OPERATING AND MAINTENANCE INSTRUCTION MANUAL

MODEL 261

DIGITAL 'UTILITY' AUDIO PROCESSOR

INOVONICS
BROADCAST

USER'S RECORD
Model 261 – Serial No. _____
Date Purchased _____
Warranty Registered? — ❑

OPERATING AND MAINTENANCE INSTRUCTION MANUAL

MODEL 261

DIGITAL 'UTILITY' AUDIO PROCESSOR

Rev. 2
March, 2008
(HF Limiter Addition)

INOVONICS BROADCAST

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Section I

INTRODUCTION

MODEL 261 PRODUCT DESCRIPTION

General

The Model 261 is an all-digital stereo AGC/Compressor/Limiter for general-purpose program audio leveling in a broadcasting or production-studio environment.

The 261 operates entirely within the digital domain and utilizes Digital Signal Processing (DSP) circuit architecture for stable and transparent operation. Both analog and digital inputs and outputs are provided.

AGC, compression and peak-control functions are normally used together to afford a comprehensive audio leveling system, but any of the three processing tasks may be enabled or defeated from the front panel menu should a particular application require only a single function or a different combination of functions.

The 261 is set up and controlled by navigating a menu with a simple series of pushbuttons. A rear-panel switch may be used to lock-out the front-panel selector buttons to protect processor setup.

Features

Leading features of the Model 261 include:

- Gain-riding AGC erases long-term level variations in the input program source.
- "Look-ahead" peak limiting provides absolute-ceiling peak control without flat-topped clipping.
- Independent high-frequency limiter affords protection for the FM pre-emphasis characteristic.
- Program-controlled time constants assure optimum sonic quality and program consistency.
- Easy installation and setup is assured by intuitive menu-selected options, which are kept to a minimum for uncomplicated operation.
- Front-panel alarms and rear-panel tally outputs give local and remote indication of program source problems.
- The straightforward all-digital design minimizes reliance on hardware, but does incorporate common, readily-available components to facilitate maintenance.

MODEL 261 TECHNICAL SPECIFICATIONS

Frequency Response:
±0.25dB, 20Hz-20kHz at 44.1kHz and 48kHz sampling rates; ±0.25dB, 20Hz-15kHz at 32kHz sampling rate.

Noise:
Digital Mode: Better than 120dB below the limiter output ceiling, 20Hz-20kHz.
Analog Mode: Better than 75dB below the limiter output ceiling, 20Hz-20kHz.

Distortion:
<0.1% THD, 100Hz-20kHz.

Crosstalk:
Digital Mode: Better than –120dB between channels.
Analog Mode: Better than 65dB between channels.

Latency:
Total program signal delay through the processor, using either analog or digital I/Os, is 4.3ms.

Program Line Inputs:
Digital: AES/EBU (XLR); accepts 16/24-bit audio at 32/44.1/48kHz sampling rates.
Analog: Active-balanced/bridging XLR inputs accept nominal program line levels between –15dBu and +15dBu.

Program Line Outputs:
Digital: AES/EBU (XLR); syncs to same rate of input program when the digital input is selected, or may be set to 32/44.1/48kHz output rate when analog program inputs are used.
Analog: Active-balanced XLR outputs deliver nominal program line levels between –10dBm and +10dBm.

AGC Function:
Unobtrusive, peak-and-average-weighted correction for long-term input level variations; ±15dB capture range.

Compressor/Limiter:
The "look-ahead" design has program-controlled attack and release timing optimized for unobtrusive operation. The average level compression feature incorporates additional gain with a 'floating platform' separation between the two functions.

Independent HF Limiter:
An independent pre-emphasis-protection limiting function guards against FM carrier overdeviation due to the 50μs or 75μs transmission pre-emphasis curve. The limiter output characteristic may be selected either for flat response or a pre-emphasized output when the HF limiter is used.

Alarms:
Front-panel flashing display and open-collector NPN transistor 'tally' outputs for:
- Input overload
- AGC out-of-limits
- Loss of input ('dead air')

Power Requirements:
105–130VAC (0.250A fuse) or 210–255VAC (0.125A fuse), 50/60Hz; 15 watts.

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

BLOCK DIAGRAM

Figure 1, below, is a simplified Block Diagram of the Model 261, shown as an "analog equivalent" of the digital audio processing architecture. A full set of schematic diagrams appears in the Appendix, Section V.

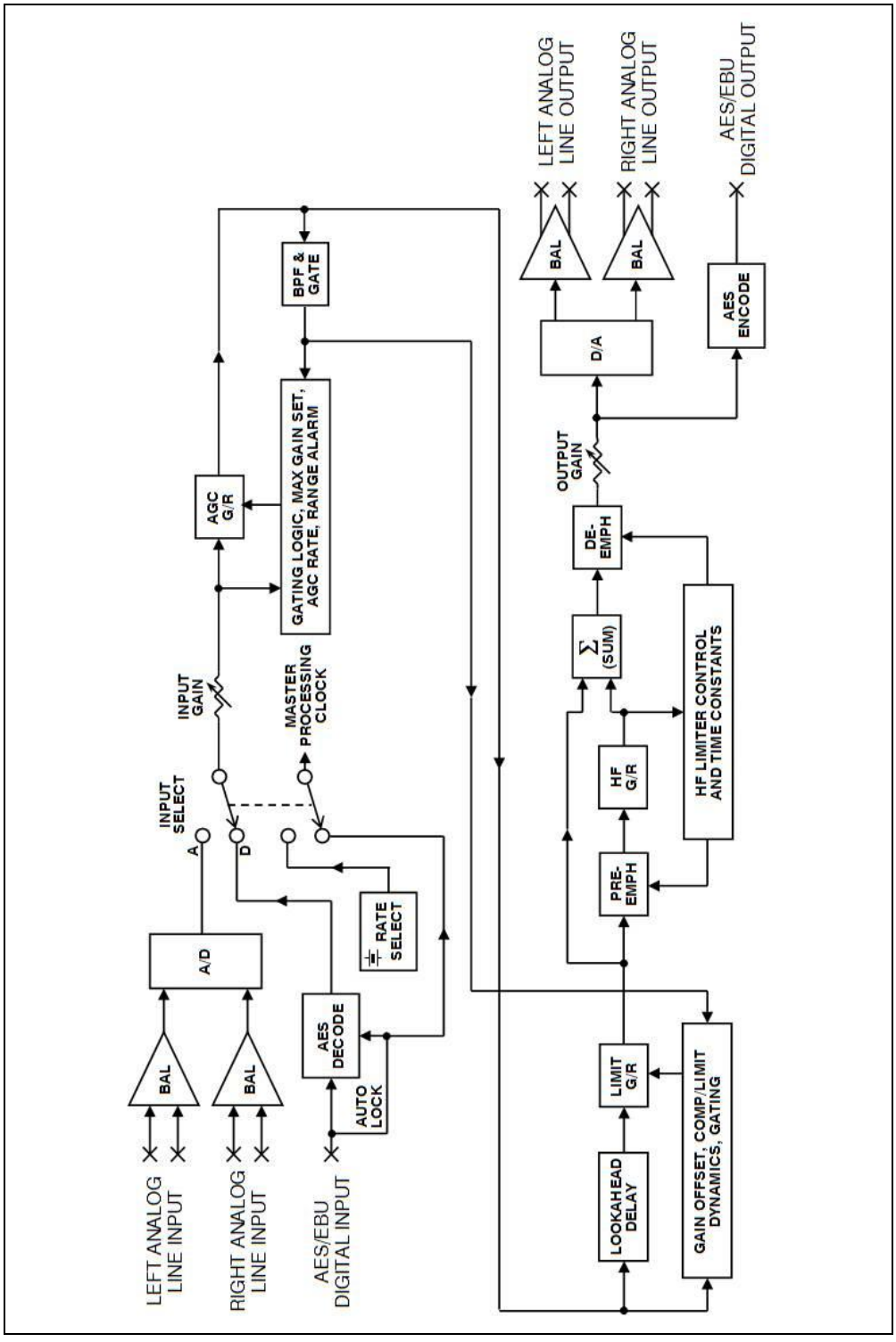


Figure 1 - Block Diagram, Model 261 Digital Utility Processor

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. Registration may also be completed online at www.inovon.com. Not only does registration assure coverage of the equipment under terms of the Warranty and provide a means of tracing lost or stolen gear, but registration also ensures that the user will automatically receive any service or modification instructions.

MOUNTING

Rack Requirement The Model 261 mounts in a standard 19-inch equipment rack and requires only 1¾ inches (1U) of vertical rack space. We recommend screws with plastic washers to protect the painted finish around the mounting holes.

Heat Dissipation Consuming less power than a fish-tank air pump, the 261 itself generates negligible heat. The unit is specified for operation within an ambient temperature range extending from freezing to 120°F/50°C. Be aware that adjacent, less efficient equipment may radiate substantial second-hand heat, so 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. Note that the cap has space for a spare fuse as well. The cap is re-

seated by reversing the removal process. This fuse also serves as a front-panel emergency power disconnect.

Mains Voltage Selector

Unless specifically ordered for export shipment, the 261 is set at the factory for operation from 115V, 50/60Hz AC mains. This can be confirmed by checking the designation beneath 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 directly behind 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 listed on the rear panel. You can remove the factory strikethrough with lacquer thinner or nail polish remover and then cross out the inappropriate marking with an indelible felt pen.

