



Bettermaker

DARTHLIMITER User's Guide

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The Bettermaker crew would like to thank all the people that were deeply involved in the development of our first products, from EQ230P till this day.

Thanks to all the Beta-testers that gave us hands-on tips and all people involved in the conceptual stage. We hope we have listened to you carefully so as to produce an ideal tool in the hands of every engineer.
Thank you guys!

I would like to personally thank my development team, the past and the present as their passion to work and bright minds made all that happen. I would not take all my wild concepts to the point they are now without you guys.

Marek Walaszek

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I. Introduction

Congratulations on your purchase of the Bettermaker DarthLimiter - all analog sound with the flexibility of digital control! Welcome to the family! The hybrid audio limiter, now in your possession, is the result of years of research and development in emerging digital control technologies. The final hand-built unit is currently glowing happily in your rack (lucky you). The DarthLimiter brings the flexibility, ease of use, and instant recall ability of software plugins to the realm of high fidelity analog processing like no other analog Limiter on the market.

1. Company

Addicted to Music began in 2004 in Warsaw, Poland as a recording and mixing studio. Long before it was a hardware company we were deeply involved in the international music and recording scene. This is not a company run by scientists who crunch numbers all day, we are a company run by engineers who live, eat, and breathe music (like you do). We know good sound, and know first-hand what it takes on both sides of the glass to capture the perfect take. We developed the DarthLimiter to go from the perfect track, and make it even better!

2. Bettermaker DarthLimiter

The Bettermaker DarthLimiter was designed to have the greatest flexibility of any analog Limiter while still allowing absolute recall and repeatability. We often found the strengths of software plug-ins wasn't their sound, but the ability to quickly audition different settings. This allowed us to make faster, better informed musical choices. The ability to jump back and forth between (sometimes vastly different) settings allowed us to keep a clear vision of the sonic goal in mind, while quickly making decisions on the best setting to use. However, we recognized the sonic superiority of our analog gear compared to their digital counterparts. In countless shoot-outs, the analog versions always won. Since we're a company that cares about better sound over processing speed, our engineers would take the extra time to use a full analog chain, because it simply sounds better.

In the traditional analog world the time spent in the act of having to set and reset knobs and buttons to audition between settings often skewed our choices. More time was spent tweaking knobs trying to recover an earlier setting than was spent listening. The limited resolution of the mechanical parts often meant only very coarse adjustments were possible (previously only solvable by very expensive mechanical switches). A difficult situation, to say the least, but the greater fidelity, openness, and depth of the analog gear was always worth.

Even after years of advancement in digital algorithms, the older analog versions always sounded better. With these goals in mind, we strove to create a hybrid DarthLimiter that was the best of both worlds: A true analog limiting based on classic designs, but with the repeatability, fine resolution, and consistency of digital plug-ins. Choosing modern components and design practices over older traditional methods helped maintain the transient response and low noise-floor necessary for today's recording practices. Wherever possible we choose over-spec'ed components to ensure trouble free operation and a long product life. Most importantly we listened first, tested, and then listened again.

The Bettermaker DarthLimiter is designed according to international standards, and is fully functional in any location with proper mains power available. This includes, but is not limited, to studio, stage, video post, on-location, festival, corporate, and both installed and temporary audio solutions. This limiter is excellent in festival situations as its instant recall makes it perfect for fast resetting between multiple stages. Once you grow accustomed to the amazingly quick recall and flexibility of this unit, we believe you will find new uses and applications for it in your professional workflow.

We hope you enjoy your DarthLimiter. Now, go make some music Better!

II. Important Safety Information

1. Before you turn the unit on

Before turning the unit on for the first time, remember to set it to correct AC voltage (115V or 230V) depending on your location. Always use quality AC power cord with safety (earth) pin and ensure that the power outlet in the wall has the earth connection too. It is important for safety reasons but also helps to keep the unit's noise levels low.

2. Safety Warnings

- do not operate this unit in the presence of rain, liquids or condensing moisture. Liquid entering the product enclosure presents the risk of electric shock injury.
- do not operate the Bettermaker DarthLimiter in any place near water. Always be sure to protect the unit from dust, particles, water, beer, groupies, and stage divers.
- for normal operation it is not necessary to access the interior of the DarthLimiter. The only user serviceable part is the AC fuse located in the compartment below the AC mains socket. Chapter VI "Troubleshooting" explains what to do in case of the unit's failure.

Always remove the AC power cord from the socket before attempting to change the fuse (0.63A slow-blow fuse).

