COMPELLOR MODEL 9301

OPERATING GUIDE

1.0 INTRODUCTION

The Aphex COMPELLOR is a multipurpose audio processor designed to give inaudible control of short and long-term average program dynamic range. The COMPELLOR operates to maintain a well-controlled "average" audio level. That is to say that the program floor is "lifted", so quiet signals become more audible, while excessively loud signals are reduced in level. The extent of control by the COMPELLOR is adjustable by simple controls.

In the COMPELLOR, the functions of compression, leveling, and limiting are interwoven with an intelligent control system to maintain all three dynamic functions simultaneously. The various dynamic characteristics of an audio signal are analyzed and the processing adjusted to minimize the audible effects of gain control. This means the "squeezing" or "pumping" effects commonly attributed to signal compressors are absent with the COMPELLOR, even when a large amount of control is used. The main attribute of the COMPELLOR, then, is that it is "invisible" in the audio system - you will not detect its presence.

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Your COMPELLOR was carefully packed at the factory, and the container was designed to protect the unit from rough handling. Nevertheless, we recommend careful examination of the shipping carton and its contents for any sign of physical damage which could have occurred in transit. If damage is evident, do not destroy the container or packing material. Immediately notify the carrier of a possible claim for damage. Shipping claims must be made by the consignee.

1.1 Limited Warranty

Aphex Systems, Ltd. warrants to the original owner that the Compellor will be free from defects in parts and labor for a period of one (1) year from the date of purchase.

THE ABOVE WARRANTY IS IN LIEU OF ANY OTHER WARRANTY, WHETHER EXPRESSED, IMPLIED OR STATUTORY, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTY OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR ANY WARRANTY ARISING OUT OF ANY PROPOSAL, SPECIFICATION, OR SAMPLE. APHEX SYSTEMS SHALL NOT BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES. APHEX SYSTEMS NEITHER ASSUMES NOR AUTHORIZES ANY PERSON TO ASSUME FOR IT ANY OTHER LIABILITY

1.2 Service Information

If it becomes necessary to return a unit for repair, **contact Aphex for a return authorization number**, repack it in the original carton and packing material, and insure the shipment. If a warranty repair, enclose a copy of proof of purchase and send package to:

APHEX SYSTEMS, LTD.
11068 Randall Street
Sun Valley, CA 91352
PH: (818) 767-2929 FAX: (818) 767-2641

WARNING: TO REDUCE THE RISKS OF FIRE OR ELECTRIC SHOCK, DO NOT EXPOSE THIS APPLIANCE TO RAIN OR MOISTURE.

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2.0 OPERATIONAL CHARACTERISTICS

The COMPELLOR is a unique combination of Compressor, Leveler, and Peak Limiter. The COMPELLOR has three detector circuits that control a single gain element (see Block Diagram). The very simple, high quality audio path provides extraordinary transparency. The compression and leveling sidechains are "intelligent," being program-controlled and interactive. The result is a very simple, easy-to-use device that is free of the sonic effects of pumping, breathing, noise build- up, popping and hole punching.

Before proceeding further the reader should be aware of the terms that are used in this manual. "Leveling " has a high compression ratio and has slow attack and release times. "Compression" has low compression ratios with faster time constants. Limiting has a high compression ratio with very fast attack time and fast release time. It is important to note that the higher the ratio and the faster the time constants, the greater the audible effect of gain control on the audio.

The Compellor combines these functions in a way to minimize the audible effects of gain reduction. The leveler provides a "platform" based on long-term average levels. The compressor, working from this "platform" has to do less gain reduction and can more easily handle short-term level changes. A PROCESS BALANCE control varies the ratio of compression to leveling. The high-speed (1 microsec) limiter catches any dynamic overshoots. The limiter also allows the compressor action to remain slow enough to maintain natural transient qualities in the audio.

To illustrate the co-functioning of the three systems, imagine a sudden 20dB increase in signal level above 0 VU. The limiter will catch the peak and hold it until the compressor causes enough gain reduction to pull the audio out of limiting. The leveler will then pull the audio out of the increased compression. This will return the audio to the same "sound" as before the 20dB increase in input.

The COMPELLOR's compression detector is influenced not only by the RMS level of the audio, but also by program dynamics and wave complexity, so audio quality is greatly enhanced over simple RMS or average responding processors. Transient sounds are preserved, pumping and breathing eliminated. It has a "soft knee" compression characteristic, with the ratio varying from 1.1 to 1 at threshold (30dB below nominal 0VU), increasing to 3 to 1 at 0VU. The attack and release times are automatically varied from 5 to 50 ms for attack and 200 to 1000ms for release.

The leveling process provides a slow and smooth control over the program level platform. It has a fairly high ratio (20 to 1) with variable attack and release times to simulate the way the ear perceives loudness over long periods. The attack and release times vary from preset values of 2.5s and 5s, respectively. The circuit's most useful purpose is to maintain a consistent compression depth, and therefore quality, regardless of the long term program input level. Certain sources, such as public address systems, can have extreme, quick level changes. Those sources require faster release times on the leveler and the speed is switchable from the front panel.

