

the **COMPELLOR™**



from **APHEX SYSTEMS LTD.**

# the COMPELLOR™ AUC

Provides computer controlled dynamics for smooth undetectable c

Presenting the COMPELLOR, a revolutionary audio processor. It delivers intelligent compression, leveling, and peak limiting simultaneously! The COMPELLOR control circuits include analog computers that constantly analyze the input signal, varying complex control characteristics sent to a single VCA per channel. Operating controls are thus kept to a minimum, for the COMPELLOR intelligently varies all the parameters for you. All you need do is set input level to control the amount of processing, adjust output level, and set the balance between compression and leveling. That's it. The COMPELLOR will then provide complete dynamic control -- smooth, inaudible compression, increased loudness, freedom from constant gain riding, and the desired density -- all automatically. Its unique circuitry actually enhances transient qualities, making even heavy processing undetectable.

This smart, versatile, cost effective processor is equally at home in broadcast pre-processing, microphone control, audio recording and production, tape duplicating, live sound and film dubbing; producing the "sound" audio engineers have always sought but seldom found.

The COMPELLOR's simple audio path is comprised of a differential instrumentation input stage, the world renowned Aphex 1537A VCA, and a new, electronically balanced, transformerless output stage which can be used balanced or single-ended. The nominal operating level of the COMPELLOR (and OVU on the meter) is internally jumper selectable at -10, 0, +4, and +8dBm to match any system.

There are three main detector circuits for compression, leveling, and peak limiting.

**LEVELING** is performed in a manner related to the way the ear perceives loudness over long time intervals. The circuit maintains output level within 1dB for a 20dB input level change. The action is slow enough to have minimal effect on program transients or short term dynamics.

When leveling and compression are used together, the leveler maintains the gain platform so that compression is consistent over varying levels of material, providing a uniquely smooth sounding dynamic compression.

The leveling action is interactive between the two channels, preserving overall balance and stereo imaging.

**COMPRESSION** is also accomplished over a 20dB range of input levels, with the ratio varying from 1:1 to 20:1, the attack and release times derived from, and varying with, the program material. This "soft knee" helps to prevent the "choked" sound usually associated with deep compression. Further program dependent characteristics are imparted by other sections of the COMPELLOR's computer, the DYNAMIC VERIFICATION GATE (DVG), and the DYNAMIC RECOVERY COMPUTER (DRC).

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.

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 can cause an increase in the compression release rate. Unrequired gain reduction is thus inhibited,

preventing loss of transient wavefronts, holes, etc. The sonic benefit is substantial, contributing toward natural, open sound, even when highly compressed.

The **PEAK LIMITER** provides further dynamic control, holding an absolute ceiling 12dB above the nominal (OVU) level. Although extremely fast, this unique limiter is virtually inaudible in its operation.

The **SILENCE GATE** detects significant gaps in program material and freezes the processing, preventing noise "swell" or buildup common in other AGC devices, then instantly releases when program resumes.

The **STEREO ENHANCE** feature does just that. By detecting and matrixing certain stereo information, and sending it to the sidechannels, STEREO ENHANCE creates a subtle natural widening of the stereo image that is fully mono compatible. It is not a "stereo synthesizer" and it has no effect on mono or center channel material.

COMPELLOR™, Dynamic Verification Gate™ and Dynamic Recovery Computer™ are trademarks of Aphex Systems Ltd.

## ULTRA-SOPHISTICATED METERING

Just as the COMPELLOR is a unique multi-function device, so is its metering system. In each of its three modes, the novel multicolor LED display shows two measurements simultaneously (Compression and Leveling for GAIN REDUCTION, Peak and Average for PROGRAM in and out), plus showing action of the DVGs, Peak Limiters, and Silence Gate, plus status of the IN/OUT and STEREO ENHANCE switches.

In the **GAIN REDUCTION** mode, the display compression as a green bar and leveling as a red dot on the same scale, thus showing total reduction at a glance.



**INPUT** is a DC control that varies the output of the VCA and, thus, the amount of processing. Maximum compression, and/or leveling, is achieved with the control fully clockwise.

**PROCESS BALANCE** sets the ratio between compression and leveling, depending on the need. A 50/50 balance is most useful, as the leveling keeps the compression constant over varying program levels.

**IN/OUT** instantly takes the COMPELLOR in or out of the circuit for A/B comparison. Sealed relays provide a hardwire bypass which is also a failsafe feedthrough in case of power supply failure. A bi-color LED indicates status at a glance (red-in, green-out).

# COMPRESSOR/LEVELER/PEAK LIMITER

compression, increased loudness, and intelligent automatic gain-riding.

from **APHEX SYSTEMS LTD.**

Unique • Revolutionary • Cost effective •

## APPLICATIONS

### BROADCASTING (as a pre-processing tool)

In the race for loudness it is quality which usually suffers. When required to work too hard, even the best multi-band processors degrade the audio. By pre-conditioning the signal with the COMPELLOR the following processor is fed a signal with an optimized dynamic range, thus allowing it to be operated in its "sweet spot" without concern for possible overload. Since the COMPELLOR does not degrade the audio, the total result will be cleaner sound, with equal or greater apparent loudness.

A different problem faces classical stations, especially with the newly expanded dynamic range of digital audio. The quieter passages get "lost" in the ambient noise floor, which may, in a moving automobile, be higher by more than 30dB. The COMPELLOR can "lift" these passages without changing dynamic and transient feel, thereby pleasing the audiophile and the computer alike.

Another benefit of having the COMPELLOR in the broadcast chain is that fader settings on the console become less critical. The sound of the station will not change from the DJ who loves the sound of the meters pegging to the DJ who is afraid to make them move.

Television broadcasters are often faced with the problem of a large difference of apparent loudness between program material and commercials. With a COMPELLOR the apparent loudness of the program can be increased, while already heavily compressed

commercials go through without further processing. The net result is consistent apparent levels from program to program and from program to commercial.

### PRODUCTION

The one drawback (if it can be called that) of the COMPELLOR is that it is almost impossible to get an "effect" or "coloration" out of it. So, if the goal is simply to have clean, uncolored level control on any particular track, the COMPELLOR is perfect. As mentioned, it is particularly natural sounding on vocals. Drums and bass also sound great processed by the COMPELLOR, though they would normally require different settings than for voice. Of course the COMPELLOR is excellent for processing a total mix to maintain maximum consistency and loudness (e.g. mastering).

### SOUND REINFORCEMENT

Feedback is one of the biggest problems in live sound. Just when the fader on a vocal input is set, the vocalist starts to sing louder! The COMPELLOR, however, can maintain maximum level before feedback.

The COMPELLOR also shines in controlling multiple sources of different levels, such as conferences. The speakers will all be equal in approximate loudness without changing the character of each individual's voice.

Paging systems can sound louder and clearer without any overload distortion and without increasing amplification.

### STL/PHONE LINE DRIVER

Maintaining consistent drive levels while controlling peaks (without overshoot and ringing) is just another way of describing the COMPELLOR. Full modulation of the STL can be sustained without concern for overload. Audio level will be kept well above the noise floor of phone lines or STL, again without crashing anything following the COMPELLOR.

### CARTING/TAPE DUPLICATION

Different audio levels from cart to cart is an all too typical problem. With the COMPELLOR, levels can be easily maintained to assure maximum signal to noise performance without tape saturation. The COMPELLOR is especially useful in assembling tapes from several sources with varying levels onto a single tape.

### MIC PROCESSING

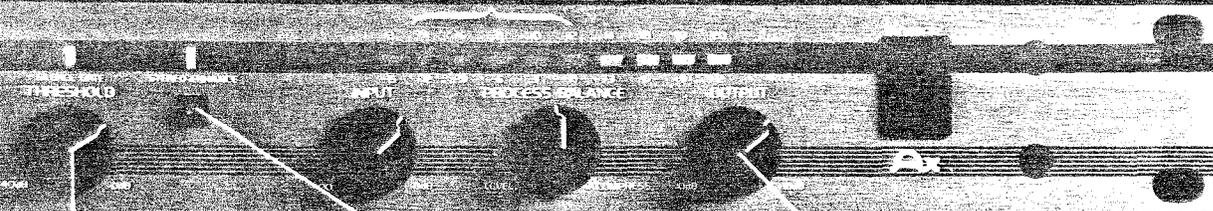
One of the most difficult signals a processor encounters is the human voice. The COMPELLOR works beautifully on voice by producing a dense, "punchy" sound while retaining dynamic and transient qualities. The apparent level will be consistent without changing the urgency and excitement of a screaming DJ or altering the intimacy of a soft-spoken female voice.

### FILM DUBBING

Matching levels between multiple sources and within a single source is often a job which requires more than one person to ride gain and switch sources at the appropriate times. The COMPELLOR makes the job much simpler. It is especially effective on optical sound tracks which are so sensitive to any peak overload.

In the **PROGRAM** mode, VU (average) level is shown as a red bar, simultaneously peak level is shown as a green bar above the red. This novel visual presentation of dynamic range can be switched to read input or output, allowing an instant display of changes in peak to average ratio.

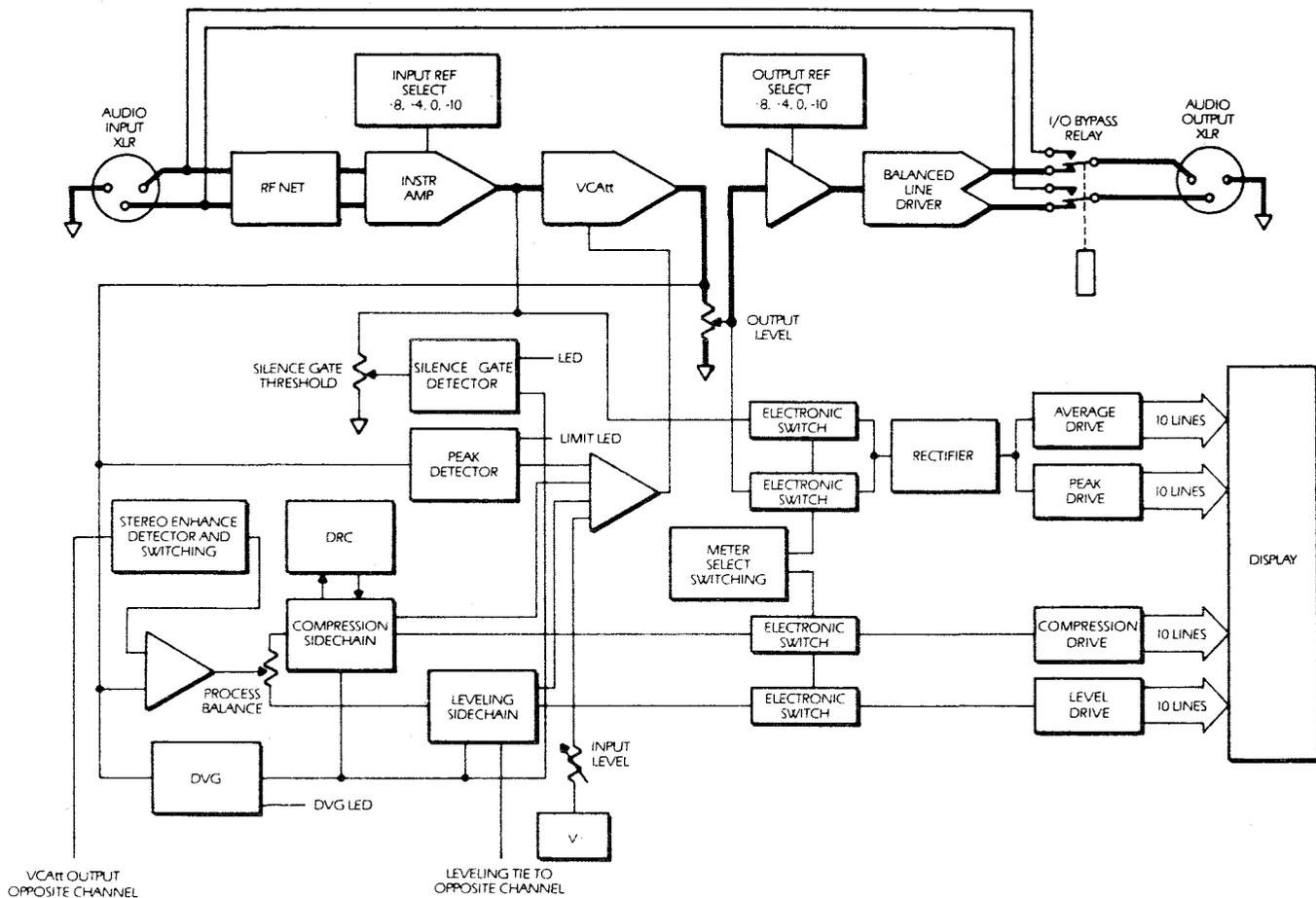
20dB PEAK LEVEL  
12dB AVERAGE LEVEL



**SILENCE GATE THRESHOLD** sets the threshold of the SILENCE GATE between -40 to +4dB referenced to nominal input level. Below threshold the SILENCE GATE freezes gain reduction release, such as during program gaps or quiet passages. This will prevent noise buildup and permits normal fades, even with heavy processing. An LED shows SILENCE GATE action.

