# TECHNICAL MANUAL

INSTRUCTIONS FOR INSTALLING

AND OPERATION OF

FM-1H3 1KW FM TRANSMITTER

HARRIS CORPORATION

Broadcast Products Division

T.M. No. 888 1065 001

HARRIS COMMUNICATIONS AND INFORMATION HANDLING

HARRIS CORPORATION Broadcast Products Division
123 Hampshire Street, Quincy, Illinois 62301

# MANUAL CHANGE NOTICE

PUBLICATION NO. 888 1065 001

PUBLICATION DATE _____ REVISED _____

ITEM FM-1H3 MODEL 994 6740 001 SERIAL _____

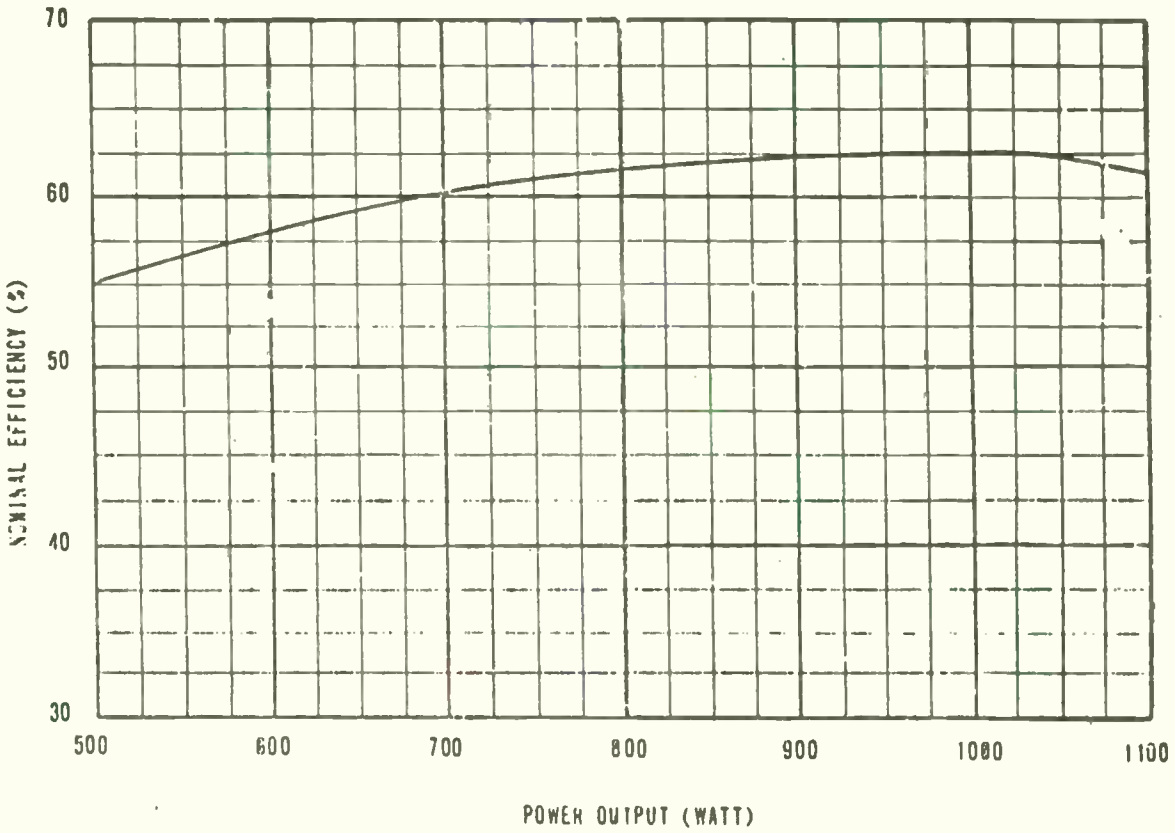
INSTRUCTIONS: Note indicated changes to manual.
File CHANGE NOTICE in front of manual.

| CHANGE NO. | DATE | AUTHORITY | REASON |
|---|---|---|---|
| 1. | 10/24/75 | ECN 17823 | 1a. Drawing Change. See Change #2.<br>1b. Component addition and deletion. |
| 2. | 07/27/78 | ECN 22456 | 2a. Drawing Change. |
| 3. | 07/27/78 | ECN 22554 | 3a. Drawing Change. |

PUBLICATION NO. 888 1065 001

| Change No. | Change |
|---|---|
| 1. | 1a. Schematic 842 6146 001, Replace w/updated Rev. E. |
| | 1b. Page 2, Parts List, Add R40, R41, and R42, Res., 22 ohm, 2W 540 0571 000, Add R43,R44 and R45, Res., 560 ohm, 2W 540 0605 000, and Delete R22, and R23, Resistor, 2000 ohm, 2W 540 0618 000. |
| 2. | 2a. Replace Drawing 842 6146 001 (FM-1 Schematic) with 842 6146 002. |
| 3. | 3a. Replace Drawing 814 8318 001 (PA Efficiency Chart) with 814 8318 001, Rev.A. |

| LTR | DATE | REVISION | DFTM | ENG | ECN |
|---|---|---|---|---|---|
| A | 4/2/77 | ADD FM1K | KWS | | 22554 |
| | | | | | |




REFER TO THE TRANSMITTER FACTORY TEST DATA FOR THE EFFICIENCY FACTOR DETERMINED ON FINAL TEST

REVISED 5-31-72
REVISED 1-20-70

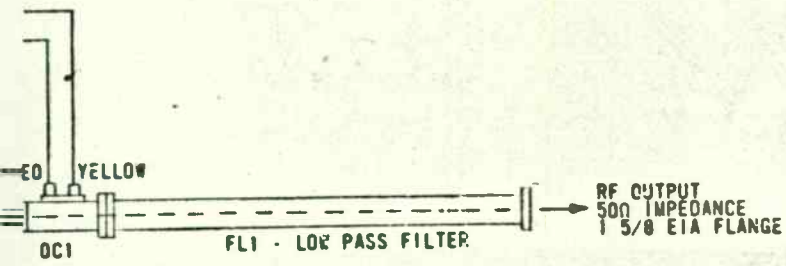
CATES RADIO COMPANY
QUINCY, ILLINOIS

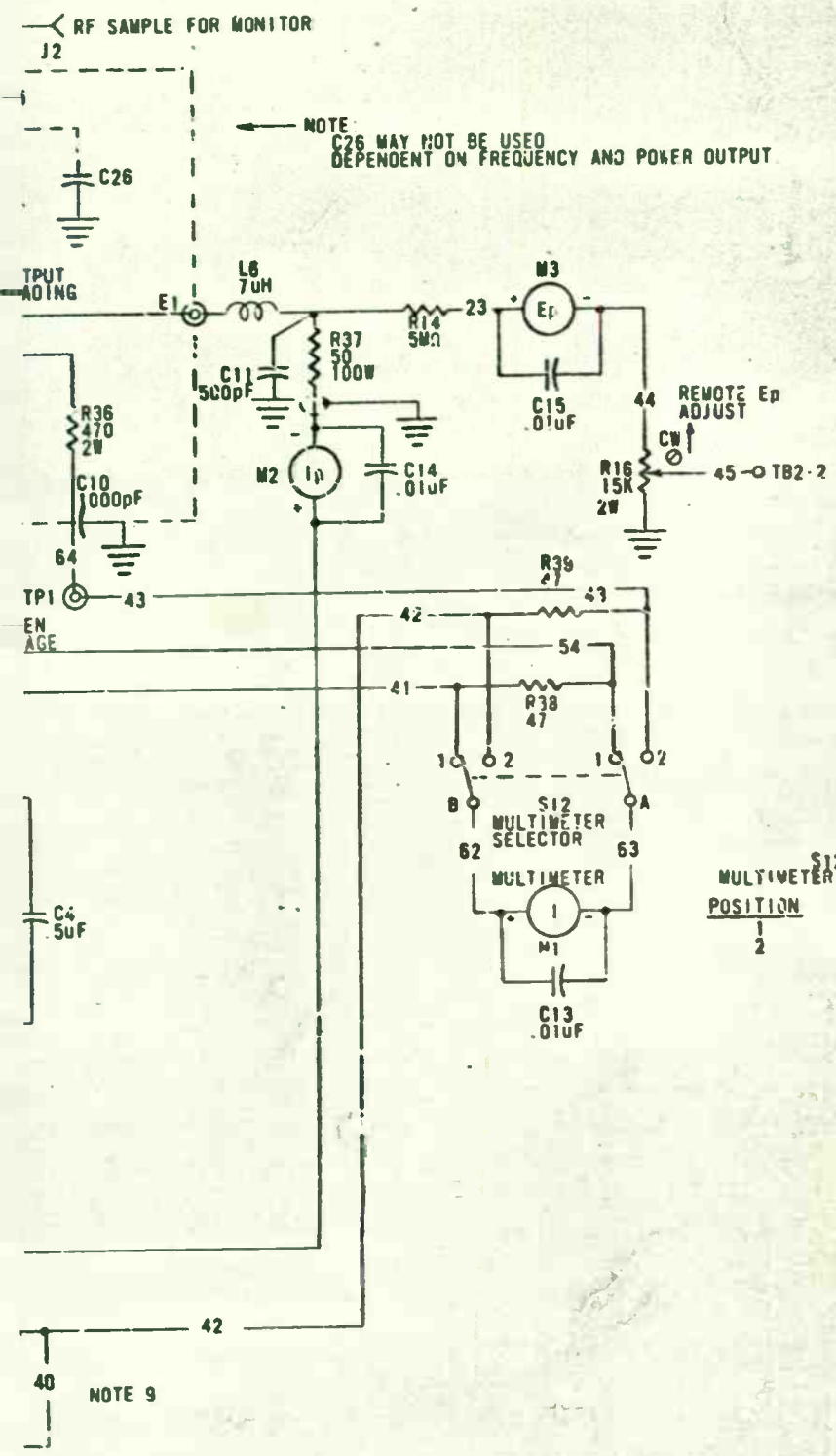
TITLE
GRAPH - PA EFFICIENCY
FM-1H2; FM-1H3, FM-1K
814 8318 001

FIA -5-31-72

842-6146-002

| NO. | DATE | REVISION | BY | CHK | APP'D |
|---|---|---|---|---|---|
| A | 9-2-77 | FMIK WAS FM1H 3 | | | |




S12 MULTIMETER SELECTOR

| POSITION | FUNCTION |
|---|---|
| 1 | GRID CURRENT |
| 2 | SCREEN CURRENT |

| TERMINAL BOARD | LOCATION |
|---|---|
| TB1 | M4845 REMOTE RF UNIT (FRONT PANEL) |
| TB1 | M6425 FM EXCITER |
| TB2 | REMOTE CONTROL (FRONT PANEL) |
| TB3 | T1 (BASE) |

TOL UNLESS NOTED: INCHES X ± .010, .XX ± .015, .XXX ± .005, ANGLES ± 1°, ALL √ INDICATES 125 MICRO INCH; MILLIMETERS X ± .5, .XX ± .40, .XXX ± .100, ANGLES ± 1°, ALL √ INDICATES 3.175 MICRONS

HARRIS

HARRIS CORPORATION Broadcast Products Division
123 Hampshire Street Quincy Illinois 62301

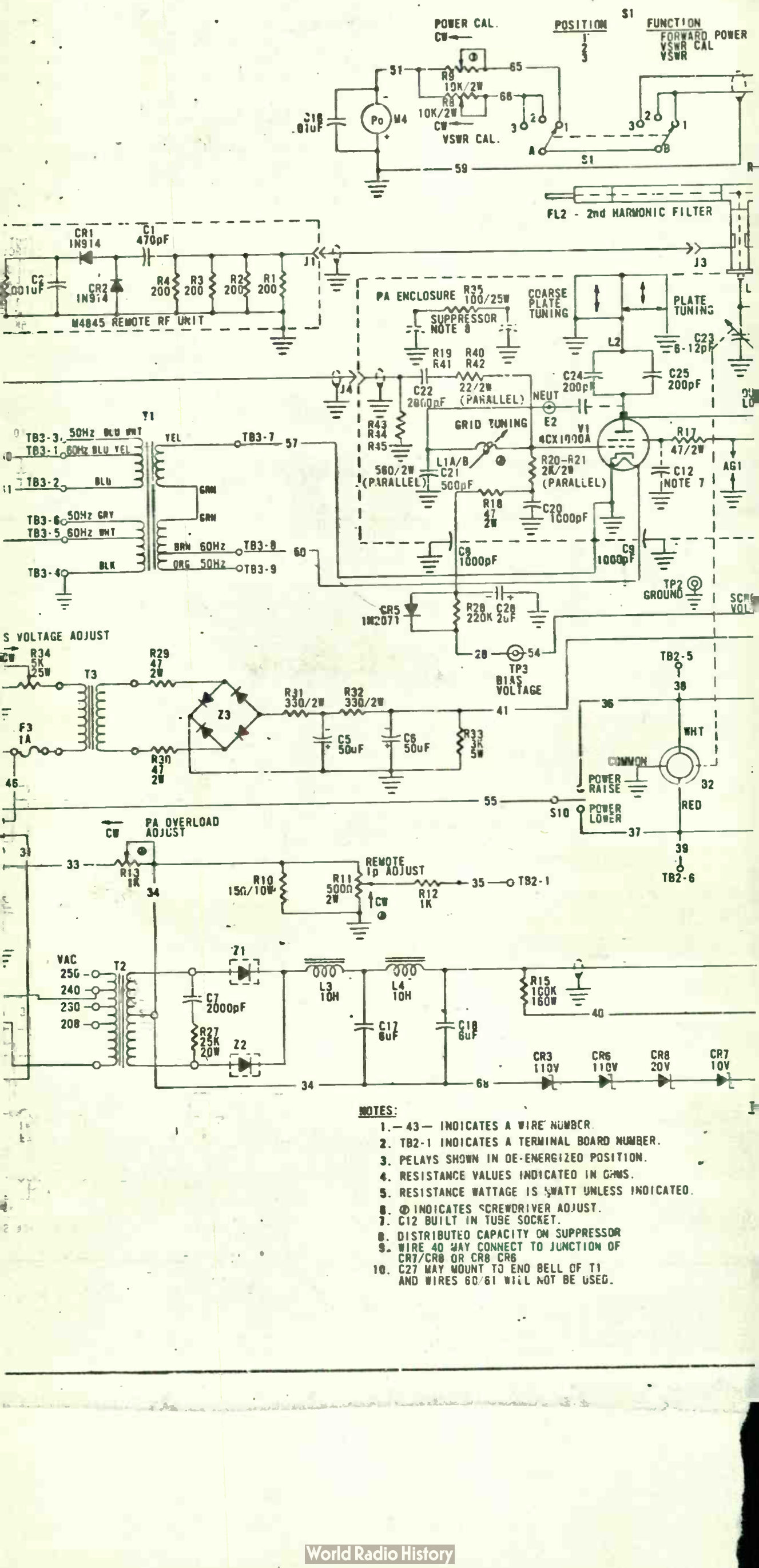
ALL DIM IN INCHES UNLESS NOTED



DR 9-2-77
CHKD V. Kouell 9/2/77
ME
PROJ ENG D. Hershberger
MFG
NEXT ASST
MATL
FIN

