INOMINI 223 KEEPS IT SIMPLE — Page 24

RADIOWORLD

NOVEMBER 9, 2016 | The News Source for Radio Managers and Engineers | $5.00 | RADIOWORLD.COM

NewBay Media

PRX Puts Podcasting in Its Catapult

CPB provides $1 million to fund unique podcasting development program

PODCASTING

BY JAMES CARELESS

BOSTON — In a bid to harness the audience-building potential of podcasts for U.S. public media radio and TV stations, the Corporation for Public Broadcasting is spending $1 million to fund Project Catapult.

Under the supervision of Public Radio Exchange (PRX), five public broadcasting stations will be selected from a pool of applicants to attend a Project Catapult podcast development "boot camp." It will be held in 2017 over 20 weeks at the PRX Podcast Garage audio production center in Boston, aided by homework at each station's own facilities.

"Our goal is to get each station's attendees to learn how to produce new and unique podcasts to build their respective station's audience base, including learning how to develop digital content for this niche, attract and train diverse talent, engage audiences and find ways to monetize these new productions," said PRX CEO Kerri Hoffman.

"Our PRX instructors will help attendees learn the technical ropes of podcasting — which isn't just radio streamed online."

At the end of Project Catapult's boot camp process in May, each participating station will have produced a podcast series with at least 20 episodes. These podcasts will be presented online by these stations in partnership with PRX within the next 12 months.

WHY PROJECT CATAPULT?

At first blush, broadcasters might be confused by the need for training their colleagues in podcast production. After

(continued on page 10)

Symposium Probes Tech Problems and Cures

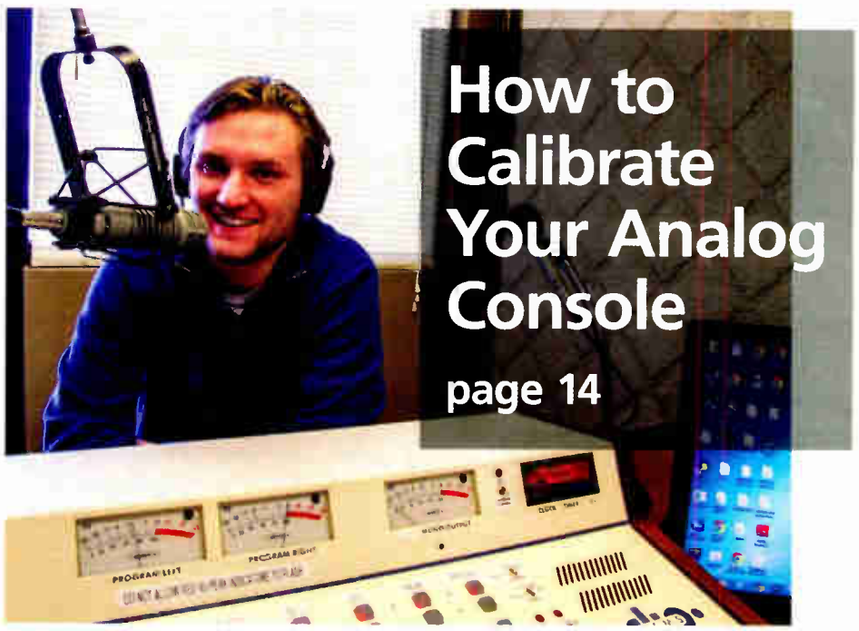
RF noise, SFNs, IBOC time alignment and new FM directions discussed at IEEE BTS

BY JAMES E. O'NEAL

HARTFORD, CONN. — Broadcast plant issues, the growing impact of manmade RF noise on broadcast operations, audio measurements, digital-only AM radio and resolution of problems peculiar to HD Radio were in the forefront of this year's IEEE Broadcast Technology Society Fall Symposium.

It's an annual gathering of radio and TV engineering personnel that began in the early 1950s in the nation's capital. Attendance at the October event topped 200 — a record for recent years — and included students and their professors from Connecticut's

(continued on page 8)



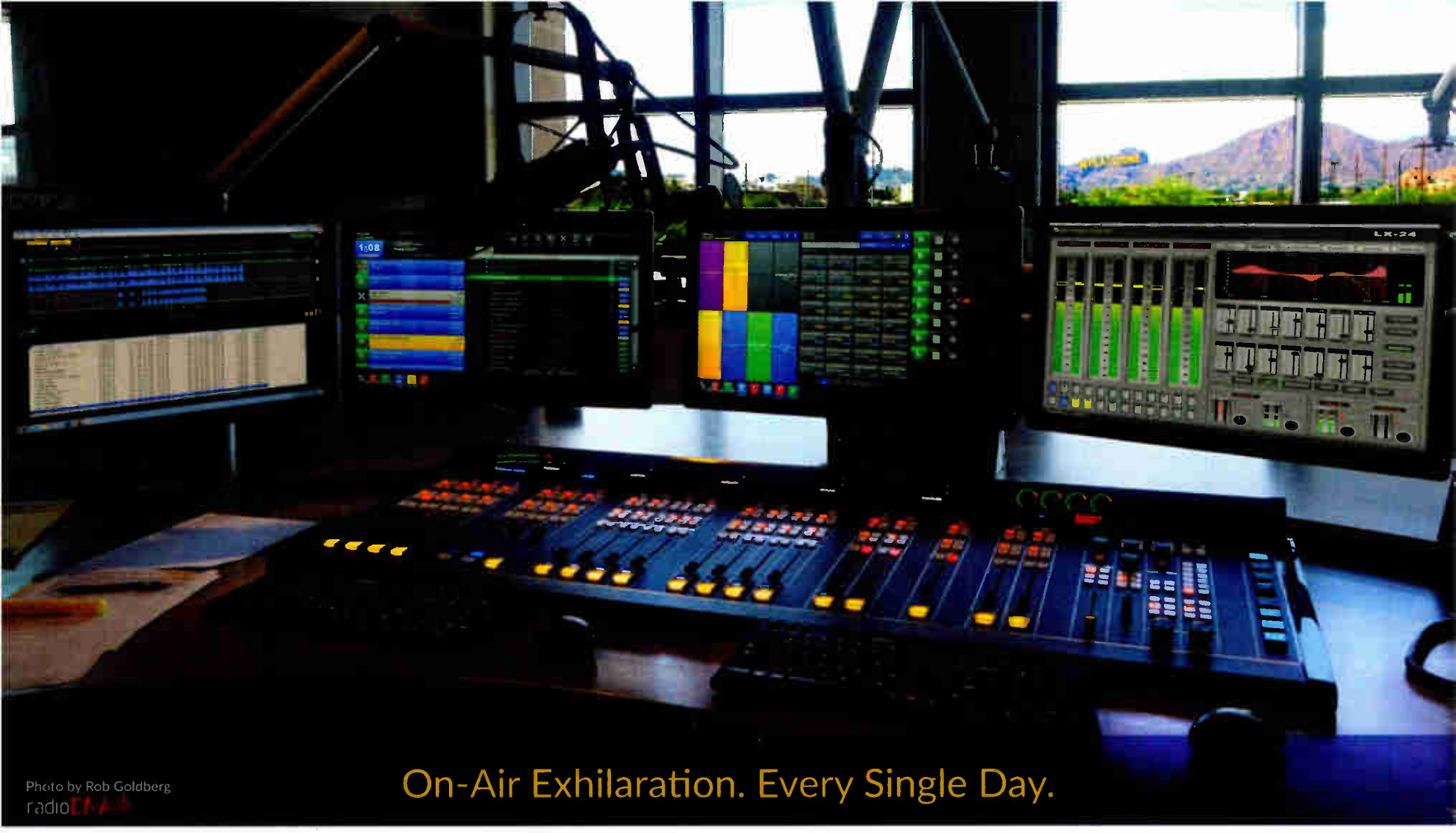


Photo by Rob Goldberg
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PantronX Seeks "Complete SDR Solution"

Its Titus II radio is an Android tablet computer with wideband digital RF receiver

RADIODESIGN

BY JAMES CARELESS

OTTAWA, ONTARIO — Take an Android tablet computer, a wideband RF tuner that covers from 100 kHz to 2 GHz, and two audio speakers. Integrate them in a rugged ABS plastic carrying case. What do you have?

Well, if you are the engineering firm PantronX, you have the Titus II software-defined radio. And when you plan to sell this ultimate receiver for less than $100 each, you hope you have a consumer sensation for the worldwide broadcast market.

Unveiled by the Panama-based company at an international broadcasting meeting in Miami in August, the Titus II SDR is not yet shipping. But it is described as capable of receiving and playing analog and digital radio transmission formats including AM, FM, shortwave, HD Radio, DAB+ and Digital Radio Mondiale. The company is considering adding a DRM+ decoder.

The initial market is among worldwide broadcasters, particularly those serving countries where listeners may lack internet; a secondary market is individual listeners, hobbyists and others.

PantronX will not supply all decoders for all formats but add them preloaded as needed.

Looking much like a 1990s' boombox except that the central section is entirely occupied by a touchscreen Android tablet, the Titus II's software-controlled capabilities, ability to receive new transmission formats through software upgrades and proposed price tag of about 90 euros wowed HFCC delegates.

Courtesy PantronX

The front of the Titus II SDR resembles a 1990s-style boombox.

"We have been following this receiver development with great interest based on the fact that it is hand portable, less than $100 initial cost and utilizes an Android tablet platform, has wide potential reception frequency range of 100 kHz to 2 GHz, and is Bluetooth-capable," said Tom King, president/CEO of manufacturer Kintronic Labs and an interested observer of the international radio marketplace.

"Best yet, the Titus II can be easily updated and improved with time by virtue of software upgrades," he said. That's something that cannot be done with a hardware-based consumer radio receiver.

The product was shown at the HFCC/ASBU B16 Coordination Conference, and the HFCC website is promoting the receiver. It said the product was developed in consultation with international religious broadcaster TWR and that the first regular-production batch is expected by the first quarter of 2017.

The HFCC is an association rooted in frequency coordination for international shortwave broadcasting — its acronym comes from High-Frequency Coordination Conference — but it has broadened its mission into other platforms and seeks a role in shaping the future of international broadcasting delivery.

HARDWARE-DEFINED, SOFTWARE-DEFINED

Up until now, the vast majority of consumer radios have been hardware-based. The physical components that make up their assemblies define what they can and cannot do. This is equally true for unpowered crystal radio receivers, tube-based superheterodyne radios and modern computer-based digital

(continued on page 6)

More Radio, More Voices

Make Radio World part of your day every day. Visit our website for great web-only Radio World content, including the following recent posts and stories:

"Stu Buck on Arctic Palm's Move to DTS" — The software development company is in the spotlight because of its acquisition by DTS Inc. Radio World asked founder Stu Buck how he got to this point, and what's next. See *radioworld.com/buck*

"Impact of a Class C4 Allocation on FM Translators"— Matthew Wesolowski follows up his recent commentary in Radio World with data that he says show that few translators would be subject to potential displacement. See *radioworld.com/c4*

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"Next-Gen STL" — The STL universe has changed dramatically in recent years. In this free e-book we explore some of the choices and help you figure out what your STL future looks like. Visit *radioworld.com/ebooks*

"Collecting Things" — Each month, blogger Dan Slentz goes "Off the Beaten Path" to present hidden treasures from the web. See a fun video about how 1930s radio created sound effects, take a look inside Shure microphones, read about 25 museums to visit before you die and enjoy a chuckle over "Star Trek — The Lost Episode." See *http://tinyurl.com/rw-otbp*

About the Sony/Warner Waiver Agreements

NAB announced deals with two record labels affecting non-royalty aspects of webcasting

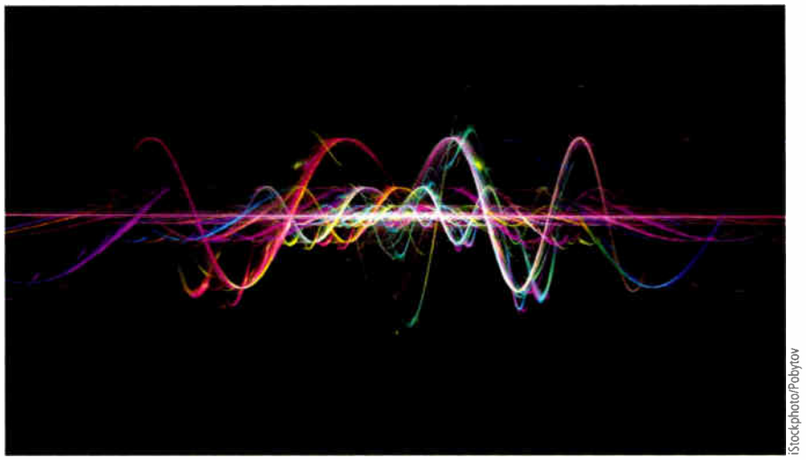
BY KEVIN GOLDBERG

On Oct. 26, 2016, the National Association of Broadcasters announced agreements it had reached with two major record labels that relieve radio broadcasters from certain compliance conditions associated with the sound recording streaming statutory license that are inconsistent with traditional broadcasting practices. They do not, however, alter radio broadcasters' royalty payment obligations under the license.

