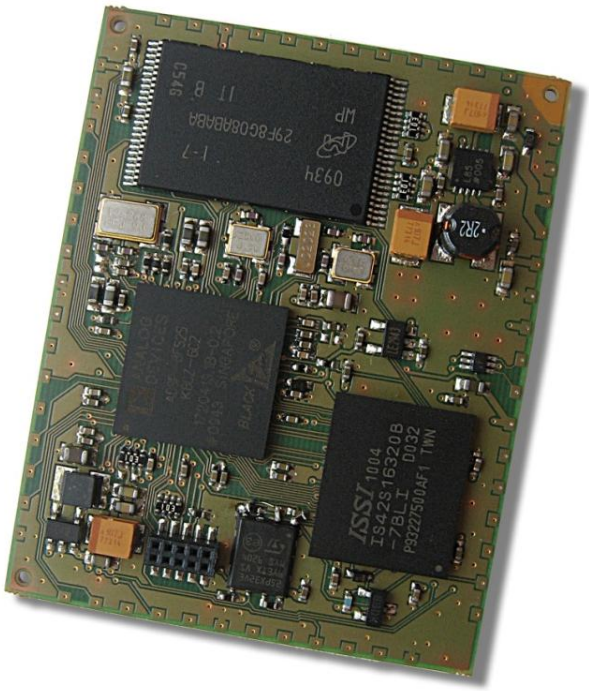
BLUE TECHNIX



Hardware User Manual

ACM-BF525C V1.1

...maximum performance at minimum space

Contact

Bluetechnix Mechatronische Systeme GmbH

Waidhausenstraße 3/19

A-1140 Vienna

AUSTRIA/EUROPE

office@bluetechnix.at

http://www.bluetechnix.com

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Table of Contents

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Information

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

Warning

Due to technical requirements components may contain dangerous substances.

Blackfin® Core Modules

TCM-BF518-C-C-Q25S32F2 (TCM-BF518)

The Tiny Core Module TCM-BF518 is powered by Analog Devices' single core ADSP-BF518 processor; up to 400MHz, 32MB SDRAM, up to 8MB flash. The 2x60 pin expansion connectors are backwards compatible with other Core Modules.

ACM-BF525C-C-C-Q25S64F4N1024

The Core Module ACM-BF525C is optimized for audio applications and performance. It is based on the high performance ADSPBF525Cfrom Analog Devices. It addresses 64MByte SDRAM via its 16bit wide SDRAM bus, has an onboard NOR-flash of 4MByte and a NAND-flash with 1024MByte.

CM-BF527-C-C-Q50S32F8 (CM-BF527)

The Core Module CM-BF527 is powered by Analog Devices' single core ADSP-BF527 processor; key features are USB OTG 2.0 and Ethernet. The 2x60 pin expansion connectors are backwards compatible with other Core Modules.

CM-BF533-C-C-Q25S32F2 (CM-BF533)

The Core Module CM-BF533 is powered by Analog Devices' single core ADSP-BF533 processor; up to 600MHz, 32MB SDRAM, 2MB flash, 2x60 pin expansion connectors at a size of 36.5x31.5mm.

TCM-BF537-C-I-Q25S32F8 (TCM-BF537)

The Tiny Core Module TCM-BF537 is powered by Analog Devices' single core ADSP-BF537 processor; up to 500MHz, 32MB SDRAM, 8MB flash, a size of 28x28mm, 2x60 pin expansion connectors, Ball Grid Array or Border Pads for reflow soldering, industrial temperature range -40°C to +85°C.

CM-BF537-C-C-Q25S32F4 (CM-BF537E)

The Core Module CM-BF537 is powered by Analog Devices' single core ADSP-BF537 processor; up to 600MHz, 32MB SDRAM, 4MB flash, integrated TP10/100 Ethernet physical transceiver, 2x60 pin expansion connectors at a size of 36.5x31.5mm.

CM-BF537-C-C-Q30S32F4-U (CM-BF537U)

The Core Module CM-BF537 is powered by Analog Devices' single core ADSP-BF537 processor; up to 600MHz, 32MB SDRAM, 4MB flash, integrated USB 2.0 Device, 2x60 pin expansion connectors at a size of 36.5x31.5mm.

CM-BF548-C-C-Q25S64F8 (CM-BF548)

The Core Module CM-BF548 is characterized by its numerous peripheral interfaces, its performance in combination with its high speed memory interface (DDR). Key features are 533MHz, 64MB DDR SD-RAM (266MHz), and 8MB flash.

CM-BF561-C-C-Q25S64F8 (CM-BF561)

The Core Module CM-BF561 is powered by Analog Devices' dual core ADSP-BF561 processor; up to 2x 600MHz, 64MB SDRAM, 8MB flash, 2x60 pin expansion connectors at a size of 36.5x31.5mm.

eCM-BF561-C-C-Q25S128F32 (eCM-BF561)

The Core Module CM-BF561 is powered by Analog Devices' dual core ADSP-BF561 processor; up to 2x 600MHz, 128MB SDRAM, 8MB flash, 2x100 pin expansion connectors and a size of 44x33mm.

