INSTRUCTION MANUAL

FM-600/FM-601
MONO/STEREO
ACC LIMITER

DECEMBER 1984 IM NO. 597-1600

BROADCAST ELECTRONICS, INC.

BE®

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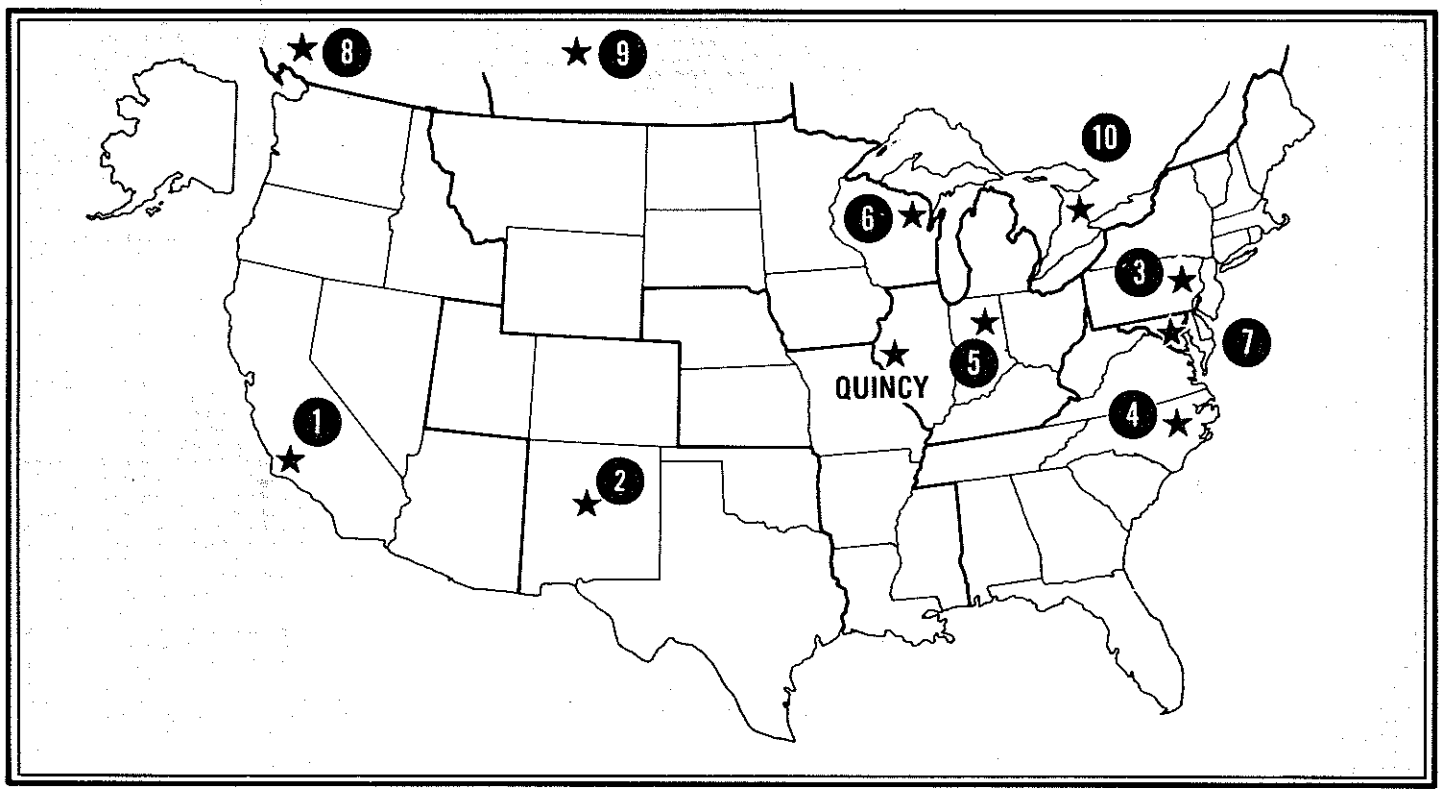

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INSTRUCTION MANUAL

FM-600/FM-601
MONO/STEREO AGC LIMITER

TABLE OF CONTENTS

List of Illustrations and Tables

SECTION 1
INTRODUCTION

1.1 GENERAL DESCRIPTION

The FM-601 (stereophonic) and the FM-600 (monophonic) are combination compressor/limiter/expander units employing unique signal processors which provide automatic level control to maximize transmitter modulation and prevent over-modulation. As the monophonic unit is simply the left channel of the stereophonic unit, this publication will discuss the stereophonic unit only in detail. The following diagrams in section 6 present electrical differences for the monophonic unit:

Figure 6-14-Master Board, Component Identification - D914-1900

Figure 6-19-Mono Peak Detector/Limit Circuit Board Assembly - D914-1912

Figure 6-20-Mono Output Circuit Board Assembly - - D914-1915

Three modes of operation are switch selectable: 1) NORMAL -provides complete gated compression/limiting expansion, 2) LIMIT - functions as a limiter/compressor, and 3) TEST - functions only as an amplifier.

Only two controls are required to adjust the operating characteristics of this equipment. The AVERAGE/PEAK RATIO control sets the dynamic range as desired from 1 dB to 35 dB. The RETURN RATE control adjusts the speed with which low-level signals are expanded. In combination, these two controls allow for tailoring operation of the FM-601 to achieve the precise sound parameters as required to meet individual station programming requirements.

The unit is equipped for operation with a DOLBY B FM encoder. It may be used ahead of the DOLBY B to provide compression or used as a peak limiter between the DOLBY B and the transmitter. The FM-601 may be set to the TEST mode to function as a straight-line amplifier while DOLBY encoding is employed.

The FM-601 utilizes a pre-emphasis input circuit and a complementary de-emphasis network at the output. Provisions allow selection of different pre-emphasis time constants.

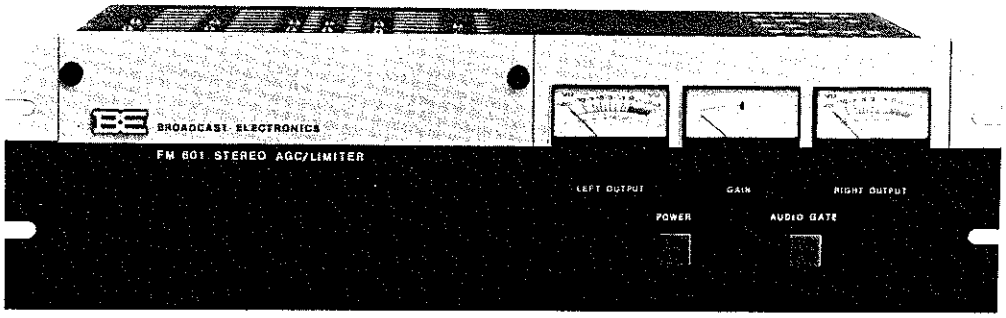


FIGURE 1-1. FM 601 AGC LIMITER

Electrical and Physical Specifications for FM AGC/Limiters

PARAMETER	SPECIFICATIONS
Input Impedance	600 Ohm, Transformer balanced
Input Level	-20 dBm to +26 dBm for +20 dBm output (-20 dBm input yields +20 dBm output with zero compression or expansion)
Frequency Response	±0.5 dB, 30 Hz-20kHz
Distortion	0.75% or less, 30 Hz-20 kHz at +20 dBm output
Signal-to-Noise	60 dB or greater below +20 dBm output -20 dBm input
Output Impedance	600 Ohm, transformer balanced
Output Level	Adjustable, +20 dBm maximum
Overall Gain	60 dB with full expansion
Compression Range	Ø to 30 dB
Expansion Range	Ø to 20 dB
Expansion Recovery Rate	Adjustable, 5 to 40 seconds for 20 dB expansion
Average/Peak Ratio	Adjustable, 35 dB minimum, 1 dB maximum
Limiter Attack Time	5 microseconds or less for 10 dB of limiting
Equalization	NORMAL Mode: 75 uS, 25 uS, or flat response (50/25 uS or flat optional TEST or LIMIT modes: Flat only
Operating Temperature Range	Ø° to 55°C
Power Requirements	105 to 125 or 210 to 230 VAC (switchable), 50/60 Hz, 30 watts.
Dimensions	19 inches Wide, 5.25 inches High, 10 inches Deep (48.3 cm x 13.3 cm x 25.4 cm)
Weight (packed)	16 pounds (7.2 kg)

SECTION 2
INSTALLATION

2.1 MOUNTING

The FM-601 mounts in 5¼ inches of vertical space in a standard 19-inch EIA rack.

2.2 CIRCUIT CARDS

Lower the hinged access panel, remove packing material and insure that all circuit cards are fully seated.

2.3 INPUT/OUTPUT/REMOTE CONNECTIONS

All input, output and remote control connections are made through a 24-pin Jones plug on the rear of the FM-601. A mating connector is supplied with the unit. For connector wiring, see drawing 906-0510.

All audio connections are balanced and floating. A shield connection is provided for each audio pair.

Remote selection of operating mode is accomplished by momentarily connecting the appropriate pin to ground. The connection may be held for any length of time, but will lock out all associated modes as long as it is held.

The maximum current switching for remote control is 3 mA (DC). Maximum open-circuit voltage is 15V.

2.4 AC POWER

The unit is supplied with NEMA standard three-wire line cord. Unless otherwise ordered, the unit is shipped for operation from 110 volt ±20%. A 220 volt ±20% power source may be accommodated by placing the power transformer primary switch (located on the master board near the power input wires) in the 220 volt position.

SECTION 3
OPERATION

3.1 GENERAL

The FM-601 left and right input and output controls are set at the factory to their maximum or counterclockwise (CCW) position. When these controls are set to their maximum-clockwise (CW) position, the unit is factory calibrated to input −20 dBm for +20 dBm out for unity or nominal gain. The input level controls may be set to accept any convenient input level above a nominal −20 dBm and below +26 dBm. The output level controls may be set to an output level of +20 dBm or below, but should fall between +4 dBm to +20 dBm to fall within the output meter calibration range.

3.2 ADJUSTMENT OF OPERATING CONTROLS

All operating controls, except the power switch, are located behind the hinged access panel on the left front of the unit. The power switch is located on the rear panel. Operating controls are: INPUT LEVEL, OUTPUT LEVEL, EXPANSION (Return) RATE, AVERAGE/PEAK RATIO, and the switches located on the Logic card.

Note

Any adjustment of a control other than the listed operator controls will necessitate realignment of the unit.

Once the unit is mounted and connected, proceed as follows:

1. Set INPUT and OUTPUT level controls to their extreme minimum (CCW) position. Set all switches OFF (down). Turn on AC power. The POWER and 75 usec lamps should light.

2. Connect an audio signal from the main studio to the left input. This should be from a mono source at normal settings.

Note

This must be at least −20 dBm.

Slowly turn up the INPUT level control for the left channel until the gain meter reads about center. The AUDIO GATE lamp on the front panel, and the GATED Light Emitting Diode (LED) on the logic card should be illuminated.

Increase the left OUTPUT level control for the desired output (100% modulation).

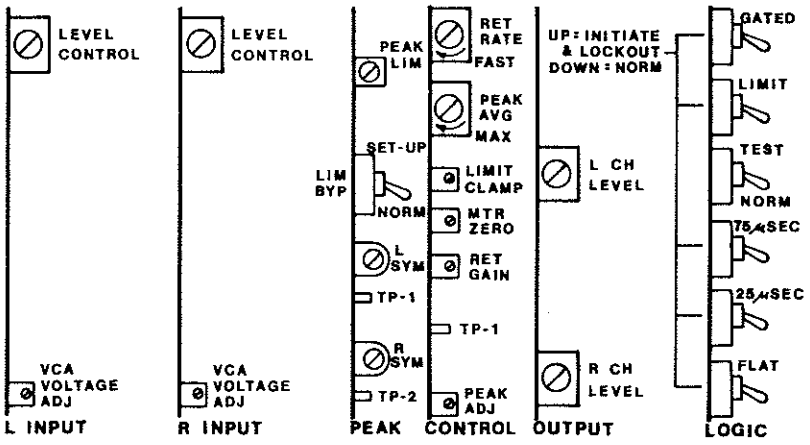


Figure 3-1. Circuit Card Location and Adjustment Identification

3. Remove the input from the left channel and connect to the right. Do not change left channel level settings. Repeat the adjustments as in step 2 above. The left and right input levels should be adjusted to show the same gain reduction for the same input level, when only one channel at a time is driven.

4. Adjust the VU meter calibration controls for "Ø" VU.

NOTE

The GATED and LIMIT ONLY LED's are on only when an audio input of sufficient level is present. They therefore act as back-up audio gate lamps.

5. Select the desired operating mode by toggling the appropriate switches (on and off) on the logic card. The switches can be left in the on position to act as a lockout. This will also insure that the unit will remain in the selected operating mode when power is removed and restored. With all switches off, the unit will always turn on in the 75 usec, GATED modes. The LED's act as positive indicators of the active modes.

6. The gated mode of operation allows 50 dB of control range. The FM-601 will compress 30 dB and expand 20 dB. The limit mode allows an adjustable amount of expansion. The compression is maintained at 30 dB. (This is available compression). Expansion may be adjusted for any desirable amount between Ø dB and 20 dB. Adjustment may be made by turning the LIMIT CLAMP control on the control PCB in the clockwise direction for increased expansion. This control is only active in the limit only mode and has been factory adjusted for Ø dB of expansion.

7. The PEAK:AVG and RETURN RATE controls are set while monitoring normal program materials.

In the MIN. direction, the PEAK:AVG control provides the widest dynamic range and, therefore, the least "compressed" sound. In the MAX. direction, the average level is held very close to the peak level, for the loudest and tightest sound. The RETURN RATE acts in conjunction with the PEAK:AVG control. It adjusts the rate at which the average level can be increased as input signal level falls. Neither adjustment will have any effect on the maximum peak output level, or the limiter attack time. The range of the two controls are such that almost all gain control action (other than peak limiting) can be disabled at one extreme, or very heavily compressed audio can be achieved at the other. No combination of control settings, however, can cause distortion or "thumping", as sometimes happens with separate AGC and limiting units.

NOTE

The FM-601 also has a bypass circuit built in. If the unit should be turned off, lose AC or DC power, or have a circuit card removed while in operation, the incoming audio is switched directly to the outgoing audio terminals. If the level into the FM-601 is adjusted below 100% transmitter modulation input level, the possibility of overmodulating during bypass is greatly reduced.

SECTION 4
ELECTRONIC THEORY OF OPERATION

4.1 GENERAL

In the following discussion, 0 dBm is one milliwatt into 600 ohms and the FM-601 input and output is normalized to 600 ohms terminations. Level is expressed as $dB=20 \log \frac{E1}{E2}$ about 0 dBm.

4.2 INPUT CARDS

Each input card provides the following functions:

Input transformer, amplifier, and level control;
Level detector for signal presence gating;
Pre-emphasis circuits;
Gain control;
Interlock.

Audio from the bypass relay is brought onto the input card through Pins 21 and 22, to the input transformer T101. The transformer is terminated by R101 so that the FM-601 provides a proper load for phone or other long lines. Input level is controlled immediately with R102 to provide maximum overhead (at least +25 dB). At maximum gain setting, signals with an average level as low as −20 dB can be processed. The I.C. 101 stage provides isolation and about 6 dB of voltage gain after the level control.

The output of the amplifier is split to the pre-emphasis and signal detectors.

I.C. 102 is an equalized amplifier which is most sensitive between 100 Hz and 4 KHz. The sensitivity is about 6 dB lower at 60 Hz and 7 KHz than at 1 KHz. This equalization corresponds generally to the spectral content of most broadcast program material. It is designed to be insensitive to noise of both high and low frequencies.

Q101 is a current driver for this amplifier, with CR101 connected as a limiter for protection against excessive peaks. CR102 rectifies the signal and sends it to the control card via Pin 4. This signal is used to determine whether a desired signal is present, and is used to generate gain expansion or return to unity control functions.

Relays K101 and K102 control the pre-emphasis on the input cards. When both relays are relaxed, C108 via R116 is connected in parallel with R114 for 75 microsecond operation (normal North American operation). When the FLAT operating mode has been selected, Pin 3 is grounded and K101 activated, and the parallel branch is removed. For 25 microsecond operation (Dolby), both Pins 2 and 3 are grounded and K101 and K102 are activated. C109 via R117 then becomes the parallel branch. R116 and R117 serve to cancel the pre-emphasis outside the audio range.

The gain control signal enters the input card through Pin 10. I.C. 105A inverts and adds this DC control voltage to a fixed voltage offset from R120. This allows the voltage controlled amplifiers to be calibrated so that they begin gain reduction at the same control voltage. I.C. 105B inverts and provides the scale factor for proper system operation over a 50 dB range. The scaled control voltage is applied to A101.

A101 and I.C. 103 function together as a voltage controlled amplifier, the audio current via R115, etc., (controlled by the gain control voltage) times R128 equals the output voltage. I.C. 104 acts as output amplifier for the input card with a voltage gain of approximately 12 dB. The control LED audio leaves the card through Pin 16.

4.3 PEAK DETECTOR/CLIPPER CARD

The peak detector/clipper card provides:

Full-wave peak detection of the left and right signals;
Symmetrical peak clipping of very fast peaks of the matrixed signals;
and Interlock.

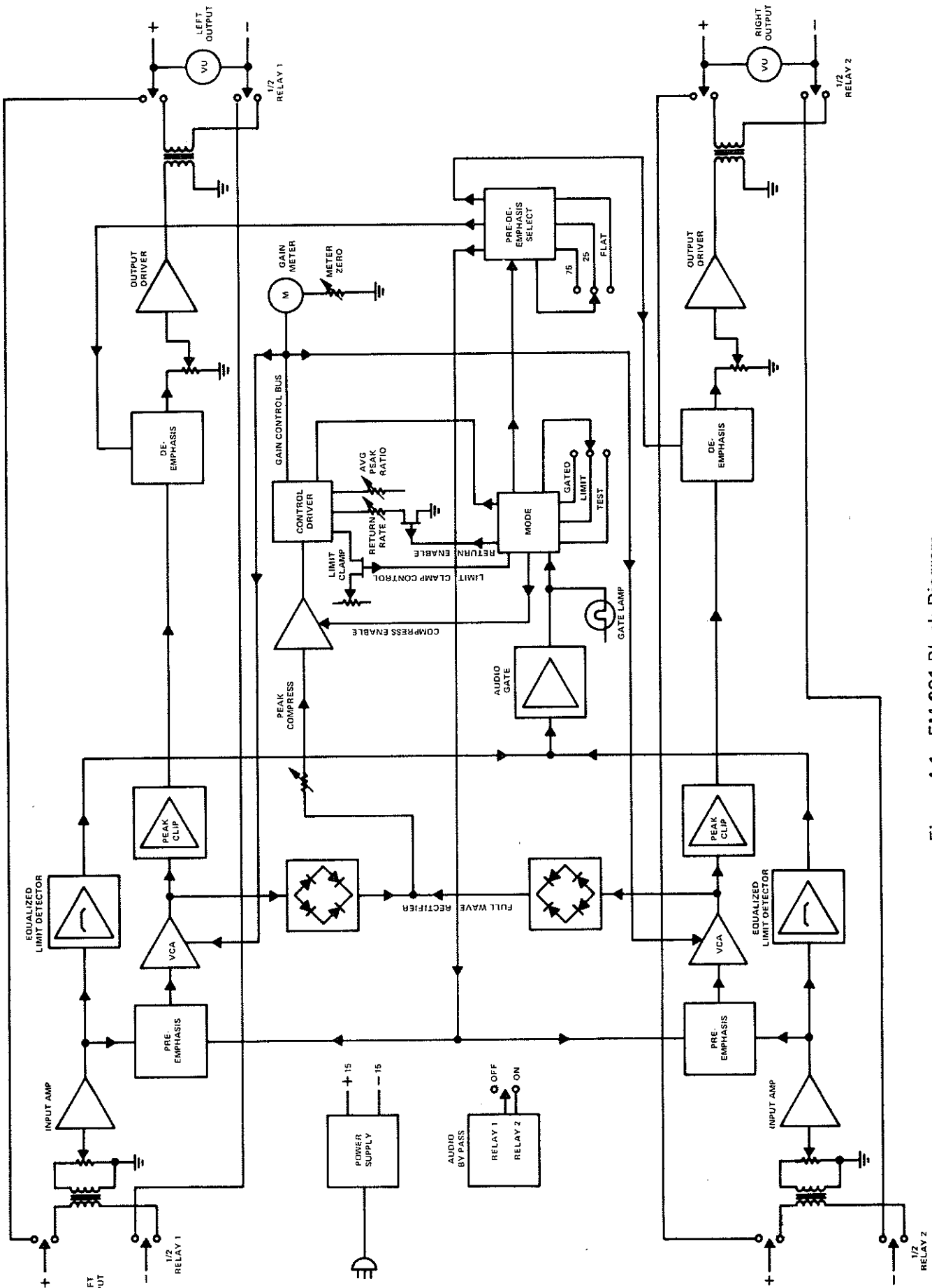


Figure 4-1. FM-601 Block Diagram

The audio from the input cards enters the peak card through Pins 16 (left) and 15 (right) and pass through I.C. 201 and I.C. 202, the peak limiting (clipping) amplifiers, and exit via Pins 19 (left) and 18 (right). The limiting is accomplished by reducing the power supplies to these amplifiers which effectively head room limits their outputs. The clipper is disabled when the test mode is selected and S201 LIM BYP is in the closed or normal position. With the test bus (Pin 1) grounded by the logic card, Q201 saturates and provided +15 volts to I.C. 203B input, a non-inverting amplifier which supplies the positive supply voltage to I.C. 201 and I.C. 202. The output of I.C. 203A, which inverts this same voltage, serves to supply I.C. 201 and I.C. 202's negative supply voltage. When Q201 is not saturated, I.C. 201 and I.C. 202's supply voltage is controlled by R205 Peak LIM. The output of I.C. 201 and I.C. 202 is thus limited by their supply voltages. I.C. 204B inverts the left channel audio and passes on the positive peaks via CR201. I.C. 205B inverts the output of I.C. 204B via the L symmetry control R220 and passes on the positive peaks through CR202, which completes the full wave rectification of the left audio. The symmetry control is used to compensate for rectifier output differences and is adjusted for peak to peak symmetry. I.C. 204A, I.C. 205A, CR204, CR205 and symmetry control R229 perform the same function for the R audio. These two signals exit through Pin 5 via CR203 and CR206.

