Merlin II
Digital Signal Processor

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The device you are holding in your hands is a true marvel of modern times. It is a Processor that works in the digital domain, that is, the analog music signal at its input is digitized, which means it is converted to numbers, and in this way, it is manipulated mathematically. This provides versatility, power, and precision, difficult to achieve by any other method.

FEATURES:

Adjustments are made via its front knob, no computer is necessary.

All adjustments happen in real-time.

6 input channels and 6 output channels.

Integrated preamplifier: it can increase the signal voltage at its input and take it up to 5 Volts RMS without distortion.

Signal level inputs (RCA) and high inputs through the included multi-connector. When the high level inputs are used, Merlin will automatically turn on when sensing an audio signal, and will additionally create a Remote output to turn on external amplifiers. This Remote out signal can perfectly manage one device at a time. If more devices need to be activated, use a relay as a current amplifier.

Input channels can be summed. For each output channel, it is possible to select where its audio signal will be taken from, without limitations, it includes all the possibilities.

Non-volatile memory: the settings made are not lost even when the device runs out of power or even if it is removed from the car.

COPY and LINK function for two channels at a time, available for channels 1 and 2, 3 and 4, 5 and 6: what has been adjusted in one of these channels is copied to the other, and from there you can Couple or Link them, in such a way that the rest of the settings that made will be applied simultaneously for those two channels.

Each channel can be individually attenuated in multiples of 0.5 decibels.

It is possible to select for each channel either a High-Pass, Low-Pass, or Band-Pass filter. In the case of subwoofers, the application of a Band-Pass filter would behave like a normal Low-Pass plus a Subsonic (Infrasonic) filter. The cutoff frequency (F3) of each filter can be adjusted in multiples of 1 Hertz, from 21 to 19,999 Hertz. The attenuation slope for each filter can be 6, 12, 18, or 24 decibels per octave (1st, 2nd, 3rd, or 4th order).

It is possible to vary the output phase of each channel between 0 and 180 degrees.

It has independent time delays for each channel. The resolution is 0.021 thousandths of a second per step (equivalent to 0.28 inches), with up to 5.5 milliseconds possible (equivalent to 73.6 inches).

…And if all this were not enough…

15-band Fully Parametric Equalizer (allows you to adjust the 3 parameters: Frequency, Gain and Bandwidth): the Center Frequency of each band can be set between 20 and 20,000 Hertz with a resolution of 1 Hertz. The Adjustment Range is from -12 to +12 decibels with a resolution of 0.5 dB. You can also adjust the "Q" Factor or Bandwidth, between values 0.2 (wide bandwidth) to 10 (narrow bandwidth), in increments of 0.1.
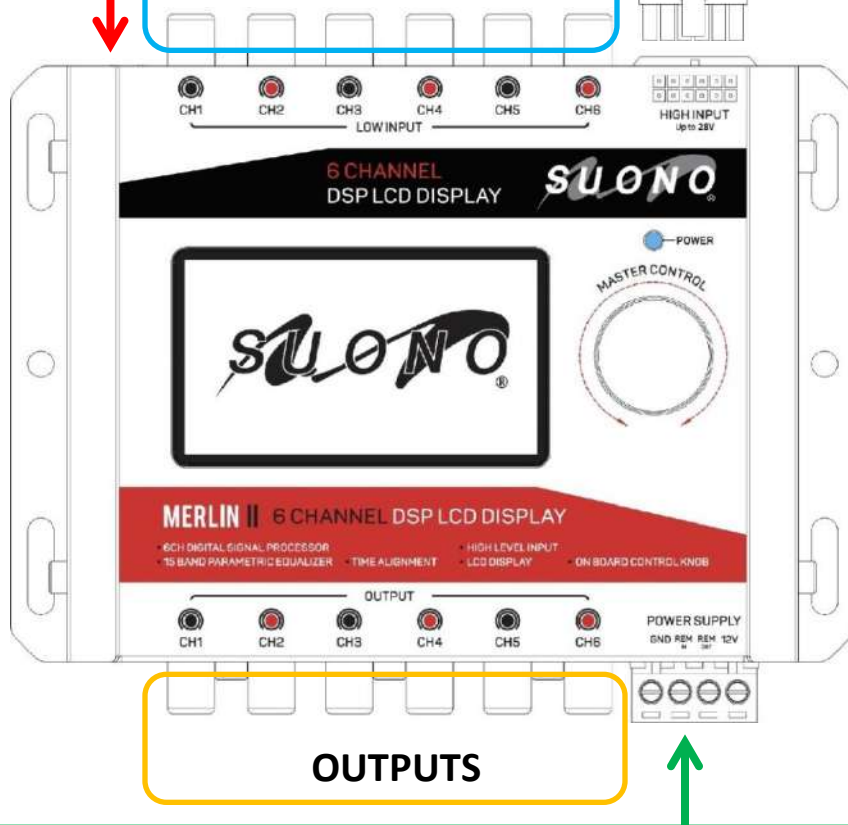
It has 6 memories.