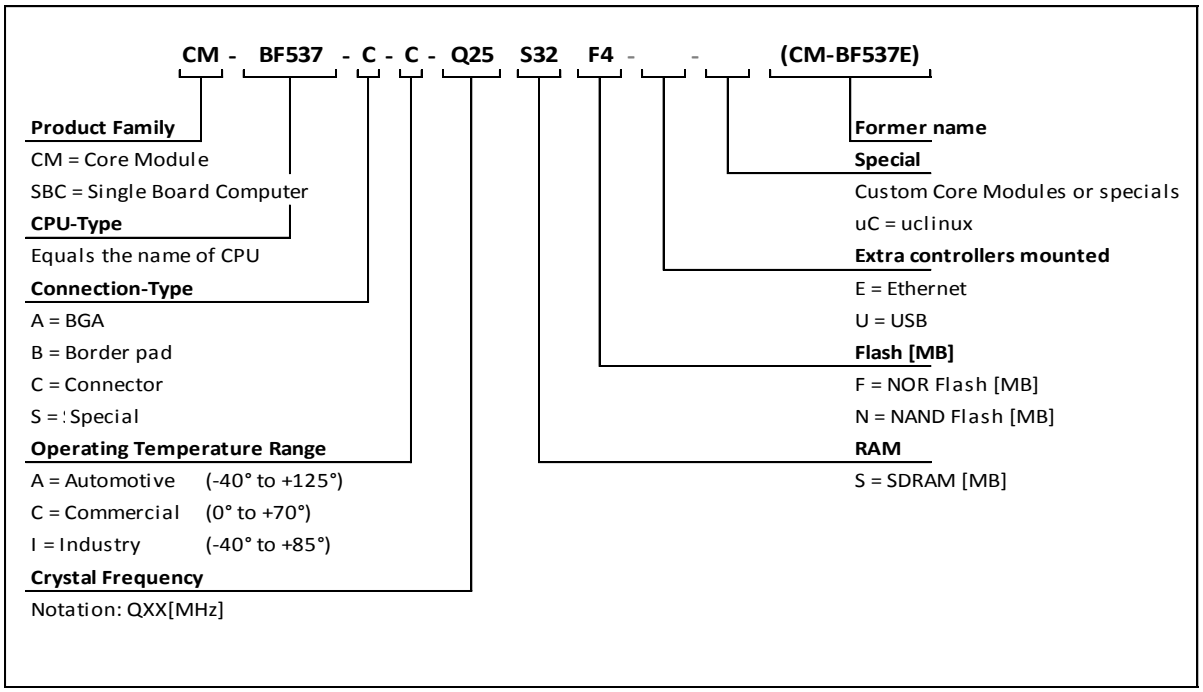
Core Module naming information

The idea is to put more Core Module specific technical information into the product name. New Core Module names will have following technical information covered in their names.

- Product Family,
- CPU-Type,
- Connection-Type,
- Operating Temperature Range,
- Crystal Frequency [MHz],
- RAM [MB],
- Flash [MB],
- External Controllers
- Optional
    - Special and/or
    - Former name

That expands of course the name but allows the customer to get the most important Core Module specific information at the first sight. Have a look at the example below to get an idea of the new Core Module names.

Example CM-BF537-C-C-Q25S32F4 (CM-BF537E)



Blackfin® Development Boards

ADEV-BF52xC

Feature rich, low cost embedded audio development platform which supports Audio Core Modules (ACM). The form factor of the ADEV-BF52xC allows easy integration of the board into OEM products. Dedicated interfaces such as USB2.0, Line In/Out, headphone out and an onboard silicon microphone turn the ADEV-BF52xC into a full-featured development platform for most embedded audio applications in commercial areas.

DEV-BF5xxDA-Lite

Get ready to program and debug Bluetechnix Core Modules with this tiny development platform including an USB-Based Debug Agent. The DEV-BF5xxDA-Lite is a low cost starter development system including a VDSP++ Evaluation Software License.

DEV-BF548-Lite

Low-cost development board with a socket for Bluetechnix' CM-BF548 Core Module. Additional interfaces are available, e.g. an SD-Card, USB and Ethernet.

DEV-BF548DA-Lite

Get ready to program and debug Bluetechnix CM-BF548 Core Module with this tiny development platform including an USB-Based Debug Agent. The DEV-BF548DA-Lite is a low-cost starter development system including a VDSP++ Evaluation Software License.

eDEV-BF5xx

Feature rich, low cost rapid development platform which provides all interfaces on dedicated connectors and has all Core Module pins routed to solder pads which easily can be accessed by the developers. The eDEV-BF5xx supports the latest debugging interface from Analog Devices - ADI-SADA (Analog Devices Stand Alone Debug Agent).

EVAL-BF5xx

Tiny, low cost embedded platform which supports Bluetechnix powerful Blackfin® based Core Modules. The form factor (75x75mm) of the EVAL-BF5xx allows easy integration of the board into OEM products. Dedicated interfaces such as USB2.0, SD-card slot, CAN interface connectors and of course Ethernet, turn the EVAL-BF5xx into a full-featured evaluation platform for most embedded applications.

Extender boards

Extender boards (EXT-BF5xx) are expanding the development and evaluation boards by several interfaces and functionalities. Targeted application areas are: audio/video processing, security and surveillance, Ethernet access, positioning, automation and control, experimental development and measuring.

Note! Bluetechnix is offering tailored board developments as well.

1 Introduction

The Core Module ACM-BF525C is optimized for audio applications and performance. The module integrates processor, RAM, flash, external peripheral controllers and power supply at a size of 38x48mm! It is based on the high performance ADSP-BF525C from Analog Devices. The ACM-BF525C is designed for commercial applications (commercial temperature range). It addresses 64MByte SDRAM via its 16bit wide SDRAM bus, has an onboard serial NOR-flash of 4MByte and a NAND-flash with 1024MByte. The integrated Stereo-Audio-Codec enables the audio interfaces Line In/Out, Mic. In and HP Out. In addition the Core Module offers the developer several digital interfaces like UART, USB, SPI, I²C and numerous GPIOs. These interfaces are building in combination with the high performance embedded processor and the high capacity onboard flash, a perfect basis for professional audio application engineering.

