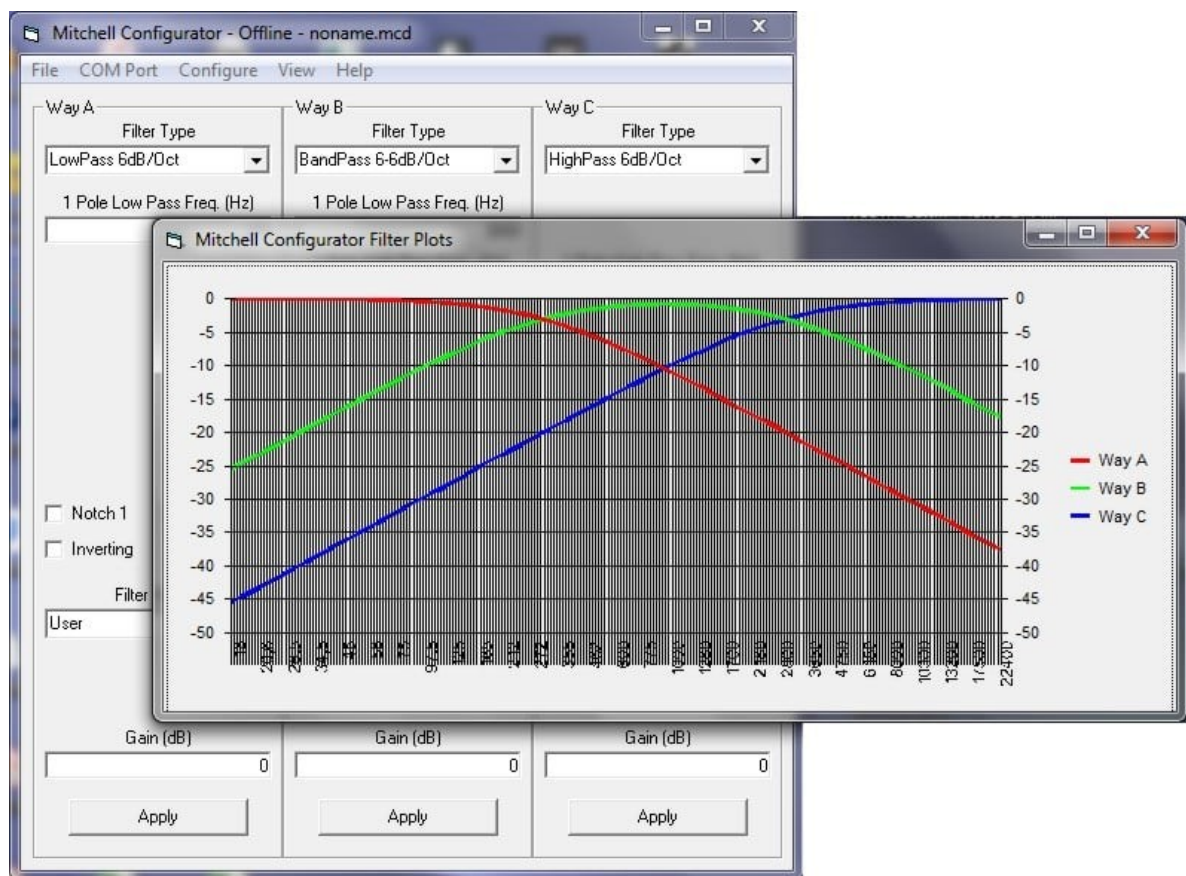


# M2TECH

## MITCHELL CONFIGURATOR

CONFIGURATION SOFTWARE

### USER MANUAL



REV. PRB – 3/2021



**WARNING:** The information contained in this manual is believed to be reliable and accurate. M2Tech reserves the right to change or modify this information in any time, without notice. We kindly ask our customers to make sure that are consulting the latest version of this manual.

Dear Customer,

thank you for purchasing MITCHELL. You are in possession of a very high quality analog electronic crossover with many unique features, designed to achieve the best performance in combination with every M2TECH product.

MITCHELL implements a number of unique technological and functional solutions, from highly versatile filter modules to high quality active and passive components, to complementary configuration software that facilitates the configuration process.

MITCHELL offers a wide range of configuration options that allow you to tailor it to the most demanding setup. Full analog operation prevents detriment of sound quality and artifacts affecting the sound of digital crossovers.

Although MITCHELL can be effectively configured through a command line terminal using the simple language designed for this purpose by M2TECH, it is much simpler and faster to use the special configuration software, available for Windows environment, called "MITCHELL CONFIGURATOR", of which this document is an instruction manual.

Marco Manunta, CEO

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## 1. Software Installation

Download the installation package from M2TECH website, from the following link:

<https://lnx.m2tech.biz/wp-content/uploads/2021/01/Mitchell-Configurator-Install-1.0.0.zip>

Since the USB communication between MITCHELL and PC is based on an interface IC by FTDI, it is necessary to download the driver for the latter, from FTDI site, unless it has already been previously installed on the chosen PC to support another product equipped with the same chip:

<https://ftdichip.com/drivers/vcp-drivers/>

Choose the one for 32-bit or 64-bit system depending on the version of Windows installed on your PC.

After installing the FTDI driver, unpack the M2TECH zip package in a temporary folder and launch the setup: in a few minutes the software is installed on your PC.

For any installation problems, you can contact us by e-mail at [support@m2tech.biz](mailto:support@m2tech.biz) or by phone at +390500984056.





## 2. Main Window



Figure 1

Let's launch the application by double clicking on the related icon that can be found in the list of installed programs. A window like the one shown in Fig. 1 will appear.

It is characterized by four specific areas:

- 1) the frame called "Way A", which refers to the configuration controls of the crossover way A (the same for both the Left and Right channels);
- 2) the frame called "Way B" (as above for way B);
- 3) the frame called "Way C" (as above for way C);
- 4) The top menu.

**NOTE: at launch, the MITCHELL CONFIGURATOR is set up to configure the crossover in stereo, therefore all settings applied to each way will be applied to both the Left and Right channels of that way. We will see later how to make the two channels of each way independent of each other.**

**WARNING: at startup, the program does not show the active configuration in the crossover, even if it is connected with its USB cable to the PC: this is because communication between the MITCHELL interface and that of the PC is not yet enabled.**

Let's analyze the controls contained within a frame. Some of them are always visible and active, others are always visible but not always active, still others are visible only when they are useful or when it is possible to use them (this may depend on the chosen configuration).

## 2.1. Filter Type

Starting from the top, we immediately find the "Filter Type" drop-down menu. It allows you to choose which configuration to apply to the route in question. It is always visible and always active, except when the via in question is connected in cascade with the via on its left to create more complex filter configurations (See 5.3 – 5.5). Numerous configurations are available that allow you to create high-pass, band-pass, high-pass, attenuate-band, boost-band, notch and all-pass filters, in various combinations.

