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User Manual

Revision History

Issue	Changes Made	Date	Initials
1.0.0	First release	06/11/06	E.P
1.0.1	Minor inconsistency about comports removed from block Diagram	26/02/07	E.P
1.0.2	Clarification about the elements in the JTAG chain	15/11/07	E.P
1.0.3	Updated JTAG header information. Wrong marking of position. Added chapters about bitstream formatting, FPGA configuration	29/02/08	E.P
1.0.4	Corrected: External Clock I/O (J1) – MMBX	07/03/11	S.M.

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1 Introduction

The SMT348 is an FPGA TIM module designed to be integrated in modular systems.

It is designed to connect to the huge range of other TIM modules and carriers developed by Sundance.

Sundance modular solutions provide flexible and upgradeable systems.

The SMT348 is a TIM module aimed at completing the range of Sundance Virtex4 modules like SMT368, SMT362, SMT339.

It provides a communications platform between an XC4VSX55 or XC4VLX160 FPGA and

- 4 banks of QDR2 SRAM at a frequency of up to 250Mhz.
- 2 32-bit SHBs.
- TIM Global Bus.
- LVDS connections for high speed parallel connections
- LVTTL connections and connectors.

This variety of connectors and interfaces provides a wide range of development options for designers to explore the capabilities of the comprehensive Sundance TIM modules family.

2 Related Documents

2.1 Referenced Documents

SUNDANCE SDB specification.

SUNDANCE SHB specification

SUNDANCE SLB specification

Samsung QDRII Datasheet

Spansion S29GLXXXN flash

2.2 Applicable Documents

TI TIM specification & user's guide .

Samtec QSH Catalogue page

Virtex 4 Datasheet

3 Acronyms, Abbreviations and Definitions

3.1 Acronyms and Abbreviations

TIM	Texas Instruments Module
TI© DSP	Texas Instrument Digital Signal Processor
Xilinx© FPGA	Xilinx© Field Programmable Gate Array.
QDR	Quad Data Rate
CP	ComPort. Communication interface
SDB	Sundance Digital Bus. Communication interface
SHB	Sundance High–Speed Bus. Communication interface

3.2 Definitions

DSP Module	Typically a TIM module hosting a TI DSP and, a Xilinx FPGA.
FPGA–only Module	A TIM with no on–board DSP, where the FPGA provides all functionality.
Firmware	A proprietary FPGA design providing some sort of functionality. Sundance Firmware is the firmware running in an FPGA of a DSP module.

4 Functional Description

This module conforms to the TIM standard (**T**exas **I**nstrument **M**odule, See TI TIM specification & user's guide) for single width modules.

It sits on a carrier board.

The carrier board provides power (5V, 3.3V, +/-12V), ground, communication links (Comport links) between all the modules fitted and a pathway to the host, for a non stand-alone system.

The SMT348 requires a 3.3V power supply (as present on all Sundance TIM carrier boards), which must be provided by the two diagonally opposite mounting holes.

