M2TECH

MITCHELL

STEREO ANALOG ELECTRONIC CROSSOVER

USER MANUAL

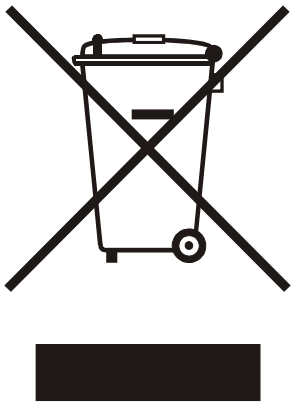
REV. PRB – 12/2020

Warning!

Changes or modifications not authorized by the manufacturer can invalidate the compliance to CE regulations and cause the unit to be no more suitable to use. The manufacturer refuses every responsibility regarding damages to people or things due to the use of a unit which has been subject to unauthorized modifications or to misuse or to malfunction of a unit which has been subject to unauthorized modifications.

This unit is compliant with the following CE regulations: CEI EN 55022:2009 Class B (Radiated Emissions), CEI EN 55024:1999, CEI EN 55024:A2/2003, CEI EN 55024:IS1/2008 (Radio Frequency Electromagnetic Fields, 50Hz Magnetic Field Immunity Test and Electrostatic Discharges – ESD).

For a proper operation of this unit, all connections to other equipment in the system must be done when all equipment are off. Failing to comply with this advice may lead to damage to the MITCHELL.



The label above, printed on the product case, indicates that the product, when no more usable, can't be treated as generic garbage, but must be disposed of at a collection point for recycling of electrical and electronic equipment, in compliance with the WEEE regulation (Waste of Electrical and Electronic Equipment).
By making sure that this unit is correctly recycled, you will help preventing potential damages to environment and human health, which could be caused by a wrong treatment of this product as generic garbage. Materials' recycling helps saving natural resources. For more in-depth information about recycling this product, please contact M2Tech Srl.

WARNING: the information contained in this manual are considered to be reliable and accurate. M2Tech reserves the right to change or modify the information any time, without prior advice. It's up to the customer to ensure that the manual being consulted is the latest version.

Dear customer,

Thank you for purchasing MITCHELL. You are the owner of a very high quality analog electronic crossover with many unique features, designed to obtain the best performance in conjunction with every M2TECH product.

MITCHELL implements a specific set of technological and functional solutions, from the highly versatile filter modules to high quality active and passive components, to the companion configuration software that eases the set-up process.

MITCHELL provides a wealth of configuration options that make it possible to tailor it to the most demanding set-up. The all-analog operation avoids the sound quality detriment and artefacts that affect digital crossover.

We're sure that your expectations will be fulfilled by purchasing MITCHELL: your hi-fi system will exhibit an incredible increase of its sonic performance, so you can now prepare for a whole new listening experience!

Marco Manunta, CEO

Please note here your MITCHELL serial number and purchase info for future reference:

S/N: _____ Date of Purchase: _____

Place of Purchase_____

Note: Proof of retail purchase, such as your purchase receipt, will be required in the unlikely event that any warranty service will be required

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1. Unpacking and Placing the Unit

Lay the box on a table and open it with a cutter or a knife, paying attention not to damage the internal box. Extract the internal box and open it. The following items are included in a cardboard tray:

- one MITCHELL;
- one 15V wall adaptor;
- one USB cable;
- two XLR adaptor cables.

Should one or more item be missing, please contact your retail dealer.

Remove the MITCHELL from the cardboard tray enclosure and place it onto a stable base, far from heat sources. Avoid full sunlight on the unit. Allow for ample room around the unit for venting.

The MITCHELL is an audio device which operates at line level, therefore, only a reduced heat production is expected. Nevertheless, its circuitry operates at high bias for improved performance. Therefore, an adequate air flow is recommended.

Avoid smoke, moisture, dirt and liquids from reaching the unit. Please note that any signs of abuse will void warranty coverage.

Do not place the unit on thick carpets or inside a box or piece of furniture, not even close to curtains.

2. Front Panel

Figure 1

1) IR sensor. Receive commands from Rockstars remote controls. It's useful to let the MITCHELL enter/exit standby together with other Rockstars units in the system. This feature must be enabled by the configuration app at set-up.

2) ON/OFF button. Allows to turn the MITCHELL on and off. Also, when the MITCHELL is in standby, pressing this button will activate it.

3) Standby LED (blue). It's on when the MITCHELL is in standby.

4) Active LED (white). It's on when the MITCHELL is active.

NOTE: during firmware update, either LEDS can be on, depending on the condition at update beginning.

5) Micro-USB port. Used for configuration and firmware update. Use the stock cable to connect to a computer.

3. Back Panel

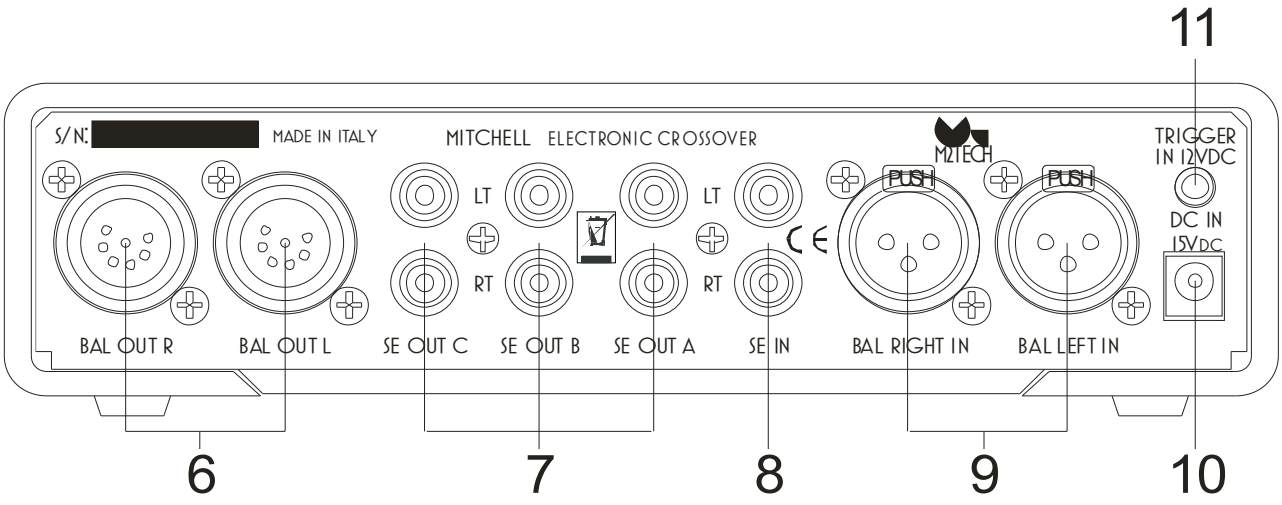

Figure 2

6) Composite balanced outputs. Each connector carries three balanced signals from the outputs of one channel. Use the stock balanced adaptor cables to connect three 3-pin balanced cables. Connect to the balanced inputs of your power amplifiers. Female 7-pin XLR connectors.

