FACTORY DIRECT

Powersoft Armonía Pro Audio Suite

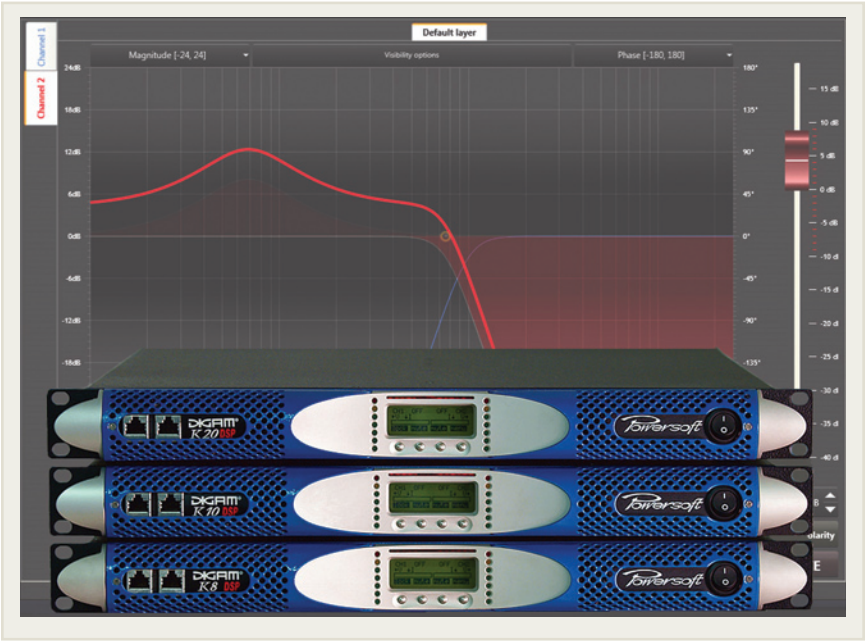
Advanced power amplifier control software.

by Claudio Lastrucci

GONE ARE THE DAYS WHEN a so-called dumb, brute force power amplifier was the simple connection between front-of-house electronics and the loudspeaker system. We're now in the age of the smart amplifier that is both software and audio driven, creating a close marriage between audio control software and the power amplifier.

In short, the power amplifier has now become a technology platform capable of supplanting many other pieces of gear that were stand-alone units like crossovers and room-tuning EQ units. To meet the challenges of this union, Powersoft has created PC-based Armonía Pro Audio Suite advanced control software to manage its K, Q, D, Duecanali and QTU1400 Series amplifiers.

Armonía provides unique capabilities that allow system engineers to efficiently maximize the interaction between the amplifier and loudspeaker, while providing programmable control of key features like damping, EQ, limiting and crossover. The full expression of Armonía is available to Powersoft amplifiers equipped with DSP and AESOP (AES3 and Ethernet Simple Open Protocol) cards. But to develop Armonía, we needed to consider the real-world aspects of designing, implementing and running a sound system for touring or installation.



BACK TO BASS-ICS

Ask any engineer, artist, show producer or audience member about the sound at an event and the bass response is usually at the forefront of comments. Delivering tight, well defined bass frequencies is of paramount importance to the sonic success of an event. We have incorporated our patented Active DampingControl feature into Armonía for precise tuning of system damping for loudspeakers reproducing frequencies under 400 Hz.

The value expressed for damping describes the ability of the amplifier to suppress undesirable movement of a cone near the loudspeaker's resonant frequency. A loudspeaker's diaphragm has mass and the cone rigidity, the combination of which forms a resonant system. A loudspeaker also generates electric current from its electromagnetic voice coil moving within the magnetic field of the natural magnet structure.

When audio frequencies are applied to a loudspeaker, excess motion can be generated at or near the resonant frequency. So, the greater the damping number, the more control.

This complex relationship between amplifier and loudspeaker relative to frequency is not the only problem. The effect of cable resistance on a high power amplifier's performance also becomes significant at low frequencies, as the cable resistance can affect the output stage's damping factor. As each installation requires different cable runs, the damping numbers can vary greatly.

Active DampingControl is a proprietary algorithm which compensates for cable resistance. This means cable parameters may be entered in either Metric or American Imperial units for cable run length and wire gauge. Armonía then sets the cable resistance value and the algorithm calculates and applies the appropriate correction. System engineers can now precisely tune each different setup based on the physical realities of a particular installation, yielding consistent sonic results from a particular amplifier/loudspeaker combination used over various events.

