

SA-39B LIMITING AMPLIFIER

SPECIFICATIONS

Input Impedance: 500/600 - 150/250 - 30/50 ohms, balanced or unbalanced.

Output Impedance: 500/600 ohms, balanced only.

Input Level: -20 to +20 DBM with 5 DB compression.

Output Level: 0 to +19 DBM as adjusted by output control R11 and AT1, AT2 and AT3 pad assembly with 5 DB compression.

Maximum Gain: 50 DB +3 DB.

Response: +1.5 DB from 30 cycles to 15 KC.

Distortion: 1% or less from 50 cycles to 15 KC @ 5 DB compression, 1.5% or less from 50 cycles to 15 KC @ 15 DB compression.

Noise: 65 DB below any output level with 5 DB compression.

GENERAL AND INTRODUCTORY

The Gates SA-39B Limiting Amplifier is a high quality low distortion amplifier for AM and FM; to be used as a device to limit the audio output above a set amount, with said limitation possible without affecting the quality of broadcast transmission. It is constructed on a flat aluminum plate mounted on a metal housing with drop-down front panel. When properly installed and maintained it will give a lifetime of satisfactory service. However, as limiters require more than normal understanding of their functions, we urge even the very experienced engineer to thoroughly acquaint himself with these instructions and the equipment.

DETAILED DESCRIPTION

1 - The SA-39B limiter is a three-stage all push-pull amplifier using highly shielded components for low noise and accurately designed parts for good balance and low distortion. The first stage employs a pair of 1612 tubes, the second stage a pair of 6SJ7 tubes and the final stage a pair of 6V6 tubes.

2 - Limiting Circuit

To obtain limiting or automatic peak control action, a portion of the output voltage is rectified by a 6H6 tube (as a full wave rectifier) and a negative DC voltage applied to the main and second control grids

of the 1612 tubes. As the audio voltage increases the grid becomes more negative, retarding the flow of current, thus lowering the gain of the stage. A-3984 shows the curve of the limiting action obtained. It will be noted that, beyond the point where limiting action starts the curve is substantially flat. And, up to the overload point of the amplifier, only a slight increase in gain is noted. Regardless of the amount of limiting action (up to overload) the quality of the program is unimpaired. Referring to the schematic, D-22199, the point of limiting is determined by the network R30-R29-R28-R27. This has been arbitrarily set in design for convenient operation. The scale on the meter, M1, is to measure the plate current of V1 and calibrate it for a direct indication of limiting action. For convenience, the scale is calibrated in "Decibels Compression". Switch S1 sets the recovery time as desired. The input control, R1, adjusts the input level to set the gain to the desired degree of compression. The output, as indicated by the curve in Drawing A-3984, must be maintained at a comparatively constant level, hence the output control (R11) and output pad assemblies (AT1, AT2 and AT3) will provide the proper output level to succeeding equipment.

3 - Power Supply

An electronically regulated power supply maintains constant voltage on the first two stages. This circuit employs a 5V4G cathode type rectifier which will relieve initial surge voltage on the input filter capacitor. As a further aid to keeping the equipment in service, the capacitor is a plug-in type which may be kept in stock for immediate replacement. The conventional regulator circuit uses a 1 - 6X5, 1 - 6SJ7, and 1 - 6L6G tubes.

4 - Mechanical Construction

The amplifier is built upon a flat plate chassis. This, in turn, is mounted in a metal frame with a drop front door which may be mounted in a standard 19" rack or cabinet. Necessary controls and the meter are located on the front door. The tubes are available from the rear. Opening the door gives access to the electrical components. After removing the controls from the front door, the chassis may be removed from the frame for major repair without removing the style strips from the cabinet.

INSTALLATION

1 - Unpacking

The SA-39B Limiting Amplifier is shipped as an integral unit, completely assembled. The rectifier tube is removed for packing. A check of the packing list will show the exact contents of container. The remaining tubes are shipped in their respective sockets. Remove any padding or tape that was added to safeguard delivery. Open the front door by loosening thumbscrew. Inspect the interior, for additional packing materials, as well as

concealed damage due to rough handling by the transportation agency. Insert the rectifier tube in its socket and check that the proper tubes are in the sockets, as stencilled.

2 - Installation

Fourteen inches of rack or cabinet space must be provided for the amplifier. The 115 volt a.c. terminals will be found on the left side (from the rear) of the chassis. The audio connections are on the right side. The terminals are stencilled (with their function) in each case. Reference to the schematic diagram will clarify the terminations. Care should be taken that all audio leads run in shielded twisted pair and kept away from 60 cycle a.c. lines as far as possible. It is suggested that, if possible, the ungrounded side of the a.c. line be connected to terminal number 8 (stencilled on under-side of chassis). Then, when the fuse is removed, the entire chassis will be at neutral or ground potential and danger of accidental shocks removed when it is necessary to work on the equipment.

