Issue

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GREG HANKS DESIGN

BA-660

Operation and Service Manual

Created in Loving Memory of Benjamin Gregory Hanks

10-2-1990 ~ 10-8-2011

CONSCIENTIOUS AUDIO DESIGN AND MANUFACTURE

Use and Care of your Mic Pre/limiter

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Suggestions for Safety

WATER AND MOISTURE - - Do not use the unit near any source of water or in excessively moist environments

OBJECT AND LIQUID ENTRY - - Care should be taken so that objects do not fall and liquids are not spilled into the enclosure through openings

VENTILATION - - When installing the unit in a rack or any other location, be sure there is adequate ventilation..

HEAT - - The unit should be situated away from heat sources such as radiators, heat registers, stoves or other units that produce heat.

POWER SOURCES - - Care must be taken to ensure that the unit is only connected for voltage that is selected via the internal selector(s).

POWER CORD PROTECTION - - AC power supply cords should be routed so that they are not likely to be walked on or pinched by items placed upon or against them, paying particular attention to cords at plugs, convenience receptacles and the point where they exit from the unit. Never take hold of the plug or cord of your hand is wet and always grasp the plug body when connecting or disconnecting it.

GROUNDING OF THE PLUG - - This unit is equipped with a 3-wire grounding type plug, a plug having a third (grounding) pin. This plug will only fit into a grounding type power outlet. This is a safety feature. If you are unable to insert the plug into the outlet, contact your electrician to replace your 2 pin receptacle. Do not defeat the purpose of this grounding-type plug by removing the grounding pin.

CARTS AND STANDS - - The unit is heavy, and made with delicate components and as such should only be used with racks and stands recommended by the manufacturer. The unit and cart combination should be moved with care. Quick stops, excessive force and uneven surfaces may cause the unit and cart combination to overturn.

WALL OR CEILING MOUNTING. - - The unit should be mounted to a wall or ceiling only as recommended by the manual.

CLEANING - - The unit should be cleaned only as recommended by the manufacturer.

NON USE PERIODS - - The AC power supply cord should be removed from the unit when left unused for a long period of time.

DAMAGE REQUIRING SERVICE - - The unit should be serviced by qualified service personnel when;

A) The AC Power supply cord or the plug has been damaged; or

B) Objects have fallen into the unit; or

C) The unit has been exposed to rain or liquids have been spilled into the unit or

D) The unit has been exposed to thermonuclear explosion; or

E) The unit does not appear to operate normally or exhibits A marked change in performance; or

F) The unit has been dropped or the enclosure exhibits significant damage.

Specifications

- **Gain:**
  Mic In
  >+90 db max.
  <-20 db min.
  Line In
  > +34 db max.
  < -20 db min.
- **Input Impedance** (20 Hz - 20 Khz)
  Mic = 1k3 Ω
  Line > 20K Ω
  Insert Return > 100 K Ω
  Side Chain Insert > 220KΩ
- **Frequency Response**
  Mic In - 6 Hz - 38 Khz
  Line In -6 Hz ->45 Khz
- **S/N Ratio**
  > 120 db (avg 129db)
- **Output Impedance**
  Line Out (20-20Khz)
  20 Ω balanced (Designed for 600 ohm load))
  Insert Send < 100 Ω
- **Phantom Voltage** nom. +48VDC (Internally adjustable to +300 VDC @ 5 ma.)
- **Attack Time** – 3ms to 30 ms
- **Release Time** - 50 ms – 184 sec
- **Ratio range**
  1.5:1 - 9:1
- **Range of limiting**
  ≥ 14db
- **Maximum Input Level**
  Mic In
  @ +14 > + 45 dbm
  @ -15 > +25 dbm
  Line In > +40 dbm
- **Maximum output level**
  > +34 dbv ref. 600 Ω into 150 Ω
- **Harmonic Distortion**
  < .6% at all levels up to +34 dbm
- **IM Distortion**
  < .5% at all levels up to +34 dbm
- **Pin conventions:**
  XLR connectors are wired as follows;
  Pin 1 = Shield
  Pin 2 = Signal Plus +
  Pin 3 = Signal Minus -
  All 1/4" connections are TRS, and are wired as follows;
  Tip = Signal Plus +
  Ring = Signal Minus -
  Sleeve = Shield/Chassis

Microphone use

- Plug the mic into the unit
- Monitor the input, (Push monitor select button "IN")
- Set the input selector and trim so that the average signal is around the yellow led.
- Set the Threshold control to -1 (first green LED to left of amber LED).
- Set the attack, release and ratio controls to 12:00
- Monitor the output signal, (Put the monitor select button in the "Out" position)
- Set the output gain makeup control for around the yellow LED.

Line level use

- Plug the Line level signal into the input of the BA-660.
- Set the monitor selector switch to the input (in) position
- Set the input selector and trim controls so that the signal is lighting the Yellow LED on average.
- Set the Threshold control to -1 (first green LED to left of amber LED).
- Set the attack, release and ratio controls to 12:00
- Monitor the output signal, (Put the monitor select button in the "Out" position)
- Set the output gain makeup control for around the yellow LED.

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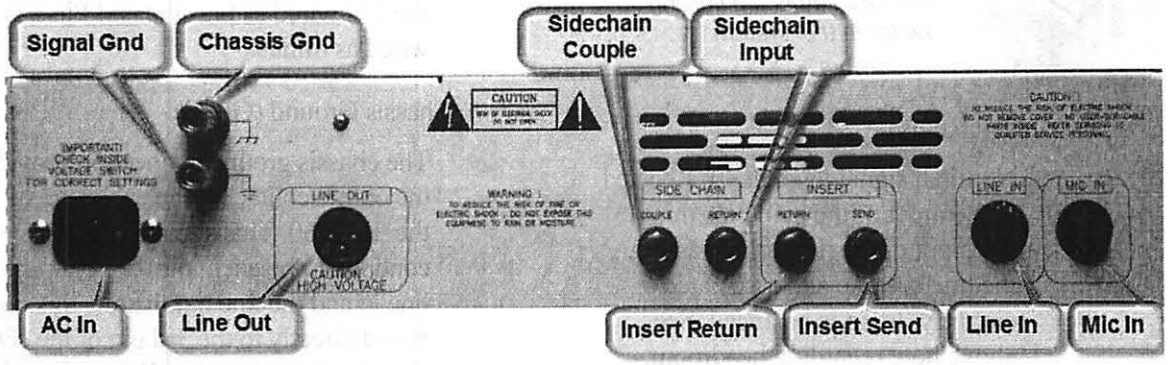
Overview I/O Connections



- MIC In

  Accepts low impedance balanced signals between -70 and +14 Nominal level. Phantom power is provided via the front panel +48V switch. Internal provisions are available for phantom voltages up to +300 VDC. Shield is carried to Pin 1 via the power ground internally for phantom purposes. The shield connection of the XLR is made via the chassis connection internally.

- Line In

  Nominal level is between -10 and +14. No provisions are made for phantom power and system will accept balanced or single ended signals. Shield is expected to be served by the driving source, and is internally lifted. If desired, there is a jumper available to provide shield connection to Pin 1.

- Insert Send

  The nominal signal level is -10. The signal is balanced, but may be used as single ended. A TRS plug should always be used. Tip is hot, Ring is minus and the shield is served on the sleeve.

NOTE- *The circuitry associated with the insert send and return is bypassed when not in use, (the bypass circuitry senses either the presence of a jack in the insert return connector or the position of the front panel switch. When active, this circuitry is the limiting factor in the system headroom.*

- Insert Return

  Nominal signal level of +4. Located at the input of the gain cell, this is the input of the limiter, bypassing the mic preamp and associated circuitry. Input is balanced. See above note regarding headroom. This signal is normalled to the side chain input

- Side chain input

  Nominal signal level of +4, balanced input, normalled source from the insert return circuitry. Provides access to the control circuitry for use in De-essing or Ducking.

- Side Chain Couple

  Provision for coupling multiple units. Both source and input are carried via this port, and the signal at this port is the active DC control line. The signal(s) are summed on this port and it should only be used with other BA-660 limiters. The protocol for direct operation of the gain cell is available upon request from the manufacturer.

- Line Output

  The line output is a balanced and floating solid state class A type power stage that can have either leg taken to ground without degradation of either headroom, gain, distortion or noise. The Output is Transformer coupled. The shield is sourced at pin 1 of the XLR. Pin 2 is wired as plus (+) and Pin 3 is wired as minus (-)

- Chassis Ground (Green)

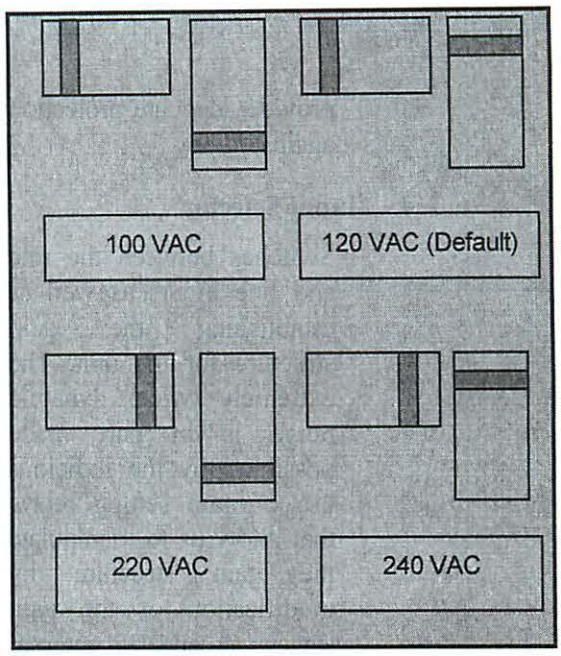
  The chassis ground connection provides the ohmic contact to the enclosure of the BA-660. This signal is also the conductor present at pin 1 of both the line in and the line out. Inside, this line is tied directly to the 3rd pin of the IEC Power entry connector. When the unit is operated with the 3rd pin of the AC cord connected, The link that is supplied should be used to connect the signal ground and the chassis ground together. In this configuration, no other studio grounds should be used.