**OUTPUT** adjusts the output level over a 20dB range to compensate for heavy gain reduction.

**STEREO ENHANCE** switches in a unique detection and matrixing circuit which causes a pleasant widening of the stereo image without affecting non-stereo information. An LED indicates circuit operation.



## SPECIFICATIONS

### INPUT

**Type** • RF-filtered true instrumentation differential balanced

**Input impedance** • 50K Ohms balanced

**Nominal operating level** • user selectable

OVU = -10, 0, +4, +8 dBm

**Max input level** • +27dBm

**CMRR** • greater than 40 dB

### SIDE CHAIN

#### Compression

Attack time • 5-50m Sec

Release time • 200m Sec-1 Sec

Ratio • 1:1:1-20:1

Threshold • 30 dB below nominal level (OVU)  
with input full clockwise

#### Leveling

Attack time • 2.5 Sec

Release time • 5 sec

Rate • .5-5dB/Sec

Threshold • same as Compression

#### Peak Limiter

Attack time • 1 $\mu$  Sec

Release time • 10m Sec

Threshold • 12dB above nominal level (OVU)

} Program dependent

} Program dependent

**Gain reduction element** • APHEX 1537A Voltage Controlled Attenuator

### OUTPUT

**Type** • Electronically balanced transformerless. May be operated balanced or single-ended at full output.

**Source impedance** • 20 ohm balanced, 10 ohm unbalanced.

**Maximum output** • +27 dBm balanced or +21 dBm unbalanced.

**Band width** •  $\pm 1$  dB 5HZ-65KHZ

**Hum and noise @ unity gain, +4op level** • -72dBm

**Noise referred to max output** • - 95dBm

**Dynamic THD @ 20dB compression, 1 KHZ, +4 op level** • .1% max

**SIZE** • 13/4" H x 19" W x 9" D

**SHIPPING WEIGHT** • 11 lbs

**POWER REQUIREMENTS** • 90-250 VAC, 50-60HZ, 20W

AC input is IEC standard receptacle, with fuse, voltage select & RF filter.



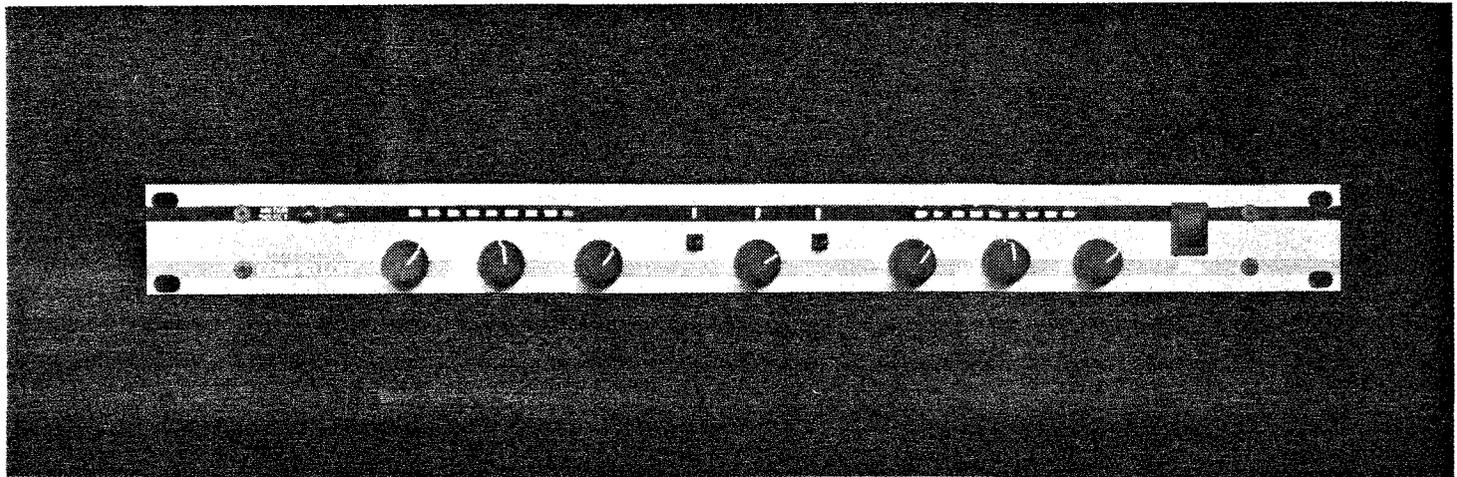
**APHEX SYSTEMS LTD.**

# studio sound

AND BROADCAST ENGINEERING

the **APHEX**

# COMPELLOR™



This article (or set of articles) is a somewhat unusual departure for us, as it represents neither an objective or subjective review, prepared by our own reviewers, nor is it the normal type of article we ask a manufacturer to write, providing an insight into a product: it is somewhere in between. Aphelex worked closely with a number of top industry names during the period before the *Compellor* was released, and ensured that it received a good deal of field testing. Aphelex asked some of their users (some who had seen the *Compellor* at the prototype stage, and others who had not) to write down their comments and experiences with the unit for us to publish. At the very least they represent a useful insight into the applications and operation of what appears to be a unique and highly useful dynamic control system.

**Barry Victor**, radio station KROQ-FM, director of technical operations. Previously chief engineer, radio station KMET. Technician, technical services CBS Television, KNXT & CBS TV CITY. Asst production director, Drake Chenault Ent Inc.

Areas that can benefit by using gain reduction are:

- (1) Main programme channel(s) before studio transmitter links;
- (2) Microphone pre-processing (levelling);
- (3) Production studio levelling (tape headroom).

Main programme channels that are before the STL (studio transmitter) link need to have the levels kept within certain parameters to protect the STL from being

overdriven so as not to cause distortion and also not to be too low in average level so as to maximise signal to noise ratio of the STL. Most radio stations are run in a "combo" operation where the disc jockey controls the audio levels as well as produces and announces the show. As most DJs are not technically inclined, levels from an on air console can range from -20 dB to +20 dB. An automatic gain control device or AGC is employed to correct for the wide discrepancies in level.

Microphone pre-processing is very desirable at many times due to the wide dynamic range of human voice. Again, as DJs are more concerned with the programming aspect of their shows, a compressor on the mic channel can be very helpful for keeping levels constant and the programming intelligible. When

interviewing guests mic levels can be kept from causing undesirable feedback on open mics from headphones by a noise gate.

Production studio levelling can prevent audio tape from over saturation causing distortion. Again air talent producing commercial spots are more concerned with the end product than with technical concerns. Audio tape headroom can be extended by employing a peak limiter to prevent unwanted transients from saturating the tape. An AGC unit can be used to provide a consistent level to maximise signal to noise during recording.

Up until the early 70's the most prevalent AGC unit was the *Audimax* and its companion limiter, the *Volumax*. These units and the many others of their type were quite good for their day. In fact you can still find many of them around in

use. The main problem with this type of limiter and compressor is that they can cause pumping or bring up a lot of background hiss during quiet passages when used to excess. Peak limiters like the UREI LA-2 and the later model 1176 have been used to protect sources from transients but they can cause pumping when used to control more than peaks.

There is then the problem of FM broadcasting in which you have a 75  $\mu$ s pre-emphasis curve to overcome signal to noise problems in the transmission. This brought out products like the *FM Volumax* which inserted a 75  $\mu$ s pre-emphasis curve in front of the limiter to cause the high frequency information to create more limiting so as not to overmodulate the transmitter with high frequency peaks. This works

## Aphex Compellor

fine when you don't have to have a "loud", competitive sound.

This was partly solved in the introduction of two types of peak limiters/levellers. The three-band *DAP-310* and similar units which allowed individual compression/limiting of three separate audio bands helped in being able to limit the high frequencies without causing unnatural-sounding loss of low frequencies. The other was *Optimod 8000* which took a 2-band limiter compressor and matched it with a stereo generator. This allowed closer attention to prevention of overshoots and peaks which cause unwanted over-modulation products.

A large problem with audio gain reduction products is that some can cause rather large amounts of harmonic distortion when they are operating. Some have built in overshoot problems due to faulty transformer designs or large amounts of IM distortion products caused by phase shifts or similar problems. Some multi-band processors will cause phase shift, ringing and distortion due to the splitting of the frequencies by very sharp filter networks and then the resampling network which can cause cancellations in the audio source.

The problem with overshoot and distortion products in the broadcast facility is that these products tend to overmodulate the broadcast transmitter causing the station to have to lower its average level of modulation to compensate for them. Of course distortion is not pleasant to listen to and will cause the listener to fatigue and possibly tune out.

Lately with the introduction of superior audio performance stereo generators, FM exciters and new high performance STL microwave radio, the gain reduction units show up as the weak link in the broadcast chain.

Long a problem in many US radio markets is the need to be as "loud" as or "louder" than the competition. This involves a large trade off, one of apparent loudness and that of audio quality. The reason behind this is that you only can modulate so much before you exceed set standards and risk being fined by the FCC. Several means have been developed to allow maximum modu-

**TABLE 1**

All measurements made with 0 dB reference at +4 dBV. Output control full clockwise. Input adjusted to achieve output level. Stereo enhance circuit out. All tests performed with Sound Technology 1710A.

### Frequency response

Process control at full compress 10 dB gain reduction  
10 Hz to 20 kHz -0.0 +1.0 dB  
50 kHz +13.0 dB

Process control at full levelling 10 dB gain reduction  
10 Hz to 20 kHz -0.0 +1.0 dB  
50 kHz +13.0 dB

### Total Harmonic Distortion

Process control at full compress 10 dB gain reduction  
700 Hz 0.065% with 30 kHz bandpass  
700 Hz 0.087% with 80 kHz bandpass  
700 Hz 0.097% with no filters  
10 kHz 0.070% with 80 kHz bandpass  
10 kHz 0.090% with no filters

Process control at full levelling 10 dB gain reduction  
700 Hz 0.055% with 30 kHz bandpass  
700 Hz 0.070% with 80 kHz bandpass  
700 Hz 0.090% with no filters  
10 kHz 0.060% with 80 kHz bandpass  
10 kHz 0.080% with no filters

Clip level at 700 Hz +20.0 dB +24.0 dBV

Noise floor 700 Hz tone at reference silence gate engaged  
-65.5 dB -61.5 dBV

Absolute noise floor. Output control full clockwise input shorted  
-74.0 dB -70.0 dBV

Smpte—IM distortion  
4:1 Ratio

Process control full compress 5 dB gain reduction  
0.056%

Process control full levelling 5 dB gain reduction  
0.25%

lation of audio programming—eg large amounts of compression to keep the average level at its highest possible level and then to use clipping to keep the peaks from overmodulating. There are several clippers in various final limiters and several clipper products made to be inserted after the stereo generator to prevent overmodulation and to maximize the average loudness. The problems with these, of course, are if you use them to excess you make a very hard sound, one that can tire the listener out. Face it, square waves are not pleasant to listen to. So the engineer has a fine line to tread to have a signal that is loud enough to cover the intended area and please the programme director (who wants to keep a competitive edge of loudness) while still trying to

maintain a quality signal that won't tire the listener, or worse yet drive him or her away completely.

I was made aware of a possible new product from Aphex Systems called the *Compellor* some time ago. I was invited to see and hear a prototype and asked for my ideas. The product sounded very good and I offered the suggestion that it be made with minimum of user controls and the cleanest audio path. Transformerless balanced floating input stages were designed so that it could be used in any environment with any type of equipment and not have side effects of transformers.

The *Compellor* can be used single ended. Either leg of the input or the 3 pin *XLR* connector can be grounded and no change of level occurs as compared to normal

balanced output. Input and output can be 0 dB referenced at +8, +4, 0, or -10 dB. The heart of the *Compellor* is the DVG and the DRC which control the attack, release and length of compression or levelling depending on where the process mix pot is set. Either full compression or full levelling or any mix in between is possible. The actual attenuator is the Aphex VCA which offers excellent performance. Refer to table 1 for actual measured performance.

