

DIO32221

Low-Power, USB 2.0 High-Speed Switch

Description

The DIO32221 is a low-power, dual SPDT2-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: QFN 2.0*1.5-10, QFN 1.8*1.4-10, and MSOP-10.

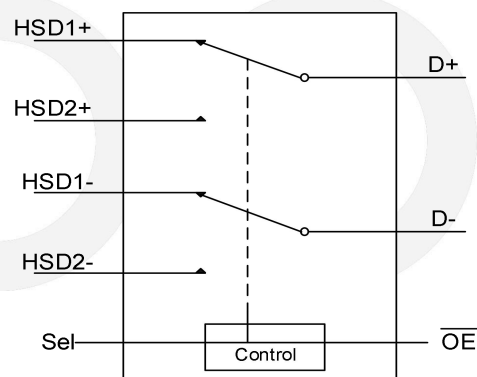
Features

- Super high bandwidth (-3 dB): 2.0 GHz
- V_{CC} 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 μ A (max.)
- Low I_{CCT} : 0.36 μ A (typ.) at $V_{IN} = 1.8$ V, $V_{CC} = 3.6$ V
- 6 kV HBM ESD on all pins
- Power-Off/On protection on common ports
- D+/D- pins tolerate up to 5.5 V
- Packaged in Green MSOP-10, QFN 1.8*1.4-10 and QFN 2.0*1.5-10

Applications

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

Block Diagram



■ Ordering Information

Part Number	Top Marking	RoHS	T _A	Package	
DIO32221MP10	DCBB2A	Green	-40 to 85°C	MSOP-10	Tape & Reel, 3000
DIO32221LP10	YW6A	Green	-40 to 85°C	QFN 1.8*1.4-10	Tape & Reel, 3000
DIO32221QN10	YW6A	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

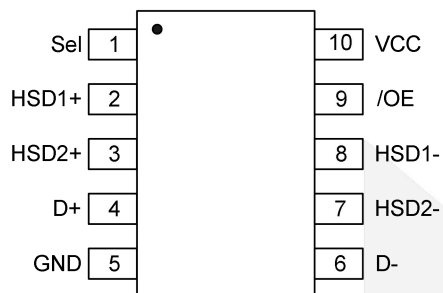


Figure 1. MSOP-10 (Top view)

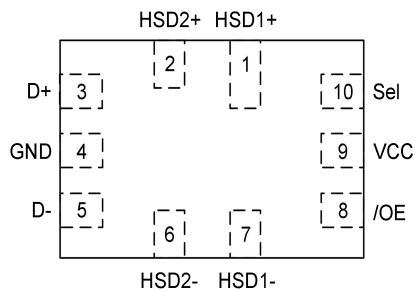


Figure 2. QFN1.8*1.4-10 (Top view)

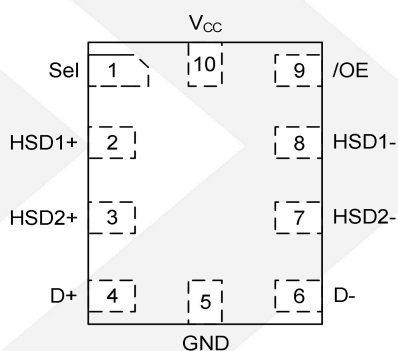


Figure 3. QFN 2.0*1.5-10 (Top view)

Table 1. Pin descriptions

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

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	6.0	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 Condition

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	V_{CC}	V
V_{SW}	Switch I/O voltage (HSD1±, HSD2±)	0	V_{CC}	V
	Switch I/O voltage (D+, D-)	0	5.5	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	Rating	Unit
ESD	HBM, JEDEC: JESD22-A114, all pins	±6	kV

5. DC Electrical Characteristics

All typical value are at $T_A = 25^\circ\text{C}$, 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	$0 \leq D_n, \text{HSD1}\pm, \text{HSD2}\pm \leq 3.6$ 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 $V_{CC} = 3.3\text{ V}$ at 25°C unless otherwise specified.

