

# FreeForm/Express S6

## PCIe Spartan-6 FMC Carrier

### User Manual



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## Customer Support Overview

If you experience difficulties after reading the manual and/or using the product, contact the Connect Tech reseller from which you purchased the product. In most cases the reseller can help you with product installation and difficulties.

In the event that the reseller is unable to resolve your problem, our highly qualified support staff can assist you. Our support section is available 24 hours a day, 7 days a week on our website at: [www.connecttech.com/sub/support/support.asp](http://www.connecttech.com/sub/support/support.asp). See the contact information section below for more information on how to contact us directly. Our technical support is always free.

## Contact Information

We offer three ways for you to contact us:

### Mail/Courier

You may contact us by letter at:  
Connect Tech Inc.  
Technical Support  
42 Arrow Road  
Guelph, Ontario  
Canada N1K 1S6

### Email/Internet

You may contact us through the Internet. Our email and URL addresses on the Internet are:

[sales@connecttech.com](mailto:sales@connecttech.com)  
[support@connecttech.com](mailto:support@connecttech.com)  
[www.connecttech.com](http://www.connecttech.com)

### Note:

Please go to the [Download Zone](#) or the [Knowledge Database](#) in the [Support Center](#) on the Connect Tech website for product manuals, installation guides, device driver software and technical tips. Submit your technical support questions to our customer support engineers via the [Support Center](#) on the Connect Tech website.

### Telephone/Facsimile

Technical Support representatives are ready to answer your call Monday through Friday, from 8:30 a.m. to 5:00 p.m. Eastern Standard Time. Our numbers for calls are:

**Toll Free:** 800-426-8979 (North America only)  
**Telephone:** 519-836-1291 (Live assistance available 8:30 a.m. to 5:00 p.m. EST, Monday to Friday)  
**Facsimile:** 519-836-4878 (on-line 24 hours)

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You may obtain warranty service by delivering this product to an authorized Connect Tech Inc. business partner or to Connect Tech Inc. along with proof of purchase. Product returned to Connect Tech Inc. must be pre-authorized by Connect Tech Inc. with an RMA (Return Material Authorization) number marked on the outside of the package and sent prepaid, insured and packaged for safe shipment. Connect Tech Inc. will return this product by prepaid ground shipment service.

The Connect Tech Inc. Lifetime Warranty is defined as the serviceable life of the product. This is defined as the period during which all components are available. Should the product prove to be irreparable, Connect Tech Inc. reserves the right to substitute an equivalent product if available or to retract Lifetime Warranty if no replacement is available.

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## Revision History

Revision 0.00e – 2011/01/26  
Revision 0.00f – 2011/03/28  
Revision 0.00g – 2011/06/27

## Introduction

Connect Tech's FreeForm/Express S6 is a reconfigurable computing platform that is based on the Xilinx Spartan-6 FPGA; featuring integrated PCI Express® blocks, advanced memory support, and 3.125 Gbps low-power transceivers. The FreeForm/Express S6 includes an industry-standard FPGA Mezzanine Card (FMC) connector, which provides a flexible I/O interface for future scaling and customization. The PCIe bus bandwidth ensures high speed communication between the host system and the application's interfaces.

A wide range of available FMC modules adds interfaces such as ADC and digital video, which makes the FreeForm/Express S6 a highly versatile platform for system development. It is ideally suited for applications requiring both prototyping and field deployment including real-time data acquisition, high performance video processing, and software defined radio. The FreeForm/Express S6 is optimized for embedded processor designs, supporting development with Xilinx's MicroBlaze.

## Features

- Spartan-6 LX45T FPGA
- PCIe x1 form factor
- 128MB DDR3 Memory
- Low Pin Count FMC connector
  - 36 LVDS pairs
  - 1 Rocket I/O channel
  - I2C interface
- 2x 10/100/1000 Ethernet ports
- 1x RS-232 port
- 4 MB Flash for FPGA configuration
- 2 MB Flash for embedded code storage
- 200 MHz oscillator
- JTAG debugging
- Industrial temperature (-40 to 85C)
- Lifetime warranty and free technical support.

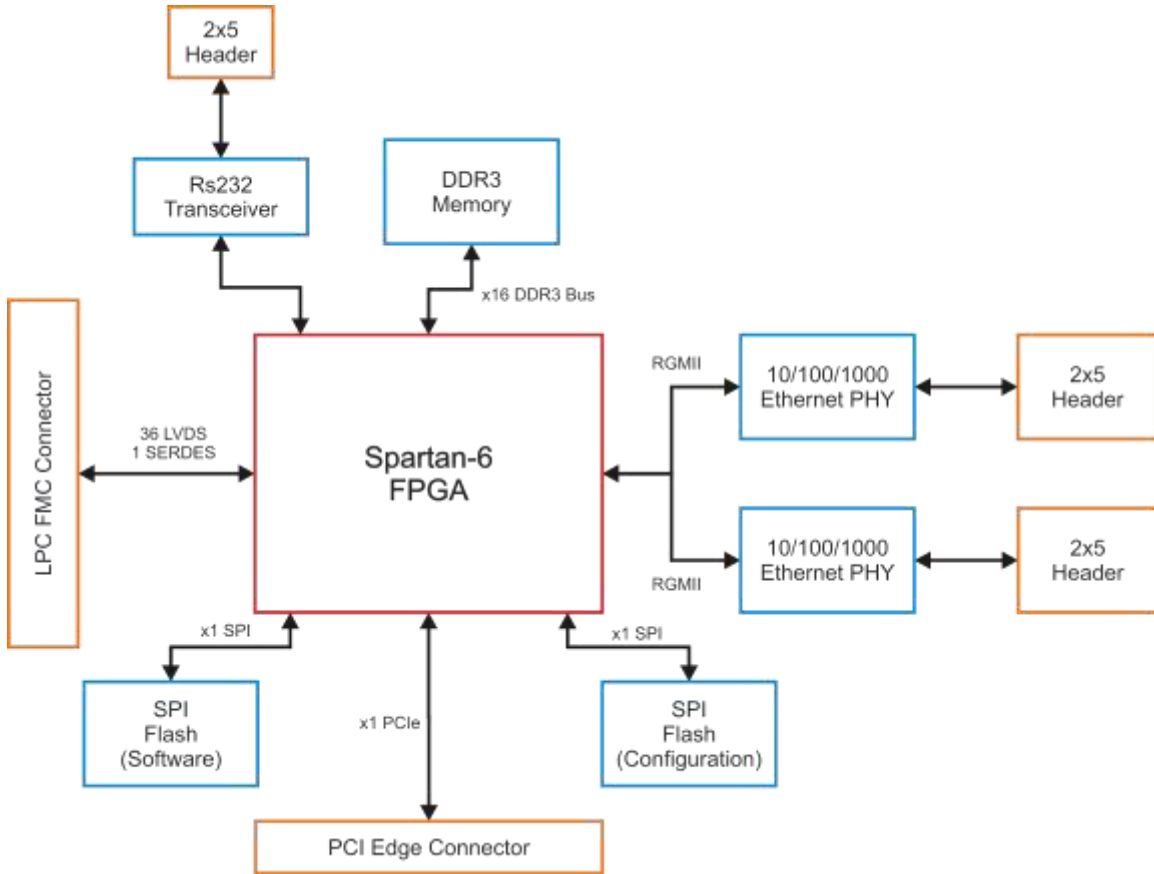
## What is an FPGA Mezzanine Card (FMC)?

