ORBAN / PARASOUND

REVERBERATION

MODEL 106 C

ORBAN/PARASOUND REVERBERATION

INSTRUCTION MANUAL

MODEL 106C

INDEX

REGISTRATION

The original purchaser of this unit should have received a registration card with this instruction manual. If that card has become misplaced or if the unit has been resold, the present owner may register his ownership with us for the purpose of enabling us to inform him of new applications, recommended modifications, news of new products, or other information that would be of interest to the owner of the 106C Reverberation.

If you have not returned the printed registration card, please send us a postcard stating your name, company, mailing address and zip, the model and serial number of your unit, and the date that you or your company purchased the unit.

If you were to also mention the nature of your business, the nature of your application for our product, why you selected it over others, and where you bought it, we would be most interested and grateful.

The return of this card in no way affects the validity of our warranty which applies only to the original purchaser.

EDITION 1: 2/1/74

ORBAN/PARASOUND products are represented worldwide by:

Parasound, Inc.
680 Beach Street, suite 495
San Francisco, California 94109

(415) 776-2808

Authorized distributors in major cities throughout the world.

INTRODUCTION

The original Orban/Parasound reverberation generators of the 105 series represented a significant advance in the price/performance ratio of artificial reverberation generators at the time of their introduction. The Model 106C which you have just purchased offers substantial refinements in versatility of application, ease of installation, and electrical performance, while retaining the distinctive sound quality which made the 105 series so successful.

The exceptional performance of the 106C is the result of the application of a number of subtle and sophisticated design techniques to the driving and pickup electronics. In order to use the 106C most successfully, these concepts should be understood.

The classical problems of spring reverberation systems have always been excessive noise and distortion in various forms. Orban/Parasound engineering has successfully minimized these problems by several interrelated design techniques:

--First, the spring driver coil is driven with a true constant-current source, synthesized with an IC opamp. This means that, compared with a conventional constant-voltage drive, there is a 6 dB/octave preemphasis above about 250 Hz due to the inductive nature of the drive coil. A complementary deemphasis in the pickup amplifier reduces both noise and distortion products. The pickup amplifier is elaborately equalized to compensate for broadband spring colorations and to simulate the coloration of a good live chamber. In addition, adjustable midrange peaking equalization is made available to the operator by means of front panel controls to use at his discretion.

--The pickup preamp uses an ultra-low-noise transistor in its input stage. This device is operated in the region of 1 dB noise factor and has been carefully matched to the pickup coil. The resulting low noise level means that it is possible to use the 106C in any mix, provided that the 106C is operated at the levels recommended in this manual.

--Four springs in parallel are employed in the delay line assembly in order to reduce effects of spring "flutter" to a negligible level. Internal hum shielding has been improved and the mounting configuration changed to permit swiveling on the mounting brackets to null out any residual hum pickup from external sources.

--The most novel feature of the 106C has been retained intact from its predecessor. This is the "floating threshold limiter" which helps control the characteristic spring "boing" sound caused by signals with sharp transients, like drums and guitars.

The limiter circuit is an advanced FET design. Harmonic distortion at high frequencies typically remains below 0.25% for any degree of limiting. Attack time is about 100 microseconds, and a dual release-time circuit is provided.

Like any other limiter circuit, this one tends to produce distortion on low-frequency material. Therefore, a switch is provided to defeat the envelope risetime limiting feature for use with instruments like organs. Even when this feature is defeated, a conventional peak limiter is provided which protects the spring driver amplifier from overload under an input overload of up to 25 dB, minimum. This is termed the "fixed" mode.

In the "floating" mode (where the envelope risetime is limited), application of an input signal that would tend to overload the spring driver amplifier will automatically switch the limiter into the "fixed" mode until the overload is removed. When the switching occurs, an LED on the front panel is illuminated to indicate that the output level of the reverb is no longer following the input level, but is being limited.

INSTALLATION -- MECHANICAL

The 106C is supplied in two assemblies: the electronics and the delay line (or spring assembly). These are interconnected by a six foot cable attached to the delay line assembly. This cable is terminated in a "ribbon"-type connector.

