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9550 Digital Noise Filter

DESCRIPTION

The GML 9550 Digital Noise Filter (DNF), in each of it's three configurations, has the ability to help in the restoration of problematic audio recordings. The DNF is a **real-time**, two-channel, digital in/out, multiband dynamic controller which analyses the signal in each of the 64 frequency bands and enables the user to separate useful signal from noise.

The GML DNF is comprised of a stand-alone rack-mount processor unit plus a desktop controller. The desktop controller has eight linear **CONTROL FADER**s, eight LEDs and an in/out switch.

It is particularly useful as a tool for the removal of noise and artifacts in the restoration/recovery of older optical sound tracks. It is particularly applicable to asynchronous, non-transient noise artifacts in bands above 1kHz, and it's selectivity *increases* with frequency.

The GML 9550 DNF supports AES/EBU, S/PDIF and Toslink optical, 44.1 or 48kHz, 24bit digital I/O, and automatically switches to an external word clock when one is applied.

OPERATIONAL DEMONSTRATION

Overall, the DNF works well on broader-band noise artifacts. The fader package gives the user quick, easy access to the filters. This is a product designed for high performance where speed is critical, like dubbing, dailies transfers, video transfers, and some broadcast or simple dialog repairs.

To understand the operation of the DNF, introduce a noisy audio program to one of the stereo digital inputs and connect a digital output to a device with a digital to analog converter.

Program suggestions:

Analog recordings with very low signal level
Noisy radio broadcasts
Deteriorating magnetic film recordings

Using the DNF "Head" place all of the **CONTROL FADER**s in the up, or full-on position. This is equivalent to **BYPASS**ing the unit.

Position all the **CONTROL FADER**s in the down, or full-off position. This is equivalent to all-bands **MUTE**.

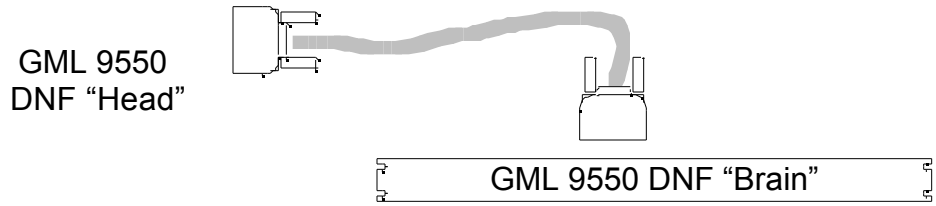
Raise each **CONTROL FADER**, listening as you do to the audio frequency bands which are allowed to "pass". The point at which each band "comes on" is dependent on the level of the program in each frequency band as it crosses the threshold set by each **CONTROL FADER**. Each frequency band has it's own, independent threshold. (See SMOOTHING) If the signal does not reach this level, it is assumed to be unwanted, and is attenuated.

If the program reaches this threshold, it is assumed to be program, and is passed without attenuation.

To optimize the performance of the DNF, use “notches” (perhaps with additional Digital E.Q.) as required to remove low-frequency hum or buzz. Then, process with the DNF, and lastly add program EQ to enliven the material or to help with articulation. If you process too much, the program can sound like a poor digital cell phone (underwater). Finally, remember that a little noise is still acceptable for most applications, and may even be desirable for some.

The GML DNF may be used in three different configurations.

CONFIGURATION 1 (Head: 9554_1, Brain GML96_4)**:**



On the “Head” eight front-panel **CONTROL FADER**s adjust the threshold from -96dB to 0dB for each of eight groups of sixty-four **BAND**s. Eight two-color LEDs indicate whether, and the degree to which, the **BAND**s in that control group are active.

The device’s response is formed by a sixty-four band FIR digital filter. The *frequencies* of this class of filters are, by nature, *linearly* distributed across the frequency spectrum. These 64 **BAND**s are ‘wired’ to the eight front-panel **CONTROL FADER**s in such a manner so as to distribute these individual filters in a more nearly *logarithmic* fashion.

The actual operation of this configuration is exactly as it’s perceived. The eight front-panel **CONTROL FADER**s set the thresholds of all of the 64 bands (associated as described in the attached sheet).

When a **CONTROL FADER** is set such that a given constituent frequency **BAND**’s threshold is *above* the level of some incoming artifact in a band, that band is attenuated at a ratio of approximately 4:1.

If the LED indicators on the “Head” are off, there is no attenuation in any of the frequency bands for that particular **CONTROL FADER**.

If the indicators on the “Head” are Yellow, there is attenuation in one or more of the frequency bands for that particular **CONTROL FADER**.

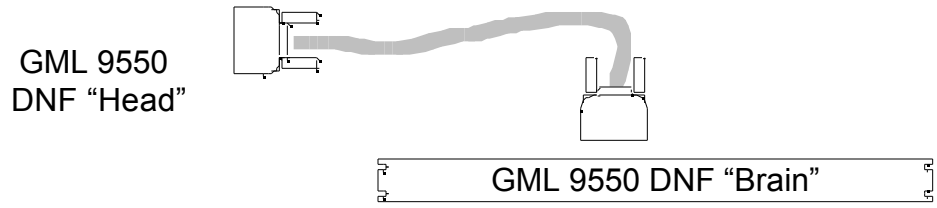
If the indicators on the “Head” are Red, there is attenuation in ***all*** of the frequency bands for that particular **CONTROL FADER**.

