OPERATING AND MAINTENANCE INSTRUCTION MANUAL

MODEL 260/CBC

STEREO AUDIO PROCESSOR

INOVONICS
INCORPORATED

- USER'S RECORD -

260/CBC - Serial No.__________

Date Purchased ______________

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STEREO AUDIO PROCESSOR

March, 1993

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Section I

FUNCTIONAL DESCRIPTION

GENERAL PRODUCT INFORMATION

260 In-Brief

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

The 260 provides three basic processing functions: slow-acting AGC, 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 variables have been thoughtfully predetermined and integrated into the 260 design. User-accessable adjustments are reduced to only those which are essential. This relegates use of the 260 to basic broadcasting situations which require ample and consistent transmitter modulation. No variables are provided to enable adjustment for "competitive loudness," as the selected format and good programming practices are invariably the keys to any station's success. With several broadcasters in a single market often providing nearly identical programming, long-term *listenability* emerges as a real and critical factor in audience satisfaction. Listenability was a primary design goal of the 260.

260/CBC Version

Units identified with the front-panel model designation "260/CBC" include certain feature and performance upgrades established at the request, and with the close cooperation, of the Canadian Broadcasting Corporation. 260/CBC units are manufactured exclusively for use in Canada. This Instruction Manual, also identified "260/CBC," specifically relates to the Canadian-exclusive product.

A Block Diagram of the Inovonics 260 is shown in Figure 1 at the top of the next page.

AUTOMATIC GAIN CONTROL (AGC)

Wandering Levels

The program mix from an audio console will invariably be subject to long-term level variations. One might naturally attribute these to inattention by the board operator, especially in a "combo" operation with duties more pressing than conscientious gain-riding. Another cause of level inequalities stems from the manner in which different operators respond to the control board's level meter. This, rather than sloppy gain-riding, is more likely the "human element" most responsible for level variations.

The "VU" Meter

The "VU" meter was developed within the broadcast industry and has been its mainstay for more than fifty years, although a number of factors have changed since the original specification was written for this device. Up until the late 1950s, radio entertainment consisted of speech and recorded symphonic or "popular" music

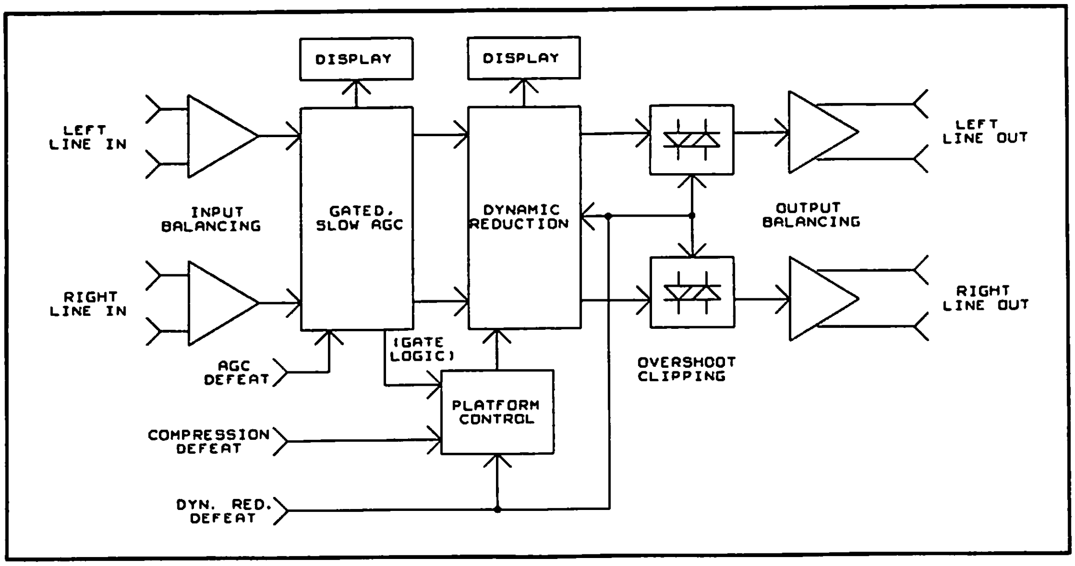


Figure 1 - Block Diagram, Model 260

which, because of the state of audio science at the time, 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.

"PPM" Metering Rationale

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 gives a much more accurate display of program dynamics in terms of system headroom and overload margin. For this reason, the slow-AGC 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 AGC, on the other hand, is a very slow and 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.

Gating

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

Stereo Correlation

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

Inhibiting The AGC

A rear-panel terminal (identified "A") may be grounded to inhibit AGC action altogether. This might be desirable with classical music programming, 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 AGC circuit. The alarm has a dual function: to warn of "dead air" and out-of-limits operation.

Whenever the input program level drifts sufficiently to require more than about ±9dB of AGC correction, the front-panel AGC ON indicator will flash rapidly until the situation is corrected. Similarly, a program pause exceeding 10 seconds will flash the LED. The flash rate of 2Hz is noticeable, even in an operator's peripheral vision. Neither alarm mode is active when AGC is manually defeated by grounding the rear-panel "A" terminal.

DYNAMIC RECUCTION (AVERAGE AND PEAK)

Average Compression and Program Peak Control are implemented by a single, gated gain control section with a complex, dual time constant. This section is a "split-spectrum" controller and block-diagrammed below.

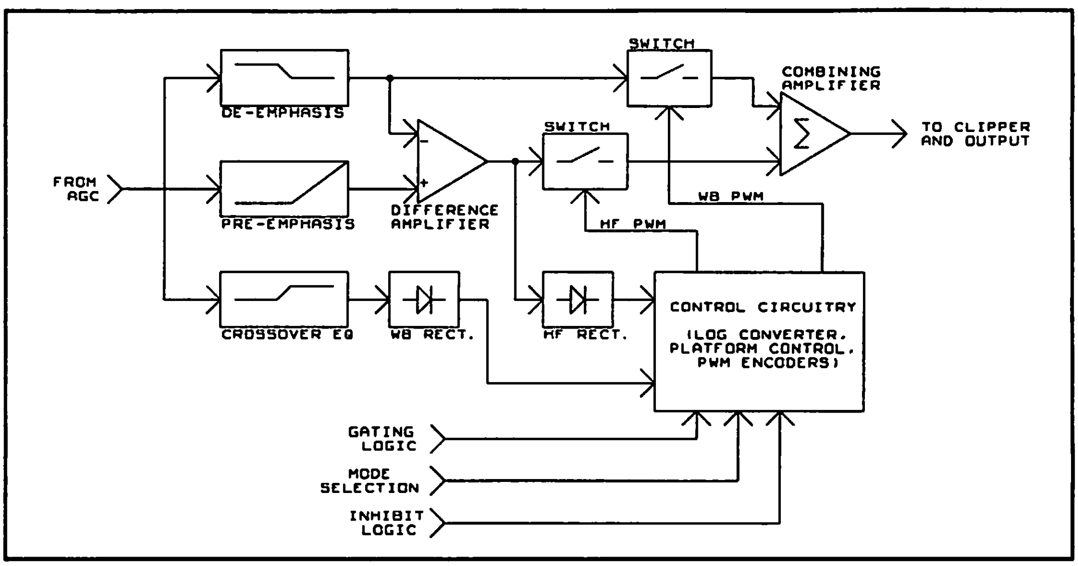


Figure 2 - Block Diagram, Split-Spectrum Dynamic Reduction Circuitry

Spectrum Division

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.

