

# DIO1634

## 2:1 MIPI 6 GHz 4-Data Lane & 1-CLK Lane Switch

### Features

- Supply voltage range: 1.65 V to 5 V
- Input signals: 0 V to 5 V
- Data rate support: up to 3.5 Gbps C-PHY, up to 4.5 Gb/s D-PHY
- DIFF BW: 6 GHz
- Switch type: SPDT (10 channels)
- Signal types: D-PHY and C-PHY
- $R_{ON}$ : 7.5  $\Omega$  typical HS MIPI  
8.4  $\Omega$  typical LP MIPI
- $I_{CCZ}$ : 0.5  $\mu A$  (max.)
- $I_{CC}$ : 26  $\mu A$  (typ.)
- $O_{IRR}$ : -25 dB (typ.)
- $X_{TALK}$ : -30 dB (typ.)
- $C_{ON}$ : 1.7 pF (typ.)
- Operating temperature: -40 to 85°C
- Package: 36-ball WLCSP

### Descriptions

The DIO1634 is a single pole double throw (SPDT) switch which can be used as a 4-data lane & 1-CLK lane D-PHY or 3-data lane C-PHY MIPI switch. This switch can be used for switching high speed signal between MIPI sources and MIPI devices.

The DIO1634 has 10 channels and high bandwidth of 6 GHz. The DIO1634 has low power consumption, so it is a good choice for low power applications.

The DIO1634 is designed for the MIPI specification and allows connection to CSI / DSI, C-PHY / D-PHY module.

### Applications

- Cellular phones, smart phones
- Display devices
- Tablets
- Portable devices

### Typical Application

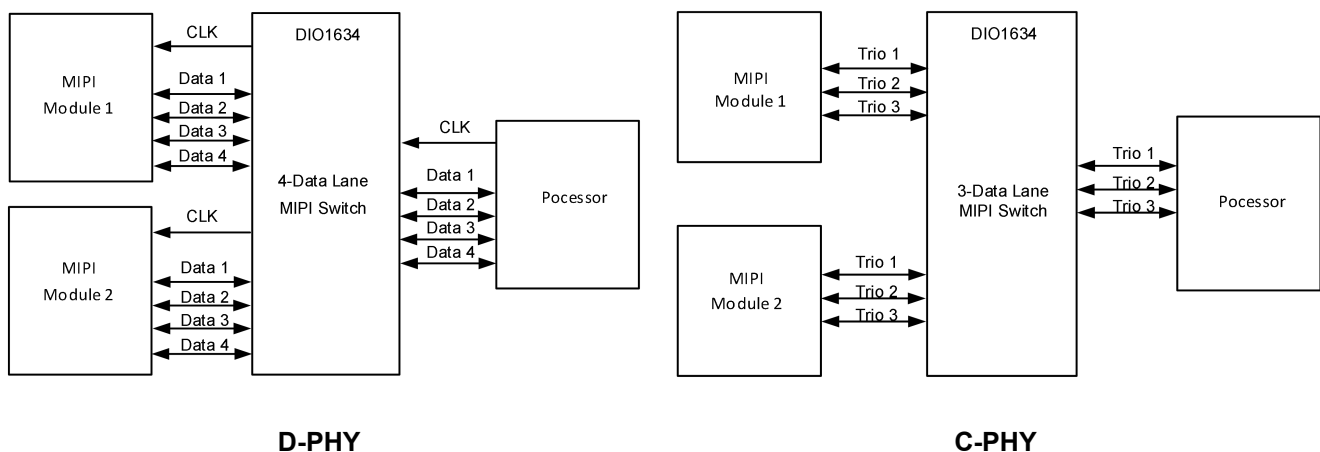


Figure 1. Typical D-PHY / C-PHY application



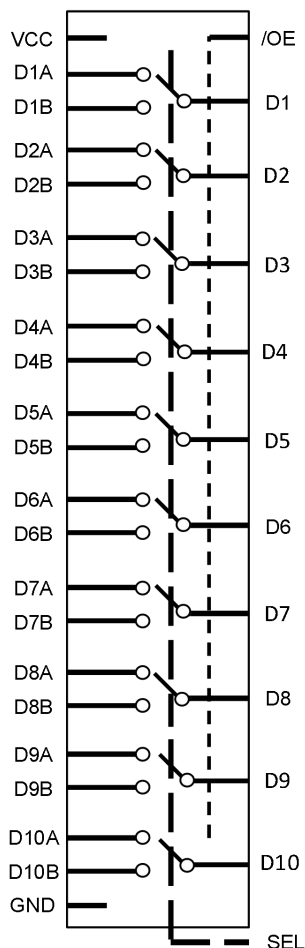
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## Ordering Information