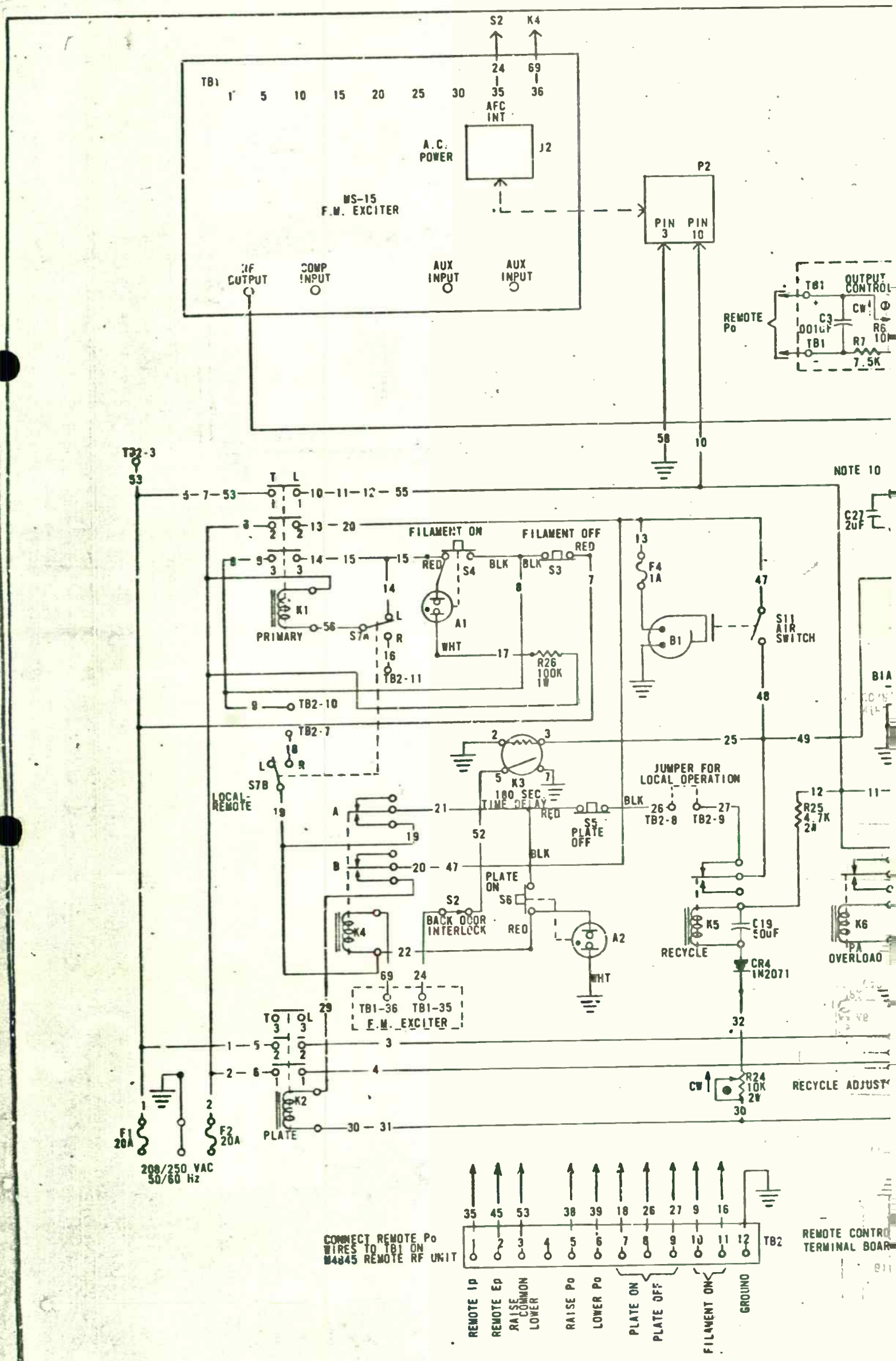
TITLE: OVERALL SCHEMATIC FMIK

REF DWG
SCALE
DWG NO 842-6146 002




NOTES:

1. — 43 — INDICATES A WIRE NUMBER.
2. TB2-1 INDICATES A TERMINAL BOARD NUMBER.
3. RELAYS SHOWN IN DE-ENERGIZED POSITION.
4. RESISTANCE VALUES INDICATED IN OHMS.
5. RESISTANCE WATTAGE IS ½WATT UNLESS INDICATED.
6. ⌀ INDICATES SCREWDRIVER ADJUST.
7. C12 BUILT IN TUBE SOCKET.
8. DISTRIBUTED CAPACITY ON SUPPRESSOR
9. WIRE 40 MAY CONNECT TO JUNCTION OF CR7/CR8 OR CR8 CR6
10. C27 MAY MOUNT TO END BELL OF T1 AND WIRES 60/61 WILL NOT BE USED.



# TECHNICAL MANUAL

INSTRUCTIONS FOR INSTALLING

AND OPERATION OF

FM-1H3 1KW FM TRANSMITTER

HARRIS CORPORATION

Broadcast Products Division

T.M. No. 888 1065 001

# ADDENDUM

## FM TRANSMITTERS

Upon completion of installation of the transmitter a check should be made on the tightness of the Allen set screws at the adjustment end of the second harmonic trap. There are two set screws that secure the short to the center conductor. If these become loose for any reason and light contact is made between the brass short and the center conductor, heating at this point may occur, resulting in possible burning and eventual destruction of the short and other parts of the filter.

A regular check on the tightness of these screws should be made at six month intervals, as part of the preventive maintenance program for the transmitter.

Dec. 1970

GATES RADIO COMPANY
QUINCY, ILLINOIS

## SAFETY NOTICE

WARNING: THE CURRENTS AND VOLTAGES IN THIS EQUIPMENT ARE DANGEROUS AND UNDER CERTAIN CONDITIONS, COULD BE FATAL.

This manual is intended as general guidance for trained and qualified installation, operating, maintenance and service personnel who are familiar with and aware of the dangers inherent to handling potentially hazardous electrical and/or electronic circuits. It is not intended to contain a complete statement of all safety precautions which should be observed by personnel in using this or other electronic equipment.

THE INSTALLATION, OPERATION, MAINTENANCE AND SERVICING OF THIS EQUIPMENT INVOLVES RISKS TO BOTH PERSONNEL AND EQUIPMENT, AND MUST BE PERFORMED ONLY BY PROPERLY TRAINED AND EXPERIENCED PERSONNEL EXERCISING DUE CARE. PERSONNEL MUST FAMILIARIZE THEMSELVES WITH SAFETY REQUIREMENTS, SAFE HANDLING AND OPERATING PRACTICE, AND RELATED FIRST-AID PROCEDURES (E.G., FOR ELECTRICAL BURNS AND ELECTRICAL SHOCK).

HARRIS CORPORATION Broadcast Equipment Division shall not be responsible for injury or damage resulting from improper installation, operation, maintenance or servicing, or from the use of improperly trained or inexperienced personnel in the performance of such tasks, or from the failure of persons engaged in such tasks to exercise due care.

As with all electronic equipment, care should be taken to avoid electrical shock in all circuits where substantial currents or voltages may be present, either through design or short circuit. Caution should also be observed in lifting and hoisting equipment, especially regarding large structures, during installation.

## LIABILITY LIMITATION

The procedures outlined in this Manual are based on the information available at the time of publication and should permit the specified use with minimum risk. However, the manufacturer cannot assume liability with respect to technical application of the contents and shall, under no circumstances, be responsible for damage or injury (whether to person or property) resulting from its use.

The manufacturer is specifically not liable for any damage or injury arising out of failure to follow the instructions in this Manual or failure to exercise due care and caution during installation, operation, maintenance and service of this equipment.

## CAUTIONARY NOTICE

Always disconnect power before opening covers, doors, enclosures, gates, panels or shields. Always use grounding sticks and short out high voltage points before servicing. Never make internal adjustments, perform maintenance or service when alone or when tired.

Never remove, short-circuit or tamper with interlock switches on access covers, doors, enclosures, gates, panels or shields. Keep away from live circuits, know your equipment and don't take chances. Proper training of experienced personnel and observing the above guidelines will help assure safe and continued operation of this equipment.

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SECTION 7 - PHOTOGRAPHS AND DRAWINGS



SECTION 8 - FM EXCITER

# SECTION I - GENERAL DESCRIPTION

## 1.1 Warranty and Safety Notice

This equipment is guaranteed under the liberal Gates Warranty, terms and conditions of which are fully explained in the standard Gates warranty which is reproduced inside the front cover of this manual.

Switch to Safety - This equipment employs voltages which are dangerous and may prove fatal if contacted by operating personnel. Extreme caution should be exercised when working with the equipment. Observe safety regulations. Do not change tubes or make adjustments inside equipment with any voltages ON. While your Gates transmitter is fully interlocked, you should not rely on the interlock switch for removing high operating voltages. It is always best to disconnect the primary power at the building wall switch and discharge all capacitors with the grounding stick provided.

## 1.2 Purpose of Book

This instruction book has been prepared to assist in the installation, operation, and maintenance of the Gates FM-1H3, 1 KW FM Transmitter.

## 1.3 Purpose of Equipment

The Gates FM-1H3 is an FM broadcast transmitter with 1,100 Watts output delivered to the transmission line. The operating frequency is 88-108 mHz. with characteristics exceeding those required by the FCC for standard FM broadcast service. The transmitter is designed for continuous broadcast operation and consists of the exciter and power amplifier, plus associated power supplies.

## 1.4 Description

Only one cabinet is required to house the entire transmitter. This cabinet is 29" wide x 78" high x 33" deep. All necessary metering is provided by four meters located on a meter panel at the top of the cabinet. Ready access to the complete transmitter is accomplished by the removable rear door. The front door is provided to offer a pleasing and symmetrical front view appearance.

The following controls are located on the front Panels:

a) Filament ON

b) Filament OFF

c) Plate ON

d) Plate OFF

e) Power Raise/Lower Switch

f) Multimeter Selector

g) VSWR Calibrate Adjust

h) Power Calibrate Adjust

i) Power/VSWR Selector

j) Remote/Local Switch

k) Grid Tuning Control (behind plug button)

l) Plate Tuning Control

m) PA Bias Adjust

n) (4) Potentiometers for adjustment of PA Plate Current Remote Reading, Recycle, PA Overload, PA Plate Voltage Remote Reading.

## 1.5 FM-1H3 Technical Data

| | |
|---|---|
| Power Output | .5 to 1.1 KW |
| Frequency Range | 88 to 108 mHz |
| RF Output Impedance | 50 Ohms |
| Output Termination | Standard EIA 1-5/8" Flange |
| Frequency Stability | ± .001% |
| Harmonic Attenuation | - 80 dB |
| Modulation Capability | ± 100 kHz |
| Audio Input Impedance | 600 Ohms |
| Audio Input Level | + 10 dBm, ± 2 dB |
| Audio Frequency Response | ± 1 dB, 30-15,000 Hz |
| Audio Distortion | 1/2% or less, 30-15,000 Hz |
| FM Noise Level | 65 dB below 100% FM modulation |
| AM Noise Level | 50 dB below equivalent 100% AM modulation |
| Power Source | 208/250 VAC, 1 phase, 50/60 Hz, 3 wire service. |
| Input AC Power Requirement | 2.5 kW, 208/250 VAC, |
| Power Line Variation (slow) | ± 5% |
| Power Factor | 90% |
| Altitude | 7,500 ft. |
| Ambient Temperature Range | -20°C to 45°C |
| Maximum VSWR | 1.7 to 1 |
| Overall Cabinet Size | 29" W. x 78" H. x 33" D. * |
| Weight | 550 lbs. |
| Front Door Swing | 29" |

* 33" is overall depth dimension. With rear door, front door handle, and meter trim strip removed minimum depth is 30".

Filter and RF plumbing extends 5" above cabinet top.

## 1.6 Vacuum Tube

The following tube is employed in the transmitter:

| | | |
|---|---|---|
| V-1 | 4CX1000A | Power Amplifier |

## SECTION 2 - INSTALLATION

### 2.1 Inspection

The FM-1H3 is carefully packed at the Gates plant to ensure safe arrival at its destination. The equipment is packed in a heavy carton and a wooden crate. Open the crate and carton carefully to avoid damaging any of the contents. Remove the packing material and search for possible loose items, such as, pilot lights, fuses, loose screws and bolts.

