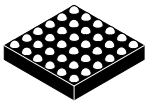
2:1 MIPI D-PHY (2.5 Gbps) 4-Data Lane & C-PHY (2.5 Gsps) 3-Data Lane Switch

FSA646



(Bottom View)

WLCSP36, 2.43x2.43x0.4
CASE 567WJ

MARKING DIAGRAM

GS = Specific Device Code
KK = Assembly Lot
X = Year
Y = Work Week
Z = Assembly Location
J– = X– Coordinates with dash as separator*
P = Y Coordinates*
UU = Two Digit Wafer ID*
*For **onsemi** internal use only.

ORDERING INFORMATION

See detailed ordering and shipping information on page 7 of this data sheet.

Description

The FSA646 is a four−data−lane D−PHY or three−data−lane C−PHY, MIPI switch. This single−pole, double−throw (SPDT) switch is optimized for switching between two high−speed or low−power MIPI sources. The FSA646 is designed for the MIPI specification and allows connection to a SCI or DSI module.

Features

- Switch Type: SPDT (10x)
- Signal Types:
  - MIPI, D−PHY & C−PHY
- V_{CC}: 1.5 to 5.0 V
- Input Signals: 0 to 1.3 V
- R_{ON}:
  - 6 Ω Typical HS MIPI
  - 6 Ω Typical LP MIPI
- ΔR_{ON}: 0.1 Ω Typical LP & HS MIPI
- ΔR_{ON_FLAT}: 0.9 Ω Typical LP & HS MIPI
- I_{CCZ}: 1 μA Maximum
- I_{CC}: 32 μA Typical
- O_{IRR}: −24 dB Typical
- Bandwidth: 4.1 GHz Typical
- Xtalk: −30 dB Typical
- C_{ON}: 1.5 pF Typical
- Skew (P), Skew (O): 6 ps Typical
- This is a Pb−Free Device

Applications

- Cellular Phones, Smart Phones
- Tablets
- Laptops
- Displays

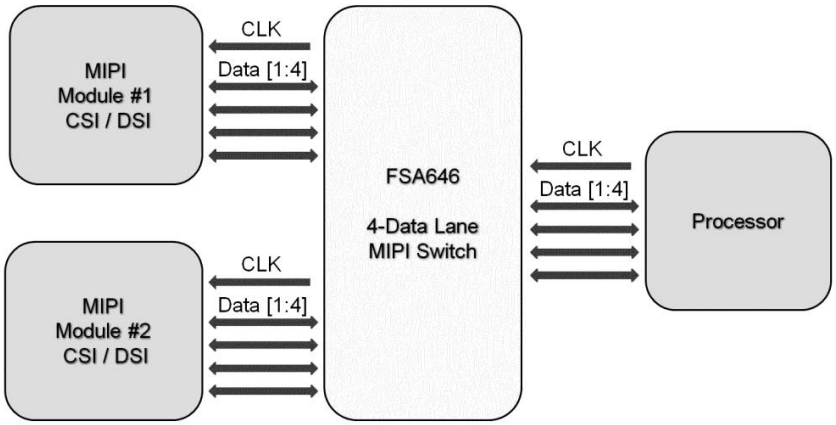
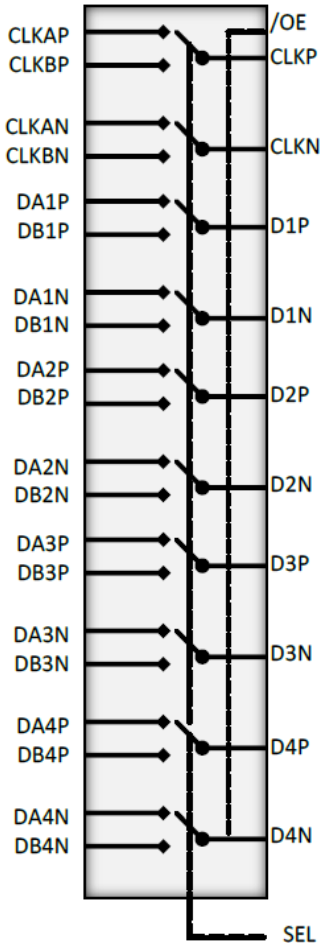