7) Single-ended outputs. Connect to the single-ended inputs of your power amplifiers. Female RCA.

8) Single-ended inputs. Connect to the single-ended outputs of your preamplifier. When the MITCHELL is set for mono operation, only the left input is used. Female RCA.

9) Balanced inputs. Connect to the balanced outputs of your preamplifier. Female RCA.

NOTE: choice between single-ended and balanced inputs is done by the app during set-up.

10) Power input socket. Connect the stock wall adaptor or the VAN DER GRAAF MKII to this socket**.** Barrel 5.5/2.1mm socket, negative on sleeve.

11) Trigger inputs. A 12V trigger signal may be sent to this input to switch MITCHELL on and off by the preamplifier or other trigger source. This input has a higher priority than the front panel switch, therefore the MITCHELL will always activate whenever the trigger voltage is applied and will not switch off as long as the trigger voltage is present, even if the front panel button is pressed.

4. Connecting and Powering the Unit

WARNING: All connections between the MITCHELL and other equipment must be made when all units are turned off and completely powered down or unplugged. Failing to do so may cause damage to the MITCHELL and/or other units.

Please refer to chapter 3, “Back Panel”.

Connect the power amplifiers inputs to the MITCHELL outputs (Fig. 2, 6 and 7) using RCA-terminated single-ended interconnects or XLR-terminated balanced interconnects using the stock balanced adaptor cables. Single-ended and balanced connections can be mixed, keeping in mind that balanced outputs have +6dB higher level than single-ended outputs.

Connect a preamplifier or other driving unit (as the YOUNG MKIV) to the MITCHELL single-ended (Fig. 2, 8) or balanced (Fig. 2, 8) inputs. Select the used input accordingly by the configuration app or directly by the related command using a simple terminal app on your computer.

If the trigger feature is to be used, connect a mono cable with 3.5mm jack to the MITCHELL trigger inputs (Fig. 2, 11).

Connect the stock wall adaptor to the MITCHELL power input socket (Fig. 2, 10) and to a wall outlet. As an alternative, you can use the VAN DER GRAAF MKII to power the MITCHELL.

WARNING: please note that using any other power supply or adaptor than the stock unit or the VAN DER GRAAF MKII will invalidate the warranty.

Push the on/off switch on the front panel (Fig. 1, 2) to turn the MITCHELL on. The operation LED (Fig. 1, 4) on the front panel will glow. If you use the trigger option and the trigger voltage is applied, then the MITCHELL will activate immediately without need to press the on/off button.

5. Cleaning the Unit

The MITCHELL should be cleaned with a soft, slightly damp cloth. Do not use alcohol or any other types of cleaning fluids as they could damage the unit.

Avoid fluids from dropping or leaking inside the unit. Fluids of any type poured into the unit will void your warranty.

Be careful not to scratch the Plexiglass front screen.

6. Trigger

The MITCHELL accepts trigger signals, $5V_{DC}$ to $15V_{DC}$. A trigger signal can be used to automatically activate the MITCHELL by a preamplifier, so that all the system is powered on and off by the preamplifier's remote control. The trigger input has priority on the front panel button: the MITCHELL cannot be turned off by the front panel button as long as the trigger voltage is applied to the trigger input. As well, the MITCHELL will power off when the trigger voltage is removed. The trigger input also has priority over the remote control: if the remote control sensing is enabled and an on/off command is sent by the remote control while the trigger voltage is applied to the MITCHELL, the unit will not turn off.

7. Theory of Operation

The MITCHELL is an all-analog stereo, 3-way electronic crossover. Its purpose is to separate the signal from a preamplifier into up to three signals with different frequency contents. This way it is possible to eliminate the passive crossover in a speakers system and drive each driver with a dedicated power amplifier. This technique is called “active multi-amplification”.

The advantages of active multi-amplification are various and more than subtle:

- more clarity and transparency in the sound due to elimination of the side-effects of non-linearities in passive power components like inductors and capacitors;
- more accurate pulse response with increased quality of soundstage presentation;
- higher dynamic;
- less distortion as each power amplifier sees an easier load to drive.

Of course, this comes at a cost, as more power amplifiers are needed than in an usual system: at least a stereo power amplifier each way, plus the crossover. E.g., in a two way, bi-amplified system the following units are required: a MITCHELL and two stereo power amplifiers. A more expensive, more refined system with 5-way speakers will need two MITCHELL set in mono mode and at least 5 stereo power amplifiers (or up to 10 monoblock power amplifiers).

Digital electronic crossovers are usually extremely versatile as their configuration software allows for shaping cut-off curves with great precision. On the other hand, they need to convert the sound from analog to digital before processing it and convert the processed signals back from digital to analog. This is often unwanted as conversions apply a strong signature to the sound and usually systems sound like the crossover's converters rather then like their high quality analog components.
To partially avoid this problem, somebody drives the digital crossover by its digital input when available. This allows to skip the input A-to-D converter and reduce the conversion artefacts. However, the crossover digital input limitations apply: quite often the highest sample rate that the input can accommodate is 96kHz or 192kHz, and DSD is never accepted as it can't be processed natively by digital crossovers. This reduces the choice of music that can be played on the system or requires real-time format conversion in the player which introduces artefacts similar to those produced by the A-to-D converter.

For the reasons above, digital crossovers should be avoided in any high-end system, particularly if both digital and analog sources are used. The solution is to use an analog electronic crossover. This may be a problem as most of the analog electronic crossovers on the market are generally too low-end or not enough versatile to properly fit a high-end system needs. Particularly, the kind of filter which each way can implement is fixed (low-pass or band-pass or high-pass) and crossover frequency are always same for adjacent filters (e.g. the cut-off frequency of the low-pass filter is usually same as the low-side cut-off frequency of the band-pass filter). This makes using electronic crossovers difficult when a unusual speakers configuration is chosen. Example: in a 2-way and half speakers system in which one driver is for low frequencies only, another driver works up to midrange

and a tweeter takes treble into charge, an electronic crossover should provide two low pass cuts at different frequencies and a high-pass cut, which are not possible with standard three-way electronic crossovers.

The Mitchell elegantly solves this problems by providing six filter modules (three per channel in stereo or all six for one channel in mono) each one can be set as low-pass, band-pass or high-pass independently.

Each filter module is composed by various blocks which can be composed in a lot of different fashions to make a large number of different filters:

- one all-pass filter for phase and delay shaping;
- one 1-pole low-pass filter;
- one 1-pole high-pass filter;
- two 2-pole state variable filters;
- one gain block;
- two inversion blocks.

