TVC-15

Broadcast Watermark Analyzer, Monitor, and Adaptive Controller

OVERVIEW

TVC-15 Overview

Broadcasting is a numbers business. Your success depends on what kind of audience you attract and hold. Audience size and composition is measured primarily by reports from private ratings agencies, and for most broadcasters, there's a direct link between those reports and a station's revenue. In electronically measured markets, having good tools—ones that help you understand the entire electronic measurement ecosystem—is essential to your station's competitive picture. With TVC-15, for the first time ever, you can detect, monitor and analyze how well each element in your programming supports watermarking. Measurements happen in real time, right off the air, *without depending on or being connected to a particular encoder.* Every 400 milliseconds, TVC-15's tone verification codec analyzes the actual code symbols in any audio you feed it, whether yours, or your competitors'. It will work from any source, live or recorded. A front panel graph of your station's watermark density gives you a granular, moment-by-moment display; you can also download reports to look at encoding quality over hours, days and weeks.

And for stations with a Voltair watermark monitor and processor, you can use TVC-15 to automatically adjust enhancement levels in real-time. TVC-15's Intelligent Adaptive Enhancement [AE] closes the feedback loop, letting you dynamically control Voltair processing based on moment-by-moment analysis of your actual air signal, pushing enhancement when it is needed, while backing off when not. For more advanced watermark monitoring, TVC-15 lets you See What Counts!

IN DEPTH

Electronic Measurement and Your Ratings

Broadcasting is a numbers business. Your success depends on what kind of audience you attract and hold. Audience size and composition are measured primarily by reports from private ratings agencies, and for most broadcasters, there's a direct link between those reports and a station's revenue. The viability of your station's watermarks is constantly varying, depending on your programming, the panelists' environments, and other variables. Changes can happen as quickly as individual syllables in an announcer's voice, or traffic noises on the highway.

How Watermarking Works

Ratings agencies bases these reports on *listener panels*, where each panelist represents many people in a market. In electronically measured markets such as the top 48 markets in the USA, panelists wear portable devices called meters. These meters register unique digital codes broadcast by each cooperating station. Thousands of these codes can be created in the course of an hour. In theory, whenever a panelist hears a station—on their car or home receivers, in a store or restaurant, or even from a colleague's Internet computer speaker—the meter hears the station's code, and the ratings system registers the listening.

The codes themselves sound something like a fax signal, and aren't pleasant to the ear... so they're deliberately 'masked' under louder sounds in the programming, in a process called *watermarking*. Masking is a psychoacoustic phenomenon that keeps us from hearing certain combinations of sounds, even though electronic meters can still detect them. But there are more than a hundred possible digital code symbols used by the meter-based system, and each requires slightly different characteristics in the masking sound.

A proprietary watermarking encoder provided by the ratings agency sits in your air chain, and looks for masking opportunities where it can embed hidden codes. When it hears a potential mask for a current digital code symbol, it generates the symbol and mixes it with the programming. Unfortunately, masks are evanescent, appearing and disappearing as your content changes... sometimes, many times per second. So the number of codes you can broadcast is also constantly changing, depending on your programming. Some content is a lot better at supporting watermarks than others. Silence doesn't support them at all.

- Got a talk show with a musical introduction? *Chances are the intro will have more encoding opportunities than the talk.*

- Running a sports show or drama? *Scenes with just play-by-play or dialog probably won't be encoded as well as those with crowds or other busy backgrounds.*

- Playing a commercial or promo? *Our research indicates a sung jingle usually encodes better than a dry voice-over... even though the spoken words might be more important to the selling message.*

Furthermore, masking requires the code symbol to be significantly softer than the masking audio. As your content gets softer, the encoding hardware has to make the codes softer. Environmental noise around the listener can interfere with those softer codes, even if your listeners don't mind the noise: Humans are very good at tracking meaningful voice or music in a noisy environment. Meters, unfortunately, aren't as smart: It's possible that a watermark signal, sent by the encoder at levels where it wouldn't be annoying in a quiet environment, doesn't get detected by panelists' meters in the real, noisy world.

Bottom Line

The viability of your station's watermarks is constantly varying, depending on your programming, the panelists' environments, and other variables. Changes can happen as quickly as individual syllables in an announcer's voice, or traffic noises on the highway.

Having good tools—ones that help you understand the entire electronic measurement ecosystem—is essential to your station's competitive picture.

What can be done?

25-Seven put years of research and testing into the technical issues with watermarking, and our groundbreaking Voltair processor works with your station's encoder to enhance watermarking codes as they're being generated. Voltair's enhancement can be varied by the station to accommodate different programming styles, and controlled by station automation for different dayparts.

