INSTRUCTION MANUAL

DC-8M

RAMKO RESEARCH
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RAMKO RESEARCH, INC.

Professional Audio Products

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INTRODUCTION

Congratulations! You have just taken a major step toward improving the quality of your sound and the reliability of your operation. As you will note your new RAMKO console embodies features that until now have been available only on units selling from 5 to 10 times more. In addition you will find features that are available only in your unit. From our exclusive DIGITAL switching to the better than a "VU" meter solid state light emitting meter.

Although your console has been 100% tested prior to shipment and packaged in a highly shock resistant manner we find that there are some freight lines that seem to take delight in testing our methods. This is usually through the drop method. Therefore BEFORE turning the unit on PLEASE take the time to remove the top cover and check to see that no internal damage has occurred and that all plug in cards are properly seated.

In addition if you'll take the time to read the following circuit descriptions and familiarize yourself with the relatively simple but new concepts you'll be time and money ahead.

Thank you for the opportunity to serve you. We will look forward to being of further assistance in the future.

Very sincerely,

R. G. Kohfeld,
President.

11355-A FOLSOM BOULEVARD • RANCHO CORDOVA, CALIFORNIA 95670

INSTALLATION

GENERAL

WE RECOMMEND THAT YOU THROUGHLY FAMILIARIZE YOURSELF WITH THE CONSOLE BEFORE PROCEEDING WITH THE INSTALLATION.

By following the good engineering practices in this manual, stable and reliable operation will be insured.

A two ground system has been utilized in this new series of consoles to insure RF and hum free operation . The safety ground wire in the AC cord is also connected to an AC filter in the console which protects the console from both AC transients and RF. The second ground appears at the rear of the console(wing nut and stud). Only at this point are the audio and chassis grounds tied together. An insulated ground strap (10 gauge stranded wire or copper braid) must be run from this point directly to your studio or station ground. The shorter the better.

All grounds on shielded cable entering the console from external sources (mics, record/playback units, TT preamps, etc.) should be connected to the barrier strip ground associated with that input. This is the only point that the shield ground should be connected and not at the source end. Connection in any other manner may cause RF and or hum problems. Caution should be exercised when the console inputs are being fed by a jack field. Jack "normals" should be wired with sleeve-to-sleeve jumpering which does not interconnect with the rack ground in which the jack strips are mounted.

Insulated, "Jacketed", shielded pair cable is strongly recommended for all external source hookups, including jack strip wiring, to reduce the possibility of accidental grounding of the cable shield.

SPECIFICATIONS - DC-5M and DC-8M (Serial #'s 163 & 1000 & up)

INPUTS:	18 inputs into 8 mixers (DC-8). 12 inputs into 5 mixers (DC-5 & SC-5). All inputs (except last channel) gain selectable from low thru high. LOW-LEVEL - 150/250 ohms balanced; As shipped -55dbm nominal, -25dbm max. HIGH-LEVEL - Balanced bridging (100K each side to ground); As shipped -10dbm nominal, +10dbm max. Input impedance may be changed to any lower impedance by placing appropriate resistor across input terminals.
OUTPUTS:	PROGRAM - 600ohm, differential balanced, +8dbm nominal, +20dbm max. AUDITION - same as program. MONITOR - 7 watts RMS per channel into 8 ohms. CUE - 0.5 watts to internal speaker. HEADPHONES - 8 ohms thru high impedance. Front panel jack.
FREQ. RESPONSE:	PROGRAM & AUDITION +0, -2db 20KHz referenced to 1 KHz at +8 dbm out. MONITOR +0, -2db 30Hz to 15KHz referenced to 1KHz @ 1 watt out.
DISTORTION:	PROGRAM, AUDITION AND MONITOR DRIVER 0.3% or less. MONITOR 0.5% THD or less at rated load and output.
SIGNAL TO NOISE:	PROGRAM, AUDITION Noise 63db (unweighted) below +8dbm out, referenced to -50dbm in.
MUTING:	Dip switch and patch panel concept allows selection of any 28 combinations (DC-8) & 16 combinations (DC-5). Cue mute follows monitor mute. Headphone cue unmuted.
POWER:	10 to 30 watts, 117 VAC, 50/60Hz.
SIZE:	DC-8's - 8" H X 37 ½" W X 14 1/2" D. DC-5's - 8" H X 28 ½" W X 14 1/2" D.
OPTIONS:	LC-2 & LC-4 accessory remote control, latching options for simulcue, console extenders. Contact foctory for more information.

HOOK UP & INSTALLATION

DC - 8M

TERMINAL & FUNCTIONS (Facing the rear of console & reading from right to left on the barrier strip)

Channel #1,	Input #1:	1+	AIR INPUT:	45+
"	"	2-	"	46-
"	"	3GRND	"	47GRND
Channel #1,	Input #2:	4-	PROG. OUTPUT:	48+
"	"	5+	"	49-
Channel #2,	Input #1:	6+	"	50 GRND
"	"	7-	AUD. OUTPUT:	51-
"	"	8GRND	"	52+
Channel #2,	Input #2:	9-	MONITOR OUTPUT:	53+ NON-MUTED DRIVER (600 ohm)
"	"	10+		
Channel #3,	Input #1:	11+	"	54+ INTERNALLY MUTED (600 ohm)
"	"	12-		
"	"	13GRND	"	55GRND
Channel #3,	Input #2:	14-	MONITOR SPEAKER:	56+ (4-8ohm)
"	"	15+	"	57 GRND
Channel #4,	Input #1:	16+	ON AIR LIGHT:	58 N.O.
"	"	17-	(Dry contacts.	59 COMMON
"	"	18GRND	Relay actuation	60 N.C.
Channel #4,	Input #2:	19-	follows mainmute)	
"	"	20+	AUX MUTE:	61 N.O.
Channel #5,	Input #1:	21+	(Dry contacts.	62 COMMON
"	"	22-	Relay actuation	63 N.C.
"	"	23GRND	follow aux mute)	
Channel #5,	Input #2:	24-		
"	"	25+		
Channel #6,	Input #1:	26+		
"	"	27-		
"	"	28GRND		
Channel #6,	Input #2:	29-		
"	"	30+		
Channel #7,	Input #1:	31+		
"	"	32-		
"	"	33GRND		
Channel #7,	Input #2:	34-		
"	"	35+		
Channel #8,	Input #1:	36+		
"	"	37-		
Channel #8,	Input #2:	38+		
"	"	39-		
"	"	40GRND		
Channel #8,	Input #3	41-		
"	"	42+		
Channel #8,	Input #4:	43-		
"	"	44+		

EXAMPLE GAIN SELECT SHEET

All Ramko consoles have the distinct advantage of full range gain select on their inputs. Thus unlike other consoles you are not tied to just HIGH/LO select but can adjust the gain of the inputs for any source level (-60dbm thru +10dbm nominal).

Refering to your input board schematic you will note the audio inputs go thru a small patch panel of resistors. There are two resistors for each input. One each for the plus and minus legs of each balanced pair. Whenever an input's gain is changed both resistors of this input must be changed. (3)

SOURCE LEVEL (Nominal)	CHANNEL INPUT RESISTOR (1)	AIR INPUT
-60 dbm	510 ohm	-50 dbm
-55 dbm	1 K	-45 dbm
-50 dbm	1.8 K	-40 dbm
-45 dbm	3.3 K	-35 dbm
-40 dbm	5.6 K	-30 dbm
-35 dbm	10 K	-25 dbm
-30 dbm	18 K	-20 dbm
-25 dbm	33 K	-15 dbm
-20 dbm	47 K	-10 dbm
-15 dbm	100 K	-5 dbm
-10 dbm	150 K	0 dbm
0 dbm	560 K	
+10 dbm	1.5 meg (2)	

(1) All resistors should be ¼ watt. Resistors used in low level applications should be carbon or metal film low noise types.

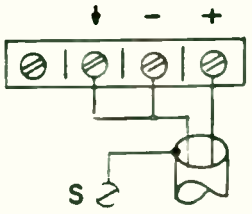
(2) Not recommended due to possible hum pickup. Suggest external signal pad down for these levels.

(3) CMR may need adjustment when input resistors are changed.

BALANCED AND UNBALANCED METHODS OF CONNECTING INPUTS AND OUTPUTS

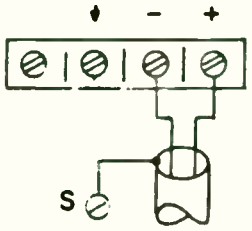
Both the inputs & outputs, when shown with both + and -, may be used in either the balanced or unbalanced configuration. CAUTION: It is important that the following procedures be followed to prevent possible damage to the consoles integrated circuitry & for proper signal processing.

INPUTS (unbalanced)



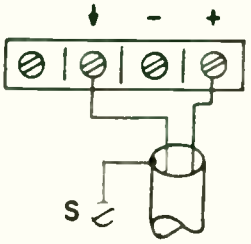
Jumper minus terminals to ground (⏚). Feed signal to plus terminal with shield tied to shield ground(S). Connect minus wire to ground (⏚).

INPUTS (balanced)



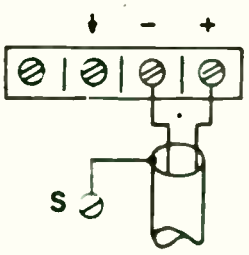
Feed signal to plus & minus terminals with shield tied to ground. The source feeding the console input must have balanced output for this mode.

OUTPUTS (unbalanced)



Audio output is taken from the plus terminal with shield tied to shield ground (S). THE MINUS TERMINAL IS LEFT FLOATING FREE. DO NOT CONNECT THIS TERMINAL TO GROUND. Minus wire is connected to ground (⏚).

OUTPUTS (balanced)



Audio output is taken from the plus and minus terminals with the shield tied to ground. FEED ONLY EQUIPMENT WITH BALANCED INPUTS IN THIS MODE.

Note: All shield wires should be as short as practical. Shield wire should be split out, and foil shielding should continue on to barrier strip

PREAMPLIFIER INPUT GAIN AND LEVEL PROGRAMMING (DCMP)

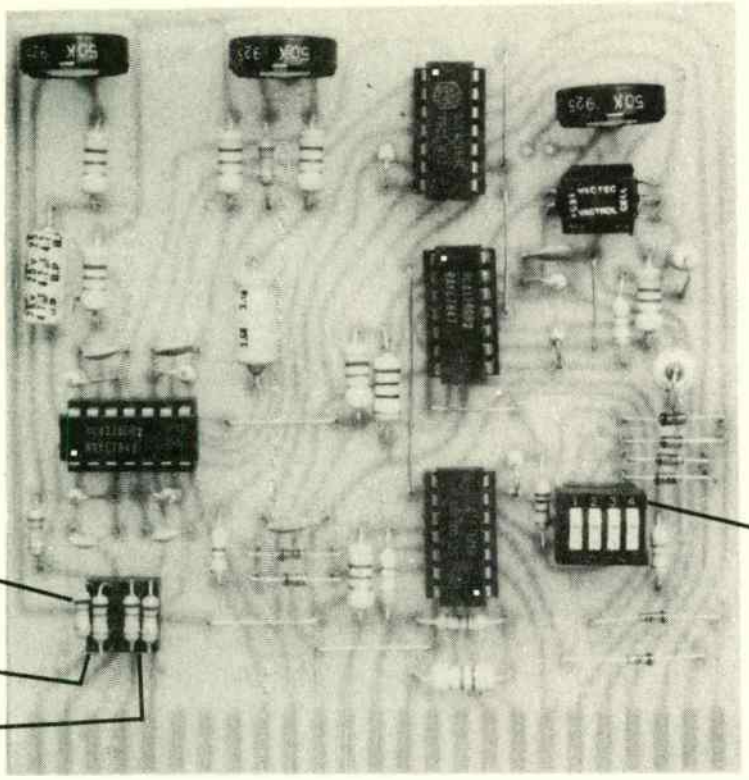
Each and every input of your console may be programmed to accept any level source normally found in a radio station or recording studio. From mic thru high level. Refering to Fig # 1 to the DCMP photo, you willsee the GAIN SELECT PATCH PANEL. Simply plug different value resistors, as shown in the accompanying chart, in the desired inputs for the level desired. Always change both resistors as changing only one of the pairs will upset the CMR of the input and at the same time provide incorrect gain.

MUTING AND ON THE AIR LIGHT PROGRAMMING

All muting (Main & Aux.), and on the air light programming is easily accomplished via the DIP switches or jumpers on the DCMP. Refering again to Fig. # 1, you will note the 4 position DIP switch located towards the bottom of the module. Positions # 4 and # 3 are for the muting of the CUE SPEAKER, and the muted monitor driver. When position # 4 is in the on mode the monitor will mute when Input # 2 and either Program of Audition is selected on this channel. Position # 3 accomplishes the same thing when Input # 1 and either Program or Audition is selected. Positions # 2 & # 1 are designed to actuate the AUX MUTE relay, K2. Position # 2 (on mode) actuate the relay when Input # 2 and either Prog. or Aud. are selected. Thus by routing the non-muted driver signal thru this relay's contacts and then to a remote power amplifier "other room" muting may be accomplished totally separate from the consoles main muting.

The ON AIR LIGHT relay actuation follows the console main functions. This relay's contacts are "dry" and no voltage is furnished by them.

Fig. # 1



DCMP (003-3018) LO
DCMP (003-3019) HI

TECHNICAL DESCRIPTIONS

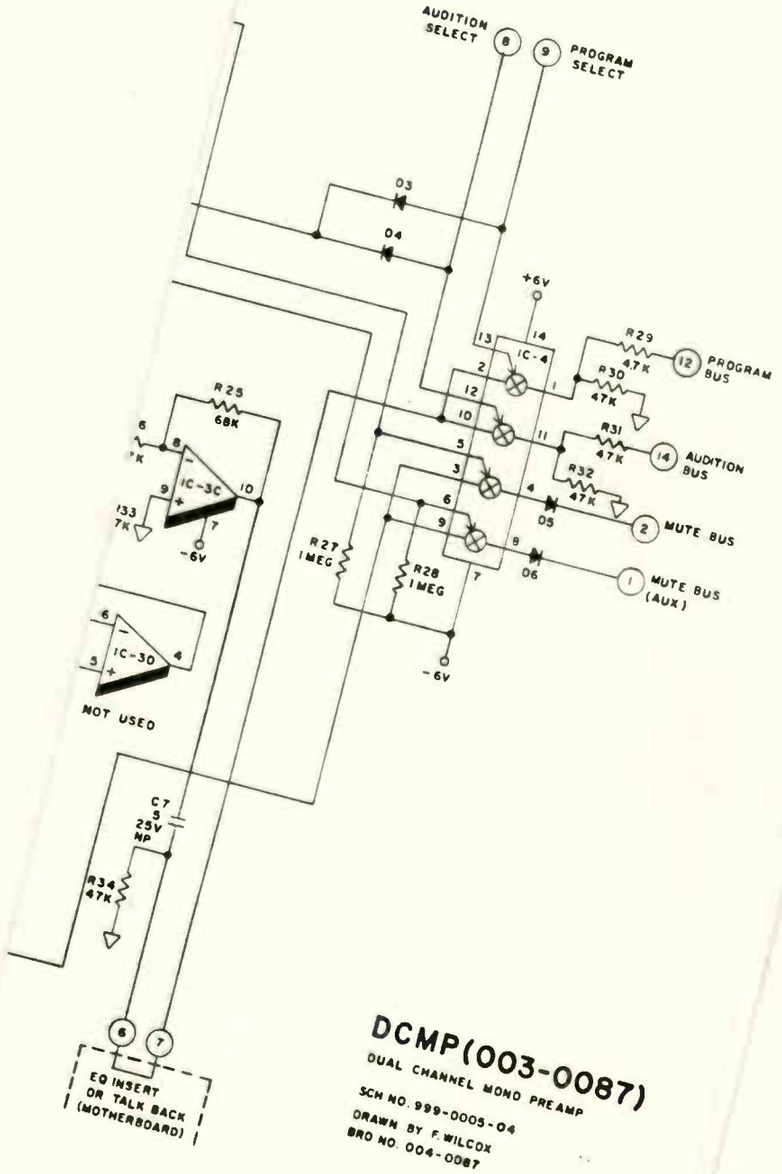
DCMP- DUAL CHANNEL MONO PREAMP

This input card contains all of the circuitry for input preamplification. Input & Aud/Prog/Off selection, electronic attenuation, cue initiation, and the main mute and aux mute programming.

The input signals enter IC-1 thru the gain select patch panel, then thru the following buffers (w/gain) and on to ½ of IC-2. IC-2 is a quad analog gate and may be viewed as 4 single pole, single throw relays in one package. The audio selected (input #1 or #2) passes thru one of these gates and is fed into LDR1. LDR1 is a light (LED) controlled resistor which varies the audio relative to that channels mixer voltage. The signal leaving the LDR goes thru another buffer and then to ½ of IC-4. The audio is then fed to the Prog or Aud buss depending on the mode selected on the front panel touch pad. If Aud & Prog are selected at the same time then the signal will be fed to both the Aud & Prog buss simultaneously.

The cue routing and initiation, and the muting logic is performed by the remaining ½ of IC-2 and IC-4, and IC-3B. The audio input selected comes out of pin #2 or pin #10 of IC-2 and, if the channel mixer is in cue, is routed out pin #4 (IC-2) to the active CUE mixing buss. The turning on or off this cue gate is accomplished by the CUE comparator IC-3B. A voltage divider consisting of R22 and R23 supplies approx. 10mv to pin #2 of IC-3B. Pin #1 the inverting input is tied to the mixer EA control voltage. With the mixer at full counter clockwise position (0 volts out) the output of IC-3B is a positive 5 volts. This voltage is applied to pin #5 of IC-2 which turns this gate on. When the mixer is moved clockwise (positive going voltages on the wiper) and goes higher than the 10mv referenced at pin #2 (IC-3B), the output of IC-3B goes to negative 5 volts thus shutting off the cue buss gate and killing the cue signal.

The remaining logic gates on IC-2 and IC-4 and switch S1 are used to generate the DC command voltages for the main mute, aux mute and ON AIR LIGHT relays. The input that is selected supplies +6V to either D1 or D2. The switches on S1 route this voltage to pin #5 and/or pin #6 of IC-3. The gate(s) will be turned depending on the combination selected by S1. If neither Aud nor Prog are on at this time nothing will happen since there is no voltage at the input pins (#9 and #3) of IC-4. If either Aud or Prog is selected +6 Volts is applied, via D3 and/or D4, to the control terminal (pin #6) of IC-2. When this occurs +6V is routed thru this gate and back to pin #3 and/or pin #9 of IC-3. A voltage may now appear on either or both mute busses.



