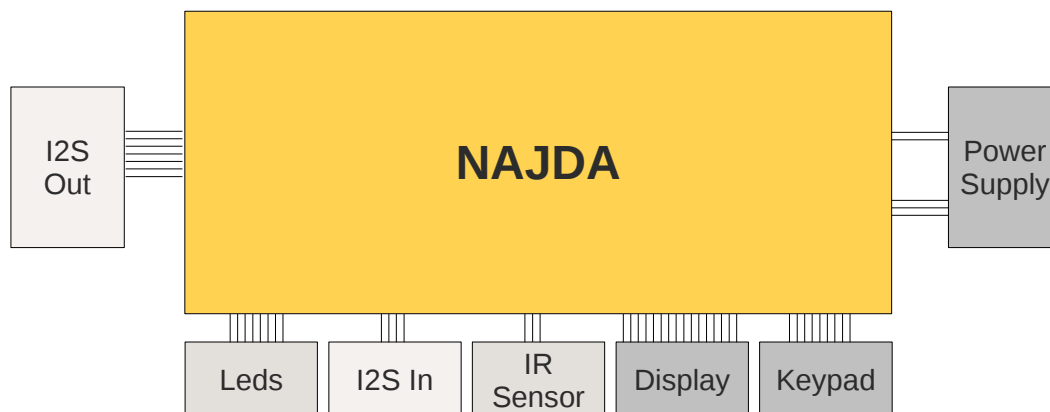


## NAJDA Startup guide FW V1.3

### I. Installing the Board

The figure below shows Najda DSP board surrounded with its peripherals, to be supplied by the user.



Among these peripherals, the Power Supply, the display and the keypad are compulsory. This means that the system will not operate without these three peripherals.

The leds and the IR sensor are optional, but highly recommended. The leds will display important status information, meanwhile the IR sensor will let you command the system with a remote controller.

The I2S In source is optional. A common such a device is a USB audio to I2S converter.

The I2S Out sink is optional as well. This is usually going to be a set of DACs of your own.

A set of 1-page complementary documents are supplied and must be kept at hand while studying the startup guide. They are:

- Appendix A: Board sizes and mounting holes locations
- Appendix B: Power supply wiring, ports location and pins numbering.
- Appendix C: Suggested rear panel layout.
- Appendix D: Rear panel template.
- Appendix E: Standalone menu structure.

No specific electronic knowledge is required for successfully completing a project built around the Najda board, however a general familiarity with electronic concepts will show helpful. If this is your first project, we recommend that you have a trusted and knowledgeable friend assisting you. In case of any doubt, put your project on hold and contact us by email at [support@waf-audio.com](mailto:support@waf-audio.com) or through the support form on our website. We endeavor to get back in touch promptly with clear answers.

Regarding the required toolset, it's advised to keep a multimeter at hand to check your power supply. In order to associate I2S expansions to the board, you will need a soldering iron. We have intentionally left the expansion headers unpopulated so that you can select the type of connectors that best suit your application.

Finally, here are a few general recommendations related to your personal safety and some rules to follow in order to satisfactorily complete the project:

- Unless you power the board from batteries, your power supply will transform the mains supply into those voltages required by the board. Mains supply is lethal. Be extremely careful with all the contacts and wires that expose the mains.
- Always disconnect immediately the power chord from the wall socket if you're having a break.
- Never let anyone approaching your bench when the mains is exposed. Be especially wary with young children and animals.
- Add a fuse to the primary of your power supply so that you limit the current drawn in case of shortcut or erroneous wiring.
- Read carefully the documentation – never attempt to guess. Contact us in case of doubt.
- Double-check your wirings. If the system is not behaving as you would expect, disconnect the power immediately and check again.
- Always turn off the board and pull off the power chord before you make any change to any part of the system.

**Read on further for installation details, and have great care while wiring the peripherals as a mistake at this level will potentially damage the board.**

### I.1. Board Sizes and Mounting Holes.

The board has five mounting holes of diam. 3.5 mm. Please refer to Appendix A for their locations as well as for board sizes.

Six screws can be fitted to your chassis' rear panel in order to secure the RCA jacks. Refer to Appendix C and Appendix D for their locations and for suggested cutouts on the rear panel.

### I.2. Power Supply

Najda requires a 3-output power supply with following parameters:

	Voltage	Recommended current	Minimal current
Output 1	+5 V	1 A	0.5 A
Output 2	+12 V	1 A	0.35 A
Output 3	-12 V	0.3 A	0.25 A

The recommended power supply specifications exceed the requirements for the sole Najda board. This is on purpose so that you can draw current from the expansion ports and supply limited power to external boards (never more than 100 mA per power line 3.3V, 5VD, 5VA, +12V and -12V).

