Film-Tech

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NEWER MODEL

"STARSCOPE" Sound
by EPRAD, Inc.

Your selection of STARSCOPE sound reproduction equipment assures that you are delivering the finest cinema sound possible to your very favorite people.....your patrons. All STARSCOPE units feature the following:

NOISE REDUCTION - Eliminates the hiss and snap noises which distract patrons during dramatic quiet scenes.

EQUALIZATION - Tunes the sound system to the individual acoustical qualities of your own auditorium. Each seat is "the best in the "house".

SURROUND CHANNEL - Furnishes the enveloping sound effects which put each patron in the center of the action.

For best results, STARSCOPE equipment should be installed by an engineer or technician experienced in working with directional sound systems.

Your STARSCOPE unit is a sturdy piece of booth equipment, manufactured under constant quality control using durable solid-state components and circuitry. You may look forward to many years of dependable service.

EPRAD, INC
2573 TRACY ROAD
NORTHWOOD, OHIO 43619
(419) 666-3266

OR

EPRAD, INC
P.O. BOX 73
ROSSFORD, OHIO 43460
1-800-782-0170

EPRAD, INCORPORATED
123 West Woodruff
P. O. Box 4712
Toledo, Ohio 43620
Phone: (419) 243-8106
Telex: 286-444 EPRAD

1-800-782-0170

STARSCOPE SERIES SOUND SYSTEM

INSTALLATION

To the user and installer, a brief description of the functions of the system.

The new system of today, of recording sound on split optical soundtracks, is much better than yesterday's sound. The difference is like day and night.

To enjoy the full benefits of these find optical soundtracks, the soundhead should have optics that are no more than 1-mill in height. Optimum for today is approximately 0.8-mills of light slit.

If your soundhead contains sound lenses of 1.25 or 1.35 optical slit, then they should be replaced (you cannot get good sound if you don't replace them).

"Slit loss" circuits do not replace the loss of frequencies, but will make the higher frequencies electrically "stronger" in relation to 1000 cycles than they were before.

SPLIT SOLAR CELL

The split solar cell replaces the present solar cell or photocell. The split cell, as the name implies, is two separate solar cells electrically bonded to one substrate. The solar cell must be adjusted so that the solar cell is as close to the film as can be, without touching it or being in any danger of touching the film emulsion side.

The split solar cell must optically be adjusted so that each half of the split cell sees only the half of the soundtrack that is supposed to see.

Using 9000 cycle film and a dual trace oscilloscope, the optical slit lens is adjusted so that not only is it properly in focus, but so that the phase relationship of the two halves is correct.

Using a scope, the two pulses can be made to align by rotating the lens azimuth while, at the same time, maintaining its precise critical focus (not an easy thing to do).

OPTICAL PREAMPS

You cannot use your single-ended preamp as furnished on your old sound equipment. It is now necessary to have two functioning preamps; one for each half of the split solar cell (each half of the optical soundtrack).

The optical preamps have a method of switching their response curve from the Academy Curve required for monaural prints, in "Flat" required for the new stereo variable area soundtracks (SVA).

Note: In order to tune-up the optical slit lens and the solar cell, the mono-stereo switch should be put to the stereo position (so that a more accurate and precise job of setting the slit lens is possible). Preamplifiers in the "stereo" are flat to 16 kc.

SOUND CHANGEOVER

It is necessary that you have exciter lamp changeover. If your theatre soundhead and exciter lamp supply were not connected so that you could change over from one projector to the other by switching ON and OFF the exciter lamps, then that provision must be made by either using double pole, double throw switches, or a commercial flip-flop relay arrangement.

To avoid electronic complexities and electronically generated noise, EPRAD does not build any electronic changeover into the preamp.

However, this means that you must make sure that the solar cells are shielded from fluorescent and other lights which would generate noise into the sound. The solar cells of both projectors are left "alive".

NOISE LIMITING SYSTEM

Inherenty the silver grains of the optical soundtrack are actual grains of silver. Even if the soundtrack were perfectly clean and brand new, the grainedness of the film recording would generate some kind of noise on top of the signals recorded on the soundtrack.

Worse, however, are the dirt and scratches which accumulate with use of the print. And, very importantly, the preamplifier itself generates some noise, inherent to all amplifiers.

Other noises picked up by the wiring or delivered by the power supply to the preamplifier or picked up by the solar cells are impressed upon the systems and are, in total, very annoying to the audience.

The noise limiting board is a dynamic volume control, which increases or decreases its amplification depending on the strength of the dialogue, music, or sound effect coming off the film.

When there is no "sound" on the film, the "noise board" simply turns down the "volume" and eliminates the inherent background noise that comes from the many sources outlined herein.

For the "noise board" to properly control the system, the noise board amplifiers are turned on as determined by the frequency content of the particular sound at that moment.

Noise boards are factory set for the proper "threshold". That means that the sound coming from the soundheads, through the preamplifiers, should be 300 millivolts when a test film is run which has a 50% modulation factor. That is; when the soundtrack is delivering half volume, the preamplifier output should be 300 millivolts of signal. Then - and only then - is the proper allowance made for the volume going up and down, as determined by the character of the noise control board.

The L.E.D. "level" lights are much more accurate than a Pointer Meter (within plus or minus 3 millivolts).

If the preamp threshold level is not set properly and checked often, you may be able to hear the noise board "breathe" or "pump". Or, it may be at a level so low that it is not serving its function at all.

This is important to repeat: A proper test film which is modulated at 50% is threaded into the projector and the test film loop is run, a preamplifier external or internal gain control is adjusted so that the input signal to the "noise board" is 300 millivolts, then the full benefit of the "system" is available.

Certain systems have a small meter to indicate this critical point. The EPRAD System uses a series of L.E.D. lights (so that you can see the effect of the adjustment at a distance). The lights are more accurate. If only the top red light is lit, the level is too high, or above 301 millivolts. If only the lower red light is lit, the level is below 300 millivolts. When both hi and lo L.E.D.'s are on, you have achieved the 300 millivolt level.

With the EPRAD System, thread the 50% modulation film through the projector, run the projector, adjust the preamplifier gain controls so that both red lights are lit.

If the EPRAD equipment is used with four-track or six-track magnetic systems, the procedure is exactly the same; the test film is put on the projector, projector is operated, and one track at a time is adjusted via that particular preamp volume control, until the green light is lit and neither red light is lit. Then the switch in the front panel of the mag/optical multi-channel EPRAD System is turned to select the next channel to be adjusted, and the procedure is repeated.

The next function of the system is to treat auditorium acoustics, speaker crossover networks, and any other amplitude distortions in the system.

A system analyzer is required. There are various analyzers on the market, from the Shure 10 channel to very expensive cathode ray tube analyzers. EPRAD prefers the Dynamic Real-Time Analyzers using 30 meters. This graphic representation of the overall acoustical response is very easy to grasp, and therefore facilitates the system "adjustment".

In any case, regardless of the analyzer, the purpose is to obtain as flat an acoustical overall response (from the audiences' point of view) as is possible.

Some equalizer systems have set bands - for example 27 separate adjustment controls - that will adjust a certain part of the frequency response of the system.

EPRAD's System has "bands" which are tuneable. The 10 filter equalizer board is one octave equalization of infinite frequency control. We have found that normally all of the requirements are met with 5 filters. We think that the 10 filter system is more than adequate for even complex auditorium problems and that normally it can be said that the 20 filter board and the 28 filter boards are "overkill".

The reason for this is that acoustical problems are generally a combination of various factors, as follows: primarily the speaker crossover network, the length of the room, the width of the room, the height of the room, and the cubical content. These five elements, the speaker crossover network being the greatest, account for 99% of the possible resonances.

The EPRAD filters are designed so that they can be "tuned". A frequency mark on the equalizer board for each filter is nominal center frequency. The filters will tune over a range of 2-4 times the frequency mark for that filter.

To properly adjust for the overall acoustics, the following procedures should be followed:

From film, or from a separate "pink" noise generator, noise is introduced to the input of the theatre sound system. This full spectrum of noise suffers all the consequences electrically and acoustically possible, and is reproduced by the theatre speaker system into the auditorium.

In the approximate center of the theatre auditorium is placed a precision microphone. The precision microphone's cable is long enough to reach the projection room and is connected to a Real-Time Graphic Analyzer.

Normally, the overall response of the system will show one deep dip at the speaker crossover network, a bump at approximately 1000 cycles, and another bump at 4-6000 cycles.

The tuneable filters of the equalizer are adjusted individually. For example, one of the filters is adjusted directly to center its effect on the crossover network. Then the amplitude of that filter is adjusted so that the effect of the crossover network is nullified and the curve becomes essentially flat.

Please note that most adjustments are something less than 5Db.

Other filters close to the frequency where the discrepancy occurs are moved to the center of the bump or valley, and the amplitude adjustment of that filter is caused to correct the overall response curve.

In a matter of a few minutes with a good analyzer, the theatre response curve from approximately 100 cycles to approximately 12,000 cycles should be essentially flat. Overall, if within plus or minus 1-1/2Db it is considered excellent. To account for high frequency recording pre-emphasis, the acoustical curve is not flat. The curve rolls off at about 4,500 cycles. (See graphs).

This essentially completes the whole system, installation and adjustments.

We have not covered power amplifiers because they probably were either in the theatre beforehand, or are a separate package. Any acoustical malfunctions that might have been introduced by the power amplifiers are corrected with the procedure above.

The final adjustment is to set the volume control of the StarScope System to approximately mid-range and the power amplifiers individually adjusted to give the proper level to the theatre.

Please note that the EPRAD System has RCA pin plug inputs and RCA pin plug outputs. The reason for this is to maintain full flexibility so that any old, present, or "in the future" system can be accommodated.

The EPRAD System is designed to handle four channels of separate optical sound, when and if required, and by use of a separate box and separate mother board, the system can be used with six channel optical or magnetic systems (EPRAD at this moment does not have magnetic preamplifiers available).

SUMMARY

The EPRAD StarScope and Starlet Directional Sound Systems have been designed to give you the cleanest optical stereo sound in the industry today. Properly installed and aligned, they will do just that.

The principle of this type of reproduction is based on a stereo-variable-area soundtrack (SVA). This system uses a split solar cell instead of the conventional single cell pick-up in the old solar cells and photo-electric cells.

The sound optics (sound lens tube) should be changed if necessary to no more than a 1.00 mill slit lens (a .8 mill slit is preferable), to give a much sharper image on the soundtrack. The adjustment of this lens is a critical alignment point. It must be adjusted to get the maximum amplitude and both signals must be in phase. This is covered in the alignment section of the instructions.

Both regular optical films and SVA film may be run on any sound-head adapted for the SVA type sound reproduction without modification. There is a simple switch on the face of the master system for this purpose (stereo/mono), or the noise boards and equalizers can be passed with the bypass switch.

Speakers used with this system must be in good condition and be capable of reproducing frequencies from 30 Hz to 15 KHz without distortion and full rated power.

Old type tube amplifiers in general will not be suitable for this new sound system due to source impedance. The main power amplifiers must be a minimum of 60 watts (RMS) and have a very low generator impedance. The StarPower 4 amplifiers fit these specifications, with plenty to spare (100 watts).

The StarScope Systems can mount on the wall or in a standard rack (19" relay rack). If mounted on the wall, you will need an area no more than 17 inches wide, 24 inches high, and 10 inches in depth. All wiring to the soundheads and from the StarScope unit will be 100% shielded (Mylar) 2-conductor sound cable as well as all wiring internal to the rack.

To insure the maximum sound reproduction this system was engineered for, make sure your installer has the knowledge and test equipment for the installation. The alignment is as important as the proper installation.

Service on the system is simple, but very important. With a proper installation and good care afterwards, you will have the finest sound system on the market today and you will be able to prove it at any SVA presentation.

BOOTH AND AUDITORIUM REQUIREMENTS
Prior to Installation

Projection Booth:

-Soundhead(s) must be clean and in good working order. Details follow under INSTALLATION.

-Exciter lamp power supply must furnish adjustable DC voltage. AC exciter supplies generate 60 cycle "hum."

-Exciter lamp (rather than pre-amp) changeover switching. This eliminates costly and unnecessary electronic switching circuitry.

Auditorium:

-Front channel speaker(s) should be high-quality, projection type. Your EPRAD dealer can advise you as to which speaker(s) will suit your auditorium; or, if using existing speaker(s), can determine whether or not they will adapt to stereo usage.

-Your EPRAD dealer can again advise you as to which surround speakers would best suit your auditorium. Some houses may require projection type speakers, while others achieve excellent effects using flat-baffle types.

-If you are using existing surround speakers (i.e. "Cinema-Scope" surrounds), inspect them carefully. If necessary, replace old or brittle speaker cones, and REMOVE any line transformers.

-Avoid placing surround speakers behind decorative baffles or grill-work. When possible, angle the surround speakers toward the auditorium in "searchlight" fashion.