DCMP(003-0087)

DUAL CHANNEL MONO PREAMP

SCH NO. 999-0003-04

DRAWN BY F. WILCOX

BRD NO. 004-0087

DC-TPC - DC TOUCH PAD CONTROL

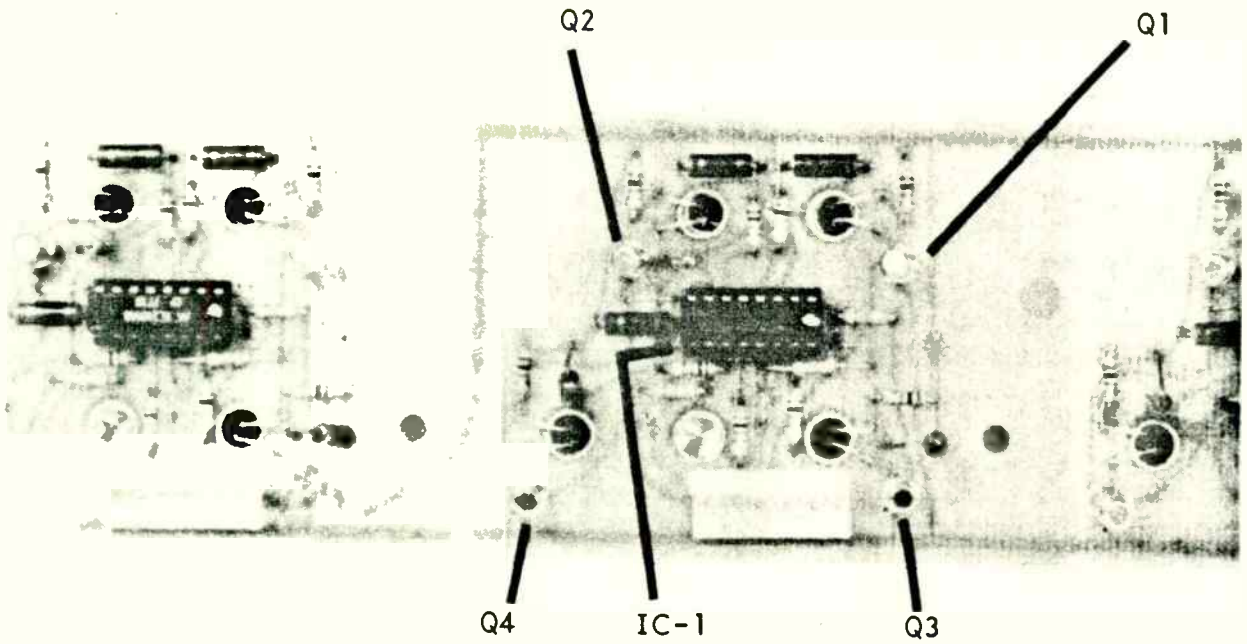
The console front panel touch pad control was designed to insure totally quiet and maintenance free operation. The metal touch pads operate on a combination of your skin resistance ond capacitance. The black escutcheon plates mounted on the console fron panel consists of an insulating material (closest to metal front panel) and a copper plate coated with a dark brown synthetic material. The copper plate carries 17 VAC and is supplied via an isolation resistor from the isolated power transformer secondary. When your finger is applied to the touch ring the voltage from the escutcheon plate is transferred to this ring; which is connected thru a 10K input protection resistor, to one input of a 4044 quad latch IC.

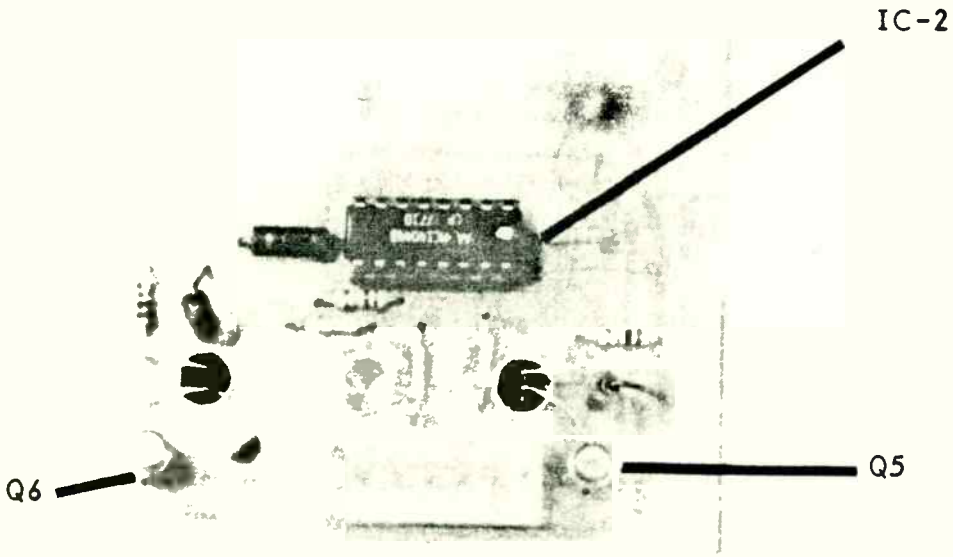
Referring to your TPC schematic you will see that the 4044 quad latch is used in 2 different ways. One is a 2 state only circuit for the 1 & 2 input select. The other is a 3 state Audition, Program and Off circuit.

Let's take the input 1 & 2 select first. Since the circuit cannot be in two states at once let us assume the input #1 is on. Thus pin #13 of IC-1A will be +6V and the "1 out" terminal will be +6V. The output of IC-1B will be -6V (pin #9) and the "2 out" terminal will be -6V. If we now touch, TOUCH PAD #2 "R" of IC-1A goes low (-6V), "S" of IC-1A is already low, so therefore "Q" of IC-1A goes low. When the output of IC-1A goes low so does "S" of IC-1B. Since "R" of IC-1B is a +6V and "S" is now -6V the output of IC-1B now goes high (+6V). Thus the circuit has changed state.

The 3 state circuit is somewhat different in that the two latches act independently except for "OFF". Keep in mind that touching a "TOUCH PAD" causes that terminal to go low. Since both "R" terminals are held high (+6V) touching the PAD causes the "S" terminal to go low and as can be seen by the truth table causes this latches output to go high. Thus you will note that either A or P may be turned on separately or both simultaneously. Touching the OFF PAD causes both "R's" to go low and since both "S's" are high, both latches will go low (off).

PARTIAL PICTORIAL



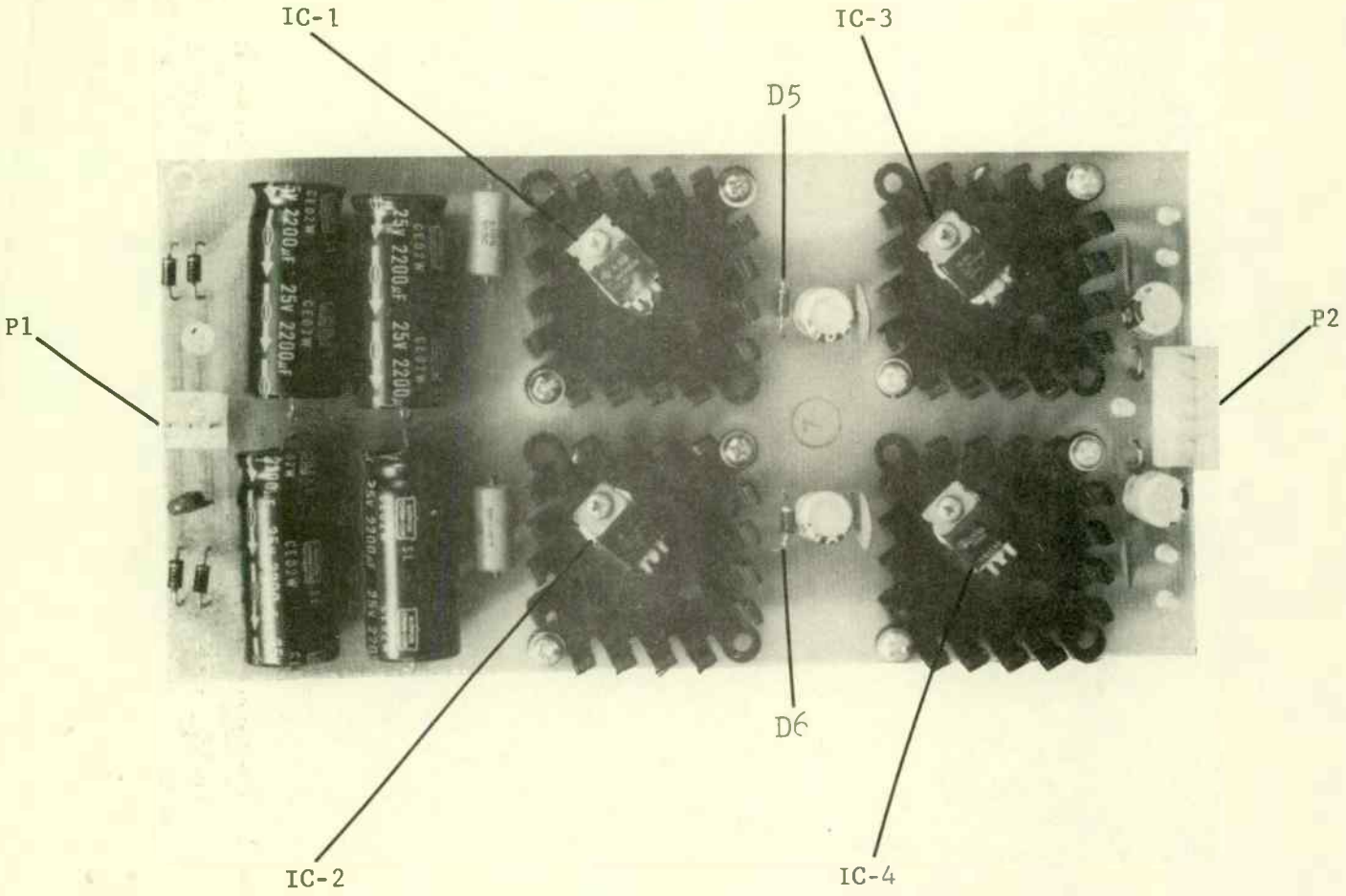


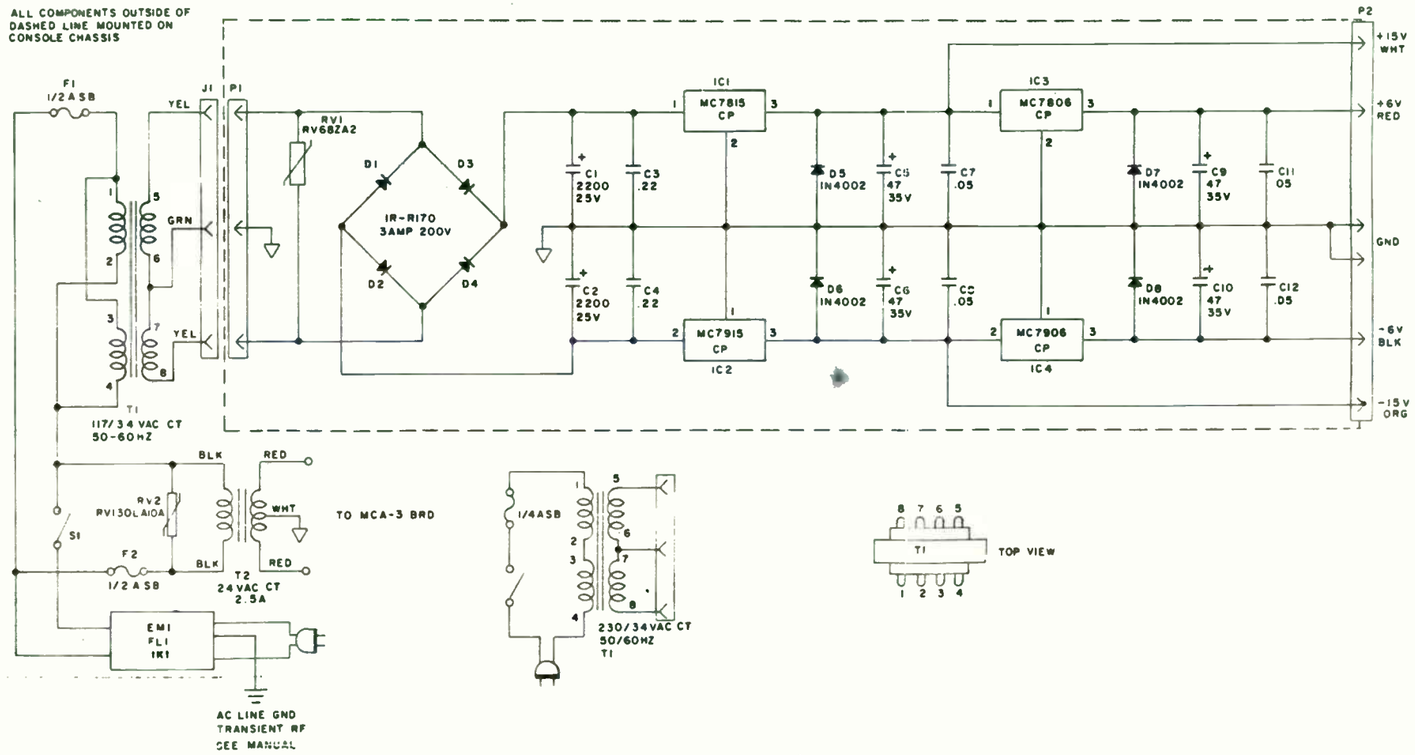
CHANNEL #5 (DC-5M, DC-5MS)
CHANNEL #8 (DC-8M, DC-8MS)

DPS-3 - DUAL POWER SUPPLY (003-0086)

The DPS-3 is a dual ±15VDC and ±6VDC supply. All circuitry in the console is supplied by this unit with the exception of the MCA-3 which has its own transformer (T2) and rectifier/filter section.

The DPS-3 receives its power from T1, is full wave rectified and then filtered by C1 & C2. The plus 22 volts across C1 is fed to IC-1 which provides a highly regulated plus 15VDC. This in turn feeds IC-3 which provides a highly regulated plus 6 volts out. IC-2 and IC-4 accomplish the same thing but are minus 15VDC and minus 6VDC regulators in that order. All capacitors with the exception of C1 & C2 are for power supply stability. Without these caps the supply would tend to oscillate. D5, D6, D7, and D8 are protection diodes and are designed to keep any of the supply voltages from momentarily reversing below ground and damaging the console electronics. RV1 across the rectifiers input is a metal oxide varistor and is an AC line transient protection device. Any spikes or steady voltages above 36 volts AC are instantaneously shorted out.





T1 NATIONAL
IC4 UA7906-CKC OR LM320T-6
IC3 UA7806-CKC OR LM340T-6
IC2 UA7915-CKC OR LM320T-15
IC1 UA7815-CKC OR LM340T-15
CAPACITORS ARE IN MICRO FARADS, 50V OR GREATER
UNLESS OTHERWISE SPECIFIED

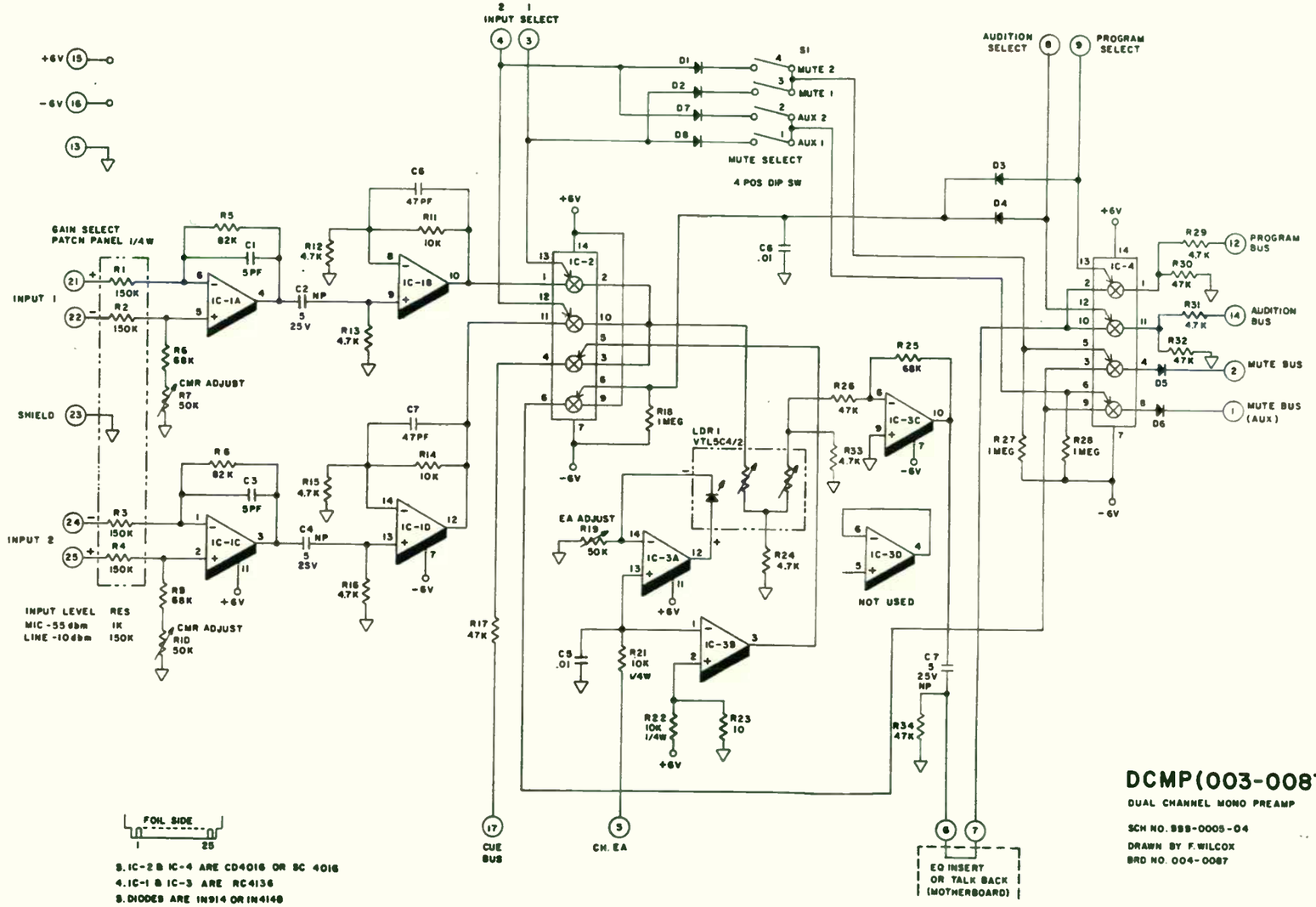
DPS-3(003-0086)

DUAL POWER SUPPLY
(±15VDC & ±6VDC)

SCH NO 999-0001

DRAWN BY F WILCOX

BRD NO. 004-0086



3. IC-2 & IC-4 ARE CD4016 OR SC 4016
4. IC-1 & IC-3 ARE RC4136
3. DIODES ARE IN914 OR IN4148
2. CAPACITORS ARE IN MICRO FARADS, 50V OR GREATER
1. RESISTORS ARE IN OHMS 1/2W ±5%
UNLESS OTHERWISE SPECIFIED

DCMP(003-0087)

DUAL CHANNEL MONO PREAMP

SCH NO. 999-0005-04
DRAWN BY F. WILCOX
BRD NO. 004-0087

THEORY DISCUSSION

With the exception of the console power supply & cue amplifier all active circuitry (amplifiers & COS/MOS switching) utilizes only Four different IC's The RC 4136 quad op amplifier; the RC 4558 dual op amp; the CA 4016 quad COS/MOS analog switch; the 4508 Dual Quad Latch. All electronic attenuation is eventually accomplished via the Voltage Controlled Attenuator.