IMPEDANCE, ALIVE & WELL

The LiveImpedance feature for Armonía provides a graphic display of instantaneous load impedance against frequency for each channel. This gives the engineer a constant update on loudspeaker and system performance over

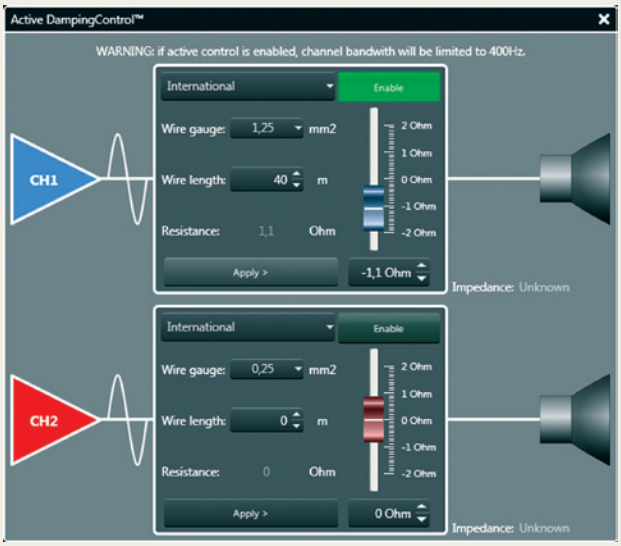
time as a function of power transfer. The instantaneous impedance is calculated from snapshot measurements of output voltage and current.

Real-world amplifier loads like loudspeakers have a complex impedance relationship against frequency and power, which means that the impedance possesses both resistive and reactive components. Because the components are in quadrature with each other, typically separated in phase by 90 degrees, the impedance has both magnitude and phase.

Both quantities are calculated and displayed by LiveImpedance for constant monitoring by an engineer. With the understanding that an amplifier's output stage might be constrained by filter assignments from handling the entire audio frequency spectrum or the audio program may not contain certain frequencies at the instant of snapshot, the display may not be a complete, full spectrum plot at any given moment in time and setup.

We color coded Armonía's displays to show the magnitude of the impedance in ohms and the phase angle of the load in degrees. The default impedance scale is from 0 to 100 ohms and the default phase scale is ±90 degrees.

The magnitude and phase buttons open drop-down lists of alternatives where the impedance scale may be reset to 0 to 25 or 0 to 50 ohms, and the phase scale to ±180 degrees. While the default impedance scale is linear, a logarithmic alternative may be selected to improve the resolution in the particularly important 1 to 10 ohms range.



Active DampingControl for maximizing damping parameters.

LiveImpedance shows instantaneous load impedance against frequency.

Apart from displaying the complex impedance interaction, the LiveImpedance graphs can also display reference data derived from the amplifier's normal (non-DSP) output impedance measurements and imported "ideal" impedance plots from speaker manufacturers. All these different graphic representations make the engineer's task of monitoring high output levels of multiple amplifiers over long periods very simple and further enhance an engineer's understanding of the relationship between the power amplifier and a particular loudspeaker at a live event.

LIMITING FACTOR

A third complicating factor we needed to address with Armonía in the relationship between the power amplifier and loudspeaker is optimizing power transfer to a speaker. To accomplish this, the TruePower limiter feature yields controlled operation for longer driver life by maintaining safe output power levels referenced to frequency and true load impedance. Armonía's power limiter section allows the user to select one of two methods of power calculation: TruePower and Equivalent Power at 8 ohms.

TruePower is the preferred setting to choose when the number of loudspeakers connected to the amplifier channel is a known quantity. It is based on averaging real-time measurements of output voltage and current to define the limiter's intervention point for power limiting in order to stay within a speaker's safe operational range. With this information, Armonía is able to estimate the instantaneous power available at the amplifier terminals. TruePower also features a peak limiting section to cover all the signal bases.

Choosing the equivalent power at 8 ohms setting will result in all power calculations being based on an arbitrary 8-ohm load. The output voltage is still measured and from that information the output current and power can be derived. Working essentially as an RMS voltage limiter, this mode is useful when the number of loudspeakers connected to the amplifier terminal is unknown.

