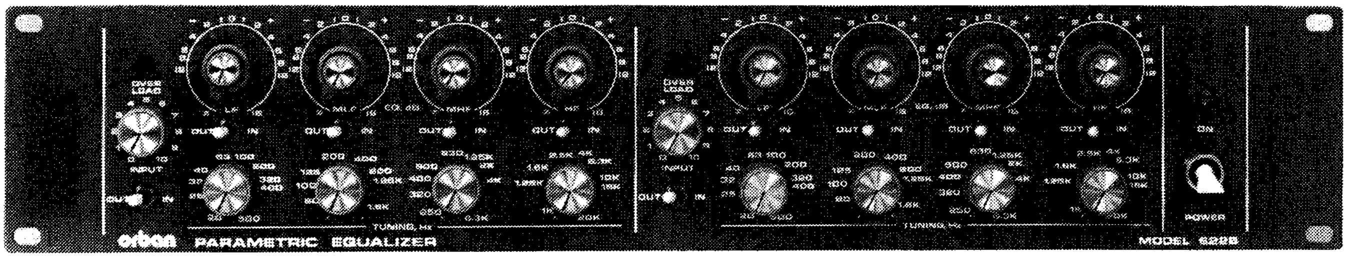
622 Parametric Equalizer

OPERATING MANUAL

orban



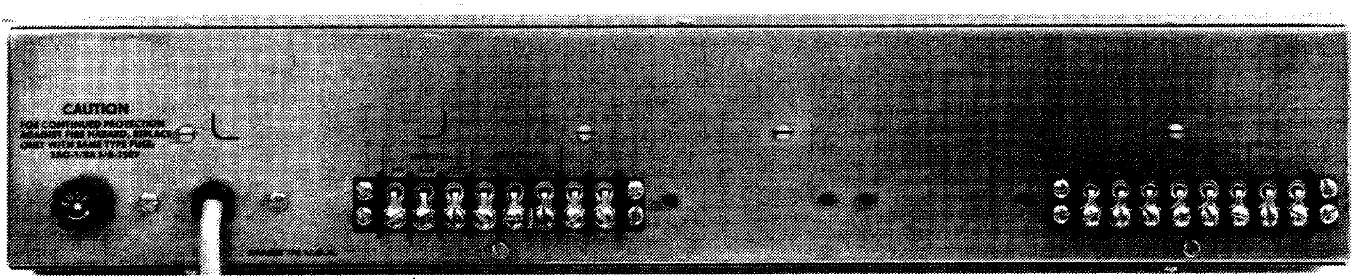
Performance Specifications

Specifications apply to each channel except as noted. All specifications apply when equalizer drives 600 ohm or higher impedances. All noise specifications assume a 20-20,000 Hz bandpass filter with 18 dB/octave Butterworth skirts.

Operating Controls: EQUALIZATION, EQUALIZATION IN/OUT, BANDWIDTH, and TUNING for each of four bands. MASTER EQUALIZATION IN/OUT, GAIN, POWER ON/OFF.
Frequency Response: (EQ controls set mechanically flat) ±0.25 dB, 20-20,000 Hz.
Available Gain: + 12 dB, adjustable to -∞ by means of front-panel GAIN control.
Input: (RF suppressed)
- Impedance: (each leg) 100K in parallel with 1000pF, electronically balanced. Driving impedance should be 600 ohms or less.
- Absolute Overload Point: + 26dBm.

Output: (RF suppressed)
- Level: greater than + 19 dBm into 600 ohms, 20-20,000 Hz
- Impedance: 47 ohms in parallel with 1000pF, unbalanced. (Option 01 provides a transformer-balanced output for both channels)
- Equalizer is unconditionally stable and will not ring with any captive load.

Risetime: less than 4 microseconds.
Slew Rate: greater than 6 V/microsecond. Internal bandlimiting assures that slew rate limiting will not occur with even the most severe equalization and program material.
Square Wave Response: Square wave exhibits no spurious ringing at any output level. The only ringing observable is that theoretically associated with any given equalization curve.
Circuitry: active RC, utilizing FET-input IC opamps. The output line driver utilizes a discrete transistor current booster.
Total Harmonic Distortion (+ 18 dBm output): less than 0.025%, 20-20,000 Hz. Typically less than 0.002% at 1kHz, + 18 dBm.
SMPTE Intermodulation Distortion: Typically 0.008% at + 18 dBm equivalent peak output, using 60 Hz/7 kHz; 4:1.
Noise: At Output, GAIN control adjusted for unity gain, all EQ switches IN, all EQ controls FLAT: Less than -84 dBm; -87 dBm typical.
Overload-to-noise Ratio of Single Parametric Bandpass Filter: greater than 102 dB for any combination of TUNING and BANDWIDTH settings.
Interchannel Crosstalk, 622B dual-channel equalizer: less than -90 dB, 20-20,000 Hz.
Equalization Characteristics: Figure 1 shows curves corresponding to the maximum and minimum bandwidths for each band. DB equalization contributions of the individual bands add without interaction. BANDWIDTH, TUNING, and EQUALIZATION controls are all continuously variable.
Range of Adjustment of "Q": 0.29 to 3.2.
Range of Adjustment of Peak Equalization: + 16 dB to -∞ . Typical notch depth obtainable is 40 dB.
Tuning Range (per band): 20-500 Hz, 68-1700 Hz, 240-5850 Hz, 800-20,000 Hz. Tuning dials are calibrated at ISO preferred frequencies.
Power Requirements: 115/230 volt 50-60 Hz AC, approximately 4 watts (622A), 7 watts (622B). Captive "U-Ground" power cord. Option 02 eliminates the AC power supply. Power requirements for the Option 02 version are ± 18 to 28 volts DC at 60 ma per equalizer channel. Option 02 is supplied on special order only, and is recommended only for users planning to install a large number of 622 channels in a given installation.
Overload Lamp: will light for approximately 200 mS if the instantaneous peak output of any amplifier in the equalizer is driven within 1 dB of its clipping point.
Size: 19" (48.3 cm) wide x 3.5" (8.9 cm) high x 5.2" (13.3 cm) deep.
Shipping Weight: 10 lbs. (4.5 kg).



orban

1525 Alvarado Street, San Leandro, CA 94577 USA
Phone: (1) 510/351-3500; Fax: (1) 510/351-0500; E-Mail: custserv@orban.com; Site: www.orban.com

P/N: 95013.000.10

Table of Contents

REGISTRATION CARD

The original purchaser should have received a postpaid Registration Card packed with this manual.

Registration is of benefit to you because it enables us to tell you of new applications, possible performance improvements, service aids, etc., which may be developed over the life of the product. It also provides us with the date of sale so that we may more promptly respond to possible claims under Warranty in the future (without having to request a copy of your Bill of Sale or other proof of purchase).

Please fill in the Registration Card and return it to us.

If the Registration Card has become lost or you have purchased the unit used, please photocopy the image of the card reproduced below and send it to us in an envelope. Use the address shown on the title page.

Model # ______________________ Serial # ______________

Name or Title ______________________

Organization ______________________

Street ______________________

City/State/Country ______________________

Zip or Mail Code ______________________

Purchased from ______________ City __________ Date of Purchase ________

Nature of your application ______________________

How did you hear about it? ______________________

Comments: ______________________

____

Fig. I: REGISTRATION CARD

WARRANTY

The Warranty, which applies only to the first end-user of record, is stated on the Warranty Certificate on a separate sheet packed with this manual. Save it for future reference.

Details on obtaining factory service are provided in **Part C.**

Part A: Installation and Operation

INTRODUCTION

The Orban 622A/B are parametric equalizers of high professional quality. The 622A is a single-channel equalizer; the 622B is a dual-channel equalizer. Each channel contains four parametric equalization bands.

Isolation of the two channels in the 622B is extremely high (greater than -90dB, 20-20,000Hz). Therefore, each channel may be used independently without danger of audible crosstalk.

The 622 is equipped with rotary-type EQ controls providing up to 16dB of boost and better than 40dB of cut. The controls are non-reciprocal, providing musically useful "constant-Q" characteristics, and permitting the equalizer to be used as a notch filter. The center frequency and bandwidth of each band are continuously variable to enable precise control of the audio spectrum.

Each channel of the 622 has an electronically-balanced bridging input and an unbalanced output which can be balanced by the addition of an optional output transformer. Input, output, and power line connections all contain effective RF filtering. 12dB of gain is available. All potential overload points in the equalizer are monitored by an extremely fast "peak-stretching" overload detector, so that peak clipping can be detected and corrected before it becomes audible.

The flexibility offered by the 622 makes it a particularly powerful tool in nearly all areas of audio: sound reinforcement, public address, recording studio, broadcasting, motion picture sound, dance bars (discos), theater...

The 622 easily meets the quality, performance, and reliability requirements of the demanding professional, and is also well-suited for use in semi-pro or audiophile applications.

The controls and features of the 622 are fully described in this manual. It will familiarize you with the unit's potential and enable you to imaginatively use the 622 for your specific installation and application.

PERFORMANCE HIGHLIGHTS

EQ Section

-- Four bands, each with TUNING and BANDWIDTH control

-- True parametric operation: non-interacting control over all three equalization parameters

-- +16dB, -infinity equalization range

-- "Constant-Q" curves

-- Each band tunes over 25:1 frequency range

-- "Q" is variable between 0.29 and 3.2

-- Bands are totally non-interacting

-- In/out switches for each equalizer band

-- Circuitry highly resistant to performance deterioration caused by control wear

General

-- 12dB available gain

-- Very low noise and distortion

-- High slew rate for minimum TIM (SID)

-- "Peak-stretching" overload lamp warns of clipping anywhere in equalizer before distortion is audible

-- Industrial-grade parts and construction

-- Extremely easy service access

-- RFI suppression on input, output, and power leads

-- Balanced output optional (order retrofit kit as required)

FRONT PANEL DESCRIPTION

The INPUT control adjusts the drive level to the equalizers.

The OVERLOAD indicator monitors all critical points to warn of excessive signal amplitude due to excessive input amplitude or to large amounts of peak boost equalization. It indicates peak clipping substantially before any audible effects are perceived. Overloads are eliminated by turning down the INPUT control.

The CHANNEL EQ IN/OUT switch defeats the entire EQ section, but retains the input buffer and output amplifier so that no gain changes (other than those associated with large amounts of equalization) occur. In the OUT position, the OVERLOAD LAMP will still operate as if full equalization were occurring. Input/output polarity is constant regardless of the position of this switch.

The BAND EQ IN/OUT switches defeat the equalization action of a given equalizer band by disconnecting the output of the bandpass resonator from its summing amplifier. Putting unused bands in the OUT position will eliminate any noise contribution from the resonators and will assure accurate flat response.

The EQ controls adjust the maximum peak or dip in each band over a range of +16dB, -infinity dB.

The TUNING controls adjust the center frequency of each of the four bands, and have a typical calibration accuracy of ±1/3 octave.

The BANDWIDTH controls adjust the "Q" (sharpness) of each band. The "Q" becomes broader when turned clockwise; sharper when turned counterclockwise. Calibration tolerance is typically ±10% of the nominal "Q" value.

REAR PANEL DESCRIPTION

The FUSE used in the 622 is a 3AG slo-blo type: 1/8 amp for either 115V or 230V operation. Replace with the same type only.

The INPUT and OUTPUT connectors provided allow connection via barrier strip (#5 screw).

AC POWER

The power transformer can be strapped for 115 volt or 230 volt 50 or 60Hz AC operation. If the unit was ordered for 230 volts, a tag on the power cord warns of the modification.

The two primary windings of the power transformer are connected in parallel for 115 volt operation, and in series for 230 volt operation. (See the **Schematic Diagram** at the back of this manual.)

To strap the power transformer for a different voltage, remove the top cover of the 622. Strapping instructions are found on the insulating fishpaper around the power tranformer. It is not necessary to rearrange the heavy insulated wiring; all strapping can be performed with bare jumper wire. Take care not to burn the insulation.

