# Low-Power, USB 2.0 High-Speed Switchr

## Features

- Super high bandwidth (-3 dB): 1.8 GHz
- $V_{CC}$ operation at 2.3 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 $I_{CCT}$ : 0.5 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

- Telematics control units
- Automotive cluster displays
- Front and rear cameras

## Package Information

| Part Number | Package | Body Size |
|---|---|---|
| DIO3001 | QFN10 | 2.0 mm × 1.5 mm |

## Description

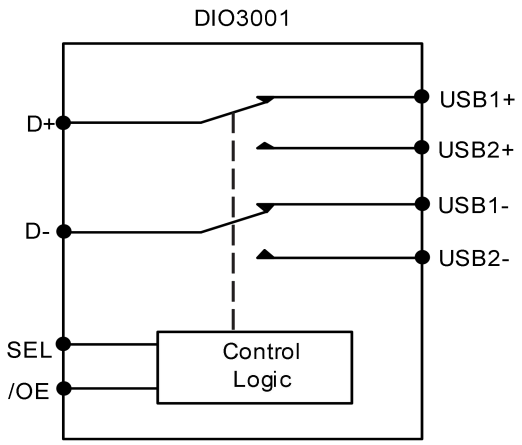
The DIO3001 is a low-power, dual SPDT 2-port high-speed analog switch. It handles bidirectional signal flow optimized for switching a high-speed (480 Mbps) source or a full-speed (12 Mbps) source.

The DIO3001 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 DIO3001 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 DIO3001 is available in the Green package: QFN2.0×1.5-10.

## Simplified Schematic



## Ordering Information

| Ordering Part No. | Top Marking | MSL | RoHS | $T_A$ | Package | |
|---|---|---|---|---|---|---|
| DIO3001QN10 | YW3A | 1 | Green | -40 to 85°C | QFN2×1.5-10 | 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

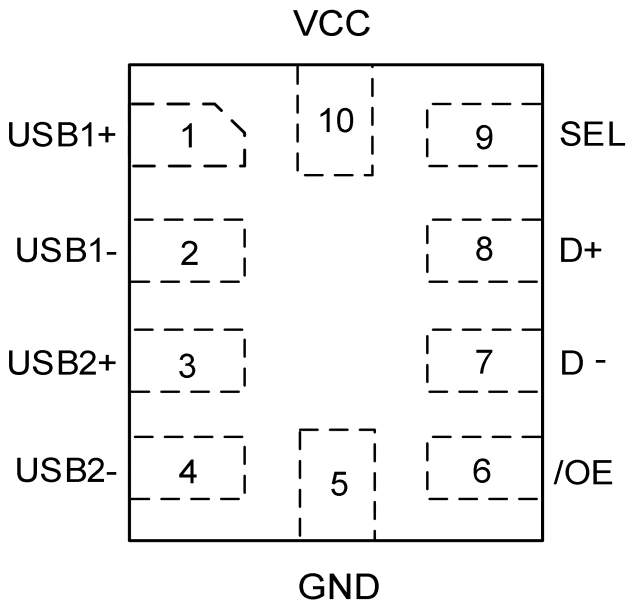



*Figure 1. QFN2×1.5-10 (Top view)*

*Table 1. Pin descriptions*

| Pin Name | Description |
|---|---|
| /OE | Switch enable |
| SEL | Switch select |
| D+, D- | USB data bus |
| USB1±, USB2± | Multiplexed source inputs |
| VCC | Power supply |
| GND | Ground |

*Table 2. Truth table*

| SEL | /OE | Function |
|---|---|---|
| X | H | Disconnect |
| L | L | D+, D- = USB1+, USB1- |
| H | L | D+, D- = USB2+, USB2- |

