OPERATING & MAINTENANCE INSTRUCTION MANUAL

MODEL 260

STEREO AUDIO PROCESSOR

INOVONICS
INCORPORATED

USER'S RECORD

Model 260 - Serial No. ________

Date Purchased ________

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INSTRUCTION MANUAL

MODEL 260

STEREO BROADCAST AUDIO PROCESSOR

January, 1985

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I FUNCTIONAL DESCRIPTION

The Inovonics 260 is a multifunction stereo audio processor for use in FM and television broadcast service. Without compromising features or performance, design of the 260 has been simplified to create a processing system which is both economical and easy to install, adjust and use.

The 260 provides the three basic processing functions of slow-acting A.G.C., average level compression and program peak control. These functions may be accessed independently, though normal operation is as a processing system with the net effect of delivering a very consistent level to the transmitter despite both long- and short-term program source variations.

Processing parameter variables have been thoughtfully predetermined and integrated into the 260 design. User-accessable adjustments have been reduced to only those which are essential. This relegates use of the 260 to the basic broadcast situations which require ample and consistent transmitter modulation. No variables are provided to enable adjustment for "competitive loudness;" format and good programming are invariably the keys to any station's success. With many stations in any one market providing nearly identical programming, however, long term listenability emerges as a real and critical factor in audience satisfaction and higher quarter-hours.

This manual is divided into sections to best present the features, design philosophies, installation and operation aspects of the Inovonics 260. Many of the specifications and operating instructions are expressed in the manual text, rather than in the more usual tabular form. Thus it is recommended that the mauual be thoroughly digested prior to placing the equipment into service.

Automatic Gain Control (A.G.C.)

The output program mix from an audio console will invariably be subject to long-term level variations. One might naturally attribute these variations to inattention by the board operator, especially in a "combo" operation with duties more pressing than consciencious gain-riding. Another cause of level inequalities stems from the manner in which different operators respond to the level meter. These probably are the primary human elements responsible for level variations.

The "VU" meter was developed for, and has been used in broadcast-

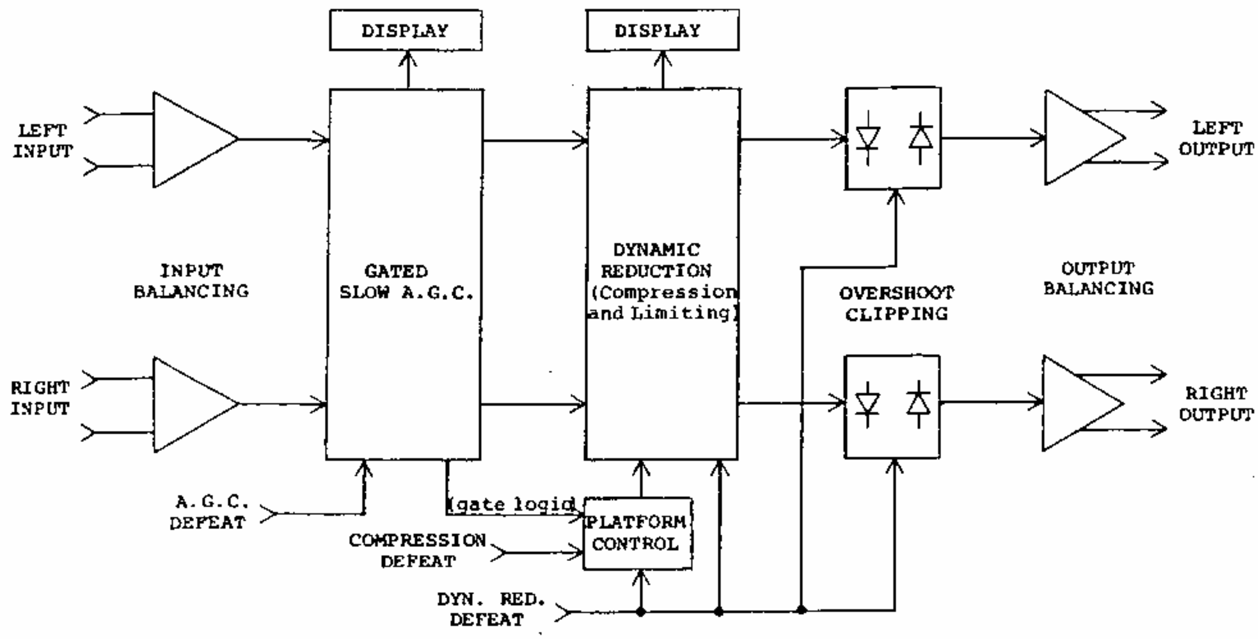


Figure 1   Block Diagram, Inovonics 260 Stereo Processor

ing for about fifty years. A number of factors have changed since the original specification was written for this device. Until fairly recently, audio entertainment consisted of speech and either recorded symphonic or "popular" music which, because of the state of audio science, had a restricted and predictable average-to-peak ratio. Contemporary music and recording techniques, on the other hand, can yield much higher average/peak ratios which are not accurately represented by the sluggish VU meter.

The European practice, and that of "enlightened" domestic recording and broadcasting facilities, is to establish audio levels based on the indication of a quasi-peak-responding "Peak Program Meter." The PPM provides a much more accurate display of program dynamics in terms of system headroom and overload margin. For this same reason, the slow A.G.C. stage of the Inovonics 260 employs the same 10-millisecond-integration peak response characteristic of the UK / EBU-standard PPM. The correction rate of the A.G.C., on the other hand, is a very slow, unobtrusive 0.5dB-per-second. This slow input level correction approximates manual gain control and does not result in program level compression or other alteration of the program dynamics. It does, nevertheless, present the following processing stages with a constant, peak-weighted level.

To inhibit unnecessary "hunting" in the absence of program, the A.G.C. circuit is "gated." Gain is held at the previous value until the program returns. During extended signal loss, gain is slowly brought back to a 0dB, unity-value figure at a rate somewhat slower than that for level correction. The gating circuit is frequency-weighted to recognize only legitimate program material. This prevents the A.G.C. from reacting to background noise, such as a crowd at a ball game. The gating control channel samples L+R energy, with -3dB points at 300Hz and 3kHz. Threshold sensitivity is preset to open the gate when the L+R midband program energy exceeds -25dB relative to nominal, corrected program "zero" level.

Left and Right A.G.C. gain are under common control to preserve stereo image. Gain is established by sampling both channels independently and reacting to the higher level.

A rear-panel terminal may be grounded to inhibit A.G.C. action altogether. This may be desirable with some classical music, or when the 260 is used as a Compressor / Limiter only.

Level Alarm

A unique feature of the 260 is a level alarm indicator associated with the A.G.C. circuit. The alarm has two functions, to warn of both a "dead air" and an out-of-limits situation.

Whenever the level of the input program drifts sufficiently to require more than about ±8dB of A.G.C. correction, the front panel A.G.C. ON indicator will flash repeatedly until the situation is corrected. Also, a program pause exceeding 10 seconds will similarly cause the LED to flash. The flash rate is fixed at 2Hz to be most noticeable in an operator's peripheral vision. Neither alarm mode is active when A.G.C. is defeated.