The power cord is terminated in a "U-Ground" plug to USA standards. The green (or green/yellow) wire (which is connected to the long prong) is connected directly to the 622 chassis. If it becomes necessary to lift this ground to suppress ground loops, this should be done with a three-prong to two-prong adapter plug, rather than by damaging the power plug. It is not recommended that this ground be defeated unless absolutely necessary because it eliminates the intrinsic safety feature of the three-wire system.

WARNING!

IF THE GROUND IS DEFEATED, CERTAIN FAULT CONDITIONS IN THE UNIT OR THE SYSTEM TO WHICH IT IS CONNECTED CAN RESULT IN APPEARANCE OF FULL LINE VOLTAGE BETWEEN CHASSIS AND EARTH GROUND. SUCH VOLTAGE IS CAPABLE OF CAUSING SEVERE INJURY OR DEATH!

MECHANICAL INSTALLATION

Vertical space of two standard rack units (3 1/2"/8.9cm) is required.

Mounting the unit directly over large heat-producing devices like a vacuum-tube power amplifier may shorten component life and is not recommended. Ambient temperature should not exceed 113 degrees F (45 degrees C) when equipment is powered.

Balanced Output Transformer Installation: If transformers were not installed at the factory, refer to the installation instructions furnished with the transformer retrofit kit, available directly from Orban. The transformers supplied with this kit have been designed to have a negligible effect on published specifications. Should you wish to use some other transformers, it would be wise to make careful performance measurements with special attention to LF distortion and HF response at high output levels, thus determining the output level achievable with performance acceptable for your application. A transformer meeting Orban standards should produce approximately +20dBm (limited by clipping in the output amplifier) without significantly compromising performance.

The **Electrical Installation** section describes grounding procedures in the event transformers are used.

ELECTRICAL INSTALLATION

Connecting the 622 Equalizer to other equipment is quite straightforward. Relatively uncomplicated systems (such as home playback systems, "semi-pro" recording studios, electronic music studios, dance bars, etc.) tend to come together without serious grounding problems even if the wiring practices are somewhat casual, provided that high RF fields are not present. Unusual situations can be analyzed if you are familiar with the standard rules governing grounding and interfacing between balanced and unbalanced systems.

The instructions below will apply to the majority of cases. A comprehensive discussion of interconnections and grounding can be found in the **Appendix.**

Input

The electronically-balanced input of each channel of the 622 equalizer is compatible with most professional and semi-professional sound equipment, balanced or unbalanced, whose source impedance is 600 ohms or less. If it is greater (as in some vacuum-tube audiophile preamps), a minor modification may be made to the input to accomodate the situation. Please refer to the **Appendix** for further details.

Nominal input level is between -10 and +4dBm. The absolute overload point is +26dBm.

Output

The two outputs of each channel of the 622 are unbalanced (unless fitted with the optional transformers), and the source impedance is 47 ohms in parallel with 1000pF to the chassis (for RFI suppression).

Wiring the 622 With Two-Conductor Shielded Cable

We recommend wiring with two-conductor shielded cable (such as Belden 8451 or equivalent) because signal current flows through the two conductors only. The shield does not carry signal, is used only for shielding, and is ordinarily connected to ground at one end only. The following table and diagram are applicable to a great majority of installations.

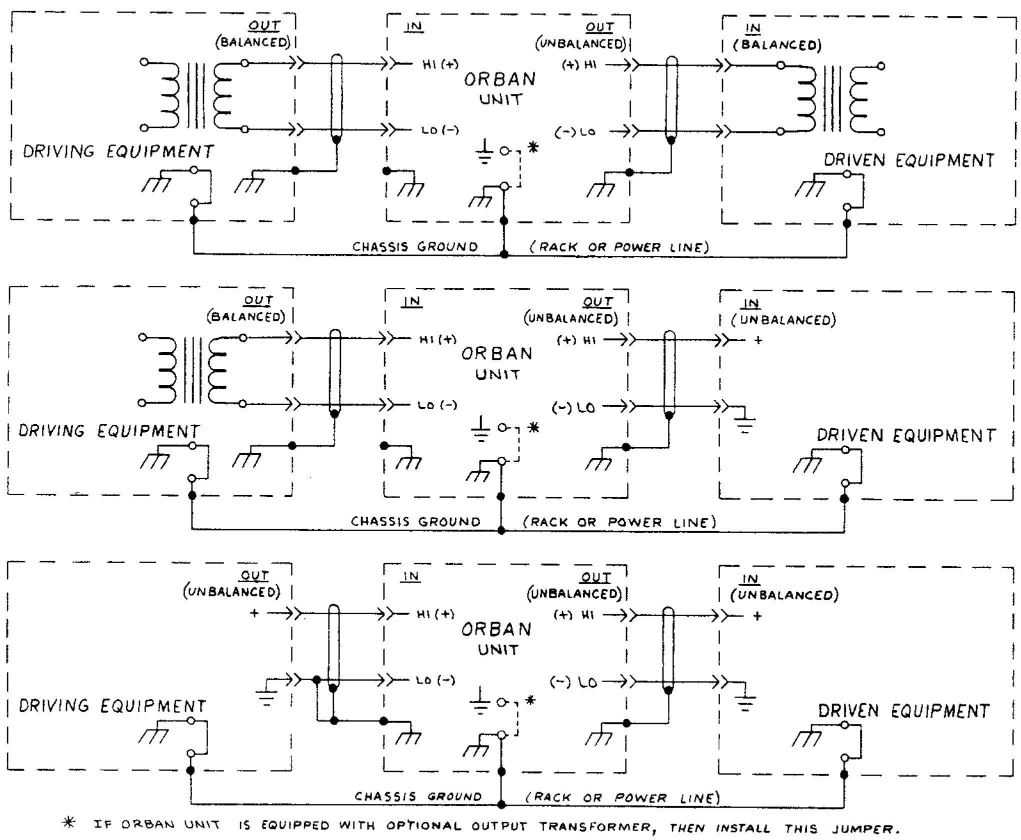


Fig. 3: GROUNDING

TABLE I:
TYPICAL INPUT/OUTPUT CONNECTION RULES

INPUT

Always use "+" and "-" as the two input terminals to the 622.

When the 622 is driven from an unbalanced source, connect shield both to circuit ground of source, and to chassis ground of 622.

When the 622 is driven from a balanced source, connect shield at source end to chassis ground. Do not connect shield at 622 end.

OUTPUT

On the 622 output, connect shield at 622 end to chassis ground (whether driving balanced or unbalanced). Do not connect shield at other end.

When driving a balanced load, jumper circuit ground to chassis ground on 622 (on rear panel). When driving an unbalanced load, do not attach jumper.

622 chassis should always be earth-grounded (i.e. through third wire in power cord or through rack.) For maximum protection from shock, float this ground only as last resort.

If optional output transformer(s) are installed on 622, jumper the circuit ground to chassis ground on the 622.

Because it is not always possible to determine if the pieces of equipment driving or being driven by the 622 have their circuit grounds internally connected to their chassis grounds (which are always connected to the ground prong of the AC line cord), and because the use of the AC power line ground often introduces problems because it can be noisy or otherwise imperfect, the wiring techniques in the diagram are not universally applicable.

If you follow the diagram and hum or noise appears, don't be afraid to experiment. If the noise sounds like a low-level crackling buzz, then probably there isn't enough grounding. Try connecting the "-" input of the 622 to a chassis ground terminal on the 622's barrier strip and see if the buzz goes away. You can also try strapping the 622's chassis and circuit grounds together, and see if this helps.

A ground loop usually sounds like a smooth, steady hum rather than a crackly buzz. If you have a ground loop, you can often break it by disconnecting the jumper between circuit and chassis grounds on the 622's rear-panel barrier strip. In either case, think carefully about what is going on, and keep in mind the general principle: one and only one circuit ground path should exist between each piece of equipment! (Bear in mind that the circuit grounds of the two channels of a 622B are connected together internally, and could conceivably introduce a ground loop if you do not take this connection into account in planning your wiring.)

OPERATING INSTRUCTIONS

The operating controls of the 622 have been configured to permit easy, intuitive adjustment. The EQ and BANDWIDTH controls are concentric; the EQ control protrudes further from the front panel. The TUNING control for each band is located below its associated EQ and BANDWIDTH controls.

To provide best value, the 622 uses controls of high reliability but modest calibration accuracy. Calibrations are approximate, and are intended primarily as reference guides. Accurately defeating the equalization in a given band is best done with the BAND IN/OUT switch. When operating with narrow bandwidths, accurate stereophonic matching of several 622 channels on the basis on panel calibrations alone is impractical. However, if the BANDWIDTH controls are set on, or more clockwise than, "5", then no problems will occur. (See the subsection on **Stereo Matching** in **Part** B for matching instructions.)

Using the EQ Sections

To use the EQ section, switch the CHANNEL EQ section switch IN, and switch IN the BAND EQ switch for each band you wish to use.

For those who have never used a Parametric Equalizer before, the easiest way to become familiar with the 622 is to center the TUNING controls, and adjust the BANDWIDTH controls to "6". The 622 will now behave like an ordinary "four-knob" console channel equalizer. Once you have gotten the "feel" of the 622 in this mode, try experimenting with the TUNING and BANDWIDTH controls to see how they affect the sound.

When you boost the EQ, discover the subtle shelving effects available from broadband peaking (BANDWIDTH control close to full clockwise; EQ control clockwise of "0"). Contrast this with the "ringy", colored quality of setting the BANDWIDTH control toward narrow (ccw).

When you cut the EQ observe the effects you now achieve. Narrowband dips are essentially inaudible, but permit suppressing sounds of fixed frequency (like hum), typically better than 40dB in each band. (If the sound to be suppressed is rich in harmonics, use one band per dominant harmonic.)

The EQ curves are not reciprocal: boost provides a wider bandwidth than cut because of the "Constant-Q" configuration of the equalizer. Experience has shown this curve family to be more musically useful than the more common "reciprocal" curves. The "Constant-Q" family also permits infinite-depth (in practice, greater than 40dB) notches to be created which are highly useful for eliminating hum or other interference of fixed pitch.

Specified "Q" range for any setting of the TUNING control is 0.29 to 3.2. When varying the BANDWIDTH control, the peak gain remains constant while the skirts of the curve vary.

Despite the non-reciprocal nature of the "Constant-Q" curves, a given amount of EQ (in recording a track, for example) can be precisely cancelled later by passing the track through the equalizer with all TUNING controls set as they were during the original recording, with all EQ controls set equal but opposite to their original settings, and with the BANDWIDTH controls readjusted (by ear) to provide a curve which is reciprocal to the one used to make the recording. If a boost is to be cancelled, use a broader "Q" setting (more clockwise); if a cut is to be cancelled, the converse is true. When the BANDWIDTH control is correctly adjusted, such a curve will be precisely reciprocal to the original.

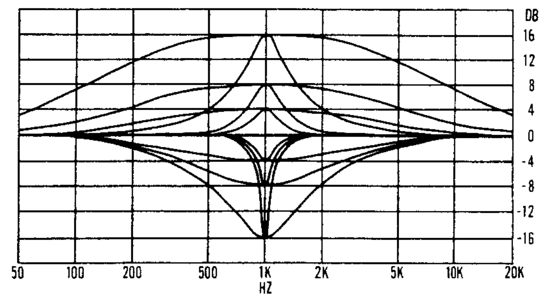


Fig. 3: CONSTANT-Q CURVE FAMILY

More boost or cut can be achieved by tuning adjacent bands to the same frequency. Typically, -80dB of cut (which is seldom more useful than the -40dB cut provided by a single band), and +32dB of boost are then available. But beware of overload and noise buildup when boosting!

While in the narrowband boost mode, a band's TUNING control can be continuously swept to give a sound similar to "phasing".

