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## FSA644 — 2:1 MIPI D-PHY (1.5Gbps) 4-Data Lane Switch

#### Features

Switch Type	SPDT (10x)
Signal Types	MIPI, D-PHY
Vcc	1.65 to 4.5 V
Input Signals	0 to V <sub>CC</sub>
Ron	6 Ω Typical HS MIPI 8 Ω Typical LP MIPI
ΔR <sub>ON</sub>	0.6 Ω Typical HS & LP MIPI
R <sub>ON_FLAT</sub>	0.3 Ω Typical
I <sub>CCZ</sub>	0.5 µA Maximum
Icc	32 µA Maximum
O <sub>IRR</sub>	-40 dB Typical
X <sub>TALK</sub>	-25 dB Typical
Bandwidth	1100 MHz Minimum
Channel-to-Channel Skew	6 ps Typical
C <sub>ON</sub>	5.2 pF
Operating Temperature	-40 to +85°C
Package	36-Ball WLCSP
FSA644UCX Top Mark	M7
Ordering Information	FSA644UCX
FSA644BUCX Top Mark	KM
Ordering Information	FSA644BUCX

#### Description

The FSA644 is a four-data-lane, MIPI, D-PHY switch. This single-pole, double-throw (SPDT) switch is optimized for switching between two high-speed or low-power MIPI sources. The FSA644 is designed for the MIPI specification and allows connection to a CSI or DSI module.

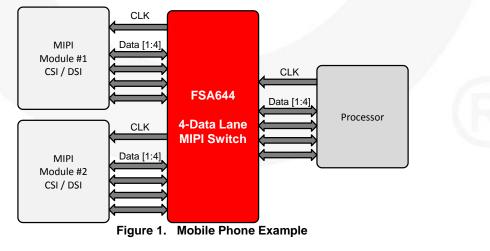
#### **Applications**

- Cellular Phones, Smart Phones
- Displays

#### **Related Resources**

FSA644 Demonstration Board

#### **Typical Application**



#### © 2011 Fairchild Semiconductor Corporation FSA644 • Rev. 2

Pin	Descriptions

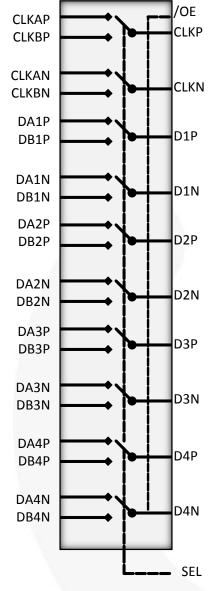


Figure 2. Analog Symbol

Pin Name			Description		
CLK <sub>P/N</sub>	Commo	Common Clock Path			
D1 <sub>P/N</sub>	Commo	n Data Pa	ath 1		
D2 <sub>P/N</sub>	Commo	n Data Pa	ath 2		
D3 <sub>P/N</sub>	Commo	n Data Pa	ath 3		
D4 <sub>P/N</sub>	Commo	n Data Pa	ath 4		
CLKA <sub>P/N</sub>	A-Side (	Clock Path	n		
DA1 <sub>P/N</sub>	A-Side I	Data Path	1		
DA2 <sub>P/N</sub>	A-Side I	Data Path	2		
DA3 <sub>P/N</sub>	A-Side I	A-Side Data Path 3			
DA4 <sub>P/N</sub>	A-Side I	A-Side Data Path 4			
CLKB <sub>P/N</sub>	B-Side (	Clock Path	า		
DB1 <sub>P/N</sub>	B-Side I	Data Path	1		
DB2 <sub>P/N</sub>	B-Side I	Data Path	2		
DB3 <sub>P/N</sub>	B-Side I	Data Path	3		
DB4 <sub>P/N</sub>	B-Side I	Data Path	4		
SEL	Control	SEL=0	CLKP=CLKAP, CLKN=CLKAN, Dn(P/N)=DAn(P/N)		
SEL	Pin	SEL=1	CLKP=CLKBP, CLKN=CLKBN, Dn(P/N)=DBn(P/N)		
/OE	Output I	Enable			
V <sub>CC</sub>	Power				
GND	Ground				
NC	No Con	nect			