If damage should occur during shipment all claims should be filed promptly with the transportation company. If a claim is to be filed, the original packing case and material must be preserved. A damage report must be filed to collect for shipping damages. Gates Radio Company is not responsible for damage occurring during shipment. Parts or components shipped to replace those damaged in transportation will be billed to the customer plus transportation expenses, the cost of which should form a portion of your claim to the transportation company.

A complete visual inspection should be made of the equipment. Determine that there are no loose connections, loose components, broken insulators, etc., that may have been damaged in shipment. Make sure all relay contacts are free and in good mechanical condition. Make sure all mechanical connections are tight. Check with a screw driver or a wrench all mechanical and electrical connections that are mechanically bolted together. All tie downs or blocking used for shipping purposes should be removed. A good overall visual inspection may save time and trouble in placing the transmitter into operating condition.

### 2.2 Packing Check List

Certain components of the transmitter have been removed for shipment and are packed separately to ensure safe handling. These parts on the FM-1H3 have been kept to a bare minimum. Refer to the packing check list which accompanies the transmitter.

### 2.3 Tube Handling and Operating Precautions, 4CX1000A

Avoid bumping this tube. Due to its mass, bumping this tube will introduce resultant stresses which may cause internal damage.

Before operating this tube, please refer to the tune-up and operating procedure given in Section 3.

## 2.4 Installation

In advance of actual placement of the equipment, certain planning should be accomplished. Holes are provided in base of transmitter for entry of power, audio and remote control wires.

Either side of the transmitter may be placed against a wall or other equipment. Complete accessibility for maintenance and installation is provided in the FM-1H3 by access from the rear of the transmitter cabinet.

Install the time delay relay, K3.

Refer to the FM Exciter Installations instructions for proper module placement in the exciter cabinet.

The 4CX1000A must be fully inserted in the tube socket before turning to engage the socket fingers. Position the tube clamp around the anode, making sure the connecting straps from both C26 and C27 are between the clamp and the anode. Tighten the clamp securely.

Bolt the 1-5/8" elbow between the directional coupler and the low pass filter. Orient the filter in the desired position and connect to the antenna coax. Support must be provided for the transmission line and low pass filter.

Select the proper taps on the power transformer, T2 for the primary line voltage.

## 2.5 Wiring Connections

After the transmitter is physically in place and the components removed for shipment have been re-installed, the audio and AC power should be brought to the transmitter.

The audio input line enters the base of the transmitter in front of the fuseblock and connects directly to terminal board TB1 of the FM Exciter. Terminals 1 and 3 are the audio inputs and terminal 2 is ground or shield connection. If stereo is used, the lines are connected in accordance with the information in the M6533 Stereo Generator instructions.

The power leads from the transmitter should come from a low reactance power source of either 208, 230, 240 or 250 VAC, 50/60 Hz, single phase, with approximately a 3000 V.A. capacity. The AC supply enters the transmitter in the lower right hand corner and connects to the fuseblock. The center terminal of the fuseblock is neutral or ground.

The conduit or wiring of the power leads should be in agreement with local electric codes and be able to carry the power requirements of the transmitter. Power leads and program leads should not be run in the same conduit or in the same wiring duct. If, due to necessity, the program leads are in close proximity to the power leads, the program leads should be separately shielded.

A good ground at FM frequencies is mandatory to keep stray RF currents to a minimum. RF usually shows up in one of two ways -- feedback or high noise, and in some cases, both. It should be pointed out that even a small amount of unshielded wire makes a very efficient antenna for FM frequencies. If RF from the cabinet field is transferred to the audio equipment, it is rectified and shows up as noise or feedback. We strongly recommend a single common ground point from the transmitter base to a good grounding system, such as, a water pipe or actual earthing ground.

## 2.6 Cooling

The transmitter is air cooled and approximately 1.5 kW of heat are developed and dissipated through the air outlet in the top of the transmitter. It may be necessary to provide a means of exhausting this air from the transmitter room or enclosure. Heat is a major factor to electronic component deterioration. A good system of removing the heated air from the transmitter and the transmitter room, and providing cool air for the air inlet of the transmitter will greatly prolong the life of the transmitter and its components. (1.5 kW equals approximately 86 BTU/Min.).

There are many installation possibilities. Each and every installation is somewhat different. Therefore, it is not possible to give complete detailed information on the transmitter cooling. Only general information can be supplied. As a suggestion, contact a local heating and cooling contractor for a detailed analysis of the problem.

In general, ductwork restrictions which might reduce the volume of air flow should be avoided. Radius type bends should be used rather than abrupt angles. Ductwork with a cross-section area at least equal to the intake or exhaust port size should be employed.

After the transmitter has operated at full output a number of hours, a temperature rise inside the transmitter must not exceed a rise of 20°C above the ambient measured at the air intake of the blower and must not rise above 60°C under any circumstances. (20°C equals 68°F; 60°C equals 140°F).

The blower is capable of moving 115 cfm at .45 inch of water pressure. The air switch is adjusted to open when the pressure below the tube deck drops to approximately 0.2 inch of water.

The disposable air filter used in the back door may be purchased from the Gates Radio Company under Part Number 448-0103-000. However, an equivalent filter may be obtained at most hardware stores.

SECTION 3 - OPERATION

## 3.1 Pre-Operation

Before placing the FM-1H3 into operation, check once again the points covered in Section 2. Have you mounted all components physically and made these electrical connections?

1. Primary power to the fuseblock.
2. Program line connected to the exciter.
3. Transmitter connected to antenna or a suitable load.

If everything appears to be in order, then you may proceed.

## 3.2 Test Data

Your equipment has gone through many different kinds of tests at the Gates factory and has been operated for several hours on your assigned operating frequency. This is to ensure correct adjustment and proper setting of all controls. Refer to the test data supplied with your transmitter. This data is attached to the front of the transmitter when shipped.

## 3.3 Adjustment

Before turning ON the AC supply check to ensure that the output loading capacitor mesh, coarse plate tuning setting, and the fine plate tuning position are the same as indicated on the Test Data sheet.

Set Local/Remote switch to Local.

Primary power may now be applied to the transmitter by pushing the Filament ON switch button. The light behind the Filament ON button should light. Next, the blower should begin to run and come up to speed. After the blower reaches operating speed, air pressure in the PA enclosure will operate the air switch. The air switch closing will allow the filament voltage to be applied to the 4CX1000A.

The filament transformer is a constant voltage type which supplies the filament voltage (6 VAC) over a wide input voltage variation. No adjustment is necessary.

A three minute time delay prevents the plate voltage from being turned ON immediately after the filaments are turned ON. This allows the PA cathode to reach its operating temperature.

Be careful when checking any voltages with the transmitter ON.

Check the bias voltage as indicated on the test data sheet. Change the PA Bias Adjust to obtain the same voltage if necessary.

The Grid Tuning control is recessed behind a plug button and should not require any adjustment.

The rear door closes the interlock to allow the Plate Voltage to be turned ON. Use extreme caution in operating the high voltage supply with the door off.

As the Plate ON switch button is pushed, the light behind the button should light. Adjust the Plate Tuning for a peak in Screen Current.

Check the VSWR on the transmission line. Position the Power/VSWR Selector Switch on the front panel to VSWR Calibrate position and set the Power Output meter for full scale deflection with the VSWR Calibrate control. Turn the selector switch to VSWR and read the reflected wave. Although the transmitter will operate into a 1.7:1 mismatch, it is recommended to keep the VSWR to a minimum. If a high VSWR is noticed it is generally traced to transmission line and/or antenna problems.

Since the transmitter was checked into a 50 Ohm resistive load, any system with a mismatch will probably change the tuning. Therefore, the recorded test data knob readings may not agree with actual operation.

The Power Raise/Lower switch should be actuated to obtain the desired power output level. Re-adjust the Plate Tuning for a peak in Screen Current.

The Power Raise/Lower switch controls a reversible motor which rotates the output loading capacitor. Since there is 360° rotation of this capacitor, it is possible to travel through minimum or maximum capacity. If this happens the rotor will mesh with the other section of the stator plates and the Power Raise/Lower silk screen designation on the front panel will be the opposite.

The loading capacitor was properly set at the factory. If the capacitor should be "turned over" reduce the Power Output until the Raise/Lower designation agrees with the Power Output meter indication and set for desired output. This switch is also used to compensate for any change in power output due to AC line voltage variation.

Adjustment of the Grid Tuning will generally not be necessary. However, as the Grid Tuning is adjusted through resonance a slight peak will be noticed in the Screen Current or the Grid Current.

RF drive to the PA is controlled by the Output Control on the 10 Watt Amplifier of the FM Exciter. The drive level is set just to the point where the PA screen current reaches a peak (15 to 30 mA.).

Refer to the test data sheets of your transmitter for the performance readings you can expect when the transmitter is operating at 1000 Watts or your designated power level.

The operation of the transmitter is very simple and once adjusted should require only a nominal amount of touching up the tuning at regular maintenance periods.

The overload is set for correct operating level at the factory. The PA plate overload is set for approximately .66 Amperes plate current. The adjustment for the overload is located under a small cover plate located on the front panel. It is referred to as symbol number R13 on the schematic.

### 3.4 Operation at Output Powers Below 1000 Watts

A wide range of power output can be achieved with the output loading capacitor and generally this is sufficient. However, if the desired power level cannot be reached with this method the output coupling loop should be moved further from the plate line for reduced coupling. Movement of about 1/2 inch should suffice for most applications.

An alternate method is possible by adding a fixed capacitor across the output loading capacitor. This reduces the effective range of the variable capacitor. However, at some frequencies this fixed capacitor may be installed for proper loading at 1000 Watts.

The overload is set to turn OFF the transmitter if the plate current exceed normal current (reduced power) by 100 to 150 mA.

### 3.5 Maintenance

Maintenance of the FM-1H3 should consist of the following:

1. Keeping the transmitter clean.
2. Changing tubes when emission falls off.
3. Checking mechanical connections and fastenings.
4. Lubricating the blower motor.

Keeping the transmitter clean from the accumulation of dust will reduce failure resulting from arcing, dirty relay contacts, and overheating of chokes, resistors, and transformers. Electrostatic fields are "dust gathers". Support insulators in the PA enclosure and other locations are the worst offenders. They must be kept clean and free of all foreign material at all times. If not, arcing may result and the insulator shattered.

The air filter should be clean at all times. Periodically, it should be discarded and replaced with a new one. The filter is a disposable type and may be obtained from Gates by Part No. 448-0103-000 or any hardware or heating supply store.

Once a month the entire transmitter should be cleaned of dust. The inside of the power amplifier should be thoroughly wiped clean of dust. A small brush, soft rag, and vacuum cleaner can be used very effectively in keeping the equipment clean.

All contactors and relays should be inspected regularly for pitting and dirt. The contacts should be burnished and cleaned if required. The overload relay is a telephone type, with sealed contacts and should require little attention.

The bearings for the motor of the PA blower should normally give long trouble-free operation. Periodically, oil should be added for lubrication. Two drops of #20 non-detergent oil to each bearing every three months is sufficient. Do not over-lubricate.

The PA tube should be removed once a month and the fins cleaned of dust. Air may be blown through the fins in the reverse direction or the anode cleaned with soap and water or denatured alcohol.

This transmitter is a precision electrical device, and as such should be kept clean at all times and free of dust and foreign materials. Dust and moisture condensation will lead to possible arc-overs and short conductive paths.

A good preventive maintenance schedule is always the best assurance for trouble-free transmitter operation.

## SECTION 4 - CIRCUIT DESCRIPTION

The FM-1H3 circuits will be described in the following sections:

Power Amplifier
Exciter
Power Supply
Control Circuits
Metering

### 4.1 Power Amplifier

The power amplifier of the FM-1H3 employs a single 4CX1000A tube in a grounded cathode amplifier circuit. The plate circuit is a shorted, one-quarter wavelength configuration with the plate line operated at DC ground potential. Coarse plate tuning is preset per operating frequency at the Gates factory. The Plate Tuning knob on the front panel is used for fine tuning.

RF output power in inductively coupled from the plate line and the amplifier loading is changed by the variable output loading control. Fixed capacitors (if used) across the output loading control are dependent upon frequency and output power.

The grid circuit is inductively tuned and is adjustable from the front or the rear by a recessed screw driver slotted shaft. At operating frequencies above 98 mHz both grid lines are used. Swamping resistors and low capacitive reactance components are used to increase the bandwidth and to improve the stability. The r.f. input is direct coupled and requires 7 to 8 Watts for 1000 Watt output.

Filament voltage (6 VAC $\pm$ 1%) for the amplifier is provided by a constant voltage transformer and does not require any adjustment. See Section 5.4.

### 4.2 Exciter

The FM Exciter is described in detail in the exciter section of this instruction book.

### 4.3 Power Supply

The high voltage power supply furnishes 3000 V. DC and 210 V. DC for the plate and screen grid respectively for the power amplifier. The basic configuration of the supply is single phase, full wave with a two section choke input filter. The silicon rectifier consist of two separate columns mounted on the base of the cabinet. Primary taps on the plate transformer, T2 can be changed to compensate for input line voltage variation. Two zener diodes are used to regulate the screen grid voltage at approximately 210 V. DC. The screen voltage will vary as the loading is changed on the amplifier.

Control grid bias voltage is supplied from a single phase, full wave circuit using silicon rectifiers. Voltage variation from -20 to -110 V. DC is available by the PA Bias Adjust.

## 4.4 Control Circuits

The control circuits of the FM-1H3 consist of the following:

K1 - Primary Contactor - applies voltage to the blower and the bias supply.

K2 - Plate Contactor - applies primary voltage to the plate transformer.

K3 - Time Delay Relay - allows cathode of the 4CX1000A to reach operating temperature before high voltage is applied.