| Ordering Part No. | Top Marking | MSL | RoHS  | T <sub>A</sub> | Package  |                   |
|-------------------|-------------|-----|-------|----------------|----------|-------------------|
| DIO1634WL36       | DR3D        | 1   | Green | -40 to 85°C    | WLCSP-36 | Tape & Reel, 3000 |

## Pin Descriptions



| Pin Name | Description        |         |          |
|----------|--------------------|---------|----------|
| Dn       | Common clock path  |         |          |
| DnA      | Common data path A |         |          |
| DnB      | Common data path B |         |          |
| SEL      | Control pin        | SEL = 0 | Dn = DnA |
|          |                    | SEL = 1 | Dn = DnB |
| /OE      | Output enable      |         |          |
| VCC      | Power              |         |          |
| GND      | Ground             |         |          |

Figure 2. Analog symbol

## Pin Definitions

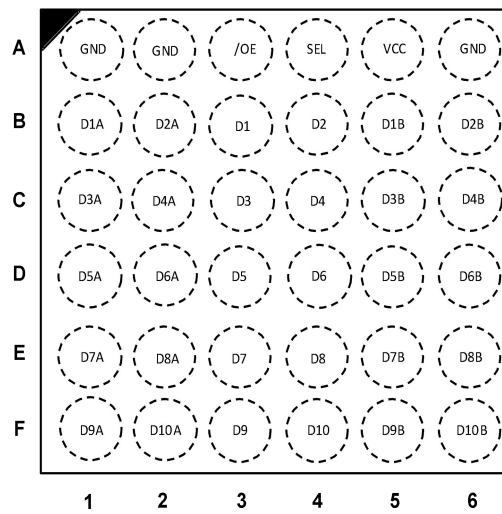


Figure 3. Top through view

| Ball | Pin Name | Ball | Pin Name |
|------|----------|------|----------|
| A1   | GND      | D1   | D5A      |
| A2   | GND      | D2   | D6A      |
| A3   | /OE      | D3   | D5       |
| A4   | SEL      | D4   | D6       |
| A5   | VCC      | D5   | D5B      |
| A6   | GND      | D6   | D6B      |
| B1   | D1A      | E1   | D7A      |
| B2   | D2A      | E2   | D8A      |
| B3   | D1       | E3   | D7       |
| B4   | D2       | E4   | D8       |
| B5   | D1B      | E5   | D7B      |
| B6   | D2B      | E6   | D8B      |
| C1   | D3A      | F1   | D9A      |
| C2   | D4A      | F2   | D10A     |
| C3   | D3       | F3   | D9       |
| C4   | D4       | F4   | D10      |
| C5   | D3B      | F5   | D9B      |
| C6   | D4B      | F6   | D10B     |



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Table 1. Truth table

| SEL  | /OE  | Function                 |
|------|------|--------------------------|
| LOW  | LOW  | Dn = DnA                 |
| HIGH | LOW  | Dn = DnB                 |
| X    | HIGH | All ports high impedance |

## Absolute Maximum Ratings

Stresses beyond those listed under “Absolute Maximum Rating” 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                                 | Ratings    | Unit |
|--------------------|-------------------------------------------|------------|------|
| V <sub>CC</sub>    | Supply voltage                            | -0.5 to 6  | V    |
| V <sub>CNTRL</sub> | DC input voltage                          | -0.5 to 6  | V    |
| V <sub>SW</sub>    | DC switch I/O voltage <sup>(1)</sup>      | -0.5 to 6  | V    |
| I <sub>OUT</sub>   | DC output current                         | Up to 25   | mA   |
| T <sub>STG</sub>   | Storage temperature                       | -65 to 150 | °C   |
| ESD                | HBM (JEDEC EIA/JESD22-A114F for all pins) | ±3.5       | kV   |

### Note:

(1) V<sub>SW</sub> refers to analog data switch paths.