In a press release circulated to radio stations around the country with the subject line "Urgent — Opt into Streaming Music Waiver," NAB announced that:

"The National Association of Broadcasters has successfully reached agreements with Sony Music Entertainment and the Warner Music Group on streaming waivers. These agreements will allow radio broadcasters to continue bringing Sony and Warner artists to millions of listeners online without risking copyright liability."

These waivers are *not* what some radio stations think (or hope) they are. They do *not* affect the obligation of a station that is engaged in webcasting to pay royalties and make certain filings to SoundExchange under the statutory license granting the right to perform sound recordings digitally. They *are*, however, a good thing because they will make it easier for radio broadcasters to comply with some of the lesser known, but also important, eligibility conditions found in that statutory license.



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Most webcasters are naturally focused on their interactions with SoundExchange, which administers the royalties paid under the statutory licenses found in Sections 112 and 114 of the Copyright Act. SoundExchange collects those royalties from webcasters (and other digital service providers like SiriusXM, music services provided through cable and satellite systems and certain business establishments) and distributes payments to the owners of digitally performed sound recordings (primarily recording artists and record labels).

What many do not realize, however, is that eligibility for the statutory license requires more than just paying those royalties and filing the corresponding paperwork; if you don't comply with certain other conditions, you run the risk of being prevented from enjoying the statutory license. And, yes, though I know many of you dislike the royalty rates and filing obligations, I intentionally chose the word "enjoy"; after all, consider the alternative: having to get the permission from each and every recording artist or record label before streaming their songs.

The Warner and Sony waivers deal with some of these other aspects of the statutory license. NAB has done a fantastic job of listing the majority of the "Important Statutory Requirements" on its website in case you need a refresher (or are just learning about them for the first time). Please review them [see the PDF at *http://tinyurl.com/rw-sonywaiver*].

For several years, radio stations engaged in webcasting enjoyed an NAB-negotiated waiver of four of these requirements. These included limited waivers of:

- The "sound recording performance complement," *i.e.*, a limitation on what a webcaster may play during any 3-hour period; absent a waiver, the maximum limits are:
  - three different selections of sound recordings from a particular album or CD;
  - two different selections of sound recordings consecutively from the same album or CD;
  - four different selections of sound recordings by same artist;
  - four different selections of sound recordings from the same boxed set of albums; and
  - three different selections of sound recordings consecutively from the same boxed set of albums.
- The prohibition against prior announcement that a particular artist will be played in a specified time period;
- The requirement that stations have in text, on their website, at the time the song is performed, the: song name; album title; artist name;
- The 6-month limitation on maintaining ephemeral copies of recordings (such as songs from a CD copied onto a station's hard drive music system to facilitate streaming).

These waivers expired at the end of 2015. A temporary extension of the Warner waiver was obtained through Sept. 30, 2016; there were also a series of short-term extensions of the Sony waiver.

Now, both waivers have been extended for the next few years, with some modifications to both eligibility for the waivers and the scope of the waivers themselves.

Under the Warner Waiver (good through Sept. 30, 2019):

- There is no obligation for radio stations engaged in webcasting to opt-in;
- There is no requirement that the station be an NAB member to take advantage of this waiver; and
- This is limited to commercial broadcasters only (its terms do not specifically cover noncommercial broadcasters).

FROM THE EDITOR

My guest this issue is Kevin Goldberg with law firm Fletcher Heald and Hildreth, on whose blog this article appeared.

— Paul McLane

THIS ISSUE

NOVEMBER 9, 2016

Under the Sony Waiver (good through Dec. 31, 2020):

- A radio station must opt-in to take advantage of this waiver;
- A station does not have to be an NAB member to take advantage of this waiver but NAB members can simply fill out an online form (*www.nab.org/sites/sonyWaiver/memberOptIn.asp*) to participate while non-members have to take the additional step of contacting NAB at (202) 429-5400 or *membership@nab.org* to participate;
- The waiver is applicable to both commercial and noncommercial webcasters;
- There are important additional conditions that will require additional action on the webcaster's part:
  - Stations that (1) play music and (2) have more than 80,000 music "aggregate tuning hours: (ATH) per month must place a prominent and proximate "buy now" button on their website, player or mobile app, in order to allow listeners to purchase a song through a Sony-authorized download store (e.g., iTunes, Amazon).
  - Stations that (1) regularly transmit music programming, (2) stream more than 80,000 music ATH per month *and* (3) make their simulcast streaming available as transmissions syndicated or aggregated through third-party websites or mobile apps must limit their streaming to the United States.

It is important to note that waiver agreements have not yet been reached with other labels, such as smaller and independent labels or, more importantly, Universal Music Group. Thus, stations should be very careful when, *e.g.*, seeking to play multiple songs by the same artist or from the same album, CD, compilation or boxed set, or when seeking to pre-announce songs to ensure that those songs are from the Warner or Sony catalogs.

Note also that in some instances, the waivers do not waive compliance with the listed eligibility conditions entirely but only provide limited relief. Please call us if you would like to know more or have specific questions regarding the scope of the waivers.

NAB (and Warner and Sony) should be congratulated for reaching these waiver agreements as they do have a big impact on a radio broadcaster's ability to maintain compliance with the statutory webcasting license. For stations whose webcasting consists of simulcasting the over-the-air broadcast via the Internet (which is the vast majority of radio stations engaged in streaming), the waivers ensure that, at least for Sony and Warner music, the tail will not wag the dog, so to speak, in terms of modifying that over-the-air programming to meet the confines of the sound performance complement and pre-announcing prohibition.

Please do not hesitate to contact us if you have any questions about these waivers or the eligibility requirements generally, including the required filings and payment to SoundExchange that are mentioned but not explained in depth in this post.

Contact Fletcher Heald & Hildreth at office@fhhlaw.com. *Comment on this or any story to* radioworld@nbmedia.com.

NEWSROUNDUP

Recent news as reported in the daily Radio World NewsBytes newsletter. Go to www.radioworld.com/subscribe *and scroll down to "Subscribe to email newsletters."*

CATHOLIC RADIO: The two largest Catholic radio networks announced a merger. Relevant Radio and Immaculate Heart Radio both own stations and also produce content. Relevant Radio, founded in 2000 and headquartered in Green Bay, Wis., owns 20 stations and has 37 affiliates. Immaculate Heart Radio, founded in 1997 and headquartered in Loomis, Calif., owns 33 stations and has 13 affiliates. A fundraiser campaign is underway with a goal to raise $30 million over three years. According to a press release, $22 million has been pledged.

CHARLOTTE SPINOFFS: Entercom Communications will buy four radio stations in Charlotte as a result of Beasley Broadcast Group's acquisition of Greater Media. The deal is valued at $24 million cash. Three of the stations are currently owned by Greater Media: WBT(FM), WBT(AM) and WLNK(FM); Entercom will begin operating them under a time brokerage agreement. It will also acquire WFNZ(AM) and an FM translator, currently owned by Beasley, which spun off assets for its acquisition of Greater Media to comply with FCC ownership caps.

SDR

(continued from page 3)

radio receivers.

The Titus II SDR breaks this mold, relying on its preloaded or downloaded software to define what this consumer radio can and cannot receive. As a result, "We keep on saying that Titus II is not a 'radio,'" said the product's developer Mike Stone. "It is a computing device that happens to incorporate a very nice wideband RF receiver." Or, as he wrote in a subsequent email, it was designed "around the needs of broadcast listeners, with hacker undertones."

The onboard applications that enable the unit's Android core to receive various radio formats can also let the Titus II operate as "a streaming video player, web browser or just about anything imaginable," Stone said. "For instance, we can use an Android like-OS called Remix that would also allow Titus to become a rather nice desktop computer."

Stone is chief engineer of the company, which was founded by Nekelda Badillo and Juan Borrell. It specializes in custom-designed, exclusive products and has done most of its work in commercial and industrial control. It has approximately 15 employees in-house plus a number of contractors and subcontractors, including large manufacturing suppliers in China.

"PantronX was formed several years ago by an international group of engineers, suppliers, business and marketing people with the task of supplying a worldwide market for innovative electronic products," he said. "When one of our potential customers brought to our attention the needs for a universal receiver to decode digital broadcast as well as analog, we researched the technology and market to come up with a unique solution taking advantage of current technology and our worldwide supply chain and manufacturers."

SPECIFICATIONS

A Radio World article detailing the advent of a radio technology requires specifications to be listed, so here they are: Built into a handle-equipped plastic case measuring 11.4 x 6 x 1.8 inches, the Titus II's Android core uses a 1.2 GHz quad-core ARM A53 processor running one of the Android 5+/6+/Remix operating systems (users can choose which they prefer). The Android core has 1 GB RAM and 8 GB flash memory; it is controlled using a 7-inch, 1024 x 600 TFT display with a five-point capacitive touch panel.

The Titus II SDR comes with demodulation software to process and playout AM, FM and digital radio broadcasts. Through a built-in Wi-Fi hotspot, it also has the ability to access open source software libraries for upgrades and new apps, and the web for more content and media files.

"Part of what we have done is to incorporate an API/plug-in standard to allow others to roll their own apps on the Titus II," said Stone. "We are doing this for the 'RF geeks' and professional app writers to take advantage of our flexible hardware platform. For instance, with an app and some calibration, a Titus II could become a nice spectrum analyzer."

Physically, the Titus II outputs 5 watts of stereo audio to its two speakers, and is powered by a rechargeable high-capacity Li-poly battery. The unit is both Wi-Fi and Bluetooth-capable. It has HDMI and USB OTG (on-the-go) output ports and an SD slot for loading in externally-sourced content; it can be fitted with an optional camera.

On the radio side, the Titus II's 100 kHz–2 GHz wideband receiver is highly sensitive yet generates little noise, according to the company. (Early digital radios often suffered from audible processor noise that degraded their audio quality.) The unit has an internal balanced tuned ferrite antenna for AM (MW)/shortwave reception, a built-in whip antenna for all other bands, and a jack to allow an external antenna to be connected.

POSITIVE REACTIONS

Stone declined to try to predict how many units might be sold; he considers the potential market "huge" and said the company's manufacturing partners could handle as many as 500,000 pieces per month. "Titus has been designed to take advantage of most possibilities, not only as a SDR but also as a piece of hardware." Nor have its methods of distribution been finalized. HFCC, Stone said, is helping PantronX assess the market among broadcasters and other potential customers. "Sales channels will be as unique as the product is."

But though it is not yet shipping, reports of the unit's capabilities, upgradable nature and proposed cost are winning positive responses.

"We're really pleased to see information about this new radio and particularly the approach taken to use a standard tablet," said Nigel Fry, head of distribution for the BBC World Service Group. "This could well be the future for radios of a certain price point. Tablets/pads provide an ideal user interface and of course access to internet services through Wi-Fi."

"Combining a DRM receiver with an Android tablet is a good idea," said Kim Andrew Elliott, audience research analyst with the Voice of America. "Decoding DRM requires processing power, and good Android tablets should have the necessary processing power. Because of that processing, the present generation of DRM receivers deplete batteries more quickly than analog portable radios. Owners of Android devices have realistic expectations about battery depletion."

However, pioneering internet radio manufacturer Grace Digital isn't so upbeat.

"Frankly, I have a hard time understanding the product, which means the average Joe won't either," said company co-founder Greg Fadul. "Customers want content and want it via a phone or PC/tablet/laptop or dedicated device. I believe the (internet radio) solutions that are out there now provide that. They certainly need to improve — better audio quality and faster buffering — but I think we are on the curve to make them better."

Courtesy PantronX

The Titus II's fold-out base doubles as a protective cover, with slots to allow audio to pass through.

But Stone said Titus was designed with an eye on users who lack internet in less-developed parts of the world and who don't have any computing device, and it most likely will be preloaded with presets and apps for their particular needs. The user interface, he said, can be changed to reflect local desires and configured to behave like a "dedicated device" where necessary.

As with most consumer technologies, the market will decide whether the Titus II SDR will take off.

"Our first production run will be before the year is out," said Stone. "We have several broadcasters that are on the initial 'waiting list.' As it all comes together, we are sure announcements will be made in the media as well as our website that was setup for broadcasters at *http://titusradio.com*."

NEWSROUNDUP

LVCC: Nevada Gov. Brian Sandoval signed a bill to provide $400 million toward a $1.4 billion multi-year expansion of the Las Vegas Convention Center. The National Association of Broadcasters and the Consumer Technology Association are among the groups that supported the plans. An increase in the Clark County hotel room tax will help pay for the project.

EMMIS: Jeff Smulyan ended his latest attempt to take Emmis Communications private, according to the Indianapolis Business Journal. Smulyan has now tried three times over a decade to take the company private, running up against investor resistance. Smulyan is both CEO of the company and a minority investor. He had extended this latest offer multiple times before telling the Securities & Exchange Commission that the proposal had expired, though he left open the possibility of another attempt. Emmis also has been making moves to reduce and reconfigure debt, including the sale of stations in Terre Haute, Ind., and Texas Monthly magazine. According to the Indianapolis Business Journal, Smulyan has said Emmis must reduce leverage whether or not it remained a public company.

CUMULUS: The plan by Cumulus Media to boost its share price through a reverse stock split got the go-ahead at a special meeting of stockholders. Every eight shares of each class of Cumulus stock were converted into one share. The move was aimed at increasing the trading price of its Class A common stock to permit the company to regain compliance with NASDAQ market listing requirements. This is generally a defensive measure used when a company is going through difficult financial times. Cumulus owns 450 radio stations and operates in 90 U.S. media markets.

