GATES

INSTRUCTIONS FOR INSTALLING AND OPERATING

GATES FM-1C TRANSMITTER

I.B. #888 0763 001
3/30/62

Gates Radio Company
Quincy, Illinois

ADDENDUM

FM - 1C

POSITION OF ANODE CONNECTOR STRAP

The position of the anode connector straps in relation to the plate lines will effect the frequency at which the plate will tune. If difficulty in getting the plate to hit frequency is experienced with the shorting bar at its factory setting, these straps should be dressed differently until plate will tune. (Closer to lines will raise frequency.)

REFERENCE: PAGE 5, FIRST PARAGRAPH

With reference to grid voltage measurement at TP401, the test point on the driver panel, this voltage will be approximately 10-20 volts with voltages removed from the driver unit. This is accomplished by removing the plug on the 600 volt rectifier stack on the 600 volt supply.

BE SURE THE ENTIRE TRANSMITTER IS TURNED OFF BEFORE REMOVING THIS PLUG.

REMOTE CONTROL

All remote control metering and OFF-ON functions are built into the FM-1C. All that is necessary to completely remote control the transmitter is the addition of the motor driven rheostat (M4703C), which will be supplied on special order.

6/11/62

Gates Radio Company
Quincy, Illinois

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SPECIFICATIONS

FM - 1C

Power Output:	1000 Watts
Frequency Range:	88 to 108 mcs.
RF Output Impedance:	50 ohms.
Type of Oscillator	Direct Crystal Controlled.
Frequency Stability:	± .001%
Type of Modulatipn:	Phase shift employing plus techniques.
Modulation Capability:	± 100 kc.
Audio Input Impedance:	600 ohms.
Audio Input Level:	+ 10 dbm, ± 2 db.
Frequency Response:	± 1.0 db 50 to 15,000 cycles. -2.0 db 30 cycles.
Distortion:	1% or less 30 to 15,000 cycles. ½% or less 100 to 10,000 cycles.
Noise:	65 db below 100% modulation (FM) 50 db below equivalent 100% (AM), modulation.
Power Input:	230 volts 60 cycles, single phase three wire, 5 KVA demand. 115 volts, 60 cycles single phase, 500 watts.
Power Supplies:	Silicon rectifiers.
Max. Altitude:	7500 feet.
Max. Ambient:	-20° to 45° C.
RF Output Connector:	7/8 inch coax flange.
Tube Complement:	6 - 6AU6 1 - 12AX7 3 - 6J6 2 - 0A2 2 - 6146 2 - 4-400A 1 - 6360 1 - 6AQ5A 1 - 6080 3 - 6201 3 - 7025 1 - 5AR4/GZ34

Size:	Width 24" Height 78" Depth 36½"
Front Door Swing:	21"
Weight:	Packed 1140 lbs., Net 880 lbs.
Cubage:	34 cu. ft. unpacked
Finish:	Two-tone gray with black accent. Brushed aluminum trim.

DESCRIPTION:

The Gates FM-1C frequency modulated broadcast transmitter will provide 1000 watts of frequency modulated power to a properly designed antenna and transmission line system on any frequency from 88 to 108 Mc. Characteristics obtained, in any proper installation, will exceed those required by the FCC for FM broadcast service.

The basic units of the FM-1C are: exciter, driver and power amplifier.

a) The exciter unit M6095 is capable of 10 watts output and is the basic exciter used in all of Gates FM equipment.

b) The driver unit M5675 is capable of 50 watts output and is link coupled to the input of the power amplifier.

c) The power amplifier of the FM-1C consists of two 4-400A power tetrodes operated in a push-pull circuit. Quarter-wave lines are employed in the plate circuit for maximum stability and efficiency.

The M6095 exciter used in this transmitter employs a phase shift modulator with pulse timing techniques and may be adapted to single or dual channel multiplexing on a plug-in basis, with blank panel space provided for the addition of the multiplex unit.

An important feature of this transmitter is the lack of frequency multiplication after the exciter. This aids in helping to eliminate spurious frequencies and gives protection to tube life, as power type tubes in doubling or tripling operation are not always operated at their most stable life lengthening conditions.

Mechanically the FM-1C has been designed to be easily maintained. Ready accessibility to all parts is accomplished by lift-off type doors. The sides of the cabinet may be easily removed by removing two screws from the holding bracket from the bottom of the side panels and lifting the side panels off.

The control panel for the FM-1C consists of the OFF-ON switches, for the line voltages, the OFF-ON switches for the plate voltage, various indicator lights, the local remote switch, the tune operate switch and the overload reset switch.

The meter panel for the FM-1C is hinged and may be lifted up by first loosening the fastener one quarter turn using a screwdriver or a coin and then lifting the meter panel up. This will give access to meter terminals and wiring of the reflectometer or Micromatch switching section.

THEORY OF OPERATION

With the pressing of S502 the low voltage ON button, primary voltage is applied to the exciter, the blower, the fan and the low voltage power supply. Filament voltage is also applied to both PA tubes, rectifier tubes and voltage is applied to the control circuitry. The exciter has its own power supply and DC voltage is applied to the exciter when its power supply comes up to operating temperature. The exciter power supply also supplies voltage for the driver screen. The low voltage supply supplies voltages for the driver plate and the amplifier screen. With switch S512 in the grid position, about a minute after S502 is pressed grid current will appear on the PA grid current meter, which is the second meter from the left on the cabinet meter panel. This meter should indicate 16 to 25 mils of grid current.

The low voltage power supply also supplies the screen voltage for the power amplifier, however, the DC path is broken through a set of contacts on K503, which is the high voltage contactor. By pressing the high voltage ON button S506 both plate and screen voltage are applied to the power amplifier.

The function of S518 is a "local-remote" switch, with the switch in the "remote" position the fail-safe relay in the remote control unit acts as the holding contacts for K501, which is the line contactor. With S518 in the "local" position the holding contacts on K501 are operative and the remote control unit is disconnected from the transmitter.

The function of S519 is the "tune operate" switch. In "tune" position S519 disables the automatic recycling unit so the transmitter is on complete manual control. The theory and operation of the automatic recycling unit is covered in a separate set of instructions which are part of this instruction book.

The function of S517 "overload reset" is the resetting of the plate overload relay K505. If S519 is in the "tune" position the transmitter experiences an overload, S517 must be pressed to reset K505 before plate voltage can again be applied to the amplifier. Overload relay K505 is in a "lock out" type of circuit. If S519 is in the "operate" position the resetting of the plate overload is automatically taken care of in the recycling unit.

To multiplex the Gates FM-1C is a relatively simple matter. The main channel exciter was specifically designed with multiplex in mind. Space has been provided directly below the exciter for the placing of the multiplex unit. A minimum amount of connections are necessary to connect this unit to the main channel exciter. Connections necessary are a coax connector to the multiplex exciter in the multiplex chain. This is done on the front panel of the two units. Other connections necessary are power from 115 volt source.

This can be taken off 115 volt terminals of the main channel exciter and the connecting of the audio to the terminal board on the multiplex unit completes the necessary wiring. The multiplex unit is capable of handling two subchannels and, therefore, there are two audio input terminal arrangements available on the terminal board of the multiplex unit.

Since the power contactors are non-circuit breaker types, they require a momentary ON and a momentary OFF type of function to operate them, the transmitter is easily remote controlled.

UNPACKING AND READYING FOR OPERATION

The FM-1C is carefully checked and packed at the Gates plant to assure that safe arrival at its destination in proper electrical and mechanical condition.

Tests of many different kinds are made at the factory and the unit is operated for several hours to assure correct adjustment and proper operating conditions.

Certain large components are removed from the unit and shipped separate to assure safe handling. The components removed are; T501, L501, L502, C501 and C502. Wires are numbered or tagged as a guide for replacement of these parts. Photographs are supplied to assist in the proper placement and orientation of the components that have been removed for shipment.

After the FM-1C has been received and unpacked, it should be carefully inspected for any mechanical damage. If any damage is noticed to any section of the equipment, a claim should be filed immediately with the delivering transportation company and necessary replacement items ordered from the Gates Radio Company.

It is a good precautionary practice to completely go over the equipment to check for loose connections, loose components, broken insulators, etc., that might have become loosened or damaged in shipment. Make sure all relay contacts are free and in good mechanical operation. Make sure all mechanical connections are tight.

The power contactors are either tied down or blocked sufficiently to keep them from vibrating during shipment. These should be checked and the shipping material removed.

A good overall visual inspection may save much time later in getting the transmitter to operate correctly.

INSTALLATION

In advance of actual placement and adjustment of the transmitter certain preliminary planning should be done. The use of drawing C-79128 and 813 5901 001 will assist in locating the power and audio input leads and the power output from the transmitter.

The following should be arranged in advance of actual installation work.

1. Leads from a low reactance power source of 230 volts, 60 cycle, single phase and 115 volts, single phase, 60 cycle AC lines should be run in conduit underneath the proposed location or platform..

   The wires should be at least #6 for 230 volts, 60 cycle, single phase and #12 for the 115 volts, 60 cycle, single phase for best regulation.

   Running these power sources in lead enclosed wires or in a steel conduit is highly recommended to obtain both audio and radio frequency shielding near the transmitter.

2. To assist in keeping RF currents in nearby audio equipment to a minimum, a good ground at these frequencies is mandatory. One of the best known methods of doing this, is the installation of a sheet of copper for the ground system beneath the complete transmitter layout. RF usually shows up in one or both of two ways, feedback or high noise level. It should be pointed out that even a small amount of wire unshielded is a very effective antenna at FM frequencies in transferring RF to the grid where it is rectified and passed on as noise or feedback. It is preferable to have a single common ground point from the transmitter copper shield to a good ground.

OPERATING AND TUNE UP PROCEDURE

Before attempting to tune the transmitter, make sure it is connected to a transmission line and antenna that will present a nominal load of 50 ohms or a non-reactive load with the proper power handling capabilities.

Before tuning the transmitter, refer to the factory test data sheets and check all dial readings to correspond with the data given on the factory test data sheets.

Switch S518 should be in the "local" position, switch S519 should be in the "tune" position.

After the installation is complete all input and output cables have been connected and the crystal oven has been operating for two hours or more punching the low voltage "ON" button applies primary voltages to all of the filaments, control circuits, the fan, the blower and the low voltage power supplies. Provision is made on the driver panel for

metering the grid bias voltage of the driver by means of a test point on the front panel. A meter such as a Simpson Model 260 or equivalent may be used. With the negative lead plugged into this test point and the positive lead grounded, a rise in grid voltage will be observed as the exciter comes up to operating temperature. This voltage should be approximately 15 to 20 volts. This is a good check on the exciter operation. Place switch S512 which is the test meter switch located on the bottom center of the amplifier panel, in the grid position, which is extreme counter-clockwise. Tune the grid circuit to resonance with control marked "grid tuning" and observe grid current on M502, this should be approximately 16 to 25 mils of grid current.

Press the high voltage ON button and tune the amplifier to resonance with the control marked "plate tune" and observe plate current on meter M503. It may be necessary to go back and re-resonate the grid circuit after high voltage is applied.

Load the amplifier to the required power by the control marked "RF output" turning control clockwise increases loading and counter-clockwise decreases loading. Observe power output on meter M505 which has been calibrated at the factory and reads power being delivered out of the transmitter to the transmission line. This meter has been calibrated and its calibrating controls locked in place and should not be tampered with without express authorization from the Gates Radio Company.

NEUTRALIZATION

Tuning of an FM transmitter in the frequency range of 88 to 108 Mcs, offers greater difficulties in regard to tuning various circuits than is normally encountered in the low AM frequencies. This is manifest in greater reaction between various circuits caused by small inductive and capacitive reactances that can normally be ignored at the lower frequencies, but which can become increasingly important at these high frequencies. Therefore, when tuning a high frequency transmitter, it is well to constantly re-check the previous adjustments as tuning progresses.

The transmitter has been properly neutralized at the factory on the customer's frequency with a 50 ohm non-reactive load. Due to rough handling during shipment neutralization may be affected. Improper neutralization is indicated by several abnormal conditions showing up in the operation.

1. When the grid current does not rise to maximum or near maximum simultaneously with a dip in plate current as the amplifier plate tank is tuned through resonance.

2. If excitation is removed from the amplifier and the PA grid relay does not open, this indicates oscillation in the power amplifier itself. This

self-oscillation produces grid current which holds the grid relay K506 closed, this keeps the plate voltage applied allowing the amplifier to continue its self-oscillation.

3. If the balance control R504 and R505 does not enable the two plate currents to maintain a balance within 10%, this condition will indicate improper neutralization.

4. A radical change in PA grid current from the value given on the factory test data sheet.

5. Spurious radiation detected across the band.

The neutralizing controls have been brought out to the front panel of the amplifier to a special machined bushing. In the center of this special bushing is a shaft with a machined screwdriver slot. It will be noted that on both this special bushing and the internal screwdriver slot shaft, there are two black dots. These two dots are aligned in a vertical position when the neutralizing capacitors are at maximum capacity.

It will also be noted that on this special bushing is a red dot which will appear directly opposite the black dot on the movable portion of the shaft. This red dot, on the special machined bushing, indicates the location of the neutralizing capacitors as they were set at the factory. These marks will serve as a good starting place if complete re-neutralization is required.

If any of the aforementioned conditions are observed when the transmitter is first placed in operation, this indicates that re-neutralization is in order. This is accomplished as follows:

1. Turn the high voltage OFF.

2. Remove the bottom cover from the PA tank.

3. Loosen the locking nuts on the rear of the neutralizing capacitor slightly, so that the capacitor shaft will turn free with a slight drag on the shaft.

4. Remove one of the leads from the high voltage rectifier stack, so as to reduce the plate voltage.

5. Replace the bottom cover plate on the amplifier tank.

6. Apply low plate voltage and adjust either C303 or C308 in one direction and again check for neutralization.

7. If improvement results adjust the other capacitor the same amount in the same direction and again re-check for neutralization.

8. Continue this procedure step-by-step rotating capacitor C303 and C308 in the direction that indicates the proper neutralization.

9. Replace the lead removed on the high voltage rectifier stack for normal operation and re-check neutralization.

10. Remove the bottom cover of the amplifier tank and re-tighten the locking nuts on the rear of the neutralizing capacitors, being careful not to move the adjustment while these locking nuts are being tightened.

GENERAL INFORMATION

There are some facts about the power amplifier that should be known and remembered that will help in good operation of the equipment and contribute to best operating results.

Tuning of the plate circuit changes the effective electrical length of the plate tank. Increasing the spacing between the tuning and the plate tank lines lengthens the effective length of the plate tank and lowers the frequency; decreasing the spacing will raise the frequency.

Switch S510 located on the power amplifier panel in the lower left hand corner is provided for checking individual cathode currents of V301 and V302 as well as the total plate current on both these tubes.

The balance control R504 and R505 is provided on the front panel to enable the operator to maintain a balance in plate currents.

S510 is used for relative balance indication of plate currents. This switch must be left in the normal or mid-position while the transmitter is operating, except on initial tune up or for checking balance between plate currents of the tubes. S512 is a multimeter switch which is used to read either total control grid current or individual screen grid currents of V301 and V302.

Protection against electrical shock from high voltage circuits are provided for by the door interlock switch S514. By removing the back door, S514 will open and immediately remove the high voltage from the amplifier. Forced air is provided for the amplifier tubes by a blower B301. B501 is provided to exhaust any hot air in the cabinet proper.

MICROMATCH OPERATION

On Drawing A-31735-2 is a complete schematic of the internal wiring for the Micromatch unit. The following is a description of this unit as used with the FM-1C transmitter.

On the Micromatch switching panel there are two controls which adjust the calibrating of the unit and a switch. One control has a knob which is the VSWR calibrating control, the other has a shaft lock. The control with the shaft lock adjusts the calibrating of the power function and is set at the factory and needs no further adjustment. The other control with the knob adjusts the calibration of the VSWR.

To calibrate the VSWR portion of the unit turn the switch to calibrate position and adjust the meter to full scale deflection using the control with the knob. Turn the switch to VSWR position and read the standing wave ratio on the lower scale of the meter.

To read forward power or power being delivered out of the transmitter to the transmission line, turn the switch to forward position and read power directly on M505.

REMOTE CONTROL

All necessary provisions for remote controlling the Gates FM-1C are built into the equipment.

1. Remote plate voltage metering is obtained from TB503 terminal 8 and is controlled by R521.

2. Remote plate current metering is obtained from TB503-7 and is controlled by R520.

3. The "LINE ON" function from the fail-safe relay in the remote control unit is connected to TB503-2 and TB503-3.

4. The plate ON function is connected between TB503-5 and TB503-6. Remove the jumper between the TB503-4 and TB503-5 for remote operation. Its function requires a momentary "on" type of function.

5. The plate OFF function is connected between TB503-5 and TB503-4. This function requires a momentary "off" type of function.

6. The remote overload reset function is connected between TB503-9 and TB503-10. This connection is 6 volt DC from a stepper position on the remote control unit.

7. The raise-lower functions are connected to TB1-1 and TB1-3 on the motor driven rheostat. (M4703C motor driven rheostat for remote control of power output not supplied.)

   In the case of the Gates RDC-10C, one side of the 115 V. primary voltage for the motor of M4703C is connected between TB101-7 on the exciter terminal board in the transmitter and TB1-2 on M4703C. The other side of the 115 V. AC line is connected to the common of the remote control unit which is TB2-27.

MAINTENANCE

Maintenance of the FM-1C should consist of periodic checking of tubes, meter readings, cleaning and visual inspection, lubricating places where required.

The use of air filters materially assists in keeping the transmitter interior clean, however, periodic removal of dust will still be necessary. Since electrostatic seals create dustcatchers, special attention should be paid to these places. Support insulators for the tank elements are probably the worst offenders and must be kept clean and free from all foreign material. Failure to do so may result in arc-over and shattering of the insulators. When inspection of the air filter discloses that it is filled with dust or foreign matter they should be discarded and replaced with a new one. The type of filter used in the FM-1C is a disposable type filter and is obtainable from most any local hardware or appliance store.

Once a month the blower and exhaust fan should be cleaned and checked for proper operations. A few drops of light machine oil should be dropped in the oil holes provided at each end of the blower motor. The exhaust fan has sealed bearings and needs no attention.

Once a month the entire transmitter should be cleaned of dust. In the case of the power amplifier, remove the back cover and the enclosure should be wiped clean of dust. The two protective relays should have the dust cleaned as required and contacts burnished with a burnishing tool. Each relay is protected with a dust cover and are telephone type relays and will require little or no attention.

This transmitter is a precision electrical device and as such, should at all times be kept clean and free from dirt and dust. Dust shortens the life of many components due to flashovers, arcs, etc., which damage the same. A small brush or soft rag can be used very effectively in keeping the equipment clean.

A good preventative maintenance schedule will provide best assurance of trouble-free transmitter operation.

PARTS LIST

FM-1C 1KW TRANSMITTER

Symbol No.	Gates Part No.	Description
B501	430 0002 000	Fan, 115V., 50/60 cy. 1500 RPM, 650 cfm.
C501,C502	510 0246 000	Cap., 4.0 mfd., 5000 V.(W)
F501,F502	398 0186 000	Fuse, 30 amp., 230 V.
L501,L502	476 0105 000	Choke, 10 Hy.
R501	552 0405 000	Rheostat, 15 ohm, 150 W.
R502,R503	540 0618 000	Res., 2000 ohm, 2W. 5%
(R504,R505)	552 0721 000	Rheostat, 2 Section in tandem, 300 ohm per section
R506,R507, R517	542 0056 000	Res., 20 ohm, 10W.
R508	542 1051 000	Res., 2.5 ohm, 10W.
R509	550 0029 000	Control, 10K ohm
R511	548 0004 000	Res., 5 meg. meter multiplier
R513	542 0565 000	Res., 100K ohm, 190 W.
R510	550 0067 000	Control, 10K ohm
S509,S511	600 0162 000	Switch, rotary
S510	600 0302 000	Switch, 1 section, 3 circuit 5 position
S512	600 0280 000	Switch, Rotary
S513	604 0208 000	Switch, Pressure
S514	604 0061 000	Interlock Switch
S516	926 6665 001	Interlock Switch and Grounding Hook Assembly
T301,T302	472 0111 000	Transformer, P.A. Filament
T501	472 0307 000	Transformer, Power
TB501	614 0047 000	Terminal Board, Audio
TB502,TB517	614 0092 000	Terminal Board, 115V. A.C.
TB506	614 0052 000	Terminal Board, Contactor Panel
TB507	614 0046 000	Terminal Board, Fan
TB510	614 0100 000	Terminal Board, Contactor Panel
TB511	614 0093 000	Terminal Board, Powerstat
TB514	614 0046 000	Terminal Board
XF501	931 8443 001	Fuse Holder Ass'y

METER PANEL

Symbol No.	Gates Part No.	Description
M501	630 0049 000	Meter, Fil. Volt 3-1/2" 0-10V. AC (non-magnetic panel)
M502	632 0074 000	Meter, PA Grid Current, 3-1/2" 0-50 MA DC (non-magnetic panel)
M503	632 0026 000	Meter, PA Plate Current, 3-1/2" 0-1 amp. DC (non-mag. panel)
M504	632 0148 000	Meter, Plate Voltage, 3-1/2" 0-1 MA DC movement W/0-5000 DC Scale (non-magnetic panel)
M505	913 1256 001	Meter, R.F. Output
C503,C504,C505, C506,C507	516 0082 000	Meter By-Pass Cap., .01 mfd., 1KV

AMPLIFIER TANK

Symbol No.	Gates Part No.	Description
B301	432 0026 000	Blower, 115V. 50/60 cycles.CCW
C303,C308	520 0091 000	Cap., Variable, 50 mmfd.
C304,C305, C306,C307	516 0204 000	Cap., 100 mmfd., 5000 V.(W)
C311	520 0249 000	Cap., Variable, 20 uuf.
C312	516 0233 000	Cap., 500 mmfd., 30 KV.
C313,C314		Neut. Padding Condenser (Det by Freq.)
DC501	620 0034 000	Micro-Match, 0-1200 W. 50 ohm.
J301	612 0232 000	Receptacle "N"
J302	612.0230 000	Receptacle "UHF"
L301	813 1281 001	Plate Choke
L302,L303 L306	494 0004 000	Choke, 7 Microhy.
L304	813 1532 001	Input Grid Coil
L305	813 1531 001	Input Coupler Coil
L309	926 5524 001	Plate Line Assembly
L310	813 1060 001	Output Coupling Loop
L311	910 9741 001	Monitor Loop Assembly
R301,R304, R305	540 0728 000	Res., 100 ohm, 2W. 10%
R306	542 0085 000	Res., 3500 ohm, 10W.
R307	542 0088 000	Res., 5000 ohm, 10W.
R308,R309	540 0740 000	Res., 1000 ohm, 2W. 10%
R310	542 0136 000	Res., 2000 ohm, 20W.
TB301	614 0113 000	Terminal Board
TB302	614 0092 000	Terminal Board

Symbol No.	Drawing No.	Description
V301,V302	374 0010 000	Tube 4-400A
XV301, XV302	404 0055 000	Socket

CONTROL PANEL

Symbol No.	Drawing No.	Description
A501,A505,A506 A507,A508	396 0105 000	Lamp, 14 V.
A503	396 0062 000	Lamp, Neon
R518,R519	540 0202 000	Res., 100K ohm, 1/2W. 10%
S502,S506	604 0067 000	Switch, Pushbutton, Black
S503,S507	604 0069 000	Switch, Pushbutton, Red
S517	604 0150 000	O.L. Reset Pushbutton Switch
S518,S519	604 0032 000	Toggle Switch, D.P.D.T.
XA501	406 0052 000	Pilot Light Assembly, Green
XA503	406 0051 000	Pilot Light Assembly, Red
XA505,XA506, XA507,XA508	406 0053 000	Pilot Light Assembly, Amber

CONTACTOR PANEL

Symbol No.	Drawing No.	Description
CR501,CR502	386 0015 000	Silicon Diode, 10 V.
K501,K503	570 0055 000	Contactor, 4 pole, 25 amp. 230V.
K502	574 0074 000	Relay, 6V. A.C., S.P.D.T.
K505,K506	572 0025 000	Relay, 2-C
K507	574 0014 000	Relay, 6V. D.C., S.P.D.T.
R514	542 0056 000	Res., 20 ohm., 10W.
R515	542 0085 000	Res., 3.5K ohm, 10W.
R516	550 0061 000	Control 1K ohm 2W.
R520,R521	550 0057 000	Control, 250 ohm, 2W.
TB503	614 0054 000	Terminal Board
TB504,TB505	614 0104 000	Terminal Board
TB513	614 0034 000	Terminal Board, O.L. Relay Deck
TB515	614 0092 000	Terminal Board
TB516	614 0094 000	Terminal Board

4000V. SILICON RECTIFIER BOARD ASSY.