The *Compellor* also has a built in fast peak limiter riding 12 dB above the 0 reference, it prevents transients above 12 dB from passing.

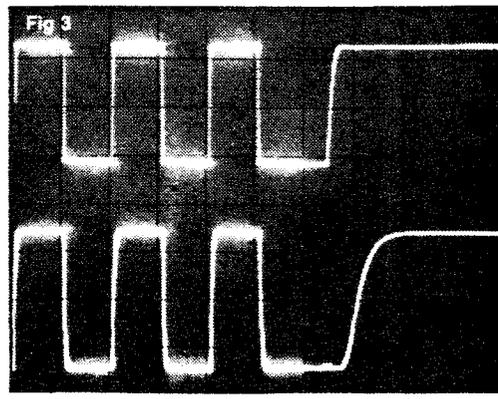
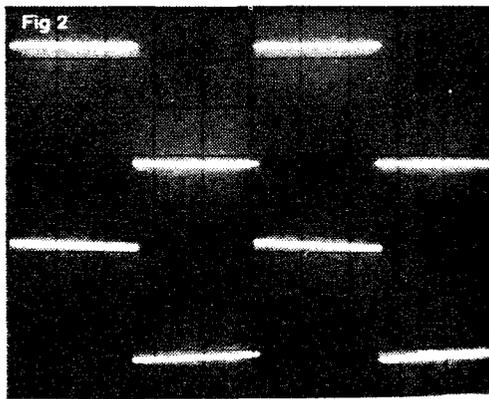
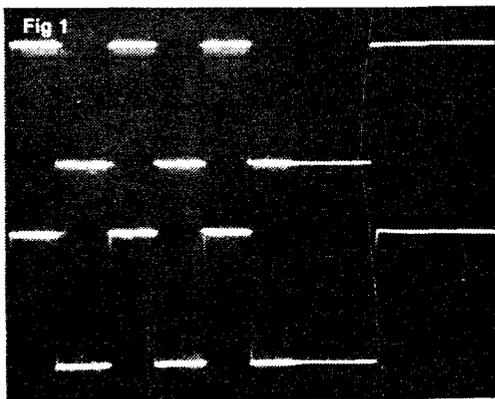
Referring to Fig 1 we have a 1 kHz square wave at 22 V amplitude. Top trace is input to *Compellor*, bottom trace is output. Both traces are vertical 10 V/div, the horizontal is 500  $\mu$ s/div and the expanded horizontal is 20  $\mu$ s/div. The *Compellor* is set for 10 dB gain reduction. As you can see the input and output traces are almost identical showing no ringing or overshoot.

Fig 2 is a 100 Hz square wave at 22 V amplitude. The top trace is the input to the *Compellor*, the bottom is the output of the *Compellor*. Both traces are vertical 10 V/div the horizontal is 2 ms/div. The *Compellor* is again doing 10 dB gain reduction. The picture shows very little tilt of the low frequency components and no ringing or overshoot whatsoever.

Fig 3 is a 10 kHz square wave with input of 22 V amplitude and output of 13 V amplitude. The *Compellor* seems to think of a square wave of this frequency a little harder as the gain reduction settled in at 20 dB. The top trace is the input at 10 V/div and the bottom trace is the output of the *Compellor* at 2 V/div. Horizontal was 50  $\mu$ s/div and the expanded was 5  $\mu$ s/div. This shows a very slight rounding of the edge of the output but once again no ringing and no overshoot.

As evident by these square wave response pictures the *Compellor* is a very transparent device exhibiting no real degradation to the audio source.

Due to the *Compellor's* unique control circuit a stereo enhancement circuit can be derived from control voltage only to cause the compressor to increase the apparent separation of the two channels enabling an increase of the stereo effect. This comes in real handy as in conven-



tional compression, the more compression that is done the less apparent the stereo effect is. The silence gate will freeze the level of the *Compellor* when audio drops to a predetermined point to avoid increasing background noise. Also you can see the silence gate detector does not control the audio directly. It controls the sidechain which instructs the VCA thereby giving a very clean yet stable command.

I was finally able to get one of the first *Compellors* off the assembly line and actually try it out. The unit was bench tested with the results in **Table 1**, and was put into service a short time later. The *Compellor* was put into the broadcast chain at the studio just before the STL. Depending on the programme material and who was running the air console the gain reduction was anywhere from 5 dB to around 18 dB. The *Compellor* was able to handle this with no problem and the silence gate made times of low or no modulation very quiet with no hint of pumping or apparent squashing effect as evidenced by other compressors. I was able to let my final limiter at the transmitter do barely any work at all except for high frequency protection due to the 75  $\mu$ s pre-emphasis.

One of the next two units went into the production room to be inserted between the production console and the input of the tape recorders. The *Compellor* has aided our production team in the production of taped spots and especially in the carting of music. We put a few songs on cart that are hard to find or only one copy is available due to limited release and the difference between playing from cart or from disc can be quite a problem from a quality standpoint. The *Compellor* was able to help cut a hotter tape without tape saturation.

The third unit was put in the mic channels for two of our on air microphones in the air studio. They interfaced very easily and have made a major difference in the sound quality of our announcers.

As a final note the *Compellor* will work very well as a pre-limiter for any final broadcast limiter on the market and able to provide a punchier sound with excellent clarity and new dimensions of openness. The *Compellor* operates with an intelligence depending on the music content. ie If the source doesn't need processing the *Compellor* doesn't process. The best thing I can say about the *Compellor* is that you can't hear it work.

David J. Holman—Independent producer/engineer. Engineering credits include platinum albums by Olivia Newton-John, *Grease* and *Xanadu* (albums and movies). Producing credits include Cindy Landis (Allergiance), Coyotes (Lorimar), King Bees, Mary MacGregor (RSO/Polygram).

I find three main problems when

using limiting on vocals; 1) The 'squashed' dull sound, 2) The pumping effect, and 3) The accentuated sibilance. Using the *Compellor*, however, none of these undesirable effects were noticed even with extreme settings, ie greater than 20 dB of gain reduction. I found it hard to believe that I was using that much gain reduction and had to flip it in and out of by-pass to make sure that it was indeed in circuit.

Prior to receiving the *Compellor*, I was mixing cuts on the new Coyotes album. On one cut I was confronted by a female's breathy, soft vocal which was at the same time, very peaky. The music tracks were heavier Rock & Roll. Using another device the peaks were squashed, words dropped out, the sibilance came up necessitating the use of a de-esser, and then EQ had to be used to correct for the de-esser. I worked like hell to make the vocal sit in the track and was really frustrated when the record company wanted a re-mix.

By that time I had installed the *Compellor*. I sat down at the console and by the end of the first verse I knew my job would be much, much easier.

On another cut off the same album I had a problem with the bass not 'sitting' in the track. I tried every compressor/limiter in the room (12 different types from old to new) but I could not get what I wanted. When I used the *Compellor* with approximately 14 dB of gain reduction the bass was even, sitting where I wanted to put it, and free from any colouration.

During a recent recording session for Cindy Landis, the signal chain consisted of microphone, pre-amp, fader, *Compellor*, to tape. Before I had the *Compellor*, I always had to EQ her voice. Even with the *Compellor* I am sure that I will have to use the EQ to record many tracks, but it does give me greater opportunity to eliminate a stage in the recording process.

I should say that I use compressors and limiters as creative devices in that each has its own "sound". For example, acoustic guitars gain sustain and vitality with compression. The *Compellor* does not do this. Simply put, if you are looking for level correction without any other sonic effect, the *Compellor* is the only device I know that does the job.

Joe Klein — producer/engineer L.A. Trax 1982 Winner of Clio award, three International Broadcast awards, sixteen Clio award finalist. Produced over 500 commercials since 1976 for the top acts for major labels including Donna Summer, Kenny Rogers, Fleetwood Mac, The Doobie Brothers, David Bowie, Sheena Easton and Lionel Ritchie.

A record commercial is the only commercial except for a movie or a

TV trailer in which the listener or viewer gets a sample of what is being sold. My job is to make a record sound bigger than life plus get a sales message across all within a span of 10 to 60 seconds. Some might think that my mixes are simple in that I typically have only three tracks—stereo programme and an announcer—and sometimes two or three more for sound effects. Given that I have as little as 10 seconds to achieve maximum impact; every millisecond, each nuance is important to me. The success I have had is due to the attention I pay to detail. One very important detail is dynamic range control.

I make commercials which play on radio (AM and FM) and TV. Every broadcaster uses some form of compression/limiting. If I were to send out tapes with levels all over the place, there would be no way to predict what effects the stations' processing would have. In order to avoid, or at least minimize, changes at the broadcast stage my spots all have tightly controlled dynamics. Aside from level and peak control I use compressor/limiters for another, perhaps not so obvious, reason.

I was always a radio freak. More often than not records sounded better to me played on the radio than on a stereo. These records apparently made the broadcast processors "pump" in such a way that the sound was actually enhanced. I set the attack and release of the compressors so that the pumping gives a more rhythmic feel to the music as well as the announcer. This technique is especially effective for R&B spots.

I use the UREI 1178, and when I want a less noticeable effect, I use either the dbx 165 or the Orban 424. I get the effects that I want with these devices, but they all have shortcomings.

I should qualify what I am going to say next because I have had the *Compellor* for a relatively short time, but I am impressed enough to be writing this report.

The *Compellor* does not have the shortcomings of the other devices in that it has no "effect". It makes a spot sound as though I had recorded and mixed very well, instead of recorded and mixed and then ran everything through a compressor. That is an amazing thing for me.

The combination of levelling and compression is a new experience for me. Although there have been other types of levelling devices, I felt that they degraded the signal too much to be of any use. The *Compellor*, without colouration, smoothes out my mixes making them easier and, at the same time, better.

I recently completed the winter campaign for ON-TV (subscription TV). Since this was all dialogue, I definitely did not want any of the compression 'effects' I mentioned before. I needed clear, clean, punchy tracks. I found that using the *Compellor*, even with over 14 dB of gain reduction, clarity was not lost.

After the *Compellor*, I used the

Aphex II *Studio Exciter*. This gave the tracks even greater intelligibility and punch. The *Aural Exciter* is a very important part of my sound, there is nothing that I have produced in almost 3 years which did not run through the unit. The combination of the *Compellor* and the *Aural Exciter* is powerful—a consistent, tight mix with a very dynamic feel.

Another spot I 'Compelled' was for Kenny Rogers "Greatest Hits" LP. The problem in that one was I had to connect 10 songs, each with a different texture, together with an announcer. The *Compellor* smoothed the transitions beautifully.

A client typically does not know what equipment was used, nor should he care. When I delivered the new spots to ON-TV, the response was "God, that sounds fantastic". That is, for me, the bottom line.

Frank Kejmar—manager/Recording Services/MCA/Whitney Studio Engineering for over 20 years. Credits include platinum albums for Barry White and Aretha Franklin, audio for Hanna-Barbera animation and Disneyland exhibit "America Sings".

I used the *Compellor* on the mixdown of the opera *Bells of Bethlehem*. The orchestra had been already mixed in London, the six soloists were recorded with AKG C12, and the twenty-five voice chorus was recorded with overhead AKG C24 mics in stereo-M/S.

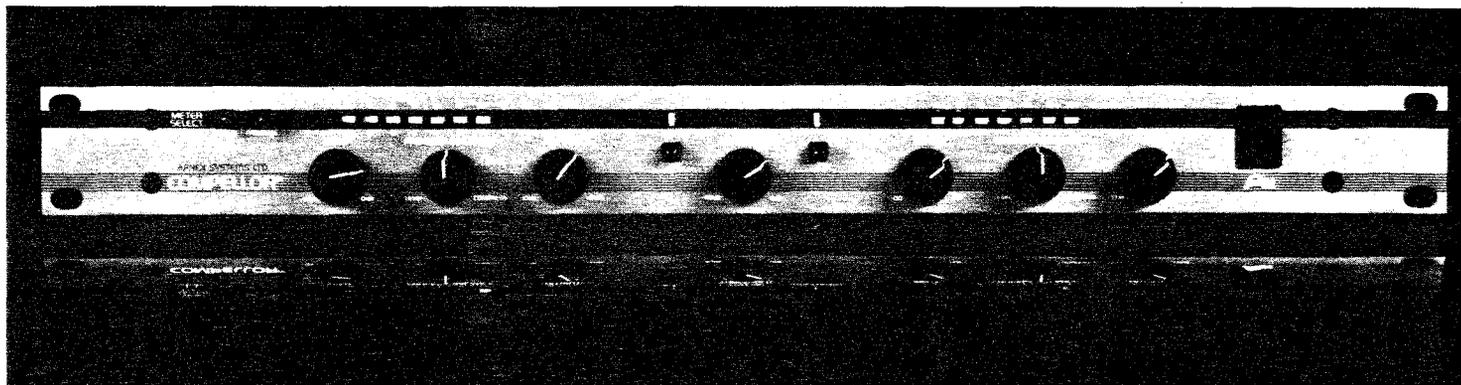
With pop music you can get away with using a variety of limiters. Classical dynamics, however, are much more varied and critical. I had at least 20 dB of dynamic changes in this project and only the *Compellor* kept the levels inaudibly controlled.