RECALL: 3M Fall Protection issued a recall of its Zorbit Energy Absorbers, specifically models with lot codes between 2101506 and 2464624, which were manufactured between March and August 2015. The company said there have been no reported accidents or injuries but that it had identified a production issue with the horizontal lifeline system designed to limit fall arrest forces on the worker. Call (800) 328-6146 or email *zorbitsna@mmm.com*.

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IEEE BTS

(continued from page 1)

University of Hartford and Quinnipiac University.

BROADCASTERS' WORST ENEMY

Conference proceedings began with a Wednesday morning welcoming address from BTS President Bill Hayes, then moved to a succession of presentations starting with John Kean of Cavell Mertz & Associates and a look at the latest audio level measurement methodologies, along with a description of measuring devices and techniques employed in broadcasting over 75 years. Kean noted that during this time, more accurate metering devices and measuring technologies have continually helped to create improved listening experiences for broadcast audiences.

Proceedings then shifted to an area in which matters have gotten progressively worse as broadcasting has evolved: radio frequency noise. A special tutorial session called "Manmade RF Noise Issues" was chaired by Glynn Walden, now a consultant to CBS Radio. It featured four presentations on this growing threat to broadcasting and what is being done to address it.

Steve Johnston, director of engineering and operations at Wisconsin Public Radio, described a series of indoor and outdoor FM band noise measurements he had conducted, and how the rising noise floor was affecting listeners.

He noted that many complaints about poor FM public radio reception were directly traceable to new consumer devices purchased by the complainants. His outdoor measurements identified a relatively new and very potent noise generator: traffic lights that have converted from incandescent bulbs to LEDS. Johnston said he had complained to the FCC about this and a field inspector was dispatched to investigate.

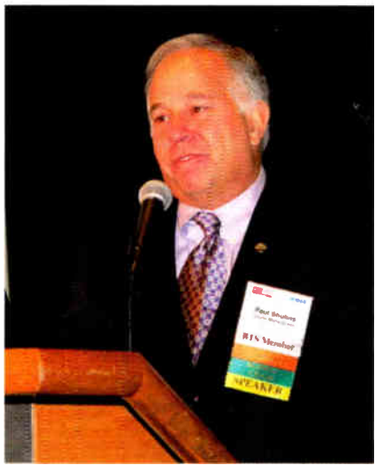
"He agreed that the levels were excessive, but took no action against the municipality which owned the traffic lights," said Johnston. "In my view, regulatory agencies have completely lost control of the situation. I haven't seen very many penalties for those exceeding interference levels."

Johnston was followed by Tom King, president of Kintronic Labs, who provided an update of anti-noise actions undertaken by a number of organizations, including the Association of Federal Communications Consulting Engineers, the Society of Broadcast Engineers and the National Public Safety Telecommunications Council. He noted that the FCC had established a website for filing complaints about RF interference.

"Current FCC Part 15 and Part 18 rules need to be expanded to address the noise floor spectrum," said King. "The FCC needs to take action to remediate this situation."

Photos by James O'Neal

Symposium organizers David Layer, Jim Stenberg and Roz Clark, from left, smile after learning of the record conference attendance.



Paul Shulins, director of technical operations at Greater Media Boston, describes testing to evaluate the effect of bitrate reduction on rating service watermarks transmitted with program audio.

BEYOND BROADCASTING

Amateur radio operators or "hams" were part of the radio communications scene long before broadcasting got started. The largest amateur radio organization in the world, the American Radio Relay League, is headquartered in nearby Newington, Conn., a fact that was not overlooked by symposium organizers. They made sure the program included speakers from that organization.

First up was the ARRL's CEO Tom Gallaher, who in a luncheon keynote described the mission of the organization and noted the frequent involvement of the amateur radio community in tracking down and helping to resolve RF interference problems.

Gallaher cited a recent example in Evanston, Ill., where keyless entry/ignition vehicles parked in a certain area of the city had become immobilized and cell phones ceased to operate. He said the Evanston police department initially contacted the FCC for assistance but were referred to the manufacturers of the automobiles. In desperation, the police turned to the amateur radio community for help.

"They called us and several of our people ... discovered that the source of the interference ... was a very noisy neon light power supply," said Gallaher. "The FCC finally did send a field engineer out to inspect, but his car wouldn't start either."

He was followed by Ed Hare, chief of the ARRL's test and measurement lab chief, who continued the noise theme with a detailed description of the ongo-

(continued on page 10)

Participants travelled from as far as South America, Asia and Europe to attend the three-day event.

Lynn Claudy of NAB, right, accepts the IEEE Jules Cohen Award for Outstanding Broadcast Engineering from BTS President Bill Hayes. The award is named for the late "dean" of Washington, D.C., broadcast engineers.

The award winning combination

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WORKBENCH
by John Bisset

Read more Workbench articles online at radioworld.com

I must say I've been surprised by the calls and emails regarding the construction of custom gear, beginning with Buc Fitch's German-made KEO audio amplifier module in the previous issue.

Wayne Kirkwood shares some time-saving kits from Velleman (*www.vellemanusa.com*). Though we could design and build these widgets ourselves, many of us simply do not have the time.

One kit Wayne found useful is the Velleman K8015 Multifunction Relay Switch. We've all had the need for 555-based time delay relays. The K8015 is an "off-the-shelf" kit using a PICmicro — Peripheral Interface Controller, trademarked by Microchip Technology — married to a power relay with a trigger input. See Fig. 1.

Using a four-position DIP switch, the timer can be configured to operate in 15 modes. Some modes provide two delays. Rather than use the tedious process of setting a trim pot on a 555 — which is difficult for long delays — the K8015 has a learning mode in which the delay time is recorded by button presses and stored in non-volatile memory.

The delays can be as short as 2 seconds to as long as 12 days. Wayne says the K8015's "blinking" mode is ideal for on-air warning lights. With the addition of a coupling capacitor on the trigger input, a tachometer signal can be used to sense loss of rotation or air flow.

Amazon has the kit available for under $30; type "Velleman K8015" in the Amazon search block.

The useful kits continue. How many times have you needed a simple split audio supply? The Velleman K8042 is a complete "symmetric" (split) supply using the popular LM317/LM337 regulators. Though it's designed for split secondary or center-tapped transformers, it can be used in a half-wave configuration to run from an AC wall-wart.

Search for Velleman K8042 in the Amazon search block. Wayne writes that the K8042 is something of a secret since searches for "split" or "bipolar" power supplies do not index to the "symmetric" K8042.

Another forward-thinking product from Velleman, the VM201 Ethernet Relay card, is ideal for remote control applications. The relays can be operated via a smart phone or web interface or under timer control. There is also a single status input. Wayne hasn't tried the VM201 but he has used the K8015 and K8042.

Wayne suggests turning to Velleman's site when you need a simple widget to solve a problem. You may find something readily available that will save you lots of time. In addition to Amazon, Velleman products are distributed by mail-order dealers such as Jameco, Fry's and Micro Center, as well as smaller local electronics shops.

While we're on the topic of kit solutions, let me tell you about network staff engineer Steve Tuzeneu and his dilemma.

Now that Dayton Industrial no longer makes receivers to use with EAS units, Steve found a little radio that just might do the job.

The LeaningTech DSP and PLL Digital Stereo FM Radio Receiver Module with serial control costs just $14.32 on Amazon and features an LCD display with very low power consumption. The module is seen in Fig. 4.

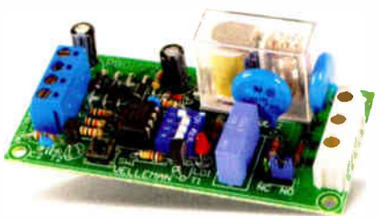

Fig. 1: The Velleman K8015 is a multifunction relay kit with adjustable delay.

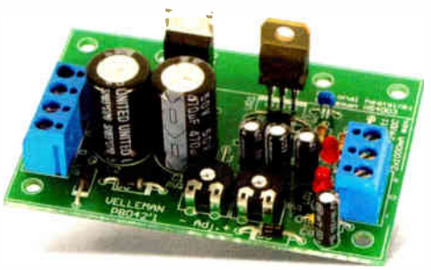

Fig. 2: The K8042 is a symmetric or bipolar power supply.

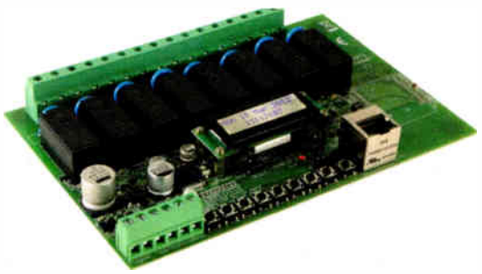

Fig. 3 Velleman's VM201 Ethernet relay card can be controlled by a smartphone.

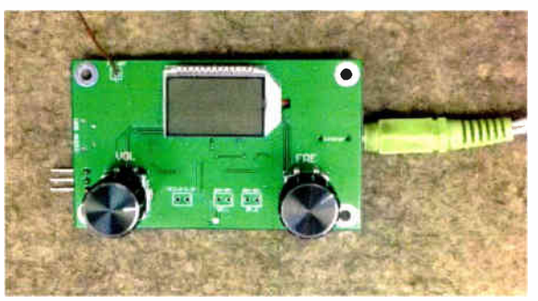

Fig. 4: LeaningTech manufactures this inexpensive FM stereo receiver module.

For use as an EAS receiver, the specs say there is an automatic memory of data prior to a power failure, so you're not resetting the tuning should the power die. It appears to be a neat project for an engineer searching for a cost-effective receiver. If you try one, let me know how it works.

Search Amazon for "leaningtech fm002." Also, you can watch a four-minute YouTube video that describes its operation at *http://tinyurl.com/rw-fm002*.

Contribute to Workbench. You'll help your fellow engineers and qualify for SBE recertification credit. Send Workbench tips to johnpbisset@gmail.com. *Fax to (603) 472-4944.*

Author John Bisset has spent 46 years in the broadcasting industry and is still learning.

WHO'SBUYINGWHAT

WKNC(FM), North Carolina State University in Raleigh, N.C., announced it has added an HD Radio signal. It was on the air effective Oct. 9, which is also the station's 50th anniversary: WKNC switched from an AM to FM radio station on that date in 1966; it airs on 88.1.

The station chose a Nautel GV15 for the project.

"We've grown enormously in the past 50 years and chose that date to highlight the transformation of the station from a carrier current station built in someone's dorm in Watauga Hall to a 25,000 Watt operation, which, in terms of wattage and coverage pattern is one of the top 1 largest student-run radio stations in the nation," said Jamie Lynn Gilbert, associate director of NC State Student Media.

WKNC began the process of adding HD Radio in 2008, but the project was stalled due to budget constraints. When the need for a new transmitter became evident, Gilbert knew it was time to upgrade to digital. Capitol Broadcasting Chief Engineer Will Patnaud served as the consulting engineer for the project.

WKNC General Manager Emily Ehling feels that the addition of HD Radio makes WKNC "ahead of the curve." The station eventually plans to multicast but is not yet ready to do so, the release says.

Photo by Patrick Neal

Student Media IT Manager Doug Flowers (left) and Will Patnaud program WKNC's new HD transmitter from Nautel.

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Calibrate Analog Audio Consoles

And educate your hosts so that they stay that way!

TECHTIPS

BY MARK PERSONS

Yes, we are in the age of digital, but in my experience the vast majority of radio broadcast audio consoles still have analog audio passing through from end to end.

Have you noticed that a monaural signal, such as a microphone, often does not come out the same on left and right console VU meters?

Why is that? Well, console repairs (and accidentally bumping a calibration control) can easily cause a noticeable imbalance between audio channels. It is especially noticeable in automobiles, where passengers are fixed in location and will hear a disparity in left/right levels. Listeners especially hear it when changing from one station to another. Console miscalibration can also result in annoying audio distortion.

However, you may have done nothing to create this situation.

Fig. 1: Note the 3 dB difference in left- and right-channel levels shown by the console VU meters in this photo of announcer Pete Vukelich in the studio of WWWI Radio in Baxter, Minn.

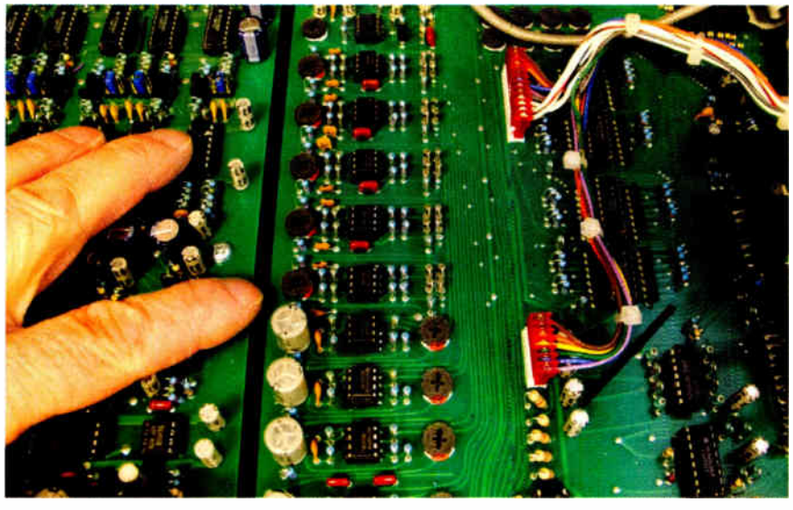

Fig. 2: Calibration controls in a Radio Systems RS-12A audio console.