The minimal power supply refers to the specifications that must be met in order to safely power the Najda board alone and the compulsory peripherals – i.e. no current being drawn from the expansion ports. These figures factor in some margin should you select a power-hungry display such as a VFD (typically 130 mA).

The board is equipped with a pair of screw terminal blocks. Connect +5V and GND to the 2-pole block, and -12V/GND/+12V to the 3-pole block. Please refer to Appendix B for the correct wiring and to the markings on the PCB (rev. 1.2).



**Double-check these connections before turning on the power, as incorrect wiring of power supply will result in the board being permanently damaged!**

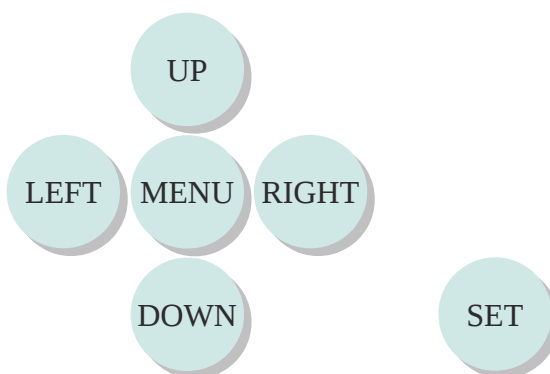
It's always a good idea to colour-code the power supply wires. As an example, we use black colour for both GND wires, red for +5V wire and yellow and orange for the pair +12V/-12V.

### I.3. Keypad Port Pinning

Connect 8 push-buttons to this single-in-line 9-position header. Refer to the table below for the pinning of the keypad port, and to the diagram for wiring details. Debouncing capacitors are provided on the board (100 nF) so that no external components other than switches are required.

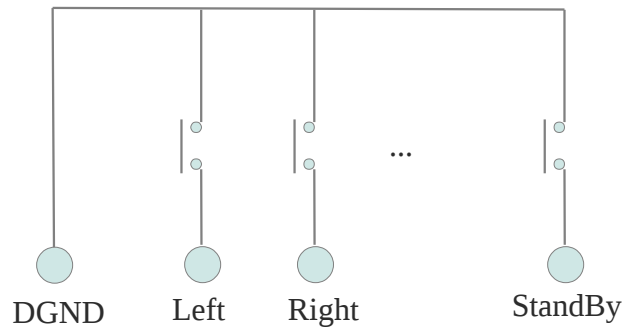
Pin	Signal
1	DGND
2	Right
3	Left
4	Down
5	Up
6	Menu
7	Set
8	Mute
9	StandBy

Because the menu is organized into pages, it's suggested to lay the Left/Right/Up/Down buttons in a cross pattern, with the Menu button located in the center of the cross and the Set button slightly aside, as shown below.



A plausible variation on this layout might be obtained by swapping the Set and the Menu buttons.

The buttons should be wired so that they share the common ground as illustrated below. See Appendix B for pin numbering.



#### I.4. Display Port Pinning

This port is a 16-position 2x8 dual-in-line standard pin header. Refer to the table below for details on how to connect your display. This port is compatible with any 2x16 (2 lines of 16 characters) LCD display based on Hitachi's HD44780 (and equivalents) display driver, as well as with some OLED displays (WS0010 driver) and VFD displays (PT6314 driver). Pick the display of type, size and colour that match best your project.

No external component required other than the display itself.

Pin	Signal
1	DGND
2	+5VD
3	Contrast Adjust*
4	RS (Register Select)
5	R/W (Read/Write)
6	E (Enable)
7	DB0 (Data Bus 0)
8	DB1
9	DB2
10	DB3
11	DB4
12	DB5
13	DB6
14	DB7
15	Backlight +5V*
16	Backlight DGND*

After you've checked that your assembly is operational, you'll need to set the display type used in the Najda Under Control (NUC) application (see the Display Options dialogue in the NUC manual) .

If you decide to run the Najda without any display attached, we strongly recommend you tie a 10 kΩ resistor between DB7 (pin 14) and DGND (pin 1). A led on the backlight power (pins 15 & 16)

\* LCD displays only. Not connected for OLED and VFD displays.

is also a good idea so that you know when the Najda is operating.

