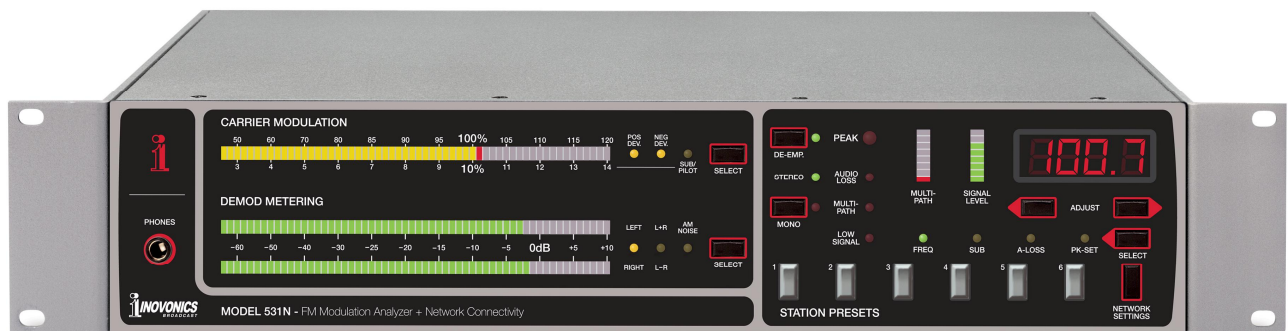


531N

FM Modulation Analyzer with Networking

Installation & User Guide



PRODUCT REGISTRATION RECORD

531N – Serial No. _____

Purchase Date _____

Warranty Registered? ☐ Web

Reg. Date _____ By: _____

Installation & Operation User Guide

531N

FM Modulation Analyzer with Networking

May, 2015

Firmware Rev. 1.0.0.0

Effective with Serial No. 3200

Inovonics, Inc. 5805 Highway 9
Felton, CA 95018

Tel: (831) 458-0552 Fax: (831) 458-0554

Register online at www.inovonicsbroadcast.com

TABLE OF CONTENTS

Section I – INTRODUCTION

531N PRODUCT DESCRIPTION	7
Features	
531N TECHNICAL SPECIFICATIONS	8
Off-Air Receiver Performance	
FM Demodulator	
Stereo Decoder	
Panel Controls and Indicators	
Web Interface (Only) Features	
Rear-Panel Connector Block	
Network Port	
Miscellaneous	
BLOCK DIAGRAM	11

Section II – INSTALLATION

UNPACKING AND INSPECTION	12
MOUNTING	12
Rack Requirement	
Heat Dissipation	
AC (MAINS) POWER	11
Mains Voltage Selector	
Mains Fuse	
Power Cord	
RADIO FREQUENCY INTERFERENCE (RFI)	13
Location	
Ground Loops	
RF INPUTS	13
Antenna Input and Antennas	
“Direct” RF Input	
RF Input Switching	
COMPOSITE/MULTIPLEX CONNECTIONS	14
Composite Output	
Composite Input	
Composite Signal Selection	
AM NOISE OUTPUT	15
PROGRAM LINE OUTPUTS	15

CONTROL AND TALLY TERMINALS	15
Remote Preset Selection	
Front-Panel Tuning Lockout	
Panel Lockout	
Alarm Tallies	
DE-EMPHASIS SELECTION	16
Changing De-Emphasis	
TOTAL-MOD DISPLAY INTEGRATION SELECTION	17
Integration Defined	
The FCC's Measurement Method	
As-Delivered	
Changing Integration Time	
A WORD ABOUT LOUDNESS	18
 Section III – BASIC SETUP AND OPERATION	
FRONT-PANEL VS. WEB INTERFACE SETUP	20
PANEL CONTROLS AND INDICATORS	20
THE READOUT SECTION (LEFT SIDE)	21
Phones	
Carrier Modulation	
Demod Metering	
THE RECEIVER SECTION (RIGHT SIDE)	22
Digital Readout	
Freq.	
Station Presets 1 – 6	
Signal Level	
Multipath	
Stereo & Forced Mono	
De-Emphasis	
Subcarrier Measurement	
Audio Loss	
Peak Flasher	
Alarm Indicators	
Network Settings	
MEASUREMENT PITFALLS AND LIMITATIONS	25
Signal Strength	
Multipath Distortion	
Composite Clipping	
Adjacent Carriers	
A GUIDED TOUR OF 531N OPERATION	27
Items Required	
Getting Ready	
Tuning In	
Signal Quality Evaluation	
Carrier Modulation Display	

- Peak Flasher
- Pilot Injection
- Subcarrier Measurements
- 38kHz “Residual”
- Demod Metering
- Forced-Mono Reception
- Program De-Emphasis
- AM Noise Measurement
- Audio Loss Alarm

Section IV – NETWORK SETUP

CONNECTION WITH THE 531N	33
Connect the 531N	
DHCP	
The IP Address	
Gateway, Subnet Mask and Primary DNS	
HOOKING-UP	34
COMPLETING THE NETWORK SETUP	34
The Network Page	
ACCESSING THE 531N REMOTELY	36
Dynamic DNS	
SNMP OPERATION	37
SNMP Overview	
SNMP Security	
SNMP Traps	
SNMP Ports	
Downloading the MIB File	
Further Study	
EMAIL PREFERENCES	39
Mail Server Setup	
Saving and Testing	
TIMEKEEPING	40
ADMINISTRATIVE SETTINGS	41
Password	
Lost Password	
Hard Reset	
The Hardware Profile	
Errata	

Section V – 531N EXTENDED FEATURES

THE WEB SCREEN HEADER	43
Remote Listening	
Signal Quality	
Alarms	

NOW PLAYING	44
Basic Station Information	
Receiver Tuning	
Station Presets	
GRAPHS AND METERING	45
MPX Spectrum Display	
XY Plot	
Meter History	
Other Displays	
RDS INFORMATION	48
RDS DATA GROUP STATISTICS	48
SIGNAL ALARMS	49
Peak Overmodulation	
Audio Loss	
Low Signal and Multipath	
EMAIL AND TEXT MESSAGE NOTIFICATIONS	51
THE ALARM LOG	52
Alarm Log Capacity	
Downloading and Clearing the Alarm Log	

Section VI – UPDATING THE 531N

THE FIRMWARE UPDATER	53
Warning	
Firmware Update Files	
Running the Firmware Updater	
Updating the Web Interface Pages	

APPENDIX

INOVONICS WARRANTY	(INSIDE BACK COVER)
--------------------------	---------------------

Section I

INTRODUCTION

531N PRODUCT DESCRIPTION

The Inovonics Model 531 Modulation Analyzer (more commonly called a *Mod-Monitor*) was introduced at the annual Convention of the National Association of Broadcasters in 2003. In the ensuing years it has become the de-facto standard among FM monitoring products, with thousands in service worldwide.

The 531N is an updated version of the product, retaining the dependability and accuracy of its predecessor, but now including IP networking capabilities that have increasingly become essential in today's radio broadcast environment.

Features

Leading features of the Inovonics 531N include:

- A full-time display of signal strength and multipath effects to validate readings and simplify antenna alignment.
- Synthesized tuning with a digital readout and six station presets (memories) to compare one's own signal with those of market companions.
- An exclusive synchronous (incidental) AM noise measurement utility to aid in transmitter alignment.
- Selective display of common data and analog subcarrier injection levels.
- Panel indicators, 'tally' outputs and email/SMS alarms for reception problems and transmission faults with error-logging.
- Intuitive setup and operation from the front panel, plus a built-in Web server for full remote operation and monitoring over any IP network.
- A Web interface that presents viewable and downloadable graphic displays of baseband spectrum (FFT), stereophony (XY) and modulation density over a selected time period).
- Comprehensive RDS/RBDS data presentation and analysis via the Web interface.
- Supports SNMP remote monitoring.

531N TECHNICAL SPECIFICATIONS

OFF-AIR RECEIVER PERFORMANCE

Receiver Topology:

Double-conversion superheterodyne;
10.7MHz first IF, 700kHz second IF

Tuning Range: 76.0MHz–108.1MHz in
100kHz steps; six station presets

Sensitivity/Noise Performance:

10 μ V (20dB μ V/10dBf) for 50dB mono quieting; 250 μ V (48dB μ V/60dBf) typically required to assure valid Total Modulation readings.

RF Inputs:

- 1) F connector for 75-ohm antenna
- 2) BNC connector for alternate 50-ohm, high-level RF sample; 7V r.m.s. maximum

Selectivity:

250kHz Gaussian IF bandwidth for full recovery of baseband components to 100kHz with negligible overshoot

AM Noise Output:

Separate AM detector with dedicated BNC output monitors incidental AM modulation of the FM carrier; also monitored by headphones when selected.

Signal Quality Metering:

RSSI (signal strength) and Multipath (distortion) metering

FM DEMODULATOR

Type:

Proprietary ultra-linear push-pull pulse-counting circuit operating at 700kHz.

Baseband Output:

BNC composite/MPX demod output; 3V p-p at \pm 75kHz deviation. Refer to Figures 1 and 2 for frequency response characteristics.

STEREO DECODER

Type:

Proprietary I/Q PLL precision decoder with unsurpassed AM rejection

Baseband Input:

Switchable between off-air FM demod and BNC composite/MPX input. External input accepts 100% modulation levels of 1V p-p or greater.

Frequency Response:

\pm 0.5dB, 10Hz–15kHz

Noise:

Unmodulated (stereo) carrier noise is better than 65dB below 100% modulation with de-emphasis applied.

Distortion:

<0.075% THD at 400Hz with 100% modulation and no de-emphasis

Stereo Separation:

Refer to Figure 3.

Crosstalk Measurement:

M/S and S/M crosstalk measurement is by the stereo sum/difference method. Refer to Figure 4.

De-Emphasis:

May be turned on and off from front panel or with Web interface; internal jumper for 50 μ s or 75 μ s.

Program Audio Outputs:

- 1) Balanced XLR left- and right-channel stereo program outputs at +4dBm
- 2) Front-panel headphone jack

PANEL CONTROLS AND INDICATORS

PLEASE NOTE: Front-panel appointments are keyed to the photographs on Pages 21 and 22 and detailed there. All panel controls and indicators are duplicated in the Web interface. Additional Web interface features are discussed separately below.

WEB INTERFACE (ONLY) FEATURES

FFT display of demodulated FM baseband

X/Y plot of stereo image

Statistical modulation display, including modulation density (loudness) over time

Display of all RDS/RBDS parameters, messaging and data group statistics

Remote Web-based monitoring of off-air audio

Comprehensive network configuration utility including dynamic DNS, plus full SNMP support with downloadable MIB file

Error alarms with logging; SMS/text or email message dispatch

REAR-PANEL CONNECTOR BLOCK

Alarms:

Tally outputs for Low Signal, Audio Loss, Excessive Multipath and Overmodulation (remote flasher). NPN transistors saturate to ground for alarm condition.

Remote Station Selection:

Station presets may be activated with a momentary contact closure to ground. A permanent ground will inhibit selection of any other station.

NETWORK PORT

Connector:

RJ45 jack for remote setup and operation via TCP/IP

Settings:

DHCP or Static IP with local or remote selection

SMTP:

Full SMTP support with downloadable MIB file

SMTP:

Supports email services with or without SSL

Dynamic DNS:

Supports dyndns.org, no-ip.org, dnsomatic.com

MISCELLANEOUS

AC Mains Requirements:

105-130VAC or 210-260VAC, 50/60Hz; 20W

Size:

H: 3½in/89mm, W: 19in/483mm

D: 12in/305mm

Weight:

14lbs/6.35kg (shipping weight)

Environmental:

Continuous operation guaranteed at ambient temperatures between 32°F/0°C and 122°F/50°C; 0-95% relative humidity, non-condensing; altitudes to 10,000ft/ 3048m.

Conformances:



