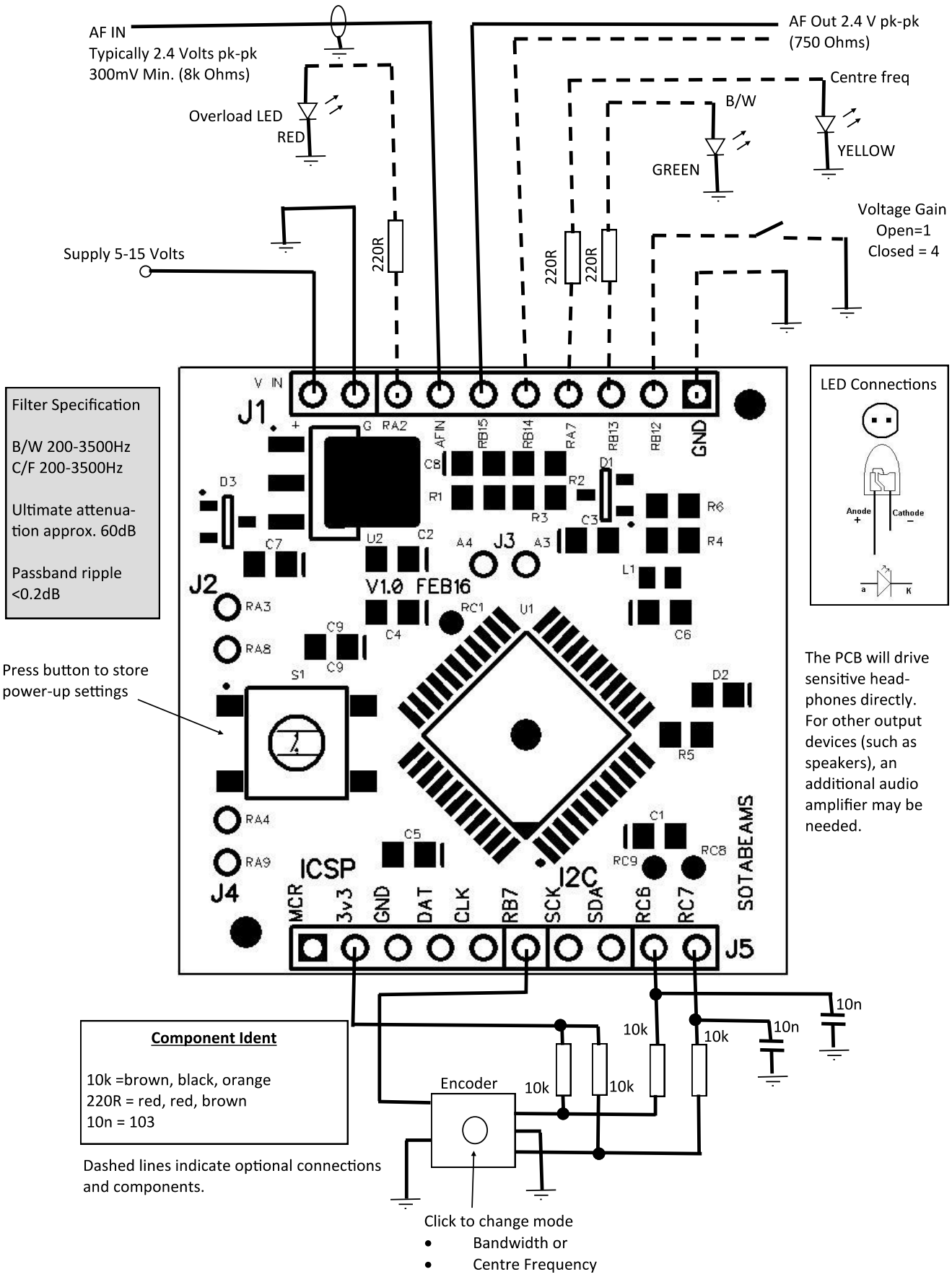


Laserbeam Vari Filter Module



Connections to the module

All the power, audio, and control connections to the Laserbeam variable filter module are made to connectors J1 and J5 (the two rows of 10 pads, along each side).