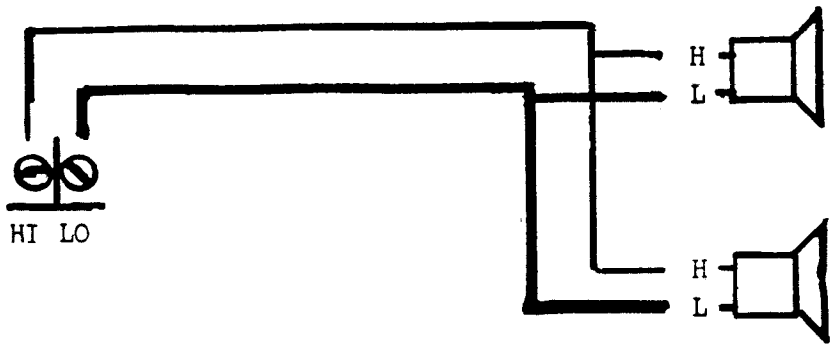
-The following pages diagram several methods of wiring surround speakers.
Surround speakers should be firmly mounted (not suspended) to insure proper bass response.

-Set all speaker crossover networks FLAT. (Front speakers, TOO).

-Surround speakers must all be the same.

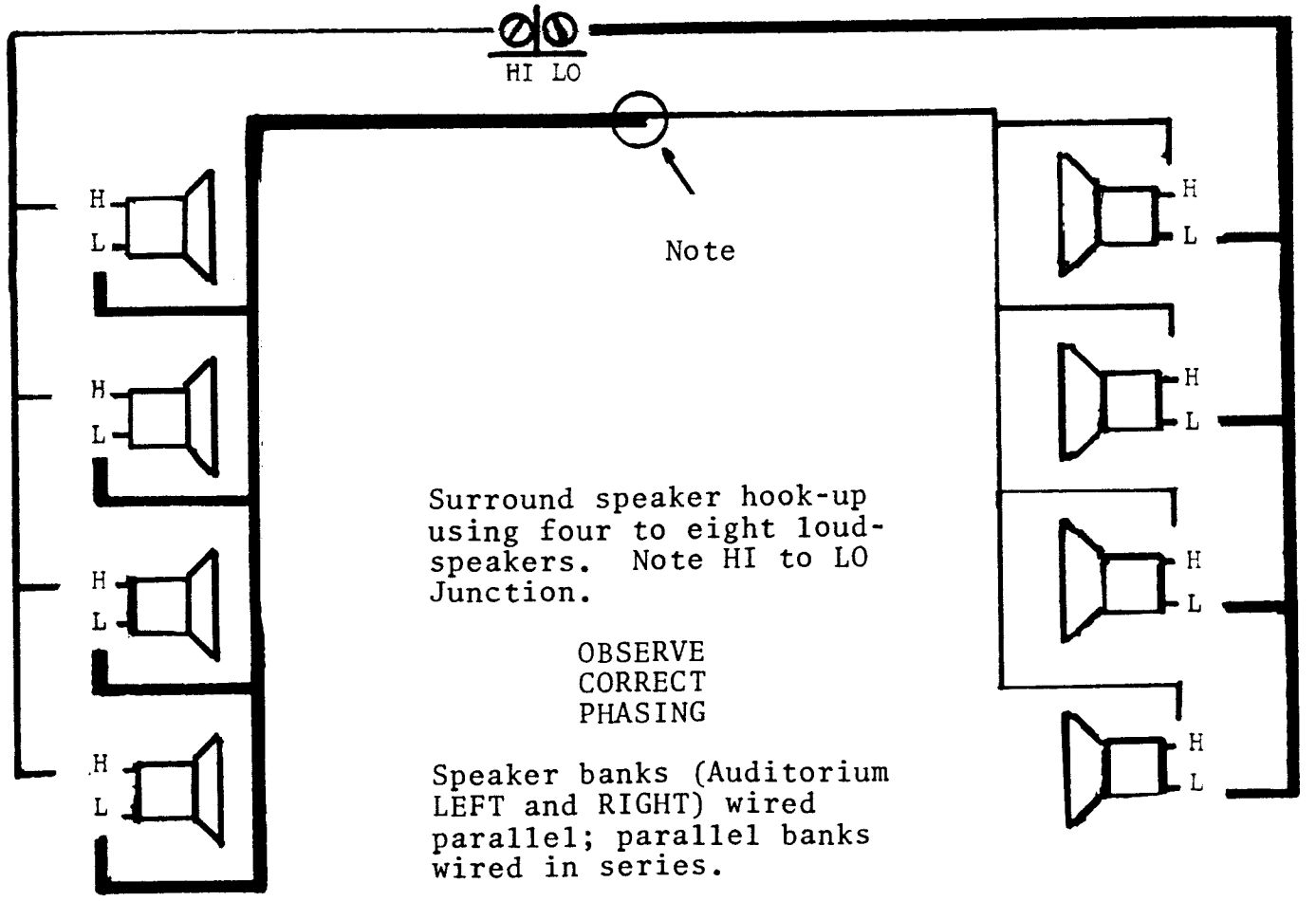
-Surround output impedance should be between 4 - 8 ohms.

-Use STRANDED wire for speaker hook-ups, no lighter than 16 gauge.



Surround Speaker hook-up using two loudspeakers.

OBSERVE CORRECT PHASING

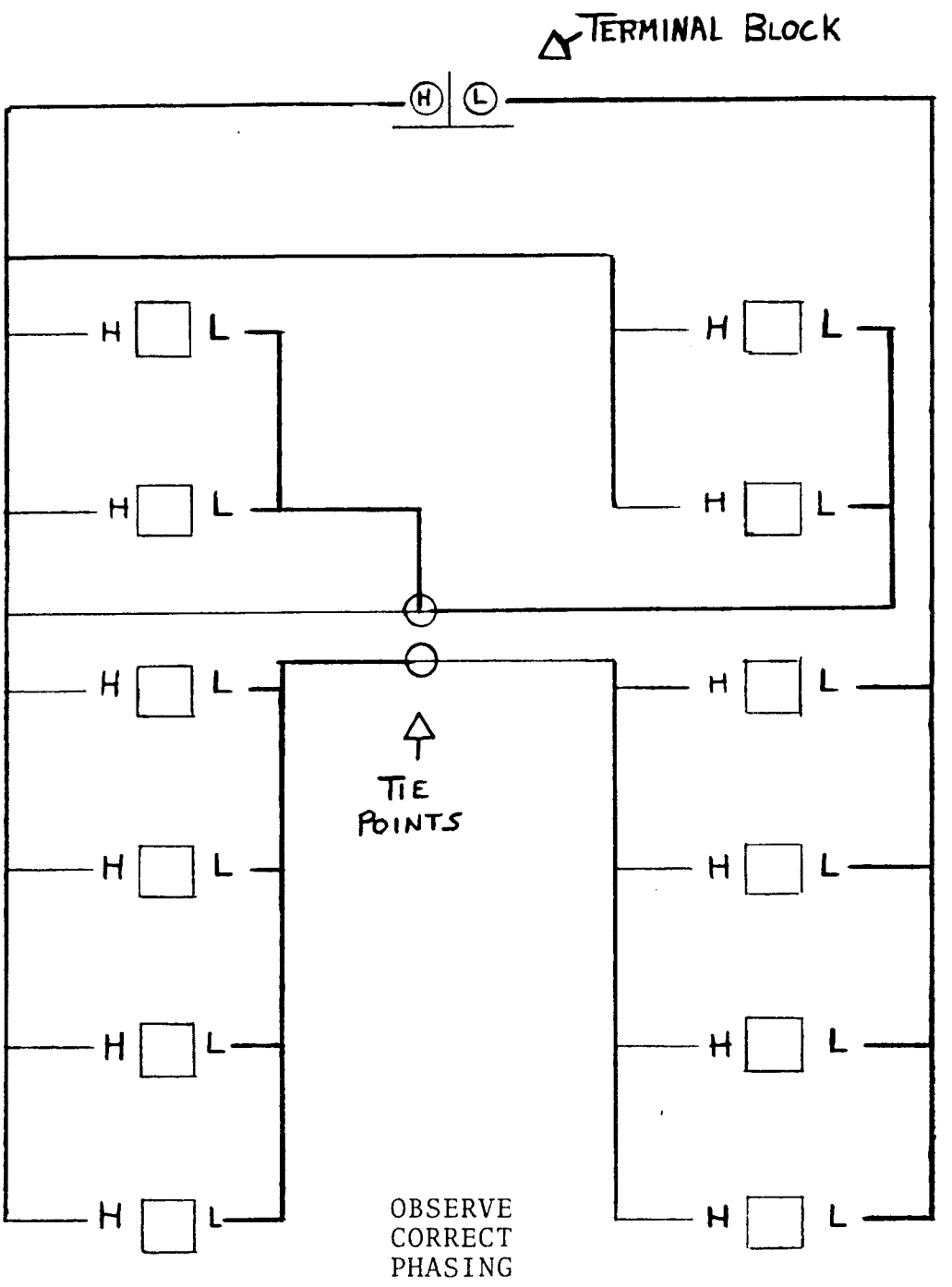


Surround speaker hook-up using four to eight loud-speakers. Note HI to LO Junction.

OBSERVE CORRECT PHASING

Speaker banks (Auditorium LEFT and RIGHT) wired parallel; parallel banks wired in series.

Optimum surround output impedance should be between 4 - 8 ohms. NO LESS than 4 ohms!



Surround speaker hook-up using eight or more loudspeakers.
NOTE: Nominal voice coil impedance 8 ohms

Do not hesitate to call your EPRAD dealer or the factory if questions arise concerning speaker hook-up.

INSTALLATION

Inspect all pieces, and report any damage to freight carrier IMMEDIATELY.

ITEMS REQUIRED FOR INSTALLATION. Asterisk (*) indicates items furnished by EPRAD.

1. Volt/Ohm Meter
2. Dual trace oscilloscope (sensitivity at least 10mv/division)
3. Sound response/Frequency analyzer
4. "Pink" noise generator
5. Solder and soldering iron
6. Buzz track film *
7. 9kc sound focus film *
8. Alternate track film *
9. 1kc 50% modulated/Pink noise film (two soundtracks) *
10. Surround test film *
11. 50 ft. Belden Beldfoil 8761 cable with 4 phono plugs attached *
12. 2 phono plugs (for non-sync sound sources) *

Carefully inspect the soundhead BEFORE mounting the split solar cell! The soundhead is the starting point of the optical stereo system, and must be in top working order.

Lateral guide roller
- Can it be adjusted properly
- When adjusted, can it be correctly locked in place?
- If necessary, replace weak springs, worn washers, and clean and relubricate bearings

Sound drum
- Must be CLEAN and, above all, CONCENTRIC
- Eliminate excessive end play

Slit lens
- Slit lenses should be replaced, if necessary, with 1.0 mill slit or preferably a .8 mill slit, when available, for proper frequency response
- Make sure adjusting screws turn freely, and when locked in place, hold the lens tube securely
- Clean all lens tube optics

Exciter lamp
- Use a NEW exciter lamp
- Check exciter voltage. When using the conventional 9V, 4A bulb, align the cell using between 5-9 V.DC. After cell is aligned, reduce voltage to 4-4.5 V.DC.
- Make sure the lamp is positioned correctly, furnishing the maximum slit illumination. Lock firmly in place.

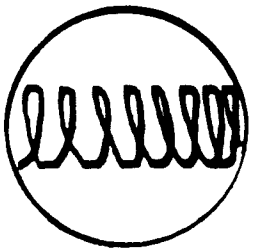
REVERSE SCANNING SOUNDHEADS MUST BE REFITTED FOR DIRECT SCAN!

SPLIT SOLAR CELL ALIGNMENT

Correct alignment of the split solar cell is THE MOST important portion of the STARSCOPE installation. The processor receives all of its optical "information" from the split solar cell, and cannot properly process a faulty signal.

Remember the data processor's "GIGO law" - "Garbage In; Garbage Out."

Before mounting the split solar cell, check the image of the exciter lamp filament through the lens tube using a small piece of paper in the center of the sound drum. Focus the sound lens to the approximate correct position, and move the exciter lamp up and down and sideways to get the image of the filament centered in the projected opening of the slit.



The image should be uniform brightness side-to-side and centered up and down in the faint outline of the slit lens.

Note that the image pictured (LEFT) is seen projected in the center of the sound drum; NOT at the film plane.

Reasonable pre-alignment of both the slit lens and split cell can be made using a similar method. Place a piece of paper at the focal point of the film ("Film Path", illustration on following page). Focus the light beam to a sharp line and rotate the lens tube to project a horizontal line.

