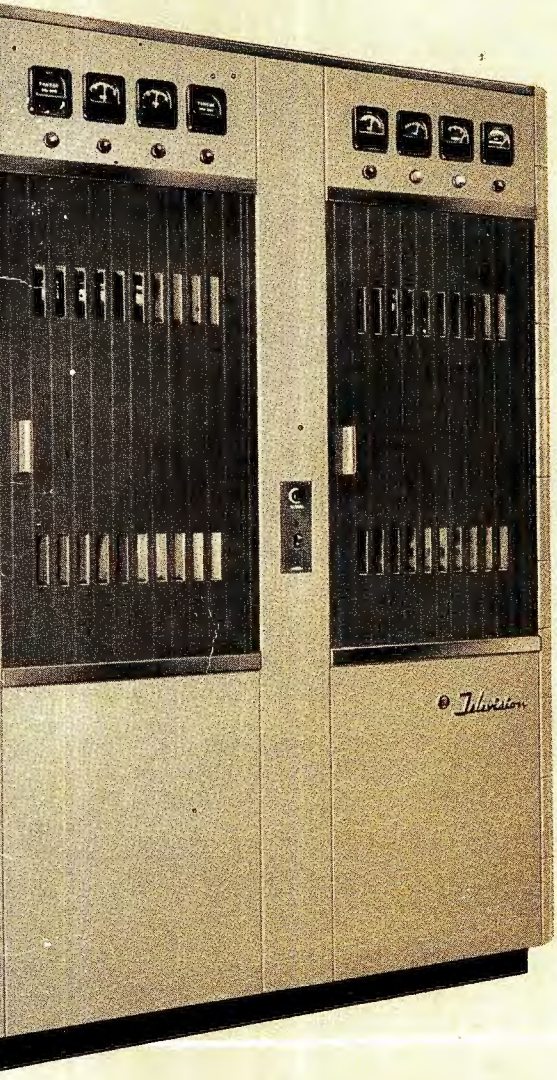


BROADCAST

TRANSMITTING

EQUIPMENT

for

UHF • VHF • TELEVISION

—

(SECOND EDITION)

TV TRANSMITTERS

TRANSMITTER CONSOLES

CRYSTALS

INPUT AND MONITORING

FILTERS

ACCESSORIES

BROADCAST TV TRANSMITTING EQUIPMENT CATALOG

BROADCAST AND TELEVISION EQUIPMENT DEPT.

RADIO CORPORATION OF AMERICA

Commercial Electronic Products Camden, N. J.

ABOUT THIS CATALOG

This Catalog is devoted solely to information on RCA television transmitting equipment designed especially for broadcast station use. Other RCA Broadcast Equipment Catalogs contain similar information on AM and FM transmitting equipment, transmission line, antennas, test equipment, audio equipment, and video equipment.

The information contained in this catalog is intended to serve as a buying guide for the users of this type equipment. In the belief that broadcast engineers want facts, rather than generalities, the content has purposely been kept brief and factual. Readers who desire more information or individual bulletins on particular equipment items are invited to write to the RCA Broadcast Representative in the RCA Regional Office nearest them (see opposite page).

OTHER RCA TECHNICAL PRODUCTS

The RCA equipment described in this catalog is specifically designed for broadcast station use. In similar manner RCA builds electronic equipment for many other industries. These include: two-way radio and microwave radio communication equipment; a complete line of equipment for theatres; optical and magnetic film recording equipment; sound systems of all types; 16mm projectors and magnetic recorders; high-fidelity components for home music systems; industrial inspection equipment; scientific equipment, such as the electron microscope; industrial television systems; intercoms; tape recorders; TV Eye; Antenaplex systems; and many types of custom-built equipment for industry and the military services. Information and catalogs or bulletins, describing these may be obtained from RCA Regional Offices.

HOW TO ORDER

The RCA Television Transmitting Equipment shown in this catalog is sold directly through RCA Broadcast Representatives, who are familiar with broadcast equipment and related problems. One or more of these RCA Representatives are located in each of the RCA Regional Offices listed below. Orders for equipment shown in this catalog, or requests for additional information, should be directed to the nearest one of these offices.

PRICES

The prices of the various equipment units shown in this catalog are given in a separate price list. Prices are listed in the order in which they are shown in the catalog. To determine the price of any equipment first note the page on which it is shown in the catalog, then consult the price list in accordance with this page number. Equipments are identified by type and MI (Master Item) numbers which are used to identify apparatus on invoices and packing slips.

YOU CAN LOCATE YOUR NEAREST RCA REPRESENTATIVE FROM THIS LIST

REGIONAL OFFICES

Front and Cooper Streets
CAMDEN 2, NEW JERSEY
Woodlawn 3-8000

•

36 West 49th Street
NEW YORK 20, NEW YORK
Judson 6-3800

•

1907-11 McKinney Avenue
DALLAS 1, TEXAS
Riverside 1371

•

1600 Keith Building
CLEVELAND 15, OHIO
Cherry 1-3450

2301 John Hancock Building
200 Berkeley Street
BOSTON 16, MASSACHUSETTS
Hubbard 2-1700

•

522-533 Forsyth Building
Forsyth and Luckie Streets, N.W.
ATLANTA 3, GEORGIA
Jackson 4-7703

•

340 Dierks Building
KANSAS CITY 6, MISSOURI
Harrison 1-6480

•

1560 North Vine Street
HOLLYWOOD 28, CALIFORNIA
Hollywood 9-2154

420 Taylor Street
SAN FRANCISCO 2, CALIFORNIA
Ordway 3-8027

•

1186 Merchandise Mart Plaza
CHICAGO 54, ILLINOIS
Delaware 7-0700

•

1625 K Street, N.W.
WASHINGTON 6, D. C.
District 7-1260

•

2250 1st Avenue, South
SEATTLE 4, WASHINGTON
Maine 8350

RCA TV TRANSMITTERS

General Information

RCA Television Transmitters are the result of over twenty years of continued and concentrated design and research in Television Broadcasting. From its first complete television station in New York City (1929) to present day television, RCA has designed and manufactured equipment for more than 250 television broadcasting stations. RCA pioneering in UHF Television is evidenced by the large number of UHF commercial stations. In combination with suitable RCA antennas, the complete line of television transmitters can produce Effective Radiated Powers ranging from one hundred watts to one million watts (UHF). Various combinations to achieve these powers are discussed briefly below.

The careful and considered planning of the transmitting equipment for a Television station is one of the first logical steps to be taken after early planning has been completed. Early plans usually involve such considerations as the market to be served, site selection, effective radiated power, antenna height and gain, sources of program material, station policies, personel and extent of programming, capital investment, future expansion, and the planning of the building.

In general, the planner should consider carefully both his present and future space needs and balance this with his planned expenditure. Usually, the provision of a little extra space will be more than repaid by the ease with which later expansion can be made.

The careful planning and layout of wiring trenches or ducts is essential to every station planner, once the amount of technical equipment has been determined accurately. It is practical to plan "trench runs" to accommodate the future addition of console sections, equipment racks and transmitter cabinets. Typical transmitter and console ductwork diagrams are shown on floor plans, but no attempt is made in RCA literature to illustrate complete station duct layouts. This is deemed a consideration, unique for each station, and is perhaps best jointly solved by the station engineer, a qualified systems consultant, and the TV equipment engineers involved.

Another suggestion is to compare the sizes of doorways to those of individual components to assure entrance of such items as transmitter cubicles and filterplexers.

VHF-ERP Range 100 to 500 Watts

A Type TTL-100A 100 watt transmitter used with two section super-turnstile antennas will provide Effective Radiated Powers up to 240 watts. This is a combination recommended for satellite and other low power applications. Higher gain antennas may be used for powers in the order of 500 watts.

VHF-ERP Range 2 to 20 KW

An economical arrangement using a Type TT-2BL Transmitter with a super-turnstile antenna provides Radiated Powers to 20 KW at low cost investment. The small floor space requirements for the TT-2BL make it an ideal transmitter for a combination studio and transmitter operation.

VHF-ERP Range 6 to 70 KW (Channels 2-6)

A Type TT-6BL Transmitter with low or high gain super-turnstile antennas can provide powers to 70 KW on the low VHF channels. The TT-6BL is easily converted to a higher powered transmitter by the addition of RCA amplifiers.

VHF-ERP Range 10 to 100 KW

An RCA 10 KW transmitter, when used with a high gain super-turnstile antenna can produce power up to 100 KW ERP. These transmitters are used as the drivers for 25 KW and 50 KW transmitters when it is desired to increase power.

VHF-ERP Range 25 to 275 KW

25 KW Transmitters are available for low and high band VHF channels. When used with 12-section super-turnstile antennas these transmitters can provide maximum power on some channels.

VHF-ERP Range 50 to 316 KW (Channels 7-13)

With 6-section or 12-section antennas the Type TT-50AH Transmitter can easily provide the maximum of 316 KW Radiated Power. Where it is desired to use a lower gain antenna, the Type TT-100AH Transmitter is recommended.

UHF-ERP Range 1 to 50 KW

For cities where UHF channels are available, the TTU-1B 1 KW UHF Transmitter will provide up to 20 KW ERP with standard UHF Pylons and up to 50 KW ERP with RCA custom high gain antennas. The TTU-1B Transmitter is used as a driver for higher powered UHF transmitters.

UHF-ERP Range 10 to 500 KW

The popular TTU-12A Transmitter and standard UHF Pylons can provide power up to 300 KW ERP. For powers to 500 KW special high gain antennas are available.

UHF-ERP Range 25 KW to 1 Megawatt

The maximum power allowed by the FCC can be obtained by the TTU-25B 25 KW Transmitter and high gain UHF antennas with power gains from 46 to 60. These antennas are provided with pattern shaping to permit the most efficient use of r-f power.

RCA Television Transmitter Characteristics

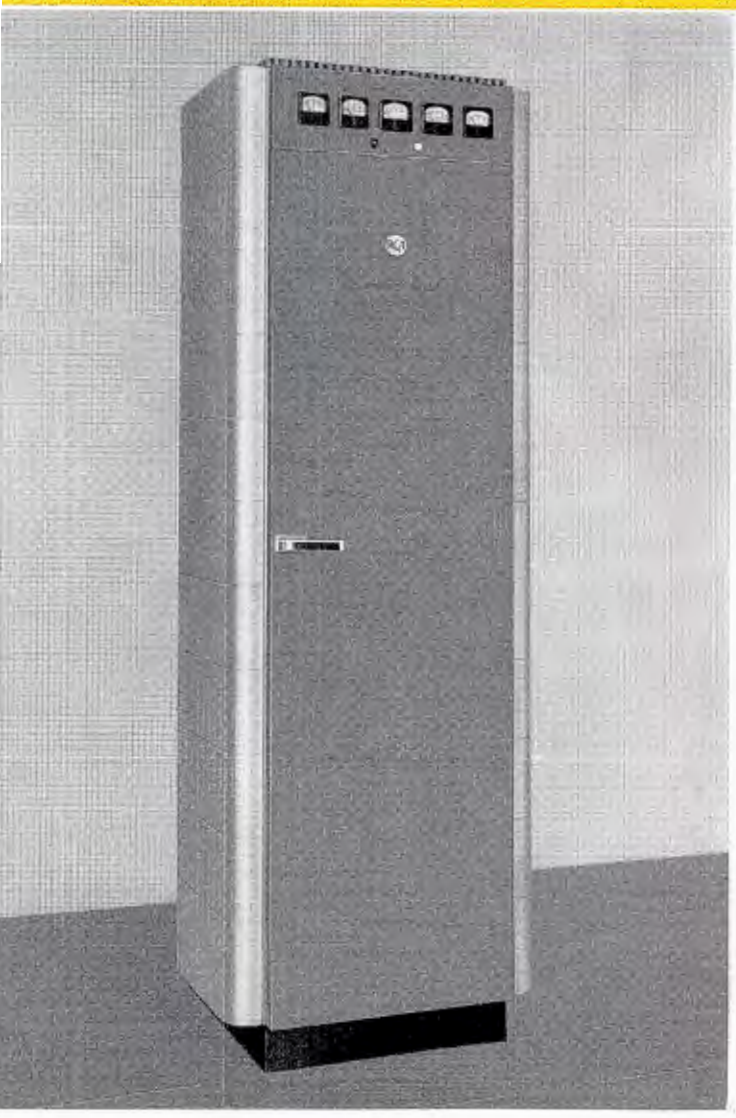
A tabulation of the major characteristics of RCA television transmitters and amplifiers is shown below. More detailed specifications are contained on the pages describing the individual transmitters.

Summary of RCA Television Transmitters and Amplifiers

		POWER OUTPUT—KW		AC POWER INPUT REQUIREMENTS			
Type	*Channels*	*Peak Visual*	*Aural*	*Voltage*	*Phase*	*Average Picture (KW)*	*Black Picture (KW)*
TTL-100A	2-13	100	50	107/117	1	1.4	1.5
TT-2BL	2-6	2	1.2	208/230	3	10.0	11.0
TT-6AL	2-6	6	3.15	208/230	3	23.2	27.2
TT-10AL	2-6	11	6	208/230	3	32.7	40.1
TT-10AH	7-13	10	6	208/230	3	34.3	41.1
TT-25BL	2-6	25	15	208/230	3	76.5	91.0
TT-25BH	7-13	25	14	208/230	3	85.5	100.5
TT-25BL (Amp.)	2-6	25	15	208/230	3	51.7	62.7
TT-25BH (Amp.)	7-13	25	14	208/230	3	54.5	66.5
TT-50AH	7-13	50	30	460	3	140.0	167.5
TT-50AH (Amp.)	7-13	50	30	460	3	118.0	132.0
TT-100AH	7-13	100	60	460	3	258.0	299.0
TTU-1B	14-83	1	0.6	208/230	1	8.6*	9.6*
TTU-12A	14-83	12.6—10.3	7.56—6.18	208/230	3	85.0*	100.0*
TTU-25B	14-83	25	12.5	460	3	108.0*	130.0*

* Transmitters operating with sound power 60% of peak visual—all others 50%.

TTL-100A 100 WATT TV TRANSMITTER



FEATURES

- Economical low powered installation for origination or satellite operation
- Housed in single standard audio rack—extremely compact and lightweight
- Designed for unattended operation
- Air cooled tubes used throughout. 4X150's used in final amplifier. All tubes used are easily obtainable, inexpensive and dependable
- Designed for color
- Independent control circuits for visual and aural sections of transmitter
- Built-in intercarrier frequency control
- All operating controls accessible from front of unit
- Dry selenium rectifier—25,000 hour minimum life

USES

The TTL-100A is a complete television transmitter, housed in a single Audio Rack, capable of developing 100 watts peak visual carrier power and 50 watts of aural carrier power on VHF channels 2 to 13. It is a new low-power equipment for telecasting in either monochrome or color and is designed for unattended operation. The transmitter can be operated with a minimum of attention from maintenance and operating personnel. If desired, the transmitter can be turned on and off remotely by controlling an integral relay of the transmitter from any convenient location. It provides an economical low power installation for origination of TV programs or for satellite operation.

The new TTL-100A will meet the standard FCC color specifications when normal transmitter auxiliaries such as color stabilizing amplifier, video low-pass filters, and phase equalizers are included. The equipment is extremely compact, being housed in a standard audio rack. The circuits employ latest design features and represent economy in operation. The equipment features standard, low-cost tubes, all of which are air-cooled and dependable. Separate amplifier stages are used to develop the visual and aural carriers resulting in new operating economies.

DESCRIPTION

RCA's new 100-watt TTL-100A Transmitter is housed in a standard equipment rack (Type BR-84) and can, if desired, be mounted adjacent to terminal facilities to produce an attractive and matching equipment arrangement. The transmitter is designed for unattended operation. This makes imperative dependable and stable operation for long periods without need for adjustment. By controlling the a-c line breaker, an integral relay of the transmitter, it may be turned on and off remotely from any convenient location.

Separate amplifier stages are used to develop the visual and aural carriers. As a consequence, a favorable ratio of power input to total r-f power output is achieved, and equally important, the cross-coupling between aural and visual outputs is held to a low value without the necessity for providing an exorbitant total r-f plate dissipation. Both amplifiers are air-cooled.

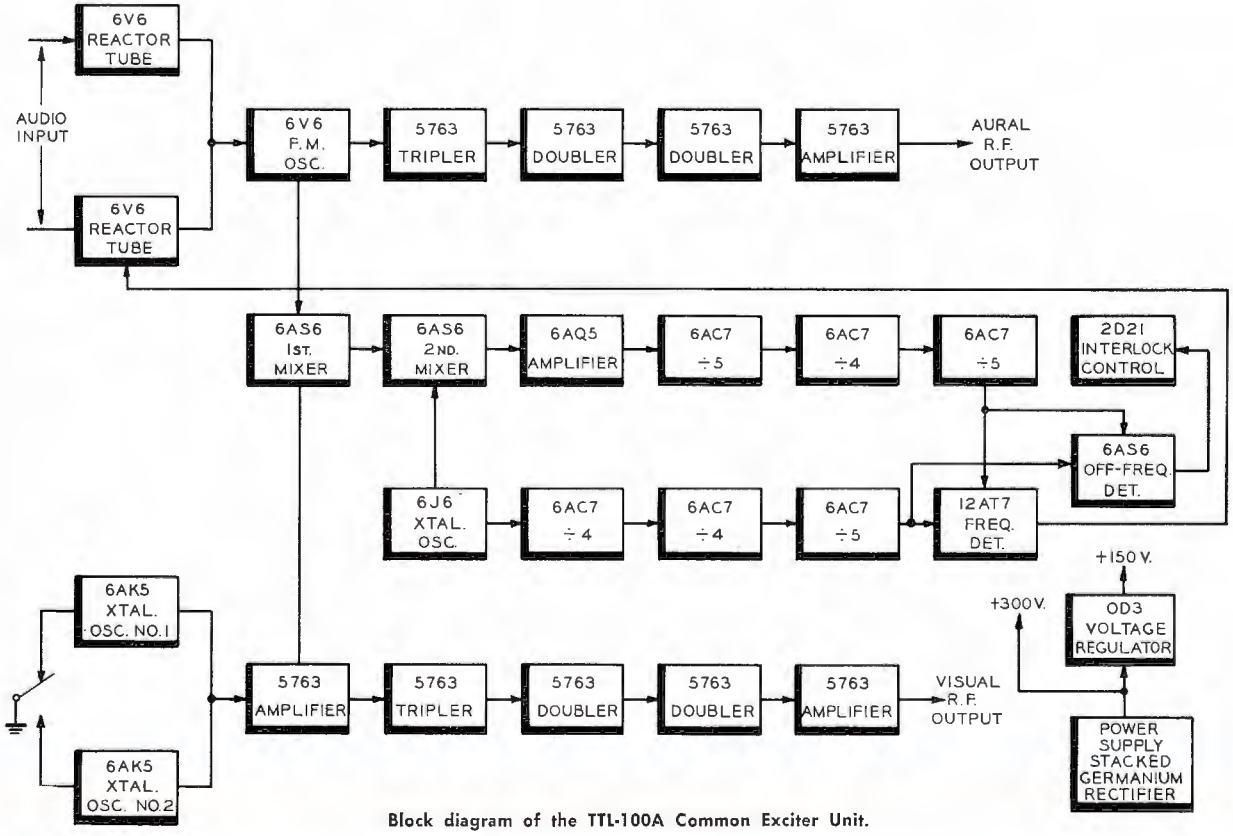
The self-contained transmitter develops 100 watts peak visual carrier power and 50 watts of aural carrier power on channels 2 to 13. The steel cabinet housing is 84⅞" high, 28" wide and 20½" deep (less door handle). The transmitter weighs approximately 600 pounds. All operating controls are accessible from the front, and four meters, mounted above the hinged front door, meter all critical circuits.

Plate voltage for the transmitter is furnished by dry selenium rectifiers which are designed for a minimum of 25,000 hours of operation.

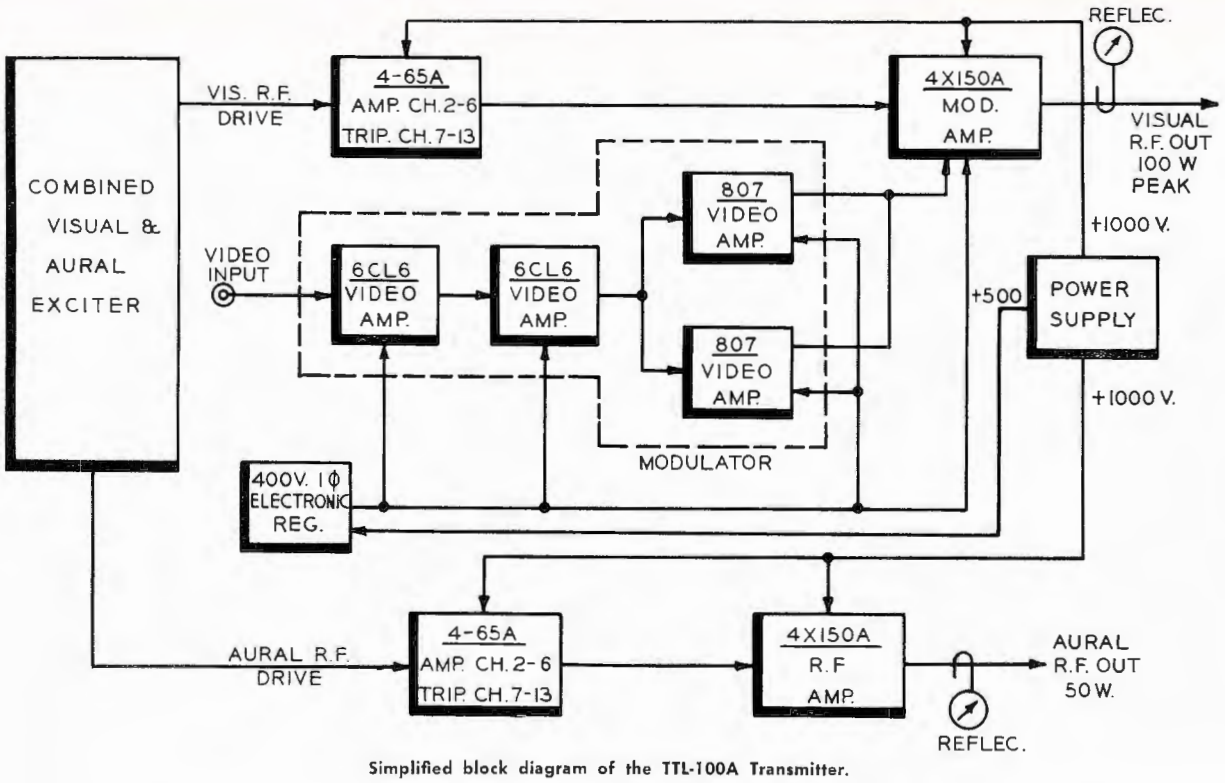
R-F Circuits

The aural and visual exciter circuits are mounted on a single chassis. Two separate crystal oscillators are employed since this allows switching from a remote point by a relay in the d-c circuit. No relays are necessary in the r-f circuit. A 5763 buffer amplifier allows the crystal oscillators to be operated at a low level. This reduces internal heating of the crystal and allows the oscillator frequency to stabilize very quickly after the plate power is applied. The buffer stage is followed by a tripler, two doublers and an amplifier all using 5763 tubes. The output power of the exciter is approximately 5 watts at both carrier frequencies.

The aural chain starts with a 6V6 master oscillator frequency modulated by two 6V6 reactance tubes. The multipliers and amplifiers which follow the master oscillator are identical to those used in the visual side. A unique feature



Block diagram of the TTL-100A Common Exciter Unit.



Simplified block diagram of the TTL-100A Transmitter.

of the exciter is the frequency control circuit for the aural master oscillator. This circuit is designed to accurately maintain the difference between the aural and visual carrier frequencies. This is accomplished by feeding a small amount of the energy from the aural and visual oscillators to a 6AS6 mixer tube. When the aural oscillator is on frequency the output of this mixer will be 1/12 of the difference frequency between the aural and visual carrier or 375 kc.

The 375-kc signal combines with the output of a 6J6 crystal oscillator in a second mixer. The sum of these two frequencies is amplified and fed to a chain of three dividers with a total division of 100. This amount of division is necessary in order to reduce the swing at the frequency detector to a point where the carrier will not drop out under any conditions of modulation of the aural transmitter. A crystal controlled reference frequency is also fed to the frequency detector. By making the 6J6 crystal oscillator serve both as a heterodyne oscillator and as a frequency reference source, considerable improvement in frequency control accuracy can be obtained.

Three dividers with a total division of 80 are also employed in the reference frequency circuit. The frequency detector is essentially a balanced modulator with a d-c component in the output which will change polarity depending upon whether the signal frequency is above or below the reference frequency. This d-c voltage is fed back to one of the reactance tubes for the master oscillator in such a way as to correct the frequency of the master oscillator. A frequency interlock circuit connected to the outputs of the two divider chains will prevent the application of plate power to the power amplifiers until the frequency control circuit is locked in.

I. P. A. and Modulated Amplifier Stages

The aural and visual outputs of the common exciter are fed to separate 4-65A amplifiers (channels 2-6) or triplers (channels 7-13). The output of these stages is at the output carrier frequency and at a power level sufficient to drive the 4X150A amplifier stages in the respective chain. The 4-65A stages are identical, simplifying maintenance and spare part requirements. The 4X150A visual amplifier is grid modulated, and has an output circuit bandwidth suitable for color TV transmission. The aural output stage is also a 4X150A and is conventional throughout. It utilizes many identical parts used in the visual output, again simplifying maintenance and spare part requirements. A reflectometer is included in each output transmission line for both aural and visual transmitters. Both aural and visual outputs appear at a standard 51.5 ohm RG 8/u fitting.

The modulator in the visual portion is a straight-forward three stage video amplifier. The amplitude response, as well as other characteristics such as differential phase, are designed to handle color TV signals.

SPECIFICATIONS

Performance Specifications

	Visual	*Aural*
Type of Emission	A-5	F-3
Frequency Range	Ch. 2-13	Ch. 2-13
Rated Power Output (measured at output fitting)	100 W (Peak)	50 W.
RF Output Impedance (RG-8/U fitting)	51.5 ohms	51.5 ohms
Input Impedance	75 ohms	600/150 ohms
Input Level	1 v. p. to p. min.	10 ±2 dbm
Amplitude vs. Frequency Response	Will meet FCC color specs. (see note)	Uniform ±1 db to 15 kc
Carrier Frequency Stability	±1 kc	±1 kc*
Modulation Capability	12.5 ±2½%	±50 kc
Audio Frequency Distortion		1.5% 50-100 cps 1.0% 100-7500 cps 1.5% 7500-15,000 cps
FM Noise Below ±25 kc		—60 db
AM Noise	—45 db	—50 db
Amplitude Variation Over One Picture Frame	5% of sync peak voltage level	
Regulation of Output	7% maximum	

Electrical Specifications

Power Line Requirements:

Line	107/117 v. 1 ph., 60 cps
Slow Variations	±5%
Rapid Variations	±3%
Power Consumption	1500 W.
P.F. (approx.)	90%
Maximum Altitude	7500 ft.
Ambient Temperature	0°C—45°C

* Maximum variation with respect to 4.5 mc separation between visual and aural carrier frequencies.

Note: Sideband and harmonic filters not furnished as part of transmitter. The transmitter will meet FCC color visual pass band performance specifications when normal transmitter color input equipment auxiliaries are included (color stab. amplifier, phase equalizers, etc.).

Tube Complement

Type	*Function*	*Qty.*
6V6	Reactance Tube Modulator	2
6V6	FM Master Oscillator	1
5763	1st Aural Multiplier	1
5763	2nd Aural Multiplier	1
5763	3rd Aural Multiplier	1
5763	Amplifier—Aural Output	1
6AS6	1st Mixer	1
6AS6	2nd Mixer	1
6AQ5	Amplifier—Difference Frequency	1
6AC7	1st Difference Frequency Divider	1
6AC7	2nd Difference Frequency Divider	1
6AC7	3rd Difference Frequency Divider	1
6J6	Crystal Oscillator—Reference Frequency	1
6AC7	1st Reference Frequency Divider	1
6AC7	2nd Reference Frequency Divider	1
6AC7	3rd Reference Frequency Divider	1
12AT7	Cathode Follower—Frequency Detector Drive	1
6AK5	Visual Crystal Oscillator #1	1
6AK5	Visual Crystal Oscillator #2	1
5763	Buffer Amplifier	1
5763	1st Visual Multiplier	1
5763	2nd Visual Multiplier	1
5763	3rd Visual Multiplier	1
5763	Amplifier—Visual Output	1
OD3	Voltage Regulator	1
2D21	Off-Frequency Interlock Control	1
6AS6	Off-Frequency Detector	1
4-65	I. P. A.	2
4X150	Modulator and R-F Amplifier	2
6CL6	Video Amplifier	2
807	Modulator	2

Mechanical Specifications

Height	84⅞"
Width	28"
Depth (less door handle)	20½"
Weight	600 lbs. (approx.)

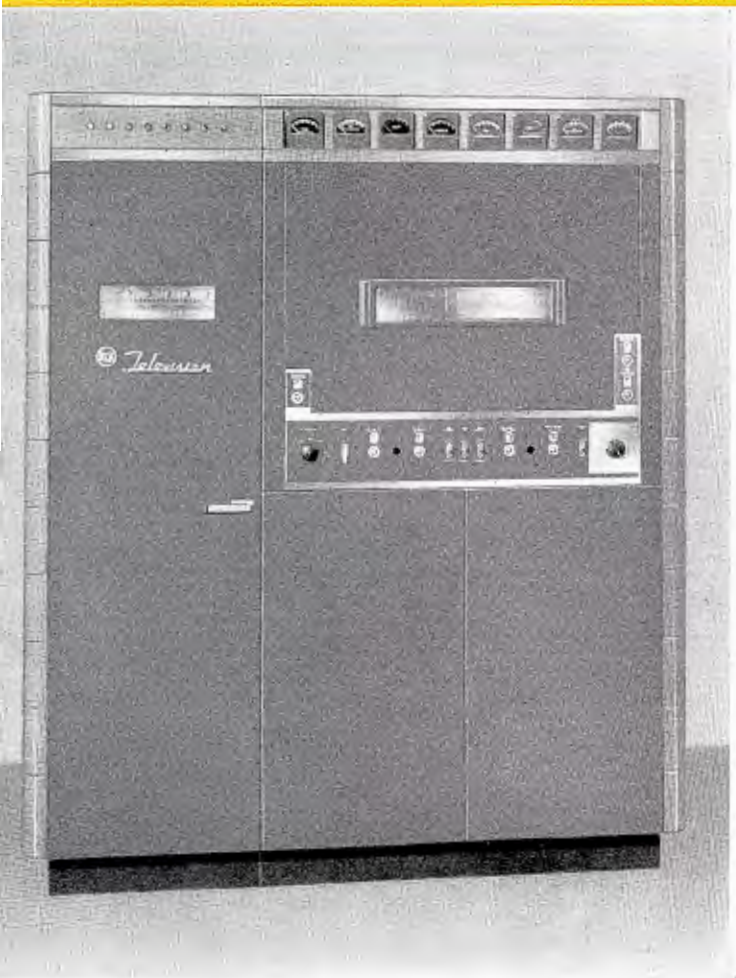
Equipment Supplied

TTL-100A Transmitter complete in cabinet. Order as:

ES-19238	For Channels 2 - 6
ES-19239	For Channels 7-13

2 KW VHF TV TRANSMITTER

TYPE TT-2BL



FEATURES

- Designed for color—linearity correction circuits built into modulator
- New compact, floor-saving cabinet design —yet offering excellent accessibility to all components
- Designed for color—built-in linearity correction circuits
- Single ended r-f circuits reduce number of tubes and circuit components
- Power increase possible with minimum change to existing equipment
- New common visual and aural exciter includes inter-carrier frequency control which accurately maintains frequency separation between aural and visual carriers
- Complete overload protection with indication lights grouped for quick location of faulty circuits
- Sloping illuminated meter panel
- Thermostatically controlled heaters provided for rectifier tubes allowing operation at low ambient temperatures

USES

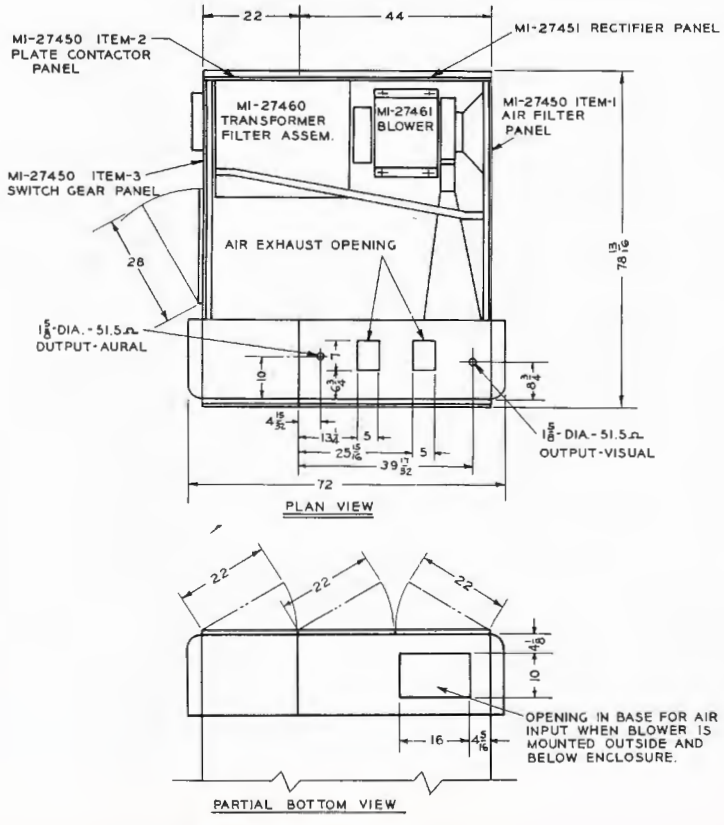
The TT-2BL VHF Television Transmitter is designed for television stations with effective radiated power requirements ranging from 2 to 20 kilowatts. This economical, low-power transmitter will provide adequate signal strength to meet a wide range of television broadcast requirements either in color or monochrome. It is designed for operation on any channel from 2 to 6 and works equally well with both RCA low and high gain type antennas. High power amplifiers may be added to the transmitter with a minimum of changes to convert it to a 6 or 25 kilowatt transmitter.

Remote control as well as local operation is an added feature of the new RCA transmitter. If and when the FCC authorizes remote control for television transmitters, the TT-2BL can, with the addition of suitable terminal equipment, be operated from a remote location over a single telephone line. All the necessary operating functions such as starting and stopping the transmitter, resetting overloads, switching in the spare crystal or spare exciter, metering all power circuits and reflectometers, controlling power output (including black level, video gain, and excitation) can be performed at the remote location. Even when the transmitter is not remotely controlled, these built-in features make it very easy to obtain fingertip control of the transmitter from a single local position such as the transmitter console.

DESCRIPTION

The RCA Type TT-2BL VHF Television Transmitter is designed to conform with all FCC and RETMA standards. It will provide a nominal power output of 2 kilowatts peak visual power as measured at the output of the sideband filter or filterplexer and 1.05 kw aural power. The transmitter is designed to operate on any specified channel between channel 2 and 6.

The transmitter is housed in a newly-styled cabinet having only one access door. The cabinet can be broken down for shipping into racks and panels of varying size for easy handling. The entire equipment is compact, easily accessible, and requires but a minimum of floor space. All r-f circuit and control units are located at the front of the enclosure, the rectified tubes are mounted on the rear wall and the heavy power components are mounted on the floor. The control unit is at the extreme left of the front end of the transmitter in a separate cabinet with status lights grouped on a panel above the door. The auxiliary switches, breakers, overload and auxiliary relays, etc. are located behind a non-interlock door. Overload indicating lights for all the circuits of the transmitter are grouped on a single strip so they can be seen through the window in the door.



Typical floor plan for the TT-2BL VHF Transmitter showing compact equipment unit and rectifier enclosure.

To the right of the control unit is the r-f rack. It contains both the aural and visual drivers as well as the exciter and modulator units. The modulator and exciter units are located at the bottom of the rack behind dutch doors, hinged at the bottom to facilitate servicing from the front of the transmitter. All important meters of the TT-2BL are mounted in a sloping panel at the top of the r-f rack. Built-in lights in the bottom of the meter panel provide illumination. Tuning controls for the high level stages are located just above the doors. These include all the tuning controls required for broadbanding the visual r-f circuit. Tuning controls are operated by a crank which is removable to prevent accidental misadjustment of the circuits during operation. An easily read counter dial enables accurate logging of all the circuits. Also located on the panel above the doors are all the operating controls such as the transmitter start switch, plate switch, power operating controls and metering switches.

A single access door on the left end of the transmitter provides access to the rear of the control racks and r-f racks as well as the rectifier mounted on the rear wall of the enclosure. This rectifier has thermostatically controlled heaters for the rectifier tubes which permits operation of the transmitter in ambient temperatures as low as 0° C. All heavy units such as the plate transformers and large reactors are mounted on a base plate on the floor.

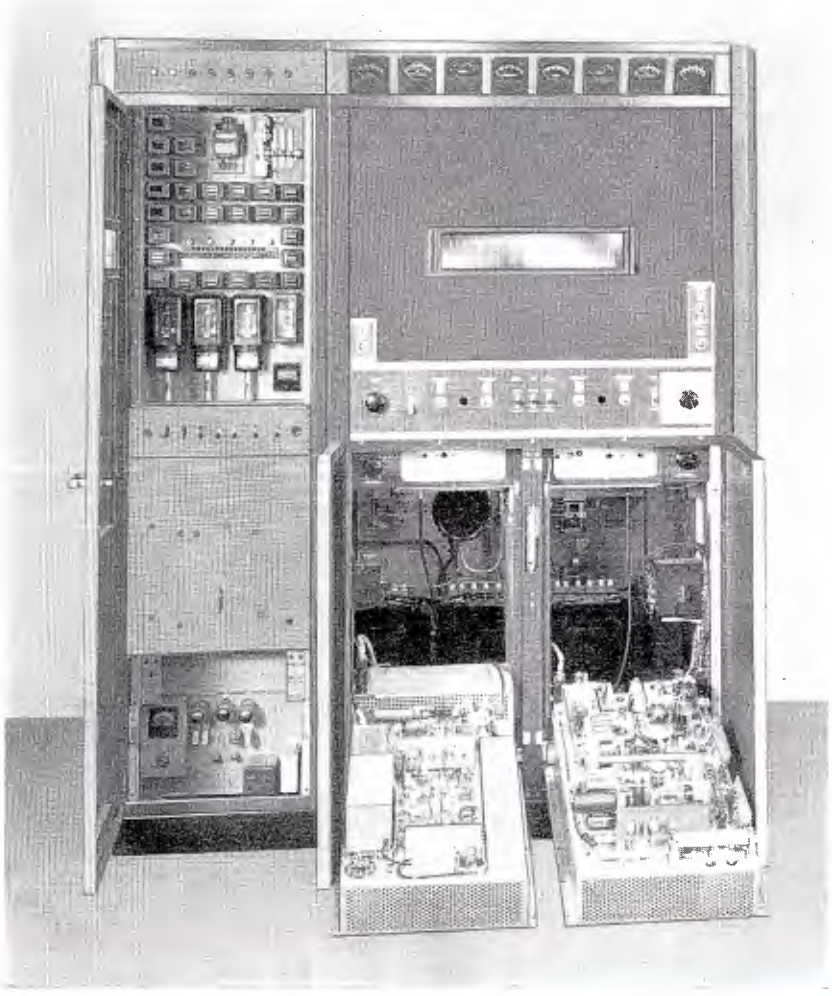
Since all operating controls and important adjustments are brought out to the front of the transmitter, it should not be necessary to enter the enclosure while power is on. Every precaution has been taken to insure the operator's safety when it is necessary to enter the enclosure for routine maintenance and service. In addition to the conventional plate inter-lock and high voltage grounding switches, the high voltage plate transformer disconnect switch is fitted with a long handle which extends across the door opening. This makes it difficult to enter the enclosure without opening the primary of the high voltage transformer. The versatility of the new transmitter cabinets is seen in the floor plans.

Circuit Description

The visual and aural exciter circuits of the TT-2BL are mounted on a single chassis. Two separate crystal oscillators are employed. This allows switching from a remote point by a relay in the d-c circuit. No relays are then

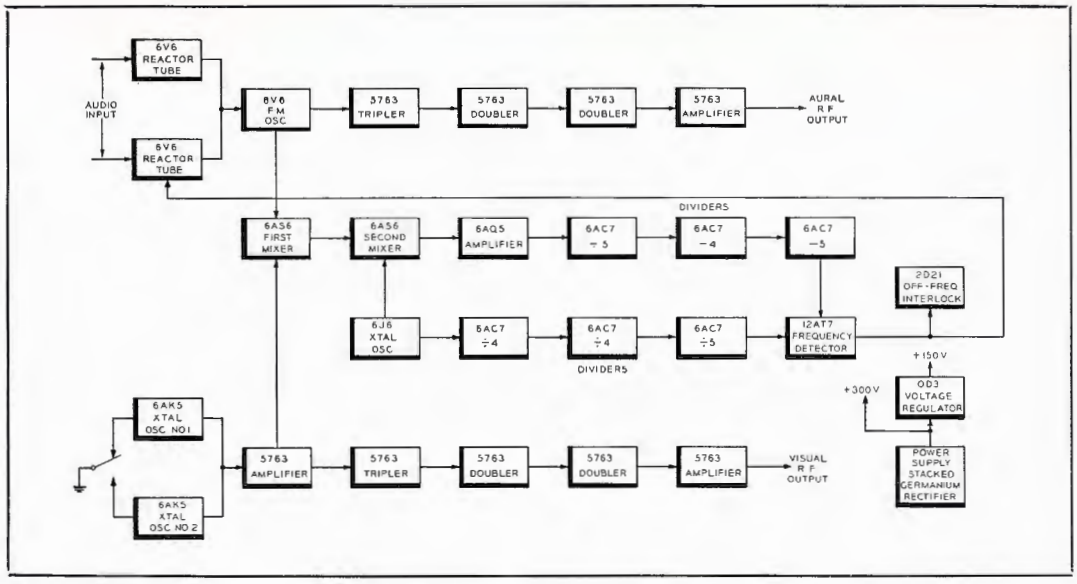
necessary in the r-f circuit. A special 5763 buffer amplifier allows the crystal oscillators to be operated at a low level. This reduces internal heating of the crystal and allows the oscillator frequency to stabilize very quickly after the plate power is applied. The buffer stage is followed by a tripler, two doublers, and an amplifier, all using 5763 tubes. The output power of the exciter is approximately 5 watts at the carrier frequency. The aural chain starts with a 6V6 master oscillator frequency modulated by two more 6V6 reactance tubes. The multipliers and amplifiers which follow the master oscillator are identical to those used in the visual side. A unique feature of this exciter is the frequency control circuit for the aural master oscillator. This circuit is designed to accurately maintain the difference between the aural and visual carrier frequencies. This is accomplished by feeding a small amount of the energy from the aural and visual oscillators to a 6AS6 mixer tube. When the aural oscillator is on frequency the output of this mixer will be 1/12 of the difference frequency between the aural and visual carrier or 375 kc. This 375-kc signal combines with the output of a 6J6 crystal oscillator in a second mixer. The sum of these two frequencies is amplified and fed to a chain of three dividers with a total division of 100. This amount of division is necessary in order to reduce the swing at the frequency detector to a point where the carrier will not drop out under any conditions of modulation of the aural transmitter. A crystal control reference frequency is also fed to the frequency detector. By making the 6J6 crystal oscillator function both as a heterodyne oscillator and as a frequency reference source, considerable improvement in frequency control accuracy is obtained. Three dividers with a total division of 80 are also employed in the reference frequency circuit. The frequency detector is essentially a balanced modulator with a d-c component in the output which will change polarity depending upon whether the signal frequency is above or below the reference frequency. This d-c voltage is fed back to one of the reactance tubes for the master oscillator in such a way as to correct the frequency of the master oscillator. A frequency interlock circuit connected to the output of the frequency detector will prevent the application of plate power to the power amplifiers until the frequency control circuit is locked in.

Front view of the TT-2BL Transmitter with control cabinet door open, and exciter and modulator units on accessible hinged chassis lowered to facilitate servicing.



R-F Circuits

The r-f circuits employ a chain of amplifiers. In the visual chain a 4-65A tube and a 4-250A tube operating in cascade drive a type 6076 grid modulated power amplifier. The aural chain consists of two stages: a 4-65A and a 4-1000A tube, both operating as class "C" amplifiers. A single high-voltage rectifier employing six type 673 tubes supplies the plate power for all the high level tubes in both the aural and visual r-f chains. A single low-voltage rectifier employing two type 866A tubes supplies the screen voltage for all the stages. Excitation for the visual modulated amplifier is controlled by varying the screen voltage on the 4-250A stage. Power output of the aural transmitter is adjusted by varying the screen voltage on the 4-1000A stage.



Block diagram showing combined aural and visual exciter for the TT-2BL.

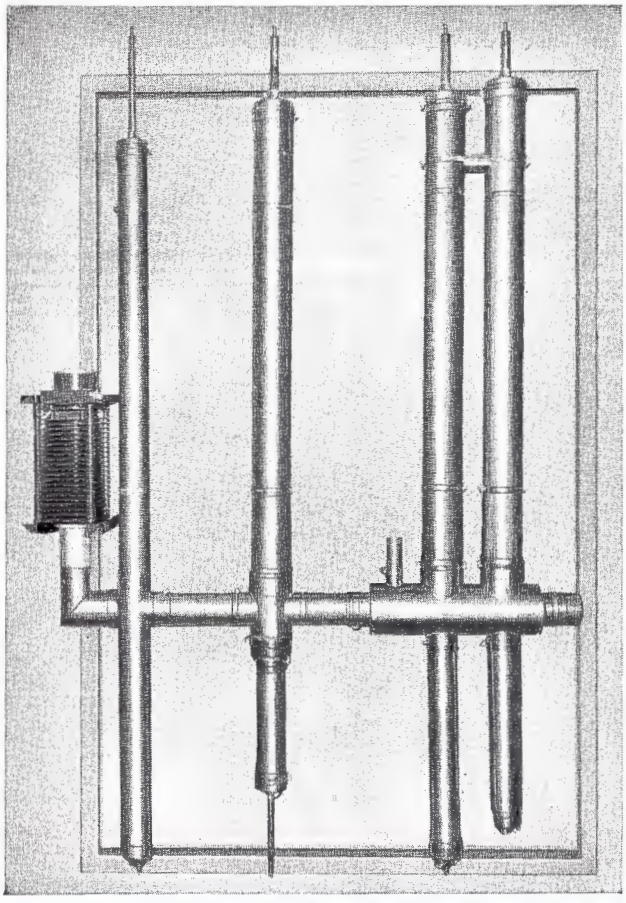
Both these controls are operated by motors and therefore can be adjusted from a remote position.

Modulator

The modulator of the transmitter is designed to take a standard 1 volt video signal and amplify it sufficiently so that it can grid modulate the 6076 stage. This requires about 250 volts peak-to-peak from the modulator. The first stage of the modulator is a conventional shunt-series peak video amplifier. This is followed by an inverter stage and a linearity corrector stage each of which has a gain of approximately one. The linearity corrector is designed to pre-distort the signal to compensate for the non-linearity which always occurs in a grid modulated stage, and takes the form of four diodes connected in the cathode circuit of that stage. The bias voltage on each diode is separately adjustable and can be made to start conducting at any brightness level. The grid of this stage is clamped in order to insure the same correction to the linearity characteristic regardless of the average brightness of the picture signal.

The linearity corrector is followed by a second video amplifier using a 6AG7 tube and by a third video amplifier consisting of two 807 tubes. The grids of the third video amplifier are also clamped and from this point on the circuit is d-c coupled. The output stage is a shunt regulated cathode follower. It consists of two 6146 tubes connected in a circuit very similar to a conventional cathode follower stage. The cathode resistor has been replaced by three 6146 tubes operating in parallel. The grid of these three tubes are fed with a signal from the plate load from the two cathode follower tubes. This essentially makes the circuit a feedback amplifier of high efficiency capable of

The new M-derived vestigial sideband filter, ES-27243, designed for the TT-2BL Transmitter.



delivering modulation at a high level to a large capacity load.

The modulated stage is followed by a bucking bias supply consisting of one 6BL7-GT and three OA2 tubes. This serves to transfer the signal from the positive voltage present in the output of the modulator stage to the negative voltage required to modulate the 6076 tubes without losing the d-c component. Back porch clamping is employed. A carefully designed sync separator and clipper circuit provides reliable clamping even with greatly degraded input signal.

A two stage monitor amplifier is employed. It can be noted from the block diagram that this monitor amplifier can be switched to many parts of the circuit, greatly aiding in making adjustments and in servicing. Plate power for all the stages in the modulator is obtained from two electronic regulators. One supplies approximately 250 volts and the other approximately 475 volts. Although the rectifier itself is remotely located on the rear wall of the transmitter enclosure the regulators are mounted on the same chassis as the video circuit in the modulator. This greatly reduces the possibility of obtaining unwanted video resonances.

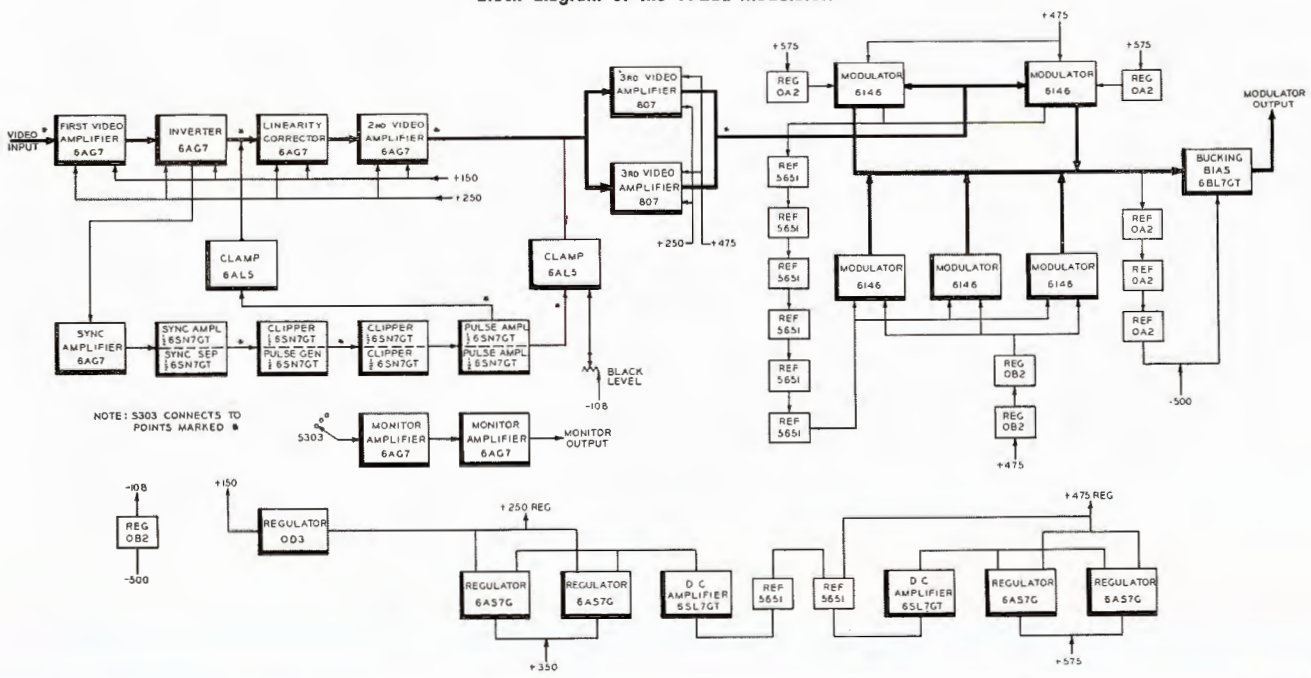
Power and Control Equipment

Wherever possible the same d-c power supplies in this transmitter were used for both the visual and aural amplifiers. This greatly reduces the number of components in the transmitter and allows operation of the complete equipment with only four power supplies as follows: An exciter supply built into the common exciter unit using stack germanium diodes; a 700 volt low voltage rectifier, using two 866-A tubes, which supplies the screen voltage for all the pentode amplifiers; a 3600 volt high voltage supply using six 673 tubes in a 3 phase full wave circuit; and the modulator and the bias supply, using two 866-A tubes and one 5R4GY tube, which supplies the plate voltage for the modulator and the bias for all the r-f stages.

A single integrated control circuit is provided for both the visual and aural transmitter. The blower, filaments, and each rectifier is protected by thermal overloads which can be adjusted to reset automatically. In addition, a main line breaker and an auxiliary are provided. This includes both thermal and magnetic trips. The primaries of the high voltage rectifier and each power amplifier tube including the 4-65A stages are protected by instantaneous d-c overloads which automatically recycle twice. If the fault continues on the third try the overload circuit will remain tripped until reset. Overload indicator lights are provided for each circuit. These lights have a separate reset and will remain on after the first overload thus providing a record of the circuit giving trouble even though it is intermittent.

The equipment includes a line corrector which provides an adjustable line voltage to the filament primaries, the exciter, the modulator, and the low voltage rectifiers. Automatic filament line voltage regulators and automatic regulators capable of handling the complete transmitter are available as optional items. In localities troubled with ex-

Block diagram of the TT-2BL Modulator.



cessive instantaneous line voltage fluctuation, and electronically controlled regulator for the low voltage supply is available as optional equipment.

Special Protective Circuits

The TT-2BL has reflectometer units for connecting in the output transmission lines of both the aural and visual amplifiers. Each unit contains a 6AL5 diode detector. The transmission line probes are installed so as to give an indication of the amount of power on meters on the front panel. Reflected power can be read by manually rotating the reflectometer heads.

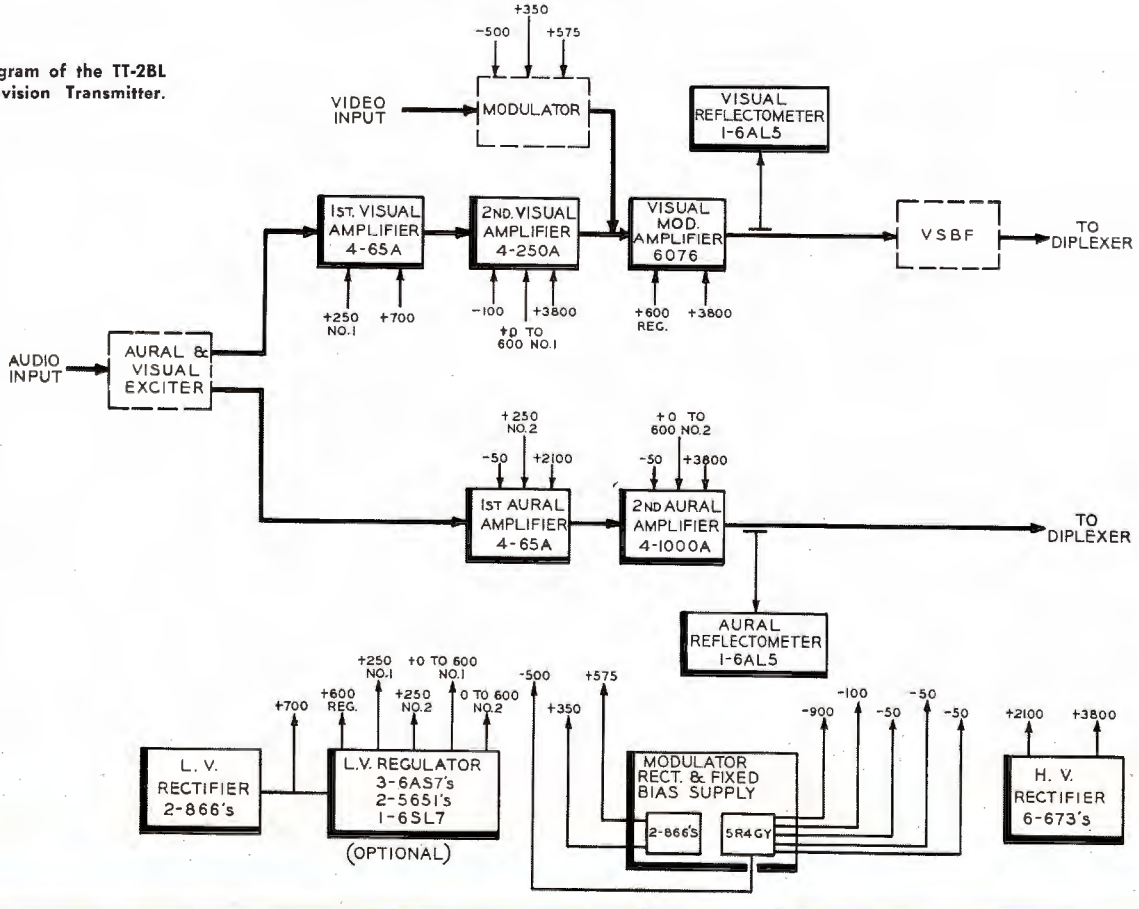
A carrier-off monitor is available as optional equipment. It acts in conjunction with the reflectometer units and is particularly useful for remote control. This unit will remove the plate voltage from all the r-f stages if the output level drops below a predetermined value, such as would be the case if an r-f arc occurred in any of the r-f stages. Sometimes such an arc does not change the plate current sufficiently to trip the d-c overload relays.

Harmonic Filter

Harmonic filters are supplied for insertion in the output transmission line. When operated in conjunction with the TT-2BL Transmitter these filters are designed to attenuate all harmonics to a value at least 60 db below the peak carrier level. Electrically, each filter consists of an M-derived half-T section, several low pass filter sections, and a constant-K half-T section. The M-derived section provides rapid cut-off in the second harmonic region and a termination impedance at one end of the filter is 51.5 ohms. Attenuation of the harmonics is accomplished by a low pass filter section, while the constant-K section serves to give termination impedance of 51.5 ohms at the other end of the unit.

A low pass filter is provided for insertion in the video input circuit. This filter attenuates all video frequencies above 4.75 megacycles at least 20 db. An all-pass phase equalizer is also included as part of the low pass filter. This equalizer corrects any phase distortion which may be introduced as a result of the sharp cut-off.

A vestigial sideband filter is furnished completely assembled and adjusted for any one of the low band VHF television channels. This filter is an integral unit designed for floor, ceiling, or wall mounting near the visual transmitter so that the input transmission line is as short as possible. The filter sections consist of lengths of coaxial line (resonant cavities), which are adjustable for tuning purposes. As the filter is pre-tuned at the factory to the channel stamped on the name plate, no operating adjustments are necessary.



Block diagram of the TT-2BL VHF Television Transmitter.

SPECIFICATIONS

Performance Specifications

	Visual	*Aural*
Type of Emission	A5	F3
Frequency Range	Ch. 2-6	Ch. 2-6
Rated Power Output	2 kw[1]	1.05 kw[2]
Minimum Power Output	1 kw[1]	.5 kw[2]
R.F. Output Impedance	51.5 ohms	51.5 ohms
Input Impedance	75 ohms	600/150 ohms
Input Level	.7 v. pk. to pk. min.	+10 ±2 dbm
Amplitude vs. Frequency Response		Uniform ±1 db from 50 to 15,000 cycles
Upper Sideband Response[3]		
+1, −1.5 db at carrier	plus 0.5 mc.	
+1, −1.5 db at carrier	plus 1.25 mc.	
+1, −1.5 db at carrier	plus 2.0 mc.	
+1, −1.5 db at carrier	plus 3.0 mc.	
+1, −1.5 db at carrier	plus 3.58 mc.	
+1, −3.0 db at carrier	plus 4.18 mc.	
−20 db max. at carrier	plus 4.75 mc.	
Lower Sideband Response[4]		
+1, −1.5 db at carrier	minus 0.5 mc.	
−20 db max. at carrier	minus 1.25 mc.	
−42 db max. at carrier	minus 3.58 mc.	
Variation in Freq. Response with Brightness[5]	±1.5 db	
Carrier Frequency Stability[6]	±1 kc	±500 cycle[7]
Modulation Capability	12.5 ±2.5% (reference white)	±50 kc
Audio Frequency Distortion		1.5% max. 50-100 cycles 1.0% max. 100-7500 cycles 1.5% max. 7500-15,000 cycles
FM Noise, below ±25 kc Swing		60 db
AM Noise, r.m.s.	40 db below 100% mod.	50 db below carrier

	Visual	*Aural*
Amplitude Variation Over One Picture Frame	Less than 5% of the peak of sync level	
Regulation of Output	7% max.	
Burst vs. Subcarrier Phase[8]	±5 degrees max.	
Subcarrier Phase vs. Brightness[9]	±7 degrees max.	
Subcarrier Amplitude[8]	±10% max.	
Linearity (Differential Gain)[10]	±15% max.	
Envelope Delay vs. Frequency[11]	±.08 μsec. from 0.2 to 2.1 mc ±0.4 μsec. at 3.58 mc ±.08 μsec. at 4.18 mc	
Harmonic Attenuation, ratio of any single harmonic to peak visual fundamental	At least 60 db	At least 60 db

Electrical Specifications

Power Line Requirements:

Transmitter:

Line	230/208 volts, 3 phase, 50/60 cycle
Slow Line Variations	±5% max.
Rapid Line Variations	±3% max.
Regulation	3% max.
Power Consumption	11 kw (black pix) 10 kw (average pix)
Power Factor (approx.)	90%

Crystal Heaters:

Line	115 volts, 1 phase, 50/60 cycle
Power Consumption	28 watts

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[1] Measured at the output of the sideband filter or filterplexer.

[2] Measured at the input to the diplexer or filterplexer.

[3] With respect to the response at 200 kc, as measured by the BW-5A Sideband Response Analyzer at transmitter mid-characteristic. 4.75 mc attenuation requires use of MI-27132 LP filter in the video input circuit.

[4] With respect to the response at 200 kc at transmitter mid-characteristic.

[5] Maximum variation with respect to the response at mid-characteristic measured with the BW-5A Sideband Response Analyzer at brightness levels of 22.5% and 67.5% of sync peak, using approximately 20% (peak to peak) modulation.

[6] Maximum variation for a period of 30 days without circuit adjustment.

[7] Maximum variation with respect to the standard 4.5 mc separation between aural and visual carriers.

[8] Maximum departure from the theoretical when reproducing saturated primary colors and their complements at 75% amplitude.

[9] Maximum phase difference with respect to burst, measured after the VSBF, for any brightness level between 75% and 15% of the sync peak using 10% (peak to peak) modulation. This is equivalent to 5% (peak to peak) modulation as indicated by a conventional diode demodulator.

[10] Maximum variation in the amplitude of a 3.58 mc sine wave modulating signal as the brightness level is varied between 75% and 15% of sync peak. The gain shall be adjusted for 10% (peak to peak) modulation of the 3.58 mc signal when the brightness is at pedestal level. This is equivalent to 5% (peak to peak) modulation as indicated by a conventional diode demodulator connected after the VSBF.

[11] Maximum departure from standard curve. The tolerances vary linearily between 2.1 and 3.58 mc and between 3.58 and 4.18 mc. To meet the specification a properly terminated phase correction network, ES-34043, is required in the video input circuit of the transmitter.

SPECIFICATIONS (Cont'd)

Tube Complement

VISUAL SECTION

Qty.	Function	Type
1	Visual Crystal Oscillator #1	6AK5
1	Visual Crystal Oscillator #2	6AK5
1	1st Visual Amplifier	5763
1	1st Visual Multiplier	5763
1	2nd Visuol Multiplier	5763
1	3rd Visual Multiplier	5763
1	Amplifier-Visual Output	5763
1	1st Visual Amplifier	4-65A
1	2nd Visual Amplifier	4-250A
1	1st Video Amplifier	6AG7
1	Inverter	6AG7
1	Linearity Corrector	6AG7
1	2nd Video Amplifier	6AG7
2	3rd Video Amplifier	807
5	Modulator	6146
1	Bucking Bias	6BL7-GT
1	1st Sync Amplifier	6AG7
1	2nd Sync Amplifier-Sync Separator	6SN7-GT
1	Sync Clipper-Pulse Generator	6SN7-GT
1	Sync Clipper-Pulse Clipper-Pulse Generator	6SN7-GT
1	Pulse Output	6SN7-GT
2	Clamp Diode	6AL5
6	Voltage Reference Tubes (D-C Coupling)	5651
1	Bias Regulator	OB2
2	Regulators (Modulator Screens)	OA2
2	Regulators (Modulator Screens)	OB2
3	Voltage Reference Tubes (Bucking Bias)	OA2
2	Voltage Reference Tubes (L.V. and H.V. Regulators)	5651
1	D-C Amplifier (High Voltage Regulator)	6SL7-GT
2	Series Regulators (Low Voltage Regulator)	6AS7-G
1	D-C Amplifier (Low Voltage Regulator)	6SL7-GT
2	Series Regulators (High Voltage Regulator)	6AS7-G
1	150 V Regulator	OD3
1	Monitor Amplifier	6AC7
1	Monitor Amplifier (Output)	6AG7
1	Visual Modulated Amplifier	6076
1	Visual Driver Reflectometer	6AL5

AURAL SECTION

2	Reactance Tube Modulator	6V6
1	FM Master Oscillator	6V6
1	1st Aural Multiplier	5763
1	2nd Aural Multiplier	5763
1	3rd Aural Multiplier	5763
1	Amplifier-Aural Output	5763
1	1st Mixer	6AS6
1	2nd Mixer	6AS6
1	Amplifier-Difference Frequency	6AQ5
1	1st Difference Frequency Divider	6AC7
1	2nd Difference Frequency Divider	6AC7
1	3rd Difference Frequency Divider	6AC7
1	Crystal Oscillator-Reference Frequency	6J6
1	1st Reference Frequency Divider	6AC7
1	2nd Reference Frequency Divider	6AC7
1	3rd Reference Frequency Divider	6AC7
1	Cathode Follower-Frequency Detector Drive	12AT7
1	1st Aural Amplifier	4-65A
1	2nd Aural Amplifier	4-1000A
1	Aural Driver Reflectometer	6AL5

COMMON POWER SUPPLY, ETC.

1	Voltage Regulator	OD3
1	Off-Frequency Interlock Control	2D21
2	Low Voltage Rectifiers	866
2	Modulated Rectifiers	866
1	Modulated Rectifier	5R4GY
6	High Voltage Rectifiers	673

Qty.	Function	Type
†1	D-C Amplifier (Low Voltage Regulator)	6SL7
†2	Voltage Reference Tubes (Low Voltage Regulator)	5651
†3	Series Regulators (Low Voltage Rectifier)	6AS7
†2	Regulators (Carrier-Off Monitor)	OD3
†4	Amplifiers (Carrier-Off Monitor)	12AU7

Mechanical Specifications

Dimensions:
- Overall Length (front line cabinets only) ..... 72"
- Overall Height (front line cabinets only) ..... 84"
- Depth (front line cabinets only) ..... 20"
- Overoll Depth ..... 78 13/16"

Weight ..... 3600 lbs.
Finish ..... Two-tone umber gray, polished stainless steel trim
Maximum Altitude[1] ..... 7500 ft.
Ambient Temperature ..... 45° C. max., 0° C. min.

Equipment Supplied

TT-2BL TELEVISION TRANSMITTER (ES-19286)

Qty.	Description	Stock No.
1	Control Unit	MI-27180
1	2-KW Unit	MI-27181
1	Set of Panels	MI-27450
1	Rectifier Panel	MI-27451
1	Transformer-Filter Assembly	MI-27460
1	Transformer	MI-27479
1	Blower	MI-27461
1	Installation Material	MI-27462
1	Wiring Material	MI-27463
2	Reflectometers	MI-27464
1	Monitoring Diode	MI-19051-B
2	Harmonic Filter	MI-27317[2]
1	Vestigial Sideband Filter	
1	4.75 MC Low Pass Filter	MI-27132
2	Side Panels (End Shields)	MI-30541-G84
1	Finish Touch-Up Kit	MI-27153
1	Miscellaneous Hardware Kit	MI-7474
1	Set of Frequency Determining Ports	MI-27482[2]
2	Crystal Unit (Visual)	MI-27492[2]
1	Set of Operating Tubes	ES-27201
*	Transmission Line (*Sales order must specify quantity for installation requirements)	MI-19113-B
1	Line Corrector	MI-27478
1	Nameplate	MI-28180-1
2	Instruction Book	IB-36280

Optional or Accessory Equipment

TTC-1C Control Console Equipment, with moster monitor but less master monitor power supply	MI-19240-A
R-F Load and Wottmeter	MI-19196-L
Complete Set of Spare Tubes	ES-27201
FCC Spare Set of Tubes	ES-27202
Input and Monitoring Equipment, Wired/Unwired	ES-19237-A/B
50 Cycle Conversion Kit	MI-27485
Line Regulator (single phase)	MI-27472
Line Regulator Control Panel	MI-27471
Rectifier Enclosure	ES-19285
Low Voltage Regulator	MI-27469
Carrier-Off Monitor	MI-27470
BW-5A Sideband Response Analyzer	ES-34010
Plate Current Meter	MI-21200-C1
WM-71A Distortion and Noise Meter	MI-30071-A
TO-524-D Oscilloscope	MI-26500

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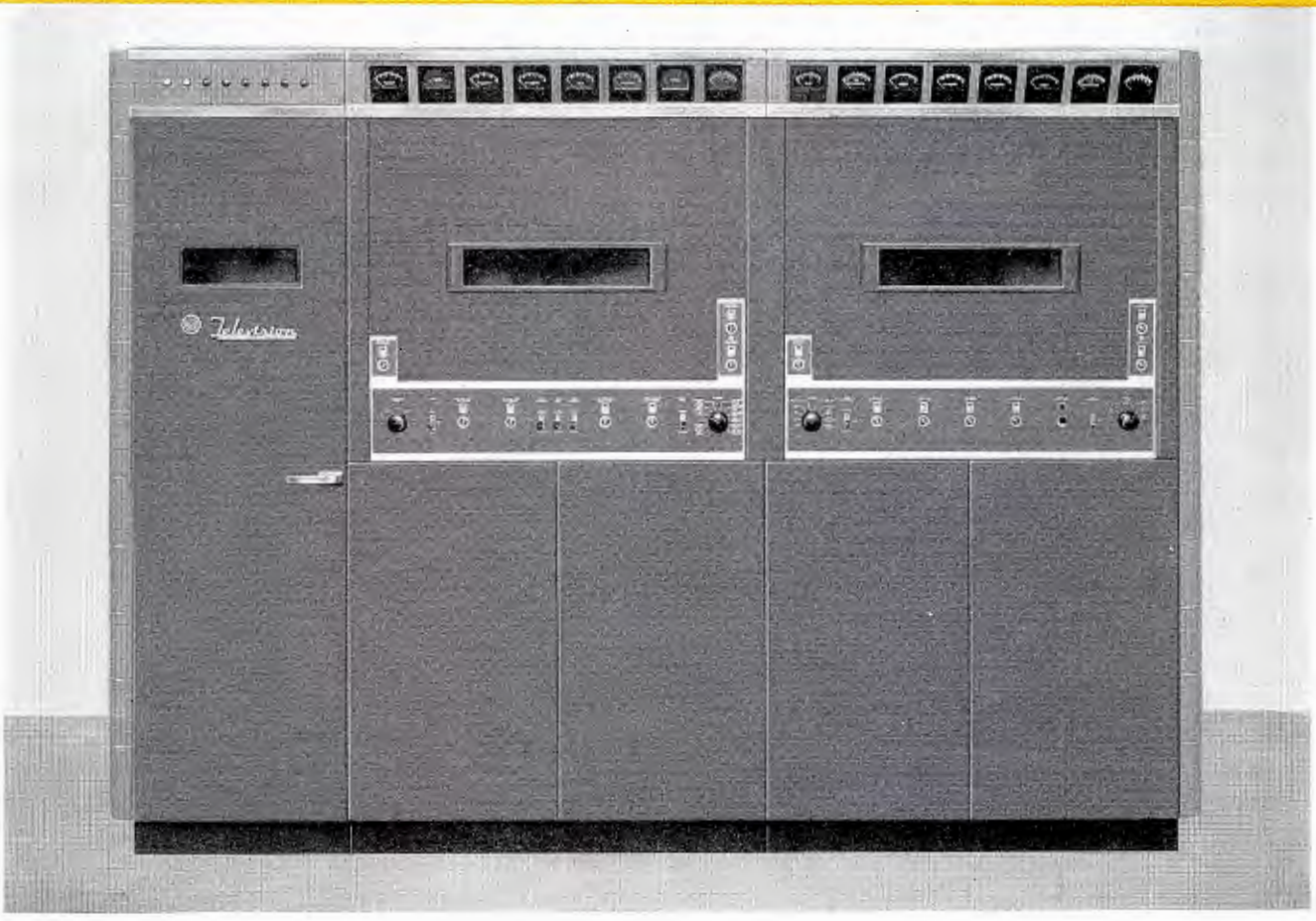
† Tubes for optional Low Voltage Regulator and Carrier-Off Monitor Equipment.
[1] For operation at rated power and normol plate voltoge.
[2] Order to suit customer's assigned channel.

VHF TV TRANSMITTER

6 KW VHF, TYPE TT-6AL



FEATURES

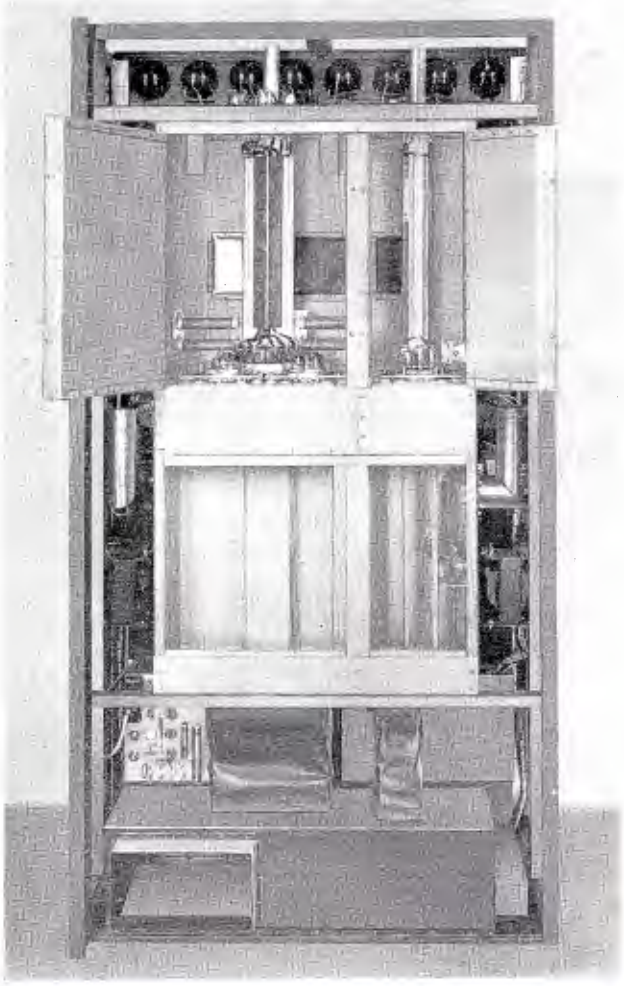
- Compact floor plan—new design cuts size of floor space required for transmitting stations
- Designed for color—linearity correction circuits built into modulator
- Low cabinet radiation—all leads from R-F compartment coupled through specially designed feed-through filters
- Uses Type 5762 air-cooled tubes, famous for long life and reliability
- Broadbanding tuning controls accessible without opening any doors
- Power increase can be made with minimum change to existing equipment
- Inter-carrier frequency control accurately maintains frequency separation between aural and visual carriers necessary for color transmission
- Thermostatically controlled heaters provided for rectifier tubes allowing operation at low ambient temperature
- Excellent accessibility
- Includes motor operated power output controls and shunts for external metering circuits
- Sloping and illuminated meter panels
- Complete overload protection with indicating lights grouped for quick location of faulty circuits

USES

The new RCA Type TT-6AL VHF Television Transmitter is designed for television stations with effective radiated power requirements ranging from 5 to 50 killowatts. It is an ideal medium power equipment for telecasting either in monochrome or color, and it is capable of covering large urban communities with a strong signal. This transmitter works equally well with both RCA low and high gain type antennas. High power amplifiers may be added to the TT-6AL with a minimum of changes to convert it to a 25-kilowatt transmitter.