Symbol	Parameter	Conditions	V_{CC} (V)	Temp ($^\circ\text{C}$)	Min	Typ	Max	Unit
t_{ON}	Turn-on time Sel, /OE to output	$R_L = 50\ \Omega$, $C_L = 5\text{ pF}$, $V_{SW} = 0.8\text{ V}$, see Figure 17	3.0 to 3.6	full		3.0		μs
t_{OFF}	Turn-off time Sel, /OE to output	$R_L = 50\ \Omega$, $C_L = 5\text{ pF}$, $V_{SW} = 0.8\text{ V}$, see Figure 17	3.0 to 3.6	full		13		ns
t_{PD}	Propagation delay	$R_L = 50\ \Omega$, $C_L = 5\text{ pF}$	3.3	25°C		0.25		ns
				full			5.0	ns
t_{BBM}	Break-before-make	$R_L = 50\ \Omega$, $C_L = 5\text{ pF}$, $V_{SW} = 0.8\text{ V}$, see Figure 16	3.0 to 3.6	25°C		18		ns
				full	10		100	ns
OIRR	Off isolation	$R_L = 50\ \Omega$, $f = 240\text{ MHz}$, see Figure 15	3.0 to 3.6	25°C		-37		dB
Xtalk	Non-adjacent channel crosstalk	$R_L = 50\ \Omega$, $f = 240\text{ MHz}$, see Figure 14	3.0 to 3.6	25°C		-55		dB
BW	-3dB bandwidth	$R_L = 50\ \Omega$, $C_L = 0\text{ pF}$, see Figure 13	3.0 to 3.6	25°C		2000		MHz
$t_{SK(P)}^{(1)}$	Skew of opposite transitions of the same output	$R_L = 50\ \Omega$, $C_L = 5\text{ pF}$	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 ($^\circ\text{C}$)	Min	Typ	Max	Unit
C_{IN}	Control pin input capacitance	$V_{CC} = 0\text{ V}$	25°C		1.2		pF
C_{ON}	D+/D- on capacitance	$V_{CC} = 3.3\text{ V}$, /OE = 0 V, $f = 240\text{ MHz}$, see Figure 12	25°C		5		
C_{OFF}	HSD1 $\pm$, HSD2 $\pm$ 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 Performance Characteristics

$T_A = 25^\circ\text{C}$, $V_{CC} = 3.6\text{ V}$, unless otherwise specified.

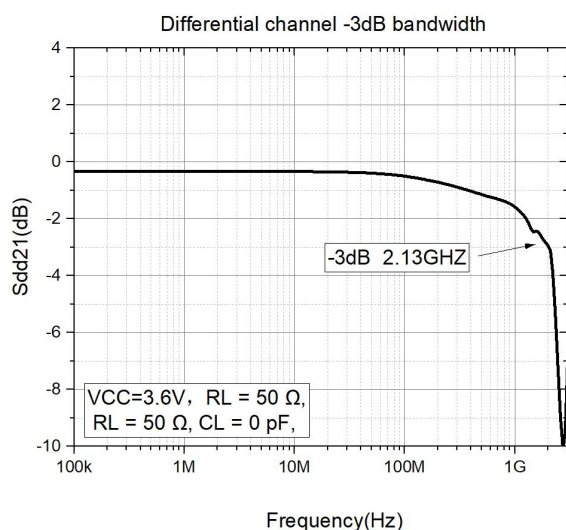
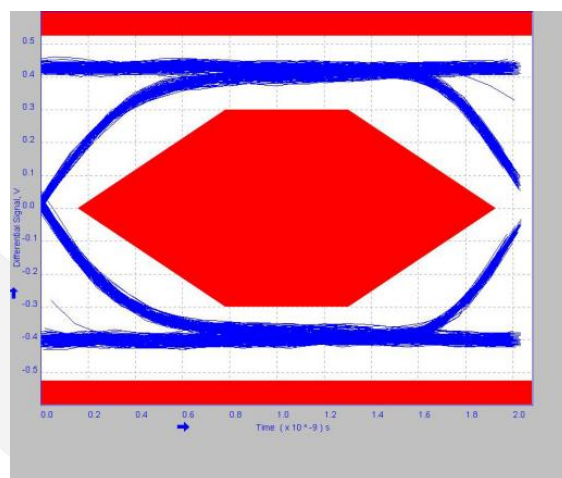


Figure 4. -3 dB bandwidth vs. frequency



TIME SCALE (0.2 ns/DIV)