An FPGA Mezzanine Card (FMC) is a standard created by VITA (VMEbus International Trade Association). The FMC standard (VITA 57.1) defines a module size and connector interface with generic reconfigurable I/O, making it perfect for FPGA daughter board applications. The standard defines two pin-outs, low pin count (LPC) and high pin count (HPC); with each type using the same connector form factor.

For more information visit <http://www.vita.com/fmc.html>.

## System Block Diagram

The following block diagram depicts component and connector interconnect, along with the appropriate bus definitions.



## Hardware Description

### FPGA

#### Description

The FreeForm/Express S6 features the Xilinx Spartan-6 LX45T FPGA in a 484 pin BGA package (Xilinx XC6SLX45T-2FGG484I). The Spartan-6 simplifies FPGA design by providing a integrated memory controller and PCI express end point, along with high performance general I/O, clocking, and internal memory resources comparable to be previous generation Virtex-class FPGAs.

For more details on the Spartan-6 capabilities, visit:  
<http://www.xilinx.com/products/spartan6/index.htm>.

### PCI Express Bus

#### Description

The FreeForm/Express S6 has a single x1 PCIe express lane, connected directly to the Spartan-6 FPGA. The PCIe interface is facilitated by the Spartan-6's integrated PCI express endpoint.

### Memory & Flash

#### Description

A single 1024 Mbit x16 DDR3 component (Micron MT41J64M16JT-15E) is connected to the Spartan-6 FPGA, providing 128 MB of high speed memory. The Spartan-6's integrated memory controller provides a generic high speed interface to FPGA logic.

In addition, a 16 Mbit SPI flash component (Numonyx M25P16) is connected to the FPGA's user I/O for storage of embedded processor code.

### Low Pin Count FMC Interface

#### Description

The FreeForm/Express S6 provides a single Low Pin Count FPGA Mezzanine Card (FMC) Interface. The LPC connector provides the following features

- 36 LVDS pairs, 2 designated as global clocks (or 68 2.5V LVCMOS pairs)
- I2C interface
- 1 SERDES TX / RX channel (Rocket I/O , GTP), with clock
- Power : +12VDC, +3.3V DC, +2.5V DC

The FreeForm/Express S6 LPC implementation differs from the VITA 57.1 specification as follows:

- VADJ is fixed to +2.5 V DC
- Only LVDS or 2.5V LVCMOS I/O is supported.

## Connector

<b>Function</b>	LPC FMC																																																																																																														
<b>Location</b>	P7																																																																																																														
<b>Type</b>	Samtec ASP-134603-01																																																																																																														
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C35	12P0V	+12V DC																																																																																																													



C36	GND	Digital Ground
C37	12P0V	+12V DC
C38	GND	Digital Ground
C39	3P3V	+3.3V DC
C40	GND	Digital Ground
D1	PG_C2M	Power good
D2	GND	Digital Ground
D3	GND	Digital Ground
D4	GBTCLK0_M2C_P	Serdes clock to FPGA
D5	GBTCLK0_M2C_N	Serdes clock to FPGA
D6	GND	Digital Ground
D7	GND	Digital Ground
D8	LA01_P_CC	LVDS clock capable pair
D9	LA01_N_CC	LVDS clock capable pair
D10	GND	Digital Ground
D11	LA05_P	LVDS pair
D12	LA05_N	LVDS pair
D13	GND	Digital Ground
D14	LA09_P	LVDS pair
D15	LA09_N	LVDS pair
D16	GND	Digital Ground
D17	LA13_P	LVDS pair
D18	LA13_N	LVDS pair
D19	GND	Digital Ground
D20	LA17_P_CC	LVDS clock capable pair
D21	LA17_N_CC	LVDS clock capable pair
D22	GND	Digital Ground
D23	LA23_P	LVDS pair
D24	LA23_N	LVDS pair
D25	GND	Digital Ground
D26	LA26_P	LVDS pair
D27	LA26_N	LVDS pair
D28	GND	Digital Ground
D29	TCK	JTAG
D30	TDI	JTAG
D31	TDO	JTAG
D32	3P3VAUX	+3.3V DC
D33	TMS	JTAG
D34	TRST_L	JTAG
D35	GA1	I2C address
D36	3P3V	+3.3V DC
D37	GND	Digital Ground
D38	3P3V	+3.3V DC