Power Cord

The detachable IEC-type power cord supplied with the 261 is fitted with a North-American-standard male plug. The individual cord conductors may be color-coded in either of two ways, regardless of the shipping destination:

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 (RFI)

Location

Although the Model 261 is expected to be installed in the vicinity of high-power radio or TV transmitters, please practice reasonable care and common sense in locating the unit away from *abnormally* high RF fields.

Ground Loops

Because the active-balanced analog inputs and outputs of the 261 are not truly floating, but are 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, although the chassis somehow must be returned to earth ground for safety. Generally, being screwed-down in the equipment rack will satisfy the safety requirement.

LINE INPUTS AND RANGE SELECTION

Digital Input Connection

The rear-panel AES/EBU DIGITAL I/O — INPUT is a transformer-coupled XLR female connector that accepts 16/24-bit stereo digital inputs at sampling rates of 32kHz, 44.1kHz and 48kHz. Sampling rate selection is automatic, and the rate is displayed on the front-panel LCD. The digital input also synchronizes the digital line output to the same rate, except when analog inputs are used.

Left and Right Analog Input Connections

The ANALOG LINE INPUT(s) are rear-panel female XLR connectors. These are electronically-balanced (transformerless) high impedance 'bridging' inputs that do not provide termination for the console or other equipment that feeds the 261. Most professional equipment nowadays has low output impedances and high input impedances. The concept and folklore of 600-ohm "line matching" dates from the age of transformer coupling and is rooted in ancient telephone practices. With few exceptions, audio line impedance matching is happily disregarded by today's hip audio industry.

Unbalanced Analog Inputs

The Model 261 may be fed from unbalanced outputs, such as found on disco mixers and consumer entertainment electronics. For unbalanced lines, the single center conductor of the shielded input lead should be connected to Pin 2 of the XLR connector, and the shield connected both to Pin 1 and to Pin 3.

Analog Input Gain Range

The 261 can accommodate line-level program inputs with a nominal "Zero-VU" value anywhere between –25dBu and +10dBu. A set of jumpers beneath the top cover optimizes the range of the menu-accessed INPUT GAIN adjustment and helps to avoid A/D converter headroom issues.

As shipped, the Model 261 is jumpered for line levels in the +4dBm, range, common to most audio consoles and other professional studio gear.

Higher program levels are typical of early US broadcast practices, but may still be encountered in European installations. Lower levels are typical of 'semi-pro' or consumer products, or with feeds from lossy studio-transmitter telephone line circuits.

Gain Jumpers

Analog input gain-set jumpers are located beneath the top cover and at the end of the rows of components directly behind the ANALOG LINE INPUT connectors. They are labeled JP1 and JP2 for the RIGHT and the LEFT channels, respectively. Each jumper strip has a push-on jumper 'shunt,' which may be placed in 3 positions as shown in Figure 2 on the following page.

The three push-on positions are marked: –10, 0 and +10. Choose the position that is closest to the nominal, "Zero-VU" program line level that is connected to the analog input of the Model 261. If the line level is +4dBm, select the "0" position. If interfacing with consumer-equipment line levels, "–10" is the proper choice. The dBu clipping point of the analog input stages and/or A/D converter is approximately 30dB above the figure shown. The 261 would have approximately 26dB of analog headroom with a +4dBm program line

when the jumper is in the "0" position. Fine adjustment of the input level to the processor is made using the front-panel menu. (See Page 13).

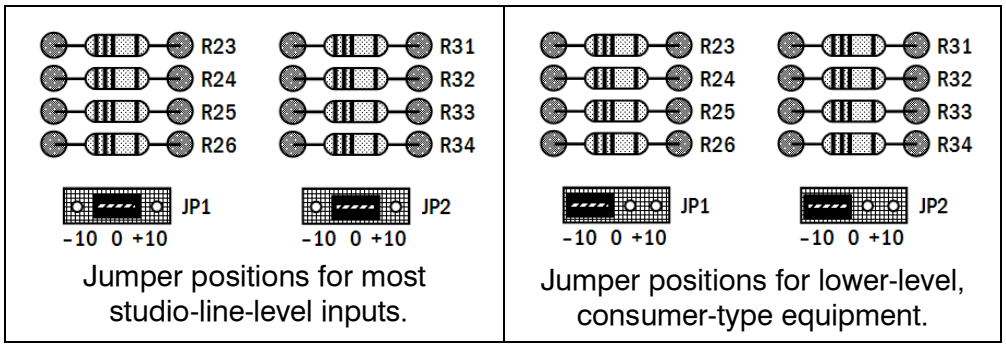


Figure 2 - Analog Input Gain Range Jumpering

LINE OUTPUTS

Analog and digital outputs are available concurrently.

Digital Output

The rear-panel AES/EBU DIGITAL I/O — OUTPUT is an XLR-male connector delivering an electronically-balanced (transformerless) digital signal. When the 261 is fed with a digital input, this output will assume the same sampling rate. When the 261 is fed left-and-right analog inputs, the output sampling rate is selected by the front-panel menu. (See Page 12)

Left and Right Analog Output Connections

Analog program line outputs are rear-panel male XLR connectors. These are true active-balanced outputs with a symmetrical resistive source impedance of 200 ohms. The nominal "0VU" output line level may be adjusted between –15dBu and +10dBu with the front-panel menu and buttons. (See Page 13)

If the 261 is connected to feed single-ended (unbalanced) equipment, connect the center conductor of the shielded interconnect lead to Pin 2 of the XLR connector and the shield both to Pin 1 and to Pin 3.

ALARM "TALLY" OUTPUTS

The 261 has rear-panel alarm 'tally' outputs for three program audio fault conditions: 1) INPUT OVERLOAD, 2) AGC RANGE LIMIT and 3) PROGRAM LOSS (silence-sense). These alarms are coincident with front-panel alarm indications, which are covered under the corresponding discussions of processor operation.

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 on the terminal strip as well. 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.

SELF-CALIBRATION UTILITY

The 261 incorporates a self-calibration routine that automatically compensates for inevitable DC offsets in the D-to-A converter. Normally this routine is performed at the factory and does not have to be repeated on a routine basis. However, if either the DSP board or the plug-in EEPROM on the main board are replaced (for a firmware upgrade, for example), the self-calibration routine will start with the next power-up. Alternatively, self-calibration can be forced by holding down all four menu-navigation buttons while power is turned on.

Whether the routine self-initiates or is forced, follow instructions that will appear on the LCD screen. The procedure takes about 3 minutes.

Section III

SETUP AND OPERATION

NAVIGATING THE MENU AND SELECTING OPTIONS

The right-hand side of the LCD display shows SETUP AND STATUS and the left-hand side shows the processing gain state for COMPRESSION AND LIMITING and AGC GAIN when these functions are enabled. When a specific LCD-screen item is discussed in the manual text, it will be defined by using this font: MENU ITEM.

Front-Panel Buttons

All processing adjustments and metering functions of the Model 261 use the four front-panel pushbuttons in concert with the LCD menu screen. Up/down ▲ and ▼ MENU buttons scroll among menu screens to show what is available for selection or adjustment. Any user-selectable/adjustable function is indicated on the LCD screen by a right-facing arrow: ▷. The left/right ◀ and ▶ SEL (select) buttons are then used to make changes in that menu item. Any changes made are automatically held in non-volatile memory, which means that the 261 will return to an 'as left' condition following a power interruption.

Panel Lockout Switch

Because the ◀ and ▶ buttons make actual (and audible) changes in the operation of the processor, a switch is provided to lock these buttons out. This switch is located on the rear panel and is labeled FRONT PANEL, with UNLOCK and LOCKED positions. When the switch is in the LOCKED position, ◀ and ▶ buttons do not function, although the menu may still be scrolled with ▲ and ▼.

INITIAL POWER-ON AND SETUP

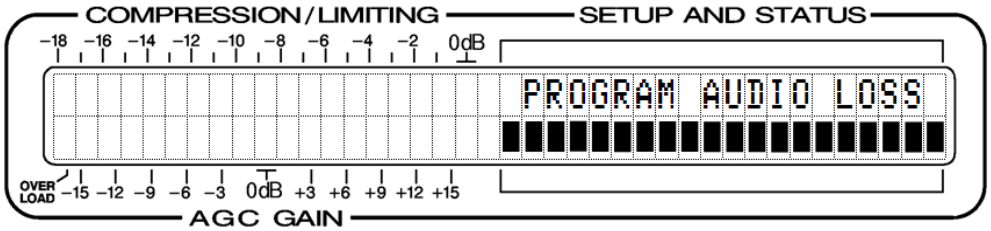
"Splash" Screen

When power is first applied to the 261, an information screen is displayed for about 3 seconds. Holding down any one front-panel button during power-up will hold this screen for extended viewing.

This "splash" screen identifies the product and shows the version of firmware installed. Firmware is updated in the field by replacing an EEPROM memory chip; more about this on Page 24.

