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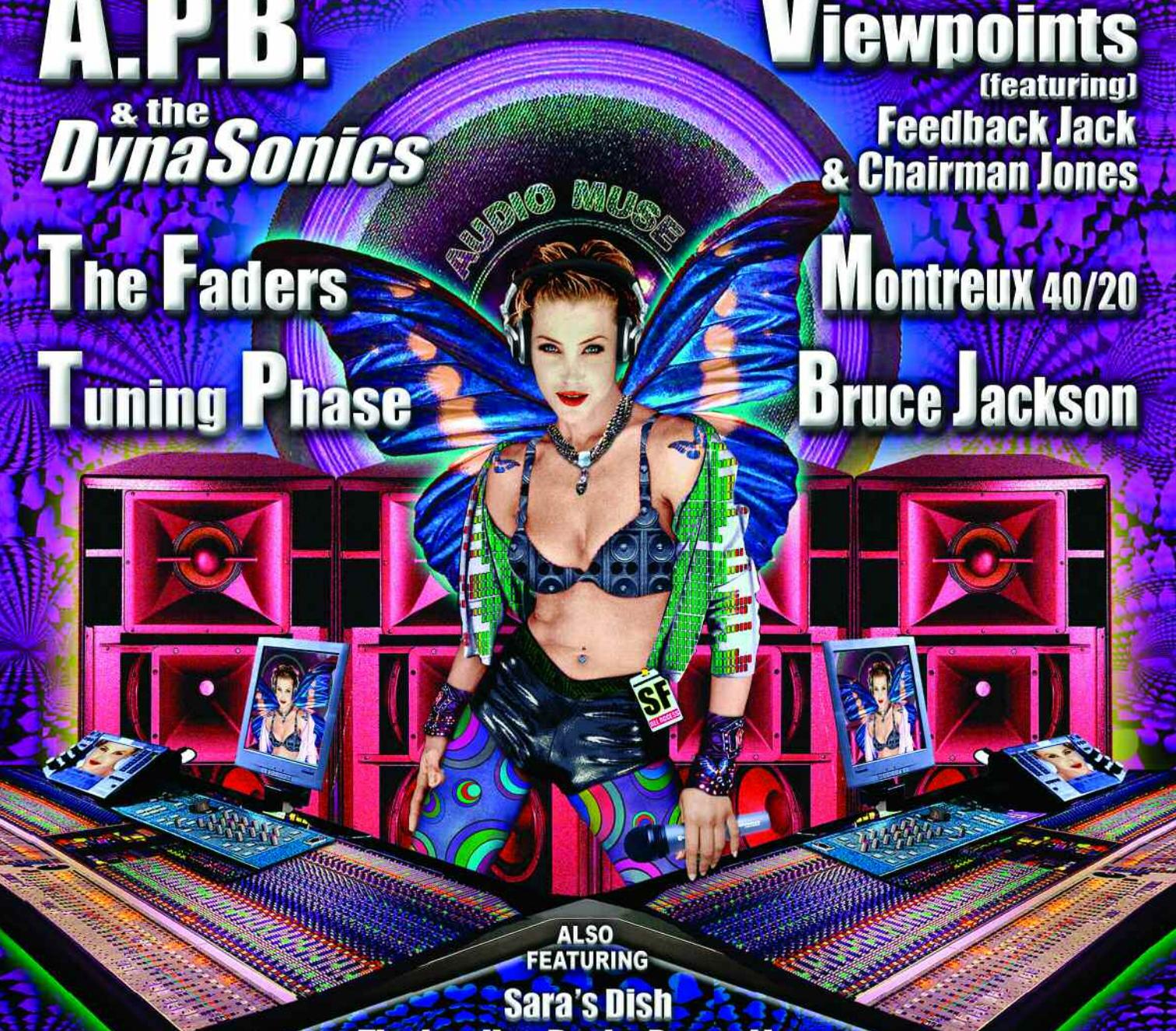
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DESIGNERNOTEBOOK

APB-DynaSonics
Spectra Consoles

Meeting expectations with a high-quality VCA design

*By Chuck Augustowski, John Petrucelli
& Taz Bhogal*

This Designer Notebook was submitted by APB-DynaSonics. Live Sound makes every effort to eliminate any use of marketing inspired hyperbole.