Symbol No.	Drawing No.	Description
	384 0020 000	Silicon Diode 1N - 2071, 96 Qty.
	516 0054 000	Cap., .001 uf., 1 KV. 96 Qty.
	540 0097 000	Res., 100K ohm., 1/2 W. 5%, 96 Qty.
	542 0059 000	Res., 75 ohm., 10 W. 2 Qty.

PARTS LIST

M-5652A POWER SUPPLY

Symbol No.	Gates Part No.	Description
C201,C202	510 0071 000	Capacitor, 8 mfd., 1000V. D.C.
F201	398 0015 000	Fuse, 1/2 amp., 250 V.
F202	398 0079 000	Fuse, Slo-Blo, 1-1/2 amp. 125V.
L201,L202	476 0017 000	Filter Reactor
R201	542 0163 000	Resistor, 100K ohm, 20W.
T202	472 0090 000	Filament Transformer
T203	472 0017 000	Plate Transformer
TB201	614 0076 000	Terminal Board
TS201,TS202	614 0189 000	Tie Point
XF201,XF202	402 0021 000	Fuseholder
XV201	404 0016 000	Socket

600V. SCREEN RECTIFIER BOARD ASSEMBLY

Symbol No.	Gates Part No.	Description
C801 thru C820	516 0054 000	Cap., .001 uf. 1 KV
CR801 thru CR820	384 0020 000	Silicon Diode, 1N2071
R801,R802	540 0728 000	Res., 100 ohm, 2W., 10%

M-4845 RF OUTPUT EXTENSION KIT

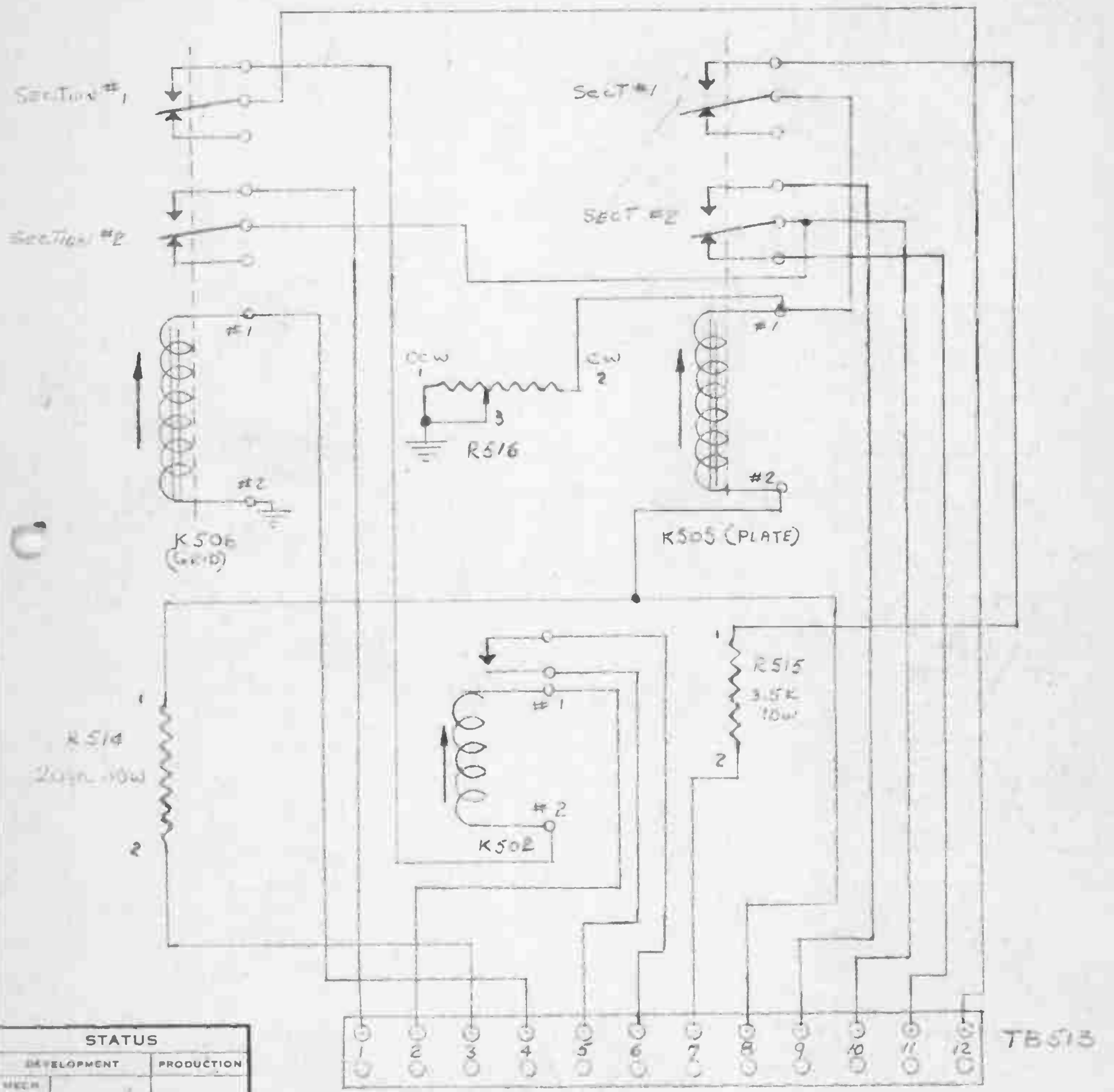
Symbol No.	Gates Part No.	Description
A1	384 0006 000	Diode
C1,C2	516 0054 000	Cap., .001 mfd., 1 KV
J1	612 0230 000	Receptacle "UHF"
L2	494 0004 000	R.F. Choke, 7 microhy.
	610 0231 000	Plug, UHF
R1	552 0545 000	Control, 1000 ohm
R2	540 0178 000	Res., 1K ohm, 1/2 W., 10%
R3,R4	540 0728 000	Res., 100 ohm, 2W., 10%
TB1	614 0069 000	Terminal Board

GATES RADIO COMPANY
QUINCY, ILLINOIS

813 6026 001

SCALE

104	103	102	101	GR. NO. / FIRST MADE FOR	LIST OF PARTS				
QTY.	QTY.	QTY.	QTY.	ITEM	REFERENCE	PT. OR G.N.	FIN.	DESCRIPTION	MATL.



STATUS	
DEVELOPMENT	PRODUCTION
MECH. CHK.	
PROJ. ENG.	
PRODUCTION BY	

CH. BY
DATE
DR. BY
DATE

MTL.
ENG.
FIN.

TITLE
O.L. RELAY DECK
10 KW DRIVER — FM-1B

UNLESS OTHERWISE SPECIFIED ALL TOLERANCES PER GATES SPEC GSM102

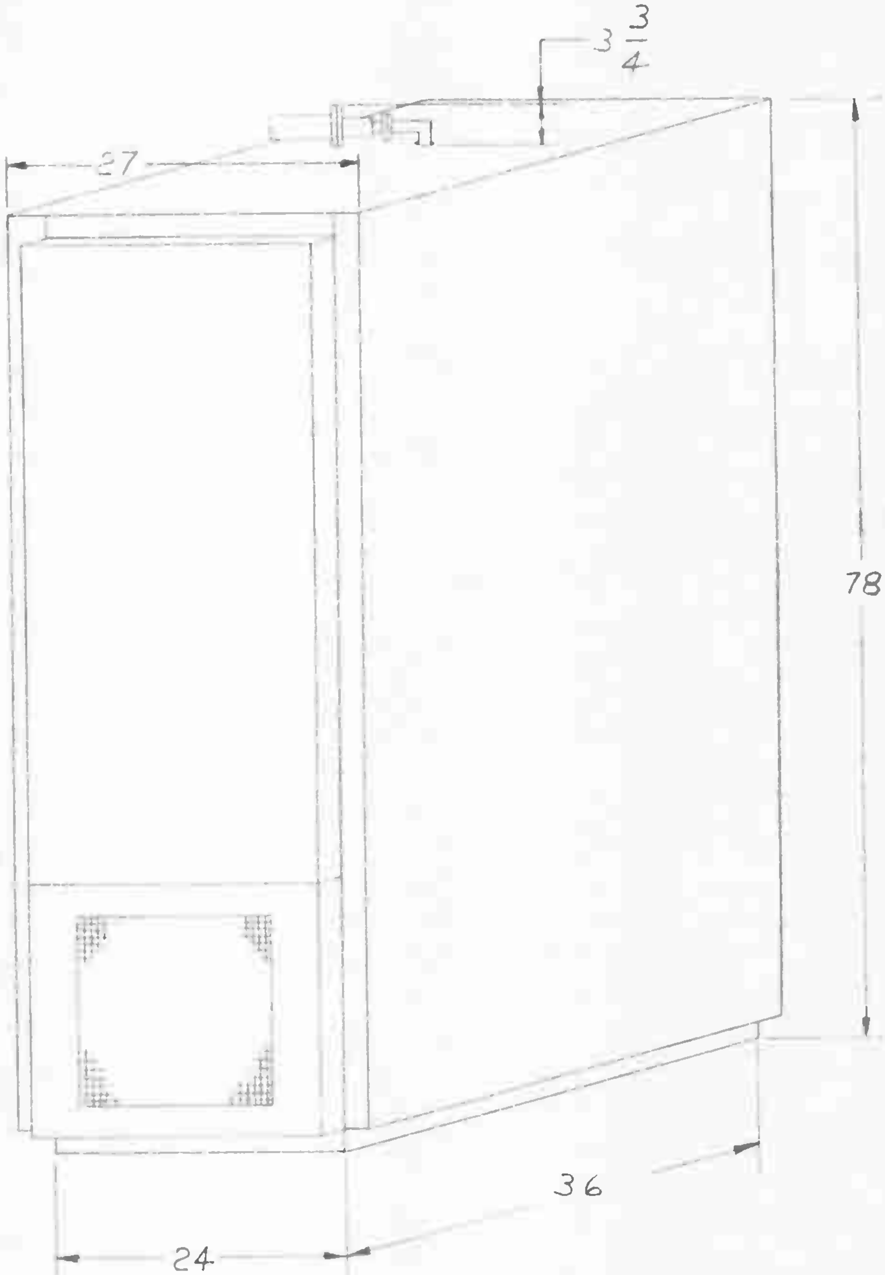
813 6026 001

GATES RADIO COMPANY
QUINCY, ILLINOIS

813 5901 001

SCALE

104	103	102	101	GR NO.	FIRST MADE FOR				
					LIST OF PARTS				
QTY.	QTY.	QTY.	QTY.	ITEM	REFERENCE	PT. OR G.N.	FIN.	DESCRIPTION	MATL.



STATUS

DEVELOPMENT		PRODUCTION
MECH CHK		
PROJ ENG		
PROD. DUCTION BY		

CH. BY	MTL —	TITLE
DATE		FILTER INSTALLATION
DR. BY	ENG	FIN. —	FM1B M-5597
DATE		

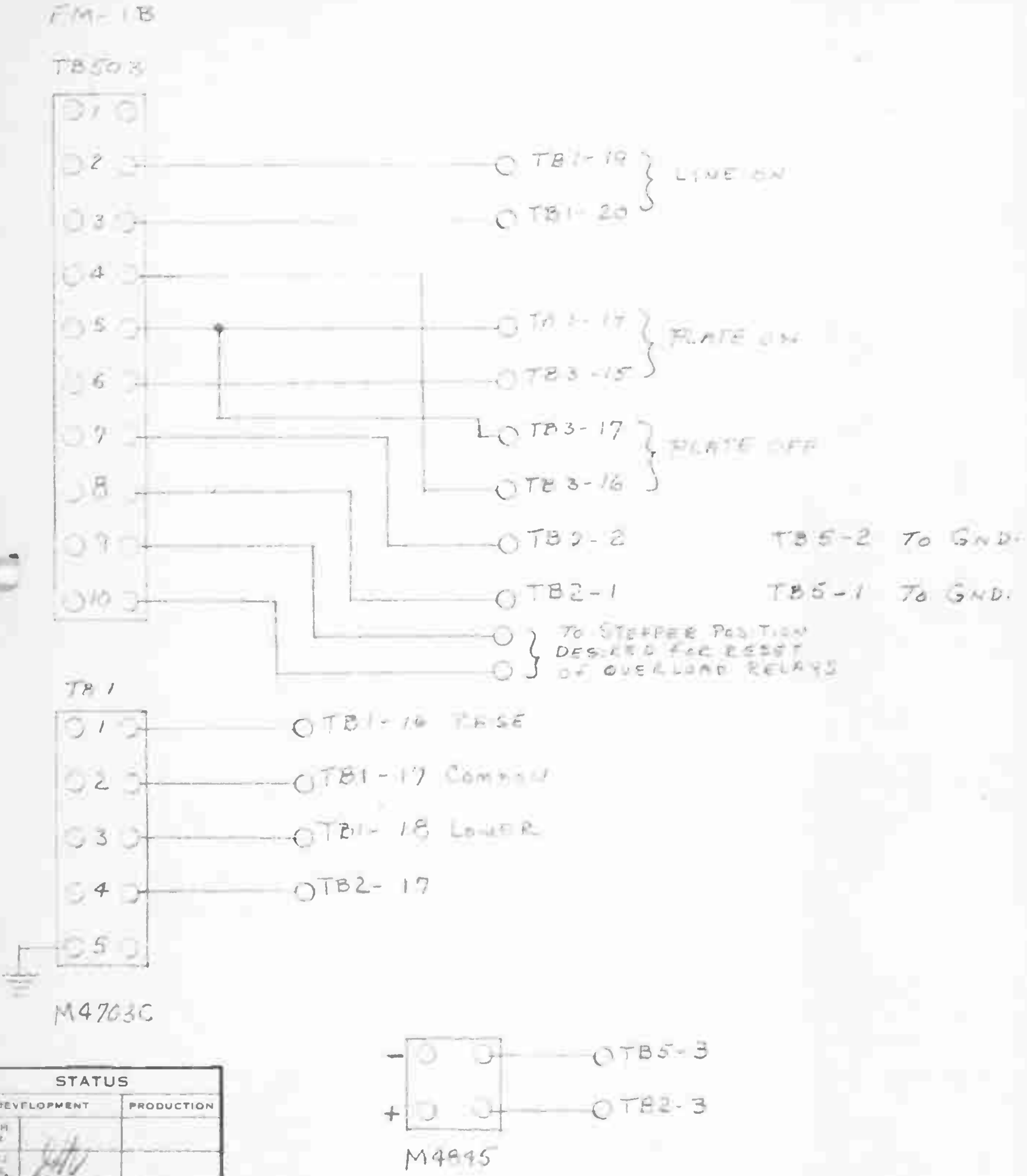
UNLESS OTHERWISE SPECIFIED ALL TOLERANCES PER GATES SPEC GSM102

813 5901 001

GATES RADIO COMPANY
QUINCY, ILLINOIS

813-5904-001
SCALE

104	103	102	101	GR. NO.	LIST OF PARTS				
QTY.	QTY.	QTY.	QTY.	ITEM	REFERENCE	PT. OR G.N.	FIN.	DESCRIPTION	MATL.

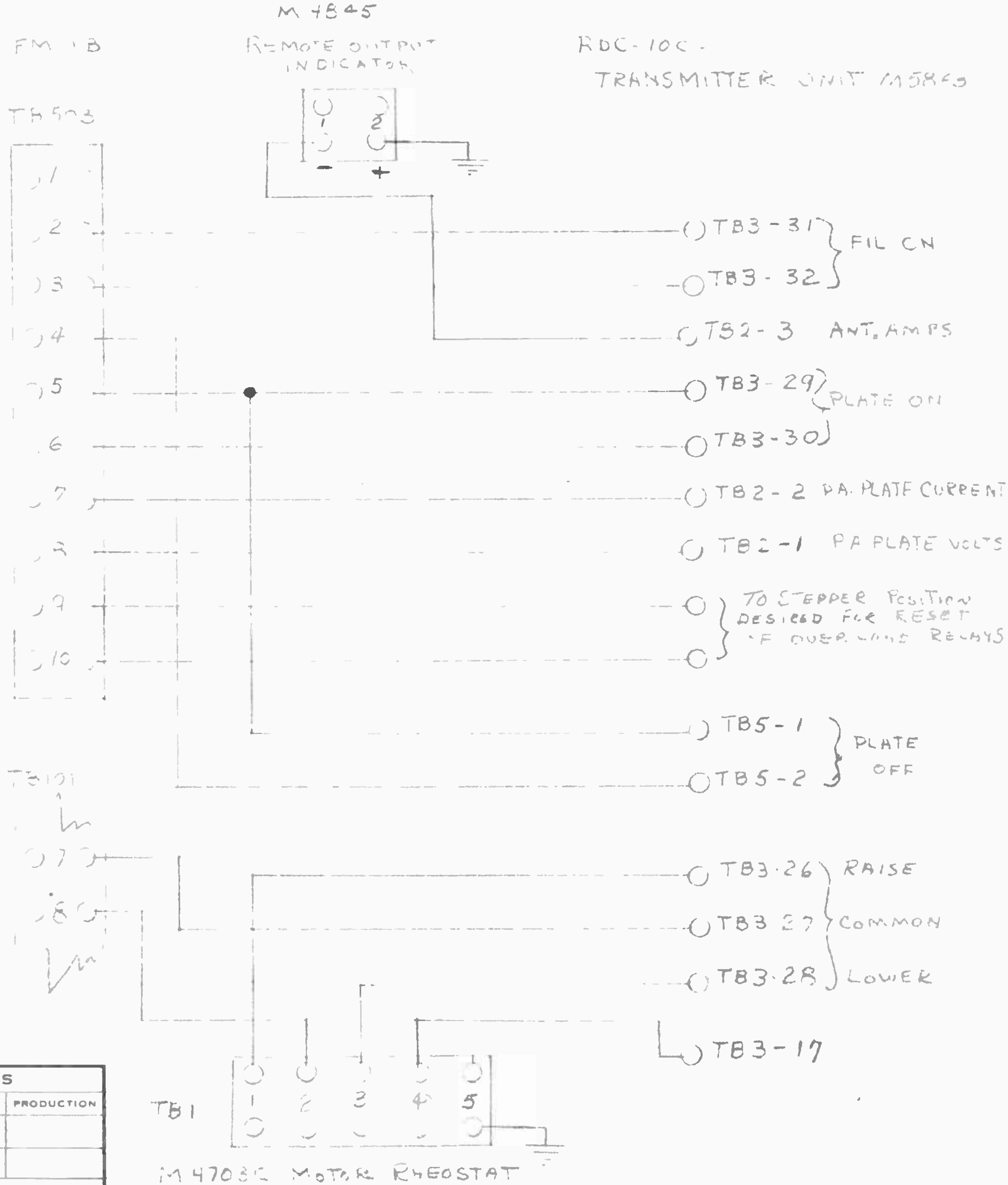


STATUS	
DEVELOPMENT	PRODUCTION
MECH. CHK.	
PROJ. ENG.	

CH. BY	MTL	TITLE	UNLESS OTHERWISE SPECIFIED ALL TOLERANCES PER GATES SPEC G5M102
DATE		REMOTE CONTROL CONNECTIONS	
DR. BY R.V. DATE 3-17-61	ENG. R.V. FIN	RDC-200A – FM-1B	813-5904-001

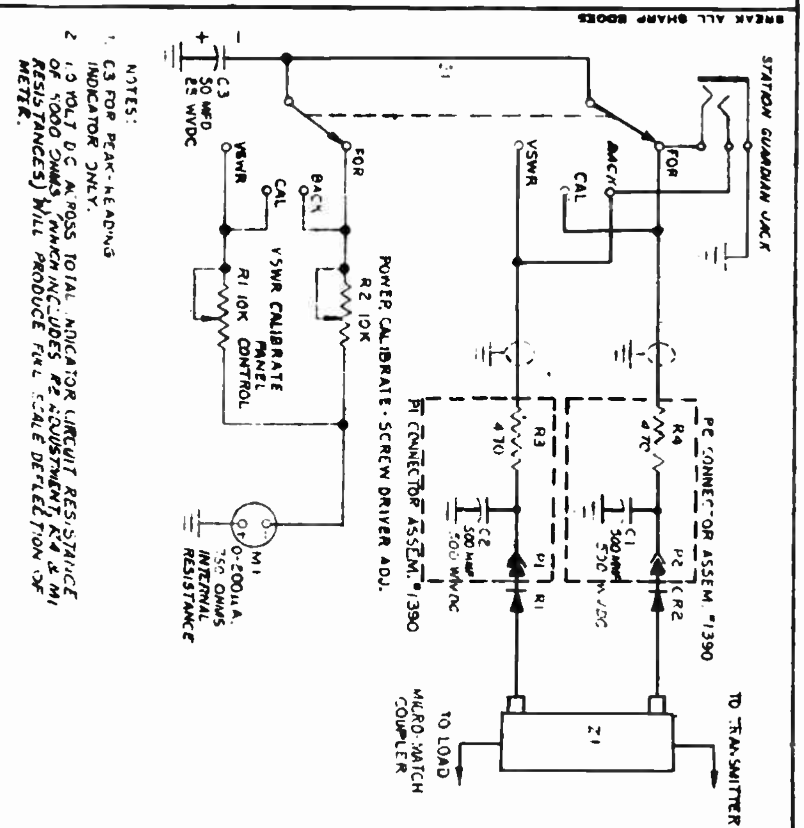
				FIRST MADE FOR	GATES RADIO COMPANY QUINCY, ILLINOIS		813-5903-001
							SCALE
104	103	102	101	GR. NO.	LIST OF PARTS		

QTY.	QTY.	QTY.	QTY.	ITEM	REFERENCE	PT. OR G.N.	FIN.	DESCRIPTION	MATL.



