1 Overview

The BeMicro FPGA development kit is a cheap and simple development platform for all kinds of FPGA design in USB stick form factor. It fits into a PC USB host connector port or a USB hub and, thus, is powered from the PC or the hub. On the stick there is an Altera CycloneIII FPGA for user logic implementation. An expansion connector allows connecting additional hardware to the FPGA.

2 System description

2.1 Components

The main components on the board are:

- Altera Cyclone III FPGA - EP3C16F256C8N
- 16 MHz clock oscillator
- 3 status LED
- 8 user LED
- 80-pin edge connector

Two optional components also can be mounted on the board:

- Low power SRAM 256k*16 – Renesas R1LV0416DSB-7LI
- Configuration EEPROM – Altera EPCS4SI8N or EPCS16SI8N

Depending on the production lot these optional components may already be mounted onto BeMicro on delivery.

2.2 Status LED

Nearby the USB connector there are 3 status LED.

Color	Meaning
red	data communication via JTAG port ongoing
yellow	FPGA design successfully loaded [2])
green	power supply enabled [1])

Notes:
1) The power for the FPGA is enabled only if the USB stick is enumerated properly by the PC. In case the green LED stays off after plugging-in the stick the driver for the stick obviously has not been installed properly.
2) The yellow LED depends on the CONF_DONE pin of the FPGA.

2.3 User LED

The 8 user LED are connected to the FPGA and, via current limiting resistor, to VCC. If the FPGA outputs low level at the appropriate pin then the LED shines. LED[7] is nearest to the USB connector LED[0] is nearest to the FPGA.

LED	7	6	5	4	3	2	1	0
Pin	B1	A7	B3	E6	D6	C3	C2	B4

2.4 SRAM (optional)

The SRAM is connected to the FPGA according to the table below:

Signal	**Pin**	**Signal**	**Pin**	**Signal**	**Pin**	**Signal**	**Pin**
A17	T3	A16	R4	D15	N5	D14	N6
A15	T4	A14	R5	D13	M6	D12	L6
A13	T5	A12	D3	D11	K5	D10	G5
A11	D1	A10	D5	D9	G2	D8	G1
A9	F3	A8	F1	D7	R3	D6	R1
A7	R7	A6	T6	D5	P2	D4	P1
A5	T7	A4	J2	D3	N2	D2	N1
A3	J1	A2	K2	D1	N3	D0	L2
A1	K1	A0	L3	CS1#	L1	CS2	F2
OE#	R6	WE#	T2	LB#	P6	UB#	P3

SRAM and FPGA I/O banks are powered from the same 3.3V supply.
The I/O standard for the FPGA pins should be set to 3.3-V LVTTL.

2.5 Clock oscillator

The 16 MHz clock runs permanently if the FPGA power is enabled. The clock oscillator is connected to the FPGA pin E2. The I/O standard for this FPGA pins should be set to 3.3-V LVTTL.

2.6 Configuration device (optional)

An optional configuration device EPCS4SI8N or EPCS16SI8N can be soldered onto mounting position U500 (see assembly drawing on page 6). An EPCS16 is needed in case you want to not only store one hardware image in the configuration device but several images and maybe even software images as well. Note that the FPGA can access the configuration device only if the boot mode is set to active serial. This can be done with the solder bridge B400.

1	**2**	**3**	**Boot mode**
■	■		passive serial (default)
	■	■	active serial

In case you want to use the configuration device for storing configuration or other data cut the connection from pad 1 to pad 2 of the solder bridge and connect pads 2 and pad 3 with some solder.

2.7 Expansion connector

In total, 64 general purpose I/O pins of the FPGA are connected to the expansion connector. Other signals are connected as well. All connector pins connected directly to the FPGA are shaded in the table below. The pin number is given in this case.

Signal	Conn	Conn	Signal	Signal	Conn	Conn	Signal
3.3V	1	2	3.3V	H16	41	42	J13
RST_N	3	4	PWR_N	H15	43	44	GND
R12	5	6	T10	G16	45	46	J12
T13	7	8	R10	G15	47	48	G11
R13	9	10	GND	F16	49	50	F14
T14	11	12	T11	F15	51	52	F13
R14	13	14	R11	GND	53	54	GND
T15	15	16	N11	D15	55	56	E11
R16	17	18	N14	D16	57	58	E10
P14	19	20	N12	C15	59	60	D14
GND	21	22	GND	C16	61	62	D12
P16	23	24	M11	C14	63	64	A13
P15	25	26	L11	B16	65	66	C11
N16	27	28	L13	A15	67	68	C9
N15	29	30	L14	B14	69	70	B11
L16	31	32	GND	A14	71	72	A11
GND	33	34	L15	B13	73	74	B10
K15	35	36	K12	B12	75	76	GND
K16	37	38	J15	A12	77	78	EXP
J16	39	40	J14	5V	79	80	5V

Non-shaded fields denote other signals. These are described below.