Figure 3 shows the block structure with all possible connections selected by various solid-state switches and multiplexers set by the 4-digit hex number sent with the SP command (see 8.1.5). The gain block is not displayed as the gain function is located on the mainboard.

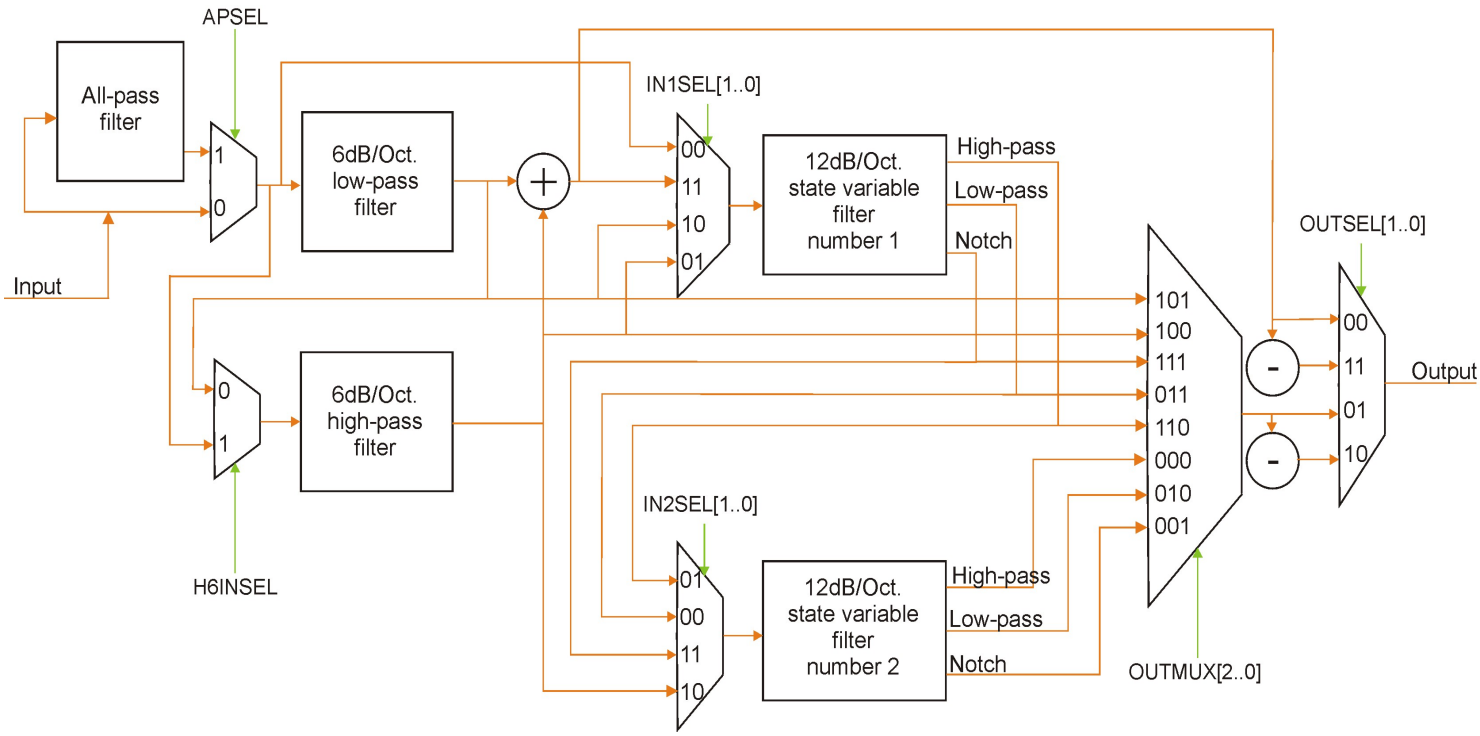

Figure 3: Filter Module Structure

Let's see in details the features of each block.

7.1. All-pass Filter

An all-pass filter is a filter which amplitude response is flat over the whole frequency range (0dB), while its phase changes linearly with frequency. In the MITCHELL, the phase goes from 0 degrees at very low frequencies to -180 degrees at very high frequencies. The frequency at which the phase is -90 degrees can be set by configuration.

An interesting feature of the all-pass filter is the group delay which it introduces, which is useful to time-align a driver emission at certain frequencies to optimize the emission beam.

7.2. 1-pole Low-pass Filter

This block implements a 6dB/Oct low-pass filter. Its cut-off frequency can be set by configuration. A 1-pole filter is the simplest filter that can be used. Many 2-way loudspeakers use 1-pole, 6dB/Oct filters in the crossover to obtain the highest emission coherence throughout the frequency range as 6-dB/Oct filters sport linear phase.

7.3. 1-pole High-pass Filter

This block implements a 6dB/Oct high-pass filter. Its cut-off frequency can be set by configuration. Its setting is totally independent from the 1-pole low-pass filter.

7.4. State Variables Filter (SVF)

A state variable filter is a smart circuit that can be set to operate as 2-pole, 12dB/Oct. low-pass, as 2-pole, 12dB/Oct. high-pass or as notch filter.

Being it a 2-pole filter, it has two parameters: the cut-off frequency and the dumping factor (Q) at cut-off. This is useful when a certain pulse response is desired with specified overshoot and ringing. Also, when composing 1-pole filters with SVF to obtain higher slope filters, it's possible to set the Q of the used SVF to obtain a specified overall response (Butterworth, Bessel, Chebishev or Linkwitz-Riley).

Two SVF are available in each filter module, each one independently configurable. Composing them with a 1-pole filter allows for obtaining slopes up to 30dB/Oct (5 poles).

Each SVF can be set to make a low-pass filter, a high-pass filter or a notch. The latter is a special filter which only deletes one single frequency and a very narrow band around it. It can be useful with drivers breakups which often affect the sound, even outside their allowed frequency range. This is typical with large woofers: They are cut quite low (say 300Hz), yet their breakups in the middle-range can be easily heard. Placing a notch filter at their main breakup frequency usually cleans up the sound.

7.5. Gain block

As speakers systems usually use drivers and/or power amplifiers with different sensitivity, the crossover must be able to compensate sensitivity differences. The MITCHELL allows each way gain to be set in a wide range (-111dB to +30dB) in 0.5dB steps.

7.4. Inversion blocks

The phase of each output can be set to non-inverting or inverting with regards to the input's absolute phase. This is useful because certain filter configuration need a phase inversion between adjacent drivers in order to obtain the correct overall response and beaming.

7.5. Composing blocks to obtain a desired filter configuration

As already said, the various blocks in a filter module can be composed to obtain more complicated filter than each block itself.

