Low-Power, USB 2.0 High-Speed Switch

Features

- Super high bandwidth (-3 dB): 2.0 GHz
- VCC operation at 2.7 V to 5.5 V
- Low C_{ON}: 5 pF (typ.)
- Low R_{ON}: 5.5 Ω (typ.)
- Low power consumption: 1 μA (max.)
- Low I_{CCT} : 0.36 μA (typ.) at V_{CNTRL} = 1.8 V, V_{CC} = 3.6 V
- ±6 kV HBM ESD on all pins
- Power-Off/On protection on common ports

Applications

- Cell-phone/PDA
- MP3/MP4/PMP
- STB/LCDTV

Package Information

Part Number	Package	Body Size
DIO32221	QFN10	2.0 mm × 1.5 mm
	QFN10	1.8 mm × 1.4 mm
	MSOP10	3.0 mm × 3.0 mm

Description

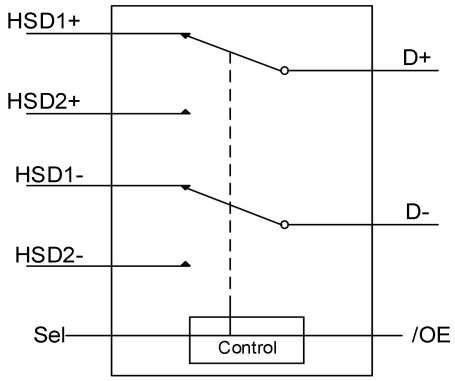
The DIO32221 is a low-power, dual SPDT 2-port high-speed analog switch. It handles bi-directional signal flow optimized for switching a high-speed (480 Mbps) source or a full-speed (12 Mbps) source.

The DIO32221 has high channel-to-channel noise isolation and low bit-to-bit skew which allows it to pass high-speed differential signals with good signal integrity. Each switch offers little or no attenuation of the high-speed signals at the outputs.

The DIO32221 contains special circuitry on the D+/D- pins, which can tolerate up to 5.5 V when the USB devices are either powered off or powered on.

The DIO32221 is available in three types of Green packages: QFN2.0×1.5-10, QFN1.8×1.4-10, and MSOP-10.

Simplified Schematic



Ordering Information

Ordering Part No.	Top Marking	MSL	RoHS	T_A	Package	
DIO32221MP10	DCBB2A	3	Green	-40 to 85°C	MSOP-10	Tape & Reel, 3000
DIO32221LP10	YW6A	1	Green	-40 to 85°C	QFN 1.8×1.4-10	Tape & Reel, 3000
DIO32221QN10	YW6A	1	Green	-40 to 85°C	QFN 2.0×1.5-10	Tape & Reel, 3000

If you encounter any issue in the process of using the device, please contact our customer service at marketing@dioo.com or phone us at (+86)-21-62116882. If you have any improvement suggestions regarding the datasheet, we encourage you to contact our technical writing team at docs@dioo.com. Your feedback is invaluable for us to provide a better user experience.

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1. Pin Assignment and Functions

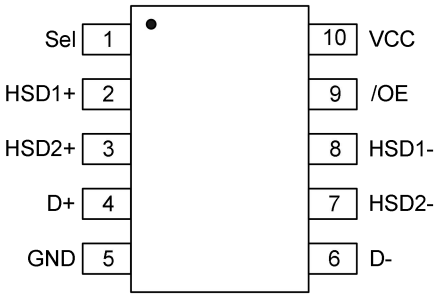


Figure 1. MSOP-10 (Top view)

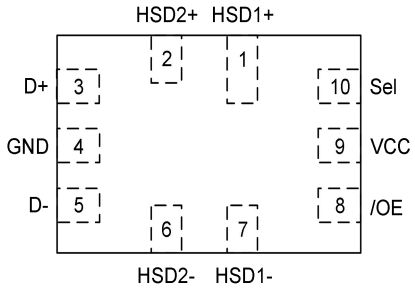


Figure 2. QFN1.8×1.4-10 (Top view)

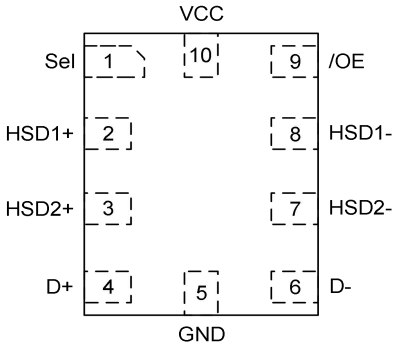


Figure 3. QFN 2.0×1.5-10 (Top view)