Signal	Description
3.3V	This net is a supply output of BeMicro. Up to 200 mA can be drawn from this source.
5V	The net is a supply input for BeMicro. See chapter 2.9 “Stand-alone operation” on page 4.
RST_N	This net is used to reset the application design in the FPGA. The net is connected to FPGA pin T12 and a 10k pull-up resistor.
PWR_N	Power enable, low-active. See chapter 2.9 “Stand-alone operation” on page 4.
EXP	Expansion board is present. The net is connected to FPGA pin A10 and a 10k pull-down resistor. On the expansion board there is a stronger pull-up resistor.
GND	Signal and power ground.

2.8 UART

Two pins of the FPGA are connected to the TxD/RxD pins of the USB controller. This controller and the corresponding driver DLL allows implementing a virtual UART on the PC. Have a look at the device manager of your PC. You will find a virtual COM port named “USB Serial Port on BeMicro”. Data sent out to this COM port is tunneled though the USB channel and, at the end, sent to the FPGA. The same applies to the reverse communication direction.

Signal	Direction	Pin
TxD	FPGA to PC	D8
RxD	PC to FPGA	C8

2.9 Stand-alone operation

In special cases you may want to run the BeMicro USB stick without a PC. This is possible, though, some measures have to be taken. First, there are two ways to supply the stick. You can us a USB power supply that connects to the main USB plug or you can power the stick from the expansion board. In this case, apply 5V to the VCC net.

In both cases, the USB controller on the stick is not enumerated and therefore, the power regulator stays off. It must be enabled by some means. In case of the use with expansion board, the PWR_N signal of the expansion connector can be pulled low, what enables the regulator.

There is a second way to enable the regulator. The solder bridge B600 is used for that.

3	2	1	Power enabled by
	■	■	signal PWR_N from expansion connector (default)
■	■		always

In case you have modified solder bridge B600 you must not plug in the stick into a PC or USB hub any more.

3 Installation

It is important to install the software on a PC before plugging-in BeMicro into a USB host connector of the PC. The complete installation procedure is listed below. It is assumed that Altera Quartus is already installed on your PC. If not, install Quartus first.

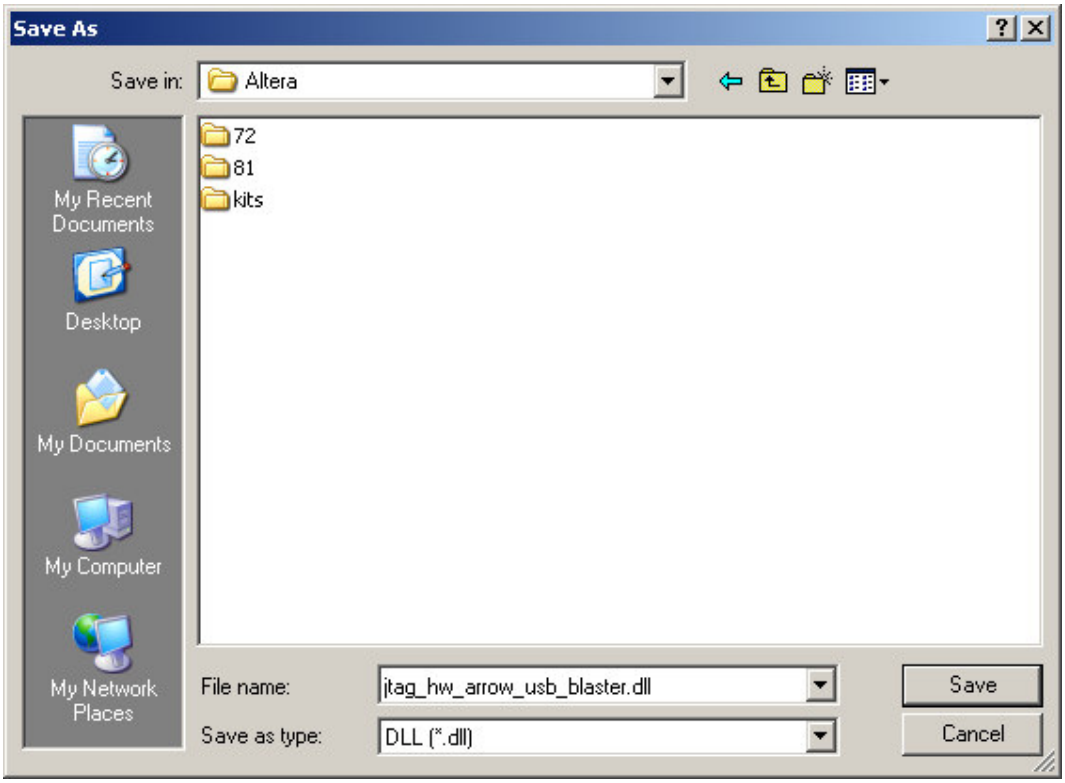
- Download the installation package from the Sasco web site. This package includes the USB driver, several DLL needed for seamless integration, and some design examples.
- Unzip the installation package to a file folder of your choice. Do not use the Quartus Program folder or a subdirectory for that. Most people use an install folder with several subdirectories for that. This is the recommend method.
- Start the installation program located in <your folder>\programmer\setup.exe.
  For details about the installation process read chapter 3.1.
- Plug-in BeMicro into a USB host connector of your PC.
- Tell Windows where to find the USB driver. This is <your folder>\driver.