The vocalists thus appeared to have excellent mic technique without any conscious effort on their part. Chances are I could have achieved the same results by riding the gain manually for five or six takes, but the *Compellor* did it perfectly the first time. Another way of achieving the effect would be to program level changes via automation, but that would be time wasted if you have a *Compellor* available.

One does have to recognise that high level and low level balances will change depending on the amount of processing. The already mixed orchestral track was fine for the album master. I had to make a special mix for cassette duplication which was going to be played back during live performances. I wanted to avoid any need for gain riding during a performance so I ran the orchestra mix through the *Compellor*. Again, it did the job without any colouration.

The *Compellor* is very simple to use, after five minutes of playing with it, I had complete confidence in its function. The metering was useful in that I had a good indication of what the unit was doing dynamically at any particular time. ■

# INNOVATIVE PRODUCTS **FROM APHEX,** FOR SUPERIOR SOUND REPRODUCTION



## COMPELLOR™ COMPRESSOR/LEVELER/ PEAK LIMITER

Presenting the COMPELLOR™, a revolutionary audio processor. It delivers intelligent compression, leveling, peak limiting simultaneously! The COMPELLOR™ control circuits are actually analog computers that constantly monitor the input, adapt and control a single VCA per channel for minimal signal path. Operating

controls are kept to a minimum, for the COMPELLOR™ intelligently varies all the parameters for you. All you need do is set input level to control the amount of processing, adjust output level, and set the balance between compression and leveling. That's it. The COMPELLOR™ will then provide complete dynamic control—smooth, inaudible compression, increased loudness, freedom from constant gain riding, and the desired density—all

automatically. Its unique circuitry actually enhances transient qualities, making even heavy processing undetectable.

This smart, versatile, cost effective processor is equally at home in broadcast pre-processing, microphone control, audio production, tape duplicating, live sound and film dubbing; producing the "sound" audio engineers have always sought but seldom found.

## THE APHEX AURAL EXCITER™

The remarkable ApheX Aural Exciter is a unique proprietary audio processing device that makes use of highly advanced psychoacoustic principals to effectively restore and enhance audio presence, brightness and intelligibility. The patented psychoacoustic process creates the perception of an increase in mid and high frequency energy, with *NO* actual increase in power or level.

The Aural Exciter can produce dramatically improved clarity, dimension and character in any sound system or application. It can also reduce distortion in P.A. and sound reinforcement applications by providing increased penetration and audibility at reduced power levels. The device can be added to virtually any new or existing system with no danger of overload-

ing other components or triggering compressors or limiters.

The Aural Exciter is a single-ended process, requiring no decoder. Once encoded, copies made from a processed tape sound every bit as good as the original.

The ApheX Aural Exciter is available in three models, each is specially designed for a specific application.



### APHEX II-B

The Studio Aural Exciter is engineered for the sophisticated recording and production studio, as well as advanced sound reinforcement applications. In the studio, the Aural Exciter effectively restores the presence and clarity which the recording process removes, reviving that bright, unmistakable "live" quality. It can also make certain segments "stand out" without actually being louder. Used typically in stereo mixdown situations, this latest version of the Aural Exciter features increased flexibility so it's ideal for virtually all types of program material, from the hardest rock and roll, to the subtlest movie dialogue and sound effects.

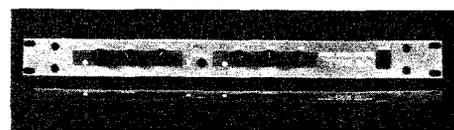
The Aural Exciter is also well suited to stage and concert use. It can make any P.A. system sound much cleaner, brighter and intelligible without adding any level or feedback to the house or monitor system. It is particularly effective in filling acoustic spaces to eliminate dead spots. The device cleans up sound in overly reverberant halls and makes speaker location much less critical.



### APHEX II-B

The Broadcast Aural Exciter has all the remarkable features and capabilities of the Studio unit, plus complete R.F. shielding and safety bypass relays in the event of power failure. Designed specifically for on-air use, this unit provides AM stations with the clarity and brightness of FM, while restoring to FM the naturalness and openness normally lost due to processing.

The most impressive aspect of the ApheX Broadcast Aural Exciter is the fact that the lower the quality of the playback system, the better the comparative benefit derived. The sound of your broadcast will satisfy the most demanding audiophile, and at the same time grab the attention of the rush-hour commuter.

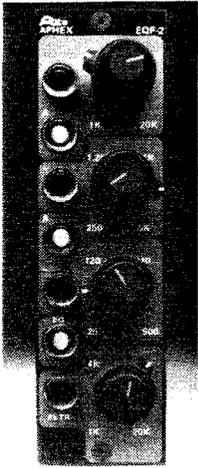


### APHEX AURAL EXCITER TYPE B

The Aural Exciter Type B is engineered for less demanding situations. It utilizes the same psychoacoustic principles to make Aural Excitement available to small clubs, studios, halls, restaurants, musicians, tape duplicators and sound contractors operating on a more modest budget. Retaining the most important features of its bigger brothers, the Aural Exciter Type B is a small, lightweight package with extensive capabilities limited only by the user's imagination.



## MODULAR PROCESSING



### EQF-2

The EQF-2 combines a 3-band sweep equalizer with a sweep Hi and Lo pass filter section. The EQ has switchable peak/shelf on the Hi and Lo sections, and reciprocal 12 dB of cut and boost on all sections. The filters are second order Butterworth and can be switched separately from the EQ section.

#### SPECIFICATIONS

**FREQ. RESPONSE:**  $\pm 1$  dB 20 Hz - 20 kHz all sections in  
**THD & IMD:** Below 0.1% at max. I/O  
**NOISE:** -123 dB below max. I/O  
**FILTERS:** Hi pass 20-500 Hz  
 Lo pass 1-20 kHz  
**EQ LOW:** 25 - 500 Hz  
**MID:** 250 - 5kHz  
**HI:** 1 - 20kHz  
**MAX. I/O:** +20 dBm (+30 dBm with opt. Jensen xfrmr)  
**SIZE:** 1-1/2" x 5-1/4" x 6" (industry standard)  
**WEIGHT:** 2 lbs.

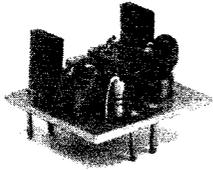


### CX-1

The CX-1 is a very versatile module combining a "soft knee" compressor/limiter with a switchable expander/gate. The CX-1 uses the proprietary Aphex VCA chip to provide an extremely clean overall sound. The expander is adjustable from 0 to 100 dB of expansion (gating) and is the only noise gate on the market that can be guaranteed not to click or pop. The unit features a multi-functional LED display that indicates input, output, compression or expansion levels.

#### SPECIFICATIONS

**BANDWIDTH:**  $\pm 1$  dB 20 - 20 KHz all sections  
**THD, IMD:** Less than 0.2% at max I/O  
**NOISE:** -85 dBm  
**MAX I/O:** +20 dBm (+30 dBm with optional Jensen xfrmr)  
**SIZE:** 1-1/2" x 5-1/4" x 6"  
 (industry standard)  
**WEIGHT:** 2 lbs.



### 2521 - OPERATIONAL MODULE

The 2521 Operational Module is a high speed, high output, short circuit proof buffer that takes on the characteristics of the IC that is plugged into it. It is current limited and can put out a full watt of power into a 62 ohm load.

#### FEATURES

100% Field-repairable  
 100% short circuit proof  
 Greatly improved overload characteristics  
 Built-in power decoupling  
 Socketed IC eliminates obsolescence  
 Extremely low noise current

#### SPECIFICATIONS

**BANDWIDTH:** 4MHz  
**THD (at clipping -1 dB):** 0.02%  
**IMD:** 0.02%  
**GAIN:** 50,000 Min.  
**SLEW RATE:**  $>10$  v/ $\mu$  Sec.  
**OUTPUT NOISE:** -113 dBm  
**MAXIMUM INPUT:** 30 Volts P-P  
**MAXIMUM POWER OUTPUT:** 1 Watt (+30 dBm)  
**MAXIMUM VOLTS OUTPUT:** Supply - 4 volts P-P  
**MAX. SUPPLY VOLTAGE:**  $\pm 18$  volts (with LF 351)

\*High voltage, high output versions are available. Consult the factory for details.



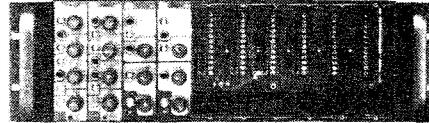
(Preliminary Data)

### MTA 401 SUPERMATCHED QUAD ARRAY

The MTA 401 is a tightly matched, junction isolated NPN transistor array with an order of magnitude improvement over conventional discrete and monolithic arrays. Most operating parameters approach theoretical limits making the MTA 401 an extremely attractive package for countless high quality audio applications such as mic, tape head and phono pre-amps, precision OTA's and multipliers as well as many instrumentation uses.

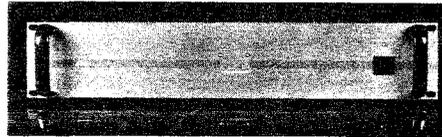
#### SPECIFICATIONS

**NOISE:**  $1.2$  nV/ $\sqrt{\text{Hz}}$  @ 2mA Ic  
**VBE MATCHING:** to  $25\mu\text{V}$   
**hFE MATCHING:** 1%



### R-1

The R-1 holds 10 Aphex modules and provides barrier strip access to all inputs and outputs. Power and ground are bussed.



### PS-3

The PS-3 is a  $\pm 16$ V @ 3.4A regulated supply with OVP that will power two R-1 racks.

## VCA PRODUCTS



### 1537A VCA IC new low price!

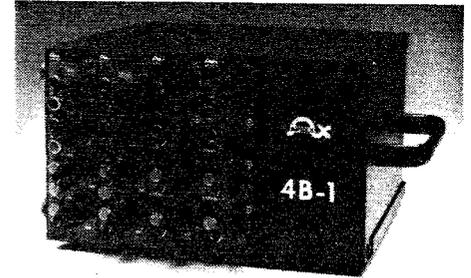
The 1537A is the only monolithic Class A voltage-controlled attenuator on the market today. Its patented design features extremely low distortion, low noise, high stability and wide dynamic range. It can provide more than 100dB of attenuation at +20 dBm. Its high slew rate gives low T.I.M. and makes it useable from DC to 50 MHz.

#### SPECIFICATIONS

**BANDWIDTH:** DC to 50 MHz  
**THD:** 0.004% TYP  
**IMD:** 0.03% TYP  
**NOISE:** -90 dBv worst case  
**MAX. ATTENUATION:**  $>100$  dB, DC - 200 kHz

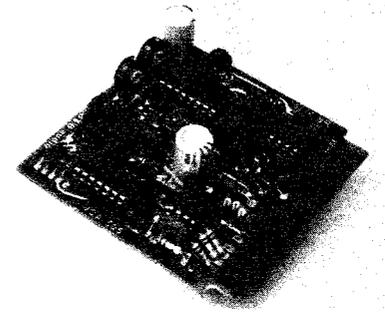
### VCA 500A

The new VCA 500 A utilizes a 1537A VCA IC to significantly improve the performance and overall sound quality of the MCI JH-500 series console. Conversion takes only a few minutes per channel with plug-in convenience.



### 4B-1

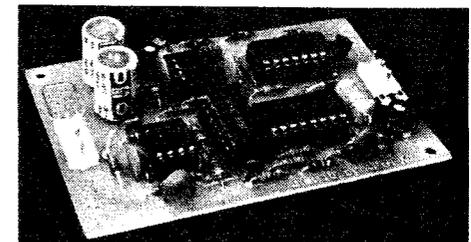
Self-powered, the 4B-1 is for the mobile engineer. It holds 4 Aphex modules and has a built-in patch board on the rear with 1/4" and T-T size jacks.



