

DIO1644

MIPI D-PHY (1.5Gbps) 10 Channels SPDT Switch

Features

- Input Voltage Range: 1.65V to 4.5V
- Input Signals: 0 to VCC
- Bandwidth: 1.5GHz Min
- Switch Type SPDT (10 channels)
- Signal Types MIPI, D-PHY
- R_{ON} : 6 Ω Typical HS MIPI
8 Ω Typical LP MIPI
- I_{CCZ} : 0.5 μ A Max
- I_{CC} : 45 μ A Max
- Xtalk: -30dB Typ
- OIRR: -22dB Typ
- C_{ON} : 4.2pF
- Operating Temperature: -40 to 85 $^{\circ}$ C
- Package: 36-Ball WLCSP

Descriptions

The DIO1644 is a 4-Data lane plus 1-Clock pairs MIPI switch. This device is an optimized 10 channels (5 differential) single-pole, double-throw switch for high speed applications.

The DIO1644 is designed to facilitate multiple MIPI compliant devices to connect to a single CSI or DSI module.

The device has excellent bandwidth, low channel to channel skew with little signal degradation.

Applications

- Cellular Phones, Smart Phones
- Displays

Typical Application

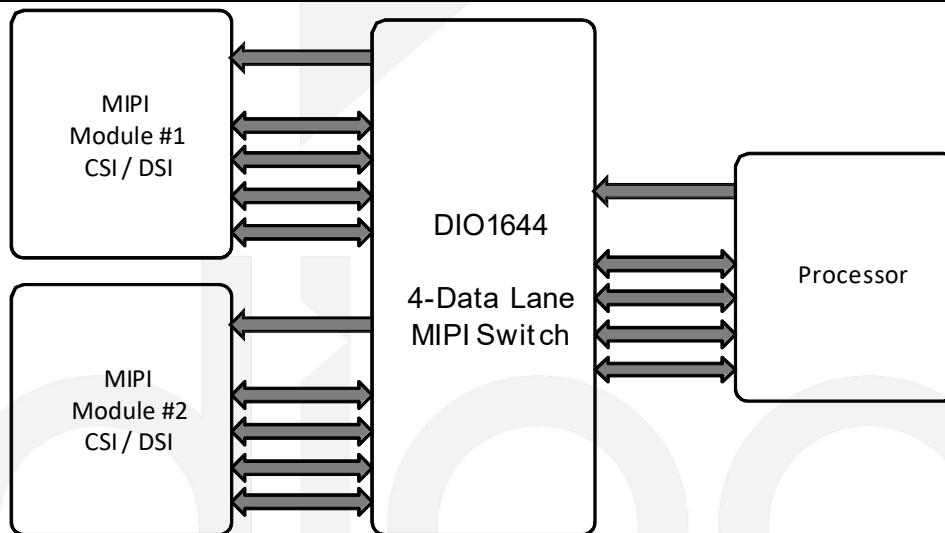


Figure 1 Typical Application

Ordering Information

Order Part Number	Top Marking		T_A	Package	
DIO1644WL36	1644	Green	-40 to 85 $^{\circ}$ C	WLCSP-36 0.4mm pitch	Tape & Reel, 3000