The electronics assembly mounts in a standard 19 inch rack and requires 1 3/4" of panel space. Four 10-32x3/8" mounting screws are provided. Be sure to measure the resistance from chassis to rack after installation and correct any high-resistance situations before proceeding. It may be necessary to scrape the paint from the rack and/or the rear of the panel to effect an adequate ground. It is advisable to make sure that the rack is grounded to some earth ground simultaneously. Grounding of racks and other equipment to power line conduit grounds as the sole means of grounding often creates troublesome problems.
In rack mounting the electronics, consideration should be given to strong magnetic fields nearby and to the proximity of heat-producing equipment. Ambient temperature should not exceed 45°C (113°F) when the electronics are powered and operating.

Input and output to the electronics appear on a Jones 140-type barrier strip on the rear apron of the chassis.

The delay line (spring assembly) is an electromechanical transducer and is somewhat sensitive to external magnetic and mechanical interference. It is approximately as sensitive to induced hum as a typical magnetic phono cartridge. It is recommended that the user experiment with various mounting locations, swiveling the unit for minimum hum, in order to obtain best performance.

Powerful acoustic fields should be avoided where the delay line is mounted. The unit should not be mounted close to monitors or on surfaces which would tend to intercept strong acoustic fields. Once a location is selected, a temporary installation should be effected to evaluate potential acoustic feedback or leakage under expected operating conditions. The unit may then be permanently mounted using the four #8x1/2" sheet-metal screws provided.

The case enclosing the springs is carefully insulated from its brackets in order to prevent casual grounding. If the unit is mounted on a conductive surface, check to make sure that the case has not become inadvertently shorted to the surface. The only ground to the case should be that provided through the cable; otherwise, severe ground loop hum may be introduced. In addition, make sure that the conductive surface itself is grounded. If it is not, it can pick up severe electrostatic fields which may cause hum pickup in the 106C.

After the delay line is mounted, the lever on the side of its case must be moved to the "unlocked" position in order to undamp the springs. THIS LEVER SHOULD BE MOVED TO THE "LOCKED" POSITION WHENEVER THE DELAY LINE IS DISMOUNTED OR MOVED! If this is not done, severe damage to the wiring or springs may result.

Then the cable should be plugged into the electronics. The return signal from the delay line is roughly at tape head level. Even though it is well-shielded, it should be dressed well away from AC wiring, transformers, etc., to minimize hum pickup. NOTE: Please do not attempt to shorten or lengthen the cable. To do so may degrade performance due to special techniques employed in the manufacture and assembly of the cable and to a certain sensitivity of the circuitry to cable capacitance changes.

A three-wire grounding line cord is installed on all units with a U.S. standard "U-ground" plug. Users in other countries may have to use an adapter or a replacement plug. Units modified to 220 volt 50 cycle operation will be shipped with the U.S. standard plug. A tag on the line cord warns of the modification.

INSTALLATION -- ELECTRICAL

Input:

The input to the 106C is unbalanced bridging with an input impedance of roughly 12K ohm. A nominal line level of -12 dBm is required. The unit limits at -6 dBm. This relatively high sensitivity has been made available for the convenience of users who will use the unit with semi-professional equipment which may not be able to supply +4 dBm levels. In any event, the source impedance driving the 106C should be 600 ohms or less.

Professional users who wish to drive the unit with a +4 dBm line can add a simple L-pad to the input, as shown in Fig. (1).

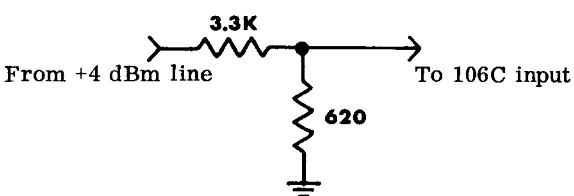


Figure 1 Pad for +4 dBm Input Level

Output:

Nominal output level of the 106C is +4 dBm, with a clipping level of approximately +20 dBm. The output is transformer-coupled, and is balanced and floating. IT IS ESSENTIAL TO TERMINATE THE OUTPUT WITH 600 OHMS IN ORDER TO ASSURE CORRECT GAIN AND FREQUENCY RESPONSE CHARACTERISTICS! In equipment with 600 ohm matching inputs, this termination is provided automatically by the input being driven. Most modern equipment provides much higher impedance bridging inputs. In this case, the terminating impedance must be provided by a 620 ohm 1/2 watt 5% resistor connected across the output. Such a resistor is supplied with every unit for your convenience.