E.g. to obtain a band-pass filter with a 12dB low frequency high-pass and a 18dB high frequency low-pass, two SVF and thee 1-pole can be cascaded. By purposely choosing frequencies and Q's, desired filters can be obtained. If Butterworth filters are needed, then the Q in the SVF used for high-pass should be set to 0.707, while the Q in the SVF used for low-pass should be set to 1. This comes from filters theory, which we will not address in detail as it's not in the scope of this manual and it's considered to be already known by the user.

To obtain the desired configuration, the user must send the SP command with the related 4-digit hex number as argument. The number is composed by selecting and chaining the right values for the various parameters shown in Figure 3: APSEL, H6INSEL, IN1SEL[1..0], IN2SEL[1..0], OUTMUX[2..0] and OUTSEL[1..0]. The 4-digit number is composed in binary format as follows:

|| OUTSEL1 | OUTSEL0 | IN1SEL1 | IN1SEL0 | 0 | 1 | APSEL | H6INSEL || +
+ || OUTMUX2 | OUTMUX1 | OUTMUX0 | 0 | 0 | 0 | IN2SEL1 | IN2SEL0 ||

As an example, let's compose the SP argument to set the path for way A, both channel, to be an inverting 6dB/oct low pass with a notch filter. APSEL must be '0' because we don't want the signal to go across the all-pass filter. As we want a notch filter, we'll use the state variable filter 1 to this purpose, therefore we must set INSEL to accept the output of the 6dB/oct low-pass filter. Its value is therefore '10'. Then, we must set the output mux to receive the signal from the notch output of the SVF1. Therefore, OUTMUX will be '111'. We want the signal path to be inverting. Therefore the output selector will choose the signal from the inverting block connected to the output mux. OUTSEL will be '10'. H6INSEL and IN2SEL are don't care and must be set to '0' and '00' respectively.

Summarizing, the final result is b'1010010011100000' or h'A4E0'. The command **#SP,A,B,A4E0** will select the desired configuration.

8. Configuring the MITCHELL

The MITCHELL can be configured using a computer connected to it via USB using the stock cable and a simple terminal program. The USB makes for a virtual UART connection, therefore the MITCHELL is seen by the computer as a UART serial device.

Settings are stored in a non-volatile memory inside the MITCHELL and are restored each time the MITCHELL powers up.

The following UART settings are required:

- Baud rate: 19200bps
- Data: 8 bits
- Handshake: none
- Parity: 1 bit

Moreover, the terminal program must be set to send the <CR><LF> characters pair when “enter” is pressed.

A simple protocol was developed by M2Tech to communicate with the Mitchell. Three kinds of commands can be sent:

- set commands;
- get commands;
- update commands.

Set commands are to apply a configuration choice (filter block cut-off frequency, filter composition, input selection...).
Get commands are used to retrieve a setting from the MITCHELL configuration memory.
Update commands are only used to update MITCHELL's firmware. They are not designed to be used by users, as firmware update is performed automatically using the free configuration software available for download on M2TECH website.

Each command starts with the “#” character and is terminated by <CR><LF>. The “#” character forces the MITCHELL to flush its receive buffer discarding all data previously typed in. Therefore, if one wrong command is typed and the user recognizes the mistake before pressing “enter”, it's possible to retype the right sequence on the same line by simply restarting from “#”.

The MITCHELL answers set commands with OK or with ERR, depending on the syntax. It may happen that a command produces no answer depending on its correct syntax completion.

Following is a complete description of the protocol. MITCHELL answers in the examples are in italic.

8.1. Set commands

8.1.1. Set Filter (SF)

Sets the frequency and Q for a filter block in one or both channels in a way.
Five parameters are required: w is the way, c is the channel, b is the filter block to be set, f is a coefficient related to the frequency and q is a coefficient related to Q. For first order filter, Q must be specified but its value is “don't care”.

The following formulas can be used to derive f and q from the desired frequency and Q:

f = Int(1024*(1-44.21/frequency)+0.5) b=[1,2,H,L]
f = Int(1024*(1-79.58/frequency)+0.5) b=A

q = Int(1024*(1-10000/(3*Q-1))+0.5)

Both parameters must be converted in hexadecimal.

Syntax:

#SF,w,c,b,f,q

where: w = [A,B,C]
c = [B,L,R]
b = [1,2,A,H,L]
f = [000..3FF]
q = [000..3FF]

A,B,C indicates the way the command is applied to (w).
B means “Both channels”.
L means “Left channel” (c).
R means “Right channel”
1 means “State Variable Filter 1”.
2 means “State Variable Filter 2”.
A means “All-pass” (b).
H means “1-pole High-pass”.
L means “1-pole Low-pass” (b).

Example 1:

#SF,A,L,L,045,1FF
OK

Selects the cut-off frequency of the 1-pole low-pass filter in the left channel of way A. as Q is not defined for a 1-pole filter, q may be any allowed value.

Example 2:

#SF,B,B,2,004,02A
OK

Selects the cut-off frequency of the second 2-pole state variable filter in both channels of way B.
The kind of filter is chosen by the SP command.

Example 3:

#SF,C,B,1,0F3
ERR

The command returns ERR because the ”q” parameter is missing.

8.1.2. Set Input (SI)

Input selection. The MITCHELL has two inputs: one single-ended and one balanced. Way A is directly connected to the selected input, while ways B and C can be connected to the selected input or to the output of the previous way (see examples).
The command has two parameters: the first one (w) indicates the way which will be affected by the command; the second one (I) indicates the choice for that way.

Syntax:

#SI,w,i

where: w = [A,B,C]
i = [B,U] when w=A
[M,P] when w = B or C

A,B,C indicates the way the command is applied to.
B means “Balanced”.
U means “Unbalanced” (single-ended).
M means “Main input”
P means “Previous input”

Example 1:

#SI,A,U
OK

Selects the single-ended (Unbalanced) input. The signal from the single-ended input will be sent to way A and, if not previously set otherwise, to ways B and C as well.

Example 2:

#SI,B,P

OK

Instructs the crossover to feed way B from the output of way A, therefore cascading the two filters to obtain a higher slope or a more complex configuration than those achievable with a single way.

Example 3:

#SI,A,B
OK
#SI,B,P
OK
#SI,C,M
OK

Configures the MITCHELL to use the balanced input, feeding way B from way A output and way C from the balanced input (chosen by the first command of the sequence). By default, the crossover is configured to feed all three ways from the single-ended input.

Example 4:

#SI,A,P
ERR

The command returns ERR because the ”P” value doesn't apply to way A.

8.1.3. Set Level (SL)

As explained earlier, the MITCHELL has a gain/attenuation block on each way which allows for equalizing the emissions of the various driver used in the system.
The command has four parameters: w indicates the way which will be affected by the command; c indicates the the channel affected by the command, a sets the attenuation and g sets the gain. The effective level is given by the following formula:

$$Level(dB) = g/2-(a-16)/2$$

Syntax:

#SL,w,c,a,g

where: w = [A,B,C,G]
c = [B,L,R]
a = [00..FF]
g = [00..3F]

A,B,C,G indicates the way the command is applied to. G means “General” to indicate that all ways will be affected.
B means “Both”.