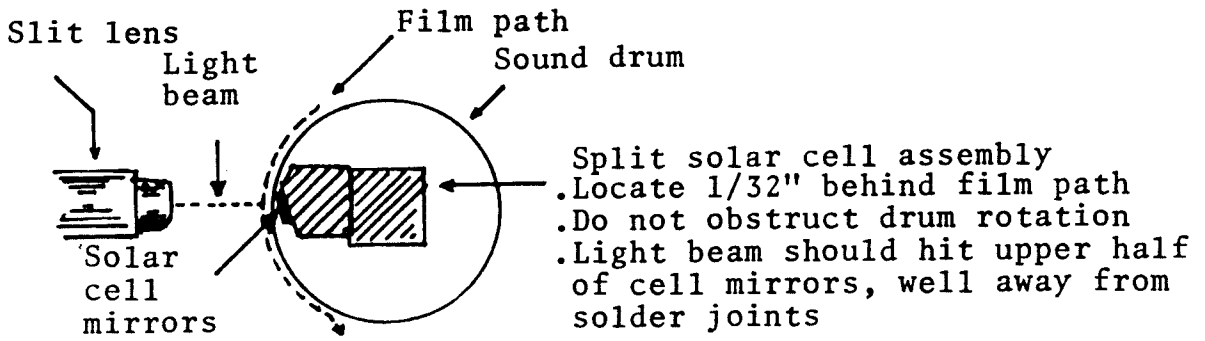
Position the cell head in and out so the light beam image is centered; symmetrical on the cell mirrors side-to-side.

For the best signal output readings on the oscilloscope, load each element (LEFT to GROUND; RIGHT to GROUND) with a 4000 to 6000 ohm resistor.

Set exciter lamp power supply output to 5-9 volts DC.

EXTREME CARE TAKEN AT THIS PHASE OF THE INSTALLATION SIMPLIFIES ALL SUBSEQUENT OPERATIONS! Make sure all soundhead components involved are firmly locked into place at the completion of each operation.

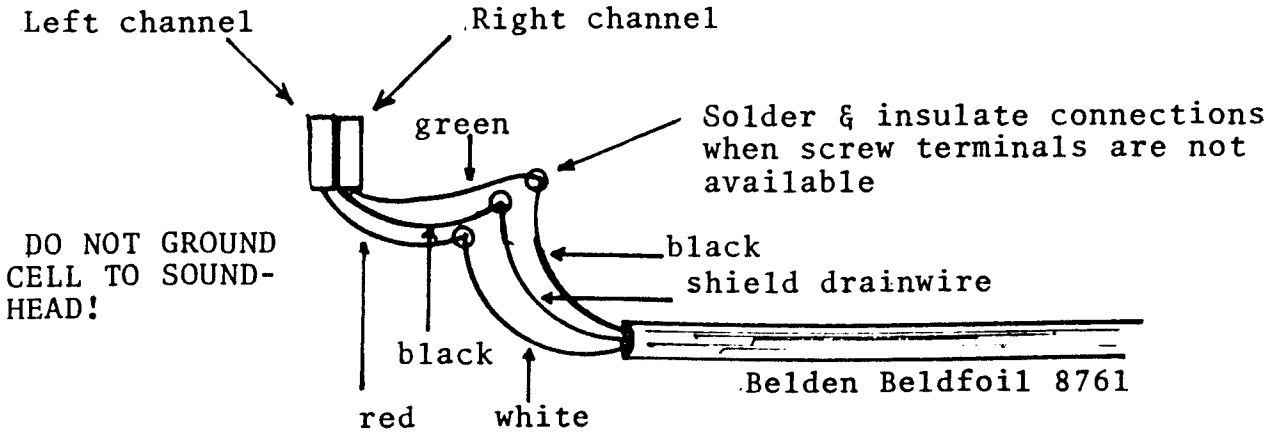
Split Solar Cell
Mounting and Wiring



1. Remove the old solar (or photoelectric) cell, and any brackets or hardware not duplicated on the new split cell.
2. Disconnect ALL existing cell wiring in the soundhead, including any pre-amplifiers and switching.
3. Mount the split solar cell as illustrated above. Note the 1/32 inch clearance between the cell and the film. While the cell must be close to the film for best output, mounting it too close will allow dust to collect, resulting in "popcorn" noises (static discharges) in the sound system.
4. Carefully route the wires. When possible, follow the old wire path. Use sleeving and cable clamps to keep the cell leads well away from moving parts.
   -For convenience, use existing screw terminals in the soundhead, but be sure all other wires have been removed.
5. Keep all other wires away from cell leads! Run a length of Beldfoil 8761 from processor to soundhead (cut to length; phono plugs attached at each end) in separate conduit. Do NOT ground shield to soundhead!

CAUTION: In some soundheads it is necessary to remove the sound drum flywheel in order to wire the cell. When replacing the flywheel, use extreme care not to push the sound drum into the split cell assembly; it is VERY FRAGILE.

6. When screw terminals are not available, wire to Beldfoil as illustrated below.



Split Solar Cell Alignment

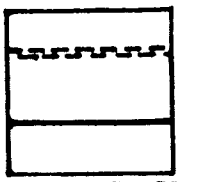
Locate the test films furnished by EPRAD. Splice them into loops. First, thread the BUZZ TRACK loop through the projector and soundhead.

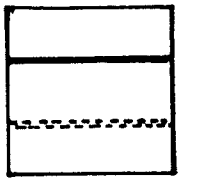
Connect dual trace oscilloscope leads to the solar cell wires. DO NOT CONNECT SOLAR CELL(S) TO PROCESSOR.

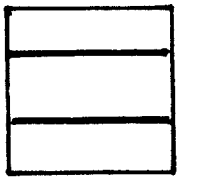
--Make sure that the exciter lamp is correctly positioned, providing maximum image illumination.

Run the BUZZ TRACK loop through the soundhead, with the exciter lamp lit. If "A" or "B" sweeps appear on the scope, adjust the lateral guide roll until "C" sweep appears. The "C" picture indicates that the soundtrack is correctly tracking directly in the path of the slit lens beam.

When the correct setting is found, lock the lateral guide roller in place.


"A"
INCORRECT


"B"
INCORRECT

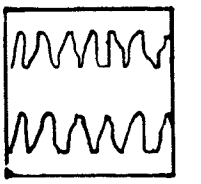

"C"
CORRECT

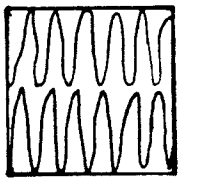
Locate the 9Kh SOUND FOCUS loop. Thread it as before; leave the 'scope connected.

Adjust the slit lens foward or back (horizontally) until the highest possible signal is read.

While holding the lens in the same relative horizontal position (to retain the correct focus), slightly rotate the lens tube to set the PHASE. This is critical, as incorrect phase settings will trigger false phase shifts, causing surround to turn on at inappropriate times.

PHASE setting represents a critical azimuth setting, affecting both mirrors of the split cell.


LOW


HIGH

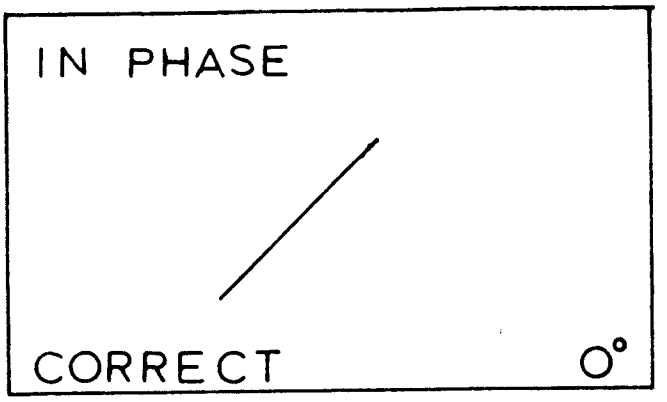
The following page illustrates the correct 'scope pictures indicating proper phase alignment.

When correct focus and phase settings are made, lock the slit lens tube into place.

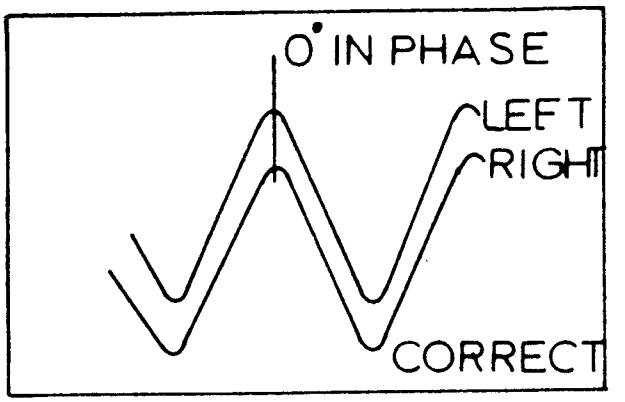
CAUTION: Watch the 'scope while locking the lens tube. The phase setting may change slightly in the process. If so, "overcompensate" the lens position, so the lens is in phase when locked.

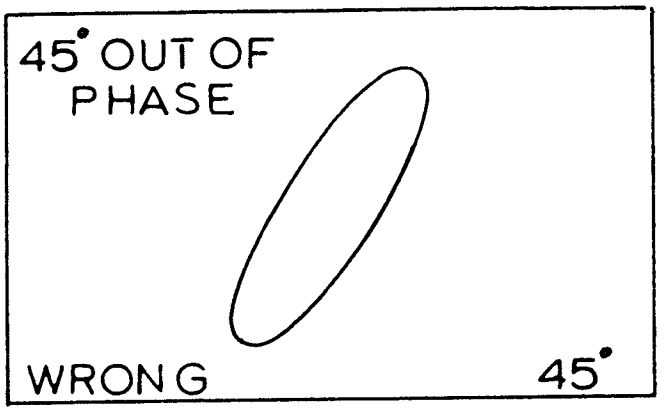
9 KHZ TEST FILM (LOOP)

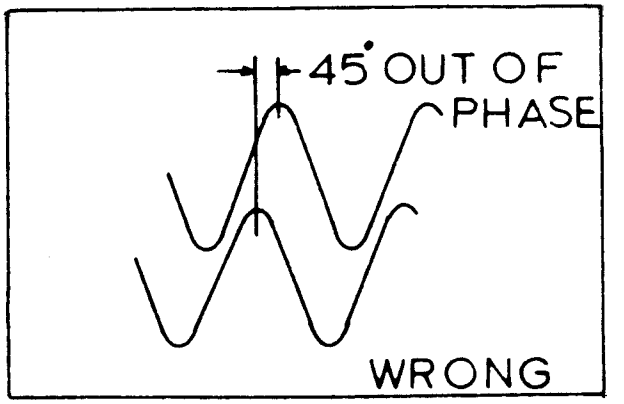
SCOPE CONNECTED FOR PHASE "PICTURES"
X-Y INPUT
Y-INPUT LEFT X-INPUT RIGHT

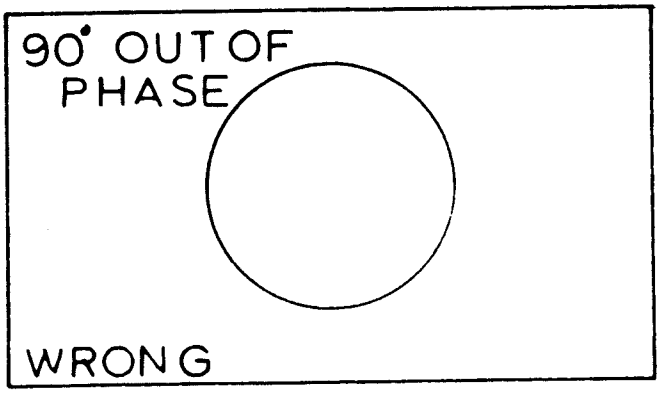


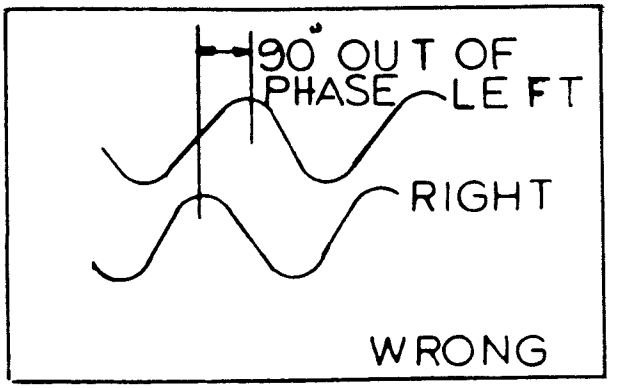
SCOPE CONNECTED FOR DUAL TRACE "PICTURES"

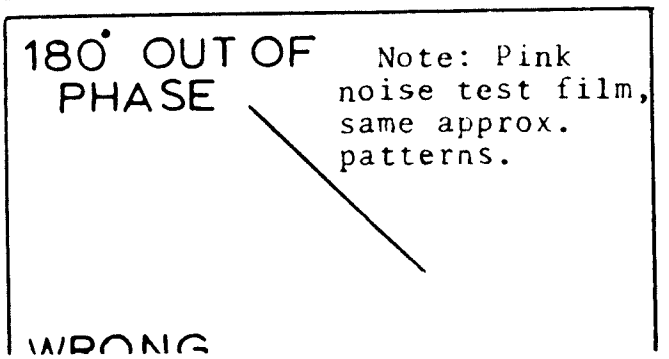




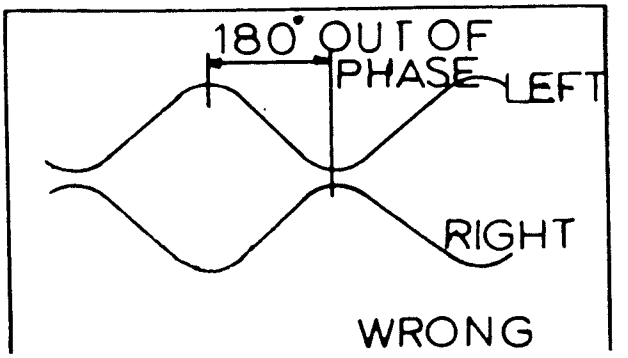








Note: Pink noise test film, same approx. patterns.

