OPERATING AND MAINTENANCE INSTRUCTION MANUAL

WebCaster

'STREAMING AUDIO' PROCESSOR

INOVONICS
INCORPORATED

—— USER'S RECORD ——
WebCaster - Serial No. ____
Date Purchased ___________
Warranty Card Mailed — ☐

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'STREAMING AUDIO' PROCESSOR

June, 2000

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Section I

INTRODUCTION

WebCaster PRODUCT DESCRIPTION

General Inovonics' WebCaster performs analog program audio processing for digital audio delivery systems. It was specifically developed to cope with the limited bandwidth and throughput of data-compressed 'streaming' audio delivered over dial-up Internet connections. The WebCaster combines the multiple functions of slow, 'gain-riding' AGC, dynamic range compression in three frequency bands, low and high frequency equalization, and tight control over program peaks. The well-defined and overshoot-compensated low-pass function restricts audio program bandwidth so that the digital encoding process will not be overtaxed. Though the cutoff frequency of the basic unit is fixed in accordance with today's streaming audio limitations, the WebCaster may also be configured for a higher cutoff frequency as improvements are made in digital audio delivery.

Processing parameters are easily set with front-panel controls, or may be controlled from a remote location using the built-in RS-232 control bus and an IBM-compatible computer or modem interface.

Features To recap, features of the WebCaster include:

- Comprehensive dynamic range processing which combines:
  - — Gated, "gain-riding" AGC
  - — 3-band average level compression
  - — Low- and high-frequency program equalization
  - — Program peak limiting with selectable clipping depth.
- Fixed low-pass filtering with patented filter overshoot compensation.
- Easy front-panel control of processing parameters, or full computer control via RS-232 bus..

WebCaster TECHNICAL SPECIFICATIONS

Frequency Response:
PROOF: ±0.25dB, 50Hz to 20kHz
OPERATE: ±0.5dB, 50Hz to 97% of nominal cutoff frequency (5kHz for –00 version, 10kHz for –01 version).

Distortion:
<1% THD at any PROGRAM DENSITY setting, and at PEAK PROCESSING settings which maintain negligible clipping depth.

Noise:
Better than 60dB below output ceiling (taken through appropriate de-emphasis network).

Gated AGC:
UK/EBU quasi-peak "PPM" response to program material; slow, 0.5dB-per-second correction rate over ±10dB range. Frequency-weighted gating threshold set at –25dB, referred to corrected input "zero" level.

Triband Compressor:
First-order band-pass function; crossovers at 250Hz and 2.5kHz. Attack and release timing optimized for each band. PROGRAM DENSITY adjustment controls timing and inter-band "blending".

Fixed Pre-Emphasis:
Follows a "truncated" 75µs curve with a 6dB/octave rising characteristic.

Variable Equalization:
HF: –6dB, –3dB, 0dB, +3dB, +6dB; variable EQ curves are in addition to the fixed pre-emphasis.
LF: –6dB, –3dB, 0dB (flat), +3dB, +6dB.

Peak Controller:
Fast peak limiter integral with hard peak clipper. PEAK PROCESSING adjustment controls release timing and program-dependent clipping depth.

Low-Pass Function:
Phase-corrected, 9-pole FDNR active-elliptic filter with proprietary overshoot compensation. (See Figure 1, below.)

Input:
Active-balanced, bridging; accepts nominal program line levels between –15dBu and +15dBu.

Output:
Active-balanced, 200-ohm resistive source; delivers 0dBm to +15dBm into a 600-ohm load.

Remote Control Provision:
RS-232 serial data port (DB-9 connector) allows all processing presets to be programmed or updated by an IBM-compatible computer. Necessary software is included.

Power Requirements:
105–130VAC or 210–255VAC, 50/60Hz; 15 watts.

Size and Weight:
1¾"H x 19"W x 10"D (1U);
10 lbs. (shipping).

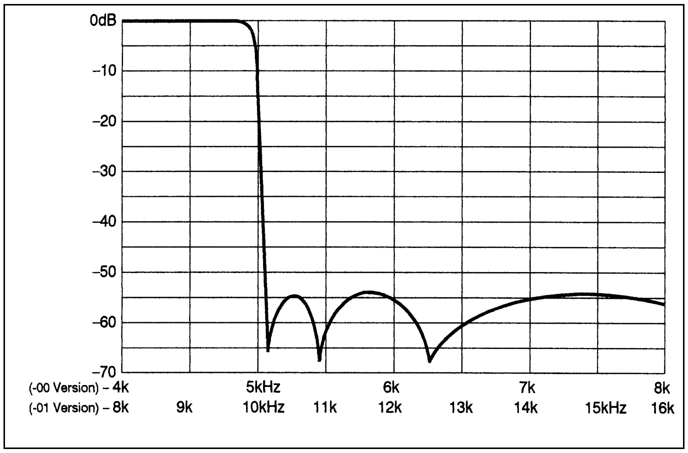


Figure 1 - WebCaster High Frequency Cutoff Characteristic

BLOCK DIAGRAM

A simplified Block Diagram of the WebCaster is shown in Figure 2, below. Processor circuitry is detailed in the Circuit Descriptions section beginning on Page 15. These descriptions reference Schematic Diagrams found in the Appendix on Pages 27-30.