Notes On Headroom

The overload-to-noise ratio available from the 622 is typically 105dB, and depends somewhat on the settings of the controls. To minimize audible noise while driving power amplifiers, for example, the overload point of the 622 should be matched to the overload point of the power amplifier. This is done by adjusting the INPUT ATTENUATOR settings on the power amp(s) to make the amp(s) barely clip when a sinewave input to the 622 is adjusted in level such that it just barely lights the 622 OVERLOAD lamp. Clipping in the amplifier may be detected by means of an oscilloscope, power output meters, or other overload indicator, depending on the amplifier used. This procedure assures minimum noise and distortion from the 622/power amp combination.

WARNING!

PRIOR TO TESTING, BE SURE THAT THE POWER AMP LOAD (SUCH AS A LOUDSPEAKER) IS NOT DAMAGED BY FULL-POWER SINEWAVE. IF YOU THINK THAT IT MIGHT BE, USE A DUMMY LOAD OR A TEST SIGNAL WITH A HIGHER PEAK-TO-AVERAGE RATIO (LIKE PINK NOISE LOWPASS FILTERED AT 1KHZ) SO AS NOT TO BURN OUT TWEETERS.

Part B: Specific Applications

This part of the manual provides very specific instructions and suggestions on how to use the 622 in the fields of Sound Reinforcement, Recording Studios, Motion Picture Sound, Broadcasting, Dance Bars, and provides comments on Electronic Music. We recommend that anyone involved in pro audio (and certainly those involved in its more eclectic aspects, such as Theater) read all the sections. The applications information in each will undoubtedly provide much food for thought.

1: STEREO

For broadband equalization (BANDWIDTH controls at or clockwise of "5"), no difficulty should result when the channels are matched on the basis of panel calibrations alone. In applications other than monitor tuning or sound reinforcement, however, if any BANDWIDTH control is adjusted "narrowband" (i.e., 0 through 5), then test instruments should be used to assure matching between stereo channels, assuring precise stereo imaging and accurate mono summing of the channels. (See the section on **Dance Bars** below for a discussion of matching requirements in monitor tuning and reinforcement applications.)

The following procedure assumes that both channels have been adjusted by ear to achieve the desired equalization, and that both are adjusted identically with reference to panel calibrations. One channel must be arbitrarily chosen as the "reference", and the other channel's controls must then be slightly tweaked to achieve a precise instrument-match to this reference. This is most readily done by the "differential method": the reference channel and the channel under adjustment are swept out-of-phase, and their outputs are summed. The channel under adjustment is tweaked to minimize the amplitude of the sum. This method is very sensitive because it automatically indicates both phase and amplitude mismatches. It is performed as follows:

1) Connect a sinewave sweep generator with logarithmic sweep to the input of the reference channel such that the hot output is connected to the reference channel's (+) input, and its (-) input is grounded.
2) Connect another output from the sweep generator to the channel under adjustment. Connect the hot output to this channel's (-) input; ground its (+) input.
3) Sum the outputs of the two channels by connecting each (+) output to one side of a 22K 5% 1/4 watt carbon resistor (the value is not particularly critical). Connect the other side of both resistors to the vertical input of an oscilloscope.
4) Sweep the channels from 20-20,000Hz, and adjust the scope sensitivity to easily see the swept component.
5) Switch all IN/OUT switches on both channels OUT. Adjust the GAIN control on the channel under adjustment to null the output observed on the scope.
6) Switch all IN/OUT switches IN (unless some of these switches are normally out on the reference channel).
7) Slightly adjust the various controls on the channel under adjustment to minimize the amplitude of the differential component as observed on the scope.

2: SOUND REINFORCEMENT

The 622 is a versatile sound reinforcement equalizer which can function as a notch filter and broadband equalizer.

Many reinforcement systems are mono. In these installations, particularly powerful results can be obtained by connecting both 622B channels in series. A total of eight bands are then available for notch filtering or equalization.

House Tuning: In an economy installation, the 622B (with both channels connected in series) can do a surprisingly effective job of tuning a reinforcement system to a room without the use of a third-octave filter set. Use three or four of the bands in their narrowband notching mode (BANDWIDTH full counterclockwise) to notch out the major ring modes. This is most effectively and safely done if there is a limiter or compressor in the circuit before the power amplifier to prevent speaker damage. Advance system gain until it feeds back at a single frequency. Make sure that the limiter is in gain reduction to protect the speakers. Estimate the frequency of the feedback, and choose a band on the 622 which covers it. Turn the BANDWIDTH control to broad, and turn the EQ control down to -infinity. Adjust the TUNING control until the feedback changes frequency. Continue to adjust the TUNING control until the feedback returns at its original frequency. Set the TUNING control half-way between the two settings where the feedback was observed to change frequency. Now reduce the BANDWIDTH to full CCW (narrowband), and readjust the TUNING as necessary to keep the notch centered on the ring frequency. Finally, turn the EQ control up toward "0" (or flat) until the ring frequency reappears. Back off about 4dB. This will leave headroom so that the ring frequency will not reappear when the system gain is increased when more ring modes are tuned out later. This procedure may be repeated with the new ring frequencies as they appear. Usually after the first four ring frequencies have been eliminated, the "point of diminishing returns" is reached.

The remaining bands on the 622B are now available to perform broadband equalization of the system. Use a pink-noise generator and third-octave real-time analyzer for most precise results. However, if your budget doesn't permit a third-octave analyzer, use your ears. Fortunately, you only have four or five bands to deal with -- not a whole third-octave set!

Notch Filtering: If a third-octave filter set is available for broadband equalization, the 622B may be used solely as a narrowband notch filter set to eliminate up to eight ring modes. The notches obtainable are somewhat sharper than those created by a third-octave equalizer.

Stage Monitors: The 622 is an effective stage monitor equalizer because of its low cost per channel and notching capabilities. Follow the instructions in **House Tuning** above.

Individual Driver Equalizer: Some practitioners have discovered that there are substantial advantages to equalizing each driver in a complex sound reinforcement system with its own parametric equalizer. It is claimed that this is the best way to correct for individual driver response anomalies without having the corrective equalization affect other drivers.

If the 622 is used in this way, simply connect each channel of 622 equalization between the appropriate output of the electronic crossover and the input of the appropriate power amplifier. If phase reversal of an individual driver is necessary, this can be accomplished either at the power amplifier output or at the 622 input (exploiting the 622's balanced input feature.)

3: DANCE BARS

The sound generally desired in a dance bar is one that will make the customers get out and boogie (or sit down and drink...). This usually implies a large bass boost in the region of 40-80Hz, and a smaller amount of treble boost. The LF and HF bands of the 622 can be employed for this purpose, leaving the remaining bands available for "house tuning". In this case, we mean smoothing out midbass and midrange acoustic response of the loudspeakers in the room.

The amount of bass boost is primarily limited not by subjective considerations but by available amplifier power and loudspeaker bass power-handling capacity. For maximum capability, bi-amping is recommended because the bass amplifier can be clipped occasionally without causing obvious harshness. In this case, an external electronic crossover is necessary.

In all cases, the setting of the 622 low frequency TUNING and BANDWIDTH controls is quite critical in obtaining bass that is punchy, "tight", and sensual, without being "boomy" (like "jukebox bass"). Correct settings will vary considerably with loudspeaker type and room acoustics. In particular, satisfactory results cannot be obtained with a horn-loaded bass system with a cutoff frequency above 40Hz. Trying to boost bass below the cutoff frequency of the horn will cause severe distortion and also has the potential of damaging the drivers.

We do not recommend that the D.J. be permitted to operate the 622 in the course of his normal activities. The 622 should be adjusted once by the installing contractor to the manager's specifications, and then locked up. If the D.J. is to be provided with equalization, sufficient power to correct the sound of inadequate records can be supplied by a simple 5-band graphic equalizer with more limited range.

If the sound contractor has access to a third-octave real-time analyzer and pink-noise source, these can be of substantial aid in adjusting the MLF and MHF bands for flat acoustic response in the midbass and midrange. Coloration here is undesirable, and can cause customer edginess. It can also interfere with conversation. For the same reason, excessive treble boost should be avoided because of its potential for subliminal irritation.

If a third-octave analyzer is available to monitor the acoustic response of the system, it is not necessary or desirable to exactly match the channels in the frequency range below 200Hz according to **Stereo Matching** above. This is because different loudspeaker locations will ordinarily produce different bass balances in the room unless the room has been acoustically designed and is symmetrical (like a good recording studio control room). In a dance bar, the chances of this occuring are slight, to say the least!

It is quite acceptable to adjust the two 622 channels substantially differently below 200Hz to smooth out standing waves, resonances, and the like. Above 200Hz, equalization is much more useful in correcting the response of the loudspeaker than in correcting room acoustics. If the loudspeakers are reasonably well-matched, the equalizer channels should therefore be adjusted to also be well-matched above

200Hz. If the "A" and "B" channel curves differ greatly, this often results in the system's being well-equalized at only one place in the room (where the measuring microphone was located) at the expense of other locations which may have their problems exaggerated!

4: RECORDING STUDIOS

The 622 can be used in the recording studio just about anywhere that a conventional equalizer is used. Most studios find at least two channels of patchable Parametric Equalization to be invaluable in cleaning up "difficult" tracks that the internal console equalizers can't handle.

If a track is plagued by hum or other interference of fixed pitch, the 622 can be used in its narrowband notching mode (BANDWIDTH full CCW; EQ at -infinity) to substantially eliminate the sound with negligible effect upon desired program material. The notching of each harmonic requires use of a separate band.

The 622 is capable of producing a wide variety of special effects. Sweeping wideband notches gives a true "phasing" sound. Sweeping narrowband peaks gives a different sound with a similar flavor.

Telephone, transistor radio, and "old-time" recording effects are most easily generated by adjusting the MLF and MHF bands close together in frequency (around 1.3kHz, for example). The BANDWIDTH controls are adjusted to give moderately narrow bandwidths and both EQ controls are set for 16dB boost. This produces the sound of a ringy bandpass filter with approximately 12dB/octave slopes and gives the distinctive sound desired. Authentic-sounding distortion can be generated by overdriving the input of the 622 beyond the point where the OVERLOAD lamp flashes.

The 622 can also be effectively employed as a monitor system equalizer, particularly when a third-octave equalizer is too costly. See the **Sound Reinforcement** section above.

5: MOTION PICTURE SOUND

The 622 can be used to particular advantage as a dialog equalizer because of its many versatile features, such as:

1) Fine-tuning capability, allowing the mixer to obtain the best possible sound for difficult or poorly-recorded location recordings;

2) Instant notch filtering which can reduce hum and camera whine;

3) Increase in flexibility when both 622B channels are cascaded to make a single-channel 8-band equalizer.

The scoring mixer can similarly benefit from the fine adjustability of the 622.

The 622 can be used to equalize the motion picture monitoring environment by adjusting the "B" chain in the re-recording theater to the studio's accepted acoustic response standard. The music scoring stage monitoring system can be similarly adjusted.

Those interested in motion picture applications should also review the section on **Recording Studios** immediately above.

6: BROADCASTING

In AM, FM, and TV broadcasting applications, the integral RF suppression will greatly facilitate installation of the 622. The optional output transformers are particularly recommended for stations with studio and transmitter at the same site. Normal precautions regarding grounding and shielding should be followed when the 622 is installed.

The 622 is invaluable in the production studio. It can be used to "sweeten" records, and to equalize the announce microphone for maximum punch.

If sibilance is a problem, the best solution is the use of an Orban Dynamic Sibilance Controller. If one is unavailable, tuning a 622 band to 6kHz, adjusting the BANDWIDTH close to approximately "5", and turning down the EQ control as necessary will help control sibilance -- although at the expense of vocal presence.

Use of narrowband peaking, and sweeping can create some wild gimmicks. However, be aware that excessive high frequency boost can saturate the 7.5ips tape cartridges usually used. This can be avoided by following the 622 with the Orban Stereo Compressor/Limiter, which assures clean carts under all EQ conditions.

