

# Hardware User Manual

## CM-BF533 V2.0 (V1.3)

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Maximum Power at Minimum Size

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# Table of Contents

1	Introduction .....	1
1.1	Overview .....	1
1.2	Benefits .....	2
1.3	Applications .....	2
2	Specification .....	3
2.1	Functional Specification .....	3
2.2	Boot Mode .....	3
2.3	Memory Map.....	4
2.4	Electrical Specification .....	4
2.4.1	Supply Voltage .....	4
2.4.2	Supply Voltage Ripple .....	4
2.4.3	External Oscillator Frequency .....	4
2.4.4	Real Time Clock Crystal .....	4
2.4.5	Supply Current .....	4
2.5	Environmental Specification.....	4
2.5.1	Temperature.....	4
2.5.2	Humidity.....	5
3	CM-BF533 (Connector Version).....	6
3.1	Mechanical Outline .....	6
3.2	Connector Footprint .....	7
3.3	Top Mounted Connector .....	8
3.4	Schematic Symbol (Signals of P1 and P2).....	9
3.5	Connectors Pin Assignment P1 – (1-60).....	10
3.6	Connector Pin Assignment P2 – (61-120) .....	11
3.7	ITU656 Camera Connector P3 (1-22).....	12
3.8	Connector P4 (1-10).....	12
4	Test Points .....	13
4.1	Footprint – Test Points.....	13
5	Application Examples .....	14
5.1	Sample Application.....	14
5.2	Stand-alone Camera System .....	15
5.3	Generic Signal Processing System.....	15

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5.4	Coprocessor Application.....	15
5.5	Digital Video System.....	16
5.6	Design Services.....	16
6	Software Support.....	17
6.1	BLACKSheep.....	17
6.2	uClinux.....	17
7	Known Bugs.....	18
8	Product Changes.....	19
9	Document Revision History.....	20
A	List of Figures and Tables.....	21

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### **Information**

For further information on technology, delivery terms and conditions and prices please contact Bluetechnix (<http://www.bluetechnix.com>).

### **Warnings**

Due to technical requirements components may contain dangerous substances.

The Core Boards and Development systems contain ESD (electrostatic discharge) sensitive devices. Electrostatic charges readily accumulate on the human body and equipment and can discharge without detection. Permanent damage may occur on devices subjected to high-energy discharges. Proper ESD precautions are recommended to avoid performance degradation or loss of functionality. Unused core boards and development boards should be stored in the protective shipping package.



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## BLACKFIN Products

### Core Modules:

- CM-BF533: Blackfin Processor Module powered by Analog Devices single core ADSP-BF533 processor; up to 600MHz, 32MB RAM, 2MB Flash, 120 pin expansion connector and a size of 36.5x31.5mm
- CM-BF537E: Blackfin Processor Module powered by Analog Devices single core ADSP-BF537 processor; up to 600MHz, 32MB RAM, 4MB Flash, integrated TP10/100 Ethernet physical transceiver, 120 pin expansion connector and a size of 36.5x31.5mm
- CM-BF537U: Blackfin Processor Module powered by Analog Devices single core ADSP-BF537 processor; up to 600MHz, 32MB RAM, 4MB Flash, integrated USB 2.0 Device, 120 pin expansion connector and a size of 36.5x31.5mm
- TCM-BF537: Blackfin Processor Module powered by Analog Devices single core ADSP-BF537 processor; up to 500MHz, 32MB RAM, 8MB Flash, 28x28mm, 120 pin expansion connector, Ball Grid Array or Border Pads for reflow soldering, industrial temperature range -40°C to +85°C.
- CM-BF561: Blackfin Processor Module powered by Analog Devices dual core ADSP-BF561 processor; up to 2x 600MHz, 64MB RAM, 8MB Flash, 120 pin expansion connector and a size of 36.5x31.5mm
- CM-BF527: From Q3 '07 a new Blackfin Processor Module powered by Analog Devices single core ADSP-BF527 processor will be available; key features are USB OTG 2.0 and Ethernet. 2x120pin expansion connectors are backwards compatible to other Core Modules.
- CM-BF548: From Q3 '07 a new Blackfin Processor Module powered by Analog Devices single core ADSP-BF548 processor will be available; key features are 64MB DDR SD-RAM 2x100pin expansion connectors.

### Development Boards:

- EVAL-BF5xx: Low cost Blackfin processor Evaluation Board with one socket for any Bluetechnix Blackfin Core Module. Additional periphery is available, such as a SD-Card.
- DEV-BF5xxDA-Lite: Get ready to program and debug Bluetechnix Core Modules with this tiny development platform including a USB Based Debug Agent. The DEV-BF5xxDA-Lite is a low cost starter development system including VDSP++ Evaluation Software License.

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DEV-BF5xx-FPGA: Backfin Development Board with two sockets for any combination of Blackfin Core Modules. Additional periphery is available, such as SD-Card, Ethernet, USB host, multi-port JTAG including a USB based Debug Agent, connector for a LCD-TFT Display and connector for a digital camera system. A large on-board SPARTAN-3 FPGA and Soft IPs make this board the most flexible Blackfin development platforms ever developed.  
Available Q2 2007

EXT-Boards: The following Extender Boards are available: EXT-BF5xx-Audio, EXT-BF5xx-Video, EXT-BF5xx-Camera, EXT-BF5xx-Exp, \*EXT-BF5xx-LVDS, \*EXT-BF5xx-ETH-USB, \*EXT-BF5xx-AD/DA. Additional boards based on customer request  
\*Available Q2 2007

### **Software Support:**

BLACKSheep: The BLACKSheep VDK is a multithreaded framework for the Analog Devices Blackfin processor family that includes driver support for a variety of hardware extensions. It is based on the real-time VDK kernel included within the VDSP++ development environment.

