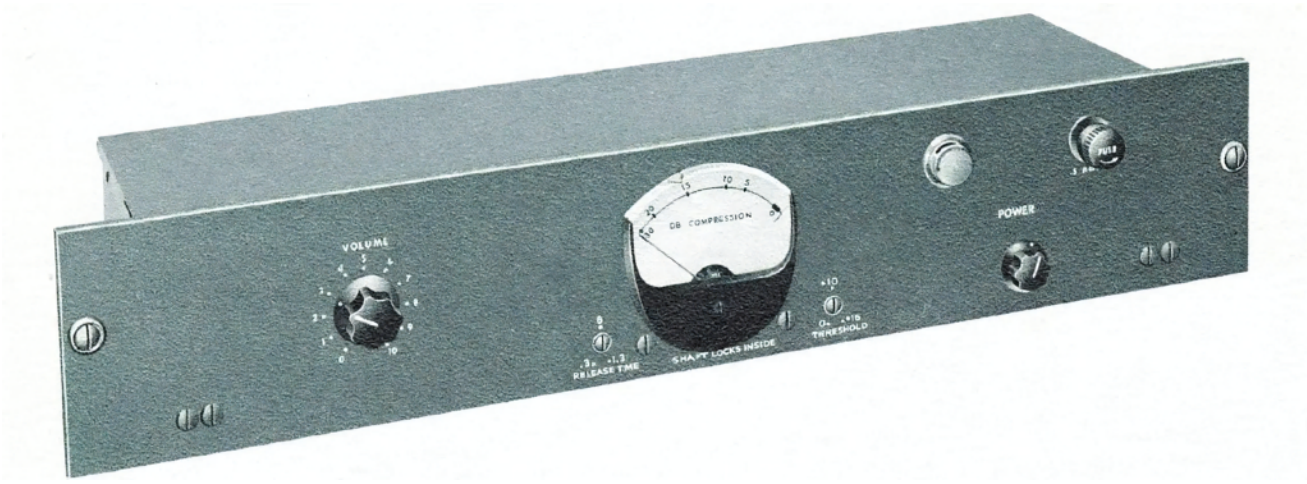
Compression and Dynamics Processing

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Compression and Dynamics Processing

Working Notes for Recording Mixing Mastering and Sound Design

Compression is a level-control tool, not a collection of magic settings. It reduces the difference between loud and quiet portions of a signal by attenuating what rises above a threshold. The musical result depends on what is allowed through, how quickly the detector reacts, how long the gain reduction remains in effect, and how the output is compared with the bypassed signal. The settings in this guide are starting points. Use them to get close, then decide by listening to the source in context.

The central discipline is simple: identify the dynamic problem, choose the least intrusive tool that solves it, and compare the result at matched loudness. A compressor that sounds impressive only because it is louder is not necessarily the best choice.

How to use this guide

- Begin with the fundamentals and the setup sequence before reaching immediately for an instrument-specific preset.
- Use the source-specific tables as ranges, not prescriptions. Threshold depends on recording level and should normally be chosen based on the desired gain reduction.
- When natural expression matters, consider clip gain, fader riding, editing, or a sidechain filter before increasing compression.
- Always check the result in the full mix and at approximately the same loudness as the bypassed mix.

Fundamentals

What a Compressor Changes

A compressor reduces level above a chosen level, referred to the **threshold**. It can make a performance's dynamics more even, keep peaks from overloading a later stage, change the balance between transients and the sustained note, or create an audible effect. It cannot decide whether the underlying performance, arrangement, microphone position, or gain staging is right. You make those decisions.

The Main Controls

Control	What it does	What to listen for
Threshold	The input level at which gain reduction begins. Lowering it makes the compressor work on more of the performance.	Does it act on the problem you meant to address, or is it reducing everything?
Ratio	How much the level above threshold is reduced. At 4:1, 4 dB above threshold becomes about 1 dB above it, before timing and detector behavior are considered.	Higher ratios sound more controlled and can become obvious more quickly.
Attack	How quickly gain reduction begins after the detector sees the signal above threshold.	Fast attack controls peaks but can remove impact. Slower attack preserves the front edge and lets the body be controlled.
Release	How quickly gain reduction returns toward zero after the signal falls.	Too fast can pump or breathe. Too slow can flatten the next note, word, or beat.
Knee	How abruptly or gradually the ratio is introduced around the threshold.	Hard knee is more definite. Soft knee is usually less conspicuous for leveling.
Makeup gain	Raises the output after attenuation so the processed signal can be compared fairly with bypass.	Match loudness before judging tone, punch, or apparent improvement.
Sidechain or detector filter	Changes what the compressor listens to without necessarily changing the audio sent to the output.	A high-pass filter can stop kick or bass energy from causing unwanted pumping.
Lookahead	Delays the audio path so the detector can respond before an approaching transient.	Useful for peak control, but too much can soften the sense of immediacy.

