OPERATING AND MAINTENANCE INSTRUCTION MANUAL

MODEL 264

"QUAD LEVELER" AUDIO PROCESSOR

INOVONICS
INCORPORATED

USER'S RECORD
Model 264 – Serial No. _____
Date Purchased _____
Warranty Card Mailed? — ❑

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MODEL 264

"QUAD LEVELER" AUDIO PROCESSOR

August, 2006

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Section I

INTRODUCTION

MODEL 264 PRODUCT DESCRIPTION

General

The Model 264 contains four separate and independent channels of analog audio gain control. Used separately, the four channels are ideal for microphone leveling or similar monaural applications. Channels may also be selectively linked for dual-stereo or split mono/stereo program control.

The 264 operates entirely within the analog domain and utilizes colorless Class-D (PWM) technology for stable and transparent operation. It employs a unique combination of peak and average response to program dynamics that delivers the gain-riding advantage of an intelligent AGC coupled with the tight peak control of a fast limiter. This particular combination of long- and short-term level correction normalizes the average-to-peak ratios of diverse audio sources to a common and natural-sounding value, giving a consistent level of subjective loudness without the need for excessive compression of program dynamics that can promote listener fatigue.

Features

Leading features of the MODEL 264 include:

- Four independent channels easily configured as 4 mono, 2 stereo, or 1 stereo and 2 mono.
- Processing establishes a fixed and consistent average/peak ratio without overly compressing program dynamics.
- Easy installation and setup is assured by a minimum of user controls. Operation is program-controlled and fully automatic.
- Alarm tally outputs allow remote indication of program source problems.
- The simple and straightforward design utilizes generic, readily available components to facilitate easy maintenance worldwide.

MODEL 264 TECHNICAL SPECIFICATIONS

Frequency Response:
±0.5dB, 20Hz-20kHz.

Noise:
Better than 70dB below the limiter output ceiling, 20Hz-20kHz.

Distortion:
<0.15% THD, 20Hz-20kHz.

Crosstalk:
Better than –70dB between any two channels.

Program Line Inputs:
Active-balanced/bridging XLR inputs accept nominal program line levels between –15dBu and +10dBu.

Program Line Outputs:
Active-balanced XLR outputs deliver nominal program line levels between 0dBm and +10dBm.

AGC Function:
Unobtrusive, peak-and-average-weighted correction for long-term input level variations; 30dB capture range.

Peak Limiter:
Limiting function has program-controlled attack and release timing optimized to yield a nominal 8dB average-to-peak ratio from raw (unprocessed) program material.

Final Safety Clipper:
Front-panel adjustment restricts incidental fast program transients to a value between 0dB and +8dB, relative to the peak limiter ceiling.

Stereo Coupling:
Internal jumpers allow gain-control coupling between Channels 1 and 2, and/or between Channels 3 and 4.

Alarm Outputs:
Open-collector NPN transistor 'tally' outputs signal out-of-limits operation for each channel. Outputs may be interconnected to provide a single remote trouble alarm.

Power Requirements:
105–130VAC or 210–255VAC, 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 264. A full set of schematic diagrams appears in the Appendix, Section V.

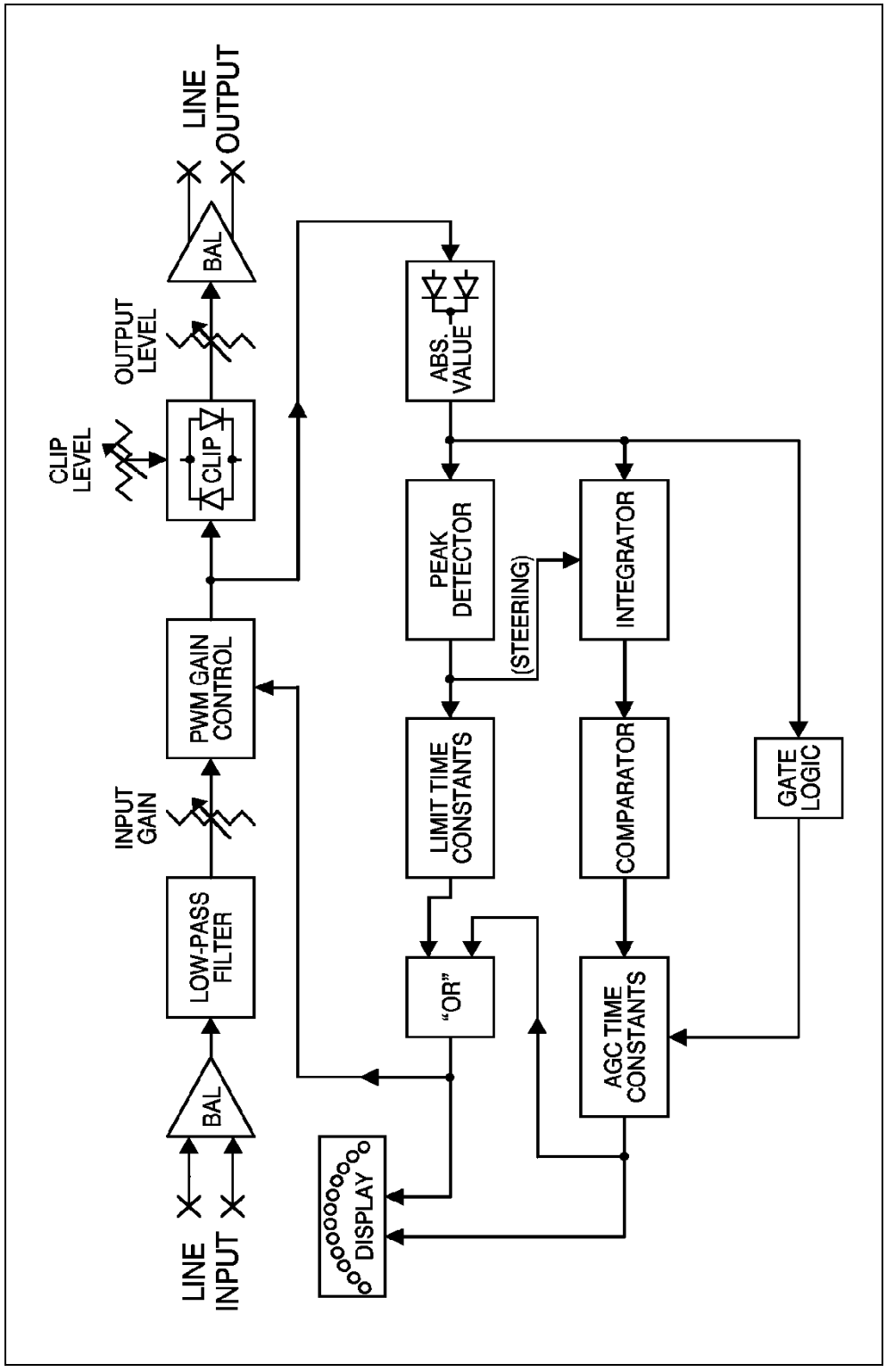


Figure 1 - Block Diagram, Model 264 "Quad Leveler"

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 this ensures that the user will automatically receive any possible SERVICE OR MODIFICATION INSTRUCTIONS.