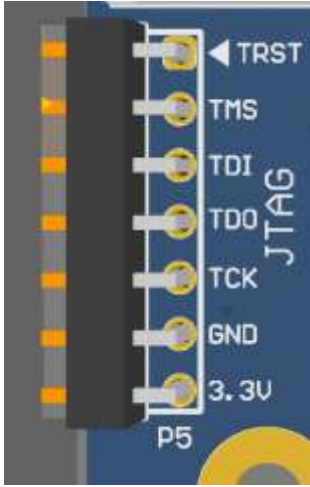
D39	GND	Digital Ground
D40	3P3V	+3.3V DC
G1	GND	Digital Ground
G2	CLK1_M2C_P	LVDS clock to FPGA
G3	CLK1_M2C_N	LVDS clock to FPGA
G4	GND	Digital Ground
G5	GND	Digital Ground
G6	LA00_P_CC	LVDS clock capable pair
G7	LA00_N_CC	LVDS clock capable pair
G8	GND	Digital Ground
G9	LA03_P	LVDS pair
G10	LA03_N	LVDS pair
G11	GND	Digital Ground
G12	LA08_P	LVDS pair
G13	LA08_N	LVDS pair
G14	GND	Digital Ground
G15	LA12_P	LVDS pair
G16	LA12_N	LVDS pair
G17	GND	Digital Ground
G18	LA16_P	LVDS pair
G19	LA16_N	LVDS pair
G20	GND	Digital Ground
G21	LA20_P	LVDS pair
G22	LA20_N	LVDS pair
G23	GND	Digital Ground
G24	LA22_P	LVDS pair
G25	LA22_N	LVDS pair
G26	GND	Digital Ground
G27	LA25_P	LVDS pair
G28	LA25_N	LVDS pair
G29	GND	Digital Ground
G30	LA29_P	LVDS pair
G31	LA29_N	LVDS pair
G32	GND	Digital Ground
G33	LA31_P	LVDS pair
G34	LA31_N	LVDS pair
G35	GND	Digital Ground
G36	LA33_P	LVDS pair
G37	LA33_N	LVDS pair
G38	GND	Digital Ground
G39	VADJ	+2.5V DC
G40	GND	Digital Ground
H1	VREF_A_M2C	Not used


H2	PRSNT_M2C_L	Present signal to FPGA
H3	GND	Digital Ground
H4	CLK0_M2C_P	LVDS clock to FPGA
H5	CLK0_M2C_N	LVDS clock to FPGA
H6	GND	Digital Ground
H7	LA02_P	LVDS pair
H8	LA02_N	LVDS pair
H9	GND	Digital Ground
H10	LA04_P	LVDS pair
H11	LA04_N	LVDS pair
H12	GND	Digital Ground
H13	LA07_P	LVDS pair
H14	LA07_N	LVDS pair
H15	GND	Digital Ground
H16	LA11_P	LVDS pair
H17	LA11_N	LVDS pair
H18	GND	Digital Ground
H19	LA15_P	LVDS pair
H20	LA15_N	LVDS pair
H21	GND	Digital Ground
H22	LA19_P	LVDS pair
H23	LA19_N	LVDS pair
H24	GND	Digital Ground
H25	LA21_P	LVDS pair
H26	LA21_N	LVDS pair
H27	GND	Digital Ground
H28	LA24_P	LVDS pair
H29	LA24_N	LVDS pair
H30	GND	Digital Ground
H31	LA28_P	LVDS pair
H32	LA28_N	LVDS pair
H33	GND	Digital Ground
H34	LA30_P	LVDS pair
H35	LA30_N	LVDS pair
H36	GND	Digital Ground
H37	LA32_P	LVDS pair
H38	LA32_N	LVDS pair
H39	GND	Digital Ground
H40	VADJ	+2.5V DC


## Configuration


The FreeForm/Express S6 is designed so that the Spartan-6 configuration image is automatically loaded from the on-board SPI flash at power-up. When a valid configuration is loaded, led D4 is illuminated. JTAG configuration can be used at any time to program the FPGA.

The FreeForm/Express S6 is fitted with a x4 32 Mbit SPI flash (Winbond W25Q32BVSFIG), which can be programmed indirectly via JTAG using Xilinx's IMPACT.

<b>Function</b>	<b>JTAG programming</b>																										
<b>Location</b>	P5																										
<b>Type</b>	1x7 0.100" header Samtec TSW-107-08-F-S-RA																										
<b>Pinout</b>	<table border="1"> <thead> <tr> <th>Pin</th> <th>Signal</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>TRST#</td> <td>Reset, not used by Xilinx products</td> </tr> <tr> <td>2</td> <td>TMS</td> <td>Select</td> </tr> <tr> <td>3</td> <td>TDI</td> <td>Data In</td> </tr> <tr> <td>4</td> <td>TDO</td> <td>Data Out</td> </tr> <tr> <td>5</td> <td>TCK</td> <td>Clock</td> </tr> <tr> <td>6</td> <td>GND</td> <td>Digital Ground</td> </tr> <tr> <td>7</td> <td>VCC</td> <td>Chain power, 3.3V</td> </tr> </tbody> </table>			Pin	Signal	Description	1	TRST#	Reset, not used by Xilinx products	2	TMS	Select	3	TDI	Data In	4	TDO	Data Out	5	TCK	Clock	6	GND	Digital Ground	7	VCC	Chain power, 3.3V
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<b>Function</b>	<b>Manual Reset</b> Pulls the Spartan-6 PROG_B pin to ground, resetting and reconfiguring the FPGA							
<b>Location</b>	J1							
<b>Type</b>	1x2 0.100" jumper block							
<b>Pinout</b>	<table border="1"> <thead> <tr> <th>Position</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>1-2</td> <td>+5V</td> </tr> <tr> <td>off</td> <td>floating</td> </tr> </tbody> </table>		Position	Description	1-2	+5V	off	floating
	Position	Description						
	1-2	+5V						
off	floating							
<b>Default</b>	Floating							
								