The 6-KW transmitter has been completely restyled to afford a compact unit requiring a minimum of floor space in the transmitting station. All critical circuits such as the modulator and the exciter are completely adjusted from the front of the transmitter, while one interlocked door affords access to all other parts of the transmitter and its component parts. Unitized construction of transmitter and antenna portions of the equipment allow the broadcaster utmost latitude in arrangement layout. Two typical types of installation are shown in accompanying floor diagrams, but numerous variations will suggest themselves to the station engineer.

Rear view of PA unit showing visual and aural amplifiers, visual bias supply, filament transformers and outputs, and air cooling ducts.



Control circuits of the TT-6AL are grouped in separate cabinet with status lights on a panel above the door. Auxiliary switches, breakers, overload and auxiliary relays, and overload indicating lights are located behind door.

The TT-6AL's circuits employ the latest design features and represent economy in operation. Highlighted features include air-cooled tubes such as the 5762, famous for long life and reliability; single ended r-f circuits which greatly reduce number of necessary tubes and circuit components; built-in control relays, motors for operating power output controls, and shunts for external metering circuits; complete overload protection with indicating lights grouped for quick location of faulty circuits, and linearity correction circuits. Thermostatically controlled heaters for the rectifier tubes permit operation of the transmitter in ambient temperatures as low as 0° C. Inter-carrier frequency control accurately maintains frequency separation between aural and visual carriers necessary for color transmission.

Remote control as well as local operation is an added feature of the new RCA transmitter. If and when the FCC authorizes remote control for television transmitters, the TT-6AL can, with the addition of suitable terminal equip-

ment, be operated from a remote location over a single telephone line. All the necessary operating functions such as starting and stopping the transmitter, resetting overloads, switching in the spare crystal or spare exciter, metering all power circuits and reflectometers, controlling power output (including black level, video gain, and excitation) can be performed at the remote location. Even when the transmitter is not remotely controlled, these built-in features make it very easy to obtain fingertip control of the transmitter from a single local position such as the transmitter console.

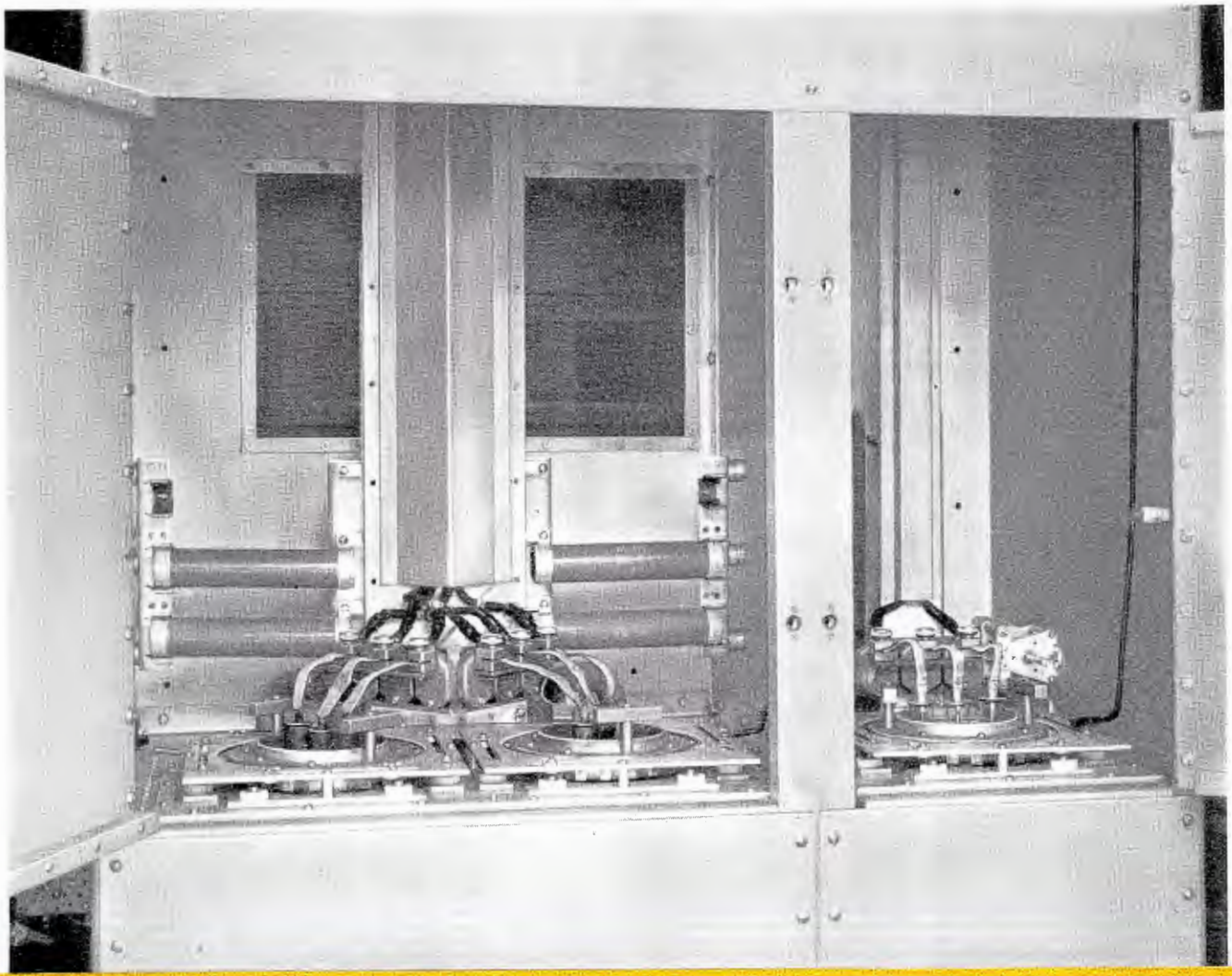
DESCRIPTION

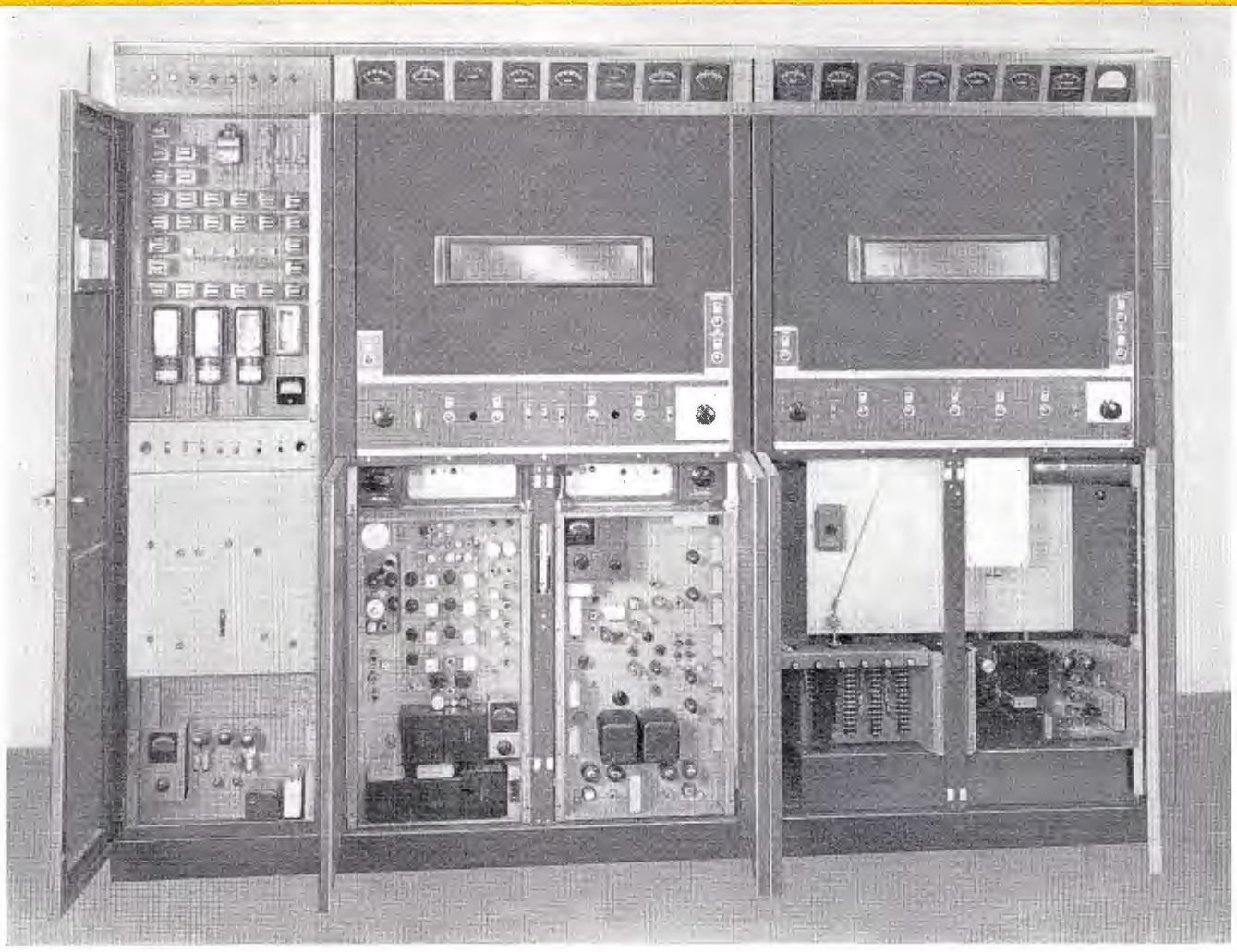
The Type TT-6AL VHF Television Transmitter is designed to conform with all FCC and RETMA standards. It will provide a nominal power output of 6 kilowatts peak visual power measured at the output of the sideband filter or filterplexer and 3.15 KW aural power. It is designed to operate on any specified channel between channel 2 and 6.

The type of enclosure employed for the TT-6AL is unusual and provides a maximum of flexibility in selecting a suitable floor plan in a minimum space. The complete transmitter is housed in what is equivalent to a single cabinet with only one access door. However, it can be broken down for shipping into racks and panels of varying size for easy handling. All r-f circuit and control units are located at the front of the enclosure, thus allowing all essential adjustments to be made with the power on. The rectifier tubes are mounted on the rear wall and the heavy power components are mounted on the floor. The rear of the transmitter housing has no access door so that this side can be mounted directly against a building wall. Where space is limited, the right side of the enclosure can also be mounted against the building wall provided an opening for the air intake is made in the wall opposite the filter.

The control units are grouped at the extreme left of the front end of the transmitter in a separate cabinet with status lights grouped on a panel above the door. The

R-F cabinets open revealing close up of air-cooled 5762 triodes utilized in the PA circuits of the TT-6AL.





Full view of TT-6AL transmitter, cabinet doors open revealing tuning controls and meters, control cabinet (left) 2-KW driver with exciter and modulators on accessible hinged chassis (center), and 6-KW PA cabinet with reflectometer switches and power supplies among lower components (right).

auxiliary switches, breakers, overload and auxiliary relays, etc. are located behind a non-interlock door. Overload indicating lights for all the circuits of the transmitter are grouped on a single strip so that they can be seen through the window in the door.

To the right of the control unit is the low power (2 KW) rack. It contains both the aural and visual drivers as well as the exciter and modulator units and is essentially the same as all the video and r-f circuits of the complete TT-2BL 2 KW VHF Transmitter. The modulator and exciter units are located at the bottom of the rack behind dutch doors. They are hinged at the bottom so that both the front and rear of these units are accessible for servicing from the front of the transmitter.

The right hand rack contains both the aural and visual amplifier units, a regulated bias supply for the visual amplifier, terminal board, and other auxiliary controls all located behind the two bottom doors. In both the driver and the power amplifier units the tuning controls for the high level stages are located just above the doors. These include all the tuning controls required for broadbanding the visual r-f circuit. The tuning controls are operated by a crank which is removable to prevent accidental misadjustment of the circuits during operation. An *easily read* counter dial enables accurate logging of all the circuits. Also located on the panel above the doors are all the operating controls such as the transmitter start switch, plate switch, power operating controls, reflectometer switch and metering switches.

All important meters of the TT-6AL are mounted in sloping panels at the top of the racks. Built-in lights in the bottom of the meter panels provide excellent illumination for the meters even while the room illumination is lowered for easy monitoring of the picture signal.

A single access door on the left end of the transmitter provides access to the rear of the control racks and r-f racks as well as the rectifier mounted on the rear wall of the enclosure. This rectifier has thermostatically controlled heat-

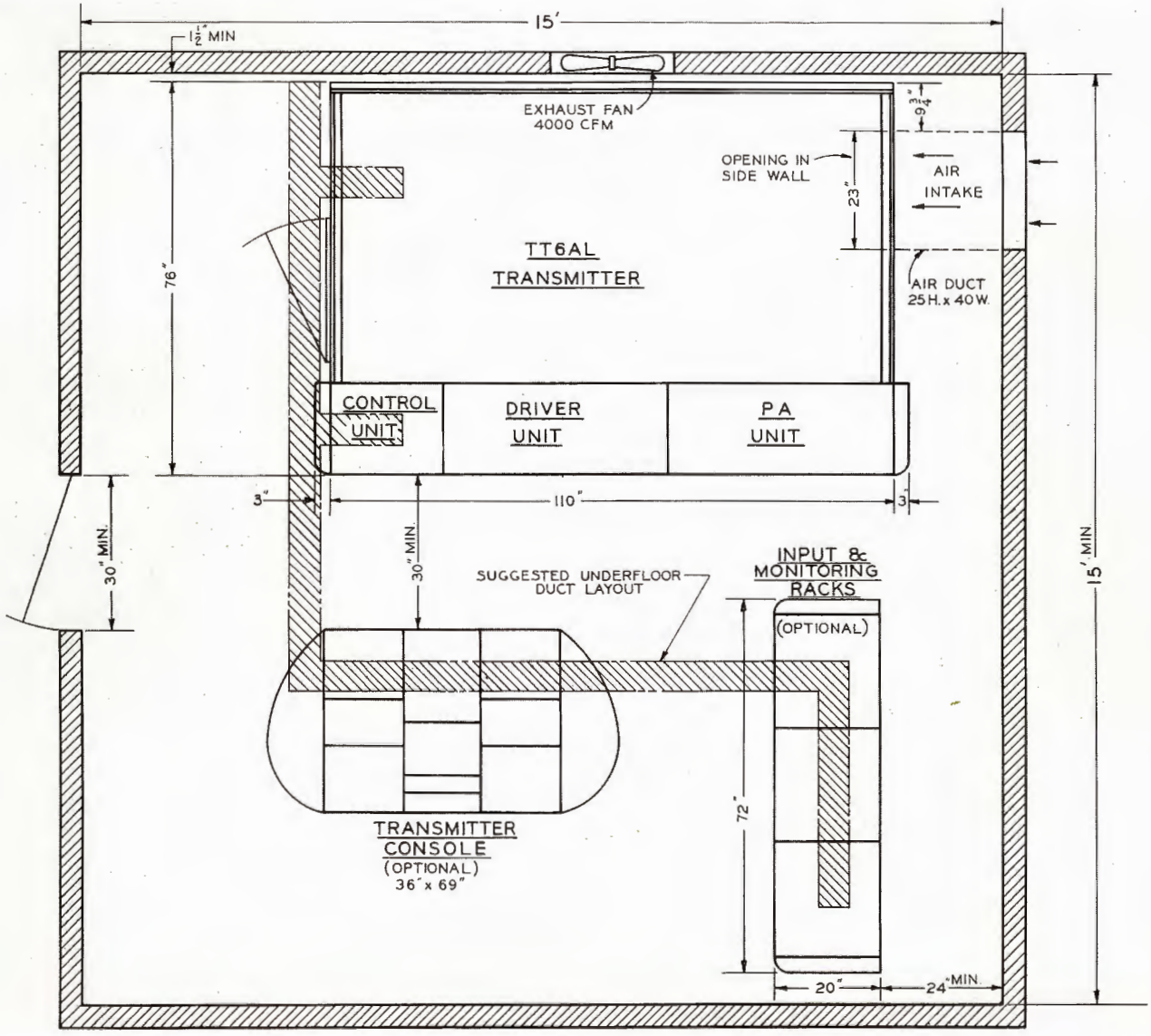
ers for the rectifier tubes which permits operation of the transmitter in ambient temperatures as low as 0° C. All heavy units such as the plate transformers and large reactors are mounted on a base plate on the floor. This makes them easily accessible for servicing.

Since all operating controls and important adjustments are brought out to the front of the transmitter, it should not be necessary to enter the enclosure while power is on. Every precaution has been taken to insure the operator's safety when it is necessary to enter the enclosure for routine maintenance and service. In addition to the conventional plate inter-lock and high voltage grounding switches, the high voltage plate transformer disconnect switch is fitted with a long handle which extends across the door opening. This makes it difficult to enter the enclosure without opening the primary of the high voltage transformer.

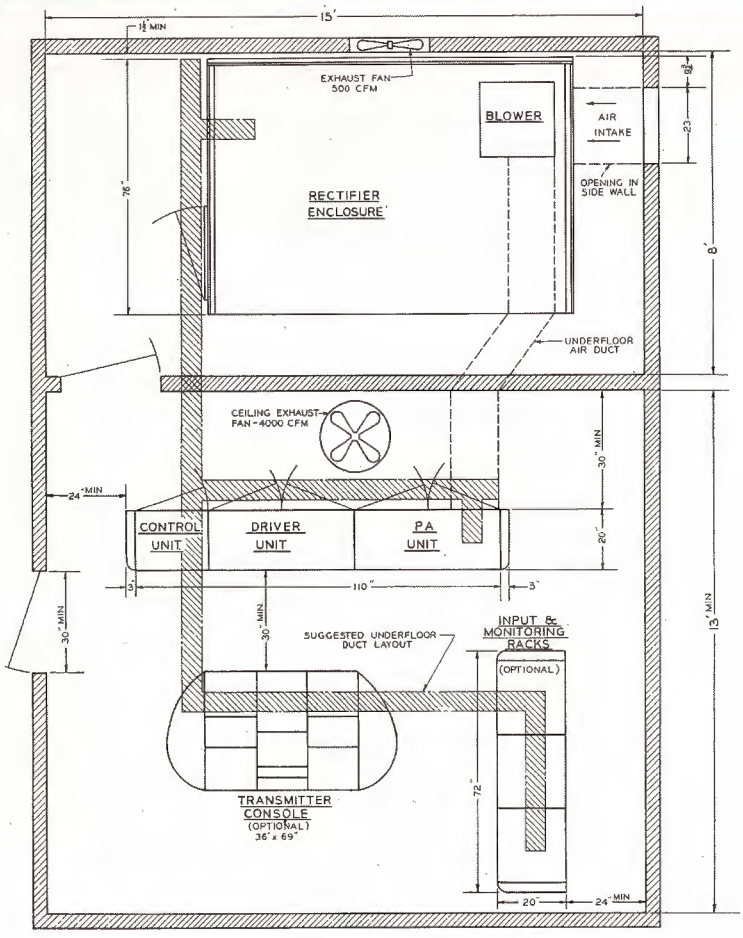
The versatility of the new transmitter cabinets is seen in floor plans No. 1 and No. 2. The latter shows an arrangement of the TT-6AL in which doors have been added to the rear of the control and r-f rack and a front wall added to the rectifier enclosure. Since this enclosure now contains no meters, operating controls or adjustments, it can be located as convenient in an adjacent room or even in the basement. If this is done, special air ducts and wiring ducts will, of course, be required to connect the rectifier to the other racks of the equipment. The arrangement will considerably reduce the amount of space required in the operating room, and will also reduce the noise in the operating room due to blower vibration, etc.

Circuit Description

The visual and aural exciter circuits of the TT-6AL are mounted on a single chassis. Two separate crystal oscil-



Typical Floor Plan for TT-6AL transmitter with rectifier enclosure attached.



Alternate floor plan for the TT-6AL transmitter with rectifier enclosure set up in an adjacent room. The new transmitter is a versatile equipment allowing the rectifier enclosure to be located on the same or on another floor, thus occupying a minimum of space.

lators are employed. This allows switching from a remote point by a relay in the d-c circuit. No relays are then necessary in the r-f circuit. A special 5763 buffer amplifier allows the crystal oscillators to be operated at a low level. This reduces internal heating of the crystal and allows the oscillator frequency to stabilize very quickly after the plate power is applied. The buffer stage is followed by a tripler, two doublers, and an amplifier, all using 5763 tubes. The output power of the exciter is approximately 5 watts at the carrier frequency. The aural chain starts with a 6V6 master oscillator frequency modulated by two more 6V6 reactance tubes. The multipliers and amplifiers which follow the master oscillator are identical to those used in the visual side. A unique feature of this exciter is the frequency control circuit for the aural master oscillator. This circuit is designed to accurately maintain the difference between the aural and visual carrier frequencies. This is accomplished by feeding a small amount of the energy from the aural and visual oscillators to a 6AS6 mixer tube. When the aural oscillator is on frequency the output of this mixer will be 1/12 of the difference frequency between the aural and visual carrier or 375 kc. This 375-kc signal combines with the output of a 6J6 crystal oscillator in a second mixer. The sum of these two frequencies is amplified and fed to a chain of three dividers with a total division of 100. This amount of division is necessary in order to reduce the swing at the frequency detector to a point where the carrier will not drop out under any conditions of modulation of the aural transmitter. A crystal control reference frequency is also fed to the frequency detector. By making the 6J6 crystal oscillator function both as a heterodyne oscillator and as a frequency reference source, considerable improvement in frequency control accuracy is obtained. Three dividers with a total division of 80 are also employed in the reference frequency circuit. The frequency detector is essentially a balanced modulator with a d-c component in the output which will change polarity depending upon whether the signal frequency is above or below the reference frequency. This d-c voltage is fed back to one of the reactance tubes for the master oscillator in such a way as to correct the frequency of the master oscillator. A frequency interlock circuit connected to the output of the frequency detector will prevent the application of plate power to the power amplifiers until the frequency control circuit is locked in.

R-F Circuits

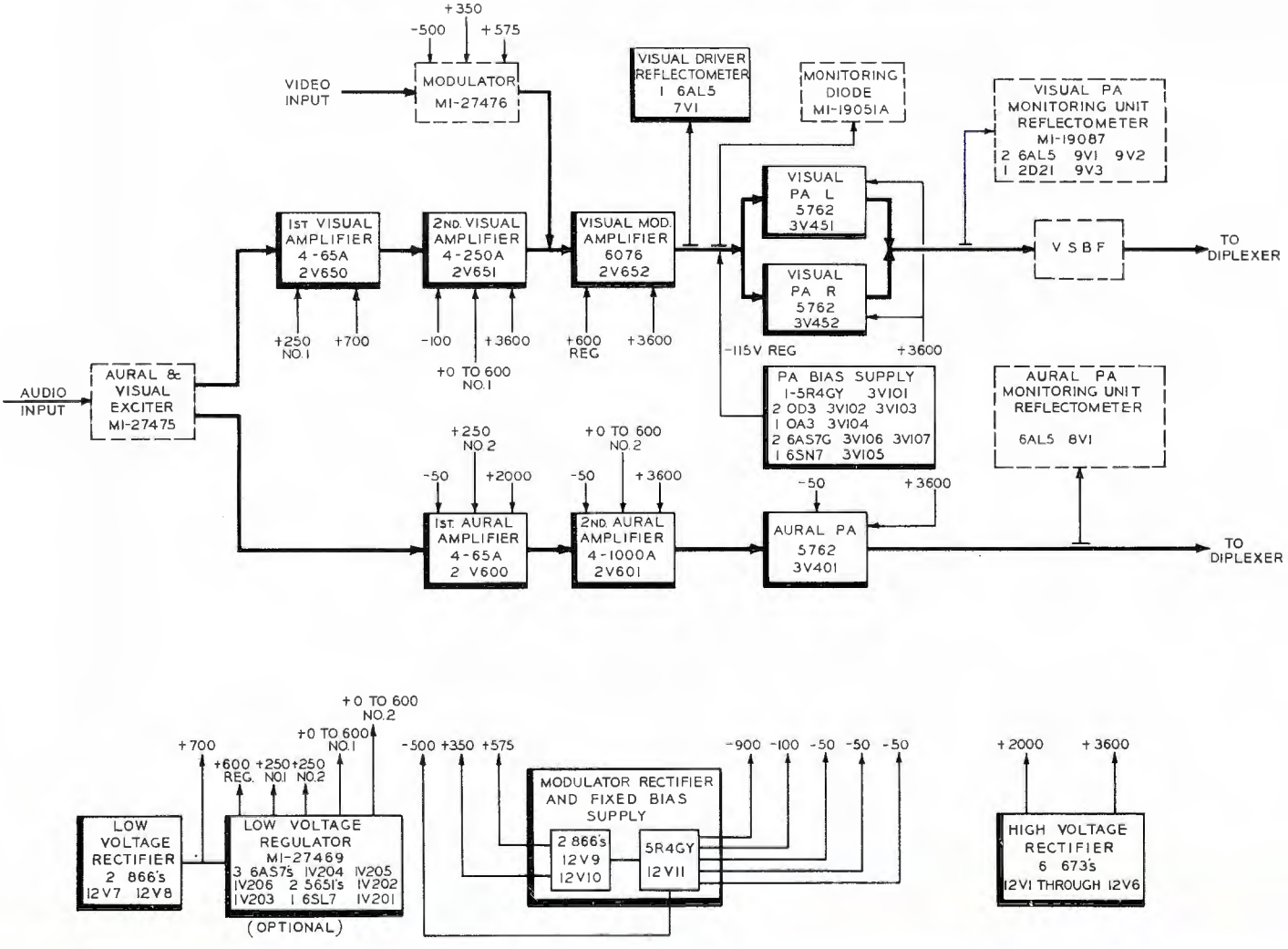
The r-f circuits employ a chain of amplifiers. In the visual chain a 4-65A tube and a 4-250A tube operating in cascade drive a type 6076 grid modulated power amplifier. This is followed by two type 5762 tubes operating in parallel in a class "B" linear circuit. The aural chain consists of three stages: a 4-65A, a 4-1000A and a type 5762 tube all operating as class "C" amplifiers. A single high-voltage rectifier employing six type 673 tubes supplies the plate power for all the high level tubes in both the aural and visual r-f chains. A single low-voltage rectifier employing two type 866A tubes supplies the screen voltage for all the stages. Excitation for the visual modulated amplifier is controlled by varying the screen voltage on the 4-250A stage. Power output of the aural transmitter is adjusted by varying the screen voltage on the 4-1000A stage. Both these controls are operated by motors and therefore can be adjusted from a remote position.

Power and Control Equipment

Wherever possible the same d-c power supplies were used for both the visual and aural amplifiers of the TT-6AL. This greatly reduces the number of components in the transmitter and allows operation of the complete equipment with only five power supplies as follows: An exciter supply built into the common exciter unit using stack germanium diodes; a 700 volt low voltage rectifier using two 866-A tubes which supplies the screen voltage for all the pentode amplifiers; a 3600 volt high voltage supply using six 673 tubes in a 3 phase full way circuit; the modulator and the bias supply, using two 866-A tubes and one 5R4GY tube, which supplies the plate voltage for the modulator and the bias for all the r-f stages except for the visual power amplifier; and a bias supply for the visual linear amplifier.

A single integrated control circuit is provided for both the visual and aural transmitters. The blower, filaments, and

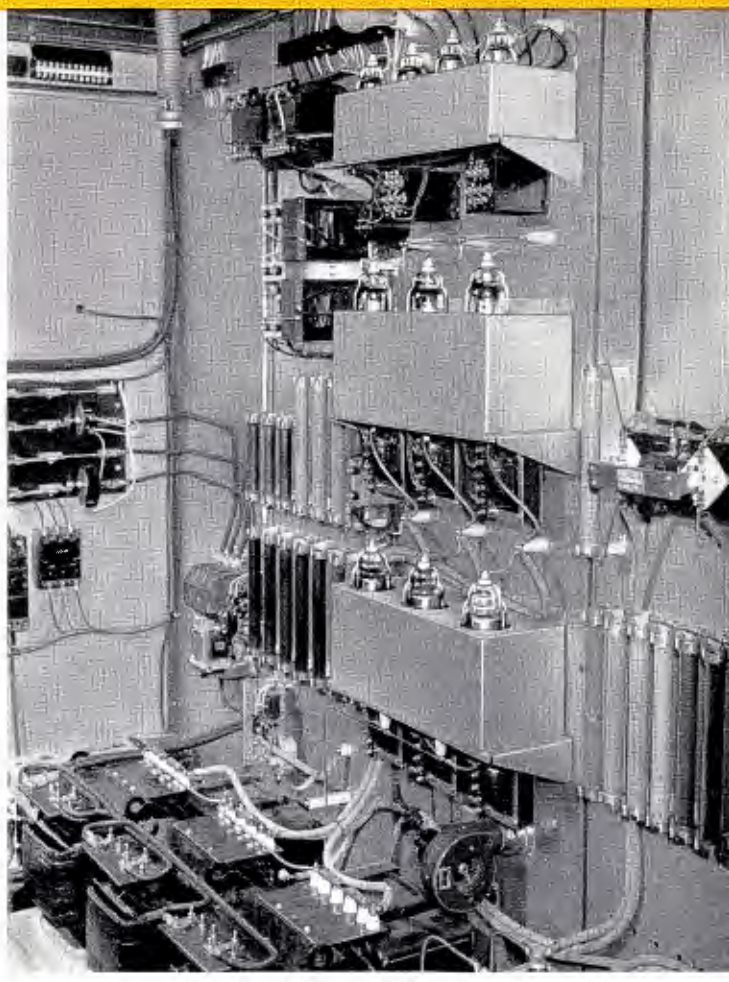
BLOCK DIAGRAM OF THE TT-6AL VHF TELEVISION TRANSMITTER



each rectifier is protected by thermal overloads which can be adjusted to reset automatically. In addition, a main line breaker and an auxiliary are provided. This includes both thermal and magnetic trips. The primaries of the high voltage rectifier and each power amplifier tube including the 4-65A stages are protected by instantaneous d-c overloads which automatically recycle twice. If the fault continues on the third try the overload circuit will remain tripped until reset. Overload indicator lights are provided for each circuit. These lights have a separate reset and will remain on after the first overload thus providing a record of the circuit giving trouble even though it is intermittent. The equipment includes a line corrector which provides an adjustable line voltage to the filament primaries, the exciter, the modulator, the low voltage rectifiers and the bias supply. Automatic filament line voltage regulators and automatic regulators capable of handling the complete transmitter are available as optional items. In localities, troubled with excessive instantaneous line voltage fluctuation, an electrically controlled regulator for the low voltage supply is also available as optional equipment.

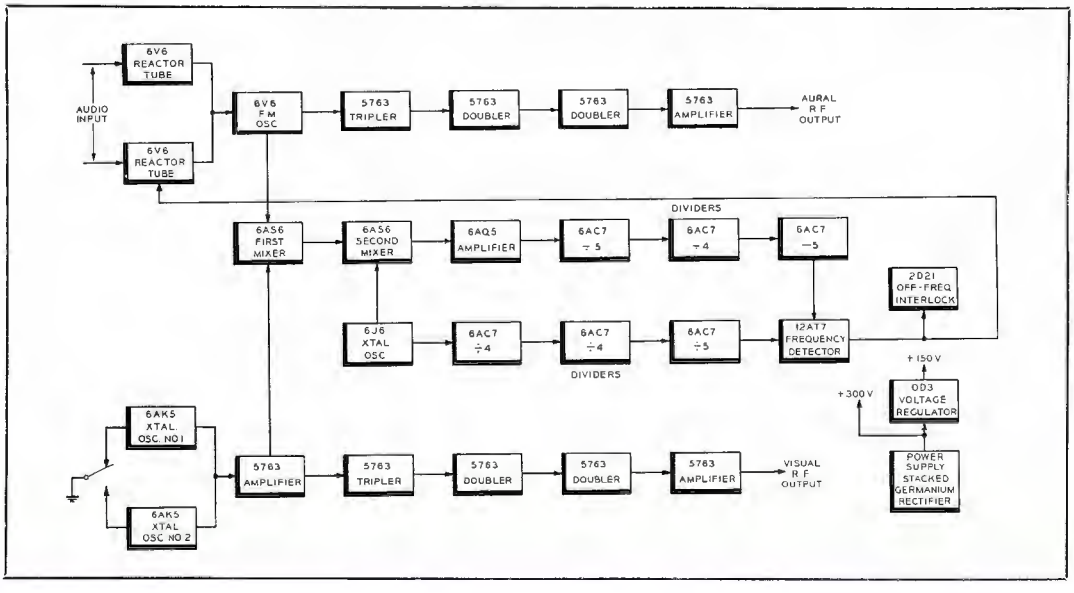
Modulator

The modulator of the transmitter is designed to take a standard 1 volt video signal and amplify it sufficiently so that it can grid modulate the 6076 stage. This requires about 250 volts peak-to-peak from the modulator. The first stage of the modulator is a conventional shunt-series peak video amplifier. This is followed by an inverter stage and a linearity corrector stage each of which has a gain of approximately one. The linearity corrector is designed to pre-



Interior view of rectifier enclosure. Rectifiers are mounted on back wall of the enclosure in heating units which permit operation of the transmitter at lower ambient temperatures.

BLOCK DIAGRAM SHOWING COMBINED AURAL AND VISUAL EXCITER FOR THE TT-6AL TRANSMITTER



distort the signal to compensate for the non-linearity which always occurs in a grid modulated stage, and takes the form of four diodes connected in the cathode circuit of that stage. The bias voltage on each diode is separately adjustable and can be made to start conducting at any brightness level. The grid of this stage is clamped in order to insure the same correction to the linearity characteristic regardless of the average brightness of the picture signal.

The linearity corrector is followed by a second video amplifier using a 6AG7 tube and by a third video amplifier consisting of two 807 tubes. The grids of the third video amplifier are also clamped and from this point on the circuit is d-c coupled. The output stage is a shunt regulated cathode follower. It consists of two 6146 tubes connected in a circuit very similar to a conventional cathode follower stage. The cathode resistor has been replaced by three 6146 tubes operating in parallel. The grid of these three tubes are fed with a signal of opposite polarity from the plate load by the two cathode follower tubes. This essentially makes the circuit a feed-back amplifier of high efficiency capable of delivering modulation at a high level to a large capacity load.

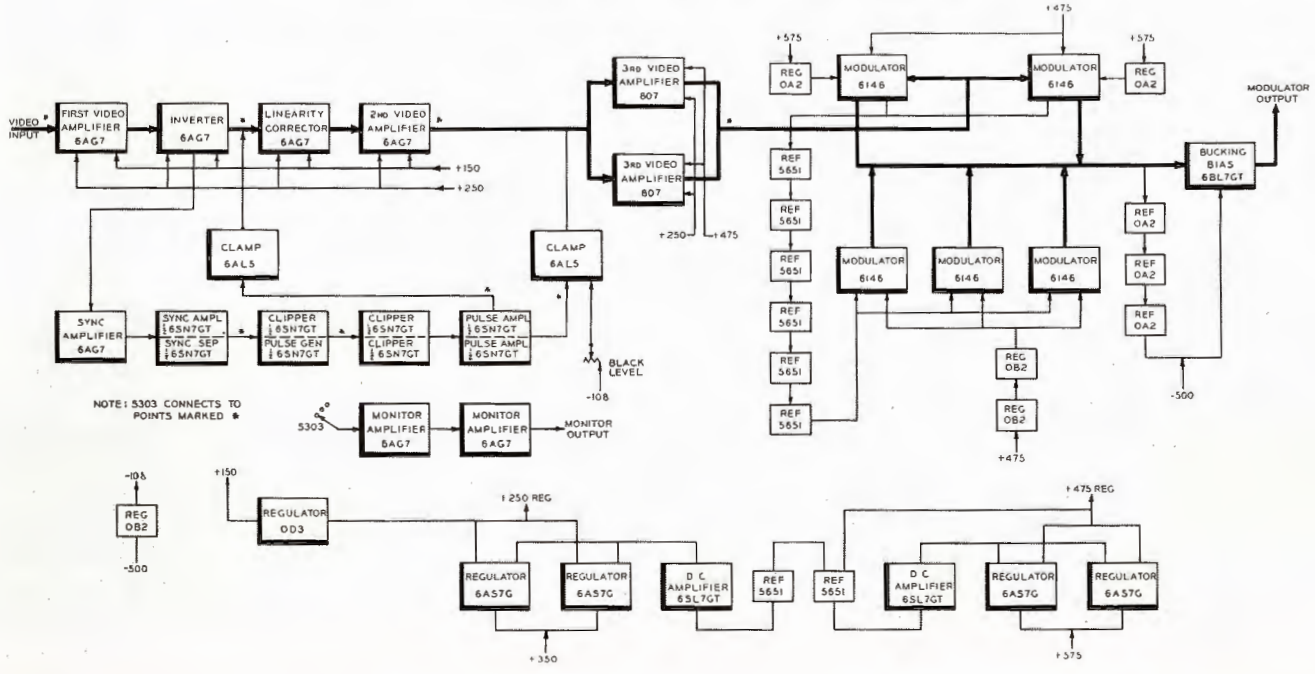
The modulated stage is followed by a bucking bias supply consisting of one 6BL7-GT and three OA2 tubes. This serves to transfer the signal from the positive voltage present in the output of the modulator stage to the negative voltage required to modulate the 6076 tubes without losing the d-c component. Back porch clamping is employed. A carefully designed sync separator and clipper circuit provides reliable clamping even with greatly degraded input signal.

A two stage monitor amplifier is employed. It can be noted from the block diagram that this monitor amplifier can be switched to many parts of the circuit greatly aiding in making adjustments and in servicing. Plate power for all the stages in the modulator is obtained from two electronic regulators. One supplies approximately 250 volts and the other approximately 475 volts. Although the rectifier itself is remotely located on the rear wall of the transmitter enclosure the regulators are mounted on the same chassis as the video circuit in the modulator. This greatly reduces the possibility of obtaining unwanted video resonances.

Special Protective Circuits

Included as part of the TT-6AL is an MI-19087 Monitoring Unit for connecting in the output transmission line of the visual amplifier. This unit contains two 6AL5 diode detectors or reflectometers. The transmission line probes are installed so as to give an indication of the amount of power and reflected power. A meter on the front panel can be switched between the two diode circuits. Power output is

BLOCK DIAGRAM OF THE TT-6AL MODULATOR



read in percent peak power which can be calibrated to read 100% for rated power. The standing-wave ratio is read directly on a specially calibrated scale. In the monitoring unit a type 2D21 thyratron tube operates in conjunction with a relay to remove the high voltage plate power from the complete transmitter when the SWR exceeds a predetermined value as would be the case if an arc occurred in the transmission line or antenna system.

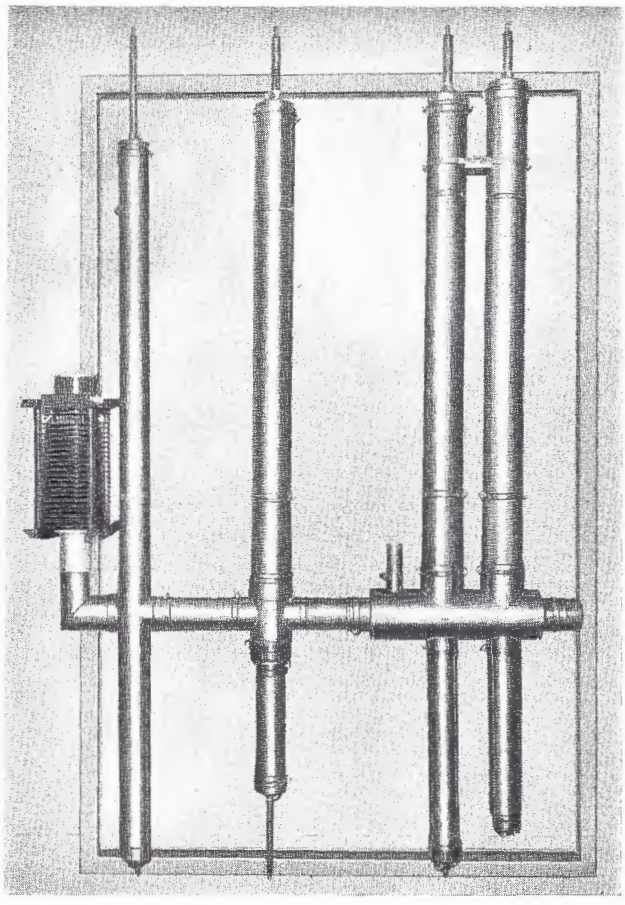
A single unit reflectometer is provided for the aural amplifier. This normally is connected to read power output. Standing wave ratio can be measured by manually rotating the reflectometer head. If desired, a complete MI-19087 monitoring unit can be supplied for the aural output as optional equipment. This unit provides two reflectometer heads as well as the SWR monitor. However, since an antenna fault will trip the visual monitor and thus interrupt the common power supply a monitoring unit in the aural line is not necessary to protect the normal antenna system.

A carrier-off monitor is available as optional equipment. It acts in conjunction with the reflectometer units and is particularly useful for remote control. This unit will remove the plate voltage from all the r-f stages if the output level drops below a predetermined value, such as would be the case if an r-f arc occurred in any of the r-f stages. Sometimes such an arc does not change the plate current sufficiently to trip the d-c overload relays.

Harmonic Filter

Harmonic filters are supplied for insertion in the output transmission line. When operated in conjunction with the TT-6AL Transmitter these filters are designed to attenuate all harmonics to a value at least 60 db below the peak carrier level. Electrically, each filter consists of an M-derived half-T section, several low pass filter sections, and a constant-K half-T section. The M-derived section provides rapid cut-off in the second harmonic region and a termination impedance at one end of the filter of 51.5 ohms. Attenuation of the harmonics is accomplished by a low pass filter section, while the constant-K section serves to give termination impedance of 51.5 ohms at the other end of the unit.

A low pass filter is provided for insertion in the video input circuit. This filter attenuates all video frequencies above 4.75 megacycles at least 20 db. An all-pass phase equalizer is also included as part of the low pass filter. This equalizer corrects any phase distortion which may be introduced as a result of the sharp cut-off.



The new M-derived vestigial sideband filter, ES-27243, designed for the TT-6AL transmitter.

Sideband Filter

A vestigial sideband filter is furnished completely assembled and adjusted for any one of the low band VHF television channels. This filter is an integral unit designed for floor, ceiling, or wall mounting near the visual transmitter so that the input transmission line is as short as possible. It also can be mounted to the top of the transmitter enclosure. The purpose of the filter is to attenuate the lower sideband output of a double sideband visual transmitter in conformance with the FCC regulations. In order to minimize reflections on the transmission line between the visual transmitter and the filter, the visual input of the filter is designed to have a constant input impedance over the band of frequencies produced by the visual transmitter including the reject band. The filter sections consist of lengths of coaxial line (resonant cavities), which are adjustable for tuning purposes. As the filter is pre-tuned at the factory to the channel stamped on the name plate, no operating adjustments are necessary.

SPECIFICATIONS

Performance Specifications

	Visual	*Aural*
Type of Emission	A5	F3
Frequency Range	Ch. 2-6	Ch. 2-6
Rated Power Output	6 KW[1]	3.15 KW[2]
Minimum Power Output	2 KW[1]	1 KW[2]
R-F Output Impedance	51.5 Ohms	51.5 Ohms
Input Impedance	75 Ohms	600/150 Ohms
Input Level	0.7 V. peak to peak min.	+10 ±2 dbm
Amplitude vs. Frequency Response		Uniform ±1 db from 50 to 15,000 cycles
Upper Sideband Response:[3]		
+1, −1.5 db at carrier	plus 0.5 mc.	
+1, −1.5 db at carrier	plus 1.25 mc.	
+1, −1.5 db at carrier	plus 2.0 mc.	
+1, −1.5 db at carrier	plus 3.0 mc.	
+1, −1.5 db at carrier	plus 3.58 mc.	
+1, −3.0 db at carrier	plus 4.18 mc.	
−20, db maximum at carrier	plus 4.75 mc.	
Lower Sideband Response:[4]		
+1, −1.5 db at carrier	minus 0.5 mc.	
−20 db max. at carrier	minus 1.25 mc.	
−42 db max. at carrier	minus 3.58 mc.	
± Variation in Frequency Response with Brightness[5]	±1.5 db	
Carrier Frequency Stability[6]	±1 kc	±500 cps[7]
Modulation Capability	12.5 ±2.5% (reference white)	±50 kc
Audio Frequency Distortion		1.5% max. 50-100 cy.
		1.0% max. 100-7500 cy.
		1.5% max. 7500-15000 cy.
FM Noise, below ±25 kc Swing		60 db
AM Noise, r.m.s.	40 db below 100% mod.	50 db below carrier

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[1] Measured at the output of the sideband filter or filterplexer.

[2] Measured at the input to the diplexer or filterplexer.

[3] With respect to the response at 200 kc, as measured by the BW-5A Sideband Response Analyzer at transmitter mid-characteristic. 4.75 mc attenuation requires use of MI-27132 LP filter in the video input circuit.

[4] With respect to the response at 200 kc at transmitter mid-characteristic.

[5] Maximum variation with respect to the response at mid-characteristic measured with the BW-5A Sideband Response Analyzer at brightness levels of 22.5% and 67.5% of sync peak, using approximately 20% (peak to peak) modulation.

[6] Maximum variation for a period of 30 days without circuit adjustment.

	Visual	*Aural*
Amplitude Variation Over One Picture Frame	Less than 5% of the peak of sync level	
Regulation of Output	7% max.	
Burst vs. Subcarrier Phase[8]	±5 degrees max.	
Subcarrier Phase vs. Brightness[9]	±7 degrees max.	
Subcarrier Amplitude[8]	±10% max.	
Linearity (Differential Gain)[10]	15% max.	
Envelope Delay vs. Frequency[11]	±.08 μsec. from 0.2 to 2.1 mc. ±.04 μsec. at 3.58 mc. ±.08 μsec. at 4.18 mc.	
Harmonic Attenuation, ratio of any single harmonic to peak visual fundamental	At least 60 db	At least 60 db

Electrical Specifications

Power Line Requirements:

Transmitter:

Line	230/208 volts, 3 phase, 50/60 cycles
Slow Line Variations	±5% max.
Rapid Line Variations	±3% max.
Regulation	3% max.
Power Consumption	27.2 KW (Black Pix) 23.2 KW (Ave. Pix)
Power Factor (approx.)	90%

Crystal Heaters:

Line	115 volts, single phase, 50/60 cycles
Power Consumption	28 watts

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[7] Maximum variation with respect to the standard 4.5 mc separation between aural and visual carriers.

[8] Maximum departure from the theoretical when reproducing saturated primary colors and their complements at 75% amplitude.

[9] Maximum phase difference with respect to burst, measured after the VSBF, for any brightness level between 75% and 15% of the sync peak using 10% (peak to peak) modulation. This is equivalent to 5% (peak to peak) modulation as indicated by a conventional diode demodulator.

[10] Maximum variation in the amplitude of a 3.58 mc sine wave modulating signal as the brightness level is varied between 75% and 15% of sync peak. The gain shall be adjusted for 10% (peak to peak) modulation of the 3.58 mc signal when the brightness is at pedestal level. This is equivalent to 5% (peak to peak) modulation as indicated by a conventional diode demodulator connected after the VSBF.

[11] Maximum departure from standard curve. The tolerances vary linearily between 2.1 and 3.58 mc and between 3.58 mc and 4.18 mc. To meet the specification a properly terminated phase correction network, ES-34034-A is required in the video input circuit of the transmitter.

SPECIFICATIONS (Cont'd)

Tube Complement

VISUAL SECTION

Qty.	Function	Type
1	Visual Crystal Oscillator #1	6AK5
1	Visual Crystal Oscillator #2	6AK5
1	1st Visual Amplifier	5763
1	1st Visual Multiplier	5763
1	2nd Visual Multiplier	5763
1	3rd Visual Multiplier	5763
1	Visual Output Amplifier	5763
1	1st Visual Amplifier	4-65A
1	2nd Visual Amplifier	4-250A
1	1st Video Amplifier	6AG7
1	Inverter	6AG7
1	Linearity Corrector	6AG7
1	2nd Video Amplifier	6AG7
2	3rd Video Amplifier	807
5	Modulator	6146
1	Bucking Bias	6BL7-GT
1	1st Sync Amplifier	6AG7
1	2nd Sync Amplifier-Sync Separator	6SN7-GT
1	Sync Clipper-Pulse Generator	6SN7-GT
1	Pulse Clipper-Pulse Amplifier	6SN7-GT
1	Pulse Output	6SN7-GT
2	Clamp Diode	6AL5
6	Voltage Reference Tubes (D-C Coupling)	5651
1	Bias Regulator	OB2
2	Regulators (Modulator Screens)	OA2
2	Regulators (Modulator Screens)	OB2
3	Voltage Reference Tubes (Bucking Bias)	OA2
2	Voltage Reference Tubes (L.V. and H.V. Regulators)	5651
1	D-C Amplifier (High Voltage Regulator)	6SL7-GT
2	Series Regulator (High Voltage Regulator)	6AS7-G
1	D-C Amplifier (Low Voltage Regulator)	6SL7-GT
2	Series Regulators (Low Voltage Regulator)	6AS7-G
1	150 V Regulator	OD3
1	Monitor Amplifier	6AC7
1	Monitor Amplifier (Output)	6AG7
1	Visual Modulated Amplifier	6076
1	Visual Driver Reflectometer	6AL5
1	Visual PA (Left)	5762
1	Visual PA (Right)	5762
1	Visual PA Forward Power Detector	6AL5
1	Visual PA Reflected Power Detector	6AL5
1	Reflectometer Thyratron	2D21

AURAL SECTION

2	Reactance Tube Modulator	6V6
1	FM Master Oscillator	6V6
1	1st Aural Multiplier	5763
1	2nd Aural Multiplier	5763
1	3rd Aural Multiplier	5763
1	Amplifier—Aural Output	5763
1	1st Mixer	6AS6
1	2nd Mixer	6AS6
1	Amplifier-Difference Frequency	6AQ5
1	1st Difference Frequency Divider	6AC7
1	2nd Difference Frequency Divider	6AC7
1	3rd Difference Frequency Divider	6AC7
1	Crystal Oscillator-Reference Frequency	6J6
1	1st Reference Frequency Divider	6AC7
1	2nd Reference Frequency Divider	6AC7
1	3rd Reference Frequency Divider	6AC7
1	Cathode Follower-Frequency Detector Drive	12AT7
1	1st Aural Amplifier	4-65A
1	2nd Aural Amplifier	4-1000A
1	Aural PA Reflectometer	6AL5
1	Aural PA	5762

COMMON POWER SUPPLY, ETC.

1	Voltage Regulator	OD3
1	Off-Frequency Interlock Control	2D21
1	Bias Rectifier	5R4GY
2	Voltage Regulators (PA Bias Supply)	OD3
1	Voltage Regulator (PA Bias Supply)	OA3
1	D-C Amplifier	6SH7
2	Series Regulators (PA Bias Supply)	6AS7-G
2	Low Voltage Rectifiers	866
2	Modulator Rectifiers	866
1	Modulator Rectifier	5R4GY
6	High Voltage Rectifiers	673
†1	D-C Amplifier (Low Voltage Regulator)	6SL7
†2	Voltage Reference Tubes (Low Voltage Regulator)	5651
†3	Series Regulators (Low Voltage Regulator)	6AS7
†2	Regulators (Carrier-Off Monitor)	OD3
†4	Amplifiers (Carrier-Off Monitor)	12AU7

Mechanical Specifications

Dimensions:
- Overall Length (front line cabinets only) ..... 116"
- Overall Height (front line cabinets only) ..... 84"
- Depth (front line cabinets only) ..... 20"
- Overall Depth ..... 78 13/16"

Weight (approx.) ..... 6000 lbs.
Finish ..... Two-tone umber gray, polished stainless steel trim
Maximum Altitude[1] ..... 7500 ft.
Ambient Temperature ..... 45° C. max., 0° C. min.

Equipment Supplied

TT-6AL TELEVISION TRANSMITTER (ES-19281)

Qty.	Description	Stock No.
1	Control Unit	MI-27180
1	2-KW Driver (Ch. 2-6)	MI-27181
1	6-KW Power Amplifier Unit (Ch. 2-6)	MI-27182
1	Set of Panels	MI-27450
1	Rectifier Panel	MI-27451
1	Resistor Panel	MI-27452
1	Transformer—Filter Assembly	MI-27465
3	Transformers	MI-27477
1	Blower	MI-27466
1	Installation Moterial	MI-27467
1	Wiring Material	MI-27468
2	Reflectometers	MI-27464
1	Monitoring Unit	MI-19087
1	Monitoring Diode	MI-19051-B
2	Harmonic Filter	MI-27317[2]
1	Vestigial Sideband Filter	ES-27234[2]
1	4.75 MC Low Pass Filter	MI-27132
2	Side Panels (End Shields)	MI-30541-G84
1	Finish Touch-Up Kit	MI-28153
1	Miscellaneous Hardware Kit	MI-7474
1	Set of Frequency Determining Parts for Driver	MI-27482[2]
1	Set of Frequency Determining Parts for Amplifier	MI-27483[2]
2	Crystal Unit (Visual)	MI-27492[2]
1	Set of Operating Tubes	ES-27205
1	Line Corrector	MI-27478
1	Nameplate	MI-28180-1
2	Instruction Book	IB-36279
*	Transmissin Line (*Sales order must specify quantity for installation requirements)	MI-19113-B

Optional or Accessory Equipment

TTC-1C Control Console Equipment, with master monitor but less master monitor power supply	MI-19240-A
R-F Load and Wattmeter	MI-19199-L
Complete Set of Spare Tubes	ES-27205
FCC Spare Set of Tubes	ES-27206
Input and Monitoring Equipment, Wired/Unwired	ES-19237-A/B
50 Cycle Conversion Kit	MI-27486
Line Regulator (3 phase)	MI-27473
Line Regulator Control Panel	MI-27471
Rectifier Enclosure	ES-19279
Low Voltage Regulator	MI-27469
Carrier-Off Monitor	MI-27470
BW-5A Sideband Response Analyzer	ES-34010
Plate Current Meter	MI-21200-C1
WM-71A Distortion and Noise Meter	MI-30071-A
TO-524-D Oscilloscope	MI-26500

† Tubes for optional Low Voltage Regulator and Carrier-Off Monitor Equipment.

[1] For operation at rated power and normal plate voltage.

[2] Order to suit customer's assigned channel.

VHF TELEVISION TRANSMITTER

11 KW CHAN. 2-6 TYPE TT-10AL
10 KW CHAN. 7-13 TYPE TT-10AH

FEATURES

- Air-cooled tubes—air-cooled transformers
- Single-ended r-f circuits reduce number of tubes and circuit components
- Fewer r-f stages—no linear amplifiers employed
- Only one broadbanded circuit to tune
- Excellent video frequency response—better than RETMA requirements
- Hum level —40 db insures satisfactory operation on non-synchronous network originations
- Vestigial sideband characteristics determined by fixed-tuned, trouble-free, factory-adjusted sideband filter
- Grid modulation of final amplifier
- Power rating provides the most economical package in combination with standard antennas for medium sized trade areas
- All important circuits are metered
- High-speed a-c and d-c overload protection
- Reduced floor space—sliding doors require no space for door swing

USES

The TT-10AL and TT-10AH Television Transmitters are designed for TV stations with effective radiated power requirements ranging from 10 to 100 kilowatts. It is an ideal equipment for telecasting in monochrome or color and is capable of covering large urban communities with a strong signal. The 10-kw transmitters work equally well with both RCA low or high-gain type antennas. High power amplifiers may be added to the TT-10AL/AH with minimum changes to convert it to a 25-kw, 50-kw or 100-kw transmitter.

To establish the vestigial sideband response required by the FCC, a factory tuned, high precision coaxial filter is employed. By utilizing an external filter, a simple broadband circuit without critical tuning adjustment can be used in the transmitter. The transmitter reduces adjacent channel interference and harmonic radiations well below FCC requirements.

DESCRIPTION

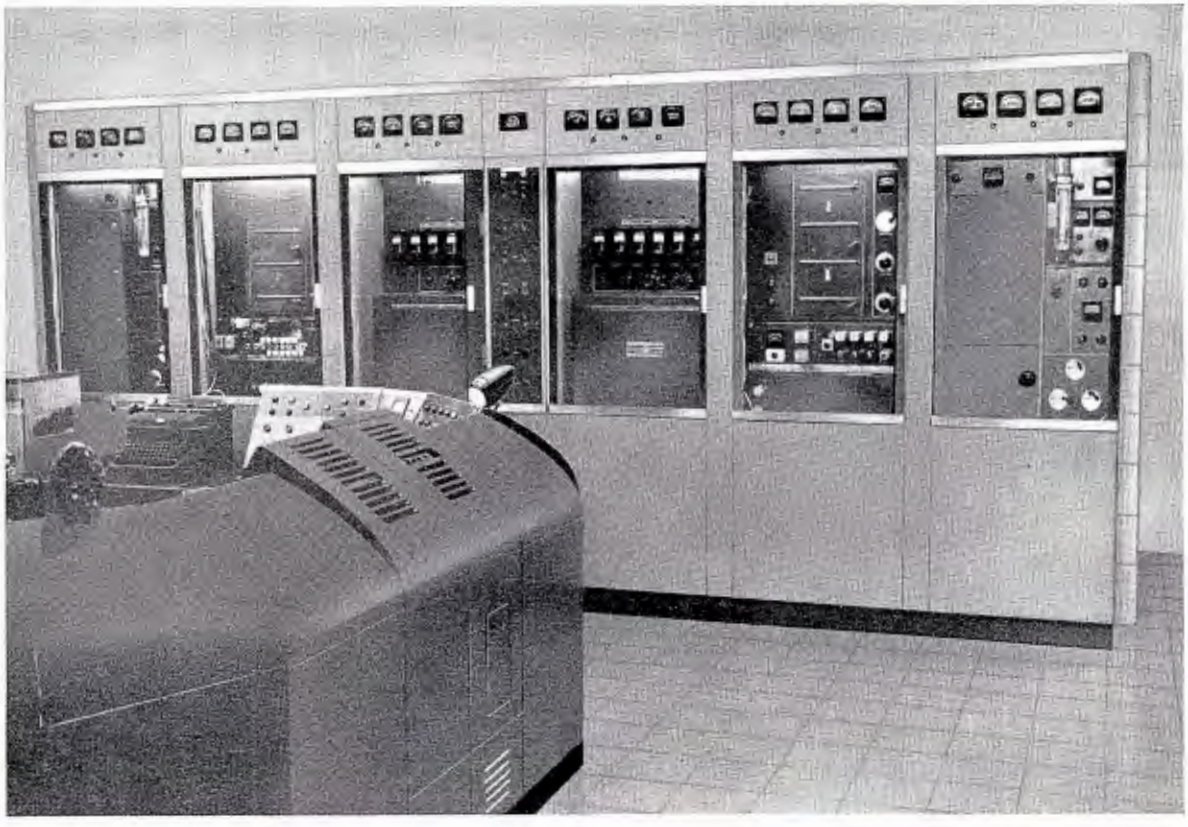
The TT-10AL and AH are high-level modulated, air-cooled television broadcast transmitters. The Type TT-10AL provides a nominal power output of 11 kilowatts and the Type TT-10AH an output of 10 kilowatts peak visual power measured at the output of the sideband filter or filterplexer, and 6 kw aural power, in conformance with FCC and RETMA Standards. The TT-10AL is designed to operate in any specified channel between channels 2 and 6; and the TT-10AH, between channels 7 and 13.

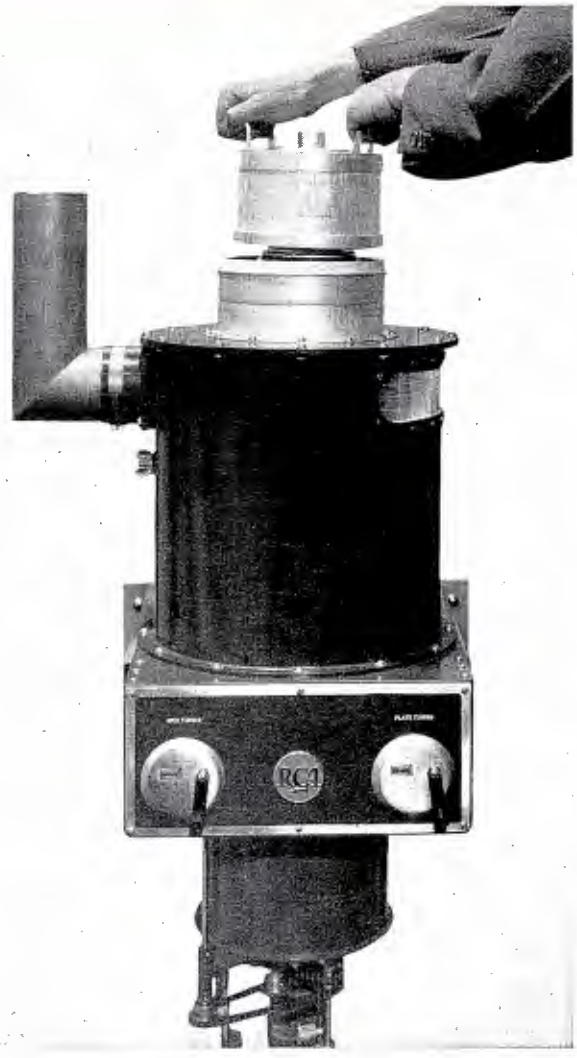
The transmitters, except for two external plate power transformers, are housed in six identical cubicles requiring a floor area of only 43.3 square feet. These cabinets are mounted adjacent to each other on rails which serve not only as a common base frame but also as wire trenches. Connecting trim strips give a unified appearance and uniform styling to the complete assembly.

An outstanding feature is the sliding panel type door which gives complete access to components and tubes from both front and rear of each cabinet. In the closed position they present a neat unified front appearance. The new type doors greatly add to the compactness and convenience of the equipment and effect great saving in required floor space.

The components and circuitry of the aural and visual sections of the TT-10AL/AH has been kept identical as far as possible, affecting considerable saving on spare parts and simplifying maintenance and operation. Built-in wiring ducts and preformed cable harness eliminate many of the time consuming details of installation. Essential tuning controls are brought out to panel positions. Adequate metering has been provided to eliminate "guesswork" in servicing and routine tests.

Front view of the TT-10AL/AH with sliding panel doors open. All tubes and other components are easily accessible through front and rear doors.





Complete 10 kilowatt r-f amplifier stage (ch. 7-13) showing plug-in tube changing feature.

The r-f exciter and driver stages are straightforward narrow band Class C amplifiers which can be quickly and accurately tuned by meter indications. Improved clamp circuit d-c restoration is employed with picture transmission.

Provision is made for a-c modulator coupling and mid-characteristic operation during tests with sine waves, square waves, or video sweep signals.

All essential transmitter operating controls are duplicated at the console control panel. Key points of the system have monitoring connections so that the operator at the console may, by push button selection, monitor the aural and visual signals at various points.

A completely air-cooled transmitter results from the use of a new VHF power tetrode tube, RCA type 6166, which is a single ended tube of 10-kw plate power dissipation. This tube is used in output stage of aural as well as visual portions in both the TT-10AL and TT-10AH transmitters.

High level modulation is employed at the grid of the 6166 power amplifier stage and a vestigial sideband filter provides sideband attenuation in compliance with standards of TV transmission. This system provides the greatest possible simplicity in operation since the only transmitter tuning adjustment which affects the video frequency response characteristic is in the final stage output circuit. The filter gives positive assurance of correct spectrum response at the antenna connection.

Circuit Features

The r-f visual exciter unit is the same for both the TT-10AL and TT-10AH transmitters. Crystal control is used to maintain frequency accuracy to ± 1 kc in the visual transmitter. This order of stability is of great importance when offset carrier operation is employed. Stability is achieved through careful application of temperature control to the crystal. The crystal is operated in a low power crystal oscillator circuit from which the output frequency is 1/6 of the assigned frequency of the TT-10AL and 1/18 the assigned frequency of the TT-10AH.

The aural exciter is also the same for both transmitters. Power output and frequency range are nearly the same

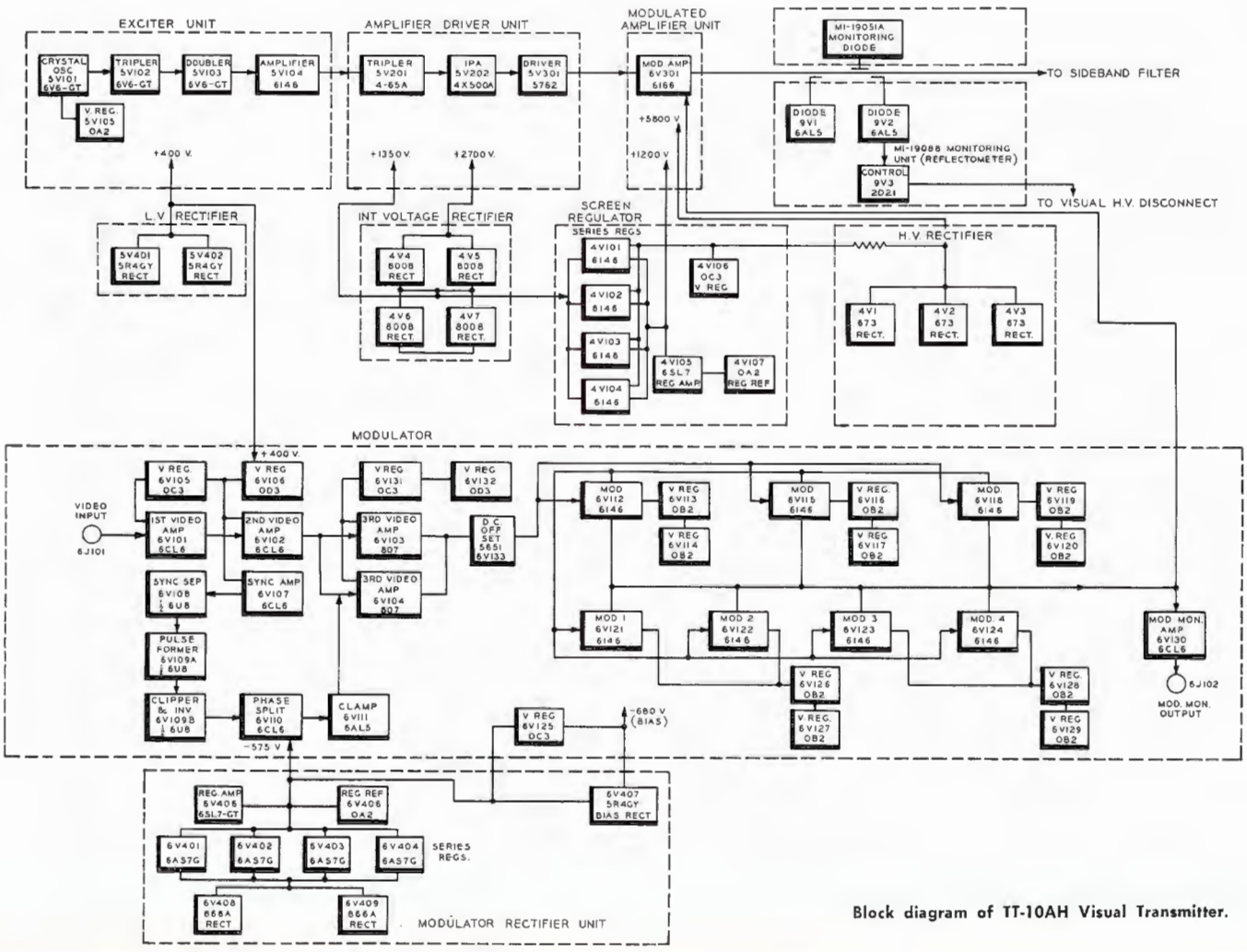
Air cooled tetrode, RCA 6166, used in the output amplifier stages of the TT-10 AL/AH.

as for the visual exciter, hence the succeeding amplifier stages are similar. The aural exciter is phase modulated. The crystal oscillator and pulse shaper are used to drive a linear sawtooth generator at the crystal frequency. The sawtooth wave is applied to the grid of the sawtooth modulator which is biased so that conduction starts at about half amplitude of the sawtooth, and the remaining portion is cut off level. The output of the sawtooth modulator is then a square wave, the leading edge of which is controlled in phase by the point on the sawtooth at which conduction starts. The cathode bias of the sawtooth modulator is varied by the audio voltage and the square wave output is differentiated to form phase modulated pulses. The resulting phase modulated signal, after an appropriate amount of frequency multiplication through several stages, results in an output at carrier frequency for channels 2-6, and at 1/3 of carrier frequency for channels 7-13 inclusive.

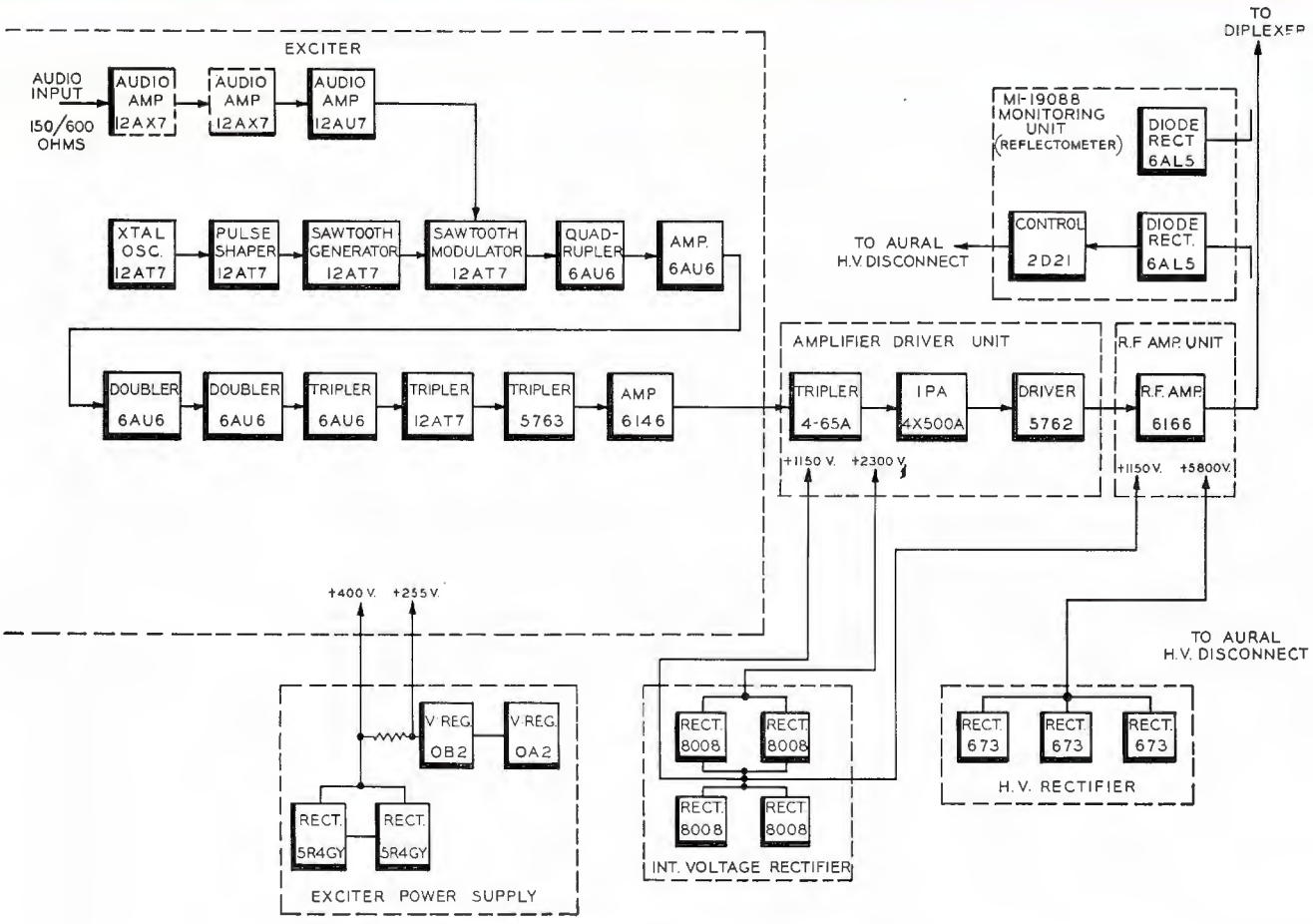
The audio amplifier of the FM exciter has a built-in pre-emphasis circuit. However the change of a single connection restores the exciter to a flat modulation response so that pre-emphasis may be inserted elsewhere in the system if desired.

The intermediate r-f amplifier circuits in the two transmitters vary somewhat. For the low-band transmitter the r-f power tube line-up following the exciter unit includes three stages: an amplifier stage operating as a straight-through amplifier, a driver stage, and an associated damping resistance load. The tube line-up for the intermediate r-f amplifier circuit of the high-band TT-10AH transmitter employs a frequency tripler, followed by two stages of straight-through amplification. In this transmitter damping is also applied at the grid of the modulated power amplifier.

The power amplifier tube in both transmitters is an RCA type 6166 especially designed for VHF broad-band television transmission. Due to the high power capability of this tube it was possible to build a single ended power amplifier stage and take advantage of somewhat simpler construction. At the same time the need for a balun was eliminated, since the transmitter is single ended throughout.



Block diagram of TT-10AH Visual Transmitter.



Block diagram of TT-10AH Aural Transmitter.

The modulated power amplifier stage utilizes a "half wave" grid circuit, making it possible to feed the modulating voltage to the grid at a point of low r-f potential without placing a large capacitive load on the modulator. The physical form of this grid circuit varies somewhat between the AL and AH versions of the transmitter.

