

# DIO32220

## Low-Power, USB 2.0 High-Speed Switch

### Features

- Super high bandwidth (-3 dB): 2.0 GHz
- $V_{CC}$  operation at 2.7 V to 5.5 V
- Low  $C_{ON}$ : 3 pF typical
- Low  $R_{ON}$ : 6  $\Omega$  typical
- Low power consumption: 1  $\mu$ A maximum
- Low  $I_{CCT}$  : 8  $\mu$ A max at  $V_{IN} = 1.8$  V,  $V_{CC} = 3.6$  V
- Packaged in Green MSOP-10, QFN1.8\*1.4-10 and QFN2.0\*1.5-10
- $\pm 6$  kV HBM ESD on all pins
- Power-off/on protection on common ports D+/D- pins tolerance up to 5.5 V

### Descriptions

The DIO32220 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 DIO32220 has a high channel-to-channel noise isolation and a 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.

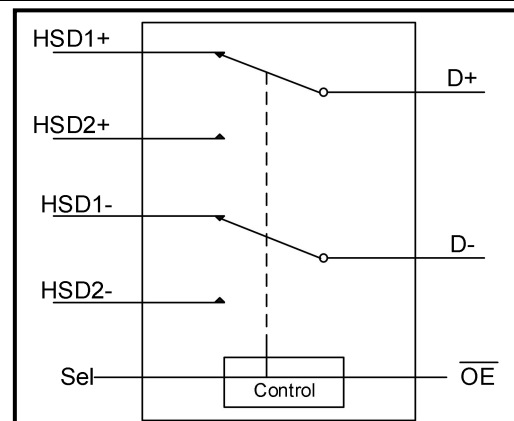
The DIO32220 contains special circuitry on the D+/D- pins, which can tolerate up to 5.5V when the USB devices either powered off or powered on.

The DIO32220 is available in three type Green packages: QFN1.8\*1.4-10, QFN2.0\*1.5-10, and MSOP-10.

### Applications

- Cell-phones/PDA
- MP3/MP4/PMP
- STB/LCD TVs

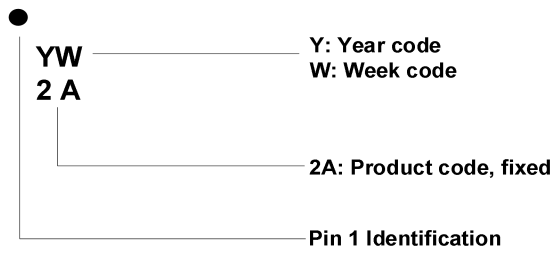
### Block Diagram



### Ordering Information

Ordering Part No.	Top Marking	MSL	RoHS	$T_A$	Package	
DIO32220MP10	DIO3222	3	Green	-40 to 85°C	MSOP-10	Tape & Reel, 3000
DIO32220LP10	YW2A	1	Green	-40 to 85°C	QFN1.8*1.4-10	Tape & Reel, 3000
DIO32220QN10	YW2A	1	Green	-40 to 85°C	QFN2.0*1.5-10	Tape & Reel, 3000