Table 1. Pin descriptions

Pin Name	Description
/OE	Switch enable
Sel	Switch select
D+, D-	USB data bus
HSD1±, HSD2±	Multiplexed source inputs
VCC	Power supply
GND	Ground

Table 2. Truth table

Sel	/OE	Function
X	H	Disconnect
L	L	D+, D- = HSD1+, HSD1-
H	L	D+, D- = HSD2+, HSD2-

2. Absolute Maximum Ratings

Exceeding the maximum ratings listed under Absolute Maximum Ratings when designing is likely to damage the device permanently. Do not design to the maximum limits because long-time exposure to them might impact the device's reliability. The ratings are obtained over an operating free-air temperature range unless otherwise specified.

Symbol	Parameter	Min	Max	Unit
V_{CC}	Supply voltage	-0.3	6.0	V
V_{CNTRL}	DC input voltage (Sel, /OE)	-0.3	V_{CC}	V
V_{SW}	DC input I/O voltage	-0.3	V_{CC} + 0.3	V
	DC input I/O voltage (D+/D-)	-0.3	V_{CC} + 0.3	V
I_{IK}	DC input diode current	-50		mA
I_{OUT}	DC output current		50	mA
T_{STG}	Storage temperature	-65	150	°C

3. Recommended Operating Conditions

Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. The ratings are obtained over an operating free-air temperature range unless otherwise specified.

Symbol	Parameter	Min	Max	Unit
V_{CC}	Supply voltage	2.7	5.5	V
V_{CNTRL}	Control input voltage (Sel, /OE)	0	Vcc	V
V_{SW}	Switch I/O voltage (HSD1±, HSD2±)	0	Vcc	V
	Switch I/O voltage (D+, D-)	0	V_{CC}	V
T_A	Operating temperature	-40	85	°C

4. ESD Ratings

When a statically-charged person or object touches an electrostatic discharge sensitive device, the electrostatic charge might be drained through sensitive circuitry in the device. If the electrostatic discharge possesses sufficient energy, damage might occur to the device due to localized overheating.

Model	Condition	Value	Unit
HBM	ESDA/JEDEC JS-001, all pins	±6	kV

5. DC Electrical Characteristics

All typical value are at T_A = 25°C, unless otherwise specified.

Symbol	Parameter	Conditions	V_{CC} (V)	Min	Typ	Max	Unit
V_{IH}	Input voltage high		3.0 to 3.6	0.85			V
V_{IL}	Input voltage low		3.0 to 3.6			0.35	V
I_{IN}	Control input leakage	V_{SW} = 0 to V_{CC}	3.6	-1		1	µA
I_{OZ}	Off state leakage	0 ≤ Dn, HSD1±, HSD2± ≤ 3.6 V	3.6	-1		1	µA
I_{OFF}	Power-off leakage current (All common ports)	V_{SW} = 0 V to 3.6 V, V_{CC} = 0 V, see Figure 11	0	-1		1	µA
R_{ON}	HS switch on resistance	V_{SW} = 0.4 V, I_{ON} = 8 mA, see Figure 10	3.3		5.5	8	Ω
ΔR_{ON}	HS delta R_{ON}	V_{SW} = 0.4 V, I_{ON} = 8 mA	3.3		0.1		Ω
I_{CC}	Quiescent supply current	V_{CNTRL} = 0 or V_{CC}	3.6		0.4	1	µA
I_{CCT}	Increase in I_{CC} current per control voltage and V_{CC}	V_{CNTRL} = 2.6 V, V_{CC} = 3.6 V	3.6		0.48	1	µA
		V_{CNTRL} = 1.8 V, V_{CC} = 3.6 V	3.6		0.36	1	µA

Note:

(1) Specifications subject to change without notice.

6. AC Electrical Characteristics

All typical value are for V_{CC} = 3.3 V at 25°C, unless otherwise specified.