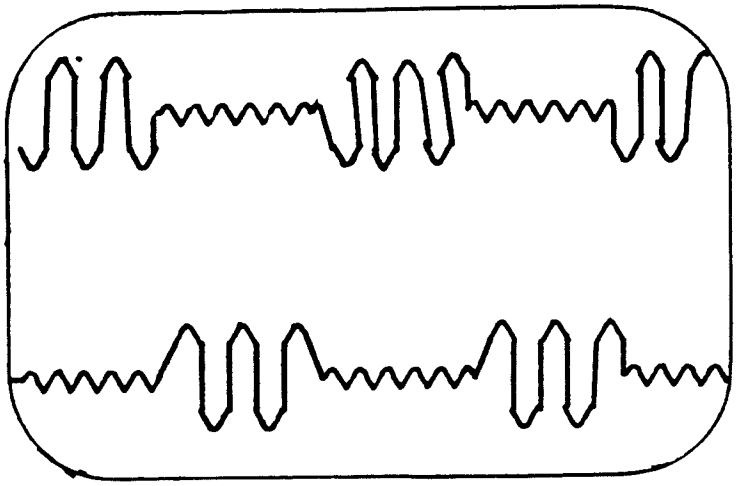


Remove the 9K loop and thread the ALTERNATE TRACK loop. This loop is used to set the cell position for minimum "crosstalk" from one cell mirror to the other.

With the loop running, adjust the cell head laterally (in and out) until the 'scope picture below is seen.

NOTE:
The "high" signal on one trace should equal the "low" signal of the other trace. It is impossible to read a "null" (straight) on the "low" signal.

"Crosstalk" cannot be eliminated, but it can be minimized, when the 'scope picture illustrated is duplicated.



A difference in amplitude from one side of the cell to the other is not unusual. This difference can be corrected in the process of setting the processor pre-amplifier.

If the amplitude variance is extreme, or if one side of the cell reads "null", order a replacement cell head.

RECHECK Focus and Phase using the 9Khz "Sound Focus" loop.

Once the split solar cell has been aligned, reduce exciter lamp voltage to 4 to 5 volts DC and connect the solar cell plugs to the processor. Take care to differentiate LEFT and RIGHT cell inputs for each projector.

Remove the front panel of the STARSCOPE processor and locate the PRE-AMP board (far left).

Note that the pre-amp is a reversible, double board. The lower half of the board is in circuit during normal operation, and the upper half is a stand-by.

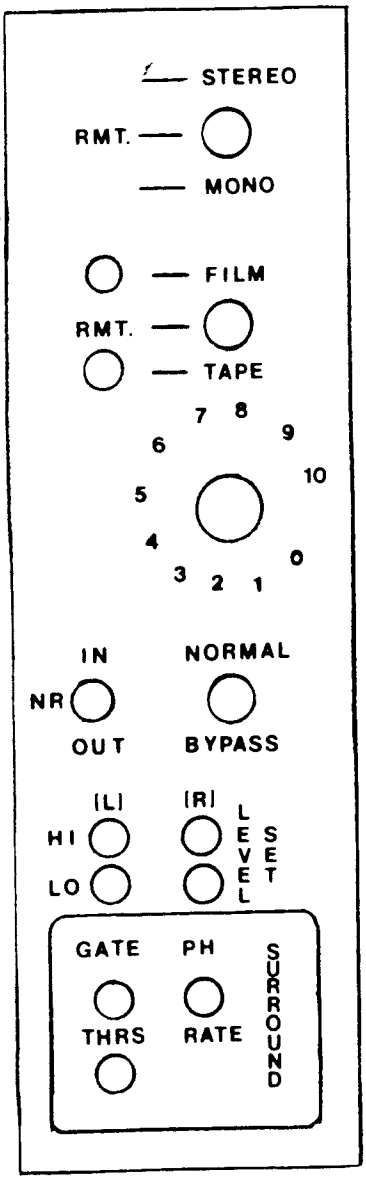
Thread the 50% MODULATED loop through the projector. This is one side of the dual-soundtrack test film which was included in the shipment; the 50% side is identified as that with regular, symmetrical modulation. The other side is "pink" noise.

To set the pre-amp input levels, turn the processor ON. It is not necessary at this stage to turn the power amplifier(s) on.

With the loop running, adjust the GAIN controls (labelled "A" on the drawing, following page). Take care to differentiate PROJ 1 and PROJ 2. The correct input (300 millivolts at 50% modulation) is indicated at point "C" (drawing), or when both HI and LO LEDs are lit simultaneously. After setting both L and R controls for one projector, all four LEDs should be lit.

Place the switches on the format board in the following positions:

1. Mode switch - stereo
2. Source switch - film
3. Fader - minimum
4. Noise reduction - in



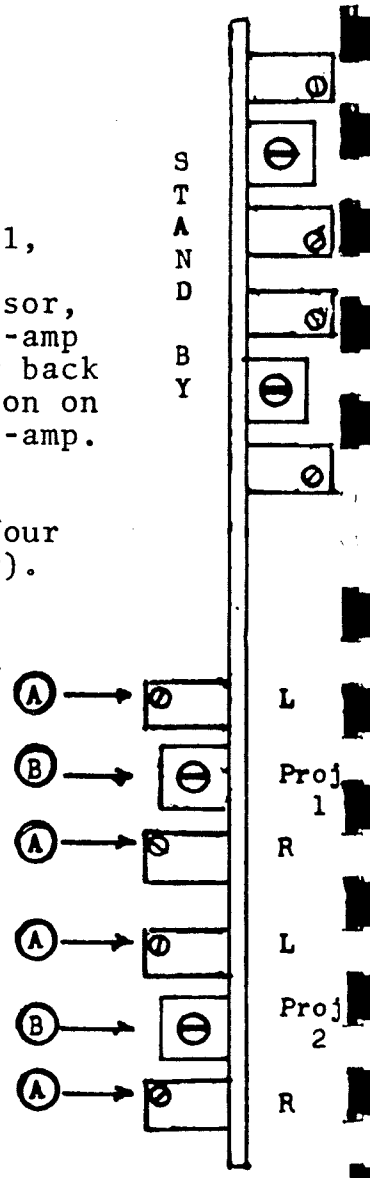
FORMAT BOARD COVER

NOTE: After setting PROJ 1, L and R, for correct input level, turn off the processor, remove and reverse the pre-amp board. Turn the processor back on, and repeat the operation on PROJ 1 on the STAND-BY pre-amp.

In all, the pre-amp input set-up must be performed four times (twice per projector).

In the case of a single projector booth, the input plugs on the rear of the processor can be re-plugged to PROJ 2 and set up as before. This provices three stand-by pre-amps;. one stand-by available by reversing the board, two more by switching solar cell input plugs.

Potentiometers "B" are used to balance split cell signals. If the input level cannot be correctly set using the GAIN (A") pots, the balance pots will change the relative signals to enable correct level setting.



PRE-AMP TRIM POTENTIOMETERS

Clockwise:
BOOST
Counterclockwise
CUT

NOTES

Prior to Equalization

-Are all speakers in good working order? If necessary, re-cone old speakers.

-Are the speakers wired in correct phase?

-Are all speakers firmly mounted? Are they directed toward the audience? Speaker direction is especially important with the high frequency horn.

-Are all speaker crossover networks set FLAT?

Use a high quality sound response/frequency or real time analyzer. Be familiar with its operation. Is it correctly calibrated?

Place the analyzer microphone in a stand at about "ear" height in the center of the auditorium, two-thirds back from the screen (i.e., at row 20 in a 30-row house.)

Connect pink noise generator to PRE-AMP OUT jacks on the rear of the processor. Set the pink noise output to the 300 mv level (all LEVEL SET LEDs lit).

-Can some features of the auditorium be improved? Does the back wall require a sound-absorbing wall cover? Can a noisy air conditioner be baffled?

EQUALIZATION

1. Turn on power amplifiers.
2. Set STARSCOPE fader control to 6 or 7. This control will become the master sound control (volume setting) for the booth.
3. Using a "Y" connector, plug "pink" noise generator into the PRE-AMP OUT jacks on the rear of the processor (illustration on following page).
4. Unplug the pre-amp board. Unplug all Noise Reduction/ Equalizer (NR/EQ) boards EXCEPT the center stage speaker channel.
5. Using the sound pressure level meter, set the center stage channel power amplifier output to 72 decibels (db) read at 1Khz range.
6. It is convenient to use 1Khz as a reference point. Sweep down through 500 Hz, 250 Hz, and BASS (63 Hz), adjusting the potentiometers (labelled on the board) to the 1Khz reference of 72 db.
   Since the adjustments are interactive, it is necessary to make at least three sweeps to achieve the correct settings. ESPECIALLY if one setting required a large correction.
   Start at 1Khz range each time.
7. Use the same procedure going UP from 1Khz. The TREBLE (8Khz) potentiometer should be set to show a 6 db "roll-off" (decrease) from the 1Khz reference of 72 db (64-68 db at 8Khz).

REPEAT this procedure for all front channel speakers; that is, unplug the center channel NR/EQ board, plug in LEFT NR/EQ board, and equalize the left channel. Then, unplug the left NR/EQ board, plug in the RIGHT NR/EQ board, and equalize the right channel.

On two-channel STARLET systems, there is only the center stage channel to equalize. If the STARLET is, in the future, upgraded to a four-channel system, the added LEFT and RIGHT boards will require the above equalization process.

Fine Tuning

a) If there is excessive sibilance ("hissing" sounds) noticeable when running an optical-stereo print, reduce the 4Khz setting by 2 db.
b) If more dialog "presence" is desired, the center channel 1Khz and 2Khz settings may be boosted 1 or 2 db.

8. SURROUND OUTPUT SETTING
   a) Remove "pink" noise output leads from PRE-AMP OUT jacks. Disconnect either PROJ 1 or PROJ 2 solar cell plugs. Plug only ONE of the "pink" noise output plugs into either one of the vacated solar cell jacks.

SURROUND OUTPUT SETTING, Continued

b) Re-connect the pre-amp board.
c) Set the surround power amplifier output

Surround Threshold

Thread the "Surround" test loop through the projector. With the loop running, adjust the THRS potentiometer (accessible on the Format Board Front Cover) until the GATE and PH LEDs flash simultaneously.

NOTE: This is an "average" set-up; the theatre owner may want more or less surround. For more surround, turn the THRS potentiometer clockwise; for less, counterclockwise.
This potentiometer is usually set at a 1 o'clock position.

OPERATOR CONTROLS

All processor operator controls are located on the front of the format board (illustration, page 10).

STEREO and MONO setting is determined by the print being run. MONO position bypasses the stereo and surround circuitry, and cuts high frequencies to conform to the "Academy" curve. STEREO position utilizes all processor circuitry for the enhanced effects of optical-stereo soundtracks.

RMT setting is used when remote control switching is incorporated. Remote control wiring is detailed in the next section.

FILM and TAPE distinguishes between "show and "intermission" inputs. In the FILM position, the processor receives its signal from the soundhead, and in TAPE, from the tape deck or other non-sync sound source.

NORMAL setting is the one used for everyday operation, whether the print being run is stereo or monophonic. BYPASS eliminates the Noise Reduction/Equalizer board from the circuitry, and is used only in the event of a NR/EQ board failure.

The Noise Reduction alone can be bypassed by removing (manually) the jumper plug from the RMT. N.R. jack on the rear of the processor. Noise Reduction (IN or OUT) can also be controlled remotely.

As mentioned before, the processor fader is used as the master booth volume control, once the power amplifier output levels are set in the process of equalization. The processor volume control increases or decreases all channels simultaneously and relative to one another.

The processor fader is used to compensate for volume differences from one print to another, noisy audiences, etc.

Resetting power amplifier faders will upset the relative balance of the different channels as set during equalization! Make all volume corrections with the processor fader!