### I.5. IR Sensor Port Pinning

Connect optionally a 5V / 36~38-kHz IR receiver module to this 3-position single-in-line header if you wish to use a remote controller. NEC, JVC, Apple and RC5 protocols are supported and the firmware includes a 'Learn' function that will recognize your compatible controller and allow you associating any key to the various commands.

Refer to the table below for wiring details and to Appendix B for port location and pin numbering. No external component required other than the sensor.

The type of IR receiver that you should install depends on the remote controller that you intend to use. NEC, JVC and Apple remotes require a 38 kHz receiver meanwhile RC5 requires a 36 kHz receiver. Note that RC5 will also work with a 38 kHz receiver, although possibly not optimally.

Following 38 kHz IR modules have been satisfactorily tested with Najda: Rohm RPM7138, Vishay TSOP34338, Vishay TSOP38238, Vishay TSOP39338.

Pin	Signal
1	+5VD
2	Sensor out
3	DGND

### I.6. Expansion Port 1 Pinning

This is a dual-in-line 28-position header that currently allows connecting an external I2S stereo audio source – so this port functions as a stereo input only for now – as well as a rotary encoder for controlling the volume. More options will be provided in the future. Please refer to Appendix B for port location and pin numbering, and to the table below for a description of the signals.

In order to connect an external I2S stereo source to Najda, follow these simple steps:

- Your device's Data Out → I2S\_EXT1\_LINE1
- Your device's FSync (or L/R) → I2S\_EXT1\_FSR
- Your device's SCLK (or BCLK) → I2S\_EXT1\_CKR
- Tie IS\_EXT1\ to DGND
- Don't forget to wire the ground, ideally one separate ground line per signal.

Pin IS\_EXT1\ is useful for letting the micro know whether there's an external I2S source on this port. If you don't use such a source, leave this pin open and the micro will not offer I2S Port 1 as an input source option in the menu, thus avoiding the unpleasant pop in your speakers while sweeping across source options.

On the other hand, if you intend to use a I2S source, make sure to tie IS\_EXT1\ pin to DGND otherwise you're not going to be able to select this source.

The source connected to this port acts as the master. All pins described in the connecting procedure above are inputs to Najda. You don't need to worry about sampling frequency as data goes through the sample rate converter.

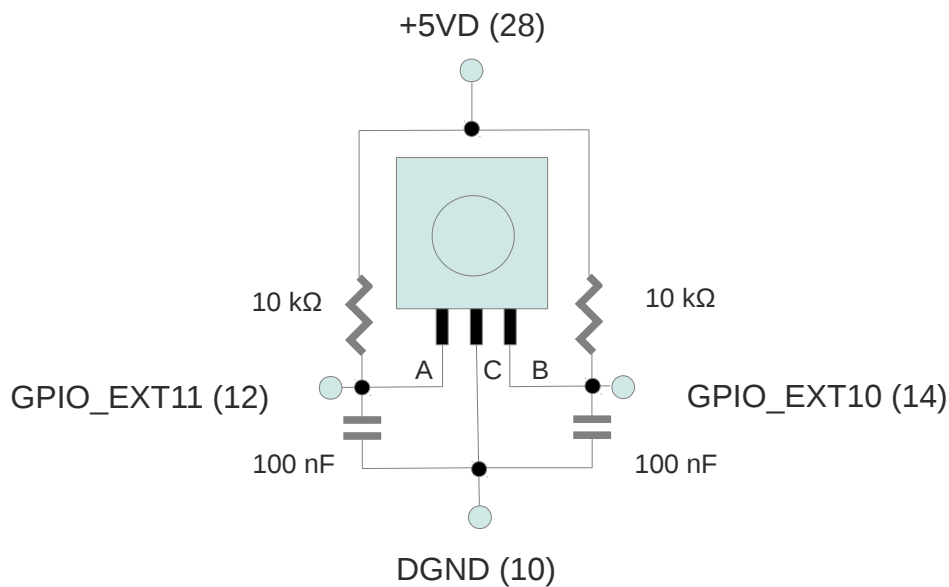
This port is nominally 3.3V TTL and 5V tolerant, so it should cope with the vast majority of I2S sources without the need for any level conversion circuitry.

Data format is the most common, i.e. 64 bit clocks per sample period in 32-bit time-slots, with data aligned to the left.