1.1 Overview

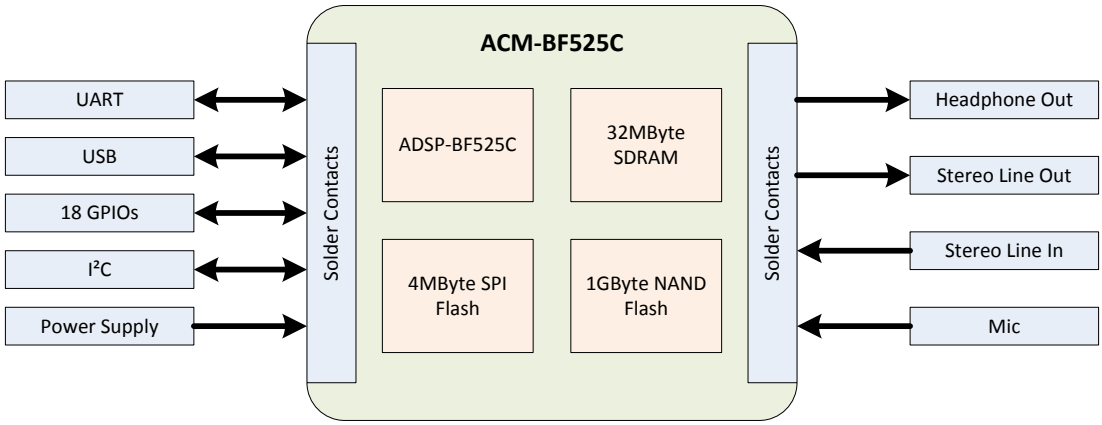


Figure 1-1: Block diagram

1.2 Key Features

- 18 GPIOs for user Interface (LEDs, buttons, etc.)
- Analog audio interface with
  - microphone input,
  - stereo line in and out and
  - stereo headphone output
- Wide operating voltage range (3.0 to 5.5V)
- 3.3V output supply for external components

1.3 Applications

- Audio processing
- Multimedia applications
- Voice-over-IP applications
- Portable media players
- Voice control
- Speech recognition

2 General Description

2.1 Functional Description

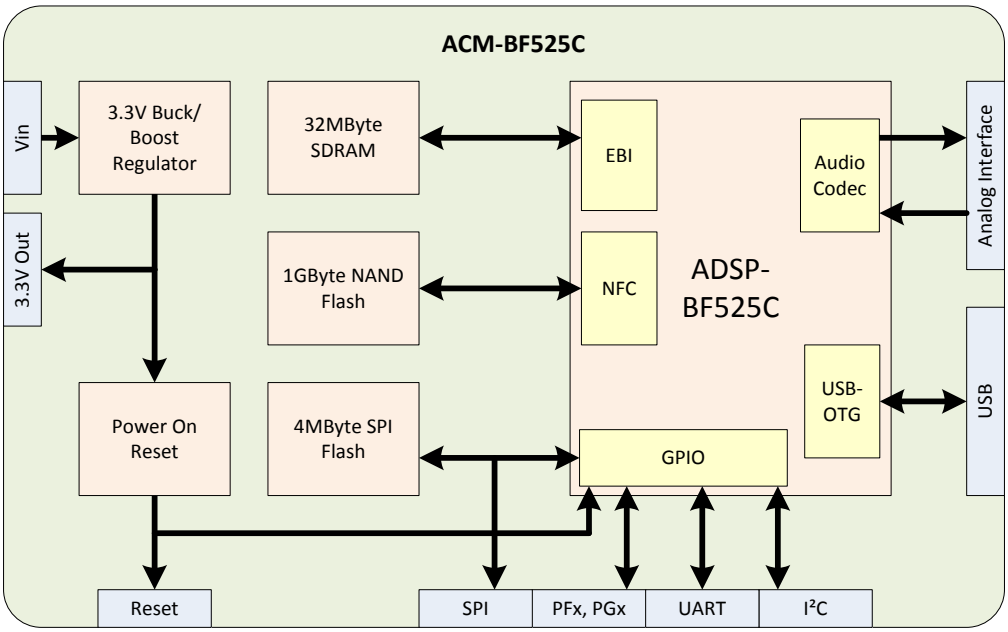


Figure 2-1: Functional overview

2.1.1 Powering the ACM-BF525C

The ACM-BF525C has an on-board Buck-Boost power controller. Therefore the module can be powered over a wide input voltage range (3.0 to 5.0V). The 3.3V supply needed for the integrated components are also available on the connectors. This voltage can be used to power some external components (or pulling resistors). The maximum deliverable current is limited to 150mA.

2.1.2 Reset Circuit

The integrated Reset circuit monitors the 3.3V power rail. If this voltage drops below 2.93V, the $\overline{\text{RESET}}$ signal will be asserted. If the 3.3V voltage domain rises above this threshold, $\overline{\text{RESET}}$ will be kept low for 140 to 280ms and will be released afterwards.

The $\overline{\text{RESET}}$ signal is an open collector output with an internal pull-up resistor of 470Ω. This signal can be used as external manual reset by connecting an external push-button that ties the signal to ground.

2.1.3 USB Device

The ADSP-BF525C has an integrated USBOTG controller. The USB-D+ and USB-D- Lines can be routed directly to a USB connector. The USB-ID Pin is used to indicate whether the ACM-BF525C is a USB-Device or a USB-Host. The VUSB pin is used to indicate, if a USB bus power is applied.

The USB data lines and the VBUS are protected against ESD complying with IEC61000-4-2 level 4 standard:

- 15kV air discharge
- 8kV contact discharge

If also the ID line is used (for OTG mode only) an external protection circuit should be applied.

2.1.4 I²C

The ACM-BF525C has a standard TWI bus interface. If the interface is used, be sure to add the needed pull-up resistor.

2.2 Interface Description

The ACM-BF525C has numerous digital IOs and a flexible analog audio interface.