### Marking Definition



### Pin Assignment

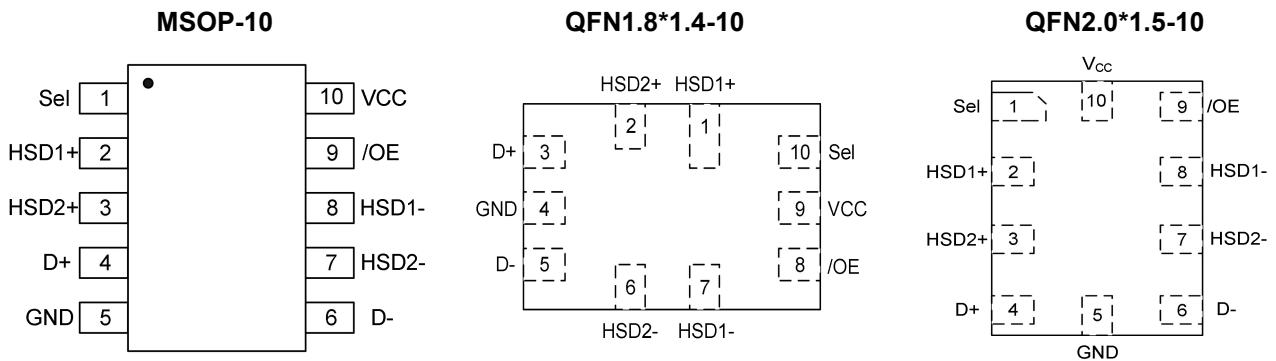


Figure 1. Top view

### Pin Descriptions

Pin Name	Description
$\overline{OE}$	Switch enable
Sel	Switch selection
D+, D-	USB data bus
HSDn+, HSDn-	Multiplexed source inputs

### Truth Table

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



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## Absolute Maximum Ratings

Stresses beyond those listed under the Absolute Maximum Rating table may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other condition beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Symbol	Parameter	Min	Max	Unit
$V_{CC}$	Supply voltage	-0.3	6.0	V
$V_{CNTRL}$	DC input voltage(Sel, $\overline{OE}$ )	-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
ESD	HBM, JEDEC: JESD22-A114, all pins	±6		kV

## Recommend Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. DIOO does not recommend exceeding them or designing to absolute maximum ratings.

Symbol	Parameter	Min	Max	Unit
$V_{CC}$	Supply voltage	2.7	5.5	V
$V_{CNTRL}$	Control input voltage(Sel, $\overline{OE}$ )	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

## 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	1.2			V
$V_{IL}$	Input voltage low		3.0 to 3.6			0.6	V
$I_{IN}$	Control input leakage	$V_{SW} = 0$ to $V_{CC}$	3.6	-1		1	μA
$I_{OZ}$	Off state leakage	$0 \leq D_n, HSD1n, HSD2n \leq 3.6V$	3.6	-2		2	μA
$I_{OFF}$	Power-off leakage current (all common ports)	$V_{SW} = 0$ V to 3.6 V, $V_{CC} = 0$ V. See Figure 9	0	-2		2	μA
$R_{ON}$	HS switch on resistance	$V_{SW} = 0.4$ V, $I_{ON} = 8$ mA. See Figure 5	3.0		6	8	Ω



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$\Delta R_{ON}$	HS delta $R_{ON}$	$V_{SW} = 0.4 V, I_{ON} = 8 mA$	3.0		0.08		$\Omega$
$I_{CC}$	Quiescent supply current	$V_{CNTRL} = 0$ or $V_{CC}$ ,	3.6			1	$\mu A$
$I_{CCT}$	Increase in $I_{CC}$ current per control voltage and $V_{CC}$	$V_{CNTRL} = 2.6 V, V_{CC} = 3.6 V$	3.6			2	$\mu A$
		$V_{CNTRL} = 1.8 V, V_{CC} = 3.6 V$	3.6			8	$\mu A$

**Note:**

(1) Specifications subject to change without notice.

## AC Electrical Characteristics

All typical value are for  $V_{CC} = 3.3 V$  at  $25^\circ C$  unless otherwise specified.

Symbol	Parameter	Conditions	$V_{CC}$ (V)	Temp	Min	Typ	Max	Unit
				( $^\circ C$ )				
$t_{ON}$	Turn-on time Sel, $\overline{OE}$ to output	$R_L = 50 \Omega, C_L = 5 pF,$ $V_{SW} = 0.8 V$ . See Figure 15	3.0 to 3.6	full		10	20	ns
$t_{OFF}$	Turn-off time Sel, $\overline{OE}$ to output	$R_L = 50 \Omega, C_L = 5 pF,$ $V_{SW} = 0.8 V$ . See Figure 15	3.0 to 3.6	full		5	10	ns
$t_{PD}$	Propagation delay	$R_L = 50 \Omega, C_L = 5 pF$	3.3	$25^\circ C$		0.25		ns
				full			5.0	ns
$t_{BBM}$	Break-Before-Make	$R_L = 50 \Omega, C_L = 5 pF,$ $V_{SW} = 0.8 V$ . See Figure 14	3.0 to 3.6	$25^\circ C$		12		ns
				full	10		28	ns
OIRR	Off isolation	$R_L = 50 \Omega, f = 240 MHz$ . See Figure 13	3.0 to 3.6	$25^\circ C$		-37		dB
Xtalk	Non-adjacent channel crosstalk	$R_L = 50 \Omega, f = 240 MHz$ . See Figure 12	3.0 to 3.6	$25^\circ C$		-45		dB
BW	-3 dB bandwidth	$R_L = 50 \Omega, C_L = 0 pF$ . See Figure 11	3.0 to 3.6	$25^\circ C$		2000		MHz
				$25^\circ C$		720		MHz
$t_{SK(P)}^{(1)}$	Skew of opposite transitions of the same output	$R_L = 50 \Omega, C_L = 5 pF$	3.0 to 3.6	$25^\circ C$		20		ps

