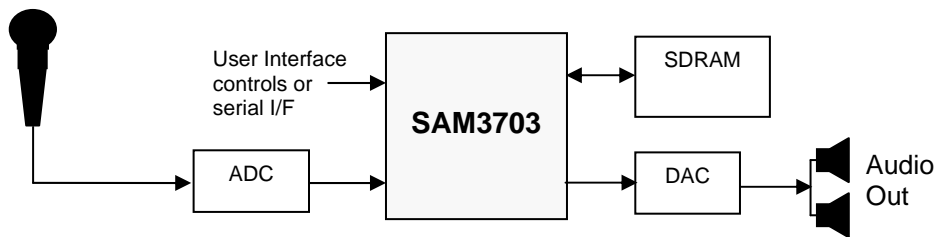
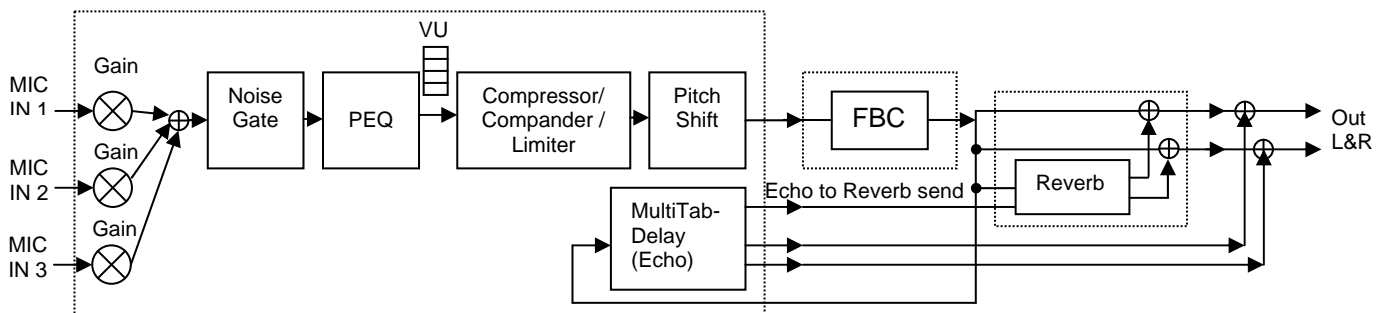


The SAM3703, driven by the firmware 3703MICFX is a low cost, high quality Multi-Effect Device especially made for Vocal FX applications, like Microphone Amplifiers and Karaoke Products. The SAM3703 includes a Microcontroller and three 24-bit DSP engines with embedded RAM and secure memory for code protection.

The low cost hardware consists of SAM3703 + SDRAM (optional) + ADC/DAC:



Signal Processing



Features

- Microphone Effect Processing:
 - up to 3 Microphone inputs with individual gain control
 - Low-Cut Filter in input, Noise Gate, Compressor / **Compander** / Limiter
 - Tone control: 4 bands parametric Equalizer (+/- 12dB at ~0.2dB steps)
 - Pitch Shifter: Key control (up to +/- 1 octave) & Funny Effects
 - Stereo Reverb
 - Stereo Echo (up to 1,35sec with external SDRAM)
- **Feedback Canceling** based on Frequency Analysis and Notch Filtering (12 Filters)
- 48 KHz sampling rate (12.288 MHz quartz), 24 bit quality

NRPN Controls

Midi Non-Registered-Parameter-Number can be used to control precisely each parameter of each module.

NRPN's are sent through 3 midi controls:

- Select first NRPN High: Midi control 99 (midi message BxH 63H nnH)
- Then select NRPN Low: Midi control 98 (midi message BxH 62H nnH)
- Then send NRPN Value: Midi control 6 (midi message BxH 06H nnH)

If needed a 14bit scale for NRPN Value, a 4th Midi control must be sent, after sending the 3 midi controls above,

- send NRPN Value (LSB): Midi control 38 (midi message BxH 26H nnH)

NRPNs concerning general setting are sent on midi channel 0 (BxH = B0H).