The level of lower program frequencies is controlled only by the energy within the lower band. However, the pre-emphasized frequencies are controlled by energies within *both* the high band *and* the lower 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 exhibit an artificial "brightness."

Feedforward Gain Control

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.

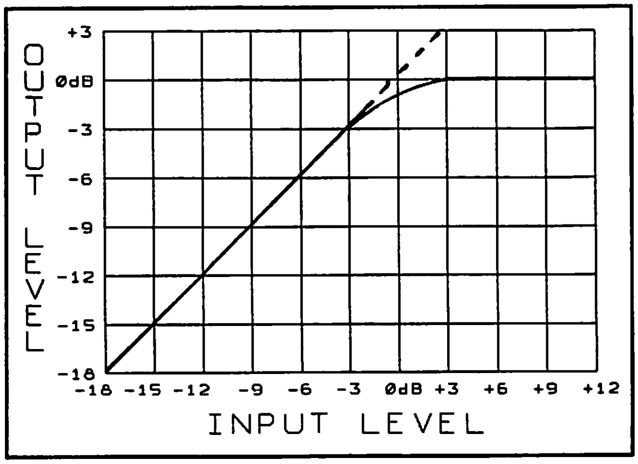


Figure 3 - Dynamic Reduction Transfer Function

The average level compression function is designed around a nominal 6dB value, which will be the typical compression in effect for normal program material. Indeed, when pre-processed by the peak-weighted, slow AGC, most speech and music will indicate this 6dB design value on the Dynamic Reduction metering scale.

Compression "Platform"

The 260 gating circuit 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 delay 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. Extended loss of program will slowly return the platform to the 6dB resting value.

Timing Specifications

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, but releases at a much quicker 0.5ms/dB.

Compression Defeat

The average level compression function may be disabled by grounding the rear-panel "C" terminal. This eliminates the delayed time constant and the gated platform. The 260 then functions as a split-spectrum, fast peak controller, with circuit gain readjusted to maintain an average *maximum* 6dB peak reduction figure and a speeded-up release timing of 10ms/dB. If the AGC is also defeated, the amount of peak control becomes a function of the INPUT GAIN setting.

Stereo Correlation

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.

Switched Preemphasis

A feature of the 260/CBC which is not available in the standard Inovonics 260 is the choice of either a "flat" or a pre-emphasized processor output.

Normally, transmission preemphasis is provided by the exciter or Stereo Generator, requiring a "flat" (*not* pre-emphasized) output from the audio processor. This means that to guard against overmodulation at high frequencies, the processor output ceiling (corresponding to 100% modulation) must have a *falling* characteristic opposing the 75-microsecond preemphasis curve.

A rear-panel switch, marked DE-EMPHASIS, allows the operator to select a standard "flat" output from the 260/CBC (DE-EMPHASIS ON) or a pre-emphasized output (DE-EMPHASIS OFF). The DE-EMPHASIS switch should be turned OFF only when pre-emphasis is *not* provided by the exciter or Stereo Generator. With the switch in the OFF position, the processor output will have a 75μs *rising* characteristic below the limiting threshold, and a *flat* characteristic above the threshold.

MODEL 260/CBC TECHNICAL SPECIFICATIONS

Tabulated below are those performance specifications of the Inovonics 260/CBC which are not specifically expressed in the text of the foregoing discussion. If a particular specification is not found below, please look for it in the discussion.

Frequency Response (below Dynamic Reduction threshold, DE-EMPHASIS switch ON): ±0.5dB, 10Hz–15kHz.

Noise: better than 65dB below 100% modulation with DE-EMPHASIS turned OFF; better than 70dB below 100% modulation with DE-EMPHASIS turned ON.

Crosstalk: better than 60dB below 100% modulation, L into R or R into L.

Distortion (DE-EMPHASIS turned OFF, 6dB steady-state gain reduction): <0.5% THD, 100Hz–15kHz; <1.0% THD at 50Hz.

Inputs: LEFT and RIGHT Line Inputs are active-balanced/bridging; accept nominal program "zero" levels between −15dBu and +18dBu.

Outputs: LEFT and RIGHT Line Outputs are active-balanced and will drive 600-ohm loads at levels between 0dBm and +15dBm, corresponding to 100% modulation.

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

Size: 1¾" X 19" X 8" overall (1U Rack Space)

Shipping Weight: 7 pounds

Section II

INSTALLATION

UNPACKING AND INSPECTION

Immediately upon receipt of the equipment, inspect carefully for shipping damage. If any damage is observed, notify the carrier at once; if not, proceed as outlined below. It is recommended that the original shipping carton and packing materials be saved 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 SERVICE OR MODIFICATION INSTRUCTIONS should they be issued by the factory.

MOUNTING

Rack Requirement The Inovonics 260/CBC mounts in a standard 19-inch equipment rack and requires only 1¾ inches (1U) of vertical rack space. *The use of plastic "finishing" washers is recommended to protect the painted finish around the mounting holes.*

Heat Dissipation Heat generated by the 260 is insignificant. The unit is specified for operation within an ambient temperature range of freezing to 120°F / 50°C. Because adjacent, less efficient equipment may radiate substantial heat, be sure that the equipment rack has sufficient ventilation to keep the temperature below the stated maximum.

AC (MAINS) POWER

As-Delivered Unless specifically ordered otherwise, the 260 is factory-set for operation from 115V, 50/60Hz AC mains. The rear-panel designation next to the fuseholder will confirm both the mains voltage selected and the value of the fuse supplied. It is factory practice to cross out the *inappropriate* marking with an indelible black marking pen. This strikethrough may be removed with solvent for redesignation.

230-Volt Operation Operation at 230VAC requires rewiring the primary circuit of the power transformer. Page 5 of the Schematic Diagram, found in the Appendix, shows this wiring option.