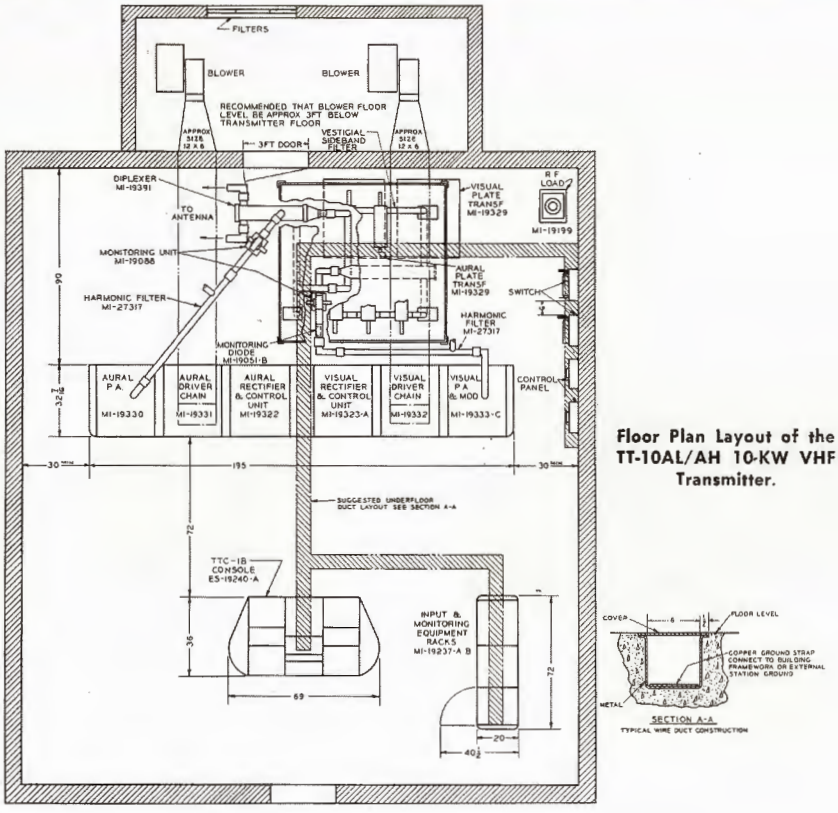
Power output indication and SWR protection of the transmitters is provided by externally mounted reflectometer units. These units attach to the 3⅛-inch output transmission line from both aural and visual units and are wired to their respective transmitter control circuits. The high voltage rectifier, which employs 3 RCA type 673 mercury vapor rectifier tubes, incorporates individual arc back indication for each tube. Should arc back occur due to faulty rectifier tube an indicator lamp associated with the offending tube will come on and remain lighted until the system is reset.

The modulator of the TT-10AL and TT-10AH is particularly designed for color usage, with low differentiated phase and high sub-carrier handling ability. The modulator unit includes a back-porch clamp circuit which features a high degree of stability especially when operated with degraded input signals. The modulator accepts an input signal as low as 0.7 volt peak-to-peak and is designed to give maximum output signal level of approximately 425 volts.

This output signal is attained through the use of three video amplifiers. The first and second video amplifiers employ 6CL6 tubes, and the third video amplifier two 807 tubes connected in parallel. These video stages provide a gain of approximately 600. The modulator stage consists of seven 6146 tubes. Its mode of operation is somewhat novel. It is direct coupled and has a gain of unity. The output stage provides isolation between the relative high impedance of the third video amplifier and the variable impedance of the r-f amplifier grid network.

10 KW Sideband Filter

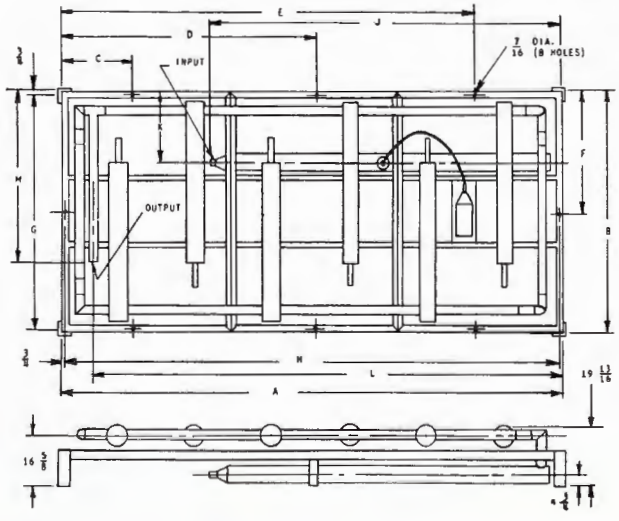
The MI-19085-L/HA Vestigial Sideband Filter is furnished completely assembled and adjusted for any one of the VHF television channels. The type MI-19085-L is specified for channels 2 through 6, and the type HA for channels 7 through 13. The filter is an integral unit designed for floor, ceiling, or wall mounting near the visual transmitter so that the input transmission line is as short as possible.



Floor Plan Layout of the TT-10AL/AH 10-KW VHF Transmitter.

The purpose of the filter is to attenuate the lower sideband output of a double sideband visual transmitter. It consists essentially of two similar parallel transmission lines which have resonant cavities connected to them at several points. The lines are jointed at the input through a bridge balun and at the output with a transformer tee. In order to minimize reflections on the transmission line between the visual transmitter and the filter, the visual input of the filter is designed to have a constant input impedance over the band of frequencies produced by the visual transmitter. The filter sections consist of lengths of coaxial line (resonant cavities), which are adjustable for tuning purposes. As the filter is pretuned at the factory to the channel stamped on the nameplate, no operating adjustments are necessary.

MI-19085-L/HA VESTIGIAL SIDEBAND FILTER



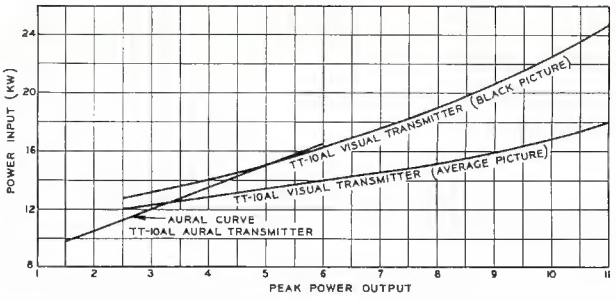
SPECIFICATIONS

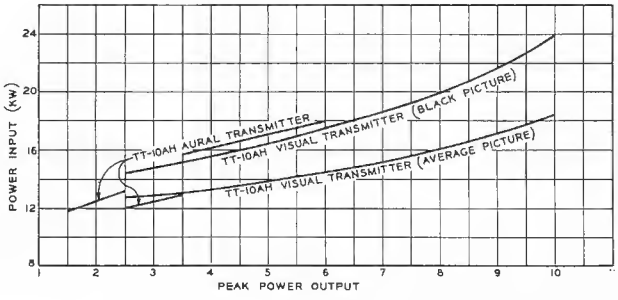
	MI-19085-L Channels 2 to 6	MI-19085-HA Channels 7-13
Frequency	54-88 mcs	174-216 mcs
Maximum Power (5000 ft. elevation)	25 kw	25 kw
Input and Output Impedance	51.5 ohms, 3 1/8" coaxial line	51.5 ohms, 3 1/8" coaxial line
VSWR	Less than 1.1	Less than 1.1
Ambient Temperature	45° C max.	45° C max.
Overall Dimensions:		
Channel 2	165"x79"x19 13/16"	
Channel 3	154 1/2"x73 3/4"x19 13/16"	
Channel 4	146"x69 1/2"x19 13/16"	
Channel 5	143 1/2"x63 3/4"x19 13/16"	
Channel 6	143 1/2"x63 3/4"x19 13/16"	
Channel 7 to 13 incl.		77"x72 7/8"x19 15/16"
Weight	930 lbs. max.	665 lbs. max.
Mounting	Wall or ceiling	Wall or ceiling
Clearance	12"	12"

SPECIFICATIONS

Performance Specifications

	Visual	*Aural*
Type of Emission	A5	F3
Frequency Range:		
TT-10AL	Chan. 2 thru 6	Chan. 2 thru 6
TT-10AH	Chan. 7 thru 13	Chan. 7 thru 13
Rated Power Output:		
TT-10AL	11 kw[1]	6 kw[2]
TT-10AH	10 kw[1]	6 kw[2]
Minimum Power Output	2.5 kw[1]	1.5 kw[2]
R-F Output Impedance	51.5 ohms	51.5 ohms
Input Impedance	75 ohms	600/150 ohms
Input Level	0.7 volt peak to peak min.	+10 ±2 dbm
Amplitude vs. Frequency Response		Uniform ±1 db from 50 to 15,000 cycles
Upper Sideband Response:[3]		
+1, −1.5 db at carrier	+0.5 mc	
+1, −1.5 db at carrier	+1.25 mc	
+1, −1.5 db at carrier	+2.0 mc	
+1, −1.5 db at carrier	+3.0 mc	
+1, −1.5 db at carrier	+3.58 mc	
+1, −3.0 db at carrier	+4.18 mc	
−20 db max. at carrier	+4.75 mc	
Lower Sideband Response:[4]		
+1, −1.5 db at carrier	−0.5 mc	
−20 db max. at carrier	−1.25 mc	
−42 db max. at carrier	−3.58 mc	
Variation in Freq. Response with Brightness[5]	±2.0 db	
Carrier Frequency Stability[6]	±1 kc	±1 kc[7]
Modulation Capability	12.5 ±2.5% (reference white)	±50 kc
Audio Frequency Distortion		1.5% max. 50-100 cy. 1.0% max. 100-7500 cy. 1.5% max. 7500-15,000 cy.
FM Noise, Below ±25 kc Swing		60 db
AM Noise, rms	40 db below 100% mod.	50 db below carrier
Amplitude Variation Over One Picture Frame	Less than 5% of the peak of sync level	
Regulation of Output	7% max.	
Burst vs. Subcarrier Phase[8]	±7 degrees max.	
Subcarrier Phase vs. Brightness[9]	±7 degrees max.	
Subcarrier Amplitude[8]	±15% max.	





Linearity (Differential Gain)[10]	15% max.	
Envelope Delay vs. Frequency[11]	±.08 μsec. from 0.2 to 2.1 mc ±.04 μsec. at 3.58 mc ±.08 μsec. at 4.18 mc	
Harmonic Attenuation, ratio of any single harmonic to peak visual fundamental	At least 60 db	At least 60 db

Electrical Specifications

Power Line Requirements:

Transmitter:

Line	230/208 volts, 3 phase, 50/60 cycles
Slow Line Variations	±5% max.
Rapid Line Variations	±3% max.
Regulation	3% max.
Power Consumption	See curve
Power Factor (approx.)	90%

Crystal Heaters:

Line	115 volts, single phase, 50/60 cycles
Power Consumption	61 watts

[1] Measured at the output of the sideband filter or filterplexer.

[2] Measured at the input to the diplexer or filterplexer.

[3] With respect to the response at 200 kc, as measured by the BW-5A Sideband Response Analyzer at transmitter mid-characteristic. 4.75 mc attenuation requires use of MI-27132 LP filter in the video input circuit.

[4] With respect to the response at 200 kc at transmitter mid-characteristic.

[5] Maximum variation with respect to the response at mid-characteristic measured with the BW-5A Sideband Response Analyzer at brightness levels of 22.5% and 67.5% of sync peak, using approximately 20% (peak to peak) modulation.

[6] Maximum variation for a period of 30 days without circuit adjustment.

[7] Maximum variation with respect to the standard 4.5 mc separation between aural and visual carriers.

[8] Maximum departure from the theoretical when reproducing saturated primary colors and their complements at 75% amplitude. A properly terminated TA-7 Stabilizing Amplifier is required in the video input circuit.

[9] Maximum phase difference with respect to burst, measured after the VSBF, for any brightness level between 75% and 15% of the Sync peak using 10% (peak to peak) modulation. This is equivalent to 5% (peak to peak) modulation as indicated by a conventional diode demodulator.

[10] Maximum variation in the amplitude of a 3.58 mc sine wave modulating signal as the brightness level is varied between 75% and 15% of sync peak. The gain shall be adjusted for 10% (peak to peak) modulation of the 3.58 mc signal when the brightness is at pedestal level. This is equivalent to 5% (peak to peak) modulation as indicated by a conventional diode demodulator connected after the VSBF. A properly terminated TA-7 Stabilizing Amplifier is required in the video input circuit.

[11] Maximum departure from standard curve. The tolerances vary linearily between 2.1 and 3.58 mc and between 3.58 mc and 4.18 mc. To meet the specification a properly terminated phase correction network, ES-34034-A is required in the video input circuit of the transmitter.

SPECIFICATIONS (Cont'd)

Tube Complements

TT-10AL Transmitter VISUAL SECTION Qty.	Type	Function	TT-10AH Transmitter VISUAL SECTION Qty.	Type
1	6V6-GT	Crystal Oscillator	1	6V6-GT
1	6V6-GT	Tripler	1	6V6-GT
1	6V6-GT	Doubler	1	6V6-GT
1	6146	Amplifier	1	6146
1	4-65A	IPA ....Tripler	1	4-65A
—	—	IPA	1	4X500A
1	4-1000A	Driver	1	5762
1	6166	Modulated Amplifier	1	6166
1	6CL6	1st Video Amplifier	1	6CL6
1	6CL6	2nd Video Amplifier	1	6CL6
2	807	3rd Video Amplifier	2	807
1	5651	D-C Off Set	1	5651
7	6146	Modulator	7	6146
1	6CL6	Video Monitor	1	6CL6
1	6U8	Sync Separator	1	6U8
1	6CL6	Sync Amplifier	1	6CL6
1	6U8	Clipper-Pulse Former	1	6U8
1	6CL6	Phase Splitter	1	6CL6
1	6AL5	Clamp Diode	1	6AL5
1	6AL5	D-C Restorer	—	
4	6AS7-G	Voltage Regulator	4	6AS7-G
4	6146	Voltage Regulator	4	6146
2	6SL7-GT	Regulator Control Amp.	2	6SL7-GT
3	OA2	Voltage Regulator	3	OA2
10	OB2	Voltage Regulator	10	OB2
4	OC3	Voltage Regulator	4	OC3
2	OD3	Voltage Regulator	2	OD3
3	673	Rectifier	3	673
4	8008	Rectifier	4	8008
2	866-A	Rectifier	2	866-A
3	5R4GY	Rectifier	3	5R4GY
2	6AL5	Reflectometer	2	6AL5
1	2D21	Reflectometer	1	2D21
AURAL SECTION			AURAL SECTION	
1	12AT7	Crystal Oscillator	1	12AT7
1	12AT7	Pulse Shaper	1	12AT7
1	12AT7	Sawtooth Generator	1	12AT7
1	12AT7	Sawtooth Modulator	1	12AT7
1	6AU6	Quadrupler	1	6AU6
1	6AU6	Amplifier	1	6AU6
1	6AU6	Doubler	1	6AU6
1	6AU6	Doubler	1	6AU6
1	6AU6	Tripler	1	6AU6
*1	12AT7	Tripler or Doubler-Doubler	1	12AT7
1	5763	Tripler	1	5763
1	6146	Amplifier	1	6146
1	12AX7	Audio Amplifier	1	12AX7
1	12AU7	Audio Amplifier	1	12AU7
1	4-65A	IPA ....Tripler	1	4-65A
—	—	IPA	1	4X500A
1	4-1000A	Driver	1	5762
1	6166	Power Amplifier	1	6166
1	OA2	Voltage Regulator	1	OA2
1	OB2	Voltage Regulator	1	OB2
3	673	High Voltage Rectifier	3	673
4	8008	Rectifier	4	8008
2	5R4GY	Rectifier	2	5R4GY
2	6AL5	Reflectometer	2	6AL5
1	2D21	Reflectometer	1	2D21

* This tube is used as a tripler for channels 2-4 and 7-13 (2 sections in parallel). For channels 5-6 it is used as two doublers.

Mechanical Specifications

Dimensions:
- Overall Length ..... 195"
- Overall Height ..... 84"
- Overall Depth ..... 32 5/16"

Weight (approx.) ..... 6000 lbs.

Finish ..... Two tone umber gray with polished stainless steel trim and fittings

Maximum Altitude[1] ..... 7500 ft.

Ambient Temperature ..... 45°C max., 10°C min.

Equipment Supplied

TT-10AL TRANSMITTER ES-19231 Qty.	Stock #	Description	TT-10AH TRANSMITTER ES-19232 Qty.	Stock #
1	MI-19320	R-F Aural Amplifier	1	MI-19330
1	MI-19325-C	R-F Visual Amplifier and Modulator	1	MI-19333-C
1	MI-19321	Aural Driver Chain	1	MI-19331
1	MI-19324	Visual Driver Chain	1	MI-19332
1	MI-19322	Aural Control Unit	1	MI-19322
1	MI-10323-A	Visual Control Unit	1	MI-19323-A
2	MI-19329	Transformers	2	MI-19329
2	MI-19346	Blower Units	2	MI-19346
2	MI-19335	Motor Starters	2	MI-19335
1	MI-28061	Set of End Shields (2 per set)	1	MI-28061
2	MI-19087	Monitoring Units	2	MI-19088
1	MI-19051-B	Monitoring Diode	1	MI-19051-B
1	MI-19337	Set of Installation Material	1	MI-19347
1	MI-19336	Set of Wiring Material	1	MI-19336
1	MI-28153	Finish Touch-Up Kit	1	MI-28153
2	MI-19450-A[2]	Type TMV-129-G Aural Crystal Units (1 spare)	1	MI-19450-A[2]
2	MI-19400-L4[2]	Type TMV-129-P Visual Crystal Units (1 spare)	1	MI-19400-L4[2]
1	ES-19233-B	Set of Operating Tubes	1	ES-19235-B
1	MI-19085-L[2]	Vestigial Sideband Filter	1	MI-19085-HA[2]
*	MI-19113-B	Transmission Line (*Sales order to specify quantity to suit installation requirements)	*	MI-19113-B
2	MI-27317[2]	Harmonic Filters	2	MI-27317[2]
1	MI-27132	Low Pass Video Filter	1	MI-27132
1	MI-7474	Miscellaneous Hardware Kit	1	MI-7474
1	MI-28180-1	Nameplate	1	MI-28180-1
2	IB-36119	Installation Instruction Books and Color Supplements	2	IB-36118CS
2	IB-36101	Instruction Books and Color Supplements	2	IB-36102CS

Optional or Accessory Equipment

ES-19240-A	TTC-1C Console with Master Monitor, but less Master Monitor Power Supply	ES-19240-A
MI-19199-L[2]	R-F Load and Wattmeter	MI-19199-H[2]
ES-19237-A/B	Color Input and Monitoring Equipment Wired/Unwired	ES-19237-A/B
ES-19203A/B	Input and Monitoring Equipment Wired/Unwired	ES-19203A/B
MI-19391[2]	Diplexer	MI-19391[2]
MI-19339	50 Cycle Conversion Kit	MI-19339
ES-19233-B	Set of Complete Spare Tubes	ES-19235-B
ES-19234-B	Set of FCC Spare Tubes	ES-19236-B
ES-34010	BW-5B Sideband Response Analyzer	ES-34010
MI-19326	FM Exciter Modulator and Power Supply	MI-19327
MI-27117	Tube Kit for Exciter and Power Supply	MI-27117
EM-6245Y	Voltage Regulator	EM-6245Y
——	Hum-Bucking Kit	MI-19349

[1] For operation at rated power and normal plate voltage.
[2] Order to suit customer's assigned frequency.

25 KW VHF AMPLIFIERS

TYPE TT-25BL/BH

FEATURES

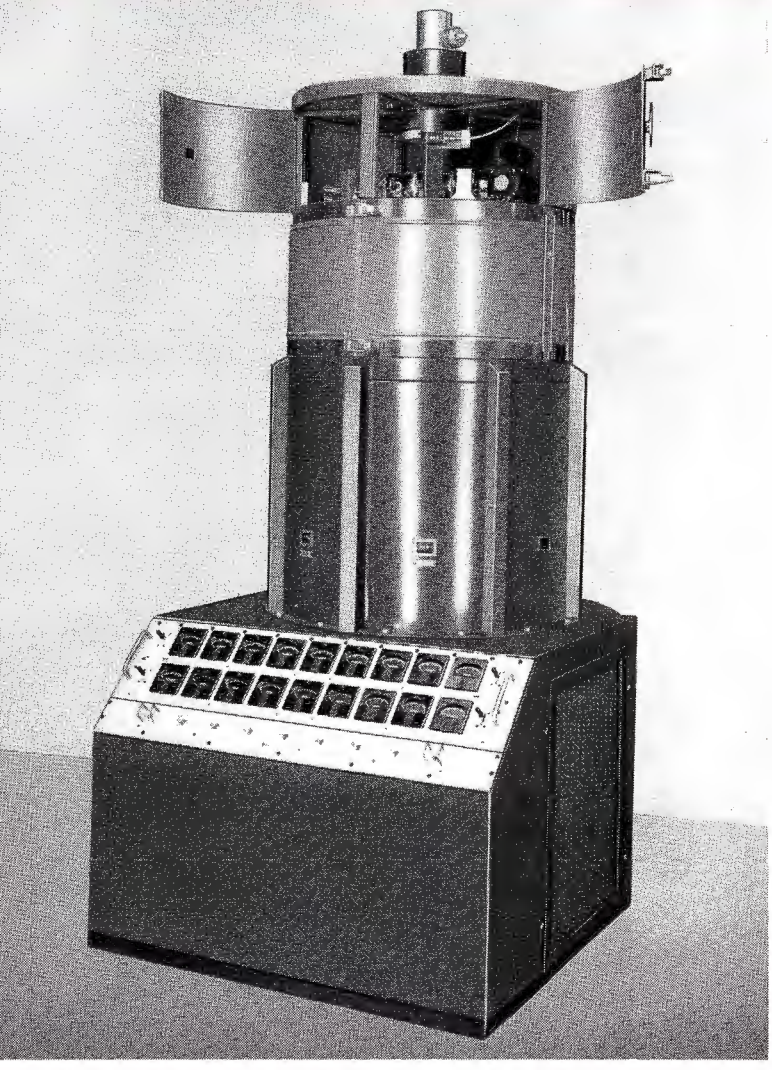
- Visual power output 25 kw peak measured at output of sideband filter or Filterplexer
- Air-cooled tubes—air-cooled transformer
- Low tube cost—easy tube change
- Utmost accessibility
- Flexible location of individual units to meet specific customer requirements
- Complete metering for all amplifier tubes
- Important amplifier meters are repeated on control unit
- High speed a-c and d-c overload protection
- Simple, single-ended r-f circuits
- Economical installation costs—low operating costs
- Vestigial sideband characteristics determined by fixed-tuned, trouble-free, factory adjusted sideband filter

USES

The 25 KW VHF Amplifiers are high-power equipments designed to convert RCA TT-10AL/AH television transmitters for higher power operation. The Type TT-25BL Amplifier is specified for use on low band channels 2 through 6, and the Type TT-25BH is used for channels 7 through 13. The amplifiers may also be used to convert the RCA type TT-5A Transmitter and other 5 to 10 kw television transmitters meeting FCC and RETMA specifications.

The amplifiers are designed to provide class "A" monochrome or color coverage for large urban centers. They are capable of up to 25 kilowatts peak visual power measured at the output of the sideband filter and 14 to 15 kw aural power. Maximum performance is necessarily dependent upon and governed by the performance of those portions of the transmitter preceding the amplifier. When used in conjunction with standard RCA superturnstile or super-gain antennas, the amplifiers permit TV stations to achieve present maximum power ratings established by the FCC.

The amplifiers provide an economical method of increasing station power as required. Full power output can be achieved on all channels at low dollar per hour operating cost. Unit construction of the add-on amplifiers allows utmost flexibility of layout and best use of existing station floor space.



External view of the high band amplifier for channels 7 to 13.

DESCRIPTION

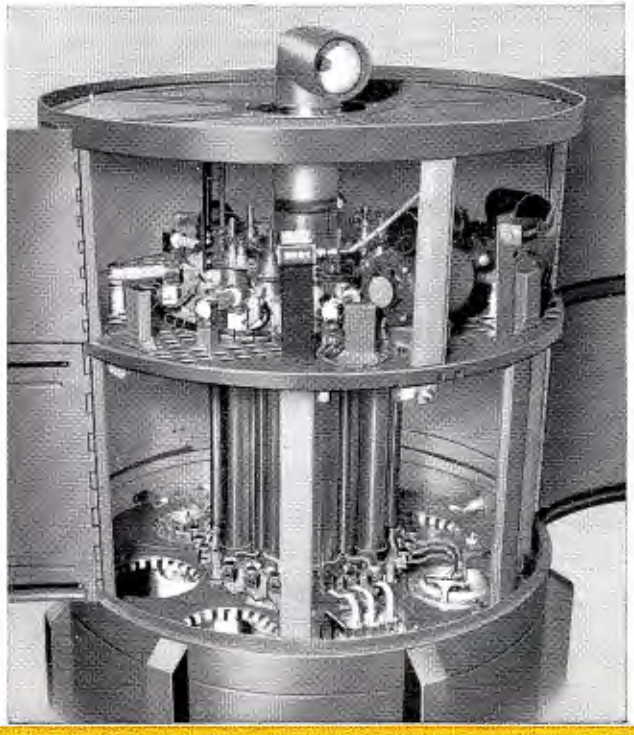
All RCA amplifier equipments include air-cooled linear broad-band amplifiers for the visual carrier, and air-cooled class "C" amplifiers for the aural carrier. Each amplifier consists of a single power stage utilizing a cluster of seven air-cooled RCA type 5762 Triodes in a grounded-grid circuit. Fewer operating tubes can be used in the aural amplifier for reduced power operation.

The complement of equipment includes dual r-f amplifier and blower units, power supplies, control units, and plate transformers—one of each for both the aural and visual sections of the driver. The equipment is housed in cabinets which are divided so that flexibility is afforded in arranging the components.

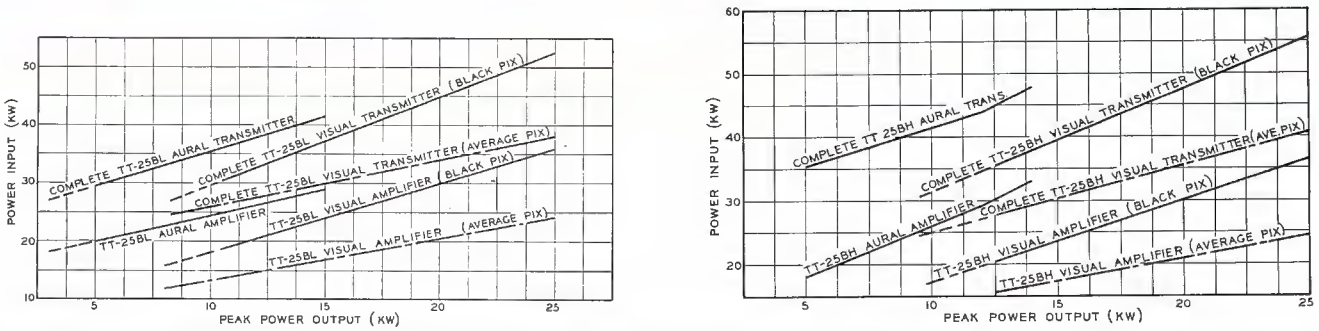
The amplifiers are housed in cylindrical cabinets which provide complete accessibility to all tubes as well as their circuit components. The amplifier base houses the blower, filament transformers, meters, and tuning controls. Air for cooling the tubes is drawn in through two filters on the sides of the bottom section and is expelled out the top of the unit.

The power supplies and control and distribution equipment for the amplifiers is housed in four cabinets identical in size and styling with the cabinets of the RCA type TT-10AL/AH Transmitters. These cabinets may be placed either in line with or away from the TT-10AL/AH. Since the two power supply cabinets do not contain any operating controls or meters, they can be mounted either with the other cabinets or in the rear of existing equipment. Two high-voltage grounding hooks are located in each power supply cabinet. Front and rear doors and removable panels are a feature of each cabinet. They allow a maximum of accessibility to maintenance and service personnel.

The ES-19247 Amplifier contains tunable tank circuits to cover channels 2 to 6 inclusive, and the ES-19248 equipment contains tank circuits to cover channels 7 to 13 inclusive. The video and audio signals are fed to the driver and the modulation occurs in this unit. The r-f output from the visual driver is fed to the class "B" linear amplifier. The aural amplifier is similar to the visual amplifier, except that it is frequency modulated and therefore operated class "C". The visual amplifier has sufficient bandwidth so that it can easily reproduce the picture information from the driver transmitter.



Closeup showing the cluster of seven air-cooled 5762 triodes used in the 25 kw amplifier equipment.

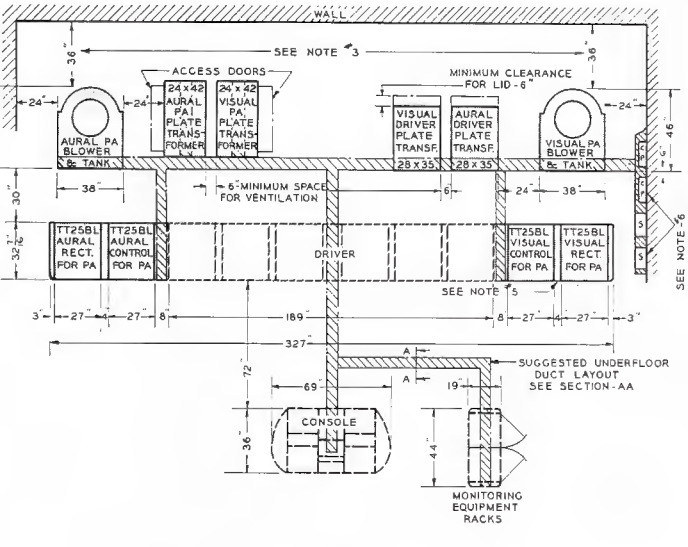


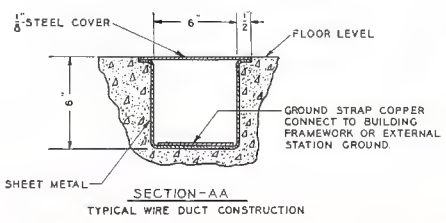
Power consumption curves showing approximate Power Input vs. Peak Power Output of the TT-25BL and the TT-25BH Visual and Aural Transmitters.

Diode monitors are included so that tuning and monitoring may be accomplished at both the input and output levels. A reflectometer is included for both the aural and the visual transmitters. This unit, which may be inserted at any convenient place in the output line, is designed to directly read percent deviation from assigned power, and standing wave ratio. RCA transmitters adding 25 kw amplifiers must have a vestigial sideband filter capable of handling 25 kw in the visual portion.

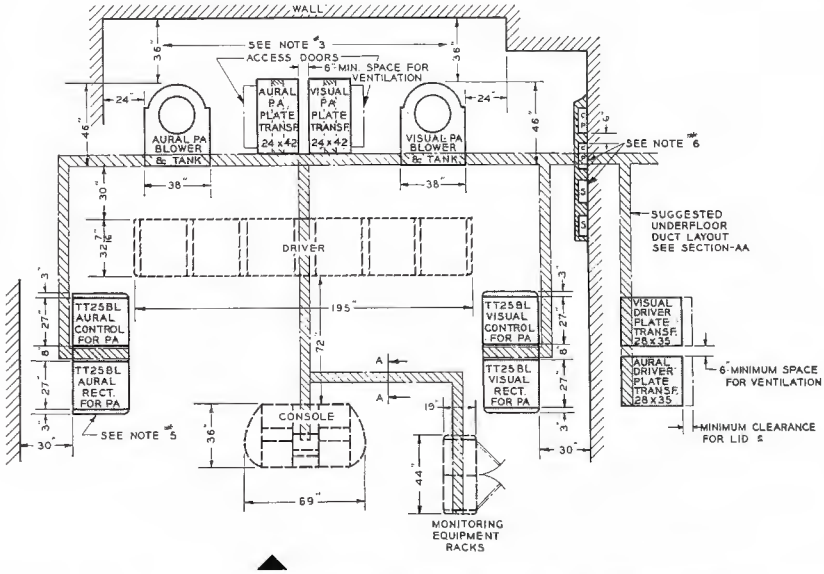
The control equipment is of conventional design. The overload system has an automatic reset feature. After an overload occurs the plate voltage is removed momentarily, then automatically returned twice. If the overload persists for the third time the plate voltage will remain cut off. All circuits such as the filament bus, the blower, and the bias supply are protected by breakers with thermal-magnetic trips. The control equipment for the aural and visual transmitters is identical, and is arranged so that either r-f amplifier may be turned on and off independently.

Except for the bias supply and slight differences in the high-voltage filter, the power supplies for the aural and visual amplifiers are identical. The high-voltage rectifiers employ six RCA 673 mercury vapor rectifier tubes in a double 3-phase half-wave circuit with a balance coil. The bias supply for the visual amplifier is well regulated, its output voltage remaining constant for large changes in grid current. The bias for the aural amplifier is essentially obtained from grid leaks with just enough fixed bias to protect the tubes when there is no drive.





Popular "in-line" arrangement in which both the rectifier and control cabinets are located with the driver cabinets.



The TT-25BL/BH amplifier unit in a "U" type arrangement. The six center cabinets correspond to the 10-kw VHF transmitter—with one power control and one rectifier cabinet at either end. Power amplifier tanks and plate transformers are located directly behind the transmitter cabinets. Shaded areas indicate amplifier units.

SPECIFICATIONS

Performance Specifications[1]

	Visual	Aural
Type of Emission	A5	F3
Frequency Range:		
ES-19247	Channels 2-6	Channels 2-6
ES-19248	Channels 7-13	Channels 7-13
Rated Power Output:		
ES-19247 (with 5 kw or more drive)	25 kw	15 kw
ES-19248 (with 5 kw drive)	20 kw	12 kw
ES-19248 (with 6 kw or more drive)	25 kw	14 kw
Input Power Level:		
ES-19247	5 kw	3 kw
ES-19248	6 kw	3.5 kw
R-F Output Impedance	51.5 ohms	51.5 ohms
R-F Input Impedance	51.5 ohms	51.5 ohms
Frequency Response:		
±1 db at carrier +0.5 mc[2]		Uniform ±1 db from 50 to 15,000 cycles
±1 db at carrier +1.25 mc		
±1 db at carrier +2.0 mc		
±1 db at carrier +3.0 mc		
±1 db at carrier +3.58 mc		
±1, −1.5 db at carrier +4.18 mc		
Variation in Frequency Response with Brightness[3]	±1½ db	
AM Noise, rms	50 db below 100% mod.	60 db below carrier
Amplitude Variation Over One Picture Frame	Less than 2% of the peak of sync level	
Regulation of Output	4% max.	
Linearity (Differential Goin)[4]	15% max.	

Electrical Specifications

Power Line Requirements:
- Line: 208/230 volts, 3 phase, 60 cycles
- Slow Line Variations: ±5% max.
- Rapid Line Variations: ±3% max.
- Regulation: 3% max.
- Power Consumption: See curve
- Power Factor (approx.): 90%

Tube Complement

VISUAL SECTION ES-19247 AMPLIFIER Qty.	Type #	Function	VISUAL SECTION ES-19248 AMPLIFIER Qty.	Type #
7	5762	Visual Linear Amplifier	7	5762
6	673	High Voltage Power Supply	6	673
1	5R4GY	Bias Supply	1	5R4GY
7	6AS7G	Bias Supply	7	6AS7G
1	6SH7	Bias Supply	1	6SH7
2	OD3	Bias Supply	2	OD3
1	OA3	Bias Supply	1	OA3
2	6AL5	Monitor	2	6AL5
1	2D21	Manitor	1	2D21

AURAL SECTION Qty.	Type #	Function	AURAL SECTION Qty.	Type #
7	5762	Aural Amplifier	7	5762
6	673	High Voltage Power Supply	6	673
1	5R4GY	Bias Supply	1	5R4GY
2	6AL5	Monitor	2	6AL5
1	2D21	Monitor	1	2D21

Mechanical Specifications

Dimensions: (For dimensions see floor plans)
Weight (approx.):
- Aural and Visual Power Amplifier and Blower, each: 1100 lbs.
- Aural and Visual Power Supply and Filter: 1100 lbs.
- Aural and Visuol Control Unit, each: 1000 lbs.
- Aural and Visual Plate Transformer, each: 1050 lbs.

Finish: Two tone umber gray with brushed chrome trim and fittings
Maximum Altitude[5]: 5000 ft.
Ambient Temperature: 45°C max., 10°C min.

Equipment Supplied

ES-19247 AMPLIFIER (Channels 2-6) Qty.	Stock #	Description	ES-19248 AMPLIFIER (Channels 7-13) Qty.	Stock #
2	MI-19065	R-F Amplifier Units	2	MI-19066
2	MI-19067	R-F Amplifier Base Units	2	MI-19067
2	MI-19068	Blower Units	2	MI-19068
2	MI-19367	Control Units	2	MI-19367
1	MI-19368	Visual Rectifier Unit	1	MI-19368
1	MI-19369	Aural Rectifier Unit	1	MI-19369
2	MI-19072-A	High Voltage Transformers	2	MI-19072-A
2	MI-19087	Monitoring Units	2	MI-19088
1	MI-19051-B	Monitoring Diode	1	MI-19051-B
2	MI-27318[6]	Harmonic Filters	2	MI-27318[6]
2	MI-19181-A	Driver Reflectameter Meters (0-20 micro-amp.)	2	MI-19181-A
1	MI-19380	Set of Installation Material	1	MI-19380
1	MI-19076	Set of Wiring Material	1	MI-19076
*	MI-19113-B	Transmission Line (*Supply quantity to suit installation requirements as specified on sales arder)	*	MI-19113-B
—	———	Transformers	2	MI-19111-11[6]
*	MI-19314-18NF	Elbows (*Supply 2 if specified on sales arder)	2	MI-19111-2
*	MI-19314-7	Coupling (*Supply 2 if specified on sales order)	—	———
1	MI-19078-A[6]	Set of Frequency Determining Parts	—	———
1	MI-28153	Finish Touch-Up Kit	1	MI-28153
1	ES-19229	Set of Equipment Tubes	1	ES-19229
1	MI-28180-1	Nameplate	1	MI-28180-1
1	MI-7474	Miscellaneous Hardware Kit	1	MI-7474
2	IB-36150	Instruction Books	2	IB-36152
2	IB-36151	Installation Instruction Books	2	IB-36153

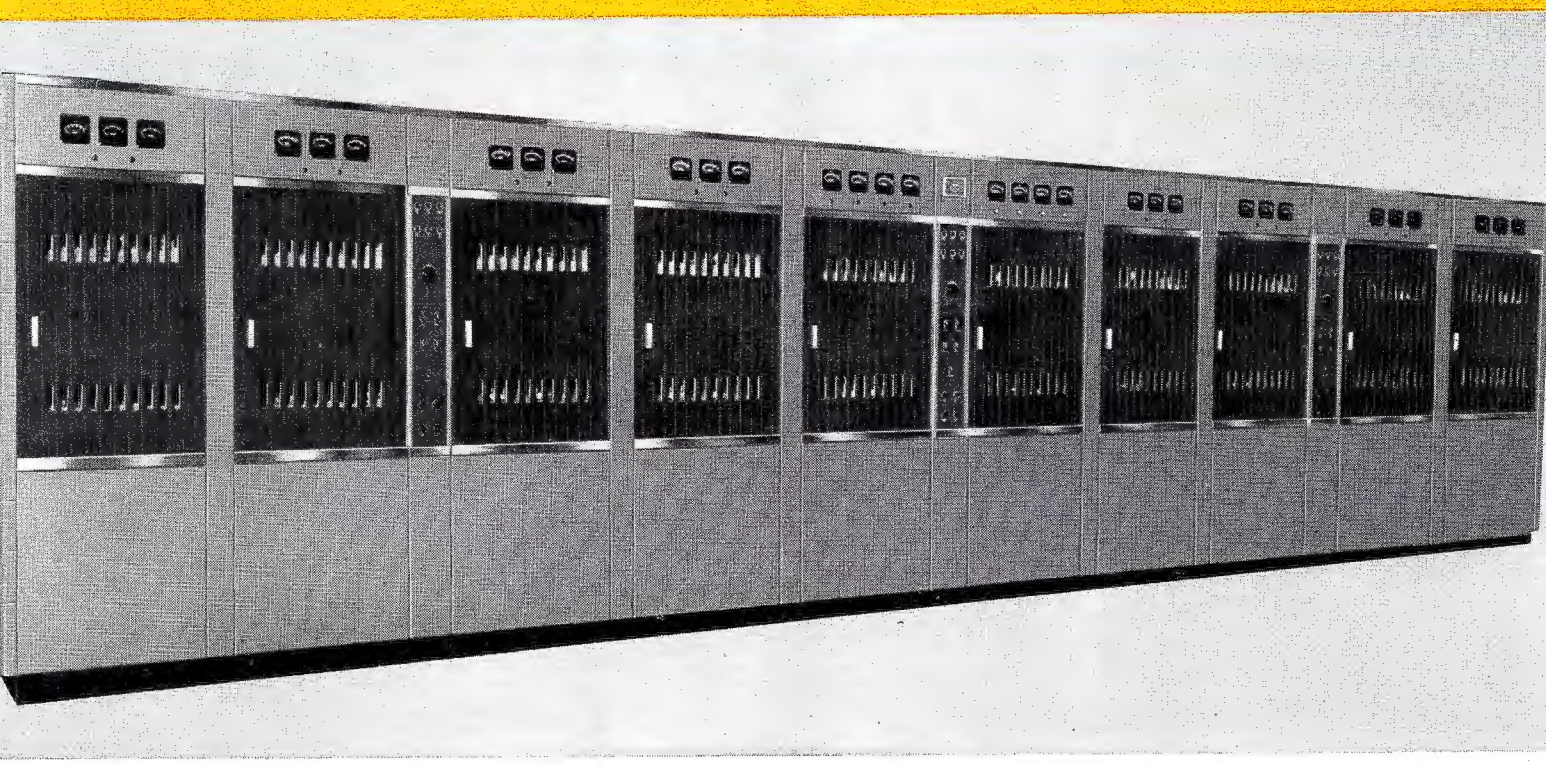
Optional and Accessory Equipment

MI-19391[6]	Diplexer	MI-19394[6]
MI-19193-L	R-F Load and Wattmeter	MI-19193-H
ES-34010	BW-5A Sideband Response Analyzer	ES-34010
ES-19229	Set of Complete Spare Tubes	ES-19229
ES-19230	Set of FCC Spare Tubes	ES-19230
MI-28061	Set of End Shields (2 per set)	MI-28061
MI-19365	Set of 4-inch Channels (1 front and 1 rear)	MI-19365
MI-19057-A	Coupling Unit (for use with BW-5A)	MI-19057-A
MI-21200-C1	Plate Current Meter	MI-21200-C1
MI-19085-L[6]	25 kw Vestigial Sideband Filter	MI-19085-HA[6]
MI-27132	Law Pass Videa Filter	MI-27132
EM-6270-D	Voltage Regulator	EM-6270-D

[1] The overall performance of a TV transmitter using the ES-19247/19248 amplifier is necessarily dependent upon and governed by the performance of those portions of the transmitter preceding the amplifier.
[2] With respect to the response at 200 kc, as measured by the BW-5A Sideband Response Analyzer at transmitter mid-characteristic. 4.75 mc attenuation requires use of MI-27132 LP Filter in the video input circuit.
[3] Maximum variation with respect to the response at mid-characteristic measured with the BW-5A Sideband Response Analyzer at brightness levels of 22.5% and 67.5% of sync peak, using approximately 20% (peak to peak) modulation.
[4] Without correction. The correction circuits are normally applied in or ahead of the video modulator in the driver. Measured at 3.58 mc with increments not larger than 10% between 15% and 75% of peak of sync voltage.
[5] For operation at rated power and narmal plate voltage.
[6] Order to suit customer's assigned frequency.

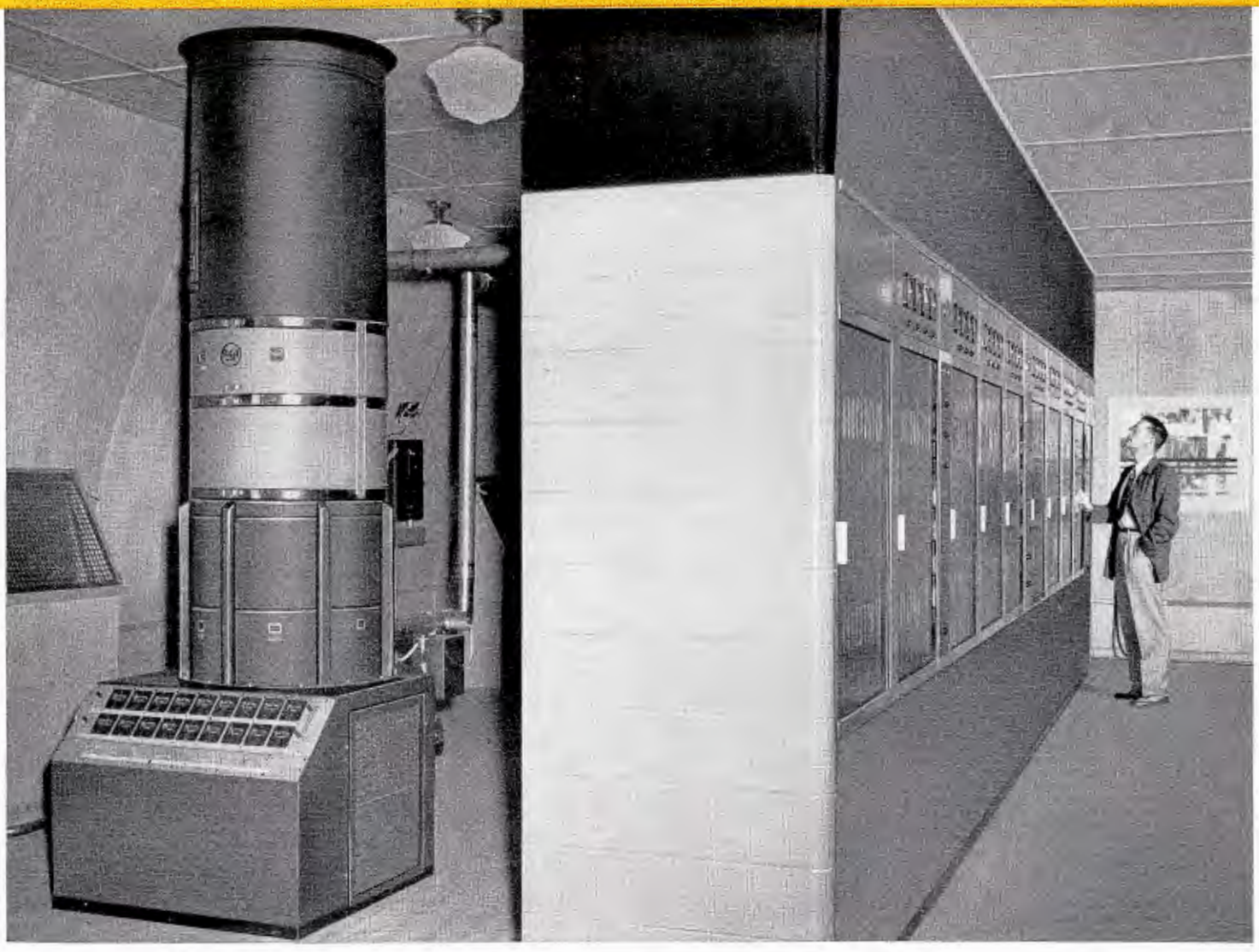
VHF TRANSMITTERS

TYPES TT-25BL & 25BH



FEATURES

- Visual transmitter power output 25 kw peak measured at output of sideband filter or Filterplexer
- Air-cooled tubes—air-cooled transformers
- Economical installation costs—low operation costs
- Single-ended r-f circuits reduce number of tubes and circuit components
- Fewer r-f stages
- Excellent video frequency response—better than RTMA requirements
- Visual carrier frequency stability ±1000 cycles for best utilization of offset carrier operation
- Meets FCC and RETMA Standards for monochrome and color
- Vestigial sideband characteristics determined by fixed-tuned, trouble-free, factory-adjusted sideband filter
- High-speed a-c and d-c overload protection
- Reduced floor space—sliding doors require no space for door swing
- Small—easily handled cubicles, 28 inches wide by 32 inches deep by 84 inches high
- Long-life, high power tubes



Full length view of KBTV's new 25-KW VHF transmitter (RCA TT-25BH). At left is one of the high power amplifiers.

USES

The TT-25BL and TT-25BH television broadcast transmitters are designed to provide class "A" monochrome or color coverage for large urban centers. They provide a nominal power output of 25 kilowatts peak visual power measured at the output of the sideband filter and 15 kw peak aural power on channels 2-6 or 14 kw peak aural power on channels 7-13 in conformance with FCC and RETMA Standards.

The TT-25BL/BH Transmitters utilize the standard TT-10-AL/AH equipments as drivers for the 25 kw amplifiers. The driver sections are operated conservatively at approximately 6 kw output, resulting in longer life of tubes and other components. The transmitters are air-cooled throughout.

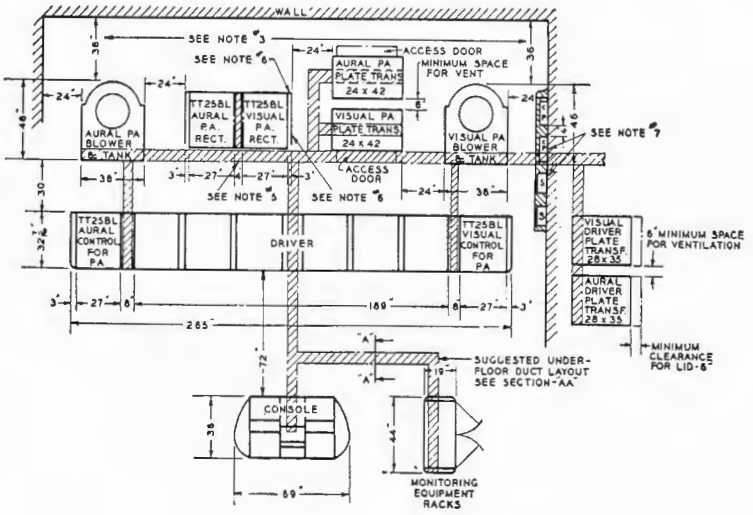
Stations may begin operation at 10 kilowatts by using only the TT-10AL/AH and later increase to 25 kw power by addition of the amplifier. This allows for logical growth of station with growth of the area served, or addition of station studios with growth of local programming. For a new station desiring to start with the maximum power the TT-25BL transmitters will provide the full 100 kw when used in connection with an RCA 6-Section Superturnstile Antenna. The TT-25BH transmitters will provide the full maximum power of 316 kw ERP when used with an RCA directional 12-Section Superturnstile Antenna.

Unitized construction of the transmitter and antenna portions of the equipment allow the broadcaster utmost latitude in arrangement layout. Three typical types of installation are shown in accompanying floor diagrams, but numerous variations will suggest themselves to the station engineer.

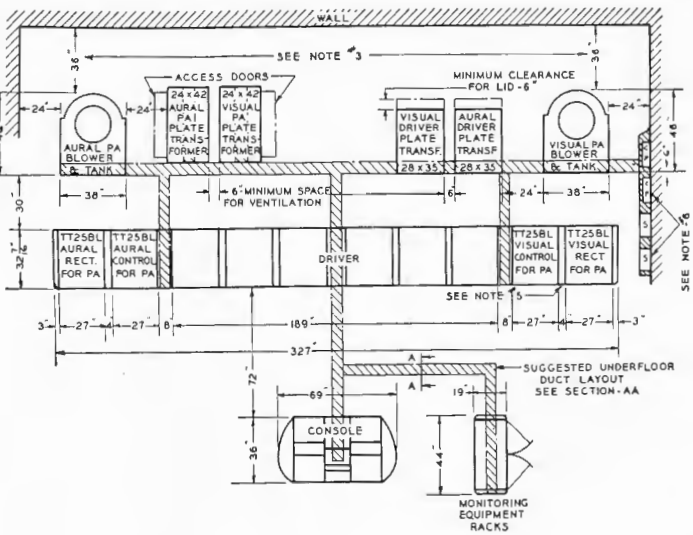
DESCRIPTION

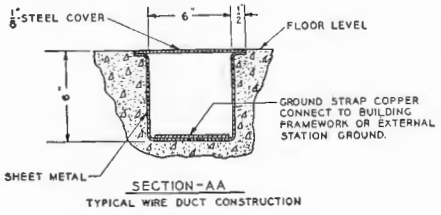
The TT-25BL/BH VHF Television Transmitter is housed in ten cubicles with modern roll-back doors, of which six comprise the 10-kilowatt driver. The four additional cabinets house the control and rectifier units for the aural power amplifier and the control and rectifier units for the visual power amplifier respectively. The aural and visual power amplifiers are self-contained units housed in cylindrical cabinets which provide complete accessibility to all tubes as well as their circuit components. The two transformers for the driver and two high-voltage transformers for the power amplifiers are also housed as separate units.

An "in-line" arrangement of the six driver cabinets with a visual control cabinet at one end and aural control cabinet at the other. Power rectifier cabinets, PA tanks, and PA plate transformers are located behind the transmitter.

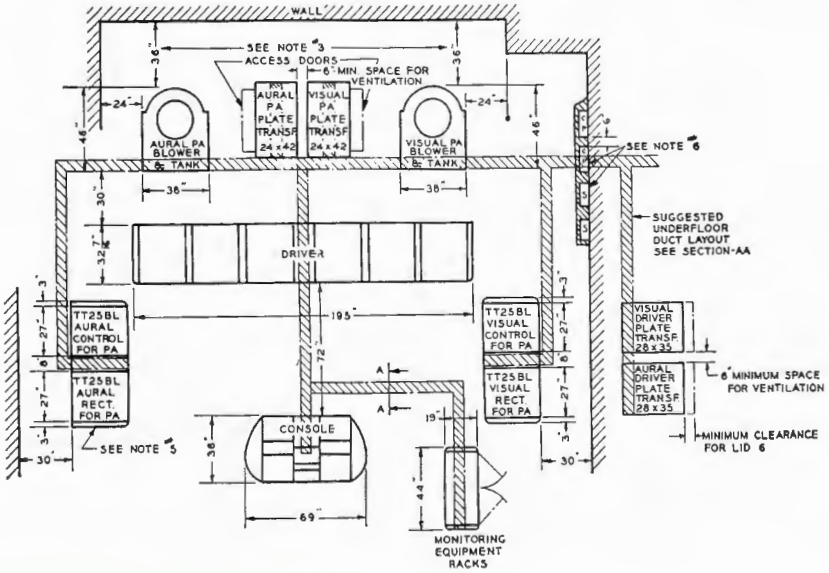


An "in-line" arrangement in which both the rectifier and control cabinets are located with the driver cabinets. The power amplifier tanks and plate transformers are located behind the transmitter.





The TT-25BL/BH VHF transmitter located in a "U" type arrangement. The six center cabinets correspond to the 10-kw VHF transmitter—with one power control and one rectifier cabinet at either end. Power amplifier tanks and plate transformers are located directly behind the transmitter cabinets.



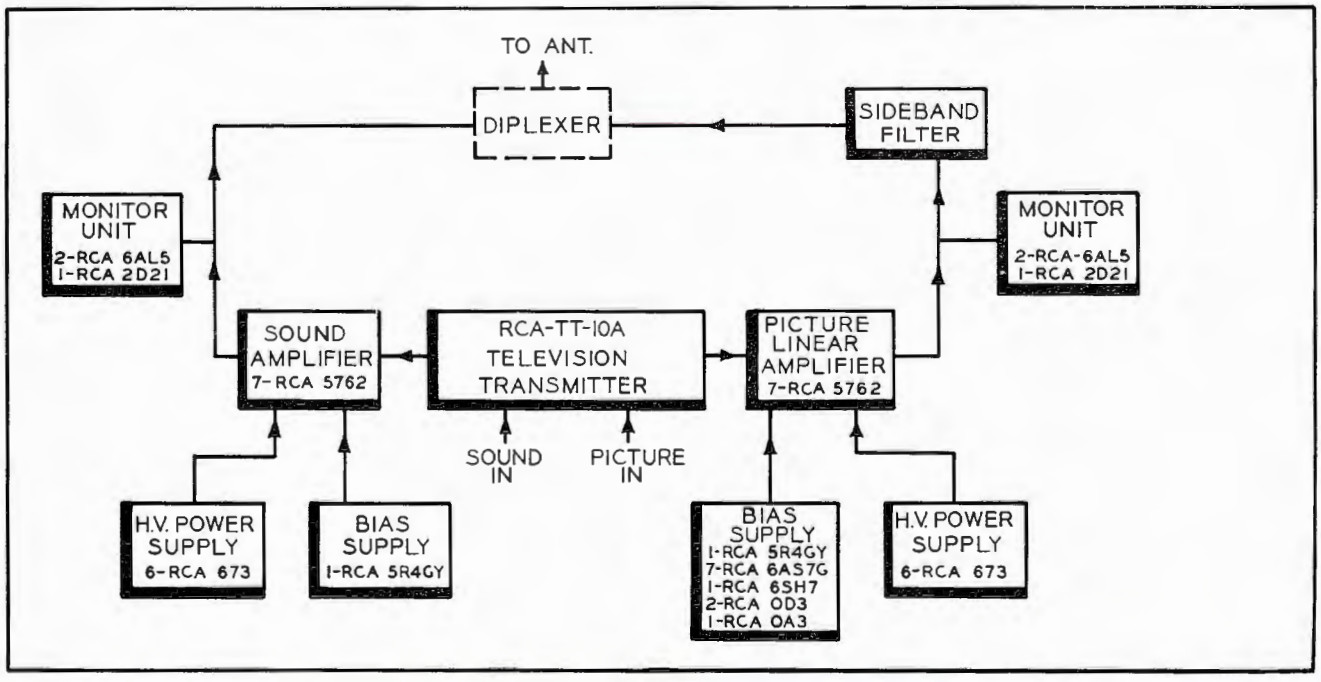
The TT-25BL/BH cabinets may be mounted adjacent to each other on rails which serve, not only as a common base frame, but also a wire trench. Connecting trim strips give a unified appearance and uniform styling to the complete assembly. If desired the cabinets can be arranged in other patterns to suit station space requirements. The sliding panel type door provides easy and complete access to components and tubes from both front and rear of each cabinet. They also add greatly to the compactness and convenience of the equipment and effect great saving in required floor space.

The components and circuitry of the aural and visual sections of the TT-25BL/BH have been kept identical as far as possible, affecting considerable saving on spare parts and simplifying maintenance and operation. Built-in wiring ducts and preformed cable harness eliminate many of the time consuming details of installation. Essential tuning controls are brought out to panel positions. Adequate metering has been provided to eliminate "guesswork" in servicing and routine tests.

All essential transmitter operating controls are duplicated at the console control panel. Key points of the system have monitoring connections so that the operator at the console may, by push button selection, monitor the aural and visual signals at various points. Diode monitors are provided so that tuning and monitoring may be accomplished at both the 10 kw and 25 kw levels. A reflectometer is included in both the aural and visual transmitters. This unit is designed to directly read percent of assigned power, and standing wave ratio. A vestigial sideband filter capable of handling 25 kw is included in the visual portion.

The r-f exciter and driver stages of the TT-25BL/BH are straightforward narrow band Class C amplifiers which can be quickly and accurately tuned by meter indications. Improved clamp circuit d-c restoration is employed with picture transmission. Provision is made for a-c modulator coupling and mid-characteristic operation during tests with sine waves, square waves, or video sweep signals. The visual amplifier has sufficient bandwidth so that it can easily reproduce the picture information from the driver transmitter.

A completely air-cooled transmitter results from the use of a VHF power tetrode tube, RCA type 6166, in the driver and seven type 5762 tubes in the power amplifier.



Block diagram of TT-25BL/BH Transmitter.

High level modulation is employed at the grid of the 6166 power amplifier stage of the driver. A vestigial sideband filter provides sideband attenuation in compliance with standards of TV transmission. This system provides the greatest possible simplicity in operation since the broad-band stages are not required to produce the vestigial characteristics thereby reducing critical tuning. This type of circuit is inherently stable over long periods of time.

Circuit Features

The r-f visual exciter unit is the same for both the TT-25BL and TT-25BH transmitters. Crystal control is used to maintain frequency accuracy to ±1 kc in the visual transmitter. This order of stability is of great importance when offset carrier operation is employed. Stability is achieved through careful application of temperature control to the crystal. The crystal is operated in a low power crystal oscillator circuit from which the output frequency is 1/6 of the assigned frequency of the TT-25BL and 1/18 the assigned frequency of the TT-25BH.

The aural exciter is also the same for both transmitters. Power output and frequency range are nearly the same as for the visual exciter, hence the succeeding amplifier stages are similar. The aural exciter is phase modulated. The crystal oscillator and pulse shaper are used to drive a linear sawtooth generator at the crystal frequency. The sawtooth wave is applied to the grid of the sawtooth modulator which is biased so that conduction starts at about half amplitude of the sawtooth, and the remaining portion is cut off level. The output of the sawtooth modulator is then a square wave, the leading edge of which is controlled in phase by the point on the sawtooth at which conduction starts. The cathode bias of the sawtooth modulator is varied by the audio voltage and the square wave output is differentiated to form phase modulated pulses. The resulting phase modulated signal, after an appropriate amount of frequency multiplication through several stages, results in an output at carrier frequency for channels 2-6, and at 1/3 of carrier frequency for channels 7-13 inclusive.

The audio amplifier of the FM exciter has a built-in pre-emphasis circuit. However the change of a single connection restores the exciter to a flat modulation response so that pre-emphasis may be inserted elsewhere in the system if desired.

The intermediate r-f amplifier circuits in the two transmitters vary somewhat. For the low-band transmitter the r-f power tube line-up following the exciter unit includes three stages: an amplifier stage operating as a straight-through amplifier, a driver stage, and an associated damping resistance load. The tube line-up for the intermediate r-f amplifier circuit of the high-band TT-25BH transmitter employs a frequency tripler, followed by two stages of straight-through amplification. In this transmitter damping is also applied at the grid circuit of the modulated power amplifier.

The amplifier tube in aural and visual drivers is an RCA type 6166 especially designed for VHF broad-band television transmission. Due to the high power capability of this tube it was possible to build a single ended power amplifier stage and take advantage of somewhat simpler construction. At the same time the need for a balun was eliminated, since the transmitter is single ended throughout.

The modulated power amplifier stage utilizes a "half wave" grid circuit, making is possible to feed the modulating voltage to the grid at a point of low r-f potential without placing a large capacitive load on the modulator. The physical form of this grid circuit varies somewhat between the BL and BH versions of the transmitter.

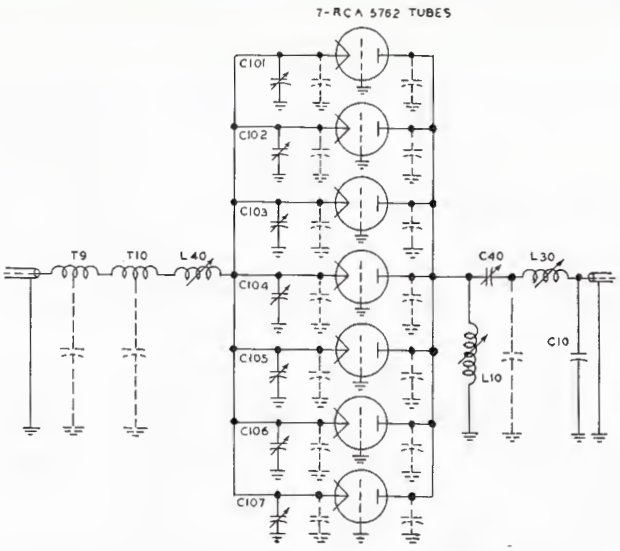
Power output indication and SWR protection of the transmitters is provided by externally mounted reflectometer units. These units attach to the 3⅛-inch output transmission line from both aural and visual units and are wired to their respective transmitter control circuits. The high voltage rectifier, which employs 3 RCA type 673 mercury vapor rectifier tubes, incorporates individual arc back indication for each tube. Should rectifier arc back occur an indicator lamp associated with the offending tube will light and remain on until the system is reset.

The modulator is particularly designed for color usage with low differential phase and high sub-carrier handling ability. It includes a back-porch clamp circuit which features a high degree of stability especially when operated with degraded input signals. The transmitter's modulator is designed to accept an input signal as low as 0.7 volt peak-to-peak and to give maximum output signal level of approximately 425 volts. This output signal is attained through the use of three video amplifiers. The first and second video amplifiers employ 6CL6 tubes, and the third video amplifier two 807 tubes connected in parallel. These video stages provide a gain of approximately 600. The modulator stage consists of seven 6146 tubes. Its mode of operation is somewhat unusual in that it is direct coupled and has a gain of unity. The output stage provides isolation between the relative high impedance of the third video amplifier and the variable impedance of the r-f amplifier grid network.

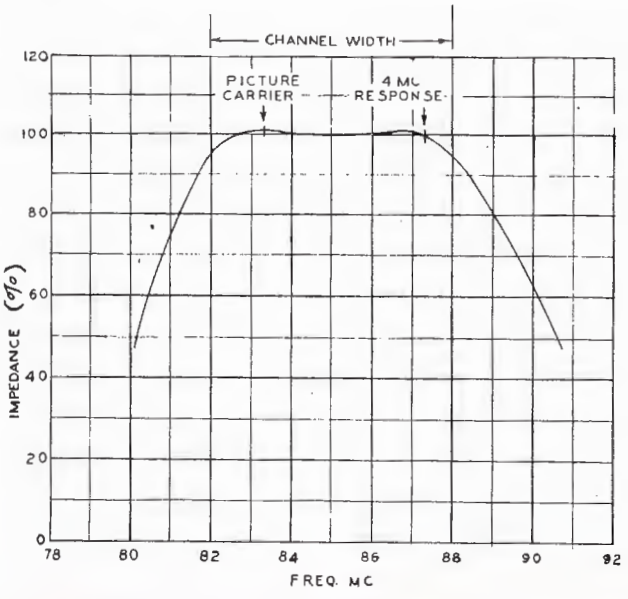
Power Amplifier Circuits

The visual r-f amplifiers for both the low-band and the high-band transmitters each employ seven RCA 5762 air-cooled tubes operating in parallel in a grounded grid circuit. The aural amplifier also contains seven RCA 5762 tubes in an almost identical circuit, however, the filaments of two of the seven tubes may be turned off if desired, leaving only five operating tubes. The general appearance of the low and high band units are similar but the internal circuits necessarily differ in several important respects.

In the low-band amplifier the plate tank circuit is tuned by the PA tank inductor. This inductance is a co-axial tank formed by the outer shell, and an inner cylinder and varied by a shorting bar located below the tubes. The shorting bar is motor driven and controlled from the front panel. The output transmission line is brought up through the center of the tank and coupled to the plate circuit through a variable capacitor which is also motor driven and controlled from the front panel. What is equivalent to a second tuned circuit is formed by inserting a shunt capacitor in the output transmission line approximately one quarter wave from the variable capacitor. This secondary circuit is tuned by sliding the shunt capacitor along the line. Inductance L-30 in the equivalent circuit is actually the first quarter wave of the output transmission line. By a suitable selection of the value of capacitor C-10 and proper adjustment of coupling capacitor C-40 a broad-band flat-topped circuit can be obtained. The optimum circuit has been found to be 8½ to 10 megacycles wide between half power points and almost flat over the six megacycle channel.



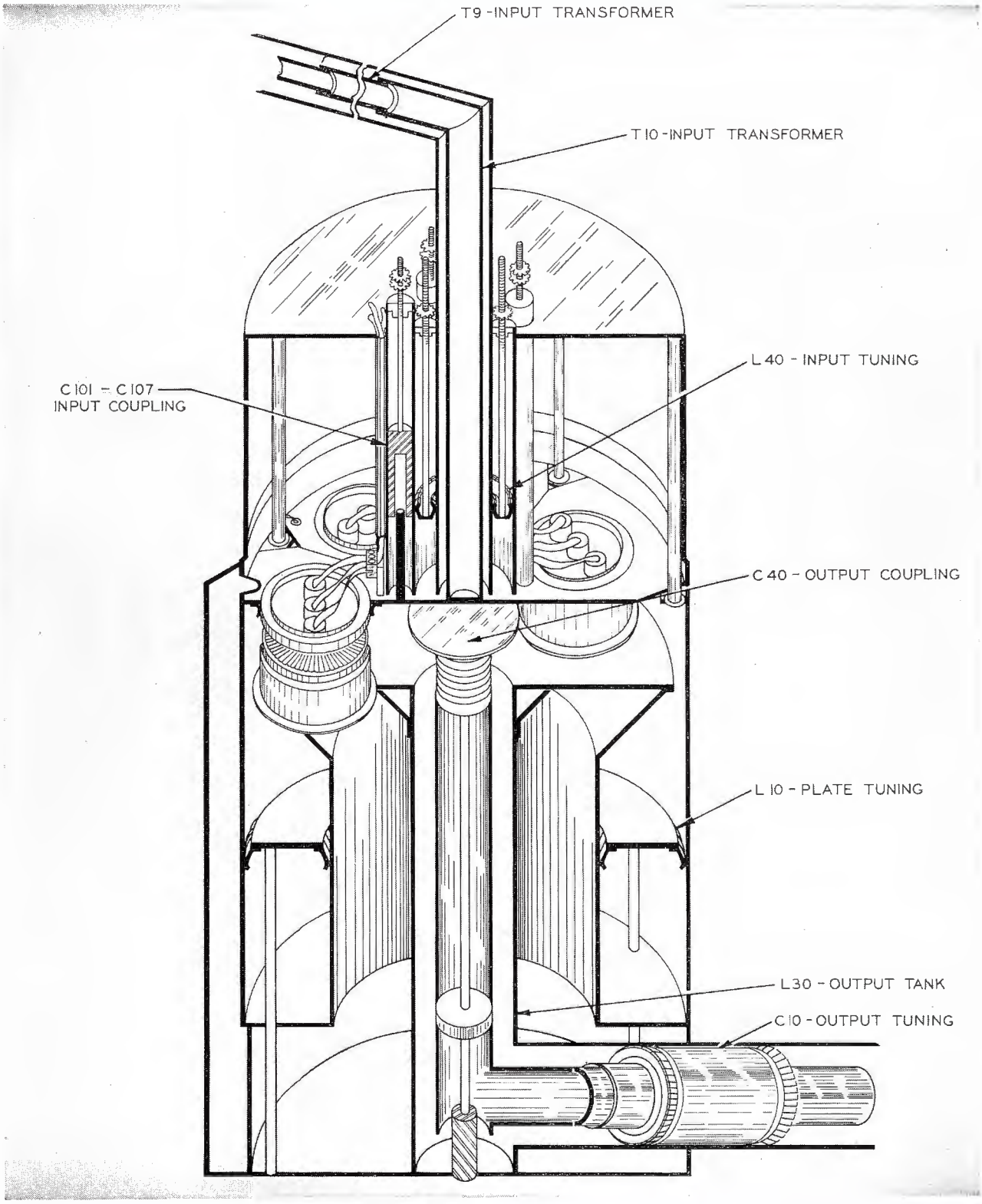
Simplified equivalent circuit of the 25 kw (low band amplifier).



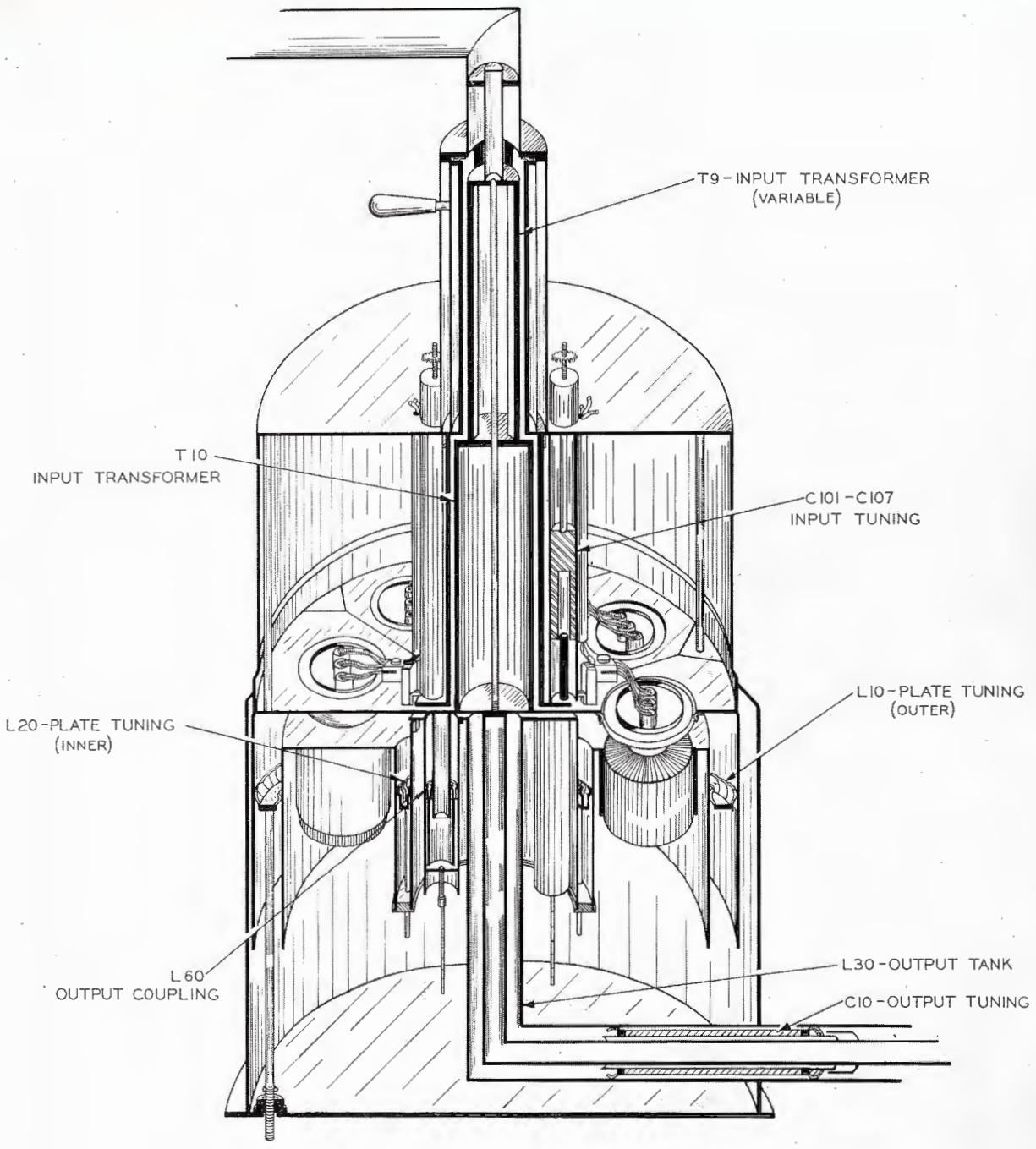
Curve showing typical response of 25 kw output circuit, channel 6.

The input or cathode circuit is also essentially a co-axial tank circuit tuned by a shorting bar. In the equivalent circuit this is shown as a variable inductance. Because of the high input capacity of seven tubes in parallel this tank is actually much less than a quarter of a wavelength long. A large part of the inductance is formed in the tube and by the tube leads. The input line is fed through the center of the cathode tank and is connected in series with the input circuit at a low impedance point. In order to match this impedance to the line from the driver two quarter-wave transformer sections are employed. In the cut-away view these are shown built into the 3⅛" input line by using the proper size center conductors for the quarter-wave sections.