EN50081-1
EN50082-1
93/68/EEC



2002/95/EC

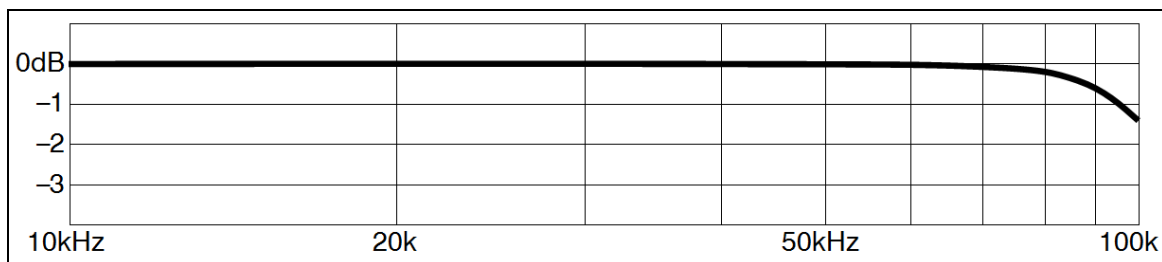


Figure 1 - Amplitude Response of Demodulated Composite Passband

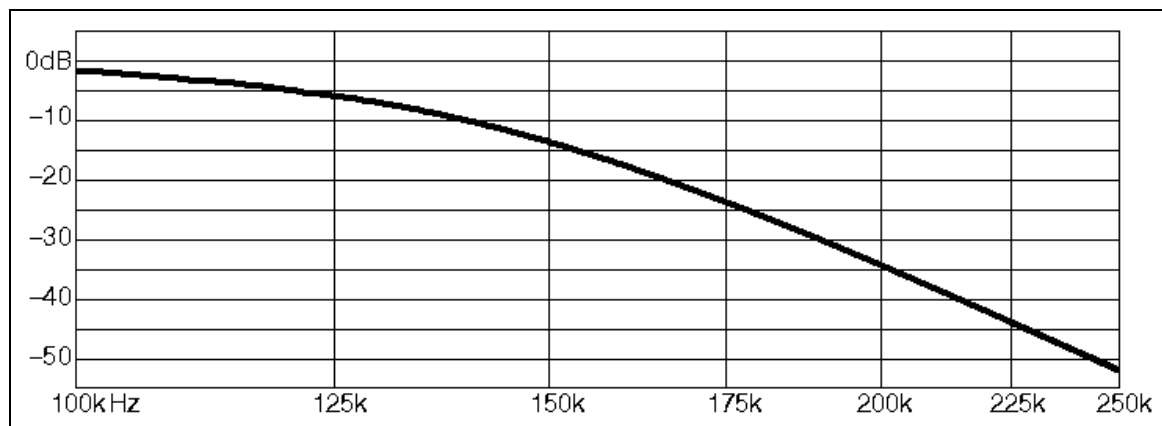


Figure 2 - Amplitude Response of Demodulated Composite Stopband

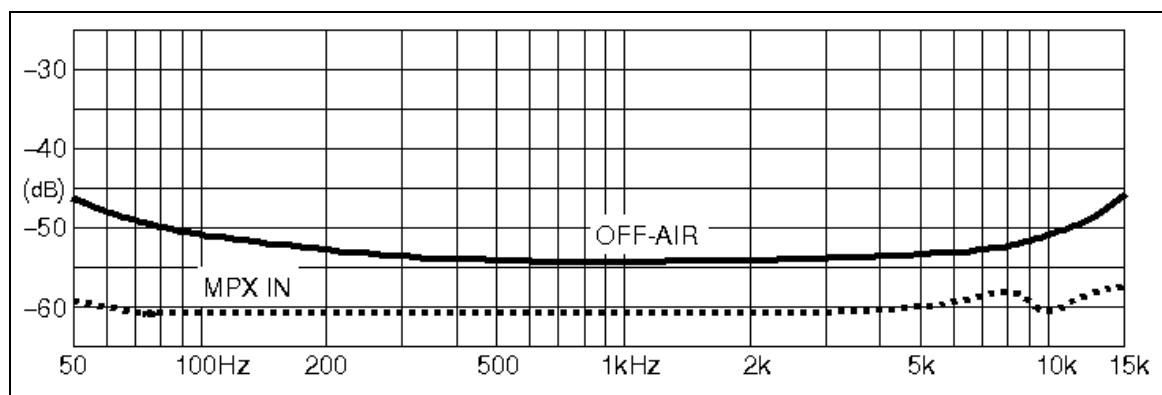


Figure 3 - Typical Stereo Separation

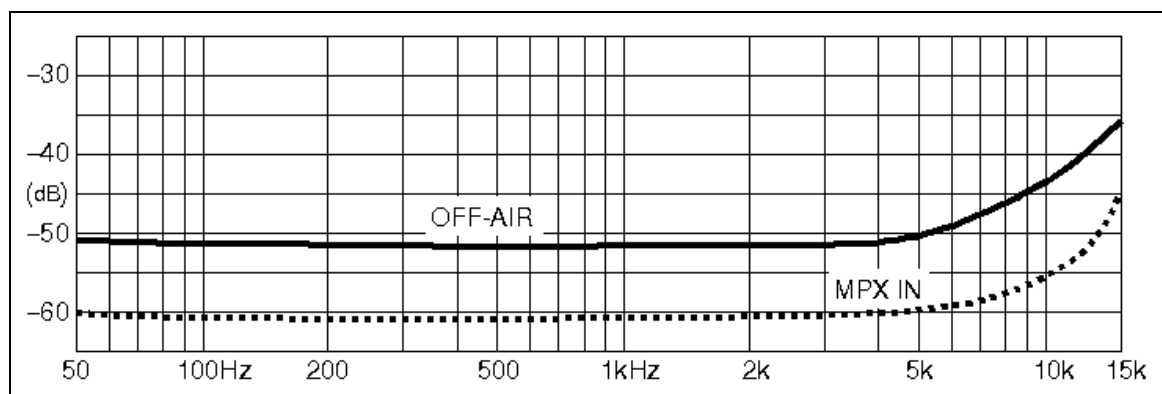


Figure 4 - Typical Crosstalk Measurement Limits

BLOCK DIAGRAM

Figure 5, a simplified Block Diagram of the Model 531N Modulation Analyzer, appears on the following page.

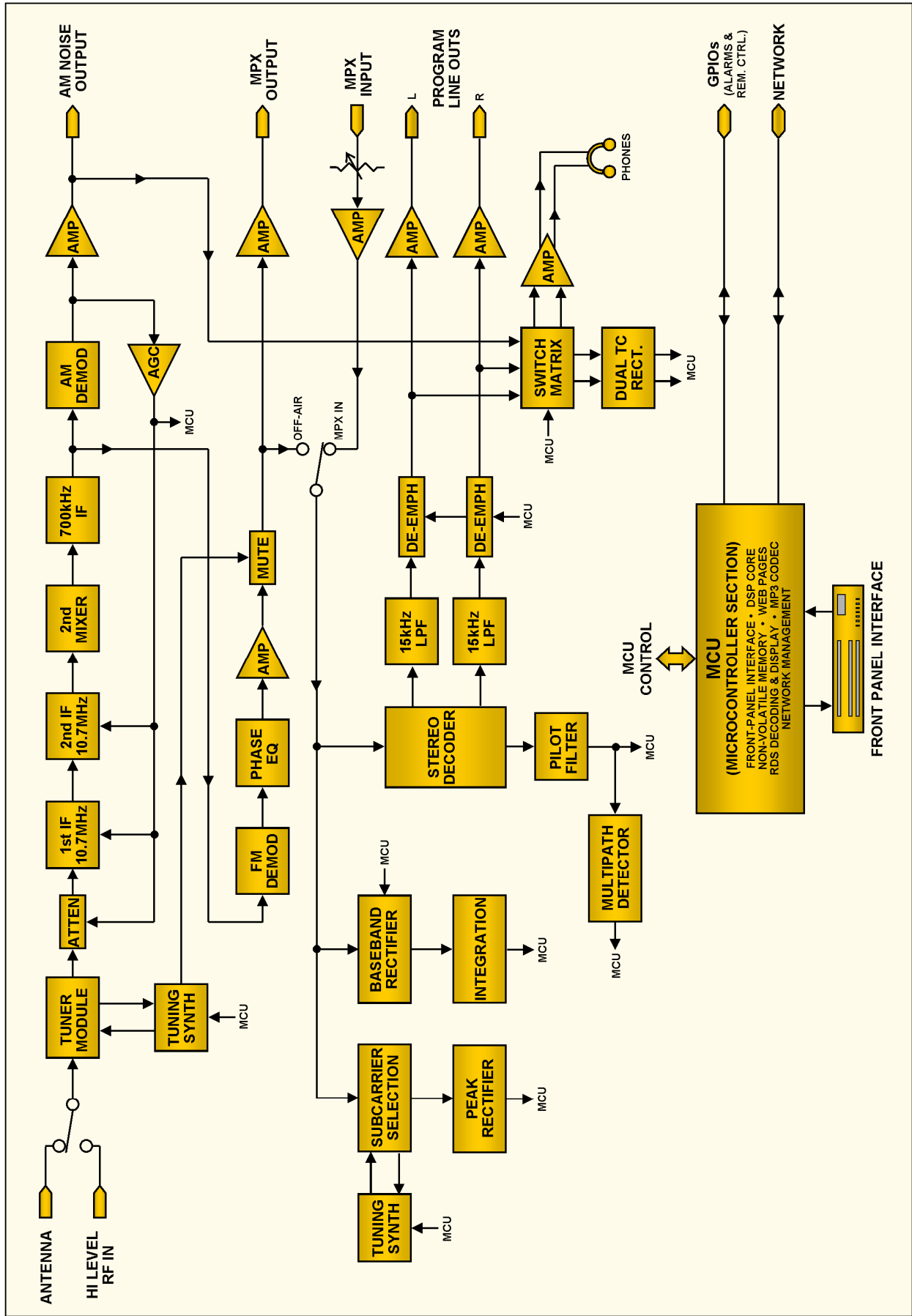


Figure 5 - Block Diagram – 531N Modulation Analyzer

Section II

INSTALLATION

UNPACKING AND INSPECTION

As soon as you receive the 531N, inspect carefully for any shipping damage. If damage is found or suspected, notify the carrier at once, and then contact Inovonics.

We recommend retaining the original shipping carton and packing materials for return or transshipment. If the unit is returned for Warranty repair, shipping damage sustained as a result of improper return packing may invalidate the Warranty!

IT IS IMPORTANT to register the Warranty of your 531N. This assures coverage of the equipment under terms of the Warranty and provides a means of tracking lost or stolen gear. This action also adds the user to a database to receive specific service instructions or software/firmware updates when issued. Register online through the link on our Website:

www.inovonicsbroadcast.com.

PLEASE 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 531N setup and use. Do please refer back to this section, however, to confirm proper physical installation and interconnection with other station equipment.

MOUNTING

Rack Requirement

The 531N mounts in a standard 19-inch equipment rack and requires only 3½ inches (2RU) of vertical rack space. We recommend using plastic or fiber washers to protect the painted finish around the mounting holes.

Heat Dissipation

Consuming roughly one-half the energy of a retro-replica LavaLite®, the 531N generates negligible heat on its own, and thus has no noisy internal fan and associated filter to change. The unit is specified for operation within an ambient temperature range extending from freezing to 120°F/50°C. But because adjacent gear may radiate substantial heat, be sure that the equipment rack is adequately ventilated to keep internal temperature below the specified maximum ambient.

AC (MAINS) POWER

- Mains Voltage Selector** Unless specifically ordered for export shipment, the 531N is set at the factory for operation from 115V, 50/60Hz AC mains. This can be confirmed by checking the designation next to the fuseholder on the rear panel. The *inappropriate* voltage and fuse value will have been crossed out at the factory with an indelible felt marker.
- To change the mains voltage, *first disconnect the AC power cord* and then remove the top cover of the unit. A clearly marked slide switch is next to the AC mains connector on the circuit board. Use a small screwdriver to set the switch for 115VAC or 230VAC operation.
- Be sure to install the appropriate fuse as listed next to the fuseholder. You can remove the factory strikethrough with solvent and then cross out the inappropriate marking with an indelible felt pen.
- Mains Fuse** It is important to install the appropriate fuse as noted on the rear panel next to the fuseholder: 1/4A for 115V mains, 1/8A for 230V operation. Fuses are GMA 5mm X 20mm 'fast blow.'
- Power Cord** The detachable IEC-type power cord supplied with the 531N is fitted with a North-American-standard male plug. If you need to replace the mains plug with another, you will find that the individual cord conductors are color-coded in one of two ways. US standards specify black for AC 'hot,' white for AC neutral (return) and green for earth ground. European CEE standards specify brown for AC 'hot,' blue for AC neutral and green with a yellow stripe for earth ground. Please keep these straight.

RADIO FREQUENCY INTERFERENCE (RFI)

- Location** Although it is expected that the 531N will be co-located with FM transmission equipment, do practice care and common sense in locating the unit away from *abnormally* high RF fields.
- Ground Loops** Because the inputs and the outputs of the Model 531N are referenced to chassis ground, a mains frequency or RF ground loop could be formed between cable shield grounds and the AC power cord ground. A 'ground-lifting' AC adapter may well remedy such a situation, though the chassis somehow must be returned to local earth ground for safety considerations.

RF INPUTS

- Antenna Input and Antennas** The 531N antenna input is a US-standard 75-ohm F connector. Inexpensive, ready-made cables of various lengths are common in this format.

A multi-element directional antenna is essential for any serious off-air pickup. “Turnstyle” or S-shaped, “all-directional” FM antennas are all but useless in nearly any reception circumstance.

Professional FM-band receiving antennas are available from various manufacturers, and are recommended for long-term applications. With cost in mind, however, a consumer-grade alternative that has proven to work quite well is the Antennacraft Model 70 Yagi, easily found at Amazon and other online suppliers.

**“Direct”
RF Input** High-level RF samples (from the transmitter’s directional coupler, for example) may be fed to the 531N through a dedicated rear-panel BNC connector. However, this HI LEVEL RF IN connection does *not* bypass the tuner, the signal is simply padded-down and applied to the tunable front-end. High-level inputs should be restricted to a maximum of 7 volts r.m.s. to avoid overloading the internal terminating resistor; and of course, the receiver must still be tuned to the incoming frequency.

**RF Input
Switching** The rear-panel RF SOURCE SELECT switch must be in the proper position for ANT (antenna) or DIR (‘direct’ high-level) inputs.

COMPOSITE/MULTIPLEX CONNECTIONS

**Composite
Output** The rear-panel MPX OUT connector is a direct output from the FM demodulator. An internal buildout resistor sets the source impedance at 100 ohms. This output is intended for oscilloscope monitoring or for feeding outboard analysis equipment with high impedance ‘bridging’ inputs.

Observe good laboratory practice and avoid long connecting cables, or otherwise highly capacitive or very low impedance loads. Heavy loading of the MPX OUT connector may compromise front-panel modulation readings.

**Composite
Input** The MPX IN connector lets you monitor external baseband signals with the 531N, either from another off-air source or directly from a composite STL receiver or FM stereo encoder.

When the MOD-MONITOR INPUT switch is in the EXT position, the RF tuner portion of the Model 531N is disconnected and the MPX IN baseband signal is routed to the level metering and stereo decoding circuitry. This is a 100k-ohm, unbalanced/bridging input that can accommodate levels of 1V p-p (peak-to-peak) or greater. The multi-turn EXT MPX IN LEVEL ADJUST control affords adjustment over the external baseband input.

**Composite
Signal Selection** The MOD-MONITOR INPUT switch selects between AIR (off-air) and EXT (external baseband input).

AM NOISE OUTPUT

The AM NOISE OUT connector is a fulltime output from the receiver's AM demodulator, a feature found on only a few, top-of-the-line FM mod-monitors. This is a 1k-ohm source that can feed an amplifier and loudspeaker, or an oscilloscope to help correlate incidental, synchronous AM noise with transmitter tuning. This signal is also available from the front panel PHONES jack when AM NOISE is selected for display on the upper DEMOD METERING bargraph readout.

PROGRAM LINE OUTPUTS

The LEFT and RIGHT PROGRAM LINE OUTPUT XLR connectors are +4dBm, balanced outputs from the stereo decoder. These are dedicated to the left and right program channels, and do *not* follow front-panel selection of stereo sum and difference or AM noise.

Keep in mind that the line outputs do respond to (de-emphasis) switching. DE-EMPH is normally left on, but a flat frequency characteristic may be necessary when using these outputs for external L/R measurements.

CONTROL AND TALLY TERMINALS

The GPIO interface for remote control and alarm connections is a 16-terminal tie-down strip. The screw-terminal part of this strip unplugs from the chassis to make wiring and servicing more convenient. Simply grab the plastic part that protrudes from the back panel and give it a hard pull.

Remote Preset Selection

The six front-panel STATION PRESETS may be remotely selected with a momentary contact closure to ground. These lines have internal pull-up resistors to +5 volts, so a dry contact closure or NPN transistor saturation will bring up the selected station.

Front-Panel Tuning Lockout

A remote tuning selection command must always be a *momentary* closure to ground. If a *permanent* ground is applied, the front-panel STATION PRESETS buttons, plus the up/down ADJUST buttons and even Web interface tuning will be disabled, and the 531N will remain tuned to the frequency associated with that preset. This 'override' feature may be used when it is imperative that the 531N be fixed-tuned to only one frequency. Simply run a wire from the desired preset terminal directly to a ground terminal.

Panel Lockout When the PANEL LOCKOUT terminal is grounded, *all* front-panel buttons are disabled. Web-interface control remains active, however.

Alarm Tallies The four alarm lines are open-collector NPN transistors that saturate to ground with an alarm. LOW SIGNAL, MULTIPATH and AUDIO LOSS conditions, as well as remote indication of the PEAK FLASHER, all have corresponding rear-panel terminals to enable remote display.