LabVIEW: LabVIEW embedded support for the CM-BF537E, CM-BF537U and TCM-BF537 Core Modules based on the BLACKSheep VDK driver Framework.

uClinux: All the Core Modules are supported by uClinux. The required boot loader and uClinux can be downloaded at <http://blackfin.uClinux.org>.

## **BLACKFIN Design Service**

Based on over three years Blackfin experience Bluetechnix offers development assistance as well as custom design services and software development.

# 1 Introduction

The CM-BF533 is a tiny, high performance and low power DSP/RISC core module incorporating Analog Devices Blackfin family of processors. The module allows easy integration into high demanding very space and power limited applications.

## 1.1 Overview

The Core Module CM-BF533 consists of the following components:

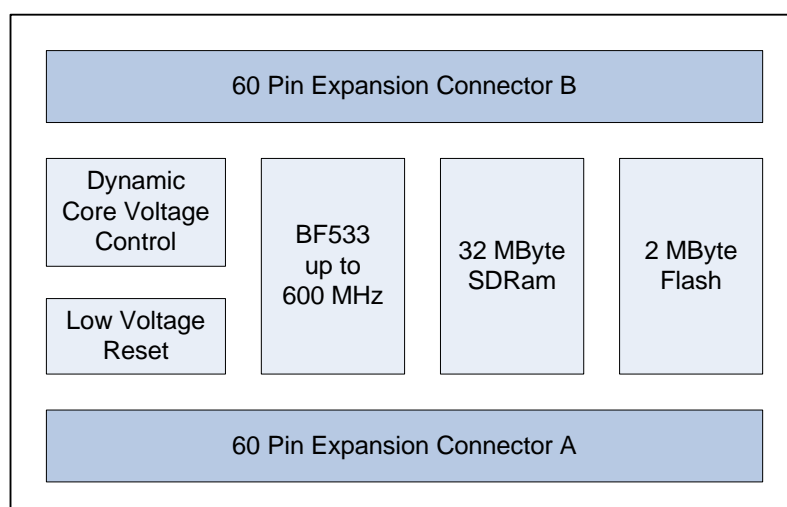


Figure 1-1: Main Components of the CM-BF533 module

- **Analog Devices Blackfin Processor BF533**
  - ADSP-BF533SKBCZ600 (0°-70°C) Standard mount
  - ADSP-BF533SBBCZ500 (-40°-85°C) Option upon request
- **32 MB SDRAM**
  - SDRAM clock up to 133 MHz
  - MT48LC16M16A2BG-7 (16Mx16 at 3.3 V)
- **2MB of Addressable Flash**
  - ITLRC28F320J3C110 (2Mx16 at 3.3 V; 2MByte addressable only)
  - Additionally flash memory can be connected through the expansion board as parallel flash using asynchronous chip select lines or as a SPI flash.



- **Low Voltage Reset Circuit**
  - Resets module if power supply goes below 2.93 V for at least 140 ms
- **Dynamic Core Voltage Control**
  - Allows to adjust core voltage by setting software registers at the Blackfin Processor
  - Core voltage range: 0.8 – 1.32V
- **Expansion Connector A**
  - Data Bus
  - Address Bus
  - Control Signals
  - Power Supply
- **Expansion Connector B**
  - SPORT 0 and SPORT 1
  - JTAG
  - UART
  - SPI
  - PPI (Parallel Port Interface)
  - GPIO's

## 1.2 Benefits

- The CM-BF533 is very compact and measures only 36.5x31.5mm
- Allows quick prototyping of product that comes very close to the final design
- Reduces development costs, faster time to market
- Very cost effective for small and medium volumes

## 1.3 Applications

- Generic high performance signal processor module
- Internet Connected Embedded System
- High performance web camera
- Robotics: Tiny processor module for mobile robots

## 2 Specification

### 2.1 Functional Specification

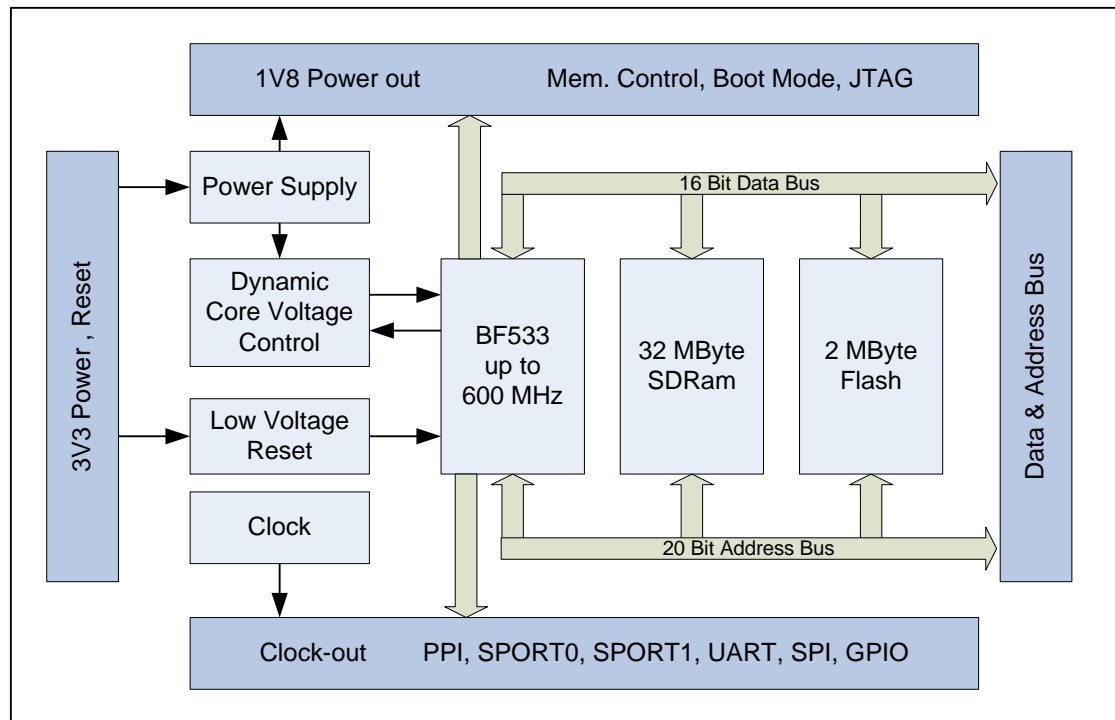


Figure 2-1: Detailed Block Diagram

Figure 2-1 shows a detailed block diagram of the CM-BF533 module. Beside the SDRAM control pins the CM-BF533 has all other pins of the Blackfin processor at its two main 60 pin connectors.