The peak limiter has a fixed threshold 12dB above nominal 0VU with an attack time of 1 microsec and release time of 10 ms. The 12dB ceiling was carefully chosen to allow maximum cooperation between the sidechains, providing natural sounding peak characteristics while maintaining a strong average level. This ensures maximum drive level to following devices without fear of clipping, overmodulation, or tape saturation. For those situations in which there is sufficient headroom or the Compellor is followed by a more sophisticated peak processor (e.g.- the Dominator) the limiter is defeatable from the front panel.

2.1 Dynamic Verification Gate (DVG)

The DVG monitors short term and long term average levels, compares them, and impedes gain changes when program dynamics might be sacrificed for arbitrary gain reduction. The DVG also prevents gain release during short-term program pauses which otherwise would cause "pumping" or "breathing" effects. Vocal material is especially benefited by this feature, sounding natural even when

extremely compressed. DVG action is indicated by a front panel LED.

2.2 Dynamic Recovery Computer (DRC)

The DRC allows very rapid recovery from gain reduction under certain complex wave conditions. Signals that are high in peak amplitude but low in relative power cause an increase in the compression release rate. Unrequired gain reduction is thus inhibited, preventing loss of transient wavefronts, holes,etc. This contributes towards a natural, open sound, even during heavy compression.

2.3 SILENCE GATE

The Silence Gate is another important part of the COMPELLOR's natural sound. Whenever the input falls below the selected threshold, the Silence Gate "freezes" the COMPELLOR, inhibiting release of the gain reduction. This eliminates noise swells and allows normal fade-outs. When the program resumes, attack is improved on the next signal because gain reduction does not now have to go full range.

This is NOT a "noise gate" which mutes all audio. Such action would actually cause greater problems, for noise modulation is much more noticeable than the noise itself. The Silence Gate simply holds everything constant - no signal, no change. The Silence Gate will hold gain reduction release indefinitely - for several hours, if necessary.

2.4 DRIVE Control

The last circuit controlling the VCA is the DRIVE control. Turning the front panel knob counterclockwise attenuates the VCA, thus reducing processing. Turning the control clockwise opens up the VCA, sending more signal to the output and the detectors, providing more processing.

2.5 I/O Circuits

The input and output circuits are transformerless, servo-balanced. These circuits allow the COMPELLOR it to be interfaced with a wide range of audio systems. The COMPELLOR can be driven from balanced or unbalanced sources, as if it had a bridging type input transformer. The common mode rejection is excellent and RFI filtering is employed.

The nominal operating level (0VU) of the input and output circuit can be set by jumpers on the main PC board for -10dBv, +4 and +8dBm levels. Since the COMPELLOR operates at a constant internal level, the input and output metering automatically follows.

The output circuit is a unique active type which can be used like a transformer winding. If one of the output legs is grounded, full voltage swing is transferred to the opposite leg of the balanced output. Gain and drive are thus preserved for unbalanced loads.

2.6 VCA Circuit

The VCA itself is the Aphex 1001 Voltage Controlled Attenuator. This component is the world's finest monolithic Class A audio control device. Its integrated construction enables absolute matching between the transistors, resulting in almost perfect tracking in thermal and gain characteristics.

2.7 Typical Applications

The COMPELLOR is a useful tool for virtually any audio system. It's hard even to imagine a situation where the sound system could not benefit from a more controlled dynamic range.

There has been so much attention brought to the newest increases in dynamic range with the onset of digital technology that some of us may have lost sight of the difference between maximum dynamic range and usable dynamic range.

In the typical live sound application, for example, there is in reality a very small difference between the

maximum level available from the sound system (or the threshold of pain), and the ambient noise level in a club, concert hall or the like. The 80 or 90dB of dynamic range so sought after is completely useless in such instances. It is also useless if it cannot be transferred from a compact disc to a cassette. Without a COMPELLOR in the audio chain, you have to decide between losing quiet signals into the noise or having distortion from overload on loud sounds.

Listeners actually prefer listening to reduced dynamic range material, as long as open, transient qualities are maintained. The COMPELLOR is designed to accomplish these goals, while remaining quite invisible in the process.

3.0 COMPELLOR INSTALLATION

3.1 Physical Considerations

The 9301 Compellor is designed to fit into one slot in an Aphex 9000 frame and dbx 900 series frames. The thumbscrews (# 6-32) secure the module to the frame.

3.2 Electrical Considerations

3.2.1 Power

The 9301 is powered by +/-15V. The power is bussed to the unit on the backplane of both the Aphex and the dbx racks. The +/-24V which appears on the dbx rack will not affect the 9301 in any way.

NOTE: The 9301 consumes 250mA worst case. Compute the total power consumption of all modules in the rack to determine if sufficient power is available from the power supply.