NRPN High	NRPN Low	Description	Midi channel (x = don't care)
Input Channel Controls			
08	01	Input Gain 1, Micro 1 Level (default=90)	X
08	02	Input Gain 2, Micro 2 Level (default = 0)	X
08	03	Input Gain 3, Micro 3 Level (default = 0)	X
Compander/Compressor/Limiter Controls			
05	00	Compressor ON/OFF: 0= OFF, else ON (default OFF)	X
05	09	Compressor Preset (See Compressor Preset table in paragraph A.1)	X
05	01	Attack time: 0=fast attack (0.1ms), ... 60=1ms, ... 100=10ms, till 127=slow attack (100ms), exp. curve (default 60=1ms)	X
05	02	Release time: 0=fast release (10ms), ... 60=100ms, ... 100=1s, till 127=slow release (~5s), exp. curve (default 60=100ms)	X
05	03	Threshold: 127=0dB, 126= -1/3dB, 125= -2/3dB, 124= -1dB, ... 7= -40dB, 1= -42dB, 0=-Inf (step = 1/3dB, default = 109, -6dB)	X
05	04	Ratio: 127=1/128, 126=2/128 (1/64), 125=3/128, ... 64=64/128 (1/2), ... 0=1/1 (default = 64)	X
05	05	Threshold2: 127=0dB, 126= -1/3dB, 125= -2/3dB, 124= -1dB, ... 7= -40dB, 1= -42dB, 0=-Inf (step = 1/3dB, default = 31, -32dB)	X
05	06	Ratio2: 127=1/128, 126=2/128 (1/64), 125=3/128, ... 64=64/128 (1/2), ... 0=1/1 (default = 64)	X
Noise Gate Controls			
05	08	Input Channel Noise Gate Threshold level Threshold: 127=-24dB, 126= -24-1/3dB, 125= -24-2/3dB, 124= -25dB, ... 7= -64dB, 1= -66dB, 0=-Inf (step = 1/3dB, default = 73, -42dB)	X
Parametric Equalizer			
09	00	On/Off, = 0 (Equalizer OFF) or 127 (Equalizer ON) (default=0, OFF)	X
09	04	Low Band Gain (0 to 127), 0=-12dB...64=0dB...127=+12dB (Default=64)	X
09	05	Low_Mid Band Gain (0 to 127), 0=-15dB...64=0dB...127=+15dB (Default=64)	X
09	06	High_Mid Band Gain (0 to 127), 0=-15dB...64=0dB...127=+15dB (Default=64)	X
09	07	High Band Gain (0 to 127), 0=-12dB...64=0dB...127=+12dB (Default=64)	X
09	08	Low Band Freq: 0=~80Hz...64=~500Hz...127=~1KHz (Default=10, ~100Hz)	X
09	09	Low_Mid Band Freq: 0=~60Hz...64=~1,25kHz...127=~2,5kHz (Default=36, ~750Hz)	X
09	0A	High_Mid Band Freq: 0=~60Hz...64=~5,12kHz...127=~10,3kHz (Default=127, ~10kHz)	X
09	0B	High Band Freq: 0=~180Hz...64=~1,5kHz...127=~3kHz (Default=127)	X
09	0D	Low_Mid Band Resonance: 0:Q=1, ... 127:Q=20 (Default=64)	X
09	0E	High_Mid Band Resonance: 0:Q=1, ... 127:Q=20 (Default=64)	X

Pitch Shift Controls			
06	00	Pitch Shift ON/OFF: 0=OFF, else ON (default=0, OFF)	X
06	05	Pitch Shift Preset (See Pitch Shift Preset table in paragraph A.2)	X
06	01	14 bit MSB, Pitch Shift coarse tune: 52= -1 octave, 53= -11 half tones, ..., 63=-1 half tone, 64=0, 65=+1 half tone, 66=+2 half tones, ..., 76= +1 octave (default=64)	X
		14 bit LSB, Pitch Shift fine tune: 0= -1/2 halftone, ... 64=no detune, ...127= +1/2 halftone (default=64)	X
06	02	Pitch Filter Frequency, 0=0Hz, 127= Fs/2 (default=127)	X
06	03	Pitch Filter Resonance, 0=full resonance, ... 127= no resonance (default=127)	X
06	04	Pitch Filter Mix, 0 = Direct signal, ... 127 = Pitch shifted signal (default=127)	X

Reverb Controls			
03	00	Reverb preset (0 to 12h): (see Reverb preset table in paragraph A.3) 0: Off 1: short room A 2: short room B 3: short room C 4: room A 5: room B 6: small hall A 7: small hall B 8: large hall A 9: large hall B 10: short plate 11: vocal plate 12: church A 13: church B 14: cathedral 15: gated reverb A 16: gated reverb B 17: gated plate 18: gated plate B 27: Spring Reverb	X
03	01	Reverb Pre High Pass Filter, 0=Off, ... 64~=480Hz to 127~=960Hz, (default=0)	X
03	02	Reverb Pre High Shelf Filter, 0=-12dB, ... 64=0dB, ... 127=+12dB (default=64, 0dB)	X
03	03	Reverb Pre Delay (0 to 127, 0..250ms), default value depending on preset	X
03	04	Reverb Level (0 to 127), default=72	X
03	05	Reverb Time (0 to 127), default=64	X
03	06	Echo Feedback (0 to 127), default=64	X
03	07	Reverb HDAMP (0 to 127), default value depending on preset	X
03	08	Reverb Gate Threshold (0 to 127) (for gated reverb presets only)	X
03	09	Direct Level (0 to 127), default=127	X
03	0A	Direct Reverb Send (0 to 127), default=0	X

Echo Controls			
04	00	Echo Preset (0 to 4): (see Echo preset table in paragraph A.4) 0=Off 1=mono echo, 2=Stereo echo, 3=Triplet echo, 4=Multi Tap	X
04	01	Echo Pre High Pass Filter, 0=OFF, ... 64~=120Hz, ... 127~=240Hz, (default=0)	X
04	02	Echo Pre High Shelf Filter Gain, 0=-12dB, ... 64=0dB, ... 127=+12dB (default=64, 0dB)	X
04	03	Echo Send to Reverb: 0...127, (default=0)	X
04	04	Echo Level: 0...127, (default=127)	X
04	05	Echo Delay: 0=0ms, ... 64=682ms, ...127=1365ms, (default=127, 1365ms)	X
04	06	Echo Feedback: 0...127, (default=64)	X
04	07	Echo HDamp Filter: 0...127, (default=64)	X
04	08	Echo Input Level: 0...127, (default =64)	X
04	09	Echo Main Tap Level (14bit), MSB=Left level(default=95), LSB=Right level(default=31) (see Appendix A.4.1)	X
04	0A	Echo 1 st Tap level(14bit), MSB= Left level(default=0), LSB= Right level(default=0) (see A.4.1)	X
04	0B	Echo 2 nd Tap level(14bit), MSB= Left level(default=0), LSB= Right level(default=0) (see A.4.1)	X
04	0C	Echo 3 rd Tap level(14bit), MSB= Left level(default=31), LSB= Right level(default=95) (see A.4.1)	X
04	0D	Echo 1 st Tap time, % of Main delay: 0...127, (default=102) (see Appendix A.4.1)	X
04	0E	Echo 2 nd Tap time, % of Main delay: 0...127, (default=77) (see Appendix A.4.1)	X
04	0F	Echo 3 rd Tap time, % of Main delay: 0...127, (default=64) (see Appendix A.4.1)	X

How to load FBC frequencies?