CAUTION: If the above precaution is not taken, remember that the a.c. switch on the front door is liable to be live (even with the fuse removed) and work accordingly.

OPERATION

1 - Preliminary Adjustments

The instrument has been carefully checked in the laboratory under actual operating conditions and should be ready for operation, as described below, without further adjustment.

2 - Initial Operating Procedure

To place the SA-39B Limiting Amplifier in operation, set the front panel controls as follows:

- 1 - Set "Input" control R1 to "off" position. The amplifier should operate with a constant input of approximately -20 VU. However, it is suggested that level of -10 to 0 VU be maintained at the input terminals on TBI-1-2.
- 2 - Set "Output" control R11 to the "off" position.
- 3 - Turn on the power switch, S2. The pilot light should light up. If no, check fuse (on rear of chassis).
- 4 - With the "Input" control at infinity (the "off" position), the DB compression scale should show 0 DB compression or full scale reading. To adjust the meter, open the front door and a knob (R3) will be noted in the lower left hand corner of the chassis. This knob controls R3, changing the bias slightly on the 1612 stage to adjust the plate current so that the meter reads 0 DB compression.

It may be found, that after the limiter has been in operation an hour or two, the zero setting will change; the needle dropping slightly. It is suggested that the setting be rechecked after complete warm-up and this setting be used for continuous service.

- 5- Now, increase the input control (R1) until the meter just begins to swing the peaks, this is the minimum level at which the limiter should be operated. For satisfactory operation "average" program level should not be allowed to compress beyond 5 DB. At this point it should be pointed out that the scale indicates a steady sine wave compression, and that dynamic program material will have a different behavior with a higher degree of compression than actually indicated on the meter; however, for all practical considerations, the meter gives the operator an excellent indication of the operation of the limiter.
- 6- Increase the output control R11 until the desired level is reached. The limiter is now ready to be placed in service.

3 - Pads

The output level is set at the factory for +12 to +19 DBM output, however, the output level may be reduced by placing the additional fixed pad assembly (AT-2 and/or AT3) in the output circuit. Referring to the schematic drawing D-22199 will supply the necessary information for these changes. These pad assemblies are located near the output transformer for ease of installation.

The output control (R11) is a vernier type control and will provide a more accurate output adjustment than obtained with a step type control.

4 - Operating Suggestions

Actual operation of the limiter will depend, to a large extent, upon the individual desires of the personnel involved. The principal reason for the use of a limiter is to permit the transmitter to be operated at a high modulation value, with the limiter being a safety valve to prevent sudden or sustained program increases from causing over modulation. In FM and TV, the SA-39B Limiter is indeed ideal; preventing excessive transmitter swing and resultant receiver distortion. Where it is desired to have considerable dynamic range to the music, the amount of compression should be reduced to a minimum. As compression is increased, the dynamic range would be compressed to where the music would lose its pleasing expression. Under normal operation, the compression should not exceed 5 DB for average program level.

The recovery time of the limiter is set by switch S1 (on the rear of the chassis). A dial is calibrated for six positions; Position #1 gives a time recovery of approximately .2 sec. and each succeeding position increases this by .2 sec. Position #3, or .6 sec., gives a good average recovery time. However, for certain types of program, it may be desirable to increase or decrease the time constant.

The jack, J7, (on the front door) may be used for aural monitoring by plugging in phones. A signal will be heard at this point regardless of the position of the output attenuator.

MAINTENANCE

The Gates SA-39B Limiting Amplifier is carefully tested in the laboratory before shipping and all controls and adjustments set as indicated in the preceding test. The amplifier has been carefully designed and should give long uninterrupted service. For the assistance of the engineer in servicing the amplifier, the various operating voltages are indicated on the schematic drawing. These readings were taken with a 20,000 ohm/volt voltmeter. If a high impedance vacuum tube volt meter is used a slight discrepancy will be noted at tube sockets although main voltages should read approximately the same.

A current jack has been placed in each cathode of the amplifier circuit. If a multi-range D.C. milliammeter is available, a standard two circuit phone plug may be inserted. The readings should approach those shown on the schematic. The polarity of the jack plug is the same as used on the companion units of the Gates SA line of amplifiers; that is, the tip is positive and the sleeve is negative.

Drawings C-78050 and C-78051 show the locations of the resistors on the terminal boards and their terminations.

The layout of the SA-39B Limiting Amplifier lends itself to rapid routine maintenance. With the front door lowered, the attenuators are readily available for occasional cleaning.