CONECTIONS:

Speaker level input Connector.
Each channel's number is printed on the chassis

HIGH INPUT   CH6

+
−

6 5 4 3 2 1

Gain knob

RCA INPUTS

CH1 CH2 CH3 CH4 CH5 CH6
LOW INPUT

HIGH INPUT
Up to 28V

6 CHANNEL
DSP LCD DISPLAY   **SUONO**

POWER

MASTER CONTROL

SUONO

MERLIN II 6 CHANNEL DSP LCD DISPLAY

6CH DIGITAL SIGNAL PROCESSOR   • HIGH LEVEL INPUT
15 BAND PARAMETRIC EQUALIZER • TIME ALIGNMENT • LCD DISPLAY • ON BOARD CONTROL KNOB

OUTPUT

CH1 CH2 CH3 CH4 CH5 CH6

POWER SUPPLY
GND REM REM 12V
IN OUT

OUTPUTS

Electric Connections:

GND: Ground. Connect to the chassis of the car in electric star configuration (each device with its own cable, all to the same point.

REM IN: Remote input. When the audio signal to the input is signal level (RCA), Merlin will not turn on until it receives a signal from the Remote cable coming from the Stereo.

REM OUT: Remote Output. When the audio signal at the input is speaker level, Merlin will turn on automatically and will also create this Remote Output to turn on the rest of the devices. In case it is required to turn on more than one amplifier, install a Relay as a current amplifier. Never use high and low inputs simultaneously.

12V: Connect to the positive current coming from the battery.

Operation / Menus:

The default screen, before we press Merlin's Knob for the first time, shows us:

LEVEL   -6.0 dB

…………………………………..

CH1: 0.0	**CH2: 0.0**
CH3: 0.0	**CH4: 0.0**
CH5: 0.0	**CH6: 0.0**

In this menu, it is only possible to adjust the Master output Level (LEVEL, the first line), while the screen shows us the Relative Levels present for each of the six channels, which can be adjusted in the first Menu, **01. LEVEL** described below. Except for some very special cases, it is usually best to leave this Master Level at 0.0 dB. Its range goes from -40 dB to +6 dB.
The first step when calibrating a sound system, after defining the input and output channels, is the adjustment of the **Gain Structure**, through the knob marked as "SENS" on the side of *Merlin*. For this, we strongly recommend using a measuring instrument such as an oscilloscope or equivalent.

If you press the knob once, all the available Menus are shown:

Menu

…………………………………….

01. LEVEL
02. RCA I/O CONFIG
03. PEQ
04. HPF
05. LPF
06. DELAY
07. LINK
08. SAVE
09. LOAD
10. SYS SETTINGS
11. EXIT

01. LEVEL
Level Trim

…………………………..

Ch:	**01**
Gain:	**0.0 dB**
Phase:	**0°**
Exit	

Ch: (Channel), shows us which channel is being adjusted.
Gain: allows us to attenuate each channel independently up to 30 dB in multiples of 0.5 dB. It is useful in cases where we need to match the output of one channel with respect to another, or if it is necessary to attenuate a set of speakers with respect to others, either the rear speakers with respect to the front ones or the low-frequency level against that of the rest of the speakers. Some of these adjustments could be made instead directly on the gains of these amplifiers, but it is also possible to do it from Merlin thanks to this option.
Phase: Allows you to change the output phase of the selected channel between 0 and 180 degrees.
Exit: Returns us to the previous menu.