Dynamic voltage control allows reducing power consumption to a minimum adjusting the core-voltage and the clock frequency dynamically in accordance to the required processing power.

A low voltage reset circuit guarantees a power on reset and resets the system when the input voltage drops below 2.93V.

### 2.2 Boot Mode

Default Boot Mode = 00 (BMODE1 = LOW, BMODE0 = LOW)

BMODE0, BMODE1 has internal pull-down resistor

Connect BMODE0 to Vcc and leave BMODE1 pin open for Boot Mode 01 (equals to 8 or 16 bit PROM/FLASH boot mode), this is the default boot mode of the Blacksheep software.

See Blackfin Datasheets or Eval/DevBoard manuals for more details.

## 2.3 Memory Map

Memory Type	Start Address	End Address	Size	Comment
FLASH	0x20000000	0x201FFFFFFF	2MB	RC28F320J3C110
SDRAM	0x00000000	0x01FFFFFFF	32MB	16Bit Bus, Micron MT48LC16M16A2BG-7

Table 2-1: Memory Map

## 2.4 Electrical Specification

### 2.4.1 Supply Voltage

- 3.3 V DC +/-10%

### 2.4.2 Supply Voltage Ripple

- 100 mV peak to peak 0-20MHz

### 2.4.3 External Oscillator Frequency

- 25MHz

### 2.4.4 Real Time Clock Crystal

- 32.768kHz

### 2.4.5 Supply Current

- Maximum supply current: 250mA @ 3.3V
- Operating conditions:
  - Processor running at 600MHz, Core Voltage 1.2V, SDRAM 20% bandwidth utilization at 130MHz: 150mA
  - Processor running at 300MHz, Core Voltage 0.8V SDRAM 20% bandwidth utilization at 130MHz: 90mA

## 2.5 Environmental Specification

### 2.5.1 Temperature

Development Version:

- Operating at full 600MHz: 0 to + 70° C

Industrial Version: (Only available upon request at a MOQ)

## **2.5.2 Humidity**

- Operating: 10% to 90% (non condensing)

### 3 CM-BF533 (Connector Version)

#### 3.1 Mechanical Outline

##### TOP VIEW

All dimensions are given in millimeters!

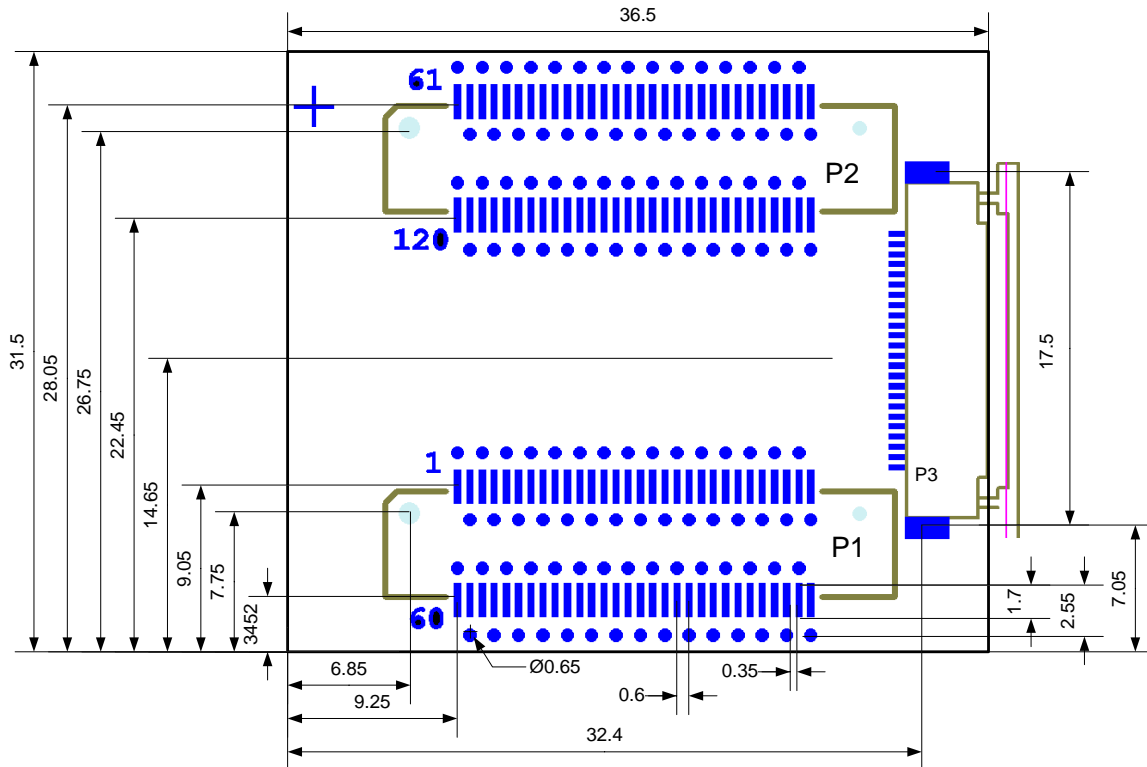


Figure 3-1: Mechanical outline and Bottom Connectors

The mechanical outline represents a top view of the connectors placed at the bottom of the core board.

The module is shipped with two 60pin connectors.

