

INSTRUCTION BOOK
FOR
SA-39B LIMITING AMPLIFIER

Gates Radio Company

MANUFACTURING ENGINEERS SINCE 1922

QUINCY, ILLINOIS

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 \pm 20 DBM with 5 DB compression.

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

Maximum Gain: 50 DB \pm 3 DB.

Response: \pm 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 and 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 and the plug for the trouble light are 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 V.U. However, it is suggested that level of -10 to 0 V.U. be maintained at the input terminals on TB1-1-2.
- 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 high impedance vacuum tube voltmeter. If an ordinary 20,000 ohm per 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 reinserted 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.
- 6 - To replace the chassis, reverse the process. Studs are provided on the rear of the frame to assist in guiding the chassis to its proper position and to relieve the load while replacing the screws.

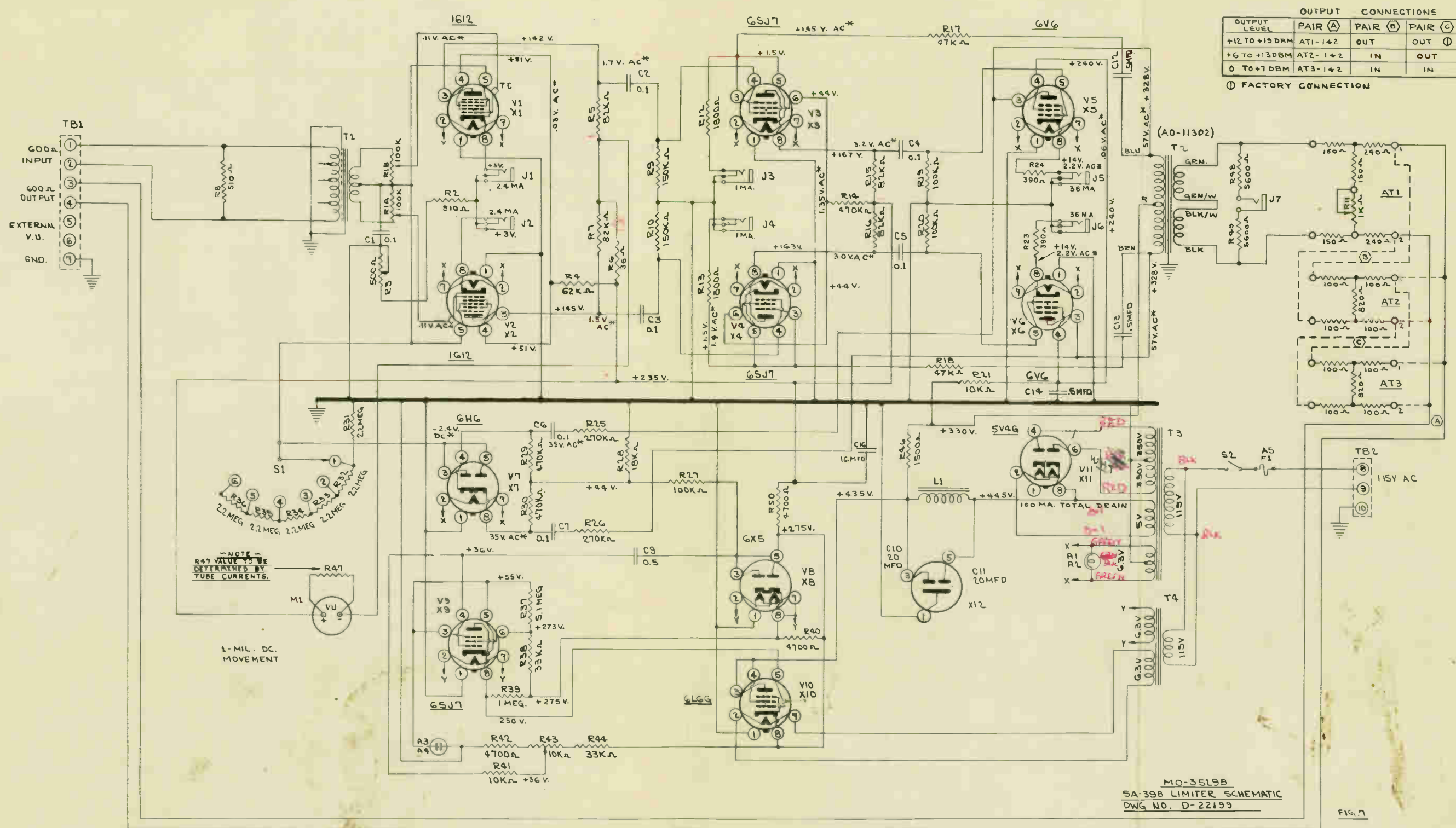
5/21/58

-6-

SA-39B

| <u>Symbol No.</u> | <u>Drawing No.</u> | <u>Description</u> |
|-------------------|--------------------|---|
| R27 | | Resistor; 100K ohms, 1W., 10% |
| R28 | | Resistor; 18K ohms, 1W., 10% |
| R29; R30 | | Resistor; 470K ohms, 1W., 10% |
| R31; R32; R33, | | |