Power Cord The detachable power cord supplied with the 260 is fitted with a North-American-standard male plug. The individual cord conductors are *supposedly* color-coded in accordance with CEE standards:

BROWN = AC "HOT," BLUE = AC NEUTRAL, GRN/YEL = GROUND.

If this turns out *not* to be the case, we offer our apologies (cord vendors vary) and advise that U.S. color coding applies:

BLACK = AC "HOT," WHITE = AC NEUTRAL, GREEN = GROUND.

RADIO FREQUENCY INTERFERENCE (R F I)

Location Though we anticipated the 260 to be operated close to broadcast transmitters, care should be exercised in locating the unit away from *abnormally* high RF fields.

Ground Loops In some installation situations a mains frequency or 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, though the chassis ultimately must be returned to earth ground for safety.

LINE INPUT AND INPUT RANGE SELECTION

The 260 has electronically-balanced (transformerless) Left and Right Channel Program Line Inputs. These are brought out to a screw-terminal barrier strip on the rear panel, and include chassis ground connections for cable shields.

Balanced Inputs A balanced feed to the 260 will use both the "+" and "−" terminals, plus ground, for each channel. Since this is a "bridging" (high impedance) input, no termination is provided for the console output or for other equipment which feeds the 260. You may place a terminating resistor between the "+" and "−" terminals, should the source require 600-ohm termination.

Unbalanced Inputs Unbalanced inputs use the Line Input "+" and "GND" (ground) barrier strip terminals. The "−" terminal should also be connected to "GND" when the input is fed from a single-ended source.

Input Gain Range The 260 accepts zero-reference input program levels between −15dBu and +18dBu. This input range is actually divided into two parts.

Gain Jumpers As shipped, the 260 will take input levels between 0dBu and +18dBu. To change the input range for program levels between −15dBu and 0dBu, four jumpers must be installed on the circuit board. Bifurcated strapping terminals, each set marked with an "X," are on the circuit board just behind the AC mains connector.

PROGRAM 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 *not* load-sensing. They will drive the balanced inputs of Stereo Generators and exciters, or normal 600-ohm program lines. If a single-ended output is required, *only* the "+" and "GND" terminals should be used; the "−" side *should not be grounded.*

Impedance 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 0dBm and +15dBm into a terminated, balanced load.

"PROOF" MODE – FUNCTION DEFEAT LOGIC

A series of three, rear-panel barrier terminals permit the user to disable any or all of the 260 gain control functions. These terminals, labeled "A," "C" and "DR," may be locally or remotely tied to chassis ground to defeat the corresponding Processor function(s).

"A" defeats the AGC when grounded

"C" defeats Average Compression when grounded

"DR" defeats Dynamic Reduction (Compression, Limiting and Clipping) when grounded

When all three terminals are taken to ground, the 260 is in the "PROOF" mode. In this mode all gain reduction circuitry is still in the signal path, but inhibited from any dynamic action on the program signal.

Section III

SETUP AND OPERATION

With only INPUT and OUTPUT level controls for the Left and Right channels, setup of the 260/CBC 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 "on-air," with the 260 in the normal audio 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 0VU = +8dBm; +5.5dBm if 0VU = +4dBm. A +1.5VU 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* the −3dB AGC GAIN indicator LEDs to light evenly.

A. This step must be performed slowly because of the very slow AGC correction rate.

B. If this adjustment is not within the range of the panel control, consult the earlier section of the Manual dealing with jumpering options.

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 "0VU" line level. The 0dB AGC GAIN indicator should light for either a Left-only, a Right-only or 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. The procedure supposes stereo transmission, wherein a single-channel input will produce 100% total carrier modulation through the combined contribution of M and S components of the baseband signal. The 19kHz Stereo Pilot should be ON and adjusted to proper level before these steps are performed.

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

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

STEP 3 Adjust the LEFT OUTPUT LEVEL control 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, recheck the Input Gain Set procedure.

STEP 5 Adjust the RIGHT OUTPUT LEVEL control for 100% modulation.

STEP 6 Drive both the Left and Right channels with the test tone. Indicated DYNAMIC REDUCTION should remain at 10dB, and transmitter modulation at 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. This adjustment will ensure that *only* the overshoot products of the filter will be 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 AGC and Compression defeat strapping and return console gain to normal.

This completes calibration of the 260.

Section IV

CIRCUIT DESCRIPTIONS

Schematics This section describes the circuitry internal to the Inovonics 260/CBC. The discussions refer to Pages 1 through 5 of the Schematic Diagram found in the Appendix of this Manual.

PWM Since its use is unique to audio processing equipment manufactured by Inovonics, 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 TUTORIAL

PWM is utilized exclusively for audio gain control in the 260/CBC. 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 260/CBC is 120kHz, very nearly ten 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)

Triangle Generator Circuitry consists of a 10-volt reference source, IC30, and a 120kHz precision triangle generator, IC31 and 32. IC31 and C78 form an integrator which feeds a comparator, IC32. 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. Referred to the 10-volt source, a 5-volt control voltage would give 6dB attenuation, 1 volt would give 20dB. The same 10-volt supply serves as a reference from which control voltages are derived, and need not be absolute.

Encoder Comparators

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 120kHz squarewave, the duty cycle (ON vs. OFF) corresponding to the intercept point of the control voltage on the triangle. This is diagrammed below in Figure 4.

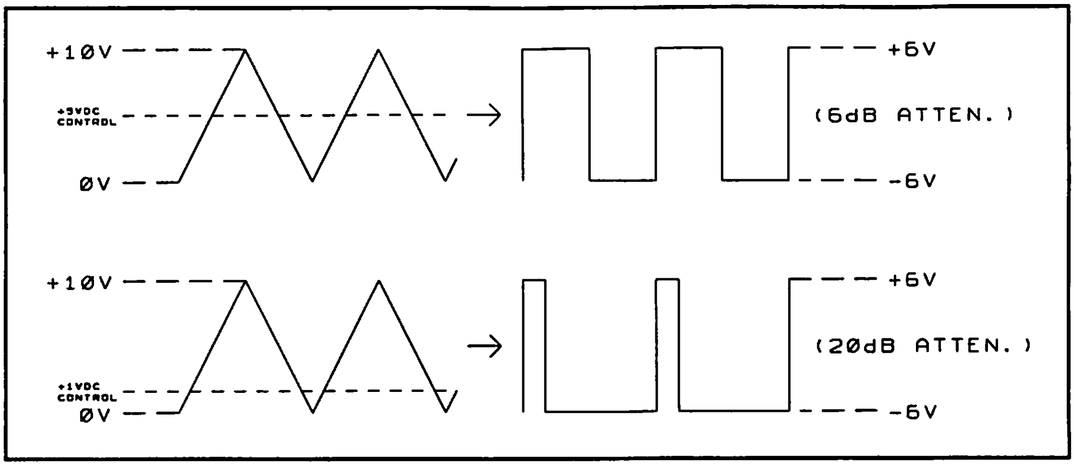


Figure 4 - PWM Generation Waveforms

INPUT AMPLIFIER AND AGC (Schematic Pages 1 and 3)

Input Circuitry

The Left channel Line Input is fed to the active-balanced input stage, IC1B. Gain may be set for the proper input line level range as discussed in the Installation section. 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 120kHz, 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.