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

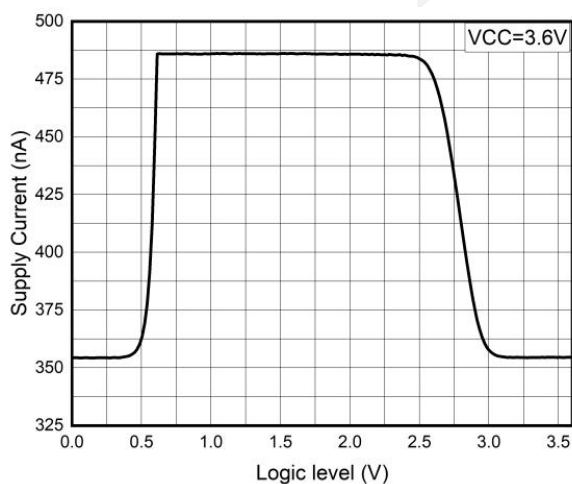


Figure 6. Supply current vs. logic level

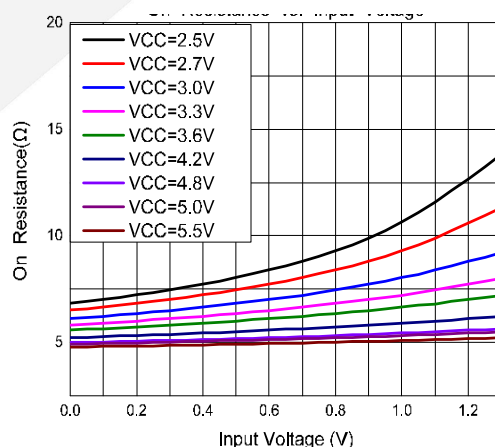


Figure 7. On resistance vs. input voltage

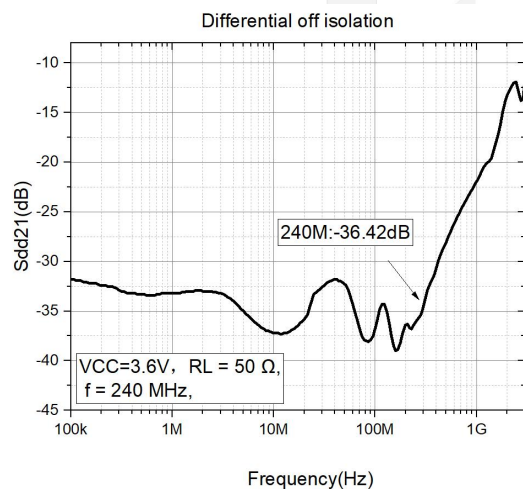


