



BROADCAST FM • TELEVISION • AM EQUIPMENT



RADIO CORPORATION OF AMERICA

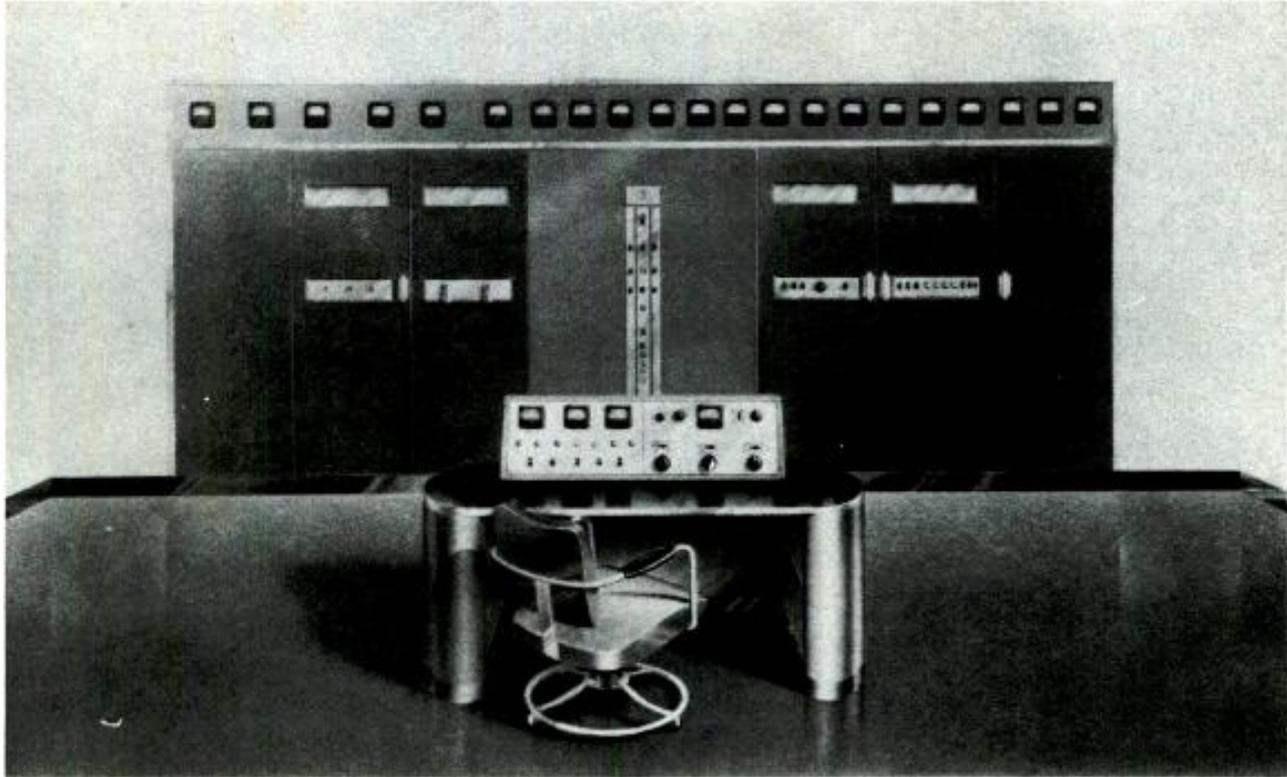
ENGINEERING PRODUCTS DEPARTMENT, Camden, N. J., U. S. A.

**50 KW
FM Transmitter
Type
BTF-50A
Equipment
Specification**

AS-6041

EFFECTIVE JULY, 1947

50 KW FM TRANSMITTER TYPE BTF-50A



Front Panel View of the BTF-50A with Supervisory Control Console.

DESCRIPTION

GENERAL

The RCA Type BTF-50A is a 50 KW air-cooled FM transmitter, featuring grounded-grid amplifiers and RCA's newly developed "direct FM" system. This transmitter will supply 50,000 watts at any specified frequency in the 88 to 108 mc. band.