2.2.1 Analog Interface

Interface	Pin Number	Function
Line In	2	Stereo audio input
Line Out	2	Stereo audio output
Mic In	2	Microphone input with phantom-power for electrets-microphones
HP out	2	Stereo audio output capable for headphones

Table 2-1: Analog interface description

2.2.2 Digital Interface

Interface	Pin Number	Function
UART	2	Module configuration
SPI	3	Usable for LCD displays with serial interface (??)
GPIO	18	Control signals and user interface (PD, RESET, REC, PAUSE, LED, etc.)
I²C	2	Low-speed communication interface
USB	2	PC connectivity (keyboard-replacement) USB flash drive, allows accessing the NAND Flash to files (e.g. audio).

Table 2-2: Digital interface description

2.3 Memory Map

2.3.1 Core Module Memory

Name	Size
L1 Instruction SRAM	48kB
L1 Instruction SRAM/Cache	16kB
L1 Data SRAM	32kB
L1 Data SRAM/Cache	32kB
L1 Scratchpad	4kB

Table 2-3: Core module memory map

2.3.2 Externally Addressable Memory (on connector)

- 32 MB SDRAM
    - SDRAM Clock up to 133MHz
    - IS42S16320B (16Mx16, 256Mbit at 3.3 V)

2.3.3 Flash

A 32Mbit (4MByte) Serial Flash M25PX32 is connected to the SPI interface.

- M25PX32
    - 32Mbit
    - 4K Subsectors
    - 64KSectors
    - Up to 75Mhz
    - 64Byte OTP area

3 Specifications

3.1 Electrical Specifications

3.1.1 Operating Conditions

Symbol	Parameter	Min	Typical	Max	Unit
V_{IN}	Input supply voltage	3.3		5.0	V
I_{3V3}	3.3V current			150	mA
V_{OH}	High level output voltage	2.4			V
V_{OL}	Low level output voltage			0.4	V
I_{IH}	IO input current			10	µA
I_{OZ}	Three state leakage current			10	µA
$I_{DEEPSLEEP}$	V_{IN} current in deep sleep mode		TBD		mA
I_{SLEEP}	V_{IN} current in sleep mode		TBD		mA
I_{IDLE}	V_{IN} current in deep sleep mode		TBD		mA
I_{TYP}	V_{IN} current in with core running at 400 MHz		TBD		mA
$I_{HIBERNATE}$	V_{IN} current in hibernate state		TBD		mA
I_{RTC}	V_{RTC} current		20		µA
I_{USB_FS}	V_{USB} current in low/full speed mode		9		mA
I_{USB_HS}	V_{USB} current in high speed mode		25		mA
f_{CCLK}	Core clock frequency	100		400	MHz

Table 3-1: Electrical characteristics

3.1.2 Maximum Ratings

Stressing the device above the rating listed in the absolute maximum ratings table may cause permanent damage to the device. These are stress ratings only. Operation of the device at these or any other conditions greater than those indicated in the operating sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Symbol	Parameter	Min	Max	Unit
V_{IO}	Input or output voltage	-0.5	3.6	V
V_{IN}	Input supply voltage	3.0	5.5	V
I_{OH}/I_{OL}	Current per pin	0	10	mA
T_{AMB}	Ambient temperature	-40	85	°C
T_{STO}	Storage temperature	-55	150	°C
T_{SLD}	Solder temperature for 10 seconds		260	°C
φ_{AMB}	Relative ambient humidity		90	%

Table 3-2: Absolute maximum ratings

3.1.3 ESD Sensitivity

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

4 Connector Description

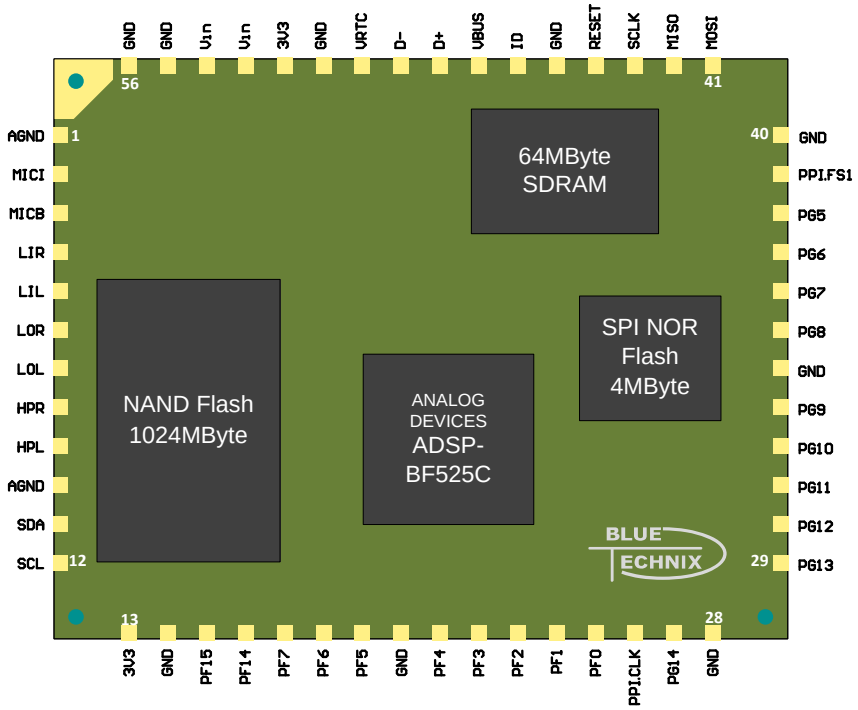


Figure 4-1: ACM-BF525C Border pad pin out (top view)