Figure 8. Off-isolation vs. Frequency

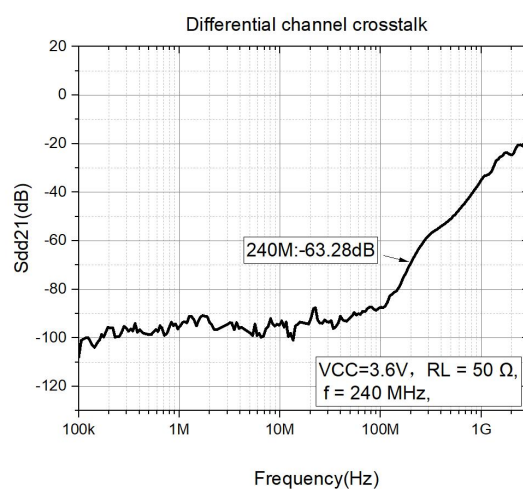


Figure 9. Crosstalk vs. Frequency

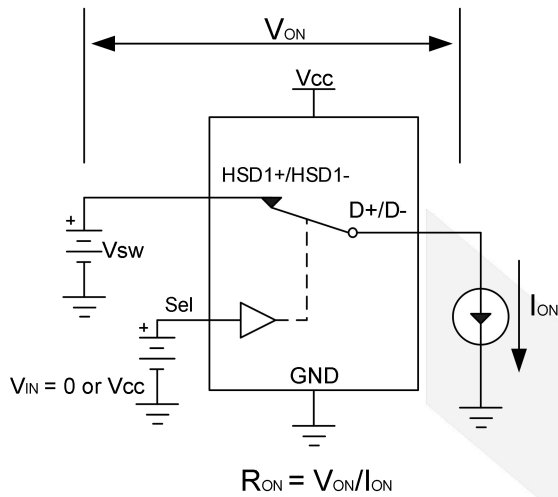


Figure 10. Switch on resistor

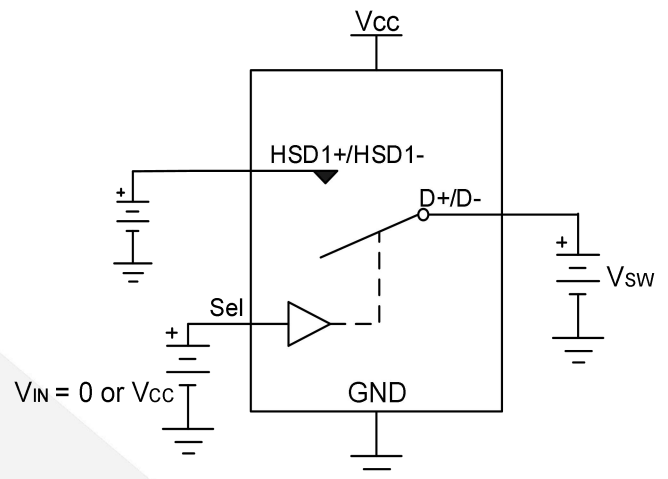