4.1 Block Diagram

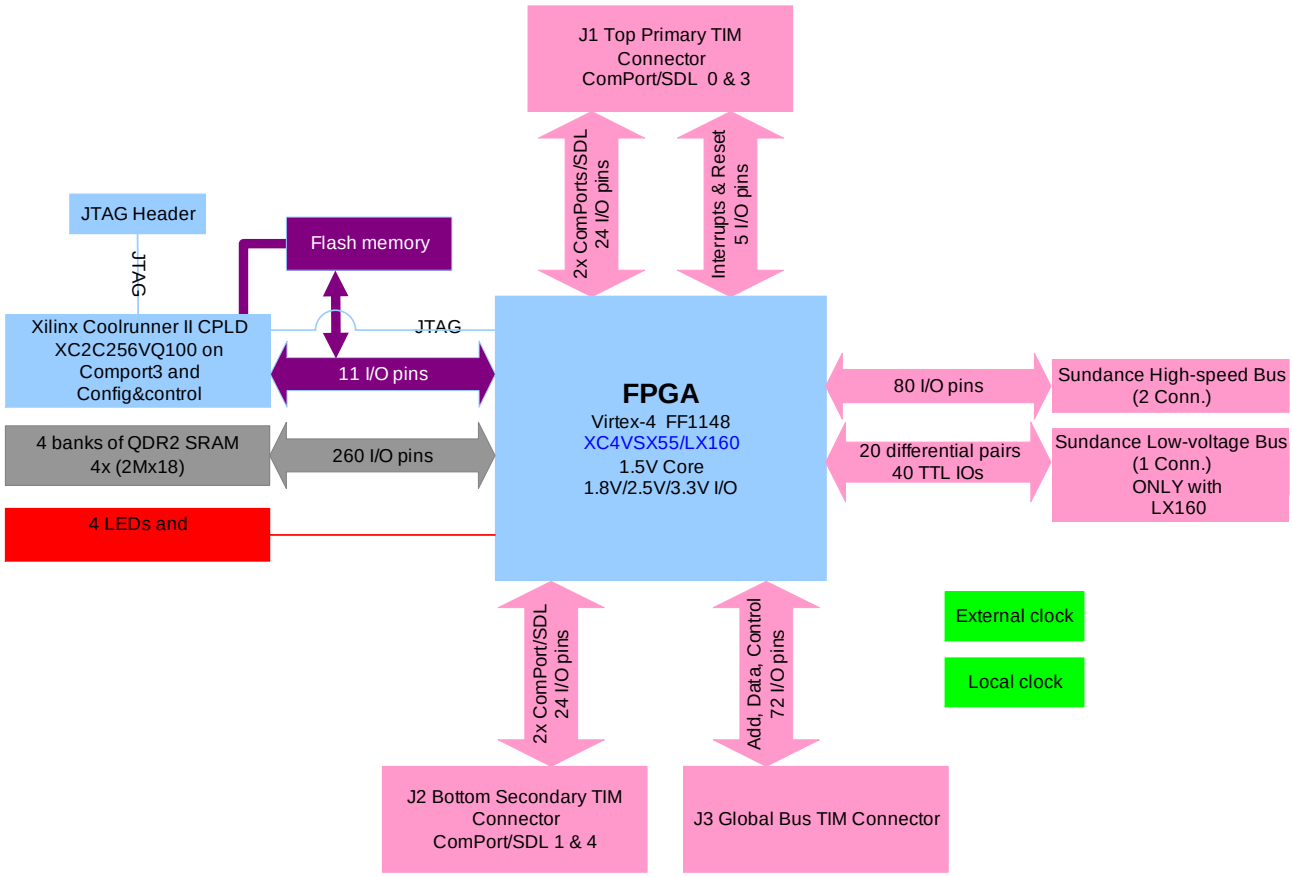


Figure 1: Block Diagram

4.2 Module Description

- Block1 and Block6 Xilinx Virtex 4 XC4VSX55/LX160 and configuration scheme.
- Block2: QDR2 SRAM memory.
- Block3: IO connectors for general purpose or dedicated interfaces.
- Block4: 50MHz or 200MHz local clocks, and external clock input.
- Block5: LEDs for development and in-use monitoring and general purpose use.

4.2.1 FPGA

Xilinx Virtex 4 XC4VSX55FF1148 or XC4VLX160FF1148 FPGA.

This device is packaged in a 1148-pin BGA package.

4.2.2 CPLD

Xilinx Coolrunner II device XC2C256-6CP132C. This device is packaged in a 132-ball BGA type package with a -6 speed grade.

It can be used to configure the FGPA via Comport 3, or from a configuration stored in flash memory.

The flash memory is programmed using the CPLD and data via the ComPort3.

4.2.3 FLASH MEMORY

S29GL256N11TFI01 is a 256Mbit flash from Spansion

It can be used to configure the FPGA at power up.

Flash accessed using Comport3 via the CPLD.

Flash programming selection via switch SW1 (See Table 3)

Software Library Support available from Sundance.

The code can run on Sundance DSP TIM or a Host.

All the flash functionalities are available.

4.2.4 JTAG Header

The JTAG header is compatible with Xilinx Parallel-IV cable signals.

It supports code download (for the FPGA), FPGA configuration, Hardware and Software Debugging tools for the Virtex-4.

This cable connects the parallel port of an engineer's Workstation/PC to the JTAG chain of the SMT348 Module.

All the Xilinx devices from block1 are chained and accessible via this JTAG header.

4.2.5 FPGA Configuration schemes

Different schemes are available to provide maximum flexibility in systems where the SMT348 is involved:

The FPGA configuration bitstream source is

- On Comport 3:

The CPLD is connected to the Comport 3 link of the SMT348 TIM connector. (See block1).

A switch is used to select Comport 3 as the link that will be used to receive the bitstream.

The CPLD allows for FPGA configuration in slave SelectMAP mode.

- Using the on-board Flash memory.

The CPLD monitors the configuration data between the Flash and the FPGA.

The FPGA configuration is operated in Slave SelectMap mode.

A switch is used to select the Flash as the source for the configuration bitstream.

- Using the on-board JTAG header and Xilinx JTAG programming tools.

The JTAG header is a Parallel-IV Header.

Note: Using JTAG to configure the FPGA bypasses the CPLD which controls configuration.

The following section describes the CPLD role and the reset scheme used.

As the CPLD is bypassed when JTAG is used to configure the FPGA, it is necessary to adopt one of the three following ways:

- If your FPGA design does not implement comport3,
    - do not use the Reset signal generated by the CPLD but use the TIM reset signal as your design's reset. You can use JTAG to configure your FPGA with your application and the design will reset and run everytime you issue a new TIM reset.
- If your design implements comport3
    - Set the switch to configure the FPGA from flash after reset. In this way a default bitstream being stored in flash will be loaded in the FPGA by the CPLD.
        - In this manner the CPLD has gone trhough the cycle of configuring the FPGA and releases the reset (FPGAresetn)
        - Then you can reconfigure the FPGA via JTAG with your application.
    - Set the switch to configure from comport 3. After reset, configure the FPGA via JTAG and provide an end key word on comport 3 to the CPLD so that it releases the Reset. (FPGAresetn).

4.2.6 FPGA Reset Scheme

The CPLD is connected to a TIM global Reset signal provided to the SMT348 via its primary TIM connector pin 30. (See TI TIM specification & User's guide).