Modern tube design assures long life; however, it is well to occasionally check the cathode currents, watching for unbalance in the tubes. In changing tubes, care should be taken that the 1612 tubes are evenly matched. This may be checked by plugging a current meter into jacks J1 and J2. Unbalance may cause fluttering or thumping in the limiter circuit on extreme low notes. It may also be a source of noise (hum) where extremely low level circuits are employed.

Removing the tubes for periodic checking has the further advantage of lowering contact potential between the pins and socket clips. The plug-in capacitor should also be removed and re-inserted to insure good contact. Good Housekeeping also indicates that all equipment should be kept clean and dust-free.

The output of the regulated power supply is indicated at 275 volts. This voltage may be adjusted by varying R43, a screwdriver slot control (located on the rear of the chassis). The voltage will be found to be very constant over quite wide variations of load current and line voltage fluctuations. In case of minor repairs to the equipment reference to the schematic and resistor board drawings should enable the engineer to make most repairs without removing the chassis from the rack. A new type of terminal has been

employed on the resistor boards, allowing easy removal of components by the application of a hot soldering iron. If a major repair is indicated, the unit may be removed with the following procedure:

- 1 - Disconnect leads from rear terminal boards.
- 2 - Remove knobs and lock nuts from the controls and switches on the front door. Also remove the leads from the meter.
- 3 - Remove the fillister head screws from the rear of the chassis.
- 4 - Remove the chassis, pulling the switches and controls through the frame.
- 5 - If necessary, the meter may be removed separately and reconnected on the work bench.

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SA-39B Amplifier

PARTS LIST

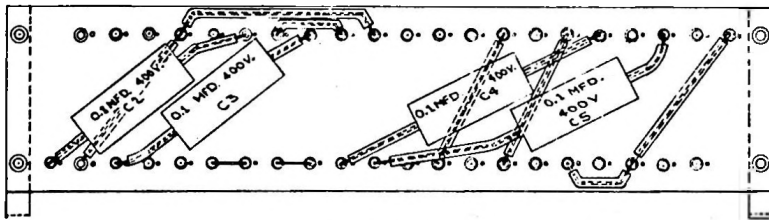
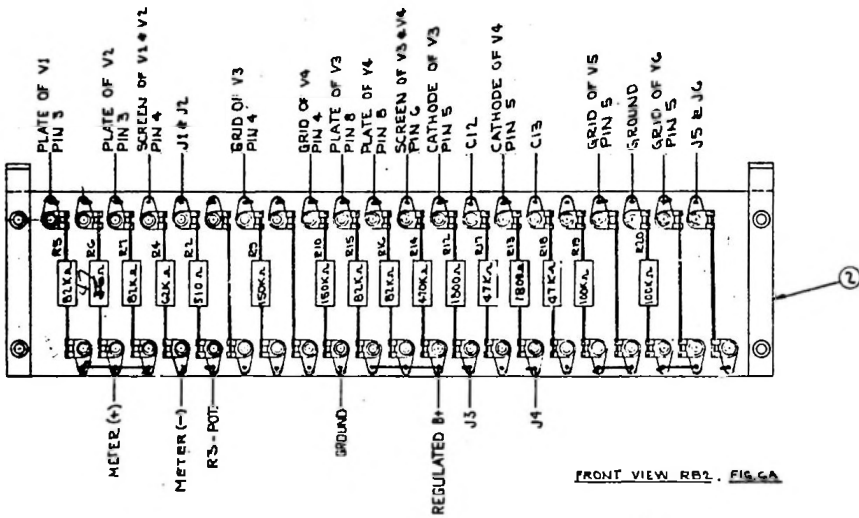
<u>Symbol No.</u>	<u>Gates Part No.</u>	<u>Description</u>
A1	406 0185 000	Pilot Light Assembly, Red
A2	396 0053 000	Lamp
A3	406 0002 000	Lamp Socket
A4	396 0070 000	Lamp, 1/4 W.
A5	402 0021 000	Fuseholder
AT1	991 2678 001	Attenuator Assembly
AT2,AT3	991 2679 001	Attenuator Assembly
C1;C2,C3, C4;C5	508 0085 000	Capacitor, .0 mfd.; 400 V.
C6;C7	506 0014 000	Capacitor, .1 mfd., 400 V.
C9,C12, C13;C14	506 0016 000	Capacitor, .5 mfd., 400 V.
C10,C11	524 0011 000	Capacitor, 20-20 mfd., 450 V.
C16	522 0133 000	Capacitor, 16 mfd., 450 V.
C17	524 0036 000	Capacitor, 3000 uf., 15V.
CR1	384 0018 000	Diode, 1N2069
FI	398 0020 000	Fuse, 3 Amp.
J1;J2;J3, J4,J5,J6	612 0284 000	Jack
J7	612 0286 000	Jack
L1	476 0009 000	Filter Choke
M1	913 0720 001	0-1 MA. D.C. Meter with Special Compression Scale
R1	550 0192 000	Control, 100,000 ohm, dual
R2	540 0325 000	Resistor, 510 ohms, 1W.; 5%
R3	552 0543 000	Potentiometer, 500 ohms, wirewound, 3/4" shaft
R4	540 0375 000	Resistor, 62K ohms, 1W., 5%
R5,R7, R15,R16	540 0491 000	Resistor, 82K ohm; 1W.; 10%
R6	540 C 300 000	Resistor, 47 ohms, 1W., 5%
R8	540 0325 000	Resistor, 510 ohms, 1W., 5%
R9,R10	540 0494 000	Resistor, 150K ohms, 1W., 10%
R11	552 0546 000	Control, 1000 ohms
R12,R13	540 0471 000	Resistor, 1800 ohms; 1W.; 10%
R14	540 0500 000	Resistor, 470K ohms, 1W.; 10%
R17;R18	540 0488 000	Resistor, 47K ohms, 1W., 10%
R19,R20	540 0492 000	Resistor, 100K ohms, 1W., 10%
R21	540 0480 000	Resistor, 10K ohms, 1W., 10%
R23;R24	540 0322 000	Resistor, 390 ohm, 1W., 5%
R25,R26	540 0497 000	Resistor, 270K ohms, 1W., 10%