Figure 11. Switch off leakage

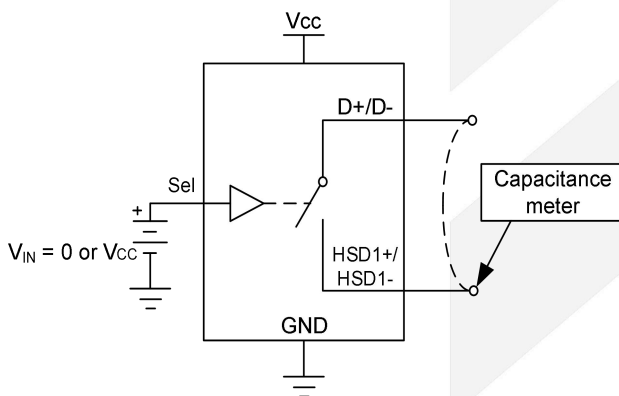


Figure 12. Channel on/off capacitance

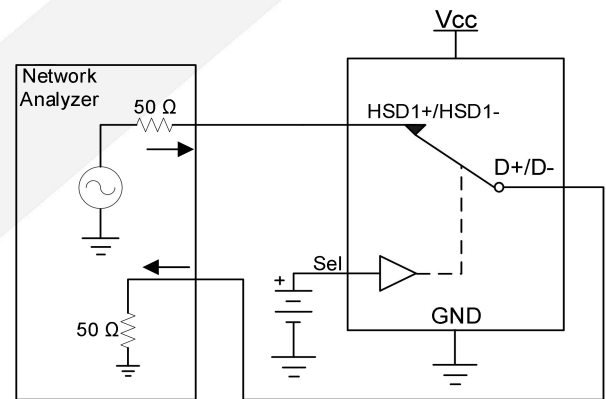


Figure 13. Bandwidth

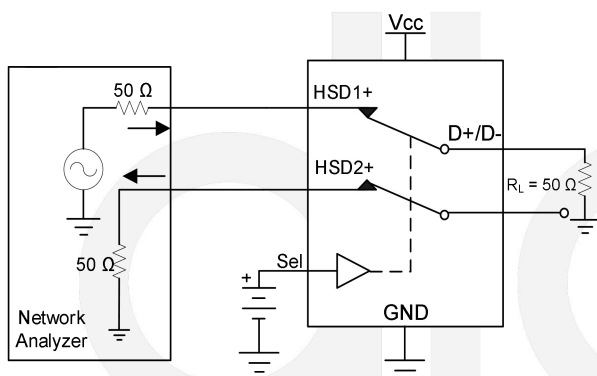


Figure 14. Channel-to-channel crosstalk