CLKN	CLKP	CLKAP	DA1P	DA2P	DA2N	Ball	Pin Name
	$\sim$	$\sim$	$\sim$		$\sim$	A1	CLK <sub>N</sub>
D1N	D1P	CLKAN	DA1N	DA3P	DA3N	A2	CLK <sub>P</sub>
1	· · · · · · · · · · · · · · · · · · ·			· · · · · · · · · · · · · · · · · · ·	$\mathbf{x}$	A3	CLKAP
D2N	D2P	NC	vcc	DA4P	DA4N	A4	DA1 <sub>P</sub>
A second	آر م					A5	DA2 <sub>P</sub>
	$\sim$		·····			A6	DA2 <sub>N</sub>
D3N	D3P	GND	NC	CLKBN	СLКВР	B1	D1 <sub>N</sub>
" a server	" a server		· · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·		B2	D1 <sub>P</sub>
						B3	CLKA <sub>N</sub>
D4N	D4P	DB4P	DB3P	DB1N	DB1P	B4	DA1 <sub>N</sub>
						B5	DA3 <sub>P</sub>
/OE	SEL	DB4N	DB3N	DB2N	DB2P	B6	DA3 <sub>N</sub>
* <u>*****</u> **	* <u>*****</u> *	New York	New York			C1	D2 <sub>N</sub>
1	2	3	4	5	6	C2	D2 <sub>P</sub>
						C3	NC
	Figure 3	. Top Th	rough Viev	N		C4	V <sub>cc</sub>
						C5	DA4 <sub>P</sub>
						C6	DA4 <sub>N</sub>
						D1	D3 <sub>N</sub>
						D2	D3 <sub>P</sub>
						D3	GND
						D4	NC
						D5	CLKB <sub>N</sub>
						D6	CLKB <sub>P</sub>
						E1	D4 <sub>N</sub>
						E2	D4 <sub>P</sub>
						E3	DB4 <sub>P</sub>
						E4	DB3 <sub>P</sub>
						E5	DB1 <sub>N</sub>
						E6	DB1 <sub>P</sub>
						F1	/OE
						F2	SEL
						F3	DB4 <sub>N</sub>
						F4	DB3 <sub>N</sub>
						F5	DB2 <sub>N</sub>
						F6	DB2 <sub>P</sub>

SEL	/OE	Function			
LOW	LOW	CLK <sub>P</sub> =CLKA <sub>P</sub> , CLK <sub>N</sub> =CLKA <sub>N</sub> , Dn(P/N)=DAn(P/N)			
HIGH	LOW	$CLK_{P}=CLKB_{P}, CLK_{N}=CLKB_{N}, Dn(P/N)=DBn(P/N)$			
Х	HIGH	DAn(P/N), DBn(P/N) Data Ports High Impedance			

#### **Absolute Maximum Ratings**

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameter		Min.	Max.	Unit
Vcc	Supply Voltage		-0.50	+5.25	V
V <sub>CNTRL</sub>	DC Input Voltage (/OE) <sup>(1)</sup>		-0.5	V <sub>CC</sub>	V
V <sub>SW</sub>	DC Switch I/O Voltage <sup>(1)</sup>		-0.50	5.25	V
I <sub>IK</sub>	DC Input Diode Current		-50		mA
I <sub>OUT</sub>	DC Output Current			50	mA
T <sub>STG</sub>	Storage Temperature		-65	+150	°C
		All Pins		3.5	
	Human Body Model, JEDEC: JESD22-A114	I/O to GND	-0.50 +5.25   -0.5 V <sub>CC</sub> -0.50 5.25   -50 50   -65 +150		
ESD		Power to GND	~	8.0	kV
E3D	Charged Device Model, JEDEC: JESD22-C101			1.5	ĸv
	IEC 61000-4-2 System	Contact		8.0	
		Air Gap		15.0	

Note:

1. 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. Fairchild does not recommend exceeding them or designing to Absolute Maximum Ratings.