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SA-39B Amplifier

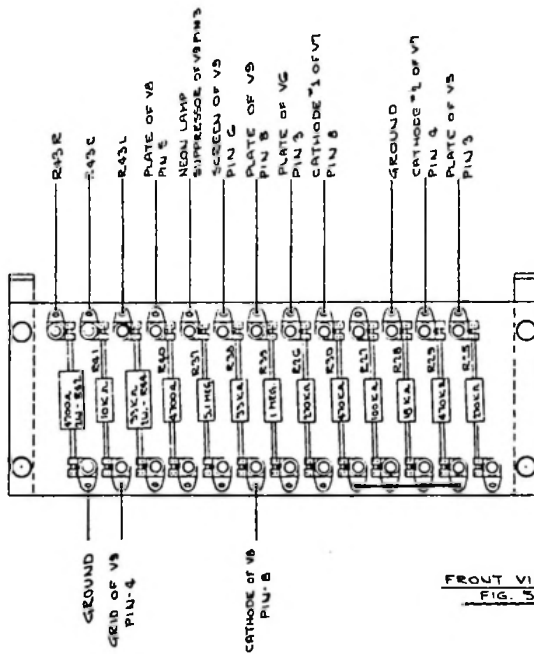
<u>Symbol No.</u>	<u>Gates Part No.</u>	<u>Description</u>
R27	540 0492 000	Resistor, 100K ohms, 1W., 10%
R28	540 0483 000	Resistor; 18K ohms, 1W., 10%
R29;R30	540 0500 000	Resistor, 470K ohms, 1W., 10%
R31;R32;R33, R34,R35,R36	540 0218 000	Resistor, 2.2 megohm; 1/2W., 10%
R37	540 0421 000	Resistor, 5.1 megohm, 1W., 5%
R38	540 0486 000	Resistor, 33K ohms; 1W.; 10%
R39	540 0504 000	Resistor, 1 megohm, 1W., 10%
R40	540 0476 000	Resistor, 4700 ohms, 1W., 10%
R41	540 0480 000	Resistor, 10K ohms, 1W., 10%
R42	540 0748 000	Resistor, 4700 ohms, 2W., 10%
R43	552 0255 000	Potentiometer, 10K ohms, 4W., wirewound
R44	540 0758 000	Resistor, 33K ohms, 2W., 10%
R46	542 0079 000	Resistor, 1500 ohms, 10W.
R47		Resistor, "X" value to be det. by tube current
R48,R49	540 0187 000	Resistor; 5600 ohms; 1/2W., 10%
R50	540 0476 000	Resistor, 4700 ohms, 1W., 10%
R51,R52,R53	540 0271 000	Resistor, 3 ohm, 1W. 5%
S1	600 0355 000	Selector Switch
S2	604 0005 000	Toggle Switch, SPST
T1	478 0142 000	Input Transformer
T2	478 0121 000	Output Transformer
T3	472 0054 000	Power Transformer
T4	472 0160 000	Filament Transformer
TB1	614 0115 000	Terminal Board
TB2	614 0111 000	Terminal Board
V1;V2	370 0146 000	Tube; 1612
V3;V4,V9	370 0094 000	Tube, 6SJ7
V5,V6	370 0102 000	Tube; 6V6GT
V7	370 0080 000	Tube, 6H6
V8	370 0106 000	Tube; 6X5GT
V10	370 0086 000	Tube, 6L6G
V11	370 0018 000	Tube, 5V4G
X1;X2;X3; X4, X5;X6,X7,X8, X9,X10,X11,X12	404 0016 000	Socket