Pin Descriptions

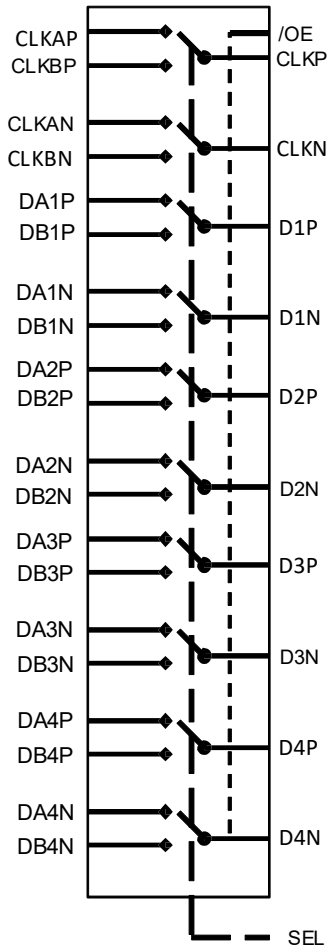
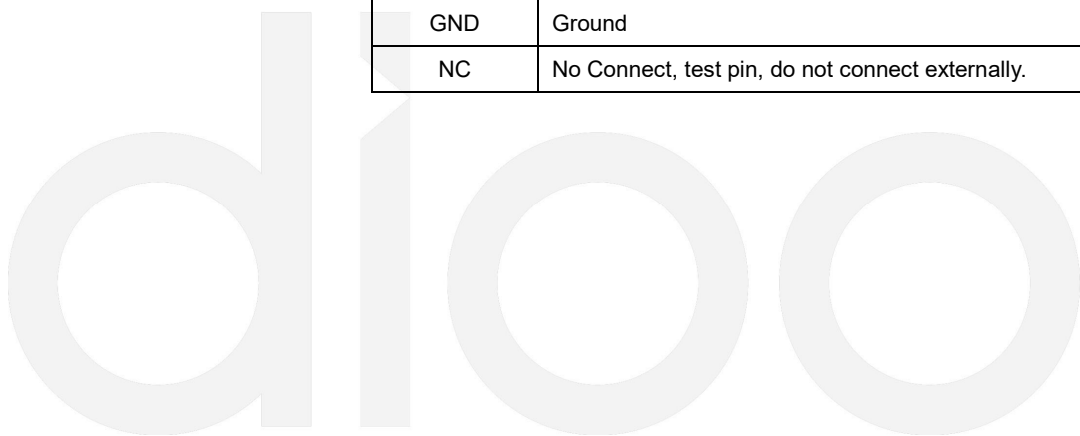


Figure 2 Analog Symbol

Pin Name	Description		
CLK _{P/N}	Common Clock Path		
D1 _{P/N}	Common Data Path 1		
D2 _{P/N}	Common Data Path 2		
D3 _{P/N}	Common Data Path 3		
D4 _{P/N}	Common Data Path 4		
CLKA _{P/N}	A-Side Clock Path		
DA1 _{P/N}	A-Side Data Path 1		
DA2 _{P/N}	A-Side Data Path 2		
DA3 _{P/N}	A-Side Data Path 3		
DA4 _{P/N}	A-Side Data Path 4		
CLKB _{P/N}	B-Side Clock Path		
DB1 _{P/N}	B-Side Data Path 1		
DB2 _{P/N}	B-Side Data Path 2		
DB3 _{P/N}	B-Side Data Path 3		
DB4 _{P/N}	B-Side Data Path 4		
SEL	Control Pin	SEL=0	CLKP=CLKAP, CLKN=CLKAN Dn(P/N)=DAn(P/N)
		SEL=1	CLKP=CLKBP, CLKN=CLKBN Dn(P/N)=DBn(P/N)
/OE	Output Enable		
V _{CC}	Power		
GND	Ground		
NC	No Connect, test pin, do not connect externally.		



Pin Definitions

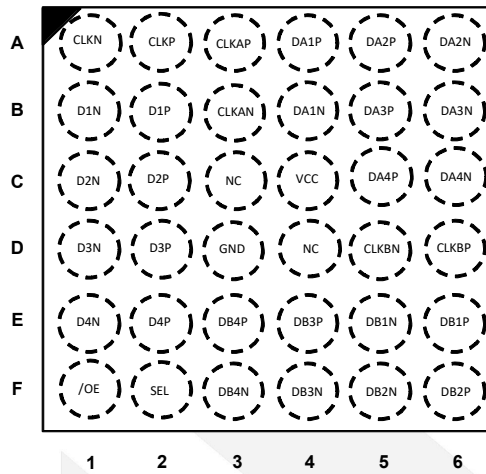


Figure 3 Top Through View

Ball	Pin Name	Ball	Pin Name
A1	CLK _N	D1	D3 _N
A2	CLK _P	D2	D3 _P
A3	CLKA _P	D3	GND
A4	DA1 _P	D4	NC
A5	DA2 _P	D5	CLKB _N
A6	DA2 _N	D6	CLKB _P
B1	D1 _N	E1	D4 _N
B2	D1 _P	E2	D4 _P
B3	CLKA _N	E3	DB4 _P
B4	DA1 _N	E4	DB3 _P
B5	DA3 _P	E5	DB1 _N
B6	DA3 _N	E6	DB1 _P
C1	D2 _N	F1	/OE
C2	D2 _P	F2	SEL
C3	NC	F3	DB4 _N
C4	V _{CC}	F4	DB3 _N
C5	DA4 _P	F5	DB2 _N
C6	DA4 _N	F6	DB2 _P