Fig. 2 shows the inside of a typical audio console. It might have been a sneaky/enterprising board operator who decided he or she could make things better by adjusting the internal controls. (Shame!) The good part is these problems are easy to fix … except for the announcer/board operator.

Remember the oscilloscope I talked about in an article titled "Your Scope Is a Tool for All Seasons" (RW Jan. 16, 2013)? Well, you need an oscilloscope to do this work.

An audio oscillator is the other tool required for this exercise. The best sine wave oscillator I've found is the Potomac Instruments AG-51 Audio Generator. It was designed in the days when stations were required to do annual audio proof of performance measurements to keep the Federal Communications Commission happy.

LET'S GET GOING

When beginning console calibration from scratch, I first attempt to get manufacturer's instructions on what levels to run. Lacking that, I set the audio generator to have -50 dBm output into 150 ohms and run it to a microphone channel at a frequency of 1 kHz. All other channel controls are set to zero while the microphone control is set to the normal point, which is typically half or two-thirds of the way up.

Ideally, the left and right VU meters will read 100 percent (0 dB), about three-quarters scale, at that point. Chances are they will not. There might be one or two gain trim controls on that channel to tweak gain to get close to 100 percent. A single control that runs left and right gains up simultaneously is easy. That means left and right audio should leave the microphone channel at equal level. The goal is to have identical audio on the program and audition mix busses. Stereo line input channels often have individual left and right gain trims, but you can deal with that when tweaking gain for each source in a studio situation.

YOU CAN DO THIS

This is a good time to look at frequency response. A failing electrolytic coupling capacitor could be limiting the low frequency response, causing the station sound "tinny." Audio proofs of the past uncovered these problems that might have otherwise gone largely unnoticed.

Change the oscillator frequency to 100 Hz, then 10 kHz. The meters should stay within 1 dB. If not, look in the manufacturer's specifications to see what is normal. Today's console designs have flat frequency response from 20 Hz to 20 kHz or more.

Advance the audio generator output to 20 dB above that point. Both VU meters should be pinned to the right. Not to worry because they will live through the experience. After all, announcers typically do that many times on a shift! (As a side note, we engineers need to educate operators to watch VU meters and set levels to peak at 100 percent for best audio consistency, not to what sounds best to their ears.)

Connect an oscilloscope to an audio output on the console. Oscilloscopes typically are unbalanced devices, so attach the scope's probe ground to console ground. Put the probe tip on one audio output terminal of the console. That assumes the console has active balanced outputs and does not have a transformer output. It's best to disconnect any wires attached to the output terminals so the circuit is not loaded in any way. If there is a transformer output, use a 600 ohm/ half-watt resistor to terminate the transformer for best frequency response. In that case, the oscilloscope's probe ground can go to one side of the transformer and the probe tip to the other.

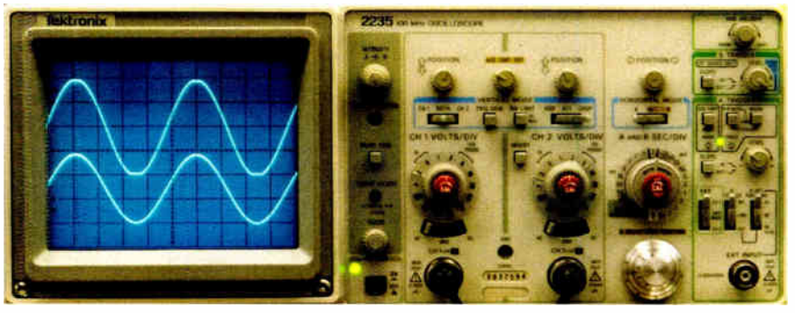

Fig. 3: An oscilloscope shows a difference between audio channels.

You should be at or near the point of clipping the audio sine wave about now. Adjust oscillator level up or down a bit. If you are using a dual0trace oscilloscope with two probes, you can view left channel on one scope trace and right channel on the other. Fig. 3 shows a level disparity between two channels.

Adjust console program amplifier master gains so the left and right channels just start to go into peak clipping (flat topping) at the same time as in Fig. 4. Then reduce oscillator level by 20 dB. The VU meters should be at about 100 percent (0dB). If not, adjust VU meter calibrate controls to get the meters to that point.

SUCCESS

Now you have 20 dB of headroom above normal level before clipping starts.

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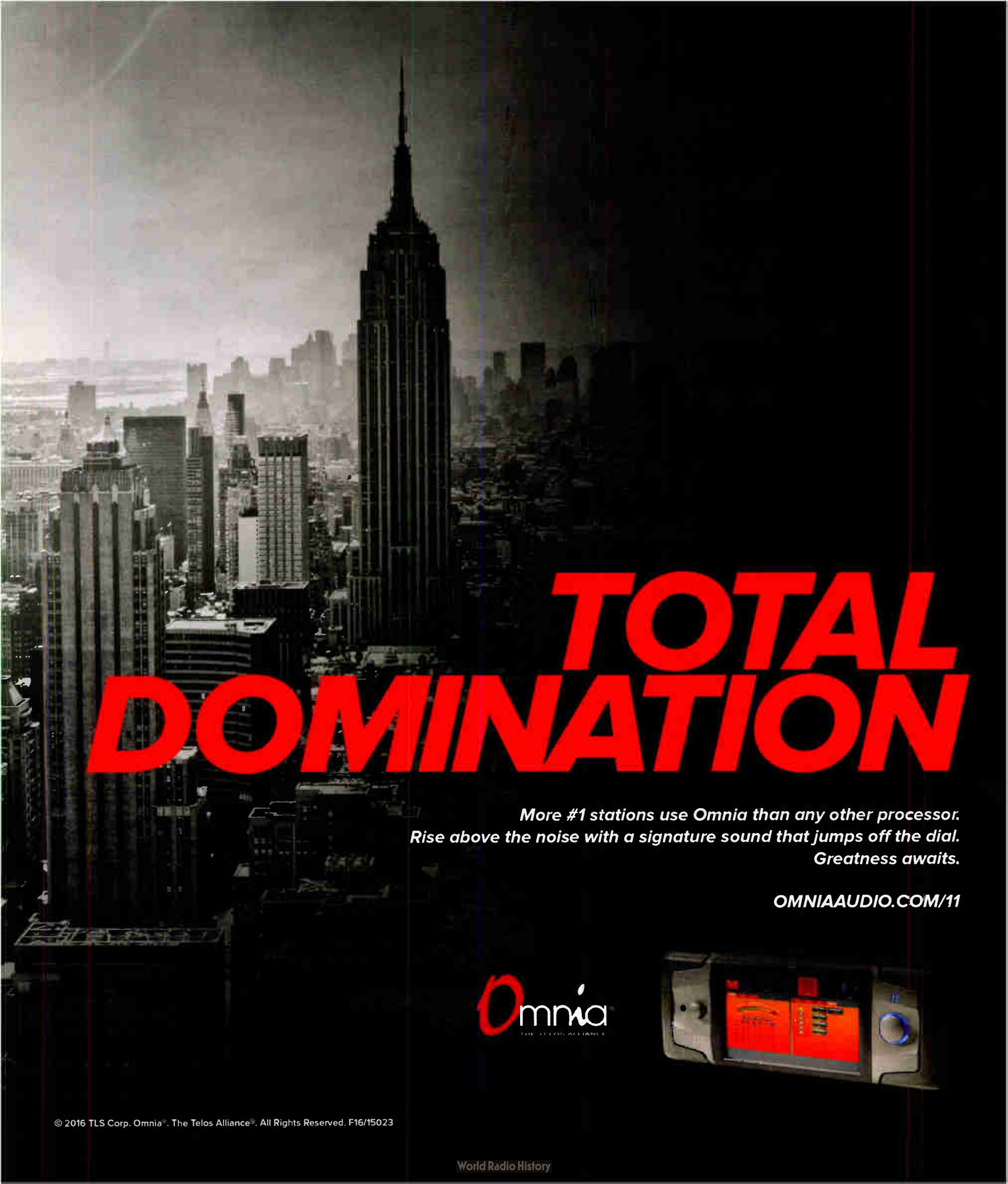

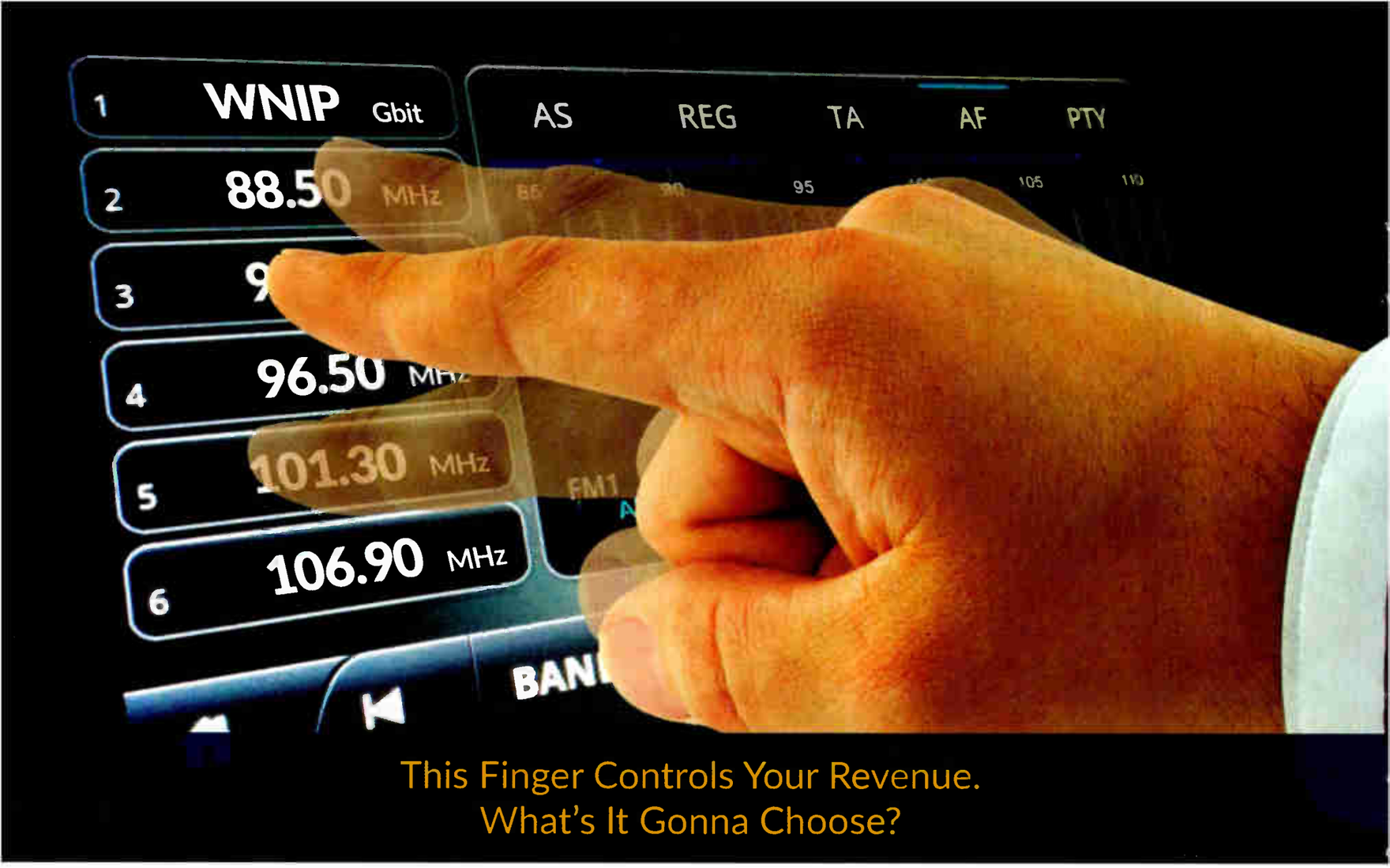

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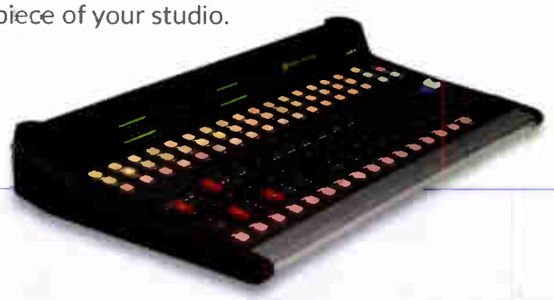

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The Lockbox of Knowledge

Locking up information can have disastrous results for your station

STATION MANAGEMENT

BY JIM WITHERS

Al Gore (with a little help from "Saturday Night Live") made the term "lockbox" famous in the 2000 presidential election by applying it to the social security fund. That seems like a fine idea, I suppose —locking away the money intended to fund citizens in their senior years — but how about when it is applied to information? That's not so good, it turns out.

I have always been a believer in sharing information with employees who might need it, so I was shocked when I caught pneumonia a few months ago and ended up in the hospital for a week. That was when I found out what a pitiful job I had been doing.

