LABS BLASTERBOARD

Assembly Manual

For **REV: E** printed circuit boards

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 only)*
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 simple soldering tools and skills.

1.1. Prepare the necessary tools:

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: E 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

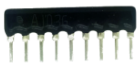
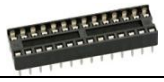
Kit 1:

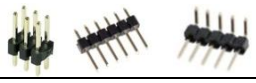
- Everything that is included in Kit 0 (see above)
- 3x Alps RK09K1110AK4 mono potentiometers
- 1x Alps RK09K12A0A2K stereo potentiometer
- 1x 3.579545MHz active crystal oscillator in DIP8 package
- 1x 4k7 resistor network (9 pins)
- 3x ferrite beads
- 1x stereo minijack socket

Kit 2:

- Everything that is included in Kit 1 (see above)
- 1x Atmega328P MCU, 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. Prepare the rest of the components from the table below. Depending on the kit acquired you might already have some of them.

Value	Details	Qty	Parts
Resistors 			
4.7k	MF, 1%, 0.25W or 0.6W	3	R1, R3, R33
270k	MF, 1%, 0.25W or 0.6W	2	R2, R11
180	MF, 1%, 0.25W or 0.6W	2	R30, R32
1k8	MF, 1%, 0.25W or 0.6W	2	R4, R5
100k	MF, 1%, 0.25W or 0.6W	15	R6, R8, R12, R14, R15, R16, R17, R18, R19, R21, R22, R24, R27, R29, R31
68k	MF, 1%, 0.25W or 0.6W	3	R7, R13, R20
22k	MF, 1%, 0.25W or 0.6W	6	R9, R10, R23, R25, R26, R28
Resistor network 			
4.7k*	9P8R, ≤ 5%	1	RN1
Electrolytic caps 			
100uF/≥16v	EL, Ø7mm, 2.5mm pitch	5	C24, C41, C42, C47, C48
10uF/≥16v	EL, Ø5mm, 2mm pitch	9	C7, C8, C14, C16, C26, C27, C28, C35, C36
Ceramic caps 			
100nF	2.54mm pitch	23	C3, C4, C5, C6, C11, C12, C13, C15, C18, C19, C20, C21, C22, C23, C25, C29, C32, C37, C38, C39, C40, C45, C46
56pF	2.54mm pitch	7	C10, C30, C31, C33, C34, C43, C44
22pF	2.54mm pitch	2	C1, C2
Film caps 			
3.3nF	Film, 5mm pitch	2	C9, C17
Diodes 			
1N4001	1N400(1/2/3/4)	2	D1, D2
1N4148		1	D4
Ferrite bead 			
≥20Ω @ 25MHz*	ℓ=7mm..4mm, Ø=5mm..2mm	3	B1, B2, B3
IC socket 			
DIP28**	socket for MCU	1	IC2

ICs 			
NOTE: 74HCT-series logic chips can also be used			
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	DIP14	3	U1, U2, U3
MCP4901-E/P**	DIP8 (8-bit DAC)	1	IC1
YM3812**	DIP24W (OPL2)	1	IC4
Y3014B**	DIP8 (DAC for OPL2)	1	IC8
ATMEGA328P-PU**	DIP28 (MCU)	1	IC2
Crystal resonator 			
20MHz	HC-49/S	1	Q1
Crystal oscillator 			
3.579545MHz*	DIP8 or DIP14	1	Q2
Voltage regulators 			
78L05	TO-92	1	V1
78L09 (or 78L08)	TO-92	1	V2
79L09 (or 79L08)	TO-92	1	V3
ATTENTION: A pair V2+V3 must be 78L0**9**+79L0**9** or 78L0**8**+79L0**8** only			
Potentiometers 			
RK09K1110AK4*	B10k mono	3	VR1, VR2, VR3
RK09K12A0A2K*	B10k, stereo	1	VR4
Pin headers 			
double 2 pins	2.54mm pitch, straight	2	H4, H5
double 8 pins	2.54mm pitch, straight	1	H6
double 3 pins	2.54mm pitch, straight	1	H7
single 3 pins	2.54mm pitch, straight	1	H8
single 2 pins, 90°	2.54mm pitch, angled	2	H1, H2
single 3 pins, 90°	2.54mm pitch, angled	1	H3
Jumpers 			
n/a	2.54mm pitch	5	n/a
Audio connector 			
PJ-306M*	3.5mm stereo socket	1	J1

* included in Kit 1 and Kit 2, ** included in Kit 2 only

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.