Although you are probably familiar with op amp operation it may be best to briefly review thier functions before getting into COS/MOS switching & the audio console circuitry

For illustration purposes a single section will be discussed.

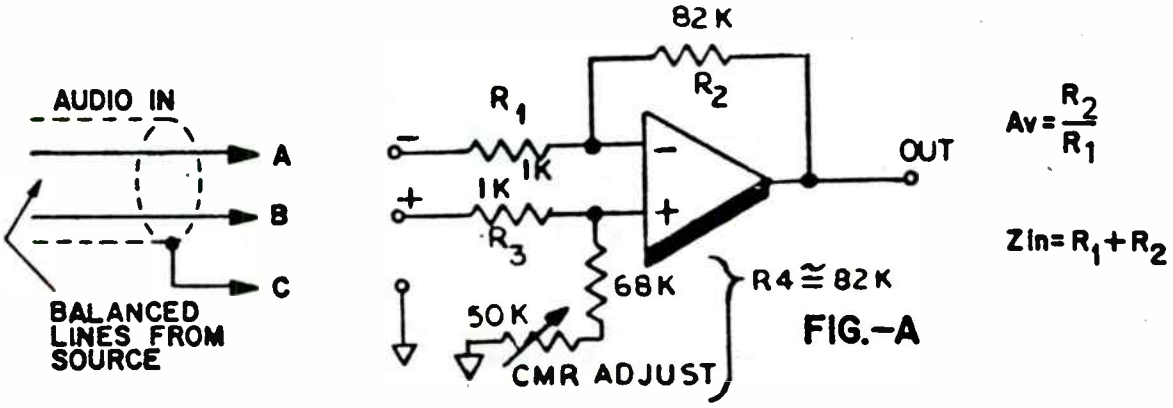


FIG.-A

The above circuit is typical of the balanced differential input circuit found in your audio console. The two things you will be concerned with are gain (gain select patch panel) & common mode Rejection (CMR). The later being a direct function of how well the inputs are balanced The circuit shown is set up for -55 dbm input level (mic level) & provides the following console amplifiers with enough level for a nominal mixer setting of around 12 o'clock & + 8 dbm out at the PROG and AUD outputs. By refering to the schematic of the electrically switched preamp card you will see that the two resistors (R1 & R3 above) may be changed to accomodate any input level(s) desired. In order to save you time & a lengthy math desertation a Gain Select Chart & example sheet are included in the back of this manual. Be sure to observe the notes at the bottom of the chart. If changing these resistors upsets the input balance (CMRR) to any great extent the CMR adjust may have to be recalibrated. This will only be necessary in a few isolated cases where high common mode hum is present on your balanced lines. Simply feed a common signal to inputs A & B with reference to ground & adjust the CMR adjust for a null or minimum signal out of the console.

This type of input stage may also be used in the single ended (unbalanced) configuration & would be connected as shown in FIG B. The minus input terminal is grounded & the signal "hot" lead is connected to the + input & the ground connected to ground. No readjustment of the CMR adjust is needed no matter what input resistor values are used.

To change gain the same chart as before is used & again both R1 & R2 are

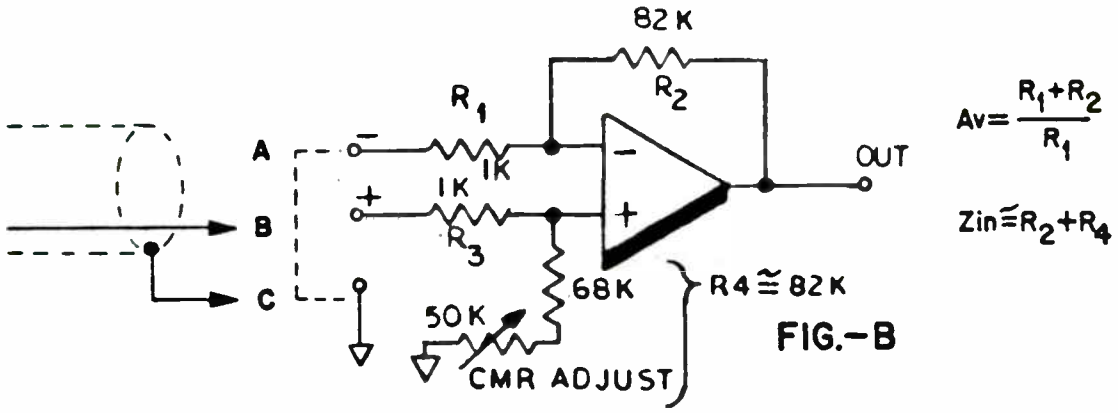


FIG.-B

There are four other types of op amp circuits used in your console. (1) A standard non-inverting configuration; (2) an inverting configuration: (3) the balanced/differential output stage; (4) and the DC voltage comparator used in the cue circuitry.

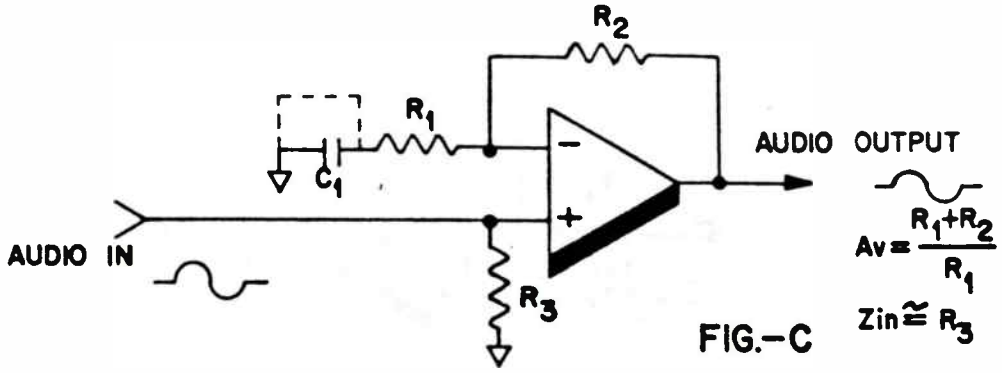


FIG.-C

1 . The non inverting type is shown in FIG-C along with some minor math used to compute the gain of this stage. The output of this stage will always be in phase with the input.

R1 may sometimes go directly to ground. This in no way affects the phase or computations above.

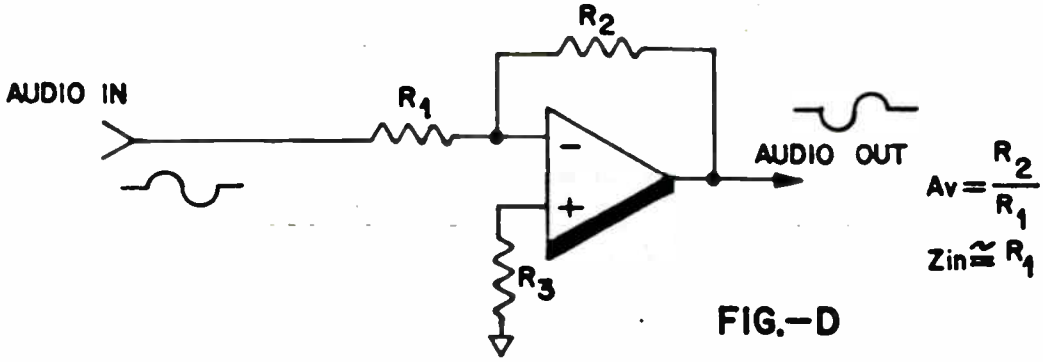


FIG.-D

2 . The inverting configuration in FIG-D is just as simple as the non inverting. The output of this stage is 180° out of phase with the input

R3 is for biasing considerations only.

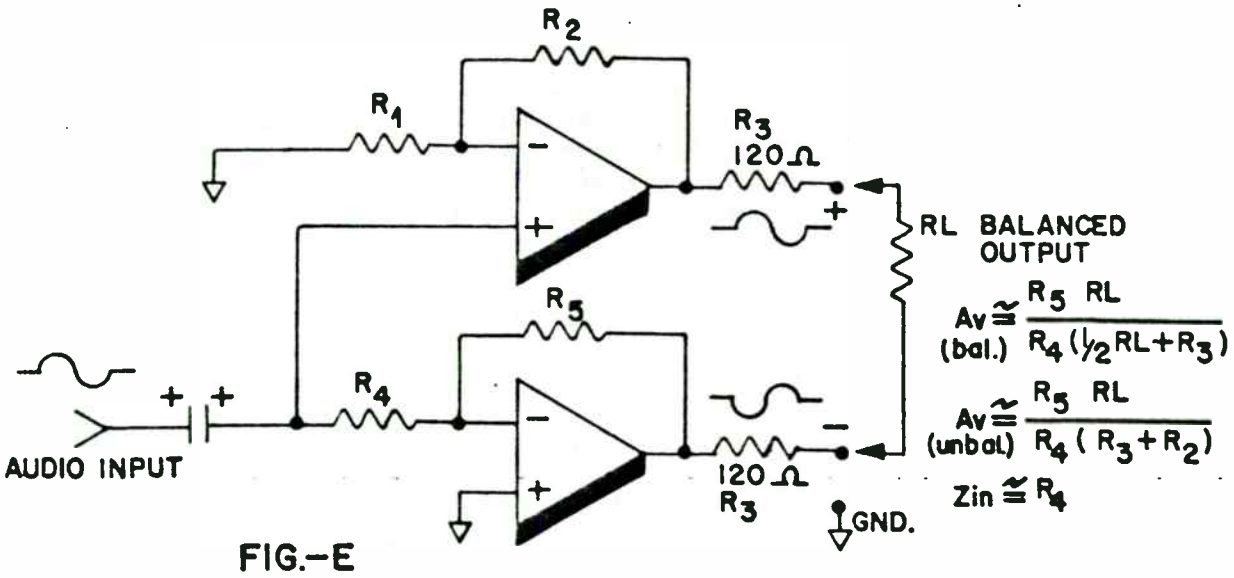


FIG.-E

3 • FIG-E depicts the balanced/unbalanced outputs utilized in your console There are several terms to note about this unique stage. First unlike transformer outputs this output circuit's distortion & response will remain unaffected by changes in output loading. In fact anything from 600 ohm thru infinity may be used without signal degradation. In addition either side of the balanced out (+ or−) may be used unbalanced to ground simultaneously or individually.

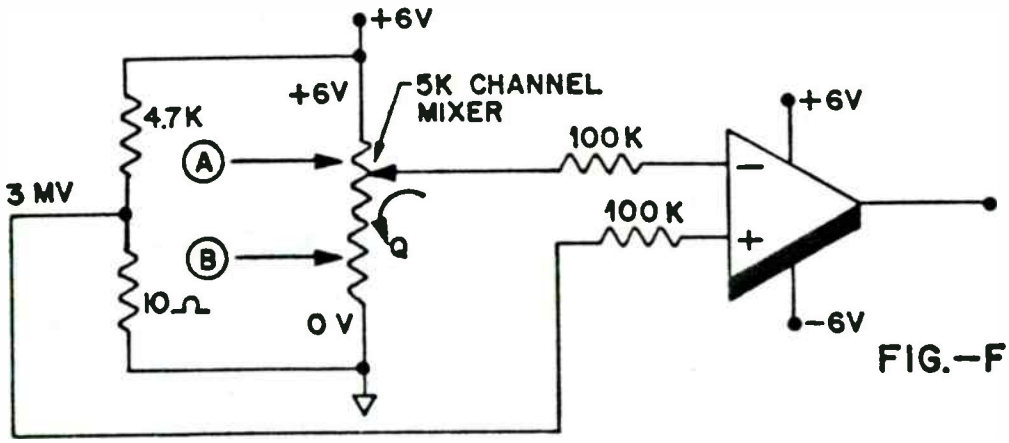


FIG.-F

4 • The cue amp switching circuit also utilizes the op amp but in this case as a DC comparator (level sensing switch).

This circuit is used in the inverting mode with no feedback. Since we are operating open loop the gain of the op amp is approx. 120 db (AV=1 000 000) The plus input is fixed at 2-3Mvvia the voltage divider & the minus is connected to the wiper of the front panel mixer control. Let us assume that your mixer is set around 12 o'clock (mid position) & pretend this is a linear pot instead of the andio taper that it actually is. Thus the -terminal of the op amp will see+3V & the + terminal+.003V. Multiply the difference between these two terminals by the gain of the amp & you have the output voltage. (3V -.003) (-1 000 000) = -2,997, 000 volts! Well the sign is right (minus), but the voltage is wrong since the amp can only switch to around ± 6 volts (to supply voltage). We now have approx. - 6 volts out which by the way will eventually turn off the CUE AMP circuitry

elsewhere Let's turn the mixer down towards CUE now until the wiper potential is almost the same as the fixed potential (3MV). Let's make it say 5MV & see what happens. (.005 – .003) (-1.000 000) = -2000V Once again the op amp output is minus but can only go to minus 6V. Now let us turn it further towards CUE (grd) to say 1MV. Thus (.001 – .003) (-1 000 000) = +2000V! Note that as the wiper crossed 3MV the output switched positive. This time to the plus supply (+6V). That's it! An electronic comparing switch that goes either to +6 or -6V out.

The last 2 types of IC's to be examined are the 4016 quad analog switch & the 4069 hex inverter.

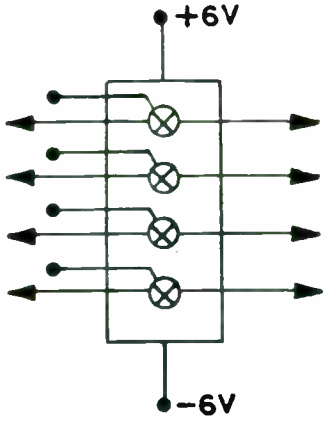
FIG G below depicts the 4016.

The straight thru arrows indicate direction of signal flow back & forth thru the gate. These gates are bilateral so the signal may flow in either direction. The gate control will always be depicted as coming off of the gate at a 45° angle. The only things to remember about these gates are: (1) the gate will be ON if the gate control has a +6V applied to it & OFF if it is -6V; (2) the gate appears as a few hundred ohms when ON & many megohms when OFF; (3) the 4016's are used to gate DC voltage (for logic) as well as routing audio signals; (4) always use a high impedance meter when taking voltage measurements.

Figure H below depicts the 4044

The last IC to be discussed here is the 4044 quad latch. The accompanying diagram & truth table explain the operation of this unit. There are two things to keep in mind here. First, in our equipment, the "1" state is always a +6V and the "0" state is a -6V. Secondly, the "enable" terminal is always connected to +6 and therefore alwa operative.

FIG.–G



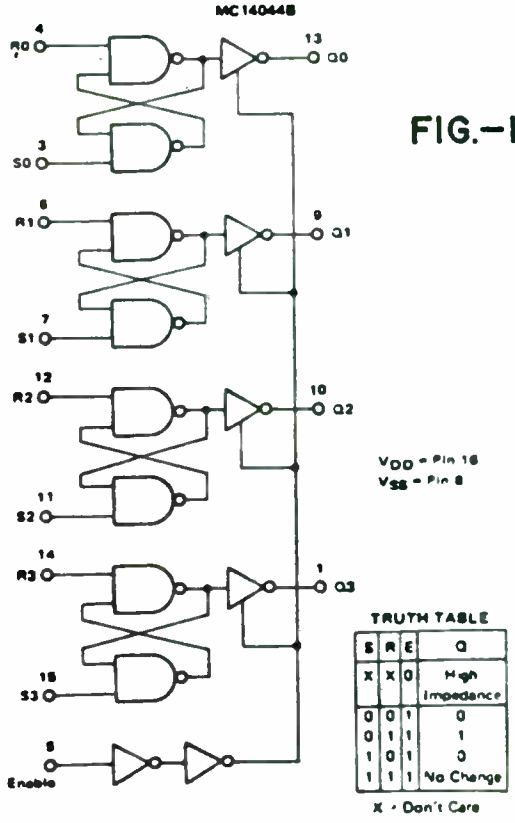


FIG.–H

DC-8 & DC-5M CALIBRATION

Although your console has been thoroughlycalibrated prior to shipment it may be necessary to make minor adjustments in the future. This will probably be necessary only if repairs have been made and/or possibly inadvertant movement of one or more of the trimmers.

There are only 3 areas of adjustment to be concerned with. The solid state meter, the input common mode rejection (CMR), and the electronic attenuator adjust. All adjustments should be performed with test equipment connected as shown at the beginning of this manual.

The input and output levels used for calibration are shown below along with the value of input select resistors you may have in your console.

The test oscillator and AC VTVM may be balanced or unbalanced. No difference in levels will be experienced whether the inputs are connected balanced or unbalanced. The output is another story. In the unbalanced output hook-up, the output level will be one half that of the balanced output. Be sure that the console output always looks into 600 ohms for all calibration procedures.