MOUNTING

Rack Requirement The Model 264 mounts in a standard 19-inch equipment rack and requires only 1¾ inches (1U) of vertical rack space. We recommend using plastic washers to protect the painted finish around the mounting holes.

Heat Dissipation Consuming less power than a pet-grooming hair trimmer, the 264 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. Note that the cap has space for a spare fuse as well. The cap is reseated 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 264 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 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 listed on the rear panel. You can remove the factory strikethrough with some nasty solvent and then cross out the inappropriate marking with an indelible felt pen.

Power Cord

The detachable IEC-type power cord supplied with the 264 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 (R F I)

Location

Although it is expected that the Model 264 may 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 active-balanced inputs and outputs of the 264 are not truly floating and 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, though 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

Input Connections

264 program line inputs 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 264. 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 ridiculed by today's hip broadcaster (you) and quick-witted equipment manufacturer (us).

Unbalanced Inputs

The Model 264 may be fed from gear with unbalanced outputs, such as 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.

Input Gain Range

The 264 can accommodate line-level program inputs with a nominal "Zero-VU" level between –15dBu and +10dBu. This 25dB range is divided into two more manageable, overlapping gain ranges that are selected by an internal jumper for each channel.

As shipped, the Model 264 is set up for professional level inputs in the 0dBu to +10dBu range. Most console and professional studio gear fall into this range, +4dBu and +8dBu being typical "zero-VU" program line levels.

Lower program levels may be encountered when interfacing with 'semi-pro' gear or with feeds from lossy studio-transmitter telephone line circuits. Extra gain for the low-level range (–15dBu to 0dBu) is enabled by changing jumpers beneath the top cover.

Gain Jumpers

Under the top cover and directly between the INPUT and OUTPUT connectors for each channel, you will a 3-pin jumper strip. These are identified as JP1, JP3, JP4 and JP6 for channels one through four, respectively. Each jumper strip has a push-on jumper 'shunt.' LOW and HIGH designations identify the jumper position for low-level and high-level inputs. Jumpering for Channel 1 is shown in Figure 2, below.

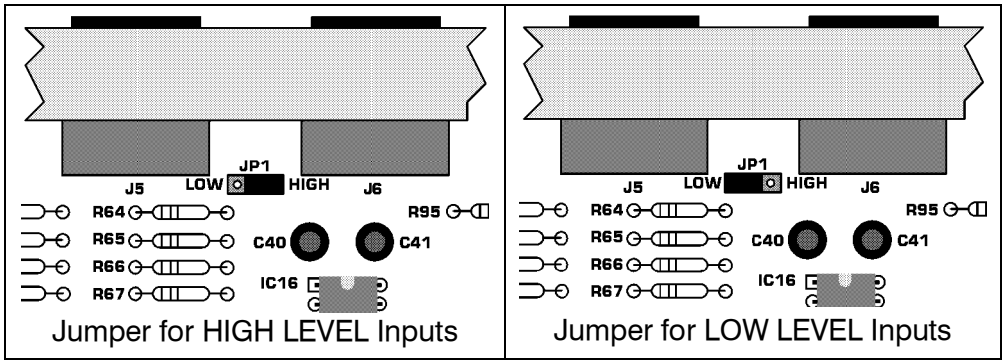


Figure 2 - Input Gain Range Jumpering

LINE OUTPUTS

Program line outputs are rear-panel male XLR connectors. These are active-balanced outputs with a symmetrical resistive source impedance of 200 ohms.

If the 264 is connected to single-ended (unbalanced) equipment, connect the center conductor of the shielded interconnect lead to Pin 2 of the XLR connector and the shield to Pin 1. *Leave Pin 3 unconnected*.

When used single-ended, the output level range is approximately 6dB below the balanced-output value. Even so, the lowest output setting of the 264, approximately –6dBu, may still prove excessive for consumer audio equipment or some computer soundcard inputs. In this case an external resistive pad will prove prudent.

STEREO COUPLING

The four independent channels of audio processing may be used for one or two stereo program feeds. To preserve stereo imaging, gain-reduction is linked between the channels used for right and left program audio. Jumpers beneath the top cover permit linking Channels 1 and 2, and/or Channels 3 and 4. These jumpers are in-line with the front-panel CLIP LEVEL controls for Channels 2 and 4, about midway back on the circuit board. Jumper JP2 links Channels 1 and 2; JP5 links Channels 3 and 4. Figure 3, below, shows how jumpers are configured for mono or stereo operation. When jumpered for stereo, the front-panel LINK indicator between the coupled channels will be lighted.

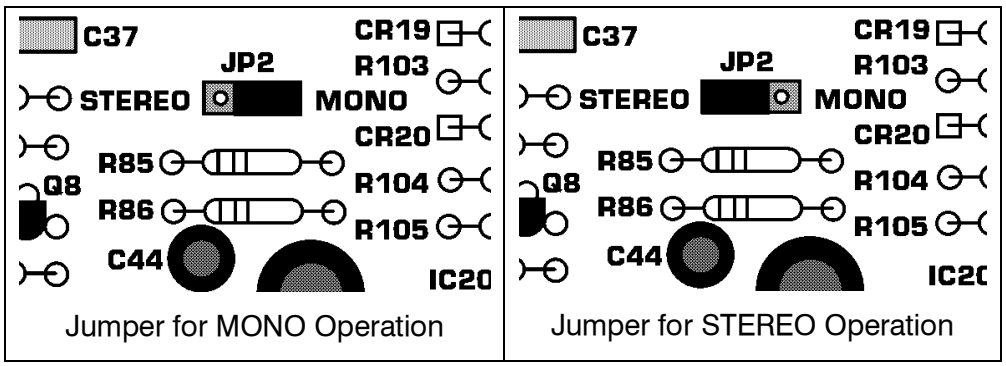


Figure 2 - Stereo Linking Jumper Placement

Section III

SETUP AND OPERATION

PANEL CONTROLS AND INDICATORS

This brief explanation of the front-panel controls and indicators for Channel 1 is typical of all four channels. Please at least skim over this section to verify that our terminology agrees with your understanding. More detailed notes on Model 264 operation follow this initial descriptive information.

The screwdriver-adjusted, front-panel multiturn trim controls (INPUT GAIN and OUTPUT LEVEL) require *fifteen to twenty complete rotations* of the adjusting screw to cover their total operating range. Depending on the manufacturer of the component actually used, the end of the range may, *or may not*, be identified by a "click-click" sound or other audible/tactile sensation.

GAIN REDUCTION METERING

The arc of sixteen LEDs displays the amount of gain correction in effect. The position of the *right-most lighted LED* indicates AGC circuit correction for the longer-term variations in the program level, and should generally hover within ±4 LEDs of the 0dB marking. The endmost LEDs are red to show that the processor is at the limit of its capture range.

AGC action of the 264 is significantly faster than the AGC sections of typical multifunction audio processors. The AGC takes 'cues' from the peak limiter to help maintain a more consistent average level.

INPUT GAIN

The INPUT GAIN control has a 15dB range, which is extended by the input gain range jumpering options described on Page 8. INPUT GAIN is typically adjusted using normal program material to maintain the indicated AGC gain in the center of its operating region. This procedure is detailed on Pages 11 and 12.