**Note:**

(1) Guaranteed by design.

(2) Specifications subject to change without notice.

## Capacitance

Symbol	Parameter	Conditions	Temp	Min	Typ	Max	Unit
			( $^\circ C$ )				
$C_{IN}$	Control pin input capacitance	$V_{CC} = 0 V$	$25^\circ C$		1.2		pF
$C_{ON}$	D+/D- on capacitance	$V_{CC} = 3.3 V, \overline{OE} = 0 V, f = 240 MHz,$ See Figure 10	$25^\circ C$		3		
$C_{OFF}$	HSD1n, HSD2n off capacitance	$V_{CC}$ and $\overline{OE} = 3.3 V$ , See Figure 10	$25^\circ C$		2		

**Note:**

(1) Specifications subject to change without notice.

## Typical Performance Characteristics

$T_A = 25^\circ\text{C}$ ,  $V_{CC} = 3.3\text{ V}$ , unless otherwise specified.

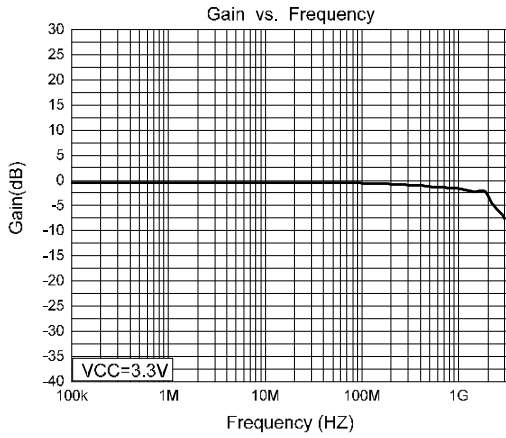
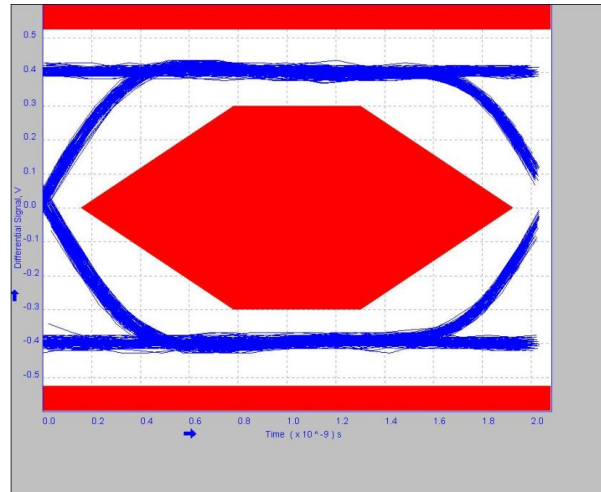


Figure 2. Gain vs. Frequency



TIME SCALE (0.2 ns/DIV)

