

541

FM Modulation Monitor

Installation & User Guide



PRODUCT REGISTRATION RECORD

541 – Serial No. _____

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Installation & Operation User Guide

541

FM Modulation Monitor

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Section I

INTRODUCTION

541 PRODUCT DESCRIPTION

Introduction The 541 is Inovonics' fourth-generation FM Modulation Monitor. It delivers a wealth of information about the transmitted signal in terms of the RF carrier and all subcarriers, the audio component defining the technical quality that the listener hears, and full decoding of RDS data and SCA audio.

The all-digital 541 combines detailed DSP signal analysis with a menu-driven touchscreen display, plus Webserver-based total access for remote operation, including measurements, graphical data and Web-browser audio monitoring of the off-air program.

Product Features

Leading features of the Inovonics 541 include:

- Unexcelled off-air reception of analog-FM broadcasts with highly-accurate displays of total-modulation and other measurements, even in the presence of on-channel or adjacent-channel HD Radio carriers at any level.
- Intuitive, menu-driven setup from the front panel, or remote setup and operation with the built-in Webserver that may be addressed over any IP network by computer or mobile device. The 541 supports full SNMP remote control and monitoring.
- Graphic front-panel and remote display of all level metering; FFT spectrum analysis of IF passband, MPX baseband and program audio; oscilloscope display of program audio and stereo XY.
- Accurate, program loudness measurement to the human-perception ITU-R BS.1770 ('LU') loudness specification.
- Collects and logs a history-over-time of FM and audio signal parameters.
- Analog, AES3-digital, HTTP/UDP Web-streaming and independent AoIP-streaming program audio outputs, plus an FM composite/MPX baseband output.
- Alarms for a range of signal faults, with tallies and SMS/text or email message dispatches to specific individuals for various alarm conditions. All alarms are also logged chronologically.
- The BandScanner™ utility scans the FM spectrum and displays each station with its signal level, PI code and callsign.
- StationRotation™ mode enables automatic sequential monitoring of multiple station presets.
- Stays on-channel and retains measurement setups through signal and power losses.

541 TECHNICAL SPECIFICATIONS

PLEASE NOTE: Specifications tabulated here are actual, real-world measurements, not optimistic allusions to theoretical ideals. Measurement results should be repeatable when using the appropriate, laboratory-grade test equipment.

RF & RECEPTION

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

Antenna Input: 75-ohm (F), 1VRMS max.

High Level RF Input: 50-ohm (BNC), 5VRMS max.

Off-Air Sensitivity (for 50dB monaural SNR):
5dB μ V or better with de-emphasis.
15dB μ V or better unweighted.

Reception Modes: Stereo / Forced Mono / SCA Program Audio

FM BASEBAND (Off-Air or High Level; **(D)** indicates measurements taken with de-emphasis.)

Frequency Response: ± 0.25 dB, 10Hz-100kHz.

Signal-to-Noise (D): >83 dB.

Distortion (D): $<0.01\%$ THD+N; $<0.01\%$ IMD (SMPTE, 60Hz/7kHz, 4:1).

FM Deviation: Indicates composite (total) and independent positive and negative deviations. ± 75 kHz = 100% Modulation; 0-200% metering with $\pm 1\%$ accuracy.

AM Noise (D): Measures down to 87dB below 100% AM Modulation.

FM Stereo Pilot: Indicates 0-15% pilot injection; pilot frequency readout has ± 0.1 Hz accuracy.

FM Subcarriers: Indicates percent injection of 38kHz (residual), 57kHz RDS, 67kHz/92kHz SCA subcarriers.

FM AUDIO PERFORMANCE (Off-Air or High Level; taken with de-emphasis; **(M)** indicates measurements taken in monaural reception mode.)

Frequency Response: ± 0.1 dB, 20Hz-15kHz

Signal-to-Noise (M):

Analog Out: >90 dB

Digital Out: >90 dB

Distortion (M):

Analog Out: $<0.01\%$ THD+N; $<0.02\%$ IMD (SMPTE, 60Hz/7kHz, 4:1).

Digital Out: $<0.01\%$ THD+N; $<0.01\%$ IMD (SMPTE, 60Hz/7kHz, 4:1).

Stereo Separation: >64 dB, 20Hz-15kHz

FM Stereo Crosstalk (Main \rightarrow Sub or Sub \rightarrow Main): >67 dB, 20Hz-15kHz.

FM De-emphasis: 75 μ s / 50 μ s / None.

INPUTS, OUTPUTS AND PORTS

MPX Output: (BNC) select either MPX or 19kHz stereo pilot sample; adjustable from 1V_{PP} to 6V_{PP} in 0.01V steps; ± 0.25 dB, 10Hz-100kHz.

Program Audio Outputs: May be assigned to the FM-stereo program or to SCA audio. Unless otherwise noted, performance parameters reflect FM Stereo Performance cited above.

Balanced Analog: (XLR) Left and Right outputs adjustable from -15 dBu to $+15$ dBu in 0.1dB steps; 200 Ω resistive source.

Program Audio Outputs (continued):

AES Digital: (XLR) Adjustable from -30 dBFS to 0dBFS in 0.1dB steps; user-selected 44.1kHz or 48kHz sample rate; 110 Ω transformer-coupled.

Dante/AES67 Compatible AoIP Port: (RJ45)

Output at 44.1kHz (Dante-only) or 44.1kHz/48kHz (Dante/AES67); AoIP utility has independent IP, Audio Format and Transmit Flow settings; level adjustable from -30 dBFS to 0dBFS in 0.1dB steps.

UDP Stream: ADTS or ADTS in MPEG-TS transport.

HTTP/Icecast 'Casual' Listening Stream: Web browser remote-listening stream employs HE-AACv2 encoding, 44.1kHz or 48kHz sample rate, bit-rates from 18kbps to 64kbps; accommodates up to 10 simultaneous listeners. HTTP/Icecast and raw UDP streams are available simultaneously.

Headphone Jack: ($\frac{1}{4}$ " TRS) Menu-adjustable listening level.

LAN Port: (RJ45) LAN connection to local network or Internet provides remote monitoring, control, listening and full SNMP implementation; user-programmable network setup and streaming parameters.

General Purpose Outputs: (Barrier Strip) Six individual open-collector NPN transistor closures to ground are associated with alarm functions. Each is programmable for GPO assignment and logic polarity. Outputs sink 100mA, 40Vdc max.

DISPLAYS AND DISPLAY OPTIONS

Bargraph & Numerical Level Metering: Carrier Modulation • Stereo Pilot & Subcarriers • MPX Power • Demodulated L/R & L+R/L-R • Stereo Separation • Stereo Crosstalk • BS.1770 Loudness • SCA Levels • Synchronous & AM Noise.

Graphic Displays and History Plots: IF Spectrum • MPX Spectrum • Audio Spectrum • Audio Oscilloscope • Audio XY • FM Modulation History • Audio Level History • RF Metrics History • BandScanner™ utility.

RDS Fields Displayed: PS • PI • Call • RT • RT+1 • RT+2 • PTY • PTYN • CT • M/S • DI • TP • TA • AF • ODA • Block Error Rate • Groups & Group Use Statistics.

TIMEKEEPING AND ALARMS

Real-Time Clock: Auto-sets to Internet time; auto/manual DST setting; battery backup.

Local & Remote Alarms: Carrier Overmod • MPX Power • Audio Loss • Low Signal • Pilot Loss • Multipath • RDS Loss • RDS PI Error • RDS RT • RDS CT • RDS TMC • Pilot Loss • MPX Power. (Most alarms have multiple parameter settings. All alarms can send text or email notifications. Alarms are automatically logged daily, weekly and monthly.)

POWER, ENVIRONMENTAL, MISCELLANEOUS

Power Requirement:

88-264VAC, Single-Phase; 12W.

AC Mains Power Factor:

Better than 0.6/0.9*

*Upon customer request

Operating Environment: 32°F/0°C - 122°F/50°C;

0%-95% non-condensing relative humidity;
10,000ft/3048m.

Size and Weight:

3.5”H x 19”W x 9”D; 12 lbs. shipping weight.

Conformances:

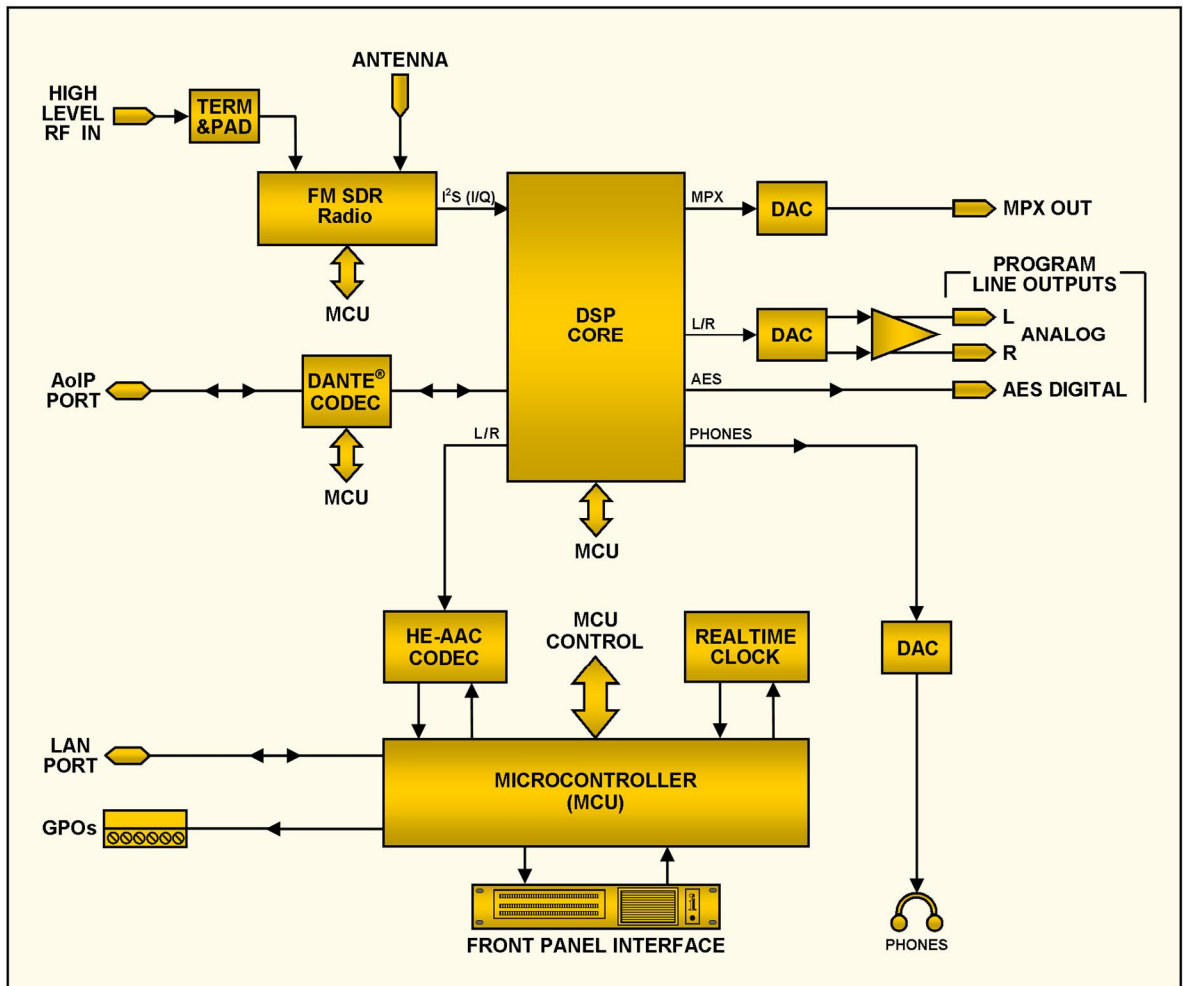


EN50081-1 / EN50082-1
93/68/EEC

2002/95/EC

BLOCK DIAGRAM

The 541 incorporates Software-Defined Radio (SDR) receiver architecture combined with similar monolithic elements in its design, such that the product is almost entirely DSP-based. Virtually all functionality is provided through firmware coding. The Block Diagram presented below illustrates product basics in an easy-to-follow form, although actual signal paths and logical functions may deviate appreciably from those depicted here.



Block Diagram of the Inovonics 541 FM Modulation Monitor

Section II

INSTALLATION

GENERAL

This section of the manual addresses the physical installation of the 541 at its operating location, the ‘nuts and bolts’ of connecting the unit. This section also references pages where pertinent setup options and adjustments are discussed.

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 possible return or transshipment. If returned for Warranty repair, shipping damage sustained as a result of careless packing for return may invalidate the Warranty!

IT IS IMPORTANT to register the Warranty of your 541. This assures coverage of the equipment under Warranty terms, provides a means of tracing lost or stolen gear, and adds the user to a database to receive specific service instructions or software/firmware updates when issued. Register online at:

www.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 setup and use of the 541 monitor. When the time comes, do please refer back to this section to confirm proper physical installation and interconnection with other station equipment.

MOUNTING, POWER AND ENVIRONMENT

Rack Requirement

The 541 is a 2U rack-mount package, occupying a nominal 3½ inches of vertical rack space.

