the COMPELLOR™

from APHEX SYSTEMS LTD.
Providing computer controlled dynamics for smooth undetectable control.

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 renown Aphex 153 7 A VCA, and a new, electronically balanced transformerless output stage which can be used balanced or unbalanced. The nominal operating level of the COMPELLOR (and DVGs on the model) is internally jumper selectable at 0, 0.4, and -6dBm 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 even within 0.2dB 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 input level change with the ratio varying from 1:1 to 25:1. The attack and release times for each stage are dependent on the program material. The attack time varying from 0.05 to 0.5 seconds, and the release time from 0.1 to 2.5 seconds. The nominal action is usually associated with deep compression. Further program dependent characteristics are monitored by other sections of the COMPELLOR's computer, the DYNAMIC VERIFICATION GATE (DVG) and the DYNAMIC RECOVERY COMPUTER (DRC).

The DVG monitors very short-term and short-term average levels, compressing and increasing gain where program dynamics might be identified for arbitrary gain reduction. The DVG also prevents gain release during short term program peaks which otherwise would cause "pumping" or "breathing" effects. The signal material is especially benefited by this feature, sounding natural even when severely 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 waveforms, hots, 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 of 12dB above the nominal (DVU) 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 when program resumes.

The STEREO ENHANCE feature does not detract. By detecting and measuring stereo interference and sending the information to the sidechains, 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.

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 true measurements simultaneously for compression and leveling for GAIN REDUCTION, Peak and Average for PROGRAM in and out, plus showing action of the DVGs, Peak Limiter, and Silence Gate plus status of the IN/OUT and STEREO ENHANCE switches.

**IN/OUT** 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.

**20dB GAIN REDUCTION**

**12dB LEVELING**

**-6dB COMPRESSION**
The Compressor/Leveler/Peak Limiter allows increased loudness, and intelligent automatic gain-riding. From APHEX SYSTEMS LTD.

APPLICATIONS

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

In the race for loudness it is quite unusual in which the USA. 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 expanded dynamic range, thus allowing it to be observed, i.e., "tweeter safe" without the possibility of 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 20db. The COMPELLOR can "lift" these passages without changing dynamic and transient feel thereby pleasing the audiophile and the computer alike.

**Television broadcasting**

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.

**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.

**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 handle and switch sources at the appropriate time. The COMPELLOR makes the job much simpler as it is especially effective on optical sound tracks which are so sensitive to any peak overload.

**STL/PHONE LINE DRIVER**

Maintaining consistent levels when compressing peaks without overloading and ringing is just another way of describing the COMPELLOR. Full modulation of the STL can be sustained without concern for overloading. Audio levels will be kept well above the noise floor of phone lines or STL, again without causing anything following the COMPELLOR.

**CARTING/TAPe DUPLICATION**

Different audio levels from cart to cart is an all too typical problem when 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.

**STEREO ENHANCE**

Switches in a unique detection and limiting 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 • +27 dBm
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 • 5-50dB/Sec
Threshold • same as Compression

Peak Limiter
Attack time • 1μ Sec
Release time • 10m Sec
Threshold • 12dB above nominal level (OVU)

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 • ±1dB 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.
13340 Saticoy St. - North Hollywood, California 91605 - (818) 765-2212 - TWX: 910-321-5762
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 µs pre-emphasis curve to overcome signal to noise problems in the transmission. This brought out products like the FM Volumax which inserted a 75 µs 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...
Apex 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/levelers. 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 over-shoots 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 over-shoot problems due to faulty transformer design 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 resumming network which can cause cancellations in the audio source.

The problem with over/short 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 modulation 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 types of peak limiters 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 Apex 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 so 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 Apex 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 us/div and the expanded horizontal is 20 ms/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 us/div and the expanded was 5 ms/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-

| 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 0.08% with 30 kHz bandpass 50 kHz 0.08% |
| Process control at full levelling 10 dB gain reduction 700 Hz 0.05% with 30 kHz bandpass 50 kHz 0.05% |
| 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 |
| Noise floor 700 Hz tone at reference silence gate engaged -65.5 dB -61.5 dBV |
| Processor control full compress 5 dB gain reduction 0.056% |
| Processor control full levelling 5 dB gain reduction 0.25% |

| Fig 1 |
| Fig 2 |
| Fig 3 |
The silence gate will freeze the level of a predetermined point to avoid increasing background noise. Also you can see the silence gate detector does not control the audio directly, but it controls the signal chain, 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 other audible effects, 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 broadcasting standards.