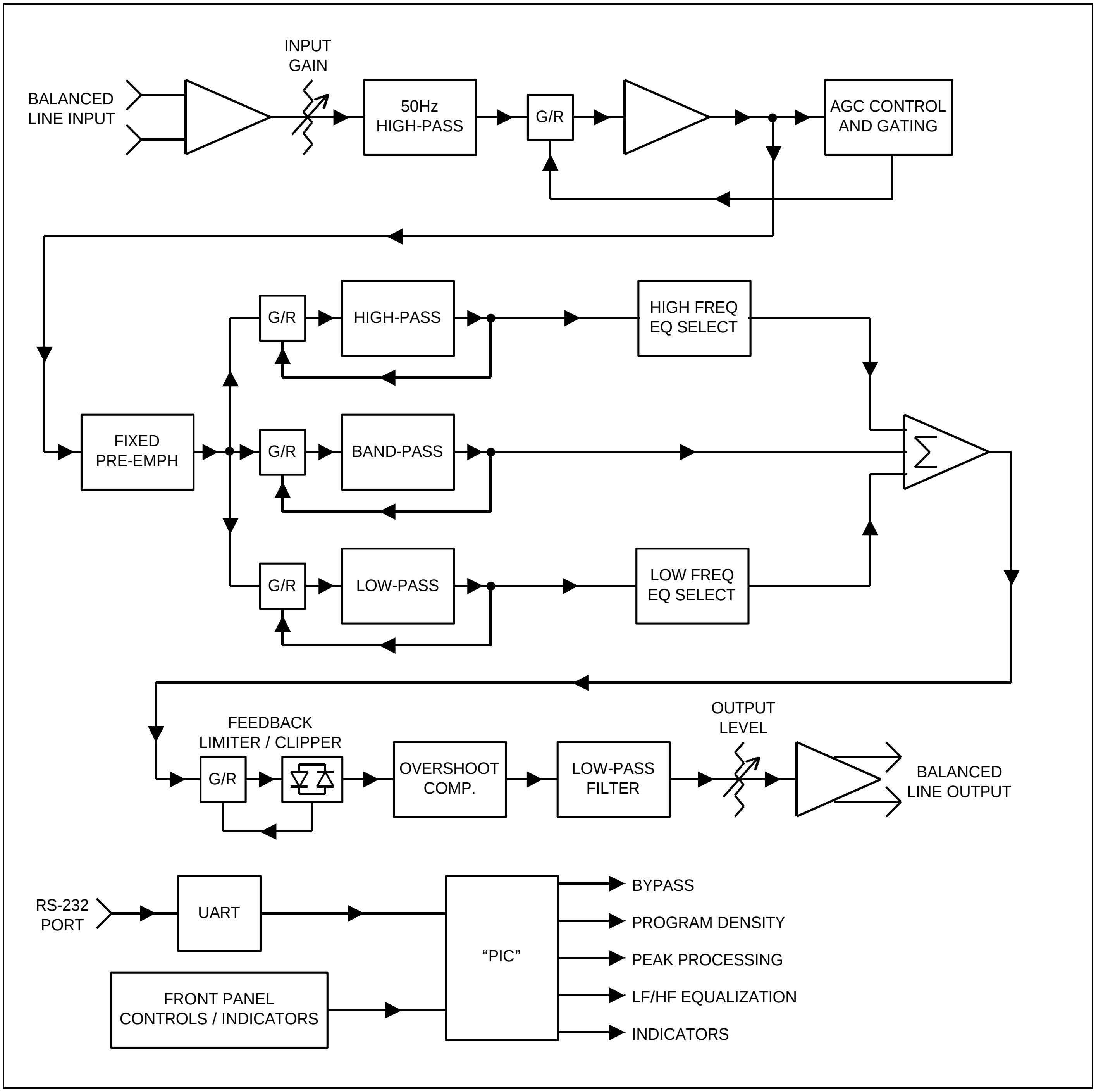


Figure 2 - Block Diagram, WebCaster Internet Audio Processor

Section II

INSTALLATION

UNPACKING AND INSPECTION

Immediately upon receipt of the equipment, 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 for return or reshipment, if 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 Inovonics.

MOUNTING

Rack Requirement The WebCaster mounts in a standard 19-inch equipment rack and requires only 1¾ inches (1U) of vertical rack space. Plastic “finishing” washers are recommended to protect the painted finish around the mounting holes.

Heat Dissipation Consuming less power than a government-issue electric pencil sharpener, the WebCaster generates negligible heat itself. 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 heat, be sure that the equipment rack is adequately ventilated to keep its internal temperature below the specified maximum ambient.

AC (MAINS) POWER

As Delivered Unless specifically ordered for export shipment, the WebCaster is set at the factory 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 a proper fuse.

Voltage Selector A mains voltage selector switch is located beneath the top cover of the unit, close to the AC mains connector on the main circuit board. *With primary AC power disconnected,* slide the red actuator with a small screwdriver so that the proper mains voltage designation (115 or 230) shows. Be certain always to install an appropriate fuse, and check that the rear-panel voltage/fuse designation is properly marked. It is factory practice to cross out the *inappropriate* designation with an indelible black marking pen. You can remove this strikethrough with lacquer thinner to redesignate.

BE SURE that the mains voltage selector setting and primary fuse value are appropriate for the mains supply before plugging the WebCaster into the wall outlet.

Power Cord The detachable IEC-type power cord supplied with the WebCaster is fitted with a North-American-standard male plug. Nevertheless, the individual cord conductors are *supposed* to be color-coded in accordance with CEE standards; that is:

BROWN = AC “HOT” BLUE = AC NEUTRAL GRN/YEL = GROUND

If this turns out *not* to be the case, we offer our apologies (cords come from many sources) and advise that US color coding applies:

BLACK = AC “HOT” WHITE = AC NEUTRAL GREEN = GROUND

RADIO FREQUENCY INTERFERENCE (R F I)

Because the input and the output of the WebCaster are chassis-ground-referenced, a mains frequency or RF ground loop could be formed between the input or output cable shield grounds and the AC power cord ground. A “ground-lifting” AC adapter will probably 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 INPUT AND INPUT RANGE SELECTION

Input Connection The WebCaster has an electronically balanced (transformerless) program LINE INPUT. This is brought out to a screw-terminal barrier strip on the rear panel, and includes a chassis ground connection for the input cable shield. *Please note that the screw-terminal barrier block can be unplugged from the chassis, simply by pulling it straight out!* This makes connection a bit easier and allows quick removal of the WebCaster from the rack should maintenance ever be required.

Balanced Input A balanced program audio feed to the Processor will use both the + and the – terminals, plus the associated G (ground). Since this is a bridging (high impedance) input, it does not provide a 'termination' for equipment that feeds the Processor. Should you feel so compelled, you may connect a 600-ohm resistor across the + and – input terminals, though the concept of 600-ohm "line matching" dates from the age of transformer coupling and the mystique of telephone lines with a characteristic impedance.

Unbalanced Input

The WebCaster can be fed from "semi-pro" gear with unbalanced outputs. In such a case, the single center conductor of the shielded input lead should be connected to the + terminal, and the shield to G. In addition, a jumper wire should be installed between the – terminal and G.

