LABS BLASTERBOARD

# Assembly Manual

For **revision F** PCBs

Welcome to the Blasterboard assembly manual. This manual will guide you through the building and setup process of the Blasterboard ISA sound card. It consists of 5 steps:

1. Preparing necessary tools and components
2. Soldering the components to the PCB
3. Installing the mounting bracket
4. Programming* and installing the MCU *(* for Kit 0 and Kit 1)*
5. Preparing the card for the first use

## 1. PREPARING NECESSARY TOOLS AND COMPONENTS

To make the process of building as DIY-friendly as possible, I tried to reduce the component count to a minimum, not degrading the card's performance. All of the components are THT and require basic soldering tools and skills.

### 1.1. Prepare the necessary tools:

*You will need a soldering iron, solder, a multimeter, wire cutters, PZ1 or PH1 screwdriver.*
*IC programmer is also required for Kit 0 or Kit 1.*

### 1.2. Check your kit contents:

*Kit 0:*

- 1x Blasterboard **REV: F** printed circuit board
- 1x custom made ISA metal bracket
- 2x white nylon mounts for the bracket
- 4x metal screws for mounting the bracket to the PCB
- 1x 3-pin 40cm wire for connecting optical drive's analog audio output to the Blasterboard
- 1x 2-pin 40cm wire for connecting PC-Speaker header on the motherboard to the Blasterboard

*Kit 1:*

- Everything that is included in Kit 0 (see above)
- 3x Alps RK09K1110AK4 mono potentiometers
- 1x Alps RK09K12A0A2K stereo potentiometer
- 1x 3.579545MHz active crystal oscillator in DIP8 package
- 1x resistor network (9 pins)
- 3x ferrite beads
- 1x stereo minijack socket

*Kit 2:*

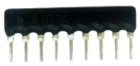
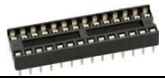
- Everything that is included in Kit 1 (see above)
- 1x Atmega MCU in DIP28 package, pre-programmed with the latest firmware
- 1x DIP28 plastic socket for the MCU
- 1x MCP4901 8-bit DAC
- 1x YM3812 (OPL2) FM synthesizer chip
- 1x Y3014B DAC

**1.3. Check your PCB revision. It is printed on the PCB and should read "REV: F"**

**1.4. Prepare the components from the table below. Depending on the kit acquired you might already have some of them.**

**NOTES**

- Possible value substitutions are indicated in round brackets
- Components marked with [1] are included in Kit 1
- Components marked with [2] are included in Kit 2

| Value | Details | Qty | Parts |
|---|---|---|---|
| **Resistors**  | | | |
| 10k | 0207 MF, 1%, 0.2W-0.6W | 12 | R1, R9, R13, R14, R15, R16, R17, R18, R21, R23, R24, R26 |
| 100k | 0207 MF, 1%, 0.2W-0.6W | 11 | R2, R5, R7, R8, R11, R12, R19, R22, R25, R27, R29 |
| 3.3k | 0207 MF, 1%, 0.2W-0.6W | 4 | R3, R4, R6, R20 |
| 560R | 0207 MF, 1%, 0.2W-0.6W | 2 | R28, R30 |
| 470k | 0207 MF, 1%, 0.2W-0.6W | 1 | R10 |
| **Resistor network**  | | | |
| 10k [1] [2] (4.7k-12k) | 9P8R, ≤ 5% | 1 | RN1 |
| **Diodes**  | | | |
| 1N4001 | 1N400(1/2/3/4) | 2 | D1, D2 |
| 1N4148 | | 1 | D3 |
| **Ferrite bead**  | | | |
| ≥20Ω @ 25MHz [1] [2] | ℓ=4mm..7mm, Ø=2mm..5mm | 3 | B1, B2, B3 |
| **Ceramic caps**  | | | |
| 100nF | 2.54mm pitch | 23 | C3, C4, C5, C6, C9, C10, C11, C13, C17, C18, C19, C20, C21, C23, C24, C28, C31, C36, C37, C38, C39, C44, C45 |
| 22pF | 2.54mm pitch | 8 | C1, C2, C29, C30, C32, C33, C42, C43 |
| **Film caps**  | | | |
| 3.3nF | Film, 5mm pitch | 2 | C15, C16 |
| **Electrolytic caps**  | | | |
| 100uF/≥16v | Ø6.3mm, 2.5mm pitch | 5 | C22, C40, C41, C46, C47 |
| 10uF/≥16v | Ø5mm, 2mm pitch | 9 | C7, C8, C12, C14, C25, C26, C27, C34, C35 |
| **IC socket**  | | | |
| DIP28 [2] | socket for MCU | 1 | IC2 |