Where the balanced output drives an unbalanced input, one side of the output line should be grounded at the input to the external equipment. A continuous shield ground is necessary between the two pieces of equipment.

Power:

The power transformer can be wired for 105-125 VAC or 210-250 VAC operation, 50 or 60 Hz. The nominal voltage for which the unit is wired is marked on the carton and on a tag affixed to the line cord.

To change line voltage: Remove the top cover. The primary transformer terminals are revealed by lifting the insulating cover. Strapping instructions are printed on the insulating cover. When altering the position of jumpers, take great care not to overheat or bend terminals. Do not rearrange the insulated wiring. The wiring for 115 VAC is indicated on the schematic, and the 230 VAC wiring can be easily deduced.

Grounding:

Chassis Ground: The power-cord ground (green wire) is connected directly to the chassis and to signal ground through a jumper between terminals 1 and 2 on the barrier strip. Whether or not to retain the connection between signal and chassis ground depends of the grounding configuration of the external system. Ground loops must be avoided, yet all parts of the system must be adequately grounded. The balanced output configuration is an aid to avoiding ground loops and RF pickup, but certain very difficult installations may benefit from the addition of an input transformer. This is particularly true where the unit is subject to high-intensity RF fields, as at a radio transmitter site.

Detailed information on system grounding technique is beyond the scope of this manual, but should be familiar to persons installing such systems. One standard reference on these techniques is The Audio Cyclopedia by H.M. Tremaine (Howard W. Sams & Co., Inc., Indianapolis; New York), section 24.

PERFORMANCE EVALUATION

The average purchaser is not likely to have the equipment necessary to thoroughly evaluate the electrical performance of the 106C. However, the ear will usually do a good job in detecting faults that develop -- particularly mechanical faults in the delay line that are virtually impossible to detect with conventional instrumentation.

In new installations, the most common problems are hum and acoustic feedback. An ideally installed unit will have, under no-signal conditions, an output noise consisting audibly of hiss and a small amount of low-frequency rumbling. There should be no hum or buzz. Hum can develop from mounting the delay line in an AC field, by grounding the case, by running the delay-line cable next to AC wiring, or by faults or ground loops in the connections to external equipment. Buzz can be caused by RF fields from transmitters, SCR dimmers, or diathermy machines. Buzz and hum problems can often be cured by reconsidering the external grounding scheme.

It is impossible to measure the noise level on a meter with flat frequency response because strong sub-audible spring microphonics of very low frequency will obscure the audible noise. In evaluating pickup amplifier noise, use a bandpass filter rolling off at 6 dB/octave above 18 kHz and at 12 dB/octave below 1 kHz. With such a filter, noise will typically measure -62 dBm.

To measure harmonic distortion, use a bandpass filter like the one described above on the input of the distortion meter. Choose a frequency between 1 and 2 kHz which provides a response peak at the output. Increase the input level until the "fixed" lamp just barely lights, and then back off 2 dB. With the midrange equalizer controls at "flat" (pot at "0"), total harmonic distortion will typically be 0.1 - 0.2%.

The frequency response consists normally of a large number of closely spaced peaks and dips. The ear is the most valuable tool in determining whether the frequency response is normal. If a pink noise source and a third-octave analyzer is available, the frequency response can be measured. It should extend from 100 to 5500 Hz with a smooth rolloff at the high end.

The limiter section must be evaluated with a sinewave oscillator, an AC VTVM/Distortion Analyzer, and an oscilloscope. To quickly verify proper operation of the limiter circuit: place the "fixed/floating" switch into the "floating" position, and observe the waveform at TP1 with a -25 dBm, 1 kHz input to the 106C. Suddenly switch the input level to -15 dBm. The level observed on the scope should not change instantaneously, but should have an observable risetime of about 100 to 200 milliseconds. This test checks the operation of the floating threshold circuitry.