02. RCA I/O CONGIF

RCA I/O Config

…………………………

OutCh:	**01**
InCh1:	**On**
InCh2:	**Off**
InCh3:	**Off**
InCh4:	**Off**
InCh5:	**Off**
InCh6:	**Off**
Exit	

RCA INPUT/OUTPUT CONFIGURATION)

Even though the nomenclature refers to RCA inputs, the operation is the same if the audio signal comes from the speaker-level inputs. (NOTE: Never supply audio signal by high and low levels simultaneously). **The number of each High Level Input channel on the Multi-Connector is stamped on the side of** *Merlin's* **chassis.**

This is the menu where we are going to define what we will have at the output of each of the 6 channels. It allows us to add input channels by activating and deactivating them, being also possible to cancel them all momentarily, which is sometimes useful while other adjustments are being made. When selecting this menu, **OutCh: 01** (Output Channel 01) appears at the top, that is, we are defining what we will have at the OUTPUT of the indicated Channel, which can be changed by pressing the button and turning it, to select any of the six Merlin output channels. Below is a list of all the input channels, where you can see which ones are active for this channel (On) and which ones are not (Off). The configuration shown above, which is the one that comes from default, indicates that Channel 1 will take audio signal only from Input Channel 1 since all other input channels show Off. If we activate other channels, for example, 3 and 5, audio output 1 will reproduce the audio signal that is present in inputs 1, 3 and 5, which is useful when the original car stereo comes with active filters, so the audio signal to the speakers is not Full Range but only highs for the tweeters, mids for the midranges and lows for the woofers. In this case, it will be necessary to SUM those three inputs to obtain a Full Range signal in two output channels and with them feed our amplifiers. Since the frequency ranges will be different for each channel, their voltages will typically not add, unlike the following example. In the event that this equipment would be using two amplifiers, output channels 3 and 4 will take their audio input signals from the same places: output channel 3 will take audio signal from inputs 1, 3 and 5, while output channel 4 will take its input signals from inputs 2, 4 and 6. If we had 3 amplifiers, output channels 5 and 6 could take their audio signal from those same input channels, and of course, each amplifier will still be able to be adjusted with different filters and equalization curves.

Another option is a system with two front channels plus a subwoofer, operating from a factory car stereo. Let's assume that the vehicle has front and rear parking sensors, which play the car's original speakers in the front or rear, as appropriate. If our system only has speakers in the front, it will be convenient for those speakers to reproduce the sounds of such sensors whether they come from the front or the rear. In this case, Merlin will have to be fed with 4 input channels (front and rear left and right), configure output channel 1 to receive audio from channels 1 and 3, while output channel 2 must receive audio from channels 2 and 4. This way the audio signal coming from the car's front and rear channels will be added to only two output channels, allowing such parking alarms to be reproduced, even though all the sounds will now come from the front. Better from the front than nothing at all, don't you think? Now please take note that in this case, as we will be adding two full-range channels, we will have double the voltage at the input (the signal will increase 6 decibels) so the *Merlin* gain will have to be adjusted accordingly.

Another possibility would be a system in which we plan to install front and rear speakers and subwoofers with three amplifiers. However, we wish to take the audio signal from only one pair of input channels from the factory or aftermarket stereo. In this case output channels 1 and 2 will take their input signal from channels 1 and 2, output channels 3 and 4 will take their input signal from channels 1 and 2, and output channels 5 and 6 will take their input signal from channels 1 and 2. So with only two input channels, it is possible to feed 6 output channels.

As you can see, we can feed each of the output channels with any or none of the input channels, including all the possibilities.

Exit. Returns us to the previous menu.

03. PEQ (PARAMETRIC EQUALIZER)

This is the menu for adjusting the Parametric Equalizers, one per channel.