On the Aphex rack model 9000R the audio ground and chassis ground come out the the power screw terminal connector seperately (see figure 1). The terminal marked ⏚ may be jumpered to the terminal marked ⏚ to electrically connect the audio and chassis grounds together.

3.2.2 Edge Connector Pin-out (see schematics)

Pin #	Description
1	No connection
2	No connection
3	Ground (Chassis)
4	Ground (Audio)
5	+15V
6	-15V
7	Ground
8	Process enable
9	Tally 2
10	Tally 1
11	Ground
12	Input +
13	Input -
14	Output +
15	Output -

3.2.3 Rear Panel Connections (screw terminals on rear of racks)

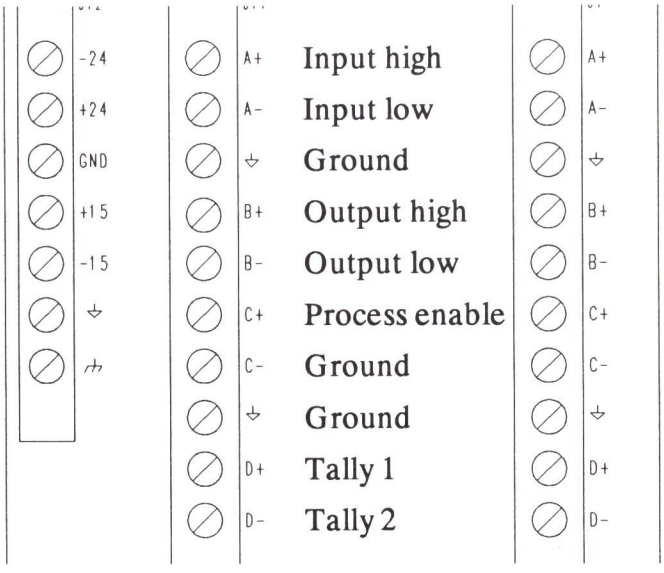


Fig: 1 Rear Panel Connections

3.2.4 Operating Level Set

The Nominal operating level of the 9301 may be set for -10dBV, +4 or +8dBm via a jumper for the input and output located on the main PCB. The appropriate position for each level is printed next to each jumper. These jumpers must be set properly and equally to avoid input overload or insufficient input level to generate gain reduction.

3.2.5 Audio Input and Output Connections

The 9301 may be driven balanced or unbalanced. If balanced "high" should be connected to A+,"low" connected to A- and shield connected to Ground. If unbalanced, connect "high" to A+, "low" to A- and connect a jumper from A- to Ground.

The output can drive either balanced or unbalanced loads. Connect B+ for output high and B- for output low. Do not connect shield. If driving a known unbalanced load, connect a jumper from B- to Ground.

3.2.6 Impedances

Some equipment is designed to drive a 600 Ω load. If the 9301 is to be driven by such equipment there is a jumper on the main board which inserts a 600 Ω termination. This termination is lifted in relay bypass.

3.2.7 Relay Bypass

The relay bypass routes audio directly from the input terminals to the output terminals. This state occurs when the relay is de- energized, providing automatic power fail-safe bypass.

The relay is energized either from the front panel "IN" switch or by remote control. The remote will operate when the front panel switch is in the "out" position, otherwise the unit is permanently in the "in" state. If the remote is in the "in" position the front panel "IN" switch cannot bypass the unit. The remote is activated by contact closure between Ground (C-) and "Process Enable" (C+) terminals.

To provide remote indication of the bypass/operate condition a relay closure between terminals D+ and D- occurs when the unit is not in bypass.

4.0 FRONT PANEL

4.1 METERING

The COMPELLOR has a unique multi-function, bi-color bargraph meter that can be switched to monitor average and peak levels for input and output, as well as show the amount of gain reduction. The momentary switch selects INPUT, OUTPUT, or GAIN REDUCTION metering.

For INPUT and OUTPUT, the last LED of the red bar indicates average level (VU) and the last LED of the green bar above it shows peak level. Program dynamics and density can be seen at a glance. The scale is 3dB per division and is on the right of the LED's.

NOTE: Use the last RED LED to determine correct nominal operating level.

In the GAIN REDUCTION mode, the meter shows the total amount of gain reduction as a green bar. A single red LED indicates the amount of leveling. The green bar portion above the red LED indicates the amount of compression. Use the scale on the left of the LED's (2dB division per LED) to read GAIN REDUCTION. For example, if 16dB of total gain reduction is indicated and the red LED is at 10dB, 6dB of compression above 10 dB of leveling is indicated.

The yellow "DVG" LED flashes to show DVG action whenever the computer control circuits have anticipated and prevented a "pumping" occurrence.

A red LED flashes whenever the limiter is operating. It will only flash if the "LMT ON" switch is engaged.