Dynamic Reduction (Average and Peak)

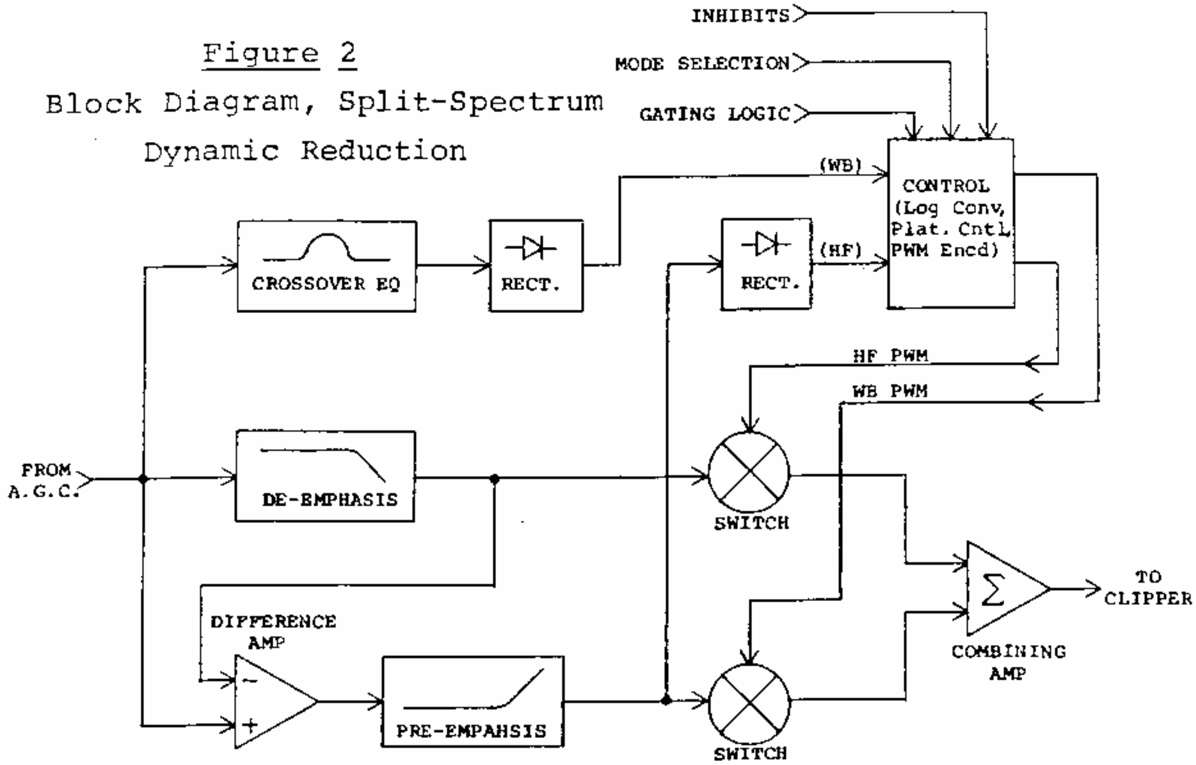
Both average level compression and program peak control are implemented by a single, gated gain control section with a dual time constant. Moreover, this section is a split-spectrum controller.

The split-band technique is block-diagrammed in Figure 2 on the next page. Broadband audio is divided into two components, one representing the portion of the spectrum which is pre-emphasized in transmission, the other component consisting of the signal which is not pre-emphasized. Each band is independently controlled so that program energy never exceeds the ceiling limit imposed by the transmission pre-emphasis curve.

Energy at the lower frequencies is controlled only by the level of the lower band. The pre-emphasized frequencies, however, are controlled both by energy within that band and by that of the lower

Figure 2

Block Diagram, Split-Spectrum Dynamic Reduction



band. Thus high frequency peaks (such as a cymbal crash) will be reduced without creating an audible "hole" in the broadband program level, yet voice (and lower) frequency peaks will reduce overall broadband gain and retain the program tonal balance. If this were not the practice, the program would sound artifically "bright."

Dynamic Reduction gain control is accomplished with a feedforward technique. The transfer function, graphed in Figure 3, has an area of increasing-ratio compression prior to the infinite, final ratio.

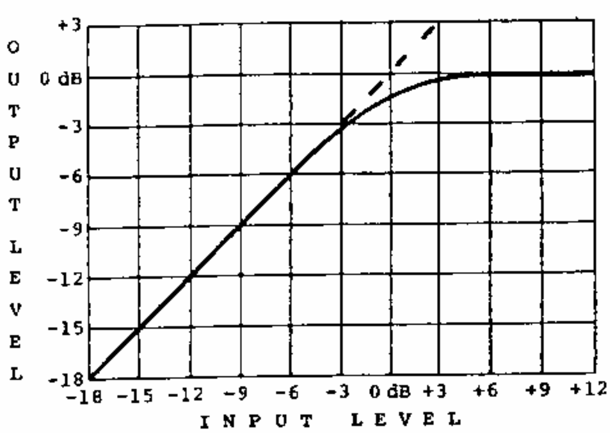


Figure 3

Dynamic Reduction Transfer Characteristic (Input vs. Output)

The average level compression function is designed around a nominal 6dB value. This means that typical average compression will be on the order of 6dB. Indeed, when pre-processed by the peak-weighted, slow A.G.C., most speech and music material will indicate a 6dB average Dynamic Reduction.

The 260 gating curcuit initially forces reduction to a "starting value" of 6dB. When legitimate program energy opens the gate, reduction follows the average program level with a delayed time constant. This delayed action characterizes a "platform" from which additional, fast gain reduction occurs as required for control of program peaks. During momentary pauses in the program, the platform "freezes" at the level of last average reduction. An extended pause will slowly return the platform to the 6dB nominal figure.

The delayed time constant for average level reduction is on the order of 5ms / dB attack, 125ms / dB release. Fast program peaks are limited instantaneously, with a 1ms / dB release to the platform value. The independent high frequency limiter also attacks instantaneously, and releases a 0.5ms / dB.

By grounding a rear-panel terminal, the average level compression function may be disabled. This eliminates the delayed time constant and the gated platform. The 260 now functions as a split-spectrum, fast peak controller, with circuit gain reset to maintain an averaged maximum figure of 6dB peak reduction and a release timing of 10ms / dB. If the A.G.C. is also defeated, the amount of peak control becomes a function of input gain.

The Left and Right Compressor / Limiter circuits track one another, both for broadband and for independent high frequency reduction. Reduction is based on the higher of the L or R signals. A final "safety" clipper, which also conforms to the pre-emphasis curve, is included in the peak control circuitry. This clipper does not normally act on program material, but guards against certain fast overshoots which can occur as the limited broadband and high frequency program components are recombined.

Although the limiter output ceiling conforms to a pre-emphasis characteristic, the output program signal is <u>not</u> pre-emphasized. Pre-emphasis is normally a function of the stereo generator or FM exciter.

Specifications

Tabulated on the following page are those performance specifications of the Inovonics 260 which are not specifically expressed in the text of the discussions or in the attendant drawings.

Frequency Response (below Dynamic Reduction threshold): ±0.5dB, 10Hz - 15kHz.

Noise*: better than 70dB below 100% modulation, 10Hz - 20kHz.

Crosstalk*: better than 60dB below 100% modulation, 10Hz - 20kHz.

Distortion*: under 0.5% THD, 20Hz - 15kHz; under 0.2% THD, 50Hz - 10kHz.

Inputs: LEFT and RIGHT; balanced-bridging, -20 to +10dBmV.

Outputs: LEFT and RIGHT; balanced, 0 to +15dBm (into 600-ohm load).

Power: 105 - 130VAC or 205 - 255VAC; 20W, 50 / 60Hz.

Size: 1-3/4" x 19" x 8" overall.

Shipping Weight: 12 lbs.

* Data taken with nominal 6dB average compression and additional 6dB peak reduction of typical program material.

II INSTALLATION

Unpacking and Inspection

Upon receipt of the equipment, inspect at once for shipping damage. Should any such damage be observed, notify the carrier at once; if not, proceed as outlined below. It is suggested that the original shipping carton and materials be retained should future reshipment become 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 some means of trace in the case of lost or stolen gear, but the user will automatically receive specific SERVICING OR MODIFICATION instructions should they be issued by Inovonics.