Figure 1. Typical D−PHY Application

PIN DESCRIPTIONS



Pin Name	Description		
CLKBP/N	B Side Clock Path		
DB1P/N	B Side Data Path 1		
DB2P/N	B Side Data Path 2		
DB3P/N	B Side Data Path 3		
DB4P/N	B Side Data Path 4		
CLKAP/N	A Side Clock Path		
DA1P/N	A Side Data Path 1		
DA2P/N	A Side Data Path 2		
DA3P/N	A Side Data Path 3		
DA4P/N	A Side Data Path 4		
CLKP/N	Common Clock Path		
D1P/N	Common Data Path 1		
D2P/N	Common Data Path 2		
D3P/N	Common Data Path 3		
D4P/N	Common Data Path 4		
/OE	Output Enable		
SEL	Control Pin	SEL=0	CLKP/N=CLKAP/N, DnP/N=DAnP/N
		SEL=1	CLKP/N=CLKBP/N, DnP/N=DBnP/N
VCC	Power		
GND	Ground		
NC	No Connect		

Figure 2. Analog Symbol

PIN DEFINITIONS

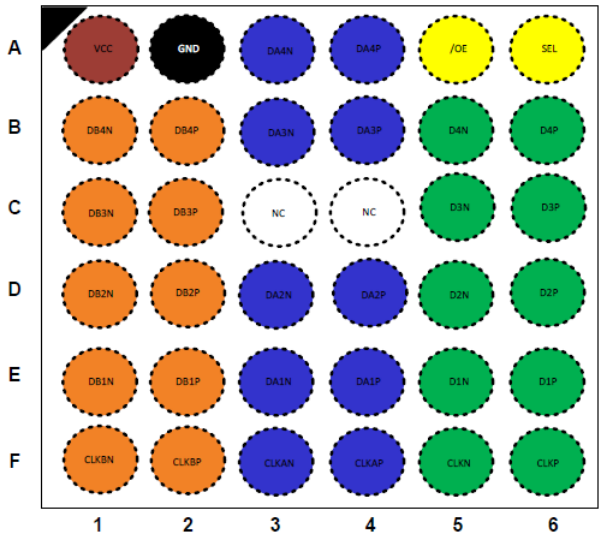


Figure 3. Top Through View

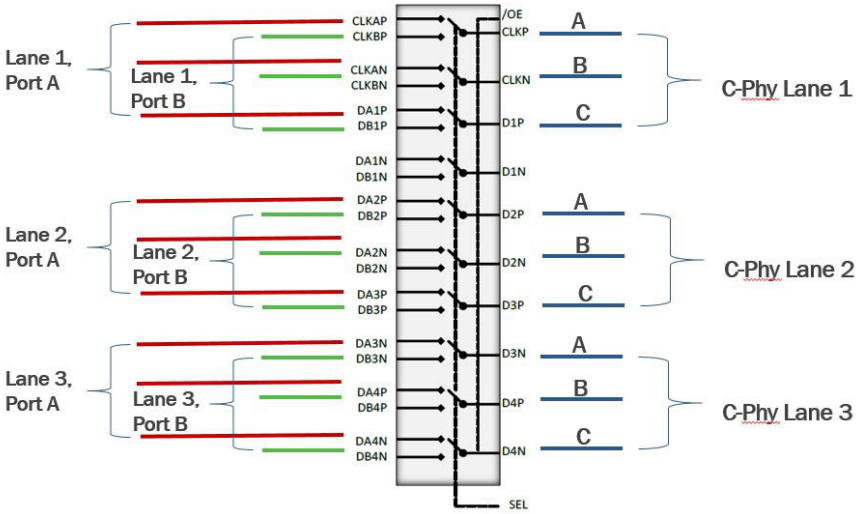


Figure 4. Recommended C−PHY Configuration

Table 1. BALL−TO−PIN MAPPINGS

Ball	Pin Name	Ball	Pin Name	Ball	Pin Name
A1	V_{CC}	C1	DB3N	E1	DB1N
A2	GND	C2	DB3P	E2	DB1P
A3	DA4N	C3	NC	E3	DA1N
A4	DA4P	C4	NC	E4	DA1P
A5	/OE	C5	D3N	E5	D1N
A6	SEL	C6	D3P	E6	D1P
B1	DB4N	D1	DB2N	F1	CLKBN
B2	DB4P	D2	DB2P	F2	CLKBP
B3	DA3N	D3	DA2N	F3	CLKAN
B4	DA3P	D4	DA2P	F4	CLKAP
B5	D4N	D5	D2N	F5	CLKN
B6	D4P	D6	D2P	F6	CLKP