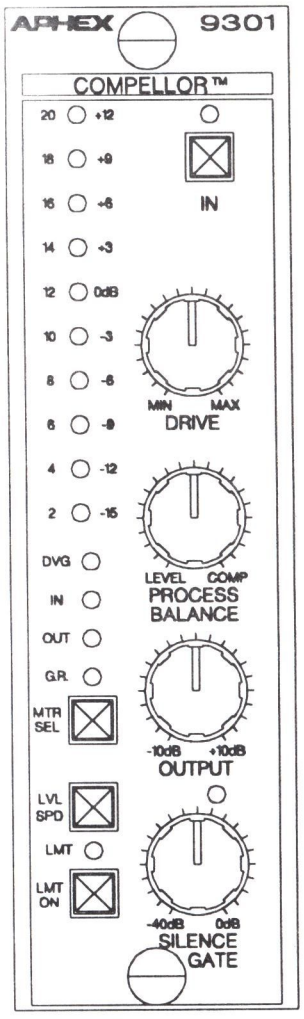


Fig: 2 Compellor Front Panel

4.2 IN Switch

The IN Switch provides a relay bypass for system in/out comparison. An accompanying LED indicates red for IN.

If the remote control of the bypass switch is used the IN/OUT Switch must be in the "OUT" position. The LED will indicate appropriate status.

4.3 DRIVE Control

The DRIVE Control sets the total amount of gain reduction by controlling the amount of signal sent to the detector circuits. Turning this control clockwise provides more gain reduction.

4.4 LVL SPD (LEVEL SPEED) Switch

This switches the release time for the leveler between "SLOW" in the OUT position and "FAST" in the IN position. Use "FAST" for speech and "SLOW" for general music programming.

4.5 PROCESS BALANCE Control

The PROCESS BALANCE Control divides the audio between the compression and the leveling sidechains, thereby controlling the ratio of leveling to compression. At the full counter-clockwise position full leveling occurs, while full compression occurs at the full clockwise position. Other positions provide a mix of the compression and leveling.

In normal operation, a mix of the two is desired, so that there is always some leveling available to absorb long term program level changes. This will ensure a more consistent amount of compression

regardless of long term program level. Unlike conventional devices with a fixed threshold that increase or decrease compression as program varies, the COMPELLOR will not change the sound quality.

4.6 OUTPUT Control

The OUTPUT Control provides a ± 10dB variation in the final signal level from the Compellor. This control is used to set unity gain at output after the gain reduction settings are made. This control may also be used to raise or lower the output level for other needs, as desired.

4.7 LMT ON (LIMITER ON) Switch

This switches the Limiter on and off. In those situations which have sufficient headroom or which the Compellor is followed by a more sophisticated peak processor such as the Dominator, the limiter in the Compellor is unnecessary and should therefore be defeated. If the switch is "IN" and the Limiter is working a red LED above the switch will light.

4.8 SILENCE GATE Control

The Silence Gate is NOT a "noise gate" that mutes the audio. Instead, it senses that the audio has dropped below your pre- determined level and directs the Compellor to "freeze", preventing any release of gain reduction. This eliminates noise build-up common to other compressors or AGC devices which occurs during pauses in program. The Silence Gate also permits fade- outs, so the AGC is not fighting you as you try to lower the output level.

The SILENCE GATE Control lets you set the Silence Gate threshold from 0 to -40dB, relative to your operating level (0VU). Since it inhibits any action by the COMPELLOR, it should never come on during normal program material. The proper threshold level should be somewhere between the lowest level program signal and the noise floor of the system before the Compellor. It should activate (after about 1 second delay) when audio stops or gets part way into a fade. Silence Gate action will be indicated by the yellow LED above the knob.

4.9 INITIAL SETTINGS

After the COMPELLOR has been properly installed perform the following steps to familiarize yourself with its operation.

Switch	Status
"IN":	OUT
METER SELECT:	INPUT

With no audio present, notice that the Silence Gate THRESHOLD LED will be lit (YELLOW), and that the meter's bargraph LEDs are not lit.

LEVELING SPEED should be "Slow" (out position)

Connect either a test tone or an audio program to the COMPELLOR's input, and verify that the meter indication on the COMPELLOR match the output of the device feeding the input. At this point, you should also see the (Silence Gate) THRESHOLD LED extinguish whenever program level exceeds the initial THRESHOLD setting.

NOTE: If you see other than unity level at the output, the COMPELLOR may need its nominal operating level changed or installation of termination resistors.

With the PROCESS BALANCE set for 50/50 mix (12 o'clock position) of compression and leveling, select GAIN REDUCTION on the METER SELECT Switch and adjust the DRIVE Control to achieve the desired amount of total gain reduction. With the DRIVE set at 3 o'clock there will be around 10dB of total gain reduction, of which 4 to 6dB is compression. Don't be afraid to use more! The Compellor is so transparent in its action that you can use greater amounts of gain reduction without affecting program quality. The leveling action cannot be heard at all, so you can easily use

10dB of leveling to handle broad program level changes.

NOTE: The amount of gain reduction generated with the input at nominal level will determine how much the lowest level signal will be increased. For example, if 16dB of gain reduction is generated with "0"VU input and the gain reduction is released when a low level signal is present, the Compellor will have brought that low level signal up 16dB.