### VCA 505

The VCA 505 is an expanded version of the highly-acclaimed 1537A Voltage Controlled Attenuator. It utilizes a 15-pin card edge mount package for easy installation, has multiple buffered control inputs for maximum versatility, and requires no additional circuitry.

**SIZE:** 2.75" high x 2.85" deep x .72" wide



# APHEX SYSTEMS LTD.

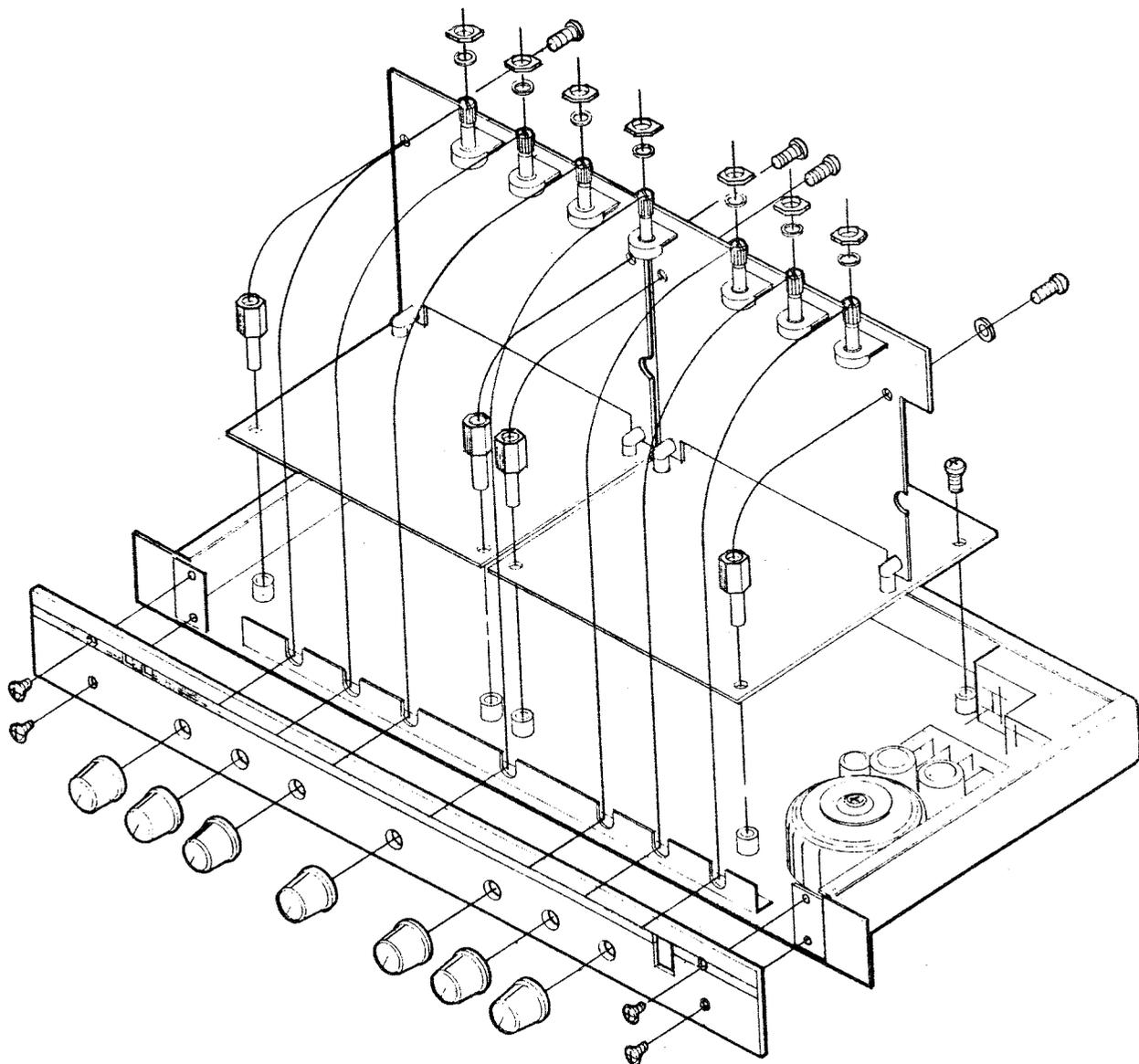
13340 Satcoy St. - North Hollywood, California 91605 - (818) 765-2212 - TWX: 910-321-5762



APHEX SYSTEMS LTD.

THE COMPELLOR

Parts List and Diagrams

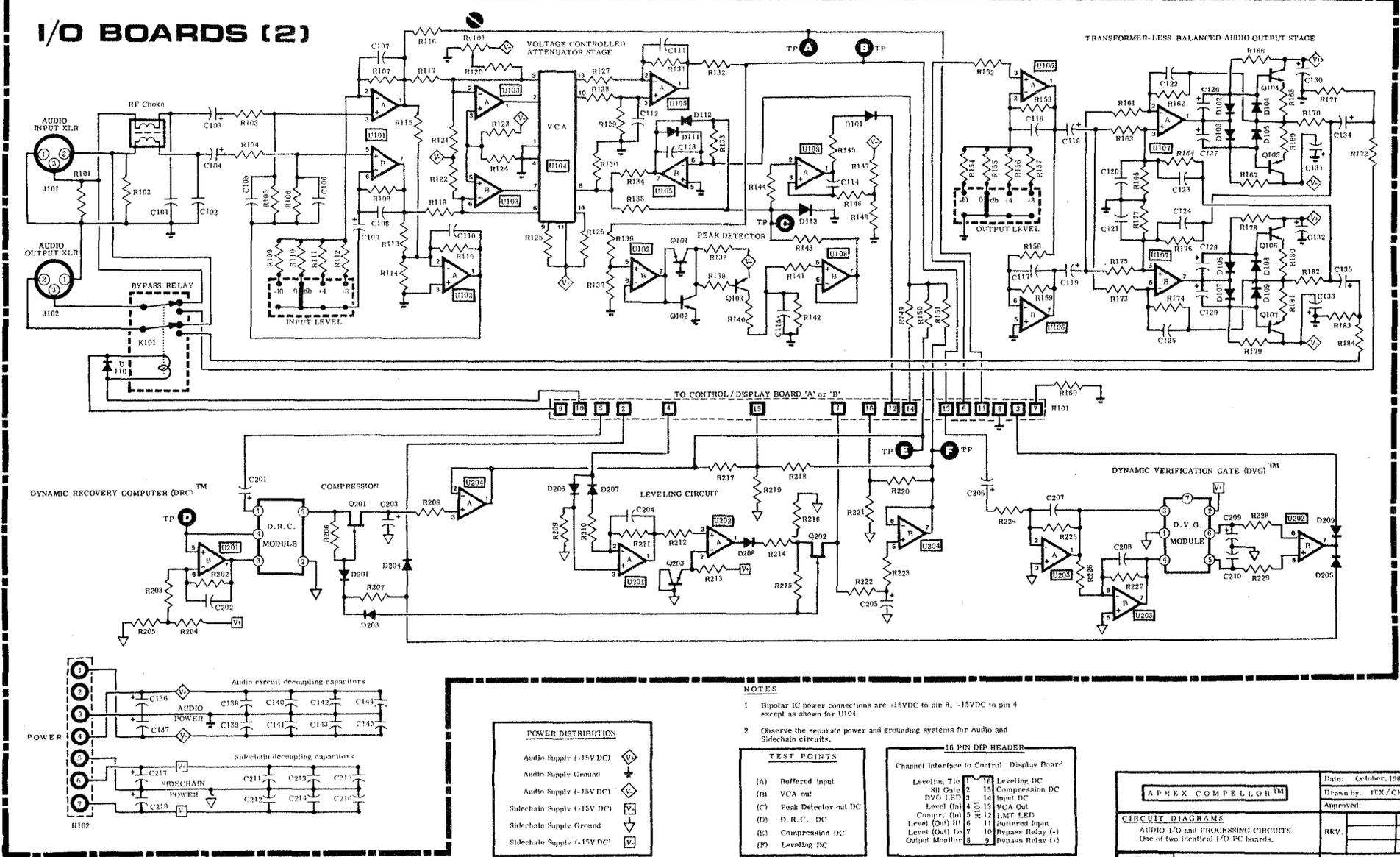


### I. DISSASSEMBLY

- 1) ( ) REMOVE TOP COVER, DON'T LOSE THE SCREWS.
- 2) ( ) REMOVE KNOBS. SOME EARLY MODELS HAVE COLLET TYPES, LATER ONE ARE SIMPLE PUSH-ONS.
- 3) ( ) REMOVE FACEPLATE.
- 4) ( ) UNPLUG THE (3) POWER CABLE FROM THE PROCESSING BOARDS (RED MOLEX CONNECTORS)
- 5) ( ) UNPLUG THE SHORT DIP JUMPER BETWEEN THE TOP BOARDS.
- 6) ( ) LOOSEN POTENTIOMETER MOUNTING NUTS (7)
- 7) ( ) REMOVE THE (4) PHILLIPS SCREWS SECURING THE FRONT OF THE DISPLAY BOARDS, THEY MAY NOW BE TILTED UPRIGHT.
- 8) ( ) REMOVE THE (2) 1/4" STANDOFFS AT THE FRONT OF EACH I/O BOARD.
- 9) ( ) REMOVE THE (2) PHILLIPS SCREWS AT THE REAR OF EACH I/O BOARD.
- 10) ( ) EACH ASSEMBLY MAY NOW BE LIFTED FROM THE CHASSIS.

# I/O & PROCESSING CIRCUITS

## I/O BOARDS (2)



### NOTES

- Bipolar IC power connections are +15VDC to pin 9, -15VDC to pin 4 except as shown for U104.
- Observe the separate power and grounding systems for Audio and Sidechain circuits.

### TEST POINTS

- (A) Buffered Input
- (B) VCA out
- (C) Peak Detector out DC
- (D) D.R.C. DC
- (E) Compression DC
- (F) Leveling DC

### 16 PIN DIP HEADER

Channel Interface to Control / Display Board	
Leveling Tie	16
SH Gate	2
DVG LRD	3
Input DC	14
Level (in)	4
Comp. (in)	5
Level (Out) H	6
Level (Out) L	7
Output Number	8
Leveling DC	16
Compression DC	14
VCA out	13
LMT LRD	12
Buffered Input	11
Bypass Relay (-)	10
Bypass Relay (+)	9

### POWER DISTRIBUTION

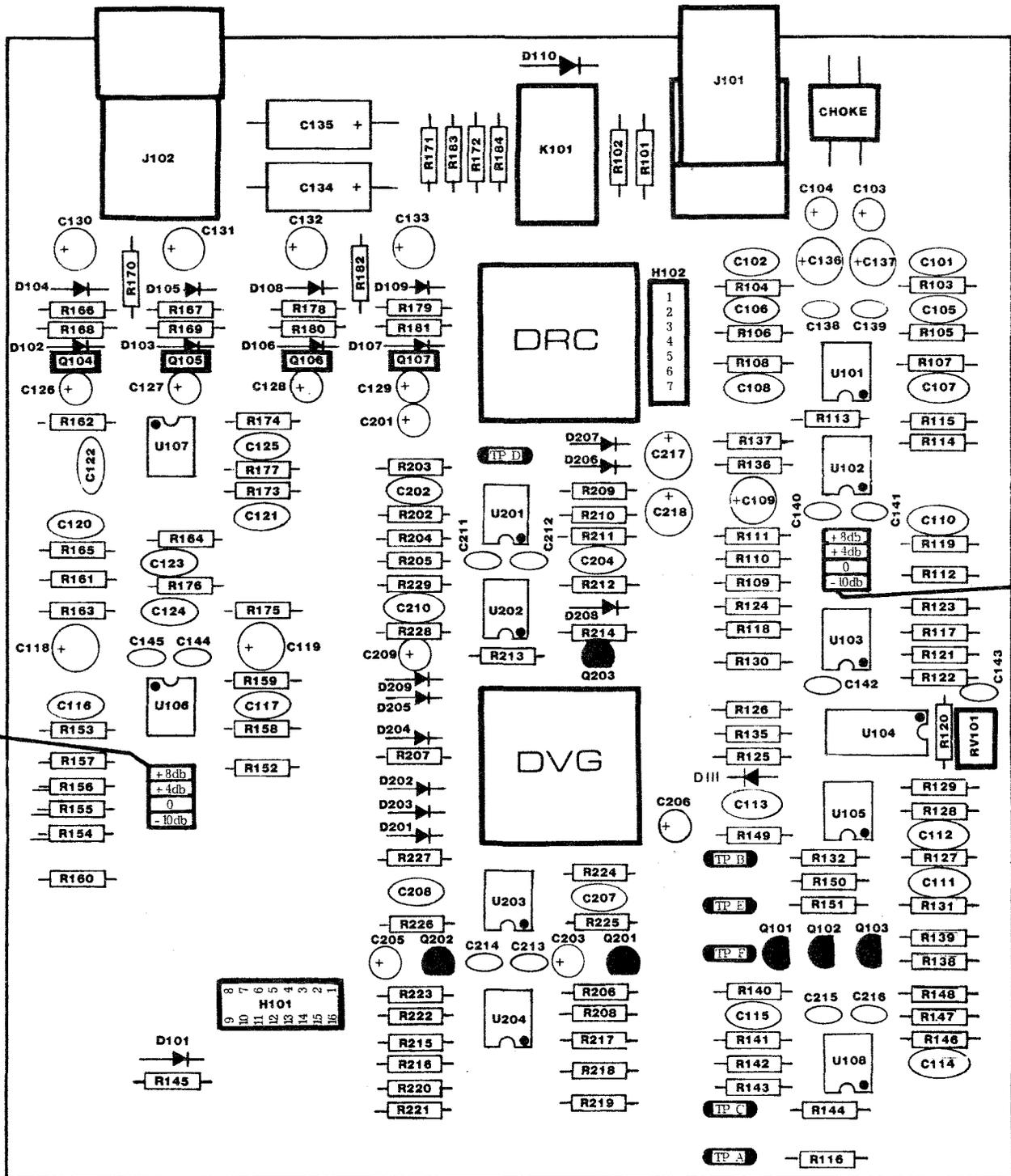
Audio Supply (+15V DC)	+
Audio Supply Ground	0
Audio Supply (-15V DC)	-
Sidechain Supply (+15V DC)	+
Sidechain Supply Ground	0
Sidechain Supply (-15V DC)	-

