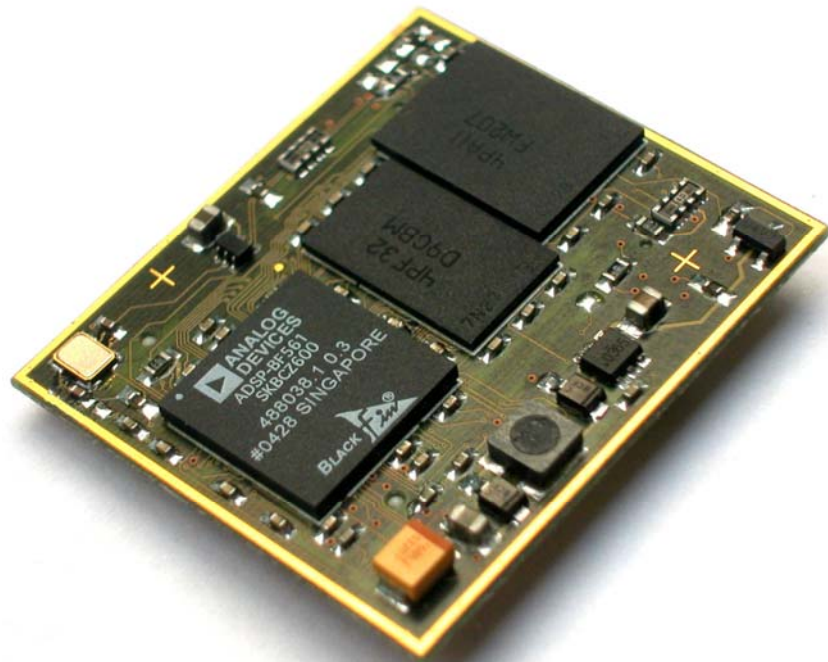
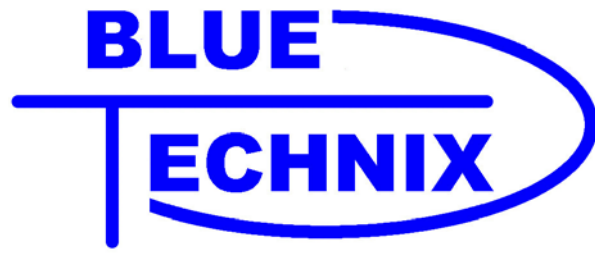




Hardware User Manual

CM-BF561 V1.2, V1.3

www.tinyboards.com

Maximum Power at Minimum Size

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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.



BLACKFIN Products

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-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
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-BF561:	Blackfin Processor Module powered by Analog Devices dual core ADSP-BF561 processor; up to 2x 600MHz, 32MB RAM, 4MB Flash, 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.
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.
EVAL-BF5xxDA:	An EVAL-BF5xx including a Debug Agent. Low cost starter development system for Bluetechnix core Modules including VDSP++ Evaluation Software License.
DEV-BF5xx:	Blackfin Development Board with two sockets for any combination of Core Modules. Additional periphery is available, such as CF-Card, SD-Card, DP-RAM, Ethernet, USB host and device, multi-port JTAG, connector for a LCD-TFT Display and connector for a digital camera system.
EXT-Boards:	The following Extender Boards are available: EXT-BF5xx-Audio, EXT-BF5xx-Video, EXT-BF5xx-Camera, EXT-BF5xx-Experimental, EXT-BF5xx-LVDS, EXP-BF5xx-ETH-USB, EXP-BF5xx-AD/DA. Additional boards based on customer request
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.

Notes: For product development it is highly recommended that the developer purchase the *DEV-BF5xx* or *EVAL-BF5xx (DA)* Blackfin development board and the BLACKSheep VDK low level driver software for the on board peripherals.

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-BF561 is an outstanding high performance and low power dual core processor 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-BF561 consists of the following components:

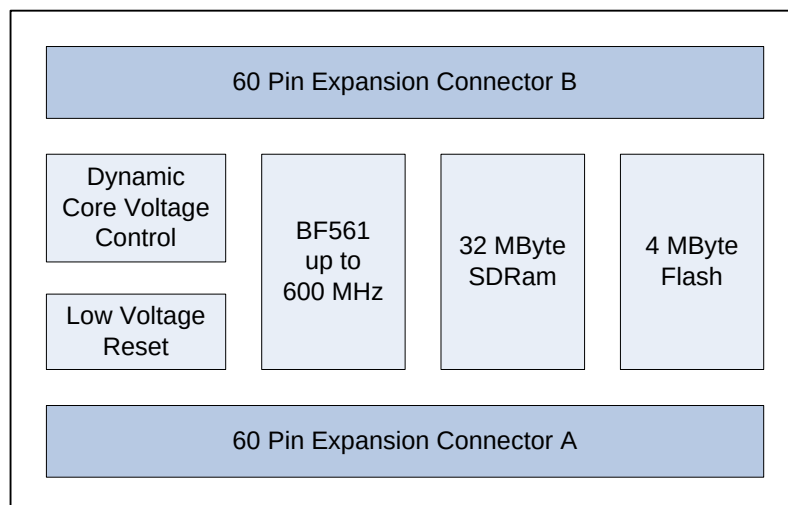


Figure 1-1: Main components of the CM-BF561 module

- **Analog Devices Blackfin Processor BF561**
 - ADSP-BF561SKBCZ600
- **32 MB SDRAM**
 - SDRAM Clock up to 133MHz
 - MT48LC8M32B2B5-7 (8Mx32, 256Mbit @ 3.3V)
- **4 MB of Addressable Flash**
 - ITLRC28F320J3C110 (2Mx16, 32Mbit @ 3.3 V; all 4MByte addressable)
 - Additional 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 2.93V for at least 140ms

