AARON 651

FM Rebroadcast Receiver

Installation & User Guide



R-D-S Radio Data System

INOVONICS BROADCAST

www.inovonicsbroadcast.com

PRODUCT REGISTRATION RECORD
AARON 651 – Serial No. _____
Purchase Date _____
Warranty Web-Registered?
Reg. Date _____ By: _____

Installation & Operation User Guide

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FM Rebroadcast Receiver

November, 2026
Firmware Rev. 1.0.0

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Section I

INTRODUCTION

AARON 651 PRODUCT DESCRIPTION

The AARON 651 is Inovonics' second-generation, professional-grade FM Rebroadcast Receiver.

Although the primary application for the AARON 651 is for FM 'translator' rebroadcasting, this receiver finds use in other program-origination and audio processing situations.

Features

Leading features of the Inovonics AARON 651:

- All-digital, Diversity-SDR (Dual-Tuner, Software-Defined Radio) offers off-air FM reception. The dual tuners can be split from diversity reception for cross-channel redundant reception of a common off-air feed.
- The 651 can rebroadcast these program sources: raw or regenerated off-air FM; internet streams; analog or AES-digital program feeds; uploaded audio files… all with multiple, programmable auto-failover options.
- The 651 can retain and supply fully-dynamic RDS data from the local playout system; off-air FM; metadata from streaming inputs; file names of uploaded backup-audio files.
- Comprehensive and versatile 5-band audio processing may be tailored to specific, multiple program sources with both factory-defined and user-programmable processing presets. A built-in test oscillator is included to aid setup.
- High-resolution FFT display of the receiver IF spectrum, MPX baseband, and audio sources from FM radio, analog, digital and streaming program inputs. Detailed metering and history of RF metrics, audio levels and BS.1770 (LU) loudness.
- Intuitive, menu-driven touchscreen setup, or use the built-in webserver and your laptop for quicker data entry and full remote-control access over any IP network. The web interface also supports full SNMP implementation.
- Local and remote self-logging alarms indicate audio, stereo pilot and RF loss, RDS error or 'hijacking' and streaming problems. Alarms are logged and can trigger personnel-selective email notifications.
- The BandScanner™ utility displays a spectrum plot of the entire FM band, identifying stations carrying RDS data and creating a list of stations and their specifics.
- The AARON 651 boots or resets in less than 20 seconds and draws just 13 watts from the AC mains.

AARON 651 TECHNICAL SPECIFICATIONS

Certain technical specs of the AARON 651 are either difficult to quantify in tabular form, or they do not adequately reflect overall performance in a real-world broadcasting situation. Explanations in the appropriate sections of the manual text further define and detail features and performance aspects.

TUNER PERFORMANCE

NOTES: Unless otherwise stated, all tests were made under these conditions:
RF input: 60dBµV at 98.1MHz
Stereo pilot injection: 9%
De-emphasis: 50µs or 75µs
Measurement Bandwidth: 20Hz-15kHz
Line Outputs: Analog and AES-Digital
Weighting: (ITU) refers to ITU-R 468 (CCIR-1k)

Receiver Tuning Range: 76.0MHz-108.0MHz in 100kHz steps.

Sensitivity: 10dBuV for 60dB (unwtd) Mono-FM SNR.

Mono/Stereo Frequency Response: 20Hz-15kHz, ±0.5dB.

Mono-FM SNR: >93dB (unwtd); >86dB (ITU).

Mono-FM THD+N: <0.005% (unwtd).

Stereo-FM SNR: >73dB (unwtd); >66dB (ITU).

Stereo-FM THD+N: <0.02% (unwtd).

Stereo-FM Separation: >60dB (20Hz-15kHz).

L/R Level Matching: ±0.1dB.

L/R Phase Matching: <0.6˚ at 15kHz.

FM De-emphasis: 75µs/50µs, selectable via menu.

Audio Muting: Low Signal alarm may be programmed to mute audio at any RSSI value between 75dBµV and the noise floor.

INPUTS & OUTPUTS

Diversity Antenna Inputs: Two, 50-ohm 'N'; maximum input: 120dBµV.

Composite/MPX Outputs (20Hz-90kHz measurement bandwidth; 60dBµV RF in)**:**

Analog (MPX 1 and MPX2)**:**
Impedance: 75-ohm (BNC X2)
Level: 1Vpp–6Vpp for 100% mod
Response: 20Hz-100kHz, ±0.15dB.
Stereo Separation: >50dB, internal generator; >45dB, FM-passthrough.
SNR: >65dB re: 100% mod (unwtd).
THD+N: <0.05% (unwtd).

AES 192 Digital-MPX:
Source: AES-Digital Out (Left Channel).
Sample Rate: 192kHz.
Response: 20Hz-75kHz, ±0.1dB.
SNR: >130dB.
THD+N: <0.0002%.

(continued)

INPUTS & OUTPUTS (continued)

Program Line Inputs:

Analog: Active-balanced (RJ45 StudioHub) accepts '0VU' line levels between –15dBu and +15dBu; +18dBu clipping; 20Hz-20kHz, ±0.3dB; >95dB SNR; <0.002% THD+N; ±0.1dB L/R level matching; <0.5˚ L/R phase matching at 20kHz.

AES Digital: Balanced (RJ45 StudioHub) accepts peak line levels between –30dBFS and 0dBFS at sample rates between 32kHz and 96kHz; 20Hz-20kHz, ±0.05dB; >138dB SNR; <0.0001% THD+N.

Streaming Input: HTTP/HTTPS Icecast, HLS with WAV, FLAC, Ogg (Vorbis, Opus), AAC (LC-AAC, HE-AACv1, HE-AACv2), MP3 audio formats.

Program Line Outputs: Analog and digital program line outputs may be switched between FM-pre-emphasized or FM 'normalized' (flat) response.

Analog: Active-balanced (RJ45 StudioHub) delivers –15dBu to +15dBu at 100% modulation; 200-ohm source; +18dBu clipping; 20Hz-20kHz, ±0.1dB; >100dB SNR; <0.002% THD+N; ±0.1dB L/R level matching; <0.5˚ L/R phase matching at 20kHz.

AES Digital: Balanced (RJ45 StudioHub) 24-bit, 44.1kHz or 48kHz sample rate; delivers –30dBFS to 0dBFS at 100% modulation; 20Hz-20kHz, ±0.05dB; >138dB SNR; <0.0001% THD+N.

Streaming: HTTP/Icecast stream with 44.1kHz or 48kHz sample rate. MP3, AAC-LC, HE-AACv1, HE-AACv2, Opus, Vorbis and FLAC selectable audio formats.

Network Port: RJ45 jack TCP/IP and UDP network connection for remote setup and operation, streaming I/Os; supports SNMP.

GPIO: 4 GPI, 14 GPO; screw-terminal connections; menu-assignable with selectable logic polarity. GPIs are opto-isolated, GPOs are NPN saturations to ground.

Headphone Jack: ¼-inch front-panel (TRS).

FAILOVER AUDIO PROTECTION

Four progressive (sequential) failovers may be selectively programmed to respond to audio, carrier or FM pilot losses and RDS data variances. Failover audio and RDS data will switch to alternate inputs or to uploaded backup audio files.

Backup Audio Files: Up to 4GB of WAV, FLAC, Ogg (Vorbis, Opus), AAC (LC-AAC, HE-AACv1, HE-AACv2), MP3 files may be uploaded.

AUDIO PROCESSOR / STEREO-GEN

AGC: ±15dB capture range with gated, dual-rate 'windowed' operation. The AGC section further provides variable subsonic filtering, crest-factoring phase rotation, 5-band consistency leveling and stereo image enhancement.

Parametric EQ: 4 sections with variable frequency, 'Q' and gain.

Bass Effects: Variable bass 'Punch' and 'Rumble' enhancement.

Compression: 5 band r.m.s./peak compression with selectable crossovers; variable master- and band-drive controls.

Final Peak Control: Wideband final peak control with independent HF limit/clip pre-emphasis protection.

Internal Test Oscillator: 20Hz-20kHz; 30dB attenuator.

Composite Clipper: 0dB-3dB clipping depth.

Processing Presets: 11 factory, 30 user-defined.

RDS/RBDS ENCODER

Radio Data System: RDS/RBDS, selectable via menu.

Fields Supported: PI, PTY, PS, RT, M/S, TP, DI, CT, AF

RDS Data Sources:

Internal RDS: Static (fixed) scrolling-PS and RadioText messages; telnet access via LAN port for station automation.

Off-Air: Pass raw RDS data from the tuned station or regenerate RDS and insert a translator-specific PI code.

Streaming Audio Metadata: Stream Title, Genre, Name (Icecast), Description (Icecast), Artist (HLS) and Album (HLS) may be selected to display in the scrolling-PS and RT fields.

(continued)

RDS Data Sources (continued):

Audio Files: File names of uploaded Backup Audio Files can be displayed in the scrolling-PS and RT fields.

Default Messaging: When expected PS and RT data is not received within a specified time period, default messages may be programmed to populate these fields.

BANDSCANNER™

An internal spectrum analyzer utility sweeps the entire FM band and creates both a spectrum display and a tabular listing of all signals received, including the RSSI value and RDS PI codes.

ALARMS AND LOGS

Alarms: Fault alarms include RF and stereo pilot losses, excessive multipath; RDS loss/PI error/RT not updated; FM, analog, digital and streaming input audio losses; stream metadata update not received. Alarms trigger front-panel indicators, local (GPO) tallies, webserver indicators and personnel-specific email notifications.

Alarm Logs: Alarms are logged and may be downloaded as daily, weekly or monthly CSV files

SNMP: All setup and operating controls and alarm functions may be placed under SNMP management.

MISCELLANEOUS

Timekeeping: The internal Real-Time Clock (RTC) automatically syncs with internet time and can follow Standard/Daylight-Saving time automatically. The clock backup battery is type CR2032.

Power Requirement: 88VAC-264VAC, 48Hz-63Hz; ('universal'); 13W.

Operating Environment: 32˚F/0˚C-122˚F/50˚C; 0% - 95% non-condensing relative humidity; 10,000ft/3048m

Conformances:

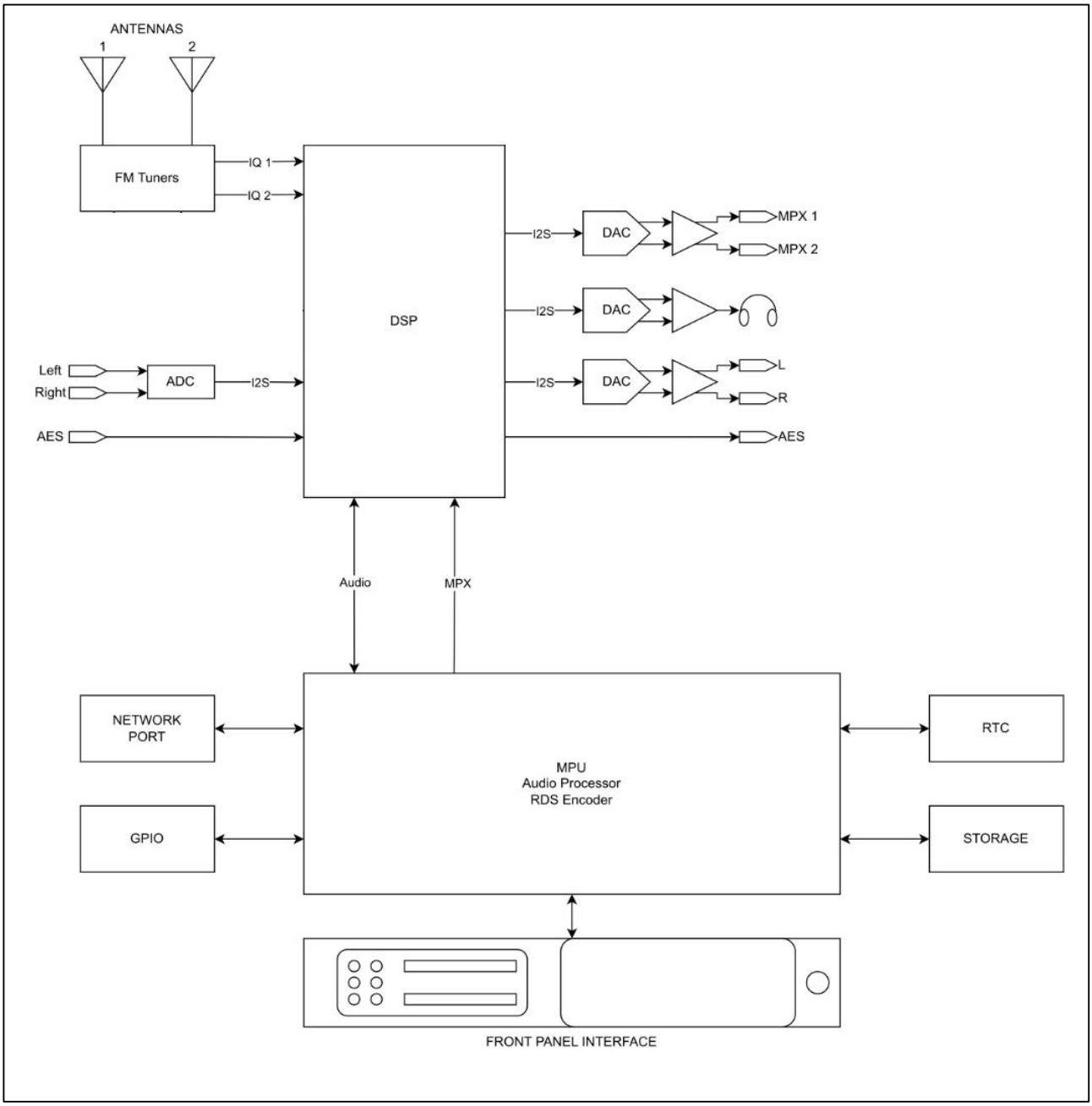
CE — EN50081-1, EN50082-1, 93/68/EEC

RoHS — 2002/95/EC

BLOCK DIAGRAM

As a rebroadcast receiver, the AARON 651 incorporates dual Software-Defined Radio (SDR) tuners, and numerous other elements in its design that make it almost totally DSP-based. Virtually all its functionality is provided through firmware coding.

This Block Diagram illustrates product basics, but the signal flow has been deliberately organized as if the AARON 651 were instead a perhaps-more-familiar *analog* design. This should give the reader a more understandable functional representation of the product, although the actual signal path may well deviate appreciably from what's shown.



Block Diagram, AARON 651 FM Rebroadcast Receiver

Section II

INSTALLATION

GENERAL

This section of the manual addresses the physical installation of the AARON 651 at its operating location… the 'nuts & bolts' specifics of connecting the unit. This section also references specific pages where pertinent setup adjustments are discussed.

NOTE: The front-panel and webpage menu trees are very similar in their organization, but do be advised that the two menus may vary slightly. Nonetheless, it should not be difficult to locate a called-out menu item in either list.

Menu callouts in this manual are presented in This Typeface, and descending levels are delineated by an arrow →. All-caps callouts IN THIS FONT will generally refer to rear-panel connector designations.

UNPACKING AND INSPECTION

As soon as the equipment is received, inspect carefully for any shipping damage. If damage is found or suspected, notify the carrier at once, and then contact Inovonics.

We recommend that you retain the original shipping carton and packing materials for return or transshipment if necessary. If returned for Warranty repair, shipping damage sustained as a result of improper packing for return may invalidate the Warranty!

IT IS IMPORTANT to register the Warranty of your AARON 651. This assures coverage of the equipment under terms of the Warranty, provides a means of tracing lost or stolen gear, and adds the user to a database for specific service instructions or software/firmware updates when issued. Register online at:

https://inovonicsbroadcast.com/support/productregistration

NOTE: Many users choose first to familiarize themselves with equipment on the bench or at their desk, in which case they may immediately turn to Section III that describes AARON 651 setup and use. When the time comes, do please refer back to this section to confirm proper physical installation and interconnection with other station equipment.

MOUNTING

Rack Requirement

The AARON 651 mounts in a standard 19-inch equipment rack and requires only 1¾ inches (1U) of vertical rack space. We recommend plastic or fiber washers to protect the painted finish around the mounting holes.

Heat Dissipation

Consuming miniscule energy that belies its powerful performance, the AARON 651 itself generates negligible heat, thus it has no noisy internal fan and bothersome filter to change or wash. The unit is specified for operation within an ambient temperature range between freezing and 120˚F/50˚C. Because adjacent gear may radiate substantial heat, be sure that the equipment rack is adequately ventilated to keep internal temperature below the specified maximum ambient.

AC (MAINS) POWER

The AARON 651 has an internal 'universal' switching power supply that accommodates main voltages between 88VAC and 264VAC. Self-protection circuits internal to the power supply module obviate the need for an external fuse.

The detachable IEC-type power cord supplied with the product is fitted with a North-American-standard male plug. If you need to replace the mains plug with another, you will find that the individual cord conductors are color-coded in one of two ways. US standards specify black for AC 'hot,' white for AC neutral and green for earth ground. European CEE standards specify brown for AC 'hot,' blue for AC neutral and green with a yellow stripe for earth ground. Please keep these straight.