| R34, R35, R36 | | Resistor; 2.2 megohm, 1/2 W., 10% |
| R37 | | Resistor; 5.1 megohm, 1W., 5% |
| R38 | | Resistor; 33K ohms; 1W., 10% |
| R39 | | Resistor; 1 megohm, 1W., 10% |
| R40 | | Resistor; 4700 ohms, 1W., 10% |
| R41 | | Resistor; 10K ohms, 1W., 10% |
| R42 | | Resistor; 4700 ohms, 2 W., 10% |
| R43 | A-3404-6 | Potentiometer, 10K ohms, 4W. Wirewound |
| R44 | | Resistor; 33K ohms, 2 W., 10% |
| R46 | | Resistor; 1500 ohms, 10W |
| R47 | | Resistor, "X" value to be det. by tube current |
| R48, R49 | | Resistor; 5600 ohms; 1/2 W., 10% |
| R50 | | Resistor; 4700 ohms, 1W., 10% |
| S1 | B-11139-7 | Selector Switch |
| S2 | | Toggle Switch, SPST |
| T1 | AI-3002 | Input Transformer |
| T2 | AO-11302T | Output Transformer |
| T3 | | Power Transformer |
| T4 | | Fil. Transformer |
| TB1 | | Terminal Board |
| TB2 | | Terminal Board |
| V1, V2 | | Tube, 1612 |
| V3, V4, V9 | | Tube, 6SJ7 |
| V5, V6 | | Tube 6V6GT |
| V7 | | Tube, 6H6 |
| V8 | | Tube; 6X5GT |
| V10 | | Tube, 6L6G |
| V11 | | Tube, 5V4G |
| X1; X2; X3; X4; | | |
| X5; X6; X7; X8; | | |
| X9, X10, X11, X12 | | Socket |

F-1 - 3 Amp fuse -



OUTPUT CONNECTIONS

| OUTPUT LEVEL | PAIR (A) | PAIR (B) | PAIR (C) |
|----------------|----------|----------|----------|
| +12 TO +15 DBM | AT1-1+2 | OUT | OUT (D) |
| +6 TO +13 DBM | AT2-1+2 | IN | OUT |
| 0 TO +7 DBM | AT3-1+2 | IN | IN |

(D) FACTORY CONNECTION

-NOTE-
R47 VALUE TO BE
DETERMINED BY
TUBE CURRENTS.

