MDWDRC2-NATIVE Dynamic Range Controller

User Guide

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Appendix

Chapter 1:

MDWDRC2-Native Introduction

01 Introduction

Introducing MDWDRC2-Native Dynamic Range Controller

Massenburg DesignWorks® (MDW) was founded in 1999 by Grammy® award-winning designer engineer/producer/lecturer and audio industry legend, George Massenburg. Building on a foundation of analog classics like the GML-8200 Parametric Equalizer and GML-8900 Compressor, George and a team of dedicated DSP engineers have enhanced and extended his benchmark analog designs into the digital domain, delivering *truly* state-of-the-art performance to plug-ins for the Professional Audio Engineer.

For the past two decades, an enduring goal for MDW has been the design of a comprehensive dynamic range controller unlike anything previously available in the digital or analog realms. All compressors rely on detectors which react to the *level* of an audio signal as it passes through a user- defined threshold. Nearly all detectors all share fundamental flaws: a crude approximation of human hearing to determine loudness and reaction time (averaging designs); a seeming disregard for psychoacoustics (designs based solely on peak electrical signals); and a corresponding increase of distortion as compression deepens.

Overcoming these flaws led MDW to the invention of a new paradigm for sensing audio loudness -- the "Variable Exponent Averager" (VEA). This patented technology allows the detector's sensitivity to range continuously from averaging-responding, to RMS-responding, to peak-responding detection. As well, the detector is tuned to model human hearing more faithfully than previous designs -- more sensitive to perceived (psychoacoustic) loudness than to electrical peak or average values (digital or analog) . The most remarkable aspect of this design is a possible dynamic control over a very wide dynamic range (40 or more dB range) that is sonically far less audible than with *any other* "*automatic level*" *devices.*

01 Introduction

MDWDRC2-AAX Plug-In Features

Massenburg DesignWorks® (MDW) Dynamic Range Controller plug-in version 2 is a mono and stereo native plug-in that defines the state-of-the-art in digital dynamic range controller. With its unprecedented,unique processing the MDW® Dynamic Range Controller is designed for unequaled sonic performance.

The **MAIN** and **PEAK** Exponent knobs set the math used to evaluate signals. You may raise the average sum to the power of 1 to 8. The **MAIN Exponent** default setting of 2 equals the square root of averaged signals squared, (more commonly known as RMS, or root mean square) and will more closely track the energy of a signal.   Higher **PEAK Exponent** values have faster attack rates which could be useful for capturing faster transients.

MDW Dynamic Range Controller is implemented in double-precision 64-bit floating-point processing to take advantage of the maximum capability of your Pro Tools®, Logic, Nuendo and other DAW using AAX64 Native, AudioUnit and VST3. This plug-in can even emulate George Massenburg's legendary GML 8900 Dynamic Gain Controller — the industry-standard reference in dynamic range controllers - and take it much further.

This guide provides information on installing and using the **MDWDRC2-Native** plug-in in Avid's Pro Tools and other major DAWs.

MDWDRC2-AAX Plug-In Features

- Revolutionary, patented detection processors that track signals more like people perceive sound.
- High-resolution processing with support for sample rates from 44.1kHz to 192kHz.
- Accurate, wide-range TrueRMS Signal Detection.
- Double-precision 64-bit processing throughout for unprecedented clarity and low noise.
- Wide-range, wide-bandwidth logarithmic processing for balanced control over wide dynamic range.
- Built-in selectable EBU BS1770_3 Loudness Normalization filtering in the side-chain.
- Look-ahead control enabling a delay setting. It can be integrated with the host's Delay Compensation (if available in a given DAW).
- Pro Tools AAX64 Native plug-in format as well as AudioUnits (MacOS) and VST3 for non-Pro Tools DAWs.
- Intel and Apple Silicon (M1/M2) support in all hosts.

Chapter 2:

Installation and Authorization

02 Installation and Authorization

System Requirements and Compatibility

To use the MDWEQ plug-in, you need the following:

- An iLok USB Smart Key (iLok 2 or 3 required)
- An iLok.com account for managing iLok licenses
- The latest iLok License Manager application
- A qualified Pro Tools system for AAX-Native. For non-Avid Pro Tools DAWs should be the latest available version. MDW can only test and guarantee the full installation and operation on the most recent versions of Pro Tools (or the latest version of other DAWs) and the iLok License Manager.

Activate Your Plug-in

In order to activate your plug-in, you will need to install the latest "iLok License Management Application" and iLok USB Smart Key 2 or 3 (shown below).

An iLok can hold hundreds of licenses for all of your iLok-enabled software. Once a license for a given piece of software is placed on an iLok, you can use the iLok to authorize that software on any computer.

An iLok USB Smart Key is not supplied with plug-ins or software options. You can use the iLok included with certain Pro Tools systems or purchase one separately.

Operating System:

This is the minimum system requirement to run MDWDRC2-Native.

MacOS:

Mojave (10.14.6),
Catalina (10.15.7),
Big Sur (11.6),
Monterey (12.6+)

Windows:

Windows 10 or 11

Installation Destinations

Each plug-in format will be installed to its own destination as below:

MacOS:

AAX: /Library/Application Support/Avid/Audio/Plug-Ins

VST3: /Library/Audio/Plug-Ins/VST3

AudioUnit: /Library/Audio/Plug-Ins/Components

Windows:

AAX: C:\Program Files\Common Files\Avid\Audio\Plug-Ins

VST3: C:\Program Files\Common Files\VST3

Removing Plug-Ins

If you need to remove a plug-in from your Pro Tools system, follow the instructions below for your computer platform.

Mac OS X:

1) Locate and open the Plug-Ins folder on your Startup drive (see previous page for the installation destination for each format).

2) Do one of the following:

- Drag the plug-in to the Trash and empty the Trash.
- Drag the plug-in to the Plug-Ins (Unused) folder

Windows:

1) Choose Start > Control Panel.

2) Click Programs and Features.

3) Select the plug-in from the list of installed applications.

4) Click Uninstall.

5) Follow the on-screen instructions to remove the plug-in.

Chapter 3:

MDWDRC2-Native Parameters

03 MDWDRC2-Native Parameters

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The Ultimate Transparent Smooth Dynamics Range Controller

Bypass
Bypass Gain affects it when **Bypassed**

"A"
shown set to current settings (green)

"Copy"
A>B (or B>A)

"B"
alternate settings (off)

"SC"
side-chain enable

"Key Listen"

Main Detector Exponent
see MDWDRC2 User Guide

Main Compressor Active
Green when MAIN RMS detector is active.

Threshold
Sets the Main Detector's real Threshold, also sets the Rotation Point.

Main Detector Timing
Expressed in constant db/sec release

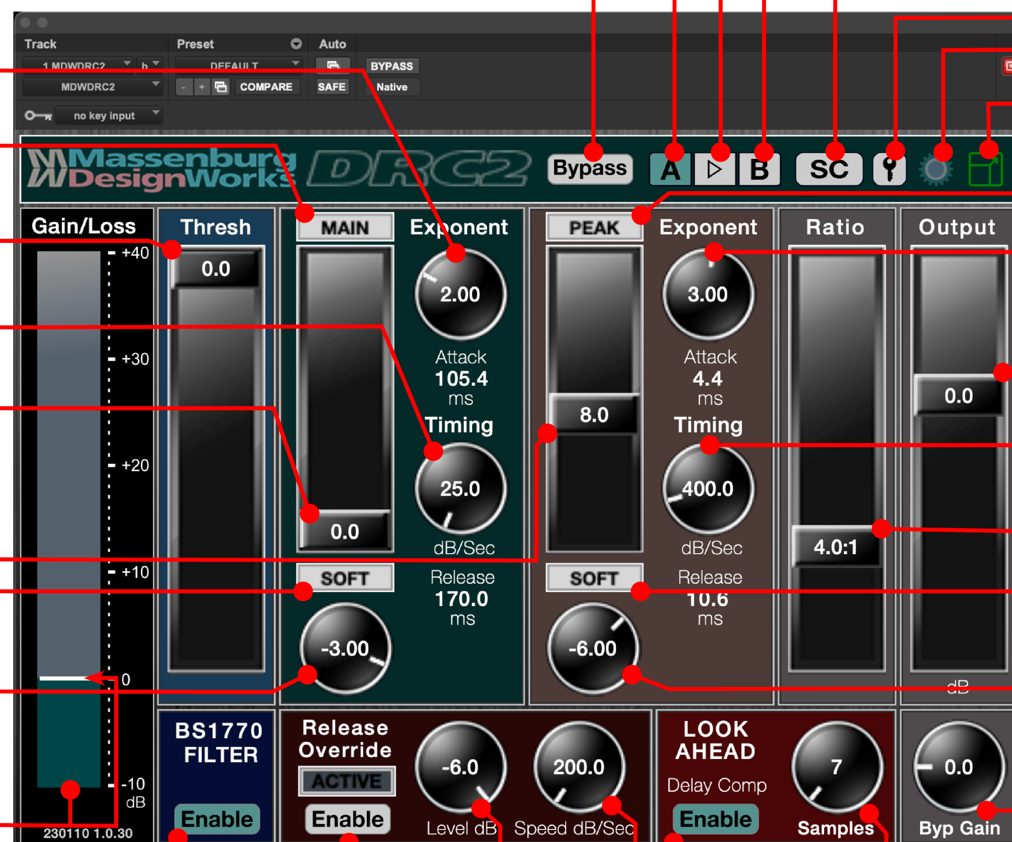
MAIN Compressor Gain
Higher values increase overall maximum compression.

PEAK Compressor Gain
Lower values increase overall Peak acompression.

Main Soft Knee Active
(Lights Blue When Active)

Main Soft Knee Control
Expressed as dB gain reduction at the Rotation Point. Adjusts the transition between MAIN and PEAK detectors. Higher (more minus) values are "softer".

Gain/Loss Meter
The line between the **vertical dark green bar** and the **vertical gray bar** is the actual instantaneous gain (or loss) of the DCA (shownj at "0" in white)
Also <option-click > brings up the Preset Popup



Preferences

Screen Size

Peak Compressor Active
Orange when Peak Detector overrides the Main Detector.

Peak Detector Exponent
see MDWDRC2 User Guide

Output
Output Gain or Loss in dB. (if not by-passed)

Peak Detector Timing
Expressed in constant db/sec release

Master Ratio
Ratio (the delta) between input and output of the DRC after Main & Peak detectors have been compared and combined.

Peak Soft Knee Active
(Lights Blue When Active)

Peak Soft Knee Control
Adjusts control smoothly between no override (of the Peak detector) and full override. Negative values are "softer".

Bypass Gain
Output Gain or Loss when **Bypassed** in dB.

Look-Ahead (in samples) may increase plug-in's latency

High-Pass Filter
Enables the DRC Detector's Loudness Normalization filtering in the control chain (only) as per ITU BS1770_3.

Release Override Enable
Turns on the Release Override function. Red indicator above shows when active.

Release Override Sensitivity
Level (in dB) of the *reverse sensitivity* to the dynamics of the signal, specifically how much the signal must drop in a short time to trigger accelerated release.

Release Override Speed
The rate at which Release Override will accelerate gain recovery overrid-ing the MAIN and PEAK detectors, .

Look Ahead Enable
For DAW's that support it, the input signal is delayed by the look-ahead length, and the host's Delay Compensation is likewise adjusted.