RADIO FREQUENCY INTERFERENCE (RFI)

Location

Although it is expected that the AARON 651 will be co-located with FM transmitters, do practice care and common sense in locating the unit away from *abnormally* high RF fields.

Ground Loops

Because the unbalanced FM-composite MPX OUT 1 and 2 are referenced to chassis ground, a mains frequency or RF ground loop could be formed between cable shield grounds and the AC power cord ground. A 'ground-lifting' AC adapter may remedy such a situation, although the chassis must somehow be returned to earth ground for safety. Generally, being screwed-down in the equipment rack will satisfy the safety requirement.

ANTENNA INPUTS

The rear-panel ANTENNA 1 and 2 connectors are 50-ohm 'N' inputs to the two SDR receivers. An 'N' to 'F' adapter is supplied, and adapters to other connector types are readily available.

Many factors will guide your selection of antennas, not the least of which is the level and purity of the off-air signal. Although the selectivity of the AARON 651 is remarkably good, it's not impossible that a band-pass or band-stop filter may be required for situations where the receiver is co-located with high power transmitters.

COMPOSITE / MPX OUTPUTS

The MPX OUT 1 and 2 BNC connectors are independent, unbalanced composite/MPX sources with 75-ohm source impedance. Levels may be independently adjusted with sliders under Setup → Audio/MPX Outputs → MPX1 Level and MPX2 Level. The open-circuit (unloaded) peak-to-peak voltage is indicated beside the sliders, and may be adjusted between 1Vpp and 6Vpp, corresponding to ±75kHz (100%) carrier deviation.

PROGRAM LINE INPUTS

Primarily due to the limited rear-panel space, 651 program audio I/Os utilize Angry Audio's popular StudioHub™ RJ-45-jack interconnect system. StudioHub pinout particulars may be found on the Angry Audio website:

https://studiohub.com/wp-content/uploads/2019/10/AAPinoutandAdapterGuide.pdf

When connecting with equipment that is not StudioHub-ready, adapters to interface with XLR connectors are supplied with the AARON 651, and are additionally available from various vendors.

Analog Line Inputs

The StudioHub ANALOG INPUT carries both the left- and right-channels. These are high-impedance, electronically-balanced 'bridging' inputs that accept nominal "0VU" levels between –15dBu and +15dBu. The incoming analog program level is displayed under Setup → Audio Inputs → Analog Level, and adjusted with the Analog Trim slider.

AES Digital Line Input

The StudioHub DIGITAL INPUT is a balanced, transformer-coupled digital stereo program input conforming to AES3 specifications. This 16/24-bit input automatically accommodates sample rates between 32kHz and 96kHz, and nominal "0VU" peak levels between –30dBFS and 0dBFS. The incoming AES-digital program level is displayed under Setup → Audio Inputs → Digital Level, and adjusted with the Digital Trim slider. Digital Status will advise of a Locked or a No Lock condition.

PROGRAM LINE OUTPUTS

AARON 651 digital and analog line outputs are available simultaneously, each with its independent settings.

Analog Line Outputs

The StudioHub ANALOG OUTPUTS on the rear panel are electronically-balanced. This means that they are ground-referenced and *not* transformer-isolated.

Under Setup → Audio Outputs, the Analog → Source may be selected from the drop-down list, and then adjusted to any nominal, "Zero-VU" line Level between –15dBu and +15dBu. The dB figures shown alongside the slider represent the *unloaded* output level. These outputs have a resistive source impedance of 200 ohms. An old-school 600-ohm-terminating load will drop the actual level 2.5dB below the Analog Level shown.

This menu section also sets the output characteristic. Selections marked (Pre-Emphasized) or (FM-Pre) follow the 50µs or 75µs FM pre-emphasis curve. (FM-Flat) is the de-emphasized output with a flat audio response, yet conforming to the overload limits defined by pre-emphasis. Your selection will depend on whether your exciter requires a pre-emphasized feed or has internal pre-emphasis. These and other selections are detailed on Page 55.

AES Digital Line Output

The rear-panel StudioHub DIGITAL OUTPUT is a balanced, transformer-coupled digital output conforming to AES3 specifications. AES3 program audio is available with 44.1kHz or 48kHz sampling. Access to setup selections is in the Setup → Audio Outputs → Digital section.

Just as described above for the Analog Line Output, an FM-Pre (pre-emphasized) an (FM-Flat) and the other source choices are selected here. The Digital Out Level slider sets the level, the notation next to the slider corresponding to program peak levels between –30dBFS and 0dBFS.

AES192 Digital Composite/MPX Output

In the context of the FM broadcast plant, the term, 'AES192' does not pertain to the NIST Advanced Encryption Standard. Rather, the term used here describes digitization of the entire FM multiplex signal, sampled at 192kHz. This includes the audio baseband, stereo pilot, 38kHz L–R subcarrier and 57kHz RDS subcarrier. This option may be selected under Setup → Audio Outputs → Digital Source → MPX (AES192) to feed an exciter having an AES192 input. In this case, only the left-channel path (defined by AES3) is employed.

NETWORK PORT

A standard RJ-45 network jack is used to connect the AARON 651 to a Local Area Network (LAN) and from there to the internet. Networking permits full remote control and input/output audio

streaming, plus full SNMP functionality. A network setup explanation begins on Page 56.

GPIOs

Removable rear-panel screw-terminal strips give access to four GPI (General-Purpose Input) and fourteen GPO (General-Purpose Output) terminals. Simply pull the screw-terminal strips straight out to make your wire connection easier.

These terminals are programmed under Setup → General Purpose Inputs / Outputs. GPOs are singly and selectively assigned to reception and other fault or unexpected-behavior alarms shown on the pull-down Type menu.

GPIs are thoughtfully included for future applications.

GPOs are easily programmed. Click Type: ⌄ and pick a fault condition, and select the Polarity:, either Active Ground (a closure) or Active Open (open circuit), as required to indicate an alarm condition on the external equipment.

GPIs and GPOs both show a current Status (Active/Inactive), and may be assigned a Polarity (Active Open or Active Ground). GPOs employ isolating optocouplers, and both the anodes and cathodes are available on the screw terminals. Current-limited +5Vdc and chassis-ground terminals are included as well.

The GPIs are opto-coupled, with both the anode and cathode of the phototransistor available. GPOs are NPN transistors that saturate to ground.

Section III

THE AARON 651 FRONT PANEL

You may place the AARON 651 in service either through local, front-panel touchscreen setup or by using the webserver interface. Touchscreen and webserver-page menu trees are arranged in much the same order, with web-based operation, using a laptop keyboard, admittedly the faster and easier option.

All 651 settings are accessible through the webserver, but some cannot be made from the front-panel touchscreen. Nevertheless, we are going to address the front panel first, as some understanding is needed to connect with the webserver utility. We do favor web-access setup of the 651 and will defer to it in subsequent sections during explanations of features and operation.

When AC power is first applied, or following a power interruption, 'boot' (startup) time of AARON 651 is under 20 seconds. Rest assured that setup and reception parameters in use previous to a power glitch are reloaded instantly from non-volatile memory into the processing core.

NAVIGATING THE TOUCHSCREEN

All setup and operating adjustments of the AARON 651 are under firmware control. There are no jumpers, switches or mechanical potentiometers. The front-panel touchscreen and the built-in webserver pages address all settings and adjustments.

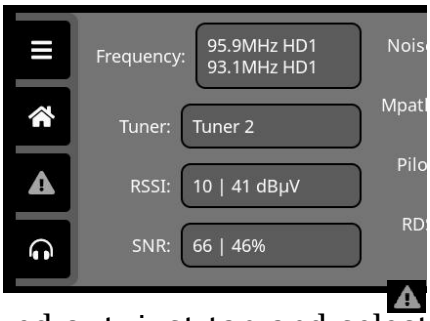


The LCD Touchscreen

The LCD touchscreen occupies the right side of the panel and presents the intuitive setup menu tree in an easy-to-follow format. This display does employ a screensaver, so when the screen either dims or disappears, simply tap the screen once to bring it back to life. No changes will be made with this wake-up tap. Setting the screensaver mode and timeout is explained in the next subsection.

Tap the 'hamburger' ☰ at the upper-left of the touchscreen to bring-up the Main Menu, which is harmonized with the very similar webserver Main Menu. Touchscreen navigation will allow you to check meters and other graphic displays, and also let you adjust most setup parameters from the front panel. But again, the web method is the easier and recommended way to set-up the 651.

Tap the little house icon to pull-up the Now Playing Home Screen.



An alert icon will turn red when one or more of the alarms is active. When the icon is red, you may tap it to see the Alarm Status for the full complement of 18 fault alarms. That screen will then allow you access to all the alarm setup parameters. When the icon is grayed-out, just tap and select Alarms → Alarm Status from the Main Menu.

The headphone symbol launches a screen for adjusting Headphones Volume and selecting the Headphones Source, or what you will be listening to. (This does not change the rebroadcast source.) Simply plugging a pair of headphones into the front-panel jack launches the screen automatically. To escape the screen, tap anywhere in the blurred-out area of the touchscreen.

Left/Right Audio Metering

LED-segment meters to the left of the touchscreen indicate left- and right-channel audio levels of the 651 rebroadcast program output. This same metering is duplicated at the top of each web-server page as well.

These meters have true peak response, and proportional scaling to optimize accuracy, display range and resolution. Peak-hold segments ride atop the two LED strings.

The display reflects the normalized output of the internal multi-band audio processor, and gives a good indication of the re-transmitted program dynamics. Do keep in mind, however, that when the 651 Audio Source is set to FM (Passthrough), the level meters will indicate the output of the tuner, directly, and will show overmodulation or other irregularities of the off-air signal.

Local Alarms

Eight front-panel LEDs at the far left of the panel give immediate indications of the more critical FM reception faults. To view the full complement of 18 fault alarms, navigate to → Alarms → Alarm Status on the touchscreen.

TOUCHSCREEN SETTINGS

Instructions in this subsection apply to setup using the front-panel touchscreen, and include the few items that are not found on the webserver pages. Navigation instructions imply starting from the hamburger icon.

Security and Passwords

Under → Admin → Security, you are able to enter or change passwords for local Front Panel users, as well as for the two-tier Web Admin (read and change settings) and Web User (read-only) users.

Password management from your computer keyboard is a far faster and easier method than using the touchscreen, so you might want to refer to Page 60 for working in that mode once you're up and running with remote webpage access.

Nevertheless, the password entry screen, shown below, should be fairly self-explanatory. Once a password is entered, touch either the ↵ or the ✓ to save the entry. The keyboard icon takes you back to the previous menu level without saving.



Panel Display Brightness and Timeout

☰ → Admin → Display/Meters opens a screen to edit the visual properties of the front-panel readouts. At the top of the list, Meter Peak Brightness manages the brilliance of the white LED bargraphs that display the audio component of the MPX output. The peak-hold segments that ride the top of the display bars are independently adjustable with the Meter Peak Hold Brightness, generally set visibly brighter than Meter Peak Brightness.

Alarm Brightness controls the group of eight red-LED alarm indicators, and Display Brightness sets the working (awake) intensity of the touchscreen backlight.

The touchscreen is programmed to either dim or go completely dark after a preset hands-off interval. Touch ☰ → Admin → Display/Meters → Display Timeout to set the slider for any interval between 5 min and 60 min. The Display Dim on Timeout setting selects either a dimmed (On) or totally blacked-out (Off) display.

Factory Defaults and Reboot

☰ → Admin → Utilities → Load Factory Defaults performs a quick restoration of all factory-default setup parameters followed by a reboot. This action will not turn back the clock to an earlier firmware version, but… *you will lose all setup options and tuner presets.* All these settings may be saved, however, using the webserver as described under **The Hardware Profile** on Page 61.

☰ → Admin → Utilities → Reboot simply reboots the unit, just like an AC-mains power interruption. No settings are lost or changed with a Reboot.

651 Product Info

The ☰ → Admin → Product Info screen shows the Serial Number of your 651; the Firmware Version currently running; the Uptime, or how many days, hours, minutes and seconds since the last reboot; and even the CPU Temperature in both Centigrade and Celsius!

Section IV

USING THE WEBSERVER INTERFACE

GENERAL

The 'responsive' design of the AARON 651 webserver interface provides an optimal viewing experience across a wide range of connected devices. A minimum of resizing, panning or scrolling is required with any device, from desktop computer monitors to tablets and mobile phones.

The previous section of the manual introduced the AARON 651 touchscreen. Suffice it to say that setup is easier and faster with a conventional keyboard, once the unit's webpages can be brought up in a computer browser.

Most 651 operations may be performed using the front panel touchscreen, and the webserver and touchscreen menus are arranged in very much the same manner. Where there are significant differences, the discrepancies will be noted. Most all menu itmes are available either way, so if one seems to be missing, just look around… it's there.

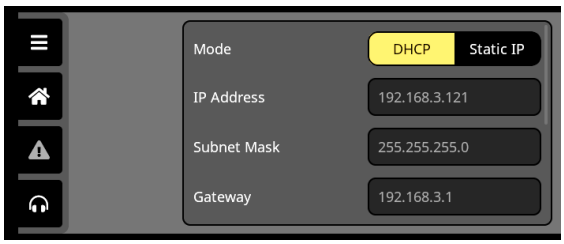
The balance of our explanations of AARON 651 setup and operation will utilize the unit's built-in webserver, and the multiple pages (webpages) that display real-time metering and graphic readouts, and allow audio monitoring and full remote control of the product's setup and operation functions.

CONNECTING TO THE INTERNET

Connect AARON 651 and your computer to the same Local Area Network (LAN). Simply cable the 651 rear-panel NETWORK PORT jack to your router, and the physical LAN port of your computer to another LAN jack on the same router.

Obtaining the 651 IP Address

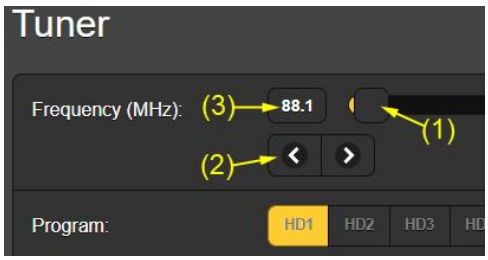
From the front panel, navigate to ☰ → Network. The factory Mode setting specifies DHCP assignment of the unit's IP Address. Do please accept that assignment for the present and jot it down. In this example, the IP of the 651 is 192.168.3.121. If your application calls for a static IP, the Mode and a good number of other networking parameters may be changed (see Page 56), but we recommend you do that following this initial setup example.



In your open browser, enter the full IP address shown on the front panel under ☰ → Setup → Network → IP Address into the browser address bar, and hit Enter. The Now Playing page will be the default screen, with a Main Menu column along the left edge of this and all other webserver pages.

Tuning the Radio

When first powered-up, the Now Playing webpage will show erroneous or missing data in the various info boxes. Connect an antenna to the unit and scroll down to the Tuner section on the Now Playing page. Click and drag the Frequency (MHz): slider (1) to tune in a local station. If you just click the slider once, then you will also be able to use your keyboard arrow keys to step the frequency up and down in 100kHz increments. You may also tune by clicking the webpage < and > (down/up) buttons (2), or simply highlight and overtype the displayed frequency (3).



The next manual section, Section V, will step you through the internal webserver's Main Menu, item by item.