Truth Table

SEL	/OE	Function
LOW	LOW	CLK _P =CLKA _P , CLK _N =CLKA _N , D _n (P/N)=DA _n (P/N)
HIGH	LOW	CLK _P =CLKB _P , CLK _N =CLKB _N , D _n (P/N)=DB _n (P/N)
X	HIGH	DA _n (P/N), DB _n (P/N) Data Ports High Impedance



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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	Min	Max	Unit
V _{CC}	Supply Voltage	-0.5	5.25	V
V _{CNTRL}	DC Input Voltage (/OE) ⁽¹⁾	-0.5	V _{CC}	V
V _{SW}	DC Switch I/O Voltage ⁽¹⁾	-0.5	5.25	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	All Pins	3.5	kV

Note:

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

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 _{CC}	Supply Voltage	1.65	4.50	V	
V _{CNTRL}	Control Input Voltage (S, /OE) ⁽²⁾	0	V _{CC}	V	
V _{SW}	Switch I/O Voltage (CLKn, CLKAn, CLKBn, Dn, DAn, DBn)	HS Mode	0.1	0.3	V
		LP Mode	0	1.2	
T _A	Operating Temperature	-40	85	°C	

Note:

- 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°C unless otherwise specified.

Symbol	Parameter	Test Conditions	V _{CC} (V)	Min	Typ	Max	Unit
V _{IK}	Clamp Diode Voltage	I _{IN} =-18mA	2.8			-1.28	V
V _{IH}	Input Voltage High		1.65 to 4.50	1.0			V
V _{IL}	Input Voltage Low		1.65 to 4.50			0.4	V
I _{IN}	Control Input Leakage (SEL, /OE)	V _{SW} =0 to V _{CC}	1.65 to 4.50	-100		100	nA
I _{NO(OFF)} , I _{NC(OFF)}	Off Leakage Current of Port CLKAn, DAN, CLKBn, DBn	CLKn, Dn=0.3V; V _{CC} -0.3V; CLKAn, DAN, or CLKBn; DBn=V _{CC} -0.3V, 0.3V, or Floating; /OE=0V	1.65 to 4.50	-100		100	nA
I _{A(ON)}	On Leakage Current of Common Ports (CLKn, Dn)	CLKn, Dn=0.3V; V _{CC} -0.3V; CLKAn, DAN, or CLKBn; DBn=V _{CC} -0.3V, 0.3V, or Floating; /OE=0V	1.65 to 4.50	-100		100	nA
I _{OZ}	Off-State Leakage	0 ≤ CLKn, Dn, CLKAn, CLKBn, DAN, DBn ≤ 3.6V, /OE=High	4.5	-100		100	nA
R _{ON_MIPI_HS}	Switch On Resistance for HS MIPI Applications ⁽³⁾	I _{ON} =-10mA, /OE=0V, SEL=V _{CC} or 0V, CLK _{A,B} , DBn or DAN=0.1, 0.2, 0.3	1.8		6	10	Ω
			2.5		6	9	
			3.6		6	9	
			4.5		6	9	
R _{ON_MIPI_LP}	Switch On Resistance for LP MIPI Applications ⁽³⁾	I _{ON} =-10mA, /OE=0V, SEL=V _{CC} or 0V, CLK _{A,B} , DBn or DAN=0, 0.6, 1.2V	1.8		6.4	11	Ω
			2.5		6.4	10	
			3.6		6.2	9	
			4.5		6.0	9	
ΔR _{ON_MIPI_HS}	On Resistance Matching Between HS MIPI Channels ⁽⁴⁾	I _{ON} =-10mA, /OE=0V, SEL=V _{CC} or 0V, CLK _{A,B} , DBn or DAN=0.1, 0.2, 0.3	1.8		0.8		Ω
			2.5		0.6		
			3.6		0.5		
			4.5		0.5		
ΔR _{ON_MIPI_LP}	On Resistance Matching Between LP MIPI Channels ⁽⁴⁾	I _{ON} =-10mA, /OE=0V, SEL=V _{CC} or 0V, CLK _{A,B} , DBn or DAN=0, 0.6, 1.2V	1.8		1.0		Ω
			2.5		0.6		
			3.6		0.4		
			4.5		0.4		
R _{ON_FLAT_MIPI_HS}	On Resistance Flatness for HS MIPI Signals ⁽⁴⁾	I _{ON} =-10mA, /OE=0V, SEL=V _{CC} or 0V, CLK _{A,B} , DBn or DAN=0.1, 0.2, 0.3	1.8		0.5		Ω
			2.5		0.5		
			3.6		0.3		
			4.5		0.2		