By choosing a particular configuration, the controls functional to it are activated and made visible under it.

In the example in Fig. 1, the low-pass configuration at 6dB/oct without full-pass and without notch was chosen for way A. For this reason, only the control relating to the low-pass block of the first order of that street appears under the "Filter Type" drop-down: the other blocks do not appear because they are not functional to the configuration. However, they are available for other functions (for example to create notch filters).

## 2.2. Filter Design

Skipping the area below the "Filter Type" drop-down menu for the moment, we scroll through the frame area until we find another drop-down menu called "Filter Design". It allows, at the user's will, to automatically design a filter. There are four possible choices:

- 1) User (the user manually sets the cutoff frequencies and Q's of the individual filter blocks);
- 2) Butterworth;
- 3) Chebishev;
- 4) Bessel.

**NOTE: it is possible to manually create second or fourth order Linkwitz-Riley filters by simply selecting the desired order configuration and setting the Q of the SVF filters (see paragraph 2.5) to 0.5.**

**NOTE: MITCHELL does not allow to create filters with finite zeros, so it is not possible to implement elliptical filters and in general filters whose suppressed band performance must be specified.**

See chapter 7 for further details on the use of this control.

## 2.3. Gain

The third control allows you to adjust the gain of the channel, between -111.5dB and 31.5dB in 0.5dB steps. This allows to equalize the average emission levels of the various channels according to the sensitivity of the drivers and the gain of the amplifiers used without having to resort to passive attenuators. It also allows you to compensate for any low sensitivity of the amplifiers so as not to exceed the level produced by the preamplifier upstream of the MITCHELL, thus avoiding saturation and excessive distortion of the various filter blocks placed on the signal path.

## 2.4. Apply

This button allows you to send the configuration composed in the relative frame to MITCHELL. By clicking on this button, the software sends various command strings (in a completely transparent way to the user) with the chosen configuration and the values of the cutoff frequency and Q of the blocks used. This takes place after disconnecting the outputs in order to avoid annoying and dangerous (for the loudspeakers) switching noises. At the end of the sending, the outputs are reactivated.

## 2.5. Filter Blocks

As explained in the MITCHELL manual, to which we refer for the technical details, each way has various modular filter blocks:

- 1) a low-pass at 6dB/oct (ie one pole);
- 2) a high-pass at 6dB/oct;
- 3) an all-pass;
- 4) two state variable filters (SVF) configurable as 12dB/oct high-pass (two poles), 12dB/oct low-pass or notch.

For the first three blocks it is possible to specify the cutoff frequency (for the full pass it is the frequency for which the phase shift is equal to 90°), for the two SVF it is possible to specify the cutoff frequency and Q.

As said before, each of these blocks is visible and therefore usable only when the chosen configuration uses it. For way A of Fig. 1 only the one-pole low-pass appears as it has been chosen to create a 6dB / oct low-pass filter.

**NOTE: SVF filters not used in a certain configuration are obviously not visible as such, but "reappear" in the form of a notch, which can be selected at the user's will. When a notch filter is selected, its frequency and Q values appear and become active.**

**NOTE: for all configurations in which neither the one-pole high-pass nor the one-pole low-pass is present, it is possible to select the variant that includes a so-called "shelving" filter that achieves an attenuation or an exaltation of a certain band.**

## **2.6. Notch, Inverting and All-Pass**

These controls allow user to activate the related functions. Intuitively, the “Inverting” control allows user to invert the phase of the channel with respect to the input signal.

The “All-Pass” control allows user to activate the all-pass filter for that channel (see 3.3).

The “Notch” controls allow user to activate one or two notch filters (see 3.4). Note that, depending on the configuration, it is possible that none, one or two notches are visible. When both are visible, the second is not usable (shaded control) unless the first is used first.

## **2.7. Upper Menu**

The upper menu allows access to numerous software functions, as detailed below.

### **2.7.1. File - Open**

It allows user to open a file containing a configuration previously saved on the PC.

### **2.7.2. File - Save**

It allows user to save the current configuration in a file on the PC. This option is only available when the software has already opened a file.

### **2.7.3. File – Save As**

It allows user to save the current configuration to a new file on the PC.

### **2.7.4. File - New**

It allows user to create a new configuration.

### **2.7.5. File – Download Configuration**

It allows user to retrieve the configuration from MITCHELL and view it in the main software window.

### **2.7.6. File – Download Configuration to File**

It allows user to retrieve the configuration from Mitchell and save it in a file on the PC.

### **2.7.7. File – Upload Full Configuration**

It allows user to send the configuration of all three ways to MITCHELL. It is equivalent to clicking in sequence on the “Apply” buttons of the three ways.

### **2.7.8. File – Exit**

Terminates the MITCHELL CONFIGURATOR session.

### **2.7.9. COM Port**

Displays the serial port management window.

### **2.7.10. Configure**

Displays the configuration window.

### **2.7.11. View - Plots**

Displays the window of the graphs that simulate the cutting curves of the three ways.

### **2.7.12. Help - About**

View software information.

### **2.7.13. Help – Query Firmware Version**

Queries MITCHELL to get the firmware version installed on it.

### **2.7.14. Help – Update Firmware**

Displays the window for updating the MITCHELL firmware.



### 3. Use of Filter Blocks

As explained in paragraph 2.5, each channel is equipped with various filter-blocks that can be composed to create the different possible configurations. Each filter block has one or two parameters.

The 6dB/oct low-pass, 6dB/oct high-pass and all-pass blocks are characterized by one parameter: for the first two blocks it is the cutoff frequency, for the third it is the frequency at which the phase shift introduced is equal to  $90^\circ$ .

In Fig. 2 we can see the main window of the MITCHELL CONFIGURATOR showing, for channel B, a 6dB/oct band-pass filter for both slopes (cut at 300Hz and 3kHz), in cascade to a centered all-pass filter at 1kHz.

Obviously, having selected the all-pass filter, the window in which we digit the desired frequency appeared. Similarly for the low-pass and high-pass blocks at 6dB/oct.



Figure 2

The two 12dB/oct SVF filter blocks are not used in this configuration, so they can be recycled as notch filters. In fact, the two controls “Notch 1” and “Notch 2” are visible. The first is active and unused, the second is not active. Let's try to select the first notch: we get what we see in Fig. 3.



Figure 3

Having selected the first notch, two windows appeared for the two parameters associated with it (cutoff frequency and Q, since the SVF is a second order filter), while the second notch is now usable.

Let's now try to choose a configuration that uses one of the 12dB/oct filter blocks to make the cut. For example, a low-pass at 18dB/oct, as shown in Fig. 4 for way A.