This signal goes to the CPLD and the FPGA.

Nevertheless as a general rule for good practice, the FPGA should not use this reset but should use the reset signal generated by the CPLD.

The CPLD provides another signal called **FPGAResetn** that offers a better Reset control over the FPGA.

At power up or on reception of a low TIM global Reset pulse, the CPLD drives the FPGAResetn signal low and keeps it low.

This is used to keep the FPGA design in reset.

A new FPGA configuration bitstream can then be downloaded.

When the ENDKEY has been received, the CPLD drives FPGAResetn high.

> Use **FPGAResetn** for the Global Reset signal of your FPGA designs.

In this manner, you can control your FPGA design Reset activity and you will also avoid possible conflicts on ComPort 3 if your FPGA design implements it.

(Comport3 is a communication resource shared by the CPLD and the FPGA. But only 1 entity is allowed to use it at a time).

> If you implement comport 3 in the FPGA you have to use Fpgaresetn generated by the CPLD, as the comport is shared between the two.

The Reset control is operated by the CPLD line FPGAResetn.

The following diagram shows the CPLD states after Reset.

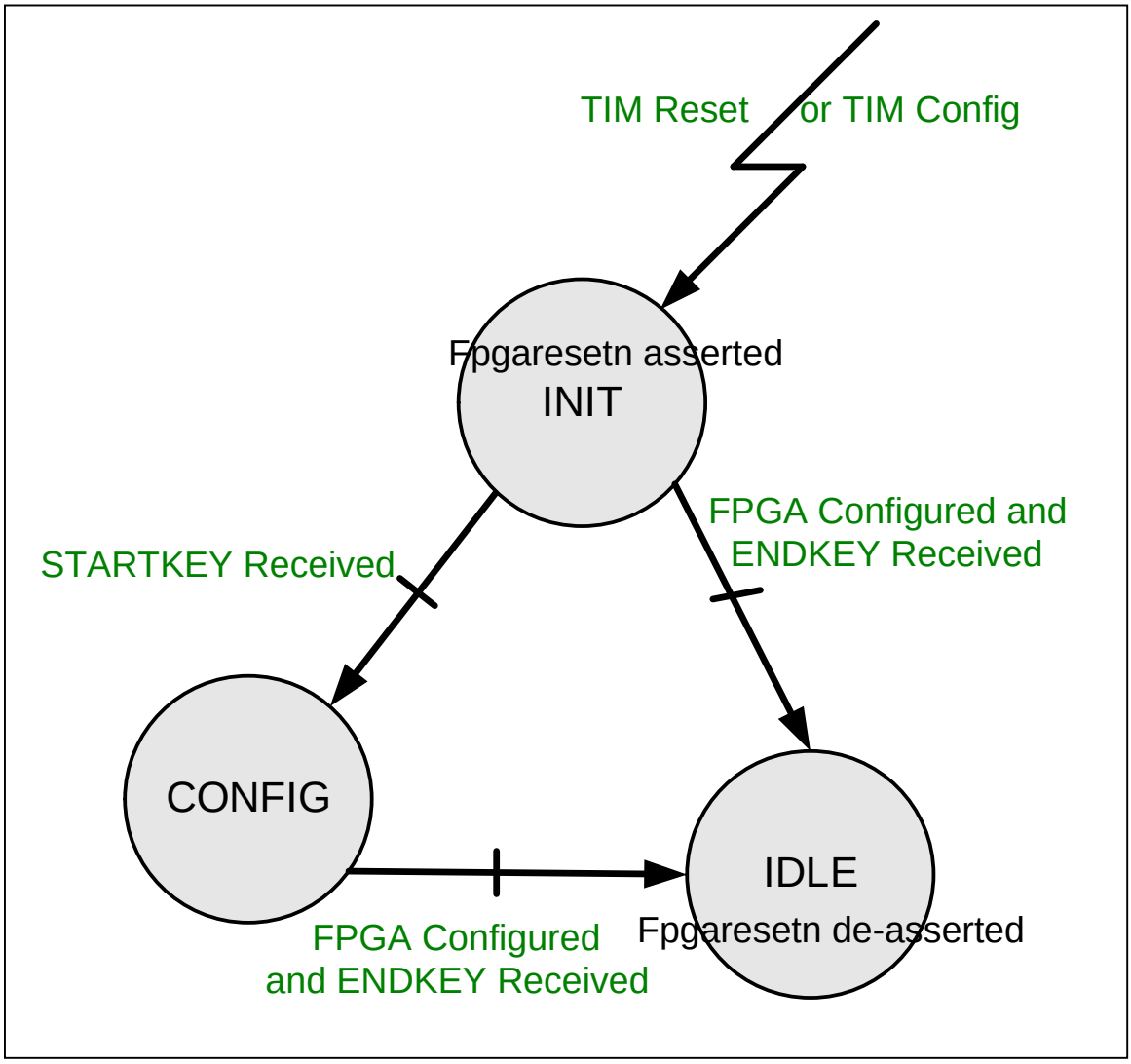


Figure 2: CPLD state machine

4.2.7 FPGA Bitstream formatting

If you generated you FPGA bitstream using Diamond FPGA, you do not need any other handling. The .app file created can be used as is to configure the FPGA.