| | | | |
|---|---|---|---|
| **ICs**  | | | |
| **NOTE: 74HCT**-series logic chips can also be used instead of 74HC | | | |
| 74HC125N | DIP14 | 1 | IC3 |
| 74HC74N | DIP14 | 2 | IC5, IC6 |
| 74HC245N | DIP20 | 1 | IC7 |
| 74HC08N | DIP14 | 1 | IC9 |
| 74HC32N | DIP14 | 2 | IC10, IC12 |
| 74HC14N | DIP14 | 1 | IC13 |
| 74HC574N | DIP20 | 3 | IC11, IC14, IC16 |
| 74HC138N | DIP16 | 3 | IC15, IC17, IC18 |
| TL074 (LF347N) | DIP14 | 3 | U1, U2, U3 |
| MCP4901-E/P [2] | DIP8 (8-bit DAC) | 1 | IC1 |
| YM3812 [2] | DIP24W (OPL2) | 1 | IC4 |
| Y3014B [2] | DIP8 (DAC for OPL2) | 1 | IC8 |
| ATMEGA88PA-PU* [2] | DIP28 (MCU) | 1 | IC2 |
| * For the list of all supported MCUs please refer to section 4: “Programming and installing the MCU” | | | |
| **Crystal resonator**  | | | |
| 20MHz | HC-49/S | 1 | Q1 |
| **Crystal oscillator**  | | | |
| 3.579545MHz [1] [2] | DIP8 or DIP14 | 1 | Q2 |
| **Voltage regulators**  | | | |
| 78L05 | TO-92 | 1 | V1 |
| 78L08 (78L09)** | TO-92 | 1 | V2 |
| 79L08 (79L09)** | TO-92 | 1 | V3 |
| ****** V2+V3 must be of equal complementry voltage, i.e. 78L0**9**+79L0**9** or 78L0**8**+79L0**8** | | | |
| **Potentiometers**  | | | |
| RK09K1110AK4 [1] [2] | B10k mono | 3 | VR1, VR2, VR3 |
| RK09K12A0A2K [1] [2] | B10k, stereo | 1 | VR4 |
| **Pin headers**  | | | |
| double row 2 pins | 2.54mm pitch, straight | 2 | H4, H5 |
| double row 8 pins | 2.54mm pitch, straight | 1 | H6 |
| double row 3 pins | 2.54mm pitch, straight | 1 | H7 |
| single row 3 pins | 2.54mm pitch, straight | 1 | H8 |
| single row 2 pins, 90° | 2.54mm pitch, angled | 2 | H0 (optional), H1 |
| single row 3 pins, 90° | 2.54mm pitch, angled | 1 | H2 |
| **Jumpers**  | | | |
| n/a | 2.54mm pitch | 5 | n/a |
| **Audio connector**  | | | |
| PJ-306M [1] [2] | 3.5mm stereo socket | 1 | J1 |

## 2. SOLDERING THE COMPONENTS TO THE PCB

***LIABILITY ISSUES***

***I will have no responsibility or liability in relation to any loss or damage that you incur, including damage to your hardware or software, arising from incorrect assembling or other misuse of the Blasterboard.***

While getting familiar with the PCB please notice that components are numbered in reading order for faster search.