- **Dynamic Core Voltage Control**

- Allows to adjust core voltage by setting software registers at the Blackfin processor
- Core voltage range: 0.8 – 1.4V

- **Expansion Connector A**

- Data Bus
- Address Bus
- Control Signals
- PPI-2 (Parallel Port Interface 2)
- Power Supply

- **Expansion Connector B**

- SPORT 0
- JTAG
- UART
- SPI
- PPI-1 (Parallel Port Interface 1)
- GPIO's

- **BGA Option**

- For very low assembling height and **small to medium volume production** the module can also ship as a BGA version with easy to route BGA footprint as can be seen in **Error! Reference source not found..**

1.2 Benefits

- The CM-BF561 is very compact and measures only 36.5x31.5 mm
- 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

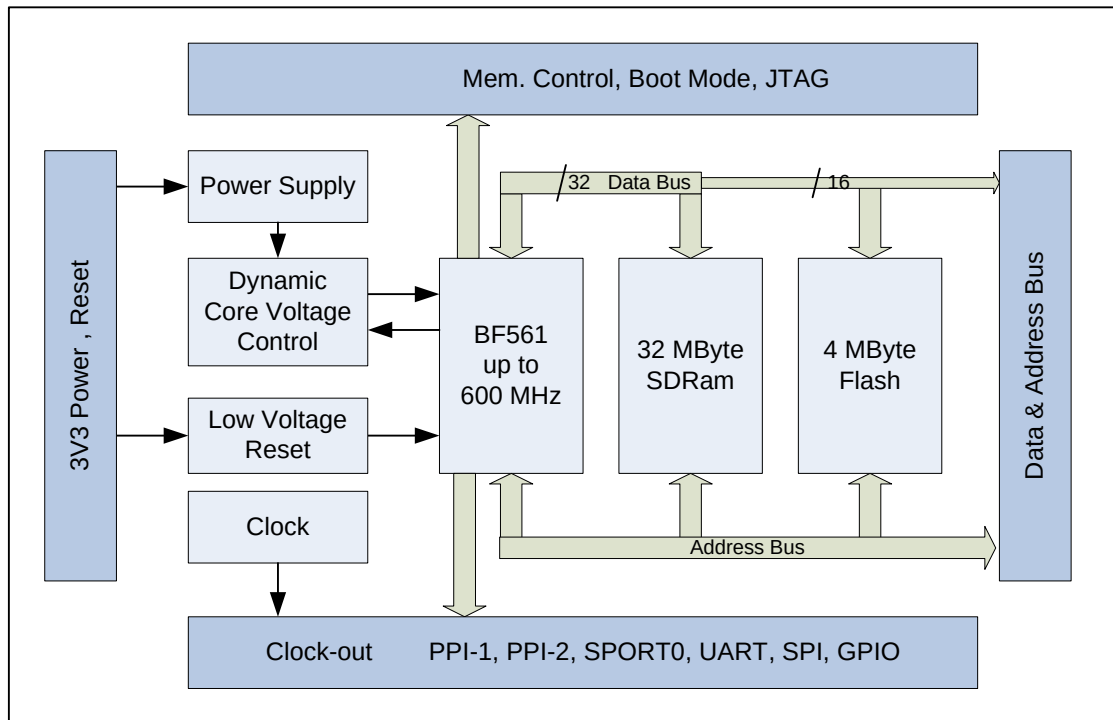


Figure 2-1: Detailed Block Diagram

Figure 2-1 shows a detailed block diagram of the CM-BF561 module. Beside the SDRAM control pins the CM-BF561 has all other pins of the Blackfin processor at its two main 60 pin connectors.

A special feature of the CM-BF561 module is the availability of two parallel port interfaces (PPI) for different applications such as the simultaneous use of one camera and one display interface; the use of one stereo camera interface; or the use two separate ports for bandwidth-hungry ADC and DAC interfaces.

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

By default the Boot Mode is set to 01 (BMODE0 = HIGH, BMODE1 = LOW).

In this mode BMODE0 has an on-board pull-up resistor (Figure 2-6, resistor R4) and BMODE1 has an on board pull-down resistor (Figure 2-6 on page 7, resistor R2), R1 and R3 are not mounted. R1 and R3 have the following function: R1 (pull-down BMODE0) and R3 (pull-up BMODE1).