NOTE: If the DRIVE Control is at 0dB (full CW), and more gain reduction is needed, either increase the input level to the COMPELLOR or readjust the OPERATING LEVEL switch on the main audio board to a lower setting.

NOTE: The PROCESS BALANCE Control, along with Drive, determines the "tightness" of the output. More Leveling gives a more "open" sound. More Compression (along with more total gain reduction) gives a "tighter" sound.

NOTE: In live applications the total amount of gain reduction may be determined by how much gain before feedback is in the system. Caution is advised therefore when using large amounts of gain reduction on open microphones.

Select OUTPUT on the METER SELECT Switch and set the OUTPUT Control to attain unity gain with 0VU input. Depending upon the "tightness" of the dynamic range as set by the DRIVE and PROCESS BALANCE controls, the long term average output of the COMPELLOR will remain close to the nominal operating level.

As you observe the audio program, set the Silence Gate THRESHOLD, so that the Silence Gate comes on (yellow LED) after the lowest audio levels (including fade-outs), yet still above the input noise floor.

An initial setting for the Silence Gate THRESHOLD is -20dB (12 o'clock position). The Silence Gate LED should come on about 1 second after audio stops, or is partly into a fade-out. A little experimentation will easily give you the right adjustment area.

NOTE: Be sure to verify that the Silence Gate does not come on during normal program, as this will inhibit proper action of the COMPELLOR.

After you are satisfied with the settings these steps, press the "IN" Switch to indicate IN (Red LED) so that the COMPELLOR is on- line.

Readjust the COMPELLOR Controls to achieve the desired "tightness" and output level as necessary. Experiment with the PROCESS BALANCE Control turned more towards LEVEL than COMPRESS.

NOTE: The leveler, having a fixed ratio, maintains a "platform" for the compressor, by holding a constant amount of a compression regardless of input level changes. This "platform" will maintain the same "sound," regardless of program level. As you turn the PROCESS BALANCE knob (CCW) toward leveling, you will notice that the instantaneous dynamic range becomes less controlled. As the PROCESS BALANCE Control is moved clockwise there will be more Compression and the sound will become "fatter".

If the leveler is used without any compression at all (full CCW), there is the possibility of some "breathing" or "swelling" with large level changes, due to the very slow attack and release. Also, the Leveling Speed switch may be set to suit either speech(fast) or music(slow) programs.

You easily can compare the sound of the audio signal with and without the COMPELLOR. When you press the "IN" Switch to the "out" position, a hardwire bypass will be inserted into the audio path.

5.0 SPECIFICATIONS

INPUT SPECIFICATIONS

Type:	Transformerless, RF-filtered, true-instrumentation, differential servo-balanced
Impedance:	50kΩ balanced
Nominal Operating Level:	User Selectable 0VU = -10dBv, +4 or + 8dBm
	Maximum Input Level: +27dBm
CMRR:	Greater than 60dB, 20Hz to 10kHz

SIDECHAIN SPECIFICATIONS

Compression

Attack Time:	5 to 50ms
Release Time:	200ms to 1s, program dependent
Ratio:	1:1 to 30:1
Threshold:	30dB below nominal level (0VU with DRIVE full clockwise)

Leveling

Attack Time:	1s/2.5s (switch selectable)
Release Time:	2s/5s (switch selectable) program dependent
Threshold:	30 dB below nominal level (0VU with DRIVE full clockwise)