A Practical Starting Setup

1. Decide what needs to change: peak control, level consistency, transient shape, sustain, density, or a deliberate effect.
2. Listen to the unprocessed track in the mix. If the problem is actually arrangement, microphone placement, noise, or a single bad peak, fix that first when practical.
3. Start with a modest ratio, often 2:1 to 4:1. Lower the threshold until the gain reduction meter shows activity on the passages that need control.
4. Set attack by deciding whether the initial transient should remain prominent. Use a faster attack for peak catching and a slower attack when punch or consonant clarity matters.
5. Set release so the compressor recovers naturally before the next important event. Tempo, phrasing, and the decay of the source matter more than a fixed number.
6. Choose knee, sidechain filtering, and lookahead only after the main behavior's adjustment is close.
7. Set makeup gain, match the bypassed loudness, and listen again in context. Reduce the amount of processing if the improvement disappears when levels are matched.

Useful gain reduction ranges

Purpose	Typical starting range	Interpretation
Transparent leveling	1-3 dB	Keeps a performance more even while leaving most of its natural movement intact.
General control	2-6 dB	A practical range for vocals, instruments, and moderate peak control.
Dense texture or parallel work	6-10 dB or more	Usually easier to hide when blended with a dry signal or used for a deliberate effect.
Safety limiting	Set by the peak that causes the problem	The limiter should catch the problem event without becoming the sound of the whole track.

These ranges describe what the meter may show, not what the ear hears. A transparent 1 dB reduction can be more appropriate than an aggressive 6 dB reduction, but a 6 dB reduction may be exactly right for a parallel texture or a safety stage.

Timing and Troubleshooting

Attack Is Also Envelope Control

Attack changes the relationship between a transient and the body that follows it. On drums, percussion, piano, plucked strings, and consonant-rich speech, a very fast attack can make the source smaller or less intelligible by reducing the first instant of the sound. A slower attack can preserve impact while still lowering the body and sustain. Judge this in the arrangement; a setting that sounds exciting in solo may make the instrument disappear in the mix.

Release Determines Recovery

A release that is too fast can make the level rise and fall in sympathy with individual cycles, words, or drum hits. A release that is too slow can keep the compressor engaged into the next phrase and make the source feel permanently smaller. Start with the music's tempo, then adjust until the gain reduction moves with the performance without calling attention to itself.

Low-Frequency Distortion

Low-frequency waveforms take longer to complete a cycle. If gain reduction changes too quickly relative to that waveform, the compressor can modulate or effectively reshape the low-frequency cycle and produce audible distortion. This is most noticeable on bass, kick, and other sustained low sounds. First try a slower attack; if the detector is being driven by low energy that is not the problem, use a high-pass filter in the sidechain. Digital lookahead can also help a peak detector respond early enough without clamping the waveform at the wrong moment.

Other Common Troubles

- Pumping or breathing often means the release is too fast, the threshold is too low, or low-frequency energy is driving the detector. Try a longer release, less gain reduction, or sidechain filtering.
- A drum or percussion part that loses impact is often being attacked too quickly. Lengthen the attack or lower the ratio before changing the threshold.
- A track that sounds better only when the compressor is engaged may simply be louder. Match the output before deciding.
- Not every compressor uses the same control law. Some units label attack and release in reverse directions; the 1176 family is a familiar example. Check the manual and the actual time behavior of an unfamiliar unit.
- If you notice that natural expression is disappearing, reduce the amount of compression then use clip gain, manual fader rides, or editing for the few events that actually need attention.

