



ST-X DSP 2021
Owner's Manual

Before operating the unit, please read this manual thoroughly and retain it for future reference.

MISSION STATEMENT

Committed to Excellence

ZAPCO is dedicated to the pursuit of audio fidelity. Our prime objectives are to design and manufacture audio products of unsurpassed quality, to provide unparalleled support and service for these products and to conduct business in a manner that will enhance the quality of life for all involved.

Experience (Knowledge from doing)

There is absolutely no substitute for experience; that is a simple fact of life. Another simple fact is that ZAPCO has, for over forty years, been the leader in defining quality standards for the car audio industry.

These years of experience have led to a thorough understanding of the challenges that are unique to the world of car audio. ZAPCO's relentless quest for sonic purity consistently yields imaginative designs that utilize the most innovative technologies. The resulting products set the criteria by which all others in the industry are judged.

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A new level of Sound Quality

Zapco has a reputation for sound quality that is unsurpassed. It is our dedication to sonic purity and our passion for performance that built that reputation. With all the new amplifiers coming into the market, none has been any threat to Zapco's standing as the premiere amp and processor company for pure sound quality.

Just check out the audio competition scene. The pros know what to use to win. Competition amps however, do not come cheap, and not everyone wants to compete. The challenge then, was to put Zapco's 40 plus years of experience to use in the development of an amplifier that would bring Zapco sound a line of products for every-day use and that everyone could afford. And the studio line is just that amplifier. In the time it has been out it has built a reputation as the best sounding amp in the class.

Of course, not everyone buys strictly by sound (although they should). Maybe it's the wrong color, maybe it's too big... or too small. But one thing is constant. Everyone who hears the studio amps agrees; it sounds better than any other product in the class.

History of the Studio Series

Perfection cannot be achieved. But that does not make its pursuit less valuable. Zapco is committed to making every product we make better than the last. We introduced the ST-X amps in 2013. In 2015 we improved the PCB design and upgraded components to make the sonically improved ST-X II.

For 2018 we developed the Studio X SQ amplifier to take affordable sound quality to a new level. We added the proprietary RCA connectors from the Z-LX amplifiers, changed the capacitors to a higher end audio cap, and made a few other small changes. All this takes the Studio sound to a new level of sonic performance for an affordable amplifier.

For 2019, we brought digital processing to the studio line in DSP/AMPs that can be controlled by PC or by iOS or Android mobile apps.

For 2021 we have upgraded the ST-DSP with new features and functions to improve your listening experience. And developed a new fan cooled aluminum heat sink for improved efficiency and reliability under extreme temperature and hard play.

The Studio-X DSP Amplifiers

With the new Studio-X DSP amps you get the sound quality that other companies offer only in their big competition amps (and better than many of them) in a compact chassis with 65W RMS/Channel @ 4Ω (ST-4X DSP) 100W/Ch. @ 4Ω (ST-6X DSP) plus the tuning power of the ST Digital Processing System. The on-board DSP provides a wide variety of digital Crossovers, Parametric EQ at each channel as well as Signal Delay, Polarity, and gain for each channel. As for analog performance, the Studio X DSP amps give you more than power. These amps have 0.2% THD+noise, over 90dB signal to noise, over 60dB separation, and produce power from 15 Hz to 30 KHz.

Main features of the Studio-X DSP amplifiers

- 4-Ch or 6-Ch Full Range, Class A/B Amplifier
- On-Board, Full Function, 8-Ch Digital Signal Processing
- High-pass and low-pass filters
- Signal Delay
- Phase (Polarity) control
- 15 channels of parametric equalization on each channel
- Optional BT Streaming (Bluetooth Port for external APTX HD Module)
- And of course, Zapco sound quality

New for 2021

- Analog input level controls with 2-stage clip indicators for accurate, distortion free gain settings
- Toslink Optical input for both the models
- 6-Channel speaker level input connections
- New high efficiency finned heat sink with fan cooling
- Both models have 8-Ch digital processor to provide processed outputs for external amplifiers

Before you start your installation

ZAPCO highly recommends that a fuse or circuit breaker be placed within 18" of the battery. Although you will add a fuse or fuse block near the amplifier it is still a possibility that a pinched power wire between the component fuse and the battery could result in a short, or even a fire. The protection device should be placed where it can be accessed easily and all wiring should be routed safely and correctly according to the following guidelines:

Do not run wiring close to hot or spinning objects.

Always use wire grommets when routing wire through the firewall or any other metal panels.

Make sure that the potential for pinched wiring is avoided by routing all wires away from moving hinges and seats. This also includes brake, gas and clutch pedals, hood and trunk hinges, etc.

Continuous exposure to excessive sound pressure levels may cause permanent hearing loss. ZAPCO strongly advises that you use common sense when setting volume levels. If you experience ringing in the ears, it could cause permanent hearing damage!