It's accurate to say that APB-DynaSonics Spectra Series analog mixing consoles, introduced late last year, were a long time coming. The three of us are affirmed life-long console 'geeks' with more than 70 years of combined console design experience, and everything we've learned has gone into this console line. Indeed, time is the greatest innovator (and goes by so fast).

But it's a disservice for us to take all of the credit, because the design also belongs to the professional audio market. Before the Spectra-T and Spectra-C consoles became a reality, we talked with – and listened very carefully to – hundreds of veterans of the sound contracting and touring segments of the industry. We then sorted out all of these great (and sometimes conflicting) ideas and implemented as many of them as humanly possible in the product definition.

In form and function, Spectra Series are true professional-caliber audio consoles, the antithesis of an "MI" piece. To us, a professional console must provide superior sound quality and last a very long time, in tandem with a feature set and functionality specifically optimized to the needs of live-sound designers, contractors and mix engineers. This definition also calls for providing customers with the best value for their money, and is verified by our decision to utilize low phase-shift circuit design, Jensen transformers, THAT Corporation VCAs and Burr-Brown microphone preamplifiers in our design.

The true professional feature set includes auxiliary output facilities, left-center-right (LCR) solo and control room monitoring, and VCA control on both outputs and matrixes. Spectra Series consoles are also outfitted with additional alternate outputs, some of which are transformer isolated. Every feature on this console has a defined purpose, most suggested by multiple sound system operators. We even received tremendous help on issues such as labeling, and didn't hesitate to
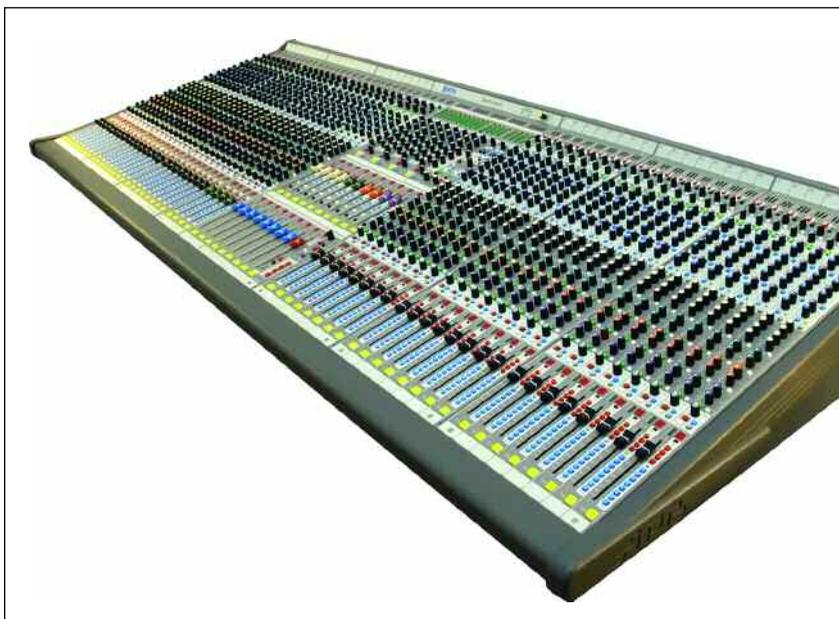
The APB-DynaSonics Spectra console.

incorporate changes even after prototypes were built.

Another key design aspect addressed right from the start was the (non-audio) electrical design. The objective was to fully address issues of general grounding, Pin-1 problems, the type of output drivers to be used and so forth; both optimizing the design and catching any potential problems before starting the manufacturing process (and, of course, not presenting customers with hum and buzz problems to deal with).

We're all members of Syn-Aud-Con (SAC) and pay close attention to the discussions and findings of that group. More specifically, attending the SAC *Hum, Buzz & Grounding* seminar last year provided us with a great opportunity to discuss and review some of our design plans with many of professional audio's top electronic gurus and noted system design consultants. Only after this exhaustive development process did manufacturing commence at our New Jersey facility.