STATUS	
DEVELOPMENT	PRODUCTION
MECH CHK	
PROJ ENG	
APPROV PRODUCTION BY	

CH. BY	MTL		TITLE	UNLESS OTHERWISE SPECIFIED ALL TOLERANCES PER GATES SPEC GSM102.
DATE			REMOTE CONTROL CONNECTIONS	
DR. BY G.V.	ENG G.V.	FIN.	RDC-10C - FM-1B	813-5903-001
DATE 3-17-61				

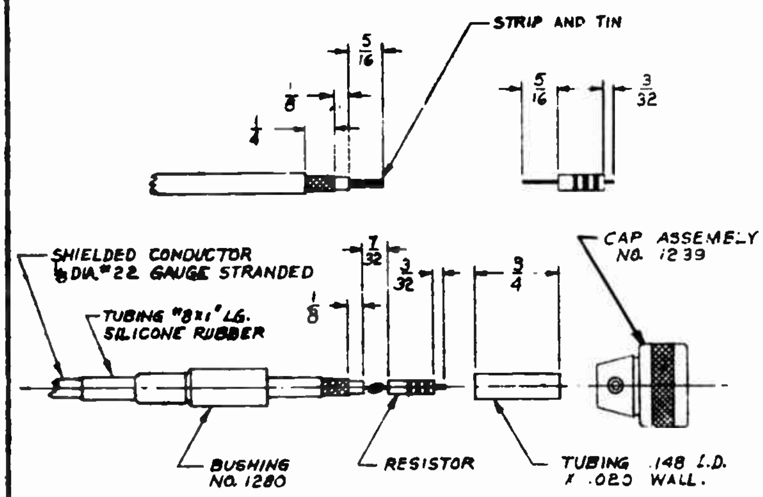


A-31735
SHEET 2 of 2

A-31735
SHEET 2 of 2

A-31735
SHEET 1 of 2

QUANTITY				PART NO	DESCRIPTION	ITEM
C4	C3	C2	C1			



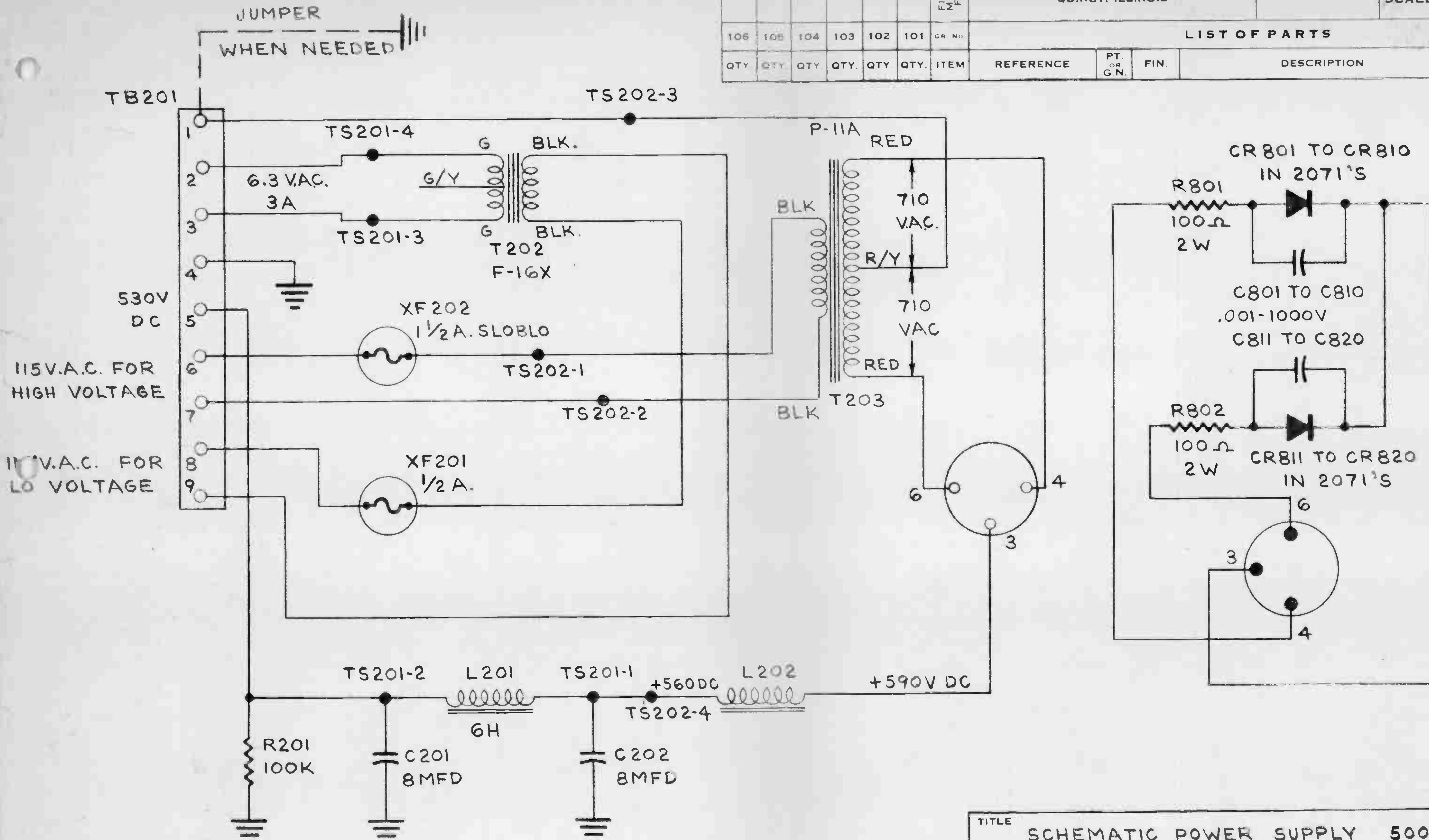
ASSEMBLY PROCEDURE

1. Prepare shielded wire and resistor as shown.
2. Bend loop in cable center conductor and long resistor lead. Crimp together and solder.
3. Assemble as shown. Slide tubing over resistor to cover soldered joint. Solder short resistor lead to capacitor in cap. Keep solder below rim of crystal contact ring.
4. Slide bushing over tubing and into cap assembly. Tighten set screw. Solder shield through hole in bushing.
5. Slide rubber tubing over wire and small diameter of bushing.

BREAK ALL SHARP EDGES

A-31735
SHEET 1 of 2

						FIRST MADE FOR	GATES RADIO COMPANY QUINCY, ILLINOIS				826-8394-001 SCALE
106	105	104	103	102	101	GR NO	LIST OF PARTS				
QTY.	QTY.	QTY.	QTY.	QTY.	QTY.	ITEM	REFERENCE	PT. OR G.N.	FIN.	DESCRIPTION	MATERIAL



STATUS	
DEVELOPMENT	PRODUCTION
MECH CHK	
PROJ ENG	
APPROV PRODUCTION BY	

ECN 9070 8-13-28-62

TITLE SCHEMATIC POWER SUPPLY 500V 200MA

M-5652A

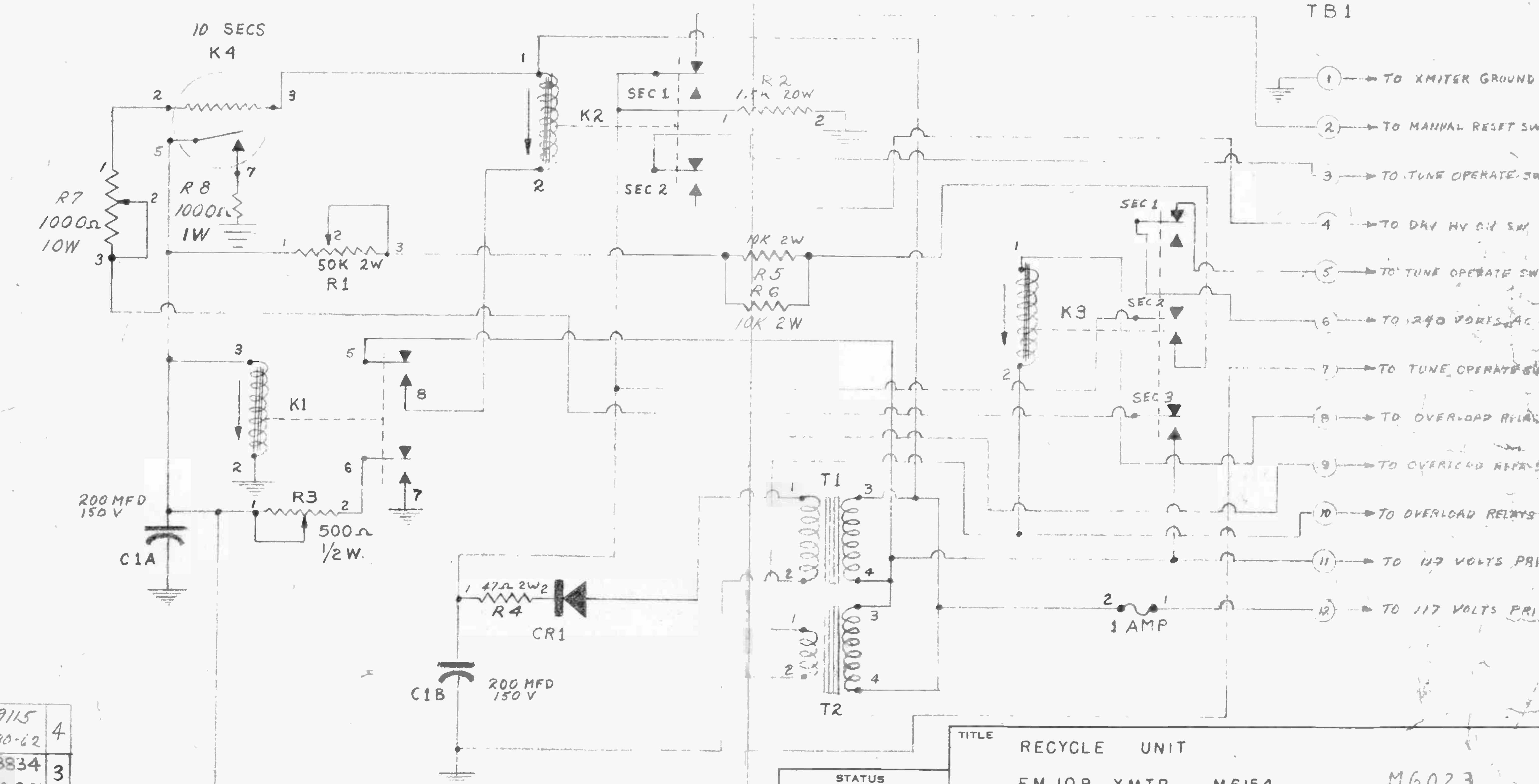
MTL	FIN.	UNLESS OTHERWISE SPECIFIED ALL TOLERANCES PER GATES SPEC GBM102
DR. BY H.A. DATE 1-2-62	CH. BY V.P.	ENG.	SHEET OF	826-8394-001

826 7314 001

FIRST MADE FOR	GATES RADIO COMPANY QUINCY, ILLINOIS		B-67314 SCALE

LIST OF PARTS

106	105	104	103	102	101	GR No					
QTY.	QTY.	QTY.	QTY.	QTY.	QTY.	ITEM	REFERENCE	PT. OR G.N.	FIN.	DESCRIPTION	MATERIAL



ECN 9115 RJ 4-30-62	4
ECN 8834 10-6-61	3
ECN 8661 5-29-61 AWC	2
ECN 8559 RAJ 2-16-61	1

STATUS	
DEVELOPMENT	PRODUCTION
MECH CHK.	
PROJ ENG. G.A.V.C.B.	
APPROV PRODUCTION BY	

TITLE RECYCLE UNIT

FM 10B XMTR M6154

M6023

MTL		FIN.	UNLESS OTHERWISE SPECIFIED, ALL TOLERANCES PER GATES SPEC GSM102
DR. BY W.L.H. DATE 5-61	CH. BY	W. HARNESS	SHEET 1 OF 1	B-67314

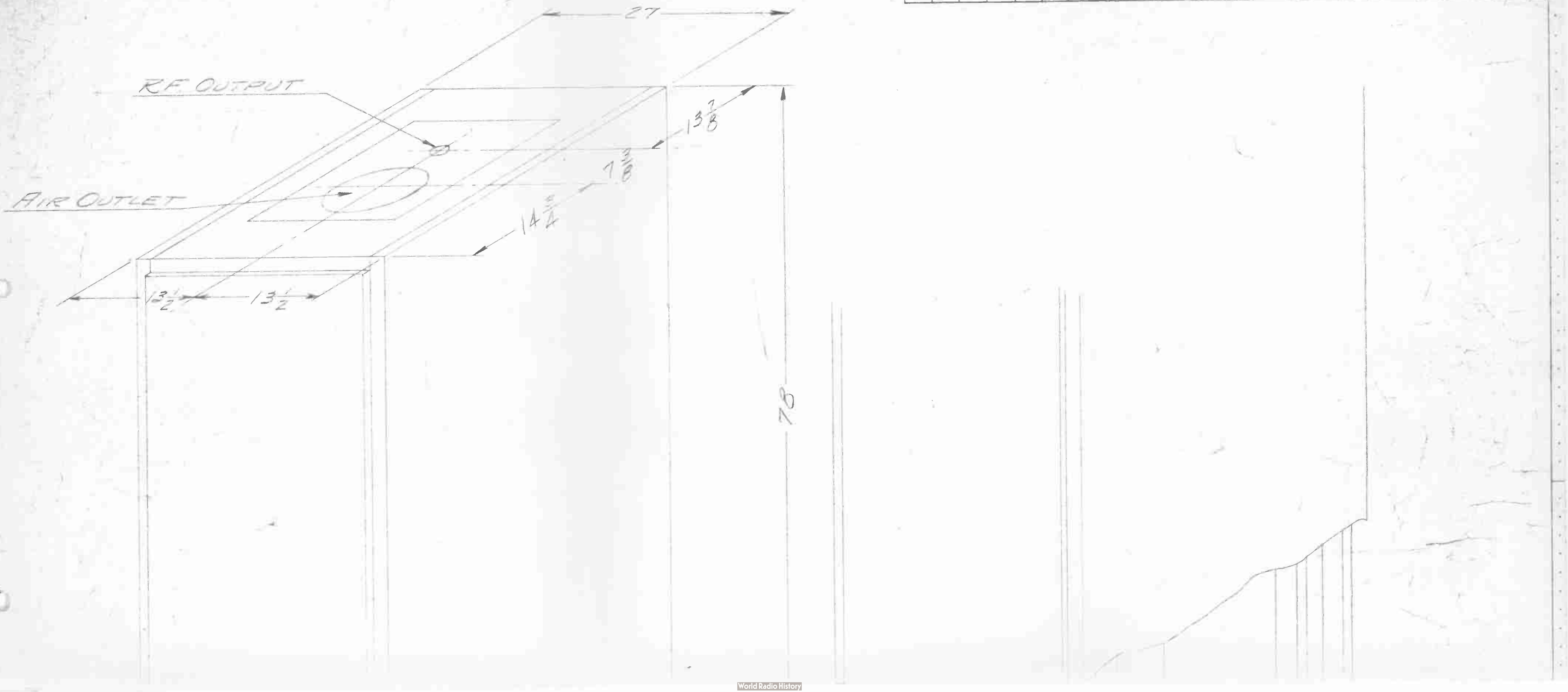
826 7314 001

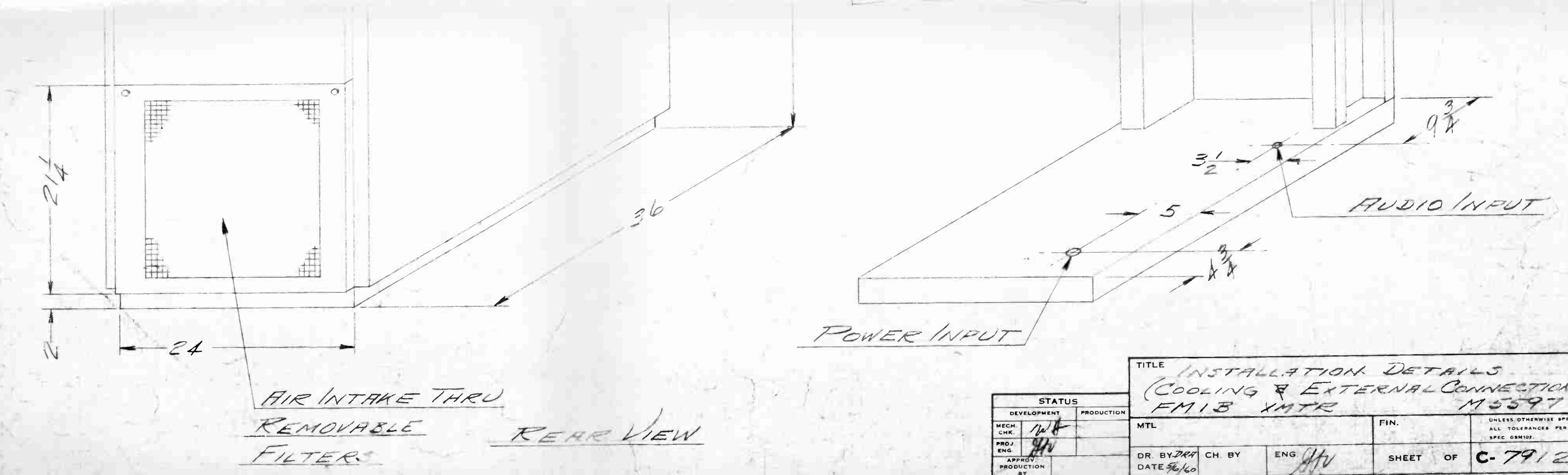
GATES RADIO COMPANY
QUINCY, ILLINOIS

C-74128

SCALE

						FIRST MADE FOR	LIST OF PARTS				
106	105	104	103	102	101						
QTY.	QTY.	QTY.	QTY.	QTY	QTY	ITEM	REFERENCE	PT. OR G.N.	FIN	DESCRIPTION	MATERIAL



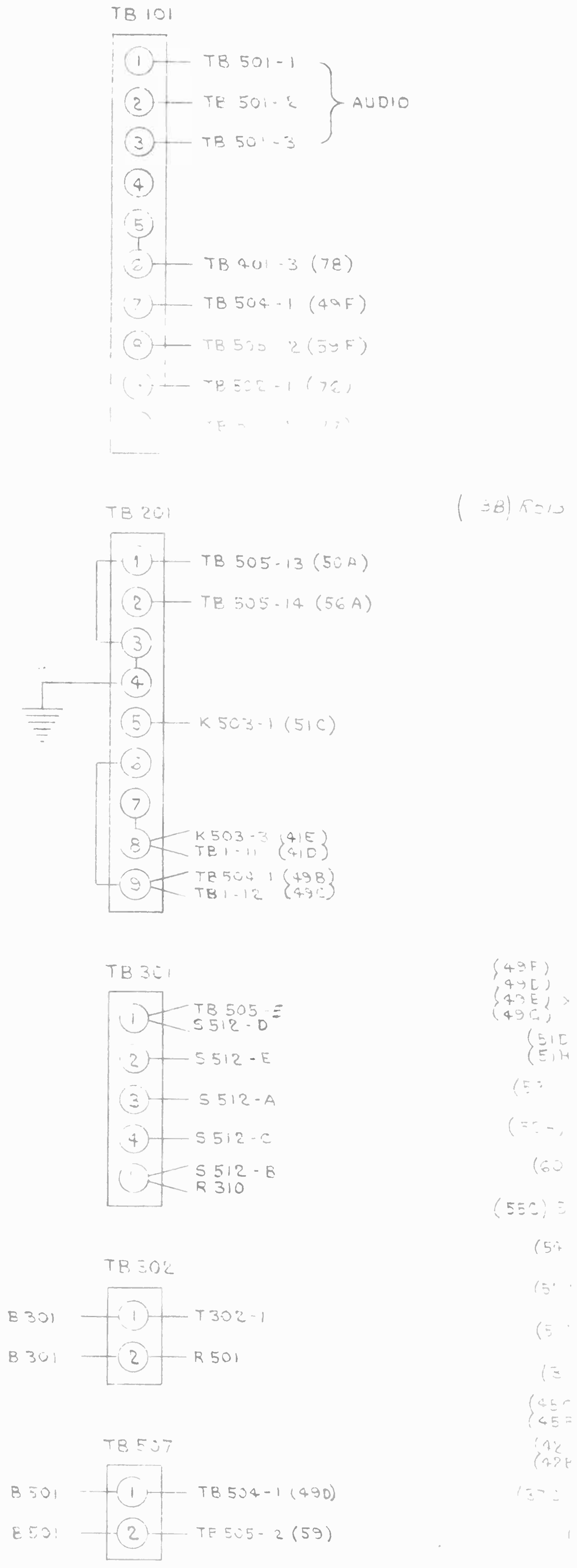


TITLE	INSTALLATION DETAILS (COOLING & EXTERNAL CONNECTIONS) FM1B XMTR M5597
STATUS: DEVELOPMENT / PRODUCTION	MECH. CHK. / PROJ ENG / APPROV. PRODUCTION BY
MTL	FIN.
UNLESS OTHERWISE SPECIFIED ALL TOLERANCES PER GATES SPEC GSM102.	
DR. BY DRA DATE 5/6/60	CH. BY
ENG	SHEET OF
C-79128	


GATES RADIO COMPANY
QUINCY, ILLINOIS
342 3513 001
SCALE
LIST OF PARTS
QTY
ITEM
REFERENCE
DESCRIPTION
MATERIAL
AUTOMATIC RECYCLING UNIT, B-67314 SCHEMATIC
TB1
M6023
GND
K507 N.C.
TB510-3
S519 SECT B-2
K503-10
TB513-5
S519 SECT A-1
K503-3
TB505-2
TB519-9
TB505-10
TB513-10
TB513-2
NOTE:
FOR REMOTE CONTROL
POWER ADJUST (FM1C)
REMOVE THIS CONNECTION
AND SUBSTITUTE M4703
MOTOR RHEOSTAT.
TB501
AUDIO
TB101
EXCITER
M6095
J101
P101
TB507
B501
CABINET FAN
TB302
B301
PA BLOWER
R501
15Ω 150W
PA FILAMENT ADJUST
T301
T302
R503 2000Ω
R502 2000Ω
R504 300Ω
R506 20Ω 10W
R505 300Ω
R507 20Ω 10W
TB514
R517 20Ω 10W
TB401
P401
J401
DRIVER
M5675
J402
P402
TO J301
XA501
LOW VOLTAGE
GND
6.3V FIL
500V DC
115V AC
115V AC
C506 .01
EP
M504
R511, 5 MEG
L501
L502
48-1N2071
75Ω 10W
BOTH
LEFT
RIGHT
R508 25Ω 10W
C505 .01
IP
M503
S510
CR502 10V ZENER
REMOTE IP
R520 25Ω
3500V D.C.
TB503-8
C312 500
L301
J302
L311
L309
L310
FOR
GRE
VSWR
S509
R510 10K
R509 10K
C507 .01
RF
M505
POWER OUTPUT
RF OUT
RED
YELLOW
DC 501
C311

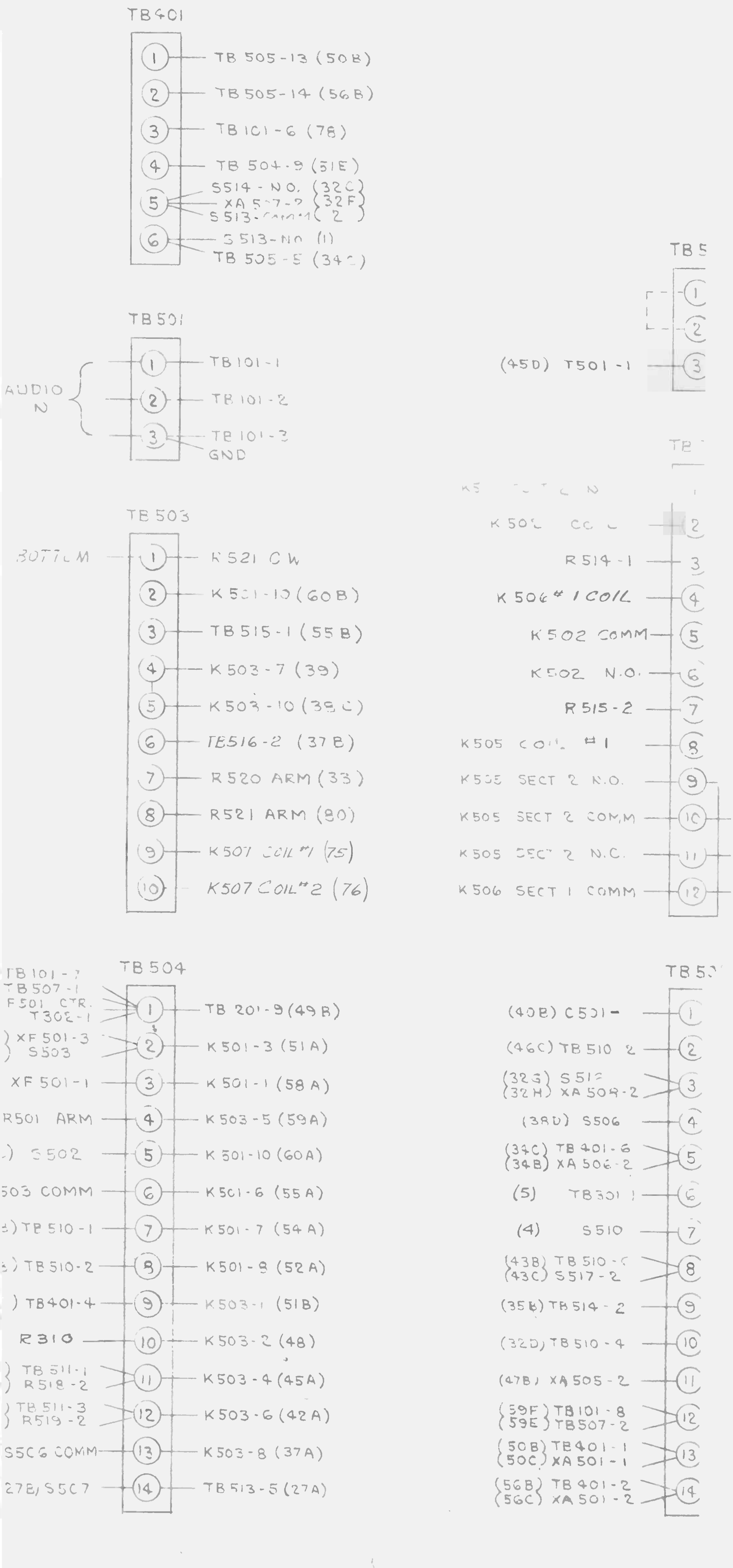
POWER SUPPLY
M5652 A
48-.001 MFD
48-.001 MFD
48-100K
75Ω
10W
48-IN2071
SILICON BOARD ASS'Y
IN AMP.
TB510-1
TB510-2
500V.DC
XR503
HI VOLTAGE
115V.A.C.
115V.A.C.
T501
500V.DC
R310
2000Ω
20W
TB513-7
R515
3.5K
10W
TB513-9
TB513-12
TB513-10
R514
20Ω 10W
K505
PLATE
O.L.
K506
GRID
U.C.
1K
R516
TB1-10
6V.A.C.
PLATE
GRID
DOOR
AIR
REMOTE
EP
R309
R301
R305
100Ω
R306
3500Ω
10W
R307
5000Ω 10W
C304
C305
100
100
L305
L306
J301
C306
C307
100
100
C308
50
R304
100Ω
TB301
S512
C504
.01