AGC Rectifier

A portion of the recovered PWM audio signal is routed to the AGC 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-weighted value.

When the gate is open (A2(4/3) closed), rectified peaks are integrated by IC5A. This integration sets the slow AGC correction rate. The integrated value is shaped into a dB-linear, +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)). The completes the closed-loop (feedback) AGC circuit which seeks to hold the signal level constant on a peak-weighted, slow correction basis. Q7 feeds the AGC gain indicator driver, IC10, for front panel display of circuit action.

AGC GATING (Schematic Page 3)

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

Gating Logic The input signal sample from IC7A is rectified by CRs 1 through 4 and fed to a hysteretic level detector, IC7B. The resultant gating logic is used by the AGC circuit to switch A2(4/3). When the gate is closed (A2(4/3) open), IC5A integrates a reference voltage from R76 to return AGC gain to a nominal "0dB" figure at a rate somewhat slower than normal correction.

Alarms 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 AGC ON indicator. Comparators IC9C and D monitor AGC indicator voltage to also flash the LED should AGC gain correction approach its limits.

DYNAMIC REDUCTION SIGNAL PATH (Schematic Page 2)

Band Division IC12B is a unity-gain inverter with a frequency de-emphasis characteristic corresponding to the 75µs transmission pre-emphasis curve, except that de-emphasis "shelves" just above the −3dB turnover point. Energy in this band represents that part of the program spectrum which is *not* pre-emphasized. IC12A subtracts this low-band energy from the program signal and, in addition, imparts 75µs pre-emphasis. If combined in a 1:1 ratio, these two signals would add to create a pre-emphasized program signal. The split-band technique used to generate this characteristic provides the means of controlling the high frequency component independently of the wideband signal.

Rectification 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-emphasized signal energy. Wideband energy is similarly rectified by IC 13A and B, and CR11 and 12, except that a small amount of equalization normalizes control at the −3dB transition frequency.

Re-Combining 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.

Clipping and Output Stage

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 switchable de-emphasis amplifier, IC19A. IC20A inverts the signal phase to provide the active-balanced line output.

DYNAMIC REDUCTION CONTROL PATH (Schematic Page 4)

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

Semi-Log Segmentation

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 accurate within ±0.2dB 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.

Average Compression "Platform" and Timing

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. Rectified fast program peaks charge C68 to a higher value which then quickly releases (discharges) 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 resting level for extended program pauses.

In the Peak-Limit-Only mode (Compression defeated), Q15 is turned on and Q14 is 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 program overlimiting. Limiter release time is also increased somewhat by the discharge of C68 through R208. These circuit changes lessen the chance of audible artifacts in the Limit-Only mode.

Semi-Log Conversion

The rectified and filtered WB and HF samples are fed to the bases of Q13 and Q11, 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 characteristic which smooths the segmentation.

HF Limiter

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

PWM Encoding

The semi-log-converted control voltages are buffered by IC22A and B, and are 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.

Section V

INTERNAL CALIBRATION ADJUSTMENTS

Through the use of PWM gain control and digital circuit techniques, the Inovonics 260 is particularly devoid of internal calibration adjustments. The two adjustments found under the top cover should never require routine calibration. The following procedures are given in the event that components are ever replaced in areas associated with one of the two adjustments.

EQUIPMENT REQUIRED

OSCILLOSCOPE: >20MHz bandwidth; with low capacitance probe
AC VOLTMETER: −60 to +30dBu 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 120kHz design center value.

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

STEP 2 Adjust R235 for 120kHz, or an 8.3μs waveform period.

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

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

CLIPPING THRESHOLD

STEP 1 Preset the Processor for Limit-Only operation by strapping the "A" and "C" rear-panel terminals to GND.

STEP 2 Apply a 1kHz sinewave test signal to the Left channel input 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. This is Pin 1 of IC17.

STEP 4 Slowly sweep the oscillator frequency upward. At about 1.5kHz the waveform amplitude should show a slight amplitude increase.

STEP 5 At the amplitude "bump" frequency, adjust R217 slowly counterclockwise until slight flattening of the waveform is observed. Note the relative position of the trim control.

STEP 6 Turn R217 slightly clockwise so that the flattening disappears.

STEP 7	Repeat STEPS 2–6 for the Right program channel, monitoring Pin 1 of IC18 with the oscilloscope. The waveform should flatten at the same relative setting of R217.
STEP 8	Reset R217 clockwise to eliminate any sign of waveshape flattening.
STEP 9	Seal R217 with a small dot of household glue.

Section VI

APPENDIX

The following Section of this Manual contains Parts Lists for the Inovonics 260/CBC, Schematic Diagrams of all electronic circuitry, and an explanation of Inovonics' Warranty Policy.

PARTS LIST

EXPLANATION OF PARTS LISTINGS

This section contains listings of component parts used in the Inovonics 260/CBC Stereo Processor. These are listed either *en-masse,* or by schematic component reference designation, and may, or may not, specify a particular manufacturer. When no manufacturer is called-out, the term "open mfgr." advises that any manufacturer's product is acceptable.

If a particular component 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 or FAX the factory with a brief description, and we'll do our best to figure out what you're talking about.

PARTS LISTING

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

a: **Under 100pF** are "dipped mica" type, DM-15 (or CM-05 military series) size designation; "PF" value is picofarads, ±5%, 200VDC. Manufacturer open.

b: **100pF to 0.47µF** are *generally* of the metalized mylar or polyester variety; whole number "PF" values are picofarads, decimal values are microfarads, ±5%, 50VDC or better. The style used in the 260 is the "minibox" package with lead spacing of 0.2 inch. **Preferred mfgr.:** WIMA, MKS-2 or FKC-2 series. **Alternates:** CSF-Thompson IRD series or Roederstein KT-1808 or KT-1817 series.

c: Some capacitors in the 100pF to 0.0047µF range may be the larger-style DM-19 (CM-06 military series) dipped mica. These should be replaced with the same type for ease in installation.