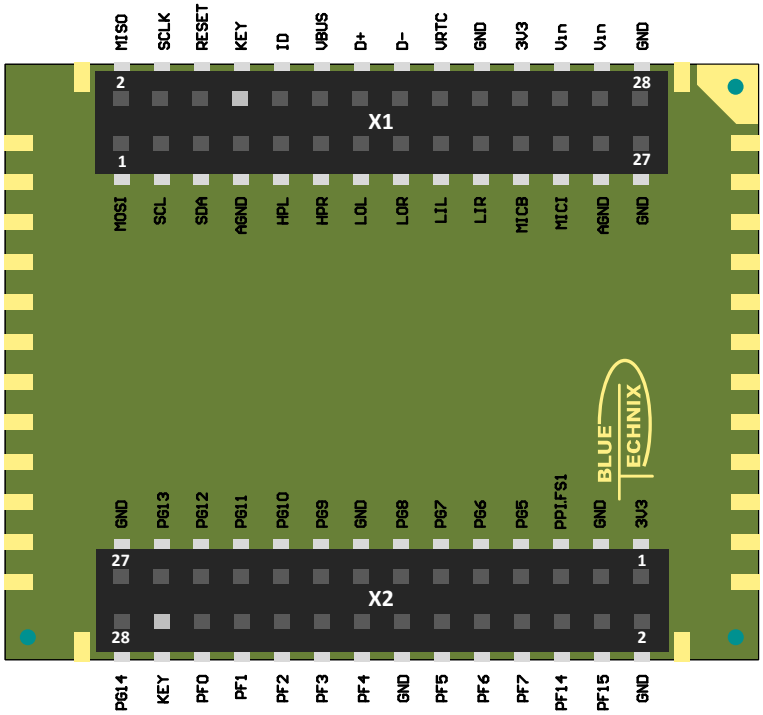


Figure 4-2: ACM-BF525C Connectors pin out (bottom view)

4.1 Connector X1

Pin No. Connector	Pin No. Edge-Contacts	Signal Name	IO Type	Function
1	41	MOSI	O	SPI Data Output
2	42	MISO	I	SPI Data Input
3	12	SCL	O	I^2C Clock
4	43	SCLK	O	SPI Serial Clock
5	11	SDA	IO	I^2C Data
6	44	RESET	IO	Power Up Reset Output and Manual Reset Input
7	1	AGND	PWR	Analog Ground
8		KEY	NC	Plugged Key Pin to prevent wrong module insertion
	51	GND	PWR	Power Ground
9	9	HPL	AO	Left Headphone or Line Out
10	46	ID	I	USBOTG ID
10	45	GND	PWR	Power Ground
11	8	HPR	AO	Right Headphone or Line Out
12	47	VUSB	I	USB Power Detection
13	7	LOL	AO	Left Line Out
14	48	D+	IO	USB Positive Data
15	6	LOR	AO	Right Line Out
16	49	D-	IO	USB Negative Data
17	5	LIL	AI	Left Line In
18	50	VRTC	PWR	Real Time Clock Power
19	4	LIR	AI	Right Line In
21	3	MICB	PWR	Microphone Bias (Phantom Power for Electrets-Mic.)
22	52	3V3	PWR	3.3V output Power
23	2	MICI	AI	Microphone Input
24	53	Vin	PWR	Power Supply
25	10	AGND	PWR	Analog Ground
26	54	Vin	PWR	Power Supply
27	55	GND	PWR	Power Ground
28	56	GND	PWR	Power Ground

Table 4-1 - Connector description X1

4.2 Connector X2

Pin No. Connector	Pin No. Edge-Contacts	Signal Name	IO Type	Function
1	13	3V3	PWR	3.3V Output Power
2	14	GND	PWR	Power Ground
3	20	GND	PWR	Power Ground
4	15	PF15	IO	Blackfin GPIO
5	39	PG0	IO	Blackfin GPIO
6	16	PF14	IO	Blackfin GPIO
7	38	PG5	IO	Blackfin GPIO
8	17	PF7	IO	Blackfin GPIO
9	37	PG6	IO	Blackfin GPIO
10	18	PF6	IO	Blackfin GPIO
11	36	PG7	IO	Blackfin GPIO
12	19	PF5	IO	Blackfin GPIO
13	35	PG8	IO	Blackfin GPIO
14	28	GND	PWR	Power Ground
15	34	GND	PWR	Power Ground
16	21	PF4	IO	Blackfin GPIO
17	33	PG9	IO	Blackfin GPIO
18	22	PF3	IO	Blackfin GPIO
19	32	PG10	IO	Blackfin GPIO
20	23	PF2	IO	Blackfin GPIO
21	31	PG11	IO	Blackfin GPIO
22	24	PF1	IO	Blackfin GPIO
23	30	PG12	IO	Blackfin GPIO
24	25	PF0	IO	Blackfin GPIO
25	29	PG13	IO	Blackfin GPIO
26	-	KEY	NC	Plugged Key Pin to prevent wrong module insertion
-	26	PG15	IO	Blackfin GPIO
27	40	GND	PWR	Power Ground
28	27	PG14	IO	Blackfin GPIO

Table 4-2 - Connector description X2

5 Application Information

5.1 Supply Voltage Decoupling

For better stability we recommend to add a 100nF capacitor to each power supply pin and an additional 47µF tantalum capacitor to the V_{IN} voltage rail next to the module.

5.2 Reset circuit

The $\overline{\text{RESET}}$ signal can be used for external components as power on reset. If you want reset the SPM manually, you can easily add a push-button, optional combined with a capacitor for hardware debouncing that ties the signal to ground.