## Recommended 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 <sub>CC</sub>    | Supply voltage                                  |         | 1.65 | 5.0             | V    |
| V <sub>CNTRL</sub> | Control input voltage (SEL, /OE) <sup>(1)</sup> |         | 0    | V <sub>CC</sub> | V    |
| V <sub>SW</sub>    | Switch I/O voltage (Dn, DnA, DnB)               | HS mode | 0    | 5               | V    |
|                    |                                                 | LP mode | 0    | 5               |      |
| T <sub>A</sub>     | Operating temperature                           |         | -40  | 85              | °C   |

### Note:

(1) The control input must be held High or Low; it must not float.



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## DC Electrical Characteristics

Typical values are at  $T_A = 25^\circ\text{C}$ , unless otherwise specified.

| Symbol                     | Parameter                                                      | Test Conditions                                                                                                | $V_{CC}$ (V) | Min  | Typ | Max | Unit          |
|----------------------------|----------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|--------------|------|-----|-----|---------------|
| $V_{IH}$                   | Input voltage high                                             | SEL, /OE at $T_A = 25^\circ\text{C}$                                                                           | 1.65         | 0.95 |     |     | V             |
|                            |                                                                |                                                                                                                | 5.0          | 1.35 |     |     |               |
| $V_{IL}$                   | Input voltage low                                              | SEL, /OE at $T_A = 25^\circ\text{C}$                                                                           | 1.65         |      |     | 0.4 | V             |
|                            |                                                                |                                                                                                                | 5.0          |      |     | 0.4 |               |
| $I_{IN}$                   | Control input leakage (SEL, /OE)                               | $V_{CNTRL} = 0$ to $V_{CC}$ , $T_A = 25^\circ\text{C}$                                                         | 5.0          |      |     | 0.5 | $\mu\text{A}$ |
| $I_{NO(OFF)}, I_{NC(OFF)}$ | Off leakage current of ports (Dn, DnA, DnB)                    | $0\text{ V} \leq V_{SW} \leq 1.3\text{ V}$ , $T_A = 25^\circ\text{C}$                                          | 5.0          | -0.5 |     | 0.5 | $\mu\text{A}$ |
| $I_{A(ON)}$                | On leakage current of common ports (Dn)                        | $0\text{ V} \leq V_{SW} \leq 1.3\text{ V}$ , $T_A = 25^\circ\text{C}$                                          | 5.0          | -0.5 |     | 0.5 | $\mu\text{A}$ |
| $I_{OFF}$                  | Power-off leakage current                                      | $0\text{ V} \leq V_{SW} \leq 1.3\text{ V}$ , $T_A = 25^\circ\text{C}$                                          | 0.0          | -0.5 |     | 0.5 | $\mu\text{A}$ |
| $I_{OZ}$                   | Off-state leakage, /OE = high                                  | $0\text{ V} \leq V_{SW} \leq 1.3\text{ V}$ , $T_A = 25^\circ\text{C}$                                          | 5.0          | -0.5 |     | 0.5 | $\mu\text{A}$ |
| $R_{ON\_MIPI\_HS}$         | Switch on resistance for HS MIPI applications <sup>(1)</sup>   | $I_{ON} = -8\text{ mA}$ , /OE = 0 V, SEL = $V_{CC}$ or 0 V, $T_A = 25^\circ\text{C}$ , $V_{SW} = 0.2\text{ V}$ | 1.65         |      | 7.5 | 10  | $\Omega$      |
|                            |                                                                |                                                                                                                | 5.0          |      |     |     |               |
| $R_{ON\_MIPI\_LP}$         | Switch on resistance for LP MIPI applications <sup>(1)</sup>   | $I_{ON} = -8\text{ mA}$ , /OE = 0 V, SEL = $V_{CC}$ or 0 V, $T_A = 25^\circ\text{C}$ , $V_{SW} = 1.2\text{ V}$ | 1.65         |      | 8.4 | 11  | $\Omega$      |
|                            |                                                                |                                                                                                                | 5.0          |      |     |     |               |
| $\Delta R_{ON\_MIPI\_HS}$  | On resistance matching between HS MIPI channels <sup>(1)</sup> | $I_{ON} = -8\text{ mA}$ , /OE = 0 V, SEL = $V_{CC}$ or 0 V, $V_{SW} = 0.2\text{ V}$                            | 1.65         |      | 0.2 |     | $\Omega$      |
|                            |                                                                |                                                                                                                | 5.0          |      |     |     |               |
| $\Delta R_{ON\_MIPI\_LP}$  | On resistance matching between LP MIPI channels <sup>(1)</sup> | $I_{ON} = -8\text{ mA}$ , /OE = 0 V, SEL = $V_{CC}$ or 0 V, $V_{SW} = 1.2\text{ V}$                            | 1.65         |      | 0.2 |     | $\Omega$      |
|                            |                                                                |                                                                                                                | 5.0          |      |     |     |               |
| $R_{ON\_FLAT\_MIPI\_HS}$   | On resistance flatness for HS MIPI signals <sup>(1)</sup>      | $I_{ON} = -8\text{ mA}$ , /OE = 0 V, SEL = $V_{CC}$ or 0 V, $0.1\text{ V} \leq V_{SW} \leq 0.3\text{ V}$       | 1.65         |      | 1.1 |     | $\Omega$      |
|                            |                                                                |                                                                                                                | 5.0          |      |     |     |               |
| $R_{ON\_FLAT\_MIPI\_LP}$   | On resistance flatness for LP MIPI signals <sup>(1)</sup>      | $I_{ON} = -8\text{ mA}$ , /OE = 0 V, SEL = $V_{CC}$ or 0 V, $0\text{ V} \leq V_{SW} \leq 1.3\text{ V}$         | 1.65         |      | 0.4 |     | $\Omega$      |
|                            |                                                                |                                                                                                                | 5.0          |      |     |     |               |
| $I_{CCZ}$                  | Quiescent Hi-Z supply current                                  | SEL = $V_{CC}$ or 0 V, $I_{OUT} = 0$ , /OE = $V_{CC}$ , $T_A = 25^\circ\text{C}$                               | 5            |      |     | 0.5 | $\mu\text{A}$ |
| $I_{CC}$                   | Quiescent supply current                                       | SEL = $V_{CC}$ or 0 V, $I_{OUT} = 0$ , /OE = 0, $T_A = 25^\circ\text{C}$                                       | 5            |      | 26  | 35  | $\mu\text{A}$ |
| $I_{CCT}$                  | Increase in $I_{CC}$ current per control voltage and $V_{CC}$  | SEL = $V_{CC}$ or 0 V, /OE = 1.65 V, $T_A = 25^\circ\text{C}$                                                  | 5            |      |     | 1   | $\mu\text{A}$ |