TRUTH TABLE

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

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter		Min.	Max.	Unit
V_{CC}	Supply Voltage		−0.5	6.0	V
V_{CNTRL}	DC Input Voltage (/OE, SEL) (Note 1)		−0.5	V_{CC}	V
V_{SW}	DC Switch I/O Voltage (Note 1,2)		−0.3	1.8	V
I_{IK}	DC Input Diode Current		−50		mA
I_{OUT}	DC Output Current			25	mA
T_{STG}	Storage Temperature		−65	+150	°C
ESD	Human Body Model, JEDEC: JESD22−A114	All Pins	2.0		kV
	Charged Device Model, JEDEC: JESD22−C101		1.0		
	IEC 61000−4−2 System	Contact	8.0		
		Air Gap	15.0		

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.
1. The input and output negative ratings may be exceeded if the input and output diode current ratings are observed.
2. V_{SW} refers to analog data switch paths.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter		Min.	Max.	Unit
V_{CC}	Supply Voltage		1.5	5.0	V
V_{CNTRL}	Control Input Voltage (SEL, /OE) (Note 3)		0	V_{CC}	V
V_{SW}	Switch I/O Voltage (CLKn, Dn, CLKAn, CLKBn, Dan, DBn)	−HS Mode	0	0.3	V
		−LS Mode	0	1.3	V
T_A	Operating Temperature		−40	+85	°C

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.
3. The control inputs must be held HIGH or LOW; they must no float.

DC AND TRANSIENT CHARACTERISTICS (T_A = 25°C unless otherwise specified)

Symbol	Parameter	Conditions	V_{CC} (V)	T_A = −40 to +85°C			Unit
				Min.	Typ.	Max.	
V_{IK}	Clamp Diode Voltage (/OE, SEL)	I_{IN} = −18 mA	1.5	−1.2		−0.6	V
V_{IH}	Input Voltage High	SEL, /OE	1.5 to 5	1.3			V
V_{IL}	Input Voltage Low	SEL, /OE	1.5 to 5			0.5	V
I_{IN}	Control Input Leakage (/OE, SEL)	V_{CNTRL} = 0 to V_{CC}	5	−0.5		0.5	μA
$I_{NO(OFF)}$ $I_{NC(OFF)}$	Off Leakage Current of Port CLKAn, Dan, CLKBn and DBn	V_{SW} = 0.0 ≤ DATA ≤ 1.3 V	5	−0.5		0.5	μA
$I_{A(ON)}$	ON Leakage Current of Common Ports (CLKn, Dn)	V_{SW} = 0.0 ≤ DATA ≤ 1.3 V	5	−0.5		0.5	μA
I_{OFF}	Power−Off Leakage Current (All I/O Ports)	V_{SW} = 0.0 or 1.3 V	0	−0.5		0.5	μA
I_{OZ}	Off−State Leakage	V_{SW} = 0.0 ≤ DATA ≤ 1.3 V /OE = High	5	−0.5		0.5	μA
$R_{ON\_MIPI\_HS}$	Switch On Resistance for HS MIPI Applications (Note 4)	I_{ON} = −8 mA, /OE = 0 V, SEL = V_{CC} or 0 V, CLKA, CLKB, DB_N or DA_N = 0.2 V	1.5		6		Ω
			2.5				
			3.3				
			5				
$R_{ON\_MIPI\_LP}$	Switch On Resistance for LP MIPI Applications (Note 4)	I_{ON} = −8 mA, /OE = 0 V, SEL = V_{CC} or 0 V, CLKA, CLKB, DB_N or DA_N = 1.2 V	1.5		6		Ω
			2.5				
			3.3				
			5				
$\Delta R_{ON\_MIPI\_HS}$	On Resistance Matching Between HS MIPI Channels (Note 4)	I_{ON} = −8 mA, /OE = 0 V, SEL = V_{CC} or 0 V, CLKA, CLKB, DB_N or DA_N = 0.2 V	1.5		0.1		Ω
			2.5				
			3.3				
			5				
$\Delta R_{ON\_MIPI\_LP}$	On Resistance Matching Between LP MIPI Channels (Note 4)	I_{ON} = −8 mA, /OE = 0 V, SEL = V_{CC} or 0 V, CLKA, CLKB, DB_N or DA_N = 1.2 V	1.5		0.1		Ω
			2.5				
			3.3				
			5				
$R_{ON\_FLAT\_MIPI\_HS}$	On Resistance Flatness for HS MIPI Signals (Note 4)	I_{ON} = −8 mA, /OE = 0 V, SEL = V_{CC} or 0 V, CLKA, CLKB, DB_N or DA_N = 0 to 0.3 V	1.5		0.9		Ω
			2.5				
			3.3				
			5				
$R_{ON\_FLAT\_MIPI\_LP}$	On Resistance Flatness for LP MIPI Signals (Note 4)	I_{ON} = −8 mA, /OE = 0 V, SEL = V_{CC} or 0 V, CLKA, CLKB, DB_N or DA_N = 0 to 1.3 V	1.5		0.9		Ω
			2.5				
			3.3				
			5				
I_{CC}	Quiescent Supply Current (Includes Change Pump)	V_{SEL} = 0 or V_{CC}, I_{OUT} = 0, /OE = 0 V	5			30	μA