<b>Function</b>	<b>Hot Swap</b> When the is being configured, FPGA I/Os will be pulled high with weak internal pull-ups							
<b>Location</b>	J2							
<b>Type</b>	1x2 0.100" jumper block							
<b>Pinout</b>	<table border="1"> <thead> <tr> <th>Position</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>1-2</td> <td>I/Os have pullups</td> </tr> <tr> <td>off</td> <td>I/Os are floating</td> </tr> </tbody> </table>		Position	Description	1-2	I/Os have pullups	off	I/Os are floating
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off	I/Os are floating							
<b>Default</b>	Floating							


<b>Function</b>	<b>FMC JTAG Bypass</b> Selects either whether or not to include the FMC module in the JTA chain											
<b>Location</b>	J3											
<b>Type</b>	2x2 0.100" jumper block											
<b>Pinout</b>	<table border="1"> <thead> <tr> <th>Position</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>1-3</td> <td>TDI to FMC</td> </tr> <tr> <td>2-4</td> <td>TDO from FMC</td> </tr> <tr> <td>3-4</td> <td>Bypass</td> </tr> <tr> <td>off</td> <td>Not applicable</td> </tr> </tbody> </table>		Position	Description	1-3	TDI to FMC	2-4	TDO from FMC	3-4	Bypass	off	Not applicable
Position	Description											
1-3	TDI to FMC											
2-4	TDO from FMC											
3-4	Bypass											
off	Not applicable											
<b>Default</b>	Bypass											

## Ethernet

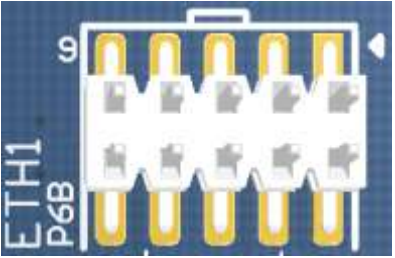
### Description

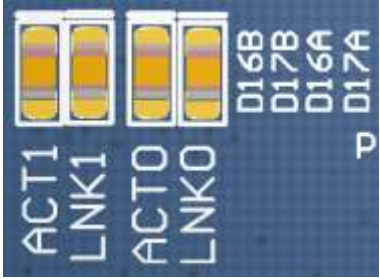
Two 10/100/1000 Ethernet ports are connected to the FPGA, via two separate RGMII capable Ethernet physical layer devices (PHYs). The FPGA logic resources are used to implement the Ethernet media access controller (MAC).

### Connector & LEDs

<b>Function</b>	<b>Ethernet</b>	
<b>Location</b>	P6A, P6B	
<b>Type</b>	2x5 2mm header MLE TSHSM-205-D-06-G-V-L (or equivalent)	

<b>Pinout</b>	<b>Pin</b>	<b>Signal</b>	<b>Description</b>	<b>Pin</b>	<b>Signal</b>	<b>Description</b>
	1	MX1-	Data	2	MX1+	Data
	3	MX2-	Data	4	MX2+	Data
	5	FGND	Frame Ground	6	FGND	Frame Ground
	7	MX3-	Data	8	MX3+	Data
	9	MX4-	Data	10	MX4+	Data




<b>Function</b>	<b>Ethernet Status LEDs</b>											
<b>Locations</b>	<table border="1"> <thead> <tr> <th>Pin</th> <th>Signal</th> </tr> </thead> <tbody> <tr> <td>D16A</td> <td>ETH0 Activity</td> </tr> <tr> <td>D17A</td> <td>ETH0 Link</td> </tr> <tr> <td>D16B</td> <td>ETH1 Activity</td> </tr> <tr> <td>D17B</td> <td>ETH1 Link</td> </tr> </tbody> </table>	Pin	Signal	D16A	ETH0 Activity	D17A	ETH0 Link	D16B	ETH1 Activity	D17B	ETH1 Link	
Pin	Signal											
D16A	ETH0 Activity											
D17A	ETH0 Link											
D16B	ETH1 Activity											
D17B	ETH1 Link											

## Serial

### Description

A standard RS232 serial ports is provided on P4, with UART implementation provided by FPGA logic.

### Connectors

<b>Function</b>	RS232				
<b>Locations</b>	P4				
<b>Type</b>	2x5 0.100" header Samtec TSW-105-07-L-D				
<b>Pinout</b>	<b>Pin</b>	<b>Signal</b>	<b>Pin</b>	<b>Signal</b>	
	1	N/C	2	N/C	
	3	RXD1	4	RTS1	
	5	TXD1	6	CTS1	
	7	N/C	8	N/C	
	9	GND	10	N/C	

## Power

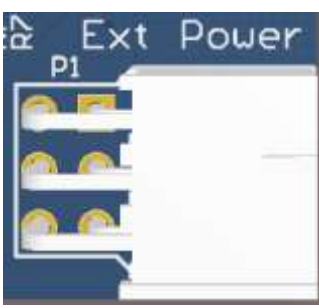
### Description

The FreeForm/Express S6 is designed to be powered from the PCIe bus. The board requires +3.3V DC for all circuitry. +12VDC is required for the FMC power good signal and as the FMC module's power source. The FreeForm/Express S6 generates all other required power rails on-board.

In addition, a programming / desktop debugging standalone power connector P1 is provided.

**WARNING:** Do not plug the FreeForm/Express S6 into a PCIe slot with an external power source connected to P1. This could lead to board damage and void the product warranty.