GATE

The AGC function of the 264 is "gated," meaning that gain is locked during brief pauses in the program to prevent background sounds from increasing to unnatural proportions. The GATE indicator will remain continuously lighted during most music programming, but will blink off during pauses in speech.

CLIP LEVEL

The average-and-peak gain control afforded by the 264 attempts to maintain the average-to-peak ratio of the output program signal at a maximum value of 8dB. Very rarely will any transient peak of legitimate pro-

gram material exceed 8dB over the average-weighted output.

A final 'safety clipper' is adjustable with the front-panel CLIP LEVEL control. In the fully-clockwise, +8 position, legitimate program material will be clipped on only rare occasions. As the control is rotated counterclockwise, clipping will increase. At 0dB, program peaks will be clipped to the peak value of a steady-state tone leveled by the 264. A more detailed discussion of this can be found on Page 13.

CLIP The CLIP indicator flashes whenever the safety clipper acts on program peaks. The indication is 'held' for a brief period to make clipping of near-instantaneous peaks visible to the operator.

OUTPUT LEVEL This control sets the value of the leveled program signal to the desired nominal line level. The level of a steady-state (sinewave) tone can be set to any value between 0dBm and +10dBm, although program peaks may exceed this value by as much as 8dB.

FUSE / DISCONNECT The front-panel fuseholder also 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.

SETUP PROCEDURE FOR SINGLE-CHANNEL (MONAURAL)

This procedure outlines setup of the Model 264, first for a single-channel, monaural application such as microphone channel leveling, and then describes additional setup considerations when two channels are linked for stereo operation.

At this point the 264 should be installed in the program chain with internal jumpering set for MONO operation (see Page 9) and power applied.

INPUT GAIN Calibration INPUT GAIN is most easily and quickly adjusted in single-channel (mono) applications with typical program material feeding the 264 input.

1. Simply adjust INPUT GAIN until the *right-most* lighted LED hovers around the 0dB point most of the time. Depending on dynamics of the input program source, LEDs to the left of the right-most one will flash as program dynamics are compressed. (The number of LEDs lighted at any given moment indicates the degree of dynamic peak limiting in effect.)
2. If this procedure suggests that control range is outside the adjustment limits, recheck the circuit board jumpering for Line Input Range Selection described on Page 8.

When this procedure is performed properly, and if an operator pays reasonable attention to console metering, the right-most LED should consistently remain in the "safe operating" zone between –8 and +8.

OUTPUT LEVEL Adjustment

The Model 264 OUTPUT LEVEL may be set to whatever value is required by the equipment that the unit feeds. Setting the output to a precise line level requires feeding a tone to the input of the 264. AGC and limiter action will level an input tone to the "peak value of the average level," and a level meter bridging the output of the 264 can be used to set the output to +4dBm or other nominal line level.

Don't discount the venerable mechanical VU meter as a tool for setting levels, using either tones or dynamic program material. Use an ANSI-standard VU meter movement with a 3600-ohm series resistor to bridge the output of a +4dBm program line. Levels may then be set at "Zero-VU" as interpreted by the operator.

SETUP PROCEDURE FOR STEREO

See Page 9 for instructions on linking two channels for stereo. The front-panel LINK indicator between paired channels will be lighted to indicate 'slaved' gain reduction for stereo operation. The channel requiring greatest gain reduction at any given moment will determine a common reduction in both channels. This practice preserves the stereo image and will actually help maintain a perception of the greatest stereo separation.

INPUT GAIN Calibration

INPUT GAIN setup is a more involved when two channels are linked for stereo. *HINT:* Consider *unlinking* the channels during setup and using the procedure for single-channel, monaural operation as described on Page 11. Then *re-link* the channels when calibration is complete. Otherwise test tones must be used as described here.

1. Make sure that the two channels are linked for stereo operation (Page 9). The front-panel LINK indicator will be lighted.
2. Apply a test tone to the left channel input that is 3dB *above* the nominal line level. (+7dBu for a +4 program line, or simply "+3" on a console VU meter.) An elevated level is required for this step as the gated, undriven channel will not allow an indication of gain reduction in the positive direction of either channel.
3. Adjust left-channel INPUT GAIN so that the –2 and –4 indicators are lighted equally. Note that the undriven, right channel will indicate a similar amount of gain reduction.

OUTPUT LEVEL Adjustment

4. With the tone feeding the input as in Steps 1-3, adjust the OUTPUT LEVEL as required by the equipment that the 264 feeds. A level meter bridging the output of the 264 can be used to set the output to +4dBm or other nominal line level.
5. Disconnect the test tone from the left channel, reconnect it to the right channel input, and repeat Steps 1-4 for the right program channel.

ADDITIONAL OPERATING NOTES

Program Dynamics and the CLIP LEVEL Control

The AGC and peak limiter functions of the Model 264 respond to both average and peak levels of the audio program. Circuitry strives to maintain a maximum program average-to-peak ratio of 8dB. This is not to say that 'squashed' material will be expanded to yield this figure, but material with a wider dynamic range will be compressed to this nominal value.

The number of LEDs lighted at any instant indicates how much dynamic reduction is in effect, but as the AGC monitors and is controlled by both average peak program content (as shown by the position of the right-most LED), the arc of lighted LEDs is not truly indicative of the dynamic range of the source material.

The peak limiter will hold legitimate program peaks to a figure 8dB above the average level. This is not to say that a gunshot or dropped Coke bottle won't generate peaks in excess of +8dB, but the built-in 'safety clipper' will slice off those excursions that violate the 8dB figure. However, the response and effectiveness of the peak limiter will ensure that what is sliced off should not be heard as clipping distortion.

The threshold of the safety clipper may be adjusted from the front panel. This is the CLIP LEVEL control, variable between +8 (essentially its 'off' position) and 0dB. The attendant CLIP indicator LED is driven by a one-shot circuit that extends the flash duration so that clipping of even very fast peaks will give a solid visual display.

A CLIP LEVEL setting below +8 is not generally required for the majority of 'leveling' applications, but may be necessitated by headroom shortcomings in the program or transmission channel. The tradeoff for increased clipping, as the CLIP LEVEL control is rotated toward 0dB, is increased audibility of clipping artifacts. Audibility of clipping will depend in large part on the nature of the program material. Pop music can tolerate a good deal more clipping than a dulcet and sonorous announce voice. Also, some solo instruments already rich in harmonic content, such as a trumpet, may well tolerate a good deal of clipping; a piano will not.

The 8dB average/peak ratio established by the limiter is a figure that will sound 'unprocessed' in most instances. Be sure to listen for clipping artifacts on representative program material when the CLIP LEVEL control is set below +8.

Section IV

CIRCUIT DESCRIPTIONS

INTRODUCTION

This Section details the circuitry of the Inovonics Model 264 Quad Leveler. Circuit descriptions refer to the six sheets of Schematic Diagrams contained in the Appendix, Section V, Pages 24 to 29.

Component Annotation

Schematics for the 264 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 logical top-to-bottom and left-to-right manner, following the physical placement of the parts in 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.