03 MDWDRC2-Native Parameters

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The Ultimate Transparent Smooth Dynamics Range Controller

Gain/Loss Meter
The line between the **vertical dark green bar** and the **vertical gray bar** is the actual instantaneous gain (or loss) of the DCA (shownj at “0” in white)
Also <option-click > brings up the Preset Popup

Preset Popup
option-click on the **Gain/Loss Meter**

03 MDWDRC2-Native Parameters

Massenburg DesignWorks
MDWDRC2-Native
The Ultimate Transparent Smooth Dynamics Range Controller

Bypass
Bypass Gain affects it when **Bypassed**

"A"
shown set to current settings (green)

"Copy"
A>B (or B>A)

"B"
alternate settings (off)

"SC"
side-chain enable

"Key Listen"

Preferences

Screen Size

Peak Compressor Active
Orange when Peak Detector overrides the Main Detector.

Threshold
Sets the Main Detector's real Threshold, also sets the Rotation Point.

MAIN Compressor Gain
Higher values increase overall maximum compression.

PEAK Compressor Gain
Lower values increase overall Peak acompression.

Gain/Loss Meter
The line between the **vertical dark green bar** and the **vertical gray bar** is the actual instantaneous gain (or loss) of the DCA (shownj at "0" in white)
Also <option-click > brings up the Preset Popup

Option-Click on the Gain/Loss Meter
Shows the Preset Popup

Plug-in Window – Basic Controls (description)

Thresh: Thresh sets the MAIN detector's real threshold. This also sets the position of the Rotation Point (see page 33 for more explanation) where it interacts with the Soft Knee and Ratio settings.

MAIN: MAIN Compression Gain. Higher values increase the amount of gain added to a signal below threshold. When the signal is above threshold, it adds no *additional* gain.

PEAK: PEAK Compression override sensitivity (threshold), in dB *above* the **MAIN** detector. Lower values increase sensitivity to peaks, all outputs from both the **MAIN** and **PEAK** detectors (as well as the **Release Override** function) are then are provided to the **Ratio** control.

MAIN Compressor Active: Green when the **MAIN** compressor is active.

PEAK Compressor Active: Orange when **PEAK** detector is overriding MAIN detector.

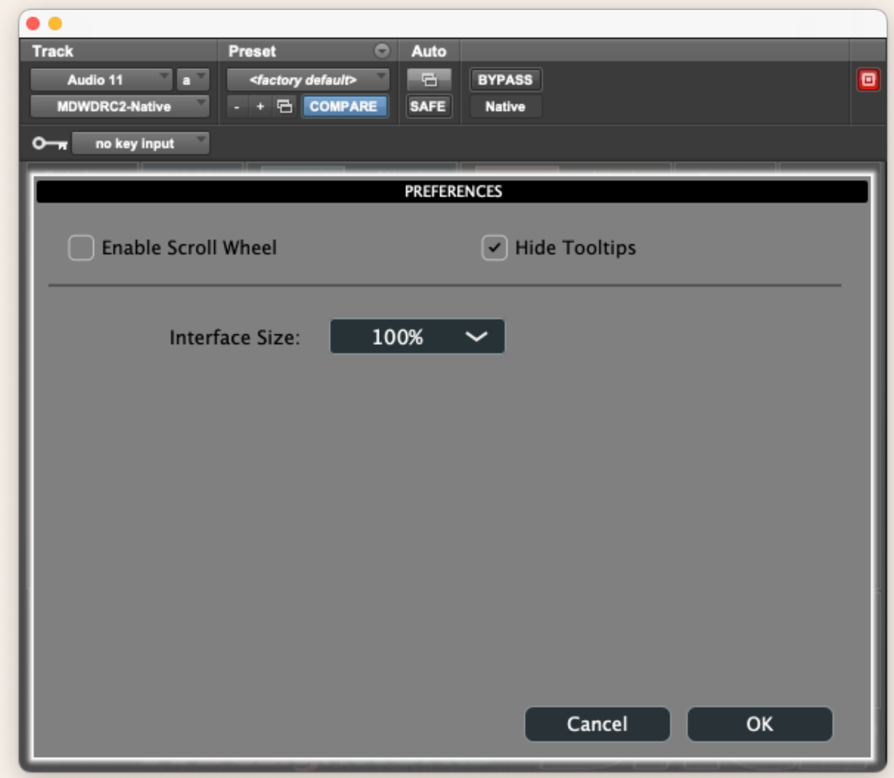
Bypass: Bypasses the plug-in. The Bypass Gain is active when bypassed.

Copy Snapshot A->B, B->A: While A is selected, duplicate all settings to Snapshot B and vice versa. You'll then have 2 settings to compare. Snapshots are not saved with the host. Only the active snapshot is saved.

SC (sidechain): Engage Sidechain signal. Active when green.

SC Key: Allows to listen to the sidechain key signal only. Active when green.

Gear Symbol: User Preference (see figure right) such as Mouse Wheel enable and Tooltips on/off. Also allows users to change the interface size



Screen Size: Allows users to change the plugin window size to 100%, 125% or 150% without going into the preference menu (see figure above)

Core Concepts and First Steps

The primary design objective of the **MDWDRC2** is *transparency of action*, starting with a detector that responds as would a tireless, authoritative “hand on the fader”. To achieve this transparency, new concepts are introduced, and many familiar terms take on deeper meanings due to the unique, interactive nature of the controls. Although the plugin can be used and abused for creative purposes, to dive into the deep-end blindly will lead to unexpected results.

With that in mind, start by loading up an instance of **MDWDRC2** with its default settings. For the purposes of setup, set the **Ratio** control to 100:1 and the **PEAK** control to 18.0 (or off, more or less). Our preliminary focus is to observe *what* is happening with the source dynamic range, rather than how “musical” the result is, without listening to “compression artifacts”.

- Play an un-mastered full-range track or dynamically complex instrument like an acoustic guitar or piano, or even voice, through the plugin.
- Pull the **Thresh** control down until the **Gain/Loss** meter starts showing a few db of activity at the “quietest” point of the source signal.
- Now push the **Main** gain control up slowly. A powerful aspect of the design will become immediately apparent: under the threshold you’ll see a simple increase in level, and track density will increase as levels below the threshold are pushed *up* towards the threshold (same as **Thresh** at 100:1). Simultaneously, an internal makeup gain pushes levels above the threshold *down*. The threshold then can be thought of as a “**Rotation Point**", like the center of a teeter-totter.
- Now, pull the **Ratio** control down from 100:1 to 4:1 and notice the track “opens up” dynamically, while maintaining its *average, long-term loudness*. The user-defined threshold still acts as the **Rotation Point**, while an internal threshold shifts to maintain overall *long-term loudness*. The **Ratio** determines the steepness of the tilt and the “width” or “range” of the dynamics.

The **MAIN Timing** control (default = 25dB/sec release rate) adjusts the response to the **MAIN** exponential detector. When set to “**2**” the detector is “true-RMS” responding, closely tracking the actual energy of the signal. This detector’s timing is symmetrical—changing the **MAIN Timing** control changes both the “**Attack ms**” and “**Release ms**” times displayed—note that these times are approximate.

- While playing the source track, adjust the **MAIN Timing** control noticing that the **Attack ms** indicator changes. You’ll hear a “sweet spot” that retains musical openness and usefulness versus the amount of control, ultimately allowing the engineer to focus on *listening to dynamics*, rather than “crush”. In fact, except for edge-cases (or intentionally bringing out the **MDWDRC2**'s euphonic growl), dynamic control can be achieved purely through refinements in **Timing**, leaving both **Exponent** controls at their default settings.

These behind-the-scenes interactions make it child's play to control a track's dynamics without changing relative mix balances; avoid being caught out by the trap of "louder is better"; effortlessly control punch and presence. All further refinements branch from this solid foundation and are fully explained in the following sections, from most esoteric to most conventional. A glossary of terms is also included along with links to further reading and instructional videos.

Plug-in Parameters – Main and Peak Detectors (description)

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Main Detector Exponent
see MDWDRC2 User Guide

Main Compressor Active
Green when MAIN RMS detector is active.

Main Detector Timing
Expressed in constant db/sec release

Main Soft Knee Active
(Lights Blue When Active)

Main Soft Knee Control
Expressed as dB gain reduction at the Rotation Point. Adjusts the transition between MAIN and PEAK detectors. Higher (more minus) values are "softer".

Peak Compressor Active
Orange when Peak Detector overrides the Main Detector.

Peak Detector Exponent
see MDWDRC2 User Guide

Peak Detector Timing
Expressed in constant db/sec release

Peak Soft Knee Active
(Lights Blue When Active)

Peak Soft Knee Control
Adjusts control smoothly between no override (of the Peak detector) and full override. Negative values are "softer".

Plug-in Parameters – Main and Peak Detectors (description)

MAIN Detector Exponent: Default is 2 - see more on page 34.

PEAK Detector Exponent: Default is 3 - see more on page 34.

MAIN Detector Timing: Expressed in dB/sec release rate - See more on page 34.

PEAK Detector Timing: Expressed in dB/sec release rate - See more on page 34.

MAIN Compressor Active: Green when **MAIN** detector output is causing gain reduction.

PEAK Compressor Active: Orange when **MAIN** detector output is causing gain reduction.

MAIN Soft Knee Control: Expressed as dB gain reduction at the *Rotation Point* (see page 48). Adjusts the shape of the transition of the Main detector. Higher negative values are “softer” knees.

MAIN Soft Knee Active: Lights up blue when active

PEAK: **PEAK** override sensitivity (threshold) in dB above the **MAIN** detector. Lower values increase sensitivity to peaks, **PEAK** override happens before the **RATIO**.

Peak Soft Knee Control: Adjusts control smoothly between no Peak override (of the **MAIN** detector) and full override. Negative values are “softer” knees.

Peak Soft Knee Active: Lights blue when active

Plug-in Parameters – Extra Controls Section

MDWDRC2-Native
The Ultimate Transparent Smooth Dynamics Range Controller

Bypass Gain
Output Gain or Loss when **Bypassed** in dB.

Look-Ahead (in samples) may increase plug-in's latency

Look Ahead Enable
For DAW's that support it, the input signal is delayed by the look-ahead length, and the host's Delay Compensation is likewise adjusted.

High-Pass Filter
Enables the DRC Detector's Loudness Normalization filtering in the control chain (only) as per EBU BS1770_3.

Release Override Enable
Turns on the Release Override function. Red indicator above shows when active.

Release Override Sensitivity
Level (in dB) of the *reverse sensitivity* to the dynamics of the signal, specifically how much the signal must drop in a short time to trigger accelerated release.

Release Override Speed
The rate at which Release Override will accelerate gain recovery after overriding the MAIN and PEAK detec-tors, .

03 MDWDRC2-Native Parameters

BS1770 FILTER: Enables Loudness Normalization filtering per ITU BS1770-3.

Release Override (dB control): Level in dB is the sensitivity to the dynamics of the signal, specifically how much the signal must drop in a short time to trigger accelerated release timing.

Release Override Speed (dB/Sec control): The rate at which **Release Override** will accelerate recovery when overriding the **MAIN** and **PEAK** detectors.

Release Override (Active): RED when **Release Override** is active.

Release Override (Enable): GREEN when

Release Override function is on.

LOOK-AHEAD: The input signal is delayed by the look-ahead length, and the host's Delay Compensation is likewise adjusted in samples. **Delay Comp Enable** enables the **LOOK-AHEAD** delay setting to adjust the Delay Compensation in the host (only when supported by the given DAW)

Bypass Gain: Output Gain or Loss if bypassed in dB.

Keyboard Controls for Each Parameter

macOS:

Option + Click : Reset the parameters to default.

Command + Drag : High resolution adjustments

Option + Click over Meter (new feature): Gives an option to Save/Load Preset, Save Snapshot and Undo & Redo Function (see next page).

Windows:

Alt + Click : Reset the parameters to default

Control + Drag : High resolution adjustments

Alt + Click over **Meter** (new feature): Gives an option to Save/Load a Preset, Save a Snapshot and access the Undo & Redo Function (see next page).

