OPERATING AND MAINTENANCE INSTRUCTION MANUAL

MODEL 631

FM REBROADCAST RECEIVER

INOVONICS
INCORPORATED

USER'S RECORD
Model 631 – Serial No. _____
Date Purchased _____
Warranty Card Mailed? — ☐

OPERATING AND MAINTENANCE INSTRUCTION MANUAL

MODEL 631

FM REBROADCAST RECEIVER

May, 2006
(Rev. C Circuit)

INOVONICS
INCORPORATED

5805 Highway 9 • Felton, CA 95018
TEL: (831) 458-0552 • FAX: (831) 458-0554
Visit our Website: www.inovonicsbroadcast.com

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Section I

INTRODUCTION

MODEL 631 PRODUCT DESCRIPTION

General

The Inovonics 631 is a frequency-agile FM broadcast receiver intended for single-channel translator (rebroadcast) service and for other professional applications that demand highest-quality, off-air FM broadcast program reception.

The 631 tunes the standard FM broadcast band in 100kHz, ditially-synthesized increments. The receive frequency and several other operating choices are selected using a front-panel, menu-driven user interface. Once selections are programmed, a rear-panel lockout switch protects these settings from being changed inadvertently.

The 631 has two outputs: a conditioned composite/MPX 'baseband' output, which may be fed directly to the broadband input of an FM exciter, and balanced program line outputs giving demodulated left- and right-channel stereo audio.

Features

Leading features of the Model 631 include:

- Dual (wide/narrow) IF bandwidth.
- Automatic output muting and over-deviation limiting circuits to protect the re-broadcast signal.
- Alarms with remote 'tally' outputs for a low incoming RF signal level and for loss of program audio.
- Comprehensive front-panel metering of composite/MPX and demodulated L/R stereo audio levels, as well as metering of the RF signal level and multipath distortion to aid in proper receive antenna alignment.
- Quickly and easily installed, the Model 631 is built largely from easy-to-find 'generic' components to simplify servicing anywhere in the world.

MODEL 631 TECHNICAL SPECIFICATIONS

Receiver Sensitivity:
10μV required for 60dB monaural S/N; 150μV for 60dB stereo S/N. (See Figure 1)

Receiver Selectivity:
WIDE IF: 280kHz
NAR. IF: 150kHz
(See Figure 2)

Stereo Separation (L→R or R→L)**:**
Typ. >40dB (See Figure 3)

Noise in Composite/MPX Output:
Wideband noise better than –40dB with 100μV RF input; better than –60dB with 1mV RF input.

Distortion (in baseband signal or demodulated L/R audio):
WIDE IF: <0.25% THD
NAR. IF: <0.7% THD

Composite Baseband Output:
Adjustable between 2V p-p and 6V p-p (re: ±75kHz deviation); 75-ohm source impedance, unbalanced.

Baseband Frequency Response:
WIDE IF: ±0.5dB, 10Hz–100kHz
NAR. IF: ±0.5dB, 10Hz–40kHz
(See Figure 4)

Program Line Ouptuts:
Left- and Right-Channel active-balanced XLR outputs deliver +4dBm into 600 ohms (re: ±75kHz deviation).

L/R Frequency Response:
±0.5dB, 20Hz–15kHz; follows selected de-emphasis curve.

Headphone Monitor:
Front-panel ¼-inch TRS jack.

De-emphasis (L/R Outputs)**:**
75μs or 50μs selected by circuit board jumpers.

Antenna Input:
Unbalanced,75-ohm, F connector; 50-ohm input with N connector optionally available.

Remote Alarm Provision:
Open-collector NPN transistors saturate to ground for low RF signal (user-programmable level) and loss of audio (user-programmable delay).

Power Requirements:
105–130VAC or 210–255VAC, 50/60Hz; 10 watts.

Size and Weight:
1¾"H x 19"W x 8"D (1U);
8 lbs (shipping).

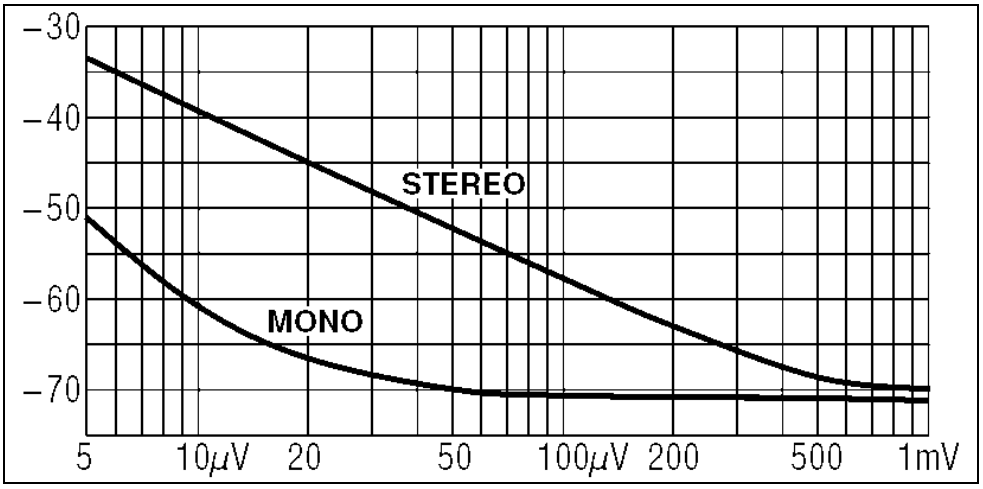


Figure 1 - Receiver Sensitivity - Output Noise vs. RF Input
L/R Line Output, 75μs De-emphasis; Measurement B/W: 10Hz–15kHz

