ORBAN/PARASOUND REVERBERATION

OPERATION AND MAINTENANCE MANUAL

Introduction:

The Orban/Parasound Reverberation system represents a significant advance in increasing the performance/cost ratio of artificial reverberation generators. New concepts in driving electronics for the Hammond spring delay line have resulted in the solution of problems typical to even the highest priced units using this delay system.

The O/P Reverb is available in four models to meet a variety of customer requirements.

MODEL 105A comes mounted behind a 1.5 x 9" panel, and is designed to be mounted in mixing consoles using standard modular strips. It has no internal power supply, and requires ± 15 volts of well-filtered DC at approximately 100 ma.

MODEL 105B is identical to model 105A except that an internal power supply is provided, and the unit is powered by the 110/220 volt AC line.

MODEL 105C is a 1 3/4" rack mounted version of the system. It is self-powered from 110/220 volts AC. There is a provision for the addition of a remote hard limiting indicator lamp which can be mounted so that it can be easily seen by the mixer.

MODEL 105D consists of two model 105C's, mounted on a single 1 3/4" rack panel. The economy of the O/P reverberation system makes multiple echo channels economically feasible for many smaller studios. The 105D provides maximum space economy.

All versions are supplied with a plug-in 4-spring delay line assembly, which is mounted separately from the electronics.

Design Concepts:

The performance of the O/P reverb is dependent on a number of different factors in the driving and pickup electronics. In order to best use the unit, these concepts should be understood.

The primary problem in spring reverb systems has always been noise and distortion in various forms. Several interrelated attacks have been made on this problem.

First, the driver coil is driven by a true constant-current source, synthesized with an IC opamp. This means that, compared with a constant-voltage drive, there is a 6 db/octave preemphasis above a few hundred Hertz. This permits the use of a corresponding deemphasis in the pickup preamp, which reduces both noise and distortion products. The pickup preamp is elaborately equalized by active and passive RC networks to simulate the sound of reverberation in a real room.

The pickup preamp uses an ultra low-noise transistor in the input stage, operated in the region of 1 dB noise factor. The operating parameters of the pickup preamp have been carefully matched to the characteristics of the delay line pickup coil. These steps mean that it is possible to use Orban/Parasound Reverberation in any mix, even using a noise reduction system, without degrading the signal to noise ratio in the mix. Naturally, the operating levels must be chosen carefully in order for this to be true.

Four springs are used in the delay line assembly in order to reduce effects of spring "flutter" to the vanishing point.

The most novel feature of the O/P reverb is its attack on "sproinging" sounds generated by a typical spring on sharp transients, like drums and guitars. A proprietary circuit limits the rate of envelope attack so that sharp transients are never permitted to reach the spring driver. The result is that the O/P reverb is the first spring system which gives acceptable sound on drums and similar instruments, provided that a typical amount of direct sound is mixed with the echo return.

Like any other limiting circuit, this circuit tends to produce distortion on very low frequencies. Therefore, for use with instruments like organs, a switch has been provided to defeat the envelope risetime limiting feature. Even if this feature is defeated, a conventional peak limiter is provided which protects the spring driver amplifier from overload under conditions of up to 25 dB input overload. This is the "fixed" or "hard limiting" mode. In the envelope risetime limiting mode (called "floating threshold"), application of a signal which would tend to overload the spring driver amplifier will automatically switch the circuit into the hard limiting mode until the overload is removed. This switching also illuminates a lamp on the front panel so that the operator knows that the output level of the reverb is no longer following the input level, but is being limited.

Harmonic distortion in the limiter circuitry at high frequencies remains below 1.0% for any degree of limiting, while the attack time is typically 10 microseconds. Circuit concepts for the basic control loop were derived from the Orban /Parasound Program-Controlled Amplifier.