Compressor Types and Techniques

Circuit Families

Type	General character	Common uses in these notes
VCA (Voltage-Controlled Amplifier)	Precise and controllable; can be transparent when used lightly.	Mix bus, piano, general instrument control, and bus compression.
Optical Ladder	Smooth, program-dependent leveling with a natural-feeling envelope.	Voice, ballads, flute, woodwind sections, brass sections, and gentle piano work.
FET	Fast, assertive, and capable of audible character.	Saxophone, aggressive lead piano, peak catching, and serial compression.
Variable-Mu	Often valued for warmth, density, and a rounded response. Because it's a vacuum tube circuit, noise may become more apparent.	Piano, full-range sources, and situations where sustain or harmonic character is welcome.

Serial Compression

Two gentle stages can be easier to hear through than one aggressive stage. A fast compressor can catch short peaks, followed by a slower optical or VCA stage that performs the broader leveling. A common use is complex brass tracks, but the principle applies anywhere the first stage and second stage have clearly different jobs.

Parallel Compression

Send a copy of the source to a heavily compressed bus, then blend that bus beneath the original. A high ratio, fast attack, and fast-to-medium release can add density and body while the dry signal retains transient detail. One starting example in these notes is around 10:1, 1-3 ms attack, 40-60 ms release, and 7-10 dB of reduction on the parallel path. The blend, not the meter alone, determines the result.

Multiband, Sidechain, and Manual Control

- Multiband compression can control a narrow problem, such as the 100 to 250 Hz boot resonance in foley or low-mid congestion in a dense mix, without moving the entire signal. Use it only when ordinary EQ or broadband compression cannot solve the problem cleanly.
- A sidechain high-pass filter keeps low-frequency energy from dominating the detector. This often sounds more natural than using a faster release to compensate for pumping.
- Clip gain and fader rides (riding the gain) are often the most transparent ways to correct a few words, notes, or brief sound effects. Compression is better reserved for a repeated dynamic behavior or a desired envelope change.

SOURCE-SPECIFIC STARTING POINTS

The following settings are grouped by instrument family. A range is given where the notes contain more than one useful approach. Threshold is intentionally described by gain reduction, unless a fixed value is part of the original working note.

Voice and vocal groups

Source	Ratio	Attack and release	Starting amount and purpose
Vocals	2:1 to 4:1	1 to 30 ms attack; 50 to 100 ms release	Aim for roughly 2 to 6 dB on louder phrases. Use a slower attack when consonants or breath need to remain clear.
Voiceover and ADR	2:1 to 4:1; up to 6:1 for very uneven speech	Start around 5 to 15 ms; 50 to 100 ms release	Set threshold for 2 to 6 dB on peaks. Preserve intelligibility and avoid word-to-word pumping.
Background vocals and loop groups	4:1-6:1 or higher for texture	1 to 10 ms attack; 40 to 100 ms release	Around 6 to 8 dB can create a consistent supporting wall. Use clip gain first if only a few peaks are excessive.
Choir or large groups	Moderate to high	Fast enough to control peaks; release timed to the phrase	Cut unwanted low and high extremes before compression when mud or harshness is the actual problem.

Acoustic and plucked strings

Source	Starting settings	Notes
Acoustic guitar	2:1 to 4:1; 5 to 40 ms attack; 100 to 300 ms release	Preserve the pick or finger transient. Use lighter reduction for exposed or intimate parts.
Electric guitar	4:1 to 8:1; around 2 ms attack; around 300 ms release	Useful for strong control, but let the instrument's natural sustain and distortion do some of the work.
Banjo	Often no compression or 1 to 3 dB; 2:1 to 3:1; 10 to 20 ms attack; 150 to 200 ms release	Protect the natural pop. For isolated spikes, try 4:1-8:1 with 1-5 ms attack and 50-100 ms release, or use parallel compression.
Lute, oud, and tagelharp	Begin around 2:1 with modest reduction; 10 to 150 ms attack; automatic setting or up to 400 ms release	Use a conservative approach and avoid ratios above 5:1 unless a specific transient needs shaping.

For banjo and other naturally articulate plucked instruments, tonal EQ may be a better first move than compression. Reduce “mud” around 300 to 400 Hz and add presence around 5 to 7 kHz only when the recording calls for it; treat those as listening points, not as fixed equalization.