**APPEX COMPELLOR™**

CIRCUIT DIAGRAMS  
AUDIO I/O and PROCESSING CIRCUITS  
One of two identical I/O DC boards.

Date: October, 1983
Drawn by: JFX/CK
Approved:
REV
DRAWING NUMBER: 834-1

**APX** APHEX SYSTEMS LTD  
No. Hollywood CA 91605



\* THESE JUMPERS ARE USED TO MATCH THE COMPELLORS INPUT, METERING AND OUTPUT CIRCUITS TO ANY SYSTEM.

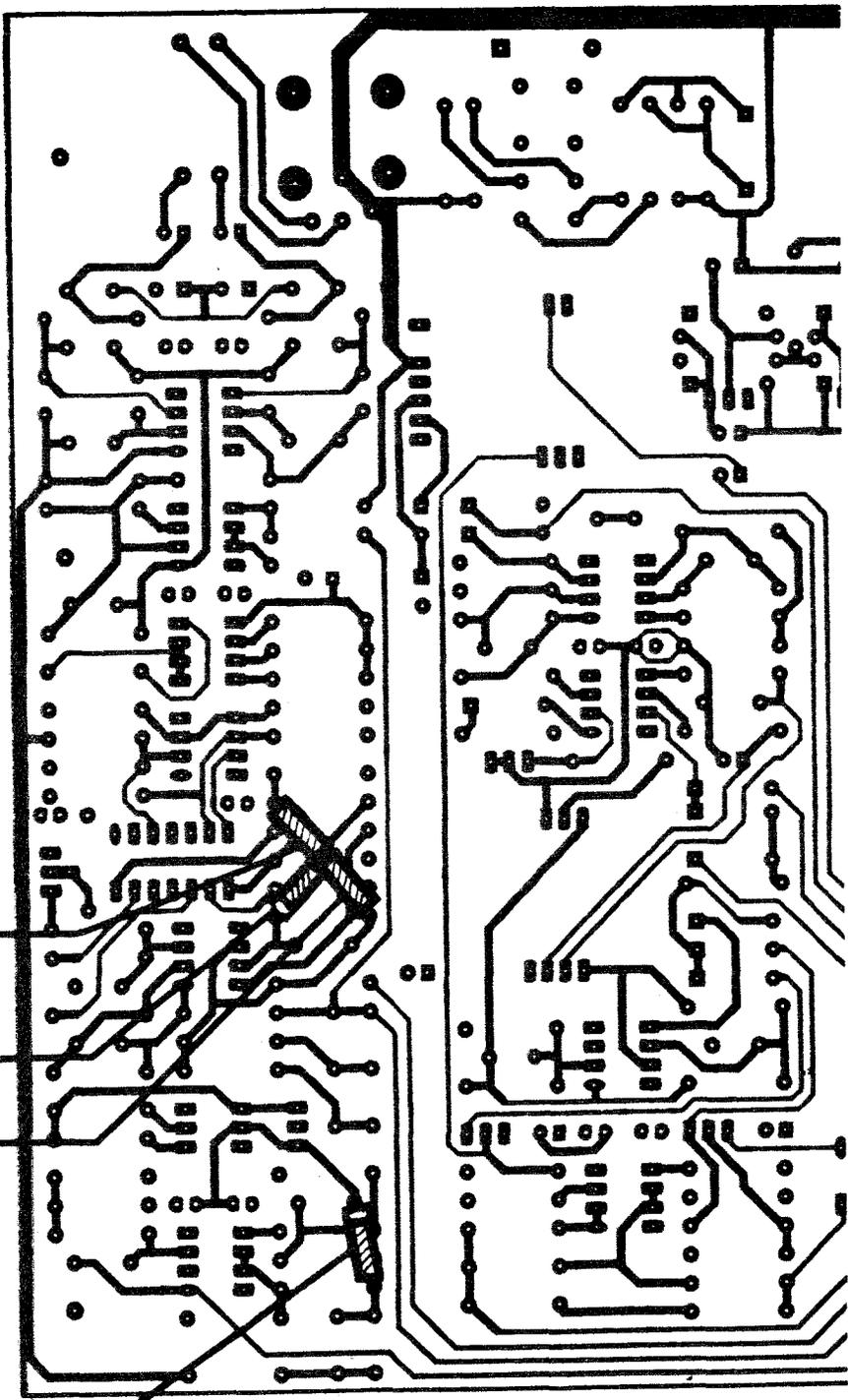
**INSTALLATION OF  
PARTS ON BOTTOM  
OF I/O BOARD**

R134

D113

R133

D112



**AUDIO BOARD**  
ORIENTATION:  
SOLDER SIDE  
SOLDER VIEW

# I/O & PROCESSING CIRCUITS

## PARTS LIST

### RESISTORS

Rv101 - 10K 10 turn	R117 - 3K32 1%	R134 - 825R 1%	R151 - 10K0	R168 - 10R
R101 - 100K 1%	R118 - 3K32 1%	R135 - 1K0 1%	R152 - 1K0 1%	R169 - 10R
R102 - 100K 1%	R119 - 330K	R136 - 34K0	R153 - 20K0 1%	R170 - 10R
R103 - 20K0 1%	R120 - 270K	R137 - 10K0	R154 - 16K2 1%	R171 - 10K0
R104 - 20K0 1%	R121 - 3K32 1%	R138 - 2K7	R155 - 9K31 1%	R172 - 10R
R105 - 13K3 1%	R122 - 3K32 1%	R139 - 2K7	R156 - 4K99 1%	R173 - 10K0 1%
R106 - 13K3 1%	R123 - 46K4 1%	R140 - 4K7	R157 - 2K87 1%	R174 - 10K0 1%
R107 - 10K0 1%	R124 - 20K0 1%	R141 - 1K0	R158 - 10K0 1%	R175 - 10K0 1%
R108 - 10K0 1%	R125 - 13K2 1%	R142 - 1M0	R159 - 10K0 1%	R176 - 10K0 1%
R109 - 2K87 1%	R126 - 13K2 1%	R143 - 150R	R160 - 500R 1%	R177 - 100K 1%
R110 - 13K3 1%	R127 - 4K99 1%	R144 - 1K0	R161 - 10K0 1%	R178 - 2K7
R111 - 34K2 1%	R128 - 4K99 1%	R145 - 1K0	R162 - 10K0 1%	R179 - 2K7
R112 - not used	R129 - 10K0 1%	R146 - 1M0	R163 - 10K0 1%	R180 - 10R
R113 - 10K0 1%	R130 - 21R5 1%	R147 - 10K0	R164 - 10K0 1%	R181 - 10R
R114 - not used	R131 - 10K0 1%	R148 - 150R	R165 - 100K 1%	R182 - 10R
R115 - 10K0 1%	R132 - 150R	R149 - 47K0	R166 - 2K7	R183 - 10K0
R116 - 150R	R133 - 20K0 1%	R150 - 10K0	R167 - 2K7	R184 - 10R
-----				
R202 - 10K0	R208 - 1K0	R214 - 10K0	R220 - 2K0	R226 - 10K0
R203 - 10K0	R209 - 10K0	R215 - 1M0	R221 - 1K2	R227 - 10K0
R204 - 15K0	R210 - 10K0	R216 - 10K0	R222 - 5M6	R228 - 1K0
R205 - 56R	R211 - 10K0	R217 - 2K0	R223 - 1K0	R229 - 1K0
R206 - 1M0	R212 - 1K0	R218 - 2K0	R224 - 10K0	
R207 - 33K0	R213 - 10K0	R219 - 750R	R225 - 22K0	

Resistors  $\frac{1}{4}$ W, 5%, except as specified.

R = Ohm; K = K-Ohm; M = M-Ohm

### CAPACITORS

C101 - 150pf	C110 - 20pf	C119 - 100uf 25V	C128 - 22uf 25V	C137 - 100uf 25V
C102 - 150pf	C111 - 10pf	C120 - 10pf	C129 - 22uf 25V	C138 - 0.1uf
C103 - 22uf 25V	C112 - 10pf	C121 - 10pf	C130 - 100uf 25V	C139 - 0.1uf
C104 - 22uf 25V	C113 - 0.001uf	C122 - 20pf	C131 - 100uf 25V	C140 - 0.1uf
C105 - 20pf	C114 - 0.01uf	C123 - 20pf	C132 - 100uf 25V	C141 - 0.1uf
C106 - 20pf	C115 - 0.01uf	C124 - 20pf	C133 - 100uf 25V	C142 - 0.1uf
C107 - 20pf	C116 - 20pf	C125 - 20pf	C134 - 330uf 25V	C143 - 0.1uf
C108 - 20pf	C117 - 20pf	C126 - 22uf 25V	C135 - 330uf 25V	C144 - 0.1uf
C109 - 100uf 25V	C118 - 100uf 25V	C127 - 22uf 25V	C136 - 100uf 25V	C145 - 0.1uf
-----				
C201 - 1uf tant	C205 - 1uf tant	C209 - 1uf tant	C213 - 0.1uf	C217 - 100uf 25V
C202 - 47pf	C206 - 4.7uf 25V	C210 - 0.15uf	C214 - 0.1uf	C218 - 100uf 25V
C203 - 1uf tant	C207 - 10pf	C211 - 0.1uf	C215 - 0.1uf	
C204 - 47pf	C208 - 47pf	C212 - 0.1uf	C216 - 0.1uf	