The 622 can also be used to enhance the sound of telephone calls, remotes, satellite feeds, shortwave broadcasts, and network feeds. The LF and HF bands may be used in their shelving mode (both BANDWIDTHs at "10", LF TUNING at 20Hz and HF TUNING at 20kHz) to remove out-of-band noise. Presence and intelligibility can often be enhanced by boosts in the 4-5kHz region.

The 622 is a most effective phone line equalizer. Unlike simpler phone company equalizers, the 622's flexibility can effectively deal with minor response "glitches".

In the main studio, the 622 can be used to notch out cart or tape machine motor hum and ventilation system noise with minimal effect on voice quality. Use one band for each major 60Hz harmonic, with BANDWIDTH control adjusted to "0".

The 622 may also be used in the AM program line to equalize the air sound, thus partially compensating for the inadequacies of typical consumer AM radios. A certain amount of high frequency boost is essential to counteract the extremely rolled-off performance of such radios. However, extreme boosts can cause problems with conventional compressors and limiters (such as severe pumping, "gulping" on material with large amounts of high frequency energy, and audibly obvious de-essing). Therefore, for ultimate performance, we recommend using the Orban OPTIMOD-AM, which is a complete signal processor <u>including</u> adjustable equalization.

7: ELECTRONIC MUSIC

The 622 is a highly valuable adjunct to any electronic music synthesizer. It is particularly useful as a formant filter, and can be used as a resonator to simulate certain instrument body sounds. (If both channels of a 622B are connected in series, up to eight high "Q" resonances can be simulated.)

The synthesist will find the more extreme equalization settings to be particularly useful in approaching live instrument sound and getting away from the raw sound of typical synthesizer systems.

As this whole area is highly specialized, we will not explore it further. We suggest that the beginner familiarize himself with the literature on musical instrument physics.

Part C: Maintenance

Introduction: This part of the manual provides instructions on how to maintain the 622, how to make sure that it is working according to specifications, and how to repair it if something goes wrong.

Factory service is available throughout the life of the 622. Please refer to **Factory Service** subsection of **MAINTENANCE AND SERVICE** below for further information.

1: PERFORMANCE EVALUATION

PERFORMANCE HIGHLIGHTS

General

This section provides a series of thorough, definitive bench tests which will verify whether or not the 622 is operating normally. Each band of the 622 has two alignment controls which are adjusted at the same time that the performance evaluation procedure is executed.

Power Supply

Equipment Required:
1) VTVM or DVM
2) Oscilloscope

The following tests will verify correct operation of the Power Supply:

1) Using the DC voltmeter, measure the voltage from circuit ground to both positive and negative unregulated supplies. This can be readily measured across the two large filter capacitors. This voltage may be expected to vary widely depending on line voltage; it should measure between ±18 and ±26 volts DC.

2) Measure the voltage between circuit ground and the outputs of the positive and negative voltage regulators, IC701 and IC702. The supplies should put out between ±14.25 and ±15.75 VDC. If either supply exceeds 15.75 VDC, it implies that its associated IC regulator is defective. If either supply is lower than 14.25 VDC, refer to the **Power Supply** portion of **Part 4** in this section for troubleshooting hints.

3) Using the oscilloscope, measure the ripple and noise on the regulated positive and negative power busses. Ripple and noise should be less than 2mV peak on each bus.

Signal Processing Circuitry

Equipment Required:

1) Oscilloscope with DC-coupled display
2) Audio sweep generator with sinewave output and logarithmic sweep (A Tektronix 5L4N Low-Frequency Spectrum Analyzer in a Tektronix 5111 Bistable Storage mainframe may be substituted for items (1) and (2).)
3) 20-20,000Hz bandpass filter, 18dB/octave slopes
4) VTVM or DVM
5) Harmonic distortion analyzer with built-in 400Hz and 80kHz filters and residual THD below 0.0015%
6) Low-distortion oscillator with residual THD below 0.0015%

(A Sound Technology 1700A or H-P 339 will satisfy (5) and (6))

For the following tests, a 600 ohm load must be provided across each 622 output. 620 ohm 1/2 watt 5% carbon resistors are suitable.

IN THE CASE OF THE DUAL-CHANNEL 622B, THE TEST PROCEDURE BELOW SHOULD BE FOLLOWED FROM BEGINNING TO END FOR CHANNEL "A", THEN REPEATED FOR CHANNEL "B".

1) **Signal Passage Test**

a) Connect the high (+) side of the 622 main output to the input of the harmonic distortion analyzer, and also to the vertical input of the oscilloscope. Connect the ground side of the 622 to instrument ground.
b) Ground the (-) input of the 622 and connect the output of the low-distortion oscillator to the (+) input of the 622.
c) Move <u>all</u> IN/OUT switches to OUT, and center all EQ controls.
d) Adjust the GAIN control clockwise, and verify that an undistorted sinewave appears at the output.
e) Continue to advance the GAIN control until clipping is barely visible. Verify that this clipping level exceeds +19dBm for 20Hz, 1kHz, and 20kHz input signals.
f) Verify that the OVERLOAD lamp flashes at, or slightly below, the clipping level at 1kHz.

2) **DC Offset**

a) Disconnect the oscillator from the 622 input.
b) Move the CHANNEL IN/OUT switch to IN. Measure the DC voltage appearing at the output of the 622. The voltage should not exceed 30mV DC.

3) **Distortion and Inverting Operation**

a) Ground the (+) input of the 622 and connect the low-distortion oscillator to the (-) input of the 622. Adjust the oscillator to 1kHz.
b) Center all operating controls, and move <u>all</u> BAND IN/OUT switches to the IN position.
c) Using the same procedure as in the **Signal Passage Test** above, verify that the gain is the same as previously measured $\pm$0.3dB.
d) Apply a 20kHz signal and adjust the output level of the oscillator and the 622's GAIN control until +18dBm is observed at the 622 main output.
e) Measure the Total Harmonic Distortion, using the 400Hz and 80kHz filter on the distortion meter. The THD should not exceed 0.025%.
f) Repeat at 20Hz; +18dBm output; 400Hz filter OUT. The THD should not exceed 0.025%.

4) **Noise**

a) Adjust the 622 GAIN control to produce unity input/output gain.
b) Switch OUT the 400Hz and 80kHz filters in the analyzer. Connect the 20-20,000Hz bandpass filter between the 622 output and the analyzer input.
c) Disconnect the oscillator from the 622, and connect both (+) and (-) 622 inputs to circuit ground.
d) Center all controls except for GAIN (adjusted in step (a)), and place all IN/OUT switches IN.
e) Measure the noise at the main output of the 622. With the test setup as described, it should not exceed -84dBm. If only the 80kHz filter internal to the analyzer is available, the noise will measure somewhat higher.

5) **HF, MHF, and MLF Equalizer Swept Response and Alignment**

The following procedure should be performed in turn on the HF, MHF, and MLF bands. The alignment procedure for the LF band is slightly different and is described immediately below. As you perform the tests, be sure that the BAND IN/OUT switches of the bands <u>not</u> under test are OUT. If the OVERLOAD lamp flashes at any time, reduce the GAIN.

The procedure below specifically refers to the HF band. The procedure should be repeated for the MHF and MLF bands by substituting the analogous controls for each band as appropriate.

a) Connect the sweep generator output to the (+) input of the 622, and the sweep generator ramp output to the horizontal input of the scope. Connect the 622 output to the vertical input of the scope. Adjust the sweep generator to produce a 20-20,000Hz log sweep.
b) Switch the CHANNEL IN/OUT switch IN, and all BAND IN/OUT switches OUT.
c) Adjust the 622 INPUT control for full-scale deflection on the scope screen.
d) Move the HF BAND IN/OUT switch to the IN position.
e) Adjust the HF EQ control to -infinity, and note that a notch appears in the swept response.
f) Adjust the HF BANDWIDTH control throughout its range (from "0" to "10") and note the change in the depth of the null. The null should remain constant throughout the range. If null depth varies appreciably, adjust R105 for minimum change in null depth as the BANDWIDTH control is varied.
g) Adjust the HF BANDWIDTH control to "10" (broad) and verify that the null is better than -25dB when the HF TUNING control is adjusted throughout its entire range. If the null is less than -25dB, adjust R125 for a maximum null at all settings of the HF TUNING control.

NOTE:

It may be necessary to fine-tune R105 as described in step (f) above.

h) Repeat steps (d) through (g) for the MHF and MLF bands.

6) **LF Band Test and Alignment**

a) Connect the output of the low-distortion oscillator to the (+) input of the 622, and adjust the oscillator's frequency to 60Hz (50Hz if that is the mains frequency in your country).
b) Switch the LF BAND IN/OUT switch IN, and all other BAND switches OUT.
c) Adjust the LF EQ control to -infinity.
d) Adjust the LF BANDWIDTH control to 10 (broad).
e) Adjust the LF TUNING control for maximum null. (Be as precise as possible).
f) Adjust the LF BANDWIDTH control throughout its range and note the change in the depth of the null. The null should remain constant. If the null varies appreciably, adjust R405 for a minimum change in the depth of the null.
g) Adjust the LF BANDWIDTH control to "0" (sharp), and verify that the null is better than -25dB when the LF TUNING control is adjusted throughout its range. If the null is less than -25dB, adjust R425 for best null at all settings of the LF TUNING control.

NOTE:

It may be necessary to fine-tune R405 as described in step (f) above.

7) **Tuning Control Calibration Test and Alignment**

a) Connect the output of the low-distortion oscillator to the (+) input of the 622.
b) Switch all BAND IN/OUT switches OUT except for the band being tested.
c) Adjust the EQ control on the band being tested to -infinity.
d) Adjust the TUNING control on the band being tested to approximately 1 o'clock.

e) Adjust the oscillator frequency to the frequency appearing on the 622 TUNING dial calibration close to the 1 o'clock position.

f) Adjust the 622 TUNING control for a null in the 622 output level, indicating that the position of the TUNING control corresponds to the oscillator frequency set in step (e). If the TUNING control reads correctly, $\pm 1/3$ octave, go on to the next band and repeat steps (b) through (f) above. If the TUNING knob is outside the $\pm 1/3$ octave tolerance, loosen the TUNING knob and readjust it until it reads the correct frequency. Retighten the TUNING knob by alternately tightening its two Allen setscrews until both are tight.

2: MAINTENANCE AND SERVICE

Preventive Maintenance

The front panel may be cleaned with a mild household detergent. Stronger solvents should be avoided, as they may damage the paint, the silk-screened lettering, or the plastic control knobs.

The interior of the 622 should be kept free of dust and dirt, since dirt buildup inside the chassis can cause loss of cooling and can also cause high-resistance short-circuits if the dirt absorbs moisture from the air. It is particularly important in a dusty or humid environment that the covers be periodically removed and the interior of the chassis cleaned.

Maintenance of Operating Controls

A new parametric bandpass resonator was designed for the 622 which is essentially immune to the effects of ordinary wear of the BANDWIDTH and TUNING controls.

Wear on the TUNING control is manifested almost completely as a slight change in bandwidth as the TUNING control is operated. However, the available notch depth is not compromised.

Wear on the BANDWIDTH control changes its calibration slightly, but does not compromise notch depth.

Wear on the EQUALIZATION control (such that its total resistance is changed) will compromise the notch depth. Therefore, with heavy use, we recommend periodic alignment of R125, 225, 325, 425, which will maximize the null depth when the EQ controls are placed in their - infinity positions. Refer to section 1 **(PERFORMANCE EVALUATION AND ALIGNMENT),** subsection 5 **(Equalizer Swept Response and Alignment)** for instructions.

The controls of the 622 are not hermetically sealed, and can therefore readily be cleaned with a commercial spray-type contact cleaner if they become noisy. If a replacement is needed, it should be ordered directly from Orban Associates, Inc. (see section below on **Factory Service),** as the controls have no commercial equivalents.