- Signal Gnd (Black)

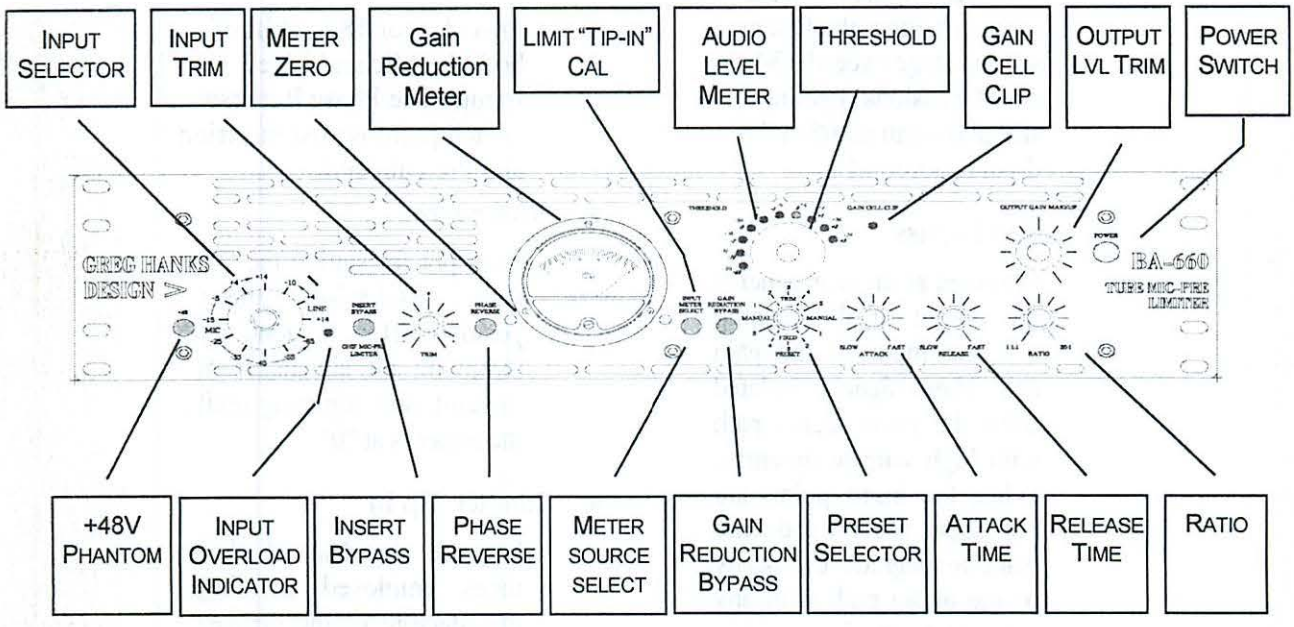
  This is the ohmic contact to the technical earth of the BA-660 and ties via a #12 cable to this point. If any studio grounds, aside from the 3rd pin of the power cord are supplied, they should be referenced to this binding post. The link should be removed when the 3rd pin is attached as well as the studio ground wire. If the 3rd pin is not attached, and the link is lifted, severe hum is likely. There is a small degree of safety provided by 2 cross shunting diodes and a .047μ cap that internally ties these two points together.

- AC Input

The IEC power input connector ties to a small PC board internally that carries a 3 Amp Slo Blo 3AG fuse and voltage selection to accommodate an input voltage range of 90 to 250 VAC. Refer to the schematic diagram for the appropriate switch settings outside of the US.



Controls: Front Panel



- **+48 V**

  Switches phantom power on and off at the Mic input connector. Internal provision is made for other voltages by changing a zener diode. Contact the manufacturer for details. Always switch the phantom power off when it is not needed as it can damage single ended signal sources. The internal build out resistors of 6k8 provide for the IEC recommended current limiting, but do not

provide adequate protection against idiocy.

- **Input Selector**

  Switches between the mic and line inputs as well as establishing the gain structure for the unit. The extremely wide dynamic range is in part made possible by the judicious use of gain setting relays that allow us to manipulate the gain structure by modification of the gain stages and internal attenuation.

- **Input overload LED**

  This LED lights when the output of either the first or second stage exceed +34 dbv. Occasional lighting still allows an additional 6 db of headroom!

- **Insert Bypass**

  Provided at the rear panel is the output of the preamp and the input to the gain cell. These signals isolated from the main signal path with high voltage op-amps. When the insert points are not being used, we do not want to degrade the purity of the audio path with any solid state devices so we sense the insertion of a jack in either the insert send or return connector. When the system is hard wired into an installation, such as a rack in a control room, we wanted to offer the provision of bypassing the insert silicon from the front panel. When there is no jack inserted in the inserts, the signal is automatically bypassed, and the front panel switch provides no function.

- **Input trim**

  This control provides ± 5 db of trim for the front end gain. Used in conjunction with the input selector, you set the input level to read approximately "0" on the Audio Meter, and then establish your threshold setting.

- **Phase reverse**

  Provides for 180 ° shift of both the Mic and Line Inputs. The Phase Reverse switch point is post insertion and Pre gain cell.

- **Meter zero**

  Trim pot for setting the "0" Gain Reduction meter position. This is done by removing all signals from the unit, and adjusting until the meter is at "0"

- **Limiter Tip In**

  Because the Mu of the tubes employed in the manufacture of the device vary significantly, we must provide for adjustment of the gain cell transconductance point. Adjustment of the unit is accomplished as follows;

1) Feed in a steady tone of any amplitude.

2) Adjust the input selector and trim so the input meter reads "0"
3) Depress the "Gain reduction Bypass" switch
4) Select Output metering on the Audio Meter
5) Adjust the output trim so that the Audio LED meter reads "0"(Yellow LED is lit)
6) Set the threshold control to fully Clockwise.
7) Insert the gain reduction by depressing the gain reduction by-pass switch.
8) Adjust the Gain Cell Tip in so that the audio remains at "0" and does not change level

- Input meter select

  This switch determines the source for the Audio Metering. When depressed, metering of the input gain stage is accomplished, and when it is out the meter is looking at the output of the unit as it feeds the outside world. "0" is equal to +4 dbu

- Gain Reduction bypass

  This switch hard bypasses the gain cell by completely cutting it off. This is accomplished by driving the cathode to >6 volts above the grid, (Clamped by zener diode).

- Preset/Manual

  5 presets are provided for your ease of use and listening enjoyment. The Presets on the top of the selector switch provide an alternate setting to each of them to allow you to trim the values of attack, release and ratio. The bottom settings bypass the front panel adjustment. (The threshold is always available for your amusement.) Additional presets are avail-able from the manufacturer on plug in cards in the PCMCIA size format. Cus-tom presets are available as well. Contact your dealer for details.

- Threshold

  The point the limiting is initiated is set with this large and sexy control. The range of limiting is adjustable from -40 to +20 ref. +4

- Gain Cell Clip

  The clip LED indicates that maximum attenuation of the gain cell has been reached. This indicates when the amount of requested gain control drives the tube into cutoff. This sounds really shitty, so we warn you when it is about to happen. If this light is blinking, you're a dumb fuck and shouldn't be allowed near a tool as powerful as this in the first place. [ALT WORDING *ED*] Operating the unit with this indicator lit will result in distorted sound. So avoid operating at these settings unless colored sound is desired.

- Attack Time

  The attack time is variable from 3ms to 40 msec. In FAST mode the unit can sound pretty strange. The best audio result usually occurs around the center position or to the right of 12 o'clock. The grayed out regions are to be avoided unless unusual

care and time for experimentation are available.

- Release Time

  The release time is variable from 40 msec to 1.4 seconds. For thumping rock and roll faster release times allow for "pumpier" sound. For minimum signal degradation, setting around 12 O'clock work best for most music. Again, the grayed out regions should be avoided by all but the stout of heart, and experimentation will provide you with the best information regarding your preferred settings.

- Ratio

  The ratio settings of 1.5:1 to 9:1 provide a range of compression sounds from easy limiting to a brick wall. (NOTE: There is only 14-18 db of limiting available from the gain cell, then it looks like a fixed attenuator!) This means that only the first 18 db of dynamic range is dynamically modified. Beyond this level the signal is no longer controlled, resulting in a compressed "squashed" sound quality which still can increase in amplitude.

- Output gain

  Provides for more than 20 db of gain make up for the gain cell. Fundamental operation of the unit is as follows;

  - Δ Set the input selector to get the signal within 5 db of "0"
  - Δ Set the input trim to get the signal close to "0"
  - Δ Set the Threshold control for the desired amount of limiting.
  - Δ Set the Preset / attack time / release time / ratio - controls for the desired sound and feel
  - Δ Set the output trim so that when metering output, approximately "0" is obtained.

- Power switch

  Provides balanced switching of the incoming power line, pre-fuse.

Overview of Operation

Setting the input level

The input selector provides gain in 10 dB stepped increments, from -65 to +14. At the lower extremes, the unit has 2 gain stages and an input transformer. With higher gains the 2nd gain stage is switched out. At even higher gains the input transformer is switched out, and at the highest gains a pad is inserted in the signal path to further lower its amplitude and along with that the 2nd stage gain is set to unity. In the lower gain configurations, the equivalent input noise goes up so the signal to noise ratio suffers. The signal should be close to "0" but with >30 dB of headroom, this is not really an issue nor is it that important. Our only real concern is being able to control the gain with the dynamics that we find audibly pleasant as well as having the output level be within reason. (It is real easy to start pumping out a nominal +26 signal level, and not even notice that you're SMOKING the next piece of gear in line!. ***Be careful, for you can develop in excess of 100 volts peak to peak signal energy***.

Monitoring levels.

The LED's around the threshold knob are two audio meters in one. The bright dot is indicating "VU" levels with ANSI ballistics. The solid bar is indicating peak level at 10 dB per division. The input monitor position of this meter looks at the signal level at the output of the 2nd stage as it appears at the gain cell input. (This is the same point as the insert return). The output monitor position is just prior to the mute relay on the output. "0" indication on the meter is calibrated to +4 dbv ref. 600Ω, or 1.23V. The maximum indicated signal level is +34 dbv, and the minimum is -56.

Set threshold

The threshold control is designed to provide a range of -40 to +20, with the "0" point occurring at the "0" LED. Threshold should be set with an exaggerated ratio control, because the gain reduction meter indicates how much limiting is going to occur, not where or when. After the threshold setting has been achieved, then the ratio control should be backed off to the point of auditory satisfaction.

Attack and Release considerations

In order to achieve pleasant results in heavy limiting for program material, the attack and release times must be VERY LONG. To

recover sustained signal material in the face of heavy background, it is often necessary to resort to very short attack and release times. Between the two is where the majority of the operating life of these controls exist. **Stay between 9 O'clock and 3 O'clock in order to keep any concept of fidelity.**

Ratio and the concept of open-ness.