If you used Xilinx ISE and created a .bit file, you need to use the Sundance executable "Getrawdata.exe" provided for free in the SMT6001 package.

Please read the SMT6001 help file at chapter: "Saving FPGA configuration data to file".

The resulting file can be used as is to configure the FPGA.

4.2.8 QDR2 SRAM

Up to 4 Mbytes of QDR2 SRAM per bank.

The memory is available as 4 independent banks.

The QDR2 memory runs at 250MHz.

Each bank is fully independent with separate address, control and data busses and arranged as follows:

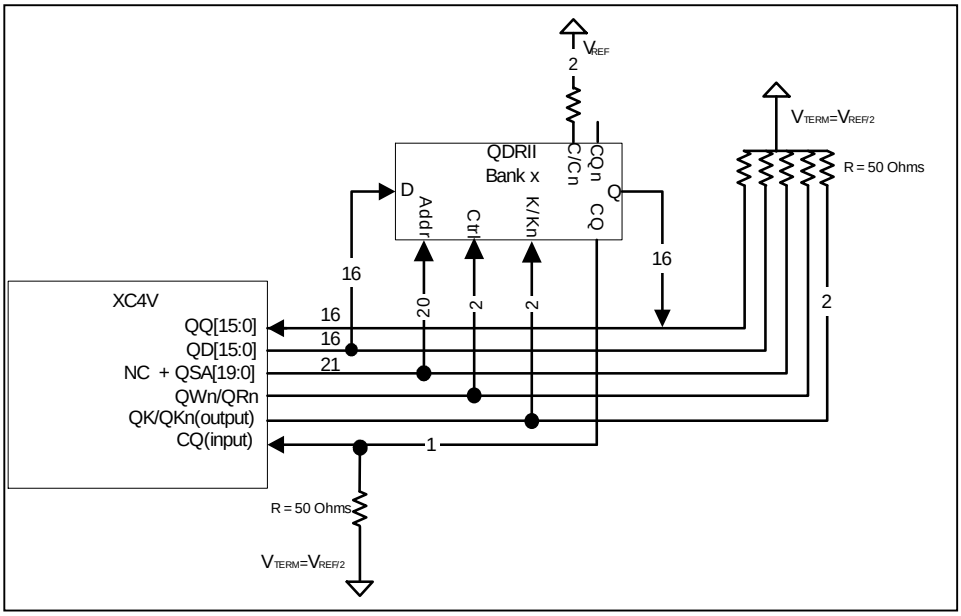


Figure 3: FPGA connections to Bank1 of QDRII

The devices used are Samsung K7R321884M. Alternative part numbers, fully compatible can be fitted depending on availability at time of order.

4.2.9 Sundance High speed Bus

2 x 60 pin connectors provide 80 IO connections between the FPGA and the outside word.

They allow interfacing to other Sundance modules providing that you implement an SHB interface in the FPGA. (See 2.1)

The SHB interface is available in Sundance SMT6500 support package. Either two 16-bit, or 1 32-bit interface can be implemented per connector.

They allow interfacing to the outside world by implementing your own interface in the FPGA.

The FPGA IO banks hosting the SHB signals are powered using Vcco = 3.3V.

4.2.10 Sundance Low voltage Bus

This bus is present on the LX160 version of the module only.

This is an LVDS bus comprising data (2 x 16 bit buses, I & Q), clock, and control signals.

They allow interfacing to Sundance mezzanine modules providing that you implement an SLB interface in the FPGA. (See 2.1)

They allow interfacing to the outside world by implementing your own LVDS interface in the FPGA.

All LVDS data pins (both I and Q) are connected to a 2.5/3.3V powered FPGA banks (link selectable by jumper JP3).

The FPGA LVDS DIFF_TERM standard should be used instead of the DCI terminations when LVDS standard is selected.

DCI terminations are only available when a 2.5v standard is selected.

The LVDS Clock signals are also in these banks.

All LVTTL signals are connected to a 3.3V powered FPGA bank.

4.2.11 TIM Connectors

TIM connectors provide 4 communication links (Comports) and a Global Bus to the FPGA.

The comports which are available on the SMT348 are CP0, CP1, CP3, and CP4.

They allow interfacing to Sundance TIM modules or to a Host PC providing that you implement a Comport Interface inside the FPGA. (See 2.1)

The Comport interface is available in Sundance SMT6500 support package.

The FPGA io banks hosting the Comport signals are powered using Vcco = 3.3v.

The TIM connectors also provide power/ground, reset and various control signals.

References and specifications for these connectors are available in TI TIM specification & user's guide

4.2.12 DIP Switches

One four-position DIP switch is connected to the CPLD to provide control over the selection of the configuration bitstream source and a special reset feature called "TIM Confign".

SW1 pos 4	TIM Config
ON	ENABLED
OFF	DISABLED

Table 1: DIP switch SW1 position for special reset feature

SW1 pos 3,2, 1	JPC3	JPC2	JPC1
C3P	OFF	OFF	OFF
Flash	OFF	OFF	ON

Table 2: DIP switch SW1 position for the selection of the configuration bitstream source

SW1 pos 3,2, 1	JPC3	JPC2	JPC1
Flash accesses	ON	OFF	OFF

Table 3: DIP switch SW1 position for the selection of the Flash erase & program operations.