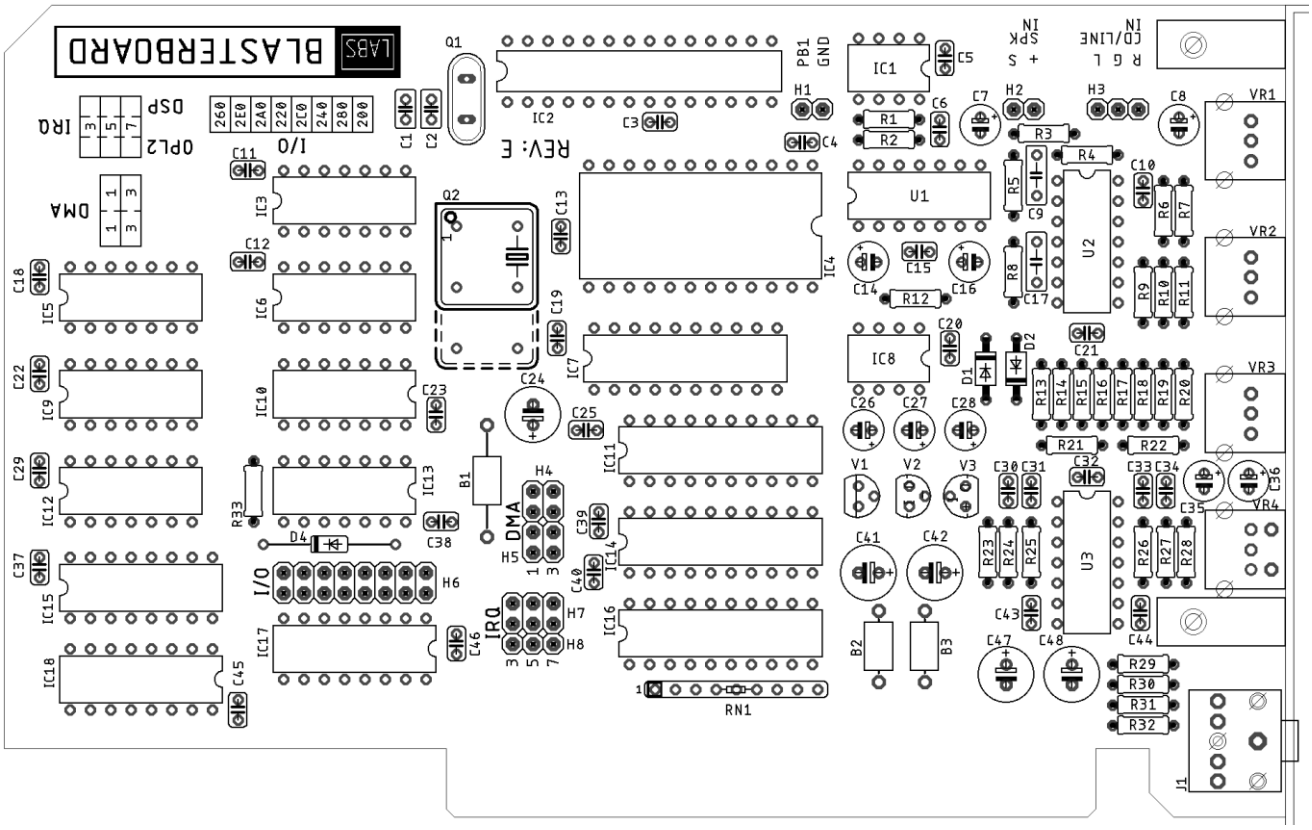
Note that the Atmega328 MCU (IC2) should not be soldered onto PCB directly. A 28-pin IC socket should be soldered first and then the MCU programmed with the latest firmware must be inserted into that socket. This is done so the MCU could be updated with future firmware releases.