2.3 Memory Map

Memory Type	Start Address	End Address	Size	Comment
FLASH	0x20000000	0x203FFFFFFF	4MB	Micron MT28F320J3FS-11
SDRAM	0x00000000	0x01FFFFFFF	32MB	32Bit Bus, Micron MT48LC16M16A2FG

Table 2-1: Memory Map

2.4 Electrical Specification

2.4.1 Supply Voltage

- 3.3V DC +/-10%

2.4.2 Supply Voltage Ripple

- 100mV peak to peak 0-20 MHz

2.4.3 External Oscillator Frequency

- 25MHz

2.4.4 Supply Current

- Maximum supply current: 600mA @ 3V3
- Operating conditions:
 - o Both core CPUs running at 600MHz, Core Voltage 1.2V, SDRAM 20% bandwidth utilization @ 130MHz: ca. 500mA
 - o Both core CPUs running at 300MHz, Core Voltage 0.8V SDRAM 20% bandwidth utilization @ 130MHz: ca. 280mA
 - o One core CPUs running at 600MHz, Core Voltage 1.2V SDRAM 20% bandwidth utilization @ 130MHz, other core idle: ca. 320mA

2.5 Environmental Specification

2.5.1 Temperature

- Operating at full 600MHz:: 0 to + 70° C
- Industrial temperature range on request only

2.5.2 Humidity

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

3 CM-BF561 (Connector Version)

3.1 Mechanical Outline

TOP VIEW

All dimensions are given in millimeters!

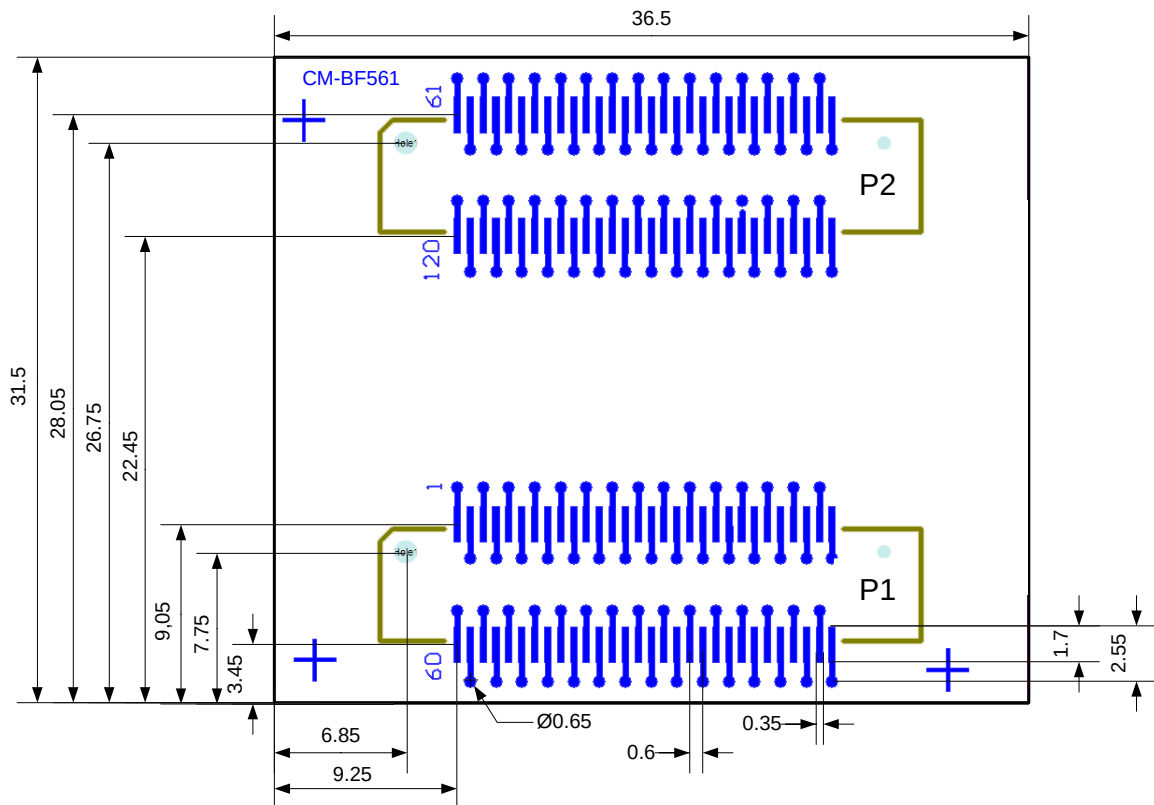


Figure 3-1: Mechanical outline and Bottom Connectors

The mechanical outline represents a top view of the connectors placed at the bottom of the core board. In addition to the connectors the balls for the BGA version are designed in as well as they are at the bottom layer of the CM-BF561 module.

The module ships either with two 60pin connectors or for volume production as a BGA version.

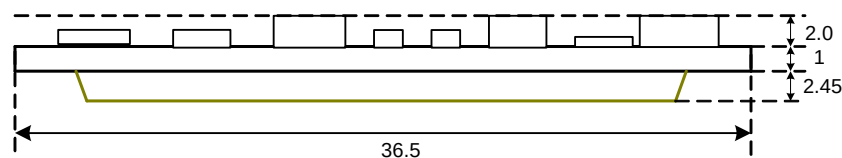


Figure 3-2: Side View with Connector mounted

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

3.1.1 Footprint - Connector Version

If the connector version (2x Hirose 0.6mm pitch) is used, the footprint for the baseboard may look as shown in **Error! Reference source not found..**

For the baseboard the following connectors have to be used.