III. Construction of the DarthLimiter

This basic overview with internal signal path diagram will help you to understand the functionality of the Bettermaker DarthLimiter. The sound of the limiter is of course based on the quality of its hardware design. But all the control and user interactions are performed in the digital domain. This allows us to incorporate options and possibilities not found in any standard analog limiter:

- Save and recall presets
- Instant reset of all parameters
- Rapid, precise and repeatable adjustments
- Precisely linked stereo operation with the ease of a single control
- DAW automation
- Comprehensive metering operations based on high quality A/D conversion and DSP

1. Analog section

Great care and thought went into the development and implementation of the analog section of the Bettermaker DarthLimiter. High quality capacitors and low noise op-amps are used in the analog path. Relays were used, whenever creating the shortest path for the audio signal was necessary.

The analog section consist of high quality input/output buffers capable of passing thru high level audio signals (up to +23dBu, balanced, THD<0.1%), independent odd and even harmonics generators (colors) with adjustable band-pass filters, M/S matrix, VCA limiter (ratio ∞ :1), clipper section (combination of soft and hard clipping) and output level attenuator. Additionally, the 24-bit A/D conversion circuit collects the audio data for measurement purposes.

All these modules are controlled by the digital section of the DarthLimiter, so no mechanical switches or knobs are required to adjust any of the parameters.

2. Digital Section

The digital section of the DarthLimiter is based around two high speed, 32-bit micro-controllers, with dedicated firmware programmed into their memory (with the possibility of updating the firmware via USB connection). One of them is responsible for controlling the VCA limiter, when the other watches over the user interface, presets management, audio measurement, USB connectivity and other DarthLimiter functions.

The use of separate ground planes for analog and digital section results in perfect noise isolation between these two worlds. The linear power supply was used instead the switching one to improve the sonic qualities even further.

3. Front panel and LCD touchscreen

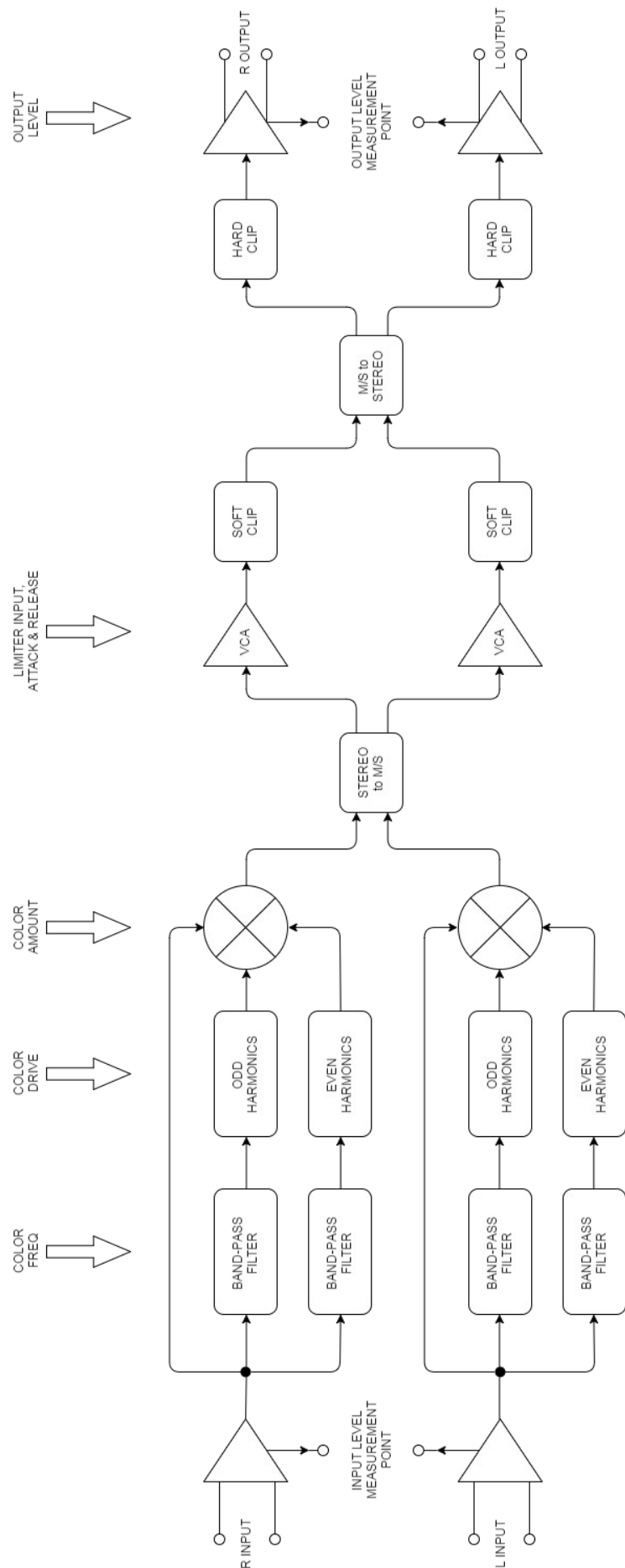
The front panel of the DarthLimiter is build around big LCD touchscreen, that allows you to control almost all functions available in the device. Apart from that, you can also monitor input/output levels, amount of gain reduction (and clipping) applied by the limiter, perform advanced measurements (FFT, LUFS, K-metering), use on-screen QWERTY keyboard for naming your presets and more. You can even display fully configurable, analog style VU meters!