When connecting our amplifiers to pre-wired stock speakers, care must be taken that there are no common connections between left and right speaker wires, i.e. two or more speakers using the same ground connection (very common in pre-85 cars), as this will cause the amplifier to go into immediate protection or may cause damage to the amplifier. Output connections are not common chassis ground. Please follow the hookup instructions in this owner's manual. Any questions should be directed to your local ZAPCO dealer.

Upgrading a Factory Stereo

If you are upgrading a factory stereo the ST-X DSP amps have a separate speaker level input plug that senses current, so you do not need to run a turn-on wire. However, auto-on is not useful in all cars as the amplifier can come on when you do not want it on, because of the car's electrical system. The ST-X DSP amps have a switch that allows you to defeat the auto-on if you find you do not want to use that function.

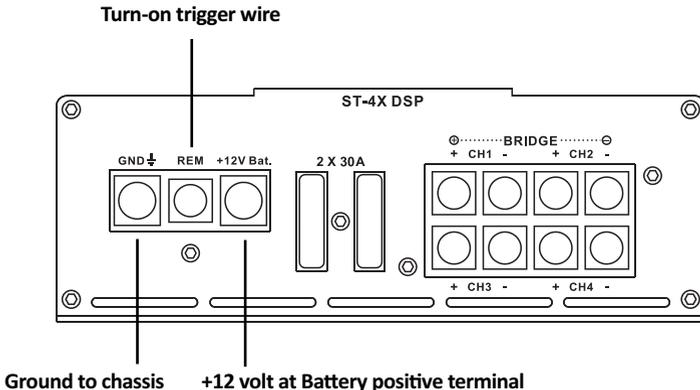
Planning your power connections

The power end plates of the Zapco ST-X DSP amplifiers carry the power connections and the speaker connections and vary somewhat by the number of channels. For example, the power end of the ST-4X DSP below has (of course) speaker connections for four channels. The ST-X DSP amps all have on-board fuses and the fuse rating as printed above the fuses. The main 12-volt power input, the 12-volt turn-on wire, and the main Ground connection are common to both models.

- The large connection at the interior of the end plate is the main power input. This must be connected the vehicle battery's positive (+) terminal, and a main system fuse should be placed close to the battery
- The large connection at the outside of the end plate is the main ground or negative connection. This must be securely attached to bare metal at the vehicle frame, or other heavy chassis component with a direct connection to the frame

Note: Seat bolts and seat belt bolts are NOT good ground points

- The small terminal between the main power and ground is the +12 turn-on input and can be connected to the head unit turn-on output wire. If none is available it can be connected to an accessory (ACC) terminal. You should avoid using any ignition-on (IGN) wire, as they can be noisy



Note: The ST-X DSP amplifiers have terminals that do not require connectors. You simply insert a bare portion of wire and tighten the connection with the supplied Hex tool. As the wire conforms to the connector the connection can loosen. You should re-tighten the connection after about a week.

Some words about Power and Ground

Note: The second most common cause of underperforming amplifiers is insufficient power current or a poor power connection. The most common cause of underperforming amplifiers is insufficient ground current or a bad ground connection.

12-volt current: Battery Power works only if it travels in a complete circuit from the battery positive terminal to the battery negative terminal. Main power input, of course, is attached to the battery positive terminal. Ground current is returned to the battery through the chassis to the point where the battery is grounded.

The current available for your amplifier to use to produce power will be restricted by the smallest gauge of wire in the circuit and by the weakest physical connection in the circuit.

Wire Size

It's often surprising how many people will obsess about signal wire but routinely provide the amplifier with only a fraction of the current it needs to do its job. The most common wire gauge used in car audio is 10-gauge, and the most common location for amplifiers is in the trunk.

Wire Sizing Chart

	←----- Length of Run -----→							
	4 ft	7 ft	10 ft	13 ft	16 ft	19 ft	22 ft	28 ft
0-20 amps	14	12	12	10	10	8	8	8
20-35 amps	12	10	8	8	6	6	6	4
35-50 amps	10	8	8	6	6	4	4	4
50-60 amps	8	8	6	4	4	4	4	2
65-85 amps	6	6	4	4	2	2	2	0
85 -105amps	6	6	4	2	2	2	2	0
105-125 amps	4	4	4	2	2	0	0	0
125-150 amps	2	2	2	2	0	0	0	0

Let's look at a fairly small system. If you use a 50 watt/ch amp (25 amps) for the highs and a 100 watt/ch amp (40 amps) for the woofers, you need at least a 4-gauge and maybe a 2-Gauge wire to provide 65 amps at the trunk. Anything less and your car won't go boom. It'll just go Blap!

Note: It takes lots of current to make lots of power!