Now, increase the level to 0 dBm. The front panel "fixed" lamp should light, and the level at TP1 should not rise more than 2 dB for a 25 dB increase in input level.

With an input of 10 kHz at 0 dBm, the total harmonic distortion can be measured at TP1. This should not exceed 0.5% and should typically be much less.

If the unit does not perform to these guidelines, a failure in some part of the circuitry is indicated. Unless someone has diddled the internal trimmer pots, it is exceedingly unlikely that the problem can be cured by simple realignment because the unit is extremely stable. Alignment instructions are, however, given in an appendix for the benefit of the technician who may have replaced a critical part that would change the alignment.

OPERATING INSTRUCTIONS

The 106C requires a 10 second stabilization period before it will pass signal. This is normal and is caused by the charging of a large capacitor in the pickup amplifier.

In a recording studio situation, the 106C should be treated like any echo chamber, with an echo send bus applied to the input, and with the output connected to an echo return input on the external mixer. No control of the ratio of direct to reverberated sound is provided in the 106C; this function must be supplied by external mixing facilities.

For best signal-to-noise ratio, the echo send bus or other input line should have a nominal level of -12 dBm (unless an input pad is used as in Fig. 1). If peak levels in excess of about -6 dBm are encountered, the internal limiter in the 106C will automatically switch to the "fixed" mode in order to protect the delay line driver amplifier from overload and clipping. This automatic mode switching is indicated by the illumination of the "fixed" lamp on the front panel.

If the envelope risetime limiter is defeated by switching the "floating/fixed" switch to "fixed", the "fixed" lamp will be on at all times. It is desirable to defeat the "floating" mode when this mode does not improve the sound, since the "fixed" mode provides a louder signal, thus improving the signal-to-noise ratio.

Typical instruments on which the "floating" mode would be used include electric bass, acoustic guitar, percussion, certain voices, and any other material containing sharp transients. Other instruments, like organ, strings, brass, reeds, etc., are best reverberated in the "fixed" mode.

There is often considerable advantage in reverberating separate instruments through separate reverberation generators, rather than using one reverb for all the echo. One can distinctly improve the clarity and control of the reverberated sound, and can also avoid certain intermodulation effects. The economy of the 106C makes the use of multiple chambers practical for many studios which formerly considered such techniques an unaffordable luxury.

The output of the 106C has been equalized to simulate a good live echo chamber. A supplementary equalizer has been provided which permits the operator to insert 0 to 11 dB of peak boost at any of four switch-selected midrange frequencies by means of controls on the front panel. This feature can be treated like a conventional equalizer. It is particularly useful in small studios with a shortage of equalizers and in broadcast installations where the reverb must be "tuned" to optimize the "punch" and perceived loudness of the station.

MAINTENANCE

Preventive Maintenance:

As the 106C is entirely solid-state, the only preventive maintenance necessary is keeping the unit physically clean, both inside and out. If the use of strong solvents is contemplated in cleaning the front panel, the effect of such solvents should be tested on the rear of the front panel to ascertain that they will not damage the finish of the panel.

The electronics are stable indefinitely and require no periodic alignment. Realignment may be necessary if components in the limiter/driver circuit are replaced (including the module), if the power supply regulator is replaced, or if someone diddles the trimmers. Alignment instructions are included as an appendix for the user who is both skilled in maintenance and possessed of the requisite equipment; otherwise, the unit may be returned to the factory under the procedure described in the section on Factory Service.

CIRCUIT DESCRIPTION
(with troubleshooting hints)

Limiter and Driver Circuit: The encapsulated module contains the control circuitry for the limiter and will not be described except as it interfaces external components, due to the proprietary nature of this circuit.

The input signal enters the limiter section through a voltage divider consisting of R106, R107, and Q101 which is an FET used as a variable resistor to control the attenuation of the voltage divider.

The module derives the DC control voltage (which is applied to Q101's gate in the voltage divider network) from information supplied by the input line and from the output of IC101. A fixed negative bias is applied to the gate of Q101 through R104 whenever no other control voltage is being generated. This results in Q101's being biased off, permitting minimum attenuation. As the module forces Q101's gate voltage more and more positive, Q101 gradually turns on, shunting signal away from IC101 and thus reducing gain.