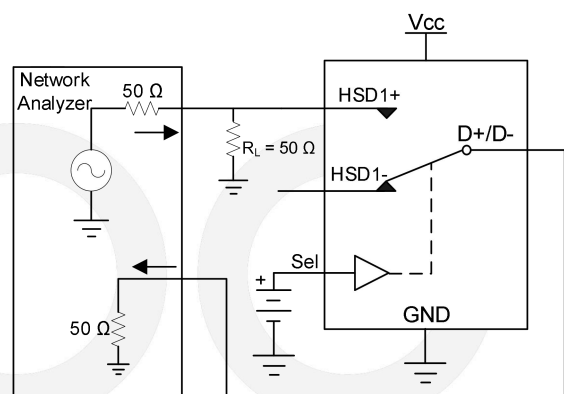


Figure 15. Off-isolation

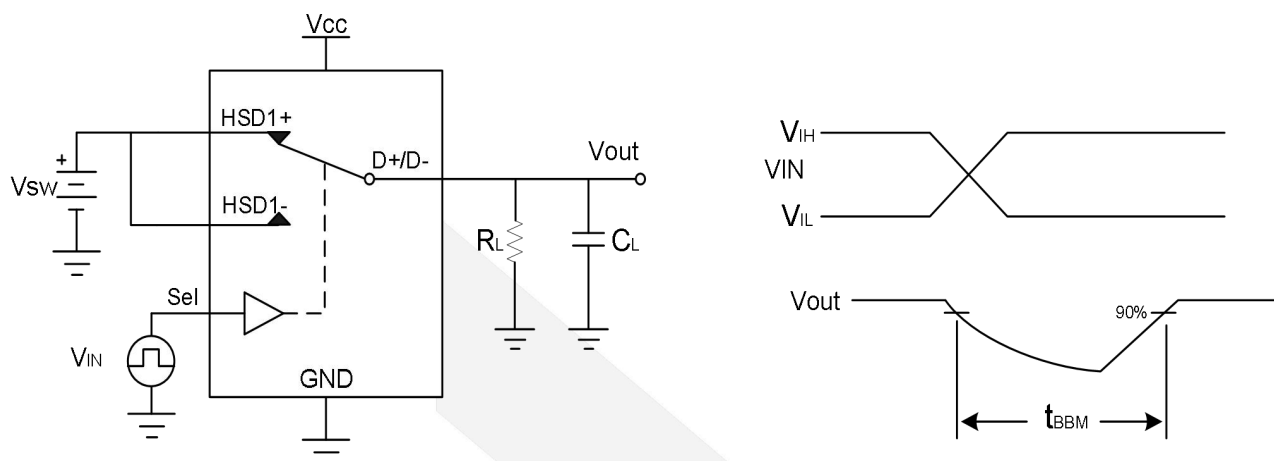


Figure 16. Break-before-make

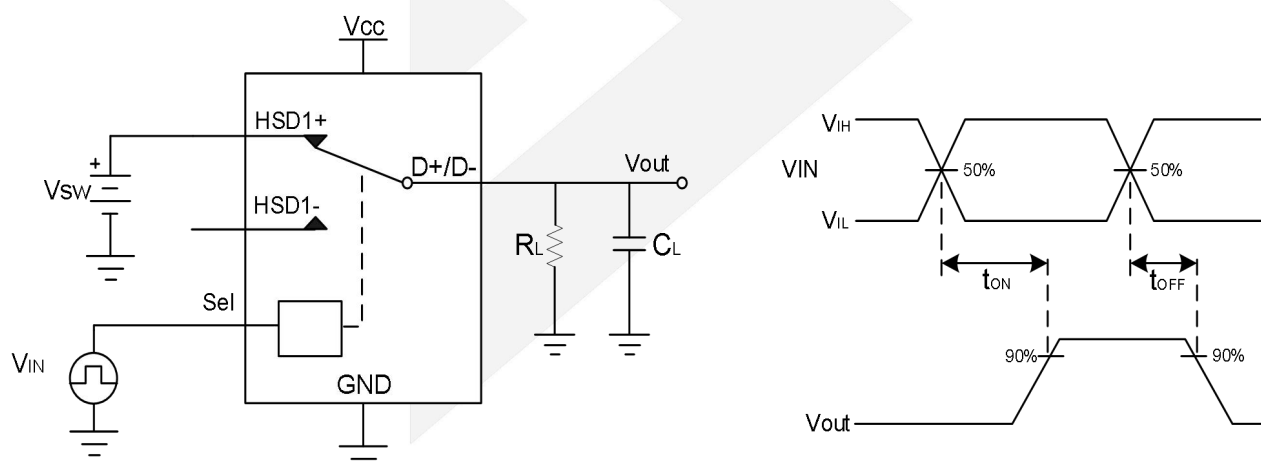
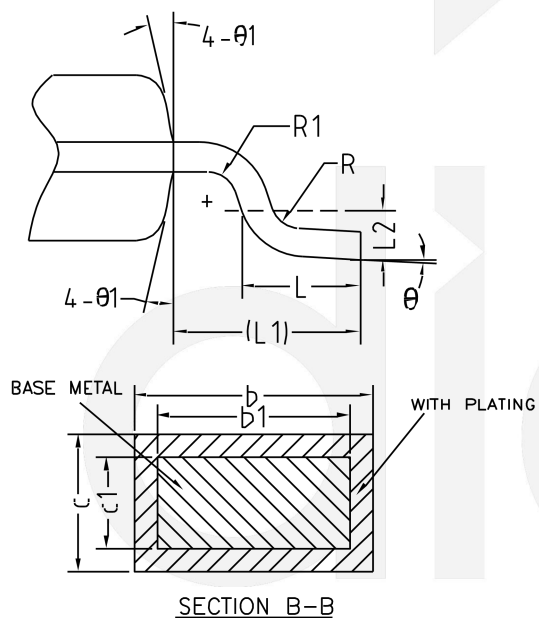
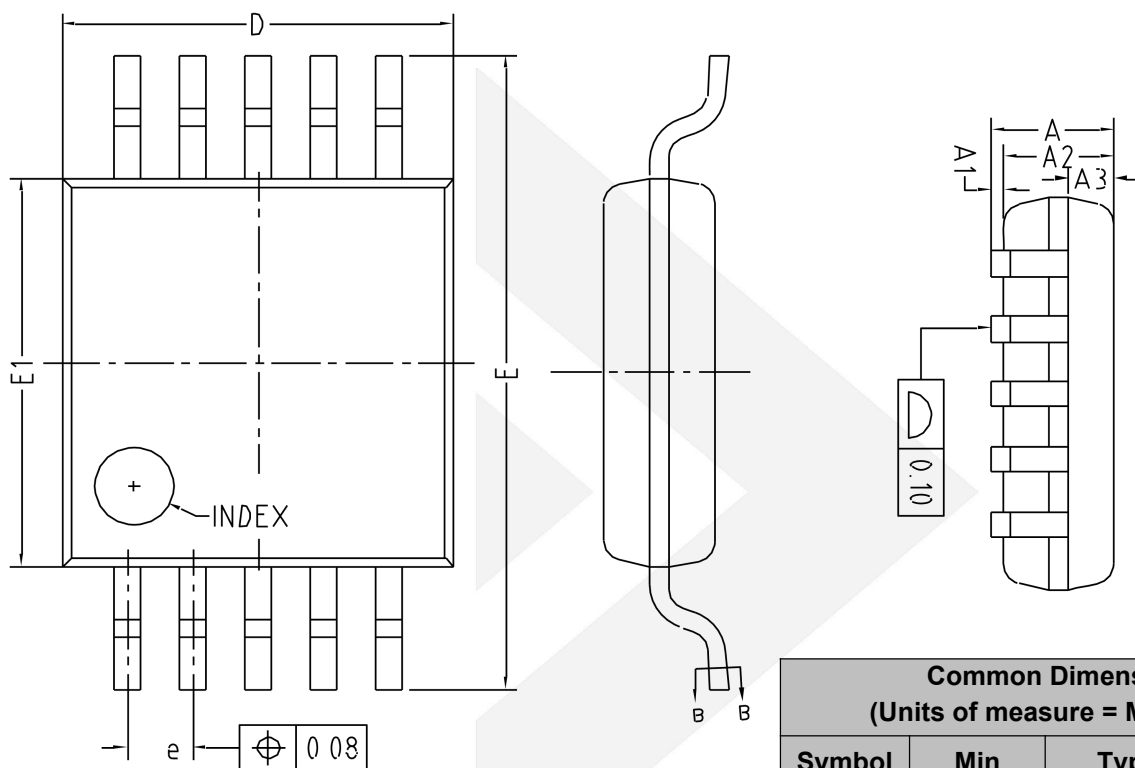