By installing the software onto your PC you are bound to the license agreement of the Arrow USB-Blaster software. The complete license agreement can be found in chapter 5, License Agreement on page 7. This license agreement, in short, allows you to use the software only in conjunction with Altera FPGA purchased or obtained in any other legal way from Arrow or a subsidiary of Arrow.

For FPGA designs without embedded CPU as well as for NIOS based FPGA designs this basic install is all you have to do. Other CPU architectures may require additional install steps.

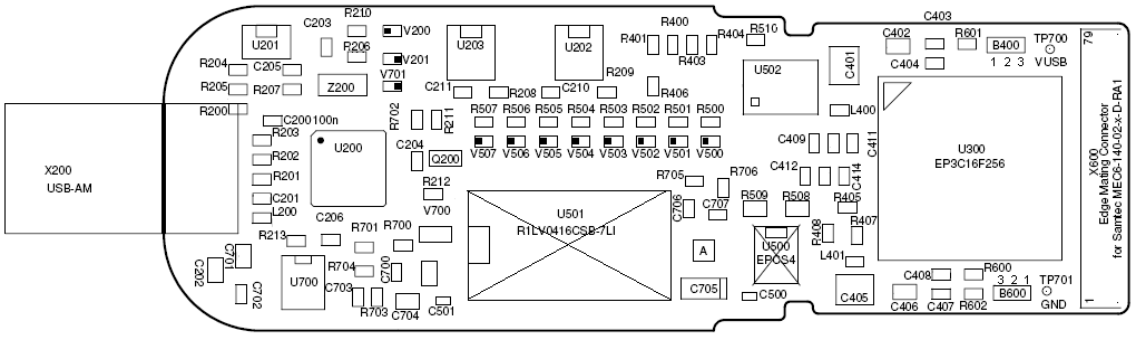
3.1 Setup.exe

You need administrator rights in order to run the setup program for BeMicro. This program executes all tasks needed to install and register the programmer hardware DLL. It asks where to store these files. Since the programmer hardware DLL can be used with different release versions of Altera Quartus it is recommended to store the DLL in the Altera root program folder. This is that location where several folders for different release versions of Altera Quartus might exist.



4 Assembly drawing

The picture below shows the mounting positions for the components. The RAM (U501) and the configuration EEPROM (U500) are crossed out since these components are optional. In case these two components are missing on your BeMicro stick you can add them on your own.



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6 Additional remarks

The Altera USB Blaster and BeMicro both use an USB controller from FTDI that use the same communication driver DLL. Communication issues might occur if an USB Blaster and a BeMicro are connected to the same PC at the same time. So, it's advisable to only use one of these devices at one time.

7 Document history

2009-02-19: Draft
2009-03-06: More details about the usage of the installation program setup.exe