On both sides of the LCD screen you will find four knobs placed on endless rotary encoders. These knobs are labeled **INPUT**, **OUTPUT**, **P1** and **P2**. While the purpose of INPUT and OUTPUT knobs is self-explanatory (but they also have other functions, like scrolling thru the presets list), the assignment of P1 and P2 knobs may vary, depending on the currently selected screen. Smaller knobs also have push-button functionality and they are velocity-sensitive, resulting in coarse changes when spun quickly, and very precise fine increment/decrements when turned slowly.

The **ENGAGE** button allows you to turn the audio processing on (the button is lit) or bypass the unit (relay based true bypass). When you turn the DarthLimiter off completely (with the **MAINS** switch) it will still pass unprocessed audio. Please note that all measurement functions will stop when the unit is in bypass mode.

4. Internal signal path diagram



IV. General Operation

The guide below will walk you thru all the screens and functions available in the DarthLimiter.

1. Connecting the DarthLimiter to your system

Apart from selecting the correct AC voltage and connecting AC plug to the wall socket (with grounding pin) you will also need:

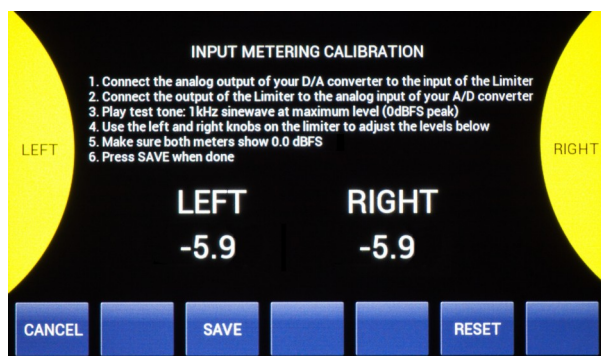
- to connect the USB LINK to your MAC/PC. It is recommended to use quality USB cable that is no longer than 1.5m or additional USB hubs might be required. The DarthLimiter works with USB 2.0 and USB 3.0 standards. The USB LINK will allow you to control the unit from your favorite DAW via VST/VST3/AAX/AU plugin and perform the firmware update in the future.

- to connect XLR inputs and outputs. Using balanced, quality cables is essential here to provide best possible signal quality with very low noise floor. Markings on the back of the unit will make this process very straightforward.



2. Input and Output Metering Calibration

IMPORTANT! Please allow the unit to warm up for at least 20 minutes in studio environment, to be sure that all parameters are stable.



The DarthLimiter is prepared to work straight from the box. In most cases the metering will be accurate and the limiter will behave perfectly. However if you would like to calibrate the internal metering to match your AD/DA readouts, please perform simple calibration procedure. Make sure you always calibrate input metering first and then output.

Form the main menu you can enter the **Settings (gear icon)** screen. Then choose **Metering IN CAL.** or **Metering OUT CAL.** and follow the steps shown on the screen. Please note that the calibration is for metering only – it will not affect audio levels during normal operation.

3. Main Menu

Straight after powering the unit up you will be transferred to the Limiter & Clipper Window. Tap in the bottom right corner of the screen to go to the Main Menu.



Here, you can either go back to the Limiter Window or go to the COLOR screen and adjust the settings of odd/even harmonics generator. You can also choose one of the measurement tools like FFT analysis, LUFS, K-metering and other that will be explained in following chapters of this manual.