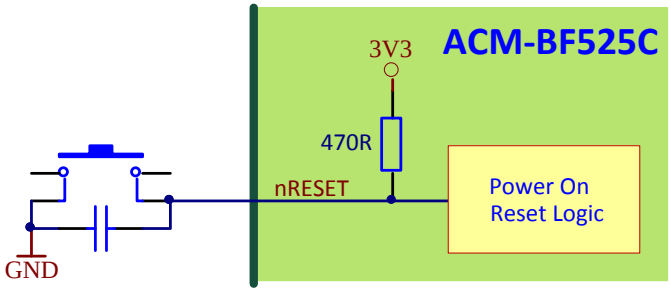


Figure 5-1: Reset circuit

5.3 Analog Interface

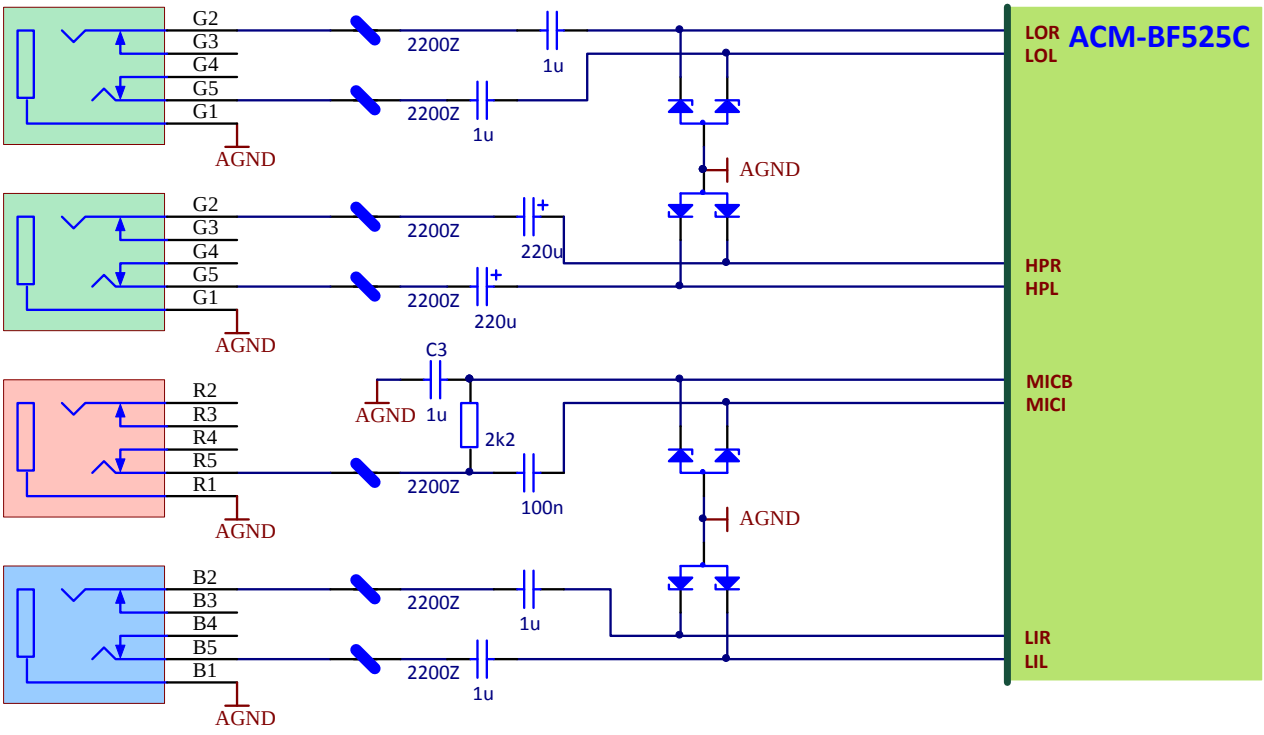


Figure 5-2: Analog interface circuit

Have a look at our ADEV-BF52xC schematics, which can be found at http://www.bluetechnix.com/goto/ADEV-BF52xC to get application examples.

6 Mechanical Outline

All Dimensions in the following section are given in mm.

6.1 Top View

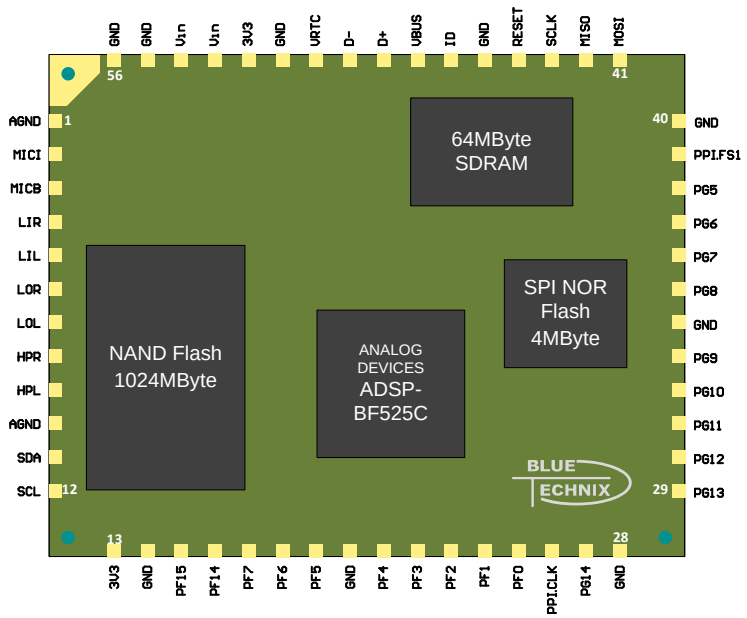


Figure 6-1: Mechanical dimensions (top view)