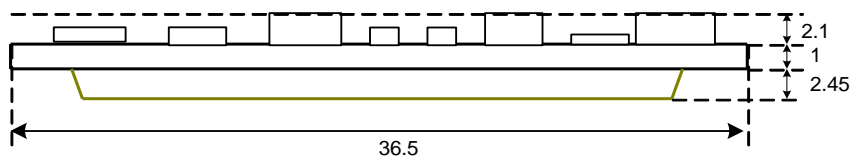


Figure 3-2: Side View with Connector mounted

The total minimum mounting height including receptacle at the motherboard is 6.1 mm.

### 3.2 Connector Footprint

If the connector version (2x Hirose 0.6mm pitch) is used, the footprint for the baseboard may look as shown in Figure 3-3.

For the baseboard the following connectors have to be used:

Part Baseboard	Manufacturer	Manufacturer Part No.
P1,P2	Hirose	FX8-60S-SV
P4 (top)	Harwin	M50-3600522

Table 3-1: Baseboard connector types

The connectors on the CM-BF533 are of the following type:

Part	Manufacturer	Manufacturer Part No.
P1,P2	Hirose 3mm height	FX8-60P-SV(21)
P3	Molex (not mounted)	52435-2491
P4 (top)	Harwin (not mounted)	M50-3150522

Table 3-2: Module connector types

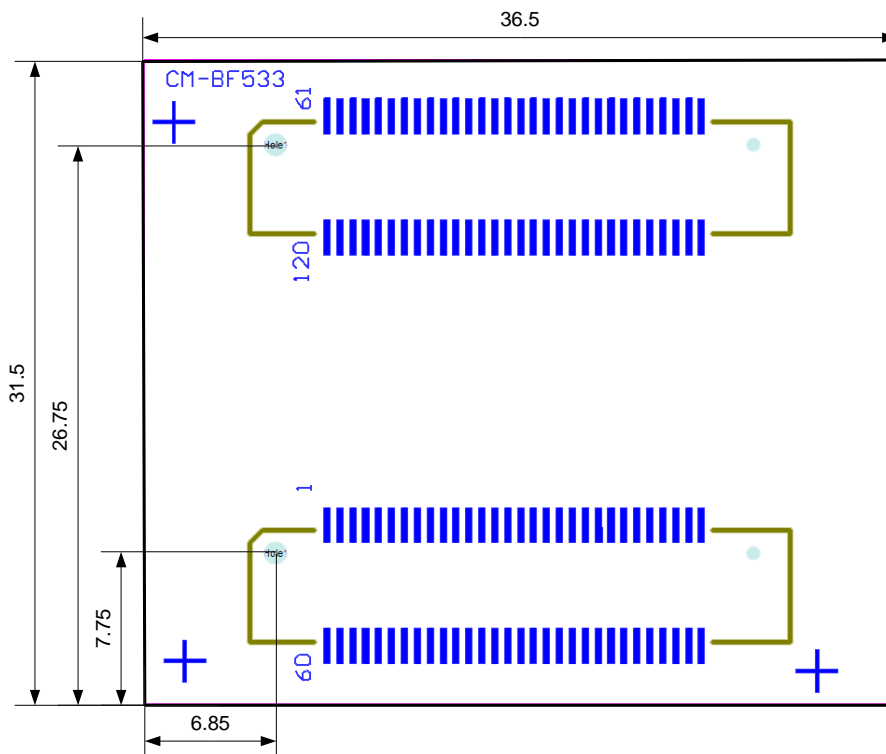


Figure 3-3: Connector Footprint for Baseboard

### 3.3 Top Mounted Connector

The optionally mounted connector P4 will not be supported in future versions.