1-MIL. DC.
MOVEMENT

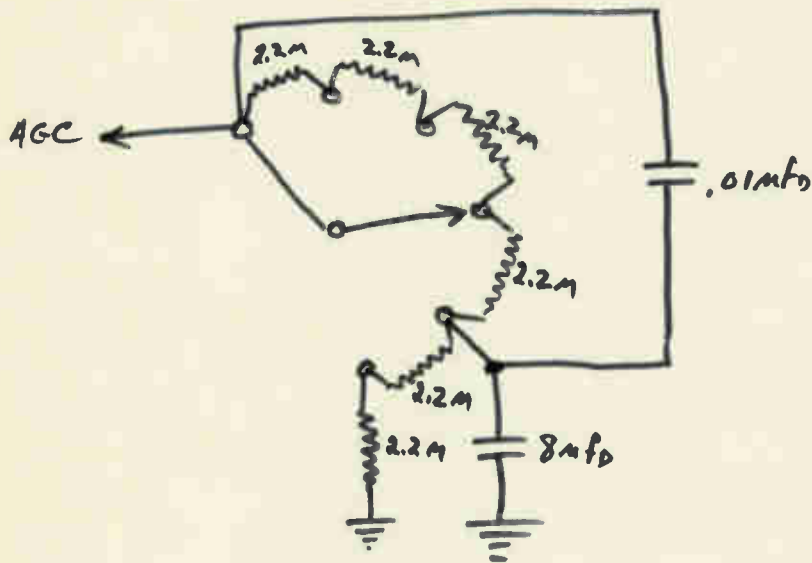
MO-3529B
SA-39B LIMITER SCHEMATIC
DWG NO. D-22199

FIG. 7

MEASUREMENTS SUCH AS +142V. ARE D.C., MEASURED WITH SIMPSON #260 METER, NO SIGNAL APPLIED
 MEASUREMENTS SUCH .41V. 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 7505 | 2 | GATES RADIO COMPANY QUINCY, ILLINOIS | |
| AWC T-22-54 | 1 | LIMITER SCHEMATIC SA-39B M3529B | |
| ECN 7478 | 1 | DR BY: AWC | DATE: 12-7-57 |
| 6-19-58 DL | 1 | CH: WJK | ENG: WJK |
| | | | D-22199 |

LIMITER MODIFICATION



SET UP :

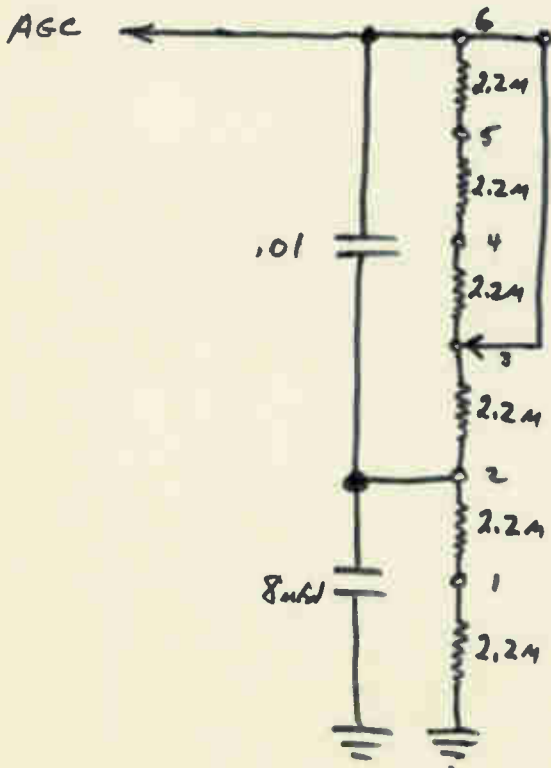
OVU = 6DB COMP.

SET FOR POS #3:

RECOVERS 2DB IN 2.2MS

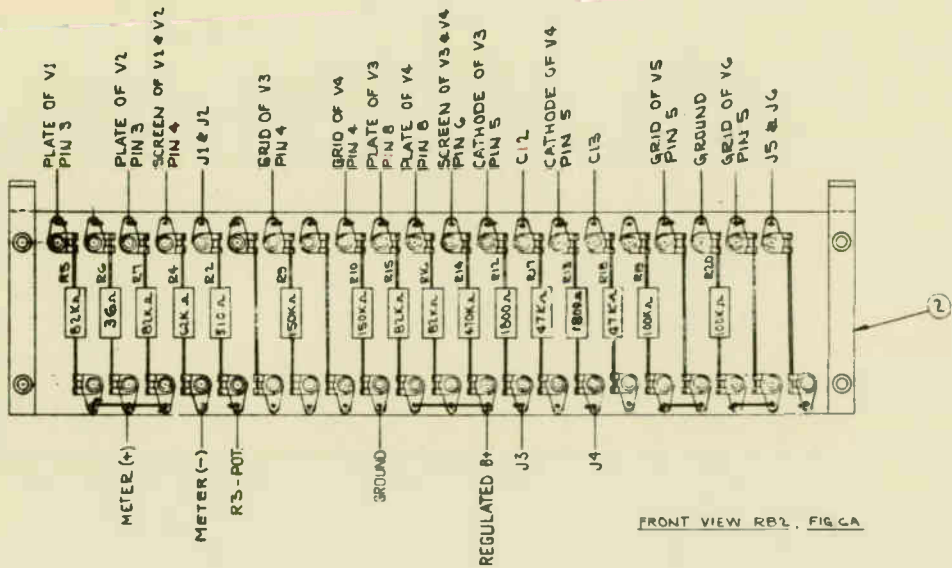
FOLLOWS ± 2DB AVG IN
35 SEC.