Figure 17. Turn-on/Turn-off

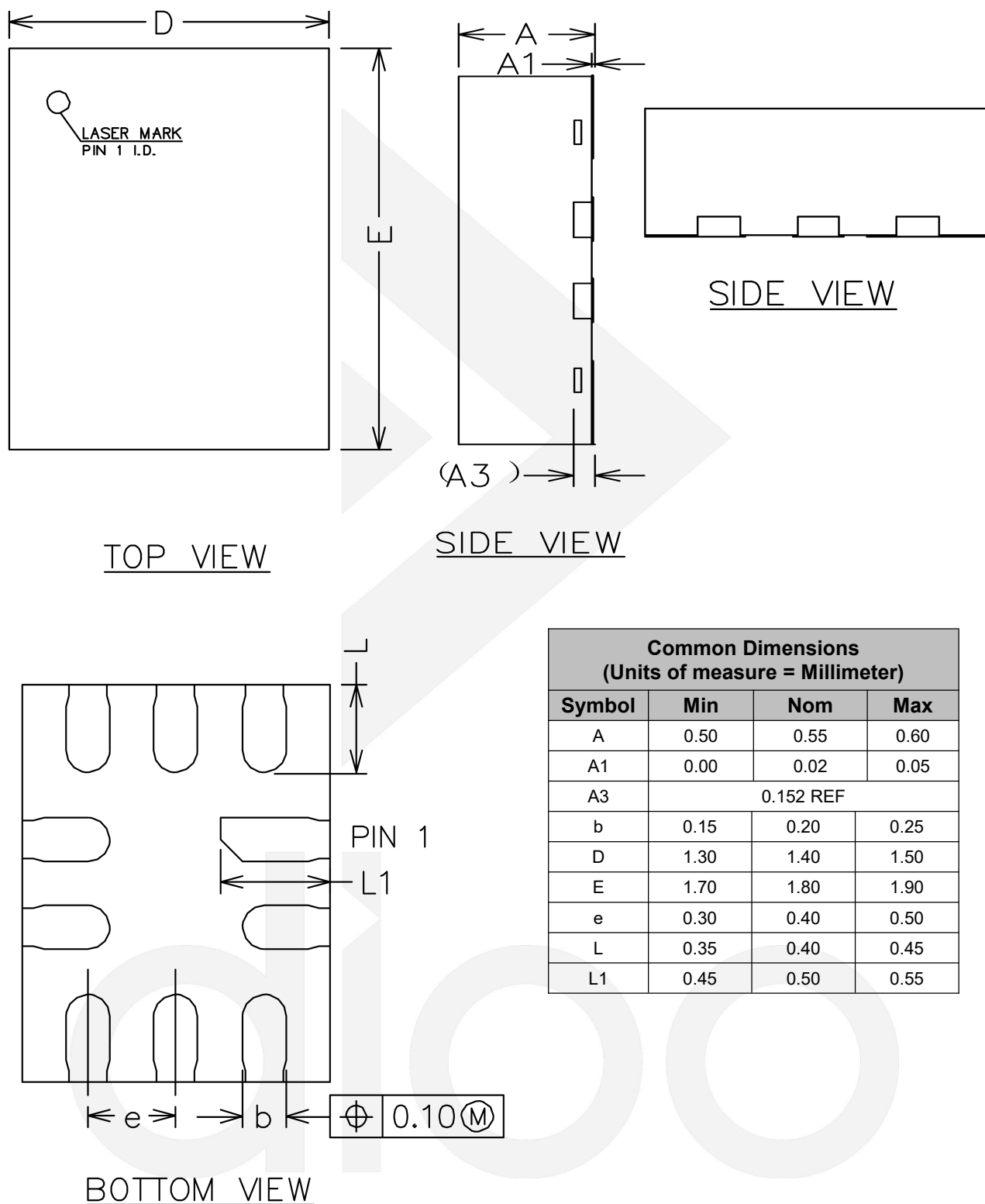
9. Physical Dimensions

9.1 MSOP-10

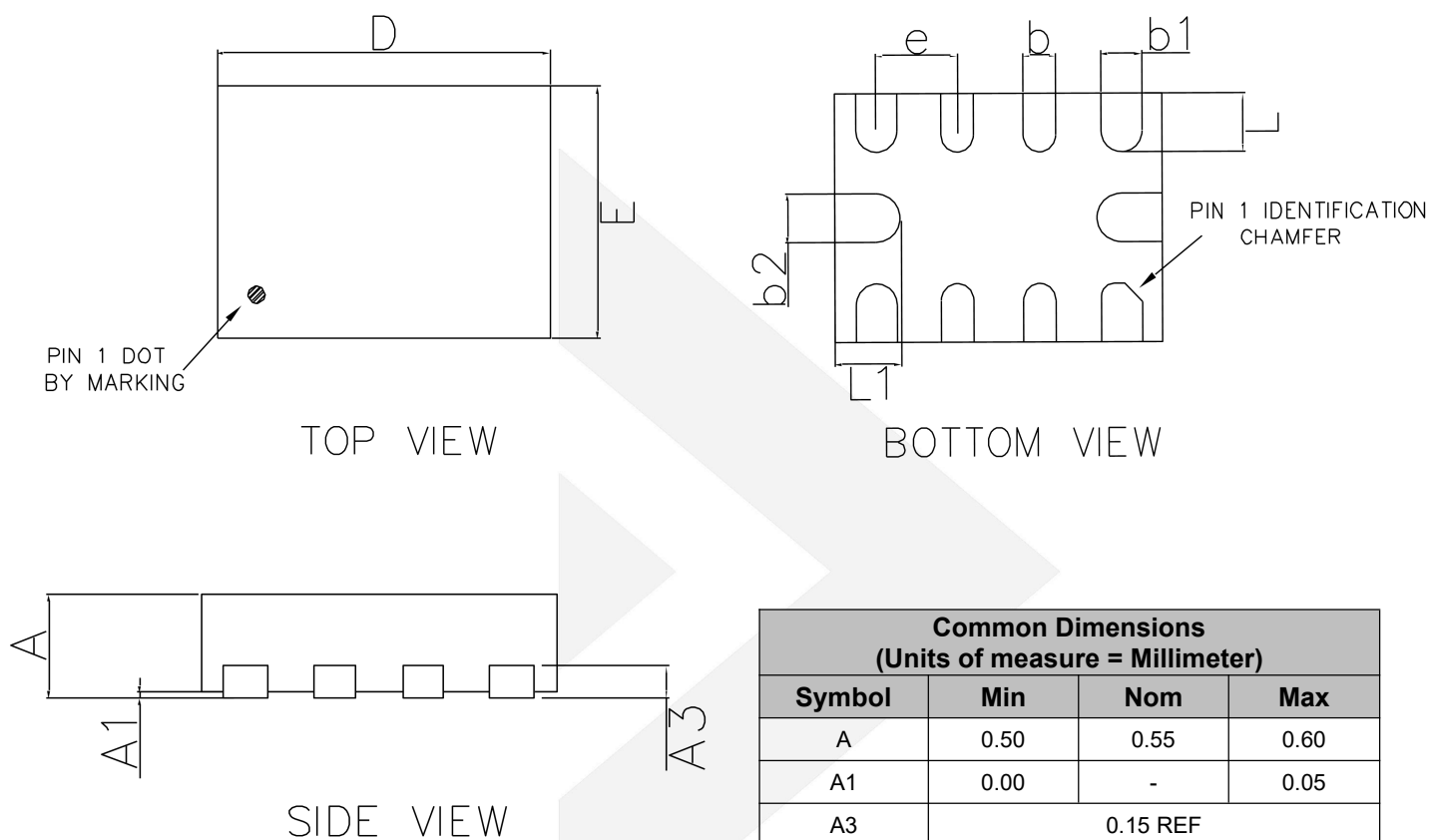


Common Dimensions (Units of measure = Millimeter)			
Symbol	Min	Typ	Max
A	-	-	1.10
A1	0	-	0.15
A2	0.75	0.85	0.95
A3	0.25	0.35	0.39
b	0.18	-	0.27
b1	0.17	0.20	0.23
c	0.15	-	0.20
c1	0.14	0.15	0.16
D	2.90	3.00	3.10
E	4.70	4.90	5.10
E1	2.90	3.00	3.10
e	0.40	0.50	0.60
L	0.40	0.60	0.80
L1	0.95 REF		
L2	0.25 BSC		
R	0.07	-	-
R1	0.07	-	-
θ	0°	-	8°
θ1	9°	12°	15°

9.2. QFN 1.8*1.4-10



9.3. QFN 2.0*1.5-10



Common Dimensions (Units of measure = Millimeter)			
Symbol	Min	Nom	Max
A	0.50	0.55	0.60
A1	0.00	-	0.05
A3	0.15 REF		
D	1.95	2.00	2.05
E	1.45	1.50	1.55
b	0.15	0.20	0.25
b1	0.20	0.25	0.30
b2	0.25	0.30	0.35
L	0.30	0.35	0.40
L1	0.35	0.40	0.45
e	0.50 BSC		

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