4.4 OUTPUT CARD

The output card provides interlock, de-emphasis, output level control, output amplification and balancing.

Audio from the peak card enters the output card through Pin 15 (left), and Pin 14 (right). I.C. 503 (right) and I.C. 501 (left) provide de-emphasis which is the exact compliment of the pre-emphasis on the input cards. The operation of the relays follows the input card relays.

Output levels are set by R505 (left) and R516 (right). The output stages are direct-coupled op-amps with complimentary transistor output current boosters. Transistors Q501 through Q506 are included in the left output amplifier circuit and they function as follows: Q506 provides the positive supply current boost with Q502 serving as its bias stabilizer, while Q504 senses and limits the current through Q506 under abnormal output load conditions. The complimentary transistor Q505 functions in much the same way as Q506, but provides the negative supply boost with Q501 and Q503 performing their complimentary functions. Including the 6 dB of transformer voltage gain, each of these amplifiers exhibit a voltage gain of approximately 16 dB. These stages provide a very low distortion (typically less than 0.1%) high level (+20 dBm) output signal from the output transformers.

The balanced outputs leave the output card to the bypass relays through Pins 19 and 20 (left), and 17 and 18 (right).

4.5 LOGIC CARD

The logic card provides the following functions:

Allows selection of operating modes by remote control;
Interlock;
Selection of operating mode by on-card switches;
Lock-out or over-ride of remote control by on-card switches;
Indication of operating mode by LED's (Light Emitting Diodes).

The operating modes can be divided into three groups:

1) Pre-emphasis - 75 or 25 microseconds (usec.), or flat;
2) Test mode;
3) Full gated expansion/compression, or limit only.

The first group, pre-emphasis, matches the operation of the peak limiting to the transmitter pre-emphasis to assure constant 100% maximum modulation by any modulating frequency. The actual component switching is done by the relays on the input and output cards. The relays are controlled from the logic card. The normal operating mode for the FM-601 is 75 usec. (will set in this mode at power turn on unless another set switch is latched). In this mode, all pre-emphasis relays are relaxed, their control busses floating. The control bus driver transistors (Q405, 75 usec., and Q404, 25 usec.) are not conducting. CR420 and CR422 are biased off, and Q406 conducts. Indicator LED I404 (above S-404 SET 75 usec.) is illuminated. Grounding one of the remote control lines or toggling one of the

other pre-emphasis mode set switches momentarily will change the mode. If the SET 25 usec. switch is set on, the emitter of Q409 grounded, the base is held high enough to turn Q409 on by R430 (if no other control busses are grounded) and the control line from the collector will go to ground. As long as the 25 usec. switch remains set, that mode is locked in, since the bases of the two other transistors remain low via CR426 and CR424. The logic will change state only when one of the collectors goes to ground. Q409 will turn off when one of the other set busses is grounded, but this will not change the mode.

When Q409 turns on, Pin 13 of I.C. 402 is pulled to ground, Pin 11 goes high and latches via I.C. 402B (NAND i.e., both inputs high, the output is low; either input low, the output is high), and Q404 turns on. LED I405 turns on, the 25 usec. control is grounded, as is the 75 usec. control bus through CR416. This means that in the 25 usec. mode, all relays are energized. Q406 is also turned off by CR420 being grounded, and the 75 usec. LED is off. CR413 pulls PIN 5 of I.C. 402 low and makes sure that the flip-flop controlling Q405 is set off.

When the FLAT mode is switched on, (all other switches off), Q408 conducts. Pin 1 of I.C. 402 is pulled low and Pin 3 must then go high. Q405 and LED I406 turn on, the normally closed contacts of the 75 usec. relays open and all pre-emphasis/de-emphasis components are removed from the circuits. CR412 pulls Pin 9 of the 25 usec. flip-flop low, resetting it and turning off Q404 and LED I405.

When the 75 usec. mode is selected from another mode, Q407 conducts. This pulls down the outputs of both flip-flops through CR408 and CR414, and resets them so that both Q404 and Q405 are off. The unit is restored to its turn-on condition.

The TEST mode (second group) disables all gain-variable functions of the unit (compression, expansion, limiting, clipping, pre-emphasis, de-emphasis), without bypassing or affecting the amplification functions of the FM-601. It should be used mainly for testing or proofs of performance. The TEST mode is on only while the TEST switch is left set. It does not affect any of the pre-set logic; the unit returns to its previous operating modes when the TEST switch is turned off. When the TEST switch is on, the test bus is grounded. The 75 usec. bus is grounded through CR423 and all 75 usec. circuits are disabled. Q404 is turned off through CR418 to disable the 25 usec. circuits. If the FLAT mode had been previously selected, the I406 (FLAT LED) will remain on; if not, it and all pre-emphasis mode LED's will be off. LED I403 will indicate that the TEST mode is on. The TEST bus is also routed to the control card, where it forces the gain to a fixed ("unit") value; and to the peak card, where it disables the clipping action.

The normal operating mode of the third group is expansion/compression, or GATED operation. When power is turned on (and neither S401 or S402 is closed and remote busses floating), Q410 and Q411 are held off. No current can flow through R407 or R408. Current is supplied, however, through R403 and R404. Current into the inverting inputs of I.C. 401 (a quad-operational transconductance amplifier), greater than the current into the non-inverting inputs, causes the output current to be cut off. Two amplifiers are connected in a latching configuration. With the output current from Pin 9 cut off (Low), Q401 is also cut off.

If the LIMIT ONLY switch is set (S402), Q411 turns on and delivers about four times the current to Pin 12 as is available to Pin 11. The output Pin 10 switches current into Pin 13 of the second stage. Pin 9 switches current into Q401, allowing it to turn on. As long as S2 is held on, the current through R408 and R405 will prevent the mode from being changed.

If S402 is opened and S401 closed, more current will be available to Pin 11 through R407 and R403 than R405 can supply to Pin 12. The logic will reset to the GATED mode again.

Q401 cannot conduct unless a path through CR405 and Q403 to ground is provided. Q403 conducts only when it receives current from Pin 4 of I.C. 401, the output of a third stage. It, in turn, supplies current when it is not receiving current from the gate drive circuit on the control card. This condition is met when sufficient audio is present at the input of the FM-601.

When audio is present, and Q401 is on (LIMIT ONLY mode), LED I402 is on and a ground signal is routed through Pin 8 of the card to the control card. At the same time, Q402 is held off. In the gated mode, Q401 is off and its LED is off. Q402 and LED I401 are allowed to turn on, and another ground signal is routed to the control card through Pin 9 of the logic card. When no audio signal is present, Pins 8 and 9 of the logic card are pulled up, and the LED mode indicators are both off. Thus, the lamps act as a back-up audio presence indicator. The logic does not lose its memory of the selected mode when the lamps are out, however.

TABLE 4-1. LOGIC OUTPUT CONTROL BUS TRUTH TABLE

Mode	Control Busses		
	25 msec.	75 msec.	TEST
75 microsec.	HIGH	HIGH	HIGH
25 microsec.	LOW	LOW	HIGH
Flat	HIGH	LOW	HIGH
Test	HIGH	LOW	LOW

4.6 CONTROL CARD

The control card provides the following functions:

Determine peak amplitudes relative to 100%;
Interlock;
Determine audio signal presence;
Generate gain control signals, to increase or decrease gain in accordance with the selected operating mode;
Provide controlled fixed gain at turn-on, loss of signal, or TEST;
Provide gain metering;
Allow operator adjustment of expansion rate (AGC speed) and peak average/ operation.

The rectified peaks from the peak card enter the control card through Pin 5. They are compared with a fixed level by one stage of I.C. 301. If the current into Pin 2 from the peaks is greater than the reference current into Pin 3, the peak signal will be switched into Q301 to turn it on. The fixed reference current is controlled by Q304. In normal operating modes, the TEST bus is floating, and Q304 turns on. The peak voltage must then only exceed ground level to turn on Q301. R301 allows the exact desired peak level to be set. In the TEST mode, however, the grounded TEST bus turns off Q304, and the reference becomes approximately 6.5 volts. The peaks out of the preceeding amplifier stage can never reach this level, so Q301 can never turn on.

Q301 is a low impedance driver for the gain reduction circuit. Current input impedance voltage follower, and Q303 is a low output impedance drive. As the voltage on C303 rises, the voltage on the control line rises. This voltage is processed on the input cards and reduces the gain of the unit. The peaks into the control card are reduced, and Q301 will deliver less charging current. This closed-loop prevents even very small increases in peak level above the set output.

In order to increase the unit's gain after a peak has passed, C303 must discharge. The only path available is through R312 and R311 into C302. C302 also is charged by Q301, but because of its greater value, and the additional voltage drop of CR303, CR304 and R310, the charging is lower and much slower. The voltage across C302 therefore follows the average signal level rather than the instantaneous level as does C303. The gain can only increase until the voltage across C303 and C302 are about equal (the unit will expand only to the previous average level). The peaks are always held constant by the voltage on C303. But the average gain of the unit is adjustable by varying the discharge time through R312. With R312 at full resistance, C303 stays charged longer, the gain stays lower, and the average level is lower. With R312 at minimum resistance, the voltage across C303 varies almost with the peaks and the average level is much higher.

C302 must have a discharge path to follow the average input level. In the GATED operating mode, this path is through R336/R337 and Q309. Q309 turns on when the logic card indicates to it that audio is present and the GATED mode has been selected. Q309 conducts to ground, so C302 will discharge to ground, the control line will follow it and the unit will be at full gain (full expansion). The capacitors are always being charged by passing peaks, and a balance between charge and discharge is established at some average gain.

For LIMIT ONLY operation, the logic card switches on Q314 in parallel with Q309. Q314 conducts to an adjustable voltage rather than ground. A limiting threshold can thus be set, and the gain of the unit cannot increase beyond this point.

The speed of operation of the average level control section is set by R336. At maximum resistance, C302 will discharge very slowly and the AGC action will be very gentle. At minimum resistance, the average gain will change very quickly with changes in input level.

There are three occasions when the unit must return to a fixed gain: just at power turn-on, when no signal is present at the input, and in the TEST mode. R330, the return gain adjust, sets the fixed gain that the unit returns to at these times.

When the power is first applied, C305 is discharged, which turns on Q310 via R333 to charge C302 and force the gain of the unit to the return gain setting. As C302 charges to the supply voltage via R334, Q310 turns off.

When the input audio drops below a useful level, the gating circuit comes into action. The gating signals from the input cards are routed through Pin 4 of the control card to Pin 6 of I.C. 301. Here they are compared to the same reference as the peak signals. The stage acts as an inverter, so there is negative output current when sufficient audio is present. The output of the stage splits to the logic card through Pin 7 of the control card, and to the base of Q305. With signal present, Q305 is conducting, Q308 is turned off, and C304 is charged by Q305 via R322 and CR310. Since the inverting input (Pin 8) of the following OTA section received no positive current, the output (Pin 9) is high and Q312 is biased off. At the same time, Q306 is held off by Q305 and the front panel audio gate lamp driver, Q307, is conducting (the lamp is on). When the audio signal drops low enough for the comparator to switch, Pin 5 of I.C. 301 goes high. Q307 turns off and the gate lamp goes out. Q308 does not supply positive current to I.C. 301 (Pin 8) until C304 discharges through R323. During this interval, all discharge paths for C302 are turned off, so the gain holds at the previous average gain. When I.C. 301 (Pin 9) goes low, Q312 turns on and forces the gain to the return gain level. The holding time is about 12 seconds. When the signal reappears, Q312 turns off immediately and releases the gain control.

When the TEST mode is selected, the gate signal comparator I.C. 301 non-inverting input (Pin 1) sees 6.5V via R320. This makes Pin 9 of I.C. 301 go low, which forces the unit to return gain or "unity" as the unit assumes no audio is present. The gate lamp goes out and C304 begins discharging. The gate of Q311 has been directly grounded by the test bus, however, and rapidly forces the gain to the return level. The peak comparator also receives 6.5V as a reference to disable the control of the gain bus (I.C. 301, Pin 4, goes low).

Gain meter zeroing is accomplished with R345. Q313 serves as a voltage reference for the meter. R343 is the scale factor resistor. The gain meter is connected between the gain control bus (Pin L of the control card), and the meter common line (Pin 10).

4.7 POWER SUPPLY

The power supply for the FM-601 consists of the power transformer and printed circuit board mounted on the chassis in the right half of the unit. AC is connected to J11, Pins 1 and 2, via the line switch and fuse on the rear panel. It is fed to the power transformer primary through J10 via the 110-220 volt switch (S2). J10 also returns the secondary voltages to bridge rectifiers CR1 and CR4. The output of CR1 bridge rectifier is filtered by C1 and is used as the raw DC for the positive 15 volt supply. CR2 and C2 provide additional filtering for the "op-amp" portion of IC1, the regulator I.C. Q2 is driven by the regulator I.C. and provides the regulated 15 volts. R1 is the current sense resistor for the output of I.C. 1 and allows internal circuitry to limit the current output of the I.C. Q1 provides fold back current limiting for Q2 with R2 and R7 used as fold back sensing and the parallel combination of R3 and R4 providing the current sensing.

C5 serves to roll off the frequency response and stabilize the 15-volt output. CR3 prevents the output from being reversed. R6 is the 15-volt output trimmer potentiometer with R5 and R8 serving to limit the range of R6 voltage adjustment. The −15 volt supply functions in much the same manner with the exception that the positive output is referenced to ground instead of minus.

4.8 MASTER BOARD

The master board contains the following functions:

Connections for all plug-in cards;
Input/output/remote control connector;
Bypass interlock circuitry;
110-220 volt input power (mains) select switch and R.F. bypass capacitors.

All input, output and remote connections to the FM-601 are made through J7 mounted on the rear panel and the master board. This connector allows quick connection and at the same time assures solid termination. Remote controls select FLAT, select 75 usec., select 25 usec., select GATED, and select LIMIT ONLY appear at the connector, and require only a momentary ground for activation. The select test input requires a ground for as long as it is selected since it overrides all other functions while selected and returns the unit to its previously selected state when cancelled.

A special bypass circuit is provided in the FM-601. This connects the outputs directly to the inputs in case of abnormal operation.

One set of contacts on each plug-in card is series connected to the regulated supply and holds Q1 in conduction when the circuit is complete. Q1 activates bypass relays K1 and K2, and connects the inputs and outputs to their proper plug-in cards. Should any card be pulled, or AC or DC power fail, the relays relax and the unit is automatically taken out of the audio chain. S1 is provided to override the circuit card interlock function for troubleshooting purposes.

4.9 METER BOARD

The meter board provides the following functions:

L audio level monitoring with calibrating control;
R audio level monitoring with calibrating control;
Gain meter through-put;
Audio presence indication (audio gate) through-put;
Power on indication (power) through-put;

The output level meters are connected directly across the output connections and will display the audio level even when the unit is in the bypass mode. R1 and R4 allow these meters to be calibrated in the range of +4 to +20 dB.

SECTION 5
CALIBRATION

Normally the only adjustments required are those described in paragraph 3.2. Should the unit not operate properly these calibration procedures may be performed:

1. Remove the unit from service. Lower the hinged access panel and remove the top cover. Place the test switch and the flat switch on the Logic PCB in the up position. All other switches should be down. Place the Input and Output controls in their full counterclockwise position. Place the Return Rate and the Peak/Avg Ratio controls in their full clockwise position. Terminate the inputs and outputs with 600 OHMS.

2. Apply AC power and allow unit to stabilize for two minutes.

3. Measure and adjust if necessary the power supply for + and – 15 VDC.

4. Measure the DC voltage on TP-1 located on the control PCB. Adjust the return gain Control for 3.5 VDC.

5. Apply a 1000 Hz sine wave signal to the Left Channel Input. Set the left input and output control to their full clockwise position. Adjust the VCA voltage adjust on the Left Channel Input PCB for an output level of +20 dBm.

6. Connect an oscilloscope to TP-1 on the Peak Detector/Limiter card. Adjust the left symmetry control for even rectification.

7. Return the left input and output level controls to their full counter clockwise position.

8. Repeat steps 5 and 6 substituting the right channel and TP-2 for the left and TP-1.

9. Adjust the meter zero control on the Control PCB for a reading on the gain meter within the green area.

10. Place the limit bypass switch on the Peak PCB into the set up position. Increase input signal to –18 dBm. Adjust the peak unit control until clipping just starts. Return the limit bypass switch to the normal mode.

11. Place the test switch on the Logic PCB in the down position. The Audio Gate light will illuminate as will the Gated LED on the Logic PCB.

12. Adjust the Peak ADJ on the Control PCB for an output level of +20 dBm.

13. Check unit for operation. Increase input level to +10 dBm. The output level should not increase more than 1 dB. The gain meter will indicate compression. Lower the input level to –10 dBm. The output should return to +20 dBm within 5 seconds. As the input is lowered, the output will continue to expand to +20 dBm. As the input approaches –40 dBm the GATE Lamp will extinguish and after 10 seconds the gain meter will return to the green position.

14. Place the limit switch on the Logic PCB in the UP position. Apply an input signal of -20 dBm.

Verify proper outputlevel +20 dBm. Lower input signal to -30 dBm. Adjust the limit clamp on the Control PCB for an output level of +10 dBm.

NOTE

IN THIS MODE THE EXPANDER IS CLAMPED OUT OF OPERATION. THE UNIT WILL COMPRESS BUT NOT EXPAND. IF SOME EXPANSION IS REQUIRED BUT NOT A FULL 20 DB AS IN THE GATED MODE, THE LIMIT CLAMP CAN BE ADJUSTED AS DESIRED.

15. The VU meters should be calibrated at time of installation.

16. OPERATIONAL CHECK AND ADJUSTMENT

17. The equipment noted below is required to perform the following tests on the FM Limiters.

I. Required Test Equipment

A. Ferrograph, RTS 2 - Recorder Test Set

B. Ferrograph, ATUI - Auxiliary Test Units.

II. Equivalent Test Equipment

A. An accurate Audio VU Meter

B. An accurate Audio Voltmeter

C. An accurate Distortion Analyzer

Proceed with tests as explained on pages 5-3 thru 5-6.