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 over 1000 overdubs and has been the production of taped spots and especially in the cutting 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 having to re-cut the tape itself.

The third unit was put in the mic channels for two of our 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 which isn't needn't processing the Compellor doesn't process. The best thing I can say about the Compellor is that you can't hear it work.

Joe Klein - producer/engineer

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 program and a mono mix. 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 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 use limiting. 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 all my 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 processors, 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. 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 limiter and compressor 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, smooths out my mixes making them easier and, at the same time, better.

I recently completed the winter campaign for ON-TV. Since this was all dialogue, I definitely did not want any of the compression 'effects' I mentioned before. I needed clean, punchy dialogue and its function 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 tool kit, and 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; all he should be aware of is when. When I delivered the new spots to ON-TV, the response was "God, that sounds fantastic". That is, for me, the bottom line.

Frank Kejamr—manager/Recording Services/MCA/Whitney Studio Engineering 1970 to present. 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 mixed down of the opera Bellisheim. The orchestra had been already mixed in London, the six vocalists were of AKG C12, and the twenty-five voice chorus was recorded with overhead AKG C42 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 did the job.

The vocalists thus appeared to have excellent mic technique without any conscious effort on their part. Chances are I could have achieved similar results if the Vocalists were 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 has to recognize that high level and low level balances will change almost instantaneously due to 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. I also 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 use. Perhaps the most useful in that I had a good indication of what the unit was doing dynamically at any particular time.
COMPELLOR® COMPRESSOR/LEVELER/PEAK LIMITER

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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.

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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 PA, 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.

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.

THE APHEX II-S

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 sublime music, dialogue, and sound effects. The Aural Exciter is also well suited to stage and concert use. It can make any PA 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.

THE 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 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.

THE APHEX AURAL EXCITER TYPE B

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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: ± 1dB 20 Hz - 20 kHz all sections
THD & IMD: Below 0.1% at max I/O
NOISE: -123 dB below max I/O
FILTERS: Hi pass 20-500 Hz
Lo pass 2-20 kHz
Eq Low: +20 dBm (+30 dBm with opt. Jensen xfrmr)
MAX. I/O: 25-500 Hz
SIZE: 1-1/2" x 5-1/4" x 5" (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: ±1dB 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 5" (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/μSec.
OUTPUT NOISE: -113 dBm
MAXIMUM INPUT: 30 Volts P-P
MAXIMUM VOLTS OUTPUT: Supply -4volts P-P
MAX. SUPPLY VOLTAGE: ±18 volts (with LF 351)

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 OTAs and multipliers as well as many instrumentation uses.

SPECIFICATIONS
NOISE: 1.2nV/Hz @ 2mA ic
VBE MATCHING: to 25μV
NFE MATCHING: 1%

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.

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 usable from DC to 50 MHz.

VCA 500A
The new VCA 500A 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.

(Deatils)
(Preliminary Data)

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

Parts List and Diagrams
1. 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) 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.
THESE JUMPERS ARE USED TO MATCH THE COMPELLORS INPUT, METERING AND OUTPUT CIRCUITS TO ANY SYSTEM.
### RESISTORS

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>R101 - 10K 10turn</td>
<td>R117 - 3K32 1%</td>
</tr>
<tr>
<td>R102 - 100k 1%</td>
<td>R118 - 3K32 1%</td>
</tr>
<tr>
<td>R103 - 20k 1%</td>
<td>R120 - 20k 1%</td>
</tr>
<tr>
<td>R104 - 20k 1%</td>
<td>R121 - 3K32 1%</td>
</tr>
<tr>
<td>R105 - 13k3 1%</td>
<td>R122 - 3K32 1%</td>
</tr>
<tr>
<td>R106 - 13k3 1%</td>
<td>R123 - 46K4 1%</td>
</tr>
<tr>
<td>R107 - 10k 1%</td>
<td>R124 - 20k 1%</td>
</tr>
<tr>
<td>R108 - 10k 1%</td>
<td>R125 - 13K2 1%</td>
</tr>
<tr>
<td>R109 - 2K87 1%</td>
<td>R126 - 13K2 1%</td>
</tr>
<tr>
<td>R110 - 13k3 1%</td>
<td>R127 - 4K99 1%</td>
</tr>
<tr>
<td>R111 - 34k2 1%</td>
<td>R128 - 4K99 1%</td>
</tr>
<tr>
<td>R112 - not used</td>
<td>R129 - 10K0 1%</td>
</tr>
<tr>
<td>R113 - 10k0 1%</td>
<td>R130 - 21K5 1%</td>
</tr>
<tr>
<td>R114 - not used</td>
<td>R131 - 10K0 1%</td>
</tr>
<tr>
<td>R115 - 10K0 1%</td>
<td>R132 - 150R</td>
</tr>
<tr>
<td>R116 - 150R</td>
<td>R133 - 20K0 1%</td>
</tr>
</tbody>
</table>