K4 - Auxiliary Relay - applies holding voltage to K2 if the air switch, door interlock, and the time delay relay contacts are closed.

K5 - Recycle Relay - energizes when the PA overload relay is energized a number of times. The number of times is determined by control R24. The overload relay contacts are in parallel across the relay circuit for K5. When the O.L. relay energizes and the contacts open, C19 starts to charge. If the contacts are open for a sufficient length of time for C19 to charge to the point that the voltage will energize K5, the contacts of K5 will break the hold circuit of K4 and the plate voltage will be switched OFF. If K5 does not operate, the overload contacts will close after an overload and the plate contactor K2, will again energize.

K6 - Plate Overload Relay - adjusted to interrupt the high voltage when the plate current becomes excessive.

S11 - Air Switch - closes after the air pressure in the plenum reaches proper pressure, closing the interlocking circuits and switching primary voltage to the PA filament transformer.

## 4.5 RF Filtering

The FCC requires the harmonics of the operating frequency to be 80 dB or 43 dB +10 x log of the Power Output in watts (whichever is best) below the carrier reference. For a 1000 Watt transmitter the harmonics are required to be 73 dB below carrier, however, the r.f. filtering in the FM-1H3 reduces the harmonics by 80 dB.

The 2nd harmonic filter, FL2, is adjusted at the Gates factory to appear as a short circuit for the correct frequency in the 176 to 216 mHz range.

Any frequency above the 2nd harmonic is attenuated by the low pass filter FL1.

Refer to drawings 814 8556 001 and 814 8554 001.

## 4.6 Metering

All necessary metering of the FM-1H3 is accomplished with four meters located on the cabinet meter panel. The first meter from the left is a multimeter used to measure Control Grid and Screen Grid Current. The multimeter selector on the front panel is used to determine which parameter is to be measured.

The second meter reads PA Plate Current and is located in the Plate B+ lead. The meter is properly insulated and isolated behind a protective plexiglass cover.

The third meter reads Plate Voltage and is located on the low potential side of the meter multiplier resistor.

The fourth meter is for indicating Power Output and VSWR on the transmission line. This meter works in conjunction with the directional coupler mounted in the output transmission line and a function switch located on the upper front panel.

Calibration of the Power Output meter is accomplished against a known standard at the Gates factory. Unless the meter is calibrated every six months against a known standard in the field it cannot be used for power output recordings on the station transmitter log. The FCC accepts the indirect method of computing power output using the DC input and efficiency of the final power amplifier stage.

## SECTION 5 - ADDITIONAL INFORMATION

### 5.1 Remote Control

Remote control capacilities are built into the FM-1H3. The transmitter may be connected to the Gates RDC-10AC or the Gates RDC-200A Remote Control Units. Also a Gates M6663 Remote Control Panel is available. Wire size #22 AWG or larger is recommended. The connections to the transmitter are made at TB-2 and TB-1 (M4845 Remote RF Unit) located on the back of the front panel. Terminal connections for the functions are shown on the schematic.

The functions are:

1. Fail-Safe, Filament ON-OFF.
2. Momentary ON-OFF for plate voltage.
3. Raise/Lower for adjusting power output.
4. Plate voltage metering.
5. Plate current metering.
6. RF power output metering.

The controls for setting the remote Plate Voltage and Plate Current for external metering are located under the cover on the front panel and are shown by symbol number on the schematic.

The loading capacitor of the power amplifier is motor controlled and is also connected to the remote control Raise/Lower function for power output adjustment.

The M4845 Remote RF Unit rectifies a sample of the transmitter r.f. output. An output control on this unit is used for calibration of a remote meter.

The remote Plate Current voltage is negative in respect to ground and the Plate Voltage and Power Output voltages are positive.

The remote Plate Current indicating voltage is negative in respect to ground. On the transmitter unit of the RDC-10AC the wires connected to K1-2, position 2 and K1-3, position 2 should be interchanged.

When the RDC-200A is being used, the appropriate wires connected to K1-C and K1-D of the transmitter unit should be interchanged. The stepper position number must correlate with the dial position for measurement of the plate current.

### 5.2 Stereophonic Operation

For stereophonic operation all that is necessary is the installation of the Gates M6533 Stereo Generator in the FM exciter. Instructions for audio and r.f. connections are given in the Exciter section of the instruction book.

## 5.3 RF Tune-up Procedure

It is assumed that the FM exciter is tuned and adjusted with the Customer's crystal, to the Customer's frequency. Also, all control circuits and d.c. supplies have been checked out and the proper r.f. connections have been made.

Set the PA coarse tuning shorting line per operating frequency. The final settings of the coarse and fine tuning shorting lines should be within one inch of each other in the horizontal plane.

Both grid inductors (L1A and L1B) are connected to C21 if the operating frequency is above 98 mHz. Below 98 mHz disconnects the inductor toward the rear of the cabinet. The inductance can be changed by varying the position of inductor in respect to the brass tuning slug. Positioning the inductors closer to the slug will decrease the effective inductance.

On the side of the PA enclosure short out CR5 and R28 with a short clip lead.

Start the transmitter by pressing the Filament ON switch.

Adjust the bias voltage for -25 V.DC.

Turn the Output Control on the exciter to it's 3/4 CW position. With the Multimeter in the Grid Current position adjust the Grid Tuning for maximum indication. Reduce exciter output as necessary to limit Grid Current to +3 mA or less.

Perform the grid tuning as quickly as possible to minimize the time that the clip lead is across CR5 and R28.

Re-adjust the bias voltage to -40 V.DC.

Switch the filaments OFF, remove the clip lead across CR5 and R28 and turn the filaments ON again.

Set the Multimeter switch to the Screen Current position.

Remove the RF Input coax plug to the 10 Watt Amplifier of the exciter.

Turn ON the high voltage circuitry by pushing the Plate On switch.

Plate dissipation of the 4CX1000A is 1000 Watts. This means with +3000 V. DC on the anode, the Plate Current has to be less than 333 mA with no power output.

With the Bias Voltage Adjust set the static Plate Current at 200 mA.

Reconnect the RF Input to the exciter and set the exciter output to its mid-position.

Adjust the Plate Tuning for a peak in Screen Current.

The Output Control on the exciter should be adjusted just to the position until the Screen Current peaks (15 to 30 mA).

The Power Raise/Lower switch should be actuated to obtain the desired power output level. Re-adjust the Plate Tuning for a dip in Plate Current, or a peak in the Screen Current.

The output inductor can be moved to change the RF coupling if the required output cannot be obtained by varying the loading capacitor.

Since there is 360° rotation of the loading capacitor it is possible to travel through minimum or maximum capacity. Also, it is possible the silk screen designation and power output change may be opposite. If the capacitor should be "turned over" reduce the Power Output until the Raise/Lower designation agrees with the Power Output meter indication and set for desired output.

The following list is the maximum operating rating on the PA tube (4CX1000A) along with typical transmitter information:

| | Maximum | Typical | |
|---|---|---|---|
| Plate Voltage (Volts) | 3000 | 3000 | * |
| Plate Current (Amp.) | 1 | 0.550 | * |
| Power Output (Watts) | | 1000 | * |
| Plate Dissipation (Watts) | 1000 | 650 | * |
| PA Plate Efficiency (%) | | 60 | * |
| Screen Voltage (Volts) | 400 | 210 | * |
| Screen Current (m Amp.) | | 27 | * |
| Screen Dissipation (Watts) | 12 | 6 | |
| Grid Voltage (Volts) | | -40 | * |
| Grid Current (m Amp.) | 5 | -2 | * |
| Filament Voltage (Volts) | 6 | 6 | * |
| Filament Current (Amp.) | 10 | 10 | |
| Tube Seal Temperature (°C) | 250° | 190° | |
| 1 Phase Line Voltage (Volts) | | 235 | * |
| 1 Phase Line Current (Amp.) | | 12 | * |
| Load VSWR | 1.7 to 1 | 1.1:1 | * |

* Recorded on Customer test data sheet.

## 5.4 Filament Transformer (50 Hz Operation)

The filament transformer (T1) as tested at the Gates Radio Company is connected for 60 Hz operation. Refer to the Overall Schematic 842 5146 001 for the tap changes on 50 Hz operation.

50 Hz Operation:

| Wire Number | Termination | Lead Color (T1) |
|---|---|---|
| 49 | TB3-6 | Grey |
| 50 | TB3-9 | Orange |
| 60 | TB3-3 | Blue/White |

The secondary voltage of T1 should be 6 V. ± 1% (5.94 V. to 6.06 V.) at TB3 as measured with an accurate iron vane voltmeter.

# FM HARMONICS IN THE TV BAND

The sharp upsurge in FM broadcasting has in some instances developed unlooked for interference with local TV reception. In every instance this interference is in so-called fringe areas for TV reception and where the strength of the TV signal is weak enough that outside highly directional home TV antennas are necessary. ----- When this condition develops, the TV viewer quickly learns from his service man that the local FM station is the offender. ----- The FM broadcaster is immediately deluged with requests to eliminate the interference. In some instances CATV (Community Antenna Television) systems are also offended as they pick up weak distant TV stations. ------ What is the FM broadcaster's responsibility? Answer: To meet FCC rules and regulations as related to harmonic radiation of his FM equipment but not to guarantee perfect TV reception.

Below is a chart showing the picture and sound frequencies of TV stations between Channels 7-13 inclusive. Channels 2-6 are not shown. FM harmonics do not fall in these Channels. In fact, commercial FM station harmonics will affect only Channels 8 and above ----- look at the chart.

| TV Channel | Picture Frequency Band ---Mc--- | Sound Frequency |
|---|---|---|
| 7 | 175.25 to 179.50 | 197.75 |
| 8 | 181.25 to 185.50 | 185.75 |
| 9 | 187.25 to 191.50 | 191.75 |
| 10 | 193.25 to 197.50 | 197.75 |
| 11 | 199.25 to 203.50 | 203.75 |
| 12 | 205.25 to 209.50 | 209.75 |
| 13 | 211.25 to 215.50 | 215.75 |

The frequency range for commercial FM broadcasting is 92.1 Mc to 107.9 Mc: --- To determine the second harmonic of your FM frequency, just multiply your frequency by 2. Example: If your frequency is 99.9 Mc, multiplied by 2 would make a second harmonic of 199.8 Mc. By consulting the above chart, you will note the second harmonic falls in the picture portion of the TV Channel 11.

## Correct FM Harmonic Radiation

The FCC stipulates that transmitters of 3000 watts power and over must have a harmonic attenuation of 80 db. For 1000 watts, 73 db., and for 250 watts, 66.9 db. All reputable manufacturers design their FM transmitters to meet or exceed these specifications.

## Fringe Area TV Strength Versus FM Harmonics

Let's take a typical FM station that radiates 70,000 microvolts per meter at 1 mile. At 80 db. harmonic attenuation (as called for by FCC), this station will radiate approximately 7 microvolts per meter at 1 mile on the second harmonic. In the case of our Channel 11 example, it is estimated that a fringe area TV station from 60 to 90 miles distance would have a signal strength of from 5 to 25 microvolts per meter. It can then be easily understood that a 7 microvolt signal, well within FCC specifications, would definitely interfere with the TV signal, yet with the FM broadcaster's equipment performing normally.

This is sometimes further aggravated by the FM station being located between the TV station and the TV receivers. In this instance the TV antennas are focussed not only on the TV station but your FM station as well. The home TV antennas are beamed at your legal second harmonic as well as the fringe TV station.

## What To Do

When interference occurs, it will develop ragged horizontal lines on the TV picture varying with the FM program content. If the TV sound portion is interfered with (usually not the case), then the FM signal will be heard in addition to the TV sound.

1. It is not up to the FM broadcaster to go on the defensive. He did not put the TV station 75 miles away nor did he select the TV Channel. ---- In most instances the condition is a natural phenomena that neither you, the TV station, nor the FCC can correct.

2. Do not adjust the FM harmonic or "T" notch filters supplied with the FM transmitter. These are factory adjusted and most FM stations do not have the expensive equipment necessary for correct adjustment. Tampering with this calibrated adjustment will probably make the condition worse.

3. Do not rely on TV service men's types of measuring equipment. They are not built to accurately measure harmonics and invariably give erroneous readings that invite the CATV or local service men's association to say "I told you so." Remember it is difficult to radiate harmonics if the equipment is built to suppress the harmonics and it is.

4. In many instances interference may be caused by overloading on the front end of the TV receiver. This problem usually occurs when the receiver is located close to the FM transmitter. This problem can be overcome by installing a trap tuned to the frequency of the FM carrier. The TV service man can and must learn how to do this. In most cases it works, while in some instances, if not properly installed or tuned, it will not completely eliminate the interference. In one case where interference of this type existed, a TV station put traps for the fundamental FM frequency on nearly every TV set in town. Not the FM transmitter.

## Summary

The FCC is well acquainted with this nation-wide problem. If TV viewers write FCC, complaining about your FM station, remember the FCC has received a few thousand similar letters. ----- It is not the obligation of the FM broadcaster to assure fringe area reception of a TV station any more than is the obligation of the TV station to assure the FM broadcaster perfect reception in his TV city.

Probably your installation will not have problems as outlined above. If they do exist, don't blame the equipment. Every transmitting device puts out a second harmonic, even the TV stations. The fact that these harmonics legally fall into the spectrum of a TV station many miles distant is coincidental, but not your fault.