Input Gain Range

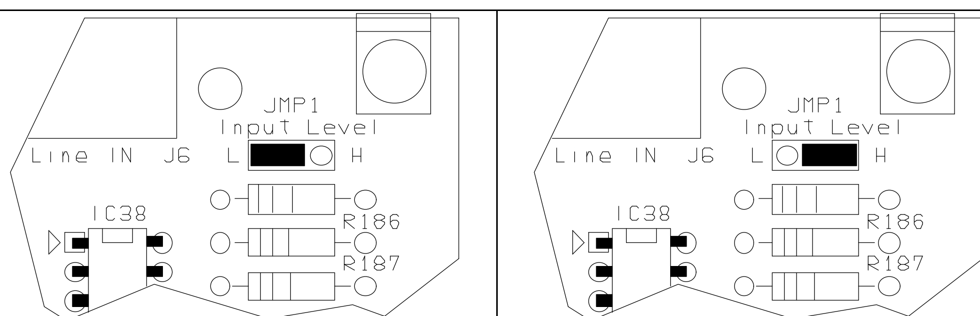
The WebCaster can accommodate line-level program input with a nominal "Zero-VU" value between –15dBu and +15dBu. This 30dB range is divided into two, more manageable 15dB ranges with an internal jumper.

As shipped, the Processor is jumpered for professional level inputs between 0dBu and +15dBu. The outputs from most professional audio products fall into this range, +4dBu, +6dBu and +8dBu being typical levels.

Lower levels between –15dBu and 0dBu may be encountered when interfacing with "semi-pro" gear, or with feeds from leased telephone circuits. Changing a jumper beneath the top cover enables the extra gain for the low-level range.

Gain Jumper

The input range jumper strip is located just behind the LINE INPUT connector and identified as "JMP1" in the circuit board legend. The jumper has an H and an L marking to indicate the proper jumper placement for High level and for Low level inputs, respectively. Figure 3 illustrates these jumpering options.



LOW LEVEL INPUTS (–15dBu to 0dBu) | HIGH LEVEL INPUTS (0dBu to +15dBu)

Figure 3 - LINE INPUT Range Selection

PROGRAM LINE OUTPUT

Output Connection and Line Level

The LINE OUTPUT of the WebCaster terminates at the removable barrier strip on the rear panel. This output is electronically balanced and *not* isolated with a coupling transformer.

The *balanced* program output level is adjustable between 0dBu and +15dBm (600-ohm-terminated). This is a normal range for professional audio equipment. When an unbalanced output at a lower level is required (to connect with the input to a computer sound card, for instance), connection should be made to the + terminal and G (ground). The unused – terminal should be left unconnected. This unbalanced connection feeding a high-impedance input will be several dB lower than the balanced output. Nevertheless, even this lower level may exceed the input level range of some semi-pro gear. If this proves to be the case, connect a 220-ohm resistor across the unbalanced output (between the + and G terminals) to reduce the level to approximately -10dBu.

REAR-PANEL “MODE” SWITCH

The 3-position toggle switch on the rear panel of the WebCaster selects OPERATE, for local (front-panel) operation, REMOTE CONTROL, for processor control by computer or modem through the RS-232 port, and PROOF, which effectively bypasses the unit.

The switch must be left in the OPERATE position if front-panel buttons are to be used for setting processing parameters. Once set, the switch may be switched to REMOTE CONTROL position to lock out the front panel buttons and protect the Processor setup. When it is in the OPERATE position, the Processor *will not respond* to remote, RS-232 commands.

The switch must be set to REMOTE CONTROL to activate the RS-232 port for remote computer or modem control. See appropriate instructions for remote Processor operation beginning on Page 13.

PROOF completely bypasses the functions of AGC, compression, pre-emphasis, equalization, limiting, clipping and the low-pass output filter. It effectively turns the Processor into a line amplifier, though the subsonic, 50Hz high-pass function is still active.

Section III

SETUP AND OPERATION

OPERATIONAL OVERVIEW AND PANEL APPOINTMENTS

This section leads off with an overview of the WebCaster with particular reference to front-panel indicators and controls. *All functions are described and explained in this overview.* Whether or not you believe in reading Manuals, please at least check these descriptions to verify that our terminology is in agreement with your understanding. If you call us (especially if you use our toll-free number!) with a question that is answered here, we are likely to be very cross with you.

AGC

WebCaster processing begins with slow, "gain-riding" Automatic Gain Control, or AGC. This is not considered a *dynamic* processing function because it does not alter program dynamics and contribute to perceived loudness of the source material. The purpose of the AGC is to erase *long-term* variations in the input program level and to present subsequent processing stages with a consistent program signal.

Input levels can wander up and down for a number of reasons. Among these are: 1) an operator's lack of attention to manual gain-riding, 2) different interpretations of console level meter readings among program production operators, or 3) the misrepresentation of the program signal waveform by the traditional, sluggish VU meter.

AGC in the WebCaster is "gated." It does not "hunt" (bring up background noise) during pauses in the program. AGC gain freezes when midrange program energy falls below the preset gating threshold.

AGC response to the program waveform is quasi-peak-responding. Its 10-millisecond integration is similar to the *response* of a European Peak Program Meter. *Correction*, on the other hand, is slow: only 1dB every couple of seconds. This makes overall operation roughly equivalent to a human operator watching a PPM and sneaking the level up and down, slowly and unobtrusively.

AGC correction spans a 20dB range. The INPUT GAIN control is adjusted to center AGC action, effectively yielding a ±10dB correction window. AGC gain is metered by the associated bargraph display, and the bottom-most GATE OPEN indicator lights whenever the circuit senses legitimate program energy to enable circuit operation.

Plus AGC readings (+5, +10) indicate that the input signal is below the optimum level and that the circuit is slowly bringing the gain up. *Minus* readings (there are no such things as *negative* dBs, at least not in our space/time continuum) show that the input signal is too "hot" and that the level is being reduced to compensate.

COMPRESSION

The definition of *compression* generally acknowledges a reduction in the *average* dynamic range of a speech or music program signal. Program level is frequently (and sometimes erroneously) expressed in r.m.s. terms integrated over a period of a hundred milliseconds or more. A *compression ratio* may be expressed or implied. This ratio might be on the order of 2:1 or 4:1, indicating that the output level changes as a fraction of the input level variation.