In general operation, the **CONTROL FADER**s are adjusted so that the program passes the wanted material content and attenuates the unwanted artifacts. Switch the **BYPASS** button in and out to compare the original signal to the processed result. Adjust the **CONTROL FADER**s accordingly.

There is a built-in curve smoothing algorithm acting on each **BAND**’S attenuation as well. If there is a *sharp* difference in attenuation between two **BAND**s, an averaging factor is applied to smooth the transition and to better avoid sharp-filter artifacts.

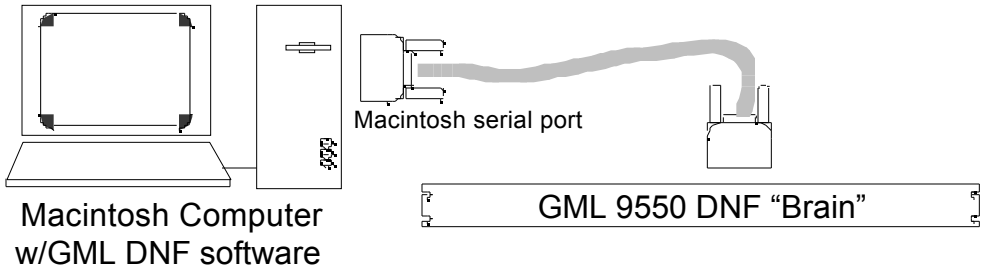
See the frequency response chart in APPENDIX A.

CONFIGURATION 1 ßeta (Head: 9554_4, Brain GML96_4, or Head: 9554_1, Brain GML97_4)**:**



Same as Configuration 1 except that the **CONTROL FADER**s are wired to the **BAND**'s as shown in the frequency response chart in APPENDIX B.

CONFIGURATION 2 (Macintosh <DNF>, Brain GML97_94)**:**

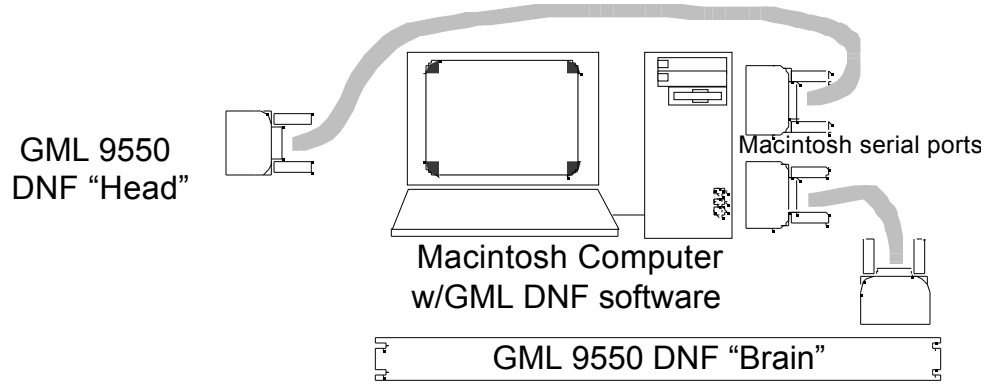


In the Macintosh front-end DNF System, the "Head" is replaced by a graphical representation of 64 frequency bands. Each Band's Threshold Level may be adjusted from -96dB to 0dB. A continuous graphical log display can be selected to show *either* the actual input spectra *or* the instantaneous gain reduction of the 64 bands. Three levels of curve-smoothing are selectable, if desired, to minimize the effects of sharp differences in adjacent controls.

The device's response is formed by a sixty-four band FIR filter as before and, again, the *frequencies* of this class of filters are, by nature, *linearly* distributed across the frequency spectrum.

The frequency bands represented can be found in APPENDIX 'A'

CONFIGURATION 3 (Head 9554_8, Macintosh <DNF>, Brain GML97_94)**:** *(to be shipped July '97)***:**



In the "Macintosh in-the-middle"" DNF System, the DNF "Head" controls the DNF "Brain" through the Macintosh. Eight **CONTROL FADER**s adjust the thresholds of sixty-four **BAND**s from -96dB to 0dB. However, in this configuration, the user graphically selects the relationship between the **CONTROL FADERS** and the **BAND**s, assigning **CONTROL FADER**s to **BAND**s as best serves the program material.

The device's response is formed by a sixty-four band FIR filter as before and, again, the *frequencies* of this class of filters are, by nature, *linearly* distributed across the frequency spectrum.