Save/Load Plugin Presets

With the latest build of **MDWDRC2**, the plug-in now offers the **Save and Load Preset** function as well as Save Snapshot and Undo/Redo. This menu is available when you click **Option + Click** over **Gain/Loss** Meter (MacOS) or **Alt + Click** over **Gain/Loss** Meter (Win).

03 MDWDRC2-Native Parameters

Save and Load Preset allows non-AAX users to save/load their own presets within the plug-in. The default location for the Presets is: $(home)/Documents/MDW/MDWDRC2-Native/Presets

Save Snapshot will take a screenshot of the current settings and save it to your desired destination.

Undo/Redo allows users to cancel or reverse the last settings.

⚠️*Note: Due to JUCE default implementation,* ***when you load a preset it clears the Undo buffer****. This means if you switch between A/B it clears the Undo buffer.*

Chapter 4:

MDWDRC2-Native Theory of Operation

04 MDWDRC2-Native Theory of Operation

These controls and indicators let you adjust the parameters, and monitor performance, of an **MDWDRC2-Native** plug-in inserted on a track or input. These parameters are independently controlled but many affect each other in a way that no other dynamic range controller does.

Gain/Loss Meter

The deceptively simplistic Gain/Loss meter provides a wealth of visual information. Owing to the transparency of **MDWDRC2**, the meter should be thought of more as a bird's eye view than a tool to micro-manage compression amounts down to the nth decimal.

The meter is scaled in decibels from -10 to +40. 0 is calibrated to -20dBFS. In its resting state, the meter is divided into two zones: gray and dark green which slide in relation to the amount of **MAIN** gain applied.

MAIN dynamics activity glows light green with a dark blue gradient overlayed to reflect its **SOFT** knee setting. **PEAK** dynamics activity glows orange which visually crossfades to light green to reflect its **SOFT** knee setting.

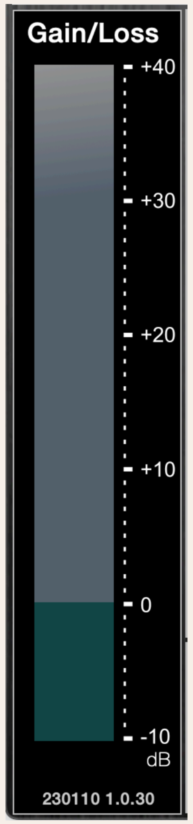
The aggregate height of these colors indicates the total amount of dynamic range control occurring. The demarcation between dark green and the other colors, always represents the gain of the control output relative to 0 on the scale.

The scaling of the meter and the Output gain provide important context for setting Thresh to tickle the meter, then utilizing Main gain and **Ratio** to achieve the desired amount of dynamic control. Balancing **Thresh**, **MAIN** gain, and **Ratio** to hover around 0 will ensure unity gain through the plugin, something that will quickly become second-nature in use.

When **MAIN** gain is left static, and only **Thresh** and **Ratio** are used to control dynamics, Gain/Loss will respond like a traditional gain-reduction meter. Importantly, the **Output** gain will then be needed to manually compensate any apparent gain or loss in loudness.

All of this can easily be understood by spending a few minutes with a tone generator plugin set to -20dBFS feeding an instance of DRC2 and experimenting with the controls.

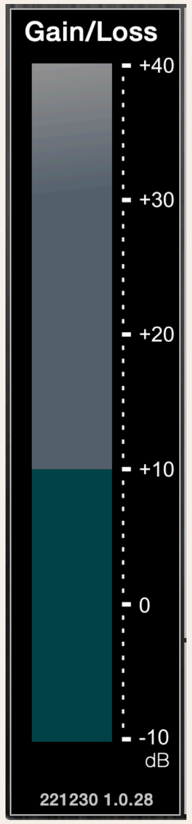
Dark Green / Dark Gray The *gain/loss* of the plugin is indicated by the division between the top of the dark green and the bottom of the dark gray, and always represents the instantaneous *static* gain of the plugin. *If there are no other colors, there is no automatic gain control active.*



No signal

MAIN = 0dB

Gain = 0dB



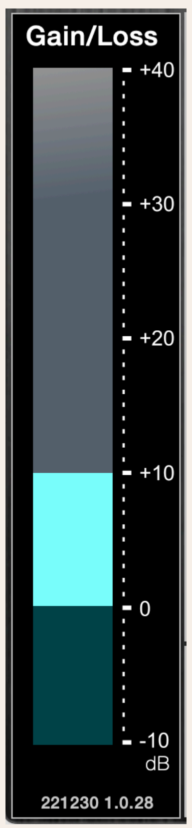
No signal

MAIN = 10dB

Gain = +10dB

04 MDWDRC2-Native Theory of Operation

Blue = Gain Reduction

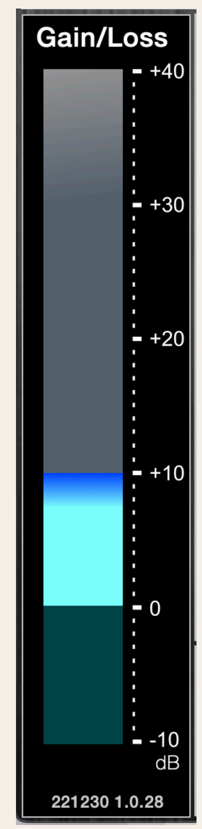


-10dBFS sine in

Thresh = -10dB
MAIN = 10dB

Soft = -0.25
Gain = 0dB

Blue (gradient) = MAIN Soft Knee



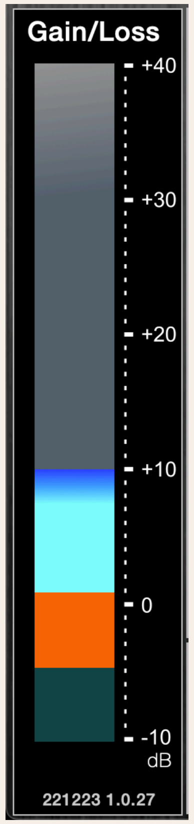
-10dBFS sine in

Thresh = -10dB
MAIN = 10dB

Soft = -3.00
Gain = 0dB

04 MDWDRC2-Native Theory of Operation

Orange = Peak Reduction



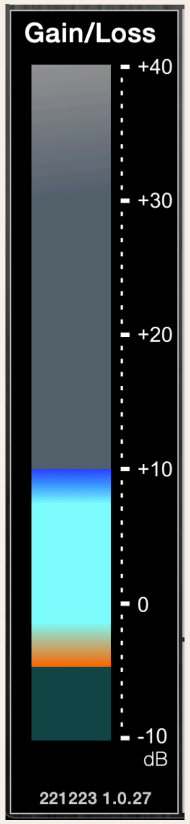
-4dBFS pulse in

Thresh = -10dB
MAIN = 10dB

PEAK = 6dB
SOFT = -0.25

(transient only - 100ms)

Orange (gradient) = PEAK Soft Knee



-4dBFS pulse in

Thresh = -10dB
MAIN = 10dB

PEAK = 6dB
SOFT = -0.25

(transient only - 100ms)

The **MAIN** section's **Main Compressor Active** Indicator lights up green whenever its RMS detector is active and the **PEAK** section's **Peak Compressor Active** Indicator lights up orange when a peak exceeding the **MAIN** detector is detected.

04 MDWDRC2-Native Theory of Operation

Main Compressor Active **Main Compressor Active**

With the **Main** section's fader default at 0.0dB and Threshold default at 0.0dB (at default value, no compression and no gain will be indicated). The **MAIN** fader controls Compression Gain for signals below threshold—a single fader that combines makeup gain, actual threshold, and the total amount of compression available.
With no signal input, moving the **MAIN** section fader up will result in an indication of an *increase* in the gain setting as shown at the top of the dark green vertical bar where it meets the background gray — this is *gain of the DCA* (digital control attenuator).

MAIN gain reduction is shown in Blue (as above), while an additional, overriding **PEAK** reduction is shown in Orange. **Soft Knee** RMS compression is shown in light Blue gradient, while **Soft Knee** overrides from the **PEAK** section are shown with an Orange gradient.

In between the **Gain/Loss** meter and **MAIN** is the **Thresh** control fader. Both the **Thresh** and the **MAIN** controls default to 0.0dB and make for fast setups of the **MDWDRC2** (see “Core Concepts and First Steps” in Chapter 3).

The Two Detectors – MAIN and PEAK

Timing and Exponent

Conventional compressors, digital and analog, are more or less *non-linear* designs. Put simply, as compression levels deepen, distortion usually increases and *actual* release times often become faster and more unpredictable. This is why 20db of compression on a snare drum sounds drastically different than 2db of compression. Musically useful, perhaps, but transparent? Emphatically not.

The **MDWDRC2**'s “Variable Exponent Averager” detectors are uniquely *linear* designs, operating in a fashion more sensitive to psychoacoustic loudness, rather than slavishly following electrical peak or average signals. Two identical VEA detectors, labeled **MAIN** and **PEAK** run in parallel. At their default settings, they behave nominally like True RMS and peak detectors. This is where the similarity ends however, and why we need more precise terms to encapsulate their function.

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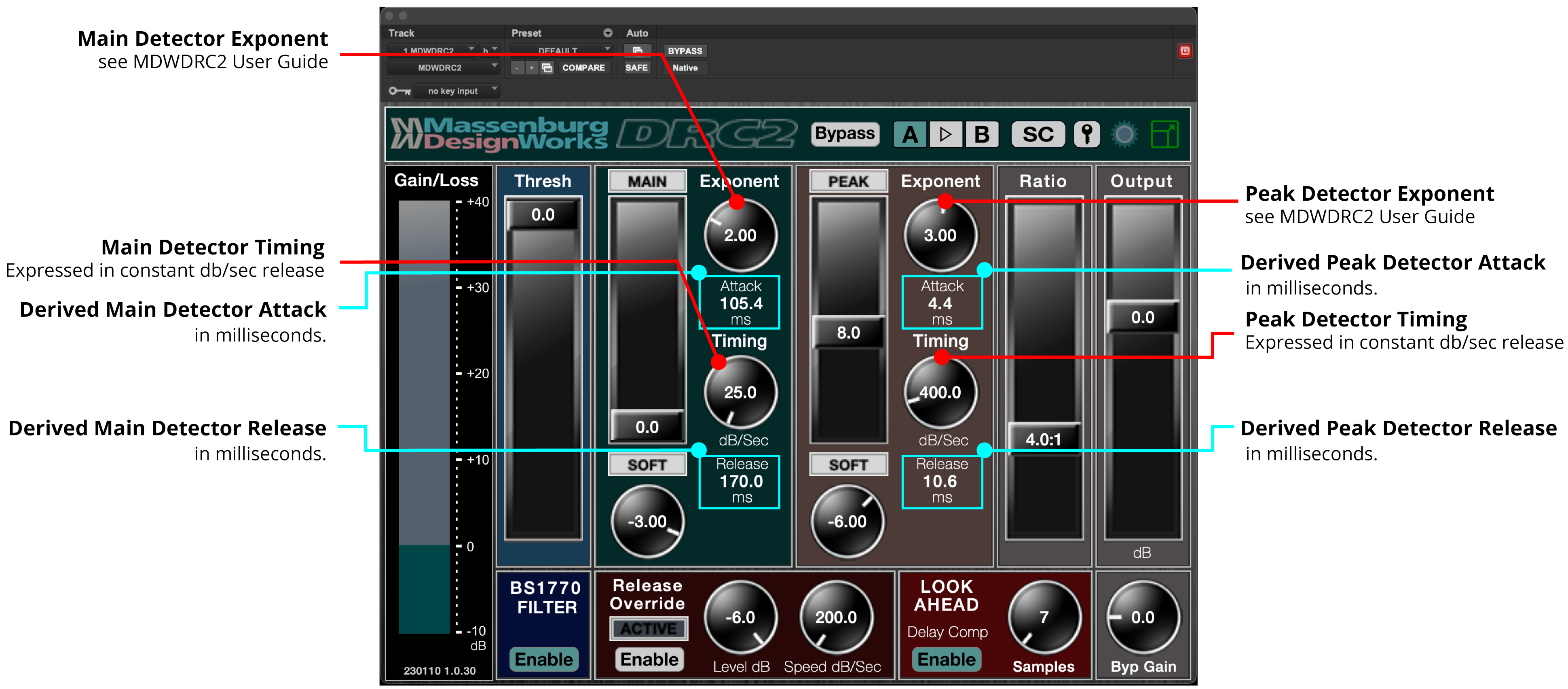
MDWDRC2-Native
The Ultimate Transparent Smooth Dynamics Range Controller



04 MDWDRC2-Native Theory of Operation

MDWDRC2-Native utilizes two VEA (Variable Exponent Averaging) detectors, **MAIN Exponent** (defaults to exponent = 2, or RMS detection) and **PEAK Exponent** (defaults to exponent = 3, or VEA detection). All detectors (including **Release Override**) send instantaneous control parameters to a single digitally-controlled gain block.