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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
$R_{ON_FLAT_M}$ I_{PL_LP}	On Resistance Flatness for LP MIPI Signals ⁽⁴⁾	$I_{ON}=-10\text{mA}$, $/OE=0V$, $SEL=V_{CC}$ or $0V$, $CLK_{A,B}$, DBn or $DAn=0, 0.6, 1.2V$	1.8		0.6		Ω
			2.5		0.6		
			3.6		0.5		
			4.5		0.5		
I_{CCZ}	Quiescent Hi-Z Supply Current	$V_{IN}=0$ or V_{CC} , $I_{OUT}=0$	4.5			0.5	μA
I_{CC}	Quiescent Supply Current	$V_{IN}=0$ or V_{CC} , $I_{OUT}=0$	2.5 to 4.5		32	45	μA
			1.8			31	
I_{CCT}	Increase in I_{CC} Current Per Control Voltage and V_{CC}	$V_{SEL}/OE=1.65V$	4.5			3	μA
			2.5			0.1	

Note:

- 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).
- Guaranteed by characterization.

AC Electrical Characteristics

All typical values are for $V_{CC}=3.3V$ 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 VCC to Output ⁽⁵⁾	$R_L=50\Omega$, $C_L=5\text{pF}$, $V_{SW}=1.2V$	2.5 to 4.5			235	μs
			1.8			364	
t_{EN}	Enable Turn-On Time, $/OE$ to Output	$R_L=50\Omega$, $C_L=5\text{pF}$, $V_{SW}=1.2V$	2.5 to 4.5		150	180	μs
			1.8		170	300	
t_{DIS}	Disable Turn-Off Time, $/OE$ to Output	$R_L=50\Omega$, $C_L=5\text{pF}$, $V_{SW}=1.2V$	2.5 to 4.5		150	300	ns
			1.8		150	300	
t_{ON}	Turn-On Time, SEL to Output	$R_L=50\Omega$, $C_L=5\text{pF}$, $V_{SW}=1.2V$	2.5 to 4.5		420	610	ns
			1.8		475	640	
t_{OFF}	Turn-Off Time, SEL to Output	$R_L=50\Omega$, $C_L=5\text{pF}$, $V_{SW}=1.2V$	2.5 to 4.5		223	275	ns
			1.8		237	301	
t_{BBM}	Break-Before-Make Time	$R_L=50\Omega$, $C_L=5\text{pF}$, $V_{SW}=1.2V$		115	180		ns
O_{IRR}	Off Isolation for MIPI ⁽⁵⁾	$R_L=50\Omega$, $f=750\text{MHz}$, $/OE=V_{CC}$, $V_{SW}=-1\text{dBm}$ (200mVpp)	1.65 to 4.5		-22		dB
X_{TALK}	Crosstalk for MIPI ⁽⁵⁾	$R_L=50\Omega$, $f=750\text{MHz}$, $V_{SW}=-1\text{dBm}$ (200mVpp)	1.65 to 4.5		-30		dB
BW	-3dB Bandwidth ⁽⁵⁾	$R_L=50\Omega$, $C_L=0\text{pF}$	3.0	1500	2000		MHz
S_{DD21}	Differential Data Rate	Inter-operability Data Rate	3.0		1.5		Gbps

Note: 5. Guaranteed by characterization.