Section V

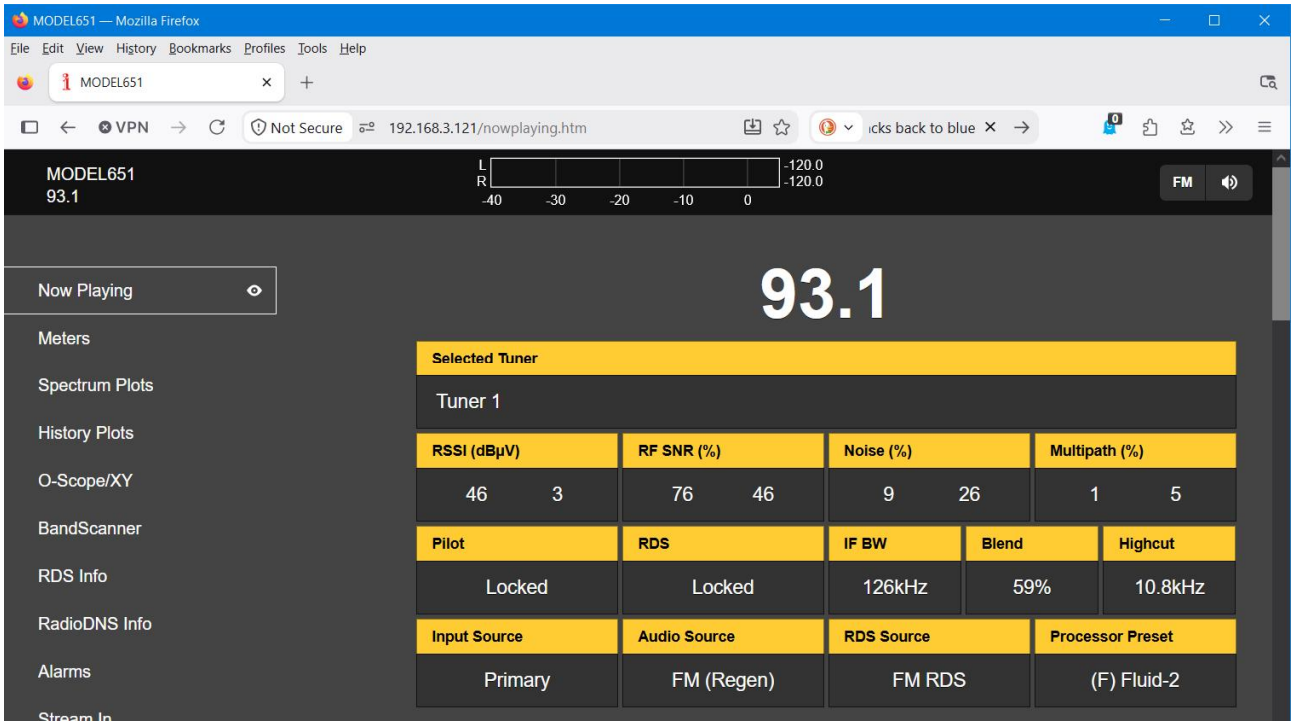
THE MAIN MENU

This section of the AARON 651 manual follows the Main Menu of the product as viewed using the internal webserver interface. As stated previously, the webserver-and-laptop approach to setting up the product is by far the most efficient means of navigating the plethora of setup options, entering data and making adjustments. The front-panel touchscreen offers an on-site alternative to the webserver, and its menu tree follows the webserver Main Menu organization fairly closely.

The following discussions cycle through Main Menu topics in the order listed at the left of the webpages.

NOW PLAYING

The image below shows the top portion of the Now Playing webpage, aspects of which will be discussed on following pages.



The Browser Address Bar

Just above this Firefox browser's address bar is a tab that displays the Inovonics logo and the webserver's Hostname. This is the page we opened by entering the IP address of the 651.

On the Network webpage, when mDNS is turned On, then any device on the local network can access the 651 by entering the Hostname followed by '.local' in any browser's address bar, Example: model651.local. This method is not case-sensitive.

You may change the Hostname: on the Network page if, say, you have two AARON 651s and wish to distinguish one from the other, or simply to nickname the product to your liking.

Program Levels and Web Audio Monitoring

The top black bar also shows the Hostname and displays the frequency it's tuned to. Level meters in the center show left and right audio channels of the program being rebroadcast. Readings replicate the LED bargraphs on the front panel, and additionally include a numerical value for the held program peak.



Click the loudspeaker icon toward the far-right to listen with your computer/device speakers. Click the box just to the left of the speaker icon for a drop-down menu to choose off-air FM, the Analog In, Digital In and Stream inputs to the 651, or the normalized (flat) output of the Processor. The Follow Input choice monitors whatever program input source is currently selected for rebroadcast.

Selecting listening options will not affect what's going out over the air. For instance, you may click back and forth between FM and Stream to compare a backup program source with the current program source. One thing to remember is that there can be a significant delay in this listening channel; several seconds, in fact, even plugged into the same LAN. This can make 'source surfing' a bit frustrating, not unlike 'channel surfing' in the age of digital television.

Multiple listeners may camp onto this feature, but keep in mind that all will have the ability to switch the listening source. The streamed output of the 651 may be made available to listeners without access to the webpages interface; this 'casual listening' feature is explained on Page##.



Password-protected operation will place a 'sign-out' button to the right of the loudspeaker icon, as pictured here. Click this for a 'clean exit' from the 651. This will also ensure that a later user of the same computer won't be automatically signed-in.

The Main Menu

Each webserver page has the Main Menu in a column at the left side of the page. Following this Now Playing page discussion, Main Menu items will be explained individually in the subheading menu sequence.

Selected Tuner

The 651 has two FM tuners for true diversity reception of the off-air signal. When two antennas are connected, the 651 uses metrics from each tuner to utilize the one that will give best reception, or use the two tuners in combination if the result is better than either tuner alone. In our example on the previous page, only Tuner 1 is in use.

RF Signal Metrics

Beneath the Selected Tuner identification area, rows 2, 3 and 4 of that matrix include readouts of tuner reception parameters. Row 2 gives basic characteristics of the received RF, showing numbers for both Tuner 1 and Tuner 2, side by side. Included is

RSSI, the incoming signal strength in dBµV; RF SNR, a percentage measure of signal-to-noise in the RF domain; and measurements of Noise and Multipath, in percent, relative to total channel energy. The 651 uses these four parameters to determine which tuner, or combination, will deliver best off-air reception.

FM Metrics

Row 3 gives additional reception information specifically for for the Selected Tuner in use. Pilot will tell whether the 19kHz stereo pilot tone is sufficiently well received to be Locked for proper reception, or is in a No lock, forced-monaural condition. RDS similarly displays a Locked or No Lock status for RadioData. IF BW displays the current IF bandwidth, whether this has been manually selected or determined by reception metrics, as discussed shortly.

What's the Output?

Row 4 of the matrix gives information concerning the current Input Source, whether Primary or Backup 1, 2 or 3 is being transmitted. Audio Source names the program feeding the MPX and line outputs, and RDS Source identifies what's originating RadioData. Processor Preset is the audio processing preset currently selected.

The Alarm Panel

The next item down on the Now Playing screen is the status display of all alarms that the AARON 651 is capable of indicating. There is a total of 11 alarms, although the front panel LEDs display status for only the eight considered most critical.



Callouts (titles) for alarms that are not enabled will be grayed-out. Once you have set the alarm's parameters and make that alarm active, the callout will turn white. When the alarm is triggered, the simulated LED to the left will glow red. Alarm setup is explained under its own subsection of the manual, beginning on Page 35.

The Tuner and its Settings

The two tuners for off-air FM reception are set up in the next four panels beneath the alarm readouts on the Now Playing webpage.

Diversity Reception

Link Tuners: On is the usual operating mode, and gives Maximum-Ratio Combining (MRC) diversity reception when the rear-panel ANTENNA 1 and ANTENNA 2 'N' connectors are routed to separate antennas. It's not within the scope of this manual to fully explain the different modes of 'diversity' reception, but basically two sources of the same signal are compared for quality, and either the best signal is automatically selected, or the two signals are combined as weighted-sums. The two antennas may favor one polarization or the other, may be aimed in slightly different directions, or simply physically separated by a wavelength-specific distance.

Unlinking the Tuners

Link Tuners: Off will pop-up a second tuning utility, which may be set to a second off-air source of the same audio program to rebroadcast. This might be a translator or LPFM 'filler' that can be trusted to provide a useable signal when the main signal fades or encounters interference, the AARON 651 automatically select-

ing the better signal source. Again, the two antenna inputs allow independent off-air optimization, although all other selectable tuner properties remain common to both.

Switching between the two tuners is automatic with no manual override, but off-tuning or disconnecting the antenna of one tuner will certainly force the other into service, should you need to confirm proper operation during setup.

The several methods of tuning the radio were previously described. Briefly, grabbing the slider, using on-screen or computer arrow keys, or overwriting the frequency.

Tuner Options

You'll find the first five tuner setup options just beneath the Frequency (MHz): tuning slider.

IF Bandwidth: defaults to Auto, bandwidth then automatically based on reception conditions. This would be the proper selection in the majority of situations. Click ⌄ for a drop-down list of alternative manual selections, which may prove useful in further reducing channel noise and interference at your option.

When it is turned On, Channel EQ: shapes the IF passband to help correct multipath distortion.

MPX Bandwidth: constrains baseband response in the FM Pass-through operating mode. For example, reducing bandwidth when SCA or RDS subcarriers are not utilized may improve reception of the recovered audio program. If subcarriers are to be passed-through, be sure this option is set to meet those bandwidth requirements. The spectrum display built into the AARON 651 may be an aid in this matter; see Page 28.

Alarm Based On: selects the tuner, or tuners, that can initiate alarms, such as Low Signal or Audio Loss. Tuner 1 is the default, but other options may be selected, depending on the Link Tuners: setting for diversity or cross-channel operation. The alarm setup you eventually determine will apply to both tuners, hence the option of selecting a single tuner, either, or both.

FM Stereo Mode heads the next options menu list. Here you may select Mono, Blend or Stereo FM reception. The 651 allows automatic or user control over the stereo-blending function based on: RSSI (dBμV):, the incoming signal strength; SNR (%):, a signal-to-noise metric in the RF domain; and Noise (%):, which factors-in noise components outside the audio program signal portion of the MPX baseband. Factory-default values have proven helpful over a range of cases.

Best results will, of course, result from programming thresholds according to the specific off-air signal and its nominal RSSI. SNR and Noise values.

For both RSSI and SNR, a *higher* number is deemed better. This means that an actual value *below* the 'low' threshold setting will result in a 100% blend (monaural), and a value *above* the 'high' threshold setting will result in no blending action at all.

Noise, on the other hand, is the other side of the coin; that is, *less* is better. So, a noise value below the 'low' threshold setting will result in no blending at all, but a value above the 'high' setting will blend the program to mono.

The numerical Blend Settings readout displays the actual percent of stereo blending in effect at that moment.

FM Highcut: is another noise-abatement function. In the Auto mode, the 651 provides top-end audio rolloff based on RF metrics. Setup for Auto operation is much the same as with the stereo blend function discussed above, except that a stereo blend *increase*, toward mono, would now correspond to a *decrease* in cutoff frequency, or a loss of brightness..

Alternatively, you may select from a wide range of manual cutoffs. Auto Highcut Settings shows the actual cutoff frequency in play at the moment.

FM Noise Reduction is an interesting option that, in many cases, may obviate the need for either the stereo-blend or high cut options. It is especially useful in reducing harsh-sounding artifacts frequently associated with multipath effects. This option is difficult to describe, thus it's best to do your own experimentation in a problematic reception situation.

Input Sources

This setup instruction will explain how to configure multiple program audio and RadioData inputs for backup to the off-air main-station program feed.

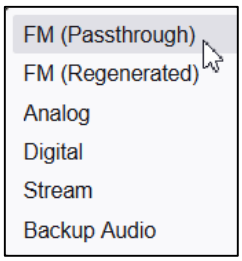
Under Input Sources, click the ✚ next to Primary. This opens a drop-down list of options for your main program source. In most instances this will be the off-air FM program at the station's primary frequency.



The Primary source and the three Backup options allow you to choose sources for Audio:, for the accompanying RDS: RadioData, and the Processor Preset: for that specific audio feed. Each category has a ⌄ drop-down menu for your selection

FM Passthrough and FM Regenerated

In some cases, Audio: will be set to FM (Passthrough), which routes the FM baseband from the tuner directly to the rear-panel MPX OUT 1 and MPX OUT 2 BNC connectors. Each output has its own, independent output level control. When FM (Passthrough) is selected, the RDS: and Processor Preset: settings are inconsequential, and can be left on any option with no effect on the rebroadcast signal.



In the FM (Regenerated) mode, the FM baseband is 'disassembled,' with left- and right-channel audio and RDS RadioData decoded independently to 'regenerate' a fresh baseband output. This mode can take advantage of the various noise-suppression

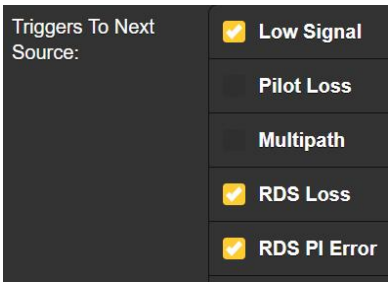
options introduced in the previous **Tuner Options** discussion, and also substitute new RDS data; for example, information or advertising specific to a given translator's market.

Alternative Input Sources

Aside from the off-air FM program, the drop-down menu also offer a choice of the various input source options, both for the retransmitted Audio: and for RDS: RadioData. As these program sources must necessarily undergo internal 'airchain' audio processing, each source is able to have its own processor setup, specific to that program source. Audio processing is discussed under its own subhead, beginning on Page 41.

Backup Program Sources

The Primary input source may be programmed to failover to Backup 1, which then, in turn, may be set in similar manner to sequentially trigger Backup 2 and, sequentially, Backup 3. Again, both the backup Audio: and RDS: sources are individually selectable, along with the audio Processor Preset:, which you may tailor to that specific Audio: source.

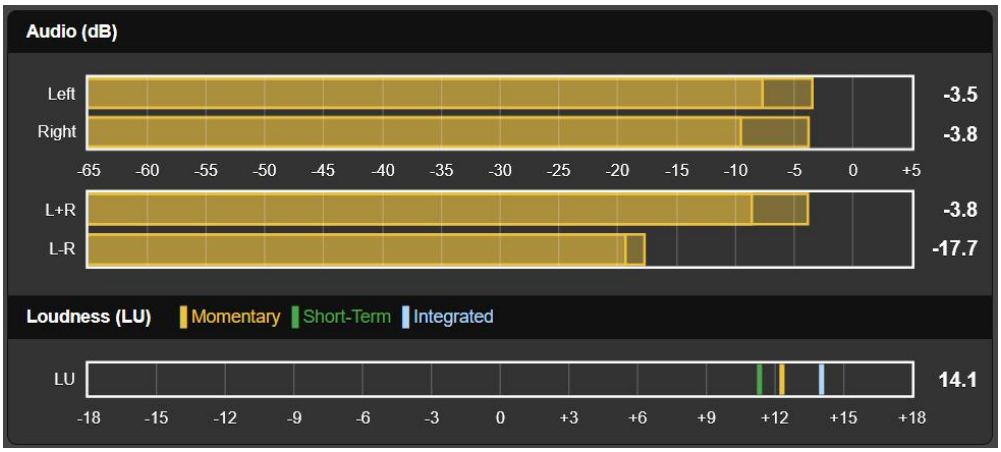


Failover Triggering

Failover is triggered by those fault alarms listed under Triggers To Next Source:. One or more of these alarms may be selected, in which case any single selected alarm will trigger the failover. Failover will remain engaged until the triggered alarms are cleared, at which point the failover will revert to the previous input source. Alarms and their setup are discussed under that subhead, beginning on Page 35.

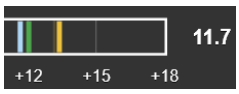
AUDIO METERING

The Meters webpage displays precise measurements of the raw program audio levels from each audio input source.



Levels are shown for Left and Right stereo channels, as well as the L+R stereo sum and L–R stereo difference. These meters have linear-dB scaling and are peak-responding. The numerical value of the held peak is also shown to the right of the bar display.

In addition, each meter shows program audio loudness to the ITU-R BS.1770 (LU) Loudness Standard. This 'Loudness Unit' measurement, supposedly keyed to how the human ear responds to sound, gives three values: a Momentary (yellow), a Short-Term (green) and an Integrated (blue) segment on the Loudness (LU) display bar.



The yellow segment shows a 'momentary' value of loudness, actually the measurement of a floating 400ms block of audio updated ten times a second. The green segment represents a short-term-integrated value derived from a 3-second block of audio refreshed every second, primarily indicating the loudest sections of program audio. The blue segment is a longer-term integrated measurement that is 'gated' so that it ignores speech pauses and other periods of silence. This is probably the most useful indicator of average program loudness over the long term.

'Zero-LU' does not conveniently correlate to a specific modulation percentage because of the Standard's specified frequency weighting. However, a 1kHz sustained tone at 100% modulation (±75kHz deviation) would drive the meter to about +22LU.

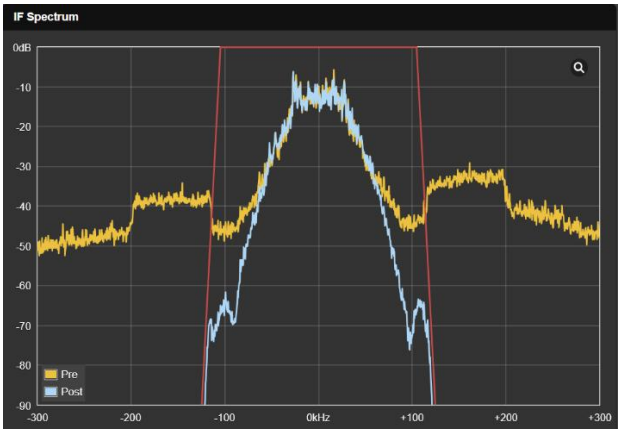
The loudness measurement window has a default value of 60 seconds. This may be changed under Setup ➔ Audio Inputs ➔ Loudness Window (Sec):, as may be suggested by the station's programming format.

SPECTRUM DISPLAYS

The AARON 651 includes an advanced, high-resolution FFT-based spectrum analyzer that delivers detailed and annotated graphic displays of selected program input signals. Images may be viewed using the webpages utility or from the front-panel touchscreen. Each signal selected for viewing carries its own family of signal selection and graph setup options.