HARRIS CORPORATION Broadcast Products Division
123 Hampshire Street, Quincy, Illinois 62301

SECTION 6 - PARTS LIST

| Symbol No. | Gates Part No. | Description |
|---|---|---|
| AG1 | | Arc Gap |
| | 913 3562 001 | Carbon block holder |
| | 813 2941 001 | Spring Contact |
| | 398 0301 000 | Carbon Block |
| | 402 0041 000 | Ceramic holder |
| B1 | 927 1715 001 | Blower, 50/60 Hz. |
| B2 | 436 0061 000 | Motor, 1 RPM |
| C4 | 508 0009 000 | Cap., .5 uF., 200 V. |
| C5 | 522 0105 000 | Cap., 50 uF., 150 V. |
| C6 | | Same as C5 |
| C7 | 516 0382 000 | Cap., 2000 pF., 15 kV. |
| C8 | 516 0235 000 | Cap., feedthru, 1000 pF., 500 V. |
| C9 | | Same as C8 |
| C10 | | Same as C8 |
| C11 | 516 0205 000 | Cap., 500 pF., 5 kV. |
| C12 | | Cap., Screen grid bypass built in tube socket |
| C13 | 516 0082 000 | Cap., .01 uF., 1 kV. |
| C14 | | Same as C13 |
| C15 | | Same as C13 |
| C16 | | Same as C13 |
| C17 | 510 0489 000 | Cap., 6 uF., 4 kV. |
| C18 | | Same as C17 |
| C19 | | Same as C5 |
| C20 | 516 0206 000 | Cap., 1000 pF., 5 kV. |
| C21 | | Same as C11 |
| C22 | 508 0282 000 | Cap., 2000 pF., 600 V. |
| C23 | 914 8553 001 | Cap., variable, 6-21 pF. (Mod.) |
| C24 | 516 0210 000 | Cap., 200 pF., 7.5 kV. |
| C25 | | Same as C24 |
| C26 | 516 0413 000 | Cap., 10 pF., 7.5 kV. |
| C27 | | Cap., 2 uF., 660 VAC, (Supplied with T1) |
| C28 | 506 0009 000 | Cap., 2 uF., 200 V. |
| CH1 | 404 0157 000 | Chimney, Tube, 4CX1000A |
| CR3 | 386 0127 000 | Diode, Zener, 110 V. 10 W. |
| CR4 | 384 0020 000 | Diode, 1N2071 |
| CR5 | | Same as CR4 |
| CR6 | | Same as CR3 |
| CR7 | 386 0016 000 | Diode, Aener, 10 V., 5%, 10 W. |
| CR8 | 386 0337 000 | Diode, Zener, 20 V. 5%, 10 W. |
| DC1 | 620 0394 000 | Directional Coupler (Part of FL2) |

| Symbol No. | Gates Part No. | Description |
|---|---|---|
| F1 | 398 0184 000 | Fuse, 20 A. |
| F2 | | Same as F1 |
| F3 | 398 0054 000 | Fuse, 1 A. |
| F4 | | Same as F3 |
| FL1 | 992 1684 001 | Filter, low pass |
| FL2 | 992 5563 001 | Filter, 2nd harmonic, w/Directional Coupler, DC1 |
| | 448 0103 000 | Filter, disposable, air |
| J2 | 612 0237 000 | Receptacle, Type "BNC" |
| J3 | | Same as J2 |
| J4 | 612 0317 000 | Receptacle, Type "BNC" |
| K1 | 570 0132 000 | Contactor, 3 pole, 230 V. AC Coil |
| K2 | | Same as K1 |
| K3 | 576 0074 000 | Relay, Time Delay, N.O. 115 VAC heater, 180 sec. |
| K4 | 574 0099 000 | Relay, DPDT, 115 VAC coil |
| K5 | 574 0153 000 | Relay, SPDT, 2 mA., DC coil |
| K6 | 572 0125 000 | Relay, 2 micro switches, 6 V. DC coil |
| L1A | 814 9846 001 | Inductor, grid |
| L1B | | Same as L1A |
| L2 | 827 4597 001 | Inductor, plate line |
| L3 | 476 0266 000 | Inductor, filter choke, 10 Hy., 800 mA. |
| L4 | | Same as L3 |
| L5 | 838 3674 001 | Inductor, output line |
| L6 | 494 0004 000 | R.F. Choke, 7 uH. |
| M1 | 632 0275 002 | Meter, 10-0-40 mA. scale, Screen Current |
| M2 | 632 0026 002 | Meter, 0-1 A. Scale, Plate Current |
| M3 | 632 0575 002 | Meter, 0-5 kV. Scale, Plate Voltage |
| M4 | 632 0661 000 | Meter, Power Output/VSWR |
| R8 | 914 9092 001 | Control, 10K ohm, 2 W. (Mod.) |
| R9 | 550 0067 000 | Control, 10K ohm, 2 W. |
| R10 | 542 0055 000 | Res., 15 ohm, 10 W. |
| R11 | 550 0059 000 | Control, 500 ohm, 2 W. |
| R12 | 540 0049 000 | Res., 1K ohm, 1/2 W. |
| R13 | 550 0061 000 | Control, 1K ohm, 2 W. |
| R14 | 914 3424 001 | Meter Multiplier, 5 megohm |
| R15 | 542 0346 000 | Res., 100K ohm, 160 W. |
| R16 | 550 0068 000 | Control, 15K ohm, 2 W. |
| R17 | 540 0579 000 | Res., 47 ohm, 2 W. 5% |
| R18 | | Same as R17 |
| R19 | 540 0571 000 | Res., 22 ohm, 2 W. |

| Symbol No. | Gates Part No. | Description |
|---|---|---|
| R20 | 540 0618 000 | Res., 2000 ohm, 2 W. |
| R21 | | Same as R20 |
| R24 | | Same as R9 |
| R25 | 540 0627 000 | Res., 4.7K ohm, 2 W. |
| R26 | 540 0380 000 | Res., 100K ohm, 1 W. |
| R27 | 542 0149 000 | Res., 25K ohm, 20 W. |
| R28 | 540 0105 000 | Res., 220K ohm, 1/2 W. |
| R29 | 540 0724 000 | Res., 47 ohm, 2 W. 10% |
| R30 | | Same as R29 |
| R31 | 540 0599 000 | Res., 330 ohm, 2W. |
| R32 | | Same as R31 |
| R33 | 542 0039 000 | Res., 3K ohm, 5 W. |
| R34 | 552 0324 000 | Control, 5K ohm, 25 W. |
| R35 | 540 0833 000 | Res., 100 ohm, 25 W. |
| R36 | 540 0603 000 | Res., 470 ohm, 2 W. |
| R37 | 546 0170 000 | Res., 50 ohm, 100 W. |
| R38 | 540 0017 000 | Res., 47 ohm, 1/2 W. |
| R39 | | Same as R38 |
| R40 | 540 0571 000 | Res., 22 ohm, 2 W. |
| R41 | | Same as R40 |
| R42 | | Same as R40 |
| R43 | 540 0605 000 | Res., 560 ohm, 2 W. |
| R44 | | Same as R43 |
| R45 | | Same as R43 |
| S1 | 914 9091 001 | Switch, rotary, 3 pole, 3 position (Mod.) |
| S2 | 604 0196 000 | Switch, interlock, N.O. |
| S3 | 604 0284 000 | Switch, pushbutton, N.C. |
| S4 | 604 0283 000 | Switch, pushbutton, N.O. w/Lamp |
| S5 | 604 0286 000 | Switch, pushbutton, N.C. red |
| S6 | 604 0285 000 | Switch, pushbutton, N.O. red w/Lamp |
| S7 | 604 0032 000 | Switch, toggle, DPDT |
| S8,S9 | | Not Used |
| S10 | 602 0056 000 | Switch, lever, 2 pole, 3 position |
| S11 | 604 0258 000 | Switch, Air, .3" to 1" water |
| S12 | | Same as S1 |
| T1 | 472 0619 000 | Transformer, filament, 10 A. 6 VAC |
| T2 | 472 0519 000 | Transformer, plate, .8 A, 3 kV, DC |
| T3 | 472 0208 000 | Transformer, bias |
| TB2 | 614 0102 000 | Terminal Board |
| TB3 | 614 0010 000 | Terminal Board |

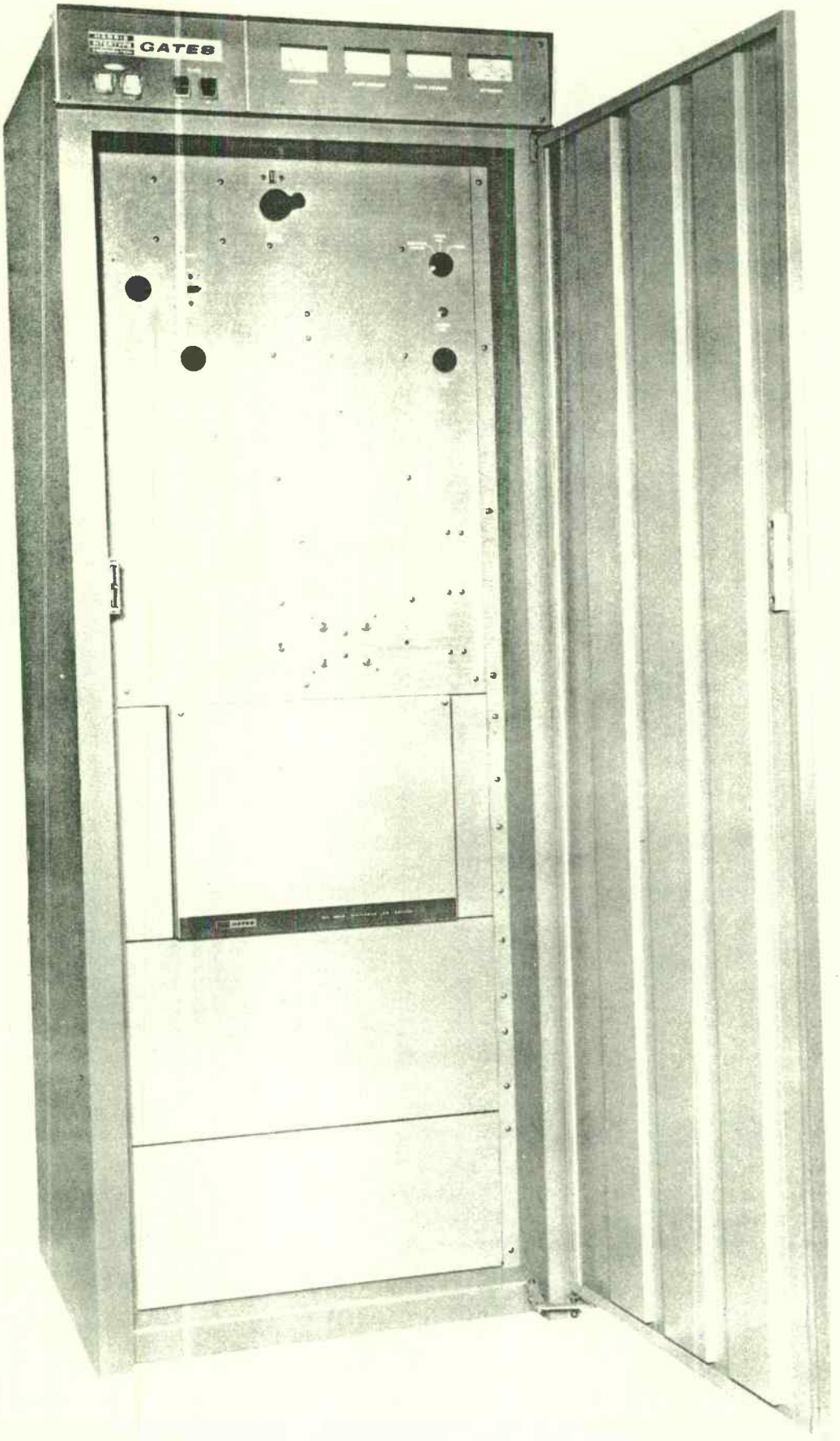


REVISED: September, 1977

| Symbol No. | Gates Part No. | Description |
|---|---|---|
| TP1, | 612 0312 000 | Test Point, white |
| TP2 | 612 0311 000 | Test Point, black |
| TP3 | | Same as TP1 |
| V1 | 374 0015 000 | Tube, 4CX1000A |
| XF1 | 402 0015 000 | Fuse Block |
| XF2 | | Same as XF1 |
| XF3 | 402 0074 000 | Fuse Holder |
| XF4 | 402 0023 000 | Fuse Holder |
| XK3 | 404 0016 000 | Socket, octal |
| XV1 | 404 0242 000 | Socket, tube, 4CX1000A |
| Z1 | 384 0159 000 | Rectifier, plate, 67-6099 |
| Z2 | | Same as Z1 |
| Z3 | 384 0121 000 | Rectifier, bias, SPF6G |

M-4845 RF OUTPUT CURRENT EXTENSION KIT

| | | |
|---|---|---|
| C1 | 516 0043 000 | Cap., 470 pF., 1 kV. |
| C2 | 516 0054 000 | Cap., .001 uF., 1 kV. |
| C3 | | Same as C2 |
| CR1 | 384 0195 000 | Diode, 1N914 |
| CR2 | | Same as CR1 |
| J1 | 612 0237 000 | Receptacle, "BNC" |
| R1 | 540 0594 000 | Res., 200 Ohm, 2 W. |
| R2 | | Same as R1 |
| R3 | | Same as R1 |
| R4 | | Same as R1 |
| R5 | | Not Used |
| R6 | 550 0067 000 | Potentiometer, 10K Ohm |
| R7 | 540 0070 000 | Res., 7500 Ohm, 1/2 W. |
| TB1 | 614 0069 000 | Terminal Board, 2 term. |