EQ Settings
…………………………………………

Ch:	01
Band:	01
Ratio:	x1
Freq:	25 Hz
Gain:	0.0 dB
Q:	1.4
Exit	

Ch: 1 (Channel 1): It indicates which output channel is being adjusted among the six available. Note: it is possible to simultaneously adjust two channels at the same time, for example, front left and right, if we previously linked them in menu 7. In this case, this screen will show: **Ch: 01 & 02**

Band: Each equalizer has 15 bands. When we choose this option and turn it, the adjustment Center Frequency indicated in the fourth line (**Freq**) will show the different adjustment bands in order. The frequency centers of these bands as configured at the factory are 25, 40, 63, 100, 160, 250, 400, 630, 1000, 1600, 2500, 4000, 6300, 10000 and 16000 Hertz, but can be changed if necessary.
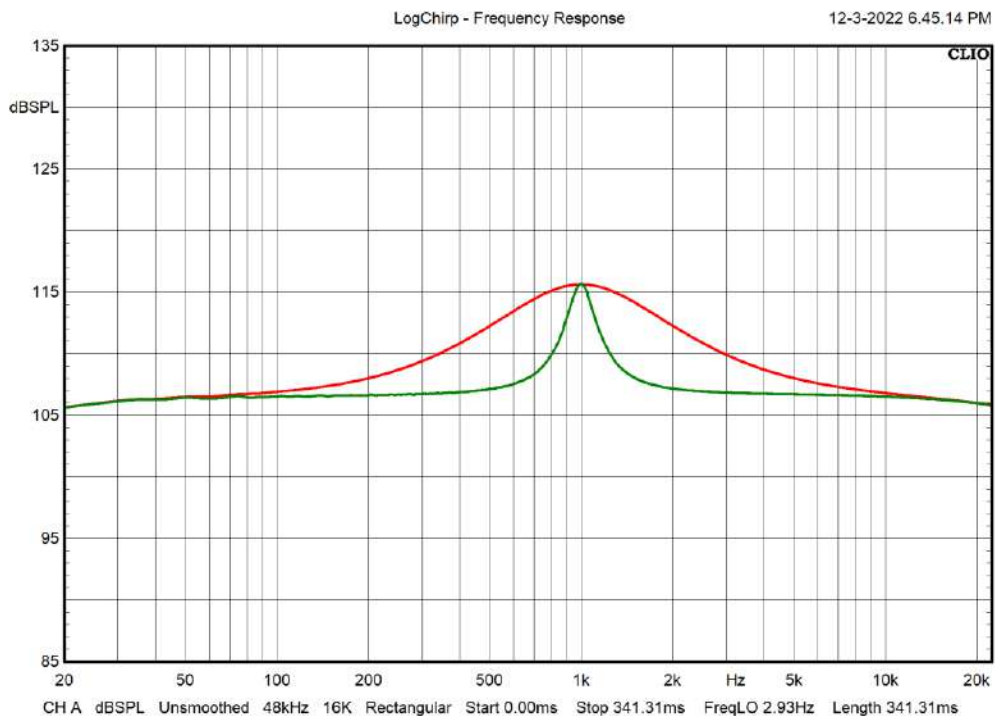
Ratio: This option allows us to navigate the next frequency setting (**Freq**) in a more agile way. The options are x1 (from frequency to frequency), x10 (every 10 Hertz), x100 (every 100 Hertz), x200 (every 200 Hertz), and x500 (500 Hertz jumps).

Freq: (Frequency): Depending on how the **Ratio** option has been selected above, this will be the resolution with which the Center Frequency of the present equalizer adjustment band can be varied.

Gain: The gain or attenuation that we will give to each band of the equalizer in decibels, between -12 and +12 decibels, with a resolution of 0.5 decibels.

Q (Q Factor (Quality) or Bandwidth). Q factor is defined as Center Frequency divided by the bandwidth at -3 dB. It is a dimensionless number that defines how many frequencies we are going to affect when making our adjustments, many or few. A low number like 0.5 covers many frequencies and a high number like 5 covers fewer frequencies. From the factory, all bands come with a Q of 1.4. Two curves are shown in the graph below, both with a gain of 9 dB @ 1,000 Hertz. Red has a Q of 0.5 and Green has a Q of 3.

Exit. Returns us to the previous menu.

LogChirp - Frequency Response   12-3-2022 6.45.14 PM

CH A dBSPL Unsmoothed 48kHz 16K Rectangular Start 0.00ms Stop 341.31ms FreqLO 2.93Hz Length 341.31ms

04. HPF (High-Pass Filter)

Hipass filter

………………………………….

Ch:	**01**
Ratio:	**x1**
Freq:	**20 Hz**
Slope:	**Off**
Exit	

Ch: 1 (Channel 1): It indicates which channel is being adjusted among the six available. **Note:** it is possible to simultaneously adjust two channels at the same time, for example, front left and right, if we previously linked them in menu 7. In this case, this screen will show **Ch: 01 & 02**. **Note 2:** the filters for the same speakers, for example, front left and right speakers or the subwoofers, typically must be identical or cancellations may occur. Even more so if the amplifier channels are being operated in bridged mode.