Part Baseboard	Manufacturer	Manufacturer Part No.
P1,P2	Hirose	FX8-60S-SV

Table 3-1: Baseboard connector types

The Connectors on the CM-BF561 are of the following type:

Part	Manufacturer	Manufacturer Part No.
P1,P2	Hirose 3mm height	FX8-60P-SV(21)

Table 3-2: Module connector types

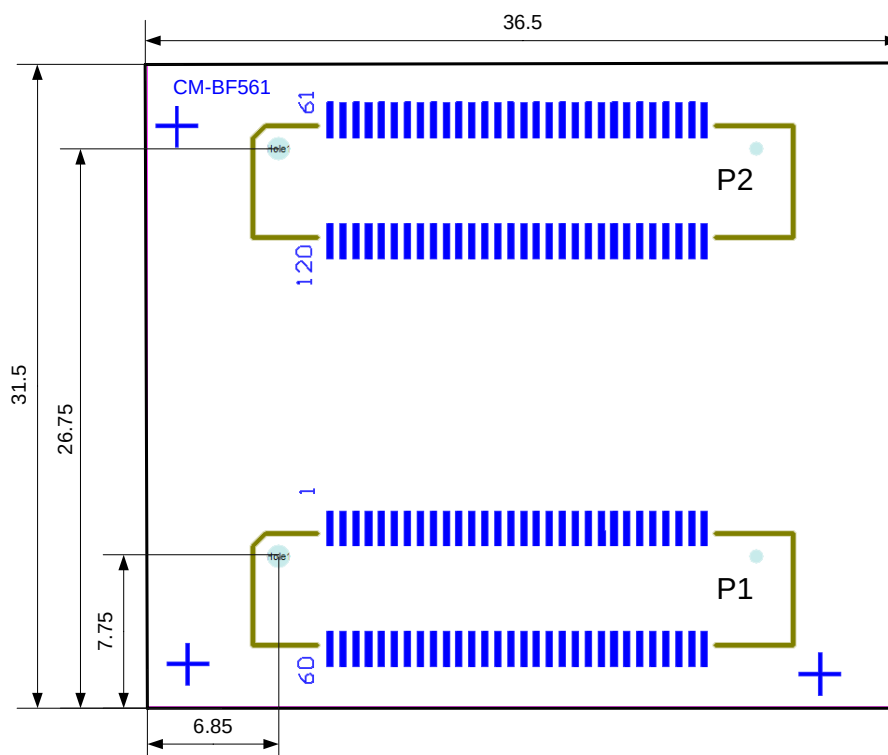


Figure 3-3: Connector Footprint for BGA Version

3.1.2 Top Mounted Components

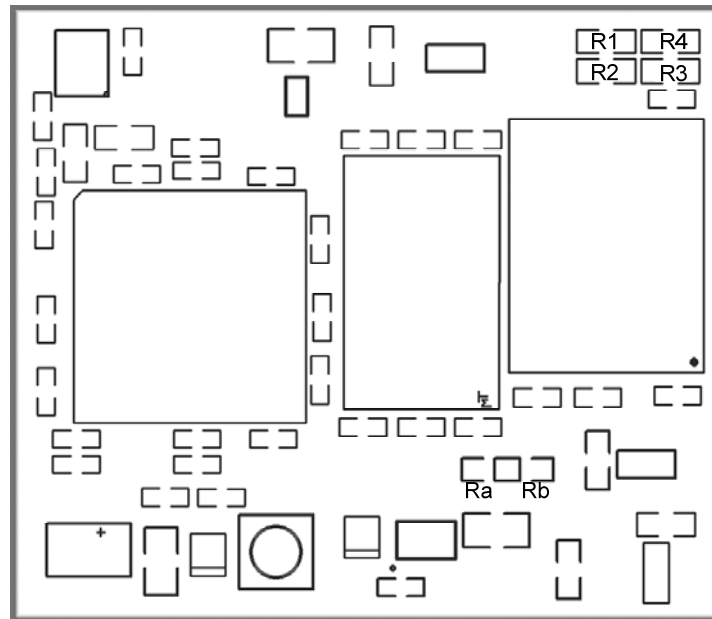


Figure 3-4: TOP VIEW

R1 to R4 set the boot mode of the Core Module. See section **Error! Reference source not found.** for the boot mode settings. Ra and Rb switch between PF11 and Clk_out on pin 5 of the Core Module. See section 2.4 for further details.