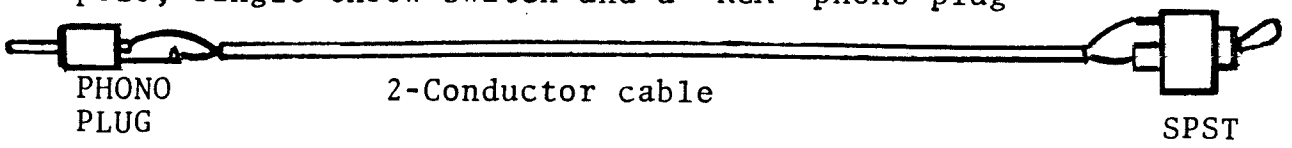
REMOTE CONTROLS

All operator controls on the processor format board can be operated from remote positions, either elsewhere in the booth, or from a station in the office or lobby.

When remote controls are used, the switches involved should be placed to the RMT position on the format board. This puts control of the function to the remote switch.

NOTE: If the format board switch is placed in RMT and no remote switches are connected, the function involved will "favor" the upper position; that is, STEREO rather than MONO would be in circuit, FILM rather than TAPE, etc.
EXCEPTION - MAG/OPT favors Optical (SUPER STARSCOPE Mag/Optical only)

Wire remote controls as illustrated below, using a single-pole, single-throw switch and a "RCA" phono plug



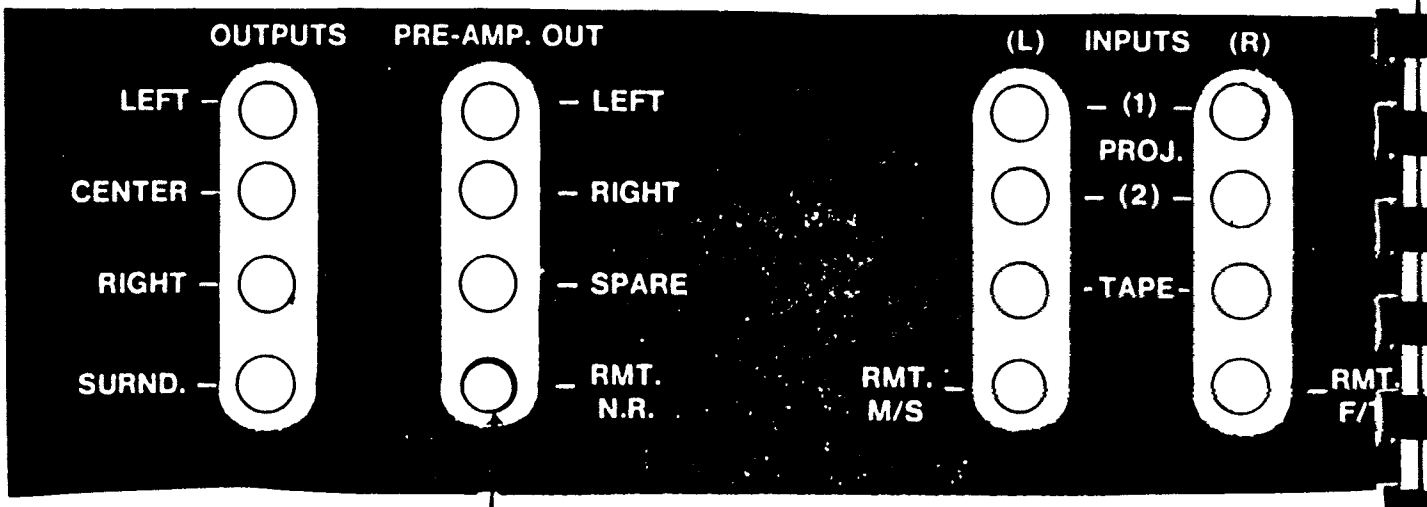
CLOSING the switch places the Format function in the upper setting (STEREO rather than MONO, etc.). OPENING the switch places the Format function involved in its opposite mode.

Remote functions can also be automated using open or closed dry relay contacts. Refer to the instructions furnished by the manufacturer of the automation equipment.

A remote volume control is available, at extra cost, from EPRAD

Remote jacks are illustrated below for the STARLET and STARSCOPE processors. These jacks are located on the back of the unit.

SUPER STARSCOPE controls will be detailed in the "Mag/Optical" section.



TROUBLESHOOTING GUIDE
STARSCOPE/STARLET

PROBLEM	PROBABLE CAUSE	REPAIR
too much surround or dialog in surround channel	1.Cell inputs out of balance	1.Adjust balance pot
	2.Cell out of phase	2.Re-set lens tube
	3.Broken connection in solar cell input plug	3.Re-solder connection
	4.Excessive end play on/or improperly fixed lateral guide roller in soundhead	4. Re-work soundhead
	5.THRS pot overset	5.Turn THRS pot down
	6.Component failure	6.Replace Format board
No surround or too little surround	1.THRS pot underset	1.Turn THRS pot up
	2.Component failure	2.Replace Format board
NOTE: Some optical stereo prints have been recorded WITHOUT a surround channel. If in doubt, ask the distributor.		
no sound	1.Power amp off	1.Turn on power amp
	2.Power amp fuse blown	2.Replace fuse
	3.Faulty NR/EQ board	3.Switch to BYPASS until replacement board is located
	4.Faulty Pre-amp board	4.Reverse pre-amp to Stand-by board
	5.Faulty power supply Board	5.Replace board
	6.Loose connection to Processor	6.Check and tighten connections
"Hum" noticeable when unit is on but not in use	1.Ground loop	1.a)Make sure solar cell is NOT grounded at the soundhead b)If processor is rack mounted, remove the ground lead (green wire with auto clip terminal) from "Mother" board c)Ground pedestal
	MOST sound problems are the result of a misaligned or damaged split solar cell. Maintain the cell CAREFULLY!	

IMPORTANT NOTES:

OVERLOADING INPUTS

If you cannot adjust "Dolby Level" (300 mv) low enough, see following:

To avoid overloading the input state, we recommend that you operate the exciter lamp at a lower voltage (approximately 5 volts). Operating the exciter lamp at five volts or less will extend the life of the exciter lamp very substantially and delay filament sagging and twisting, insuring better functioning of surround electronics.

If it is not convenient or undesirable from your point of view to lower the exciter lamp voltage, then add a low noise 2500 ohm resistor (approximate) across each half of each solar cell.

STATIC NOISES IN SOUND SYSTEMS

If the split solar cell is too close to the film, the electrostatic discharges (especially in dry climates) will cause random mysterious noises in the sound.

Move the split solar cell further away from the film.

Do not move solar cell more than necessary to eliminate noise. The further you move the solar cell away, the less "separation" of left and right track signals.

HIDDEN FUSES

Please note that the Starlet has under the power amplifier chassis and on the power supply chassis, four fuses. These are diode and DC fuses.

Further, with all Starlets being delivered after December 1, 1979, there are an additional four fuses on the power amplifier printed circuit board.

On all Star Power Amplifier Systems, starting on October 1, 1979, there are additional fuses on the sub-chassis.

The above arrangement of fuses is a result of some program logic fuse array designs, to allow the system to continue working even though certain critical parts might fail.

Note: It is possible that some of the fuses may be "blown" and from listening to the system you could not detect it.

It is also possible that certain of these fuses may blow and either cause the complete failure of the system or failure of part of the system.

These failures can be detected externally by observing the pilot lights.

OPTICAL PRE-AMP

OVERVIEW

The Starlet/StarScope #25410A Pre-Amp Module is configured as two completely independent dual stereo-optical sound track pre-amplifiers, each of which is designed to amplify the split solar cell outputs of a two projector booth utilizing exciter lamp changeover. The two dual stereo pre-amps reside symmetrically on opposite sides of the module and have no common component except for the printed circuit board.

It is intended that side #2 be the back-up pre-amp in an emergency situation, so it is advised that side #2 be set-up and maintained identically to that of side #1 at all times, so that in the unlikely event of a failure in side #1 the only action necessary is to extract the 25410A module, turn it upside down, and re-insert.

Regardless of which side is being used, the adjustment potentiometers on the lower half of the module and to the left are those in current control. These adjustments provide Projector #1 left and right gain, Projector #2 left and right gain, right and left channel slit loss correction and a left-right gain balance control for each projector.

ELECTRICAL DESCRIPTION

Refer to Drawing 25410S (Pre-Amp Schematic)

Power is supplied to the active pre-amp through the lower most pair of edge connector pins (1 and A). The power originates on the power supply module and is produced by an integrated voltage amp regulator dedicated to the Pre-Amp Module. The voltage at this point is approximately +15 volts and has 60 and 120 Hz components summing to less than 1mv.

This voltage is further decoupled from line frequency components by a 100 ohm resistor and 1000 microfarad capacitor network. The voltage here in normal operation is reduced to +12 volts ± .5 volts which indicates the typical 30 ma current drain.

Each of the four solar cell inputs is terminated in a load of 4,700 ohms in parallel with 680 pfd. The capacitance plus the distributed capacitance in 25 feet of shielded cable of the type EPRAD supplies, produces a 6 db/octave roll-off starting at 12 to 15 Hz.

Ferrite beads are placed in the signal lines as a good compromise between attenuating radio frequency energy in the area and immunity to picking up stray 60 Hz magnetic fields.

ELECTRICAL DESCRIPTION (Continued)

It is suggested that after lens tube, solar cell and guide roller adjustments have been made, that an exciter lamp voltage be selected that will produce 50-100 millivolt peak-to-peak signal across the 4,700 ohm load resistor when 100% modulated film is run through the projector. This will produce a best compromise between noise ratios if the signal is too low and solar cell distortion if this level is too high. If the situation dictates, a load resistor as low as 1,000 ohms may be substituted for the 4,700 ohm load.

The heart of the amplification system of each two-projector pre-amp is a pair of LM382's. These are industry standard dual low-noise pre-amp integrated circuits. They are rated for 9-40 volt power supply operation and have a typical total equivalent input noise of less than 1 microvolt.

The gain of each solar cell input channel may be varied from 17 to 34 db by adjusting the 10k ohm gain pot. An additional 2 to 9 db range may be realized between the left and right channel gains of any one projector by varying the balance control, (All normal operating situations would advantageously leave the balance control in mid-position).

All gain controls would be necessarily adjusted during set-up, so as to produce 600 mv rms on each left and right pre-amp output when running 100% modulated film (300 mv for 50% modulation).

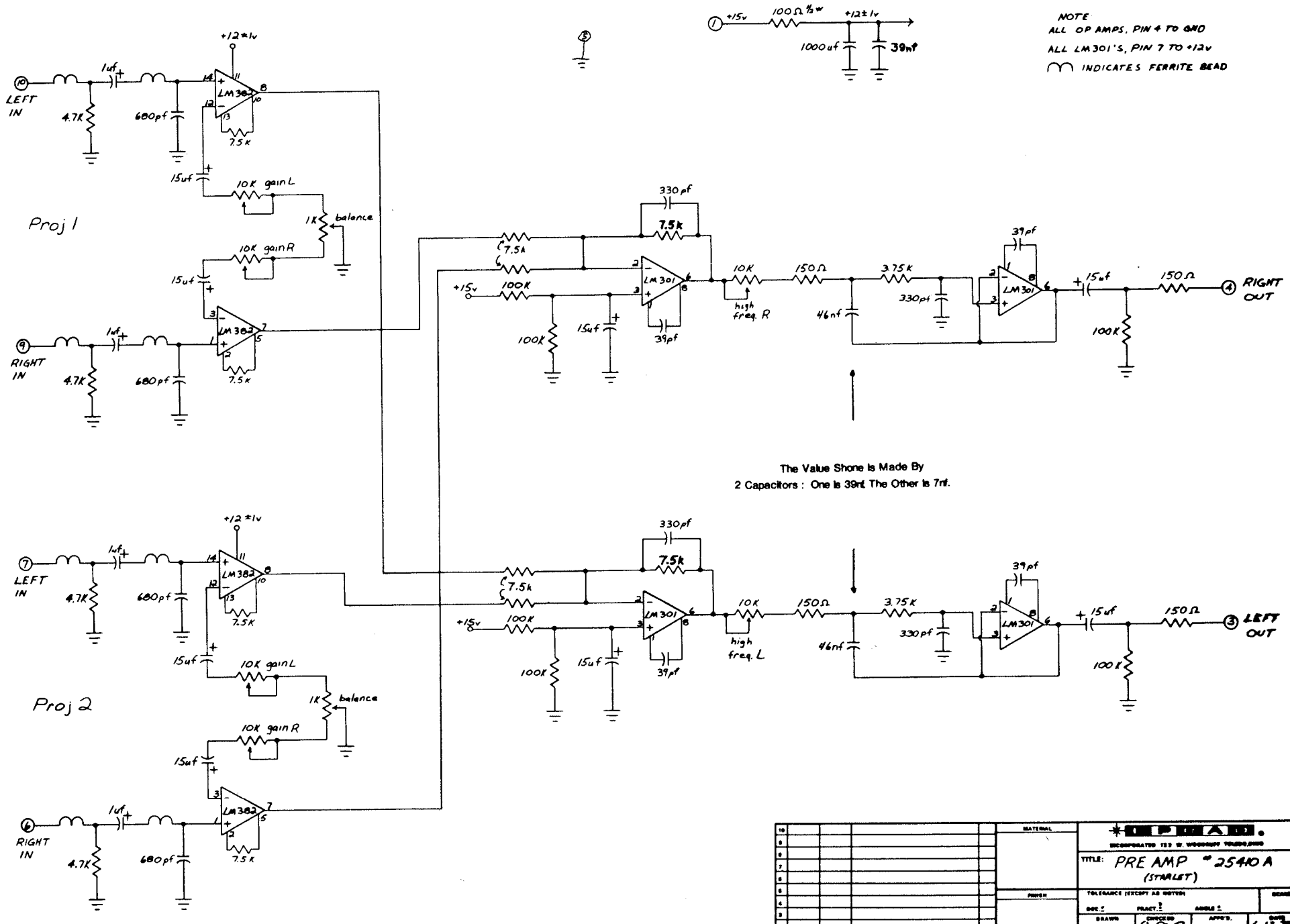
As a troubleshooting aid, all inputs of the LM382's are at 1.25 volt dc, all outputs are at 6 v dc.