The WebCaster compresses program dynamics in three frequency bands. These are labeled LOW, MID and HIGH. In the interest of maximizing perceived loudness, the compression ratio in each of these three bands is made uncommonly steep for a compressor, 20:1 or greater. Thus the circuit acts more like a 3-band *limiter* than a traditional *compressor*. Attack time within each band is quite rapid. Release, on the other hand, is variable with the PROGRAM DENSITY setting, which is explained in more detail under the next heading. The three COMPRESSION displays show dBs of gain reduction in each band.

PROGRAM DENSITY

Two up/down buttons allow the operator to choose eight relative degrees of density control. These are indicated on the adjacent LED bar display.

Set at (MIN), the 3-band compressor has a slow release to what we call a *platform* value. The platform is established by an average of the gain reduction in all three frequency bands. This platform causes the circuit to perform more like a single-band compressor, and spectral density of the processed program audio is only marginally affected.

As PROGRAM DENSITY is increased toward (MAX), the platform and the "blending" of the bands is reduced so that the full multiband advantage may be realized. Compressor release timing is progressively shortened as well, and this imparts a "busy" character to the program to further increase perceived loudness.

EQUALIZATION

In addition to the fixed program pre-emphasis, the WebCaster affords a range of control over both high- and low-frequency program equalization.

The LOW FREQ. and HIGH FREQ. buttons cycle the EQUALIZATION settings through the five choices for each end of the spectrum: –6dB, –3dB, 0dB, +3dB, +6dB.

CLIP
PEAK
LIMIT

The final processing block of the WebCaster is a unique "feedback" peak-limiter/clipper. A final clipping circuit is able to monitor its own action and tell the limiter how hard to work, depending on how aggressively the PEAK PROCESSING (described next) has been set. This feedback technique establishes a stable and fixed *clipping depth*, or ratio between the two peak control functions. Two LEDs flash as circuitry copes with program peak excursions, enabling a visual interpretation of this limit-to-clip ratio.

PEAK PROCESSING

Two up/down buttons select the eight levels of program peak control indicated on the adjacent LED display. At the (MIN) setting, typical values of peak reduction are on the order of 5dB, and *no* clipping is allowed. Setting number 2 also restricts peak reduction to the same 5dB figure, but enables a small amount of clipping as well. From setting number 3 upward, peak reduction runs about 10dB, with clipping increasing as the setting approaches (MAX).

NOTE: Always pay particular attention to the effect of heavy peak processing on solo voices. Complex waveforms, such as instrumental music, can tolerate a good deal more clipping than solo vocals and voice announcements.

INPUT GAIN

Input sensitivity of the Processor is adjusted by this 15-turn potentiometer to accommodate varying input levels. The control itself has 15dB *continuous* adjustment. This, coupled with input level range jumpering (Figure 3, Page 8), accommodates the WebCaster's full 30dB input signal level range. The INPUT GAIN control is set so that normal program material keeps the AGC indicator close to center-scale.

OUTPUT LEVEL

This multi-turn control adjusts the Processor output level to match the input requirements of a computer sound card or other digital encoder. (See the discussion of output level on Page 9.)

POWER

Harmonically in accord with today's humanity-based concepts of *nurturing* and *self-esteem*, Inovonics has included this special switch, the operation of which *emPOWERs* the operator of the WebCaster to reach new heights in Internet presence *sustainability*. (?)

PROCESSOR SETUP PROCEDURE

Input Level Adjustment

The INPUT GAIN control is adjusted to center the AGC operating range with a nominal "Zero-VU" program line input. If the following procedure shows control range to be outside adjustment limits, recheck circuit board jumpering for *Input Gain Range* selection as described on Page 8.

1. Apply a 500Hz test tone from the program signal source at a level one-and-one-quarter dB *above* normal reference level. This is simply a VU meter indication of +1¼VU.
2. Adjust the INPUT GAIN control so that *both* the 0dB AGC GAIN indicator *and* the one just below it (–2.5dB) light equally. Remember that the AGC circuit responds very slowly to level change, so exercise patience in making this important adjustment.

Once the INPUT GAIN has been adjusted with a test tone, you can switch to normal program material. If the procedure has been performed properly, and if the program creator pays reasonable attention to the VU meter, AGC GAIN will nearly always remain in the 'safe' area between +5dB and –5dB.

Output Level Adjustment

Perform this part of the setup procedure under normal operating conditions and using typical program material. To simplify output level adjustment, initially set both the PROGRAM DENSITY and PEAK PROCESSING adjustments at MAX.

Advance the OUTPUT LEVEL control to a maximum point consistent with optimum utilization of the digital transmission channel. This means the highest level that does *not* drive the sound card (or other encoder) into any form of analog or digital signal *clipping*. Consult the instructions for the specific encoding equipment to determine how this level is established. A simple listening test, adjusting for the onset of audible distortion is *not good enough*. Any signal clipping, either in the analog domain prior to encoding or in the digital signal stream, can seriously compromise transmission throughput and quality.

Once the INPUT and OUTPUT adjustments have been made, reduce the PROGRAM DENSITY and PEAK PROCESSING settings for a less aggressive "sound." These two parameters should be experimented with, and a final choice for the settings based on the collective subjective decision of programming personnel.

REMOTE CONTROL OF THE WebCaster

Computer and Modem Compatibility

Control software provided with the WebCaster is written in Visual Basic 5®. It runs only under Windows 95® or subsequent 32-bit versions of Microsoft's powerful, popular and memory-hungry operating system for IBM-compatibles. The software enables remote control of the Processor, either from a computer connected directly to the WebCaster, or via modem interface.

Any Hayes-compatible modem *should* permit remote computer control of the Processor over an intermediate dial-up telephone circuit. The compatibility issue will be one between the computer's own modem and the remote modem associated with the WebCaster. With full compatibility between the two modems, the interconnection will appear transparent, allowing the software to give the same rapid and effective control over the processing parameters as if the computer were connected directly.

Interconnection

From an interconnection standpoint, the WebCaster is a data *output* device, thus the RS-232 SERIAL INTERFACE connector is a DB09 *female*. A standard serial interconnect cable may be used to directly connect the Processor to the computer's serial (COM) port. As the computer is classed as an *input* device, it will have either a DB09 or DB25 *male* connector. If necessary, you may use one of the common 25-pin to 9-pin "mouse" adapter/reducers.