INPUT AND OUTPUT LEVELS

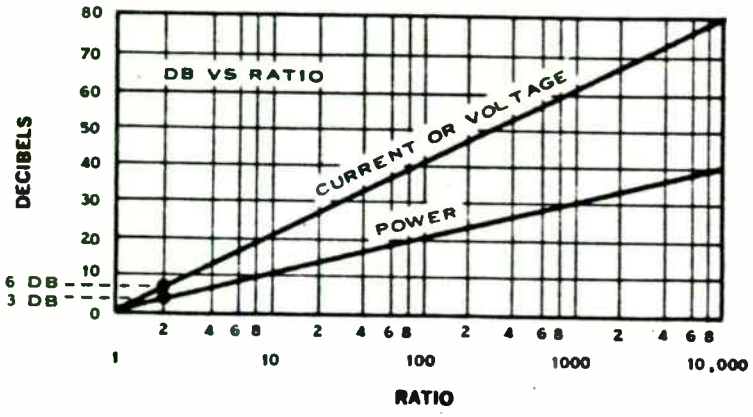
INPUT SELECT RESISTORS	INPUT LEVEL	OUTPUT LEVEL BALANCED	OUTPUT LEVEL UNBALANCED
560 ohm	1 mv	+8 dbm (2v)	+2 dbm (1v)
1K ohm	1.8 mv	"	"
1.8K ohm	3.3 mv	"	"
56K ohm	80 mv	"	"
150K ohm	250 mv	"	"
560K ohm	500 mv	"	"

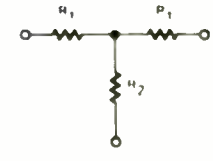
All adjustments are made with the test oscillator set at 100Hz.

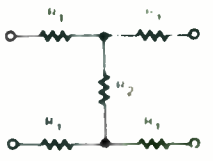
(1) SOLID STATE METER CAL. - Refer to the solid state pictorial on page #____. There are 2 adjustments for each meter display. -21 & 0 "VU". After determining the value of input resistors and a proper input level from the test oscillator, adjust the console master control for +8dbm (bal) or +2dbm (unbal.) out of the console. Adjust the appropriate 0 "VU" trimmer so that the 0 "VU" LED just begins to turn on. Now turn the console master down until your test meter reads 21 db below the 0 "VU" reading. Adjust the -21 trimmer until the first LED (-21) just begins to turn on. Repeat this procedure one more time. Both meter sections are identical and calibrated the same.

Voltage applies to 600 ohm circuits only. Power applies to any impedance.

dB DOWN	LEVEL	dB UP
VOLTS	dB mW	VOLTS
0.774 6	0+	0.774 6
0.690 5	1	0.869 1
0.616 7	2	0.975 2
0.548 4	3	1.094
0.488 7	4	1.228
0.435 6	5	1.377
0.388 2	6	1.546
0.346 0	7	1.734
0.308 4	8	1 946
0.274 8	9	2.183
0.244 9	10	2.449
0.218 3	11	2.748
0.194 6	12	3.084
0.173 4	13	3.460
0.154 6	14	3.882
0.137 7	15	4.356
0.122 8	16	4.887
0.109 4	17	5.484
0.097 52	18	6.153
0.086 91	19	6.905
0.077 46	20	7.746
0.043 56	25	13.77
0.024 49	30	24.49
0.013 77	35	43.56
0.007 746	40	77.46
0.004 356	45	137.7
0.002 449	50	244.9
0.001 377	55	435.6
0.000 774 6	60	774.6
0.000 435 6	65	1 377
0.000 244 9	70	2 449
0.000 137 7	75	4 356
0.111 077 46	80+	7 746

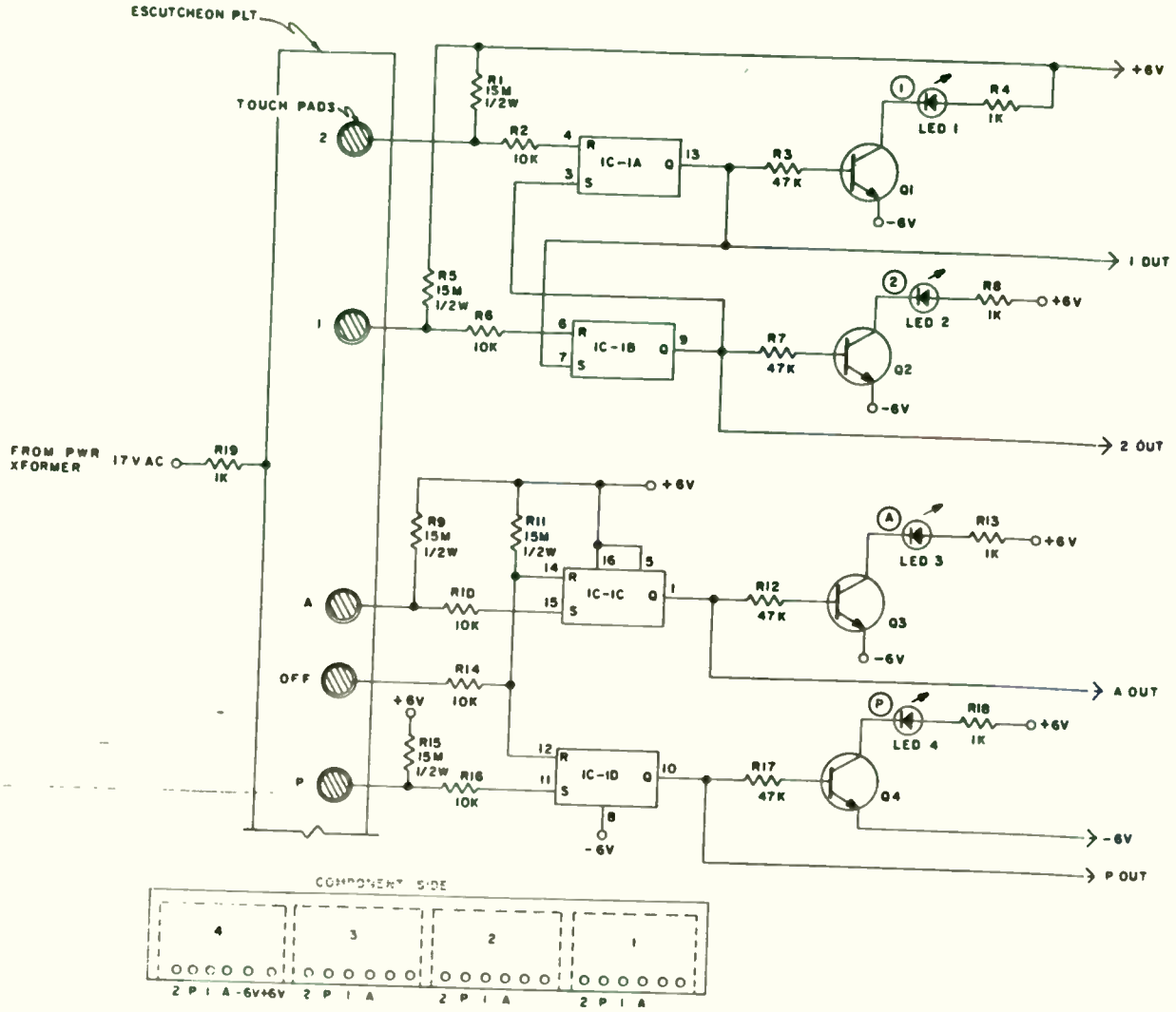






Impedance	600 Ohms		600 Ohms	
Loss, dB	R_1 Ohms	R_2 Ohms	R_1 Ohms	R_2 Ohms
0	0	∞	0	∞
0 1	3 58	50204	1 79	50204
0 2	6 82	26280	3.41	26280
0 3	10 32	17460	5 16	17460
0.4	13 79	13068	6 90	13068
0 5	17.20	10464	8 60	10464
0 6	20 9	8640	10 45	8640
0 7	24 2	7428	12 1	7428
0 8	27 5	6540	13 75	6540
0 9	31.02	5787	15 51	5787
1 0	34.5	5208	17 25	5208
1 5	51 8	3452	25 9	3452
2.0	68 8	2582	34 4	2582
2 5	85 9	2053	42 9	2053
3 0	102.7	1703	51 3	1703
3.5	119 2	1448	59 6	1448
4 0	135.8	1249	67 9	1249
4 5	152.2	1109	76 1	1109
5.0	168.1	987.6	84 1	987.6
5.5	184.0	886.8	92.0	886.8
6.0	199.3	803.4	99.7	803.4
6.5	214.6	730.8	107.3	730.8
7 0	229.7	685 2	114 8	685.2
7.5	244.2	615.6	122 1	615 6
8.0	258.4	567.6	129 2	567.6
8.5	272.3	525.0	136.1	525 0
9 0	285.8	487 2	142.9	487 2
9.5	298.9	453 0	149 5	453 0
10.0	312.0	421 6	156.0	421 6
11.0	336.1	367 4	168.1	367 4
12.0	359.1	321.7	179 5	321.7
13.0	380.5	282.8	190 3	282.8
14 0	400 4	249.4	200 2	249 4
15.0	418.8	220.4	209.4	220 4
16.0	435 8	195 1	217.9	195.1
17 0	451.5	172.9	225.7	172 9
18.0	465.8	152.5	232.9	152.5
19 0	479.0	136.4	239.5	136 4
20.0	490 4	121.2	245.2	121.2
22.0	511.7	95.9	255.9	95.9
24.0	528.8	76.0	264 4	76 0
26.0	542.7	60.3	271.4	60.3
28.0	554 1	47.8	277.0	47 8
30.0	563.0	37.99	281.0	37 99
32.0	570.6	30.16	285.3	30.16
34.0	576 5	23.95	288.3	23.95
36.0	581.1	18.98	290.6	18.98
38.0	585.1	15.11	292 5	15.11
40.0	588.1	12.00	294.1	12.00

ATTENUATOR NETWORK



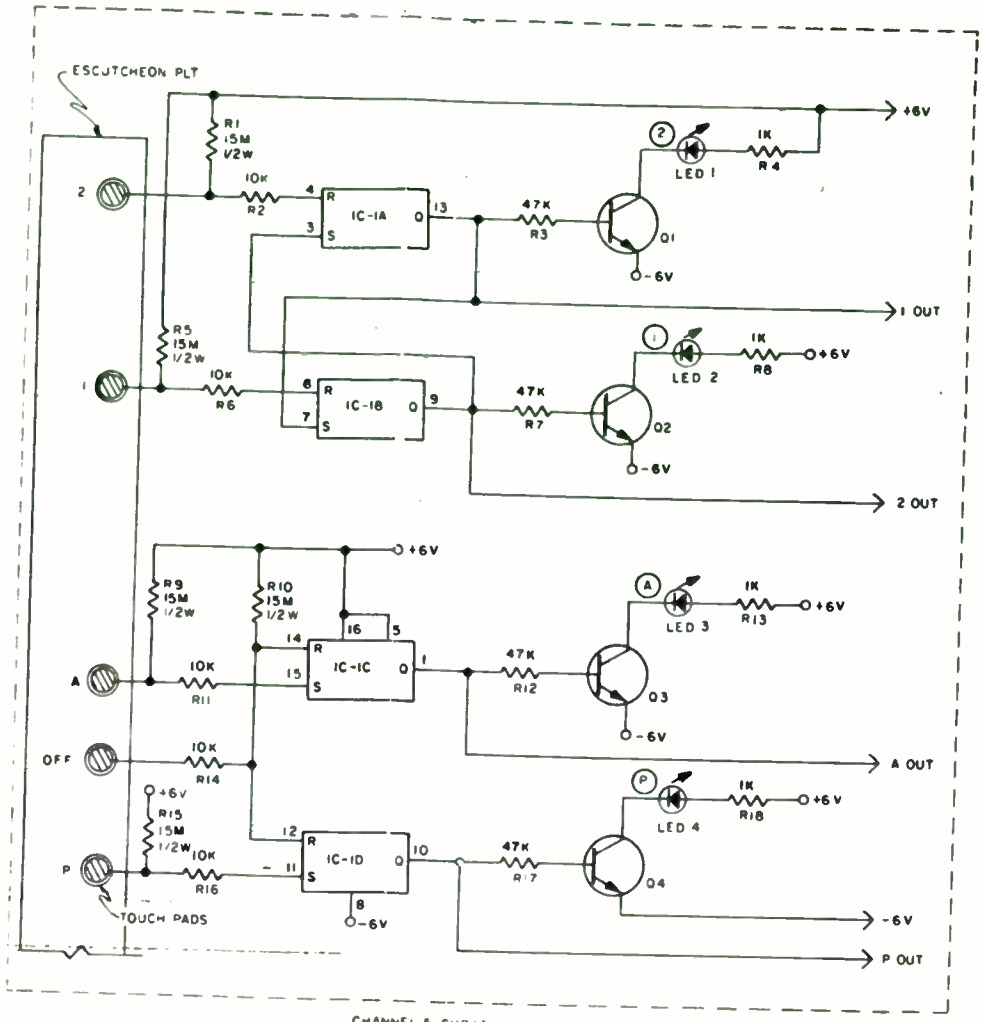
5 ONLY ONE OF FOUR CHANNELS SHOWN
4 IC-1 IS MCI4044B OR CD4044B
3 LED'S ARE MV5054-1
2 TRANSISTORS ARE 2N2222
1 RESISTORS ARE IN OHMS 1/4W ±5%

UNLESS OTHERWISE SPECIFIED

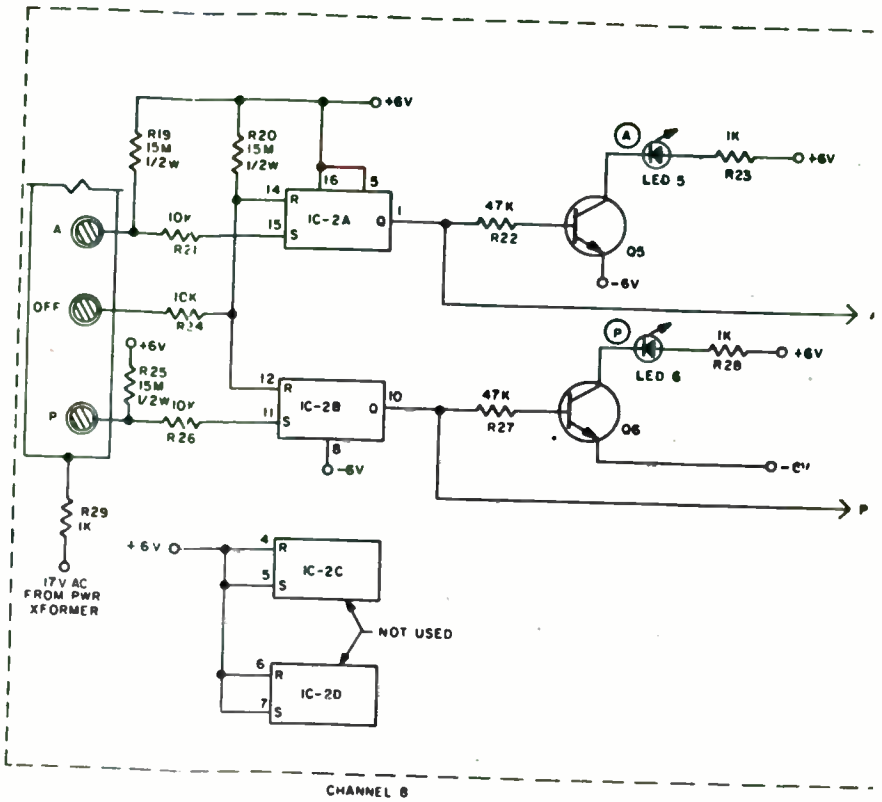
DC

TPC 1-4 (003-0096)

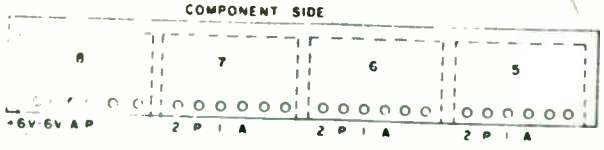
DUAL CHANNEL
TOUCH PAD CONTROL
CHANNELS 1 THRU 4
SCH NO. 999-0017
BRD NO 004-0096
DRAWN BY F WILCOX



CHANNEL 5 SHOWN
CHANNELS 6,7,8 IDENTICAL



CHANNEL 8



4 IC-1 & IC-2 ARE MC14044B OR CD4044B
3 LED'S ARE MV5054-1
2 TRANSISTORS ARE 2N2222
1 RESISTORS ARE IN OHMS 1/4W ±5%
UNLESS OTHERWISE SPECIFIED

DC
TPC 5-8(003-0097)