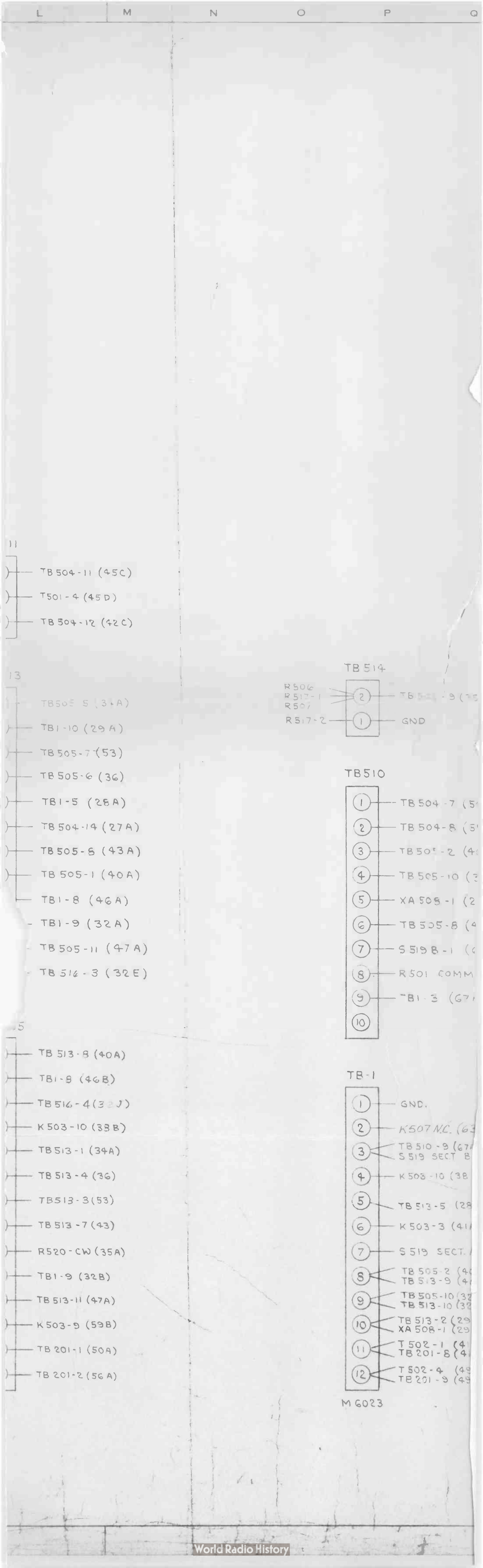
K501
S518B
K503
TB513-6
S502
ON
S503
OFF
S506
ON
S507
OFF
S518 SHOWN IN LOCAL POSITION
K502
INTERLOCK AUX.
XA505
XA506
XA508
XA507
D E H C
1 2 3 4 5
IG
ISG
M502
N.C.
N.O.
NC
NO
S516
S514 DOOR
S513 AIR
TB401-6
TB511
TB807
S518A
LOCAL-REMOTE
TB503
REMOTE CONTROL TERM. BRD.
K507
REMOTE O.L. RESET
TB1-2
NOTE: FOR REMOTE CONTROL OPERATION REMOVE JUMPERS 4 TO 5
S517
TB505-8
O.L.RESET
K507 ARM
S519B
TB510-7
TB1-3
TB1-7
S519A
"TUNE-OPERATE" SWITCH
SHOWN IN OPERATE POSITION
F806 8A
F804 15A
F807 8A
L808
T808
PLATE VOLTAGE ADJUST
NOTE: ASSEMBLY SHOWN IN DOTTED LINES LOCATED IN CENTER CABINET FOR FM15/20
OFF
S511
VF
C503 .01
M501
NOTE: ALL RELAYS & CONTACTORS SHOWN DE-ENERGIZED AIR OFF DOOR OPEN
ECN 8957 1-15-62
FOR FMIC WITH SERIAL NO. AFTER 67783
TITLE
OVERALL SCHEMATIC FMIB & DRIVER FOR FM 15/20B
M-5597
STATUS
DEVELOPMENT
PRODUCTION
MTL
FIN
DR
CH BY
ENG.
SHEET
OF
842-3513-001



TB 101
TB 501-1
TB 501-2
TB 501-3
AUDIO
TB 401-3 (78)
TB 504-1 (49F)
TB 505-2 (59F)
TB 201
TB 505-13 (50A)
TB 505-14 (56A)
K 503-1 (51C)
K 503-3 (41E)
TB 1-11 (41D)
TB 504-1 (49B)
TB 1-12 (49C)
TB 301
TB 505-E
S 512-D
S 512-E
S 512-A
S 512-C
S 512-B
R 310
TB 302
B 301
B 301
T 302-1
R 501
TB 507
B 501
B 501
TB 504-1 (49D)
TB 505-2 (59)

G H I J K


TB401
1 TB 505-13 (50B)
2 TB 505-14 (56B)
3 TB 101-6 (7B)
4 TB 504-9 (51E)
5 S514-NO. (32C)
XA 507-2 (32F)
S513-COMM (2)
6 S513-NO (1)
TB 505-5 (34C)
TB501
AUDIO IN
1 TB 101-1
2 TB 101-2
3 TB 101-3
GND
TB 503
BOTTOM
1 K521 CW
2 K501-10 (60B)
3 TB 515-1 (55B)
4 K 503-7 (39)
5 K 503-10 (39C)
6 TB516-2 (37B)
7 R520 ARM (33)
8 R521 ARM (80)
9 K507 COIL #1 (75)
10 K507 COIL #2 (76)
TB 504
TB 101-?
TB 507-1
F501 CTR.
T302-1
XF 501-3
S503
XF 501-1
R501 ARM
S502
503 COMM
TB 510-1
TB 510-2
TB401-4
R310
TB 511-1
R518-2
TB 511-3
R519-2
S506 COMM
27E/S507
1 TB 201-9 (49B)
2 K501-3 (51A)
3 K501-1 (58A)
4 K503-5 (59A)
5 K501-10 (60A)
6 K501-6 (55A)
7 K501-7 (54A)
8 K501-8 (52A)
9 K503-1 (51B)
10 K503-2 (48)
11 K503-4 (45A)
12 K503-6 (42A)
13 K503-8 (37A)
14 TB 513-5 (27A)
TB 5
(45D) T501-1
K502 COIL
R514-1
K 506 #1 COIL
K502 COMM
K502 N.O.
R515-2
K505 COIL #1
K505 SECT 2 N.O.
K505 SECT 2 COMM
K505 SECT 2 N.C.
K506 SECT 1 COMM
TB 50
1 (40B) C501
2 (46C) TB 510-2
3 (32G) S512
(32H) XA 509-2
4 (38D) S506
5 (34C) TB 401-6
(34B) XA 506-2
6 (5) TB 301
7 (4) S510
8 (43B) TB 510-6
(43C) S517-2
9 (35B) TB 514-2
10 (32D) TB 510-4
11 (47B) XA 505-2
12 (59F) TB 101-8
(59E) TB 507-2
13 (50B) TB 401-1
(50C) XA 501-1
14 (56B) TB 401-2
(56C) XA 501-2


L
M
N
O
P
Q
TB 504-11 (45C)
T501-4 (45D)
TB 504-12 (42C)
13
TB505-5 (34A)
TB1-10 (29A)
TB 505-7 (53)
TB 505-6 (36)
TB1-5 (28A)
TB 504-14 (27A)
TB 505-8 (43A)
TB 505-1 (40A)
TB1-8 (46A)
TB1-9 (32A)
TB 505-11 (47A)
TB 516-3 (32E)
TB 513-8 (40A)
TB1-8 (46B)
TB 516-4 (32J)
K 503-10 (33B)
TB 513-1 (34A)
TB 513-4 (36)
TB513-3 (53)
TB 513-7 (43)
R520-CW (35A)
TB1-9 (32B)
TB 513-11 (47A)
K 503-9 (59B)
TB 201-1 (50A)
TB 201-2 (56A)
TB 514
R506
R517-1
R507
R517-2
GND
TB510
TB 504-7
TB 504-8
TB 505-2
TB 505-10
XA 508-1
TB 505-8
S 519 B-1
R501 COMM
TB1-3
TB-1
GND.
K507 N.C.
TB 510-9
S 519 SECT. B
K 503-10 (38
TB 513-5 (28
K 503-3
S 519 SECT.
TB 505-2
TB 513-9
TB 505-10
TB 513-10
TB 513-2
XA 508-1
T 502-1
TB 201-8
T 502-4
TB 201-9
M 6023

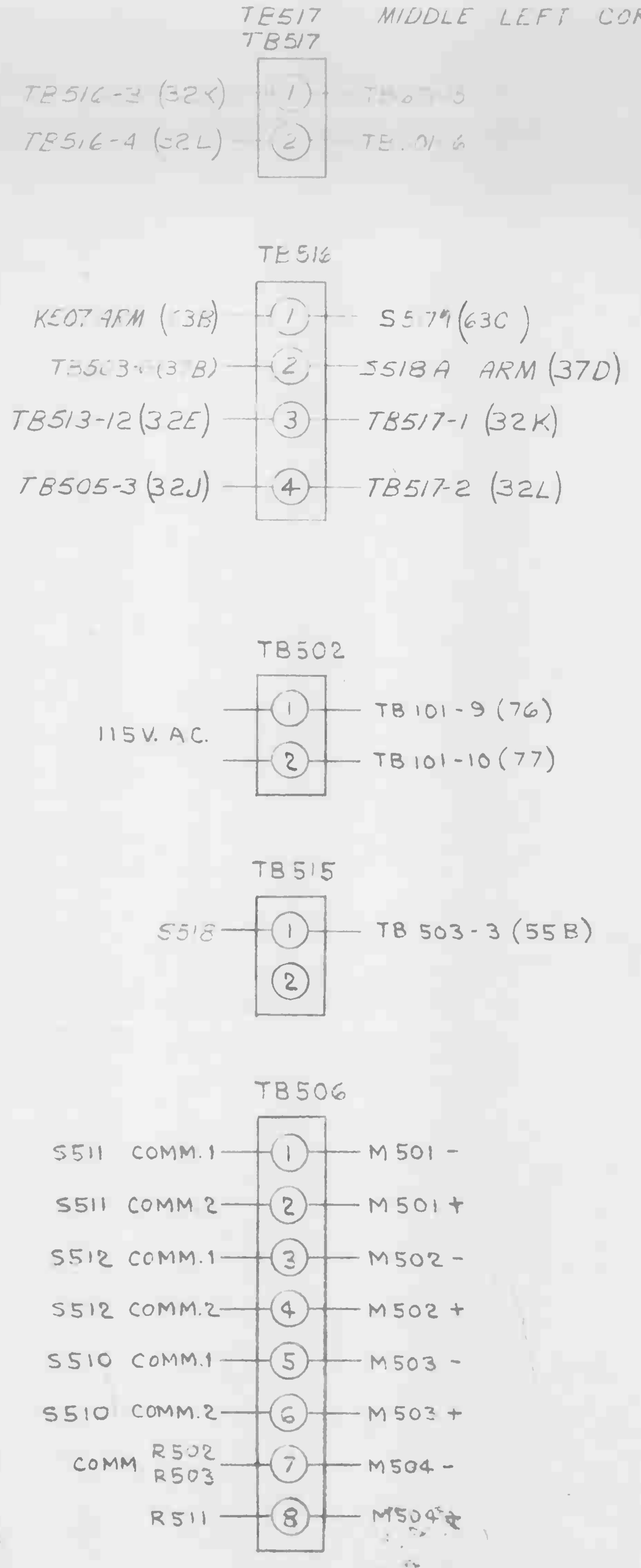
R S T U V

106	105	104	103	102	101	GR NO
QTY	QTY	QTY.	QTY.	QTY.	QTY	ITEM

FIRST MADE FOR

S519 TUNE OPERATE SW.
S518 LOCAL - REMOTE SW
S517 O.L. RESET

TB1 RECYCLE UNIT
TB101 EXCITER
TB201 600 VOLT POWER SU
TB301 AMPLIFIER
TB302 AMPLIFIER BLOWER
TB401 DRIVER
TB501 AUDIO INPUT
TB503 REMOTE BOARD
TB504 CONTACTOR PANEL
TB505 CONTACTOR PANEL
TB507 CABINET FAN
TB510 MIDDLE LEFT FRONT
TB511 LOWER LEFT FRON
TB513 O.L. RELAY DECK
TB514 PA. PANEL
TB502 XTAL. OVEN
TB506 UPPER LEFT CORNE
TB515 CONTACTOR PANEL
TB516 CONTACTOR PANEL
TB517 MIDDLE LEFT CORNER



2	1
ECN 8761 AWC 5-29-61	ECN 8569 2-24-61

STATUS

DEVELOPMENT	PRODUCTION
MECH CHK	
PROJ ENG	
APPROV PRODUCTION BY	

W X 842 Y 3127 Z 1

GATES RADIO COMPANY QUINCY, ILLINOIS		D-23127 SCALE

LIST OF PARTS

REFERENCE	PT OR G N	FIN.	DESCRIPTION	MATERIAL

PPLY

T POST } REAR VIEW
T POST

R POST (REAR VIEW)

POST (REAR VIEW)

...ER TB517-1 TO TB517-2 FOR 1 K.W. OPERATION

TITLE INTERNAL WIRING FM 10 A DRIVER M 5833 B

MTL	FIN	UNLESS OTHERWISE SPECIFIED ALL TOLERANCES PER GATES SPEC.
DR BY / DATE 11-4-60 · CH. BY · ENG.	SHEET OF	D-23127

842 3127 001

ADDENDA SHEET

M-6095 FM EXCITER UNIT

852 5774 001 Schematic ECN-9105

1. Change value of C115 and C116 from 1 mfd. to 2 mfd.
2. Change value of C183 and C184 from .03 mfd. to .027 mfd. (Audio input circuit)
3. Change value of R180 from 10K ohm, 2W. to 10K ohm, 10W.

852 5774 001 Schematic ECN-9095
837 9534 001 Functional Block Diagram " "

1. Delete "or S5019" from V118.
   GZ34/5AR4 tube is supplied with unit.

4/12/62

Gates Radio Company
Quincy, Illinois

INSTRUCTION BOOK

FOR

THE M-6095 FM EXCITER

I.B. #888 0648 001

August 1, 1961

Gates Radio Company

Quincy, Illinois

INDEX

M6095 EXCITER

(Freq. Range 88 - 108 MC.)

ES-6170	Standard 75 Microsecond Pre-emphasis Curve
A-4165	Test Set-Up for FM
826 7991 001	Typical Waveforms of Stages V101 thru V106
826 7990 001	Typical Waveforms of Stages V107 thru V112

Tables and Charts Included Within Text of Book That are Helpful in Trouble Shooting:

NOTE: Complete Tune-up Procedure At Customer Request

SPECIFICATIONS

Power Output:	0 - 10 watts, continuously variable
Frequency:	88 - 108 Mc.
RF Output Impedance:	51-72 ohms
Frequency Stability:	± .001%
Type of Oscillator Circuit:	Direct Crystal Control
Type of Modulation:	Phase shift employing pulse techniques
Modulation Capability:	+ 100 Kc 100% Modulation equals ± 75 Kc
Audio Input Impedance:	600 ohms
Audio input level for 100% modulation at 400 cycles:	+ 10 dbm, ± 2 db
Overall Audio Frequency Response:	± 1.0 db 50 to 15,000 cycles. -2.0 db 30 cycles.
Distortion at 100% Modulation:	1% or less 30 to 15,000 cycles. ½% or less 100 to 10,000 cycles.
FM noise:	65 db below 100% modulation at 400 cycles or better.
AM noise:	60 db below equivalent 100% amplitude modulation.
Power input:	Approximately 120 watts when exciter is putting out full 10 watts. (1 ampere at 117 volts.) Approximately 6 watts (intermittent) crystal oven circuit.

SPECIFICATIONS

Tube Complement:	3 - 6201
	6 - 6AU6
	1 - 6AQ5A
	3 - 6J6
	1 - 12AX7
	2 - 0A2
	1 - GZ34/5AR4
	1 - 6080
	1 - 6360
	3 - 7025

INTRODUCTION

All FM transmitters require a device that will supply an RF driving voltage of sufficient amplitude to drive the succeeding amplifier stage to the required output power level. In addition, this device must have necessary provisions made for frequency modulating the carrier the proper amount.

These requirements are fulfilled by the M6095 exciter unit. The exciter panel is standard 19" wide for rack mounting, height is 14". A rear dust cover is provided that extends 2-1/2" beyond the back of the panel. This dust cover is held on by four acorn nuts easily removed from the front of the panel. The highest unit on the front of the panel is the crystal oven which extends 4-1/2" beyond the panel proper.

The unit is complete with its own power supply. It is light in weight; 21-1/2 lbs, this makes it very easy to remove the unit from the cabinet or rack in which it is mounted and to place it on a bench. All that is needed to operate the unit is an AC cord connected from TB101-7&8 to a 117 V. AC outlet.

INSTALLATION

Generally, when the exciter unit is received at the point of operation it will be mounted in a cabinet along with additional amplifier stages. The unit finds its greatest usage in driving 50 watt and 250 watt amplifier stages. With some additional external metering, the unit becomes a complete 10 watt FM transmitter.

Forced air cooling is not required for the unit. Sufficient ventilation should be allowed to provide normal circulation and up-draft at least for the front of the panel, where all of the tubes are mounted.

External wiring to the unit consists of the following:

1. A shielded, twisted pair that connects to TB101-1 -2-3. The shield should connect to TB101-3 which is ground. These are the audio input terminals. Audio requirements for 100% modulation are approximately +10 DBM, and the input impedance is 600 ohms.

2. Two wires connected to TB101-7&8. These wires are to provide operating voltages for the unit. Requirements are

117 volts, AC at 1 ampere.

3. Two wires to connect to TB101-9&10. This provides operating voltage for the crystal oven. Requirements are 117 volts, AC at about 6 watts intermittent service.

In addition, if the exciter unit is used to supply B+ to some other unit a wire must be connected from TB101-6 to the other unit. An additional 20 to 30 milliamps at +320 volts may be drawn from this terminal when the exciter is transmitting a full 10 watts. If output power from the exciter unit can be reduced to 3 or 4 watts, up to 50 milliamps may be drawn from TB101-6.

The exciter may also be used to supply filament voltage to some other unit. To do this, a wire must be connected from TB101-4 to the other unit. 6.3 volts, AC at about 1-1/2 amps. is available to be drawn from this terminal.

If the power amplifier stage of the exciter unit (V115) is to be externally metered the jumper connecting TB101-5&6 should be removed. A wire should then be connected from TB101-5 to the positive terminal of the external milliammeter and a wire should be connected from TB101-6 to the negative terminal of the milliammeter. The final stage will draw about 65 milliamps when output power is 10 watts. The external milliammeter should have a minimum full scale deflection of 100 milliamps.

PRE-OPERATION

In almost all cases the exciter unit has been properly tuned up to customer frequency at the Gates plant. If all tubes and other components are properly in place, wires connected, etc., the exciter may be placed into operation by turning S101 to the "ON" position. This switch is located in the primary circuit of T103. When it is turned "ON" both the filament voltage and the B+ voltage come on to all tubes. The rectifier tube is of the slow heating indirect cathode type, and positive voltage will not exist for perhaps 20 seconds, after this length of time the exciter power output will come up.

The only adjustments that will have to be made are to tune C169 (output coupling) and C167 (V115 plate tune) for maximum power output into a load, following stage, or antenna. Final adjustment of C167 and C169 should be done only after the exciter has come up to full operating temperature; this will take about 15

minutes after first turning the unit on. Stray capacities of tubes tend to change slightly as the tube warms up and a small change of even 1/4 pf can considerably de-tune a circuit operating in the VHF range.

Frequency adjust control C104 should be set to the value given in the factory test data sheet. Oven pilot lamp A101 will start cycling after the oven heater has been on for about 20 minutes. The crystal oven does not really stabilize until it has been on for about 1 hour. If, after this length of time, the carrier center frequency does not agree with that shown on a frequency monitor of know accuracy, readjust the C104 for proper center frequency. Normal cycling of oven pilot lamp A101 will be"ON" 1/3 and "OFF" 2/3 timeswise for a room temperature of 75° F.

A quick check of the B+ voltage is advisable. This can be done by placing the negative probe of a 20,000 ohms per volt meter into a black test point (TP122 or TP123), and a positive probe into TP121. The voltmeter should read +320 volts DC.

DAILY OPERATION

It is considered good practice to arrange wiring and control circuits so that the crystal oven heater operates independently of the main power switch. If this is done, and the crystal oven remains on all the time, the exciter will be close to center frequency, even from a cold start. Power requirements for the oven are about 6 watt and this only intermittently. On a presumed basis of the oven being "ON" 1/3 of the time, the oven would use only 2 watt of power per hour.

Assuming that the crystal oven is on continuously, then the only thing that needs to be done in the normal days operation is to turn the main power "ON" when starting the broadcasting day and "OFF" when finished. In most cases, this will be accomplished when the low voltage switch is turned on in the transmitter, whether the transmitter be 250, 1000 or 5000 watts.

If the exciter is turned on 10 or 15 minutes before "AIR" time, no other adjustments should be necessary. The exciter will reach 80 to 90% of full power in about 5 minutes and full power in 10 to 15 minutes. This assumes that the unit was fine tuned while thoroughly warmed up.

THEORY OF OPERATION & GENERAL EXPLANATION OF CIRCUITRY.

Of all the known methods used to generate a frequency modulated signal, the one used in this exciter unit is the simplest and most straight forward. Since the signal generation depends upon direct crystal control, the output frequency will be very stable. In addition, tuned circuits will be uncritical in operation and low cost receiving type tubes may be used in the majority of circuits.

V101 is a crystal controlled oscillator. The crystal controlled output of V101 is shaped into a series of sawtooth waveforms by V101 and V102, for application to Modulator #1, V104. The output of Modulator #1, V104, is then again shaped into a sawtooth waveform at crystal frequency for application to Modulator #2.