These tally outputs can sink 50mA from an external power supply without stress. The +5 volts provided on the two right-hand terminals is current-limited, however, and is intended for LEDs, optical couplers or other low-consumption devices.

Figure 6, below, suggests a possible remote hookup, which includes a carrier-loss indication that would be difficult to ignore.

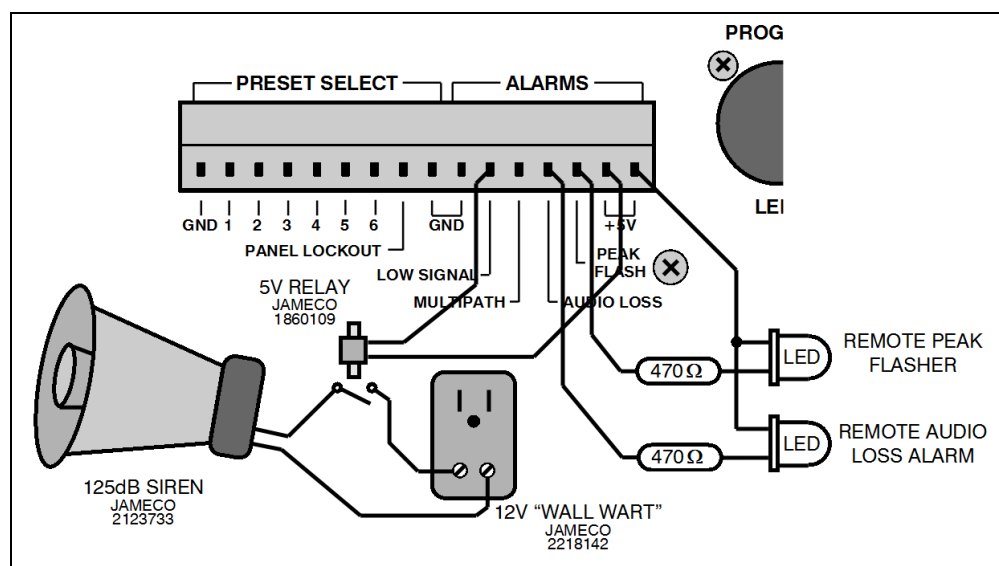


Figure 6 – Suggested Remote Alarm Connection

DE-EMPHASIS SELECTION

The 531N accommodates both the 75-microsecond (Western Hemisphere) and 50-microsecond (Europe and Asia) FM broadcasting pre-emphasis standards. De-emphasis that is appropriate to the shipping destination is set at the factory, but this is easily changed if required.

Changing De-Emphasis Remove the top cover of the 531N. With the front panel facing you, locate the long row of integrated circuits just behind the rear-panel AM NOISE connector. On either side of IC35, you'll find 3-pin jumper strips, each with a removable jumper shunt. The jumpers are labeled JP3 and JP4. Each is marked with a 50 and a 75, corresponding to the de-emphasis selection. Figure 7 on the following page shows proper placement of the jumper shunts for each characteristic.

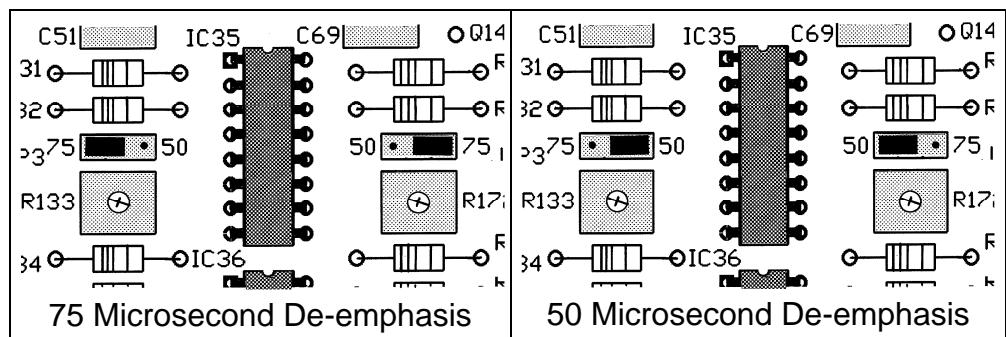


Figure 7 – De-emphasis Jumping

TOTAL-MOD DISPLAY INTEGRATION SELECTION

Integration Defined

“Peak Integration” refers to the practice of allowing brief overdeviations of the FM carrier to slide-by, seemingly unnoticed. In the case of the Model 531N, non-repetitive modulation peaks lasting less than a predetermined period will *not* be displayed at their actual peak value on the CARRIER MODULATION bargraph display. In this case the display shows the *integrated* value of repetitive peaks.

Broadcasting regulations, including those of the FCC in the US, are often a bit vague on this subject. Nearly all mod-monitors include some provision for ignoring exceedingly fast program peaks, vaguely referred-to (in the US) as “peaks of infrequent occurrence.” In all fairness, non-repetitive overshoots that do not materially increase the broadcaster’s occupied bandwidth may legitimately be ignored in a measurement of total carrier deviation, as they pose no threat of interference to an adjacent-channel signal. But by allowing *repetitive* peaks to drive modulation consistently past the legal limit, the broadcaster is courting the wrath of his regulatory agency.

The FCC’s Measurement Method

One reliable guideline in determining just how far you dare go with respect to total carrier modulation is with an awareness of how at least one government authority monitors a broadcaster’s signal. As far as we have been able to determine, the United States FCC does not use any form of commercial mod-monitor with a metered readout. Instead, they connect an oscilloscope to the composite baseband output of a wideband FM receiver and look for deviations beyond a predetermined peak amplitude. As freely explained by one Field Engineer, who wishes to remain anonymous, “the FCC is not looking for the occasional overshoot, but for consistent and flagrant overmodulation.” This is a condition that is usually *noticed* and *complained about* before the station is flagged for scrutiny.

As Delivered

The Inovonics 531N allows the user to select among four integration times: 100µs, 200µs, 500µs, and 1.0ms. As delivered, the 531N is set for the fastest (100µs) integration period. This is the safest choice, but the one that consistently shows the

highest total modulation reading for any given signal. Offered an open-ended selection, most broadcasters will opt for longer integration, even as much as 10ms! We feel that this long an integration period equates to “fooling no one but yourself.” The longest (1.0ms) integration afforded by the Model 531N can probably be considered safe under typical station operation, although the user is cautioned to compare his modulation with that of his companions in the market to avoid sticking out like the proverbial sore thumb.

Changing Integration Time

With the uncovered 531N facing you, locate the ribbon cable that connects the main board with the front panel assembly. Just behind this cable, below IC17, you'll find a 4-position jumper strip labeled JP2. The jumper shunt can be pulled off and replaced in any of 4 positions, each position identified in the PC board legend. Figure 8 at the top of the following page shows proper shunt placement for each integration selection.

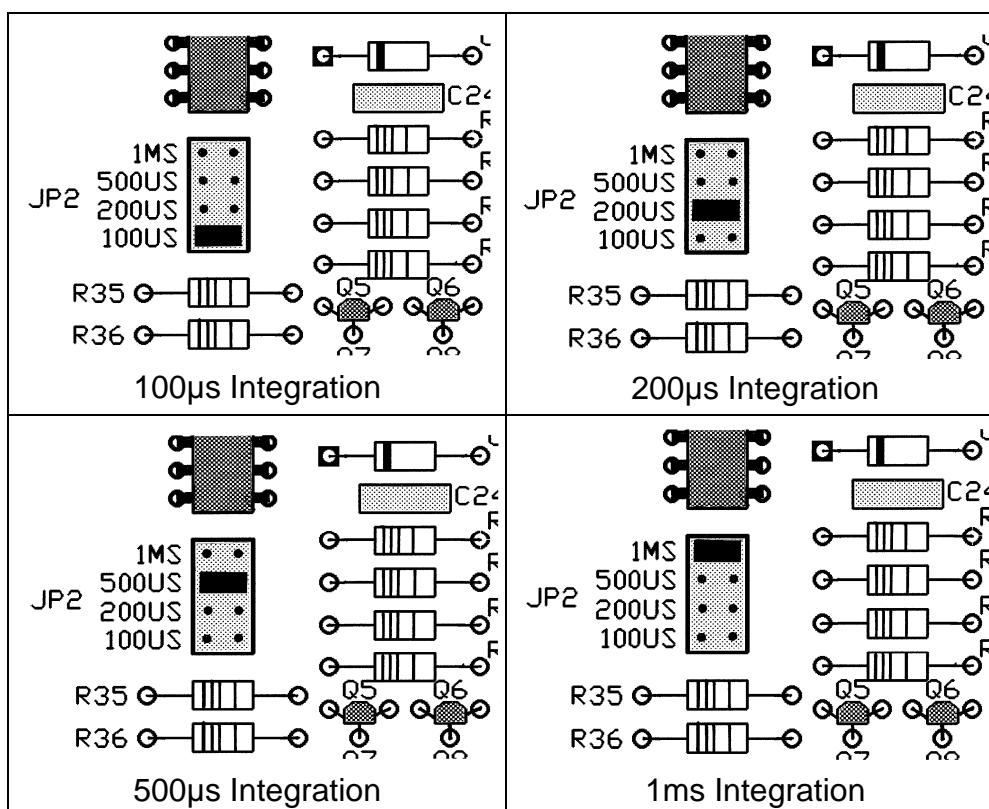


Figure 8 – Integration Period Jumpering

A WORD ABOUT LOUDNESS

Radio “loudness wars” began in the US in the mid-1960s. This is about the same time that radio programming began to be defined by “format,” with the broadcaster competing for advertising dollars with a growing number of stations in his same market, many of which were playing the very same songs. Rather than courting listeners with programming variety or amiable air

personalities, station owners and Program Directors grasped at technical gimmicks to attract listeners.

At some point, “perceived loudness” emerged as a buzzword and a benchmark for broadcasting success. As if, “...who cares about programming, play it louder and it’ll grab the listeners. If the ratings slip, it’s the Chief Engineer’s fault!” Despite the obvious idiocy of this line of reasoning, the availability of more complex and more expensive audio processing equipment is a testament to its belief, and to the paranoia and shortsightedness of station ownership and management.

Aggressive audio processing and the accurate measurement of resulting carrier deviation are interwoven in broadcasting today. But the high degree of *technical capability* that we now have at our disposal should never be confused with *technical excellence*. Innovative, refreshing *programming* and long-term *listenability* will continue to be the keys to any station’s enduring success.

Section III

BASIC SETUP AND OPERATION

FRONT-PANEL VS. WEB INTERFACE SETUP

Instructions in this Section cover initial setup of the 531N using the front-panel buttons and LED readouts.

Anything that can be done from the front panel of the 531N may also be accomplished using the Web interface. Moreover, many additional features and measurement options are afforded by networking the 531N. But as tempted as the user may be put the 531N on his network right away, we stress the importance of first becoming familiar with the unit ‘manually,’ and then proceed with the more comprehensive remote control capabilities. In a good many installations, the 531N can, and will be, used without a network connection, as indeed it has been over the years of its manufacture prior to a networking utility being added.

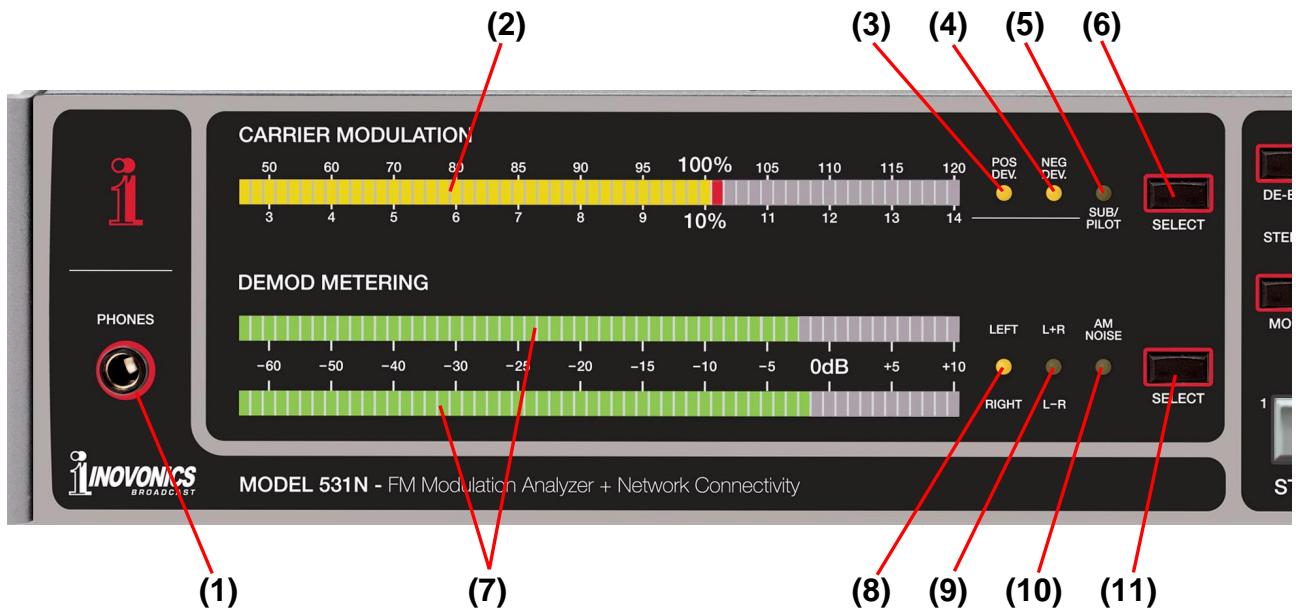
We thus recommend starting with front-panel setup, as this method not only gives the immediate gratification of a hands-on experience, but is necessary for initiating network connectivity in the first place.

PANEL CONTROLS AND INDICATORS

The following overview of the Model 531N front panel is keyed to the coded front-panel photographs that appear on the next couple of pages, with an even more detailed ‘guided tutorial’ following this initial introduction. To the conscientious reader, much of the information presented in this section may seem redundant, appearing both in the overview and in the tutorial. We have anticipated that an impatient user might miss valuable tips in either one part or the other, and thus apologize in advance for explanations that may seem unnecessary, redundant or belittling of the reader’s common sense.

The 531N front panel is split into two sections for discussion.

THE READOUT SECTION (LEFT SIDE)



(1) PHONES

Headphones monitor the stereo program audio when DEMOD METERING (7) is switched to LEFT / RIGHT (8) or L+R / L-R (9). Alternatively, when the 531N is switched to show AM NOISE (10) the headphones then monitor the incidental synchronous AM noise component of the FM carrier.

Headphone volume is fixed, but should prove adequate with most low- or medium-impedance headphones.

(2) CARRIER (3) MODULATION

The upper bargraph (2) defaults to a display of total carrier modulation. It is calibrated in percent, with 100% corresponding to $\pm 75\text{kHz}$ carrier deviation. This display is quasi-peak-responding, and it updates and holds the highest peak momentarily as a single glowing segment above the dynamic display.

