

6.0 Setting Up Processing

The two major functions of FM audio processing are to absolutely control and limit the transmitter's modulation, and to generate a desired sonic character as perceived by the radio station's audience. The FM Pro integrates these functions in a manner that gives you unusual latitude in how you can make your radio station sound. In order to get the great on-air sound you are seeking, you should first become aware of all the features and capabilities the FM Pro has to offer. The actual controls and user interface details are discussed fully in sections 3, 4, and 5 of this manual. While many users will be satisfied with one of the factory supplied presets, many others will want to create their own sound design. This section focuses upon the "how to" part of designing your station's signature sound.

6.1 Steps In Setting Up

Taking a logical approach is helpful in getting the sound you like. The following steps should be taken as you design your sound.

1. Target the processing goals
2. Create a Global preset
3. Select a factory preset to start from
4. Adjust processing
5. Save your preset

6.2 Targeting Processing Goals

You should begin with an idea of what you need the FM Pro to provide. Do you want an open sound, or a wall of sound? Do you want a stressed, intense effect, or a laid back effect? Do you want it as transparent as possible? Are you willing to accept distortion in order to squeeze out an ounce more loudness? You may change your mind as you tune up your processing and listen to the competing stations. You may find that what you thought you wanted is not what you like now. That's all right. You just need a place to start.

One good way to pick a processing goal is to target a successful radio station and make yours sound better. A fact often overlooked when considering competitive FM processing is that how you sound compared to other stations in your market is far more important than how you sound absolutely. For example, if your radio market is filled with trashy sounding stations but they are all pushing the envelope on loudness, you don't have to be perfectly clean, just cleaner and equally loud, to beat the competition.

In your quest to create the perfect on-air sound, you will be faced with the question of how "loudness" factors in. How loudly your station jumps from the dial compared to other stations in your area can easily become a paranoia. We urge you to remain rational. It has been demonstrated in many markets that sounding better, rather than louder, wins the audience. The perception of loudness is also variable. Many programmers and engineers get trapped into gathering fatness and grunge for loudness when actually a station will be perceived as louder and "bigger" by the audience when it sounds more open and dynamic.

6.3 Create the Global Preset

Refer to section 7 of this manual and create a Global preset if you have not already done so. This will match the FM Pro to your system and allow the factory presets to function correctly.

6.4 Select A Factory Preset

One of the eight factory presets (P01 through P08) will probably come close to your processing goal. We evaluated eight widely used radio formats and gathered information about how they typically process their sound. We then built our presets to be competitive against other audio processors for those formats. There are certainly many more than eight identifiable radio formats in existence, and new ones continue to appear. If your FM format is not among those provided for, simply pick one that seems most relevant. You can listen to all of them, if necessary, and then pick the one that comes closest to your needs.

6.5 Adjusting the Processing

This is where the FM Pro gets fun. So as not to fill these pages with redundant material, it shall be assumed that you have previously read sections 2 through 5 of this manual. You also need to skip ahead to section 7 and learn how to create your Global preset if not already saved. You should now understand the menus and processing characteristics of the FM Pro and be ready to get started designing your air sound.

The initial sequence of processing adjustments follows a logical order: the order of signal flow through the processor. It is always ok to jump ahead or back and readjust a processing function, however, and you will do that after you become

more expert. For now, we will step through things sequentially. The steps of adjustments are as follows.

1. Leveling
2. Multiband Compression
3. Limiting
4. Bass Enhancement
5. Brightness Enhancement
6. Pre-emphasis Limiting

6.6 Leveling

The leveler provides automatic gain control over your program level. In pondering how to set the various adjustments, consider what you want the leveler to do. It can virtually “jock-proof” your radio station by compensating for widely varying levels or it can merely smooth out variations in an otherwise well produced program stream.

6.6.1 Control Locks

Set the “Max gain” lock according to the amount of correction you need for low program levels. If you want really tenacious control, set it to +15dB. This makes the leveler bring everything down to 15dB below reference level up to full level. A consequence of this tenacity is that it will kill program fades. On the other hand, if you want program fades to be allowed, you should set the Max gain to +6dB. This will make the leveler hold up a falling level only until the signal falls below -6dB. From that point signal will be allowed to continue fading naturally.