tant = tantalum capacitor

### TRANSISTORS

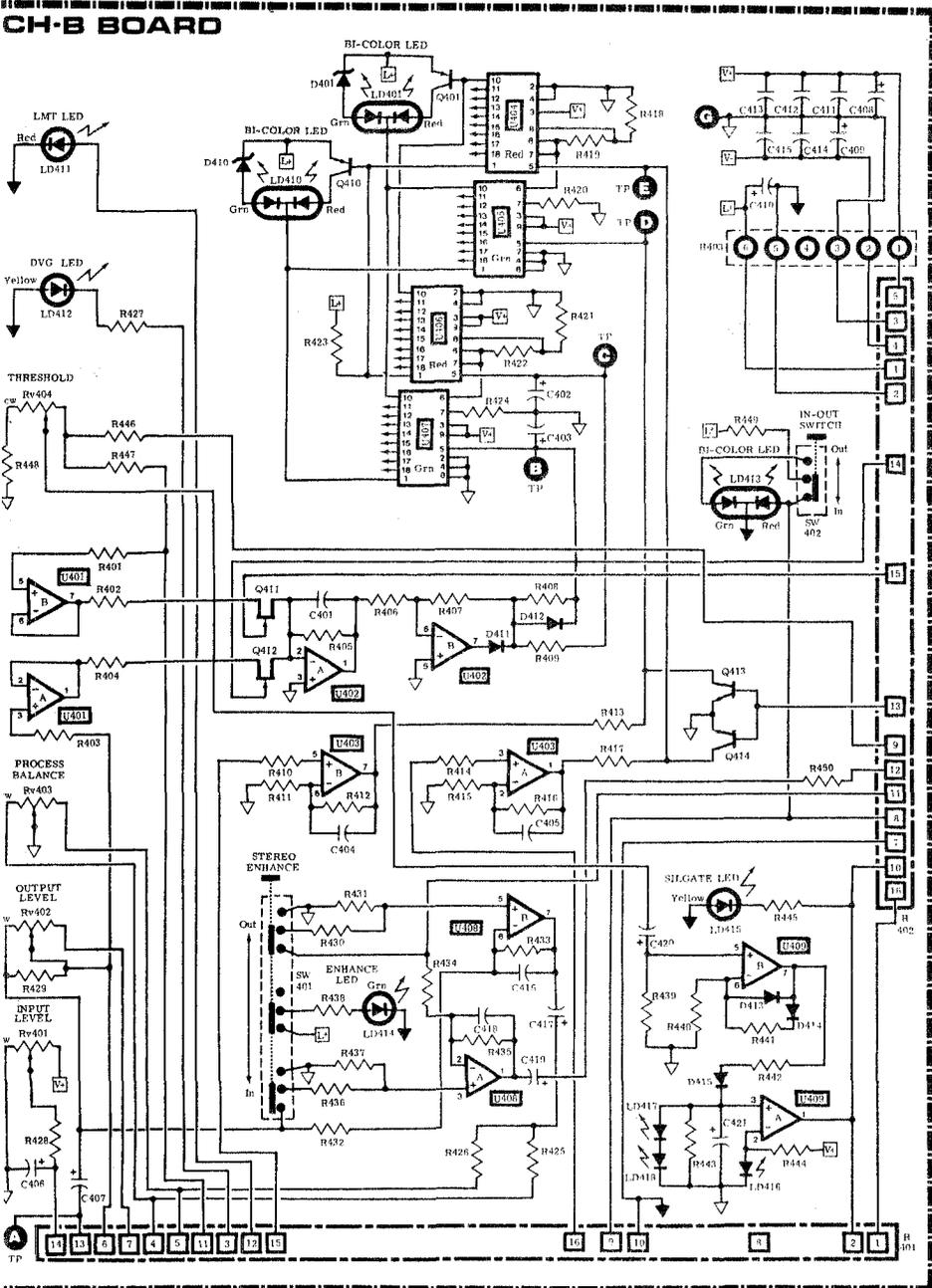
Q101 - 2N3906	Q103 - 2N3904	Q105 - MJE171	Q107 - MJE171
Q102 - 2N3906	Q104 - MJE181	Q106 - MJE181	
-----			
Q201 - J113	Q202 - J113	Q203 - 2N3906	

### ICs, DIODES, CHOKE

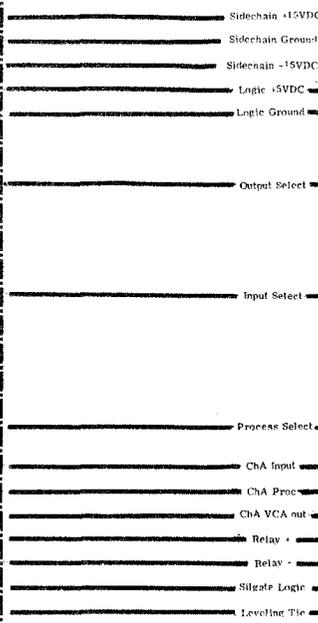
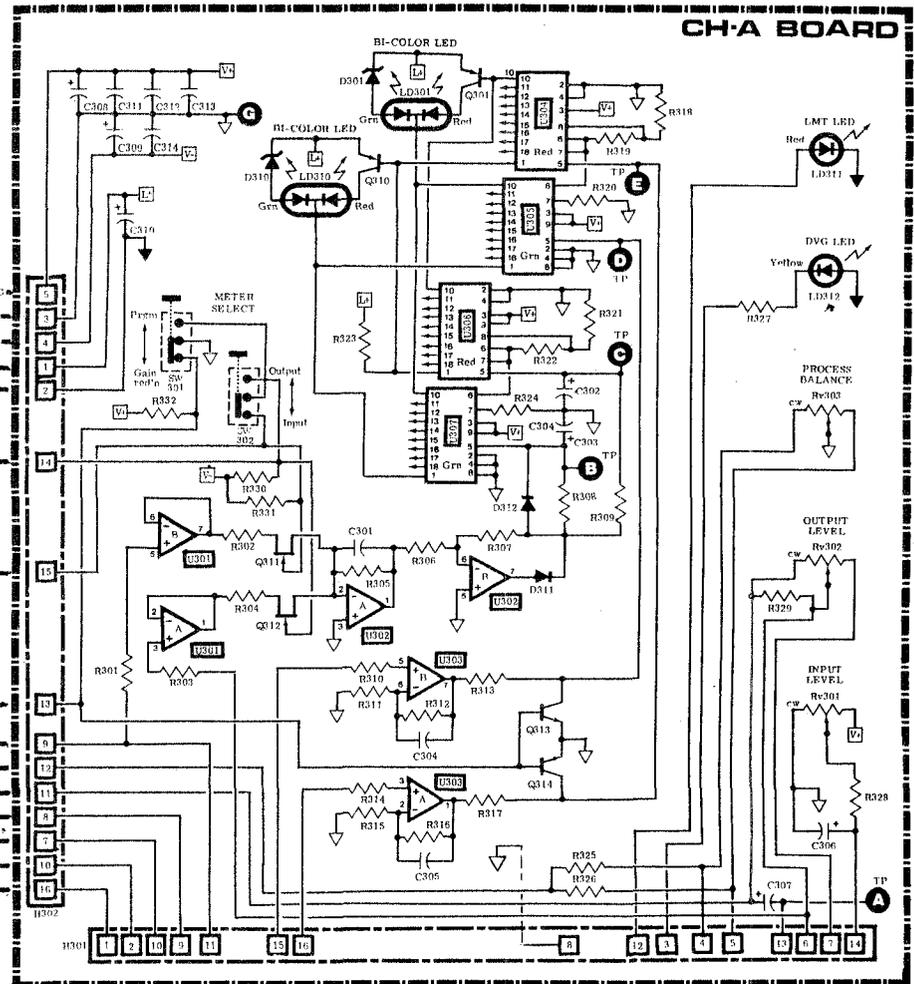
ICs:	U101, U102, U103, U106, U107, U201, U202, U203, U204 = LF353;	U104 = 1537A	U105 = NE5532N
DIODES:	D101, D102, D103, D104, D105, D106, D107, D108, D109, D111, D112, D113 = 1N914B	D110 = 1N4003	
CHOKE:	Special, Aphex Part # 72-003	D201, D203, D204, D205, D206, D207, D208, D209 = 1N914B	

# CONTROL & DISPLAY CIRCUITS

## CH-B BOARD



## CH-A BOARD



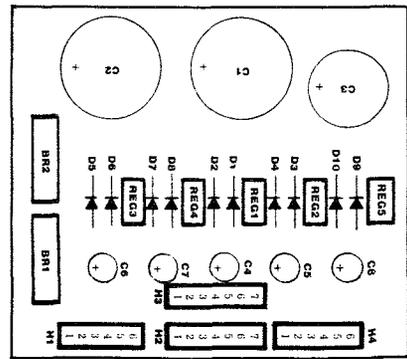
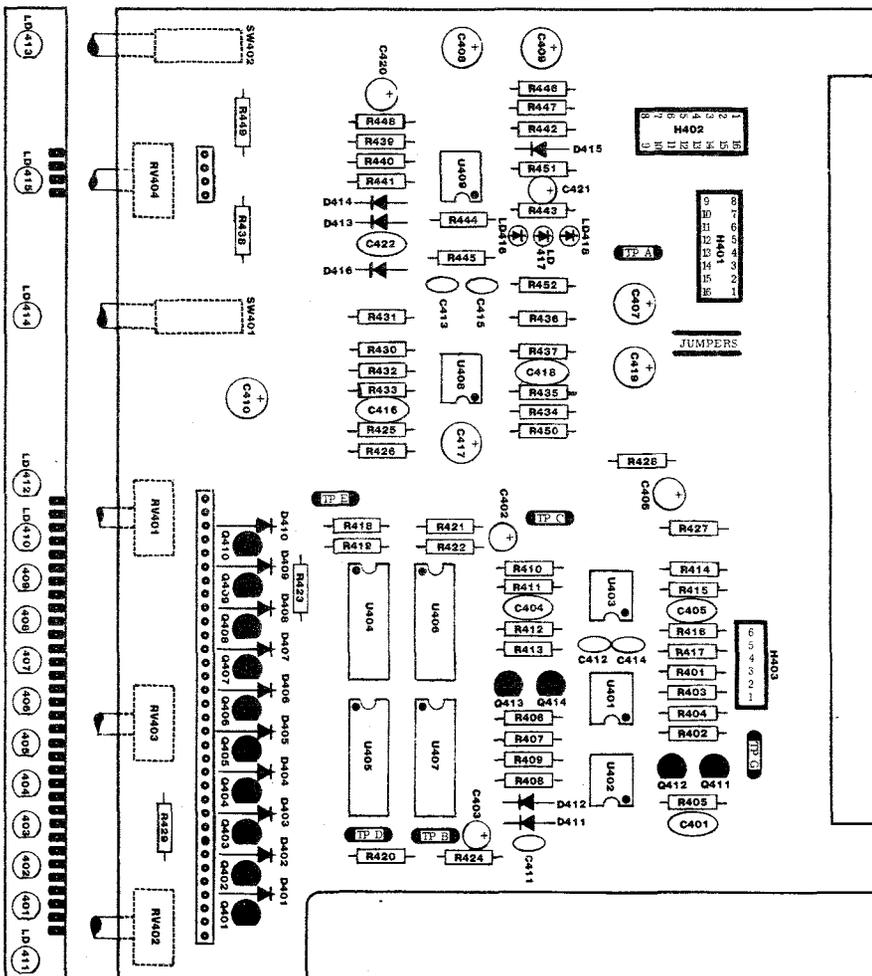
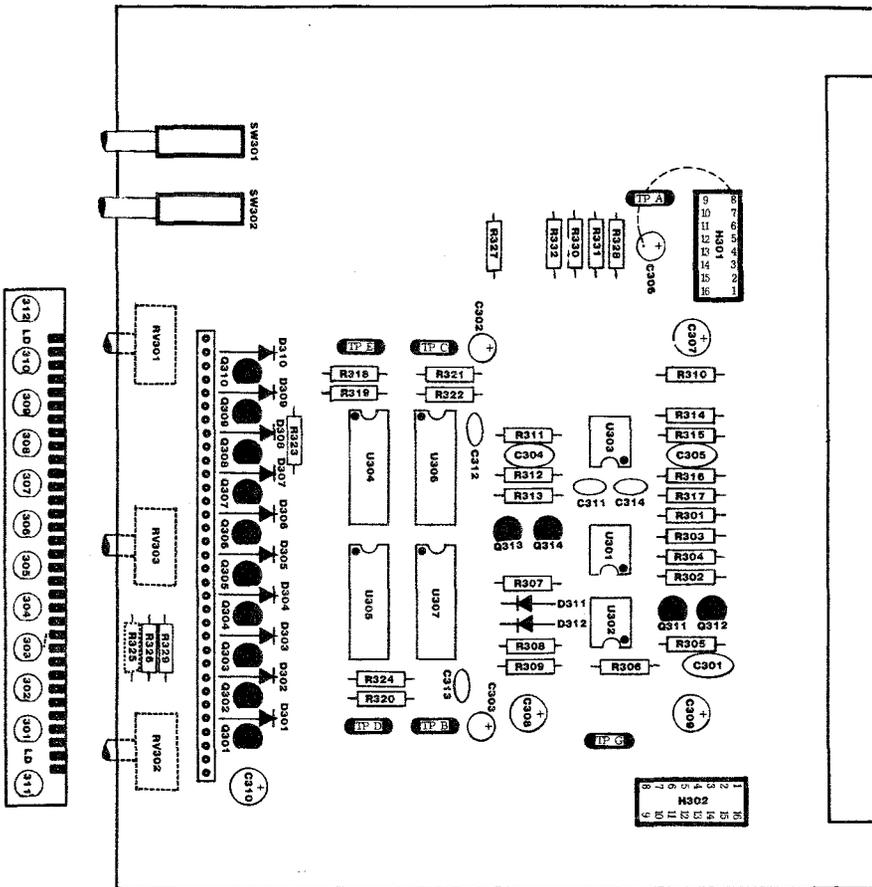
16 PIN DIP HEADERS		TEST POINTS		NOTES
CH A - CH B Board Interface Headers		A VCA out		
Logic Supply (+)	1 16	Leveling Tie	B Peak DC	2 Bipolar IC power connections are +15VDC to pin 8, -15VDC to pin 4, except ICs 1304/404, 1305/405, 1306/406 and 1307/407 which are connected as shown.
Logic Supply (G)	2 15	Input Select	C Average DC	
Sidechain Supply (+)	3 14	Output Select	D Compression DC	
Sidechain Supply (-)	4 13	Process Select	E Leveling DC	
Sidechain Supply (G)	5 12	Channel A Proc.	F Test Ground	
Bypass Relay (-)	6 11	Channel A VCA Out		
Bypass Relay (+)	7 10	Silence Logic		
To respective Audio I/O & Processing Circuits	8 9	Channel A Input		
Leveling Tie	1 16	Leveling DC		
311 Gate	2 15	Input DC		
DVG LED	3 14	VCA Out		
Level (In)	4 13	LMT LED		
Comp. (In)	5 12	Buttored Input		
Level (Out) H	6 11	Bypass Relay (-)		
Level (Out) L	7 10	Bypass Relay (+)		
Leveling Tie	8 9			