When both the POS DEV (3) and NEG DEV (4) indicators are lighted, the highest deviation in either polarity is displayed. This is the default measurement mode. By cycling the SELECT button (6), the display may be switched to read positive or negative carrier deviations independently.

The SELECT button (6) also switches the readout to display injection level of the 19kHz stereo pilot. The SUB/PILOT indicator (5) lights, and injection references the scale below the bargraph meter, which is calibrated in appropriately smaller percentages of total carrier deviation.

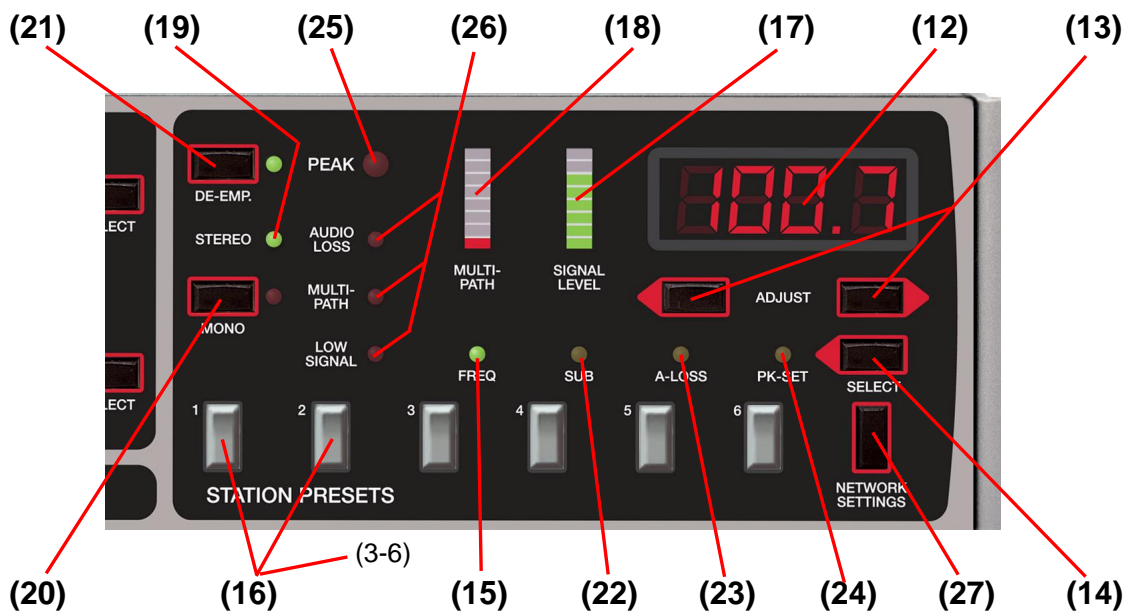
- (7)
 - (8)
 - (9)
 - (10)
 - (11)
- DEMOMETERING

The SELECT button (11) associated with DEMOD METERING cycles the two lower bargraph displays (7) among their various readout options, each identified with an associated LED indicator (8), (9), (10).

The default selection displays left- and right-channel program audio (8). Alternatively, stereo sum-and-difference (9) may be metered. All program audio measurements are quasi-peak-responding above an indicated level of -30dB, and average-responding below the -30dB point.

When the SELECT button (11) is cycled to measure AM NOISE (10), a *relative* reading of AM carrier noise is displayed on the upper of the bargraph readout pair, and the lower readout is blanked. Although a meter reading of 0dB does correspond to 100% carrier amplitude modulation, meter scaling is not the annotated linear-dB function below this point, and the measurement should be considered a relative (more/less) one. When AM NOISE (10) is selected, the incidental AM component is heard in the headphones.

THE RECEIVER SECTION (RIGHT SIDE)



- (12)
 - (13)
 - (14)
- DIGITAL READOUT

The SELECT button (14) cycles the digital LED readout (12) among its several display functions, and the two up/down ADJUST buttons (13) change appropriate parameters. What actually is shown on the four-digit readout depends on what measurement function is active. Stay tuned, this will all

		be made clear.
(15)	FREQ	The default mode for this display gives the frequency of the monitored off-air signal. FREQ indicator (15) lights when the incoming carrier frequency is displayed, and the receiver may then be tuned up or down with the two ADJUST buttons (13).
(16)	STATION PRESETS 1 – 6	Memory buttons (16) allow as many as six stations to be programmed into non-volatile memory for instant recall. Once the 531N has been tuned to a desired frequency with the up/down ADJUST buttons (13), simply press and <i>hold down</i> one of the six memory buttons (16). After a couple of seconds the digital readout (12) will ‘wink’ to show that the frequency has been entered into that memory slot. Thereafter, simply give the button a normal, momentary push to recall the programmed station.
(17)	SIGNAL LEVEL	As foretold under the Specifications, and in additional detail on Page 25, the 531N requires a strong, noise-free signal to ensure an accurate off-air measurement of total carrier modulation. The SIGNAL LEVEL bargraph (17) gives a <i>relative</i> indication of incoming RF signal strength. Generally, three or more display segments must be lighted for valid modulation readings. The LOW SIGNAL alarm (26) will light when the RF level is too low. NOTE: If <i>all</i> SIGNAL LEVEL readout (17) segments (<i>including the top-most</i>) are lighted, the receiver should be considered <i>overloaded</i> for purposes of AM noise measurement (only). Total modulation readings will remain valid, however.
(18)	MULTIPATH	As detailed on Page 26, multipath distortion effects will invalidate off-air modulation measurements. The 531N incorporates a sophisticated, ‘real-world’ multipath detector to qualify the incoming signal in this regard, and the MULTIPATH bargraph (18) displays multipath severity. Generally, two or more lighted segments will indicate excessive multipath and activate the appropriate alarm (26).
(19) (20)	STEREO & FORCED MONO	The stereo decoder section of the Model 531N is active both for off-air readings and for composite baseband signals applied to the rear-panel MPX IN connector. When the 19kHz stereo pilot is recognized, the green STEREO indicator (19) will light. The MONO button (20) can be used to turn the stereo decoder off. The red LED next to the button will indicate a “forced-mono” mode.

- | | | |
|------|------------------------|---|
| (21) | DE-EMPHASIS | <p>The DE-EMP button (21) turns program audio de-emphasis on and off. ‘On’ is indicated by the green LED next to the button. De-emphasis is generally left on, but it may be defeated for stereo separation and other measurements using test tones. De-emphasis applies to the metered values (7) as well as to the program audio available at the PHONES jack and at the rear-panel PROGRAM LINE OUTPUT connectors.</p> <p>Program de-emphasis may be jumpered for 75µs or 50µs as described on Page 16.</p> |
| (22) | SUBCARRIER MEASUREMENT | <p>The SELECT button (14) also enables subcarrier injection level measurements. When the SUB indicator (22) is lighted, the digital display (12) shows the subcarrier frequency, which can be tuned with the up/down ADJUST buttons (13). Subcarrier frequency choices are 57kHz (RDS/RBDS), 67kHz and 92kHz (SCA). 38kHz (residual stereo subcarrier) may be measured as well, though this measurement is meaningless in the presence of program audio.</p> <p>Subcarrier injection shows up on the CARRIER MODULATION display (2). The SUB/PILOT indicator (5) lights and percent-injection may be read against the scale markings below the bargraph.</p> <p>Subcarrier levels may also be read with acceptable precision using the FFT baseband spectrum display available through the Web interface. This is discussed on Page 45.</p> |
| (23) | AUDIO LOSS | <p>Loss of program audio gives a front panel indication (26) and a rear-panel AUDIO LOSS tally. When SELECT button (14) is cycled to light the A-LOSS indicator (23), the digital readout (12) displays a delay, in seconds, between program audio loss and the alarm condition. The two up/down ADJUST buttons (13) allow you to program the delay between 1 and 120 seconds.</p> |
| (25) | PEAK FLASHER | <p>With SELECT button (14) cycled to light the PK-SET indicator (24), the digital readout (12) displays the PEAK (flasher) (25) threshold in percent-modulation. Up/down ADJUST buttons (13) allow you to set this value between 95% and 120% in one percent increments. This setting applies to the trip level of the front-panel indicator (25), the rear-panel PEAK FLASHER alarm tally, and the SMS/text and email alarm notification utility available using the Web interface.</p> |

(26)	ALARM INDICATORS	These LED alarm condition indicators (26) are duplicated with corresponding ‘tally’ closures to ground on the Model 531N rear panel, as well as with SNMP support through the Web interface, which is covered in Section IV. See Page 16 for a discussion of connecting remote indicators; an example is shown in Figure 6 on that page.
(27)	NETWORK SETTINGS	The NETWORK SETTINGS button (27) allows setup of the various network parameters to secure communication between the 531N and a Local Area Network (LAN) or Internet. Setting up a network connection is detailed in Section IV.

MEASUREMENT PITFALLS AND LIMITATIONS

It is important for the user to recognize various inherent limitations of making transmission performance measurements ‘off-air.’ Although the Model 531N has a high level, ‘direct’ RF input, the signal still passes through tuned RF and IF stages. Thus even these directly-coupled measurements are subject to some of the same limitations as an off-air signal.

Signal Strength The term “FM Advantage” refers to the inherent freedom from noise that a frequency-modulated signal enjoys over its amplitude-modulated counterpart. Nevertheless, random noise does result in a certain amount of ‘dither’ at carrier zero-crossings, which translate to jitter in the time domain that can sabotage accurate measurement of total carrier deviation.

The basis for FM receiver sensitivity specifications dates to the early days of monaural FM broadcasting. Tuners from this era boasted sensitivities in the low-microvolt range. Honest and forthright manufacturers would qualify this specification with: “signal required for 50dB of quieting,” which referred to a *monaural* transmissions. This isn’t a particularly difficult spec to meet in mono receivers, which can both tolerate and profit from a much narrower IF bandwidth than what is required for decent stereo performance.

Stereo reception adds all the noise present in the 23kHz–53kHz ‘sub’ band that rides above the 30Hz–15kHz monaural reception range. What’s worse, it’s the amplitude component (AM) of the sub band that is converted down to audible noise and added to the program signal. That’s why the noise performance of FM-stereo is always about 20dB worse than that of a monaural broadcast.

Reverting to the specification from days gone by, the Model 531N exhibits 50dB of mono quieting with only 10μV coming in, actually pretty decent considering the “broad as a barn” RF/IF passband that’s required for stereo signal parameter

monitoring. For the *valid* measurement of total modulation, over the entire baseband signal range (10Hz–100kHz), the 531N requires 150 μ V (55dBf) for a total-mod reading that's no more than 2% in error, and 250 μ V (60dBf) for less than a 1% error.

The front-panel SIGNAL LEVEL bargraph is a *relative* display and should not be considered linear, either in terms of field strength or transmission power. Generally, at least three or four segments must be lighted for valid total-mod readings. The LOW SIGNAL alarm comes on when a total-mod reading would be compromised by more than 1%.

**Multipath
Distortion**

Multipath effects arise from the reception of a radio signal from more than one direction (multiple paths). The primary path is generally 'direct' (line-of-sight), and subsequent arrivals of the same signal come along after it has bounced off buildings or natural terrain. This multiplicity of arrival times compromises certain parameters of the otherwise robust FM transmission. Long before its effects can be heard, multipath can invalidate total-mod measurements.

The Model 531N incorporates a multipath distortion detector and bargraph readout. Used together, the MULTIPATH and SIGNAL LEVEL displays can be an aid in aiming the receiving antenna for best reception. A multipath alarm comes on when more than a couple of the MULTIPATH bargraph segments are lighted. The associated alarm is preset to the maximum value of multipath distortion that can be tolerated for an accurate total-mod reading.

**Composite
Clipping**

A small amount of well-regulated "hard clipping" of the composite waveform is a common technique with broadcasters to secure maximum modulation efficiency and, as a result, the highest 'perceived loudness.' Modern composite clipping circuits perform their action prior to injection of the stereo pilot, or they may 'detour' the pilot signal around the clipper to prevent its being clipped along with the program signal. This does not mean, however, that composite clipping does not generate harmonics at 19kHz. These can add to and subtract from the legitimate pilot tone, essentially manifesting as 'pilot modulation.'

Because the Model 531N translates a measurement of pilot amplitude modulation to an equivalent degree of multipath distortion, excessive composite clipping may show up on the MULTIPATH display, even when no secondary signal path is present. This could be the case in a direct, high-level RF connection as well. This does not mean that a multipath alarm should be ignored when no possibility of multipath exists. If excessive composite clipping does indeed cause a multipath indication, chances are that occupied bandwidth limits are being exceeded despite proper constraints on peak deviation.

Adjacent Carriers The inherent (and necessary) wide bandwidth of the Model 531N makes it vulnerable to interference from stations that are first-, and even second-adjacent to the frequency being monitored. Of course signal strength will be a factor in this equation; the stronger the interfering carrier, the greater the interference effect.

One technique to identify adjacent-channel interference is to observe independent negative and positive deviation readings. Unless an FM transmission has audio processing problems or gross exciter non-linearity, program deviation should be fairly symmetrical about the carrier frequency.

Using the SELECT button associated with the CARRIER MODULATION display, compare the POS DEV and NEG DEV readings. If POS DEV measures considerably *higher* than NEG DEV, interference from a strong station *above* the monitored frequency would be suspect... and vice-versa. In this example, the NEG DEV measurement can *probably* be trusted as an indication of total carrier modulation, although this should be confirmed with an interference-free 'nearfield' or direct-connection reading of the transmitter. In any event, steps should be taken to eliminate the interference. A more directional antenna may solve the problem, or a band-pass filter may be required at the primary frequency, or a trap at the interfering frequency.

A GUIDED TOUR OF 531N OPERATION

The short "hands-on" tutorial that follows walks you through setup and typical operation of the Model 531N, using the front-panel controls and readouts. The additional features available using the Web interface are discussed separately in Section IV. This quick and informal guided tour will give you a better understanding of procedures and pitfalls, proving quite useful in day-to-day use of the unit.

Numbers shown in the following text refer back to the keyed photos of the Model 531N front panel on Pages 21 and 22.

Items Required You'll need a pair of good stereo headphones and a connection to an outside antenna. (If the transmitter is close by, a 3-foot length of insulated hookup wire ought to suffice for this 'guided tour'.)

Getting Ready Attach the power cord to the Model 531N and plug the free end into the wall socket. Plug the headphones into the front-panel PHONES jack (1). If you have no connection to an outside antenna, twist a stripped end of the 3-foot wire and carefully insert it into the very center of the rear-panel ANTENNA connector. To ensure the continued integrity of this connector, do not force the wire into it; rather, find a wire that fits securely without distorting the connector.

Check to make sure that the rear-panel RF SOURCE SELECT switch is in the ANT (antenna) position, and that the MOD-MONITOR INPUT switch is set to AIR (off-air operation).