Figure 3. Eye Pattern: 480 Mbps with USB switch in signal path

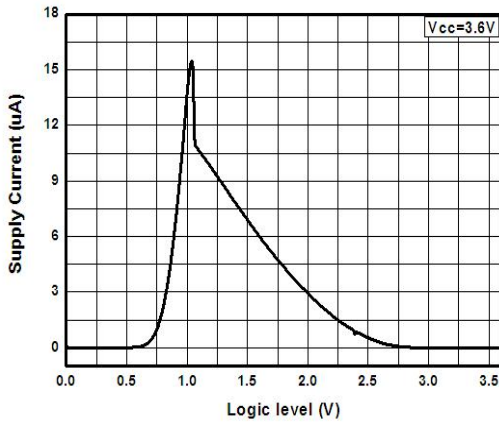


Figure 4. Supply current vs. Logic level

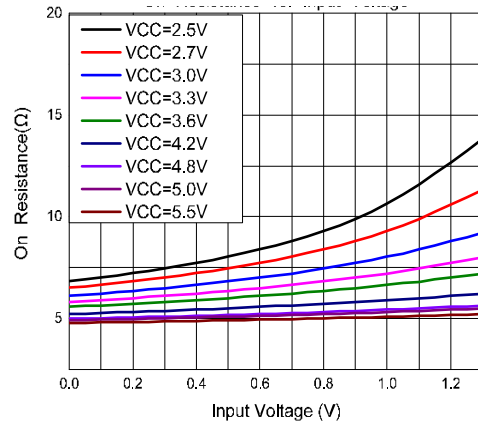


Figure 5. On resistance vs. Input voltage

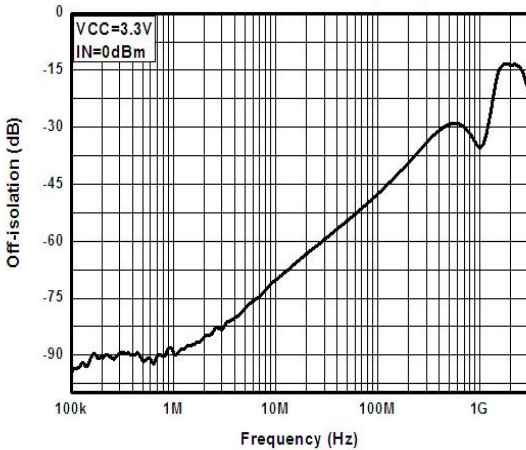


Figure 6. Off-isolation vs. Frequency