To load FBC frequencies, send back the sysEx message got by NRPN 0C30h.

For example:

If you received the following sysEx message from 0C30h command:

```
F0 00 20 00 00 00 43 00 00 02 06 06 01 03 7F 40 02 55  
01 21 6D 02 07 5D 43 07 5E 44 0D 00 05 14 00 06 14 33  
07 1C 31 48 1D 38 09 08 42 2A 0C 41 4B F7
```

Then to load frequencies, send back the same SysEx message:

```
F0 00 20 00 00 00 43 00 00 02 06 06 01 03 7F 40 02 55  
01 21 6D 02 07 5D 43 07 5E 44 0D 00 05 14 00 06 14 33  
07 1C 31 48 1D 38 09 08 42 2A 0C 41 4B F7
```

Compressor/Compander/Limiter Presets

Preset is selected by using midi NRPN 0509h:
 B0h 63h 05h B0h 62h 09h B0h 06h XX

XX: preset number, from 0 to 9. (see list below)

COMPRESSOR/COMPANDER/LIMITER PRESETS

Nb	Name	Preset Default values					
		Attack Nrpn 0501h	Release Nrpn 0502h	Threshold Nrpn 0503h	Ratio Nrpn 0504h	Threshold2 Nrpn 0505h	Ratio2 Nrpn 0506h
0	NO COMPRESSION	64	0	127	0	0	0
COMPRESSOR / COMPANDER							
1	COMPRESSOR 1: -18dB 2:1	64	0	16	64	0	0
2	COMPRESSOR 2: -15dB 3:1	64	0	22	84	0	0
3	COMPRESSOR 3: -21dB 7:1	64	0	11	110	0	0
4	COMPRESSOR 4: -24dB 12:1	64	0	8	117	0	0
5	COMPRESSOR 5: -18dB 5:1 COMPANDER -24dB 2:1	64	0	16	100	8	64
6	COMPRESSOR 6: -6dB 12:1 COMPANDER -24dB 12:1	64	0	64	117	8	117
LIMITER / LIMANDER							
7	LIMITER 1: -6dB	0	64	64	127	0	0
8	LIMITER 2: -18dB	0	64	16	127	0	0
9	LIMITER 3: -12dB LIMANDER: -24dB	0	64	32	127	8	127

Pitch Shift Presets

Preset is selected by using midi NRPN 0605h:
 B0h 63h 06h B0h 62h 05h B0h 06h XX

XX: preset number, from 0 to 32. (see list below)

PITCH SHIFT PRESETS

Nb	Name	Preset Default values				
		Coarse Tune Nrpn 0601h 14bit MSB	Fine tune Nrpn 0601h 14bit LSB	Filter Cut Frequency Nrpn 0602h	Filter Resonance Nrpn 0603h	Pitch shifted signal Nrpn 0604h
VOCAL PITCH SHIFT						
1	Male Voice	61	0	127	0	127
2	Robot Voice	58	0	96	120	127
3	Dark Voice 1	55	0	64	64	127
4	Dark Voice 2	52	0	32	110	127
5	Female Voice	67	0	127	0	127
6	Duck Voice	70	0	64	110	127
7	Mouse Voice 1	73	0	64	0	127
8	Mouse Voice 2	76	0	64	0	127
9	Choir (Doubling)	64	12	127	0	64

Notes:

Some Pitch Shift Presets are using an additional 12dB low pass filter with Resonance for doing special sound effects (e.g. in "Dark Voice" or "Robot Voice").

Reverb/Gate Presets

Preset is selected by using midi NRPN 0300h:
B0h 63h 03h B0h 62h 00h B0h 06h XX

XX: preset number, from 0 to 18. (see list below)

REVERB/GATE PRESETS

Nb	Name	Preset Default Values			
		Volume Nrpn 0304h	Time Nrpn 0303h / 0305h	Hdamp Nrpn 0307h	ThresGate Nrpn 0308h
0	OFF	0	/	/	/
REVERB					
1	Short Room A	56	52	127	/
2	Short Room B	56	52	96	/
3	Short Room C	56	52	64	/
4	Room A	56	60	64	/
5	Room B	56	60	64	/
6	Small Hall A	56	60	48	/
7	Small Hall B	56	60	48	/
8	Large Hall A	56	72	48	/
9	Large Hall B	56	72	32	/
10	Short Plate	56	72	0	/
11	Vocal Plate	56	72	0	/
12	Church A	56	72	48	/
13	Church B	56	72	32	/
14	Cathedral	56	72	0	/
GATE					
15	Gated Reverb A	56	64	64	16
16	Gated Reverb B	56	64	48	16
17	Gated Plate A	56	64	0	16
18	Gated Plate B	56	64	0	16
27	Spring Reverb	56	64	32	/