Installation:

All of the external connections for the O/P reverb are brought out on a Jones strip on the back of the chassis. In the 105C and 105D, a standard AC line cord is brought out. This is a three-prong type, to correspond to certain local electrical codes, and the ground wire is connected to the chassis but not to the negative power supply. The decision as to whether to connect the negative power supply to the chassis by means of a jumper on the rear strip depends on each individual installation, with the installation being made so as to avoid system ground loops.

The input is unbalanced bridging, but must be driven by source impedances of 600 ohms or lower to avoid reflecting distortion back into the line, since the input impedance is somewhat non-linear. Nominal input level is +4 dBm; hard limiting occurs at roughly +10 dBm. This will change slightly with temperature and also from unit to unit.

Output impedance is in the order of 50 ohms, with 600 ohms being the minimum load. The output is unbalanced. A level loss of approximately 10-15 dB, depending on the nature of the input material and the limiting mode, will be observed from input to output. This was necessary to avoid saturating the output amplifier on certain resonant peaks in the delay line response. These peaks are very narrow, but some are very large compared to the average response.

The Jones strip terminals are numbered from left to right. In all cases, 5 and 7 are signal ground, while 6 is the hot output and 8 is the hot input. The other connections vary from model to model.

105A:	1	=	+15 volts DC supply
	2	=	-15 volts DC supply
	3	=	power supply ground
	4	=	chassis
105B	1	=	110/220V AC in
	2	=	110/220V AC in
	3	=	chassis
	4	=	chassis

105C and 105D

1	=	remote hard limiting indicator lamp
2	=	remote hard limiting indicator lamp
3	=	chassis
4	=	chassis

110 or 220V restrapping instructions are found on the power transformer cover paper. Models 105C and 105D provide for a remote hard limiting lamp. This should be a 28 volt 40 ma lamp, and it can be supplied by Orban/Parasound. (catalog # 1050)

If it is absolutely necessary to mount the delay line in a rack, an accessory rack mount kit for the delay line is available (catalog #1051) at a nominal charge. However, the delay line is subject to hum pickup from stray AC magnetic fields, and should therefore be oriented experimentally before final installation in order to minimize hum pickup. With the universal mounting bracket provided, the delay line can be mounted on almost any surface. It must be mounted in the orientation shown on the delay line label in order to achieve maximum performance with minimum sensitivity to external vibration. The delay line should also be mounted away from loud monitor speakers, since there is a possibility of leakage of the monitor signal onto the delay line, or else actual acoustic feedback through the delay line. It is not recommended that leads to the delay line be shortened or lengthened, or that the factory arrangement in wiring the delay line-to-electronics connector be tampered with.

The electronics chassis itself is relatively non-critical in physical placement, and may be operated in virtually any position and any place.

If the electronics are operated with the delay line disconnected, application of an input signal will result in the production of a very loud clipped signal inside the unit. Particularly in the 105A, this signal might tend to leak into other parts of the system. Therefore, the O/P reverb should not be operated without connecting the delay line to the electronics.

Since the system is unbalanced in and out, particular attention should be paid to avoiding ground loops and other problems. This problem is beyond the scope of this manual, but has been treated elsewhere, and is a problem familiar to any experienced engineer. In severe or seemingly insoluable cases, it may be necessary to add an external input transformer, output transformer, or both. The chassis is entirely isolated from the signal ground, and the two may be strapped at the connector strip at the rear of the electronics chassis if this gives optimum performance in a given system. Note too that the grounding system for the delay line has been carefully worked out, and the delay line must not be inadvertantly grounded in the installation.

Correct installation will result in system output noise which is essentially all hiss, with a small amount of low-frequency rumbling. There should be no hum or buzzing. System noise measurements will usually be meaningless, since strong subaudible and very-low-frequency rumble components generated by spring microphonics will mask noise components with spectral content that would tend to make them most objectionable to the ear. The ear (unless elaborate weighting filters are available) must be the final judge when testing for adequate system signal/noise.

Operation:

The O/P reverberation generator should be treated as an echo chamber, with one input being applied to the unit, and one reverberated output being available. No control of the ratio of direct to reverberated sound is available on the reverb electronics themselves; this function must be provided in the external mixing facilities.