Heat Dissipation

As a result of its power-efficient design, the 541 generates little heat itself. This obviates the noisy internal fan and bothersome filter of many other lab-grade instruments. The unit is specified for operation within an ambient temperature range extending from freezing to 120°F/50°C. Because adjacent, less-efficient 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	<p>The 541 employs an internal ‘universal’ switchmode power supply that accommodates mains voltages between 88VAC and 264VAC. Certified self-protection circuits have replaced the once-familiar fuseholder.</p> <p>If you need to replace the North-American 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. It is essential that you to follow this coding to ensure product safety.</p>
Radio Frequency Interference (RFI)	<p>Although it is expected that the 541 will be co-located with other radio equipment, do practice care and common sense in locating the unit away from abnormally high RF fields.</p>
Ground Loops	<p>A mains frequency or RF ground loop could possibly be formed between cable shield grounds and the AC power cord ground. If hum or similar invasive noise is noted in analog outputs, a ‘ground-lifting’ AC adapter may remedy the problem, although the chassis must somehow be returned to earth ground for safety. Rack-mounting the chassis normally satisfies this requirement.</p>

INPUTS, OUTPUTS AND PORTS

Antenna Input and Considerations	<p>The rear-panel ANTENNA connector is a female, 75-ohm F connector. While the F is a common connector in the US, adapters to other connector types are readily available worldwide.</p> <p>Factors guiding your selection of an antenna will include the level and purity of the off-air signal. Selectivity of the 541 is remarkably good, but the ultra-wideband nature of the receiver may still require you to insert an outboard band-pass or band-stop filter in certain situations where the 541 and high-power transmitters are co-located.</p>
High Level Input	<p>The rear-panel HIGH LEVEL RF INPUT is a 50-ohm-terminating BNC input meant to connect directly to a transmitter or coupler tap as an alternative to off-air signal reception. Maximum input voltage should not exceed 5Vrms. Input selection is made under the LCD-touchscreen or Webpage Tuner menus.</p>
Multiplex or Pilot Sync Output	<p>The rear-panel MPX OUT BNC connector delivers either the FM baseband signal or a 19kHz stereo pilot-sync sample. Mode selection and output level adjustment is made under the LCD-touchscreen or Webpage Setup menus. The output may be varied between 1Vpp and 6Vpp.</p>
Analog Line Outputs	<p>LEFT and RIGHT ANALOG OUTPUTs on the rear panel are electronically-balanced. This means that they are ground-referenced and <i>not</i> transformer-isolated. These outputs have a resistive source impedance of 200 ohms. Output levels are expressed in</p>

dBu (unloaded) notation next to the adjusting sliders on LCD-touchscreen or Webpage Setup menus.

Although seldom seen in modern times, a legacy 600-ohm-terminating load will drop the actual dBm level 2.5dB below the figure shown beside the associated slider.

An unbalanced output should be taken from the 'hot' or '+' side of any analog output and ground, leaving the 'return' or '-' side of the output floating. The unbalanced output level will be 6dB below the figure shown beside the slider.

Analog levels may be set to any figure between -15dBu and +15dBu, corresponding to 100% (± 75 kHz) deviation of a monaural FM carrier. The default setting is +4dBu.

**AES Digital
Line Output**

The AES DIGITAL OUTPUT delivers balanced, transformer-coupled AES3 digital stereo program audio from a source impedance of 110 ohms. This is a 24-bit output at a selectable sample rate of 44.1kHz or 48kHz.

AES-digital sample rate and levels may be set under LCD-touchscreen or Webpage Setup menus. Levels may be varied between -30dBFS and 0dBFS, corresponding to 100% (± 75 kHz) carrier deviation. The default setting is -10dBFS.

**AoIP Streaming
Port and Levels**

The Dante-compliant AoIP (Audio over Internet Protocol) outputs appear at the rear-panel RJ45 AoIP PORT. This port is independent of the LAN PORT network connection and its 'casual streaming' utility.

Dante/AoIP streaming first requires basic Dante setup under the Webpage or LCD Dante menus as detailed on Pages 43-44. Output levels are adjusted on the Setup / MPX and Audio Outputs / Dante Output Webpage, or under the LCD Setup / Dante Outputs menu. The dB notation beside each slider control corresponds to the level of program peaks at 100% FM modulation. These are adjustable between 0dBFS and -30dBFS; the default setting is -10dBFS.

**LAN Network
Port**

The RJ45 LAN PORT connects the 541 to a Local Area Network (LAN) or the Internet. Network setup is under the Webpage or LCD Network menu and detailed later in the appropriate section. Networking enables remote control, full SNMP functionality, and the HTTP/UDP Web-browser 'casual listening' utility.

GPOs

A removable screw-terminal strip on the rear panel accesses six GENERAL PURPOSE OUTPUTS (GPO) terminals, the alarm output 'tallies.' GPOs are NPN transistors that saturate to ground and can sink up to 100mA at up to 40V. Alarm polarity (active ground or active open) is software-programmable. GPOs may be assigned to the various reception and program-fault alarms as detailed on Page 41.

Section III

PREPARING TO CONNECT

THE 541 FRONT PANEL

Front Panel vs. Web Interface Setup

Setup and operating adjustments of the 541 are under firmware control; there are no jumpers, switches or mechanical potentiometers. The unit may be set-up locally through the front-panel LCD-touchscreen, or remotely using the built-in Webserver interface and any networked computer, tablet or mobile device with a Web browser.

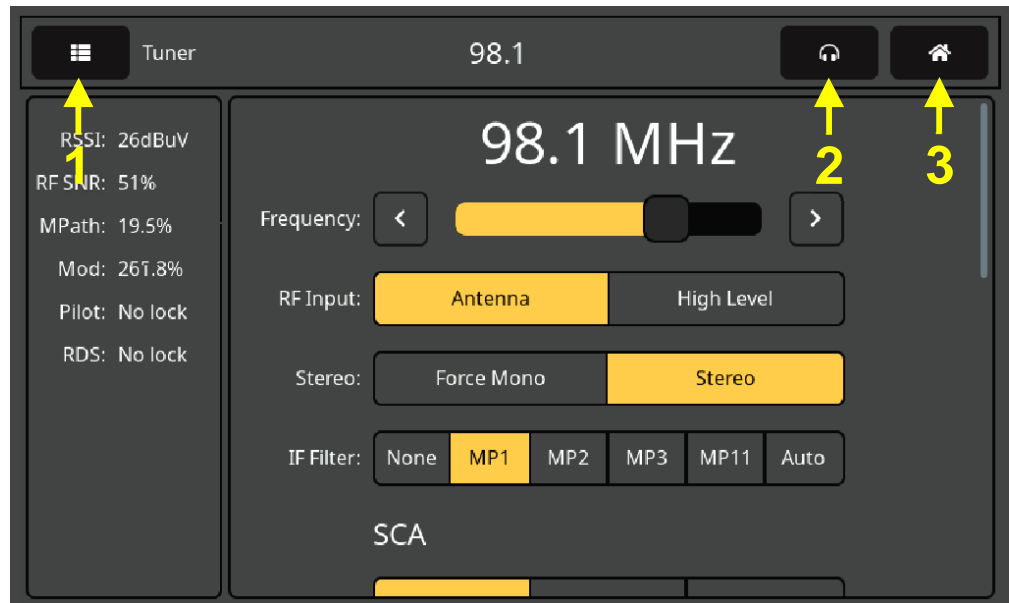
LCD and Web menus follow one another in a reasonably faithful manner, and the few differences are covered in the various discussions that follow. You will at least need to access the LCD-touchscreen to find the unit's IP address, so some familiarity with the front panel is useful.

Powering-Up

'Boot' (startup) time of 541 is under five seconds. When power is first applied, or following a power interruption, the unit is back in full operation quickly. Setup and reception parameters in effect previous to a power glitch are reloaded instantly from non-volatile memory into the processing core.

The LCD-Touchscreen

The LCD-touchscreen has an adjustable timeout feature with a factory default timeout of 5 minutes. Touching the screen will wake it up and reset the timer. Below is an image of what you might see initially with factory-default options.



Arrows in the illustration identify items in the LCD screen header. An additional icon will pop up in the header when an alarm is triggered, just to the left of the headphone symbol. Touch that icon to show the alarm panel screen.



Arrow #1 points to the Menu-select tab. Touch the screen here and a list of all 541 LCD menus will replace the information in the left section. You'll have to scroll down the list to reach the bottom. Scroll down (brush up on the screen) and then touch Admin.

The Admin Menu



The Admin menu hosts Security settings. In addition it displays the unit's current firmware version and serial number, and shows how long the 541 has been running since AC mains power was last applied. Housekeeping features that show up here, along with a few more that can be accessed only through the Webpages interface, will be detailed later in this manual. This LCD-touchscreen Admin menu also gives the only access to front-panel display brightness and timeout options.

LED and LCD Display Settings

You may program brightness of the LED-string level meters on the left portion of the front panel with the LED Meters Brightness sliders labeled Peak: and Peak Hold:. Peak: adjusts the bar brightness and Peak Hold: independently sets brightness of the hanging segment representing the highest peak registered. Use your

finger to push the slider left and right or click the < and > buttons to fine-tune your setting.

Similarly, for the LCD display itself, Brightness: controls the backlight. Timeout: sets the time that the display will remain on after you finger leaves the screen. Toggling the Dim on timeout: button will instead just reduce the brightness to a low, but still visible level rather than turning the backlight off. Touch Sleep Display to preview your timeout action.

LED Level Readout Bars

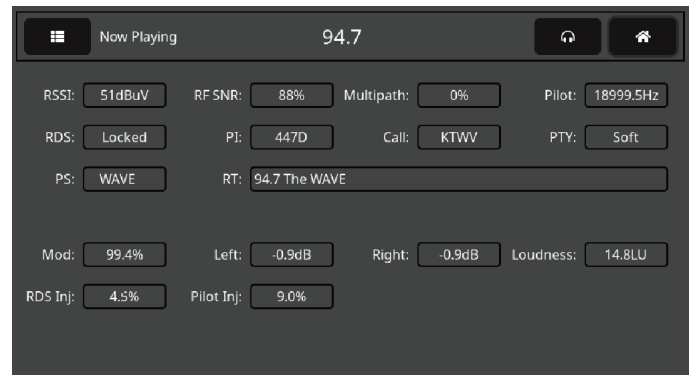
The three peak-responding LED bargraph readouts give quasi-peak-responding level displays of the FM composite-MPX signal and the demodulated left/right channel analog-FM program audio. A peak-hold segment hovers above each bar to indicate the highest, most-recent value registered.

Headphone Volume

Arrow #2 on Page 11 points to the headphone icon. Touching this will bring up a screen where the headphone volume may be adjusted. This screen will pop up automatically when headphones are plugged in. The program line outputs and their levels may be selected and set here, as well as under the LCD and Webpage Setup menus.

The 'Home' Menu

Arrow #3 on Page 11 points to the little cottage icon. Touching this will bring the 'Home' screen into view, giving an overview of station signal parameters, including the more pertinent RDS data fields.



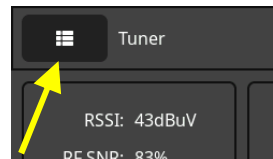
BRINGING UP THE WEBPAGE SERVER

Network Considerations

To access the 541 Webserver interface, both the 541 and your computer must be on the same Local Area Network (LAN). As promised, the 541 can be accessed from a computer, tablet or mobile phone anywhere in the world, but your network must first be set up to make this possible. This process is addressed in the Networking section later in the manual.

Finding the 541 IP Address

With both your computer and the 541 plugged into your LAN, and both turned on, go to the 541 LCD-touchscreen and touch the menu icon in the upper-left corner. Then touch Network to open the screen that includes the network setup options shown on the following page.

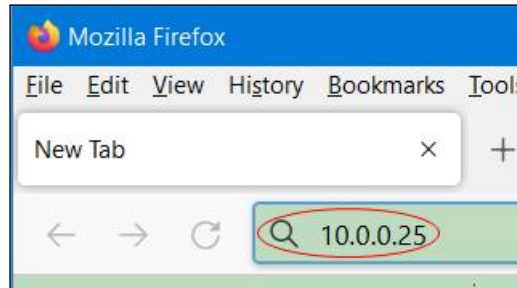


DHCP is the factory-default network Mode. The IP Address: of your 541 appears in the first box. DHCP should work for you at least initially, but if your 541 needs a static IP address, touch Static IP to unlock the grayed-out boxes underneath. As you then touch each box, an on-screen keyboard pops up permitting you to overwrite the default entries. (Once connected, you may perform this operation more easily using the Webserver interface covered in the next section.)



Connecting

Bringing up the Webserver interface is as simple as entering the IP address of the 541 into your browser's address bar and clicking Enter.



Alternatively, a Windows computer is able to locate and connect to the 541 by using the unit's 'Hostname' followed by a forward slash in place of the IP address. The Hostname is shown on the 541 Network menu screen. In the LCD-touchscreen image on the previous page, the default Hostname: is MODEL541. This name may be changed to a more convenient or personalized identification of the unit, as may be required to differentiate between multiple units on the same LAN.

Connecting will bring up the Now Playing Webpage. Starting at this point in the manual, most setup and operating discussions and instructions will use this Webpage interface utility, mainly because it's easier to navigate and type into. Nevertheless, rest assured that very nearly anything can be accomplished from the front panel as well.

Section IV


USING THE WEB INTERFACE

Internal Webserver

The Inovonics 541 internal Webserver contains multiple interactive pages, or menus, for setup and operation of your unit. These pages provide ready and interactive access to all settings, readouts, graphics, audio monitoring and alarms.

Now Playing is the landing, 'home' Webpage shown here.

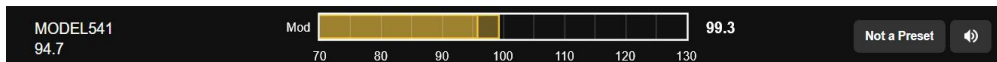
- The Menu List** A list of all the Webpage menus can be found at the left edge of any page. Click on any menu heading to go immediately to that Webpage.

- Menu Variances** We have made every effort to coordinate the Webpages with the LCD-touchscreen menus, but this is not possible in all cases. This means that you may have to hop around a bit to find corresponding features. For example, the Tuner and StationRotation headings on the Now Playing Webpage are both on the LCD-touchscreen Tuner menu, and the “red LED” alarm indicators near the top of the Now Playing Webpage are found under Alarms on the LCD-touchscreen. The LCD-touch-screen Now Playing menu is accessed by touching the little cottage icon, and that screen carries information actually spread out appropriately over multiple Webpages. 

- ‘Responsive’ Webpages** We do apologize for these ‘discrepancies beyond our control,’ but feel confident that your good common sense will guide you on your circuitous journey through the 541 learning maze. The ‘responsive’ 541 internal webserver provides an optimal viewing experience across a wide range of devices: desktop computers, tablets and mobile phones. Specific to the device, the Webpage is cleverly and automatically reconfigured to give the best view as the image size varies.

THE WEBPAGE HEADER


Each of the 541 Webpages carries the header shown here:



- Monitor ID** At the left, the hostname of the 541 identifies the specific unit connected. You can specify your own unique hostname to differentiate between multiple units on the LAN.

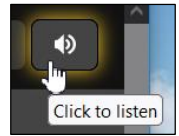
- Tuned Frequency** The frequency that the 541 is currently tuned-to is displayed just below the hostname.

- Total-Mod Display** Both a bargraph and a numerical readout display total carrier modulation at the top of each Webpage.