As the DarthLimiter has build in memory of 399 presets, this screen also displays the last loaded preset and warns you if the preset was changed by your adjustments and needs to be saved again. And finally the bottom row of buttons: **BACK** (jumps back to the previous screen), **SAVE/LOAD** (presets) and **SETTINGS** (gear icon). The **USB** icon shows that the unit is connected with your PC/MAC and you can control the Limiter with dedicated DAW plugin.

4. Settings



This screen allows you to adjust the **BRIGHTNESS** of the screen (touch and drag the virtual slider on the screen), check the firmware version of your unit, see the number of power cycles (how many times the unit was turned off and on), but also to **CLEAR** presets memory and perform the **METERING CALIBRATION**

procedure (it has to be done only once when you connect the DarthLimiter for the first time. However if you change your D/A converters you might need to calibrate the limiter again. We've talked about the calibration procedure on the previous page).

IMPORTANT! If you decide that you want to erase presets memory, you need to remember that you can't undo your action. All your presets will be gone!

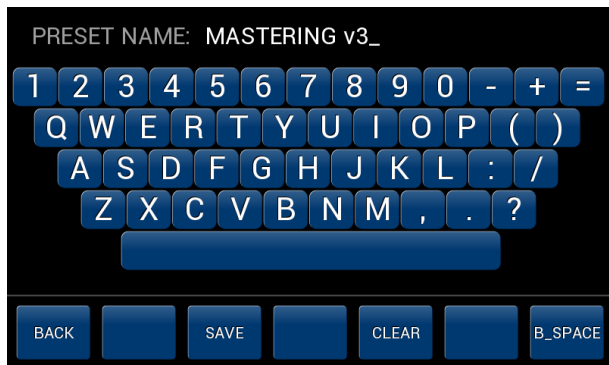
If you wish to clear the presets memory simply tap on CLEAR and confirm your choice. You will see the progress on the screen. When the procedure is over you will be asked to restart the DarthLimiter. If you wish to **RESET SETTINGS** like metering source (input or output) or RTA settings – you can do it here as well.

5. Presets

All adjustable parameters of the limiter, clipper and color (harmonics generator) can be saved as presets within the unit. Each preset also remembers configuration of measurement tools (for example LUFS limits or type of analog meters you have been using). To save new preset or overwrite the old one, tap on **SAVE** button in Main Menu window.



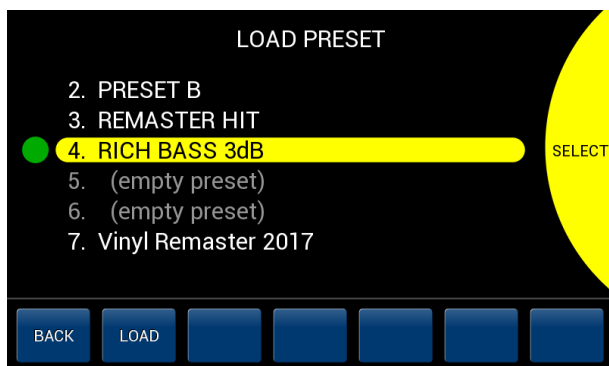
You can scroll the presets list with the OUTPUT knob. Once you choose the preset number, tap on SAVE button - you will be asked to confirm your choice (if you are overwriting an existing preset) or you will be transferred straight to the on-screen keyboard, that will allow you to give your new preset an unique name.



You can also **DELETE** existing preset to free some space in the internal memory.

When you are overwriting an existing preset (in most situations it means that you loaded a preset, made some changes and now you need to save it again) the PRESET NAME field will preload the name for you. You can change the name (**CLEAR** and **BACKSPACE** buttons will help you to

do so) or just press SAVE straight away. If you are saving preset into "(empty preset)" cell, **PRESET NAME** field will be blank.



Loading presets is very simple too. Just Press **LOAD** in the Main Menu, choose the preset and hit LOAD in the LOAD PRESET window. The DarthLimiter will recall all the settings and activate the ENGAGE. Press BACK or scroll thru other presets to find the one that suits your needs.

On the preset list you might notice the **RED** or **GREEN** dot beside the preset number and name. The dot shows up when some preset was loaded or saved. If you've loaded a preset, but haven't made any changes to it, the dot will be GREEN. But if any changes were made to the loaded preset the dot would turn RED. Also you will get UNSAVED! warning in the Main Menu – that is a sign that you should save your preset again before you turn the unit off.

6. Limiter & Clipper

This is the screen that you will probably see the most. It contains all limiter related controls and list of “color” settings (you can enable or disable harmonics in the top right of the screen or edit it by pressing COLOR).