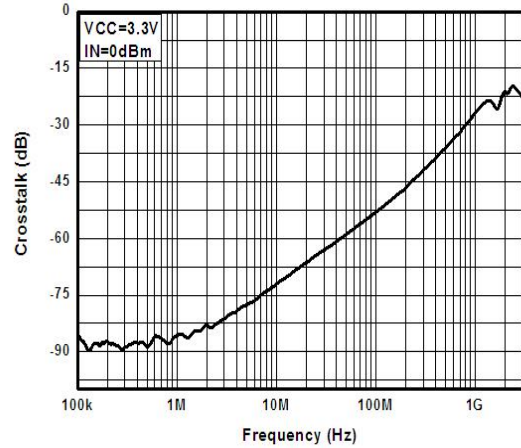


Figure 7. Crosstalk vs. Frequency

Test Diagrams

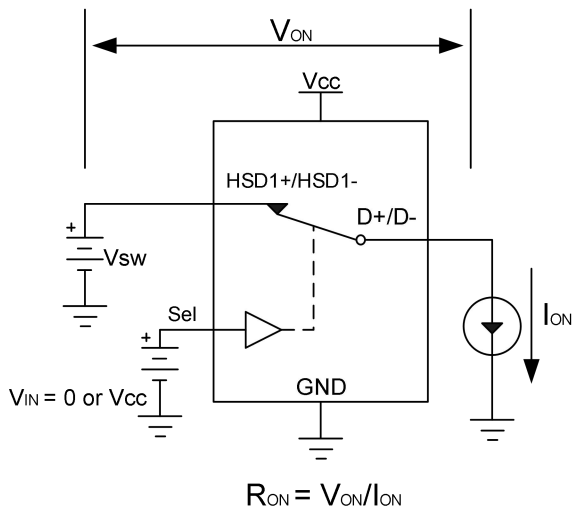


Figure 8. Switch on resistor

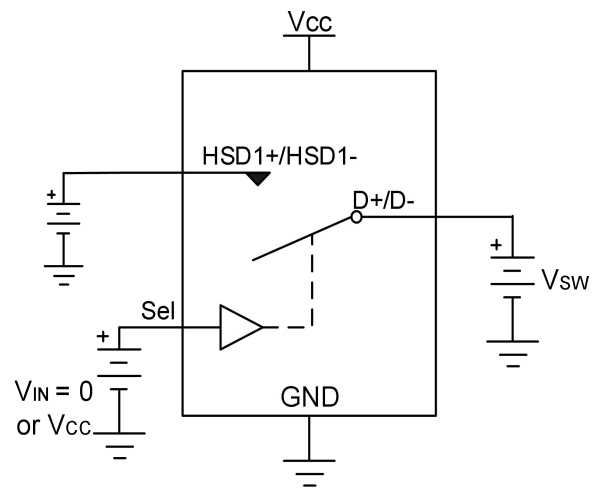


Figure 9. Switch off leakage

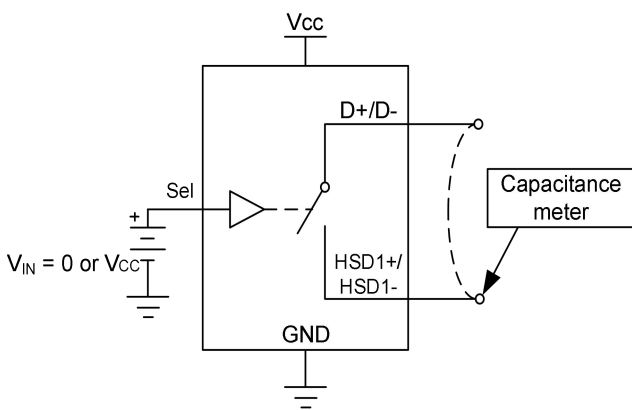


Figure 10. Channel on/off capacitance