The stage following the LM382's is a unity gain current summing network mixing the left channels of projector #1 and #2, and likewise the right channels of projector #1 and #2.

The stage following each current summing network is the slit-loss corrector which also serves as an output buffer. The 10 k ohm high frequency response which rises from unity gain at a 3 KHz to +12 db at 12 KHz. This response compliments the solar cell output spectrum to 12 KHz when incorporating the EPRAD supplied .8 mil optical slit. Frequencies beyond 12 KHz roll off at greater than 18db/octave.

All input and output voltages of the current summing and slit-loss correction operational amplifiers are normally 6 volts, ± 1 volt.

The full-gain background noise generated by the pre-amp in the 1 KHz octave is typically below 90 db down referenced from 1 volt rms.


+15v
100Ω ½w
+12±1v
1000uf
39nf
NOTE
ALL OP AMPS, PIN 4 TO GND
ALL LM301'S, PIN 7 TO +12v
INDICATES FERRITE BEAD
Proj 1
LEFT IN
RIGHT IN
4.7K
1uf
680pf
LM382
7.5K
15uf
10K gain L
10K gain R
1K balance
330pf
7.5k
100K
LM301
39pf
10K
high freq. R
150Ω
3.75K
46nf
330pf
100K
RIGHT OUT
Proj 2
high freq. L
LEFT OUT
The Value Shone Is Made By
2 Capacitors : One Is 39nf The Other Is 7nf.
TITLE: PRE AMP # 25410 A
(STARLET)
DRAWN
CHECKED
APP'D.
6-13-77
25410S

FORMAT CARD

OVERVIEW

The 25430B is a truly multi-functional device. It accomplishes the Film/Tape, Stereo/Monaural, and Normal/Bypass selections, the Dolby Level Indication and the Surround Function, as well as the System Volume Control.

ELECTRICAL DESCRIPTION

The Film/Tape switching is performed by four N-Channel junction F.E.T.'s. The appropriate pair is turned on by a slightly positive gate voltage which is clamped by the appropriate L.E.D. indicator.

The associated triple pole, triple throw front panel switch parallels the appropriate on F.E.T.'s and applies -15 volts to the pair's gates during manual operation. For remote control selection, the front panel switch must be placed in the center (No connection) position which enables an I.C. (LM 2901 and LM 339) to control the F.E.T. gate voltages in reaction to the remote Tape/Film input.

A short to ground of the remote input produces the tape channels, and open switches in the optical pre-amp outputs. When the manual switching is used the remote input is overridden.

The Stereo/Mono section immediately follows the Film/Tape Circuitry to the upper right portion of the schematic. Here the left and right channels are buffered by low noise TL072's or LF353's before being passed to the associated NR-EQ cards. In addition, an equal mixture of left and right is accomplished by a current summing network to produce a center channel.

On the input side of the left and right channel buffers a pair of N-Channel junction F.E.T.'s may be turned on which will switch in .61NF capacitors in order to reduce the high frequency responser for monaural type features. The gate voltages of these F.E.T's may be manipulated directly by the front panel switch or remotely from the Remote Stereo/Mono input, when the front panel switch is in the center off position. A remote short to ground produces monaural, and open, stereo. Manual operations overrides the remote input.

The Normal/Bypass selection is depicted at the left-center of Drawing #35430S when the left, center, and right channels return from their respective NR-EQ modules. At this point the triple-pole double throw switch selects the NR-EQ processed channels or the optical pre-amp outputs. This option is valid for failures of NR-EQ modules or the power supplies that power to them, since the pre-amp has its own independent supply.

FORMAT CARD

ELECTRICAL DESCRIPTION (Continued)

The Dolby/Level indication circuitry is shown in the lower left of Drawing #25430S. The left and right pre-amp outputs are first fed through calibrated voltage amplifiers. The gains of these stages are set at the factory for proper Dolby level indication. The diodes immediately following form a peak-to-peak detector with d.c. output. This level is compared to a voltage divider network by an LM2901 I.C. Comparator which drives two pair of L.E.D.'s labeled "HI" and "LO".

If the rms value of a pre-amp channel output is far below Dolby Level, the corresponding channel will light the "LO" L.E.D. if higher, then the "HI" L.E.D. If the value is 300 + 2 millivolts, both the "HI" and "LO" L.E.D.'s of that channel will be lighted. Indications are valid only for sine waves below 2 KHz.

The Surround circuitry is shown in the lower right of Drawing #25430S.

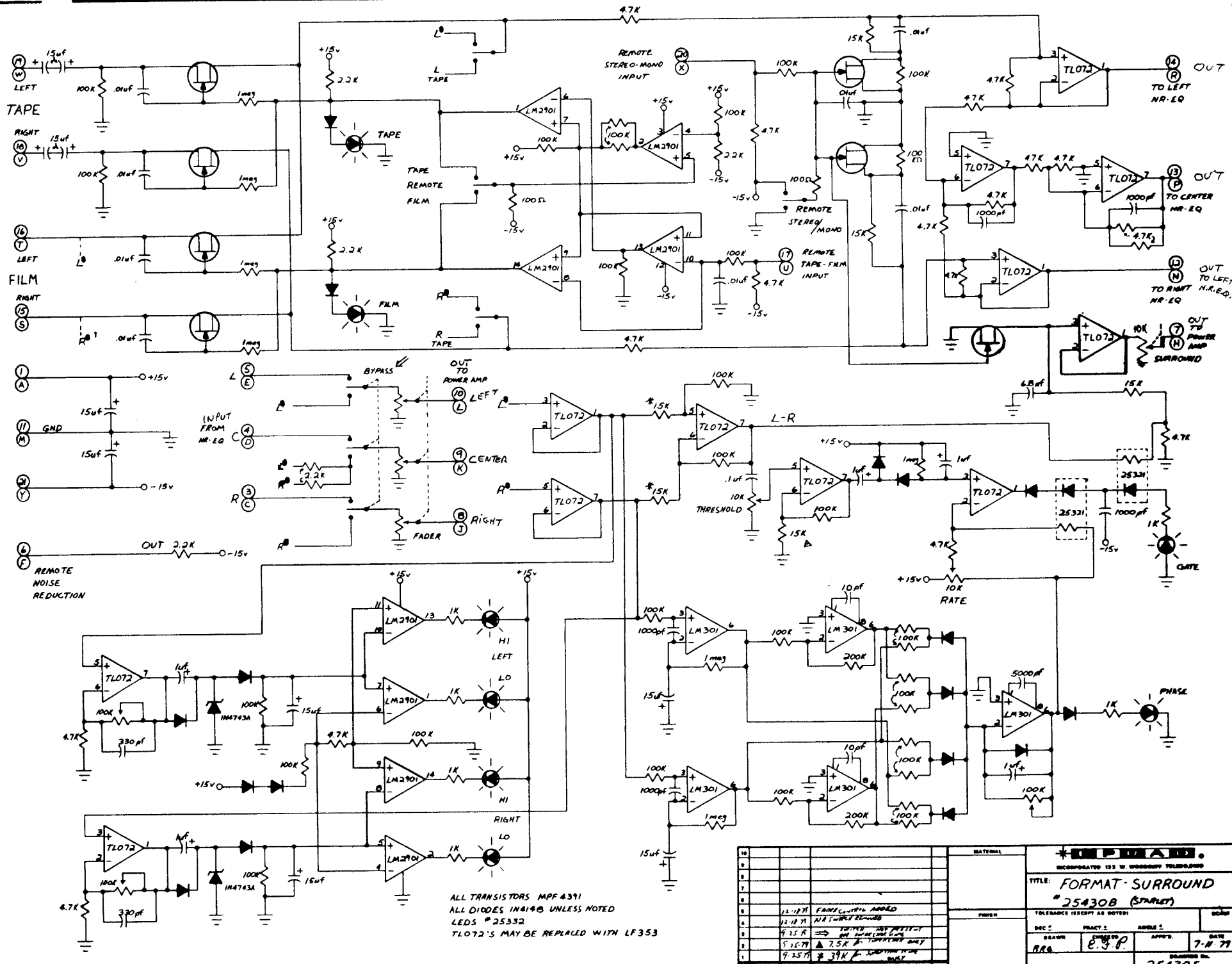
A differential amplifier monitors the difference between the left and right pre-amp channels. This produces a channel called "L-R" which is the material heard in the surround channel if the surround gate is open. The L-R signal is also fed down to the threshold potentiometer when a portion of it is peak-to-peak detected. The pre-amp outputs are also fed down to a phase detector comprised of five LM301's. The output of the phase detector will go positive and light the "phase" L.E.D. for all phase relationships of the predominant signal between 90 degrees and 270 degrees.

It is the combination of the positive going phase output and the negative going peak-to-peak L-R detector, which drive the surround gate (25321 opto-resistor) open.

And it's the novel connection of a notched pair of L.E.D. activated resistors in the surround gate and feedback path of the driving op-amp which makes it a highly controlled gating.

Adjustment of the threshold control provides for more or less surround content. The rate control provides for the speed of the transition between off and on of the surround channel.

There is a phase gain control which is preset at the factory to slightly over half-full sensitivity.


TAPE
LEFT
RIGHT
FILM
LEFT
RIGHT
TAPE
FILM
L TAPE
R TAPE
TAPE REMOTE FILM
REMOTE STEREO-MONO INPUT
REMOTE STEREO/MONO
REMOTE TAPE-FILM INPUT
LM2901
TL072
OUT TO LEFT NR-EQ
OUT TO CENTER NR-EQ
OUT TO RIGHT NR-EQ
OUT TO POWER AMP SURROUND
BYPASS
OUT TO POWER AMP
LEFT
CENTER
RIGHT
FADER
INPUT FROM NR-EQ
GND
+15v
-15v
OUT 2.2K
REMOTE NOISE REDUCTION
L-R
THRESHOLD
RATE
GATE
PHASE
HI LEFT
LO
HI RIGHT
LO
LM301
IN4743A
25332
ALL TRANSISTORS MPF 4391
ALL DIODES IN4148 UNLESS NOTED
LEDS #25332
TL072'S MAY BE REPLACED WITH LF353
TITLE: FORMAT-SURROUND
#254308 (STAPLED)
DRAWN RAG
CHECKED E.S.P.
DATE 7-11-79
DRAWING No. 25430S

NOISE REDUCTION/EQUALIZER MODULE

OVERVIEW

The 25420 module performs three-band noise reduction as well as full octave equalization, including bass and treble control for any one audio channel.

This module is used in the Starlet, StarScope and Super StarScope Sound Systems and may be freely interchanged throughout the current product line without modification.

The only adjustments recommended during normal installation and routine house calibration are those to the equalization boost-cut controls. These controls are located for convenient identification and adjustment without the need of an extender cord in all Star type systems.

ELECTRICAL DESCRIPTION

Reference to Drawing #25420S.

The 25420 module functions most effectively when powered by plus and minus 15 volt supplies, as is done in all Star family systems.

The maximum of 100% input level (Pins 4 & D) must be 600mv rms (approximately 2 volts peak-to-peak) for optimum playback performance of any currently available optical or magnetic soundtrack. This is not to mean that non-sync (tape output) channels must also meet this same stringent amplitude criteria. In general, any non-sync amplitude which fills the auditorium with a comfortable level of music or commercial broadcast dialogue is compatible with the Noise Reduction/downward-expansion characteristics of the 25420 module. But in no case can the input be allowed to exceed 1 volt rms. Of course, there is always the option to manually or remotely defeat the Noise Reduction function.

The first active stage that follows the input is a voltage amplifier with a gain of six. This brings the channel to be proceeded to an additional 16db further above any residual semi-conductor noise that may be generated in the module itself.