Bowed strings and low strings

Source	Ratio	Attack and release	Gain reduction and role
Violin and viola	2:1 to 3:1	40 to 50 ms attack; about 100 ms release	Keep reduction near 3 dB for transparency and expression.
Cello as a background part	2:1 to 3:1	Moderate attack; about 100 ms release	Light control is usually enough when the cello is not carrying the low end.
Cello as a bass instrument	3:1 to 4:1	Moderate attack; about 100 ms release	Allow roughly 4-6 dB when the cello must hold a stable low foundation.
Contrabass	4:1 to 10:1	1 to 10 ms attack; 180 to 300 ms release	Control spikes and resonance carefully; use the sidechain filter if low energy causes distortion or pumping.

Woodwinds

Woodwinds usually benefit from preserving breath, articulation, and natural changes of level. Use light control and avoid more than about 5 dB of ordinary gain reduction unless the sound is intentionally being shaped.

Source or group	Starting settings	Notes
Saxophone	FET; medium attack; fast release; roughly 5 to 7 dB when needed	Useful for controlling a wide dynamic range while retaining the instrument's character.
Flute	2:1 to 3:1; slow attack and release; 3-5 dB maximum	Keep the airy natural movement. Lighter compression is usually better outside deliberately dense styles.
Woodwind section	Optical; slow attack and release; about 3 dB	In classical settings, fader riding is often more transparent than compression.
Tin whistle, baroque recorder, and sharm	2.5:1 to 3:1; around 100 ms attack; around 300 ms release	Start conservatively and keep reduction modest. An optical compressor can provide a natural envelope.

Brass

Source	Type and ratio	Attack and release	Notes
Full brass section	Optical or minimal VCA; 2:1 to 3:1	10 to 18 ms attack; 200 to 300 ms release	Aim for about 3 to 5 dB on peaks while preserving the initial punch.
Trumpet	Optical; subtle	Slow attack and release	Set about 3 to 5 dB of reduction and caution against disturbing high-frequency transients.
Trombone	Optical or VCA; 2:1 to 3:1	Slow attack and release	Treat as a natural section instrument; keep reduction moderate.
Tuba	FET; variable ratio	Backed-off attack; fast release	Watch the low end. Multiband control below about 170 Hz may be useful if the resonance is the problem.
Horns in general	2.5:1 to 3:1	About 100 ms attack; about 300 ms release	Set threshold near -8 dB for one setup, but gain reduction and musical consistency are safer guides.

For difficult brass tracks, serial compression is recommended: a faster FET compressor to catch peaks followed by a slower optical compressor or limiter for broad leveling. Reduce energy below 200 Hz for boom and adding presence around 2 kHz only when the arrangement needs it.

Percussion, drums, and timpani

Source	Starting settings	Primary decision
Kick drum	4:1 to 8:1; about 10 ms attack; about 100 ms release	Keep enough attack to retain the hit. If the low end distorts or thins, slow the attack and filter the detector.
Snare drum	Around 3:1; fast attack or medium-slow release depending on the desired envelope	Fast control can shorten the crack; a slower attack can preserve impact.
Timpani	2:1 to 4:1; 1 to 5 ms to tame the “swack” or 10 to 30 ms to preserve it; 50 to 100 ms release	Aim for no more than about 3-6 dB unless the effect is deliberate. Let the tail decay naturally.

Timpani may need more than compression. Add harmonics with gentle saturation, then remove excessive sub-bass and competing mid-bass so the drum retains perceived weight without occupying the whole low end. If ordinary compression sounds forced, sidechain the timpani’s compressor against kick or bass so it ducks only when those instruments need space.

Piano, keyboards, organs, and synthesizers

Source or context	Ratio	Attack and release	Target and character
Piano in pop or rock	3:1 to 4:1	5 to 15 ms attack; 100 to150 ms release	Aim for about 2-4 dB. Avoid more than about 6 dB if the natural hammer transient matters.
Piano solo or classical	1.5:1 to 2:1	25 to 30 ms or slower attack; 200 to 400 ms release	Preserve the full dynamic shape and long decay.
Piano parallel bus	Around 10:1	1 to 3 ms attack; 40 to 60 ms release	Suggest 7 to 10 dB on the parallel signal, blended beneath the dry piano for body and punch.
Synthesizer	Around 4:1	About 10 ms attack; about 100 ms release	Control dynamics without erasing the programmed character.
Live or general keyboard	2:1 to 3.5:1	About 10 ms attack; up to about 1000 ms release	A long release can create a smooth sustaining level; listen for pumping.
Pipe organ	Around 2:1	30 ms attack; 100 ms release	Usually needs little compression because the harmonic output is already steady.
Harpsichord	1.5:1 to 2:1	Around 100 ms attack; about 115 ms release	Even the level gently without overpowering its articulation.
Electronic organ and synth bass	Around 1.8:1	About 1.8 ms attack; about 85 ms release	A faster envelope can help place the part in a dense arrangement, but check low-frequency distortion.