APPENDIX ‘A’ - Band Frequency Distribution Configuration 1

BAND RESPONSE at 48.0kHz BAND RESPONSE at 44.1kHz

CONTROL	frequency	frequency	CONTROL	frequency	frequency
	begin - Hz	end - Hz		begin - Hz	end - Hz
1	**0**	**375**	1	**0**	**343.75**
2	**375**	750	2	**343.75**	687.50
	750	**1125**		687.50	**1031.25**
3	**1125**	1500	3	**1031.25**	1375
	1500	1875		1375	1718.75
	1875	**2250**		1718.75	**2062.50**
4	**2250**	2625	4	**2062.50**	2406.25
	2625	3000		2406.25	2750
	3000	3375		2750	3093.75
	3375	**3750**		3093.75	**3437.50**
5	**3750**	4125	5	**3437.50**	3781.25
	4125	4500		3781.25	4125
	4500	4875		4125	4468.75
	4875	5250		4468.75	4812.50
	5250	**5625**		4812.50	**5156.25**
6	**5625**	6000	6	**5156.25**	5500
	6000	6375		5500	5843.75
	6375	6750		5843.75	6187.50
	6750	7125		6187.50	6531.25
	7125	7500		6531.25	6875
	7500	7875		6875	7218.75
	7875	**8250**		7218.75	**7562.50**
7	**8250**	8625	7	**7562.50**	7906.25
	8625	9000		7906.25	8250
	9000	9375		8250	8593.75
	9375	9750		8593.75	8937.50
	9750	10125		8937.50	9281.25
	10125	10500		9281.25	9625
	10500	10875		9625	9968.75
	10875	11250		9968.75	10312.50
	11250	11625		10312.50	10656.25
	11625	12000		10656.25	11000
	12000	12375		11000	11343.75
	12375	**12750**		11343.75	**11687.50**

CONTROL	frequency begin - Hz	frequency end - Hz	CONTROL	frequency begin - Hz	frequency end - Hz
8	**12750**	13125	**8**	**11687.50**	12031.25
	13125	13500		12031.25	12375
	13500	13875		12375	12718.75
	13875	14250		12718.75	13062.50
	14250	14625		13062.50	13406.25
	14625	15000		13406.25	13750
	15000	15375		13750	14093.75
	15375	15750		14093.75	14437.50
	15750	16125		14437.50	14781.25
	16125	16500		14781.25	15125
	16500	16875		15125	15468.75
	16875	17250		15468.75	15812.50
	17250	17625		15812.50	16156.25
	17625	18000		16156.25	16500
	18000	18375		16500	16843.75
	18375	18750		16843.75	17187.50
	18750	19125		17187.50	17531.25
	19125	19500		17531.25	17875
	19500	19875		17875	18218.75
	19875	20250		18218.75	18562.50
	20250	20625		18562.50	18906.25
	20625	21000		18906.25	19250
	21000	21375		19250	19593.75
	21375	21750		19593.75	19937.50
	21750	22125		19937.50	20281.25
	22125	22500		20281.25	20625
	22500	22875		20625	20968.75
	22875	23250		20968.75	21312.50
	23250	23625		21312.50	21656.25
	23625	**24000**		21656.25	**22000**

APPENDIX B - Band Frequency Distribution Configuration 1 ßeta

BAND RESPONSE at 48.0kHz BAND RESPONSE at 44.1kHz

CONTROL	frequency	frequency	CONTROL	frequency	frequency
	begin - Hz	end - Hz		begin - Hz	end - Hz
1	**0**	375	1	**0**	343.75
	375	**750**		343.75	**687.50**
2	**750**	1125	2	687.50	1031.25
	1125	**1500**		1031.25	**1375**
3	**1500**	1875	3	**1375**	1718.75
	1875	**2250**		1718.75	**2062.50**
4	**2250**	2625	4	**2062.50**	2406.25
	2625	3000		2406.25	2750
	3000	3375		2750	3093.75
	3375	**3750**		3093.75	**3437.50**
5	**3750**	4125	5	**3437.50**	3781.25
	4125	4500		3781.25	4125
	4500	4875		4125	4468.75
	4875	5250		4468.75	4812.50
	5250	**5625**		4812.50	**5156.25**
6	**5625**	6000	6	**5156.25**	5500
	6000	6375		5500	5843.75
	6375	6750		5843.75	6187.50
	6750	7125		6187.50	6531.25
	7125	7500		6531.25	6875
	7500	7875		6875	7218.75
	7875	**8250**		7218.75	**7562.50**
7	**8250**	8625	7	**7562.50**	7906.25
	8625	9000		7906.25	8250
	9000	9375		8250	8593.75
	9375	9750		8593.75	8937.50
	9750	10125		8937.50	9281.25
	10125	10500		9281.25	9625
	10500	10875		9625	9968.75
	10875	11250		9968.75	10312.50
	11250	11625		10312.50	10656.25
	11625	12000		10656.25	11000
	12000	12375		11000	11343.75
	12375	**12750**		11343.75	**11687.50**