### Connectors & Jumpers

<b>Function</b>	Standalone power			
<b>Location</b>	P1			
<b>Type</b>	2x3 0.100" power header, shrouded Samtec IPL1-103-01-L-D-RA-K			
<b>Pinout</b>	<b>Pin</b>	<b>Signal</b>	<b>Description</b>	
	1	GND	Digital Ground	
	2	GND	Digital Ground	
	3	GND	Digital Ground	
	4	+3.3V	+3.3V DC, used by circuitry and power regulators	
	5	+3.3V	+3.3V DC, used by circuitry and power regulators	
	6	+12V	+12V DC used by FMC module, and power good circuit	

## Hardware Installation

### Standard computer

1. Ensure all computer power supplies are off and disconnected (remove AC line cord)
2. Install the FMC module, if required.
3. Verify all jumper settings from the relevant sections
4. Install the necessary cables for the application.

**WARNING:** Do not plug the FreeForm/Express S6 into a PCIe slot with an external power source connected to P1. This could lead to board damage and void the product warranty.

5. Install the FreeForm/Express S6 module into x1 PCIe slot.
6. Connect the appropriate interface cables to the FMC bracket I/O.
7. Connect the computer's AC line cord to the computer's power supply.
8. Turn on the computer system.



## Cables & Interconnect

### Mating Cables

Description	Location	PCB Connector	Cable Part Number [Drawing Number]	PCB End	Interface End
Power	P1	Samtec IPL1-103-01-L-D-RA-K	Samtec MMSD-03-20-L-03.25-S-K	2x3 IPD	Un-terminated
Serial	P4	Samtec TSW-105-07-L-D	CAG104 [ CTIC-00048 ]	2x5 0.100" IDC	DB-9
GBE	P6A, P6B	MLE TSHSM-205-D-06-G-V-L	CBG065 [CTIC-00181 ]	2x5 2mm socket	RJ45 socket

Cable drawings are available upon request

### Mating Connectors

Description	Location	PCB Connector	Mating Connector	Note
FMC	P7	Samtec ASP-134603-01	Samtec ASP-134604-01	10 mm stack
			Samtec ASP-134606-01	8.5 mm stack

## FPGA Design

In general, FPGA designs developed for the FreeForm/Express S6 can be based on IP generated with Xilinx's CORE Generator. The following table lists the CORE Generator IP proven to be compatible, along with their current versions numbers.

Function	IP	Version	Note
Memory	MIG	3.6	
Rocket I/O	Spartan-6 FPGA GTP Transceiver Wizard	1.7	
PCIe	Spartan-6 Integrated Block for PCI Express	1.4	
Ethernet	Tri Mode Ethernet MAC	4.4	A valid license is required to use this IP, contact Xilinx for details

For the latest reference designs developed by Connect Tech Inc., visit <http://devel.connecttech.com>

## FPGA Pinout

The following table lists the FPGA pin (ball) to signal mapping. The standard Spartan-6 pin name is listed, along with the I/O standard used and bank number.

Pin Number	Signal Name	Pin Name	IO Standard	Bank
V20	cfg_busy	IO_L74N_DOUT_BUSY_1	LVC MOS25*	1
Y20	cfg_cclk	IO_L1P_CCLK_2	LVC MOS25*	2
AB20	cfg_csi_b_mosi_miso0	IO_L3N_MOSI_CSI_B_MISO0_2	LVC MOS25*	2
AA3	cfg_cso_b_csn	IO_L65N_CSO_B_2	LVC MOS25*	2
AA20	cfg_d0_miso1	IO_L3P_D0_DIN_MISO_MISO1_2	LVC MOS25*	2
R13	cfg_d1_miso2	IO_L12P_D1_MISO2_2	LVC MOS25*	2
T14	cfg_d2_miso3	IO_L12N_D2_MISO3_2	LVC MOS25*	2
AA6	cfg_d3	IO_L49P_D3_2	LVC MOS25*	2
AB6	cfg_d4	IO_L49N_D4_2	LVC MOS25*	2
Y5	cfg_d5	IO_L62P_D5_2	LVC MOS25*	2
AB5	cfg_d6	IO_L62N_D6_2	LVC MOS25*	2
W9	cfg_d7	IO_L48P_D7_2	LVC MOS25*	2
C3	cfg_hswapen	IO_L1P_HSWAPEN_0	LVC MOS25*	0
Y4	cfg_init_b	IO_L65P_INIT_B_2	LVC MOS25*	2
AA21	cfg_m0	IO_L1N_M0_CMPMISO_2	LVC MOS25*	2
Y8	cfg_rdw_r_b	IO_L48N_RDWR_B_VREF_2	LVC MOS25*	2
K2	ddr3_a<0>	IO_L47P_M3A0_3	SSTL15_II	3
K1	ddr3_a<1>	IO_L47N_M3A1_3	SSTL15_II	3
K5	ddr3_a<2>	IO_L49N_M3A2_3	SSTL15_II	3
M6	ddr3_a<3>	IO_L45P_M3A3_3	SSTL15_II	3
H3	ddr3_a<4>	IO_L51N_M3A4_3	SSTL15_II	3
M3	ddr3_a<5>	IO_L44P_GCLK21_M3A5_3	SSTL15_II	3
L4	ddr3_a<6>	IO_L44N_GCLK20_M3A6_3	SSTL15_II	3
K6	ddr3_a<7>	IO_L49P_M3A7_3	SSTL15_II	3
G3	ddr3_a<8>	IO_L52P_M3A8_3	SSTL15_II	3
G1	ddr3_a<9>	IO_L52N_M3A9_3	SSTL15_II	3
J4	ddr3_a<10>	IO_L51P_M3A10_3	SSTL15_II	3
E1	ddr3_a<11>	IO_L54N_M3A11_3	SSTL15_II	3
F1	ddr3_a<12>	IO_L53N_M3A12_3	SSTL15_II	3
J6	ddr3_a<13>	IO_L55P_M3A13_3	SSTL15_II	3
H5	ddr3_a<14>	IO_L55N_M3A14_3	SSTL15_II	3
J3	ddr3_ba<0>	IO_L48P_M3BA0_3	SSTL15_II	3
J1	ddr3_ba<1>	IO_L48N_M3BA1_3	SSTL15_II	3
H1	ddr3_ba<2>	IO_L50N_M3BA2_3	SSTL15_II	3
M4	ddr3_cas_n	IO_L43N_GCLK22_IRDY2_M3CASN_3	SSTL15_II	3
K3	ddr3_ck_n	IO_L46N_M3CLKN_3	DIFF_SSTL15_II	3