Most of the screen is occupied by the **OUTPUT LEVEL** meter (it can be switched to the input monitoring mode), the **GAIN REDUCTION** meter, that shows the amount of reduction applied to the signal by the VCA limiter, and **CLIPPER** meter showing how much of the signal amplitude have been “cut” by the clipping circuit (only if the Clipper is enabled).

It is worth to understand the internal signal path of the DarthLimiter (presented a couple of pages earlier) as it helps to understand the behavior of the limiter while different settings are changed. The Bettermaker DarthLimiter is a fixed threshold type limiter. It means that applying more signal to the input results in more VCA compression (and clipping). The thresholds of the VCA limiter and clipping circuit are set approx. 3dB apart, so the VCA limiting takes place first. Any transients that pass thru the VCA stage (due to limited attack time of the VCA type limiter) will be “caught” by the clipping circuit. The input gain can be boosted with the **INPUT** knob and up to 20dB of gain can be added here.

If you are not using the CLIPPER (you can switch it on and off with **CLIPPER ON/OFF** button in the bottom of the screen) you can adjust the **ATTACK** and **RELEASE** times of the VCA limiter with P1 and P2 knobs. If the clipping circuit is enabled then the **CLIPPITER** value is introduced instead of usual attack time. The

Clippiter value is simply the ratio between the VCA limiting and signal clipping. In fact, you are still adjusting the attack time of the VCA limiter – set longer attack time (higher ratio) and more transients will be passed to the clipping circuit; set shorter time (lower ratio) and the VCA will do most of the job. If you set the Clippiter value to 100% the VCA circuit will shut off completely and the DarthLimiter will start to reduce the signal amplitude only by using the clipper circuit. The amount of clipping can still be adjusted with the INPUT knob.

If you don't wish to adjust the RELEASE time manually, you can use **IREL** (intelligent release) mode, enable by pressing IREL button in the bottom of the screen. In this mode the release time is set automatically based on the musical content of the signal and amount of gain reduction applied.

The **OUTPUT** knob adjusts the output level of the DarthLimiter (check the internal signal path diagram). Using it will allow you to set proper output level of the device and ensure that you are not overloading your A/D converters with the signal coming back from the limiter.

The DarthLimiter can work in stereo or mid-side mode. Use **M/S** button to toggle between. When the device is working in M/S mode, the labels beside the Gain Reduction meters will change. It is typical to see most of the reduction take place in the MID part of the signal, but of course it all depends on the musical content of the signal being processed. Working in M/S mode allows you also to change the **WIDTH** of the signal (side gain). This can create very spacious, big soundings effects, but also almost completely monophonic sound. To adjust, tap on the WIDTH value on the screen (it will become highlighted) and turn the OUTPUT knob. To give the OUTPUT knob its previous purpose of controlling the output level, simply tap on OUTPUT value on the screen again.

There are three additional buttons on the bottom of the screen:

LEVEL (INPUT/OUTPUT) – lets you select the signal source for the level metering (see the internal signal path diagram). Choose either the input of the device (before harmonic generator circuit) or output (after the output level circuit).

RESET – this button will set all limiter, clipper and “color” (harmonic generator) settings to their default values. You can also double click on P2 knob.

PREFS – let's you choose between peak/RMS metering, different widgets (COLOR or real-time momentary LUFS readout) and other.

7. Color (harmonic generator) window:

There are two stereo harmonic generators build into the unit. One of them is responsible for creating odd harmonics (3rd, 5th, 7th etc.), while the other one – even harmonics (2nd, 4th, 6th etc.). There is an adjustable band pass filter before each of the generators. All this functionality corresponds to two sets of controls: **DRIVE**, **FREQUENCY** and **AMOUNT**. You can only adjust one generator at a time. You choose which one by taping on the left or right side of the screen.