To allow for variation in tube input capacity and for variation in feed-through power a means for making some adjustment to the input coupling is achieved by adding in shunt capacitors. These capacitors take the form of seven co-axial capacitors. To vary the capacity, a mycalex cylinder which has a dielectric constant of approximately 6 is inserted between the center and outer tubes. These seven mycalex cylinders are mechanically ganged together and driven by a tuning motor. Since the tube leads from a portion of the tank inductance these capacitors are not actually in parallel with the tube input but are part way down the tank circuit where it has been found that they serve as a coupling adjustment and have little effect on the resonant frequency of the circuit.



Cut-away view showing R-F circuits of the 25 kw low band amplifier.



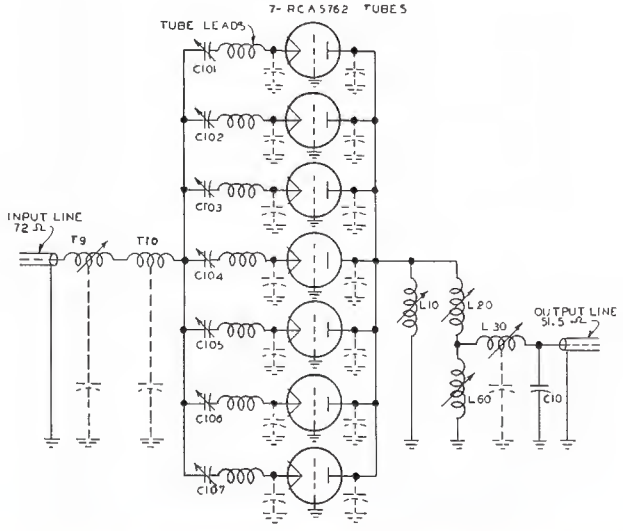
Cut-away view showing R-F circuits of the high band amplifier.

The general appearance of the high-band amplifier in the TT-25BH transmitter is similar to the low band unit in the TT-25BL, but the circuit actually differs in several important details. Because the operating frequency is much higher, it would be impractical to use a simple quarter wave concentric link tank similar to that used in the low band amplifier since there would be little or no tank circuit left outside of the tubes themselves. To overcome this, two

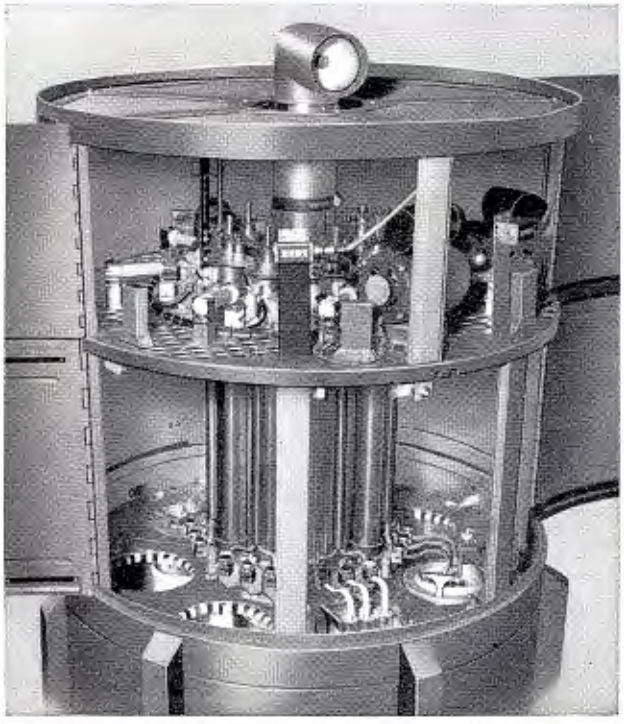
co-axial tank circuits are employed. One of these tanks is inside the other. These function as inductances in parallel and thus raise the effective resonant frequency. The output is coupled to the inner of these plate tank circuits across a shunt inductance. To preserve the circuit symmetry this inductance is actually made up of seven small adjustable shorted transmission lines connected in parallel and located on a circle just inside the inner plate tank. Like the low band unit, the secondary or output circuit is formed by inserting a shunt capacitor in the output transmission line and is tuned by sliding this capacitor along the line.

Because the two circuits are coupled at a low impedance point this capacitor is located approximately ½ wavelength along the line. This secondary circuit, coupled to the plate circuit by means of a mutual reactance forms the necessary elements of an over-coupled broadband circuit whose response is equivalent to that shown for channel 6.

The cathode circuit, like the plate circuit, cannot be made a conventional quarter-wave tank because the first low impedance point will occur on the tube straps. To compensate for this extra inductance of the straps, the seven co-axial capacitors are connected in series with the tube leads instead of in shunt as was the case in the low band amplifier. These capacitors are variable and when mechanically ganged together serve as the input tuning control. This cathode circuit is matched to the 72 ohm input by two quarter-wave transformer sections in series. To provide for an input coupling adjustment one of the transformers is constructed so as to have a variable characteristic impedance as the outer shell is rotated through 90°.



Equivalent circuit of the 25 kw high band amplifier for channels 7 to 13.



Closeup showing the cluster of seven air-cooled 5762 triodes used in the 25 kw amplifier equipment.

The control equipment is of conventional design. An instantaneous trip relay is connected in the cathode return circuit of each of the seven power amplifier tubes. In addition, a total d-c current relay is provided and a-c relays are inserted in the primary leads of the high voltage plate transformer. The overload system has an automatic reset feature. After an overload occurs the plate voltage will be removed momentarily then automatically returned twce. If the overload persists for the third time the plate voltage will remain off. All circuits such as the filament bus, the blower and the bias supply are protected by breakers with built-in overload trips. The control equipment for the aural transmitter is identical to that for the visual transmitter and the two are arranged so that the two carriers may be turned on and off independently.

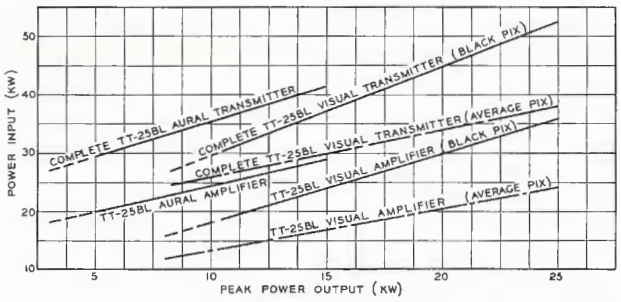
Except for the bias supply and slight differences in the high voltage filter, the power equipment for the aural and visual equipments are identical. The high voltage rectifier for each employs six RCA 673 mercury vapor rectifier tubes in a three-phase full wave circuit with a balance coil. The bias supply for the visual amplifier is well regulated, its output voltage remaining constant for large changes in grid current. The bias for the aural amplifier is essentially obtained from grid leaks with just enough fixed bias to protect the tubes when there is no drive.

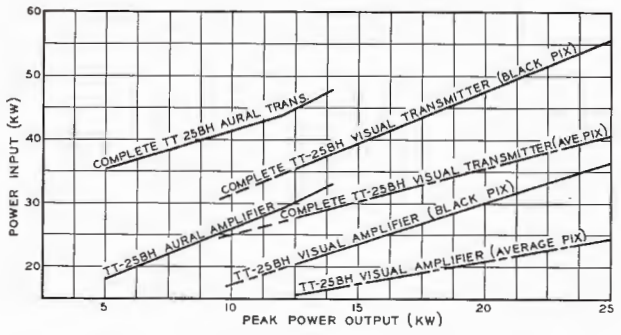
Vestigial Sideband Filter

The MI-19085-L/HA Vestigial Side Band Filter is furnished completely assembled and adjusted for any one of the VHF television channels. The type MI-19085-L is specified for channels 2 through 6, and the type HA for channels 7 through 13. The filter is an integral unit designed for floor, ceiling, or wall mounting near the visual transmitter so that the input transmission line is as short as possible.

The purpose of the filter is to attenuate the lower side-band output of a double side band visual transmitter. It consists essentially of two similar parallel transmission lines which have resonant cavities connected to them at several points. The lines are jointed at the input through a bridge balun and at the output with a transformer tee.

In order to minimize reflections on the transmission line between the visual transmitter and the filter, the visual input of the filter is designed to have a constant input impedance over the band of frequencies produced by the visual transmitter. The filter sections consist of lengths of coaxial line (resonant cavities), which are adjustable for tuning purposes. As the filter is pretuned at the factory to the channel stamped on the nameplate, no operating adjustments are necessary.



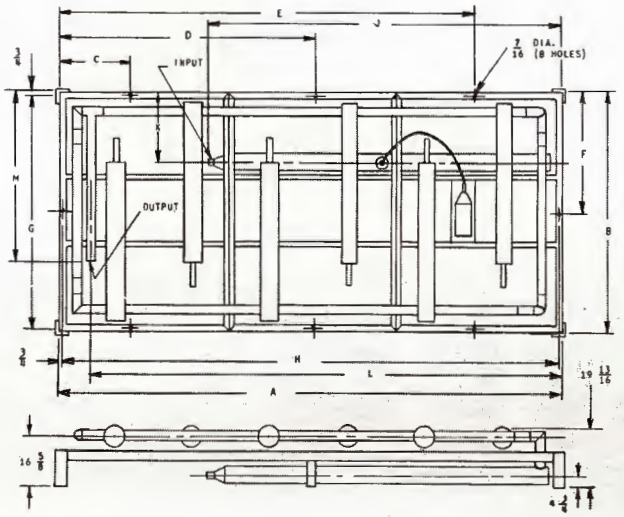


Power consumption curves showing approximate Power Input vs. Peak Power Output of the TT-25BL and the TT-25BH Visual and Aural Transmitters.

MI-19085-L/HA VESTIGIAL SIDEBAND FILTER

SPECIFICATIONS

	MI-19085-L Channels 2 to 6	MI-19085-HA Channels 7-13
Frequency	54 88 mcs	174-216 mcs
Maximum Power (5000 ft. elevation)	25 kw	25 kw
Input and Output Impedance	51.5 ohms, 3⅛" coaxial line	51.5 ohms, 3⅛" coaxial line
VSWR	Less than 1.1	Less than 1.1
Ambient Temperature	45° C max.	45° C max.
Overall Dimensions:		
Channel 2	165"x79"x19 13/16"	
Channel 3	154½"x73¾"x19 13/16"	
Channel 4	146"x69½"x19 13/16"	
Channel 5	143½"x63¾"x19 13/16"	
Channel 6	143½"x63¾"x19 13/16"	
Channel 7 to 13 incl.		77"x72⅞"x19 15/16"
Weight	930 lbs. max.	665 lbs. max.
Mounting	Wall or ceiling	Wall or ceiling
Clearance	12"	12"



SPECIFICATIONS

Performance Specifications

	Visual	*Aural*
Type of Emission	A5	F3
Frequency Range:		
TT-25BL	Chan. 2-6	Chan. 2-6
TT-25BH	Chan. 7-13	Chan. 7-13
Rated Power Output:		
TT-25BL	25 kw[1]	15 kw[2]
TT-25BH	25 kw[1]	14 kw[2]
Minimum Power Output:		
TT-25BL	10 kw[1]	5 kw[2]
TT-25BH	10 kw[1]	6 kw[2]
R-f Output Impedance	51.5 ohms	51.5 ohms
Input Impedance	75 ohms	600/150 ohms
Input Level	0.7 volts peak-to-peak min.	+10 ±2 dbm
Amplitude vs. Frequency Response		Uniform ±1 db from 50 to 15,000 cycles
Upper Sideband Response:[3]		
+1, −1.5 db at carrier	+0.5 mc	
+1, −1.5 db at carrier	+1.25 mc	
+1, −1.5 db at carrier	+2.0 mc	
+1, −1.5 db at carrier	+3.0 mc	
+1, −1.5 db at carrier	+3.58 mc	
+1, −3.0 db at carrier	+4.18 mc	
−20 db max. at carrier	+4.75 mc	
Lower Sideband Response:[4]		
+1, −1.5 db at carrier	−0.5 mc	
−20 db max. at carrier	−1.25 mc	
−42 db max. at carrier	−3.58 mc	
Variation in Freq. Response with Brightness[5]	±2.0 db	
Carrier Frequency Stability[6]	±1 kc	±1 kc[7]
Modulation Capability	12.5 ±2.5% (reference white)	±50 kc
Audio Frequency Distortion		1.5% max. 50-100 cy. 1.0% max. 100-7500 cy. 1.5% max. 7500-15,000 cy.
FM Noise, Below ±25 kc Swing		60 db
AM Noise, rms	40 db below 100% mod.	50 db below carrier
Amplitude Variation Over One Picture Frame	Less than 5% of the peak of sync level	
Regulation of Output	7% max.	
Burst vs. Subcarrier Phase[8]	±7 degrees max.	
Subcarrier Phase vs. Brightness[9]	±7 degrees max.	
Subcarrier Amplitude[8]	±15% max.	
Linearity (Differential Gain)[10]	15% max.	
Envelope Delay vs. Frequency[11]	±.08 μsec. from 0.2 to 2.1 mc ±.04 μsec. at 3.58 mc ±.08 μsec. at 4.18 mc	
Harmonic Attenuation, ratio of any single harmonic to peak visual fundamental	at least 60 db	At least 60 db

[1] Measured at the output of the sideband filter or filterplexer.
[2] Measured at the input to the diplexer or filterplexer.
[3] With respect to the response at 200 kc, as measured by the BW-5A Sideband Response Analyzer at transmitter mid-characteristic. 4.75 mc attenuation requires use of MI-27132 LP filter in the video input circuit.
[4] With respect to the response at 200 kc at transmitter mid-characteristic.
[5] Maximum variation with respect to the response at mid-characteristic measured with the BW-5A Sideband Response Analyzer at brightness levels of 22.5% and 67.5% of sync peak, using approximately 20% (peak to peak) modulation.

Electrical Specifications

Power Line Requirements:
- Transmitter:
  - Line: 208/230 volts, 3 phase, 60 cycles
  - Slow Line Variations: ±5% max.
  - Rapid Line Variations: ±3% max.
  - Regulation: 3% max.
  - Power Consumption: See curve
  - Power Factor (approx.): 90%
- Crystal Heaters:
  - Line: 115 volts, 50/60 cycles, single phase
  - Power Consumption: 61 watts

Tube Complement

TT-25BL TRANSMITTER ES-19245			TT-25BH TRANSMITTER ES-19246	
AURAL SECTION			AURAL SECTION	
1	12AT7	Crystal Oscillator	1	6AU6
1	12AT7	Pulse Shaper	1	6AU6
1	12AT7	Sawtooth Generator	1	6AU6
1	12AT7	Sawtooth Modulator	1	6AU6
1	6AU6	Quadrupler	1	6AU6
1	6AU6	Amplifier	1	12AT7
1	6AU6	Doubler	1	12AT7
1	6AU6	Doubler	1	12AT7
1	6AU6	Tripler	1	12AT7
1	12AT7	Tripler or Doubler-Doubler	1	12AT7
1	5763	Tripler	1	5763
1	6146	Amplifier	1	6146
1	12AX7	Audio Amplifier	1	12AX7
1	12AU7	Audio Amplifier	1	12AU7
1	4-65A	IPA ..... Tripler	1	4-65A
—	—	IPA	1	4X500A
1	4-1000A	Driver	1	5762
1	6166	Amplifier	1	6166
1	OA2	Regulator	1	OA2
1	OB2	Regulator	1	OB2
3	673	Rectifier	3	673
4	8008	Rectifier	4	8008
2	5R4GY	Rectifier	2	5R4GY
2	6AL5	Reflectometer	2	6AL5
1	2D21	Reflectometer	1	2D21
7	5762	Aural Power Amplifier	7	5762
1	2D21	Aural Monitor	1	2D21
2	6AL5	Aural Monitor	2	6AL5
1	5R4GY	Aural Power Supply	1	5R4GY
6	673	Aural Power Supply	6	673

[6] Maximum variation for a period of 30 days without circuit adjustment.
[7] Maximum variation with respect to the standard 4.5 mc separation between aural and visual carriers.
[8] Maximum departure from the theoretical when reproducing saturated primary colors and their complements at 75% amplitude. A properly terminated TA-7 Stabilizing Amplifier is required in the video input circuit.
[9] Maximum phase difference with respect to burst, measured after the VSBF, for any brightness level between 75% and 15% of the Sync peak using 10% (peak to peak) modulation. This is equivalent to 5% (peak to peak) modulation as indicated by a conventional diode demodulator.
[10] Maximum variation in the amplitude of a 3.58 mc sine wave modulating signal as the brightness level is varied between 75% and 15% of sync peak. The gain shall be adjusted for 10% (peak to peak) modulation of the 3.58 mc signal when the brightness is at pedestal level. This is equivalent to 5% (peak to peak) modulation as indicated by a conventional diode demodulator connected after the VSBF. A properly terminated TA-7 Stabilizing Amplifier is required in the video input circuit.
[11] Maximum departure from standard curve. The tolerances vary linearity between 2.1 and 3.58 mc ond between 3.58 mc and 4.18 mc. To meet the specification a properly terminated phase correction network, ES-34034-A is required in the video input circuit of the transmitter.

SPECIFICATIONS —(Cont'd)

Tube Complement (Cont.)

VISUAL SECTION Qty.	Type	Function	VISUAL SECTION Qty.	Type
1	6V6-GT	Crystal Oscillator	1	6V6-GT
1	6V6-GT	Tripler	1	6V6-GT
1	6V6-GT	Doubler	1	6V6-GT
1	6146	Amplifier	1	6146
1	4-65A	IPA	Tripler 1	4-65A
—	—	IPA	1	4X500A
1	4-1000A	Driver	1	5762
1	6166	Modulated Amplifier	1	6166
1	6CL6	1st Video Amplifier	1	6CL6
1	6CL6	2nd Video Amplifier	1	6CL6
2	807	3rd Video Amplifier	2	807
1	6CL6	Phase Splitter	1	6CL6
7	6146	Modulator	7	6146
1	6CL6	Video Monitor	1	6CL6
1	6CL6	Sync Amplifier	1	6CL6
1	6U8	Sync Separator	1	6U8
1	5651	D-C Offset	1	5651
1	6U8	Clipper and Pulse Former	1	6U8
1	6AL5	Clamp Diode	1	6AL5
4	6AS7-G	Voltage Regulator	4	6AS7-G
4	6146	Voltage Regulator	4	6146
2	6SL7-GT	Regulator Control Amplifier	2	6SL7-GT
3	OA2	Voltage Regulator	3	OA2
10	OB2	Voltage Regulator	10	OB2
4	OC3	Voltage Regulator	4	OC3
2	OD3	Voltage Regulator	2	OD3
3	673	Rectifier	3	673
4	8008	Rectifier	4	8008
2	866A	Rectifier	2	866-A
3	5R4GY	Rectifier	3	5R4GY
2	6AL5	Reflectometer	2	6AL5
1	2D21	Reflectometer	1	2D21
7	5762	Visual Power Amplifier	7	5762
1	2D21	Visual Monitor	1	2D21
2	6AL5	Visual Monitor	2	6AL5
6	673	Visual Power Supply	6	673
7	6AS7-G	Visual Power Supply	7	6AS7-G
1	6SH7	Visual Power Supply	1	6SH7
2	OD3	Visual Power Supply	2	OD3
1	OA3	Visual Power Supply	1	OA3
1	5R4GY	Visual Power Supply	1	5R4GY

Mechanical Specifications

Mechanical Dimensions (approx.): (cab. assem.)

Overall Length ..... 327"
Overall Height ..... 84"
Overall Depth ..... 32 7/16"

Weight (approx.) ..... 10,500 lbs.

Finish ..... Two tone umber gray with polished stainless steel trim and fittings

Maximum Altitude[2] ..... 5000 ft.

Ambient Temperature ..... 45°C max., 10°C min.

Equipment Supplied

TT-25BL TRANSMITTER ES-19245 Qty.	Stock #	Description	TT-25BH TRANSMITTER ES-19246 Qty.	Stock #
1	MI-19320	Aural RF Amplifier	1	MI-19330
1	MI-19325-C	Visual RF Amp. and Modulator	1	MI-19333-C
1	MI-19321	Aural Driver Chain	1	MI-19331
1	MI-19324	Visual Driver Chain	1	MI-19332
1	MI-19322	Aural Control Unit	1	MI-19322
1	MI-19323-A	Visual Control Unit	1	MI-19323-A
2	MI-19329	Transformers	2	MI-19329
2	MI-19346	Blower Units	2	MI-19346

Equipment Supplied

2	MI-19335	Motor Starters	2	MI-19335
1	MI-28061	1 Set of End Shields (2 per set)	1	MI-28061
2	MI-19087	Monitoring Units	2	MI-19088
1	MI-19051-B	Monitoring Diode	1	MI-19051-B
1	MI-19085-L[1]	Vestigial Sideband Filter	1	MI-19085-HA[1]
1	MI-19337	Set of Installation Material	1	MI-19347
1	MI-19336	Wiring Material Kit	1	MI-19336
2	MI-19450-A[1]	Aural Crystal Units (one spare)	2	MI-19450-A[1]
2	MI-19400-L4[1]	Visual Crystal Units (one spare)	2	MI-19400-L4[1]
1	ES-19233-B	Set of Operating Tubes	1	ES-19235-B
1	MI-28153	Finish Touch-Up Kit	1	MI-28153
*	MI-19113-B	Transmission Line (*Sales order to specify quantity to meet installation requirements)	*	MI-19113-B
2	IB-36101	Instruction Books and Color Supplements	2	IB-36102
2	IB-36119	Installation Instruction Books and Color Supplements	2	IB-26118
2	MI-19065	RF Amplifier Units	2	MI-19066
2	MI-19067	RF Amplifier Base Units	2	MI-19067
2	MI-19068	Blower Units	2	MI-19068
2	MI-19367	Control Units	2	MI-19367
1	MI-19368	Visual Rectifier Unit	1	MI-19368
1	MI-19369	Aural Rectifier Unit	1	MI-19369
2	MI-19072	High Voltage Transformers	2	MI-19072
2	MI-19087	Monitoring Units	2	MI-19088
1	MI-19051-B	Monitoring Diode	1	MI-19051-B
2	MI-19181-A	Driver Reflectometer Meters	2	MI-19181-A
2	MI-27317	VHF Harmonic Filter	2	MI-27317
1	MI-27132	Low Pass Video Filter	1	MI-27132
1	MI-19380	Set of Installation Material	1	MI-19380
1	MI-19076	Wiring Material Kit	1	MI-19076
1	MI-19078-A[1]	Set of Freq. Determining Parts	—	—
—	—	Transformers	2	MI-19111-11[1]
—	—	Elbows	2	MI-19111-2
1	ES-19229	Set of Operating Tubes	1	ES-19229
1	MI-28180-1	Nameplate	1	MI-28180-1
1	MI-7474	Miscellaneous Hardware Kit	1	MI-7474
2	IB-36150	Amplifier Instruction Books	2	IB-36152
2	IB-36151	Amplifier Installation Instruction Books	2	IB-36153

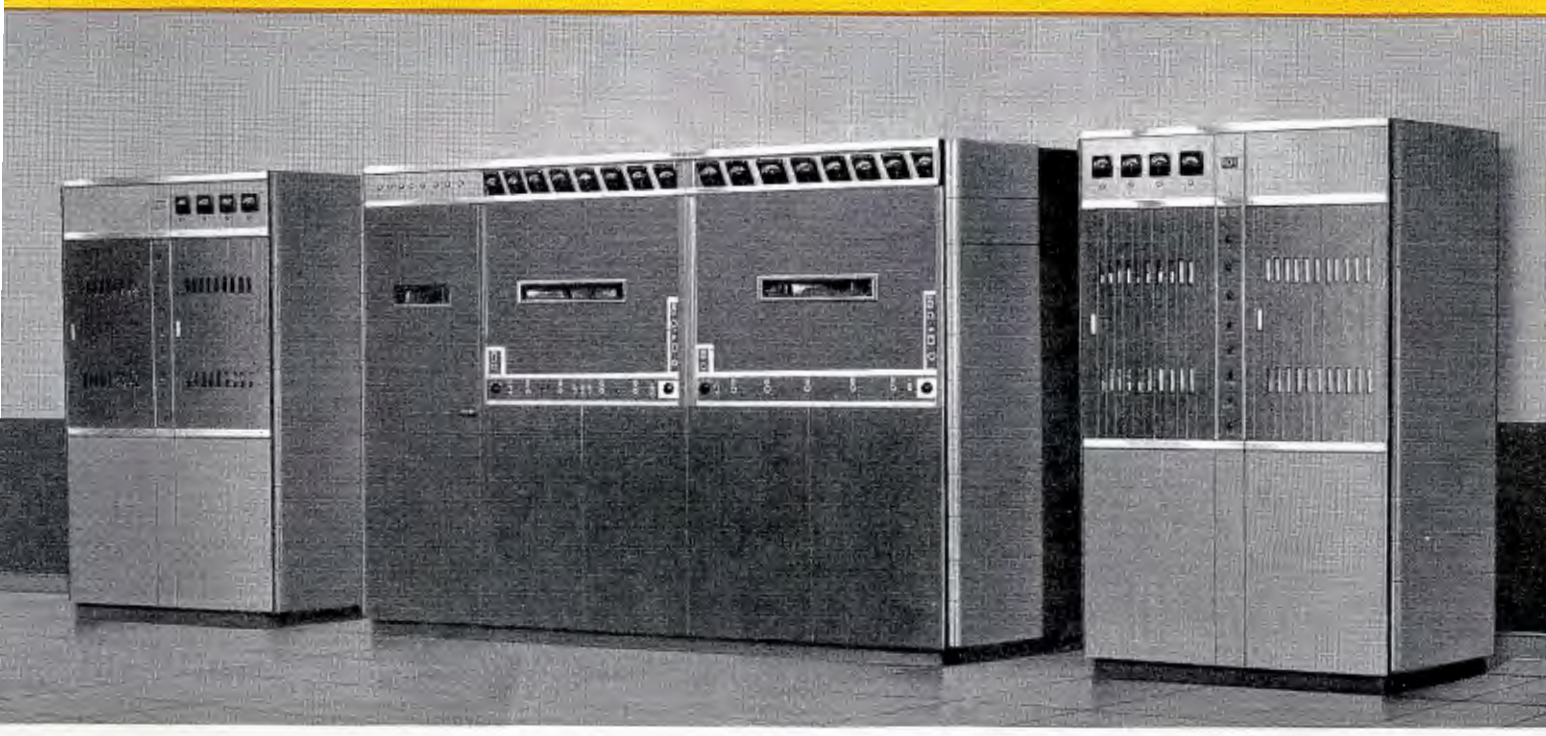
Optional and Accessory Equipment

TT-25BL TRANSMITTER Stock #	Description	TT-25BH TRANSMITTER Stock #
ES-19233-B	Set of Transmitter Spare Tubes	ES-19235-B
ES-19234-B	Set of FCC Trans. Spare Tubes	ES-19236-B
ES-19229	Set of Amplifier Spare Tubes	ES-19229
ES-19230	Set of FCC Ampli. Spare Tubes	ES-19230
MI-19193	RF Load and Wattmeter (15 KW)	MI-19193
ES-19240-A	TTC-1C Control Console	ES-19240-A
ES-19237-A/B	Color Input and Monitoring Equipment, Wired/Unwired	ES-19237-A/B
MI-19391[1]	TV Diplexer	MI-19394[1]
MI-28061	Set of End Shields (2 per set)	MI-28061
MI-19365	Set of 4" Channels (1 Front and 1 Rear)	MI-19365
MI-19314-18-NF	Elbows 6 1/8" 90°	— ———
MI-19314-7	Couplings	— ———
ES-34010	BW-5A Sideband Response Analyzer	ES-34010
ES-34006	BW-4B Demodulator	ES-34006
MI-19339	50-Cycle Conversion Kit	MI-19339
EM-6270-D	Voltage Regulator	EM-6270-D

[1] Order to suit customer's assigned frequency.
[2] For operation at rated power and normal plate voltage.

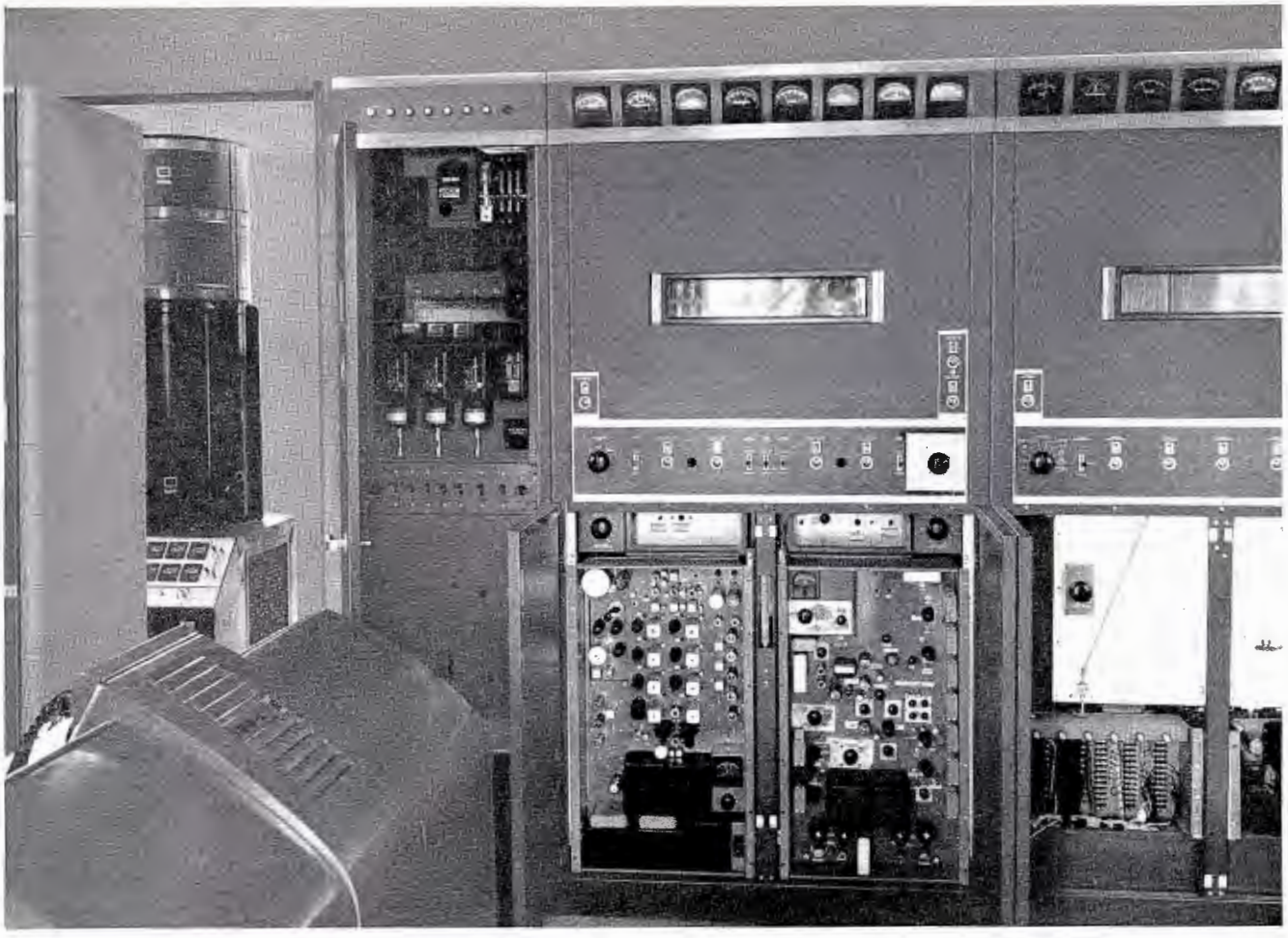
VHF TV TRANSMITTER

25 KW VHF, TYPE TT-25CL



FEATURES

- Visual power output 25 kw peak measured at output of sideband filter or Filterplexer
- Designed for color—linearity correction circuits built into modulator
- Flexible location of individual units to meet specific customer requirements
- Economical installation costs—low operating costs
- Uses Type 5762 tubes, famous for long life and reliability
- Broadbanding tuning controls accessible without opening any doors
- Tubes and components of transmitter all air cooled
- Vestigial sideband characteristics determined by fixed-tuned, trouble-free, factory adjusted sideband filter
- Inter-carrier frequency control accurately maintains frequency separation between aural and visual carriers necessary for color transmission
- Excellent accessibility
- Includes motor operated power output controls
- Important amplifier meters repeated on control unit
- Complete overload protection with driver indicating lights grouped for quick location of faulty circuits



Close up of TT-25CL VHF Transmitter showing aural 25-kw amplifier and control cabinet to extreme left beyond transmitter console. The TT-6 driver is shown with the doors open revealing the control cabinet, exciter and modulator in bottom of 2-kw portion, and the 6-kw amplifier at the extreme right.

USES

The RCA Type TT-25CL VHF Television Transmitter is designed for television stations with effective radiated power requirements ranging from 10 to 100 kilowatts. It is an ideal equipment for telecasting either in monochrome or color, and is capable of covering large urban communities with a strong signal. The TT-25CL Transmitter utilizes an RCA TT-6AL Transmitter in combination with the TT-25BL VHF Amplifier. The amplifier provides an economical method of increasing station power as required. It provides up to 25 kw power output on channels 2-6 at low dollar per hour operating cost. Unit construction allows utmost flexibility of layout and best use of existing station floor space. The TT-25CL Transmitter works equally well with both low and high gain type antennas.

DESCRIPTION

The Type TT-25CL VHF Television Transmitter is designed to conform with all FCC and RETMA standards. It will provide a nominal power output of 25 kilowatts peak visual power measured at the output of the sideband filter or filterplexer and 15 kw aural power. It will operate on any specified channel between channel 2 and 6. The transmitter has been completely styled to afford a compact unit requiring a minimum of floor space in the transmitting station. All critical circuits such as the modulator and the exciter are completely adjusted from the front of the transmitter. Unitized construction of transmitter and antenna portions of the equipment allow the broadcaster utmost latitude in arrangement layout. A typical installation is shown in the accompanying floor diagram, but

numerous variations will suggest themselves to the station engineer.

The TT-25CL's circuits employ the latest design features and represent economy in operation. Highlighted features include air-cooled tubes such as the 5762, famous for long life and reliability; single ended r-f circuits which greatly reduce number of necessary tubes and circuit components; built-in control relays and motors for operating power output controls, complete overload protection with indicating lights grouped for quick location of faulty circuits, and linearity correction circuits. Inter-carrier frequency control accurately maintains frequency separation between aural and visual carriers necessary for color transmission.

Remote control as well as local operation is an added feature of the new RCA transmitter. If and when the FCC authorizes remote control for television transmitters, the TT-25CL can, with the addition of suitable terminal equipment, be operated from a remote location over a single telephone line. All the necessary operating functions such as starting and stopping the transmitter, resetting overloads, switching in the spare crystal or spare exciter, metering all power circuits and reflectometers, controlling power output (including black level, video gain, and excitation) can be performed at the remote location. Even when the transmitter is not remotely controlled, these features make it very easy to obtain fingertip control of the transmitter from a single local position such as the transmitter console. The TT-6AL driver has the necessary circuits and facilities provided for remote control terminal equipment. The circuits in the 25 kw amplifier can be readily modified to work with remote control equipment by adding a kit.

The equipment provides separate visual and aural amplifiers for use with the driver. This equipment includes air-cooled linear broad-band amplifiers for the visual carrier, and air-cooled class "C" amplifiers for the aural carrier. Each amplifier consists of a single power stage utilizing a cluster of seven air-cooled RCA type 5762 Triodes in a grounded-grid circuit. Fewer operating tubes can be used in the aural amplifier for reduced power operation.

The complement of equipment includes dual r-f amplifier and blower units, power supplies, control units, and plate transformers—one of each for both the aural and visual sections of the driver. The equipment is housed in cabinets which are divided so that flexibility is afforded in arranging the components.

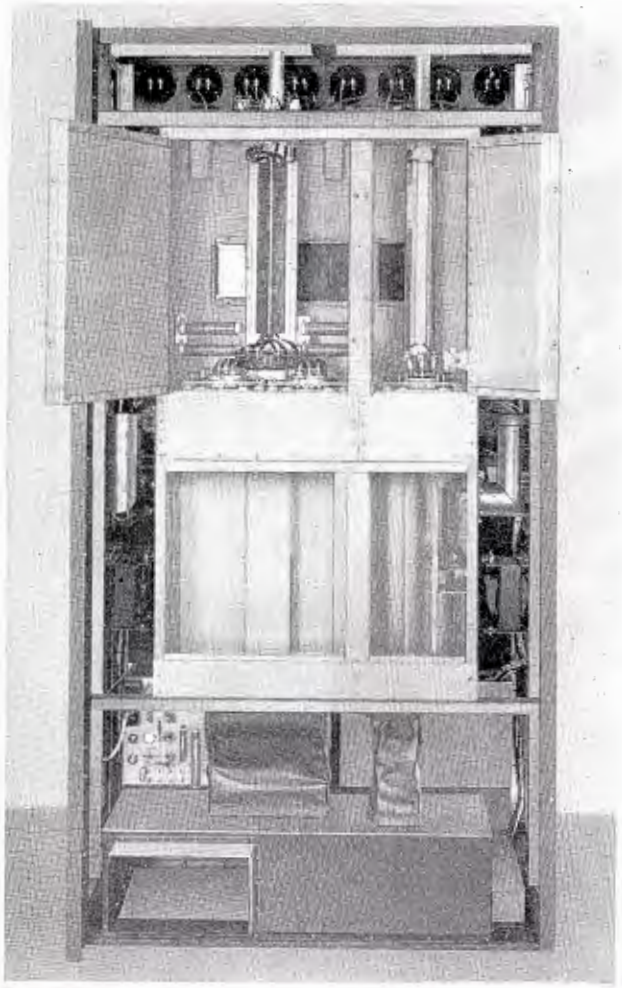
The amplifiers are housed in cylindrical cabinets which provide complete accessibility to all tubes as well as their circuit components. The amplifier base houses the blower, filament transformers, meters, and tuning controls. Air for cooling the tubes is drawn in through two filters on the sides of the bottom section and is expelled out the top of the unit.

The power supplies and control and distribution equipment for the amplifiers is housed in four cabinets identical in size and styling. These cabinets may be located to suit available space and to provide convenient operation. Since the two power supply cabinets do not contain any operating controls or meters, they can be mounted either with the other cabinets or in the rear of existing equipment. Two high-voltage grounding hooks are located in each power supply cabinet. Front and rear doors and removable panels are a feature of each cabinet. They allow a maximum of accessibility to maintenance and service personnel.

Type TT-25BL VHF Power Amplifier.

Circuit Discription of TT-6AL Driver

The visual and aural exciter circuits of the TT-6AL are mounted on a single chassis. Two separate crystal oscillators are employed. This allows switching from a remote point by a relay in the d-c circuit. No relays are then necessary in the r-f circuit. A special 5763 buffer amplifier allows the crystal oscillators to be operated at a low level. This reduces internal heating of the crystal and allows the oscillator frequency to stabilize very quickly after the plate power is applied. The buffer stage is followed by a tripler, two doublers, and an amplifier, all using 5763 tubes. The output power of the exciter is approximately 5 watts at the carrier frequency. The aural chain starts with a 6V6 master oscillator frequency modulated by two more 6V6 reactance tubes. The multipliers and amplifiers which follow the master oscillator are identical to those used in the visual side.



Rear view of 6 kw PA unit showing visual and aural amplifiers, visual bias supply, filament transformers and outputs, and air cooling ducts.

A unique feature of this exciter is the frequency control circuit for the aural master oscillator. This circuit is designed to accurately maintain the difference between the aural and visual carrier frequencies. This is accomplished by feeding a small amount of the energy from the aural and visual oscillators to a 6AS6 mixer tube. When the aural oscillator is on frequency the output of this mixer will be 1/12 of the difference frequency between the aural and visual carrier or 375 kc. This 375-kc signal combines with the output of a 6J6 crystal oscillator in a second mixer. The sum of these two frequencies is amplified and fed to a chain of three dividers with a total division of 100. This amount of division is necessary in order to reduce the swing at the frequency detector to a point where the carrier will not drop out under any conditions of modulation of the aural transmitter. A crystal control reference frequency is also fed to the frequency detector. By making the 6J6 crystal oscillator function both as a heterodyne oscillator and as a frequency reference source, considerable improvement in frequency control accuracy is obtained. Three dividers with a total division of 80 are also employed in the reference frequency circuit. The frequency detector is essentially a balanced modulator with a d-c component in the output which will change polarity depending upon whether the signal frequency is above or below the reference frequency. This d-c voltage is fed back to one of the reactance tubes for the master oscillator in such a way as to correct the frequency of the master oscillator. A frequency interlock circuit connected to the output of the frequency detector will prevent the application of plate power to the power amplifiers until the frequency control circuit is locked in.

R-F Circuits

The r-f circuits employ a chain of amplifiers. In the visual chain a 4-65A tube and a 4-250A tube operating in cascade drive a type 6076 grid modulated power amplifier. This is followed by two type 5762 tubes operating in parallel in a class "B" linear circuit. The aural chain consists of three stages: a 4-65A, a 4-1000A and a type 5762 tube all operating as class "C" amplifiers. A single high-voltage rectifier employing six type 673 tubes supplies the plate power for all the high level tubes in both the aural and visual r-f chains. A single low-voltage rectifier employing two type 866A tubes supplies the screen voltage for all the stages. Excitation for the visual modulated amplifier is controlled by varying the screen voltage on the 4-250A stage. Power output of the aural transmitter is adjusted by varying the screen voltage on the 4-1000A stage. Both these controls are operated by motors and therefore can be adjusted from a remote position.

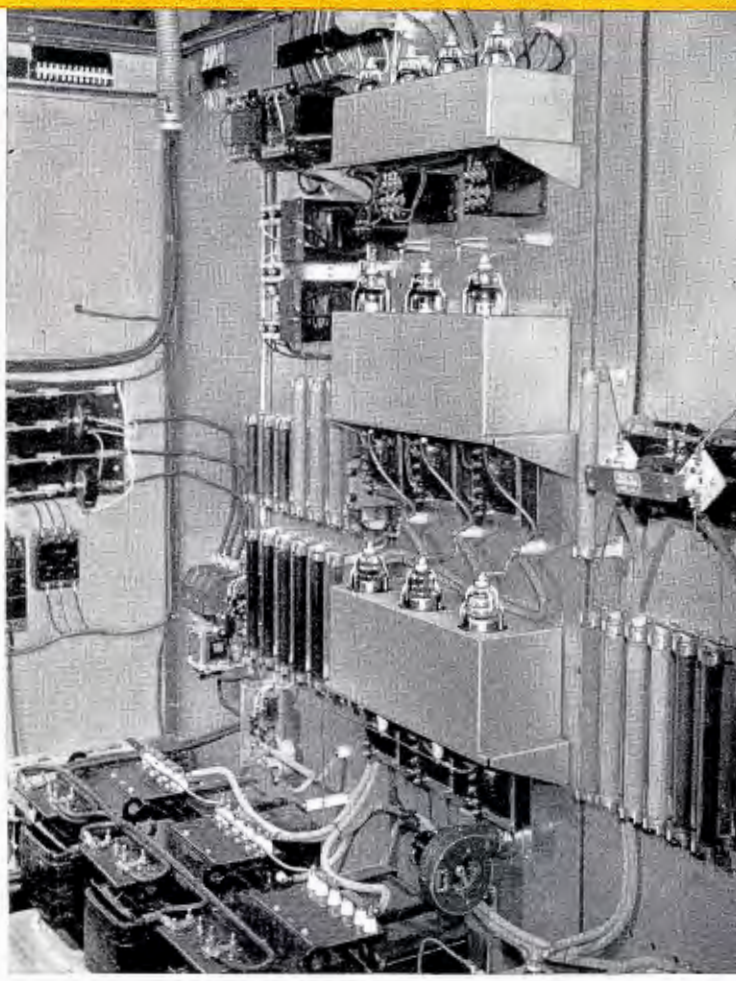
Power and Control Equipment

Wherever possible the same d-c power supplies were used for both the visual and aural amplifiers of the TT-6AL. This greatly reduces the number of components in the transmitter and allows operation of the complete equipment with only five power supplies as follows: An exciter supply built into the common exciter unit using stack germanium diodes; a 700 volt low voltage rectifier using two 866-A tubes which supplies the screen voltage for all the pentode amplifiers; a 3600 volt high voltage supply using six 673 tubes in a 3 phase full way circuit; the modulator and bias supply, using two 866-A tubes and one 5R4GY tube, which supplies the plate voltage for the modulator and the bias for all stages except for the visual power amplifier; and a bias supply for the visual linear amplifier.

A single integrated control circuit is provided for both the visual and aural transmitters. The blower, filaments, and each rectifier is protected by thermal overloads which can be adjusted to reset automatically. In addition, a main line breaker and an auxiliary are provided. This includes both thermal and magnetic trips. The primaries of the high voltage rectifier and each power amplifier tube including the 4-65A stages are protected by instantaneous d-c overloads which automatically recycle twice. If the fault continues on the third try the overload circuit will remain tripped until reset. Overload indicator lights are provided for each circuit. These lights have a separate reset and will remain on after the first overload thus providing a record of the circuit giving trouble even though it is intermittent. The equipment includes a line corrector which provides an adjustable line voltage to the filament primaries, the exciter, the modulator, the low voltage rectifiers and the bias supply. Automatic filament line voltage regulators and automatic regulators capable of handling the complete transmitter are available as optional items. An electrically controlled regulator for the low voltage supply is supplied to reduce variations in output which might be caused by line voltage fluctuations.

Modulator

The modulator of the transmitter is designed to take a standard 1 volt video signal and amplify it sufficiently so that it can grid modulate the 6076 stage. This requires about 250 volts peak-to-peak from the modulator. The first stage of the modulator is a conventional shunt-series peak



Interior view of rectifier enclosure. Rectifiers are mounted on back wall of the enclosure in heating units which permit operation of the transmitter at lower ambient temperatures.

video amplifier. This is followed by an inverter stage and a linearity corrector stage each of which has a gain of approximately one. The linearity corrector is designed to pre-distort the signal to compensate for the non-linearity which always occurs in a grid modulated stage, and takes the form of four diodes connected in the cathode circuit of that stage. The bias voltage on each diode is separately adjustable and can be made to start conducting at any brightness level. The grid of this stage is clamped in order to insure the same correction to the linearity characteristic regardless of the average brightness of the picture signal.

The linearity corrector is followed by a second video amplifier using a 6AG7 tube and by a third video amplifier consisting of two 807 tubes. The grids of the third video amplifier are also clamped and from this point on the circuit is d-c coupled. The output stage is a shunt regulated cathode follower. It consists of two 6146 tubes connected in a circuit very similar to a conventional cathode

follower stage. The cathode resistor has been replaced by three 6146 tubes operating in parallel. The grid of these three tubes are fed with a signal of opposite polarity from the plate load by the two cathode follower tubes. This essentially makes the circuit a feed-back amplifier of high efficiency capable of delivering modulation at a high level to a large capacity load.

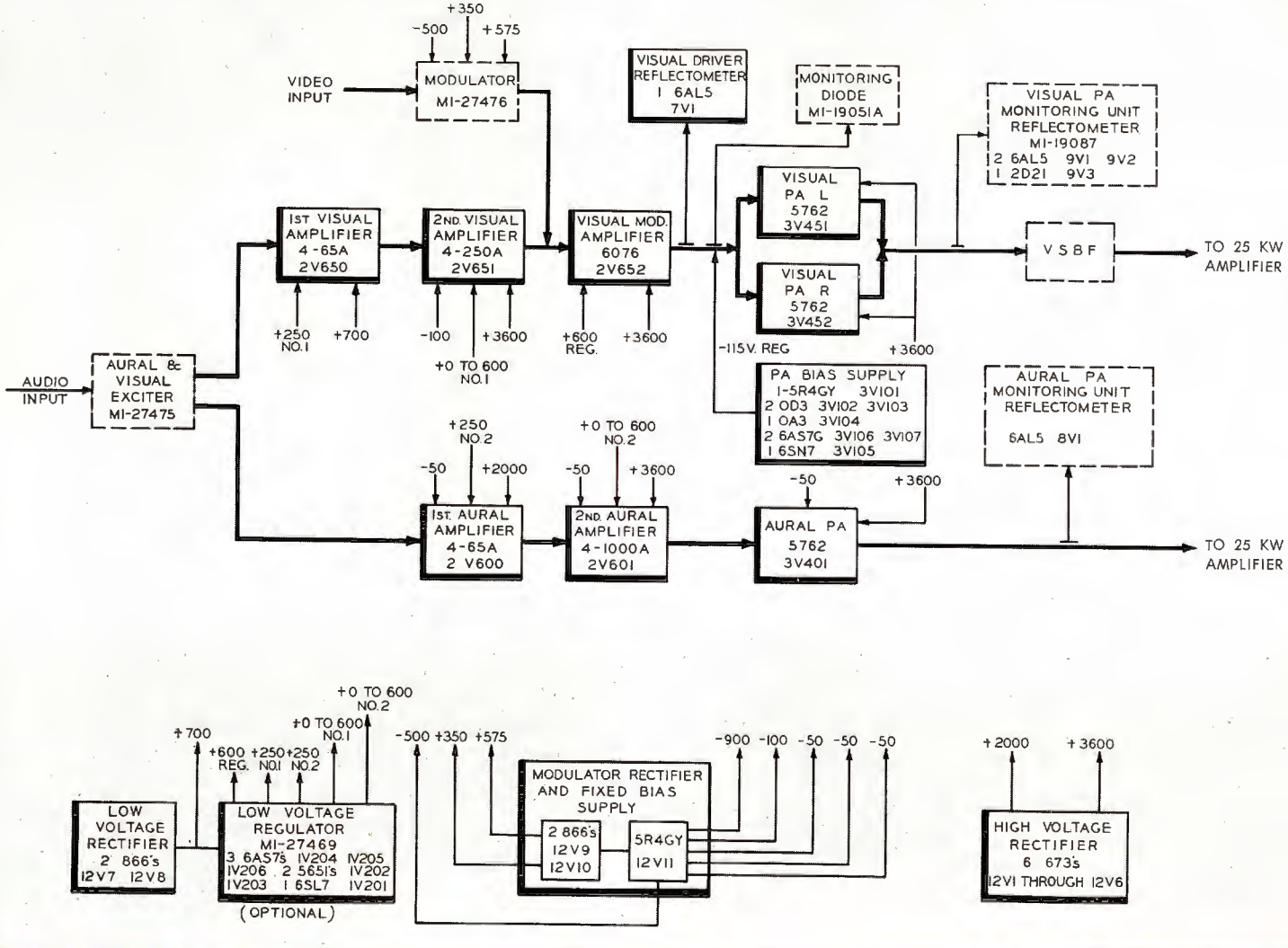
The modulated stage is followed by a bucking bias supply consisting of one 6BL7-GT and three OA2 tubes. This serves to transfer the signal from the positive voltage present in the output of the modulator stage to the negative voltage required to modulate the 6076 tubes without losing the d-c component. Back porch clamping is employed. A carefully designed sync separator and clipper circuit provides reliable clamping even with greatly degraded input signal.

A two stage monitor amplifier is employed. It can be noted from the block diagram that this monitor amplifier can be switched to many parts of the circuit greatly aiding in making adjustments and in servicing. Plate power for all the stages in the modulator is obtained from two electronic regulators. One supplies approximately 250 volts and the other approximately 475 volts. The rectifier is located on the rear wall of the transmitter enclosure and regulators are mounted on the same chassis as the video circuit in the modulator. This greatly reduces the possibility of obtaining unwanted video resonances.

Special Protective Circuits

Included as part of the TT-6AL is an MI-19087 Monitoring Unit for connecting in the output transmission line of the visual amplifier. This unit contains two 6AL5 diode de-

BLOCK DIAGRAM OF THE TT-6AL VHF TELEVISION TRANSMITTER (DRIVER)



tectors or reflectometers. The transmission line probes are installed so as to give an indication of the amount of power and reflected power. A meter on the front panel can be switched between the two diode circuits. Power output is read in percent peak power which can be calibrated to read 100% for rated power. The standing-wave ratio is read directly on a specially calibrated scale. In the monitoring unit a type 2D21 thyratron tube operates in conjunction with a relay to remove the high voltage plate power from the TT-6AL when the SWR exceeds a predetermined value.

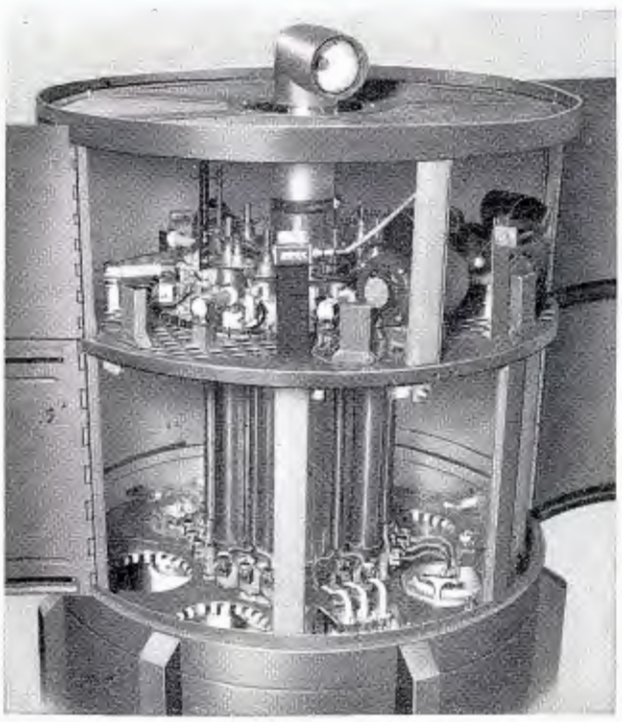
A single unit reflectometer is provided for the aural amplifier. This normally is connected to read power output. Standing wave ratio can be measured by manually rotating the reflectometer head. If desired, a complete MI-19087 monitoring unit can be supplied for the aural output as optional equipment. This unit provides two reflectometer heads as well as the SWR monitor.

25 KW Power Amplifier

The ES-19247 Amplifier contains tunable tank circuits to cover channels 2 to 6 inclusive. The video and audio signals are fed to the driver and the modulation occurs in this unit. The r-f output from the visual driver is fed to the class "B" linear amplifier. The aural amplifier is similar to the visual amplifier, except that it is frequency modulated and therefore operated class "C". The visual amplifier has sufficient bandwidth so that it can easily reproduce the picture information from the driver transmitter. Diode monitors are included so that tuning and monitoring may be accomplished at both the input and output levels. A reflectometer is included for both the aural and the visual transmitters. This unit, which may be inserted at any convenient place in the output line, is designed to directly read percent of assigned power, and standing wave ratio.

The control equipment is of conventional design. The overload system has an automatic reset feature. After an overload occurs the plate voltage is removed momentarily, then automatically returned twice. If the overload persists for the third time the plate voltage will remain cut off. All circuits such as the filament bus, the blower, and the bias supply are protected by breakers with thermal-magnetic trips. The control equipment for the aural and visual transmitters is identical, and is arranged so that either r-f amplifier may be turned on and off independently.

Except for the bias supply and slight differences in the high-voltage filter, the power supplies for the aural and visual amplifiers are identical. The high-voltage rectifiers employ six RCA 673 mercury vapor rectifier tubes in a double 3-phase half-wave circuit with a balance coil. The bias supply for the visual amplifier is electronically regulated, its output voltage remaining constant for large changes in grid current. The bias for the aural amplifier is essentially obtained from grid leaks with just enough fixed bias to protect the tubes when there is no drive.



Close up showing the cluster of seven air-cooled 5762 triodes used in the 25 kw amplifier section.

Power Amplifier Circuits

The visual r-f amplifiers employ seven RCA 5762 air-cooled tubes operating in parallel in a grounded grid circuit. The aural amplifier also contains seven RCA 5762 tubes in an almost identical circuit, however, the filaments of two of the seven tubes may be turned off if desired, leaving only five operating tubes.

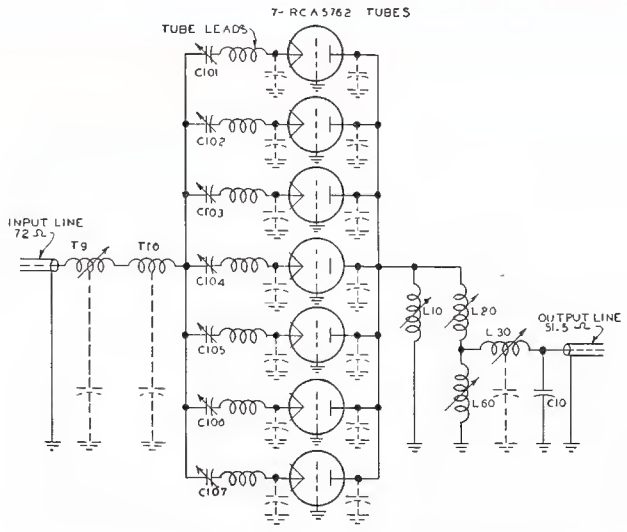
In the 54-88 mc amplifier the plate tank circuit is tuned by the PA tank inductor. This inductance is a co-axial tank formed by the outer shell, and an inner cylinder and varied by a shorting bar located below the tubes. The shorting bar is motor driven and controlled from the front panel. The output transmission line is brought up through the center of the tank and coupled to the plate circuit through

a variable capacitor which is also motor driven and controlled from the front panel. What is equivalent to a second tuned circuit is formed by inserting a shut capacitor in the output transmission line approximately one quarter wave from the variable capacitor. This secondary circuit is tuned by sliding the shunt capacitor along the line. An inductance L-30 in the equivalent circuit is actually the first quarter wave of the output transmission line. By a suitable selection of the value of capacitor C-10 and proper adjustment of the coupling capacitor C-40 a broadband flat-topped circuit can be obtained. The optimum circuit has been found to be 8½ to 10 megacycles wide between half power points and almost flat over the six megacycle channel.

The input or cathode circuit is also essentially a co-axial tank circuit tuned by a shorting bar. In the equivalent circuit this is shown as a variable inductance. Because of the high input capacity of seven tubes in parallel this tank is actually much less than a quarter of a wavelength long. A large part of the inductance is formed in the tube and by the tube leads. The input line is fed through the center of the cathode tank and is connected in series with the input circuit at a low impedance point. In order to match this impedance to the line from the driver two quarter-wave transformer sections are employed. These are built into the 3⅛" input line by using the proper size center conductors for the quarter-wave sections.

To allow for variation in tube input capacity and for variation in feed-through power a means for making some adjustment to the input coupling is achieved by adding in shunt capacitors. These capacitors take the form of seven co-axial capacitors. To vary the capacity, a mycalex cylinder which has a dielectric constant of approximately 6 is inserted between the center and outer tubes. These seven mycalex cylinders are mechanically ganged together and driven by a tuning motor. Since the tube leads from a portion of the tank inductance these capacitors are not actually in parallel with the tube input but are part way down the tank circuit where it has been found that they serve as a coupling adjustment and have little effect on the resonant frequency of the circuit.

A carrier-off monitor is available as optional equipment. It acts in conjunction with the reflectometer units of the driver and amplifiers. This unit will remove the plate



Simplified equivalent circuit of the 25 kw (low band amplifier).

voltage from all the r-f stages if the output level drops below a pre-determined value, such as would be the case if an r-f arc occured in either of the 25 kw amplifiers. Sometimes such an arc does not change the plate current sufficiently to trip the d-c overload relays.

Vestigial Sideband Filter

The MI-19085-L Vestigial Side Band Filter is furnished completely assembled and adjusted for any one of the low band VHF television channels. The filter is an integral unit designed for floor, ceiling, or wall mounting near the visual transmitter so that the input transmission line is as short as possible.

The purpose of the filter is to attenuate the lower sideband output of a double side band visual transmitter. It consists essentially of two similar parallel transmission lines which have resonant cavities connected to them at several points. The lines are jointed at the input through a bridge balun and at the output with a transformer tee.

In order to minimize reflections on the transmission line between the visual transmitter and the filter, the visual input of the filter is designed to have a constant input impedance over the band of frequencies produced by the visual transmitter. The filter sections consist of lengths of coaxial line (resonant cavities), which are adjustable for tuning purposes. As the filter is pretuned at the factory to the channel stamped on the nameplate, no operating adjustments are necessary.

Harmonic Filter

Harmonic filters are supplied for insertion in the output transmission line. When operated in conjunction with the TT-25CL Transmitter these filters are designed to attenuate all harmonics to a value at least 60 db below the peak carrier level. Electrically, each filter consists of an M-derived half-T section, several low pass filter sections, and a constant-K half-T section. The M-derived section provides rapid cut-off in the second harmonic region and a termination impedance at one end of the filter of 51.5 ohms. Attenuation of the harmonics is accomplished by a low pass filter section, while the constant-K section serves to give termination impedance of 51.5 ohms at the other end of the unit.

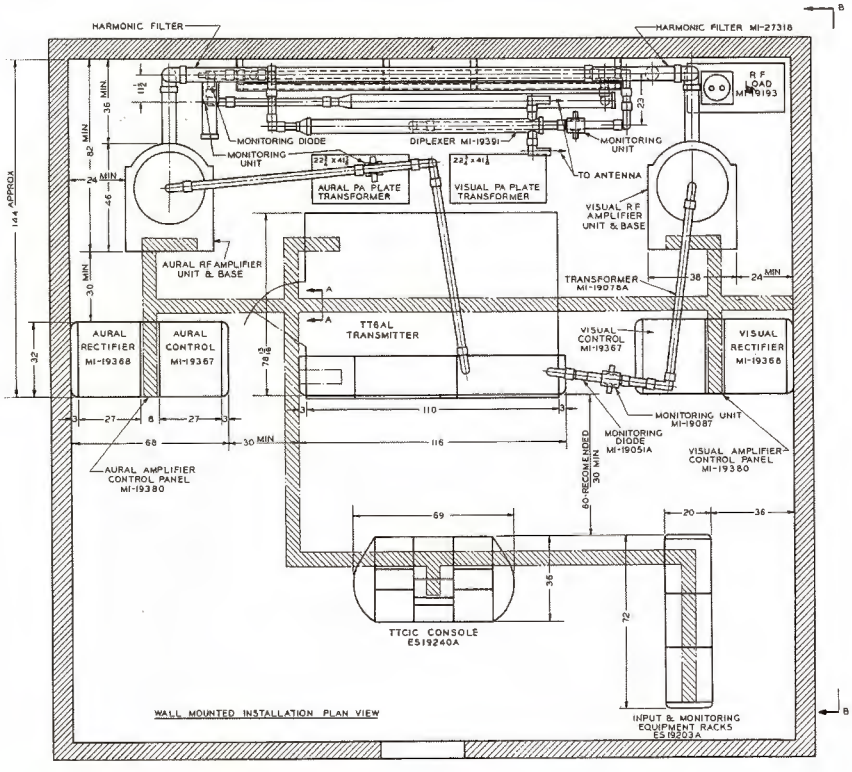
A low pass filter is provided for insertion in the video input circuit. This filter attenuates all video frequencies above 4.75 megacycles at least 20 db. An all-pass phase equalizer is also included as part of the low pass filter. This equalizer corrects any phase distortion which may be introduced as a result of the sharp cut-off.

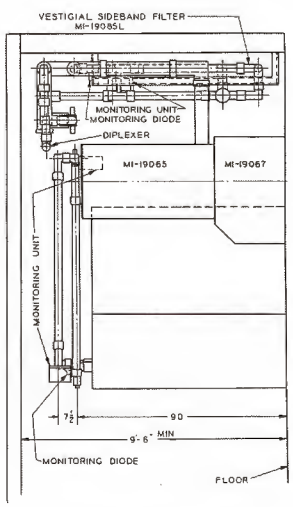
Installation Plans

The new TT-25CL Transmitter offers one of the most compact floor arrangements yet devised by RCA. Unitized construction of the driver and amplifier portions allow the broadcaster utmost latitude in arrangement layout. A typical installation is shown below, but numerous variations will suggest themselves to the station engineer.

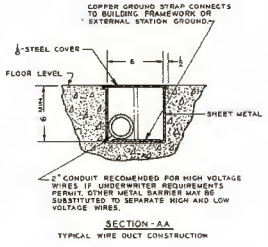
The complete driver is housed in what is equivalent to a single cabinet with only one access door. However, it is broken down for shipping into racks and panels of convenient size for easy handling. All r-f circuit operating controls are located at the front of the enclosure, thus allowing adjustments to be made with the power on. The rectifier tubes are mounted on the rear wall and the heavy power components are mounted on the floor. Four additional cabinets with roll-back doors house the control and rectifier units for the visual and aural power amplifiers. The visual and aural power amplifiers are self-contained units housed in cylindrical cabinets which provide complete accessibility to all tubes as well as their circuit components. The two high-voltage transformers for the power amplifiers are housed as separate units.

TT-25CL TYPICAL FLOOR PLAN





WALL MOUNTED INSTALLATION
SIDE VIEW B-B

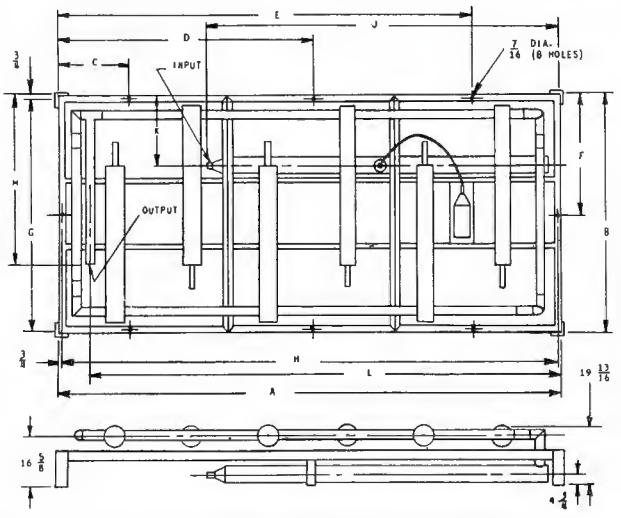


SECTION - AA
TYPICAL WIRE DUCT CONSTRUCTION

MI-19085-L VESTIGIAL SIDEBAND FILTER

SPECIFICATIONS

Frequency	54-88 mcs
Maximum Power (5000 ft. elevation)	25 kw
Input and Output Impedance	51.5 ohms, 3⅛" coaxial line
VSWR	Less than 1.1
Ambient Temperature	45° C max.
Overall Dimensions:	
Channel 2	165"x79"x19 13/16"
Channel 3	154½"x73¾"x19 13/16"
Channel 4	146"x69½"x19 13/16"
Channel 5	143½"x63¾"x19 13/16"
Channel 6	143½"x63¾"x19 13/16"
Weight	930 lbs. max.
Mounting	Wall or ceiling
Clearance	12"



SPECIFICATIONS

Performance Specifications

	Visual	*Aural*
Type of Emission	A5	F3
Frequency Range	Ch. 2-6	Ch. 2-6
Rated Power Output	25 kw[1]	15 kw[2]
Minimum Power Output	10 kw[1]	5 kw[2]
R-F Output Impedance	51.5 ohms	51.5 ohms
Input Impedance	75 ohms	600/150 ohms
Input Level	0.7 v. peak-to-peak min.	+10 ±2 dbm
Amplitude vs. Frequency Response		Uniform ±1 db from 50 to 15,000 cycles

Upper Sideband Response:[3]
- +1, −1.5 db at carrier plus 0.5 mc.
- +1, −1.5 db at carrier plus 1.25 mc.
- +1, −1.5 db at carrier plus 2.0 mc.
- +1, −1.5 db at carrier plus 3.0 mc.
- +1, −1.5 db at carrier plus 3.58 mc.
- +1, −3.0 db at carrier plus 4.18 mc.
- −20, db maximum at carrier plus 4.75 mc.

Lower Sideband Response:[4]
- +1, −1.5 db at carrier minus 0.5 mc.
- −20 db max. at carrier minus 1.25 mc.
- −42 db max. at carrier minus 3.58 mc.

± Variation in Frequency Response with Brightness[5]	±1.5 db	
Carrier Frequency Stability[6]	±1 kc	±500 cps[7]
Modulation Capability	12.5 ±2.5% (reference white)	±50 kc
Audio Frequency Distortion		1.5% max. 50-100 cy. 1.0% max. 100-7500 cy. 1.5% max. 7500-15,000 cy.
FM Noise, below ±25 kc Swing		60 db
AM Noise, r.m.s.	40 db below 100% mod.	50 db below carrier

[1] Measured at the output of the sideband filter or filterplexer.

[2] Measured at the input to the diplexer or filterplexer.

[3] With respect to the response at 200 kc, as measured by the BW-5A Sideband Response Analyzer at transmitter mid-characteristic. 4.75 mc attenuation requires use of MI-27132 LP filter in the video input circuit.

[4] With respect to the response at 200 kc at transmitter mid-characteristic.

[5] Maximum variation with respect to the response at mid-characteristic measured with the BW-5A Sideband Response Analyzer at brightness levels of 22.5% and 67.5% of sync peak, using approximately 20% (peak-to-peak) modulation.

[6] Maximum variation for a period of 30 days without circuit adjustment.

[7] Maximum variation with respect to the standard 4.5 mc separation between aural and visual carriers.

SPECIFICATIONS (Continued)

Performance Specifications (Continued)

	Visual	Aural
Amplitude Variation Over One Picture Frame	Less than 5% of the peak of sync level	
Regulation of Output	7% max.	
Burst vs. Subcarrier Phase[1]	±5 degrees max.	
Subcarrier Phase vs. Brightness[2]	±7 degrees max.	
Subcarrier Amplitude[1]	±15% max.	
Linearity (Differential Gain)[3]	15% max.	
Envelope Delay vs. Frequency[4]	±.08 μsec. from 0.2 to 2.1 mc. ±.04 μsec. at 3.58 mc. ±.08 μsec. at 4.18 mc.	
Harmonic Attenuation, ratia of any single harmonic to peak visual fundamental	At least 60 db	At least 60 db

Electrical Specifications

Power Line Requirements:

Transmitter:

Line	230/208 volts, 3 phase, 50/60 cycles
Slow Line Variations	±5% max.
Rapid Line Variations	±3% max.
Power Consumption	(Black Pix) (Ave. Pix)
Power Factor (approx.)	90%

Crystal Heaters:

Line	115 volts, single phase, 50/60 cycles
Power Consumption	28 watts

Tube Complement

DRIVER VISUAL SECTION

Qty.	Function	Type No.
1	Visual Crystal Oscillator No. 1	6AK5
1	Visual Crystal Oscillator No. 2	6AK5
1	1st Visual Amplifier	5763
1	1st Visual Multiplier	5763
1	2nd Visual Multiplier	5763
1	3rd Visual Multiplier	5763
1	Visual Output Amplifier	5763
1	1st Visual Amplifier	4-65A
1	2nd Visual Amplifier	4-250A
1	1st Video Amplifier	6AG7
1	Inverter	6AG7
1	Linearity Corrector	6AG7
1	2nd Video Amplifier	6AG7
2	3rd Videa Amplifier	807
5	Modulator	6146
1	Bucking Bias	6BL7-GT
1	1st Sync Amplifier	6AG7
1	2nd Sync Amplifier-Sync Separator	6SN7-GT
1	Sync Clipper-Pulse Generator	6SN7-GT
1	Pulse Clipper-Pulse Amplifier	6SN7-GT
1	Pulse Output	6SN7-GT
2	Clamp Diode	6AL5
6	Voltage Reference Tubes (D-C Coupling)	5651

Tube Complement (Continued)

Qty.	Function	Type No.
1	Bias Regulator	OB2
2	Regulators (Modulator Screens)	OA2
2	Regulators (Modulator Screens)	OB2
3	Voltage Reference Tubes (Bucking Bias)	OA2
2	Voltage Reference Tubes (L.V. and H.V. Regulators)	5651
1	D-C Amplifier (High Voltage Regulator)	6SL7-GT
2	Series Regulator (High Voltage Regulator)	6AS7-G
1	D-C Amplifier (Low Voltage Regulator)	6SL7-GT
2	Series Regulators (Low Voltage Regulator)	6AS7-G
1	150 V Regulator	OD3
1	Monitor Amplifier	6AC7
1	Monitor Amplifier (Output)	6AG7
1	Visual Modulated Amplifier	6076
1	Visual Driver Reflectometer	6AL5
1	Visual PA (Left)	5762
1	Visual PA (Right)	5762
1	Visual PA Forward Power Detector	6AL5
1	Visual PA Reflected Power Detector	6AL5
1	Reflectometer Thyratron	2D21

DRIVER AURAL SECTION

2	Reactance Tube Modulator	6V6
1	FM Master Oscillator	6V6
1	1st Aural Multiplier	5763
1	2nd Aural Multiplier	5763
1	3rd Aural Multiplier	5763
1	Amplifier—Aural Output	5763
1	1st Mixer	6AS6
1	2nd Mixer	6AS6
1	Amplifier-Difference Frequency	6AQ5
1	1st Difference Frequency Divider	6AC7
1	2nd Difference Frequency Divider	6AC7
1	3rd Difference Frequency Divider	6AC7
1	Crystal Oscillator-Reference Frequency	6J6
1	1st Reference Frequency Divider	6AC7
1	2nd Reference Frequency Divider	6AC7
1	3rd Reference Frequency Divider	6AC7
1	Cathode Follower-Frequency Detector Drive	12AT7
1	1st Aural Amplifier	4-65A
1	2nd Aural Amplifier	4-1000A
1	Aural PA Reflectometer	6AL5
1	Aural PA	5762

[1] Maximum departure from the theoretical when reproducing saturated primary colors and their complements at 75% amplitude.

[2] Maximum phase difference with respect to burst, measured after the VSBF, for any brightness level between 75% and 15% of the sync peak using 10% (peak to peak) modulation. This is equivalent to 5% (peak to peak) modulation as indicated by a conventianal diode demodulator.

[3] Maximum variation in the amplitude of a 3.58 mc sine wave modulating signal as the brightness level is varied between 75% and 15% of sync peak. The gain shall be adjusted for 10% (peak to peak) modulation of the 3.58 mc signal when the brightness is at pedestal level. This is equivalent to 5% (peak to peak) modulation as indicated by a conventional diode demodulator connected after the VSBF.

[4] Maximum departure from standard curve. The tolerances vary lineorily between 2.1 and 3.58 mc and between 3.58 mc and 4.18 mc. To meet the specification o properly terminated phase correction network, ES-34034-A is required in the video input circuit of the transmitter.

SPECIFICATIONS (Continued)

DRIVER COMMON POWER SUPPLY, ETC.