Symbol	Parameter	Min.	Max.	Unit	
V <sub>cc</sub>	Supply Voltage		1.65	4.50	V
V <sub>CNTRL</sub>	Control Input Voltage (S, /OE) <sup>(2)</sup>	0	Vcc	V	
N/	Switch I/O Voltage (CLKn, CLKAn, CLKBn, Dn,	HS Mode	0.1	0.3	V
V <sub>SW</sub>	DAn, DBn)	LP Mode	0	1.2	V
T <sub>A</sub>	Operating Temperature		-40	+85	°C

Note:

2. The control input must be held HIGH or LOW; it must not float.

FSA644 — 2:1 MIPI D-PHY (1.5Gbps) 4-Data-Lane Switch

#### **DC Electrical Characteristics**

All typical values are at T<sub>A</sub>=25°C unless otherwise specified.

Symbol	Parameter	Conditions		T <sub>A</sub> =- 4	0°C to	+85°C	Unit
Symbol	Parameter	Conditions	V <sub>cc</sub> (V)	Min.	Тур.	Max.	Uni
VIK	Clamp Diode Voltage	I <sub>IN</sub> =-18 mA	2.8			-1.2	V
VIH	Input Voltage High		1.65 to 4.50	1.0			V
VIL	Input Voltage Low		1.65 to 4.50			0.4	V
I <sub>IN</sub>	Control Input Leakage (SEL,/OE)	$V_{SW}$ =0 to $V_{CC}$	1.65 to 4.50	-100		100	nA
I <sub>NO(OFF)</sub> , I <sub>NC(OFF)</sub>	Off Leakage Current of Port CLKAn, DAn, CLKBn, DBn	CLKn, Dn=0.3 V; $V_{CC}$ -0.3 V; CLKAn, DAn, or CLKBn; DBn= $V_{CC}$ -0.3 V, 0.3 V, or Floating; /OE=0 V	1.65 to 4.50	-100		100	nA
I <sub>A(ON)</sub>	On Leakage Current of Common Ports (CLKn, Dn)	CLKn, Dn = 0.3 V; $V_{CC}$ -0.3 V; CLKAn, DAn, or CLKBn; DBn= $V_{CC}$ -0.3 V, 0.3 V, or Floating; /OE=0 V	1.65 to 4.50	-100		100	nA
I <sub>OFF</sub>	Power-Off Leakage Current	CLKn, Dn, or CLKAn; DAn or CLKBn, DBn; $V_{IN}=0$ V to 4.5 V; $V_{CC}=0$ V	0	-100		100	nA
l <sub>oz</sub>	Off-State Leakage	0 ≤ CLKn, Dn, CLKAn, CLKBn, DAn, DBn ≤ 3.6 V, /OE=High	4.5	-100		100	nA
			1.8		7	12	
	Switch On Resistance for	$I_{ON}$ =-10 mA, /OE=0 V,	2.5		6	9	
KON_MIPI_HS	HS MIPI Applications <sup>(3)</sup>	SEL=V <sub>CC</sub> or 0V, CLK <sub>A, B</sub> , DBn or DAn=0.1, 0.2, 0.3	3.6		6	9	Ω
			4.5		6	9	
	Switch On Resistance for	I <sub>ON</sub> =-10 mA, /OE=0 V, SEL=V <sub>CC</sub> or 0V, CLK <sub>A, B</sub> , DBn or DAn=0, 0.6, 1.2 V	1.8		6.7	12.0	- Ω
Р			2.5		6.4	9.0	
KON_MIPI_LP	LP MIPI Applications <sup>(3)</sup>		3.6		6.2	9.0	
			4.5		6.0	9.0	
			1.8	6	0.8		
	On Resistance Matching Between HS MIPI	$I_{ON}$ =-10 mA, /OE=0 V,	2.5		0.6		Ω
$\Delta \mathbf{R}_{ON_MIPI_HS}$	Channels <sup>(4)</sup>	SEL=V <sub>CC</sub> or 0 V, CLK <sub>A, B</sub> , DBn or DAn=0.1, 0.2, 0.3	3.6		0.5		12
Ioz Ron_mipi_hs Ron_mipi_lp ΔRon_mipi_hs		, - ,	4.5		0.5		
		-	1.8		0.8		
	On Resistance Matching	$I_{ON}$ =-10 mA, /OE=0 V,	2.5		0.6		
$\Delta R_{ON_MIPI_LP}$	Between LP MIPI Channels <sup>(4)</sup>	SEL=V <sub>CC</sub> or 0 V, CLK <sub>A,B</sub> , DBn or DAn= 0.0, 0.6, 1.2 V	3.6		0.5	1	Ω
			4.5		0.5		
			1.8		1.5		
D	On Resistance Flatness for	$I_{ON}$ =-10 mA, /OE=0 V,	2.5		0.5		
R <sub>ON_FLAT_MIPI_HS</sub>	HS MIPI Signals <sup>(4)</sup>	SEL=V <sub>CC</sub> or 0 V, CLK <sub>A, B</sub> , DBn or DAn=0.1, 0.2, 0.3	3.6		0.3		Ω
			4.5		0.2		1
			1.8		3.5		
D	On Resistance Flatness for	$I_{ON}$ =-10 mA, /OE=0 V,	2.5		2		
RON_FLAT_MIPI_LP	LP MIPI Signals <sup>(4)</sup>	SEL=V <sub>CC</sub> or 0 V, CLK <sub>A, B</sub> , DB <sub>n</sub> or DAn=0.0, 0.6, 1.2 V	3.6		1		Ω
			4.5		0.5		1