Following the voltage divider, the signal is amplified by IC101, a 709C opamp. R118, R110, C101, and C102 control the frequency response of the opamp to assure stability. IC101 is operated in a non-inverting configuration with the feedback resistor being the sum of R109 and R102, and the input resistor being R108. Gain of the amplifier is adjusted with R102. For low offset, the DC gain is limited to unity by C103, which also controls the amplifier's low-frequency response. A portion of the output signal is fed back through R101 and C104 to the gate of Q101 to linearize Q101.

The module also controls the "fixed" lamp I1, which is switched by Q102. Current through the lamp is limited by R303.

The output of IC101 is passed through a gain control, R103, and then to the constant-current-source delay line driver, IC102. This opamp, operated in the inverting configuration, is frequency-compensated by R115 and C106. Current from the output of IC102 flows through the delay line driver coil and then through R116, generating a voltage across R116 proportional to the current through the coil. This voltage is fed back through R112 and C105. C105 rolls off the frequency response above 7 kHz to compensate for the fact that the driver coil's inductive reactance causes a 6 dB/octave rise in the voltage drive to the coil above about 250 Hz. If this rise were permitted to continue indefinitely, very small high-frequency inputs would cause IC102 to clip. R113 permits improvement in IC102's slew rate.

Pickup Amplifier Circuit: The signal from the delay line is amplified by the direct-coupled feedback pair Q103 and Q104, which are biased for minimum noise. The signal enters the base of Q103 through the DC blocking capacitor C109. R124 is a low-noise metalfilm resistor that serves as a collector load for Q103. R136 and C110 filter the power supply voltage going to Q103. The collector of Q103 is directly coupled to the base of Q104. R125 is Q104's collector load. The emitter resistor of Q104 is divided into two parts, R126 and R127. The junction of R126 and R127 remains at about 0.55 volts -- Q103's nominal base-emitter voltage -- when Q104 is biased for maximum undistorted voltage swing. A change in the operating point of Q104 will be reflected around the loop consisting of the two transistors and R122, which provides the base bias current for Q103. This feedback is negative, and therefore stabilizes the operating current of Q104. C111 bypasses R126 and R127 to prevent feedback of audio frequencies around the DC loop.

The AC feedback, which determines the frequency response and gain of the Q103/Q104 pair, is provided by the network consisting of C112, C113, R130, R131, and R123. The feedback is negative between the collector of Q104 and the emitter of Q103. The feedback establishes a high input impedance at the base of Q103, and also provides a dual-time-constant high-frequency rolloff, similar in shape to the RIAA phono playback curve (although with different characteristic frequencies).

C120 is a DC blocking capacitor. It couples the Q103/Q104 amplifier to a passive bridge-tee notch filter consisting of R128, R129, C114, and C115.

IC103b is a non-inverting amplifier with 26 dB gain which also serves as an adjustable active equalizer. R134 is its feedback resistor; R140 is its input resistor; C121 rolls off the gain below 100 Hz. Bias current for IC103b flows through R139.

R140, the input resistor, can be bypassed to a variable extent by the series resonant circuit consisting of L1, R135, and C116-119. This circuit exhibits a minimum impedance at a certain frequency, and increasing impedance at higher and lower frequencies. R140 is therefore bypassed in a frequency-dependent manner. This changes the negative feedback around IC103b in a frequency-dependent manner, and this results in the availability of peak equalization at the resonant frequency of the series-resonant circuit.

The output of IC103b drives the unity-gain inverting amplifier IC103a. These amplifiers drive the primary of the output transformer in a full-bridge configuration: the opposite ends of the primary of T2 are driven by equal but opposite-polarity voltages, thus increasing the output capability of the circuit. T2 is connected as a 2:1 stepdown transformer, and can deliver +20 dBm into 600 ohms.

IC103 is a Raytheon RC4558DN and must be replaced with an exact replacement. A 1558-type device is <u>not</u> satisfactory.

<u>Power Supply:</u> The AC line can be connected to the power transformer for either 115 or 230 VAC operation by jumpering several lugs according to the installation instructions.