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### Note:

- (1) Measured by the voltage drop between A and B pins at the indicated current through the switch. On resistance is determined by the lower of the voltage on the two (A or B ports).
- (2) Specifications subject to change without notice.

## AC Electrical Characteristics

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

| Symbol     | Parameter                                   | Test Conditions                                                                       | $V_{CC}$ (V) | Min | Typ | Max | Unit          |
|------------|---------------------------------------------|---------------------------------------------------------------------------------------|--------------|-----|-----|-----|---------------|
| $t_{INIT}$ | Initialization time $V_{CC}$ to output      | $R_L = 50\ \Omega$ , $V_{SW} = 0.6\text{ V}$                                          | 3.3          |     | 40  |     | $\mu\text{s}$ |
| $t_{EN}$   | Enable turn-on time, /OE to output          | $R_L = 50\ \Omega$ , $V_{SW} = 0.6\text{ V}$                                          | 3.3          |     | 40  |     | $\mu\text{s}$ |
| $t_{DIS}$  | Disable turn-off time, /OE to output        | $R_L = 50\ \Omega$ , $V_{SW} = 0.6\text{ V}$                                          | 3.3          |     | 50  |     | ns            |
| $t_{ON}$   | Turn-on time, SEL to output                 | $R_L = 50\ \Omega$ , $V_{SW} = 0.6\text{ V}$                                          | 3.3          |     | 880 |     | ns            |
| $t_{OFF}$  | Turn-off time, SEL to output                | $R_L = 50\ \Omega$ , $V_{SW} = 0.6\text{ V}$                                          | 3.3          |     | 60  |     | ns            |
| $t_{BBM}$  | Break-before-make time                      | $R_L = 50\ \Omega$ , $V_{SW} = 0.6\text{ V}$                                          | 3.3          |     | 320 |     | ns            |
| $O_{IRR}$  | Off isolation for MIPI <sup>(1)</sup>       | $R_L = 50\ \Omega$ , $f = 1250\text{ MHz}$ , /OE = High, $V_{SW} = 0.2\text{ V}_{PP}$ | 1.8          |     | -25 |     | dB            |
| BW         | -3 dB differential bandwidth <sup>(1)</sup> | $R_L = 50\ \Omega$ , $C_L = 0\text{ pF}$ , $V_{SW} = 0.2\text{ V}_{PP}$               | 1.8          |     | 6   |     | GHz           |
| $X_{TALK}$ | Crosstalk for MIPI <sup>(1)</sup>           | $R_L = 50\ \Omega$ , $f = 1250\text{ MHz}$ , SEL = High, $V_{SW} = 0.2\text{ V}_{PP}$ | 3.3          |     | -30 |     | dB            |
|            |                                             | $R_L = 50\ \Omega$ , $f = 1250\text{ MHz}$ , SEL = Low, $V_{SW} = 0.2\text{ V}_{PP}$  |              |     | -30 |     |               |