The IF Spectrum

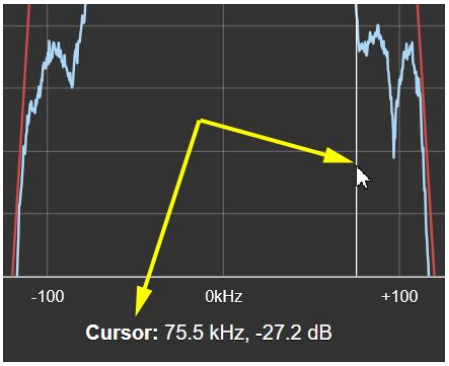
This first screenshot shows the receiver's IF spectrum. In this instance, the 651 is set for FM (Passthrough) operation.



At the center of the screen, 0kHz represents the tuned carrier frequency, obviously an HD Radio station, but with a high noise floor and perhaps other reception irregularities.

The red line boundary represents IF filtering. In this example, filtering has been switched-in to specifically exclude HD-Radio

digital carriers and other out-of-band signal components that could compromise cleanest-possible FM-audio recovery.

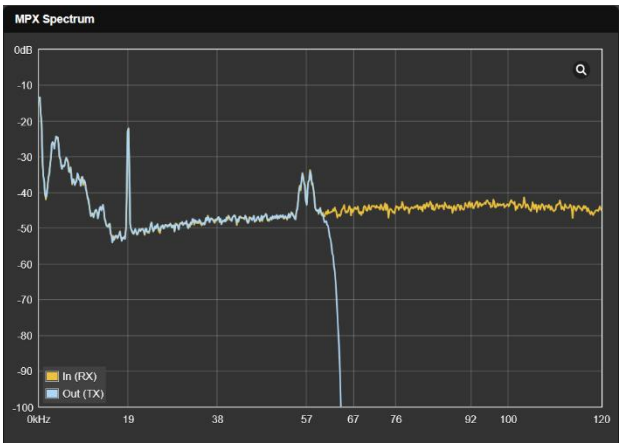


Using the webpages utility, the IF display allows you to hover your mouse over the screen to bring up the indicated cursor and readout. This lets you measure the signal level at any point along the X axis.

All three spectrum displays in this section include either a View Options:, Show: or View: selector for choosing what will be displayed in the spectrum plot. Display Response: to the signal may be changed between an Average, Peak or [Peak] Hold (accumulated) display. The pull-down Averages: menu lets you select the number of samples averaged, effectively determining display integration time (smoothing) for all three Response: settings.

MPX Baseband

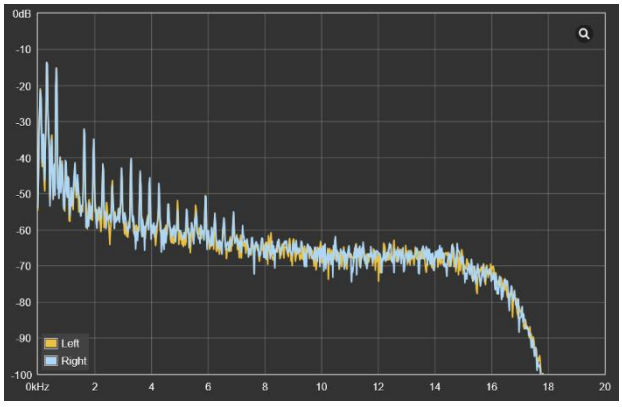
This next screenshot is a spectrum display of the composite MPX baseband signal for that same station. Note the sharp drop off just above the RDS subcarrier, a result of the MPX Bandwidth setting on the Now Playing page.



In both the IF and MPX screenshot examples, the (yellow) raw, off-air signal and the (blue) filtered signal for retransmission are overlayed to show the differences clearly.

The Audio Spectrum

Use the View: buttons in the Audio mode to select left and right channel audio spectrum analysis of any of the five possible audio program sources.



This final image is off-air audio from the tuner, which is tuned to a jazz station The spectrum is irrefutably representative of the saxophone solo playing at the moment.

HISTORY PLOTS

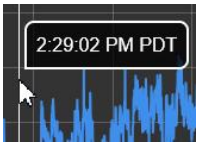
The AARON 651 records the history and offers plots of reception and audio metrics, viewable over a range of time periods, from the past minute to a 48-hour extended time study.

The RF Metrics screen shown at the top of the next page is typical of the history plots. The selector buttons along the top bring to view the noted signal metrics or parameters.

On each plot screen, Show: will allow selective display of individual, color-coded parameters. Time Span: sets the desired capture period of the scrolling display. All signal metrics are held in memory for a full 48 hours, allowing you to check on events that far back in the past.



Mousing-over the webpage screen pops-up a cursor, shown as the vertical white line in the above illustration. The individual metric values that appear just under the plot will show readings at the cursor point, rather than the 'right-now' time at the origin. For a Time Span: of an hour or more, the cursor's date and time position will also be noted as shown here.



Once the cursor is on the screen, your mouse scroll wheel will let you zoom-in on the plot. Then hold-down the left mouse button and pan the mouse left and right to search through that screen's time period to locate a particular event and the very second that it took place.

OSCILLOSCOPE

The built-in O-Scope/XY feature of the 651 can present an oscilloscope-like display of the composite/MPX baseband, and a dual-trace display of left- and right-channel program audio sources. The 'scope can be turned into an X/Y display of the selected stereo program to view the vector relationship between the channels in real time.



This is a screenshot of the O-Scope function as it displays both the left and right program audio channels.

The View: buttons let you select any one of the program audio sources, or the MPX baseband. C

Clicking the Pause bar will freeze the image for analysis. You can click the little magnifying glass in the corner for full-screen O-scope display. The inset photo shows the same music track in the 'scope's X/Y display mode.

THE BANDSCANNER™

The 651 BandScanner utility is an annotated RF spectrum analyzer that is able to graphically display the entire FM band.

Warnings!

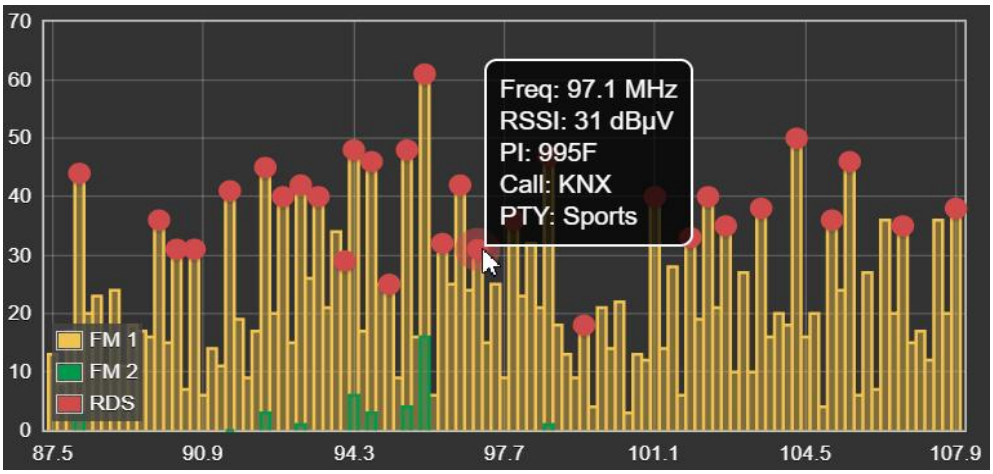


1) Band-scanning interrupts all FM-mode rebroadcast functionality during the scan cycle, during the time that both FM tuners essentially step across the entire band collecting data from each station in the market. Program audio outputs are muted, and scanning will interrupt signal history studies.

2) Also, keep in mind that any time after the display is presented, *clicking* on a bar will immediately tune the 651 to that station, which you may not want to do.

At the top of the following page is a full-function FM-band scan of the busy Los Angeles market. Three Scan Type: modes may be selected at the bottom of the screen. RSSI is the quickest scan, but will show only RSSI signal levels. But the 651 can also scan and display both RSSI + RDS information, which will take a bit longer.

Range: defaults to the traditional 87.5-107.9 MHz FM band, although the 'extended' band, used in some countries, is also available.



Start Scanning

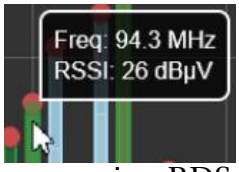
To launch a band scan, click the Scan bar at the bottom. Step Size: defaults to 200kHz, but 100kHz steps are also available.

In the RSSI + RDS scan illustrated above, every FM carrier is represented by a vertical bar; yellow bars for Tuner 1, green bars for Tuner 2.

Bar height indicates signal strength in dBµV per the annotation along the left edge. Had this scan been run in the simple RSSI mode, all stations would show up as yellow or green bars with no red dots.

REMEMBER: if you *click* on any colored bar, the 651 will immediately tune that station and switch to the Now Playing Webpage.

Bars and Dots





Hovering over a yellow or green bar will only reveal the Freq: and RSSI: in a pop-up box. At the completion of an RSSI + RDS scan, bars with red dots indicate a station carrying RDS data. Hovering on the red dot will add station Call: (letters) and the RDS PI: (Program Identification) and PTY: (Program TYpe) information as shown in the second inset.

An RSSI + RDS scan will also create a list and number of RDS Stations: below the scan plot. These will be listed by ascending frequency along with their PI, Callsign, PTY and RSSI values.

RDS INFO

The RDS Info webpage presents a comprehensive display of the RDS information that now accompanies the majority of FM transmissions. (Note the abundance of red dots in the BandScanner illustration at the top of the page.)

The upper screen area shows the more important blocks of RDS data: the static or scrolling PS; the PI Code, either assigned or (in the US and Canada) derived from the Callsign; and RadioText and its interactive RT+1 and RT+2 derivatives. PTY and the optional PTYN define the station's format, and Time is transmitted to set clocks in certain FM radios. 'Flags' at the bottom of the screen area assist radios in responding to RDS system commands.



Next down the webpage is an analysis of the RDS Block Error Rate. This is useful in troubleshooting RDS issues. Below that is a dynamic and statistical presentation of all RDS data groups, including the percentage of the RadioData total each group represents.



Finally, if the station has an AF List, Alternative Frequencies are totaled and each is listed. Proprietary Open Data Applications are also totaled and shown. Click the Clear/Reset RDS bar at the very bottom to reset all RDS statistics shown. The utility will then repopulate with current data.

RadioDNS INFO

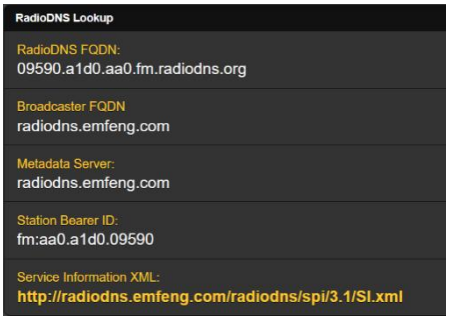
What is RadioDNS?

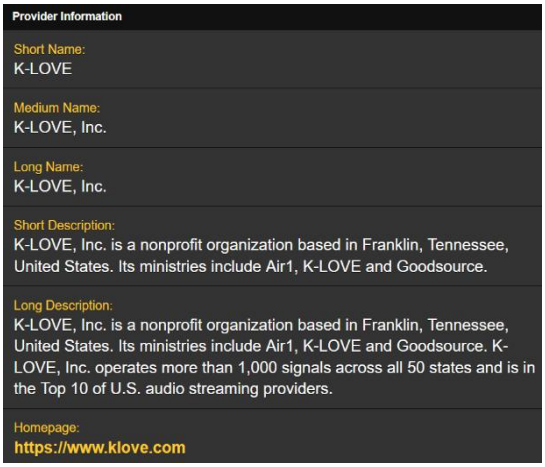
RadioDNS Hybrid Radio© is the registered trademark of a non-profit international standards organization founded by the European Broadcast Union (EBU). This organization promotes the integration of over-the-air digital radio broadcasting with internet-delivered content. In Europe, digital audio broadcasting (DAB) utilizes a multiplicity of scattered, low-power transmitters. The ability to follow a broadcast over a wide area, even across borders, can make good use of ubiquitous, worldwide

internet connectivity in keeping a listener 'tuned' to a radio program even in areas without off-air radio reception.

In addition to keeping a listener connected to the station, RadioDNS is also able to capture images, associated streaming content and other web links, as well as program-associated metadata that cannot be accommodated by over-the-air broadcasting. When a DNS-ready radio tunes to a DNS-registered station, it uses information in the broadcast signal to construct a 'DNS query,' which will tell a radio how to connect directly to that station via the internet.

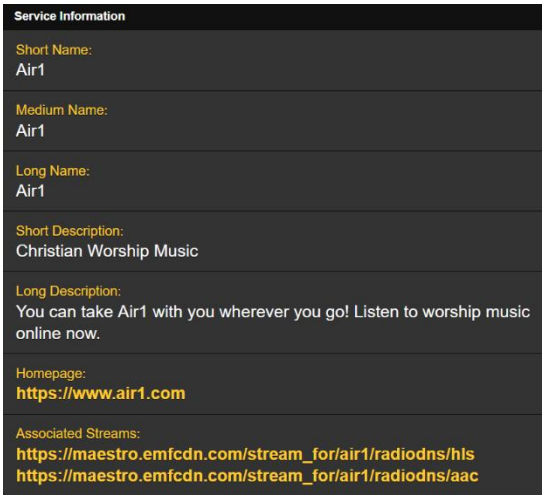
Info Panels





The first Radio DNS Lookup panel, shown directly above, is data registered with the RadioDNS organization.

The Provider Information panel, above right, gives information relating to the corporate entity that owns and manages the station.



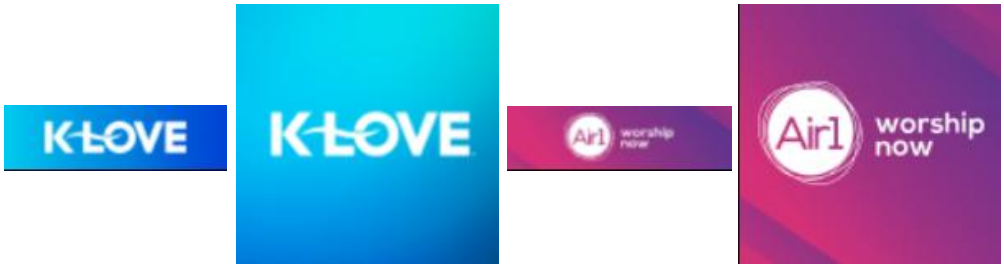
This third Service Information panel on the right relates exclusively to the station broadcasting the radio signal; that is, a specific 'child' of the corporate entity.

Images

RadioDNS is capable of linking logos and similar images to the broadcast program, using the internet for image file transport.

Examples of actual images for the broadcast entity cited in the information panels are shown at the top of the next page.

Images are classified either as Provider Logos, representing the corporate or network entity, or Service Logos tied to the specific station being heard.



The first two pictured are Provider Logos, the second pair, Service Logos. There were actually a few more of each that would normally be displayed on the 651 RadioDNS Info webpage; they varied from those shown only by shape or size. For each image displayed, the 651 also notes the image Type:, the Format: and the Size:.

Broadcasters interested in this technology should reach out to the organization's website: http://radiodns.org for particulars regarding the system's features and advantages, and the registration process for its use.

ALARMS

Alarm Status

The AARON 651 provides a multiplicity of alarms for RF signal, audio or program-related error conditions. Simulated LED Alarm Status indicators head the Alarms Webpage, and are duplicated on the Now Playing Webpage. Front-panel LED indicators indicate only major signal failure modes, although all alarms may be viewed on the touchscreen under ☰ → Alarms → Alarm Status.

Alarms may be triggered either by a metric falling outside a predetermined normal range, or by a go/no-go situation with predetermined trigger and/or reset time intervals, or the alarm can use both criteria, a metric plus trigger and reset time intervals.

Low Signal and Muting

The Low Signal alarm monitors RSSI, the incoming FM carrier signal level. This alarm is typical of those that have both metric value and time interval trigger and reset criteria. Other alarms with these same properties are Multipath, FM Audio Loss, Analog Audio Loss, Digital Audio Loss and Stream Audio Loss. Setup of this criteria group will be detailed only once, but the reader may refer back to this description for the other, similar alarm types.



Referring to the example here, Alarm: must of course be set On to arm the function. The grayed-out RSSI (dBµV): meter shows the current (and typical) program level of 57 (dBµV) for the station being monitored.

In this case we're looking for a too-low signal level condition, so the Threshold On (dBµV): setting of 40 is what the RSSI must fall to, and remain below, for the Time On (Sec.) interval of 15 seconds, to initiate an alarm.

For the alarm to reset (clear), RSSI (dBµV): must rise back up to the Threshold Off (dBµV): value of 50, and remain above that figure for the Time Off (Sec): period of 30 seconds. Of course you must determine signal level limits for your own station, with allowances for possible atmospheric and other conditions.