Pin Number	Signal Name	Pin Name	IO Standard	Bank
K4	ddr3_ck_p	IO_L46P_M3CLK_3	DIFF_SSTL15_II	3
F2	ddr3_cke	IO_L53P_M3CKE_3	SSTL15_II	3
N4	ddr3_dm	IO_L42N_GCLK24_M3LDM_3	SSTL15_II	3
R3	ddr3_dq<0>	IO_L37P_M3DQ0_3	SSTL15_II	3
R1	ddr3_dq<1>	IO_L37N_M3DQ1_3	SSTL15_II	3
P2	ddr3_dq<2>	IO_L38P_M3DQ2_3	SSTL15_II	3
P1	ddr3_dq<3>	IO_L38N_M3DQ3_3	SSTL15_II	3
L3	ddr3_dq<4>	IO_L41P_GCLK27_M3DQ4_3	SSTL15_II	3
L1	ddr3_dq<5>	IO_L41N_GCLK26_M3DQ5_3	SSTL15_II	3
M2	ddr3_dq<6>	IO_L40P_M3DQ6_3	SSTL15_II	3
M1	ddr3_dq<7>	IO_L40N_M3DQ7_3	SSTL15_II	3
T2	ddr3_dq<8>	IO_L36P_M3DQ8_3	SSTL15_II	3
T1	ddr3_dq<9>	IO_L36N_M3DQ9_3	SSTL15_II	3
U3	ddr3_dq<10>	IO_L35P_M3DQ10_3	SSTL15_II	3
U1	ddr3_dq<11>	IO_L35N_M3DQ11_3	SSTL15_II	3
W3	ddr3_dq<12>	IO_L33P_M3DQ12_3	SSTL15_II	3
W1	ddr3_dq<13>	IO_L33N_M3DQ13_3	SSTL15_II	3
Y2	ddr3_dq<14>	IO_L32P_M3DQ14_3	SSTL15_II	3
Y1	ddr3_dq<15>	IO_L32N_M3DQ15_3	SSTL15_II	3
N1	ddr3_dqs_n	IO_L39N_M3LDQSN_3	DIFF_SSTL15_II	3
N3	ddr3_dqs_p	IO_L39P_M3LDQS_3	DIFF_SSTL15_II	3
L6	ddr3_odt	IO_L45N_M3ODT_3	SSTL15_II	3
M5	ddr3_ras_n	IO_L43P_GCLK23_M3RASN_3	SSTL15_II	3
E3	ddr3_reset_n	IO_L54P_M3RESET_3	LVC MOS15	3
P3	ddr3_udm	IO_L42P_GCLK25_TRDY2_M3UDM_3	SSTL15_II	3
V1	ddr3_udqs_n	IO_L34N_M3UDQSN_3	DIFF_SSTL15_II	3
V2	ddr3_udqs_p	IO_L34P_M3UDQS_3	DIFF_SSTL15_II	3
H2	ddr3_we_n	IO_L50P_M3WE_3	SSTL15_II	3
G11	fmc_clk0_m2c_n	IO_L35N_GCLK16_0	LVDS_25	0
H12	fmc_clk0_m2c_p	IO_L35P_GCLK17_0	LVDS_25	0
F16	fmc_clk1_m2c_n	IO_L37N_GCLK12_0	LVDS_25	0
E16	fmc_clk1_m2c_p	IO_L37P_GCLK13_0	LVDS_25	0
A8	fmc_dp0_c2m_n	MGTTXN1_101		
B8	fmc_dp0_c2m_p	MGTXP1_101		
C9	fmc_dp0_m2c_n	MGTRXN1_101		
D9	fmc_dp0_m2c_p	MGTRXP1_101		
D11	fmc_gbtclk0_m2c_n	MGTREFCLK1N_101		
C11	fmc_gbtclk0_m2c_p	MGTREFCLK1P_101		
T5	fmc_i2c_scl	IO_L7N_3	LVC MOS15	3
T6	fmc_i2c_sda	IO_L7P_3	LVC MOS15	3