Symbol	Parameter	Conditions	V_{CC} (V)	Temp	Min	Typ	Max	Unit
t_{ON}	Turn-on time Sel, /OE to output	R_L = 50 Ω, C_L = 5 pF, V_{SW} = 0.8 V, see Figure 17	3.0 to 3.6	full		3.0		µs
t_{OFF}	Turn-off time Sel, /OE to output	R_L = 50 Ω, C_L = 5 pF, V_{SW} = 0.8 V, see Figure 17	3.0 to 3.6	full		13		ns
t_{PD}	Propagation delay	R_L = 50 Ω, C_L = 5 pF	3.3	25°C		0.25		ns
				full			5.0	ns
t_{BBM}	Break-before-make	R_L = 50 Ω, C_L = 5 pF, V_{SW} = 0.8 V, see Figure 16	3.0 to 3.6	25°C		18		ns
				full	10		100	ns
O_{IRR}	Off isolation	R_L = 50 Ω, f = 240 MHz, see Figure 15	3.0 to 3.6	25°C		-37		dB
X_{TALK}	Non-adjacent channel crosstalk	R_L = 50 Ω, f = 240 MHz, see Figure 14	3.0 to 3.6	25°C		-55		dB

BW	-3dB bandwidth	R_L = 50 Ω, C_L = 0 pF, see Figure 13	3.0 to 3.6	25°C		2000		MHz
$t_{SK(P)}$(1)	Skew of opposite transitions of the same output	R_L = 50 Ω, C_L = 5 pF	3.0 to 3.6	25°C		20		ps

Note:

(1) Guaranteed by design.

(2) Specifications subject to change without notice.

7. Capacitance

Symbol	Parameter	Conditions	Temp	Min	Typ	Max	Unit
C_{IN}	Control pin input capacitance	V_{CC} = 0 V	25°C		1.2		pF
C_{ON}	D+/D- on capacitance	V_{CC} = 3.3 V, /OE = 0 V, f = 240 MHz, see Figure 12	25°C		5		
C_{OFF}	HSD1±, HSD2± off capacitance	V_{CC} and /OE = 3.3 V, see Figure 12	25°C		2		

Note:

(1) Specifications subject to change without notice.

8. Typical Characteristics

T_A = 25°C, V_{CC} = 3.6 V, unless other otherwise specified.

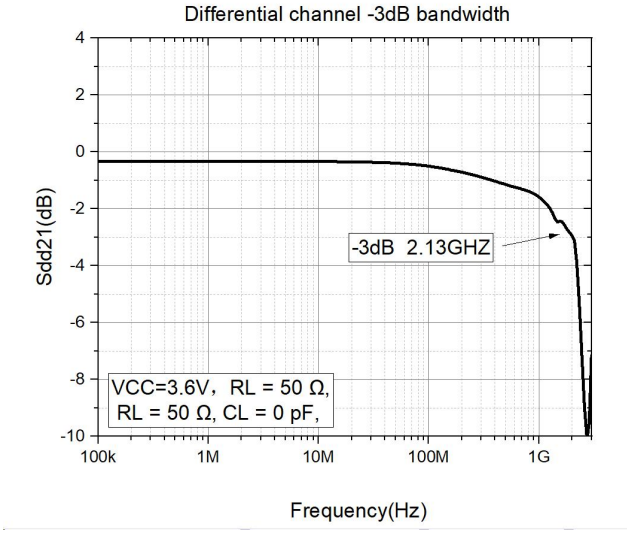
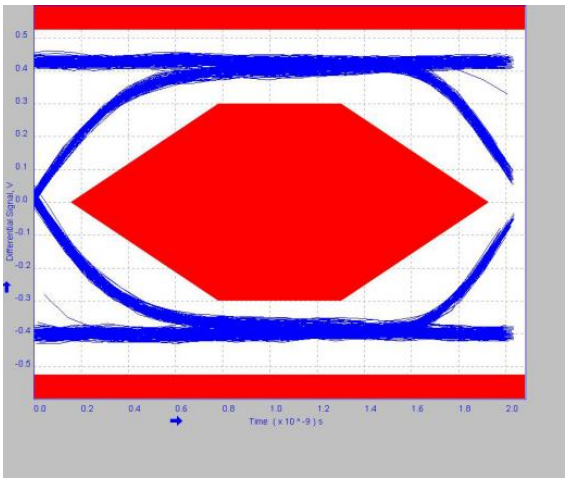


Figure 4. -3 dB bandwidth vs. Frequency



TIME SCALE (0.2 ns/DIV)