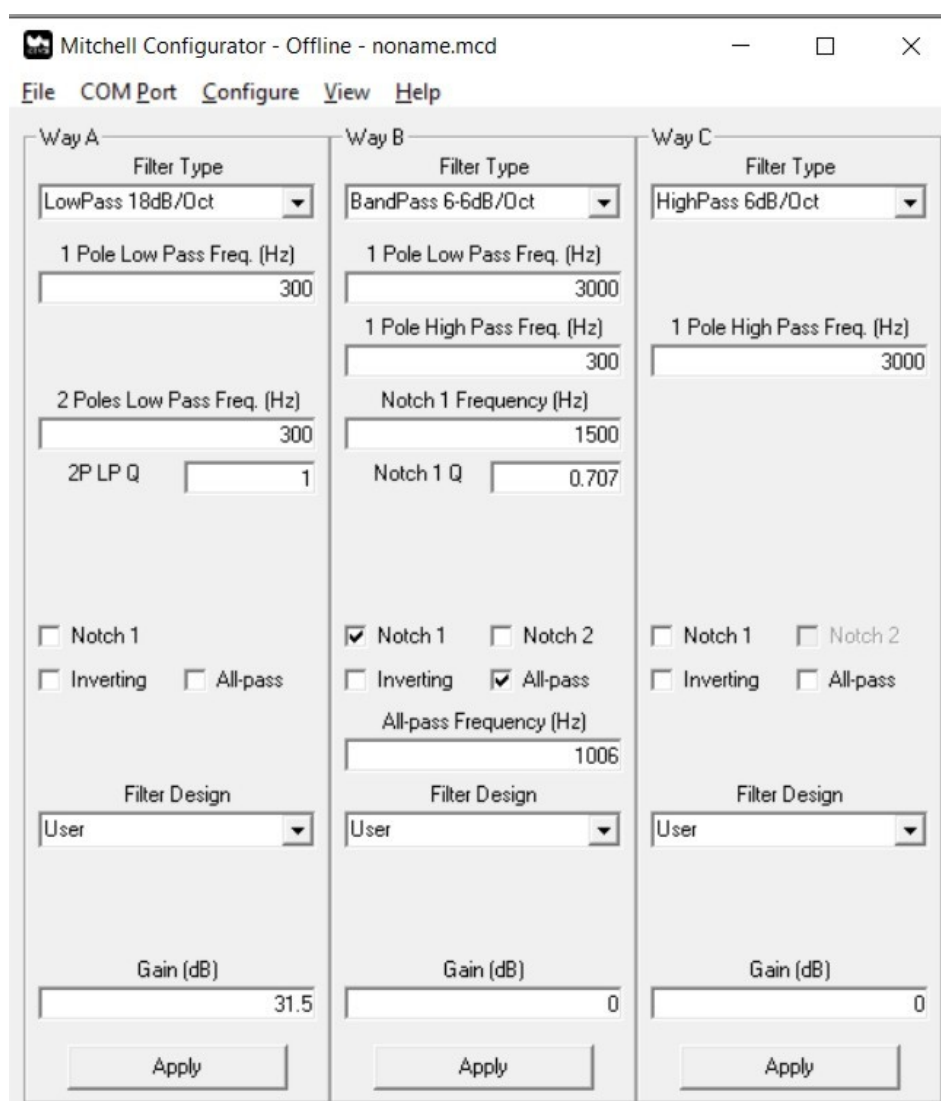


Figure 4

Since a filter at 18dB/oct is obtained by cascading a 6dB/oct (1 pole) filter and a 12dB/oct (2 poles) filter, the windows relating to the filter blocks used are now visible: cut-off frequency for the 6dB/oct block and cut-off frequency and Q for the 12dB/oct block. Note that only one notch is available for via A with the chosen configuration: since one of the two SVF blocks is used to make a 12dB/oct low-pass filter, we can only use the second SVF block as a notch.

### 3.1. Updating the Parameters of a Single Filter Block

As explained in paragraph 2.4, clicking on the "Apply" button of a certain street causes the parameters of all the active blocks of that street to be sent to MITCHELL. When you are performing the fine tuning of a cut, it is not necessary to send all the other parameters at each variation of the parameter of interest: this slows down the tuning work and causes useless writes in the crossover memory which shorten its duration. To avoid this, it is

possible to send only the parameter of interest simply by pressing the "enter" button on the PC after having typed in the new value.

**NOTE: this technique only applies to frequency parameters: updating a Q factor and pressing “enter” does not update the parameter. To update the Q, after changing the parameter, it is necessary to click on the relative cutoff frequency and then press “enter”. This apparently cumbersome technique is explained by the fact that, for a given filter block, cut-off frequency and merit factor are sent with the same message.**

## 3.2. Shelving

It was mentioned in paragraph 2.5 that for any configuration that uses only the SVF blocks (low-pass and high-pass at 12 or 24 dB/oct, band-pass at 12dB/oct on both cuts) it is possible to reuse the low-pass and high-pass blocks at 6dB/oct of that way to implement a filter capable of enhancing or attenuating a certain band, called, somewhat improperly but effectively, "shelving". Fig. 5 shows, for the way C, such a configuration.

The shelving behaves as a boost-band or attenuate-band depending on the cut-off frequencies of the two low-pass and high-pass blocks at 6dB/oct: if the cut-off frequency of the low-pass is lower than that of the high, then there is a band attenuation. Conversely, if the high-pass cutoff frequency is lower than that of the low-pass, then there is a band boost.

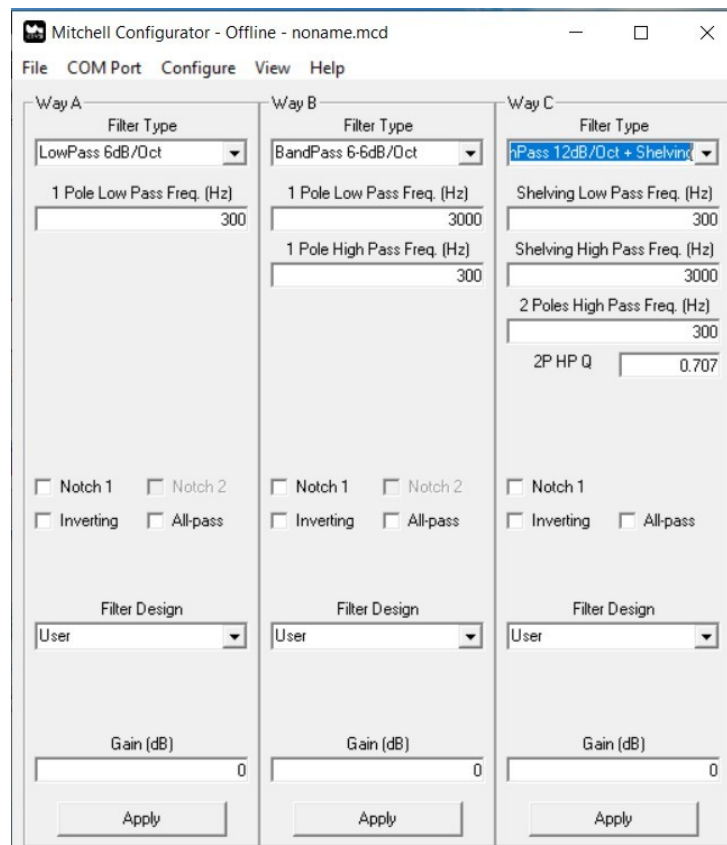


Figure 5

### 3.3. All-pass

The all-pass filter block has a rather particular behavior that can be useful in situations where the emission centers of the various speakers are not temporally aligned.