A PWM PRIMER

PWM Gain Control

The 264 operates strictly in the analog domain, but utilizes Pulse-Width Modulation (PWM) techniques rather than the more traditional VCAs (voltage-controlled amplifiers) commonly associated with analog processing. PWM technology, as applied to audio processing for broadcast, was pioneered by Inovonics in the early 1980s. We found PWM a simple, colorless, quasi-digital (on/off) method of linear gain control that avoids several hassles associated with more expensive and possibly single-sourced VCA integrated circuits. Our implementation of PWM utilizes the popular 4000-series CMOS parts that are dirt cheap and available in any civilized area.

PWM sets the gain of an analog circuit simply by sampling, or 'chopping,' the analog signal; that is, turning it on and off at a rapid rate. Consider an audio program signal which can be turned on and off with a toggle switch. When the switch is *on* attenuation is zero, and when *off* attenuation is infinite. If we satisfy Dr. Nyquist's axiom, toggling this switch at a rate at least twice that of the highest audio frequency, linear signal attenuation becomes directly proportional to the OFF time as depicted in the chart at the top of the next page.

The 264 sampling rate is 200kHz, ten times the highest program audio frequency. Since this is well above the Nyquist rate, anti-aliasing and reconstruction filters can be simple and gentle.

MODEL 264 PWM GAIN CONTROL ACTION			
Switch ON	**Switch OFF**	**Attenuation Per Section**	**Total Attenuation**
100%	0%	0dB	0dB
50%	50%	6dB	12dB
25%	75%	12dB	24dB
10%	90%	20dB	40dB
1%	99%	40dB	80dB

PROGRAM SIGNAL PATH

NOTE: The four channels have identical circuitry, hence only Channel 1 (Page 24) will be detailed here.

Line Input Balancing

IC10B is a differential amplifier that provides the 'electronically balanced' input with its inherent rejection of common-mode signals. R64 is jumpered in for typical line level inputs in the 0dBu to +10dBu range, or may be jumpered out of the circuit to increase input sensitivity for lower level signals in the –15dBu to 0dBu range.

IC6A is a variable-gain, low-pass filter stage. The filtering suppresses high frequency noise that could be aliased into audibility by the PWM sampling action. R6, in the feedback path of IC6A, is the front-panel INPUT GAIN control to afford variable adjustment over input sensitivity.

PWM Gain Control Stages

For the 40dB of total gain control required, two identical PWM switch-and-filter stages have been cascaded. This reduces the dependence on very small duty cycles (short 'off' time).

CMOS analog switches IC7A and IC7B are driven by a common PWM squarewave to 'chop' the program audio at a 200kHz rate. The duty cycle of the switching waveform determines the degree of gain reduction per the chart at the top of the page. IC8A and IC8B are low-pass 'reconstruction' filter/amplifier stages that remove the 200kHz switching component from the program audio signal. Derivation of the switching waveform is discussed on the next page.

Safety Clipper

Program audio is routed through R60 to transistors Q9 and Q10. The base-emitter junctions of these transistors perform the output clipping function.

The emitter of Q9 is biased at a positive voltage from IC15A, and the base of Q10 at an identical negative voltage from inverter IC15B. The bias is determined by the front-panel CLIP LEVEL control, R20, and buffered by IC15A. The network around R20 scales the voltage to the front-panel markings and CR8 provides temperature compensation for Q9 and Q10.

Q7 is driven into conduction whenever Q9 or Q10 clips the program waveform. Q7 and Q8 form a one-shot multivibrator, driving the

CLIP indicator to full brilliance for a finite period when even a very brief program peak is clipped.

R60 is actually part of active low-pass filter stage IC12A, which begins to roll-off above 20kHz. The fact that the clipper is 'embedded' within this filter helps to reduce the higher-order clipping harmonics.

Output Stage The program signal from IC12A passes through front-panel OUTPUT LEVEL control R39. IC12B drives one side of the symmetrical, 'active-balanced' output, and unity-gain inverter IC10A drives the other side in opposite phase. R41 and R40 establish the 200-ohm resistive output impedance of the 264 and provide elementary protection from output short circuits, lightning and other acts of God.

PWM GENERATION

PWM Ramp Referring to Page 28, IC27A and IC27B comprise a 200kHz free-running multivibrator. IC27C buffers the squarewave, and IC27D differentiates the positive-going edge to generate a narrow negative-going pulse. This pulse turns on Q17 for about 250ns, instantly charging C75 to +6 volts. C75 then discharges with a dB-linear, R/C characteristic to a point just below ground, at which time the next pulse charges C75 once again.

AGC Back on Page 24, the program audio signal is full-wave rectified by IC9A and IC9B. The absolute-value (program peak) output from IC9B is integrated by R53 and C28 to represent the average value of the program signal. This is applied to one input of comparator IC11A, and a fixed DC voltage corresponding to a "0dB" average value of the program signal to the other. IC11A toggles between the power supply rails as the average level of the program varies above and below the "0dB" point.

IC11A feeds IC11B, a true integrator with a fairly long time constant. The DC 'correction' voltage from IC11B passes through CR13, R46 and R45 to one input of high-speed comparator IC16B. (The time constant of R45/R46 and C40 is negligible compared to the slow integration of IC11B.) The PWM ramp from Page 28 feeds the other input of IC16B, which generates the square switching waveform delivered to the two CMOS switches. This describes a fairly traditional feedback AGC circuit that will attempt to maintain a constant average level of the program waveform.

Gating The output of the peak-responding rectifier also feeds one input of comparator IC6B. The other input is fixed at a DC level approximately 25dB below the "0dB" program level. C26 turns IC6B into an integrator as well, making it more-or-less average-responding above the –25dB threshold.

IC6B lights the front-panel GATE indicator when program material is present and the gate is open, but also applies a DC bias to comparator IC14A when the gate is closed. With this bias applied,

IC14A allows AGC gain to release slowly to the 0dB resting value, catching it at this point so that overall circuit gain does not go to the maximum +12 figure during silent periods in the program.

Peak Limiting

The full-wave rectified program signal is also applied to the base of Q5. The emitter of this transistor is biased to a DC level corresponding to the peak value of a "0dB" program signal. Q5 drives Q6 to deliver DC through CR12 and R45 to the PWM comparator, IC16B. This describes a fairly straightforward feedback peak limiter.

Limiter attack time is moderated by the time constant of R45 and C40, and also by local feedback around the Q5/Q6 pair through C30. The limiter releases as C40 discharges back to the AGC-corrected (average) level through R46.

AGC Steering

In the normal course of dynamic gain reduction by the peak limiter circuit, the AGC would compensate for the decreased average level by increasing gain in the signal path. To obviate this, the AGC is 'steered' by the peak limiter to effectively impart its peak-responding characteristic to the AGC only when the limiting threshold is exceeded.

IC13A buffers AGC correction voltage and also imparts both a small bit of gain and a slight positive offset. This is fed to comparator IC13B, which also monitors the 'composite' DC fed to the PWM comparator representing both AGC and the peak limiter gain corrections. Thus whenever peak limiting exceeds AGC average-level correction, IC13B toggles to the positive supply rail. This is fed through R51 to the AGC average-value comparator, IC11A, enabling the AGC to respond to program peak information as well.

STEREO COUPLING

AGC correction voltage appears at the cathode of CR13. Voltage at the collector of Q6 additionally includes peak limiter correction values. These two points are tied to corresponding ones in the companion channel (Page 25) using CMOS analog switch sections. A circuit board jumper couples the channels and lights the LINK indicator (see Page 9).