For best signal/noise, the echo send bus should have a nominal +4 dBm signal level. If peak levels in excess of +10 dBm are reached, the internal limiter in the O/P reverb will revert to the "hard limiting" mode in order to protect the driver amplifier from overload and clipping. This mode switching is indicated by means of the "hard limiting" mode lamp, which will light whenever the limiter automatically switches into hard limiting. If it is desirable to defeat the envelope risetime limiter, then the hard limiting lamp will stay lit at all times. Defeat of the envelope risetime limiter ("floating threshold") is accomplished by switching the mode selector switch to the "hard limiting" position. It is desirable to defeat the floating threshold mode whenever it does not provide an improvement in sound, since this will tend to improve the perceived signal/noise in the reverb system by providing a louder drive signal. Typical instruments on which the floating mode would be used might be electric bass, guitar, percussion, certain voices, and any music containing sharp transients. Other instruments, like organ, strings, brass, reeds, and so forth are best reverberated in the "hard limiting" mode.

It has been found that there is often considerable advantage in reverberating separate instruments through separate reverberation generators, rather than using one reverberation generator for all of the echo. The advantage comes in greater control of the sound of each instrument, as well as an increase of clarity caused by the absence of intermodulation and other interactions between the different instruments in the same reverberation generator. The economy of the O/P reverb makes the use of multiple chambers economically feasible for many studios.

The output from the O/P reverb has been equalized to simulate real reverberation in a hall with good acoustics. Nevertheless, the mixer may wish to equalize the output in order to obtain certain desired effects. This is perfectly possible, and should be left to the discretion of the mixer.

Maintenance:

The O/P reverb is an entirely solid-state device, and no routine maintenance is necessary, with the exception of keeping the unit free from dust and dirt.

The rest of the maintenance to be considered is that of correcting faults that develop. For purposes of this discussion, the reverb can be divided into four parts: the limiter, the delay line driver, the delay line, and the pickup amplifier.

Test points have been provided in order to track the signal through the various stages in the reverb. TP1 follows the special limiting circuitry. This circuit is complicated and subtle, and requires special equipment including precision distortion measuring equipment and a high-speed triggered sweep oscilloscope for adequate performance evaluation and adjustment. It is therefore recommended that any difficulties with this section be repaired at the factory. The five trimmer pots to be found are used to initially align this circuit for normal component tolerances. These trimmers need not be adjusted by the user of the reverb, as their settings are very stable with time.

The delay line driver is an integrated circuit operational amplifier connected as a voltage/current converter, to supply the spring driver with an infinite output impedance driving source.

A fast check for proper operation of the limiter and delay line driver can be obtained as follows.

Connect a 1000 Hz sine wave generator to the reverb input, and connect an oscilloscope to TP2. Adjust the generator for a -10 dBm output. Switch the mode switch to "floating". Now suddenly switch the output level of the generator to 0 dbm and observe the output level at TP2 while the level is being switched. The TP2 level should not change instantly, but instead should have a perceptible risetime, although this risetime will be quite fast (typically around 200 msec). Now increase the input level until the "hard limiting" lamp lights (this should be around +10 dBm). Increase the input level 15 dB. Throughout this 15 dB range, the output should not rise more than 1.5 dB, and the waveform should remain undistorted. If these tests are passed, it is reasonably certain that the limiter is operating correctly, and that the driver amplifier is driving the delay line correctly. Certain faults, particularly those involving failure of the limiter to catch both negative and positive peaks, are not revealed by this test, and tend to show up in actual operation as a failure to efficiently protect the delay line against transients.

A detailed discussion, with reference to the schematic, of the limiter and driver circuitry now follows.