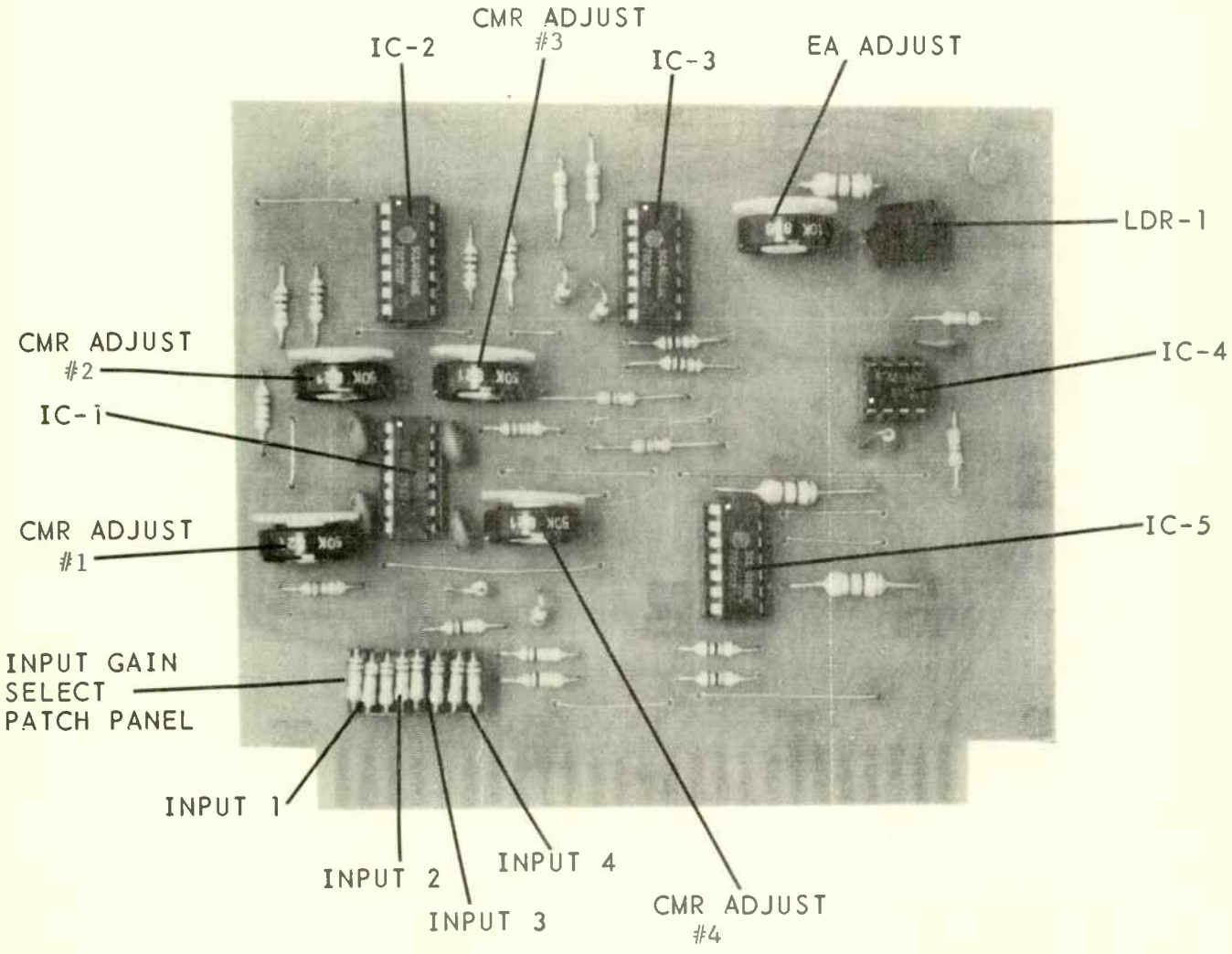
DUAL CHANNEL CONSOLE
TOUCH PAD CONTROL
CHANNELS 5 THRU 8
SCH NO 999-0019
BRD NO 004-0097
DRAWN BY F. WILCOX

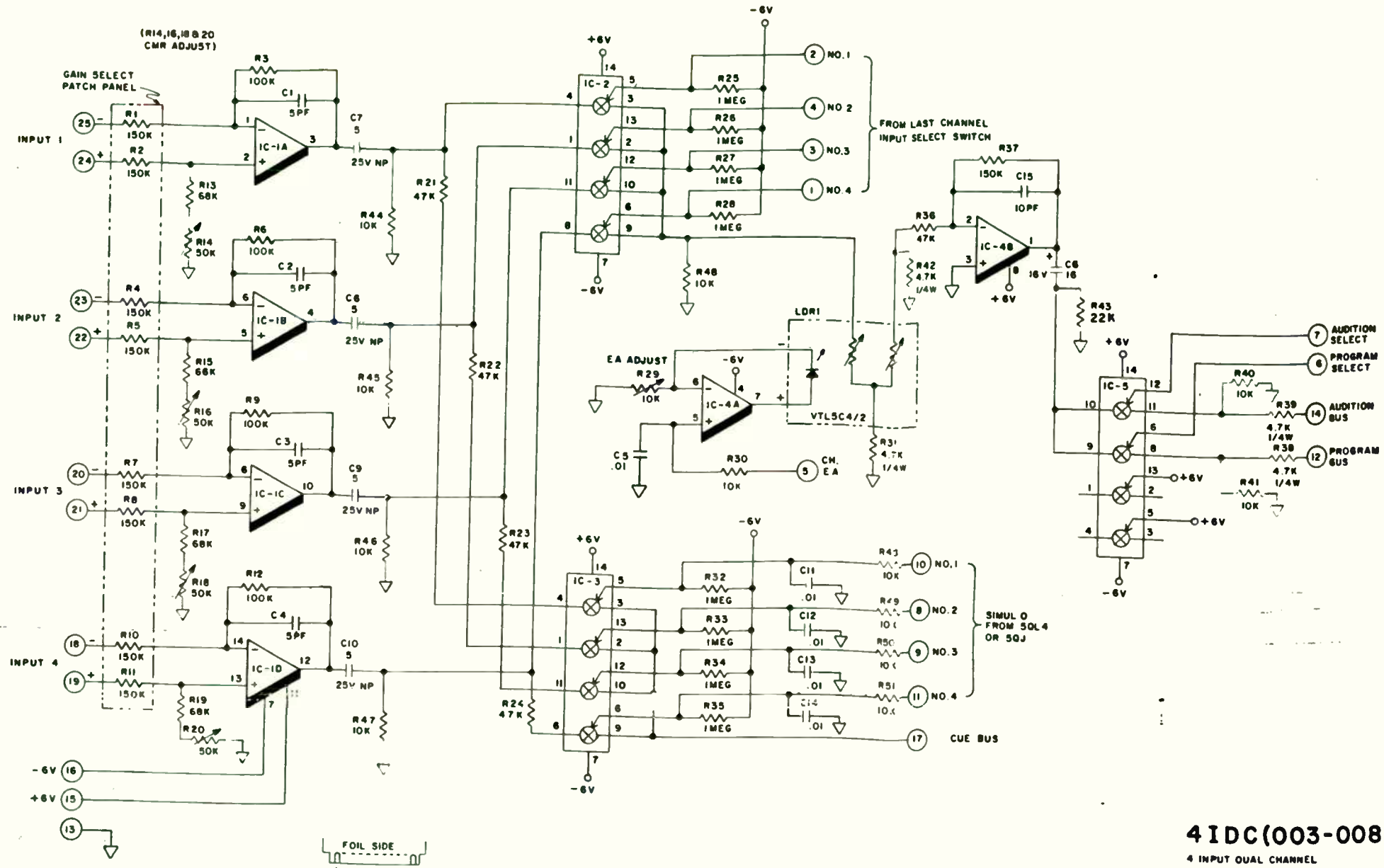
4IDC-FOUR INPUT DUAL CHANNEL PREAMP (003-0088)

This module contains four balanced inputs, SIMUL-Q cueing logic, input select logic, electronic mixing attenautor, and Aud/Prog/Off select logic for the last channel of your console.

After the input signal passes thru the GAIN SELECT PATCH PANEL and the balanced differential operational amplifiers it branches off to both IC-2 (input select gates) and IC-3 (cue select gates). The front panel input select rotary switch supplies +6V to the gates of IC-2 which in turn allows audio to pass thru LDR1 (electronic attenautor) thru IC-4B (buffer w/gain) and to IC-5 (pin #1 and pin #10). IC-5 taking its command signals from the front panel A/OFF/P touch pad then routes the desired audio to the Aud and/or Prog buss.

The signal that was branched to IC-3 is routed to the CUE BUSS upon command of the 4 momentary push buttons located on the front panel next to the rotary input select switch. It should be noted that any or all inputs may be cued up on the cue speaker and/or phones irregardless of which input of this channel is being aired. Your console comes standard with the SIMUL-Q switches in a momentary configuration. If a push on/push off latching action is desired, the SQ-4L option may be ordered from the factory and simply inserted into the edge connector in place of the SQJ printed circuit card currently installed.





8. IC-1 IS RC4136
4. IC-2, IC-3 & IC-5 ARE CD4016
3. IC-4 IS RC4558
2. CAPACITORS ARE IN MICRO FARADS 50V OR GREATER
1. RESISTORS ARE IN OHMS 5%, 8.2K OR GREATER 1/4W, LESS THAN 8.2K 1/2W UNLESS OTHERWISE SPECIFIED

4IDC(003-0088

4 INPUT DUAL CHANNEL PREAMP (MONO)

SCH NO. 999-0003-02
DRAWN BY F WILCOX
BRD NO. 004-0088

MPC - MUTE AND PHONES CONTROL

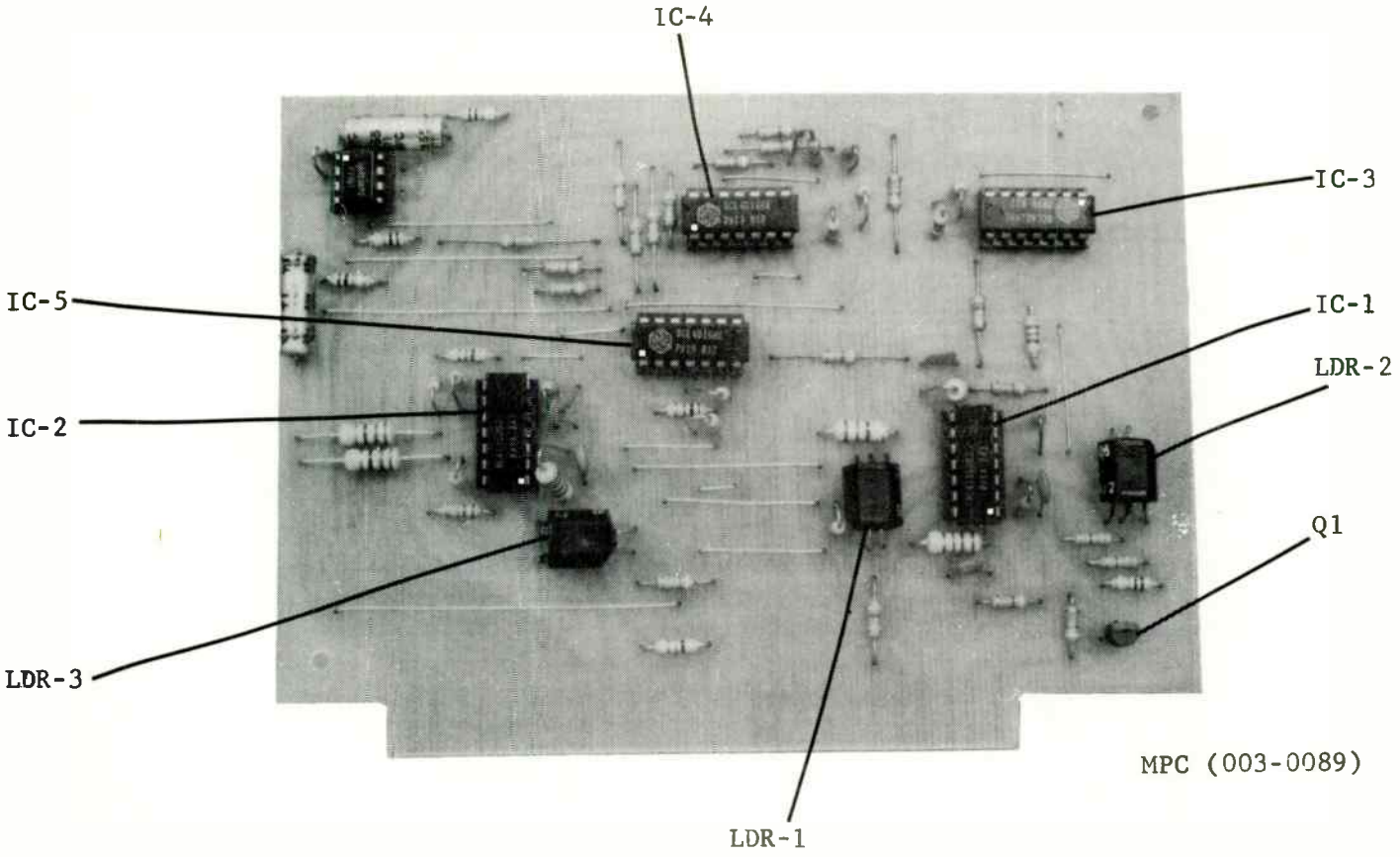
This module contains the electronic attenuators operated by the front panel MONITOR GAIN CONTROL, the CUE GAIN CONTROL and the PHONES GAIN CONTROL. Inaddition the MONITOR DRIVER, CUE DRIVER, PHONES OUTPUT, MAIN MUTE and all associated MONITOR SELECT and PHONES SELECT routing logic are contained on this card.

IC-1A is the MONITOR AMP driver/buffer used to drive both the UNMUTED MONITOR DRIVER output and the MONITOR GAIN CONTROL (electronic attenuator). The signals used to drive this section are derived to analog gates (pin #3 & #9) of IC-3 and on gate (pin #8) of IC-4. The switching voltages used to open these gates is the standard +6V and comes from the front panel MONITOR SELECT.

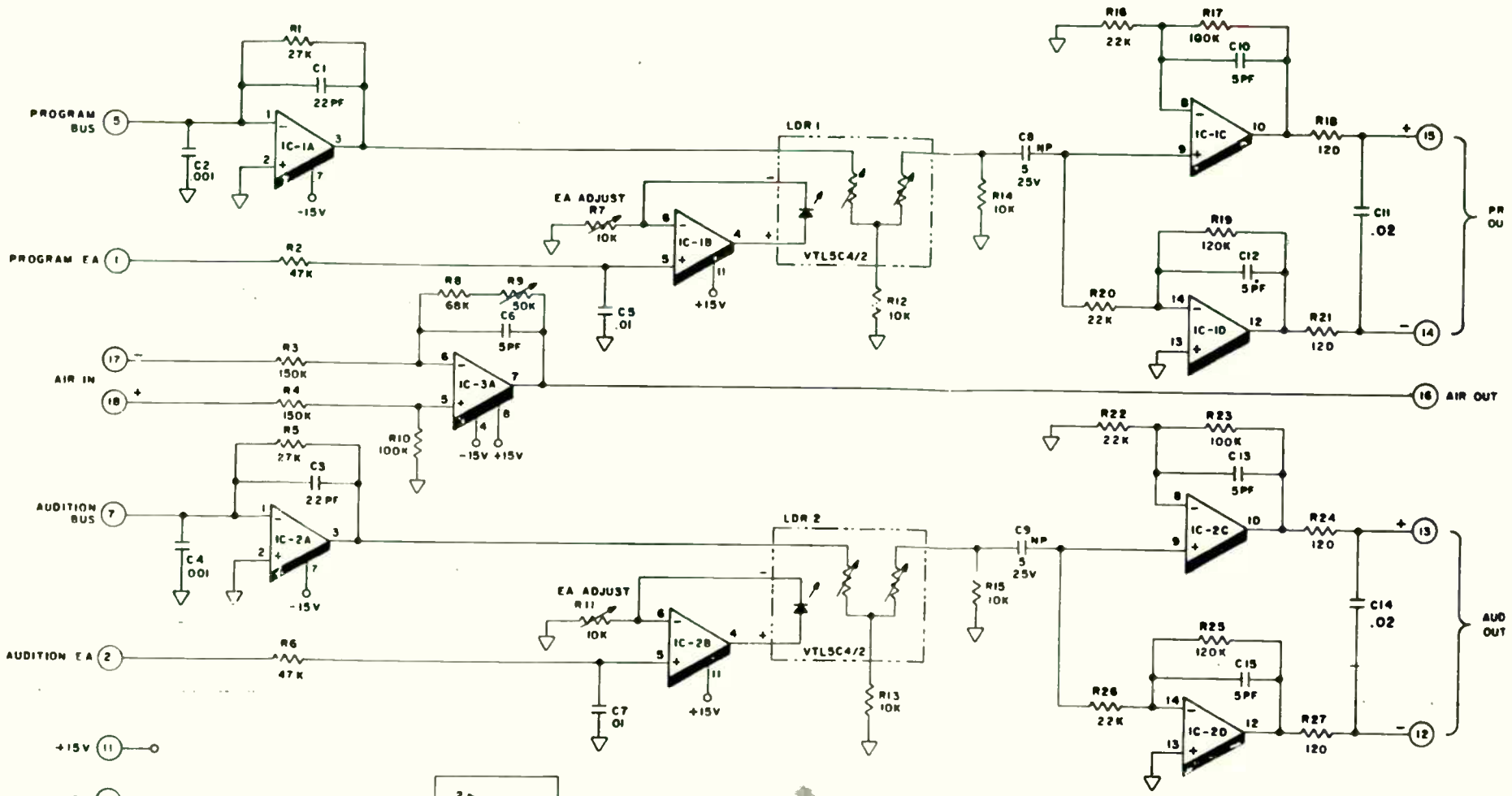
IC-2A is the PHONES driver/buffer used to drive the PHONES electronic attenuator which in turn feeds the dual (right & left) PHONES OUTPUT stage.

IC-2A derives its signal from analog gates IC-4 (pins #11, 2 & 4) and IC-5 (pin #8). The switching voltages used to open these gates is +6V and comes from the front panel PHONES SELECT switch.

IC-1C is the active mixing amp for the CUE buss which feeds the CUE GAIN electronic attenuator. This in turn feeds an analog gate IC-3 (pin #1) and from there goes to the CUE speaker amplifier on the MCA-3. The analog gate IC-3 (pin #1) is controlled by Q1 which when sensing a negative voltage aon the MUTE BUSS turns off, causing R7 to go to +6V thus turning the IC-3 gate on. NOTE that IC-1, IC-3, IC-4, IC-5 all have ±6V supplies while IC-2 uses ±15V.