EXCITER

In the exciter unit of the BTF-50A, frequency modulation is produced by push-pull reactance tubes connected directly across the frequency determining circuit of the modulated oscillator. Center frequency stability is maintained by an automatic frequency control circuit which is completely independent of the modulator circuit. This control circuit operates by comparing a sub-harmonic of the modulated signal with a standard developed by a temperature controlled precision ground quartz crystal oscillator. Any difference between the mean frequency of the modulated signal and that of the standard actuates a frequency compensating condenser which is connected across the tuned circuit of the modulated oscillator. This condenser is driven by a two phase motor in which the information supplied by a beat frequency between the above two signals determines the position. Two quartz-crystal units are furnished for the frequency standard oscillator; the stand-by crystal is maintained at operating temperature and is connected into the oscillator circuit by the flick of a switch.

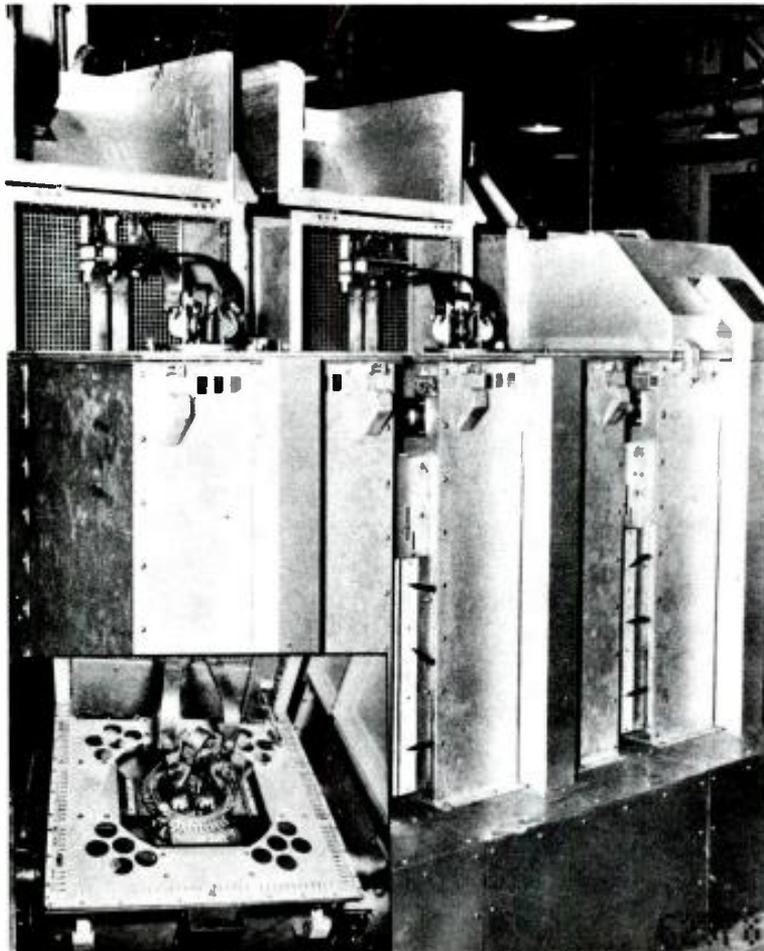
RF SECTION

Simplified single ended amplifiers operating Class "C" and comprising a minimum of variable elements form the r-f section of the BTF-50A. High stability grounded-grid amplifiers are used in all stages above the 250 watt level, and shielded grid tubes are used in the stages of lower power. All tubes above the 250 watt level are forced-air cooled triodes, with the number of types held to a minimum, allowing a minimum of spares.

All filaments are heated with power frequency A-C voltage, and filament voltages are maintained within specified limits by means of an automatic induction regulator. The filaments of the two final amplifier tubes and the driver amplifier are operated with 120° phase displacement in order to maintain a three-phase balanced load.

RECTIFIERS

A single high power rectifier supplies all anode voltages to the r-f stages. Six RCA Type 857-B tubes are used in a full wave 3 phase connected circuit with a half voltage tap for the lower power stages. The rectifier has a heated spare tube which may be switched into the circuit manually. The plate transformer is a three phase air cooled unit with extended windings on the primary to provide reduced voltage for test and tuning purposes. The high voltage rectifier is located in the rear center of the



Driver and Final Amplifier Tanks. Insert is a top view showing the Type 5592 tube used in these stages.

transmitter for convenience of d-c and a-c connections. All inter-connections are made in either built-in or over-head ducts, so that the only conduit or trenches required are those for the supervisory console and incoming power.