The reason for two Modulators is to increase the modulating ability of the Exciter at low frequencies. The two modulator stages are driven in parallel from audio stages V116 and V117. V107 through V114 are frequency multiplier stages. V107 through V111 are single ended pentode stages, while V112 through V114 are push-push doublers. V115 is a power amplifier stage, which is capable of producing 10 watts at output frequency of 88 to 108 mcs. The coaxial jumper between J101 and J102 connects frequency multiplier stage V111 to V112, when Multiplex is not in use. When Multiplex is used, the output of J101 feeds into the Multiplex unit and the Multiplex unit feeds back to the input jack, J102.

Stages V119 through V122 make up a conventional regulated power supply with an output voltage of 320 volts. Maximum current to be drawn from this power supply is in the vicinity of 160 milliamps.

This unit has been properly tuned up at the factory. If the customer desires a complete tune-up procedure for the M6095 Exciter unit, it may be obtained by writing to the Gates plant.

GENERAL

If the exciter has been properly tuned up, output power in the vicinity of 10 watts should be obtained. If trouble is experienced along the way in the tune-up procedure, the fault can usually be isolated by referring to typical test point voltages given on a following page. There are five key test points that are indicative of proper operation.

About -35 volts should be obtained at TP106, this indicates that the pulse stages V101 thru V106 are properly operating.

About -2 volts should be obtained at TP108, this indicates that V107 and associated circuitry is working O.K.

Approximately .5 volts RMS RF voltage should be obtained at TP113 and/or TP114, this would indicate that the frequency multiplier stages V107 thru V111 are operating properly.

Around -7 volts should be obtained at TP118, this indicates sufficient driving power to final amplifier stage V115.

If a defect is suspected, but can not be spotted, checking resistance of the various tuning coils L101 thru L115 may locate the trouble.

The proper resistance value of these coils is listed below along with the capacitor values for comparison purposes. The measured resistance should not deviate by more than about 10%. If the accuracy of the voltmeter is not known, a comparison between similar coils can be made. For example, the resistance of L101, L102 and L103 should be the same.

COIL	DC RESISTANCE	CONDENSER VALUE ACROSS COIL
L101;L102,L103	21 ohms	150 mmf.
L104;L105	9.6 ohms	100 mmf.
L106;L107	5.5 ohms	24 mmf.
L108,L109	2.1 ohms	24 mmf.
L110,L111	1 ohm	See Schematic
L112,L114,L115	.12 ohm	See Schematic
L113	.43 ohm	See Schematic

Considerable deviation of resistance from the above given values indicate either the wrong coil, shorted turns, open turns, or a change in value of some other component connected across the coil.

The value of any other parts connected across the coils is to be considered insignificant when compared to the DC resistance of the coil.

COUPLING EXCITER TO A FOLLOWING STAGE

It is preferred that the final amplifier of the exciter be connected to an external dummy load of 51 ohms through a 51 ohm cable while tuning. Tuning the final amplifier in this manner is a good check on its proper operation.

When changing the RF output connection of the exciter from a dummy load to a following amplifier stage an attempt should be made to get a proper match to 51 ohms at the input to the follower amplifier stage.

If the output coupling control, (C169) and plate tune (C167) on the exciter unit, have to be considerably readjusted when coupled into the succeeding amplifier stage, a major mis-match of impedance is to be suspected at the input of the following amplifier stage. This will result in considerable loss of drive to the following stage and cause high standing waves to appear on the inter-connecting coax between the exciter and the following stage.

Most of the amplifier stages that will be used following the M6095 exciter unit will not generally require the full 10 watts of driving power. A 50 watt amplifier stage will require about 2 watts of drive and a 250 watt amplifier about 4 watts of drive.

In no case, should C167 (plate tune) or C169 (output coupling) be de-tuned to reduce output power. This is equivalent to operating V115 in an off-resonant condition and would damage the tube eventually.

Output power can be reduced to almost zero by tuning R167 (output control) to a counterclockwise position. This reduces screen voltage to V115 and, consequently, the plate current which increases efficiency to V115.

In some cases, B+ voltage of 320 volts will be tapped off of TB101-6 to supply screen voltage to a following amplifier stage.

The external +320 volts should not exceed a drain of about 30 milliamps for continuous operation.

Reducing screen voltage of V115 by adjustment of R167 will drop V115 current drain from about 60 milliamps for 10 watts output to about 25 milliamps for 2 watts output. This extra current may then be used for external purposes.

In summary, when driving an additional amplifier stage from the exciter unit, reduce output by adjustment of R167 and keep C167 and C169 tuned for maximum grid drive in the following stage.

V115 EFFICIENCY

An external jumper is provided on TB101-5&6. An ammeter may be connected in series with this jumper to measure V115 plate current.

B+ voltage has been previously set at +320. Power input to the plate circuit of V115 may be calculated from the ammeter and voltage readings. The voltage drop across R155 must first be calculated. This resistor is in the cathode circuit of V115, its value is 250 ohms.

The formula to use would then read:

$$\text{Power input to plate circuit V115} = I_p \times (E_p - (IR))$$

Where IR is the drop across R155

If, for example, the ammeter reading obtained when connected in series with TB101-5 and 6 was 60 ma. and B+ to ground was +320 V.:

$$\begin{aligned}\text{Power input V115} &= .06 \times (320 - (.06 \times 250)) \\ &= .06 \times (320 - 15) \\ &= .06 \times 305 \\ &= 18.3 \text{ watts}\end{aligned}$$

Assuming an output power of 10 watts:

$$\text{Plate dissipation V115} = \text{Power input} - \text{Power output}$$

$$= 18.3 - 10$$

$$= 8.3 \text{ watts}$$

$$\text{Efficiency of V115 Stage} = \frac{\text{Power output}}{\text{Power input}}$$

$$= \frac{10}{18.3}$$

$$= 54.8\%$$

These figures can be considered typical. If the output power is not known, an efficiency factor of 55% should be assumed.

TYPICAL DC TEST POINT VOLTAGES OF M6095 EXCITER UNIT NO MODULATION. MEASURED WITH 20,000 OHMS/VOLT VOLTMETER

	WITH DRIVE VOLTS	NO DRIVE VOLTS
TP101	-27	0
TP102	+12	+29
TP103	+1	+1.4
TP104	-4	0
TP105	+9.2	+15
TP106	-30	0
TP107	+60	+33
TP108	-3.2	0
TP109	+61	+50
TP110	+72	+34
TP111	+68	+30
TP112	+133	+195
TP113	.46 RMS (H.P. Probe)	0
TP114	.42 RMS (H.P. Probe)	0
TP115	+113	+185
TP116	+140	+235
TP117	+227	+260
TP118	-.6	0
TP119	+157	+187
TP120	+172	+172
TP121	+320	+320

Note. Readings for TP118 and TP119 were obtained with R155 output control full clockwise or maximum output position.

PROOF OF PERFORMANCE

Center Frequency, Noise, Distortion, Response

Proof of performance data as made by the Gates Radio Company on FM transmitters can be likened to listening to the transmitter on a high quality receiver. This tends to "prove-out" the transmitter since measuring and listening equipment is completely external to the transmitter proper and the RF signal is taken from "off-the-air".

Instead of a receiver, an FM monitor of good quality and FCC approved is used. Reference to drawing A-4165 will show the general test set up for making proof of performance measurements.

First off, a sample of the transmitted RF is coupled to the modulation and frequency monitor. This is taken from the antenna, transmission line or from the PA chamber. The method used is determined somewhat by the amount of power needed by the monitor (usually about 1 watt) and by the output power of the transmitter. For low power FM transmitters up to perhaps 250 watts, a sample of RF may be taken by "tapping" off the output transmission line with a variable condenser in series with the coaxial line going to the monitor. This has the disadvantage though of introducing a slight mismatch back into the transmitter. Usually, it is impossible to obtain enough power to drive the monitor from the antenna without introducing another amplifier ahead of the monitor to raise the receiver signal up to the necessary level. In higher powered transmitters, a monitor loop is usually coupled to the final amplifier section to sample a portion of the transmitted output.

A good quality audio oscillator of 600 ohms output impedance is then connected to the audio input terminals. These are TB101-1,2 and 3 on the exciter unit with terminal #3 being ground. Output level requirements are at least +10 DBM. Since the exciter itself is capable of generating a frequency modulated carrier with distortion ranging as low as .2% the audio oscillator must be in good working order.

A distortion analyzer or meter is connected to the audio output terminals of the monitor. An oscilloscope while being an optional item in making measurements is very helpful in tracing any possible difficulty.

The complete method used to adjust the exciter for proper response, distortion, noise and etc., will now be given as it is done at the Gates factory. Proper proof of performance adjustments at the factory are made only after complete tune-up has been done. After the customer receives the unit, any part of the measurements may be made without undue effect upon other measurements.

All proof of performance measurements should be made with shield covers in place.

SETTING CARRIER FREQUENCY

It is desirable to first set the exciter unit to proper carrier frequency. This should be done first, not only because it is desirable to have the unit on proper frequency, but if the carrier is several thousand cycles off center, undesirable beats may occur within the monitor. This will cause noise readings and may effect apparent frequency response.

Usually, all that is required to place the exciter unit on proper center frequency, is to sample a portion of the RF output with a good frequency standard and adjust C104 (frequency adjust control) until the frequency standard shows proper frequency.

Occasionally, a crystal may be used that can not be set exactly to center frequency by means of C104 alone. Also, a crystal that was originally on proper frequency may drift off the range of C104 due to ageing. When this happens additional frequency adjustment may be made by varying the value of C105. This capacitor controls the amount of feedback to the crystal. Increasing the value of C105 lowers the carrier frequency and decreasing the value of C105 raises the carrier frequency.

With the value of C105 set at the optimum value of 150 PF, varying C104 (frequency adjustment control) from minimum to maximum will cause the center frequency to vary approximately 30,000 cycles. Changing the value of C105 from 150 PF to 50 PF will raise carrier frequency about 10,000 cycles. Changing C105 from 150 PF to 250 PF will lower carrier frequency about 3,000 cycles.

DISTORTION MEASUREMENTS AND ADJUSTMENTS

After the exciter unit has been properly set to carrier frequency distortion adjustments are made. Set the modulator selector switch (S2) in the modulator #2 position. Set the audio oscillator frequency to 30 cycles and modulate the exciter with +14 DBM. Next, adjust C119 so that the FM monitor reads 70% modulation. Distortion adjustment control (R126) is then adjusted for best distortion. If R126 is considerably away from the proper adjustment point, it may be impossible to obtain the desired level of modulation or the waveform obtained may be completely torn up. If such is the case, adjust R126 for minimum distortion while modulating somewhat less than 70%, say, about 50%. Then, reset the level on the audio oscillator to +14 DBM and adjust C119 and R126 as described above. Then place the modulator selector switch in the modulator #1 position, and follow the procedure just described to adjust modulator #1. In this case, however, the capacitor adjustment is C111 and the distortion adjustment control is R115.

If it is impossible to reduce distortion at 30 cycles, it is advisable to check just the audio portion of the exciter unit and/or the audio oscillator itself. The audio portion of the exciter consisting of tubes V116 and V117 may be checked by running test leads from TP120 and TP122 or TP123 to the input of the distortion analyzer. Distortion as measured at TP120 should be well below .5% at any audio frequency. If distortion from the audio section is O.K. but overall distortion as measured from the monitor is not, then the waveforms of the pulse circuitry should be checked. Typical waveforms of V101 thru V106 are given on drawing 826 7991 001.

100% modulation should occur at an input level of approximately +10 DBM from 30 to 1,000 cycles. This input level will cause an RMS audio voltage at TP120 of about 15 volts. If an input level of +10 DBM does not generate an RMS voltage of about 15 volts at TP120, then a defect in the audio section may be suspected. If sufficient RMS voltage exists at TP120 and the exciter will not modulate 100%, then a defect in the modulator or previous stage should be suspected.

In any FM system worse distortion occurs at the lowest modulating frequency. In other words, if distortion is 1% at 30 cycles then the distortion can be expected to be better at all higher modulating frequencies. Occasionally, a high distortion figure may result between 10,000 and 15,000 cycles. The fault will not generally lie in the modulator stage, however, it could lie in the audio section.

If high distortion is present at the higher modulating frequencies only, it can usually be traced to one of three causes.

1. High FM or AM noise.

2. Insufficient bandwidth in the frequency multiplier stages.

3. Frequency and modulation monitor not correctly tuned to carrier frequency.

A standard FM monitor contains de-emphasis circuitry that causes lower modulating frequencies of 30 to 1,000 cycles to come out of the monitor with an apparent advantage of around 15 to 17 DB over the audio that is recovered at 15,000 cycles. If noise is down only 40 to 50 DB with respect to 100% modulation at 400 cycles, it will usually not prevent a good distortion reading at a low modulating frequency. However, if frequencies between 10,000 and 15,000 cycles are 15 DB lower in amplitude then 400 cycles, the noise with respect to these frequencies, will only be about 30 DB down. This would correspond to the 3% distortion range on a distortion analyzer. A quick check to determine whether noise is causing an apparent high distortion reading is to remove all modulation from the input to the exciter or transmitter. If the distortion meter needle does not drop appreciably a noise measurement should be made on the exciter.

If bandwidth is insufficient in frequency multiplier stages, some of the higher frequency sidebands will be clipped causing undue distortion. A complete re-tune up is then recommended.

Mis-tuning of the monitor will also cause some clipping of sidebands at higher frequencies. In addition, beat frequencies may be present that show up as noise and prevent a good distortion reading.

Once set, the distortion controls R115, C111, R126 and C119 may not have to be re-set for the life of the the exciter unit. Changing modulator tubes will probably not cause distortion figures to change by more than .1 or .2%. There are exceptions to every rule though.

OVERALL FREQUENCY RESPONSE

If the exciter unit is used in the FM broadcast band of 88 to 108 MC or as the aural exciter unit for TV transmitters, overall frequency response should follow the 75 microsecond curve ** shown on drawing ES-6170. In other frequency ranges, it may be desirable to have the overall frequency response flat.

Several methods of making frequency response measurements using an FM monitor are available. Two will be described; the simplest is to set the audio frequency at about mid-range, say 5000 cycles, and modulate the exciter the proper amount, in this case the proper modulation level would be 35%. Keeping the input audio level constant, the frequency may then be adjusted upward to 15,000 cycles and then downward to 30 cycles. Using this method the response will seldom rise above the curve and makes it easy to calculate the percent or decibel error. For example, if at 15,000 cycles modulation the modulation monitor reads only 80% modulation, it can be quickly seen from the drawing ES-6170 that the response is 2 DB below the normal curve. The same reasoning may be applied to the low end of the curve. If the input attenuator is calibrated in small steps, it is also possible to determine the amount that the audio input has to be increased to bring the monitor up to the required percentage of modulation at any modulating frequency.

Another method of measuring frequency response involves keeping the percentage of modulation constant as read on the monitor. To use this method the audio oscillator output must be accurately calibrated. To start with, the carrier should be modulated 100% at 400 cycles, changing the audio frequency from about 30 cycles to 400 cycles should not change the percentage of modulation appreciably. If the modulating frequency is raised upward, say to 5,000 cycles, the input level must be reduced to keep the percent of modulation at 100%. For 5,000 cycles the amount of reduction should be 8.2 DB. For 15,000 cycles the amount of reduction of input level should be 16.9 DB. Recording the amount of reduction of the input level versus modulating frequency and reversing the sign of polarity, will give the curve and frequency response. This can then be compared to the curve of drawing ES-6170.

The second suggested method is particularly useful when response measurements are being made at 25 and 50% modulation levels, or when a standard FM monitor is being used to measure response of an exciter being used to generate the aural carrier for a TV transmitter where normal 100% modulation is ±25 KC. This will correspond to 33-1/3% modulation on a standard FM monitor for the FM broadcast band of 88 to 108 MC.

** <u>For U.S.A. duty only</u>.

Seldom will any difficulty be encountered in coming close to the standard 75 microsecond curve between 400 and 10,000 cycles. Generally, if troubles develop with response it will show up as being 2 or 3 db down at 15,000 cycles. A frequency compensating capacitor has been incorporated in the audio amplifier section to take care of just such a contingency. C170 affects response between 10,000 and 15,000 cycles. Increasing the value of C170 raised the frequency response between 10 and 15,000 cycles. Decreasing the value of C170 drops frequency response between 10 and 15,000 cycles.

Stagger tuning L103 will also help response at 15,000 cycles a DB or so, when this is done a voltmeter should be connected to TP108 and the amount of staggering of L103 should not reduce the negative voltage observed by more than .5 volts.

FM NOISE

FM noise is measured with respect to 100% modulation at 400 cycles. To make this measurement, modulate the exciter 100% at 400 cycles and set a reference level on the distortion analyzer. Remove all modulation and read the FM noise on the appropriate scale. FM noise of the exciter unit can be expected to approach 70 DB or better.

If FM noise is high the audio section is the most logical place to start looking. Removal of the last audio tube V117 is a quick way of checking if the trouble is in the audio. The next best bet is the power supply. Hum and noise voltage of the power supply should be between 85 and 90 DB down with respect to +320 volts DC. If these two places fail to show any defect the noise is probably originating from the pulse circuits V101 thru V106. Stages after V106 are unlikely to cause FM noise.

AM NOISE

AM noise is measured or referenced with respect to 100% amplitude modulated wave. This AM noise usually consists of 60 or 120 cycle hum superimposed upon the carrier. There are several ways of making this measurement. Some FM monitors have a provision for making this measurement. This measurement should be made with no modulation present.

AM noise as measured from the exciter unit is usually so low as to be difficult to measure. It will generally be better than

70 DB. If AM noise is high, it can actually originate in most any stage. However, if, upon analyzing the type of noise, it is found to have a basic 120 cycle component the power supply should be suspected. If the noise appears to be mostly a 60 cycle component a heater to cathode leak in any stage should be suspected. A loose connection in any stage will cause the AM noise to rise when the exciter cabinet is jarred. A point often overlooked when making AM noise measurements is the sampling loop or device. For example; if the RF sampling loop is mounted in a PA chamber where blower vibration is apt to occur, this vibration will show up as high AM noise, if the sampling loop is not securely mounted.

TYPICAL PROOF OF PERFORMANCE READINGS

If the exciter unit has been shipped as an individual unit the complete test data sheet will probably have been filled out and included in this section. If the exciter unit is part of a high power transmitter the test data sheet is included with the overall instruction book. A set of typical readings for proof of performance is given below:

Carrier Frequency, O.K.

	Distortion at 100% modulation	Response with reference to standard 75 micro-second pre-emphasis curve
30 cycles	1.75	-1.7 DB
50 cycles	.85	- .2
100 cycles	.56	+ .5
400 cycles	.47	+ .8
1000 cycles	.42	+ .8
2500 cycles	.38	+ .5
5000 cycles	.34	+ .4
7500 cycles	.58	+ .3
10,000 cycles	.58	+ .1

15,000 cycles	.48	- 1

FM Noise: -68 DB

AM Noise: Better Than -70 DB

MAINTENANCE

Since moving parts are at a minimum in the exciter unit routine maintenance is a simple procedure. The few moving parts that are used, such as, variable capacitors, potentiometers and variable inductors will perhaps stay set in one position for the life of the exciter unit. The one exception to this would be C103 the frequency adjust control.

Because routine maintenance is used to prevent trouble and not start it, it is not deemed advisable to poke and pull at every component part at a pre-arranged time. Tubes are the most likely components to go bad. A routine testing of all of the tubes at least once every six months is recommended.

One of the best ways to foretell trouble is by test point voltages. These are recorded on the factory test data sheet. When the exciter is first received and placed into operation, it is advisable to go over these test point voltages and record the reading obtained. The test point voltages should then be checked weekly or monthly. A substantial variation from the original recorded value would indicate a failing tube or other component in that circuit. These voltage measurements should always be made with the same meter since a normal 10% variation from one meter to the next may be expected.

An occasional check on the noise, distortion and response with a test set up such as shown in drawing A-4165 will probably reveal an eminent failure of one of the audio stages or one of the pulse stages V101 thru V106.

When tubes are checked and replaced, it is wise to replace them in their original sockets. If V113, V114 or V115 is changed, it may be necessary to retune associated circuitry for best performance.

TROUBLE SHOOTING

It would be impossible to list every failure and possible cure that might occur in the exciter unit. The same thing may be said of any other piece of electronic gear. However, 90 to 95% of all failures can perhaps be predicted with a few possible clues listed that may help in locating the defect.

Failures or difficulties that may occur in the exciter unit can be divided into two broad categories.

1. Problems associated with carrier only.

2. Problems associated with modulation of carrier.

Problems associated with carrier only can be sub-divided into several groups.

A. No carrier (no power output)

B. Low Carrier (power output low)

C. Intermittent carrier

D. Oscillation

E. Carrier off frequency

Problems associated with carrier only will now be discussed and possible remedies and trouble shooting hints suggested.

NO CARRIER

Of the many problems that can occur, this perhaps is the most serious and yet the easiest defect to find. When this happens, a tube has usually gone completely dead. A comparison of test point voltages with those given at the end of the complete tune-up procedure, test data sheet or voltages recorded when the unit was working properly should reveal the defective stage. The difference in test point voltages with and without drive is in the most cases quite pronounced. When a tube has gone completely sour or dead, voltages noted at test points located in the plate circuit of that particular tube will rise up to the full plate voltage of ≠320 volts. If the tube is drawing excessive current, the voltage noted at the test point will be extremely low. A failure of any circuit from oscillator stage to power amplifier stage will, of course, cause loss of carrier. The power supply itself should not be overlooked.

To quickly isolate the trouble to a single general area the following procedure could be followed.

1. Check to see if B+ voltage exists at TP121.

2. Check the negative voltage at TP106, a reading of about -35 volts here indicates V101 thru V106 are operating properly.

3. Check negative voltage at TP108. A negative reading here from -2 to -3 volts indicates that the grid of V108 is receiving drive from previous stages.

4. Check RF voltage at TP113 and/or TP114. An RF voltage here of about .5 volts RMS indicates that there is sufficient drive up to this point.

5. Check negative grid voltage of V115 at TP118. A reading of at least -5 volts here indicates plenty of drive and that the grid circuit of V115 is operating.

Should all of the suggested methods fail to locate the trouble a more thorough check will have to be made. Reference to voltages listed on the schematic diagram 852 5774 001 and to waveform measurements on diagrams 826 7991 001 and 826 7990 001 in the back of the book may help. Approximate RF voltage measurements are also included at the end of this section.

LOW CARRIER

The same general routine used to track down the stage causing a carrier failure can be used to check for a low carrier. Tracing down the fault for a low carrier can be more elusive though because voltages will not deviate as much from normal. Low carrier levels are usually caused by a tube with low emission. A slight mis-tuning somewhere along the frequency multiplier chain can cause low output. Reference to the RF voltage chart at the end of this section may be of additional help.

INTERMITTENT CARRIER

An intermittent carrier can be very difficult to track down because about the time test equipment is set up to find the trouble, it disappears. A recommended method finding this is to start at the final stage (V115) and place a meter probe into TP119. Then tap on the chassis or whatever else it takes to cause the intermittent condition. Working back toward the crystal from stage to stage and test point to test point; a point should be reached where a test point voltage does not vary. This should be the last properly operating stage. Immediately following the point where the test point voltage is not varying. An intermittent carrier can be caused by most anything. A bad tube, capacitor, resistor or loose connection or an intermittent short.

OSCILLATION

It is an almost unheard of condition for a frequency multiplier stage to oscillate since frequencies found in the grid circuit are different from frequencies found in the plate circuit. It is within the realm of possibility, however. If an oscillation should occur, it will probably be traced to the final amplifier stage, V115. This stage is self neutralizing and will probably not cause any trouble as long as the shields over the coils are tightly in place and all connections are tight.

A condition somewhat akin to oscillation has been noted while using pulse circuitry similar to that in this exciter unit. A leaky capacitor or intermittent connection in the pulse circuitry can cause the frequency multiplier stages to "fire" off at their resonant frequency. This oscillation will be damped and only occurs momentarily but may be aggravating.