### Note:

- (1) Guaranteed by characterization.
- (2) Specifications subject to change without notice.

## Capacitance

| Symbol   | Parameter      | Conditions                                                 | Min | Typ | Max | Unit |
|----------|----------------|------------------------------------------------------------|-----|-----|-----|------|
| $C_{ON}$ | On capacitance | $V_{CC} = 3.3\text{ V}$ , /OE = 0 V, $f = 1250\text{ MHz}$ |     | 1.7 |     | pF   |

### Note:

- (1) Specifications subject to change without notice.

## Typical Performance Characteristics

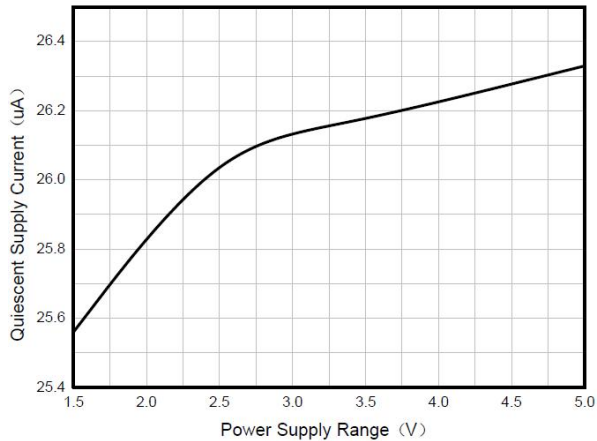


Figure 4. Quiescent supply current

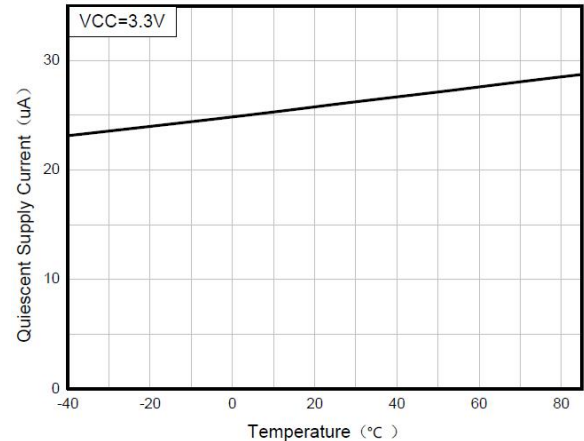


Figure 5. Quiescent supply current vs. Temperature

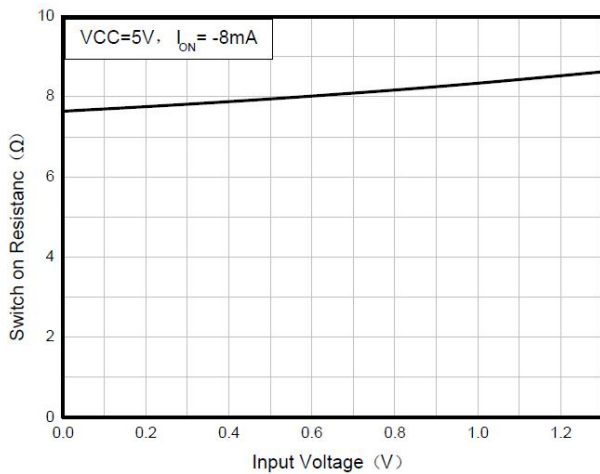


Figure 6. Switch on resistance vs. Input voltage

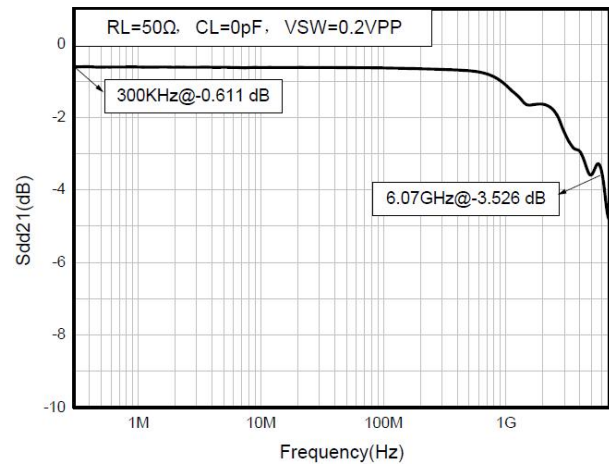


Figure 7. Differential -3 dB bandwidth

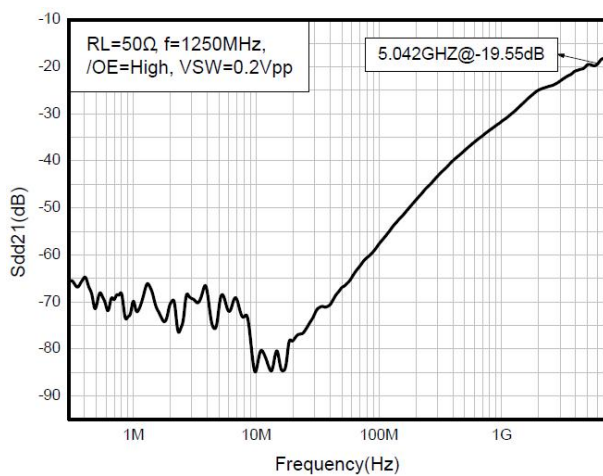
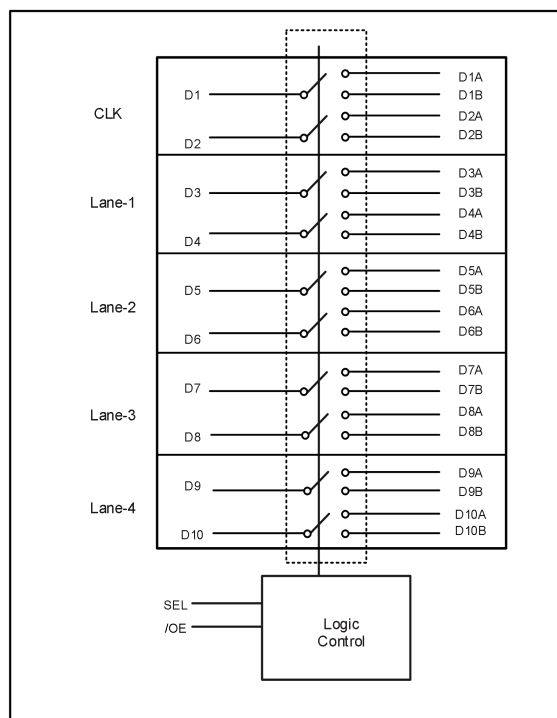
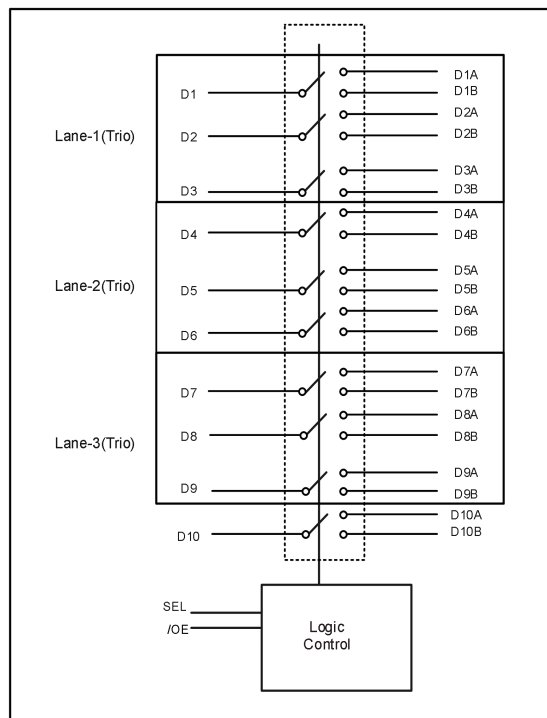