The robust characteristics of the gain cell make it easy to squash the crap out of a good sounding dynamically alive signal and make everything sound like an AM radio mix. This is not a desirable objective. The design goal of the limiter is to be able to control the dynamics of acoustically originated signals without sucking the life out of them. The higher the ratio, the less dynamic range, and the more control over the signal dynamics you maintain. The lower the ratio, the more dynamic range, and the less control you exercise, but the better it sounds. In the beginning, use the presets, determine which ones you like the sound of the most. The curious can contact their GREG HANKS DESIGN dealer or the factory for technical information about attack and release times along with the ratio for each preset.

Presets.

There are 5 presets built into the BA-660 are my impression of the following;

1) Fairchild 660
2) LA-2
3) Neve Console Bus limiter
4) SSL Quad limiter
5) RCA BA-6

There are two positions for the presets, primary and trim. The primary position (lower) allows you Trim control of the threshold, with no control over the ratio, attack and release times. The "Trim" position (Upper) allows complete control over the threshold and trim over the ratio, attack and release.

Manual Control.

Manual control leaves the audio characteristics at your mercy.

Output level

A trim is provided for output gain make-up that has a range of a few dB of loss to +20 dB of gain, to compensate for whatever attenuation is provided by the gain cell.

Summary

The operation is a little different from other limiters that you have used. This unit provides for no gain in the gain control cell. There is no provision for gain change as in most compressors, and this unit only provides for program controlled attenuation of the signal path. As such, when you increase the ratio, the attenuation increases and the signal level decreases. This is to be made up manually. You have to play with the controls to get where you want to go, but after walking around the solo a couple of times with the unit, you should find it to respond as you now expect it to.

Installation Considerations

- Shields and signal grounding

  In the best of all possible worlds, you plug in the input, output and power and everything sounds GREAT, no problems, and everything is right with the world. Such is not usually the case when interfacing large quantities of equipment in a cogent mess such as a recording studio control room.

  ⇒ The microphone must be shielded. If it is not, the phantom power won't work and it will probably hum badly. In fixed installations, please ensure that the only connection to the shield of the microphone is though the signal line that connects it to the unit, and not touching the building steel through the mic box!

  ⇒ The line input should have the shield source'd at the origination point and the shield should drop at the BA-660. There are internal provisions for supplying a shield source from the BA-660, but this is not recommended.

  ⇒ The Insert send sources the shield. The return shield is dropped internally. If this is a problem, correct it by tying the shield to the chassis at the returning signal source.

  ⇒ The side chain insert return shield is also floating and should be referenced at the driving source.

- Rear Panel Ground connections

  There are two 5 way binding posts on the rear of the unit. The green one is attached directly to the chassis, and the Black one is tied directly to Tech Earth internally. The link that is provided external to the chassis is the only point that the chassis and Tech Earth, (Audio Common) are brought together. This connection must be maintained either through the link or via the studio wiring. Your technical consultant will be your best guide to determining the correct installation method for your room.

⇒ Shields and the output. The shield at the Line Output is carried from pin 1. This is the source of the shield for the output wire, but should not be carried through the input of the driven load.

- Input and Output balance

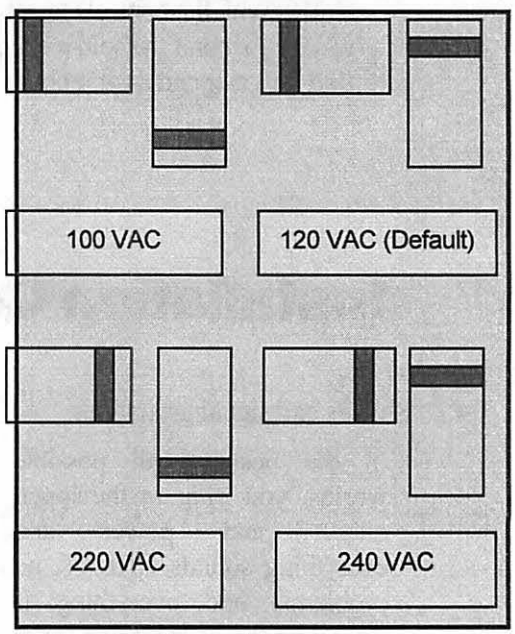
  Both the Mic, Line, insert return, side chain insert and the Line Output circuits are balanced and floating. The Insert send is balance

⇒ When taking a single ended input, always bring the grounded line to ground at the signal source. This will treat the line as a balanced line and reduce the hum induction.

⇒ The output of this device is transformer isolated and floating. To use the unit unbalanced, it is best practice to bring the negative signal to ground at the output connector.

⇒ When taking the insert send to an unbalanced input it is imperative that the low side be disconnected from the ring and tied to the sleeve at the BA-660. The output drive is not ground current sensing, and should not drive ground. This ***WILL*** oscillate when driving ground.

!DANGER!



Fuse location and Input power voltage selection. The fuse is located directly behind the IEC Power input connector. There are two internal switches with which the input voltage range can be set to accommodate anything between 90 and 250 VAC. Please leave this adjustment to qualified personnel. When in doubt, call the factory!

Theory of Operation

SUMMARY OF HOW TO FOLLOW THE DIAGRAMS.

The best way to understand the operation of the BA-660 is to study the system drawing of the schematics. The boxed figures that indicate sheets are hierarchical symbols that relate directly and functionally. As an example, the first stage of gain is on sheet three and all of the interconnections to the rest of the box are indicated by the lines on sheet one. The input coupling is all contained on sheet 3. The input coupling of the "Line In" is indicated completely on the system diagram.

All signal interconnections are done via signal names, such as "MIC_OUT-". The interconnected names will be indicated wherever possible on the left and right sides of the individual schematic sheets.

The basic function is indicated by the name of the sheet.

The circuitry is unique as it fully balanced from input to output both internally and externally. The signal paths for the "+" and the "-" are cross-coupled and balanced. The circuit topology keeps them separate and they are not combined at any point internally in the unit.

Basic tube operation.

The tube operates at a nominal quiescent voltage of +150 VDC. The swing range is +300 to 0V. and the idling point is set by the servo feedback op-amps that drive the bottom current source. The tubes are operating pure "Class-A" at 4.5 ma. This operating point is established by the resistor on the bottom current source that is approximately 249Ω. The traditional cathode biasing resistor and bypass capacitor have been replace by a triple cascode connected constant current source.

Gain Settings

The gain of the three gain stages is determined by the Mu of the tube minus the degeneration of the coupling resistor between the cathodes. When the cathodes are shorted together the tube gain is almost the idealized Mu converted to db!

When the unit runs out of range using degeneration, (it is a somewhat noisy gain setting method at the lower ranges), pads are inserted and gain stages are eliminated to maximize signal to noise ratio and minimize total harmonic distortion.

System Gain Structure Control

Because of the humongous gain available, and the response to near DC, the gain switching, stage switching and transformer removal are accomplished via gas filled gold plated fast relays. These relays, along with special timing circuits, enables the unit to delay the change, mute the output, make the change, allow the output to settle, and then remove the mute. This logic and timing is all accomplished with Q46, Q17, Q10 Q29, Q56 and Q23 on sheet two. The left side of the drawing delays the switch action for approximately 10 ms while the right side enables the mute for approximately 500 ms. ***Because of this muting action, the input selector nor the preset switch should be used after initial setup when employing this unit for live broadcast***!

Insert Sends and Returns

The signal level appearing at the insert send is nominally -10 when the meter reads "0". This is done because the 2nd stage output is buffered to this point with 2 op-amps. The maximum level at these devices is +26, the maximum level out of the 2nd stage is +42. Therefore, in order to not make the insert send buffer the limiting element of the headroom of the box, the level is lowered at the send, so that +40dB can be accommodated internally. The insert return is nominally +4 (this gain differential must be made up via the insert loop) and goes directly into the gain cell through 2 small isolation resistors, and 2 100k dividing resistors. Any unbalance that occurs will result in signal degradation, so care must be exercised in this regard. The silicon is bypassed when there is no insert connection. This is accomplished via relay K7. The output of this relay is also the point that the side chain signal is developed. The nominal signal for the side chain is also therefor +4.

Level Meter

The 10 segment level meter employs a unique combination of 2 separate audio level meter circuits. The output of a VU driver and a Peak driver are hard wire Or'ed to obtain the dual metering function. In order to distinguish between the ballistics of the two metering circuits the visual intensity of each scale is varied according to signal level. The peak scale is dim for the first 7 LED's and then is bright, whereas the Vu scale is Bright for the first 7 LED's and dim for the last 3 segments. This is set so that a wide dynamic range signals can be simultaneously displayed along with subtle 1 dB changes in signal level. The signal is selected at the insert return point and just prior to the mute relay at the output. The signal is attenuated by 18 db to obtain the dynamic range necessary for operation and then converted to single ended at the metering detection circuitry. Signal conditioning is performed on the gain cell control PCB, and the DC meter drive is presented to the front panel board independently.

Gain Cell

The gain cell employs the same medium Mu twin triode as the gain stages. The tube is used as a transconductance shunt element. What this means in layman's terms is that the conductance of the vacuum tube, (i.e. resistance) is a function of the ratio of the Cathode current to the grid bias. If you will look at sheet 7, and note R12 and R13, these are build out resistors for the tube acting as a shunt resistor. The cathodes are shorted together, so the more the tube conducts, the closer the two plates are to each other the more attenuation through the circuit. The transistors above and below are there to control the bias and no audio flows through them! The plate circuit and the cathode circuit are forced by the gain control line which appears on the right side of R6 to increase the current through the tube, in equal and opposite directions. The two tube sections are part of the same tube, therefore hopefully track one another. The transistors are part of a super-matched array, so they will track one another, and U1A sets the quiescent bias point with no limiting. The zener Z13 clamps the cathodes to +6 v above the grid so that the tube doesn't become a diode. Whenever the control line goes above .75V the gain cell clip indicator comes on and distortion ensues.

The gain reduction bypass is a relay that simply cuts the tube off by putting a large negative bias on its grids. We also insert a 3 db loss via shunt resistor elements to emulate the tip in characteristic of the tube.

The tip-in adjustment is necessary because the point that the tube conducts initially is both noisy and abrupt. This point varies greatly from one tube to another, which is why the offset voltage between the output of the gain control system and the point of conduction is adjustable. This point is set so that with no limiting, the tube conducts approximately 3 db. The reason for this is that without it, the transition to limiting is sonically abrupt and thumpy. More than 3 db of limiting doesn't really seem to help and it comes right off the top of the maximum available limiting which is tube bound to approximately 18 db.