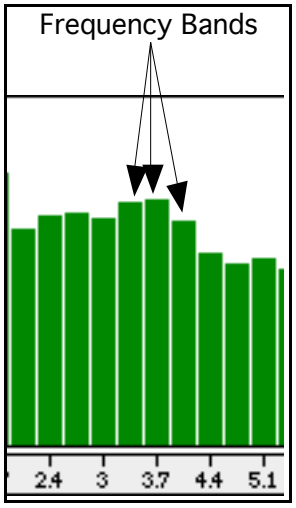
CONTROL	frequency begin - Hz	frequency end - Hz	CONTROL	frequency begin - Hz	frequency end - Hz
8	**12750**	13125	**8**	**11687.50**	12031.25
	13125	13500		12031.25	12375
	13500	13875		12375	12718.75
	13875	14250		12718.75	13062.50
	14250	14625		13062.50	13406.25
	14625	15000		13406.25	13750
	15000	15375		13750	14093.75
	15375	15750		14093.75	14437.50
	15750	16125		14437.50	14781.25
	16125	16500		14781.25	15125
	16500	16875		15125	15468.75
	16875	17250		15468.75	15812.50
	17250	17625		15812.50	16156.25
	17625	18000		16156.25	16500
	18000	18375		16500	16843.75
	18375	18750		16843.75	17187.50
	18750	19125		17187.50	17531.25
	19125	19500		17531.25	17875
	19500	19875		17875	18218.75
	19875	20250		18218.75	18562.50
	20250	20625		18562.50	18906.25
	20625	21000		18906.25	19250
	21000	21375		19250	19593.75
	21375	21750		19593.75	19937.50
	21750	22125		19937.50	20281.25
	22125	22500		20281.25	20625
	22500	22875		20625	20968.75
	22875	23250		20968.75	21312.50
	23250	23625		21312.50	21656.25
	23625	**24000**		21656.25	**22000**

DNF Software Instructions for Configurations 2 & 3

The following information may also be found in the Apple Guide File for each application. To use the Apple Guide Files, make sure Apple Guide is enabled on your Macintosh, run the application, and select **DNF Guide** from the Apple Guide menu.

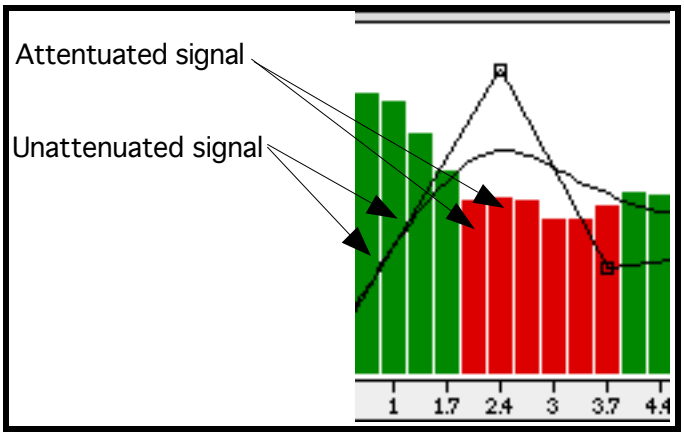
Macintosh interface for Configuration #2

With Configuration #2 software, the "DNF Head" is replaced by a graphical representation of 64 frequency bands. Each Band's Threshold Level may be adjusted from -96dB to 0dB. A continuous graphical log display can be selected to show either the actual input spectra or the instantaneous gain reduction of the 64 bands.



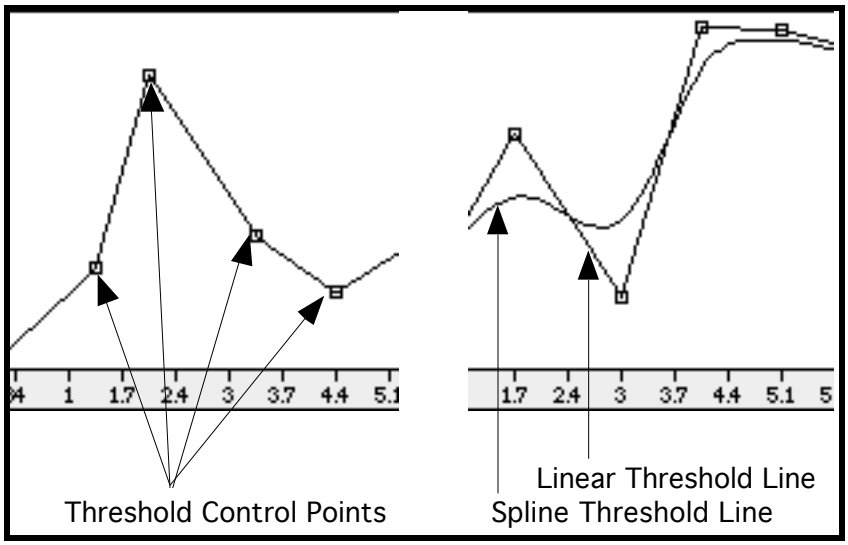
What is a Threshold Level?

A Threshold Level is used to set the point at which the audio for each Band is attenuated. If the signal does not reach the Threshold Level, it is assumed to be unwanted, and is attenuated. If the signal reaches this threshold, it is assumed to be program, and is passed without attenuation. Unattenuated Bands are Green and attenuated Bands are Red.