Figure 5. Eye pattern: 480 Mbps with USB switch in signal path

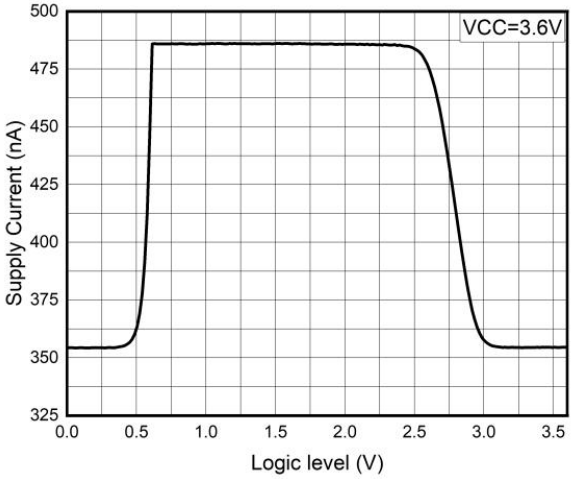


Figure 6. Supply current vs. Logic level

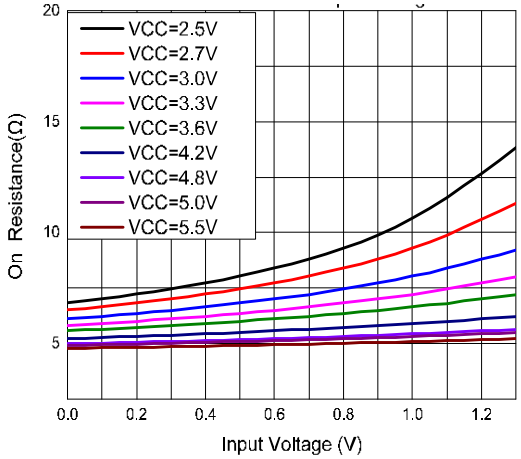


Figure 7. On resistance vs. Input voltage

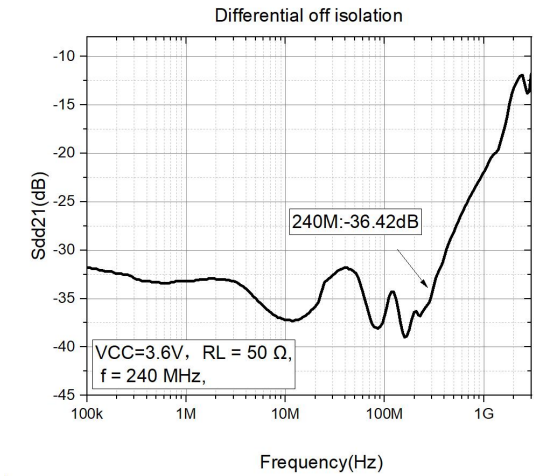