The Low Signal alarm has one feature that the others in this group don't. Mute: may be set On to mute program audio when the alarm is active (triggered and not yet cleared). We recommend setting Mute: to On, for not only will it obviate an irritating blast of noise, but will ensure that the FM Audio Loss alarm can also trigger if the station leaves the air.

Pilot Loss

Loss of the 19kHz FM stereo pilot could be used for failover to an alternate program source if, for some inexplicable reason, an incoming FM transmission mysteriously switches to monaural.

This Pilot Loss alarm is typical of the go/no-go alarms with time interval constraints. That is, there are no threshold values to set, only the delay time before an alarm is triggered, and a wait period for the alarm to clear once the pilot returns. Another alarm in this criteria group is RDS Loss.

Just as with other alarms that have time interval settings, Time On (Sec): is the interval between loss of pilot and trigger of the alarm. Time Off (Sec): is the delay between return of the pilot and the alarm being cleared. Remember, the pilot has to be gone completely for the set Time On (Sec): time, and must come back and remain valid for the entire Time Off (Sec): interval

A similar alarm, but with just a trigger delay (and a zero-wait period), is RDS Radio Text Not Updated, explained shortly.

Multipath

Multipath distortion of the received FM signal results in audible noise, or noise 'flutter,' particularly with stereo-FM programming. The AARON 651 tuners provide some mitigation from multipath effects by way of the Now Playing → Tuner → Channel EQ:, FM Blend Settings, FM High Cut Settings and FM Noise Reduction:

settings. These were discussed under the Now Playing setup section.

The Multipath alarm is set similarly to the Low Signal alarm discussed previously, except that we are looking for a too-high multipath value. Multipath includes a grayed-out measure of current multipath distortion. When setting the Threshold On (%): and Threshold Off (%), first listen to the off-air audio to determine what severity of multipath effect can be considered tolerable.

RDS Loss

This alarm is triggered when the RDS subcarrier disappears, and is set in the same manner as the Pilot Loss alarm.

RDS PI Error

RDS data transmitted with an FM broadcast contains a PI code unique to that station. The AARON 651 can use this to authenticate reception and guard against intentional signal 'hijacking,' or to keep from rebroadcasting another station sharing the same frequency should the primary signal be lost. For this to work, enter the station's true PI code in the PI Code box. The code being received at the moment is shown to the right of this box. If this is indeed your station's PI; simply enter the hex value as shown and click Save. The usual Time On and Time Off parameters of the other alarms apply.

RDS RadioText Not Updated

When a playout system 'sticks,' while sending RDS RadioText, it can cause problems, not only as the RadioText message is displayed on the listener's dashboard, but attendant RT+ functions may be erratic as well.

Turn the RDS RadioText Not Updated Alarm: On and set a Time On (Min): at a nominal figure of 20 minutes or so to alert personnel to a 'stuck' RadioText field.

Audio Loss: FM, Analog-In, Digital-In, Stream

Audio-loss alarms serve as a 'dead air' alert, whether the fault is the station going off-air or a failure in the program-audio air chain. For an analog-FM broadcast, note the **Low Signal and Muting** discussion at the start of this subsection.

The grayed-out Level (dB): value shown for the current incoming audio is a held-peak reading. This reduces audio 'bounce,' thus taking some of guesswork out of setting alarm criteria.

Like the Low Signal alarm, these audio-loss alarms have both level and time interval settings. Setup is much the same as the Low Signal alarm.

You must take program dynamic range into consideration when adjusting audio-loss alarm settings. Audio program levels can vary a lot, and time interval settings may need to reflect the station's format. A radio talk show can have significant pauses, and classical music can fall to very low levels.

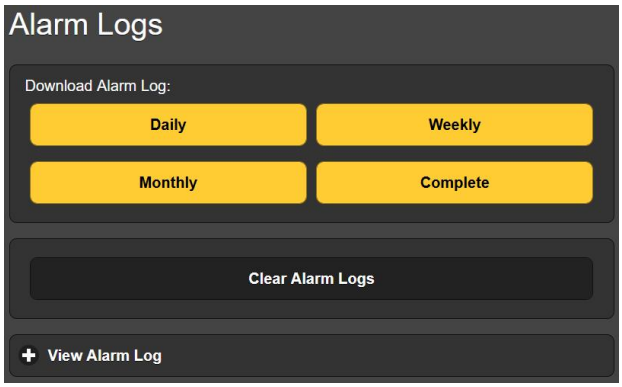
Remember that Level (dB): must fall below and *remain below* the Threshold On (dB): value for the entire duration of the Time On (Sec): setting to trigger an alarm. And for the alarm to reset, the level must reach and *remain above* the Threshold Off (dB): setting for the entire duration of the Time Off (Sec): period.

Stream Metadata Not Updated

For all intents and purposes, this alarm is identical to any of the other '…Not Updated' alarms. You may set Alarm: On if your stream program source includes metadata, and set the Time On (Min): to an interval that is somewhat longer than the expected metadata refresh rate.

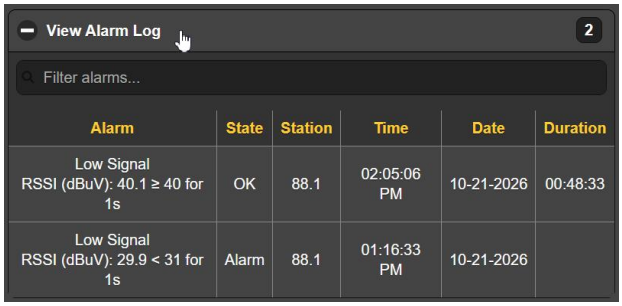
Alarm Logs

Aside from visual displays, GPO tallies and email alerts for signal and program – related faults, all alarms are logged as well.

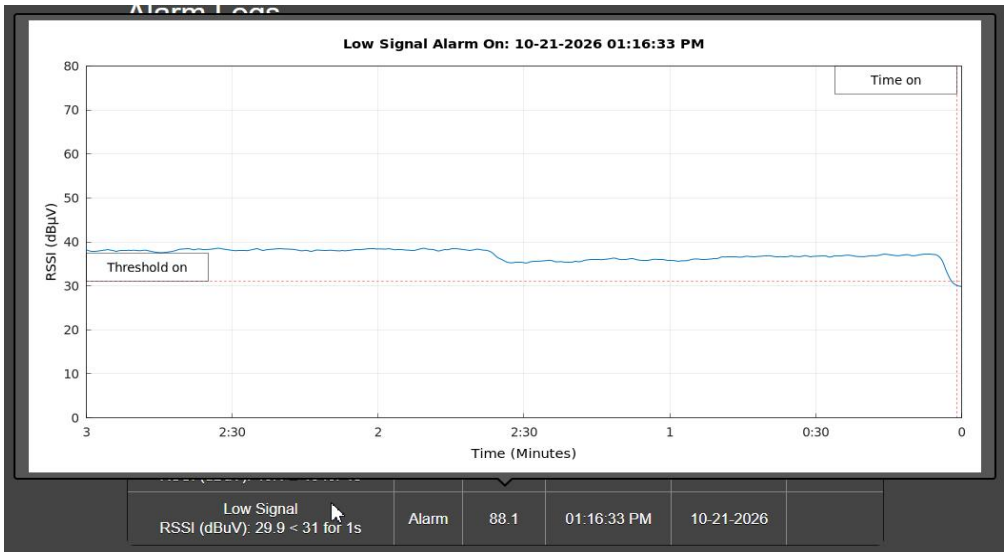


Click Download Alarm Log: for Daily, Weekly, Monthly or Complete (all history) time periods. Downloads are saved to your computer as small .csv text files.

Click ⊞ View Alarm Log at the bottom of the page for a listing of all alarms in order of time and date. The log holds data on the type of Alarm, the current State (status) of that alarm, the Station (frequency), and the Time and Date that the alarm occurred, plus the alarm Duration, or total time to clear.



Hovering over an alarm event on the list will display a graphic history of the fault in question, as shown below. In the case of the Low Signal alarm at 01:16:33 PM on the list above, we see that the RSSI (dBμV): was comfortably above the trip level for a good three minutes before the alarm triggered.



The graph does show a power dip about two and a half minutes prior to the alarm, and a second, 'fatal' dip just seconds before the alarm triggered. View Alarm Log shows that the RSSI failed to return and reset the alarm by the time the screenshot was taken.

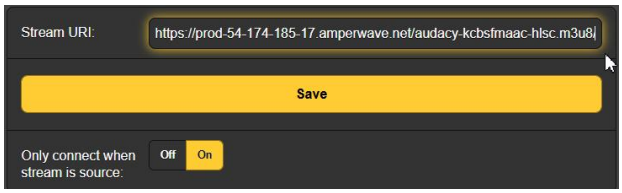
The Alarm Logs will continue to accumulate entries almost indefinitely, as 651 memory has oodles of space. Clear it completely at any time by clicking the Clear Alarm Logs bar. This will delete all entries. You'll be asked to confirm this action, at which point you might decide first to download the Complete log of all alarms, just to be on the safe side.

THE STREAM INPUT

The AARON 651 is able to receive internet streaming program audio and metadata, as either the main or a backup source of rebroadcast programming.

The Stream Address

Streaming content sources are technically URI (Uniform Resource *Identifiers*), rather than the more familiar URL (Uniform Resource *Locators*) associated with websites and individual webpages.





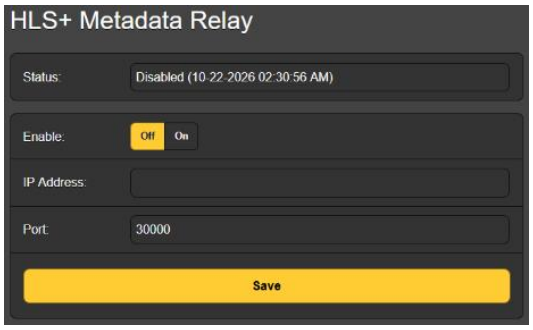
You must obtain the URI from the program provider and enter it into the Stream URI: field as shown in the upper screenshot. As this URI is a long one, the entire string does not display here. But click Save, and if the stream address is valid, it not only will appear 'wrapped' in full at the top of the Stream In page, as shown in the second illustration, but also populate with the URI Format and additional relevant information.

In the upper screenshot, note the option to Only connect when stream is source. Turn this On to save network bandwidth when the stream does not serve as the program audio source.

HLS+ Metadata Relay

This feature of the 651 can relay (forward) HLS #EXTINF title metadata to another device or to a computer, making it compatible with technology from Quu, Inc.. Using the Quu 360 Visual Radio platform, the broadcaster can display program information and advertising on the dashboard of listeners' automobiles.

There are three additional entries that require attention when the HLS+ Metadata Relay function is used. Enable: simply turns the function On or Off. IP Address: and Port: define the recipient equipment IP address and the TCP port to use. The Status: window indicates current operation of the feature.



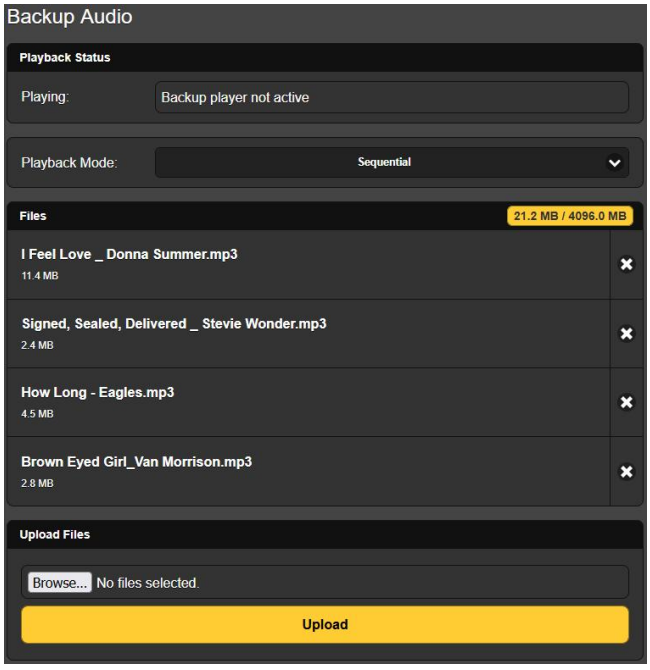
Additional information on this emerging technology can be found on the web: www.myquu.net.

BACKUP AUDIO

Uploading Audio Files

You can upload up to 4GB of miscellaneous audio files to the AARON 651, to serve as a 'last resort' source of emergency audio programming when the primary and all subsequent failover sources have been lost through a communications channel failure. Accepted formats are WAV, FLAC, Ogg (Vorbis, Opus), AAC (LC-AAC, HE-AACv1, HE-AACv2), MP3.

Under the Upload Files section at the bottom of the Backup Audio webpage, first click Browse..., then navigate to music files already on your computer, or in another location that you can access, and highlight the song file you wish to transfer. You can hold down the Ctrl key to highlight multiple files, and you might want to enter a station ID every couple of songs. Then click the Upload bar to transfer those files up into the Files section. Once resident there, you may drag song files up or down to rearrange the sequence. Select either Sequential or Random under Playback Mode to determine a playback sequence that follows the listings, or a 'shuffled' order.



When Backup Audio is active, the source of RDS information in the DPS and RadioText fields can be set to display the file names

of songs being played. Audio: and RDS: sources are selected on the Now Playing page; failover options are detailed on Page 27.

THE 651 AUDIO PROCESSOR

Overview

The AARON 651 includes a built-in, comprehensive audio processing system that features AGC, Equalization, Leveling, Multiband Compression, Split-Band Limiting/Clipping and a Stereo Generator. Most of the operating parameters are user-adjustable, yet a series of factory presets will satisfy most everyday needs. Processing presets are held in nonvolatile memory.

Presets

Setup for presets is accessed at the bottom of the Processor webpage. Presets are applied automatically to the specific program audio source as it is selected for on-air operation. This means that you may process off-air (tuner) audio one way, and a streaming backup source another.

Click the ✚ to open the Presets list. There are eleven (F) factory presets, which are fixed and cannot be changed. However, these can serve as a starting point in evolving your own presets to create a 'signature sound,' and the 651 accommodates up to 30 user presets. The numbers at the right of the bar indicate how many user presets have been programmed.



Factory Presets

Heading the list of (F) factory presets are two options that offer a minimalistic approach to audio processing. (F) Peak Limiting defeats all audio processor functions except for peak limiting and the adjustments for the associated stereo generator. This setting affords overmodulation protection only, and assumes that the program audio has already been processed to sound as you want it retransmitted.

(F) AGC + Peak Limiting also offers peak protection, but precedes limiting with 'gain-riding' AGC to normalize wandering input levels. This ensures that the peak limiter is fed a consistent input signal and produces the same program density regardless of input sources and level variations.

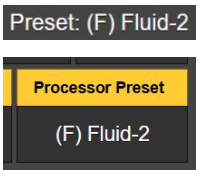
The remaining nine (F) factory presets are in three groups, each with three subsettings. Rather than referencing various music genres or other programming formats, the primary groups are named Organic, Fluid and Punch, and correspond to light, medium and heavy degrees of audio processing, respectively. Within each group, the -1, -2 and -3 subsettings further define incremental variations in processing sonics.

Creating User Presets

In developing your station's 'signature sound,' we recommend first trying all (F) factory presets with program material typical for your station's format. Find one or two that seem to work well, and then refine the various processing adjustments to home-in on the sound you are looking for.

Naming and Saving your Presets

All presets require a name, and the naming process has been made near-automatic. Preset IDs show up at the top of the Processor webpage and on the Now Playing page. The two presets shown here are (F) factory presets.



When you change any of the audio processor or stereo-gen settings, the preset name at the top of the Processor page will notify you that the named setting has been changed (Modified).



Once your make all your changes to give you the sound you are looking for, drop down near the bottom of the Processor page and click Save Preset. This will pop-up a Save Preset box and ask for a name. Type in a name that identifies your preset and then click Save. This will add that preset, KINO Hit Sound in this case, at the bottom of the Presets list:

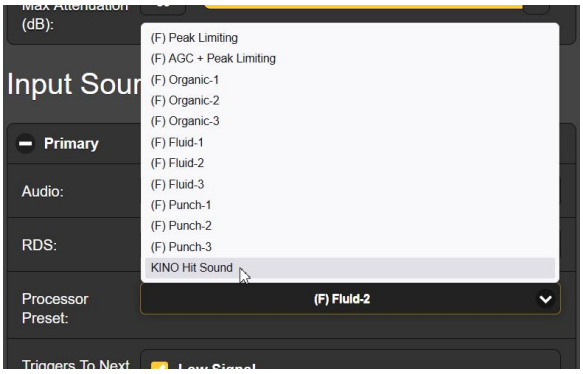




This same process allows changes in an existing user preset, the only difference being that the prompt changes from Save Preset to Save Changes.