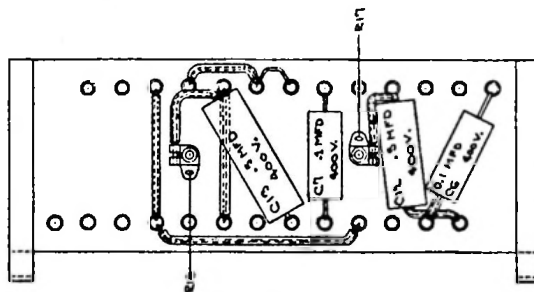
LIST OF PARTS						
RESISTOR BOARD ELECTRICAL ASSEMBLY						C-78050
QTY.	REF.	REFERENCE	VAL.	PR.	DESCRIPTION	MATERIAL
X	1	THIS DWG.			ASSEMBLY	
1	2	C-15930	107		BOARD ASSEMBLY	
1	4	R6			57% ALLEN-BRADLEY	1W.
1	5	R7			57% ALLEN-BRADLEY	1W.
2	6	R11, R13			1800Ω 10% ALLEN-BRADLEY	1W.
1	7	R4			62KΩ 5% ALLEN-BRADLEY	1W.
2	8	R11, R18			47KΩ 10% ALLEN-BRADLEY	1W.
4	9	R5, R7, R9, R11			82KΩ 10% ALLEN-BRADLEY	1W.
2	10	R19, R20			100KΩ 10% ALLEN-BRADLEY	1W.
2	11	R9, R10			150KΩ 10% ALLEN-BRADLEY	1W.
1	12	K14			47% ALLEN-BRADLEY	1W.
4	15	C1, C3, C4, C5			0.1 MFD. 400V. C.D. PAPER	DT-4-P1

SYMBOLS REFER TO:
 SCHEMATIC D-22189 FOR SA-39B

RESISTOR BOARD ELECTRICAL ASS'Y FOR FRONT PANEL FOR M3529B SA-39B LINDER AMPLIFIER			
REV. 7505	2	DATE: 7-10-51	TRACED BY: J.S.
REV. 7505	2	DATE: 7-10-51	CHECKED BY: J.S.
GATES RADIO COMPANY		C-78050	