It is characterized by a constant amplitude response equal to 0dB, while the phase varies linearly with the frequency, starting from -180 ° at frequencies close to zero and increasing up to 0 ° at very high frequencies. At the "cutoff" frequency of the filter, the phase is -90 °. By appropriately choosing the cutoff frequency, it is possible to apply a phase delay to the speaker of that channel such as to acoustically realign the emission to that of the speaker with which it crosses. This technique is often used with dome tweeters when crossed with cone midrange on perfectly vertical front panels.

### 3.4. Notch Filters

A notch filter is a particular filter that strongly attenuates a very narrow band centered on its cutoff frequency, while the response is practically flat at 0dB for all other frequencies.

Such a filter is useful for managing the breakup phenomena of large cones, which at medium and high frequencies tend to resonate freely, producing unwanted noises and distortions. This also happens in the transition band and also in the suppressed one, that is precisely where it is painful that the speaker does not emit.

The breakup frequencies are easily identifiable by observing the graph of the speaker's frequency response and also that of the impedance: a narrow peak in one or both graphs generally indicates the presence of breakup. Centering a notch on that frequency can help limit the effect of the breakup.

Since the notch filter is a 12dB/oct filter, it is also characterized by a cutoff frequency and a Q factor. The higher the merit factor, the narrower the intervention band.

### 3.5. Granularity of the Cutoff Frequencies

The cut-off frequencies in the MITCHELL are set via integrated 1024-position analog potentiometers. Therefore, 1024 different cut-off frequencies are available. Unfortunately, the distance between two frequency values is not uniform across the audio band. It is minimal at low frequencies end and wider at the high frequencies. Furthermore, there may not be an exact correspondence between the desired value and the one actually set. The MITCHELL CONFIGURATOR takes this into account, accepting the value entered by the user, recalculating the closest effective one and presenting it in the relevant text window. For example, a desired frequency of 3000Hz corresponds to an effective frequency of 3018Hz. It is a 0.6% difference that does not affect the correctness of the cut.



## 4. Communication between MITCHELL and PC

**WARNING: All connections between the MITCHELL and other equipment must be made with all units turned off and completely disconnected. Failure to observe this precaution could result in damage to the MITCHELL and/or other units.**

Connect the micro-USB port on the front panel of the MITCHELL to a USB port on the PC with the cable supplied with the MITCHELL.

When the MITCHELL is turned on, if the FTDI driver has been installed, a serial port representing the USB connection between the crossover and the PC will appear in the PC system resources. To enable communication between the crossover and the PC, access the communication management window and select the serial port (COM) relating to the MITCHELL. Let's analyze the window shown in Fig. 6.

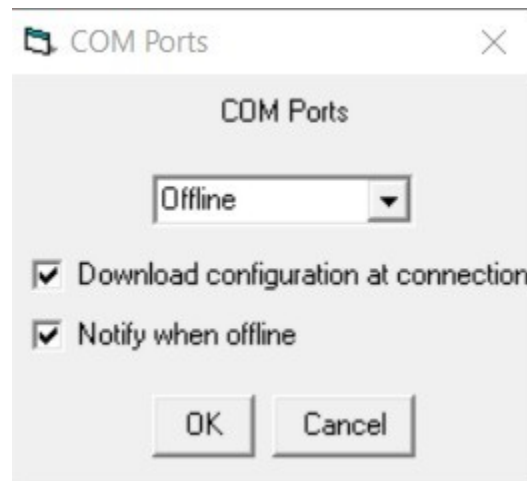


Figure 6

The drop-down menu allows user to choose the serial port to connect to. The two options below speak for themselves: the first allows user to immediately retrieve the configuration stored on the MITCHELL upon connection, while the second allows, when the connection is not active and the user is using the software for a simulation or for an initial setting of the parameters, to ensure that the software warns the user or not, at each update of a parameter, that the transfer of the new value has not occurred due to lack of connection.

**WARNING: it may happen that, despite having correctly connected the MITCHELL to the PC, that no serial appears in the drop-down menu: this could be due to the fact that the number of the virtual serial created by the FTDI driver is higher than 11. In this case it is need to enter the Windows system configuration and manually rename the serial with a number less than 12 (if available).**



## 5. Configuration Parameters

The MITCHELL offers great versatility of use, to better adapt to the most diverse needs. It can be configured in stereo or mono. When configured in stereo, the two channels can be configured together or separately. If necessary, it is possible to cascade two or all three ways to obtain more complex filters than those obtainable using the filter blocks of only one way.

Furthermore, the MITCHELL is equipped with an infrared receiver capable of “hearing” the on/off command of the M2TECH remote controls of the Rockstars series, to ensure that the crossover is switched on or off together with other M2TECH products.

Let's see in detail on which configuration parameters it is possible to intervene, by accessing the configuration window (Fig. 7).

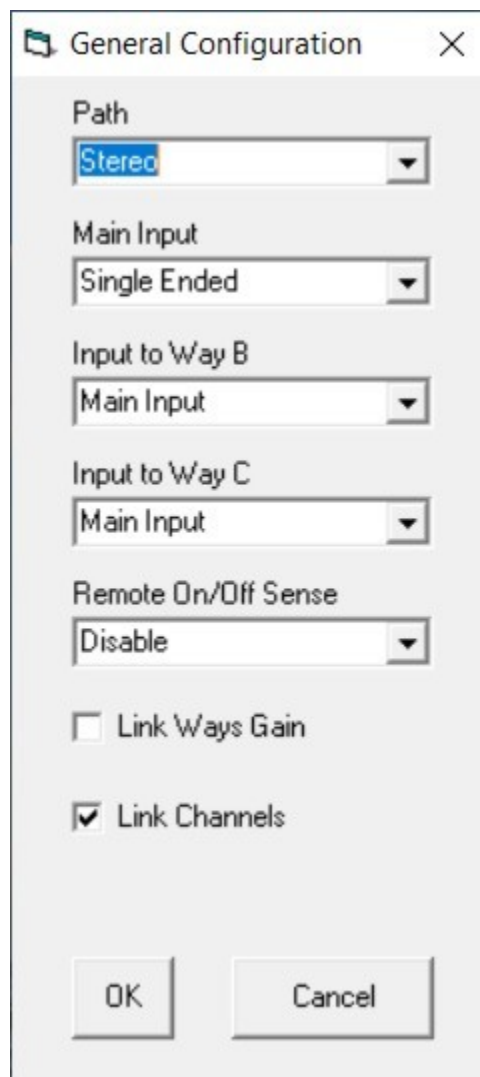


Figure 7

## 5.1. Path

Allows user to choose whether to use the MITCHELL as a stereo product (up to 3 ways per channel) or mono (up to 6 ways). This allows to use two MITCHELL with complex speakers systems with more than 3 ways, or to create complicated filters and/or with high slopes by connecting two ways in cascade.

