DIO1648

10 Channels (4-Data plus 1-Clock Pairs)

3.5 Gbps Differential MIPI Switch

Description

The DIO1648 is a 4-data lane plus 1-clock pairs MIPI switch. This device is an optimized 10 channels (5 differential) single-pole, double-throw (SPDT) switch for high speed applications.

The DIO1648 is designed to facilitate multiple MIPI compliant devices to connect to a single CSI or DSI module. The device has an excellent bandwidth, low channel-to-channel skew with little signal degradation.

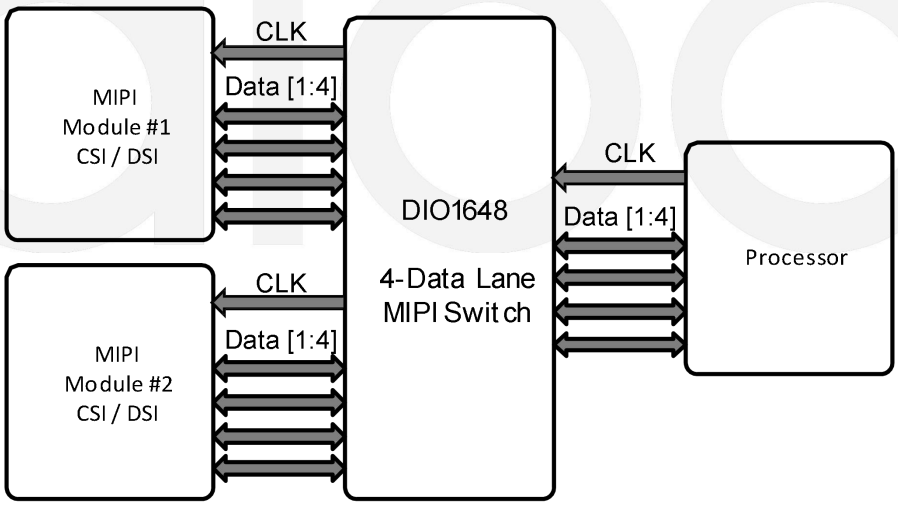
Features

- Input voltage range: 1.65 V to 5 V
- Input signals: 0 to 1.3 V
- DIFF BW: 3.5 GHz
- Switch type: SPDT (10 channels)
- Signal types: MIPI, D-PHY
- R_{ON}: 7.5 Ω typical HS MIPI
  8.4 Ω typical LP MIPI
- I_{CCZ}: 1 μA maximum
- I_{CC}: 25 μA typical
- O_{IRR}: -25 dB typical
- Xtalk: -30 dB typical
- C_{ON}: 1.5 pF typical
- Operating temperature：-40 to 85°C
- Package: 36-ball WLCSP (0.4 mm pitch)

Applications

- Cellular phones, smart phones
- Displays
- Tablets
- Laptops

Typical Application



Ordering Information

Part No.	Top Marking	RoHS	T_A	Package	
DIO1648WL36	1648	Green	-40 to 85°C	WLCSP-36	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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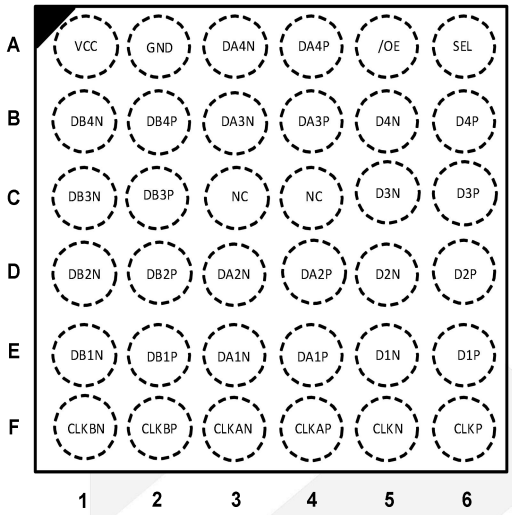
1. Pin Assignment and Functions