METERING AND ALARMS

IC5 (Page 28) is a PIC (Peripheral Interface Controller) with eight on-chip A-to-D converters. The DC correction voltages from the AGCs and peak controllers of all four channels are given dB-linear scaling and converted into a serial data stream. Display driver IC4 receives the serial stream from IC5 to light the individual LEDs on the front panel circuit board assembly diagrammed at the top of Page 29.

IC5 also monitors excursion of correction voltage values for all four channels. Individual output transistors saturate to give an effective closure to ground should any value come close to the limit of its operating range. The four collectors of the transistors may be bussed together to generate a common alarm for the four channels if desired. +5V is available on the rear-panel terminal strip as well, but is current-limited to operate LEDs or optical couplers.

POWER SUPPLY

Signal path circuitry operates from the bipolar 9-volt supply diagrammed on Page 29. The two supplies are regulated by linear "three-terminal" IC voltage regulators: IC1 for the +9-volt supply, IC2 for the –9-volt supply. IC3 is a separate +5V regulator for the display and alarm circuits.

The power transformer has dual primary windings that may be switched in parallel or in series for 115V or 230V mains, respectively.

Section V

APPENDIX

This section of the Model 264 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 264 Quad Leveler. 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, 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 variety. Whole number (XXXp) 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 in the 264 is the "minibox" package with 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 264 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, .0047μF, 440VAC; Murata/Erie DE7150 F 472M VA1-KC
C7,8	Capacitor, Electrolytic, axial leads, 1000uF, 35V; (open)
C9,10	Capacitor, Monolithic Ceramic, 0.1uF, 35V; (open)
C14,45,77,108	Capacitor, Non-Polar Electrolytic, 22μF, 25V; (open)
CR1-7	Diode, Silicon Rectifier; (open) 1N4005
CR8-47	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.)
I1,3,4,6,8,9	T1 Yellow LED; ParaLight L-314YD
I2,5,7,10,501,516, 517,532,533, 548,549,564	T1 Red LED; ParaLight L-314HD
I502-515,518-531, 534-547,550-563	T1 Green LED; ParaLight L-314GD
IC1	Integrated Cct.; (open) LM317-T
IC2	Integrated Cct.; (open) LM337-T
IC3	Integrated Cct.; (open) LM7805
IC4	Integrated Cct.; Maxim MAX7219
IC5	Integrated Cct.; (Inovonics) PIC Controller *(Requires Factory Programming)*
IC6,8-15,17,19-26, 28,30-37,39,41-48	Integrated Cct.; (open) LF353N
IC7,18,29,40	Integrated Cct., (open) CD4066B
IC16,38	Integrated Cct.; (open) LM319
IC27	Integrated Cct.; (open) CD4069
J1	Connector, AC Mains; Switchcraft EAC303
J2,3,501	Connector, Dual-Row "Breakapart" Header *(as req.)*
J4	Connector, 6-position 'Barrier'; Weco 121-M-211/06 Plug-In Terminal Block is Weco 121-A-111-06
J5,7,9,11	Connector, XLR Male; Neutrik NC3MAH
J6,8,10,12	Connector, XLR Female; Neutrik NC3FAH2-0
JP1-6	Connector, Single-Row "Breakapart" Header *(as req.)* Shorting "Shunt" for 0.1-inch header strips; (open)
Q1-11,14-16,18, 21-24,27-29	Transistor, NPN; (open) 2N3904
Q6,7,12,13,17, 19,20,25,26	Transistor, PNP; (open) 2N3906

Except at noted by reference designation, **all resistors** used in the 264 are the value specified on the schematic, qualified as follows:

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** (front-panel adjustable) are Tocos RJC097P series, or equivalent 'cermet' types.

R20,94,174,248	Potentiometer, 10k; Piher PT10MH01-103A2020 with Figure 15 spindle. *Inovonics P/N 0580*
S1	Switch, Voltage-Selector; ITW 18-000-0022
T1	Transformer, Power; Signal LP-20-600 (or direct cross-ref.)

SOURCES FOR COMPONENT PARTS

Inovonics strives to maintain factory stock of all parts used in the products we manufacture. A large proportion of the components in the Model 264 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 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 generate the necessary paperwork. Always check with the factory, 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."

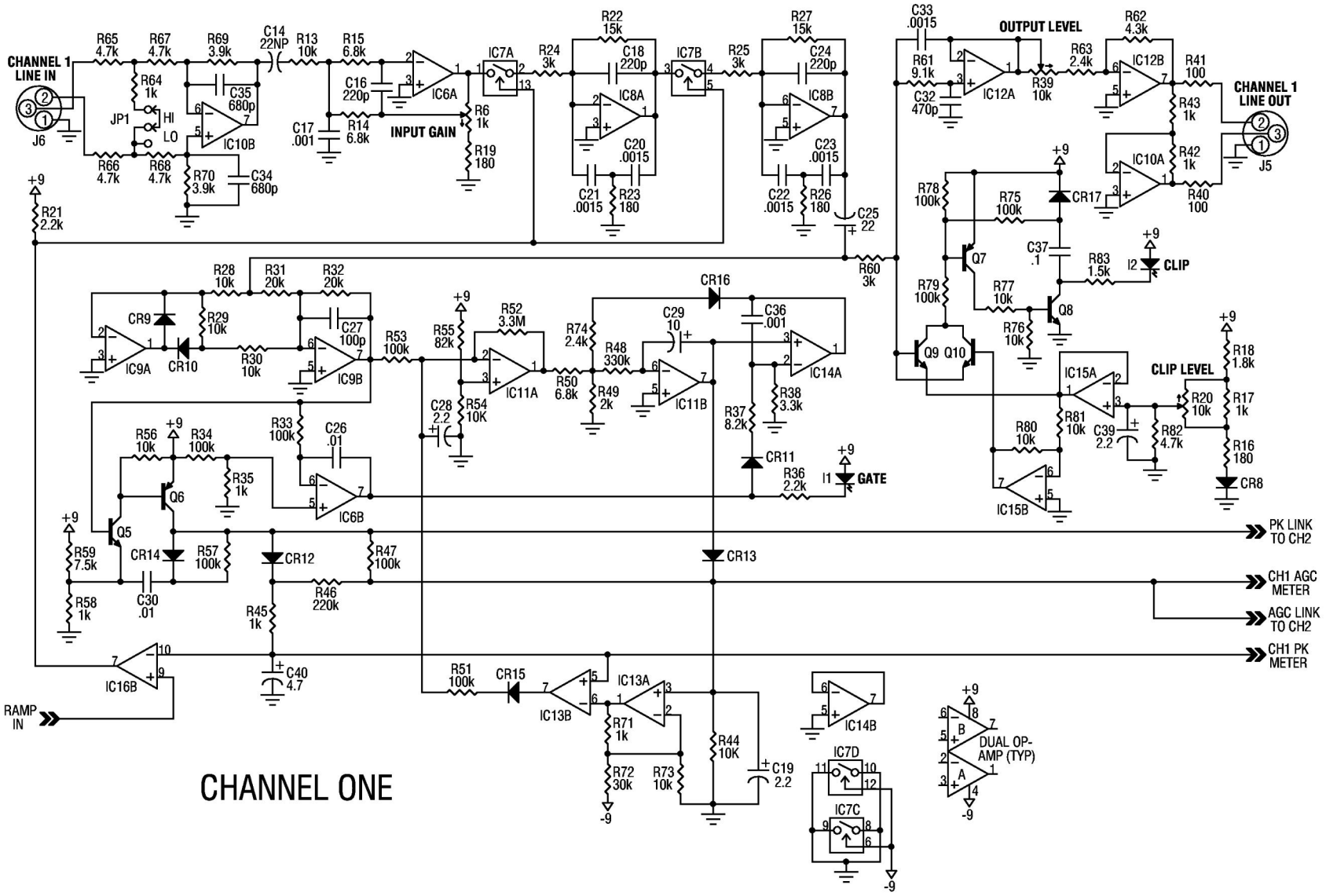
Nearly any semiconductor, IC, capacitor, resistor or connector used in the 264 will be available from one or more of these firms. Each supplier maintains a Website and publishes a full-line printed catalog, which is free for the asking. Minimum-order restrictions may apply, and export orders may prove 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