Echo Presets

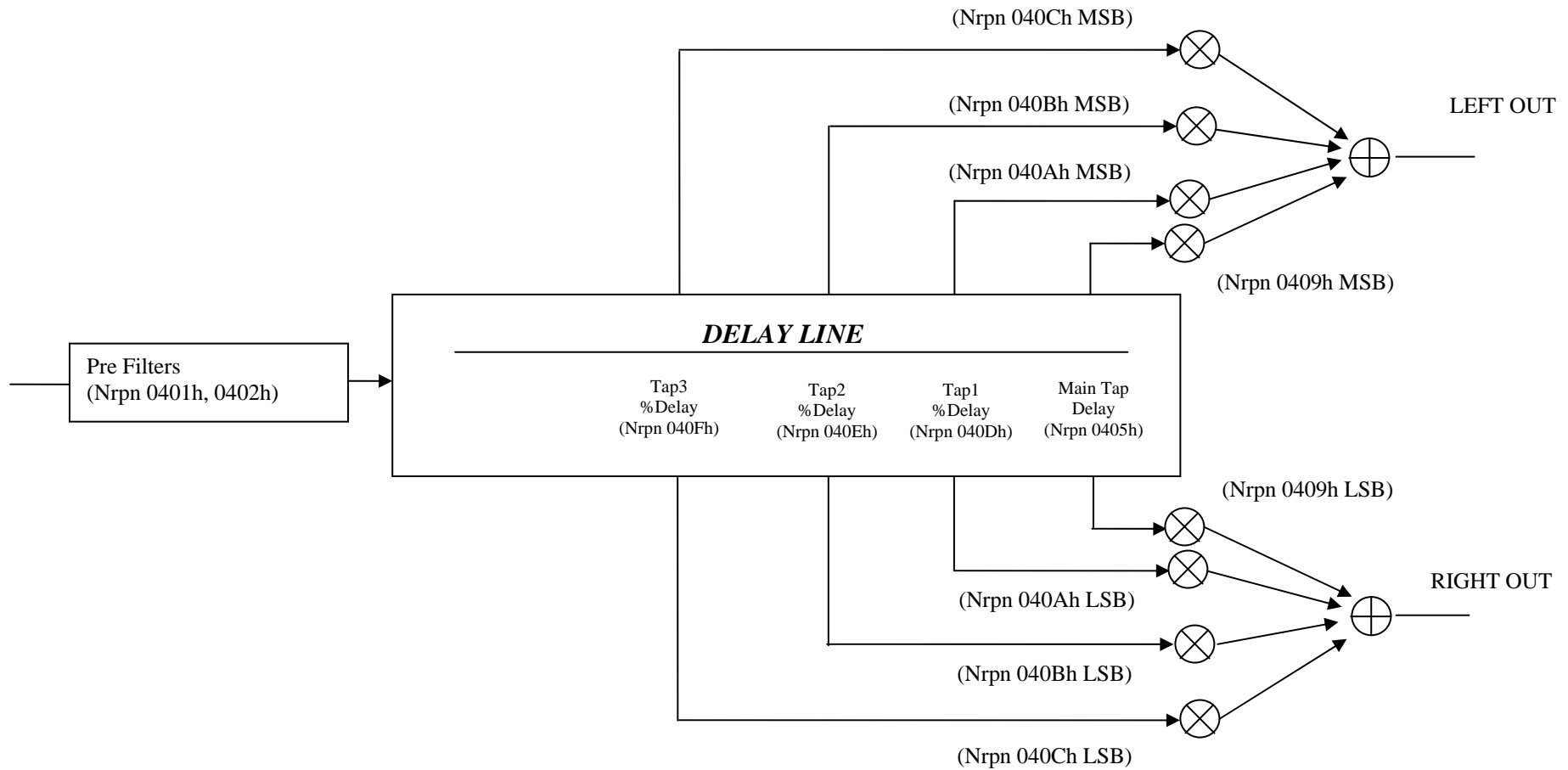
Preset is selected by using midi NRPN 0400h:
B0h 63h 04h B0h 62h 00h B0h 06h XX

XX: preset number, from 0 to 4. (see list below)

ECHO PRESETS

Nb	Name	Preset Default Values			
		Volume Nrpn 0404h	Delay Nrpn 0405h	Feedback Nrpn 0406h	Hdamp Nrpn 0407h
0	OFF	0	/	/	/
1	Delay 1: Mono	64	30	64	0
2	Delay 2: Stereo	64	30	64	0
3	Delay 3: Stereo Triplet	64	30	64	0
4	Delay 4: Multi-Tap	64	30	64	0