- Presets** On the right, the tuned station button lets you change stations from among the presets that have been entered into memory. In the example header none had been preset, so Not a Preset is displayed. Once stations are entered, clicking on the button will drop down the menu shown at the right. Clicking one of the presets will re-tune to that station. Entering presets is explained on Page 20. 

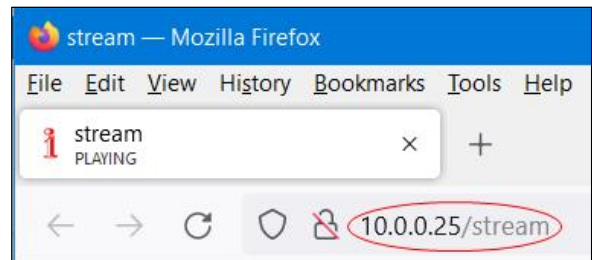
Remote Listening

Click the loudspeaker icon at the top-right of this or any other Webpage to listen to off-air audio through your Web browser. Up to 10 listeners can access this audio stream simultaneously, but listeners may also be restricted. Instructions for FM or SCA program selection and for limiting the number of listeners are given in the streaming audio discussion on Page 40.



Other Stream-Listening Options

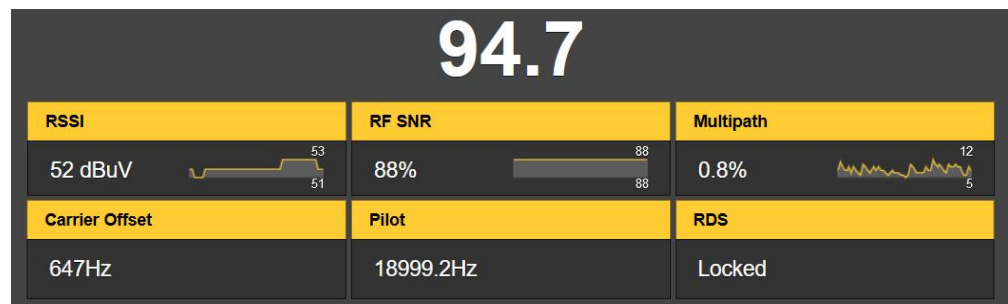
You may wish to allow personnel outside the engineering staff to listen to the 541 stream without granting them the ability to view 541 Webpages or change any of its settings. You will need to open a router port to use this IP-address method, but then one simply 'points' a computer browser or media player app at the URL of the audio stream, adding /stream as shown here. Of course this isn't a terribly secure privilege as the slash may suggest other suffixes to be tried to hack other functions.



NOW PLAYING

The Now Playing Webpage was shown complete on Page 15. This page and some others require you to scroll down to see everything, depending on the device you are using and its browser settings. Pages that require scrolling will be discussed by separate function sections.

Reception Status-In-Brief

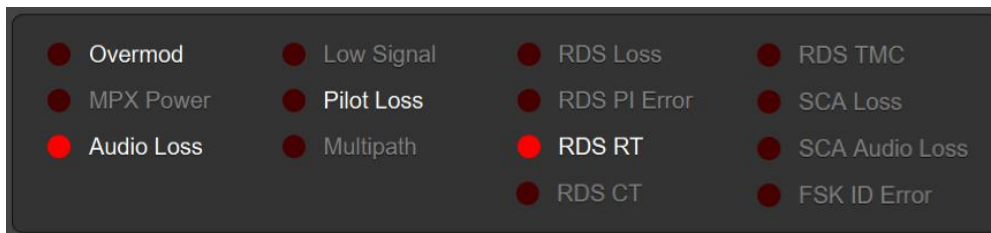


This top part of the Now Playing Webpage screen shows just the more critical incoming signal parameters. The frequency is prominent above the signal-quality matrix. Note that some readout boxes contain a tiny scrolling graphic to display the subject parameter over time. Y-axis scaling is automatic with maximum/minimum figures for the time period. Some of these parameters, along with others not in this grid, are displayed graphically with much greater detail and with selectable time scaling on the History Plots Webpage.

Readouts in the top row give: RSSI, the incoming FM carrier strength in dB (relative to 1 microvolt at the antenna input); RF

SNR, or signal-to-noise in percent relative to an ideal (100%) signal; and signal Multipath distortion, again relative to an ‘ideal’ value of 0.0%. Carrier Offset does not display with absolute, compliance-level accuracy, but is useful to show shorter-term ‘wanderings’ of the FM carrier frequency. Pilot displays the 19kHz stereo-pilot frequency and RDS indicates lock with the incoming 57kHz RDS subcarrier.

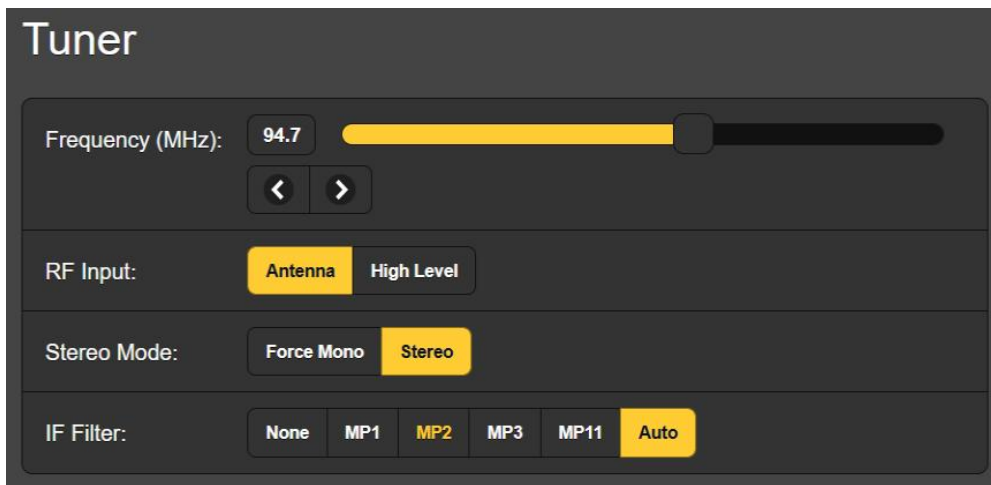
The Alarm Panel



This Now Playing alarm panel is a duplicate of the one atop the Alarms Webpage. Setup of the alarms and alarm messaging is detailed under that discussion in a later section.

Alarms that have been enabled by the user are noted in white text, grayed-out alarms are not enabled. Once an alarm triggers, based on signal level and/or on and off delay settings, that alarm is indicated by the simulated red LED. The example above illustrates a station that has lost audio and has not received an RDS RadioText update in timely fashion.

Tuning the 541



This snapshot shows the Tuner subsection of the Now Playing Webpage. What’s discussed in connection with this image is also found in the LCD-touchscreen Tuner menu.

In this example the 541 is tuned to Los Angeles station KWAV at 94.7MHz. You may tune the 541 by any of three methods: 1) mouse-grab the tuning slider and push it up and down the dial; 2) fine-tune in 100kHz increments by clicking the < and > buttons; 3) overtyping the frequency display to the left of the slider.

RF Input Selection	<p>The 541 has rear-panel connectors labeled ANTENNA and HIGH LEVEL RF INPUT. The high-level BNC input is generally used when a wired direct connection to the transmitter is preferred over off-air signal reception.</p> <p>Under RF Input: select Antenna or High Level. This selection does become a part of the saved Preset Stations data and would allow automatic ‘pushbutton’ high-level input selection for your own station and off-air reception for others.</p>
Mono/Stereo	<p>The setting here is Stereo by default, but may be changed to Force Mono if, for instance, the lower noise during mono reception is considered essential to some measurement. This option is also saved as a Preset Stations condition.</p>
IF Filter	<p>The advent, acceptance and implementation of the iBiquity Digital HD Radio™ digital broadcasting system makes measurement of analog-FM signal parameters a challenge. The proximity of the HD Radio digital carrier groups to the analog-FM sidebands requires stringent filtering in the RF domain for accuracy in the measurements of analog broadcast parameters.</p> <p>The four IF Filter: selections correspond to four distinct modes of HD Radio “hybrid” (simultaneous analog and digital) transmission. It is outside the scope of this manual to detail the particulars of these transmission modes, but the avid reader can find them explained in the iBiquity Digital Corp. document, <i>HD Radio™ Air Interface Design Description Layer 1 FM</i>.</p> <p>The 541 includes a utility that automatically applies the correct filtering. Simply select IF Filter: Auto. The applied filter will be highlighted in yellow.</p>
SCA Subcarrier Tuning and Measurement	<p>Audio SCA “narrowcasts” are received, and their parameters measured, by a utility built into the 541. An SCA subcarrier rides above the L-R (S’) DSB subcarrier, typically at either 67kHz or 92kHz. SCA subcarriers have historically carried background music for stores, readings for the blind and foreign-language programming. Noise performance of this auxiliary channel has deteriorated over the years, first from overcrowding of the FM band, next by the advent of stereo-FM and by very aggressive audio processing. SCAs have subsequently fallen into disuse, replaced, ironically, by the additional subchannels afforded by SCA’s most recent technical nemesis: HD Radio!</p>
SCA Settings	<p>Frequency: selects the SCA subcarrier frequency. A None selection turns the SCA decoder off. De-Emphasis: selects that parameter from among the values shown, with 150μs the historical default.</p> <p>Audio fidelity of the recovered SCA program is somewhat limited and, as already mentioned, this service is plagued by interference from both the main channel, auxiliary and off-channel sources. We’ve included two variable filters to help with this situation: BPF Bandwidth (kHz): limits the reception bandwidth around the subcarrier center frequency, and Audio Bandwidth (kHz): is a low-</p>

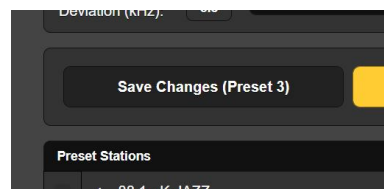
pass function following the SCA demodulator. Use these controls to clean up the audio as best you can.

Deviation (kHz): defines the 100%-modulation point of the SCA subcarrier. The default value of ± 5 kHz is the de-facto specification, although FM subcarrier parameters are no longer subject to government regulation in the US. Whatever this slider is set for represents 0dB on the SCA modulation readout (see Page 25).

Station Presets

The 541 offers thirty station-memory presets. Once tuned to a station, click Save as New. This will open a box where you can enter call letters or a short 'street name' for the station. Then click Save in that same box and your entry will be entered at the bottom of the Preset Stations list. Presets are cleared from the list by clicking on the **X** at the right of the listing.

Stored Preset Stations data also contains the various setup options and alarms *specific to that station preset* when it was entered into memory. If you make changes to *any* option, the grayed-out Save Changes bar will immediately come alive as shown here, prompting you to save the changes, assuming that you want them updated.



Important!



Alarm programming instructions begin on Page 34. If you make any changes to alarm settings, or to the miscellaneous selections listed below, you *must return* to the Now Playing Webpage and click the Save Changes bar to permanently associate your option updates with that station preset.

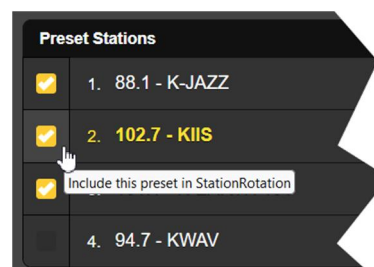
StationRotation™

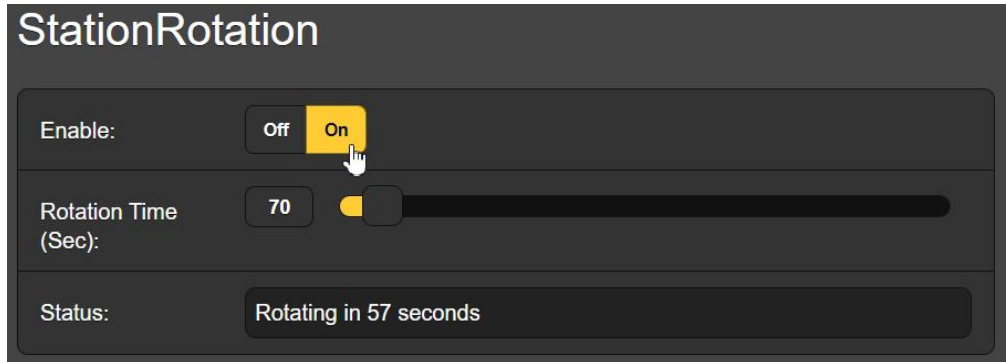
A mod-monitor is historically employed as the station's fulltime measurement utility to alert engineering personnel to out-of-tolerance operation. Although the 541 certainly fulfills this basic qualification, it has the added versatility of being able to 'ride herd' over multiple stations in the local market, but not without some dilution of its primary functionality.

The 541 has the built-in capability of sequencing through all the saved Preset Stations entries in the order listed, and at a sequence rate set by the user. This could, for example, allow a contract engineer to receive alarms from any of a number of stations he might service in a given market.

First, stations in the Preset Stations list must be 'tagged' to be included in rotation. Click the checkbox next to the listing to place the station on the rotation schedule.

Next, enable StationRotation by setting Enable: to On as shown in the next illustration. This will inhibit manual tuning by graying-out the manual Tuner setup section completely. This means you will have to reset Enable: to Off to manually tune the 541 and set any additional station presets.





Finally, you must program the Rotation Time (Sec);, and this may take some planning. Many of the 541 alarms have Time On (Sec): and Time Off (Sec): settings that will impact your Rotation Time (Sec): choice. See the Alarms discussion beginning on Page 34.

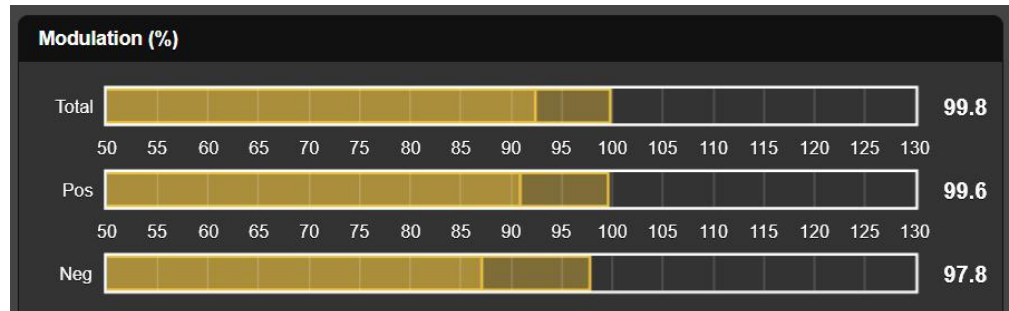
The Status: display gives a second-by-second countdown of rotation time or shows that the feature is Off.