MAIN Exponent and **PEAK Exponent** knobs set the math used to evaluate signals in each detector. You may raise the sum of the averages of exponentiated signals to the power of 1 up to 8, although it is recommended to retain the **MAIN** default setting = **2** (True RMS) and to retain the **PEAK** default setting = 3 (VEA) for these instructional discussions, and for most purposes.

Higher exponents have faster attack rates which allows you to capture faster Peak signals.

The **Timing** and **Exponent** controls combine to create secondary indicators: "*Attack ms*", *and "Release ms"*. They provide a frame of reference to better-known, conventional release rates, expressed in milliseconds. You cannot set the Attack ms or Release ms directly, they are *estimated* timings.

Changing the setting of **Timing** (both **MAIN** and **PEAK**) alters both Attack ms and Release ms. Changing the setting of the **Exponent** (both **MAIN** and **PEAK**) *visually alters only Attack ms*.

04 MDWDRC2-Native Theory of Operation

Timing is a concept first introduced in the venerable GML 8900 Dynamic Range Controller (analog!). Further refined from the venerable hardware, the **MDWDRC2** attack and release envelopes are primarily determined by single **Timing** controls: turn clockwise to increase response time to loudness changes and speed of recovery; turn counter-clockwise to decrease sensitivity to loudness changes and slow the speed of recovery. In other words, to tighten or relax the timing, or musical feel.

Unlike its GML8900 predecessor, **MDWDRC2** exposes the mathematical aspect of the **Timing** controls to user input via the **Exponent** control. The decimal values themselves are quite literally the exponents used in the math to determine a range of detection, from average to True RMS, to degrees of peak loudness in a musically useful way. A more technical explanation can be found in the Appendix.

These two independent detectors, **MAIN** and **PEAK**, are in theory exactly the same code and controls, but used differently in application.

The two **Timing** controls are calibrated in the number of decibels per second required to return to their resting state.

The **Exponent** control defaults to 2.00 for the **MAIN** section; an exponent of 2 (square root of averaged signals squared) means that an True RMS (Root-Mean-Square) detector is tracking changes in loudness. The **PEAK** section's **Exponent** control defaults to 3.00 or (cube root of averaged signals cubed) as it tracks *short* peak transients more faithfully than a True RMS detector.

For purely invisible dynamic range control, the two **Exponent** controls can be left at their default positions. Roaming further afield with the **Exponent** controls allows for more flexible envelope control, adapting to a particular groove of a track or for usage in mastering contexts.

You may directly enter a specific **Timing** by typing in a value in the center of the **Timing** control knobs, and the Attack ms and Release ms times will change accordingly.

You are invited to experiment with increased **Exponent** settings for special effects. Higher settings can increase artifacts and it is recommended that you start with these two controls at their defaults (you can reset these and other controls to their default value using the ‘factory default’ preset).

When the **MAIN Exponent** is at 2 (RMS), changing the **Timing** control yields release times from 8500.0ms to 10.6ms, and attack times from 5720ms to 6.6ms.

When the **PEAK Exponent** is set to 3 (cube root of averaged signals each raised to the 3rd power) the **PEAK Timing** control yields Release times from 8500.0ms for **Timing** set to 0.5, 10.6ms for **Timing** set to 400, and 2.1ms for **Timing** set to 2000.

Should you wish for a slower Release time, you might dial in a longer **Timing** (with a longer release time). (For faster release times at a given, slower **Timing**, it is recommended to enable the **Release Override** function.)

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04 MDWDRC2-Native Theory of Operation

Mastery of the **MDWDRC2-Native** can be hastened by understanding that both **MAIN** and **PEAK** detectors, with the exception of internal scaling differences, use identical VEA (**MAIN Exponent** = 2.00, **PEAK Exponent** = 3.00) detectors running in parallel. Both of these detectors are constantly handing off to each other to present a single value to the **RATIO** control. The same holds true If the **Release Override** is active.

Both **MAIN** and **PEAK** detectors are fed by the **Thresh** and **MAIN** gain sliders whose basic functions are described here. The **PEAK** detection slider is expressed in decibels relative to this aggregate threshold. The **PEAK** detector can essentially be turned off by setting the **PEAK** slider to its maximum.

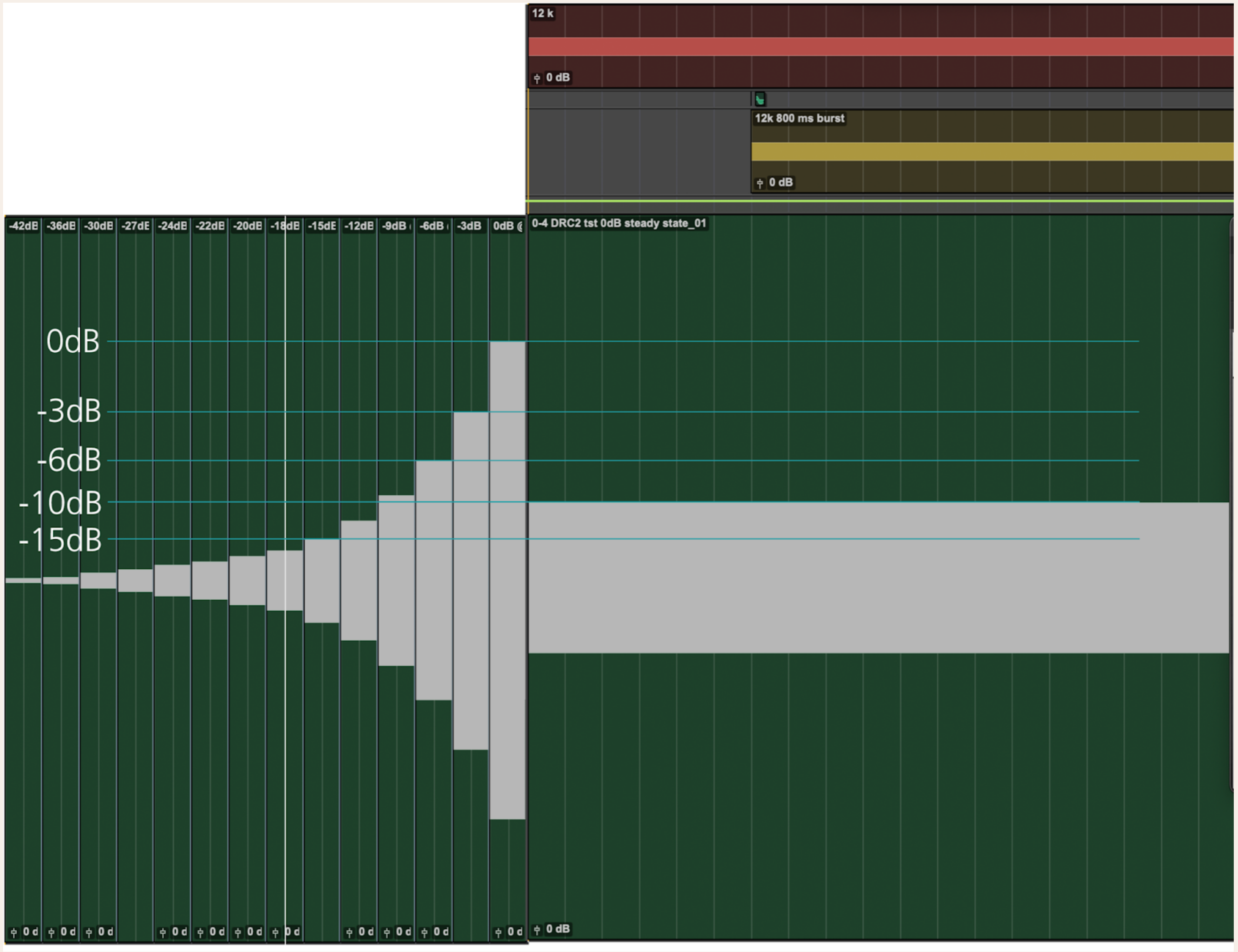
The **MAIN** indicator glows green when active.

The **PEAK** indicator glows orange when active.

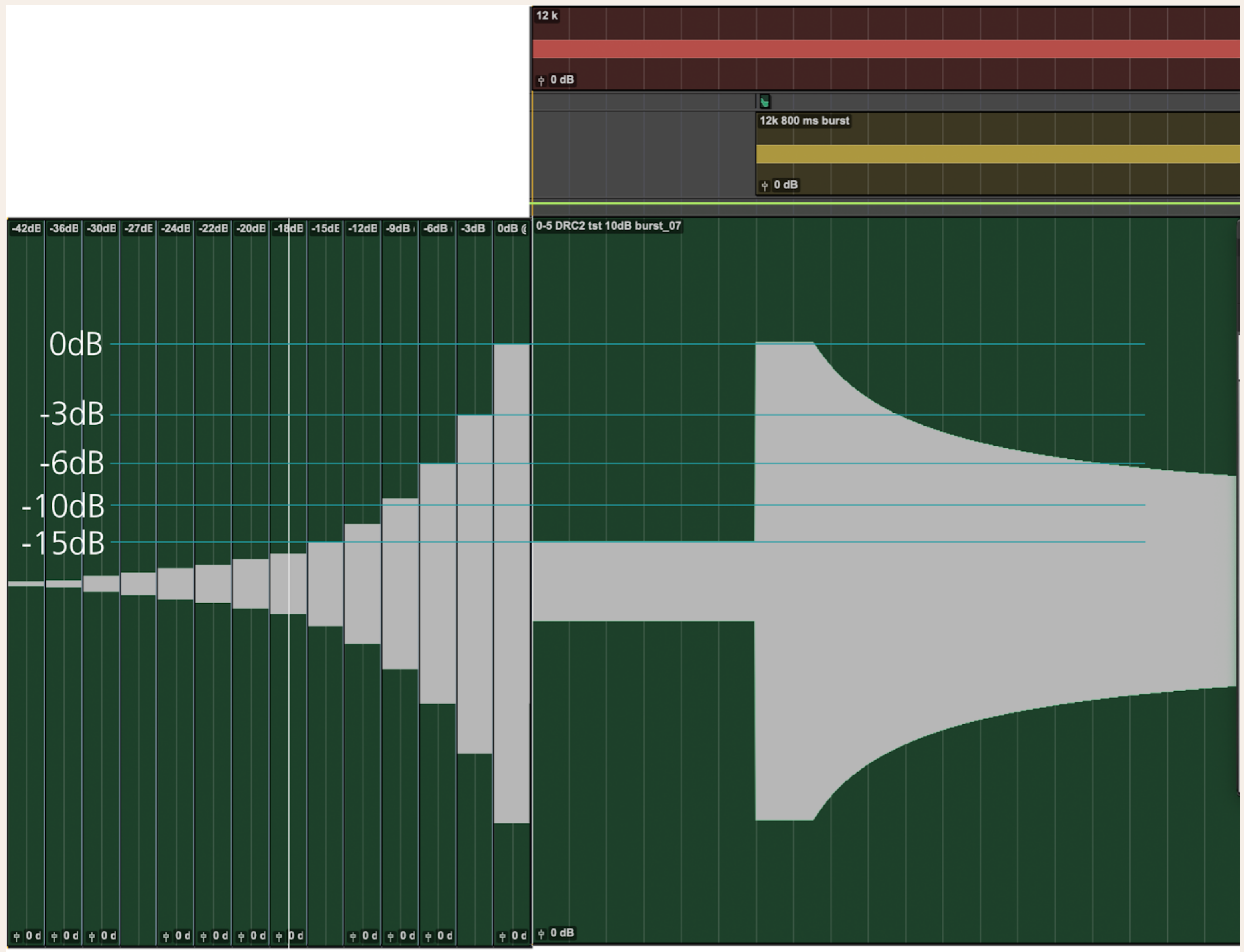
04 MDWDRC2-Native Theory of Operation

Below are some graphics to demonstrate the sample operation of the two detectors in the **MDWDRC2-Native**; the following measurements start with the **MAIN** section active only.