For piano, VCA or optical compression gives transparent dynamics control. Variable-Mu coloration is useful when warmth or sustain is wanted. The deciding factor is whether the compressor supports the instrument's transient and decay or simply flattens them.

Sound Effects and Foley

Sound effects

Effects often need consistent level without losing their transient identity. Start around 2:1-4:1; use 1-5 ms attack to catch a transient or 10-30 ms to keep more impact, with 50-150 ms release. Aim for roughly 3-6 dB only on the peaks that need it.

Foley tracking

Stage	Approach	Working notes
Recording	2:1 to 3:1 with a gentle threshold	Provides a more consistent headphone level and reduces the chance that hard impacts clip. Do not drive the microphone preamp to create the compression; peaks around -15 dBFS are a useful conservative tracking reference.
Peak control	Fast compressor or limiter before the main stage	Catches isolated shoe strikes, scuffs, or other rogue peaks.
Main mix compression	Lower threshold with slower attack and release	Levels the performance after peak control without making the room or background noise unnaturally prominent.
Problem-specific control	Multiband or EQ-triggered processing	The notes identify 100-250 Hz as a useful range to investigate for boomy boots. Use a transient designer or sidechain only when it solves a clearly heard problem.

Foley working principles

- Avoid heavy broadband compression when the desired result is natural movement. A crushed foley track often sounds less believable than a gently edited one.
- Use a high-pass filter from 60 to 80 Hz and gentle EQ when rumble or boxiness is the actual problem.
- Layering several takes can average out unevenness naturally and reduce the amount of processing required.

Delivery and Production

Tracking and Recording

Tracking compression should protect the recording and make monitoring comfortable without committing the performance to an unnatural envelope. Use conservative ratios and leave headroom. If the source is unpredictable, a safety limiter can catch the occasional peak, but it should not be working continuously.

Mix Bus and Full Mix

A low ratio around 2:1 is a common starting point for broad mix control. The working notes include fast attack and long release examples, but the attack should be lengthened if the mix loses drum or consonant impact. Release may be around 500 ms or matched to the musical pulse. Keep gain reduction modest unless the sound of compression is part of the production.

Streaming and Digital Delivery

Context	Working level notes	Caution
General streaming delivery	Limiter ceiling around -1.0 dBTP with true-peak detection	Allows room for inter-sample peaks and codec conversion. Confirm the requirements of the actual delivery target.
Very loud master	The notes suggest as low as -2.0 dBTP when a master is louder than about -14 LUFS integrated	Treat this as a conservative working choice, not a universal platform rule.
Digital video delivery	Overall loudness notes range from -14 to -24 LUFS integrated; true peak around -1 to -2 dBTP	Platform, broadcaster, and program specification take priority.
Professional post	Dialogue peaks around -12 to -15 dBFS; overall mix peaks around -10 to -6 dBFS in the working notes	These are production references, not a replacement for the delivery specification.

Analog Tape, Vinyl, and Broadcast Studio-To-Transmitter Links

Maximum levels from -0.3 to -0.5 dBFS are recommended for analog tape, and below -1 dBFS for vinyl-oriented masters, with extra margin sometimes preferred. Because analog tape, record lathes, and level meters do not behave like the same digital peak domain, verify the actual machine, meter, and mastering specifications. Don’t treat these numbers as universal.

For studio-to-transmitter links and broadcast, set a -1 dBTP ceiling, use true-peak limiting, and 4x or 8x oversampling so that inter-sample peaks are not missed. Transmission standards and the broadcaster's loudness specification remain the final authority.

Automatic Gain Control for Video Sound

AGC is useful for live call-in shows and for unattended recordings where level changes cannot be managed manually. It is not usually suitable for studio, podcast, and pre-recorded work because preserving natural dynamics and avoiding noise pumping matters. Aggressive AGCs can raise the noise floor; the exact algorithm and its defaults must be checked before use.