Pin	Signal	Description
1	I2S_EXT1_LINE1	Audio data pair 1
2	DGND	Digital ground
3	I2S_EXT1_LINE2	Audio data pair 2
4	DGND	Digital ground
5	I2S_EXT1_LINE3	Audio data pair 3
6	DGND	Digital ground
7	I2S_EXT1_LINE4	Audio data pair 4
8	DGND	Digital ground
9	I2S_EXT1_LINE5	Audio data pair 5
10	DGND	Digital ground
11	I2S_EXT1_LINE6	Audio data pair 6
12	GPIO_EXT11	GPIO or I2C
13	IS_EXT1\	Detect expansion board
14	GPIO_EXT10	GPIO or I2C
15	CS_EXT1\	SPI Chip Select
16	MISO_EXT1	SPI Master In Slave Out
17	SCLK_EXT1	SPI Serial Bit Clock
18	MOSI_EXT1	SPI Master Out Slave In
19	I2S_EXT1_FST	I2S Frame Sync Transmit
20	+3.3V	Power supply (out)
21	I2S_EXT1_CKT	I2S Serial Clock Transmit
22	DGND	Digital ground
23	I2S_EXT1_CKR	I2S Serial Clock Receive
24	DGND	Digital ground
25	I2S_EXT1_FSR	I2S Frame Sync Receive
26	DGND	Digital ground
27	EXT_CLK	External master clock input
28	+5VD	Power supply (out)

Expansion Port 1 also allows connecting a wheel (rotary encoder) for controlling the volume. See the diagram below for connection details. Note that, additionally to the encoder, you must provide 2

100 nF capacitors and 2 10 k $\Omega$  resistors.



Power supplies are provided if you wish to power your external device from Najda, however don't draw more than 100 mA from each power line.

### I.7. Expansion Port 0 Pinning

This is a dual-in-line 28-position header that allows connecting up to three I2S external stereo DACs – so this port functions as an output only. Please refer to Appendix B for port location and pin numbering, and to the table below for a description of the signals.

Pin	Signal	Description
1	+12V	Power supply (out)
2	-12V	Power supply (out)
3	+5VA	Analogue supply 5V (out)
4	+5VA	Analogue supply 5V (out)
5	+3.3V	Power supply (out)
6	AGND	Analogue ground
7	SPI_MOSI	SPI Master Out Slave In
8	+5VD	Digital supply 5V (out)
9	FSYNC_DAC	I2S frame sync master out
10	SPI_CLK	SPI Serial Bit Clock
11	DGND	Digital ground
12	BCLK_DAC	I2S bit clock master out
13	DGND	Digital ground
14	MCLK	Master Clock Out
15	DGND	Digital ground

16	BCLK_ADC	Factory use only
17	FSYNC_ADC	Factory use only
18	MISO_EXT0	SPI Master In Slave Out Ext0
19	CS_EXT0\	SPI Chip Select Ext0
20	I2S_EXT0_LINE3	I2S Audio Data Out Pair 3
21	DGND	Digital ground
22	I2S_EXT0_LINE2	I2S Audio Data Out Pair 2
23	DGND	Digital ground
24	I2S_EXT0_LINE1	I2S Audio Data Out Pair 1
25	DGND	Digital ground
26	GPIO_EXT00	GPIO Ext0 Line 0
27	IS_EXT0\	Detect expansion board
28	GPIO_EXT01	GPIO Ext0 Line 1

The voltage level on this port is 3.3V TTL. If your DACs require incompatible voltage levels, you'll need to add your own level conversion circuitry.

Six audio channels are available as three pairs on pins I2S\_EXT0\_LINE1 to I2S\_EXT0\_LINE3.

Any of the ten DSP processing channels can be routed to these lines.

In the present configuration, Najda acts as the master. The L/R (or FSync) clock is available on pin FSYNC\_DAC and the bit clock is available on pin BCLK\_DAC.

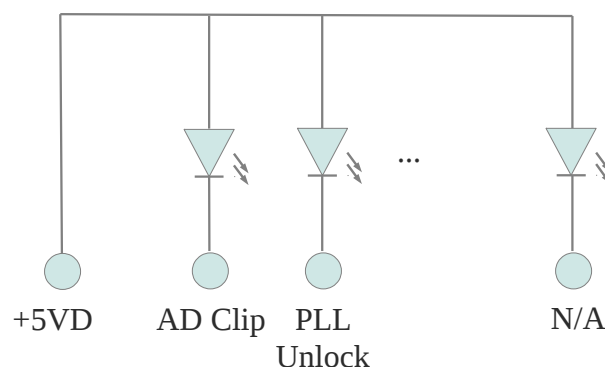
Data format is 64 bit clocks per sampling period, organized in two 32-bit time-slots with msb of 24-bit data aligned to the left. Sampling frequency is the one selected for the master clock (48, 96 or 192 kHz).