1	Off-Frequency Interlock Detector	6AS6
1	Voltage Regulator	OD3
1	Off-Frequency Interlock Control	2D21
1	Bias Rectifier	5R4GY
2	Voltage Regulators (PA Bias Supply)	OD3
1	Voltage Regulator (PA Bias Supply)	OA3
1	D-C Amplifier	6SH7
2	Series Regulators (PA Bias Supply)	6AS7-G
2	Low Voltage Rectifiers	866
2	Modulator Rectifier	866
1	Bias Rectifier	5R4GY
6	High Voltage Rectifiers	673
†1	D-C Amplifier (Low Voltage Regulator)	6SL7
†2	Voltage Reference Tubes (Low Voltage Regulator)	5651
†3	Series Regulators (Low Voltage Regulator)	6AS7
†2	Regulators (Carrier-Off Monitor)	OD3
†4	Amplifiers (Carrier-Off Monitor)	12AU7

AMPLIFIER VISUAL SECTION

7	Visual Linear Amplifier	5762
6	High Voltage Power Supply	673
1	Bias Supply	5R4GY
7	Bias Supply	6AS7G
1	Bias Supply	6SH7
2	Bias Supply	OD3
1	Bias Supply	OA3
2	Monitor	6AL5
1	Manitor	2D21

AMPLIFIER AURAL SECTION

7	Aural Amplifier	5762
6	High Voltage Power Supply	673
1	Bias Supply	5R4GY
2	Monitor	6AL5
1	Monitor	2D21

Mechanical Specifications

Dimensions.....(For dimensions see floor plans)
Weight (approx.):
- 6-KW Driver.....6000 lbs.
- Aural and Visual Power Amplifier and Blower, each.....1100 lbs.
- Aural and Visual Power Supply and Filter.....1100 lbs.
- Aural and Visual Control Unit, each.....1000 lbs.
- Aural and Visual Plate Transformer, each.....1050 lbs.

Finish.....Two-tone umber gray, polished stainless steel trim
Maximum Altitude[1].....5000 ft.
Ambient Temperature.....45° C. max., 0° C. min.

Equipment Supplied

TT-25CL TELEVISION TRANSMITTER (ES-19288)

Qty.	Description	Stock No.
1	Control Unit	MI-27180
1	2-KW Driver (Ch. 2-6)	MI-27181
1	6-KW Power Amplifier Unit (Ch. 2-6)	MI-27182
1	Set of Panels	MI-27450
1	Rectifier Panel	MI-27451
1	Resistor Panel	MI-27452
1	Transformer—Filter Assembly	MI-27465
3	Transformers	MI-27477/-A
1	Blower	MI-27466
1	Installation Material	MI-27467
1	Wiring Material	MI-27468
2	Reflectometers	MI-27464
3	Monitoring Unit	MI-19087

Equipment Supplied (Continued)

Qty.	Description	Stock No.
2	Harmonic Filter	MI-27318[2]
1	Vestigial Sideband Filter	MI-19085-L[2]
1	4.75 MC Low Pass Filter	MI-27132
2	Side Panels (End Shields)	MI-30541-G84
1	Set of Frequency Determining Parts for Driver	MI-27482[2]
1	Set of Frequency Determining Parts for 6-KW Amp.	MI-27483[2]
2	Crystal Unit (Visual)	MI-27492[2]
1	Line Corrector	MI-27478
1	Low Voltage Regulator	MI-27469
1	Regulator (Three Phase)	MI-27473
1	Line Regulator Control Panel	MI-27471
5	Transmission Line Coupling 90° Elbow	MI-19112-18NF
12	Transmission Line Coupling Straight	MI-19112-8
2	R-F Amplifier Units	MI-19065
2	R-F Amplifier Base Units	MI-19067
2	Blower Units	MI-19068
2	Control Units	MI-19367
1	Visual Rectifier Unit	MI-19368
1	Aural Rectifier Unit	MI-19369
2	High Voltage Transformers	MI-19072/-A
2	Driver Reflectometer Meters (0-20 micro-amp.)	MI-19181-A
1	Set of Installation Material	MI-19380
1	Set of Wiring Material	MI-19076
*	Transmission Line (*Supply quantity of each and components to suit installation requirements as specified on sales order)	MI-19112/19113-C
*	Elbows (*Supply 2 if specified on sales order)	MI-19314-18NF
*	Coupling (*Supply 2 if specified on sales order)	MI-19314-7
1	Set of Frequency Determining Parts	MI-19078-A[2]
1	Finish Touch-Up Kit	MI-28153
1	Tool Kit	MI-27088
1	Set of Equipment Tubes (for 25-KW Amplifier)	ES-19229
1	Set of Operating Tubes (for 6-KW Driver)	ES-27205
1	Miscellaneous Hardware Kit	MI-7474
1	Nameplate	MI-28180-1
2	Instruction Books	IB-36150
2	Installation Instruction Books	IB-36151
2	Instruction Books	IB-36279

Optional or Accessory Equipment

TTC-1C Control Console Equipment, with master monitor but less master monitor power supply	MI-19240-A
R-F Load and Wattmeter	MI-19193-L
Complete Set of Spare Tubes (for 6-KW Driver)	ES-27205
Set of Complete Spare Tubes (for 25-KW Amplifier)	ES-19229
FCC Spare Set of Tubes (for TT-25CL Transmitter)	ES-27240
Input and Monitoring Equipment, Wired/Unwired	ES-19237-A/B
50 Cycle Conversion Kit	MI-27486
Rectifier Enclosure	ES-19279
Carrier-Off Monitor	MI-27470
BW-5A Sideband Response Analyzer	ES-34010
Plate Current Meter	MI-21200-C1
WM-71A Distortion and Noise Meter	MI-30071-A
TO-524-D Oscilloscope	MI-26500
Diplexer	MI-19391[2]
Set of End Shields (2 per set)	MI-28061
Set of 4-inch Channels (1 front and 1 rear)	MI-19365
Coupling Unit (for use with BW-5A)	MI-19057-A
Voltage Regulator	EM-6270-D
Transmission Line 6⅛, 51.5 Ohms	MI-19314

† Tubes for optional Low Voltage Regulator and Carrier-Off Monitor Equipment.
[1] For operation at rated power and normal plate voltage.
[2] Order to suit customer's assigned channel.

VHF TELEVISION AMPLIFIER

50 KW, TYPE TT-50AH

FEATURES

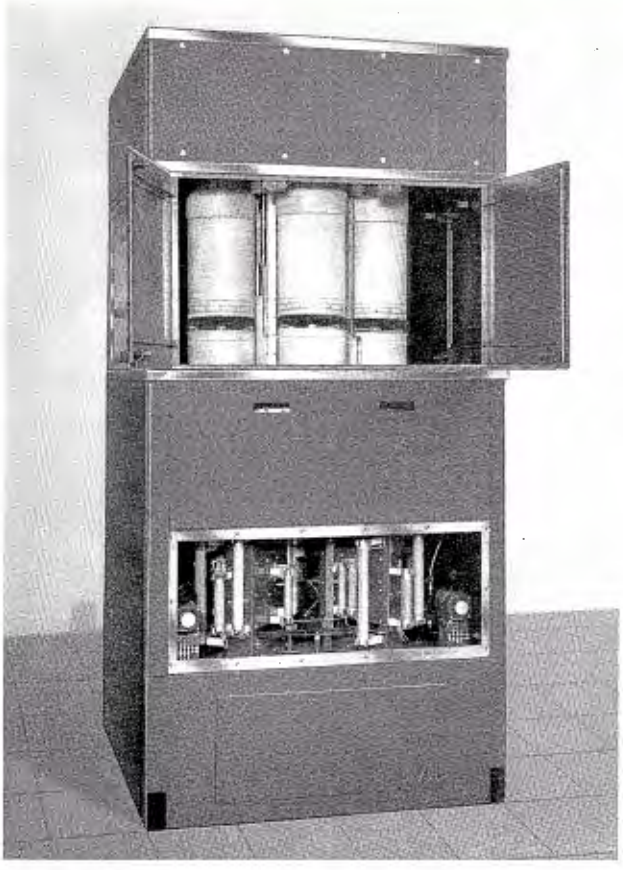
- Provides a power gain of 8.5 and operates with any 5 to 10 kw driver transmitter meeting FCC and RETMA specifications
- Excellent performance—low operating costs
- Visual power output 50 kw peak measured at output of sideband filter or filterplexer
- Equipment and tubes completely air cooled
- Simplified, single-ended r-f circuits
- High speed a-c and d-c overload protection
- Unitized construction permits utmost flexibility in station layout

USES

The RCA type TT-50AH VHF Amplifier is designed primarily to convert RCA TT-5A or TT-10AH television transmitters for higher power operation in VHF channels 7 through 13. The amplifiers may also be used to convert any 5 to 10-kw driver transmitter that meets FCC and RETMA specifications. A custom kit of parts is required to adapt the equipment for operation with a particular transmitter.

The amplifier equipment has a power gain of 8.5; sufficient to provide an economical method of increasing station power to meet maximum ERP requirements. It provides full power output on channels 7 to 13 by actual measurement at low, dollar-per-hour operating cost. Utmost flexibility of layout is accomplished by the unitized construction of the amplifier.

The TT-50AH Amplifier has the extra reserve power needed for best color telecasting, and it can greatly extend the class "A" and class "B" reception areas. The equipment thus offers maximum high-band effective radiated power for broadcast stations in major market areas, and for those stations faced with either expanding or strengthening signal in their areas.



Rear view of the 50-KW Power Amplifier showing RCA type 6166 tetrodes with protecting air ducts above, and circuit components below. All five panels on rear and sides are removable to provide complete accessibility to the equipment.

DESCRIPTION

The RCA TT-50AH VHF Amplifier equipment units are housed in cabinets which harmonize with those of the RCA type TT-5A or TT-10AH transmitter. The units include the air-cooled class "C" amplifiers for the aural carrier, the air-cooled linear broad-band amplifiers for the visual signal, two blower filter equipments, a high voltage rectifier, two filter reactors, the plate transformer, the switchgear unit, and three sliding door cabinets which match the TT-10AH driver and house the control and distribution unit, rectifier and d-c switching unit, and the regulator unit, respectively.

Both aural and visual power amplifier units consist of a single power stage utilizing a cluster of five RCA type 6166 tetrodes in a grounded-grid circuit. The air-cooled PA's are similar electrically and mechanically, with the exception of biasing and video bypassing. The following description then applies equally for either the aural or the visual power amplifier.

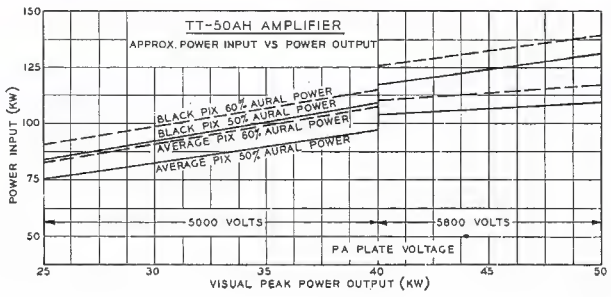
The input to the amplifier contains a variable transformer in order to match the output of the driver to the low impedance of the amplifier input circuit. The transformer is constructed similarly to the one used in the TT-25BH amplifier and is controlled from the front panel of the amplifier. The input circuit consists of the tube elements, a short section of fixed line, and a variable capacitor which is common to all five tubes. Tuning of the input circuit is accomplished by means of a reversible motor controlled by a switch on the front panel.

The plate circuit, which is also tuned by means of a reversible motor, consists of the tube elements and two variable lines which act as inductors. In order to reach the top frequency limit and maintain components large enough to handle the required power, the variable lines operate in parallel. The output circuit consists of the first half wave length of output line, and a lumped capacity which can be moved along the line. This configuration in connection with the plate circuit gives a broadband output with the proper impedance for feeding the sideband filter.

The amplifiers are housed in cabinets which provide complete accessibility to all tubes as well as their circuit components. The front panel of the amplifier contains the tuning motor switches, individual tube meters, tuning indicators, plate switches and status lamps. The tubes are located at a convenient height behind hinged access doors, and are of the plug-in type so that rapid changes can be made. The resistors, capacitors, motors, and other electrical components are mounted in the unit behind panels which have quick disconnect fasteners. Air for cooling the tubes is brought in through the base of the amplifier and expelled out the top of the unit.

Air requirements for the amplifiers are supplied by two separate external blowers, one for the aural amplifier and one for the visual amplifier. The power equipment in general is common to both sections. A 460-volt, three-phase supply enters the switchgear cubicle, which contains line and distribution circuit breakers, the main rectifier plate contactor, voltage regulators, and a distribution transformer. The blowers are fed through appropriate starters and circuit breakers at 460 volts. All filaments and low-power rectifiers are fed through an automatic voltage regulator to take care of small line variations. Bias supplies are electronically regulated. Protection is supplied both for d-c overloads and nominal a-c overloads.

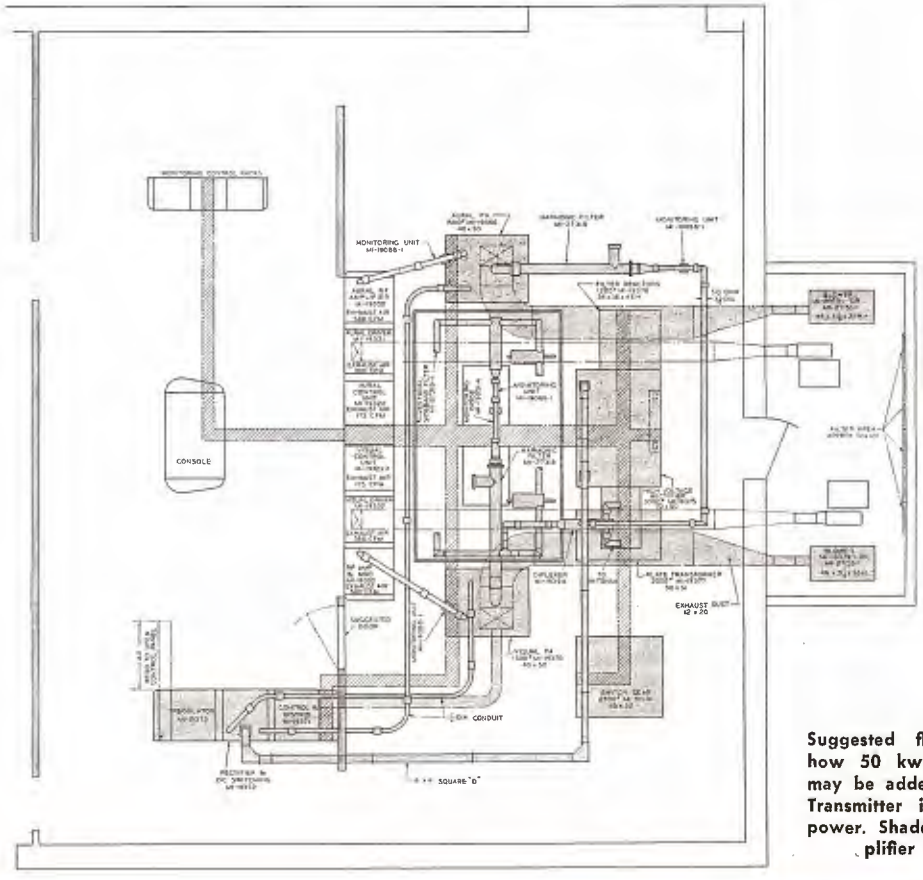
Power for both aural and visual sections is furnished by one main rectifier and one screen rectifier. D-c switching and isolation is provided. The main rectifier uses six RCA type 857-B mercury vapor tubes in a wye connected full-wave circuit, with half voltage taken from the neutral. Separate filters are used in the high voltage supply to the visual and aural amplifiers to prevent interaction. One filter, common to all unmodulated stages, is used on the center tap 2900 volt supply. The 1200 volt screen rectifier



using three RCA type 673's in a three phase half wave rectifier, is common, but a separate filter is used for aural and visual sections.

Reflectometers and associated meters are supplied to indicate power output of both picture and sound amplifiers. These meters also indicate voltage standing wave ratio and connect to the protective circuit which removes transmitter plate power when the VSWR exceeds a predetermined value. Facilities are provided to permit continuous picture monitoring. All essential operating controls are duplicated at the control panel of the RCA type TTC-1C console, designed for operation with the TT-50AH.

Switchgear Unit of the TT-50AH Amplifier which distributes 230 volt regulated and 460 volt a-c power to the amplifier.



Suggested floor layout showing how 50 kw amplifier equipment may be added to the 10 kw VHF Transmitter in order to step up power. Shaded blocks denote amplifier units furnished.

SPECIFICATIONS

Performance Specifications[1]

	Visual	*Aural*
Type of Emission	A5	F3
Frequency Range	Channels 7-13	Channels 7-13
Rated Power Output	50 kw max.	30 kw max.
Power Gain	8.5	8.5
R-F Output Impedance	51.5 ohms	51.5 ohms
R-F Input Impedance	51.5 ohms	51.5 ohms
Frequency Response:		
±1 db at carrier	+0.5 mc[2]	Uniform ±1 db from 50 to 15,000 cycles
±1 db at carrier	+1.25 mc	
±1 db at carrier	+2.0 mc	
±1 db at carrier	+3.0 mc	
±1 db at carrier	+3.0 mc	
+1, −1.5 db at carrier	+4.18 mc	
Variation in Frequency Response with Brightness[3]	±1½ db	
AM Noise, rms	40 db below 100% mod.	50 db below carrier
Amplitude Variation Over One Picture Frame	Less than 2% of the peak of sync level	
Regulation of Output	4% max.	
Linearity (Differential Gain)[4]	15%	

Electrical Specifications

Power Line Requirements:

Line	460 volts, 3 phase, 60 cycles
Slow Line Variations	±5% max.
Rapid Line Variations	±3% max.
Regulation	3% max.
Power Consumption	See curve
Power Factor (approx.)	90%

Tube Complement

VISUAL SECTION

Qty.	*Function*	*Type*
5	Linear Final Amplifier	6166
1	Voltage Regulator	6SH7
7	Voltage Regulator	6AS7-G
1	Voltage Regulator	OA3
2	Voltage Regulator	OD3
1	Rectifier	5R4GY
2	Reflectometer	6AL5
1	Reflectometer	2D21

AURAL SECTION

5	Power Amplifier	6166
2	Reflectometer	6AL5
1	Reflectometer	2D21

RECTIFIER SECTION

6	Main Rectifier	857-B
3	Auxiliary Rectifier	673

[1] The overall performance of a TV transmitter using the TT-50AH amplifier is necessarily dependent upon and governed by the performance of those portions of the transmitter preceding the amplifier.

[2] With respect to the response at 200 kc as measured by the BW-5A Sideband Response Anolyzer at transmitter mid-characteristic. 4.75 mc attenuation requires use of MI-27132 LP Filter in the video input circuit.

[3] Maximum variation with respect to the response at mid-characteristic measured with the BW-5A Sideband Response Analyzer at brightness levels of 22.5% and 67.5% of sync peak, using approximately 20% (peak-to-peak) modulation.

Mechanical Specifications

Dimensions:

Aural and Visual Power Amplifiers	84" high, 42" wide, 53" deep
Control Rectifier and Regulator Cabinets (each)	84" high, 30" wide, 32½" deep
Blower Units	34⅞" high, 47⅞" wide, 23⅝" deep
Switchgear	75⅜" high, 52" wide, 48" deep
High Voltage Rectifier	84" high, 70" wide, 50" deep
Filter Reactors	46½" high, 36" wide, 36" deep
Plate Transformer	45⅛" high, 51" wide, 30" deep
Total Weight of Amplifier Equipment approx.)	15,000 lbs.
Finish	Two tone umber gray, polished stainless steel trim
Maximum Altitude[5]	7500 ft.
Ambient Temperature	45° C max., 10° C min.

Equipment List

TT-50AH TELEVISION AMPLIFIER (ES-19276)

Qty.	*Description*	*Stock No.*
1	Aural Power Amplifier	MI-19366
1	Visual Power Amplifier	MI-19370
1	Control and Distribution Unit	MI-19371
1	Rectifier and D-c Switching Unit	MI-19372
1	Regulator Unit	MI-19373
1	Switchgear	MI-19374
1	High Voltage Rectifier	MI-19375
2	Filter Reactors	MI-19376
1	Plate Transformer	MI-19377
2	Blower and Filter Equipments	MI-27153
1	Monitoring Diode	MI-19051-B
2	Power Amplifier Output Monitoring Units	MI-19088
1	Set of End Shields (2 per set)	MI-28061
1	Set of Installation Material	MI-27159
1	Miscellaneous Hardware Kit	MI-7474
1	Set of Operating Tubes	ES-19277
1	Nameplate	MI-28180-1
2	Harmonic Filters	MI-27318[6]
1	Finish Touch-Up Kit	MI-28153
*	Transmission Line (*Sales order must specify quantity for installation requirements)	MI-19313
1	Installation Instruction Book	IB-36157
1	Instruction Book	IB-36158
1	Vestigial Sideband Filter	MI-27315-H[6]

Optional and Accessory Equipment

TTC-1C Control Console Equipment, with master monitor but less master monitor power supply	MI-19240-A
Diplexer	MI-19394[6]
R-F Load and Wattmeter	MI-19191-H
TV Station Monitoring Equipment Wired/Unwired	ES-19203-A/B
Color TV Station Monitoring Equipment Wired/Unwired	ES-19237-A/B
Complete Set of Spare Tubes	ES-19277
FCC Spare Set of Tubes	ES-19278
BW-5A Sideband Response Analyzer	MI-34010
Plate Current Meter	MI-21200-C1
WM-71A Distortion and Noise Meter	MI-30071-A
TO-524-D Oscilloscope	MI-26500

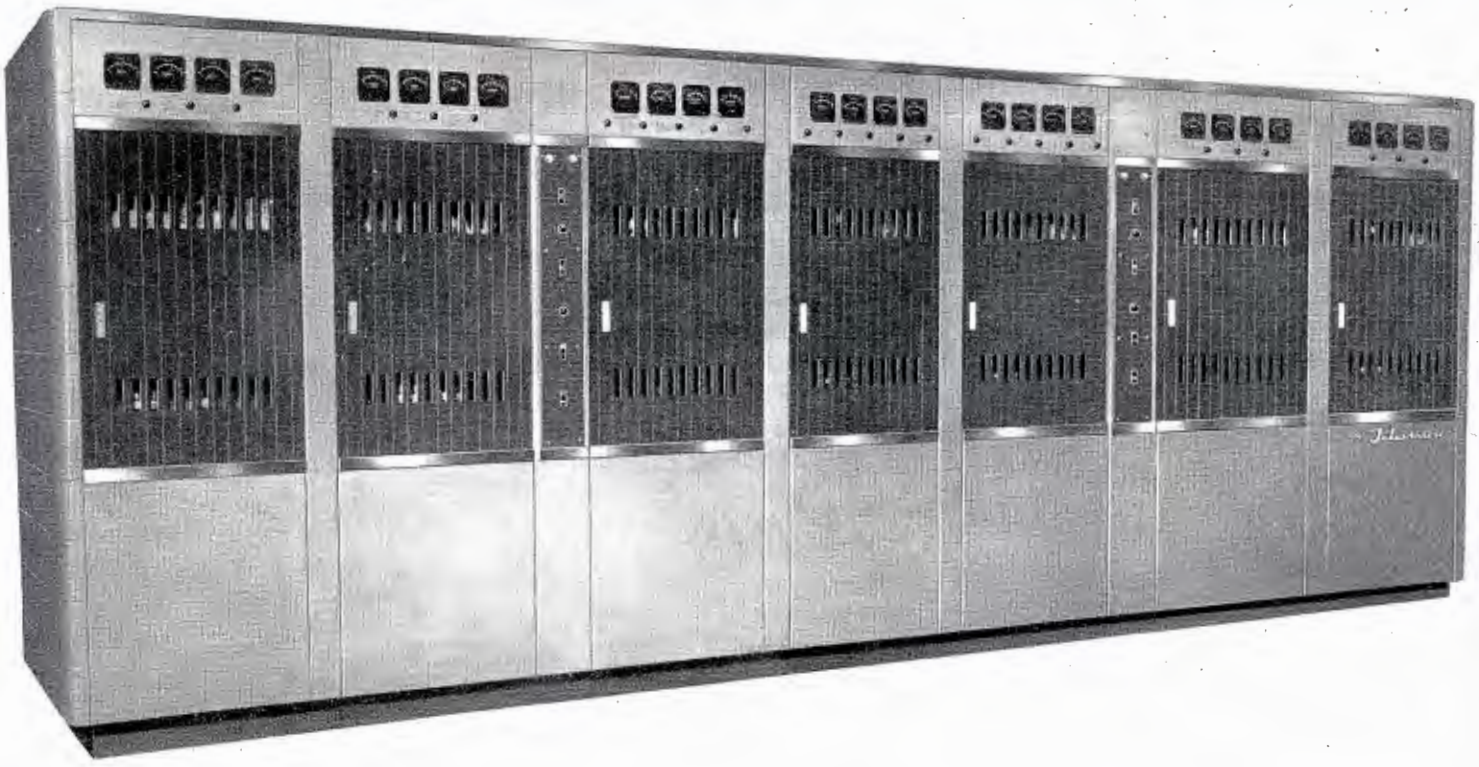
[4] Without correction. The correction circuits are normally applied in or ahead of the video modulator in the driver. Measured at 3.58 mc with increments not larger than 10% between 15% and 75% of peak of sync voltage.

[5] For operation at rated power and normal plate voltage.

[6] Order to suit customer's assigned frequency.

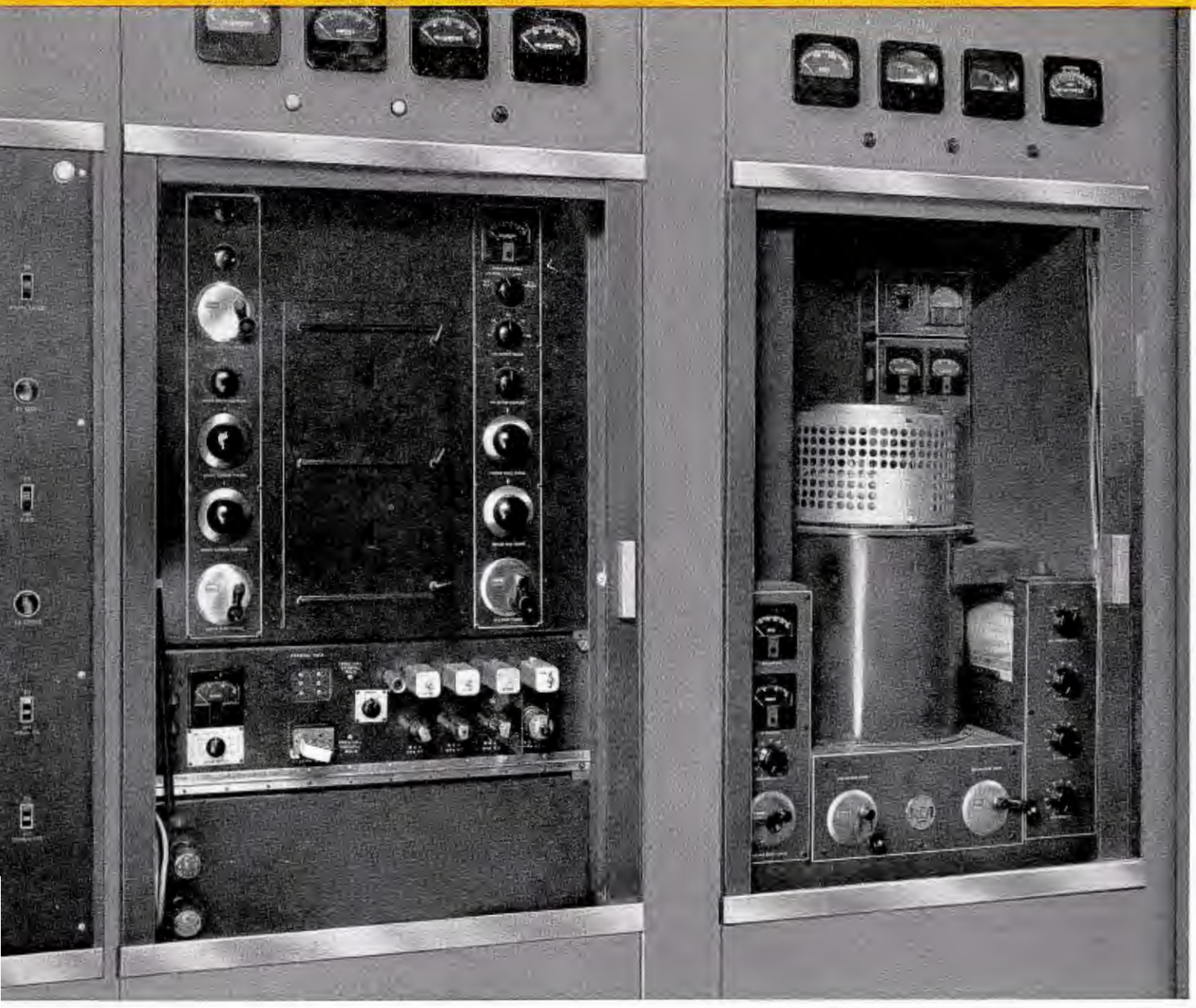
VHF TELEVISION TRANSMITTER

50 KW VHF, TYPE TT-50AH



FEATURES

- Power output 50 kw peak at output of sideband filter or filterplexer
- Air-cooled tubes—air-cooled transformers
- Economical installation—low operation costs
- Excellent video frequency response—better than RETMA requirements
- Hum level —40 db insures satisfactory operation on non-synchronous network originations
- Visual carrier frequency stability ±1 kc
- Aural carrier frequency stability ±1 kc
- Accessory 50-kw Cut Back Kit permits easy power cutback to 10 kw
- Vestigial sideband characteristics determined by fixed-tuned, trouble-free, and factory-adjusted sideband filter or filterplexer
- All important circuits are metered
- High-speed a-c and d-c overload protection
- Lower installation costs—preformed inter-cabinet connection cable
- Reduced floor-space—sliding doors require no space for door swing
- Small, easily handled cubicles



Visual transmitter section of the 10 kw driver used for the low power section of the TT-50AH transmitter. Photo shows visual driver chain and r-f amplifier cabinets.

USES

RCA's powerful VHF television transmitter, the TT-50AH, is designed to provide a maximum output of 50 kw peak visual signal at the output of the sideband filter in conformance with FCC and RETMA standards and 30 kw of aural power at the output of the transmitter. The equipment operates in VHF television channels 7 to 13 (174-216 mc) and, when used in combination with RCA antennas, easily provides the maximum of 316 kw e.r.p. with plenty of power to spare.

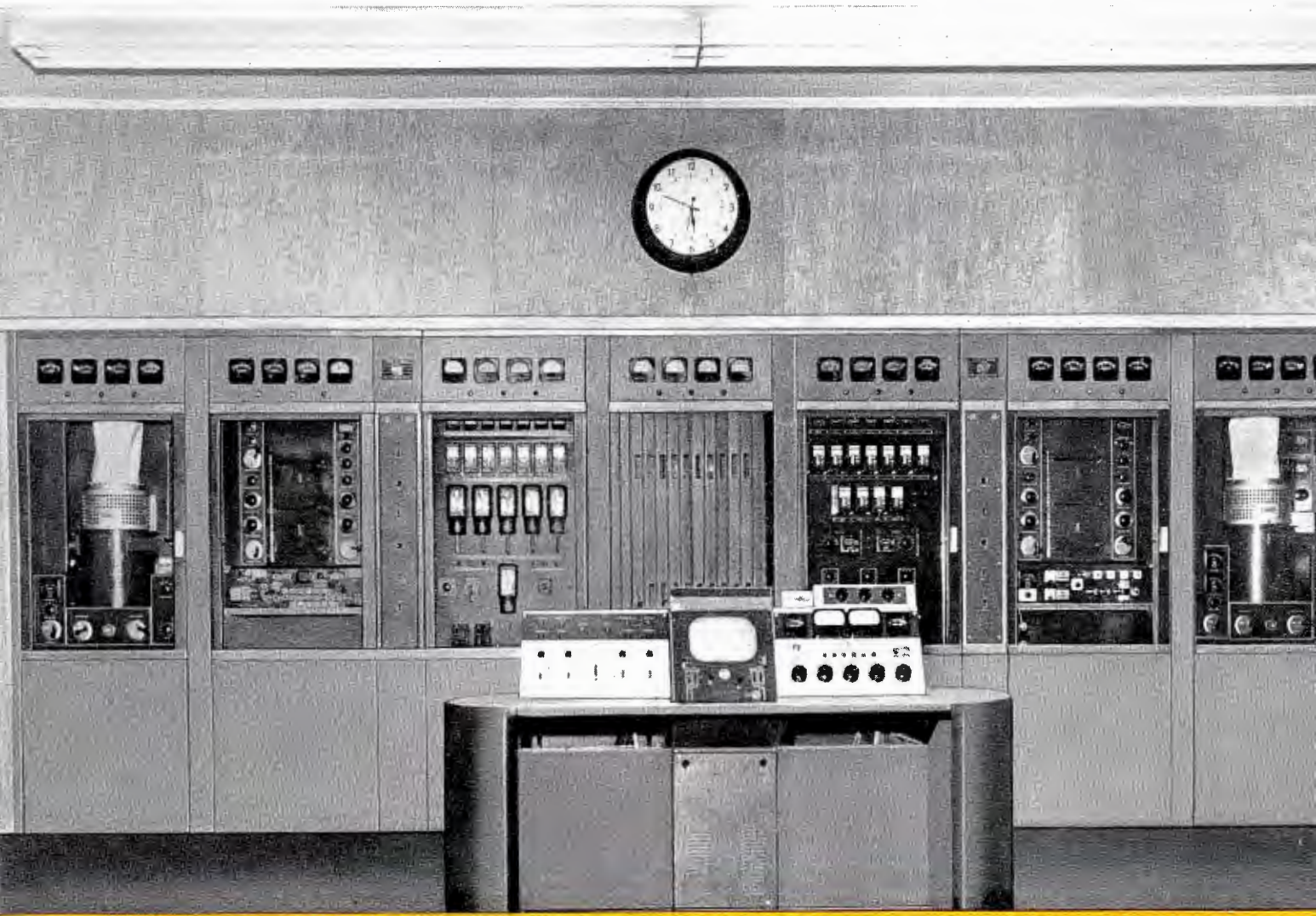
The equipment thus offers maximum high-band effective radiated power for broadcast stations in major market areas. It provides "saturation" coverage and conservative, reliable operation with power in reserve. Better linearity, finer pictures, good frequency response, low phase shift maintained as tubes age, longer tube life, and less time consumed in making adjustments to maintain proper levels are derived from the TT-50AH's conservative design. The equipment has the extra reserve power needed for clearest color telecasting possible, and can greatly extend the class "A" and class "B" reception areas of most stations. The TT-50AH is recommended for all major broadcast stations planning to program with multiple studio facilities.

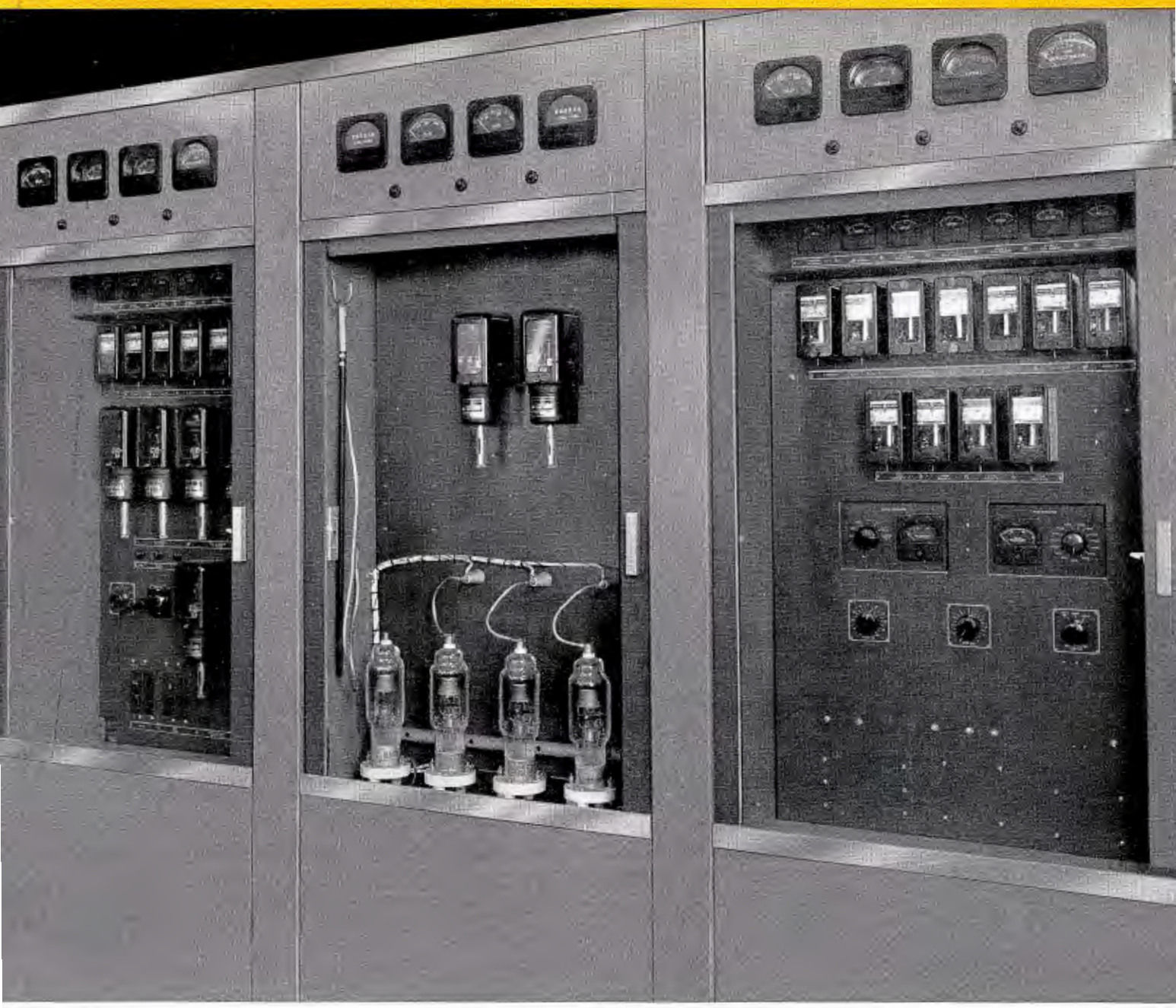
DESCRIPTION

The RCA type TT-50AH Transmitter consists of the r-f sections of the type TT-10AH which include visual and aural modulators followed by amplifiers which raise the power level to the specified 50 kw. These amplifiers, visual and aural, are very similar in circuitry and construction to those used in the model TT-25BH Transmitter. The d-c power supplies and the a-c switchgear are common to both the visual and aural sections, with d-c switching and isolation to facilitate servicing.

The 10-kw driver and control circuits are housed in seven cubicles equipped with sliding front and rear access doors. These cabinets are mounted adjacent to each other on rails which serve not only as a base frame but also wire trench. Two cabinets, grouped at the left, house the aural driver section which employs a phase modulated exciter and includes a built-in pre-emphasis network. The visual driver section, located in the two right-hand cabinets, features high-level, grid modulation of the 10 kw amplifier. This amplifier and the 50 kw output amplifier stages are the only broadband stages in the equipment. The three center cabinets house the overload relays, regulated power supplies, and control and distribution components. These three cabinets are common to both the aural and visual sections of the transmitter.

Front view of TT-50AH Transmitter with front cabinet doors open, and TTC-1B Transmitter control console. Photo by courtesy of WTRF-TV, Wheeling, W. Va.





Central cabinets of the 10 kw driver showing control and distribution, screen rectifier, and regulator units.

The TT-50AH employs high-gain RCA 6166 air-cooled tetrode tubes in both aural and visual amplifiers and drivers. R-f amplifier and modulator circuits employ the latest design features which result in the highest degree of aural and visual transmission fidelity. High level modulation is employed at the grid of the 6166 driver power amplifier stage and a vestigial sideband filter provides sideband attenuation in compliance with standards of TV transmission. This system provides the greatest possible simplicity in operation since the only transmitter tuning adjustment which affects the video frequency response characteristic are in the modulated and final stage circuits. The filter shapes the sideband response and gives positive assurance of correct spectrum response at the antenna connection. Reflectometers and associated meters are supplied to indi-

cate power output of both picture and sound transmitters. These meters also indicate voltage standing wave ratio and connect to the protective circuit which removes transmitter plate power when the VSWR exceeds a predetermined value. Similar equipment is also supplied to indicate power and VSWR between the 10-kw modulated amplifier and the output amplifiers. These reflectometers also tie into the transmitter control circuit and remove power in the event that the VSWR exceeds the predetermined value.

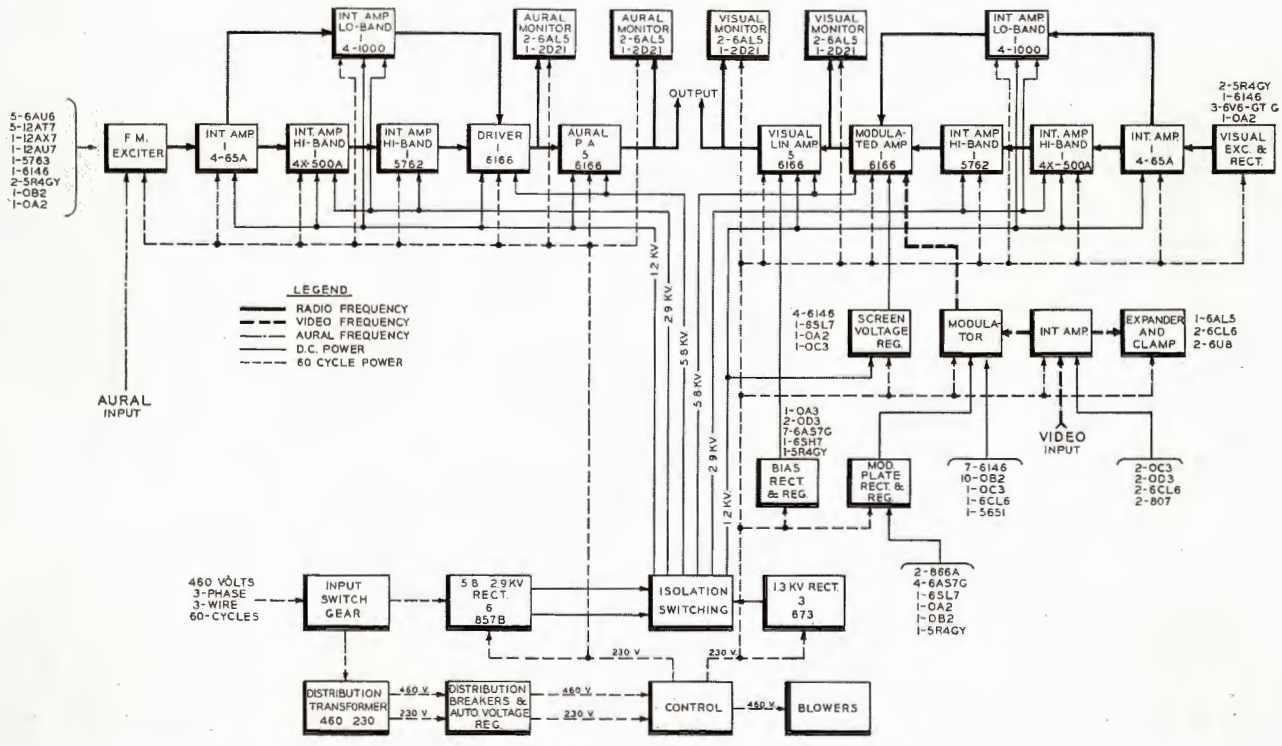
Facilities are provided to permit continuous picture monitoring at various points in the system, including diodes before the linear amplifier and at the input of the sideband filter. All essential transmitter operating controls are duplicated at the control panel of the RCA type TTC-1C console, designed as an accessory equipment for operation with the TT-50AH.

TT-50AH Circuits

Complete units from the TT-10AH driver are used for the low-power section of the TT-50AH. These provide an aural r-f section up to and including the driver amplifier and a visual section up to and including the modulated amplifier.

Crystal control is used to maintain frequency accuracy to ±1 kc in the visual transmitter. This order of stability is of great importance when offset carrier operation is employed. The stability is achieved through the very accurate application of temperature control to the crystal. This crystal is operated in a low power crystal oscillator circuit from which the output frequency is 1/18 the assigned frequency of the TT-50AH. Three additional stages—a tripler, doubler, and amplifier stage, are associated with the low power crystal oscillator and together constitute the visual exciter unit

Simplified block diagram of the TT-50AH Transmitter.



The power amplifier tube in both transmitters is an RCA type 6166 especially designed for VHF broadband television transmission. Due to the high power capability of this tube it was possible to build a single ended power amplifier stage and take advantage of somewhat simpler construction. At the same time the need for a balun was eliminated, since the transmitter is single ended throughout.

The modulated power amplifier utilizes a "half wave" grid circuit, dispensing with the usual blocking capacitor. By this scheme the modulator load capacitance is reduced to the sum of the tube capacitance and the distributed r-f circuit capacitance.

The modulator of the transmitter is designed to accept an input signal as low as 0.7 volt peak-to-peak and to give maximum output signal level of approximately 425 volts. This output signal is attained through the use of three video amplifiers. The first and second video amplifiers employ 6CL6 tubes, and the third video amplifier two 807 tubes connected in parallel. These video stages provide a gain of approximately 600. The modulator stage consists of seven 6146 tubes. Its mode of operation is somewhat novel. It is direct coupled and has a gain of unity. The output stage provides isolation between the relative high impedance of the third video amplifier and the variable impedance of the r-f amplifier grid network.

The modulator is particularly designed for color usage, with low differential phase and high sub-carrier handling ability. It includes a back-porch clamp circuit which features a high degree of stability especially when operated with degraded input signals.

Power Amplifiers

The air cooled visual and aural power amplifiers are similar electrically and mechanically, with the exception of biasing and video bypassing. The following description then applies equally for either of the power amplifiers.

In order to obtain the required power output from each amplifier, five RCA type 6166 air-cooled tetrodes are used in parallel in a grounded grid circuit. The tubes are physically located in a ring so that each can be driven equally, and output power coupled from each tube in the simplest manner.

The input to the amplifier contains a variable transformer in order to match the 51.5 ohm output of the driver to the low impedance of the amplifier input circuit. This transformer is constructed similarly to the one used in the TT-25BH amplifier and is controlled from the front panel of the amplifier. The input circuit consists of the tube elements, a short section of fixed line, and a variable capacitor which is common to all five tubes.

The plate circuit consists of the tube elements and two variable lines which act as inductors. In order to reach the top frequency limit and maintain large enough components to handle the required power the variable lines operate in parallel. The output circuit consists of the first half wave length of output line, and a lumped capacity which can be moved along the line. This configuration in conjunction with the plate circuit gives a broadband output with the proper impedance for feeding the sideband filter.

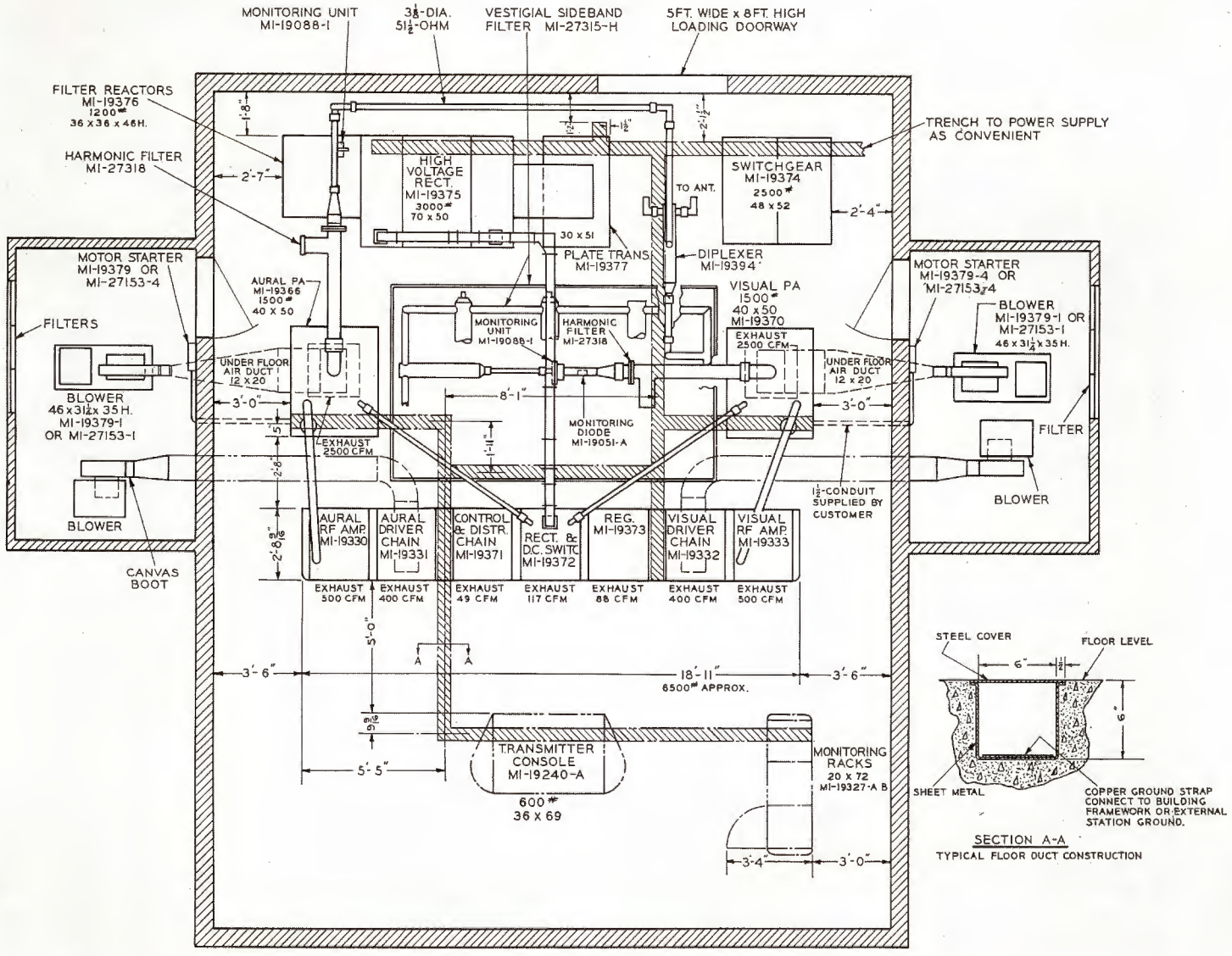
The front panel of the amplifier contains the tuning motor switches, individual tube meters, tuning indicators, plate ON switches and status lamps. The tubes are located at approximately waist height behind hinged access doors, and are of the plug-in type so that rapid changes can be made. The resistors, capacitors, motors, and other electrical components are mounted in the unit behind panels which have quick disconnect fasteners.

Air requirements for the amplifiers are satisfied by using two separate external blowers, one for the aural amplifier and one for the visual amplifier. The power equipment in general is common to both sections. A 460 volt, three-phase supply enters the switchgear cubicle, which contains line and distribution circuit breakers, the main rectifier plate contactor, voltage regulators, and a distribution transformer. The blowers are fed through appropriate starters and circuit breakers at 460 volts. All filaments and low-power rectifiers are fed through an automatic voltage regulator to take care of small line variations. Bias supplies are electronically regulated. Protection is supplied both for d-c overloads and nominal a-c overloads.

One main rectifier and one screen rectifier supply power for both aural and visual sections. D-c switching and isolation is provided. The main rectifier uses six RCA type 857-B mercury vapor tubes in a wye connected full-wave circuit, with half voltage taken from the neutral. Separate filters are used in the high voltage supply to the visual and aural amplifiers, to prevent interaction. One filter, common to all unmodulated stages, is used on the center tap 2900 volt supply. The 1200 volt screen rectifier, using three RCA type 673's in a three phase half wave rectifier, is common, but a separate filter is used for aural and visual sections.

Isolation and Switching

D-c power is routed into a switching cabinet and distributed to the various amplifiers through appropriate remotely controlled switches. The transmitter control circuits are so arranged as to provide proper sequencing and to provide "cold break" switching. In the event of a fault in either the visual or aural sections, the usual three shot reclosing system will attempt to return the transmitter to the air. If the fault persists, the transmitter will be "locked out." Status lights, located at strategic front panel positions, will indicate the location of the trouble. The operator can, by means of a switch on the front panel, isolate the faulted side and return the non-affected side to the air. At the same time the air interlocks, the personnel interlocks, and the other protective interlocks are bypassed, so that with normal safety precautions, the faulted side can be serviced while the non-affected side continues in operation.



Suggested floor layout for the TT-50AH showing in-line arrangement of the driver with power amplifier, rectifier, filter reactor and switching units grouped in rear.

SPECIFICATIONS (Cont'd)

Tube Complement

TT-50AH TUBE COMPLEMENT (ES-19274)

VISUAL SECTION

Quantity	Function	Type
1	Crystal Oscillator	6V6-GT
1	Tripler	6V6-GT
1	Doubler	6V6-GT
1	Amplifier	6146
1	Tripler	465-A
1	IPA	4X500A
1	Driver	5762
1	Modulated Amplifier	6166
5	Linear Final Amplifier	6166
1	1st Video Amplifier	6CL6
1	2nd Video Amplifier	6CL6
2	3rd Video Amplifier	807
1	Phase Splitter	6CL6
7	Modulator	6146
1	Video Monitor	6CL6
1	Sync Amplifier	6CL6
1	Sync Separator	6U8
1	D-C Off Set	5651
1	Clamp Diode	6AL5
1	Clipper and Pulse Former	6U8
4	Voltage Regulator	6146
1	Voltage Regulator	6SH7
2	Regulator Control Amplifier	6SL7-GT
6	Voltage Regulator	6AS7-G
4	Voltage Regulator	OC3
3	Voltage Regulator	OA2
1	Voltage Regulator	OA3
10	Voltage Regulator	OB2
4	Voltage Regulator	OD3
2	Rectifier	866-A
4	Rectifier	5R4GY
4	Reflectometer	6AL5
2	Reflectometer	2D21

AURAL SECTION

Quantity	Function	Type
1	Crystal Oscillator	12AT7
1	Pulse Shaper	12AT7
1	Sawtooth Generator	12AT7
1	Sawtooth Modulator	12AT7
1	Quadrupler	6AU6
1	Amplifier	6AU6
1	Doubler	6AU6
1	Doubler	6AU6
1	Tripler	6AU6
1	Tripler	12AT7
1	Tripler	5763
1	Amplifier	6146
1	Audio Amplifier	12AX7
1	Audio Amplifier	12AU7
1	Tripler	4-65A
1	IPA	4X500A
1	Driver	5762
1	Driver Amplifier	6166
5	Power Amplifier	6166
2	Rectifier	5R4GY
1	Voltage Regulator	OA2
1	Voltage Regulator	OB2
4	Reflectometer	6AL5
2	Reflectometer	2D21

RECTIFIER SECTION

6	Main Rectifier	857B
3	Auxiliary Rectifier	673

Mechanical Specifications

Dimensions:
- Overall Length (front line cabinets only) ..... 18' 11"
- Overall Height (front line cabinets only) ..... 84"
- Overall Depth (front line cabinets only) ..... 32 9/16"

Weight (approx.) ..... 19,000 lbs.

Finish ..... Two-tone umber gray, polished stainless steel trim

Maximum Altitude[1] ..... 7500 ft.

Ambient Temperature ..... 45°C max., 10°C min.

Equipment Supplied

TT-50AH TELEVISION TRANSMITTER (ES-19270)

Quantity	Description	Stock No.
1	Aural Driver Chain	MI-19331
1	Aural RF Amplifier	MI-19330
1	Aural Power Amplifier	MI-19366
1	Visual Driver Chain	MI-19332
1	Visual RF Amplifier and Modulator	MI-19333-C
1	Visual Power Amplifier	MI-19370
1	Control and Distribution Unit	MI-19371
1	Rectifier and DC Switching Unit	MI-19372
1	Regulator Unit	MI-19373
2	10 kw Blowers	MI-19346
1	Switchgear	MI-19374
1	High Voltage Rectifier	MI-19375
2	Filter Reactors	MI-19376
1	Plate Transformer	MI-19377
2	Blower and Filter Equipments	MI-27153
2	Monitoring Diodes	MI-19051-B
2	PA Output Monitoring Units	MI-19088
2	PA Input Monitoring Units	MI-19088
2	Aural Crystal Units (1 spare) to be ordered to suit customer's assigned frequency	MI-19450-A
2	Visual Crystal Units (1 spare) to be ordered to suit customer's assigned frequency	MI-19400-L4
1	Set of End Shields (2 per set)	MI-28061
1	Lot of Installation Material	MI-19378
1	Miscellaneous Hardware Kit	MI-7474
1	Set of Operating Tubes	ES-19274-B
1	Low Pass Video Filter	MI-27132
1	Nameplate	MI-28180-1
1	Vestigial Side Band Filter (*Order to suit customer's assigned channel)	MI-27315-H*
2	Harmonic Filters (*Order to suit customer's channel)	MI-27318*
1	Finish Touch-up Kit	MI-7499-A
*	Transmission Line (* Sales order must specify quantity for installation requirements)	MI-19313
1	Installation Instruction Book	IB-36157
1	Instruction Book	IB-36158

Optional or Accessory Equipment

TTC-1C Control Console Equipment, with master monitor but less master monitor power supply ES-19240-A

Diplexer (* Order to suit customer's assigned channel) MI-19394*

R-F Load and Wattmeter MI-19191-H

TV Station Monitoring Equipment Wired/Unwired ES-19203-A/B

Color TV Station Monitoring Equipment Wired/Unwired MI-19237-A/B

Complete Set of Spare Tubes ES-19274-B

FCC Spare Set of Tubes ES-19275-B

50 KW Cut Back Kit MI-27157

BW-5A Sideband Response Analyzer ES-34010

Plate Current Meter MI-21200-C1

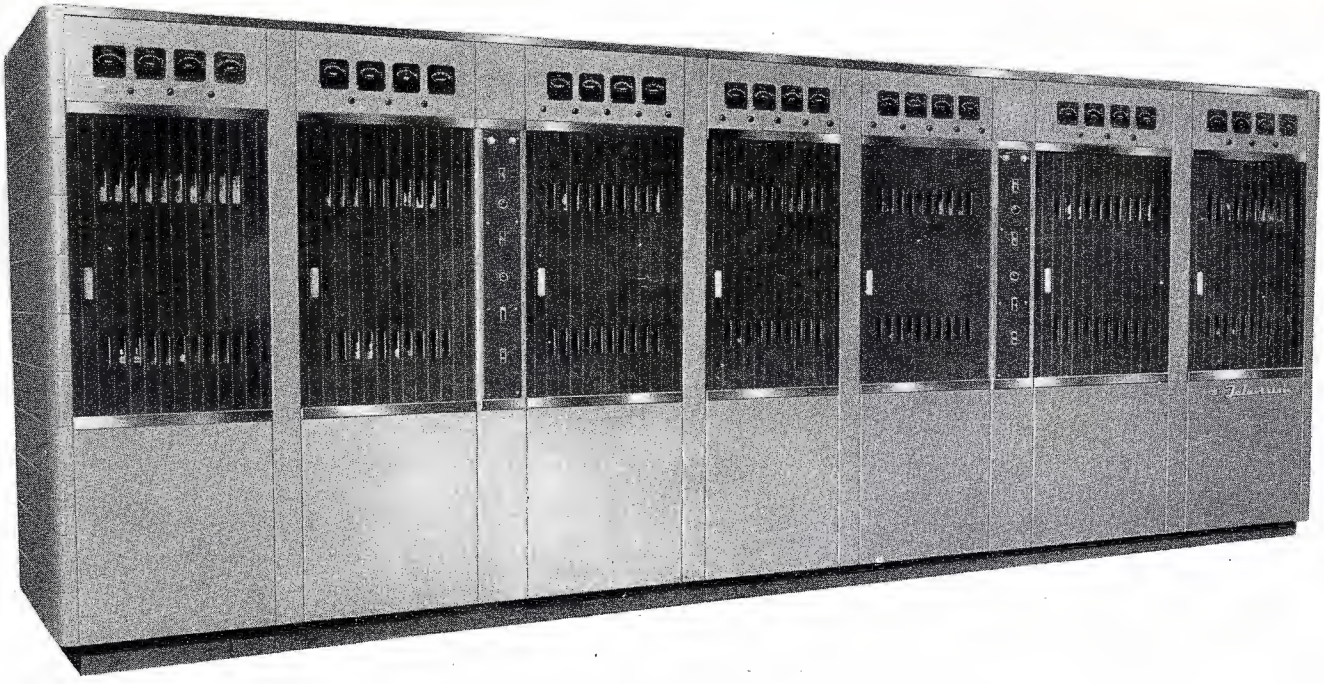
WM-71A Distortion and Noise Meter MI-30071-A

TO-524-D Oscilloscope MI-26500

[1] For operation at rated power and normal plate voltage.

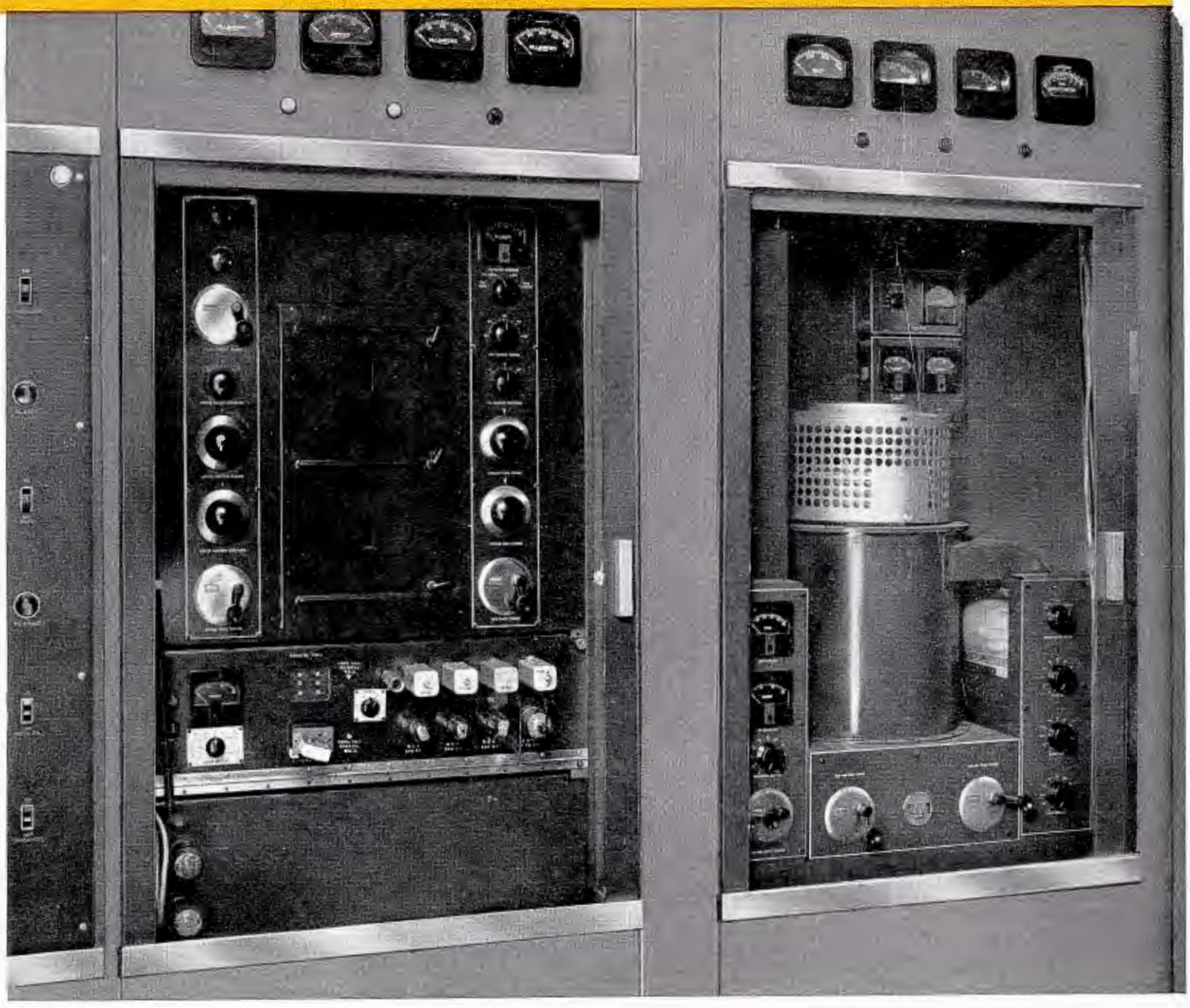
VHF TELEVISION TRANSMITTER

100 KW VHF, TYPE TT-100AH



FEATURES

- Power output 100 kw peak at output of sideband filter or filterplexer
- Air-cooled tubes—air-cooled transformers
- Economical installation—low operating costs
- Excellent video frequency response—better than RETMA requirements
- Hum level —40 db insures satisfactory operation on non-synchronous network originations
- Visual carrier frequency stability ±1 kc
- Aural carrier frequency stability ±1 kc
- Vestigial sideband characteristics determined by fixed-tuned, trouble-free, and factory-adjusted sideband filter
- All important circuits are metered
- High-speed a-c and d-c overload protection
- Lower installation costs
- Reduced floor-space—sliding doors require no space for door swing
- Small, easily handled cubicles
- Cut-back to 50 kw and 10 kw available as optional equipment



Visual transmitter section of the driver used for the low power section of the TT-100AH transmitter. Photo shows visual driver chain and modulated r-f amplifier cabinets.

USES

RCA's most powerful VHF television transmitter, the TT-100AH, is designed to provide a maximum output of 100 kw peak visual signal at the output of the sideband filter in conformance with FCC and RETMA standards and 60 kw of aural power at the output of the transmitter. The equipment operates in VHF television channels 7 to 13 (174-216 mc) and, when used in combination with low gain antennas, easily provides the maximum of 316 kw e.r.p. with plenty of power to spare.

The equipment thus offers maximum high-band effective radiated power for television stations in major market areas. It provides "saturation" coverage and conservative, reliable operation with power in reserve. Better linearity, finer pictures, good frequency response, low phase shift maintained as tubes age, longer tube life, and less time consumed in making adjustments to maintain proper levels are derived from the TT-100AH's conservative design. The equipment has the extra reserve power needed for clearest color telecasting possible, and can greatly extend the class "A" and class "B" reception areas of most stations. The TT-100AH is recommended for all major broadcast stations planning to program with multiple studio facilities.

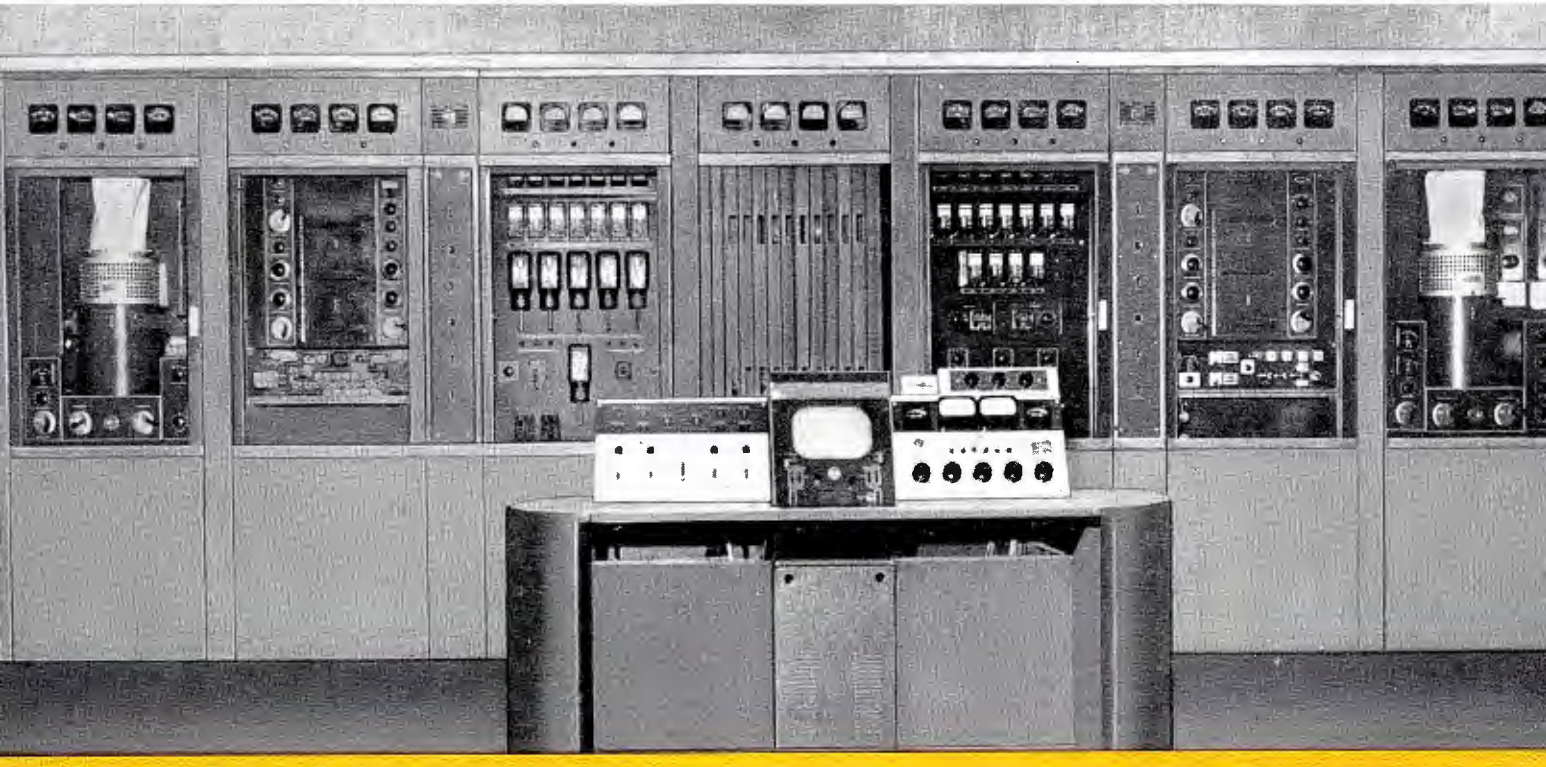
DESCRIPTION

The RCA type TT-100AH Transmitter consists of the r-f sections including visual and aural modulators of the type TT-10AH followed by parallel amplifiers which raise the power level to the specified 100 kw. These amplifiers, visual and aural, are very similar in circuitry and construction to those used in the TT-50AH Transmitter. The driver units and one visual and one aural amplifier have common d-c power switchgear. The other power amplifiers have a common d-c power supply and a-c switchgear.

The 10-kw driver portions and one set of controls of the transmitter are housed in seven cubicles equipped with sliding front and rear access doors. These cabinets are mounted adjacent to each other on rails which serve not only as a base frame but also wire trench. Two cabinets, grouped at the left, house the aural driver section which employs a phase modulated exciter and includes a built-in pre-emphasis network. The visual driver section, located in the two right-hand cabinets, features high-level, grid modulation of the 10 kw amplifier. The two parallel amplifiers and the 10 kw modulated amplifier are the only broadband stages in the equipment. The three center cabinets house the overload relays, regulated power supplies, and control and distribution components. These three cabinets are used in common by the aural and visual sections of the transmitter.

The TT-100AH employs high-gain RCA 6166 air-cooled tetrode power amplifier tubes in both aural and visual amplifier and driver units. R-f amplifier and modulator circuits employ the latest design features which result in the highest degree of aural and visual transmission fidelity. Visual Modulation is employed at the grid of the 6166 driver power amplifier stage and a vestigial sideband filter provides sideband attenuation in compliance with standards of TV transmission. This system provides the greatest possible simplicity in operation since the only transmitter tuning adjustment which affects the video frequency response characteristic are in the modulated and final stage circuits. The filter shapes the sideband response and gives positive assurance of correct spectrum response at the antenna connection.

Front view of TT-100AH transmitter with front cabinet doors open, and transmitter control console.



Central cabinets of the 10 kw driver showing control and distribution, screen rectifier, and regulator units.

Reflectometers and associated meters are supplied to indicate power output of both picture and sound transmitters. These meters also indicate voltage standing wave ratio and connect to the protective circuit which removes transmitter plate power when the VSWR exceeds a predetermined value. Similar equipment is also supplied to indicate power and VSWR between the 10 kw modulated amplifier and the output amplifiers. These reflectometers also tie into the transmitter control circuit and remove power in the event that the VSWR exceedes the predetermined value.

Facilities are provided to permit continuous picture monitoring at various points in the system, including diodes before the linear amplifier and at the input of the sideband filter. All essential transmitter operating controls are dupli-

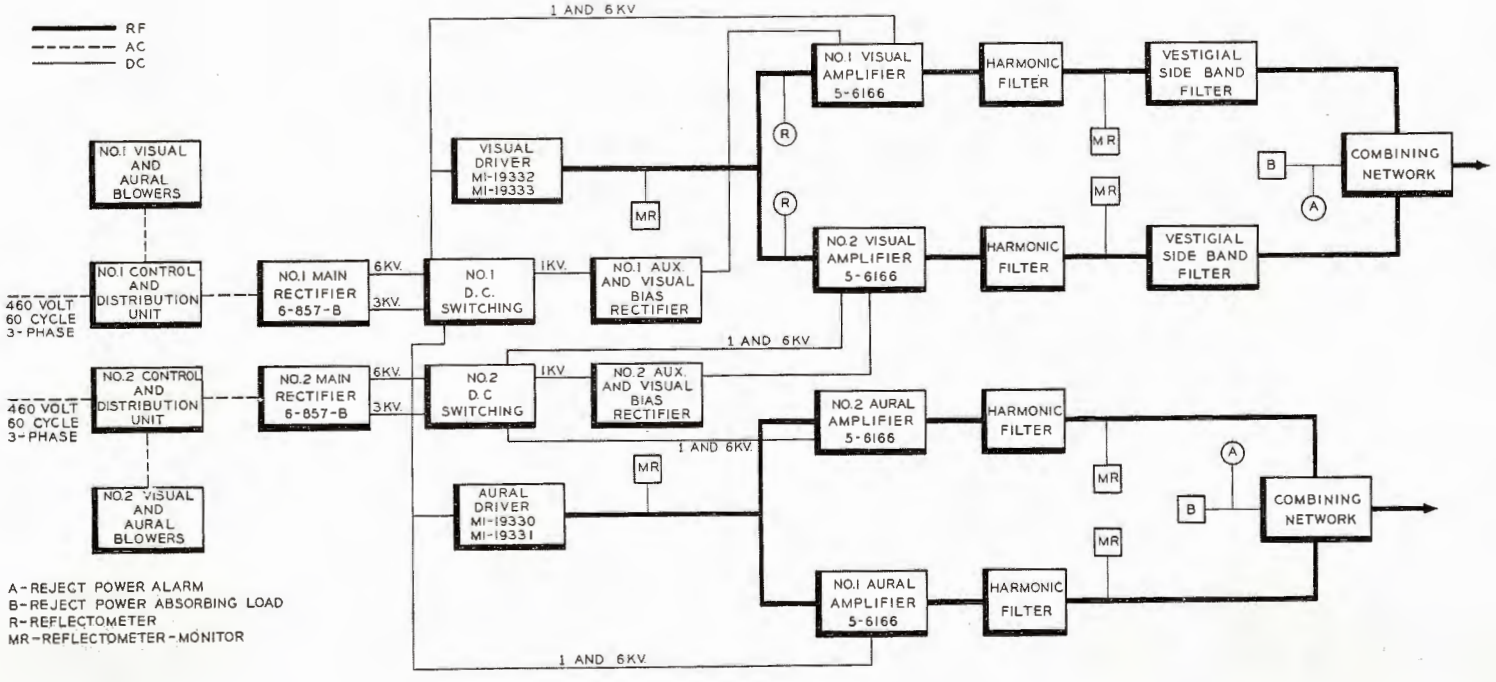
cated at the control panel of the RCA type TTC-1C console. The console is an optional item designed for operation with the TT-100AH.