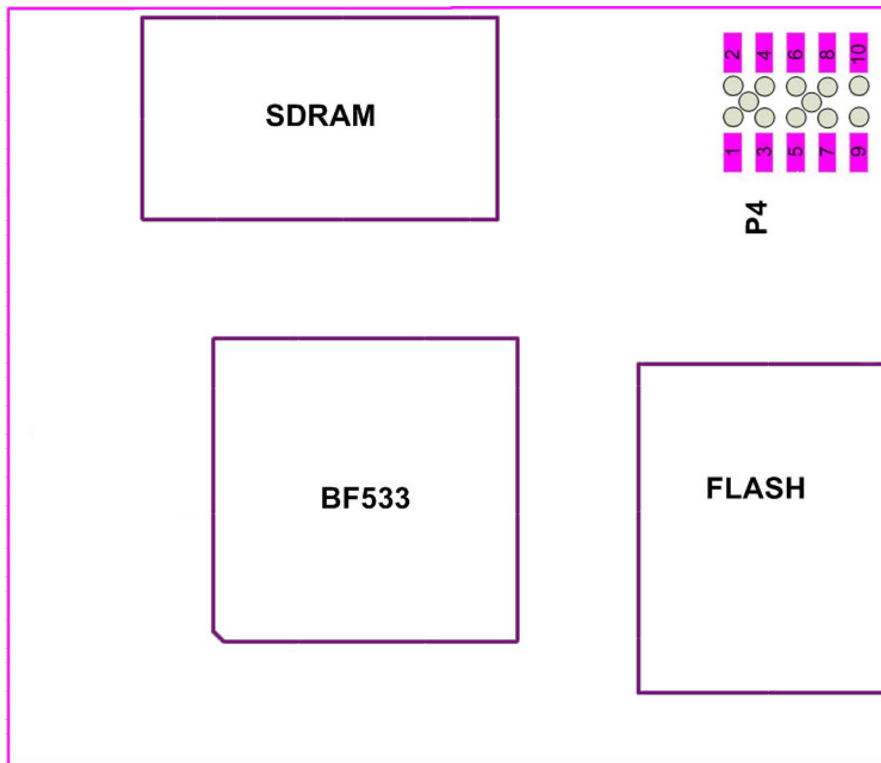


Figure 3-4: TOP VIEW

### 3.4 Schematic Symbol (Signals of P1 and P2)

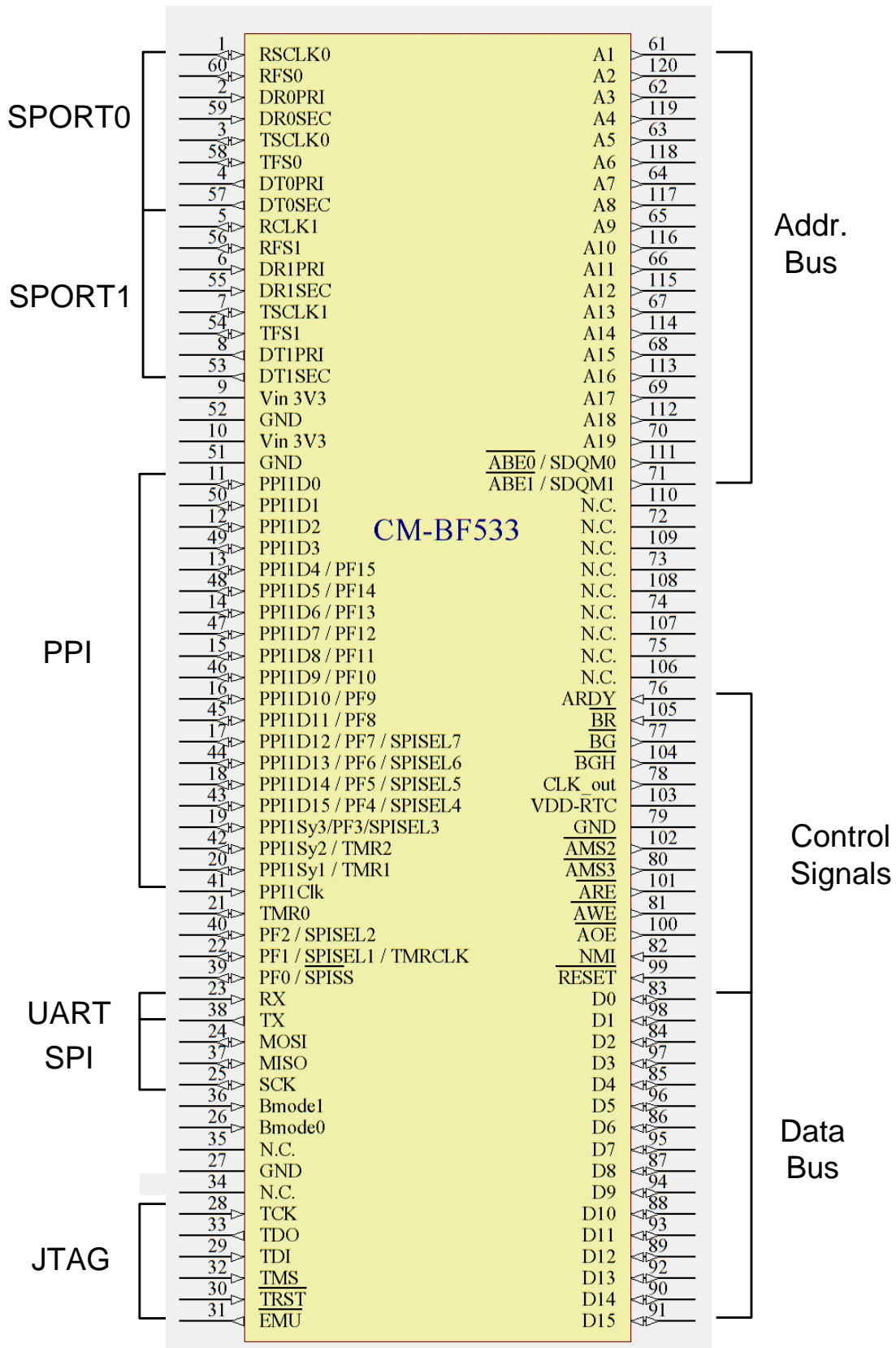


Figure 3-5: Schematic Symbol of Module



**3.5 Connectors Pin Assignment P1 – (1-60)**

Pin No.	Signal	Signal type	Pin No.	Signal	Signal type
1	RSCLK0	I/O	2	DR0PRI	I
3	TSCLK0	I/O	4	DT0PRI	O
5	RSCLK1	I/O	6	DR1PRI	I
7	TSCLK1	I/O	8	DT1PRI	O
9	Vin 3V3	PWR	10	Vin 3V3	PWR
11	PPI1D0	I/O	12	PPI1D2	I/O
13	PF15 / PPI1D4	I/O	14	PF13 / PPI1D6	I/O
15	PF11 / PPI1D8	I/O	16	PF9 / PPI1D10	I/O
17	PF7/SPISEL7/PPI1D12	I/O	18	PF5/SPISEL5/PPI1D14	I/O
19	PF3/SPISEL3/PPI1Sy3	I/O	20	TMR1 / PPI1_Sy1	I/O
21	TMR0	I/O	22	PF1/SPISEL1/TMRCLK	I/O
23	RX	I	24	MOSI	I/O
25	SCK	I	26	BMODE0	I
27	GND	PWR	28	TCK	I
29	TDI	I	30	nTRST	I
31	nEMU	O	32	TMS	I
33	TDO	O	34	N.C.	-
35	N.C.	-	36	BMODE1	I
37	MISO	I/O	38	TX	O
39	PF0 / nSPISS	I/O	40	PF2/SPISEL2	I/O
41	PPI_CLK	I/O	42	TMR2 / PPI1Sy2	I/O
43	PF4/SPISEL4/PPI1D15	I/O	44	PF6/SPISEL6/PPI1D13	I/O
45	PF8 / PPI1D11	I/O	46	PF10 / PPI1D9	I/O
47	PF12 / PPI1D7	I/O	48	PF14 / PPI1D5	I/O
49	PPI1D3	I/O	50	PPI1D1	I/O
51	GND	PWR	52	GND	PWR
53	DT1SEC	O	54	TFS1	I/O
55	DR1SEC	I	56	RFS1	I/O
57	DT0SEC	O	58	TFS0	I/O
59	DR0SEC	I	60	RFS0	I/O

Table 3-3: Connector P1 pin assignment

All Pin names of the connectors correspond to the names found in the Blackfin BF533 datasheet from Analog Devices.