## 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 (S, /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 |

## 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 | 2.3 | 5.5 | V |
| $V_{CNTRL}$ | Control input voltage (S, /OE) | 0 | $V_{CC}$ | V |
| $V_{SW}$ | Switch I/O voltage (USB1±, USB2±) | 0 | $V_{CC}$ | 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 | JEDEC: JESD22-A114, 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 | -2 | | 2 | μA |
| $I_{OZ}$ | Off-state leakage | 0 ≤ Dn, USB1±, USB2± ≤ 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, see Figure 3 | 0 | -1 | | 1 | μA |
| $R_{ON}$ | ON-state resistance | $V_{SW}$ = 0.4 V, $I_{ON}$ = 8 mA, see Figure 2 | 3.3 | | 5.5 | 8 | Ω |
| $\Delta R_{ON}$ | ON-state resistance match between + and - paths | $V_{SW}$ = 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 $V_{CC}$ | $V_{CNTRL}$ = 1.8 V | 3.6 | | 0.5 | 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(°C) | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|---|
| $t_{ON}$ | Turn-on time S, /OE to output | $R_L$ = 50 Ω, $C_L$ = 5 pF, $V_{SW}$ = 0.8 V, see Figure 9 | 3.0 to 3.6 | full | | 2 | | μs |
| $t_{OFF}$ | Turn-off time S, /OE to output | $R_L$ = 50 Ω, $C_L$ = 5 pF, $V_{SW}$ = 0.8V, see Figure 9 | 3.0 to 3.6 | full | | 20 | | 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 8 | 3.0 to 3.6 | 25°C | | 12 | | ns |
| | | | | full | 10 | | 28 | ns |
| OIRR | Off isolation | $R_L$ = 50 Ω, f = 240 MHz, see Figure 7 | 3.0 to 3.6 | 25°C | | -37 | | dB |
| Xtalk | Non-adjacent channel crosstalk | $R_L$ = 50 Ω, f = 240 MHz, see Figure 6 | 3.0 to 3.6 | 25°C | | -42 | | dB |
| BW | -3dB bandwidth | $R_L$ = 50 Ω, $C_L$ = 0 pF, see Figure 5 | 3.0 to 3.6 | 25°C | | 1.8 | | GHz |
| $t_{SK(P)}$ | 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) Specifications subject to change without notice.

# 7. Capacitance

| Symbol | Parameter | Conditions | Temp(°C) | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $C_{IN}$ (1) | 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 4 | 25°C | | 5 | | |
| $C_{OFF}$ (1) | USB1±, USB2± off capacitance | $V_{CC}$ and /OE = 3.3 V, see Figure 4 | 25°C | | 2 | | |

**Note:**

(1) Guaranteed by design.

(2) Specifications subject to change without notice.