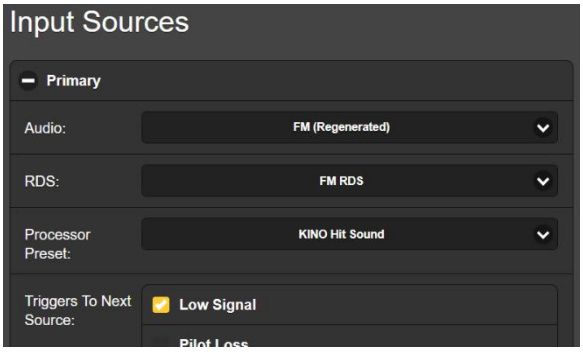
Assigning Presets

Navigate back to the Now Playing webpage. Scroll down to Input Sources and click-open the Primary folder. Then click ⌄ for a drop-down list of all the saved processing presets.



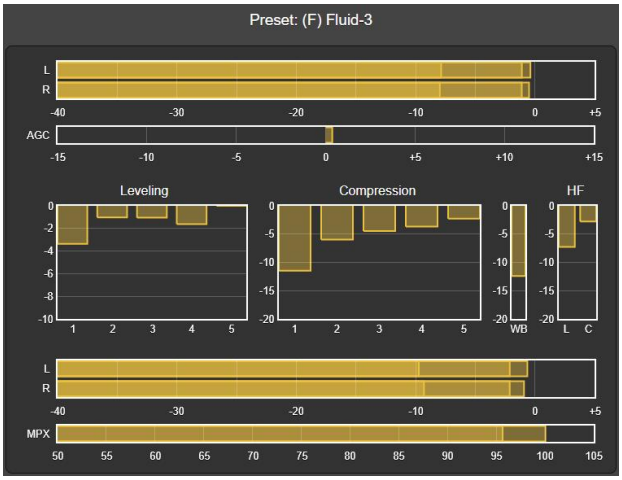
The modified (F) Fluid-2 setup was modified, renamed and saved as KINO Hit Sound, now at the bottom of the list. We can now click on that entry to select it as the Processor Preset: for the Primary input source.

Our example now shows the off-air FM (Regenerated) signal as the audio source, and RDS: derived from that same off-air signal. Now that we have selected KINO Hit Sound as the audio Processor Preset:, making it the de-facto Processor Preset: for the Primary input source.



The three Backup sources may be set up in this same manner; you can refer back to Page 27 for the discussion of failover-triggering options and their implications.

Processor Metering



The topmost readout area on the Processor Webpage identifies the processing preset that is engaged, and displays the dynamic activity of ongoing processing action in near-real time. Although metering is meant to respond instantaneously to gain changes, the actual dynamics of processor activity is probably best represented visually by the front-panel touchscreen LCD. The webpage utility must time-share all the busy data between 651 hardware and the webpages utility, and thus cannot respond quite as quickly as the hardware-based LCD screen.

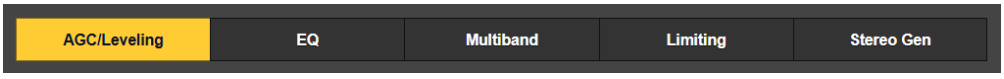
dB reference annotation parallels all bargraph readouts. The first meter shows L (left) and R (right) input audio channels to the processing section. Just below that is the current gain of the wideband 'gain-riding' AGC stage.

Next comes gain-reduction metering for each of the five frequency-discriminant audio bands. Leveling is longer-term, average-value gain control within each frequency band. Compression, on the other hand, is a more active, peak-responding function that can be used to increase spectral density.

The WB display column shows wideband program peak reduction after the five frequency bands have been recombined. Dual HF metering displays action of the independent frequency-selective limiter/clipper that protects the spectrum that is subject to 75µs or 50µs FM pre-emphasis. L (limiting) and C (clipping) are shown individually.

Processor output measurements are shown at the bottom of this screen section. L (left) and R (right) program audio are de-emphasized per the selected pre-emphasis characteristic. The MPX output auto-corrects to maintain program peaks at 100%, regardless of mono or stereo operation, or injection levels of the stereo pilot and RDS subcarrier.

Five selector buttons just below the metering area give access to the various processor subsections. The first section, AGC/ Leveling, is discussed first here.



High-Pass

A steep High-Pass Filter (Hz) helps attenuate subsonic program artifacts that can compromise FM modulation efficiency. Factory presets assume a clean audio signal and will default to 20 or 25 (Hz).



Phase Rotator

The Phase Rotator: is an all-pass filter that actually 'scrambles' program audio phase to control the program audio crest factor, or asymmetry.

AGC

Think of AGC (Automatic Gain Control) as a conscientious board operator manually adjusting audio gain to compensate for level differences between music tracks, or between music and dialog. In the 651 this is a wideband, slow gain-riding function that is unobtrusive in operation, yet it presents the following processing stages with a consistent average program level.

The 651 AGC is 'gated,' meaning that during pauses in program audio, the gain does not slowly crank-up toward maximum. Rather, it essentially freezes for short pauses, and then slowly drifts back to the 0dB resting point.

The operator may control the level correction Rate (dB/s): (dBs per second), the Max Gain (dB): that the AGC can impart to low-level program content, and the width of the Window (dB):. The window is centered at 0dB on the AGC: meter. The Rate (dB/s): setting is the correction rate outside the window, but inside the window correction is slowed to one-half the set rate. This minimizes any tendency for the AGC to 'breathe' or 'pump' for small AGC corrections.

Leveling

Leveling is essentially an extension of AGC, but is integrated within the 5 frequency divisions of the multiband compressor. Rather than taming program dynamics, Leveling is a slower and more gentle function than compression. The effect is that of 'auto-equalization,' tending to normalize (flatten the spectral distribution of the audio program. The associated Drive (dB): slider adjusts the extent of this auto-EQ function.

Stereo Enhance

The program audio stereo image can be expanded to a limited extent by setting the Stereo Enhance feature to Enable: On. The stereo soundstage expands from 0 (normal) to 1 (maximum) in ten steps of the Width: control. Range of this adjustment has

purposely been curtailed due to concerns over its effect on multipath distortion, particularly in reception fringe areas.

Equalization

The AARON 651 provides the user with four sections of parametric equalization. Each section allows control of the resonant Frequency (Hz):, the plus or minus Gain (dB): at resonance, and the Q: (shape) of the resonance peak.

Click ✚ to open each of the four cascaded EQ sections. Each is independently adjustable in the three parameters of Frequency (Hz):, Gain (dB): and Q:. Use these controls to tailor your 'signature sound,' or to make up for response irregularities in the associated program audio source. The effect of all four EQ sections is shown graphically, giving a good visual representation of what you are hearing as you adjust the values.



The 5-Band Section

The next processor section splits the audio spectrum into five frequency-discriminant bands. There's a plethora of adjustments in this section, and we recommend that you commence your signature-sound setup starting with one of the (F) factory processing presets. If things begin sounding not-quite-right, you can always come back and start over.

Bass Effects

The Punch: slider accentuates the percussive effect of instruments like the kick-drum. Unlike a limiting function that suppresses initial transients, Punch: acts more like a dynamic expander for percussive wavefronts.

Rumble:, on the other hand, isolates and accentuates the underlying persistent, or hanging-on elements of bass-instrument notes. These are deep-bass effect controls meant for music tracks and do little, if anything, even on male voices.

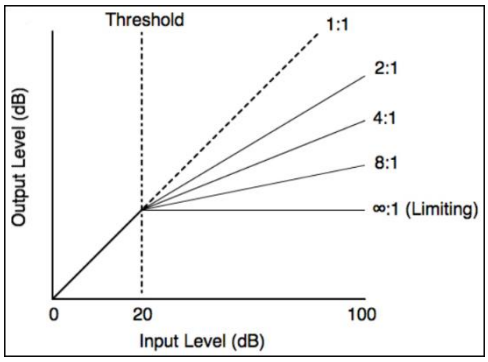
Multiband Compression

The Compression subsection affords control over the input to the 5-band compressor function, and also has adjustments that are common to all five compressors.

Drive (dB): is the ganged input gain control to all five compressors. Drive (dB): is post-Leveling. and determines how hard the compressors work. The Compression readouts in the metering area gives the best indication of how hard the compressors are driven.

The five compressors have both r.m.s and peak response to program audio. Centered at 0, the RMS/Peak Balance: blends the two sensing functions equally. Negative settings are increasingly r.m.s.-sensing, positive settings respond more to program peaks.

Ratio: describes the compression ratio of all five bands. With the slider set to 1 (a ratio of 1:1), the compressors are essentially linear amplifiers. As the compression ratio increases, the slope of the transfer function above the compression threshold becomes flatter. The maximum setting of 100 (100:1), or for all practical purposes anything much over 20 (20:1) describes the action of a limiter, rather than a compressor. The inset is a textbook-style illustration of compression ratio.



Band EQ (dB) is a another means of tailoring the sound of the 651. The zero-center sliders may be used like a classic graphic equalizer, as they are in the compressor band outputs and modify system response as the five bands are summed back into a full-range program audio signal. Band EQ (dB): sliders are named for the portion of the spectrum they are designed to control. Although Bass:, Low:, Mid:, Presence: and High describe the intended spectrum sectors, the actual band crossover frequencies are selectable in the Crossovers panel. We recommend sticking close to (F) factory settings, as strange artifacts can emerge when certain musical-physics constraints are violated.

Other adjustments within the compressor section pertain to coupling between adjacent bands attack/release time constants.

Band Coupling

A multiband compressor with relatively steep filters can sound somewhat 'swishy' if no provision is made for inter-band coupling. With Band Uncoupling (%): at 100, the five bands are totally independent. Pulling back from this maximum allows commutation between bands, such that each band is controlled to some degree by its neighbor(s). Again, we recommend starting with (F) factory settings and not deviating too far from them.

Compressor Time Constants

The same goes for Attack & Release (ms) settings. These are provided with a very wide adjustment range, wide enough to get you into trouble with certain types of program material. Once more, if you must, deviate from (F) factory settings incrementally and listen carefully. If things don't sound good, come back to the (F) factory values and proceed cautiously from there.

Final Program Peak Control

The 651 utilizes split-band limiting and clipping to protect audio program components subjected to 50µs or 75µs FM pre-emphasis. The selected rebroadcast pre-emphasis setting determines how the audio spectrum is split for limiting.

There are actually two limiters, a wideband limiter and a separate high-frequency limiter/clipper.

Wideband Limiting

The Wideband limiter has two operating modes, and its action on program audio can be followed on the WB readout in the metering area.

When Mode: is set to Normal, it is a traditional fast peak limiter with a very fast attack, and a release consistent with low distortion of frequencies below the pre-emphasis crossover point. The PIPP (Polarity Independent Peak Processing) mode acts on positive and negative program peaks independently to maximize FM modulation efficiency. (A full discussion of this concept can be found in US Patent 6,658,120.)

Drive: adjusts the level of program audio feeding the limiter, and thus how hard it works. Density: controls limiter time constants. Higher settings generally encourage greater perceived loudness, though one must take care in balancing Drive: and Density: to avoid audible artifacts.

High Frequency Limiting

Program audio components that are boosted, according to the pre-emphasis curve, are limited separately from the lower audio frequencies. The high frequency limiter has decidedly faster time constants, and is integrated with a peak clipper, which may be used judiciously to reduce the apparent loss of high frequency headroom inherent in FM broadcasting. Action of the High Frequency Limiter is displayed by the HF readout in the metering area; L for limiting, C for clipping.

The Limit – Clip: control determines the depth of high frequency peak clipping. A very conservative setting of 0 will allow only a modest amount of top-end clipping, an aggressive setting of 1 relies entirely on clipping for top-end control. Listen off-air to snares, cymbals and sibilants in determining where to set the Limit – Clip: slider.

Stereo Generator Settings

Click the Stereo-Gen button to access the various settings for the FM stereo generator. Here you can set Pre-Emphasis: to 50μs or 75μs for European or American requirements, respectively. The Stereo/Mono: selection will allow you to transmit your rebroadcast in monaural, should it be a talk show, or if you wanted to provide a cleaner signal to listeners in the reception fringe area.

Pilot Injection (%): is universally set at 9 percent, which is the factory default and worldwide standard. There really is no technical, political or aesthetic reason to set it to any other value.

RDS Injection (%): is normally set to about 5%. Setting it lower does not really help to squeeze every mB* of loudness into program audio.

* (A millibel, or mB, is 0.01dB, not to be confused with Millibelle the Banker in the video game, *Hollow Knight*.)

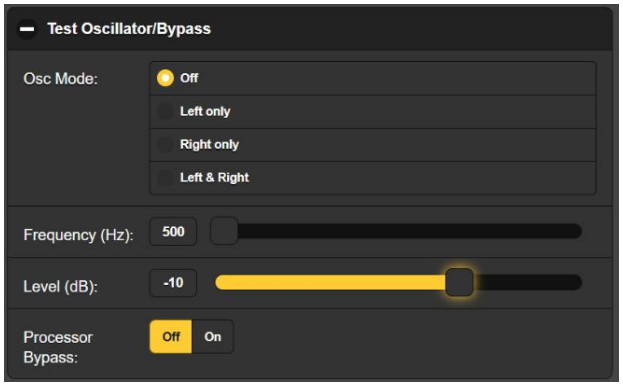
Composite Clipping

Composite Clipping (dB): can be used judiciously to increase program loudness to a limited degree. This operation clips the multiplex signal prior to combining the 19kHz stereo pilot and RDS subcarrier. But this does not truly equate to clipping in the RF domain, as the baseband and sideband components of the

multiplex signal are demodulated by the receiver in much the same way they were generated, and harmonics that were pushed out beyond audibility are restored as clipped audio. One-dB of composite clipping is generally safe.

Test Oscillator

The AARON 651 incorporates a Test Oscillator (tone generator) that can be activated and routed to the input of the processing section. During processor set-up, this allows you to view processor metering action in both a steady-state-tone condition as well as with dynamic audio program material.



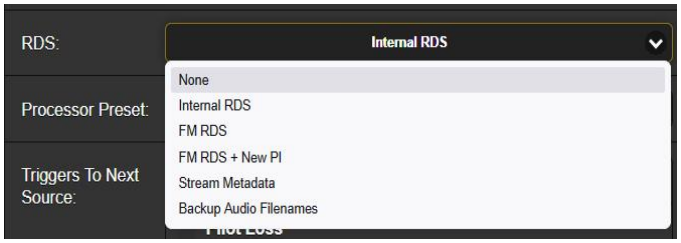
Osc Mode: routes the test tone to either the Left only or the Right only stereo channel, or to both Left & Right. Frequency (Hz): is variable between 20 and 20000, using either the slider or by overtyping the readout box. The oscillator Level (dB): may be varied between –30 and 0 in the same manner.

Processor Bypass

Processor Bypass: Off is the proper setting for normal operation of the AARON 651. You may turn Processor Bypass: On to compare raw and processed program audio. This will give unity gain through the audio processing stages, and all processor sliders, including Composite Clipping (dB): will be rendered inactive. It is not necessary to bypass the processor during FM (Passthrough) operation.

THE RDS ENCODER

The AARON 651 includes a built-in RDS Encoder that can accept pre-formatted or unformatted text for retransmission and display on RDS-equipped automobile and tabletop receivers. Under Input Sources on the Now Playing webpage, note the available source options for RDS RadioData Options can be changed or customized for the three Backup input sources as well.



It may be of value to know which 651 retransmission options actually use the internal RDS encoder, and which don't.

Under Input Sources on the Now Playing page, when the Audio: source is FM (Passthrough), or when the RDS: source is FM RDS, the RDS encoder is not in use, and its settings will be inconsequential.

When the RDS: source is FM RDS + New PI, only the programmed-in PI is used, all other RDS data is passed as-received, regardless of how other RDS encoder fields are programmed.

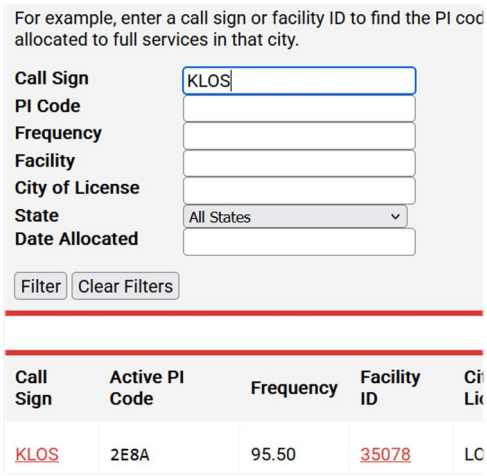
Live Output

On the RDS Encoder webpage, Live Output shows what is currently being transmitted to radios in real time. RDS Source identifies the currently-selected source for the RDS data. The static or scrolling 8-character-at-a-time PS message is shown exactly as it is being parsed and transmitted, and RadioText displays the entire RT message, up to 64 characters.

RDS Encoder Settings

A PI (Program Identification) code must be entered for RDS functions to operate correctly. PI codes are derived from call letters in the US and Canada, and assigned by a relevant broadcast authority in other countries. We have incorporated a pair of handy lookup utilities in the 651 that simplify this procedure.