TT-100AH Circuits

Complete units from the TT-10AH driver are used for the low-power section of the TT-100AH. These provide an aural r-f section up to and including the driver amplifier and a visual section up to and including the modulated amplifier.

Crystal control is used to maintain frequency accuracy to ±1 kc in the visual transmitter. This order of stability is of great importance when offset carrier operation is employed. The stability is achieved through the very accurate application of temperature control to the crystal. This crystal is operated in a low power crystal oscillator circuit from which the output frequency is 1/18 the assigned frequency of the TT-100AH. Three additional stages—a tripler, doubler, and amplifier stage, are associated with the low power crystal oscillator and together constitute the visual exciter unit.

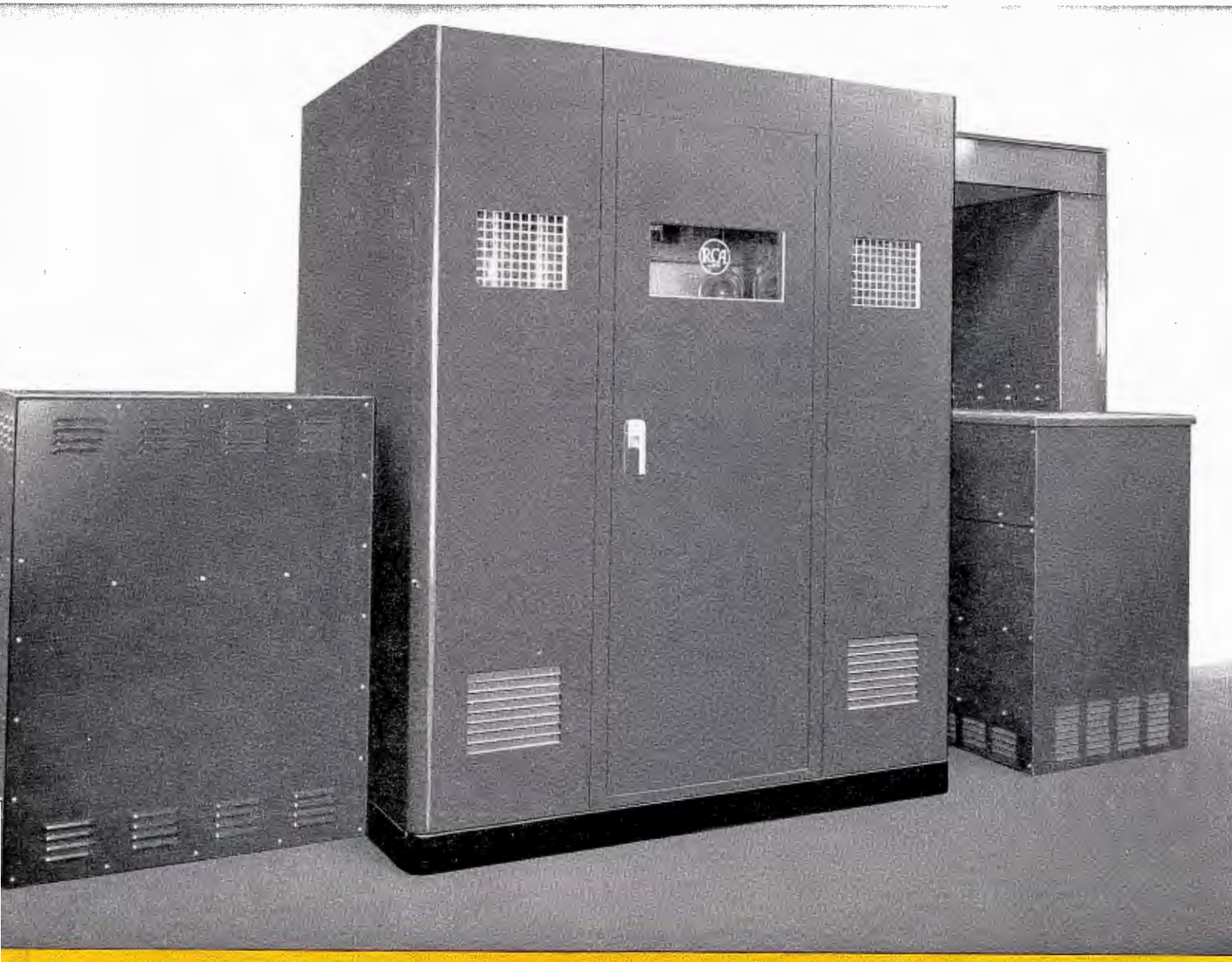
Simplified block diagram of the TT-100AH Transmitter.

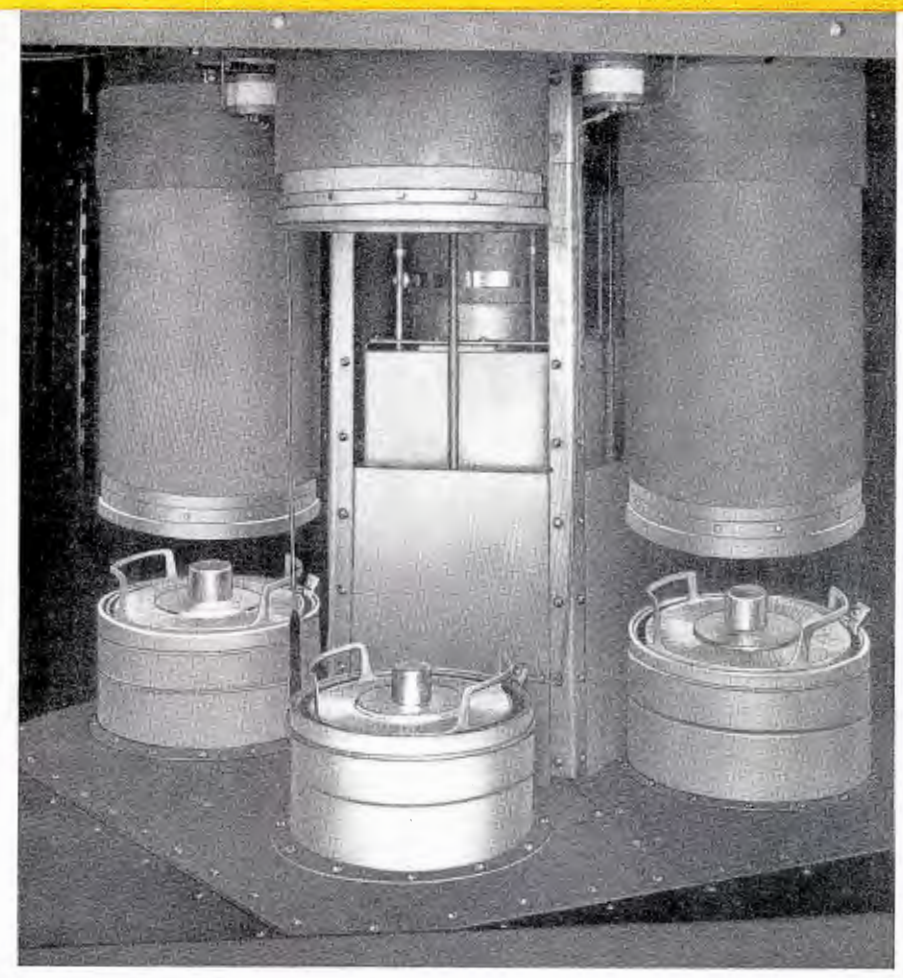


Aural Exciter

In the aural section of the transmitter an FM exciter unit replaces the visual exciter described above. Power output and frequency ranges are nearly the same for aural and visual exciters, hence the succeeding amplifier stages are similar. In this unit, a crystal oscillator and pulse shaper produce narrow pulses which are used to drive the linear sawtooth generator at crystal frequency. The linear sawtooth pulses are then clipped in the sawtooth modulator at a level which is a function of the audio frequency information. These clipped pulses are used to drive a tuned circuit, and a phase modulated result is obtained. An appropriate amount of frequency multiplication then results in an output at ⅓ of carrier frequency for channels 7-13. A pre-emphasis circuit is built into the audio amplifier of the FM exciter. However the change of a single connection restores the exciter to a flat modulation response so that pre-emphasis may be inserted elsewhere in the system.

Photo of high voltage rectifier cabinet with high voltage plate transformer on right and filter reactors on the left. Ductwork is pictured at the right top of photo.





RCA type 6166 air-cooled tetrode, five of which are used in parallel in a grounded grid circuit in each power amplifier. The tubes are mounted in a circular arrangement so that each can be driven equally, and output power coupled from each tube in the simplest manner.

Intermediate R-F Amplifiers

The R-F power tube line-up for the TT-100AH following the exciter unit includes four stages. The first following stage, an RCA 4-65A, is used as a frequency tripler. This stage is followed by two stages of straight through amplification. First, is an RCA 4X500 amplifier followed by a grounded grid stage using the RCA 5762 tube. Swamping is applied between the output of the driver and the grid circuit of the modulated power amplifier.

The power amplifier tube in both transmitters is an RCA type 6166 especially designed for VHF broadband television transmission. Due to the high power capability of this tube it was possible to build a single ended power amplifier stage and take advantage of somewhat simpler construction. At the same time the need for a balun was eliminated, since the transmitter is single ended throughout. The modulated power amplifier utilizes a "half wave" grid circuit, dispensing with the usual blocking capacitor. By this scheme the modulator load capacitance is reduced to the sum of the tube capacitance and the distributed r-f circuit capacitance.

The modulator of the transmitter is designed to accept an input signal as low as 0.7 volt peak-to-peak and to give maximum output signal level of approximately 425 volts. This output signal is attained through the use of three video amplifiers. The first and second video amplifiers employ 6CL6 tubes, and the third video amplifier two 807 tubes connected in parallel. These video stages provide a gain of approximately 600. The modulator stage consists of seven 6146 tubes. Its mode of operation is somewhat unconventional. It is direct coupled and has a gain of unity. The output stage provides isolation between the relative high impedance of the third video amplifier and the variable impedance of the r-f amplifier grid network.

One of the power amplifiers of the TT-100AH showing front panel with tuning motor switches, individual tube meters, tuning indicators, switches and status lamps. Tubes, located behind hinged access doors, are of plug-in type for rapid change.

Power Amplifiers

The air cooled visual and aural power amplifiers are similar electrically and mechanically, with the exception of biasing and video bypassing. The following description then applies equally for either of the power amplifiers.

In order to obtain the required power output two type TT-50AH amplifiers are paralleled. Each amplifier has five RCA type 6166 air-cooled tetrodes used in parallel in a grounded grid circuit. The tubes are mounted in a circular arrangement so that each can be driven equally, and output power coupled from each tube in the simplest manner. The input to the amplifiers is fed through a power-splitting tee which matches the 51.5 ohm output of the driver to the 51.5 ohm inputs of each amplifier. The input of each amplifier contains a variable transformer to match the 51.5 ohm output of each leg of the tee to the low impedance of the power amplifier input circuit. This transformer is constructed similarly to the one used in the TT-50AH amplifier and is controlled from the front panel of the amplifier. The input circuit consists of the tube elements, a short section of fixed line, and a variable capacitor which is common to all five tubes.

The plate circuit of each amplifier consists of the tube elements and two variable lines which act as inductors. In order to reach the top frequency limit and maintain large enough components to handle the required power the variable lines operate in parallel. The output circuit consists of the first half wave length of output line, and a lumped capacity which can be moved along the line. This configuration in conjunction with the plate circuit gives a broadband output with the proper impedance for feeding the sideband filter.

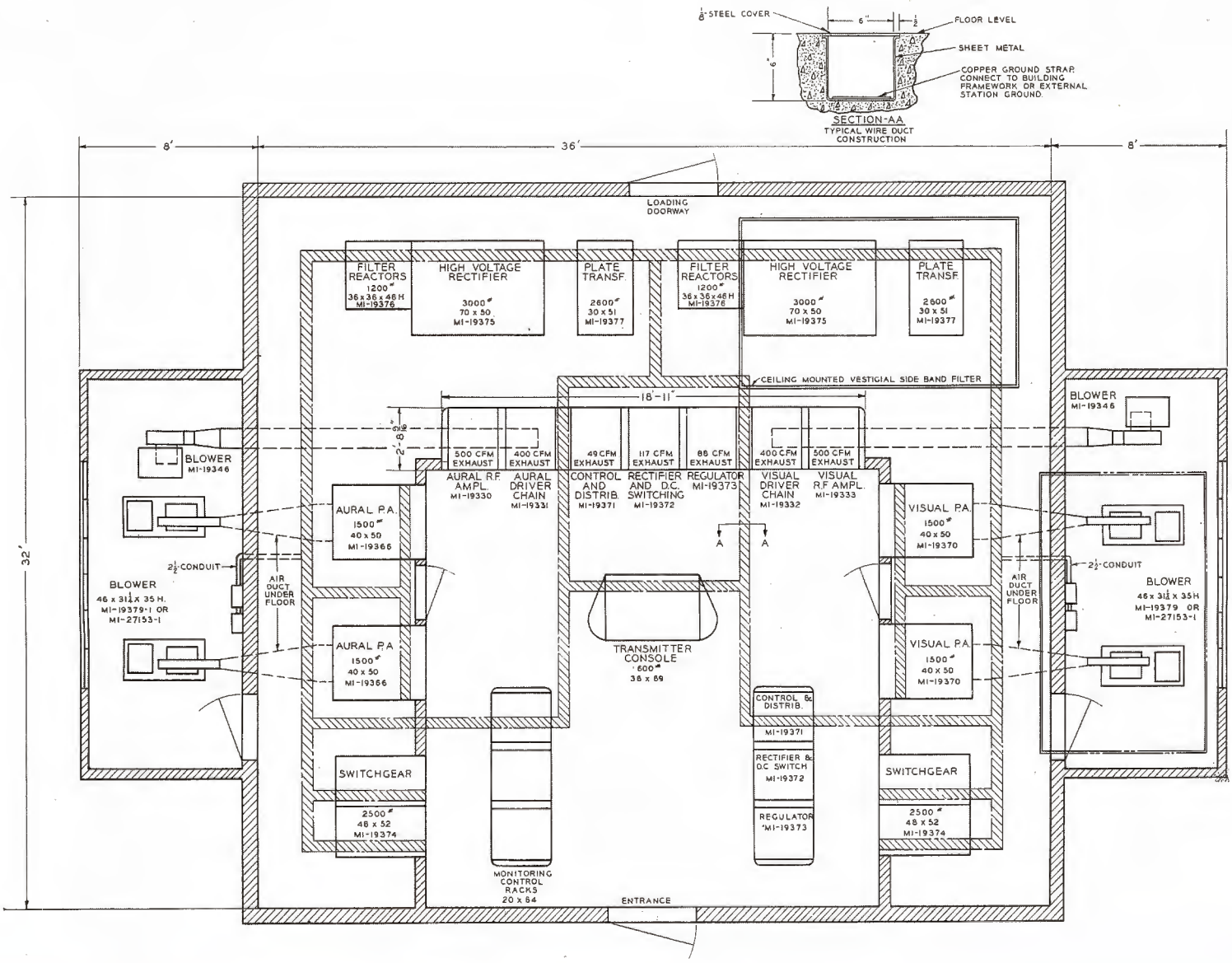
The front panel of the amplifier contains the tuning motor switches, individual tube meters, tuning indicators, plate ON switches and status lights. The tubes are located at approximately waist height behind hinged access doors, and are of the plug-in type so that rapid changes can be made. The resistors, capacitors, motors, and other electrical components are mounted in the unit behind panels which have quick disconnect fasteners.

Air requirements for the amplifiers are satisfied by using four separate external blowers, two for each of the aural amplifiers and two for each of the visual amplifiers. Two separate power equipments are required. Each of the power supplies consists essentially of a switchgear unit which distributes alternating current to a main rectifier for the power tubes, to a low voltage rectifier for the common driving stages, and to various transmitter components, including blowers, filament supplies, a bias supply, and other accessories. As indicated by the block diagrams, one of the power supplies feeds both the aural and visual drivers, the Section 1 Aural amplifier and Section 1 Visual amplifier. The other power supply feeds only the Section 2 Aural and Visual amplifiers. A 460 volt, three-phase supply enters each of the switchgear cubicles, which contains line and distribution circuit breakers, the main rectifier plate contactor, voltage regulators, and a distribution transformer. The blowers are fed through appropriate starters and circuit breakers at 460 volts. All filaments and low-power rectifiers are fed through an automatic voltage regulator to take care of small line variations. Bias supplies are electronically regulated. Protection is supplied both for d-c overloads and nominal a-c overloads.

One main rectifier and one screen rectifier supply power for both aural and visual sections. The main rectifier uses six RCA type 857-B mercury vapor tubes in a wye connected full-wave circuit, with half voltage taken from the neutral. Separate filters are used in the high voltage supply to the visual and aural amplifiers, to prevent interaction. One filter, common to all unmodulated stages, is used on the center tap 2900 volt supply. The 1200 volt screen rectifier, using three RCA type 673's in a three phase half wave rectifier, is common, but a separate filter is used for aural and visual sections.

Combining Network

The combining network of the TT-100AH is a bridge balun which combines the power of the dual amplifiers and feeds it out to the antenna system through a 6⅛" 51.5 ohms output. Input connections of the combining network are 3⅛" 51.5 unflanged line. One leg of the unit is terminated in a resistive load that absorbs any unbalance of power



Suggested floor layout for the TT-100AH showing in-line arrangement of the driver and power amplifiers, rectifiers, filter reactors and switching units behind partitions of transmitter control room.

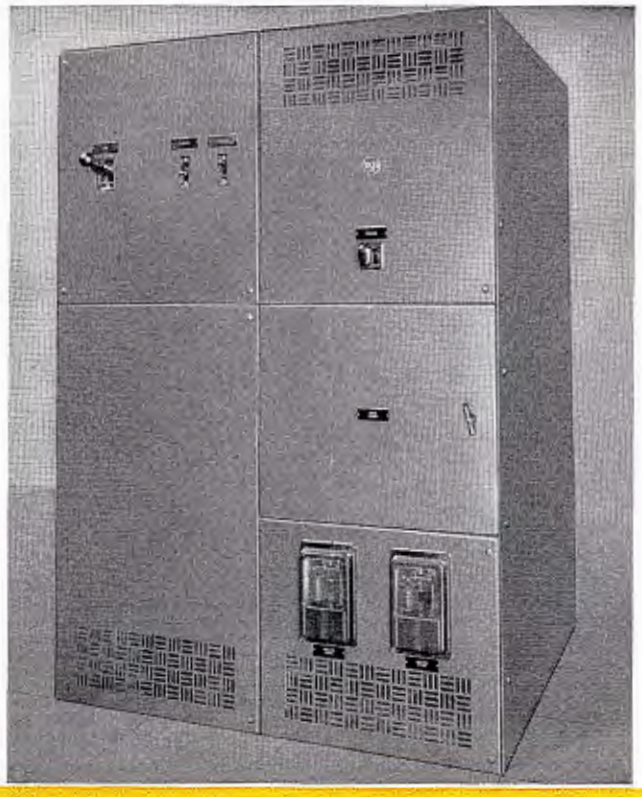
that might be developed during mixing from the associated amplifiers. An interlock protective circuit is incorporated with the transmitter utilizing a reflectometer if the unbalance of power becomes excessive.

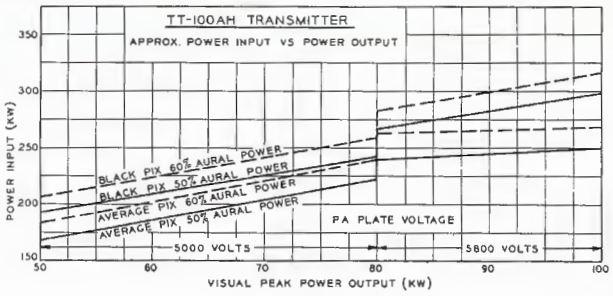
Vestigial Side Band Filter

Two MI-27315-H Vestigial Side Band Filters are furnished completely assembled and adjusted for any one of the VHF television channels 7 through 13. They are integral units designed for ceiling mounting near the 100 kw visual transmitter.

The purpose of the filters is to attenuate the lower sideband output of a double side band visual transmitter. Each consists essentially of parallel transmission lines which have resonant cavities connected to them at several points. The lines are jointed at the input through a bridge balun and at the output with a transformer tee.

One of the switching cabinets of the TT-100AH which distributes a-c power to the various amplifiers through appropriate remotely controlled switches.





In order to minimize reflections on the transmission line between the visual transmitter and the filters, the visual input of the filters is designed to have a constant input impedance over the band of frequencies produced by the visual transmitter. Since resonant circuits of the inductance-capacitance type are impractical at the frequencies involved, the filter sections consist of lengths of coaxial line (resonant cavities). The cavities are adjustable for tuning purposes and proper operation of the filters is achieved when both sides are balanced.

Power Cutback (100/50/10 kw)

It has been found very desirable in most installations to provide for cutting out a defective amplifier unit or power supply and operating at reduced power while repairs are being made. In order to do this, it is generally necessary to: by-pass one or more radio-frequency output circuits by means of coaxial transmission line switches; remove d-c and a-c power from a defective amplifier, or if necessary, switch the amplifier from one power supply to the other; and by-pass normal interlocking circuits at certain points while repairs are being made.

All of these steps may be accomplished quickly and without danger of damage to equipment, or injury to personnel, through the use of an optional power cutback equipment now available as an accessory item. The equipment makes it possible to operate with one amplifier alone, or directly out of the driver only, with either visual or aural transmitters, so that power can be reduced to 50 or 10 kw as desired. Thus, maximum reliability is possible.

SPECIFICATIONS

Performance Specifications

	Visual	*Aural*
Type of Emission	A5	F3
Frequency Range	Channels 7-13	Channels 7-13
Rated Power Output	100 kw[1]	60 kw[2]
Minimum Power Output	50 kw[1]	25 kw[2]
R-f Output Impedance	51.5 ohms	51.5 ohms
Input Impedanc	75 ohms	600/150 ohms
Input Level	0.7 v. peak-to-peak min.	+10 ±2 dbm
Amplitude vs. Frequency Response		Uniform ±1 db from 50 to 15,000 cycles
Upper Sideband Response:[3]		
+1, −1.5 db at carrier	+0.5 mc	
+1, −1.5 db at carrier	+1.25 mc	
+1, −1.5 db at carrier	+2.0 mc	
+1, −1.5 db at carrier	+3.0 mc	
+1, −1.5 db at carrier	+3.58 mc	
+1, −3.0 db at carrier	+4.18 mc	
−20 db max. at carrier	+4.75 mc	
Lower Sideband Response:[4]		
+1, −1.5 db at carrier	−0.5 mc	
−20 db max. at carrier	−1.25 mc	
−42 db max. at carrier	−3.58 mc	
Variation in Freq. Response with Brightness[5]	±2.0 db	
Carrier Frequency Stability[6]	±1 kc	±1 kc[7]
Modulation Capability	12.5 ±2.5% (reference white)	±50 kc
Audio Frequency Distortion		1.5% max. 50-100 cy. 1.0% max. 100-7500 cy. 1.5% max. 7500-15,000 cy.
FM Noise, below ±25 kc Swing		60 db
AM Noise, rms	40 db below 100% mod.	50 db below carrier

[1] Measured at the output of the sideband filter or filterplexer.

[2] Measured at the input to the diplexer or filterplexer.

[3] With respect to the response at 200 kc, as measured by the BW-5A Sideband Response Analyzer at transmitter mid-characteristic. 4.75 mc attenuation requires use of MI-27132 LP filter in the video input circuit.

[4] With respect to the response at 200 kc at transmitter mid-characteristic.

[5] Maximum variation with respect to the response at mid-characteristic measured with the BW-5A Sideband Response Analyzer at brightness levels of 22.5% and 67.5% of sync peak, using approximately 20% (peak to peak) modulation.

[6] Maximum variation for a period of 30 days without circuit adjustment.

[7] Maximum variation with respect to the standard 4.5 mc separation between aural and visual carriers.

[8] Maximum departure from the theoretical when reproducing saturated primary colors and their complements at 75% amplitude. A properly terminated TA-7 Stabilizing Amplifier is required in the video input circuit.

	Visual	*Aural*
Amplitude Variation Over One Picture Frame	Less than 5% of the peak of sync level	
Regulation of Output	7% max.	
Burst vs. Subcarrier Phase[8]	±7 degrees max.	
Subcarrier Phase vs. Brightness[9]	±7 degrees max.	
Subcarrier Amplitude[8]	±15% max.	
Linearity (Differential Gain)[10]	15% max.	
Envelope Delay vs. Frequency[11]	±.08 μsec. from 0.2 to 2.1 mc ±.04 μsec. at 3.58 mc ±.08 μsec. at 4.18 mc	
Harmanic Attenuation (ratio of any single harmonic to peak visual fundamental)	at least 60 db	at least 60 db

Electrical Specifications

Power Line Requirements:

Transmitter:

Line	460 volts, 3 phase, 60 cycles
Slow Line Variations	±5% max.
Rapid Line Variations	±3% max.
Regulation	3% max.
Power Consumption	See curve
Power Factor (approx.)	90%

Crystal Heaters:

Line	115 volts, single phase, 60 cycles
Power Consumption	61 watts

Mechanical Specifications

Dimensions:

Overoll Length (front line cabinets only)	18′ 11″
Overall Height (front line cabinets only)	84″
Overall Depth (front line cabinets only)	32 9/16″
Weight (approx.)	34,000 lbs.
Finish	Two-tone umber gray, polished stainless steel trim
Maximum Altitude[12]	7500 ft.
Ambient Temperature	45°C max., 10°C min.

[9] Maximum phase difference with respect to burst, measured after the VSBF, for any brightness level between 75% and 15% of the sync peak using 10% (peak to peak) modulation. This is equivalent to 5% (peak to peak) modulation as indicated by a conventional diode demodulator.

[10] Maximum variation in the amplitude of a 3.58 mc sine wave modulating signal as the brightness level is varied between 75% and 15% of sync peak. The gain shall be adjusted for 10% (peak to peak) modulation of the 3.58 mc signal when the brightness is at pedestal level. This is equivalent to 5% (peak to peak) modulation as indicated by a conventional diode demodulator connected after the VSBF. A properly terminated TA-7 Stabilizing Amplifier is required in the video input circuit.

[11] Maximum departure from standard curve. The tolerances vary linearily between 2.1 and 3.58 mc and between 3.58 mc and 4.18 mc. To meet the specification a properly terminated phase correction network, ES-34034-A is required in the video input circuit of the transmitter.

[12] For operation at rated power and normal plate voltage.

SPECIFICATIONS (Cont'd)

Tube Complement

TT-100AH TUBE COMPLEMENT (ES-27230)

VISUAL SECTION

Quantity	Function	Type
1	Crystal Oscillator	6V6-GT
1	Tripler	6V6-GT
1	Doubler	6V6-GT
1	Amplifier	6146
1	Tripler	4-65A
1	IPA	4X500A
1	Driver	5762
1	R-F Amplifier	6166
10	Linear Final Amplifier	6166
1	1st Video Amplifier	6CL6
1	2nd Video Amplifier	6CL6
2	3rd Video Amplifier	807
1	Offset	5651
7	Modulator	6146
1	Video Monitor	6CL6
1	Sync Amplifier	6CL6
1	Sync Separator	6U8
1	Pulse Former and Clipper	6U8
1	Phase Splitter	6CL6
1	Clamp Diode	6AL5
4	Voltage Regulatar	6146
2	Voltage Regulator	6SH7
2	Regulator Control Amplifier	6SL7-GT
18	Voltage Regulator	6AS7-G
2	Voltage Regulator	OA3
3	Voltage Regulator	OA2
10	Voltage Regulator	OB2
4	Voltage Regulator	OC3
6	Voltage Regulatar	OD3
2	Rectifier	866A
5	Rectifier	5R4GY
10	Reflectometer	6AL5
4	Reflectometer	2D21

AURAL SECTION

Quantity	Function	Type
1	Crystal Oscillator	12AT7
1	Pulse Shaper	12AT7
1	Sawtooth Generator	12AT7
1	Sawtooth Modulator	12AT7
1	Quadrupler	6AU6
1	Amplifier	6AU6
1	Doubler	6AU6
1	Doubler	6AU6
1	Tripler	6AU6
1	Tripler	12AT7
1	Amplifier	5763
1	Amplifier	6146
1	Amplifier	12AX7
1	Amplifier	12AU7
1	Tripler	4-65A
1	IPA	4X500A
1	Driver	5762
1	R-F Amplifier	6166
10	Power Amplifier	6166
2	Rectifier	5R4GY
1	Voltage Regulator	OA2
1	Voltage Regulator	OB2
10	Reflectometer	6AL5
4	Reflectometer	2D21

RECTIFIER SECTION

Quantity	Function	Type
12	Main Rectifier	857B
6	Auxiliary Rectifier	673

Equipment Supplied

TT-100AH TELEVISION TRANSMITTER (ES-27229)

Quantity	Description	Stock No.
1	Aural Driver Chain	MI-19331
1	Aural RF Amplifier	MI-19330
2	Aural Power Amplifier	MI-19366
1	Visual Driver Chain	MI-19332
1	Visual RF Amplifier and Modulator	MI-19333-C
2	Visual Power Amplifier	MI-19370
1	Control and Distribution Unit, Section 1	MI-27800
1	Control and Distribution Unit, Section 2	MI-27801
1	Rectifier and DC Switching Unit, Section 1	MI-27802
1	Rectifier and DC Switching Unit, Section 2	MI-27803
1	Regulator Unit, Section 1	MI-27804
1	Regulator Unit, Section 2	MI-27805
2	10 kw Blowers	MI-19346
2	Switchgear	MI-19374
2	High Voltage Rectifier	MI-19375
4	Filter Reactars	MI-19376
2	Plate Transformer	MI-19377
4	Blower and Filter Equipments	MI-27153
2	Monitoring Diodes	MI-19051-B
8	PA Output Monitoring Units	MI-19088
2	Pawer Splitting Monitor Units	MI-27807
2	Aural Crystal Units (1 spare)	MI-19450-A
2	Visual Crystal Units (1 spare)	MI-19400-L4
*	Set of End Shields (2 per set) (*Supply 1 or 2 sets as specified on sales order)	MI-28061
1	Lot of Installation Material	MI-27806
1	Miscellaneous Hardware Kit	MI-7474
1	Set of Operating Tubes	ES-27230
1	Low Pass Video Filter	MI-27132
1	Nameplate	MI-28180-1
2	Vestigial Side Band Filter	MI-27315-H
1	Finish Touch-Up Kit	MI-28153
*	3⅛" Transmission Line (*Sales order must specify quantity for installation requirements)	MI-19313
*	6⅛" Transmission Line (*Sales order must specify quantity for installation requirements)	MI-19314
1	Installation Instruction Book	IB-36157
4	Harmonic Filters (50 kw)	MI-27318-7/-10
2	Combining Network (100 kw)	MI-27394
2	Power-Splitting Tee (PA Input)	MI-27808
2	RF Load and Wattmeter, 6 kw (Reject Power)	MI-19199-H
1	Instruction Book	IB-36158

Optional or Accessory Equipment

TTC-1C Control Console Equipment, with master monitor	ES-19240-A
R-F Load and Wattmeter	MI-19191-H
TV Station Monitoring Equipment Wired/Unwired	ES-19203-A/B
Color TV Station Monitoring Equipment Wired/Unwired	ES-19237-A/B
Complete Set of Spare Tubes	ES-27230
FCC Spare Set of Tubes	ES-27231
50 KW Power Cutback Kit	MI-27157
BW-5A Sideband Response Analyzer	ES-34010
Plate Current Meter	MI-21200-C1
WM-71A Distortion and Noise Meter	MI-30071-A
TO-524-D Oscilloscope	MI-26500

UHF TELEVISION TRANSMITTER

1 KW, TYPE TTU-1B

FEATURES

- High visual transmission fidelity—color or monochrome
- Power output 1 kw peak measured at output of filterplexer
- Fewer r-f stages
- Excellent video frequency response
- Visual carrier frequency stability ±1000 cycles for best utilization of off-set carrier operation
- Air-cooled tubes—air-cooled transformers
- Simple to tune
- High level modulation
- Vestigial sideband characteristics determined by fixed-tuned, trouble-free, factory-adjusted filterplexer
- Hum level —40 db to insure satisfactory operation on non-synchronous network originations

USES

The RCA type TTU-1B Transmitter is specifically designed to answer the needs of broadcasters planning both color and black and white television program operations in the ultra-high frequency channels 14 to 83. It is an all air-cooled equipment that provides a 1 kilowatt peak visual power measured at the output of the filterplexer and 600 watts maximum aural output in conformance with FCC and RETMA Standards. When used with standard UHF antennas, this 1-kw transmitter is capable of furnishing up to 20-kw effective radiated power.

The Model TTU-113 provides a means to start broadcasting with a minimum investment in equipment and technical manpower. The transmitter also serves as the basic driver section of the more powerful 12½-kw UHF transmitter and broadcasters can increase UHF power at a later date with RCA "add-on" amplifiers.

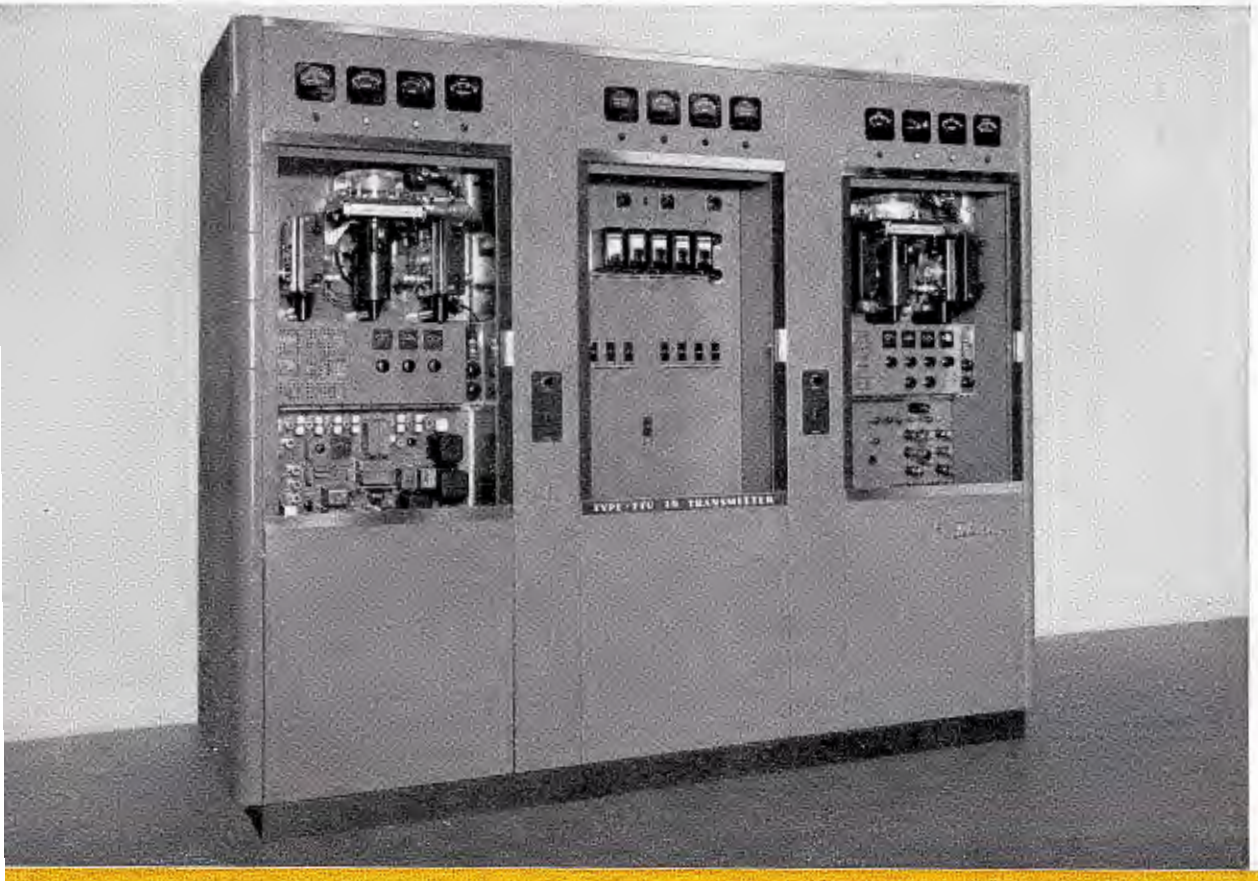
The TTU-1B's circuits employ the latest design features and represent the ultimate in simplicity and economy. The highest degree of black and white or color visual transmission fidelity is attained. The aural and visual transmitters and their control circuits operate independently, giving a maximum of operational flexibility. Frequency stability of both aural and visual sections is exceptionally good, permitting use of offset carrier operation, if desired.

A control console, RCA type TTC-1C, is available as accessory equipment for operation with the transmitter. It is constructed as a monitoring center where the operator has complete fingertip control over operation of the transmitter. In the console are the gain controls for both visual and aural inputs to the transmitter, plus complete monitoring facilities for both visual and aural signals.

DESCRIPTION

The RCA type TTU-1B UHF TV Transmitter is housed in three sliding door cabinets which conserve floor space and increase operating convenience. The center cabinet contains the necessary switches, relays, and circuit breakers for separate operation and overload protection of visual and aural transmitters, and a single blower which draws filtered air in through the rear lower section of the center section and supplies cooling air to the various tubes and units in the other two cabinets. It is the only rotating unit employed. The right hand cabinet contains the visual transmitter and the left hand cabinet the aural transmitter.

Except for the low level r-f stages and the video modulator, the aural and visual transmitters are practically identical. The frequency and power multiplier stages, ipa



View of TTU-1B Transmitter with sliding panels open to show front panel components and controls. Cabinets left to right are: Aural, Power Control, and Visual.

units, the final stages, and the high voltage plate supplies are the same in aural and visual portions of the transmitter. The two sections may be operated independently of each other except for the common cooling air supply.

Final power amplifiers of the aural and visual sections each utilize a single RCA 6181 tube. This tube is especially developed for operation up to 900 mc and will provide 1-kw peak video output. It is an air-cooled tetrode with ceramic seals for low loss at high frequencies. All coaxial connections make possible rapid tube change. Similarity of construction of aural and visual portions results in reduced number of spare parts and simplifies maintenance. All circuits are simple to tune and since they are of the coaxial type, there is minimum leakage or radiating currents flowing in the cabinet frames.

The visual transmitter final output stage is high level cathode modulated. All r-f stages have non-critical adjustments and lend themselves readily to meter tuning. No appreciable picture degradation can occur by careless tuning. A filterplexer connected to the output of the transmitter gives positive assurance of proper spectrum response at the antenna connection.

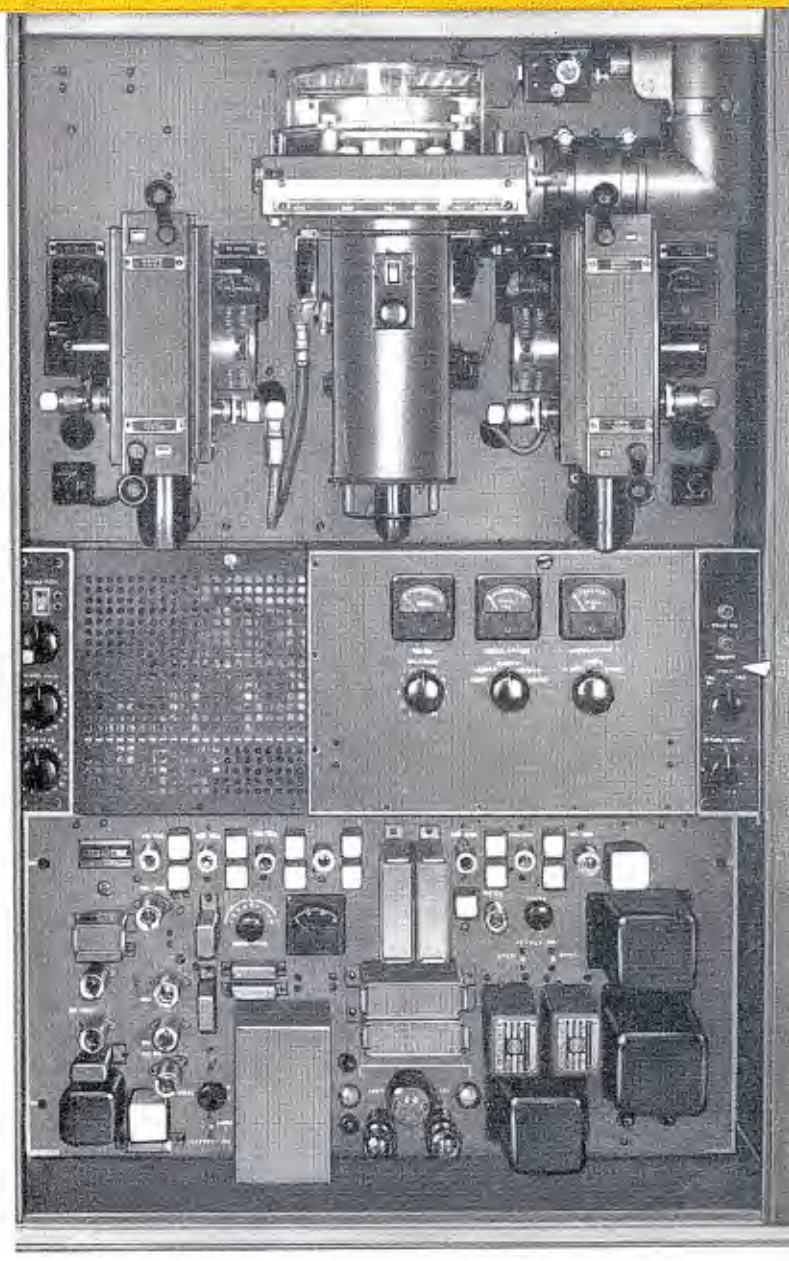
Frequency stability of both visual and aural transmitters is exceptionally good, permitting use of offset carrier operation if desired. Frequency separation between visual and sound transmitter is maintained within close limits assuring correct operation of intercarrier sound type television receivers.

The visual transmitter modulator circuit employs the latest design features for both color and black and white and represents the ultimate in simplicity and economy. Power output meters are supplied for both picture and sound transmitters. These meters also indicate VSWR. Facilities are provided to permit continuous picture monitoring at various points in the system.

Radio Frequency Circuits

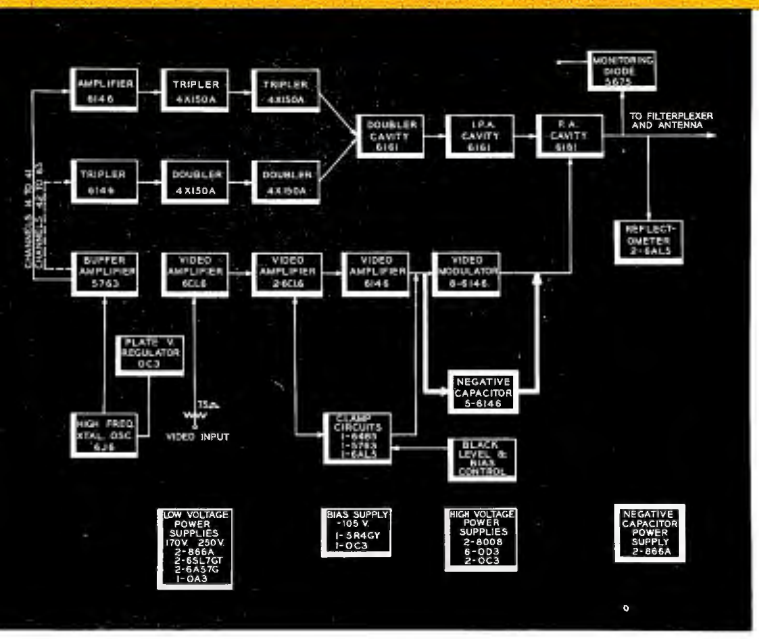
Since the aural and visual r-f circuits are identical except for the very low level stages most of the description of the visual circuit which follows will apply to the aural transmitter. Block diagrams of the visual and aural transmitters bear out the similarity.

The visual transmitter frequency is controlled by third overtone crystals to reduce the multiplication factor required to reach the high UHF channels and to insure the good stability necessary to meet requirements of "off-set" carrier operation which requires a final frequency stability of ±1000 cycles. Stability is also enhanced by accurate thermostatically controlled crystal heaters, low voltage regulated plate supply for the crystal oscillator, and a buffer stage.



R-f circuits of the aural transmitter.

The output of the visual crystal buffer stage is coupled to an RCA 6146 amplifier for channels 14 to 41 or tripler for channels 42 to 85. The 6146 is followed by two stages using RCA 4X150A tubes which triple or double respectively for the above mentioned channels. Including a 6161 doubler stage, the frequency multiplication factor is 18 for the lower channels and 24 for the higher channels. The resonance output of the second 4X150A is one-half final frequency, and above the present VHF bands so the tuned circuits depart from conventional lumped constants. Thus the anode circuit consists of a pair of parallel plates with a movable shortening bar.



Block diagram of TTU-1B Visual Transmitter.

The doubler and ipa stages use RCA 6161 triode tubes, operated grounded grid, in special tuned circuits commonly called "cavities". The final amplifier is an air cooled tetrode—type 6181—in another special "cavity". To allow meter monitoring of power output, two reflectometers are coupled to the output transmission line. An external filterplexer is used to combine the aural and visual signals and to attenuate the undesired visual sideband as required by the FCC. A low pass video filter is supplied to attenuate the upper sideband above channel edge.

Video Modulator

Video modulation is introduced into the cathode circuit of the power amplifier tube. The plate current of the pa flows though eight RCA 6146 tubes which are operated in parallel as the modulator. The modulator stage itself is preceded by three video amplifier stages, with shunt peaking provided in each stage. This provides a flat amplitude versus frequency response necessary for good color and black and white transmission.

A negative capacitor circuit is utilized to cancel the effect of shunt capacity across the modulator load (pa internal resistance). This prevents phase change from black to white, a vital provision for good color transmission. The d-c component of the television signal is restored at the grid of the modulator which is in turn direct coupled to the modulated power amplifier. The d-c restoration circuit is a conventional clamp circuit.

The TTU-1B is used in conjunction with a TA-7B Stabilizing Amplifier model for color work. The picture and sync controls for the stabilizing amplifier are included in the transmitter console so that the depth of modulation and the synchronizing to picture ratio can be monitored and adjusted from the operating position. Since the transmitter is always preceded by the stabilizing amplifier, which, among other things, adjusts the sync/picture ratio, no sync stretching is built into the transmitter proper.

FM Aural Exciter

The FM aural exciter is direct crystal controlled, and has a frequency stability of ±1000 cycles with respect to visual frequency. The crystal oscillator in the phase modulator operates at 130 kc, and the large multiplication required to reach the final frequency would result in a large deviation not only at the desired modulating rate, but for the noise components as well. To keep the noise level down, it is necessary to translate the carrier and its sideband components to a higher frequency without increasing the frequency deviation. This is done by a heterodyning process using a second crystal oscillator.

A low frequency crystal oscillator and a pulse shaper produce a series of narrow pulses which are used to synchronize a sawtooth generator. The sawtooth produced is very linear, but is clipped at a level corresponding to the instantaneous audio modulation applied. New pulses are formed from the clipped sawtooth but the new pulses vary in time at an audio rate. These pulses, still at the oscillator frequency are fed to a series of frequency multipliers and are restored to sinewave form. The second crystal oscillator and mixer translates the frequency modulated signal to a new portion of the spectrum without altering the initial deviation. Amplifiers which follow the mixer increase the signal level and act as selective filters to prevent any other signal components from being passed to the remainder of the transmitter.

Since this unit is a phase modulator, a frequency selective device is provided at the audio input terminals to make the audio output of the second audio amplifier vary inversely with frequency. This is done to maintain a frequency deviation independent of the modulating frequency. A pre-emphasis network is included in the modulator.

Doubler, IPA and PA Cavities

The TTU-1B visual and aural r-f circuits employ cavities in the final stages for the doubler, ipa and pa tubes. The right hand rectangular cavity is a doubler employing a 6161 tube which reaches the final frequency with a power output of approximately 90 watts. The left hand rectangular cavity is the ipa stage also employed a grounded grid 6161 triode. The power output of this stage is approximately 150 watts. The pa cavity in the center employs a 6181 tetrode operated grounded grid grounded screen. The screen grid is bypassed to the output circuit; the control grid is bypassed to the input circuit. In addition, the two grids are bypassed to each other.

Cooling air is circulated through all of the cavities. In the case of the 6161 doubler and the 6161 ipa the air is brought into the cavity and then out through the radiator of the tube. In the pa, three separate sources of air are provided. Air is supplied via a Teflon tube up the center of the input cavity to blast the filament seal. Another source of air leads in through the rear of the cavity between the control grid and the screen grid section to cool the remaining tube seals and the output cavity. Finally the main source of air enters a plastic shield on top of the cavity and exhausts through the 6181 radiator out the top of an interlocked cover.

Flexible coaxial cables are used to couple the ultra high frequency energy from the output of one cavity to the input circuit of the following cavity. Impedance matching is accomplished by adjusting the coupling and the tuning of the input circuit until the cable is properly terminated. A plug-in reflectometer is furnished for measuring the standing wave ratio in the interconnecting cable.

UHF Filterplexer

The RCA MI-19086-A UHF Filterplexer unit is supplied completely assembled and adjusted for operation in any one of the UHF television channels from channel 14 through channel 83. The unit is required to attenuate the lower sideband of a double sideband visual transmitter, and to feed the outputs from the visual transmitter and the aural transmitter simultaneously through a single coaxial line to an antenna. It therefore serves the double purpose of a vestigial sideband filter and a diplexer unit.

In order to minimize reflections on the transmission line between the transmitter and the filterplexer, the visual input of the filterplexer is designed to have a constant input impedance over the band of frequencies produced by the transmitter. Since resonant circuits of the inductance-capacitance type are impractical at the frequencies involved, the filter sections consist of lengths of coaxial line. The sound notching filters are resonant cavities. The resonant cavities and lines are all adjustable for tuning purposes. These units have been pretuned and adjusted at the factory, where the specialized instruments needed for these adjustments are available.

The RCA filterplexer varies in size and weight for the various frequencies, and so it is always necessary to specify, when ordering, the channel and operating frequency of the television station. The filterplexer will handle visual power of up to 1 kilowatt in the channel for which it is adjusted, when working into a nominal 50 ohm load.*

The insertion loss is less than 1 db to 4 megacycles above picture carrier frequency, which represents a very desirable band pass characteristic. The vestigial side band characteristics are also maintained by having the lower side-band frequencies attenuated to more than 20 db from the low end of the channel (1.25 megacycles) to 4.25 megacycles below the picture carrier.

The filterplexer should be mounted as near the transmitter as possible. The unit can be supported from the ceiling since this effects economy of floor space. It should be mounted where a free circulation of air will be obtained, but should not be exposed to drafts or direct sunlight. The air circulation is necessary to cool the absorbing load resistor, and to dissipate any heat developed in the resonant elements. For optimum performance of the transmission system it is recommended that 3⅛-inch, 50 ohm (RCA MI-19089) transmission line be used. Each of the four filterplexer terminals is equipped with a gas barrier to permit the separate pressurizing of connecting transmission line with gas to insure the continual maintenance of filterplexer pressure when opening connecting transmission line for various testing operations.

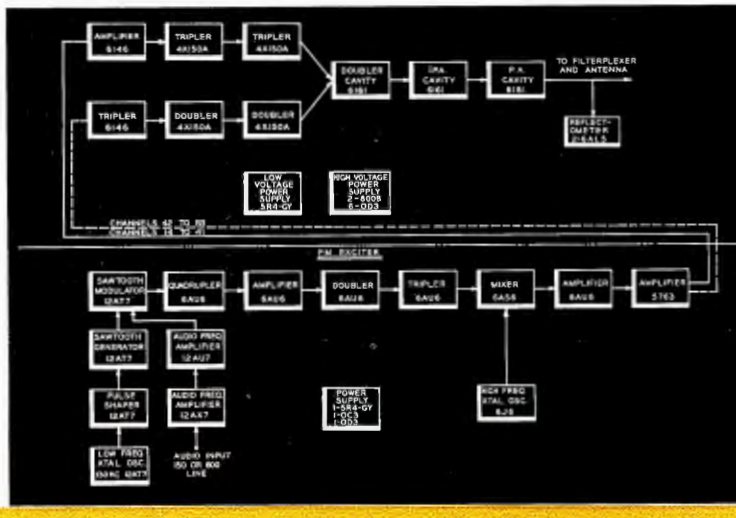
Performance Features

The modulator frequency response is adjusted by use of a peaking-coil for the first video stage. This can be done from the front of the transmitter. The overall response is flat and the bandwidth is determined principally by the modulator cutoff. The frequency response, as illustrated, is taken ahead of the filterplexer. The response at the output of the filterplexer must contain a deep notch at 4.5 mc similar to that produced by the sound traps in a television receiver. The frequency response illustrated is the output of a diode demodulator ahead of the filterplexer.

The TTU-1B can be installed with a minimum of trouble. The equipment is housed in three modernly styled alumi-

* Filterplexers supplied with the TTU-1B transmitter can be converted for use at higher powers when 12½-kw power amplifiers are employed with the 1-kw transmitter.

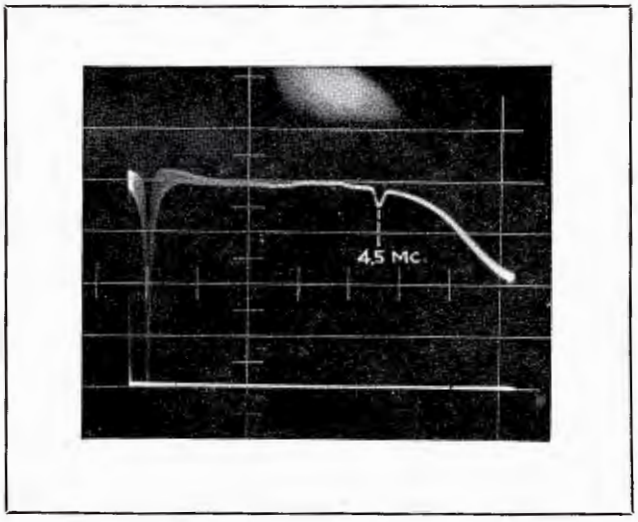
Block diagram of TTU-1B Aural Transmitter, with the tube complement indicated.



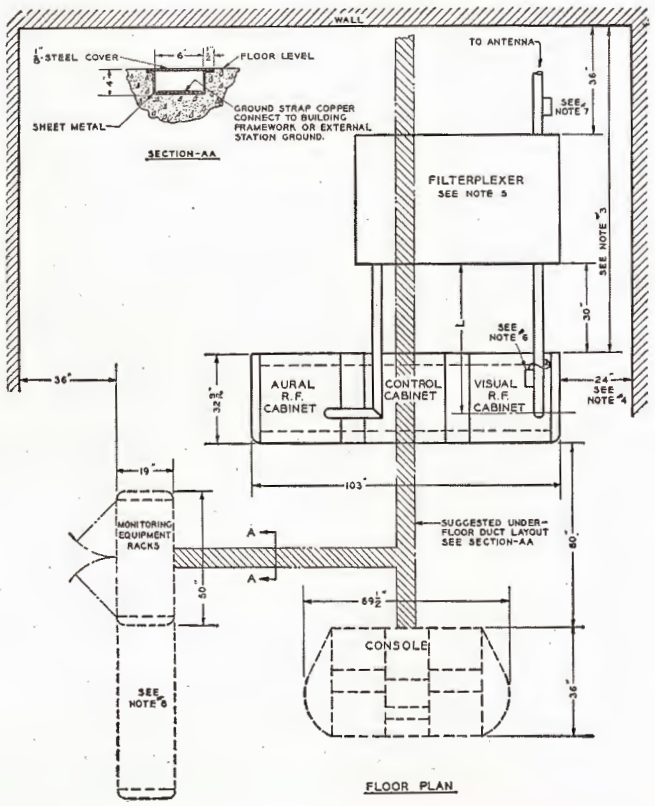
num cabinets having space-saving sliding front and rear doors which are properly interlocked. Vertical chassis type construction is used for convenience and accessibility with heavy transformers and reactor units supported by a steel base. The vertical chassis is flanged and fastened directly to side panels allowing maximum use of the inside volume of the transmitter cabinets. The blower unit is contained within the transmitter.

The cabinets rest on metal wiring ducts, front and rear, through which all interconnections and external connections are readily made. A preformed cable is supplied for cabinet interconnections.

Where specified, crystals are furnished for offset carrier operation to minimize co-channel interference. The filterplexer is tuned for a specific channel, and serves not only for the required sideband attenuation in the transmitter output, but also functions as a Diplexer to permit feeding the aural and visual sections into a common antenna. Equipment associated with the TTU-1B includes the TTC-1C console for power control and monitoring, an r-f load and wattmeter for test measurements, and the MI-19237-C/D or MI-19203-C/D monitoring rack equipment for routine operation.



Overall frequency response of the TTU-1B—Marker at 4.5 mc.



FLOOR LAYOUT FOR THE TTU-1B

Note 1—Main line voltage, 208/230 volts at 60 cycles, single phase enters cabinet MI-19351-B at Rear. No. 6 wire recommended. Approximately 10 kw input.

Note 2—Wire ducts, monitoring racks, and control console not supplied with transmitter. (Control console ES-19240-A and monitoring equipment rack, MI-19237-C/D or MI-19203-C/D.)

Note 3—This dimension not critical, however allowance must be made for an adequate flow of air to MI-10351-B control cabinet. Input air filter located rear lower portion of this cabinet. Approximately 850 CFM air. Air leaves transmitter at top of MI-19350-C aural and MI-19352-C visual.

Note 4—Minimum clearance determined by considerations other than technical, allow 24" minimum.

Note 5—Filterplexer MI-19086-A Ch. 14-83 (channel specified) has the following dimensions. Folded: 6'-2" long, 3'-7" wide 3'-4" high. Extended: 10'-2" long, 3'-7" wide, and 3'-4" high. Dimensions given are for lowest frequency unit and will be smaller for higher frequencies. It can be operated folded or extended (shipped folded). Can be floor, wall, or ceiling mounted. Visual and aural input lines and antenna line 3⅛" 50 ohms. Unit should not be subjected to drafts.

Note 6—MI-19364 monitoring diode. Requires 110 volts at 60 cycles (negligible power) RG-11/U cable to control console. Can be located at any position in length L.

Note 7—BWU-4A demodulator directional coupler pickup. Demodulator mounted in monitoring rack and lead length up to 50' allowable. Position in line not important.

Note 8—3 extra equipment racks shown to include synchronizing generator and power supplies and equipment necessary for "Basic Buy."

SPECIFICATIONS

Performance Specifications

	Visual	*Aural*
Type of Emission	A5	F3
Frequency Range (ch. 14-83)	470-890 mc	470-890 mc
Rated Power Output	1 kw peak of sync[1]	0.6 kw[2]
Minimum Power Output	0.5 kw peak of sync[1]	0.3 kw[2]
R-f Output Impedance	50 ohms	50 ohms
Input Impedance	75 ohms	600/150 ohms
Input Level	1.0 volt peak-to-peak min.	+10 ±2 dbm
Amplitude vs. Frequency Response		Uniform ±1 db from 50 to 15,000 cycles
Upper Sideband Response:[3]		
+1, −1.5 db at carrier	+0.5 mc[3]	
+1, −1.5 db at carrier	+1.25 mc	
+1, −1.5 db at carrier	+2.0 mc	
+1, −1.5 db at carrier	+3.0 mc	
+1, −1.5 db at carrier	+3.58 mc	
+1, −3.0 db at carrier	+4.18 mc	
−20 db max. at carrier	+4.75 mc	
Lower Sideband Response:[4]		
+1, −1.5 db at carrier	−0.5 mc	
−20 db max. at carrier	−1.25 mc	
−42 db max. at carrier	−3.58 mc	
Variation in Freq. Response with Brightness[5]	±2.0 db	
Carrier Frequency Stability[6]	±1 kc	±1 kc[7]
Modulation Capability	12.5 ±2.5% (reference white)	±50 kc
Audio Frequency Distortion		1.5% max. 50-100 cy. 1.0% max. 100-7500 cy. 1.5% max. 7500-15,000 cy.
FM Noise, Below ±25 kc Swing		60 db
AM Noise, rms	40 db below 100% mod.	50 db below carrier
Amplitude Variation Over One Picture Frame	Less than 5% of the peak of sync level	
Regulation of Output	7% max.	
Burst vs. Subcarrier Phase[8]	±7 degrees max.	
Subcarrier Phase vs. Brightness[9]	±7 degrees max.	
Subcarrier Amplitude[8]	±15%	
Linearity (Incremental Gain)[10]	80% min.	
Envelope Delay vs. Frequency[11]	±.04 μsec. at 3.58 mc ±.08 μsec. at 4.18 mc ±.08 μsec. from 0.2 to 2.1 mc	
Harmonic Radiation (below peak visual power)	60 db	60 db

[1] Measured at the output of the sideband filter or filterplexer.

[2] Measured at the input to the diplexer or filterplexer.

[3] With respect to the response at 200 kc, as measured by the BWU-5A Sideband Response Analyzer at transmitter mid-characteristic. 4.75 mc attenuation requires use of MI-27132 LP filter in the video input circuit.

[4] With respect to the response ot 200 kc at transmitter mid-characteristic.

[5] Maximum variation with respect to the response at mid-characteristic measured with the BWU-5A Sideband Response Analyzer at brightness levels of 22.5% and 67.5% of sync peak, using approximately 20% (peak to peak) modulation.

[6] Maximum variation for a period of 30 days without circuit adjustment.

[7] Maximum variation with respect to the standard 4.5 mc separation between aural and visual carriers.

Electrical Specifications

Power Line Requirements:

Transmitter:

- Line: 208/230 volts, single phase, 60 cycles
- Slow Line Variations: ±5% max.
- Rapid Line Variations: ±3% max.
- Regulation: ±3% max.

Power Consumption:

- Black Picture: 9.6 kw
- Average Picture: 8.6 kw
- Power Factor (approx.): 0.9
- Accessory Equipment: 115 volts, single phase, 60 cycles,
- Power Consumption: 3.3 kw (approx.)

Crystal Heaters:

- Line: 115 volts, single phase, 60 cycles
- Power Consumption: 108 watts

Tube Complement

VISUAL SECTION

Qty.	*Type*	*Function*
1	6J6	Oscillator
1	5763	Buffer
1	6146	Tripler-Amplifier
1	4X150-A	Doubler-Tripler
1	4X150-A	Doubler-Tripler
1	6161	Doubler
1	6161	Intermediate Power Amplifier
1	6181	Modulated Power Amplifier
1	6CL6	Video Amplifier
1	6CL6	Video Amplifier
1	6CL6	Video Amplifier
1	6146	Video Amplifier
8	6146	Modulator
5	6146	Negative Capacitor
1	6485	Sync Separator
1	5763	Sync Amplifier
1	6AL5	Clamp Diode
1	5R4GY	Low Voltage and Bias Rectifier
4	866-A	Rectifier
2	8008	High Voltage Rectifier
2	6SL7-GT	D-C Amplifier
2	6AS7-G	Control Tube
6	OD3	Regulator
4	OC3	Regulator
1	OA3	Regulator
2	6AL5	Reflectometer
1	5675	Monitoring Diode

[8] Maximum departure from the theoretical when reproducing saturated primary colors and their complements at 75% amplitude. A properly terminoted TA-7 Stabilizing Amplifier is required in the video input circuit.

[9] Maximum phase difference with respect to burst, measured after the VSBF, for any brightness level between 75% and 15% of the sync peak using 10% (peak to peak) modulation. This is equivalent to 5% (peak to peak) modulation as indicated by a conventional diode demodulator.

[10] Maximum variation in the amplitude of a 3.58 mc sine wave modulating signal as the brightness level is varied between 75% and 15% of sync peak. The gain shall be adjusted for 10% (peak to peak) modulation of the 3.58 mc signal when the brightness is at pedestal level. This is equivalent to 5% (peak to peak) modulation as indicated by a conventional diode demodulator connected after the VSBF. A properly terminated TA-7 Stabilizing Amplifier is required in the video input circuit.

[11] Maximum departure from standard curve. The tolerances vary linearily between 2.1 and 3.58 mc and between 3.58 mc and 4.18 mc. To meet the specification a properly terminated phase correction network, ES-34034-A is required in the video input circuit af the transmitter.

SPECIFICATIONS (Cont'd)

Tube Complement (Cont'd)

AURAL SECTION

Qty.	Type	Function
1	12AT7	Crystal Oscillator
1	12AT7	Pulse Shaper
1	12AT7	Sawtooth Generator
1	12AT7	Sawtooth Modulator
1	6AU6	Quadrupler
1	6AU6	Amplifier
1	6AU6	Doubler
1	6AU6	Tripler
1	6J6	High Frequency Oscillator
1	6AS6	Mixer
1	6AU6	Amplifier
1	5763	Amplifier
1	12AX7	Audio Frequency Amplifier
1	12AU7	Audio Frequency Amplifier
1	5R4GY	Rectifier
7	OD3	Regulator
1	OC3	Regulator
1	6146	Tripler-Amplifier
1	4X150-A	Doubler-Tripler
1	4X150-A	Daubler-Tripler
1	6161	Doubler
1	6161	Intermediate Power Amplifier
1	6181	Power Amplifier
1	5R4GY	Low Voltage Rectifier
2	8008	High Voltage Rectifier
2	6AL5	Reflectometer

Mechanical Specifications

Dimensions:

Width ..... 103"

Height ..... 84"

Depth ..... 32 9/16"

Weight ..... 3,000 lbs. (approx.)

Finish ..... Two-tone umber gray with brushed chrome trim fittings

Maximum Altitude[1] ..... 7500 ft.

Ambient Temperature ..... 45°C max., 10°C min.

Equipment Supplied

TTU-1B TELEVISION BROADCAST TRANSMITTING EQUIPMENT ES-19250-B

Quantity	Description	Stock No.
1	Aural Transmitter Section	MI-19350-C
1	Control Section	MI-19351-B
1	Visual Transmitter Section	MI-19352-C
1	Set of Operating Tubes	ES-19251-A
1	Monitoring Diode	MI-19364
1	Set of End Shields (2 per set)	MI-28061
1	Filterplexer	MI-19086-A[2]
2	6161 Doubler Cavities	MI-27150
2	6161 IPA Cavities	MI-27151
3	6181 PA Cavities	MI-27151
2	Type TMV-129-P Visual Crystal Units (1 spare) including crystal, for customer's assigned frequency	MI-19400-H
2	Type TMV-129-G Aural Crystal Units (1 spare) including crystal, for 130.00 kc	MI-19450-A
2	Type TMV-129-P Aural Crystal Units (1 spare) including crystal	MI-19400-H
1	Nameplate	MI-28180-1
1	Lot of Installation Material	MI-19357-B
1	Finish Touch-Up Kit	MI-7499-A
1	Harmonic Filter	MI-27327-L/H[2]
1	Low Pass Video Filter	MI-27132
*	Transmission Line Components (Sales order to specify quantity for installation requirements)	MI-19089
*	Coax Stub, Extra Long (Sales order to specify quantity. Two required for channels 14-15)	MI-27129
*	Coax Stub, Extra Short (Sales order to specify quantity. Two required for channels 77-83)	MI-27130
*	Set of Complete Spare Tubes (Sales order must specify quantity)	ES-19251-A
*	Set of FCC Spare Tubes (Sales Order must specify quantity).	ES-19252-A
2	Installation Instruction Books	IB-36131
2	Instruction Books	IB-36130

* Supplied if and as specified on sales order.

Optional or Accessory Equipment

Complete Spare Set of Tubes	ES-19251-A
FCC Spare Set of Tubes	ES-19252-A
TTC-1C Console with Master Monitor, but Less Monitor Power Supply	ES-19240-A
UHF FM Exciter-Modulator and Power Supply	MI-19363
Tube Kit for UHF Exciter and Power Supply MI-19363	MI-27102
BWU-5A Sideband Response Analyzer	ES-34009
Input and Monitor Racks, Wired/Unwired	ES-19203-C/D
Color Input and Monitor Racks, Wired/Unwired	ES-19237-C/D
RF Load and Wattmeter	MI-19197
BWU-4A Demodulator	ES-34007

[1] For operation at rated power and normal plate voltage.
[2] Sales order must specify customer's assigned frequency.

UHF TELEVISION TRANSMITTER

12½ KW, TYPE TTU-12A

FEATURES

- Designed for Color TV operation
- Employs standard TTU-1B Transmitter as driver
- 1-KW Power Cutback possible
- Uses standard, small size, RCA-6448 Hi-Power Tetrode in aural and visual P.A.s
- Quick, simple, "glide-in" tube and cavity change
- Electronic micro-second overload protection
- Power outputs up to 12½ KW—measured at output of filterplexer
- Fixed-tuned, trouble-free, factory-tuned filterplexer
- Visual hum level—40 db to insure satisfactory operation on non-synchronous network originations
- Lower installation costs—preformed inter-cabinet connection cable
- Reduced floor space—sliding doors require no space for door swing
- Small—easily handled cubicles—30" wide by 32" deep by 84" high

USES

The RCA TTU-12A UHF Television Broadcast Transmitter is designed to operate on any specified channel between 14 and 83. Available to provide higher power, it is a companion to the popular RCA 1-KW UHF Transmitter. UHF Transmitter power output up to 12½ KW (dependent upon channel) is made possible (see curve). Television stations can elect to install the higher power transmitter at the start—or begin with a lower power transmitter such as the TTU-1B and "block-build" with a 12½-KW High-Power amplifier. This is a particularly logical and economical step for owners of the RCA TTU-1B which is the TTU-12A driver.

The TTU-12A UHF Transmitter (when used in conjunction with RCA high-gain UHF Pylon antennas) is capable of providing Effective Radiated Powers from 200 to 300 KW. This is an ideal combination for "fringe area" coverage—or for saturated metropolitan coverage.

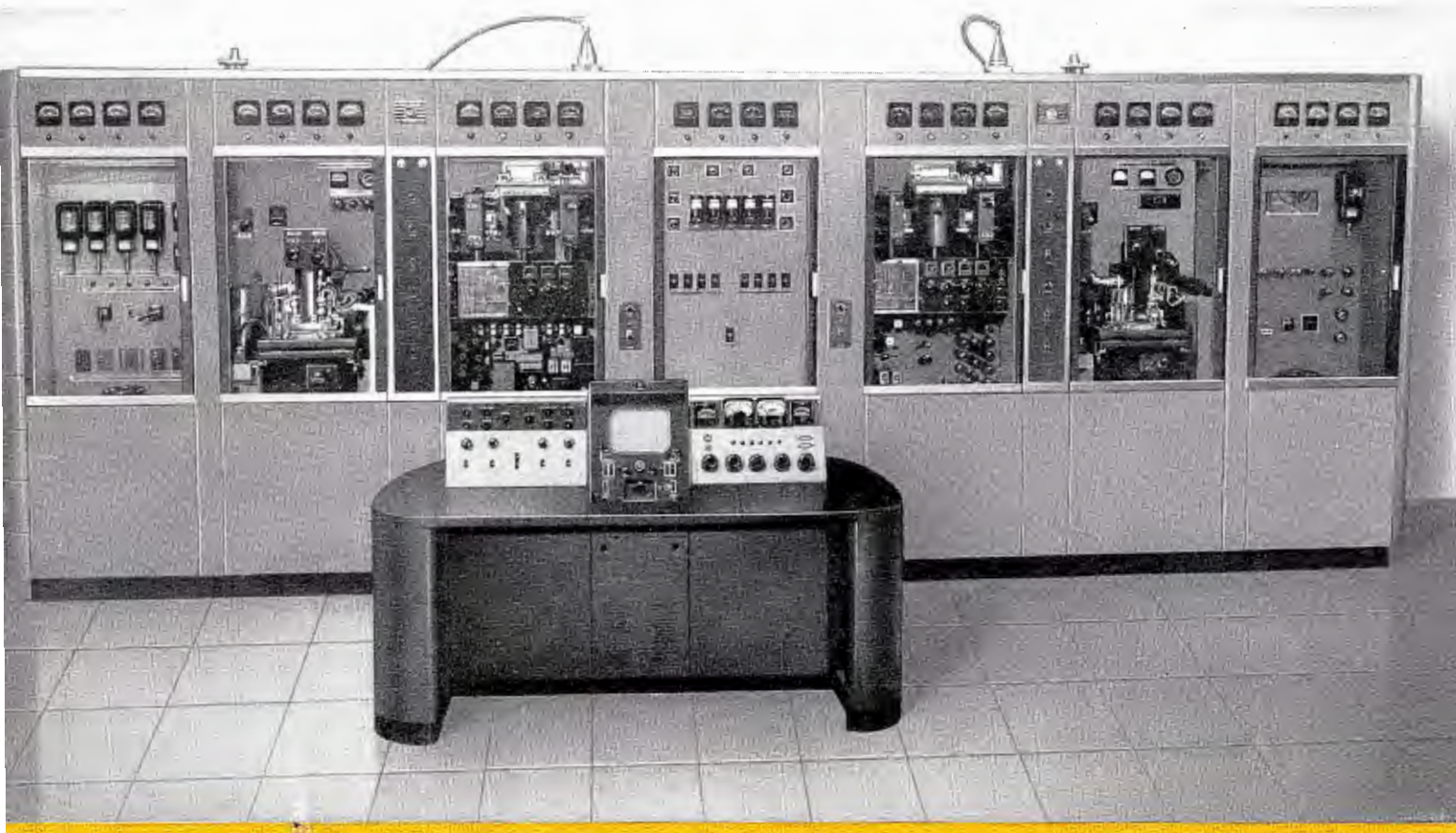
DESCRIPTION

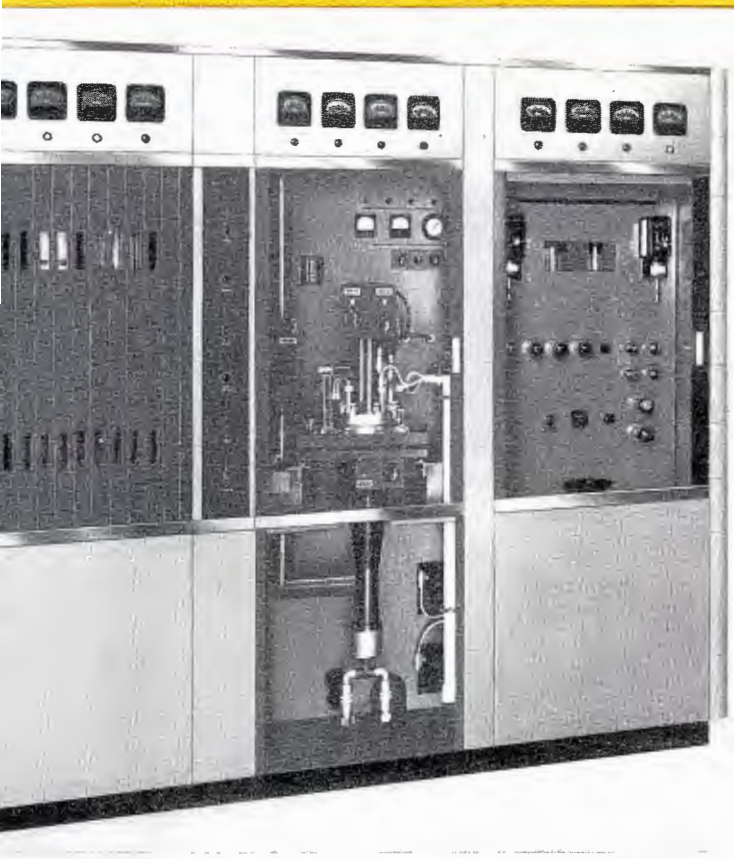
The RCA 12½-KW UHF Transmitter provides reliable and economical high-power TV operation. It is a combined result of the practical operating experience gained with RCA's popular 1-KW transmitter plus over seven years of intensive UHF engineering and research. The TTU-12A is designed for power output up to 12½ KW. Specially developed and highly accurate crystals assure stable operation of the transmitter even when offset carrier technique is used to minimize interference between co-channel stations. The electrical performance and stability of characteristics meet all the new FCC and RETMA standards for television transmitters, both monochrome and color.