MPC (003-0089)



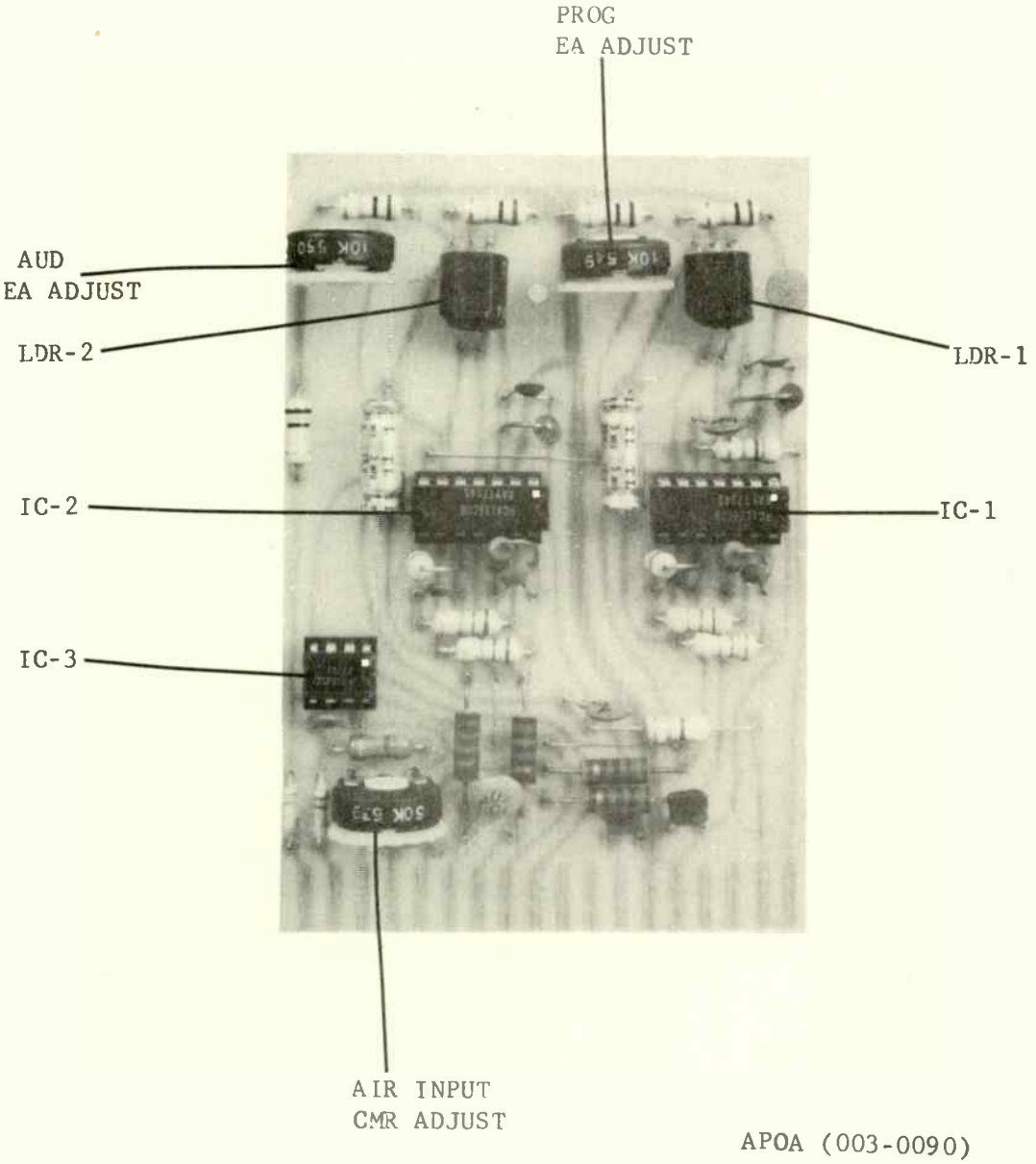
4 IC-3 IS RC4558
3 IC-1 & IC-2 ARE RC4136
2 CAPACITORS ARE IN MICRO FARADS, 50V OR GREATER
1 RESISTORS ARE IN OHMS 1/2W ±5%
UNLESS OTHERWISE SPECIFIED

APOA (003-0090)

AUDITION, PROGRAM, AIR OUTPUT
SCH NO. 999-0004-01
DRAWN BY F WILCOX
BRD NO 004-0090

APOA - AUDITION/PROGRAM OUTPUT AMPLIFIER

This module contains the circuitry of the AIR input, the PROG and AUD active mixing amplifiers, PROG and AUD electronic attenuators (controlled by the front panel master gain controls) and the solid state balanced outputs. Please refer to the theory section for a detailed explanation of the stages involved here.



APOA (003-0090)

MPC - MUTE AND PHONES CONTROL

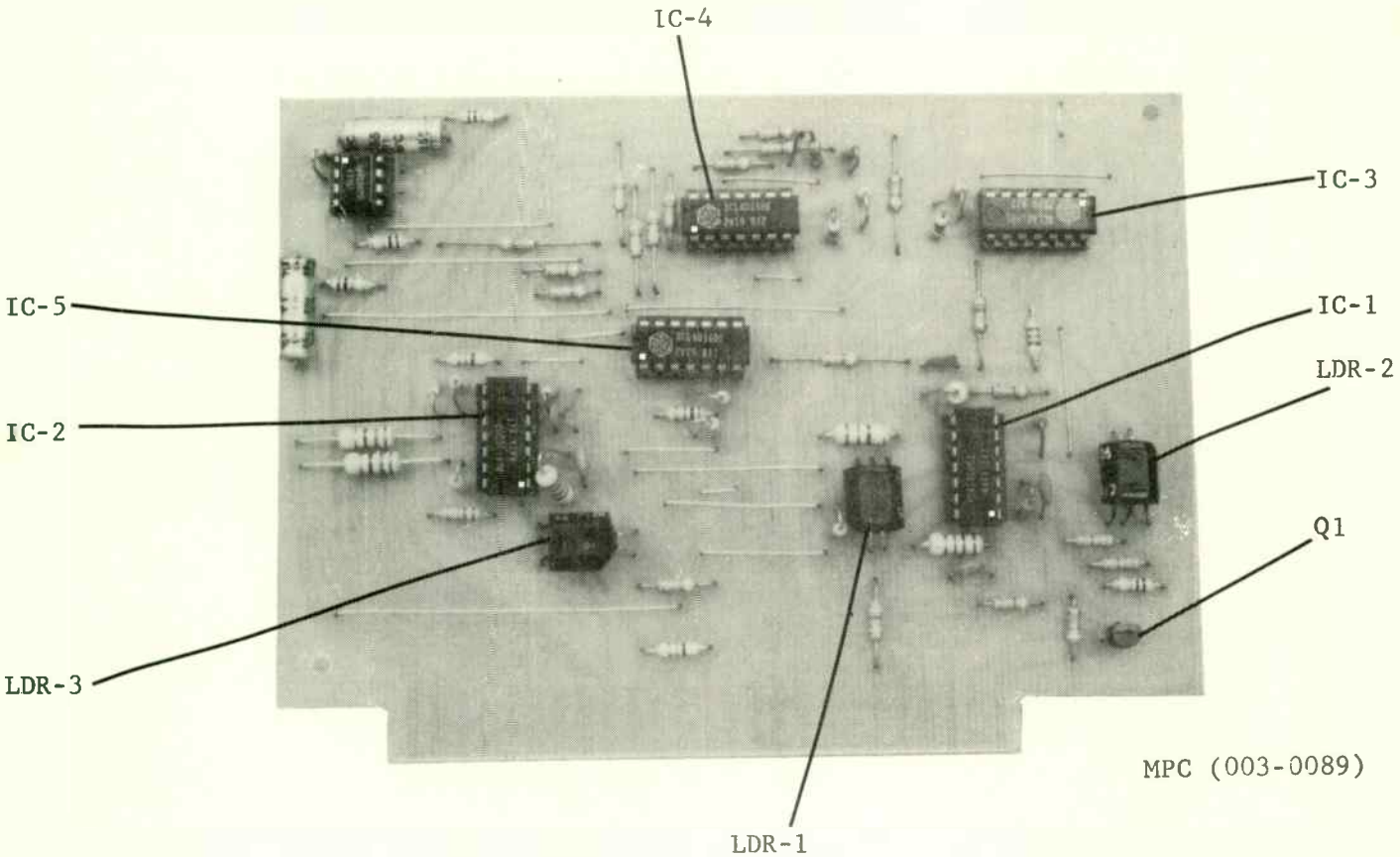
This module contains the electronic attenuators operated by the front panel MONITOR GAIN CONTROL, the CUE GAIN CONTROL and the PHONES GAIN CONTROL. Inaddition the MONITOR DRIVER, CUE DRIVER, PHONES OUTPUT, MAIN MUTE and all associated MONITOR SELECT and PHONES SELECT routing logic are contained on this card.

IC-1A is the MONITOR AMP driver/buffer used to drive both the UNMUTED MONITOR DRIVER output and the MONITOR GAIN CONTROL (electronic attenuator). The signals used to drive this section are derived to analog gates (pin #3 & #9) of IC-3 and on gate (pin #8) of IC-4. The switching voltages used to open these gates is the standard +6V and comes from the front panel MONITOR SELECT.

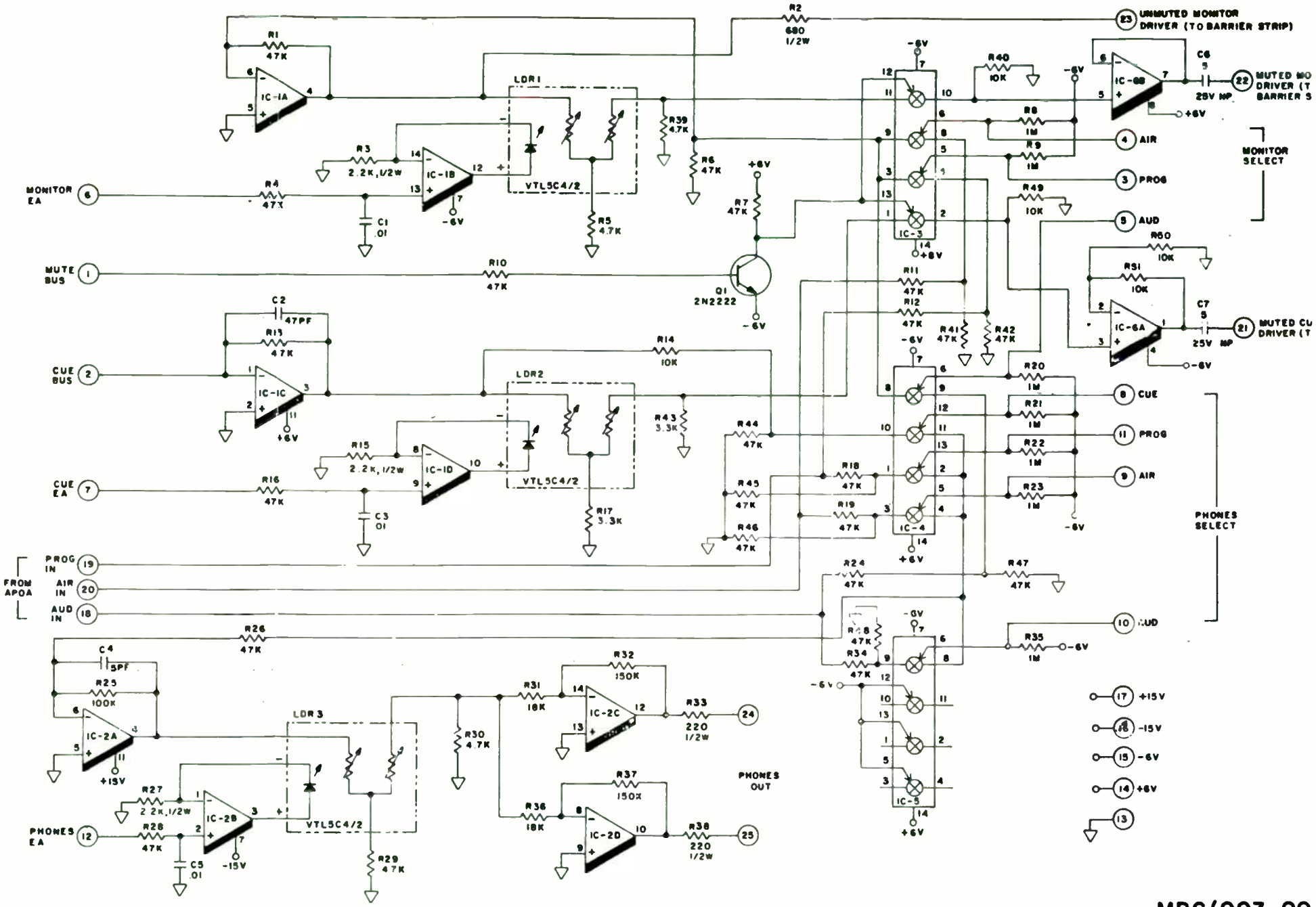
IC-2A is the PHONES driver/buffer used to drive the PHONES electronic attenuator which in turn feeds the dual (right & left) PHONES OUTPUT stage.

IC-2A derives its signal from analog gates IC-4 (pins #11, 2 & 4) and IC-5 (pin #8). The switching voltages used to open these gates is +6V and comes from the front panel PHONES SELECT switch.

IC-1C is the active mixing amp for the CUE buss which feeds the CUE GAIN electronic attenuator. This in turn feeds an analog gate IC-3 (pin #1) and from there goes to the CUE speaker amplifier on the MCA-3. The analog gate IC-3 (pin #1) is controlled by Q1 which when sensing a negative voltage aon the MUTE BUSS turns off, causing R7 to go to +6V thus turning the IC-3 gate on. NOTE that IC-1, IC-3, IC-4, IC-5 all have ±6V supplies while IC-2 uses ±15V.



MPC (003-0089)



5 IC-6 IS RC4558
4 IC-3,-4 & -5 ARE CD4016 OR SC4016
3 IC-1 & IC-2 ARE RC4136
2 CAPACITORS ARE IN MICRO FARADS 50V OR GREATER