Click the NRSC: Full-service FM station PI codes bar to be taken to the website hosting this utility. In the example at the top of the next page we have entered the Call Sign for KLOS, an FM station in the Los Angeles area. Clicking Filter, the utility then pops up quite a bit of useful information about that station, including the PI code, which in this case is hex code 2E8A. You would then enter this into the PI Code: space on the RDS Encoder page, and then click Save.



FM rebroadcast translators are subject to a somewhat different PI code assignment system. As most AARON 651s will find use in translator identification, the second provided utility, NRSC: FM Translator PI codes, should prove of some help. The interface is quite similar to what's shown in the example, except that you may have to identify your translator from a list of area assignments. Enter additional information, such as the Frequency of the translator, its City of License and State to help identify your translator from others that may be on the list. Then enter the PI into the 651's PI Code: box.

Housekeeping

Other settings in this particular area, (MS), (DI), (TP) and (CT) are the typical RDS 'housekeeping' options and should be self-explanatory.

Be sure that you have the RDS/RBDS: selection switched for your location; RBDS (NA) for North America, and RDS (EU) for Europe and other parts of the planet.

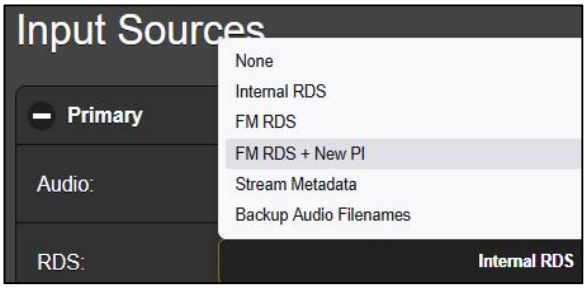
PTY The RDS system has assigned PTY (Program Type) categories to station formats as an aid to a listener seeking a particular genre of programming. On the Program Type (PTY): bar, click ▾ and make a selection that best represents your station's format.

PTYN In addition to the carved-in-stone PTY codes, you may further define your format by entering a more specific identification for it into the Program Type Name (PTYN): box. Although there is no standard for this programming description, it will display on some RDS radios, thus aiding a listener in finding your specific programming. PTYN is limited to eight characters. Some valid examples: Cajun, Punk, Ska, or 80s Hits.

Alternative Frequencies Alternative Frequencies (AFs): are the frequencies of your translators that carry the same programming as your main station signal. Click Add AF and enter the frequency of all sources of your main signal, including the main station frequency and the frequency of the translator you are setting up. Radios use this information to ensure the best reception as a mobile listener encounters varying signal conditions. AF-equipped radios seamlessly switch between frequencies as reception changes.

Dynamic PS Navigate to the Now Playing webpage and scroll down to the Input Sources area. Under Primary, or any of the Backup options, click ▾ to view the list of possible RDS data sources available for retransmission.

Note the Internal RDS entry, as selected in this screenshot. This would be your choice for a scrolling, repeating fixed message when the 651 is not connected to a playout system to send song artist and title information.



Back in the Dynamic PS area of the RDS Encoder webpage, click into the DPS: area to open the entry field. You may enter text or change an existing message to scroll repeatedly on the faceplate of RDS radios.

A Parse: setting of Auto divides the PS message into blocks of text that fit the 8-character-at-a-time screen restriction of RDS PS messaging. Short words are sent together; words longer than 8 characters are broken into contiguous sections. Auto is the generally-preferred messaging mode, the numbered options refer to how many unparsed letters will be sent at a time.

DPS Speed (Sec): represents the number of seconds between successive message 'screens.' the factory default, 2 seconds, has been found to work best with nearly all RDS radios currently

being manufactured. This is also a rate that is reasonably safe for a driver to glance at without neglecting driving responsibilities.

DPS Defaults

When dynamic PS is truly dynamic; that is, controlled by station automation for promotion, advertising or song info, or derived from similar off-air or streaming sources, DPS Defaults can insert a fixed, scrolling PS message when the incoming data is not updated within a reasonable timeframe.

Just as with Dynamic PS, click into the DPS Default: area and type-in your fallback message. Then set DPS Timer (Min): to the number of minutes for the 651 to wait for a message update. At the end of the wait, your typed-in message will then begin scrolling on RDS radios. When the normal DPS source returns, this function will be reset.

RadioText

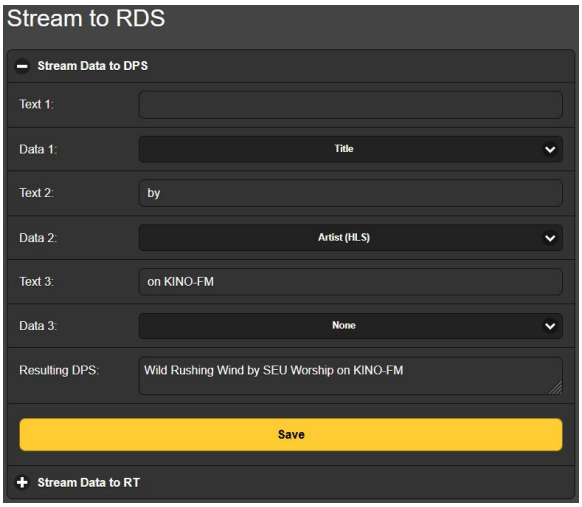
RDS RadioText is quite similar to Dynamic PS, except that it is sent as a single 64-character text message. On RDS radios, the entire message might be displayed on a screen, or parsed by the radio into a smaller display similar to RDS dynamic PS.

As far as the RT:, RT Default: and RT Timer (Min): settings are concerned, these are programmed in the same manner as the corresponding Dynamic PS messaging options already described.

Remove Extra Spaces is a feature of the 651 RDS encoder that streamlines RadioText messaging by removing unnecessary spaces in RT messages. Playout system and other message sources frequently pad messages with extra spaces to fill the 64-character register. When Enable: is turned On, the 651 will remove those extra spaces, except in the FM (Passthrough) mode and in other instances when the encoder is not fully in use (see Pages 48-49).

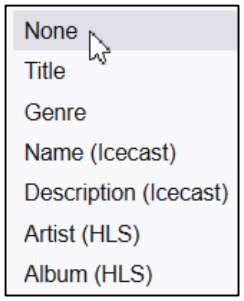
Stream to RDS

The 651 RDS encoder is capable of receiving metadata from streaming sources and formatting it properly for RDS transmission into the PS and RadioText messaging fields, including the corresponding RT+ tags for RadioText, automatically, when applicable.



This conversion requires no third party or programming effort; the job is done within an interface that is common to both PS and RT, as well as streaming. The Dynamic PS interface is shown at the right.

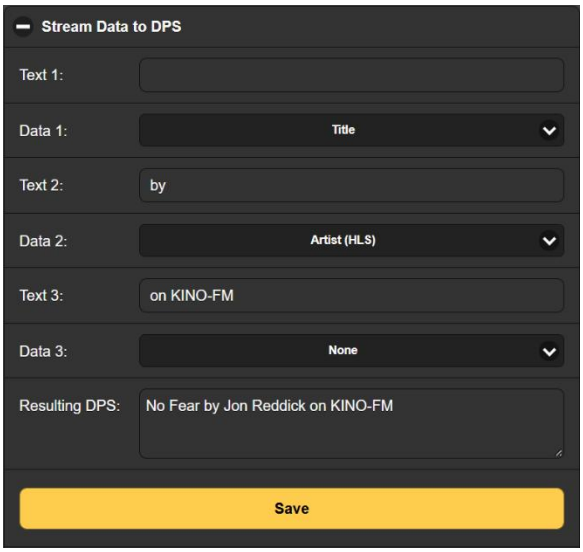
The 651 accepts data corresponding to the selected category in a drop-down menu for Data 1:, 2: and 3:.



In the above example, we selected Title for the Data 1: spot, and have typed'¤by¤' in the Text 2: area. (In this tutorial we use the '¤' symbol to represent a typed-in space, which must be inserted manually between words that are inserted into your message text.)

Next, Artist is selected for the Data 2: spot, '¤on KINO FM¤' for Text 3: and, finally, Name for the Data 3: spot. When all entries have been completed, click Save.

If you are receiving a streaming source with metadata while you are setting-up this feature, you will see instant Resulting DPS: results. In this example the 651 was receiving a stream from the AIR-1 network. The scrolling PS reads: No Fear by Jon Reddick on KINO-FM. Note that the 'by' and 'on KINO-FM' (along with their bracketing spaces), were typed into the Text 2: and Text 3: fields to bridge the title and artist callouts.



Of course you can be very inventive with this formatting, the scrolling-PS could as easily have read: KBLA features Michael Jackson performing Thriller, stay tuned for more! But of course, keeping it simple makes a given formatting setup more suitable for a wider range of possible songs and artists.

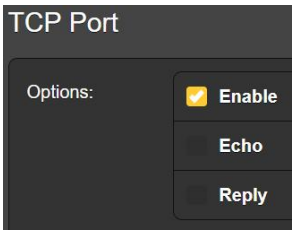
For the Data 1, 2, 3: entries for the Stream to RDS choice, you need to take the stream coding into account, selecting either the (Icecast) or (HLS) entries, depending on the source formatting.

ADDRESSING THE RDS ENCODER

Station automation addresses the 651 RDS encoder using the encoder's TCP or UDP ports.

The TCP Port

The TCP Port first must be enabled, and also has the options of echoing and replying to incoming commands, as may be required by station automation. The Port: number defaults to 10001, but may be changed by overtyping, followed by a Save.



Status: will indicate either Idle, or Update received, followed by the sender's IP address, for a valid command.

The UDP Port

TCP and UDP ports operate under slightly different protocols. The 651 UDP Port offers a Multicast Group: option for addressing multiple encoders with a special IP address common to them all, but otherwise is set up in the same manner as the TCP Port just described. The Multicast Group: identifies your encoder as a valid recipient of RDS-data 'datagrams' to its specific group of encoders, which first requires that you type-in the special multicast address, and then click Save.

The Received Data History area finds use in troubleshooting port connection problems and badly-formatted messages. Whatever data is received on the TCP and UDP ports will accumulate in a list of data received over a quite long period; new data is added at the bottom of the list. Here are examples of incoming updates to two of the encoder's static messages:

Data Ports

Received Data History

Data	Valid	Source	Time	Date
DPS=Top hits all the time on KINO-FM	✓	TCP1	3:17:22 PM	11/12/26
RTDEFAULT=Top hits all the time... KINO-FM	✓	TCP1	3:19:27 PM	11/12/26

The Command List

In addition to properly-formatted dynamic messaging, other RDS encoder setup options can be accessed using headers. Open the Command List for guidance in setup by this means.

In the above example, we used the popular PuTTY terminal program to gain access to the encoder by entering the encoder's TCP address and port number. Once connected, headers and commands from the Command List were typed-in as pictured in the example to change the DPS and RTDEFAULT data.

DPS and RT Commands for Automation

Station automation bears the responsibility of sending song title and artist info, and/or station promo and advertising messaging to the 651 RDS encoder. Automation sends properly-formatted text to the encoder's TCP or UDP port, and uses headers to route the text to the proper registers for transmission.

Factory-default headers for messaging are shown in the DPS & RT Commands area of the RDS Encoder webpage, and also illustrated here.



Refer to the Command List and note that automation must always insert an equals sign after the header, and an 'Enter' or 'carriage return' at the end of the command. Thus to send artist and title to the DPS field, automation would send something like this:

DPS=Patient Zero by Taylor Swift on KINO-FM↵

And when received by the encoder, this popped-up in Received Data History and became resident in the Dynamic PS register.



The IP Whitelist

'Whitelisting' gives your RDS encoder an extra level of protection by denying access to any incoming IP addresses to the RDS encoder ports that you have not entered manually on this page.

In the IP Whitelist area, enter permitted IP addresses into the IP 1: through IP 4: boxes, and then chick Save. Of course Enable must be turned On for this feature to work.

THE SETUP PAGE

NOTE: Some of the information in this section is redundant to earlier discussions; most notably, descriptions of inputs and outputs. Be watchful of references to those pages here.

Radio Setup

Here you set the FM De-Emphasis: characteristic for off-air reception; 75μs for North America, 50μs for Europe and some other areas.

Similarly, RDS/RBDS:, the two, slightly different radio data standards, must be matched to your service area. These are delineated for you; the two choices are RDS (Europe) or RBDS (North America), doubtless complementing your pre-emphasis settings.

The Country: setting is only necessary for RadioDNS operation. RadioDNS is discussed on Page 33.

Audio Inputs

Loudness Window (Sec): is an adjustment associated with the ITU-R BS.1770 (LU) loudness metering utility. This is discussed on Page 28. The factory-default setting is 60.

Refer back to Page 14 for the initial discussion of program line inputs.

Adjustment sliders are provided for program audio inputs that are subject to level variations. Off-air FM program levels are well regulated by broadcast standards that define peak levels. But analog, digital and streaming inputs can vary over a wide range, depending on level consistency of the source, as well as differing de-facto line level and streaming level specifications.

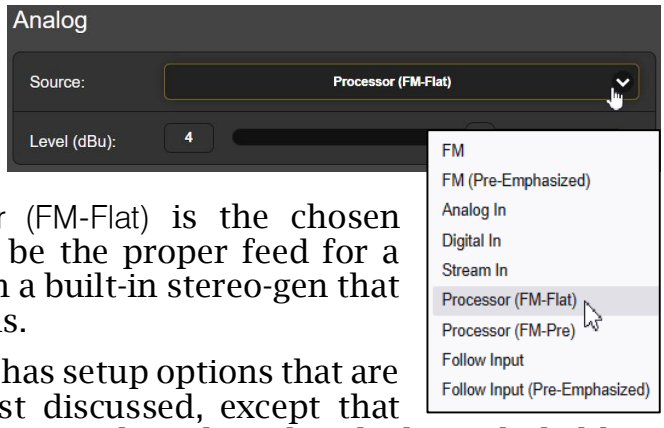
A feature of the AARON 651 is that these program inputs may be preset and level-trimmed offline, without having to be the re-broadcast source during setup. Each input has a meter that shows the adjusted level, including a numerical peak-hold display. These meters are peak-responding, so with a typical program feed adjust the Trim (dB): slider so that the highest program peaks hover around –3dB, seldom-if-ever reaching 0dB.

Audio Outputs

The introductory discussion of 651 program line outputs can be found on Page 15.

The 651 has program line outputs that can feed translator exciters with internal stereo generators. Each output can have individual source assignments and output level adjustments.

The Analog line output is shown here, along with its drop-down menu of source options for this output. In this illustration, Processor (FM-Flat) is the chosen Source:, which would be the proper feed for a translator exciter with a built-in stereo-gen that provides pre-emphasis.

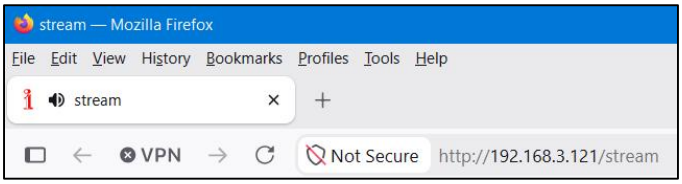


The Digital line output has setup options that are identical to those just discussed, except that the digital Sample Rate: may be selected with the included buttons. In addition, the composite-multiplex (MPX) baseband output from the internal stereo-gen of the 651 is routed to the digital line output in when 192kHz (MPX) is selected.

The Streaming Output

The 651 provides a streaming audio output that can be accessed using any web browser, or by a hardware player that can handle Icecast streams. This streaming output enables the Click to Listen web-listening utility at the top of each 651 webpage. But 'casual' listeners can also monitor the selected listening option by entering the IP address of the 651 into a web browser, followed by /stream as in the example here.





In this manner, office or other non-technical personnel can listen, but without access to 651 operating controls.

Note that the streaming Codec:, Bitrate (kbps): and Sample Rate: are all selectable to meet your specific networking protocols. Be sure to click Save after making any changes to these settings.

Composite/MPX Outputs

Two rear-panel BNC outputs deliver independent MPX 1 and MPX 2, composite-multiplex outputs of the 651 stereo-gen. MPX1 Level (Vpp): and MPX 2 Level (Vpp): offer control over the peak-to-peak levels. Outputs may be adjusted between 1Vpp and 6Vpp.

General Purpose Inputs/Outputs

Removable screw-terminal strips on the rear panel give access to four General Purpose Inputs and fourteen General Purpose Outputs. These are also identified as to function and status here as well. Please refer to the earlier discussion on Page 16 for connection and programming information.

NETWORK SETUP

Connecting the 651 to your network was first introduced on Page 20. Refinements of network operation are covered here on the Network webpage.

DHCP IP Assignment

With the 651 plugged into your network, and Mode: set to DHCP, your router will have automatically assigned an IP address: to the 651. With this DHCP connection established, the following four or five fields will have automatically populated.

Manual IP Setup

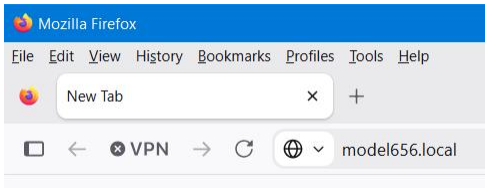
For any of several reasons, you may need to set the IP address of the 651 manually. Select Static IP and manually enter the four or five remaining network values. When you're finished, be sure to click Save for the new entries.