The following is a graphic (**MDWDRC2-Native** output level vs time) with *MDWDRC2 Bypassed* of a basic test condition: a steady-state 12kHz tone (-10dB in/out).



Gain reduction results when a steady-state tone is interrupted by a *10dB higher burst*, resulting in a 10dB gain reduction. (Timing = 25, -20dBFS steady state in, a -*10dBFS pulse*, 10dB gain reduction)

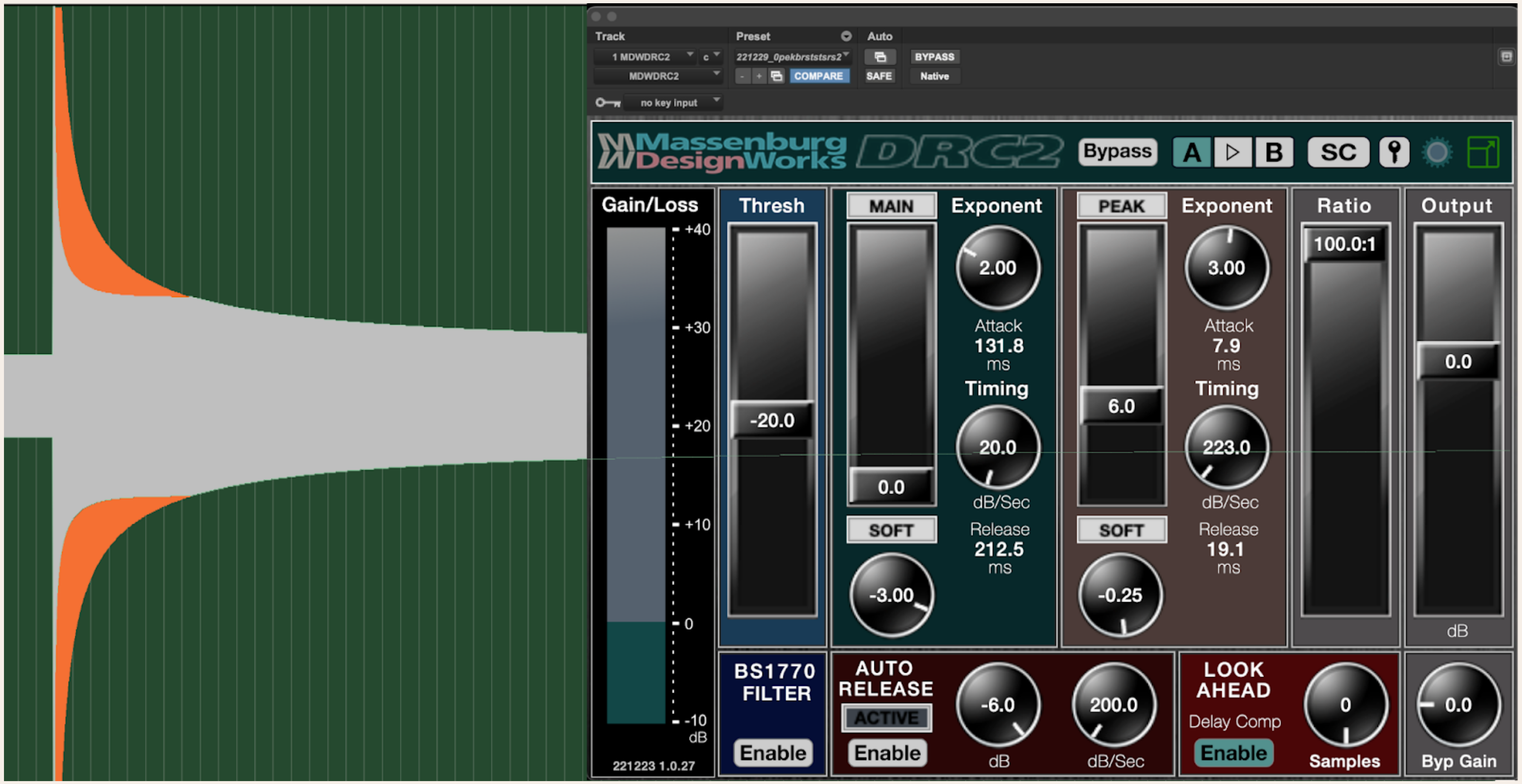


The bars on the left are a graphical representation of the actual levels below 0dB Full Scale in Pro Tools.

In the following example the **Timing** control is set to 20, resulting in a significantly long attack overshoot, as shown here:

04 MDWDRC2-Native Theory of Operation

The **PEAK** section might then be asked to *override* these “overshoots” that have been that allowed past the **MAIN** detector.



Finally, to soften the transition between **MAIN** control and **PEAK** control, you could increase the **Soft Knee** of the **PEAK** section (shown in blue).

BS1770 Filter

The ITU BS1770 FILTER engages an internal sidechain filter similar to the accompanying graphic: 80hz 2nd order high-pass, and a 1khz second-order high shelf. Pressing the **Enable** button toggles the filter on and off. When on, the button will be shaded green.

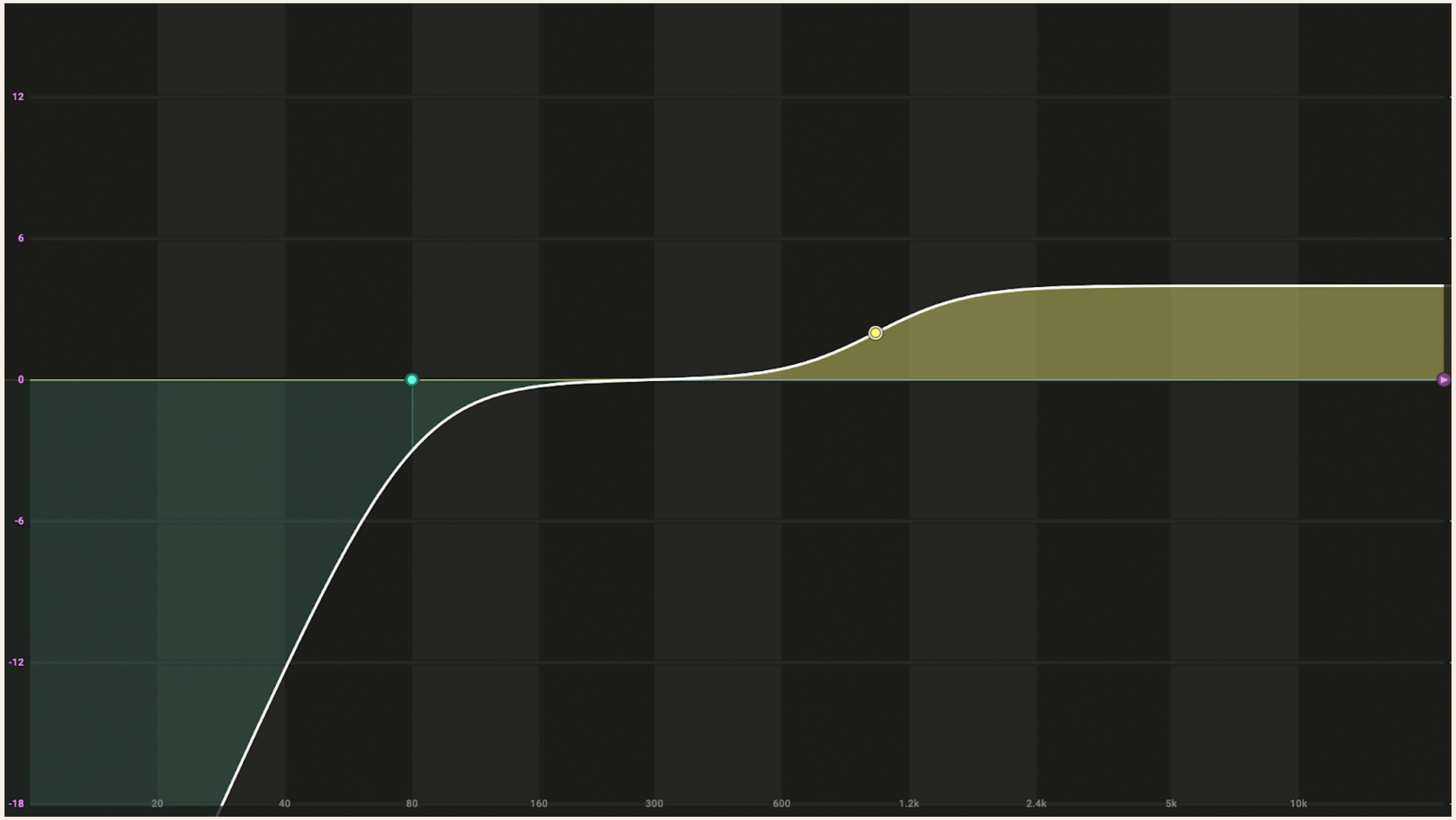
To better understand its purpose, it is important to provide some historical context. The ITU was formed in 1865 by an International Union of engineers and civil servants to codify and regulate communications standards. At the outset, the "T" represented Telegraph! In 1941, this was modernized to Telecommunications. As purely digital end-to-end transmission has become ubiquitous, these standards have continued to evolve.

Digital streaming is now commonplace for the transmission of music, and these same standards have been adopted. The specification pertinent to our industry is termed LKFS, more commonly called LUFS: LOUDNESS UNITS relative to digital FULL SCALE. For example, at the time of this writing, Apple Music defines their loudness specification as -16 LUFS with a -1dB true-peak (a reconstructed analog waveform rather than a raw PCM quantization).

The LKFS specification is defined within the ITU Broadcasting Service (sound) category, recommendation number 1770. BS1770 in its entirety consists of "algorithms to measure audio programme loudness and true-peak audio level". The filter's purpose in this context is to pre-condition LUFS metering by broadly approximating non-linearities in human hearing. It serves the same primary function in relation to the VEA detectors in **MDWDRC2**. A useful secondary function is to negate the need to patch in an external key input to control low frequency over-modulation.