Mounting

The Inovonics 260 is packaged to mount in a standard 19-inch equipment rack and requires only 1-3/4 inches of rack space. The 260 generates negligible heat, and itself is unaffected by wide variations in the ambient operating temperature.

AC Power

Unless it has been special-ordered for export shipment, the 260 is factory-wired to operate from 115V, 50/60Hz AC mains power. If rewired for 230V operation, the unit will be so identified on the rear panel near the AC connector. Page 5 of the Schematic Diagram shows the power transformer primary wiring scheme for both 115 and 230 volt operation. NOTE that the value of fuse has been specified on the rear panel for each line voltage.

The power cord is fitted with a North American-standard male connector, but the individual cord conductors are color-coded in accordance with CEE standards. (BROWN: "hot" / BLUE: neutral / GREEN & YELLOW: ground)

RFI

The Inovonics 260 is specifically designed to operate in close proximity to broadcast transmitters; nevertheless, care should be exercised in locating the unit away from abnormally high RF fields.

In some installation situations an RF ground loop may be formed between the input or output cable shield grounds and the AC power cord ground. Use of a "ground-lifting" AC adapter should remedy the problem, but the chassis of the unit should somehow be returned to earth ground for safety.

Line Inputs and Board Strapping Options

The Inovonics 260 has separate Left and Right electronically-balanced (transformerless) bridging line inputs. These are brought out to the rear panel barrier strip and include a chassis ground connection for cable shields.

Should the equipment which feeds the Processor require output loading, a 600-ohm terminating resistor may be placed across the input terminals.

The "+" and "-" input terminal designations remain in phase with line output terminals similarly identified. If the 260 is fed single-ended, connect the signal to the "+" terminal and strap "-" to ground.

The 260 accepts zero-reference input program levels between -20 and +10dBmv. This input range is divided into two parts. As shipped, the 260 will take input levels between -5 and +10dBmv. To change the input range for program levels between -20 and -5dBmv, the four "X" straps on the circuit board must be installed. These bifurcated strapping terminals are on the circuit board just behind the AC mains connector.

Line Outputs

The Left and Right line outputs appear at the rear panel barrier strip along with ground terminals for cable shields. Outputs are electronically balanced (transformerless) but <u>not</u> load-sensing. They will drive the <u>balanced</u> inputs of stereo generators and transmitters or normal program lines.

> If a single-ended output is required, only the "+" and "GND" terminals should be used; the "-" side should <u>not be grounded</u>.

The characteristic output impedance of the 260 is 600-ohms. When terminated in a similar value of resistance, the output level will be 6dB below the unloaded value. The outputs are variable between 0 and +15dBm into a terminated, balanced load.

Line outputs are designated "+" and "-" for program phase considerations, and are in phase with the similarly-designated line input terminals.

The 260 line output has a flat, <u>not</u> a pre-emphasized characteristic. The normal pre-emphasis imparted by the transmitter or stereo generator satisfies the transmission system requirement.

<u>Mode Defeat Commands - "Proof"</u>

A series of three, rear-panel barrier terminals permit the user to disable any of the 260 gain control functions. These terminals, labeled "A," "C," and "DR," may be locally tied, or remotely switched to chassis ground to defeat the corresponding Processor function(s) as noted on the rear panel. In this manner the Processor may be used as an A.G.C.-only, Peak Limiter-only, Compressor/Limiter-only or A.G.C./Limiter-only device.

Because of the configuration of the split-spectrum Dynamic Reduction control circuitry, it is not possible to utilize the Compression function of the 260 without also calling the peak control circuitry into play.

When all three rear-panel DEFEAT terminals are grounded, the 260 is in the "PROOF" mode. The complete Processor signal path remains intact, but gain-reduction circuits are totally disabled.

III SETUP AND OPERATION

With only input and output level controls for the Left and Right channels, setup of the 260 Processor is simple and straightforward. The only test equipment required is a 500Hz, sinewave signal source which can be routed through the audio console. Setup is performed with the Inovonics 260 "on air" in the normal broadcast chain.

Input Gain Set

STEP 1 Apply a 500Hz sinewave test signal to the Left input (only) of the Processor from the audio console or from whatever other equipment directly feeds the unit.

STEP 2 Adjust the level of the test tone for a value exactly 1.5dB above the normal program "zero" level.

- A. This would be +9.5dBm if 0 VU = +8dBm; +5.5dBm if 0 VU = +4dBm. A +1.5 VU indication on the console meter is sufficiently accurate.
- B. This would be 1.5dB above the "TEST" level if Peak Program Meters are used.

STEP 3 Adjust the LEFT INPUT GAIN control to a point which causes both the 0dB and -3dB A.G.C. GAIN indicator LEDs to light evenly.

- A. This step must be performed slowly because of the very slow A.G.C. correction rate.
- B. If this adjustment is not within the range of the panel control, consult Page 9 for input gain range strapping instructions.

STEP 4 Remove the test signal from the Left input and apply it to the Right input (only). Repeat STEPS 2 and 3 for the Right channel.

STEP 5 Reduce the 500Hz test signal to nominal line level. The 0dB A.G.C. GAIN indicator should light for either a Left-only, a Right-only of a Left and Right test signal input from the console.

Output Level Adjustment

This procedure is performed "on air" using the station Modulation Monitor and a 500Hz sinewave test signal from the audio console.

STEP 1 With rear-panel strapping, defeat both the A.G.C. and Compression functions of the 260 ("A" and "C" to GND).

STEP 2 Apply a 500Hz sinewave test signal from the console to the Left input (only) of the 260 at a level which yields 10dB of DYNAMIC REDUCTION as indicated by the 260 LEDs

STEP 3 The LEFT OUTPUT LEVEL control is now adjusted for 100% modulation of the transmitter as monitored by the station Modulation Monitor.

STEP 4 Remove the signal from the Left input and apply 500Hz to the Right input (only) at the same level. This should also yield a display of 10dB DYNAMIC REDUCTION. If not, repeat the Input Gain Set procedure.

STEP 5 Adjust the RIGHT OUTPUT LEVEL control for 100% modulation of the transmitter as monitored by the station Modulation Monitor.

STEP 6 Drive both the Left and Right channels with the test tone. Indicated DYNAMIC REDUCTION should remain at 10dB, and transmitter modulation should still indicate 100%.

A. If some form of composite clipping is employed to control overshoot of the low-pass filter in the stereo generator, the clipping threshold can be adjusted at this time to "just barely touch" the peaks of the composite signal. Such adjustment will insure that only the overshoot products of the filter are clipped.

B. If there is no provision to control LPF overshoot, both the LEFT and RIGHT channel OUTPUT LEVEL controls will have to be backed-down to avoid overmodulation of the carrier by overshoot products. The amount of level reduction will have to be determined experimentally, as it will depend on the stereo generator LPF characteristics.

STEP 7 Remove the A.G.C. and Compression defeat strapping and return program gain to normal.

This completes calibration of the unit for use.

IV CIRCUIT DESCRIPTIONS

This section describes the circuitry used in the Inovonics 260. The discussions refer to Pages 1 through 5 of the Schematic Diagram contained in the Appendix.

Since its use in unique to the Model 260 Processor, the first part of this section covers the general subject of Pulse Width Modulation (PWM), and specifically its implementation in the Model 260. Signal path circuitry discussions then follow.

Pulse Width Modulation

PWM is utilized exclusively for audio gain control in the Inovonics 260. It is perhaps the most simple and colorless means of varying the amplitude of an analog signal with a DC control voltage.