The Flash erase & program operations are operated by the CPLD.

Commands are provided via Comport3 from an application running on a Host or DSP.

Status information from the Flash is given over Comport3 as well.

4.2.13 Clocking scheme

The SMT348 module contains a 50MHz LVTTL clock, a 200MHz clock, and a connector for an external LVTTL clock input/output.

50 MHz LVTTL oscillator: Main system clock. Clocks the CPLD and the FPGA. Can be input in a DCM.

200MHz LVTTL oscillator: QDRII clock. Can also be used as a main FPGA clock. Can be input in a DCM.

An external clock input is provided to the Virtex 4 FPGA via an MMBX connector. This connector is NOT fitted by default or if a mezzanine is required. YOU MUST ask Sundance if needed for your application.

4.2.14 LEDs

4 Red LEDs connect to the FPGA and are available to the User: D4, D5, D6, D7.

1 Green Led: D1, connects to the DONE pin of the FPGA and is lit to show that the FPGA is configured. (depending on supply from manufacturer a red led can be fitted instead).

4.2.15 Performance

The FPGA features like speed grade and density dictate most performances.

The performances achievable by the other components are given in the chapters above and the components respective data sheets.

4.3 Interface Description

For the TIM to carrier board or external world interfacing, see in Sundance Help file (that you can download from the Sundance Wizzard)

4.3.1 Power Budget

The SMT348 draws its power from the 3.3v rail of the PCI.

The PCI specification stipulates that the maximum power for one card is 25W.

Therefore, the maximum current that the SMT348 could draw from +3.3V is 7.6A, assuming zero current on all the other supply voltages.

But this limit is "system dependent," so a given system might not have the full 7.6A available for a slot even if it is the only PCI card in the system.

A system might balance the power capabilities differently between the +5V and +3.3V (and +/-12V) supplies, rather than making 25W available from +5V and 25W available from +3.3V.

As a result, check your main power supply ratings.

If your system is likely to reach 25W per power rail we advice that you provide extra power to the carrier board using an external power supply.

Device	Name	Quantity	Voltage(V)	Current(mA)	Power(W)	Source
3.3v power supply	V33	1	3.3	7600	25	PCI specifications

Table 4: Total available power.

Device	Name	Quantity	Voltage(V)	Current(mA)	Power(W)	Source
XC4VLX160FF1148-11 Vccint=1.2v	Vfpga	1	1.2	1.805	2.166 (design implementation of 4 independent qdrii controllers)	Virtex-4 power estimator
Fpga Vccint power plane capacity	Vfpga	1	1.2	14000	16.8	TI TPS50410

Table 5: Power budget on 1.2v

Device	Name	Quantity	Voltage(V)	Current(mA)	Power(W)	Source
XC4VLX160FF1148-11 Vcco=2.5v (LVDS TX pairs on SLB bus)	V25	40	2.5	10	1	Virtex-4 power estimator
XC4VLX160FF1148-11 Vcco=2.5v (LVCMOS TX on SLB bus)	V25	27	2.5	12	0.81	Virtex 4 ds302 v1.17 p.7
Total power consumed	V25				1.81	
Fpga 2.5v power plane capacity	V25	1	2.5	1.5	3.75	LT1963-1.5A Linear Regulator 3.3v to 2.5v/1.5A
Excess power					1.94	

Table 6: Power budget on 2.5v

Device	Name	Quantity	Voltage(V)	Current(mA)	Power(W)	Source
Samsung QDR II burst 4 (18-bit interface)	V18	4	1.8	800	5.76	Samsung QDRII (-25), datasheet rev1.1 p.9
ML6554CU DC/DC converter	V18	1	1.8	0.01	0.018	Fairchild ML6554CU (obsolete)
Coolrunner XC2C256CP132	V18	1	1.8	0.55	0.00099	Ise 8.2.03i Xpower software version: I.34
XC4VLX160FF1148-11 HSTL II	V18	1 (design implementation of 4 independent qdrii controllers)	1.8	829	1.497	Virtex-4 power estimator
Total power consumed	V18				7.27599	
HSTL power plane (1.8v) capacity	V18	1	1.8	6000	10.8	TI TPS54611PWP
Excess power					3.525	

Table 7: Power budget on 1.8v.

Device	Name	Quantity	Voltage(V)	Current(mA)	Power(W)	Source
QDRII Vtt termination resistor (50 ohms) (See details)	V09	240	0.9	18.0	3.89	Samsung QDRII (-25), datasheet rev1.1 p.9
Total power consumed	V09				3.89	
HSTL Vtt termination Power Plane (0.9v) capacity	V09	1	0.9	3000	5.76	Fairchild ML6554CU (obsolete)
Excess power					1.87	

Table 8: Power budget on QDRII 0.9v Termination voltage.