Replacement of Components on Printed Circuit Boards

It is important to use the correct technique for replacing components mounted on PC boards. Failure to do so will result in possible circuit damage and/or intermittent problems.

The circuit board used in the 622 Equalizer is of the double-sided plated-through variety. This means that there are traces on both sides of the board, and that the through-holes contain a metallic plating in order to conduct current through the board. Because of the plated-through holes, solder often creeps 1/16" up into the hole, requiring a sophisticated technique of component removal to prevent serious damage to the board.

If the technician has no practical experience with the elegant and demanding technique of removing components from double-sided PC boards without board damage, it is wiser to cut each of the leads of an offending component from its body while the leads are still soldered into the board. The component is then discarded, and each lead is heated independently and pulled out of the board with a pair of long nose pliers. Each hole may then be cleared of solder by carefully heating with a low-wattage soldering iron and sucking out the remaining solder with a spring-activated desoldering tool. THIS METHOD IS THE ONLY SATISFACTORY METHOD OF CLEARING A PLATED-THROUGH HOLE OF SOLDER!

The new component may now be installed by following the directions below starting with step (4).

Use the following technique to replace a component:

1) Use a 30 watt soldering iron to melt the solder on the solder (underneath) side of the PC board. Do not use a soldering gun or a high-wattage iron! As soon as the solder is molten, vacuum it away with a spring-actuated desoldering tool like the Edsyn "Soldapullt". AVOID OVERHEATING THE BOARD; overheating will almost surely damage the board by causing the conductive foil to separate from the board. Use a pair of fine needle-nose pliers to wiggle the lead horizontally until it can be observed to move freely in the hole.

2) Repeat step (1) until each lead to be removed has been cleared of solder and freed.

3) Now lift the component out.

4) Bend the leads of the replacement component until it will fit easily into the appropriate PC board holes. Using a good brand of rosin-core solder, solder each lead to the bottom side of the board with a 30 watt soldering iron. Make sure that the joint is smooth and shiny. If no damage has been done to the plated-through hole, soldering of the topside pad is not necessary. However, if the removal procedure did not progress smoothly, it would be prudent to solder each lead at the topside as well in order to avoid potential intermittent problems.

5) Cut each lead of the replacement component close to the solder (underneath) side of the PC board with a pair of diagonal cutters.

6) Remove all residual flux with a cotton swab moistened with a solvent like 1,1,1 trichloroethane, naptha, or 99% isopropyl alcohol. The first two solvents are usually available in supermarkets under the brand name "Energine" fire-proof spot remover and regular spot remover, respectively. The alcohol, which is less effective, is usually available in drug stores. Rubbing alcohol is highly diluted with water and is ineffective.

   It is good policy to make sure that this defluxing operation has actually removed the flux and has not just smeared it so that it is less visible. While most rosin fluxes are not corrosive, they can slowly absorb moisture and become sufficiently conductive to cause progressive deterioration of performance.

Troubleshooting IC Opamps

IC opamps are usually operated such that the characteristics of their associated circuits are essentially independent of IC characteristics and dependent only on external feedback components. The feedback forces the voltage at the (-) input terminal to be extremely close to the voltage at the (+) input terminal. Therefore, if the technician measures more than a few millivolts between these two terminals, the IC is probably bad.

Exceptions are IC's used without feedback (as comparators) and IC's whose outputs have been saturated due to excessive input voltage because of a defect in an earlier stage. Also, be sure that the voltmeter is not interacting with these sensitive points and affecting the measured voltage. However, if an IC's (+) input is more positive than its (-) input, yet the output of the IC is sitting at -14 volts, this almost certainly indicates that it is bad. The same holds if the above polarities are reversed.

A defective opamp may appear to work, yet it may have extreme temperature sensitivity. If parameters appear to drift excessively, freeze-spray may aid in diagnosing the problem. Freeze-spray is also invaluable in tracking down intermittent problems. But, use sparingly, because it can cause resistive short circuits due to moisture condensation on cold surfaces.

Factory Service

Please refer to the terms of your Orban Associates Limited One-Year Standard Warranty, which extends to the first end-user. This warranty was packed separately from the 622 and is not bound with this manual. After expiration of the warranty, a reasonable charge will be made for parts, labor, and packing if you choose to use the factory service facility. Repaired units will be returned C.O.D. In all cases, transportation charges (which are usually quite nominal) shall be borne by the customer.

Ordering Parts From the Factory: If parts are ordered from the factory, we require all of the following information:

-- The Orban part number, if ascertainable from the Parts List
-- The Reference Designator (e.g. R503)
-- A brief description of the part
-- And, from the serial label on the rear of the unit
- the exact Model Number
- the Serial Number
- The "M" number, if any

Returning the 622 to the Factory: After a formal Return Authorization number is obtained from the factory, units should be shipped to CUSTOMER SERVICE at the address shown on the front page of this manual.

YOUR RETURN AUTHORIZATION NUMBER MUST BE SHOWN ON THE LABEL, OR THE PACKAGE WILL NOT BE ACCEPTED!

PHONE (415) 957-1067
OR TELEX 17-1480

Shipping Instructions

If the original packing material is available, it should be used. Otherwise, a carton of at least 200 pounds bursting test and no smaller than 22" x 10" x 10" should be employed.

The 622 Equalizer should be packed so that there is at least 1-1/2" of packing material protecting every point. A plastic wrap around the chassis will protect the finish. Cushioning material such as Air-Cap, Bubble-Pak, foam "popcorn", or fibre blankets are acceptable. Folded newspaper is not suitable. Blanket-type materials should be tightly wrapped around the 622 Equalizer and taped in place to prevent the unit from shifting out of its packing and contacting the walls of the carton.

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

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

The package should be marked with the name of the shipper, and the words in red: DELICATE INSTRUMENT, FRAGILE! Even so, the freight people will throw the box around as if it were filled with junk. The survival of the unit depends almost solely on the care taken in packing!

3: CIRCUIT DESCRIPTION

General: Except for the power supply, the left and right channels of the 622 are independent and identical. In the following discussion, the LEFT CHANNEL will be described.

The circuitry is divisible into seven major blocks. These are:

1) input buffer and "active transformer"
2) high frequency equalizer (HF)
3) mid-high frequency equalizer (MHF)
4) mid-low frequency equalizer (MLF)
5) low frequency equalizer (LF) with discrete current-booster output stage
6) overload indicator
7) power supply

These will be described in order.

Input Buffer

The signal enters the 622 in balanced form. C1A, C1B shunt RF from the input leads to the chassis. These capacitors are not effective at VHF and higher frequencies; therefore, ferrite beads have been placed around the input and output leads to suppress such high frequency RF. It should be noted that this degree of RF-proofing is moderate but adequate for a vast majority of installations. However, installation next to a high-power transmitter may still cause problems. Additional RF suppression, careful examination of the grounding scheme, and other considerations familiar to the broadcast engineer may have to be used in conjunction with the 622's built-in RF suppression.

The filtered signal is applied to IC1, a low-noise FET-input opamp configured as a differential amplifier with a gain of 0.5. When both non-inverting and inverting inputs are driven by a source impedance which is small with respect to 100K (such as 600 ohms or less), the amplifier is essentially insensitive to signal components that appear equally on the non-inverting and inverting inputs (such as hum), and responds with full gain to the difference between the non-inverting and inverting inputs. Thus it serves as an "active transformer". Ordinarily, best results are obtained for unbalanced signals if the non-inverting input is grounded and the inverting input is driven.

The GAIN control is located after IC1. Therefore, IC1 will overload if its differential input exceeds approximately +26dBm. The OVERLOAD lamp will indicate this.

High Frequency Equalizer

The first equalizer stage is configured for 18dB gain to make up for the 6dB loss in IC1 and to make an additional 12dB gain available.

Equalization is achieved by taking the output of a two-pole bandpass resonator and either adding it to or subtracting it from its input signal.

HF Bandpass Resonator: Except for the values of the two tuning capacitors Cx01, Cx03 (where "x" denotes a digit corresponding to the band in question: "1" for the HF band, for example), all resonators are identical. The resonator in the HF band will be specifically discussed. However, this discussion applies to all of the bands if the reference designators are changed appropriately.

The resonator has substantial gain. To avoid overdriving the resonator, its input is attenuated by voltage divider R101, R103. The normal gain at the peak resonant frequency, measured from the wiper of R9 to the resonator outputs (pins 1 and 7 of IC502), is +16.8dB in the HF section. This complements the 18dB gain in main amplifier IC101. In the other bands (which have 0dB gain), the peak resonator gain is padded down to -1.2dB. Measuring the gain at the resonant peak provides one fast way of determining if the resonator is faulty.

Because the details of resonator operation are best explained mathematically, only a general description will be provided.

Basically, the resonator consists of a pair of allpass phase shift networks. The phase shift of the two cascaded phase shifters varies from 0 to 360 degrees as a function of frequency, but the gain of the phase shifters is constant at all frequencies.

If the input to the phase shifters is subtracted from the phase shifters' output, the 0 and 360 degree frequencies will cancel and the 180 degree frequency will reinforce, producing a bandpass response as desired. By adjusting the phase shift of the phase shifters with dual-ganged TUNING control R111, the peak frequency of the bandpass response produced can be adjusted without affecting the gain at the peak of the bandpass response.

To change the "Q" of the bandpass response produced, both positive and negative feedback are taken around the phase shifters. The positive feedback increases the "Q" and is fixed by R515. The "Q" can be reduced (and the response broadened) by introducing a user-adjustable amount of counteracting negative feedback through the BANDWIDTH control R109. Adjusting the amount of feedback changes the "Q" (sharpness) of the resonance without affecting the peak gain, provided that circuit gains are correctly adjusted. A trimmer control R105 is provided for this purpose. Ordinarily, R105 need be adjusted only once, and should only require field adjustment if a resistor within the resonator is replaced.

Troubleshooting the Resonator: Because the resonator uses multiple feedback loops, familiar signal-tracing procedures are not effective when troubleshooting, and "cut-and-try" procedures must usually be used.

First, replace the opamps. If this does not cure the problem, the adjustable controls are suspect because they are subject to wear. If neither the controls nor the opamps are defective, then passive component failure should be suspected. Test capacitors C101, C103 on an impedance bridge for correct value and negligible (greater than 50 megohms) conductance. If the capacitors are good, then the fixed resistors must be tested one-by-one. Because these metalfilm resistors are very understressed and highly reliable, resistor failures are most improbable.

Operation of the HF EQUALIZATION Control: The main output of the resonator is pin 7 of IC502B. This output is inverting with respect to the resonator's input. This main resonator output is connected to IC502A, operated as a unity-gain inverter. Not only does the output of IC502A provide the source for the negative feedback within the resonator, but also provides an in-phase output of the resonator which is used in conjunction with the out-of-phase output from IC502B to provide either boost or cut equalization.

The amount of in- or out-of-phase addition (and thus the amount of EQ) is determined by EQ control R115 in association with its taper-adjusting network R113, R117, R119. When R115 is rotated toward pin 1 of IC502A, an in-phase signal is added to the input signal in IC101, and peak boost equalization results. When R115 is rotated toward pin 7 of IC502A, and out-of-phase signal is added to the input signal, and peak dip results.

The taper adjust resistors set the point of zero equalization at 12 o'clock on the EQ control and adjust the control operation so that the first ±4dB of equalization occurs symmetrically about the 12 o'clock point.

Achieving precise cancellation of the resonator's peak frequency in summing amplifier IC101 when the EQ control is in the (-) infinity position requires that the peak gain of the resonator be precisely matched (and out-of-phase) to the gain of the unequalized input signal. This gain match is achieved by adjusting trimmer R125. Since wear on R115 (which changes its total resistance) will slightly change the characteristics of the entire taper-adjusting network, R125 may have to be readjusted from time to time if the equalizer is frequently used as a notch filter and maximum nulls are required.