### 3.6 Connector Pin Assignment P2 – (61-120)

Pin No.	Signal	Signal type	Pin No.	Signal	Signal type
61	A1	O	62	A3	O
63	A5	O	64	A7	O
65	A9	O	66	A11	O
67	A13	O	68	A15	O
69	A17	O	70	A19	O
71	ABE1/SDQM1	O	72	N.C.	-
73	N.C.	-	74	N.C.	-
75	N.C.	O	76	ADRY	I
77	nBG	O	78	CLK_Out	O
79	GND	PWR	80	nAMS3	O
81	nAWE	O	82	NMI	I
83	D0	I/O	84	D2	I/O
85	D4	I/O	86	D6	I/O
87	D8	I/O	88	D10	I/O
89	D12	I/O	90	D14	I/O
91	D15	I/O	92	D13	I/O
93	D11	I/O	94	D9	I/O
95	D7	I/O	96	D5	I/O
97	D3	I/O	98	D1	I/O
99	nReset	I	100	nAOE	O
101	nARE	O	102	nAMS2	O
103	VDD-RTC	PWR	104	nBGH	O
105	nBR	I	106	N.C.	-
107	N.C.	-	108	N.C.	-
109	N.C.	-	110	N.C.	-
111	ABE0/SDQM0	O	112	A18	O
113	A16	O	114	A14	O
115	A12	O	116	A10	O
117	A8	O	118	A6	O
119	A4	O	120	A2	O

Table 3-4: Connector P2 pin assignment

Non processor Pins:

CLK\_OUT: 25MHz buffered output clock of main oscillator

All other pins are connected directly to the respective ADSP-BF533 processor pins.

For details about the meaning of the signal names consult the Blackfin ADSP-BF533 datasheet.

### 3.7 ITU656 Camera Connector P3 (1-22)

The ITU656 connector has been tested only for the OmniVision cameras available in our camera kit Kit-CAM-OV. It is not recommended to use this connector!

Pin No.	Signal	Signal type	Pin No.	Signal	Signal type
1	N.C.	-	2	AGND	PWR
3	SIO_D	I/O	4	AVDD	PWR
5	SIO_C	I	6	RESET	I
7	VSYNC	O	8	PWDN	I
9	HREF	O	10	DVDD	PWR
11	DOVDD	PWR	12	D7	O
13	XCik	I	14	D6	O
15	DGND	PWR	16	D5	O
17	PCLK	O	18	D4	O
19	D0	O	20	D3	O
21	D1	O	22	D2	O
23	N.C.	-	24	N.C.	-

Table 3-5: Connector P3 pin assignment

### 3.8 Connector P4 (1-10)

The top optionally mounted connector P4 can be used as a stand-alone connector for a system requiring only power supply and one or two communication ports (UART and SPI)

Pin No.	Signal	Signal type	Pin No.	Signal	Signal type
1	RX	I	2	TX	O
3	MOSI	I/O	4	GND	PWR
5	SCK	I/O	6	PF0	I/O
7	PF2	I/O	8	MISO	I/O
9	3V3	PWR	10	PF1	I/O

Table 3-6: Connector P4 pin assignment

## 4 Test Points

### 4.1 Footprint – Test Points

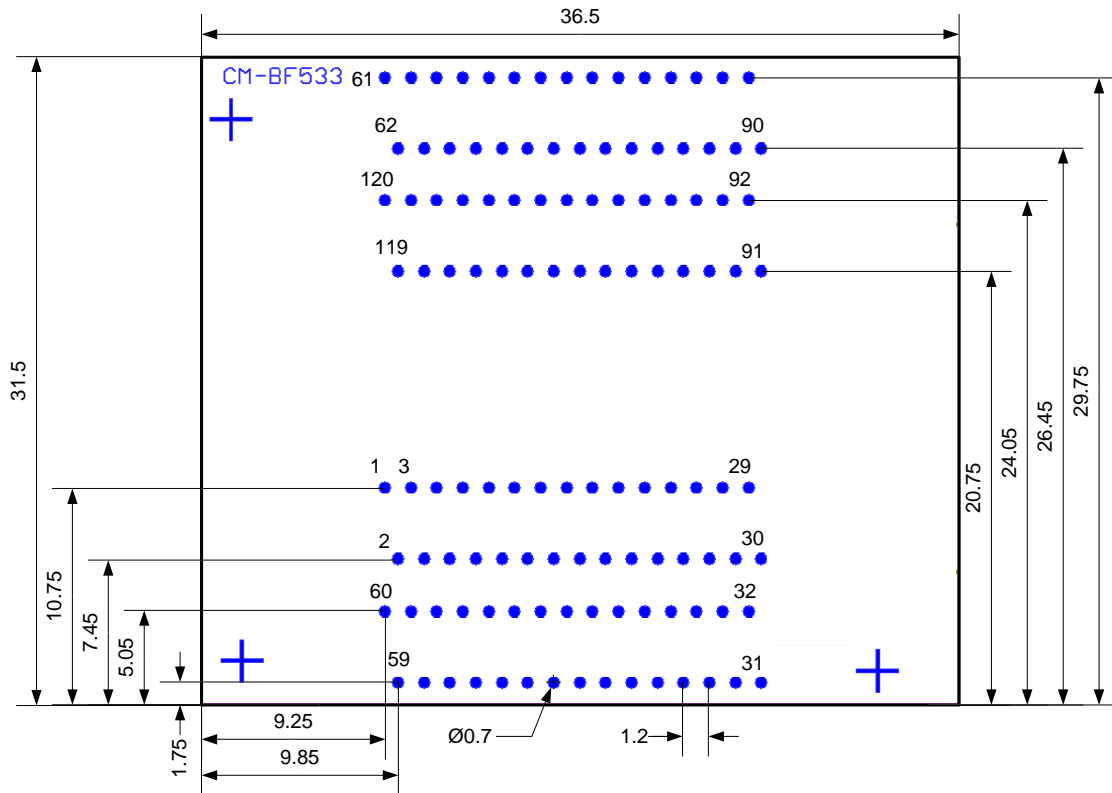


Figure 4-1: Test Points of the Core Module

## 5 Application Examples

### 5.1 Sample Application

In this minimum configuration the CM-BF533 is used as a high performance SPI-based co-processor module.