CHANNEL ONE

. SCHEMATIC DIAGRAM - INOVONICS MODEL 264 QUAD LEVELER	
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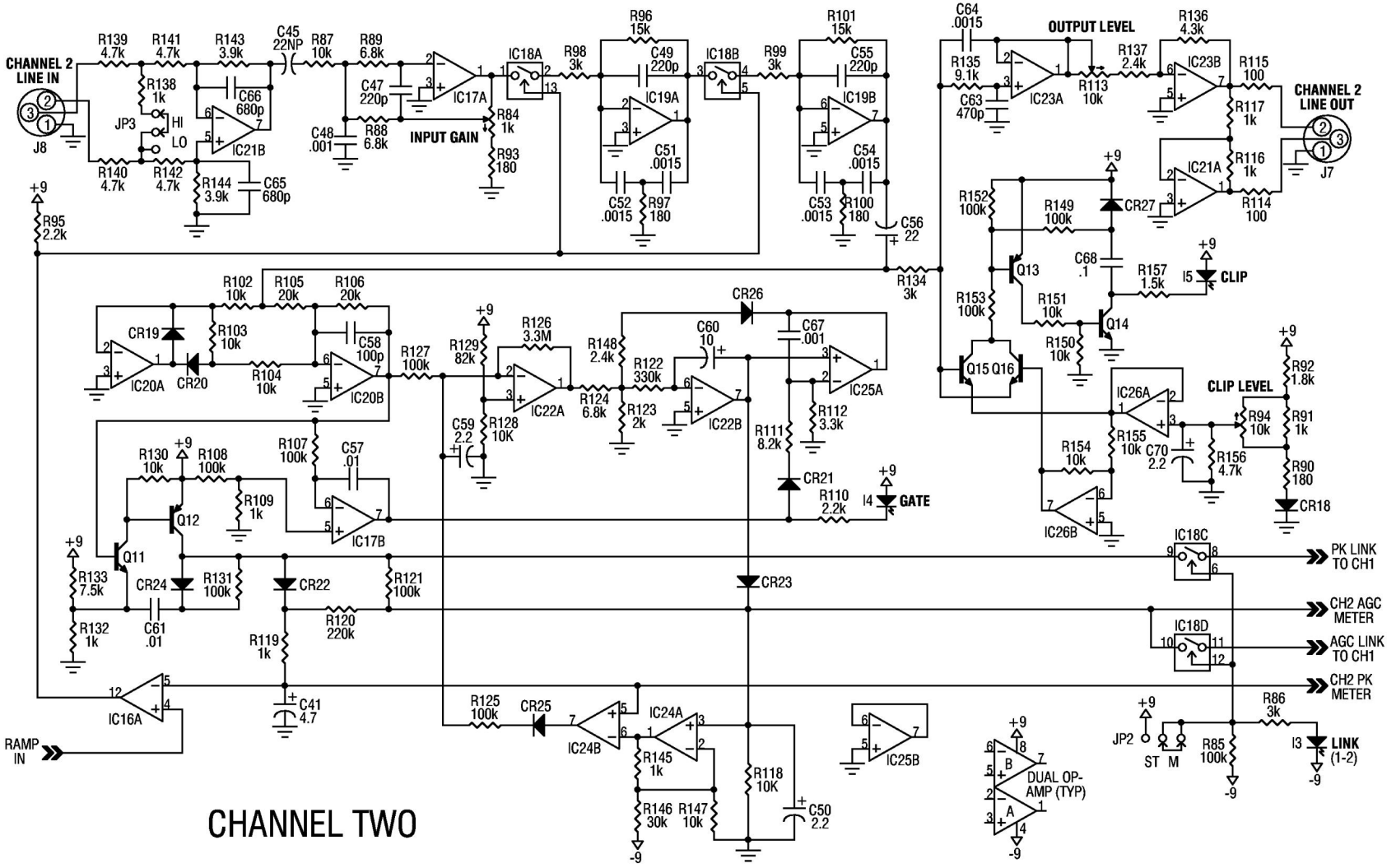
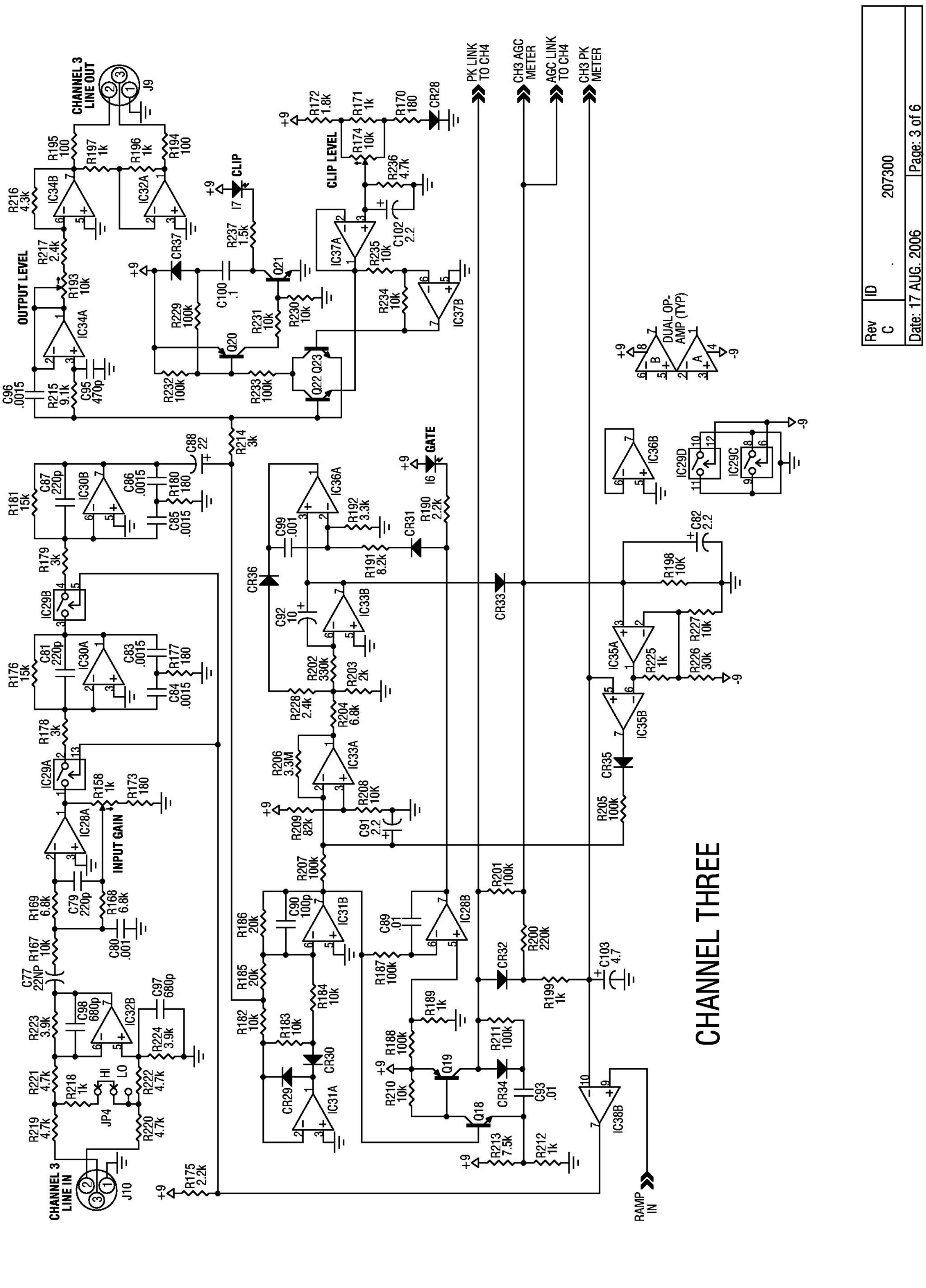