Gain Cell Control

The audio signal is converted into a DC voltage that is an average of the LOG of the input signal. This is then presented to a logarithmic charge pump, whose charge time is adjustable linearly in time/db. This results in an attack time that tracks the average level of the input signal and is not affected by its crest factor. The parameters of ratio, attack and threshold are set with linear dc voltages. The release time is also determined via a log converted charge pump, which resets the past memory of the average signal level at a fixed recovery time. The objective was to provide transparent gain control without removing the life from the performance.

PRESETS

A linear DC voltage controls all of the parameters of the signal dynamics, making remote and preset operation easy to implement. The control elements are voltage dependent, not current, so that they can have some variability in their switch elements. This enables simple FET gates to provide the matrix selections. The manner in which the preset voltages were obtained is a trade secret but for some good PR we will tailor them for YOU; consult your dealer or the factory for details.

Output Stage

The same circuitry from the previous gain stages is employed for the output driver. The output stage itself is something else however. The power supply winding that feeds the 60 VDC to the output stage is balanced and floating in relation to ground. The circuit operates as a balanced transformer coupled output and allows either polarity of the output to be grounded. Due to ongoing issues with interface, a Bad Ass Jensen JT-11 transformer is used. This can be bypassed with a jumper in J14 (In front of the Output Transformer). Short Pins 1-2 and 3-4.

Warranty

GREG HANKS DESIGN will repair or replace this product with new or rebuilt parts, free of charge in the USA or Puerto Rico in the event of a defect in materials or workmanship as follows:

1. Parts:

   New or rebuilt parts in exchange for defective parts for the duration of the warranty of the unit, excluding vacuum tubes which carry a 6 month limited warranty.**

2. Labor:

   Carry in or mail in service for three (3) years after the date of original purchase. **

TERM:

The warranty term is to be for the 3 years to the original purchaser, and is transferable.

LIMITS AND EXCLUSIONS

There are no express warranties except as listed above.

GREG HANKS DESIGN SHALL NOT BE LIABLE FOR SPECIAL, INCIDENTAL, CONSEQUENTIAL OR PUNITIVE DAMAGES, INCLUDING WITHOUT LIMITATION, DAMAGE TO TAPES RECORDS, OR DISCS, LOSS OF GOODWILL, OR ANY ASSOCIATED EQUIPMENT, DOWNTIME COSTS OR CLAIMS OF ANY PARTY DEALING WITH PURCHASER FOR SUCH DAMAGES, RESULTING FROM THE USE OF THIS PRODUCT OR ARISING FROM BREACH OF WARRANTY OR CONTRACT, NEGLIGENCE OR ANY OTHER LEGAL THEORY. ALL EXPRESS AND IMPLIED WARRANTIES, INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE LIMITED TO THE APPLICABLE WARRANTY PERIOD SET FORTH ABOVE

We will not honor claims laid against the innocent, or for obvious physical abuse. Pot damage, (looking for "11") meter glass and cosmetic damage are not covered

Unless otherwise specified, All diodes are type 1n4148

SYSTEM

REVISION RECORD			
LTR	ECO NO:	APPROVED:	DATE:
1	R107 FROM 49.9K to 42.2	GH	5/2012

MIN GAIN=1DB
NOM GAIN=33DB
MAX GAIN=48DB

NOM -55

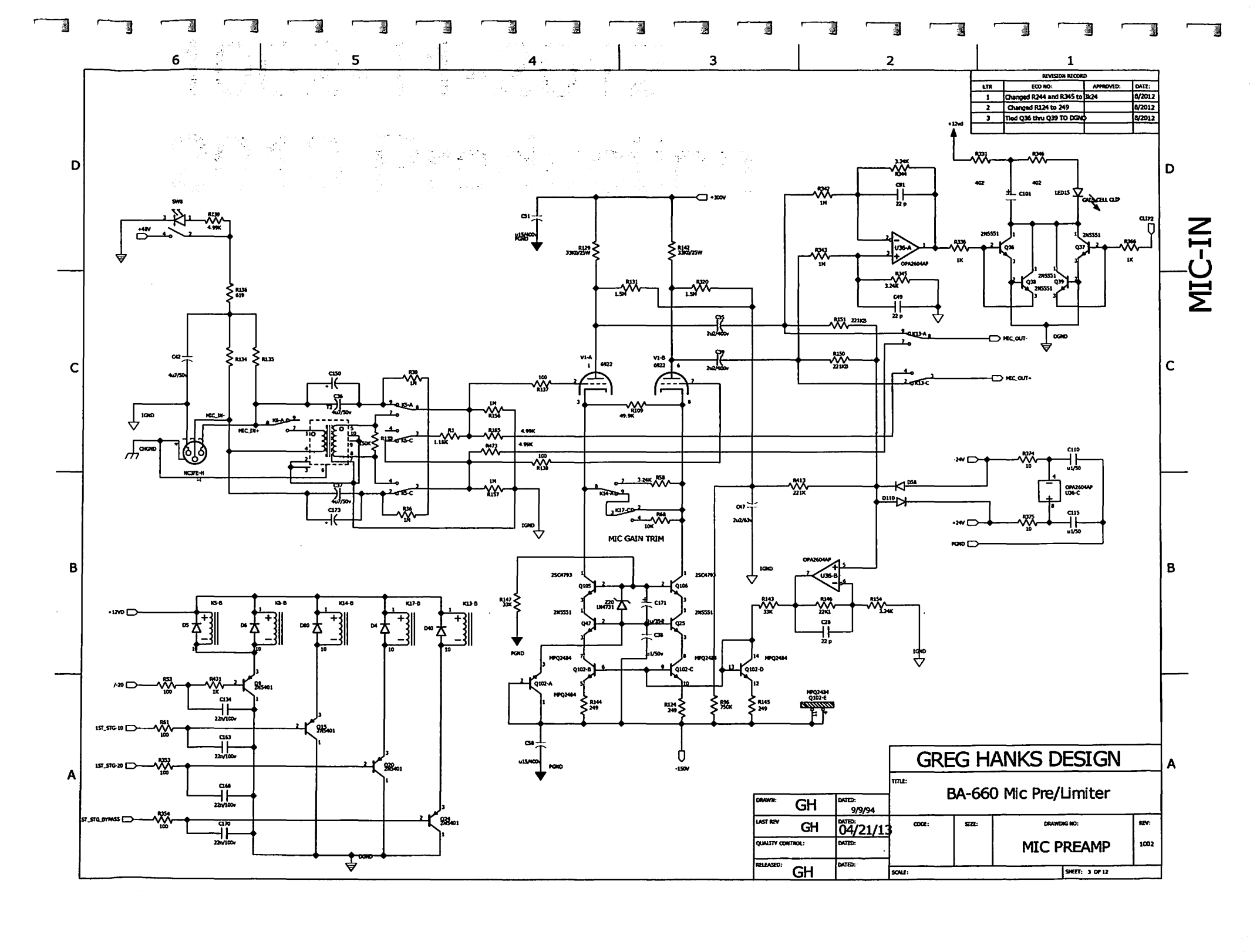
DRAWN: GH	DATED: 10/2/94	
LAST REV GH	DATED: 04/21/2013	
QUALITY CONTROL:	DATED:	
RELEASED: GH	DATED:	

GREG HANKS DESIGN

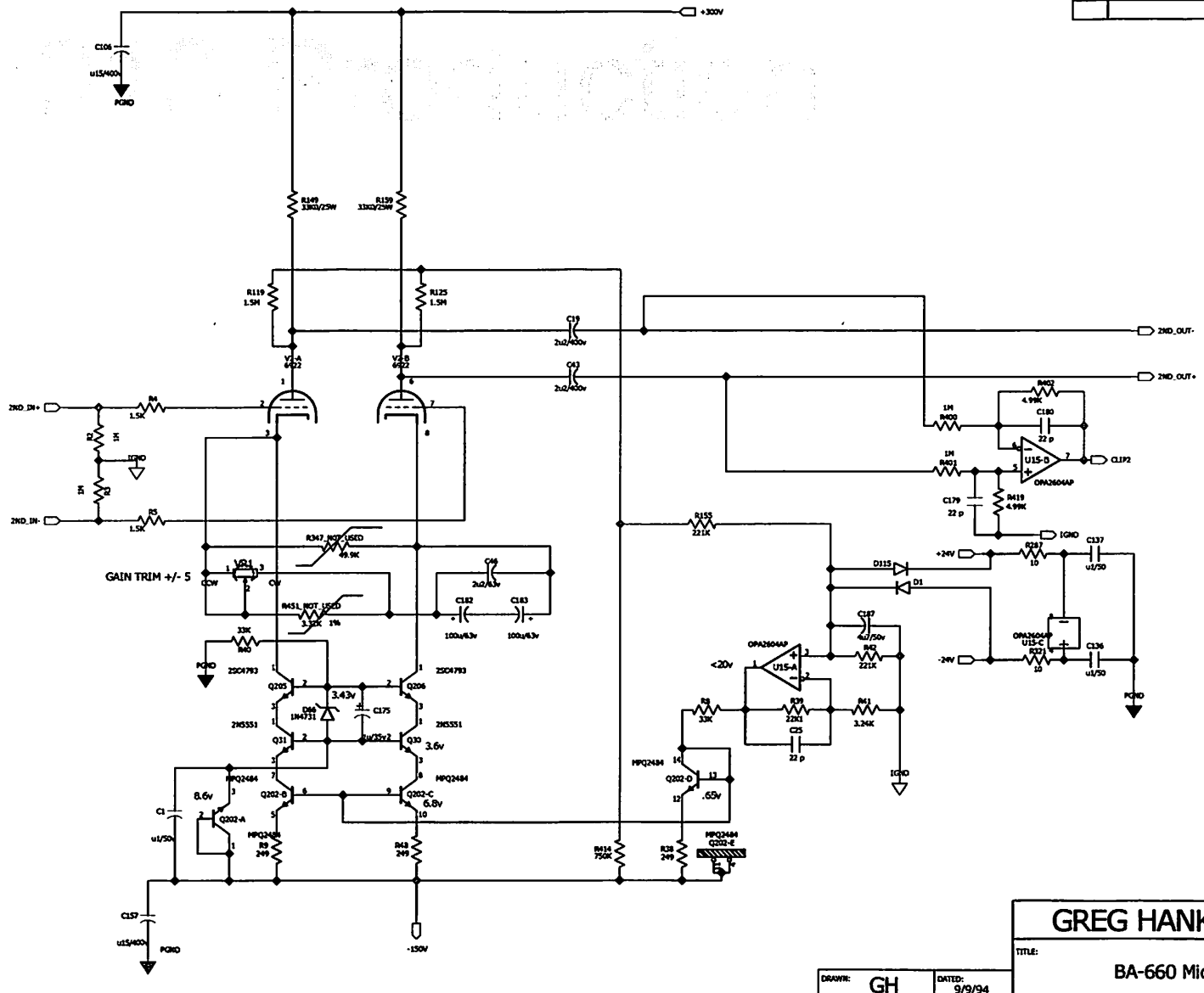
TITLE: BA-660 Mic Pre/Limiter

CODE:	SIZE:	DRAWING NO:	REV:
		SYSTEM	1002

SCALE: | SHEET: 1 OF 12


REVISION RECORD
LTR | ECO NO: | APPROVED: | DATE:
1 | Changed R244 and R345 to 3k24 | | 8/2012
2 | Changed R124 to 249 | | 8/2012
3 | Tied Q36 thru Q39 TO DGND | | 8/2012
MIC-IN
MIC GAIN TRIM
GREG HANKS DESIGN
TITLE:
BA-660 Mic Pre/Limiter
DRAWN: GH
DATED: 9/9/94
LAST REV: GH
DATED: 04/21/13
QUALITY CONTROL:
RELEASED: GH
CODE:
SIZE:
DRAWING NO:
MIC PREAMP
REV: 1002
SCALE:
SHEET: 3 OF 12