Many stations have found Voltair effective to help make their electronically derived ratings a better match for the audiences they know they've got, and more reliable during hard-to-encode programming. But to really manage this kind of problem, you have to be able to quantify it.

Both Voltair and hardware provided by ratings agencies include ways to meawsure how encodable a program stream is. Voltair can be particularly helpful, with a minute-by-minute front panel display of code reliability, techniques to reduce randomness when calibrating Enhancement settings against ratings reports, and optional downloadable history reports and Excel graphs of a station's coding activity.

But neither system can give you moment-by-moment measurements of how well each element in your programming supports watermarks.

And neither system takes this information to the next level, *actually adjusting enhancement levels in real-time* to compensate for the wide variety of sounds that keep a radio station interesting.

You need to understand the entire electronic rating system. You need tools that can quickly and precisely measure how it works. And you need efficient ways to apply this knowledge so it can optimize your station's product.

That's why we developed TVC-15.

SPECIFICATIONS

We are constantly working to improve our products. Specifications and features are subject to change without notice

ANALOG LINE INPUTS:

- Input Impedance: >40 k ohms, balanced
- Nominal Input Range: +4 dBu
- Input Headroom: 20 dB above nominal input
- A/D Conversions: 24-bit, Delta-Sigma, 256x oversampling

POWER SUPPLY AC INPUT

- Auto-ranging supply, 100VAC to 240VAC, 50 Hz to 60 Hz
- IEC receptacle, internal fuse, on/o switch
- Power consumption: 55 Wa s

OPERATING TEMPERATURES

- 0 degree C to +40 degree C, <90% humidity, no condensation

DIMENSIONS AND WEIGHT

- Chassis Dimensions (ex protrusions): 19" (48.2 cm) wide 3.5" (8.9 cm) height 11.75" (30 cm) depth
- Chassis Weight: 14.5 lbs. (6.57 kg)
- Shipping Dimensions & Weight: Contact customer support

FEATURES & BENEFITS

Every 400 milliseconds — 150 times per minute — TVC-15's tone verification codec analyzes the actual code symbols in any audio you feed it.

- Raw symbol reliability is displayed on a constantly changing bar. The symbols that make up a complete station identification message are then processed through our proprietary algorithms.

A front panel graph of your station's watermark reliability updates every 400 milliseconds.

- That's fast enough to track individual program elements, or style changes in a song, or even the difference between a host and a call-in guest.

A front panel timer updates every time your station broadcasts a complete watermark message.

- It takes 4.8 seconds for the watermark system to assemble enough code symbols for full station identification. Under ideal circumstances1, TVC decodes a complete message every 4.8 seconds. Each time you do, the timer resets and appropriate message details are displayed.

- During periods of low masking (silence, spoken word, some music), the timer doesn't get as many chances to reset. It keeps counting, and changes color to alert you to the condition.

TVC-15 doesn't depend on a particular encoder, and doesn't have to be connected to it.

- You can connect TVC to an air monitor. Or to an Internet radio, a HD receiver, or any other way listeners are getting a signal with watermarking codes. Use any convenient analog source, and get an instant reading of how strong its codes are.

- TVC is switchable between encoding formats: Layer 1 (used for US radio) and Layer 2 (Canada and some other countries).

- You can equalize or distort the signal going to TVC to simulate low-quality radios. Or you can feed TVC from a microphone pointed to any radio or loudspeaker, in a quiet test room or noisy public space2.

- You can bias TVC's measurements using statistical noise simulation. Or you can record actual environmental noise and other possible interference, and mix it with the signal you're feeding TVC.

- You can feed it other stations' signals, to assure code reliability across a broadcast group... or even see how your competition is encoding. All this can happen in the privacy of your own local network, with nobody else able to see how you're making programming decisions.

- TVC's front panel and reports even identify when it sees different encoders, so you can scan multiple signal sources and sort them out later.

TVC-15 will work from any source, real-time or recorded.

- You can feed TVC recordings of your own or other stations' signals, whether they're from your program line, off-air monitors, or recordings from public spaces.

- You can use it offline with a spare encoder, to analyze program segments or production elements. TVC's fast response lets you compare different sub-elements within a program stream.

- You can use it with an automated switcher to cycle among various stations and program streams in your group to verify that encoders are working.

- Operation is completely flexible: Input can be switched between program sources or among different encoders without the need to recalibrate or reboot.

TVC-15 gives you downloadable reports and remote readouts.

- You can access TVC's password protected real-time display from any connected computer, even over the web. You'll know in an instant how well your programming is supporting watermark codes.