Screen voltage for the low power stages is supplied by a rectifier using one RCA type 5U4G, and is located in the low power r-f chassis.

CONTROL CIRCUITS

High-speed air circuit breakers of the hum free mechanical latch type are employed in all high power switchgear. Overload protection consists of a selective relaying system combining high speed tripping on d-c overloads and short circuit faults, with time delay tripping on nominal a-c system over-current and under voltage faults.

The control system is carefully engineered to provide proper starting sequence and automatic protection against most operating faults. Circuit indicator lamps provide a quick means for analyzing and localizing transmitter, tube or line faults, etc. A reclosing system will return full power automatically if the plate voltage is removed due to operation of overload devices on rectifier backfires, vacuum tube gas arcs, antenna flash-overs or other causes. This operation is repeated three times on the high power rectifier. If the fault persists on the third re-application of plate voltage, the recloser will lock out until reset manually.

MECHANICAL DESIGN

The general arrangement of the transmitter consists of a series of self-supporting chassis in line with a front enclosure to form a unified front panel. A typical floor plan (refer to Dwg. W-309550) permits installation of the radio frequency portion of the transmitter in a space sixteen and one-half feet long by nine feet deep. With such an arrangement, the blower and power equipment can be installed to suit individual choice and available space as follows:

1. To the rear of the radio frequency area.
2. In the basement immediately below the R.F. section.
3. The blower on the left hand side of the 50 KW amplifier and the balance of the equipment to the right of the low power R.F. Section.

All equipment is dead front constructed, with doors in the front enclosure allowing free access to the driver and P.A. R.F. cabinets and to the transmitter area. With the transmitter "on the air," station personnel can walk behind the enclosure and around the individual units for close inspection.

All incoming power supply and high power rectifier switchgear along with lower power distribution circuits, contactors, and control relays are centralized in a single unit. This unit also contains the voltage regulator and distribution transformers.

For installation, the transmitter can be broken down into units no larger than thirty by fifty-two and one-half by eighty inches, with the exception, in height, of enclosure sections, which will be approximately eighty-four inches high.

Operational controls, indicating instruments, indicator lights, and tuning controls are located on the front panel at appropriate intervals. Tuning operations required for normal daily adjustments are remotely controlled by front panel key switches controlling motor drives on the tuning elements. P.A. tuning controls are conveniently located with respect to the corresponding meters for easy viewing of D.C. power input and R.F. output during tuning operations.

A supervisory control console designed to be set up in a convenient position in front of the transmitter is included as part of the overall operating equipment. Essential operational controls and indicator lamps are duplicated on the R.F. turret of the console. The audio turret of the console has all controls for program handling. Space and mounting convenience has been provided in the R.F. turret for mounting three 4" meters in a recessed position behind the front panel, the choice of the meters being left to the discretion of the station personnel.

ANTENNA CUTBACK

To provide for continuous broadcast service with a minimum of interruption, antenna cut-back is furnished as standard equipment. A single control switch enables the antenna to be instantly switched from the final amplifier to a lower power r-f amplifier, at approximately the 7 KW level, and at the same time isolates the final amplifier, the driver amplifier, and the high power blower. Final amplifier or driver amplifier tubes may be changed, or necessary servicing done to these units or the high power blower, while program continuity is maintained at the lower power level.

Tube changing in the driver and power amplifier stages is facilitated by the use of mechanically operated tube hoist, solidly mounted in a swivel supporting structure and suitably located for easy access to the high power tubes. Two swivel supports are provided. The hoist can be easily lifted from one support to the other, depending upon which tube is to be removed. Lower power tubes are arranged to facilitate tube changing, and a minimum of time required is assured by use of quick opening clamp type filament connectors.

The transmitter is completely air cooled. Air cooling for tubes up to the 250 watt level is provided by an exhaust fan and small blowers suitably located to keep cool air circulating. A single blower, mounted external to the R.F. cabinets is used to supply forced air cooling through suitable ducts, to the 7C24 tubes used in the 2nd and 3rd stages and the I.P.A. stage. All cooling mediums have filtered air intakes. Air for the driver and final amplifiers is supplied by a separate blower, having a filtered intake by drawing its air from outside the transmitter area. The heated air from these stages may be exhausted into a manifold for outside delivery, or for heating purposes, if desired.