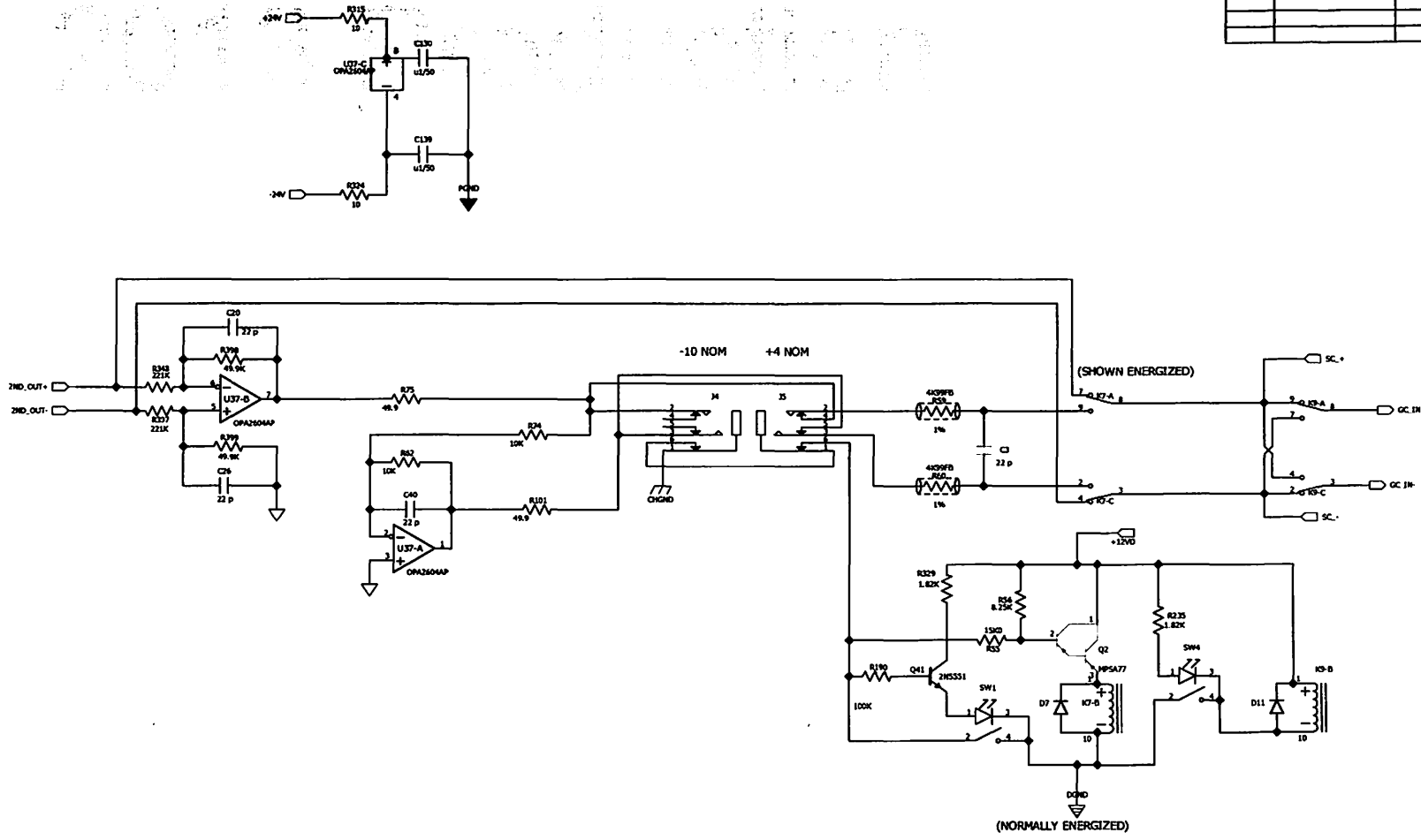
REVISION RECORD			
LTR	ECO NO:	APPROVED:	DATE:
1	Changed VR1 to Bourns 91	GH	4/30/12
2	R402 and R419 changed to 4k99	GH	8/2012
3	R38 changed to 249R	GH	8/2012



2ND-ST

DRAWN: GH	DATED: 9/9/94	GREG HANKS DESIGN	
LAST REV GH	DATED: 4/21/2013	TITLE: BA-660 Mic Pre/Limiter	
QUALITY CONTROL:	DATED:	CODE:	SIZE: DRAWING NO: 2ND STAGE REV: 1002
RELEASED: GH	DATED:	SCALE:	SHEET: 4 OF 12

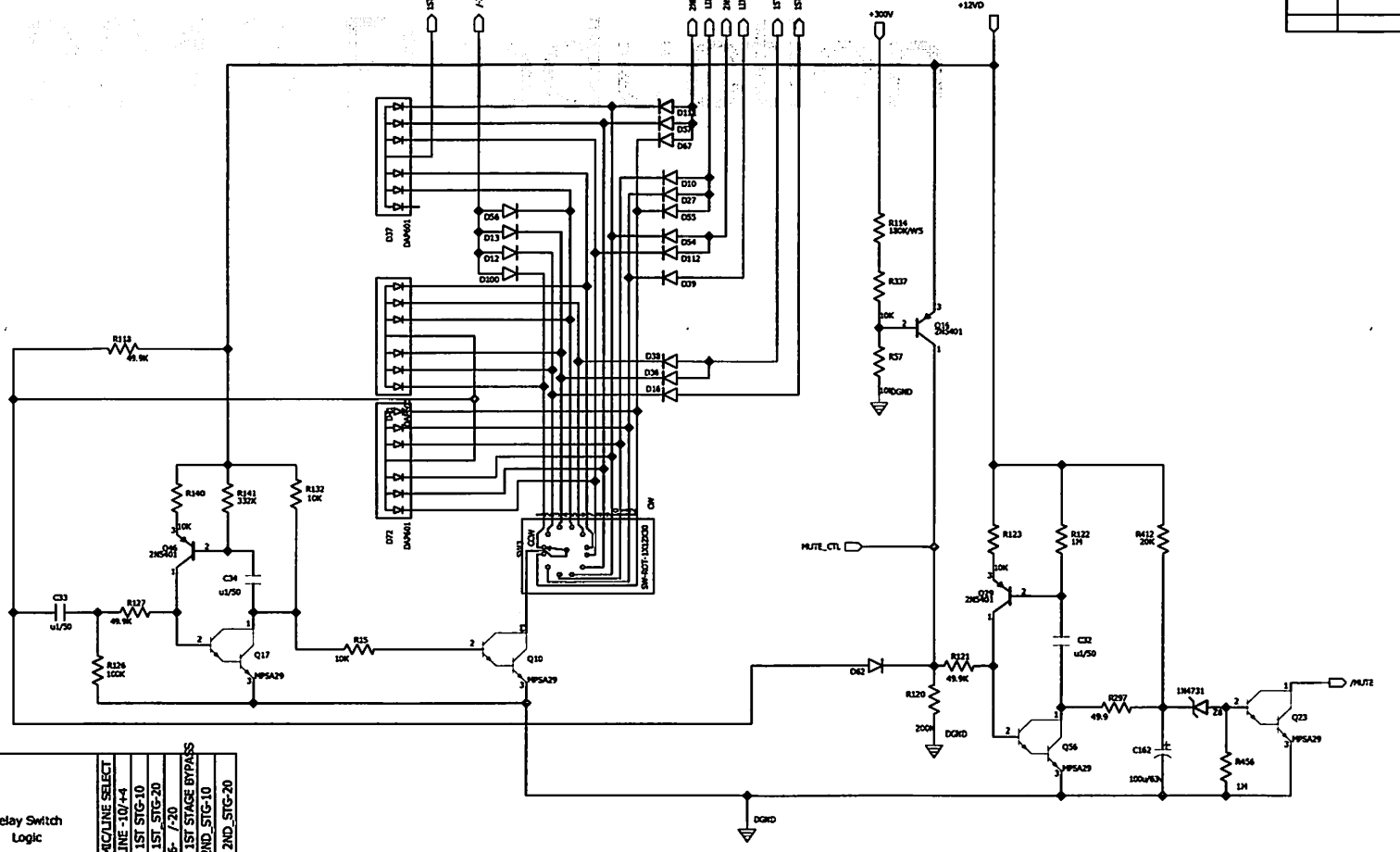
REVISION RECORD			
LTR	ECO NO:	APPROVED:	DATE:



INSERT

DRAWN: GH	DATED: 5/5/95	COMPANY: GREG HANKS DESIGN	
CHECKED:	DATED:	TITLE: BA-660 Mic Pre/Limiter	
QUALITY CONTROL:	DATED:	CODE:	SIZE: DRAWING NO: INSERT SEND AND RTN REV: 1002
RELEASED: GH	DATED: 04-2013	SCALE:	SHEET: 5 12

REVISION RECORD			
LTR	ECO NO:	APPROVED:	DATE:



Relay Switch Logic	K2- MIC/LINE SELECT	K1- LINE -10/+4	K14- 1ST STG-10	K17- 1ST_STG-20	K5,K6- /-20	K13- 1ST STAGE BYPASS	K4- 2ND_STG-10	K16- 2ND_STG-20
X=ON								
CW								
12- LINE +14	X							X
11- LINE +4	X	X						
10- LINE -10	X							
9- MIC +14						X	X	X
8- MIC +4						X		X
7- MIC -5						X	X	
6- MIC -15						X		
5- MIC -25				X				
4- MIC -35					X	X		
3- MIC -45				X	X			
2- MIC -55			X		X			
1- MIC -65					X			
CCW								