The amount of information needed to keep my station on the air, yet that was not easily accessible to anyone other than me, was crazy. The station and I both survived the crisis (although it was pretty close call for me), but the experience taught me a lot.

I'M HERE FROM CORPORATE TO HELP YOU

In a large corporation, there are multiple layers of employees spread over many clusters of stations. Someone gets sick, someone else steps in. But in smaller operations, like mine, there are no other clusters; there aren't even other stations. So I have to get creative about "layering up" the knowledge base. I hadn't done that, but I'm doing it now.

I have to get creative about "layering up" the knowledge base.

Our station is in Texas. I'm in St. Louis. Everything — sales, programming, operations, engineering — it's all done in "y'all" country. Everything, that is, except traffic and billing and a whole bunch of other stuff I didn't think about, like taxes. I do that here.

There are a few good reasons for this: Some of the tasks just have to follow accounting, which I do here as well. But also, I can keep my finger on sales progress, outstanding invoices and the general financial performance of the station.

The bad news is, I got sick and the whole thing ground to a halt for a week (three weeks, really, as I still had a long recovery after I got home, but who's counting). Sales went on, logs were manually generated in Texas, thanks to a great effort from my operations manager, but getting the whole thing back on the rails later that month was an order of magnitude harder than

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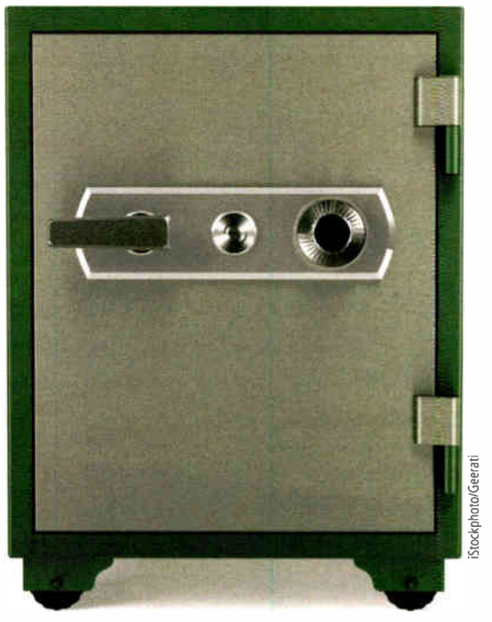


iStockphoto/Geerati

CALIBRATE

(continued from page 14)

That is a good place to be because the noise floor of the audio should be 60 dB or more below that point, which is the specification for FM broadcasting. It is 45 dB for AM broadcasting, but you can do better than that nowadays. This 100 percent audio level is a balance between clean audio without clipping, down to residual noise. You are fighting both ends of the audio dynamic range at this point. Do the same for the audition and any other busses.

Fig. 5 shows an analog audio console block diagram to make it easier for you to visualize what it all about.

I built WDCQ, now WJUA, in Pine Island Center/Fort Meyers, Fla., back in 1986. It was at the peak of the AM stereo days so I modified the main studio audio console to provide "gain tilt" for on-air microphones. All was normal when only one of the two microphones was turned on.

The left/right gain of the two microphone channels changed whenever the second mic was on. The main announcer was full volume on left channel, but was 6 dB low on right channel. The opposite was true for the second microphone. When listening in a car to the two-headed morning show, the listener would hear the main announcer on the left and his sidekick on the right. It was an interesting effect that brought good comments. But the CRL audio processing provided a fair amount of monaural gain support, so monaural listeners hardly heard a volume difference.

This article is your recipe to ensure clean and balanced audio.

Comment on this or any article. Write to radioworld@nbmedia.com.

Mark Persons, WØMH, is a Certified Professional Broadcast Engineer and has more than 30 years' experience. His website is www.mwpersons.com.

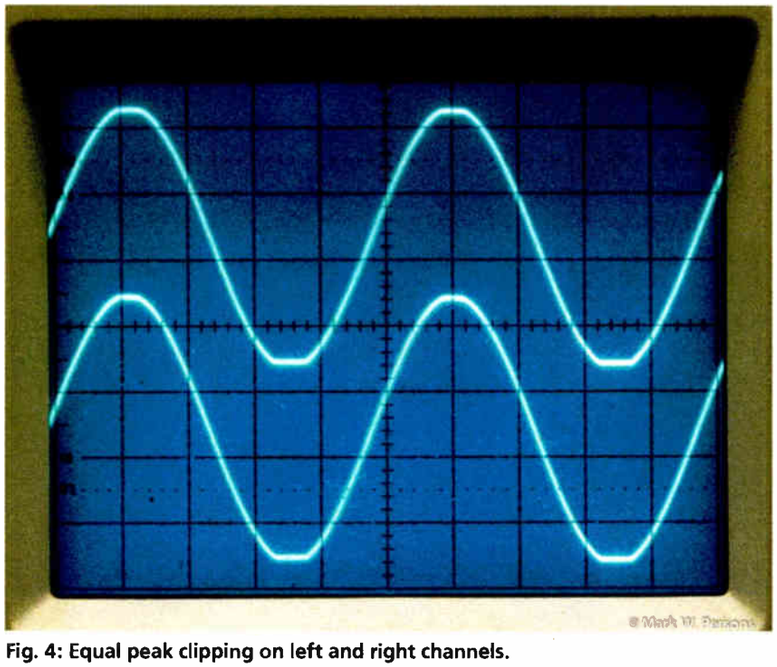


Fig. 4: Equal peak clipping on left and right channels.

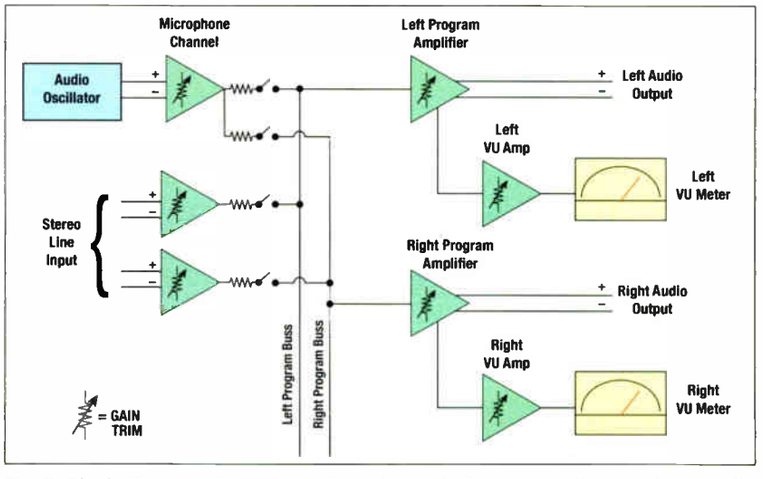
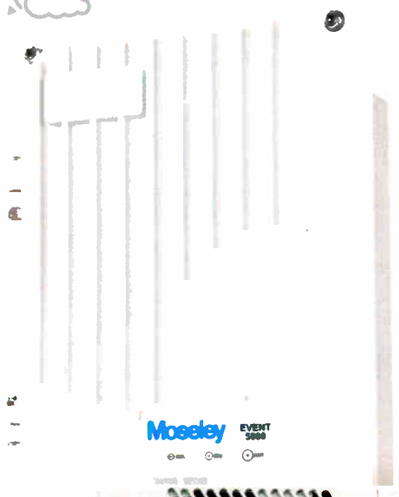


Fig. 5: Block diagram shows a portion of a typical analog radio broadcast audio console.

HIGH CAPACITY
EVENT STUDIO TRANSMITTER LINKS

outdoor unit



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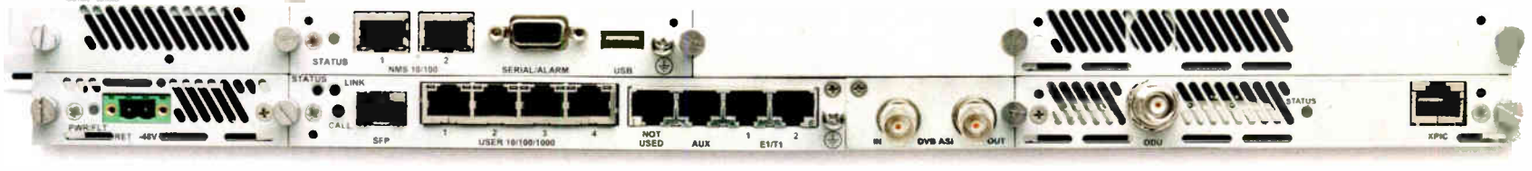
indoor unit



INTELLIGENT SYSTEM DESIGN

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LOCKBOX

(continued from page 18)

it had to be when I finally got well.

I simply had no backup plan to cope with a major illness.

Simple things — where the payroll checks are kept (in the front closet in a lockbox, of all things), who can log on to my laptop, etc. — became problematic; as did things a bit more complex, like how to compute and pay the monthly payroll taxes.

I knew it all. No one else did.

LESSON LEARNED

The lesson? If you are a family-owned station, get one or more family members involved. Not when you think you might get around to it. Do it now.

Everyone else in my family works, so this is not that easy, but with the help of cellphone videos and computers, you can make it work.

I made a flash drive with everything I could think of on it: copies of contact lists and how those people were related to the station (employees, the station's FCC attorney, the tax person, the traffic system main contact person, utility contact numbers, building maintenance people; the list is daunting). I also included videos of how I do the traffic and accounting processes, from order entry all the way through to billing.

This video turned out to be very long, so I divided it into chapters. Chapter 1, logging onto the traffic system, backing it up and restoring it, if needed. Chapter 2, order entry and so on. You'll need a big flash drive.

And one other thing: Make sure the person who might need to take over knows where the drive is. I gave one to my son and he put it in his safety deposit box.

You also need this in reverse. My operations guy got sick this year, too (it's been an odd year), and I had to learn how to schedule music very quickly without his help. That led to a couple of very long nights and an eclectic playlist for a few days.

TIMING IS EVERYTHING

I got lucky (if you can count laying flat on your back in a daze for several days lucky) because I happened to get sick on the third day of the month. Payroll and invoicing was done and sent, no taxes were due until the 15th; very few orders couldn't be delayed for a few days. It could have been much, much worse.

If you get really unlucky and head to the big studio in the sky, your heirs or partners will need to file a Form 316 (involuntary transfer of control) with the FCC.

The point is, you cannot schedule when you get sick. Or worse, when or even if, you might get well again. And some of the things that need to be done — actually, many of them — are very time-sensitive.

If you get really unlucky and head to the big studio in the sky, your heirs or partners will need to file a Form 316 (involuntary transfer of control) with the FCC. Failure to do this can result in an ample fine or, in a particularly egregious case, license issues.

Unpaid payroll taxes carry a hefty fine and interest. And of course, employees tend to get grumpy if they don't get paid on time.

Trying to navigate all of this with an oxygen mask on — or, worse, from the great beyond — is a prospect you do not want to contemplate.

PARTNERS AND FAMILIES

Remember, also, that this bit of operational insurance is not just meant for family stations.

Do you have a partner? A financial backer who is great at providing money, but knows little about the daily operations of a station? Silent partners are great when you are healthy, but if you get sick, your silent partner is going to get very loud indeed if the operations fall apart while you're sucking oxygen through a nose tube.

Even with all the automation and improvements in transmitter reliability, radio is still a complicated business. For the uninitiated dealing with a family loss, it would likely be incomprehensible. And in radio, you can't put a sign on the door that says "Closed for Three Weeks Due to Family Illness."

It's much better to open up the lockbox of knowledge and give a few people you trust a chance to peek inside ahead of time.

Comment on this or any story to radioworld@nbmedia.com.

Screen Time Is Real Time

Communication screens belong in your control room

BY MARK LAPIDUS

PROMO POWER

Mark Lapidus

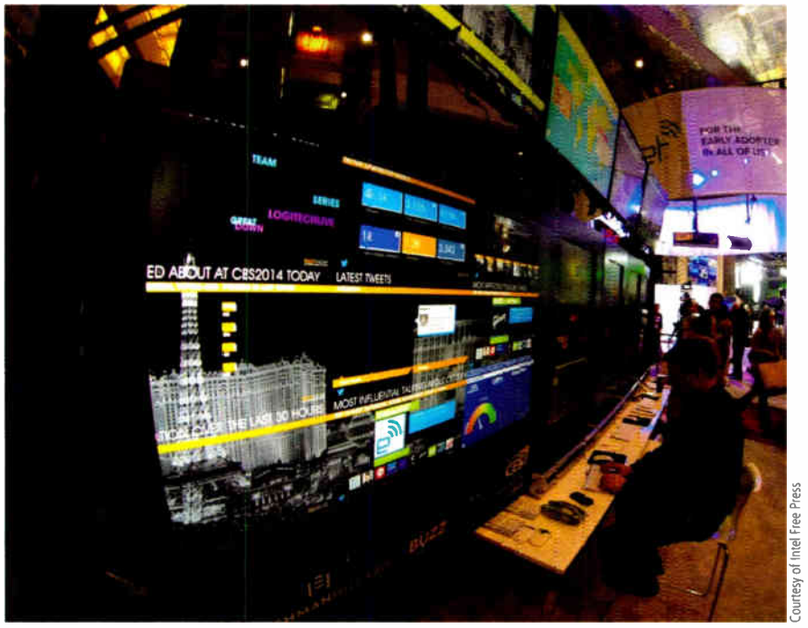
When your on-air talent is in the control room, are they plugged into the outside world? Or is your broadcast studio more like the Cone of Silence on "Get Smart"?