The equalization in a given band is defeated by disconnecting the output of the EQ control from IC101 by means of BAND IN/OUT switch S101.

C107 controls the high frequency response of IC101 by rolling it off in the RF region (starting at 175kHz). The entire equalizer is purposely designed to have limited bandwidth above the audio range, which contributes greatly to the equalizer's stability and immunity to RF interference.

Mid-High and Mid-Low Frequency Equalizers

These two equalizers are identical except for their tuning capacitors C201, C203; C301, C303. These stages are identical to the high frequency equalizer except that they provide unity gain instead of +18dB gain under no-equalization conditions. The values of R221 and R321 are chosen to yield unity gain, and the resonator input voltage dividers R201, R203; R301, R303, are chosen to yield -31.3dB loss.

Low Frequency Equalizer

The LF equalizer is similar to the three equalizers preceding it except for two major additions. The first is a discrete-transistor current booster which enables the equalizer to drive 600 ohm loads. The second addition assures that summing amplifier IC401 is switched from normal inverting operation to non-inverting operation when the CHANNEL IN/OUT switch is switched OUT. This retains constant input/output polarity regardless of the position of the CHANNEL IN/OUT switch.

When the CHANNEL IN/OUT switch is in the IN position, the LF equalizer operates exactly like the other equalizers, except that

a) two capacitors C407, C411 are inserted in series with the summing junction to isolate IC401 and the switching from possible pop-producing DC offsets; and
b) a complementary-symmetry discrete-transistor output stage is included within IC401's feedback loop.

Discrete Output Stage: The output transistors Q403, Q407 are operated as emitter followers in a class-AB configuration. R443, R445 provide local DC feedback to stabilize the quiescent bias current through the output stage. The output stage is biased by diode-connected transistors Q401, Q405, which are thermally coupled to their associated output transistors to provide thermal feedback which stabilizes the output stage against thermal runaway.

Current limiting to short-circuit protect the output stage is provided by CR405, CR407 in conjunction with R443, R445. When the voltage drop across R443 or R445 exceeds the turn-on threshold of its associated diode (about 0.55 volts), then the diode conducts, shunting the drive current away from Q403, Q407 and into the load, thus protecting Q403, Q407 from burnout.

IC401, the driver, is loaded by R439, R441. The junction of R439 and R441 is boostrapped to the output of the emitter followers by C415, which forces the junction of R439 and R441 to follow the AC voltage excursions of the output. Because the output stage has a gain of almost +1, this means that IC401 does not see a load of 5.4K (R439+R441), but rather a constant current sink because the voltage across R439 (and therefore the current through it) does not vary. The boostrap thus relieves IC401 from the task of driving a relatively low-impedance load, and reduces distortion.

The output is connected to the outside world through RF suppression network R447, C419A, C419B. This makes the output impedance of the equalizer 47 ohms in parallel with 1000pF. (**Note:** When the optional output tranformer is installed, R447 is replaced with a jumper to assure best performance from the transformer.)

Channel In/Out Switch: R429 assures that C407 and C411 do not build up a DC charge which could cause a pop upon switching. Because R429 is connected between true ground and the virtual ground produced by the summing junction of IC401, it has almost no other effect upon circuit operation.

When the CHANNEL IN/OUT switch is switched OUT, the (-) input of IC401 is connected to AC ground through C411, R431. Simultaneously, the (+) input of IC401 is ungrounded and connected to the wiper of the GAIN control through C409. R433 assures that C409 does not pick up a DC charge which could cause a pop, and R435 assures that the (+) input of IC401 is referenced to ground while the CHANNEL IN/OUT switch is operating.

Under these conditions, IC401 has a non-inverting gain of +18dB, making up for the fact that IC101 is no longer in the circuit and assuring equal gain in both CHANNEL IN and CHANNEL OUT modes.

The entire circuit is carefully arranged to avoid pops due to differences in DC potential. However, because the program is interrupted for a few milliseconds while the switch is being operated, a click due to waveform discontinuity may be heard if program material is being passed through the equalizer as the switch is operated.

Overload Indicator

The output of each main-signal-path amplifier in the 622 is connected to its own pair of diodes. One diode is connected to a +10 volt bus (created by voltage divider R601, R603); the other diode is connected to a -10 volt bus (created by R609, R611). If the instantaneous output of any amplifier exceeds $\pm$10.6 volts, then the appropriate diode will conduct and couple a pulse onto one of the busses, which are relatively high impedance.

Positive-going overload pulses are fed into transistor inverter Q601 and appear at Q601's collector amplified and inverted so that they are negative-going. Negative going overload pulses are connected directly to Q601's collector. Thus any overload appears at Q601's collector as a negative-going pulse, and is coupled through C603 to IC601 and associated circuitry, connected as a one-shot multivibrator.

Ordinarily, IC601 is held OFF (pin 6 LOW) because R615 holds IC601's (-) input at a higher voltage than voltage divider R613, R617 holds its (+) input. A negative-going pulse transmitted through C603 pulls IC601's (-) input down, thus briefly switching IC601's output HIGH. This in turn pulls IC601's (+) input HIGH through R619, C605, and latches IC601's output HIGH until C605 can discharge through R613, R617, R619, which normally takes about 200 milliseconds. While IC601's output is HIGH, the OVERLOAD lamp is illuminated through R621. Thus very fast overloads are "time stretched" and can be easily seen.

Under continuous overload conditions, it is normal for the OVERLOAD lamp to flash on and off.

Power Supply

Unregulated voltage is supplied by two pairs of full wave diode rectifiers CR701, CR702 and CR703, CR704 operating into a pair of energy storage capacitors C701, C702. The power transformer T1 is strappable for either 115 volt or 230 volt operation; the two sections of the primary are paralleled for 115 volt operation and connected in series for 230 volt operation.

The nominal unregulated voltage is $\pm$22 volts DC at rated line voltage. This will vary widely with line voltage variations. Regulator dropout will occur if the unregulated voltage falls below about $\pm$17.8 volts.

Regulated voltages are supplied by a pair of overrated 500mA "three terminal" IC regulators IC701, IC702. Because they are operated so conservatively, they can be expected to be extremely reliable. Therefore, before replacing the regulators, check to see whether other abnormalities in the circuitry (such as a shorted IC) have caused excessive current demand which is causing the regulator IC's to go either into current limiting or into thermal shutdown, their two built-in protective modes. If it becomes necessary to replace a regulator, be sure to replace its heat sink and to securely insulate the heat sinks from each other by means of the fish paper included in the original assembly.

To prevent high frequency oscillations, the regulators IC701 and IC702 are frequency-compensated by small ceramic capacitors C705-C714 distributed around the PC board. These also prevent signal-carrying IC's from oscillating due to excessive power-lead inductance.

CR705, CR706 are connected from ground to each power bus in reverse polarity, and protect the rest of the circuitry from a fault condition that might otherwise cause a reverse polarity voltage on either power bus.

Appendix: Interconnections and Grounding

Small systems usually come together easily because cable runs are usually short and the interconnections between various pieces of equipment are not terribly complex. Therefore, do not be intimidated by the seeming complexity of the discussion on interconnections and grounding below. This is more information than most people will ever need to successfully install a small system; we have included it in case things don't work right and you need to find out why.

DRIVING THE 622 FROM HIGH IMPEDANCE/ HIGH LEVEL SOURCES

Both "+" and "-" sides of the 622 inputs are bypassed to chassis ground for RF through 1000pF capacitors. To assure common mode rejection, and to assure that these capacitors do not affect the frequency response of the system, the output impedance of the equipment driving the 622 should be 600 ohms or less. Most professional and semi-professional sound equipment will satisfy this requirement.

The 622 can be driven by unbalanced sources up to 10,000 ohms (such as the outputs of some vacuum tube preamps) by removing the 1000pF capacitors from the "+" inputs, and driving these inputs from the hot side of the driving equipment's outputs. (See the section below on **Grounding** for an explanation of balanced and unbalanced connections.)

If the 1000pF capacitors are left in place and the source impedance is 10K, the capacitors will cause a high frequency rolloff which is 3dB down at 16kHz, and which rolls off at 6dB/octave thereafter.

The absolute clipping level of the 622 input is +26dBm. If such clipping occurs, it will cause the OVERLOAD lamp to flash on and off regardless of the setting of the GAIN control.

If levels greater than +26dBm are expected, an external loss pad must be used before the 622 input. The Audio Cyclopedia, Section 5, contains instructions for making such pads. (Tremaine, H.M.: The Audio Cyclopedia, Second Edition, Indianapolis, Howard W. Sams & Co., Inc., 1969).

GROUNDING

Grounding serves two purposes: it joins the ground references of various pieces of electronic equipment, and it shields the electronics from various electric fields (RFI and hum).

(Interference caused by magnetic fields is not decreased by conventional shielding, and special magnetic shielding materials must be used where hum is a problem. In audio, such shielding is ordinarily used with low-level magnetic transducers like tape heads, magnetic phono cartridges, and dynamic microphones, and with low-level transformers. Line-level equalizers such as the 622 are not normally sensitive to this sort of interference.)

There are two types of ground: circuit and chassis. Circuit ground serves as a ground reference for the electronics. Chassis ground permits use of the chassis as a shield in the same way that the shield on shielded cable protects the inner conductors. Whether the circuit and chassis grounds are identical, are separate, or are intentionally joined depends on the type of equipment and the interconnecting scheme.

In professional systems correct grounding is important. The general principles are these:

1) In an audio system, the chassis of each piece of equipment must be connected to a good common ground point (ideally a cold water pipe or a rod driven into the earth) by one and only one wire.

2) Meanwhile, there must be one and only one circuit ground path between each piece of equipment.

It is when these two requirements become confused, omitted, or redundant that problems develop. If there is a connection missing, hum and noise will result. If more than one ground path exists, then a "ground loop" may develop.

A ground loop can be viewed as a single turn of a giant transformer. Because 60Hz AC magnetic fields exist at every point served by mains power, the ground loop will have a hum current induced in it by stray AC magnetic fields. Because the ground wire has appreciable impedance, this current will cause a hum voltage to appear between different parts of the ground system. If great care is not taken, this hum voltage can intrude on the audio signal.

How grounding is accomplished depends on whether the equipment to be interconnected is balanced or unbalanced.

An unbalanced connection uses two terminals: "hot" and ground. Wires used in such connections are typically single-conductor shielded. (RCA plugs and two-conductor phone plugs are often used to terminate such cables.) If, because of stray fields or ground loops, a hum voltage appears between "hot" and ground, then this hum will be mixed into the desired signal since the unbalanced connection cannot distinguish between the desired signal and hum.

In the case of balanced connections, audio is applied to the "+" and "-" terminals; the input responds to the difference between the voltages at the two terminals. A third terminal is connected to chassis ground and is available for the connection of the shield of the two-conductor shielded wire that would be used (Belden 8451, for example). If a hum voltage is developed between the shield and both audio wires, then the balanced input would reject this "common mode" voltage, since the input responds only to the difference in voltage between the audio wires. This ability to reject hum and noise is the primary advantage of a balanced configuration.

Referring back to the **ELECTRICAL INSTALLATION** section, notice how these rules are applied in the table and diagram.

For involved systems such as arena-type sound reinforcement, professional recording studios, or large broadcasting facilities, a formal and systematic "transmission ground system" should be worked out for the entire system. See Section 24 of The Audio Cyclopedia for details (op. cit.).

(Interesting digression: The "balanced" technique was first perfected by the telephone company, which has to run miles of unshielded cables close to each other and also to high voltage AC lines without pickup of excessive hum or crosstalk from other circuits. Originally, telephone circuits were unbalanced on single wires, with the earth providing the ground return. As soon as electric lighting became popular and power lines were placed on telephone poles, the power lines interfered with the telephone service so badly as to render conversation impossible. The telephone company embarked on a research program which led to both the balanced line technique, and to the choice of the familiar 600 ohm impedance as the optimum compromise between rejection of electrical and magnetic interference. Today, the telephone company's specification for maintenance of line balance is extremely tight, as proper common mode rejection is vital to the success of the entire system.)