CARRIER OFF FREQUENCY

When the carrier is consistently too far removed from proper center frequency, the trouble can be traced directly to the oscillator stage. This could be due to the oven thermostat sticking and causing the crystal to overheat or could be due to the oven not heating at all. If the thermostat is sticking, pilot lamp A101 will be on all the time provided it is not burned out. If the oven is not heating at all, the pilot lamp should not light.

Some crystals will age and drift off frequency after a length of time. Replacement of the crystal is the only solution here. A change of value of almost any component in the oscillator stage V101 could also cause the carrier frequency to deviate.

Problems associated with modulation of the carrier will now be discussed and some possible remedies and trouble shooting hints suggested. Under this category, sub-division might be as follows:

A. High Distortion

B. Improper Frequency Response

C. Will not Modulate at all

D. High FM Noise

E. High AM Noise

When it is known that any of the above listed faults exist, it will save time to first isolate the trouble to either the audio stages or the rest of the exciter unit. It is easy to check the output of the audio stages by connecting a ground lead from a black test point and a "hot" lead from TP120. These two leads can then be run to the input of a distortion analyzer. If these leads are very long, they should be shielded or they may pick up external hum and noise.

HIGH DISTORTION

When high distortion is present, it can usually be divided into three categories.

1. Distortion high throughout the audio spectrum 30 to 15,000 cycles.

2. Distortion high at low frequencies only.

3. Distortion high at high frequencies only.

When distortion is high through the audio spectrum of 30 to 15,000 cycles the fault is apt to lie in the audio stages of V116 and V117. It is wise to check these stages anyway when modulation difficulties are experienced. A failure of any component in the audio stages could cause the distortion to rise. Checking voltages against the schematic should show the difficulty. Changing a tube will usually cure the trouble.

It is characteristic of an FM system that the greatest difficulty in attempting to modulate occurs at the low frequencies. When the overall distortion is high between 30 and 400 cycles only, the trouble will usually be found in either one or both of the modulator stages or in the pulse circuitry just preceding them. A check of the waveform in stages V101 thru V106 is advisable. These can be checked against drawing 826 7991 001.

These waveforms were made on a calibrated scope type 524AD Tektronix, if a calibrated scope is not available an ordinary scope may be calibrated approximately by the following method: Peak-to-peak waveforms are always 2.8 times the RMS value of a sine wave. The hot scope lead can be connected to a hot filament wire which should have an AC voltage present of about 6.3 volts AC. The peak-to-peak value would then be 17 or 18 volts. The scope can then be calibrated accordingly by setting a reference point on the scope screen.

The two most important waveforms to check are those at TP102 and TP105. With pin 7 of V103 disconnected, the waveform at TP102 should be a good saw-tooth with an amplitude of 25 to 30 volts peak-to-peak. The leading edge should be linear with no rounding off. When pin 7 of V103 is connected and the bias properly set the waveform will be cut approximately in the middle horizontally.

With V106 removed the waveform at TP105 should be a good saw-tooth with an amplitude of about 25 to 30 volts peak-to-peak. The leading edge should be linear with no rounding off. When V106 is inserted and the bias properly set the waveform will be cut approximately in the middle horizontally.

IMPROPER FREQUENCY RESPONSE

If the frequency response is not correct, the audio section should again be checked for proper response. The frequency response as noted at TP120 should be approximately the desired overall frequency response. It usually will be 2 DB or so high at both extremes of the audio spectrum.

Should the frequency response noted at TP120 prove to be O.K., but overall frequency response be down at 15,000 cycles, it will usually be caused by too narrow a bandwidth or mis-tuning of some of the low frequency multiplier stages, L101 thru L107. L101 thru L103 are most apt to cause this difficulty. Improper tuning of the modulation and frequency monitor can also affect apparent frequency response.

A change in the components associated with the modulator stages can cause poor low frequency response, this is especially true of C112, C121, R114, R113, R115, R126 and R127.

WILL NOT MODULATE AT ALL

This condition will probably resolve down to a dead audio stage.

FM NOISE

If FM noise exists the audio stages can be quickly eliminated by pulling V117 from its socket. Noise in the audio stage can be caused by a heater to cathode leak or a filament wire lying near a grid connection. Hum from the power supply or improper regulation of the power supply can cause noise in the audio stages.

If the noise is not located in the audio stages, the next most probable suspect is the pulse stages of V101 thru V106. An amplitude variation in these stages will cause a frequency modulated noise component. This could be caused by a heater to cathode leak or failure of a stage to properly limit. Hum from the power supply could also cause this difficulty. Modulation at a 60 cycle rate can also be caused in the crystal circuit by induction from the crystal heater.

AM NOISE

AM noise is one fault that will not usually be traced to the audio stages because an amplitude variation in the audio stages causes an FM noise component to appear. While this type of difficulty can occur in most any stage except the audio stages, it is most apt to prevail in one of the frequency multiplier stages and usually near the higher frequency end of the multiplier chain. Hum in B/ coming from the power supply, heater to cathode leakage or an intermittent connection can cause this defect. Hum from heater to cathode leakage will show itself as a 60 cycle component and power supply hum as a 120 cycle component.

All Values Are RMS

Location	Reading
Pin 5, V107	13.5 V.
Junction C130,C131,L102	8.2 V.
Pin 1, V108	6.0 V.
Pin 5, V108	18.0 V.
Pin 1, V109	5.2 V.
Pin 5, V109	29.0 V.
Pin 1, V110	4.7 V.
Pin 5, V110	29.0 V.
Pin 1, V111	6.6 V.
Pin 5, V111	34.0 V.
J101, TP113	.47 V.
J102, TP114	.51 V.
Pin 5, V112	6.2 V.
Pin 6, V112	6.4 V.
Pin 1 & 2, V112	21.0 V.
Pin 5, V113	9.0 V.
Pin 6, V113	10.5 V.
Pin 1 & 2, V113	23.0 V.
Pin 5, V114	9.0 V.
Pin 6, V114	9.5 V.
Pin 1 & 2, V114	26.0 V.
Pin 1 & 3, V115	19.0 V.
Pin 6 & 8, V115	150 V.

PARTS LIST

Symbol No.	Gates Part No.	Description
A101	396 0045 000	Lamp, 6-8 V. #47
C101,C102,C103	506 0005 000	Cap., 0.1 uf., 200V(W) D.C.
C104	520 0301 000	Cap., Variable, 5-100 uuf.
C105	502 0028 000	Cap., 150 uuf., 500V(W) D.C.
C106,C123,C147, C148,C155,C157, C189	516 0054 000	Cap., .001 uf., 1000V(W) D.C.
C107	516 0185 000	Cap., 50 uuf., 600V(W) D.C.
C108,C114	516 0191 000	Cap., 100 uuf., 600V(W) D.C
C109,C120,C127, C128,C129,C132, C133,C134,C173	516 0082 000	Cap., .01 uf., 1 KV.
C110,C118,C135, C137,C138,C139, C141,C142,C143, C146	516 0074 000	Cap., .005 uf., 1000V(W) D.C.
C111,C119	520 0292 000	Cap., Variable, 50-400 uuf.
C112,C121	506 0009 000	Cap., 2 uf., 200V(W) D.C.
C113,C149,C156	516 0173 000	Cap., 10 uuf., 600V(W) D.C.
C115,C116	506 0084 000	Cap., 2 uf., 400V(W) D.C.
C122,C130,C131	516 0175 000	Cap., 15 uuf., 600V(W) D.C.
C136,C158	516 0172 000	Cap., 5 uuf., 600V(W) D.C.
C140	502 0183 000	Cap., 1 uuf., ± 2.5 mmf. 500V(W) D.C.
C150,C152	516 0252 000	Cap., 330 uuf., 600V(W) D.C.
C151,C153	516 0179 000	Cap., 25 uuf., 600V(W) D.C.
C154	506 0016 000	Cap., 0.5 uf., 400V(W) D.C.
C144	516 0345 000	Cap., 0.5 uuf., 600V(W) D.C.
C159,C160,C161, C163,C165,C166, C188,C190,C191	516 0043 000	Cap., 470 uuf., 1 KV(W) D.C.
C162,C169	520 0112 000	Cap., Variable, 2.7-19.6 uuf.
C164,C167	520 0169 000	Cap., Variable, 2.4-10.8 uuf.
C168	516 0319 000	Cap., 1000 uuf., Feedthru
C174,C175,C176, C177,C178,C179, C185,C186,C187	516 0319 000	Cap., 1000 uuf., 500V(W) D.C.
C170	518 0039 000	Trimmer Cap., 50-380 uuf.
C171	506 0014 000	Cap., .1 uf., 400V(W) D.C.
C172	506 0010 000	Cap., .01 uf., 400V(W) D.C.
C180	522 0133 000	Cap., 16 uf., 450V(W) D.C.
C181,C182	524 0013 000	Cap., 30/30 uf., 525V(W) D.C.
C183,C184	508 0265 000	Cap.,.027 uf., 600V(W) D.C.
C192,C193	500 0759 000	Cap., 100 uuf., 500V.

PARTS LIST

Symbol No.	Gates Part No.	Description
F101	398 0079 000	Fuse, Slo-Blo, 1-1/2 amp.
F102	398 0011 000	Fuse, 1/4 amp.
HR101	558 0016 000	Crystal Oven, 6.3 V. 60° C.
J101,J102	612 0237 000	Receptacle, UG-290A/U
J103	612 0232 000	Receptacle, UG-58/U
J104	612 0369 000	Phone Jack
L101	913 1104 001	Freq. Mult. Coil Assy.
L102,L103	913 1105 001	Freq. Mult. Coil Assy.
L104	913 1106 001	Freq. Mult. Coil Assy.
L105	913 1107 001	Freq. Mult. Coil Assy.
L106,L107	913 1108 001	Freq. Mult. Coil Assy.
L108,L109	913 1109 001	Freq. Mult. Coil Assy.
L110,L111	913 1110 001	Freq. Mult. Coil Assy.
L112,L115	492 0025 000	Coil, 2-3.7 uh.
L113	492 0027 000	Coil, 3.4-7 uh.
L114	492 0024 000	Coil, Var. w/Brass Slug
L116	813 1112 001	Plate Coil for V114
L117	813 1113 001	Grid Coil for V115
L118	813 1114 001	Plate Coil for V115
L119	813 1115 001	Output Coupling Coil for V115 (Part of 6360 Output Coil Assy
L120	494 0110 000	R.F. Choke, 3.3 uh.
L122,L123,L126, L127,L128	494 0004 000	R.F. Choke
L121	476 0013 000	Choke, 6 hy., @ 160 ma., 165 ohm
L124,L125	913 1116 001	Parasitic Suppressor
P101,P102	610 0238 000	Plug, UG-88/U
P103	620 0122 000	Adaptor, UG-27/U
R101,R178,R179	540 0218 000	Res., 2.2 megohm, 1/2 W. 10%
R102	540 0476 000	Res., 4700 ohm, 1W. 10%
R103	540 0644 000	Res., 24K ohm, 2W. 5%
R104	540 0758 000	Res., 33K ohm, 2W. 10%
R105,R112,R128	540 0497 000	Res., 270K ohm, 1W. 10%
R106,R119,R169, R170,R171,R175, R193	540 0202 000	Res., 100K ohm, 1/2W. 10%
R107,R118	540 0180 000	Res., 1500 ohm, 1/2W. 10%
R108,R109,R124	540 0492 000	Res., 100K ohm, 1 W. 10%
R110,R160	540 0178 000	Res., 1000 ohm, 1/2 W. 10%
R111,R113,R125, R127,R136,R137, R143,R147,R156	540 0186 000	Res., 4700 ohm, 1/2 W. 10%
R114	540 0198 000	Res., 47K ohm, 1/2 W. 10%

PARTS LIST

Symbol No.	Gates Part No.	Description
R115,R126	550 0071 000	Potentiometer, 50K ohm
R116,R130	540 0498 000	Res., 330K ohm, 1W.
R117	540 0766 000	Res., 150K ohm, 2W.
R120,R121, R122,R164	540 0190 000	Res., 10K ohm, 1/2W. 10%
R123	540 0496 000	Res., 220K ohm, 1W. 10%
R129	540 0762 000	Res., 68K ohm, 2W. 10%
R131,R151	540 0184 000	Res., 3300 ohm, 1/2 W. 10%
R132,R135,R142, R146,R150,R152, R154,R157,R158, R161,R162, R176,R177	540 0206 000	Res., 220K ohm, 1/2W. 10%
R134,R137,R140, R141,R144,R145, R148,R149	540 0210 000	Res., 470K ohm, 1/2W. 10%
R138	540 0082 000	Res., 24K ohm, 1/2W. 5%
R153	540 0056 000	Res., 2000 ohm, 1/2W. 5%
R155,R159	540 0760 000	Res., 47K ohm, 2W. 10%
R163	540 0752 000	Res., 10K ohm, 2W. 10%
R165	542 0064 000	Res., 250 ohm, 10W.
R166	540 0166 000	Res., 100 ohm, 1/2W. 10%
R167	550 0073 000	Potentiometer, 100K ohm
R168,R184	540 0756 000	Res., 22K ohm, 2W. 10%
R172	540 0196 000	Res., 33K ohm, 1/2W. 10%
R173	540 0189 000	Res., 8200 ohm, 1/2W. 10%
R174	540 0183 000	Res., 2700 ohm, 1/2W. 10%
R181	540 0754 000	Res., 15K ohm, 2W. 10%
R182	550 0067 000	Potentiometer, 10K ohm
R183	540 0213 000	Res., 820K ohm, 1/2W. 10%
R185	540 0188 000	Res., 6800 ohm, 1/2W. 10%
R186,R187, R190,R191	540 0171 000	Res., 270 ohm, 1/2W. 10%
R188,R189	540 0160 000	Res., 33 ohm, 1/2W. 10%
R192	913 2346 001	Resistor Assy. 0.1 ohm
R180	542 0095 000	Res., 10K ohm, 10W.
S101	604 0001 000	Toggle Switch
S102	602 0005 000	Switch, 3 pos., 2 pole
T101	472 0088 000	Heater Transformer, Pri. 115V., 50/60 cy. Sec. 6.3V. C.T. @ 1.2 amp.
T102	478 0144 000	Audio Input Transformer
T103	472 0248 000	Power Transformer
TB101	614 0054 000	Terminal Board
TP101 thru TP121	612 0312 000	Test Point Jack
TP122,TP123	612 0311 000	Test Point Jack

PARTS LIST

Symbol No.	Gates Part No.	Description
V101,V102,V105	370 0229 000	Tube, 7025
V103,V104,V106	370 0228 000	Tube, 6201
V107,V108,V109, V110,V111,V121	370 0040 000	Tube, 6AU6
V112,V113,V114	370 0082 000	Tube, 6J6
V115	374 0054 000	Tube, 6360
V116	370 0116 000	Tube, ECC83/12AX7
V117	370 0032 000	Tube, 6AQ5A
V118	370 0133 000	Tube GZ34/5AR4
V119	370 0158 000	Tube, 6080
V120,V122	370 0001 000	Tube, OA2
XA101	406 0057 000	Pilot Light Assembly
XC181,XC182, XV118,XV119	404 0016 000	Socket, 8 pin
XF101,XF102	402 0021 000	Fuseholder
XHR101	404 0068 000	Socket, 8 pin
XV101,XV102, XV103,XV104, XV105,XV106, XV115,XV116	404 0042 000	Socket, 9 pin miniature
XV107,XV108, XV109,XV110, XV111,XV112, XV113,XV114, XV117,XV120, XV121,XV122	404 0038 000	Socket, 7 pin miniature
Y101		Crystal in T9D Holder (Det. by Customer Order)

Warranty

This equipment is warranted under the liberal Gates Radio Company warranty, terms and conditions of which are fully set forth on the reverse page.

GATES RADIO COMPANY

PRESIDENT

WARRANTY

This equipment is warranted by Gates Radio Company of Quincy, Illinois to be free from defects in workmanship and material and will be repaired or replaced in accordance with the terms and conditions set forth below:

1. Gates Radio Company believes that the purchaser has every right to expect first-class quality, materials and workmanship and has created rigid inspection and test procedures to that end, and excellent packing methods to assure arrival of equipment in good condition at destination.

2. Gates Radio Company will endeavor to make emergency shipments at the earliest possible time giving consideration to all conditions.

3. Gates Radio Company warrants new equipment of its manufacture for one (1) year (six (6) months on moving parts), against breakage or failure of parts due to imperfection of workmanship or material, its obligation being limited to repair or replacement of defective parts upon return thereof f.o.b. Gates Radio Company's factory, within the applicable period of time stated. Electron tubes shall bear only the warranty of the manufacturer thereof in effect at the time of the shipment to the purchaser. Other manufacturers' equipment covered by a purchaser's order will carry only such manufacturers' standard warranty. These warranty periods commence from the date of invoice and continue in effect as to all notices, alleging a defect covered by this warranty, received by Gates Radio Company prior to the expiration of the applicable warranty period.
The following will illustrate features of the Gates Radio Company warranty:

   Transmitter Parts: The main power or plate transformer, modulation transformer, modulation reactor, main tank variable condensers all bear the one (1) year warranty mentioned above.

   Moving Parts: As stated above, these are warranted for a period of six (6) months.

   Electron Tubes: As stated, Electron tubes will bear such warranty, if any, as provided by the manufacturer at the time of their shipment. Gates Radio Company will make such adjustments with purchasers as given to Gates Radio Company by the tube manufacturer.

   All other component parts (except as otherwise stated): Warranted for one (1) year.

   Abuse: Damage resulting from abuse, an Act of God, or by fire, wind, rain, hail, in transportation, or by reason of any other cause or condition, except normal usage, is not covered by this warranty.

4. Operational Warranty — Gates Radio Company warrants that any new transmitter of its manufacture, when properly installed by purchaser and connected with a suitable electrical load, will deliver the specified radio frequency power output at the output terminal(s) of the transmitter, but Gates Radio Company makes no warranty or representation as to the coverage or range of such apparatus. If a transmitter does not so perform, or in the event that any equipment sold by Gates Radio Company does not conform to any written statement in a contract of sale relative to its operating characteristics or capabilities, the sole liability of Gates Radio Company shall be, at the option of Gates Radio Company, either to demonstrate the operation of the equipment in conformance with its warranty, or to replace it with equipment conforming to its warranty, or to accept its return, f.o.b. purchaser's point of installation and refund to purchaser all payments made on the equipment, without interest. Gates Radio Company shall have no responsibility to the purchaser under a warranty with respect to operation of equipment unless purchaser shall give Gates Radio Company a written notice, within one (1) month after arrival of equipment at purchaser's shipping point, that the equipment does not conform to such warranty.

5. Any item alleged by a purchaser to be defective, and not in conformance with a warranty of Gates Radio Company shall not be returned to Gates Radio Company until after written permission has been first obtained from the Gates Radio Company home office for such return. Where a replacement part must be supplied under a warranty before the defective part can be returned for inspection, as might be required to determine the cause of a defect, purchaser will be invoiced in full for such part, and if it is determined that an adjustment in favor of the purchaser is required, a credit for an adjustment will be given by Gates Radio Company upon its receipt and inspection of a part so returned.

6. All shipments by Gates Radio Company under a warranty will be f.o.b. Quincy, Illinois or f.o.b. the applicable Gates Radio Company shipping point.

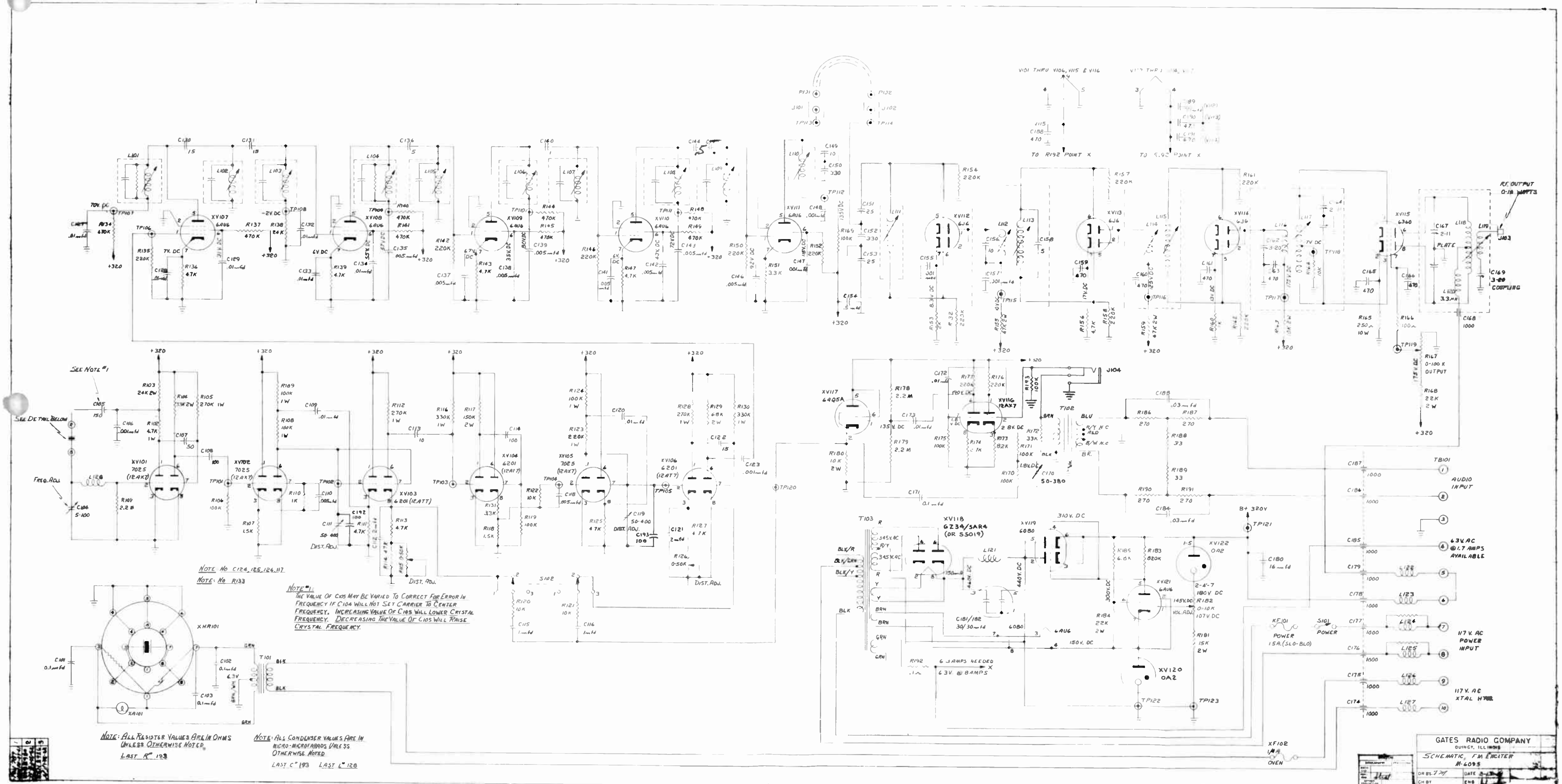
7. Gates Radio Company is not responsible for the loss of, or damage to, equipment during transportation or for injuries to persons or damage to property arising out of the use or operation of Gates equipment. If damage or loss during transportation occurs, or if the equipment supplied by Gates Radio Company is otherwise damaged, Gates will endeavor to make shipment of replacement parts at the earliest possible time giving considration to all conditions. It is the responsibility of a purchaser to file any claim for loss or damage in transit with the transportation company and Gates will cooperate in the preparation of such claims to the extent feasible when so requested.

8. Gates Radio Company, in fulfilling its obligations under its warranties, shall not be responsible for delays in deliveries due to depleted stock, floods, wars, strikes, power failures, transportation delays, or failure of suppliers to deliver, acts of God, or for any condition beyond the control of Gates that may cause a delayed delivery.

9. This warranty may not be transferred by the original purchaser and no party, except the original purchaser, whether by operation of law or otherwise, shall have or acquire any rights against Gates Radio Company by virtue of this warranty.