The Spectra-T EQ is sweepable in all four bands and includes shelving/bell switches on both HF and LF bands.

EQ OPTIONS

The Spectra Series, currently comprised of Spectra-C and Spectra-T models, is intended for live sound reinforcement, including installed and portable applications. Both models are available in 24, 32, 40, 48 and 56-

The Aux outputs offer pre/post assignment to matrix section and assignments to left, right, center and mono buses.

input (mono) formats, along with four additional stereo input channels. The only difference between Spectra-C and Spectra-T can be found in the EQ section, although both do include a variable high-pass filter (20 Hz to 400 Hz) with ON switch and LED.

The Spectra-C EQ offers simpler operation, envisioned for applications such as churches where there are typically a lot of volunteer operators. The EQ is four-band with high- and low-frequency shelving, each switchable between two frequencies (LF is 60/120 Hz; HF is 8 kHz/12 kHz), while the two mid bands have a 1-octave bandwidth and are sweepable over a 20:1 range.

However, the Spectra-T EQ is more sophisticated, driven by user requests that it be sweepable in all four bands and include shelving/bell switches on both HF and LF bands. The HF/LF bell mode features an asymmetric response, with 2/3-octave boost and 1/4-octave cut. The two mid-bands are switchable between 1-octave and 1/3-octave bandwidth in both boost and cut while keeping the same 20:1 sweep range of the Spectra-C.

Respected system designer/consultant David W. Robb of JaffeHolden in Connecticut, as well as several members of his audio and video systems group, was very involved in the development and tuning of the Spectra EQ. It was their suggestion to give the HF and LF bell an asymmetric shape.

To assist their efforts, we constructed a special EQ unit that facilitated evaluation and adjustments of various types of EQ. This box offered fixed frequency bands and bandwidth as well as variable controls, so David and his team could easily mix, match and evaluate. Their recommendations drove our selection as to the type of EQ as well as the frequency ranges and bandwidths of each band.

MONITOR OPTIONS

Spectra-T and Spectra-C have been designed to also meet monitor console applications. The monitor (auxiliary) master outputs are always on 100 mm faders, eliminating the need for potentially confusing fader-flip switches. Both models can provide up to four stereo and four mono mixes or 10 mono and one stereo (plus two additional mono mixes from the channels assignment switches and four matrixes). Outputs are XLR balanced with insert points.

To further increase monitor functionality, an application-specific input-priority switch is included as part of the solo system. This allows the operator to automatically toggle between output and input signals for critical monitoring during a performance. Each aux output section includes talkback preset, polarity reverse and pre/post matrix send switches in addition to internally illuminated solo and mute switches.

Designer Notebook

MAKING IT VCA

From the outset, the intention was to develop a VCA-based design, and our extensive research process with the market confirmed this. More specifically, we found that even novice operators have an easier time correctly handling VCA group control if they're not confused with the difference between analog and VCA grouping.

Having only VCA grouping simplifies the understanding of the console and reduces the possibility of gain stage errors during setup. The elimination of conventional analog subgroups helps lower cost by reducing parts count and by reducing the physical amount of space a conventional analog subgroup would have occupied.

Operators experienced with VCAs tend not to use analog subgroups unless additional group signal processing is desired. To accommodate this need, all 10 auxes on the Spectra are equipped with insert points and bus assignment switches. Any aux bus can thus be used as an analog subgroup; the insert-processed aux signal can then be assigned back into the main buses.

Operationally, a VCA allows the control of an audio signal via a DC control voltage. Well, that's an easy

thing to say, but doing it right takes a bit of work. We need to start with the right VCA element itself, one that accurately follows a control law, provides low distortion at all control voltage (CV) settings, and oh, sounds good too.