The passive resistive-capacitive circuits immediately following perform the function of dividing the audio spectrum into three adjacent bands. The circuits immediately following these filters are nearly identical for each of the bands. Each of these circuits contains: 1. A second order filter with band pass characteristics to insure smooth and even downward expansion between adjacent bands.

ELECTRICAL DESCRIPTION (Continued)

2. A full wave peak detector with negative polarity output which is directly proportioned to the amplitude within that particular bandpass. 3. A gain control (100k pot) which is adjusted at the factory to start the downward expansion in that band at approximately 18db down (about 75mv, rms). 4. A dc amplifier with a field-effect transistor in its feedback path which produces a non-linear output. 5. An attenuation network comprised of 1.5k ohm and 75 ohm resistors and a second field-effect transistor whose characteristics are matched to that of the F.E.T. in the dc amplifier. The output of the non-linear dc amp controls the F.E.T. attenuator so as to produce a downward expansion slope of nearly two over an input range of 20db.

The contents of these three independent parallel paths is combined in a current summing network as shown at the very center of the 25420S diagram. The amplitude at the output of this summing amplifier (pin 6 of the LM301) is at an amplitude of about three times that of the input level.

The noise reduction process is overridden by applying greater than -6 volts to pins 6 and F.

The last two 301 op-amps following the current summing stage each have four band reject filters attached to their positive and negative inputs by way of the wiper-arms of 50k ohm potentiometers. Seven of the eight of these filters contain a dual op-amp circuit with an input to output feedback arrangement (gyrator) which simulates the properties of an inductor. This inductance in series with the capacitor attached to the 50k ohm pot form a series L-C-R resonant trap. As the wiper arm of any 50k ohm pot is moved toward the positive LM301 input (counter-clockwise) a reduction of the amplitude of frequencies of that filter band-width occurs.

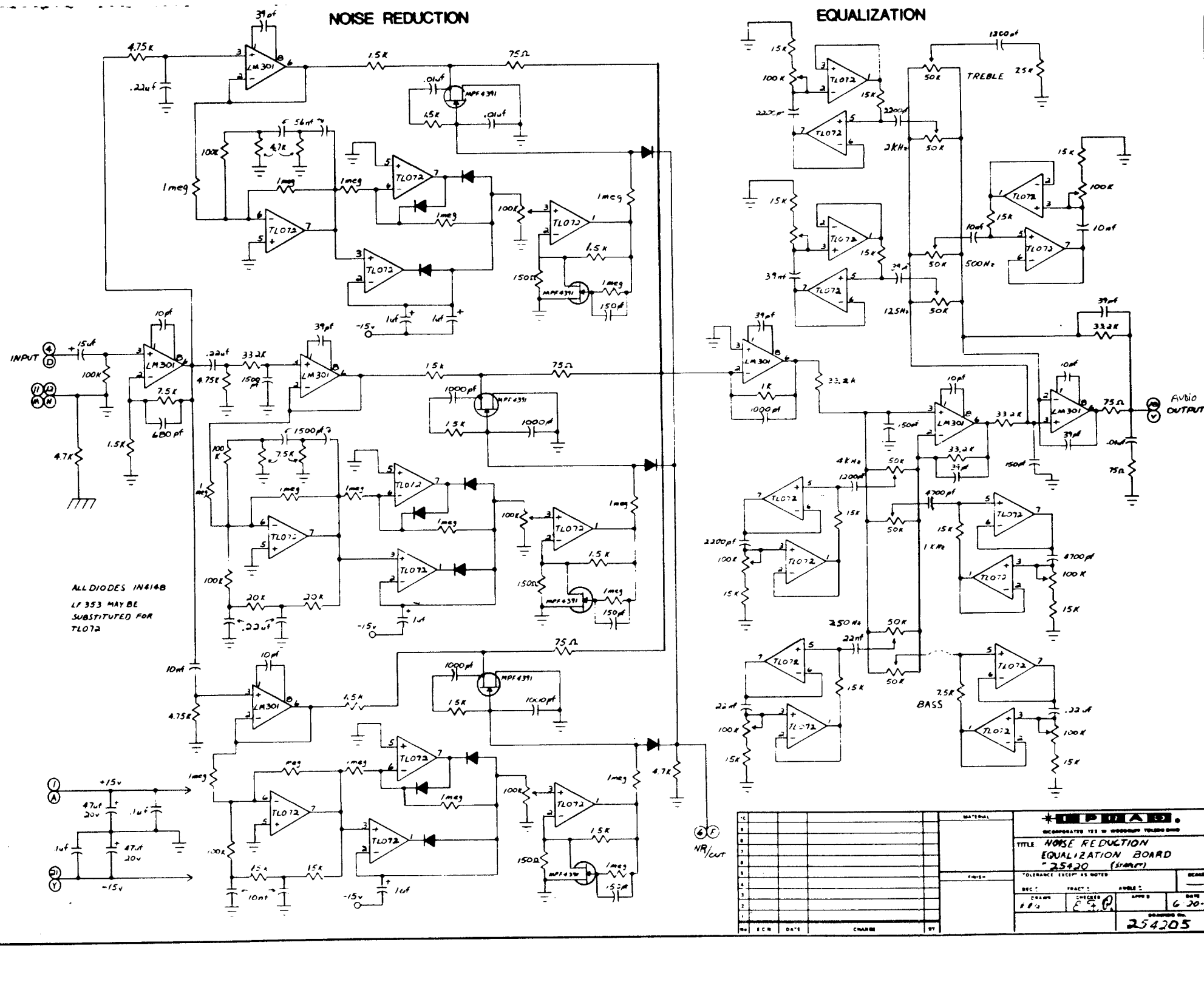
As the wiper arm is moved toward the negative input (clockwise) an increase of the band-width is realized.

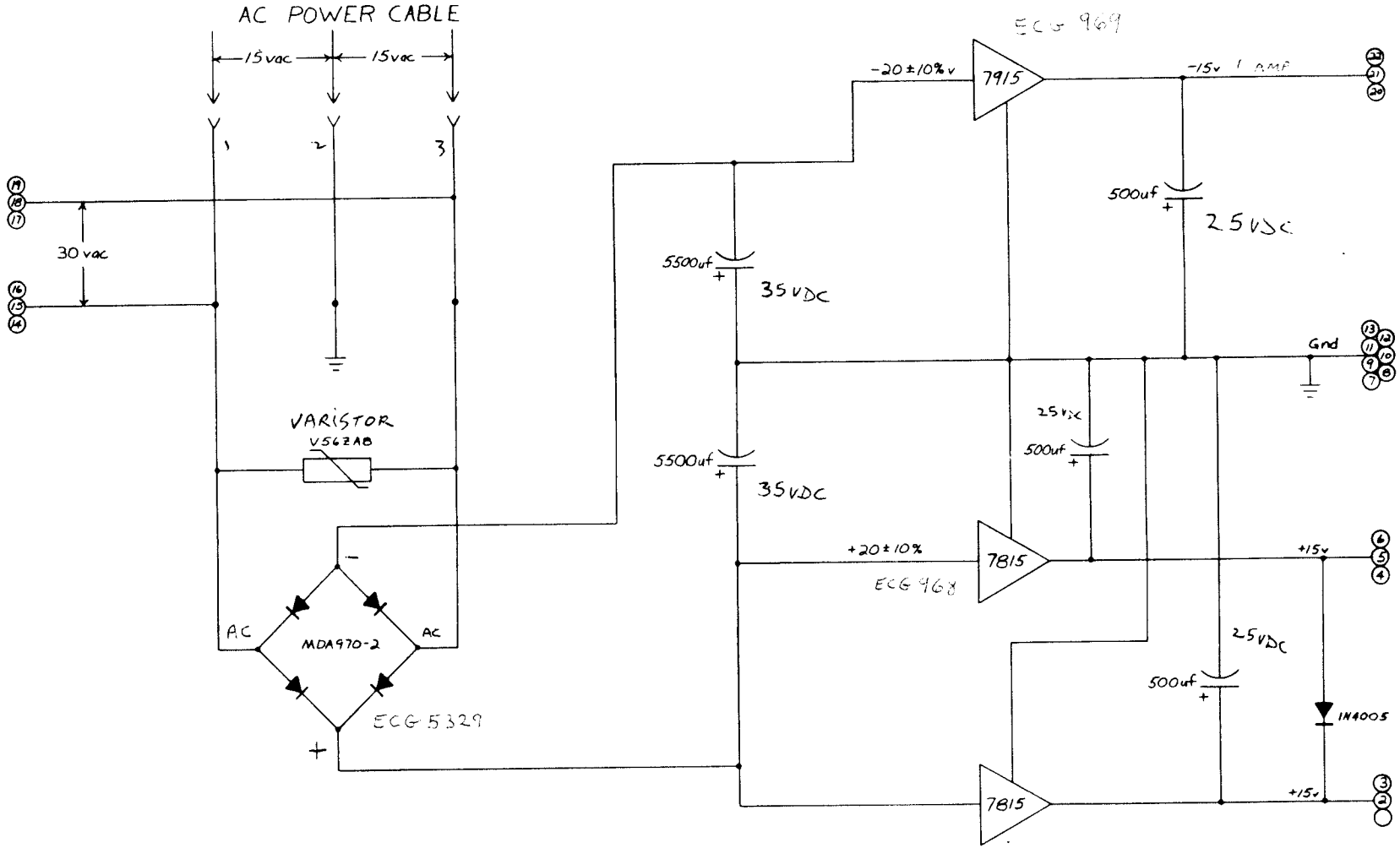
The maximum boost or cut with any one equalizer control is approximately plus or minus 10 db with a maximum Q of 2.

The 100k ohm pots in each of the seven gyrators provides an octave of center frequency adjustment and all are preset to the center frequency legends on the printed circuit board.

The noise present at the 25420 module output, from internal sources and with all equalizer controls set to the mid-position is -100db in the 1 KHz octave.

As a troubleshooting aid, under zero input conditions the input and output pins of all op-amps, except for the output pins of the TL072's in the peak detector, will be at circuit gnd potential plus or minus 250mv dc.


NOISE REDUCTION
EQUALIZATION
INPUT
AUDIO OUTPUT
NR/CUT
TREBLE
BASS
ALL DIODES IN4148
LF 353 MAY BE SUBSTITUTED FOR TL072
LM301
TL072
MPF4391
+15v
-15v
TITLE NOISE REDUCTION EQUALIZATION BOARD "25420 (stereo)
254205

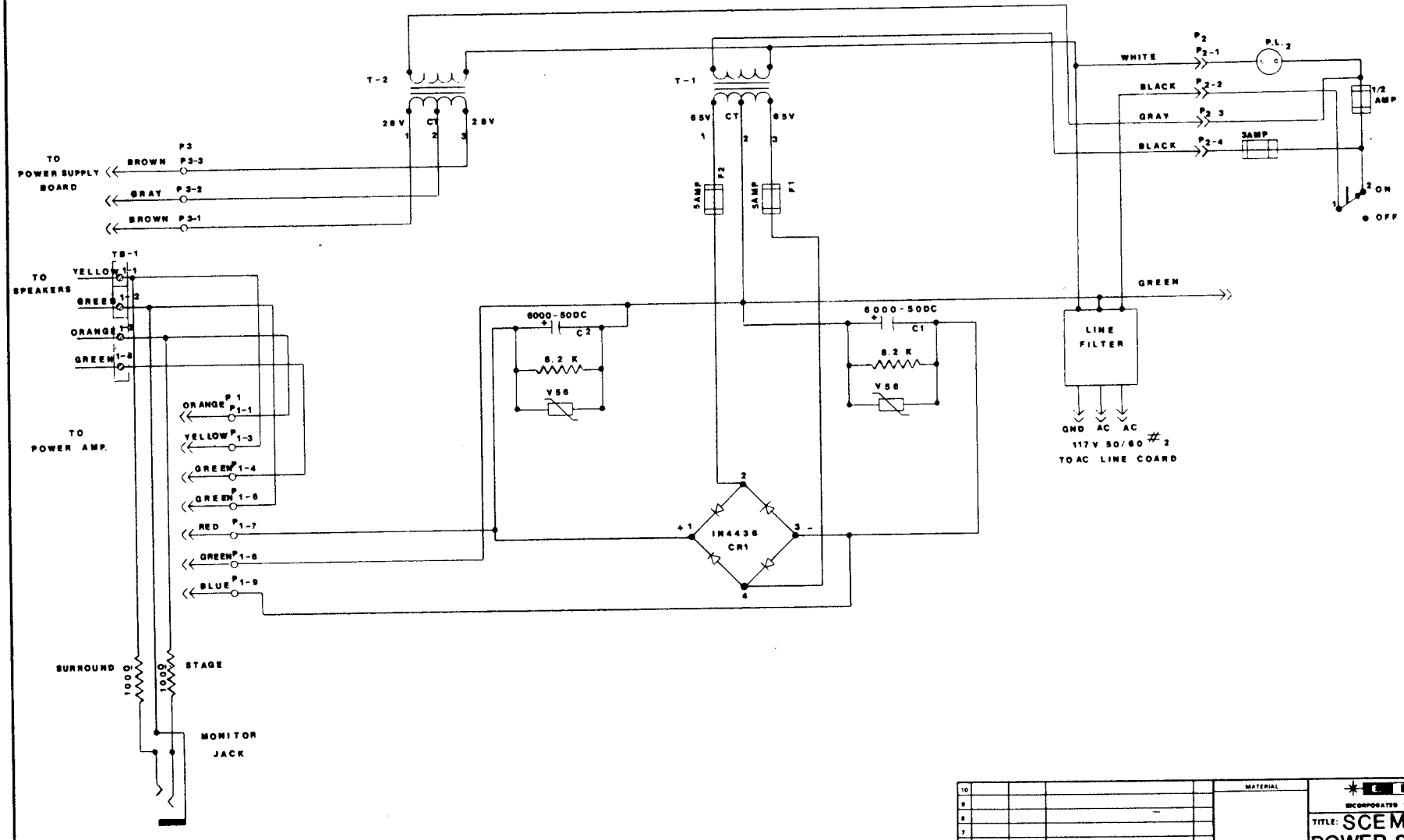


MATERIAL					
FINISH					
TOLERANCE (EXCEPT AS NOTED)					SCALE
DEC ±	FRACT ±	ANGLE ±			
DRAWN	CHECKED	APP'D	DATE		
RRG			6-19-79		
			DRAWING No. 25452		