DC AND TRANSIENT CHARACTERISTICS (T_A = 25°C unless otherwise specified) (continued)

Symbol	Parameter	Conditions	V_{CC} (V)	T_A = −40 to +85°C			Unit
				Min.	Typ.	Max.	
I_{CCZ}	Quiescent Supply Current (High Impedance)	V_{SEL} = 0 or V_{CC}, I_{OUT} = 0, /OE = 0 V	5			1	μA
I_{CCT}	Increase in I_{CC} Current Per Control Voltage and V_{CC}	V_{SEL} = 0 or V_{CC}, /OE = 1.5 V	5		1		μA

4. 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).

AC ELECTRICAL CHARACTERISTICS (V_{CC} = 3.3 V and T_A = 25°C unless otherwise specified)

Symbol	Parameter	Conditions	V_{CC} (V)	T_A = −40 to +85°C			Unit
				Min.	Typ.	Max.	
t_{INIT}	Initialization Time V_{CC} to Output (Note 5)	R_L = 50 Ω, C_L = 0 pF, V_{SW} = 0.6 V	1.5 to 5		60		μs
t_{EN}	Enable Time /OE to Output	R_L = 50 Ω, C_L = 0 pF, V_{SW} = 0.6 V	1.5 to 5		60	150	μs
t_{DIS}	Disable Time /OE to Output	R_L = 50 Ω, C_L = 0 pF, V_{SW} = 0.6 V	1.5 to 5		35	250	ns
t_{ON}	Turn−On Time SEL to Output	R_L = 50 Ω, C_L = 0 pF, V_{SW} = 0.6 V	1.5 to 5		350	1100	ns
t_{OFF}	Turn−Off Time SEL to Output	R_L = 50 Ω, C_L = 0 pF, V_{SW} = 0.6 V	1.5 to 5		125	800	ns
t_{BBM}	Break−Before−Make Time	R_L = 50 Ω, C_L = 0 pF, V_{SW} = 0.6 V	1.5 to 5	50		450	ns
t_{PD}	Propagation Delay (Note 5)	C_L = 0 pF, R_L = 50 Ω	1.5 to 5	30	67	100	ps
O_{IRR}	Off Isolation for MIPI (Note 5)	R_L = 50 Ω, f = 1250 MHz, /OE = HIGH, V_{SW} = 0.2 V_{PP}	1.5 to 5		−24		dB
X_{TALK}	Crosstalk for MIPI (Note 5)	R_L = 50 Ω, f = 1250 MHz, SEL = High, V_{SW} = 0.2 V_{PP}	1.5 to 5		−30	−25	dB
		R_L = 50 Ω, f = 1250 MHz, SEL = Low, V_{SW} = 0.2 V_{PP}			−30	−25	
BW	−3 db Bandwidth (Note 5)	R_L = 50 Ω, C_L = 0 pF, V_{SW} = 0.2 V_{PP}	1.5 to 5	2.5	4.1		GHz
IL	Insertion Loss at 750 MHz (Note 5)	R_L = 50 Ω, C_L = 0 pF, V_{SW} = 0.2 V_{PP}	1.5 to 5		−0.7		dB

5. Guaranteed by characterization.

HIGH−SPEED−RELATED AC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Conditions	V_{CC} (V)	T_A = −40 to +85°C			Unit
				Min.	Typ.	Max.	
$t_{SK(P)}$	HS Mode Skew of Opposite Transitions of the Same Output (Note 6)	R_L = 50 Ω, C_L = 0 pF, V_{SW} = 0.3 V	1.5 to 5		6		ps
$t_{SK(O)}$	HS Mode Skew of Channel−to−Channel Single−Ended Skew (Note 6)	R_L = 50 Ω, C_L = 0 pF, V_{SW} = 0.3 V	1.5 to 5		6		ps