Keep in mind that all the audio outputs will reflect StationRotation operation. Ask yourself, “Who might be hearing this?”

METERS

The Meters Webpage displays metering for all FM signal measurements. From the front panel, the Meters menu will offer multiple sub-screens to accommodate this plethora of readouts.

FM Carrier Modulation



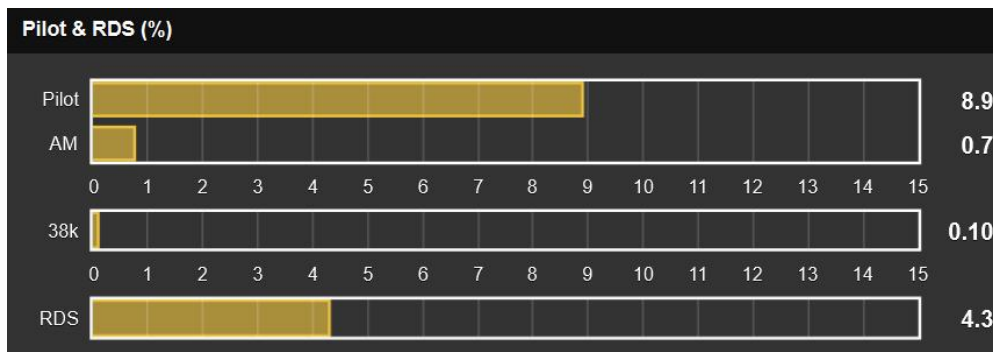
These three bargraphs and their associated numerical readouts on the right give quasi-peak-response measurement of FM carrier deviation. Total modulation and individual Pos and Neg deviation are shown in percent, 100% equal to $\pm 75\text{kHz}$ deviation.

The integration time for these measurements is set by the Mod Response: buttons on the Webpages and LCD-touchscreen Setup / Radio screens. The default selection is the fastest, $50\mu\text{s}$ setting, but more instantaneous-peak-forgiving selections of $100\mu\text{s}$, $200\mu\text{s}$, $500\mu\text{s}$ and 1ms are also available. We recommend the more conservative default value, but it’s your call.

You should typically see negligible difference between positive and negative deviation readings, reflecting only the asymmetry normally encountered in speech and music waveforms. Consistent discrepancies indicate a possible FM exciter issue.

With an appropriate filter selected (Page 19), these modulation readings should not be affected by accompanying HD Radio programs. Precise IF filtering eliminates false indications of FM-overmod at any HD carrier-pair injection ratio. Any observed interaction between analog and digital program channels should certainly prompt further investigation.

Pilot, 38kHz and RDS Levels

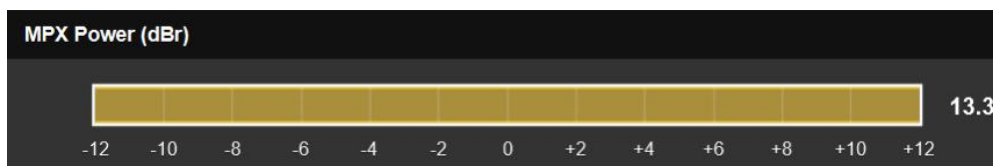


This next section of the display screen first shows the injection level of the 19kHz stereo pilot. On an FM station broadcasting in stereo, Pilot should be a rock-steady reading of about 9.0%. Composite clipping or other nonlinearity in the transmission path can cause this reading to ‘bounce’ to a lesser or greater extent. These level perturbations will show up on the accompanying AM bargraph as amplitude modulation of the stereo pilot.

Early FM stereo exciters generated the FM baseband signal using analog multipliers, which required calibration to null the 38kHz carrier component. Today’s stereo-gens don’t need this, yet the 541 includes a readout of 38kHz energy. You shouldn’t see much action on the 38k bar, yet music heavy in sub-bass may cause this readout to flicker-on occasionally. A steady-state reading or a great deal of bass-associated activity may indicate a stereo-gen problem.

The RDS readout gives the injection level of the RadioData sub-carrier at 57kHz. Similar to the stereo pilot, this should be a solid reading at about 5%. Program audio should not modulate the amplitude of this reading at all. Variations in RDS level again suggest MPX transmission path nonlinearity or a problem with the RDS encoder.

Multiplex Power



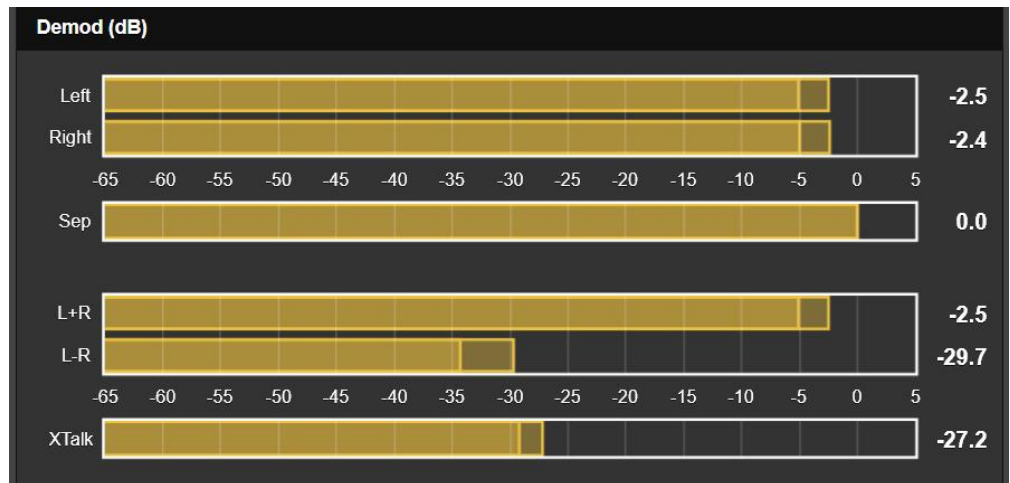
This measurement relates only to European broadcasting Standard ITU-R BS.412-9, which specifies a limit on the overall r.m.s. power of the FM multiplex signal, rather than (but in addition to) the usual *peak deviation* limit. The MPX Power (dBr) measurement comprises the entire FM baseband, including the stereo pilot and any audio (SCA) or data subcarriers. The measurement is

calculated and integrated within a floating 1-minute measurement window.

As a point of reference, 0dBr equates to the r.m.s. power of a single-tone sinewave modulated with a peak deviation of $\pm 19\text{kHz}$, which is some 12dB below the $\pm 75\text{kHz}$ FM peak deviation limit. You can imagine that the European standard effectively limits the program average-to-peak ratio (loudness) to a figure far below typical US broadcasting practices (as exemplified in the illustration!).

ITU-R BS.412-9 has been mandatory in Germany, Austria and Switzerland since 2004, but with some latitude. Germany adheres to a strict 0dBr limit, but Austria and Switzerland, for example, are able to exceed that point by 3dB, to +3dBr.

Demodulated FM Audio



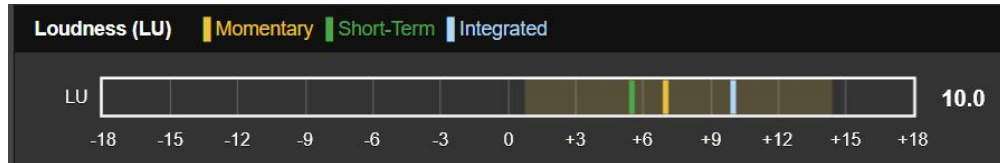
This metering area displays the demodulated FM program audio. Left and Right channel levels have quasi-peak response and a rapid fallback to give a good visualization of instantaneous vs. average program energy. Bear in mind that these meters in no way approximate true “VU” ballistics. A floating peak-hold ‘ghost’ hovers briefly above these meters showing the highest peak value recently indicated. This held value is also shown numerically at the right of the bargraph.

Sep is a measure of stereo separation based entirely on the level difference between the Left and Right meter readings. This measurement is valid only for steady-state-tone separation tests with a single channel driven. It is *not* an indication of the stereophony of dynamic (speech and music) program audio.

The L+R stereo sum and L-R stereo difference meters have the same ballistic characteristics and scaling as the Left and Right meters above them. This dynamic sum-and-difference metering gives a better visual representation of stereo separation with program audio. Note in the example that Left and Right levels are less than a dB apart, yet the L+R and L-R meters indicate reasonable stereo activity. Left and Right meters do not factor-in phase differences between the stereo channels, and phase differences can play a big part in stereophonic perception.

XTalk (stereo crosstalk) is similar to the Sep (stereo separation) measurement, but in this case it indicates the level difference between the L+R and L-R program audio components. Like the Sep readout, it is useful only with tone tests and is *not* an indication of crosstalk issues in the program audio.

FM Program Loudness



The measurement of FM program loudness adheres to a Standard of European origin that has become a de-facto means of assessing this parameter worldwide, both in radio and in television broadcasting.

The ITU-R BS.1770 Loudness Standard

The ITU-R BS.1770 Standard is ostensibly based on listener perception of audio loudness. Meter readings under this standard are expressed in “LUs” (Loudness Units), one LU increment equivalent to 1dB. In using this function, it’s best to consider LU measurements as “locally-relative,” or most useful in comparing loudness between various audio sources, market companions, music cuts, processing presets, talent voices, etc.

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

Loudness metering has a 100ms refresh rate. ‘LU’ is displayed as a bargraph featuring three color-coded Loudness (LU) indicator bar-segments labeled Momentary, Short-Term and Integrated, or ‘M,’ ‘S,’ and ‘I.’

The yellow segment shows a ‘momentary’ value of loudness, actually the loudness of a floating 400ms block of audio updated at the 100ms refresh rate. This gives the best ‘right now’ measurement of loudness. The yellow ‘wash’ behind the display represents the range of gated ‘M’ within the ‘I’ measurement window, providing a visual representation of program dynamic range.

The green segment represents a short-term-integrated value derived from a 3-second block of audio refreshed every second, a readout primarily indicating the loudest sections of program audio.

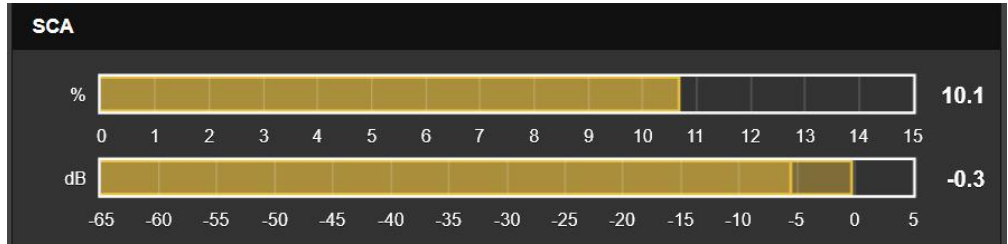
The blue segment is a longer-term integrated measurement that is ‘gated’ to ignore speech pauses and other periods of silence. This is probably the most useful overall, average-program-loudness reading.

The loudness measurement window has a default value of 120 seconds. This may be user-adjusted under Setup / Radio /

Loudness Window: down to 30 seconds, as may be dictated by the station's programming format.

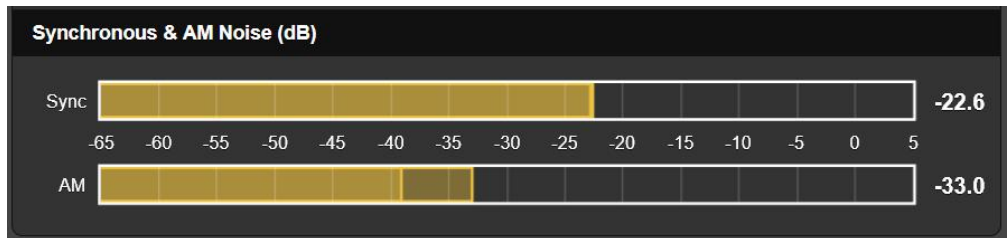
This metering method reflects the broadcast implementation of the BS.1770 Standard, and is explained in further detail in EBU Loudness Standard R-128.

SCA Subcarrier Measurements



The % scale shows the injection level of the SCA subcarrier in percent of total FM carrier modulation. The traditional figure of 10% indicates ± 7.5 kHz deviation of the carrier. The dB scale displays the audio level of the recovered SCA program. 0dB equates to the deviation set by the Now Playing / Tuner / SCA / Deviation (kHz): slider (Pages 19-20.) With the slider at its default of 5.0, ± 5 kHz SCA deviation by a steady-state tone would drive dB to 0.

Synchronous and AM Noise



Sync (synchronous) FM noise refers to amplitude modulation of the FM carrier by the FM baseband signal, predominantly by program audio. If the passband of the transmitter is not frequency-flat, then as the carrier deviates toward the channel frequency extremes the carrier level might undergo amplitude rolloff at the band edges, which would amplitude-modulate the FM carrier.

AM noise is considered asynchronous, or FM-carrier amplitude modulation from any source other than baseband modulation, such as mains ripple in the DC supply to the final RF amplifier stage. This AM noise measurement is valid only when modulation is not applied.

Both these noise measurements are expressed in dB, 0dB equal to 100% amplitude modulation of the FM carrier.

SPECTRUM PLOTS

The 541 monitor includes an advanced, high-resolution FFT-based spectrum analyzer that delivers detailed and annotated graphic displays of selected signals. Images may be viewed either through the Webpages utility or from the front-panel LCD-touchscreen. Each signal selected for viewing carries its own family of graph setup options below the display.

The IF Spectrum

The Webpage screenshot shown below is the receiver's IF spectrum. 0kHz represents the carrier frequency of the currently-tuned station, obviously an HD Radio station in this case.



Clicking the magnifying glass in the corner will toggle to a full-screen display, and mousing over the display area brings up the cursor (white arrow vertical line) shown. The exact frequency and level at that point is presented below the spectrum.