The supporting VCA circuitry must also be carefully designed so that its response tracks the labeling on the faders. Having the ability to assign a channel to multiple VCA masters complicates the process a bit since there's the potential that the CV can range beyond "reasonable" limits, and the VCA will be called upon to produce 80 dB of channel gain (assign a channel to all eight VCA groups and add 10 dB of boost). We include clamping circuits to prevent that excess, along with bi-color LEDs to give the operator clear indication of the channel's actual CV (and any CV abuse). This CV LED is one of those 'extra' features that we hear mentioned quite a bit in the reviews – it really helps the operator (especially during crunch-time) determine what a channel's VCA should be doing.

THAT Corporation is the only game in town when it comes to producing high-quality VCAs meeting our criteria. There are other providers, but none who produce anything close to what we consider a true professional

caliber VCA. THAT Corp. has been in business a long time and devising integrated circuits (ICs) for demanding pro audio applications is the focus of their business.

Another deciding factor is that the company truly acts as an adjunct R&D resource. When developing the VCA circuits for Spectra, we sent THAT Corp. the schematic design for review, and several times they pointed out aspects that could be better optimized and/or suggested approaches that led to an improved overall design. This not only benefits the specific circuit being addressed, but results in a stronger product, which, after all, is only as good as the weakest point in the chain.

ABSOLUTE BALANCE

Spectra consoles also utilize VCA control on the four primary outputs – left, right, center and mono. Even the matrix outputs can be VCA controlled. Because outputs experience complex waveforms from the many signals being mixed together, it's vital to keep distortion levels even lower. In order to share the load, a pair of VCAs are dedicated to each output, and this approach really makes a difference in retaining signal integrity at even the highest levels.

A big reason for putting VCAs on
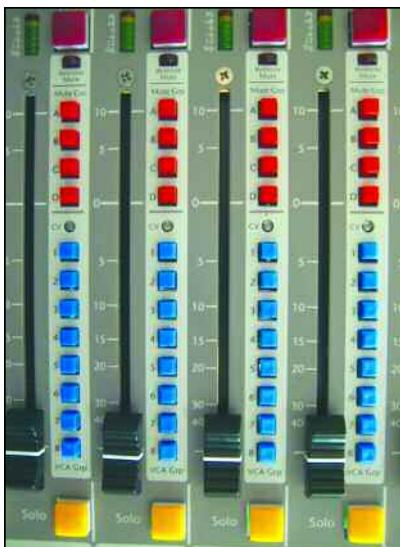
The VCA and mute assign section – VCA grouping can simplify understanding and reduce gain stage errors during setup.

THAT Corporation high-quality VCAs in place in a Spectra console, meeting APB's strict criteria.

Designer Notebook

the main output – using a single fader to control left, center, right and mono signals – can be credited to an approach advanced by system designer Tom Young and several others that calls for separate, discretely fed/controlled subwoofers. In other words, employing discrete sends from an input channel to the subs. (This is also commonly called the 'aux fed sub' approach.)

One of the most critical aspects of this mixing method is maintaining absolute balance between the left, right, center and subwoofer outputs; using a single fader to control all four outputs guarantees that balance. Setting up the relative balance between these different elements is typically done at the system/loudspeaker processor.

However, for those who do prefer having individual controls for left, right, center and subwoofer directly in front of them, the Spectra also offers an alternate output section that can be put in series with any of the primary outputs, providing easy access for trimming levels. If these alternate outputs aren't used for this trimming function, they can be used as additional outputs for video feeds, CD recording or any other purpose (there can never be too many outputs from a console).

The video-feed situation is a good example of our responding to user feedback; we outfitted the mono alternate outputs with isolation transformers to protect those outputs against the phantom voltage that is typically found on video camcorders, even when it's not supposed to be there ('it's switched off, I swear it'). And because this is a true pro audio desk, the transformers are, of course, from Jensen.

PREAMP QUALITY

Our approach for the microphone preamp is probably best categorized as 'why reinvent the wheel if you don't really have to?'