Device	Name	Quantity	Voltage(V)	Current(mA)	Power(W)	Source
QDRII Vref	VR09	8	0.9	0	0	Samsung QDRII (-25), datasheet rev1.1 p.9
XC4VLX160FF1148-11 HSTL Vref	VR09	16	0.9	0.01	0.000144	DS302 (v1.17) table 3 p.3
Total power consumed	VR09				0.000144	
HSTL Vref plane (0.9v) capacity	VR09	1	0.9	3	0.0027	Fairchild ML6554CU (obsolete)
Excess power					0.002556	

Table 9: Power budget on QDRII and FPGA 0.9v reference voltage.

Device	Name	Quantity	Voltage(V)	Current(mA)	Power(W)	Source
25 Mhz Clock oscillator	V33	1	3.3	15	0.05	Jauch VX3 Quartz crystal oscillators datasheet
200 Mhz Clock oscillator	V33	1	3.3	20	0.066	Jauch VX3 Quartz crystal oscillators datasheet
Linear Regulator 3.3v to 2.5v/1.5A	V33	1	3.3	1.136	3.75	LT1963-1.5A
DC/DC converter 3.3v to 0.9v	V33			13.75	N/A	Fairchild ML6554CU (obsolete)
DC/DC converter 3.3v to 1.2v	V33			14000	N/A	TI TPS50410
DC/DC converter 3.3v to 1.8v	V33			6000	N/A	TI TPS54611PWP
DIP Switch	V33	1	3.3	0.7	0.002	Four 4.7 Kohm pullup
Flash memory	V33	1	3.3	90	0.297	S29GL256N
XC4VLX160FF1148-11 LVTTL Vcco=3.3v	V33	1	3.3		Depends on implemented design	Virtex-4 power estimator
3.3v power plane	V33	1	3.3	7600	25W	TI TPS50410

Table 10: Power budget on 3.3v.

Details:

Coolrunner XC2C256-6-CP132 power requirements based on design:

Macrocells Used	Pterms Used	Registers Used	Pins Used	Function Block Inputs Used
218/256 (86%)	531/896 (60%)	190/256 (75%)	69/106 (66%)	445/640 (70%)

Table 11: Coolrunner II resources summary.

Signal Type	Required	Mapped	Pin Type	Used	Total
Input	8	8	I/O	65	96
Output	40	40	GCK/IO	3	3
Bidirectional	20	20	GTS/IO	0	4
GCK	1	1	GSR/IO	1	1
GTS	0	0	CDR/IO	0	1
GSR	0	0	DGE/IO	0	1

Table 12:Coolrunner II pin resources.