It wasn't so long ago that placing a television in your control room was a radical move. The naysayers of the day said that a TV would distract the hosts and that the minute nobody was looking, the midday guy would be watching "Jeopardy" instead of paying attention to the on-air product. Smart program directors installed TVs anyway because they wanted to be sure that when a major news event occurred, their talent was in the loop and could respond quickly.

Today, a TV in a communications room is a reasonable resource tool, but there are several more screens that your talent should be able to access easily.

While there are limited free tools available for talent to follow social media (Twitter, Instagram, Facebook and others), most of them aggregate only limited feeds from one or two platforms. The good news is that there are now many companies that are essentially "screen aggregators," creating social walls on screens.

These products allow the user to set up predetermined hashtags/handles on various social platforms and then display the choices on a customized screen. For example, you can take your station or talent hashtags and combine them with many others, such as those of news organizations or music industry outlets. Pull them onto one screen in your control room and you can see the flow of communication in social media happening in real time.



Courtesy of Intel Free Press

Social screens keep on-air talent in the loop and are great at events.

Three of the many companies that provide this service are Tint (*www.tintup.com*), Snapcastr (*www.snapcastr.com*) and Sparkle (*www.getsparkle.io*).

SOCIAL WALL

There are two practical and appealing side benefits of having a social wall in your control room.

You can create social walls for display at station events, concerts, you name it — anywhere you have access to a screen. And these social walls can all be different. You can create one for inside your station/office/lobby and make one custom for every event. They are web-based, so anywhere you have an internet connection and a browser, you can display a social wall.

Another key communication component for every control room is a text tool that enables the end user to see all incoming text messages on screen. It also allows you to respond individually if desired or to send out mass text blasts to opt-in users. Again, there are many companies in this biz such as Vibes (*www.vibes.com*), Hipcricket (*www.hipcricket.com*) and Twilio (*www.twilio.com*).

No on-air talent should be sending or receiving text messages from a phone! Stations of all sizes should budget for a robust tool to handle this task. I know some will say that text messaging is so early 2000s and it's been around for way too long. They are right — and this is precisely why it is so important to recognize it as a key communication tool.

Even with voice-tracking, social and text screens belong in your control room(s), as well as your program director's office, because they may be needed for live shows and emergency situations.

I know that many an old-school skeptic will say, "Stick to the core business of radio! Who needs this stuff?" I am not suggesting that social media become the center of your broadcast universe. However, if broadcasters are to stay relevant, they need to live with their listeners in the real-time world.

Todd Cochrane, Titan of Podcasting

Early entry and commercial success help him stand out from the competition

BY JAMES CARELESS

Todd Cochrane is an undisputed titan of podcasting.

His company, Blubrry/RawVoice, created the PowerPress podcasting plugin that powers nearly 60,000 podcasting sites; it is an open source WordPress plugin that is free to the public. PowerPress host these podcasts while providing its podcasters with listenership statistics, while Blubrry provides publishing tools and services for podcasters to build their brands.

BluBrry/RawVoice is based in Columbus, Ohio and has 12 employees. It has 345,000 shows in its podcasts directory, and provides hosting, stats service, or access to BluBrry's PowerPress plug-in to 75,000 of them using cloud-based servers. ("We are profitable and have been so since we started business in 2005," said Cochrane.)

Blubrry also provides advertising opportunities for podcasters, where the podcaster gets paid 70 percent of any ad revenues and Blubrry gets the other 30 percent. Overall, Cochrane's Blubrry team and user tools interact with 75,000 podcasters worldwide.

"We have the largest privately-held podcast portal on the internet, with over 325,000 shows listed," said Cochrane.

Thanks to this portal, BluBrry/RawVoice can compile and offer detailed metrics to their customers and the industry on podcasting.

"They can also tie in listener demographics to form a perfect picture of each show's audience, provide data on the listening platform used [mobile/desktop], the duration of time listened, plus unique and download totals that are of value to advertisers," he said.

RawVoice offers this data in two flavors: a basic free package for podcasters using the service and detailed data for the bulk of its professional customers. They also provide enterprise services to companies such as ABC, ESPN and Moody Radio to name a few.

If the above isn't enough to cement Cochrane's status as a podcasting titan, consider the following: As the host/executive producer of the tech podcast "Geek News Central" — online since October 2004, and about to hit show #1130 — Todd Cochrane was one of the first people to make money from a podcast.

There is a knowledge that comes from being in the business that can't be faked.

– Todd Cochrane

His commercial success included attracting GoDaddy as one of the first-ever podcast advertisers. (GoDaddy still advertises on his podcast.) In 2005, Cochrane wrote "Podcasting: The Do-It-Yourself Guide" — widely acknowledged as the first book written about podcasting — and founded both the People's Choice Podcast Awards and the Tech Podcast Network.

And by the way, Cochrane was one of the first inductees into the Podcast Hall of Fame.

Even for the most seasoned of broadcasters, Cochrane's achievements would be noteworthy. But they are amazing considering that he is a self-taught podcaster who got into the business by accident.

It all began when the career Navy officer seriously injured his back.

"I had spent 24 years fixing and flying airplanes, when my injury sidelined me from doing my regular work," Cochrane said. "Since the U.S. military has a philosophy of putting you out to pasture if you can't be productive, I got myself an out-of-town assignment babysitting some airplanes that were under modification."

Bored in his hotel room during off-hours, and already an avid internet tech hobbyist, Cochrane discovered some of the first podcasts offered.

"I was hooked," he said. "So I went across the street to a store, bought a $14.95 Labtec microphone, plugged it into my laptop, and started producing what is now 'Geek News Central.'"

Since that time, Cochrane's production facilities have been upgraded. "Although you can record a podcast on any kind of small audio recorder or laptop, I do use a professional-level production studio," he said.

When he started out, Cochrane had no expectations of making a living from podcasting and podcast consulting.

"Even today, many of the podcasts that Blubrry hosts only make enough to cover a dinner out, or maybe the rent if they are doing well," he said. "But others who have built their brands by attracting listeners and advertisers are doing quite well — and I am making a full-time living from it."

Cochrane believes his success as an active podcaster is central to the value of Blubrry/RawVoice's podcasting analysis and marketing advice.

"There is a knowledge that comes from being in the business that can't be faked," he said. "I understand things about podcasting that people who haven't been behind the mic just can't."

Speaking of analysis, Cochrane's team has compiled some interesting data of what is popular in podcasts today.

"By far the most dominant category in production is faith-based podcasting; not just from Christian churches, but across all faiths," he said, based on Blubrry's own content categories. "Sports is also huge, followed by comedy and technology." Other podcasting categories show slow, steady growth, with arts-based podcasts having the lowest number of shows.

For radio stations wanting to repurpose their morning shows online, Cochrane offers this advice: "Rather than divide three-hour drive into three one-hour podcasts, instead simply select the best short spoken word sections and compile them into two to three short 10-minute podcasts," he said. "This way, you highlight the most lively parts of your show, entertaining your on-demand audience while giving them a reason to tune in on radio."

Cochrane also recommends that radio stations have their talent produce original content, establishing new podcasts. "This gives listeners another reason to download them and to connect with your brand."

He is as active and enthused about podcasting today as he was in the beginning. "There's a huge opportunity for forward-thinking radio stations to extend their brands into podcasting," he concluded. "All it takes is the willingness, effort and time to make it happen."

PEOPLE NEWS

Robin Riehl
Beasley Media Group Inc.
promoted to corporate controller

Brian Kerkan
Crawford Broadcasting
returns to Detroit as the cluster's chief engineer

Richard Stengel
Broadcasting Board of Governors
has been nominated by President Obama as the next chairman

Dirk Berar
Stage Tec
will serve as head of software and systems development

Robert Weller
NAB
tapped to advise the NTIA on wireless spectrum management policy

Christa Babcock
Interactive Advertising Bureau
upped to a new role as vice president of learning and certification

Kevin LeGrett
iHeartMedia
will become president of the new Southwest Division

J.D. Crowley
CBS Radio
named executive vice president of digital

Justine Roller
Entercom Sacramento
appointed to general sales manager

Johannes Rietschel
Barix
is rejoining the company as its chief technology officer

Kim Guthrie
Cox Enterprises
will lead Cox Media Group as its president

Michael Skoler
Louisville Public Media
chosen as president and general manager

Lori Bennett
Cumulus Media Grand Rapids
promoted to operations manager for the cluster in Michigan

Send information to radioworld@nbmedia.com *with People News in the subject field.*

INOmini 223 Keeps It Simple

Inovonics puts DSP to work to beef up a popular box multimode processor

PRODUCT EVALUATION

BY BILL DEFELICE

I have four decades of engineering under my belt, but it was at the dawn of my career that I learned the importance of audio processing. I cut my teeth in my early teens on Gates and Collins tube limiters and later the venerable "Max" brothers, the CBS Audimax and Volumax. In my post-grad years I worked with the CRL AM-4S stack, multiband processors like the DAP and Optimod as well as custom solutions devised by various station engineers.

Many members on my low-power broadcast enthusiasts website *HobbyBroadcaster.net* have used the Inovonics 222 AM compliance processor. One high-end Part 15 transmitter manufacturer not only recommends it but considers it their de facto standard audio processor.

With that in mind I was champing at the bit once I heard about the release of the Inovonics INOmini 223 multimode audio processor and wanted to put it through its paces.

Retailing for $990, it is marketed for use in US/NRSC AM, worldwide AM, shortwave, U.S./Europe monaural FM, TIS and analog SCA applications. Company founder Jim Wood is not only a supporter of low-power radio but also a member of my site's forum community and was instrumental in arranging for an evaluation unit.

Details of crossover frequencies for the three-band compressor.

EVOLUTION

The INOmini 223 represents the digital evolution of its predecessor. This versatile processor is packaged in the company's new "rack pack" one-third-rack-width enclosure, allowing several INOmini series devices to be mounted in a single shelf 1 RU high.

The rear panel is equipped with standard XLR connectors for audio input and output; there are dual coaxial power connectors allowing multiple 12 VDC INOmini series devices to share a common switching mode power supply as long as their combined current draw is below the power supply's rated maximum. The rear also contains a strain-relief post to wire-tie the power cables to prevent accidental disconnections.

Thanks to application-specific integrated circuits, there's quite a bit of power contained in this pint-sized unit. This DSP processor consists of an automatic gain control stage combined with a three-band compressor with adjustable crossover points followed by a lookahead limiter. Depending on the selected operating mode, the output pre-emphasis and filtering is adjusted for its intended application.

Initial setup was a snap, with the factory-supplied default settings serving as a starting point. Besides the ability for processing AM NRSC 10 kHz standard audio, the INOmini 223's AM cutoff frequency is adjustable to 5 kHz, 7 kHz and 9 kHz. The processor presets also feature appropriate processing settings intended for FM SCA and Traveler's Information Service applications at 5 kHz in addition to monophonic FM processing for Europe and U.S. standards at 15 kHz. A bonus is that the processor can be used in studio configuration, allowing full-bandwidth audio for processing for tasks such as remotes, microphones, etc.

The multifunction LCD display makes it easy to monitor and adjust the processing blocks. Several scale legends are silkscreened on the front panel for use with of the certain measures. Functions such as the AGC operating window and gain reduction levels, compressor and limiter drive, crossover and EQ adjustments, pre-emphasis and relative asymmetrical modulation can be displayed. More utilitarian functions

PRODUCT CAPSULE

INOVONICS INOMINI 223
Multimode Audio Processor

Thumbs Up
+ Versatile multiple mode audio processor for AM, FM and studio uses
+ Look-ahead limiter reduces distortion products
+ Price

Thumbs Down
– No dayparting
– No multiple presets storage

MSRP: $990

For information, contact Gary Luhrman at Inovonics in California at (831) 458-0552 or visit *www.inovonicsbroadcast.com*.

like application mode, firmware revision, alarm, operate/proof and system defaults modes are accessible through a hidden menu setting. Adjustable system parameters can be manipulated easily with the combined rotary pushbutton knob next to the display screen. A headphone jack rounds out the front panel.

"Because things in DSP are so easy, it was a simple matter to make the processor into something more than the 222 originally was," Jim Wood told me. The older 222 required discrete component changes to change cut-off frequencies while this same functionality is accomplished digitally in the INOmini 223. The front-panel USB connector not only allows for improvements through firmware updates but an advantage in custom-tailoring the unit should an operator need a parameter considered outside of the norm.

The gated AGC stage sports variable speed windowed operation with a ±15 dB operating range, assuring subsequent stages operate at their optimum. Within a smaller ±5 dB window the gain change occurs slower than when a more substantial amount of gain control is required. This is reminiscent of how I would envision an Audimax would operate had it been developed in today's digital age.

The triband compressor provides flexibility in creating a signature sound not only by adjustable crossover frequencies but also varying its drive. The display indicates the drive to this stage's middle band via the selectable real time bargraph.

