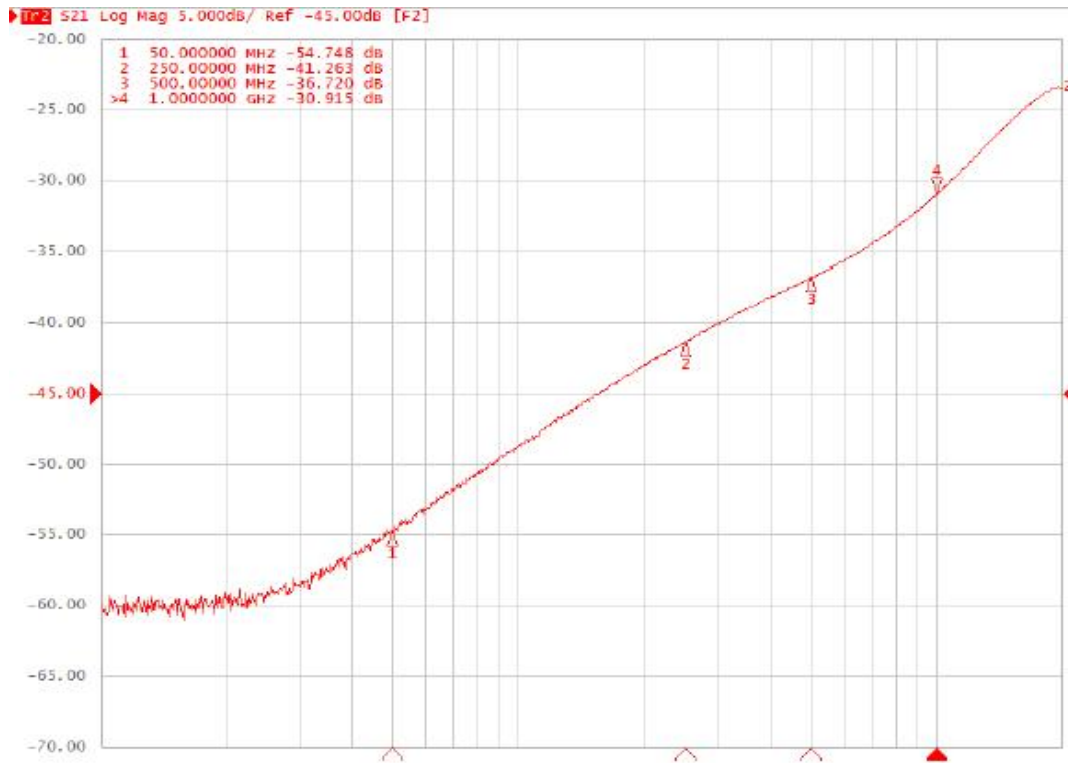


Fig 8. Switch Channel to Channel Cross-Talk