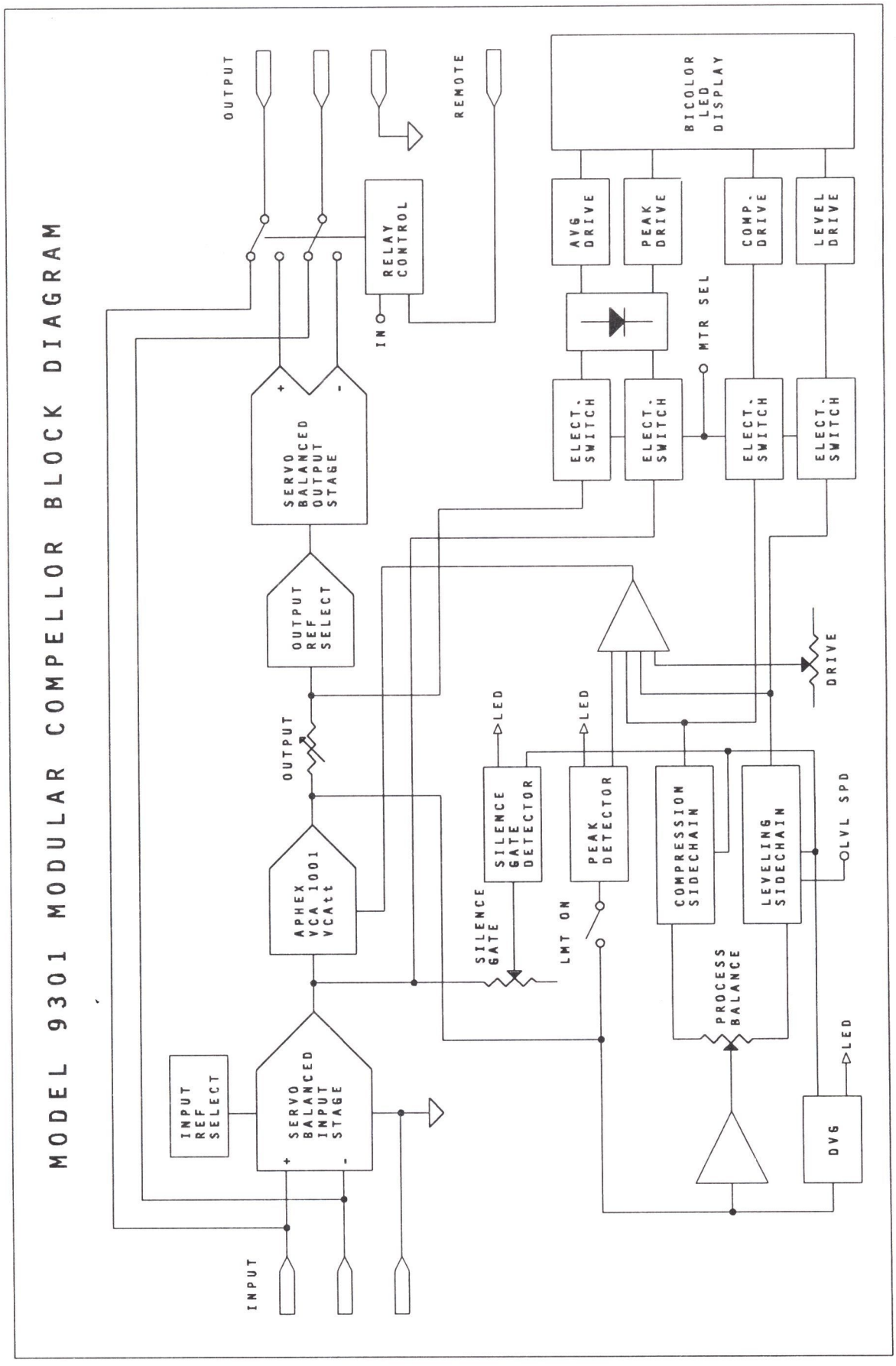
Peak Limiter

Attack Time:	1μs
Release Time:	200ms
Threshold:	12dB above nominal level (0VU)