A.4.1 Echo MultiTap Structure

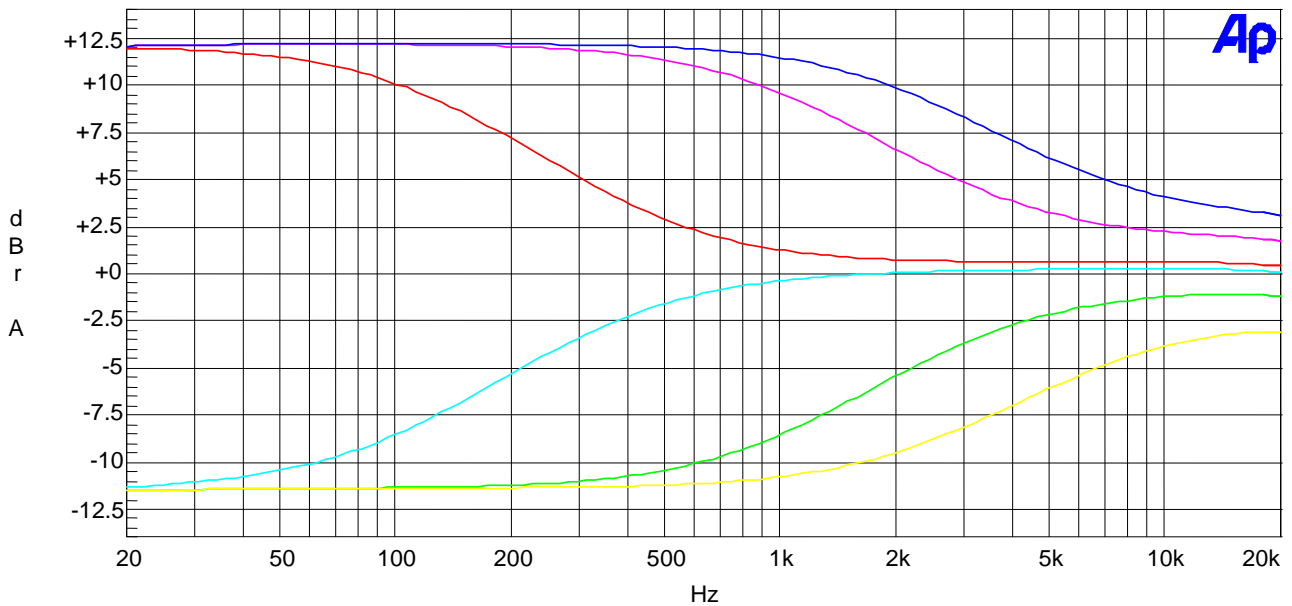


Parametric Equalizer

Parametric Equalizer is a 4 band equalizer, a low shelf filter, 2 parametric mid bands, and a high shelf filter. For low and high shelf filters the gain can be set from -12dB to $+12\text{ dB}$, for the 2 middle bands the gain can be set from -15dB to $+15\text{ dB}$, Q factor can be set from 1 to 20.

Low Shelf filter

The low pass Shelf Filter frequency range is from 80 Hz to 1 kHz. The following diagram shows the behavior of low pass filter at different frequencies:



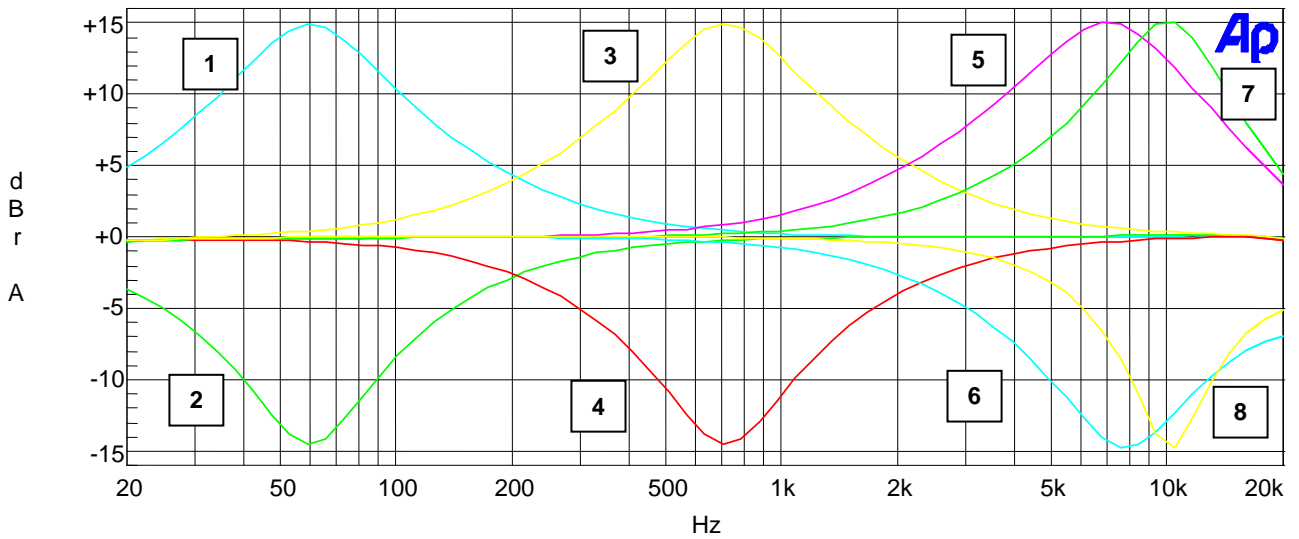
Red and cyan: frequency midi value is 0 (80Hz) at $+12$ and -12 dB

Magenta and green: frequency midi value is 64 (500Hz) at $+12$ and -12 dB

Blue and yellow: when frequency midi value is 127 (1KHz) at $+12$ and -12 dB

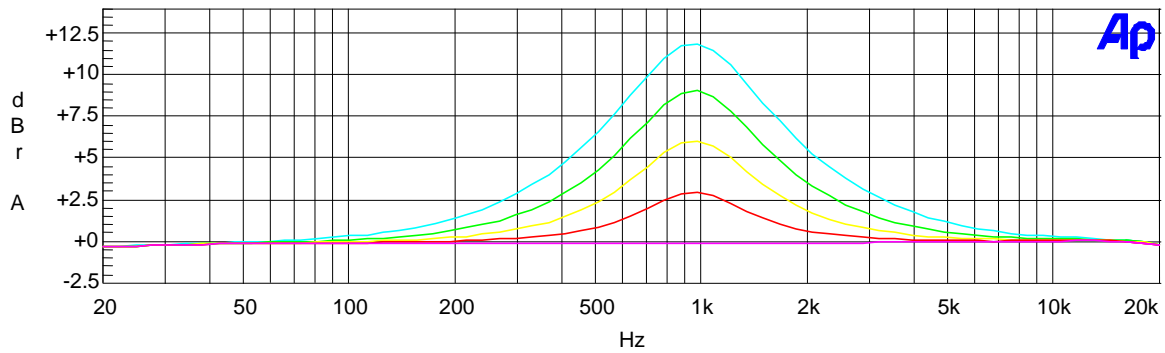
Middle BandPass/BandStop filter

Frequency NRPN value are between 0 and 127, (respectively from 60Hz to 10,3 kHz). Measurements are done at -15dB and +15dB, and Q of 1.0