The use of filtered air greatly reduces dust accumulation and increases continuity of service by reduction of associated arcs from dust "pile ups" etc.

SAFETY

Safety of operating personnel has been given special consideration. All access doors to compartments having high voltage are equipped with automatic interlock switches, so that when any of these doors are opened all rectifiers are de-energized. In addition, the I.P.A., driver and P.A. compartments are equipped with mechanically operated grounding bars which ground the D-C circuits when protective doors are opened.

FEATURES

- Entirely air cooled—no liquid coolant.
- Simplified single ended circuits throughout.
- High stability grounded grid amplifiers.
- Low operating cost—low power input.
- Conservative operation of all parts and tubes.
- Built in wiring ducts—minimizes conduit and wire trenches—low installation cost
- Simplified power supply—only one main rectifier—one screen supply rectifier.
- Simplified effective control with high speed air circuit breakers.
- Single phase filament heating of all vacuum tubes.
- Reduced power operation to a lower powered stage by use of antenna cutback, accomplished by throwing a single switch.
- Driver and final amplifier serviced or tubes changed while operating with reduced power.
- Motor driven tuning—essential circuit metering.
- Breaks down into small units for ease of installation—all units handled by average passenger elevator.
- Sectional fault indication on front panel enclosure.
- Protection against transmission line or antenna failure.
- Attractive appearance achieved by functional styling.
- Vertical chassis construction for accessibility and ease of ventilation.

PERFORMANCE SPECIFICATIONS

Type of emission	Frequency modulation
Frequency range	Any specified frequency between 88 to 109 mc
Power output (into transmission line)	10,000 to 50,000 watts
R.F. Output impedance	51.5 ohms
Carrier frequency stability, deviation less than	1000 cycles
Modulation capability	± 100 KC
Method of modulation	Reactance tubes
Audio input impedance	600/150 ohms
Audio input level for 100% modulation (at input terminals of pre-emphasis network MI-4926A)	$+10 \pm 2$ dbm
Audio input level for 100% modulation (without pre-emphasis filter)	-14 ± 2 dbm
Audio frequency response*	$1 \pm$ db 30 to 15,000 cycles
Audio frequency distortion** 30 to 15,000 cycles (including all harmonics up to 30 KC at ± 75 KC swing)	less than 1%
FM noise level** (below 75 KC swing)	Not more than -65 db
AM noise level (below 100% amplitude modulation)	Not more than -50 db
Power line requirements—transmitter line voltage (nominal open circuit)	From 440 to 480 volts
Phase	3
Frequency	60 cycles (can be adapted for 50 cycles with minor modifications)
Total variation below nominal, including regulation	5%
Power consumption	125 KW (approximate)
Power factor	87% (approximate)
Power line requirements—crystal heaters	
Line voltage	115 volts
Phase	1
Frequency	50/60 cycles
Power consumption	28 watts

* For pre-emphasis response the pre-emphasis filter (MI-4926A) is provided to be inserted in the 600 ohm audio input line, at the most effective point.

** Distortion and noise are measured following a standard de-emphasis network.

TUBE COMPLEMENT

The following is a list of one complete set of tubes for the BTF-50A Transmitter.

For the FM Exciter

Modulators	2 RCA 6V6
Modulated Oscillator	1 RCA 6V6
1st Buffer-Multiplier	1 RCA 6V6
2nd Buffer-Multiplier	1 RCA 2E26
3rd Buffer-Multiplier	1 RCA 2E26
1st Frequency Divider	1 RCA 6AC7
2nd Frequency Divider	1 RCA 6AC7
3rd Frequency Divider	1 RCA 6AC7
4th Frequency Divider	1 RCA 6AC7
Motor Tubes	4 RCA 1614 or 6L6
Crystal Frequency Divider	1 RCA 6AC7
Crystal Oscillator	1 RCA 6SH7
Cathode-Ray Indicator	1 RCA 2BP1

For the Exciter Power Supply

Low Voltage Rectifier	2 RCA 5U4G
High Voltage Rectifier	1 RCA 5U4G
Voltage Regulators	2 RCA OD3/VR150
Voltage Regulator	1 RCA OC3/VR105

For the R.F. Units

Doubler	1 RCA 4D21/4-125A
1st R.F. Amplifier	2 RCA 4D21/4-125A
2nd R.F. Amplifier	1 RCA 7C24
3rd R.F. Amplifier	1 RCA 7C24
Intermediate Power Amplifier	2 RCA 7C24
Driver Amplifier	1 RCA 5592
Final Amplifier	2 RCA 5592
High Voltage Rectifier	6 RCA 857B
Low Voltage Rectifier	1 RCA 5U4G

For Transmission Line Monitor

R.F. Rectifier	1 RCA 6AL5
Thyratron	1 RCA 2D21
R.F. Rectifier	1 RCA 6X5

Mechanical Specifications

Refer to floor plan drawing W-309550.