No	E.C.N.	DATE	CHANGE	BY
10				
9				
8				
7				
6				
5				
4				
3				
2				
1				

EPIAD
INCORPORATED 123 W WOODRUFF TOLEDO,OHIO

TITLE: POWER SUPPLY BOARD #25450 (SHIELD)



No.	E.C.R.	DATE	CHANGE	BY
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9				
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7				
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4				
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2				
1				

MATERIAL

FINISH

EPRAD

INCORPORATED 133 W. WOODRUFF TOLEDO, OHIO

TITLE: SCEMATIC DIAGR
POWER SUPPLY (STARLE

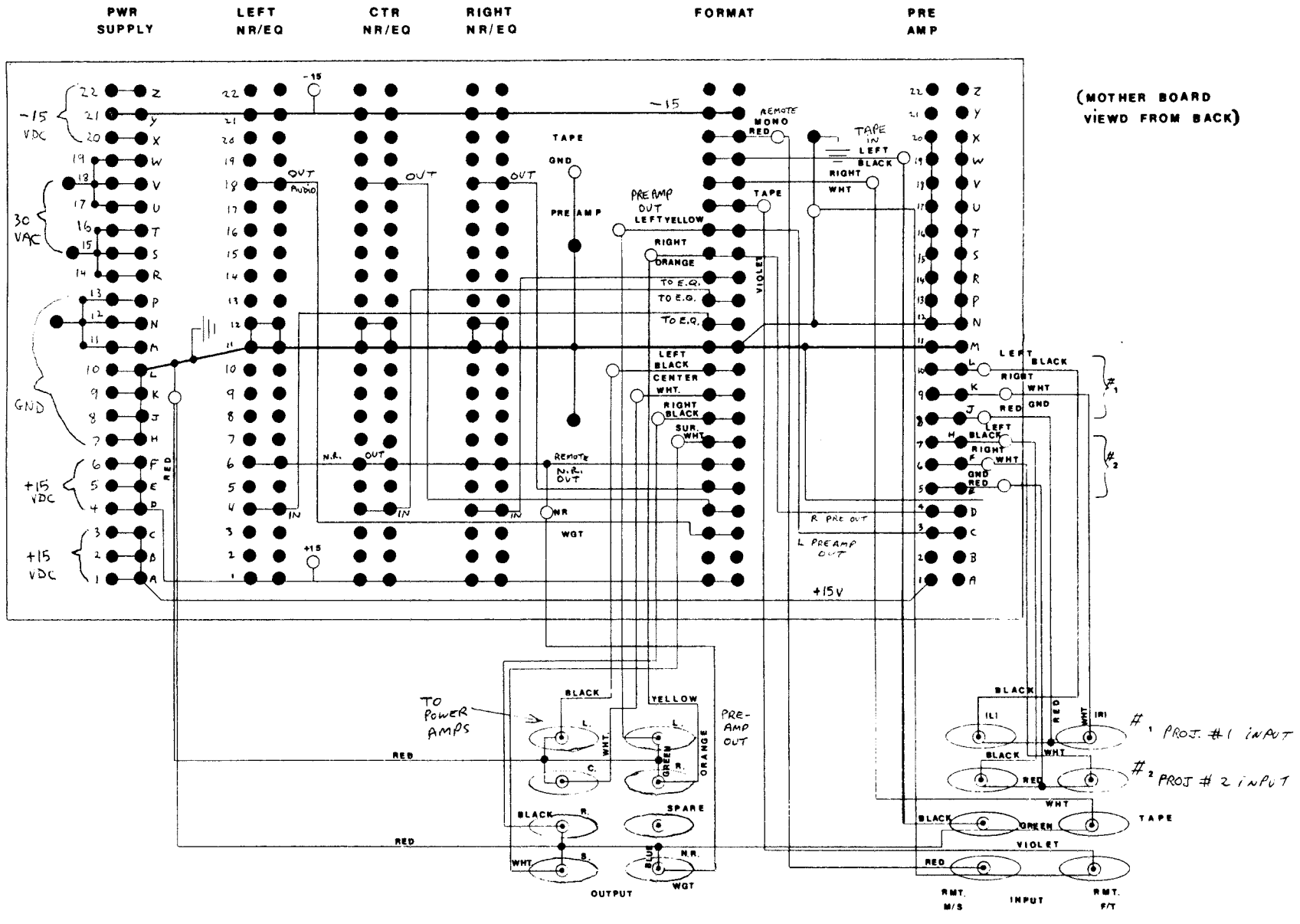
TOLERANCE (EXCEPT AS NOTED)

DEC ± FRACT ± ANGLE ±

SCALE

DRAWN	CHECKED	APP'D	DATE
		CS	3.7.8

DRAWING No.
25459-8



MATERIAL					
FINISH					
TOLERANCE (EXCEPT AS NOTED) DEC ± FRACT ± ANGLE ±					SCALE
DRAWN	CHECKED	APP'D	DATE		
	DCC		3/6/81		
				DRAWING No.	25459-B

No.	E.C.N.	DATE	CHANGE	BY
10				
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7				
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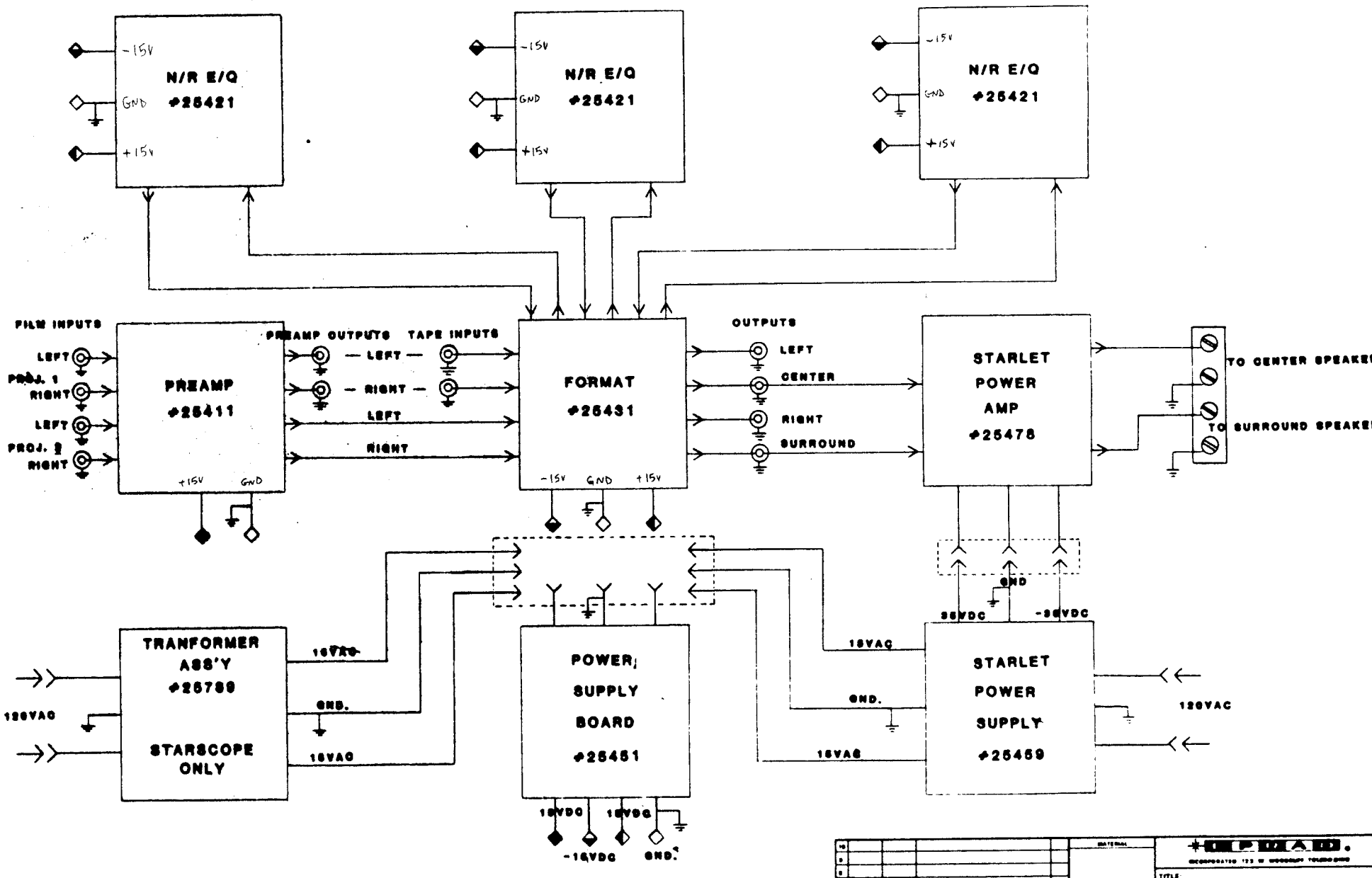
3				
2				
1				

PRAD.
INCORPORATED 123 W WOODRUFF TOLEDO OHIO

TITLE: MOTHER BD. INPUT OUTPUT SCEMATIC

STARLET/STARSCOPE BLOCK DIAGRAM



					MATERIAL	
					FINISH	
NO.	ECN.	DATE	CHANGE	BY		

TITLE: BLOCK DIAGRAM

TOLERANCE EXCEPT AS NOTED

DRAWN D.C.C. | CHECKED | APP'D | DATE 4/14/

DRAWING No. 25842

PRODUCT LIMITED WARRANTY

We at EPRAD, Incorporated are proud of our efforts to insure the optimum quality of each of our products and we warrant to the original purchaser that each new Starlet, StarScope or Super StarScope Sound System of our manufacture will, for a period of three (3) years after original shipment, be free from defects in material and workmanship under normal and proper operating conditions, and that properly used during such period, they will perform in accordance with our specifications.

EPRAD, Incorporated's obligation and the purchaser's exclusive remedy for any defect or failure to meet specifications shall be limited, at our option, to repair or replacement or, if we determine said defect or failure to be so defective as to preclude remedying repair or replacement, the purchaser's sole and exclusive remedy shall be limited to refund of the purchase price. Our warranty does not include reimbursement of shipping charges incurred for shipping repaired merchandise.

EPRAD, Incorporated shall have no obligation if defects result from improper use, operation above rated capacities, misapplication of the equipment, negligence, lack of preventive maintenance, accident, repairs in any way outside our Toledo, Ohio Factory, or any EPRAD factory branch which in our judgement affects the condition or operation of any product. Our warranty does not extend to the equipment and parts made by others, except to the extent of the original manufacturer's warranty to us. EPRAD, Incorporated assumes no liability for any damage, defect, or failure allegedly caused to any non-EPRAD product when said product is used in conjunction with EPRAD equipment, nor do our warranty terms extend to damage, defect, or failure to EPRAD equipment caused by the use of auxiliary non-EPRAD products.

The warranty of EPRAD, Incorporated does not cover labor and incidental costs occasioned by removal, replacement or repair of merchandise (other than by EPRAD), unless we have given previous specific written or telegraphic authorization. No other warranty is expressed or implied.

All warranty returns to EPRAD must first be authorized by the Factory sales office and are to be shipped prepaid. All non-warranty returns to EPRAD will by subject to a restocking charge of up to 15%. Returns on which transportation charges have not been prepaid may not be accepted.