WLCSP
Top view

Pin No.	Name	Description		
F5, F6	$CLK_{P/N}$	Common clock path.		
E5, E6	$D1_{P/N}$	Common data path 1.		
D5, D6	$D2_{P/N}$	Common data path 2.		
C5, C6	$D3_{P/N}$	Common data path 3.		
B5, B6	$D4_{P/N}$	Common data path 4.		
F3, F4	$CLKA_{P/N}$	A-side clock path.		
E3, E4	$DA1_{P/N}$	A-side data path 1.		
D3, D4	$DA2_{P/N}$	A-side data path 2.		
B3, B4	$DA3_{P/N}$	A-side data path 3.		
A3, A4	$DA4_{P/N}$	A-side data path 4.		
F1, F2	$CLKB_{P/N}$	B-side clock path.		
E1, E2	$DB1_{P/N}$	B-side data path 1.		
D1, D2	$DB2_{P/N}$	B-side data path 2.		
C1, C2	$DB3_{P/N}$	B-side data path 3.		
B1, B2	$DB4_{P/N}$	B-side data path 4.		
A6	SEL	Control pin; Do not float.	SEL = 0	CLKP = CLKAP, CLKN = CLKAN, Dn(P/N) = DAn (P/N)
			SEL = 1	CLKP = CLKBP, CLKN = CLKBN, Dn(P/N) = DBn (P/N)
A5	/OE	Output enable. Do not float.		
A1	V_{CC}	Power.		
A2	GND	Ground.		
C3, C4	NC	Do not connect externally.		

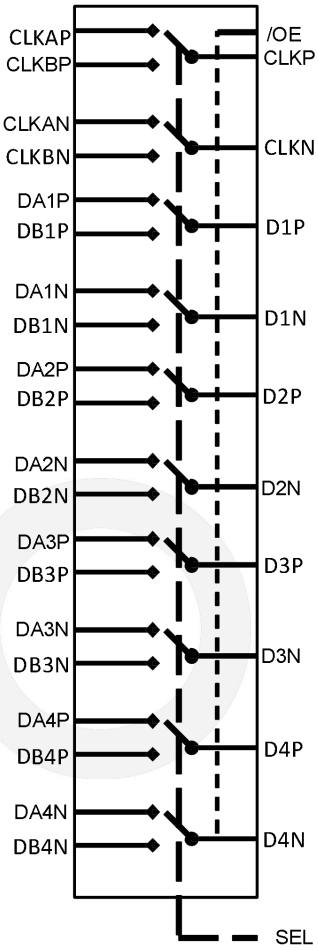


Figure 1. Analog symbol

Table 1. Truth table DB2N

SEL	/OE	Function
LOW	LOW	$CLK_P = CLKA_P$, $CLK_N = CLKA_N$, Dn(P/N) = DAn (P/N)
HIGH	LOW	$CLK_P = CLKB_P$, $CLK_N = CLKB_N$, Dn(P/N) = DBn (P/N)
X	HIGH	Clock and data ports high impedance

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	Ratings	Unit
V_{CC}	Supply voltage	-0.5 ~ 6	V
V_{CNTRL}	DC input voltage (/OE)[1]	-0.5 ~ 6	V
V_{SW}	DC analog data switch I/O voltage[1]	-0.5 ~ 6	V
I_{IK}	DC input diode current	-50	mA
I_{OUT}	DC output current	25	mA
T_{STG}	Storage temperature	-65 ~ 150	°C

Note:

[1] The input and output negative ratings may be exceeded if the input and output diode current ratings are observed.

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		Ratings	Unit
V_{CC}	Supply voltage		1.65 ~ 5.0	V
V_{CNTRL}	Control input voltage (SEL, /OE)		0 ~ V_{CC}	V
V_{SW}	Switch I/O voltage (CLKN, CLKAN, CLKBN, DN, DAN, DBN)	HS mode	0 ~ 0.3	V
		LP mode	0 ~ 1.3	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
Human body model	ANSI/ESDA/JEDEC JS-001	2000	V

5. Thermal Considerations

The thermal resistance determines the heat insulation property of a material. The higher the thermal resistance is, the lower the heat loss. Accumulation of heat energy degrades the performance of semiconductor components.