04 MDWDRC2-Native Theory of Operation

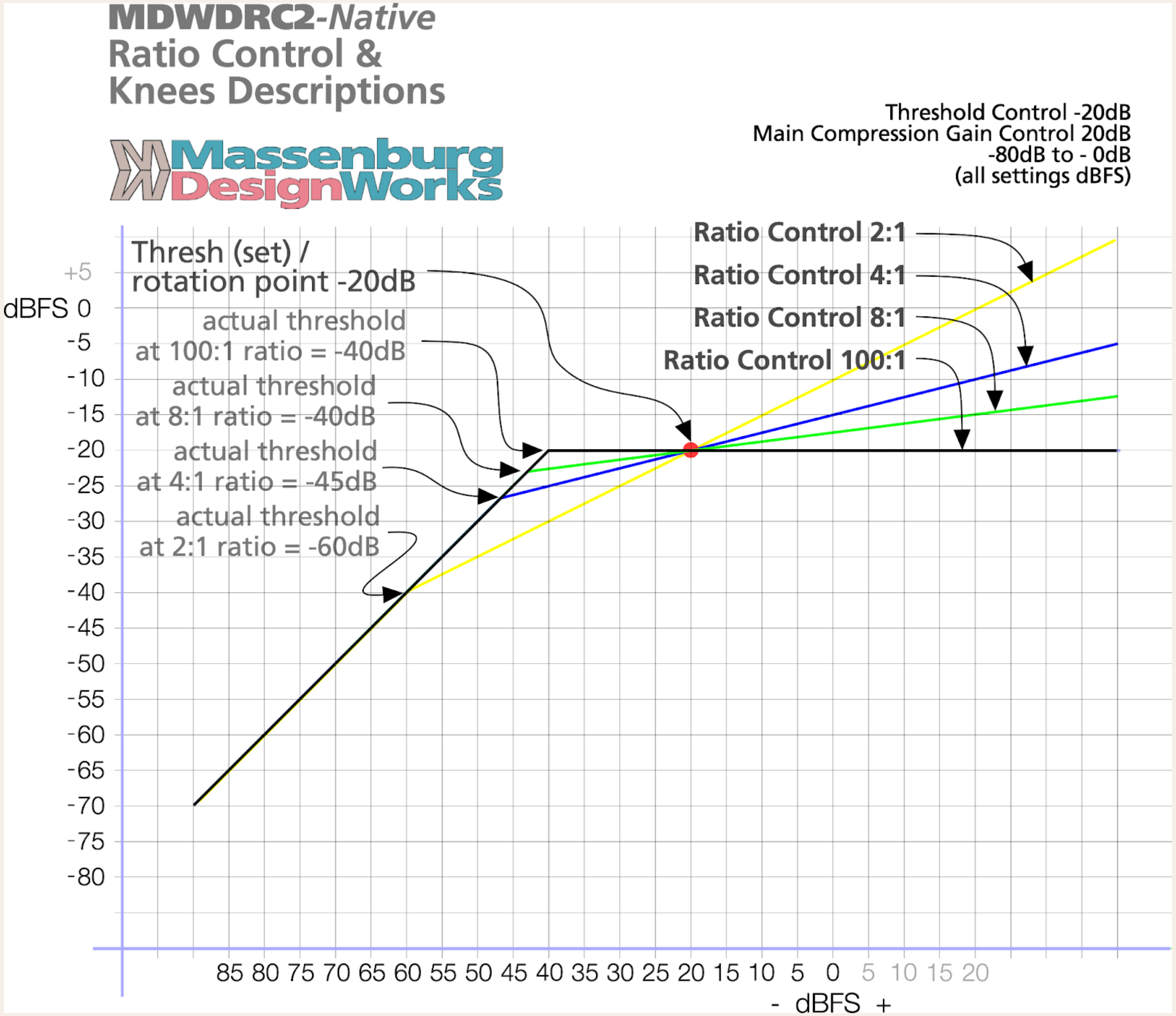
Mixing music has always placed a premium on artistic intent. Mixing for picture and broadcast, these specifications are well understood and scrupulously adhered to. The principles are the same though -- balancing audibility and impact. **MDWDRC2** has been designed from the outset to bridge both disciplines.



Further description can be found in the Appendix.

Rotation Point

One of the resurrected control concepts employed in the design of **MDWDRC2-Native** is that of a ‘Rotation Point’.



MDWDRC2-Native Theory of Operation

The Rotation Point is a point on the line which graphically represents the difference between the input and output signals. The line “bends” where the incoming signal triggers a gain reduction. For a 100:1 ratio and a Soft Knee = 0.25 the hard knee compressor is best represented by a straight line which "pivots" sharply at the rotation point. For Ratios less than 100:1, the actual threshold level is lower than the Rotation Point as shown above.   (For Soft Knees the actual threshold is even lower.)

Changing to a 2:1 ratio, the line that *was* nearly a straight horizontal line at 100:1 pivots at the *same Rotation Point* but downward from there increases signals below the set rotation point. It reduces signals that are higher than the rotation point, making it a powerful tool as you refine a mix. This makes setting ratio as important as setting threshold on the **MDWDRC2**. For increasingly broad Soft Knee’s, the Rotation Point is at the center point of the soft knee curve.

The **MDWDRC2-Native**’s default compression ratio is 4:1.

Soft Knees

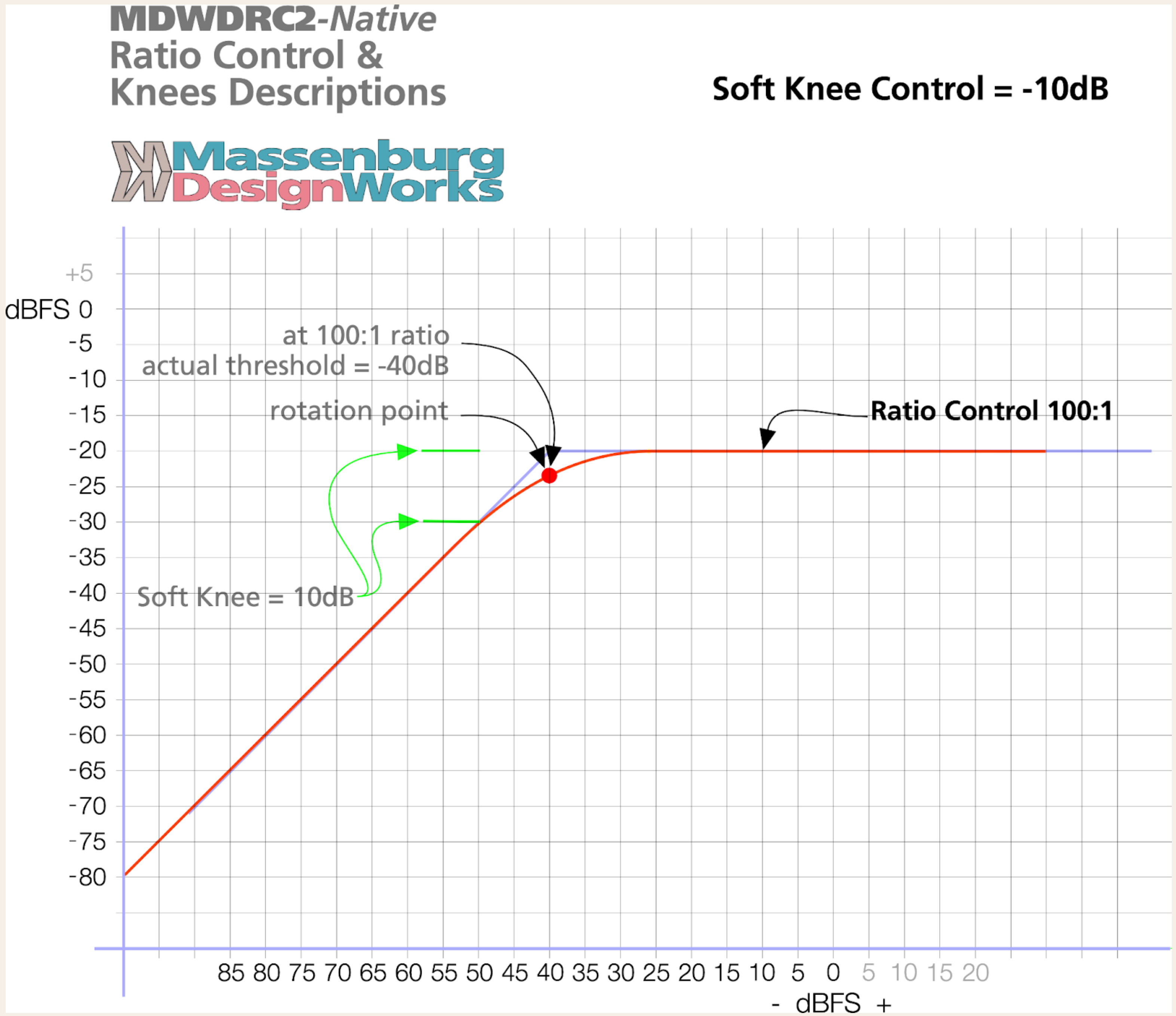
The **SOFT** Knee controls in the **MAIN** and **PEAK** sections are functionally similar to other compressor designs, smoothing the transition into compression. However, it is important to understand the implications of their use, as they *do alter the internal threshold*, but do not internally compensate for any gain added or lost. Higher **MAIN** Gain settings mitigate this level change, but care should be taken not to disturb mix balances when these controls are adjusted later in the process.

At a **Ratio** control setting of 100:1 the **Thresh** value set by the user defines the Rotation Points of the **MAIN SOFT** Knee arc. The **PEAK SOFT** Knee control controls the transition between *gain control* coming from the **MAIN** Detector, and *gain control* coming from the **PEAK** Detector. Turning the **SOFT** Knee controls clockwise straightens the arc of each knee and raises the internal thresholds. Turning the controls counter-clockwise, rounds the arc of each knee, and lowers the internal thresholds. Settings from -12 to -16 mimic the broader soft knee behavior of the GML 8900.

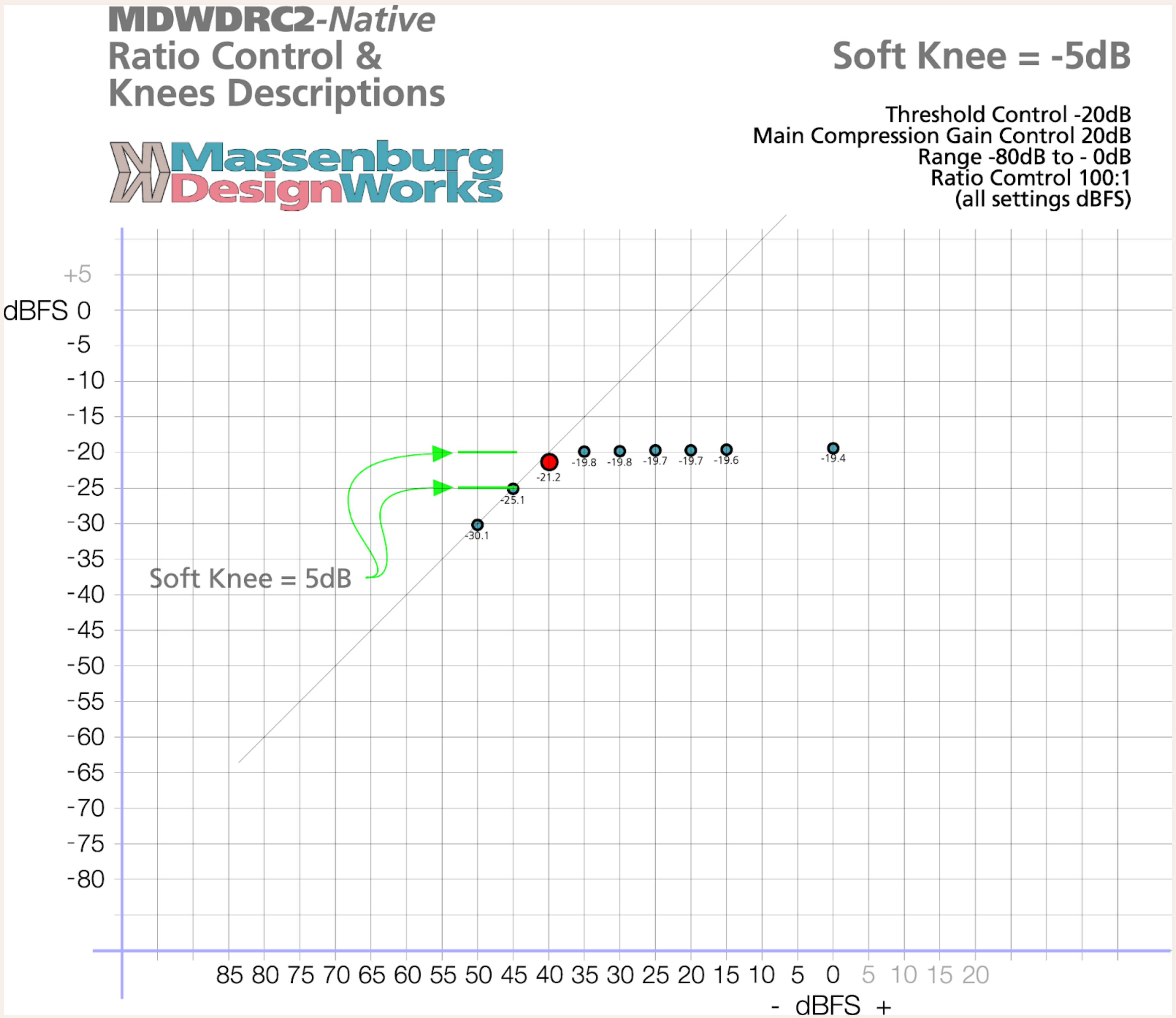
Decreasing (i.e. setting more negative) values of the **Soft Knees** are one of the main tools available to further reduce the severity of artifacts once you have established a reasonable **Ratio**.