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.

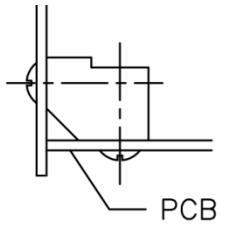


Pic. 1. PCB layout for additional reference.

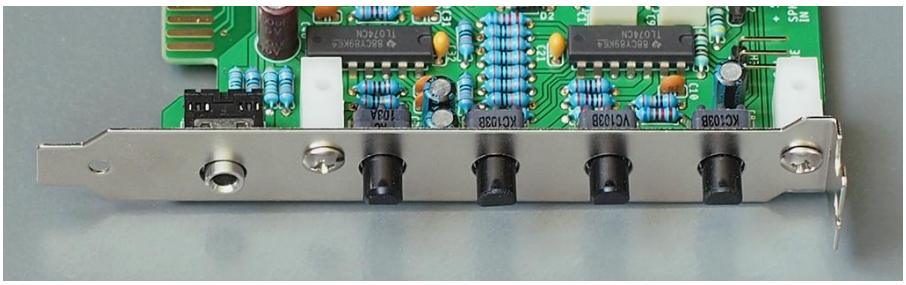
After soldering is completed, thoroughly clean the solder side of the PCB with solvent to remove flux, solder bits and other leftovers. Also carefully clean ISA contacts with a piece of cloth soaked in solvent until there is no dissolved flux left and the contacts don't stick when dry. Inspect your work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

If you have a pre-programmed MCU (comes with Kit 2) – insert the MCU into IC2 socket correctly and skip to the next section.

If you do not have a pre-programmed MCU (Kit 0 and Kit 1), then you should download the firmware and program the MCU yourself. The process of programming the Atmega328P MCU assumes that you have an appropriate hardware IC programmer, programming software and knowledge on how to use them properly.

4.1. Downloading the firmware

The latest firmware can be downloaded from the official BlasterBoard repository:

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

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

`/?.?-current`

You will need 2 files from this folder:

`fuses.bin` – fuse settings for Atmega328P MCU (or see *fuses-pic.png* in the same folder)
`bb-?_?.hex` – compiled firmware in Intel HEX format for the Atmega328P MCU

4.2. Programming the MCU

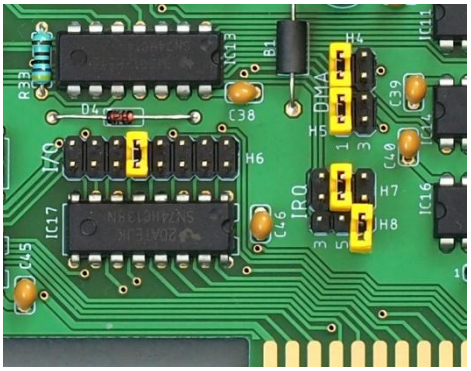
The process of programming the Atmega328P MCU is explained in its datasheet, which can be downloaded from the Microchip website. It also fully depends on your platform and tools you use, so cannot be covered in this document. Please refer to your hardware programmer's documentation about programming the Atmega328P 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 programming experiments and should not be used during normal operation of BlasterBoard leaving IRQ line free for other hardware that could use it.

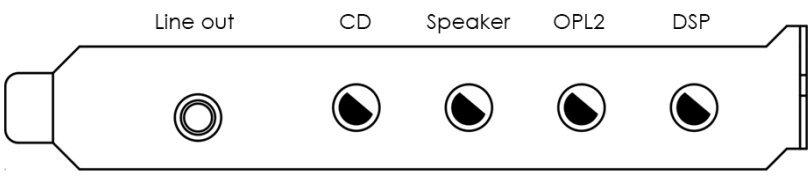
DMA number is selected by setting 2 jumpers together on H4 and H5.



Pic. 3. Hardware settings for I/O port 220, DMA 1, IRQ 5.
Jumper on H8 is not used (floating).

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 output. 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

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