Ratio: This control allows us to navigate the next frequency setting (**Freq**) in a more agile way. The options are x1 (from frequency to frequency), x10 (every 10 Hertz), x100 (every 100 Hertz), x200 (every 200 Hertz), and x500 (hops every 500 Hertz).

Freq: F3 or the cut-off Frequency of the filter.

Slope: Slope or Attenuation is the order of the filter that we will use. The options for this knob are:
- **OFF**: Without any filter, Full-Range signal;
- **06dB/Oct**: Corresponds to a First Order filter with an attenuation of 6 decibels per octave:
- **12dB/Oct:** Corresponds to a Second Order filter with an attenuation of 12 decibels per octave:
- **18dB/Oct:** Corresponds to a Third Order filter with an attenuation of 18 decibels per octave:
- **24dB/Oct:** Corresponds to a Fourth Order filter with an attenuation of 24 decibels per octave:

Exit: Returns us to the previous menu.

The graph below shows four different High-Pass filters, all with an F3 Frequency of 100 Hertz, first, second, third, and fourth order. The fourth order is the one with the steepest slope.
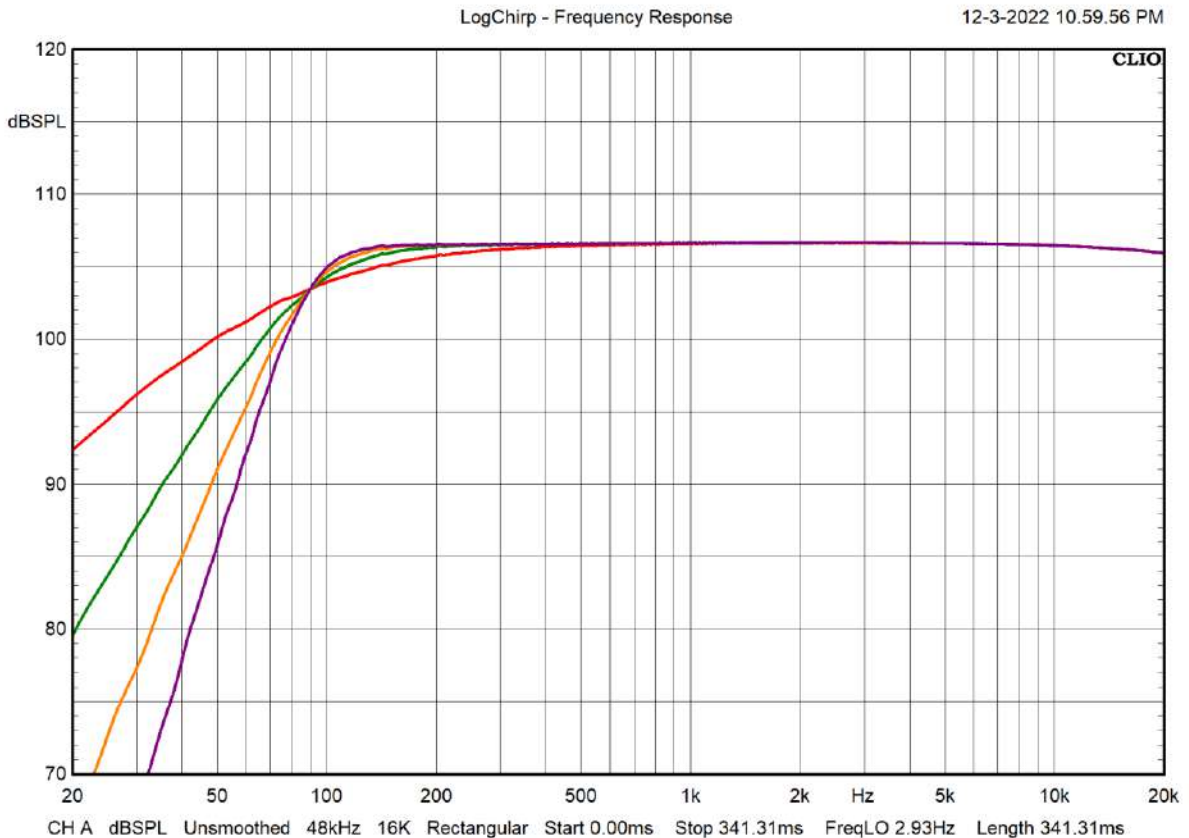
05. LPF (Low-Pass Filter)

Lowpass filter

……………………………………………….