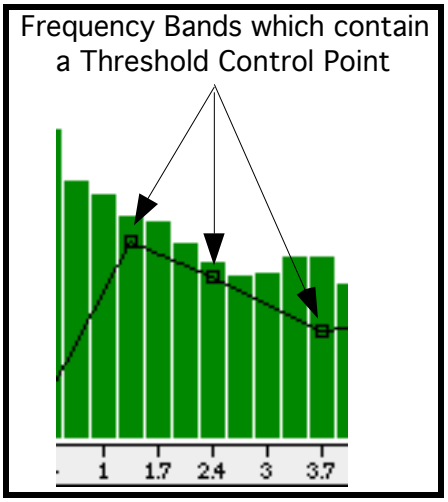


How the Threshold Levels are calculated.

Threshold Levels are calculated from either the Linear Threshold Line or the Spline Threshold Line. A Linear Threshold Line is a straight line drawn from one Threshold Control Point to another Threshold Control Point. A Spline Threshold Line is a curved line drawn from one Threshold Control Point to another Threshold Control Point. You may toggle between Linear and Spline Threshold Lines by selecting **Disable Spline Drawing** from the **Preferences** menu. The Spline Threshold Line provides for smoother Threshold Levels than the Linear Threshold Line. Three levels of curve-smoothing are selectable, if desired, to minimize the effects of sharp differences in adjacent Threshold Control Points.



If a Band contains a Threshold Control Point, then that Band's Threshold Level is set by the Threshold Control Point. If a Band does not contain a Threshold Control Point, then its Threshold Level is calculated from the Threshold Line intersecting it.



How to change the Threshold Levels.

If you want to change the Threshold Level for a specific Band, you will need to create a Threshold Control Point for that Band. To create a Threshold Control Point, move the cursor to the desired Band and click.

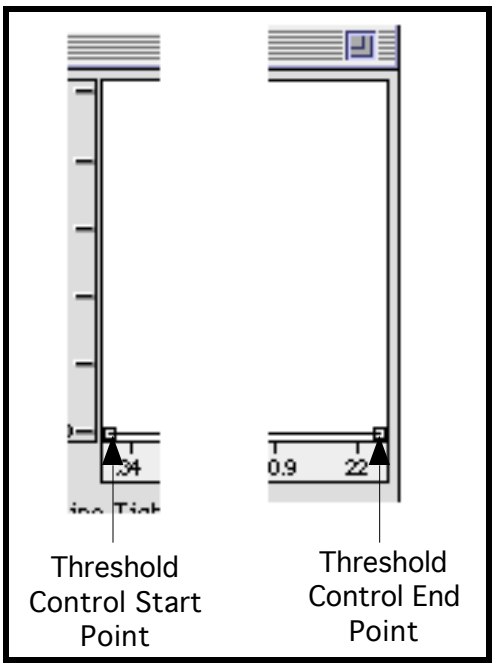
To move a Threshold Control Point, position the cursor over the Threshold Control Point and while holding the mouse button down, drag the mouse vertically. As you change the Threshold Level, you can hear the effect it has on the program. If a Band has a Threshold Control Point, then you may click anywhere inside the Band, and the Threshold Control Point will snap to that vertical location.

To delete a Threshold Control Point, while holding the Command Key ( ) down, click on the Threshold Control Point. The Threshold Level of the corresponding Band will be re-calculated based upon the intersecting Threshold Line.

To move all the Threshold Control Points at the same time, use the Master Offset Control. Using the mouse, click on the control and drag vertically. All the Threshold Control Points and Threshold Lines are moved accordingly. As you move the Master Offset Control, you can hear the effect it has on the program. You can move just the Master Offset Control without effecting the Threshold Levels by holding the Command Key ( ) down while moving it.

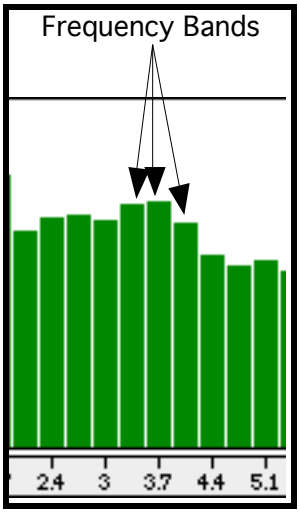
Master Offset Control

The Threshold Control Start and End Points are the default Threshold Control Points. These cannot be deleted, however they can be moved like a Threshold Control Point.



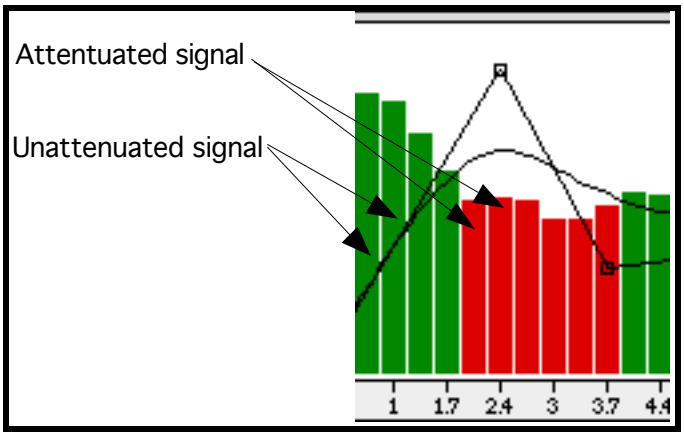
Macintosh interface for Configuration #3

In the “Macintosh in-the-middle” DNF System, the DNF “Head” controls the DNF “Brain” through the Macintosh. Eight CONTROL FADERs adjust the Threshold Levels of 64 Bands from -96dB to 0dB. However, in this configuration, the user graphically selects the relationship between the CONTROL FADERs and the Bands, using Frequency Groups.