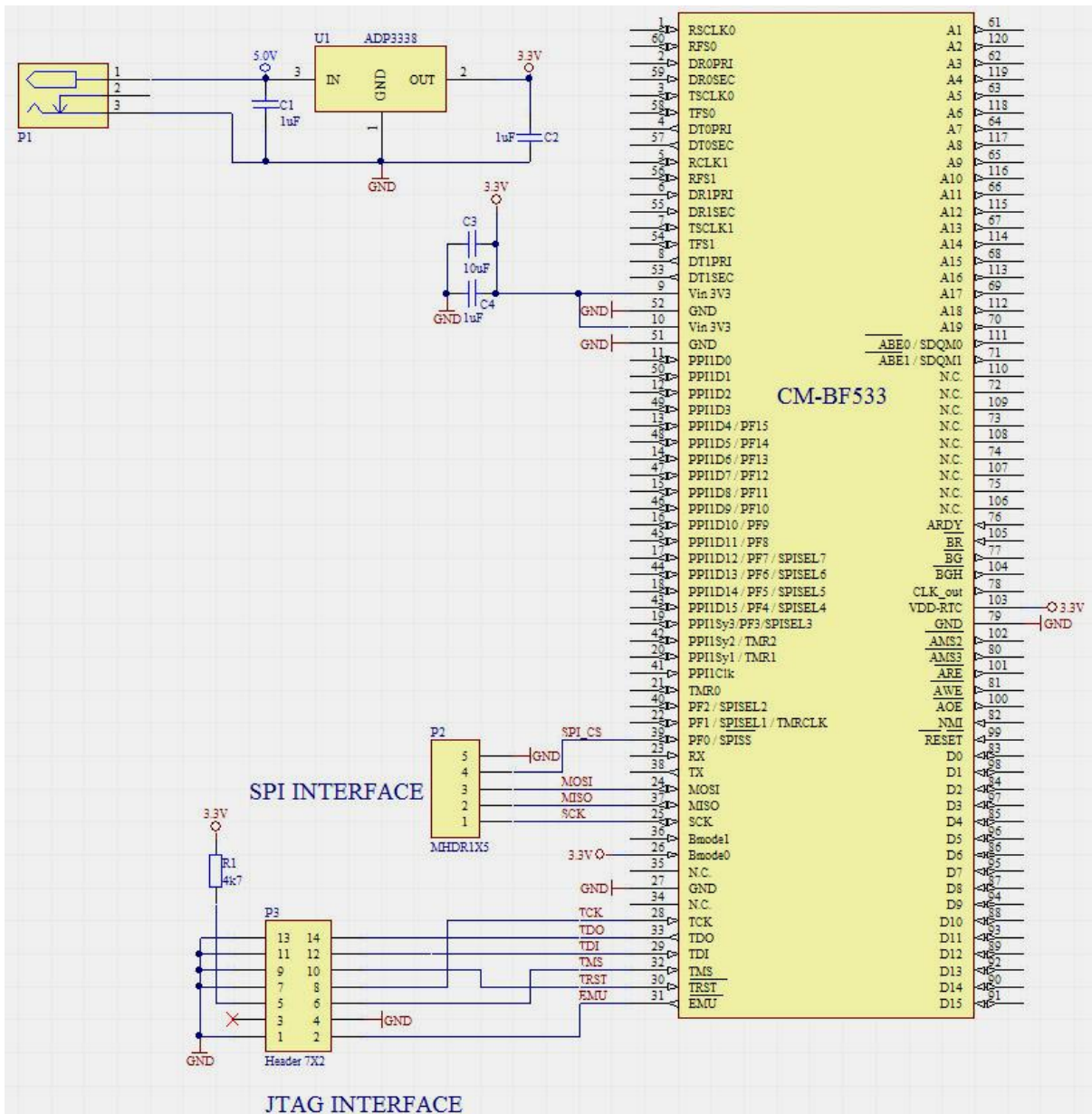


Figure 5-1: Minimum Configuration with SPI and JTAG Connector

## 5.2 Stand-alone Camera System

The CM-BF533 module can be used as a stand-alone module for a camera system requiring only power supply and the direct attachment of a compatible video camera. A camera kit including drivers can be purchased from Bluetechnix: KIT-CAM-OV (O.Nr 100-9901)

The digital ITU656 camera directly connects to P3 while the power supply and any of two communication ports (SPI and UART) can be connected to the 10 pin P4 connector as well as over the large connectors P1 and P2 at the bottom.