# 8. Typical Characteristics

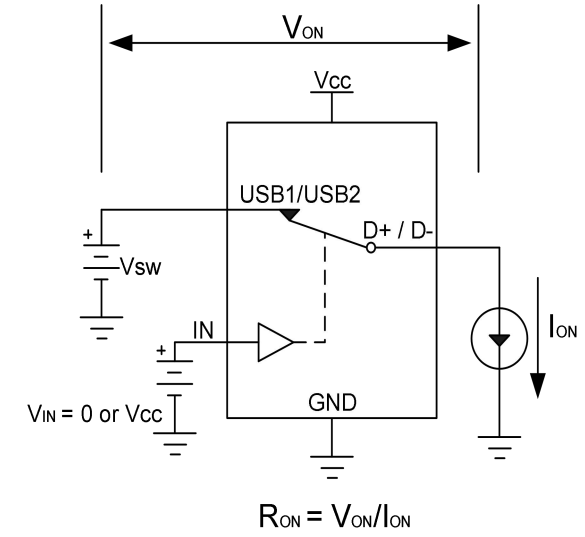



*Figure 2. Switch on resistor*

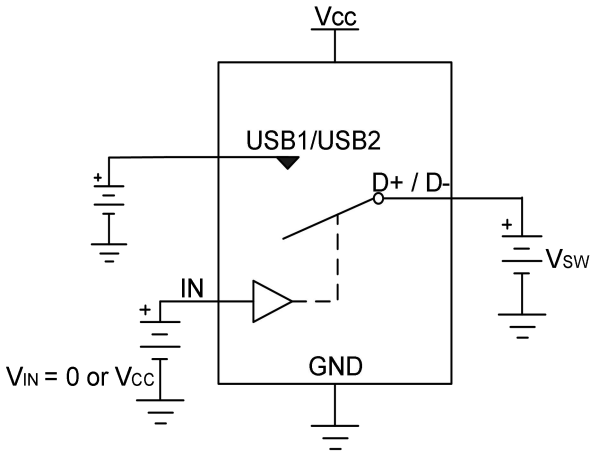



*Figure 3. Switch off leakage*

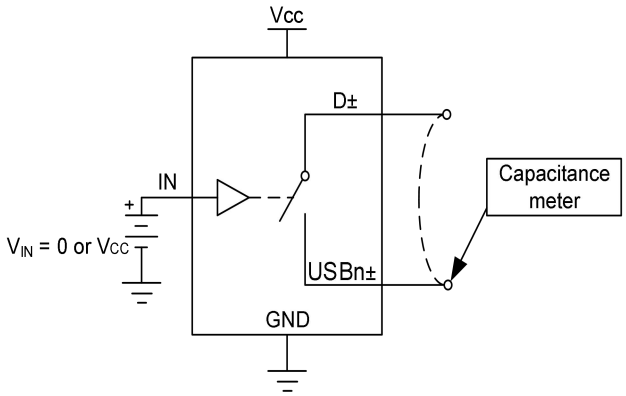



*Figure 4. Channel on/off capacitance*

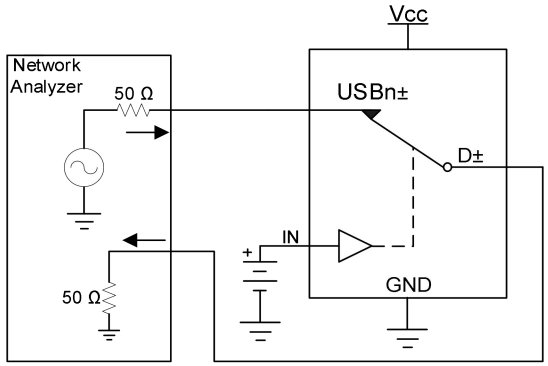



*Figure 5. Bandwidth*

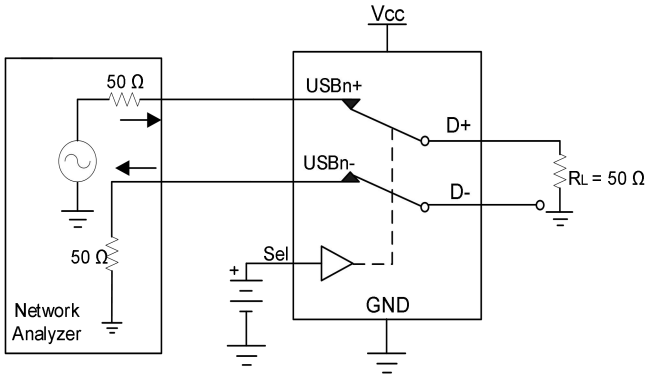