When the Mitchell is configured in mono, the main window changes to show all six ways, as it is now necessary to access each route independently of the others, as shown in Fig. 8.

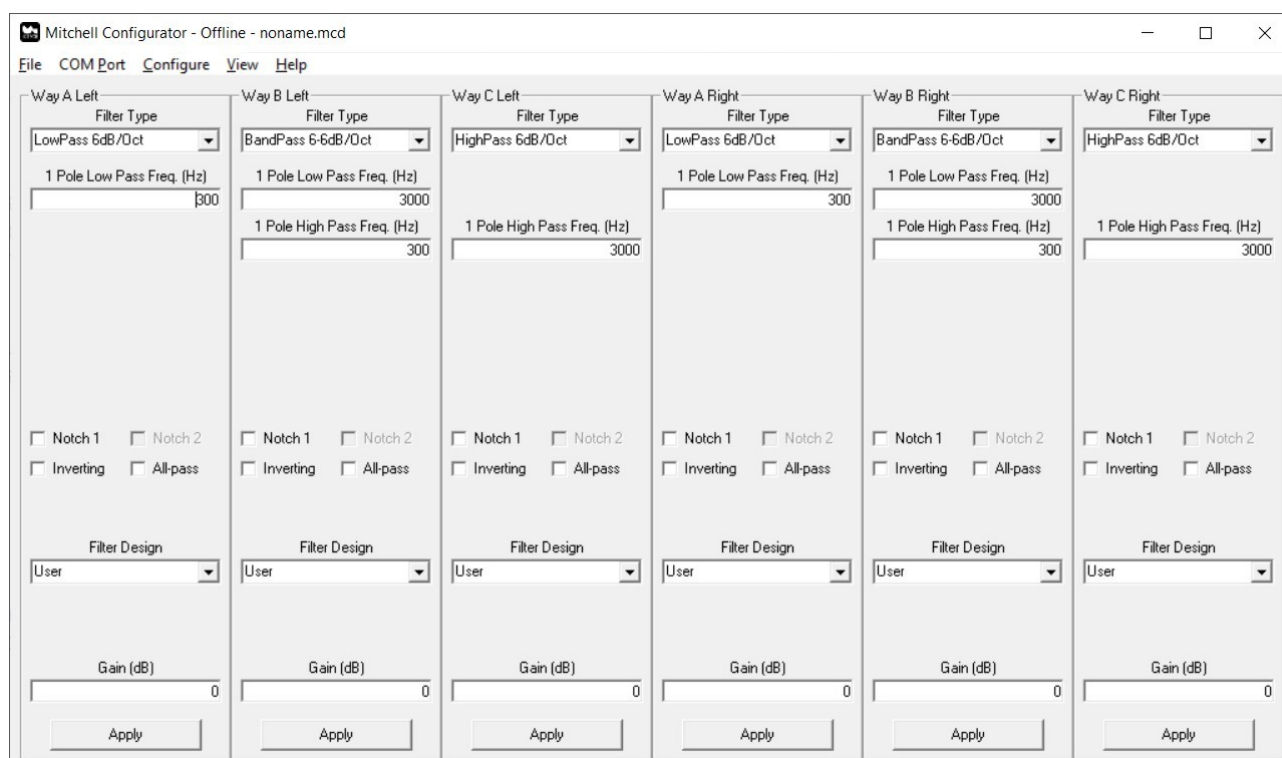


Figure 8

## 5.2. Main Input

The MITCHELL is equipped with an unbalanced input on RCA sockets and a balanced one on XLR sockets. Through this control it is possible to choose which input to use to send the signal to the ways for filtering.

## 5.3. Input to Way B

As explained above, the MITCHELL allows two or three ways to be connected in cascade in order to use a greater number of filter blocks to filter a certain loudspeaker and obtain more complex filters than those obtainable with a single way. This control allows user to choose whether way B should receive the signal from the input selected by "Main Input" or from the output of way A ("Way A Output"). In this case, a filter is obtained consisting of



the filter blocks of way A and those of way B. The useful signal is taken at the output of way B. Fig. 9 shows how the main window changes when way B is connected in cascade to way A. Note that now it is not possible to choose the configuration of way B: it changes according to the configuration chosen for way A, which will only offer choices of filters that can be realized with a subset of those of way A and way B (for example, a low-pass at 36dB/oct which is achieved using the two SVFs of way A and one SVF of way B).