EQUIVALENT CIRCUIT

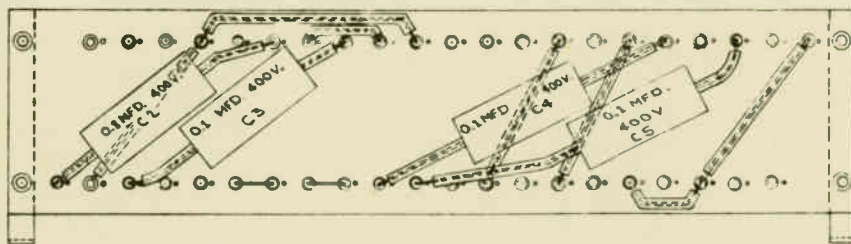


.01 SECTION RELEASE (63%)
2.2 TO 8.8 MSEC
(WHEN USED)

8mfd SECTION RELEASE (63%)
35.2 SEC
OR
(WHEN IN #1 POS.)
17.6 ATTACK - 17.6 RELEASE



FRONT VIEW RB1, FIG. CA

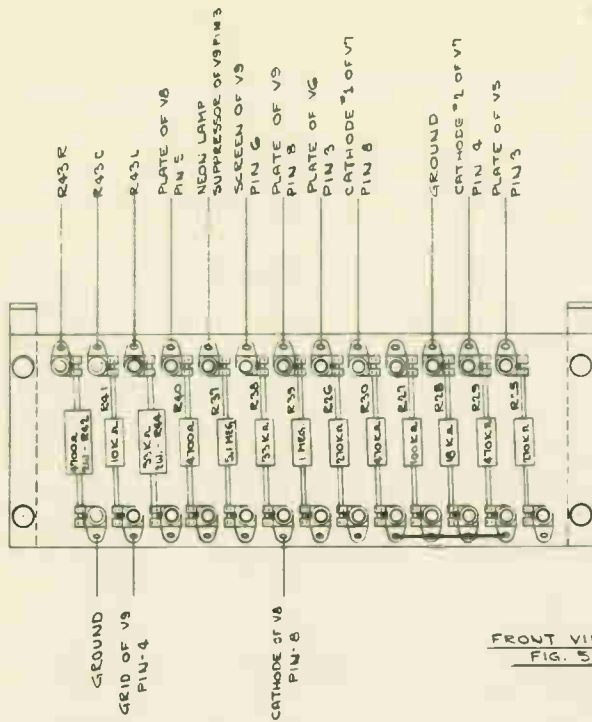


REAR VIEW RB1, FIG. CA

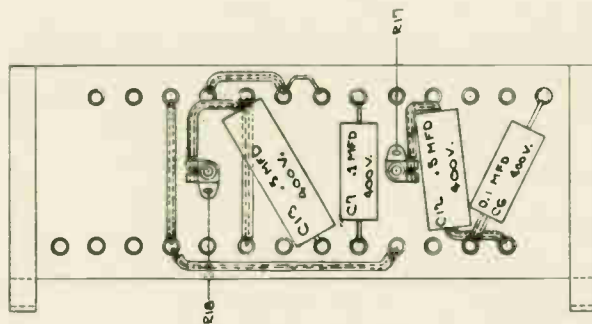
| LIST OF PARTS | | | | | | |
|------------------------------------|------|------------------|-------------|------|---------------------------|---------|
| RESISTOR BOARD ELECTRICAL ASSEMBLY | | | | | | C-78050 |
| QTY. | ITEM | DESCRIPTION | QTY. IN KIT | REF. | DESCRIPTION | REMARKS |
| X | 1 | THIS DWG. | | | ASSEMBLY | |
| 1 | 2 | C-15930 | 102 | | BOARD ASSEMBLY | |
| 1 | 4 | R6 | | | 36 Ω 5% ALLEN-BRADLEY | 1W. |
| 1 | 5 | R2 | | | 510 Ω 5% ALLEN-BRADLEY | 1W. |
| 2 | 6 | R12, R13 | | | 1800 Ω 10% ALLEN-BRADLEY | 1W. |
| 1 | 7 | R3 | | | 61K Ω 5% ALLEN-BRADLEY | 1W. |
| 2 | 8 | R17, R18 | | | 47K Ω 10% ALLEN-BRADLEY | 1W. |
| 4 | 9 | R5, R7, R15, R16 | | | 81K Ω 10% ALLEN-BRADLEY | 1W. |
| 2 | 10 | R19, R20 | | | 100K Ω 10% ALLEN-BRADLEY | 1W. |
| 2 | 11 | R9, R10 | | | 150K Ω 10% ALLEN-BRADLEY | 1W. |
| 1 | 12 | R14 | | | 470 Ω 10% ALLEN-BRADLEY | 1W. |
| 4 | 13 | C2, C3, C4, C5 | | | 0.1 MFD. 400V. C.D. PAPER | DT-4 P1 |

SYMBOLS REFER TO:
SCHEMATIC D-77199 FOR SA-39B

| | | |
|---------------------|---|--|