Pin Number	Signal Name	Pin Name	IO Standard	Bank
AB11	fmc_la00_cc_n	IO_L32N_GCLK28_2	LVDS_25	2
Y11	fmc_la00_cc_p	IO_L32P_GCLK29_2	LVDS_25	2
AB12	fmc_la01_cc_n	IO_L31N_GCLK30_D15_2	LVDS_25	2
AA12	fmc_la01_cc_p	IO_L31P_GCLK31_D14_2	LVDS_25	2
AB4	fmc_la02_n	IO_L63N_2	LVDS_25	2
AA4	fmc_la02_p	IO_L63P_2	LVDS_25	2
AB7	fmc_la03_n	IO_L47N_2	LVDS_25	2
Y7	fmc_la03_p	IO_L47P_2	LVDS_25	2
R8	fmc_la04_n	IO_L59N_2	LVDS_25	2
R9	fmc_la04_p	IO_L59P_2	LVDS_25	2
U6	fmc_la05_n	IO_L64N_D9_2	LVDS_25	2
T7	fmc_la05_p	IO_L64P_D8_2	LVDS_25	2
Y6	fmc_la06_n	IO_L60N_2	LVDS_25	2
W6	fmc_la06_p	IO_L60P_2	LVDS_25	2
AB9	fmc_la07_n	IO_L43N_2	LVDS_25	2
Y9	fmc_la07_p	IO_L43P_2	LVDS_25	2
AB8	fmc_la08_n	IO_L45N_2	LVDS_25	2
AA8	fmc_la08_p	IO_L45P_2	LVDS_25	2
U8	fmc_la09_n	IO_L57N_2	LVDS_25	2
T8	fmc_la09_p	IO_L57P_2	LVDS_25	2
W8	fmc_la10_n	IO_L58N_2	LVDS_25	2
V7	fmc_la10_p	IO_L58P_2	LVDS_25	2
AB10	fmc_la11_n	IO_L41N_VREF_2	LVDS_25	2
AA10	fmc_la11_p	IO_L41P_2	LVDS_25	2
V9	fmc_la12_n	IO_L50N_2	LVDS_25	2
U9	fmc_la12_p	IO_L50P_2	LVDS_25	2
Y10	fmc_la13_n	IO_L44N_2	LVDS_25	2
W10	fmc_la13_p	IO_L44P_2	LVDS_25	2
W11	fmc_la14_n	IO_L42N_2	LVDS_25	2
V11	fmc_la14_p	IO_L42P_2	LVDS_25	2
Y12	fmc_la15_n	IO_L40N_2	LVDS_25	2
W12	fmc_la15_p	IO_L40P_2	LVDS_25	2
U10	fmc_la16_n	IO_L46N_2	LVDS_25	2
T10	fmc_la16_p	IO_L46P_2	LVDS_25	2
U12	fmc_la17_cc_n	IO_L29N_GCLK2_2	LVDS_25	2
T12	fmc_la17_cc_p	IO_L29P_GCLK3_2	LVDS_25	2
AB13	fmc_la18_cc_n	IO_L30N_GCLK0_USERCCLK_2	LVDS_25	2
Y13	fmc_la18_cc_p	IO_L30P_GCLK1_D13_2	LVDS_25	2
U13	fmc_la19_n	IO_L16N_VREF_2	LVDS_25	2
U14	fmc_la19_p	IO_L16P_2	LVDS_25	2

Pin Number	Signal Name	Pin Name	IO Standard	Bank
T11	fmc_la20_n	IO_L22N_2	LVDS_25	2
R11	fmc_la20_p	IO_L22P_2	LVDS_25	2
U15	fmc_la21_n	IO_L23N_2	LVDS_25	2
T15	fmc_la21_p	IO_L23P_2	LVDS_25	2
Y14	fmc_la22_n	IO_L20N_2	LVDS_25	2
W14	fmc_la22_p	IO_L20P_2	LVDS_25	2
W13	fmc_la23_n	IO_L18N_2	LVDS_25	2
V13	fmc_la23_p	IO_L18P_2	LVDS_25	2
AB15	fmc_la24_n	IO_L21N_2	LVDS_25	2
Y15	fmc_la24_p	IO_L21P_2	LVDS_25	2
AB14	fmc_la25_n	IO_L6N_2	LVDS_25	2
AA14	fmc_la25_p	IO_L6P_2	LVDS_25	2
V15	fmc_la26_n	IO_L4N_VREF_2	LVDS_25	2
U16	fmc_la26_p	IO_L4P_2	LVDS_25	2
W15	fmc_la27_n	IO_L17N_2	LVDS_25	2
Y16	fmc_la27_p	IO_L17P_2	LVDS_25	2
Y18	fmc_la28_n	IO_L5N_2	LVDS_25	2
W17	fmc_la28_p	IO_L5P_2	LVDS_25	2
W18	fmc_la29_n	IO_L2N_CMPMOSI_2	LVDS_25	2
V17	fmc_la29_p	IO_L2P_CMPCLK_2	LVDS_25	2
AB17	fmc_la30_n	IO_L15N_2	LVDS_25	2
Y17	fmc_la30_p	IO_L15P_2	LVDS_25	2
AB16	fmc_la31_n	IO_L19N_2	LVDS_25	2
AA16	fmc_la31_p	IO_L19P_2	LVDS_25	2
AB19	fmc_la32_n	IO_L13N_D10_2	LVDS_25	2
Y19	fmc_la32_p	IO_L13P_M1_2	LVDS_25	2
AB18	fmc_la33_n	IO_L14N_D12_2	LVDS_25	2
AA18	fmc_la33_p	IO_L14P_D11_2	LVDS_25	2
R16	fmc_prsnt_m2c_l	IO_L70N_1	LVC MOS25*	1
F10	main_clk_n	IO_L34N_GCLK18_0	LVDS_25	0
G9	main_clk_p	IO_L34P_GCLK19_0	LVDS_25	0
A2	mig_calib_done_led	IO_L3N_0	LVC MOS25*	0
E5	mig_error_led	IO_L4P_0	LVC MOS25*	0
R7	mig_rzq	IO_L1P_3	SSTL15_II	3
W4	mig_zio	IO_L2P_3	SSTL15_II	3
D5	pcie_perst	IO_L2N_0	LVC MOS25*	0
B10	pcie_refclk_n	MGTRFCLK0N_101		
A10	pcie_refclk_p	MGTRFCLK0P_101		
C7	pcie_rx_n	MGTRXN0_101		
D7	pcie_rx_p	MGTRXP0_101		