Symbol	Standard	Value	Unit
$R_{\theta JA}$	Junction-to-ambient thermal resistance (JEDEC/JESD 51-2)	57.6	°C/W

6. Electrical Characteristics

6.1. DC electrical characteristics

The typical values are obtained under these conditions unless otherwise specified: T_A = 25°C.

Symbol	Parameter	Test Conditions	V_{CC} (V)	Min	Typ	Max	Unit
V_{IK}	Clamp diode voltage	I_{IN} = -18 mA	1.65	-1.0		-0.75	V
V_{IH}	Input voltage high	SEL, /OE	1.8	0.825			V
			3.3	0.85			V
			5.0	1.1			V
V_{IL}	Input voltage low	SEL, /OE	1.8			0.4	V
			3.3			0.4	V
			5.0			0.4	V
I_{IN}	Control input leakage (SEL, /OE)	V_{CNTRL} = 0 to V_{CC}	5.0			0.5	uA
$I_{NO(OFF)}$, $I_{NC(OFF)}$	Off leakage current of port CLKAN, DAN, CLKBN, DBN	V_{SW} = 0 ≤ Data ≤ 1.3 V	5.0	-0.5		0.5	uA
$I_{A(ON)}$	On leakage current of common ports (CLKN, DN)	V_{SW} = 0 ≤ Data ≤ 1.3 V	5.0	-0.5		0.5	uA
I_{OZ}	Off-state leakage, /OE = High	V_{SW} = 0 ≤ Data ≤ 1.3 V	5.0	-0.5		0.5	uA
$R_{ON\_MIPI\_HS}$	Switch on resistance for HS MIPI applications[1]	I_{ON} = -8 mA, /OE = 0 V, SEL = V_{CC} or 0 V, CLKA, B, DBn or DAn = 0.2 V	1.65		7.5	10	Ω
			2.5				
			3.3				
			5.0				
$R_{ON\_MIPI\_LP}$	Switch on resistance for LP MIPI applications[1]	I_{ON} = -8 mA, /OE = 0 V, SEL = V_{CC} or 0 V, CLKA, B, DBn or DAn = 1.2 V	1.65		8.4	11	Ω
			2.5				
			3.3				
			5.0				
$\triangle R_{ON\_MIPI\_HS}$	On resistance matching between HS MIPI channels[1]	I_{ON} = -8 mA, /OE = 0 V, SEL = V_{CC} or 0 V, CLKA, B, DBn or DAn = 0.2 V	1.65		0.2		Ω
			2.5				
			3.3				
			5.0				
$\triangle R_{ON\_MIPI\_LP}$	On resistance matching between LP MIPI channels[1]	I_{ON} = -8 mA, /OE = 0 V, SEL = V_{CC} or 0 V, CLKA, B, DBn or DAn = 1.2 V	1.65		0.2		Ω
			2.5				
			3.3				
			5.0				
$R_{ON\_FLAT\_MIPI\_HS}$	On resistance flatness for HS MIPI signals[1]	I_{ON} = -8 mA, /OE = 0 V, SEL = V_{CC} or 0 V, CLKA, B, DBn or DAn = 0.1 to 0.3 V	1.65		0.5		Ω
			2.5				
			3.3				
			5.0				

$R_{ON\_FLAT\_MIPI\_LP}$	On resistance flatness for LP MIPI signals[1]	I_{ON} = -8 mA, /OE = 0 V, SEL = V_{CC} or 0 V, CLKA, B, DBn or DAn = 0 to 1.3 V	1.65 2.5 3.3 5.0		1		Ω
I_{CCZ}	Quiescent supply current (high impedance)	V_{SEL} = 0 or V_{CC}, I_{OUT} = 0, /OE = V_{CC}	5			1	μA
I_{CC}	Quiescent supply current (includes charge pump)	V_{SEL} = 0 or V_{CC}, I_{OUT} = 0, /OE = 0	5		25	35	μA
I_{CCT}	Increase in I_{CC} current per control voltage and V_{CC}	V_{SEL} = 0 or V_{CC}, /OE = 1.65 V	5		1		μA

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).