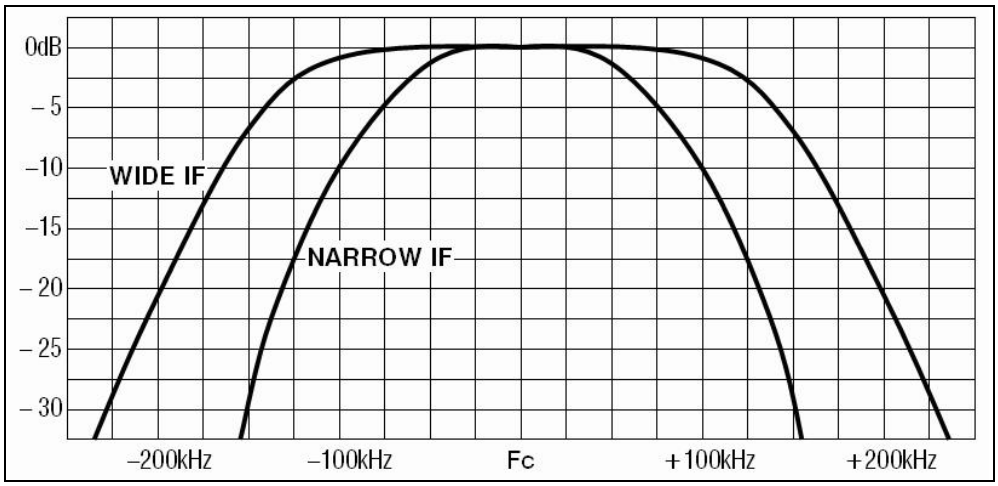


Figure 2 - Receiver IF Selectivity

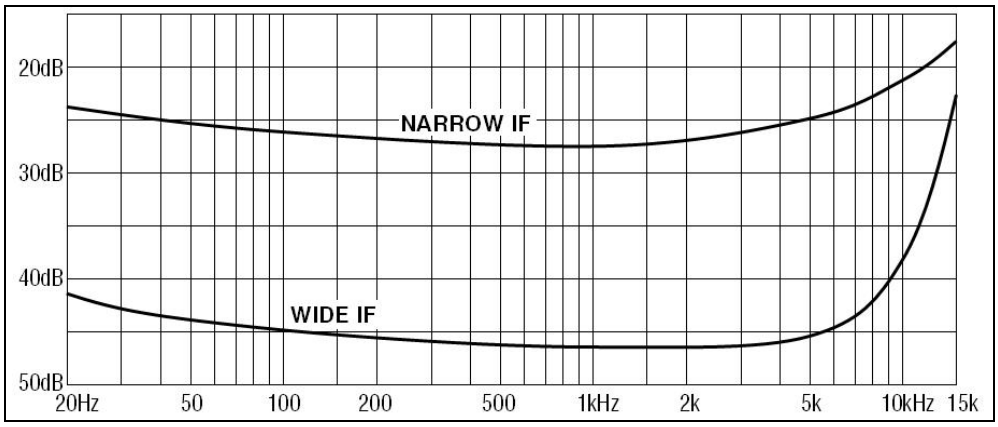


Figure 3 - Stereo Separation vs. Frequency
L/R Line Output

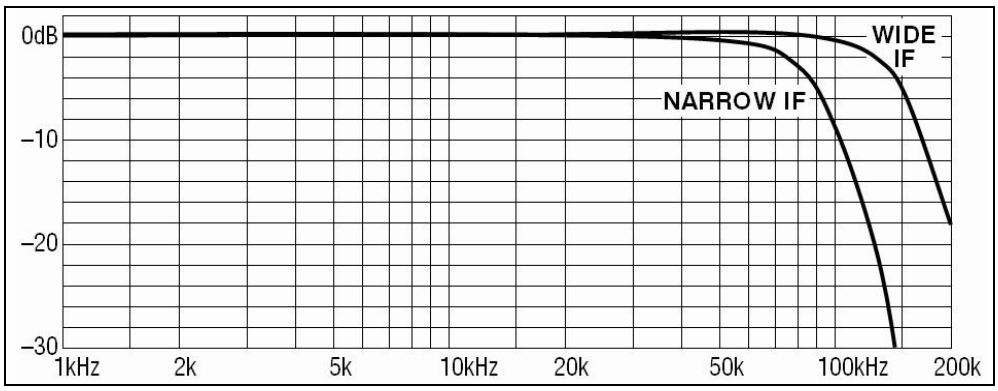


Figure 4 - Receiver Composite/MPX Frequency Response

BLOCK DIAGRAM

Figure 5, below, is a simplified Block Diagram of the Model 631 receiver. A full set of schematic diagrams appears in the Appendix, Section V.

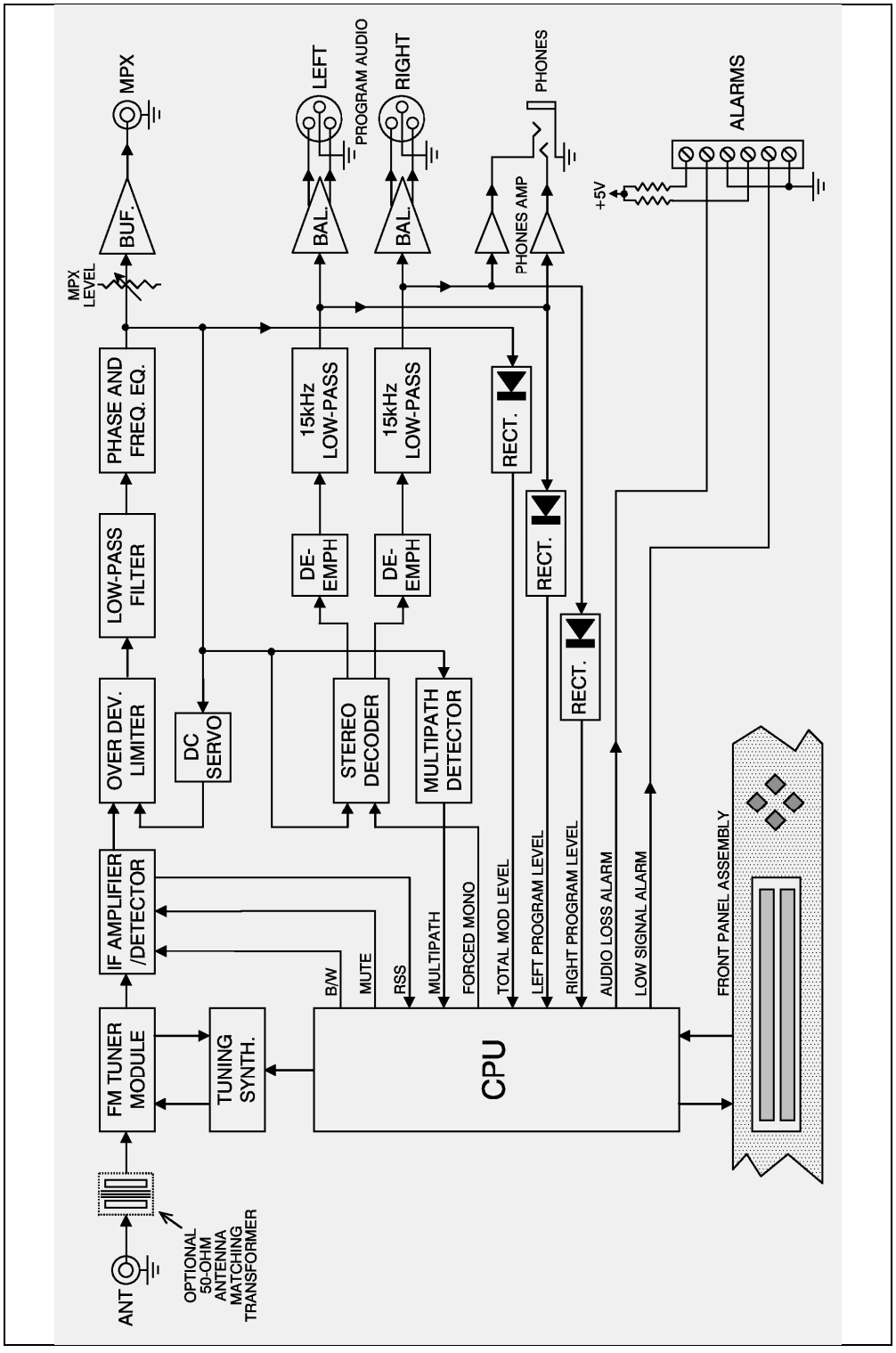


Figure 5 - Block Diagram — Model 631

Section II

INSTALLATION

UNPACKING AND INSPECTION

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

We recommend that you retain the original shipping carton and packing materials, just in case return or reshipment becomes necessary. In the event of return for Warranty repair, shipping damage sustained as a result of improper packing for return *may invalidate the Warranty!*

IT IS VERY IMPORTANT that the Warranty Registration Card found at the front of this Manual be completed and returned. Not only does this assure coverage of the equipment under terms of the Warranty and provide a means of tracing lost or stolen gear, but also the user will automatically receive specific SERVICE OR MODIFICATION INSTRUCTIONS should the factory issue them.

MOUNTING

Rack Requirement

The Model 631 receiver mounts in a standard 19-inch equipment rack and requires only 1¾ inches (1U) of vertical rack space. The use of plastic washers is recommended to protect the painted finish around the mounting holes.