Pin Number	Signal Name	Pin Name	IO Standard	Bank
E6	pcie_stat_led<0>	IO_L4N_0	LVC MOS25*	0
B3	pcie_stat_led<1>	IO_L5P_0	LVC MOS25*	0
A3	pcie_stat_led<2>	IO_L5N_0	LVC MOS25*	0
A6	pcie_tx_n	MGTTXN0_101		
B6	pcie_tx_p	MGTTXP0_101		
M19	rgmii0_clk	IO_L40N_GCLK10_M1A6_1	LVC MOS25*	1
K19	rgmii0_intn	IO_L34P_A13_M1WE_1	LVC MOS25*	1
H20	rgmii0_mdc	IO_L33N_A14_M1A4_1	LVC MOS25*	1
J19	rgmii0_mdio	IO_L33P_A15_M1A10_1	LVC MOS25*	1
K17	rgmii0_resetn	IO_L36P_A9_M1BA0_1	LVC MOS25*	1
H21	rgmii0_rx_ctl	IO_L37P_A7_M1A0_1	LVC MOS25*	1
K22	rgmii0_rxc	IO_L41N_GCLK8_M1CASN_1	LVC MOS25*	1
H22	rgmii0_rxd<0>	IO_L37N_A6_M1A1_1	LVC MOS25*	1
G22	rgmii0_rxd<1>	IO_L35N_A10_M1A2_1	LVC MOS25*	1
F21	rgmii0_rxd<2>	IO_L31P_A19_M1CKE_1	LVC MOS25*	1
F22	rgmii0_rxd<3>	IO_L31N_A18_M1A12_1	LVC MOS25*	1
E22	rgmii0_tx_ctl	IO_L32N_A16_M1A9_1	LVC MOS25*	1
D22	rgmii0_txc	IO_L28N_VREF_1	LVC MOS25*	1
B21	rgmii0_txd<0>	IO_L10P_1	LVC MOS25*	1
B22	rgmii0_txd<1>	IO_L10N_1	LVC MOS25*	1
C22	rgmii0_txd<2>	IO_L20N_1	LVC MOS25*	1
D21	rgmii0_txd<3>	IO_L28P_1	LVC MOS25*	1
P20	rgmii1_clk	IO_L42P_GCLK7_M1UDM_1	LVC MOS25*	1
P21	rgmii1_intn	IO_L46P_FCS_B_M1DQ2_1	LVC MOS25*	1
U20	rgmii1_mdc	IO_L49P_M1DQ10_1	LVC MOS25*	1
T22	rgmii1_mdio	IO_L48N_M1DQ9_1	LVC MOS25*	1
T21	rgmii1_resetn	IO_L48P_HDC_M1DQ8_1	LVC MOS25*	1
R22	rgmii1_rx_ctl	IO_L47N_LDC_M1DQ1_1	LVC MOS25*	1
L22	rgmii1_rxc	IO_L43N_GCLK4_M1DQ5_1	LVC MOS25*	1
P22	rgmii1_rxd<0>	IO_L46N_FOE_B_M1DQ3_1	LVC MOS25*	1
N22	rgmii1_rxd<1>	IO_L45N_A0_M1LDQSN_1	LVC MOS25*	1
M22	rgmii1_rxd<2>	IO_L44N_A2_M1DQ7_1	LVC MOS25*	1
M21	rgmii1_rxd<3>	IO_L44P_A3_M1DQ6_1	LVC MOS25*	1
Y21	rgmii1_tx_ctl	IO_L52P_M1DQ14_1	LVC MOS25*	1
Y22	rgmii1_txc	IO_L52N_M1DQ15_1	LVC MOS25*	1
U22	rgmii1_txd<0>	IO_L49N_M1DQ11_1	LVC MOS25*	1
V22	rgmii1_txd<1>	IO_L50N_M1UDQSN_1	LVC MOS25*	1
V21	rgmii1_txd<2>	IO_L50P_M1UDQS_1	LVC MOS25*	1
W22	rgmii1_txd<3>	IO_L51N_M1DQ13_1	LVC MOS25*	1
R17	rs232_cts	IO_L72P_1	LVC MOS25*	1

Pin Number	Signal Name	Pin Name	IO Standard	Bank
P18	rs232_rts	IO_L71N_1	LVCMOS25*	1
T18	rs232_rx	IO_L73N_1	LVCMOS25*	1
T19	rs232_tx	IO_L73P_1	LVCMOS25*	1
A4	tmp	IO_L6N_0	LVCMOS25*	0
F7	user_led0	IO_L7P_0	LVCMOS25*	0
F8	user_led1	IO_L7N_0	LVCMOS25*	0
C5	user_led2	IO_L8P_0	LVCMOS25*	0
U19	X1_SPI_CLK	IO_L59P_1	LVCMOS25*	1
T17	X1_SPI_CSN	IO_L72N_1	LVCMOS25*	1
W20	X1_SPI_MISO	IO_L51P_M1DQ12_1	LVCMOS25*	1
P19	X1_SPI_MOSI	IO_L53P_1	LVCMOS25*	1



## Specifications

<b>Form Factor</b>	PCIe x1, half-length
<b>FPGA</b>	Spartan-6 LX45T FPGA
<b>General Purpose I/O</b>	Low Pin Count FMC connector 36 LVDS pairs 1 Rocket I/O channel I2C interface
<b>Memory</b>	128MB DDR3 RAM 4 MB Flash for FPGA configuration 2 MB Flash for embedded code storage
<b>Ethernet</b>	2x Gigabit Ethernet Ports
<b>Serial</b>	1x RS-232
<b>Temperature</b>	-40 to 85C <sup>[1]</sup>
<b>Power</b>	+3.3V DC, +12V DC required by some FMC
<b>Power Consumption</b>	TBD
<b>Dimensions</b>	4.375" x 6.600"
<b>Weight</b>	TBD
<b>Warranty and Support</b>	Lifetime warranty and free technical support

[1] Actual operating temperature depends on the user FPGA configuration, refer to ISE reports for details

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