Parts List

Parts are listed by part class by assembly in Reference Designator order except for certain widely used common parts such as:

Fixed Resistors, 3/8" Square Trimmer Resistors, Signal Diodes

which are described generally under the appropriate heading and which must be examined to determine the exact value.

DIODES

ALL DIODES NOT LISTED BY REFERENCE DESIGNATORS ARE:

Diodes, Signal	22101-000	FSC 1N4148	MANY

NOTE: This is a silicon small-signal diode, ultra fast recovery, high conductance. It may be replaced with 1N914 or, in Europe, with BAY-61.

BV: 75V min. @ I_r = 5V I_r : 25nA max. @ V_r = 20V V_f : 1.0V max. @ I_f = 100mA t_{rr} : 4ns max.

NOTE: For Zener Diodes (VR...) see Miscellaneous Section

RESISTORS

ALL COMMON RESISTORS NOT SPECIFICALLY LISTED ARE GENERALLY SPECIFIED BELOW:
Replace resistors only with the same style and with the exact value as marked on the resistor body, lest performance or stability be compromised. If the resistor is damaged, consult the factory or refer to the Schematic to obtain the value.

Metal Film Resistors

Body: conformally-coated
I.D: five color band or printed value
Orban P/N: 20038-XXX - 20045-XXX
Power Rating: 1/8 Watt @ 70°C
Tolerance: 1%
Temperature Coefficient: 100 PPM/°C
U.S. Military Spec.: MIL-R-10509, Style RN55D
Manufacturers: R-Ohm (CRB-1/4FX), TRW/IRC, Beyschlag, Dale, Corning, Matsushita

Carbon Composition Resistors

Body: molded phenolic
I.D.: four color bands
Orban P/N: 2001X-XXX
Power Rating: (70°C) 1/4 Watt (Body 0.090" x 0.250")
1/2 Watt (Body 0.140" x 0.375")
Tolerance: 5%
U.S. Military Spec.: MIL-R-11, Style RC-07 (1/4W) or RC-20 (1/2 W)
Manufacturers: Allen-Bradley, TRW/IRC, Stackpole, Matsushita

Carbon Film Resistors

Body: conformally-coated
I.D.: four color bands
Orban P/N: 20001-XXX
Power Rating: 1/4 Watt @ 70°C
Tolerance: 5%
Manufacturers: R-Ohm (R-25), Piher, Beyschlag, Dale, Phillips, Spectrol, Matsushita

Cermet Trimmer Resistors

Body: 3/8" square (9mm)
I.D.: printed marking on side
Orban P/N: 20510-XXX, 20511-XXX
Power Rating: 1/2 Watt @ 70°C
Tolerance: 10%
Temperature Coefficient: 100 PPM/°C
Manufacturers: Beckman (72P, 68W- Series), Spectrol, Matsushita

OBTAINING SPARE PARTS

Because special or subtle characteristics of certain components are exploited in order to produce an elegant design at a reasonable cost, it is unwise to make substitutions for listed parts. It is also unwise to ignore notations in the Parts List indicating "Selected" or "Realignment Required" when replacing components. In such cases, the factory should be consulted if optimum performance is to be maintained.

Orban normally maintains an inventory of tested, exact replacement spare parts to supply any present or normal future demand quickly at nominal cost.

When ordering parts from the factory, we will need all of the following information:

- The Orban Part Number, if ascertainable
- The Reference Designator for a defective component
- A brief description of the part

-From the Serial Label on the rear
-The exact Model Number
-The Serial Number
-The "M" number, if any

Orban can supply standardized Spare Parts Kits for this product during its production life. Consult your dealer or the factory for the contents of such kits and their prices.

Parts for this unit have been chosen from the catalogs of well-known manufacturers for ease in future maintenance. The U.S. headquarter addresses are listed at the end of the Parts List. Most manufacturers have extensive distribution facilities throughout the world and may often be contacted through local offices.

Rev. 01 1/86

REF DES	DESCRIPTION	ORBAN P/N	VEN (1)	VENDOR P/N	ALTERNATE VENDORS (1)	NOTES
CHASSIS ASSEMBLY						
Capacitors						
C1,2	Ceramic Disc, 1KV, 10%; 0.001uF	21112-210	CRL	DD-102		
C419,420	Ceramic Disc, 1KV, 10%; 0.001uF	21112-210	CRL	DD-102		
Diodes						
CR601	LED, Red	25103-000	GI	MV-5053	FSC	
CR707	LED, Green	25104-000	GI	MV-5253	FSC	
Inductors						
L1,2	Inductor, RF Choke, 1mH, 160 mA	29502-000	MIL	4662		
Miscellaneous						
NONE	Fuse, 3AG, Slo-Blo, 1/8A	28004-113	LFE	313.125	BUS	
NONE	Line Cord, AC, 3 Wire	28101-000	BEL	17534		
NONE	Transformer, Power, 38 VCT, 4.3 VA	29001-000				
Resistors						
R9,10	Pot, Single, 5K 20%, CW Log	20717-000	CTS			
R109,110	Pot, Concentric, 20K/100K 10%, CCW Log	20718-000	CTS			
R111,112	Pot, Dual, 50K/50K 10%, CCW Log	20708-001	CTS			
R115,116	Pot, Concentric, 20K/100K 10%, CCW Log	20718-000	CTS			
R209,210	Pot, Concentric, 20K/100K 10%, CCW Log	20718-000	CTS			
R211,212	Pot, Dual, 50K/50K 10%, CCW Log	20708-001	CTS			
R215,216	Pot, Concentric, 20K/100K 10%, CCW Log	20718-000	CTS			
R309,310	Pot, Concentric, 20K/100K 10%, CCW Log	20718-000	CTS			
R311,312	Pot, Dual, 50K/50K 10%, CCW Log	20708-001	CTS			
R315,316	Pot, Concentric, 20K/100K 10%, CCW Log	20718-000	CTS			
R409,410	Pot, Concentric, 20K/100K 10%, CCW Log	20718-000	CTS			
R411,412	Pot, Dual, 50K/50K 10%, CCW Log	20708-001	CTS			
R415,416	Pot, Concentric, 20K/100K 10%, CCW Log	20718-000	CTS			
Switches						
S101,102	Switch, Toggle, Min., SPDT	26037-009	CK	7101SYA		
S201,202	Switch, Toggle, Min., SPDT	26037-009	CK	7101SYA		
S301,302	Switch, Toggle, Min., SPDT	26037-009	CK	7101SYA		
S401,402	Switch, Toggle, Min., SPDT	26037-009	CK	7101SYA		

FOOTNOTES:
(1) See last page for abbreviations
(2) No Alternate Vendors known at publication
(3) Actual part is specially selected from part listed, consult Factory
(4) Realignment may be required if replaced, see Circuit Description and/or Alignment Instructions

SPECIFICATIONS AND SOURCES FOR REPLACEMENT PARTS
EQUALIZER MODEL 622A/B
CHASSIS ASSEMBLY
Capacitors/Diodes/Inductors/Miscellaneous/Resistors/Switches

REF DES	DESCRIPTION	ORBAN P/N	VEN (1)	VENDOR P/N	ALTERNATE VENDORS (1)	NOTES
PCB MAIN ASSEMBLY						
Capacitors						
C3-6	Tantalum, 35V, 10%; 0.33uF	21307-433	SPR	196D334X9035HA1	MANY	
C7,8	Mica, 500V, +1/2pF -1/2pF; 10pF	21017-010	CD	CD15-CD100D03		
C101-104	Capacitor Set, .0015uF and .015uF	28501-001	ORB			
C107,108	Mica, 500V, 5%; 12pF	21020-012	CD	CD15-CD120J03		
C109,110	Tantalum, 35V, 10%; 6.8uF	21307-568	SPR	196D685X9035KA1	MANY	
C201-204	Capacitor Set, .005uF and .05uF	28501-002	ORB			
C207,208	Mica, 500V, +1/2pF -1/2pF; 10pF	21017-010	CD	CD15-CD100D03		
C301-304	Capacitor Set, .018uF and .18uF	28501-003	ORB			
C307,308	Mica, 500V, +1/2pF -1/2pF; 10pF	21017-010	CD	CD15-CD100D03		
C401-404	Capacitor Set, .062uF and .62uF	28501-004	ORB			
C407-410	Tantalum, 35V, 10%; 6.8uF	21307-568	SPR	196D685X9035KA1	MANY	
C411,412	Tantalum, 15V, 10%; 15uF	21304-615	SPR	196D156X9015JA1	MANY	
C413,414	Mica, 500V, 5%; 12pF	21020-012	CD	CD15-CD120J03		
C415,416	Tantalum, 15V, 10%; 22uF	21304-622	SPR	196D226X9015KE3	MANY	
C501	Mica, 500V, 5%; 22pF	21020-022	CD	CD15-ED220J03		
C502	Mica, 500V, 5%; 180pF	21020-118	CD	CD15-FD181J03		
C601-604	Ceramic Disc, 50V, +80% -20%; 0.005uF	21108-250	CRL	CK-502		
C605,606	Ceramic Disc, 25V, 20%; 0.15uF	21106-415	CRL	UK25-154		
C701,702	Alum., Axial, 40V, -10% +100%; 470uF	21224-747	SPR	TVA-1315-1000-40	SIE,PAN	
C703,704	Alum., Radial, 25V, -20% +100%; 100uF	21206-710	PAN	ECE-A1EV101S		
C705-714	Monolythic Ceramic, 50V, 20%; 0.1uF	21123-410	SPR	1C25Z5U104M050B		
Diodes						
CR701-706	Diode, Rectifier, 400V, 1A	22201-400	MOT	1N4004	MANY	
Integrated Circuits						
IC1,2	Linear, Single Opamp	24009-202	NAT	LF356N		
IC101,102	Linear, Single Opamp	24010-202	NAT	LF357N		
IC201,202	Linear, Single Opamp	24013-202	TI	TL071CP		
IC301,302	Linear, Single Opamp	24013-202	TI	TL071CP		
IC401,402	Linear, Single Opamp	24013-202	TI	TL071CP		
IC501,502	Linear, Dual Opamp	24202-202	RAY	4558NB	MOT,FSC	
IC601,602	Linear, Single Opamp	24002-202	NAT	LM741CN	TI	
IC701	D.C. Regulator, 15V Positive	24304-901	FSC	F78M15UC		
IC702	D.C. Regulator, 15V Negative	24303-901	FSC	F79M15AUC		
Transistors						
Q401-404	Transistor, Signal, NPN	23202-101	MOT	2N4400	FSC	
Q405-408	Transistor, Signal, PNP	23002-101	MOT	2N4402	FSC	
Q601,602	Transistor, Signal, NPN	23201-101	MOT	2N4123	FSC	

P/L REVISIONS

	06013-VER-09	CHASSIS ASSEMBLY
	30115-VER-09	PCB MAIN ASSEMBLY

FOOTNOTES:
(1) See last page for abbreviations
(2) No Alternate Vendors known at publication
(3) Actual part is specially selected from part listed, consult Factory
(4) Realignment may be required if replaced, see Circuit Description and/or Alignment Instructions