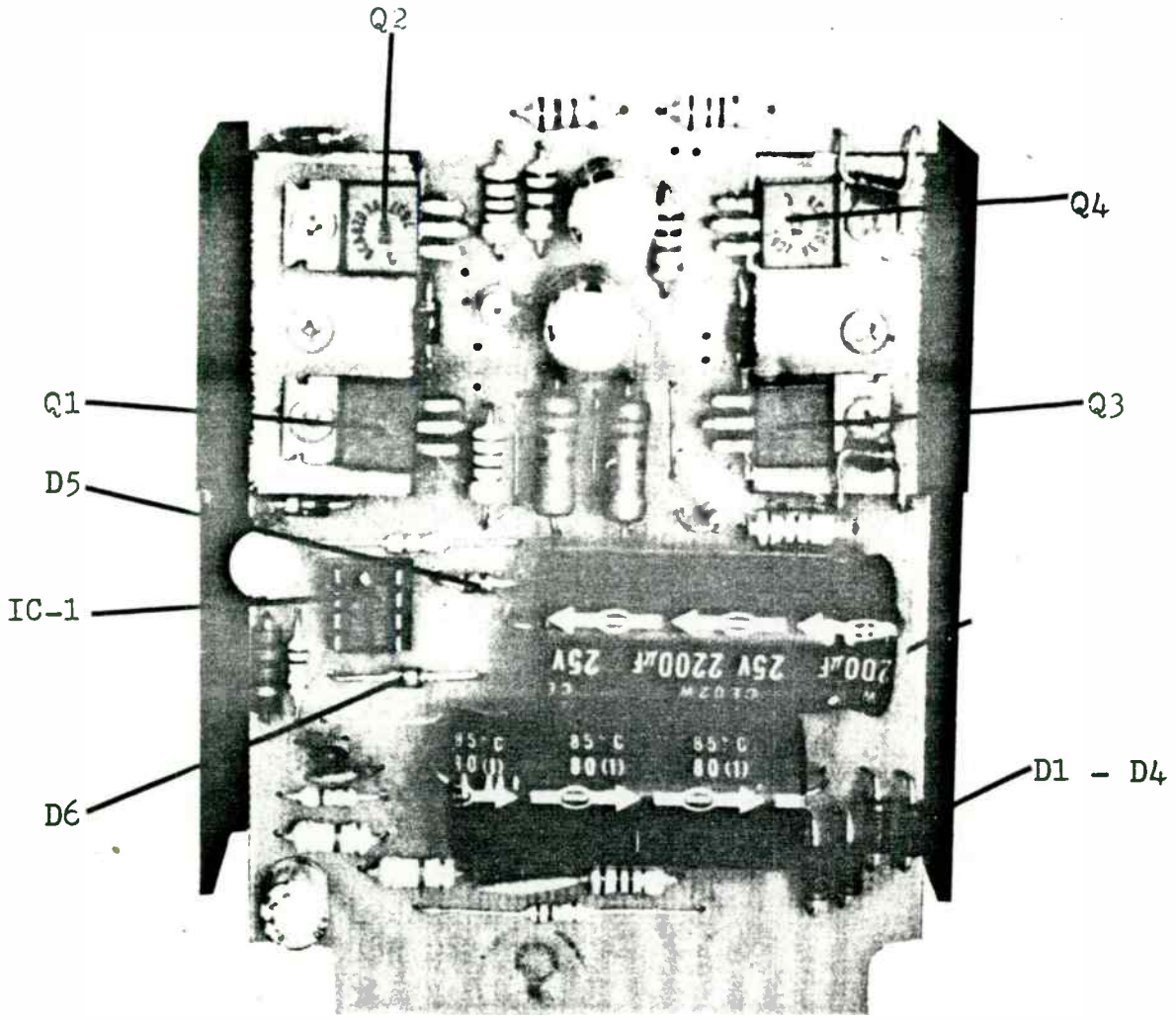
MPC1003-00

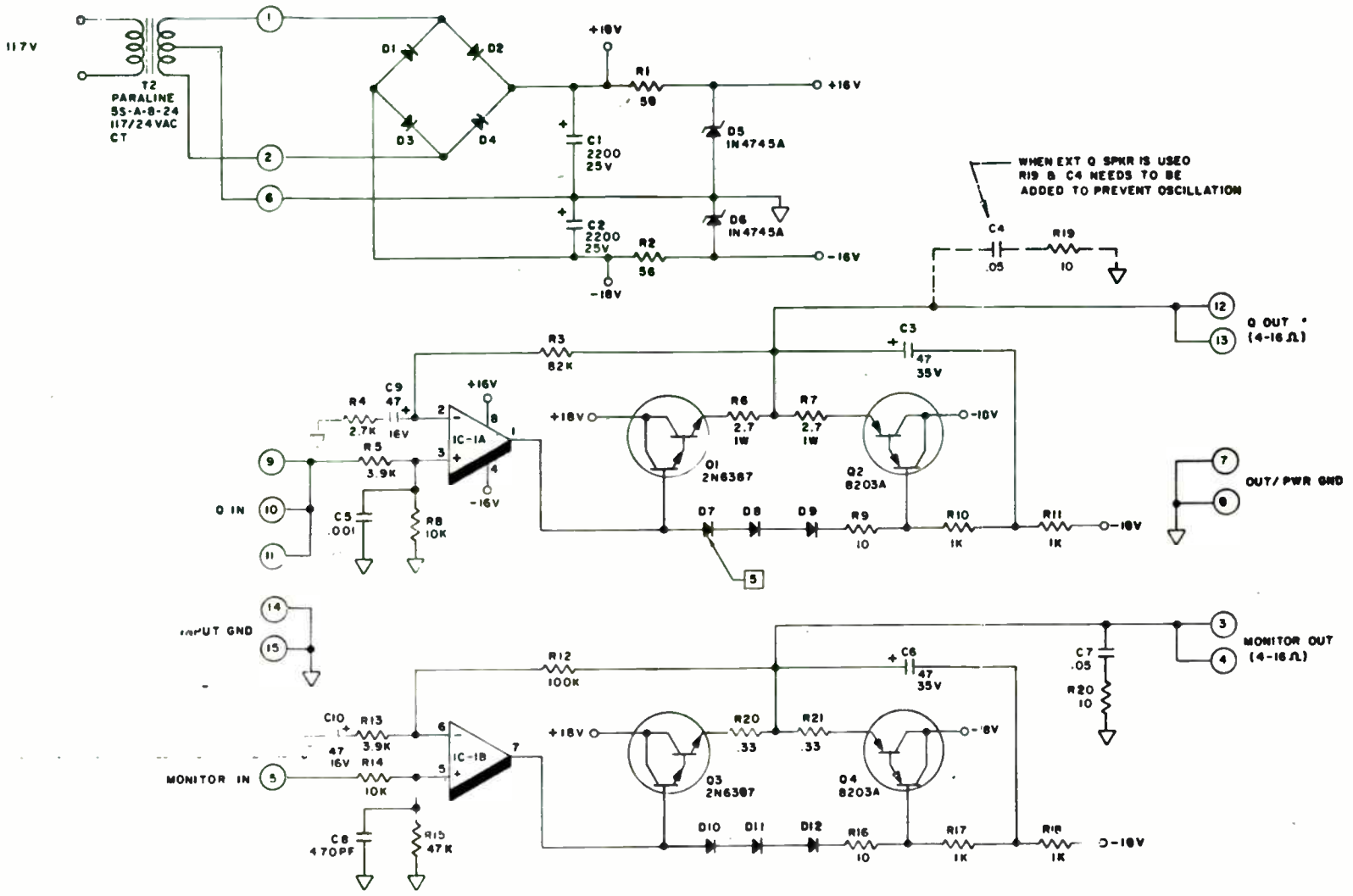
MUTE PHONES CONTROL

SCH NO. 999-0007-01
DRAWN BY F. WILCOX
BRD NO 004-0089-01

MCA-3 - MONITOR/CUE AMP

The MCA-3 consists of a dual power supply (±18VDC for the power output stages and regulated ±16 VDC for IC-1) and dual power amplifiers. The CUE SPEAKER amp consists of IC-1A and a pair of complimentary darlington power transistors. D7, D8, D9 & R9 comprise the biasing for the darlingtons and at the same time set the crossover point for min. distortion. R3 sets the voltage gain of this amplifier while R6 & R7 limit the power supplied to the CUE speaker. C4 & R19 at the output insure stability when working into a highly reactive load. The MONITOR SPEAKER amp is identical in function to the CUE amp with the exceptions being higher gain and the elimination of the two 2.7 ohm limiting resistors.





FOIL SIDE

5 D7 THRU D12, ARE IN4002, D8 & D11 MUST BE IN THERMAL CONTACT WITH HEAT SINK
D7,D9,D10 & D12 MUST BE IN THERMAL CONTACT WITH TRANSISTOR TAB
4 Q1 THRU Q4, HEP170 OR 3 AMP 200 PIV
3 IC-1, RC4558 OR UA4558 OR TL072CP
2 RESISTORS ARE IN OHMS & 2K OR GREATER 1/4W, ±5% LESS THAN 8.2K 1/2W ±5%
1 CAPACITORS ARE IN MICRO FARADS, 50V OR GREATER

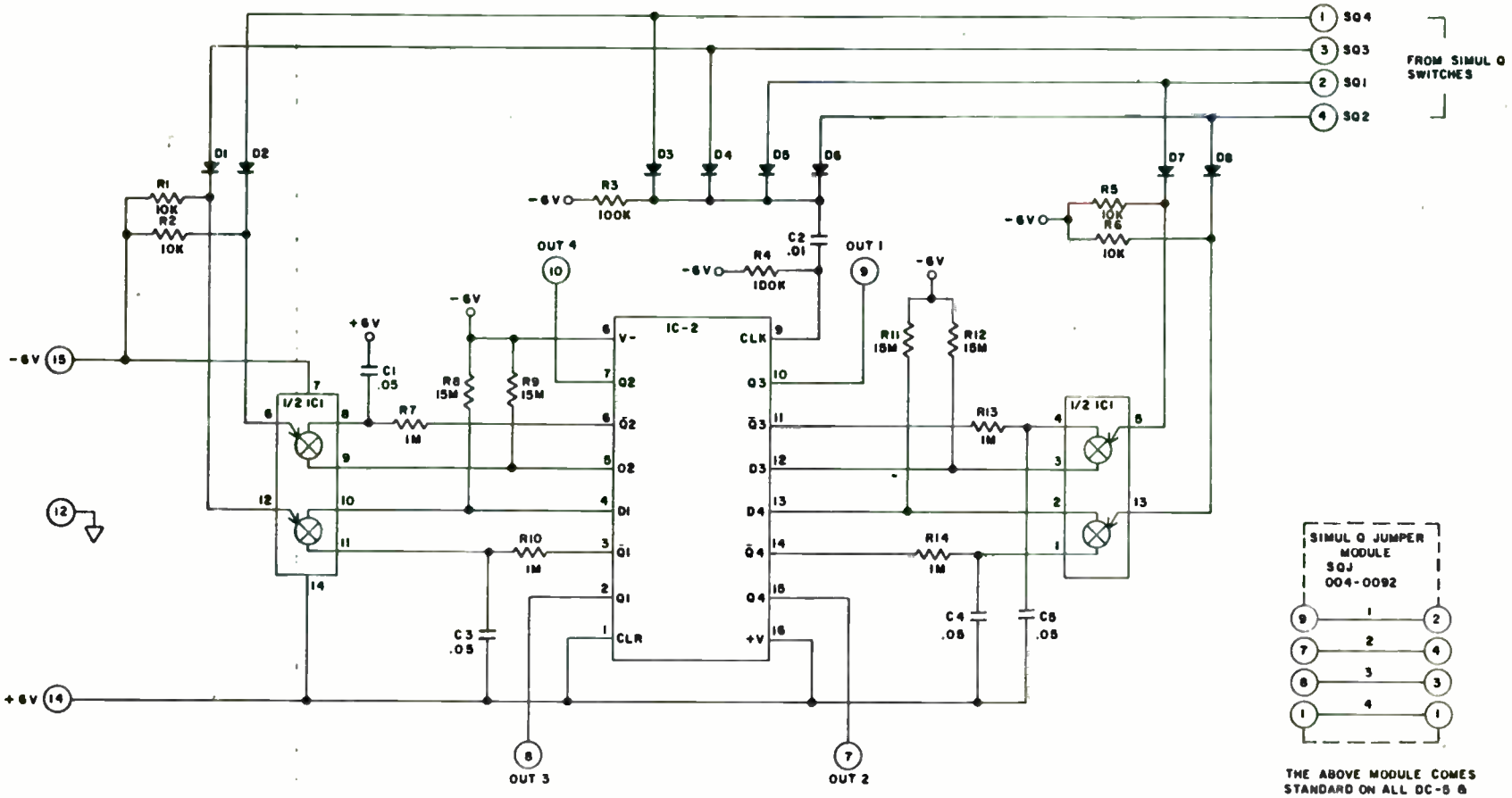
UNLESS OTHERWISE SPECIFIED

MCA-3(003-0

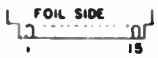
5 WATT MONITOR AMP
2 1/2 WATT Q AMP

SCH NO. 999-0006-02

DRAWN BY F WILCOX
BRD NO. 004-0051-03



THE ABOVE MODULE COMES STANDARD ON ALL DC-8 & DC-8 CONSOLES



6. THE SQL4 BRD IS AN OPTION, SQJ BRD IS NORMALLY SUPPLIED
5. IC-2 IS MM54C175 OR 4017S QUAD LATCH
4. IC- IS CD4016 OR SC4016
3. DIODES ARE IN914 OR IN4148
2. CAPACITORS ARE IN MICRO FARADS, 50V OR GREATER
1. RESISTORS ARE IN OHMS 1/2W ± 5%

UNLESS OTHERWISE SPECIFIED

SQL4 (003-0091) OPTIONAL

SIMUL Q LATCHING MODULE

SCH NO. 999-0011

DRAWN BY F WILCOX

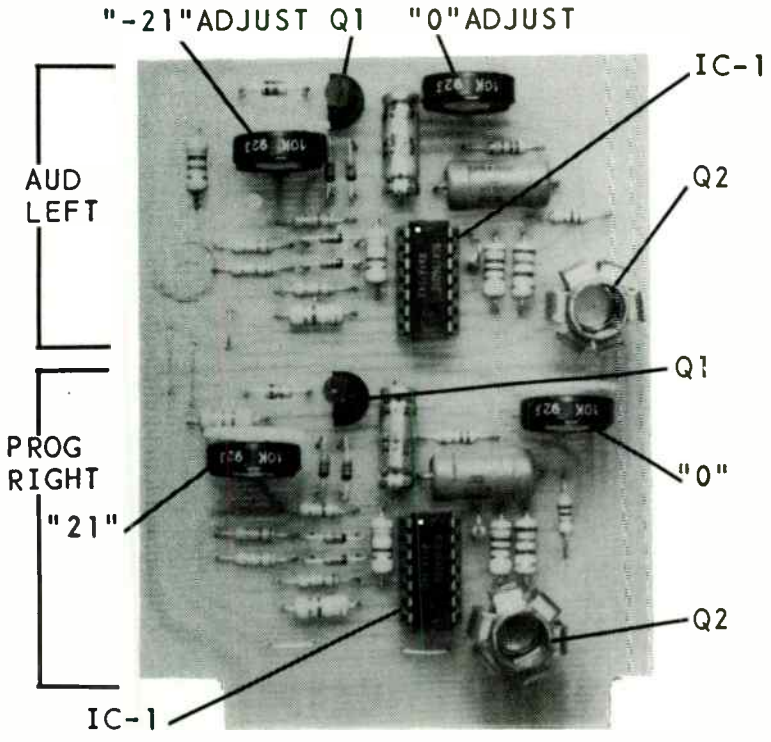
BRD NO. 004-0091

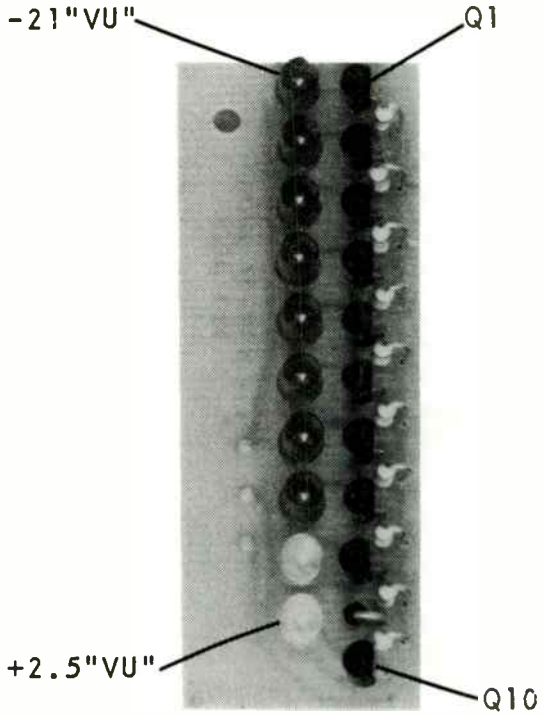
SSM-2E - SOLID STATE METER (003-0094)

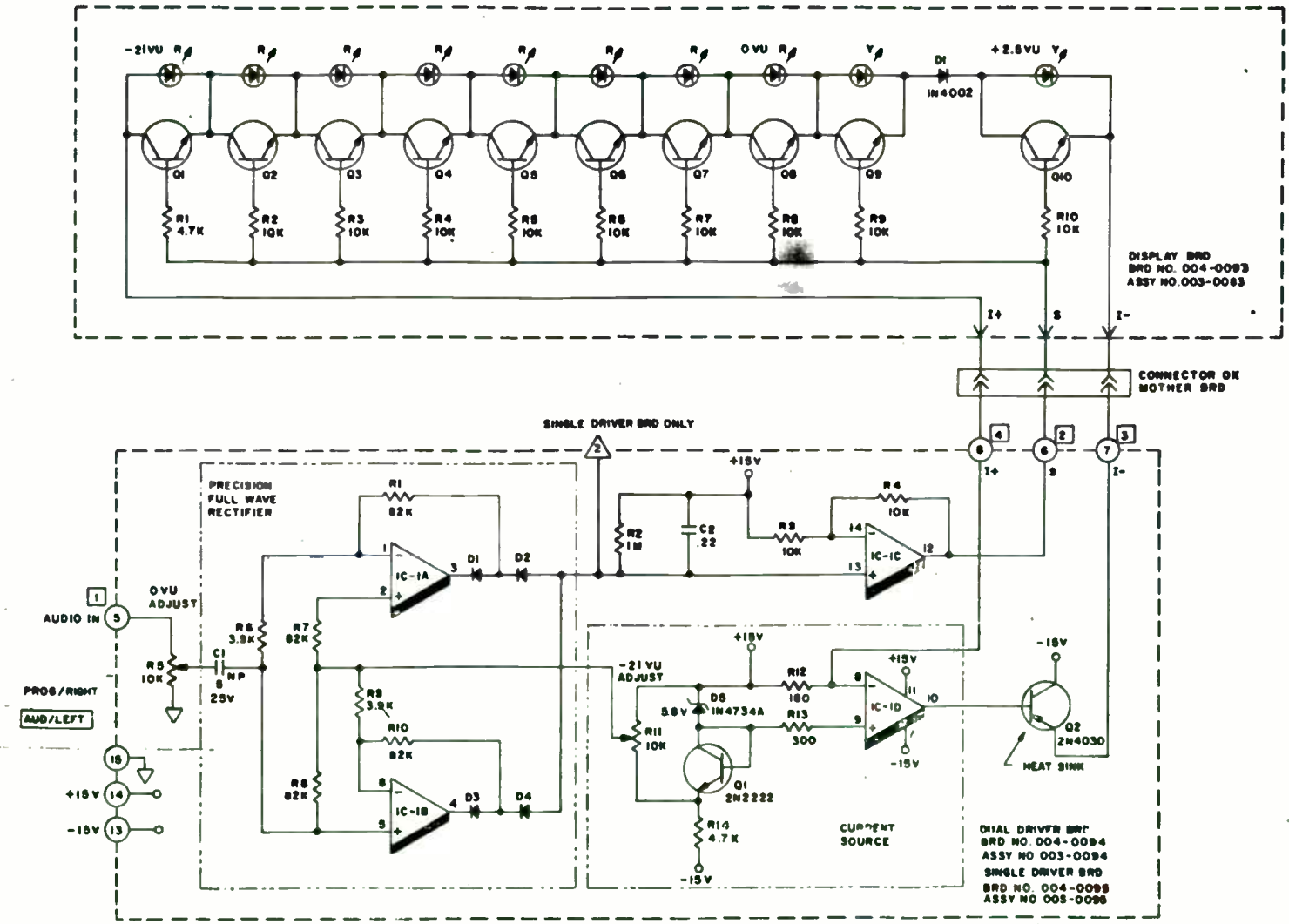
The SSM-2 consists of two seperate modules. The dual meter driver (plug in module) and the dual display board mounted on the front panel.

The solid state meter consists of 6 different functional circuits. (1) The precision full wave rectifier (IC-1A & IC-1B); (2) the display delay network (1 meg & .22uf) which affords fast attack and slow decay; (3) the temperature compensated voltage reference (2N3565 & 5.6V zener); (4) the constant current generator (IC-1D)/ (5) the transistor switches (IC-1C)/ (6) the display itself (10 transistors and 10 LEDS).

The first thing to remember is that in the no signal state all display LEDS are shorted out by the parallel transistors. These transistors are all conducting until a signal comes along and one by one are turned off. When the transistors turn off, this short is essentially removed thus allowing the LEDS to light. The second thing to keep in mind is the constant current generator IC-1D and the + & - inputs of the IC are connected across the 5.6V zener, the current thru the LEDS and transistors will always be the same. Thus the display intensity will remain constant regardless of whether only 1 LED is on or all are on. Let's now go back and trace a signal thru. IC-1B and IC-1A comprise the negative going full wave rectifier. This rectifier converts the audio signal into negative pulses which in turn drive IC-1C. This non inverting amp in turn has a negative going output that sequentially turns off the bases of the display transistors. Although this sequence of events has been designed for virtually instantaneous attack time it is immediately apparent that it would be undesirable for it to work the other way. That is, for the display to exhibit an instantaneous release time. If this were the case, you find that many transients would come and go so fast that although the meter would track them they would be so fast that the eye would never see them. Therefore the 1 meg & .22uf cap charging network which gives the meter a decay period of about 1/3 of one second. Thus zippity-zap on the way up & "VU" balistics on the way back.







SSM-2E/SSM-

SOLID STATE METER
(DISPLAY & DRIVER)

SCH NO. 999-0008-02

DRAWN BY F.WILCOX

8. ONLY ONE CHANNEL OF DRIVER & DISPLAY SHOWN SECOND CHANNEL DRIVER CONNECTIONS DESIGNATED BY BOXED NUMBERS
7. TRANSISTORS ARE 2N2222
6. YELLOW LEDS ARE XC556Y OR MV5053
5. RED LEDS ARE XC556R OR MV5054-1
4. DIODES ARE IN914 OR IN4148
3. IC-1 IS RC4136
2. CAPACITORS ARE IN MICRO FARADS 50V OR GREATER
1. RESISTOR ARE IN OHMS 1/4W ±5% ON DISPLAY, 1/2W ± 5%-ON DRIVER.

UNLESS OTHERWISE SPECIFIED

FOIL SIDE

DC-TPC - DC TOUCH PAD CONTROL

The console front panel touch pad control was designed to insure totally quiet and maintenance free operation. The metal touch pads operate on a combination of your skin resistance and capacitance. The black escutcheon plates mounted on the console fron panel consists of an insulating material (closest to metal front panel) and a copper plate coated with a dark brown synthetic material. The copper plate carries 17 VAC and is supplied via an isolation resistor from the isolated power transformer secondary. When your finger is applied to the touch ring the voltage from the escutcheon plate is transferred to this ring; which is connected thru a 10K input protection resistor, to one input of a 4044 quad latch IC.