6.2. AC electrical characteristics

The typical values are obtained under these conditions unless otherwise specified: V_{CC} = 3.3 V,T_A = 25°C.

Symbol	Parameter	Test Conditions	V_{CC}(V)	Min	Typ	Max	Unit
t_{INIT}	Initialization time V_{CC} to output[1]	R_L = 50 Ω, C_L = 0 pF, V_{SW} = 0.6 V	3.3		45		μs
t_{EN}	Enable turn-on time, /OE to output	R_L = 50 Ω, C_L = 0 pF, V_{SW} = 0.6 V	3.3		40	100	μs
t_{DIS}	Disable turn-off time, /OE to output	R_L = 50 Ω, C_L = 0 pF, V_{SW} = 0.6 V	3.3		80	100	ns
t_{ON}	Turn-on time, SEL to output	R_L = 50 Ω, C_L = 0 pF, V_{SW} = 0.6 V	3.3		900	1100	ns
t_{OFF}	Turn-off time, SEL to output	R_L = 50 Ω, C_L = 0 pF, V_{SW} = 0.6 V	3.3		90	200	ns
t_{BBM}	Break-before-make time	R_L = 50 Ω, C_L = 0 pF, V_{SW} = 0.6 V	3.3	50		750	ns
t_{PD}	Propagation delay[1]	R_L = 50 Ω, C_L = 5 pF	3.3		0.3		ns
O_{IRR}	Off isolation for MIPI[1]	R_L = 50 Ω, f = 1250 MHz, /OE = High, V_{SW} = 0.2 Vpp	1.65 to 5		-25		dB
X_{TALK}	Crosstalk for MIPI[1]	R_L = 50 Ω, f = 1250 MHz, SEL = High, V_{SW} = 0.2 Vpp	1.65 to 5		-30	-20	dB
		R_L = 50 Ω, f = 1250 MHz, SEL = Low, V_{SW} = 0.2 Vpp			-30	-20	
BW	-3 dB bandwidth[1]	R_L = 50 Ω, C_L = 0 pF, V_{SW} = 0.2 V_{PP}	1.65 to 5	2.5	3.5		GHz

Note:

[1] Parameter guaranteed by design and characterization; not subjected to production test.

6.3. Capacitance

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
C_{IN}	Control pin input capacitance[1]	V_{CC} = 0 V, f = 1 MHz		2.2		pF
C_{ON}	On capacitance[1]	V_{CC} = 3.3 V, /OE = 0 V, f = 1250 MHz (in HS common value)		1.5		
C_{OFF}	Off capacitance[1]	V_{CC} and /OE = 3.3 V, f = 1250 MHz (both sides in HS common value)		1		

Note:

[1] Parameter guaranteed by design and characterization; not subjected to production test.