Figure 8. Off-isolation vs. Frequency

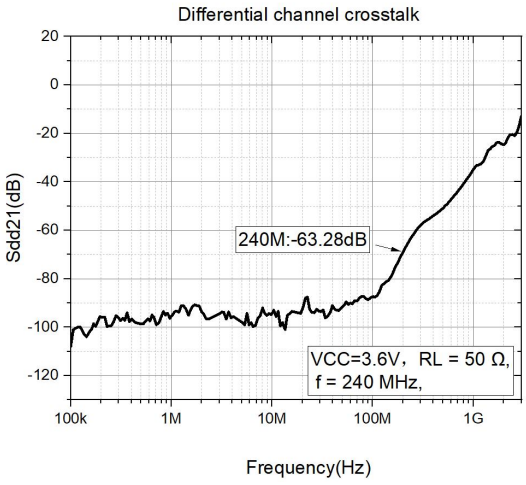


Figure 9. Crosstalk vs. Frequency

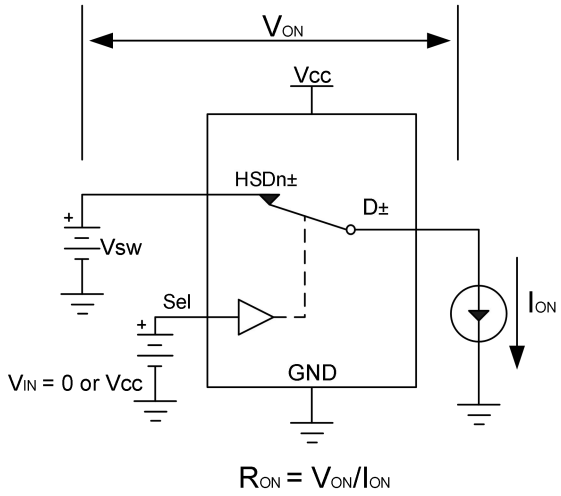


Figure 10. Switch on resistor

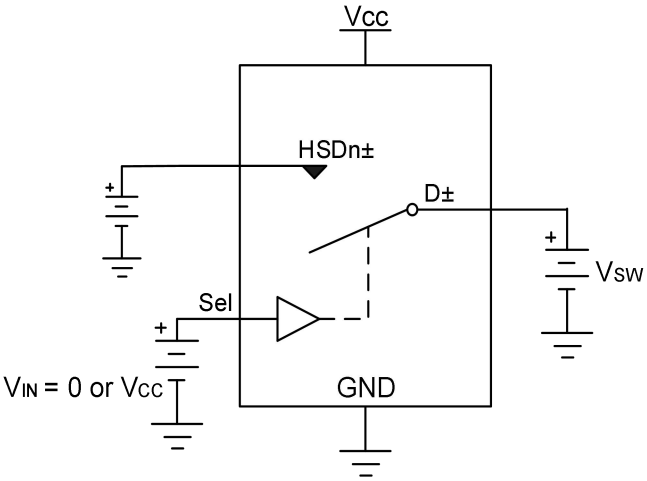