In essence the limiter has two controls that determine how much it interacts with program processing. Similar to the compressor drive, limiter drive determines the amount of signal being applied to this stage in the processor. Release time operates in a dual-platform mode with very quick release from a peak value to average program levels and a slower release from average value to full circuit gain with no limiting applied. Limiter release timing is adjustable using the Smooth versus Loud control, a manufacturing decision that was made to prevent the operators from getting themselves in trouble. The lookahead limiter also has the advantage to not requiring the need for clipping to take place in the audio path.

The output of the INOmini 223 supports upwards of 140 percent positive modulation in the operating modes for AM broadcast. A selectable display mode displays a dual bargraph, simultaneously showing positive and negative modulation, which may prove handy as a confidence monitor for comparison against your off-air monitoring.

TESTING

My testing consisted of playing a variety of audio programming through

(continued on page 26)

iRig Mic Studio: Small Package, Big Flexibility

IK Multimedia offering fits the bill for those wanting a small work footprint

SHORT TAKE

BY PAUL KAMINSKI

If you want to reduce the amount of gear you roll with, but still want professional results when you record a voice track, IK Multimedia's iRig Mic Studio may find a place in your bugout bag.

Technically, the iRig Mic Studio is a USB sound card, which can connect to a smartphone or tablet (Android or Apple flavor) or a Windows or Mac laptop. Operationally, it's a large-diaphragm cardioid condenser microphone (1 inch), with a microphone preamp and monitor channel, powered by the device to which it is connected. The iRig Mic Studio will connect to Apple and Android devices running Android 5 or higher.

The connection is made with an OTG cable for Android devices, a Lightning cable for Apple devices and a USB cable for connection to laptops, all three of which are enclosed with the iRig Mic Studio. A 30-pin Apple connector is available from IK Multimedia.

It has a 3.5 mm jack for headphones and level controls for microphone output and headphone output. LED indicators include shades of blue for standby and power, green to orange for setting optimum output levels, and the red LED which, with your ears, will tell you to back off on the gain.

The iRig Mic Studio comes with its own mount and folding desk stand, and a pouch to protect the mic from scratches in transit.

I used the iRig Mic Studio and Lexis Audio Editor to record short liners for my "Radio-Road-Test" program on a Nexus 7 tablet running Android 6. The device recognized the iRig Mic Studio as a sound input via the OTG cable with no recognition drama. With my Galaxy S4 running Android 5.0, I recorded a short test count using Lexis Audio Editor. That sort of flexibility is helpful if you need to do quality work in a big hurry, and your studio is not available for whatever reason.

Admittedly it's not a Neumann U 87, but it does produce the warm, robust sound one would expect from a condenser microphone with a 1-inch diaphragm. IK Multimedia specifications say the unit will pass audio with a 20 Hz to 20 kHz frequency response and 24-bit, 44.1/48 kHz resolution. The maximum SPL for the iRig Mic Studio is listed as 133 dB.

Because of the inherent sensitivity of a condenser microphone, quiet spaces would be optimal for recording with the iRig Mic Studio — so, too, use of a windscreen or a pop filter if you tend to get close to the microphone.

So what applications might the iRig Mic Studio be used for? It could be used to do voiceovers, cutting voice tracks, and, if using a live origination app like Skype or Luci Live Lite, to substitute a full-fidelity microphone for the onboard microphone on a smartphone or tablet.

The list price for the iRig Mic Studio is $179.95, street price is around $149.99.

For information, contact IK Multimedia in Florida at (954) 846-9101 or visit www.ikmultimedia.com.

PROCESSOR

(continued from page 25)

the processor connected to a carrier current AM transmitter, while monitoring the off-air product using a commercial modulation monitor. I decided to duplicate this experience to share with others via video.

My bench test video setup used a three-minute WAV audio file consisting of jingles and song segments with track durations less than 30 seconds each. The under 30-second length was chosen to prevent triggering a copyright violation as short song segments are usually allowed for demonstration use under Title 17, Section 107 (fair use). Each audio selection was mixed to a single audio file with Adobe Audition. The test audio was played into an Audioarts AIR-1 console into the INOmini 223. The output of the INOmini 223 was connected directly to a 10 W Radio Systems TR-6000 AM transmitter, whose off-air signal was monitored and recorded using a Belar AMM-3.

Developing a sonic signature outside of the INOmini 223's defaults is accomplished by altering the Smooth versus Loud setting for density control in addition to the post-compressor bass and higher-frequency equalizers as they perform in concert with the three-band compressor's crossover frequencies.

I noticed that even when operating at its highest density settings, the INOmini 223 doesn't have the busy sound/listener fatigue factor familiar to those running the older 222. Dynamics can be adjusted from very aggressive to a more open sound.

During the on-air bench testing I ran the INOmini 223 through its operating modes and pleasantly discovered that mode changes takes place immediately with no reboot necessary. With no noticeable latency your station's talent won't be thrown off by listening to the off-air processed signal.

Special applications haven't escaped the design of this processor. The INOmini 223 easily handles unbalanced audio for applications such as campus AM where they may be using consumer equipment. Jim's firsthand experience with a California-based college campus broadcaster and past TIS applications served as inspiration for the onboard 30 dB output pad slide switch internal to the processor.

The supplied manual is written clearly though I'd bet the majority of engineers could get up and running simply by exploring the menus and running a signal through the processor.

Inside the Inovonics INOmini 223.

While the processor stores the current active settings, some users might miss the lack of multiple presets storage or daypart ability. I don't consider either of these deal-breakers because where can you find a versatile three-band processor like the INOmini 223 for under $1,000?

Because it uses modern surface-mount technology, most independent or group engineers aren't going to perform self-service. Inovonics provides the INOmini 223 with a three-year warranty in the unlikely event the unit requires repairs beyond that of a firmware update.

Jim mentioned to me that the older 222 would remain available in the product line for a while longer although it's expected that stations would opt for the additional performance afforded to them by the latest addition to their product line.

The INOmini 223 allows a station to reap the rewards of today's digital technology thanks to this feature-rich, budget friendly processor.

Bill DeFelice is former chief engineer of WMMM(AM)/WCFS(AM) in Westport, Conn., and webmaster of the History of Westport Connecticut Radio. His Part 15 website is HobbyBroadcaster.net.

ACOUSTICS

ANTENNAS/ TOWERS/CABLES

CCA FM8000G Trans 107.9, great cond; 4-Bay Jampro antenna w/deicers; 3-bay Shively antenna FM. D Brockman, 606-965-3436.

AUDIO PROCESSING (INCLUDES ON-AIR)

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Teletronix LA-2A's, UREI LA-3A's & LA-4's, Fairchild 660's & 670's, any Pultec EQ's & any other old tube compressor/limiters, call after 3PM CST - 214 738-7873 or sixtiesradio@yahoo.com.

Wanted: real plate reverb. abgrun@gmail.com.

AUTOMATION EQUIPMENT

WANT TO SELL

DIY-DJ Version 2.0 is now available. Over 500 copies of DIY-DJ, a Linux based radio automation system, have been distributed and now version 2.0 is available. Voice tracking, join satellite feeds, do unattended sports and remote events, temperature announce, scheduler, automatic cut editing on import, and much more. It's FREE. If you are using version 1.0 or would like to try DIY-DJ, go to krwsfm.com, register and download your free full version. The only thing we ask is that you let us know if and how you are using the software. Call (406) 679-0527 or email krws@digitaldevelopment.net for a copy today.

WANT TO SELL

1934 RCA 77A double ribbon microphone, originally used by Arthur Godfrey at WFBR Baltimore. 100% perfect condition. Contact Bill Cook, 719-684-6010.

WANT TO BUY

RCA 77-DX's & 44-BX's, any other RCA ribbon mics, on-air lights, call after 3PM CST, 214 738-7873 or sixtiesradio@yahoo.com.

MISCELLANEOUS

WANT TO SELL

I'm selling between 150 and 200 cassette tapes that consist of old-time radio shows, sports shows, some local New York radio talk shows, etc... Must take entire collection and the price is negotiable. Please call me for details and, my phone number is 925-284-5428.

Radio broadcasts of Major League Baseball, NFL, and some college football games that are on cassette tapes, approx 100 to 125 games, time period of entire collection os from the 1950's – 1970's, BO. Must purchase entire collection. Contact Ron, 925-284-5428 or ronwtamm@yahoo.com

WYBG 1050, Messina, NY, now off the air is selling: 8-channel Harris/Gates console; 250' tower w/building on 4 acres; collection of very old 78s dating back to 1904; 12' satellite dish on concrete base; prices drastically slashed. 315-287-1753 or 315-528-6040

WANT TO BUY

Collector wants to buy: old vintage pro gears, compressor/limiter, microphone, mixing consoles, amplifiers, mic preamps, speakers, turntables, EQ working or not, working transformers (UTC Western Electric), Fairchild, Western Electric, Langevin, RCA, Gates, Urei, Altec, Pultec, Collins. Cash - pick up 773-339-9035 or ilg821@aol.com.

2" plastic "spot" reels 6.5 or 8" diameter, as used for quad video. Wayne, Audio Village, 760-320-0728 or audiovlg@gte.net.

Equipment Wanted: obsolete, or out of service broadcast and recording gear, amplifiers, processing, radio or mixing consoles, microphones, etc. Large lots preferred. Pickup or shipping can be discussed. 443-854-0725 or ajkivi@gmail.com.

I'm looking for San Francisco radio recordings from the 1920's through the 1980's. For example newscast, talk shows, music shows, live band remotes, etc. Stations like KGO, KFRC, KSFO, KTAB, KDIA, KWBR, KSFX, KOBY, KCBS, KQW, KRE, KTIM, KYA, etc, I will pay for copies... Feel free to call me at 925-284-5428 or you can email me at ronwtamm@yahoo.com.

Looking for a broadcast excerpt of a SanFrancisco Giant's taped off of KSFO radio from 1959, interviews with Willie Mays, Dusty Rhodes & some play by play excerpts, also features a homerun by Willie Mays and Felipe Alou stealing second base, running time is 18:02, also looking for SF Giants games and/or highlights from 1958-1978 also taped off KSFO Radio. Ron, 925-284-5428 or ronwtamm@yahoo.com.

Looking for KFRC signoff radio broadcast from 1930 Andy Potter, running time is 0:22 & also the KLX kitchen the program guest is Susanne Caygill, a discussion of women's affairs with a long promotion for Caygill's appearance at a local store. Anne Truax, Susanne Caygill, running time is 13:44. Ron, 925-284-5428 or email ronwtamm@yahoo.com.

Looking for KTIM FM radio shows from 1981-1984 if possible unscoped. R Tamm, 925-284-5428 or ronwtamm@yanoo.com.

RECEIVERS/ TRANSCEIVERS

WANT TO SELL

Johnson Electronic SCA880 module, 67/92 Khz, 417-881-1846.

RECORDING & PLAYBACK HARDWARE

WANT TO BUY

1960s-vintage MacKenzie Repeater machines, magazines, spare parts and manuals, complete or "parts" machines considered, James, 870-777-4653.

Large or small collections of 16" transcriptions or 12" transcriptions, not commercial LPs. Bill Cook, 719-684-6010.

Schnader telescriptions 16 mm musical films produced in the early 50 s. Bill Cook, 719-684-6010.

Standard Short-tune series. Bill Cook, 719-684-6010.

TAX DEDUCTIBLE EQUIPMENT

Donations Needed: All Volunteer, Non-profit Low Power community radios stations need Equipment. Will offer tax deduction letter, You determine donation value, We will pay shipping. Equipment shared between three Wisconsin stations. Looking for Mics, Mixers, field equipment, etc. You name it. Email: Dan@WIECradio.org.

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3.5 KW	2000	Harris Z3.5CD, solid-state
3.5 KW	2006	Harris Z3.5CD, solid-state
1.3/3.5 KW	2006	Harris Z6HD- Tri-Mode HD
5 KW	1995	Harris HT5CD
5 KW	1992	BE FM5B
7.5KW	2006	Harris Z7.5CD, solid-state, 1-phase
10 KW	1998	Harris Z10CD, solid-state, 1-phase
10 KW	2002	Harris Z10CD, solid-state
20 KW	2002	Harris Z20CD, 2x Z10 Combined
21.5 KW	1990	Continental 816R2B
25 KW	1982	Harris FM25K with DIGIT
35 KW	1991	BE FM35B

Used AM Transmitters

10 KW	1988	Nautel ND10, solid-state
10 kW	2001	Nautel XL12, solid-state

Exciters & Miscellaneous Equipment

Exciters->Harris DIGIT, Continental 802B
Bird Model 8932, 10 kW air-cooled RF Load
Harris N + 1 Controller

Used TV Transmitters DTV & ATV
FLO TV Transmitters
Rohde & Schwarz Harris Maxiva

Please visit our website, www.fmamtv.com, for additional listings.

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Continental Electronics
HARRIS nautel
CROWN BROADCAST

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OMB, Rohde & Schwarz and Technalogix

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VHF and UHF (10 W to 10 KW)
TV Antennas
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READER'SFORUM

IT'S ABOUT VARIETY

Regarding "AM Revitalization Questions," Reader's Forum, Sept. 1 issue:

AM revitalized! This is not a complicated item. Give people what they want and they will listen in. The Class A stations serve a purpose ... and that is variety!