L means “Left”.
R means “Right”

Example 1:

#SL,A,B,15,00
OK

Sets an attenuation of 2.5dB (that is, a gain of -2.5dB) for both channels of way A.

Example 2:

#SL,G,B,10,04
OK

Sets a gain of 2dB for all ways.

Example 3:

#SL,A,R,10
ERR

The command returns ERR because the g parameter is missing.

Example 4:

#SL,A,R,10,40
ERR

The command returns ERR because the g parameter is our of range.

8.1.4. Set Mode (SM)

The MITCHELL can be set for stereo operation (3 ways) or mono operation (6 ways) by this command.
The command has one parameter: m indicates the chosen mode.

Syntax:

#SM,m

where: m = [M.S]

M means “Mono”
S means “Stereo”

Example 1:

#SM.S

OK

Sets the MITCHELL to operate as a stereo 3-way crossover.
Example 2:

#SM.P
ERR

The command returns ERR because the ”P” value doesn't apply to this command

8.1.5. Set Path (SP)

Set the configuration for one or both channels in a way.
The command has three parameter: w is the way to be configured, c is the channel to be configured in the chosen way, p is the set configuration (in hex format). Please consult Appendix A for details on the various configurations available.

#SP,w,c,p

where: w = [A,B,C]
c = [B,L,R]
p = 4-digit hex number

A,B,C indicates the way the command is applied to.
B means “Both channels”.
L means “Left channel”.
R means “Right channel”.

Example 1:

#SP,A,B,44A0
OK

Set both channels of way A on the MITCHELL to operate as 6dB/Oct low-pass filter, non inverting.

Example 2:

#SP,B,L,9501
OK

Set left channel of way B on the MITCHELL to operate as 30dB/Oct high-pass filter, non inverting.

Example 3:

#SP,C,R,44
ERR

Command is wrong because the configuration value is not a 4-digit hex number.

8.1.6. Set Remote (SR)

Choice of the group code the MITCHELL will recognize when receiving an ON/OFF IR command.
The command has one parameter, that is the code to be recognized (in hex format).

#SR,c

where: c = [00,6A,96,A5]

00 means that the remote sensing is disabled.
6A means that the MITCHELL will accept commands with the same group code as M2Tech DAC's.
96 means that the MITCHELL will accept commands with the same group code as M2Tech amplifiers.
A5 means that the MITCHELL will accept commands with the same group code as M2Tech streamers.

Example 1:

#SR,00
OK

Disables the IR sensing. No ON/OFF command will have effect on the MITCHELL.

Example 2:

#SR,33
ERR

The command returns ERR because 33 is not amongst the group code the MITCHELL recognizes.

8.1.7. Set Standby (SS)

It is possible to toggle standby from configuration any time, provided the trigger input is not used, otherwise an error message will be produced.
The command has one parameter, which can be “1” (MITCHELL is active) or “0” (MITCHELL is in standby).

#SS,s

where: s = [0,1]

Example:

#SS,0

OK

Activates the MITCHELL. If the crossover is already active, the command has no effect.

8.2. Get commands

8.2.1. Get Configuration (GC)

Returns the complete configuration of the MITCHELL in verbose mode so that it can be easily read by the user.

Syntax:

#GC

Example:

#GC
WAY A, INPUT: FROM SINGLE-ENDED
WAY B, INPUT: FROM INPUT
WAY C, INPUT: FROM INPUT
MODE: STEREO
REMOTE: 00

LEFT, WAY A:
ALL PASS: 3E5
LOW PASS: 369
HIGH PASS: 1FF
SVF1: 369,237
SVF2: 3F1,237
PATH: 6440
LEVEL: 10,00

LEFT, WAY B:
ALL PASS: 3E5
LOW PASS: 3F1
HIGH PASS: 369
SVF1: 369,237
SVF2: 3F1,237
PATH: 5540
LEVEL: 10,00

LEFT, WAY C:
ALL PASS: 3E5
LOW PASS: 1FF
HIGH PASS: 3F1
SVF1: 369,237
SVF2: 3F1,237

PATH: 4401
LEVEL: 10,00

RIGHT, WAY A:
ALL PASS: 3E5
LOW PASS: 369
HIGH PASS: 1FF
SVF1: 1FE,1FF
SVF2: 1FE,1FF
PATH: 44A0
LEVEL: 10,00

RIGHT, WAY B:
ALL PASS: 3E5
LOW PASS: 3F1
HIGH PASS: 369
SVF1: 1FE,1FF
SVF2: 1FF,1FF
PATH: 4480
LEVEL: 10,00

RIGHT, WAY C:
ALL PASS: 3E5
LOW PASS: 1FF
HIGH PASS: 3F1
SVF1: 1FE,1FF
SVF2: 1FF,1FF
PATH: 4580
LEVEL: 10,00
END OF CONFIGURATION DUMP

8.2.2. Get Filter (GF)

Returns the frequency and Q for a filter block in one channel in a way.
Three parameters are required: w is the way, c is the channel and b is the filter block to be read.

Syntax:

#GF,w,c,b

where: w = [A,B,C]
c = [L,R]
b = [1,2,A,H,L]

A,B,C indicates the way the command is applied to (w).
L means “Left channel” (c).
R means “Right channel”
1 means “State Variable Filter 1”.
2 means “State Variable Filter 2”.

A means “All-pass” (b).
H means “1-pole High-pass”.
L means “1-pole Low-pass” (b).

Example 1:

#GF,A,L,L
100

Returns the cut-off frequency of the 1-pole low-pass filter in the left channel of way A. as Q is not defined for a 1-pole filter, q is “don't care” and it's not returned.

Example 2:

#GF,B,B,2
065,0A2

Returns the cut-off frequency of the second 2-pole state variable filter in both channels of way B.
Please note that this command can't tell which output of the stave variable filter is selected. Please use the GP command to get this information.

Example 3:

#GF,C,B,1
ERR

The command returns ERR because the it's not possible to read two channels at the same time.

8.2.3. Get Input (GI)

Returns the selected input for the specified way. If the way is A, then the command returns the chosen input on the back panel.
The command has one parameter: w indicates the way which input must be returned.

Syntax:

#GI,w

where: w = [A,B,C]

A,B,C indicates the way the command is applied to.

Example 1:

#GI,A
BALANCED

Example 2:

#GI,B
MAIN

Example 3:

#GI,C
PREVIOUS

Example 4:

#SI,G
ERR

The command returns ERR because the ”G” value doesn't apply to this command.