Tuning In Find a strong, local station. Use the up/down ADJUST buttons **(13)** to tune the 531N to a good signal at your location. If you cannot pick up your own signal easily, choose a station that does come in well.

You may wish to set some of the station presets **(16)** to your own and other local signals. Enter your first choice into memory #1 by holding down the #1 memory button. In a couple of seconds the frequency readout **(12)** will ‘wink,’ signaling that the choice is entered.

Re-tune the 531N to other stations and enter each into additional memory positions in the same manner. Once frequencies are entered, give any button a momentary push to bring up the stored frequency.

Signal Quality Evaluation Even with a 3-foot wire antenna, a strong local station should light at least half the segments of the SIGNAL LEVEL display **(17)**. Be sure that the station you select has low multipath distortion as well; no more than a couple of the segments in the MULTIPATH bargraph **(18)** should be lighted. Try repositioning the 3-foot wire to minimize multipath pickup. Neither the LOW SIGNAL nor the MULTIPATH alarm indicators **(26)** should light. If either alarm condition is indicated, choose another station or connect a roof-mounted antenna.

When the 531N is in actual Mod-Monitor service, the two signal-quality warning indicators **(26)** *must be off* if measurements are to be trusted. This usually calls for a rooftop antenna with a rotator for meaningful comparative measurements of other stations in your market.

Carrier Modulation Display Neglecting the effects of a low signal or multipath distortion condition, the CARRIER MODULATION display **(2)** shows peak deviation as a percentage, with 100% equivalent to $\pm 75\text{kHz}$ carrier deviation.

The default measurement mode for total modulation looks for carrier deviations in both directions and gives the higher of the positive or negative deviation peaks. The 531N is in the default mode when *both* the POS DEV **(3)** and NEG DEV **(4)** indicators are lighted. As previously discussed under MEASUREMENT PITFALLS AND LIMITATIONS on Page 25, the SELECT button **(6)** lets you monitor positive and negative deviation independently. Refer back to that discussion for how and when to use this feature.

Unless there is a reason for doing otherwise, the CARRIER MODULATION display **(2)** should be kept in the default mode (LEDs **(3)** and **(4)** both on) for the most exact confirmation of the station’s maximum carrier deviation.

Also, refer back to TOTAL-MOD DISPLAY INTEGRATION SELECTION on Page 17 for the discussion of jumper options that will effect this reading.

Peak Flasher

The 531N includes the usual 'Peak Flasher,' an alarm for carrier deviations beyond an acceptable maximum value. There is a front-panel PEAK indicator **(25)**, a rear-panel closure to ground for a remote flasher or other alarm, and SMS/text and email notifications through the Web interface.

The peak flasher follows the total modulation measurement, which, by default, is the composite of positive and negative carrier deviations. This does mean that if the display has been switched to monitor only positive or only negative excursions, the peak flasher will respond accordingly.

Cycle SELECT button **(14)** to light the PK-SET indicator **(24)**. The digital readout **(12)** now shows the flasher trip level directly in modulation percentage. Using the up/down ADJUST buttons **(13)** set this trip point at any value between 95% and 120%.

The flasher may be programmed for a modulation level that will give frequent indications of modulation peaks. For instance, if the audio processor has been set for a maximum deviation of 100%, the flasher can be set at 99% to show that modulation is consistently meeting a deviation goal. Using this feature as the intended alarm, on the other hand, requires that the trip level be set somewhat above the maximum modulation point. Again, if the processor is set to hold peaks at precisely 100%, an alarm value of 102% might be selected. This would represent a value that should never be attained in normal operation, one that would indicate a legitimate fault.

Pilot Injection

SELECT button **(6)** also cycles the CARRIER MODULATION display **(2)** to read the injection level of the 19kHz stereo pilot. When the SUB/PILOT indicator **(5)** lights, pilot injection is read off the lower metering scale. Stereo pilot is typically set to 9% injection.

Subcarrier Measurements

The CARRIER MODULATION readout **(2)** is also used to display the injection levels of analog and digital subcarriers. This measurement mode is accessed with SELECT button **(14)**, over on the right side of the 531N.

The 531N does not *demodulate* data or analog subcarriers, but it does give a peak-based indication of the *injection level* with good accuracy.

Cycle the SELECT button **(14)** to light the SUB indicator **(22)**. The digital readout **(12)** now indicates the frequency, in kHz, of the subcarrier being measured. The default frequency is the 57kHz RDS/RBDS RadioData subcarrier.

Use the ADJUST buttons **(13)** to bring up analog SCA subcarriers at 67kHz and 92kHz, as well as the 'residual' of the 38kHz suppressed stereo subcarrier (see next page).

RDS/RBDS and SCA injections are read on the CARRIER MODULATION display **(2)** using the scale below the readout.. Typically, RDS/RBDS will be in the 4% to 5% range, and SCAs up around 10%.

**38kHz
“Residual”**

Stereo-FM broadcasting encodes the L-R ‘stereo-difference’ information as a double-sideband, suppressed-carrier signal that is added to the L+R (mono) program. Historically, this DSB subcarrier was generated with analog multiplier circuits, and these had to be carefully balanced to null (suppress) the 38kHz carrier frequency completely. Although modern FM stereo generators employ digital techniques to generate the entire composite baseband signal, regulating agencies may nonetheless still specify a maximum level for the 38kHz residual component in the absence of audio modulation.

For measuring the 19kHz stereo pilot and analog or digital subcarriers, a narrow filter is used to extract the targeted signal from the composite baseband. The pilot and subcarriers are protected by guardbands, or a dead space above and below. Sidebands of the 38kHz stereo subchannel, on the other hand, can, in theory, extend right down to the subcarrier frequency. Thus program modulation *must be turned off* to get a meaningful measurement of any residual 38kHz component. What shows on the display when program information is present is low-frequency stereo-difference information.

Demod Metering

The default mode for DEMOD METERING **(7)** displays left- and right-channel program material with the LEFT / RIGHT indicator **(8)** lighted.

Use the SELECT button (11) to cycle the DEMOD METERING display **(7)** to show stereo sum and difference. The L+R / L-R indicator **(9)** will light, but headphones continue to monitor the L/R stereo program.

Unless something is terribly wrong (like one channel missing entirely), the L+R sum will always have more energy than the L-R difference. In the real world this energy rule applies to nearly all recorded music. Two notable exceptions are: 1) pop music that has been processed with ‘spatial enhancement’ devices that augment the stereo difference information, and: 2) classical music that has been recorded as ‘true binaural’ using only two microphones. (Nearly all popular music is initially recorded as a number of monaural tracks, and then manipulated to create an artificial ‘stereo soundstage’ during the mix-down process.)

In some instances the L+R and L-R meters may be close in value, but the L-R meter should generally lag the L+R meter by at least a few dB. For voice announcements without background music, or for other mono sources, the L-R indication may drop almost off-scale.

**Forced-Mono
Reception**

Press the MONO button **(20)**, which will light the adjacent red LED indicator. With ‘forced mono’ engaged, the stereo decoder is disabled and the station is received monaurally with left and right program channels equally combined.

You should notice a couple of things in the MONO mode: 1) a big difference in the sound, especially when monitored with headphones. The stereo image will collapse and much of the detail may be missing from the music. It may even sound as if some of the top-end has disappeared. Also: 2) the L+R meter will jump up a bit in mono, but the L-R meter will drop almost off-scale. Actually, a perfect monaural signal should have no L-R component, but circuit and component tolerances within the Model 531N make something in the -50dB range about the best L-R cancellation. Keep this in mind because this represents the best sub/main, main/sub crosstalk reading obtainable from the 531N, even though actual system crosstalk may be lower. See Figure 4 on Page # for typical crosstalk measurement performance limits.

**Program
De-emphasis**

While listening to off-air program audio, press the DE-EMP button **(21)**. The green LED indicator next to the button will turn off and program audio will sound considerably brighter, even to the point of shrillness. Pressing the button again will turn de-emphasis back on. As you cycle program de-emphasis on and off, you may notice that, although the audio sounds quite different, the left- and right-channel program audio displays 8 do not change much, if at all. Despite a very audible difference, there is very little musical *energy* at the high frequencies. It’s the subtle overtones that are boosted out of proportion without proper de-emphasis.

Unless you are doing system crosstalk or other proof-of-performance tests that require ‘flat’ program audio, the DE-EMP button **(21)** should be left in the default ‘on’ position with the green LED lighted. After listening for a short time with de-emphasis turned off, a return to the proper tonal balance will sound somewhat dull. This notion will pass after listening properly again for a short while.

**AM Noise
Measurement**

While monitoring the local signal source, press SELECT button **(11)** until the AM NOISE indicator **(10)** lights. What you now hear in the headphones should bear only a vague similarity to the program audio signal monitored in the LEFT / RIGHT or L+R / L-R measurements modes. What you are listening to is the amplitude-modulation component of the FM carrier.

A perfect FM carrier would have no ‘incidental’ or ‘synchronous’ AM component. What’s more, this parameter of the FM carrier is difficult to measure off-air, as the receiver must have a broad, flat bandwidth characteristic and a linear IF amplifier. Without these qualities the receiver can introduce its own AM component to the incoming signal.

The Model 531N is not a perfect receiver in this regard, but it does yield useful *comparative* readings. When switched to read AM noise, the upper DEMOD METERING bargraph **(7)** gives a *relative* indication of the demodulated AM component. This metered value does *not* have linear-dB scaling. What is *heard* in the headphones (or via the rear-panel AM NOISE output connector) will have the greatest significance in exposing incidental AM noise in the FM carrier.

It is important to have a strong signal for AM noise measurements. As you listen off-air and tune among local stations, the amount of ‘non-synchronous’ background noise (noise *not* associated with the transmitted program) will vary quite a lot. What you want to listen for *is* the program-related noise, which should have only odd-order harmonic content. The 531N can be used as a tool in tuning transmitter stages for minimum program-related ‘garbage’; just remember that what you hear through the headphones or with an audio monitor is more important than what is displayed on the meter.

Though the 531N can prove an effective tool in monitoring and minimizing AM noise, an off-air measurement should not be considered a substitute for a dedicated broadband AM-noise measuring set connected directly to the FM transmitter. We acknowledge the *Radio Design Labs ACM-3* as the definitive such device and recommend it as an excellent aid in transmitter stage tuning.

Audio Loss Alarm

It is important to realize that in FM broadcasting an AUDIO LOSS alarm is meaningless in the absence of an RF carrier. It is the nature of FM receivers to put out a ‘white noise’ (hiss) level that can exceed normal program peak values when no carrier is received. The 531N indicates AUDIO LOSS for a ‘dead air’ or missing channel situation, but will not give an alarm when no station at all is tuned in. In the case of carrier failure, a LOW SIGNAL alarm would be dispatched.

An AUDIO LOSS alarm is triggered when the peak level of either program channel falls below -10dB on the DEMOD METERING meters **(7)** for an interval of time programmed as described below. The AUDIO LOSS alarm lights the panel indicator **(26)**, provides a rear-panel closure to ground for remote indication, and dispatches SMS/text or email notifications through the Web interface.

Cycle the SELECT button **(14)** to light the A-LOSS indicator **(23)**. The digital readout **(12)** now shows the delay interval, in seconds, between audio loss and the alarm. This delay can be programmed with the ADJUST buttons **(13)** from 1 second to 120 seconds (2 minutes).

Section IV

NETWORK SETUP

CONNECTING WITH THE 531N

Up to this point we've used front-panel buttons and readouts to get the 531N up and running. Most basic mod-monitor function may be accessed in this manner, but the Web interface opens up a host of additional measurement features.

Connect the 531N

Our first order of business is to get the 531N communicating with your network. Connect the RJ45 NETWORK PORT jack on the back of the 531N to a LAN port of your server or router.

DHCP

Press the NETWORK SETTINGS button **(27)** once. The digital LED frequency readout will switch from display of your frequency, such as **95.9**, to **dHCP**. Press the NETWORK SETTINGS button once again and the display will probably show the default DHCP assignment: **00**.

At this point you may use the ADJUST buttons **(13)** to toggle DHCP between **00** and **0FF**. Unless you need to assign the 531N a fixed IP address, you'll want to leave the DHCP selection **00** so that your router or server will automatically assign connection addresses to the 531N. Press the NETWORK SETTINGS button once again to return to a readout display of **dHCP**.

The IP Address

With **dHCP** showing on the readout, press the right-hand ADJUST button to bring **IP** onto the display. Press NETWORK SETTINGS once, and the first address group of the current IP will appear, very probably the digits **192**. If the IP address is to be assigned manually, DHCP would have been set to **0FF**, and you would now be able to use the ADJUST buttons to set this first group of three digits to any value between 0 and 255. With DHCP **00**, however, this function is locked out.

With the first group of digits noted, pressing NETWORK SETTINGS once again will bring up the next three digits in the address, perhaps **.168**. With DHCP set to **0FF**, this group of three digits may be changed as described for the first group, and similarly for the third and fourth groups.

Press the NETWORK SETTINGS button until **IP** returns to the readout.

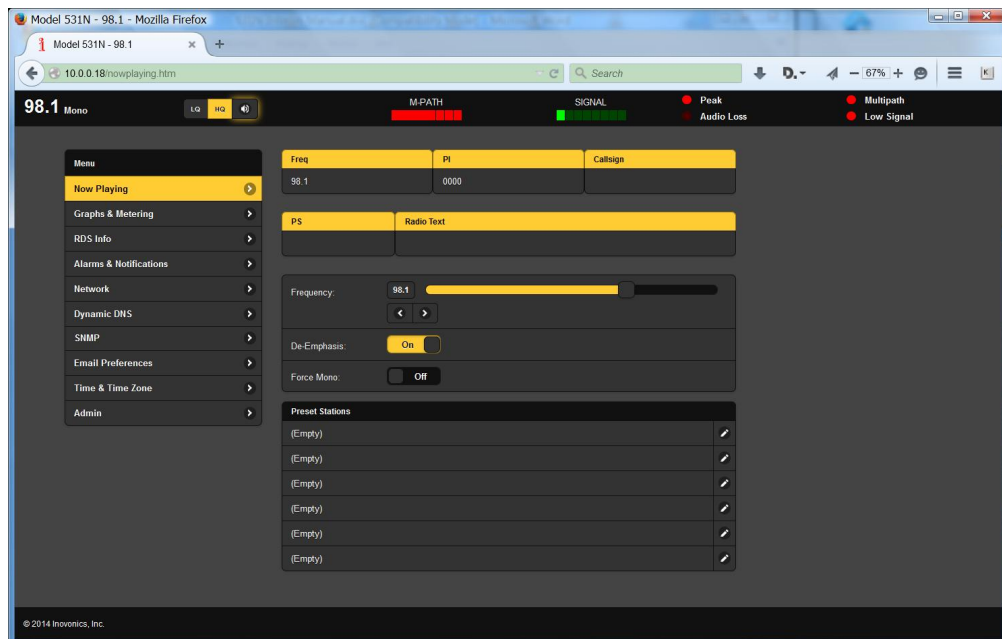
Gateway, Subnet Mask and Primary DNS

Now, with **IP** showing on the readout, press the right-hand ADJUST button to take you into the **GATE** (gateway) setup area. This area will be locked-out under DHCP control, but with DHCP **0FF**, you may program the gateway address in exactly the same manner as described for **IP**.