Alarms

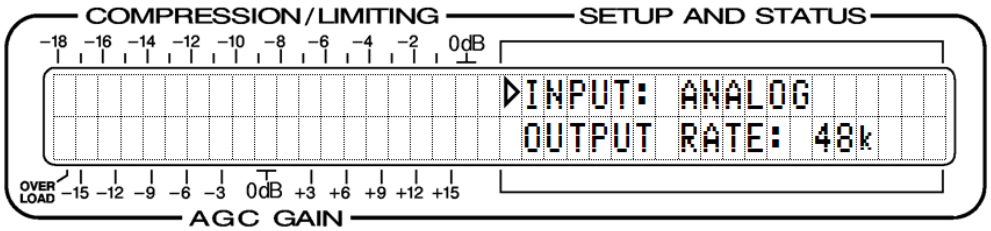
Certain conditions of the program input signal will initiate flashing front-panel indications and rear-panel 'tally' logic outputs. These alarms will be addressed in the appropriate discussions of processing functions. However, the PROGRAM AUDIO LOSS alarm needs to be mentioned here, as it will appear with no program input connected.



The 261 monitors the AGC-corrected program level through a frequency-weighting filter that favors legitimate speech and music frequencies. When the program level falls approximately 26dB below nominal for a period of 10 consecutive seconds, the 261 will give the PROGRAM AUDIO LOSS alarm shown in the illustration. Concurrent with the flashing front-panel alarm, a closure to ground will be put on the rear-panel PROGRAM LOSS terminal. *Pressing any front-panel button will reset the flashing indication for about 5 seconds, allowing menu items to be selected and set.* The rear-panel 'tally' will not be interrupted, however. Remote alarm outputs are *not* temporarily reset with the front-panel buttons, but require the fault condition to be cleared.

Analog/Digital Inputs

Use the ▲ and ▼ buttons to cycle to the INPUT and OUTPUT screen. With the ▷ cursor set as shown below, use ◀ and ▶ buttons to select either the ANALOG input or the DIGITAL input, whichever is the one that will be used.

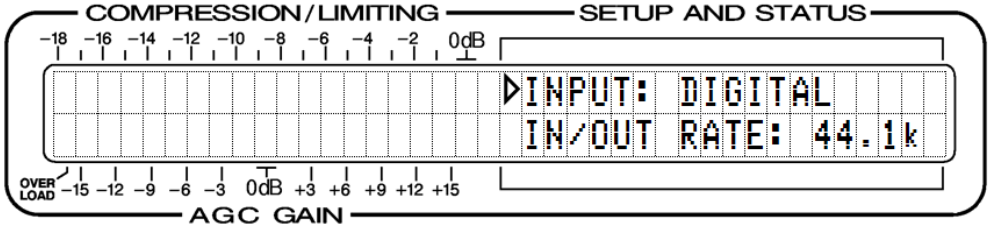


Output Sampling Rate

Regardless of the input mode selection, both the analog and digital outputs are simultaneously available. When using analog inputs, the output sampling rate is set on this same screen by dropping the cursor down and selecting between 32kHz, 44.1kHz and 48kHz.

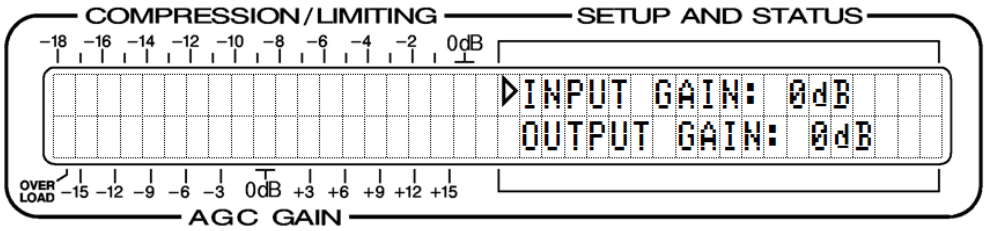
When the DIGITAL input is selected, the 261 will determine the incoming sampling rate and display it on the bottom line of the Status screen. With no digital input, or with a nonstandard sampling rate, a ? (question mark) will be displayed and the 261 will be nonfunctional.

The output sampling rate will always be the same as the input rate when the DIGITAL input is used.



Input Gain Adjustment

Use the ▲ and ▼ buttons to cycle to the INPUT GAIN and OUTPUT GAIN screen:



With the ▷ cursor set as shown above, the ◀ and ▶ buttons allow adjustment of the input gain over a ±15dB range in 1dB steps. This setting applies to either the analog or the digital inputs, whichever is selected. *There is no provision for independent gain settings for analog and digital input signals.* If the two input modes are used alternately, then input gain may have to be reset when the selection is changed.

Refer to Page 8 for proper circuit board jumper positions for the analog line inputs. For typical studio-level program lines circuit board jumpers will be set to the default "0" position.

Analog Input Gain (Studio Levels)

The input gain structure is such that, with a nominal input line level of 0dBu and an INPUT GAIN: setting of 0dB, AGC GAIN should wander slowly in the center of its range for most program material. This means that a typical +4dBm studio program line would require an INPUT GAIN: setting of -4dB. Similarly, a +8dBm program line would require a -8dB setting.

Analog Input Gain (Semi-Pro Equipment)

Disco mixers, consumer CD players and other gear of that genre has typical line levels in the 300mV range, or about –10dBu. When connecting the ANALOG INPUT(s) to this equipment, observe the connection instructions on Page 8, and set the circuit board input gain jumpers in the –10 position as described on the same page.

Digital Input Gain Structure

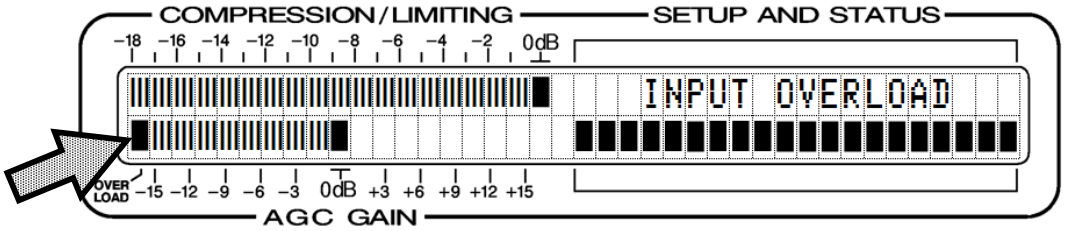
When the AES/EBU digital input is selected, an INPUT GAIN: setting of 0dB matches a digital "0VU" level of –20dBFS. INPUT GAIN: may be adjusted ±15dB from this value.

Regardless of the input mode selected, INPUT GAIN: *is optimally set when the* AGC GAIN *bargraph hovers about the 0dB point on the scale, or when* INPUT GAIN: *is adjusted for a desired amount of* COMPRESSION/LIMITING *when AGC is not used.*

Input Overload Alarms

The Model 261 has bodacious internal headroom in both the analog and the digital domains. There are two alarms, however, that monitor program waveform excursions to alert the operator should internal levels reach about 95% of digital full-scale.

The primary alarm gives both a flashing INPUT OVERLOAD indication on the Status screen and a closure on the rear-panel INPUT OVERLOAD terminal.



This primary alarm has an *integrated* peak response to program signal overloads, allowing the occasional transient to slip through. However, a secondary indicator, marked OVERLOAD (arrow) has instantaneous peak response. This secondary flasher is held for a sufficient period to make even the briefest overload visible to the operator.

NOTE: This alarm, marked by the arrow in the illustration, is shared with the peak limiter as well (see Page 18), and it is *not* associated with a rear-panel closure for remote indication.

Output Gain Setting

With the ▷ cursor positioned with the ▲ and ▼ buttons, OUTPUT GAIN: is also variable over a ±15dB range, adjusting both the analog and digital outputs concurrently. *There is no provision for independent gain control over the analog and digital outputs,* although a common setting should be satisfactory for both modes, which are available simultaneously.

Analog Output Level

With reference to the maximum, fully-limited "ceiling" output of the peak limiter, an OUTPUT GAIN: setting of 0dB will yield a balanced analog line output of 0dBu. Thus to match a nominal +4dBm program line, OUTPUT GAIN: would be set to +4dB. To match typical consumer equipment line levels, OUTPUT GAIN: would be set somewhere in the -10dB range.

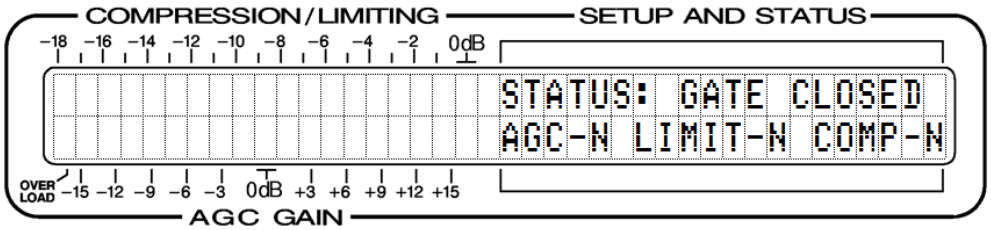
Digital Output Level

Again, referred to the fully-limited "ceiling" output of the peak limiter, an OUTPUT GAIN: setting of 0dB sets the digital ceiling value at –20dBFS. This can then be adjusted over a ±15dB range.

PROCESSING FUNCTIONS DISCUSSED AND ILLUSTRATED

Status Screen

In the SETUP AND STATUS display area, the Status screen is 'home base' for the various menu options. It shows whether audio is present (GATE OPEN), and which of the three processing functions is enabled: Y for yes, N for no, and the numerical indication of 50u or 75u when the independent pre-emphasis-protection limiter is enabled (see Page 20).