Power supplies are provided if you wish to power your external device from Najda. Don't draw more than 100 mA from each power line.

### I.8. Status Leds Port

Up to 7 leds can be connected to this single-in-line 8-position pin-header. Please refer to Appendix B for port location and pin numbering. This port is powered through a high-current line driver and on-board 220  $\Omega$  resistors so you don't need to worry about the current drawn by the leds you've picked. Refer to the table below for the condition that will light on any of the leds.

The figure below shows how to connect your leds to the port. Note that no other external component is required.





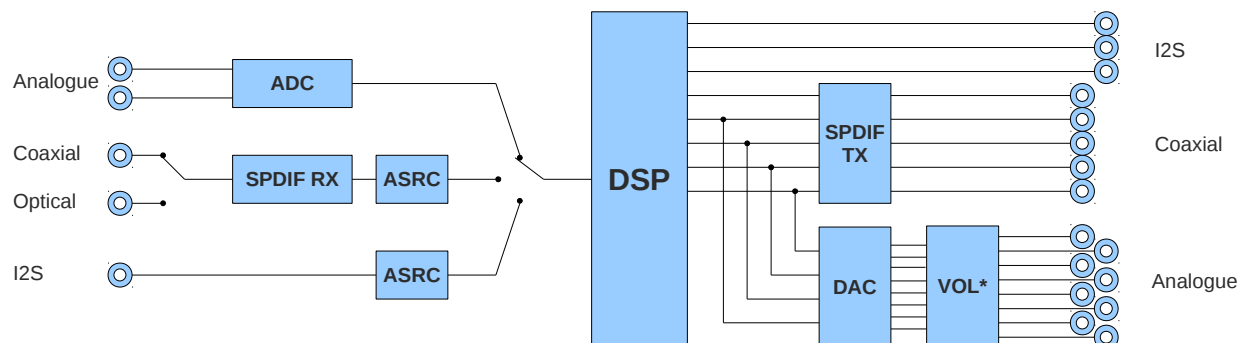
Pin	Signal	Description
1	+5VD	Common anode (+)
2	AD Clip	Analogue input clipping: Attenuate input signal
3	PLL Unlock	Master clock PLL unlocked: Should not happen permanently
4	SPDIF Lock	SPDIF receiver can extract a suitable clock from the supplied SPDIF stream
5	Bass/Treble Clip	Clipping in Bass/Treble section: Increase headroom
6	Output Processing Clip	Clipping in Output Processing section: Lower gains – check coefficients
7	Input Processing Clip	Clipping in Input Processing section: Lower gains – check coefficients
8	DSP Overload	Processing strategy exceeding DSPs capabilities – reduce number of taps or filters.

### I.9. Other Ports

Two debugging ports are present onboard, one for the micro (DEBUG uC) and one for the DSP (DEBUG DSP). These ports are not described in this document and must remain unconnected.

## II. Ins and Outs

The figure below shows the audio signal's electrical path. The Volume chip Vol\* is optional.



### II.1. Analogue Ins

Najda features one analogue stereo input, whose signal is sampled at the rate set as central processing rate, which is one of 48, 96 or 192 kHz.

Nominal input level is  $1 V_{RMS}$ . A larger input signal will clip at AD conversion stage and the AD Clip led will light on.

### II.2. SPDIF Ins

Najda can handle both coaxial and optical SPDIF inputs. The SPDIF Lock led will light on when the supplied stream is suitable for clock extraction and audio data decoding.

Data coming in through the SPDIF receiver passes across the sample rate converter so you don't need to worry about the signal's sampling frequency. Note that there's no guarantee that the receiver will lock onto an optical signal at a rate higher than 96 kHz, and that the coaxial input is not isolated.

Please also note that there's only one receiver onboard. An analogue switch controlled by the micro will route one of the optical or coaxial input to the receiver.

If the SPDIF stream is tagged as Compressed (i.e. non-PCM) in the Channel Status, the DSP will zero the inputs.

### II.3. Analogue Outs

Eight analogue outputs are available.

Nominal output level is  $1 V_{RMS}$  if the board doesn't feature the optional analogue volume chip. If the latter is present, then the output level can be adjusted up to  $6 V_{RMS}$  in  $0.5 V_{RMS}$  steps. This is especially helpful for compensating for headroom introduced in the digital path (for example, if you set 6 dB of headroom in the DSP in order to make sure that processing won't clip the audio, then you can add 6 dB of gain back in the analogue domain and recover  $1 V_{RMS}$  of output level).