The sample display here has Normalization: under the view option settings. This sets X-axis 0dB to represent the unmodulated FM

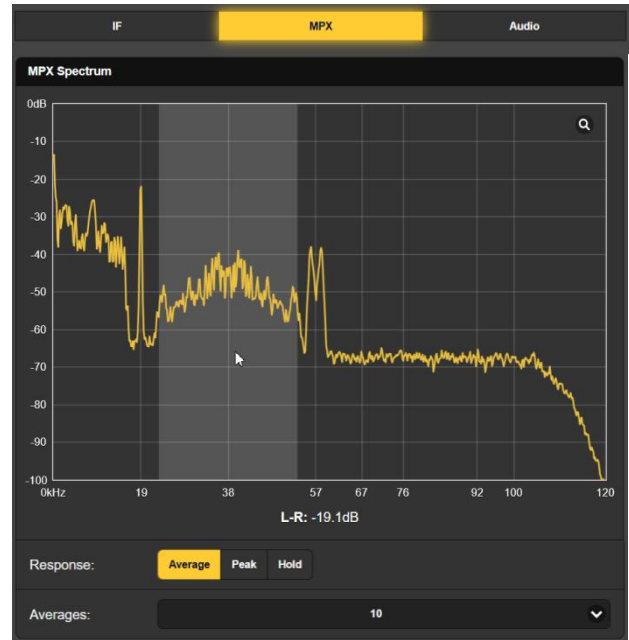
carrier level. Response: set to Average yields the default display shown in the example. Peak will show the peak value of the signal, and Hold accumulates the highest peak value until the function is deselected.

At the bottom, the display Averages: the number of FFT computations selected in the drop-down box. 200 is the factory default, a lower number will follow program audio more rapidly, but with a much jumpier display.

The FM Baseband Spectrum

Select MPX to view the FM baseband spectrum. The L+R 'main' channel, 19kHz stereo pilot, 38kHz DSB 'sub' channel and 57kHz RDS subcarrier are easy to identify, and will in fact be highlighted and the amplitude value shown as you slide your cursor across the screen.

Click the magnifying glass for a full-screen display. Mousing, will highlight a specific region of the FM baseband spectrum, the L-R component in this case. The value posted below the plot is the same as that indicated on the Meters menu.

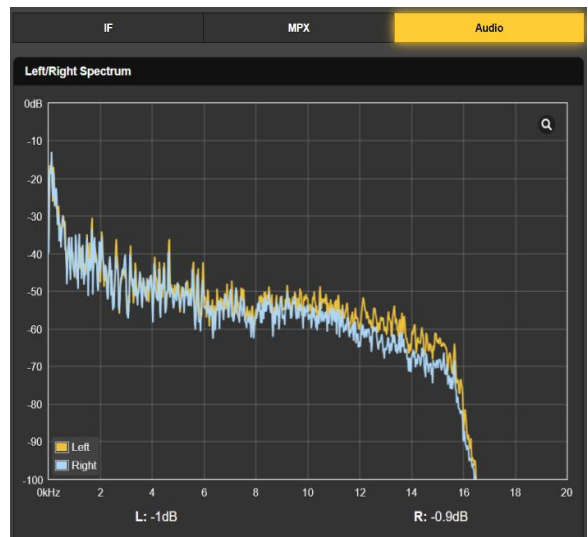


Set Response: to Average for a stable and meaningful display, the default 10 FFT Averages: is a good compromise for a dynamic, yet easy-to-read plot. Selecting Peak will reveal peak levels of the spectrum components, and Hold accumulates the highest peak value for as long as it remains selected.

Audio Spectrum Display

Select Audio at the top for a spectral display of left and right program audio. The left channel is shown in yellow, the right channel in blue.

Response: and Averages: settings offer the same display options described above for the MPX display.



HISTORY PLOTS

The 541 offers plots of reception and audio parameters viewable over a specified time period, from the past minute to a full, 24-hour time study.

Although these data are available through both the Webpages and front-panel LCD-touchscreen displays, Webpage presentation provides some extended options covered in this discussion that will be found missing with front-panel operation.

History Screen Basics

The Modulation screen shown below is typical of the 541 history-display plots; the buttons at the top select the various signal parameters.



Note the Show: buttons below the screen. When all buttons are activated (by default as pictured), all four parameters are displayed above in different colors. If a particular display is confusing, you can easily turn-off those measurements you don't need to see.

The Time Span: selected here is 1 Minute. That means that the 'rolling' display shows the past 60 seconds of activity. For a time

study over a longer period you may select a window that shows up to the last 24 Hours.

Rolling your mouse over this screen will drag a cursor over the plot, the arrow and vertical white line just to the right of center in the example screenshot. The numerical values directly below the plot show the multiple parameter levels at the cursor position, and the current incoming value when the cursor is not on the screen. With Time Span: set at an hour or more, actual clock time of the event is shown bedside the cursor.

Modulation The Modulation screen used in the example above displays both the (integrated) instantaneous peak value of carrier deviation in yellow (Mod %:), and a held-peak (Mod Peak %:) value in green. (The Mod Peak %: reading is also the value used for the overmodulation alarm.)

RF Metrics Reception metrics really ought to be rock-solid. The station shown here does exhibit slight variations in RSSI and RF SNR, with numerical values shown below the plot for the current moment. Again, a white-line cursor allows you to read the exact values of these parameters at any point within the displayed time-frame.



Audio History Left- and right-channel program audio levels are shown here in 2 colors. These are quasi-peak readings that will give a good indication of program dynamics. In this example, the pop-music station went into a commercial cluster a little over 20 seconds before the screenshot was taken; note the change in program dynamics.

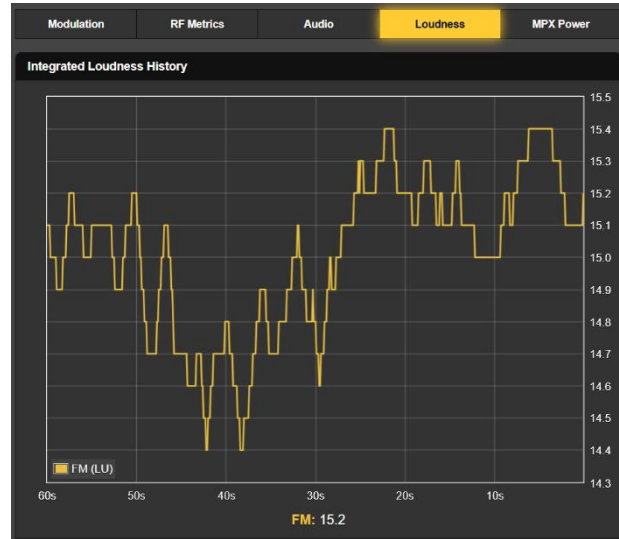


Integrated Loudness History

This screen plots the loudness level of the FM broadcast, adhering to the ITU-R BS.1770 Standard discussed on Page 24. These readings are integrated (long-term) “LU” loudness measurements.

Per the previous discussion, LU numbers don’t equate well with total carrier modulation peak readings, as LU measurements are both frequency- and time-weighted.

The LU Y-axis scale at the right of the screen actually auto-ranges to always give the best level resolution over the displayed time period. As you change the Time Span: to cover a longer sampling period, vertical scaling will change to accommodate the level range for that particular timeframe.

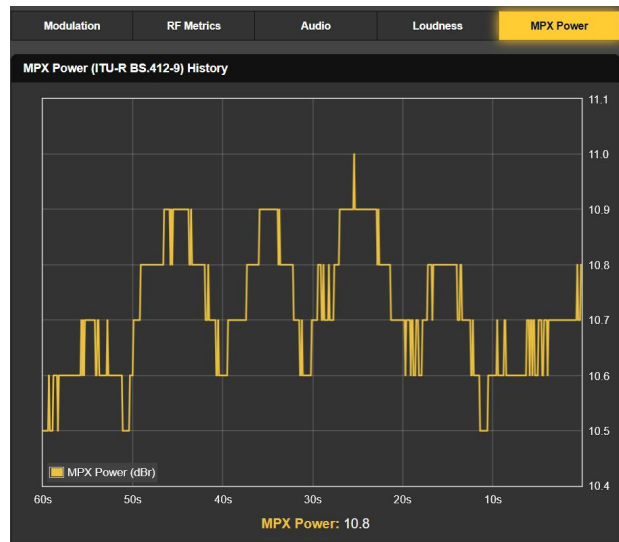


MPX Power

Similar in function to the Loudness History utility just described, MPX Power instead reflects the ITU-R BS.412-9 Standard for total r.m.s. power of the FM-multiplex signal. You may wish to refer back to the discussion on Page 24 for an understanding of just what this implies.

The readout here is in dBr, and as mentioned in the previous discussion,

European broadcasters under ITU jurisdiction may be limited in total MPX power to something in the 0dBr range, perhaps as scandalously high as +3dBr. Note that in our example here, a typical major-market US broadcaster is running MPX power some 15dB above his old-world counterparts... that’s more than a 30-fold MPX power increase!



OSCILLOSCOPE

A built-in oscilloscope utility has been included for viewing audio and other waveforms through either the Webpages or the LCD-touchscreen displays. Vertical sensitivity is scaled and annotated with respect to the 100%-modulation point, and the horizontal timebase adjusts for the most meaningful display of the selected signal.

O-Scope Applications

A primary function of the Oscilloscope utility is to view actual signal waveforms. View: buttons allow selection between MPX (the FM-baseband signal), the FM stereo Pilot, the DSB RDS subcarrier, and left and right program audio. The 57kHz RDS subcarrier waveform is on display here. These are real-time oscillograms, and the Pause bar at the bottom of the screen lets you freeze the waveform. The little magnifying glass in the upper-right corner will switch you to a full-screen display.



Audio XY Display

The 'scope function can also serve as an XY "stereoscope." XY displays indicate both level and phase differences between left and right channels, giving a visual representation of the 'stereophony' of the program and a warning of monaural compatibility issues.

When XY is implemented with a traditional analog oscilloscope, the display resembles a 'connect-the-dots' image of the so-named children's activity. The 541 and most digital 'scopes can optionally show either Lines or Points. The Points option presents a more artistic 'constellation' as seen in the example, and in this instance Points and Persistence were both engaged to show the short-term trend of the stereo image.



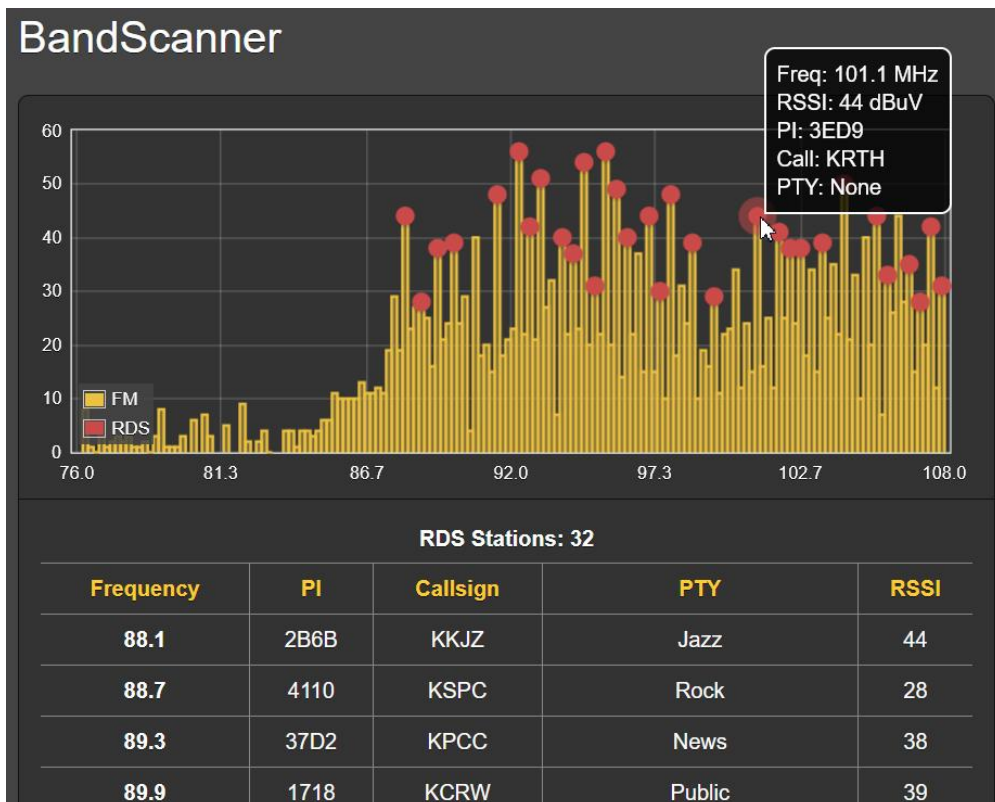
THE BANDSCANNER™ UTILITY

The 541 BandScanner is an annotated RF spectrum analyzer utility that is able to graphically display the entire FM band. From the front panel, BandScanner is found under Graphs.

Warnings!



- 1) Band-scanning interrupts all mod-monitor functionality during the scan cycle, as it essentially tunes across the band and collects data from each station in the market. Program audio outputs are muted, and scanning will temporarily interrupt the history studies.
- 2) Keep in mind that once the display is presented, clicking on a bar will immediately tune the 541 to that station, which you may not want to do.



Shown above is an entire FM-band plot of the busy Los Angeles FM market. Two 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 541 can also scan and display both RSSI + RDS information, which will take a bit longer.

Start Scanning

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

In the example scan, every FM carrier found is represented by a vertical yellow bar. Bar height indicates signal strength in dBuV per the annotation along the left edge. The example is an RSSI + RDS scan. Had it been run in the simple RSSI mode, all stations would show up as yellow bars without the red dots.

Bars and Dots ‘Hovering’ over a yellow-only bar pops up only the Freq: and RSSI: in a pop-up box. At the completion of an RSSI + RDS scan, a yellow bar with a red dot indicates a station with RDS. Hovering over an RDS station will also present call letters and the PTY (Program TYpe) information as shown in the example.

A full RSSI + RDS scan will also create a list of those stations with RDS below the scan area. These will be listed in ascending frequency order along with their PI, Callsign, RDS PTY and RSSI values. Click on any station’s frequency to immediately tune the 541 to that station and be taken to the Now Playing Webpage.

RDS INFORMATION

RDS Info This 541 Webpage presents a comprehensive display of the RDS information that now accompanies the majority of analog-FM transmissions. (Note the red dots in the illustration on the previous page.)