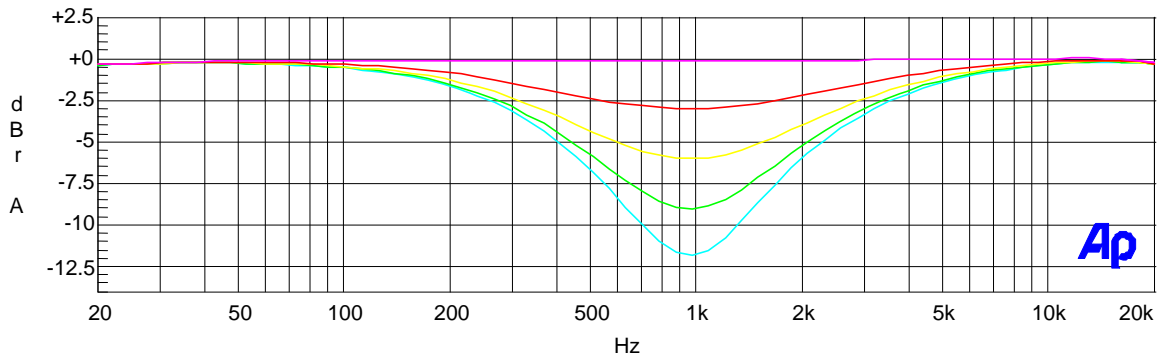
Sweep	Color	Comment
1	Cyan	Gain=127(+15dB) Fc=0(60Hz) Q=0 (1)
2	Green	Gain=0(-15dB) Fc=0(60Hz) Q=0 (1)
3	Yellow	Gain=127(+15dB) Fc=9(700Hz) Q=0 (1)
4	Red	Gain=0(-15dB) Fc=9(700Hz) Q=0 (1)
5	Magenta	Gain=127(+15dB) Fc=88(7kHz) Q=0 (1)
6	Cyan	Gain=0(-15dB) Fc=88(7kHz) Q=30
7	Green	Gain=127(+15dB) Fc=127(10,3kHz) Q=41
8	Yellow	Gain=5(-15dB) Fc=127(10,3kHz) Q = 72

For Boost, Cut and Q, measurements are done at 1kHz, boost gain NRPN value are from 64 to 127, (respectively from 0dB to +15dB):



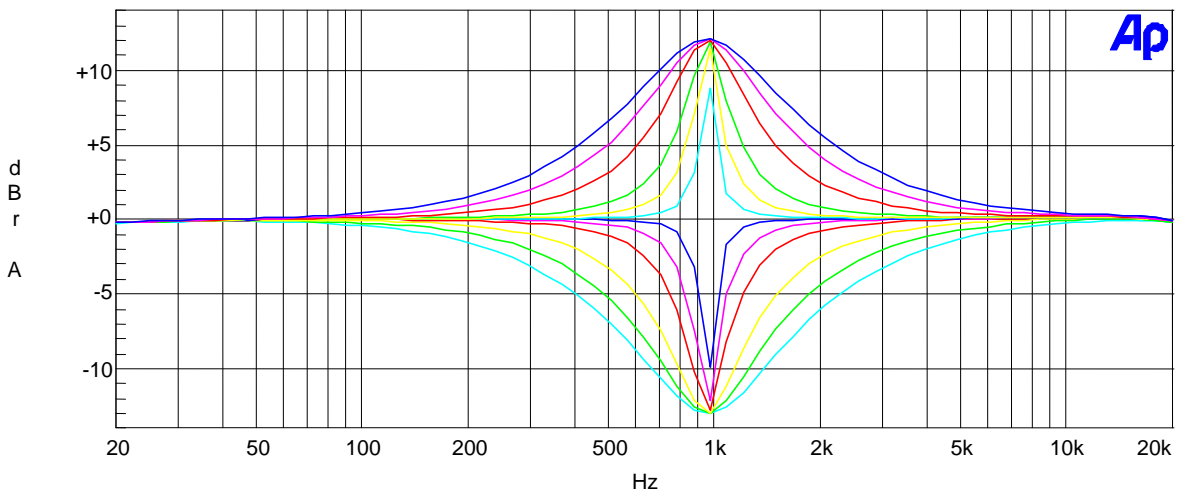
Sweep	Trace	Color	Comment
1	1	Cyan	Gain=120(+12dB)
2	1	Green	Gain=100(+9dB)
3	1	Yellow	Gain=82(+6dB)
4	1	Red	Gain=69(+3dB)
5	1	Magenta	Gain=64(0dB)

Cut gain NRPN value are from 0 to 64, (respectively from -15dB to 0dB):



Sweep	Trace	Color	Comment
1	1	Cyan	Gain=4 (-12dB)
2	1	Green	Gain=12 (-9dB)
3	1	Yellow	Gain=24 (-6dB)
4	1	Red	Gain=41 (-3dB)
5	1	Magenta	Gain=64(0dB)