Heat Dissipation

Consuming less mains power than most TV sets with their power turned off, the 631 itself generates negligible heat. The unit is specified for operation within an ambient temperature range extending from freezing to 120°F/50°C. But because adjacent, less efficient equipment may radiate substantial second-hand heat, be sure that the equipment rack is adequately ventilated to keep its internal temperature below the specified maximum ambient.

AC (MAINS) POWER

Fuseholder

The fuseholder is at the far left of the front panel. Apply downward pressure and pull the cap outward to access the 5mm mains fuse. The cap is reseated by reversing the removal process. This fuse also serves as a front-panel emergency power disconnect for the receiver.

Mains Voltage Selector

Unless specifically ordered for export shipment, the Model 631 is set at the factory for operation from 115V, 50/60Hz AC mains. This can be confirmed by checking the designation next to the mains connector 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 remove the top cover of the unit. A clearly-marked slide switch is next to the AC mains connector on the circuit board. *With power disconnected*, use a small screwdriver to set the switch for 115VAC or 230VAC operation.

Be sure to install the appropriate fuse as listed on the rear panel. You can remove the factory strikethrough with most any nasty carcinogenic solvent, and then cross out the inappropriate marking with an indelible felt pen.

Power Cord

The detachable IEC-type power cord supplied with the receiver is fitted with a North-American-standard male plug. The individual cord conductors may be color-coded in either of two ways:

1) In accordance with US standards:

BLACK = AC "HOT" WHITE = AC NEUTRAL
GREEN = EARTH GROUND

2) To European CEE standards:

BROWN = AC "HOT" BLUE = AC NEUTRAL
GRN/YEL = EARTH GROUND

RADIO FREQUENCY INTERFERENCE (R F I)

Location

Although it is expected that an FM rebroadcast receiver will be installed close to exciters (or transmitters of even higher-power!), please practice reasonable care and common sense in locating the unit away from *abnormally* high RF fields.

Ground Loops

Because the unbalanced MPX OUTPUT connector of the Model 631 is referenced to chassis ground, a mains frequency or RF ground loop could be formed between output cable shield ground 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 earth ground for safety. Generally, being screwed-down in the equipment rack will satisfy the requirement.

ANTENNA CONSIDERATIONS

The 631 is normally supplied with a characteristic input impedance of 75 ohms, and fitted with an "F" connector for the antenna. Appropriate cables, connectors, and even antennas with quite good performance are available on the consumer-electronics market. Alternatively, the 631 is available from the factory with a 50-ohm antenna input terminated in the more professional "N" connector. This

connector and the required matching transformer can also be fitted in the field.

Antenna Transformer

The 50-ohm antenna matching transformer is a surface-mounted part that solders onto the circuit board just behind the antenna connector. The two illustrations in Figure 6 show antenna wiring for the standard, 75-ohm version of the Model 631, and the installation of the matching transformer for 50-ohm transformer option.

PLEASE NOTE: for 75-ohm antenna connections, the transformer *must not* be installed on the board.

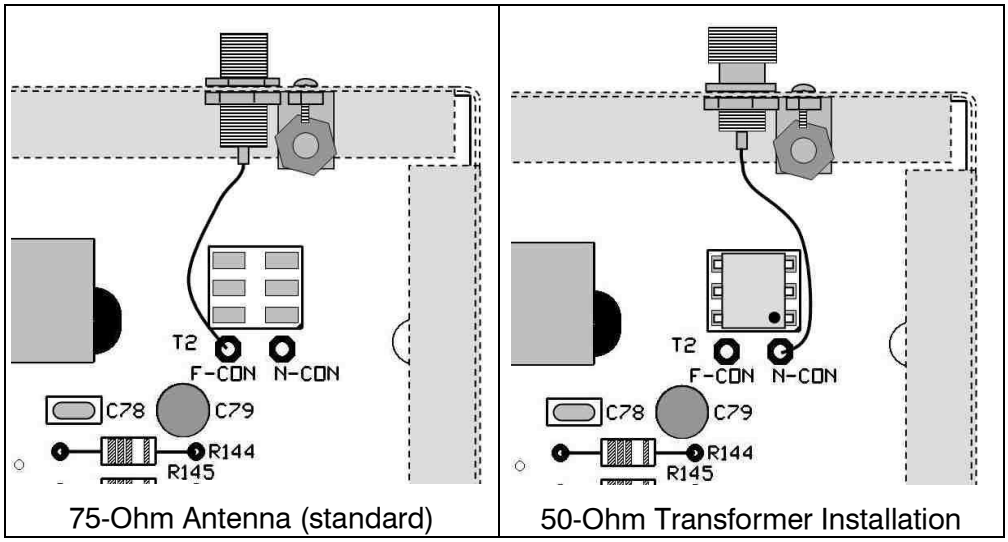


Figure 6 - Antenna Transformer Option

For field installation, the 50-ohm matching transformer may be ordered either from Inovonics or directly from the manufacturer: Mini-Circuits Corp. www.minicircuits.com, their part number ADT1.5-17. An appropriate "N" connector is available from RF Industries www.rfindustries.com; their part number RFN-1022-5.

The Receiving Antenna

Almost by definition, FM relay (translator) installations are quite likely to be in the fringe of the station's coverage area. This dictates use of a high-gain, directional receiving antenna if the retransmitted program is to maintain the best broadcast quality. This is particularly important when the composite baseband signal is rebroadcast. SCA and RDS subcarriers can be significantly degraded even when the stereo program *sounds* fine.

A number of professional FM receiving antennas are available to broadcasters through broadcast equipment distributors. These antennas are almost always of 50-ohms impedance, and although little sensitivity is sacrificed when connected to the receiver's 75-ohm antenna input, 50-ohm antennas will require the optional matching transformer for optimum results.

Do not discount residential FM antennas for translator service. Something equivalent to the Radio Shack® 15-2163 is quite acceptable for an installation on a budget, or where long-term durability of a professional antenna is not of prime concern. Some antennas in this class actually have a 300-ohm characteristic impedance, but are

generally supplied with a matching 'balun' (transformer) for a 75-ohm coax downfeed.

DE-EMPHASIS SELECTION

The rear-panel PROGRAM LINE OUTPUTS (and the front panel PHONES jack) follow the transmission de-emphasis characteristic. Either the 50- or the 75-microsecond curve may be selected. The factory setting should be proper for the delivery destination.

De-emphasis selection is made with push-on jumper 'shunts' beneath the top cover. Two jumper strips labeled JMP1 and JMP2 in the circuit board legend are located just below IC15, near the front-center of the circuit board. Figure 7, below, illustrates the two jumpering options.

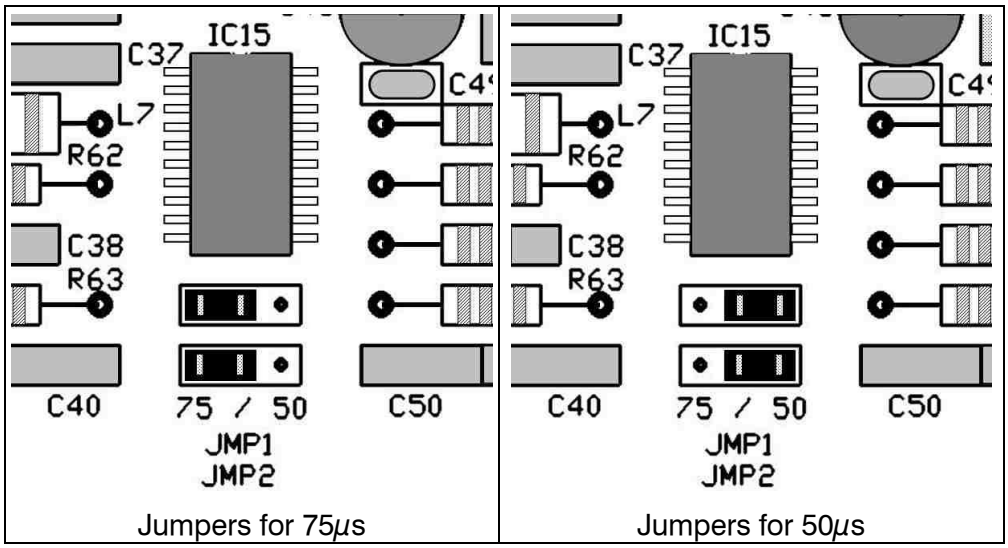


Figure 7 - De-Emphasis Jumpering

THE COMPOSITE/MPX OUTPUT

The composite/MPX or 'baseband' output of the Model 631 is a conditioned, amplified, wideband output taken directly from the FM detector. It contains the multiplex stereo program signal along with any SCA, RDS or special-service subcarriers.