7. Typical Performance Characteristics

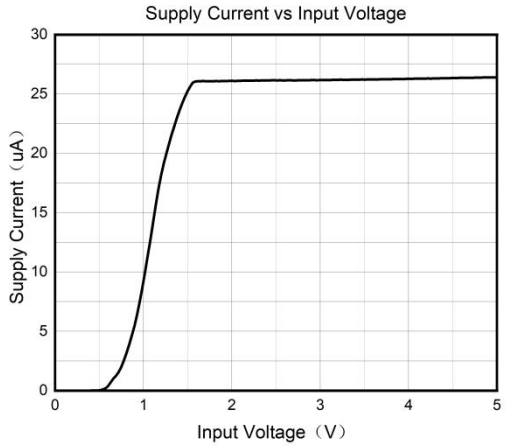


Figure 2. Supply current vs. Input voltage

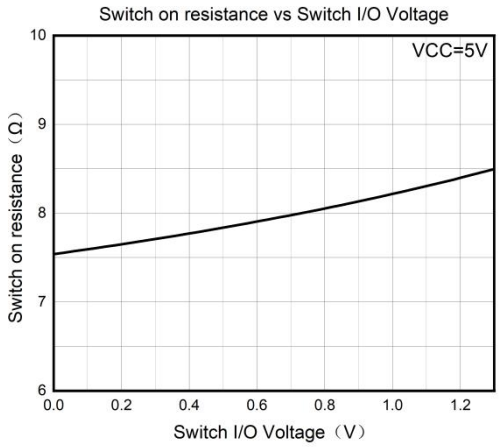


Figure 3. Switch on resistance vs. Switch I/O voltage

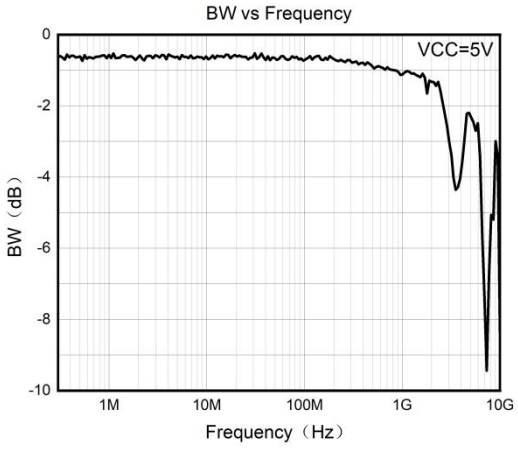
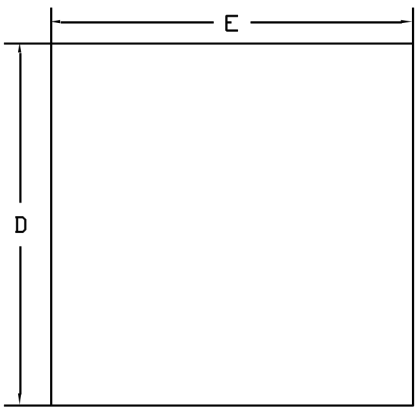
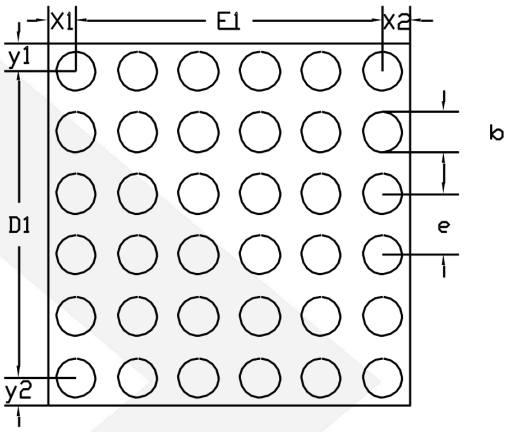


Figure 4. Bandwidth vs. Frequency

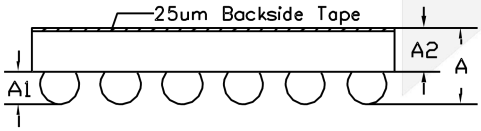
8. Physical Dimensions: WLCSP-36



TOP VIEW
(MARK SIDE)



BOTTOM VIEW
(BALL SIDE)



SIDE VIEW

Common Dimensions (Units of Measure = Millimeter)			
Symbol	**Min**	**Nom**	**Max**
A	0.455	0.500	0.545
A1	0.190	0.210	0.230
A2	0.265	0.290	0.315
D	2.340	2.370	2.400
D1		2.000 BSC	
E	2.340	2.370	2.400
E1		2.000 BSC	
b	0.238	0.258	0.278
e		0.400 BSC	
x1		0.185 REF	
x2		0.185 REF	
y1		0.185 REF	
y2		0.185 REF	

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