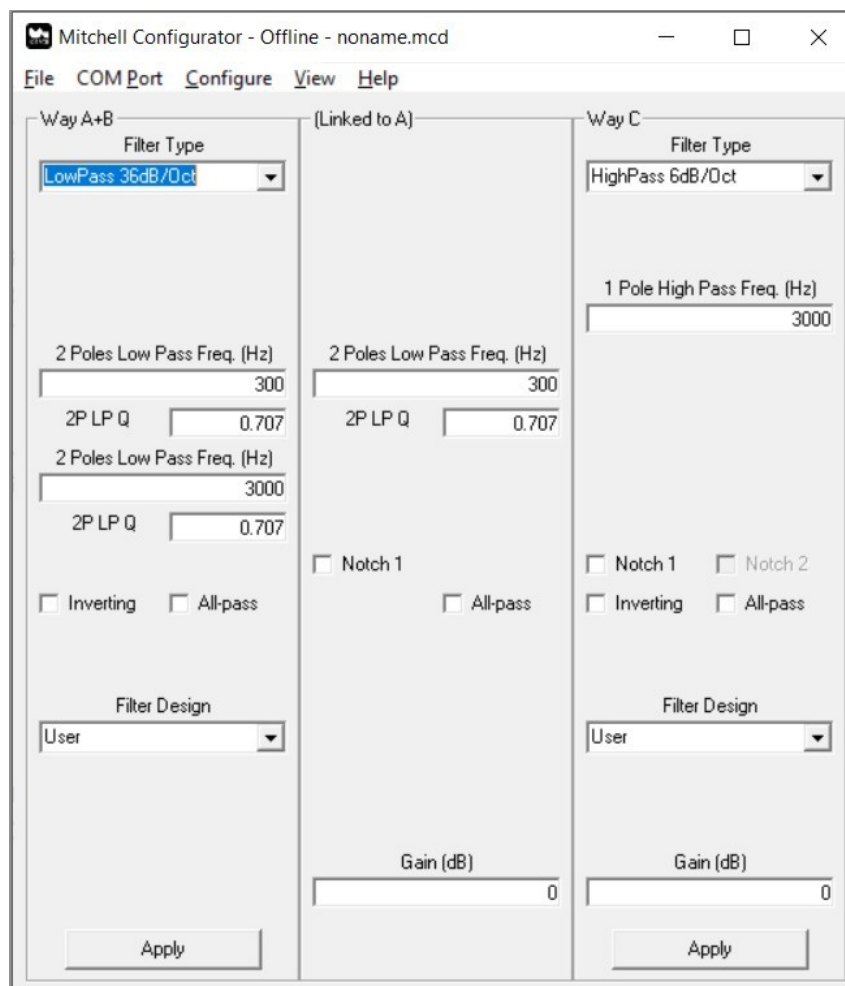


Figure 9

## 5.4. Input to Way C

The concept explained in paragraph 5.3 also applies to way C. By choosing “Way B Output” for the “Input to Way C” control, way C is connected in cascade to way B. The useful signal is taken from the output of way C. Fig. 10 shows how the main window changes in this case.

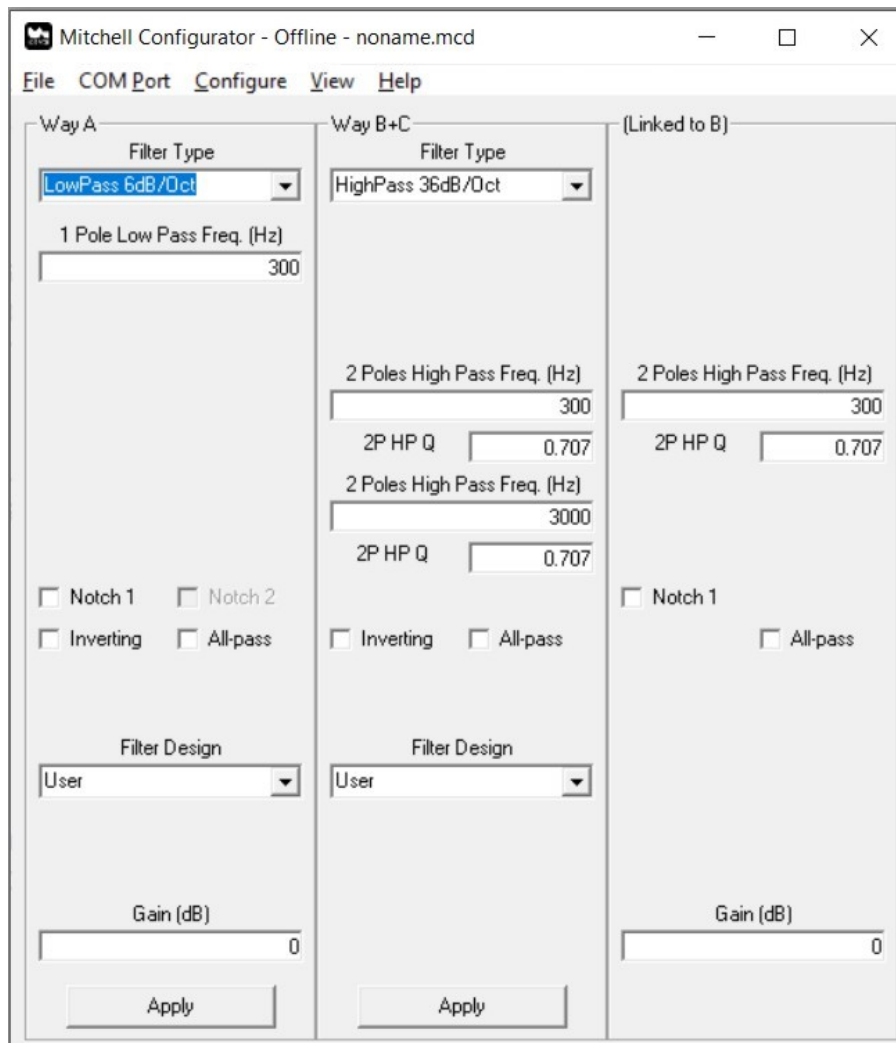


Figure 10

## 5.5. Connect the Three Ways of MITCHELL in Cascade

It might seem useless, but it is possible to connect all three MITCHELL ways in cascade, thus taking the signal only from the output of way C. In this way, the Mitchell is "dedicated" to a single driver, creating extremely complex filters, with various shelving, notches and multiple slopes.

This possibility derives directly from the fact that it is possible to connect the input of way B to the output of way A and the input of way C to the output of way B. Slopes up to 78 dB/oct) can in fact be exploited, probably in application fields not related to music ...

Fig. 11 shows how the main window changes in this case.