Because IBOC digital radio transmission utilizes separate RF carriers for the digitized program signal, any IBOC-related information in the FM baseband is only incidental noise and does not convey the digital audio coding for 'pass-through' rebroadcast. This 'incidental noise' will, however, influence the indicated reading on the front-panel CARRIER MODULATION bargraph readout.

The rear-panel BNC connector labeled MPX OUTPUT is an unbalanced output with a source impedance of 75 ohms. Cable runs from this output should be kept as short as possible, consistent with providing good isolation between the Model 631 receiver and the re-

broadcast transmitter. The 631 is capable of driving 75-ohm cables up to about 100 feet in length. Cables over 20 feet should be terminated with a 75-ohm resistor at the far end. Excessive cable length can degrade performance, reducing stereo separation and compromising subcarrier quality.

MPX Output Level Adjust

A 15-turn MPX OUTPUT LEVEL ADJ. control can be found next to the MPX OUTPUT BNC connector on the rear panel. This control sets the level of the composite/MPX output to any level between 2 volts p-p and 6 volts p-p. This control does not affect the demodulated left- and right- channel program audio outputs.

The MPX OUTPUT signal is 'conditioned' with low-pass filtering, frequency and phase equalization, and limiting of program peak-excursions. The low-pass filter is flat to 100kHz, serving mainly to reduce noise components outside the baseband spectrum. A peak clipping circuit in the output signal path is factory-set to restrict program peaks in excess of 130% modulation (±100kHz deviation). This prevents overdeviation of the rebroadcast transmission in the event of unexpected, gross interference with the off-air feed.

THE STEREO PROGRAM OUTPUTS

L/R Line Outputs

The demodulated left- and right-channel stereo line outputs appear at the two XLR connectors on the rear panel of the receiver. These are labeled PROGRAM LINE OUTPUT, LEFT and RIGHT, and are active-balanced with a resistive source impedance of 200 ohms. At 100% modulation (±75kHz deviation) these outputs will drive 600-ohm loads to approximately +4dBm. This is a fixed level and is not affected by the MPX OUTPUT LEVEL ADJ. control.

Headphone Jack

A front-panel PHONES jack monitors the off-air signal. This is a buffered output at a fixed level, and drives headphones of various popular types at a comfortable listening level.

REMOTE ALARM OUTPUTS

The 631 receiver has rear-panel alarm 'tally' outputs for two fault conditions: 1) AUDIO LOSS and 2) LOW SIG, or a drop in level or loss of the RF carrier. These alarms are coincident with front-panel alarm indications, and setups for the alarm criteria are discussed on Pages 13 and 14.

The alarm outputs are NPN transistor saturations to ground. These outputs can sink up to 100mA at source voltages up to about 30VDC. +5VDC and ground (+5V and GND) are provided also. The +5V source is current-limited at about 10mA, but is sufficient to drive an opto-coupler or a remote LED indicator. The alarm tally barrier strip may be unplugged from the chassis to facilitate connection.

Section III

SETTING UP THE RECEIVER

THE LCD DISPLAY

The front-panel LCD display and its attendant pushbuttons give menu-guided control over Model 631 receiver setup. Two up/down MENU pushbuttons: ▲ and ▼ scroll the display through the several measurement and setup categories, and two left/right SEL buttons: ◀ and ▶ allow the user to select various features and values.

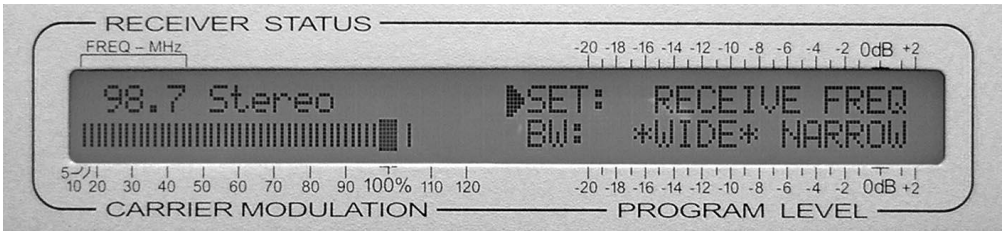
Front-Panel Lockout

The up and down MENU buttons for scrolling the display are always responsive, but a toggle switch on the rear panel of the receiver locks out the left and right SEL buttons to guard against unauthorized tampering and clumsy accidents. Make sure that this FRONT PANEL switch (on the rear panel!) is in the UNLOCK position during setup, and in the LOCKED position once the receiver has been placed in service. The internal memory that keeps track of setup parameters is non-volatile, so settings will not be lost.

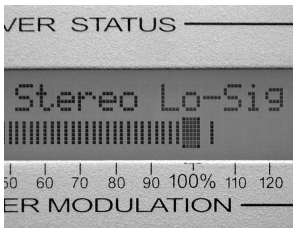
RECEIVER SETUP

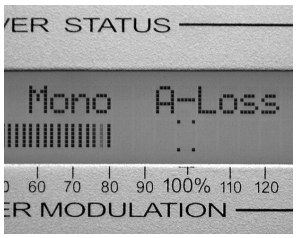
Setting the Receive Frequency

Cycle the ▲ button so that RECEIVE FREQ shows at the top-right of the LCD screen. This is at the very top of the list of menu options. Using the ◀ and ▶ buttons, set the receive frequency. The photo below shows the panel display for a setting at 98.7MHz.



The notation to the right of the frequency readout shows this as a Stereo transmission; otherwise the word Mono would appear. Signal alarms are also noted in this area. Lo-Sig and A-Loss alert the operator to a low incoming signal level or loss off program audio. These alarms are pictured here, and their programming is detailed in a subsequent discussion.





The Carrier Modulation Display

The bargraph display just below the frequency readout is a peak-responding display of total carrier modulation. The display is annotated in percent-modulation in the panel artwork below the LCD.

A 'floating dot' above the dynamic readout holds the value of maximum modulation for a brief interval, and 100% modulation is clearly noted by an oversize bargraph segment (see previous photo). Modulation resolution is 2% per bargraph segment, except at the very bottom of the readout. The last two segments show modulation levels of 10% and 5%, ensuring that the stereo pilot is always visible.

As mentioned previously, IBOC digital carriers will show up as a certain amount of incidental noise in the composite/MPX output, and will skew the CARRIER MODULATION reading to some extent. Despite the resolution of the bargraph display, the 631 receiver is *not* a mod-monitor!

Receiver Bandwidth

Scroll down with the ▼ button to put the LCD cursor on BW:. The SEL buttons now select either the WIDE or the NARROW IF filter set. The active mode is indicated by asterisks on either side of the selection (see photo on previous page).