The external modem, on the other hand, is a data *output* device and will have a DB09 or DB25 *female* connector. A custom cable will need to be purchased or constructed.

Schematic Sheet 4 on Page 30 diagrams the several options for interconnect cables between the WebCaster and computer or modem.

Section IV

CIRCUIT DESCRIPTIONS

This section details circuitry of the Inovonics WebCaster. Circuit descriptions refer to four pages of Schematic Diagrams contained in the Appendix, Section V, Pages 27 through 30.

If you're looking for some sort of alignment procedure for this Processor, prepare for a disappointment. There are no internal controls for any sort of calibration, the circuitry being rock-solid through impeccable design.

NAVIGATION

Schematic component reference designations have not been assigned in as haphazard a manner as they might at first appear. Instead of annotating the *schematic* in a logical sequence, we instead have chosen to designate the *components on the circuit board* following their physical placement, top-to-bottom, left-to-right. We expect this practice will prove useful when troubleshooting, making it easier to locate the physical part after analyzing the diagram.

The WebCaster schematic consists of three sheets that cover the main circuit board and the front-panel assembly. Main-board components begin with the number "1"; i.e.: R1, C1, IC1. Front-panel components are in the five-hundred series; i.e.: R501, S501.

The front-panel assembly interconnects with the main board using three short ribbon-cable jumpers. J2 on the main board mates with J502 on the panel assembly, J4 to J504, and J5 to J505.

INPUT STAGE (Schematic Sheet 1, Page 27)

Line Input Balancing IC36B is an "active-balancing" stage for the program line input. It affords RF suppression and rejection of other, unwanted common-mode signals. When R183 is jumpered into the input network with JMP1, the Line Input accepts "High" program levels between 0dBu and +15dBu. For "Low" level inputs, between –15dBu and 0dBu, R183 is jumpered out of the circuit. Input range jumpering is described on Page 9.

High-Pass Subsonic Filter IC37B performs the dual function of a variable-gain stage and a 50Hz high-pass filter. Assuming negligible musical content below 50Hz, we can maximize loudness and optimize channel utilization by attenuating program frequencies below 50Hz at a rate of 12dB-per-octave.

The feedback path of IC37B includes the front-panel INPUT GAIN control, R212. This pot affords the 15dB of continuous level adjustment within each jumpered input gain range.

TECH NOTE: The sinewave signal level at the output of IC37B which will maintain AGC gain at 0dB is –5dBu.

AGC AMPLIFIER (Schematic Sheet 1, Page 29)

Antediluvian Gain-Control Element Explained

The next paragraph details operation of the AGC amplification stage, but the gain-control technique used there is typical throughout the Processor.

IC38B is a classic inverting op-amp, but with transistors Q35 and Q36 included in the input network. It is the *saturation resistance* property of these two transistors that is used effectively to shunt input signal *current* to ground and control the overall gain of this stage. The signal voltage swing, being electrically very close to a current summing node, is negligible, far below the $V_{CE(SAT)}$ of the bipolar NPN devices used here. The upside-down, back-to-back transistor hookup helps linearize the circuit for a low figure of distortion. Surprisingly, gain reduction vs. base current is a stable and predictable function.

If this circuit is unfamiliar to you, don't feel bad. It is somewhat unconventional and dates from one of Inovonics' first products developed in the early 1970s. It is also the subject of a long-expired patent.

Rectifier and AGC Control

IC39B and IC40B, along with diodes CR27 and CR28, give full-wave peak rectification of the gain-controlled input signal. R197 and C67 yield the 10-millisecond-integration for AGC response to program material.

IC41B is a DC gain stage with a fixed offset. Its output sits at +1.5VDC when the program level from IC38B is exactly –5dBu. The output of IC41B is driven negative when the program exceeds –5dBu, and is driven positive when program level drops below –5dBu.

Let's assume for the moment that the output of IC41B is routed through IC42A directly to IC41A, an inverting comparator with a reference voltage of +1.5V and a tiny bit of hysteresis. The output of IC41A is going to snap smartly to the positive rail when program audio rises above –5dBu, and to the negative rail when it falls below this level. This toggles analog switch IC42B that steers integrator IC40A.

The integrator is driven from its own output when the program level is too low, and from an inversion of its output when the level is too high. This gives a *logarithmic* voltage ramp that matches the *logarithmic* transfer function of the gain-control stage to yield a *linear* dB/second correction. The time constant of R173 and C58 determine the slow, unobtrusive, 0.5dB/second correction rate of the AGC.

AGC Gating Gating amplifier IC38A monitors the level-corrected program signal. This is a first-order, band-pass filter with –3dB points at 300Hz and 3kHz. The purpose of this frequency weighting is to favor legitimate program material, and neglect rumbles and hisses which might otherwise cause the AGC to readjust these noises to annoying levels.

The band-passed program signal is rectified by CR23 and CR24, and sensed by comparator IC37A. The output of this IC sits at the positive supply rail until a program signal exceeds the gating threshold, at which point it toggles to the negative rail, lighting the GATE OPEN indicator and switching IC42A from NO (normally-open) to NC (normally-closed).

When the gate is open, IC42A feeds program-level-derived DC from IC41B to comparator IC41A. This enables AGC circuitry to correct input gain. When the program level drops below threshold and IC37A toggles low, the actual AGC gain-control voltage is instead presented to comparator IC41A. This causes AGC gain slowly to return to the 0dB, resting value.

TRIBAND COMPRESSOR (Schematic Sheet 1, Page 29)

Fixed Pre-Emphasis C53 is in the input path of IC38A and imparts a fixed pre-emphasis to the program signal ahead of the 3-band compressor. The resultant increase in high frequency energy is kept in check by normal compressor action.

Band-Pass Compression IC28B is a first-order band-pass stage defining the frequency characteristic of the MID band. Gain control ahead of this stage gives a distortion-reduction advantage because the *compressed* signal is filtered. The MID band samples some energy in the adjacent bands to help maintain a more uniform response under heavy compression and eliminate "phase-swishing" and other audible artifacts.