Equipment Weight

Refer to floor plan drawing W-309550.

Ventilation Requirements

Refer to floor plan drawing W-309550.

EQUIPMENT LIST

The BTF-50A Broadcast Transmitter, as herein specified consists of the equipment listed below. Broadcast audio equipment, monitoring and test equipment, antennas and transmission feed line are not furnished as part of this equipment and should be specified and ordered separately if required. The RCA type BTF-50A FM Broadcast Transmitting equipment is identified as MI-28926 and consists of the following major items:

Item	Quantity	Description
1	1	Power Amplifier Unit
2	1	Power Amplifier R.F. Harness
3	1	Rectifier
4	1	Control and Distribution Unit
5	1	Plate Transformer
6	1	Filter Reactor
7	1	Main Blower and Filter Equipment
8	1	Enclosure and Metal Panel
9	1	Transmission Line Monitor
10	1	Harmonic Attenuator
11	1	Cut Back Equipment
12	1 (See Note 1)	FM Exciter Unit
13	1	Low Power R.F. Units
14	1	Pre-emphasis Filter (600 ohms)
15	1	Touch-up Enamel Kit
16	2	Set of Operating Tubes

Item	Quantity	Description
17	1	Blower for 2nd R.F., 3rd R.F. and I.P.A. Units (and air duct)
18	1	Type BTC-1A Supervisory Control Console
19	2 (See Note 2)	TMV-129G Crystal Units
20	2	Instruction Books
21	2	Set Installation Instructions
22	1	Installation Material Kit
23	1	Tube Hoist and Accessories

Note 1: When dual FM exciters are to be specified, order in addition to item 22 above, the spare FM exciter kit MI-7015 listed under accessories.

Note 2: Order two (2) TMV-129G crystal units and specify the carrier frequency when ordering.

ACCESSORIES (Consult Local RCA Office for Particulars)

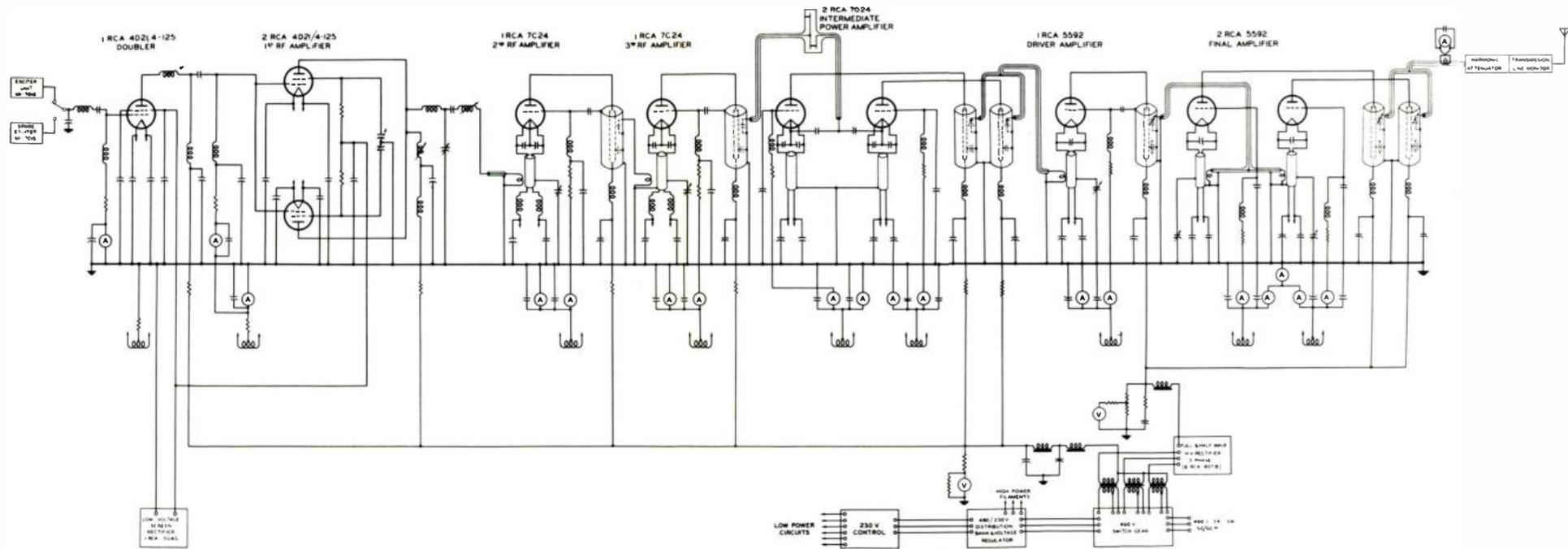
Spare FM Exciter Unit	MI-7015
Set of Operating Tubes for Spare FM Exciter	MI-7020
Modification Kit for 50 cycle Power Source	MI-28248
Spare Parts	On Application
Antennas and R.F. Transmission Lines	On Application
Broadcast Audio Equipment	On Application
Test and Measuring Equipment	On Application