Figure 11. Switch off leakage

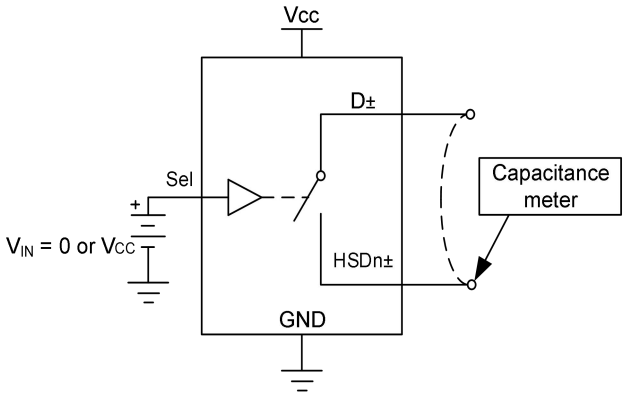


Figure 12. Channel on/off capacitance

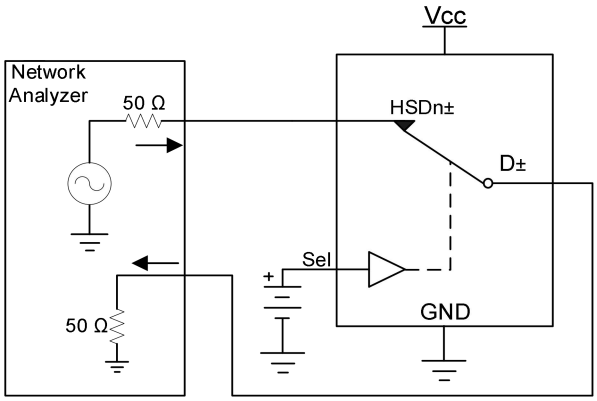


Figure 13. Bandwidth

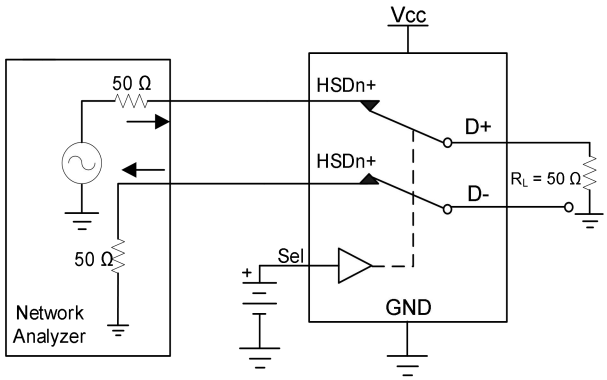


Figure 14. Channel-to-channel crosstalk