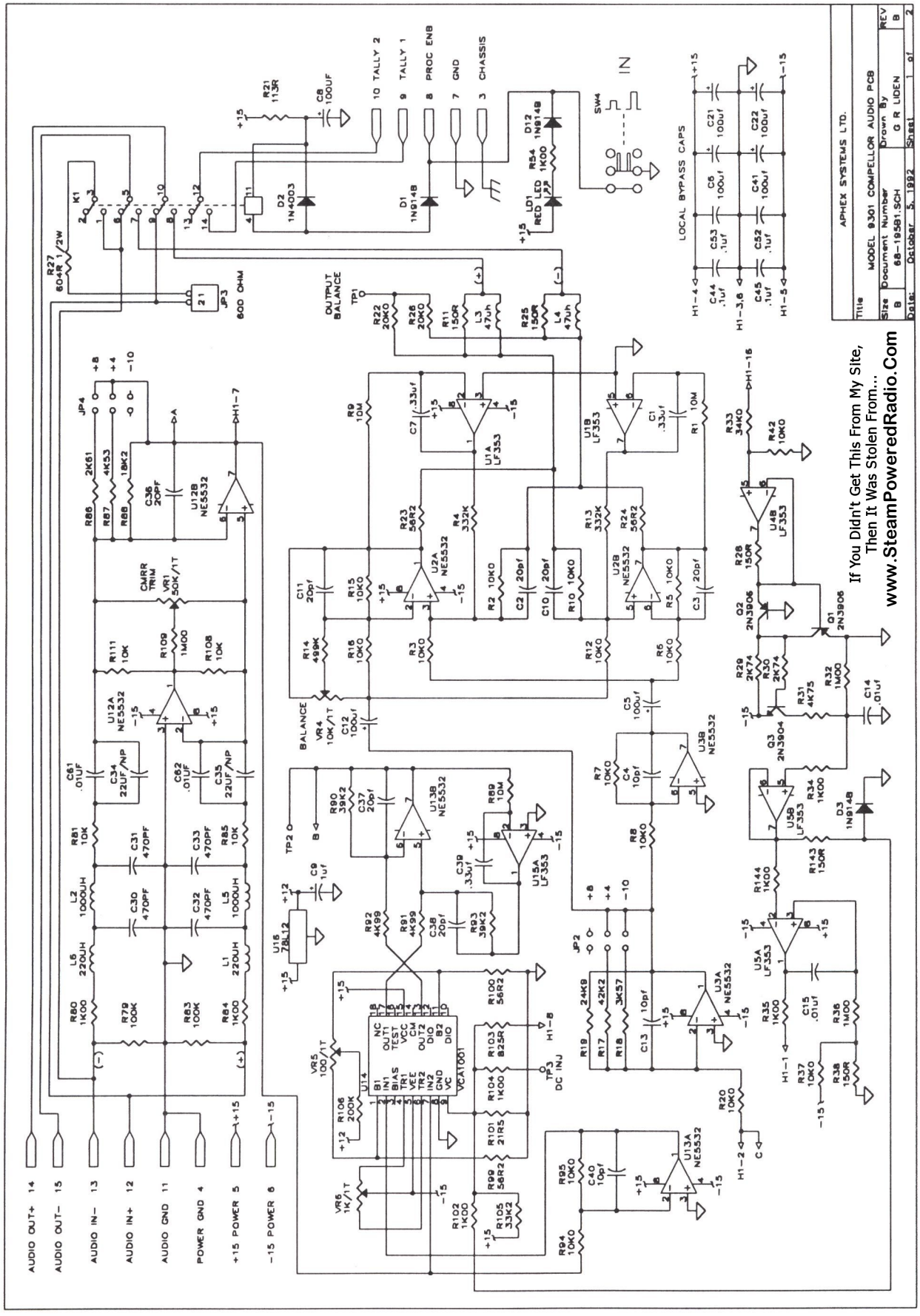
OTHER SPECIFICATIONS

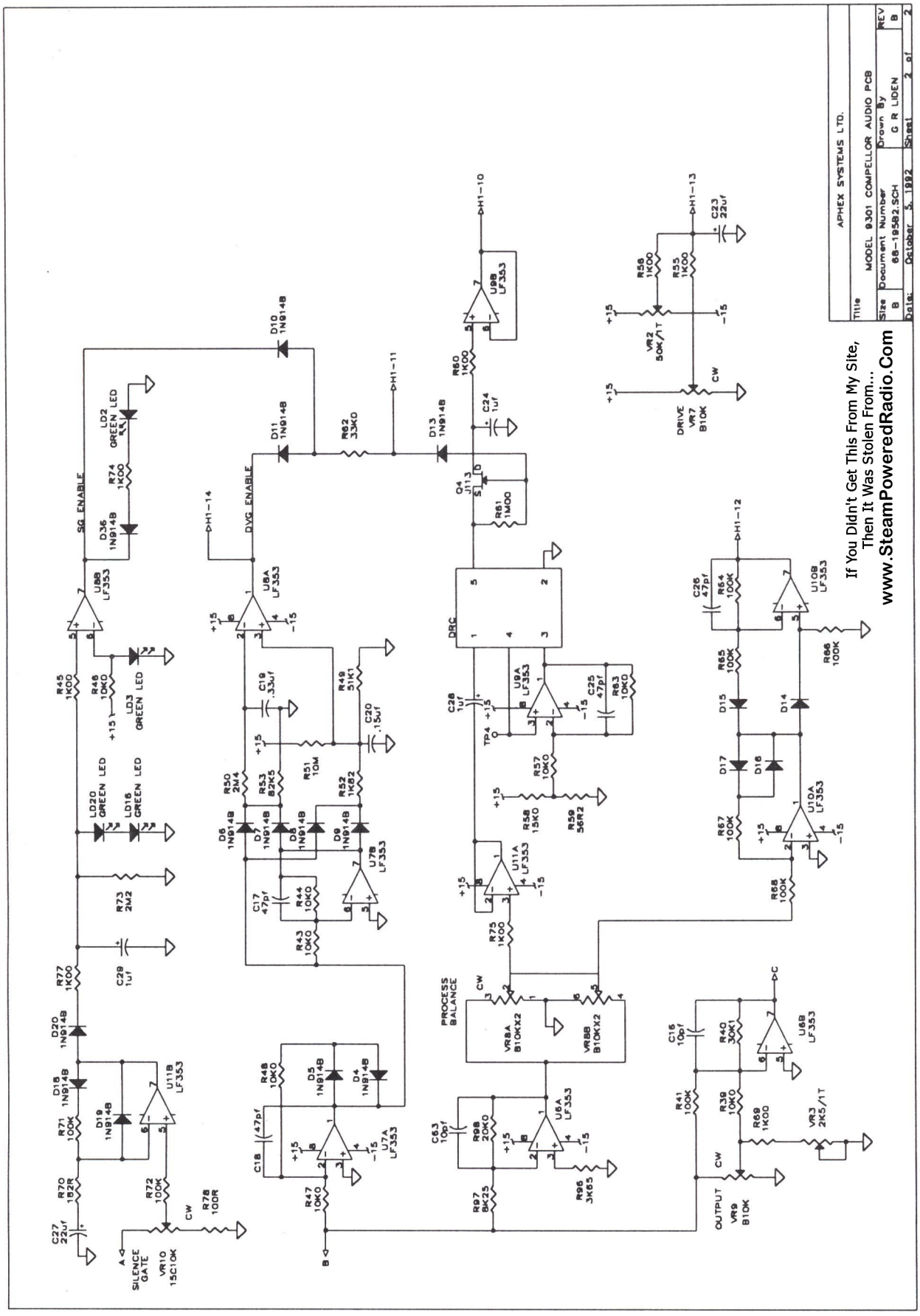
Power requirements:	+/-15 Volts DC, 250mA
Weight:	2lbs