The “Max atten” lock can usually be left at -15dB. This allows excessive levels to be fully compensated by the leveler before the multiband compressor gets the signal. In a few rare cases you may want excessive levels above a certain point to go uncompensated by the leveler and ram the multiband compressor to create a dramatic effect. An example of this might be a classical music station wanting to emphasize the orchestral crescendos.

6.6.2 DVG

Generally, the DVG should be turned on at all times except when you are striving for the fattest and loudest, most stressed sound. When on, the DVG allows the leveler to control level in a less obvious manner. If the DVG is off, the leveler can press harder upon the signal envelope and create slightly more loudness at the expense of potential

pumping. When on, the DVG reduces the pumping effect and makes the audibility of leveling much less perceptible.

6.6.3 Sticky Leveler

Generally the Sticky Leveler should be turned on at all times, especially for a leveling rate faster than 10 seconds. The sticky window is usually best around 1 to 2dB. You may not always hear the effect of the sticky leveler, but it becomes quite evident with certain program material. You can turn off the sticky to get the fattest, most compressed audio quality. The sticky can dramatically improve very fast leveling (2-3 seconds), especially with voice material and open, punchy music such as found on Jazz and AOR formats.

6.6.4 Silence Gate

You’ll almost always want the silence gate turned on to eliminate background noise swelling during program pauses. The silence gate on/off control is mainly for testing. You should set the silence gate threshold below the lowest expected program signal and above the highest expected background noise. This will usually be between -17 and -38dB. In practice this threshold is not critical since the silence gate is delayed and will not modify the leveler’s action other than to lock the gain during silence. You cannot adjust the silence gate to “flicker” and modulate the leveler’s release rate as on some other FM processors. Typically, a threshold of -38dB (the lowest setting) is appropriate. Test the threshold by stopping the program source and finding whether the silence gate comes on after about 1 second. Don’t do this test by unplugging the audio lines from the FM Pro. You need to see the natural noise floor of the program feed.

6.6.5 Leveling rate

The attack of the leveler is approximately two times faster than the indicated rate. In other words, if the leveler rate is set to 10, it will take about 5 seconds to attack and reduce the gain by 10dB and it will take 10 seconds to release back and increase the gain by 10dB. In the context of leveling, a rate of 2 seconds (the fastest rate of the FM Pro) should be considered quite fast. If your program tends to change levels very quickly, as typically occurs between the microphones of live interview shows, you may want to use the fastest leveling rate of 2 seconds. In such a case you can turn on the Sticky leveler with a 1 to 2dB window to help

reduce the perception of gain riding. If you are processing mixed programming and want to leave a sense of texture in the mix, then you should use a moderate rate in the range of 7 to 14 seconds.

Note: The leveling rates associated with the factory presets are pretty close to ideal for their formats. We suggest you use the presets as a basis to your own leveler adjustments.

6.7 Multiband Compression

This is where you will do the most to design your sound. To be sure, this element of the FM Pro is the most difficult to teach because the optimum parameters tend to be interdependent. You will have to experiment with the adjustments to get your best settings. Because the adjustments are grouped and arranged logically, you will quickly develop a friendly relationship with this multiband compressor, however. We offer you the following advice to get you started.

6.7.1 Crossovers

Set the crossover frequencies to enhance the sound as you make other adjustments such as release time, and the mix ratio. The crossovers associated with the factory presets are good choices in most cases.

To keep all 4 bands fully formed, crossover tuning should follow the 4X rule, i.e., a crossover frequency should be at least 4 times higher than the next lower crossover. For example, if F1 is 120Hz, then F2 should be at least 480Hz. Typical ranges for crossovers are as follows. The ranges are typical, not the law.