Each connector is numbered starting from the square pad - marked GND on J1, and MCR on J5. You can either solder strips of standard header pins into J1 and J5 or solder wires directly to them.

Connector J1

Pin	Designation	Comment
1	GND	Ground. Try to use a single ground point for all circuits.
2	RB12	Voltage Gain. Leave open for Voltage gain = 1 (recommended for most applications), connect to ground for Voltage gain = 4. Note this setting does not affect the maximum output level, it just sets the size of input signal needed to achieve full output.
3	RB13	Encoder mode output, bandwidth. Optional. Suggested connection: LED to ground with 220 ohm series resistor. This will output 3.3V if turning the encoder will adjust the filter's bandwidth, and 0V otherwise.
4	RA7	Encoder mode output, centre frequency. Optional. Suggested connection: LED to ground with 220 ohm series resistor. This will output 3.3V if turning the encoder will adjust the filter's centre frequency, and 0V otherwise.
5	RB14	AF Out 1. DC coupled differential output, used in conjunction with AF Out 2. If driving earbuds connect AF Out 1 to the left earpiece pin and AF Out 2 to the right earpiece pin. Leave the ground on the earbuds floating. One output can be used for single input amplifiers. Maximum output approx 1.2 V pk-pk. Most audio ICs (e.g. LM380N, LM386, TBA820 etc.) can be used as differential amplifiers. In general using both outputs as a differential pair will give best results. A suggested circuit diagram can be found towards the end of these instructions.
6	RB15	AF Out 2. See above.
7	AF IN	Single ended audio input. 2.4V pk-pk max. Input is AC coupled and is protected from excessive levels.
8	RA2	Overload LED. Suggested connection: LED to ground with 220 ohm series resistor. This optional LED is used to help you get the best input levels for using your Laserbeam Filter. Adjust input to just below the point where the LED lights on signal peaks. This LED is optional. A second Overload LED is mounted on the PCB. Occasional lighting of the LED while the filter is in use is acceptable.

9	G	Ground
10	V IN	Power input, requires between +5 and +15 Volts DC, current draw is typically around 50 mA.

Connector J5

Pin	Designation	Comment
1	MCR	Not used, leave disconnected.
2	3V3	+3.3V power output. Encoder pullup resistors should be connected to this as shown in the diagram at the start of these instructions.
3	GND	Ground
4	DAT	Not used, leave disconnected.
5	CLK	Not used, leave disconnected.
6	RB7	Input for toggling encoder mode. The push switch in the encoder should be connected between this pin and one of the ground pins. Alternatively you could use a separate push button (not supplied). An internal pullup to 3.3V is enabled on this pin. Short circuit this pin to ground momentarily, to switch between adjusting centre frequency and bandwidth.
7	SCK	Not currently used, leave disconnected.
8	SDA	Not currently used, leave disconnected.
9, 10	RC6, RC7	Rotary encoder input. Connect to the encoder as shown in the diagram at the start of these instructions. This is a standard quadrature (2-bit Gray code) signal pair, as commonly used in incremental rotary encoders.

Components mounted on the module

Designation	Comment
S1 - button	Press to save the current filter settings as the power-up default.
D2 - overload LED	This will light up red when the signal level is too large. It can be used to help you get the best input levels - adjust input to just below the point where the LED lights on signal peaks. Occasional lighting of the LED while the filter is in use is acceptable. (See also RA2 on connector J1)

All ground pins on the module are internally connected to each other.