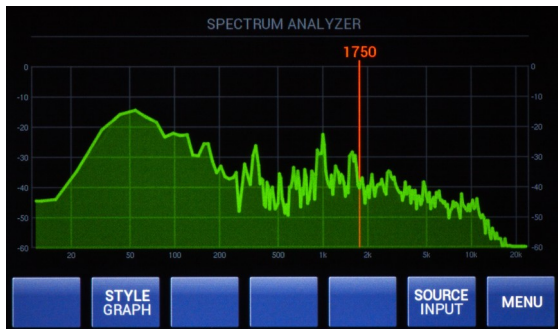
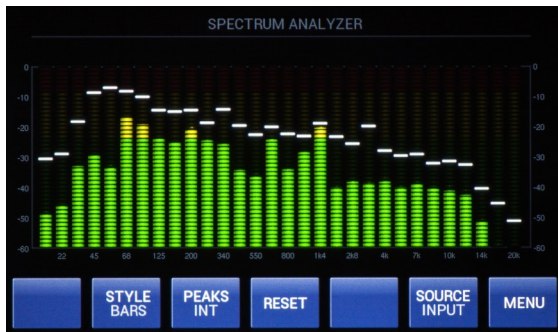
Use the ON/OFF buttons on the bottom of the screen to enable or disable one or both of the harmonic generators (colors). Press **RESET** to set the generators settings to their default values. Use **METER** to switch to GR metering.

The P1 knob adjust the DRIVE parameter that changes the character of harmonics being generated (from soft to really distorted, depending on the input level of the signal being processed). The P2 knob adjust the FREQUENCY response of the band pass filters. This allows you to add color to the specific part of the frequency spectrum of the sound. And finally use the big OUTPUT knob to adjust the AMOUNT of created harmonics to be added to dry signal.

This allows you for example to add small amount of odd harmonics to the low frequencies of your mix, and lots of even harmonics to the top end.

If you wish to change the limiter's input gain (big **INPUT** knob) without leaving the color window – go ahead. The yellow bubble with the value will pop up on the screen. This is very handy feature as adding harmonics might change the signal level and amount of VCA (and clipper) gain reduction.

8. Spectrum Analyzer window:

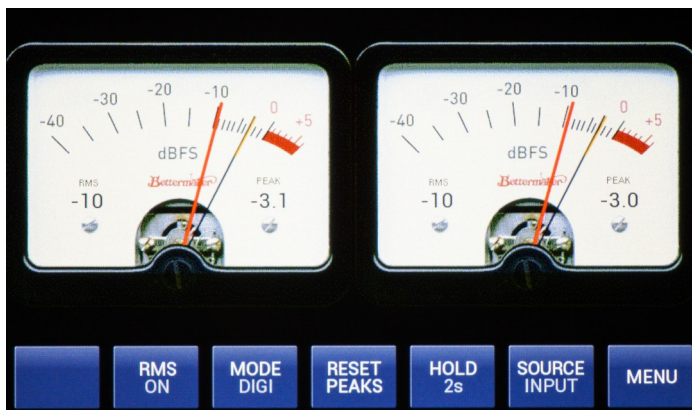


The spectrum analyzer window gives you a great, real-time insight into the current frequency content of the processed signal. By pressing the **STYLE** button you can choose two types of graphical representation to fulfill your needs. BARS style with 30 animated meters and peak hold functionality (you can personalize this feature by pressing the **PEAKS** button) or GRAPH style with movable frequency pointer (just drag your finger across the screen to see how it works). You can choose the point of measurement between input and output of the DarthLimiter (**SOURCE** button). By pressing **RESET** you can reset the peak holds.

9. Analog-style metering

There are 4 types of analog-like level metering available in the DarthLimiter – PPM, VU meter (in two styles) and linear dBFS moving-coil meter. They all serve different purpose and have different ballistic. You can scroll between different types of meters by pressing **MODE** (PPM, VU1, VU2, DIGI) button.

PPM – Peak Programme Meter has a 4dB spacing between the scale marks (with 0dBFS on mark 6). The TYPE1 PPM has an integration time of 5ms (return time of 20dB in 1.7s) and the TYPE2 PPM - 10 ms (return time of 20dB in 2.8s). The T.PEAK type provides almost instant integration time (return time of 20dB in 1.7s).



VU – Volume Unit Meter, calibrated to show 0dB when 0dBFS 1kHz sine signal is present. The fall time is the same as the integration time - 300 ms.

DIGI – digital full-scale meter with true peak response and adjustable fall time (use **PEAK** button to select preferred fall time).

10. K-metering



K-metering system build in the DearthLimiter supports **K-12**, **K-14** and **K-20** standards. It helps you calibrate your studio monitoring levels and produce more consistent music content, while still maintaining high dynamic range.

Please refer to excellent paper "An integrated approach to Metering, Monitoring and Leveling" by Bob Katz for further details.

11. Loudness measurements

This section of metering helps you to monitor programme's loudness (momentary, short and integrated/long term), dynamic range and maximum true-peak levels to ensure that they meet EBU R128 standards issued by the European Broadcasting Union. All algorithms are based on ITU-R BS.1770 and EBU Tech 3341 recommendations.