Referring to your TPC schematic you will see that the 4044 quad latch is used in 2 different ways. One is a 2 state only circuit for the 1 & 2 input select. The other is a 3 state Audition, Program and Off circuit.

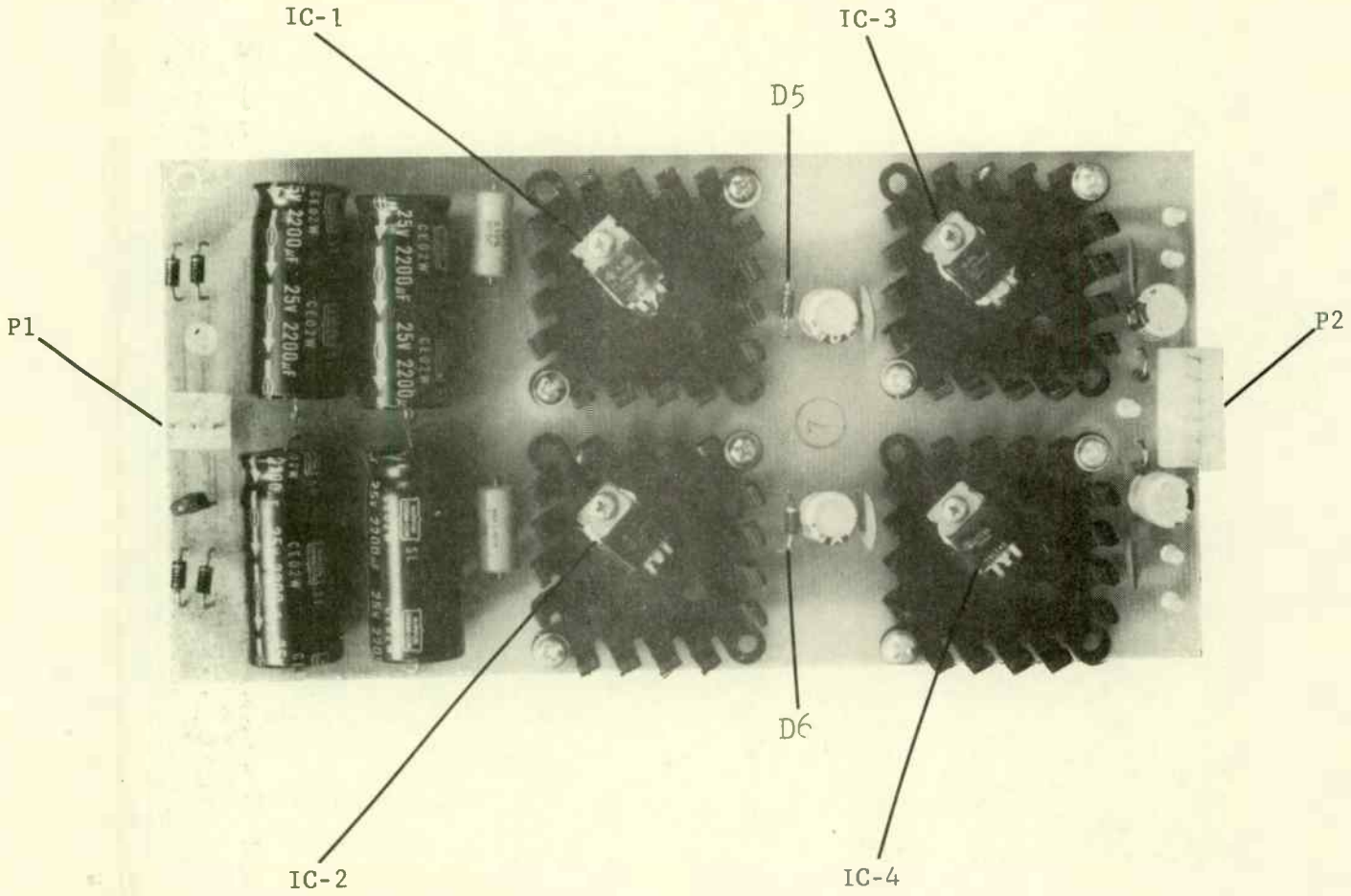
Let's take the input 1 & 2 select first. Since the circuit cannot be in two states at once let us assume the input #1 is on. Thus pin #13 of IC-1A will be +6V and the "1 out" terminal will be +6V. The output of IC-1B will be -6V (pin #9) and the "2 out" terminal will be -6V. If we now touch, TOUCH PAD #2 "R" of IC-1A goes low (-6V), "S" of IC-1A is already low, so therefore "Q" of IC-1A goes low. When the output of IC-1A goes low so does "S" of IC-1B. Since "R" of IC-1B is a +6V and "S" is now -6V the output of IC-1B now goes high (+6V). Thus the circuit has changed state.

The 3 state circuit is somewhat different in that the two latches act independently except for "OFF". Keep in mind that touching a "TOUCH PAD" causes that terminal to go low. Since both "R" terminals are held high (+6V) touching the PAD causes the "S" terminal to go low and as can be seen by the truth table causes this latches output to go high. Thus you will note that either A or P may be turned on separately or both simultaneously. Touching the OFF PAD causes both "R's" to go low and since both "S's" are high, both latches will go low (off).

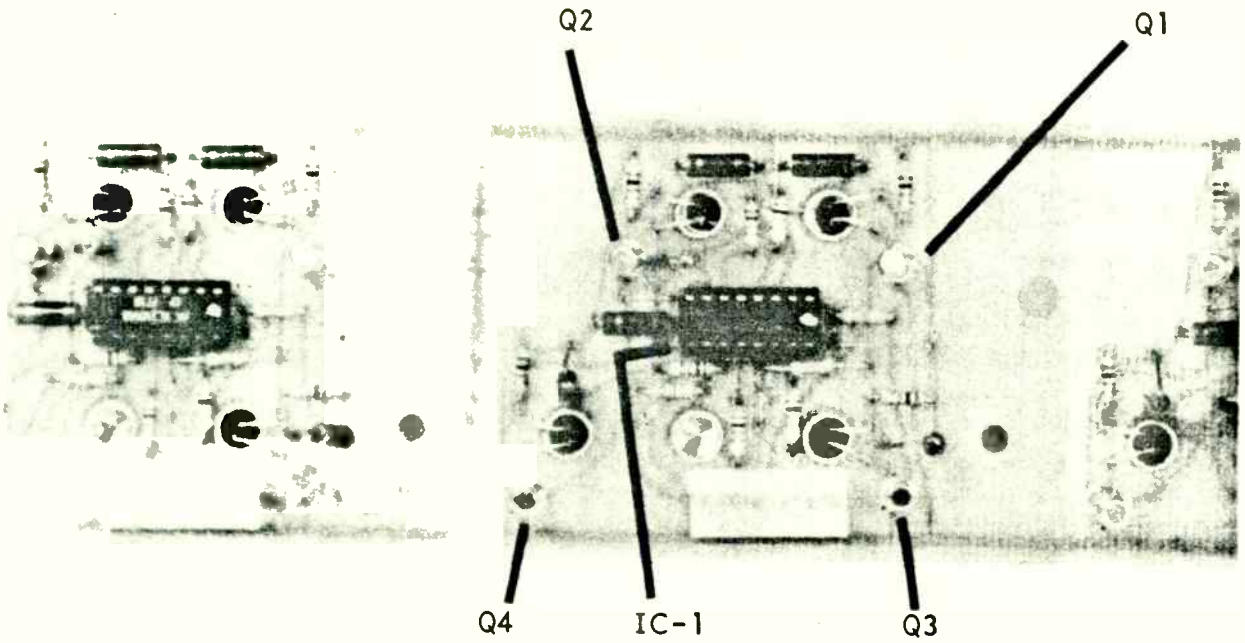
DPS-3 - DUAL POWER SUPPLY (003-0086)

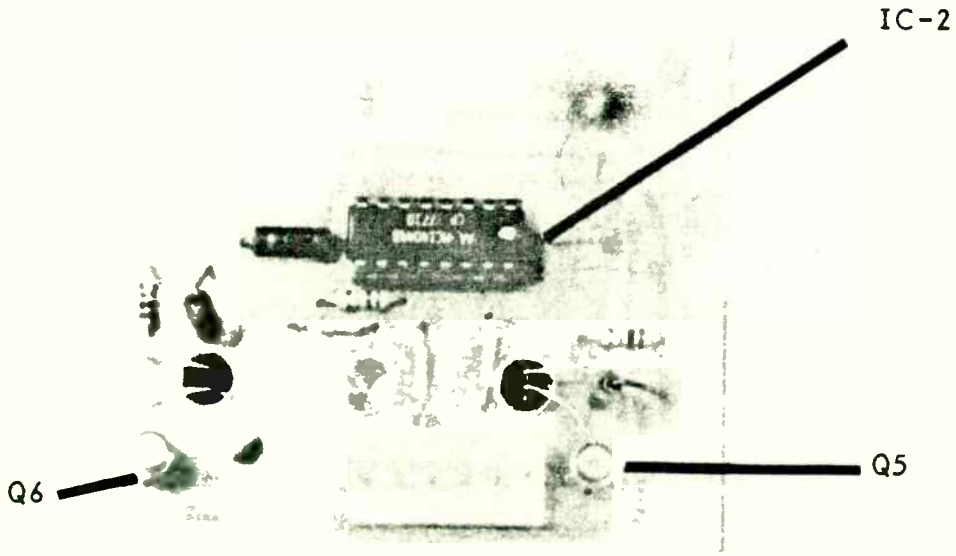
The DPS-3 is a dual ±15VDC and ±6VDC supply. All circuitry in the console is supplied by this unit with the exception of the MCA-3 which has its own transformer (T2) and rectifier/filter section.

The DPS-3 receives its power from T1, is full wave rectified and then filtered by C1 & C2. The plus 22 volts across C1 is fed to IC-1 which provides a highly regulated plus 15VDC. This in turn feeds IC-3 which provides a highly regulated plus 6 volts out. IC-2 and IC-4 accomplish the same thing but are minus 15VDC and minus 6VDC regulators in that order. All capacitors with the exception of C1 & C2 are for power supply stability. Without these caps the supply would tend to oscillate. D5, D6, D7, and D8 are protection diodes and are designed to keep any of the supply voltages from momentarily reversing below ground and damaging the console electronics. RV1 across the rectifiers input is a metal oxide varistor and is an AC line transient protection device. Any spikes or steady voltages above 36 volts AC are instantaneously shorted out.



PARTIAL PICTORIAL





CHANNEL #5 (DC-5M, DC-5MS)
CHANNEL #8 (DC-8M, DC-8MS)

TERMS AND CONDITIONS OF SALE

CREDIT TERMS: Open account shipments will be made to all firms approved by RAMKO. A minimum of 3 business references and your bank will be required before an open account may be established. All other orders will be shipped only with payment in advance or C.O.D. C.O.D. orders require 20% payment in advance unless customer is well known to us. Payment terms are net 20 days on open accounts. A finance charge of 1½% per month (annual = 18%) may be levied on past due accounts. All sales on open accounts are subject to approved by RAMKO RESEARCH.

SHIPMENTS: All shipments are F.O.B. Rancho Cordova, Calif. Accessories and other items not manufactured by RAMKO may be drop shipped F.O.B. vendors plant. Unless specifically stated by the buyer, we will exercise our best judgment as to method of shipment. A full range of shipping services are available.

TWO WEEK FREE TRIAL PERIOD: All items manufactured by Ramko Research are offered for evaluation on a free 2 week trial basis with prior credit approval. The trial period begins upon customers receipt of item. Any extended use will be subject to a restocking charge. Customer is responsible for shipping charges.

RETURN OF GOODS: Equipment in "like-new" condition of current manufacture may be accepted for return within 90 days of purchase subject to a 15% restocking and handling charge. (Exception-see 2 week free offer). Liability for a safe, insured, prepaid return rests with the shipper. Do not return any equipment without prior approval from the customer service department.

RETURN FOR REPAIR: If the need for a replacement unit or repair should arise return authorization numbers must be obtained from Ramko prior to returning merchandise.
Upon receipt of outhorization the following proceedure should be followed:

1. Package carefully
2. Insure for full value
3. Mark authorization number on outside of shipping container
4. Ship to: Ramko Research Inc., 11355 "A" Folsom Blvd., Rancho Cordova, Calif 95670
5. Prepay shipping. Collect shipments will NOT be accepted. We suggest you use United Parcel Service wherever available.

LEASING: Leasing and time payment plans on request. Please contact us for details.

TELEPHONE SERVICE: Our telephone number is (916) 635-3600. Feel free to call collect for technical assistance or to place an order.

WARRANTY: All equipment designed and manufactured by RAMKO RESEARCH INC. is warrantied against defects in workmanship and material that develop under normal use within a period of 2 years(4 years on some items) from the date of original shipment, so long as the purchaser is not in default under his contract of purchase and subject to the following additional conditions and limitations:

1. The sole responsibility of RAMKO RESEARCH INC. for any equipment not conforming to this warranty shall be, at its option:
   A. To repair or replace such equipment or otherwise cause it to meet the represented specifications either at the purchaser's installation or upon the return thereof f.o.b. Rancho Cordova, Calif., as directed by RAMKO;or
   B. To accept the return thereof f.o.b. Rancho Cordova, Calif., credit the purchaser's account for the unpaid portion, if any, of the purchase price theretofore paid; or

C. To demonstrate that the equipment has no defect in workmanship or material and that it meets the represented specifications, in which event all expenses reasonalby incurred by RAMKO, in so demonstrating, including but not limited to costs of travel to and from the purchaser's installation and subsistance, shall be paid by purchaser to RAMKO.

2. In case of any equipment thought to be defective, the purchaser shall promptly notify RAMKO giving full particulars as to the defects. RAMKO will give instructions respecting the shipment of the equipment, or such other manner as it elects to service this warranty as above provided.

3. This warranty extends only to the original purchaser and is not assignable or transferable, does not extend to any equipment which has been subjected to abuse, misuse, physical damage, alteration, operation under improper conditions or improper installation, use or maintenance, and does not extend to equipment not manufactured by RAMKO, and such equipment is subject to only such adjustments as are available from the manufacturer thereof.

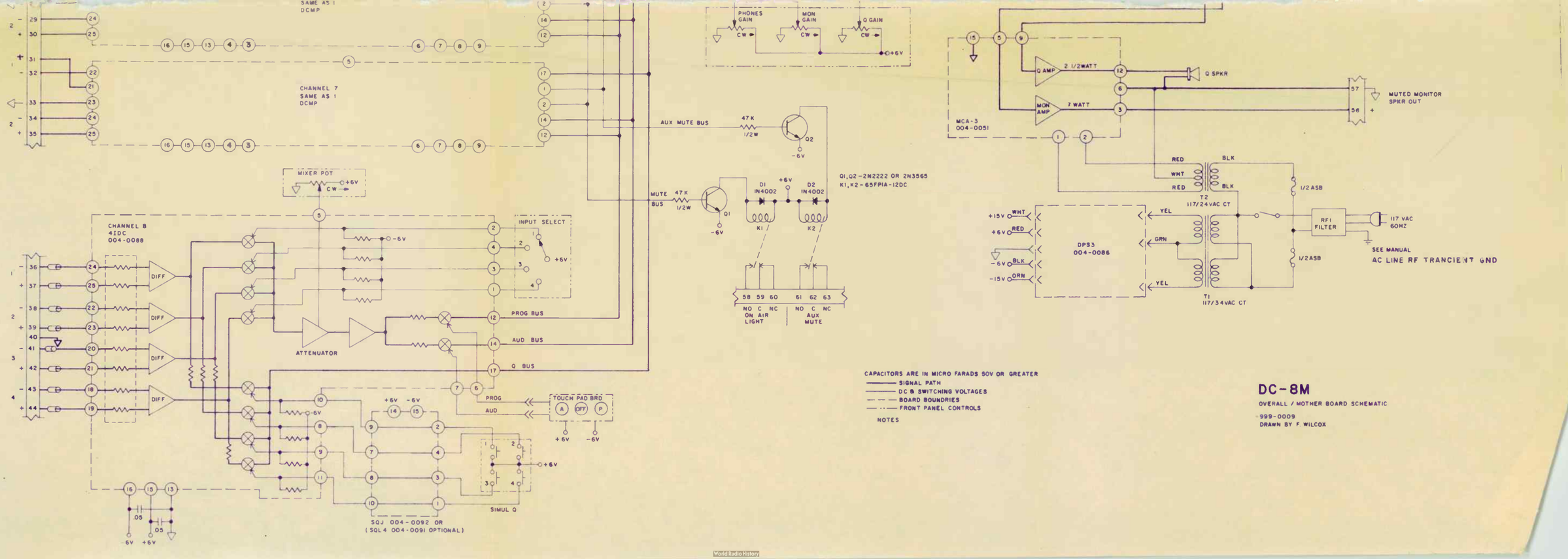
4. No other warranties, express or implied, shall be applicable to any equipment sold by RAMKO and no representative or any other person is authorized to assume for it any liability or obligation with respect to the condition or performance of any equipment sold by it, except as provided in this warranty. This warranty is the sole right and remedy of the purchaser and RAMKO shall in no event have ony liability for consequential damages or for loss, damage or expense direct or indirectly arising from the use of equipment purchased from or manufactured by RAMKO RESEARCH.

5. All claims for shortages or damaged merchandise must be made directly with the carrier within 5 days of receipt. Notify Ramko within the same period of time. Freight companies and carriers are quite strict with reference to claims and if not notified within 5 days, claims will be disallowed.

6. Warranty parts, loaner units, etc., will be billed to the customer and credit will be issued upon receipt of defective parts. All loaner units, units for repair, and defective parts shipped to the factory must be sent freight prepaid. Ramko will ship loaner units, repair parts, and return repaired units freight prepaid.

When ordering parts/components, etc., please have the serial number(s) of the unit(s) in question along with the date of purchase due to design changes.

Minimum billing is $5.00.



CAPACITORS ARE IN MICRO FARADS 50V OR GREATER

- SIGNAL PATH
- DC & SWITCHING VOLTAGES
- BOARD BOUNDRIES
- FRONT PANEL CONTROLS

NOTES

DC-8M

OVERALL / MOTHER BOARD SCHEMATIC

999-0009

DRAWN BY F. WILCOX