5 Footprint

5.1 Top View

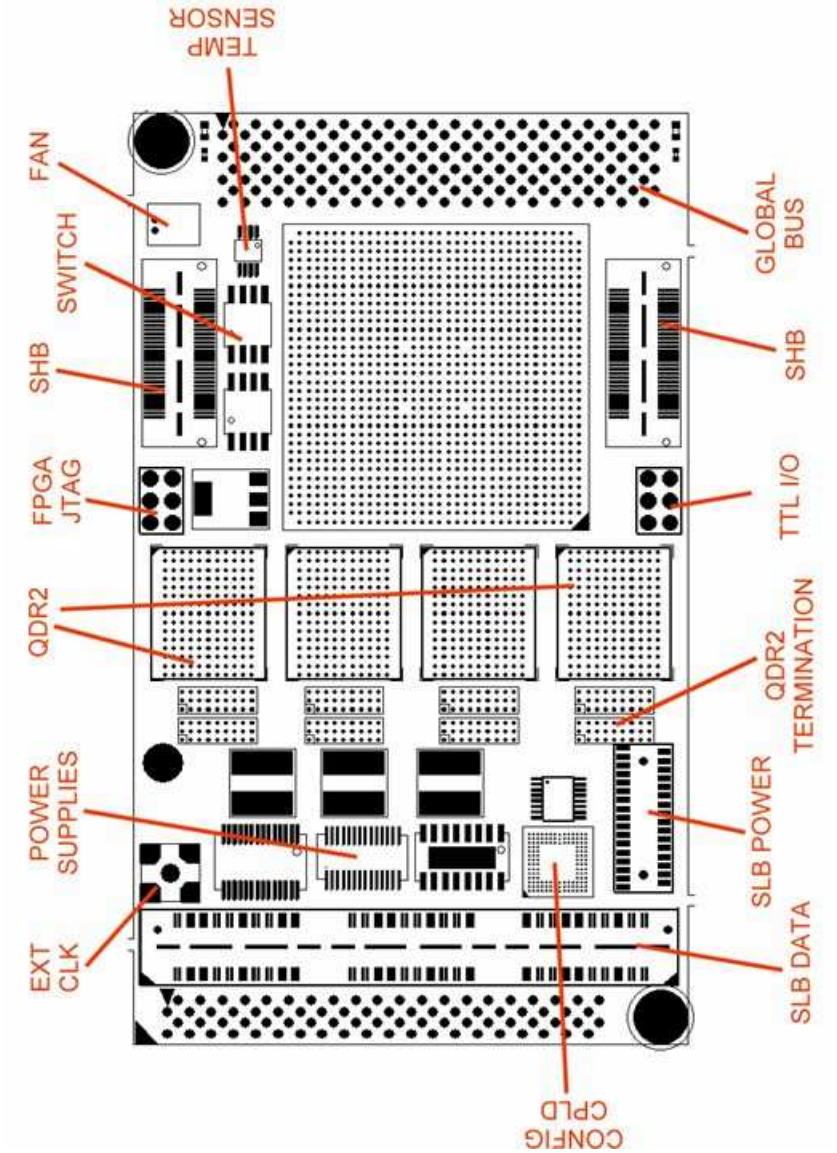


Figure 4: Top View

5.2 Bottom View

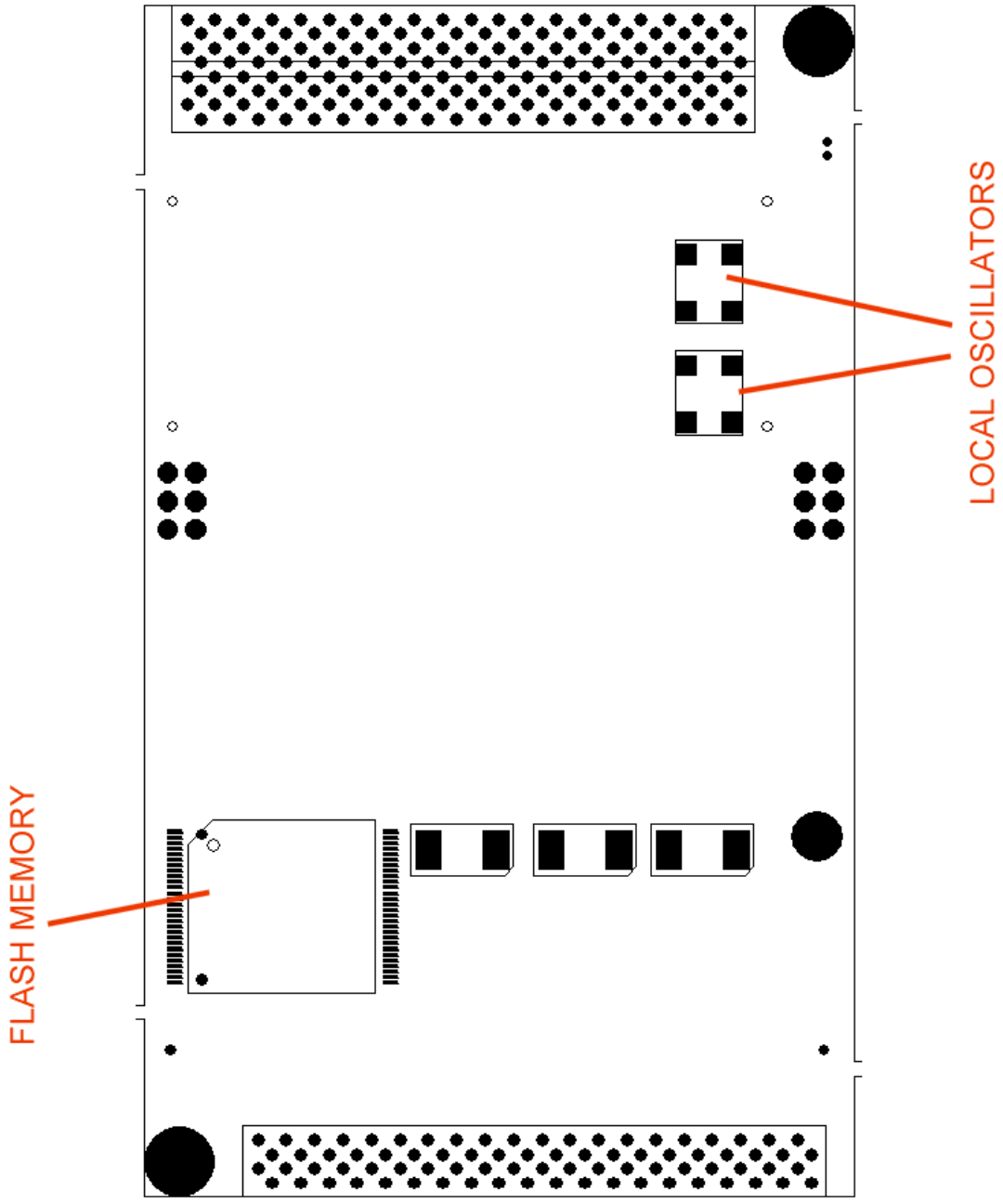


Figure 5: Bottom view

6 Pinout

6.1 FPGA Pin allocation by bank

Bank	I/O	Vr*	QDR2	SHB	CP	SLB	GB	Other	Total
1	48	0							
2	48	0	Clocks & DLL control					8xConfig	8
3	16	0							2
4	16	0						Clocks & Reset & Switches	13
5	64	4	Bank C Data + Control						64
6	64	4	Bank B Data + Control						64
7	64	6				SLB LVTTL	13 Control	PXI, TTL, INTs, LEDs, Misc.	64
8	64	6					32 Data & 31 Address & 1 Control		64
9	64	4	Bank D Data & Control						64
10	64	4	Bank A Data & Control						64
11	64	6		1xSHB	2xCP				64
12	64	6		1xSHB	2xCP				64
13	64	6				16 Diff Data & 4 Diff Clocks			46
14	64	6				16 Diff Data & 4 Diff Clocks			46