F1 - 80 to 280Hz
F2 - 330 to 1700Hz
F3 - 3000 to 6000Hz

If crossovers are tuned too close together then one or more of the bands may become tuned out of existence leaving you with a 1, 2, or 3 band compressor. This may be done intentionally by some users who want the characteristics of less than 4 bands. For example, you can tune F1 to 10Hz, essentially taking away band 1. You can also tune F2 to 25Hz, essentially leaving only bands 3 and 4. It is impossible to visualize all the effects of irrational crossover tuning unless you are using the remote control Windows software which graphs the actual shape of the bands for you. Nevertheless,

it is completely acceptable to tune the crossovers in any way that works for you. This means that it is not important to keep the bands properly shaped using the 4X rule if the resulting sound is what you like. Do not be afraid to experiment in this area.

6.7.2 Multiband Drive

This sets the depth of compression, i.e., increased drive pushes more compression. The texture and density of the sound can be controlled by the depth of drive and other settings. More compression makes the audio louder and more homogeneous. Light compression makes the sound more punchy and open. Compression depth is indicated on the multiband gain reduction meters. Running more than 12dB gain reduction on peaks would be considered heavy compression. Light compression is under 6dB of gain reduction.

The FM Pro allocates sufficient dynamic range to the Multiband Compressor to allow 20dB of gain reduction (well off the scale) before any distortion creeps in. Do not be afraid to push the drive if you want very heavy processing. On the other hand, the Multiband Compressor has a low enough noise floor to allow light compression without an appreciable noise penalty. With Aphex you have it all.

6.7.3 Band Release

Faster release results in more density and loudness over all, or in a given band.

One strategy for setting the band releases is to tune all four bands at once, starting them at the slowest end of the range and gradually speeding up the time until you reach a “sweet spot”. When all bands are at the same time setting you get a more cohesive sound. All the bands will tend to recover at the same rate which reduces the effect of obvious dynamic equalization.

Another strategy for setting the band releases is to set all the bands to a slow or moderate time and speed up the bands you want boosted or emphasized. For example, you may want to brighten up the mix, so speed up B3 and B4, making B4 the fastest. You may want to peak up the midrange, so speed up B3 only, etc. Varying the band releases in conjunction with varying the band mix will bring you to an optimal compromise between a desired overall tonal rebalance and the

desired dynamic program enhancement.

6.7.4 Band Mix

This is where you can set the overall tonal balance of the program. You should start with all bands at 0dB and then boost or cut bands as desired. It is not correct to assume that 0dB in all bands contribute to a flat frequency response. With a multiband compressor, the above-threshold frequency response is always changing depending on the gain reduction of each band. In addition, the bands may have different band-center gain if the crossovers are not tuned sufficiently apart in frequency. It is therefore incumbent upon you to set the band mixes according to the ear, and not by estimation or assumption.

When tuning the band mix, you may end up with none of the bands remaining at 0dB. It would then be a good idea to normalize your mix by going to “update all” and raising or lowering all the mix levels simultaneously until one of the middle two bands lands on 0dB. This will keep your relative mix intact while adjusting the overall mix to a normal level.

6.7.5 Band Coupling

Hard stereo coupling should be chosen when you want the absolute stereo imaging preserved. This option is excellent for Classical music, or a highly definitive Jazz station. Elastic coupling is an FM Pro unique coupling method that allows global coupling, i.e., the baseline compression will tend to track between channels while the faster “peak” compression will remain independent. Elastic coupling is excellent for nearly every format since it maintains the perceptual stereo balance and imaging while preventing a transient event in one channel from poking a gain hole into the other channel.

Band-to-band coupling can be used to reduce the dynamic equalization that occurs with multiband compression. Usually we want the dynamic equalization to remain since it constitutes enhancement of the sound and helps get the unique on-air sound we are after. However, there are times when we may want to keep a flatter frequency response, at least between two of the bands. Band-to-band coupling is elastic like the elastic stereo coupling. This allows coupled bands to remain independent for compression of transients and thus preserves many of the benefits of multiband compression.