The upper area of the screen 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; RadioText and its interactive RT+1 and RT+2 derivatives; plus other IDs and ‘flags’ that assist RDS receivers in responding to system commands.

PS	PI Code	Callsign	
Bumpin	2B6B	KKJZ	
RadioText			24 / 64
Bumpin BY Wes Montgomery			
RT+1		RT+2	
01 Title - Bumpin BY Wes Mo		04 Artist - mery	
PTY	PTYN	Time	
Jazz			
M/S	DI	TP	TA
Music	Stereo	On	Off

Next down the page 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.

RDS Block Error Rate			
0.00%			
0A	35.68%	0B	0%
1A	0%	1B	0%
2A	30.52%	2B	0%
3A	5.63%	3B	0%
4A	0%	4B	0%
5A	0%	5B	0%
6A	0%	6B	0%
7A	0%	7B	0%
8A	24.88%	8B	0%
9A	0%	9B	0%
10A	0%	10B	0%
11A	0%	11B	0%
12A	3.29%	12B	0%
13A	0%	13B	0%
14A	0%	14B	0%
15A	0%	15B	0%

Finally, if the station has an AF List, Alternative Frequencies are totaled, each is listed, and proprietary Open Data Applications are totaled and shown.

Alternative Frequencies	3	Open Data Applications	2
AF1	90.7	8A	0xCD46 (RDS-TMC)
AF2	98.5	12A	0x4BD7 (RadioText+)
AF3	93.7		

Clicking the Clear/Reset RDS bar at the bottom will indeed clear the registers and begin a new RDS data collection. Reset is automatic when the station is changed.

ALARMS

Alarm Status The 541 provides alarms for signal or program-related error conditions. Alarm Status ‘indicator lamps’ head the Alarms Webpage and also appear on the Now Playing Webpage.

Set the Clock! Alarms are logged with time and duration stamps. Be sure to select the time zone and ensure that the 541 is sync’d with Internet time. This is explained shortly.

Important!



When you *manually* tune-in a station and then set an alarm, those alarm settings will ‘stick’ and apply to any other station subsequently tuned *manually* as well. However, individual station memories inherit all unique alarm and other settings as Preset Stations or ‘virtual pushbuttons’ (see Page 20).

To associate any alarm setting *change* (update), while the station is still tuned-in you must navigate to the Now Playing Webpage and Save Changes under the Tuner heading so that those alarm updates will then pertain only to that station. This Save Changes procedure must be completed immediately after programming or changing alarm settings, before the 541 is retuned to another frequency.

Any of the alarms is also able to initiate email or SMS/text messages to selected personnel. These alarms will also be logged for later analysis.

Up to six alarms may be assigned to rear-panel GPO ‘tally’ outputs for interface with remote-control equipment or local alert devices. Alarm conditions must first be set-up as described in the remainder of this section, and following that the email/SMS messaging and rear-panel GPO tallies may be programmed. These procedures will be described in the Setup and Email Webpage discussions, respectively.

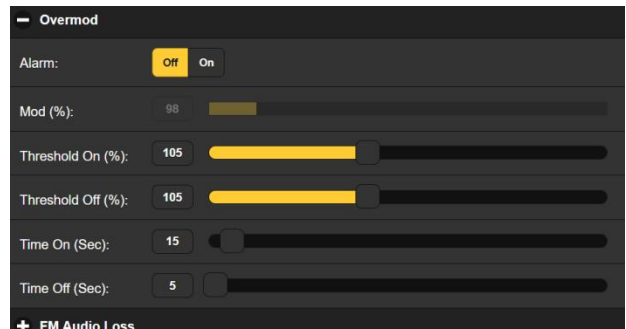
Programming Alarms

NOTE: Do please read the following discussions in their entirety. A setup explained for one alarm that is common (or quite similar) to the setup of others may not be explained in the same initial detail in succeeding setup discussions.

Click any **+** under Alarm Settings to open the setup boxes.

Overmod

Alarm: On ‘arms’ the function in this and all other alarms to be discussed. If the alarm is turned Off, there will be no indicator on the Now Playing or Alarm Webpages, no contact closure at a rear-panel GPO terminal, nor will



the 541 send SMS/text or Email alerts to station personnel or log the alarm. *This applies to all alarms.*

Mod (%): displays the integrated and held-peak value of the total modulation level for the off-air program being received. This is the level represented by the green trace on the History Plots / Modulation / Mod History / Mod Peak screen. The level display here is ‘grayed-out’ as there is no adjustment that can be made to the displayed value. Levels displayed in grayed-out meters are included to help make alarm setup decisions.

Threshold On (%): is the set point that Mod Peak must reach to trigger an alarm. Moreover, the Mod Peak level must remain at or above this set point for the number of seconds programmed with the Time On (Sec): slider.

The alarm will reset (clear) when Mod Peak drops to, and remains at or below, the Threshold Off (%): setting for the number of Time Off (Sec): seconds.

In the example shown, Mod Peak must reach 105% and stay at or above that figure for 5 seconds before an alarm is triggered. Then when Mod Peak drops, it must stay below 105% for 20 seconds for the alarm to reset.

In this case we have determined 105% as a ‘drop-dead’ alarm figure, and a full 20-second blast of overmod as an alarm condition as well. This example alarm setting has no hysteresis, but provision for this has been included as we’ll see next.

MPX Power

NOTE: Setup of an alarm for MPX power excesses will be of exclusive interest to European broadcasters operating under ITU-R BS.412-9 restrictions. Setup for this function should be essentially identical to the preceding illustration for Overmod setup, although some deference to the introduction of hysteresis may be applicable. Read on.

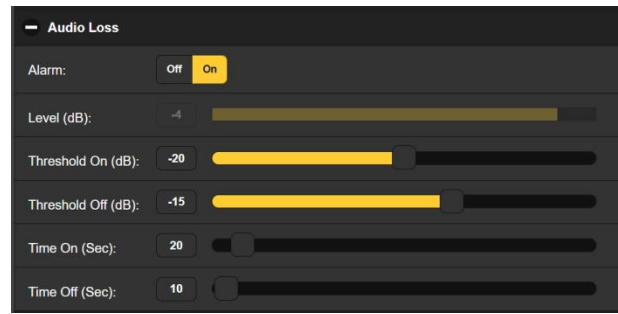
‘Hysteresis’ Type Alarms

This discussion relates to several alarms with very similar setup options. This will pertain to all alarms that have dual threshold settings: Threshold On (—): and Threshold Off (—):.

Audio Loss

We'll use Audio Loss as a typical example of a hysteresis-type alarm.

Alarm: must of course be set On to arm this function. The grayed-out Level (dB): meter shows the current program level for the station being monitored.



In this case we're looking for a low-level program audio condition, so the Threshold On (dB): setting of -20 is what the program level has to fall to, and remain below, for the Time On (Sec.) interval of 10 seconds to initiate an alarm.

For the alarm to reset/clear, Level (dB): must rise back up to the Threshold Off (dB): value of -15, and remain above that figure for the Time Off (Sec): period of 10 seconds.

This same logic applies to the other alarms in this hysteresis group. Just remember that it's both level *and* time settings that trigger and reset these alarms.

Low Signal and Muting

The Low Signal alarm is programmed in the same manner as the Audio Loss alarm just described. But this 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 reset/cleared). FM audio naturally 'fries bacon' when the carrier disappears. We recommend setting Mute: to On, for not only will it obviate an unending blast of noise, but also will ensure that the FM Audio Loss alarm will trigger if the station leaves the air.

Pilot Loss

This alarm indicates loss of the FM stereo pilot, a rare transmitter plant failure mode but still an included alarm. There is no threshold setting, just Time On (sec): and Time Off (sec):.

Multipath

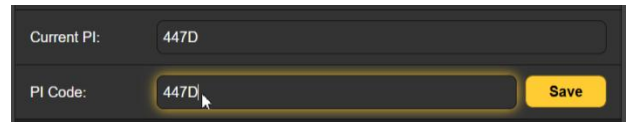
Multipath effects are usually associated more with reception problems rather than transmission faults, although an audio processor or stereo-gen fault can appear as excessive multipath. Again, the current Multipath (%): figure is shown grayed-out. Threshold and time settings can be programmed to trigger an alarm for an undue condition.

RDS Alarm

Under RDS Alarm there are two On / Off settings for basic RDS issues. Turning RDS Loss: On delivers an alarm when the RDS sub-carrier simply goes missing. Setting PI Error: On gives an alarm when RDS is received with a PI code mismatch.

A station's PI code consists of RDS data unique to just that station. A PI mismatch can signal a translator 'hijacking' by a radio hooligan, or the less sinister condition of the expected signal going off-air and a distant on-channel broadcast received in its place.

To enable the PI mismatch function, enter the station's true PI code in the PI Code:



box. The code being received at the moment is shown as the Current PI:. If you are confident that what you see there is indeed the PI of your station, simply enter that same hex value and click Save.

There are no threshold settings for RDS alarms, and both RDS loss and PI mismatch share the same Time On (Sec): and Time Off (Sec): settings that work the same way as alarms already discussed.

RDS RadioText Not Updated

When a playout system 'sticks' while sending RDS RadioText, it can cause problems... not only the display of the RadioText, message, but any attendant RT+ functions 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.

RDS CT Out of Range

This alarm function compares local Internet time with the transmitted RDS time, frequently used my car radios to set listeners' clocks. Rather than absolute, to-the-second accuracy calibration, this is more a safeguard against transmitting a false hour figure and really confusing your listeners.

If the tuned station is not sending RDS time, then RDS Time: Invalid will show below Unit Time:. The Threshold On (Min): lets you set a 'margin of error' between Unit Time: and RDS Time:. If these times disagree by more than a minute or two, you might check to see where your RDS encoder is getting its updates.

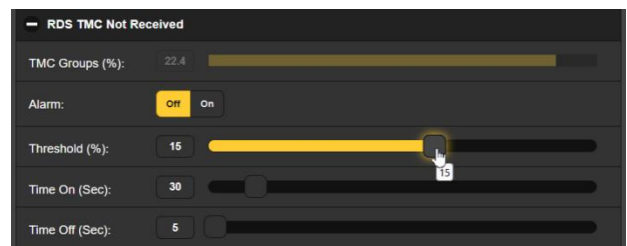
The RDS Clock Time (CT) feature compares the off-air RDS time with the 541 system time, assuming of course that the 541 has been set-up properly and is receiving Internet time updates (Pages 46-47). Internet (Unit Time:) shows at the top of the screen.

There is only a Threshold On (Min): setting, the alarm simply triggers (or resets) when the mismatch exceeds (or falls back below) the set number of offset minutes.

RDS TMC Not Received

The Traffic Message Channel provides traffic congestion updates to GPS navigation systems in the vicinity of the host FM station. Information is updated constantly, so RDS 8A group activity falling below expected usage can be used to trigger an alarm.

The grayed-out TMC Groups (%): indicator shows the current level of activity, which in practice can easily reach the 25% pegged-out maximum. Based on typical group usage,



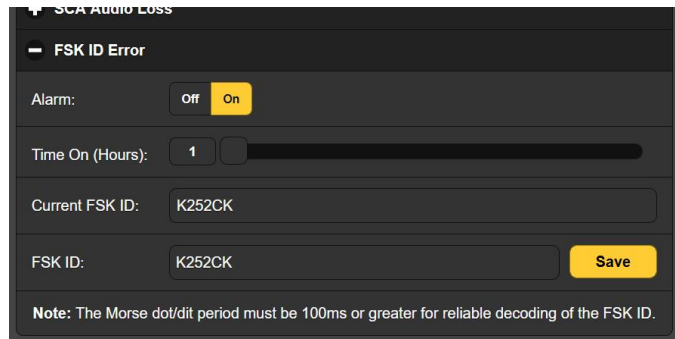
program appropriate Threshold (%);, Time On (Sec): and Time Off (Sec): settings.

SCA Loss Stations running an SCA subcarrier first need to set up the proper measurement parameters on the Tuner menu (Page 19). Only then should this alarm be used. Current SCA Injection (%): is shown so that threshold and timing sliders may be set appropriately. Note that this alarm refers to loss of the subcarrier, not loss of SCA audio.

SCA Audio Loss This alarm signals loss of SCA audio. Its setup is identical to that of program audio loss discussed earlier in this section.

FSK ID Error FM transmissions from low-power rebroadcast ‘translators,’ or repeaters in the US are able to utilize Morse-encoded frequency-shift-keying (FSK) of the station carrier frequency as a legally-valid station ID, if voice announcements are not made hourly. The 541 is able to decode and verify these unique identifiers, and initiate an alarm when either the ID is not received regularly, or if a wrong ID is received.

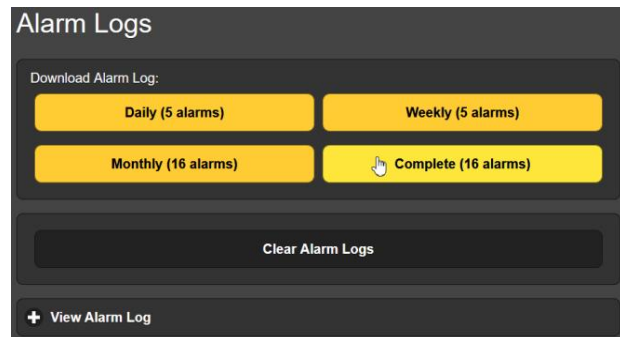
To enable this alarm, type the text of your ID into the FSK ID: field and **Save** the entry.



Next, set Time On (Hours): for a period of time greater than the interval between expected ID transmissions. Then you can set Alarm: to On. The next time an actual ID is received off-air, the decoded identifier will populate the Current FSK ID: space.

Tuning away from the station frequency, or utilizing the Station Rotation feature, will automatically reset the Time On (Hours): timer, possibly missing the next transmitted ID. This is why the timer can be set to ID intervals much greater than the anticipated one-hour repetition rate, to make the alarm more ‘forgiving’ of interruptions. Keep in mind that all alarms are valid only for the station that’s tuned-in at the moment.

Alarm Logging In addition to local displays/tallies and SMS or email alerts for signal and programming faults, all alarms are logged and stored. You can click + View Alarm Log at the bottom of the page for a display of all alarms in order of time and date.



The log holds data on the type of Alarm, which monitored Station it pertains to (important when the StationRotation feature is active), the Time and Date received plus the alarm Duration.