Gain stage IC29B feeds the full-wave rectifier comprised of Q26, Q27 and Q28. This simple, yet effective rectifier configuration is attributable to British circuit genius Peter Baxandall. Rectifier reference bias comes from the same source used by the peak control circuitry. Midband attack time is fixed by R138 and C49. Release is through R139 to a "platform" established by C59 and a discharge resistance selected by IC43 per the PROGRAM DENSITY setting.

The LOW and HIGH bands have low-pass and high-pass characteristics, respectively. LOW and HIGH band compressor operation is identical to that described for the MID band, except that time constants are scaled appropriately.

Compression "Platform" At the (MIN) PROGRAM DENSITY setting, IC43 selects R208 as a discharge path for C59. The DC control voltages from all three bands combine to charge C59 to an average of the three. This establishes a compression "platform" to which each band will release quickly. All three bands then further release, slowly and simultaneously, through R208. This gives the effect of independent, multiband action for program transients, but a slow and gentle broadband compression characteristic for the average value of the program.

At the most aggressive (MAX) setting of PROGRAM DENSITY, C59 is shorted directly to ground through IC43. This means that C59 cannot charge from DC compression-control voltages. There is no “platform” in this case, and each band of has its own fast release through R120, R139 or R150, giving maximum multiband performance. Intermediate settings of PROGRAM DENSITY furnish compressor behavior between the two extremes.

VARIABLE EQUALIZATION (Schematic Sheet 1, Page 27)

The outputs of the three compressor sections are combined in summing stage IC34A. The MID band is fed through fixed resistance R127, but the LOW and HIGH bands are routed through selectable networks. IC33 and IC37 allow selection of five EQUALIZATON settings, both for LOW FREQ. and HIGH FREQ. This varies the gain of the LOW and HIGH bands in the final output “mix.”

PEAK CONTROL (Schematic Sheet 2, Page 28)

Compressed program signals are applied to IC26B, which includes the previously explained Q15/Q16 antediluvian gain-control element for linear peak limiting.

Q7 and Q8 serve a dual function. With emitters tied to stiff voltage sources, the base-emitter junctions *clip* the program signal at a predetermined and absolute “ceiling.” In addition, collector current that flows as the peaks are clipped is further amplified to generate a *limiter* control voltage for linear gain reduction. Bias to establish this limiter threshold / clipping level is from voltage dividers tied to the power supply rails.

The PEAK PROCESSING selector controls analog switch IC14 to set peak limiter release time. The faster the release, (a lower value of resistance switched through IC14), the greater the incidence of program clipping and its attendant increase in perceived loudness.

At the two least-aggressive PEAK PROCESSING settings (1 and 2), a small DC bias from R43 and R44 is introduced into the limiter release equation. This assigns a fixed loss to the limiter circuit and reduces the total amount of peak level control to approximately 5dB.

Limiter release timing is programmed for the most useful working range of limiter/clipper action. The signal level at the output of IC26B that represents a ‘ceiling’ output level is +5dBu.

FILTER OVERSHOOT COMPENSATION (Schematic Sheet 2, Page 28)

Sources of Overshoot

All low-pass filters exhibit a certain amount of overshoot and ringing when presented with complex input waveforms. Generally, the sharper the cutoff, the more pronounced the effect. Overshoots result from the elimination of higher-order input signal components that helped define the signal peak amplitude before they were filtered out. Even a fully phase-corrected filter will exhibit overshoots, and a 9-pole “elliptic” filter, like the one used in the WebCaster, can overshoot 3dB or more... perhaps *much* more, depending on the program waveform!

Other systems of overshoot control permit the primary low-pass filter to overshoot, then isolate and re-introduce the overshoots to cancel themselves in the signal path. The patented overshoot compensator used here, on the other hand, pre-conditions the limited program signal *ahead* of the filter so there is little or no tendency for the filter to *generate* any overshoots.

Phase-Lag and Recombining

As previously related, Q7 and Q8 constitute a “hard” clipper at the input of the compensation circuit and are biased to a point that represents the output ‘ceiling’ value.

IC25B buffers the output of the Q7/Q8 clipper and incorporates a gentle second-order rolloff above 15kHz. IC24B is an all-pass, phase-lag stage that time-displaces the fast leading and trailing edges of steep waveforms. This means that the primary characteristic of a program waveform that would normally excite filter overshoots is instead added to the waveform *amplitude*. A second clipper, Q22 and Q23, also biased to the ‘ceiling’ level, “strips” these displaced-and-added components from the program signal. IC22B compares the “stripper” input and output to recover the stripped-off components. These contain much of the program harmonic (high frequency) information, so we cannot simply throw them away. By recombining these stripped-off program components with the stripped program signal *in opposite phase*, the spectral integrity of the program is maintained. This 180-degree displacement of certain program overtones is not discernible to the listener, but is quite effective in inhibiting filter overshoots.

For a more detailed discussion of this strange and marvelous filter overshoot compensation scheme, the reader is directed to U.S. Patent No. 4,737,725.

LOW-PASS FILTER (Schematic Sheet 2, Page 28)

The 9-pole, elliptic-function (Cauer) low-pass filter is an active version of the classic L-C design worked-out in Germany during the late 1940s, probably with a slide rule! The particular active configuration used in the WebCaster is sometimes called the “FDNR” because each of the legs to ground simulates a Frequency-Dependent Negative Resistance. Referring back to the classic L-C design, resistors in series with the signal replace series inductors, and each of the active circuits to ground simulates an inductor/capacitor series-resonant element.

A great “cookbook” which includes this and other filter circuits useful to the circuit experimenter is the *Electronic Filter Design Handbook* by Arthur B. Williams, published by McGraw-Hill. The reader is kindly directed to this source for a more informed discussion of how the FDNR circuit works than we could possibly deliver here, not only because of the limited scope of this Instruction Manual, but due to our own marginal understanding of how these confounded things work!

IC22A buffers the output of the low-pass filter; IC21A provides phase inversion and gain to compensate for filter insertion loss. *TECH NOTE:* The signal level corresponding to the output ‘ceiling’ level at the output of IC21A is +5dBu.

OUTPUT STAGE (Schematic Sheet 2, Page 28)

Q13 and Q14 form an output “safety” clipper biased to the same ceiling as the integrated limiter/clipper. Tight limiting/clipping and effective filter overshoot control ensure that only very seldom will Q13 and Q14 act on the program signal. Nevertheless, they are included, “just in case...”