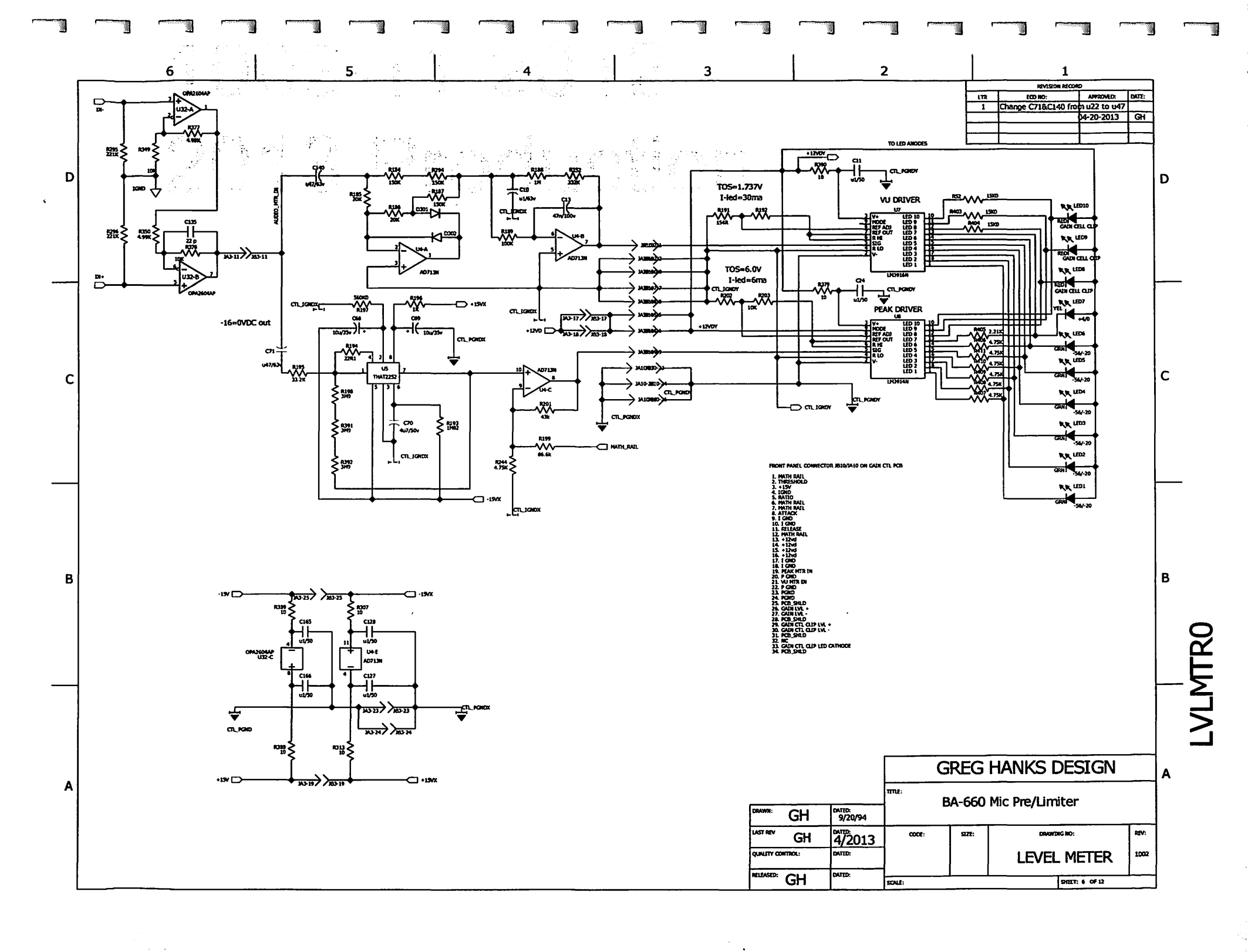
K1- LINE -10/+4
K2- MIC/LINE SELECT
K4- 2ND_STG-10
K16- 2ND_STG-20
K5- /-20 (MIC XFMR BYPASS)
K6- MIC INP XFRMR BYPASS
K7- INSERT BYPASS
K8- O/P MUTE
K9- PHASE INVERT

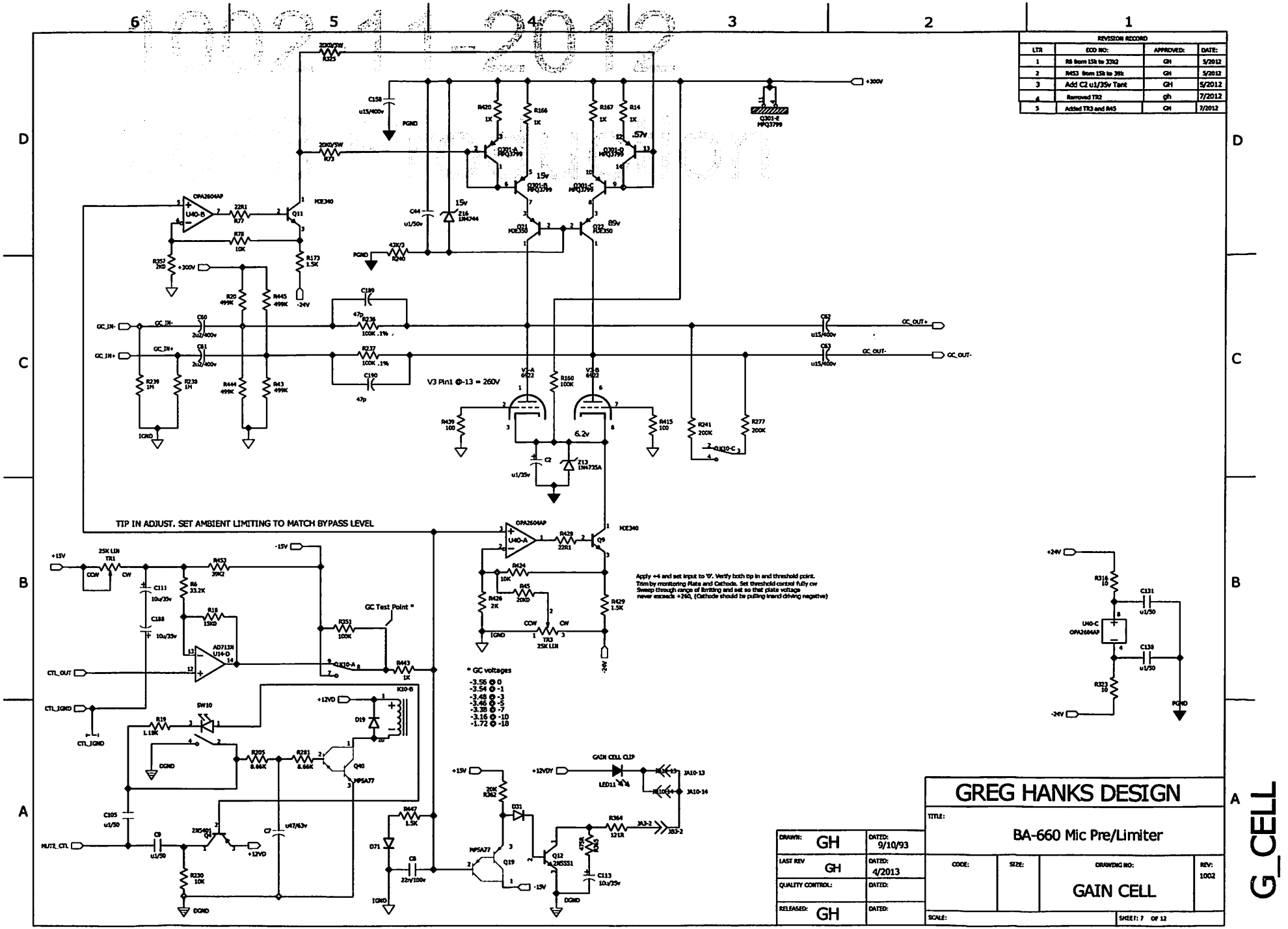
K11- OP UNBAL -
K12- OP UNBAL +
K13- 1ST STAGE BYPASS
K14- 1ST STG-10

K16- GR BYPASS
K17- 1ST_STG-20

IN-SEL

DRAWN: GH	DATED: 10/1/94	GREG HANKS DESIGN	
LAST REV GH	DATED: 04-2013	TITLE: BA-66 Mic Pre/Limiter	
QUALITY CONTROL:	DATED:	CODE:	SIZE: DRAWING NO: INP SEL & MUTE CTL REV: 1002
RELEASED: GH	DATED:	SCALE:	SHEET: 2 OF 12


REVISION RECORD
LTR | ECO NO: | APPROVED: | DATE:
1 | Change C718,C140 from u22 to u47 | | 04-20-2013 | GH
TO LED ANODES
TOS=1.737V
I-led=30ma
TOS=6.0V
I-led=6ma
VU DRIVER
PEAK DRIVER
-16=0VDC out
FRONT PANEL CONNECTOR JB10/JA10 ON GAIN CTL PCB
1. MATH RAIL
2. THRESHOLD
3. +15V
4. IGND
5. RATIO
6. MATH RAIL
7. MATH RAIL
8. ATTACK
9. I GND
10. I GND
11. RELEASE
12. MATH RAIL
13. +12vd
14. +12vd
15. +12vd
16. +12vd
17. I GND
18. I GND
19. PEAK MTR IN
20. P GND
21. VU MTR IN
22. P GND
23. PGND
24. PGND
25. PCB_SHLD
26. GAIN LVL +
27. GAIN LVL -
28. PCB_SHLD
29. GAIN CTL CLIP LVL +
30. GAIN CTL CLIP LVL -
31. PCB_SHLD
32. NC
33. GAIN CTL CLIP LED CATHODE
34. PCB_SHLD
GREG HANKS DESIGN
TITLE: BA-660 Mic Pre/Limiter
DRAWN: GH DATED: 9/20/94
LAST REV GH DATED: 4/2013
QUALITY CONTROL: DATED:
RELEASED: GH DATED:
CODE: SIZE: DRAWING NO: LEVEL METER REV: 1002
SCALE: SHEET: 6 OF 12
LVLMTR0