- You can download csv-formatted daily history reports of minute-by-minute actual code reliability, for custom analysis or for display in a program like Excel. Reports are private and you control who sees them.

And optionally, the big benefit for Voltair users:

TVC-15 can control your Voltair in real-time!

TVC-15's Intelligent Adaptive Enhancement [AE] closes the feedback loop, letting you dynamically control Voltair processing based on moment-by-moment analysis of your actual air signal.

You can take coding enhancement beyond simplistic "set and forget" or daypart setting strategies. TVC and Voltair work together like a continuous, intelligent automatic gain control on your hidden watermarks!

Have male and female hosts in a conversation? Got a call-in guest on a very compressed cell phone? Airing a stopset with jingles, dry announce, and produced sweepers? TVC-15 lets you compensate for all their different encoding requirements, continuously and with minimum annoyance to your listeners.

- Feed TVC-15 with your air signal, give it your Voltair's log-in address, and AE will constantly adjust your connected Voltair to provide just enough enhancement for the watermark confidence you want to achieve...while protecting the sound you want for your station, with minimum noticeable processing changes and artifacts.

Benefiting From TVC-15

Monitoring & Analysis of Station Encoding

It's vital to know that your watermarking system is working properly. Common wisdom in radio today is, "If you aren't encoding, you might as well be off the air."
But there aren't many ways to verify when you're encoding. The standard watermark encoder provides only a simple "no code" warning and basic error messages on an LCD. It won't alert you if a program stream is only marginally supporting watermarks. You might miss a lot of message opportunities before there's an alert.
The monitoring facility in Voltair is more powerful, sending initial warnings when 15 seconds have gone by without a valid message, and adding more warnings as the condition gets longer. Its front panel and optional downloadable reports give a minute-by-minute analysis of coding confidence, and let you simulate how various forms of environmental noise will affect it[5].

But both the standard encoder and Voltair's analysis can look only at the codes as they are being generated. Before those codes get to a listener, they'll often pass through a composite clipper or some data compression. Then they can be hit with transmitter issues or RF interference. In some installations, watermarking is also affected by airchain equalization or multiband compression.

You wouldn't consider your audio monitoring complete without a tuner, internet receiver, or some other form of real-world verification.

TVC-15 lets you do the same thing for your encoding.

You can feed TVC-15 with any audio signal, from a monitor receiver, a consumer radio that's flipping station-to-station, a field recording, a remote microphone, a router or patchbay... any source of analog audio.

On top of that, our sophisticated algorithms bring confidence analysis to levels that were never before possible with any system.

Near-instantaneous response:
- TVC-15's signal strength bar continuously responds to signal strength in the frequencies used by watermarking.

- It takes 400 ms for the encoder to create a valid code symbol, so TVC's front-panel graph updates that quickly: 150 times per minute. That's fast enough to indicate the differences when two on-air hosts have a conversation, or distinguish a sung jingle from a donut voice-over. The most recent two minutes of confidence measurements are displayed on a scrolling graph.

- A complete identification message requires 12 valid code symbols, carried on a combination of 10 different frequency channels. As soon as a valid ID is received, TVC's front-panel timer starts counting. If it takes too long for TVC to see a new valid message, the timer changes color.

More detailed information:
- A detailed 0 – 100% display of the likelihood each potential message will be received.

- Identification tags for each encoder. You can tell at a glance which of your streams—or your competitors'—is being analyzed.

- The timestamp encoded in each successful message. You can tell at a glance if an encoder's clock isn't accurate, a situation which can interfere with reliable ratings.

Complete remote access:
- TVC has a built-in, password-protected web server. You can log in with any connected browser, and assign different users the ability to either monitor TVC's readings, or remotely control its behavior.

Downloadable full reports:
- TVC's internal web server also lets you download a complete analysis of every signal TVC has received, available for any day it's been turned on. TVC reports are available as detailed files of each 4.8-second complete message analyzed over the course of a day, or as one-minute averages. They're in csv format, so you can analyze them with your own software, display them as an Excel spreadsheet, or compare them with station ratings reports. Reports are available only by password-protected log in: You control who sees the data.

Controlling Voltair Enhancement in Real-time

Voltair caused a revolution in station processing, enhancing watermarks so they'd have a better chance of being picked up by panelists' meters… even when a signal didn't support watermarking perfectly, or when a panelist was in a noisy environment. Voltair doesn't create 'phantom panelists' in the ratings system, but it helps make sure stations get credit for the listeners they really have. Unfortunately, too much enhancement can actually discourage listeners, breaking through the masking phenomenon, making watermark messages audible in the program stream. Listeners may hear this as extra noise or distortion. In extreme situations, they can be chased away.