Gated AGC

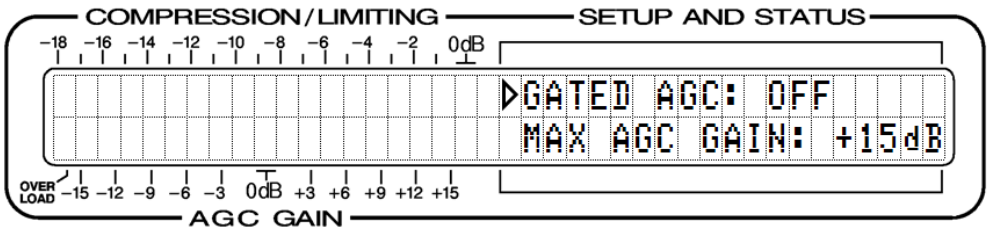
AGC, or Automatic Gain Control, is a slow "gain riding" function of the 261, analogous to a conscientious board operator closely watching the level meter and regulating the audio level very gradually.

AGC is sometimes also called 'leveling,' and is useful in erasing the *long-term* audio level variations that are a normal result of operator inattention, inconsistency between music cuts, or even the response or interpretation of volume-indicating meters. AGC should have negligible audible effect, serving instead to deliver a more constant level to subsequent limiting and compressions stages so that they might provide more consistent results.

AGC Response

The actual *response* of the AGC circuit to program material is quasi-peak-responding, with an integration characteristic similar to that of a European PPM. The *correction rate*, on the other hand, is slow and unobtrusive.

AGC is enabled by scrolling with the ▼ button to the next screen.

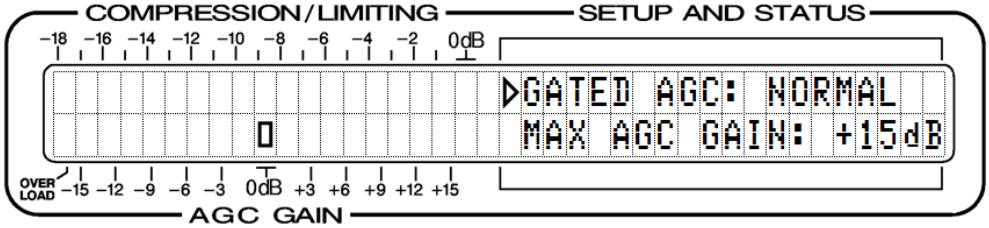


With the ▷ cursor positioned as shown above, ◀ and ▶ may be used to toggle the AGC among its three modes: OFF, NORMAL and FAST.

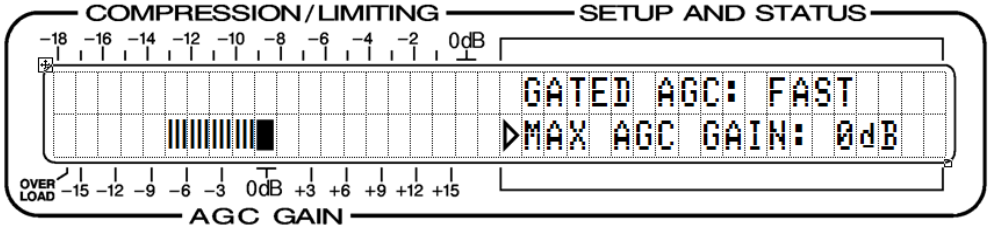
Gating Defined and the GATE Indicators

An AGC or other processing function is said to be *gated* when gain is held, or locked, during brief pauses in the program. This prevents background sounds from increasing to unnatural proportions; think of crickets in the background of a movie dialog track.

When Model 261 AGC is enabled, a gate indicator 'box' appears above the 0dB mark. The box is 'empty' when the gate is closed; that is, during pauses in speech or when no program is present. The box becomes a solid block when the gate is open and the AGC is operating.



The AGC has a 'resting' value at the 0dB point on the AGC GAIN scale. A proper adjustment of Model 261 input gain causes the AGC to hover around the 0dB mark most of the time that the AGC is operating. When the gate closes, AGC gain will slowly return to the 0dB resting point.



The previous illustration introduces a couple of other AGC options:

AGC Rate (Speed)

The NORMAL setting for the AGC is the best choice for most processing situations. The NORMAL correction rate of the AGC is very slow and unobtrusive. Very 'tight' pop-music formats, on the other hand, may well benefit from more rapid AGC action offered in the FAST mode. The primary risk in using a faster AGC is the danger of gain-riding action becoming audible under some circumstances. In an interview situation, for instance, it may be more apparent that the gain is being ramped up and down when the FAST mode is selected. Classical and jazz music may suffer this risk as well.

The FAST AGC setting is always useful when setting up the 261, allowing INPUT GAIN: to be set more quickly. AGC should probably be reset to NORMAL once gain has been adjusted.

Maximum AGC Gain

Typically, the AGC works *symmetrically* around a nominal 0dB gain. When the level drops, AGC gain increases; when the level rises, AGC gain goes into the negative region. The normal AGC *capture range* is ±15dB.

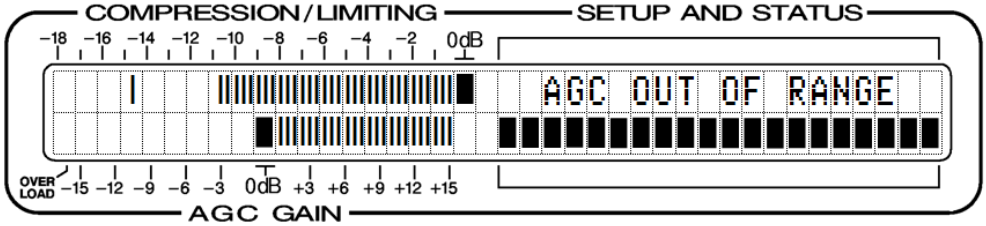
Some situations are better served with non-symmetrical AGC action. Sportscasting and classical music are two examples. In both instances, low-level events such as crowd noises and *pianissimo* passages are legitimate parts of the program. These may well be of a sufficient level to open the AGC gate, but they do not want to be brought slowly to full modulation by the AGC.

For this reason, a cap, or 'ceiling' value, may be placed on the AGC gain. Scrolling the ▷ cursor down to MAX AGC GAIN allows the operator to set the maximum AGC gain at any value between +15dB and 0dB. With 0dB selected, AGC can bring *down* the level of loud program material, but will not bring background sounds or low-level music *up* to full level.

AGC Range Alarm

The AGC has a stated capture range of ±15dB. This range should be more than adequate for all situations, and the need for additional long-term control indicates a problem elsewhere in the audio program chain, suggesting a possible violation of signal headroom constraints as well.

Whenever AGC gain gets to the end of its ±15dB range limit, the 261 initiates an alarm. The flashing front-panel AGC OUT OF RANGE indication is shown on the next page. This is accompanied by a rear-panel AGC RANGE LIMIT closure to ground for a remote indication.



The Dynamics of Model 261 Processing

The Limiting and Compression functions of the 261 utilize an equivalent common signal path and control loop for the digital audio signal. Limiting and Compression are separated by a floating gain 'platform' that establishes static gain and the processor's attack and recovery timing.

Limiting is a very quick peak-control function. Attack timing of the Model 261 is "negatively instantaneous," as the look-ahead technology is able to act on a program peak actually before it happens! Release is similarly quite fast, the object being to control the level of isolated program peaks without 'poking a hole' or causing audible 'ducking' in the program envelope.

The term Compression is subject to various interpretations and definitions. Historically, a studio level compressor had a specified compression *threshold* and certain compression *ratio*. Beginning at a specified input level, the 1:1 input vs. output relationship would take a different slope; maybe 1.5:1, 2:1 or even steeper. But 'compression,' as offered by the 261 and many other fine Inovonics products, means just that: *compression of the program dynamic range*. There is, of course, still a threshold, below which the program is treated on a 1:1 basis. But in our products this tends to be quite near the output final-limited "ceiling" value, leaving all dynamics of the program untouched before a certain critical amplitude, at which all action starts to take place.

The Compression 'Platform'

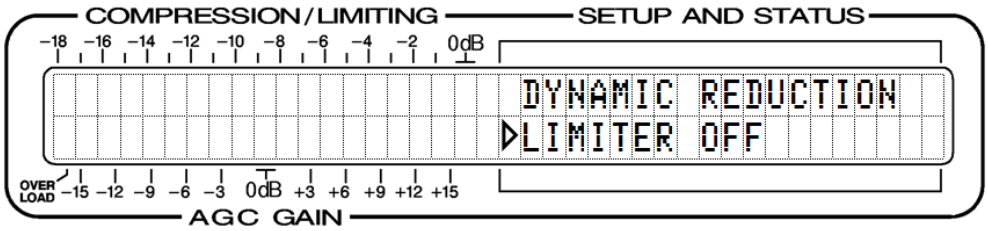
Beginning with the introduction of our first audio-dynamics processor for broadcasting in 1974, Inovonics has utilized the 'floating platform' principle of dynamic range compression. A certain amount of static gain is added to the signal, forcing it well into final limiting, with attack and release timing of the complex dynamic control defining the difference between Compression and Limiting.

In short, a dual time constant applies to processing dynamics: a quick release of peak reduction to a certain 'platform' level, and then a slower release of the platform toward the restoration of full circuit gain. The platform level is established by an *average* response to program dynamics, and typically rides about 6dB below the normal value of peak reduction.