Remember! An electrical circuit is just that... a complete circuit. For current to travel, you must complete the circuit from the positive terminal to the negative terminal (which is connected to the vehicle frame). So what ever Gauge wire you use for power (B+) you must also use for ground (B-).

Note: A 4-gauge power wire needs 4-gauge ground wire!

Use the Wire Sizing Chart! Add up the fuse values on the amplifier(s) then choose the proper size wire based on the distance from the car battery to the amplifier location. Again, always use the same gauge wire for the main ground as you do for the main power. Always make your ground as short as possible and secure it to a clean solid surface, preferably the vehicle frame.

Mounting your ST-X DSP amplifier

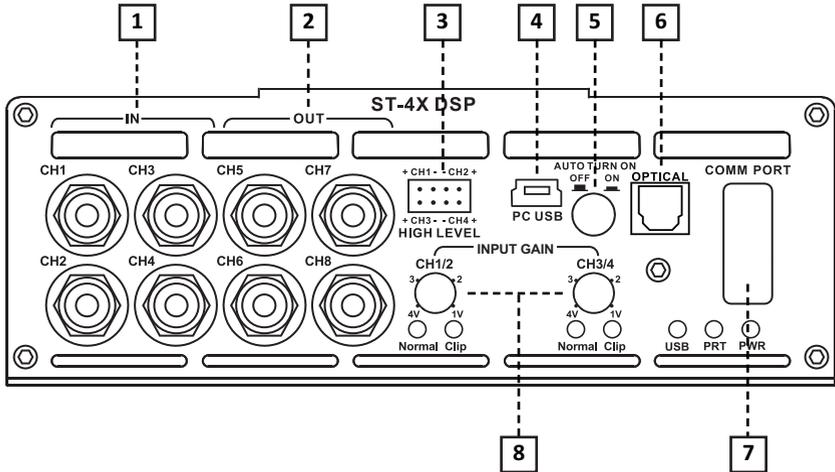
Mounting your Zapco amplifier is easy. Just keep in mind a few guidelines:

- The amplifier can be mounted in any direction, on wood, metal, or carpet
- The metal chassis of the amp can be grounded or left isolated
- The amplifier requires adequate ventilation. Creating power creates heat, and cooling requires air. Position the amplifier with sufficient surrounding area for air supply and keep the end plates clear for future access
- Keep the amplifier out of the engine compartment or other locations that may cause excessive heat or moisture
- Do not mount the amplifier to a subwoofer box or other place that may have excessive vibration

Setting Input Gains: Gain pots are not volume controls. Before you first turn on your system, you should make sure all gain controls are set to minimum (counter clockwise). After the system is installed and all components are connected; play a loud track with your head unit at 3/4 to 7/8 volume. While watching the 2-stage clip LEDs... turn the input gain controls up on the channels you are using for input until the channel's LED indicators turn from green to red, then back off just slightly. If you reach a volume that you consider too loud before you see the red LED, that's OK too. Leave the controls at that level. After you have set the controls just watch them for through the rest of the song to be sure the red clip lights don't come back on.

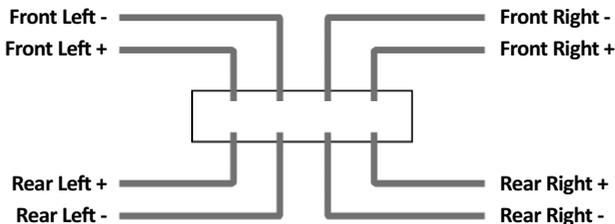
ST-4X DSP Input/Controls Ends

The ST-4X DSP is a 4-Channel amplifier with on-board Digital processing. The input functions are described below:



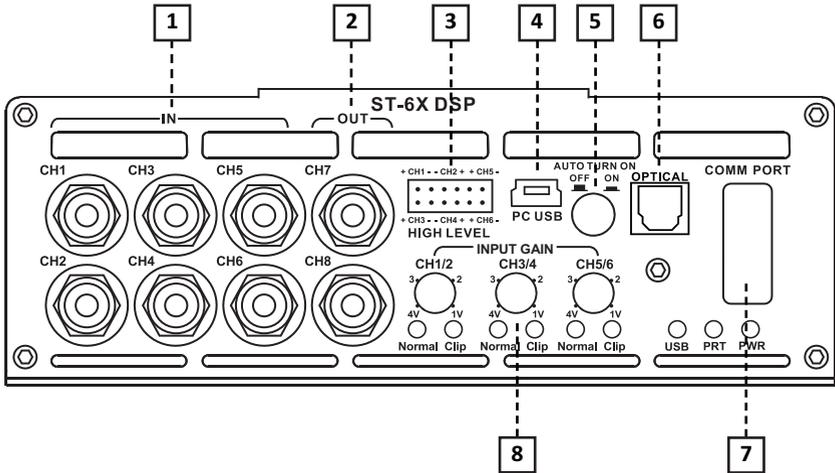
- 1 • 4 Channels (1/2 and 3/4) of RCA level inputs for the internal amplifier
- 2 • 4 Channels (5/6 and 7/8) of processed RCA outputs for external amplifiers
- 3 • High-level OEM input plug
- 4 • USB Port for PC control connection
- 5 • Auto turn-on Switch to turn the system on by signal sensing
- 6 • Toslink Port for digital input
- 7 • Comm Port for expansion
- 8 • Analog input gain controls with clip indicators