REVISION RECORD
LTR | ECO NO: | APPROVED: | DATE:
1 | R8 from 15k to 33k2 | GH | 5/2012
2 | R453 from 15k to 39k | GH | 5/2012
3 | Add C2 u1/35v Tant | GH | 5/2012
4 | Removed TR2 | gh | 7/2012
5 | Added TR3 and R45 | GH | 7/2012
TIP IN ADJUST. SET AMBIENT LIMITTING TO MATCH BYPASS LEVEL
V3 Pin1 @-13 = 260V
Apply +4 and set input to '0'. Verify both tip in and threshold point. Trim by monitoring Plate and Cathode. Set threshold control fully cw Sweep through range of limiting and set so that plate voltage never exceeds +260, (Cathode should be putting knand driving negative)
* GC voltages
-3.56 @ 0
-3.54 @ -1
-3.48 @ -3
-3.46 @ -5
-3.38 @ -7
-3.16 @ -10
-1.72 @ -10
GREG HANKS DESIGN
BA-660 Mic Pre/Limiter
GAIN CELL
G_CELL
DRAWN: GH
LAST REV GH
QUALITY CONTROL:
RELEASED: GH
SIZE:
REV: 1002
SHEET: 7 OF 12

OP_STG

REVISION RECORD			
LTR	ECO NO:	APPROVED:	DATE:
	R454 to 0	05-07-12	GH
	R455 not used	05-07-12	GH
	R93 changed to 249R	8/2012	
	J4-J5 added to correct BOM		

GAIN MAKEUP

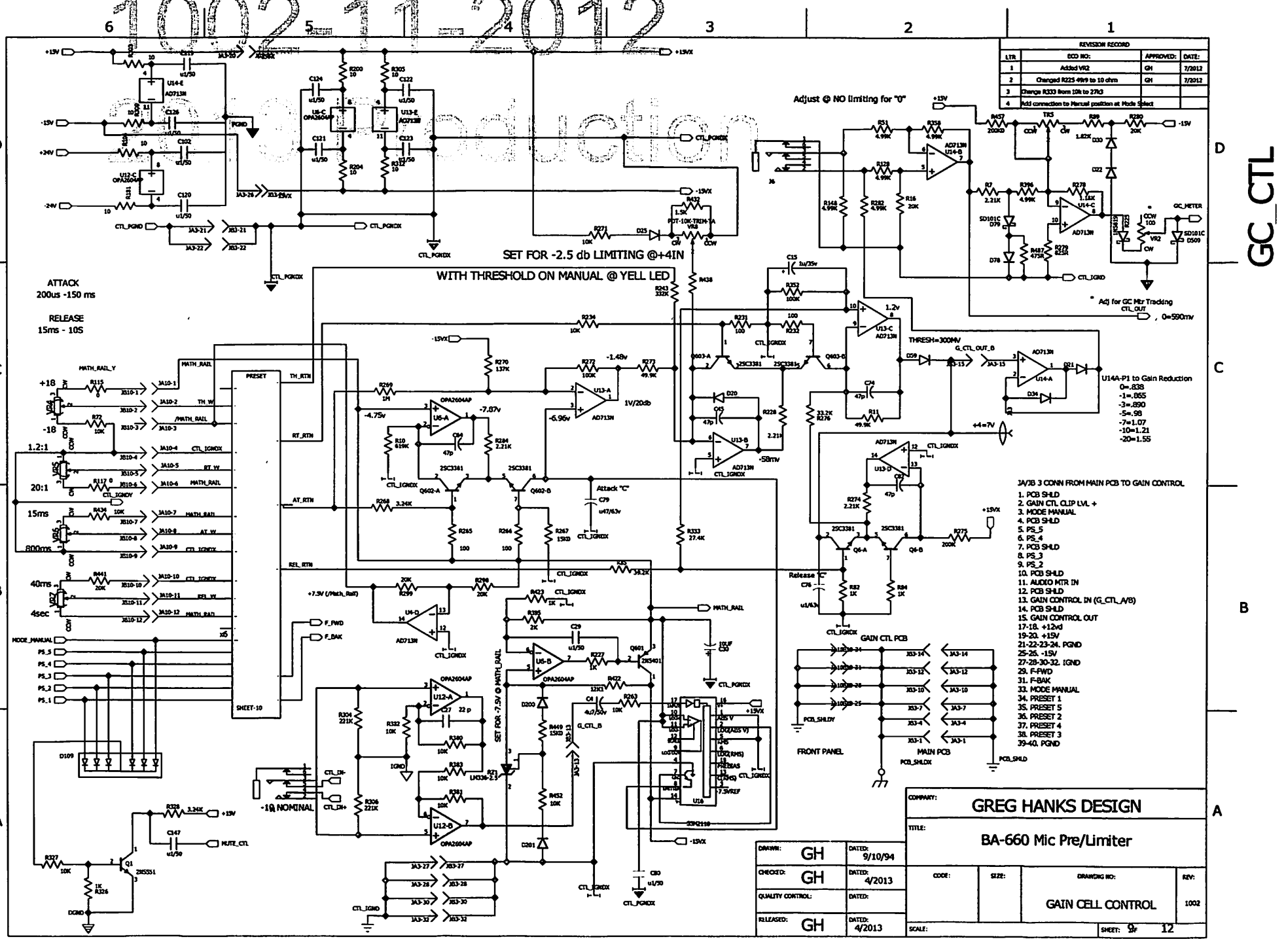
DRAWN:	IF	DATED:	5/5/95
LAST REV	GH	DATED:	4/2013
QUALITY CONTROL:		DATED:	
RELEASED:		DATED:	

GREG HANKS DESIGN

TITLE: BA-660 Mic Pre/Limiter

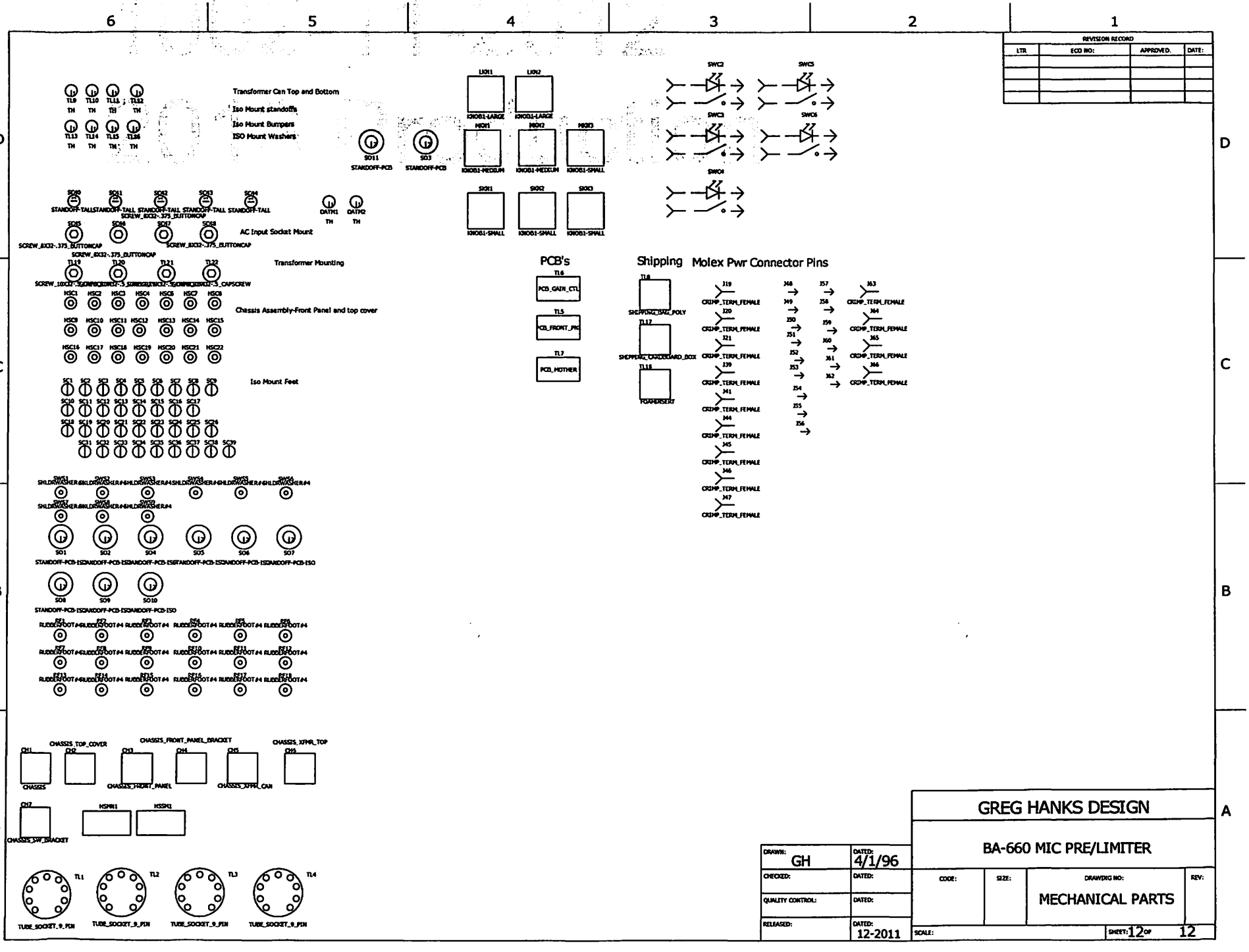
CODE:	SIZE:	DRAWING NO:	REV:
		OUTPUT STAGE	1002

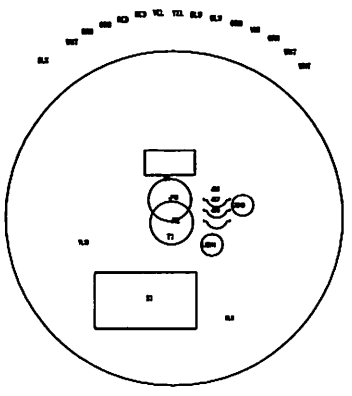
SCALE: SHEET: 8 OF 12

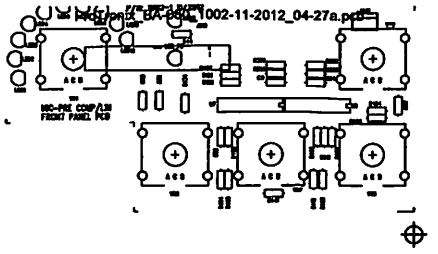


REVISION RECORD			
LTR	ECO NO:	APPROVED:	DATE:
1	Added VR2	GH	7/2012
2	Changed R225 499 to 10 ohm	GH	7/2012
3	Change R333 from 10k to 27k3		
4	Add connection to Manual position at Mode Select		