This 6dB target figure depends very much on the dynamics of the program material. Speech, with its high average-to-peak ratio, will result in a greater amount of peak limiting, while contemporary pop-music (generally already highly compressed!) will show lighter peak control. In this manner, the dynamics of program control action complement the dynamics and requirements of the source material. The peak limiter works harder on 'peaky' sources and the compres-

sor regulates program levels more smoothly based on an average response to the material.

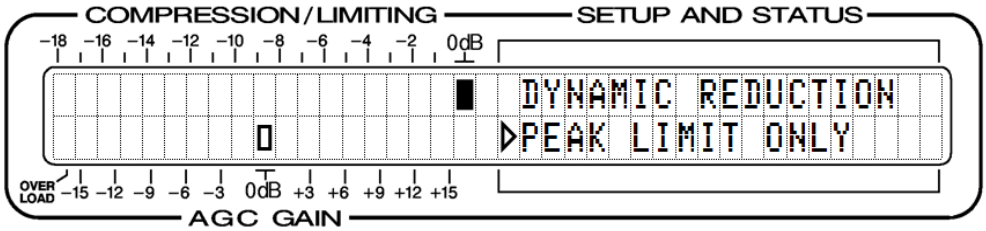
The DYNAMIC REDUCTION screen is illustrated here:



Operating mode choices are made with the ◀ and ▶ select buttons. These are: LIMITER OFF, PEAK LIMIT ONLY and LIMIT AND COMPRESS. The independent high frequency, pre-emphasis-protection limiter is a separate function and is discussed on Page 20.

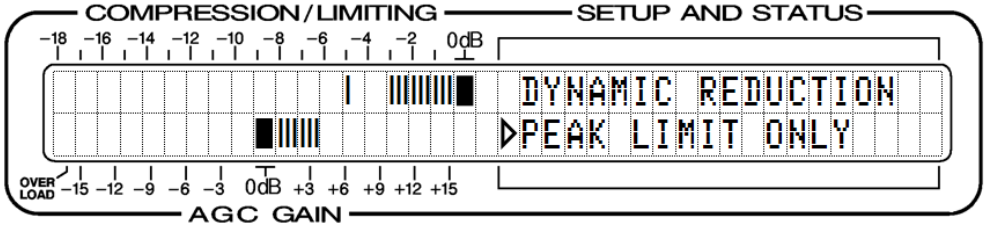
The Limit-Only Mode

Although the 261's limiter can be used entirely by itself (with AGC and Compression turned off), we recommend using AGC ahead of the limiter. The gentle gain-riding action of the AGC will ensure that the limiter always operates in its optimum range, controlling only the program peaks in an unobtrusive manner.



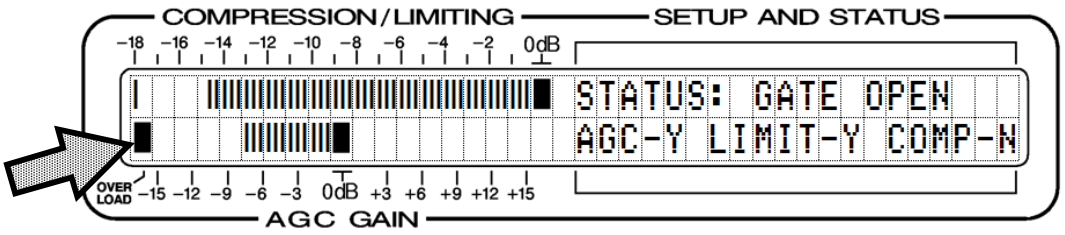
In the limit-only mode, limiter action is not gated. Note the solid block at 0dB on the COMPRESSION/LIMITING scale. Also note that AGC has been enabled in this case, and that the gate is closed.

Peak reduction will be shown on the upper bargraph, with a peak-hold segment showing the highest recent value of gain reduction, as illustrated below. The lower bargraph indicates action of the AGC as it maintains a constant input to the limiter.



Limiter Overload

When the limiter is used alone, or with compression, or even in concert with the AGC when 'peaky' material is processed, it is possible that the limiter will be called on to work harder than expected. An OVERLOAD indicator flashes with a fixed duration whenever the limiter attenuates more than about 18dB.

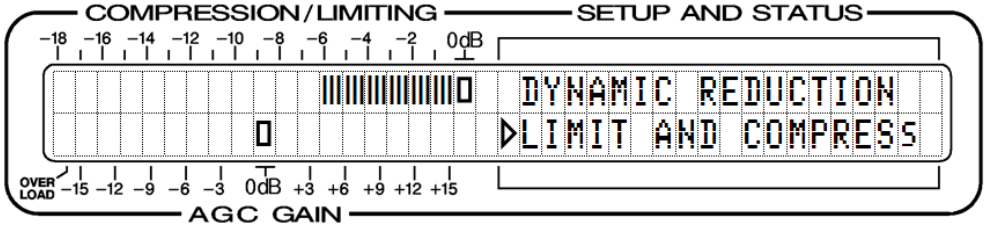


This alarm is located in the lower, left-hand corner of the screen and indicated by the arrow here. This alarm is shared with the input-overload-sensing circuit, which is discussed at the top of Page 14. This alarm has no associated tally output.

Limit and Compress

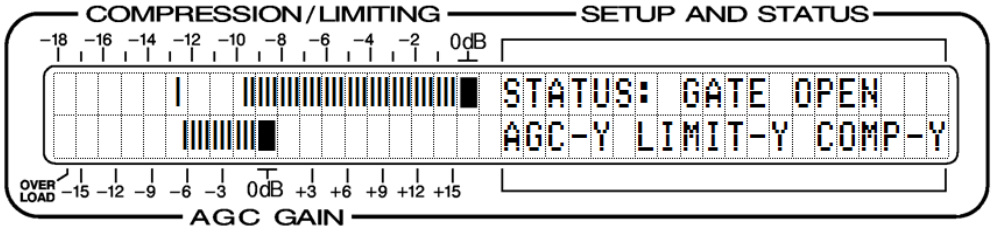
Compression of program dynamics is available only as an extended feature of the peak limiter, as explained earlier under the discussion of the compression 'platform.' Compression is not available as an independent function.

When compression is enabled, the level of the signal applied to the limiter section is increased by a static 6dB. At the same time, this added gain is subtracted-out by forcing the compression platform to a –6dB resting point.



Compression is gated, the same as the AGC, and in the illustration above the gate is closed. Compression will seek its –6dB resting value just as the AGC seeks 0dB.

As the input program signal has been given additional static gain, the comparative loudness of the program material will increase correspondingly. The limiter will continue to work quickly on program peaks, but the compressor will act more on the average level of the signal. The combination of all three processing functions ensures a certain consistency to the audio program.



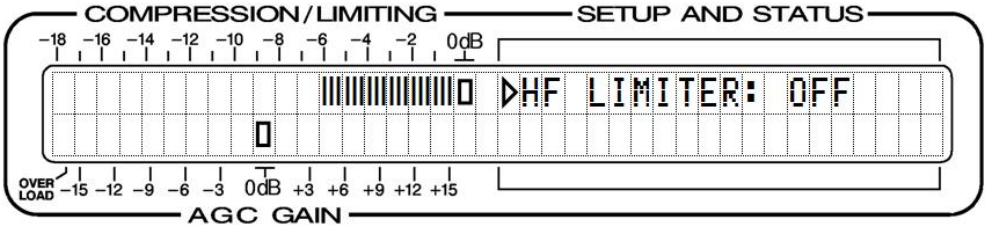
This illustration shows how the 261 might appear in operation as a general-purpose leveler for loudness normalization.

The Independent High Frequency Limiter

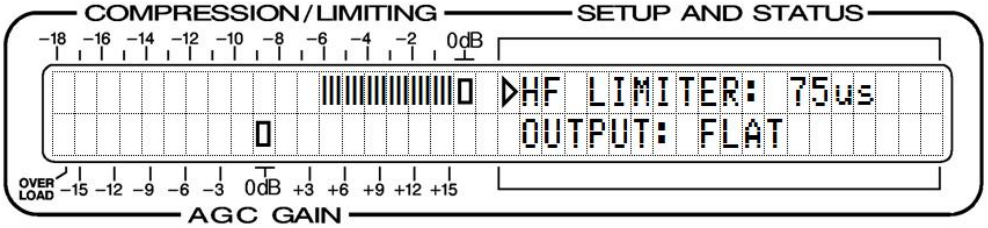
A pre-emphasis protection limiting function was added to the 261 with the introduction of Rev. 2 firmware. When the 261 is used as an FM airchain processor, this function ensures that overmodulation will not occur as a result of the normal 50- or 75-microsecond transmission pre-emphasis characteristic.

NOTE: The HF limiter is to be used only with systems that employ transmission pre-emphasis and complementary de-emphasis in the receiver. This includes FM broadcasting and analog L/R-mode STL links.