The same goes for `Sub` (subnet mask) and `Dns` (primary DNS). These are either assigned by DHCP or may be programmed manually with static addresses using the technique described.

HOOKING-UP

With both the 531N and a computer connected to a common network, bring up a browser window and enter the Hostname (under Windows) or the IP address of the 531N (any OS). The Windows OS permits typing the default Hostname into the browser, which must be done exactly like this: `MODEL531N/` In short order you should see the main Now Playing Webpage on your screen as shown here:



A header at the top of the page and a Menu list on the left are common to all 531N Web pages. The header displays the tuned frequency, alarm status indicators, signal quality readouts and the remote listening utility.

COMPLETING THE NETWORK SETUP

Before we get to the interesting, everyday-useful aspects of the 531N Web interface, let's first finish-up with the remaining networking setup items. These are quite simple under Web interface control.

The Network Page

Click on `Network` in the Menu section of the default, Now Playing screen. This will change the Web page with the active window shown at the top of the next page.

Mode:	DHCP Static IP
Hostname:	MODEL531N
HTTP Port:	80
IP Address:	10.0.0.17
Gateway:	10.0.0.1
Subnet Mask:	255.255.255.0
Primary DNS:	10.0.0.1
MAC Address:	D8:80:39:12:A1:B3
Save	

Here is the network setup information that we entered (or confirmed) in such a painstaking manner with front-panel buttons. Because DHCP is selected, most of the values below are grayed-out. If operation were toggled to Static IP, however, all these values, with the exception of the MAC Address, could be entered or overwritten very easily right here on the screen. The MAC Address is unique to the particular hardware of your 531N and cannot be changed.

You are free to change the Hostname from the factory assignment to whatever you wish. The Hostname allows the user to assign a unique ID to the equipment. Once you are on the same network, this is what you enter into a Windows browser address bar to connect a Windows computer, tablet or mobile device to the 531N.

The HTTP Port has a default value of 80. This is a common assignment, but one reason it might need to change is if you have more than one 531N on your network. Your IT department will know all about this and how to do it.

ACCESSING THE 531N REMOTELY

On a common local network (LAN), we already have accessed the 531N Web interface by entering its IP address or, under Windows, its Hostname into your browser's address bar.

To address the 531N from outside your LAN (from the Internet), the unit needs to have a static IP address. If your router makes DHCP assignments for other equipment on the network, simply assign the 531N 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 (let your IT department help here).

You also need to open a specific port for the 531N 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 default port number for the 531N is 80, but as we pointed out earlier it may be changed to any reasonable 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 531N from anywhere. Just type the IP address and port number into your browser as shown in this example:

`http://55.76.38.170:2345`

But if your ISP issues you a *dynamic* IP, which is most often the case, this mandates 'Dynamic DNS' operation, using the services of an IP-forwarding provider.

Dynamic DNS

It would not be possible to address equipment behind a dynamic IP address if it were not for IP-forwarding providers available on the Internet. Their services, which are either free or at a very modest cost, will allow the 531N to keep the provider apprised of its reassigned IP address each time that address is updated by the ISP. The IP-forwarding provider intercepts data attempting to connect with the 531N and converts the IP address to the updated one.

There are three popular forwarding service providers available on the Internet. Their basic service (all you really need) may be free of charge, but advanced features may command a nominal annual fee. All services require registration on the appropriate Website.

Click Dynamic DNS on the 531N Menu. This will bring up the appropriate Web page, shown at the top of the next page.

Dynamic DNS is disabled.

Mode: Disabled

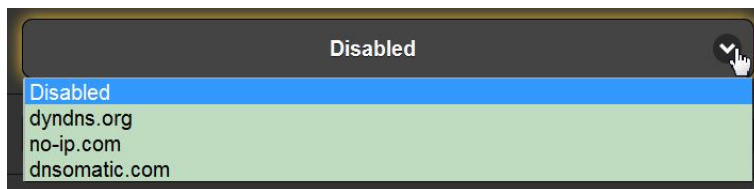
Hostname:

Username:

Password:

Save

The dynamic DNS function is shown as Disabled, but if you click on the arrow on the right you'll see the list of the three popular providers.



Jot down these provider names and enter each in your Web browser to learn more about their services, and to register with whichever provider seems best to meet your needs.

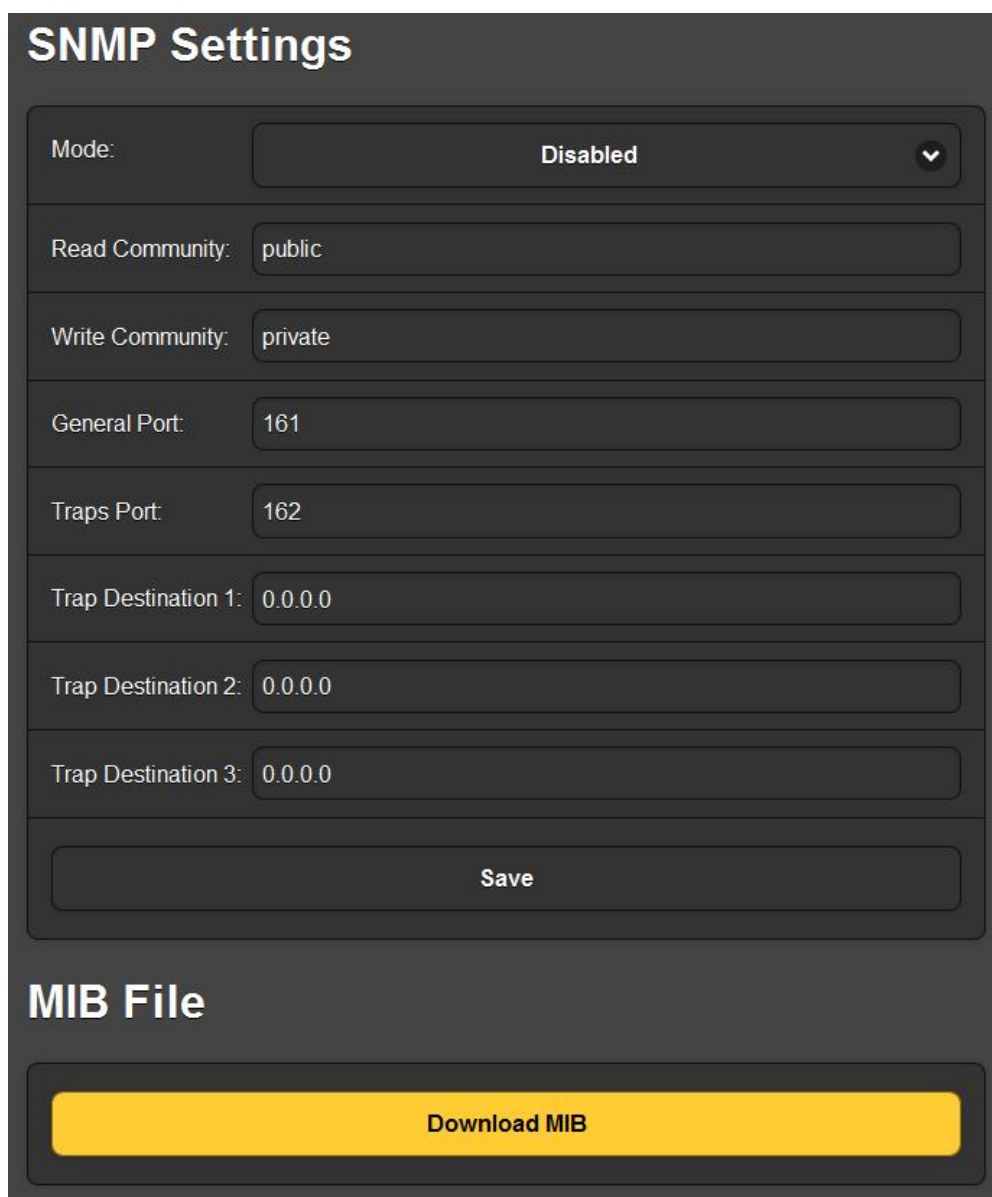
When you register, the provider will issue you a Hostname, Username and Password. Click on the provider you choose, and then type the information right onto the screen and click Save. This will allow you to access your 531N with a dynamic IP address.

SNMP OPERATION

SNMP Overview SNMP, or Simple Network Management Protocol, allows other TCP/UDP/IP equipment on the same Local Area Network (LAN) to communicate directly with the 531N, and for the 531N, itself, to initiate an alarm on the network.

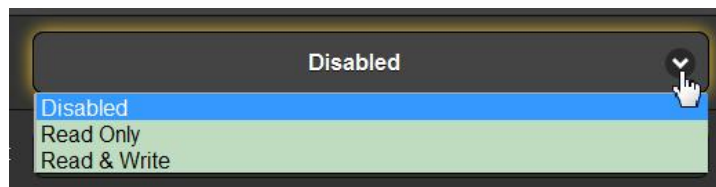
The 531N will interface directly with a network controller, which technically is known as the SNMP 'Manager.' The 531N incorporates an embedded ASCII text file called a Management Information Base, or MIB. In setting up for SNMP operation, the MIB file is downloaded from the 531N and uploaded to the SNMP Manager.

On the 531N Menu tree, click SNMP to bring up this active window.



The image shows the 'SNMP Settings' window. It has a title bar 'SNMP Settings'. Below it, there are several input fields: 'Mode:' with a dropdown menu showing 'Disabled', 'Read Community:' with 'public', 'Write Community:' with 'private', 'General Port:' with '161', 'Traps Port:' with '162', 'Trap Destination 1:' with '0.0.0.0', 'Trap Destination 2:' with '0.0.0.0', and 'Trap Destination 3:' with '0.0.0.0'. At the bottom of this section is a 'Save' button. Below the settings section is a section titled 'MIB File' with a large yellow button labeled 'Download MIB'.

The default mode for SNMP is Disabled, which inhibits communication between the 531N and the SNMP Manager. Click the arrow to the right of Disabled to view operating choices.



Changing the Mode: to Read Only allows the 531N to be interrogated by the SNMP Manager so that 531N settings, meters, RDS data and alarms can be integrated with other equipment on the network.

	Setting Mode: to Read & Write allows the SNMP Manager to send commands to the 531N. This allows other equipment to change station Presets and adjust nearly all setup parameters of the 531N.
SNMP Security	SNMP 'Communities' serve as passwords for this function. Go into the Read Community: and Write Community: boxes to enter text that is specified for the read/write strings on the SNMP Manager monitoring device. As with similar text-entry screens, execute a Save after entering.
SNMP Traps	When the 531N initiates an alarm, rather than being queried or polled for one, the alarm is known as a 'trap.' You may enter three local network IP addresses as Trap Destinations, each corresponding to other devices on the LAN that want to be apprised of alarms.
SNMP Ports	The default SNMP Ports, General Port 161 and Trap Port 162, are customary assignments for the majority of SNMP operations. These may be changed as required by typing-in new values.
Downloading the MIB File	The MIB file is a small text (.txt) file that is read by the network controller, or SNMP Manager. To download and read this file yourself, click: Download MIB. The file may be saved in the usual Windows manner. The MIB file is in plain text and may be read with Windows Notepad.
Further Study	The foregoing discussion of SNMP operation is purposely abbreviated. SNMP is a complex utility, managed exclusively by whatever SNMP Manager (the monitoring equipment) is employed. Refer to published instructions for the SNMP Manager in setting-up the 531N. From the active 531N SNMP browser screen, you can download the MIB file to help unravel mysteries in this regard as well.

EMAIL PREFERENCES

	Set up the 531N for outgoing mail on the Email preferences Web page.
Mail Server Setup	<p>The email server settings and email addresses for the various recipients of email or SMS text messages are entered here on the Email Preferences menu page; in other words, 'who gets it and how.' However, the alarm preferences for email notifications, or 'who gets which alarm message' are set on the Alarms and Notifications menu page. This is described under the discussion of alarms on Page 51.</p> <p>An example at the top of the next page shows typical setup for an SMTP mail server. Mail server settings vary, but essentially you create a separate email account for your 531N. The User: name can be anything you like, and will actually be the formal name of the sender. But with most email clients, when emails from the 531N are received the sender will be identified by the</p>

“friendly” name: Model 531N – 95.9 (or whatever frequency the 531N is tuned to when the message is sent).

SMTP Server:	smtp.office365.com
Port:	465
SSL:	On
User:	ModMonitor@ktn.com
Password:	••••••••
Recipient 1:	4085551212@txt.att.net
Recipient 2:	r.smith@ktn.com
Recipient 3:	

Recipient 1: and Recipient 2: in this example are the SMS/text message and email addresses, respectively, for the station's Chief Engineer.

Saving and Testing

When this utility has been set up, click: **Save** at the bottom of the page to commit this information to memory. You may also click: **Send test Email** to immediately dispatch a confirming test message to all recipients.

TIMEKEEPING

Open the Time & Time Zone Web screen to set up the internal timekeeping function of the 531N. Correct timekeeping is essential for tagging alarm notifications and for meaningful Alarm Log listings.

Select your offset from Universal Coordinated Time (operation on planet Earth is assumed here) using the Time Zone (Hours): slider. When this is set correctly, local time will show at the top of the window. You may make allowance for Daylight Saving Time here too. Choose either the automatic function, DST fulltime, or to disregard DST altogether by leaving both boxes unchecked.

The Time Server defaults to the US Government Web-based time authority, but you may enter an alternative Server: if desired.

Be sure to click: **Save** at the bottom of the window to commit your choices to memory.

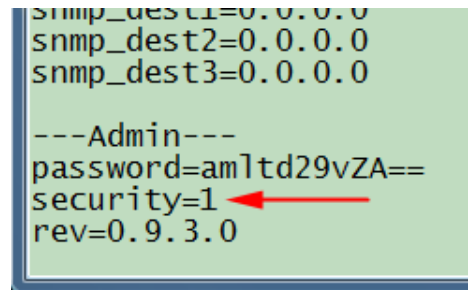
ADMINISTRATIVE SETTINGS

Password The Admin Web screen allows you to set up a password for the 531N. Simply type the password into the Password: field, click: **Enable**, and then click: **Save**. You'll be immediately prompted with a pop-up window asking for a User Name: and Password:. The User Name: is optional and may be left blank; it is not used with any other 531N function at this time. Just enter your new password in the Password: field. This pop-up will greet you each time you launch the 531N Web pages. Again the User Name: is optional.

You'll probably notice that your password remains in plain sight on this page. This is not a security breach, as you can't get to this page without first giving the password in the pop-up window.