A Filterplexer is employed (supplied as a part of the transmitter equipment) to suppress the undesired sideband, as well as to combine the aural and visual transmitter outputs. This greatly simplifies tuning of the transmitter for proper monochrome or color TV operation.

Throughout the design of the transmitter, easily controlled, "proved-in" circuits and small size, easy-to-handle tubes are utilized. For example, it contains as a driver the complete RCA TTU-1B (1-KW) Transmitter, which is operating so successfully throughout the United States. It employs

Front view of RCA 12½ KW UHF Transmitter with doors rolled back.





The power amplifier cabinet with amplifier unit in place and lower front panel removed to expose details of the bottom compartment is shown above. To right the complete amplifier assembled with the 6448 beam triode tube is shown being rolled into place in visual PA cabinet.

the RCA-developed hi-power tetrode, Type 6448 in the final power amplifier stages. Quick tube and cavity change, micro-second overload protection, wide bandwidth, operation for color, and modern flush rollback doors are other features.

Simplified front-panel control is provided and all important circuits are metered. Operation can practically be reduced to the turning "off and on" at the transmitter. Power output meters are supplied for both picture and sound transmitters. These meters also indicate VSWR. Facilities are provided to permit continuous picture monitoring (which is necessary to assure proper adjustment for color) at various points in the system. Aural and visual transmitters and their control circuits are independent, giving a maximum of operational flexibility.

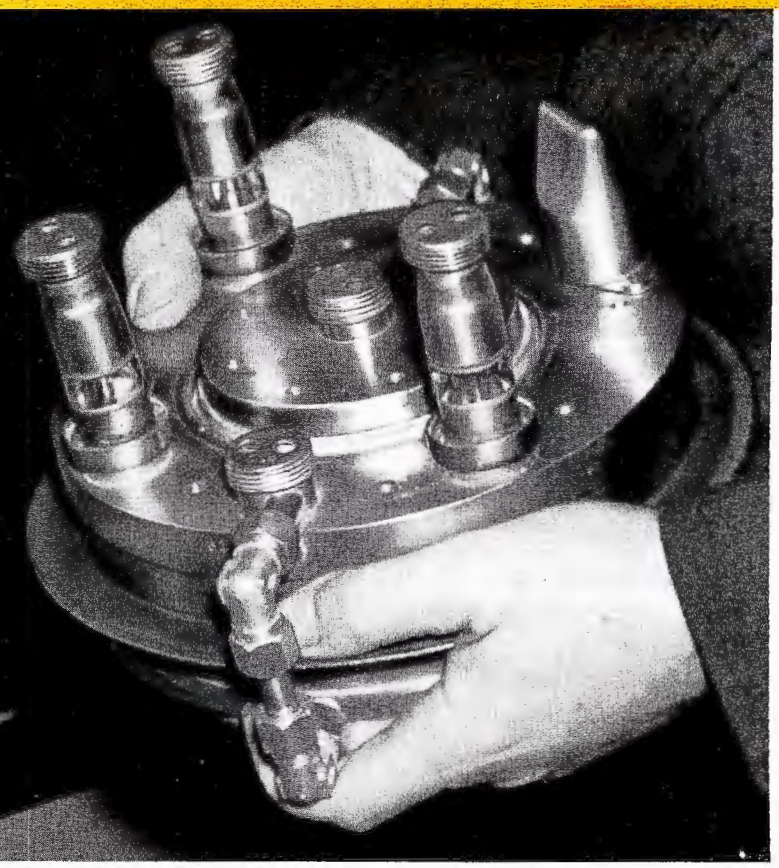
The Final Amplifiers

The small but rugged concentric construction of the RCA tetrode (utilized in both the aural and visual sections of the power amplifier) minimizes circuitry, results in simple mechanical arrangements, avoids leakage currents in cabinet frames, and reduces tuning requirements. Only one set of cavities are required to tune the entire UHF spectrum. Only two tuning controls are required—one for the input circuit and one for the output circuit. Latest techniques and principles are employed, but they are easily understood by all station operators, since the RCA TTU-12A Transmitter contains only conventional types of vacuum tubes throughout.

Similarity in construction of aural and visual cavities results in a reduced number of spare parts and facilitates familiarity on the part of operating personnel with circuit and component details. Compactness of the tetrode and unique cavity construction permits the operator, unassisted, to replace the complete final stage with an auxiliary amplifier within five minutes. The replacement P.A. assembly for easy tube change is supplied as a part of the transmitter equipment.

The aural R-F and P.A. amplifiers are housed in two cabinets at the left of the center control cabinet, and the R-F and P.A. visual amplifiers are in two cabinets at the right of the central control cabinet.

Cooling of the final stages of the TTU-12A is accomplished by a closed re-circulating water system that utilizes a dry type of water-to-air heat exchanger. This system is capable of properly cooling the transmitter within the temperature and altitude ranges listed under mechanical specifications.



Small-size, conventional tetrodes (RCA Type 6448) are used in the Aural and Visual "P.A." sections of the 12½ KW transmitter. Use of conventional types of tubes throughout results in economical operation, easy maintenance, and simple, straightforward circuitry.

Mechanical Arrangement

Mechanically, the transmitter is housed in nine cubicles equipped with sliding front and rear access doors. Seven of the cabinets are mounted adjacent to each other on two rails which serve not only as a base frame but also as a wire trench. Preformed inter-cabinet connection cables are furnished to reduce installation costs.

Vertical chassis type construction is used for convenience and accessibility with heavy transformers and reactor units supported by a steel base. The vertical chassis is flanged and fastened directly to side panels allowing maximum use of the inside volume of the transmitter cabinets.

Two cabinets contain the thyratron unit and P.A. power supply. These cabinets and the water cooling equipment, plate transformers, and regulators are mounted at the rear of the transmitter (see floor plans). The seven cabinets that form the transmitter proper, the two auxiliary cabinets in the rear for housing the P.A. supply, the usual number of video, audio, and monitoring racks, and a studio console unit can be conveniently located in the comparatively small room area of 26′ x 26′ and still provide sufficient space for efficient maintenance, operation and through traffic of personnel.

The TTU-12A's flush, rollback doors also are unusually conserving of valuable floor area. This feature alone results in a saving of up to 100 square feet in floor space over that required by other transmitters.

1-KW Driver (TTU-1B)

The aural and visual outputs of the 1-KW driver each utilize a single RCA 6181 tube. This tube is especially developed for operation up to 900 mc and will provide 1-KW peak video output. It is an air-cooled tetrode with ceramic seals for low loss at high frequencies. All co-axial connections make possible rapid tube change. Similarity of construction of aural and visual portions results in reduced numbers of spare parts and simplifies maintenance. All circuits are simple to tune and since they are of the co-axial type, there is a minimum of leakage and radiating currents flowing in the cabinet frames.

The visual transmitter final output stage is high level cathode modulated. All R-F stages have non-critical adjustments and lend themselves readily to meter tuning. No appreciable picture degradation can occur by careless tuning.

Frequency stability is exceptionally good, permitting use of offset carrier operation, if desired. Frequency separation between visual and sound transmitter is maintained within close limits assuring correct operation of intercarrier sound type television receivers.

The visual modulator circuit employs the latest design features and represents the ultimate in simplicity and economy. The highest degree of visual transmission fidelity is attained.

Power and Control

The control and distribution equipment of the TTU-12A transmitter is housed in the extreme left-hand cabinet and bias and screen rectifier equipment is in a cabinet at the extreme right.

In addition to providing the normal high standards of protection such as interlocking all necessary components, metering all important circuits, and shielding all high-voltage areas, an exclusive protective circuit of inestimable value is included in the transmitter.

This unique device provides protection for power tubes and equipment from any momentary or sustained overload. Protection is achieved in the exceptionally short time of ten micro-seconds. For demonstration purposes, a .005" diameter wire can be placed directly across the 7000 volt supply. No physical change will be experienced by the wire due to the rapidity with which the protective circuit acts.

In order to facilitate maintenance, simplify the number of controls and reduce the number of operating tubes, only one power supply is used for both the aural and visual

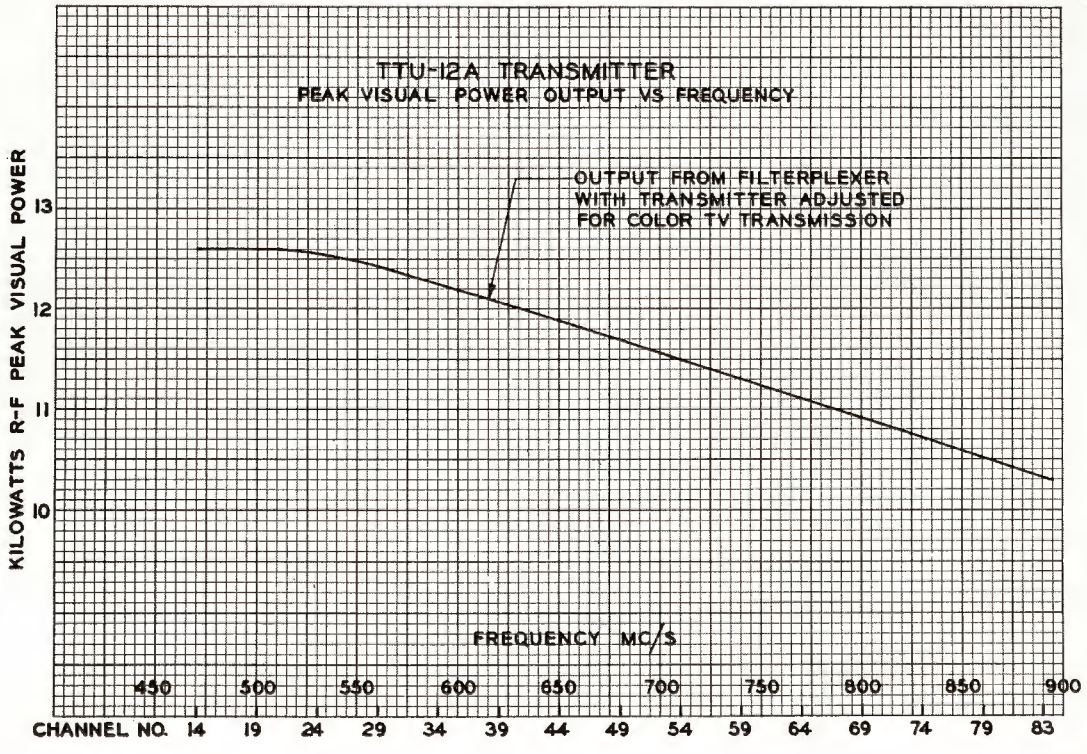
Power Amplifiers. Associated with this common power supply is a high-voltage transfer switch which can completely isolate and ground either the aural Power Amplifier or the Visual Amplifier to permit independent operation of amplifiers.

Plate transformers are non-inflammable, oil-filled types to assure long life and a minimum of maintenance. They consist of three separate, identical single-phase transformers which are connected in a double "Y", three-phase connection.

UHF Filterplexer

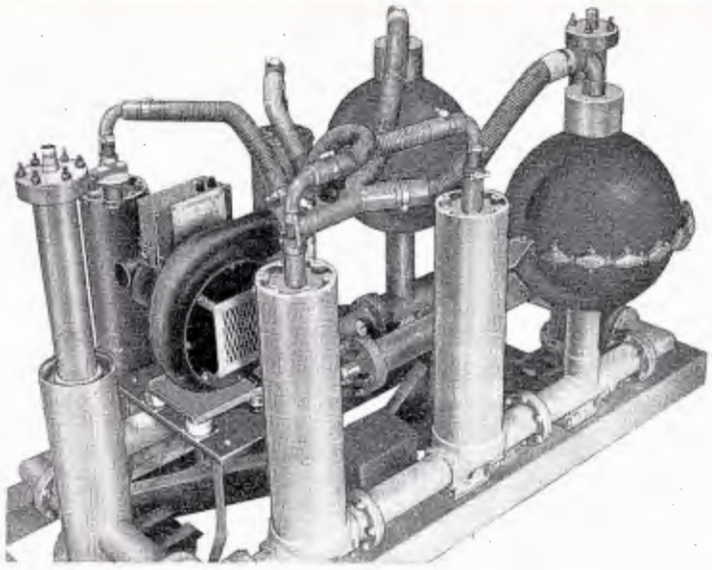
The MI-19086-B UHF Filterplexer unit is supplied completely assembled and adjusted for operation in any one of the UHF television channels from channel 14 to channel 83. The unit is required to suppress the undesired sideband as well as to combine the aural and visual transmitter outputs to satisfy both monochrome and color TV requirements. It therefore serves the double purpose of a vestigial side band filter and a diplexer unit. It greatly simplifies the tuning of the transmitter, and eliminates the possibility of out-of-channel radiation.

In order to minimize reflections on the transmission line between the transmitter and the filterplexer, the visual input of the filterplexer is designed to have a constant input impedance over the band of frequencies produced by the transmitter. Since resonant circuits of the inductance-capacitance type are impractical at the frequencies involved, the filter sections consist of lengths of coaxial line. The sound notching filters are resonant cavities. The resonant cavities and lines are all adjustable for tuning purposes. These units have been pretuned and adjusted at the factory, where the specialized instruments needed for these adjustments are available.



The filterplexer varies in size and weight for the various frequencies, and so it is always necessary to specify, when ordering, the channel and operating frequency of the television station. The floor plan shows dimensions of the unit. The filterplexer will handle a peak visual power of up to 12.5 kw in the channel for which it is adjusted, when working into a nominal 50 ohm load. The insertion loss is less than 1 db to 4 megacycles above picture carrier frequency, which represents a very desirable band pass characteristic. The vestigial side band characteristics are also maintained by having the lower side-band frequencies attenuated to more than 20 db from the low end of the channel (1.25 megacycles) to 4.25 megacycles below the picture carrier.

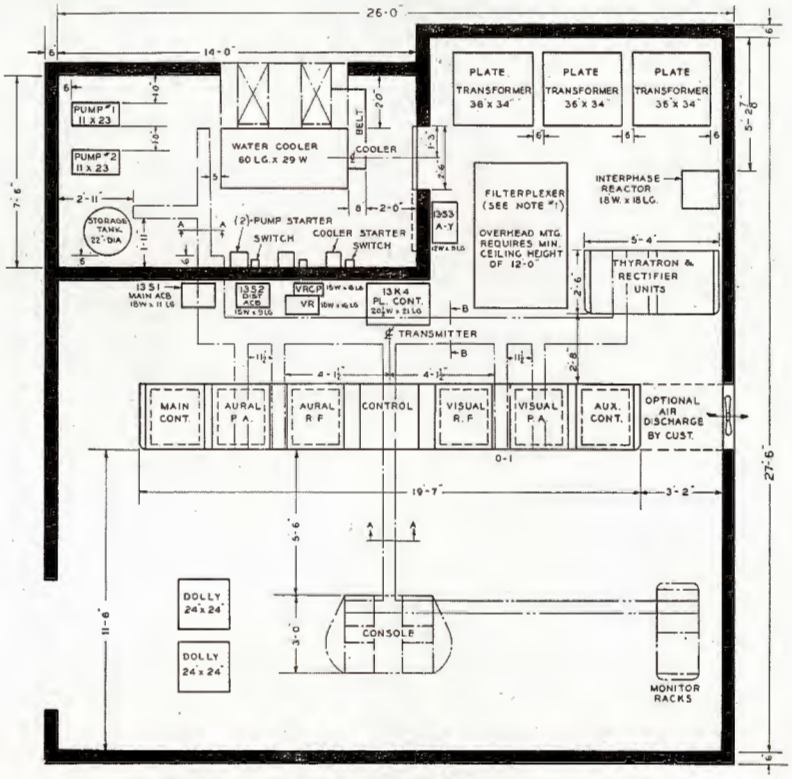
A blower kit is included with the unit to cool the co-axial and spherical cavities. For optimum performance of the transmission system it is recommended that 3⅛ inch, 50 ohm (RCA MI-19089) transmission line be used. The filterplexer is gassed with sulphurhexafluoride gas (SF_6), at 12 lbs/sq. in. pressure. Each of the 4 filterplexer terminals is equipped with a gas barrier to permit the separate pressurizing of connecting transmission line with nitrogen and to insure the continual maintenance of filterplexer pressure when opening connecting transmission line for various testing operations.

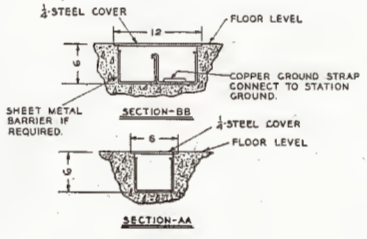


View of MI-19086-D UHF Filterplexer supplied with TTU-12A.

TTU-12A FLOOR PLAN LAYOUT

(With Filterplexer Ceiling-Mounted)





NOTE NO 1 — FILTERPLEXER MI-19086 CH. 14-83 (CHANNEL SPECIFIED) HAS THE FOLLOWING DIMENSIONS. FOLDED 5'-8 LG. x 3'-7 W. x 4'-2 HIGH. EXTENDED 9'-6" LONG x 3'-7 W. x 4'-2 HIGH. DIMENSIONS GIVEN ARE FOR LOWEST FREQUENCY UNIT AND WILL BE SMALLER FOR HIGHER FREQUENCIES. IT CAN BE OPERATED FOLDED OR EXTENDED (SHIPPED FOLDED) MUST BE CEILING MOUNTED, BUT ABSORBING LOAD MUST BE HORIZONTAL VISUAL AND AURAL INPUT LINES AND ANTENNA LINE 3⅛-50-OHMS UNIT SHOULD NOT BE SUBJECTED TO DRAFTS.

SPECIFICATIONS

Performance Specifications

	Visual	*Aural*
Type of Emission	A5	F3
Frequency Range	Channels 14-83	Channels 14-83
Rated Power Output	See Graph p. 5[1]	60% of peak visual output[2]
Minimum Power Output	6 kw[1]	3.6 kw[2]
R-f Output Impedance	50 ohms	50 ohms
Input Impedance	75 ohms	600/150 ohms
Input Level	1.0 v. peak to peak min.	+10 ±2 dbm
Amplitude vs. Frequency Response		Uniform ±1 db from 50 to 15,000 cycles
Upper Sideband Response:[3]		
+1, −1.5 db at carrier	+0.5 mc	
+1, −1.5 db at carrier	+1.25 mc	
+1, −1.5 db at carrier	+2.0 mc	
+1, −1.5 db at carrier	+3.0 mc	
+1, −1.5 db at carrier	+3.58 mc	
+1, −3.0 db at carrier	+4.18 mc	
−20 db max. at carrier	+4.75 mc	
Lower Sideband Response:[4]		
+1, −1.5 db at carrier	−0.5 mc	
−20 db max. at carrier	−1.25 mc	
−42 db max. at carrier	−3.58 mc	
Variation in Freq. Response with Brightness[5]	±2.0 db	
Carrier Frequency Stability[6]	±1 kc	±1 kc[7]
Modulation Capability	12.5 ±2.5% (reference white)	±50 kc
Audio Frequency Distortion		1.5% max. 50-100 cy. 1.0% max. 100-7500 cy. 1.5% max. 7500-15000 cy.
FM Noise, Below ±25 kc Swing		60 db
AM Noise, rms	40 db below 100% mod.	50 db below carrier
Amplitude Variation Over One Picture Frame	Less than 5% of the peak of sync level	
Regulation of Output	7% max.	
Burst vs. Subcarrier Phase[8]	±7 degrees max.	
Subcarrier Phase vs. Brightness[9]	±7 degrees max.	
Subcarrier Amplitude[8]	±15%	
Linearity (Incremental Gain)[10]	15% max.	
Envelope Delay vs. Frequency[11]	±.08 μsec. from 0.2 to 2.1 mc ±.04 μsec. at 3.58 mc ±.08 μsec. at 4.18 mc	
Harmonic Attenuation, ratio of any single harmonic to peak visual fundamental	At least 60 db	At least 60 db

[1] Measured at the output of the sideband filter or filterplexer.

[2] Measured at the input to the diplexer or filterplexer.

[3] With respect to the response at 200 kc, as measured by the BW-5A Sideband Response Analyzer at transmitter mid-characteristic. 4.75 mc attenuation requires use of MI-27132 LP filter in the video input circuit.

[4] With respect to the response at 200 kc at transmitter mid-characteristic.

[5] Maximum variation with respect to the response at mid-characteristic measured with the BW-5A Sideband Response Analyzer at brightness levels of 22.5% and 67.5% of sync peak, using approximately 20% (peak to peak) modulation.

[6] Maximum variation for a period of 30 days without circuit adjustment.

[7] Maximum variation with respect to the standard 4.5 mc separation between aural and visual carriers.

Electrical Specifications

Power Line Requirements:

Transmitter:

Line	208/230 volts, 60 cycles, 3-phase
Slow Line Variations	±5% max.
Rapid Line Variations	±3% max.
Regulation	3% max.
Power Consumption	100 kw black picture, 85 kw average picture
Power Factor (approx.)	90%

Crystal Heaters:

Line	115 volts, 60 cycles, single phase
Power Consumption	110 watts

Mechanical Specifications

Transmitter Overall Dimensions:

Width (front line cabinets)	235"
Height (front line cabinets)	84"
Depth (front line cabinets)	32 9/16"
Weight (front line cabinets)	6000 lbs. (approx.)
Total Weight	15,000 lbs. (approx.)
Finish	Two-tone umber gray with brushed chrome trim fittings
Maximum Altitude[12]	7500 ft.
Ambient Temperature	45°C max., 10°C min.

Tube Complement

Power Amplifiers and Common Power Supply:

	Aural		*Visual*		*Common Power Supply*	
Function	*Qty.*	*Type*	*Qty.*	*Type*	*Qty.*	*Type*
Monitoring Diode			1	5675		
Reflectometers	2	6AL5	2	6AL5		
SWR Monitor	1	2D21	1	2D21		
Power Amplifier	1	6448	1	6448		
Plate Supply Rectifiers					6	5563A
Plate Protection Tube	1	5563A	1	5563A		
Screen Supply Rectifiers					2	8008
Regulated Bias Supply Rectifiers			2	5R4GY		
Regulator			3	OD3		
Regulator			1	OA3		
Regulator			4	6AS7-G		
Regulator			1	6SH7		
Screen Protection Tube	1	5563A	1	5563A		

[8] Maximum departure from the theoretical when reproducing saturated primary colors and their complements at 75% amplitude. A properly terminated TA-7 Stabilizing Amplifier is required in the video input circuit.

[9] Maximum phase difference with respect to burst, measured after the VSBF, for any brightness level between 75% and 15% of the sync peak using 10% (peak to peak) modulation. This is equivalent to 5% (peak to peak) modulation as indicated by a conventional diode demodulator.

[10] Maximum variation in the amplitude of a 3.58 mc sine wave modulating signal as the brightness level is varied between 75% and 15% of sync peak. The gain shall be adjusted for 10% (peak to peak) modulation of the 3.58 mc signal when the brightness is at pedestal level. This is equivalent to 5% (peak to peak) modulation as indicated by a conventional diode demodulator connected after the VSBF. A properly terminated TA-7 Stabilizing Amplifier is required in the video input circuit.

[11] Maximum departure from standard curve. The tolerances vary linearily between 2.1 and 3.58 mc and between 3.58 mc and 4.18 mc. To meet the specification a properly terminated phase correction network, ES-34034-A is required in the video input circuit of the transmitter.

[12] For operation at rated power and normal plate voltage.

SPECIFICATIONS—(Continued)

Function	Qty.	Type
AURAL SECTION		
Crystal Oscillator	1	12AT7
Pulse Shaper	1	12AT7
Sawtooth Generator	1	12AT7
Sawtooth Modulator	1	12AT7
Quadrupler	1	6AU6
Amplifier	1	6AU6
Doubler	1	6AU6
Tripler	1	6AU6
Amplifier	1	6AU6
High Frequency Oscillator	1	6J6
Mixer	1	6AS6
Amplifier	1	5763
Audio Frequency Amplifier	1	12AX7
Audio Frequency Amplifier	1	12AU7
Rectifier	1	5R4GY
Regulator	7	OD3
Regulator	1	OD3
Amplifier-Tripler	1	6146
Doubler-Tripler	1	4X150-A
Doubler-Tripler	1	4X150-A
Doubler	1	6161
Intermediate Power Amplifier	1	6161
Power Amplifier	1	6181
Low Voltage Rectifier	1	5R4GY
H.V. Rectifier	2	8008
Reflectometer	2	6AL5

Function	Qty.	Type
VISUAL SECTION		
Oscillator	1	6J6
Buffer	1	5763
Tripler Amplifier	1	6146
Doubler-Tripler	1	4X150-A
Doubler-Tripler	1	4X150-A
Doubler	1	6161
Intermediate Power Amplifier	1	6161
Modulated Power Amplifier	1	6181
Video Amplifier	1	6CL6
Video Amplifier	1	6CL6
Video Amplifier	1	6CL6
Video Amplifier	1	6146
Modulator	8	6146
Sync Separator	1	6485
Sync Amplifier	1	5763
Clamp Diode	1	6AL5
Negative Capacitor	5	6146
Low Voltage and Bias Rectifier	1	5R4GY
Rectifier	4	866-A
Rectifier (H.V.)	2	8008
D. C. Amplifier	2	6SL7-GT
Control Tube	2	6AS7-G
Regulator	6	OD3
Regulator	4	OC3
Regulator	1	OA3
Reflectometer	2	6AL5
Monitoring Diode (Triode)	1	5675

Equipment Supplied

TTU-12A TELEVISION TRANSMITTER (ES-19260)

Qty.	Description	Stock No.
1	Transmitter Driver	ES-19250-B
1	Aural Power Amplifier	MI-19353
1	Visual Power Amplifier	MI-19354
1	Control and Distribution Unit	MI-19355
1	Rectifier Unit	MI-19356
3	Plate Transformers	MI-19359/MI-19359-A
1	Interphase Reactor	MI-27147/MI-27147-A
1	Auxiliary Control Unit	MI-19358
1	Thyratron Unit	MI-19362
1	Cooler Installation	MI-19360
1	Regulator	MI-19361
1	Set of Tubes for Driver	ES-19251-A
1	Set of Tubes for the Power Amplifier	ES-19261
1	Installation Material and Miscellaneous Equipment	MI-27136
*	Transmission Line (*Sales Order to specify quantity required for customer's installation)	MI-19089
1	Set of End Shields	MI-28061
1	Wiring Material Kit	MI-27138
3	Power Amplifier Cavities and Mounting Shelves	MI-27139[1]
2	Power Amplifier Carriages	MI-27140
1	Diode Demodulator	MI-19364
1	Filterplexer	MI-19086-D[1]
1	Nameplate	MI-28180-1
2	R-F Monitor Units (Reflectometers)	MI-27137
1	Water Ejector Equipment	MI-27143
1	Line Stretcher Kit	MI-27149
1	Finish Touch-up Kit	MI-7499-A
1	Miscellaneous Hardware Kit	MI-7474
2	Installation Instruction Books	IB-36182
2	Instruction Books	IB-36203

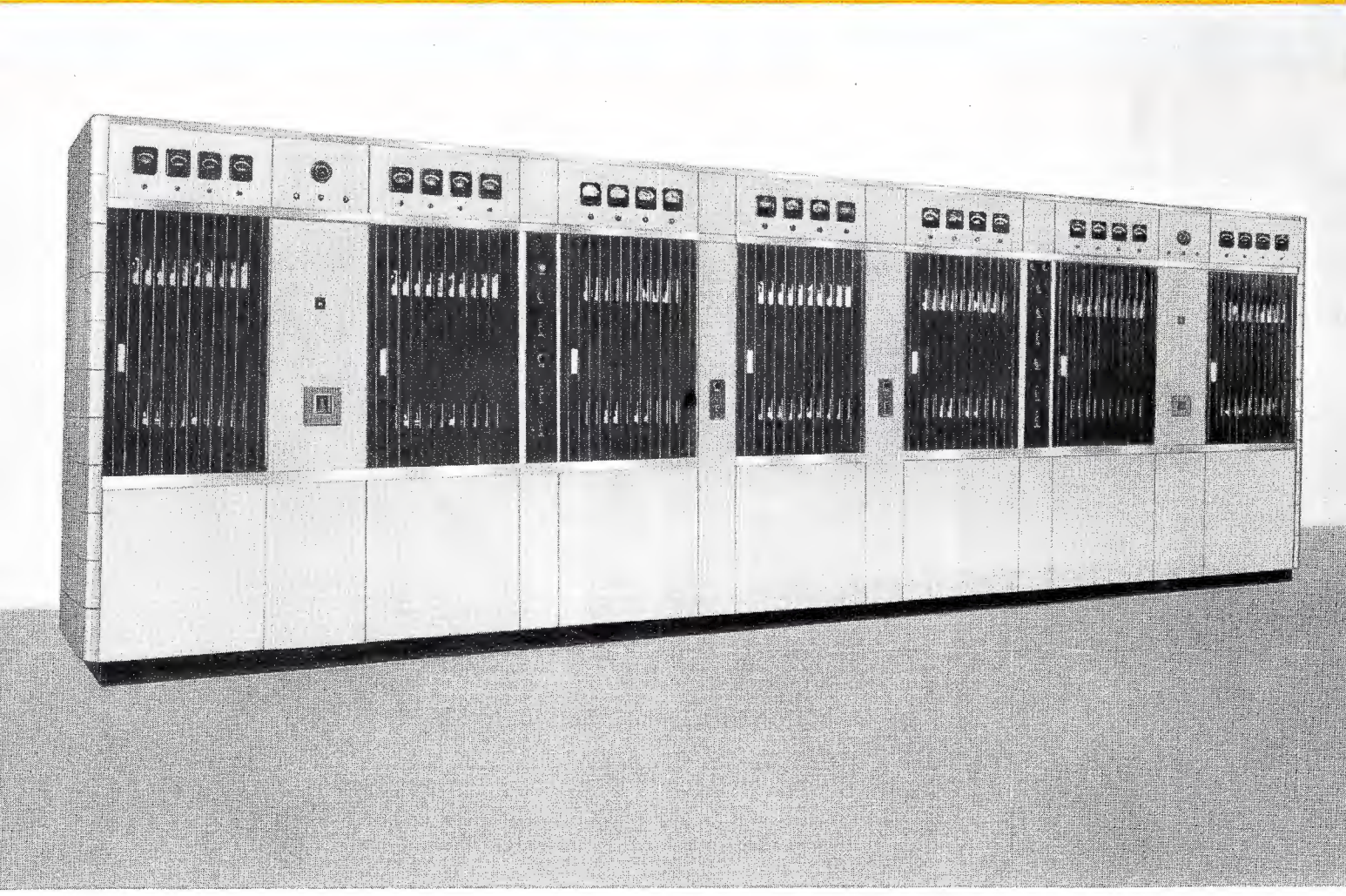
Optional or Accessory Equipment

TTC-1C Control Console with Master Monitor, but less Master Monitor Power Supply	ES-19240-A
R-F Load and Wattmeter	MI-19198-A
Harmonic Filter	MI-27327-L/HA[1]
Low Pass Video Filter	MI-27132
Input and Monitor Racks, Wired/Unwired	ES-19203-C/D
Color Input and Monitor Racks, Wired/Unwired	ES-19237-C/D
Cavity Water By-Pass	MI-27406
Complete Set of Spare Tubes for Driver	ES-19251-A
Complete Set of Spare Tubes for Power Amplifier	ES-19261
FCC Set of Spare Tubes for Driver	ES-19252-A
FCC Set of Spare Tubes for Power Amplifier	ES-19262
BWU-5A Sideband Response Analyzer	ES-34009
BWU-4A Demodulator	ES-34007
Transformer (Motor Booster)	MI-27141

[1] Sales order to specify customer's assigned frequency.

UHF TELEVISION TRANSMITTER

25 KW, TYPE TTU-25B



FEATURES

- Maximum coverage (up to 1000 KW ERP) for minimum investment, power consumption, and operating expense
- Designed for Color TV operation
- Employs one standard, small size Hi-Power Tetrode in aural and visual P.A.'s
- Single meter indication for proper tuning
- Nominal power of 25 KW measured at output of filterplexer
- Minimum tuning controls
- Quick, simple, "glide-in" tube and cavity change
- Comparatively low voltages—electronic micro-second overload protection
- Visual hum level —40 db to insure satisfactory operation on non-synchronous network originations
- Lower installation costs—preformed inter-cabinet connection cable
- Conserves floor space

USES

RCA's new TTU-25B UHF Television Broadcast Transmitter provides reliable and economical high-power TV operation for stations operating on any specified channel between 14 and 83. The transmitter has a nominal rated power output of 25 kilowatts from the visual transmitter and 12½ kilowatts from the aural. When used with ultra-gain UHF pylon antennas and efficient transmission lines, the TTU-25B can achieve the allowable maximum UHF effective radiated power of 1000-KW. The electrical performance and stability characteristics of the transmitter more than meet the requirements of the new FCC and RETMA standards for color and monochrome transmission.

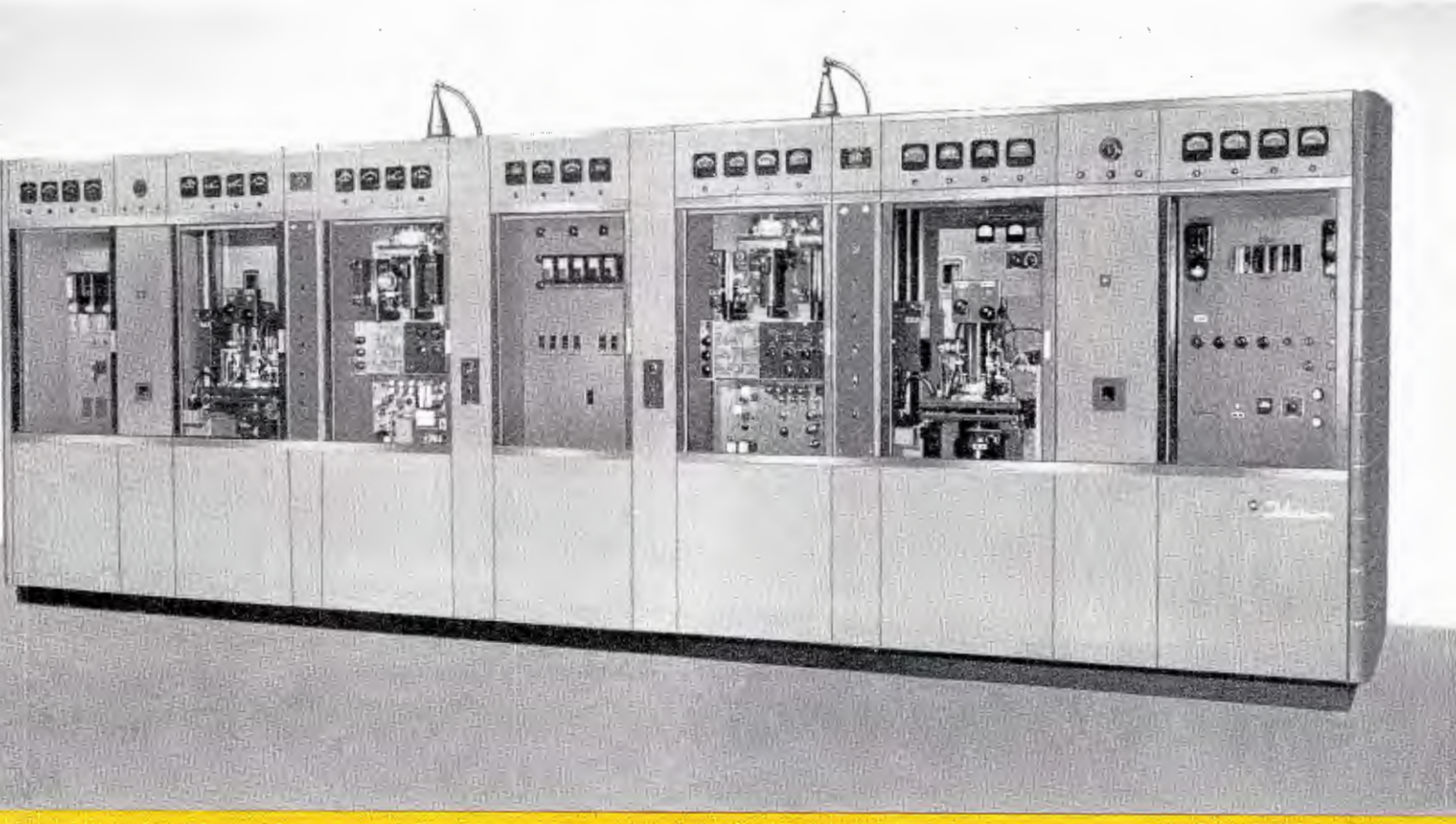
The TTU-25B transmitter makes possible the much needed extended television coverage for many existing low power UHF stations. At the same time, it is a complete equipment that will meet the requirements of the most exacting purchaser of a new UHF station.

The TTU-25B transmitter is a companion to the popular RCA 1-KW and 12½-KW models. Television stations now operating with either of the lower powered transmitters can achieve the new higher power by block-building with additional equipment. This is a particularly logical and economical step since the TTU-1B Transmitter remains the basic driver for both the higher powered 12½ and 25-KW models.

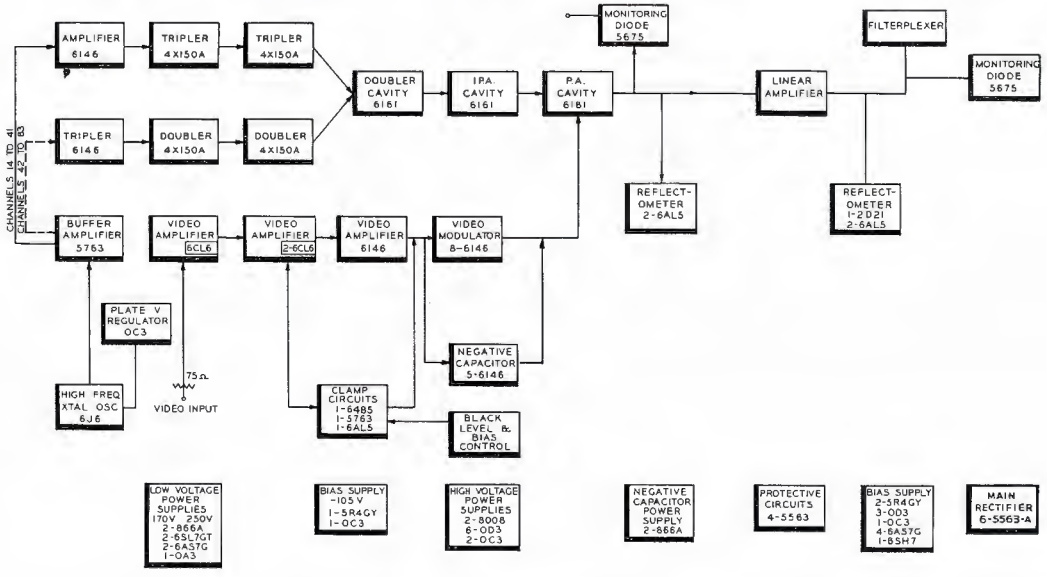
DESCRIPTION

The TTU-25B UHF Television Transmitter is designed to produce, in conjunction with the RCA ultra-gain antennas, maximum permissible ERP on any of the ultra-high frequency channels. Specially developed and highly accurate crystals assure stable operation of the transmitter even when offset carrier technique is used to minimize interference between co-channel stations. Filterplexer and harmonic filters are employed to suppress the undesired sidebands, as well as to combine the aural and visual transmitter outputs. This greatly simplifies tuning of the transmitter for proper monochrome or color TV operation. The new higher UHF power is accomplished with a min-

Front view of RCA 25 KW UHF Transmitter with doors rolled back.



SIMPLE BLOCK DIAGRAM OF 25 KW TRANSMITTER (VISUAL PORTION)



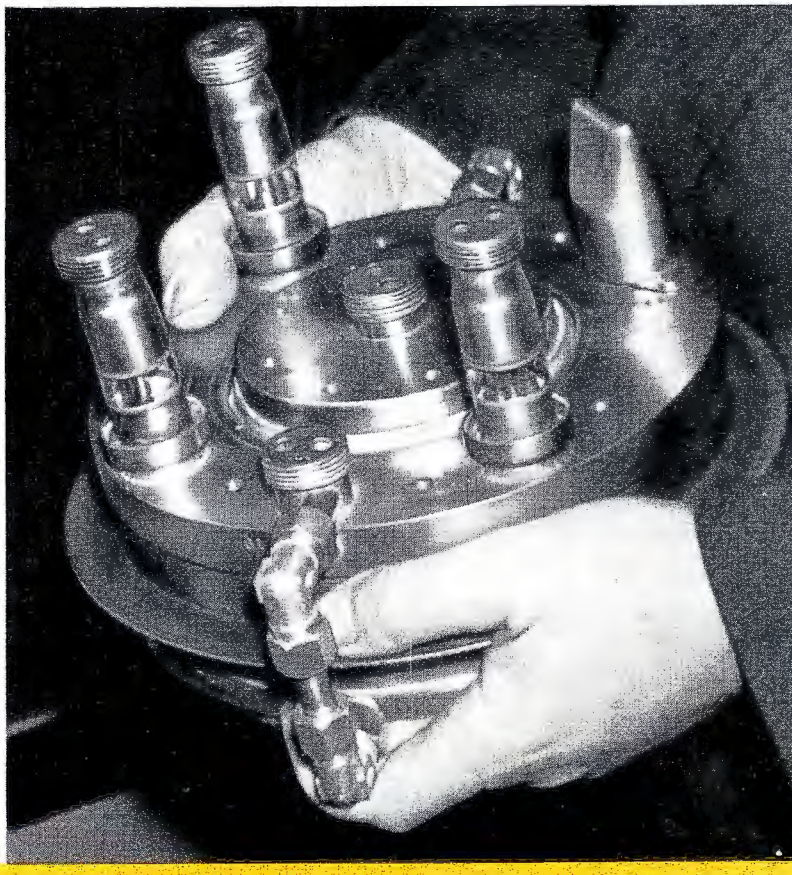
imum of investment, low power consumption, and very low operating expense. One-man operation of the transmitter has been made possible by simplified front-panel control and metering of all important circuits. Operation can practically be reduced to turning "on and off" at the transmitter. Power output meters are supplied for both picture and sound transmitters. These meters also indicate VSWR. Facilities are provided to permit continuous picture monitoring (which is necessary to assure proper adjustment for color) at various points in the system.

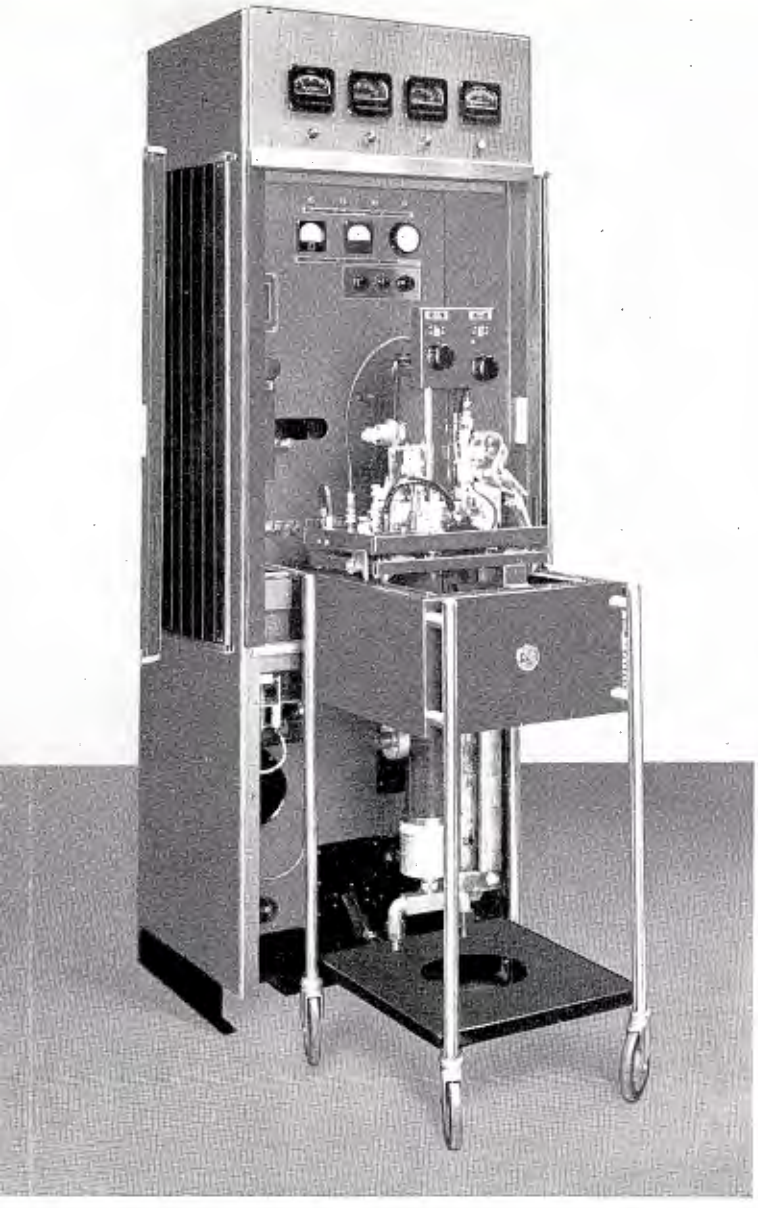
The transmitter contains as a driver the complete TTU-1B (1-KW) transmitter, while an RCA-developed high-power tetrode is employed in the final power amplier stages. Throughout the design of the TTU-25B, easily controlled "proved-in" circuits and small size, easy-to-handle tubes are utilized. Quick tube and cavity change, micro-second overload protection, wide-bandwidth, operation for color, and modern flush rollback doors are other design features.

The Final Amplifiers

The small but rugged concentric construction of the RCA tetrode (utilized in both the aural and visual sections of the power amplifier) minimizes circuitry, results in simple

Small-size conventional tetrodes, RCA Type 6806, are used in the Aural and Visual "P.A." sections of the 25 KW transmitter, Use of conventional types of tubes throughout results in economical operation, easy maintenance, and simple, straightforward circuitry.





Complete amplifier assembled with the UHF beam tetrode tube shown being rolled into place in the visual Power Amplifier cabinet. Input and output tuned circuits are assembled with the tube and are pre-tuned under power for optimum performance.

mechanical arrangements, avoids leakage currents in cabinet frames, and reduces tuning requirements. Only one set of cavities are required to tune the entire UHF spectrum. Only two tuning controls are required—one for the input circuit and one for the output circuit. Latest techniques and principles are employed, but they are easily understood by all station operators, since the RCA TTU-25B Transmitter contains only conventional types of vacuum tubes throughout.

Identical construction of aural and visual cavities results in a reduced number of spare parts and facilitates familiarity on the part of operating personnel with circuit and component details. Compactness of the tetrode and unique cavity construction permits the operator, unassisted, to replace the complete final stage with an auxiliary amplifier within five minutes. The replacement P.A. assembly for easy tube change is supplied as a part of the transmitter equipment.

The aural driver and P.A. amplifier are housed in two cabinets at the left of the center control cabinet, and the visual driver and amplifier are in two cabinets at the right of the central control cabinet.

Cooling of the final stages of the TTU-25B is accomplished by a closed re-circulating water system that utilizes a water-to-air heat exchanger. This system is capable of properly cooling the transmitter within the temperature and altitude ranges listed under mechanical specifications.

Mechanical Arrangement

Mechanically, the transmitter is housed in nine cubicles equipped with sliding front and rear access doors. Seven of the cabinets are mounted adjacent to each other on two rails which serve not only as a base frame but also as a wire trench. Preformed inter-cabinet connection cables are furnished to reduce installation costs.

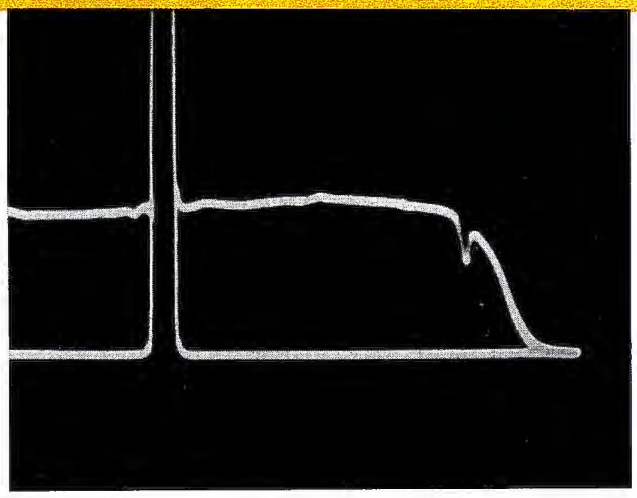
Vertical chassis type construction is used for convenience and accessibility with heavy transformers and reactor units supported by a steel base. The vertical chassis is flanged and fastened directly to side panels allowing maximum use of the volume of the transmitter cabinets.

Two cabinets contain the thyratron unit and P.A. power supply. These cabinets are mounted at the side of the transmitter (see floor plans). The seven cabinets that form the transmitter proper, the two auxiliary cabinets, the usual number of video, audio, and monitoring racks, and a studio console unit can be conveniently located in the small room area of approximately 31′ x 22′ and still provide sufficient space for efficient maintenance, operation and through traffic of personnel.

The TTU-25B's flush, rollback doors also are unusually conserving of valuable floor area. This feature alone results in a saving of up to 100 square feet in floor space over that required by other transmitters.

1-KW Driver (TTU-1B)

The aural and visual outputs of the 1-KW driver each utilize a single RCA 6181 tube. This tube is especially developed for operation up to 900 mc and will provide 1-KW peak video output. It is an air-cooled tetrode with ceramic seals for low loss at high frequencies. All co-axial connections make possible rapid tube change. Similarity



The TTU-25B output video frequency response before filterplexer. Marker at 4.2 mc channel 44, mid-characteristic operation.

of construction of aural and visual portions results in reduced numbers of spare parts and simplifies maintenance. All circuits are simple to tune and since they are of the co-axial type, there is a minimum of leakage and radiating currents flowing in the cabinet frames.

The visual driver final output stage is high level cathode modulated. Frequency stability is exceptionally good, permitting use of offset carrier operation, if desired. Frequency separation between visual and sound transmitter is maintained within close limits assuring correct operation of intercarrier sound type television receiver.

The visual modulator circuit employs the latest design features and represents the ultimate in simplicity and economy. The highest degree of visual transmission fidelity is attained.

TTU-25B TRANSMITTER
Typical Amplifier Performance and Meter Readings

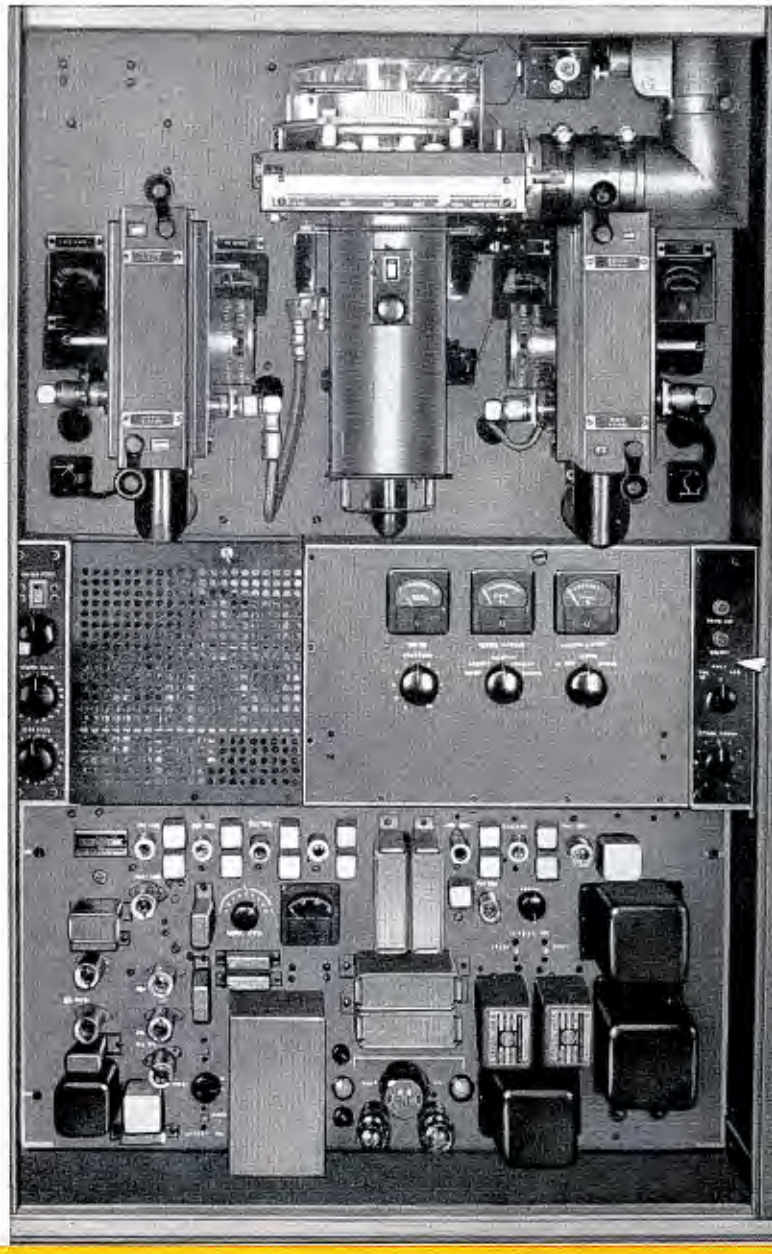
	Visual (Black picture)	*Aural (C.W.)*
Filament voltage, per phase	1.35	1.35
Grid voltage	—140	—180
Grid current, amperes	.01	.01
Screen voltage	1000	1000
Screen current, amperes	0.160	0.220
Plate voltage	8000	8000
Plate current, amperes	6.25	5.5
Power output, filterplexer, KW	25	12.5
Plate efficiency, average, percent		30.3
Plate efficiency, peak, percent	40	

Power and Control

The control and distribution equipment of the TTU-25B transmitter is housed in the extreme left-hand cabinet and bias and screen rectifier equipment is in a cabinet at the extreme right.

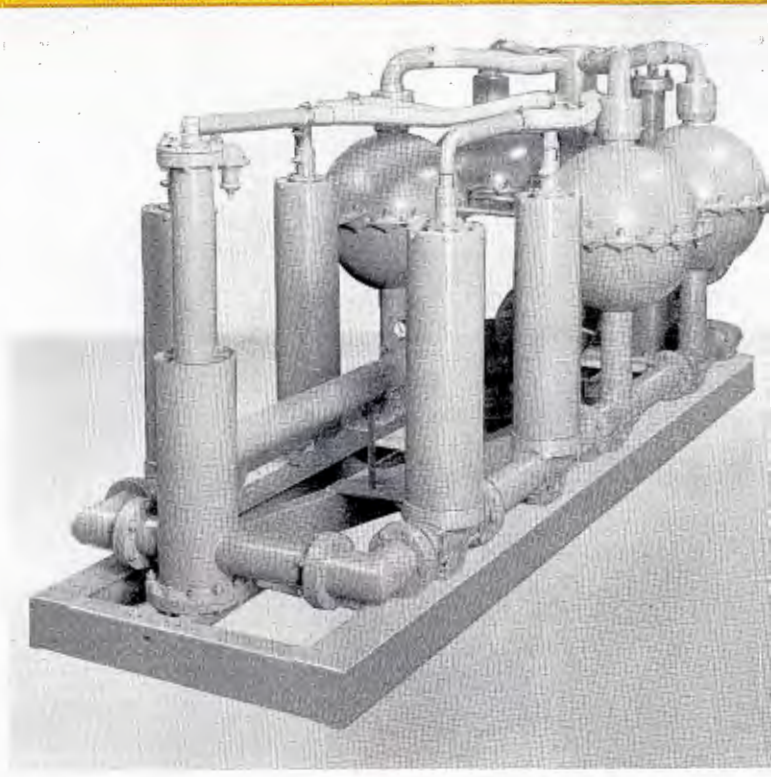
In addition to providing the normal high standards of protection such as interlocking all necessary components, metering all important circuits, and shielding all high-voltage areas, an exclusive protective circuit is included in the transmitter.

In order to facilitate maintenance, simplify the number of controls and reduce the number of operating tubes, only one power supply is used for both the aural and visual



Power Amplifiers. Associated with this common power supply is a high-voltage transfer switch which enables the operator to transfer the high voltage only to the visual side. Thus emergency repairs may be performed on the aural P.A. while programming is continuing with 1-KW aural power and 25-KW visual power.

Plate transformers are oil-filled types to assure long life and a minimum of maintenance. They consist of three separate, identical single-phase transformers which are connected in a double "Y", three-phase connection.



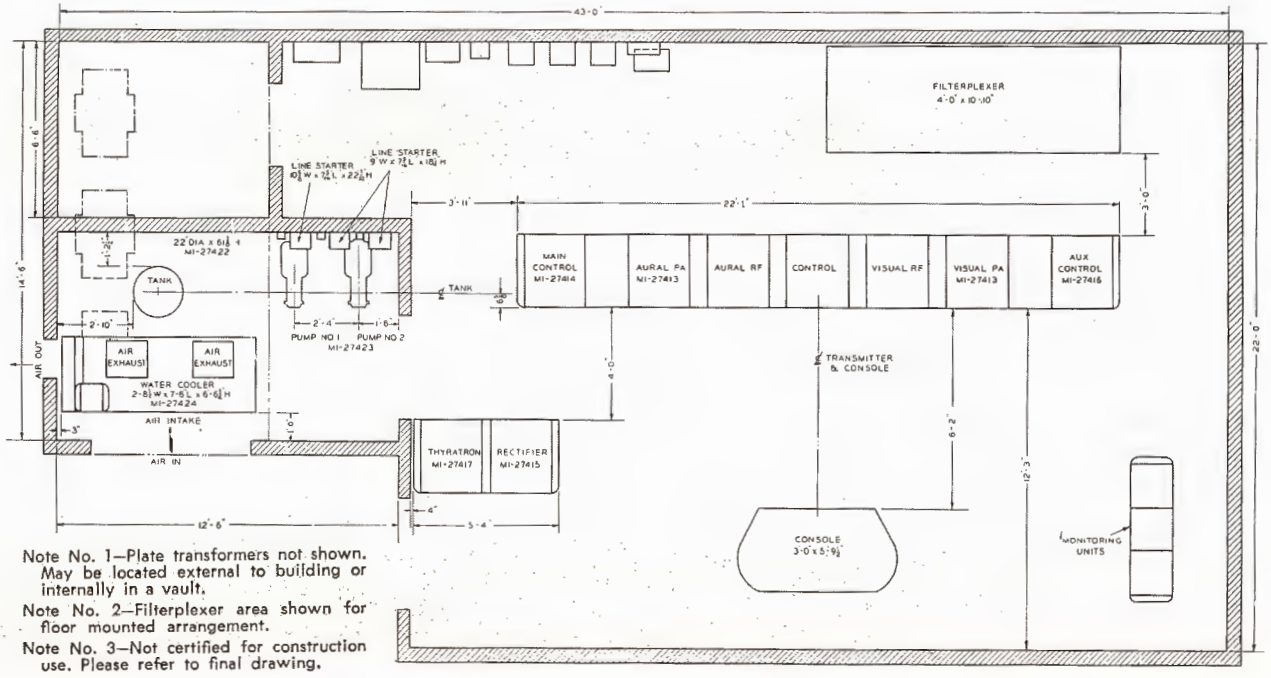
UHF Filterplexer

The MI-27323 UHF Filterplexer unit is supplied completely assembled and adjusted for operation in any one of the UHF television channels from channel 14 to channel 83. The unit is required to suppress the undesired sideband as well as to combine the aural and visual transmitter outputs to satisfy both monochrome and color TV requirements. It therefore serves the double purpose of a vestigial side band filter and a diplexer unit. It greatly simplifies the tuning of the transmitter, and eliminates the possibility of out-of-channel radiation.

The filterplexer varies in size and weight for the various frequencies, and so it is always necessary to specify, when ordering, the channel and operating frequency of the television station. The floor plan shows dimensions of the unit.

A blower kit is included with the unit to cool the co-axial and spherical cavities. The control circuits for the blower provide inter-locked connection with the transmitter protective circuits.

TTU-25B FLOOR PLAN LAYOUT



Note No. 1—Plate transformers not shown. May be located external to building or internally in a vault.

Note No. 2—Filterplexer area shown for floor mounted arrangement.

Note No. 3—Not certified for construction use. Please refer to final drawing.

SPECIFICATIONS

Performance Specifications

	Visual	*Aural*
Type of Emission	A5	F3
Frequency Range	Channels 14-83	Channels 14-83
Rated Power Output	25 kw[1]	12.5 kw[2]
Minimum Power Output	12 kw[1]	6 kw[2]
R-f Output Impedance	50 ohms	50 ohms
Input Impedance	75 ohms	600/150 ohms
Input Level	1.0 v. peak to peak min.	+10 ±2 dbm
Amplitude vs. Frequency Response		Uniform ±1 db from 50 to 15,000 cycles
Upper Sideband Response:[3]		
+1, −1.5 db at carrier	+0.5 mc	
+1, −1.5 db at carrier	+1.25 mc	
+1, −1.5 db at carrier	+2.0 mc	
+1, −1.5 db at carrier	+3.0 mc	
+1, −1.5 db at carrier	+3.58 mc	
+1, −3.0 db at carrier	+4.18 mc	
−20 db max. at carrier	+4.75 mc	
Lower Sideband Response:[4]		
+1, −1.5 db at carrier	−0.5 mc	
−20 db max. at carrier	−1.25 mc	
−42 db max. at carrier	−3.58 mc	
Variation in Freq. Response with Brightness[5]	±2.0 db	
Carrier Frequency Stability[6]	±1 kc	±1 kc[7]
Modulation Capability	12.5 ±2.5% (reference white)	±50 kc
Audio Frequency Distortion		1.5% max. 50-100 cy. 1.0% max. 100-7500 cy. 1.5% max. 7500-15000 cy.
FM Noise, Below ±25 kc Swing		60 db
AM Noise, rms	40 db below 100% mod.	50 db below carrier
Amplitude Variation Over One Picture Frame	Less than 5% of the peak of sync level	
Regulation of Output	7% max.	
Burst vs. Subcarrier Phase[8]	±7 degrees max.	
Subcarrier Phase vs. Brightness[9]	±7 degrees max.	
Subcarrier Amplitude[8]	±15%	
Linearity (Differential Gain)[10]	15% max.	
Envelope Delay vs. Frequency[11]	±.04 μsec. at 3.58 mc ±.08 μsec. at 4.18 mc ±.08 μsec. from 0.2 to 2.1 mc	
Harmonic Attenuation, ratio of any single harmonic to peak visual fundamental	At least 60 db	At least 60 db

[1] Measured at the output of the sideband filter or filterplexer.

[2] Measured at the input to the diplexer or filterplexer.

[3] With respect to the response at 200 kc, as measured by the BWU-5A Sideband Response Analyzer at transmitter mid-characteristic. 4.75 mc attenuation requires use of MI-27132 LP filter in the video input circuit.

[4] With respect to the response at 200 kc of transmitter mid-characteristic.

[5] Maximum variation with respect to the response of mid-characteristic measured with the BWU-5A Sideband Response Analyzer at brightness levels of 22.5% and 67.5% of sync peak, using approximately 20% (peak to peak) madulation.

[6] Maximum variation for a period of 30 days without circuit adjustment.

[7] Maximum variation with respect to the standard 4.5 mc separation between aural and visual carriers.

Electrical Specifications

Power Line Requirements:

Transmitter:

- Line: 460 volts, 60 cycles, 3-phase
- Slow Line Variations: ±5% max.
- Rapid Line Variations: ±3% max.
- Regulation: 3% max.
- Power Consumption: 130 kw block picture, 108 kw average picture
- Power Factor (approx.): 90%

Crystal Heaters:

- Line: 115 volts, 60 cycles, single phase
- Power Consumption: 110 watts

Mechanical Specifications

Transmitter Overall Dimensions:

- Width (front line cabinets): 265"
- Height (front line cabinets): 84"
- Depth (front line cabinets): 32 3/16"
- Weight (front line cabinets): 6,000 lbs. (approx.)
- Total Weight: 15,000 lbs. (approx.)

Finish: Two-tone umber gray with brushed chrome trim fittings

Maximum Altitude[12]: 7500 ft.

Ambient Temperature: 45°C max., 10°C min.

Tube Complement

POWER AMPLIFIER AND COMMON POWER SUPPLY:

	Aural		*Visual*		*Common Power Supply*	
Function	*Qty.*	*Type*	*Qty.*	*Type*	*Qty.*	*Type*
Monitoring Diode			1	5675		
Reflectometers	2	6AL5	2	6AL5		
SWR Monitor	1	2D21	1	2D21		
Power Amplifier	1	6806	1	6806		
Plate Supply Rectifiers					6	5563A
Plate Protection Tube	1	5563A	1	5563A		
Screen Supply Rectifiers					2	8008
Regulated Bias Supply Rectifiers			2	5R4GY		
Regulator			3	OD3		
Regulator			1	OA3		
Regulator			4	6AS7-G		
Regulator			1	6SH7		
Screen Protection Tube	1	5563A	1	5563A		

[8] Maximum departure from the theoretical when reproducing saturated primary colors and their complements at 75% amplitude. A properly terminated TA-7 Stabilizing Amplifier is required in the video input circuit.

[9] Maximum phase difference with respect to burst, measured after the VSBF, for any brightness level between 75% and 15% of the sync peak using 10% (peak to peak) modulation. This is equivalent to 5% (peak to peak) modulation as indicated by a conventional diode demodulator.

[10] Maximum variation in the amplitude of a 3.58 mc sine wave madulating signal as the brightness level is varied between 75% and 15% of sync peak. The gain shall be adjusted for 10% (peak to peak) modulation of the 3.58 mc signal when the brightness is at pedestal level. This is equivalent to 5% (peak to peak) modulation as indi- VSBF. A properly terminated TA-7 Stabilizing Amplifier is required in the video input circuit.

[11] Maximum departure from standard curve. The tolerances vary linearity between 2.1 and 3.58 mc and between 3.58 mc and 4.18 mc. To meet the specification a properly terminated phase correction network, ES-34034-A is required in the video input circuit of the transmitter.

[12] For operation at rated power and normal plate voltage.

SPECIFICATIONS (Cont'd)

DRIVER (AURAL SECTION)

Qty.	Type	Function
1	12AT7	Crystal Oscillator
1	12AT7	Pulse Shaper
1	12AT7	Sawtooth Generator
1	12AT7	Sawtooth Generator
1	6AU6	Quadrupler
1	6AU6	Amplifier
1	6AU6	Doubler
1	6AU6	Tripler
1	6AU6	Amplifier
1	6J6	High Frequency Oscillator
1	6AS6	Mixer
1	5763	Amplifier
1	12AX7	Audio
1	12AU7	Audio
1	5R4GY	Rectifier
7	OD3	Regulator
1	OC3	Regulator
1	6146	Amplifier-Tripler
1	4X150-A	Doubler-Tripler
1	4X150-A	Doubler-Tripler
1	6161	Doubler
1	6161	Intermediate Power Amplifier
1	6181	Power Amplifier
1	5R4GY	Low Voltage Rectifier
2	8008	H.V. Rectifier
2	6AL5	Reflectometer

DRIVER (VISUAL SECTION)

Qty.	Type	Function
1	6J6	Oscillator
1	5763	Buffer
1	6146	Buffer
1	4X150-A	Doubler-Tripler
1	4X150-A	Doubler-Tripler
1	6161	Doubler
1	6161	Intermediate Power Amplifier
1	6181	Modulated Power Amplifier
1	6CL6	Video Amplifier
1	6CL6	Video Amplifier
1	6CL6	Video Amplifier
1	6146	Video Amplifier
8	6146	Modulator
1	6485	Sync Separator
2	5763	Sync Amplifier
1	6AL5	Clamp Diode
5	6146	Negative Capacitor
1	5R4GY	Low Voltage and Bias Rectifier
2	866-A	Rectifier
2	866-A	Rectifier
2	8008	Rectifier (H.V.)
2	6SL7-GT	D. C. Amplifier
2	6AS7-G	Control Tube
6	OD3	Regulator
4	OC3	Regulator
1	OA3	Regulator
2	6AL5	Reflectometer
1	5675	Monitoring Diode (Triode)

Equipment Supplied

TTU-25B TELEVISION TRANSMITTER (ES-27225)

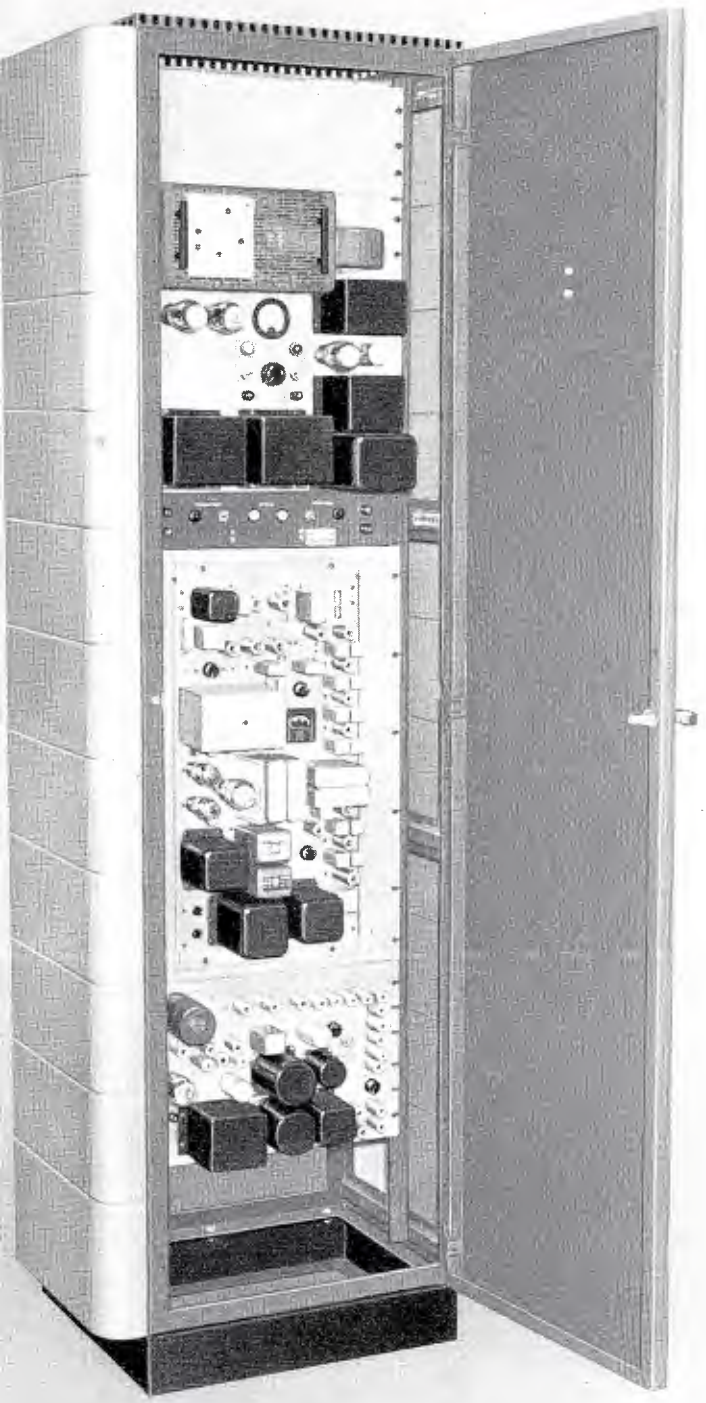
Qty.	Description	Stock No.
1	Transmitter Driver	ES-19250-B
2	Power Amplifiers	MI-27413
1	Control and Distribution Unit	MI-27414
1	Rectifier Unit	MI-27415
3	Plate Transformers	MI-27410/MI-27410-A
1	Interphase Reactor	MI-27411/MI-27411-A
1	Auxiliary Control Unit	MI-27416
1	Thyratron Unit	MI-27417
1	Water Tank	MI-27422
1	Cooler	MI-27424
1	Pump	MI-27423
1	Regulator	MI-19361
1	Water Ejector	MI-27143
1	Water Compartment Parts	MI-27432
1	Flowmeter and Parts	MI-27426
1	Electrical Installation Material	MI-27435
1	Circuit Breaker	MI-27436
1	Gassing Kit	MI-27328
6	Filter Capacitor	MI-27428
3	Frequency Determining Parts	MI-27429
2	Harmonic Filter	MI-27327-L/H
1	Finish Touch-Up Kit	MI-7499-A
3	Distribution Transformer	MI-27427
3	Grid Cavities	MI-27443
3	Set of Tubes for Driver	ES-19251-A
1	Set of Tubes for the Power Amplifier	ES-27226
1	Installation Material and Miscellaneous Equipment	MI-27420
*	Transmission Line (*Sales Order to specify quantity required for customer's installation)	MI-19089
1	Set of End Shields	MI-28061
1	Wiring Material Kit	MI-27421
3	Power Amplifier Cavities and Mounting Shelves	MI-27418
2	Power Amplifier Carriages	MI-27140
1	Diode Demodulator	MI-19364
1	Filterplexer	MI-27323
1	Nameplate	MI-28180-1
2	R-F Monitor Units (Reflectometers)	MI-27137
1	Miscellaneous Hardware Kit	MI-7474
1	Line Stretcher	MI-27425
2	Filter Reactor	MI-27412-A
1	Set of Miscellaneous Equipment	MI-27419

Optional or Accessory Equipment

TTU-25B Power Amplifier (less Driver)	ES-27224
TTC-1C Control Console with Master Monitor, but less Master Monitor Power Supply	ES-19240-A
Low Pass Video Filter	MI-27132
R-F Load	MI-27366
R-F Wattmeter	MI-27363
Input and Monitor Racks, Wired/Unwired	ES-19203-C/D
Color Input and Monitor Racks, Wired/Unwired	ES-19237-C/D
Complete Set of Spare Tubes for Driver	ES-19251-A
Complete Set of Spare Tubes for Power Amplifier	ES-27226
FCC Set of Spare Tubes for Driver	ES-19252-A
FCC Set of Spare Tubes for Power Amplifier	ES-27228
BWU-5A Sideband Response Analyzer	ES-34009
BWU-4A Demodulator	ES-34007
Recommended Station Spare Parts	8904397-501

STUDIO TRANSMITTER LINK EQUIPMENT

TYPE BTL-1C

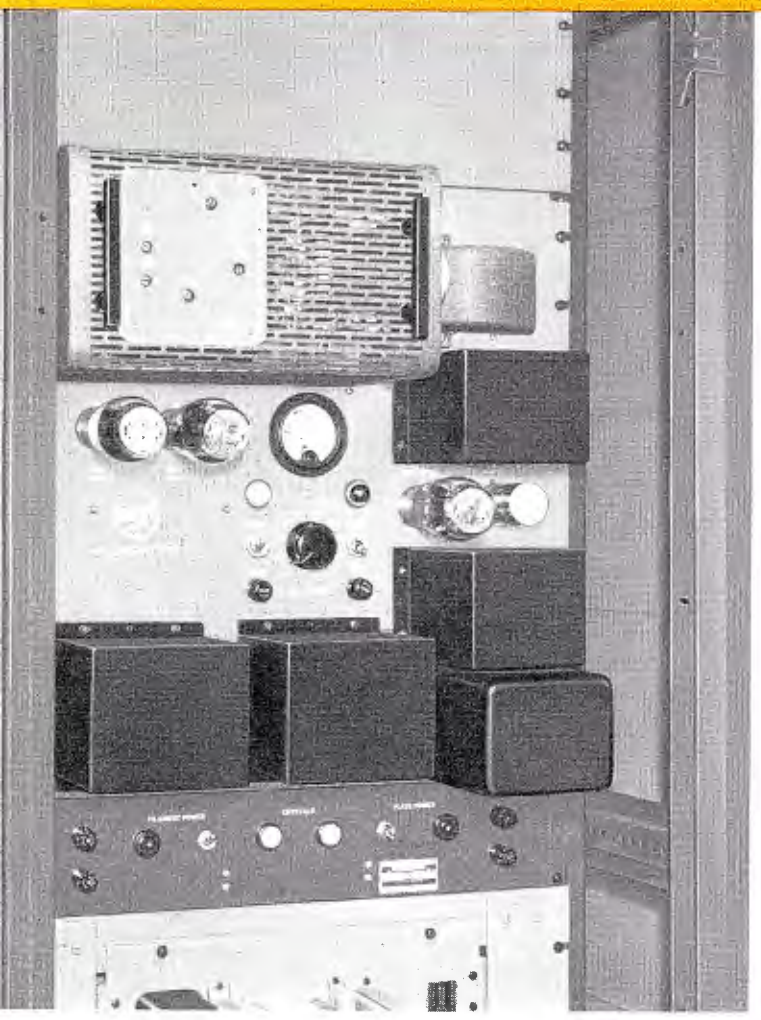


FEATURES

- High quality broadcast transmission from 890 to 960 mc
- Standard phase modulated exciter as used in all RCA UHF TV transmitters
- Highly directive propagation up to 35 miles, depending on terrain
- Low tube cost replacement — no costly klystrons or magnetrons
- Coax connection to standard or high gain parabolic reflectors
- Service channel available
- Provision for fault indication

USES

The RCA type BTL-1C STL Equipment provides a high-quality studio transmission link with overall fidelity equal to that required for television and radio applications. It may be utilized in the 890-911 mc band for TV aural channels; by AM stations in the shared service band of 925-940 mc; and by FM stations in the 940-952 mc band, to relay aural portions of the transmission. The STL equipment is utilized to replace existing wire or carrier-current systems for reasons of dependability, accessibility, or economy. Such microwave radio systems are also used to maintain independence between aural and visual portions of TV transmission as contrasted to those microwave systems that transmit visual and aural intelligence on the same carrier and risk failure of complete transmission by interruption in common relay link.