10. Gates Radio Company reserves the right to modify or rescind, without notice, any warranty herein except that such modification or rescission shall not affect a warranty in effect on equipment at the time of its shipment. In the event of a conflict between a warranty in a proposal and acceptance and a warranty herein, the warranty in the proposal and acceptance shall prevail.

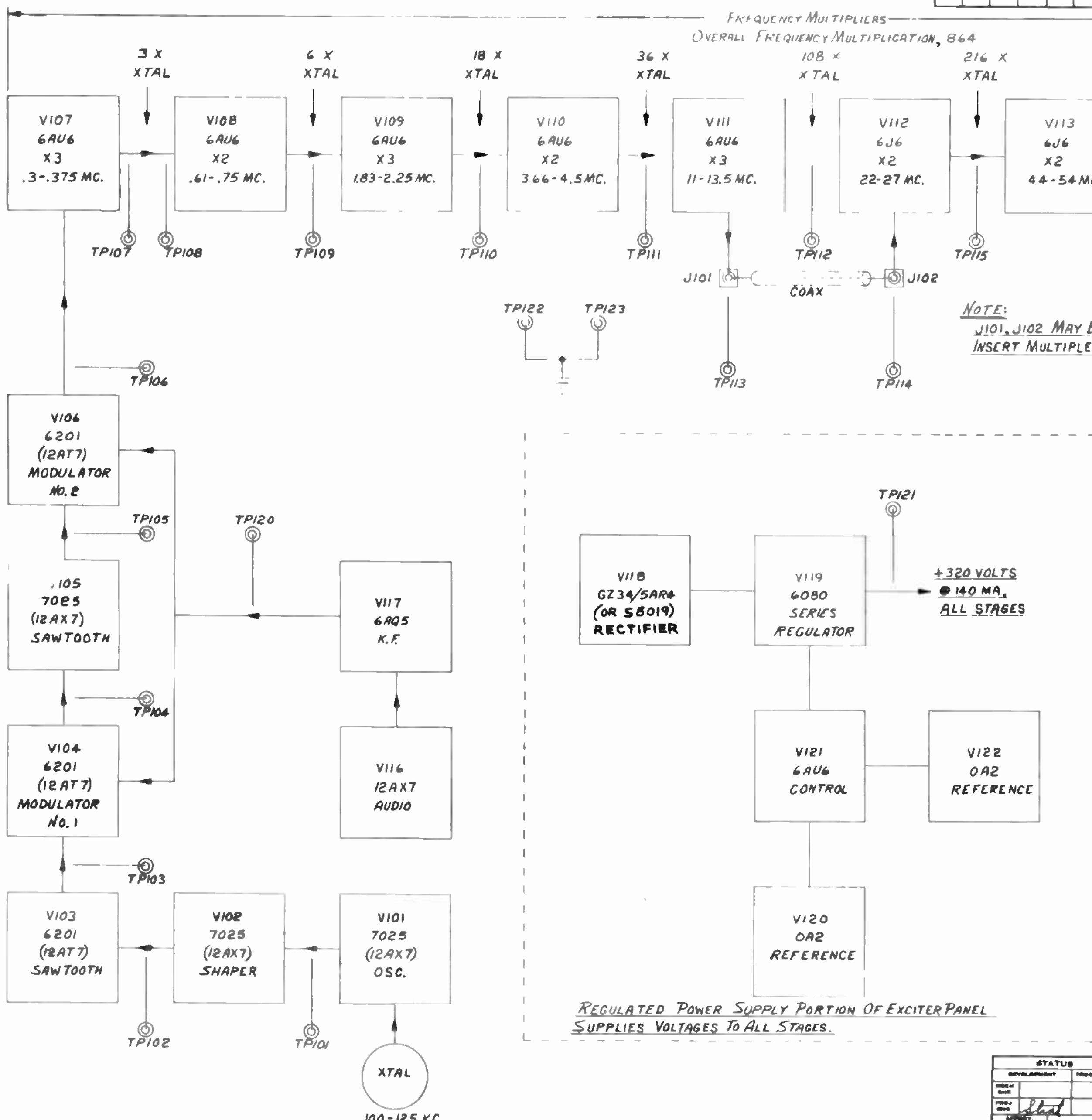
11. This warranty shall be applicable to all standard Gates catalog items sold on or after March 1, 1960.



SEE NOTE #1
NOTE: No C124, 125, 126, 117
NOTE: No R133
NOTE #1:
THE VALUE OF C105 MAY BE VARIED TO CORRECT FOR ERROR IN FREQUENCY IF C104 WILL NOT SET CARRIER TO CENTER FREQUENCY. INCREASING VALUE OF C105 WILL LOWER CRYSTAL FREQUENCY. DECREASING THE VALUE OF C105 WILL RAISE CRYSTAL FREQUENCY.
NOTE: ALL RESISTOR VALUES ARE IN OHMS UNLESS OTHERWISE NOTED.
LAST R 193
NOTE: ALL CONDENSER VALUES ARE IN MICRO-MICROFARADS UNLESS OTHERWISE NOTED
LAST C 193 LAST L 128
R.F. OUTPUT 0-18 WATTS
AUDIO INPUT
6.3V AC @ 1.7 AMPS AVAILABLE
117 V. AC POWER INPUT
117 V. AC XTAL HTR
GATES RADIO COMPANY
QUINCY, ILLINOIS
SCHEMATIC, FM EXCITER
M-6095

852 5774 001

						FIRST USED FOR	GATES RADIO COMPANY QUINCY, ILLINOIS		837 9534 001
									SCALE
106	105	104	103	102	101		LIST OF PARTS		
QTY.	QTY.	QTY.	QTY.	QTY	QTY.	ITEM	REFERENCE	FIN.	DESCRIPTION	MATERIAL



EXPLANATIONS:

NOTATIONS MADE JUST ABOVE THE UPPER ROW OF BLOCKS GIVE INFO. ON HOW MANY TIMES XTAL FREQUENCY HAS BEEN RAISED AT THAT POINT. (EXAMPLE: 216 X XTAL MEANS THAT CIRCUITS BETWEEN V112 & V113 ARE TUNED TO 216 TIMES CRYSTAL FREQUENCY.)

X2 MEANS STAGE IS A DOUBLER
X3 MEANS STAGE IS A TRIPLER

FREQUENCIES NOTED IN BLOCKS REFER TO THE PLATE CIRCUIT OF THAT STAGE.

APPROXIMATE LOCATION OF TEST POINTS ARE SHOWN BY TP101 THRU TP123

1	ECN 8950 1-15-62

TITLE: FUNCTIONAL BLOCK DIAGRAM EXCITER UNIT M-6095

STATUS: DEVELOPMENT / PRODUCTION

DR. | CH. BY | ENG. | SHEET OF | 837 9534 001

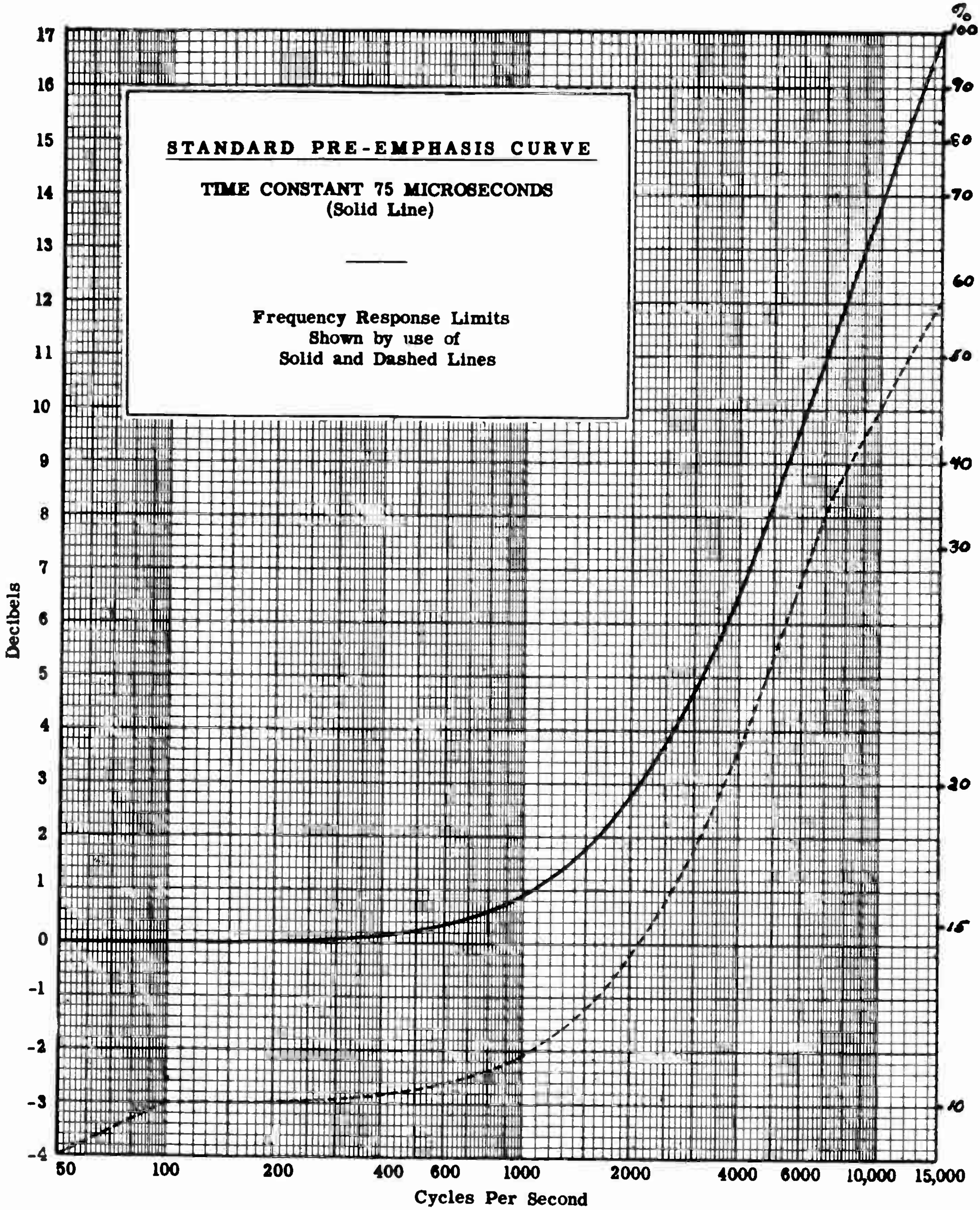
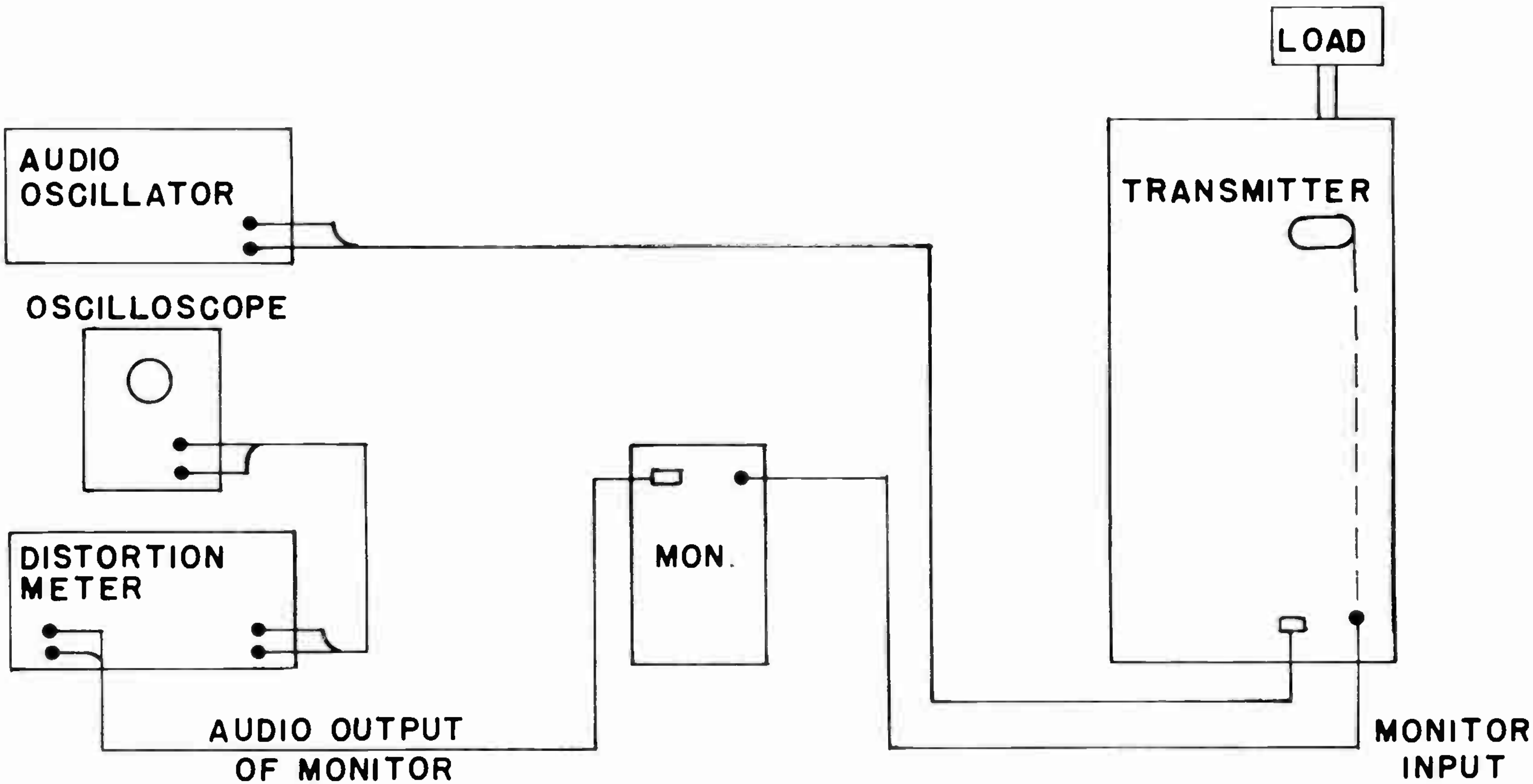


FIGURE 12

ES-C170

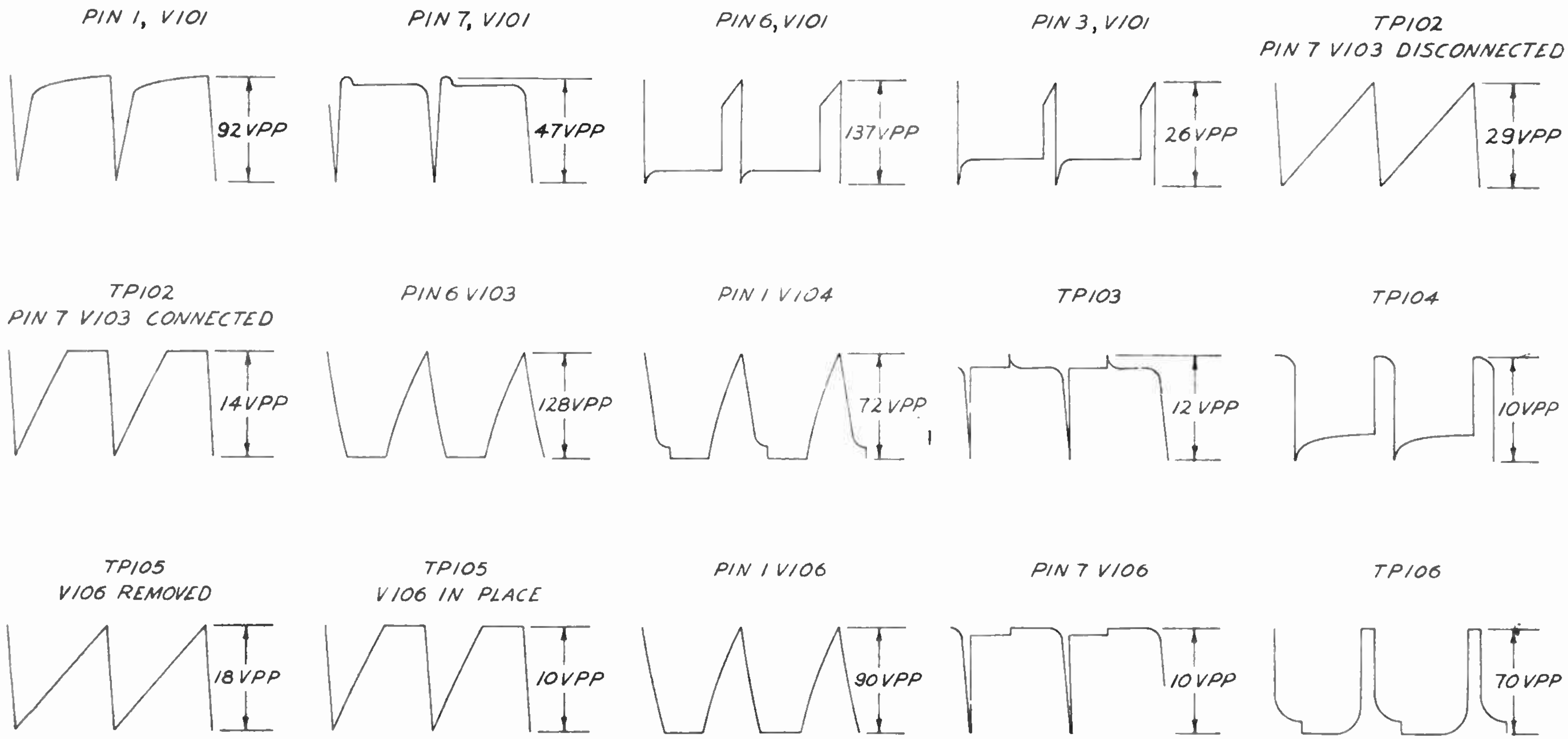


REDRAWN CJN 12-31-58
REDRAWN WLS 1-7-56

GATES RADIO COMPANY
QUINCY, ILLINOIS

TEST SETUP FOR F.M.

DR. CRB		A-4165
CH. BEP	ENG BEP	

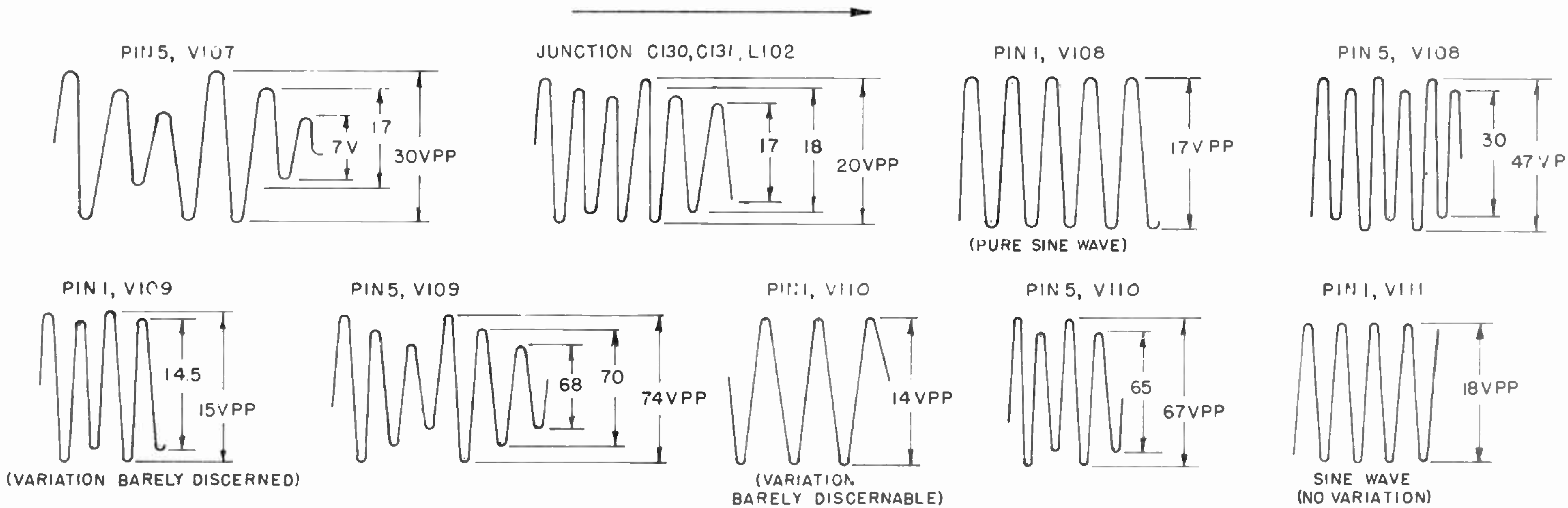


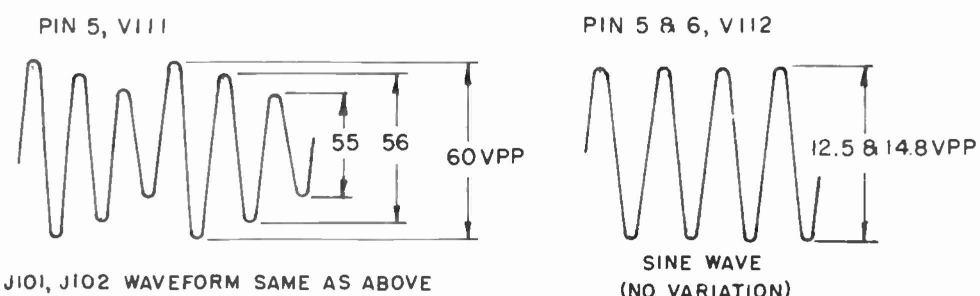
NOTE:

THE ABOVE PP WAVEFORM MEASUREMENTS WERE MADE WITH A MODEL 524 AD TEXTRONIX SCOPE. AN UNCALABRATED SCOPE MAY BE CALIBRATED BY USING FILAMENT VOLTAGE TO SET A REFERENCE. PEAK TO PEAK VOLTAGE EQUALS 2.8 X RMS VALUE. 6.3 VAC = 17.5 VPP.

TYPICAL WAVEFORMS OF STAGES V101 THROUGH V106 OF THE M6095 EXCITER

826 7991 001





J101, J102 WAVEFORM SAME AS ABOVE BUT AMPLITUDES WERE 1.4, 1.3, 1.25 VPP RESPT.

NOTE: TO MAKE THE WAVEFORM MEASUREMENTS SHOWN ON THIS DRAWING, A MODEL 524AD TEXTRONIX SCOPE WAS USED. AN ATTENUATOR PROBE WAS USED WHICH REDUCED CAPACITY. FREQUENCY OF THE UNIT UNDER TEST WAS 88.1 MC. IN EACH CASE THE STAGE UNDER TEST HAD TO BE RETURNED WHEN THE PROBE WAS CONNECTED. IT MAY BE IMPOSSIBLE TO RE-RESONATE THE CIRCUIT UNDER TEST IF THE EXCITER IS TUNED UP NEAR THE HIGH END OF THE BAND.

IF AN UNCALIBRATED SCOPE IS USED, IT MAY BE CALIBRATED BY USING FILAMENT VOLTAGE TO SET A REFERENCE. PEAK TO PEAK VOLTAGE EQUALS 2.8 X RMS VALUE. 6.3 VAC THEN EQUALS 17.5 VPP. IT WAS IMPOSSIBLE TO SYNC SCOPE AFTER V112.

TYPICAL WAVEFORMS OF STAGES V107 THROUGH V112. M6095 EXCITER

826 7990 001

INSTRUCTIONS FOR OPERATION OF M5675 AMPLIFIER

General Description

The M5675 amplifier covers a frequency range of 88 to 108 mc. This is done without the addition or removal of any padding components in either grid or plate circuits. Power gain of this amplifier is approximately 10. When used as a final output stage, maximum power output is in the vicinity of 50 to 60 watts. The M5675 may also be used to drive following amplifier stages.