Consideration was briefly given to creating a new design from scratch, but there are already so many proven, quality preamps available, and in reality, there's only so many ways to design this circuitry correctly.
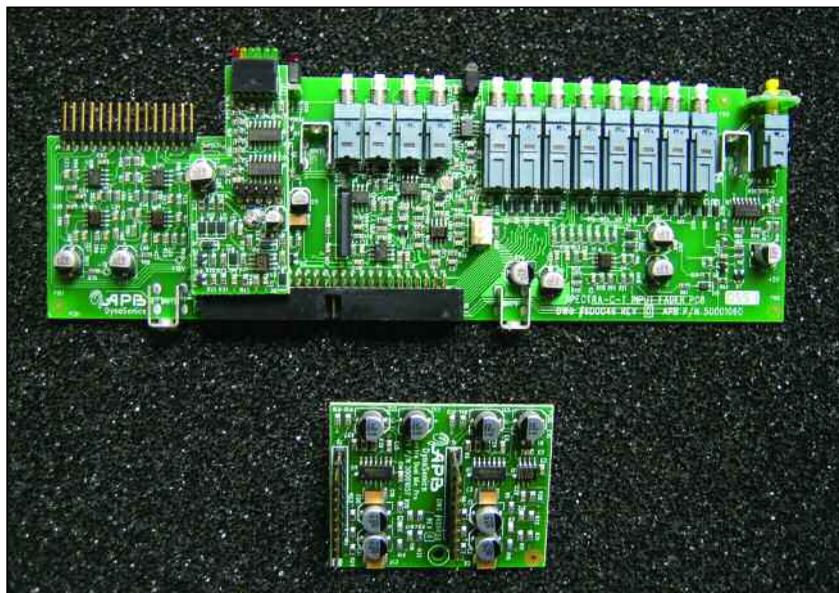
A close look at fader (above) and mic preamp circuit boards, the latter featuring Burr-Brown preamp chips.

We've all seen the claims made about spending hundreds of thousands of dollars to come up with a 'radical new preamp design' when in reality it doesn't perform that much better than what's already out there.

Attention turned to reviewing the most viable existing designs, including transformer-coupled and discrete approaches, all of which have pluses and minuses. Our testing (and product constraints) narrowed the field to an IC from Burr-Brown that really nails key parameters, such as low-noise and distortion, along with a design impedance commensurate with mic inputs and also very much in-line with our specifications.

The Burr-Brown preamp chip sounds quite transparent, and this was confirmed by our evaluation group as well. We designed our circuitry to optimize this IC specifically for the Spectra console, minimizing the capacitive coupling and going to more of a servo-type design to enhance the sound quality.

Furthering this is the Spectra's basic design, which in all cases takes the straightest path possible. Circuits are direct-coupled wherever feasible, eliminating electrolytic capacitors that can compromise overall frequency response, particularly in the bass

region. Electrolytic capacitors also tend to 'dry out' over time, degrading sound quality. On the rare occasions where there was no way around this coupling, additional film capacitors (poly caps) are used for their sonic qualities.

DESIGNED FOR ACCESS

Unique circuit board design and construction methods were also used to insure audio quality and keep costs down while making repair and replacement easy. Each input block consists of eight channels with common metalwork, with a single circuit board spanning the length of the module between the top of the panel and the pan control. This circuit board is nearly all passive, with most of the active electronics on additional plug-in circuit boards.

These circuit boards are very accessible, they can be easily unplugged from the main board and replaced – swapped out on an individual per-channel basis. An input module block has eight individual EQ 'daughter boards', while each of the four mic preamp boards contains the circuitry for two adjacent channels.

If service is needed, the console doesn't need to be flipped upside-down in order to get to the 'guts'.