C81,82	Capacitor, Ceramic Disc "Safety," .0047µF, 440VAC; Murata/Erie DE7150 F 472M VA1-KC
C70,71	Capacitor, Electrolytic, axial leads, 1000µF, 35VDC; (open mfgr.)
C37,38,72-76	Capacitor, High-Reliability Electrolytic, radial leads, 2.2µF, 50V; Illinois Capacitor 225 RMR 050M (preferred)
C3,4,14,17, 18,28,34,35	Capacitor, Electrolytic, radial leads, 22µF, 25V; (open mfgr.)
C32,67,68	Capacitor, Electrolytic, radial leads, 1.0µF, 50V; (open mfgr.)
C33,69	Capacitor, Electrolytic, radial leads, 4.7µF, 25V; (open mfgr.)
(Plug-in board, 6 places)	Capacitor, "High-Q," .0033µF, 2.5%, 100VDC; WIMA FKC-2 (Polycarbonate) preferred, any equivalent *must* have identical characteristics.
CR1-18,23-35, 37-42,51,52	Diode, Silicon Signal; (open mfgr.) 1N4151 or equiv.
CR19-22	Diode, Schottky; Hewlett-Packard 1N5711

C36	Diode, Germanium Signal; (open mfgr.) 1N34A or equiv.
CR43-50	Diode, Silicon Rectifier; (open mfgr.) 1N4005
F1	Fuseholder; Littlefuse 345-611-010 with 345-601-020 Cap for ¼-inch fuses, or 345-621-020 Cap for 5mm fuses. (Fuse is normal "fast-blow" in value specified on rear panel for mains supply.)
I1-23	LED Indicator, Diffused Red, T-1 package; Stanley PR 5734S
IC1-5,12,14, 16-19,20, 22,25	Integrated Cct.; (open mfgr.) LF353N
IC6,23,24	Integrated Cct.; (open mfgr.) LM311N
IC7,8,21	Integrated Cct.; Raytheon RC4558NB
IC9,13,15	Integrated Cct.; Raytheon RC4136DB
IC10,11	Integrated Cct.; (open mfgr.) LM3914N
IC26,28,30	Integrated Cct.; (open mfgr.) LM317T
IC27,29	Integrated Cct.; (open mfgr.) LM337T
IC31,32	Integrated Cct.; Harris CA3100T (or CA3100N)
A1-3	Integrated Cct.; (open mfgr.) CD4066BE (CMOS)
-	AC Mains Connector; Switchcraft EAC309
-	Barrier Strip, 16-Position, PC-mount; Magnum A204116NL-R-50
L1,2	Inductor, 1mHy; Delevan 2500-28 or equiv.
Q1-4,6-8,10,12	Transistor, NPN; (open mfgr.) 2N3904
Q5,11,13	Transistor, PNP; (open mfgr.) 2N3906
Q9,14-17	Transistor, FET; (open mfgr.) J108

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

a: **Fixed resistors** with no tolerance specified are ¼-watt, 5%, carbon-film. With 1% tolerance specified, ¼-watt, 1% metal-film. Values are in ohms; K signifies kilohms, M signifies megohms. Manufacturer open.

b: **Multi-Turn Trimming Potentiometers** (front-panel adjustable) are Beckman 89PR series or equivalent "cermet" type.

c: **Single-Turn Trimmers** (circuit board) are Beckman 91AR series.

S1	Switch, SPDT Rocker, Power; Carling RA911-RB-B-0-N
-	Switch, DPDT Pushbutton; ITT-Schadow FG-EE-FG/BLK
T1	Power Transformer, PC-mount; Signal LP34-340 or direct cross-ref.