*Figure 6. Channel-to-channel crosstalk*

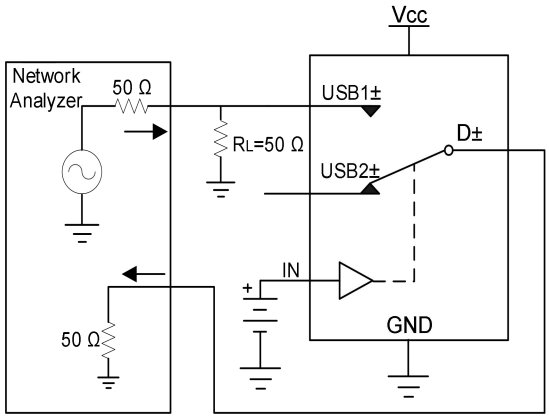



*Figure 7. Off-isolation*

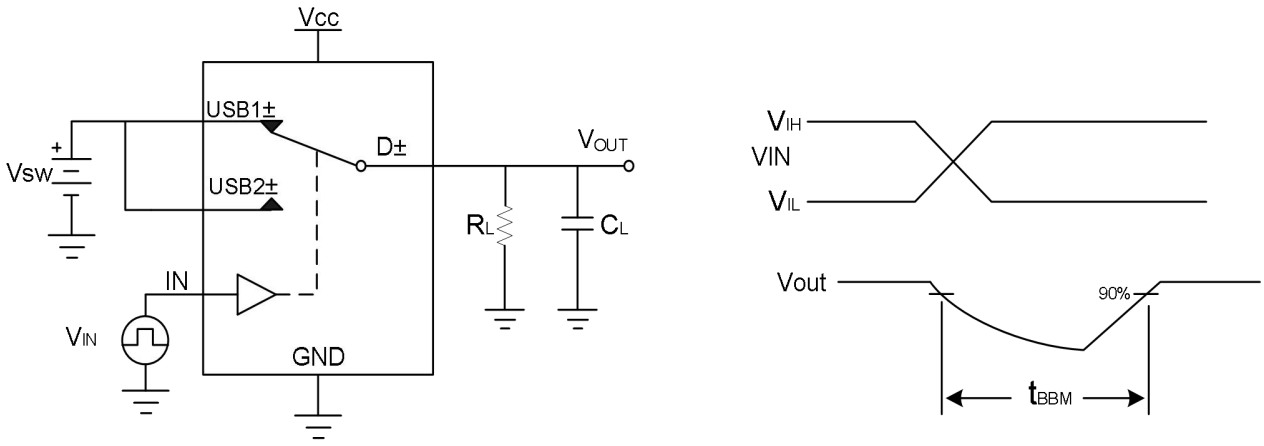



*Figure 8. Break-before-make*

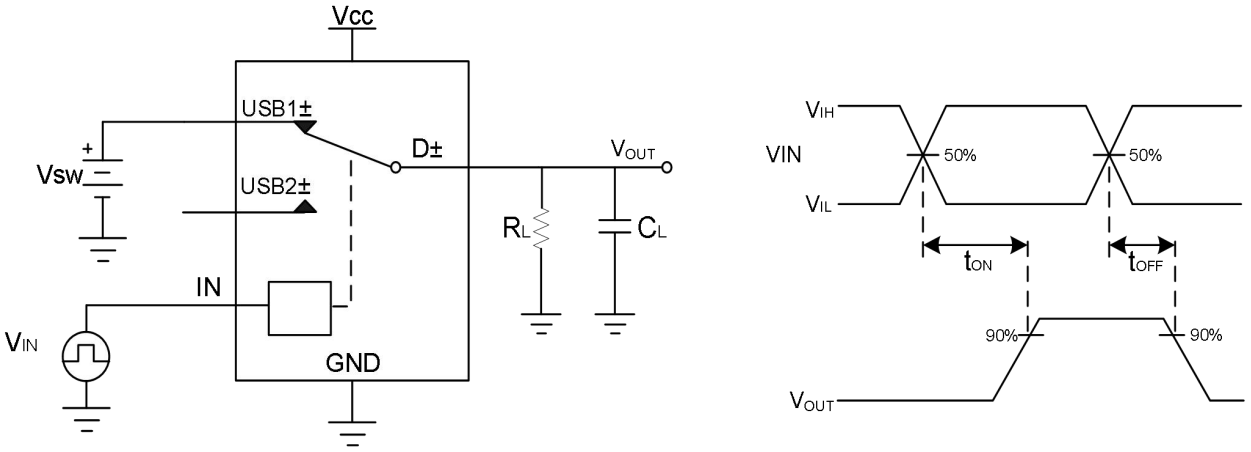



*Figure 9. Turn-on/Turn-off*

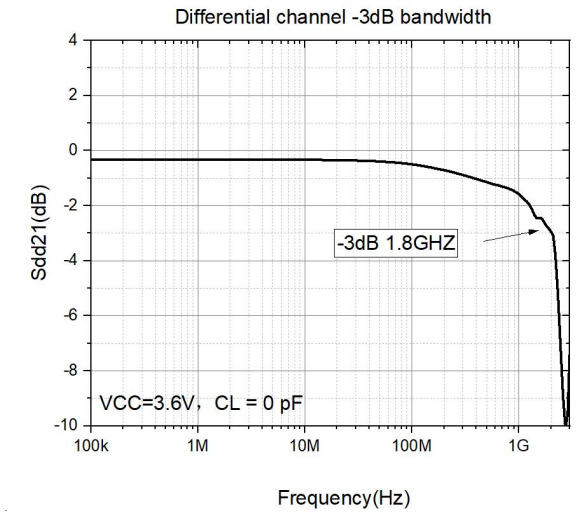



*Figure 10. Differential channel -3 dB bandwidth*