3.2 Schematic Symbol (Signals of P1 and P2)

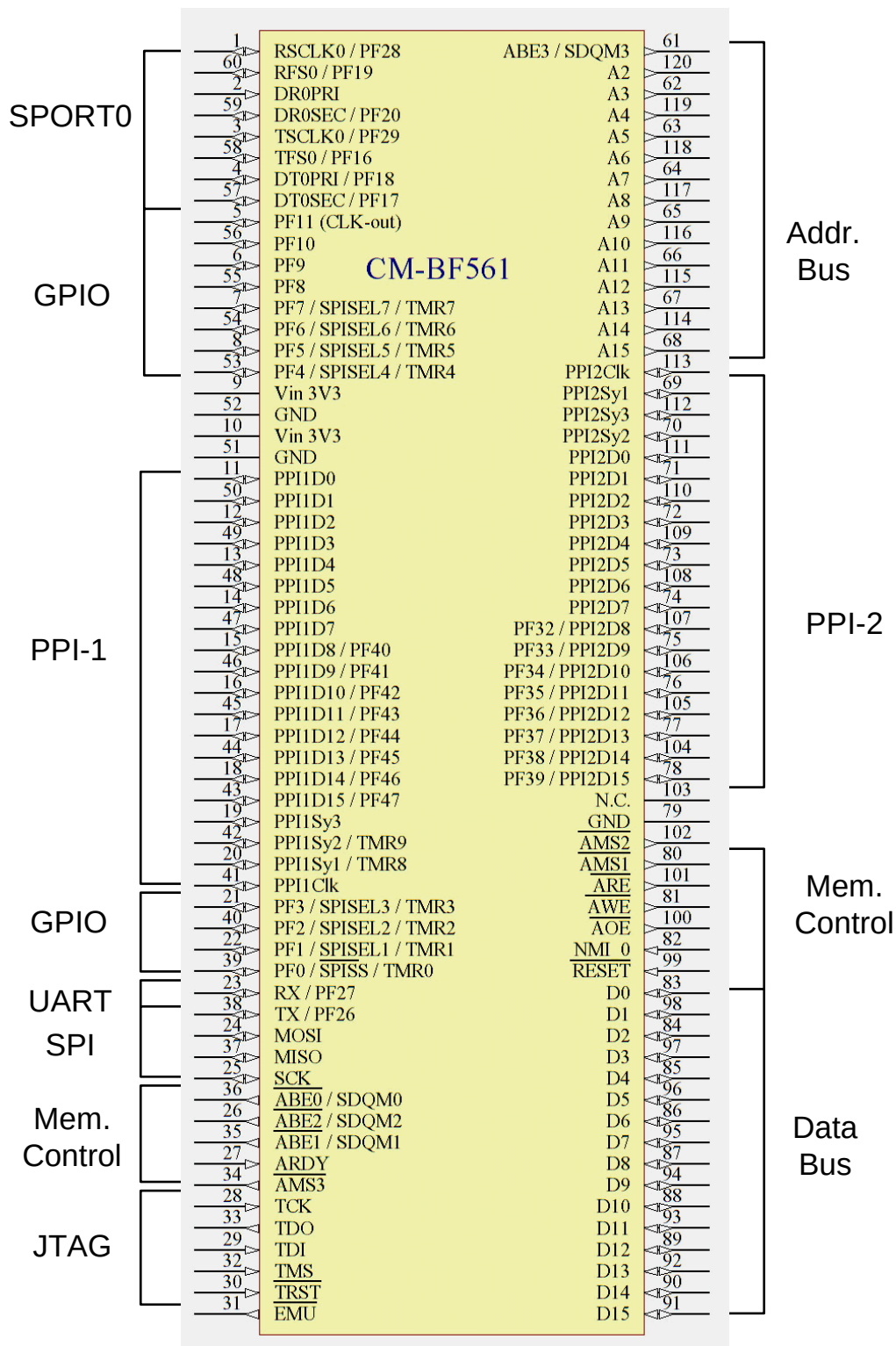


Figure 3-5: Schematic Symbol of the CM-BF561 Module

3.3 Connector P1 – (1-60)

Pin No.	Signal	Signal type	Pin No.	Signal	Signal type
1	RSCLK0 / PF28	I/O	2	DR0PRI	I
3	TSCLK0 / PF29	I/O	4	DT0PRI / PF18	I/O
5	PF11(Clk_out)*	I/O	6	PF9	I/O
7	PF7/SPISEL7/TMR7	I/O	8	PF5/SPISEL5/TMR5	I/O
9	Vin 3V3	PWR	10	Vin 3V3	PWR
11	PPI1D0	I/O	12	PPI1D2	I/O
13	PPI1D4	I/O	14	PPI1D6	I/O
15	PPI1D8 / PF40	I/O	16	PPI1D10 / PF42	I/O
17	PPI1D12 / PF44	I/O	18	PPI1D14 / PF46	I/O
19	PPI1SYNC3	I/O	20	PPI1SYNC1 / TMR8	I/O
21	PF3/SSEL3/TM3	I/O	22	PF1/SPISEL1/TMR1	I/O
23	RX / PF27	I/O	24	MOSI	I/O
25	SCK	I/O	26	nABE2/SDQM2	O
27	ARDY	I	28	TCK	I
29	TDI	I	30	nTRST	I
31	nEMU	O	32	TMS	I
33	TDO	O	34	nAMS3	O
35	nABE1/SDQM1	O	36	nABE0/SDQM0	O
37	MISO	I/O	38	TX / PF26	I/O
39	PF0/SPISS/TMR0	I/O	40	PF2/SSEL2/TMR2	I/O
41	PPI1CLK	I	42	PPI1SYNC2 / TMR9	I/O
43	PPI1D15 / PF47	I/O	44	PPI1D13 / PF45	I/O
45	PPI1D11 / PF43	I/O	46	PPI1D9 / PF41	I/O
47	PPI1D7	I/O	48	PPI1D5	I/O
49	PPI1D3	I/O	50	PPI1D1	I/O
51	GND	PWR	52	GND	PWR
53	PF4/SPISEL4/TMR4	I/O	54	PF6/SPISEL6/TMR6	I/O
55	PF8	I/O	56	PF10	I/O
57	DT0SEC / PF17	O	58	TFS0 / PF16	I/O
59	DR0SEC / PF20	I	60	RFS0 / PF19	I/O