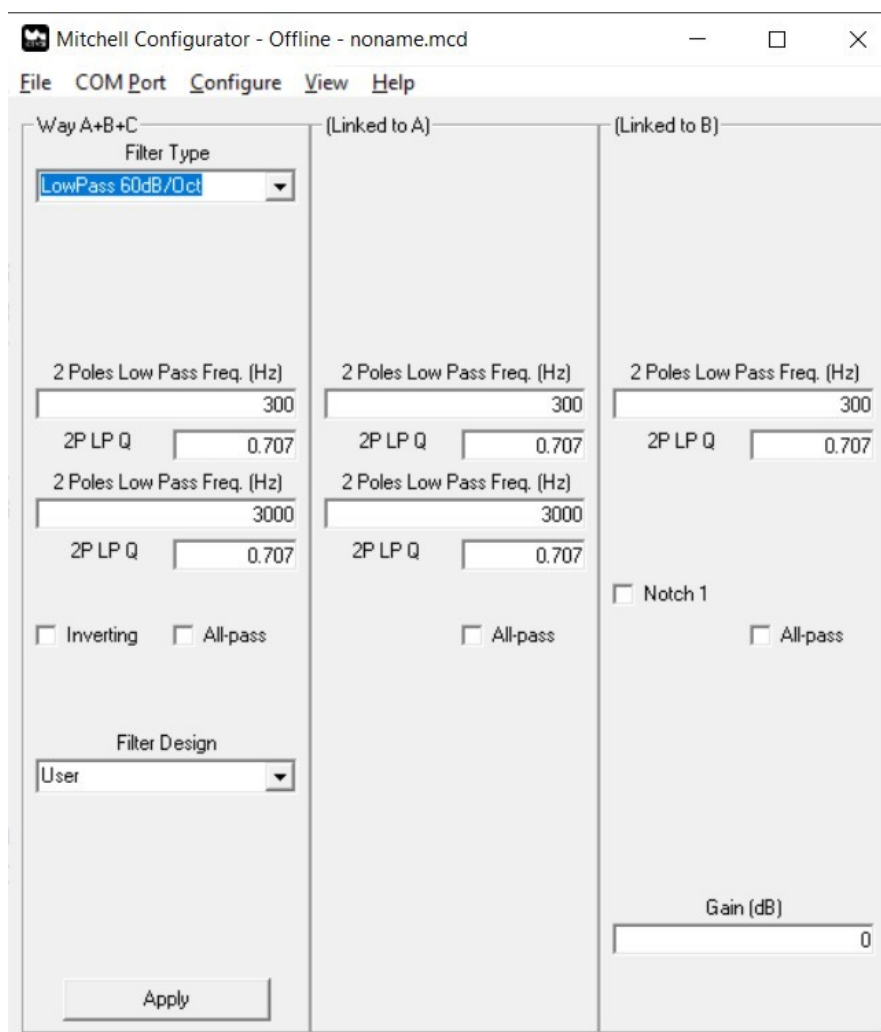


Figure 11

## 5.6. Remote On/Off Sense

As previously mentioned, it is possible to instruct the MITCHELL to hear the on/off commands that are sent from the remote control of an M2TECH product of the Rockstars series (DAC, Amplifier or Streamer). In this way it is possible to turn the MITCHELL on and off when the other device is turned on and off. This function can be used as an alternative to the trigger input that MITCHELL is equipped with.

## 5.7. Link Ways Gain

Each way of the MITCHELL is equipped with its own level control. At the user's will, it is possible to set the same level value for all three ways, by activating this control.

## 5.8. Link Channels

This option refers to the stereo configuration only (when the “Mono” value is chosen for the “Path” control, then this control is disabled and is grayed out). It allows you to choose whether the filters of the two channels of each way must be modified together or independently.

If you choose to act on the ways of the two channels independently, the main window changes as shown in Fig. 8.

In fact, the main difference between setting the MITCHELL in mono and in stereo with the connection between the Left and Right channels deactivated is that in the first case all six ways are fed by the Left input, while in the second case the Left ways receive the signal from the Left input and the Right ways from the Right input.

## 6. Plots

The MITCHELL CONFIGURATOR offers the possibility of displaying the frequency response of the curves set for the various channels in a graph, as shown in Fig. 12

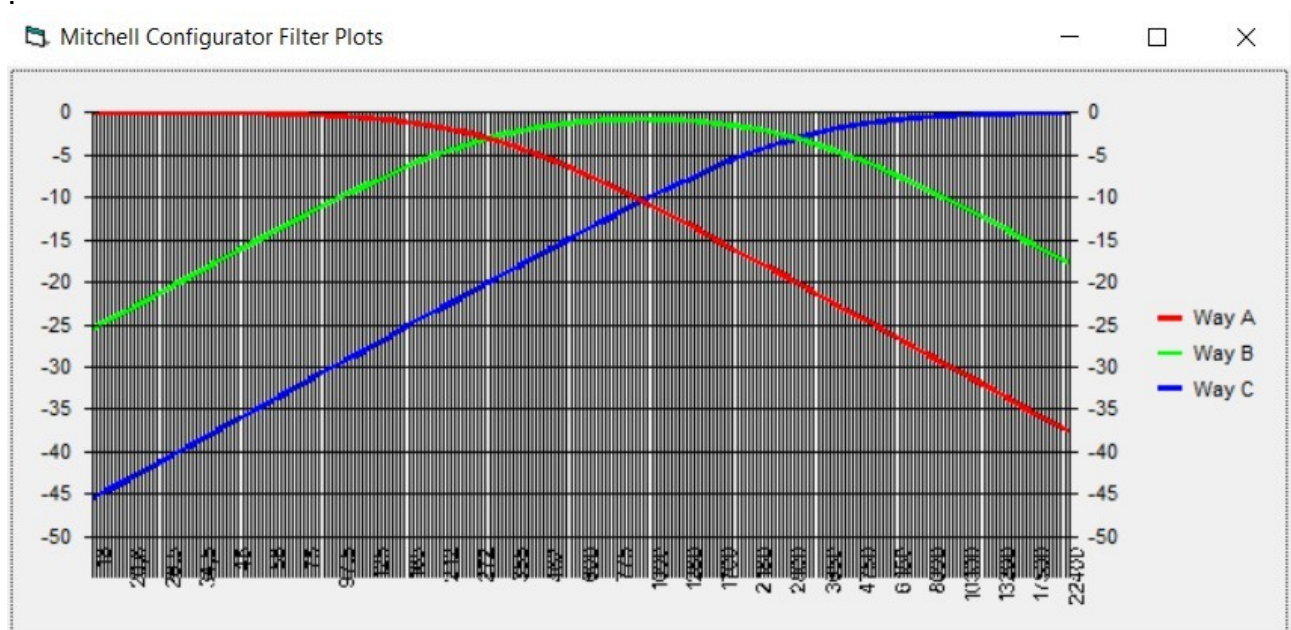


Figure 12

Depending on the chosen configuration, the relevant curves are displayed. Fig. 12 shows what is displayed if the MITCHELL is configured in stereo, with the connection between the ways of the two channels active and if all three channels receive the signal from the selected input.

The graphs are redrawn every time a change is applied to any parameter of any path.

## 7. Assisted Design of a Filter

Designing a filter, especially when the slope is high, can take long and tedious calculations. For this reason, the MITCHELL CONFIGURATOR offers the possibility to automate this process for standard type filters: Butterworth, Chebishev, Bessel.

To design the filter to be used for a certain channel, it is first necessary to select the configuration (high-pass, low-pass or band-pass) and the slope of the filter using the “Filter Type” drop-down menu.

Then, choose the type of filter you want from the “Filter Design” drop-down menu. Below it, a text box (Butterworth and Bessel) or two (Chebishev) will appear, in which the parameters related to the filter will be entered (cut-off frequency and, only for Chebishev, the ripple, which can be equal to 0.5dB or to 1dB). See Fig. 13.

The screenshot displays the Mitchell Configurator software interface, titled "Mitchell Configurator - Offline - noname.mcd". The interface features a menu bar with "File", "COM Port", "Configure", "View", and "Help". Below the menu bar, there are three vertical panels labeled "Way A", "Way B", and "Way C", each containing filter design settings.

**Way A:**

- Filter Type:** LowPass 18dB/Oct
- 1 Pole Low Pass Freq. (Hz):** 311
- 2 Poles Low Pass Freq. (Hz):** 531
- 2P LP Q:** 1.706
- Notch 1:** ☐
- Inverting:** ☐ **All-pass:** ☐
- Filter Design:** Chebishev
- Frequency (Hz):** 497 **Ripple (dB):** 0.5
- Gain (dB):** 0
- Apply:** [Button]

**Way B:**

- Filter Type:** BandPass 6-6dB/Oct
- 1 Pole Low Pass Freq. (Hz):** 3000
- 1 Pole High Pass Freq. (Hz):** 300
- Notch 1:** ☐ **Notch 2:** ☐
- Inverting:** ☐ **All-pass:** ☐
- Filter Design:** User
- Gain (dB):** 0
- Apply:** [Button]

**Way C:**

- Filter Type:** HighPass 6dB/Oct
- 1 Pole High Pass Freq. (Hz):** 3000
- Notch 1:** ☐ **Notch 2:** ☐
- Inverting:** ☐ **All-pass:** ☐
- Filter Design:** User
- Gain (dB):** 0
- Apply:** [Button]

Figure 13

By pressing "enter" on the PC keyboard, you will see that the parameters relating to the filter blocks used (and therefore visible) of the channel will be updated with the correct values of sampling frequency and Q. By pressing F1 to display the graphs, it will be seen that the plot of the way involved in the design has the desired profile.