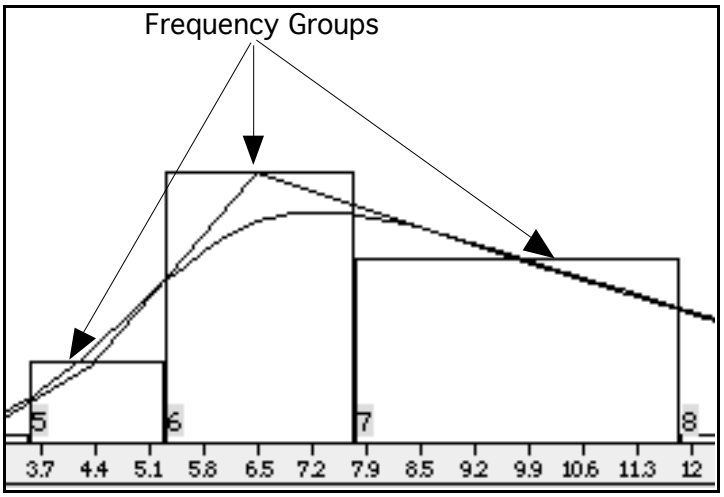
What is a Threshold Level?

A Threshold Level is used to set the point at which the audio for each Band is attenuated. If the signal does not reach the Threshold Level, it is assumed to be unwanted, and is attenuated. If the signal reaches this threshold, it is assumed to be program, and is passed without attenuation. Unattenuated Frequency Bands are Green and attenuated Frequency Bands are Red.



What is a Frequency Group?

A Frequency Group represents a single CONTROL FADER on the DNF "Head". It represents the Threshold Level for the controlled Bands and the number of Bands it controls. A Frequency Group can have as few a single Band and a single Frequency Group can have as many as 57 Bands.



How the Threshold Levels are calculated.

Threshold Levels are calculated from either the Linear Threshold Line or the Spline Threshold Line. A Linear Threshold Line is a straight line drawn from one Frequency Group to another Frequency Group. A Spline Threshold Line is a curved line drawn from one Frequency Group to another Frequency Group. You may toggle between Linear and Spline Threshold Lines by selecting **Disable Spline Drawing** from the **Preferences** menu. The Spline Threshold Line provides for smoother Threshold Levels than the Linear Threshold Line.

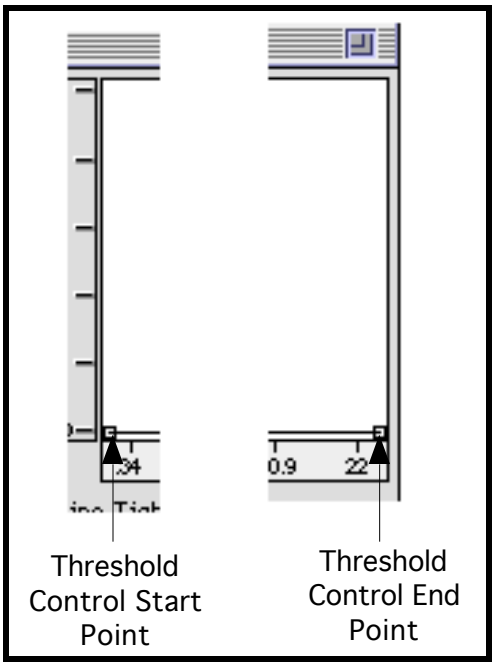
How to change the Threshold Levels.

To change the Threshold Level of a Frequency Group, you may either move the corresponding CONTROL FADER on the DNF "Head", or use the mouse. To use the mouse, move the cursor over the top edge of a Frequency Group until the cursor changes to an up/down arrow. Then, while holding the mouse button down, move the mouse vertically.

To move all the Frequency Groups at the same time, use the Master Offset Control. Using the mouse, click on the control and drag vertically. All the Frequency Groups are moved accordingly as are the Threshold Levels. As you change the Threshold Level, you can hear the effect it has on the program. You can move just the Master Offset Control without effecting the Frequency Groups by holding the Command Key ( ) down while moving it.

Master Offset Control

The Threshold Control Start and End Points are the default Threshold Control Points. These cannot be deleted, however they can be moved like a Threshold Control Point.



How to change the Bands controlled by a Frequency Group.

To change the Bands controlled by a Frequency Group , position the cursor over the left or right edge of the control until the cursor changes to a left/right arrow. Then, hold down the mouse button and drag horizontally. The Frequency Group will expand/shrink accordingly as will its neighbor. The Frequency Group will not resize until the cursor has been dragged beyond the next Band.

How to solo a Frequency Group.