IC26A buffers the output signal and includes a gentle low-pass function for frequencies beyond the primary low-pass cutoff. IC27B and IC27C route the Processor input signal around the active circuitry in the PROOF mode.

OUTPUT LEVEL control R211 feeds gain stage IC25A. This stage includes current-booster transistors Q11 and Q12 to drive interconnect cabling and different input loads with good power margin. CR19 and CR20 set bias for the two output transistors, and CR21 and CR22 give short-circuit protection. This is one-half of a “bridge” output configuration, the other half comprises unity-gain inverter IC23A, also with output-boosting discrete circuitry, to drive the opposite output polarity. The balanced program LINE OUTPUT is taken from between the two output amplifiers, an unbalanced output connection from between the + terminal and ground.

GAIN REDUCTION METERING (Schematic Sheet 3, Page 29)

DC control voltages from the AGC stage and the 3 bands of compression are fed to IC3B, a 1-of-4 analog multiplexer. Oscillator/counter IC2 sequences IC3, acting like a motor-driven rotary switch to commutate the four control-voltage inputs.

Control voltage represents the semi-log gain control transfer function. CR1 and CR2 translate this to a linear scale that is DC-offset by a reference voltage from IC1A. Thus the output of IC1B sits at approximately +3V with no gain reduction in effect, and drops toward ground as control voltage goes positive in response to gain reduction.

IC1B feeds display driver IC501, which drives the paralleled cathodes of the four LED readouts. Each LED readout has a common-anode connection fed by an emitter-follower. These four transistors are sequenced by IC3A to be in step with the sequenced control voltages from I3B. Thus a common log converter and display driver can serve the four, multiplexed gain-reduction displays.

COMMON CONTROL CIRCUITRY (Schematic Sheet 3, Page 29)

The WebCaster makes efficient use of a device called a “PIC,” or Peripheral Interface Controller, IC8 on the Schematic. This is a simple, single-chip microcontroller meant for elementary logic and uncomplicated control functions. We program it to perform certain routines dealing with front-panel buttons and indicators, and RS-232 serial communications.

IC9 converts the six panel button closures into a 3-bit binary address. The PIC keeps track of buttons pressed and latches individual, 3-bit binary output commands for LOW FREQ. and HIGH FREQ. EQUALIZATION, PROGRAM DENSITY and PEAK PROCESSING settings. The 3-bit outputs are also paralleled to a series of decoders that light the respective LED indicator strings for these four functions.

Switch S2, located on the rear panel of the Processor, enables two operating modes in addition to local, front-panel control of the Processor.

In PROOF, processing circuitry is bypassed and the WebCaster becomes a unity-gain amplifier with flat frequency response. The PIC not only re-routes signal path circuitry, but also flashes front-panel indicators to alert the operator that the unit is in PROOF.

In the REMOTE position, the PIC locks-out the front-panel buttons and instead responds to RS-232 serial commands for setting processing parameters. IC7 is an RS-232 level translator, buffering the serial data send and receive lines from the PIC.

POWER SUPPLY (Schematic Sheet 2, Page 28)

WebCaster circuitry utilizes ±9-volt supplies for op-amps and other linear stages, and a +5-volt supply for digital logic. Each of these three sources is regulated by a “3-terminal” linear voltage regulator; IC4 for +9 volts, IC6 for –9 volts, and IC5 for +5 volts.

The power transformer, T1, has dual primary windings that may be switched in parallel or in series to accommodate 115V or 230V mains, respectively.

Section VI

APPENDIX

The following section of this Manual contains Parts Lists and Schematic Diagrams for the WebCaster, and an explanation of Inovonics' Warranty Policy.

PARTS LIST

EXPLANATION OF PARTS LISTINGS

This section contains listings of component parts used in the Inovonics WebCaster 'streaming audio' processor. These are listed either *en-masse*, or by schematic component reference designation. The listing 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, so long as it carries the proper generic part number.

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. We'll do our best to figure out what you need and get it on its way to you quickly.

PARTS LISTING

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

a) **100pF to 0.47µF** are of the metalized mylar or polyester variety. Whole number "P" values are picofarads, decimal values are microfarads, ±5%, 50VDC or better. The style used in the Webcaster is the "minibox" package with a lead spacing of 0.2 inch. **Preferred part:** Wima MKS-2 or FKC-2 series. **Alternates:** CSF-Thompson IRD series, or Roederstein KT-1808 or KT-1817 series.

b) **1.0µF and above** are radial-lead electrolytics, value per schematic, 25VDC; (open mfgr.).

C1,2	Capacitor, Ceramic Disc "Safety" Mains Bypass, .0047µF, 440VAC; Murata/Erie DE7150 F 472M VA1-KC (preferred)
C4,5	Capacitor, Electrolytic, axial leads, 1000µF, 35VDC; (open mfgr.)
C15	Capacitor, Memory Back-Up, 1 Farad, 5.5VDC; (open mfgr.)
C21-24, 26,29-33	Capacitor, "High-Q," .0033µF, 2.5%, 100VDC; Wima FKC-2 (Polycarbonate) preferred, any equivalent *must* have similar, very-low-loss characteristics.
C38,39	Capacitor, Electrolytic, radial leads, 220µF, 6VDC; (open mfgr.)
CR1,2,11-29	Diode, Silicon Signal; (open mfgr.) 1N4151 or equiv.
CR3-10	Diode, Silicon Rectifier; (open mfgr.) 1N4005
CRES1	Ceramic Resonator, 4MHz; Mouser 520-ZTT400MG