CHANNEL TWO

Rev	ID
C	. 207300
Date: 17 AUG. 2006	Page: 2 of 6


CHANNEL THREE
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J10
CHANNEL 3 LINE OUT
J9
INPUT GAIN
OUTPUT LEVEL
CLIP LEVEL
CLIP
GATE
PK LINK TO CH4
CH3 AGC METER
AGC LINK TO CH4
CH3 PK METER
RAMP IN
DUAL OP-AMP (TYP)
Rev C
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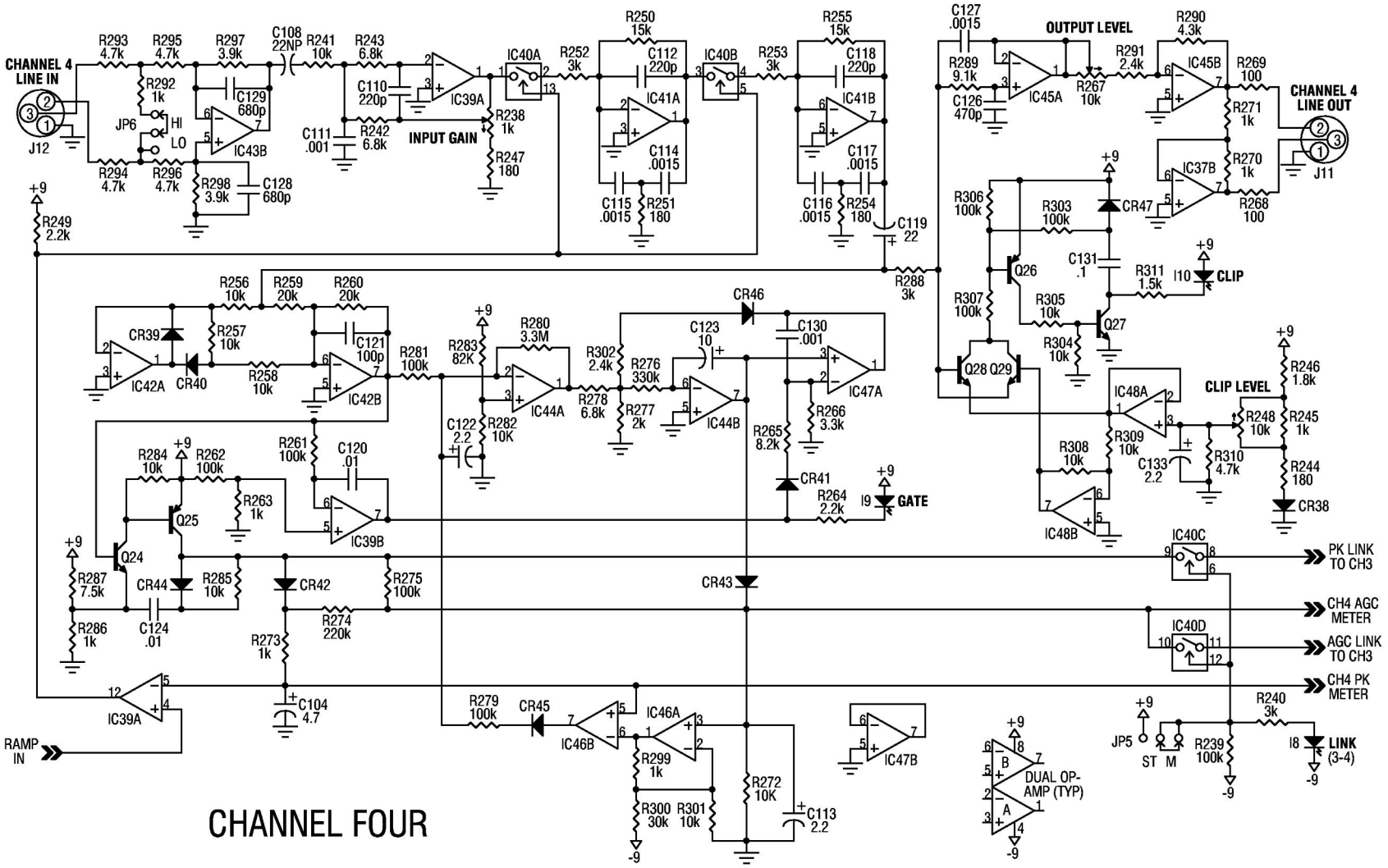