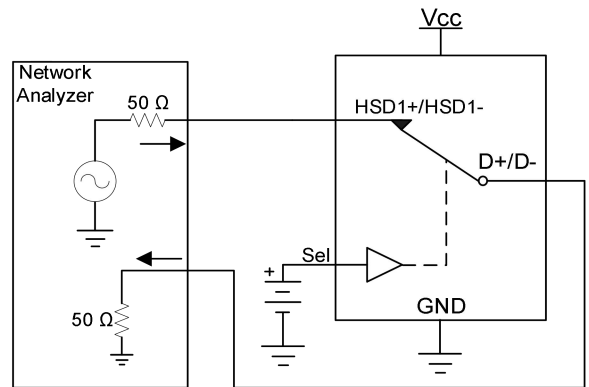


Figure 11. Bandwidth

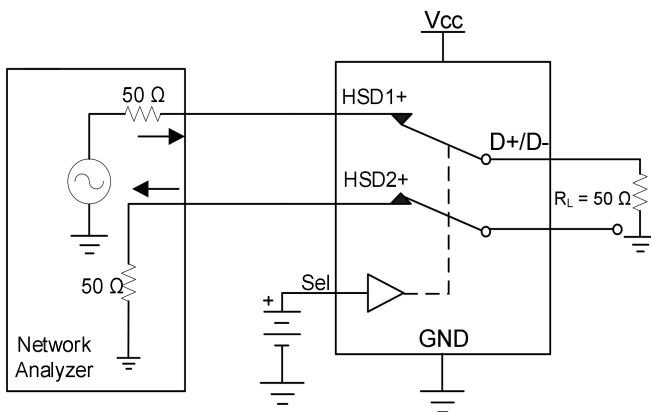


Figure 12. Channel-to-channel crosstalk

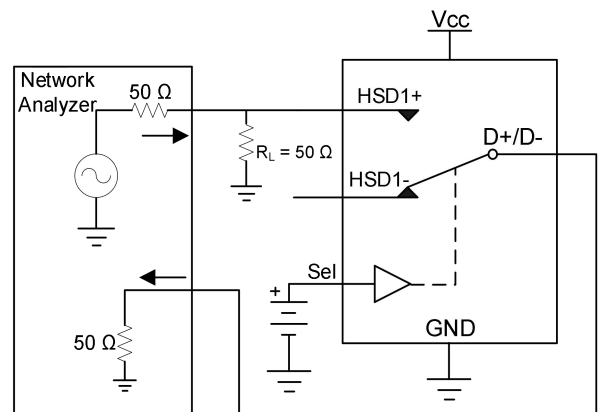


Figure 13. Off-isolation

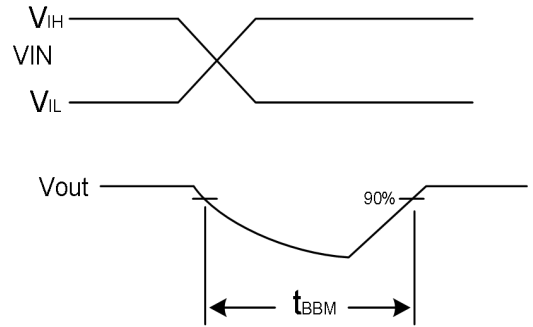
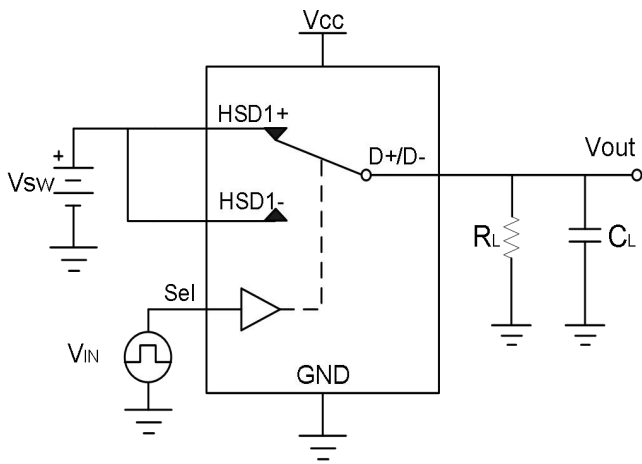