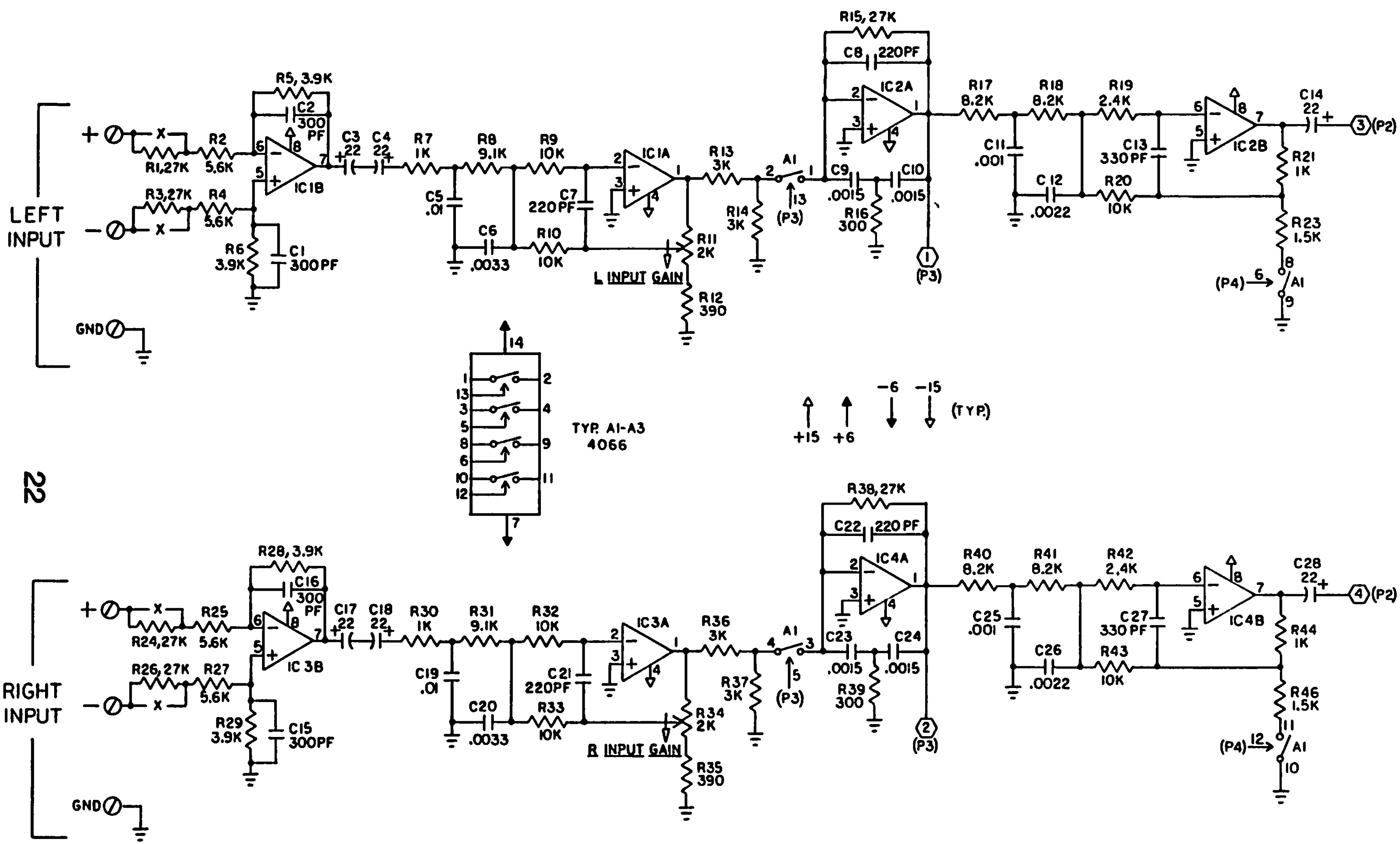
MAIL-ORDER COMPONENT SUPPLIERS

The following electronic component distributors have proven to be reputable suppliers of both large and small quantities of parts. Any semiconductor, IC, capacitor, resistor or connector used in the 260/CBC is available from one or more of these firms. Each supplier publishes a full-line catalog, available free of charge.

Mouser Electronics - Call: 1-800-34-MOUSER

Digi-Key Corporation - Call: 1-800-DIGI-KEY

ACTIVE (div. of Future Electronics - Call: 1-800-677-8899

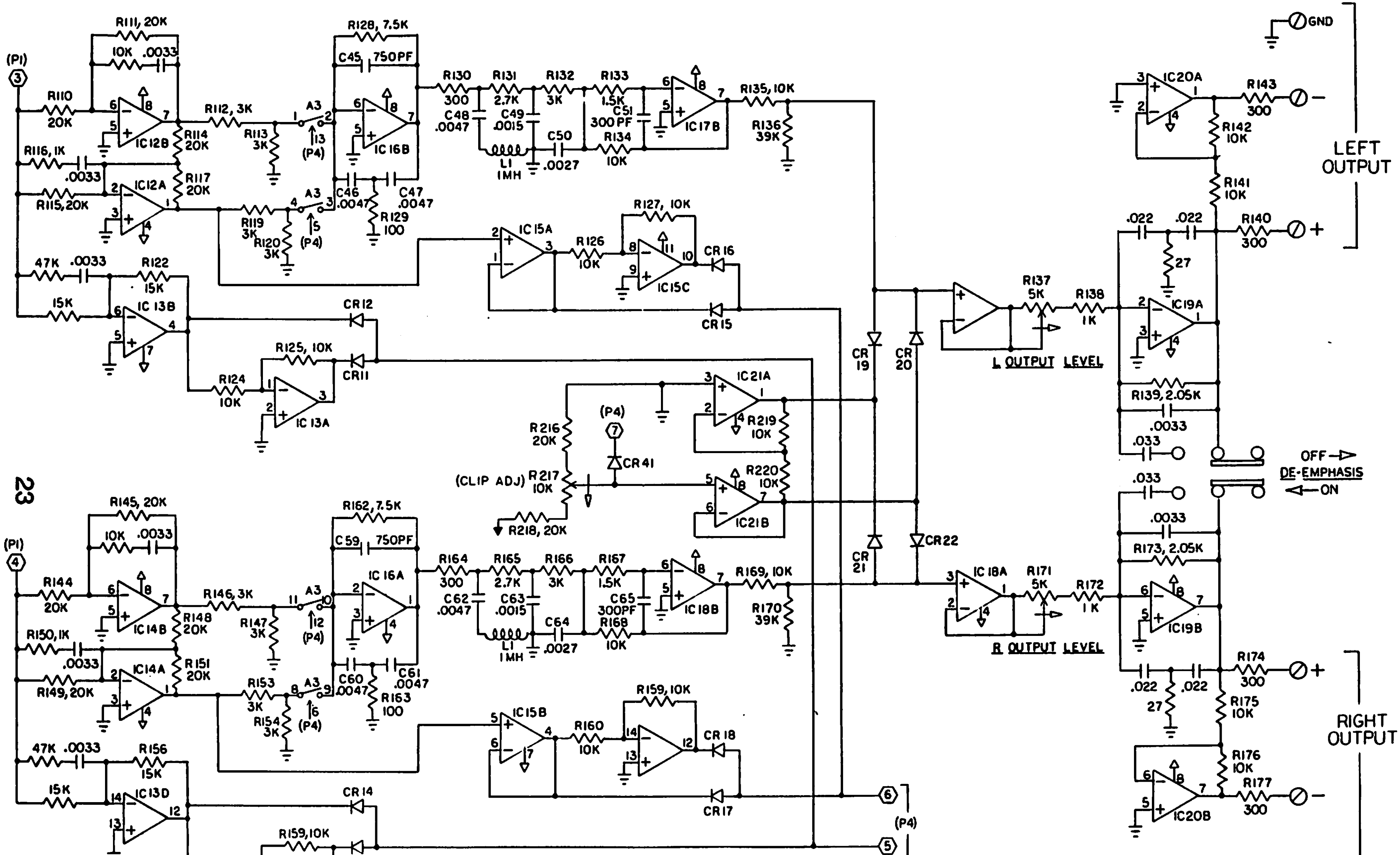


NOTES:

UNLESS OTHERWISE SPECIFIED . . . .

1. RESISTORS ARE 1/4W, 5%; VALUE IN OHMS.
2. CAPACITOR VALUES IN µF; TYPE, VOLTAGE AND TOLERANCE PER PARTS LISTING.
3. ALL IC's AND OTHER SEMICONDUCTORS PER PARTS LISTING.

PAGE 1	JIM	3-10-93	INOVONICS
	CBC SPECIAL		SCHEMATIC, MODEL 260
		1 - 5	175501	A



NOTE:
COMPONTS ON THIS PAGE WITHOUT REFERENCE DESIGNATIONS ARE ON THE PLUG-IN AUXILIARY CIRCUIT CARD.