Designer Notebook
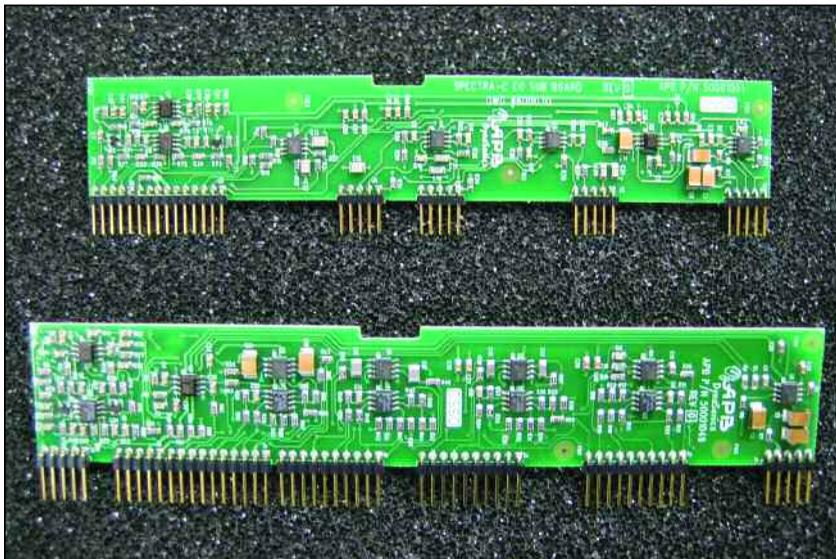
The EQ 'daughter' boards, eight of which are included on each input module.

The EQ boards in place on the main board, and each can be easily swapped out if required.

Instead, removing just six screws frees the individual module metalwork from the frame, and it then lifts up from the top of the chassis. Unplugging the rear XLR or TRS connectors when doing module service is not necessary, which is very handy for tight, fixed installs or for consoles in 'dog-housed' road cases.

Further, individual vertical circuit boards are also used in the fader area. The fader itself is not soldered to the main circuit board, but is provided with a plug-in connector which allows easy field replacement and upgrade-

ability. Not only does this approach simplify troubleshooting and repair, it also increases the overall circuit board area, allowing for greater engineering flexibility in circuit layout.

Speaking of circuit layout, we still do things by hand (well, actually with a computer), but no auto-routers are used for any of the PCB layouts. It takes more time, but this way we know where each trace is going and who its neighbors are – critical factors when trying to attain the best crosstalk and noise performance from a PC board.

For these critical layout tasks, we depend on our mechanical engineer, Olga Gomelskaya, to get things right. Olga's been part of the team for years and is also responsible for the overall mechanical design and appearance aspects of our products. She turns Chuck's initial drawings into 3-D views through the magic of SolidWorks and other modeling programs so we can all form a better idea of what the final product should look like.

Olga's attention to detail results in PCBs and metalwork that fit together properly even when we're assembling our initial prototypes. (She's also our product color coordinator and still can't believe how 'color-blind' we guys tend to be.)

NOW & THE FUTURE

Spectra-C and Spectra-T are the first consoles introduced by APB-DynaSonics, and response from the professional install and live sound markets has been extremely positive. We were confident enough to provide a unit for a very public review and evaluation on the *ProSoundWeb* 'Road Test' forum, and we encourage you to check out what this community of audio professionals had to say in this uncensored discussion. *(Go to www.srforums.prosoundweb.com to access the forum.)*

In the future, additional models within the Spectra Series will be introduced, as well as other consoles and related products that span the needs of professionals. These will range from extremely basic analog units to more complicated (of course) digital products.

Regardless of the product, the feature set and user interface will always be based on feedback from professionals. We look forward to serving the needs of the live performance community and being a useful and active part of the industry that we all love. ∎

Based in Totowa, New Jersey, Chuck Augustowski, John Petrucelli and Taz Bhogal are the founding members of APB-DynaSonics (the first letters of their last names form the 'APB'). Reach Chuck at chucka@apb-dynasonics.com.