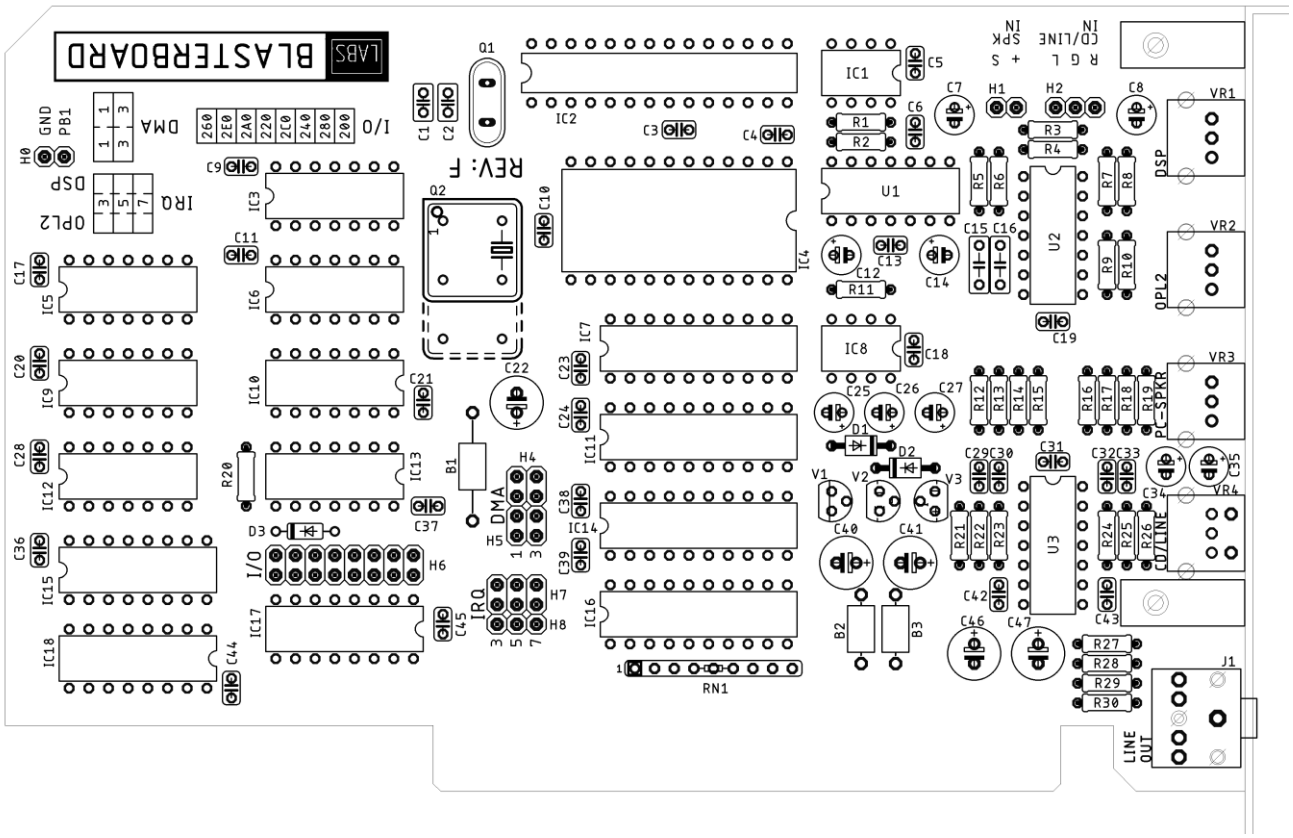
Note that the Atmega MCU (IC2) should not be soldered onto PCB directly. A 28-pin IC socket should be soldered first and then the programmed MCU with the latest firmware must be inserted into that socket. This is done so the MCU could be updated with future firmware releases.

When inserting VR1-VR4 potentiometers, push them into place until click, so they sit well into position.

For your comfort I really recommend to print out the component table above and mark your soldering progress on paper, so you don't miss anything.