6.8 Peak Limiting

The limiter’s master drive control may be considered to be a master gain control operating after the multiband compressor’s 4 band output mix controls. It sets the amount of mixed multiband compressor signal which will be pushed into the FM Pro’s split band clipper. The clip threshold is set to match your transmitter’s 100 percent modulation level. The multiband compression threshold is coupled to the split band clipper in such a manner as to cause the compression threshold to vary as a function of clipping. This allows you to get the most limiting possible within minimum distortion constraints. As you increase the master drive level, you cause a greater depth of multiband compression because the split band clipper is progressively instructing the compression threshold to decrease, thus avoiding excess clipping, causing more gain reduction. The greater you increase the master drive, the louder your signal will become. At some point, as you advance the master drive, you must begin to accept more noticeable distortion to permit the loudness you demand. This point occurs at approximately +4.8dB.

A good method for setting the Master Drive is to start at about 0dB and try to increase it if the loudness is insufficient. There is an optimum balance between limiter drive and compression for gathering loudness. It is sometimes better to highly compress and moderately limit. This brings the most density and that “wall of sound” effect. However, for a more open effect that is still loud, you should try lighter or slower compression and more limiting.

6.9 Bass Enhancement

Consistent, strong bass is an essential part of a competitive air sound. A good method for using the FM Pro’s bass processing is to start with the Master Bass at 0dB and the Warm Bass and Sub Bass boosts at 0%. Mix the multiband compression output as you like, but do not use the B1 mix to get the full bass boost, rather use it moderately like up to about 2.5dB only. Go to the Warm Bass and increase it slowly until the overall bass takes on a slightly boosted feel. Next, go to the Sub Bass and increase it until you hear the lower bass come up noticeably. This will probably occur at around 30% boost. Next, go to the Master Bass and drop it slightly, like about 1 to 2 dB. Finally, go back to the Warm and Sub Bass and adjust them for

the overall bass punch and resonance you are after. Dropping the Master Bass has the effect of shelving down all frequencies below 200Hz, and reducing the drive into the bass portion of the split band clipper. This is beneficial because it allows you to equalize the Warm and Sub bass for a very good spectral balance while reducing the overall bass energy drive to the bass interactive clipper. By optimally driving the bass interactive clipper, you can optimize the loudness-presence-bass equation.

6.10 Brightness Enhancement

This process allows you pick up the presence, brightness, and loudness of your air sound without overtaxing the multiband compressor. You will usually find that about 2dB of brightness boost will be sufficient. We recommend adjusting the multiband mix with only moderate boost not over +3dB in bands 3 and/or 4 then using the brightness enhancement to obtain the additional brightness you desire. In some cases, running a brightness boost above +3dB may cause you to observe an increased noise floor. This is due to picking up the high frequencies of the program material. In most cases, the increased noise is greatly offset by the benefits of the bright and sparkling sound quality.

6.11 Pre-emphasis Limiting

There are only two parameters to adjust here. One parameter was set up when you created your Global preset, the pre-emphasis/de-emphasis characteristic. What is left is to set the “Hardness” setting. In the FM Pro, the pre-emphasis is created dynamically and automatically readjusted to prevent high frequency overmodulation caused by the pre-emphasis boost. An embedded distributed clipper is associated with the final non-overshooting 15KHz low-pass filter of each channel. This clipper catches all peak overshoot remaining after the dynamic pre-emphasis limiting. Setting the Hardness to 0% leaves little for the clipper, the work being done dynamically, but the sound tends to become duller due to the sweeping pre-emphasis curve. At 100% Hardness, the dynamics are locked and the clipper does all peak control. This provides a brighter sound but causes sibilance distortion. Somewhere between 0 and 100% Hardness you will find a good setting with no appreciable distortion and good brightness. Generally that will be at 50%, but it depends on your Multiband Compressor mix, limiter Master Drive, and other factors. You should go for the highest Hardness setting that does not

cause sibilance distortion.

There is an optimum balance to be found between the Hardness setting and the Multiband Compressor mix. You may have attempted too high a boost in the B4 mix if you have to drop the Hardness much below 50%.