The Next Generation
of Analog Consoles...
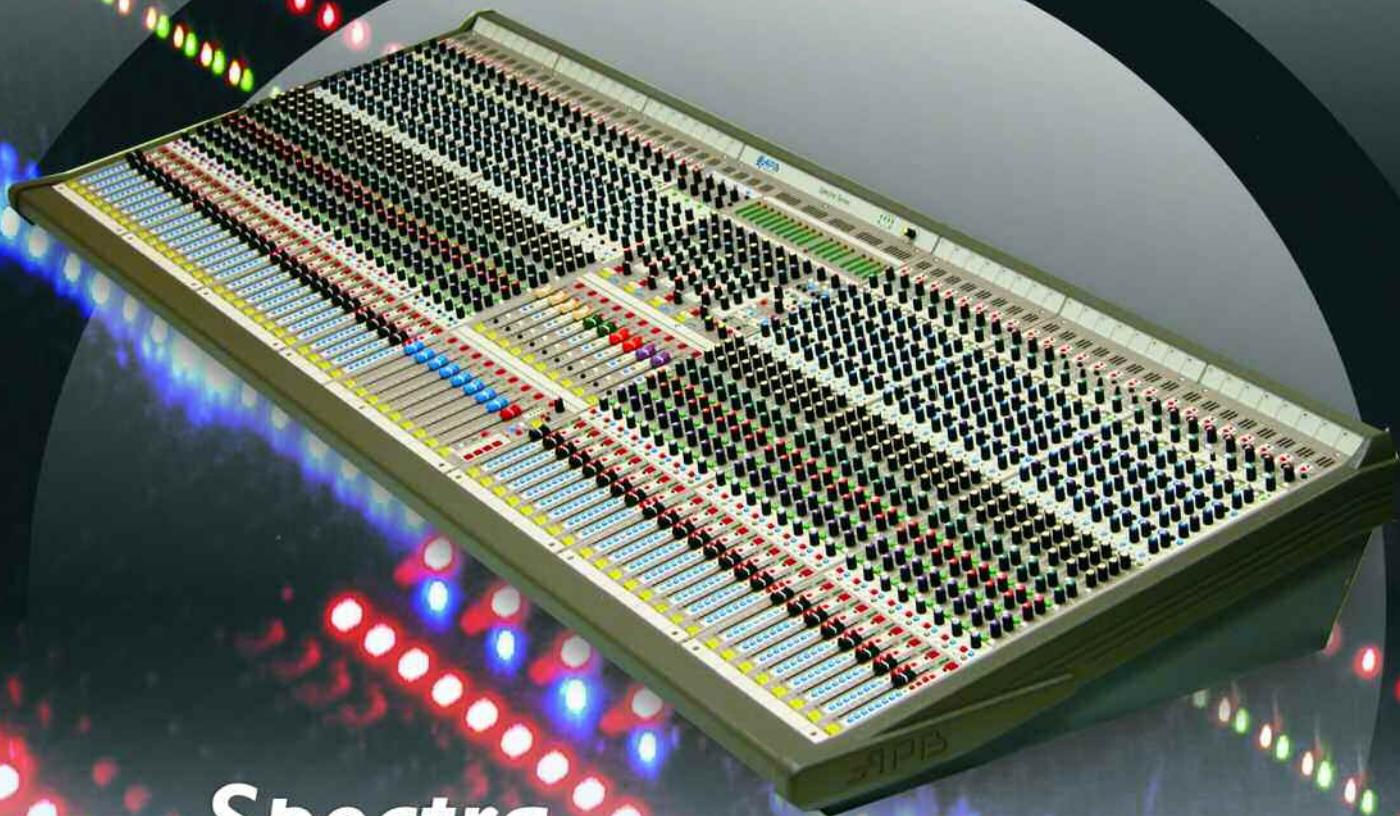
Spectra
C and T Series Consoles

APB-DynaSonics introduces the next generation of live performance analog consoles. Designed and manufactured in Totowa, New Jersey (USA), Spectra Series meets the demanding needs of both the Sound Contracting and Touring communities.

With an emphasis on audio quality, reliability, and affordable price, Spectra is loaded with desirable features such as VCA control of both inputs and outputs, mono/stereo/3 speaker LCR monitoring and inserts on all primary outputs including aux and matrix. A master VCA output fader can simultaneously control the levels of left/right, center, mono (sub-woofer), and any of the four (4) matrix outputs. Two versions of Spectra are initially available differing only in the complexity of their EQ section; the basic Spectra-C and the advanced Spectra-T (shown). Available in 24, 32, 40, 48 and 56 mono configurations, all formats include four additional line input channels which may be configured for stereo, dual mono, or split track operation.

With over 63 years of combined console design experience, the engineers of APB-DynaSonics have taken a fresh approach to live performance console design. Check it out for yourself and you will instantly see the APB-DynaSonics advantage.

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