DRAWN: GH	DATED: 9/10/94	COMPANY: GREG HANKS DESIGN	
CHECKED: GH	DATED: 4/2013	TITLE: BA-660 Mic Pre/Limiter	
QUALITY CONTROL:	DATED:	CODE:	SIZE:
RELEASED: GH	DATED: 4/2013	DRAWING NO: GAIN CELL CONTROL	REV: 1002
		SCALE:	SHEET: 9 OF 12

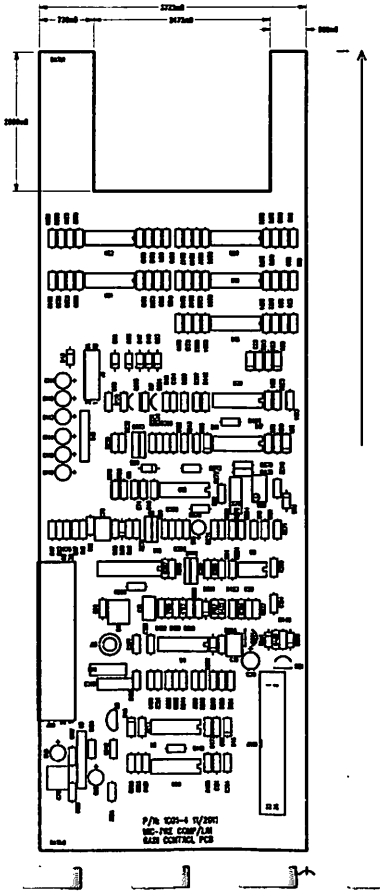

REVISION RECORD
LTR
ECO NO:
APPROVED.
DATE:
Transformer Can Top and Bottom
Iso Mount standoffs
Iso Mount Bumpers
ISO Mount Washers
AC Input Socket Mount
Transformer Mounting
Chassis Assembly-Front Panel and top cover
Iso Mount Feet
PCB's
Shipping
Molex Pwr Connector Pins
GREG HANKS DESIGN
BA-660 MIC PRE/LIMITER
MECHANICAL PARTS
DRAWN: GH
DATED: 4/1/96
CHECKED:
QUALITY CONTROL:
RELEASED:
DATED: 12-2011
SCALE:
SHEET: 12 OF 12

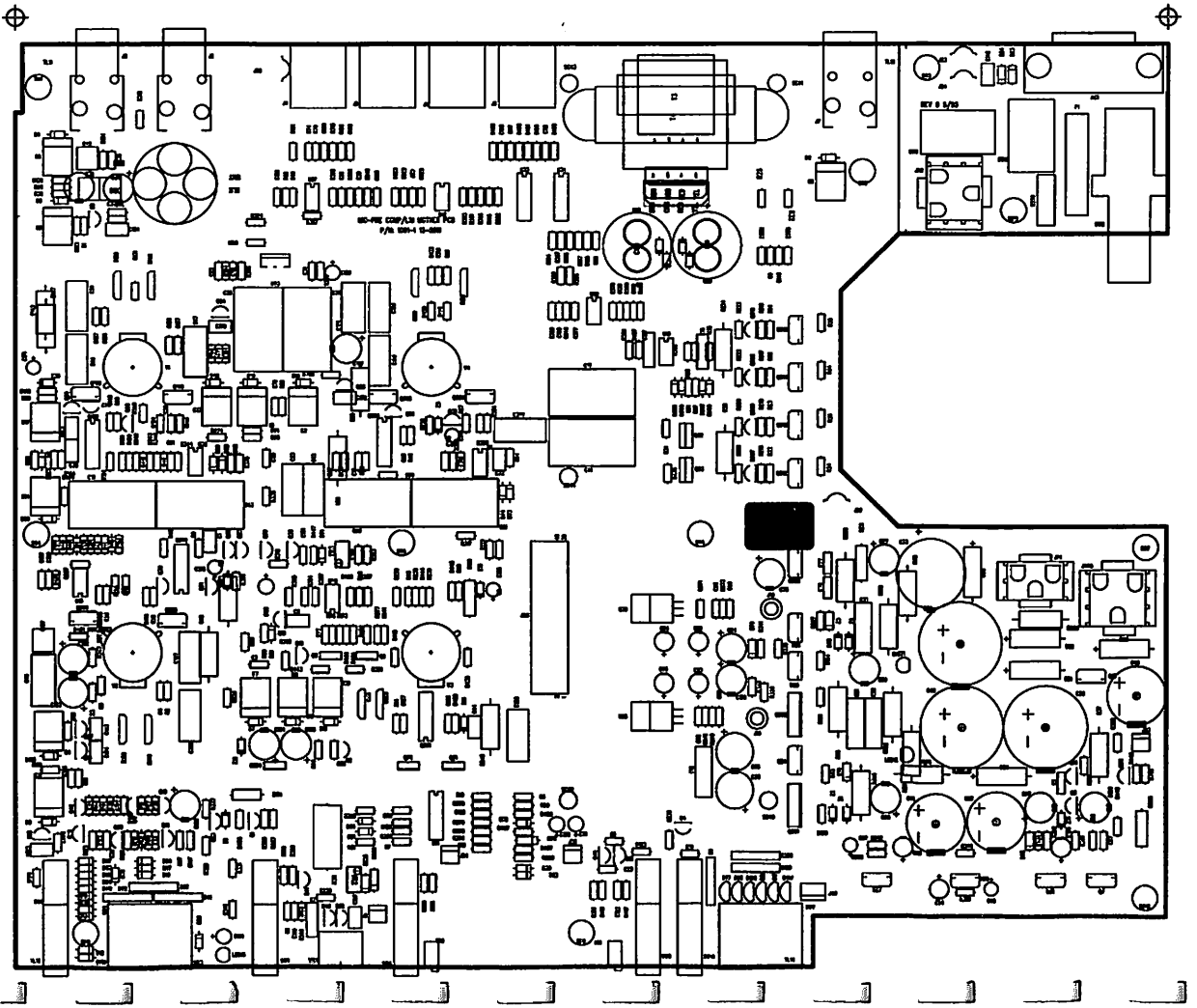




SILK SCREEN-1 LAYER

SILK SCREEN-1 LAYER





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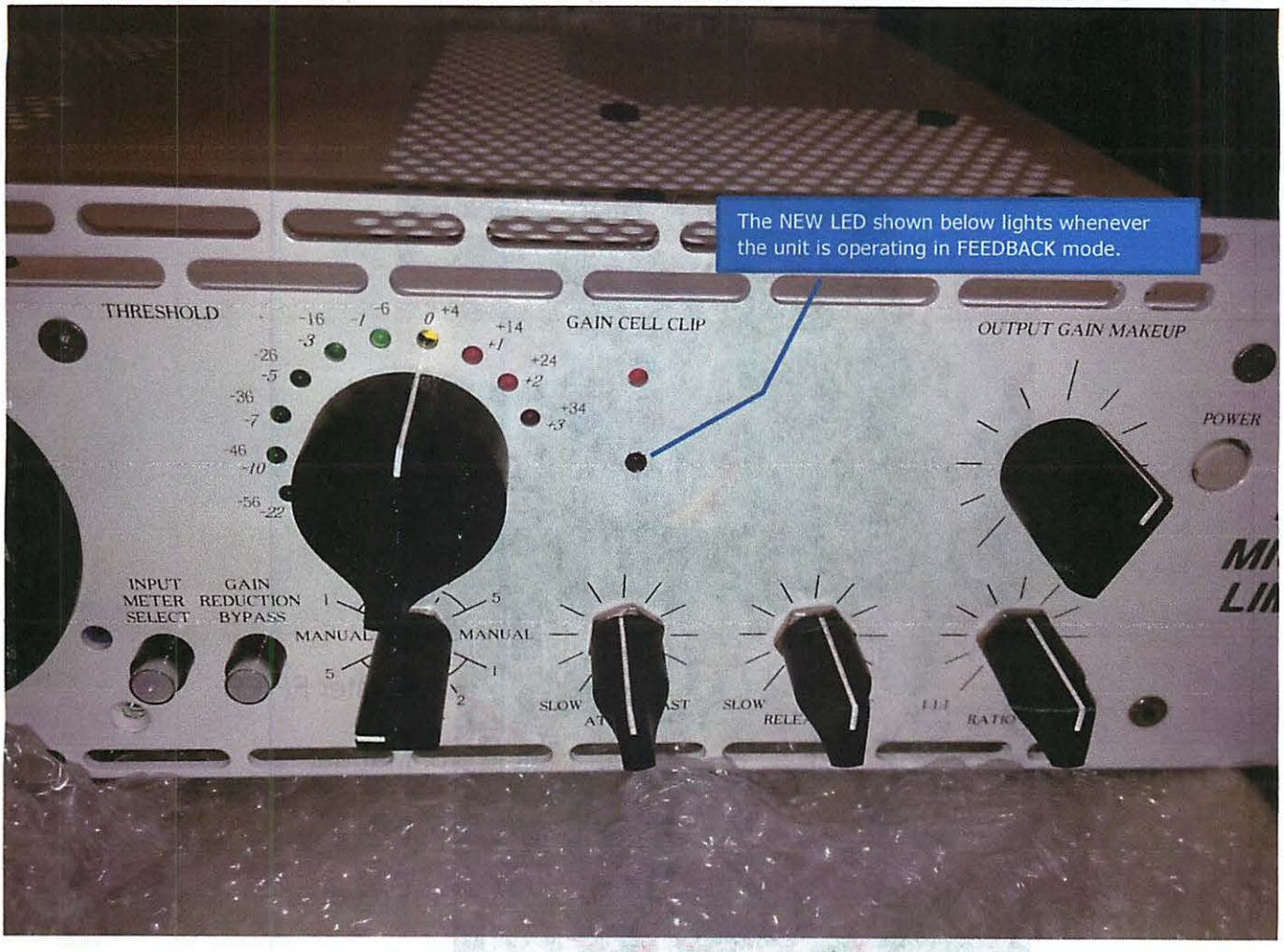
Addendum

FEED FORWARD AND FEED BACK SELECTION AND INDICATION



Default operation of the unit is Feed Forward. Feedback mode is selected with jumpers on the Gain Control PCB. The jumpers affect manual and preset modes. The last position allows for the addition of a MASTER FeedForward / FeedBack mode switch. The jumpers in the picture are all set on the right side pin only . When the jumper is in this position, the mode is Feed Forward. When the jumper covers both pins, the mode is FeedBack and the front panel LED will light. In Feed Back mode the threshold will change, and the limiting metering scale will no longer be accurate. The Ratio will become much greater and the output trim will affect the threshold. The sonic results make it worth while to investigate.