The series type of circuit is used in the grid and a conventional parallel type of circuit is used in the plate. This tends to make for less susceptibility of parasitics at higher frequencies than the amplifier is used. Screens of the 6146 amplifier tubes are isolated by chokes rather than RF grounded. This has proven to be more effective at VHF frequencies and eliminates the need for neutralizing. The reader should refer to schematic B-65555 for a better understanding of the circuit.

Tune-up

This particular amplifier should be tuned up for best efficiency and coupled for best transfer of power even if considerably less than full output power is desired. The screen control may then be turned down to reduce output power to the desired level.

To tune the grid circuit, place the negative probe of a voltmeter, into TP401 and ground the positive lead. With drive connected to input receptacle J401, tune C401 (grid tuning) for maximum negative reading on the voltmeter. This voltage may vary all the way from -15 to -45 volts depending on the amount of drive. This reading will drop as soon as screen and plate voltage are applied to the amplifier.

After the grid circuit has been properly tuned, coupling between L401 and L402, L403 should be varied to obtain the maximum negative voltage at TP401 with a minimum of drive. C401 must be retuned each time coupling is changed.

When the input circuit has been properly tuned, plate and screen voltage may be applied to the amplifier and the plate circuit tuned. It is recommended that this be done with the amplifier coupled into a 51 ohm non-reactive load. If plate current is being metered, tune the plate tune control C407 for a dip. Otherwise, tune C407 for maximum power output. Now vary coupling between L404 and L405. Turn amplifier back on and tune C406 for maximum power output along with C407. Several trys may be needed to find the best point of coupling between L404 and L405. Each time the coupling between L404 and L405 is varied, the plate must be retuned along with output coupling capacitor C406.

After tuning has been completed for best power output and efficiency, screen control R405 should be set for the desired power output. In no case should the output circuit be de-coupled to reduce output power.

It should be emphasized that this amplifier is easily over-driven. For 50 watts output power approximately 3 watts drive is required. For 15 to 25 watts output power, about 1 watt of driving power is required. If driving power is increased above the required amount, power output of the amplifier will fall off due to high grid leak bias being created. A typical set of reading are given on this amplifier on the following page.

Coupling Amplifier To Another Stage.

When the amplifier is going to be used to drive another amplifier stage, it is suggested that it first be tuned up into a load and then coupled to the grid circuit of the following amplifier stage.

To reduce the possibility of oscillations and/or parasitics, the input circuit of the following stage should be properly coupled and matched to the 51 ohm coaxial line connected to the output of the 50 watt amplifier. This may be done with a micromatch coupling unit. The following grid and input circuit should be adjusted for minimum SWR.

If a micromatch coupling unit is not available, the input coupling and grid tuning of the following stage should be tuned for maximum grid current in that stage.

If the following input circuit is properly matched, plate tuning of the 50 watt amplifier will not change appreciably when switching from a non-reactive load to being coupled to the following amplifier stage.

If the 50 watt amplifier stage was properly tuned up into a load and plate tuning deviates radically from where it was after being coupled into another stage, a major mis-match exists.

If the 50 watt amplifier unit is over-driving the following amplifier, screen control R405 should be adjusted for the desired drive. Do not de-couple the 50 watt amplifier stage.

TYPICAL OPERATIONAL TEST DATA
OBTAINED ON
M5675 AMPLIFIER OPERATING AT 99.1MC

Pwr. Out	65 W.	50 W.	23 W.	17 W.	13 W.
Plt. Current	250 Ma.	215 Ma.	140 Ma.	130 Ma.	110 Ma.
Plt. Voltage	500 volts	520 volts	570 volts	580 volts	590 volts
Screen volts	290 volts	235 volts	150 volts	147 volts	132 volts
Screen Current	12 Ma.	8.5 Ma.	3 Ma.	2.2 Ma.	1.5 Ma.
Cathode volts	68 volts	58 volts	35 volts	33 volts	29 volts
Driving power	6.5 watts	2.5 watts	1 watt	.8 watt	.8 watt
Grid Voltage	-10/-42"	-7/-33"	-8.5/-23"	-6.5/-20"	-3.5/-15"

(Grid voltage measured at TP401. " indicates voltage before applying screen and plate voltage)

Plt.Pwr.Input	107 watts	97 watts	75 watts	72 watts	61 watts
Plt. Dissipation	42 watts	47 watts	52 watts	55 watts	48 watts
Plt. Circuit Efficiency	61%	52%	31%	23.5%	21%

Figures below obtained with no drive.

Plt. Voltage	550 volts	560 volts	580 volts	580 volts	590 volts
Plt. Current	165 Ma.	155 Ma.	125 Ma.	125 Ma.	105 Ma.
Cathode volts	45 volts	40 volts	31 volts	31 volts	27 volts
Plt.Dissipation	83 watts	80 watts	69 watts	69 watts	59 watts

(All readings were made with screen connected to regulated +320 regulated supply)

PARTS LIST

Symbol No.	Gates Stock No.	Description
C401	520 0004 000	Cap., Variable, 2-19 mmfd.
C402	520 0194 000	Cap., 500 mmfd., 500V. Button Type
C403,C404, C405	516 0215 000	Cap., 100 mmfd., ±10%
C406	520 0115 000	Cap., Variable, 5-25 mmfd.
C407	520 0164 000	Cap., Variable, 2-15 mmfd.
C408,C409	516 0227 000	Feedthru Cap., 500 mmfd.
C410	516 0235 000	Feedthru Cap., 1000 mmfd.
C411	520 0112 000	Var. Cap., 2.2-21.5 mmfd.
J401,J402	612 0233 000	Receptacle
L401	813 1772 001	Grid Coupling Coil
L402	813 1762 001	Grid Coil
L403	813 1761 001	Grid Coil
L404	913 1774 001	Plate Coil Assembly
L405	813 1771 001	Plate Output Loop
L406	494 0007 000	R.F. Choke
L407,L408, L410,L411	494 0004 000	R.F. Choke
L409	813 0246 001	Filament Choke
L412	813 3607 001	Coil
L413	813 3608 001	Coil
P401,P402	620 0122 000	Right Angle Adaptor, UG-27C/U
R401,R402	540 0482 000	Res., 15K ohm, 1W. 10%
R403	552 0058 000	Res., 500 ohm, 25W. Adj.
R404	540 0367 000	Res., 30K ohm, 1W., 5%
R405	550 0073 000	Control, 100K ohm
R406	540 0748 000	Res., 4700 ohm, 2W., 10%
R407,R408	540 0752 000	Res., 10K ohm, 2W. 10% (Used in FM-1B/1C only)
TB401	614 0096 000	Terminal Board
TP401	614 0312 000	Test Point Jack
V401,V402	374 0051 000	Tube, 6146
XV401,XV402	404 0016 000	Socket, Octal

-- SPECIFICATIONS --

The FM harmonic filter is of a distributed constant nature using coaxially designed elements.

The characteristic impedance of the filter is 50 . ohm, therefore matching both the output impedance of the transmitter and the transmission line to be used.

The insertion loss of the filter is 0.2 db or less at the operating frequency resulting in low power loss in the filter.

With the aid of the filter all transmitter harmonics are suppressed at least 70 db below the fundamental.

Since the filter is of a symmetrical design either end can be used as an input.

The filter proper is an 11 foot section of 1-5/8" dia. coaxial line provided with 1-5/8" fixed flanges at each end. Included with the filter are two adaptors for reduction to a 7/8" coaxial line. A 7/8" right angle bend is also provided to aid in a flexible installation.

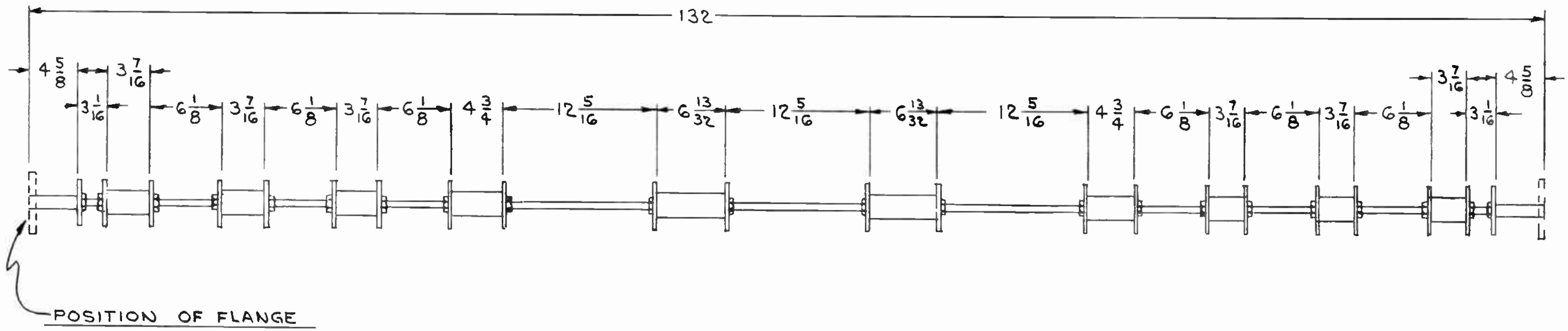
-- INSTALLATION --

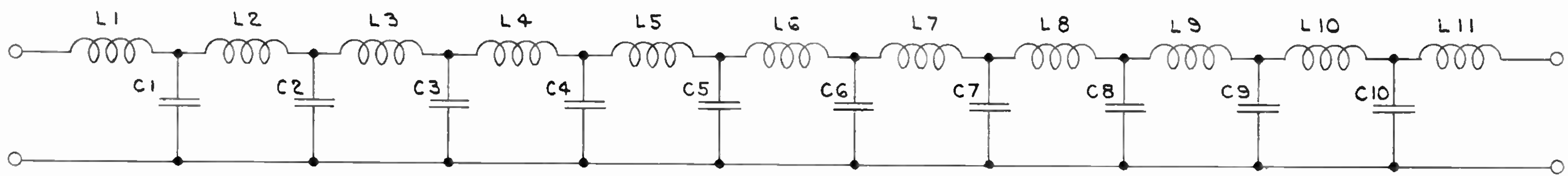
Since the filter is not a standard section of transmission line, special care should be taken when installing the filter to prevent damage to the inner conductor.

If the 1-5/8" to 7/8" coaxial adaptor is used this problem is reduced because the inner conductor is captive. When using the 1-5/8" coaxial line directly, it is suggested that the inner conductor of the filter be slipped out several inches and mated with the inner conductor of the transmission line. If the filter is mounted vertically it is very important that the transmission line sections above the filter be installed properly so as not to have the added weight of the inner conductors bearing down upon the inner conductor of the filter.

						FIRST MADE FOR	GATES RADIO COMPANY QUINCY, ILLINOIS		B-65672 SCALE
106	105	104	103	102	101	GR. NO.	LIST OF PARTS		

QTY.	QTY.	QTY.	QTY.	QTY.	QTY.	ITEM	REFERENCE	PT. OR G.N.	FIN.	DESCRIPTION	MATERIAL





LOW FREQ. EQUIVALENT CIRCUIT

50. Ω INPUT

fc = 165 MC

INSERTION LOSS = 0.2 db OR LESS

LENGTH = FILTER WITH END FLANGES = 11',

FILTER PLUS END FLANGES & ADAPTOR = 12' 6"

MATES WITH 7/8" ANDREW #560 COAX

1 ECN 7869 CJN 6-5-59

TITLE COAXIAL LOW PASS FILTER INFORMATION
M5737

MTL.			FIN.	UNLESS OTHERWISE SPECIFIED, ALL TOLERANCES PER GATES SPEC G8M101.
DR. BY DATE 7-2-58	CH. BY	ENG. JB	SHEET OF	B-65672

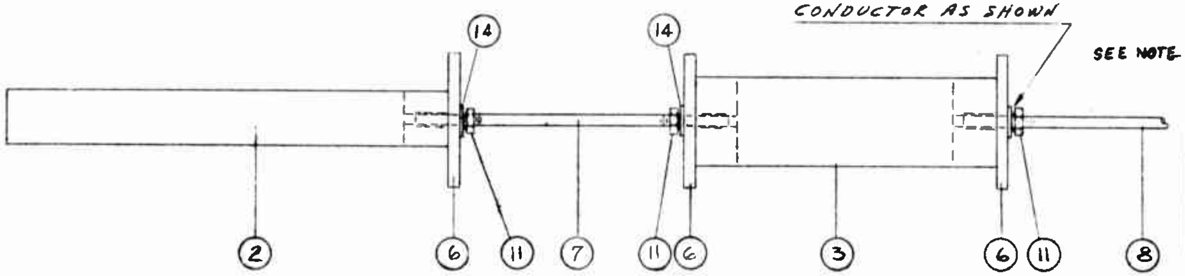
PROCEDURE

BOTTOM NUTS ON INNER CONDUCTING RODS ITEMS 7, 8 & 9 INSTALL BEADS ITEM 6 ON ROD AND INSTALL ITEMS AS SHOWN BELOW. BOTTOM ALL RODS BEFORE TIGHTENING STOP NUT, ITEM 11. MAKE CERTAIN ALL CONNECTIONS ARE TIGHT, THEN INSTALL ASSEMBLY INTO ITEM 10.
USING APPROPRIATE HARDWARE AT EACH ITEM 12 TO ONE END & ITEMS 12 & 13 TO THE OTHER END OF ITEM 10

GATES RADIO COMPANY
QUINCY, ILLINOIS

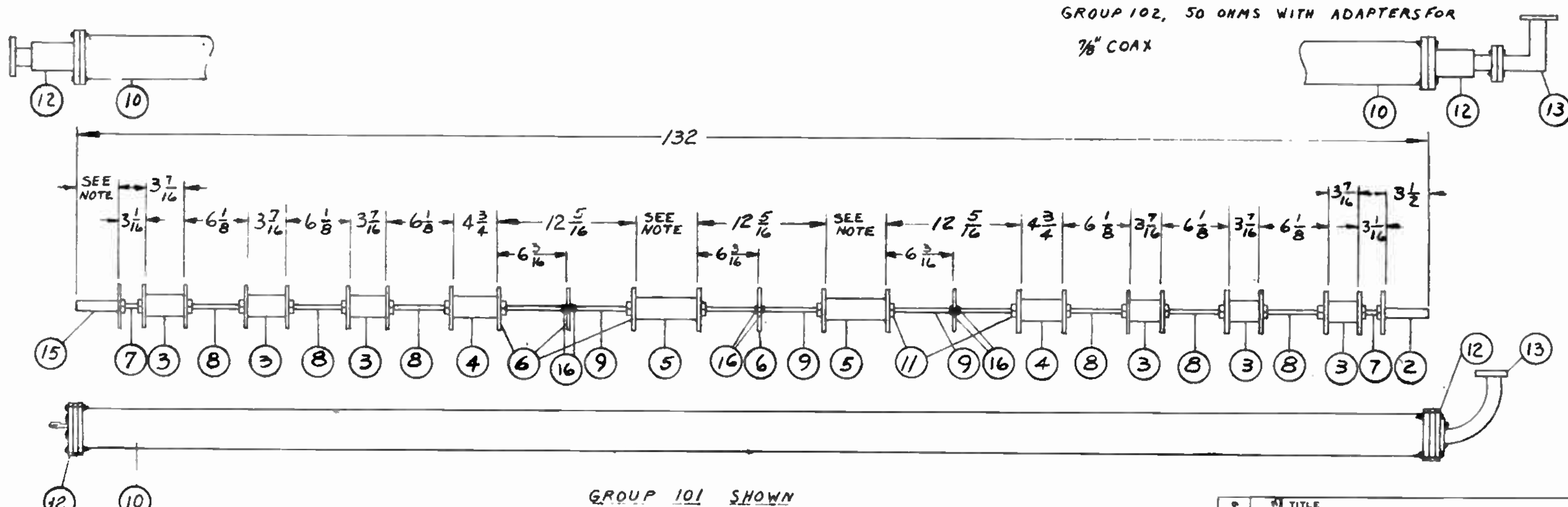
LIST OF PARTS

106 QTY	105 QTY	104 QTY	103 QTY	102 (50Ω) QTY	101 (51.5Ω) QTY	ITEM	REFERENCE	PT GN	FIN	DESCRIPTION	MATERIAL
				X	X	1	THIS DWG		GA 50	ASSEMBLY	
					1	2	913-1524-003		GA 50	ASSEMBLED COAX ADAPTER	
				6	6	3	913-1523-001		GA 50	ASSEMBLED INNER CONDUCTOR	
				2	2	4	913-1523-002		GA 50	ASSEMBLED INNER CONDUCTOR	
				2	2	5	913-1523-003		GA 50	ASSEMBLED INNER CONDUCTOR	
				25	25	6	813-1522-001		GA 50	BEAD	
				2	2	7	813-5611-004		GA 50	INNER CONDUCTING ROD	
				6	6	8	813-5611-005		GA 50	INNER CONDUCTING ROD	
				3	3	9	813-5611-006		GA 50	INNER CONDUCTING ROD	
					1	10	926-5673-002		GA 50	ASSEMBLED OUTER CONDUCTOR	
				22	22	11	304-0051-000			6-32 HEX HD ELASTIC STOP NUT BRASS	
					2	12	620-0089-000			REDUCING ADAPTER	
					1	13	620-0054-000			RIGHT ANGLE BEND (ANDREW #12693	
				22	22	14	308-0005-000		GP103	#6 FLAT WASHERS BRASS	
					1	15	913-1524-004		GA 50	ASSEMBLED COAX ADAPTER	
				X	X	16	299-0006-000			3/4" WIDE #33 SCOTCH TAPE	
				1		2	913-1524-003		GA 50	ASSEMBLED COAX ADAPTER	
				1		10	926-5673-002		GA 50	ASSEMBLED OUTER CONDUCTOR	
				2		12	620-0089-000			REDUCING ADAPTER, #1860 ANDREW	
				1		13	620-0054-000			RIGHT ANGLE ELBOW, #1060M ANDREW	
				1		15	913-1524-004			ASSEMBLED COAX ADAPTER	



NOTE -- ITEM 16 TAPE, WRAP SEVERAL TURNS EACH SIDE OF BEADS AS SHOWN TO PREVENT LINEAR MOVEMENT

ITEMS 5 & 15, LENGTH IS DETERMINED BY FREQUENCY. SEE DWG A-31690



GROUP 101 SHOWN

GROUP 102 ADDED 5-25-59	ECN 7729
TITLE	F.M. LOW PASS FILTER M5737
MTL	FIN
DR BY / DATE	CH. BY	ENG
SHEET 1 OF 1	C-78163

ADDENDUM

M-6023 AUTOMATIC RECYCLING UNIT

1. R7 has been added in heater circuit of K4 to compensate for individual differences of this time delay relay. It is adjusted at the factory for a ten second delay.

   If K4 should be changed, it may be necessary to re-adjust R6 for a ten second delay.

2. R8 has been added in contact circuit of K4 to insure more dependable performance of the time delay relay by preventing arcing and consequent sticking of its contacts.

ECN-9115

M-6023 AUTOMATIC RECYCLE UNIT

THEORY OF OPERATION

General

The unit is designed to provide a low voltage source for pilot lights and interlock circuits. In addition, with the transmitter wired properly, it provides a lock-in function on overloads for maximum indication of source of trouble. This lock-in feature can be reset manually at the transmitter or at a remote point.

The third function of the unit makes recycling possible when an overload occurs and the "tune-operate" switch is switched to "operate" position. An R/C circuit operating an auxiliary relay provides three complete recycles during a 10 second interval.

NOTE: The above number of recycles can be changed by adjusting a potentiometer to almost any desired number within a certain time period. Also, the total recycle time can be changed by inserting another time delay relay of the desired type. When using a 10 second time delay and the transmitter has overloaded, the following will occur. If, during the 10 second interval, the transmitter overload has not corrected itself, the transmitter overload at fault will lock out and remain locked out until manually reset. If the transmitter experiences one or two overloads and then clears itself, the recycle unit will again be ready for three more complete recycles after approximately 15 seconds.

Circuit Description

The time constant which determines the pulse interval for recycling is the 50 K 2 W. potentiometer, R1, and the capacity of C1A. When the voltage on the positive terminal of C1A equals the voltage necessary to close the relay K1, this occurs causing the capacitor to discharge through R3, 100 ohm to ground. The discharge time constant is chosen to allow sufficient time for the high voltage contactor to close prior to the reopening of relay K1.

This discharge interval must not be sufficiently long to allow damage to the transmitter in an overloaded condition.

The second set of contacts on relay K2, a slave relay, switches the heavier currents involved in closing the high voltage contactor and also breaking the 130 volts D.C. which locks in the overload relays. Therefore, recycling of the reset occurs just prior to the closing of the high voltage contactor.

The time delay relay K4 is activated the instant that K3 energizes which occurs when an overload relay locks down. After an elapsed time of ten seconds or three recycle periods, K4 closes, shorting the coil of K1 to ground, thus stopping the operation of the time constant circuit. After this elapsed time of ten seconds, the unit must be reset either remotely or by the reset button located on the front panel of the 1Kw driver. It is necessary to wait approximately 15 seconds for the element in K4 to cool before you can expect another three recycles.

Relay K3 performs three functions, the aforementioned closing of K2 when K3 is energized and also to supply 130 V. DC to potentiometer R1 in an overload condition. It also breaks the 230 V. AC which supplies the high voltage contactor coil. In an unenergized condition K3 breaks 130 V. DC to K1 through R1 and maintains coil voltage to the high voltage contactor. Also, the time delay relay K4 has operating voltage removed which should increase the operating life of this relay. K3 is operated by 6 V. AC which is supplied by the unit. One coil terminal is tied common to the 6 V. AC transformer and the other coil terminal is tied in series with a parallel string of overload relay contacts which return to the other side of the 6 V. AC transformer.

Resistor R4 acts as a surge resistor while R2 is merely a bleeder resistor.

The two switches and one push button which control the recycle unit are mounted on the 1KW driver control panel. The operation of the push button acts as a manual reset. It is a normally closed switch, which when open, removes 130 V. DC from the 3.5K resistors in series with the coil and overload potentiometers of the overload relays. These relays then open to again permit operation of the transmitter.

The "local-remote" switch opens the circuit for the remote "on" function, thus placing the transmitter in a local operate condition only.

The "tune-operate" switch performs two functions, in "tune" position it shorts out the coil of K1 in the recycle unit, thus making the unit inoperative. In "operate position", the short is removed from the coil of relay K1. When the 1KW transmitter is used as a driver for a higher power amplifier, the "tune-operate" switch also performs the following functions. It supplies 240 V. AC to the manual push button on the P.A. high voltage control panel when in tune position. In this position the driver and P.A. high voltages must be turned on independently. In "operate" position the short is removed from the coil of K1 and the 240 V. AC is removed from the P.A. high voltage push button on the P.A. Instead 240 V. AC is supplied to one contact of the K809 under drive auxiliary relay, which when closed, turns the P.A. high voltage contactor on.

PARTS LIST

M-6023 AUTOMATIC RECYCLING UNIT

Symbol No.	Drawing No.	Description
C1	524 0091 000	Cap., 200-200 mfd., 150 V.
CR1	384 0020 000	Silicon Rectifier
F1	398 0017 000	Fuse, 1 amp. 250V.
K1	574 0020 000	Plug-in Relay, Double Pole
K2	574 0040 000	Relay, 115V. AC, D.P.D.T.
K3	574 0073 000	Relay, 6V. A.C, 3P.D.T.
K4	576 0019 000	Time Delay Relay, 115V. 10 Sec.
R1	550 0071 000	Control, 50K ohm, 2W.
R2	542 0135 000	Res., 1.5K ohm, 20W.
R3	550 0059 000	Control, 500 ohm, 2 W.
R4	540 0724 000	Res., 47 ohm, 2W. 10%
R5, R6	540 0752 000	Res., 10K ohm, 2W. 10%
R7	552 0023 000	Adj. Res., 1000 ohm, 10 W.
R8	540 0468 000	Res., 1000 ohm, 1 W. 10%
T1	472 0208 000	Isolation Transformer
T2	472 0090 000	Fil. Transformer
TB1	614 0034 000	Terminal Board
XF1	402 0021 000	Fuseholder
XK1, XK4	404 0016 000	Octal Socket