FM-601 OPERATIONAL CHECK AND ADJUSTMENT

MODE (CONTROL LOCATION)	TEST POINT (LOCATION)	ADJUSTMENT CONTROL (LOCATION)	OPERATION	TEST CONDITIONS
POWER ON (Rear Panel)	15 Volts (Power Supply Pins 1 and 2)	15 Volt Adj (Power Supply R6 Top Left)	Adj 15 Volts	Power Input 110 Volts ±25%
	-15 Volts (Power Supply Pins 9 and 10)	15 Volt Adj (Power Supply R14 Middle Right)	Adj -15 Volts	When switched for 220 Volt Operation 220 Volts ±25%
		Limit Clamp (Control PC Bd)	Preset CW	
		Level (L Input PC Bd)	Preset CW	
		Level (R Input PC Bd)	Preset CW	
		L Ch Level (Output PC Bd)	Preset CW	
		R CH Level (Output PC Bd)	Preset CW	
TEST, FLAT (Logic PC Bd)	TP-1 (Control PC Bd)	Ret Gain (Control PC Bd)	Adj to 3.5 VDC	
	FM-601 Output Left (Input/Output Connector, Rear Panel)	VCA Voltage Adj (L Input PC Bd)	Adj to +20 dBm Output	1 KHz -20 dBm Left Ch Input 600 Ohm Output Termination
	VCA Adj Arm R120 (Input Left)		Observe App. 2.3 Volts DC at VCA Adj Arm R120	
	Left Output Meter (Front Panel)	Mtr Adj (Meter PC Bd Left)	Adj to 0 VU	
	FM-601 Output Right (Input/Output Connector, Rear Panel)	VCA Voltage Adj (R Input PC Bd)	Adj to +20 dBm Output	1 KHz -20 dBm Right Ch Input 600 Ohm Output Termination
	VCA Adj Arm R120 (Input Right)		Observe App. 2.3 Volts DC at VCA Adj Arm R120	
	Right Output Meter (Front Panel)	Mtr Adj (Meter PC Bd Right)	Adj to 0 VU	
	TP-1 (Peak PC Bd)	L Sym (Peak PC Bd)	Adj for Equal Peaks	1 KHz -20 dBm Left Ch Input
	TP-2 (Peak PC Bd)	R Sym (Peak PC Bd)	Adj for Equal Peaks	1 KHz -20 dBm Right Ch Input
NORMAL, FLAT (Logic PC Bd)	FM-601 Output Left (Remote Connector)	Peak Adj (Control PC Bd)	Adj to +20 dBm Out	1 KHz -20 dBm Left Ch Input 600 Ohm Output Termination

MODE (CONTROL LOCATION)	TEST POINT (LOCATION)	ADJUSTMENT CONTROL (LOCATION)	OPERATION	TEST CONDITIONS
NORMAL, FLAT (Logic PC Bd)	FM-601 Gain Meter	Mtr Zero (Control PC Bd)	Preset Mtr Zero to Full CW. Adj Mtr Zero CCW to Unity	
LIMIT, FLAT (Logic PC Bd)	FM-601 Output Left (Remote Connector)	Limit Clamp (Control PC Bd)	Adj to +10 dBm Out	1 KHz -30 dBm Left Ch Input 600 Ohm Output Termination
NORMAL, FLAT (Logic PC Bd)		Ret Rate (Control PC Bd)	Preset CCW	
	FM-601 Output Left (Remote Connector)	Distortion Null (Input PC Bd) Left R127	Adj for Minimum Distortion (Less than 0.1%)	1 KHz -10 dBm Left Ch Input 600 Ohm Output Termination
		Ret Rate (Control PC Bd)	Preset CCW	
	FM-601 Output Right (Remote Connector)	Distortion Null (Input PC Bd) Right R127	Adj for Minimum Distortion (Less than 0.1%)	1 KHz -10 dBm Right Ch Input 600 Ohm Output Termination
		Ret Rate (Control PC Bd)	Preset CW	1 KHz -20 dBm Left Ch Input Reduce Input to -36 dBm (AUDIO GATE MUST REMAIN ON)
	FM-601 Output Left (Remote Connector)		Observe +20 dBm Out Observe +20 dBm Out After App. 5 sec.	
		Ret Rate (Control PC Bd)	Preset CCW	
	FM-601 Output Left (Input/Output Connector)		Observe +20 dBm Out Observe +20 dBm Out After App. 50 Sec.	1 KHz -20 dBm Left Ch Input Reduce Input to -36 dBm (AUDIO GATE MUST REMAIN ON)
		Ret Rate (Control PC Bd)	Preset CW	
	Gain Meter (Front Panel)		Observe Audio Gate on Unity Gain	1 KHz -20 dBm Left Ch Input
	Gain Meter, Audio Gate (Front Panel)		Observe Gain Expand for App. 10 Sec. Before Gain Returns to Unity	Reduce Input Until Audio Gate Light is Off (-37 dBm to -42 dBm)

MODE (CONTROL LOCATION)	TEST POINT (LOCATION)	ADJUSTMENT CONTROL (LOCATION)	OPERATION	TEST CONDITIONS
TEST, FLAT (Logic PC Bd)	FM-601 Output Left and Right (Input/Output Connector)		Observe Noise Less than 70 dBm Below +20 dBm in Both Channels	Remove Input Signals (Terminate with 600 Ohm Termination Both Channels)
	FM-601 Output Left (Input/Output Connector)		Observe Crosstalk Below Noise Level	1 KHz -20 dBm Input Right
NORMAL, 75 Micro-Sec (Logic PC Bd)	FM-601 Output Left (Input/Output Connector)		Observe +17 dBm Out (3dB Point 75 Micro-Sec Deemphasis Verification)	2122 Hz -20 dBm Left Ch Input
	TP-1 (Control PC Bd)		Observe 3.7 Volts DC (75 Micro-Sec Preemphasis Gain Correction)	
NORMAL, 25 Micro-Sec (Logic PC Bd)	FM-601 Output Left (Input/Output Connector)		Observe +17 dBm Out (3dB Point 25 Micro-Sec Deemphasis Verification)	6366 Hz -20 dBm Left Ch Input
	TP-1 (Control PC Bd)		Observe 3.7 Volts DC (25 Micro-Sec Preemphasis Gain Correction)	
POWER, (Rear Panel)	FM-601 Output Left (Input/Output Connector)		Observe 1 KHz, -20 dBm, Output Left	1 KHz -20 dBm Input Left
	FM-601 Output Right (Input/Output Connector		Observe 1 KHz, -20 dBm, Output Right	1 KHz -20 dBm Input Right
POWER (Rear Panel)	FM-601 Output Left (Input/Output Connector)	BYP, Norm Switch (Master PC Bd)	Preset to Bypass Remove L Input PC Bd Observe No 1 KHz Output Left	1 KHz -20 dBm Input Left

MODE (CONTROL LOCATION)	TEST POINT (LOCATION)	ADJUSTMENT CONTROL (LOCATION)	OPERATION	TEST CONDITIONS
POWER ON (Rear Panel)	FM-601 Output Left (Input/Output Connector)		Set to Norm and Observe -20 dBm Output Left Replace L Input PC Bd Observe +20 dBm Output Left	1 KHz -20 dBm Input Left
TEST (Logic PC Bd)	FM-601 Output Left (Input/Output Connector)	LIM BYP Switch (Peak PC Bd) Peak LIM (Peak PC Bd)	Set to Set-Up Set Peak LIM Control to Not Clip at +21.5 dBm Output and to Clip at any Higher Level Return LIM to Norm	1 KHz -18.5 dBm Input Left Vary Input as Required
NORMAL (Logic PC Bd)	FM-601 Output Left (Input/Output Connector)		Observe +20 dBm	1 KHz +10 dBm
	Gain Meter (Front Panel)		Observe Gain Compress	
	Gain Meter (Front Panel)		Observe Gain Expand	1 KHz -30 dBm

SECTION 6
ASSEMBLY DRAWINGS AND SCHEMATICS

6.1 INTRODUCTION

This section provides descriptions and part numbers of parts and assemblies followed by assembly drawings, schematic diagrams and wiring diagrams required for maintenance of the FM-601 Stereo AGC Limiter and the FM-600 Mono AGC Limiter.

6.2 LIST OF FIGURES

6.3 LIST OF TABLES

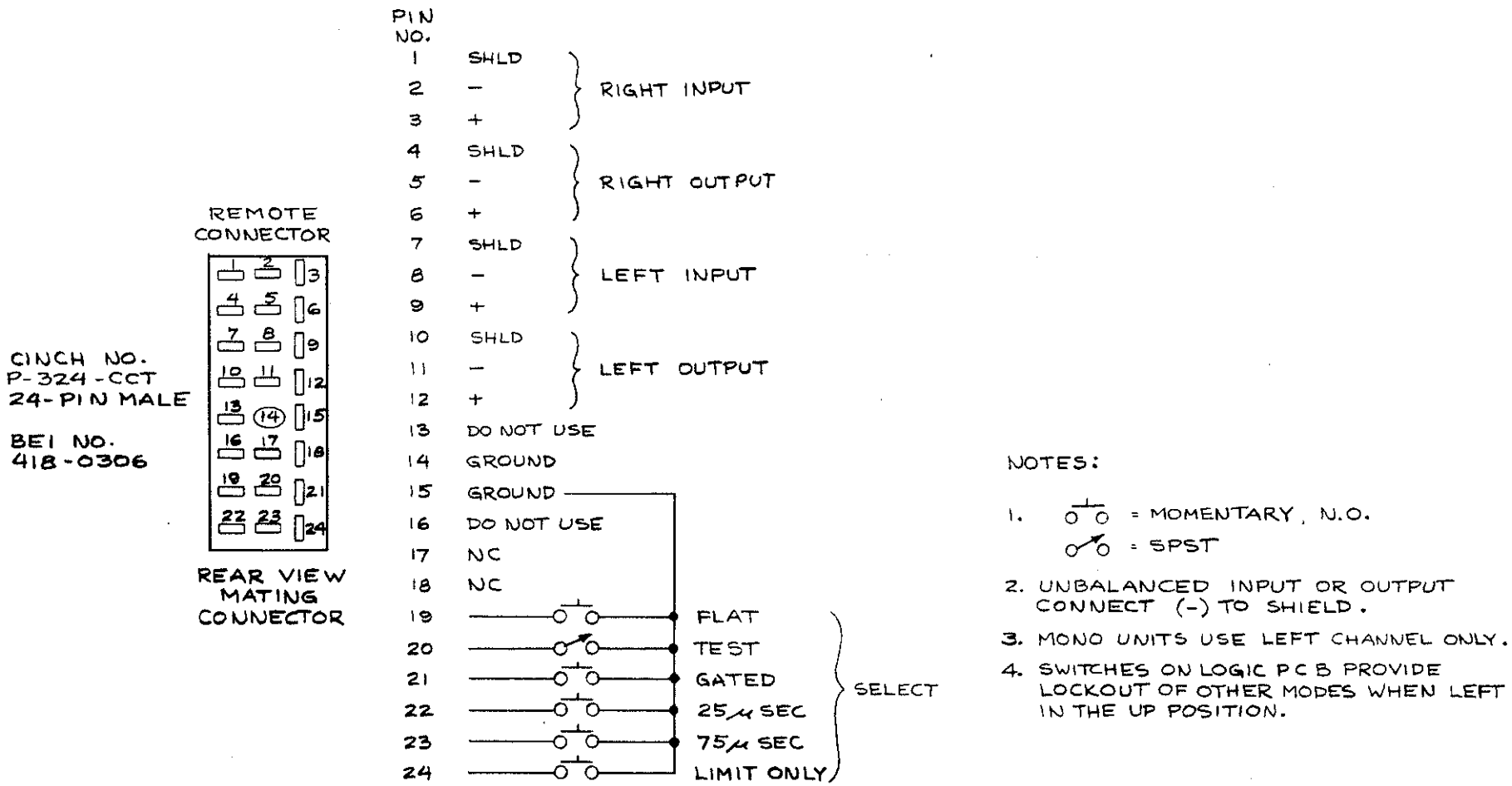


Figure 6-1. Input/Output Remote Connector Wiring Diagram (DWG. 906-0510)

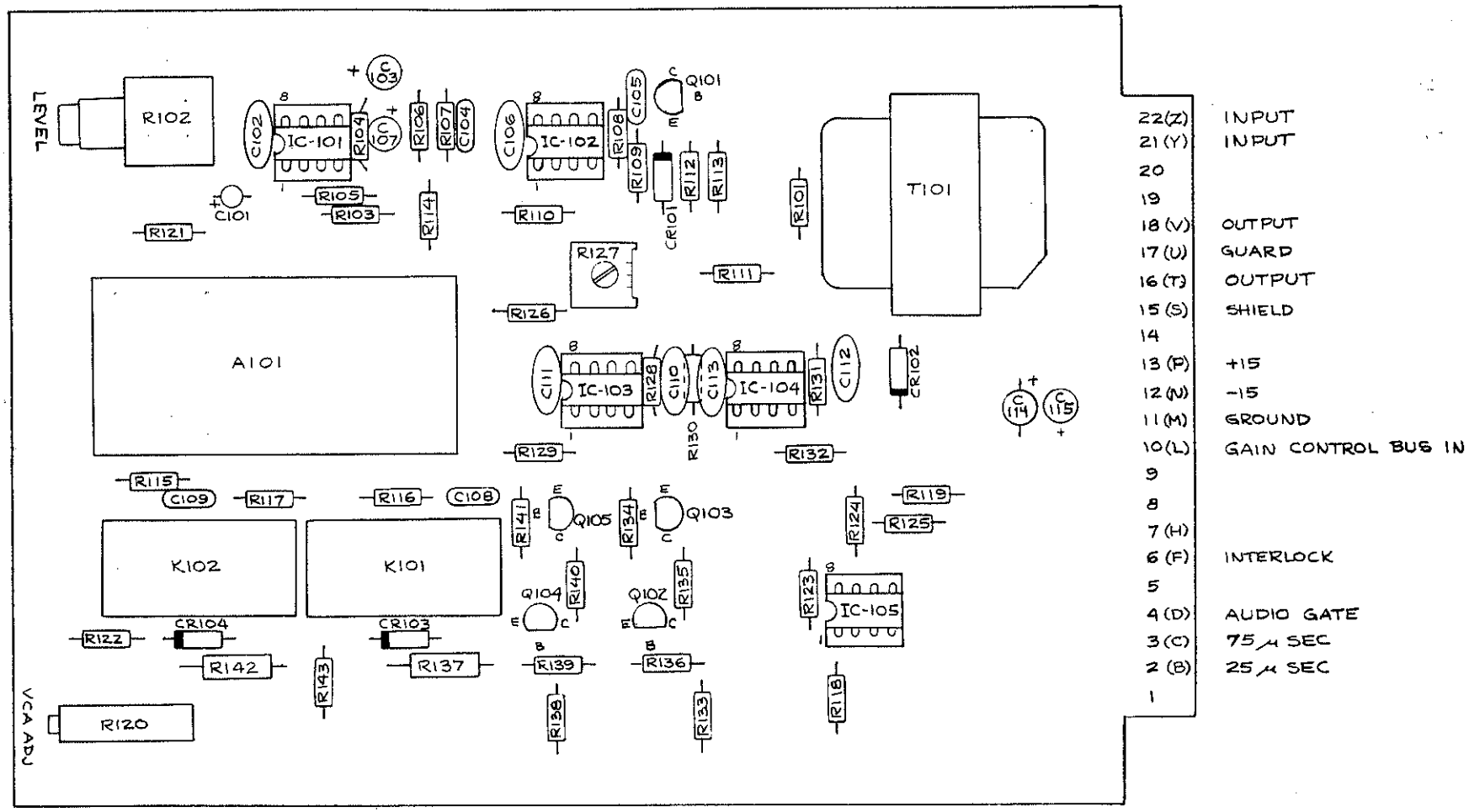


Figure 6-2. Input Card, Component Identification (DWG. 914-1901)

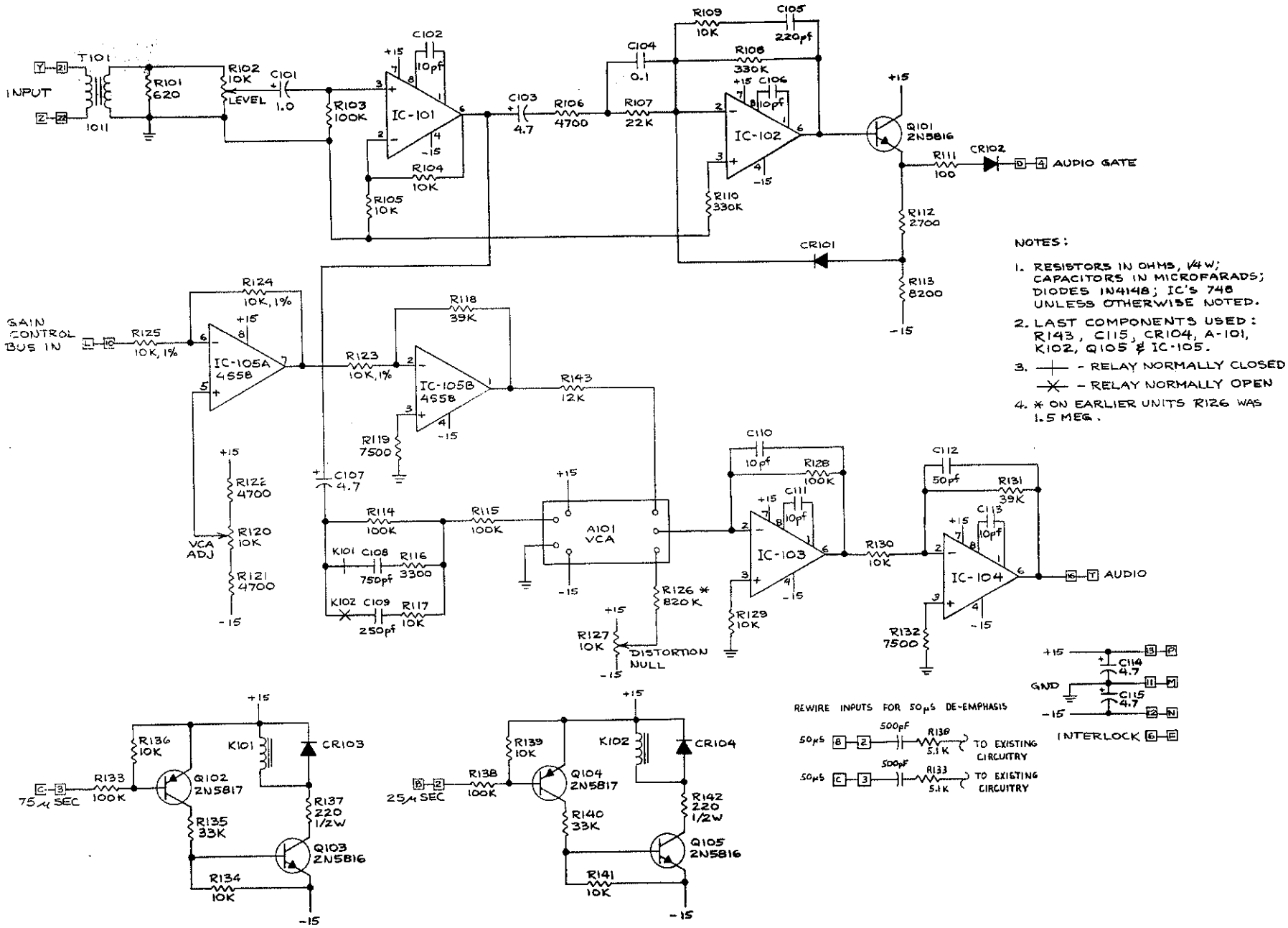


Figure 6-3. Input Card, Schematic Diagram (DWG. 906-0507)

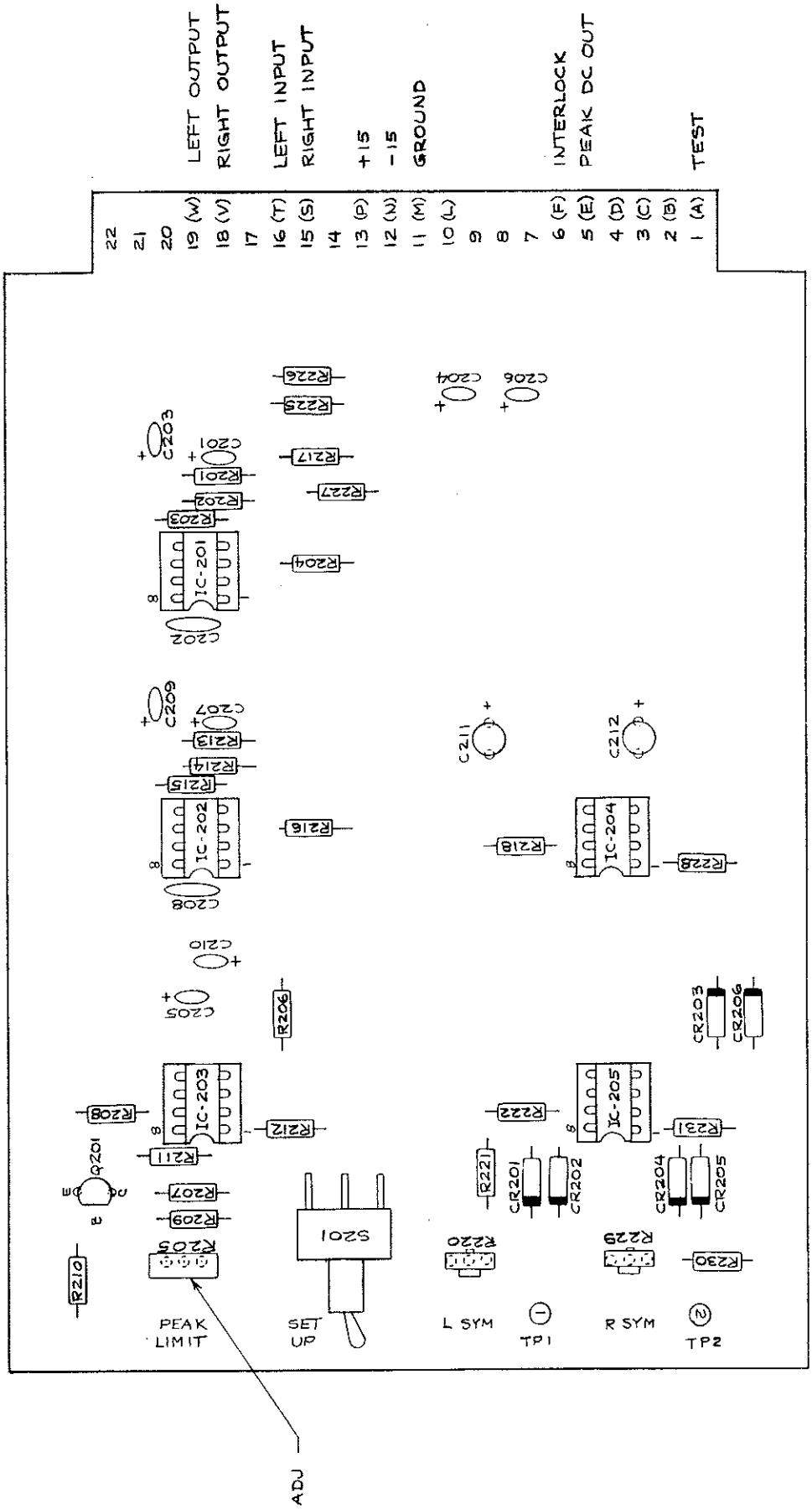
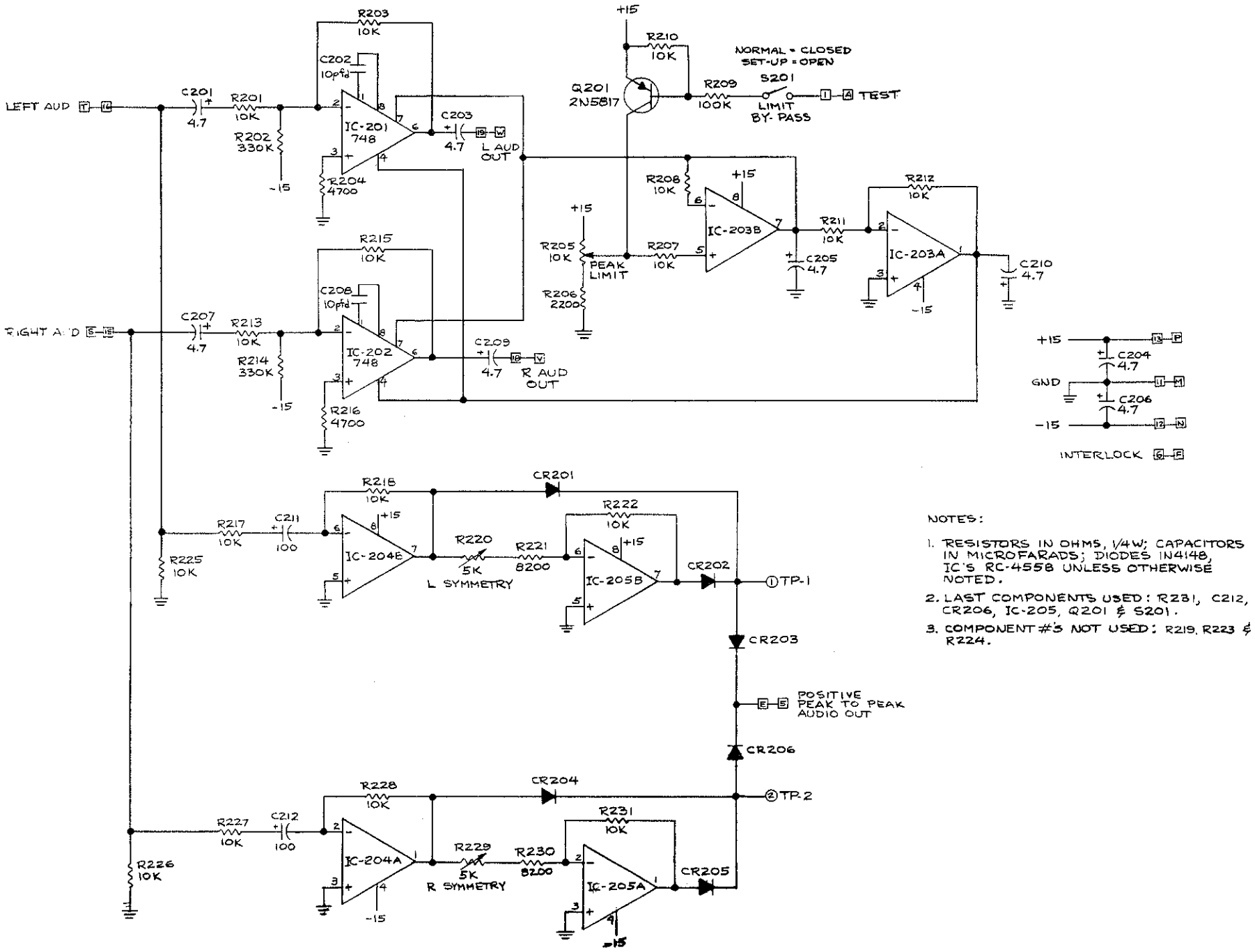


Figure 6-4. Peak Detector/Limiter Card (Stereo), Component Identification (DWG. 914-1902)



NOTES:

1. RESISTORS IN OHMS, 1/4W; CAPACITORS IN MICROFARADS; DIODES IN4148, IC'S RC-4558 UNLESS OTHERWISE NOTED.
2. LAST COMPONENTS USED: R231, C212, CR206, IC-205, Q201 & S201.
3. COMPONENT #'S NOT USED: R219, R223 & R224.