**WARNING!**
**During assembly carefully check position and polarity of the components before soldering!**
**Incorrectly placed, they can be damaged and cause your computer's hardware to malfunction!**

Solder components according to the table above - filling positions from column "Parts" with respective "Values". It is recommended to start with resistors and go on as component's height increases.

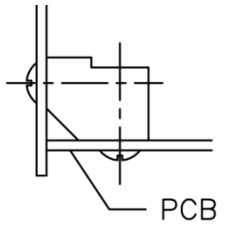



*Pic. 1. REV: F board layout for additional reference.*

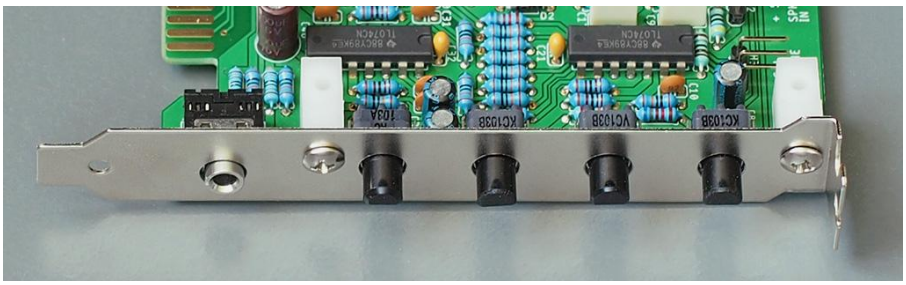
After soldering is completed, thoroughly clean the solder side of the PCB with solvent to remove flux, solder bits and other leftovers. Also carefully clean ISA contacts with a piece of cloth soaked in solvent until there is no dissolved flux left and the contacts don't stick when dry. Thoroughly inspect your work eliminating any possible problems. Bad soldering and other inaccuracies can cause shorting or bad contacts.

## 3. INSTALLING THE MOUNTING BRACKET

Install the metal bracket using 2 nylon mounts and 4 screws as shown →




Make sure all potentiometers rotate freely.
Otherwise slightly adjust the bracket.



*Pic. 2. Correctly installed mounting bracket.*

## 4. PROGRAMMING AND INSTALLING THE MCU

Blasterboard **Kit 2** comes with a pre-programmed Atmega88PA-PU MCU. If this is your case - insert the MCU into IC2 socket according to the key position and skip to section 5: "Preparing the card for the first use".

The process of programming the MCU assumes that you have an appropriate hardware IC programmer, programming software and knowledge how to use them properly.

### 4.1. Downloading the firmware

Blasterboard's firmware comes in 2 flavours to support wider range of MCUs. This is the same firmware, but compiled for 2 groups of Atmega MCUs in 28-pin DIP package:

1) With ≥16k of program memory, can be burned to:

- ATmega168-20PU
- ATmega168A-PU
- ATmega168PA-PU
- ATmega168PA-PN
- ATmega328-PU
- ATmega328P-PU
- ATmega328P-PN

2) With less than 16k of program memory, can be burned to:

- ATmega48-20PU
- ATmega48A-PU
- ATmega48PA-PU
- ATmega48PA-PN
- ATmega88-20PU
- ATmega88A-PU
- ATmega88PA-PU
- ATmega88PA-PN

To download the latest firmware go to the official Blasterboard repository:

**https://github.com/labs-lv/blasterboard/tree/master/Firmware**

A folder with a '–current' suffix contains the latest firmware.