Consider an audio signal which can be turned on and off with a toggle switch. When the switch is ON, attenuation is zero; when OFF, attenuation is infinite. If this switch can be turned on and off at a rate at least twice that of the highest audio frequency, linear signal attenuation becomes directly proportional to the OFF time.

ON	OFF	dB ATTEN
100%	0%	0dB
50%	50%	6dB
25%	75%	12dB
10%	90%	20dB
1%	99%	40dB
0%	100%	(infinite)

This technique gets a bit touchy at small duty cycles (40dB or more attenuation), relegating it to uses which do not require great amounts of gain reduction. PWM thus lends itself well to audio processing because it is easily implemented and very predictable over the 0 - 30dB attenuation range required.

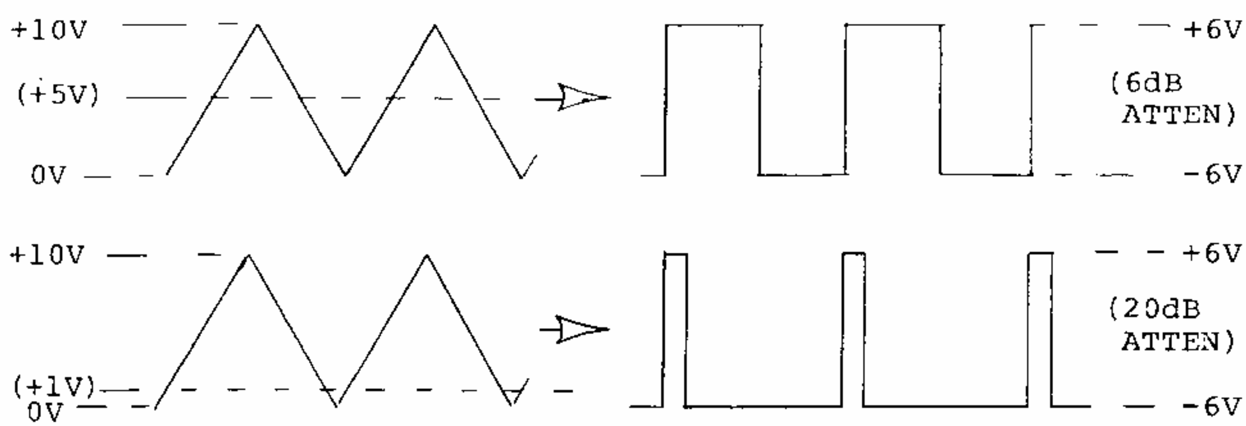
The switching frequency used in the Inovonics 260 is 100kHz; better than 6 times the highest audio frequency passed. Relatively simple low-pass filters prevent "aliasing" and remove the switching frequency component from the output signal.

PWM Generation (Schematic Page 5)

Circuitry consists of a 10-volt reference source, IC28, and a 100kHz precision triangle generator, IC31 and 32. IC31 and C78 form an integrator which feeds comparator, IC 32. Hysteresis provided by FET, Q17, causes IC32 to toggle back and forth, driving the integrator in an opposite direction each time. The overall action is that of a free-running, high-linearity triangle generator with a positive peak value equal to the 10-volt reference, and a negative peak value of 0 volts.

The 10-volt reference is used by several circuits within the Processor. +10 volts corresponds to a DC level-controlling voltage representing zero attenuation. With reference to the 10-volt source, a 5-volt control voltage would result in 6dB attenuation, 1 volt yielding 20dB. The 10-volt value serves as a reference from which control voltages are derived, and need not be absolute.

The precision triangle wave is applied to one input of each PWM encoder comparator (eg. IC23, Page 4). The other comparator input receives a DC control voltage representing the amount of required signal attenuation in each case. The comparator output is a 100kHz squarewave, the duty cycle (ON vs. OFF) corresponding to the intercept point of the control voltage on the triangle. This is diagrammed below.



Input Amplifier and A.G.C. (Schematic Pages 1 and 3)

The Left channel line input is fed to the active-balanced input stage, IC1B. Gain may be set for the input line level range per Page 9 of the manual. IC1A is a 15kHz, low-pass filter. Gain of this stage is varied by the L INPUT GAIN control, R11. A1(1/2) is one section of a CMOS, Quad Bilateral Switch (analog gate) IC which is driven by the 100kHz, duty-cycle-modulated switching waveform to provide linear audio gain control. The CMOS switch is operated between the ±6-volt power supply rails to pass ground-referenced audio signals without distortion. Low-pass filter, IC2A, recovers audio from the PWM signal. Further filtering is afforded by IC2B, the gain of which may be selected by A1(8/9) to provide a Compress/ Limit or a lower, Limit-only signal level to the following Dynamic Reduction circuitry.

A portion of the recovered PWM audio signal is routed to the A.G.C. gating and control circuitry on Page 3 of the Schematic. Q3 and 4 form a Baxandall full-wave rectifier for the Left channel, Q1 and 2 for the Right. The two rectifiers are connected such that the higher of the Left or Right channel signals determines the resultant DC level. The L/R composite is further amplified by Q5 and integrated by C33 to a quasi-peak, UK/EBU-based value.

When the gate is open (A2(4/3) closed), rectified peaks are integrated by IC5A. This integration sets the slow A.G.C. correction rate. The integrated value is shaped into a linear-dB, +10-volt-referenced control voltage by Q6 and fed to IC6, the PWM-encoder comparator. The variable duty cycle squarewave output of IC6 switches the CMOS analog switch gates for both Left and Right channels (A1(1/2 and 4/3)). This completes the closed-loop (feedback) A.G.C. circuit which seeks to hold the signal level constant on a peak-weighted, slow correction basis. Q7 feeds the A.G.C. GAIN indicator driver, IC10, for front panel display of circuit action.

<u>A.G.C. Gating</u> (Schematic Page 3)

Circuit "gating" prevents the gradual increase in A.G.C. gain to the maximum figure when no input signal is present. Left and Right input signals are summed by IC7A. C29 and 30 impart a first-order bandpass function to this amplifier; -3dB points at 300Hz and 3kHz. This reduces susceptibility of the gating circuit to non-program noise. A2(1/2 and 11/10) turn gating off when A.G.C. and Compression are both defeated.

The input signal sample from IC7A is rectified by CR1 through 4 and fed to a hysteretic level detector, IC7B. The resultant gating logic is used by the A.G.C. circuit to switch A2(4/3). When the gate is closed (A2(4/3) open), IC5A integrates a reference voltage from R76 to return A.G.C. gain to a nominal "0dB" figure at a rate somewhat slower than normal correction.

Gating logic also sets and resets a timer comprised of IC9A and C35/R97. Should the gate close for more than about 10 seconds, the timer causes astable multivibrator IC9B to flash the A.G.C. ON indicator. Comparators IC9C and D monitor A.G.C. indicator voltage to also flash the LED should A.G.C. gain correction approach its limits.

Dynamic Reduction - Signal (Schematic Page 2)

IC12B is a unity-gain inverter which has a frequency de-empahsis corresponding to the transmitter pre-emphasis curve. IC12A amplifies the difference between the input signal and the de-emphasized component and, in addition, imparts pre-empahsis to the difference signal. If the outputs of IC12B and IC12A were combined, the resultant would be a pre-emphasized program signal. The split-band technique used to generate the characteristic provides the means of controlling the high frequency component independently of the wideband signal.

The high frequency component is full-wave-rectified by IC15A and C, and CR15 and 16 to generate a DC output proportional to the pre-empahsized signal energy. Wideband energy is similarly rectified by IC13A and B, and CR11 and 12, except that a small amount of equalization normalizes control at the -3dB transition frequency.