3.3 V Power, SPI, UART

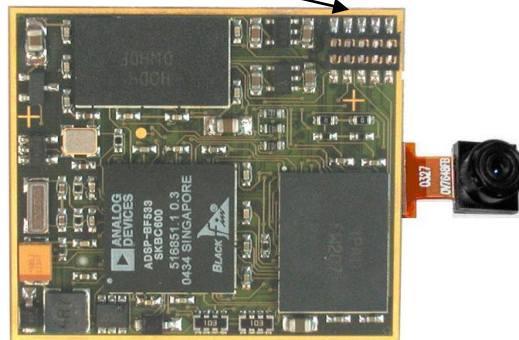


Figure 5-2: Stand-alone Camera System

## 5.3 Generic Signal Processing System

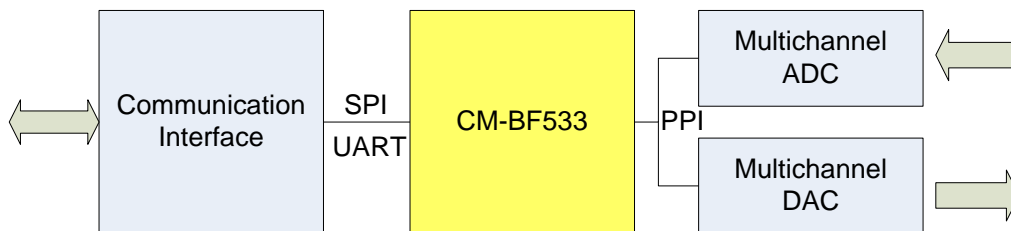


Figure 5-3: Block Diagram – Analog Signal Processing Module

## 5.4 Coprocessor Application

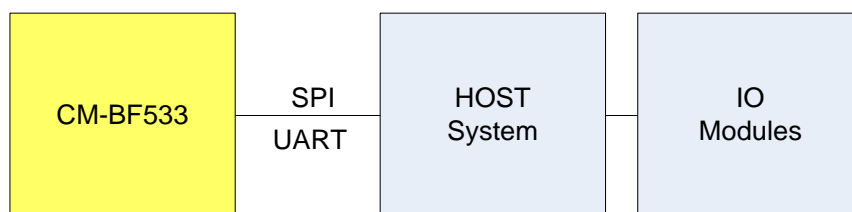


Figure 5-4: Block Diagram – Coprocessor Module

## 5.5 Digital Video System

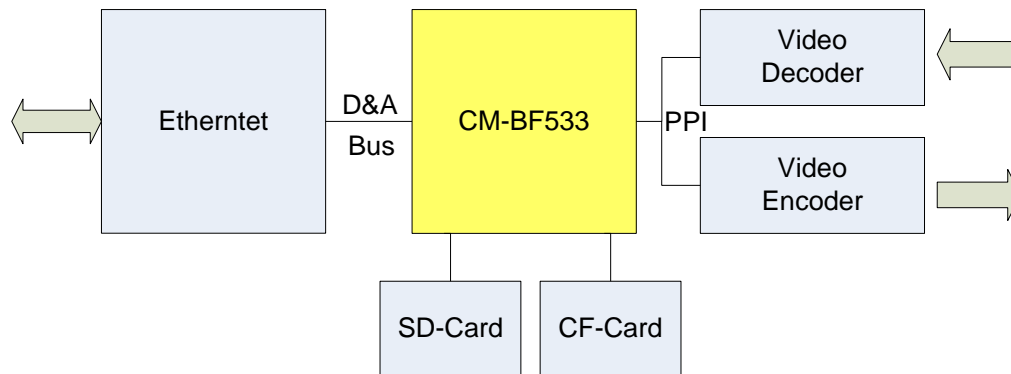


Figure 5-5: Block Diagram: Digital Video System

## 5.6 Design Services

Bluetechnix offers custom design services and software development.

## 6 Software Support

### 6.1 BLACKSheep

The Core Module is delivered with a pre-flashed basic version of the BLACKSheep VDK multithreaded framework. It contains a boot-loader for flashing the Core Module via the serial port.

Please mind the software development documents.

### 6.2 uClinux

The Core Module is supported by the open source platform at <http://blackfin.uclinux.org>. Since the Core Modules are pre-flashed with BLACKSheep you have to flash uBoot first. For flashing the uBoot you can use the BLACKSheep boot-loader.



## 7 Known Bugs

	NONE
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Table 7-1: Known Bugs

## 8 Product Changes

Version	Changes
1.2 to 2.0 (1.3)	Pin 75 (1.8V) in a future revision not supported
1.2 to 2.0	Crystal frequency (27MHz to 25MHz)
1.2 to 2.0	Boot mode default settings from 00 to 01
1.2 to 2.0	RoHS compliant

Table 8-1: Product Changes

## 9 Document Revision History

Date	Document Revision
2007-04-05	BGA option removed
2007-03-25	Bugs, Product Changes and Revision Tables updated
2006	Several minor Changes
2005-12-22	New version of the document – Board CM-BF533 V2.0
2005-12-20	Updated Figures and tables
2005-10-13	Modifications on Table 2-3: EMU and TMS Signal type changed, Signal names of PPI and timer pins changed.
2005-01-09	Memory Map added
2004-08-28	First release V1.0 of the Document

Table 9-1: Revision History

## A List of Figures and Tables

### Figures

Figure 1-1: Main Components of the CM-BF533 module .....	1
Figure 2-1: Detailed Block Diagram .....	3
Figure 3-1: Mechanical outline and Bottom Connectors .....	6
Figure 3-2: Side View with Connector mounted.....	6
Figure 3-3: Connector Footprint for Baseboard .....	7
Figure 3-4: TOP VIEW .....	8
Figure 3-5: Schematic Symbol of Module .....	9
Figure 4-1: Test Points of the Core Module.....	13
Figure 5-1: Minimum Configuration with SPI and JTAG Connector.....	14
Figure 5-2: Stand-alone Camera System .....	15
Figure 5-3: Block Diagram – Analog Signal Processing Module .....	15
Figure 5-4: Block Diagram – Coprocessor Module .....	15
Figure 5-5: Block Diagram: Digital Video System .....	16

### Tables

Table 2-1: Memory Map .....	4
Table 3-1: Baseboard connector types.....	7
Table 3-2: Module connector types.....	7
Table 3-3: Connector P1 pin assignment .....	10
Table 3-4: Connector P2 pin assignment .....	11
Table 3-5: Connector P3 pin assignment .....	12
Table 3-6: Connector P4 pin assignment .....	12
Table 7-1: Known Bugs .....	18
Table 8-1: Product Changes .....	19
Table 9-1: Revision History .....	20