A *WIDE* bandwidth will always ensure the best stereo separation and lowest distortion, and will help preserve the integrity of any subcarriers. Nevertheless, 'splatter' interference from adjacent stations can be eliminated or substantially reduced by selecting the *NARROW* bandwidth. Figures 2 and 4 on Page 5 illustrate the effect of bandwidth selection on selectivity and baseband response.

Forced Mono Reception

Scrolling down to the next setup option with the ▼ button sets the LCD cursor on MODE:. With *STEREO* selected, stereophonic broadcasts will separate into their left- and right-channel components at the rear-panel PROGRAM LINE OUTPUT XLR connectors and at the front-panel PHONES jack. Selecting *MONO* defeats the receiver's stereo decoder circuitry to provide "forced mono" reception. However, the MODE: selection option will make no difference in the composite/MPX output of the receiver. Reverting to monaural reception is sometimes necessary to recover a very weak signal.

Audio Loss Alarm

The next setup option brings the LCD cursor to AUDIO LOSS:. An alarm will be given if either of the stereo channels disappears, or if the total modulation drops more than 20dB for the selected interval. The SEL buttons are used to set the delay-time interval between the actual loss of program audio and alarm activation. Time may be set in one-second increments between 5 seconds and four minutes.

Auto Mute Function

Cycling the ▼ button once more sets the LCD cursor to AUDIO MUTE:. SEL buttons turn this function on or off.

When *ON*, both the MPX OUTPUT and the PROGRAM LINE OUTPUT will be muted (silenced) when the incoming RF level falls below a preset threshold. This threshold level can be set by the user, and this procedure is described under a following heading. With AUDIO MUTE: *OFF*, typical inter-station 'hiss' or chatter from adjacent frequencies will be delivered to the outputs when the tuned carrier is lost.

Multipath Indicator

M-PATH: is a bargraph readout quantifying multipath effects in the received signal. M-PATH: and SIG: (signal strength) indicators are useful when aiming the receive antenna. Both readouts are *relative measurements only* and do not refer to the adjacent panel markings.

The multipath detector circuit monitors incidental amplitude modulation of the 19kHz stereo pilot to create the M-PATH: display. This means that the measurement function is valid only when receiving a stereo broadcast.

Excessive composite clipping will also excite the multipath detector. Most FM airchain audio processors inject the 19kHz pilot into the composite/MPX signal *after* the waveform is clipped, but less sophisticated processing systems may not.

Signal Strength Display and Muting Level Setup

Cycling the ▼ button down to the next menu item bring SIG: and MUT: onto the LCD screen. Although SIG: is a *relative* indication of incoming RF level and has no direct association with the adjacent dB markings on the panel, you can still get a rough idea of incoming RF level as follows: +2dB = 10mV; –2dB = 1mV; –8dB = 100μV; –16dB = 10 μV. Remember, this is only an *approximation*!

With the SIG: screen displayed, the ◀ and ▶ SEL buttons control the position of the single bargraph element to the right of the MUT: designation. This sets the low signal threshold, below which the outputs will be muted (with AUTO MUTE: *ON*) and a low signal alarm will be given. (An alarm results whether or not muting is enabled.)

The position of the bar is with reference to the SIG: display immediately above it. In other words, the level can be set accurately relative to the level received. When the SIG: readout drops below the MUT: setting, the outputs will mute and an alarm will be initiated.

Typically, a minimum acceptable incoming signal level would be established and the MUT: level set at that point. When establishing this level, it's important to make allowances for adjacent carriers that might show up on the SIG: display when the tuned carrier is lost completely.

Program Audio Levels

The next push of the ▼ button brings us to the bottom of the menu list. L: and R: bargraphs meter the left and right channels of the demodulated stereo program signal. These readouts are program-peak-responding and refer to the dB markings on the panel. This is a linear-dB display with a resolution of 0.5dB per segment.

0dB is an oversize segment that will rarely come on with normal program modulation. 0dB is equivalent to 100% modulation (±75kHz deviation) by a low-frequency, steady-state tone from a *monaural* transmission. Because of the automatic 9% modulation sacrifice due the stereo pilot, a stereophonic transmission is already 1dB lower than a monaural one. Also, receiver de-emphasis further reduces program audio energy at the higher frequencies.

OTHER FRONT-PANEL APPOINTMENTS

FUSE/ DISCONNECT The front-panel fuseholder provides a means of disconnecting AC mains power in an emergency. Push the fuseholder cap down and pull it away from the panel to interrupt power.

PHONES The PHONES jack is a separately-buffered output at a fixed level that should allow comfortable listening with a variety of popular headphones.

Section IV

CIRCUIT DESCRIPTIONS

INTRODUCTION

This Section details the circuitry of the Model 631 Receiver. Circuit descriptions refer to the three sheets of Schematic Diagrams contained in the Appendix, Section V, Pages 24, 25 and 26.

Component Annotation

Schematics for the Model 631 receiver may appear to have component reference designations assigned in a haphazard manner. Rather than annotate the *schematic* in a logical sequence, we have instead chosen to designate the *components* on the circuit board in a top-to-bottom and left-to-right manner, following the physical placement of the parts in their neat little rows. It is our expectation that this practice will make any necessary troubleshooting easier, as a component can physically be located quickly following analysis of the schematic.

RECEIVER SECTION

The Model 631 employs an OEM 'front end' tuner subsystem that features a triple-tuned RF stage. The nominal antenna input characteristic of this module is 75 ohms, although 50-ohm antennas may be connected with negligible loss. T2 is an optional matching transformer that will precisely match 50-ohm antennas, and is supplied with the type N connector common to 50-ohm systems.

The tuner works in conjunction with a dedicated PLL synthesizer, IC23, which is controlled by microprocessor IC8 to establish the operating frequency.

Relay RLY1 selects either of two sets of IF filters. CF1 and CF2 are the 'wide' pair, CF4 and CF3 the 'narrow' set. Receiver selectivity is graphed in Figure 2 on Page 5.

IC25 is a monolithic IF amplifier and quadrature-type of FM detector. This chip also provides signal strength metering and baseband muting, which are interpreted and controlled, respectively, by microprocessor IC8.

The baseband composite/MPX output of IC25 is fed to gain stage IC26A. This stage also implements the overdeviation limiter, which uses biased transistors Q6 and Q7 to clip the baseband signal at a level equivalent to 100kHz carrier deviation. IC26A is followed by a passive 100kHz low-pass filter, frequency-equalizer stage IC26B and phase-equalizer stage IC27B. These two equalizers are adjusted to

flatten passband response and to optimize stereo separation. IC27A is a DC-servo amplifier that feeds an offset current into the summing node of IC26A to maintain a ground-referenced baseline for the composite/MPX signal.

IC16B and associated discrete components form an output-protected, variable-gain line-drive amplifier for the composite/MPX output. This allows the Model 631 to feed reasonable lengths of 75-ohm coax without instability.

IC22 is a full-wave, peak-responding rectifier that delivers a DC voltage to the microprocessor for metering total carrier modulation.

MULTIPATH DETECTOR

IC17, IC18 and IC19 comprise a pair of cascaded 19kHz 'biquad' band-pass filters that strip the stereo pilot from the composite/MPX signal. The filtered pilot is presented in antiphase to CR19 and CR18, which full-wave-rectify the 19kHz signal. The resultant DC is filtered by a 4-pole low-pass stage, IC20B, which removes frequency components above about 200Hz.

The pilot-derived DC is AC-coupled to a full-wave rectifier built around the two sections of IC21. A rock-solid stereo pilot yields no output from the rectifier, but as multipath effects cause amplitude modulation of the pilot, the rectifier generates a proportional DC voltage. This is fed to the microprocessor for the multipath readout.