It's a question of balance: You need enough enhancement to make codes reliable even during hard-to-encode program segments, or when there's a lot of environmental noise. But you don't want to annoy listeners. How much enhancement is *too much*? It depends on the program material, listening situation, and even listener expectations—the right enhancement for a news talk show might be too much for a high-quality acoustic music set.

Voltair includes tools including a "toggle test," to calibrate the amount of enhancement. It lets you add controlled amounts that can be correlated with ratings reports, so users can run their own tests. It also lets you preset three different Enhancement levels with GPIO control: You can have an "emergency watermark boost" button in master control, change enhancement when the host turns on his microphone, or have your station's automation system change enhancement for different dayparts.

But to get the highest level of control you'd need a trained operator, constantly monitoring your actual on-air signal with TVC, and continuously adjusting Voltair's enhancement for different air talents, audio sources, noise levels, and quality requirements. An operator who knows the personality and sound you want to present. One who's subtle enough to control watermark enhancement while avoiding abrupt or annoying changes. One who can pay perfect attention 24 hours a day, 7 days a week…

### TVC-15's Intelligent Adaptive Enhancement can be that operator.

TVC-15, together with Voltair, closes the feedback loop around your watermarking ecosystem. It acts as a "smart AGC" for Voltair enhancement, monitoring actual encoding, and adjusting the amount of enhancement as quickly as twice per second. But like a good transmitter processor, you can fine-tune its behavior to preserve your station's unique sound, setting minimum desirable confidence levels, as well as maximum enhancement to annoying artifacts, how quickly enhancement can be changed, and more.

Finally: complete, full-time control over ratings enhancement levels!

FRONT PANEL

TVC-15 gives you a live, highly detailed display of actual watermark symbols, evaluated every 400 ms. for confidence, completeness and reliability.
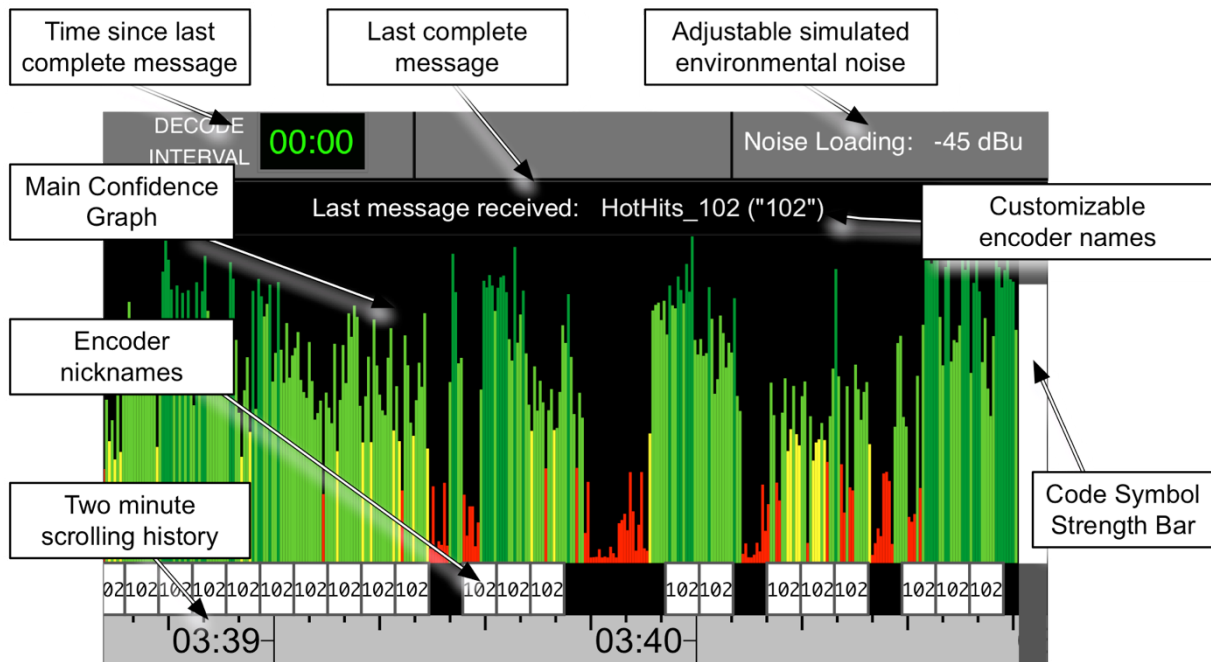
Our proprietary algorithms constantly analyze the input signal, looking for valid code symbols that the system combines to build meaningful station identifications. The input can be any real-world source: your off-air signal (or a competitor's), a test file from a production studio, an Internet stream, or even a live mic listening to a sample radio or a public space[7]. If there are symbols hidden in the audio, TVC-15 will report their details.