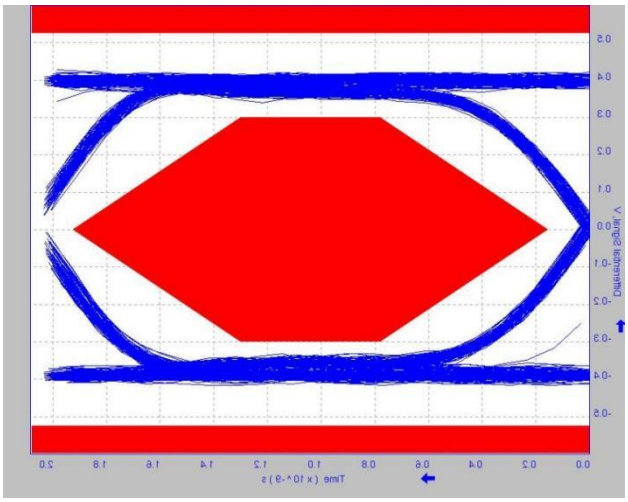


*Figure 11. Eye pattern*

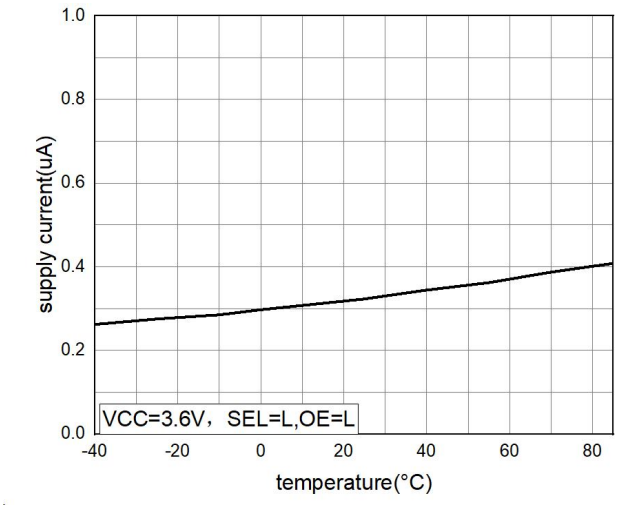



*Figure 12. Supply current vs. Temperature*

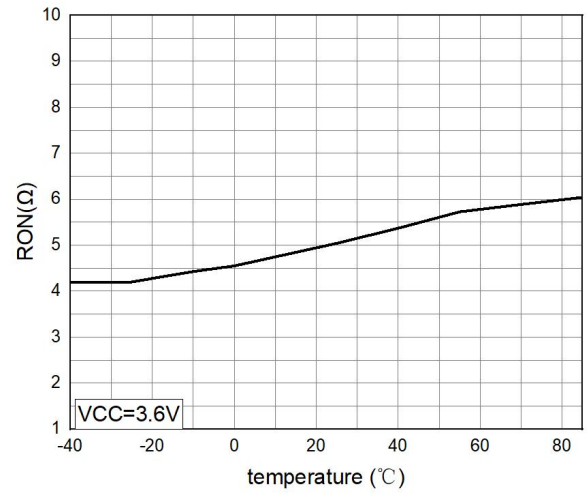



*Figure 13. $R_{ON}$ vs. Temperature*

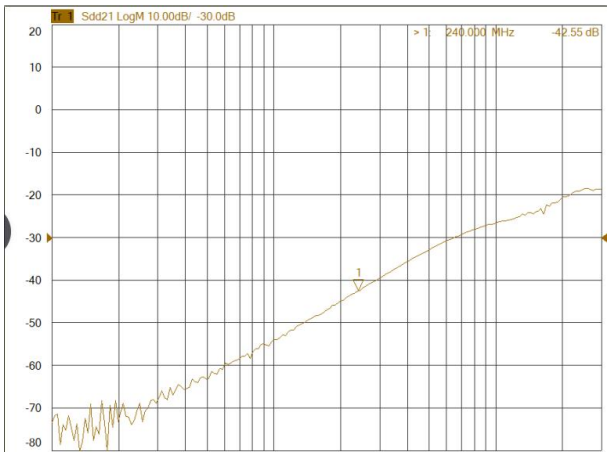



*Figure 14. Crosstalk vs. Frequency*

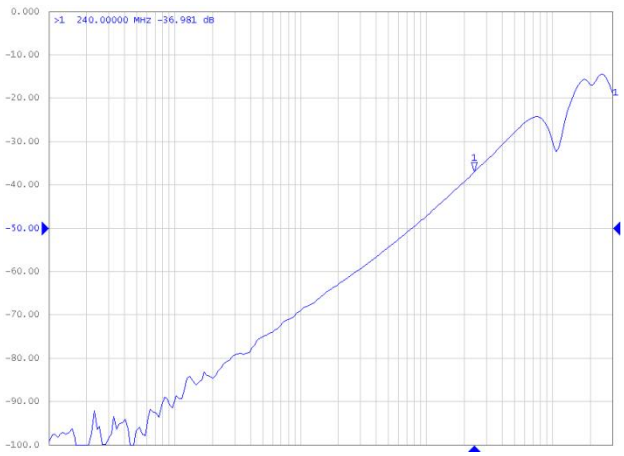