It is really not within the scope of this discussion to detail any added complexities of static-IP setup procedure, but a competent IT professional should be familiar with the intricacies of this operation.

mDNS

Multicast DNS (mDNS) is able to prohibit or allow addressing the 651 with its Hostname followed by .local. Set mDNS: Off or mDNS: On, respectively.

With Network → mDNS: On, you will be able to access the 651 with any web browser as shown here: model651.local.



Assigning a Hostname

Network → Hostname lets you assign a specific name to the 651 to identify it on your network. You may change the default name MODEL651 to personalize the equipment name, or to differentiate one 651 from another on the same network.

Enter a hostname of your choice. The Hostname assignment cannot include spaces, but you can used both uppercase and lowercase letters. Be sure to Save the name once you've entered it.

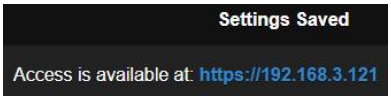
Under some conditions, browsers may require you to enter the complete IP address of the unit, which you will find by navigating from the front panel menu to Network → IP Address.

The MAC Address: of your 651 is shown next. This is factory-assigned and cannot be changed.

Link Speed: is simply the maximum theoretical data rate of the network connection between the 651 and your router. This generally sits at 1000Mbps.

Webserver Protocol

The web server internal to the 651 may be configured for internal web server Protocol: as either HTTP, HTTPS or Both. Choose how you want the 651 to appear to browsers and click Save. A pop-up will confirm the saved IP.



SNMP OPERATION

The 651 will interface directly with a network controller, technically known as the SNMP Manager. The 651 has an embedded ASCII text file called a Management Information Base, or MIB. In setting up for SNMP operation, the MIB file will have to be downloaded from the 651 through the SNMP webpage interface, as discussed shortly, and uploaded to the SNMP Manager.

Mode

The SNMP default Mode: setting is Disabled, which inhibits communication between the 651 and the SNMP Manager.

Changing Mode: to Read Only allows the 651 to be interrogated by the SNMP Manager, so that programmed setup parameters, alarms, etc. can be integrated with other equipment on the network.

Setting the Mode: to Read & Write allows the SNMP Manager to send commands to the 651.

Communities

SNMP 'communities' are, and serve as, passwords. In the Read Community: and Write Community: fields, overtype the factory defaults and enter text that is specified for the read/write strings on the SNMP Manager monitoring device. Execute a Save after entering.

Ports

The default SNMP Ports, SNMP Port: 161 and Trap Port: 162, are customary for a majority of SNMP operations. These may be overtyped to change them as required.

Traps

When the 651 *initiates* an alarm, rather than being *queried* or *polled* for one, the alarm is known as a 'trap.' Five local network IP addresses may be entered in the Trap Destination fields, each

corresponding to other devices on the LAN that need to be apprised of alarm and status info.

MIB File

The MIB File is a small text file required by the SNMP Manager. At the bottom of the SNMP webpage, click: Download MIB to save this file to your normal Downloads folder. The MIB file is in plain text with a .mib extension, and may be read with Windows Notepad or any equivalent text reader.

This is an abbreviated discussion of SNMP operation. SNMP is a complex utility, managed exclusively by the SNMP Manager (monitoring equipment) employed. Refer to all instructions supplied with, and for, the SNMP Manager hardware in setting-up the 651.

EMAIL

Using its normal internet connection, the 651 can send email alarm notifications to one or multiple recipients, with the ability to direct which alarms to which personnel.

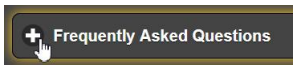
NOTE: The time-stamp feature for email notifications and the Alarm Log depends on a network connection to sync with internet time, along with setting the proper time zone and other options explained, starting on Page 59.

SMTP Setup

The 651 must first be properly programmed to send mail under SMTP Server. The 651 needs an actual email account, the setup of which is just like setting-up any conventional email account.

Information to be entered here may depend on the provider you choose. Many now require 2-step verification to create 'app passwords'; that is, passwords that are entered automatically by hardware, like the 651. When you apply for the email account, much of this information will be assigned to you.

We have included a 'help' utility that may answer most of your email setup questions. Click ✚ to open the FAQ utility.



Under SMTP Server:, enter the provided outgoing mail server info (e.g.: smtp.gmail.com), the required Port: number and the proper TLS: setting. (Hover over the settings to pop-up further info.)

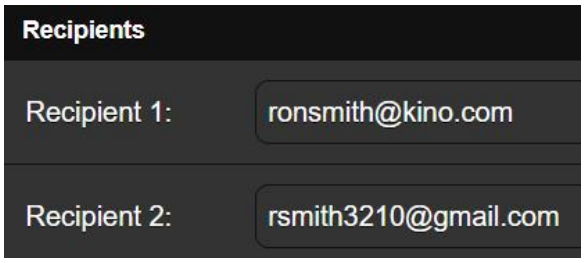
Address: under From is the full email address of your 651 mail account. Name:, however, is a 'friendly' name that can identify the 651 to the email recipient. You can use station call letters: KINO-FM or: RDS Alarm.

Authentication

Username: is again the full email address of the unit, usually the same as From Address: above. Password: is the 651 email account log-in password.

The Email List (Send To)

Next, enter up to ten email recipients, personnel who will be receiving alarm notifications. Type-in the full email address. After this you'll decide who gets what alert.



Email addresses typically take the form of the examples in the illustration here. Ron Smith, KINO's Chief Engineer has entered both his work and home email addresses. When all recipients have been entered, or after adding a new one, click Save.at the bottom of the page. You may also click Send Test Email, which will blanket-message all recipients to confirm proper communications setup.

Log Emails

Because the alarm log can comprise a vast number of entries, a provision has been included to specify a timeframe for sending just the alarm logs. Of course, individual alarms will always dispatch to indicated personnel immediately.

Hour Sent: is the time of day that the 651 will send logs, whether daily, weekly or monthly. Weekly Log Day: is for setting the day of the week for weekly alarms to be sent. Monthly alarms will dispatch on the first day of the month.

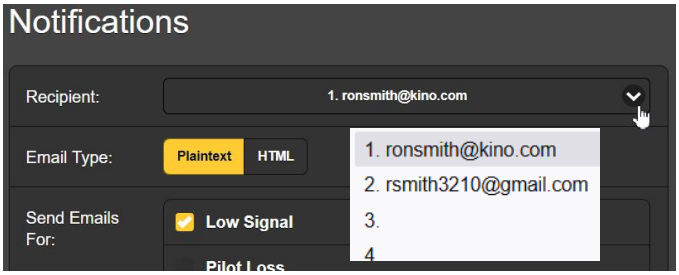
Email Status

Click the Status bar ✚ for a listing of the most recently sent emails, and whether they indeed were sent, or the attempt failed.

Notifications, (Send What)

You can assign any or all alarms to any or all email or text addresses in the Notifications section. Email alarm notifications can either be in Plaintext (text only), or in HTML. HTML emails provide a graph of the relevant metric over the 5 minutes prior to the alarm, if the alarm is one with threshold values.

First, click ⌄ for the drop-down list of all recipient personnel, then click an email address to place that person as Recipient: under Notifications.



Now, with a Recipient: selected, click one or more Send Emails For: boxes to choose which alarm conditions will be reported to that individual. In the example Ron will get an email at work when the carrier fails, but can receive alarms for as many of the other faults as he cares to receive. He can also sign himself up to receive a daily, weekly or monthly log of all alarms.

TIMEKEEPING SETUP

Time Zone

At the top of the Time webpage, click the Time Zone: ⌄ to select your local zone from the drop-down list. This selection also

assures a proper Daylight Saving or Standard Time setting for your area.

An internet connection will sync the internal real-time clock with the online time server. Today's date and the local time should appear at the top of the page. Maintaining an internet connection will assure that time will remain correct.

You may also select the Time Format: and Date Format: for your preference. The current condition of the RTC Battery: will let you know if replacement of the Real Time Clock battery is necessary.

Time Servers

A factory-default internet time server has been pre-programmed into the 651, actually the same URL for Time Server 1: through Time Server 4:. You may change the list, adding alternattive servers if you like, simply by overtyping the entry in any of the four slots. Be sure to click Save after making or changing any single entry.

Minimum Poll Time: represents the time used initially, after booting, to poll the server for the current time info. As the 651 continues, powered-on, this time is incrementally doubled until it reaches the Maximum Poll Time:. This is in the interest of reducing 'data waste' by constant, frequent polling of the server(s) for the time of day.

Time Server Status

This is an informational display of all time servers being polled. Stratum 1 represents a 'top-rated,' master time server with minimum drift, providing precise and stable time so other devices and networks can synchronize to it. Poll Interval is the current polling interval for that time server. Reach indicates the number of successful polls out of the last eight for each time server. Last Sync shows the number of seconds since the last sync with the time server. Offset is that between the specified time server and the 651's internal real time clock.

ADMIN SETTINGS

Passwords

All AARON 651 settings are protected by usernames and passwords, which must then be entered before access to the 651 will be granted and operational changes made available.

Front Panel: access requires a password only, no username. This may be entered either through the Admin webpage, or locally at the front panel, and will be visible in both locations.

Web Admin (Read/Write) access requires both a Username and a Password. You may accept the factory admin username, or pick another. Once each field has been completed, followed by a Save command, you will immediately be locked-out and prompted to enter that username and password to continue. The Web Admin user is able to leaf through the webpages and make all setting and adjustment changes to the 651.

The other category of user is the Web User (Read Only). Signing-in with this credential allows full access to all webpages, but without the ability to make any adjustments or other changes to the unit. Username: and Password: setup is identical to what was just described above.

REMEMBER: Once signed-in at either the Web Admin or Web User level, you must **SIGN OUT!** If you neglect to do so, subsequent users of the same computer will essentially be signed in as well. Treat this security measure as you would your online banking.

There is no sign-out provision at the front panel of the unit, but the AARON 651 front panel will 'sleep' whenever the screen times-out and goes dim or dark, once the unit is untouched for the programmed timeout period. The front panel can be forced closed by navigating to ☰ → Admin → Display/Meters and touching Sleep Display.

When front-panel password protection is in place, you will be prompted to enter the password before any menu can be accessed and any adjustments made. This will be necessary each time the unit is awakened from a dark screen.

With remote operation, a Web Admin or Web User password must be entered for a new browser connection. There is no timeout if the browser remains connected.

Lost Password (Hard Reset)

To recover control of the AARON 651 if the password is lost, you must do a "hard reset" from the front panel of the unit. This is accomplished by disconnecting AC mains power, and then doing this: Place several fingers on the front-panel LCD screen and move them back and forth as you reapply AC mains power, keep rubbing until the display shows the message Factory Defaults Loaded on the LCD.

NOTE: A hard reset deletes not only the usernames and passwords, but will also return the AARON 651 to all-factory-default conditions and values. *All User settings will be lost!* This illustrates the importance of keeping a Hardware Profile current.

The Hardware Profile

The entire AARON 651 setup, which includes off-air receiver and all other input source setups, audio processing presets, stereogen and RDS settings, alarm notification preferences and SNMP options… all may be saved to your computer as a small text file. A Hardware Profile is useful for restoring a previous receiver setup or for 'cloning' a second unit for backup service.

Under Admin → Configuration, click Download Hardware Profile to save the profile to your system. This will place a small .json file in the Downloads area on your computer.



To upload a saved setting in future, on the Admin webpage click Select Hardware Profile, navigate to where you have saved the profile, click to highlight it, then click Upload Hardware Profile. This will replace all setup parameters that are currently loaded and

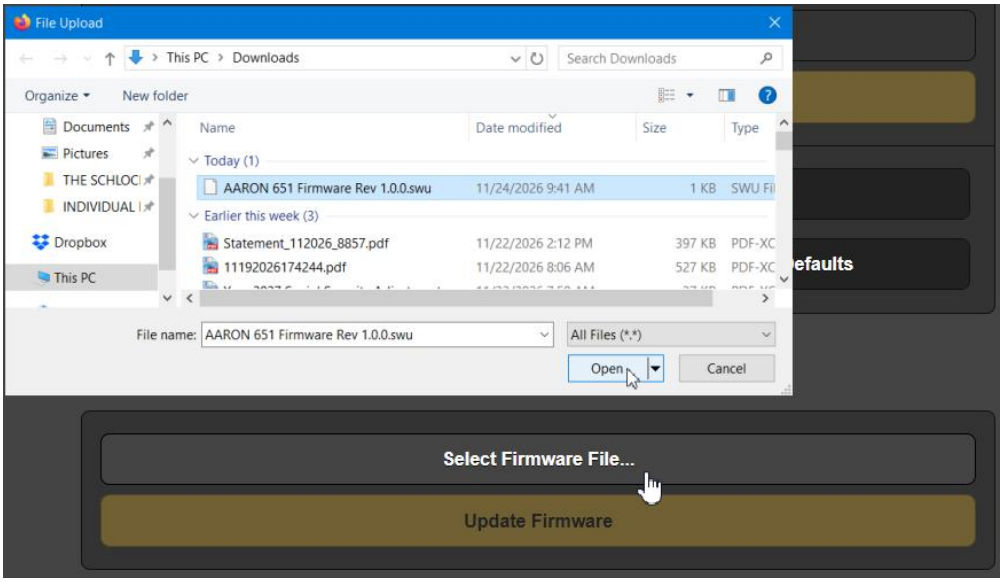
running in your 651 with the saved ones. Your AARON 651 will reboot following a Hardware Profile update.

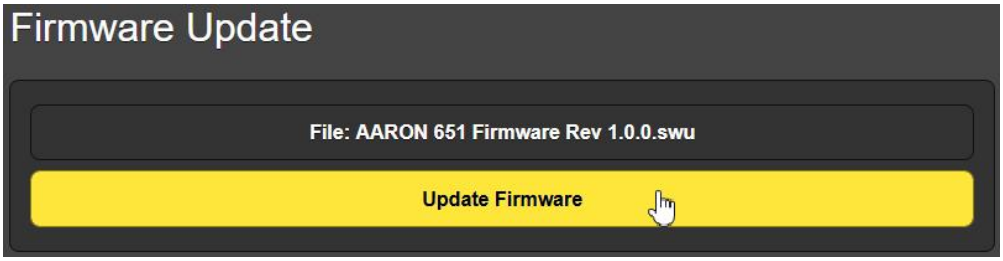
Updating Firmware

Any updated AARON 651 firmware and webpages are easily uploaded to the unit when issued by Inovonics.

NOTE: It would be an excellent idea to update your Hardware Profile, as a firmware update may affect some user settings.

Updates are issued as .swu files that may be downloaded, either to your Downloads folder or to your computer Desktop. From the Firmware Update utility at the bottom of the Admin screen, click Select Firmware File… and then navigate to the downloaded file and double-click it. This will transfer the file, name to the updater as shown here.





This will have transferred the updated firmware to the updater, as shown above. Next click Update Firmware and follow prompts to complete the process. Updating takes about 30 seconds and will ultimately return you to the Now Playing webpage when the operation is complete.

We have included a PDF copy of the AARON 651 manual within the unit for screen reading.

The Admin webpage also gives information about the unit at the bottom of the page, including a Check for Updates link.

INOVONICS WARRANTY

I **TERMS OF SALE:** Inovonics products are sold with an understanding of "full satisfaction"; that is, full credit or refund will be issued for products sold as new if returned to the point of purchase within 30 days following their receipt, provided that they are returned complete and in an "as received" condition.

II **CONDITIONS OF WARRANTY:** The following terms apply unless amended *in writing* by Inovonics, Inc.

A. Register the Warranty online at www.inovonicsbroadcast.com within 10 days of delivery.

B. This Warranty applies only to products sold "as new." It is extended only to the original end-user and may not be transferred or assigned without prior written approval by Inovonics.

C. This Warranty does not apply to damage caused by misuse, abuse, accident or neglect. This Warranty is voided by unauthorized attempts at repair or modification, or if the serial identification label has been removed or altered.

III **TERMS OF WARRANTY:** Inovonics, Inc. products are warranted to be free from defects in materials and workmanship.

A. Any discrepancies noted within THREE YEARS of the date of delivery will be repaired free of charge, or will be replaced with a new or remanufactured product at Inovonics' option.

B. Parts and labor for factory repair required after the three-year Warranty period will be billed at prevailing prices and rates.

IV **RETURNING GOODS FOR FACTORY REPAIR:**

A. Equipment will not be accepted for Warranty or other repair without a Return Authorization (RA) number issued by Inovonics prior to its return. An RA number may be obtained by calling the factory. The number should be prominently marked on the outside of the shipping carton.

B. Equipment must be shipped prepaid to Inovonics. Shipping charges will be reimbursed for valid Warranty claims. Damage sustained as a result of improper packing for return to the factory is not covered under terms of the Warranty and may occasion additional charges.

Revised May, 2017

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