The front panel LCD is arranged for maximum usability:

Time since last complete message

This reports minutes and seconds since the last successfully decoded message. It flashes green and restarts from 00:00 whenever a complete and coherent message is received.

- Continuously short timings are good: They mean the program includes a lot of reliable messages. The display will be green.

- Longer times between restarts mean the programming isn't supporting codes well. The display changes to yellow if ten seconds have gone by with no messages, to red if thirty seconds have gone by. While there may be exceptions, chances are a station won't be identified during those times.

- The Interval Display is constantly updating, and gives you a quick go/no-go indication of the current signal.

Last Complete Message Received

This is based on the actual Encoder ID that accompanied the last valid message, along with an optional display of the time stamp that accompanied it. Encoder IDs are arbitrary and set by the ratings agency, and don't include a station's call letters or frequency. So TVC-15 identifies them simply as **Encoder A**, **Encoder B**, and so on. You can rename them easily (to show call letters, frequency, HD stream, or any other useful tag), and TVC will use that name every subsequent time it sees that encoder.

The end of this line includes a short nickname in quotes. This nickname is used for flags at the bottom of the Main Confidence Graph.

Simulated Environmental "Noise Loading"

If everyone listened to broadcasts using headphones, the signal would go straight from the receiver into human ears. If they also used an adapter cable, it could go straight into a panelist's portable meter as well. But most listening is done with speakers, and in a variety of acoustic environments. Whether a panelist is driving their car, attending a sports event, or in a bar that has radio or TV for background, ambient noise is a factor that can affect how portable meters receive your code. So, to help gauge the impact of different noisy environments, we let you apply various levels of simulated noise.

25-Seven's Voltair is designed for real-world, real-time watermark evaluations while a station is broadcasting. It lets you simulate different listening situations with built-in recordings of actual random-noise environments (traffic with car honks, households with baby cries, dishes clattering in restaurant) and apply them to your measurements.

TVC's, however, can also be used for accurate offline comparisons of different program streams. The randomness of real-world noise can affect these comparisons, depending on each programs' timing. So TVC can generate a signal to simulate real-world noise in a repeatable way. It acts as a constant "load" on the watermark energy. It lets you compare different programs with the confidence that environmental noise will have a similar influence on each. You can also use this Noise Loading to scale TVC's measurements, for more convenient analysis and graphing.

If you want, you can substitute your own noise source instead. This can be recorded environmental noise that you mix with the test signal before feeding to TVC. Or it can be a live mic in a real-world space, picking up both your program and the location's actual noise.

This shows the confidence level for complete messages during the past two minutes. A complete message consists of twelve individual code symbols in a valid pattern, so TVC-15 draws a new Confidence line every 400ms. The line height displays zero to 100% confidence, and its color provides a quick visual reference:

- Dark green lines indicate 80% confidence or better. This can be the result of programming choices, Voltair enhancement, or a combination of both.

- Light green lines show at least 40% confidence. Many of your watermarks will probably get through, unless there's a lot of environmental noise.

- Orange lines show at least 30% confidence. Watermarks may be getting lost. Red lines show less than 30% confidence. There's a good chance panelists' meters won't register your station at all, even if they're actively listening.

- No line at all is rare, but can occur during prolonged silences.

Code Symbol Strength Bar

This white line constantly changes height to show the strength of potential code signals in watermark channels. This bar reacts instantly, to provide visual feedback that encoding *could* be taking place. Actual code symbols require 400 ms to broadcast, and they're measured and displayed in the Main Confidence Graph.

Encoder Nickname Tags

These are abbreviated from the encoder name, and mark each time a complete message comes through. The tag will be either the last word of the name, if it's short enough to fit on the graph; or the first three letters of the last word.

Two Minute History

The time display on the bottom of the Confidence Graph is calibrated in minutes: seconds, based on TVC's real-time clock[10], to help you correlate confidence readings with moment-by-moment changes in your programming. This is *not* the time-stamp encoded on watermark messages.

Other User Controls

TVC-15 includes complete, flexible control over its operation. Clock and system settings, network access, how TVC controls a connected Voltair, and remote passwords can be set from the front panel. Most of these settings, along with maintenance and customization functions, are also available remotely using any web browser.