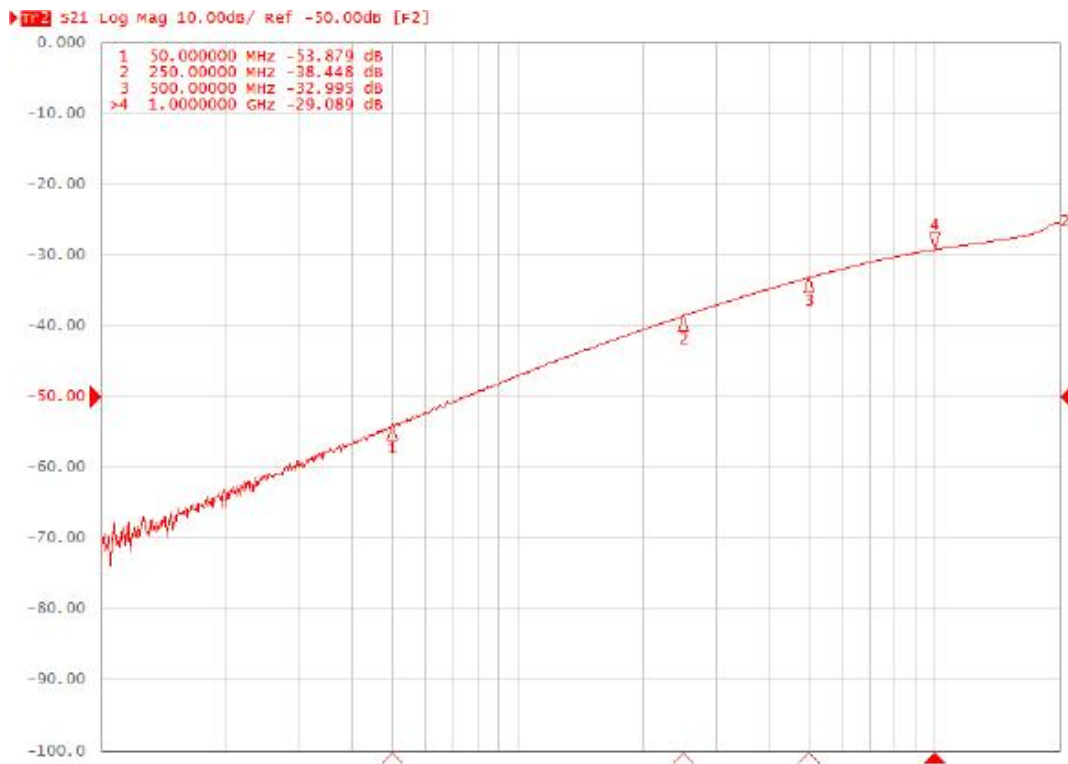
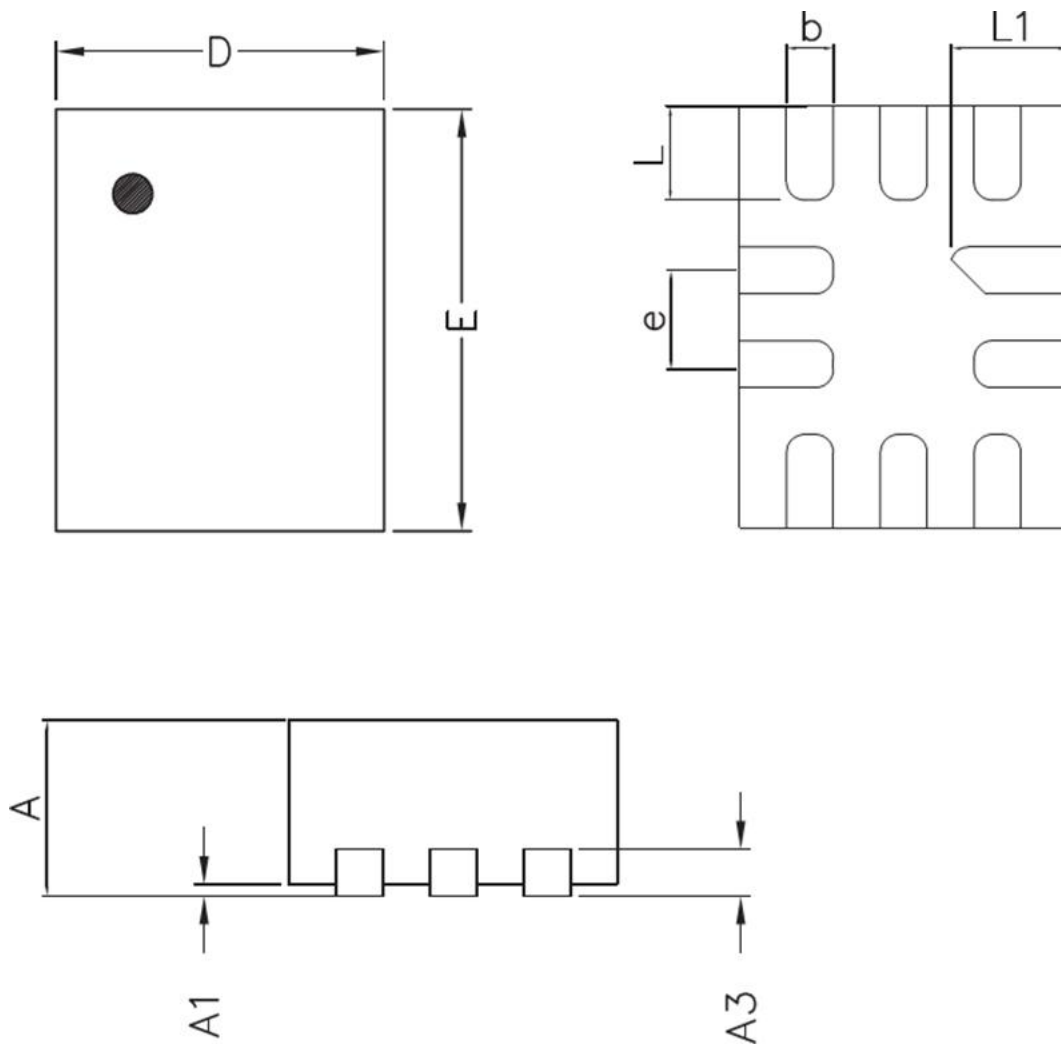