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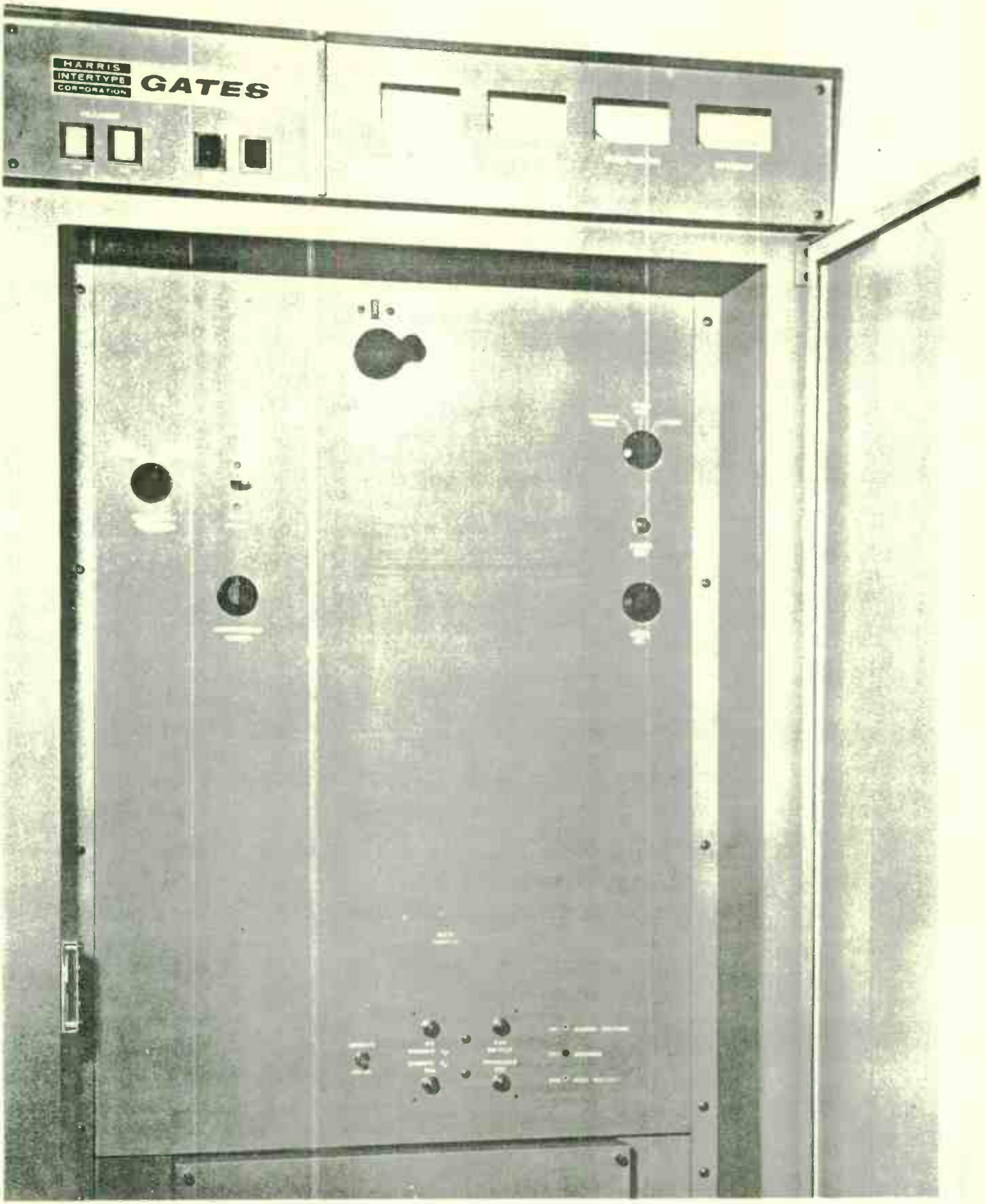


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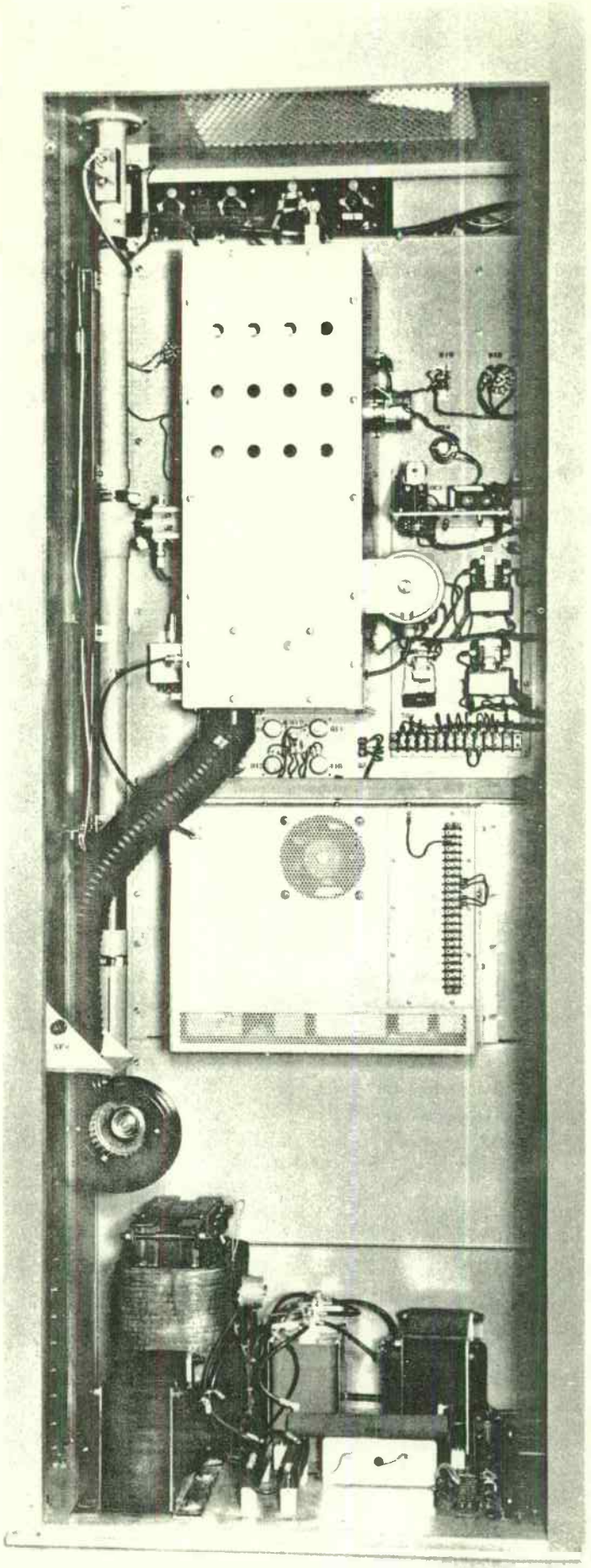

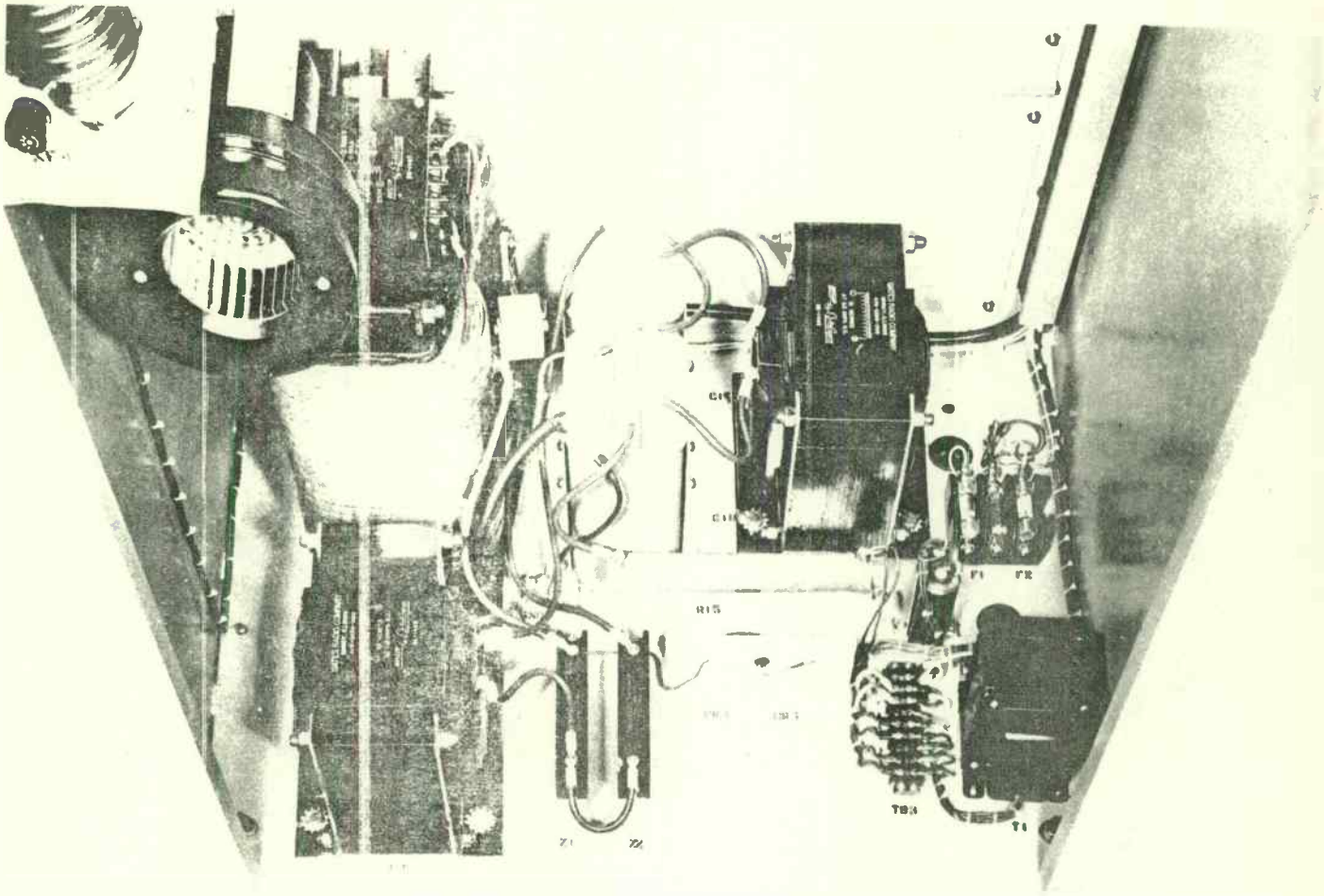

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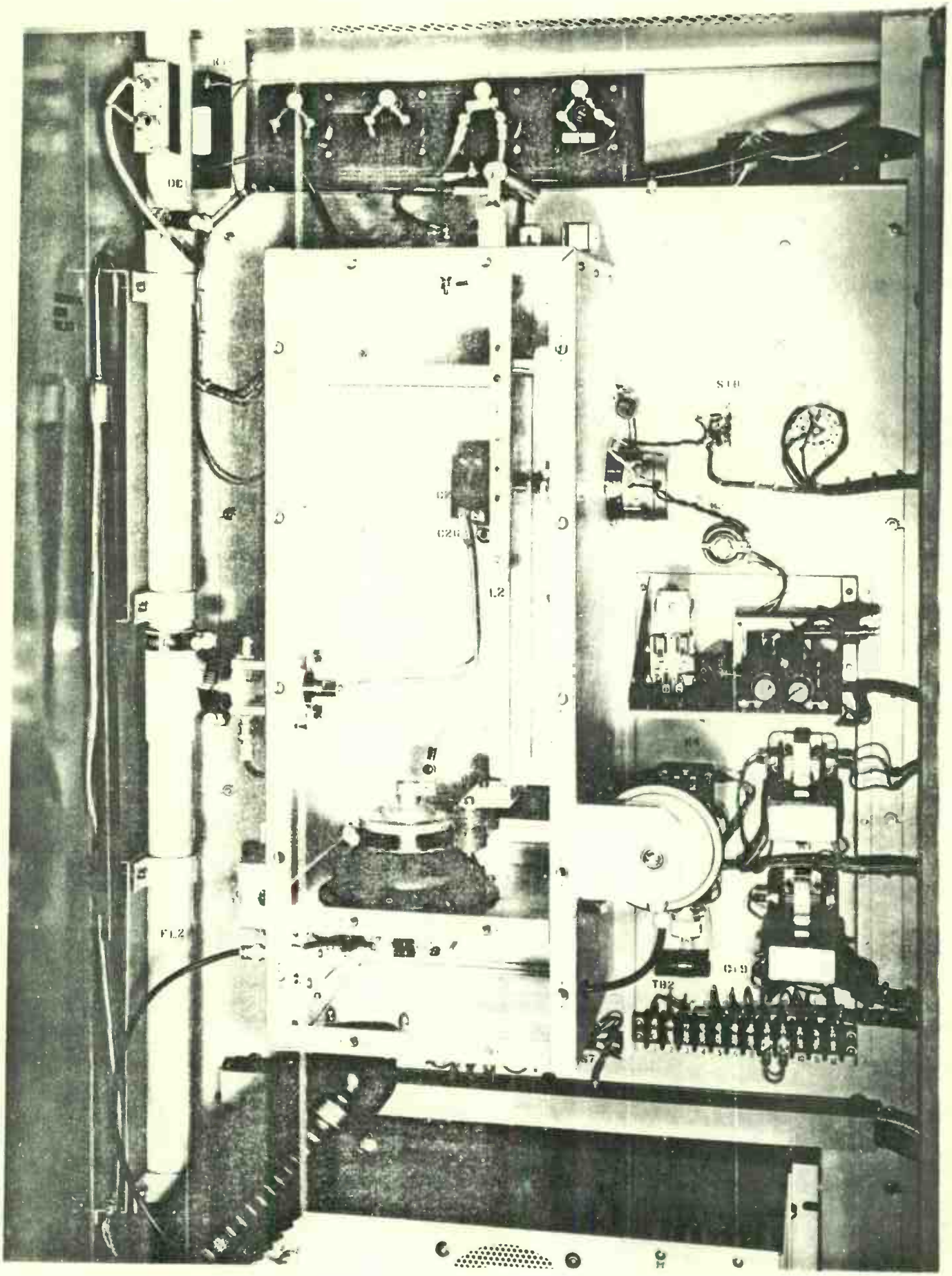