A3(1/2 and 4/3), controlled by PWM switching, feed the two signal components to LPF combining amplifier, IC16B. IC17B further filters the signal which, at this point, still maintains a pre-emphasized characteristic.

CR19 and 20, biased to the proper threshold level by IC21, clip any overshoots which may occur as the WB and HF signal components are combined. The safety clipper is followed by a buffer, IC17A, the OUTPUT LEVEL control and de-empahsis amplifier, IC19A. IC20A inverts the signal phase to provide the active-balanced line output.

Dynamic Reduction - Control (Schematic Page 4)

The Compression / Limiting (Dynamic Reduction) gain control circuits of the Inovonics 260 are of open-loop, feedforward design. The transfer characteristic (input vs. output) is plotted in Figure 3, Page 5.

Once a desired gain control transfer function is established, that curve can be used to derive a corresponding relationship between a rectified input signal voltage and a DC control voltage to effect the required dB of gain reduction. This relationship is a semi-log function, and in practice is sufficiently well approximated by 7-piece segmentation to be within ±0.2dB of ideal over a 30dB range.

The wideband (WB) and pre-emphasized (HF) rectified signal samples are filtered by C68 and C67, respectively. In both cases, attack time is kept short through direct, full-current charging of the capacitors. HF release timing is the relatively fast, simple R/C function of C67 and R178. WB release is more complex.

When the gate is closed, C69 is charged to the DC level set by R212 and 213, through R214 and 211. IC25B, a unity-gain buffer, applies this DC level to C68 through R208. This level corresponds to 6dB of Dynamic Reduction, the nominal "platform" value (see Pages 5 and 6). Rectified fast program peaks charge C68 to a higher value and release (discharge) to the platform level. When the gate is open, Q14 is turned on and rectified WB peaks are also integrated by R210 and C69. This integrated value is usually close to the 6dB platform figure, but depending on program average/peak ratio, the charge on C69 can wander either up or down. When the gate closes, Q14 turns off, holding Dynamic Reduction at the last integrated level, with a slow return to the 6dB platform for extended program pauses.

In the Peak-Limit-Only mode (Compression defeated), Q15 is turned on, Q14 held off. This forces the ungated "platform" level to "0dB" so that C68 discharges completely between program peaks. Simultaneously, the level of drive to the Dynamic Reduction circuitry is reduced to prevent overlimiting of the program; also, Limiter release time is increased by the discharge of C68 through R208. Both these modifications lessen the chances of undesirable audible effects in the Limit-Only mode.

The rectified and filtered WB and HF samples are fed to the bases of Q13 and 11, respectively. In a no-signal, off condition, the collector of Q12 sits at the +10-volt reference through R190. As current is fed to Q12 through R204, initial voltage gain of this stage is set by R190. When the collector voltage drops to a point where CR24 begins to conduct, R192 also becomes a collector load resistor and the gain of Q12 drops to the "next segment" value. The gain of Q12 continues to decrease as the input current increases, creating the required semi-log relationship. Each collector load diode has a "soft" turn-on characterisitc which smoothes the segmentation.

CR36 forces reduction in the HF channel identical to WB reduction. The HF channel, however, is able to independently reduce gain as required to conform the program to the frequency-selective nature of the transmission system ceiling.

The semi-log-converted control voltages are buffered by IC22A and B, and fed to PWM encoder comparators, IC23 and 24. The duty-cycle-modulated squarewaves drive the CMOS analog switch attenuators for both Left and Right program channels.

The HF LIMIT indicator, I23, shows reduction in the HF channel that is in excess of WB reduction.

V INTERNAL CALIBRATION ADJUSTMENTS

Through the use of PWM gain control and digital circuit techniques, the Inovonics 260 is unusually free from internal calibration adjustments. The few adjustments that are available, however, should not require routine calibration. The following procedures are given in the event that components are ever replaced in areas associated with a calibration adjustment.

Equipment Required

OSCILLOSCOPE: 35mHz bandwidth with low capacity probe
AC VOLTMETER: -60 to +30dBmv full-scale sensitivity
AUDIO GENERATOR: 20Hz - 20kHz; -40 to +10dBm output

PWM Clock Frequency

R235 adjusts the frequency of the precision triangle generator. The actual frequency is not at all critical; the Processor would operate as well within ±20% of the design center value.

STEP 1 Monitor the triangle output with the oscilloscope. The left-hand end of R237 (under filter cap. C71) is a convenient monitor point.

STEP 2 Adjust R235 for 100kHz; one-cycle-per-box at an oscilloscope timebase setting of 10us / division.

STEP 3 Check that the triangle is 10 volts peak-to-peak and ground-referenced.

STEP 4 Seal R235 with a small dot of household glue.

Clipping Threshold

STEP 1 Preset the Processor for Limit-Only operation ("A" and "C" rear-panel terminals strapped to ground).

STEP 2 Apply a 2.1kHz sinewave test signal to both inputs of the Processor at a level which yields 10dB of Dynamic Reduction.

STEP 3 Monitor the output of the Left channel clipper buffer stage with the oscilloscope; IC17, pin 1.

STEP 4 Adjust R217 CCW (counterclockwise) until slight flattening of the waveform is observed.

STEP 5 Switch the oscilloscope to the output of the Right channel clipper buffer stage; IC18, pin 1. The signal should show the same amount of flattening as the Left channel.

STEP 6 Adjust R217 slowly CW until flattening just disappears on both the Left and Right channels.

STEP 7 Seal R217 with a small dot of household cement.