Figure 6-5. Peak Detector/Limiter Card (Stereo), Schematic Diagram (DWG. 906-0504)

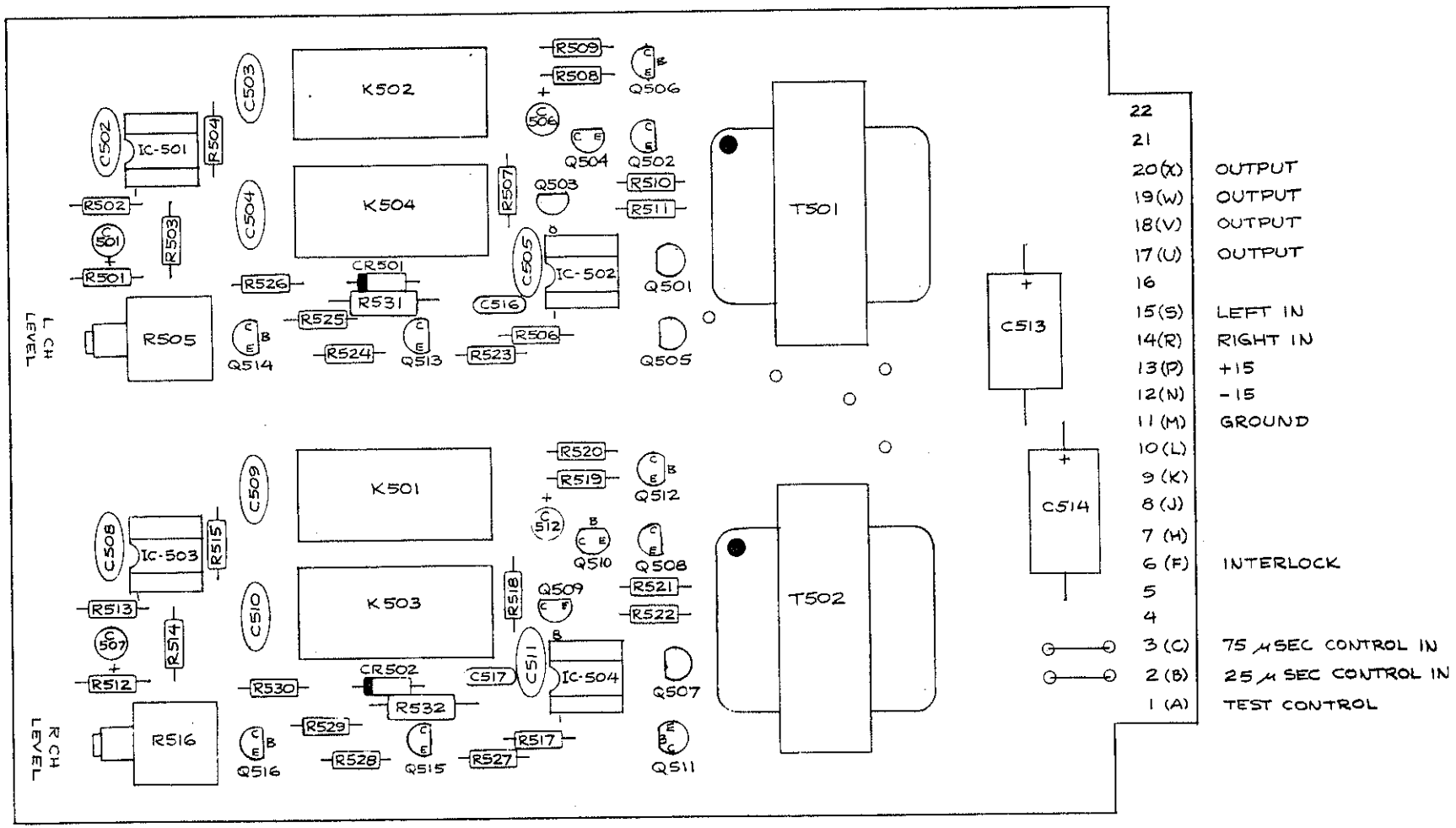


Figure 6-6. Output Card (Stereo), Component Identification (DWG. 914-1905)

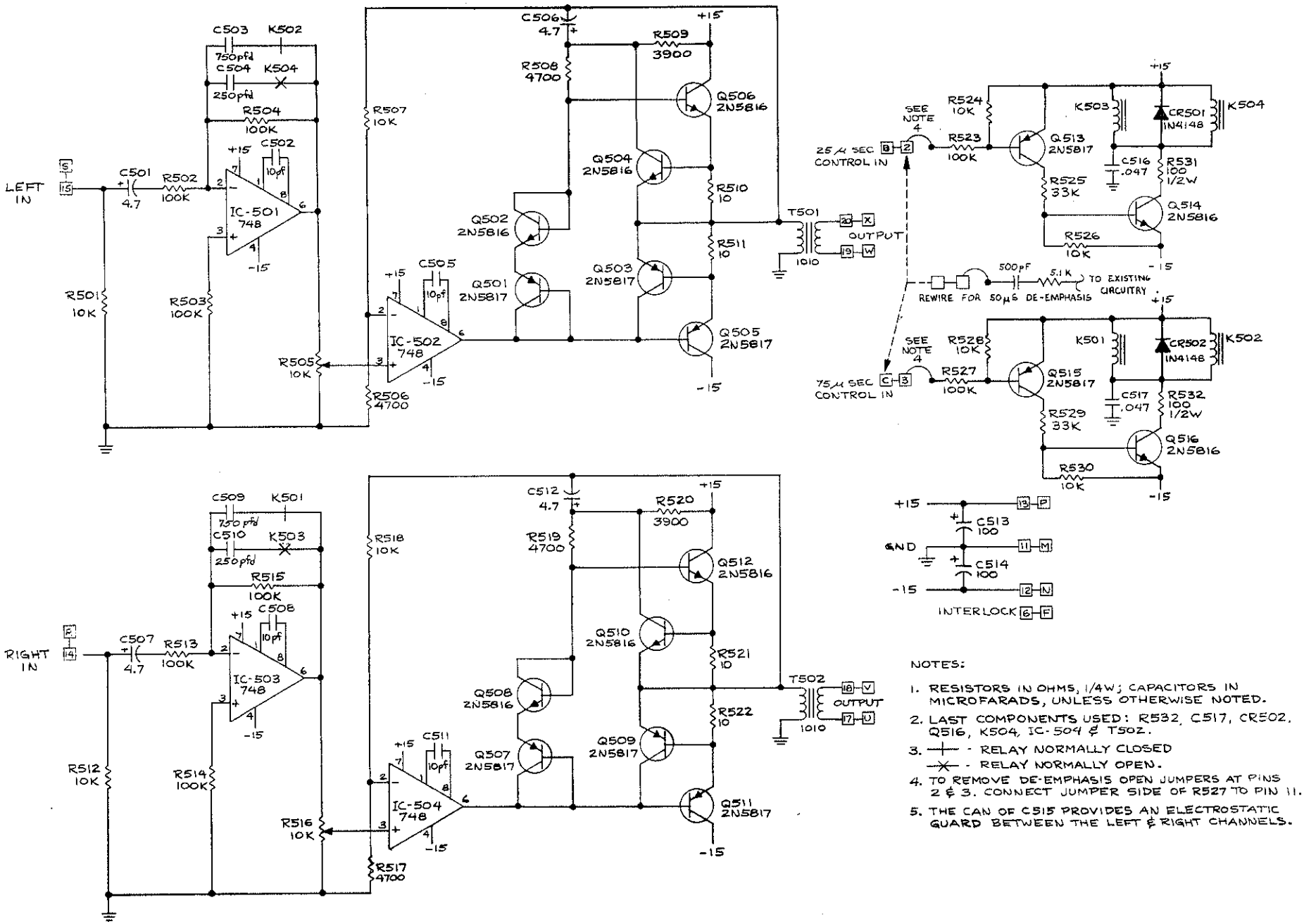
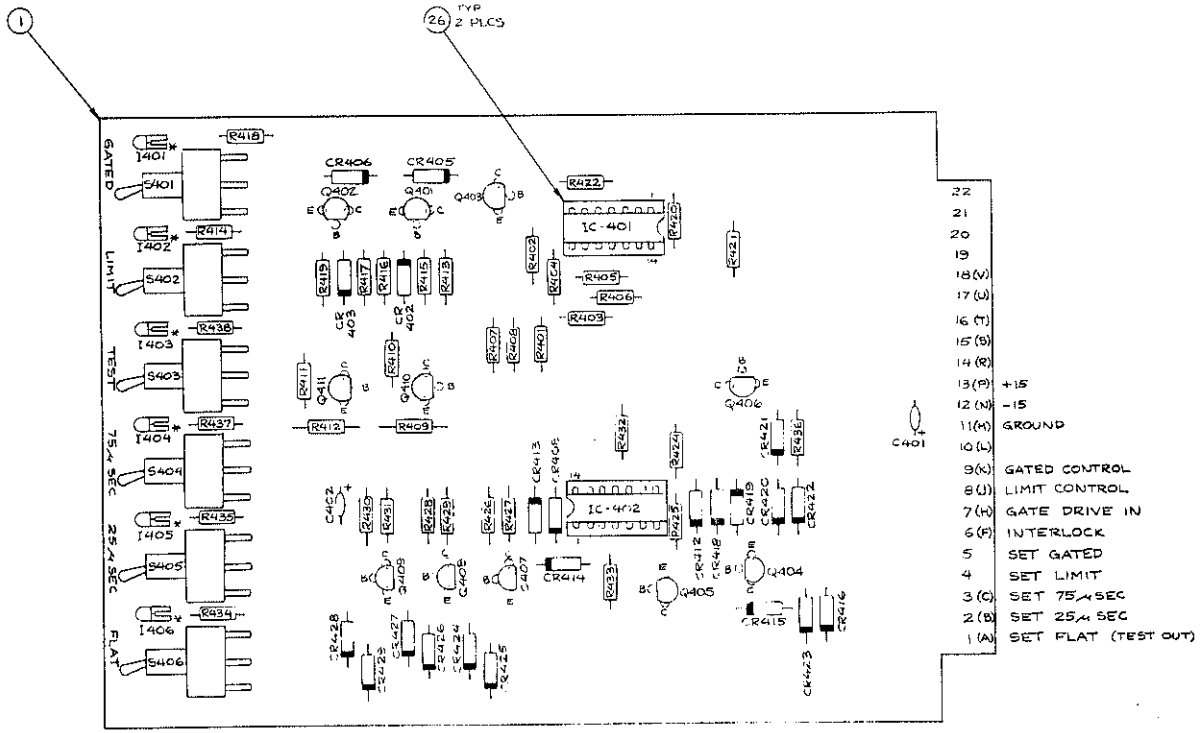


Figure 6-7. Output Card (Stereo), Schematic Diagram (DWG. 906-0505)



ITEM	QTY REQD	PART NUMBER	DESCRIPTION	NOTE
30	REF	C-906-0503	SCHEMATIC	
29				
28				
27				
26	2	417-1400	14-PIN DIP SOCKET	
25	1	221-7400	74C ØØN, QUAD 2 IC	(IC-402)
24	1	221-3900	3900 IC	(IC-401)
23	6	348-0123	SWITCH, SPDT TOGGLE (S401 THRU S406)	
22				
21				
20	2	210-5817	GES 5817 TRANSISTOR (Q410, Q411)	
19	3	211-6566	6566 TRANSISTOR	(Q407, Q408, Q409)
18	6	211-5816	GES5816 TRANSISTOR (Q401 THRU Q406)	
17				
16				
15	19	203-4148	IN4148 DIODE (CR402, CR405, CR406, CR408, CR412, CR413, CR414, CR415, CR416, CR418, CR420, CR422 THRU CR429)	
14				
13	3	200-0009	IN4739 DIODE (CR419, CR421, CR403)	
12	6	324-5082	LED INDICATOR (I401 THRU I406)	
11				
10	2	064-4763	4.7 MFD TANT CAPACITOR (C401, C402)	
9	1	100-8253	82K Ω 1/4W RESISTOR	(R424)
8	8	100-4743	4700Ω,	(R415, R416, R419, R427, R429, R431, R432, R433)
7	1	100-2753	27K Ω	(R422)
6	6	100-2243	2200 Ω	(R414, R418, R434, R435, R437, R438)
5	2	100-2073	2MEG Ω	(R403, R404)
4	6	100-1073	1 MEG Ω	(R405, R406, R407, R408, R420, R421)
3	4	100-1063	100K Ω	(R411, R411, R428, R430)
2	9	100-1053	10KΩ, 1/4 W RESISTOR (R401, R402, R403, R412, R413, R417, R424, R425, R426)	
1	1	514-1904	BLANK P C BOARD	

LIST OF MATERIAL

NOTES:

1. * - INDICATES LONG LEG OF LED INDICATOR.

Figure 6-8. Logic Card, Component Identification (DWG. 914-1904)

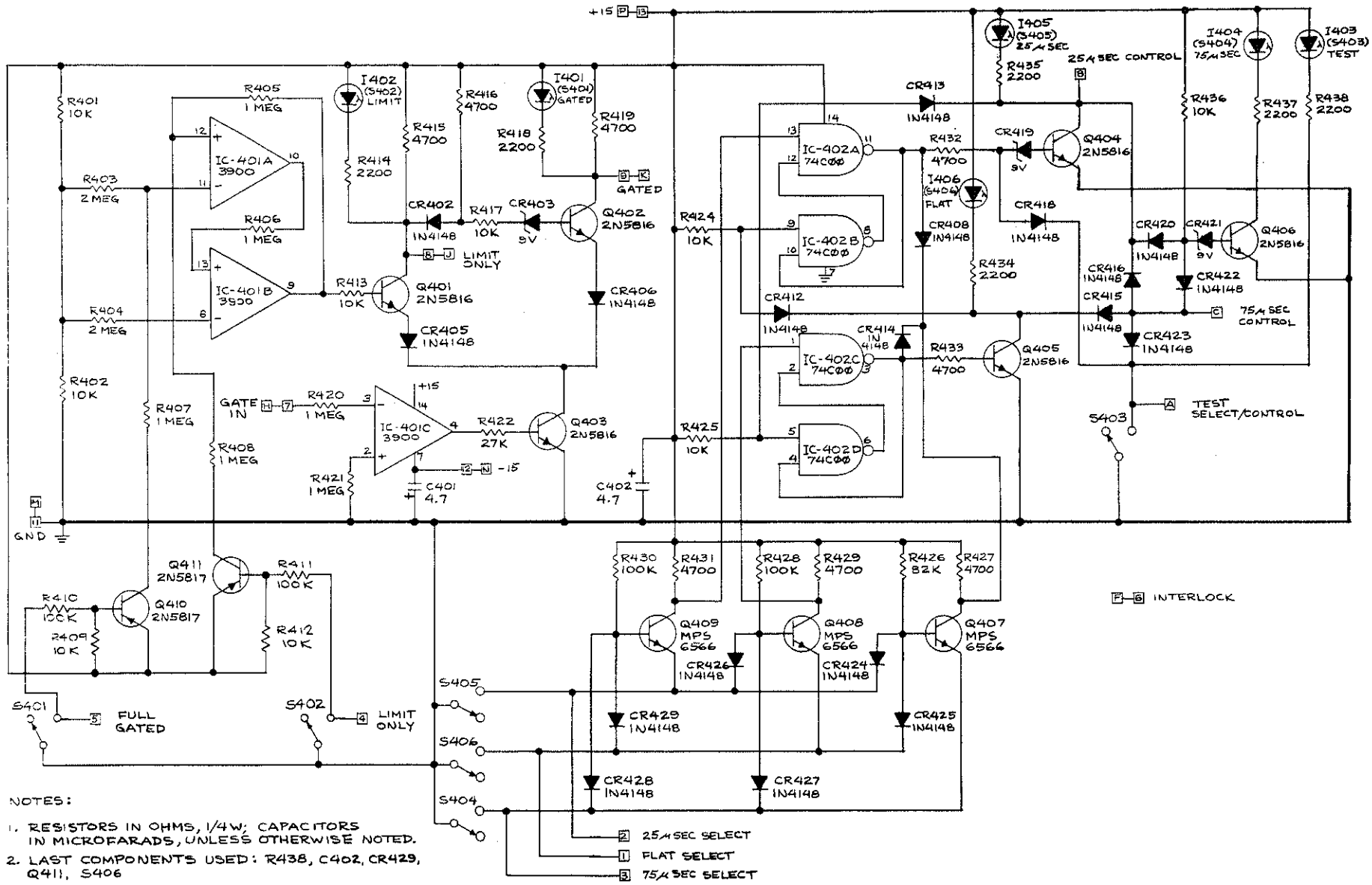


Figure 6-9. Logic Card, Schematic Diagram (DWG. 906-0503)

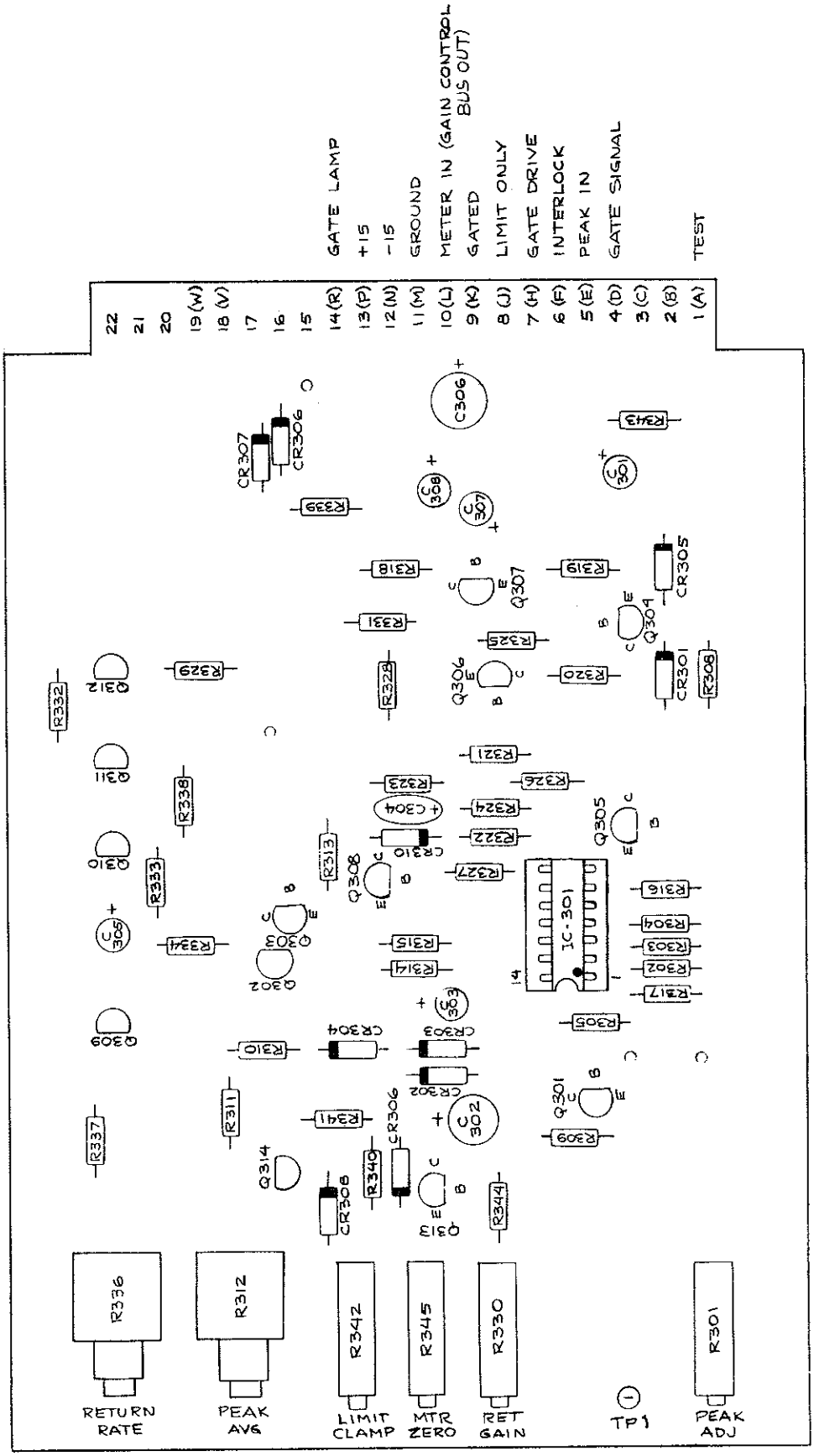


Figure 6-10. Control Card, Component Identification (DWG. 914-1903)