The audio input enters at TB1-8, and is reduced to a nominal 30 mv rms by the voltage divider R106 and R107. Field-effect transistor Q101 shunts R107 and serves as a voltage-controlled resistor to vary the loss of the voltage divider. The signal at the output of the voltage divider is built up to levels which will drive the control loop by means of operational amplifier A101, operated in the non-inverting mode. Its gain is determined by R108, R109, and R102. R 110 stabilizes the amplifier, while R118, C101, and C102 are frequency compensation components to prevent amplifier oscillation. Low-frequency cutoff frequency is determined by R108 and C103.

An audio signal is introduced to the gate of the FET Q101 through R101 and C104 in order to cancel out second harmonic distortion caused by unbalanced operation of the FET.

A control signal is derived by a proprietary circuit inside the encapsulated module. This control signal is applied to the gate of Q101 to determine the overall gain of the limiter at any one moment. C108 and R121 decouple the positive power supply from the module, while C107, CR101, and R117 provide a +12 volt supply for the module. Q102 operates in a switching mode to switch the "hard limiting" lamp on or off.

The output from the limiter is applied to the driver amplifier, operational amplifier A102, through a level control R103, which is adjusted so that A102 does not clip at any input level and at any frequency below 5 kHz.

A102 is operated as a voltage/current converter. All of its output current passes through the delay line driver coils. This current then passes through R116 and develops a voltage proportional to the current through the delay line driver coil. This voltage is used as a feedback voltage through R112, C105, and R111. Since the delay line driver is inductive, the drive voltage across it tends to rise at 6 db/oct above a few hundred Hertz in order to maintain constant current. In order to prevent clipping at high frequencies above the usable frequency range of the delay line, the constant-current characteristic is rolled off at 6 db/oct above 7000 Hz by C105 and R112. R115 and C106 provide frequency compensation; R113 permits wider voltage swings with the MC1439G.

Performance evaluation of the delay line itself is not particularly easy, and the best test is simply the substitution of a delay line known to be good. Problems typical of the delay line include mechanical distortions, buzzing, scraping, etc. Sharp resonances and "flutter" also imply delay line problems.

A discussion of the pickup amplifier follows.

The output signal from the delay line is typically 1 mv rms and therefore requires great care in amplification in order to get a usable signal/noise ratio. The output is first stepped up with a transformer in order to match the optimal source impedance of the input transistor. The signal is then coupled through C109 to the base of Q103. R124, a low-noise metal film resistor, serves as the collector load for Q103. The collector of Q103 is direct-coupled to the base of Q104. R126 and R127 raise the voltage at the emitter of Q104 to the point where direct coupling is possible. C111 bypasses R126 and R127 to prevent loss of open-loop gain. The DC operating point for Q103 and Q104 is determined by a DC feedback loop from the junction of R126 and R127 to the base of Q103 through R122. There is essentially no voltage drop across R122 because of the miniscule (20 pa typical) base current through Q103. The junction of R126 and R127 is therefore held at the same voltage as the base of Q103, and the operating point is determined essentially by the base-emitter diode voltage of Q103.

R136 and C110 serve as a power supply filter for Q103.

AC feedback is provided from the collector of Q104 to the emitter of Q103 through C112, R130, C113, and R131. These networks serve to provide a controlled high-frequency rolloff with the necessary frequency contouring to broadly equalize the characteristics of the delay line and also to provide some of the high-frequency rolloff typical of real reverberation.

The output of the Q103/Q104 pair drives a passive RC bridge T notch filter. This filter is centered at 300 Hz and serves to correct broad delay line resonances in this area. The filter consists of R128, R129, C115, and C114. The required light loading for the notch filter is provided by emitter-follower Q105. Q105 in turn drives a passive RC 6 db/oct highpass filter with a breakpoint at about 100 Hz. This rolloff is necessary to reduce the effects of low-frequency spring noise as well as low-frequency roughness of spring response.

The ability to drive a 600 ohm load comes from emitter-follower Q106, which also provides the required light loading on highpass filter C116, R134, and R133.

It should be noted that the time constant of C109 and R122 is such that it requires about 40 seconds after the application of power supply voltage for the pickup amplifier to reach its proper DC operating point. This is necessary to achieve lowest possible noise.