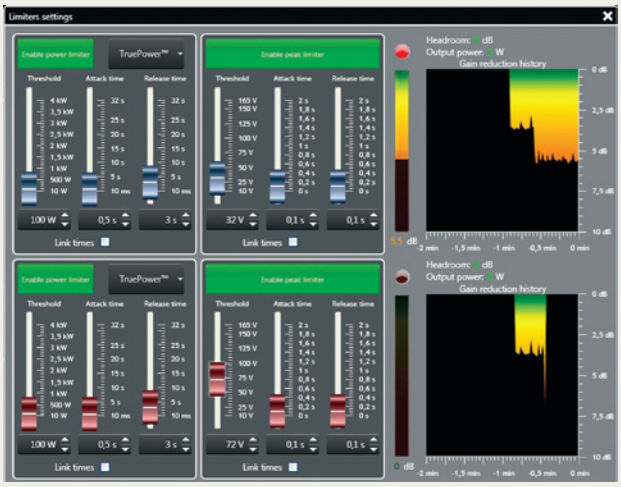
MODELING IN FASHION

Armonía also offers an amplifier modeling feature that can address ampli-

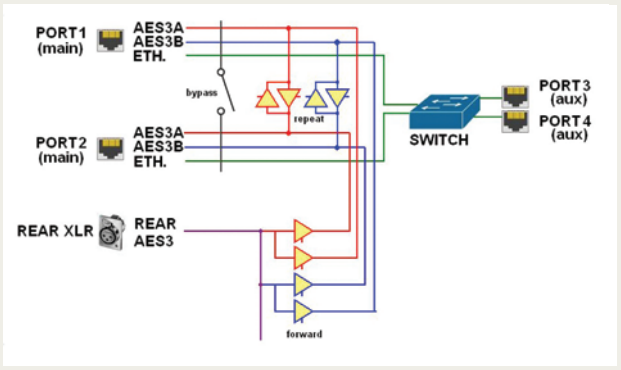
fier DSP and routing online or offline. In offline mode, Armonía lets a systems engineer plan out an intended system of any size at the office (or even on a tour bus or plane) using virtual amplifiers for programming before connecting to a network. This is very useful to the engineer to match amplifiers with appropriate DSP functions like crossover and EQ to loudspeakers before the system is on the truck. This also gives a clear picture of system resources needed for a particular event.

When used in online mode, system information can be sent or retrieved from the synchronized network. From here it is possible to copy an amplifier's presets to the PC running Armonía and vice versa, including the very useful option of copying a set of presets to multiple amplifiers simultaneously.

All parameters designed in offline mode can be sent to the online actual amplifiers and, when used with the optional Powersoft Ethernet KAESOP board, a system engineer can extend the network to a virtually unlimited number of amplifiers through either auto-addressing with self-assigned IP addresses or end-user configurable IP addresses.



TruePower limiting fosters controlled operation for longer loudspeaker driver life.



With an optional Ethernet KAESOP board, a network can be extended to a virtually unlimited number of amplifiers.

MAKING THE CONNECTION

Armonía is an Ethernet-based software package that offers full control of all amplifier parameters while accommodating AES3 audio on the same cable. The software has built-in redundancy and extensive logging and alerting features designed to provide worry free operation for the sound engineer.

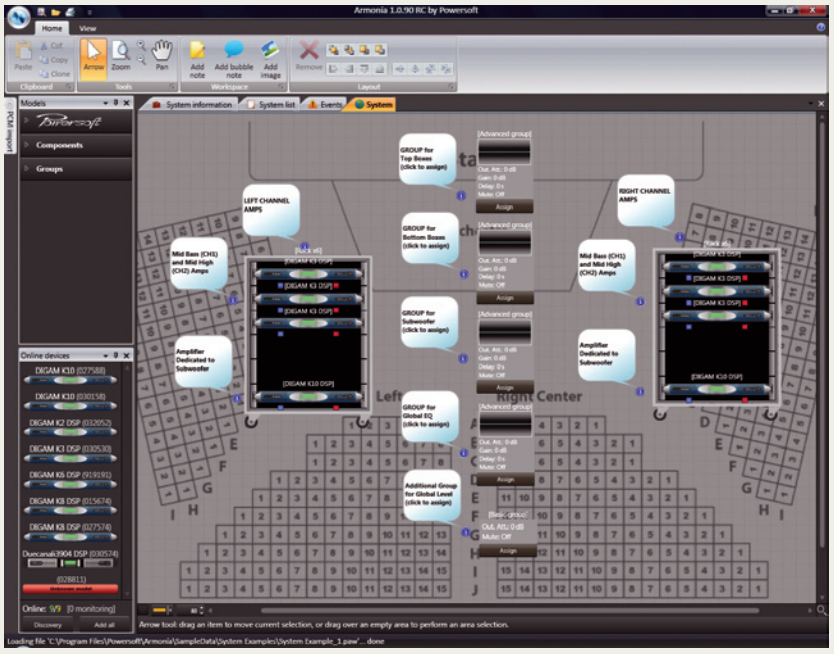
The platform delivers control and monitoring of all amplifier functions including AC mains current draw, headroom, protections and faults. The software also includes advanced grouping options.