Figure 14. Break-before-make

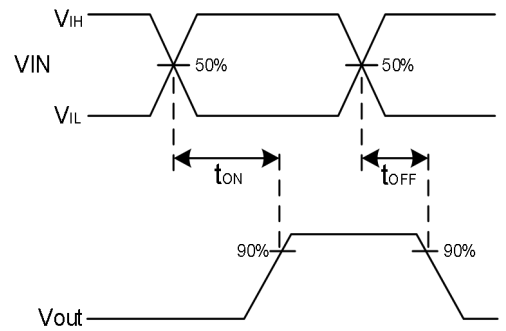
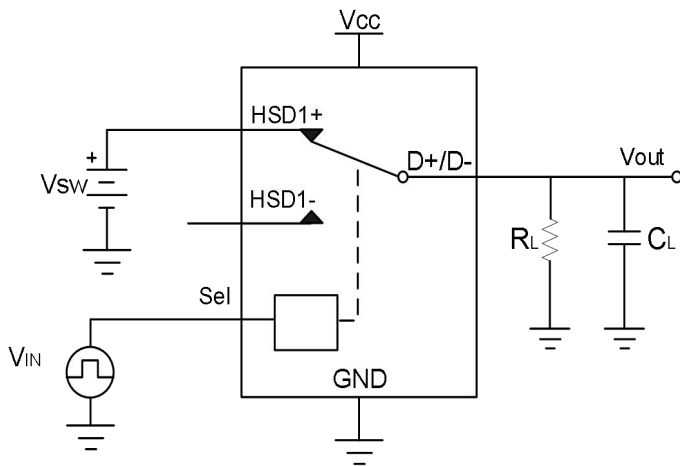
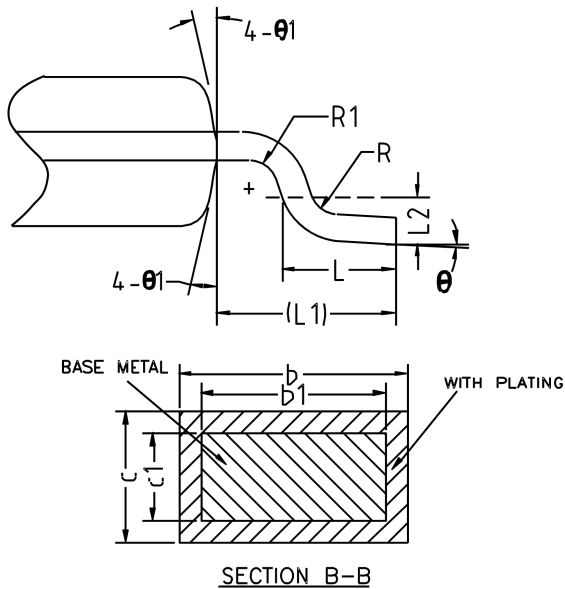
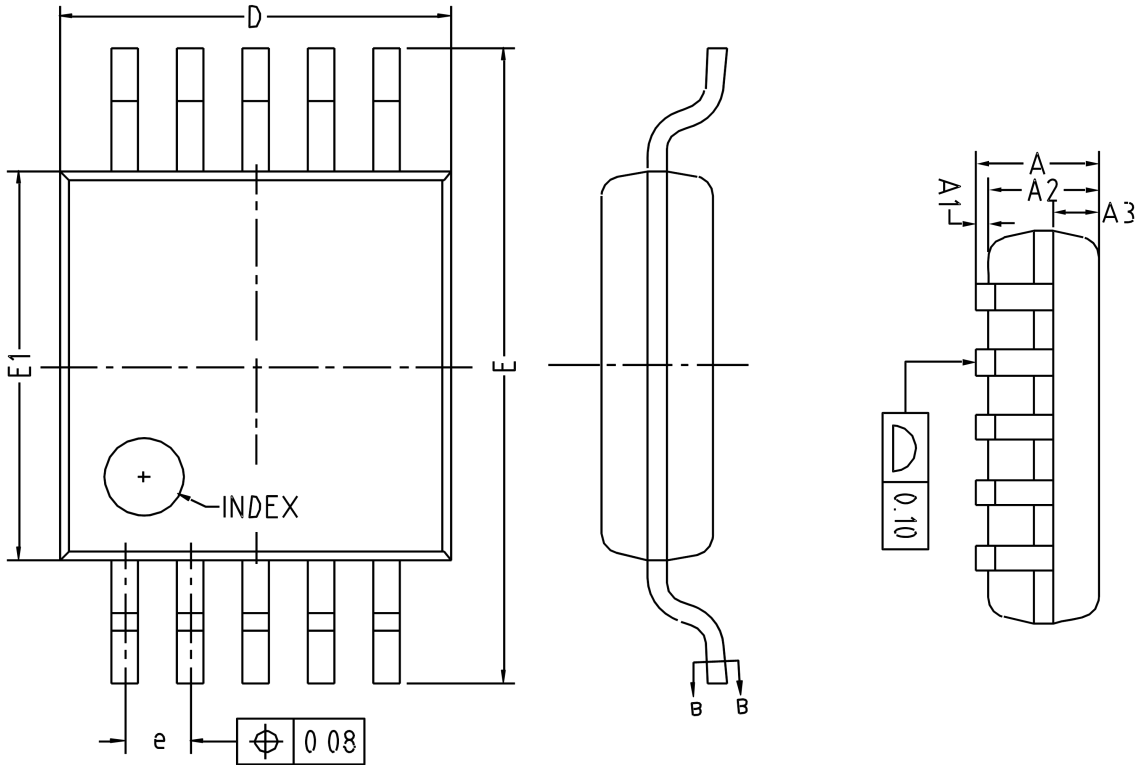