6.2 Bottom View

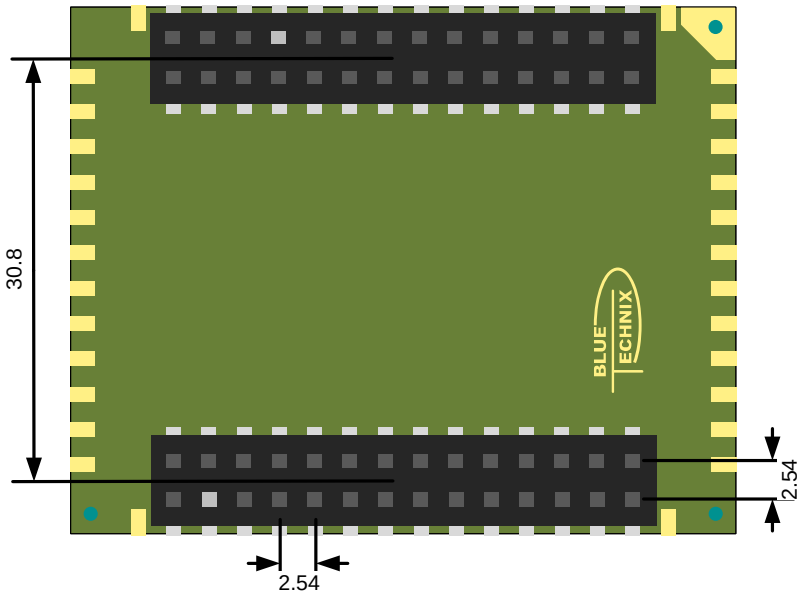


Figure 6-2: Mechanical dimensions with connectors (bottom view)

6.3 Side View

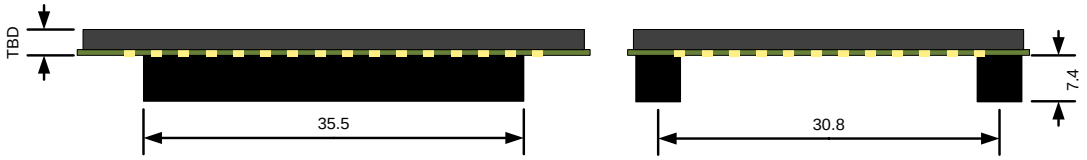


Figure 6-3: Mechanical dimensions with connectors (side views)

6.4 Footprint

6.4.1 Connector Version

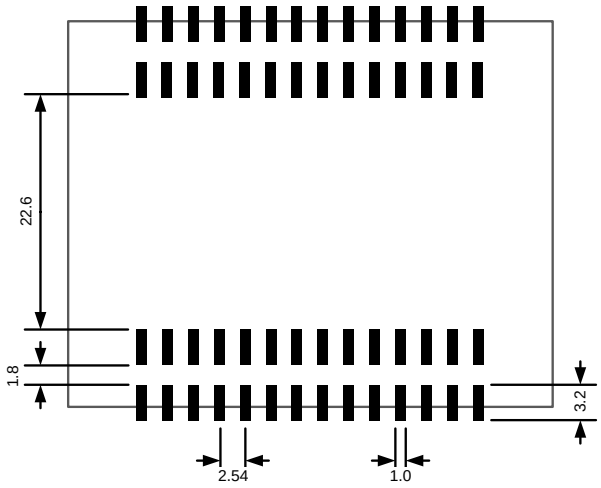


Figure 6-4: Recommended footprint for connector version

6.4.2 Solder Version

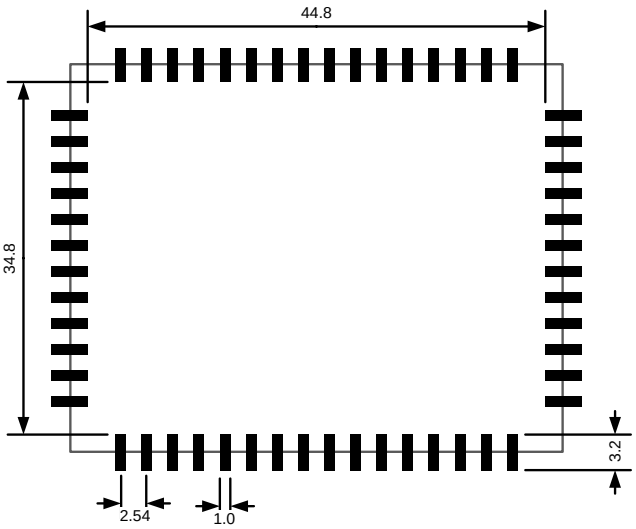


Figure 6-5: Recommended footprint for solder version

7 Support

7.1 General Support

General support for products can be found at Bluetechnix' support site https://support.bluetechnix.at/wiki

7.2 Board Support Packages

Board support packages and software downloads are for registered customers only https://support.bluetechnix.at/software/

7.3 Blackfin® Software Support

7.3.1 BLACKSheep® OS

BLACKSheep® OS stands for a powerfully and multithreaded real-time operating system (RTOS) originally designed for digital signal processing application development on Analog Devices Blackfin® embedded processors. This high-performance OS is based on the reliable and stable real-time VDK kernel from Analog Devices that comes with VDSP++ IDE. Of course BLACKSheep® OS is fully supported by all Bluetechnix Core-Modules and development hardware.

7.3.2 LabVIEW

You can get LabVIEW embedded support for Bluetechnix Core Modules by Schmid-Engineering AG http://www.schmid-engineering.ch.

7.3.3 uClinux

You can get uClinux support (boot loader and uClinux) for Bluetechnix Core Modules at http://blackfin.uClinux.org.