**Resistors J/W, 5%, except as specified.**

**R - Ohm; K - K-Ohm; M - M-Ohm**

### CAPACITORS

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C101 - 150pf</td>
<td>C110 - 20pf</td>
</tr>
<tr>
<td>C102 - 150pf</td>
<td>C111 - 10pf</td>
</tr>
<tr>
<td>C103 - 22uf 25V</td>
<td>C112 - 10pf</td>
</tr>
<tr>
<td>C104 - 22uf 25V</td>
<td>C113 - 0.00uf</td>
</tr>
<tr>
<td>C105 - 20pf</td>
<td>C114 - 0.0uf</td>
</tr>
<tr>
<td>C106 - 20pf</td>
<td>C115 - 0.0uf</td>
</tr>
<tr>
<td>C107 - 20pf</td>
<td>C116 - 25pf</td>
</tr>
<tr>
<td>C108 - 20pf</td>
<td>C117 - 20pf</td>
</tr>
<tr>
<td>C109 - 100uf 25V</td>
<td>C118 - 100uf 25V</td>
</tr>
<tr>
<td>C110 - 100uf 25V</td>
<td>C122 - 22uf 25V</td>
</tr>
<tr>
<td>C111 - 100uf 25V</td>
<td>C127 - 100uf 25V</td>
</tr>
<tr>
<td>C112 - 20uf 25V</td>
<td>C128 - 22uf 25V</td>
</tr>
<tr>
<td>C113 - 100uf 25V</td>
<td>C137 - 100uf 25V</td>
</tr>
<tr>
<td>C114 - 0.1uf</td>
<td>C205 - 1uf tant</td>
</tr>
<tr>
<td>C115 - 0.1uf</td>
<td>C206 - 4.7uf 25V</td>
</tr>
<tr>
<td>C116 - 25pf</td>
<td>C207 - 10pf</td>
</tr>
<tr>
<td>C117 - 20pf</td>
<td>C208 - 4.7pf</td>
</tr>
</tbody>
</table>

**tnt = tantalum capacitor**

### TRANSISTORS

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q101 - 2N3906</td>
<td>Q103 - 2N3906</td>
</tr>
<tr>
<td>Q102 - 2N3906</td>
<td>Q104 - MJE181</td>
</tr>
<tr>
<td>Q103 - MJE181</td>
<td>Q106 - MJE181</td>
</tr>
<tr>
<td>Q104 - MJE181</td>
<td>Q107 - MJE181</td>
</tr>
<tr>
<td>Q201 - J113</td>
<td>Q202 - J113</td>
</tr>
<tr>
<td>Q203 - 2N3906</td>
<td>Q204 - 4.7pf</td>
</tr>
</tbody>
</table>