8.2.4. Get Level (GL)

Returns the level setting of the selected way and channel. Two parameters are required: w is the selected way, c is the selected channel

Syntax:

#GL,w,c

where: w = [A,B,C]
c = [L,R]

A,B,C indicates the way the command is applied to.
L means “Left”.
R means “Right”

Example 1:

#GL,A,L
10,00

Example 2:

#GL,A
ERR

The command returns ERR because the “c” parameter is missing.

8.2.5. Get Mode (GM)

Returns the operation mode the MITCHELL is set to.

Syntax:

GM

Example 1:

#GM
STEREO

8.2.6. Get Path (GP)

Returns the configuration of the selected way and channel as a 4-digit hex number.
The command has two parameter: w is the selected way, c is the selected channel. Please consult Appendix A for details on the various configurations available.

#GP,w,c

where: w = [A,B,C]
c = [L,R]

A,B,C indicates the way the command is applied to.
L means “Left channel”.
R means “Right channel”.

Example 1:

#GP,A,R
44A0

Example 2:

#SP,B,B
ERR

ERR is returned because “B” doesn't apply for c.

8.2.7. Get Remote (GR)

Returns the selected remote base code as a 2-digit hex number.

#GR

Example 1:

#GR
00

8.2.8. Get Status (GS)

Returns the MITCHELL status.

#GS

Example 1:

#GS
ACTIVE

Example 2:

#GS
STANDBY

8.2.9. Get Version (GV)

Returns the version of the active firmware.

#GV

Example 1:

#GV
1.06

8.3. Update commands

Update commands are used to handle the firmware update. While certain commands can be issued manually, the actual data transfer is a lengthy process which is hardly managed by a human and is generally performed by the related command in the configuration app. The commands are only listed below for reference.

8.3.1. Update Start (US)

Initiates or re-initiates the update procedure for the MITCHELL firmware.

Syntax:

#US

Example 1:

#US
READY

WARNING: this command forces the MITCHELL to totally delete and clear its program memory (except the boot block containing the update management code) and jump to the update routine. DO NOT send this command manually!

8.3.2. Update Data (UD)

Sends a block of 16 data bytes to the MITCHELL, in the form of 16 x 2-digit hex numbers plus a checksum. The checksum value is the lower byte of the sum of all 16 payload bytes.

Syntax:

#UD[16 x hh]cc

Where: hh,cc are 2-digit hex number

Example 1:

#UD14E6FF3430303030302F0AFFFFFFFFFFA3
OK

Example 2:

#UD8B00013F51FFFF04AAF330303030CC6F9E
WRITE

Note: checksums in both examples are not right values.

As the MITCHELL writes data in its memory in 64-byte blocks, 4 transfers are required from the host to the MITCHELL before a write in memory actually happens. Data are temporarily stored in MITCHELL's RAM memory until 64 bytes are available, then the write to the flash memory occurs. The MITCHELL acknowledges data reception and temporary storage in RAM with “OK”, while data reception and write to flash memory is acknowledged with “WRITE”.

8.3.3. Update End (UE)

Terminates the update procedure, eventually flushing to flash the data still in RAM.

Syntax:

#UE

Example 1:

#UE
OK

8.4. Configuration software

As manually configuring the MITCHELL can be cumbersome, particularly when frequencies and dumping factors must be calculated and converted in the numbers accepted by the MITCHELL via the SF command, M2TECH has developed a free configuration software running under Windows, called “Mitchell Configurator”.

The software allows for thoroughly configuring the MITCHELL, as well as for simulating the various filter modules frequency response graphs, uploading/downloading configurations and saving configuration parameters on files.

Figure 4: Mitchell Configurator basic layout

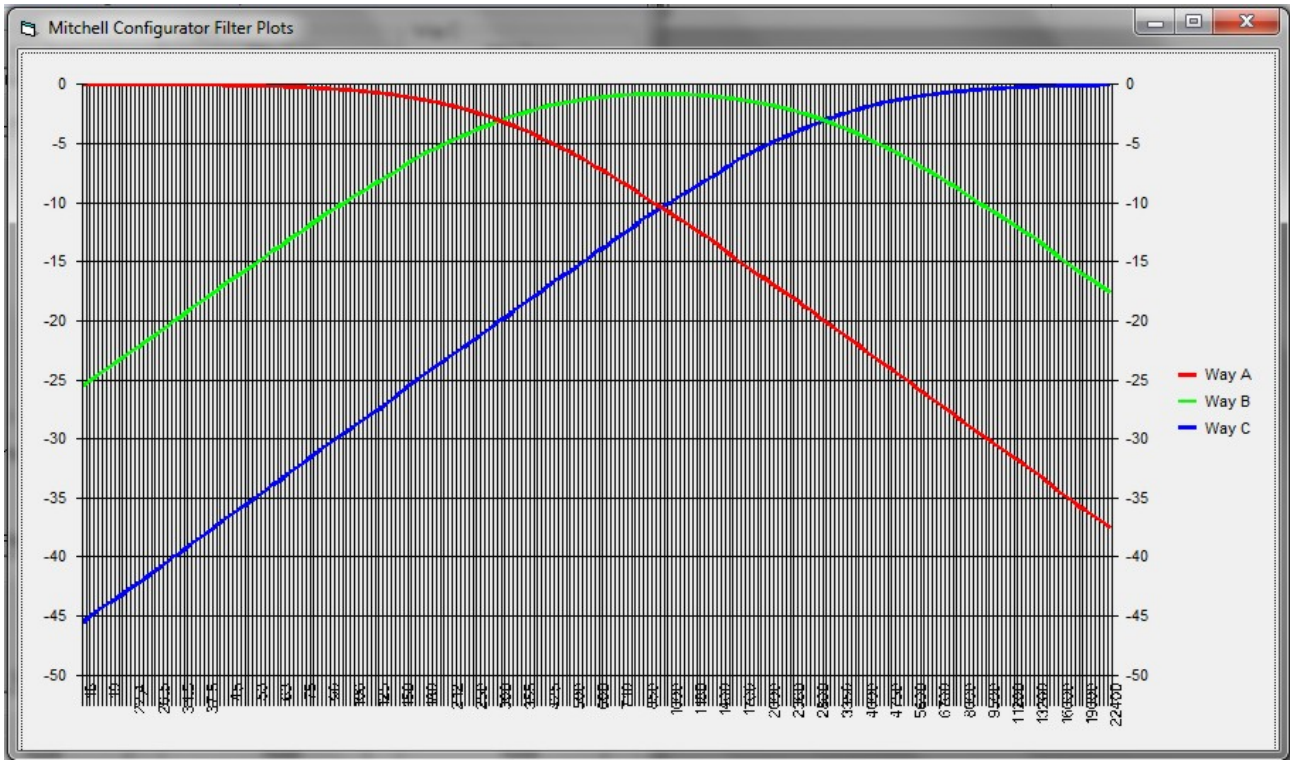

Figure 5: Mitchell Configurator Filter Plots

The use of the configuration software, albeit quite straightforward, is scope of a specific manual.