PAGE 2

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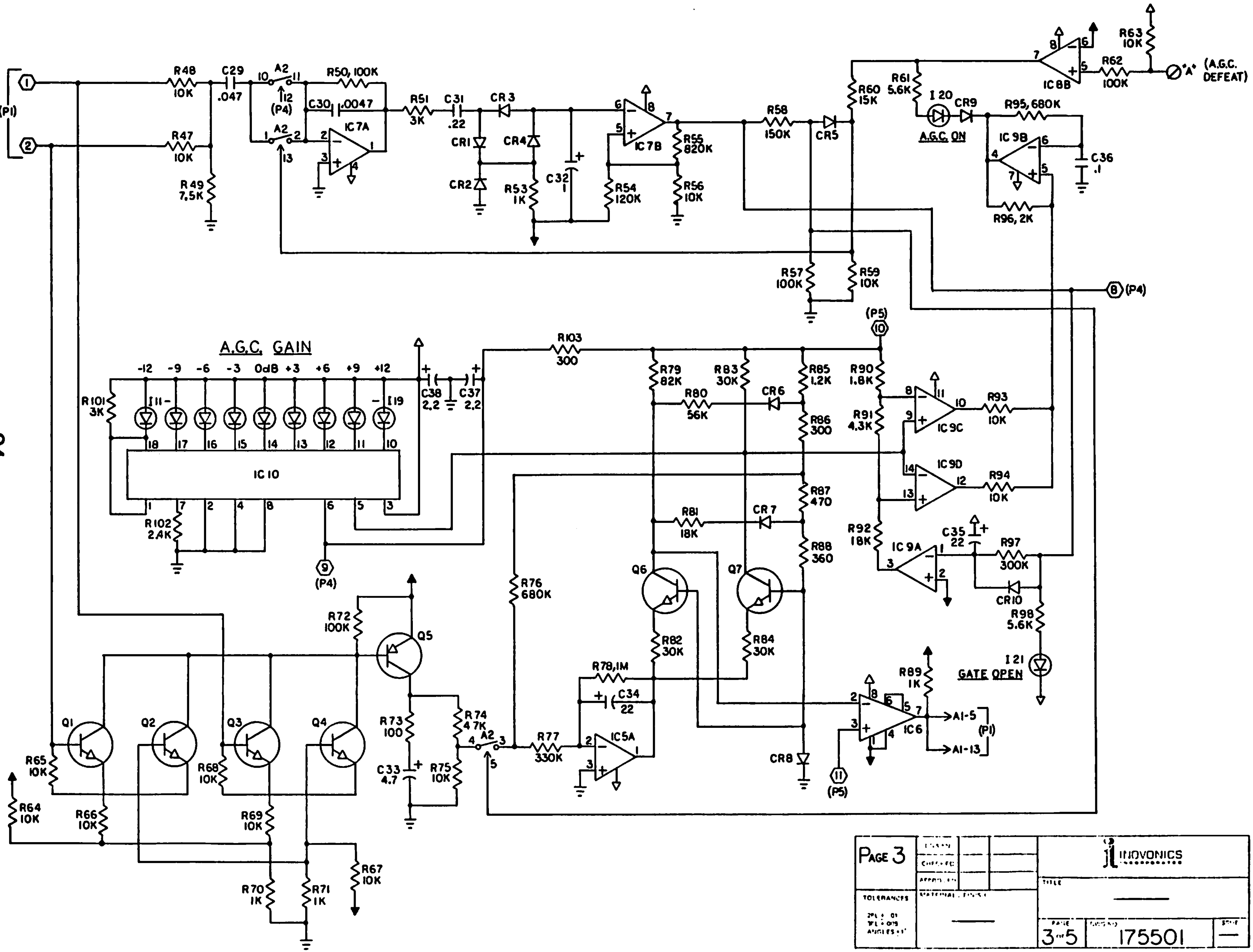
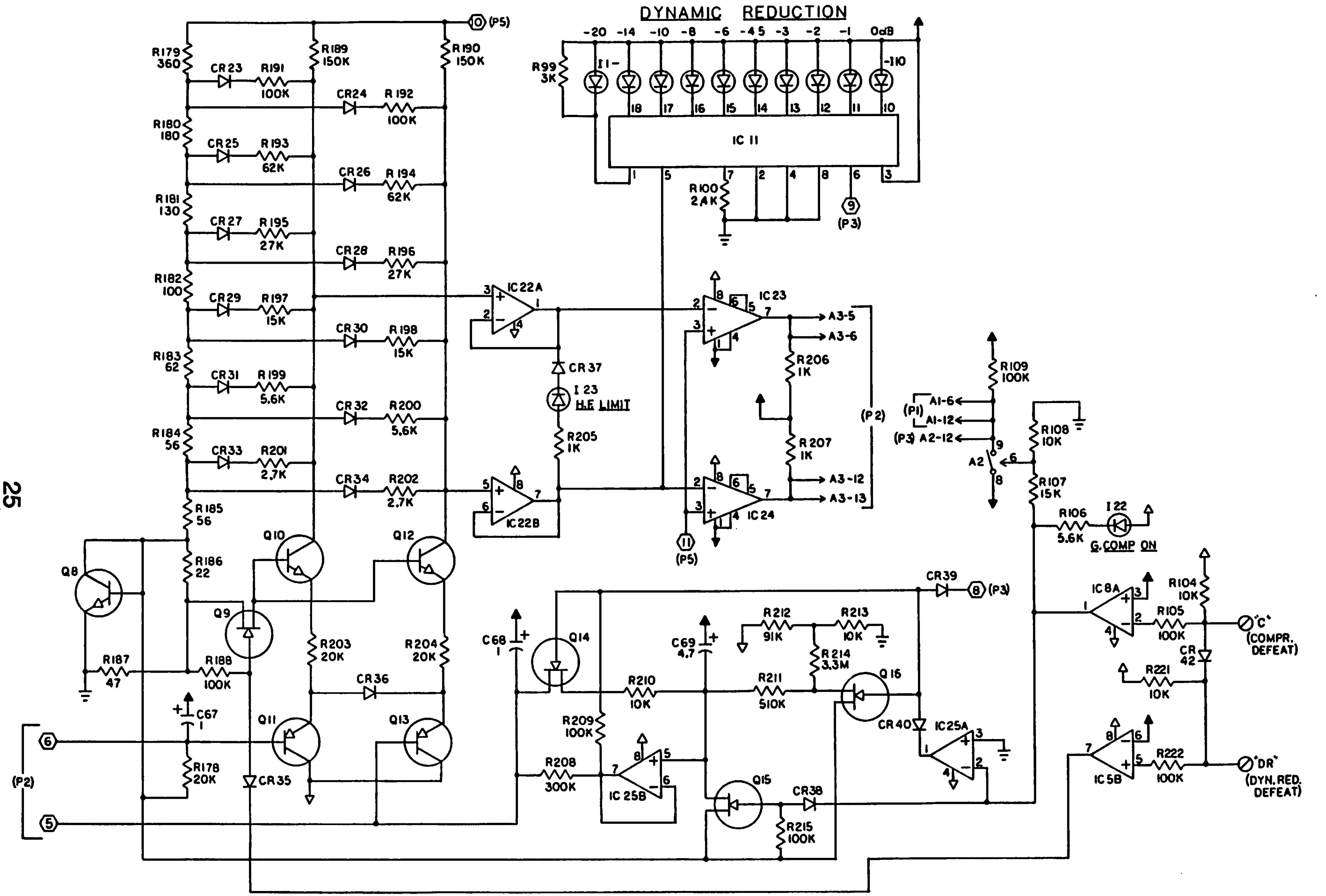