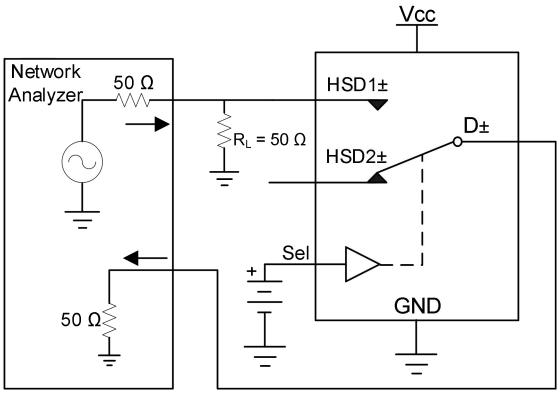


Figure 15. Off-isolation

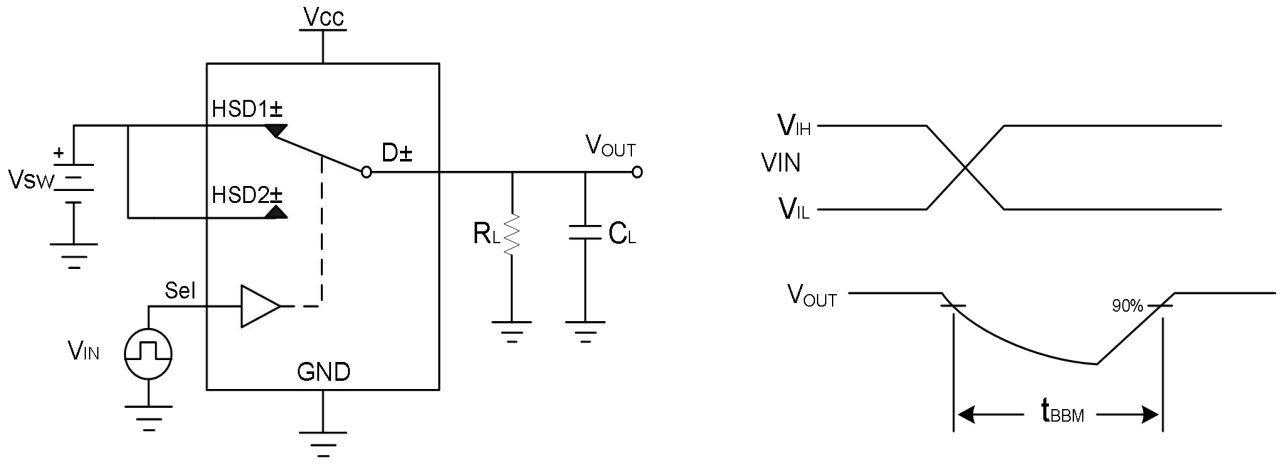


Figure 16. Break-before-make

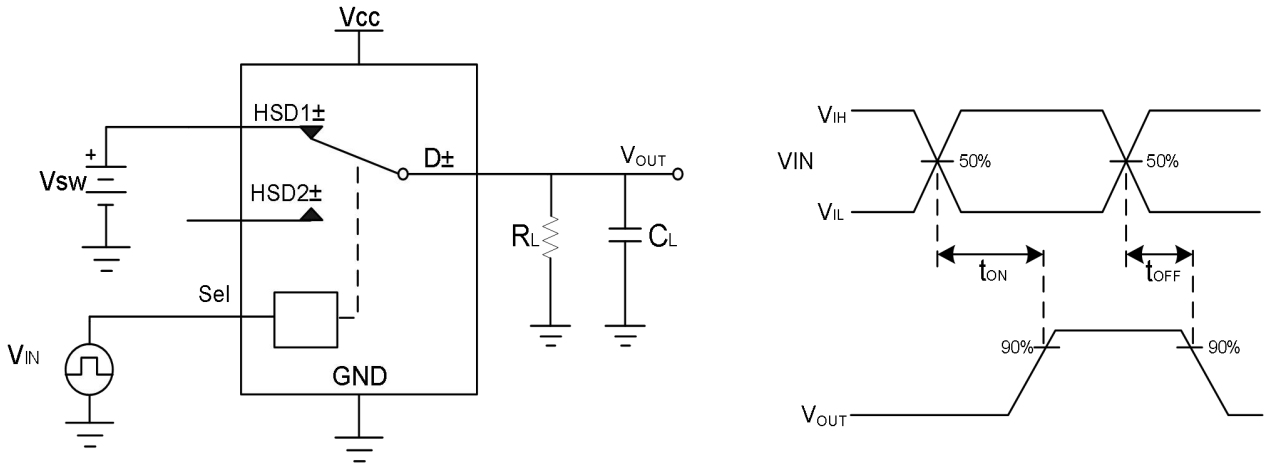
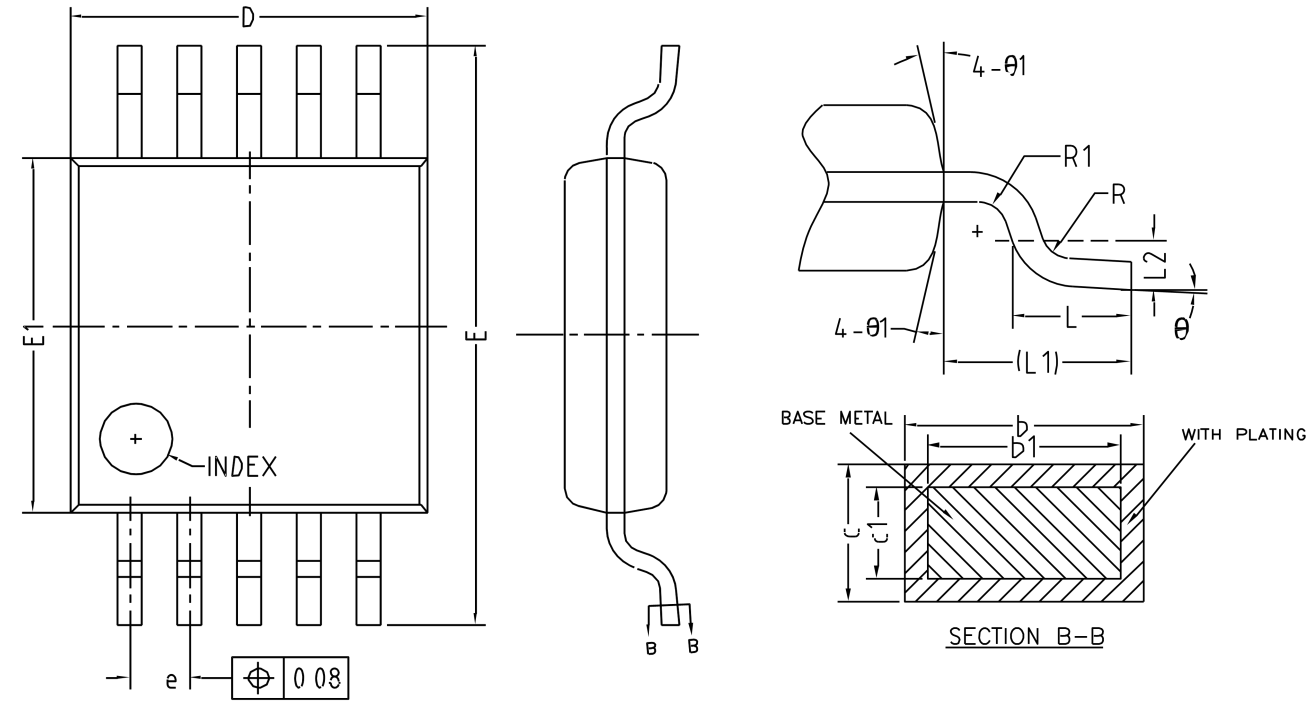
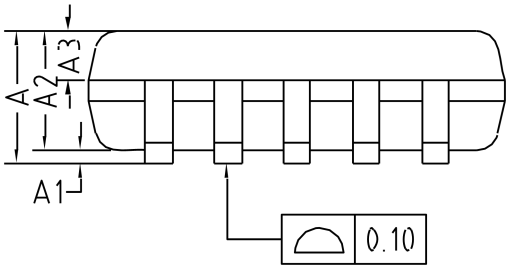