INSTALLATION

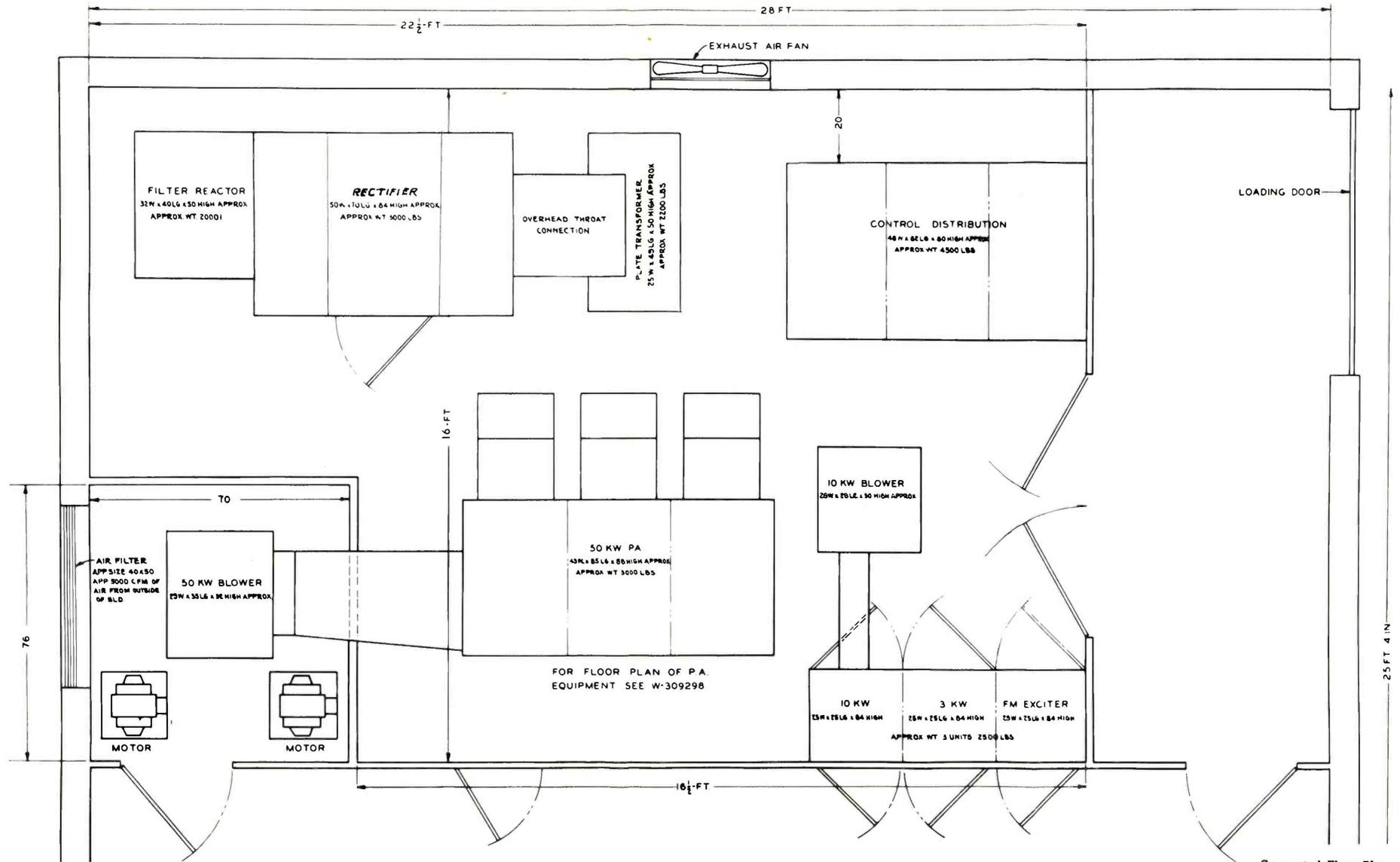
Installation engineering services are not included as a part of this specification but can be furnished separately if required. RCA Service Company of the Radio Corporation of America maintains a staff of broadcast equipment specialists who are available for supervising the station installation, tuning-up the transmitting equipment, and servicing such equipment.