The independent high-frequency limiter may be enabled only when the broadband limiting function is turned on. With DYNAMIC REDUCTION set to PEAK LIMIT ONLY, or to LIMIT AND COMPRESS, scroll down ▼ one more screen to this menu:



With the ◀ and ▶ select buttons, the HF limiter can be set to protect either the 50μs or 75μs pre-emphasis transmission curves:



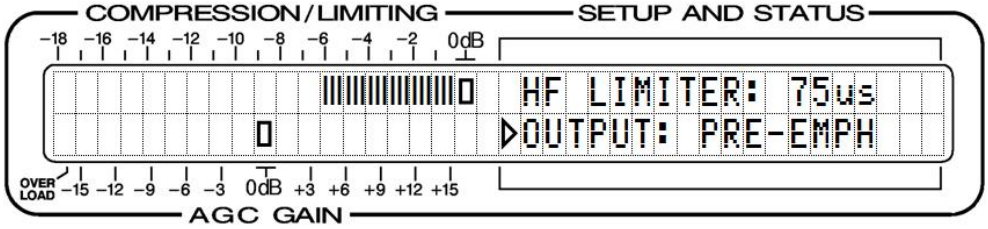
When either characteristic is chosen, another programming option becomes available.

Flat or Pre-Emphasized Output

With the HF limiter engaged, the output of the 261 may be set to have either a flat or a pre-emphasized output characteristic. This is set by scrolling down ▼ to OUTPUT: and making a selection with the ◀ and ▶ buttons.

Set to FLAT, the 261 output will exhibit a frequency-flat overall characteristic below the HF limiting threshold. Above threshold the limited output 'ceiling' will fall at the rate of 6dB/octave, beginning at the pre-emphasis turnover frequency. This is the proper setting when pre-emphasis is supplied by the stereo generator or digital stereo-gen in the FM exciter. In this case, the *falling* response of the 261 is complemented by the *rising* characteristic of transmission pre-emphasis to maintain carrier deviation at full modulation at all frequencies.

With OUTPUT: set to PRE-EMPH, the output of the 261 will follow the pre-emphasis curve below the HF limiting threshold, and then level-off at the limiter ceiling value at frequencies above the pre-emphasis turnover point. Use this setting only if pre-emphasis is turned off in the stereo-gen or exciter.



CAUTION: Be aware that "double pre-emphasis" will result if the 261 is set as shown above, *and* the stereo generator or FM exciter imparts transmission pre-emphasis as well. This is a condition to be avoided like the proverbial plague.

Section IV

CIRCUIT DESCRIPTIONS

INTRODUCTION

This Section details the circuitry of the Inovonics Model 261 Digital Utility Audio Processor. Circuit descriptions refer to the four pages of Schematic Diagrams contained in the Appendix, Section V.

Component Annotation

Schematics for the 261 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 main circuit board in a logical top-to-bottom and left-to-right manner, following the physical placement of the parts in 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.

With respect to the SMD components on the plug-in DSP board, *good luck!* This is a multilayer board with microscopic parts on both sides and some circuit points completely inaccessible. I suppose this is one of the great benefits of the rapid progress in our industry.

ANALOG INPUTS AND OUTPUTS

Analog Line Input

Referring to the left program channel (which is identical to the right), IC11A and IC11B are unity-gain buffers for the differential (balanced) analog program line input. The 'T' attenuator associated with the circuit board gain-range jumper, JP2, delivers a balanced drive to pins 31 and 32 of the DSP board via main-board connector J9.

Jumping up to the DSP board, the balanced program input is buffered and single-ended by IC5B, and then fed to the analog left-channel input of IC1, a DSP support chip that provides all A-to-D, D-to-A and AES/EBU digital signal conversion functions.

Analog Line Output

Pin 51 of IC1 is the single-ended, left channel D-to-A output. A corresponding DC reference comes out on pin 57. These D/A pins are fed differentially to IC4B, which filters, amplifies and buffers the analog program audio delivered to the main board on pin 4 of main-board connector J9.

Back on the main board, IC9B performs additional filtering and drives the monolithic balanced line-driver stage, IC8. This device is intended exclusively for professional audio applications and contains

a cross-coupled feedback network that make it perform more like a transformer-coupled output than the more common antiphase op-amp circuits.

With the 261 delivering a "+4" output, for example, +4dBu will be measured *between* pins 2 and 3 of the LEFT ANALOG LINE OUT connector. If the voltmeter instead measures either output pin with a *ground* reference, however, the reading will be 6dB low, or –2dBu. But grounding either pin 2 or pin 3 will force the other side of the output back up to +4dBu. A truly balanced output!

DIGITAL INPUTS AND OUTPUTS

The AES/EBU digital input of the Model 261 is transformer-isolated by T2. Digital audio is fed to the DSP board on pin 36 of J9.

On the DSP board, digital audio is delivered directly to pin 23 of the DSP support chip, IC1, where it is formatted for processing by the DSP, IC2.

IC1 also converts raw processed data back into the AES/EBU format, which is delivered to the main board on pin 35 of J9. The various sections of IC6 deliver a quasi-balanced AES/EBU digital output to the connector of the same name on the rear panel of the 261.

ALARM TALLIES

The DSP chip, IC2, directly drives three transistors, Q1, Q2 and Q3. The open collectors of these transistors provide a "solid state" closure to ground for the three program signal fault alarms. +5V is delivered to the terminal strip as well, and is current-limited by R6.

POWER SUPPLY

The power transformer, on the main circuit board, has dual primary windings that may be switched in parallel or in series for 115V or 230V AC mains. Bridge rectifier CR1 delivers raw DC to three switching regulators, IC1, IC2 and IC3, providing +3.3V, +12V and –12V, respectively. Linear regulators IC4 and IC5 reduce the ±12V to ±5V for analog ICs on the DSP board.

THE DSP BOARD

There's really not much to say about the DSP board, beyond the analog buffer amplifiers already described.

The ADAV803 'DSP support chip,' IC1, has already been credited with providing all A/D, D/A and AES/EBU formatting functions. In

its latter role, IC1 contains a PLL circuit to lock to the incoming digital audio data rate. A secondary 'support' chip, IC3, initiates a power-on reset to both IC1 and DSP IC2.

Both IC1 and IC2 operate from a +3.3V supply rail, which is delivered by separate +3.3A (analog) and +3.3D (digital) power buses, which eventually go back to the +3.3V switching regulator. In addition, IC2 requires yet another power supply source, but thankfully supervises its own switching supply, requiring only a MOSFET, Q1, and coil L1.

PROGRAM AND SETTINGS MEMORY

IC12 on the main board is a serial EEPROM 'memory chip.' At power-up, the contents of this memory are loaded into the DSP. This includes the processing algorithms and all user settings, which are loaded back into this chip as they are made.

IC12 provides an easy and relatively inexpensive means of issuing updates for the 261. Replacing this plug-in IC amounts to 'firmware' updating, as opposed to 'software' updating, which would be accomplished with a download or from a disk. Omitting a communications port in the Model 261 has greatly simplified the design, and was judged not to pose a compromise in an otherwise uncomplicated product.

Section V

APPENDIX

This section of the Model 261 Manual contains Parts Listings, Schematic Diagrams and an explanation of Inovonics' Generous and Liberal Warranty Policy.

PARTS LIST

EXPLANATION OF PARTS LISTINGS

This section contains listings of component parts used in the Inovonics 261 Digital Utility Processor. Not all components are listed by schematic reference designation; those that are considered 'generic' may have qualification notations, however.

NOTE: The DSP board has a redundant numbering sequence that starts over from the beginning. Components on the plug-in DSP board are *not considered replaceable* and are not listed here.

Component descriptions may or may not specify a particular manufacturer or vendor. 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.

Should you need to order part that is not listed here, 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… maybe a surprise!

PARTS LISTINGS

C1,2	Capacitor, Y-class Ceramic Disc, .0047μF, 440VAC; Murata/Erie DE7150 F 472M VA1-KC
C3	Capacitor, Electrolytic, radial leads, 2200μF, 35V; Digi-Key P7 466-ND
C4,6,8	Capacitor, Electrolytic, radial leads, 100μF, 50V; (open)
C5,7,9	Capacitor, Electrolytic, radial leads, 470μF, 16V; (open)
C10,17,20,21,22,28, 29,31,32,35,36,39, 42,43,46,47,48,49	Capacitor, Monolithic Ceramic, 0.1uF, 35V; (open)
C11-14	Capacitor, Electrolytic, radial leads, 2.2μF, 50V; (open)
C15,16,1819,34,38	Capacitor, Mylar, "Mini-Box", 0.01 μF, 5%, 100V; Wima FKS-2 or MKS-2 series.
C23-26	Capacitor, Disc Ceramic, 100pF, 100V; (open)
C27,30,40,41,44,45	Capacitor, Non-Polar Electrolytic, 22μF, 25V; (open)
C33,37,	Capacitor, Mylar, "Mini-Box", 0.0022 μF, 5%, 100V; Wima FKS-2 or MKS-2 series.