STEREO DECODER

IC15 is a one-chip FM stereo decoder. An internal PLL locks to the 19kHz pilot and steers switching logic to separate the left and right program channels, and to cancel the stereo pilot from the program channel outputs. IC15 sends stereo/mono status to the microprocessor and accepts incoming logic for 'forced mono' operation.

Program de-emphasis is selected by push-on shorting 'shunts' on the JMP1 and JMP2 jumper strips, and the left and right audio channels are routed through low-pass filter stages to remove the 38kHz switching components. The filter buffer stages, IC10A and IC10B deliver one signal phase to the program line outputs, and inverting stages IC9A and IC9B generate the opposite polarity for an electronically-balanced output. IC5 is a simple gain stage to feed and isolate the front-panel headphone jack.

IC6 and IC7 are full-wave peak-responding rectifiers for the program audio channels. DC from these rectifiers is routed to the microprocessor for the decoded L/R program audio level display.

CONTROL AND USER INTERFACE

IC8 is a 'PIC' microcontroller that performs 631 receiver housekeeping chores. Five DC voltage inputs are applied to on-board A-to-D converters for metering; the remaining control lines are logic-level commands.

The four front-panel pushbuttons and the LCD display are wired directly to the microprocessor. The low-signal and loss-of-audio alarms from IC8 are fed to open-collector transistor switches that give a 'virtual contact closure' for remote alarms.

POWER SUPPLY

Receiver circuitry operates from the bipolar 9-volt and +5-volt supplies diagrammed on the second page of schematics. These supplies are regulated by linear "three-terminal" IC voltage regulators: IC2 for the +9-volt supply, IC1 for the –9-volt supply, and IC3 for the +5-volt supply. The power transformer has dual primary windings that may be switched in parallel or in series for 115V or 230V mains, respectively (see Page 8).

Section V

APPENDIX

This section of the Model 631 Manual contains Parts Listings, Schematic Diagrams and an explanation of Inovonics' Generous and Most Liberal Warranty Policy.

PARTS LIST

EXPLANATION OF PARTS LISTINGS

This section contains listings of component parts used in the Inovonics Model 631 Receiver. Not all components are listed by schematic reference designation; those that are considered 'generic' may have qualification notations, however.

Descriptions may or may not specify a particular manufacturer. When no manufacturer is called out, the term (open) advises that any manufacturer's product carrying the given part number (or the same description in the case of a generic part) is acceptable.

If a part is not listed at all, this means that we do not consider it a typical replacement item. Should you need to order an unlisted part, call, write, fax or e-mail the factory with a brief description of what it is that you need. We'll then do our very best to figure out what to send you.

Components with reference designations below 500 are contained on the main printed circuit board. 500-series components are on the separate front-panel circuit board, and those in the 600s are chassis-mounted components.

PARTS LISTINGS

Unless specifically noted by component reference designation, **capacitors** are specified as follows:

a: **Under 100pF** are general-purpose disc ceramic capacitors with no specific technical specification. The letter 'p' following the value indicates picofarads.

b: **100pF to 0.47μF** are of the metallized Mylar or polyester film variety. Whole number (XXp) values are picofarads, decimal values are microfarads. All capacitors in this category have 5% tolerance and are rated at 50VDC or better. The style used by Inovonics is the "minibox" package with a lead spacing of 0.2 inch. The preferred manufacturer is WIMA, their FKS-2 or MKS-2 series. Possible alternates are the CSF-Thompson IRD series or the Vishay-Roederstein KE-1808 or KT-1817 series.

c: **1.0μF and above** are general-purpose aluminum electrolytics with radial leads. A safe voltage rating for any electrolytic in the Model 631 would be 25V, but because of size and other considerations a replacement capacitor should always carry the same rating as the one being replaced.

C1,2	Capacitor, Y-class Ceramic Disc, 0.0047μF, 440VAC; Murata/Erie DE7150 F 472M VA1-KC
C6,7,10,11,12,13	Capacitor, Ceramic Disc, 0.001 μF, 100VDC; (open)
C8,9	Capacitor, High-Rel 'Snap-In' Electrolytic, 2200uF, 25V; Panasonic ECOS1EA222BA
C18,21,22,33,36,49, 69,70-72,78,80,81	Capacitor, Monolithic Ceramic, 0.1 μF, 100VDC; (open)
C19,20,67.68	Capacitor, Monolithic Ceramic, 47pF, 100VDC; (open)
C23,26-29,31,39, 41-46,51-53,59,60	Capacitor, "High-Q" Polypropylene, 0.0033μF, 2.5%, 100VDC; WIMA MKP-2 series
C37	Capacitor, Dipped-Mica, 270pF, 5%, 100VDC; (open)
C48,63	Capacitor, Non-Polar Electrolytic, 22μF, 25V; (open)
C82	Capacitor, Dipped-Mica, 68pF, 5%, 100VDC; (open)
CF1,2	Ceramic IF Filter, 10.7MHz/280kHz; Murata SFECS10M7FA00-R0
CF3,4	Ceramic IF Filter, 10.7MHz/150kHz; Murata SFECV10M7JA00-R0
CR1-7,30	Diode, Silicon Rectifier; (open) 1N4005
CR8-297	Diode, Silicon Signal; (open) 1N4151
F1	Fuseholder; Littlefuse 0286067 (The fuse itself is a 5mm normal "fast blow" type; the value should match the specification stated on the rear panel.)
FB601	Ferrite Bead; Amidon 73-801
IC1	Integrated Cct.; (open) LM337-T
IC2,3	Integrated Cct.; (open) LM317-T
IC4	Integrated Cct.; Microchip 24LC01B-I/P-ND
IC5-7,9-14, 16-22,26,27	Integrated Cct.; (open) LF353N
IC8	Integrated Cct., 'PIC' microprocessor 16F77-I/P; *requires programming: Inovonics P/N 3354*
IC15	Integrated Cct., FM Stereo Decoder; Philips TDA1591T
IC23	Integrated Cct. Receiver Synthesizer; *Inovonics P/N 1365*
IC24	Integrated Cct., Dual Op-Amp; Analog Devices OP279GS
IC25	Integrated Cct., FM IF/Det.; Philips TDA1597T
J1	Connector, AC Mains; Switchcraft EAC303
J2	Connector, Headphone Jack; Switchcraft RN112BPC
J3,4	Connector, XLR Male; Mouser 568-NC3MAH-0
J7	Connector, 6-position 'Barrier'; Weco 121-M-211/06 Plug-In Terminal Block is Weco 121-A-111-06
J601	Connector, BNC Bulkhead; Mouser 523-31-221-75RFX
J602	Connector, "F"; Digi-Key CP-1010-ND (Alternate "N" connector is RF Industries RFN-1022-5.)
JMP1,2	Shorting "Shunt" for 0.1-inch header strips; (open)
L1-6	Inductor, 47μH Molded; Mouser 43LS475

L7	Inductor, 470μH Molded; Inductors, Inc. CTS3-471J
L8	Variable Inductor, 2.7 μH; Toko 836BN-0079Z
L9	Inductor, 560μH Molded; Inductors, Inc. CTS3-561J
L10	Inductor, 220μH Molded; Inductors, Inc. CTM3-221K
Q1,2,3,5,7	Transistor, NPN; (open) 2N3904
Q4,6	Transistor, PNP; (open) 2N3906

Except at noted by reference designation, **all resistors** used in the 631 Receiver are the value specified on the schematic, qualified per the following:

a: **Fixed Resistors** with values carried to decimal places implying a 1% tolerance (*example:* 232, 3.01K, 10.0K, 301K) are ¼-watt, 1% metal film type.

b: **Fixed Resistors** with values typical of a 5% tolerance (*example:* 220, 3.3K, 10K, 270K) are ¼-watt, 5% carbon film type.

c: **Single-Turn Trimming Potentiometers** (circuit board) are Tocos GF063U1 series.

d: **Multi-Turn Trimming Potentiometers** (panel-adjustable) are Tocos RJC097P series, or equivalent 'cermet' types.