VI APPENDIX

Parts Lists

Schematic Diagrams

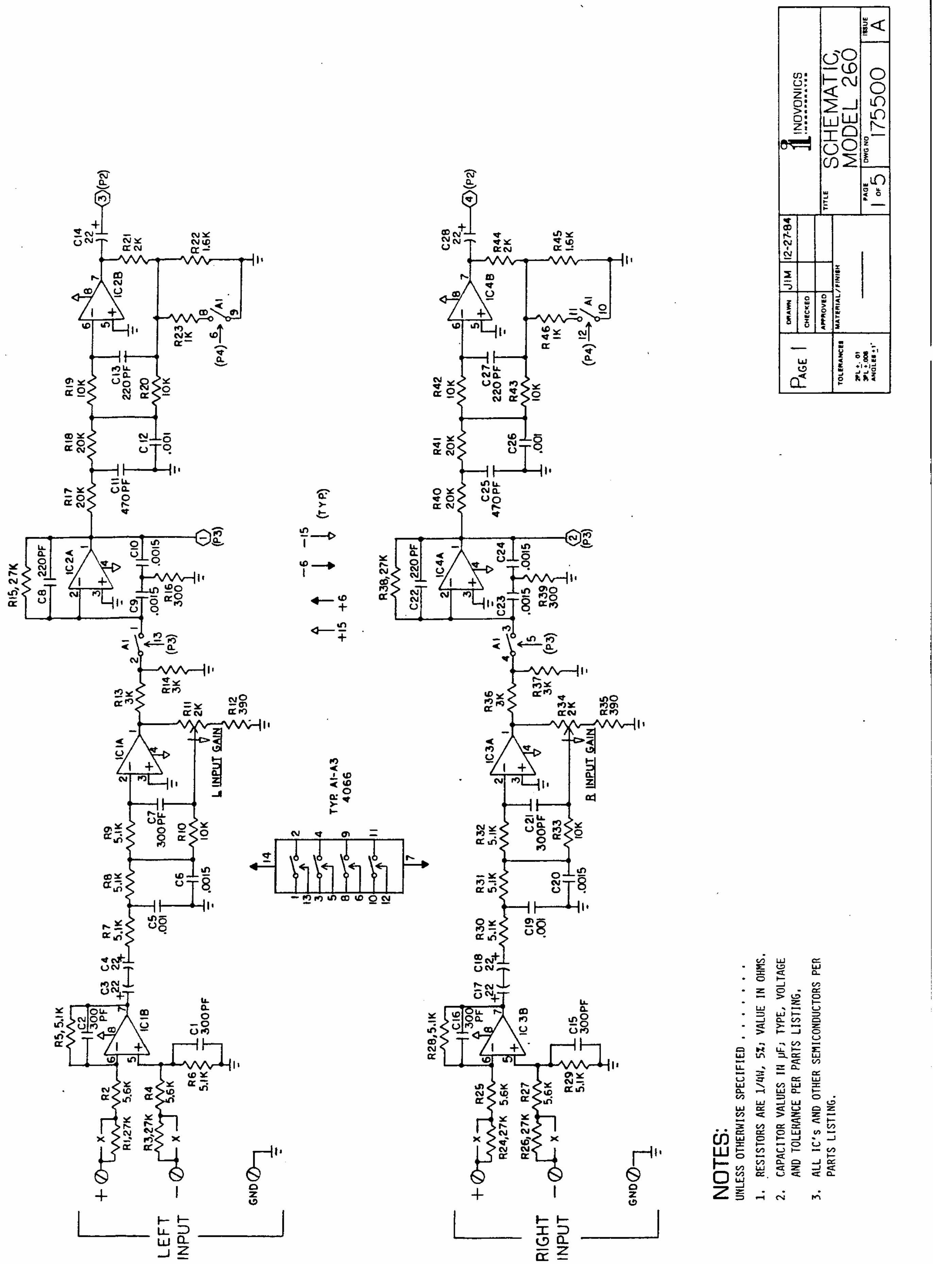
Warranty

SCHEMATIC DESIGNATION	INOVONICS PART NO.	GENERIC PART DESCRIPTION AND / OR MANUFACTURER'S ID & PART NO.
		<u>Circuit Board Assembly</u> (A/N 175000)
A1-3	1335	CMOS Analog Switch; Type CD 4066BE
C1,2,7,15, 16,21,41,51, 55,65	0827	Capacitor, Mica, 300pF; DM 15 - 301J
C3,4,14,17, 18,28	1088	" Electrolytic, 22uF, 25V, Radial
C5,12,19,26, 80	0930	" Mylar, 0.001uF, 63V
C6,9,10,20, 23,24,49,63	1080	" " 0.0015uF, 63V
C8,13,22,27	0814	" Mica, 220pF; DM 15 - 221J
C11,25,30,78	0876	" Mylar, 470pF, 63V
C29	1082	" " 0.047uF, 63V
C31	1087	" " 0.22uF, 63V
C32,67,68	1067	" ~~Tantalum,~~ 1uF, 35V (Electrolytic)
C33,69	1054	" " 4.7uF, 25V
C34	1071	" " 22uF, 25V
C35	1078	" " " 35V
C36	0932	" Mylar, 0.1uF, 63V
C37,38,72-76	1053	" ~~Tantalum~~, 2.2uF, 25V (Electrolytic)
C39,40,43, 44,52,53,54, 57,58,66	0829	" Mica, 3000pF; DM 19 - 302J

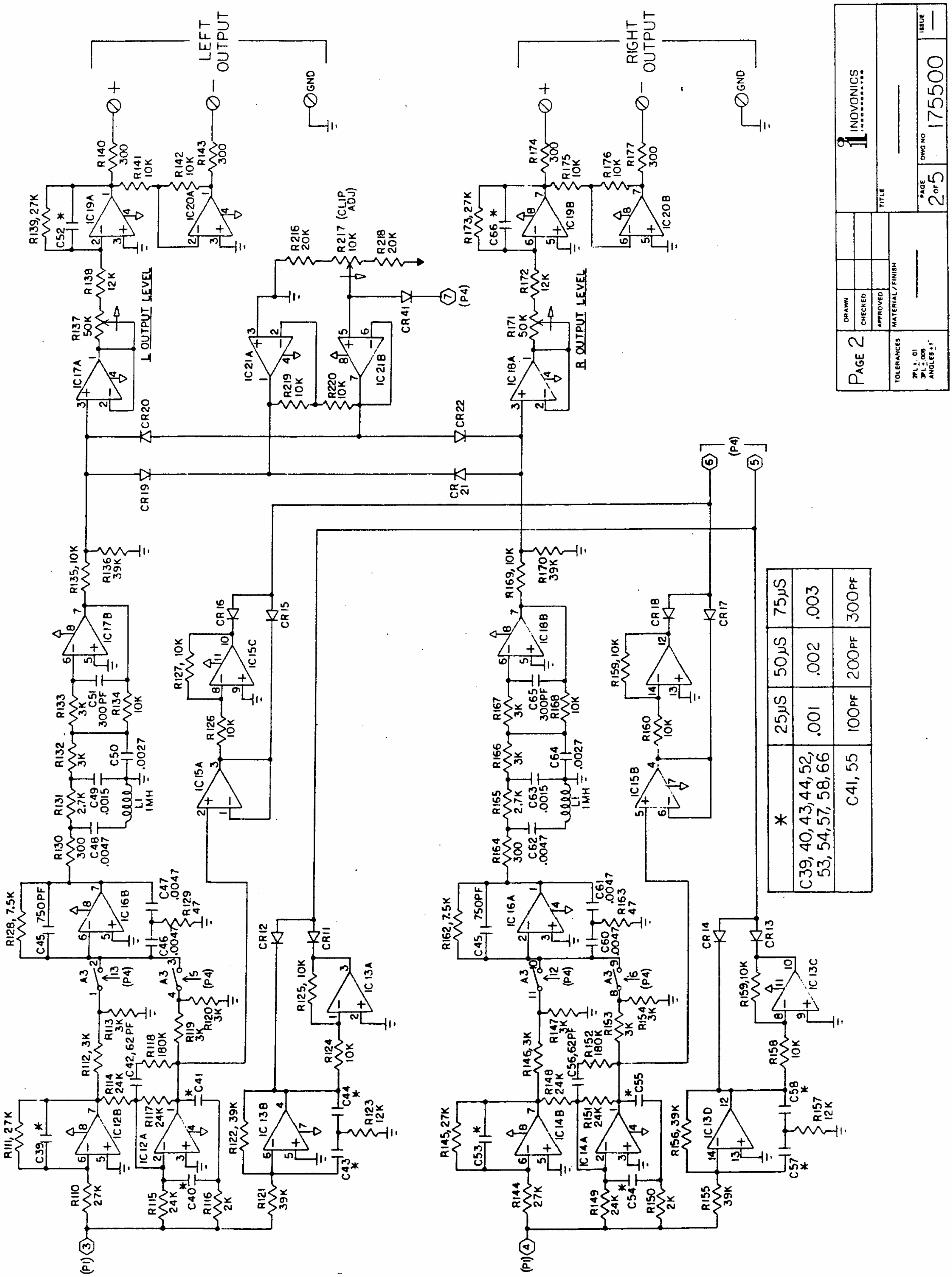
SCHEMATIC DESIGNATION	INOVONICS PART NO.	GENERIC PART DESCRIPTION AND / OR MANUFACTURER'S ID & PART NO.
C42,56	0832	Capacitor, Mica, 62pF; DM 15 - 620J
C45,59	0828	" " 750pF; DM 19 - 751J
C46,47,48, 60,61,62	1083	" Mylar, 0.0047uF, 63V
C50,64	1084	" " 0.0027uF, 63V
C70,71	0902	" Electrolytic, 1000uF, 35V, axial
C77	0801	" Mica, 10pF; DM 15 - 100J
C79	0810	" " 100pF; DM 15 - 101J
CR1-18,23-35,37-42,51,52	1100	Diode, Silicon Signal; 1N4151 (General Purpose)
CR19-22	1127	" Silicon Schottky; Hewlett-Packard 1N5711
CR36	1106	" Germanium Signal; 1N34A (General Purpose)
CR43-50	1124	" Silicon Rectifier; 1N4005 (1A, 100V General Purpose)
I1-23	2019	Light Emitting Diode, Red; Stanley SPR 5731 (or equivalent)
IC1-5,12,14, 16,17,18,25	1375	Integrated Circuit, National LF 353N
IC6,23,24	1317	" " " LM 311N
IC7,8,21	1313	" " ~~Raytheon RC 4558NB~~ National LF353N
IC9,13,15	1320	" " " RC 4136DB
IC10,11	1376	" " National LM 3914N
IC19,20,22	1314	" " ~~Signetics NE 5535N~~ National LF353N