6.0 BLOCK DIAGRAM



7.0 SCHEMATICS

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REV B
Date: October 5, 1992
Sheet 2 of 2
SG ENABLE
DYG ENABLE
SILENCE GATE
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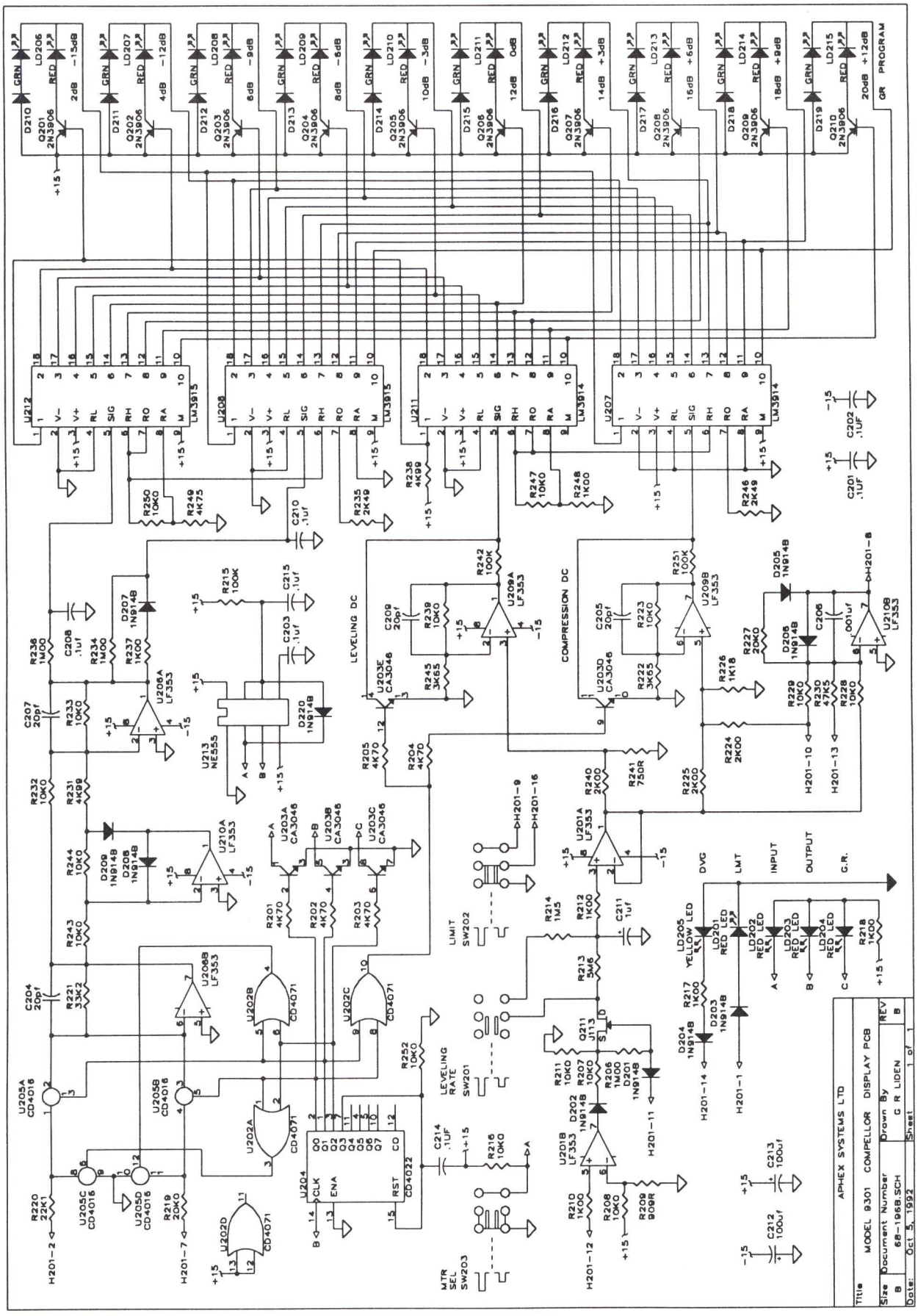
PROCESS BALANCE
VR8A B10KX2
VR8B B10KX2
OUTPUT
VR9 B10K
DRIVE
VR7 B10K
VR2 50K/1T
VR3 2K5/1T
DRG
If You Didn't Get This From My Site,
Then It Was Stolen From...
www.SteamPoweredRadio.Com



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