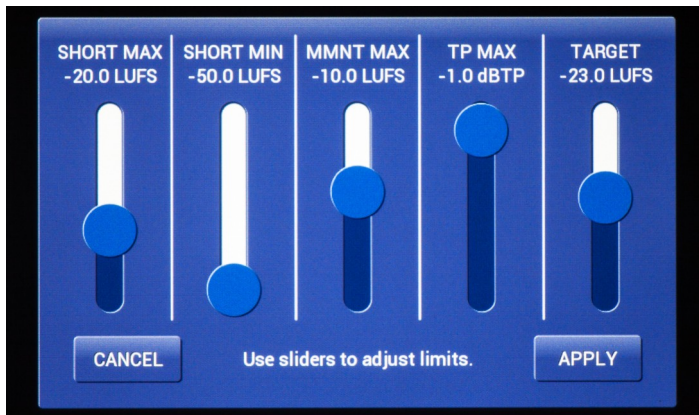


There are two types of layouts to choose from in **PREFS** window. You can also change integration time for LRA (20 or 60 secs of collecting samples before LRA value is given), change LUFS and LKFS units and set the timeout for warnings. If INFINITE WARNING HOLD is ON then every value that is above or under set limits will stay red until the end of the measurement.



Once you press **PLAY** the DearthLimiter will start analyzing audio. You will see the clock counter start and history graph move. Tap on the graph to change its speed.

You can **PAUSE** the measurement (and resume again) or **STOP** to end the measurement. Please note that if you press PLAY on this stage, a new measurement will start and previous results will be lost. As the loudness measurement is gated and it will not include silence in the results, you can start measurement first and then play the programme from DAW/tape. You can also go back to main limiter window, even when the measurement is in progress, however you will not be able to change the metering source (input or output of the DarthLimiter) until you stop the measurement.

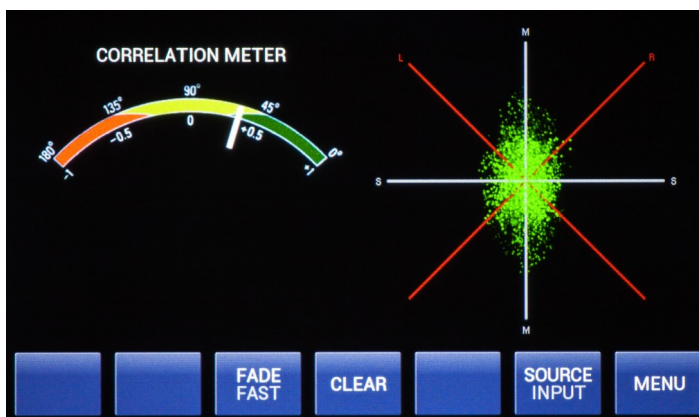


LIMITS window allows you to set targets for the analysis. If any of the values goes above or under this limits it will turn red. You can set desired range for short term loudness, maximum momentary loudness, maximum TruePeak level (the limiter uses 4x oversampling to calculate the level) and most importantly – the target for Integrated Loudness

(default value is **-23 LUFS**). If the result is more than 1 LUFS away from the target the value will turn red, indicating that the programme's loudness is too high or too low.

12. Phase & correlation metering

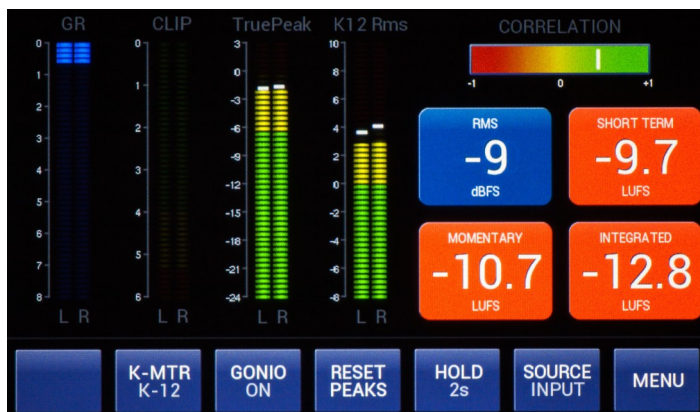
Press **PHASE** in main menu to display the Goniometer and Stereo Phase Correlation Meter. It is very useful tool for checking mono compatibility of your mix.



Pressing **FADE** button will toggle between different fade timeouts. **CLEAR** will reset the correlation graph.