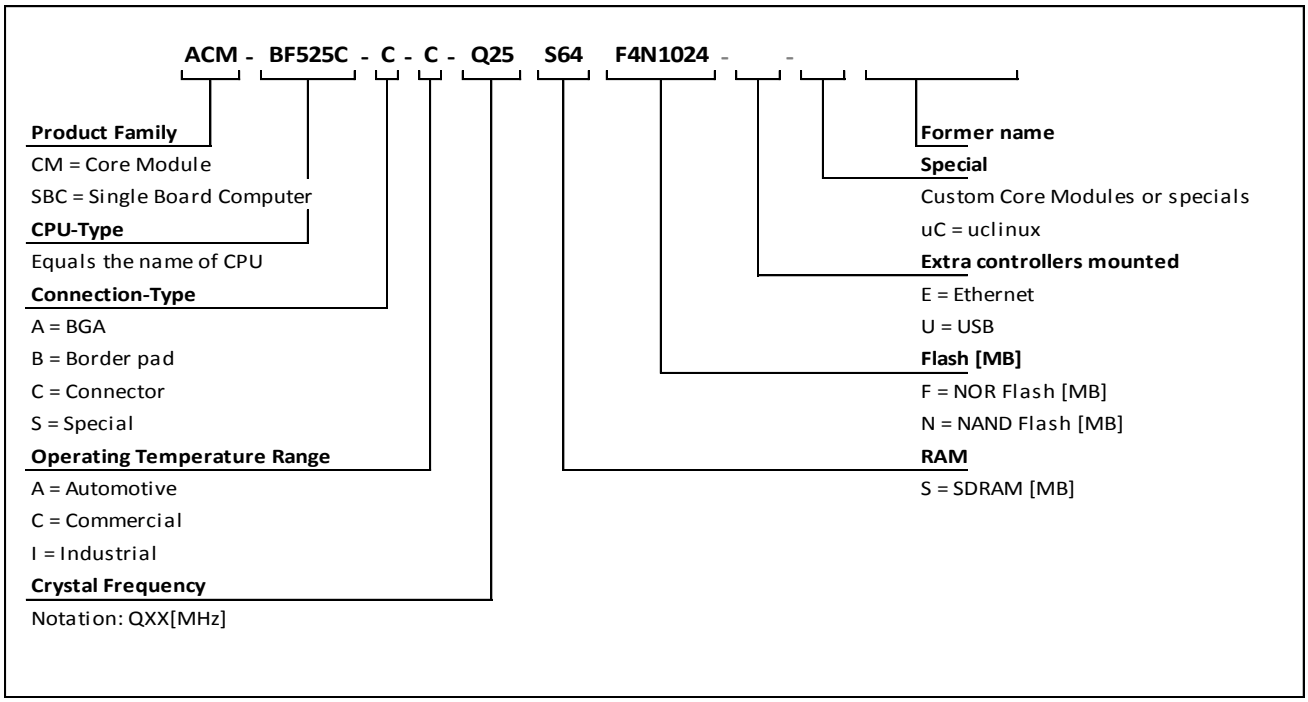
7.4 Blackfin® Design Services

Based on more than seven years of experience with Blackfin, Bluetechnix offers development assistance as well as custom design services and software development.

7.4.1 Upcoming Products and Software Releases

Keep up to date with all product changes, releases and software updates of Bluetechnix at http://www.bluetechnix.com.

8 Ordering Information



8.1 Predefined mounting options for ACM-BF525C

Article Number	Name	Temperature Range
100-8233-1	ACM-BF525C-C-C-Q25S64F4N1024	Commercial
100-8233-1-TR	ACM-BF525C-C-C-Q25S64F4N1024 Tape Reel	Commercial

Table 8-1 - Mounting options

NOTE: Custom Core Modules are available on request! Please contact Bluetechnix (office@bluetechnix.com) if you are interested in custom Core Modules.

9 Dependability

9.1 MTBF

Please keep in mind that a part stress analysis would be the only way to obtain significant failure rate results, because MTBF numbers just represent a statistical approximation of how long a set of devices should last before failure. Nevertheless, we can calculate an MTBF of the Core Module using the bill of material. We take all the components into account. The PCB and solder connections are excluded from this estimation. For test conditions we assume an ambient temperature of 30°C of all Core Module components except the Blackfin® processor (80°C) and the memories (70°C). We use the MTBF Calculator from ALD (http://www.aldservice.com/) and use the reliability prediction MIL-217F2 Part Stress standard. Please get in touch with Bluetechnix (office@bluetechnix.com) if you are interested in the MTBF result.

10 Product History

10.1 Version Information

Version	Date	Changes
1.1	2011 25 03	To have the possibility to access the PPI, the PPI-CLK signal is used in state of PG15 and PPI_FS1 in state of PG0.
1.0	2011 04 01	First release V1.0 of the Hardware.

Table 10-1: Overview product changes

10.2 Anomalies

Version	Date	Description
1.1	2011 25 03	No anomalies reported yet.
1.0	2011 04 01	No anomalies reported yet.

Table 10-2: Overview product anomalies

11 Document Revision History

Version	Date	Document Revision
2	2011.03.25	Changes for Board Revision V1.1 added
1	2011 03 11	First release V1.0 of the Document

Table 11-1: Revision history

12 List of Abbreviations

Abbreviation	Description
AI	Analog Input
AMS	Asynchronous Memory Select
AO	Analog Output
EBI	External Bus Interface
ESD	Electrostatic Discharge
GPIO	General Purpose Input Output
HP	Headphone
I	Input
I²C	Inter-Integrated Circuit
IO	Input/Output
MTBF	Mean Time Between Failure
NC	Not Connected
NFC	NAND Flash Controller
O	Output
PPI	Parallel Peripheral Interface
PWR	Power
SoC	System on Chip
SPI	Serial Peripheral Interface
SPM	Speech Processing Module
SPORT	Serial Port
UART	Universal Asynchronous Receiver Transmitter
USB	Universal Serial Bus
USBOTG	USB On The Go

Table 12-1: List of abbreviations

A List of Figures and Tables

Figures

Tables