## 7.1. Design of a Band-pass Filter

A band-pass filter has two cuts, a high-pass and a low-pass. The MITCHELL gives users full freedom to shape each cut to meet their needs: for example, the high pass can be a Butterworth at 6dB/oct and the low pass a Chebishev at 18dB/oct.

For this reason, when designing a band-pass filter, the choice of the cut on which to operate is made when choosing a type of filter, selecting the desired cut in the window that appears (Fig. 14 for way B).

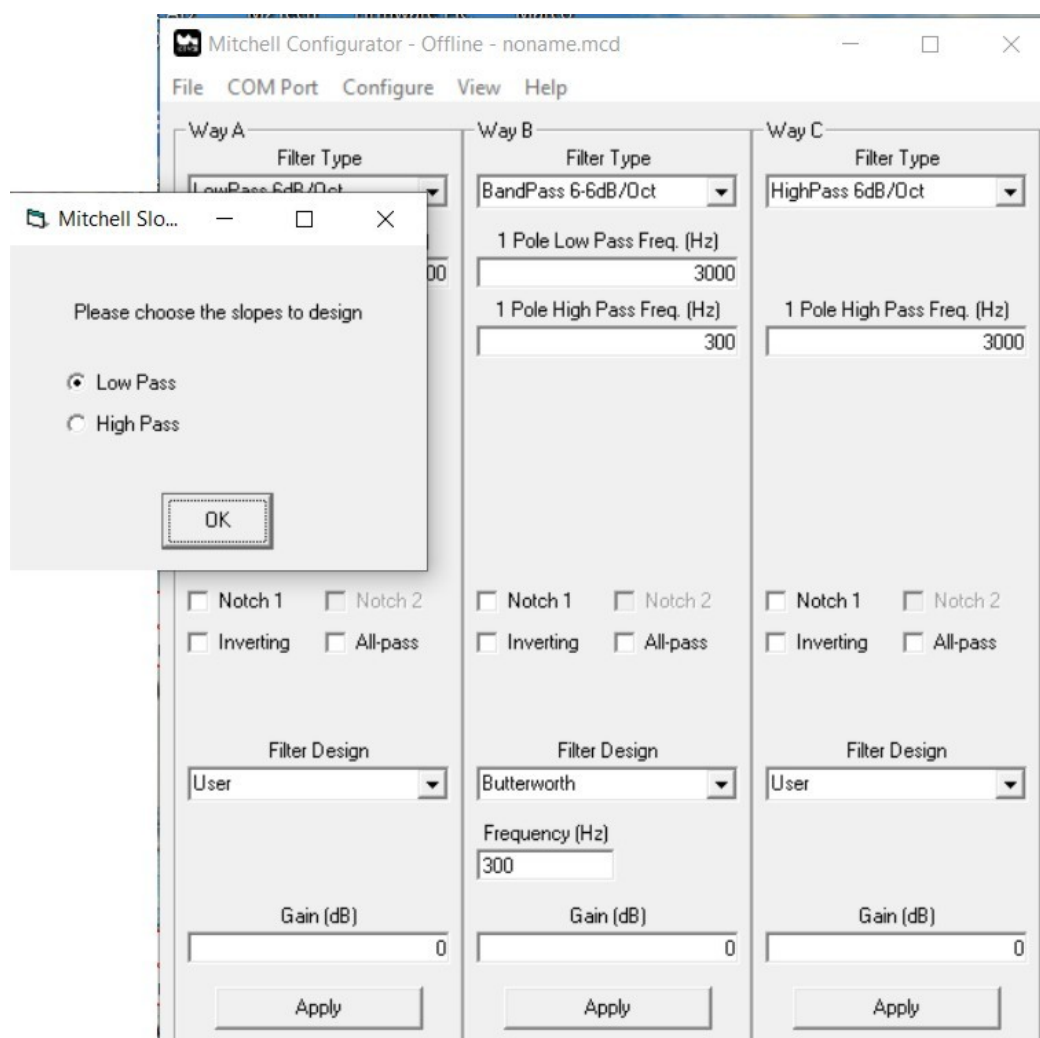


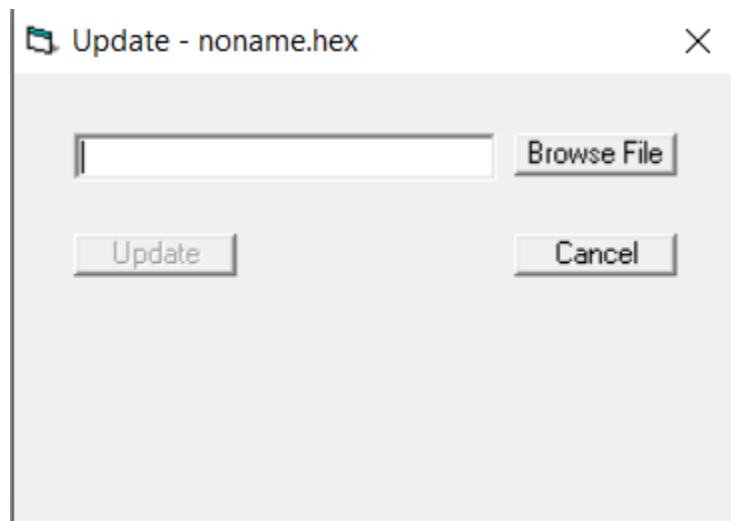
Figure 14

To repeat the design process for the other slope, just choose a filter type again in the "Filter Design" drop-down menu.

## 8. MITCHELL Firmware Update

The MITCHELL is a rather complex product managed by a microprogrammed controller. For this reason, it has been possible to update the firmware, if necessary, using the same MITCHELL CONFIGURATOR, through a specific item in the “Help” tab of the menu.

By accessing the Help - "Update Firmware" item, the update window is shown, as shown in Fig. 15.



*Figure 15*

Its use is very simple: just click on the “Browse File” button and choose the new firmware to load on the MITCHELL, then click on the “Update” button. The update will start immediately and the progress of the operation will be displayed with a bar. When finished, the MITCHELL will automatically reset to load the new firmware.

It may be convenient, before carrying out an update, to check the firmware version currently present on the MITCHELL. This can be done with the “Help - Query Firmware Version” command.