(P1)
R48 10K
R47 10K
R49 7.5K
C29 .047
A2
(P4)
R50, 100K
C30 .0047
IC7A
R51 3K
C31 .22
CR3
CR1
CR2
CR4
R53 1K
C32 1
IC7B
R55 820K
R54 120K
R56 10K
R58 150K
CR5
R60 15K
R57 100K
R59 10K
R61 5.6K
I 20
A.G.C. ON
CR9
R95, 680K
IC9B
C36 .1
R96, 2K
IC8B
R62 100K
R63 10K
"A" (A.G.C. DEFEAT)
(P4)
(P5)
A.G.C. GAIN
-12
-9
-6
-3
0dB
+3
+6
+9
+12
R101 3K
I11
I19
IC10
R102 2.4K
C38 2.2
C37 2.2
R103 300
R79 82K
R80 56K
R83 30K
CR6
R85 1.2K
R86 300
R90 1.8K
R91 4.3K
IC9C
R93 10K
IC9D
R94 10K
R87 470
R81 18K
CR7
R88 360
R92 18K
IC9A
C35 22
R97 300K
CR10
R98 5.6K
I21
GATE OPEN
R76 680K
Q6
Q7
R82 30K
R84 30K
R78, 1M
C34 22
IC5A
R77 330K
R89 1K
IC6
A1-5
A1-13
CR8
Q5
R72 100K
R73 100
R74 4.7K
R75 10K
C33 4.7
Q1
Q2
Q3
Q4
R65 10K
R66 10K
R68 10K
R69 10K
R64 10K
R67 10K
R70 1K
R71 1K
PAGE 3
INOVONICS
TOLERANCES
3 of 5
175501



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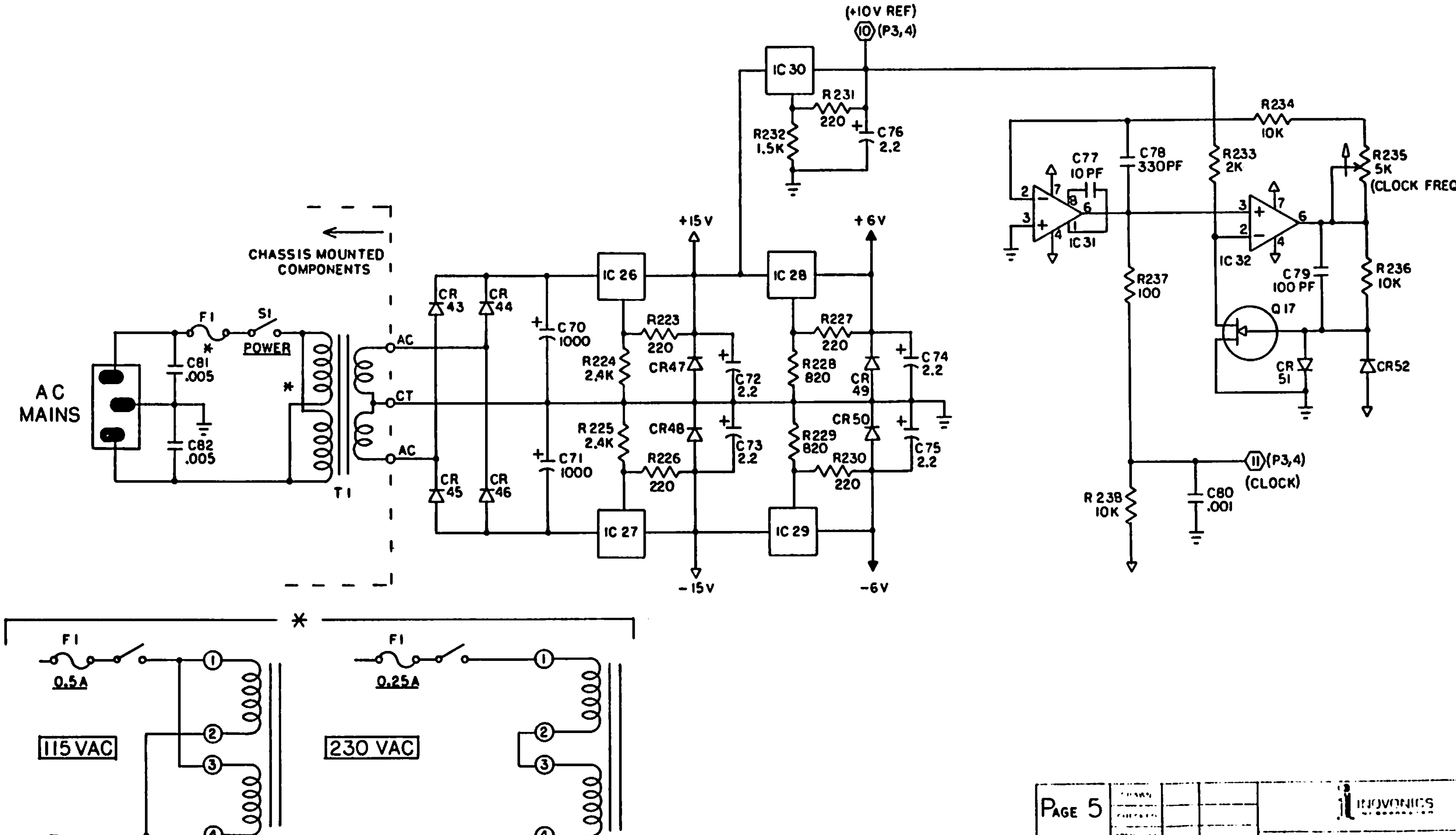

PAGE 5	INOVONICS
5-5	175501

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 shipment, provided that they are returned in "as-shipped" condition.

II **CONDITIONS OF WARRANTY:** The following terms apply unless amended *in writing* by Inovonics, Inc.

A. Warranty Registration Card supplied with product *must* be completed and returned to the factory within 10 days of delivery.

B. Warranty applies only to products sold "as new." It is extended only to the original end-user and may not be transferred or assigned.

C. Warranty does not apply to damage caused by misuse, abuse or accident. Warranty is voided by unauthorized attempts at repair or modification, or if the serial identification 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 90 days of the date of delivery will be repaired free of charge, or the equipment will be replaced at the option of Inovonics.

B. Additionally, parts for repairs required between 90 days and one year from the date of delivery will be supplied free of charge. Labor for *factory* installation of such parts will be billed at the prevailing "shop rate."

IV **RETURN OF 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, and should be prominently displayed 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.