| GCN 7905 | 2 | RESISTOR BOARD ELECTRICAL ASS'Y FOR PRINT MADE FOR M3529B SA-39B, LIMITER AMPLIFIER |
| AWC 7-25-59 | 1 | DESIGNED BY: RLW |
| GCN 7870 | | FORN BY: 7-19-51 |
| AWC 7-25-59 | | CHECKED BY: M.J.S. |
| GATES RADIO COMPANY | | C-78050 |



FRONT VIEW RB1
FIG. 5A



REAR VIEW RB1
FIG. 5B

| LIST OF PARTS | | | | | |
|---------------|------|-------------|-------------|------|--------------------------------------|
| C-78051 | | | | | |
| QTY. | ITEM | DESCRIPTION | PKT. OR SH. | PKT. | MATERIAL |
| 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 | R39 R30 | | | 470K Ω 10% ALLEN-BRADLEY 1W. |
| 1 | 6 | R27 | | | 100 K Ω 10% ALLEN-BRADLEY 1W. |
| 1 | 7 | R44 | | | 33 K Ω 10% ALLEN-BRADLEY 2W. |
| 1 | 8 | R38 | | | 33 K Ω 10% ALLEN-BRADLEY 1W. |
| 1 | 9 | R28 | | | 18 K Ω 10% ALLEN-BRADLEY 1W. |
| 1 | 10 | R41 | | | 10 K Ω 10% ALLEN-BRADLEY 1W. |
| 1 | 11 | R42 | | | 4700 Ω 10% ALLEN-BRADLEY 2W. |
| 1 | 12 | R40 | | | 4700 Ω 10% ALLEN-BRADLEY 1W. |
| 2 | 13 | R25 R26 | | | 270 K Ω 10% ALLEN-BRADLEY 1W. |
| 2 | 14 | C2 & C1 | | | 0.1 MFD. 400V. AEROVOX, P922M |
| 2 | 15 | C2 & C3 | | | .5 MFD. 400V. AEROVOX, P922M |

SCHEMATIC D-22199 FOR 5A-39B

| | |
|--|----------------|
| RESISTOR BOARD ELECTRICAL ASSY. | |
| FLYING LEADS FOR M3529B SA39B LIMITER AMP. | |
| DESIGNED BY R.K. 7-19-51 | TRACED BY |
| FORWARDED BY | CHECKED BY |
| GATES RADIO COMPANY | C-78051 |
| QUANTITY | REVISION |