POWER DISTRIBUTION		CIRCUIT DIAGRAMS		Date: October 1983
Sidechain Supply, (+15VDC)	V1	CONTROL / DISPLAY BOARDS	Channel A	Drawn by: ITX/CK
Sidechain Supply, (-15VDC)	V2	Channel B	REV.	Approved:
Sidechain Supply, Ground	V3			
Logic Supply, (+5VDC)	V4			
Logic Supply, Ground	V5			

	APX SYSTEMS, LTD No. Hollywood, CA 91605	DRAWING NUMBER <b>834-2</b>
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# PARTS LIST

## RESISTORS

Rv301 - 10K Rv401 - linear	Rv302 - 10K Rv402 - audio	Rv303 - 3K Rv403 - linear	Rv404 - 10K rev.audio	
R301 - 1K0	R308 - 100K	R315 - 3K6	R322 - 10K0	R329 - 10K0
R302 - 20K0	R309 - 100K	R316 - 10K0	R323 - 20K0	R330 - 100K
R303 - 1K0	R310 - 1K0	R317 - 100K	R324 - 820R	R331 - 100K
R304 - 5K6	R311 - 3K6	R318 - 1K0	R325 - 5K6	R332 - 20K0
R305 - 33K0	R312 - 10K0	R319 - 10K0	R326 - 5K6	
R306 - 10K0	R313 - 100K	R320 - 820R	R327 - 1K0	
R307 - 10K0	R314 - 1K0	R321 - 4K7	R328 - 1K0	
-----				
R401 - 1K0	R411 - 3K6	R421 - 4K7	R431 - 3K6	R441 - 100K
R402 - 20K0	R412 - 10K0	R422 - 10K0	R432 - 3K25	R442 - 1K0
R403 - 1K0	R413 - 100K	R423 - 20K0	R433 - 57K6	R443 - 2M2
R404 - 5K6	R414 - 1K0	R424 - 820R	R434 - 8K25	R444 - 10K0
R405 - 33K0	R415 - 3K6	R425 - 5K6	R435 - 57K6	R445 - 1K0
R406 - 10K0	R416 - 10K0	R426 - 5K6	R436 - 33K0	R446 - 2K0
R407 - 10K0	R417 - 100K	R427 - 1K0	R437 - 3K6	R447 - 2K0
R408 - 100K	R418 - 1K0	R428 - 1K0	R438 - 150R	R448 - 100R
R409 - 100K	R419 - 10K0	R429 - 10K0	R439 - 100K	R449 - 150R
R410 - 1K0	R420 - 820R	R430 - 33K0	R440 - 100R	R450 - 56R

Fixed resistor 1/4W, 5%

R = Ohm; K = K-Ohm; M = M-Ohm

## CAPACITORS

C301 - 20pf	C304 - 20pf	C307 - 100uf/25V	C310 - 100uf/25V	C313 - 0.1uf
C302 - 1uf/tant	C305 - 20pf	C308 - 100uf/25V	C311 - 0.1uf	C314 - 0.1uf
C303 - 1uf/tant	C306 - 22uf/25V	C309 - 100uf/25V	C312 - 0.1uf	
-----				
C401 - 20pf	C406 - 22uf/25V	C411 - 0.1uf	C416 - 10pf	C421 - 1uf/tant
C402 - 1uf/tant	C407 - 100uf/25V	C412 - 0.1uf	C417 - 100uf/25V	
C403 - 1uf/tant	C408 - 100uf/25V	C413 - 0.1uf	C418 - 10pf	
C404 - 20pf	C409 - 100uf/25V	C414 - 0.1uf	C419 - 100uf/25V	
C405 - 20pf	C410 - 100uf/25V	C415 - 0.1uf	C420 - 4.7uf/25V	

tant = tantalum capacitor

## TRANSISTORS

Q301 - 2N3906	Q304 - 2N3906	Q307 - 2N3906	Q310 - 2N3906	Q313 - 2N3904
Q302 - 2N3906	Q305 - 2N3906	Q308 - 2N3906	Q311 - J113	Q314 - 2N3904
Q303 - 2N3906	Q306 - 2N3906	Q209 - 2N3906	Q312 - J113	
-----				
Q401 - 2N3906	Q404 - 2N3906	Q407 - 2N3906	Q410 - 2N3906	Q413 - 2N3904
Q402 - 2N3906	Q405 - 2N3906	Q408 - 2N3906	Q411 - J113	Q414 - 2N3904
Q403 - 2N3906	Q406 - 2N3906	Q409 - 2N3906	Q412 - J113	

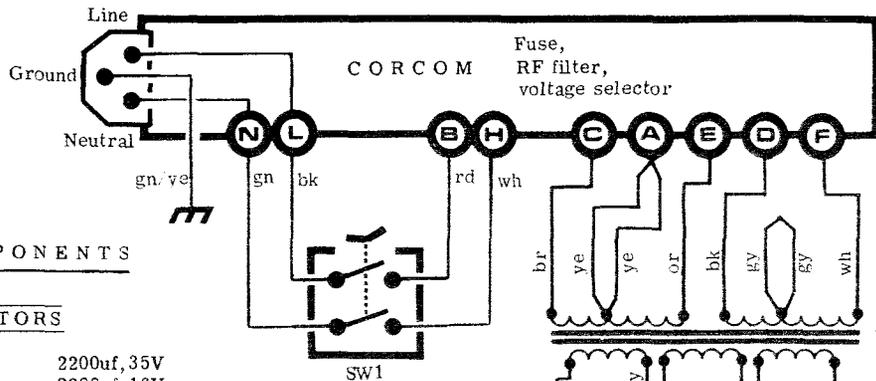
## ICs, DIODES, LEDs

<b>ICs:</b>	U301, U302, U303 U401, U402, U403, U408, U409 = <u>LF353</u>	U304, U305 U404, U405 = <u>3914</u>	U306, U307 U406, U407 = <u>3915</u>
<b>DIODES:</b>	D301 through 310 = <u>1N6551 A or B</u> D401 through 410 = <u>1N6551 A or B</u>	D311, D312 D411, D412, D413, D414, D415 = <u>1N914B</u>	
<b>LEDs:</b>	LD301 th LD310 = <u>T-13/4</u> LD401 th LD410 = <u>Bicolor</u> LD413 = <u>Red/Gr</u>	LD311 = <u>T-13/4</u> LD411 = <u>Red</u>	LD312 = <u>T-13/4</u> LD412 = <u>Yellow</u> LD415 = <u>Yellow</u>
		LD414 = <u>T-13/4</u> LD416 = <u>Green</u>	LD417 = <u>T-1</u> LD418 = <u>Green</u>

## SWITCHES

ALL SWITCHES = 4PDT latching, non-shorting, Alps SUJ Series

# POWER SUPPLY



## COMPONENTS

### CAPACITORS

C1, C2 2200uf, 35V  
 C3 2200uf, 16V  
 C4 - C8 luf, tantalum

### BRIDGES

BR1, BR2 MDA101A  
 Motorola

### TRANSFORMER

T1 Toroid, Apex pt# 70-009

### REGULATORS

REG1, REG2 LM340T-15  
 or 7815  
 REG3, REG4 LM320T-15  
 or 7915  
 REG5 LM340T-5  
 or 7805

### DIODES

ALL DIODES 1N4002

### HEADERS

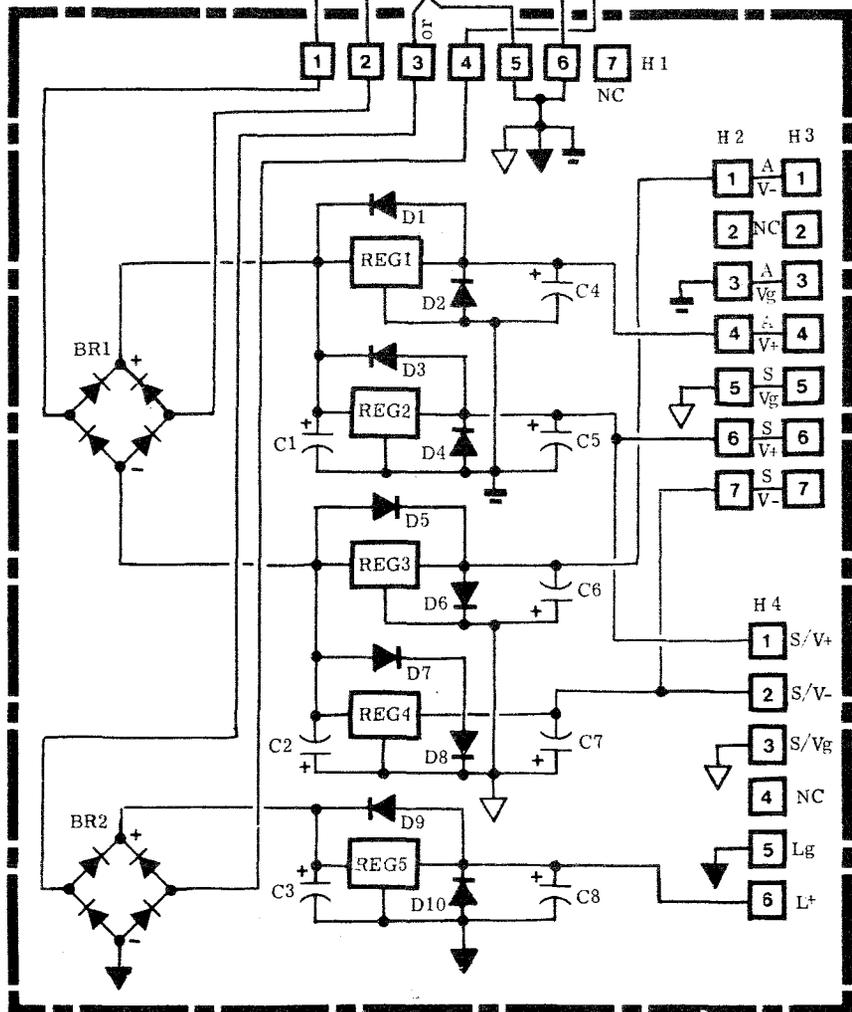
H1 7 pin (AC fr T1)  
 H2 7 pin (to I/O board)  
 H3 7 pin (to I/O board)  
 H4 6 pin (to display boards)

### SWITCH

SW1 DPDT rocker switch  
 Marquardt # 1852-1121

### AC CONNECTOR ASSEMBLY

UNIT = Corcom type 6J4  
 FUSE = 100/120V-1A;  
 220/240V- $\frac{1}{2}$ A.  
 RF filter & voltage selector  
 included in assembly.  
 IEC standard input



Chassis ground Audio ground Sidechain ground Logic ground

A = Audio Power: L = Logic Power: S = Sidechain Power

### WIRE COLOR CODE

gn	Green
bl	Blue
bk	Black
br	Brown
gy	Gray
or	Orange
rd	Red
wh	White
ye	Yellow

APHEX COMPELLOR™

Date: October 1983

Drawn by: ITX/CK

Approved:

CIRCUIT DIAGRAM

Power Supply

REV



APHEX SYSTEMS Ltd  
 No. Hollywood, CA 91605

DRAWING NUMBER: **834-3**