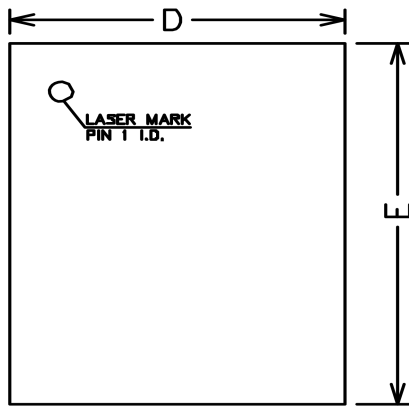
Figure 15. Turn-on / Turn-off

## Physical Dimensions: MSOP-10

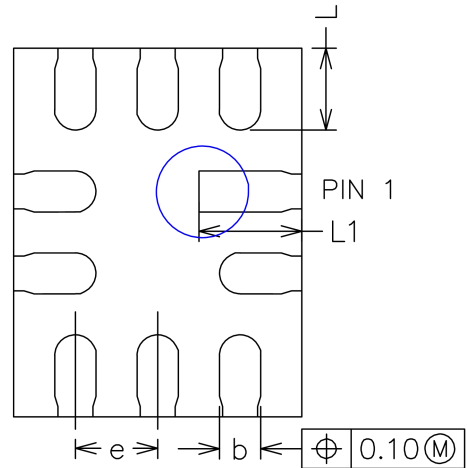


Common Dimensions (Units of measure = Millimeter)			
Symbol	Min	Nom	Max
A	-	-	1.10
A1	0.05	0.10	0.15
A2	0.75	0.85	0.95
A3	0.30	0.35	0.40
b	0.18	-	0.27
b1	0.17	0.20	0.23
c	0.15	-	0.20
c1	0.14	0.15	0.16
D	2.90	3.00	3.10
E	4.75	4.90	5.05
E1	2.90	3.00	3.10
e	0.40	0.50	0.60
L	0.40	0.55	0.70
L1	0.95 REF		
L2	0.25 BSC		
R	0.07	-	-
R1	0.07	-	-
θ	0°	-	8°
θ1	9°	12°	15°

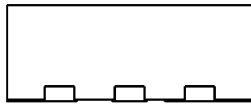
## Physical Dimensions: QFN1.8\*1.4-10



TOP VIEW

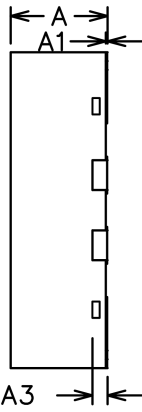
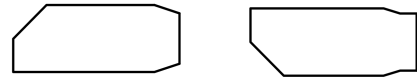


BOTTOM VIEW



SIDE VIEW

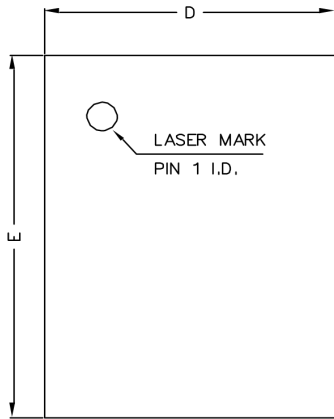
Two options



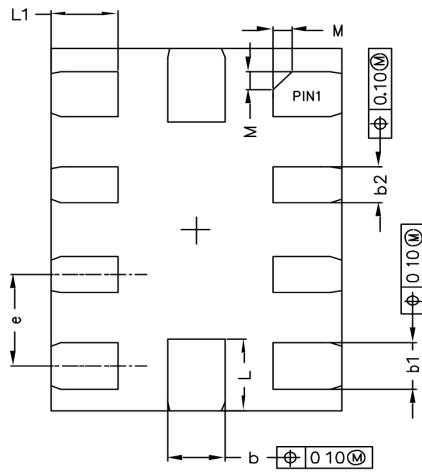
SIDE VIEW

Common Dimensions (Units of Measure = Millimeter)			
Symbol	Min	Nom	Max
A	0.50	0.55	0.60
A1	0.00	0.02	0.05
A3	0.152 REF		
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

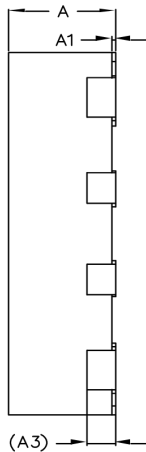
## Physical Dimensions: QFN2.0\*1.5-10



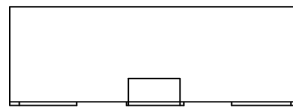
TOP VIEW



BOTTOM VIEW



SIDE 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
A3	0.152 REF		
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		

## CONTACT US

Dioo is a professional design and sales corporation for high-quality and performance analog semiconductors. The company focuses on industry markets, such as cell phones, handheld products, laptops, medical equipment, and so on. Dioo's product families include analog signal processing and amplifying, LED drivers, and charger ICs. Go to <http://www.dioo.com> for a complete list of Dioo product families.

For additional product information or full datasheet, please contact our sales department or representatives.