9. Specifications

Input and output headroom:	$9V_{rms}$ (single-ended) $18V_{rms}$ (balanced)
SNR:	110 to 120dB ($1V_{rms}$ in, $1V_{rms}$ out, A-weighted, depending on configurations)
THD+N:	0.015% (1Wrms on 4 Ohms)
Supply voltage:	$15V_{DC}$
Power consumption:	12VA
Size:	200x50x200mm (w x h x d)
Weight	2kg (device and ancillaries) 2.5kg (packed)

Appendix A: List of Available Configurations in the Configuration Software

Below is a list of all possible configurations which are generated by the configuration software when choosing a certain path and all-pass/inverting/notch bouquet and the related arguments to be passed with the #SP command.

A.1. Without all-pass

Low-pass, 6dB/Oct, non-inverting: 44A0
Low-pass, 6dB/Oct, inverting: 84A0
Low-pass, 12dB/Oct, non-inverting: 4460
Low-pass, 12dB/Oct, inverting: 8460
Low-pass, 18dB/Oct, non-inverting: 6460
Low-pass, 18dB/Oct, inverting: A460
Low-pass, 24dB/Oct, non-inverting: 4440
Low-pass, 24dB/Oct, inverting: 8440
Low-pass, 30dB/Oct, non-inverting: 6440
Low-pass, 30dB/Oct, inverting: A440

High-pass, 6dB/Oct, non-inverting: 4580
High-pass, 6dB/Oct, inverting: 8580
High-pass, 12dB/Oct, non-inverting: 44C0
High-pass, 12dB/Oct, inverting: 84C0
High-pass, 18dB/Oct, non-inverting: 55C0
High-pass, 18dB/Oct, inverting: 95C0
High-pass, 24dB/Oct, non-inverting: 4401
High-pass, 24dB/Oct, inverting: 8401
High-pass, 30dB/Oct, non-inverting: 5501
High-pass, 30dB/Oct, inverting: 9501

Band-pass, 6-6dB/Oct, non-inverting: 4480
Band-pass, 6-6dB/Oct, inverting: 8480
Band-pass, 6-12dB/Oct, non-inverting: 6560
Band-pass, 6-12dB/Oct, inverting: A560
Band-pass, 6-18dB/Oct, non-inverting: 5460
Band-pass, 6-18dB/Oct, inverting: 9460
Band-pass, 6-24dB/Oct, non-inverting: 5540
Band-pass, 6-24dB/Oct, inverting: 9540
Band-pass, 6-30dB/Oct, non-inverting: 5440
Band-pass, 6-30dB/Oct, inverting: 9440

Band-pass, 12-6dB/Oct, non-inverting: 64C0
Band-pass, 12-6dB/Oct, inverting: A4C0
Band-pass, 12-12dB/Oct, non-inverting: 4400

Band-pass, 12-12dB/Oct, inverting: 8400
Band-pass, 12-18dB/Oct, non-inverting: 6400
Band-pass, 12-18dB/Oct, inverting: A400

Band-pass, 18-6dB/Oct, non-inverting: 54C0
Band-pass, 18-6dB/Oct, inverting: 94C0
Band-pass, 18-12dB/Oct, non-inverting: 5500
Band-pass, 18-12dB/Oct, inverting: 9500
Band-pass, 18-18dB/Oct, non-inverting: 5400
Band-pass, 18-18dB/Oct, inverting: 9400

Band-pass, 24-6dB/Oct, non-inverting: 6401
Band-pass, 24-6dB/Oct, inverting: A401

Band-pass, 30-6dB/Oct, non-inverting: 5401
Band-pass, 30-6dB/Oct, inverting: 9401

Notch, non-inverting: 44E0
Notch, inverting: 84E0
Double notch, non-inverting: 4423
Double notch, inverting: 8423

Low-pass, 6dB/Oct + notch, non-inverting: 64A0
Low-pass, 6dB/Oct + notch, inverting: A4A0
Low-pass, 6dB/Oct + double notch, non-inverting: 6423
Low-pass, 6dB/Oct + double notch, inverting: A423
Low-pass, 12dB/Oct + notch, non-inverting: 4420
Low-pass, 12dB/Oct + notch, inverting: 8420
Low-pass, 18dB/Oct + notch, non-inverting: 6420
Low-pass, 18dB/Oct + notch, inverting: A420

High-pass, 6dB/Oct + notch, non-inverting: 55E0
High-pass, 6dB/Oct + notch, inverting: 95E0
High-pass, 6dB/Oct + double notch, non-inverting: 5523
High-pass, 6dB/Oct + double notch, inverting: 9523
High-pass, 12dB/Oct + notch, non-inverting: 4421
High-pass, 12dB/Oct + notch, inverting: 8421
High-pass, 18dB/Oct + notch, non-inverting: 5421
High-pass, 18dB/Oct + notch, inverting: 9421

Band-pass, 6-6dB/Oct + notch, non-inverting: 54E0
Band-pass, 6-6dB/Oct + notch, inverting: 94E0
Band-pass, 6-6dB/Oct + double notch, non-inverting: 5423
Band-pass, 6-6dB/Oct + double notch, inverting: 9423
Band-pass, 6-12dB/Oct + notch, non-inverting: 5520
Band-pass, 6-12dB/Oct + notch, inverting: 9520
Band-pass, 6-18dB/Oct + notch, non-inverting: 5420
Band-pass, 6-18dB/Oct + notch, inverting: 9420
Band-pass, 12-6dB/Oct + notch, non-inverting: 6421
Band-pass, 12-6dB/Oct + notch, inverting: A421

Band-pass, 18-6dB/Oct + notch, non-inverting: 5521
Band-pass, 18-6dB/Oct + notch, inverting: 9521

Shelving, non-inverting: 0500
Shelving, inverting:.....C500
Shelving + notch, non-inverting:.....75E0
Shelving + notch, inverting:.....B5E0
Shelving + double notch, non-inverting:.....7523
Shelving + double notch, inverting:.....B523

Low-pass, 12dB/Oct + shelving, non-inverting:.....7560
Low-pass, 12dB/Oct + shelving, inverting:.....B560
Low-pass, 12dB/Oct + shelving + notch, non-inverting:.....7520
Low-pass, 12dB/Oct + shelving + notch, inverting:.....B520
Low-pass, 24dB/Oct + shelving, non-inverting:.....7540
Low-pass, 24dB/Oct + shelving, inverting:.....B540