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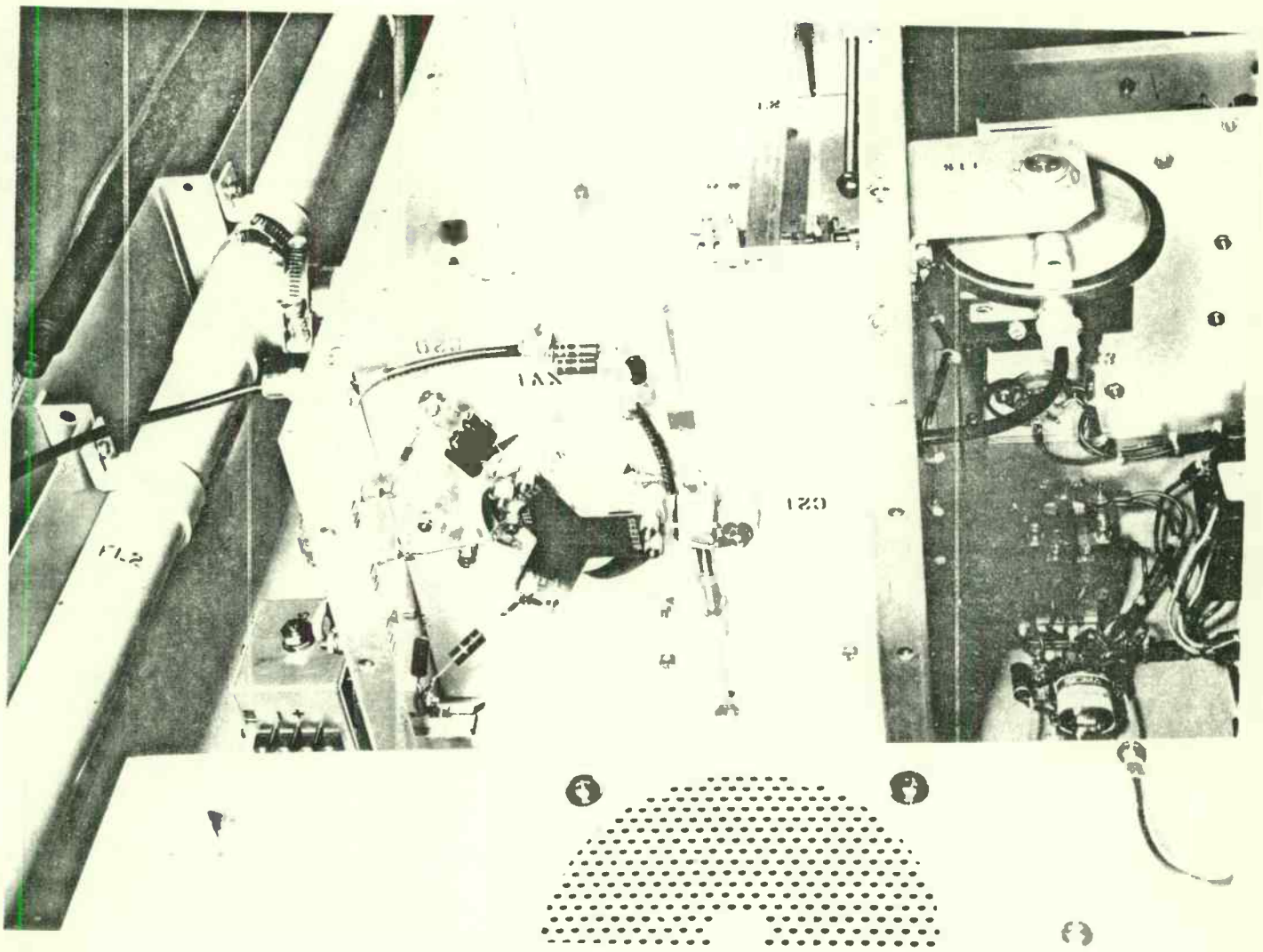

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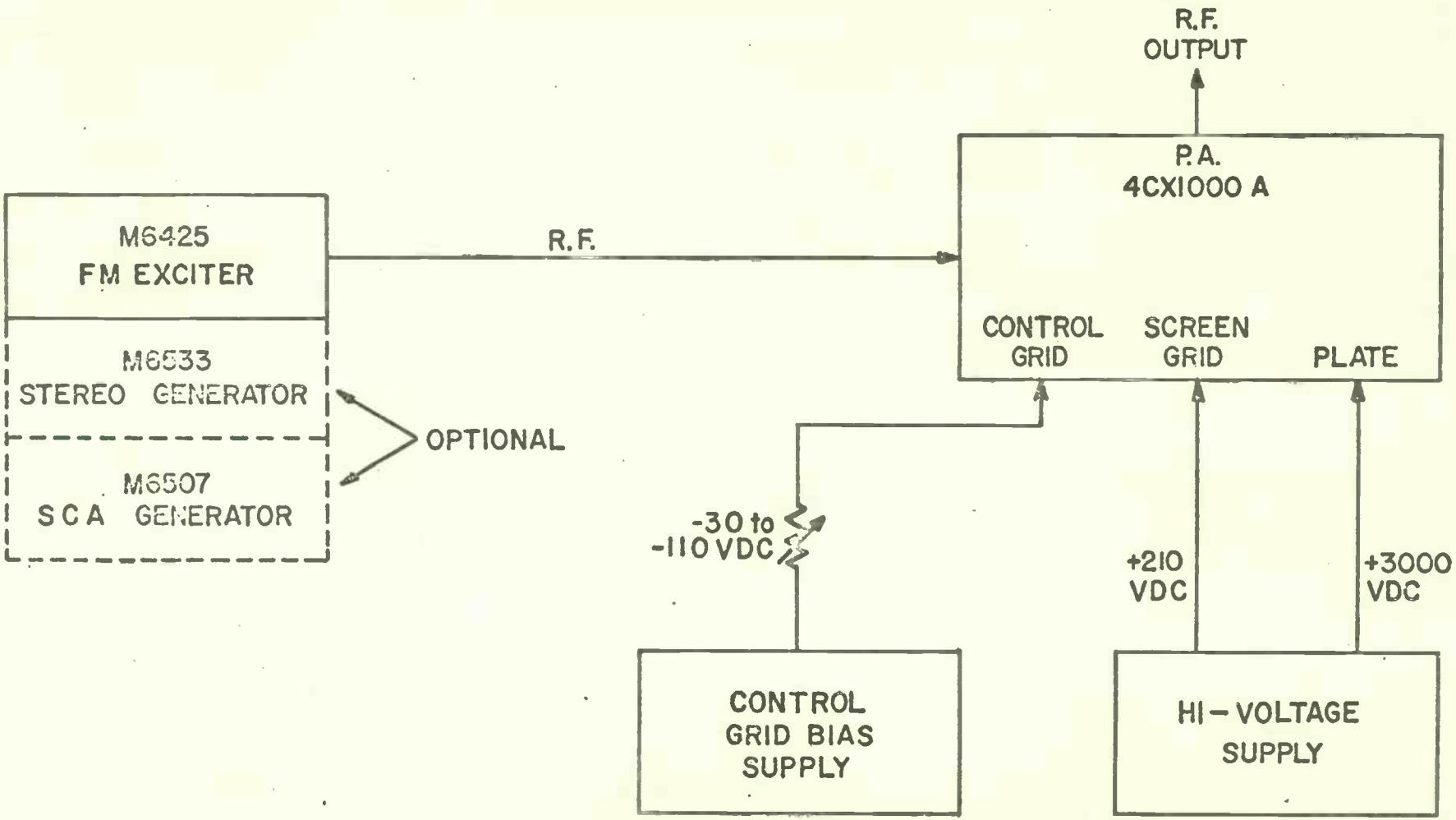
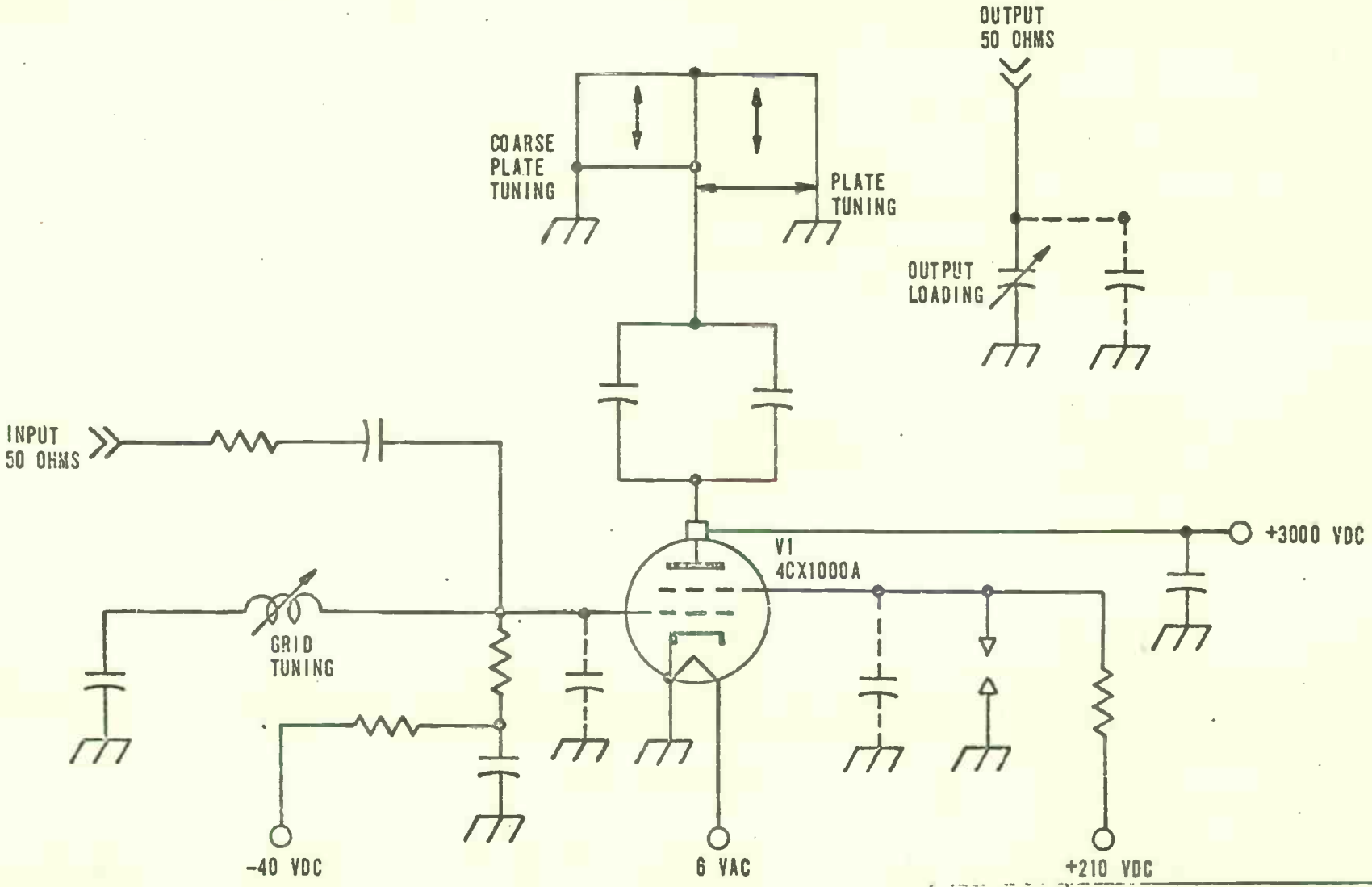



BLOCK DIAGRAM
FM1H-2
FM1H-3




| | |
|---|---|
| [illegible] RADIO COMPANY<br>QUINCY, ILLINOIS | |
| SIMPLIFIED RF SCHEMATIC<br>FM-1H2; FM-1H3 | 814 8320 001 |

| LTR. | DATE | REVISION | DRFTM | ENG | ECN |
|---|---|---|---|---|---|
| A | 3 9 72 | REV PER MARKED PRINT | D.S. | | P.C.R. 6560 |
| | | | | | |
| | | | | | |
| | | | | | |