Soloing a Frequency Group allows one to hear the effect one Frequency Group has on the program material while keeping the other Frequency Groups in bypass mode. The program for the Bands that are controlled by a Frequency Group that is in bypass mode pass unattenuated. The program for the Bands that are controlled by a Frequency Group that is in solo mode continue to be processed.

To place a Frequency Group in solo mode, hold the Command key ( ) down and click inside a Frequency Group . The bypassed Frequency Groups will be displayed in yellow. Repeat to place other Frequency Groups in solo mode.

To take a Frequency Group out of solo mode, hold the Command key ( ) down and click inside a Frequency Group in solo mode.

Presets

Presets are used to store and recall the Frequency Group settings. This allows the user to easily change the resolution of the CONTROL FADERs to accommodate different program material.

Up to 16 presets can be stored. The preset data is stored in the preference file named “DNF Config #3 prefs”. This file may be located in the GML folder which is located in the Preferences Folder of the System Folder.

If the preference file is thrown in the Trash or removed from the GML Folder, upon rebooting of the application, the Presets will revert to their defaults.

To save a preset, select **Save a Preset**. A dialog will be displayed listing all 16 presets. Choose one to write over and click on the **Save** button. Another dialog will be displayed allowing you to enter a name for the preset. Enter a new name if you like and click on the **Rename** button.

DNF Configuration Parts

Configuration #1

DNF Brain
DNF Head
Standard DNF Cable[1]

Configuration #2

DNF Brain
Macintosh software for Configuration #2
Custom DNF Cable[2]

Configuration #3

DNF Brain
DNF Head
Macintosh software for Configuration #3
Custom DNF Cable[2]

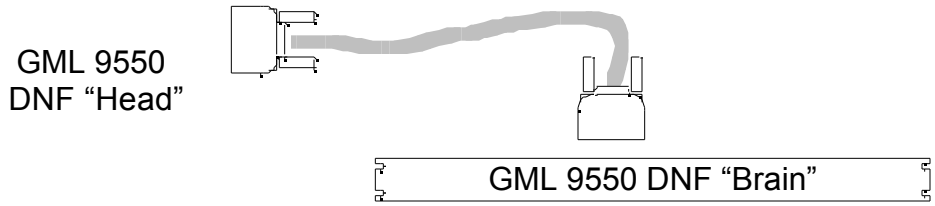
Notes:

1. Standard DNF Cable
   10 ft. 9 pin Male D-Connector to 9 pin Female D-Connector

2. Custom DNF Cable
   10 ft. 9 pin Male D-Connector to Male DIN Connector
   connected to
   10 ft. 9 pin Female D-Connector to Male DIN Connector

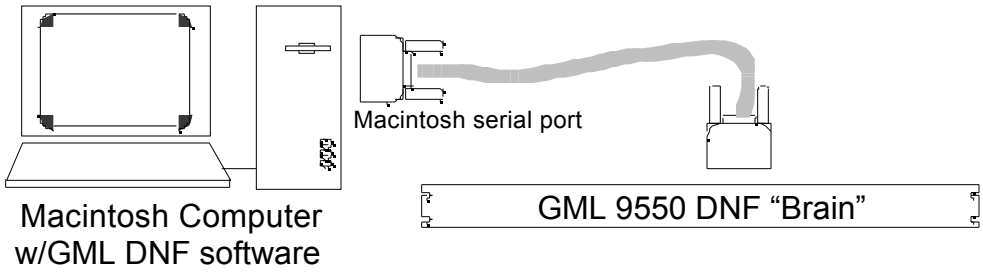
DNF Configuration Setup

Configuration #1



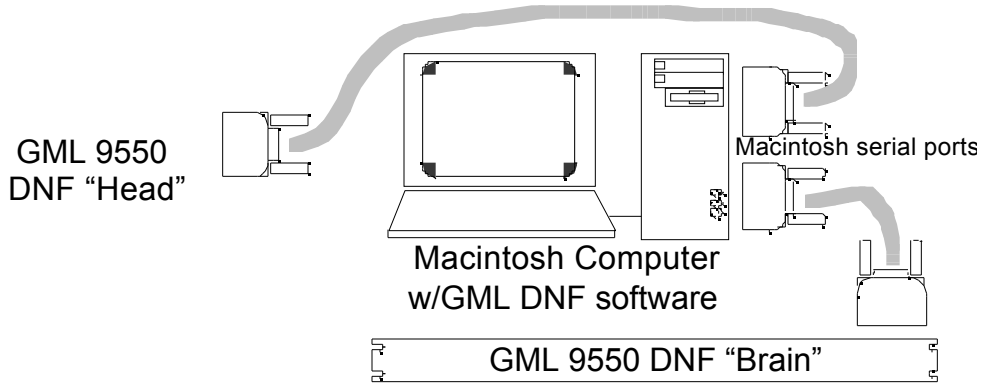
1. Plug the Male 9 pin connector of the Standard DNF cable into the “Control Head Link” on the rear of the DNF Brain.
2. Plug the Female 9 pin connector of the Standard DNF cable into the “Processor Link” on the rear of the DNF Head.
3. Connect your audio cables to the rear of the DNF Brain.
4. Turn the DNF Brain on.
5. The Power indicator on the DNF Brain should be lit blue, the Unlock/Mute indicator should not be lit red, and the Power indicator on the DNF Head should be lit green. When the power is first turned on, the LEDs on the DNF Head change from red to yellow for about 1 second.
6. You are now ready to use the DNF.