### 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, D110, D111, D112, D113 = IN914B D110 = IN4002

**CHOKE:** Special, Aphex Part # 72-002 D201, D203, D204, D205, D206, D207, D208, D209 = IN914B
RESISTORS

<table>
<thead>
<tr>
<th>Parts List</th>
<th>Linear</th>
<th>Audio</th>
<th>Linear</th>
<th>Audio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rx001 - 10K</td>
<td>Rx002 - 10K</td>
<td>Rx003 - 3K</td>
<td>Rx004 - 10K rev. audio</td>
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</tr>
<tr>
<td>Rx01 - 1K</td>
<td>Rx01 - 1K</td>
<td>Rx01 - 1K</td>
<td>Rx01 - 1K</td>
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</tr>
<tr>
<td>Rx02 - 2K</td>
<td>Rx02 - 2K</td>
<td>Rx02 - 2K</td>
<td>Rx02 - 2K</td>
<td></td>
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<tr>
<td>Rx03 - 3K</td>
<td>Rx03 - 3K</td>
<td>Rx03 - 3K</td>
<td>Rx03 - 3K</td>
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<tr>
<td>Rx04 - 4K</td>
<td>Rx04 - 4K</td>
<td>Rx04 - 4K</td>
<td>Rx04 - 4K</td>
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</tr>
<tr>
<td>Rx05 - 5K</td>
<td>Rx05 - 5K</td>
<td>Rx05 - 5K</td>
<td>Rx05 - 5K</td>
<td></td>
</tr>
<tr>
<td>Rx06 - 6K</td>
<td>Rx06 - 6K</td>
<td>Rx06 - 6K</td>
<td>Rx06 - 6K</td>
<td></td>
</tr>
<tr>
<td>Rx07 - 7K</td>
<td>Rx07 - 7K</td>
<td>Rx07 - 7K</td>
<td>Rx07 - 7K</td>
<td></td>
</tr>
<tr>
<td>Rx08 - 8K</td>
<td>Rx08 - 8K</td>
<td>Rx08 - 8K</td>
<td>Rx08 - 8K</td>
<td></td>
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<tr>
<td>Rx09 - 9K</td>
<td>Rx09 - 9K</td>
<td>Rx09 - 9K</td>
<td>Rx09 - 9K</td>
<td></td>
</tr>
<tr>
<td>Rx10 - 10K</td>
<td>Rx10 - 10K</td>
<td>Rx10 - 10K</td>
<td>Rx10 - 10K</td>
<td></td>
</tr>
</tbody>
</table>

CAPACITORS

<table>
<thead>
<tr>
<th>Capacitors</th>
<th>20nF</th>
<th>1uf</th>
<th>100uf/25V</th>
<th>100uf/25V</th>
</tr>
</thead>
<tbody>
<tr>
<td>C301 - 20nF</td>
<td>C302 - 1uf</td>
<td>C303 - 1uf</td>
<td>C304 - 1uf</td>
<td></td>
</tr>
<tr>
<td>1uf/5%</td>
<td>1uf/5%</td>
<td>1uf/5%</td>
<td>1uf/5%</td>
<td></td>
</tr>
</tbody>
</table>

TRANSISTORS

<table>
<thead>
<tr>
<th>Transistors</th>
<th>2N3906</th>
<th>2N3906</th>
<th>2N3906</th>
<th>2N3906</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q301 - 2N3906</td>
<td>Q302 - 2N3906</td>
<td>Q303 - 2N3906</td>
<td>Q304 - 2N3906</td>
<td></td>
</tr>
</tbody>
</table>

ICs, DIODES, LEDS

<table>
<thead>
<tr>
<th>ICs</th>
<th>U301, U302, U303</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diodes</td>
<td>U402, U403, U408, U409</td>
</tr>
</tbody>
</table>

SWITCHES

All switches - 4PDT latching, non-shorting, Alps SUJ Series
POWER SUPPLY

COMPONENTS

CAPACITORS
C1, C2 2200uf, 35V
C3 2200uf, 16V
C4 - C8 1uf, tantalum

BRIDGES
BR1, BR2 MDA101A
Motorola

TRANSFORMER
T1 Toroid, Aplex pt# 70-009

REGULATORS
REG1, REG2 LMB40T-15 or 7915
REG3, REG4 LMB20T-15 or 7915
REG5 LMB30T-5 or 7805

DIODES
ALL DIODES 1N4002

HEADERS
H1 7 pin (AC to 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; 220V-1A.
RF filter & voltage selector included in assembly.
IEC standard input

WIRE COLOR CODE

<table>
<thead>
<tr>
<th>Code</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>gn</td>
<td>Green</td>
</tr>
<tr>
<td>bl</td>
<td>Blue</td>
</tr>
<tr>
<td>bk</td>
<td>Black</td>
</tr>
<tr>
<td>br</td>
<td>Brown</td>
</tr>
<tr>
<td>gy</td>
<td>Gray</td>
</tr>
<tr>
<td>or</td>
<td>Orange</td>
</tr>
<tr>
<td>rd</td>
<td>Red</td>
</tr>
<tr>
<td>wh</td>
<td>White</td>
</tr>
<tr>
<td>ye</td>
<td>Yellow</td>
</tr>
</tbody>
</table>

Chassis ground  Audio ground  Sidechain ground  Logic ground
A = Audio power  L = Logic Power  S = Sidechain Power

APHEX COMPELLOR™

CIRCUIT DIAGRAM
Power Supply

APELLX SYSTEMS Ltd
No Hollywood, CA 91605

DRAWING NUMBER: B34-3