OEM Speaker level Input plug



ST-6X DSP Input/Controls Ends

The ST-6X DSP is a 6-Channel amplifier with on-board Digital processing. The input functions are described below:



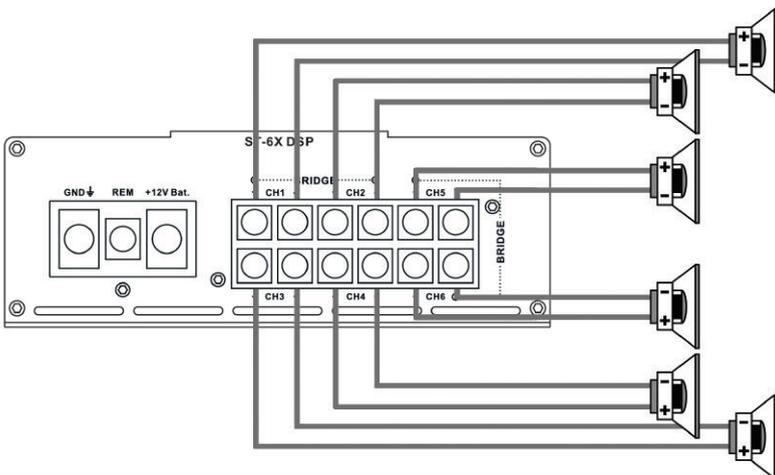
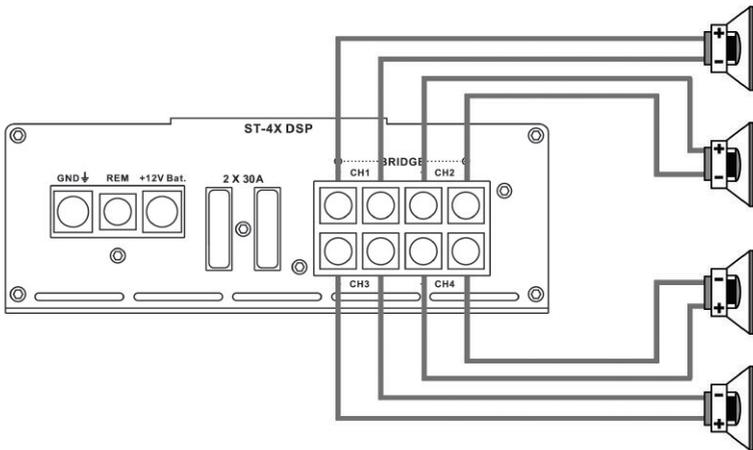
- 1• The ST-6X DSP has RCA inputs for 6-channels
- 2• The processed RCA outputs let you run an active 3-way system and still have an output for a sub amp
- 3• The 6X DSP has 6 channels of high-level input
- 4• USB port for PC control connection
- 5• Auto-on Switch to turn the system on by signal sensing
- 6• The Toslink connector provides an SPDIF digital input
- 7• Comm Port for expansion
- 8• Analog input level (gain) controls with 2-stage Clipping indicators

Speaker Wiring of the ST-X DSP Amplifiers

The Very Basics

- No speaker wires can be shorted to, or touching either ground or each other. This will put the amp into protect and may damage the amplifier
- When bridging the left and right channels of any ST-X DSP amplifier, you use the left channel (Ch1) positive and the right channel (Ch2) negative, as indicated on the chassis by the speaker terminals

NOTE: If you bridge channels be sure to make all adjustments identical between bridged channels



The ST-X DSP GUI Program

Before beginning the setup be sure all signal sources are turned fully down so there is no volume until after the crossovers are set.

The control program (GUI) for the ST-X DSP amplifiers is the same functionally for both the 4-Ch ST-4X DSP and the 6-Ch ST-6X DSP except for the number of channels. Both will have a default system in the channel designation column but since you have complete control over all functions, you can use all channels as they best suit your individual system.



Loading the GUI

Download the GUI (Graphic User Interface) from www.zapco.com > Downloads, if you have not already done that, and load the GUI from the .exe file. Connecting the PC: Connect the PC to the ST-X DSP amp using the supplied USB cable. NOTE: The ST-X DSP GUI is very forgiving about PC Screen resolution. However the ideal resolution 1600 x 900 optimal on most PC's.