SCHEMATIC DESIGNATION	INOVONICS PART NO.	GENERIC PART DESCRIPTION AND / OR MANUFACTURER'S ID & PART NO.
IC26,28,30	1373	Integrated Circuit, National LM 317T
IC27,29	1374	" " " LM 337T
IC31,32	1354	" " RCA CA 3100E
L1,2	1403	Fixed Inductor, ImHy; Delevan 2500-28
Q1-4,6-8, 10,12	1204	Transistor, NPN General Purpose; ~~National PN3567-5~~ 2N3904 or equiv.
Q5,11,13	1205	" PNP " " " ~~PN3645-5~~ 2N3906 " "
Q9,14-17	1235	" FET, National/Siliconix J108
R11,34	0508	Resistor, Multiturn Variable, 2k; Bourns 3006P-1-202
R137,171	0513	" " " 50k; " 3006P-1-503
R217	0559	" Single-turn, Variable, 10k; Beckman 91AR10K
R235	0558	" " " " 5k; " 91AR5K
		NOTE: all fixed resistors are 1/4-watt, 5%, carbon film type; value per Schematic Diagram.

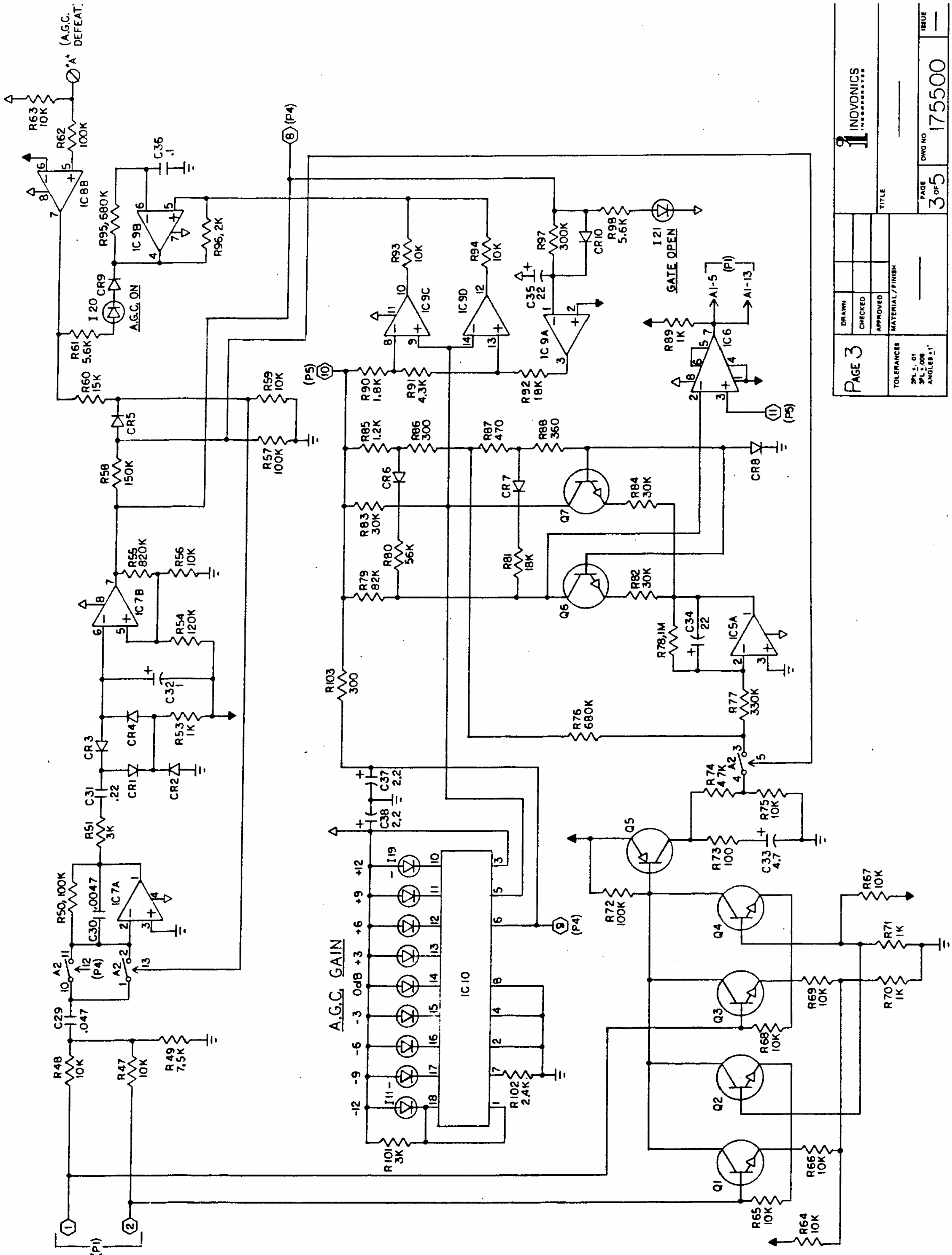
SCHEMATIC DESIGNATION	INOVONICS PART NO.	GENERIC PART DESCRIPTION AND / OR MANUFACTURER'S ID & PART NO.
Chassis-Mounted Components		
C81,82	1064	Capacitor, Disc Ceramic, 0.005uF, 1kV
F1 (115V)	2702	Fuse, 3AG - 1/2A
F1 (230V)	2701	" 3AG - 1/4A
J2	1694	Power Connector; Switchcraft EAC-301
S1	1830	Power Switch; Arrow-Hart 1602-11E / BLACK
T1	1523	Power Transformer; Triad FP 34-340 (or equivalent 2nd. source)