CR1	Diode, Bridge Rectifier; Rectron VM48
CR2,3,5	Diode, Silicon Schottky; (open) 1N5822
CR4,6	Diode, Silicon Rectifier; (open) 1N4005
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.)
IC1,2,3	Integrated Cct.; National LM2594N-3.3
IC4	Integrated Cct., LM7805/TO-220; Digi-Key NJM#7805FA-ND
IC5	Integrated Cct., LM7905/to-220; Digi-Key NJM#7905FA-ND
IC6	Integrated Cct.; (open) 74HC04-DIP
IC7,8	Integrated Cct.; Analog Devices SSM2142PZ
IC9,10,11	Integrated Cct.; (open) LF353N
IC12	Integrated Cct.; Microchip 24AA512-I/P *(Requires factory programming, available only from Inovonics)*
J1	Connector, AC Mains; Switchcraft EAC303
J2	Connector, 6-position 'Barrier'; Weco 121-M-211/06 Plug-In Terminal Block is Weco 121-A-111-06
J3,5,6	Connector, XLR Male; Neutrik NC3MAH
J4,7,8	Connector, XLR Female; Neutrik NC3FAH2-0
J9,10,11,501	Connector, Dual-Row "Breakapart" Header *(as required)*
JP1,2	Connector, Single-Row "Breakapart" Header *(as required)* Shorting "Shunt" for 0.1-inch header strips; (open)
L1-3	Inductor, 78uH, 0.82A; Digi-Key TE2097-ND
Q1-3	Transistor, NPN; (open) 2N3904

Except at noted by reference designation, **all resistors** used in the 261 are the value specified on the schematic, qualified as follows:

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

S1	Switch, Voltage-Selector; ITW 18-000-0022
S2	Switch, SPDT Toggle; C&K 7101-M-D9-A-B-E
S501-504	Switch, Pushbutton; ITT KSLOM312 Button Cap is TEE G004A
T1	Transformer, Power; Signal IF-14-20
T2	Transformer, Pulse; *Inovonics P/N 1545*
LCD DISPLAY	2 X 40 Alphanumeric; Optrex C-51850NFQJ-LW-AAN

SOURCES FOR COMPONENT PARTS

Inovonics strives to maintain factory stock of the parts used in products that we manufacture. A good many of the components in the Model 261 are 'generic' and may be obtained from a wide variety of sources.

A few parts may be more-or-less proprietary. These either are manufactured specifically for Inovonics or purchased directly from a manufacturer that sells only in 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' parts at no charge, rather than bothering to generate the necessary paperwork. Always check with the factory as we may well prove the best source for your replacement component needs.

The electronic component distributors listed below have proven themselves 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."

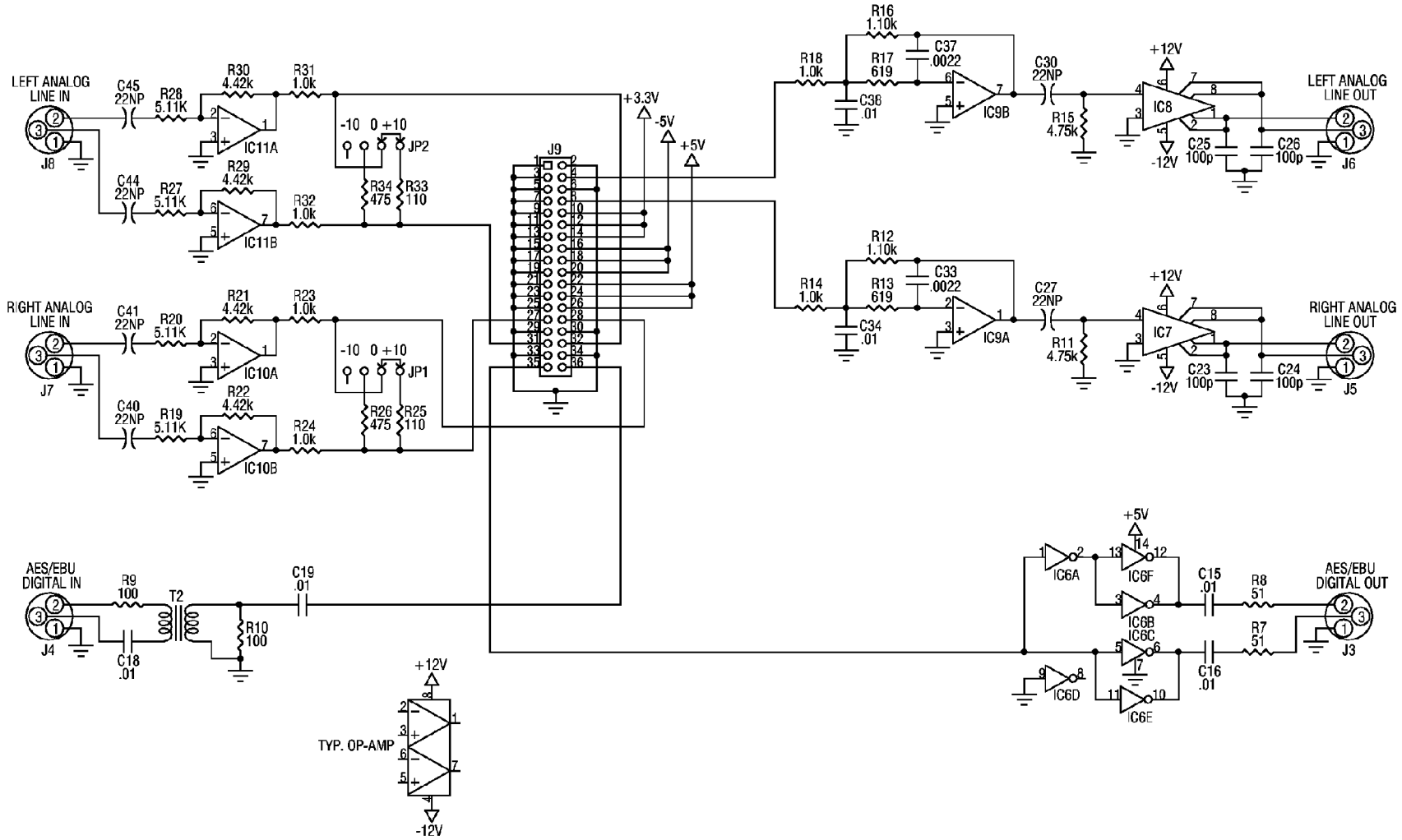
A majority of the ICs, capacitors, resistors or connectors used in the 261 will be available from one or more of these firms. Each supplier maintains a Website and publishes a full-line printed catalog, which is free for the asking. Minimum-order restrictions may apply, and export orders may prove somewhat problematical.

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

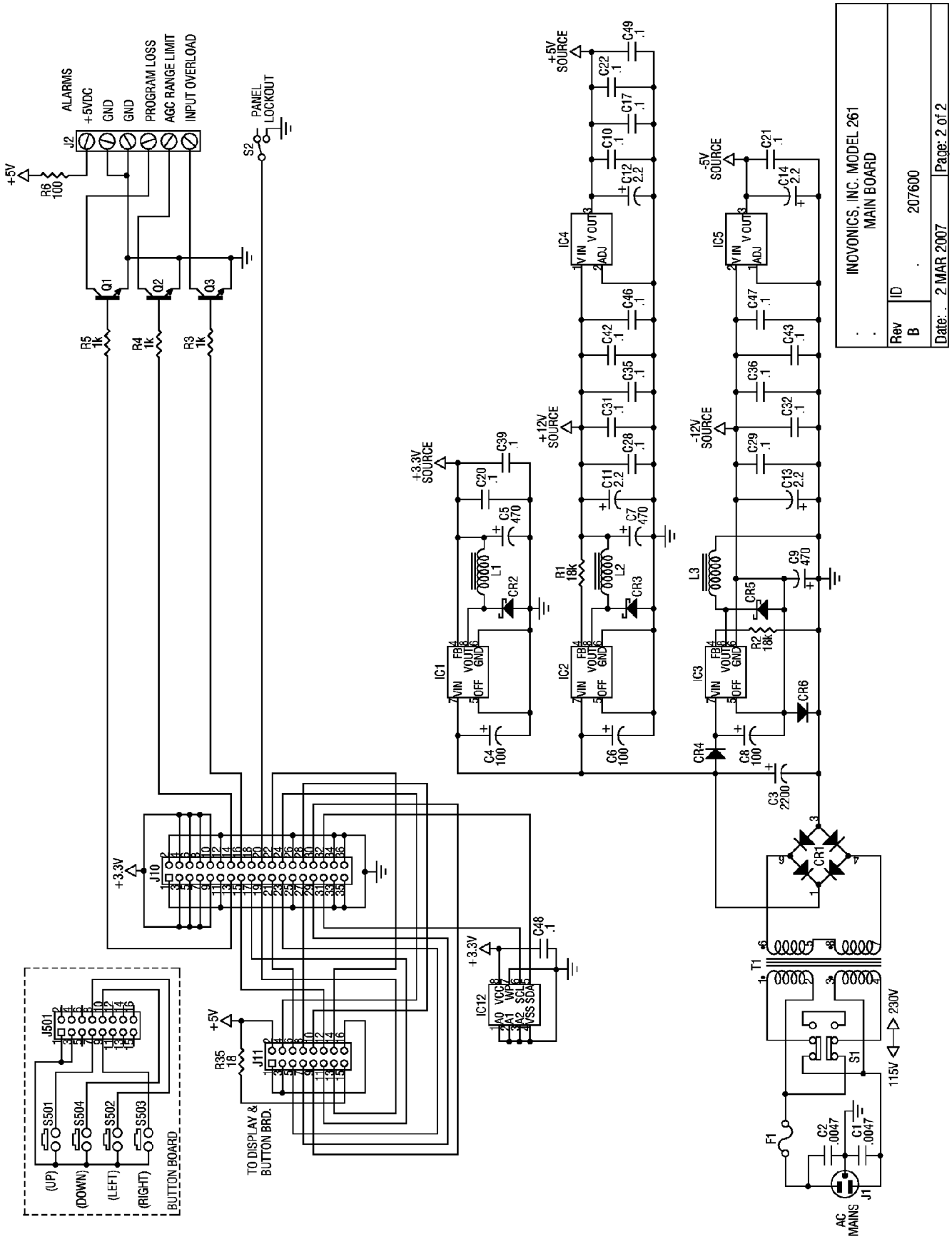
Digi-Key Corporation
www.digikey.com — 1-(800) 344-4539