Continued on the following page ...

#### **DC Electrical Characteristics**

All typical values are at  $T_A=25$ °C unless otherwise specified.

Symbol	Parameter	Conditions		T <sub>A</sub> =- 40°C to +85°C			l lmit
Symbol	Farameter	Conditions	V <sub>cc</sub> (V)	Min.	Тур.	Max.	Unit
I <sub>CCZ</sub>	Quiescent Hi-Z Supply Current	V <sub>IN</sub> =0 or V <sub>CC</sub> , I <sub>OUT</sub> =0	4.5			0.5	μA
1	Quiescent Supply Current	V <sub>IN</sub> =0 or V <sub>CC</sub> , I <sub>OUT</sub> =0	2.5 to 4.5			32	
I <sub>CC</sub>			1.8			22	μA
1	Increase in Icc Current Per		4.5			4	
Ісст	Control Voltage and $V_{CC}$	V <sub>SEL,/OE</sub> =1.65 V	2.5			0.1	μA

Notes:

3. 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).

4. Guaranteed by characterization.

#### **AC Electrical Characteristics**

All typical values are for V<sub>CC</sub>=3.3V at T<sub>A</sub>=25°C unless otherwise specified.

0	Barrata	O and little and	N/ 00	T <sub>A</sub> =-	40°C to +	85°C	Unit
Symbol	Parameter	Conditions	V <sub>cc</sub> (V)	Min.	Тур.	Max.	Unit
	Initalization Time	italization Time	2.5 to 4.5			100	
t <sub>INIT</sub>	V <sub>CC</sub> to Output <sup>(5)</sup>	R <sub>L</sub> =50 Ω, C <sub>L</sub> =5 pF, V <sub>SW</sub> =1.2 V	1.8			150	μs
	Enable Turn-On Time,		2.5 to 4.5		120	200	
t <sub>EN</sub>	/OE to Output	R <sub>L</sub> =50 Ω, C <sub>L</sub> =5 pF, V <sub>SW</sub> =1.2 V	1.8		250	500	ns
	Disable Turn-Off Time,		2.5 to 4.5		25	50	20
t <sub>DIS</sub>	/OE to Output	R <sub>L</sub> =50 Ω, C <sub>L</sub> =5 pF, V <sub>SW</sub> =1.2 V	1.8		50	90	ns
	Turn-On Time, SEL to Output	$R_1 = 5000 C_1 = 5000 V_{000} = 1.2 V_1$	2.5 to 4.5		50	100	ns
t <sub>ON</sub>			1.8		75	125	
	Turn-Off Time		2.5 to 4.5	1	50	200	