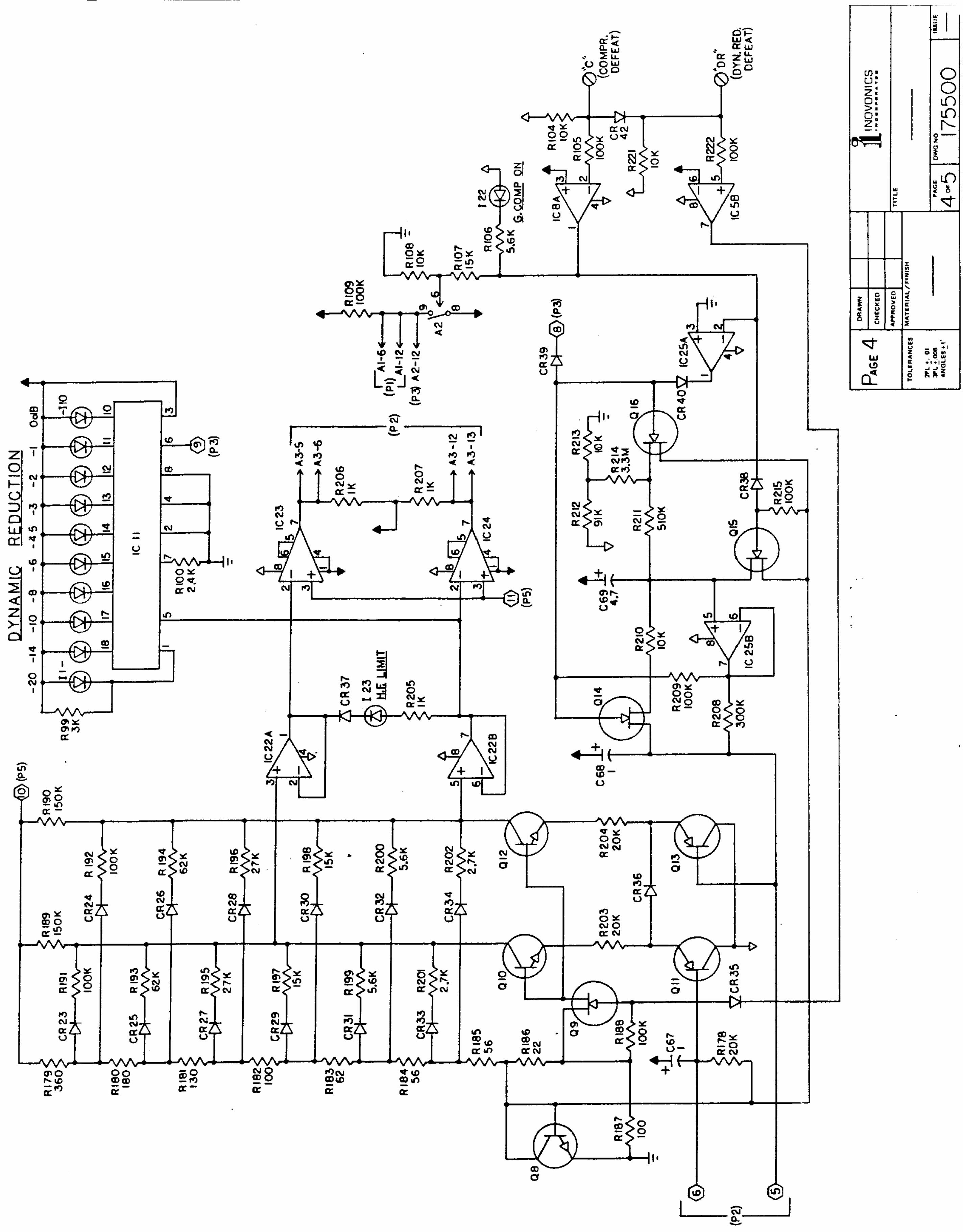
Schematic Diagram - PAGE 1



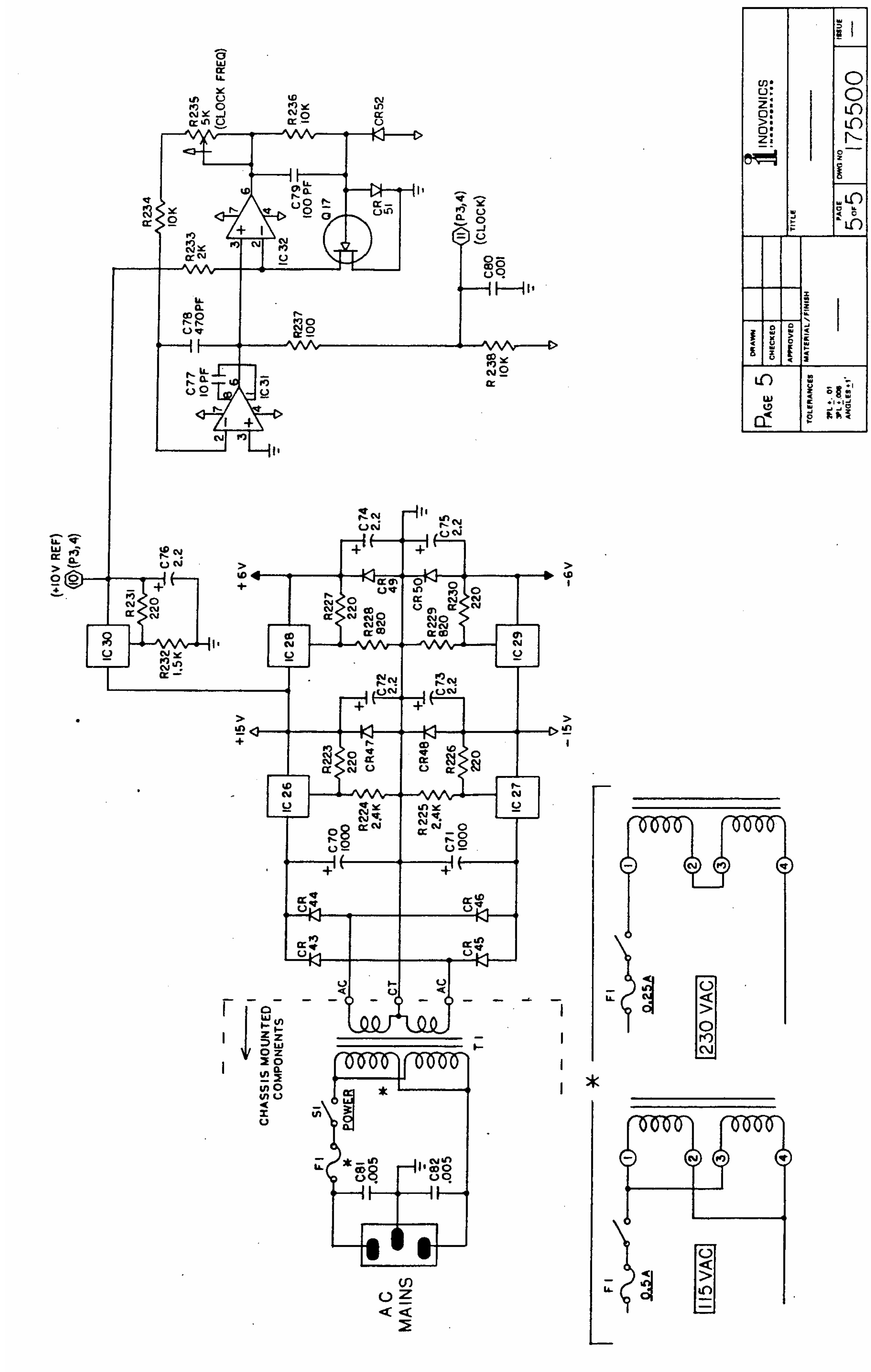
Schematic Diagram - PAGE 2



Schematic Diagram - PAGE 3



Schematic Diagram - PAGE 4



Schematic Diagram - PAGE 5

INOVONICS WARRANTY

Inovonics, Inc. products are warranted to be free from defects in material and workmanship. Any discrepancies noted within 90 days of the date of purchase will be repaired free of charge. Additionally, parts for repairs required between 90 days and one year from the date of purchase will be supplied free of charge, with installation billed at normal rates. It will be the responsibility of the purchaser to return equipment for warranty service to the dealer from whom it was originally purchased unless prior arrangement is made with the dealer to inspect or repair at the user's location.

This warranty is subject to the following conditions:

1. Warranty card supplied with the equipment must be completed and returned to the factory within 10 days of purchase.

2. Warranty is void if unauthorized attempts at repair or modification have been made, or if serial identification has been defaced, removed, or altered.

3. Warranty does not apply to damage caused by misuse, abuse, or accident.

4. Warranty valid only to original purchaser.

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