The screenshot shows a mobile application interface titled "View Alarm Log" with a notification badge showing the number "3". Below the title is a search bar labeled "Filter alarms...". The main content is a table with the following data:

Alarm	Station	Time	Date	Duration
Signal loss RSSI (dBuV): -7 < 35 for 5s	88.1	08:23:39 PM	10/31/22	
Signal back RSSI (dBuV): 37 ≥ 35 for 5s	88.1	08:21:33 PM	10/31/22	00:00:58
Signal loss RSSI (dBuV): 37 < 65 for 5s	88.1	08:20:35 PM	10/31/22	

You may View Alarm Log on your screen and even filter the results by overtyping Filter alarms... with a search term from an appropriate column.

You may also download the Alarm Logs for Daily, Weekly, Monthly or Complete (all alarms) time periods. The number of alarms received for these time periods is shown on the right above the listing. Downloads are saved to your computer as small .csv text files.

The Alarm Log will continue to accumulate entries indefinitely. 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 to be on the safe side.

SETUP

541 setup requires entries on a number of the Webpages. Items specific to the Setup page will be discussed in order here.

Radio Settings

75 μ s is the default De-Emphasis: setting, but may be reset here to 50 μ s, the standard for Europe and some other regions outside North America, or to None, as might be required for certain test purposes.

RDS/RBDS: sets the mode for RadioData to either the North American RBDS (North America) Standard (factory setting), or to the European RDS (Europe) Standard.

Mod Response: refers to signal integration for the quasi-peak readout of FM peak carrier modulation. An FCC specification for this measurement no longer exists, but it is our recommendation to err (if necessary) on the side of caution and choose the fastest, 50 μ s setting.

Loudness Window (Sec): settings refer to the long-term-integrated LU loudness bargraph reading under Meters / Loudness (LU), and the time study under History Plots / Loudness / Integrated Loudness History. The range is adjustable by the slider between 30 and 120 seconds. The ITU-R BS.1770 Standard is a bit nebulous with regard to this integration; we recommend the default value of 120 seconds.

MPX Output	<p>The rear-panel MPX OUT BNC connector can deliver either the FM-baseband MPX signal or the 19kHz stereo Pilot tone. The Level (Vpp): of the waveform is adjustable in 10mV increments between 1 and 6 volts peak-to-peak.</p> <p><i>NOTE:</i> The Webpage slider adjusts in 50mV increments, but entering a number into the accompanying box refines this to 10mV steps.</p>
Program Line Outputs	<p>The analog left/right and AES-digital line outputs are independently programmed and adjusted for output levels, both in the same manner. The Source: choice in either case is audio from FM or from the SCA audio subcarrier.</p> <p>You may set the Analog Level (dBu): anywhere between -15 and +15, and the Digital Level (dBFS): between -30 and 0. Other information regarding these outputs is found on Pages 9-10.</p> <p>The Digital Output sample rate defaults to 48kHz, but can be set to 44.1kHz as may be required.</p>
Dante/AoIP Streams	<p>This section of the Setup Webpage adjusts only the program line levels of the simultaneous Dante/AoIP output streams on the rear-panel RJ45 AoIP Port. As with other digital outputs, the Level (dBFS): may be set between -30 and 0. Other Dante settings are addressed in a separate subsection shortly.</p>
Other Streaming Options	<p>The 541 offers HTTP/Icecast Streams for general ‘tune-in’ listening, and as independent UDP streams that allow the 541 to send raw compressed audio to a specific IP address and port. Both modes are available concurrently and are set-up under the Stream category on the Setup Webpage. (The little loudspeaker icon at the top of each 541 Webpage makes use of HTTP/Icecast streaming.)</p>
HTTP/Icecast Setup	<p>The streaming Codec: is fixed to HE-AACv2 standards. Like the line outputs, the program Source: may be switched here between FM and SCA. The streaming Sample Rate: default is 48kHz, but may be changed to 44.1kHz. The streaming Bitrate (kbps): defaults to 64 but may be manually reset all the way down to 18 kbps for a really poor network connection.</p> <p>For the general-listening HTTP/Icecast Stream, a useful 541 feature is the ability to add-in a fixed Audio Latency (Sec): delay to the inevitable delay inherent in transport. This provides more data “ready to go” upon connection, in turn helping the client’s buffer to fill and playback to start faster.</p> <p>Although the 541 can accommodate as many as 10 simultaneous Web listeners, this number can be truncated in the interest of better streaming service to fewer authorized listeners. Set the Max Listeners: slider anywhere between 0 and 10.</p>
UDP Streaming	<p>The 541 can stream over UDP to any IP Address: with a designated Port:. Enable: must be set On and a proper Transport: mode selected. Check with the receiving end to confirm which.</p>

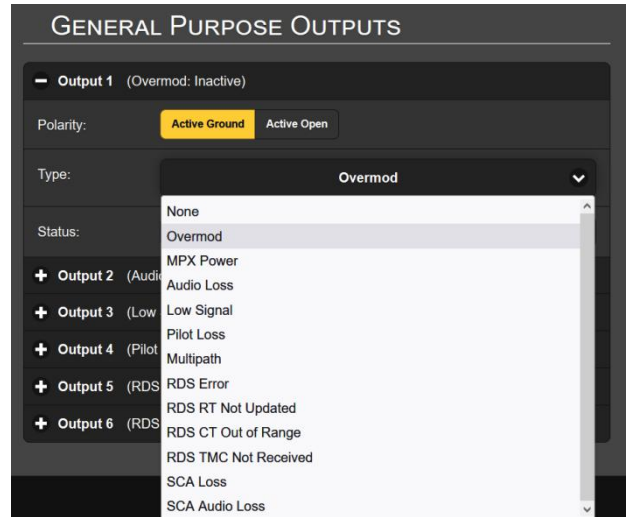
Save the Settings!

Once streaming parameters have been set-up or modified, settings must be saved by clicking the Save bar at the bottom of the section. This action will reset the streaming utility and disconnect any current Web listeners, who then must then log back on.

GPO Setup (Alarm ‘Tallies’)

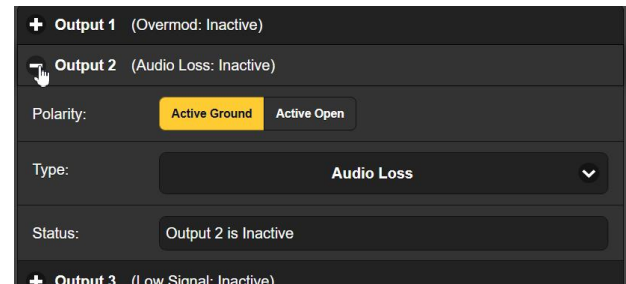
The rear-panel General Purpose Outputs (GPOs) serve as ‘tallies’ for up to six of the 541’s fault alarms.

Click the + to open an alarm options window. Although the Type: of alarm has been factory-set to the more critical faults, the pull-down menu seen here allows you to reassign any of the possible alarms to any GPO terminal. Each output is numbered to match the legend above the rear panel terminal strip.



The alarm function assigned to each tally line is listed, and you can specify alarm tally Polarity:, whether you want an Active Ground (chassis ground) or Active Open (open circuit) when the alarm is triggered.

In this example, Output 2 has been programmed for Polarity: to deliver an Active Ground to GPO terminal 2 for an alarm Type: of Audio Loss. It could as easily have been set to deliver ground on that terminal all the time, and then go Active Open (ungrounded) when the alarm is received.

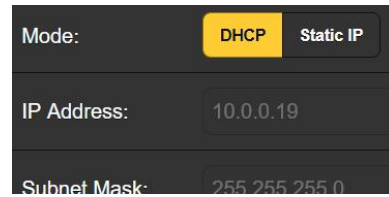


The Status: line in this example shows Output 2 is Inactive as the assigned Audio Loss alarm has not been tripped.

Individual alarm setup procedures begin on Page 34; see Page 10 for GPO tally output wiring information.

NETWORK SETUP AND INTERNET ACCESS

IP Setup With Mode: set to DHCP, your router automatically assigns the 541 an IP Address: and will populate the four associated fields, although they will be 'grayed-out' and you'll not be able to edit those data. If you reset Mode: to Static IP, then you must make the appropriate entries in all four fields and click the Save bar at the bottom.



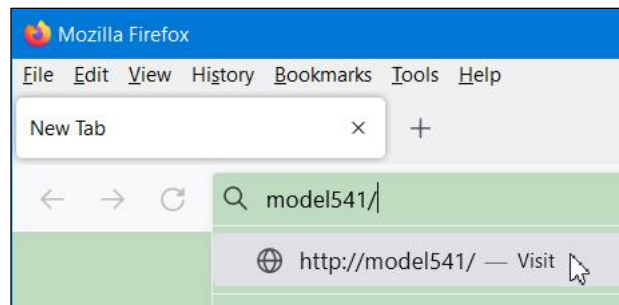
Assigning a Hostname You may change the default name MODEL541 to something else, either to personalize the equipment name or to differentiate between two or more 541 monitors on the same network. Simply overtype the default Hostname: without using spaces. Be sure to click the Save bar once entries are finalized.

HTTP Port The default HTTP Port: 80 is common when accessing networked equipment like the 541 on a local network (LAN). You may change this to another port number as may be required under certain circumstances. Remember to Save your new setting.

MAC Address The MAC Address: (Media Access Code) for your particular 541 is factory-assigned and cannot be changed. You may wish to make note of your unit's MAC Address: to help identify it on your network.

Link Speed Link Speed: is an indication of connection status and the expected bitrate between your 541 and the local network (LAN).

Addressing the 541 Under the Windows operating system, you may access 541 Webpages on a common LAN by typing its Hostname and a forward-slash into the browser address bar as shown below. The entry is not case-sensitive.

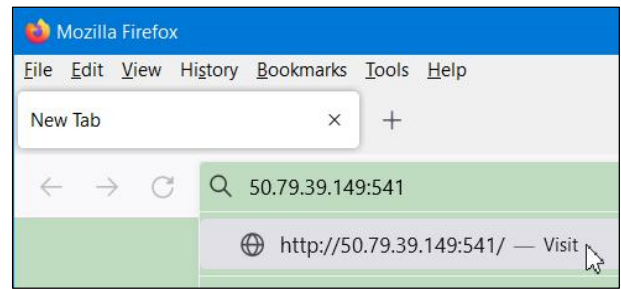


Non-Windows browsers may require you to enter the complete IP address of the unit, which can be found in the Network menu.

Incoming Internet Access To access the 541 from the Internet, the unit must be assigned a static IP address. If your router makes DHCP assignments for other equipment on the network, simply assign a static IP that is outside the router's DHCP range. This should be an easy matter with the aid of the router's Help utility.

You also need to open a specific port for the 541 on the network router. Within the router's Port Forwarding utility you will be able to enter your static IP address for the unit (Internal IP), followed by a colon and a port number. The port number may be any number in the router's range.

If your Internet Service Provider (ISP) assigns you a static IP address, then it is a simple matter to address the 541 from anywhere. Just type the IP address and port number into your browser as pictured here.



But if your ISP issues a *dynamic* IP, which is more often the case, this mandates ‘Dynamic DNS’ operation, using the services of an IP-forwarding provider. This is an operation you should entrust to your IT department. Further explanations and instructions are available from multiple Web resources.

DANTE® AND AoIP STREAMING

The term Dante® refers to networking technology developed by the Australian firm, Audinate Pty. Ltd. It enables simple connection with other Dante-equipped devices, and gives AES67 AoIP (Audio over Internet Protocol) compliance and interoperability among a wide range of pro-AV products. It is generally also compatible with proprietary systems from independent manufacturers of AoIP-enabled products.

IP Settings

The Dante-based AoIP utility of the 541 is quite similar to the product’s general networking function. Like the LAN connection, the independent AoIP connection may accept IP address assignments in either a DHCP or Static IP assignment Mode:. Static IP operation requires manual entries into the four fields that are grayed-out when your router makes DHCP assignments.

The AoIP MAC Address

The MAC address: for AoIP streaming is not the same as the one for general Web interactivity of the 541; these are two independent network connections. Like the rear-panel LAN PORT, the AoIP PORT has a unique MAC Address: that is factory-assigned and cannot be changed.

Link Speed

Link Speed: is a readout showing connection status and the expected networking rate for the AoIP connection.

Remember to click on the Save bar after making or changing Dante setup parameters.

AES67 Enable

The Dante utility is able to AoIP-stream audio at two sample rates, as discussed shortly. The AES67 Standard specifies a 48kHz sample rate, but 44.1kHz is a rate with wide use in radio and television broadcasting and is the default rate for the 541. With AES67 Enable: set to Enabled, streaming is forced to a 48kHz sample rate.

Audio Format

Encoding: refers to the word length for the PCM-encoded digital audio to be sent as AoIP. PCM 16 , PCM 24 and PCM 32 refer to

word length for Dante AoIP flows; AES67 flows are locked to PCM 24 regardless of this setting.

Sample Rate: is forced to 48kHz for AES67 streaming, but 44.1kHz is the 541 default rate unless AES Enable: has been set to Enable.

Transmit Flows The AoIP utility can specify multiple destinations for the audio stream. Flows are individual audio channels, left and right program channels in the case of the 541. Any specific flow can be sent to more than one recipient.

An AES67 flow is initiated from the Dante menu. You may start an Auto flow: with the IP: and Port: set automatically. Or you can set a Manual IP Address: and HTTP Port: to send the stream to. Click Start Flow when setup is complete.

The Dante Controller The Dante Controller is a free software utility available from Audinate, Dante's developer. It is an essential software means of finding, setting-up and controlling Dante-enabled devices on your network. It may be downloaded for operation under either Windows or Macintosh operating systems from the following link.

<https://www.audinate.com/products/software/dante-controller>

SNMP OPERATION

Overview SNMP (Simple Network Management Protocol) allows other equipment on the same Local Area Network (LAN) to communicate directly with your 541, and for your unit to send alarms and supplementary information to other equipment on the network.

The 541 will interface directly with a network controller, technically known as the SNMP 'Manager.' The 541 has an embedded ASCII text file named Management Information Base, or MIB. In setting up for SNMP operation, the MIB file will have to be downloaded from your unit through the Web interface and uploaded to the SNMP Manager. This is detailed later-on.