toff	SEL to Output	$R_L=50 \Omega$ , $C_L=5 pF$ , $V_{SW}=1.2 V$	1.8		200	325	ns
t <sub>BBM</sub>	Break-Before-Make Time	$R_L$ =50 $\Omega$ , $C_L$ =5 pF, $V_{SW}$ =1.2 V	1	10	50	11	ns
O <sub>IRR</sub>	Off Isolation for MIPI <sup>(5)</sup>	R <sub>L</sub> =50 Ω, f=750 MHz, /OE=V <sub>CC</sub> V <sub>SW</sub> =-1 dBm (200 mV <sub>PP</sub> )	1.65 to 4.5		-18		dB
X <sub>TALK</sub>	Crosstalk for MIPI <sup>(5)</sup>	R <sub>L</sub> =50 Ω, f=750 MHz, V <sub>SW</sub> =-1 dBm (200 mV <sub>PP</sub> )	1.65 to 4.5		-25	(D	dB
BW	-3db Bandwidth <sup>(5)</sup>	R <sub>L</sub> =50 Ω, C <sub>L</sub> =0 pF	3.0	1100	1600		MHz
S <sub>DD21</sub>	Differential Data Rate	Inter-operability Data Rate	3.0		1.5		Gbps

Note:

5. Guaranteed by characterization.

#### **High-Speed-Related AC Electrical Characteristics**

Symbol	Parameter	Conditions	V <sub>cc</sub> (V)	$T_{A}=-40^{\circ}C \text{ to }+85^{\circ}C$			Unit
	Falameter	Conditions	VCC (V)	Min.	Тур.	Max.	Unit
t <sub>SK(O)</sub>	Channel-to-Channel Single- Ended Skew <sup>(6)</sup>	TDR-Based Method (V <sub>SW</sub> =0.2 V <sub>PP</sub> , C <sub>L</sub> =C <sub>ON</sub> )	3.3		6	20	ps
t <sub>SK(P)</sub>	Skew of Opposite Transitions of the Same Output <sup>(6)</sup>	TDR-Based Method (V <sub>SW</sub> =0.2 V <sub>PP</sub> , C <sub>L</sub> =C <sub>ON</sub> )	3.3		6	20	ps

Note:

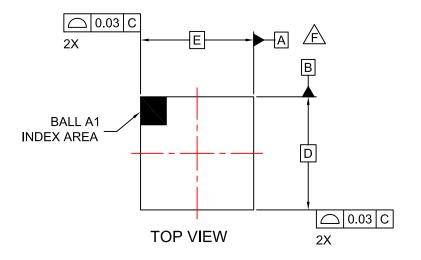
6. Guaranteed by characterization.

#### Capacitance

Symbol	Parameter	Conditions	T <sub>A</sub> =- 4	0°C to +	+85°C	Unit
	Faidilielei	Conditions	Min.	Тур.	Max.	Unit
C <sub>IN</sub>	Control Pin Input Capacitance	V <sub>CC</sub> =0 V, f=1 MHz		2.1		
C <sub>ON</sub>	Out On Capacitance	V <sub>CC</sub> =3.3 V, /OE=0 V, f=1 MHz		5.2		pF
COFF	Out Off Capacitance	V <sub>CC</sub> and /OE=3.3 V, f=1 MHz		2.0		