The center-tapped secondary voltage is rectified by two full-wave rectifier pairs, CR301-304 which work into the main energy storage capacitors C301 and C302 to provide nominal unregulated DC voltages of + and - 24 volts DC. These voltages will vary considerably with changes in line voltage and load current.

A voltage regulator, IC301, provides the + and - 15 VDC regulated sources. C303 and C304 bypass high-frequency noise and ripple at IC301's output, and also serve to frequency-compensate IC301.

IC301 provides complete internal protection against failure due to overheating or excessive output current. The device will shut down automatically if its current or thermal limits are exceeded until such overloads have been removed. Therefore, absence of regulated voltages does not necessarily mean that the regulator has failed. Possible causes of excessive current demand should be investigated before replacing the regulator.

The output voltage of IC301 under normal load conditions should be within 0.5 volt of the nominal 15 volts, and the difference between the absolute values of the positive and negative voltages should be less than 0.3 volts. If the absolute value of either output voltage rises above 15.5 volts, it can be assumed that IC301 is defective unless pin 2 has become ungrounded for some reason.

Typical ripple is about 0.7 millivolts rms when measured through a 30-18,000 Hz bandpass filter (Fig.2). Ripple dramatically in excess of this value implies a defective IC301.

If replacement of IC301 is ever required, a Raytheon RC4195T should be employed. Be sure to reinstall the finned heatsink using a small amount of heatsink compound, Dow DC-340 or equivalent. Realignment would be indicated -- see Appendix.

<u>Delay Line:</u> The delay line is a conventional spring reverberation device. An electrodynamic drive coil provides torsional excitation of the spring. The torsional waves travel to opposite ends of the spring. Most of the energy is reflected; a small amount is absorbed by an electrodynamic pickup transducer. The reflected energy is reflected off the input end and then returns to the pickup, bouncing back and forth and slowly decaying. In this way, the time delays and exponential decay of natural reverberation are simulated.

The signal energy detected is returned to the electronics chassis to be amplified and equalized.

There are four springs, each with a slightly different delay period averaging around 30 milliseconds. The use of multiple springs helps avoid the characteristic flutter of a single spring caused by its single delay time.

If a defect in the delay line seems audible, the best test is to compare its performance with a delay line known to be good. Subtle defects in the delay line are unusual. Rough handling may result in the unhooking of springs from their mounts, or breaks in the delicate interwiring. Shipping the unit without the lock in place often causes such problems.

The service technician should use great caution in opening the spring case for examination. The locking lever should be unlocked and eight screws removed. The two halves of the case may then be parted bearing in mind that they are interconnected with rather fine wire. It may be necessary to slide the upper half of the case sideways to avoid the end flange's catching on the spring assemblies, which are suspending on small mounting springs inside the case.

FACTORY SERVICE

Factory service is available throughout its life from the address below. During the warranty period no charge will be made for parts or labor, subject to the warranty conditions. After expiration of the warranty, a reasonable charge will be made for parts, labor, and packing. In any event, transportation charges (which are usually quite nominal) shall fall on the customer.

Before returning any unit for repair, please write or telephone for instructions, stating the trouble experienced. Often a problem can be solved by consultation, saving everyone the delay, inconvenience, and expense of actually returning the unit.

SHIPPING INSTRUCTIONS

Before packing the spring, make sure that the locking lever is moved to the "locked" position. Otherwise, damage to the delicate springs is probable and the warranty is voided.

If the original packing material is available, it should be employed. Otherwise, a carton of at least 200 lb. bursting test should be obtained which is no smaller than 22 x 10 x 9 inches.

The two assemblies should be packed so that there is at least 1 1/2" of packing material protecting every point.

Cushioning material such as Air-Cap, Bubble-Pak, foam "popcorn", or fiber blankets are acceptable. Folded newspaper is not suitable.

Blanket-type materials should be tightly wrapped around the assemblies and taped into place to prevent the units from shifting out of their packing and contacting each other or the walls of the carton.

The carton should be packed evenly and fully with the packing material filling all voids such that the units cannot shift in the carton. Test for this by closing but not sealing the carton and shaking it vigorously. If the units can be heard or felt moving, use more packing.