If all that there were was local (like FM VHF), I wouldn't bother to have a radio. The AM band is variety. I do listen to stations like WSM, WHO, CKLW, CFZM, WGN, WRCR, CFRX, WATR, WWCR, BBC-4 longwave for the program variety and news that you don't normally hear (this is where shortwave is tops).

Digital noise has prevented reception of WBZ, KDKA and others. Their own noise drowns them out — if it's not the hiss, it's the grinding sound. Furthermore, to use this digital mode, the main AM is degraded; highs are cut as well as the lows. Result: low fidelity.

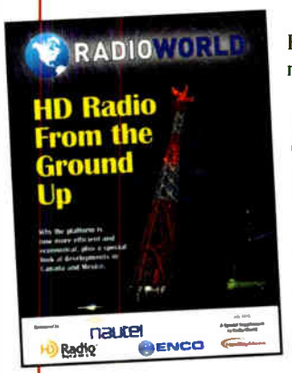
At this time, CFZM stands out. Just put the H.H. Scott tuner in wide mode, and who needs over-processed FM? Yes, they are mainly a music format. What a pleasant experience to listen to them at night.

The other problem is noise generated from cheap switcher supplies. That has to be stopped! Even electric toothbrush chargers and the big stuff like the new washing machines or motor-driven appliances with triac PWM drivers drown out even the car radio a mile away.

This rant is aimed at those that don't feel the need for variety — which is sorely lacking in this age of mega stations and cookie cutter formats. That will and has already driven folks away from radio. Go back to block format, local talent — "radio unscripted."

Mike Koscak
WA1MT

DON'T FORGET AM HD



I noticed that Radio World's entire supplement "HD Radio From the Ground Up" was geared towards HD FM. The only mention of AM was in the Nautel advertisements.

There are still a few AM stations transmitting HD Radio; but since you don't gain additional money-making channels (HD2 and up), you can't get nearly as much benefit from it, and since radio is just about making money, it makes one believe that AM HD is not worth the effort.

Very few manufacturers are making AM/FM radios for home use that can pick up both analog and digital on both bands — lots of car radios, but no table or portable radios. How much more can it cost to put a $50 car radio, two loudspeakers and a small power supply into a box?

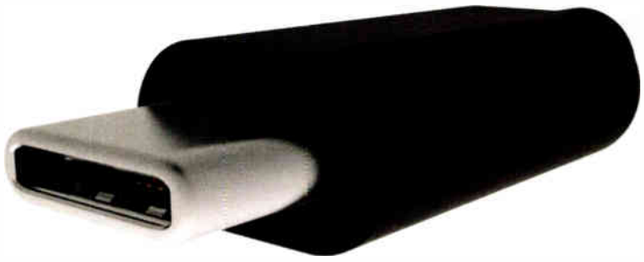
BestBuy had a portable HD Radio: FM only. It seems that when HD first came out, you could buy radios with AM-HD and FM-HD, but not now. At least one automaker has dropped AM entirely in their in-car entertainment systems because their vehicles create so much internal noise that they wipe out the AM reception. So it was easier and cheaper to just eliminate AM, and also AM-HD, rather than reduce the emissions from the vehicle computer systems.

I read a reader comment about trying to mandate HD Radio in all car radios, as FM was some 40 to 50 years ago. I bet there were no licensing fees then for FM; try to do that now with HD Radio and their fee structure.

Do you want some other technology to research? Try to buy a Wi-Fi/ internet tabletop radio. Every one has analog FM, possibly FM stereo, some have RDS. Absolutely none has AM. Some have iPod chargers and ways to interface smartphones, but no AM. They have two alarms and remote controls, but no AM. They can do wired or wireless networking, but no AM.

One side of me says AM HD was a bad idea from the beginning, and it should go away, but the other side says if it's really going to stay, then it should have way more product support than it currently has.

Bob Meister
Hamden, Conn.



USB VERSUS MINI JACK

I read with great disdain your small article in the Sept. 1 issue's News Roundup about USB [Type-C] taking the place of the mini jack in audio applications.

If they go ahead and replace mini jacks with USB, my days in engineering are surely numbered. The average audio guy isn't going to be able to simply wire up a cable for an innie or an outie and stick it in a hole to create an inexpensive, reliable audio interface for a lot of smaller broadcast equipment.

As I see it, until they get USB more stable and reliable, there's no way it can be used in a pro audio setting. It's bad enough that we have to use unbalanced audio and mini jacks for too much equipment interfacing as it is. I know it sounds like an oxymoron, but I'll take a mini jack any day over USB.

Here's just some of the USB interfacing flaws we already face today: USB can disassociate from a particular port when rebooting the device, so then your software mapping for the device goes to hell. Also, USB fails for no apparent reason because of fake power drains on the USB buss created by devices plugged into it, even when those devices aren't taking power form the buss. And USB drivers don't always operate at top speed; USB is as slow and clunky to implement as any serial device and impairs the transfers of high frequency analog signals.

I challenge you to find a USB oscilloscope that can measure broadcast frequencies, or even run correctly. USB scopes can barely do audio, let alone video or RF measurements.

And then there's the expense of everything needing another USB adapter hanging out of the equipment to get it into, or out of, the device. It's just more junk hanging off an already crowded table of equipment. How in the heck are you going to clip the USB converter on your hip along with you recorder and cellphone and everything else you have to carry?

The humble analog audio or video jack may seem low tech and not "hip" for modern day interfacing, but it sure is a lot cheaper, simpler and more reliable interface than putting another weak-kneed piece of digital tech between your signal and the transmission device or recorder.

How in the heck do you wire a microphone to go into a USB port without some tech know-how imported direct from China? At least analog cables are simple and can be serviced easily for opens or shorts. An analog cable requires no batteries or power sources to go bad.

When USB goes flooey, how does a jock service that on a live remote? People barely know how to use the tech we have already. And they want to add another thing in the chain to go wrong?

Also, is there going to be an analog to digital converter quality standard so we know what the heck were getting for frequency response? At least with analog, I pretty much know it's all there if amplified correctly.

With a bad USB A/D converter, the junk could royally screw up the fidelity of what's going into it, or worse, scramble the audio into digital mayhem, which already happens enough. At least with recorders, I mostly count on their A/D converters to be of reasonably high quality. If USB is used, I don't think the A/D converters are going to be that great.

There's more I could take issue with using the USB paradigm, but I'll let this be enough for now.

Marvin Walther
Chief Engineer, Carroll Broadcasting
Program Director, WIOS(AM)
Tawas City, Mich.

READER'S FORUM

FM CLASS C4

Regarding "Pai: Don't Neglect the FM Band," RW Oct. 12:

First, congratulations to Matthew Wesolowski of SSR Communications and WYAB(FM). His well-founded idea for a new FM Class C4 looks to have survived a bureaucratic black hole at the FCC, more than two years later after the proposal was initially offered. With Commissioner Ajit Pai's encouraging and affirmative comments in support of C4 at the 2016 Radio Show, we will hopefully see positive movement on the proposal.

As Wesolowski has stated, a C4 class would primarily benefit several hundred FM stations in rural and smaller city markets. With the commission's strong push in recent years for maintaining and increasing broadcast radio service in rural (and tribal) areas, including its firm prohibition of "rural into urbanized areas" station moves, a higher-power C4 class would make such service more financially viable for many commercial FM broadcasters in less densely populated areas.

I think the creation of a C4 class would also add greater interest and value to new FM allocations in future FCC FM auctions. As we saw in the previous FM Auctions 94 and 98, most of the new allocations were in rural and small town areas. In those auctions, many of the FM allocations justifiably received no bids because of their limited Class A signals, which only covered very sparsely populated areas.

Predictably, there have been some negative responses to the C4 proposal, and most notably from broadcast attorney John Garziglia. He argues that allowing hundreds of Class A FMs to upgrade to C4 would result in the forced displacement and termination of operations of an equal number of FM translators, many of which were only recently — and expensively — acquired by AM stations as part of the FCC's "revitalization" efforts.

Full-power FM broadcasters have also invested tens and hundreds of thousands of dollars in FM translators to create HD sub-channel stations, which often provide valuable and interesting niche programming that can serve sizable audiences, despite the limited 250-watt ERP signals of the translators. I will agree with Garziglia's reservations about potential interference from new C4 FMs to incumbent FM translators, but those concerns do not make the idea now dead and over with.

My further proposal, to assuage the legitimate concerns of the FM translator owners and operators and others like Garziglia, is that all FM translators that are already either operating, being constructed or applied for, would be specifically protected from displacement or termination of operations up until the day before a final report and order establishing an FM Class C4 is issued by the commission for publication in the Federal Register.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FM Class C4 Would Bring Welcome Relief

Why small commercial broadcasters should embrace Commissioner Pai's speech

COMMENTARY

BY MATTHEW K. WESOLOWSKI AND DAVID HONIG

Pai: Don't Neglect the FM Band

Commissioner spotlights Class C4 idea

What Can You Learn From 100 Radio Station Tours?

page 14

However, I would further require that this special FM translator protection be limited to licensees who are broadcasting a local signal, and not to the nationwide religious and other satellite programmers who are operating dozens to several hundred FM translators across the country and not providing truly local service. FM translators for these national satcasters would continue to retain their secondary service, subject to displacement by a local broadcaster looking to more effectively serve their local community.

With my suggestions above for protections for local owners and operators of FM translators, I strongly encourage the FCC to proceed with a Notice of Proposed Rulemaking to establish an FM Class C4. I hope that the other commissioners will see the value in the Class C4 proposal that Commissioner Pai does. Even two-plus years later, it is an idea whose time still remains, and strongly so.

Robert Lee
QXZ MediaWorks LLC
Corpus Christi, Texas

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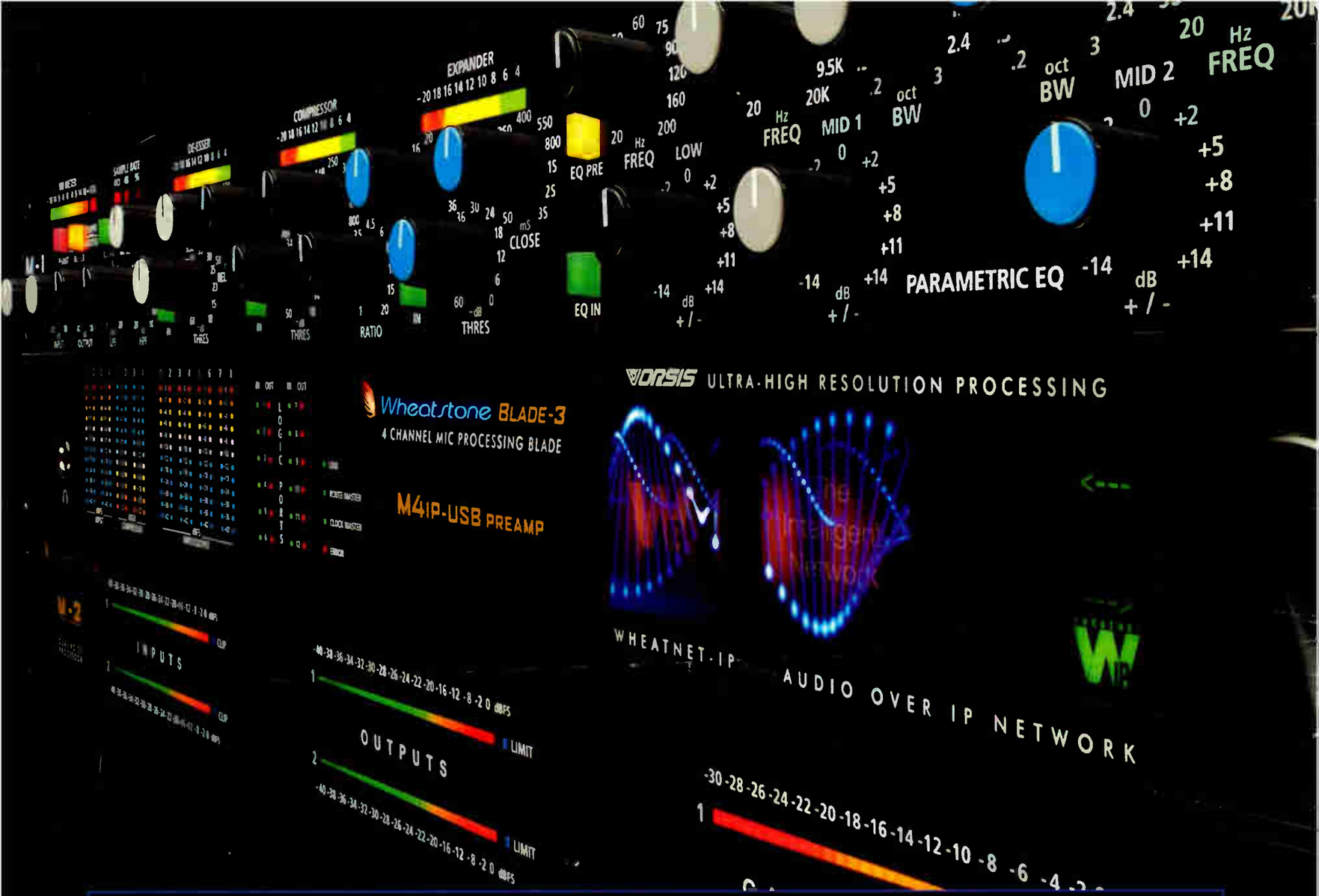

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