Table 3-3: Connector P1 Pin Assignment

All pin names of the connectors correspond to the names found in the Blackfin BF561 datasheet from Analog Devices.

*Mount option Ra and Rb:

Default is Ra mounted = PF11; unmounting Ra and mounting to position Rb outputs the buffered clock at the pin 5 of the connector. (see Figure 2-6)

3.4 Connector P2 – (61-120)

Pin No.	Signal	Signal type	Pin No.	Signal	Signal type
61	nABE3/SDQM3	O	62	A3	O
63	A5	O	64	A7	O
65	A9	O	66	A11	O
67	A13	O	68	A15	O
69	PPI2SYNC1	I/O	70	PPI2SYNC2	I/O
71	PPI2D1	I/O	72	PPI2D3	I/O
73	PPI2D5	I/O	74	PPI2D7	I/O
75	PPI2D9 / PF33	I/O	76	PPI2D11 / PF35	I/O
77	PPI2D13 / PF37	I/O	78	PPI2D15 / PF39	I/O
79	GND	PWR	80	nAMS1	O
81	nAWE	O	82	NMI_0	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	N.C.	-	104	PPI2D14 / PF38	I/O
105	PPI2D12 / PF36	I/O	106	PPI2D10 / PF34	I/O
107	PPI2D8 / PF32	I/O	108	PPI2D6	I/O
109	PPI2D4	I/O	110	PPI2D2	I/O
111	PPI2D0	I/O	112	PPI2SYNC3	I/O
113	PPI2CLK	I	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

4 CM-BF561 BGA (Ball Grid Array Version)

The BGA version has the same size and pin assignment than the connector Version. The mounting height is reduced to only 3.1 mm! The connector on the top side remains the same. Since for the BGA and the Connector version the same boards are used, please take care of the remaining pads for the connectors.

4.1 Footprint - BGA Version

For the BGA version, the footprint for the baseboard may look like follow:

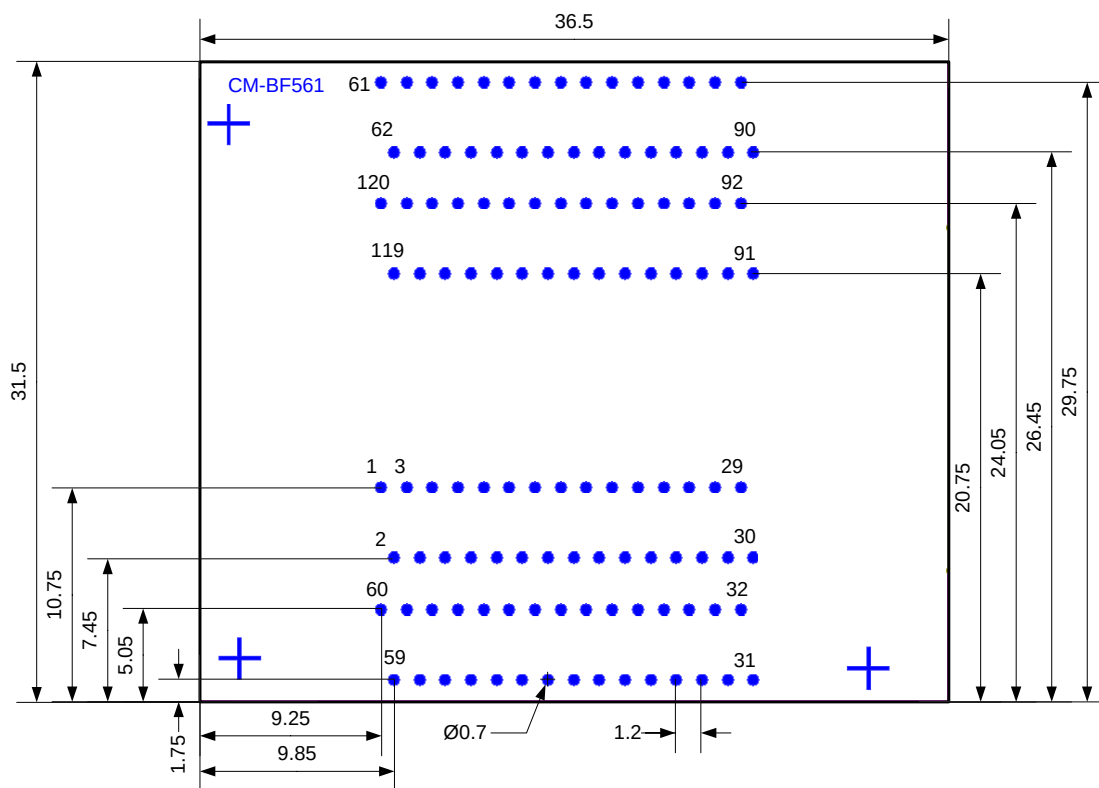


Figure 4-1: BGA Footprint for Baseboard

5 Application Examples

5.1 Sample Application

In this sample application the Core Module is used as a high performance SPI based co-processor module.