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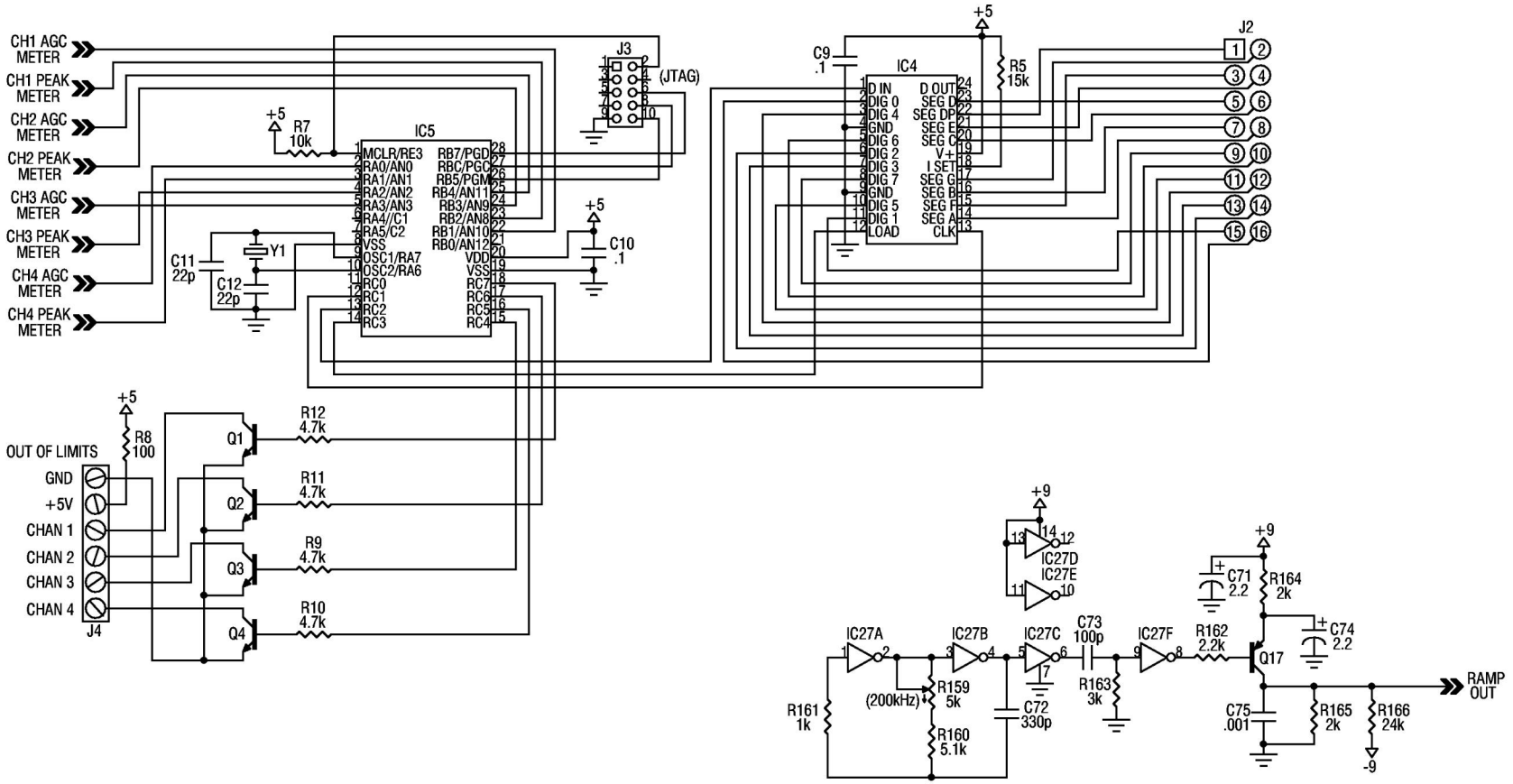
Date: 17 AUG. 2006	Page: 4 of 6



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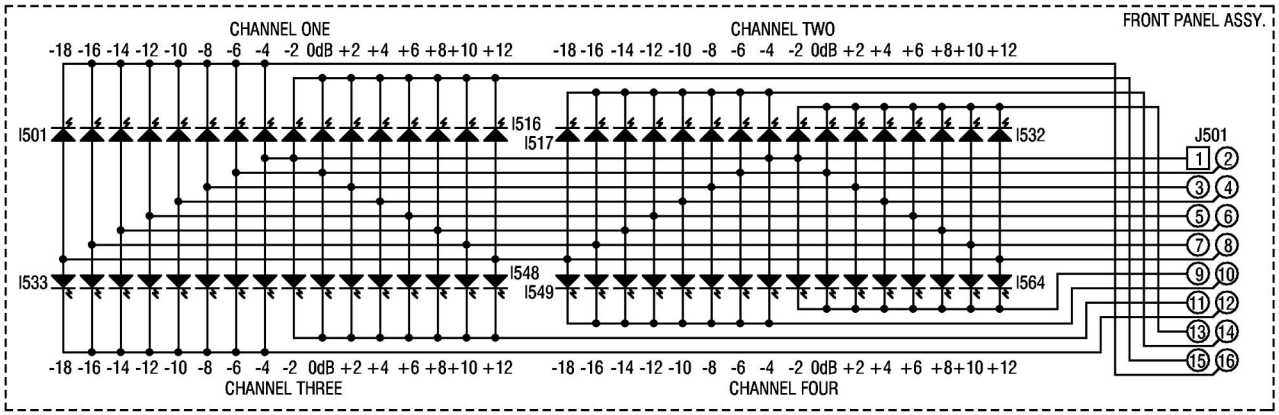

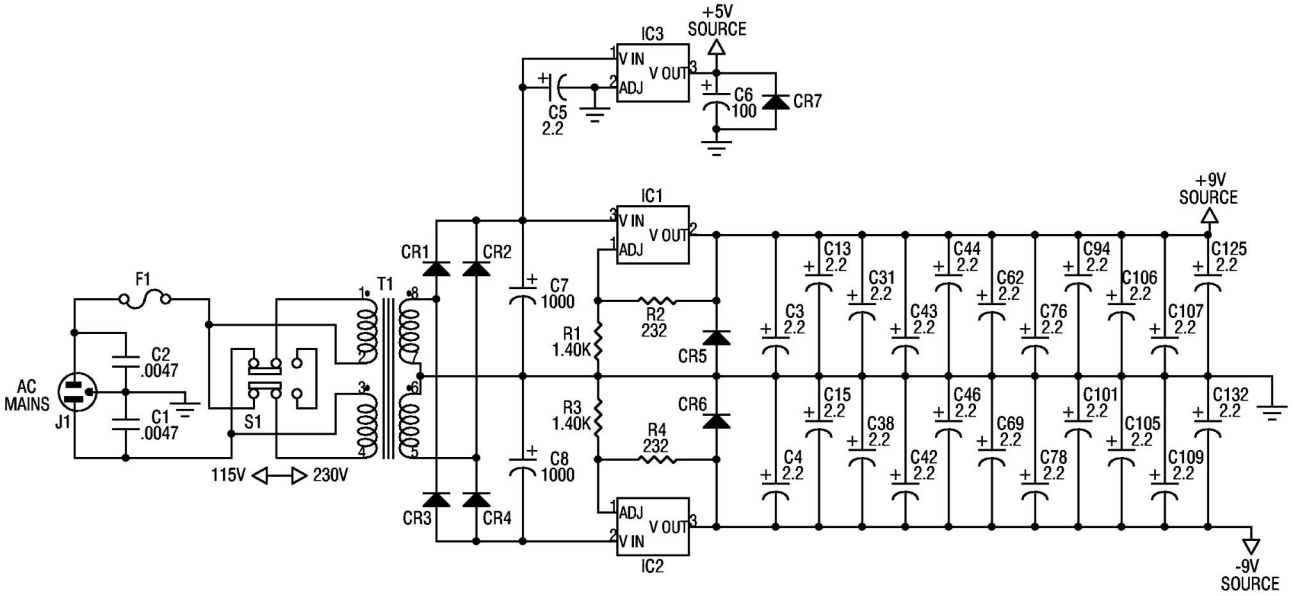

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NOTES AND DOODLES

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 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 ONE YEAR 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 one-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 Feb. 2003