Fig 9. Switch Off Isolation



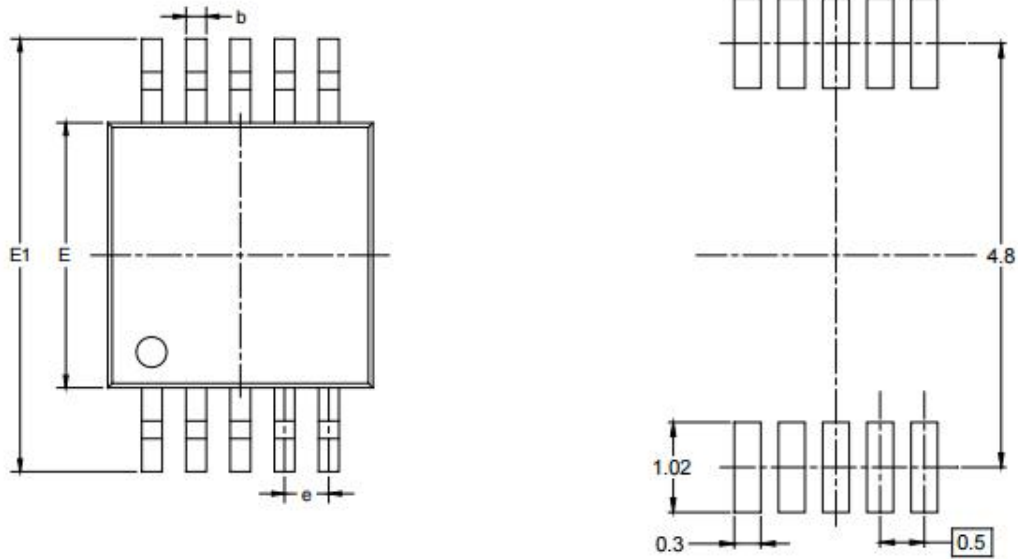
## PACKAGE OUTLIHNE DIMENSIONS(All dimensions in mm.)

(1) Package Type: UQFN 1.4x1.8 -10L

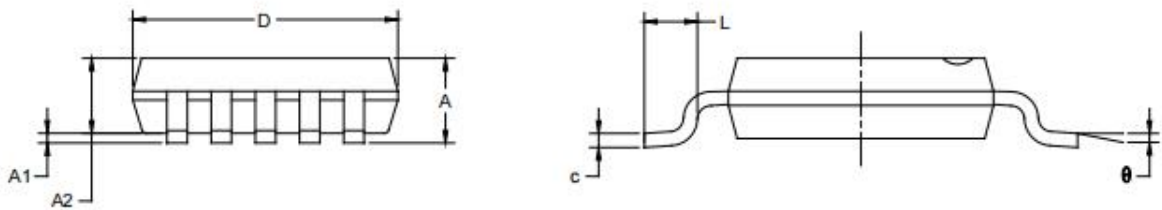


Symbol	Dimension in Millimeters	
	Min.	Max.
A	0.450	0.550
A1	0.000	0.050
A3	0.152 Ref.	
D	1.350	1.450
E	1.750	1.850
b	0.150	0.250
e	0.400 Typ.	
L	0.350	0.450
L1	0.450	0.550

(2) Package Type: MSOP10



RECOMMENDED LAND PATTERN (Unit: mm)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.180	0.280	0.007	0.011
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.500BSC		0.020BSC	
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°