Note too that the typical output level of the pickup amplifier is about -10 dbm with +4 dbm inputs.

The DC power supply is a dual polarity supply with active filtering. Output voltage should be about ±15 volts DC with less than 1.0 mv rms ripple. DC regulation is imperfect; the supply has been designed for maximum AC ripple rejection with minimum complication.

The unregulated supply is obtained from a bridge rectifier working with a grounded-center-tap secondary power transformer. The unregulated DC output voltage will vary between ±20 and ±24 volts depending on operating conditions.

An essentially ripple-free DC voltage is derived at the positive and negative regulators by means of a pair of capacitor/diode filters. These ripple-free voltages are then "amplified" by darlington emitter-followers to provide very low-impedance, low-ripple voltages for the rest of the circuitry.

A pair of zener diodes, CR 307 and CR308, are used to approximately fix the DC level of the filtered voltage. The filtered voltage will be about 1.5 volts below the zener voltage, although this figure is dependent upon both ambient temperature and load current.

RF Interference:

The O/P Reverb has been found to be subject to RF interference when operated in the immediate vicinity of powerful FM or VHF or UHF television transmitters. If this problem occurs, an effective solution in every case that we have encountered is to add a 100pf mica or ceramic capacitor between base and emitter of Q103. This should be done on the foil side of the PC board, and the leads of the capacitor should be cut as short as possible.

Servicing:

All servicing should be done by technicians thoroughly familiar with solid-state circuitry. It is recommended that any servicing of the limiter section be done at the factory. Under no circumstances should the trimmer controls be adjusted casually, since misadjustment can seriously damage the system. Factory service is available for any problem through the address given below. Before sending a unit back for service, be sure to write requesting return authorization, and describe the problem exactly in the letter. Many problems can be solved over the phone or by letter without necessity for actual return of the unit.

Guarantee:

The Orban Associates Division of the Kurt Orban Co., Inc., guarantees the Orban/Parasound Reverberation System against failures due to defective parts or workmanship for a period of one year after initial delivery to the customer. Orban Associates will repair the reverberation system during this time without charge for parts or labor. Shipping is not included in this warranty, and it is understood that if the customer chooses to have the repair performed by someone other than Orban Associates that labor charges will become the customer's responsibility. Orban Associates will replace any defective parts with new parts without charge during the warantee period, but will not provide cash reimbursement for parts that the customer has purchased from outside vendors. This guarantee may be voided if the reverberation system is subject to unusual physical or electrical abuse, is electrically or mechanically modified, or is operated contrary to the instructions in this manual.

Contact for Information:

Orban Associates Inc.
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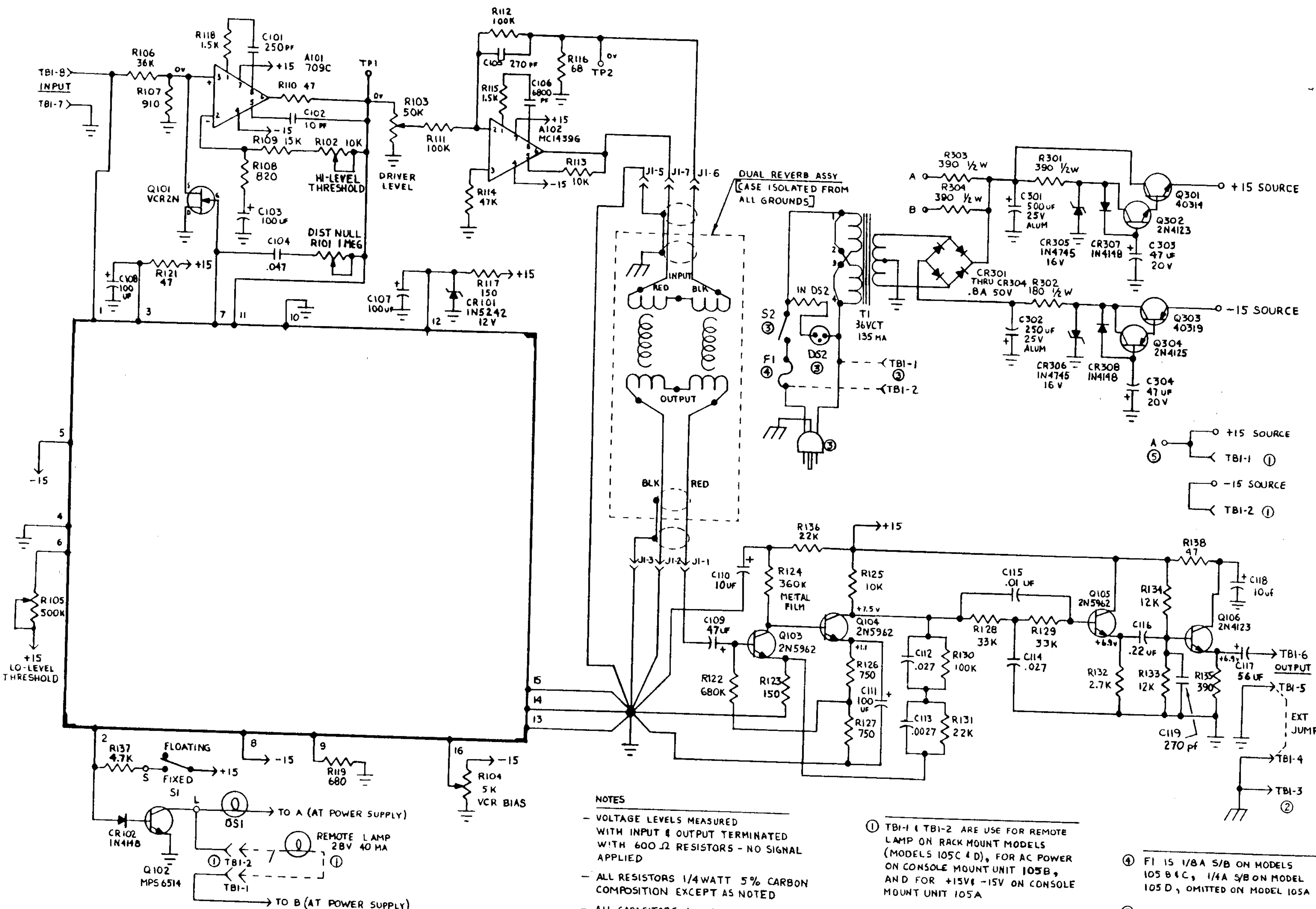
San Francisco, CA 94107



NOTES

- VOLTAGE LEVELS MEASURED WITH INPUT & OUTPUT TERMINATED WITH 600 Ω RESISTORS - NO SIGNAL APPLIED
- ALL RESISTORS 1/4 WATT 5% CARBON COMPOSITION EXCEPT AS NOTED
- ALL CAPACITORS 1 UF AND OVER ARE TANTALUM EXCEPT AS NOTED
- POWER SUPPLY OMITTED ON MODEL 105A

① TB1-1 & TB1-2 ARE USE FOR REMOTE LAMP ON RACK MOUNT MODELS (MODELS 105C & D), FOR AC POWER ON CONSOLE MOUNT UNIT 105B, AND FOR +15V & -15V ON CONSOLE MOUNT UNIT 105A

② TB1-3 CONNECTED TO ⏚ MODEL 105A ONLY FOR USE AS DC COMMON

③ S2, DS2 & POWER CORD ARE OMITTED ON CONSOLE MOUNT UNITS 105A & B

④ F1 IS 1/8A S/B ON MODELS 105 B & C, 1/4A S/B ON MODEL 105 D, OMITTED ON MODEL 105A

⑤ MODEL 105A ONLY

ORBAN/PARASOUND REVERBERATION SCHEMATIC MODELS 105A-D
DWG. 30004-00E