6. Guaranteed by characterization.

CAPACITANCE

Symbol	Parameter	Conditions	T_A = −40 to +85°C			Unit
			Min.	Typ.	Max.	
C_{IN}	Control Pin Input Capacitance (Note 7)	V_{CC} = 0 V, f = 1 MHz		2.1		pF
C_{ON}	On Capacitance (Note 7)	V_{CC} = 3.3 V, /OE = 0 V, f = 1250 MHz (in HS common value)		1.5		
C_{OFF}	On Capacitance (Note 7)	V_{CC} and /OE = 3.3 V, f = 1250 MHz (both sides in HS common value)		0.9		

7. Guaranteed by characterization.

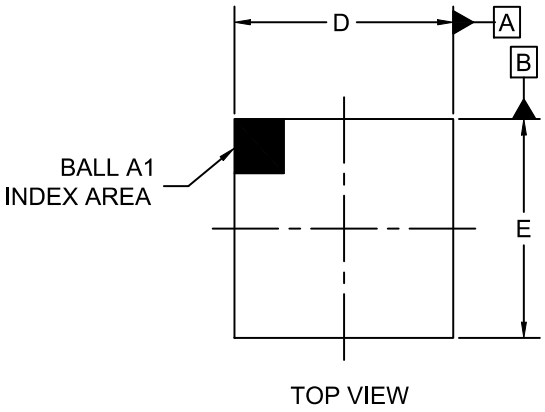
The table below pertains to the Packaging information on the following page.

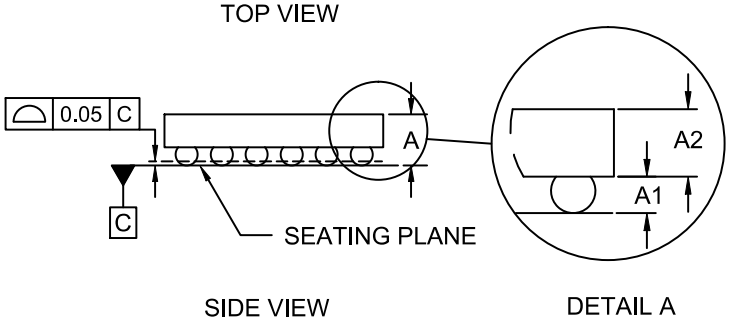
ORDERING INFORMATION

Part Number	Top Marking	Package	Top Mark
FSA646UCX	−40 to +85°C	36−Ball WLCSP, Non−JEDEC 2.43 x 2.43 mm, 0.4 mm Pitch	GS

WLCSP36 2.43x2.43x0.488
CASE 567WJ
ISSUE A

DATE 03 OCT 2018

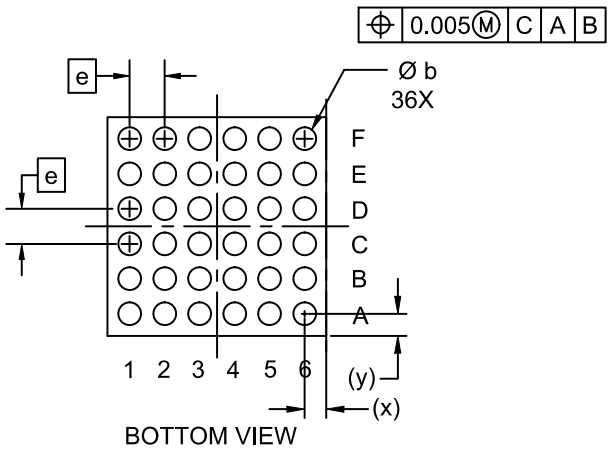


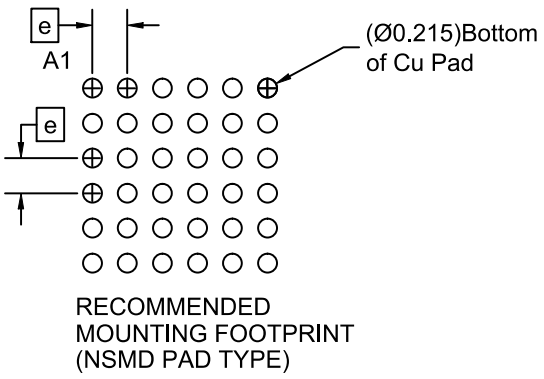


NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DATUM C APPLIES TO THE SPHERICAL CROWN OF THE SOLDER BALLS

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	0.450	0.488	0.526
A1	0.176	0.196	0.216
A2	0.274	0.292	0.310
b	0.240	0.260	0.280
D	2.400	2.430	2.460
E	2.400	2.430	2.460
e	0.40 BSC		
x	0.200	0.215	0.230
y	0.200	0.215	0.230





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