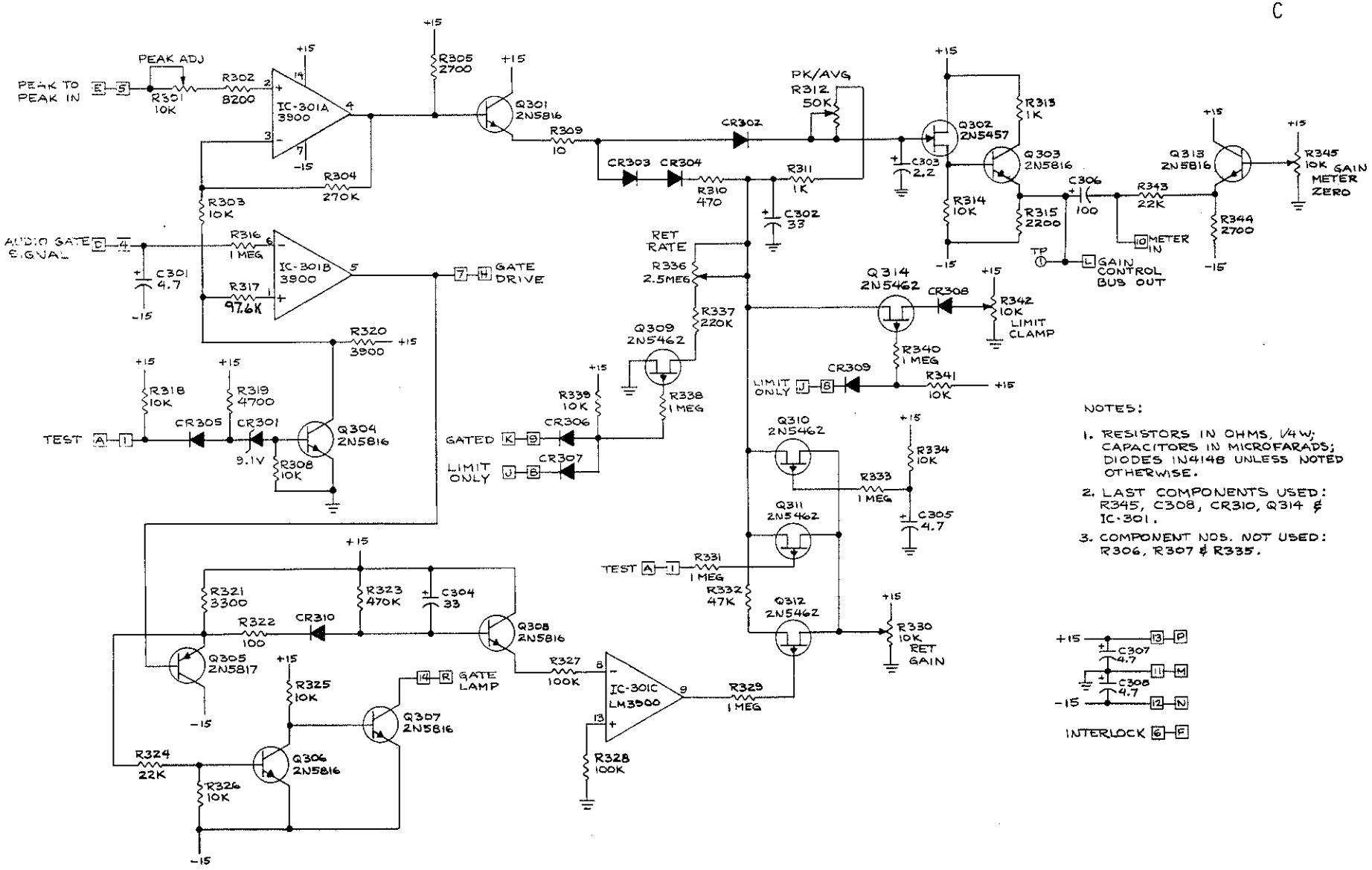
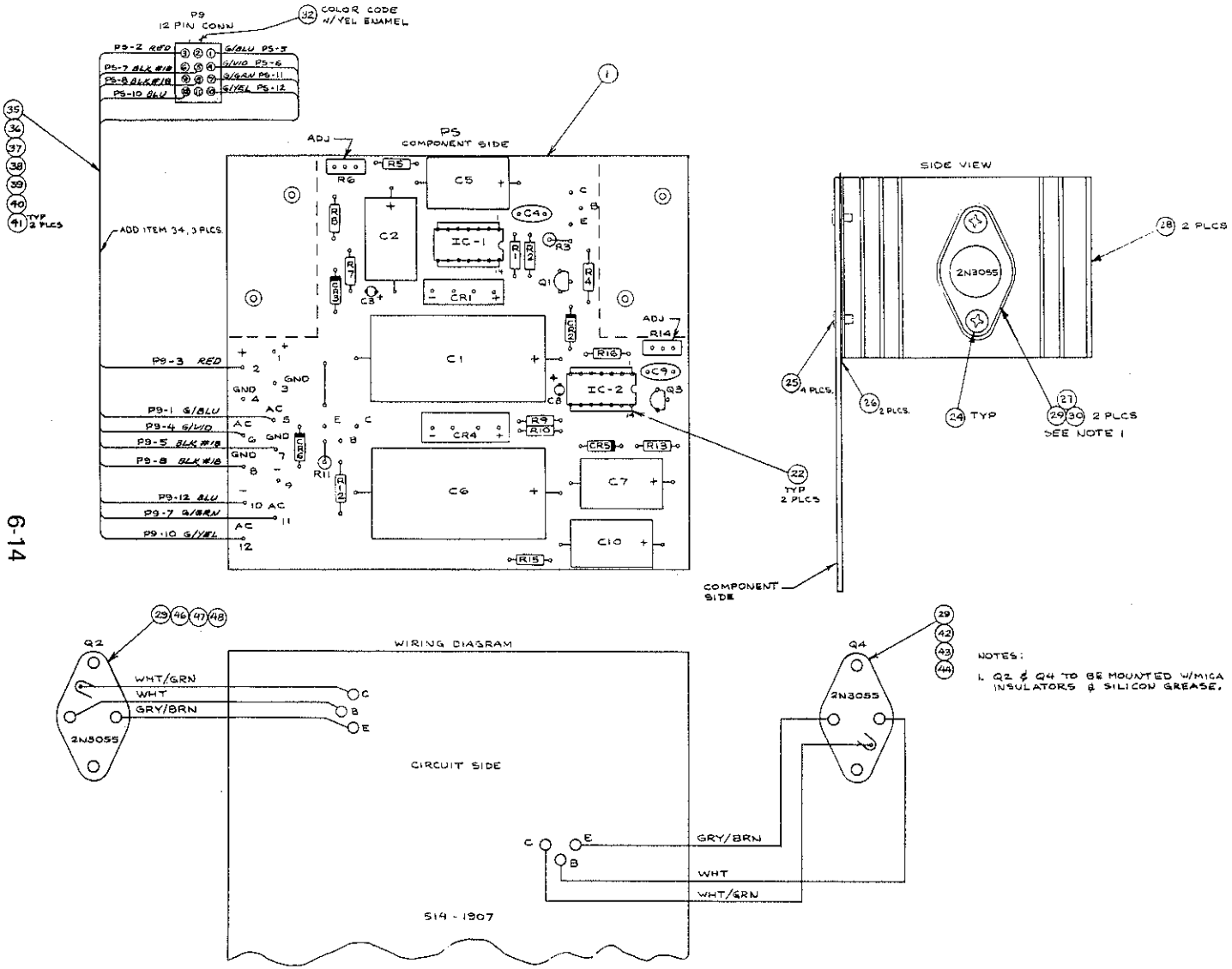


Figure 6-11. Control Card, Schematic Diagram (DWG. 906-0506)

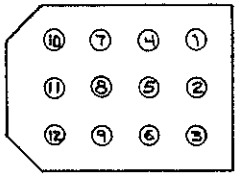


ITEM	QTY REQ	PART NUMBER	DESCRIPTION	NOTE
50	REF	C-906-3502	SCHEMATIC	
49				
48				
47	1	601-2203	WIRE AWG 22, UNIT 4-1/2 LG	
46	1		G/BRN 4-1/4 LG	
45	1		W/GRN 4-3/4 LG	
44	1	601-2209	WHT 3-1/2 LG	
43	1		AWG 22 G/BRN 3 LG	
42	1		AWG 22 W/GRN 3-3/4 LG	
41	2	601-1800	AWG 18 BLK, 9 LG	
40	1		AWG 22 G/VIO, 9 LG	
39	1		G/BLU 9 LG	
38	1		G/GRN, 9 LG	
37	1		G/YEL, 9 LG	
36	1	601-2206	BLU, 9 LG	
35	1	601-2202	WIRE, AWG 22 RED, 9 LG	
34	3	402-0000	TY-RAP	
33	1	601-0022	WIRE, BUS, AWG 22, 3/4" LG	
32	1	418-1271	12-PIN CONN (P9)	
31	2	211-3904	TRANSISTOR 2N3904 (Q1, Q3)	
30	2	219-3055	TRANSISTOR 2N3055 (Q2, Q4)	
29	2	417-0298	TRANSISTOR SOCKET	
28	2	8455-0003	HEAT SINK	
27	2	418-0010	INSULATOR, MICA, TO-3 TSTR PKG.	
26	2	A-407-0021	INSULATOR, FOR 8-455-0003	
25	4	421-1101	RIVET, BLIND DOMED HEAD	
24		420-6108	PAN HEAD SCREW #6-32 X 1/2	
			(IC-1, I.C.-2)	
23	2	227-0723V	I.C. 723 VOLTAGE REGULATOR	
22	2	417-1400	14-PIN IC SOCKET	
21				
			CR4)	
20	2	239-0003	BRIDGE RECTIFIER MDA9703 (CR1,	
19				
18	2	202-0098	DIODE IN98 (CR3, CR6)	
17	2	203-4005	DIODE IN4005 (CR2, CR5)	
16				
15				
14	2	040-1022	CAPACITOR, 100 pf 30V MICA (C4, C9)	
13	2	064-1063	1.0 MFD 35V TANT (C3, C8)	
			C7, C10)	
12	4	014-1084	100 MFD ELECT (C2, C5,	
11	2	014-1094	CAPACITOR, 1000 MFD ELECT (C1, C6)	
10				
9	4	100-3943	RESISTOR, 3900 1/4W (R2, R8, R10, R16)	
8	2	100-1553	15K 1/4W (R15, R7)	
7	2	100-3343	3300 1/4W (R5, R13)	
6	2	110-3913V	3.9Ω 1/2W (R4, R12)	
5	2	120-1013	1Ω 1W (R3, R11)	
4				
3	2	100-2223	RESISTOR, 22Ω 1/4W (R1, R9)	
2	2	178-2044	TRIMMER 2K (R6, R14)	
1	1	8-514-1907	BLANK P.C. BOARD (P5)	

LIST OF MATERIAL

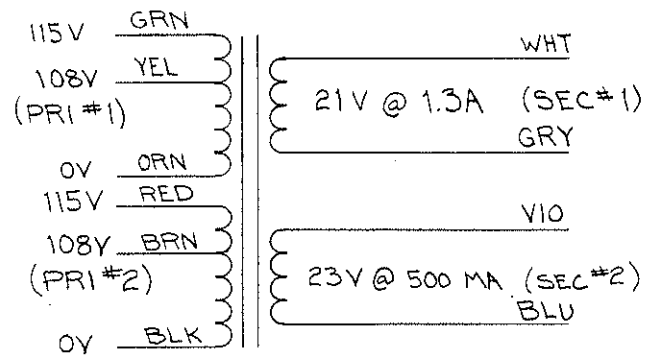
Figure 6-12. Power Supply, Component Identification (DWG. 914-1907)

MATING SIDE OF TRANSFORMER PLUG
SOCKET PART NO. 418-1271
PINS PART NO. 417-0053



POWER TRANSFORMER (376-7656 & 376-7660 WIRING

PIN	120V	110V	240V	220V
1	VIO	VIO	VIO	VIO
2	BRN	RED	BRN	RED
3	BLK	BLK	BLK	BLK
4	BLU	BLU	BLU	BLU
5	ORN	ORN	(OPEN)	(OPEN)
6	RED	BRN	RED	BRN
7	WHT	WHT	WHT	WHT
8	JUMPER	JUMPER	(OPEN)	(OPEN)
9			ORN	ORN
10	GRY	GRY	GRY	GRY
11	YEL	GRN	YEL	GRN
12	GRN	YEL	GRN	YEL



REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	110V WAS 105V; 220V WAS 210V	6/27/75	
B	ECN 739 (DWG # WAS 906-3100)	3/30/76	
C	ECN 3024	JAH 10/2/81	
D	ECN 3898	JAH 10/28/82	JLT
E	ECN 4089	JAH 2/14/83	JLT
F	ECN 4889	RES 1-31-84	mH

REF.	1	376-7656	FM 600 SERIES AGC LIMITER AMP (120/240V)
REF.	1	376-7656	3000 SERIES CART. MACH. PWR XMFR
REF.	1	376-7660	5000 SERIES CART. MACH. PWR XMFR

ITEM	QTY RQD	PART NUMBER	DESCRIPTION	NOTE

LIST OF MATERIAL

TOLERANCE UNLESS OTHERWISE SPECIFIED
DECIMAL 2 PL ±.01 3PL ±.005
FRACTIONAL ± 1/64
ANGULAR ± 1°
SHARP EDGES TO BEND RADII
FILLET RADII

DRAWN MSD DATE 2/24/25
CHECKED BY DATE
PROJECT ENGR DATE
APPROVED BY

MATERIAL —

TREATMENT OR FINISH —

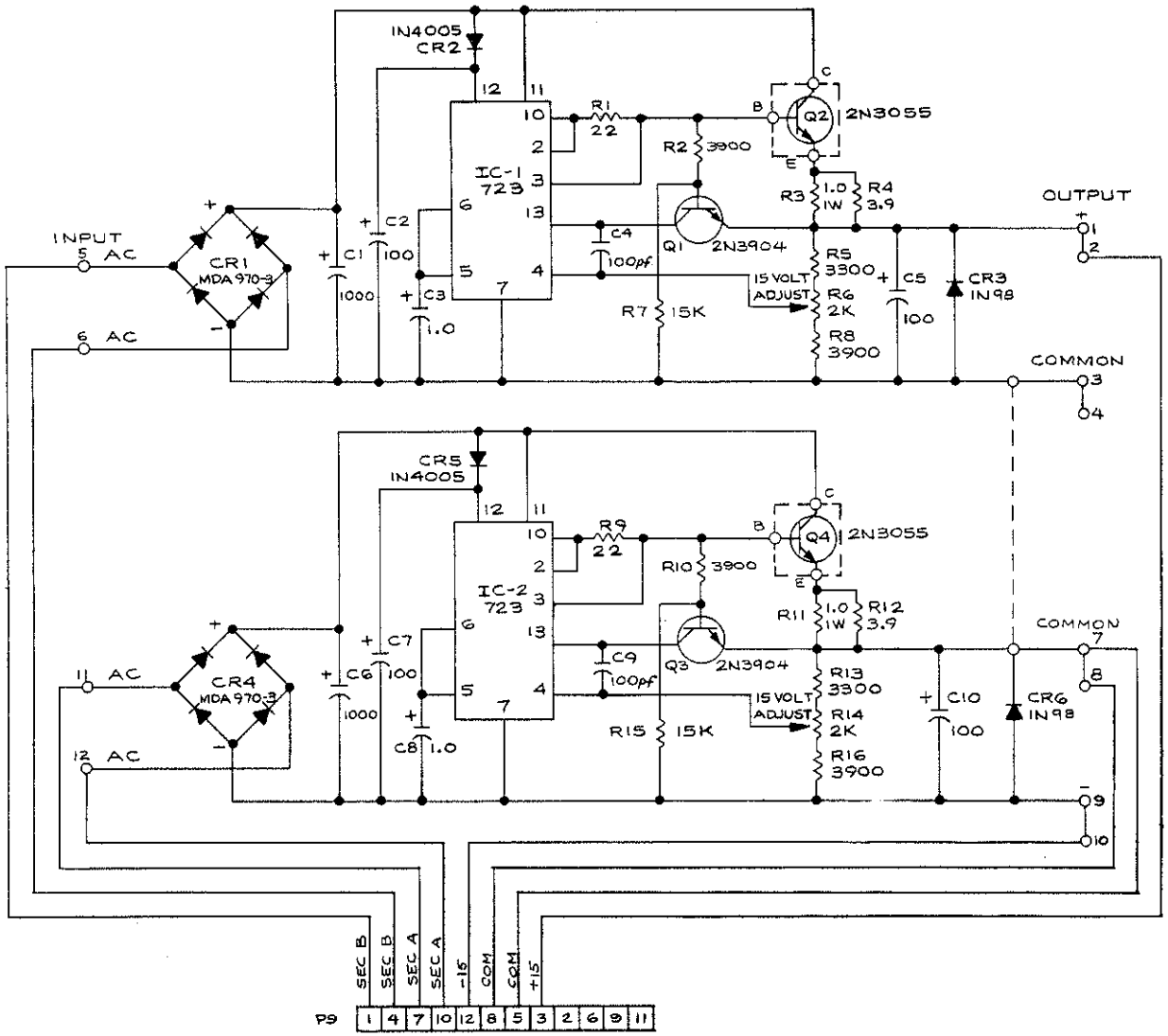
BROADCAST ELECTRONICS INC.

TITLE POWER XFMR WIRING

B DWG NO. 906-3136 REV F

SCALE — SHEET 1 OF 1

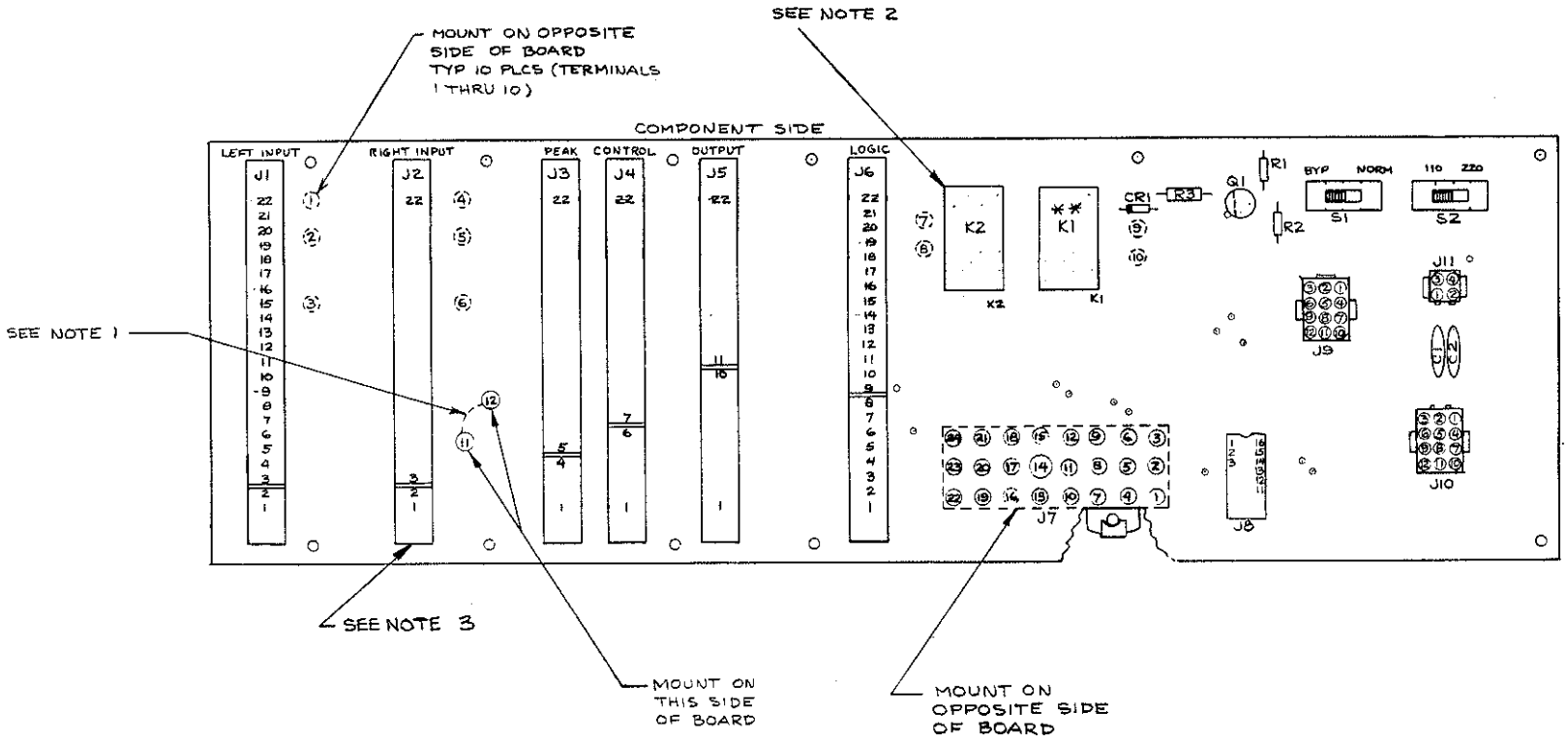
FIGURE 6-15.