Lost Password If you lose or forget your password, you must perform a 'hard reset' on the 531N (see below). This will purge all setup and other information from memory. To obviate this inconvenience, we recommend periodically downloading and saving a Hardware Profile, which retains all the setup data and can be uploaded back to the 531N. This procedure is described in due course.

Of course the old, lost password is part of the Hardware Profile, so you must edit this file before uploading it, otherwise you'll be back to where you started. The snapshot at the right shows the very bottom of the Hardware Profile where the administrative data is held. Note the numeral '1' marked with the arrow. This shows that the password is enabled. Use MS Notepad or another text editor to change the one to a zero. This turns password protection off. Re-save the edited file. You can now do a hard reset of the 531N and then upload the edited Hardware Profile. This will restore your previous settings, and even let you see the old password, which you may use or replace.



```
snmp_dest1=0.0.0.0
snmp_dest2=0.0.0.0
snmp_dest3=0.0.0.0

---Admin---
password=am1td29vZA==
security=1
rev=0.9.3.0
```

Hard Reset A hard reset of the 531N will purge all setup information from memory. Please see the Hardware Profile discussion that follows to save settings and restore them to the 531N.

To perform a hard reset, hold down the far-right **SELECT** button **(14)** while power-cycling the unit. Remember, this restores the 531N to 'factory-fresh' condition; you will lose all setup information.

- The Hardware Profile** The entire 531N setup, which includes the Preset Stations list, receiver setup choices, hardware options, alarm notification preferences and SNMP options, may be saved to your computer as a small text file.
- The Hardware Profile is useful for restoring a previous mod-monitor setup or for ‘cloning’ a second unit for backup service. Click: Download Hardware Profile to save the profile to your system. Depending on your browser and version, the file will normally be saved to a Downloads folder unless you are asked for a specific ‘save to’ location. The file has a default name of 531Nsettings.ini.
- To upload a saved Hardware Profile to your 531N, first click: Browse... to locate the saved profile on your computer, and then click: Upload Hardware Profile. This will replace all setup parameters that are currently loaded and running in your unit.
- Errata** At the bottom of the Admin Web screen, you will find the serial number of your 531N, total ‘up time’ of the unit, and versions of the firmware and Web pages files. Click: Check for Updates to see if new versions are available. Updates to firmware and the interactive Web screens is covered in Section VI, beginning on Page 53.

Section V

531N EXTENDED FEATURES

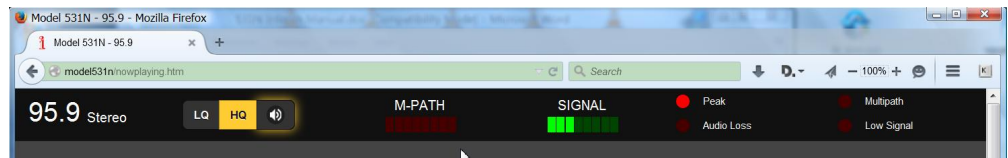
The time-honored Inovonics 531 FM Modulation Analyzer was transformed into the 531N when comprehensive networking capability was added to the product. Not only does this allow remote-control operation, but new features, monitor modes and measurement options are now available.

Basic mod-monitor functions of the 531N were detailed in Section III, beginning on Page 20. The fact that these functions are available remotely with the Web interface does not otherwise change their functionality at all, so they will not be described all over again here, except as differences are noted.

Instead, the new, extended features of the 531N will be detailed. At this point you should be running the Web interface, setup of which was covered in the previous Section.

THE WEB SCREEN HEADER

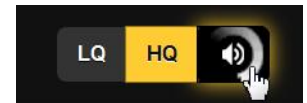
All Web screen pages present the common header shown here:



At the far left is the frequency of the currently-tuned station. Next is the audio streaming utility.

Remote Listening

Click the loudspeaker icon in the header to listen to the station from a remote location.



Two audio quality options are available. LQ has an MP3 data rate of 64kbps, and HQ is 128kbps. With marginal connections, LQ may prove the better choice.

The encodings/decoding and buffering time (latency) of the audio will depend to some degree on the connection path and network quality, but may be several seconds, even on a Local Area Network. This listening utility has been included to confirm the presence of audio, not for performing a critical assessment of off-air audio quality. Keep in mind that the audio will lag metering.

Signal Quality The front-panel MULTIPATH and SIGNAL LEVEL readouts are duplicated in the header as shown here.



Alarms The header also echoes the four front-panel alarms.



NOW PLAYING

Basic Station Information

In addition to the incoming frequency, this section of the Now Playing Web screen also presents the more basic RDS RadioData information: the PI code, or 'digital address' of the station,

Freq	PI	Callsign
88.1	2B6B	KKJZ
PS	Radio Text	
KJazz	KJazz 88.1 - America's Jazz And Blues Station	

PI is a hexadecimal identifier specific to this station, the station's "digital address" as it were. The PI code is derived from the station's callsign in the US and Canada, so these two are related in those countries. Elsewhere Callsign will be blank.

PS, the Program Service Name, is an 8-character field where stations call letters or 'street name' for display on any RDS radio faceplate. The PS field is often 'dynamic' to scroll song artist and title information in this area.

Radio Text is a 64-character field that is displayed by some radios, but not by all. This field is generally used to convey program information, such as artist and title, or may be used for station information (Website, phone, etc.) or even advertising tie-ins.

Other RDS data is displayed in the RDS Info Web screen and will be discussed a bit later.

Receiver Tuning

The balance of this Web screen is used for receiver tuning and the individual tuning presets.

The receiver tuning controls are displayed in a dark-themed interface. At the top, the 'Frequency:' label is followed by a text box containing '88.1' and a horizontal slider bar. Below the frequency controls are two buttons with left and right arrow symbols. The 'De-Emphasis:' section features a yellow 'On' button. The 'Mono:' section features a grey 'Off' button.

The tuned Frequency: is displayed, and several methods of changing it are offered. You may grab the 'slider' and drag it back and forth, you may highlight the slider and then use the computer cursor keys to change frequency, you may click the on-screen ◀ and ▶ buttons to increment tuning up or down in 100kHz steps, or you may clear and re-type a frequency directly into the display window and then hit Enter.

Click: De-emphasis: or Mono: on this screen to turn these functions On and Off as well.

Station Presets

Up to six station frequencies may be programmed into the Station Presets memories.



With the 531N tuned to a desired frequency, simply click the little pencil icon on the right. The currently-tuned frequency will be transferred into that memory, whether the slot is shown as (Empty) or already has an entry. The Web screen directly reflects the six STATION PRESETS buttons on the front panel. Just click any Station Preset to tune immediately to that frequency.

GRAPHS AND METERING

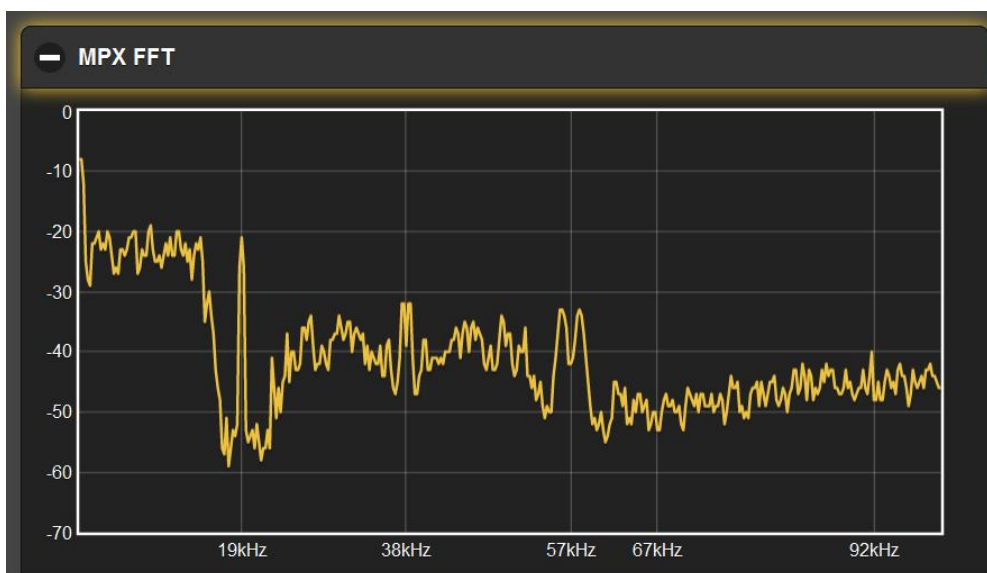
MPX Spectrum Display

The first item under Graphs & Metering is MPX FFT. This presents a spectrum display of the composite/MPX baseband signal demodulated from the off-air signal, or the plot of a baseband input applied to the rear-panel MPX IN connector.

This is a very useful display as it gives a graphic representation of the composite/MPX spectrum, showing injection levels of the stereo pilot and all subcarriers, plus FM baseband noise and anomalies.

In the example spectrum plot shown at the top of the next page, the levels of the 19kHz stereo pilot and the 57kHz RDS subcarrier may be visually measured with acceptable accuracy. The baseband noise floor, shown rising with frequency in this case, is a good indication that this station simultaneously

transmits HD Radio® digital carriers along with the primary FM signal.

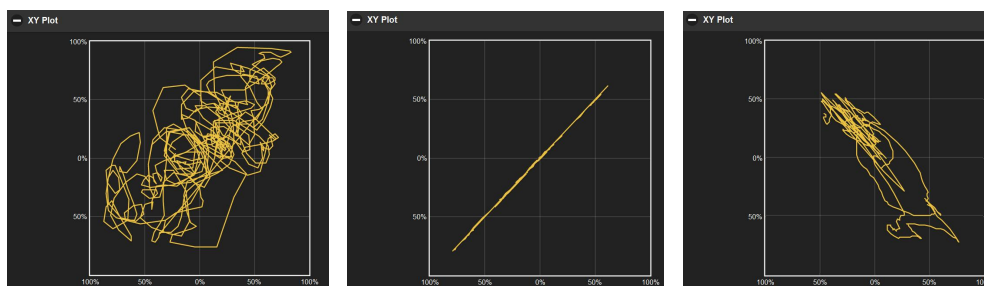


The MPX FFT plot may be saved as an image file using the computer's Prt Scr utility or any common 'screen snipping' tool.

XY Plot

In the XY Plot, left and right program audio channels are plotted against one another in an XY 'scope' box. The XY display gives a good measure of program audio *stereophony*, or how 'wide' the stereo image is, as well as a good indication of how heavily it is modulated.

In the series of snapshots below, the first example shows a densely-modulated program audio signal with an apparently wide *soundstage*, or stereo image, very probably the result of 'stereo enhancement' by the station's audio processor.



The central image is of a station ID between music cuts, which has no appreciable L-R component, a monaural program for all intents and purposes. Note that the plot is pretty much a 45-degree diagonal line sloping upward. The reverse of this, or any waveform with a diagonal tendency sloping downward, would indicate an out-of-phase condition between the stereo channels, as shown on the right.

The XY Plot may be saved as an image file using the computer's Prt Scr utility or any common 'screen snipping' tool.

Meter History

The 531N Meter History utility is able to graph the values of modulation components over a given period of time. Total carrier modulation, left and right stereo audio, the stereo pilot and the selected subcarrier may be plotted simultaneously or independently. Click the colored blocks below the graph to add or remove an item from the plot.



Click the checkmark at the bottom-right of the window to select history periods of ten seconds, one minute and ten minutes. Click Clear at any time to start the graph afresh.

The Mod plot always displays modulation peak values, but the values of the other plots are integrated in accordance with the selected display period. Mod provides a first-order measure of program loudness, as the amount of time that program peaks spend at or near the maximum modulation value is a persuasive indication of program audio density.

In the example above, this station looks to be pretty well within US modulation guidelines. A highly-processed Babyface track was playing at the graph start point of 60s. A 10-second ID came along at the 40s mark, and this led into a mellow GQ track for the final 30 seconds to the 0s end point. The difference in *peak* modulation level between the two songs is about 5%, also reflected in the left- and right-channel *integrated* readings that show about a 0.5dB difference. Never lose sight of the proven fact that over-processed audio leads to early listener fatigue and lower TSL (time spent listening!).

**Other
Displays**

The Meter History plot may be saved as an image file using the computer's Prt Scr utility or any common 'screen snipping' tool.

The Carrier Modulation, Demod Metering and Subcarrier displays simply echo the front-panel bargraph readouts and their respective selection options, the operation of which was detailed in a previous section of this manual.

RDS INFORMATION

The 531N decodes and presents a wealth of information about the RDS subcarrier being received. Here is an example of the RDS utility put to good use by a station:

PS	PI Code	Callsign	
94.7 The	447D	KTWV	
Radio Text			
94.7 The WAVE Michael Jackson - You Are Not Alone			
Time	PTY	PTYN	
	Soft		
M/S	DI	TP	TA
Music	Stereo	Off	Off
RT+1		RT+2	
4 Artist - Michael Jackson		1 Title - You Are Not Alone	

About the only thing that this station does not transmit is the local Time. Many stations elect not to send time data, rather than risk sending incorrect time or the wrong DST or UTC offset info, which tends to make listeners quite irate. The RT+ fields indicate that this station participates in RDS 'song tagging.'

RDS DATA GROUP STATISTICS

The 531N calculates the percentage of RDS resources used for each of the RDS data groups. This is illustrated in the screenshot on the next page.

0A	51.17%	0B	0%	8A	0%	8B	0%
1A	0%	1B	0%	9A	0%	9B	0%
2A	23.23%	2B	0%	10A	0%	10B	0%
3A	12.79%	3B	0%	11A	0%	11B	0%
4A	0%	4B	0%	12A	0%	12B	0%
5A	0%	5B	0%	13A	12.80%	13B	0%
6A	0%	6B	0%	14A	0%	14B	0%
7A	0%	7B	0%	15A	0%	15B	0%
Alternative Frequencies List							
Open Data Applications							
13A							

This is the same station in the foregoing example, a typical pop-music station in an urban market. Despite its thorough use of RDS capabilities, only a few of the RDS data groups are actually needed. Also, this station has no rebroadcast ‘translators,’ hence no Alternative Frequencies List entries are shown. This station is, however, making use of Open Data Applications with RT+ song tagging.

SIGNAL ALARMS

This is an important section of the 531N Web interface utility that requires thoughtful setup.

Also, the time-stamp feature for email notifications and the Alarm Log depends on Internet time, plus the proper time offset and relationship to DST. Correct time setup should be confirmed before proceeding here; Internet time setup was explained on Page 40.

Peak Overmodulation

The front-panel Peak Flasher is duplicated in the header at the top of all 531N Web screens. The Peak Flasher is the basis for overmodulation alarm dispatches and the Alarm Log.

The trigger point of the Peak Flasher may be set with the Peak Set slider.

Peak

Peak Set: 108

Time On (Sec): 10

Time Off (Sec): 2

Grab and drag the slider knob, or highlight it and use the computer's cursor keys. The value should be set to a point just at, or a bit above, your normal modulation peak excursion value.