R39,40	Resistor, carbon film, 3.3 ohms, ½-watt, 5%; (open)
RLY1	Relay, DPDT; Mouser 653-G5V-2-DC5
S1	Switch, Voltage-Selector; ITW 18-000-0022
S2	Switch, SPDT Toggle; C&K 7101-M-D9-A-B-E
SW501-504	Switch, Pushbutton; ITT KSLOM312 Button Cap is ITT G004A
T1	Transformer, Power; Signal IF-14-20
T2	Transformer, Optional 50-Ohm Antenna-Matching; Mini-Circuits ADT1.5-17
X1	Crystal, 20MHz, HC49; Digi-Key X036-ND
X2	Crystal, 3.20MHz, HC49; Standard Crystal 2AAK3M20000/GNE22A

PARTS SUPPLIERS

Inovonics strives to maintain factory stock of all parts used in the products we manufacture. A large proportion of the components in the Model 631 is 'generic' and may be obtained from a wide variety of sources.

A few parts can be more-or-less proprietary. These either may be manufactured specifically for Inovonics, or we purchase them directly from a manufacturer who sells only in large production quantities.

Inovonics does not depend on parts sales to fatten our coffers, nor do we impose a minimum charge for parts. In some cases we will elect to supply 'nuisance quantities' of parts at no charge, rather than

generate the dreaded necessary paperwork. Always check with the factory, we may well prove the best source for your replacement component needs.

The electronic component distributors we list below are proven and reputable suppliers for small quantities of component parts for broadcasters and for other commercial or professional users.

> With all due-diligence, please avoid the temptation to use cross-referenced hobbyist or TV/VCR Repair Shop "direct replacement *(ha!)* parts."

Nearly any semiconductor, IC, capacitor, resistor or connector used in the Model 631 will be available from one or more of these firms. Each supplier maintains a Website and publishes a full-line printed catalog, which is free for the asking. Minimum-order restrictions may apply, and export orders may prove somewhat problematical.

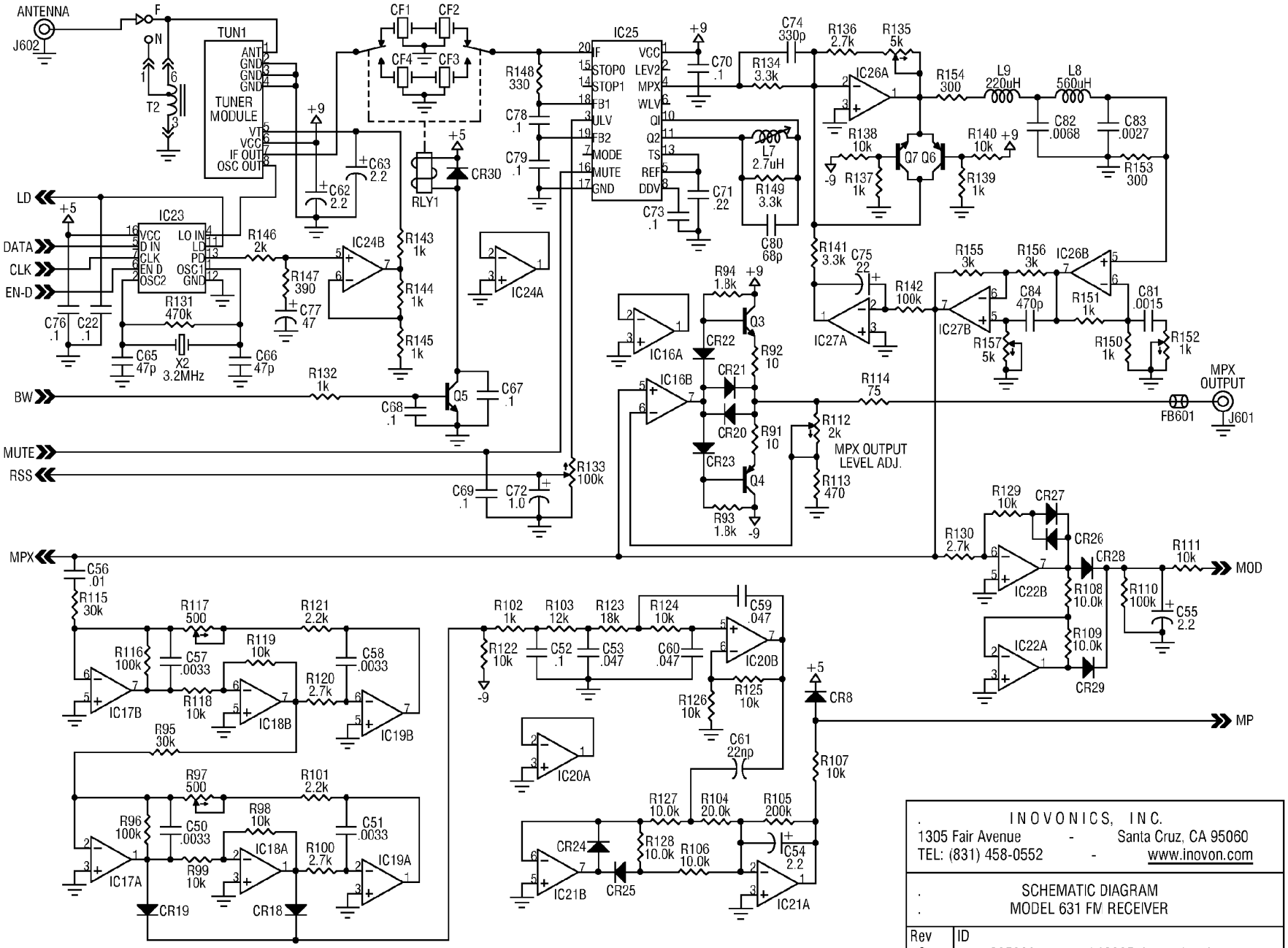
Mouser Electronics
www.mouser.com — 1-(800) 346-6873