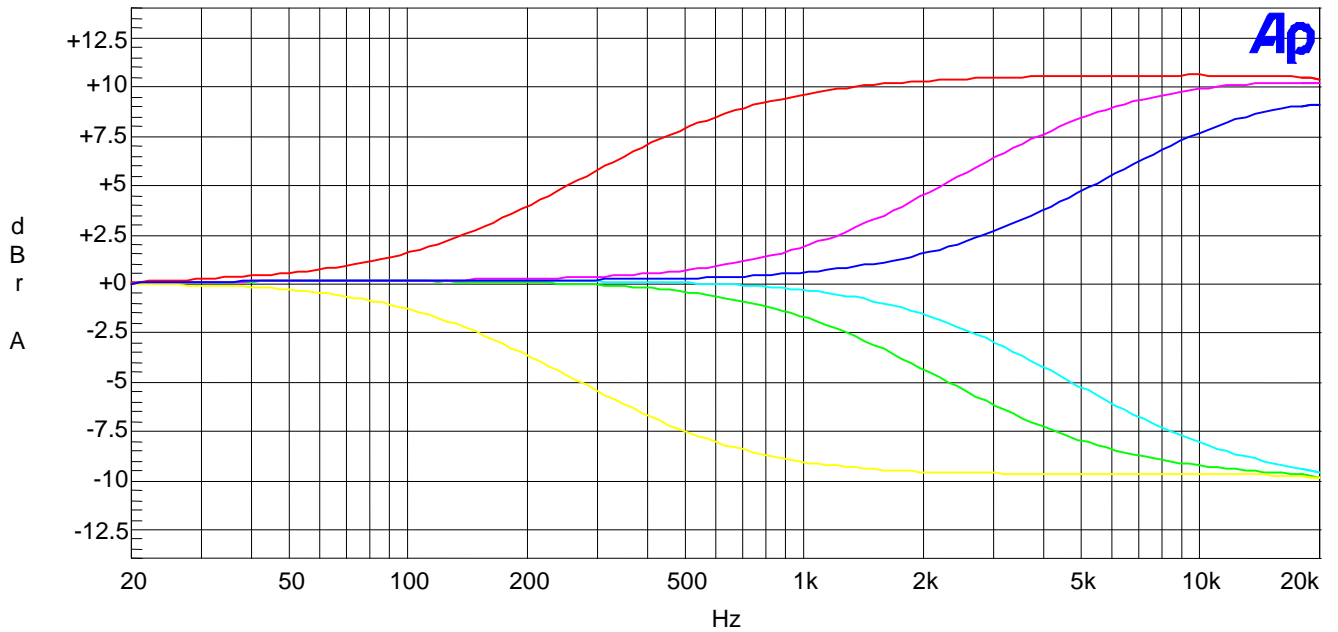
Q factor NRPN value is between 0 and 127, (respectively Q from 1 to 20):



Sweep	Trace	Color	Comment
1	1	Cyan	Q=0 (1) (BandStop)
2	1	Green	Q=32 (BandStop)
3	1	Yellow	Q=64 (BandStop)
4	1	Red	Q=96 (BandStop)
5	1	Magenta	Q=110 (BandStop)
6	1	Blue	Q=127 (BandStop)

High Shelf filter

The high pass filter frequency range is variable from 180 Hz to 3kHz. (at -3dB from 0dB).



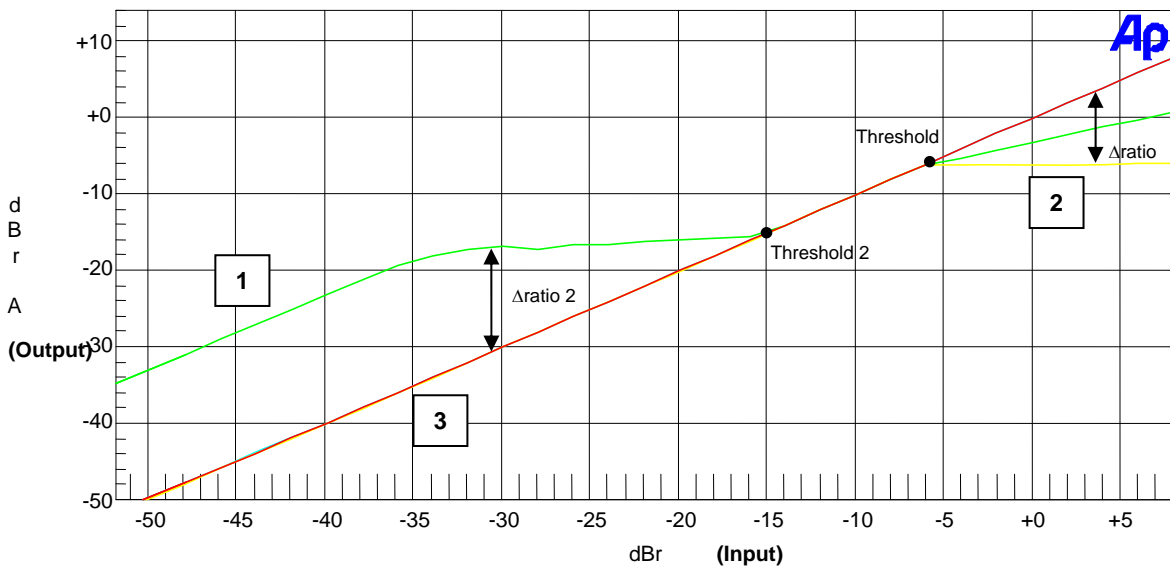
Red and yellow: when frequency midi value is 0 (180Hz) at + 12 and -12 dB
 Magenta and green: when frequency midi value is 64 (1,5KHz) at + 12 and -12 dB
 Blue and cyan: when frequency midi value is 127 (3KHz) at + 12 and -12 dB

Compander function

Compander function is useful for voice processing. Dynamic process is delimited by 2 inflections point (threshold, and threshold2), between these 2 points, signal is unchanged (unity gain).