Working with the GUI

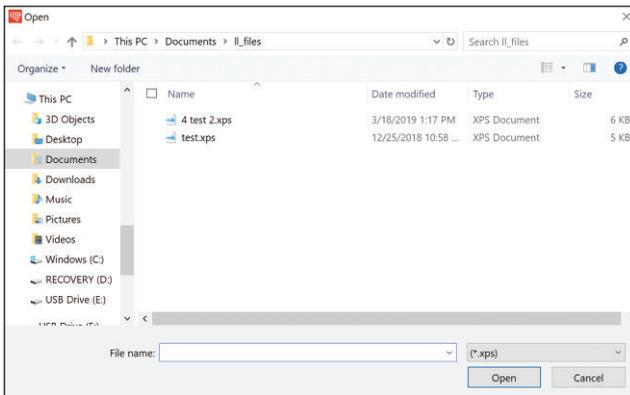
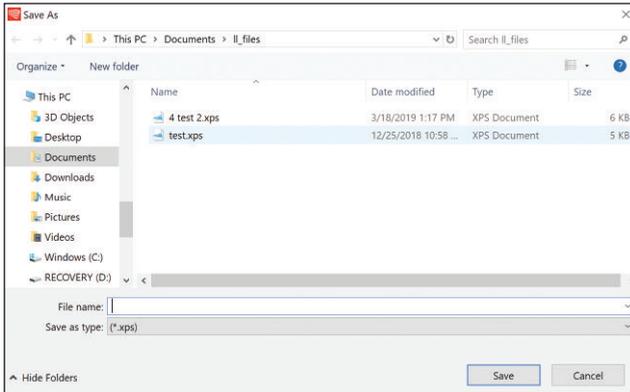
Navigation bar: At the very top of the Screen you will find the Navigation bar. At the left is the connection indicator. When you open the program while you are connected to the DSP it will automatically link so you can use the GUI. If connection is lost it will show Not Linked so you can check the connections.

Next is **Channel Setup**, which is where you will tell the program what inputs and outputs you are using.



To begin you need to define your system. Fixed 2-Ch inputs (Toslink and Digital BT) will apply left channel information to all odd number output channels and right channel information to all even numbered output channels. The analog input is for Aftermarket head units and OEM (factory) head unit adaptations. These can be 2-Ch, 4-Ch, or 6-Ch RCA inputs. There are also 4-Ch of speaker level inputs for OEM Integration. The SUM button will combine highs and lows from a 2-way factory system to make a single full range signal for processing. The Custom/Sum lets you determine your configuration. After you have chosen your input you can move on using the GUI.

Save, lets you save to a file on the PC or to a preset in the Processor. After you spend valuable time setting up and tuning the system, you won't want to lose the setup, so you always want save your setup to one of the available presets. And for a backup and to keep extra presets you should save all your setup and tunes to a file on your PC.



When you Save to File you will be taken to a folder on the PC so you can choose a name for the tune and click Save.

Load, of course, works just the opposite. Click load from file and you will go to the same folder, pick the desired preset, and click Open.

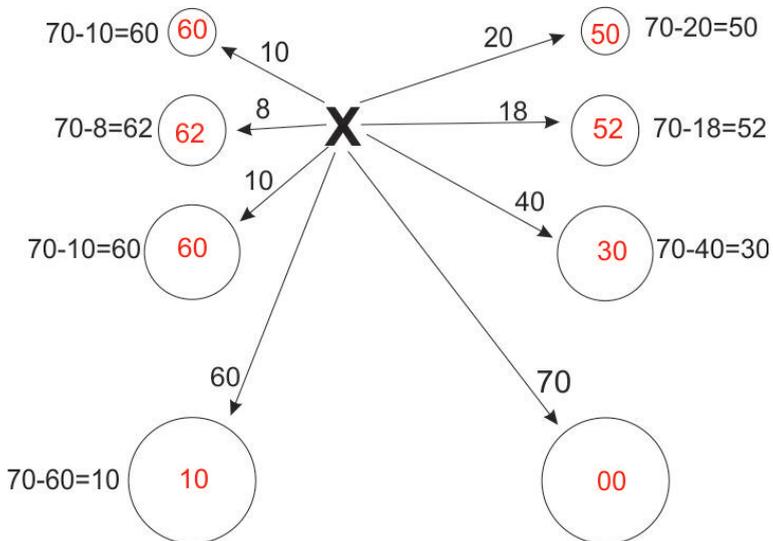
At the right side of the Navigation bar is the setting button. This will only be used if there is a firmware upgrade at some future point in time.