Volume control on Analogue Outs is available regardless of whether the analogue volume controller chip is installed.

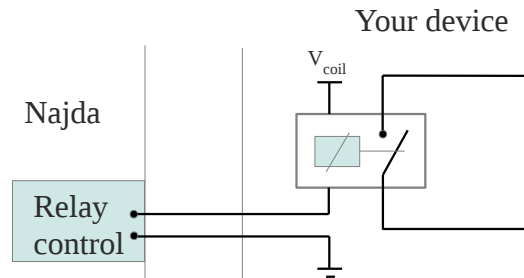
### II.4. SPDIF Outs

Najda features ten transformer-isolated coaxial SPDIF outputs in five stereo pairs. Volume control is not available on these outputs.

## II.5. External Relay Command

Najda can control an external relay through its dedicated isolated port. This feature has been devised to connect and disconnect your speakers from your power amps – but it can be used to control any external electrical equipment.

Below is a simple application using a hypothetical SPST relay.



## II.6. USB Port

This port is only suitable for controlling Najda with the PC application. You cannot stream audio via this port.

If you wish to stream audio data from the USB port of a player such as a PC, use a device that transforms a USB audio stream into a I2S stream and connect that device to Expansion Port 1 as described in Section I.6.

## III. Operating Najda Standalone

In order to create a Preset (i.e. a collection of DSP processing parameters), you need to connect the PC control application to the board. In any other circumstance, Najda can operate standalone. This section sums up the features available in standalone operation.

Functions 1 to 6 enumerated below are accessible by pressing a keypad's button or a remote controller button. The remaining functions are available in the menu.

Preset and Source change require to enter the menu – but they may also be assigned to remote controller buttons. See the details further below.

### III.1. StandBy

Press this button to turn on or put the board in stand by mode. Before the board goes in stand by, the micro must complete a certain number of operations, among which storing all the settings (volume, balance, source etc) in the EEPROM, so always end your listening session by going into stand by. Don't take the power off the board unless Najda is already in Stand By mode otherwise you will loose your settings.

### III.2. Mute

Press this button to mute the analogue outputs. SPDIF and I2S outputs are not affected.

### III.3. Volume

From the main screen, press the Up or Down button – or the assigned remote controller buttons – to set the volume to your liking, in the range 0 dB to -96 dB in dB steps. Volume doesn't affect SPDIF and I2S output levels.

### III.4. Bass

From the main screen, press the Left button, then press the Up/Down buttons to adjust the amount of bass – or press the assigned remote controller buttons. Bass is adjustable in dB steps in the range -6/+6 dB. This function implements a low frequency shelving filter whose corner frequency is adjustable in the PC application. Headroom adjustment is also available. Bass and Treble can be disabled in order to save DSP resources.

### III.5. Treble

From the main screen, press the Right button, then press the Up/Down buttons to adjust the amount of treble – or press the dedicated remote controller buttons. Treble is adjustable in dB steps in the range -6/+6 dB. This function implements a high frequency shelving filter whose corner frequency is adjustable in the PC application. Headroom adjustment is also available. Bass and Treble can be disabled in order to save DSP resources.

### III.6. Balance

From the main screen, press the Set button, then press the Left or Right button to adjust channel balance in dB steps – or use the Balance Left/Right buttons on your remote controller. You can attenuate one of the channels down to -15 dB in dB steps.

### III.7. Menu

From the main screen, press the Menu button to enter the menu. Press the Left or Right key to navigate through the menu pages and locate the item you wish to modify, and use the Up and Down keys to scroll through the available options. Then press the Set button to validate the current option or press Menu again to exit the menu and discard the change. Refer to Appendix E for the menu structure diagram.

### *Source Select*

Allows selecting the input source. This command is also available from the remote controller. Source Exp1 (I2S) is available only if pin IS\_EXT1\ is tied to DGND (see section I.6).

### *Preset Select*

Allows selecting a processing preset. This command is also available from the remote controller. Najda has memory space provision for up to nine presets. If - say - only three presets have been stored into the board's memory, then only three options will appear under this menu item. There must always be at least one preset in the board's memory (the PC control application will not let you deleting all of the presets). Preset names are user specified (up to 13 characters).

### *IR Remote Ctrl*

This menu item will start the IR Remote learn procedure. Select the protocol of your controller (NEC, JVC, Apple and RC5 supported), then follow the instructions on the display. The procedure will first identify the controller's address, then subsequently collect your controller's key codes for each of the commands available.