For example:

**/2.1-current**

You will need 2 files from this folder:

1) **fuses.bin** – fuse settings for Atmega MCU in binary format (*fuses-pic.png* in the same folder shows the fuse settings as well)

2) **bb-<?_?>--<mcu>.hex** – compiled firmware in Intel HEX format

**<?_?>** - indicates the firmware version
**<mcu>** - indicates Atmega MCU group:
**m88** – for MCUs with less than 16k or program memory
**m328** – for MCUs with 16k or more of program memory

For example if you want to burn Blasterboard firmware of version 2.1 to Atmega48-20PU chip (4k of program memory) use:

**bb-2_1--m88.hex**

For the same firmware version and Atmega168A-PU chip (16k of program memory) use:

**bb-2_1--m328.hex**

### 4.2. Programming the MCU

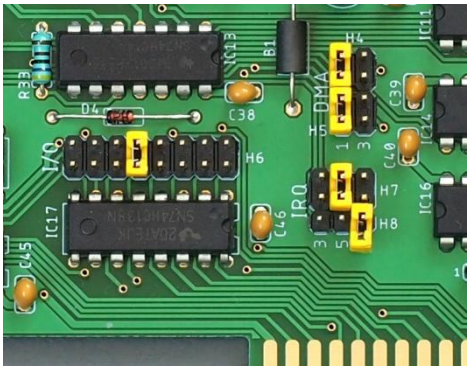
The process of programming the Atmega MCU is explained in its datasheet, which can be downloaded from the Microchip website. It also fully depends on your platform and tools you use, so cannot be covered in this document. Please refer to your hardware programmer's documentation about programming the Atmega MCU's fuses and firmware in Intel HEX format.

After successful programming insert the MCU into IC2 socket on the Blasterboard PCB.

## 5. PREPARING THE CARD FOR THE FIRST USE

First of all you need to select hardware settings using jumpers. Value tables are printed on the PCB near the logo. Blasterboard has an ability to select IRQ for OPL2 chip (H8 header), which adds 2 hardware timers to a system. But since this option was absent on the original SB card, there is no software (at least to my knowledge) that uses this functionality. So it is here only for experimental reasons and should not be used during normal operation of Blasterboard leaving IRQ line free for other hardware.

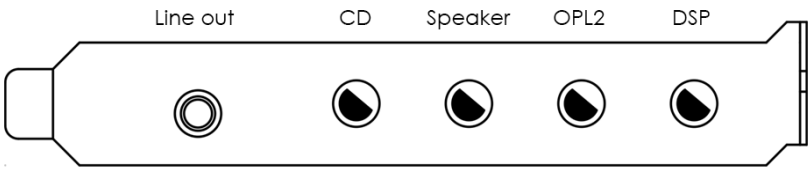
DMA number is selected by setting 2 jumpers together on H4 and H5.




*Pic. 3. Hardware settings for I/O port 220, DMA 1, IRQ 5.*
*Jumper on H8 is left floating and not connecting any pins.*

After installing the Blasterboard into 8-bit or 16-bit ISA slot, use 3-pin wire to connect analog output of your optical drive (R–G–L pins) to the corresponding pins of Blasterboard's "CD/LINE IN" header. Then use 2-pin wire to connect PC Speaker's VCC pin to "+" and the other pin to "S" pin on the card's "SPK IN" header. You can also use "CD/LINE IN" header to connect stereo output of any other audio hardware (for example MIDI sound module) and feed it through internal mixer to Blasterboard's output.

Blasterboard's output is unbalanced stereo 3.5mm jack. Individual volume levels can be set for each sound source using corresponding potentiometers.




*Pic. 4. Blasterboard controls.*

Do not forget to set up a BLASTER variable for your DOS environment by adding corresponding line to C:\AUTOEXEC.BAT. For hardware settings on picture 3 the line should look like this:

```
SET BLASTER = A220 D1 I5 T3
```

**Axxx** – I/O address (200/220/240/260/280/2A0/2C0/2E0)
**Dx** – 8-bit DMA setting (1/3)
**Ix** – IRQ number (3/5/7)
**Tx** – Sound Blaster model: 3 is for SB 2.0, so is for the Blasterboard

All done! Enjoy your Blasterboard!

If something is not working as it should, please follow these steps:

- Check jumper settings
- Thoroughly clean ISA contacts of the PCB with solvent. Even a little bit of not completely cleaned flux can create bad contact with ISA slot of the motherboard.
- Check components placement using PCB layout on picture 1
- Walk around all contacts with hot soldering iron, there might be bad connections left