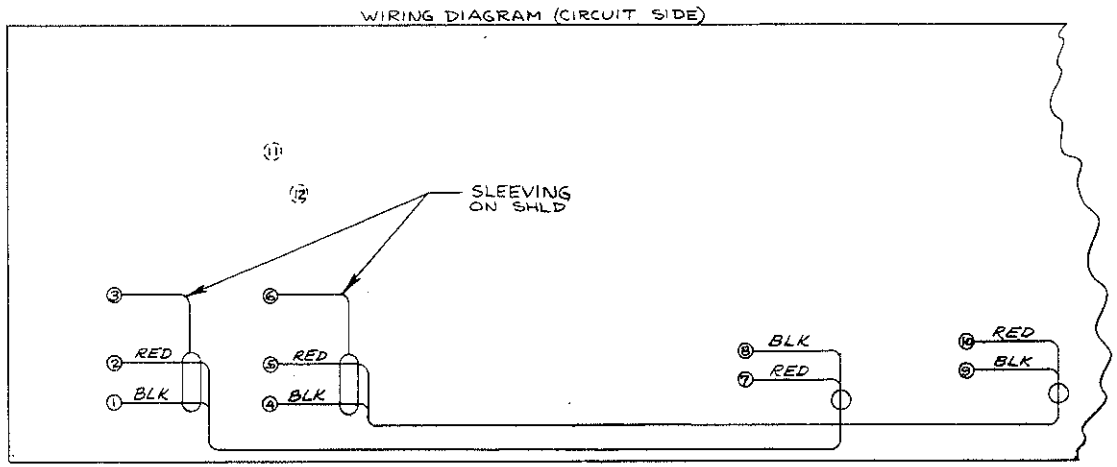


NOTES:

1. ALL RESISTORS IN OHMS 1/4W UNLESS OTHERWISE NOTED.
2. ALL CAPACITORS IN MFD UNLESS OTHERWISE NOTED.

FIGURE 6-14. POWER SUPPLY, SCHEMATIC DIAGRAM (DWG. 906-0502)





NOTES:

1. JUMPER INSTALLED IN MONO UNITS ONLY.
2. ** K1 (ITEM 9) DELETED IN MONO UNITS.
3. J2 DELETED IN MONO UNITS

DASH NO.	DESCRIPTION
914-1900-1	STEREO - AS SHOWN
914-1900-2	MONO - PER NOTES 1 & 2

FIGURE 6-15. MASTER BOARD, SCHEMATIC DIAGRAM (DWG. 914-1900)

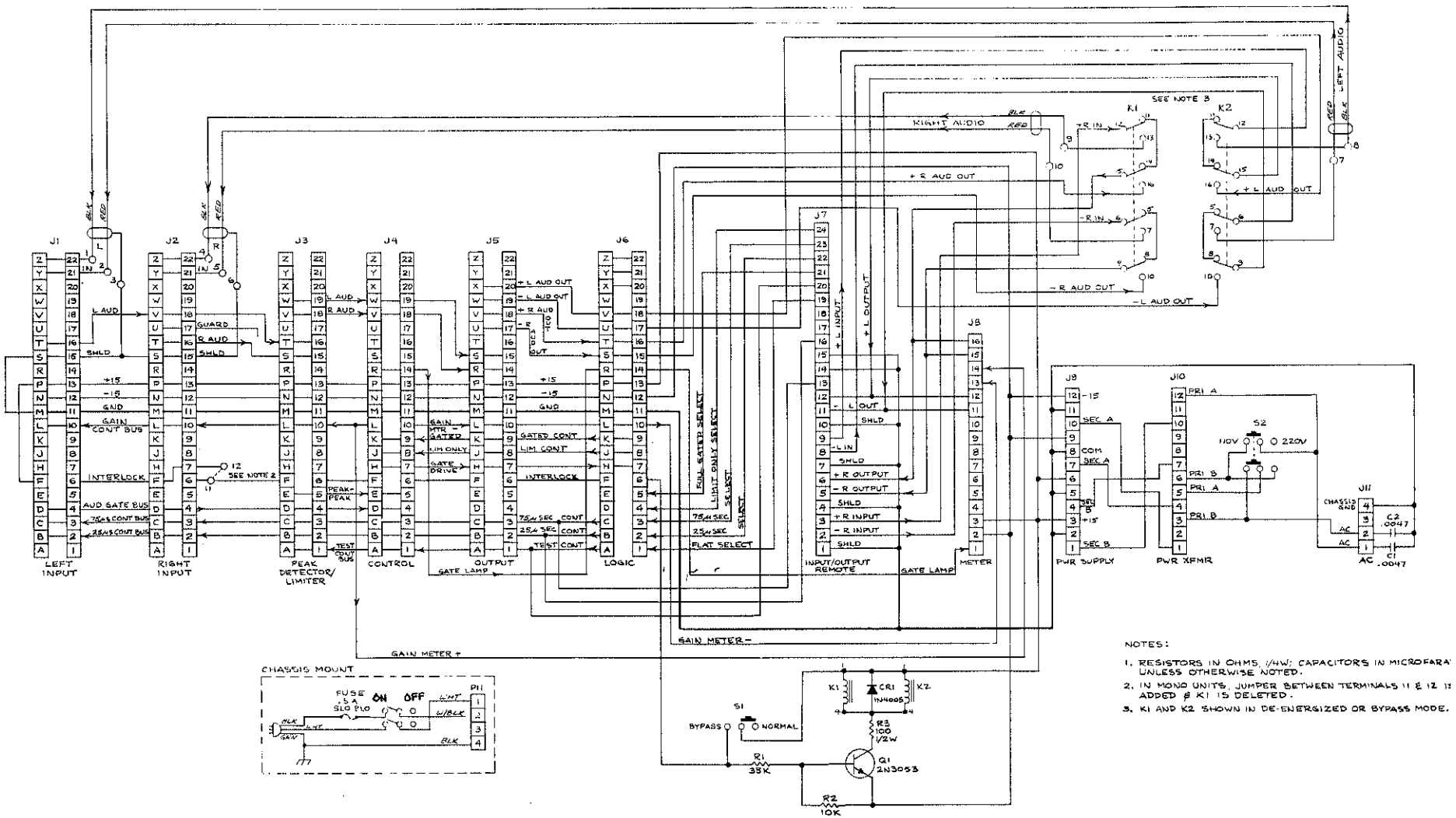
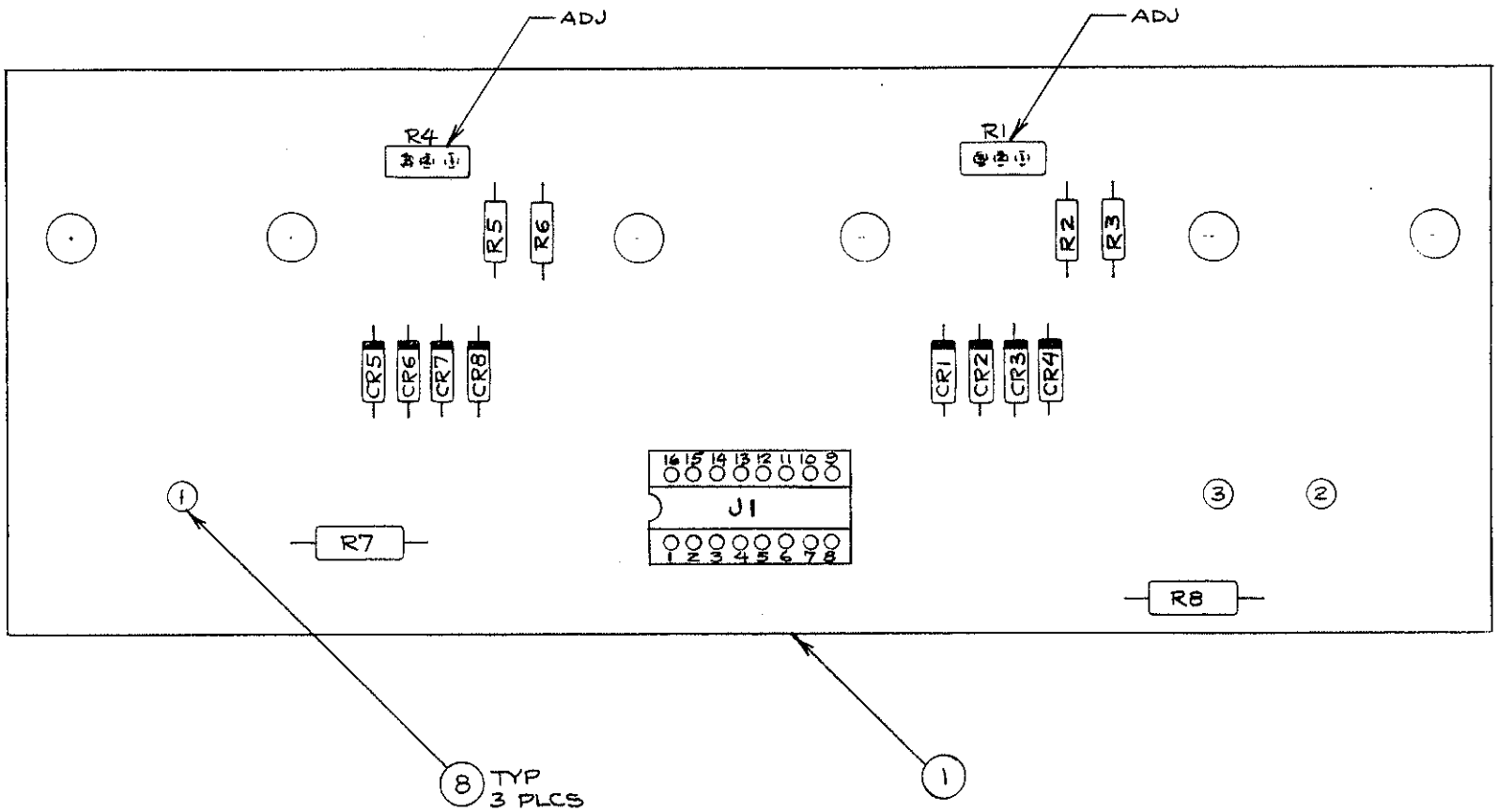


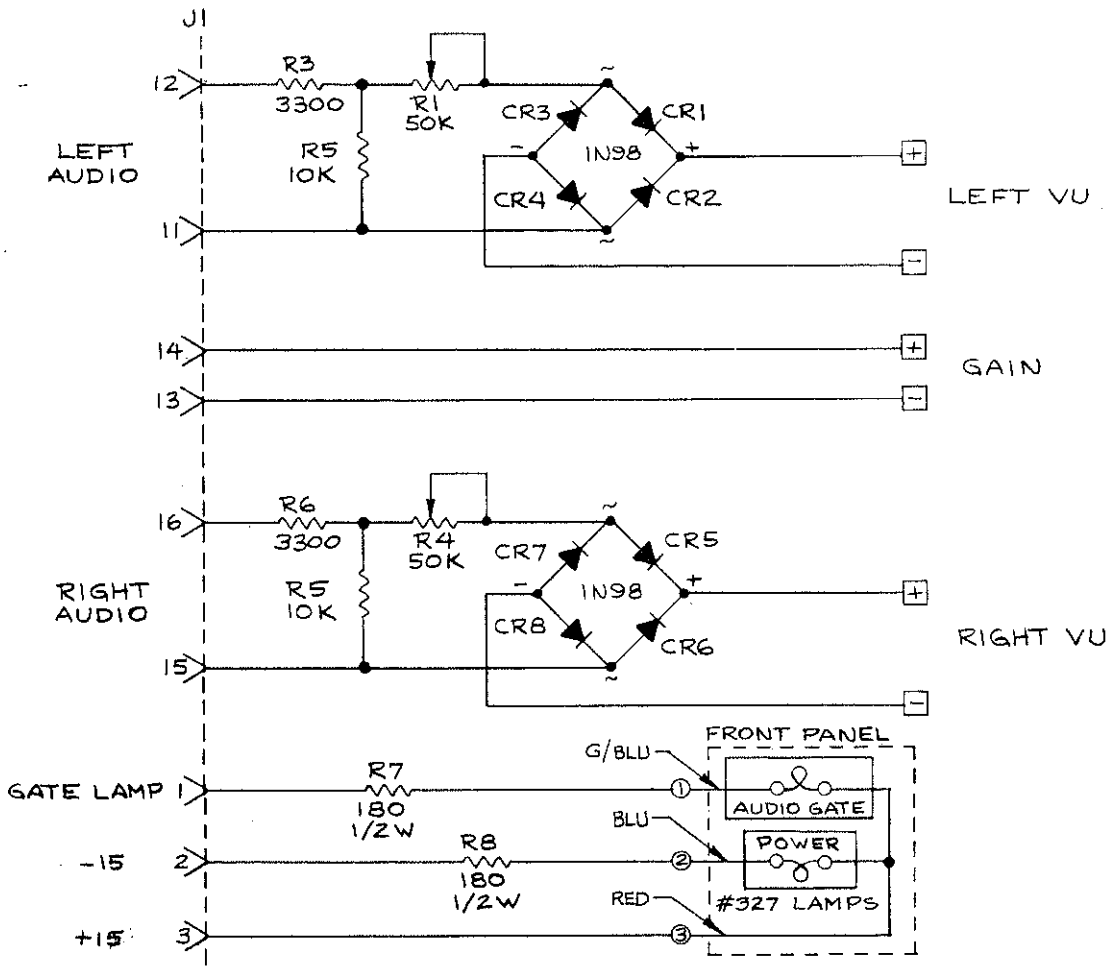
FIGURE 6-16. MASTER BOARD,SCHEMATIC DIAGRAM (DWG. 906-0511)



ITEM	QTY RQD	PART NUMBER	DESCRIPTION	NOTE
12	REF	B-906-0501	SCHEMATIC	
11				
10				
9				
8	3	413-1597	TURRET TERMINAL	
7	1	417-1601	16-PIN DIP SOCKET	(J1)
6	8	202-0098	1N98 DIODE	(CR1 THRU CR8)
5	2	110-1833	180Ω, 1/2 W RESISTOR	(R7, R8)
4	2	100-3343	3300Ω, 1/4W RESISTOR	(R3, R6)
3	2	100-1053	10K Ω, 1/4W RESISTOR	(R2, R5)
2	2	178-5054	50K Ω TRIMMER, HORIZ ADJ	(R1, R4)
1	1	C-514-1906	BLANK P C BD	

LIST OF MATERIAL

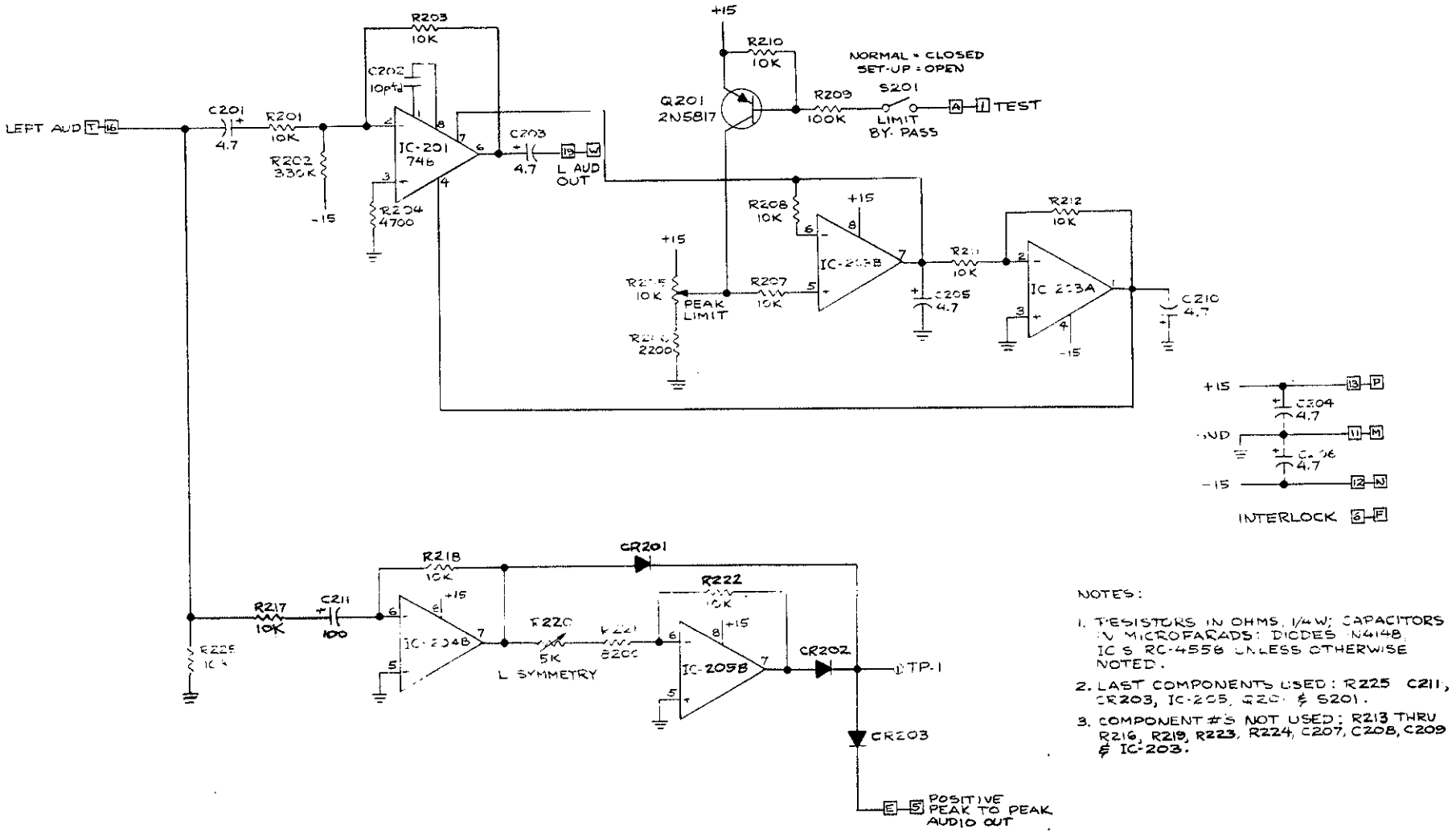
FIGURE 6-17. METER BOARD,COMPONENT IDENTIFICATION (DWG. 914-1906)



NOTES:

1. RESISTORS IN OHMS, 1/4W, UNLESS OTHERWISE NOTED.
2. ○ - P C BD TERMINALS
   □ - METER TERMINALS

FIGURE 6-18. METER BOARD,SCHEMATIC DIAGRAM (906-0501)



NOTES:

1. RESISTORS IN OHMS, 1/4W; CAPACITORS IN MICROFARADS; DIODES 1N4148; IC'S RC-4558 UNLESS OTHERWISE NOTED.
2. LAST COMPONENTS USED: R225 C211, CR203, IC-205, Q201 & S201.
3. COMPONENT #'S NOT USED: R213 THRU R216, R219, R223, R224, C207, C208, C209 & IC-203.