The carton should be well-sealed with 3" reinforced sealing tape applied across the top and bottom of the box in an "H" pattern. Narrower or parcel-post type tapes will not withstand the stresses applied to commercial shipments.

The package should be marked with the name of the shipper and the words, in red, DELICATE INSTRUMENTS, FRAGILE!

Even so, the freight people will throw the box around as if it were filled with junk. So, use care in packing.

WARRANTY

The Orban Associates Division of the Kurt Orban Company, Inc. guarantees the Orban/Parasound model 106C against failures due to defective parts or faulty workmanship for a period of one year after delivery to the original customer as evidenced by the invoice date. Orban Associates Division will repair the 106C during this period without charge for parts or labor, but not including shipping. Repairs effected by others are not included in this warranty, except that defective parts will be replaced upon presentation and verification of allegedly defective parts.

Claims under this warranty must be accompanied by a copy of the customer's invoice showing the date of purchase and the serial number.

This warranty shall be voidable by Orban Associates Division if the 106C is subjected to physical or electrical abuse, is electrically or mechanically modified without written permission, or is operated contrary to the instructions in this manual.

APPENDIX: ALIGNMENT INSTRUCTIONS

The 106C DOES NOT require periodic alignment. The only time alignment should be attempted is when a part has been replaced in the driver circuitry, or when the power supply regulator, IC301, is replaced.

Equipment Required:

DC voltmeter, 20,000 ohms/volt or VTVM
Low-distortion audio oscillator
(Heath IG-72, Eico 378)
AC VTVM and harmonic distortion analyzer
(HP 333A)
Oscilloscope
Bandpass filter, 30-18,000 Hz (Fig. 2)

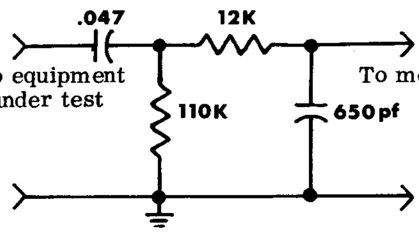


Figure 2   30-18,000 Hz Bandpass Filter

1. Connect oscillator to input of 106C. Connect distortion meter to TP1 through bandpass filter. Connect scope to output of distortion meter. Connect DC voltmeter to read (negative) DC voltage between ground and wiper of R104. See Fig. (3) for trimmer locations.

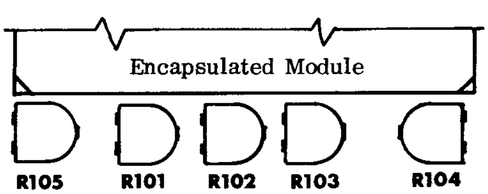


Figure 3   Trimmer Location

2. Apply a 100 Hz -20 dBm signal to input of 106C. Set mode switch to "fixed". Adjust R104 until the signal level at TP1 just starts to decrease. Note the voltage reading on the DC voltmeter. Adjust R104 further until the reading is 0.3 volts more negative than the previous reading. Remove the DC voltmeter from the circuit.