Armonía is also compatible with both the latest offerings and many of our legacy products. Powersoft amplifiers can connect to a PC running Armonía in two ways: through an RS-485 serial connection or via Ethernet. Amplifiers of the K and Duecanali Series can be equipped with either or both methods of connectivity while earlier remotely-controllable models have only an RS-485 connection. A system can be configured using both connection pathways simultaneously, extending the functional life of older amplifiers.

The range of network topologies which can be used in wiring a real system varies between the two communications methods. Ethernet provides a slightly greater degree of freedom, as standard IT network switches may be used to create multiple hub-and-spoke systems. A looped Ethernet topology is also permissible, which will provide redundancy in the event of a network failure. An amplifier system using an RS-485 network can either be daisy-chained throughout or use the Powersoft PowerHub as a local switch.

Further, a wireless access point can be made directly to any Ethernet-enabled Powersoft amplifier, allowing wireless control via laptop or tablet PC. Powersoft employs the IEEE 802.11n standard that currently yields faster, more reliable connectivity, extended usable range, plus offers an increase in available channels over earlier versions. This makes 802.11n far more suitable for use in fixed and tour sound applications where multiple amplifiers need to be addressed.

Ethernet networking also assures faster data refreshing and data exchange between each amplifier and the host computer, delivering real time monitoring of amplifier status, remote connection, mains presence, current draw, input signal, output voltage, internal temperature, short-circuit protection, clip and fault. Armonía also offers real time control of amplifier on/off/stand-by levels, solo, mute, sensitivity, max output voltage, max mains current draw, presets locking and input selection (digital/analog/KAESOP).



Armonía's display and graphical interface can be customized according to individual needs.

DSP POWER

The final area of focus in the development of Armonía was in providing the capability to program and implement extensive DSP functions affecting both input and output signals. For those amplifiers equipped with optional DSP cards, a greater range of features and facilities were made available including input and output equalization, alignment delays and FIR filters. We developed the features list through the input of top industry engineers and system designers to address the real needs of delivering and implementing a sound system, keeping in mind that the amplifier itself was taking over the role previously held by external pieces of equipment.

Equalization was implemented to cover all aspects of system equalization. As such, Armonía makes available up to three EQ layers of 32 filters each in the input EQ, as well as 16 EQ filters plus two crossover filters in the output EQ. In addition, DSP control was further enhanced by Armonía's grouping feature which combines input EQ, input delay and input attenuation DSP parameters within a graphic interface that is easy to use.

Preset protection was assured through a multilevel locking feature with invisibility of parameters. The input EQ was designed to be used as either parametric or graphic, depending on the intended mission of the EQ. Armonía's DSP remote control also has the capability of importing frequency response curves as ASCII data from the most popular measuring software for an easy re-design of loudspeaker presets on location.

While the output EQ has a similar general appearance of the input EQ, it has several important differences. The output EQ curve the amplifier employs was intended to be created from a speaker manufacturers' data for the particular loudspeaker cabinets or arrays used in a system. It provides a range of hi-pass and low-pass crossover filters as well as 16 individual peaking filters.

It is also possible to import and export crossover/filter response curves. The available filters for crossover include Butterworth, Bessel, Linkwitz-Riley, FIR and Hybrid FIR filters with the turnover frequency fully adjustable for all types. The filter slope was made selectable in 6dB/oct increments from 6 dB/oct to 48 dB/oct for Butterworth and Bessel types, and in 12 dB/oct increments from 12 dB/oct to 48 dB/oct for Linkwitz-Riley types. FIR and Hybrid FIR filters have slopes which are defined by the turnover frequency, so dedicated slope adjustment parameters are unavailable.

Signal delay capabilities allow the engineer to precisely tune the correct time delay for side fill, under balcony or any speakers that are set up beyond the main front of house system. The delay functions can insert a per-channel fixed delay in the output equalizer as well as in the input equalizer. The primary use of delays added here is to time-align individual drivers in multi-way loudspeaker systems.

Delay values can be specified as time, in 0.01 millisecond (mS) increments up to 32 mS, or as distance in 1 millimeter increments up to 35-plus feet (10.9 meters). The distance units may be changed to feet by selecting Imperial instead of International. The distance/time conversion is based on a sound velocity value of 1,125 feet per second (343 meters per second) in dry air at 68 degrees F (20 degrees C).

The design challenges in creating an amplifier capable of becoming a technology platform controlled by intuitive, feature laden software were legion. The result was the integration of real-world issues experienced with large sound systems, coupled with hard science to yield a comprehensive software package. ■

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