13. Custom metering

The Bettermaker DARTHlimiter allows you to display **three independent and fully configurable sets of measurements**. It will free your main computer screen and provide convenient way of monitoring levels of your mix/master.



By tapping on different parts of the screen you can scroll thru all available measurements. The Limiter will remember your choices. As there are three CUSTOM sets available you can use them for different jobs, for example: mixing, TV mastering, audio stream mastering.

The list of available measurements include:

- input and output peak and RMS levels
- VCA gain reduction
- amount of clipping applied by the Limiter
- TruePeak level
- K-metering (peak or RMS)
- Goniometer for phase correlation check
- Loudness measurements (note that integrated loudness value will be available only if the measurement is running in the background)
- and more..

V. DAW integration

The Bettermaker DarthLimiter can communicate with your DAW via USB connection.



The unit appear as a HID device and can be managed via Bettermaker DarthLimiter Plugin.

Please download the latest version of the plugin installer form our site:

<https://www.bettermaker.com/downloads>

Everything you set on the hardware will appear in the plugin and every change of the plugin will be followed by the DarthLimiter. All the settings will be stored in you session every time you save the project in your DAW.

The plugin appears in your DAW as an audio effect plugin. You can open it as an insert or anywhere in your Host (on mix bus for example). We recommend to keep the plugin on the track that you are currently editing, so it will be obvious for you what track is affected. Notice that the plugin only sends and receives parameter changes of the DarthLimiter, it does not affect the sound by itself - you need to insert your analog limiter physically via your D/A & A/D converter. The plugin will connect automatically with the limiter as soon as you load the session (you need to power up the unit first).

VI. Product Specifications

Maximum input level: +21,5 dBu (balanced)

Maximum output level: +23 dBu (THD < 0.1%)

Operating Level: +4dBu

Maximum gain reduction: 20 dB

Makeup gain: automatic

Attack time: 0.1 – 250ms

Release time: 0.01 – 1.3s + IREL (intelligent release)

Input impedance (differential): 48k Ω (for balanced signal)

Output Impedance: 50 Ω + 50 Ω (electronically balanced)

Frequency response 5Hz to 30kHz; +/- 0.1dB

Dynamic range: 107 dB @ +21 dBu, 20 kHz BW

THD+N: <0.03%, +4 dBu, unity gain, 20 kHz BW

CMRR: max 80 dB @ 3 kHz, min 55 dB @ 50Hz, 20 kHz BW

Crosstalk: min -90 dB @ 1KHz, max -57 dB @ 30Hz, +18 dBu, 20 kHz BW

Maximum power consumption: 30W (uses 630mA slow blow fuse)

Shipping weight: 5.5 kg

VIII. Contact info / RMA warranty

In case of failure, please contact Addicted to Music for RMA information to have your unit repaired under warranty.

Addicted To Music

Phone: +48 604 649 220

Email: info@bettermaker.com

Web: www.bettermaker.com

Warranty:

Addicted to Music warrants to the purchaser of a new Bettermaker DarthLimiter that the unit is free from manufacturing defects in materials and workmanship for a period of one (1) year from the original date of purchase. Addicted to Music's sole obligation under this warranty shall be to provide, without charge, parts and labor necessary to remedy defects, if any, which appear within one (1) year from the original date of purchase. All warranties expressed or implied by Addicted to Music, including warranties of merchantability and fitness, are limited to the period of this warranty. Addicted to Music is not responsible for indirect, incidental or consequential damages arising from the use or failure of this product, including injury to persons or property. This warranty does not cover damage due to: misuse, abuse, modification, accident, or negligence. The warranty does not apply if the unit is connected, installed or used otherwise than in accordance with the instructions furnished by Addicted to Music. If the equipment requires warranty repair, return authorization must be obtained from Addicted to Music prior to shipment. Equipment should not be shipped until return authorization and proper shipping address is obtained from Addicted to Music. The equipment (with all its component parts and connecting cables) must be suitably packaged, including a note with the registered owners name, return address, telephone number, and description of the reason for return. The owner is responsible for all shipping charges, and it is suggested that the shipment be insured for its full value.

This limited warranty is in lieu of all other warranties, expressed or implied, and no representative or person is authorized to represent or assume for Addicted to Music any liability in connection with the sale of our products than set forth herein.

We hope you enjoy your new Bettermaker DarthLimiter! If you have any thoughts, ideas, concerns, notions, or brilliant revelations you would like to share about our products, please bring them to our attention at info@bettermaker.com

Happy Better Making!