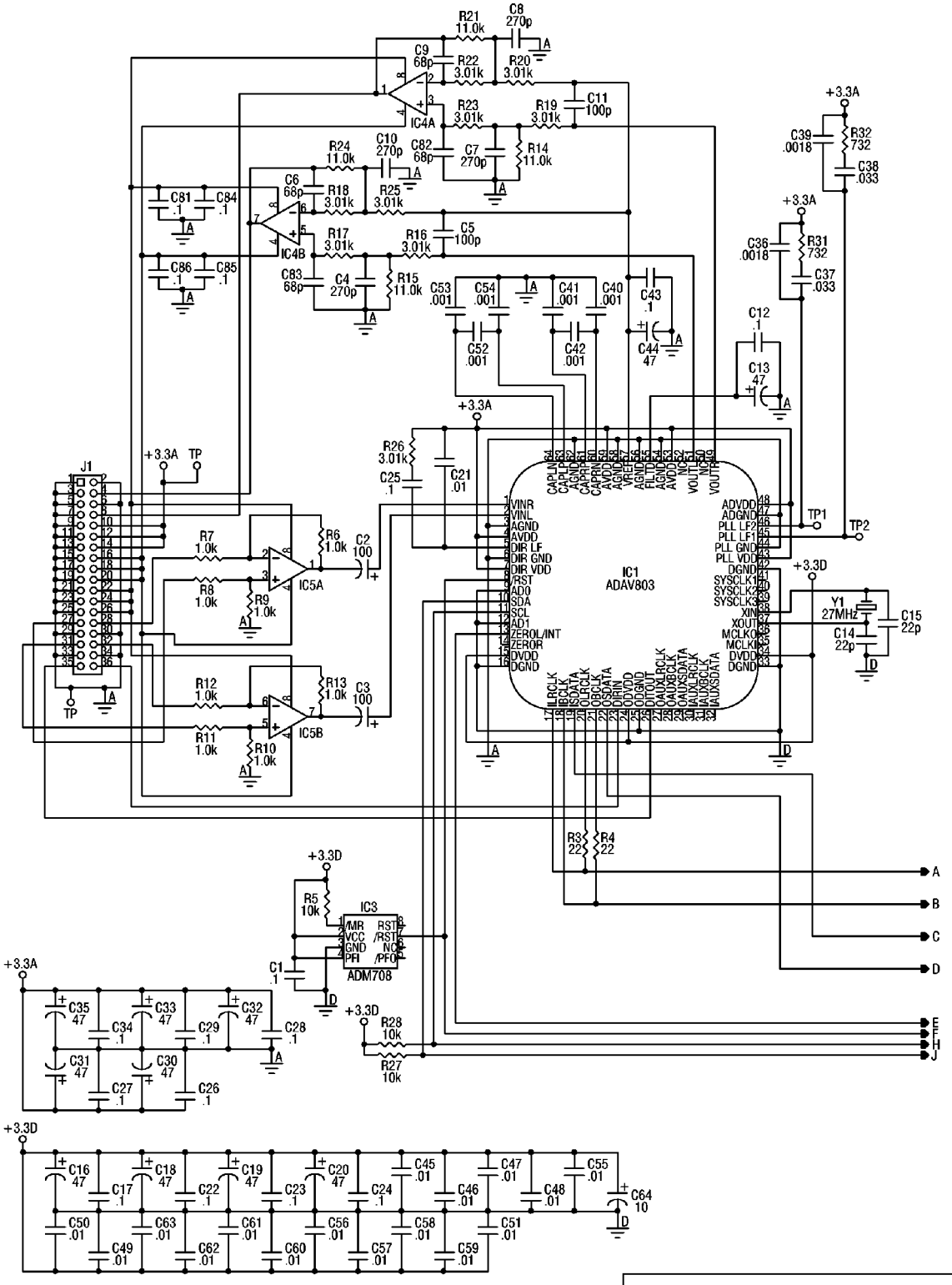
Future-Active Industrial Electronics
www.future-active.com — 1-(800) 655-0006

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



.	INOVONICS, INC. MODEL 261 MAIN BOARD
Rev B	ID . 207600
Date: . 2 MAR 2007	Page: 1 of 2


INOVONICS, INC. MODEL 261
MAIN BOARD
Rev B
ID . 207600
Date: . 2 MAR 2007
Page: 2 of 2
ALARMS
+5VDC
GND
GND
PROGRAM LOSS
AGC RANGE LIMIT
INPUT OVERLOAD
PANEL LOCKOUT
+5V SOURCE
-5V SOURCE
+12V SOURCE
-12V SOURCE
+3.3V SOURCE
BUTTON BOARD
(UP)
(DOWN)
(LEFT)
(RIGHT)
TO DISPLAY & BUTTON BRD.
AC MAINS
115V
230V



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.	DSP BOARD
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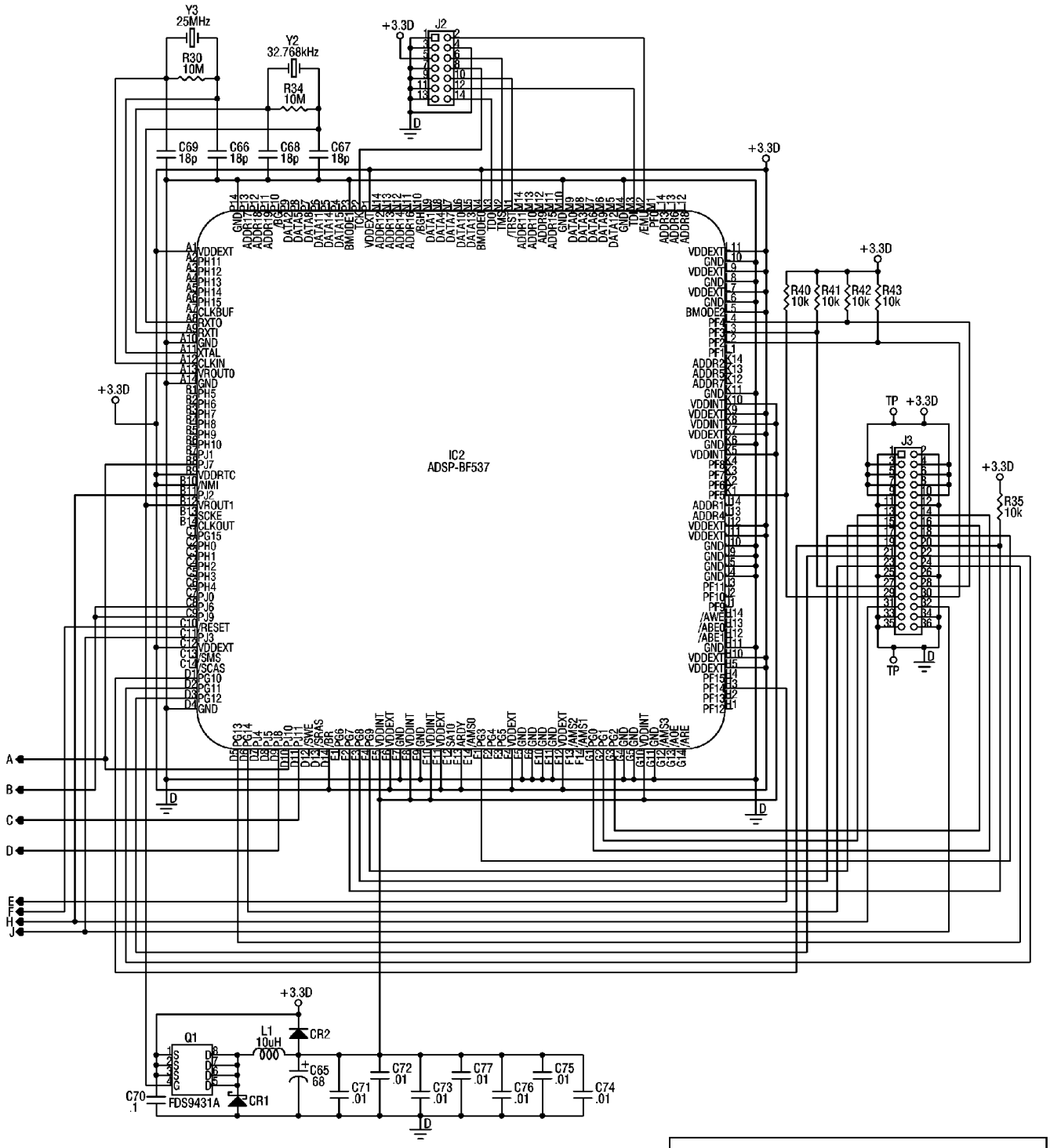

.	INOVONICS, INC. MODEL 261 DSP BOARD
Rev B	ID . 207700
Date: 2 MAR 2007	Page: 2 of 2

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.

Revised Aug. 2012