6.12 Save Your Preset

After you have reiterated your adjustments and are at a point you want to save what you have created, follow the steps outlined section 7 of this manual to save your user preset. By saving several variations to presets, and recalling them, you can compare your processing ideas and make appropriate further adjustments. Gaining on a competitor may be as easy as a first time shot, or might require incremental adjustments.

6.13 Tutorial: A “HOW TO” Experience

The following is a slightly different slant on setting up processing, being somewhat anecdotal, and it may shed further insights for many readers.

The first question to consider is format. The type of music will dictate the overall processing amount, equalization, and “personality”. An FM processing system is designed to control modulation primarily, but as competition in the marketplace has increased, so has the need to aggressively process the audio signal to increase apparent loudness. It goes without saying that a radio station that can sound different and even better than the competition can be at some sort of an advantage in the ratings/revenue game.

At Aphex, we believe that high quality and the ability to be competitive in audio processing can go hand in hand.

Once the format type is determined, choose a similar factory preset that will give you a starting place in getting the sound desired. Copy the factory preset to a User preset location and name it. Then recall that preset and begin the fun of making adjustments.

Concentrate immediately on the mechanics. Is the Input level correct? Is the modulation level appropriate? Is the pilot level correct? Make the necessary adjustments to bring the above parameters to the desired levels, then save those settings to the Globals preset. Now go back and insure that you

are currently using the preset that was selected and named above. The processor is now able to be customized to fit the stations needs.

Provided modulation level and density are close to expectations, the equalization of the compressor and the bass enhancements sections are the next areas to deal with. Examine the crossover frequency settings, and the gain reduction readings on the multiband compressor. If the compressor seems to be working harder on one band more than the others, and the program material is wideband, then consider moving the crossover frequencies to better suit your needs. Remember that the Multiband equalizer will be affected by the crossover changes, so be careful with any extreme equalization boosts or cuts while changing crossover frequencies. As tuning continues, and the high frequency information is meeting expectations, move to the Limiter/Bass menu. Examine the amount of master drive that the limiter is currently set at, and how much limiting is being indicated by the meter. Provided there are not any strange gain settings, the limiter should be indicating anywhere from 3-6 dB of limiting during normal program material. If the low frequency content is not meeting expectations, either adjust the Bass drive, or move to the next page and make adjustments to the bass enhancement circuits. Additional adjustments may be made to the mix and release times in the Multiband compressor in order to continue to bring the overall tonal balance to a place that works.

Loudness in FM broadcasting is a factor of modulation density. This is generally referred to as peak to average ratio. The Fm Pro is capable of creating a very dense audio signal with very acceptable levels of degradation. Remember, the louder or more dense the signal becomes, the more potential for distortion. If loudness is desired, there are two ways to get it: limit and clip, or compress hard. Combining the two in this processor allows the user the ability to keep the audio as clean as possible, yet increase density. To further avoid artifacts that will be most noticeable on simple voice material when processing aggressively, place the multiband crossover points at frequencies that allow the voices to fall in to one band of the compressor almost exclusively. These suggestions will allow the user to increase loudness by driving the compressor and limiter harder with fewer apparent artifacts.

The less distortion and apparent loudness, the more open and clean a station will appear to sound.

No matter the system, this processing tradeoff is always present. The FM Pro has a great many tools that allow the user to increase loudness and density, yet retain brightness in the high frequencies and dimension in the low end. Unlike other processors, the processing systems in the FM Pro are very interactive. The input signal from one section is very dependent upon the output from the preceding section. One of the keys to running the processor aggressively with success lies in understanding what the various sections of the device are doing and how they are interacting with each other as the audio is passed through.

Like any Fm Processing chain, time, patience and awareness will net a great deal of information and direction. Be sure to take the time to be consistent with the tuning of the Fm Pro. Attempt one change at a time, log your changes, and update presets frequently. Listen in many different environments, and develop a language that will allow effective expression of what your ears are experiencing.

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