High-pass, 12dB/Oct + shelving, non-inverting:.....75C0
High-pass, 12dB/Oct + shelving, inverting:.....B5C0
High-pass, 12dB/Oct + shelving + notch, non-inverting:.....7521
High-pass, 12dB/Oct + shelving + notch, inverting:.....B521
High-pass, 24dB/Oct + shelving, non-inverting:.....7501
High-pass, 24dB/Oct + shelving, inverting:.....B501

Band-pass, 12-12dB/Oct + shelving, non-inverting:.....7500
Band-pass, 12-12dB/Oct + shelving, inverting:.....B500

A.2. With all-pass

Low-pass, 6dB/Oct, non-inverting:.....46A0
Low-pass, 6dB/Oct, inverting:.....86A0
Low-pass, 12dB/Oct, non-inverting:.....4660
Low-pass, 12dB/Oct, inverting:.....8660
Low-pass, 18dB/Oct, non-inverting:.....6660
Low-pass, 18dB/Oct, inverting:.....A660
Low-pass, 24dB/Oct, non-inverting:.....4640
Low-pass, 24dB/Oct, inverting:.....8640
Low-pass, 30dB/Oct, non-inverting:.....6640
Low-pass, 30dB/Oct, inverting:.....A640

High-pass, 6dB/Oct, non-inverting:.....4780
High-pass, 6dB/Oct, inverting:.....8780
High-pass, 12dB/Oct, non-inverting:.....46C0
High-pass, 12dB/Oct, inverting:.....86C0
High-pass, 18dB/Oct, non-inverting:.....57C0
High-pass, 18dB/Oct, inverting:.....98C0
High-pass, 24dB/Oct, non-inverting:.....4601
High-pass, 24dB/Oct, inverting:.....8601
High-pass, 30dB/Oct, non-inverting:.....5701

High-pass, 30dB/Oct, inverting:	9701
Band-pass, 6-6dB/Oct, non-inverting:	4680
Band-pass, 6-6dB/Oct, inverting:	8680
Band-pass, 6-12dB/Oct, non-inverting:	6760
Band-pass, 6-12dB/Oct, inverting:	A760
Band-pass, 6-18dB/Oct, non-inverting:	5860
Band-pass, 6-18dB/Oct, inverting:	9660
Band-pass, 6-24dB/Oct, non-inverting:	5740
Band-pass, 6-24dB/Oct, inverting:	9740
Band-pass, 6-30dB/Oct, non-inverting:	5640
Band-pass, 6-30dB/Oct, inverting:	9640
Band-pass, 12-6dB/Oct, non-inverting:	66C0
Band-pass, 12-6dB/Oct, inverting:	A6C0
Band-pass, 12-12dB/Oct, non-inverting:	4600
Band-pass, 12-12dB/Oct, inverting:	8600
Band-pass, 12-18dB/Oct, non-inverting:	6600
Band-pass, 12-18dB/Oct, inverting:	A600
Band-pass, 18-6dB/Oct, non-inverting:	56C0
Band-pass, 18-6dB/Oct, inverting:	96C0
Band-pass, 18-12dB/Oct, non-inverting:	5700
Band-pass, 18-12dB/Oct, inverting:	9700
Band-pass, 18-18dB/Oct, non-inverting:	5600
Band-pass, 18-18dB/Oct, inverting:	9600
Band-pass, 24-6dB/Oct, non-inverting:	6601
Band-pass, 24-6dB/Oct, inverting:	A601
Band-pass, 30-6dB/Oct, non-inverting:	5601
Band-pass, 30-6dB/Oct, inverting:	9601
Notch, non-inverting:	46E0
Notch, inverting:	86E0
Double notch, non-inverting:	4623
Double notch, inverting:	8623
Low-pass, 6dB/Oct + notch, non-inverting:	66A0
Low-pass, 6dB/Oct + notch, inverting:	A6A0
Low-pass, 6dB/Oct + double notch, non-inverting:	6623
Low-pass, 6dB/Oct + double notch, inverting:	A623
Low-pass, 12dB/Oct + notch, non-inverting:	4620
Low-pass, 12dB/Oct + notch, inverting:	8620
Low-pass, 18dB/Oct + notch, non-inverting:	6620
Low-pass, 18dB/Oct + notch, inverting:	A620
High-pass, 6dB/Oct + notch, non-inverting:	57E0
High-pass, 6dB/Oct + notch, inverting:	97E0
High-pass, 6dB/Oct + double notch, non-inverting:	5723

High-pass, 6dB/Oct + double notch, inverting:.....9723
High-pass, 12dB/Oct + notch, non-inverting: 4621
High-pass, 12dB/Oct + notch, inverting: 8621
High-pass, 18dB/Oct + notch, non-inverting: 5621
High-pass, 18dB/Oct + notch, inverting: 9621

Band-pass, 6-6dB/Oct + notch, non-inverting: 56E0
Band-pass, 6-6dB/Oct + notch, inverting: 96E0
Band-pass, 6-6dB/Oct + double notch, non-inverting: 5623
Band-pass, 6-6dB/Oct + double notch, inverting:.....9623
Band-pass, 6-12dB/Oct + notch, non-inverting: 5720
Band-pass, 6-12dB/Oct + notch, inverting: 9720
Band-pass, 6-18dB/Oct + notch, non-inverting: 5620
Band-pass, 6-18dB/Oct + notch, inverting: 9620
Band-pass, 12-6dB/Oct + notch, non-inverting: 6621
Band-pass, 12-6dB/Oct + notch, inverting: A621
Band-pass, 18-6dB/Oct + notch, non-inverting: 5721
Band-pass, 18-6dB/Oct + notch, inverting: 9721

Shelving, non-inverting: 0700
Shelving, inverting:.....C700
Shelving + notch, non-inverting:.....77E0
Shelving + notch, inverting:.....B7E0
Shelving + double notch, non-inverting:.....7723
Shelving + double notch, inverting:.....B723

Low-pass, 12dB/Oct + shelving, non-inverting:.....7760
Low-pass, 12dB/Oct + shelving, inverting:.....B760
Low-pass, 12dB/Oct + shelving + notch, non-inverting:.....7720
Low-pass, 12dB/Oct + shelving + notch, inverting:.....B720
Low-pass, 24dB/Oct + shelving, non-inverting:.....7740
Low-pass, 24dB/Oct + shelving, inverting:.....B740

High-pass, 12dB/Oct + shelving, non-inverting:.....77C0
High-pass, 12dB/Oct + shelving, inverting:.....B7C0
High-pass, 12dB/Oct + shelving + notch, non-inverting:.....7721
High-pass, 12dB/Oct + shelving + notch, inverting:.....B721
High-pass, 24dB/Oct + shelving, non-inverting:.....7701
High-pass, 24dB/Oct + shelving, inverting:.....B701

Band-pass, 12-12dB/Oct + shelving, non-inverting:.....7700
Band-pass, 12-12dB/Oct + shelving, inverting:.....B700