

## RAKK Active Output Impedance and Gain

The RAKK Active Output stage has a wide range of gain, input impedance and output impedance that the user may choose from to best meet his needs. The output impedance and part of the gain is switch selectable for convenience. If the RAKK Active Output is being used as a preamp, the input impedance and part of the gain also can be selected with switch settings. When used as a DAC output stage, part of the effective gain may be adjusted by changing the size of the input current-to-voltage (I/V) resistors.

### Output

Here is the affect of the gain switches on the output board:

Gain Switch	Gain	Output impedance
High gain	-12dB	350Ω
Low gain	-18dB	100Ω

### Preamp Input

The line-level inputs are galvanically isolated with transformers. The winding ratio of the transformers may be selected as either 1:1 or 2:1 which sets the gain and input impedance of the circuit. The type of volume control used will also affect the maximum gain. Conventional wisdom has it that the input impedance must be very high – the higher the better – for the best sound. That may be true for some older circuits; however the RAKK Active Output is optimized for best sound with a low input impedance. To achieve the high input impedance, the older circuits would use a 50K, 100K, or even 250K volume control on the input. The RAKK Active Output is designed to use a 10K volume control. An ordinary 10K potentiometer or stepped attenuator will work fine as a volume control; however Kevin Carter has designed a special 10K stepped attenuator (the K&K Audio attenuator) especially for the input configuration used by the RAKK Active Output. The difference is that an ordinary volume control will insert a minimum of 6dB attenuation, while the K&K attenuator will insert a minimum of 0dB attenuation, which allows for twice the range for controlling the volume.

Here is how the combination of the gain switches on the main board, with a volume control, affects the gain and input impedance:

Gain switch	Volume Control	Gain	Input impedance
High gain	10K	-6dB	10K
High gain	K&K	0dB	10K
Low gain	10K	-12dB	40K
Low gain	K&K	-6dB	40K

## Dac Input

The gain switches on the main board do not affect the DAC input. However, as with the preamp input, the type of volume control does affect the gain. The input impedance is directly determined by the size of the input resistors.

Volume Control	Gain	Input impedance
10K	-6dB	91Ω
K&K	0dB	91Ω
None	0dB	91Ω

The size of the I/V resistors does not affect the gain of the circuit; rather, it sets the level of the input signal voltage. The size of the I/V resistors supplied with the kit (91Ω) was chosen to provide 2VRMS output. This is with 0dBFS input to the RAKK dac, no volume control and the gain switches on the output board set to High Gain. The output level may be increased or decreased by changing the size of the four I/V resistors (R1 – R4). The result is a linear ratio: for example, if you changed the resistors to be 75Ω, the ratio is  $75/91 = 0.82$  and therefore the output voltage will be  $0.82 \times 2VRMS = 1.65VRMS$ .

The size of the I/V resistors can be anything less than 91Ω; however there is a limit to going larger than 91Ω. At some point the voltage on the RAKK dac will be insufficient to drive a large resistor; however you will notice audible distortion way before you reach this point. For best results, the size of the I/V resistors should be limited to 100Ω.

## Complete Active Output

The gain base of the amplifier is approximately +24dB, which is added to the gains chosen for the input and output sections.

For a preamplifier, the total gain ranges from a high of +12dB (24 -12 +0) to a low of -6dB (24 -18 -12). This range should satisfy the vast majority of audio systems. The same gain setting can be obtained by different combinations of choices and the final choice of settings should be made by listening evaluation.

For a DAC output, the total gain is not important; rather it is the output voltage that is important. The gain should be set as high as possible and the size of the I/V resistors should be as small as possible.

For an Active Output that has both line-level and DAC inputs, set the gain to accommodate the line-level inputs and then adjust the size of the I/V resistors for the desired voltage. As long as the resistors are 100Ω or less, you are all set. If it turns out the I/V resistors need to be larger than 100Ω then you will need to increase the gain of the output section and decrease the gain for the line-level inputs.