Figure 17. Turn-on/Turn-off

9. Physical Dimensions

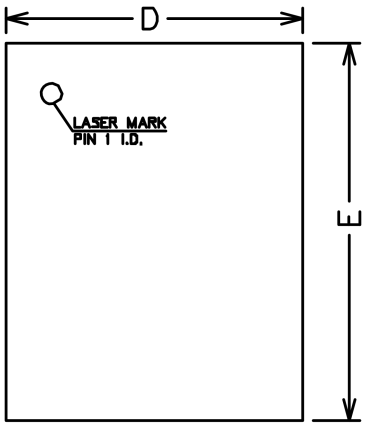
9.1. MSOP-10



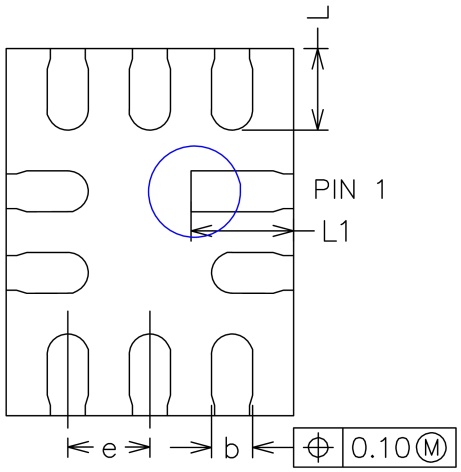


Common Dimensions (Units of measure = Millimeter)			
Symbol	**Min**	**Typ**	**Max**
A	-	-	1.10
A1	0	-	0.15
A2	0.75	0.85	0.95
A3	0.25	0.35	0.39
b	0.18	-	0.27
b1	0.17	0.20	0.23
c	0.15	-	0.20
c1	0.14	0.15	0.16
D	2.90	3.00	3.10
E	4.70	4.90	5.10
E1	2.90	3.00	3.10
e	0.40	0.50	0.60
L	0.40	0.60	0.80
L1	0.95 REF		
L2	0.25 BSC		
R	0.07	-	-
R1	0.07	-	-
Θ	0°	-	8°
Θ1	9°	12°	15°

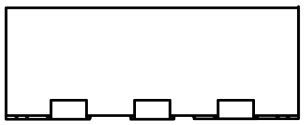
9.2. QFN 1.8×1.4-10



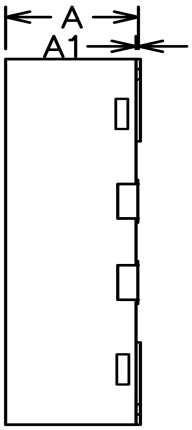
TOP VIEW



BOTTOM VIEW

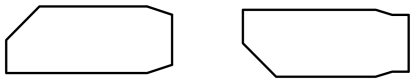


SIDE VIEW



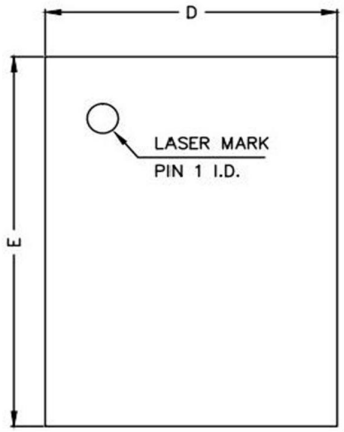
SIDE VIEW

Two options

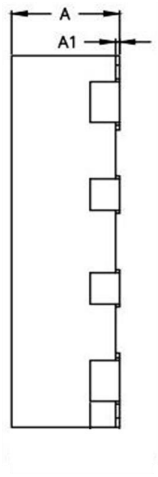


Common Dimensions (Units of Measure = Millimeter)			
Symbol	**Min**	**Nom**	**Max**
A	0.50	0.55	0.60
A1	0.00	0.02	0.05
b	0.15	0.20	0.25
D	1.30	1.40	1.50
E	1.70	1.80	1.90
e	0.30	0.40	0.50
L	0.35	0.40	0.45
L1	0.45	0.50	0.55

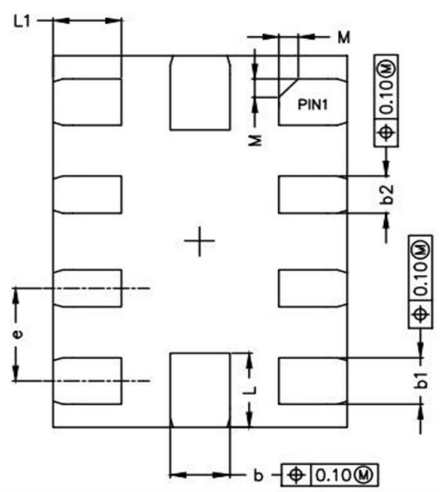
9.3. QFN 2.0×1.5-10



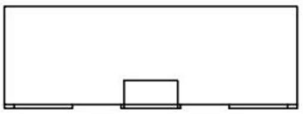
TOP VIEW



SIDE VIEW



BOTTOM VIEW



SIDE VIEW

Common Dimensions (Units of measure = Millimeter)			
Symbol	**Min**	**Nom**	**Max**
A	0.50	0.55	0.60
A1	0	0.02	0.05
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	0.10 REF		

Disclaimer

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