CHANGES IN DESIGN

In order to make improvements in design and to effect economies in manufacture, the RCA Victor Division of the Radio Corporation of America reserves the right to change the design of its products at any time, and in accordance with its sole judgment, while adhering in good faith to the intent of these specifications.

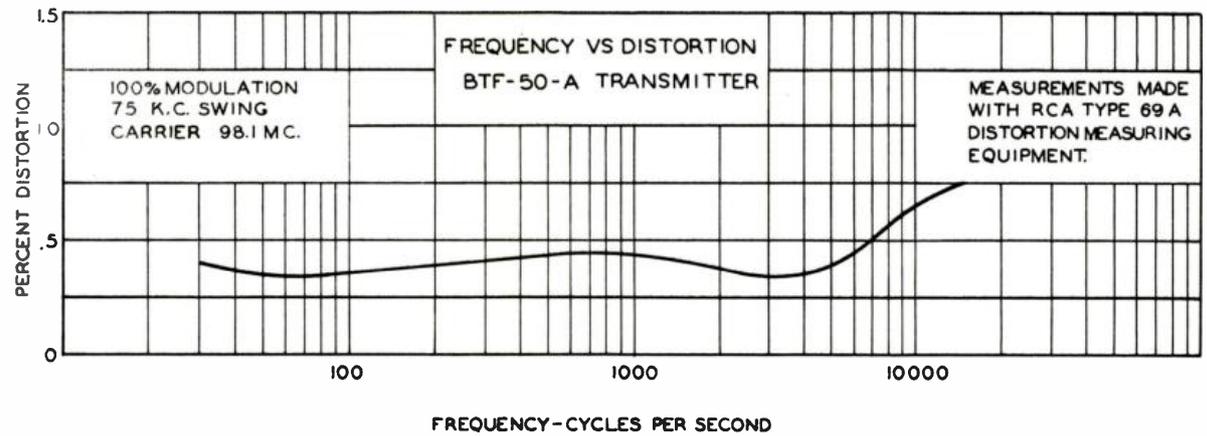


Simplified Schematic Diagram
 BTF-50A Transmitter
 W-309547



FOR FLOOR PLAN OF PA
EQUIPMENT SEE W-309298

Suggested Floor Plan
BT-50A Transmitter
W-309550





Address all inquiries and orders to one of the field offices listed below. At each location you will find a broadcast equipment specialist who is anxious to help you with your problems.

36 W. 49th Street
New York 20, N. Y.

1907-11 McKinney Ave.
Dallas 1, Texas

718 Keith Building
Cleveland 15, Ohio

221 W. 18th Street
Kansas City 8, Mo.

666 N. Lake Shore Drive
Chicago 11, Illinois

621 S. Hope Street
Los Angeles 14, California

820 Metropolitan Bldg.
260 Tremont Street
Boston, Massachusetts

1355 Market Street
San Francisco, California

530 Citizens & Southern Bank Bldg.
Atlanta, Georgia

RADIO CORPORATION OF AMERICA

Engineering Products Department
Camden, N. J.