FRONT VIEW R.B.1
FIG. 5A

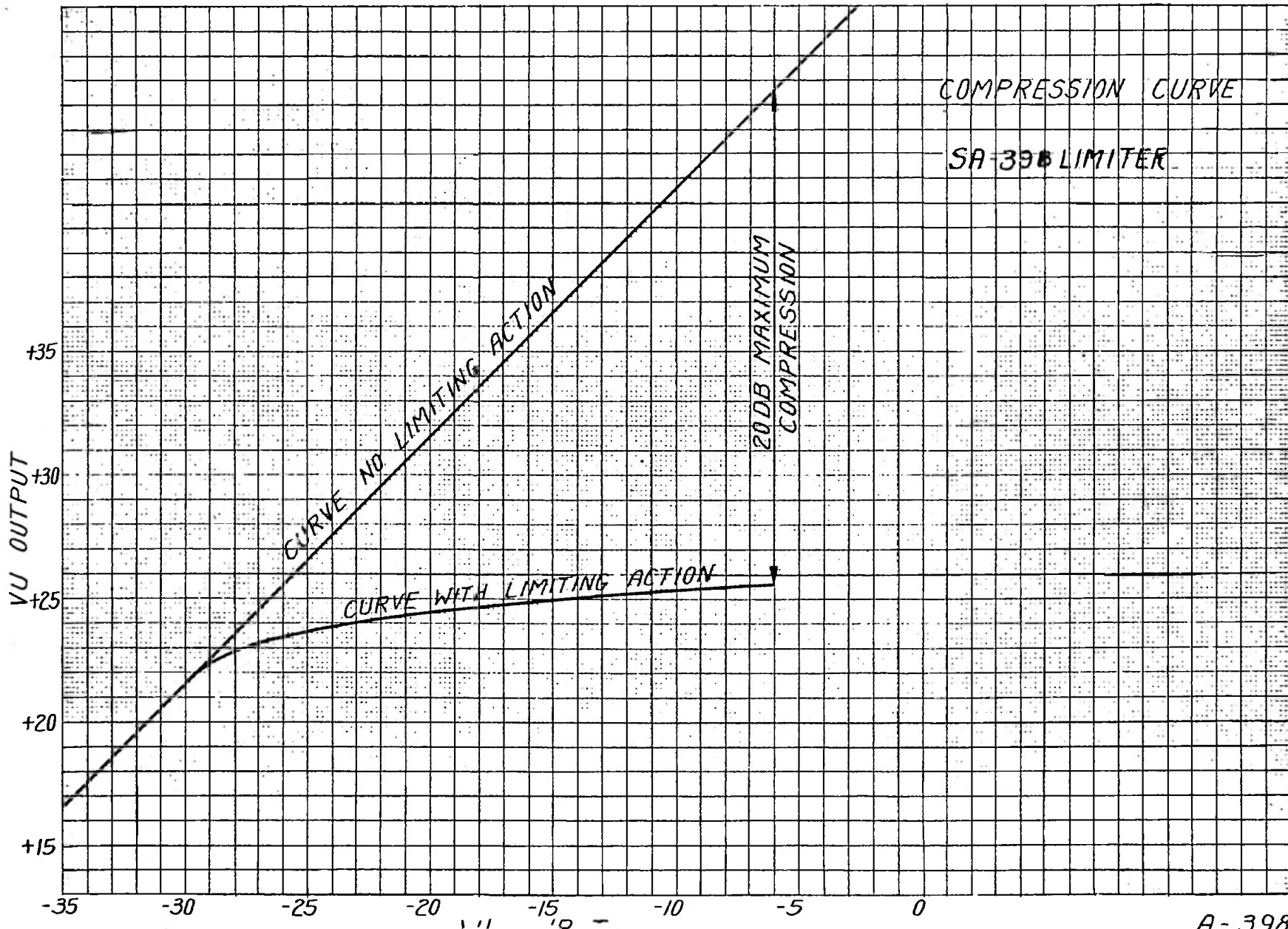


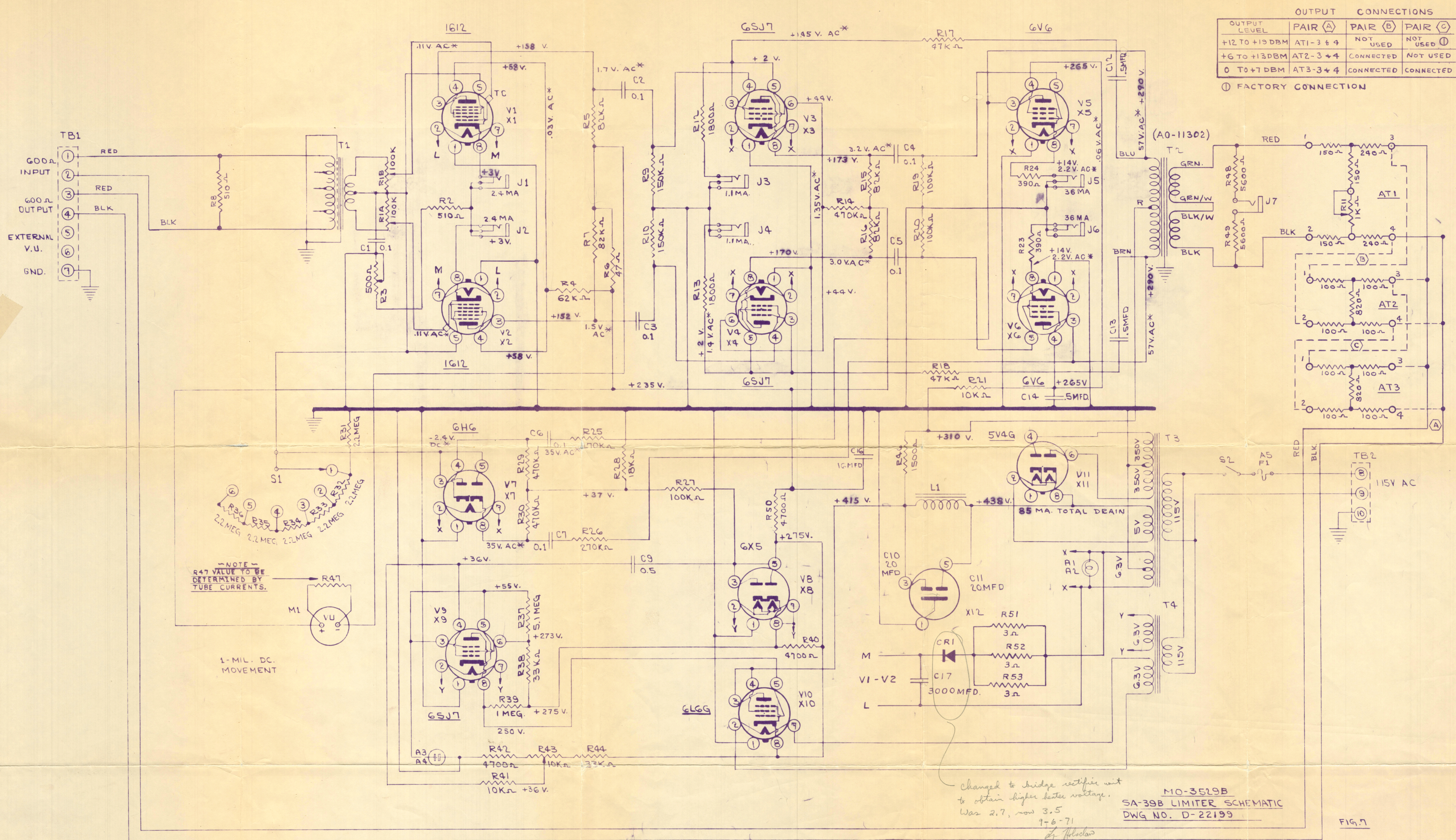
REAR VIEW R.B.1
FIG. 5B

		LIST OF PARTS				
		C-78051				
QTY.	ITEM	REFERENCE	VAL.	PR.	DESCRIPTION	NATIONAL
X	1	THIS DWG.			ASSEMBLY	
1	2	C-15962	101		MECHANICAL ASSY.	
1	3	R37			5.1 MEG. 5% ALLEN-BRADLEY	1W.
1	4	R39			1 MEG. 10% ALLEN-BRADLEY	1W.
2	5	R15 R50			470K. 10% ALLEN-BRADLEY	1W.
1	6	R27			100 K. 10% ALLEN-BRADLEY	1W.
1	7	R44			33 K. 10% ALLEN-BRADLEY	1W.
1	8	R38			33K. 10% ALLEN-BRADLEY	1W.
1	9	R28			15 K. 10% ALLEN-BRADLEY	1W.
1	10	R61			10 K. 10% ALLEN-BRADLEY	1W.
1	11	R42			4700 . 10% ALLEN-BRADLEY	1W.
1	12	R40			4700 . 10% ALLEN-BRADLEY	1W.
2	13	R25 R26			270K. 10% ALLEN-BRADLEY	1W.
2	14	C6 C7			0.1 MFD. 400V. AEROVOX, P922	
2	15	C12 C13			.5 MFD. 400V. AEROVOX, P922	