F1	Fuseholder, PC-mounting; Littlefuse 345-101-010 with 345-101-020 Cap for ¼-inch (U.S.) fuses, or 345-121-020 Cap for 5mm (European) fuses. (Fuse is normal “fast-blow” type in value specified on rear panel with reference to mains supply.)
I501	LED Indicator, pastel red, T-1 package; Stanley MVR 3378S
I502	LED Indicator, pastel green, T-1 package; Stanley MPG 3878S
I503,504,505	10-Segment LED-bar display module, green; Kingbright DC-10GWA
I506	10-Segment LED-bar display module, yellow; Kingbright DC-10YWA
I507,508,509	10-Segment LED-bar display module, red; Kingbright DC-10EWA
IC1,12,13, 17-26,28-32, 34,36-41	Integrated Cct.; (open mfgr.) LF353N
IC2	Integrated Cct; (open mfgr.) CMOS 4060B
IC3	Integrated Cct; (open mfgr.) CMOS 4052B
IC4,5	Integrated Cct.; (open mfgr.) LM317-T (Uses Aavid 574602 B03700 Heat Fin)
IC6	Integrated Cct.; (open mfgr.) LM337-T (Uses Aavid 574602 B03700 Heat Fin)
IC7	Integrated Cct.; Maxim MAX232
IC8	Integrated Cct.; *SPECIAL FACTORY-PROGRAMMED “PIC,”* type 16C62A. Order by designation, reference the WebCaster.
IC9	Integrated Cct.; (open mfgr.) 74HC148
IC10,11,15,16	Integrated Cct.; (open mfgr.) 74HC138
IC14,33,37,43	Integrated Cct; (open mfgr.) CMOS 4051B
IC27,42	Integrated Cct; (open mfgr.) CMOS 4053B
IC501	Integrated Cct.; (open mfgr.) LM3914N
J1	AC Mains Connector, PC-mounting; Switchcraft EAC303
J3	Connector, 9-pin “D-Sub” female, PC-mounting; (open mfgr.)
Q1-4,6,7, 10,12,14,19, 20,22,26, 27,31,32,34	Transistor, NPN; (open mfgr.) 2N3904
O5,8,9,11, 13,21,23,28,33	Transistor, PNP; (open mfgr.) 2N3906
Q15-18,24, 25,29,30,35,36	Transistor, NPN; (open mfgr.) 2N5088

All resistors are specified as follows:

a) **Fixed resistors** with values carried to decimal places implying a 1% tolerance (*example:* 3.01K, 10.0K, 15.0K, 332K) are ¼-watt, 1% metal film type.

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

c) **Multi-Turn Trimming Potentiometers** (front-panel adjustable) are Tokos RJC097P series, Beckman 89PR series, or equivalent “cermet” types.

S1	Switch, DPDT Slide, Voltage Selector; C&K V202-12-MS-02-QA
S2	Switch, SPST Toggle; C&K 7103-M-D9-A-B-E
S501-506	Switch, SPDT Momentary Pushbutton; ITT-Schadow D6-04-01, with F14-04 gray cap
S601	Switch, Power Rocker; Carling RA 911-RB-O-N
T1	Power Transformer, PC-mounting; Signal LP-20-600 or direct cross-reference

MAIL-ORDER COMPONENT SUPPLIERS

The following electronic component distributors have proven themselves reputable suppliers of small quantities of replacement parts for professional equipment.

> The temptation to use cross-referenced hobbyist or TV-shop ‘direct replacement parts’ (ha!) should be avoided!

Any semiconductor, IC, capacitor, resistor or connector used in the WebCaster is *probably* available from one or more of these firms. Each supplier publishes a full-line catalog, available free for the asking. Minimum-order restrictions may apply, and export orders may be difficult.

Mouser Electronics — Call (800) 346-6873

Digi-Key Corporation — Call (800) 344-4539

ACTIVE (div. of Future Electronics) — Call (800) 677-8899

Allied Electronics (div. of Avnet) — Call (800) 433-5700

Schematic Sheet 1

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Schematic Sheet 2
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Schematic Sheet 3

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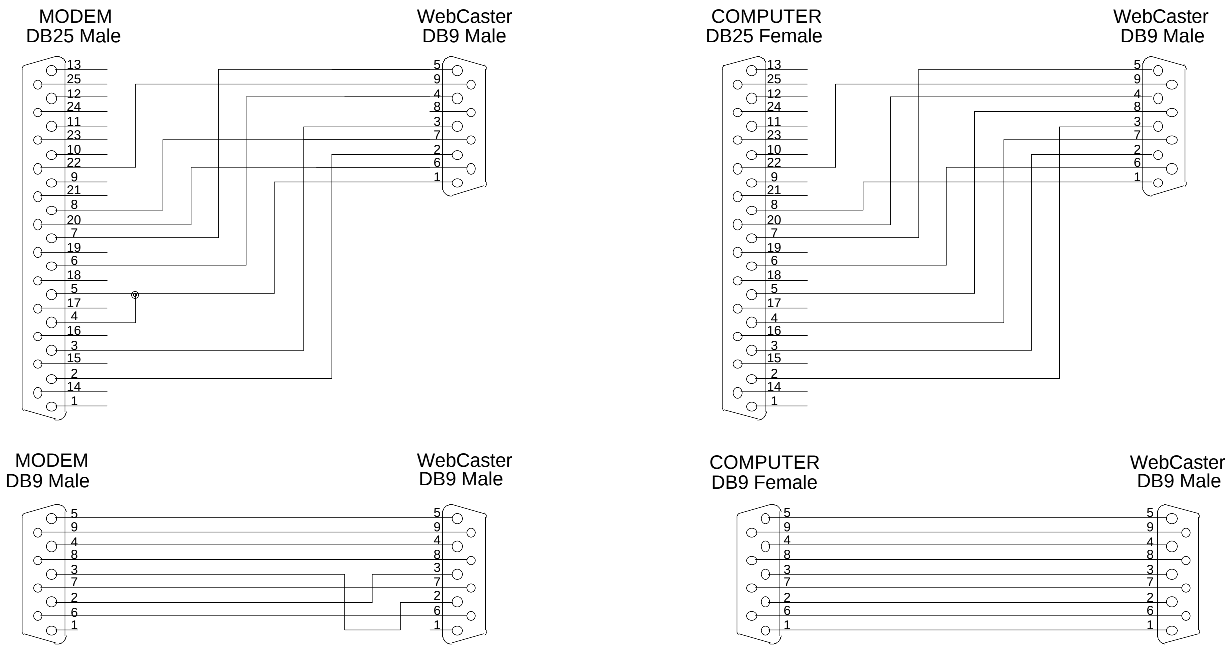

Interconnect Cables — WebCaster to Computer or Modem

Schematic Sheet 4

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 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 Inovonics 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 without prior written approval by Inovonics.

C. Warranty does not apply to damage caused by misuse, abuse, accident or neglect. 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 with a new or remanufactured product at Inovonics' option.

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 labor rate."

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.