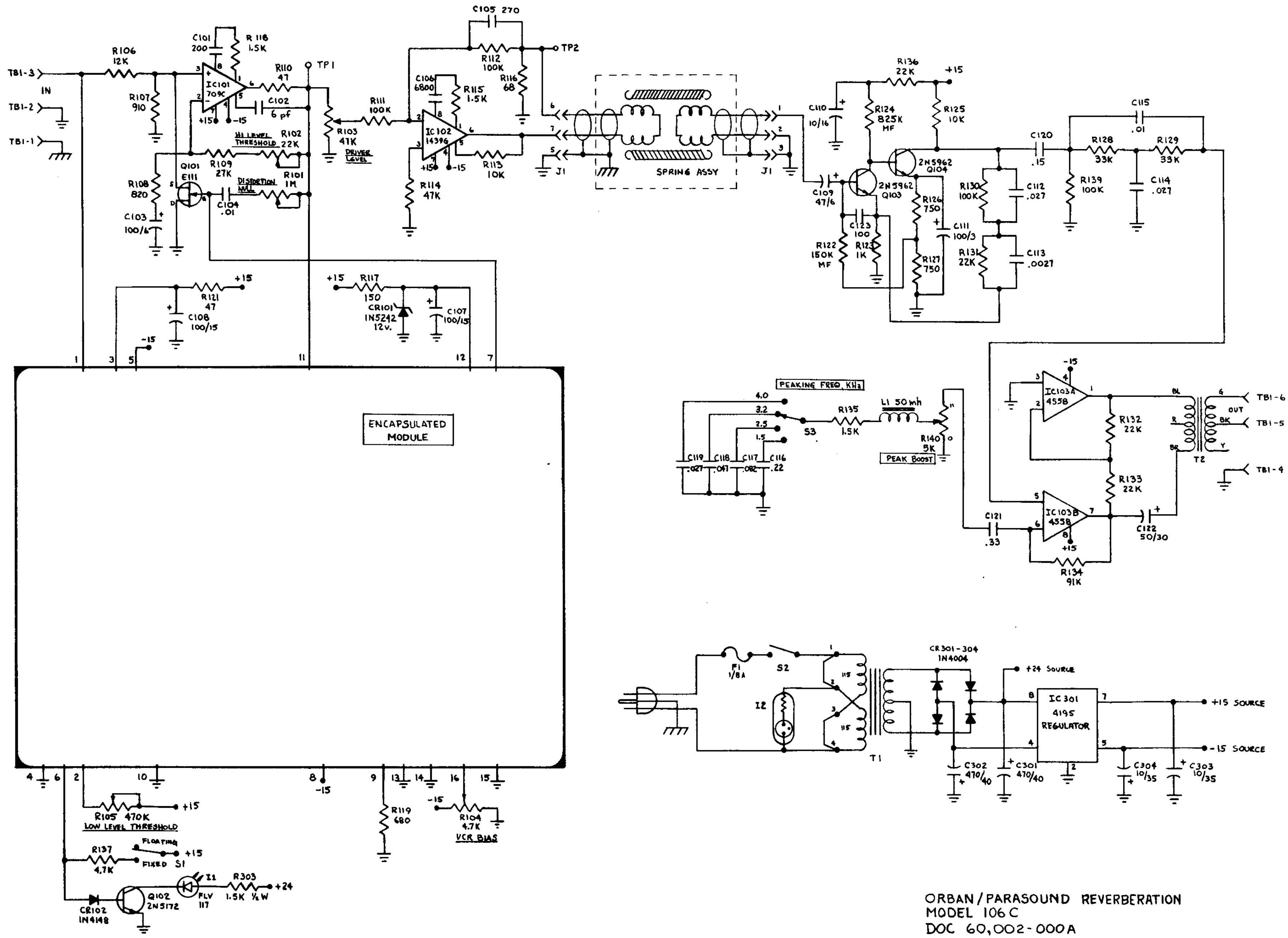
3. Set reverb mode switch to "floating". Increase output of oscillator until "fixed" lamp just starts to light. Back off oscillator output 2 dB. Measure harmonic distortion at TP1 and observe distortion waveform (output of distortion analyzer) on scope. Adjust R105 full clockwise. Adjust R102 until sawtooth component of distortion waveform just barely vanishes. WARNING: UNDER NO CIRCUMSTANCES ADJUST R105 WITHIN 1/10 TURN OF FULL COUNTER-CLOCKWISE. SERIOUS DAMAGE TO THE CIRCUITRY WILL RESULT!

4. Slowly reduce the output of the oscillator to zero, while observing the distortion waveform. If the sawtooth component reappears, trim R105 until it just vanishes, noting warning above. Make sure sawtooth cannot be observed for any level between zero and two dB below the onset of the "fixed" lamp.

5. Remove the bandpass filter from the circuit. Change the oscillator to 10 kHz at 0 dBm. The "fixed" lamp should light. Measure the harmonic distortion at TP1. Adjust R101 to null the distortion. The distortion should be less than 0.5%.

6. Connect the AC VTVM/distortion analyzer to TP2. Adjust oscillator for 5 kHz at +20 dBm. Adjust R103 until the waveform at TP2 is unclipped. This will be approximately 0.30 volts rms as read on the AC VTVM.

This completes the alignment procedure.



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