Live Concert Sound

In live sound, manual gain staging is generally preferred for music. AGC and peak limiting have different jobs: AGC manages longer-term level while a limiter catches fast overloads. If AGC is used, observe the following starting ranges.

Processor	Working settings	Purpose
AGC	Target around -14 LUFS or -18 dBFS; 20-50 ms attack; 500-1000 ms release	Keep long-term level more consistent without rhythmically breathing.
AGC noise control	Activity threshold just above the ambient stage noise; maximum boost around 10-20 dB	Prevent quiet passages from lifting hiss and room noise. For music, disable AGC or use it very sparingly.
Peak limiter	Threshold about 1-3 dB below 0 dBFS or near -1 dBTP; 10-20 ms lookahead; high ratio or limiting; 100-300 ms release	Provide a safety net for sudden peaks without becoming the audible envelope of the concert.

Expansion and Noise Control

Expansion is the opposite direction of compression: it increases the level difference between louder and quieter material. Downward expansion reduces quiet material and is commonly used for noise reduction or bleed control. Upward expansion increases the level of material above a threshold and can restore contrast, but it can also raise peaks and require attenuation to avoid exceeding maximum allowable levels.

Parameter	Individual tracks	Mixdown or mastering	HI-FI and stereo systems
Threshold	Often just above the noise floor or bleed to be reduced.	Set to restore contrast without disturbing wanted tails or ambience.	Target the system noise floor while leaving music untouched.
Ratio	Higher ratios, such as 10:1, for gate-like control when necessary.	Lower expansion ratios, roughly 1:2 to 1:4, for subtle widening of dynamics.	Moderate to high ratios may be used for noise reduction or peak unlimiting, depending on the system.
Attack and release	Fast attack for transient clarity; medium release to avoid chatter.	Slower timing protects natural decay and reverb tails.	Tune timing to prevent audible swells, breathing, or chopping.
Range or depth	Defines the maximum attenuation of quiet signals.	Caps the amount of gain change so the process cannot overreact.	Sets the intensity of the dynamic expansion.
Makeup gain	Usually not needed for downward expansion.	May be needed for upward expansion because peaks can become higher.	Depends on whether the system is restoring or reducing dynamic range.

In HI-FI systems, DBX-style dynamic range expanders restore the dynamic range lost by excessive compression during the recording.

Troubleshooting and Final Checklist

What you hear	Likely cause	First move
Drums or percussion lose impact	Attack is too fast or the ratio is too high.	Lengthen attack, reduce ratio, or use parallel compression so the dry transient remains.
Bass or kick distorts	The detector is reacting too quickly to a long low-frequency cycle.	Slow the attack, high-pass the sidechain, or try lookahead.
The level pumps or breathes	Release is too fast, low frequencies dominate the detector, or gain reduction is excessive.	Lengthen release, filter the sidechain, and reduce the amount of reduction.
The source sounds smaller or duller	Too much gain reduction or transient loss.	Match output level, then lengthen attack or reduce threshold and ratio.
Noise becomes more obvious	Compression or AGC is raising quiet material and background noise.	Reduce makeup gain; edit or expand downward; do not compress the noise floor.
The compressor seems to respond backward	The unit's control direction or time scale differs from another compressor.	Check the manual and listen for the actual response.
A classical or exposed part loses expression	Compression is being used where fader riding or editing would be more transparent.	Reduce gain reduction and automate the few level changes that need correction.

Before Finalizing the Dynamic Processing

- Can I state the dynamic problem in one sentence?
- Is compression actually the best tool, or would editing, fader riding, EQ, placement, or arrangement solve it more cleanly?
- Have I chosen attack and release for the source's envelope rather than by habit?
- Does the gain reduction meter move in a way that makes musical sense?
- Have I listened in the full mix as well as in solo?
- Have I matched the processed and bypassed loudness?
- Does the source still have the transient, sustain, noise floor, and expression that the arrangement requires?
- If this is a delivery or broadcast path, have I checked true peak, loudness, codec, and the actual specification?

The best setting is the one that makes the intended musical or technical improvement easy to hear while leaving the listener unaware of the processing. When the processing becomes the main thing being heard, back off and reconsider the problem.