The Main GUI Screen

The main screen has upper and lower sections. The upper section is where all the original system setup will take place, while the lower section contains the equalization controls and the frequency graph.

Delay: At the left of the main GUI Screen is the Delay section. Since you can not sit directly in the center of the car, the program can delay the arrival time of near speakers so it will sound as though you are right in the middle of the car. Setting delay is quite straightforward. The purpose is to make every speaker the same distance from you, so you are in the middle.

- Measure the distance between each speaker and where your ears will be in the actual listening position.
- Identify the farthest speaker.
- Add distance to each of the other speaker so that ALL speakers have the same distance. You do this by subtracting each of the shorter speaker distances from the longest (see example below).



In this example, the longer speaker distance is 70" so we subtract each of the other speakers from 70 and enter the results in the Delay chart. After you have entered the distances in **cm** or **inch** you can click **ms** to see the delay in milliseconds.



The next section holds the **Channel Selection** and **Crossover**.

DSP CHANNEL	LINK	HIGH PASS			LOW PASS		
		FREQ	TYPE	SLOPE	FREQ	TYPE	SLOPE
CH-1 FL TW	<input type="radio"/>	4000	LINK-R ▾	24dB/oct ▾	20000	LINK-R ▾	24dB/oct ▾
CH-2 FR TW	<input type="radio"/>	4000	LINK-R ▾	24dB/oct ▾	20000	LINK-R ▾	24dB/oct ▾
CH-3 FL WF	<input type="radio"/>	80	LINK-R ▾	24dB/oct ▾	4000	LINK-R ▾	24dB/oct ▾
CH-4 FR WF	<input type="radio"/>	80	LINK-R ▾	24dB/oct ▾	4000	LINK-R ▾	24dB/oct ▾
CH-5 RL	<input type="radio"/>	80	LINK-R ▾	24dB/oct ▾	20000	LINK-R ▾	24dB/oct ▾
CH-6 RR	<input type="radio"/>	80	LINK-R ▾	24dB/oct ▾	20000	LINK-R ▾	24dB/oct ▾
CH-7 L-OUT	<input type="radio"/>	20	LINK-R ▾	24dB/oct ▾	80	LINK-R ▾	24dB/oct ▾
CH-8 R-OUT	<input type="radio"/>	20	LINK-R ▾	24dB/oct ▾	80	LINK-R ▾	24dB/oct ▾

You can select a channel to tune by clicking on the desired speaker in the car diagram/Delay section or by clicking on its box in the DSP Channel column. You can pick channels on at a time or you can pick them by pair. Double clicking the dot between a pair of channels links that pair. Similarly, if one channel is already chosen and active, then clicking on the dot will pair them.

This is important as you should always set crossovers by channel pair so the left and right speakers will be the same. It is also easiest to do initial equalization by channel pair.

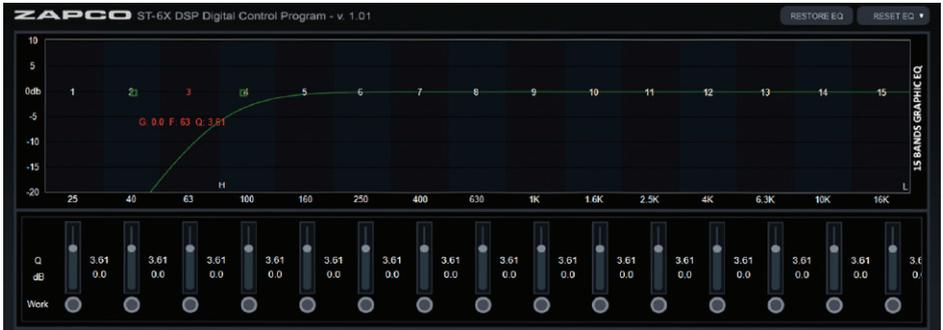
Each channel has a High Pass (HP) and a Low Pass (LP) filter. You can control the frequencies of the filters by highlighting the FREQ box and typing in a value or by using the keyboard up/down arrows. You can choose the Shape of the crossover from Butterworth, Linkwitz-Riley, or Bessel and the Slope using the drop-down menus. The default crossovers are all 24dB/Octave Linkwitz-Riley. The best source for information on the proper crossovers for your own speakers is the speaker maker. He can tell you what crossover to use and also how much power the speakers can handle at different slopes and frequencies.

Phase/Level: The next section is for adjusting levels and checking Polarity to be sure all speakers are in phase with each other.



There are a number of systems for checking System Phase. If the systems speakers are not all in phase there will be issues you can not fix by tuning. You can see the section on System Phasing to see one method of Phase checking. The MUTE buttons allow you to turn off any speakers that you do not want to hear while you are tuning other speakers. You will also find a master level control here and a system MUTE button.