Ch:	**01**
Ratio:	**x1**
Freq:	**20000 Hz**
Slope:	**Off**
Exit	

Ch: 1 (Channel 1): It indicates which channel is being adjusted among the six available. **Note:** it is possible to simultaneously adjust two channels at the same time, for example, front left and right, if we previously linked them in menu 7. In this case, this screen will show **Ch: 01 & 02**. **Note 2:** the filters for the same speakers, for example, front left and right speakers or the subwoofers, typically must be identical or cancellations may occur. Even more so if the amplifier channels are being operated in bridged mode.

Ratio: This control allows us to navigate the next frequency setting (**Freq**) in a more agile way. The options are x1 (from frequency to frequency), x10 (every 10 Hertz), x100 (every 100 Hertz), x200 (every 200 Hertz), and x500 (hops every 500 Hertz).

Freq: F3 or the cut-off Frequency of the filter.

Slope: Slope or Attenuation is the order of the filter that we will use. The options for this knob are:

- **OFF:** Without any filter, Full-Range signal;
- **06dB/Oct:** Corresponds to a First Order filter with an attenuation of 6 decibels per octave:
- **12dB/Oct:** Corresponds to a Second Order filter with an attenuation of 12 decibels per octave:
- **18dB/Oct:** Corresponds to a Third Order filter with an attenuation of 18 decibels per octave:
- **24dB/Oct:** Corresponds to a Fourth Order filter with an attenuation of 24 decibels per octave:

Exit: Returns us to the previous menu.

The graph below shows four different Low-Pass filters, all with an F3 Frequency of 100 Hertz, first, second, third, and fourth order. The fourth order is the one with the steepest slope.
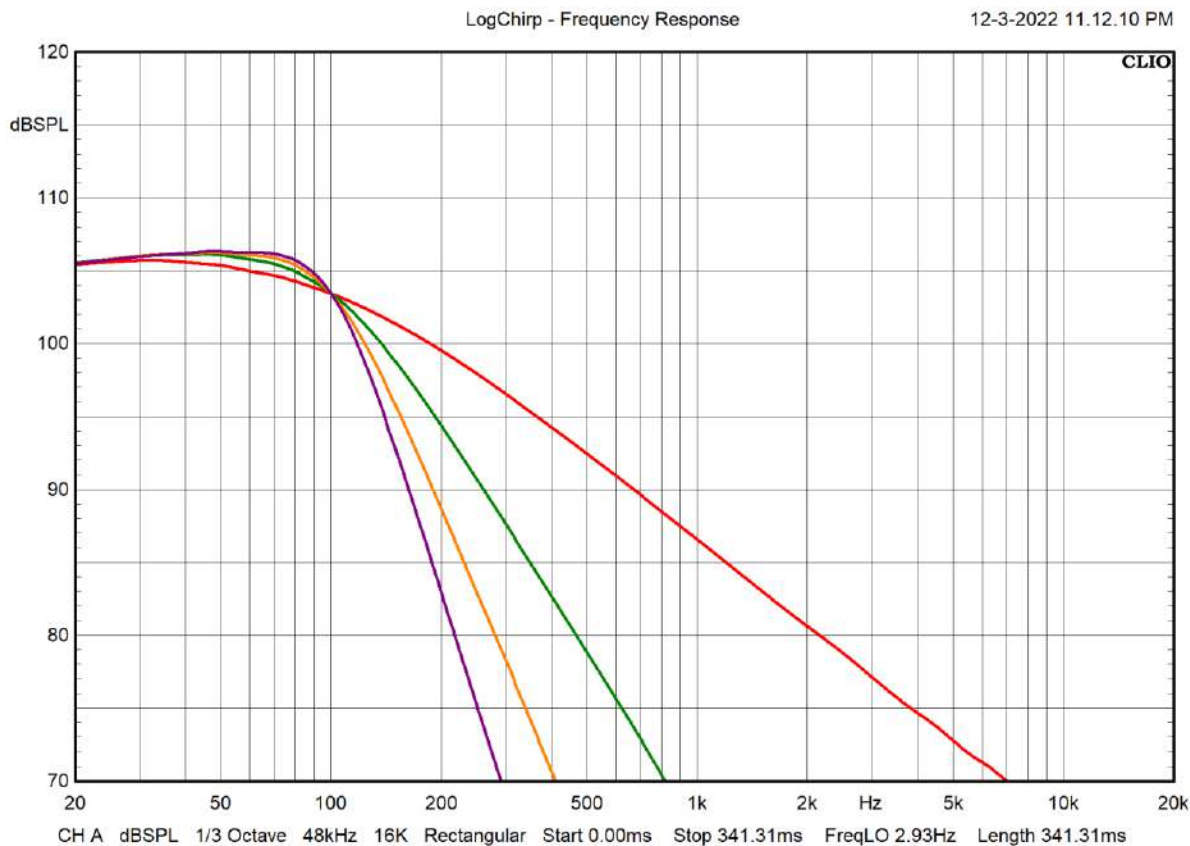
06. DELAY (Time Delay)