FIGURE 6-19. PEAK DETECTOR/LIMITOR, SCHEMATIC (DWG. 906-0512)

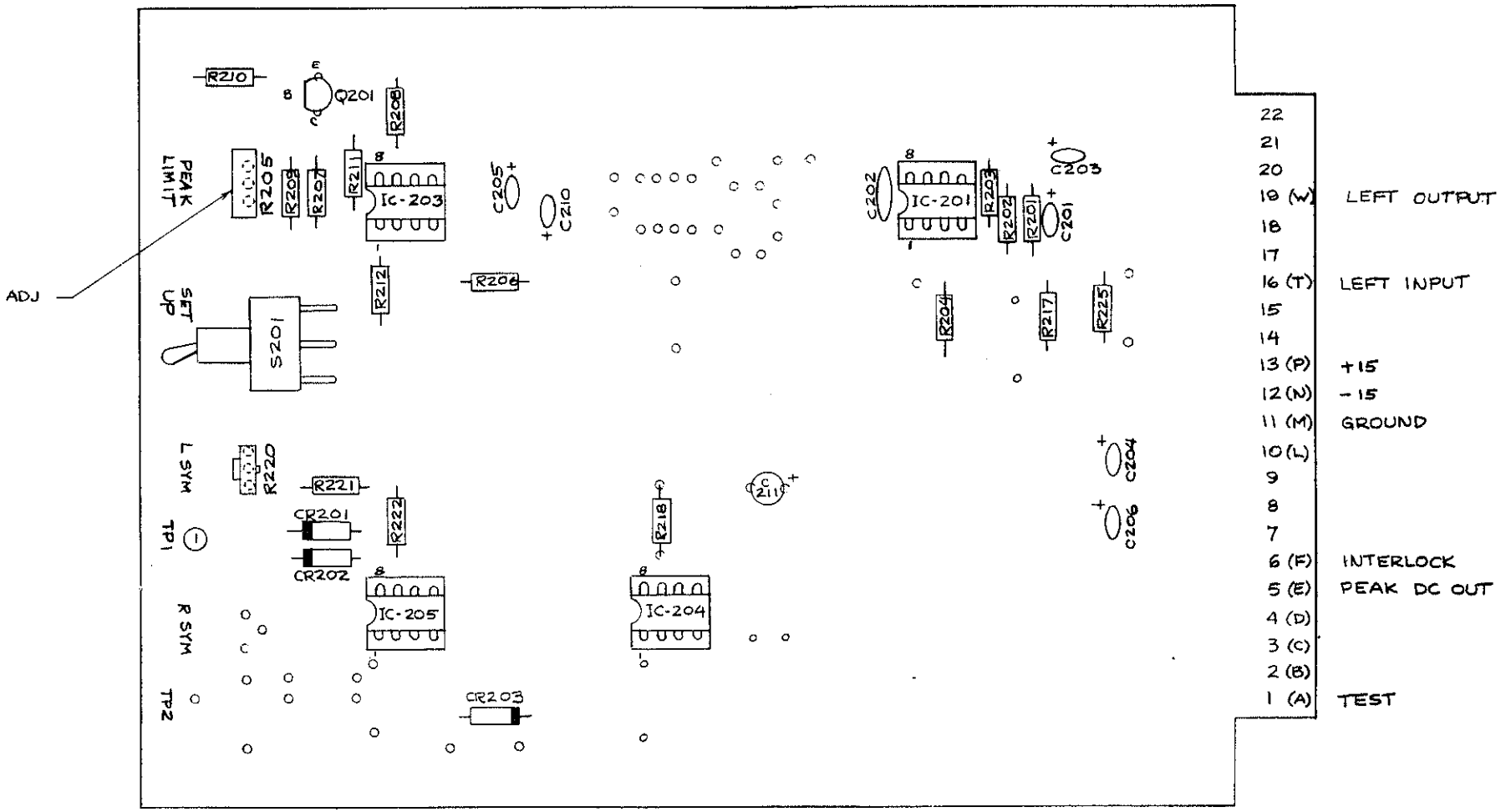


FIGURE 6-20. PEAK DETECTOR/LIMIT ASSEMBLY (DWG. 914-1912)

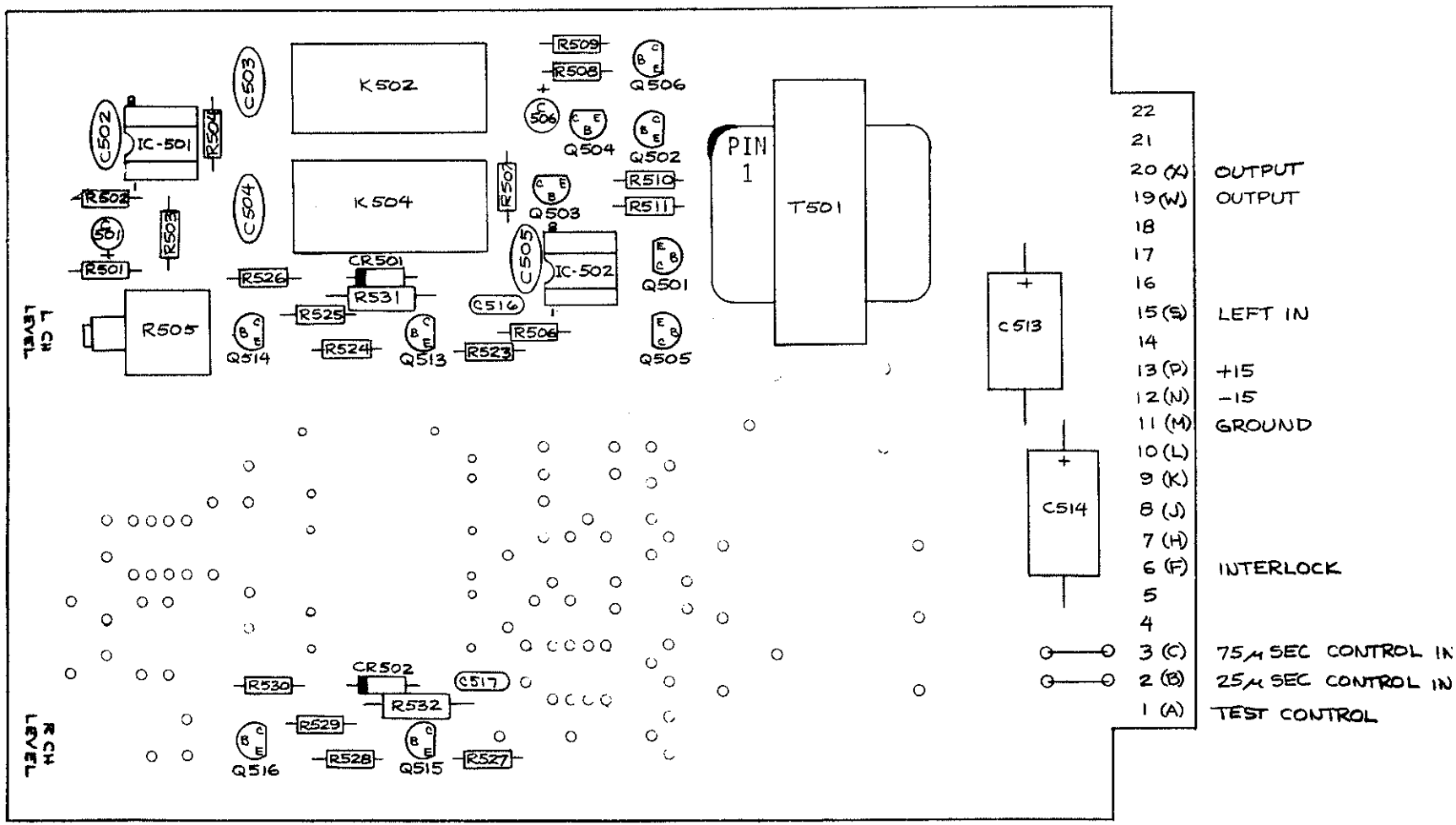


FIGURE 6-21. OUTPUT CIRCUIT BOARD ASSEMBLY (DWG.914-1915)

TABLE 6-1. FM AGC/LIMITER, MONO PARTS LIST - 937-0600

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Connector, 12-Pin	418-1271	1
----	Plug, 4-Pin	418-0240	1
----	Transformer: Dual Primary: 115V to 108V @ 50/60 Hz Dual Secondary: 21V @ 1.3A; 23V @ 0.5A	376-7656	1
----	Meter, VU, 3.5 inch (8.89 cm) dc Microammeter type, 1900 Ohm Movement, Type A scale	319-0030	1
----	Meter, Gain Indicator, 3.5 inch (8.89 cm) dc Microammeter type, 1900 Ohm Movement, Unity gain face plate	319-0031	1
----	Fuse, 3AG, 0.5 Ampere, 250V, Slow-Blow	334-0050	1
----	Fuse Holder	415-2012	1
----	Switch, Toggle, DPDT, 1 Ampere @ 250V or 3 Amperes @ 125V	348-8363	1
----	Lamp, #327, 28V, 0.040 Ampere	321-0327	2
----	Indicator, Lamp Holder	324-0125	2
----	Cap for Switch (Red)	343-0013	1
----	Cap for Switch (Green)	343-0018	1
----	Connector, 24-Pin	418-0306	1
----	Printed Circuit Board, Power Supply Assembly	914-1907	1
----	Printed Circuit Board, Master Assembly	914-1900	1
----	Printed Circuit Board, Input Assembly	914-1901	1
----	Printed Circuit Board, Peak Detector Assembly	914-1912	1
----	Printed Circuit Board, Control Assembly	914-1903	1
----	Printed Circuit Board, Logic Assembly	914-1904	1
----	Printed Circuit Board, Output Assembly (Mono)	914-1915	1
----	Printed Circuit Board, Meter Assembly	914-1906	1

TABLE 6-2. FM AGC/LIMITER, STEREO PARTS LIST - 937-0601
(Sheet 1 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Connector, 12-Pin	418-1271	1
----	Plug, 4-Pin	418-0240	1
----	Transformer: Dual Primary: 115V to 108V @ 50/60 Hz Dual Secondary: 21V @ 1.3 Amperes; 23V @ 0.5 Amperes	376-7656	1
----	Meter, VU, 3.5 inch (8.89 cm) dc Microammeter type, 1900 Ohm Movement, Type A scale	319-0030	1
----	Meter, Gain Indicator, 3.5 inch (8.89 cm) dc Microammeter type, 1900 Ohm Movement, Unity gain face plate	319-0031	1
----	Fuse, 3AG, 0.5 Amperes, 250V, Slow-Blow	334-0050	1
----	Fuse Holder	415-2012	1

TABLE 6-2. FM AGC/LIMITER, STEREO PARTS LIST - 937-0601
(Sheet 2 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Switch, Toggle, DPDT, 1 Ampere @ 250V or 3 Amperes @ 125V	348-8363	1
----	Lamp, #327, 28V, 0.040 Amperes	321-0327	2
----	Indicator, Lamp Holder	324-0125	2
----	Cap for Switch (Red)	343-0013	1
----	Cap for Switch (Green)	343-0018	1
----	Connector, 24-Pin	418-0306	1
----	Printed Circuit Board, Power Supply Assembly	914-1907	1
----	Printed Circuit Board, Master Assembly	914-1900-1	1
----	Printed Circuit Board, Input Assembly	914-1901	2
----	Printed Circuit Board, Peak Detector Assembly	914-1902	1
----	Printed Circuit Board, Control Assembly	914-1903	1
----	Printed Circuit Board, Logic Assembly	914-1904	1
----	Printed Circuit Board, Output Assembly	914-1905	1
----	Printed Circuit Board, Meter Assembly	914-1906	1
----	Cable Assembly	906-0509	1

TABLE 6-3. FM-600 - MASTER PRINTED CIRCUIT BOARD ASSEMBLY - 914-1900-2

REF. DES.	DESCRIPTION	PART NO.	QTY.
C1,C2	Capacitor, Ceramic Disc, 0.0047 uF, 1400V	002-2724	2
CR1	Diode, 1N4005	203-4005	1
J1 THRU J6	Socket, 22-Pin	417-2300	6
J7	Socket, 24-Pin	418-0303	1
J8	Socket, 16-Pin	417-1601	1
J9,J10	Socket, 12-Pin	417-1276	2
J11	Socket, 4-Pin	418-0255	1
K2	Relay, SPDT, 24V	270-0007	1
Q1	Transistor, 2N3053	211-3053	1
R1	Resistor, 33 k Ohm ±5%, 1/4W	100-3353	1
R2	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R3	Resistor, 100 Ohm ±5%, 1/2W	110-1033	1
S1,S2	Switch, Slide, DPDT	345-0863	2
----	Blank Circuit Board	514-1900	1

TABLE 6-4. FM-601 - MASTER PRINTED CIRCUIT BOARD ASSEMBLY - 914-1900-1

REF. DES.	DESCRIPTION	PART NO.	QTY.
C1,C2	Capacitor, Ceramic Disc, 0.0047 uF, 1400V	002-2724	2
CR1	Diode, 1N4005	203-4005	1
J1 THRU J6	Connector, 22-Pin	417-2300	6
J7	Connector, 24-Pin	418-0303	1
J8	Socket, 16-Pin	417-1601	1
J9,J10	Socket, 12-Pin	417-1276	2
J11	Socket, 4-Pin	418-0255	1
K1,K2	Relay, SPDT, 24V	270-0007	2
Q1	Transistor, 2N3053	211-3053	1
R1	Resistor, 33 k Ohm ±5%, 1/4W	100-3353	1
R2	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R3	Resistor, 100 k Ohm ±5%, 1/2W	110-1033	1
S1,S2	Switch, Slide, DPDT	345-0863	2

TABLE 6-5. INPUT PRINTED CIRCUIT BOARD ASSEMBLY - 914-1901
(Sheet 1 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
A101	Voltage Controlled Attenuator	221-0202	1
C101	Capacitor, Tantalum Dipped, 1.0 uF	064-1063	1
C102	Capacitor, Ceramic Disc, 10 pF	001-1014	1
C103	Capacitor, Tantalum Dipped, 4.7 uF	064-4763	1
C104	Capacitor, Mylar, 0.1 uF	030-1053	1
C105	Capacitor, Mica, 220 pF	040-2223	1
C106	Capacitor, Ceramic Disc, 10 pF	001-1014	1
C107	Capacitor, Tantalum Dipped, 4.7 uF	064-4763	1
C108	Capacitor, Mica, 750 pF	042-7522	1
C109	Capacitor, Mica, 250 pF	042-2522	1
C110,C111	Capacitor, Ceramic Disc, 10 pF	001-1014	2
C112	Capacitor, Mica, 50 pF	040-5013	1
C113	Capacitor, Ceramic Disc, 10 pF	001-1014	1
C114,C115	Capacitor, Tantalum Dipped, 4.7 uF	064-4763	2
CR101 THRU CR104	Diode, 1N4148, Silicon, 10 mA, 100V	203-4148	4
IC101 THRU IC104	Integrated Circuit, 748C, High Performance, Operational Amplifier, 8-Pin DIP	221-7480	4
IC105	Integrated Circuit, RC4558DN, Dual Operational Amplifier, 8-Pin DIP	221-4558	1
K101,K102	Relay, SPDT, 24V	270-0024	2
Q101	Transistor, GES5816	211-5816	1
Q102	Transistor, GES5817	210-5817	1
Q103	Transistor, GES5816	211-5816	1
Q104	Transistor, GES5817	210-5817	1
Q105	Transistor, GES5816	211-5816	1
R101	Resistor, 620 Ohm ±5%, 1/4W	100-6233	1

TABLE 6-5. INPUT PRINTED CIRCUIT BOARD ASSEMBLY - 914-1901
(Sheet 2 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
R102	Potentiometer, 10 k Ohm, 10%	196-1053	1
R103	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	1
R104,R105	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	2
R106	Resistor, 4700 Ohm ±5%, 1/4W	100-4743	1
R107	Resistor, 22 k Ohm ±5%, 1/4W	100-2253	1
R108	Resistor, 330 k Ohm ±5%, 1/4W	100-3363	1
R109	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R110	Resistor, 330 k Ohm ±5%, 1/4W	100-3363	1
R111	Resistor, 100 Ohm ±5%, 1/4W	100-1033	1
R112	Resistor, 2700 Ohm ±5%, 1/4W	100-2743	1
R113	Resistor, 8200 Ohm ±5%, 1/4W	100-8243	1
R114,R115	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	2
R116	Resistor, 3300 Ohm ±5%, 1/4W	100-3343	1
R117	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R118	Resistor, 39 k Ohm ±5%, 1/4W	100-3953	1
R119	Resistor, 7500 Ohm ±5%, 1/4W	100-7543	1
R120	Potentiometer, 10 k Ohm, 10-Turn	179-1053	1
R121,R122	Resistor, 4700 Ohm ±5%, 1/4W	100-4743	2
R123 THRU R125	Resistor, 10 k Ohm ±1%, 1/4W	100-1051	3
R126	Resistor, 820 k Ohm ±5%, 1/4W	100-8263	1
R127	Potentiometer, 10 k Ohm, Vertical Adjust, 1/2W	177-1054	1
R128	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	1
R129,R130	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	2
R131	Resistor, 39 k Ohm ±5%, 1/4W	100-3953	1
R132	Resistor, 7500 Ohm ±5%, 1/4W	100-7543	1
R133	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	1
R134	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R135	Resistor, 33 k Ohm ±5%, 1/4W	100-3353	1
R136	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R137	Resistor, 220 Ohm ±5%, 1/2W	110-2233	1
R138	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	1
R139	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R140	Resistor, 33 k Ohm ±5%, 1/4W	100-3353	1
R141	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R142	Resistor, 220 Ohm ±5%, 1/2W	110-2233	1
R143	Resistor, 12 k Ohm ±5%, 1/4W	100-1253	1
T101	Transformer, Audio Input (B.E. Manufactured)	371-0002	1
----	Socket, Integrated Circuit, 8-Pin	417-0800	1
----	Blank Circuit Board	514-1901	1

TABLE 6-6. PEAK DETECTOR/LIMIT PRINTED CIRCUIT BOARD ASSEMBLY - 914-1902

REF. DES.	DESCRIPTION	PART NO.	QTY.
C201	Capacitor, Tantalum, 4.7 uF, 35V	064-4763	1
C202	Capacitor, Ceramic Disc, 10 pF, 10%	001-1014	1
C203 THRU C207	Capacitor, Tantalum, 4.7 uF, 35V	064-4763	5
C208	Capacitor, Ceramic Disc, 10 pF, 10%	001-1014	1
C209,C210	Capacitor, Tantalum, 4.7 uF, 35V	064-4763	2
C211,C212	Capacitor, Electrolytic, 100 uF, 25V	023-1083	2
CR201 THRU CR206	Diode, 1N4148, Silicon, 10 mA, 75V	203-4148	6
IC201,IC202	Integrated Circuit, 748, High Performance, Operational Amplifier, 8-Pin DIP	221-7480	2
IC203 THRU IC205	Integrated Circuit, RC4558DN, Operational	221-4558	3
Q201	Transistor, GES5817, PNP, Small Signal, TO-18 Case	210-5817	1
R201	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R202	Resistor, 330 k Ohm ±5%, 1/4W	100-3363	1
R203	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R204	Resistor, 4700 Ohm ±5%, 1/4W	100-4743	1
R205	Potentiometer, 10 k Ohm ±10% 1/2W	178-1054	1
R206	Resistor, 2200 Ohm ±5%, 1/4W	100-2243	1
R207,R208	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	2
R209	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	1
R210 THRU R213	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R214	Resistor, 330 k Ohm ±5%, 1/4W	100-3363	1
R215	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R216	Resistor, 4700 Ohm ±5%, 1/4W	100-4743	1
R217,R218	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	2
R220	Potentiometer, 5 k Ohm	176-5044	1
R221	Resistor, 8200 Ohm ±5%, 1/4W	100-8243	1
R222,R225	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	5
R229	Potentiometer, 5 k Ohm	176-5044	1
R230	Resistor, 8200 Ohm ±5%, 1/4W	100-8243	1
R231	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
S201	Switch, Toggle, SPDT, PC Mount	348-0123	1
----	Blank Circuit Board	514-1902	1

TABLE 6-7. CONTROL PRINTED CIRCUIT BOARD ASSEMBLY - 914-1903
(Sheet 1 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
C301	Capacitor, Tantalum, 4.7 uF, 35V	064-4763	1
C302	Capacitor, Electrolytic, 33 uF, 35V	024-3335	1
C303	Capacitor, Tantalum, 2.2 uF, 35V	064-2263	1
C304	Capacitor, Electrolytic, 33 uF, 35V	024-3335	1
C305	Capacitor, Tantalum, 4.7 uF, 35V	064-4763	1
C306	Capacitor, Electrolytic, 100 uF, 25V	023-1083	1
C307,C308	Capacitor, Tantalum, 4.7 uF, 35V	064-4763	2
CR301	Diode, Zener, 1N4739, 9.1V ±10%, 1W	200-0009	1
CR302 THRU CR310	Diode, 1N4148, Silicon, 10 mA, 75V	203-4148	9
IC301	Integrated Circuit, LM3900, Quad Operational Amplifier, 14-Pin DIP	221-3900	1
Q301	Transistor, GES5816, NPN, Small Signal, TO-18 Case	211-5816	1
Q302	Transistor, 2N5457, JFET, N-Channel, 25V	212-5457	1
Q303,Q304	Transistor, GES5816, NPN, Small Signal, TO-18 Case	211-5816	2
Q305	Transistor, GES5817, PNP, Small Signal, TO-18 Case	210-5817	1
Q306 THRU Q308	Transistor, GES5816, NPN, Small Signal, TO-18 Case	211-5816	3
Q309 THRU Q312	Transistor, 2N5462, JFET, P-Channel, 40V	212-5462	4
Q313	Transistor, GES5816, NPN, Small Signal, TO-18 Case	211-5816	1
Q314	Transistor, 2N5462, JFET, P-Channel, 40V	212-5462	1
R301	Potentiometer, 10 k Ohm ±10%, 0.75W	179-1053	1
R302	Resistor, 8200 Ohm ±5%, 1/4W	100-8243	1
R303	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R304	Resistor, 270 k Ohm ±5%, 1/4W	100-2763	1
R305	Resistor, 2700 Ohm ±5%, 1/4W	100-2743	1
R308	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R309	Resistor, 10 Ohm ±5%, 1/4W	100-1023	1
R310	Resistor, 470 Ohm ±5%, 1/4W	100-4733	1
R311	Resistor, 1 k Ohm ±5%, 1/4W	100-1043	1
R312	Potentiometer, 50 k Ohm ±10%	196-5053	1
R313	Resistor, 1 k Ohm ±5%, 1/4W	100-1043	1
R314	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R315	Resistor, 2200 Ohm ±5%, 1/4W	100-2243	1
R316	Resistor, 1 Meg Ohm ±5%, 1/4W	100-1073	1
R317	Resistor, 976 k Ohm ±1%, 1/4W	103-4766	1
R318	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R319	Resistor, 4700 Ohm ±5%, 1/4W	100-4743	1
R320	Resistor, 3900 Ohm ±5%, 1/4W	100-3943	1
R321	Resistor, 3300 Ohm ±5%, 1/4W	100-3343	1
R322	Resistor, 100 Ohm ±5%, 1/4W	100-1033	1
R323	Resistor, 470 k Ohm ±5%, 1/4W	100-4763	1