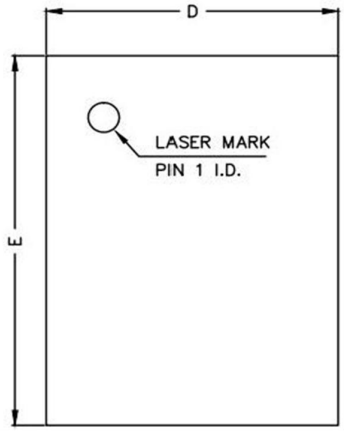


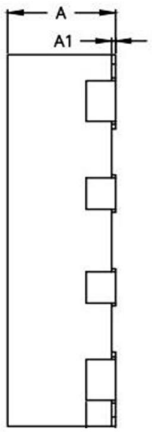

*Figure 15. Off-isolation vs. Frequency*

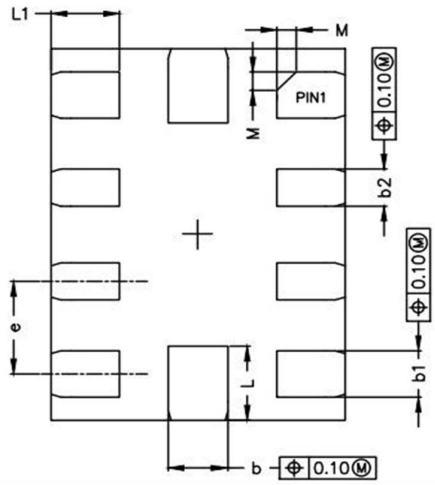
# 9. Physical Dimensions: QFN2.0×1.5-10



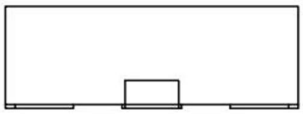

TOP VIEW




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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