Vr* = Vrp + Vrn + Vref

Table 13: Pin allocation by Bank

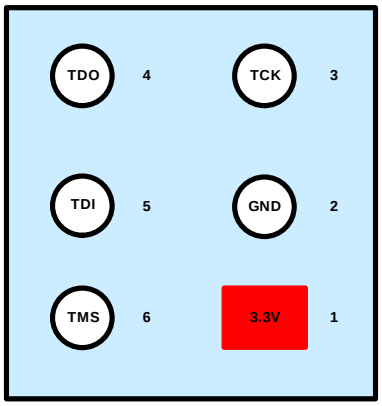
6.2 SHB

SUNDANCE SHB specification

6.3 SLB

SUNDANCE SLB specification

6.4 JTAG



JP1

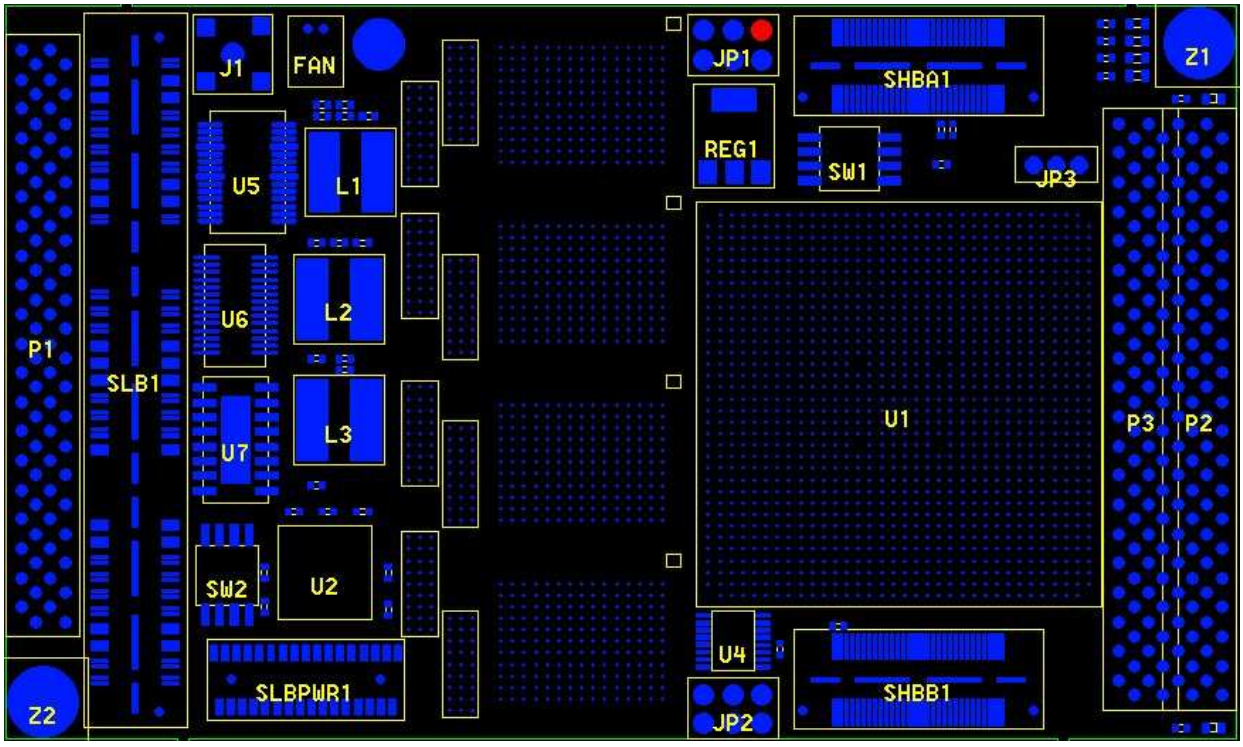


Figure 6: JTAG Connector, top view

7 Qualification Requirements

7.1 Qualification Tests

7.1.1 Meet Sundance standard specifications

- Meet the TIM standard specifications
- Meet the SLB specifications (LVDS standard).
- Meet the SHB specifications.

7.1.2 Speed qualification tests

- QDR2 memory accesses at 250MHz.

7.1.3 Integration qualification tests

- Must work on ALL Sundance platforms as a root TIM module or as part of a network of TIMs on carriers.
- Must be able to work stand-alone.

8 Support Packages

9 Physical Properties

Dimensions		
Weight		
Supply Voltages		
Supply Current	+12V	
	+5V	
	+3.3V	
	–5V	
	–12V	
MTBF		

10 Safety

This module presents no hazard to the user when in normal use.

11 EMC

This module is designed to operate from within an enclosed host system, which is build to provide EMC shielding. Operation within the EU EMC guidelines is not guaranteed unless it is installed within an adequate host system.

This module is protected from damage by fast voltage transients originating from outside the host system which may be introduced through the output cables.

Short circuiting any output to ground does not cause the host PC system to lock up or reboot.