Equalizer: The lower section of the GUI is devoted to equalization.

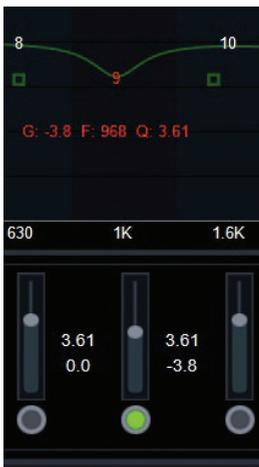


Here are 15 bands of parametric equalization for each output channel and you can vary Frequency, Gain, and Q (the shape of the adjustment) for each band in several ways.

Frequency: Each band is numbered. You can simply click onto a band button and drag it to where you want it. When you click onto a band there is a “Heads-up display” of the frequency, gain, and Q of the band. Any band that has been adjusted from 0dB is highlighted by the green dot under the band’s slider.

Band # shows in Red, as do the Gain, Freq, and Q. The green squares show the width (Q) of the filter.

You can click into the Gain or Q value box of any band and adjust using the up/down arrow keys.

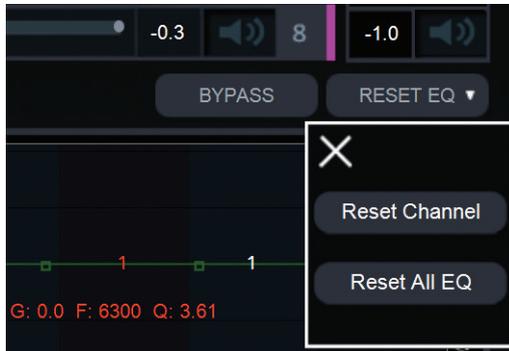


Gain: Gain can be adjusted by using the up/down arrows when the band's EQ dot is highlighted. You can also click into the gain or Q rows of any band and adjust with the up/down arrows. You can move from one band to the next with the right/Left keyboard arrows.

Q Setting: Q can be set as above using the keyboard arrows. You can also make rough adjustments by dragging one of the green boxes in the EQ graph to make Q wider or narrower to affect a smaller or larger group of frequencies with your EQ adjustment.



To aid the tuning process you can temporarily bypass a channels equalization. You can also the reset function to reset one channel or to reset all channel to default positions with no equalization.



System Phasing: Before you start the equalization you want to be sure the system is phased properly. Below we offer one system to help you phase the system.

You were promised more on polarity. Before equalization you should assure that all speakers are in phase as a system at the listening position. All speakers need to have the same polarity so they move the same direction at the same time. If they are not, you will not be able to get a proper tune. There are a number of methods for doing this. We offer one.

Tweeters: (A) Mute all speakers except the tweeters and play a high female vocal soloist. You should hear the voice at a single point near upper middle of the windshield. If the speakers are out of phase the voice will not be localized but will seem to come from everywhere. To test, using the Phase buttons, change the phase of the right speaker and listen for the difference. Do this a couple of times as needed. The position that puts the voice in a small single location on the window is the correct phase. (B) Note where the Tweeter center is located. It should be just slightly above and to the left of the center of the windshield (for left hand drive cars). If it is off to the opposite side of center or too far to the left, and if you have measured correctly, then you have a gain difference and you can correct by a slight level adjustment reduce the right tweeter to bring it left or reduce the left channel to take it right. No more that 1dB or 2dB. Now the tweeters are set. From here on out you cannot change the levels or phase of either tweeter.

Mids, Mid-bass (woofers), and subs: Now mute the tweeters and un-mute the midranges. The process is the same for each pair of speakers. The sound should come from a single focused point near the center of the windshield. For midranges and larger drivers, you want to use a deeper male vocal. The larger drivers are much easier to tell the differences between in-phase and out of phase. Also, with the larger speakers you will hear a dramatic reduction of bass if the speakers are out of phase. So, for midrange and larger speakers you will look for a focused sound source in the windshield with stronger bass.

NOTE: Once each channel pair is adjusted, they cannot be separated. Any change of phase must be done by the pair.

Phasing the pairs: Again, listening to a single vocalist. Mute all channels again except the tweeters. Then bring in the midranges. If these pairs are in proper phase the sound should be near center in the upper part of the windshield. If they are not in phase the sound will be pulled down lower. You can reverse the phase of BOTH mids now and listen for the difference in the sound location. Choose the phase position that puts the sound high near the center.

Once you have these phased you can bring in the mid-bass with the same process. Again, the focus should be high in the dash. If the mid-bass is out of phase with the tweeters and mids then they will pull the sound down toward the floor.