Plotted on a graph that shows input level on the X axis and output level on the Y axis, the transfer function of a hard knee compressor at Ratio 100:1 is a two-segment line: it rises at 45 degrees up to the threshold and is flat after exceeding it. As the knee value is progressively softened, the threshold of the “bend” – the transfer function ceases to be a sharp one and starts to resemble an arc.

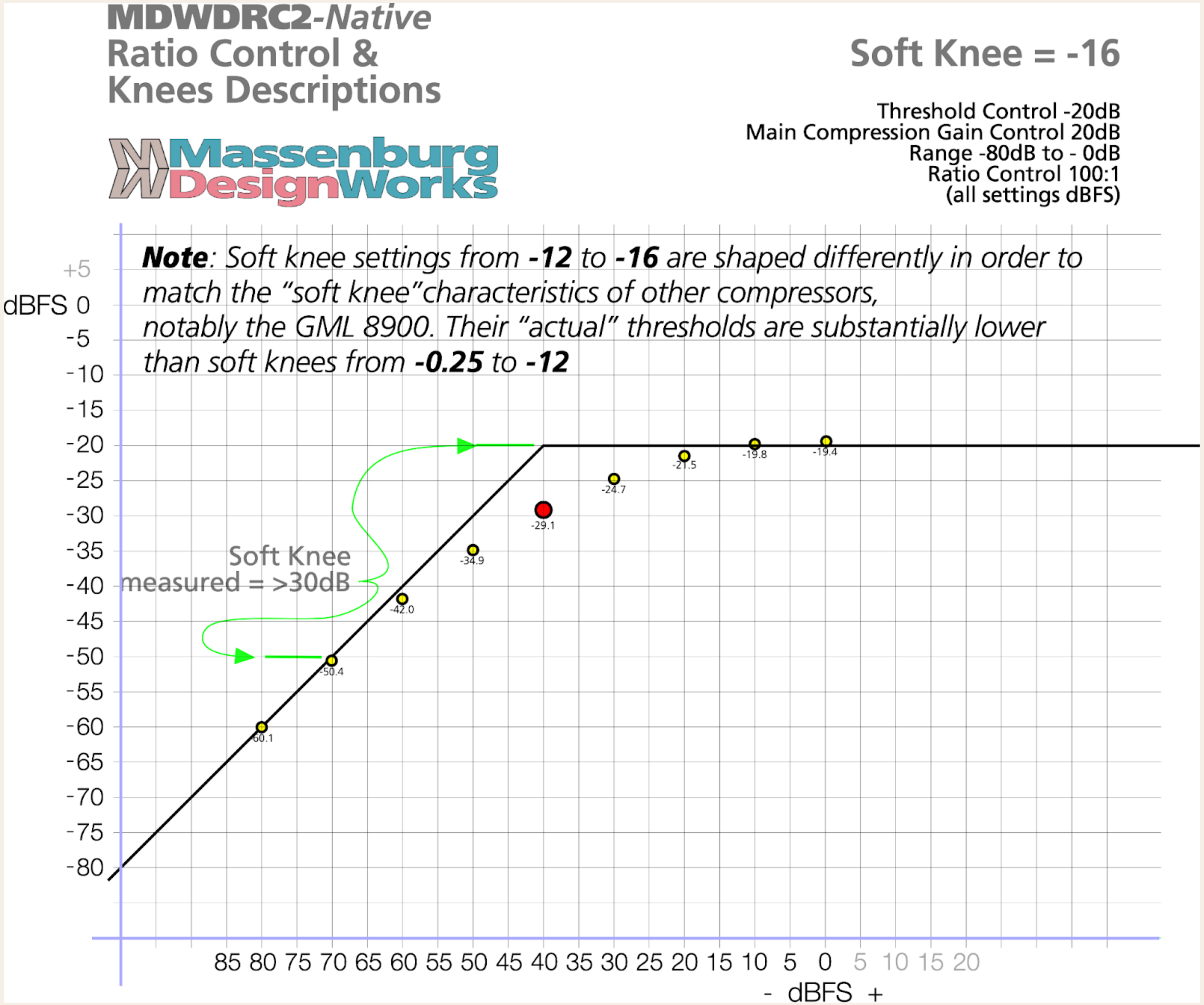
The softer the knee, the wider the arc. In **MDWDRC2** In “MDW speak”, the rotation point is the midpoint of the Soft Knee “curve” (as below). The **Thresh** control in **MDWDRC2** Native sets the position of this rotation point for *minimum* Soft Knee — meaning, unlike the threshold control on most compressors, it interacts with the knee setting.



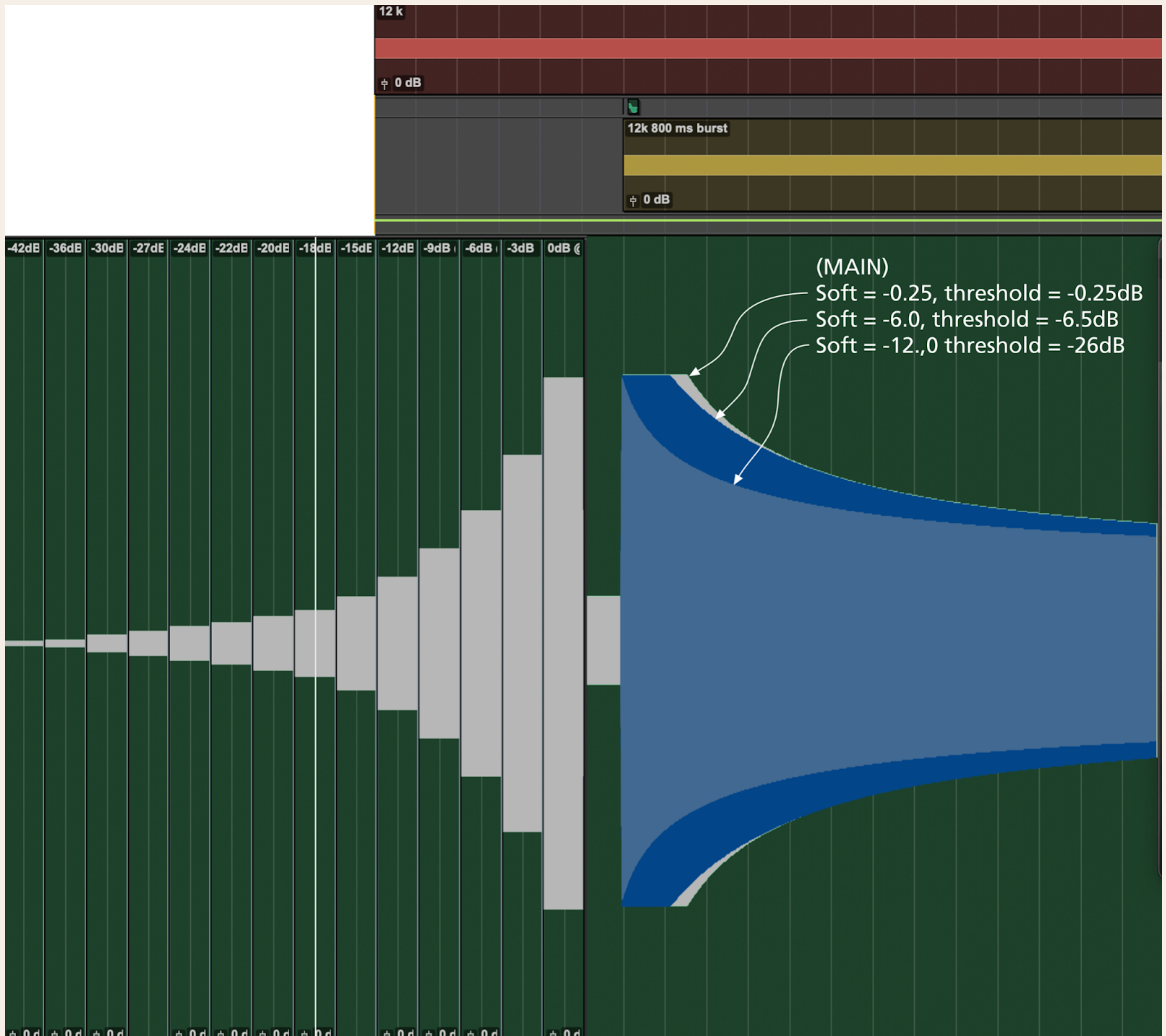
Measured Soft Knees



04 MDWDRC2-Native Theory of Operation



The following graphic shows the effect of varying the **MAIN** detector Soft Knee settings, and showing actual thresholds.

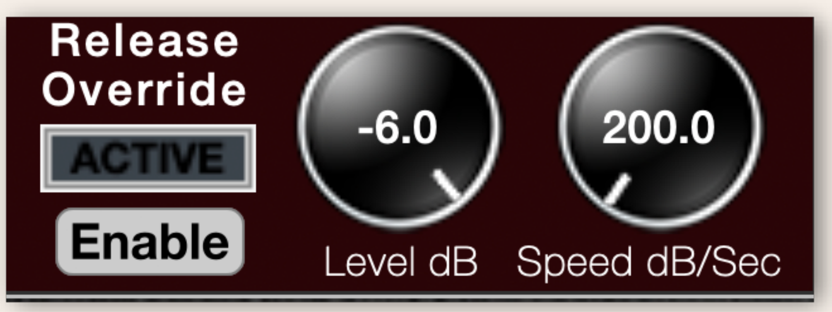


Release Override

The **Release Override** provides a secondary release that can more gracefully account for wide and rapid changes in level. It is a further refinement of the "Hysteresis" control on the GML 8900.

It is based on *another, faster* detector (fast-averaging responding) which is compared to the other detectors to identify rapidly dropping signal levels, which are presumably slower than the **Release Override** Detector, and may be set to force a faster release at the speed set by **Release Override** Speed.

One extremely important application for the **Release Override** is for musically-varying sources such as electric tremolo guitar – a Fast RMS Release within the dynamic envelope of the guitar’s tremolo effect would squish the effect — but you would at the same time wish to release rather quickly when an actual level drop happens such as might be the case in-between notes.