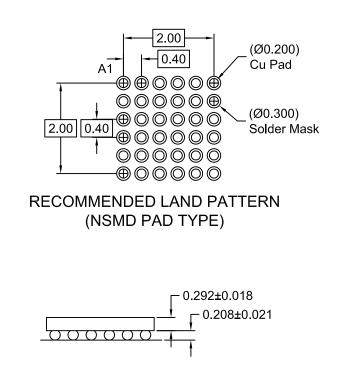
#### **Ordering Information**

Part Number	Top Mark	Package	D	Е	Х	Y
FSA644UCX	M7	36-Ball WLCSP, Non-JEDEC 2.36 mm x 2.36 mm, 0.4 mm Pitch	2.36 mm	2.36 mm	0.18 mm	0.18 mm
FSA644BUCX	KIVI	36-Ball WLCSP, Non-JEDEC 2.415 mm x 2.415 mm, 0.4 mm Pitch	2.415 mm	2.415 mm	0.208 mm	0.208 mm



0.05 C

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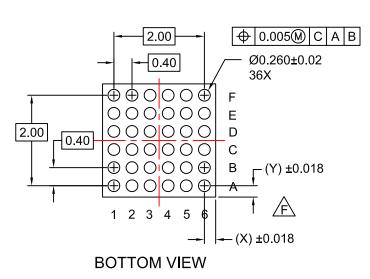
SIDE VIEWS

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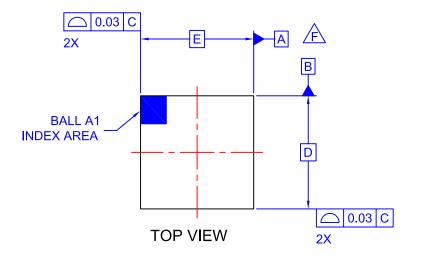
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SEATING PLANE



NOTES

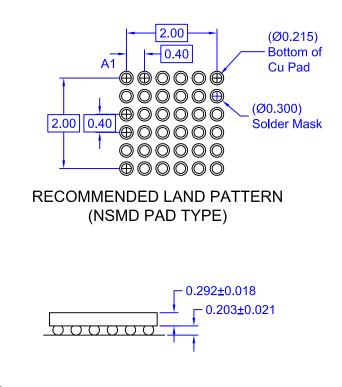
- A. NO JEDEC REGISTRATION APPLIES.
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS AND TOLERANCE PER ASMEY14.5M, 1994.
- D. DATUM C IS DEFINED BY THE SPHERICAL CROWNS OF THE BALLS.
- E. PACKAGE NOMINAL HEIGHT IS 500 ± 39 MICRONS (461-539 MICRONS).
- <u>F.</u> FOR DIMENSIONS D, E, X, AND Y SEE PRODUCT DATASHEET.
- G. DRAWING FILNAME: MKT-UC036AArev1.



0.05 C

С

/D



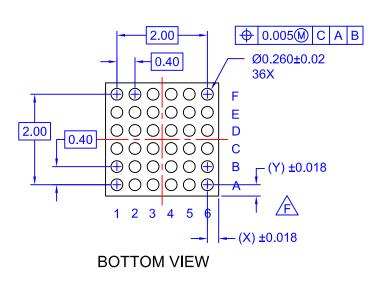
SIDE VIEWS

// 0.06 C

/e\

0.534

SEATING PLANE



NOTES

- A. NO JEDEC REGISTRATION APPLIES.
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS AND TOLERANCE PER ASMEY14.5M, 2009.
- D. DATUM C IS DEFINED BY THE SPHERICAL CROWNS OF THE BALLS.
- E. PACKAGE NOMINAL HEIGHT IS 495 ± 39 MICRONS (456-534 MICRONS).
- F. FOR DIMENSIONS D, E, X, AND Y SEE PRODUCT DATASHEET.
- G. DRAWING FILNAME: MKT-UC036AB REV1.



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