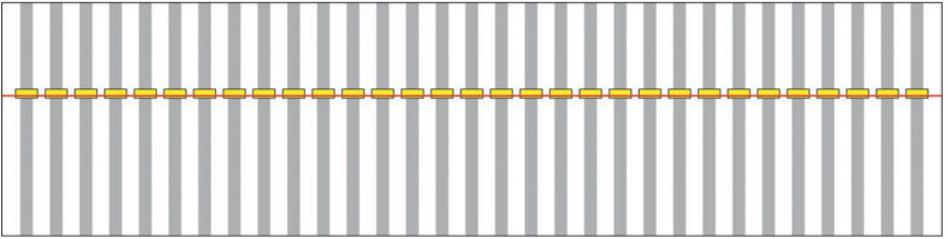
Woofers or Subs: There will be bass! You have phased the woofers, so we know there will be bass. What you need to listen for here is location, and mid-bass (something with kick drums is ideal). Proper woofer phasing will work with the mid-bass drivers to give good solid, crisp mid-bass. Out of phase will result in a soft, low-impact mid-bass. Bass out of phase with the mid-bass will also be more located in the back of the vehicle while a properly phased bass will blend better into the front soundstage.

Tuning - The Simple Rules

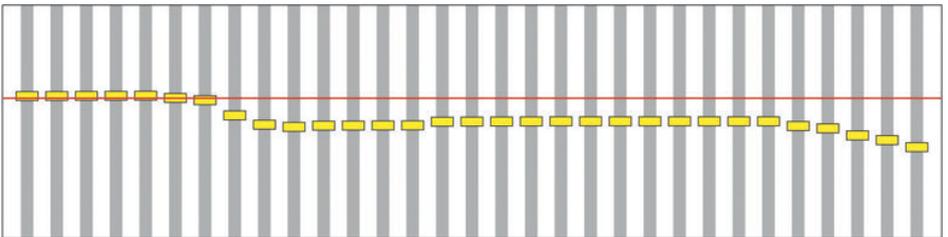
Before you can get what you want, you need to know what you want. In the graphs below, we look at some different response curves and what they mean and sound like.

Keep in mind that these illustrations are NOT what your EQ graph looks like. They are what your RTA looks like. If you have a flat response like below on your RTA, your EQ graph will have lots high spots and low spots to make the RTA graph look like that.

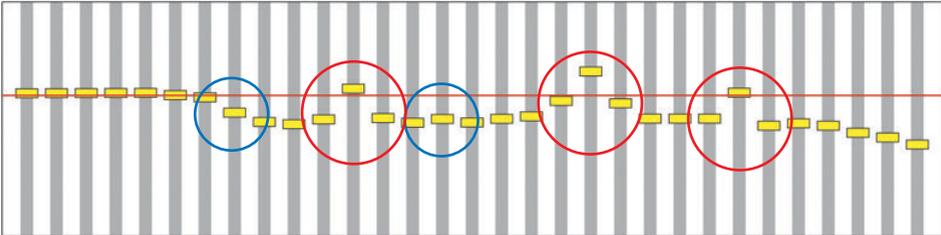
Flat is not the goal: Generally, a flat response will give a sound lacking in bass and will sound harsh on the high end and a little "thin" without a lot of body.



An Excellent response curve: Here is a curve that will almost always sound superb in a vehicle. The bass area is 3 to 4dB above the midrange and the highs slope off smoothly. This will have good solid bass and a smooth sound through the midrange and highs.



Problem Curve: Here is a problem curve. The small variations in blue are OK. They are 2dB or less and you likely will never hear them. However, the variations in the red circles are bad. While the ear is not so sensitive to dips in the response, it is very sensitive to peaks. The response peaks are what makes a speaker sound "harsh" and cause "ear fatigue" (You listen for a while then turn it off because it starts to irritate your ears). With this curve you want to pull down those peaks to put them in line with the rest of the signal response. Once that is done the system should sound just about right.



Technical Specifications

	ST-4X DSP	ST-6X DSP
Power @ 4Ω:	4 x 65 watts	6 x 100 watts
THD @ Rated Power:	< 0.5%	< 0.5%
Power @ 2Ω:	4 x 90 watts	6 x 130 watts
Power Bridged @ 4Ω:	2 x 180 watts	3 x 250 watts
Signal to Noise Ratio:	> 90dB	> 90dB
THD + Noise:	< 0.2%	< 0.2%
Channel Separation:	> 60dB	> 60dB
Input Sens. Low:	1V/4V	1V/4V
Input Sens. High:	4V/8V	4V/8V
Digital Input:	Toslink Optical	Toslink Optical
Freq. Response ±1dB:	15Hz - 30KHz	15Hz - 30KHz
Dimensions (WxHxL):	160 x 57 x 284 mm	160 x 57 x 450 mm
Overall (WxHxL):	160 x 57 x 309 mm	160 x 57 x 475 mm



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