TABLE 6-7. CONTROL PRINTED CIRCUIT BOARD ASSEMBLY - 914-1903
(Sheet 2 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
R324	Resistor, 22 k Ohm ±5%, 1/4W	100-2253	1
R325,R326	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	2
R327,R328	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	2
R329	Resistor, 1 Meg Ohm ±5%, 1/4W	100-1073	1
R330	Potentiometer, 10 k Ohm ±10%, 0.75W, 10-Turn	179-1053	1
R331	Resistor, 1 Meg Ohm ±5%, 1/4W	100-1073	1
R332	Resistor, 47 k Ohm ±5%, 1/4W	100-4753	1
R333	Resistor, 1 Meg Ohm ±5%, 1/4W	100-1073	1
R334	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R336	Potentiometer, 2.5 Meg Ohm, ±10%	196-2573	1
R337	Resistor, 220 k Ohm ±5%, 1/4W	100-2263	1
R338	Resistor, 1 Meg Ohm ±5%, 1/4W	100-1073	1
R339	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R340	Resistor, 1 Meg Ohm ±5%, 1/4W	100-1073	1
R341	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R342	Potentiometer, 10 k Ohm ±10%, 0.75W, 10-Turn	179-1053	1
R343	Resistor, 22 k Ohm ±5%, 1/4W	100-2253	1
R344	Resistor, 2700 Ohm ±5%, 1/4W	100-2743	1
R345	Potentiometer, 10 k Ohm ±10%, 0.75W, 10-Turn	179-1053	1
XIC301	Integrated Circuit Socket, 14-Pin DIP	417-1400	1
----	Blank Circuit Board	514-1903	1

TABLE 6-8. LOGIC PRINTED CIRCUIT BOARD ASSEMBLY - 914-1904
(Sheet 1 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
C401,C402	Capacitor, Tantalum, 4.7 uF, 35V	064-4763	2
CR402	Diode, 1N4148, Silicon, 10 mA, 75V	203-4148	1
CR403	Diode, 1N4739, 9.1V, ±10%, 1W	200-0009	1
CR405,CR406, CR408,CR412 THRU CR416, CR418	Diode, 1N4148, Silicon, 10 mA, 75V	203-4148	9
CR419	Diode, 1N4739, 9.1V, ±10%, 1W	200-0009	1
CR420	Diode, 1N4148, Silicon, 10 mA, 75V	203-4148	1
CR421	Diode, 1N4739, 9.1V, ±10%, 1W	200-0009	1
CR422 THRU CR429	Diode, 1N4148, Silicon, 10 mA, 75V	203-4148	8
I401 THRU I406	Indicator, LED, 20 mA @ 1.6V	323-7344	6
IC401	Integrated Circuit, LM3900, Quad Operational Amplifier, 14-Pin DIP	221-3900	1
IC402	Integrated Circuit, 74C00N, Quad 2 Input NAND Gate, 14-Pin DIP	221-7400	1

TABLE 6-8. LOGIC PRINTED CIRCUIT BOARD ASSEMBLY - 914-1904
(Sheet 2 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
Q401 THRU Q406	Transistor, GES5816, NPN, Small Signal, TO-18 Case	211-5816	6
Q407 THRU Q409	Transistor, MPS6566, NPN, Silicon, Small Signal, TO-92 Case	211-6566	3
Q410,Q411	Transistor, GES5817, PNP, Small Signal, TO-18 Case	210-5817	2
R401,R402	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	2
R403,R404	Resistor, 2 Meg Ohm ±5%, 1/4W	100-2073	2
R405 THRU R408	Resistor, 1 Meg Ohm ±5%, 1/4W	100-1073	4
R409	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R410,R411	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	2
R412,R413	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	2
R414	Resistor, 2200 Ohm ±5%, 1/4W	100-2243	1
R415,R416	Resistor, 4700 Ohm ±5%, 1/4W	100-4743	2
R417	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R418	Resistor, 2200 Ohm ±5%, 1/4W	100-2243	1
R419	Resistor, 4700 Ohm ±5%, 1/4W	100-4743	1
R420,R421	Resistor, 1 Meg Ohm ±5%, 1/4W	100-1073	2
R422	Resistor, 27 k Ohm ±5%, 1/4W	100-2753	1
R424,R425	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	2
R426	Resistor, 82 k Ohm ±5%, 1/4W	100-8253	1
R427	Resistor, 4700 Ohm ±5%, 1/4W	100-4743	1
R428	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	1
R429	Resistor, 4700 Ohm ±5%, 1/4W	100-4743	1
R430	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	1
R431 THRU R433	Resistor, 4700 Ohm ±5%, 1/4W	100-4743	3
R434,R435	Resistor, 2200 Ohm ±5%, 1/4W	100-2243	2
R436	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R437,R438	Resistor, 2200 Ohm ±5%, 1/4W	100-2243	2
S401 THRU S406	Switch, SPDT, Toggle	348-0123	6
XIC401, XIC402	Integrated Circuit Socket, 14-Pin DIP	417-1400	2
----	Blank Circuit Board	514-1904	1

TABLE 6-9. OUTPUT PRINTED CIRCUIT BOARD ASSEMBLY - 914-1905
(Sheet 1 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
C501	Capacitor, Tantalum, 4.7 uF, 35V	064-4763	1
C502	Capacitor, 10 pF ±10%, 1 kV	001-1014	1
C503	Capacitor, Mica, 750 pF ±5%, 500V	042-7522	1
C504	Capacitor, Mica, 250 pF ±5%, 500V	042-2522	1
C505	Capacitor, 10 pF ±10%, 1 kV	001-1014	1
C506,C507	Capacitor, Tantalum, 4.7 uF, 35V	064-4763	2
C508	Capacitor, 10 pF ±10%, 1 kV	001-1014	1
C509	Capacitor, Mica, 750 pF ±5%, 500V	042-7522	1
C510	Capacitor, Mica, 250 pF ±5%, 500V	042-2522	1
C511	Capacitor, 10 pF ±10%, 1 kV	001-1014	1
C512	Capacitor, Tantalum, 4.7 uF, 35V	064-4763	1
C513,C514	Capacitor, Electrolytic, 100 uF, 40V	014-1084	2
C516,C517	Capacitor, Mylar Film, 0.047 uF ±10%, 100V	030-4743	2
CR501,CR502	Diode, 1N4148, Silicon, 10 mA, 75V	203-4148	2
IC501 THRU IC504	Integrated Circuit, NE5534AN, Low Noise Operational Amplifier, 8-Pin DIP	221-5534	4
K501 THRU K504	Relay, SPDT, 24V	270-0024	4
Q501	Transistor, GES5817, PNP, Small Signal, TO-18 Case	210-5817	1
Q502	Transistor, GES5816, NPN, Small Signal, TO-18 Case	211-5816	1
Q503	Transistor, GES5817, PNP, Small Signal, TO-18 Case	210-5817	1
Q504	Transistor, GES5816, NPN, Small Signal, TO-18 Case	211-5816	1
Q505	Transistor, GES5817, PNP, Small Signal, TO-18 Case	210-5817	1
Q506	Transistor, GES5816, NPN, Small Signal, TO-18 Case	211-5816	1
Q507	Transistor, GES5817, PNP, Small Signal, TO-18 Case	210-5817	1
Q508	Transistor, GES5816, NPN, Small Signal, TO-18 Case	211-5816	1
Q509	Transistor, GES5817, PNP, Small Signal, TO-18 Case	210-5817	1
Q510	Transistor, GES5816, NPN, Small Signal, TO-18 Case	211-5816	1
Q511	Transistor, GES5817, PNP, Small Signal, TO-18 Case	210-5817	1
Q512	Transistor, GES5816, NPN, Small Signal, TO-18 Case	211-5816	1
Q513	Transistor, GES5817, PNP, Small Signal, TO-18 Case	210-5817	1
Q514	Transistor, GES5816, NPN, Small Signal, TO-18 Case	211-5816	1
Q515	Transistor, GES5817, PNP, Small Signal, TO-18 Case	210-5817	1

TABLE 6-9. OUTPUT PRINTED CIRCUIT BOARD ASSEMBLY - 914-1905
(Sheet 2 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
Q516	Transistor, GES5816, NPN, Small Signal, TO-18 Case	211-5816	1
R501	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R502 THRU R504	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	3
R505	Potentiometer, 10 k Ohm, ±10%	196-1053	1
R506	Resistor, 4700 Ohm ±5%, 1/4W	100-4743	1
R507	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R508	Resistor, 4700 Ohm ±5%, 1/4W	100-4743	1
R509	Resistor, 3900 Ohm ±5%, 1/4W	100-3943	1
R510,R511	Resistor, 10 Ohm ±5%, 1/4W	100-1023	2
R512	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R513 THRU R515	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	3
R516	Potentiometer, 10 k Ohm, ±10%	196-1053	1
R517	Resistor, 4700 Ohm ±5%, 1/4W	100-4743	1
R518	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R519	Resistor, 4700 Ohm ±5%, 1/4W	100-4743	1
R520	Resistor, 3900 Ohm ±5%, 1/4W	100-3943	1
R521,R522	Resistor, 10 Ohm ±5%, 1/4W	100-1023	2
R523	Resistor, 100 k OHm ±5%, 1/4W	100-1063	1
R524	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R525	Resistor, 33 k Ohm ±5%, 1/4W	100-3353	1
R526	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R527	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	1
R528	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R529	Resistor, 33 k Ohm ±5%, 1/4W	100-3353	1
R530	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R531,R532	Resistor, 100 Ohm ±5%, 1/2W	110-1033	2
T501,T502	Transformer, 1010, Audio Output	371-0004	2
XIC501 THRU XIC504	Integrated Circuit Socket, 8-Pin DIP	417-0800	4
----	Blank Circuit Board	514-1905	1

TABLE 6-10. METER PRINTED CIRCUIT BOARD ASSEMBLY - 914-1906
(Sheet 1 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
CR1 THRU CR8	Diode, 1N98, Germanium, 20 mA, 100V	202-0098	8
J1	Integrated Circuit Socket, 16-Pin DIP	417-1601	1
R1	Potentiometer, 50 k Ohm ±10%, 1/2W	178-5054	1
R2	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R3	Resistor, 3300 Ohm ±5%, 1.4W	100-3343	1

TABLE 6-10. METER PRINTED CIRCUIT BOARD ASSEMBLY - 914-1906
(Sheet 2 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
R4	Potentiometer, 50 k Ohm ±10%, 1/2W	178-5054	1
R5	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R6	Resistor, 3300 Ohm ±5%, 1/4W	100-3343	1
R7,R8	Resistor, 180 Ohm ±5%, 1/2W	110-1833	2
----	Blank Circuit Board	514-1906	1

TABLE 6-11. POWER SUPPLY PRINTED CIRCUIT BOARD ASSEMBLY - 914-1907
(Sheet 1 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
C1	Capacitor, Electrolytic, 1000 uF, 50V	014-1094	1
C2	Capacitor, Electrolytic, 100 uF, 40V	014-1084	1
C3	Capacitor, Tantalum, 1.0 uF, 35V	064-1063	1
C4	Capacitor, Mica, 100 pF, 50V	040-1022	1
C5	Capacitor, Electrolytic, 100 uF, 40V	014-1084	1
C6	Capacitor, Electrolytic, 1000 uF, 50V	014-1094	1
C7	Capacitor, Electrolytic, 100 uF, 40V	014-1084	1
C8	Capacitor, Tantalum, 1.0 uF, 35V	064-1063	1
C9	Capacitor, Mica, 100 pF, 50V	040-1022	1
C10	Capacitor, Electrolytic, 100 uF, 40V	014-1084	1
CR1	Bridge Rectifier, MDA970A3, 4 Amps, 50-200V	239-0003	1
CR2	Diode, 1N4005, Silicon, 1 Ampere, 600V	203-4005	1
CR3	Diode, 1N98, Germanium, 20 mA, 100V	202-0098	1
CR4	Bridge Rectifier, MDA970A3, 4 Amps, 50-200V	239-0003	1
CR5	Diode, 1N4005, Silicon, 1 Ampere, 600V	203-4005	1
CR6	Diode, 1N98, Germanium, 20 mA, 100V	202-0098	1
IC1,IC2	Voltage Regulator, UA723, 14-Pin DIP	227-0723V	2
P9	Plug, 12-Pin	418-1271	1
----	Pins for P9	417-0053	9
Q1	Transistor, 2N3904, Silicon, NPN, TO-92 Case	211-3904	1
Q2	Transistor, 2N3055, Silicon, NPN, Power, TO-3 Case	219-3055	1
Q3	Transistor, 2N3904, Silicon, NPN, TO-92 Case	211-3904	1
Q4	Transistor, 2N3055, Silicon, NPN, Power, TO-3 Case	219-3055	1
R1	Resistor, 22 Ohm ±5%, 1/4W	100-2223	1
R2	Resistor, 3900 Ohm ±5%, 1/4W	100-3943	1
R3	Resistor, 1 Ohm ±5%, 1W	120-1013	1
R4	Resistor, 3.9 Ohm ±5%, 1/2W	110-3913	1
R5	Resistor, 3300 Ohm ±5%, 1/4W	100-3343	1
R6	Potentiometer, 2 k Ohm ±10%, 1/2W	178-2044	1
R7	Resistor, 15 k Ohm ±5%, 1/4W	100-1553	1
R8	Resistor, 3900 Ohm ±5%, 1/4W	100-3943	1
R9	Resistor, 22 Ohm ±5%, 1/4 Watt	100-2223	1
R10	Resistor, 3900 Ohm ±5%, 1/4W	100-3943	1

TABLE 6-11. POWER SUPPLY PRINTED CIRCUIT BOARD ASSEMBLY - 914-1907
(Sheet 2 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
R11	Resistor, 1 Ohm ±5%, 1/4W	120-1013	1
R12	Resistor, 3.9 Ohm ±5%, 1/2W	110-3913	1
R13	Resistor, 3300 Ohm ±5%, 1/4W	100-3343	1
R14	Potentiometer, 2 k Ohm ±10%, 1/2W	178-2044	1
R15	Resistor, 15 k Ohm ±5%, 1/4W	100-1553	1
R16	Resistor, 3900 Ohm ±5%, 1/4W	100-3943	1
XIC1,XIC2	Integrated Circuit Socket, 14-Pin DIP	417-1400	2
----	Blank Circuit Board	514-1907	1

TABLE 6-12. PEAK DETECTOR/LIMIT PRINTED CIRCUIT BOARD (MONO) ASSEMBLY
914-1912

REF. DES.	DESCRIPTION	PART NO.	QTY.
C201	Capacitor, Tantalum, 4.7 uF, 35V	064-4763	1
C202	Capacitor, Ceramic Disc, 10 pF, 1 kV	001-1014	1
C203 THRU C206,C210	Capacitor, Tantalum, 4.7 uF, 35V	064-4763	5
C211	Capacitor, Electrolytic, 100 uF, 25V	023-1083	1
CR201 THRU CR203	Diode, 1N4148, Silicon, 10 mA, 75V	203-4148	3
IC201	Integrated Circuit, 748C, High Performance, Operational Amplifier, 8-Pin DIP	221-7480	1
IC203 THRU IC205	Integrated Circuit, RC4558DN, Operational Amplifier, 8-Pin DIP	221-4558	3
Q201	Transistor, GES5817, PNP, Small Signal, TO-18 Case	210-5817	1
R201	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R202	Resistor, 330 k Ohm ±5%, 1/4W	100-3363	1
R203	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R204	Resistor, 4700 Ohm ±5%, 1/4W	100-4743	1
R205	Potentiometer, 10 k Ohm ±10%, 1/2W	178-1054	1
R206	Resistor, 2200 Ohm ±5%, 1/4W	100-2243	1
R207,R208	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	2
R209	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	1
R210 THRU R212,R217, R218	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	5
R220	Potentiometer, 5 k Ohm	176-5044	1
R221	Resistor, 8200 Ohm ±5%, 1/4W	100-8243	1
R222,R225	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	2
S201	Switch, Toggle, SPDT, 5A @ 125 VAC & 28 VDC	348-0123	1
----	Blank Circuit Board	514-1902	1

TABLE 6-13. OUTPUT PRINTED CIRCUIT BOARD (MONO) ASSEMBLY - 914-1915
(Sheet 1 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
C501	Capacitor, Tantalum, 4.7 uF, 35V	064-4763	1
C502	Capacitor, Ceramic Disc, 10 pF, 1 kV	001-1014	1
C503	Capacitor, Mica, 750 pF, 500V	042-7522	1
C504	Capacitor, Mica, 250 pF, 500V	042-2522	1
C505	Capacitor, Ceramic Disc, 10 pF, 1 kV	001-1014	1
C506	Capacitor, Tantalum, 4.7 uF, 35V	064-4763	1
C513,C514	Capacitor, Electrolytic, 100 uF, 40V	014-1084	2
C516,C517	Capacitor, Mylar Film, 0.047 uF, 100V	030-4743	2
CR501,CR502	Diode, 1N4148, Silicon, 10 mA, 75V	203-4148	2
IC501,IC502	Integrated Circuit, 748C, High Performance, Operational Amplifier, 8-Pin DIP	221-7480	2
K502,K504	Relay, SPDT, 24V	270-0024	2
Q501	Transistor, GES5817, PNP, Small Signal, TO-18 Case	210-5817	1
Q502	Transistor, GES5816, NPN, Small Signal, TO-18 Case	211-5816	1
Q503	Transistor, GES5817, PNP, Small Signal, TO-18 Case	210-5817	1
Q504	Transistor, GES5816, NPN, Small Signal, TO-18 Case	211-5816	1
Q505	Transistor, GES5817, PNP, Small Signal, TO-18 Case	210-5817	1
Q506	Transistor, GES5816, NPN, Small Signal, TO-18 Case	211-5816	1
Q513	Transistor, GES5817, PNP, Small Signal, TO-18 Case	210-5817	1
Q514	Transistor, GES5816, NPN, Small Signal, TO-18 Case	211-5816	1
Q515	Transistor, GES5817, PNP, Small Signal, TO-18 Case	210-5817	1
Q516	Transistor, GES5816, NPN, Small Signal, TO-18 Case	211-5816	1
R501	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R502 THRU R504	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	3
R505	Potentiometer, 10 k Ohm, ±10%	196-1053	1
R506	Resistor, 100 Ohm ±5%, 1/4W	100-4743	1
R507	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R508	Resistor, 100 Ohm ±5%, 1/4W	100-4743	1
R509	Resistor, 3900 Ohm ±5%, 1/4W	100-3943	1
R510,R511	Resistor, 10 Ohm ±5%, 1/4W	100-1023	2
R523	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	1
R524	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R525	Resistor, 33 k Ohm ±5%, 1/4W	100-3353	1
R526	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1

TABLE 6-13. OUTPUT PRINTED CIRCUIT BOARD (MONO) ASSEMBLY - 914-1915
(Sheet 2 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
R527	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	1
R528	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R529	Resistor, 33 k Ohm ±5%, 1/4W	100-3353	1
R530	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R531,R532	Resistor, 100 Ohm ±5%, 1/2W	110-1033	2
T501	Transformer, Audio Output	371-0004	1
----	Blank Circuit Board	514-1905	1

PRODUCT WARRANTY

LIMITED TWO YEAR

While this warranty gives Purchaser specific legal rights, which terminate two (2) years (one year on cartridge and blower motors) from the date of shipment, Purchaser may also have other rights which vary state to state.

Broadcast Electronics, Inc. ("Seller") hereby warrants cartridge machines, consoles, and other new Equipment manufactured by Seller against any defects in material or workmanship at the time of delivery thereof, that develop under normal use within a period of two (2) years (one year for cartridge and blower motors) from the date of shipment, as such term is defined herein. Other manufacturer's and suppliers' Equipment and services, if any, including electronic tubes, solid state devices, transmission line, antennas, towers, related equipment and installation and erection services, shall carry only such manufacturer's or suppliers' standard warranty. This warranty extends to the original user and any subsequent purchaser during the warranty period. Seller's sole responsibility with respect to any equipment or parts not conforming to this warranty is to replace such equipment or parts upon the return thereof F.O.B. Seller's factory or authorized repair depot within the period aforesaid.

In the event of replacement pursuant to the foregoing warranty, only the unexpired portion of the warranty from the time of the original purchase will remain in effect for any such replacement. However, the warranty period will be extended for the length of time that Purchaser is without the services of the Equipment due to its being serviced pursuant to this warranty. The terms of the foregoing warranty shall be null and void if the Equipment has been altered or repaired without specific written authorization of Seller, or if Equipment is operated under environmental conditions or circumstances other than those specifically described in Seller's product literature or instruction manual which accompany the Equipment. Seller shall not be liable for any expense of any nature whatsoever incurred by the original user without prior written consent of Seller.

Seller shall not be liable to Purchaser for any and all incidental or consequential damages for breach of either expressed or implied warranties. However, some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to Purchaser. All express and implied warranties shall terminate at the conclusion of the period set forth herein. Any card which is enclosed with the equipment will be used by Seller for survey purposes only.

If the Equipment is described as used, it is sold as is and where is. If the contract covers equipment not owned by Seller at this date, it is sold subject to Seller's acquisition of possession and title.

EXCEPT AS SET FORTH HEREIN, AND EXCEPT AS TO TITLE, THERE ARE NO WARRANTIES, OR ANY AFFIRMATIONS OF FACT OR PROMISES BY SELLER, WITH REFERENCE TO THE EQUIPMENT, OR TO MERCHANTABILITY, FITNESS FOR A PARTICULAR APPLICATION, SIGNAL COVERAGE, INFRINGEMENT, OR OTHERWISE, WHICH EXTEND BEYOND THE DESCRIPTION OF THE EQUIPMENT ON THE FACE HEREOF.

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