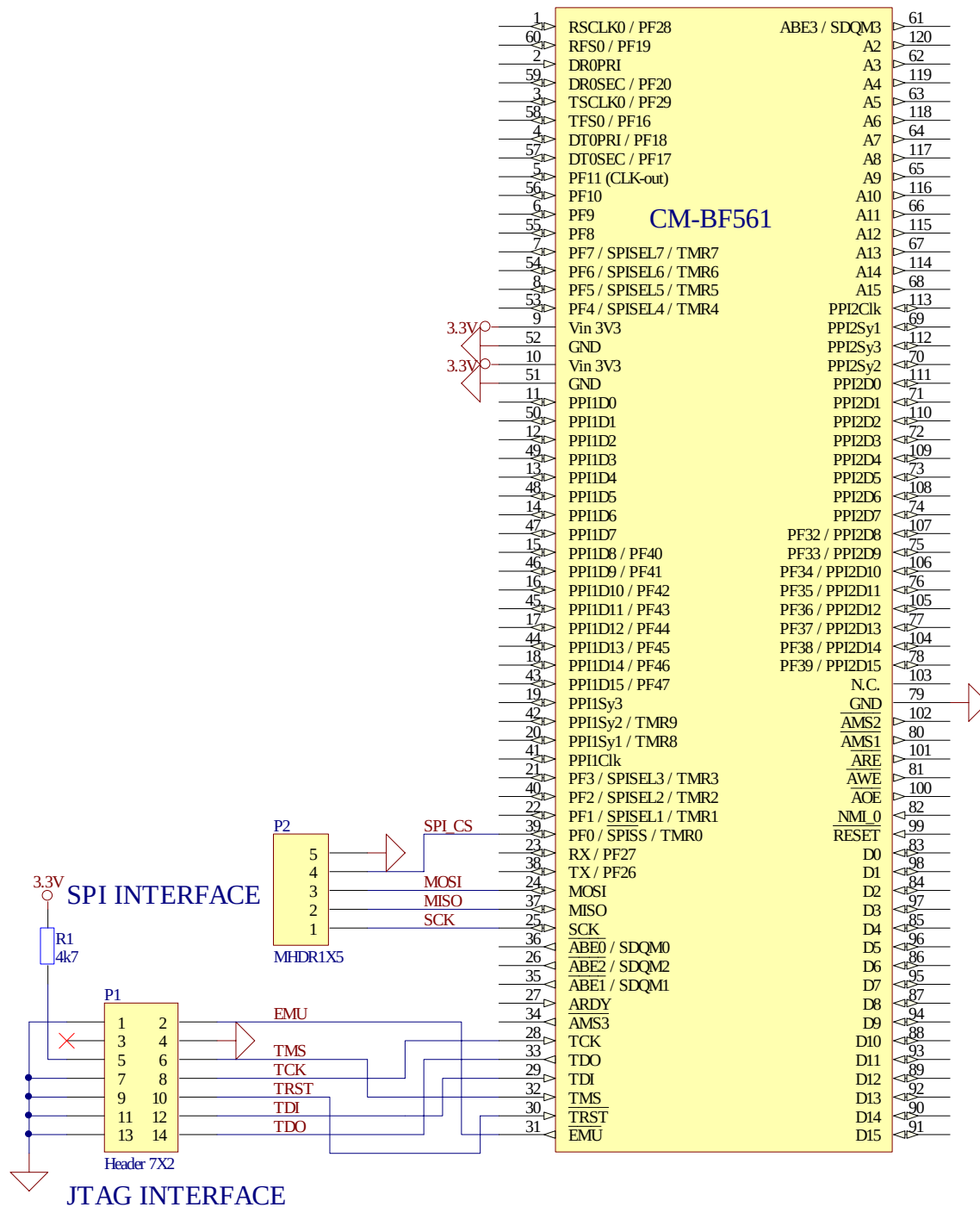


Figure 5-1: Sample Application with SPI and JTAG Connector

5.2 Stereo Camera System

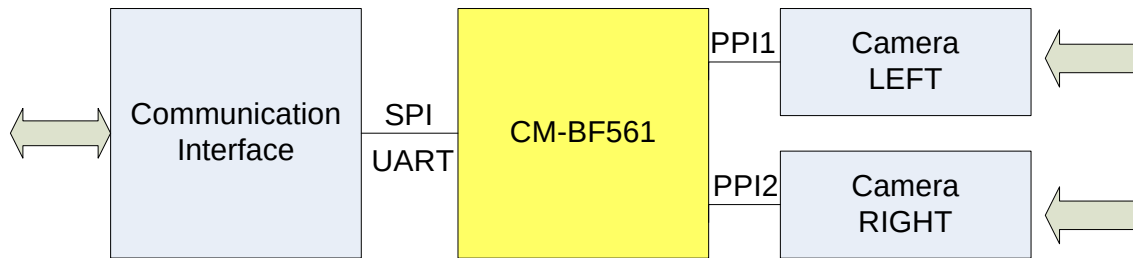


Figure 5-2: Image Recognition System with Stereo Cameras

5.3 High Performance Symmetric Processing System

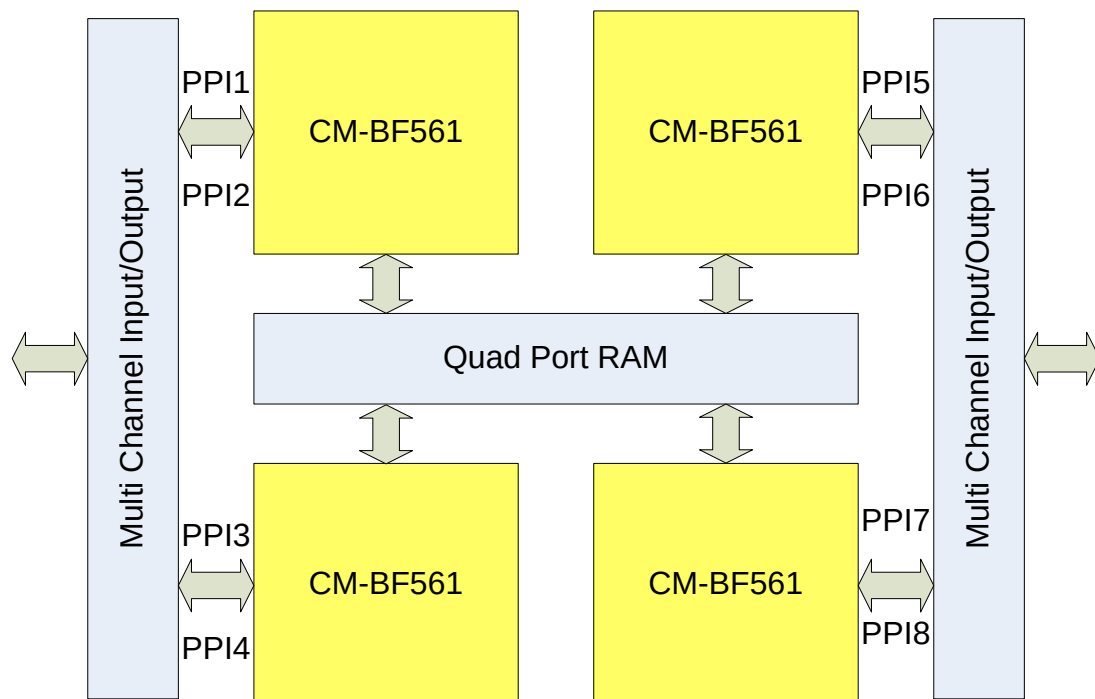


Figure 5-3: Block Diagram: Digital Video System

5.4 Video Processing System

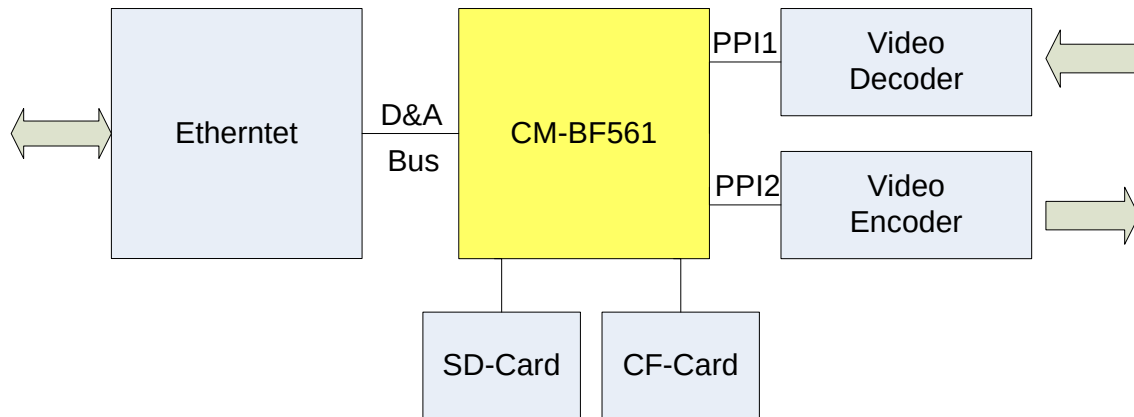


Figure 5-4: Real-time Video Processing System

5.5 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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8 Revision History

2004 08 30	First release V1.0 of the Document
2004 12 18	Document Version V1.1 Changed Pin Assignment Exchanged connector names P1 and P2
2005 03 16	Document Version V1.2 Changed Pin Assignment Tables and Figures
2005 05 24	Corrected Ra and Rb mounting option description
2005 10 18	Layout Revision updated all figures
2006 04 26	Updated figures
2006 02 06	Changed Table 8-1: Connector P2 Pin Assignment

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