Delay

……………………………………

Ch:	**01**
Unit:	**Ms**
Value:	**0.0000**
Exit	

Ch: 1 (Channel 1): It indicates which channel is being adjusted among the six available.

Unit: The units in which the same amount of time delay is expressed. The options we have are Ms (thousandths of a second), Cm (centimeters) and Inch (inches).

Value: Depending on the unit selected in the previous option, the equivalent amount of time or distance will appear here, either in thousandths of a second, centimeters, or inches.

Exit: Returns us to the previous menu.

Why do we want to delay time? One possibility is to try to achieve a more robust stereophonic sound. The objective of stereophonic sound is the creation of a musical three-dimensionality, that the instruments and singers appear in front of us in the position where they were originally located when the recording was made: the singer typically in the center of the stage, with the rest of the instruments at both sides, left and right, in different planes. Achieving this effect with two speakers is no easy feat, and one of the original basic requirements is having both speakers left and right in front of the listener, at the same distance; think of an equilateral triangle, both speakers facing us at two of its vertices, while our head is at the third. If both speakers to our left and right are at identical distances from our ears, both the intensity and the arrival time of the sound to our head will be the same, a fundamental requirement to achieve the stereophonic effect. The problem lies in the fact that in a car this does not happen since we do not sit in the center of the vehicle. Therefore, if we are for example on the steering wheel side, the left speaker will be perceived louder from our seat than the right speaker, as it is closer, and its sound will reach our ears earlier in time for the same reason. But thanks to the digital handling of the signals from the *Merlin* processor, it is possible to delay the output time of the sound in one of the speakers, to compensate for these differences in distances, and be able to have an identical arrival time from both speakers. This may have the ability to substantially improve the perception of an excellent front-end soundstage and image within the car. Of course, to do so requires that a few other things are also taking place, but this one, the arrival time, is possible to achieve with this setting.

How is it done? Assuming that the place we are interested in improving is the driver's side, we start by adjusting the seat in the right driving position, and with the help of a Tape Measure, we measure the distance between our left ear and the left tweeter, as well as the distance between our right ear and the right tweeter. Let's assume that such distances are 36 and 45 inches. There is a difference of 9 inches. With this data we select the channel that is feeding our left speaker, suppose channel 1, we select in **Unit** the **Inch** option, and we turn the **Value** knob until reaching the closest available value to 9 inches. That is all. If all else is right, this act has the ability to make us feel that the voices are coming from the center of the vehicle, we kind of stop hearing the sound as coming from the speakers but instead we just hear music, instruments all across the dash, a magical musical experience. Please note that the further these front speakers are from us, the percentage of error between their distances to our ears will be less, so the necessary time delay will also be less, making it easier for all these effects to be achieved.