Compressing signal below Threshold2 is possible by adjusting ratio2 parameter. Higher the parameter ratio2 is, higher the signal below threshold2 will be amplified (useful for example for small voice, Maximum amplification is 18dB).

Compressing signal above Threshold is possible by adjusting ratio parameter. Higher the parameter ratio is, higher the signal will be limited (yellow curve).



Sweep	Color	Comment
1	Green	Thershold2=7(-15dB), Ratio2=127, Threshold=20(-6dB), Ratio=64
2	Yellow	Limiter, Thershold2=0, Ratio2=0, Threshold=20(-6dB), Ratio=127
3	Red	Unity gain, Thershold2=0, Ratio2=0, Threshold=127, Ratio=0 (OFF)

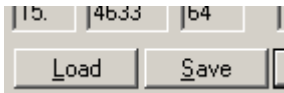
Evaluation Kit

An Evaluation Kit / Reference Design is available, the 3703-EK. A Software control panel (Windows GUI) is provided with the Evaluation Kit for easy parameter control and testing of all features. Following you can find some explanations how to use the Software Control Panel.

Software Control Panel (Windows GUI)

Save/Load functions

Each window (Input Control, PEQ, PitchShift, Sound Mix, Echo, Reverb) has Save and Load buttons.



- "Save" function saves window parameter value in "Mike3000.ini" file
- "Load" function allows loading parameters saved by "Save" function from "Mike3000.ini" file

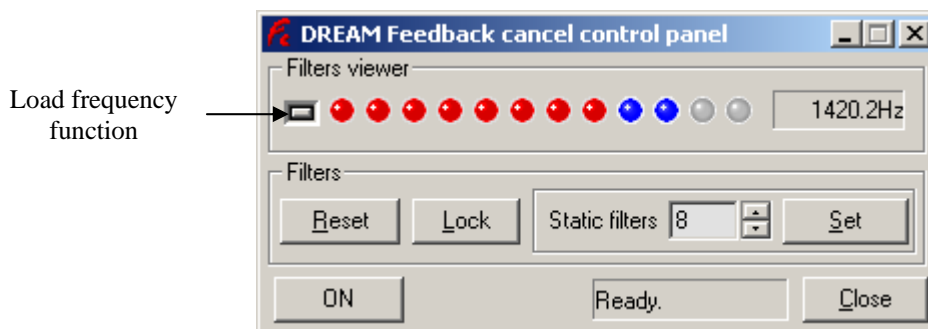
Each window save and load function have its own settings in Mike3000.ini file, it means that when saving and loading from a window, it will only save or load parameters for this window.

For example:

If you press save button in "Sound Mix" window, you will only save for mixing parameters, not for Echo ...

A global Save/Load function is available from "Settings" Menu: Load/Save All settings.

FBC Window



Button function:

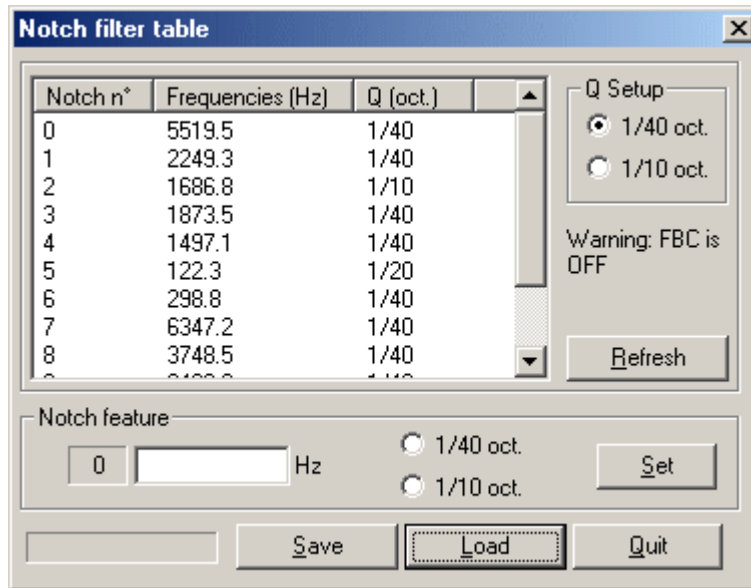
- RESET:** Reset all filters.
- LOCK/UNLOCK:** Freeze actual filters settings. It locks ALL filters found by the feedback cancel, (**important:** new feedback frequencies will be ignored). It's possible to unlock, by pressing again Unlock button.
- SET:** Enter number of desired static filters and press SET button. All filters will be initialized.
- ON:** "ON" = Go through notch filters. "Bypassing..." = Bypass Notch filters.
- CLOSE:** Close FBC window.

LEDS meaning: Red LED means static filters.
Blue LED means dynamic filters.

Dynamic filters: When dynamic filters are full, next feedback frequencies will cyclically overwrite the oldest dynamic filter.

Load frequency function:

important: In Loading frequency function, feedback cancel is not running



Button function:

- SAVE:** Save frequency table and current settings into a file.
- LOAD:** Load frequency table and settings from a file.
- REFRESH:** Request frequencies and refresh display.
- SET:** Set new Q and frequency value for a specific notch filter in frequency table.
- Q Setup:** Change Q setting, for next feedback found by the feedback cancel.
- QUIT:** Quit this dialog.

Dream Contact

info@dream.fr

Website

<http://www.dream.fr>

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