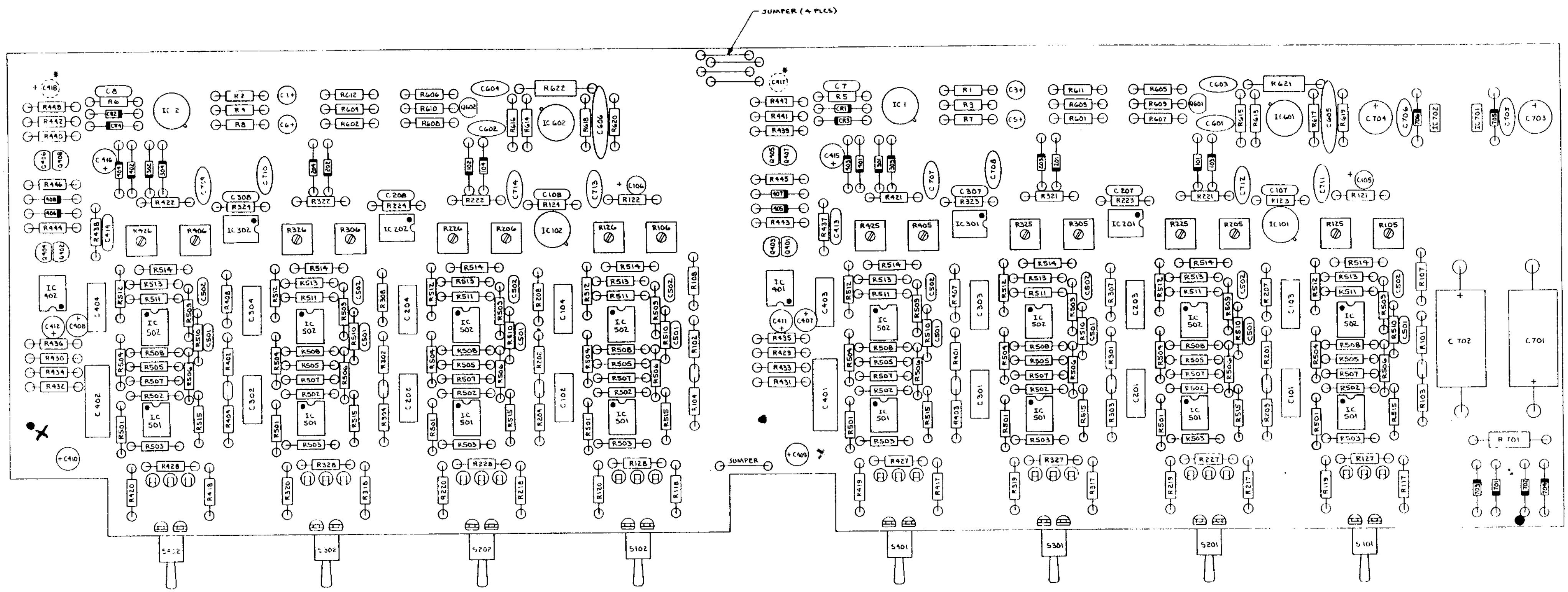
SPECIFICATIONS AND SOURCES FOR REPLACEMENT PARTS

EQUALIZER MODEL 622A/B

PCB MAIN ASSEMBLY
Capacitors/Diodes/ICs/Transistors

Vendor Codes

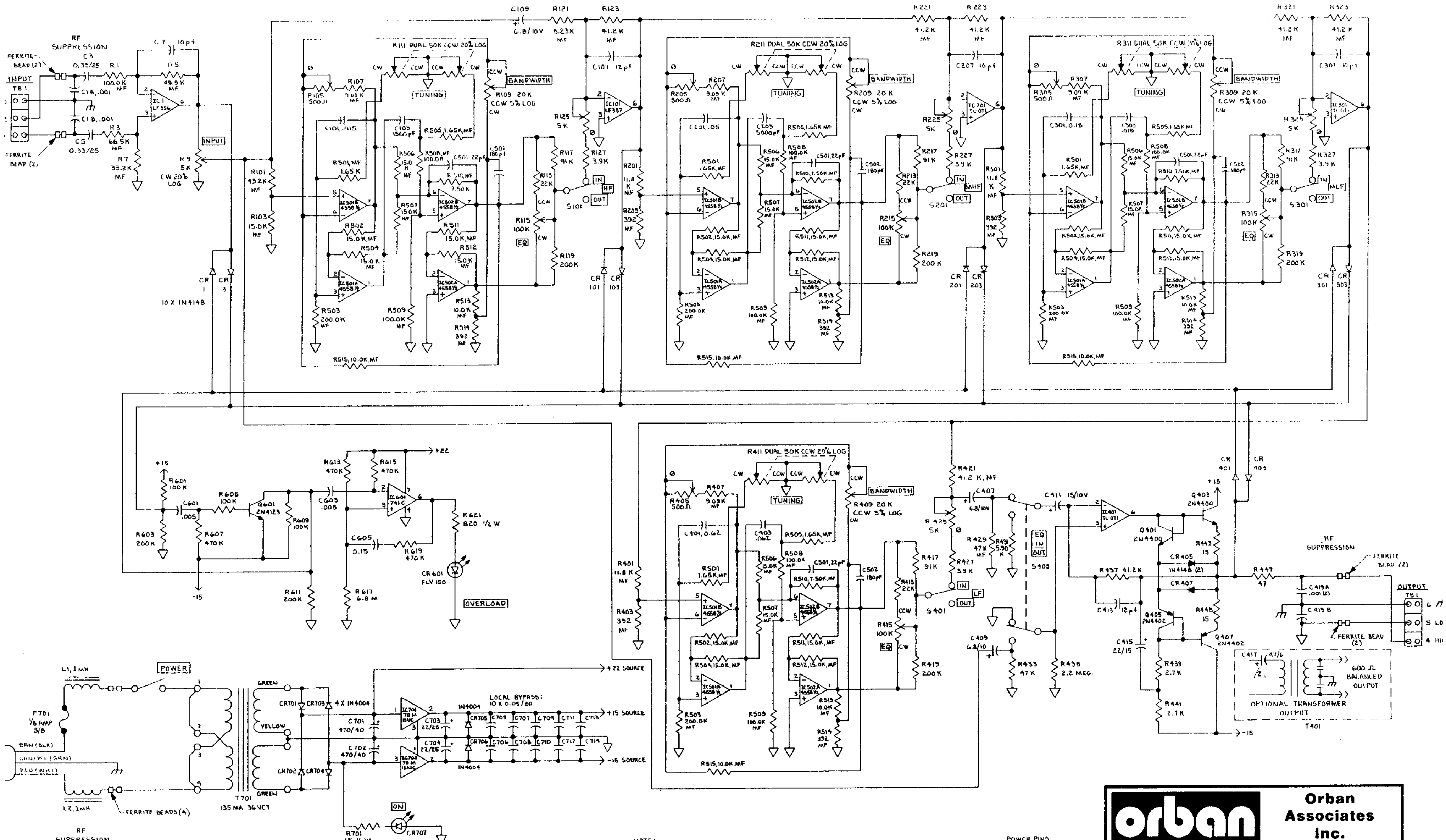
Code	Vendor
AB	Allen-Bradley Co. 1201 South Second Street Milwaukee, WI 53204
AD	Analog Devices, Inc. Route 1, Industrial Park P.O. Box 280 Norwood, MA 02062
AM	Amphenol North America An Allied Company 2122 York Road Oak Brook, IL 60521
BEK	Beckman Instruments, Inc. Helipot Division 2500 Harbor Blvd. Fullerton, CA 92634
BEL	Belden Corporation Electronic Division Richmond, IN 47374
BRN	Bourns, Inc. Trimpot Products Division 1200 Columbia Avenue Riverside, CA 92507
BUS	Bussmann Manufacturing Div. McGraw-Edison Company P.O. Box 14460 St. Louis, MO 63178
CD	Cornell-Dubilier Electronics 150 Avenue "L" Newark, NJ 07101
CH	Cutler-Hammer Landmark Office Center 2081 Landings Drive Mountain View, CA 94043
CK	C & K Components, Inc. 15 Riverdale Avenue Newton, MA 02158
COR	Corcom, Inc. 1600 Winchester Road Libertyville, IL 60048
CRL	Centralab, Inc. A North American Company 5757 North Green Bay Ave. Milwaukee, WI 53201
CTS	CTS Corporation 905 North West Blvd. Elkhart, IN 46514
ECI	Electrocube 1710 South Del Mar Avenue San Gabriel, CA 91776
ERE	Erie Tech. Products, Inc. 644 West Twelfth Street Erie, PA 16512
EXR	Exar Integrated Systems, Inc. P.O. Box 62229 Sunnyvale, CA 94088
FDY	F-Dyne Electronics Company 449 Howard Avenue Bridgeport, CT 06605
FSC	Fairchild Camera & Instr. Corp. 464 Ellis Street Mountain View, CA 94042
GI	General Instruments Optoelectronics Div. 3400 Hillview Avenue Palo Alto, CA 94304
HP	Hewlett-Packard Corporation 1501 Page Mill Road Palo Alto, CA 94304
INS	Intersil, Inc. 10710 North Tantau Avenue Cupertino, CA 95014
IRC	TRW/IRC Resistors 401 North Broad Street Philadelphia, PA 19108
LFE	Littelfuse A Subsidiary of Tracor 800 East Northwest Highway Des Plaines, IL 60016
MAL	Mallory Timers Company Emhart Electrical/Electronic Gr. 3029 East Washington Street Indianapolis, IN 46206
ME	Mepco/Electra, Inc. Columbia Road Morristown, NJ 07960
MIL	J.W. Miller Division Bell Industries 19070 Reyes Avenue P.O. Box 5825 Compton, CA 90221
MOT	Motorola, Inc. P.O. Box 20912 Phoenix, AZ 85036
NAT	National Semiconductor Corp. 2900 Semiconductor Drive Santa Clara, CA 95051
NOB	Noble Teikoku Tsushin Kogyo Co. Ltd. 335, Kariyado, Nakahara-ku Kawasaki 211, JAPAN
OHM	Ohmite Manufacturing Company A North American Philips Co. 3601 Howard Street Skokie, IL 60076
ORB	Orban Associates, Inc. 645 Bryant Street San Francisco, CA 94107
PAK	Paktron Div. of Illinois Tool Works Inc 900 Follin Lane, S.E. Vienna, VA 22180
PAN	Panasonic Electronic Components Div. P.O. Box 1503 Seacaucus, NJ 07094
RAY	Raytheon Semiconductor Division 350 Ellis Street Mountain View, CA 94042
RCA	RCA Solid State Division Route 202 Somerville, NJ 08876
SAE	Stanford Applied Eng. 340 Martin Avenue Santa Clara, CA 95050
SCH	ITT Schadow, Inc. 8081 Wallace Road Eden Prairie, MN 55343
SIE	Siemens Components Division 186 Wood Avenue, South Iselin, NJ 08830
SIG	Signetics Corporation A Sub. of US Philips Corp. P.O. Box 9052 Sunnyvale, CA 94086
SPR	Sprague Electric Co 125 Marshall Street North Adams, MA 01247
STK	Stackpole Components Co P.O. Box 14466 Raleigh, NC 27620
SYL	Sylvania Conn. Prod. Op. GTE Products Corp. Box 29 Titusville, PA 16354
TI	Texas Instruments P.O. Box 225012 Dallas, TX 75265
WES	Westlake 5334 Sterling Ctr Drive Westlake Village, CA 91361
WIM	WIMA P.O. Box 2345 Augusta-Anlage 56 D-6800 Mannheim 1 GERMANY



* INSTALLED A[illegible] BY TEST [illegible]

Orban Associates Inc.

TITLE:
ASSEMBLY DRAWING
MODEL 622A/B
30115-VER-08



NOTE:
1. CHANNEL 1. SHOWN
CHANNEL 2. IDENTICAL
POWER SUPPLY POWERS BOTH CHANNELS.
2. C417, ON OPTIONAL TRANSFORMER OUTPUT, INSTALLED AS NEEDED BY TEST. REFER TO DOCUMENT 60012-000-XX

POWER PINS

	V+	V-	G
4558	8	4	-
TL 071	7	4	-
LF 356	7	4	-
LF 357	7	4	-

orban

Orban Associates Inc.

TITLE: SCHEMATIC
MODEL 622A/B
60013-000-09