07. LINK

Link

....
1&2 Copy:	**1 → 2**
1&2 Link:	**Off**
3&4 Copy:	**3→ 4**
3&4 Link:	**Off**
5&6 Copy:	**5 → 6**
5&6 Link:	**Off**
Exit	

This menu is used to join channels in pairs, so all settings made are identical for both. The first option tells us Copy 1 → 2, which can be inverted to Copy 2 → 1. Suppose we have already made some adjustments on one channel and then we remember that we have to repeat them on the second channel. Instead of repeating them, we can copy everything that has been done in one of them to the second (or vice versa). If we want what is on Channel 2 to be copied to Channel 1, we select **1&2 Copy**, press the button, and turn the knob until **2 → 1** appears. We exit this option and now activate the **Link** function (from Off to On). Once turned On, both channels now have the same settings (the same as the source channel), and all subsequent settings will be made simultaneously on both channels. When turned on, the adjustment menus change their nomenclature and now show that they are working with both channels in unison (**Ch: 01 & 02** for example). The settings that can be linked are Level and Phase (Attenuation and Phase), PEQ (Equalizer), HPF (High-Pass Filter), and LPF (Low-Pass Filter). It does not copy or link the settings of the input channels or DELAY (Time Delay). You can only link channels 1 with 2, 3 with 4 and 5 with 6.

Once we have finished all the adjustments that we want to be the same, we can turn off the LINK mode (Off), and from that moment on we can proceed to make other independent adjustments, different for each channel, such as a slightly different equalization curve for our front left and right channels, in order to fine-tune the stereo image. **Note:** the filters should be the same for both channels, otherwise cancellations may occur.

08. SAVE

Preset Save

....
Preset:	**A**
Preset:	**B**
Preset:	**C**
Preset:	**D**
Preset:	**E**
Preset:	**F**
Exit	

Merlin has 6 non-volatile memories, that is, they are not lost even if the device is removed from the car. To save the current settings to Memory, select one of the six available Memory letters and press the button, that's it. Everything that has been configured up to that moment will be saved there. What can be saved are the attenuation for each channel and their phases, the equalization curves, both the high-pass and low-pass filters as well as the time delays. The Master Output Level, the Channel Settings for the inputs and outputs, the options for linking the channels and the settings selected in **Menu 10: System Settings**, are not saved in Memory.

09. LOAD

Preset Load

………………………………….
Preset:	**A**
Preset:	**B**
Preset:	**C** ←
Preset:	**D**
Preset:	**E**
Preset:	**F**
Exit	

When the **LOAD** option is pressed, an arrow appears indicating which Memory is currently being listened to (Memory C for this example). To load any other memory simply choose it, from A to F, and press the button.

10. SYS SETTINGS (System Settings)

System Settings

…………………………..
Backlight:	**Auto**
Contrast:	**12**
Restore:	
About	
Exit	

Backlight: (Screen illumination). It allows us to adjust the way the lighting of the screen will work. The options are **Auto**, that is, it turns on automatically for a few seconds while we manipulate the knob, and **On**, that is, always on while Merlin is on.

Contrast: Allows us to change the contrast of the screen. Simply twist and adjust where the digits are most clearly visible.

Restore: used to return Merlin to its factory settings. The options are **No** and **Yes**. If you want to erase all present settings and memories and return *Merlin* to how it was when first taken out of its original packaging, turn the knob to the On position and press it.

About: The version and date of the installed software are displayed.

Exit: Returns us to the previous menu.

11. EXIT

Takes us back to the main screen.

SPECIFICATIONS

- 6 input channels, 6 output channels.

- Channel Routing: it is possible to send the audio signal from the input channels to any output channel.

- Maximum output voltage before distortion: 5 V RMS.

- Integrated preamplifier: 5 Volts RMS output before distortion can be achieved even from radios with only 0.35 Volts at its RCA output.

- Input voltage range at signal level (RCA): 0.35 to 6.5 Volts RMS.

- High Inputs capable of accepting up to 28 Volts RMS (200 watts).

- Input impedance > 30,000 ohms.

- Output impedance < 80 ohms.

- Automatic turn-on when fed with high audio signals, creating a Remote output to turn on external amplifiers.

- All settings in Real Time.

- 15-band Parametric Equalizer per channel.

- High-Pass, Low-Pass and Band-Pass filters per channel with the option to select the attenuation slopes in 1st, 2nd, 3rd or 4th order.

- Phase shift per channel between 0 and 180⁰.

- Time delay per channel up to 5.5 ms (187 cm or 73.6").

- Operating voltage: 9.5 – 16 V.