If you don't want to use a command with your remote (for example because your controller has less buttons than the number of commands available), you can choose to skip that command. You can anytime cancel the routine by pressing the Left keypad button and start over again. Refer to the instructions on the display.

Following are a few recommendations, some of these should be pretty obvious.

- While you run the Learn Ir procedure, press the controller's keys once when requested.
- Don't select the same controller key for different commands.
- Press only one key at a time.

Below is the list of commands available for the remote controller:

- Stand By
- Mute
- Volume +/-
- Preset +/-
- Source Next (one single command for selecting next available source)
- Source Analogue / Coaxial / Optical / Expansion 1 (individual commands)
- Preset 1 → Preset 9
- Bass +/-
- Treble +/-
- Balance L/R

When the routine has gone through the list of commands, the screen displays *Protocol Capture Completed* and the board is ready to receive commands from the remote controller.

### *Relay Timer*

Lets you set a delay after which Najda will command the external relay on when coming out of Stand By mode. The relay is turned off immediately when Najda enters Stand By mode.

### *Display Mode*

With a LCD display, you can choose to have the backlight *Always ON*, *Always OFF* or *Auto OFF*. In the latter mode, the backlight turns on every time an event occurs (button press or remote

controller command) and turns off automatically after 2 seconds of inactivity.  
With OLED and VFD displays, only the *Always ON* and *Auto OFF* options are available.

#### *LCD Contrast – VFD Brightness (not available with OLED displays)*

For LCD displays, this menu item offers 12 levels of contrast so that you can optimally adjust the contrast for that particular LCD display you've picked.

For VFD displays, the menu item lets you select among 4 levels of brightness.

OLED displays don't feature any contrast or brightness adjustment. As a consequence this item is not available in the menu when an OLED display has been selected.

This menu item has a couple of peculiarities. One is that it does not wrap around when you have reached the minimum or maximum contrast / brightness. The other is that the setting is remembered whether you press the Set or the Menu key to exit the menu. This is because Najda expects that you won't leave the menu until you're happy with the settings.

#### *Wake Up Host*

If Najda is connected to a computer that's hibernating or in Sleep mode, taking Najda out of Stand By mode will also wake up the computer. Note however that you should not let a connected computer go into sleep mode while the control application is active.

#### *Volume Control*

By default, volume is adjusted by pressing the Up and Down buttons. Volume can also be controlled via a rotary encoder connected to Expansion Port 1 if the appropriate hardware is installed and if this menu option is set accordingly. See Section I.6 for details.

## IV. Testing Your Project Build

Have you read through the whole StartUp Guide (this document)?

Have you double-checked your wirings?

If yes, then you're ready to test your project. We advise that you leave I2S expansions out of the way the first time you turn on the system. Making sure the main external components are properly installed and configured is absolutely essential.

The board comes out of the box with three factory presets pre-loaded: *Pass Thru 48*, *Pass Thru 96* and *Pass Thru 192*. They are simple pass-through of respective sampling frequency 48 kHz, 96 kHz and 192 kHz, allowing you to test your assembled device and its interaction with external components before you're getting to the stage of running the PC application. Although the board can already output audio, we recommend that you leave the Ins and Outs unconnected for now.

Press the StandBy button (a long press is required, about half a second). A welcome screen will appear on the display and show the firmware version number, then after two seconds you should see the 'root screen' which displays the preset currently running (*Pass Thru 48*) and the active source (*Source Analogue*). Also, the PLL Unlocked led will briefly light on – this is normal and expected when you turn on the system.

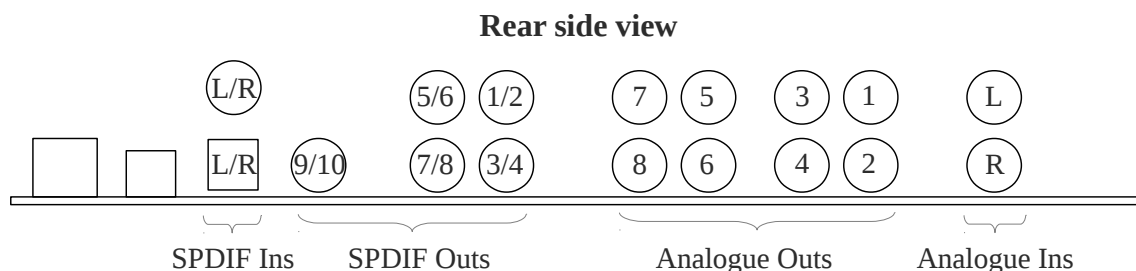
Nothing of the above is happening?