SCHEMATIC D-22153 FOR SA-328

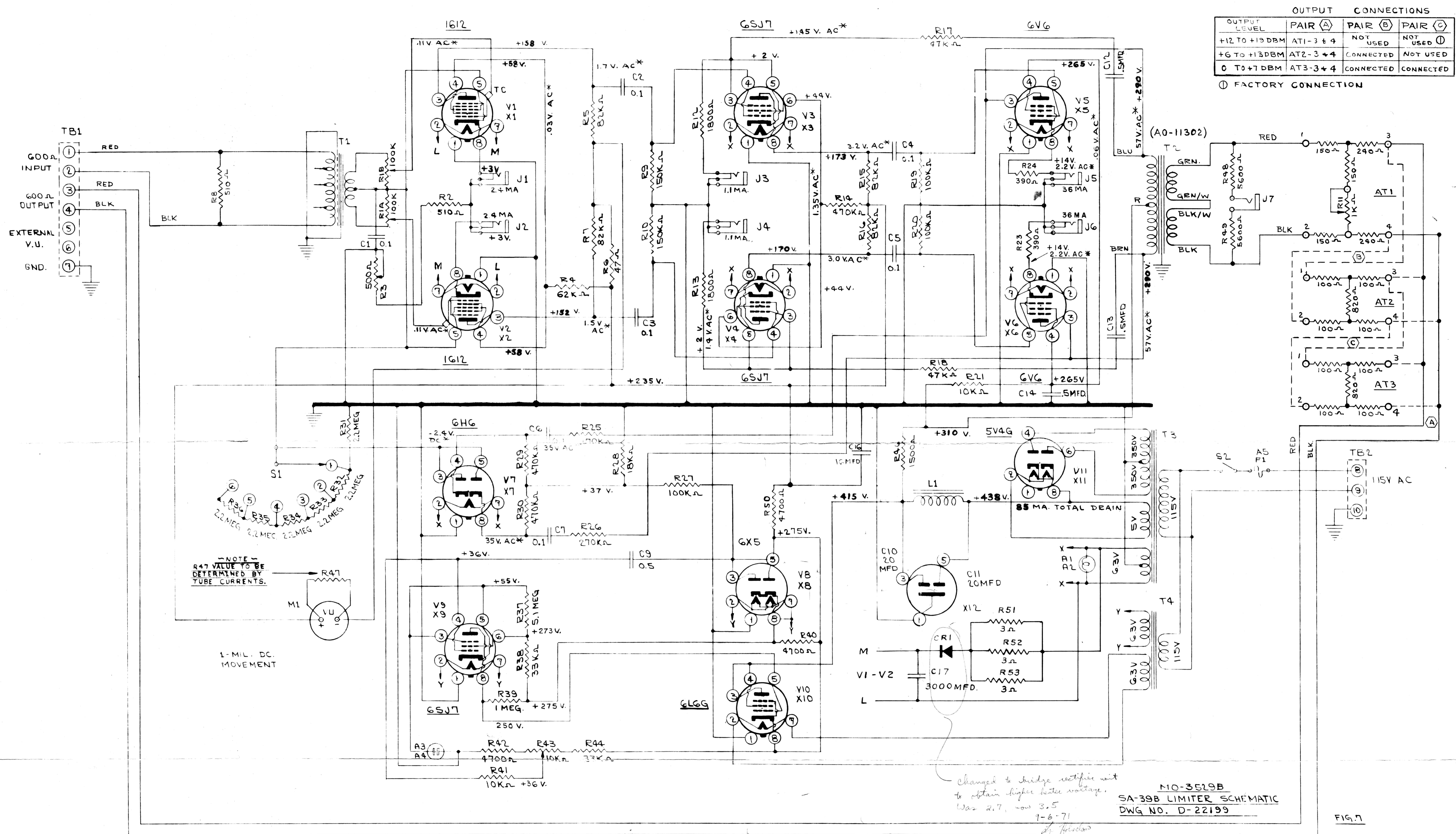
RESISTOR BOARD ELECTRICAL ASSY.	
PART NAME FOR M3520B SA328 LIMITER AMP.	
DESIGNED BY: R.E. 7-12-51	DRAWN BY: J.C.
GATES RADIO COMPANY	
C-78051	





MEASUREMENTS SUCH AS +142V. ARE D.C., MEASURED WITH SIMPSON #260 METER, NO SIGNAL APPLIED
 MEASUREMENTS SUCH AS +11V. AC* ARE 1000 CYCLE RMS, MEASURED WITH HEWLETT PACKARD DISTORTION ANALYZER ON THE "METER" POSITION.
 USE THESE METERS, OR EQUIVALENT, AND: EXPECT MINOR VARIATIONS IN READING.

ECN 9250	DL 9-6-62	G	GATES RADIO COMPANY QUINCY, ILLINOIS
ECN 9225	SWY 8-15-62	E	
ECN 8841	AWC 11-3-61	F	LIMITER SCHEMATIC SA-39B M3529B
AWC 11-3-61	REVISION	3	
ECN 7905	AWC 7-22-59	2	DR BY AWC DATE 12-7-57
ECN 7478	8-15-58	DL 1	
CH WSK	ENG WJK.		D-22199



OUTPUT CONNECTIONS

OUTPUT LEVEL	PAIR (A)	PAIR (B)	PAIR (C)
+12 TO +19 DBM	AT1-3 & 4	NOT USED	NOT USED
+6 TO +13 DBM	AT2-3 & 4	CONNECTED	NOT USED
0 TO +7 DBM	AT3-3 & 4	CONNECTED	CONNECTED

① FACTORY CONNECTION

MEASUREMENTS SUCH AS +142V. ARE D.C., MEASURED WITH SIMPSON #260 METER, NO SIGNAL APPLIED
 MEASUREMENTS SUCH HV.AC* ARE 1000 CYCLE RMS, MEASURED WITH HEWLETT PACKARD DISTORTION ANALYZER
 ON THE "METER" POSITION.
 USE THESE METERS, OR EQUIVELANT, AND: EXPECT MINOR VARIATIONS IN READING.

ECN 9250	6	GATFS RADIO COMPANY QUINCY, ILLINOIS
D.L. 9-6-62	6	
LCN 7287	5	LIMITER SCHEMATIC SA-39B M3529B
GCN 7287	5	
ECN 7905	4	DR BY AWC
AWC 7-22-59	4	DATE 12-7-57
ECN 19-58	1	CH WJK
		ENG W.J.K.

D-22199