The **Level** control indicates the number of decibels a signal must change relative to the speed of the two primary **Timing** controls in order to override their settings. Turning clockwise, the release override will occur more frequently. Turning counter-clockwise, more precipitous changes in level are required, and/or slower Timing settings.

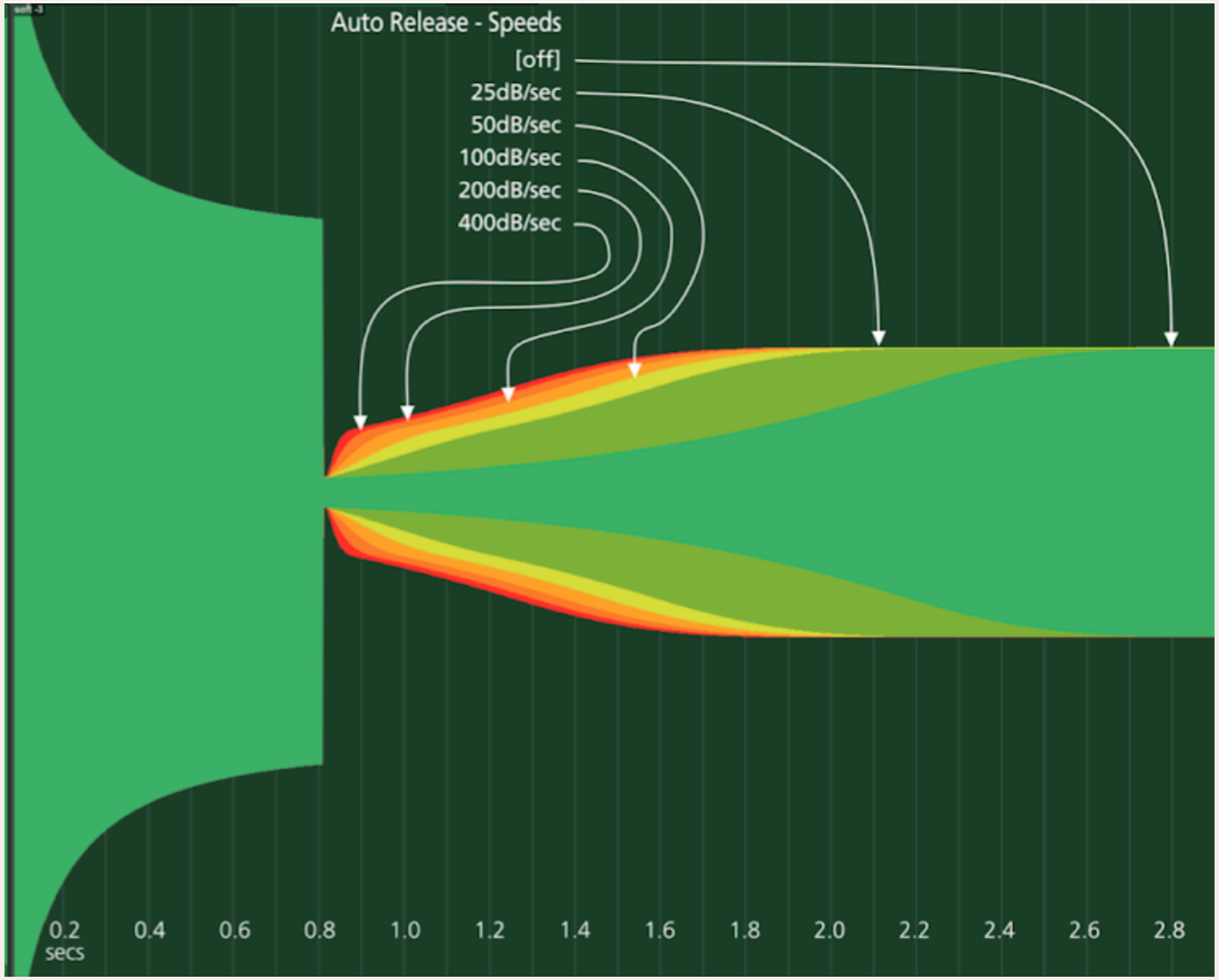
The **Speed** control determines the rate of this secondary release expressed in decibels per second. Turning clockwise speeds the release. Turning counter-clockwise slows the release.

Importantly, this secondary release can also be overridden by the primary (**MAIN** and **PEAK**) releases if and when they catch up to the release rate of the Speed control.

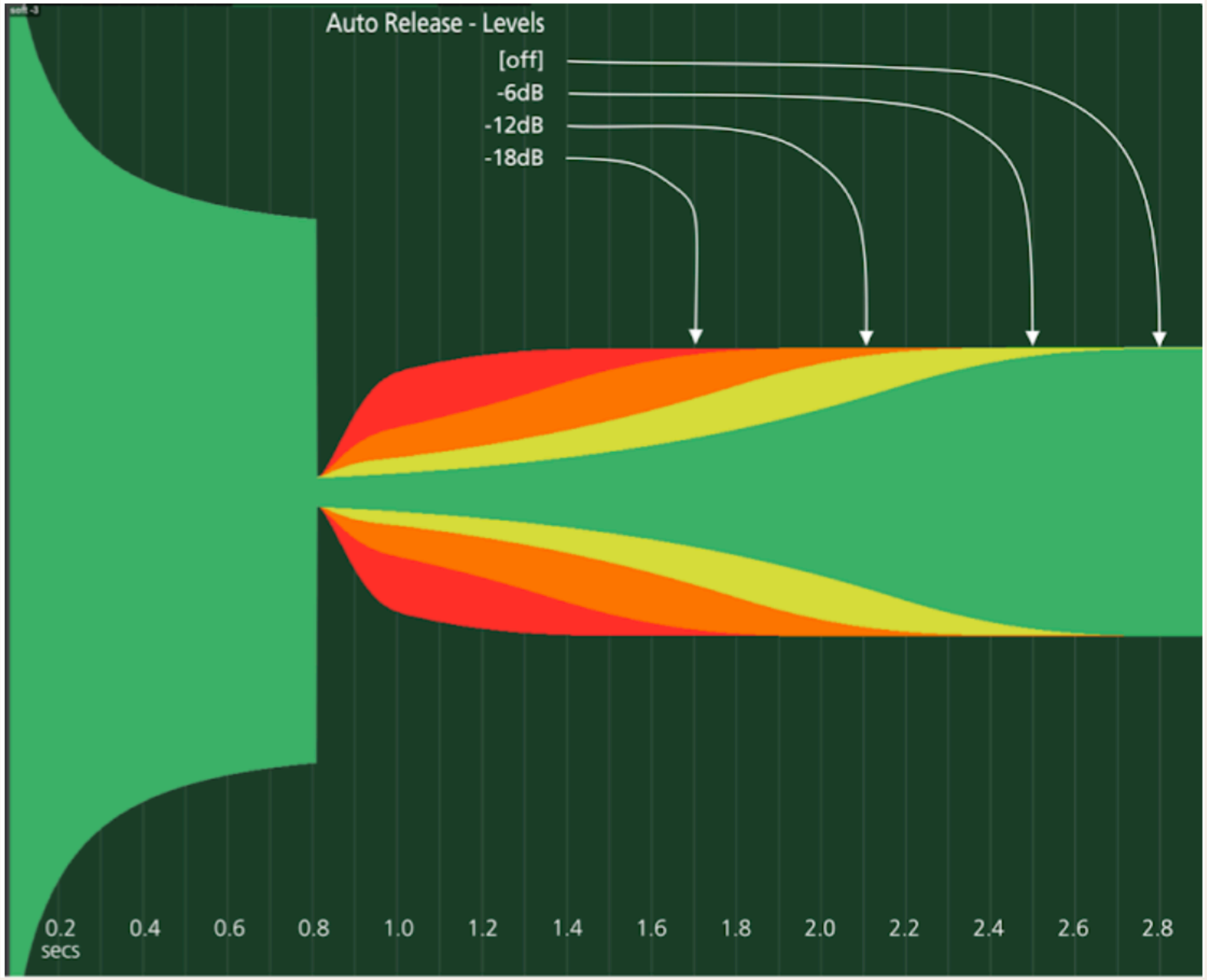
An **ACTIVE** indicator glows red during periods of activity.

Pressing the **Enable** button toggles **Release Override** on and off. When on, the button will be shaded green.

The following graphic shows the relationship between **Release Override Speed** and release rate (**MAIN Soft Knee** = -3):



The following graphic shows the relationship between **Release Override Level** and release profile (MAIN Soft Knee = -3):



Appendix

Variable Exponent Averager

True "RMS" is a long-established and useful measure of average signal voltage, be it in audio or in an electrical power context. A Peak measurement is necessary to measure and control signals that might be in danger of hitting a limit. However, neither one is adapted to the uniquely human task of assessing psychoacoustic loudness. This is where **MDWDRC2** stands apart.

VEA is *not* a re-branding of conventional RMS. It is a world-wide, patented, unique concept that has been developed after years of critical listening as our benchmark."

ITU BS1770_3

ref: https://www.itu.int/dms_pubrec/itu-r/rec/bs/R-REC-BS.1770-3-201208-S!!PDF-E.pdf

ref: https://www.itu.int/dms_pubrec/itu-r/rec/bs/R-REC-BS.1770-4-201510-I!!PDF-E.pdf

ref: https://tech.ebu.ch/docs/r/r128.pdf

source: Massenburg DesignWorks MDWDRC2-Native

"The MDW VEA is an attempt to increase the sophistication of this calculation, designed to make the level detection in **MDWDRC2-Native** more akin to the complex response of the human ear. The idea, in other words, is that gain reduction in **MDWDRC2-Native** is triggered not by the level rising above some arbitrary point, but by a measurement of loudness that we would perceive as being subjectively *louder*.

Appendix

This is achieved first by optionally filtering the side-chain using the BS1770 filter (closely akin to the well-known “K-Weighting” filter), which anticipates the dynamic and timbral sensitivity of the human ear, and also by combining two separate detector timing algorithms. The **MAIN** detector uses a sophisticated RMS algorithm to identify loud events on a relatively broad scale, but there’s also a second detector labeled **PEAK**. This uses a different RMS calculation and would typically be set up using faster time constants, the idea being that it has the power to override the **MAIN** detector when a sharp transient event is detected. It’s important to note that these are not two separate dynamic control devices placed in series, like for example the compressor and limiter on a Neve 33609. They’re separate methods of analyzing the side-chain signal which are combined to trigger gain reduction in one device."

source: Loudness - Everything You Need To Know | Production Expert

"...we needed a meter that could measure and display loudness, in the same way, our ears hear loudness and to achieve this, the standard loudness measurement BS1770 was developed and has become a single universal standard for measuring loudness and all broadcasters delivery specs being based on this BS1770 standard.”

A number of governments and broadcasters across the world have addressed this problem with legislation. In the USA, the law is called the CALM act supported by the ATSC A/85 standard. France and Spain have also passed laws for the control of all their broadcast channels’ loudness, using the EBU R128 standard.

Appendix

Whereas other countries like Germany, Switzerland, Austria, Norway and the UK have voluntarily implemented EBU R128 recommendations across all their TV broadcast channels. Austria has even made the bold claim that they have reduced their loudness complaints to…ZERO."

source: Leq(m) Loudness - What Is It And When Is It Used? | Production Expert

With BS1770 loudness metering, there are 3 measurements, momentary (M), which is averaged over 400ms, Short Term (S) which is averaged over 3 seconds and Integrated (I), which is the average over the complete program.

For more information, please visit us on the web:

Home: https://massenburgdesignworks.com

Contact Page: https://massenburgdesignworks.com/about-mdw/

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version: MDWDRC2_1.0.31