Sense delicately with your finger the heat dissipated by the chips and the peripherals. If a component is getting hot, turn off the power immediately (don't even bother going into Stand By mode, just pull off the power chord) and check again your wiring. The LCD screen and the IR sensor must run cool, as do all chips onboard except the optional analogue volume controller (CS3318), the AD/DA converters (CS42428) and the three linear voltage regulators located next to the screw terminal blocks.

If nothing is hot, then there's probably no power. Get your meter and check the readings on the screw terminal blocks. Refer to Appendix B.

Hopefully you didn't encounter any issue and the system is running by now. Allow you some time to gain familiarity with the hardware and the menu. Connect sources and speakers. Keep the volume low so that you take no chance of damaging your speakers or – much worse – your hearing. Audio routing of the factory presets is as follows (please refer to the diagram below):

- Input L → Outs 1, 3, 5, 7, 9
- Input R → Outs 2, 4, 6, 8, 10



All the commands described in this section are operational (Volume, Mute, Bass/Treble etc). The sampling frequency of the preset is going to reflect on the SPDIF and I2S outputs (so for example if you activate the *Pass Thru 96* preset, then the SPDIF outs will output a 96 kHz SPDIF stream).

Run now the IR learn procedure and install your I2S expansions if any. Then test it all again.

Congratulations for your hard work!

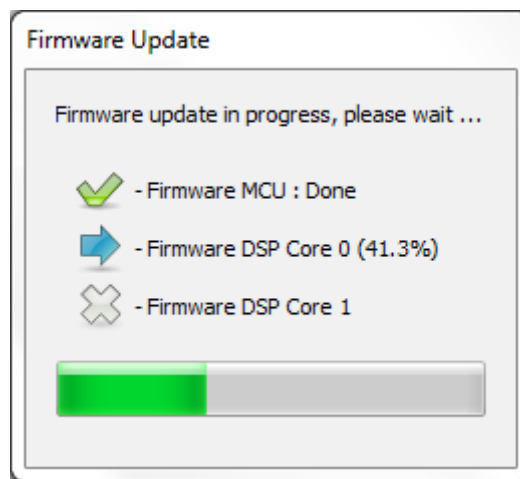


## V. Connecting Najda with the PC Application

Once that you've successfully run Najda in standalone, you can connect the board and the PC application in order to access processing parameters and create your own configuration files.

Connect a USB cable between the board and your PC, then launch the application “Najda Under Control” downloaded from our website. Select *File* → *Connect* or alternately use the shortcut *Alt-C*. That's it: connection is established. Please note that the keypad and the IR module are disabled while Najda is connected with the application.

We intend to supply regularly software updates so that we can offer more processing options. If your board's firmware version is outdated, a dialogue will invite you to proceed with firmware update, after what a window like the one below will pop-up on your PC screen.



Update procedure can last up to two minutes. During this time, **don't unplug the power supply and don't pull off the USB cable**. If you disconnect power or USB during update process, chances are that the board will not boot anymore and you will have to send it back to us. When update has completed, the board is ready to communicate with the PC again: set now the type of display that you have installed in the Display Options dialogue.

For more information on the control application and the processing options, please refer to “Najda Under Control” Software User Guide.

## VI. Customizing Hardware

Onboard opamps are mounted on sockets so that you can easily swap them with your favorite model. We have chosen the LM833 for its excellent performance to price ratio. If your budget is flexible and you believe the rendering could benefit from a different opamp model, feel free to replace these chips. Make sure to insert the new opamps with correct orientation.

With the same aim for allowing flexibility in selecting components on the analogue path, all the big audio capacitors are through-hole components so that you can easily replace them with your favorite model. Unlike opamps swapping, you will need here a soldering iron. See the silkscreen marks for the recommended capacitance values and for correct mounting orientation.

Before you replace opamps and/or capacitors, make sure to turn off the board and unplug the power chord.

## Document/Firmware revision history

<b>Version</b>	<b>Changes</b>	<b>Date</b>
V 0.1	Preliminary	FEB 2013
V 0.5	Added DSP Overload led	APR 2013
V 0.6	Added individual IR keys for each source Added Apple remote support	MAY 2013
V 1.0	Official release – no change	OCT 2013
V 1.1	Added volume rotary encoder	DEC 2013
V 1.2	Added RC5 remote support Added OLED and VFD support	APR 2014
V 1.3	Display bug fix	MAY 2014

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