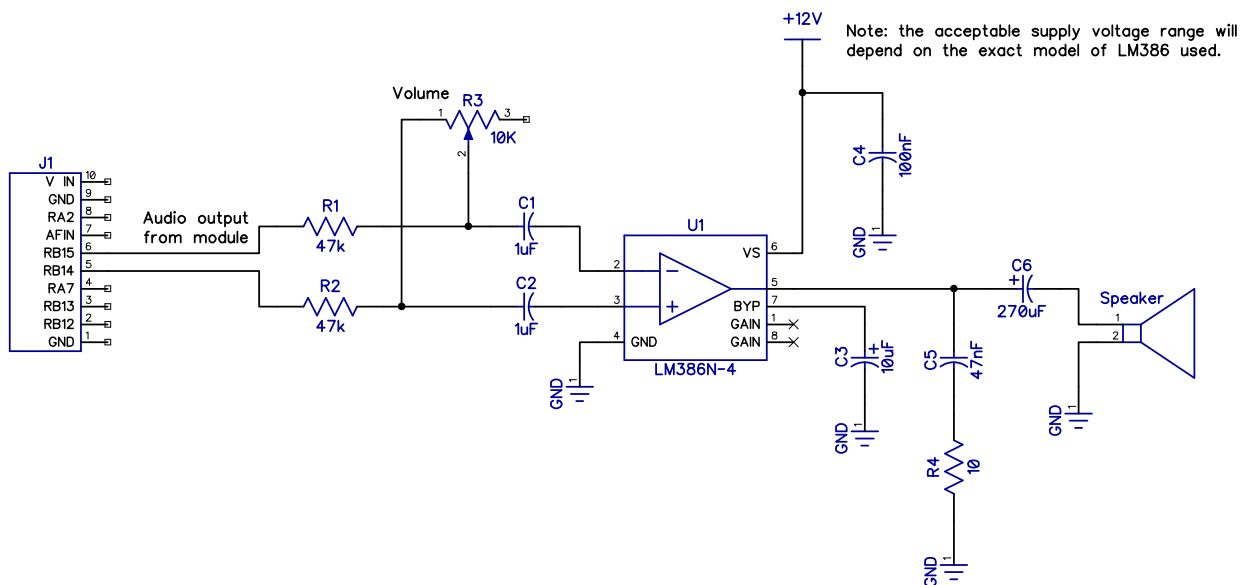
Using the Laserbeam-Vari

A single clickable rotary encoder provides the main functionality, allowing you to adjust the filter passband. Press the encoder to switch between adjusting variable bandwidth or centre frequency. LED outputs are provided to indicate the current adjustment mode (see connection instructions above for details).

The Laserbeam filter board will provide sufficient output to drive sensitive earbuds directly. The levels are adequate for operating in a quiet environment.

The Laserbeam filter has a differential output. Almost all audio amplifier ICs are suitable for a differential input, although many pre-made amplifier modules do not connect them up in that way and only allow a single-ended input.

A possible amplifier circuit with differential input is shown below.



Notes for controlling the filter from a microcontroller

Although there are some pins on connector J5 reserved for an I2C connection, these are currently unused.

At the moment, the only way of controlling the Laserbeam variable filter automatically is by simulating encoder pulses, and generating/reading signals on the other pins as required (for example, checking RA7 and RB13 to determine the current encoder mode, and momentarily grounding RB7 to toggle between encoder modes).

The encoder step size varies based on the current value.

Centre frequency / Hz:
200-2000: step size 25
2000-3500: step size 50

Bandwidth / Hz:
200-400: step size 20
400-700: step size 50
700-3500: step size 100

So for example, the available values for centre frequency are:
200, 225, 250 ... 1950, 1975, 2000, 2050, 2100 ... 3400, 3500

One step = one cycle through all 4 Gray code states of the two encoder pins RC6+RC7.

Both centre frequency and bandwidth are limited to 200-3500 Hz.

The filter passband edges are also limited to 200-3500 Hz. The upper and lower edges are calculated based on centre frequency and bandwidth, then limited to 200-3500 Hz, before being used to generate the filter coefficients. So:

- centre=200 and bandwidth=200 would result in a passband of 200-300Hz.
- centre=300 and bandwidth=200 would result in a passband of 200-400Hz.

There is no way of setting upper and lower edges directly, they have to be controlled via centre frequency and bandwidth.

Factory default settings are centre=1500, width=2400, adjustment mode=centre. The current values of all three of these are saved when the button on the module is pressed.