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High-Speed-Related AC Electrical Characteristics

Symbol	Parameter	Test Conditions	V _{CC} (V)	Min	Typ	Max	Unit
t _{SK(O)}	Channel-to-Channel Single-Ended Skew ⁽⁶⁾	TDR-Based Method (V _{SW} =0.2V _{PP} , C _L =C _{ON})	3.3		6	20	ps
t _{SK(P)}	Skew of Opposite Transitions of the Same Output ⁽⁶⁾	TDR-Based Method (V _{SW} =0.2V _{PP} , C _L =C _{ON})	3.3		6	20	ps

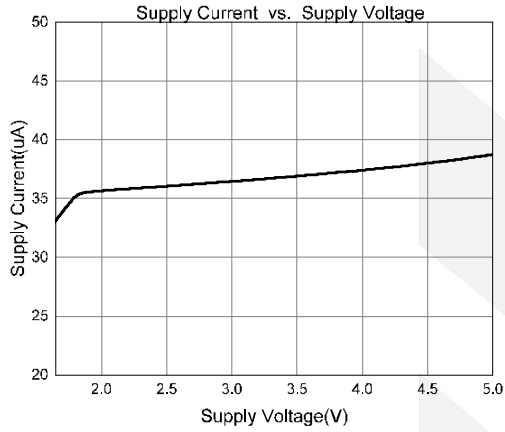
Capacitance

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
C _{IN}	Control Pin Input Capacitance	V _{CC} =0V, f=1MHz		1.7		pF
C _{ON}	Out On Capacitance	V _{CC} =3.3V, /OE=0V, f=1MHz		5.0		
C _{OFF}	Out Off Capacitance	V _{CC} and /OE=3.3V, f=1MHz		1.9		

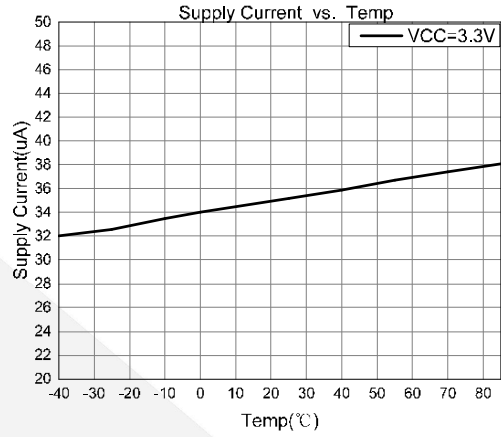


Typical Performance Characteristics

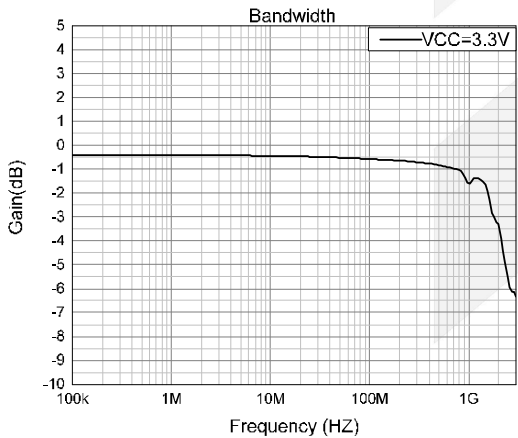
I_{CC} vs. V_{CC}



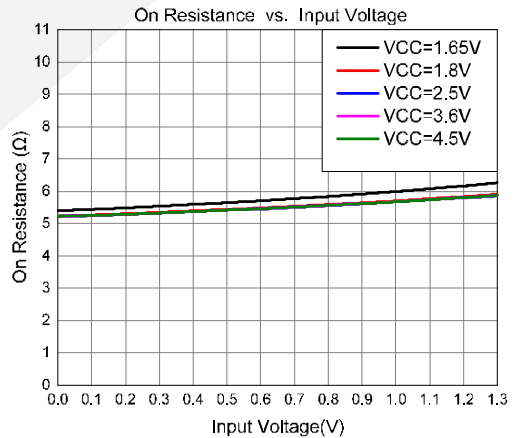
I_{CC} vs. Temperature



Bandwidth



On Resistance vs. Input Voltage





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CONTACT US

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