Mode The SNMP submenu default Mode: setting is Disabled, which inhibits communication between the 541 and the SNMP Manager.

Changing Mode: to Read Only allows the 541 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 your 541 Monitor for remote control of all functions.

Security SNMP 'Communities' serve as passwords for this function. In the Read Community: and Write Community: fields, overtype the factory default public and private entries, entering text that is specific to

the read/write strings on your SNMP Manager monitoring device. Do a Save after entering your text.

- Ports** The default SNMP Ports, SNMP Port: 161 and Trap Port: 162, are customary for a majority of SNMP operations. Overtyping these defaults to change them, followed by a Save.
- Trap Destinations** When the 541 *initiates* an alarm, rather than being *queried* or *polled* for one, the alarm is known as a ‘trap.’ Three local network IP addresses may be entered in the Trap Destination 1:, 2:, and 3: fields, each corresponding to other devices on the LAN that require alarm notifications. Overtyping the defaults with valid IP addresses of other equipment and Save.
- The MIB File** The MIB File is a small text file required by the SNMP Manager. Click: Download MIB to save this file using the usual Windows methods. The MIB file is in plain text with a .mib extension, and may be read with Windows Notepad.

NOTE: This is an abbreviated discussion of SNMP operation. SNMP is a complex utility, managed exclusively by whatever SNMP ‘Manager’ (monitoring equipment) is employed. Refer to all instructions supplied with, and for, the SNMP Manager hardware and/or software in setting-up the 541.

EMAIL AND SMS/TEXT MESSAGING

- Email and Text Notifications** 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. This is detailed under the next subheading.

Connected to the Internet, the 541 can send email or SMS/text notifications of reception and other faults to one or more recipients. Which alarms go to what recipient is a separate setup routine.

- SMTP Setup** The 541 must first be properly programmed to send mail under SMTP Settings. You need to set up an actual email account, the elements of which are just like setting up any conventional email account. Information to be entered here depends on the provider you choose. When you apply for the account, much of this information will be assigned to you. Consult your IT professional for help setting up email accounts.

Under SMTP Server:, enter the provided outgoing mail server info (e.g.: smtp.gmail.com), the required Port: number and whether TLS: is On or Off.

From: is the ‘friendly’ name that identifies the 541 to the email or SMS/text recipient. You could use station call letters or something like ModMonAlarm. User: is the full email address (username) of the email account you’re using for the 541, and the Password: you chose for this account.

**Recipients,
(Send To)**

Next enter up to ten email recipients, typing-in the full email address. After this you'll decide who gets what alert.

Email addresses typically take the form of the upper example here. If instead you wish to send a text message to a recipient's cell phone, the entry may look like the second image. In this instance the alarm notifications are being directed to a Verizon subscriber's phone. Further information on these naming protocols is available on the Web, or you can check with the wireless carrier to confirm the proper addressing style for Internet texting delivery.

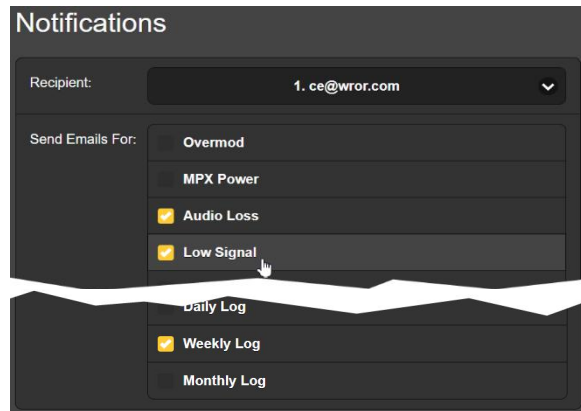


When all recipients have been entered, click Save. You may also click Send Test Email, which will message *all* recipients to confirm proper communications setup. The Status: field will show whether the test message has been properly formatted, dispatched and accepted by the email provider.

**Notifications,
(Send What)**

You may assign any or all alarms to any or all email or text addresses Recipients the Notifications section.

Referring to the example here, click the down arrow to select Recipient: 1. through 10. With a Recipient: selected, click the Send Emails For: boxes to choose which alarm condition(s) will be reported (and/or alarm logs dispatched) to that specific individual.



In this abbreviated example, the Chief Engineer will receive a text message on his phone for Audio Loss and Low Signal alarms, and have the Weekly Log downloaded to his phone as well.

When you've finished with this Recipient:, proceed to the next. No Save command is necessary in this operation.

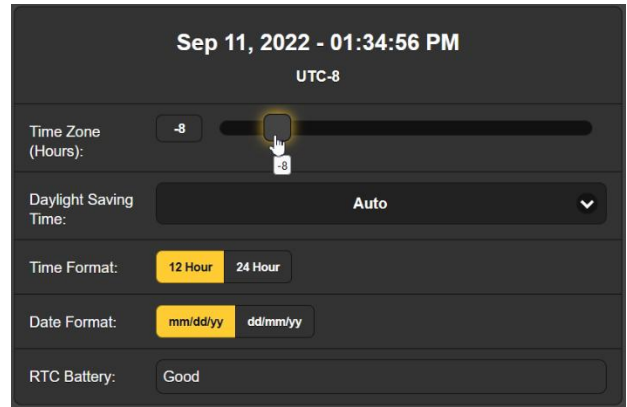
TIME SETUP

Time and DST

The internal Real Time Clock gets daily updates from Internet Time and has sufficient inherent precision to remain accurate within this schedule.

Grab and drag the Time Zone (Hours): slider for the proper offset from Universal Coordinated Time for your location.

In this example, the -8 represents West Coast US (Pacific) time. The time at the top of the page will update rapidly, so you can simply drag the slider until the time shown here agrees with your Rolex Cosmograh, or perhaps an even-more-accurate (crystal-controlled) Timex.



Daylight Saving Time: defaults to the Auto mode, though you may either opt for this convenience or click the down arrow to select On or Off for DST.

Presentation Formats

Time Format: can show either a 12 Hour or a 24 Hour clock, and the Date Format: can reflect either US or European conventions. The date is automatically set by the Internet Time Server.

RTC Battery

The Real Time Clock has a backup battery located on the main 541 circuit board. This is a 3V CR2032 flat 'coincell' battery with the + side facing out. Replace the battery when RTC Battery: indicates other than Good.

Time Server

We have provided a reliable default time server, which is 1.inovonics.pool.ntp.org. If you prefer another, overtype the Server: entry with your alternate and click Save.

ADMINISTRATIVE MATTERS

Security and Passwords

Access to your 541 may be protected by multilevel passwords, which must then be entered before screens can be viewed or entries changed.

NOTE:

Once the 541 front panel LCD-touchscreen is unlocked, all passwords will appear in clear text on the Admin menu.

All passwords are hidden on the Admin Webpage when logged-in as a 'Read Only Web User'.

Under the Security heading of the Admin Webpage, type-in the Front Panel: password, which henceforth must be manually entered at the front-panel screen at the equipment site.

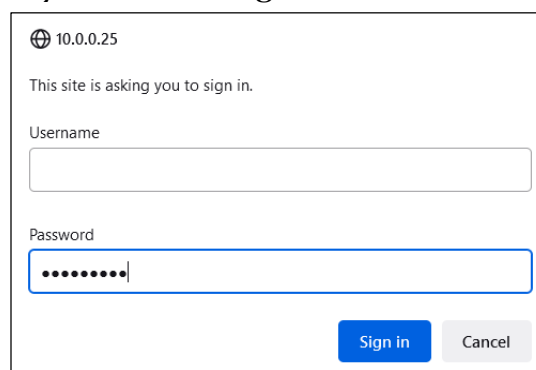
There are two Webpages-access passwords. Web Admin Password (Read/Write): is the Administrator password that allows full access to the 541. Web User Password (Read Only): will permit a lower-level user to view all data, but that user cannot retune the

receiver or make changes to any settings. Once passwords have been assigned, click Save to lock them into nonvolatile memory.

Once passwords have been entered and saved, the front-panel Now Playing screen will be the only one visible, and all Web interface screens will be locked out.

Signing In Once password protection is in place, at the installation site you will be prompted to enter the front panel password through the LCD-touchscreen before any menu other than Now Playing can be accessed. Use the on-screen keyboard to spell-out the password, and then click ✓. This will be necessary each time the unit times out to a dark or dim screen, so you may wish to reset the Admin / Display / Timeout interval while you're working on the unit.

A Webpage password will have to be entered on any connecting device. When this image appears on your screen, ignore Username and enter either the Web Admin or the Web User password into the Password field, then click Sign in.



Lost Password (Hard Reset) *NOTE:* A 'hard reset' is required to bypass a local or a Web interface password. *This must be done at the installation site!* A hard reset not only deletes the password, but will also return the 541 to all-factory-default settings. *All User settings will be lost!* This illustrates the importance of maintaining a current Hardware Profile, which is discussed shortly.

If the password is lost, the only way you can recover control of the 541 is at the equipment site following this procedure:

1. Disconnect AC mains power.
2. Wait 10 seconds and then reapply AC power.
3. Immediately when the Inovonics logo 'i' lights, place two or more fingers on the LCD-touchscreen.
4. You should see confirmation on the LCD that the 541 is re-booting with factory-default values. If this is NOT the case, if the unit boots starting with the usual Booting Tuner, Booting DSP sequence, perform the sequence again until you see Loaded Factory Default settings heading the boot sequence list.

The Hardware Profile The entire 541 'setup' may be saved to your computer as a small text file. The Hardware Profile includes user settings, alarm notification preferences, SNMP options, passwords, etc., and is useful for restoring a previous setup or for cloning a second unit for backup service.

To save a profile to your computer, under Configuration click: Download



Hardware Profile. With the Firefox browser used in this example, Windows 10 automatically saves the file to your Windows Downloads folder as a small file with a .json extension. From there you can move it to a location of your choice. Other browsers may ask you to specify a Save as: location. The file carries a default name of 541_settings.json.

To upload (restore) saved settings, first click Select Hardware Profile... under Configuration and navigate to where you have saved the profile. When prompted, Open the file. Then click Upload Hardware Profile. This will replace all setup parameters currently loaded and running in your 541 with the saved ones.

Reboot

Uploading a Hardware Profile *automatically* reboots the 541. There may be other circumstances under which you might want to reboot the unit manually. This can be done by clicking Reboot in the Configuration area.

A *manual* reboot does not change any settings or purge any data that would not be lost with a power cycle. The 541 will come back tuned to the same station and with all the same settings.

However, at any time you wish to ‘clean house’ and restore all settings and preferences to factory values, click: Load Factory Defaults. In this case you will lose your settings, except for IP settings (to maintain access to the unit), so first doing a Download Hardware Profile might be a smart move.

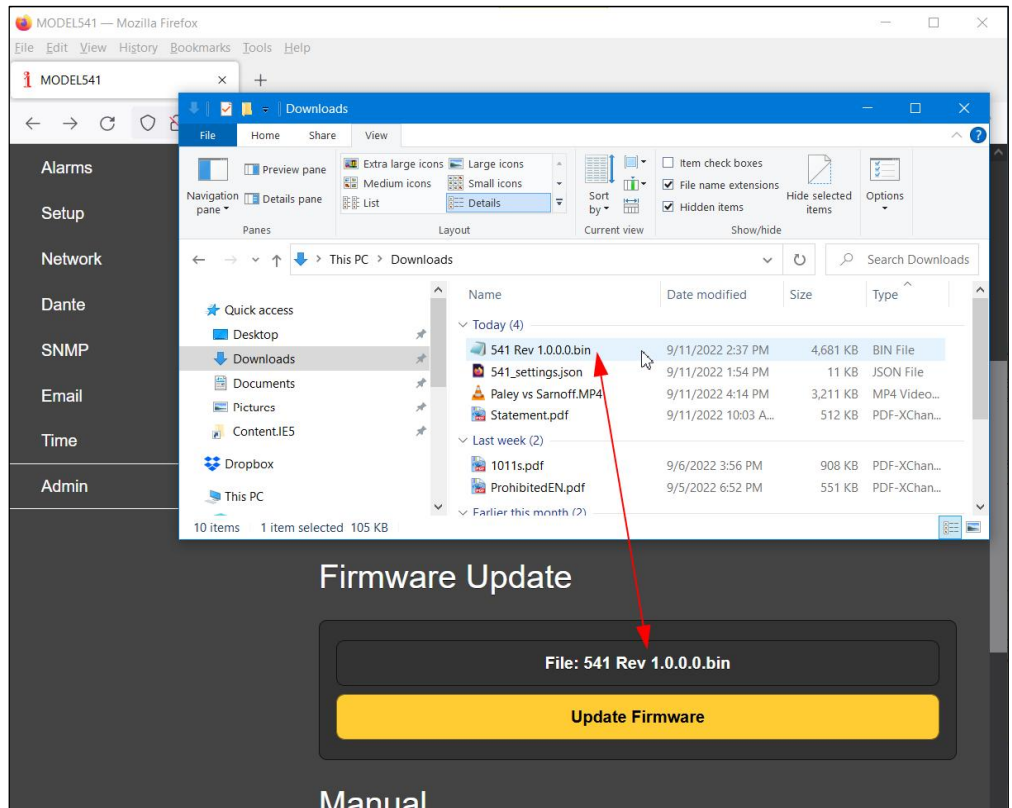
Updating Firmware

NOTE: Before attempting a firmware update, we do recommend first saving a fresh Hardware Profile, as a firmware update may affect user settings. If there is danger of compromising stored data, the firmware update will include notes to that effect.

541 firmware updates are issued as small .bin files that are downloaded from the Inovonics Website to your computer Desktop or into in a folder set aside for this purpose.

Updates including the Web interface pages and are easily uploaded to your 541. From the Firmware Update utility at the bottom of the Admin screen, click Select Firmware File... and double-click the downloaded .bin file. This will transfer the file to the updater as shown in the screenshot at the top of the next page.

With the name of the new .bin showing in File:, Click Update Firmware and follow prompts to complete the process. Updating takes a minute or so and will return you to the new Web interface pages once the operation is complete.



541 Manual
'About' Info

A PDF of the 541 manual has been included in the firmware. The bottom of the Admin screen shows the Serial Number: of your 541, gives the current Firmware Rev: and displays the Uptime:, or how long your 541 has been running since power was last applied. You also may click Check for Updates to see if a new version of the firmware has been issued, and view Open Source Licenses boilerplate.



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.