Configuration #2



1. Plug the Male 9 pin connector labeled “Control Head Link” into the “Control Head Link” connector on the rear of the DNF Brain.
2. Plug the Male serial connector with the Modem icon into the Modem Port on the rear of a Macintosh.
   Any serial port may be used, however the Configuration #2 software defaults to using the Modem Port. If the DIN connector was plugged into a different serial port, you’ll need to select the serial port in the software. Refer to the software documentation on how to change serial ports. The other two connectors are not used for this configuration.
3. Connect your audio cables to the rear of the DNF Brain.
4. Turn the DNF Brain on.
5. The Power indicator on the DNF Brain should be lit blue, the Unlock/Mute indicator should not be lit red.
6. You are now ready to use the DNF.

Configuration #3



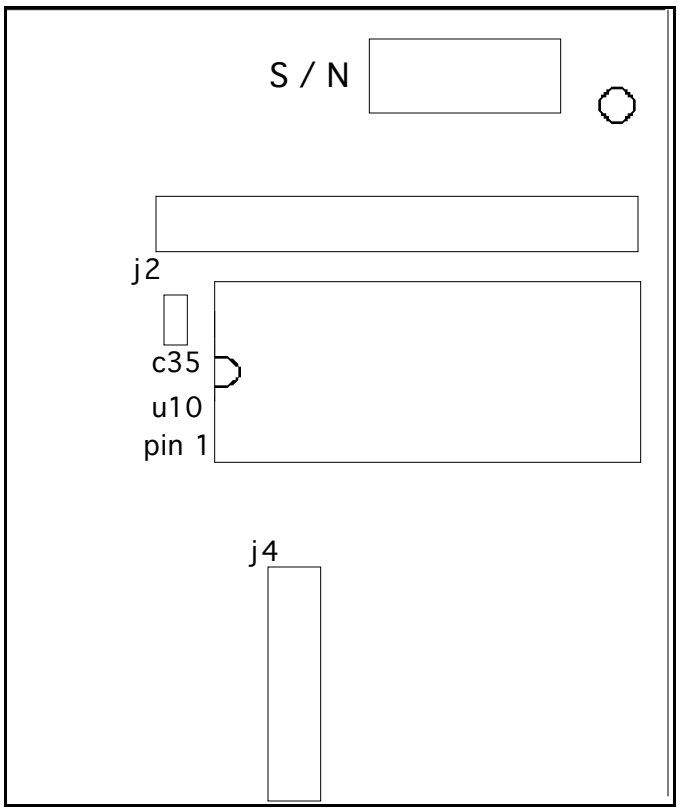
1. Plug the Male 9 pin connector labeled "Control Head Link" into the "Control Head Link" on the rear of the DNF Brain.
2. Plug the Male serial connector with the Modem icon into the Modem Port on the rear of a Macintosh.
3. Plug the Female 9 pin connector labeled "Processor Link" into the "Processor Link" on the rear of the DNF Head.
4. Plug the Male serial connector with the Printer icon into the Printer Port on the rear of a Macintosh.
   Any serial port may be used, however the Configuration #3 software defaults to using the Modem Port for the DNF Brain and the Printer Port for the DNF Head. If the DIN connector was plugged into a different serial port, you'll need to select the serial ports in the software. Refer to the software documentation on how to change serial ports.
3. Connect your audio cables to the rear of the DNF Brain.
4. Turn the DNF Brain on.
5. The Power indicator on the DNF Brain should be lit blue, the Unlock/Mute indicator should not be lit red, and the Power indicator on the DNF Head should be lit green. When the power is first turned on, the LEDs on the DNF Head change from red to yellow for about 1 second.
6. You are now ready to use the DNF.

Installing EEPROM Instructions

DNF Brain

To install an EEPROM in the DNF Brain, follow these steps:

1. Turn power OFF to the DNF Brain.
2. Make sure to ground yourself so you will not destroy the EEPROM due to static.
3. Remove the top of the DNF Brain.
4. Locate EEPROM socket u10 on the pcb.
5. Remove the existing EEPROM and store it in a non-static area.
6. Install the new EEPROM.
7. Make sure the orientation of the chip is correct (i.e. make sure the notch on the EEPROM corresponds with the notch in the socket). Refer to the picture below.
8. Close the unit up and apply power.



DNF Head

To install an EEPROM in the DNF Brain, follow these steps:

1. Turn power OFF to the DNF Brain.
2. Make sure to ground yourself so you will not destroy the EEPROM due to static.
3. Open the DNF Head.
4. Locate IC socket u4 on the pcb.
5. Remove the existing EEPROM with the proper chip extraction tool and store it in a non-static area.
6. Install the new PROM.
7. Make sure the orientation of the chip is correct (i.e. make sure the notch on the EEPROM corresponds with the notch in the socket). Refer to the picture below.
8. Close the unit up and apply power.