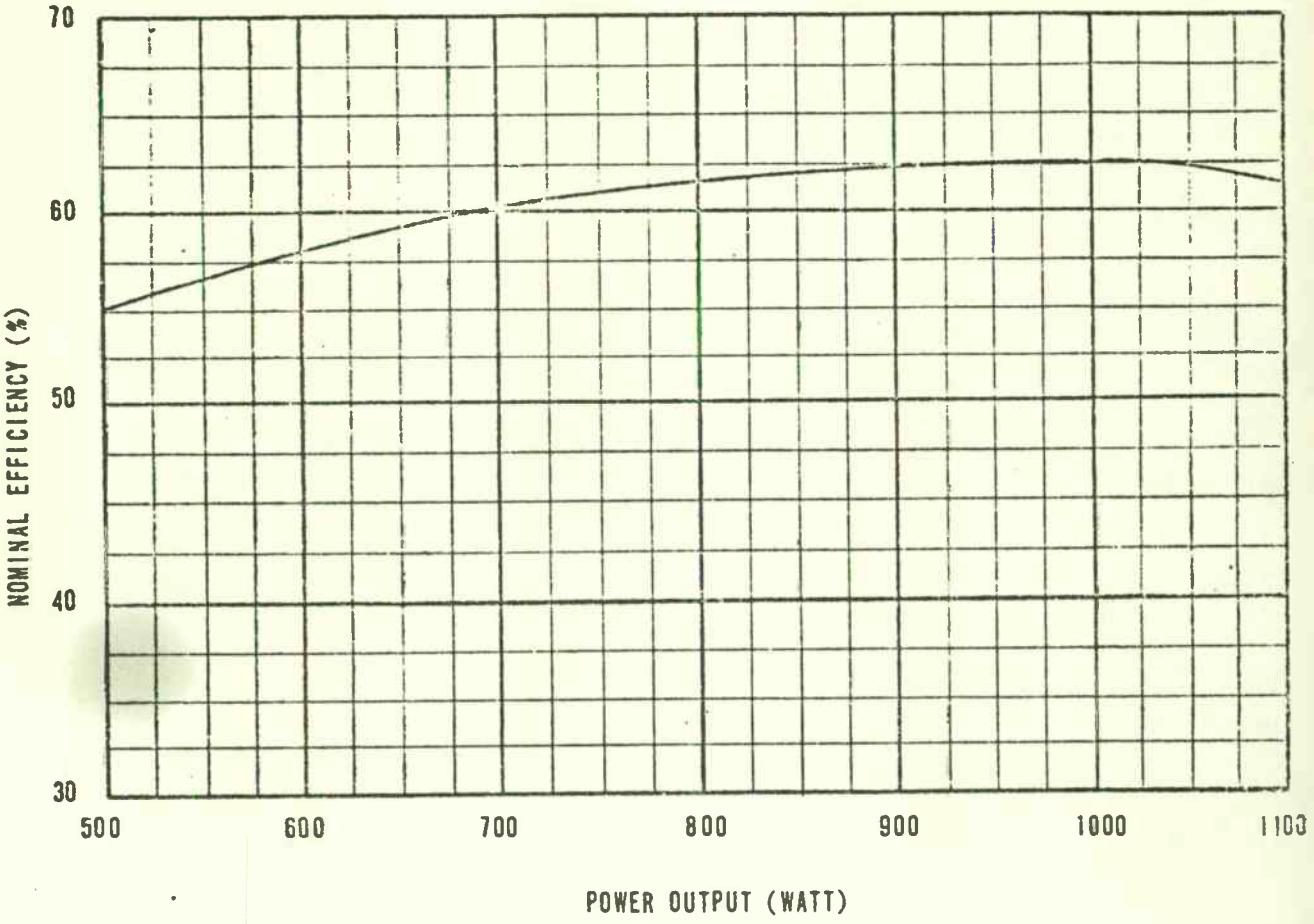
| POSITION OF COARSE TUNING SHORTING LINE ALONG PLATE LINE L2 | |
|---|---|
| HOLE NUMBER FROM TOP | FREQUENCY RANGE (MHz) |
| 1 | 87.5 - 90.9 |
| 2 | 91.1 - 94.3 |
| 3 | 94.5 - 97.7 |
| 4 | 97.9 - 101.1 |
| 5 | 101.3 - 104.5 |
| 6 | 104.7 - 107.9 |

GATES RADIO COMPANY
QUINCY, ILLINOIS

TITLE CHART, COARSE PLATE TUNING
FM-1H2; FM-1H3

814 8316 001

814 8316 001

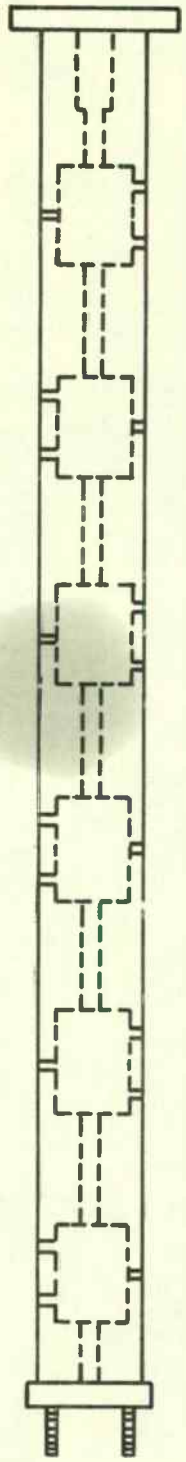


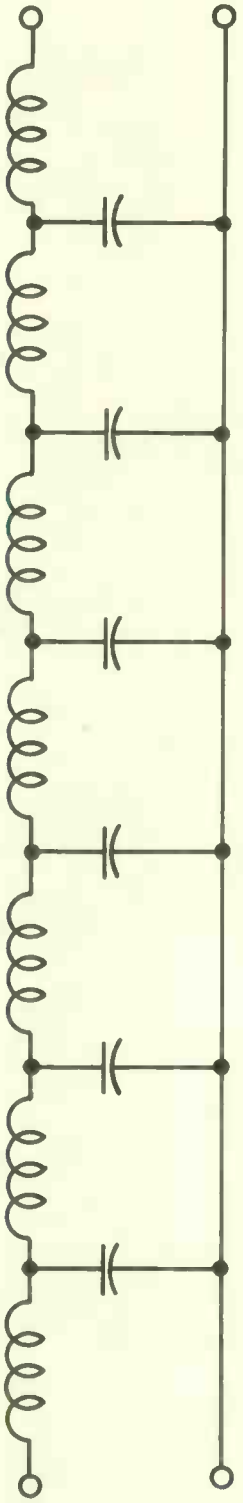

REFER TO THE TRANSMITTER FACTORY TEST DATA FOR THE EFFICIENCY FACTOR DETERMINED ON FINAL TEST

REVISED 5-31-72
REVISED 1-20-70

CATCO RADIO CORP.
QUINCY, ILLINOIS

TITLE
GRAPH - PA EFFICIENCY
FM-1H2; FM-1H3
814 8318 001





EQUIVALENT CIRCUIT-LOW PASS FILTER

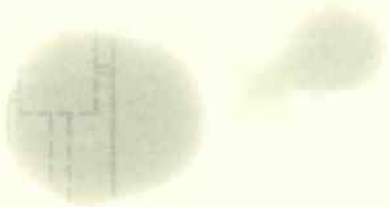
3 1/8" TRANSMISSION LINE, OVERALL LENGTH 72 1/8".

LOW PASS FILTER
FM TRANSMITTERS

**LOW PASS FILTER**
**FM TRANSMITTERS**
**814 8556 001**

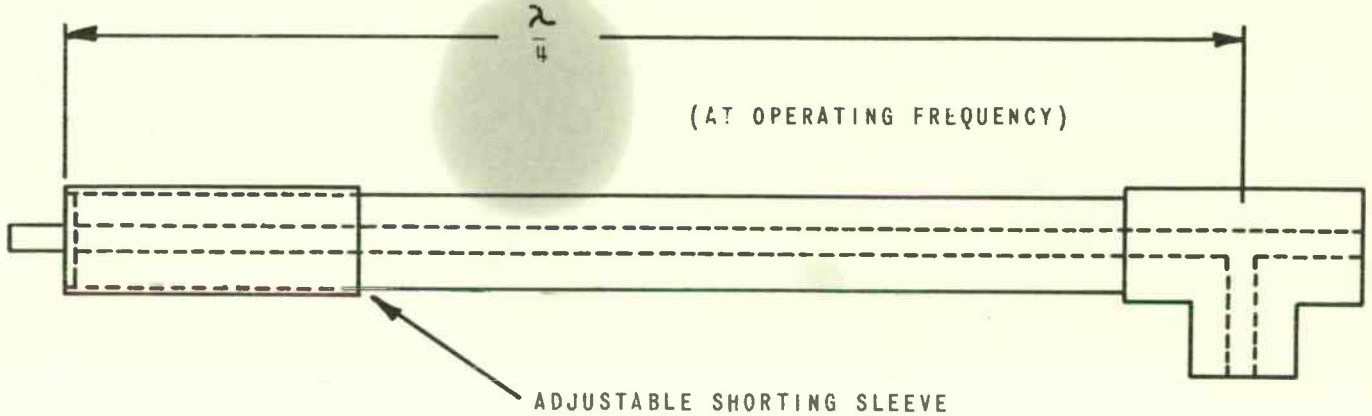
HARRIS CORPORATION Broadcast Products Division
123 Hampshire Street, Quincy, Illinois 62301

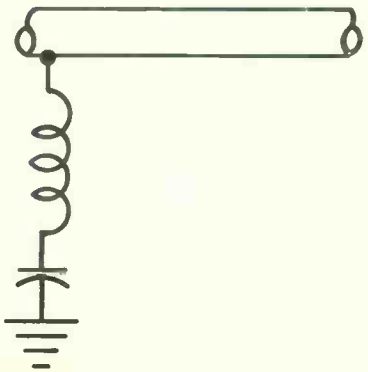
Warning, disconnect primary power prior to servicing.



HARRIS CORPORATION Broadcast Products Division
123 Hampshire Street, Quincy, Illinois 62301

Warning, disconnect primary power prior to servicing.



APPEARANCE OF NOTCH FILTER
AT SECOND HARMONIC

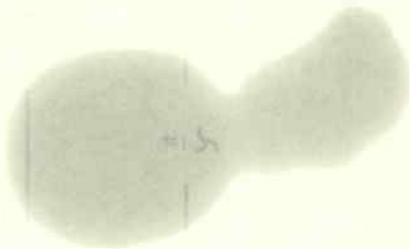
AT FREQUENCIES BELOW RESONANCE
THE "STUB" APPEARS AS AN INDUCTANCE.

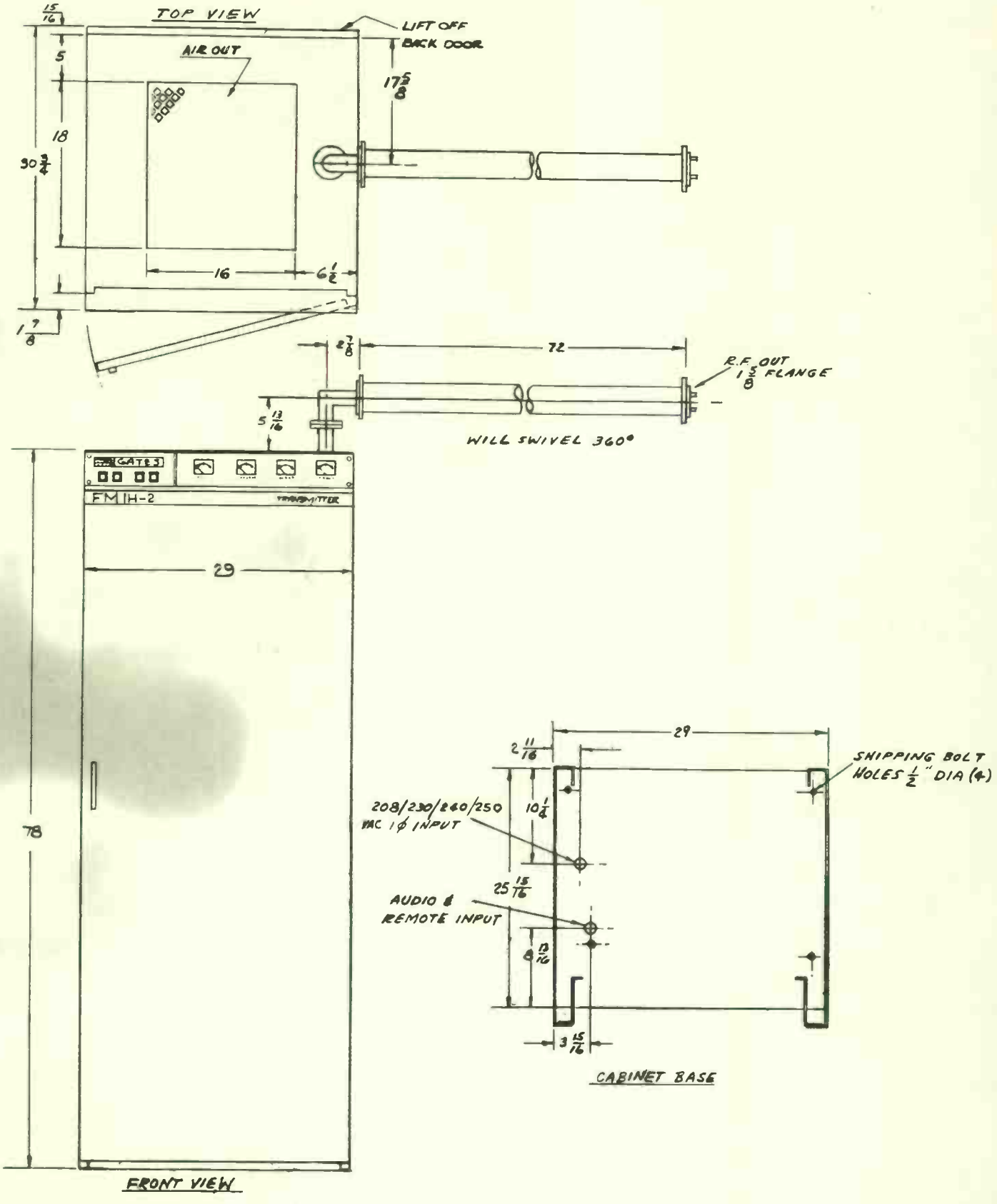
AT FREQUENCIES ABOVE RESONANCE THE
"STUB" APPEARS AS A CAPACITY.

AT THE SECOND HARMONIC FREQUENCY,
THE "STUB" APPEARS AS A SERIES
RESONANT CIRCUIT OR DEAD SHORT.

2nd HARMONIC FILTER -
FM TRANSMITTERS

**2ND HARMONIC FILTER**
**FM TRANSMITTERS**
**814 8554 001**






GATES DIVISION
HARRIS-INTERTYPE CORPORATION
123 HAMPSHIRE STREET • QUINCY, ILLINOIS 62301 U.S.A.

**INSTALLATION LAYOUT**
**FM1H-2, FM1H-3**
**838 3682 001**