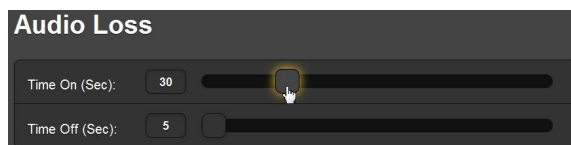
Time On (Sec) is programmed in like manner. This is the time in seconds that an indicated peak must remain above the trigger point to dispatch a notification or appear in the Alarm Log. What you should be looking for is unusual modulation activity that would indicate a processing or transmitter malfunction. You certainly don't want a series of text messages to your smart phone for occasional deviation overshoots, so set Time On (Sec): accordingly. In the example it would take a continuous overmodulation condition of ten full seconds to initiate an alarm. If you got that sort of text message, something is definitely amiss.

Time Off (Sec): is the number of seconds that carrier modulation must remain below the Peak Flasher threshold to reset the Peak alarm timer. This is certainly not as critical a setting, but a higher number here will obviate multiple notifications and loggings for a trouble condition that comes and goes.

Audio Loss

This alarm monitors the left- and right-channel signals independently and has a level threshold fixed at about -10dB with respect to 0dB on the peak-responding DEMOD METERING scale. This means that dead air or a missing channel will trigger an alarm.

Nearly any broadcast format, even classical music programming will contain peaks that reach the Audio Loss trigger point.



Nonetheless, to avoid unnecessary alarms from short instances of 'dead air' (or *pianissimo* passages), a Time On (Sec): setting between 30 seconds and one minute is probably a safe one. If you suspect that you have short-term dropouts and wish to be apprised of these fleeting periods of silence you may set Time On (Sec): to a small number. But pauses in speech may then initiate an alarm.

As with the Peak alarm, Time Off (Sec): is not critical at all, unless you want to catch those very quick dropouts.

Low Signal and Multipath

This pair of alarms is associated more with the quality of the off-air signal than with probable transmission problems. However, Low Signal is the alarm that will let you know that the transmitter has gone off the air. As in the case of the alarms previously described, Time On (Sec) can be set to a full minute or more, as the likelihood of the transmitter shutting down and then resetting itself in this time interval is doubtful.

There are few transmission faults that will manifest as multipath distortion. Reflections off aircraft and other receive-path perturbations are more likely to cause a brief indication. Even

with gross overmodulation, which can cause multipath-like effects, the chances are that a Low Signal or Peak alarm will be the first hint of a transmitter problem.

EMAIL AND TEXT MESSAGE NOTIFICATIONS

There must be at least one Recipient listed under the Email Preferences menu heading for the message dispatch utility to work; an example is shown on Page 40.

In the Email Notifications section of the Web screen, click the arrow at the right of the Recipient: box. This will display a pull-down list showing all potential recipients of alarm messages. In the example, the first recipient is selected, an SMS/text-messaging address for Ron Smith, the station's Chief Engineer.

The screenshot shows the 'Email Notifications' web interface. On the left, there are two labels: 'Recipient:' and 'Send Emails For:'. To the right of 'Recipient:', there is a dropdown menu currently displaying '1. 4085551212@txt.att.net' with a downward arrow icon. Below this, a pull-down list is open, showing a numbered list of potential recipients: '1. 4085551212@txt.att.net', '2. r.smith@ktn.com', '3.', '4.', '5.', '6.', '7.', '8.', '9.', and '10.'. The first item is highlighted in blue, and a mouse cursor is pointing at it. Below the list, there are three buttons: 'Daily Log', 'Weekly Log', and 'Monthly Log'.

Now select the various alarm notifications and logs that will be automatically dispatched by text message to the C.E. This is shown below on the left. Then we'll bring up Ron's email address and determine what to send him there. Since Ron gets the alarms on his phone, we'll email just the daily and monthly logs, as shown on the right.

This screenshot shows the 'Email Notifications' interface with the 'Recipient:' dropdown set to '1. 4085551212@txt.att.net'. Under the 'Send Emails For:' section, there are several checkboxes and labels: 'Peak' (checked), 'Audio Loss' (checked), 'Multipath' (unchecked), 'Low Signal' (checked), 'Daily Log' (unchecked), 'Weekly Log' (unchecked), and 'Monthly Log' (unchecked).

This screenshot shows the 'Email Notifications' interface with the 'Recipient:' dropdown set to '2. r.smith@ktn.com'. Under the 'Send Emails For:' section, there are several checkboxes and labels: 'Peak' (unchecked), 'Audio Loss' (unchecked), 'Multipath' (unchecked), 'Low Signal' (unchecked), 'Daily Log' (checked), 'Weekly Log' (unchecked), and 'Monthly Log' (checked).

Repeat this exercise for any other potential recipients; each will receive notifications made to order.

THE ALARM LOG

The 531N logs all alarms. Pull-up the Alarm Log by clicking the + next to Alarm Log at the bottom of the screen.

Alarm	Station	Time	Date
M-Path high	90.9	12:51:44 PM	5/02/15
Low signal	90.9	12:51:44 PM	5/02/15
Peak high	90.9	12:51:44 PM	5/02/15

This log shows three concurrent alarms, doubtless due to some momentary transmitter glitch. The Low signal and Peak high alarms would have been sent to Ron's phone immediately, and these three will remain in the log until cleared.

Alarm Log Capacity

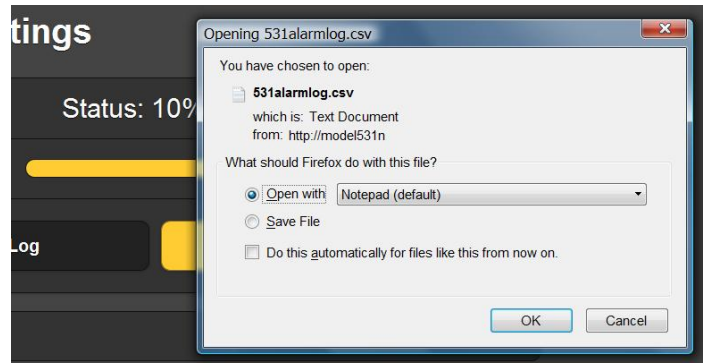
Status: is a notation of how full the log is at the moment. Although the log is capable of containing a couple of thousand events, it might be important to know when you have accumulated a certain number of entries.

The Email when % full: slider sets-up an independent email notification when the alarm log reaches the set point. This email notification can be an alert to a frequently-recurring problem, or simply serve as a reminder to download and clear the log.

**Downloading
and Clearing
the Alarm Log**

Click: Download Alarm Log. This opens a browser dialog box where the log may be opened immediately with a default text reader, or the .csv file download for archiving or for further analysis with a spreadsheet program.

Click: Clear Alarm Log to purge all entries.



Section VI

UPDATING THE 531N

THE FIRMWARE UPDATER

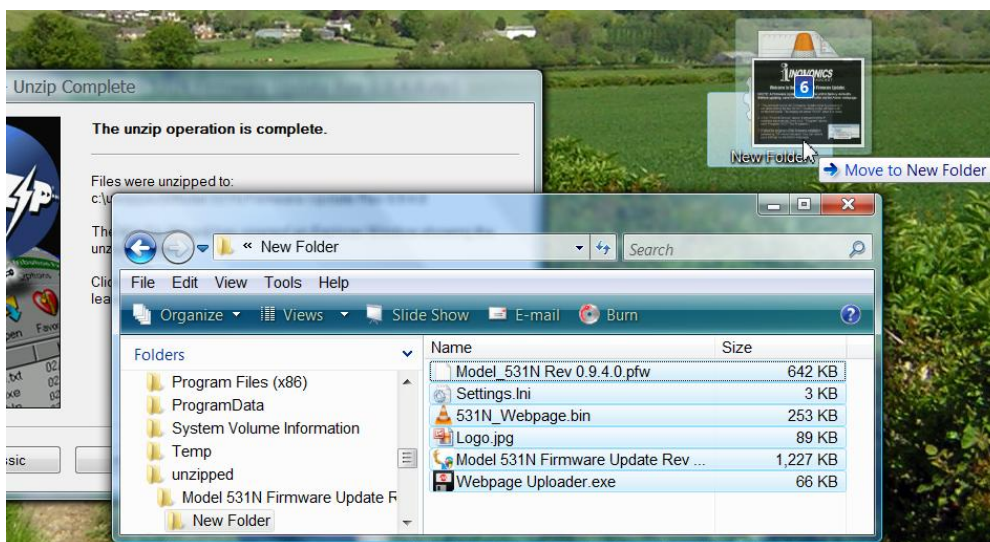
The 531N hosts two operating files that may be easily updated by the user in the field. These files are the primary firmware, which controls the functions, memories and Web interface of the unit, and the individual Web pages that comprise the Web interface screens.

The 531N includes a 'bootloader' utility that allows firmware to be updated whenever Inovonics issues changes to add features, to improve performance, or otherwise to expand the usefulness of the product. Inovonics supplies firmware updates free of any additional charges.

A bootloader is a simple software routine that runs on any PC connected to the same network as the 531N. Refer to Section IV for specifics on assuring a connection between the 531N and your computer. This *must* be a wired, LAN connection for both the PC and for the 531N. Attempting to use a Wi-Fi link will almost guarantee failure.

Warning A firmware update will restore the 531N to factory defaults. *All settings and presets will be overwritten!* Always save a Hardware Profile (Page 42) before proceeding with an update. This will retain all user setup parameters that can be restored afterward.

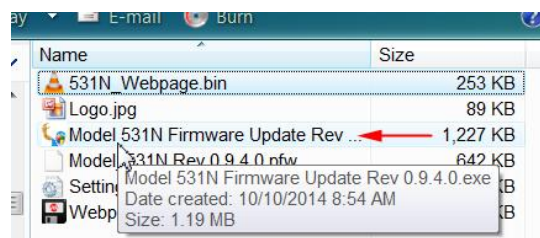
Firmware Update Files A firmware update will be supplied as a 'zipped' folder containing a number of files. Make a temporary New Folder on your PC Desktop and unzip these files to it as shown below.



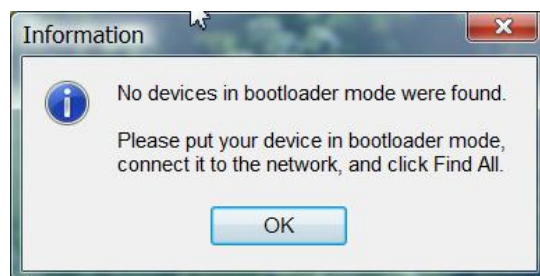
Running the Firmware Updater

One of the supplied files is the third-party bootloader utility, an 'executable' (.exe) file. Because executables are notorious for propagating viruses, many antivirus programs will not allow .exe files to be downloaded and will urge you not to install them. But we insist that you trust us and throw caution to the wind.

Navigate to your temporary Desktop folder (New Folder) and double-click the Firmware Update (.exe) file. This is the file marked with the arrow in the snapshot on the right.



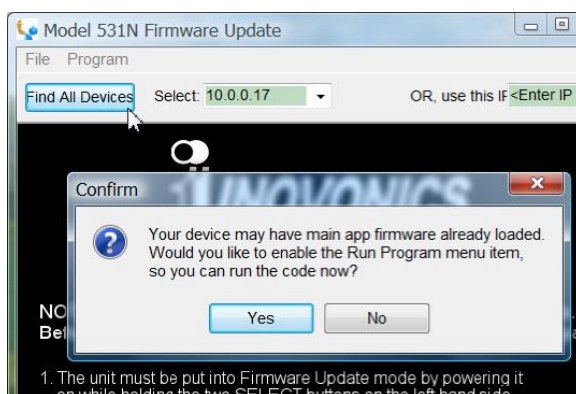
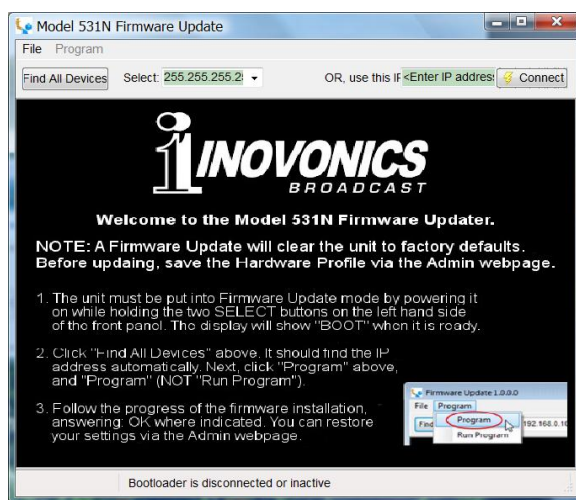
This will bring up the Information message shown here, advising that the Firmware Updater does not yet find the 531N. Click: OK to start the firmware updating utility and display its main screen.



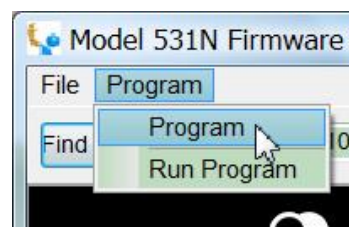
The bootloader window outlines the firmware update process in three easy steps.

The first step advises that the 531N must, itself, be in the 'bootloader' (firmware update) mode. Simply hold down the two **SELECT** buttons **(6)** and **(11)** on the left side of the 531N front panel, and while holding them down, power-cycle the unit by unplugging and replugging the AC mains cord. This will display the word **boot** on the front-panel LED frequency readout.

Next, click: Find All Devices at the top of the Firmware Update window. The IP address of the 531N should populate the Select: area, and a Confirm box will pop-up on the screen as well.

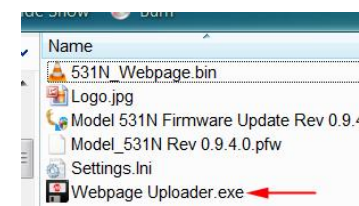


The Confirm box is a ‘watchdog’ feature included in the third-party bootloader utility, but it is not relevant to the 531N update procedure. Click: No in the Confirm box to close it, and then click: Program at the top of the window, and finally click: Program, the first item in the drop-down list. ***DO NOT*** click: Run Program. The update utility will run and then return the 531N to normal operation with factory-default values. You may then upload a Hardware Profile to reclaim all user setup parameters (Page 42).



Updating the Web Interface Pages

If a new version of firmware calls for a Webpage update, there will be an extra Webpage Uploader.exe file in the Firmware Update folder. The snapshot at the right shows this file identified with an arrow.



Immediately after the firmware update is bootloaded, while the 531N is in communication with your computer, return to the unzipped bootloader folder and double-click this Webpage Uploader.exe file. The utility will ask you to enter the IP address of your 531N. Next click: Update and the existing Webpages will summarily be replaced with updated ones.



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. The Warranty Registration Card supplied with this product *must* be registered 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.