Digi-Key Corporation
www.digikey.com — 1-(800) 344-4539

Future-Active Industrial Electronics
www.future-active.com — 1-(800) 655-0006

Allied Electronics
www.alliedelec.com — 1-(800) 433-5700

Jameco Electronics
www.jameco.com — 1-(800) 831-4242



.	INOVONICS, INC.	
1305 Fair Avenue	-	Santa Cruz, CA 95060
TEL: (831) 458-0552	-	www.inovon.com
.	SCHEMATIC DIAGRAM	
.	MODEL 631 FM RECEIVER	
Rev C	ID 205900	(c)2005, Inovonics, Inc.
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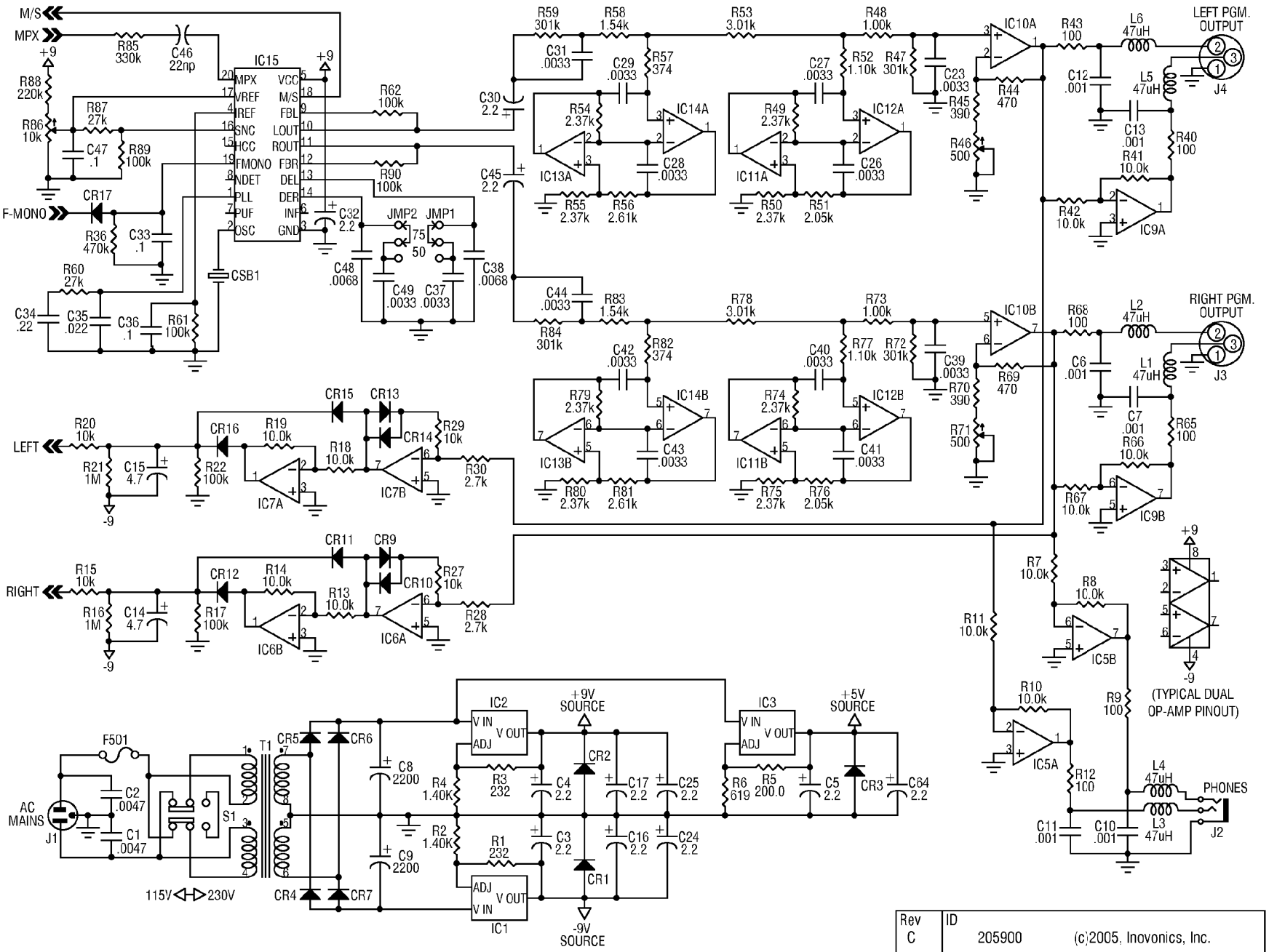

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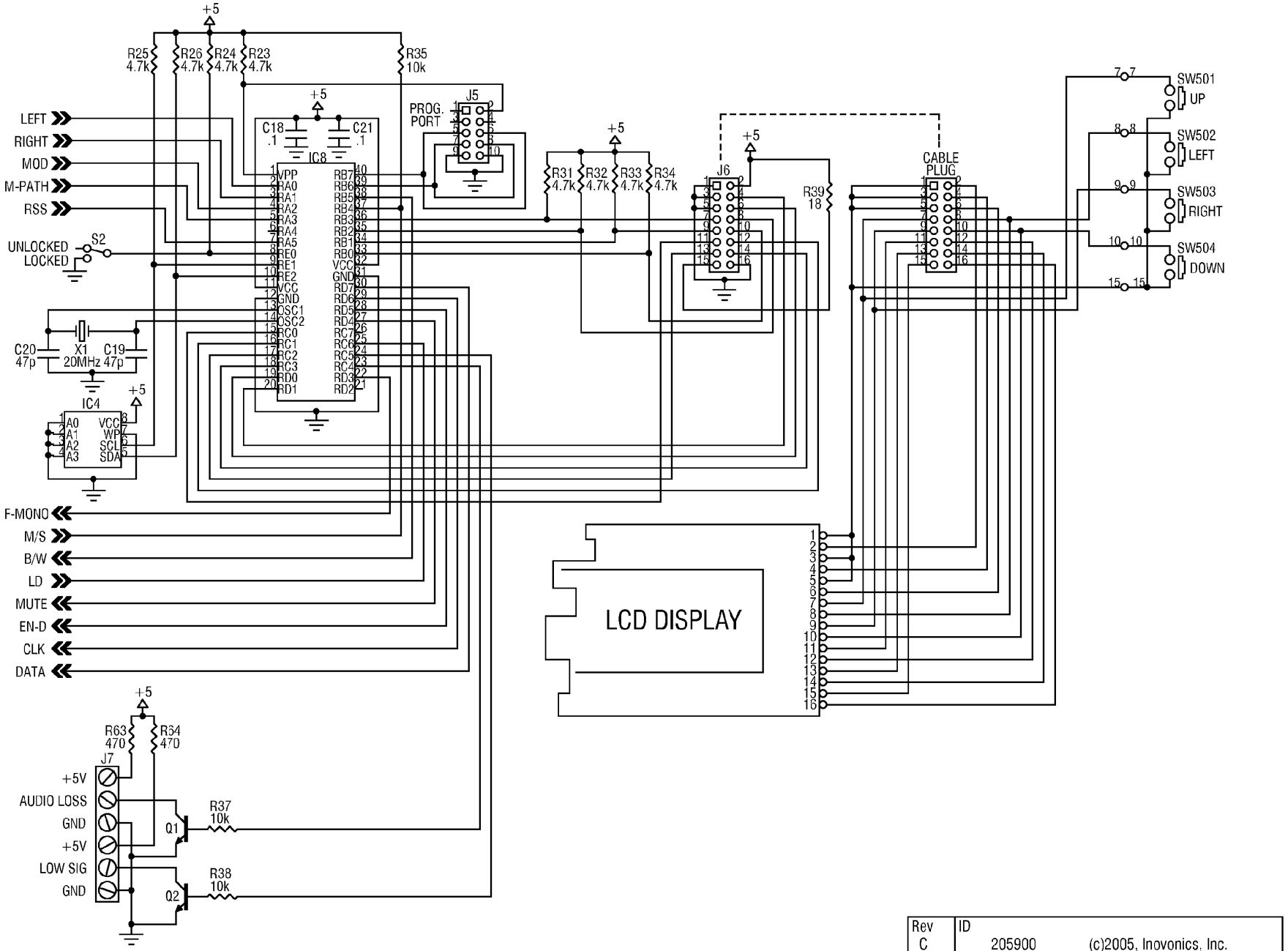

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INOVONICS WARRANTY

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 completed and returned to Inovonics, or the Warranty registered online at www.inovon.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 the equipment will be replaced with a new or remanufactured product at Inovonics' option.

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

IV **RETURNING GOODS FOR FACTORY REPAIR:**

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

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

Revised Sept. 2011