Figure 8. Differential off isolation

### Block Diagram

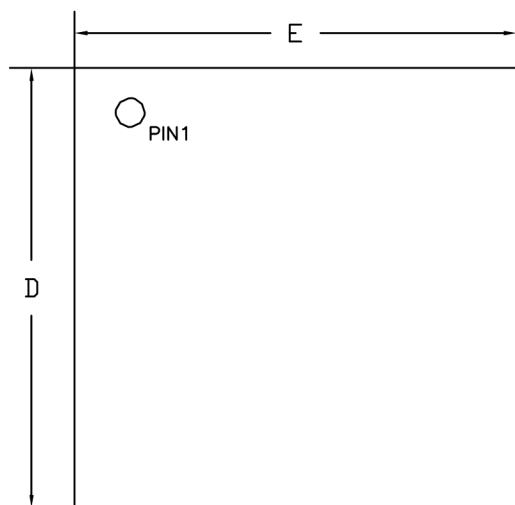


D-PHY

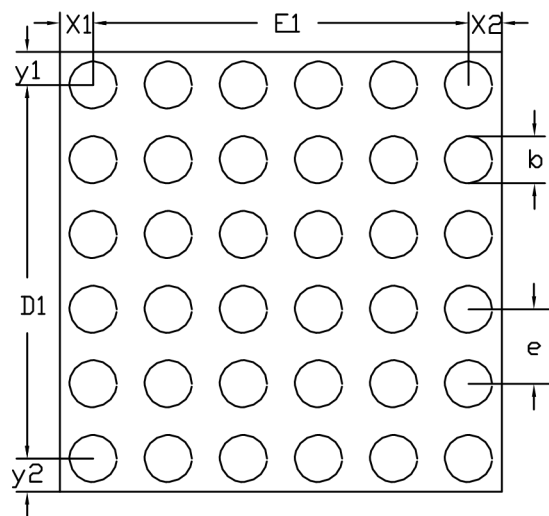


C-PHY

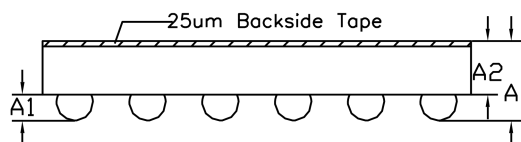
### Physical Dimensions: WLCSP-36 (0.35 mm pitch)



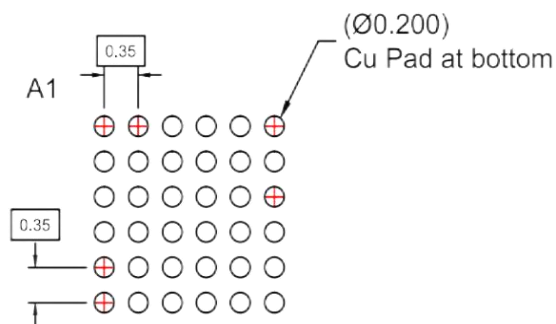
TOP VIEW  
(MARK SIDE)



BOTTOM VIEW  
(BALL SIDE)



SIDE VIEW



Recommended Land Pattern

| Common Dimensions<br>(Units of measure = Millimeter) |           |       |       |
|------------------------------------------------------|-----------|-------|-------|
| Symbol                                               | Min       | Nom   | Max   |
| A                                                    | 0.391     | 0.432 | 0.473 |
| A1                                                   | 0.130     | 0.150 | 0.170 |
| A2                                                   | 0.261     | 0.282 | 0.303 |
| D                                                    | 2.030     | 2.060 | 2.090 |
| D1                                                   | 1.750 BSC |       |       |
| E                                                    | 2.030     | 2.060 | 2.090 |
| E1                                                   | 1.750 BSC |       |       |
| b                                                    | 0.197     | 0.217 | 0.237 |
| e                                                    | 0.350 BSC |       |       |
| x1                                                   | 0.155 REF |       |       |
| x2                                                   | 0.155 REF |       |       |
| y1                                                   | 0.155 REF |       |       |
| y2                                                   | 0.155 REF |       |       |



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## **CONTACT US**

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