Close-up of air-cooled transmitter unit with self-contained power supply and meter switch for indicating operating currents and voltages. Below is the power switching panel.

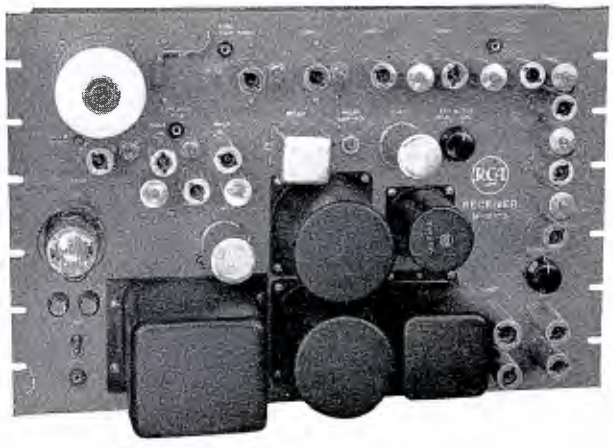
The BTL-1C is a high-quality, crystal-controlled studio transmitter that offers an overall service range up to 35 miles but dependent upon terrain characteristics (free space line of sight), propagation conditions, and type of transmission line used. The complete system fully complies with FCC regulations established for this service. With the addition of channeling equipment, the system is capable of carrying supervisory control, facsimile, teletype, telemetering, or voice transmission channels over a single radio circuit. Such multiplexing is especially useful to broadcast stations for purposes of low quality order service.

DESCRIPTION

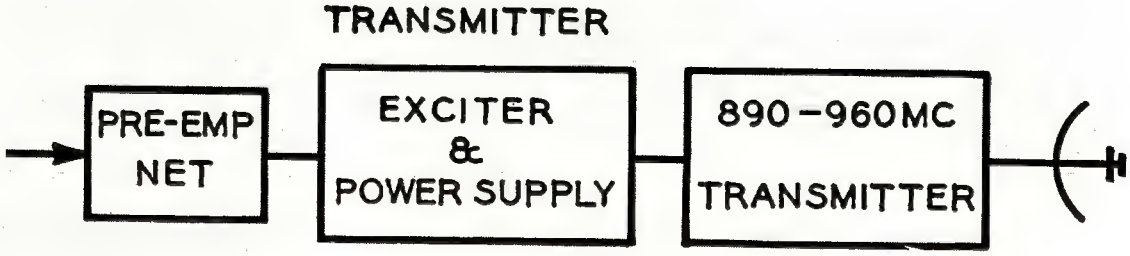
The BTL-1C is a uni-directional transmission system designed to operate in the 890-960 mc frequency band and consisting of a crystal-controlled transmitter and receiver with associated FM exciter-power supply, and power switching panel. The equipment is housed in a standard Broadcast Cabinet Rack, finished in two-tone umber gray, which matches all RCA transmitters and studio equipment.

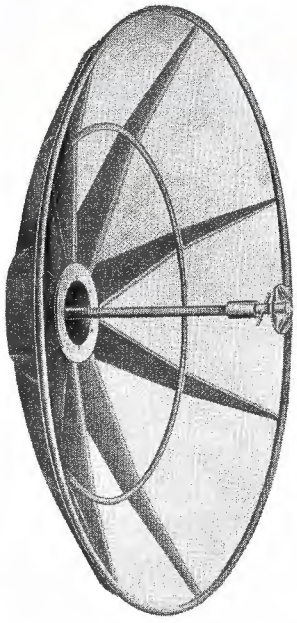
Both the transmitting and receiving antennas use a ½ wave dipole and 48 or 72-inch parabolic reflector type antenna, each providing a gain of 18 db and 22 db respectively. Connection to the antenna is made by means of a ⅞-inch styroflex line or RG-17U cable. The exact type of transmission line to be used may be determined from the typical service range charts.

Both the transmitter and receiver units are crystal-controlled for high frequency stability. Unique transmitter design includes a modified version of the standard RCA exciter unit as supplied in all RCA UHF TV transmitters. The aural exciter is direct crystal controlled, and has a frequency stability of ±1000 cycles. The crystal oscillator in the phase modulator operates at 130 kc, and the large multiplication required to reach the final frequency would result



The BTL-1C Crystal-controlled Receiver is complete with built-in power supply—and suitable for standard cabinet rack mounting.





Both the BTL-1C Transmitting and Receiving Antennas employ a half-wave dipole and a sturdy reflector. The 4' antennas provide a gain of 18 db, the 6' antennas a gain of 22 db.

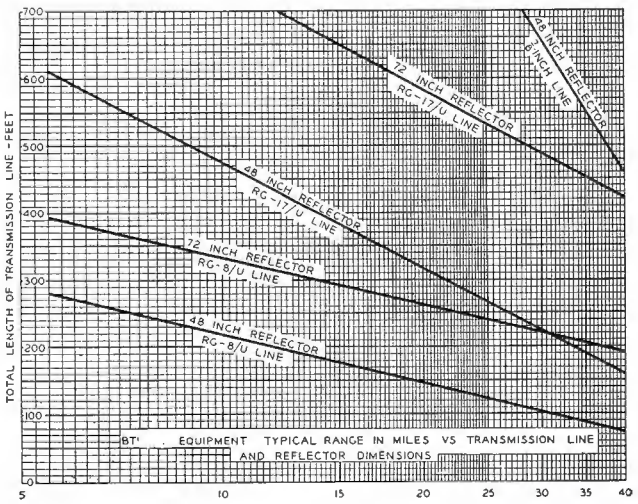
in a large deviation not only at the desired modulating rate, but for the noise components as well. To keep the noise level down, it is necessary to translate the carrier and its sideband components to a higher frequency without increasing the frequency deviation. This is done by a heterodyning process using a second crystal oscillator.

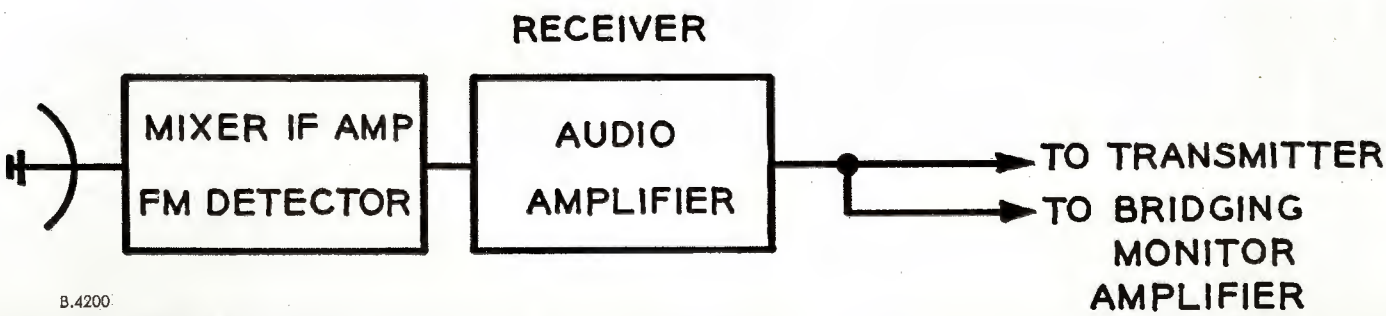
A low frequency crystal oscillator and a pulse shaper produce a series of narrow pulses which are used to synchronize a sawtooth generator. The sawtooth produced is very linear, but is clipped at a level corresponding to the instantaneous audio modulation applied. New pulses are formed from the clipped sawtooth but the new pulses vary in time at an audio rate. These pulses, still at the oscillator frequency are fed to a series of frequency multipliers and are restored to sinewave form. The second crystal oscillator and mixer translates the frequency modulated signal to a new portion of the spectrum without altering the initial deviation. Amplifiers which follow the mixer increase the signal level and act as selective filters to prevent any other signal components from being passed to the remainder of the transmitter.

Since this unit is a phase modulator, a frequency selective device is provided at the audio input terminals to make the audio output of the second audio amplifier vary inversely with frequency. This is done to maintain a frequency deviation independent of the modulating frequency. A pre-emphasis network is included in the modulator.

The receiver is of the double superheterodyne-type with crystal controlled heterodyne frequencies and a self-contained power supply. The audio output may be strapped to provide a pre-emphasized or de-emphasized output level of +10 dbm to the FM transmitter. The unit is contained in a 19-inch chassis requiring a 12¼-inch panel space, which may be mounted in the cabinet rack in the transmitter control room.

The BTL-1C cabinet rack may be installed flush with the wall or placed adjacent to other racks in the control room. The front and rear doors are ventilated, and the rear door is interlocked to insure complete protection against high voltages. Electrical side shields are available if desired. The antenna reflectors should be installed in such a manner as to permit a line-of-sight path clearance of at least fifty feet over all obstructions including trees, buildings, etc.





SPECIFICATIONS

Performance Specifications

System Audio Frequency Response.....±1 db 30 to 15,000 cps

System Audio Distortion.....Less than 1% 100-7500 cycles
Less than 1.5% 50-100 cps and 7500-15,000 cps

System Signal-to-Noise Ratio.....Better than 65 db below 100% modulation

System Transmission Loss Rating.....100 db

Emission .....“Direct FM”

Carrier Frequency Range.....890-960 mc

Carrier Frequency Stability.....Better than ±.002%

Carrier Modulation.....±150 kc

Transmitter Power Output.....2 watts

Antenna Gain (48” Diameter Reflectors)
(over ½ wave dipole).....18 db each (Trans. and Receiver)

(72” Diameter Reflectors) (over ½ wave dipole).....22 db

Transmission Line Impedance (Trans. and Receiver).....52 ohms

Transmitter Audio Input Level.....+10 ±2 dbm

Transmitter Audio Input Impedance.....600 ohms

Receiver Load Impedance.....600 ohms (150-ohm output can be provided where necessary)

Receiver Program Output Level.....+10 dbm

Receiver Monitor Output.....0.5 watts max.

Receiver I.F. Frequencies.....19 mc (high)
115.8-123.5 mc (high)

Electrical Specifications

Transmitter Power Consumption
(115/230 v., single phase, 60 cps).....900 watts

Receiver Power Consumption
(115 v., 1 phase, 60 cps).....100 watts

Tube Complement

Receiver:

1 5R4GY	1 6J6	1 12AU7
8 6AG5	1 6AL5	
4 6AK5	1 6AQ5	

Transmitter:

1 2E26	1 829B
3 5R4GY	1 4X150A

FM Exciter and Power Supply:

4 12AT7	1 6AS6	1 OC3
5 6AU6	1 12AX7	1 OD3
1 5763	1 12AU7	1 5R4GY
1 6J6		

Mechanical Specifications

Transmitter Rack Dimensions
(incl. doors and handles).....84” high, 28” wide, 24¼” deep

Transmitter Weight (packed).....550 lbs.

Receiver Weight (packed).....50 lbs.

Antenna Weight (48”).....64 lbs.
(72”).....150 lbs.

Equipment Supplied

BTL-1C Studio Transmitter Link Equipment.....ES-28953-B
including unassembled items as follows:

1 Transmitter, including in place:.....MI-31465-A
- 1 FM Exciter, less tubes.....MI-19363
- 1 Power Switching Panel.....MI-27146
- 1 Transmitter Unit, less tubes.....MI-31474-A/C*
  (*Sales Order must specify customer’s operating frequency)
- 1 Receiver, with RCA type RC-9 Crystal (MI-16263-B) installed and tested, and 1 set of tubes in place.....MI-31470-A

1 Type TMV-129-G Crystal Unit.....MI-19450-A*
1 Type TMV-129N Crystal Unit.....MI-19450*
(* Sales Order must specify crystal requirements to suit customer’s operating frequency)

2 Side Panels.....MI-30541-G84

2 Instruction Books and Addenda.....IB-30231

Optional and Accessory Equipment

48” Antenna.....MI-31045-B1

72” Antenna.....MI-31045-C1

Antenna Pole Mounting.....MI-31041-A

Antenna Wall Mounting.....MI-31041-W

Set of Electron Tubes for Exciter and Power Supply.....MI-27102

Set of Electron Tubes for Transmitter Unit.....MI-31467

Set of Spare Electron Tubes for Receiver.....MI-31472

STL TRANSMISSION LINE ITEMS

Transmission Line Kit, Type RG-17/U, comprising:.....MI-31038-26
- 1 Adapter (⅞” Flanged to UG-215/U).....MI-31038-6
- 1 Spare O Ring.....MI-31038-7
- 1 Spare Hardware Kit.....MI-31038-28
- 1 Wraplock.....MI-31032-10
- 1 Cable RG-8/U.....MI-31134-20
- 1 Plug.....MI-31404-C
- 1 Plug.....MI-31404-D

STYROFLEX TRANSMISSION LINE ITEMS

*⅞” Styroflex Transmission Line.....MI-13317

Flanged Adaptor to ⅞” Styroflex Line.....13-516

Styroflex Line to Type “N” Adaptor.....20-516

Line Pressurizing Fittings.....MI-31038-10

Transmission Line, Type RG-8/U.....MI-74

Dry Air Pump.....MI-31487

60” Line, RG-8/U with Connectors.....MI-31031-60

* Note: When ordering Styroflex line, specify length required in order that proper flange can be installed on line before shipment.

TRANSMITTER CONTROL CONSOLE

TYPE TTC-1C

FEATURES

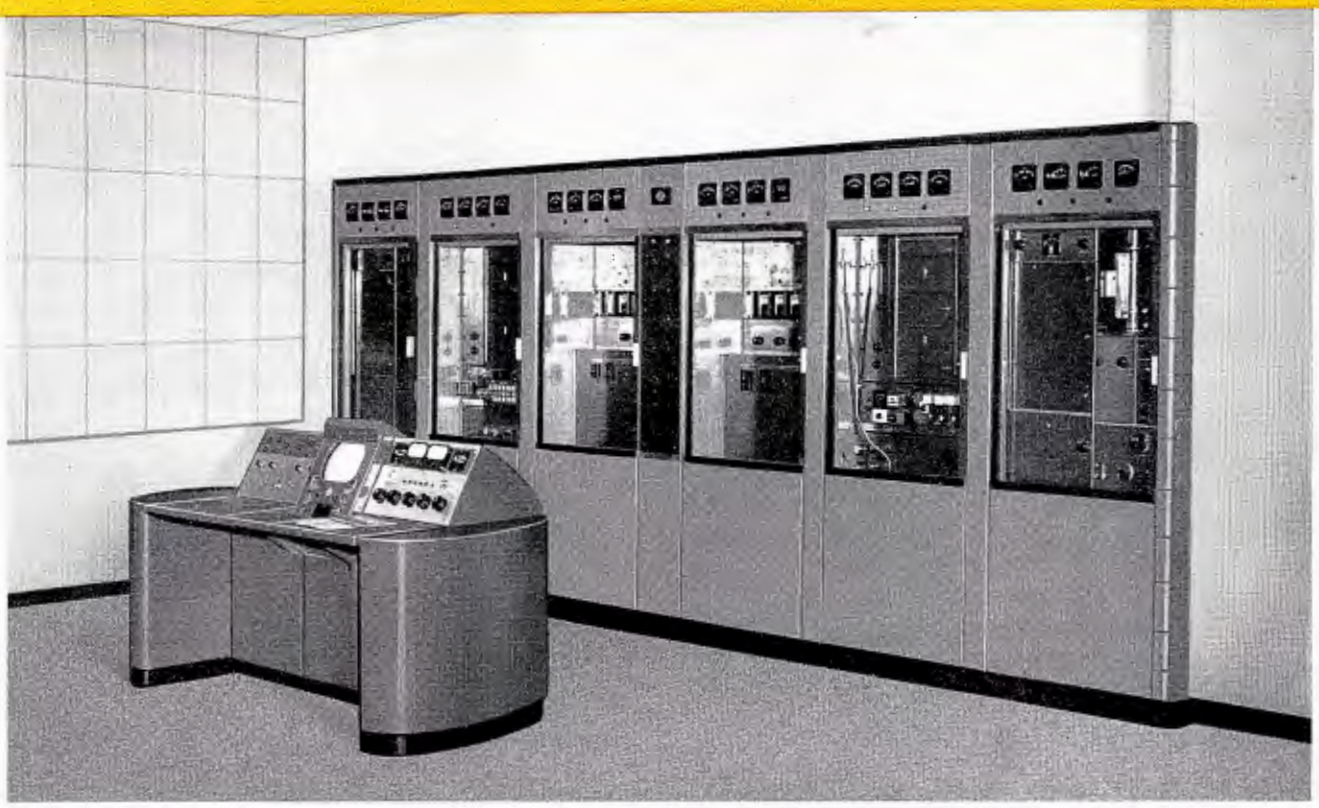
- Provides centralized finger-tip control center for RCA TV broadcast transmitters
- High quality wide-band picture monitor allows independent viewing of both picture and waveform
- Block construction permits addition of desk sections and control turrets for one or more transmitters of any type—AM, FM, and TV
- Incorporates remote control for stabilizing amplifier—color or monochrome
- Provides spare monitoring circuits for both aural and visual sections of transmitter
- Push button point to point monitoring aids in isolation and identification of trouble
- Repeats all major controls from transmitter proper, including aural and visual power output indication
- Provision for measuring depth of modulation on the visual carrier—contains chopper with mercury contacts
- Hinged control turret panels provide utmost accessibility for maintenance and service of equipment
- Uniform styling to harmonize with RCA transmitters and auxiliary TV equipment

USES

The TTC-1C Control Console provides a complete monitoring and operating control for RCA's UHF and VHF broadcast television transmitters. The right hand section of the console is devoted to the audio and video gain and monitoring circuits. The left hand section contains all necessary indicating lights and switches for normal transmitter operation. The center section houses an RCA type TM-6C Master Monitor for viewing the picture, and the waveform of the video signal, at various points throughout the transmitter. The TTC-1C has provisions for switching between two program channels, aural as well as visual. It permits previewing of the second program line, or both lines when neither is in use.

The console is assembled at the time of installation from block-type turret and desk constructions. These additional sections, which can be added at any time to the basic console, can provide for the control and supervision of other AM, FM, or TV transmitters from a central location. By employing such additional units, they can readily be combined to form a large and complex control and monitoring console.

Where desired, the TTC-1C may be combined with RCA TV studio control and switching equipment. However, its main purpose is transmitter control and monitoring; and other TV functions can often be better performed at a point separate from the transmitter console.



Typical transmitter installation showing the use of the TTC-1C Transmitter Control Console.

DESCRIPTION

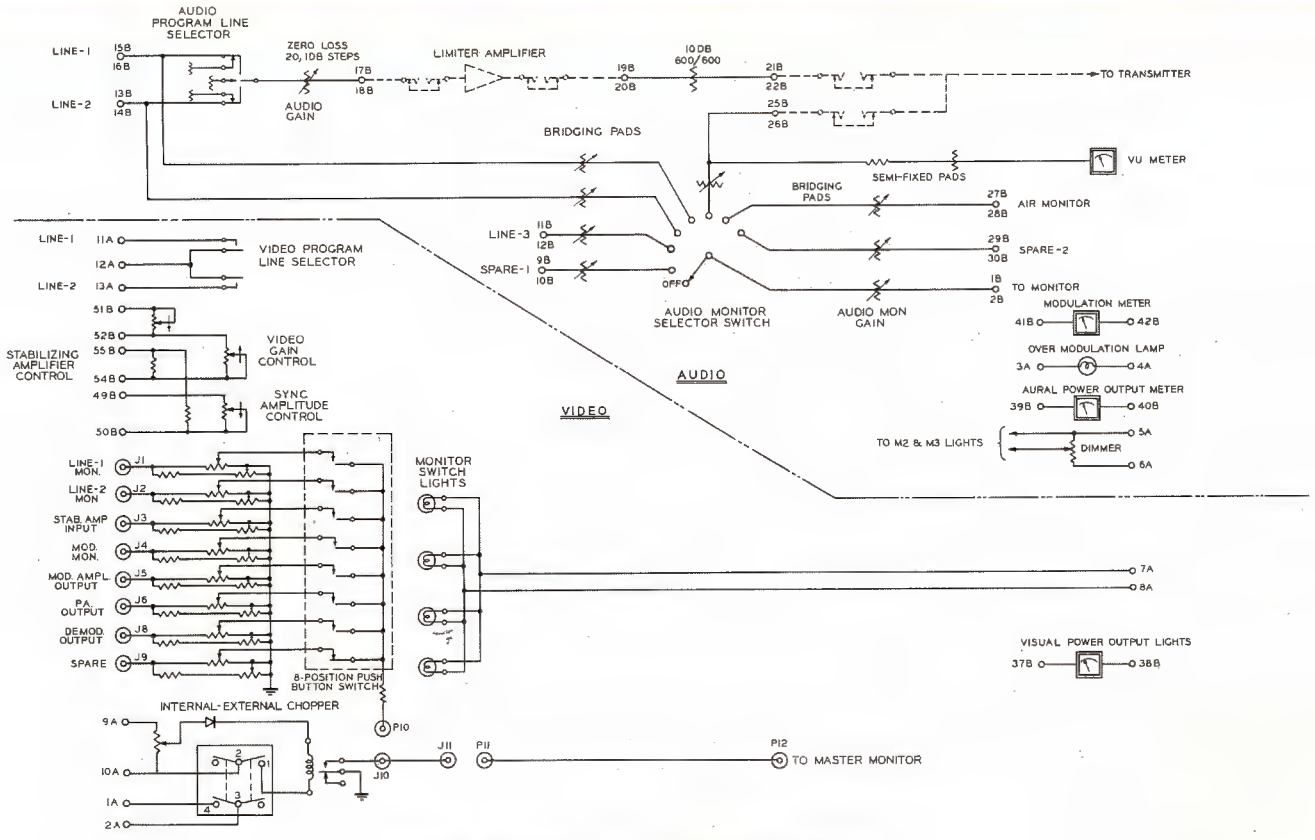
The TTC-1C Control Console is divided into three major units, the Power Control Turret, the Master Monitor and the Monitor Control Turret which form the left, center, and right hand sections of the console respectively. Each of these units is mounted in or on a standard universal console housing or desk section of metallic construction. The end sections of the console contain two convenient shelves each for storing logs, records and the like.

The Power Control Turret contains switches, overload reset pushbuttons, and indicator lamps for transmitter supervisory control and operation. Although adapted especially for RCA transmitters these circuits can be used with almost any contactor controlled transmitter. All panel indicating lamps operate on 220 volts a-c which is obtained from the transmitter, while a 110-volt step-down transformer supplies 6.3 volts for the meter lights. Lamp connections, as well as those from the other console components, are tied to terminal boards in each turret. Connections to all console items, therefore, need be made only at these boards when the equipment is installed. Wiring to the console may be installed in conduit, or in a duct terminating below the desk.

The TTC-1C is equipped with a TM-6C Master Monitor, mounted in the center of the console. It receives its power from a WP-33B power supply mounted in an external rack, while its input signals come from the monitor control turret on the right. A sliding-type mount for the unit permits the monitor to be pulled forward, either partly or completely from the console proper after the four retaining screws have been loosened. This permits rapid inspection or adjustment of the unit.

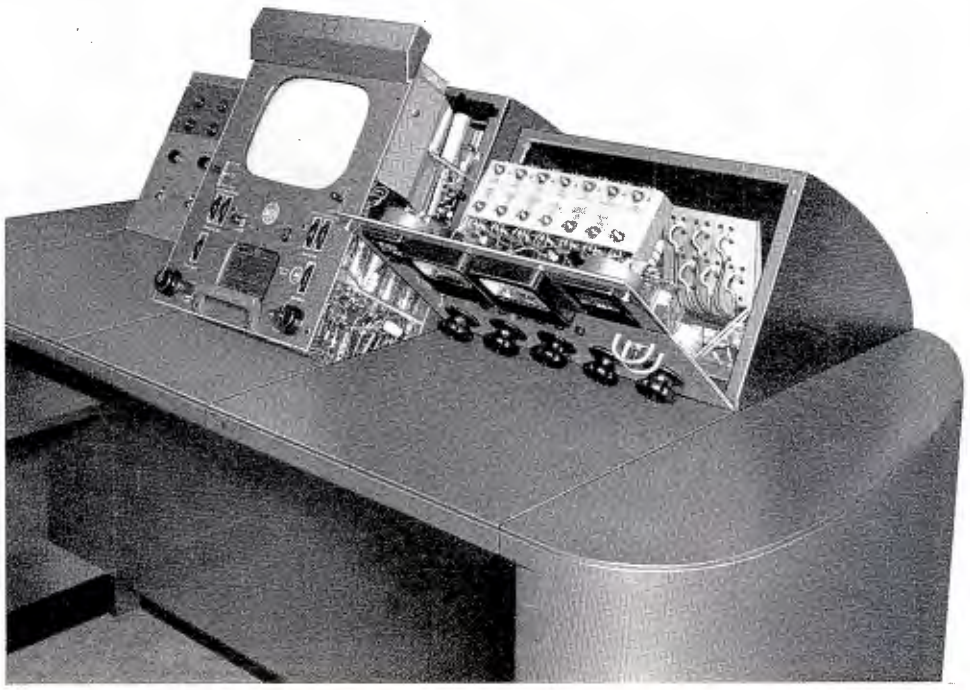
The vertical front panel of the monitor is arranged with an opening at the top center, fitted with a rectangular mask, for the 10-inch kinescope to present the picture screen. The screen of the 5-inch oscilloscope, immediately below the kinescope screen, contains an edge-lighted calibrated lucite scale. The lower section of the panel carries the operational switches and controls, conveniently grouped. Eight additional "set-up" controls have been brought out at the top, on a covered sub-panel, above the kinescope. The remaining controls are easily accessible from the side; and the cathode-ray oscilloscope tube is easily removed from the bottom of the unit. The unit includes three filament transformers, but d-c currents for the tube plate circuits and centering circuits are obtained from an external regulated power supply. Plug connections on the master monitor facilitate disconnecting the signal and power circuits, and an interlock opens the d-c power circuit when the monitor is withdrawn from the console.

The Monitor Control Turret is designed to work in conjunction with the RCA type ES-19237 series of input and monitoring equipment racks. It requires one set of these racks or equivalent components, for full use of its facilities. The



Function diagram of the TTC-1C Monitor Control Turret.

Closeup of TTC-1C console showing "block-build" turret and desk construction and convenient slide and hinge arrangements for accessibility to master monitor and control turrets.



Monitor Control Turret includes four major circuit functions and other related ones, namely, meter circuits, audio monitor circuits, video monitor circuits, and aural and visual input signal level indication and control.

The four meters provide for continuous indication of visual power output, aural power output, aural transmitter input level, and aural percentage modulation. The power output functions are provided by meters which duplicate the reflectometer meters on the transmitter. The aural transmitter input level is indicated by a Weston type-30 VU meter with a suitable multiplier pad connected to the input line of the aural transmitter; and the aural modulation percentage is indicated by a meter which matches the VU

meter but repeats the indication of the aural monitor in the racks. The meter provided is suited to either the General Radio 1183T or Hewlett Packard series of monitors.

In addition to the audio metering described above the aural monitor circuits provide means of switching the input of an audio monitoring amplifier and speaker to any of seven points in the aural system from input line to off the air monitor. Two of these positions are spares which may be used for any desired auxiliary function. The video monitoring circuits provide for switching the input to the master monitor to any of eight positions in the visual transmitter system, one of these is a spare, and like the audio monitoring spares, may be used as desired. Potentiometers in every monitor termination insure proper termination.

In order to make the above monitoring facilities more useful, an audio gain control with 20 one db steps is provided for connection ahead of the program amplifier (usually a limiting amplifier) so that the aural input to the transmitter can be controlled. Similarly gain and sync amplitude remote controls for a stabilizing amplifier, which is normally used ahead of the visual transmitter, are provided to control the input to the visual transmitter.

In addition to the above circuits a lamp in parallel with the overmodulation flasher of the aural monitor and a switch to control the chopper of the visual monitor are provided in the monitor control turret. Also the monitor is provided with a rheostat to dim the lights in the meters to suit the ambient light around the console to eliminate unnecessary operator annoyance and fatigue from meter lights which are brighter than necessary.

Each control turret is enclosed by a removable cover, which need not be taken off for inspection, since the panels tilt forward on concealed bottom hinges. This arrangement provides utmost accessibility to the equipment for maintenance and servicing.

SPECIFICATIONS

Performance Specifications

Impedances:

Audio Line Input (2)	600 ohms, balanced
Audio Line Output	600 ohms, balanced
Audio Monitor Input	10,000 ohms, balanced
Audio Monitor Output	250 ohms, balanced
Master Monitor Inputs (6)	75 ohms, unbalanced
VU Meter Circuit (across transmitter input)	5000 ohms

Volume Controls:

Video Gain	Remote control for controlling video gain in Stabilizing Amplifier.
Sync Amplitude	Remote control for controlling sync amplitude in Stabilizing Amplifier.
Audio Gain	600 to 600 ohms, 20 steps, 1 db per step; initial insertion loss zero.
Audio Monitor Gain	10,000 to 250 ohms, 20 steps, 2 db per step, tapered; last step infinite; insertion loss 38 db.
Meter Volume Units	Weston type, 30, Scale "B"

Electrical Specifications

Console Power Requirements:

Indicator Lights (from transmitter)	220 volts a-c
Meter Lights (6.3 volts from transformer)	110 volts a-c, 50/60 cycles
TM-6C Master Monitor (a-c line for tube heaters)	105-125 volts, 50/60 cycles, 90 watts
TM-6C Master Monitor (from Regulated Power Supply)	280 volts d-c, 450 ma

Tube Complement

TM-6C Master Monitor:

4 6197	1 6AL5	1 12BH7
3 6485	2 6BQ6-GT	2 12AX7
7 12AT7	1 12AU7	1 10SP4 (kinescope)
	2 6CB6	1 5ABP1(CRT)

TM-6C High-Voltage Supply:

1 6L6	1 6BQ7A	4 1X2A

WP-33B Regulated Power Supply:

4 5R4GY	1 6SL7-GT	1 NE32
3 6AS7-G	2 OD3	

Mechanical Specifications

Dimensions:

Width	69"
Depth	36"
Height	41"
Weight	500 lbs. (approx.)

Equipment Supplied

TTC-1C Transmitter Control Console Equipment ES-19240-A
including unossembled items as follows:

Qty.	Description	Stock No.
1	Power Control Turret	MI-19318
1	Monitor Control Turrett	MI-19319-B
1	Master Monitor	MI-26136-B
1	Master Monitor Housing	MI-26266-A1
2	Basic Desks	MI-28401-1
1	End Section, Left Hand	MI-26265-1
1	End Section, Right Hand	MI-26265-2
1	Blower for the Master Monitor	MI-26579-B
1	C-R Oscilloscope Tube for Master Monitor	MI-26667
1	Kinescope Tube far Master Monitor	MI-26655
†1	Aural Modulation Meter (For GR-1183T Frequency Monitor)	MI-19116-3
	(For Hewett-Packard 335ER Frequency Monitor)	MI-19116-6
2	Instruction Books	IB-36258

Optional Equipment

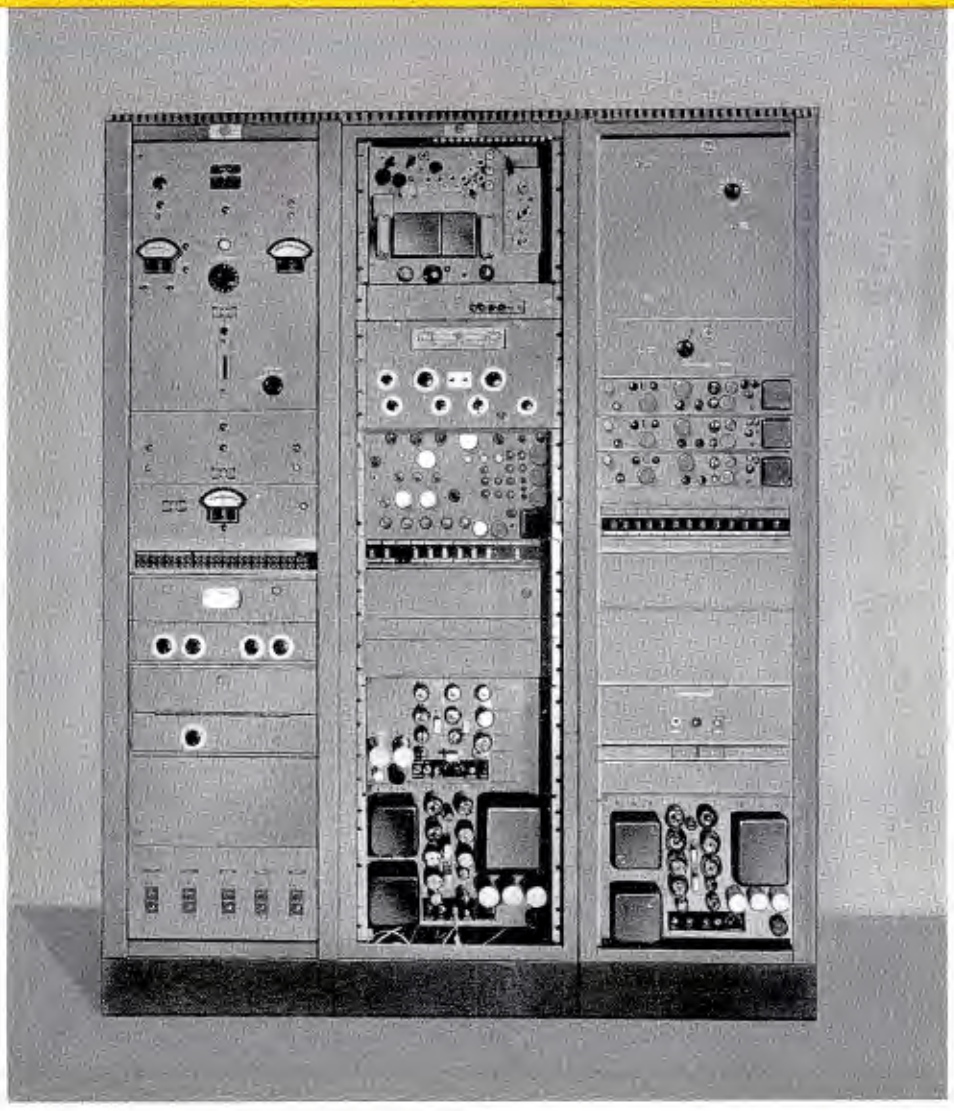
WP-33B Regulated Power Supply, including tubes in place. MI-26085-B
(The power supply is normally included with the ES-19237-A or 19237-C monitoring equipment which is designed for use in conjunction with subject console equipment. If ES-19237 is omitted, one power supply is required.)

Calibratian Meter	MI-21200-C1
Extra Desk Section	MI-28401-1
Extra Control Panel	MI-19133
Housing for MI-19133 Control Panel	MI-26266-B2
90° Desk Section	MI-28401-2
Extra Control Turret	MI-19318
Extra Monitor Control Turret	MI-19319
Set of Spare Tubes	MI-26713
Set of Spare Tubes	MI-26713-A
Program Line Selector	MI-27407

† Sales order.

TRANSMITTER INPUT AND MONITORING EQUIPMENT

ES-19237 SERIES

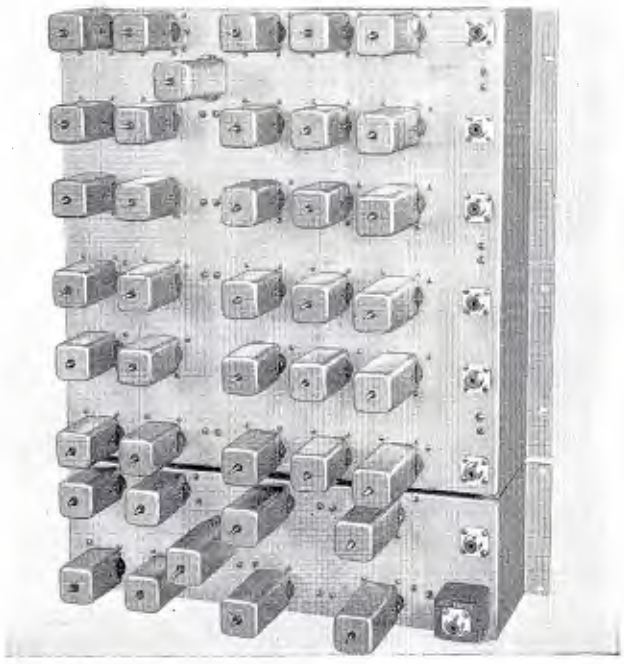


FEATURES

- Provides full monitoring and input control for any color or monochrome VHF or UHF transmitter
- Every unit chosen to meet requirements of the FCC and good operating practice
- Choice of cabinets with or without preformed wiring connections
- Compact, lightweight cabinets—easily installed
- Rack components arranged with regard to operating convenience
- BW-5A sideband response analyzer permits adjusting transmitter broadband response
- Provides continuous check from transmitter console position
- Plug and socket connectors for all power, video, audio, and r-f connections

Television Monitor, Type 335ER.

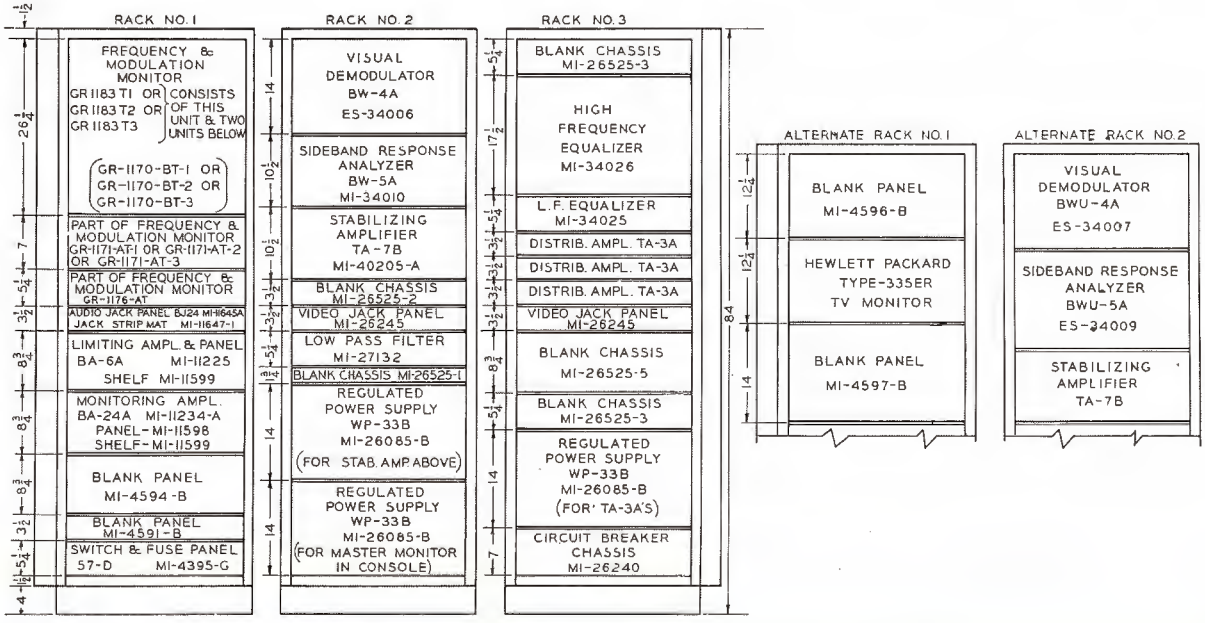
The ES-19237 Series of monitoring equipment is supplied in four different arrangements: 1. ES-19237-A includes factory wired racks for VHF TV monochrome or color transmitters. 2. ES-19237-B same as ES-19237-A except less wiring. 3 ES-19237-C includes factory wired racks for UHF TV monochrome or color transmitters. 4. ES-19237-D same as ES-19237-C except less wiring.



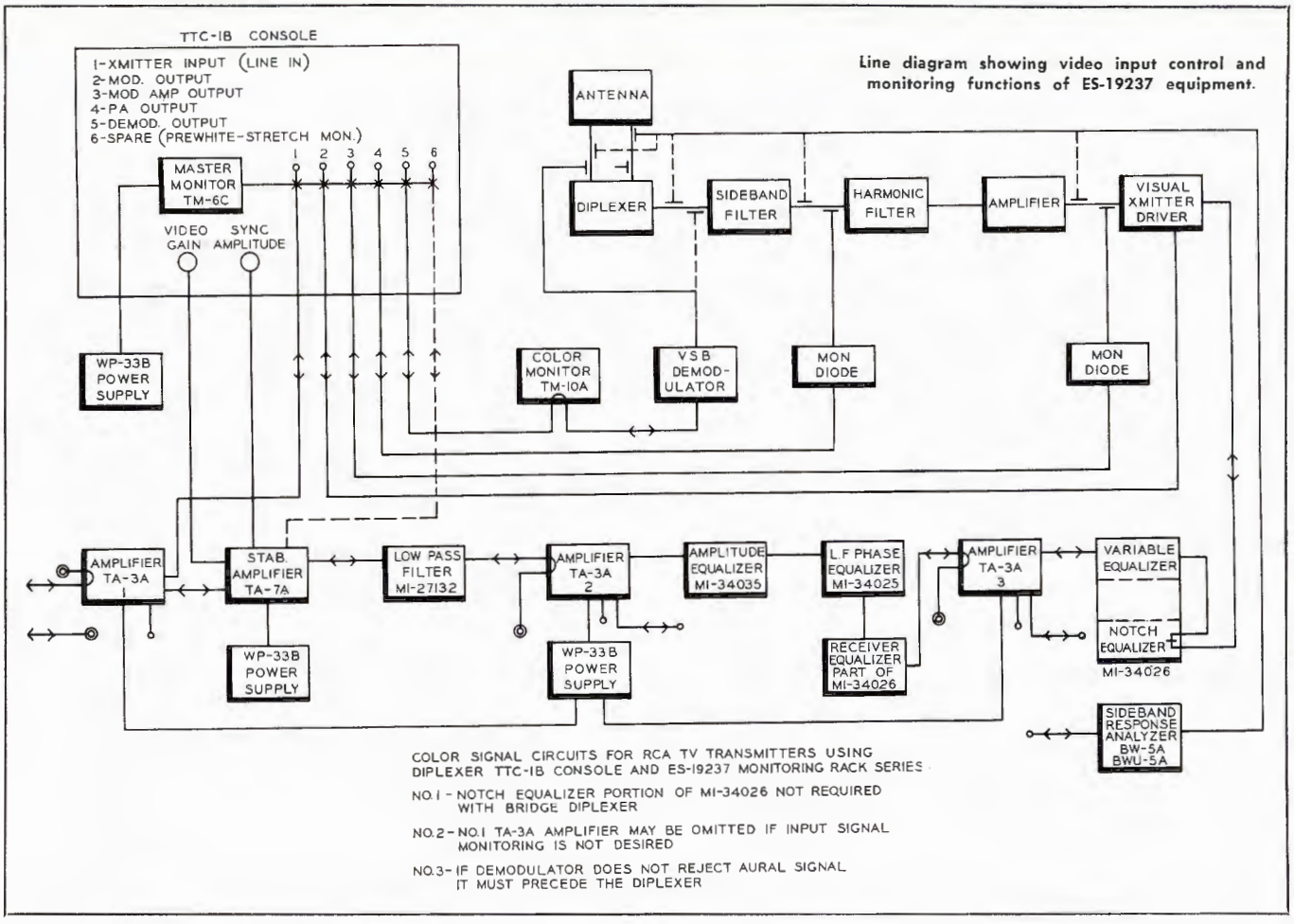
Rear view of high and low frequency equalizer equipment.

USES

The RCA type ES-19273 Transmitter Input and Monitoring Equipment enables stations to meet all requirements of the FCC and good operating practice for monitoring and input control of any RCA television transmitter. The equipment items are contained in three standard mounting racks which are intended to be used in conjunction with an RCA TTC-1C Transmitter Console as a central monitoring and control center.



Suggested rack arrangement for Transmitter Input and Monitoring Equipment.



Line diagram showing video input control and monitoring functions of ES-19237 equipment.

DESCRIPTION

The units included in RCA Input and Monitoring Equipment are enumerated in the accompanying specifications list. Units are arranged in the racks in the manner which makes them most effective and as compact as possible with due regard to convenience of operation, grouping of related units, and easy connections. The functions of each item can best be learned from a study of the block diagrams which show the interconnections of all units to a typical TV transmitter system.

When RCA monitoring equipment racks are used with a TTC-1C console, they provide everything required for routine TV station monitoring. The functions monitored are:

Visual Carrier Frequency,

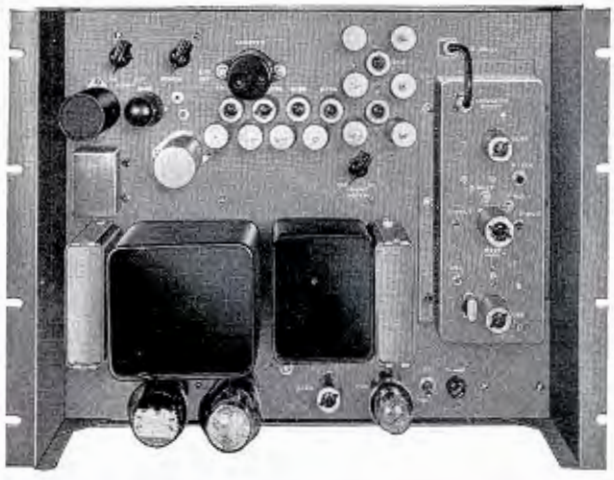
Aural Carrier Frequency,

Aural Modulation. (This meter is on GR1183T and is repeated on the TTC-1C console),

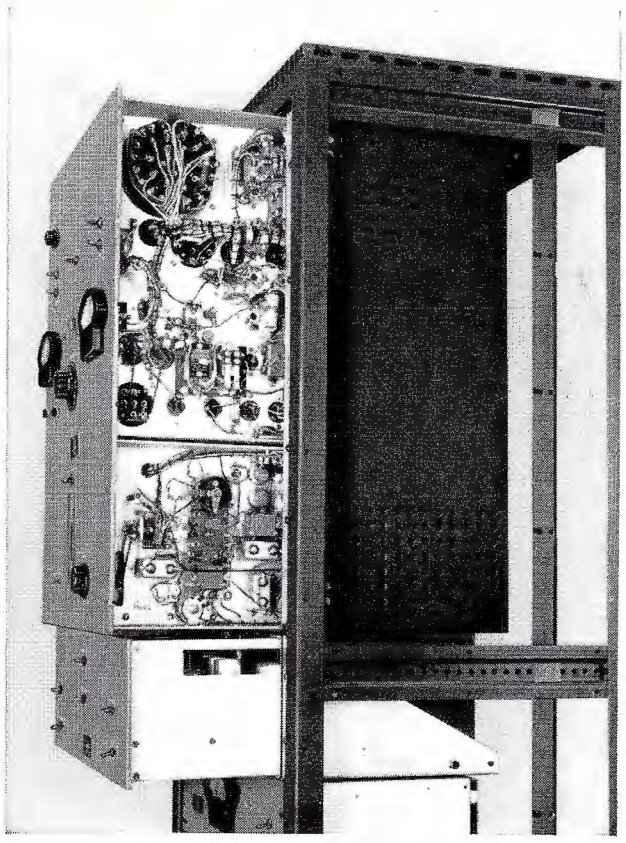
Visual Modulation (CRO on Console),

Aural Signals at all points where aural signals are available. Level of Transmitter input signal by VU meter; and sound quality by means of the monitoring amplifier and an external loudspeaker,

Visual Signals at all points where visual signals are available. Levels are measured by the CRO in the master monitor of the console and picture quality is observed on the kinescope.



View of the BW-4A Demodulator.



The GR-1183-T Monitor Equipment is removable from the front of the rack for servicing and inspection.

In addition to the monitoring functions listed, the racks provide:

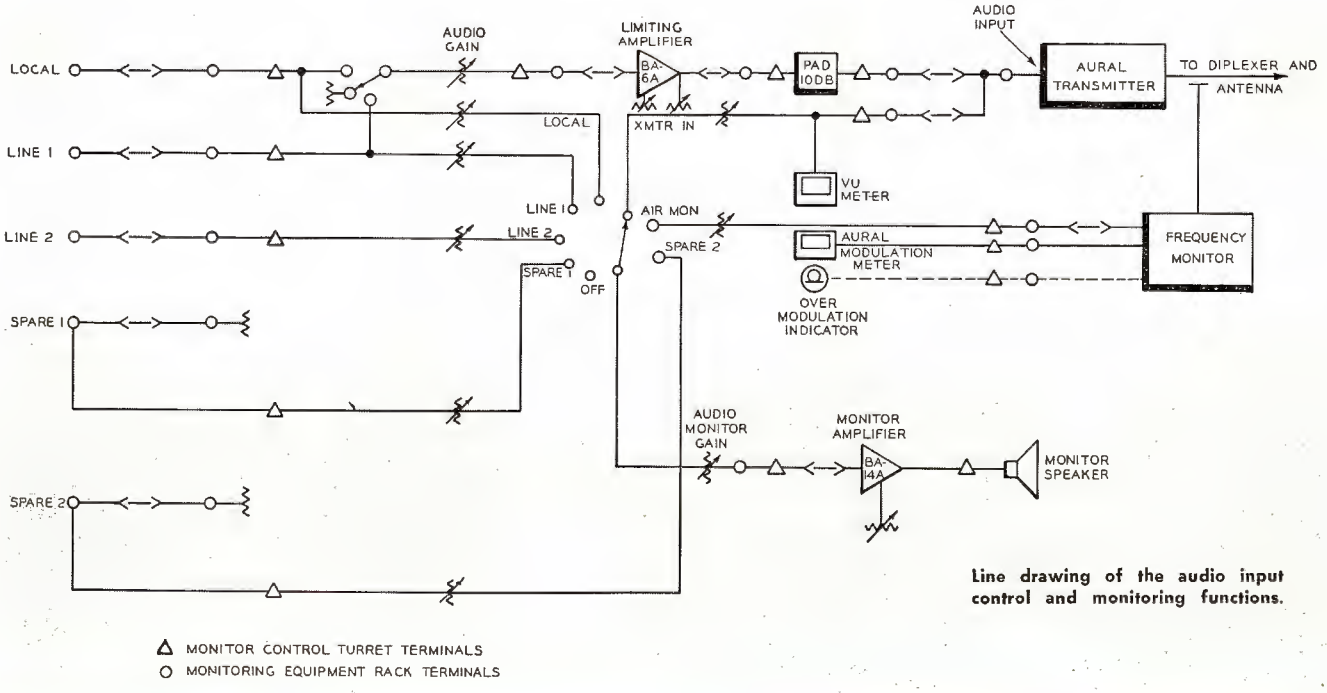
A. Limiting amplifier BA-6A for the aural signal before application to the transmitter.

B. Stabilizing amplifier for the visual signal to the transmitter.

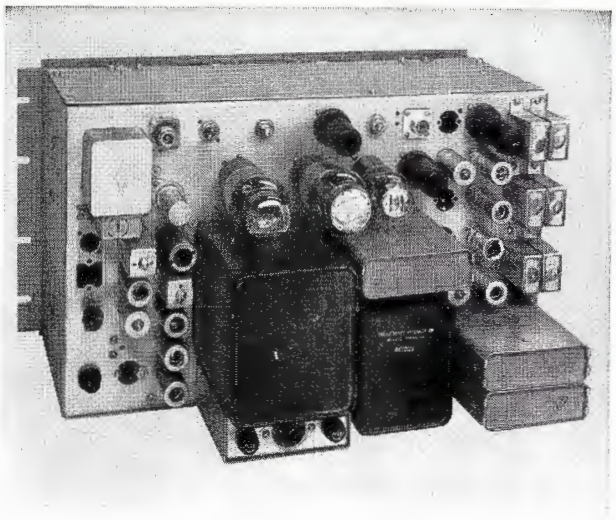
C. Sideband response analyzer BW-5A which provides a special video sweep and a synchronized selective receiver for adjusting transmitter broadband response.

The output of the sideband analyzer is fed through a cable to an external oscilloscope of standard design which may be located anywhere in the transmitter room. The resultant pattern on the cathode ray oscilloscope is a plot in which the horizontal dimensions are related to modulating frequency, and the vertical dimensions are proportional to the side-band response of the transmitter at each modulation frequency.

A General Radio Station Monitoring Unit consisting of three integrated instruments—the type 1170-BT FM Monitor, the 1171-AT Visual Transmitter Frequency Monitor, and the type 1176-AT Frequency Deviation Meter provide facilities for monitoring the frequency and percentage modulation of the aural transmitter, and the frequency of the visual transmitter. The equipment is rack-mounted together. Three types are available: Type 1183-T1 for stations in VHF channels 2-6; the Type 1183-T2 for the VHF channels 7-13; and Type 1183-T3 for the UHF channels 14 to 83.



Line drawing of the audio input control and monitoring functions.



Top-of-chassis view of the BW-5A Sideband Response Analyzer.

A more compact TV monitor is the Hewlett-Packard Model 335ER which may be designated in place of the General Radio Station Monitoring Unit. This VHF-UHF Television Monitor performs every important carrier monitoring function continuously and without adjustment, and with dependability and accuracy. It is equally useful in monochrome or color broadcasting. In addition to continuous, precise indication of visual and aural frequency deviation and percentage of aural modulation, the Model 335ER shows inter-carrier separation directly. No calculation is required.

Carefully engineered crystal reference oscillators provide accuracy in excess of FCC requirements for all channels. Because discriminator accuracy does not depend on a tuned circuit, no time-consuming adjustments are required during operation. It is never necessary to reset carrier level or realign circuits. Proper operation of the monitor can be checked conveniently by controls located behind the hinged panel cover.

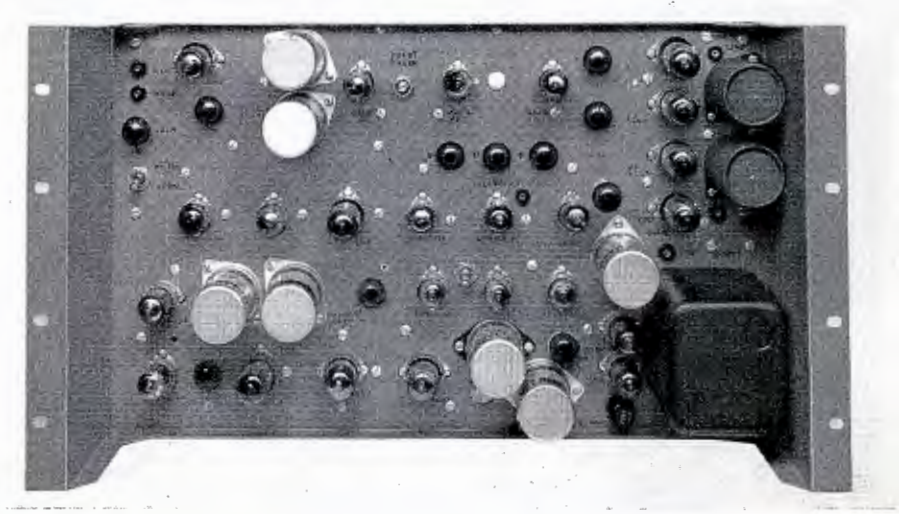
The three panel meters monitor visual and aural carrier frequency and percent modulation of the aural carrier with 100% modulation equal to 25 kc deviation. A peak modulation indicator lamp is included as standard equipment; the instrument also has provision for remote indicating meters, remote peak modulation indicating lamp, and a demodulated signal for measuring FM and AM noise levels, frequency response and distortion of the aural transmitter and for continuous program monitoring.

The master oscillator is controlled by a crystal operating in the 20-30 megacycle region. The crystal is mounted in a carefully-designed oven that controls temperature to within approximately 0.10° C. Oven temperature is indicated by a thermometer readable at the front panel. The master oscillator is provided with a vernier tuning adjustment for correcting long time drift. A cathode-coupled type oscillator circuit has been incorporated because of the exceptionally small effect varying stray capacities have on the frequency of the crystal used in this arrangement. As a further precaution, a constant-voltage transformer is provided to regulate the master-oscillator filaments.

The 335ER is particularly designed for long years of trouble-free operation. Highest quality components and construction are used throughout. A new chassis design increases accessibility of components and makes possible cool operation. The chassis is mounted on slides for easy withdrawal from the rack. The instrument includes a front panel crystal temperature indicator and illuminated meter faces.

The monitoring and control units are accommodated in three sturdy metal cabinets the same height as RCA transmitters. The MI-19237 equipment is finished in a two-tone umber gray, blending with all RCA transmitters, and provide utmost flexibility in arrangement for future expansion. The ventilated top with slotted edges provides complete ventilation but protects the equipment from falling particles and dust. The cabinets are of metal construction, welded and bolted together in one standard height and width. Units may be placed singly or used in tandem. When placed adjacently they may be rigidly bolted together to produce a secure assembly.

Top view of chassis of the Type TA-7A Stabilizing Amplifier.



SPECIFICATIONS

Performance Specifications

FREQUENCY AND MODULATION MONITOR UNIT

Frequency Range.....Channels 2-83

Input Sensitivity.....1 volt, or better, on high impedance input; 500 milliwatts, or less, on low impedance input

Intermediate Frequency.....150 kc for zero offset; 140 kc for —10 kc offset; 160 kc for +10 kc offset

Discriminator.....Pulse-counter type, linear to better than 0.1% over a range of at least ±75 kc

Accuracy.....Crystal frequency when monitor is received is within ±0.0002% of specified channel frequency. Center frequency is adjustable over ±25 parts per million.

Percentage Modulation.....Meter is calibrated from 0 to 133% with additional db scale provided

Accuracy .....±5% modulotion

Residial Distortion.....Less than 0.1% for 25 kc deviation

Response.....50 to 30,000 cycles per second ±½ db

Maximum Output.....1.5 volts into 100,000 ohms

Residual Noise Level.....—65 db or better for 25 kc deviation

Audio Monitoring Output:
- Impedance .....600 ohms, unbalanced
- Output.....—12 dbm at 25 kc deviation
- Response.....50 to 15,000 cycles per second ±¼ db

VISUAL TRANSMITTER FREQUENCY MONITOR

Frequency Range.....Channels 2 to 83

Input Sensitivity.....1 volt, or better, on high impedance input; 500 milliwatts, or less, on low impedance input

Carrier Frequency Deviation.....Accuracy of less than ±25 cycles

Overall Stability....Better than ±1.5 parts per million for 30 day period

FREQUENCY DEVIATION METER

Range.....—1.5 kc to +1.5 kc, in 50 cycle divisions

Accuracy.....±20 cycles +60 cycles per 30 days

Input Voltage.....0.25 to 150 volts

Input Impedance.....0.5 megohms

335ER TV MONITOR

Aural Frequency Monitor:
- Deviation Range.....+3 kc to —3 kc mean frequency deviation
- Accuracy.....Channel 2-6 ±500 cps for 90 days; Channel 7-13 ±500 cps for 45 days; Channel 14-83 ±500 cps for 14 days

Aural Modulation Meter:
- Modulation Range.....Meter reads full scale on modulation swing of 33.3 kc. Scale calibrated to 100% at 25 kc swing; 133% at 33.3 kc. Also includes db scale where 0 db = 100%.
- Accuracy.....±5% over entire scale from 50 to 15,000 cps

Modulation Peak Indicator (peak flash range).....50% to 120% modulation (25 kc = 100%)

Visual Frequency Monitor.....Same as Aural Frequency Monitor above

Inter-Carrier Spacing.....Directly measured, accuracy ±500 cps for six months

Audio Output:
- Frequency Range....500 to 15,000 cps. Response flat within ±.5 db. Equipped with standard 75 microsecond de-emphasis circuit.
- High Impedance Output.....10 volts into 100,000 ohms at 100% modulation at low frequencies. Distortion less than 0.25% at 100% modulation. Residual noise at least 65 db below output level corresponding to 100% modulation at low frequencies.
- Monitoring Output.....1 milliwatt into 600 ohms, balanced, at 100% modulation at low frequencies

General:
- Frequency Range.....Channels 2 to 83 inclusive, including offset channels
- R-F Power Required.....Less than 1 watt. Separate type N connectors provided for aural and visual inputs
- Ambient Operating Temperature.....113° F. maximum
- External Meter Indication.....External meter indication available for aural carrier deviation, visual carrier deviation, aural modulation percentage and peak indication. Use of external meters does not affect operation of panel meters.

LIMITING AMPLIFIER

Source Impedance.....600/150 ohms

Input Impedance.....600/150 ohms, balanced or unbalanced

Frequency Response.....30 to 15,000 cps reference below verge of limiting up to 20 db gain reduction +1 db to —2 db

Input Level:
- Minimum.....—24 dbm at limiting verge
- Maximum .....±14 dbm

Output Level:
- Maximum (limiting off) at 1000 cps.....38.5 dbm
- At verge of limiting with output controls in minimum attenuation position.....29.5 dbm ±1 db

Gain.....54 db +1 db at 1000 cps, 600-ohm source to 600-ohm load

Signal to Noise Ratio.....83 db at verge of limiting

Gain Controls:
- Input.....20 steps, 2 db per step
- Output.....20 steps, 1 db per step and fine adjustment

Harmonic Distortion (total RMS).....12 db gain reduction (100-15,000 cycles) less than 1%

MONITORING AMPLIFIER

Source Impedance.....27.5/150/600 ohms

Input Impedance.....Unloaded transformer, high in comparison with source impedance

Load Impedance.....4/8/16/150/600 ohms

Output Impedance (approx.).....1.3/1.8/3/21/78 ohms

Maximum Input Level.....—30 dbm

Maximum Gain.....104 db ±2 db

Frequency Response.....±2 db 30-15,000 cps

Maximum Output Level.....10 watts (40 dbm)

Harmonic Distortion.....Less than 1% 100-7,500 cps
At 8 W (39 dbm output).....Less than 2% 50-15,000 cps

Noise Level.....—122 dbm referred to input (—18 dbm at output at 104 db gain)

VISUAL SIDEBAND DEMODULATOR

Frequency Range:
- BW-4A .....Channels 2-13
- BWU-4A .....Channels 14-83

Output Impedance.....75 ohms, unbalanced

Input Impedance.....50 ohms, unbalanced

Polarity of Sync Pulses.....Negative

Output Voltage.....1.5 volts, peak-to-peak (max.)

BW-5A/BWU-5A SIDEBAND RESPONSE ANALYZER

Frequency Range.....10-0-10 mc cont. variable by panel control

Output.....0-2 volt (peak-to-peak) cont. variable by panel control

Output Impedance.....72 ohms

Rep. Rate.....120 cycles (for 60 cycle power supply)

Hum Level.....—50 db below 2.0 volt (peak-to-peak)

SPECIFICATIONS (Cont'd)

Sweep Frequency Response.....±0.5 db 0.2 to 4.0 mc
±1.0 db 0.2 to 7.0 mc
Marker Accuracy.....200 kc throughout range
Marker Width.....50 kc approximately
Marker Amplitude....Chassis control (min. 5% of demodulated response)
Ambient Temperature Range.....±5°C. to +45°C.

BWU-5A R-F INPUT UNIT

Input and Output Impedances.....50 ohms
Frequency Range.....Channels 14 to 83 ±1 db within 10 mc of center frequency
Response.....±½ db within 5 mc of center frequency
Linearity.....Within ±1 db for input signals to the attenuator ranging from 0.1 to 3.0 volts rms
Output.....0.3 volt rms across 50 ohm load with 2.0 volt rms input to attenuator (Channel 7)
Overall Bandwidth.....20 megacycles

STABILIZING AMPLIFIER

Input Signal Requirements:
- Composite Video (minimum).....0.45 volt peak-to-peak, negative
- Local Sync (when required).....4.0 volts peak-to-peak, negative

Output Signal Amplitudes:
- Line (variable).....0-1.9 volts, peak-to-peak
- Monitor.....0-1.7 volts, peak-to-peak
- Sync.....4.0 volts, peak-to-peak
- Special Monitor.....1.7 volts, peak-to-peak

Input Impedances:
- Video .....75 ohms
- Sync .....1 megohm

Output Impedances:
- Line .....75 ohms
- Monitor.....600 ohms, approx.
- Special Monitor.....75 ohms, approx.
- Separated Sync .....75 ohms

VIDEO DISTRIBUTION AMPLIFIER

Input Impedance.....2.7 megohms shunted by 27mmf
Input Signal Levels:
- Blanked Video Only.....1.5 volts peak-to-peak, max.
- Composite Video.....2.0 volts peak-to-peak, max.
- Sync.....3.5 to 8.0 volts peak-to-peak

Gain.....0.5 to 2.0 adjustable
Number of Outputs.....3
Output Impedance.....75 ohms, internally terminated
Output Signal Levels:
- Blanked Video Only.....1.5 volts peak-to-peak, max.
- Composite Video.....2.0 volts peak-to-peak, max.
- Sync.....Zero to 0.4 volt peak-to-peak

Sine-Wave Frequency Response:
- 1.0 Cycle to 8 mc.....Flat ±0.3 db
- 0.5 Cycle to 10 mc.....Flat ±1.0 db

Low-Frequency Square-Wave Tilt.....1.5% max. at 60 cycles

PHASE EQUALIZER EQUIPMENT

Type of Circuit.....Non-minimum phase reactance network (no tubes or power supply required)
Impedance (input and output).....75 ohms
Circuit Attenuation.....0.5 db
Sweep Frequency Response.....±0.5 db to 4.2 mc
Phase Response:
- Low Frequency Phase Equalizer.....Constant envelope delay from 2.0 mc to 4.2 mc. Four envelope delay ranges; frequency range of envelope delay adjustment 0 to 2.0 mc.
- High Frequency Phase Equalizer:
  - Receiver Equalizer.....Follows FCC specified curve
  - Notch Equalizer.....Zero delay from 0 to 3 mc; choice of 2 curves above 3 mc
  - Variable Equalizer.....Zero delay from 0 to 2 mc; choice af 10 curves above 2 mc

Electrical Specifications

Overall Power Requirements.....105-125/210-250 volts, 50/60 cycles, 2 kw (includes power requirements for the transmitter control console).

Unit Power Requirements:
- Frequency and Modulation Monitor....105 to 125 volts, 50/60 cycles, 425 watts
- Limiting Amplifier.....105, 115, 125 volts, transformer taps provided for, 50/60 cycles, 105 watts
- Monitoring Amplifier.....105-125 volts, 50/60 cycles, 105 watts
- Visual Sideband Demodulator....11$-125 volts, 50/60 cycles, 250 watts
- Sideband Responce Analyzer....105-125 volts, 50/60 cycles, 200 watts (with internal power supply 260 volts d-c regulated)
- Stabilizing Amplifier.....A-c 110-125 volts, 50/60 cycles, 55 watts D-c 280 volts, 320 ma
- WP-33 Power Supply.....105-129 volts, 50/60 cycles, 400 watts
- Video Distribution Amplifier .....105-125 volts, 50/60 cycles, 55 watts

Tube Complement

Rack #1:

1170-BT FM Monitor

1 12AU7	2 2050	2 OD3
1 6AK6	2 6SJ7	1 5964
2 6AG7	6 6AL5	1 991
1 6AC7	4 6SL7-GT	1 6SK7
1 6SN7-GT	2 6C4	1 6AS7-G
1 6AG5	1 815	1 OC3
		2 3-4

1170-P VHF Tuning Units

1 6BE6	2 6AG5	

1170-P UHF Tuning Units

1 6J6	1 9005	3 6AG5

1171-AT Visual Transmitter Frequency Monitor

2 6AU6	1 6BE6	1 OD3
1 6C4	1 6J6	1 5Y3-GT
	1 2D21	

1176-AT Frequency Deviation Meter

1 6H6	1 6SN7-GT	1 6V6
1 6SQ7	1 6J5-GT	1 OA3
1 6X5	2 6SJ7	1 3-4

BA-6A Limiting Amplifier

2 6SK7	2 6V6-GT	1 OD3
2 6J7	1 6H6	1 5R4GY

BA-24A Monitoring Amplifiers

1 12AX7	2 6V6-GT/G	1 5Y3-GT/G
	1 MI-11299 (Selected 12AY7)	

Rack #2:

BW-4A/BWU-4A Visual Demodulator

2 6C4	1 6AG7	1 6AS7
4 6CB6	1 6AK6	1 OC3
1 6J6	1 5V4	1 6BC6/6BQ7A
	1 6AS6/6CB6	(Ch 7-84 only)

BW-5A VHF Sideband Response Analyzer*

2 6J6	3 6AS6	1 6C4
3 12AU7	2 6AH6	1 6AS7G
1 6SQ6	1 6AK6	1 6SJ7
2 6BA6	1 5R4G	1 OD3

TA-7B Stabilizing Amplifier

8 6CL6	3 6AU6	1 12AU7
3 6AH6	1 12B4	1 12AX7
3 6AL5	2 12AT7	1 6AS6

(2) WP-33B Regulated Power Supplies

8 5R4GY	2 6SL7-GT	4 OD3
	6 6AS7-G	2 NE-32

Rack #3:

(3) TA-3A Video Distribution Amplifiers

3 6BQ7-A	3 5687	3 6X4
6 6BX7	6 OB2	6 6U8

WP-33B Regulated Power Supply

4 5R4GY	1 6SL7-GT	2 OD3
	3 6AS7-G	1 NE-32

(* The BWU-5A utilizes all the tubes listed above under the BW5A VHF Sideband Response Analyzer as well as those tubes specified here: 1—6AF4, 1—6J4, 1—6X4, 1—OA2, and 1—6J6.)

SPECIFICATIONS (Cont'd)

Mechanical Specifications

Unit	Overall Dimensions Height	Width	Depth	Weight
1170-BT FM Monitor	26¼"	19"	13¼"	88 lbs.
1171-AT Visual Transmitter Frequency Monitor	7"	19"	11¼"	31 lbs.
1176-AT Frequency Deviation Meter	5¼"	19"	11¼"	19½ lbs.
BA-6A Limiting Amplifier	7⅝"	16¾₁₆"	14"	37 lbs.
BA-24A Monitoring Amplifier	4 21/32"	8⅜"	10⅜"	16¼ lbs.
BWU-4A Visual Demodulator	14"	19"	10"	38 lbs.
BW-4A Visual Demodulator	14"	19"	10"	38 lbs.
BW(U)-5A VHF Sideband Response Analyzer	10½"	19"	14½"	58 lbs.
BWU-5A UHF Sideband Response Analyzer R-F Input Unit	3½"	19"	7¾"	11 lbs.
TA-7B Stabilizing Amplifier	10½"	19"	10¼"	20 lbs.
TA-3A Video Distribution Ampli.	3½"	19"	10⅜"	12½ lbs.
High Frequency Equalizer	17½"	19"	10"	23 lbs.
Low Frequency Equalizer	5¼"	19"	10"	9 lbs.
580-D Regulated Power Supply	10½"	19"	12"	58 lbs.
WP-33B Regulated Power Supply	14"	19"	9"	82 lbs.
BR-84 Standard Cabinet Racks	84"	22"	18"	225 lbs.
Overall Equipment (Tandem Cabinets)	84"	50"	18"	925 lbs. (approx)

Equipment Supplied

INPUT AND MONITORING EQUIPMENT

For VHF Transmitters ES-19237-A (wired)	ES-19237-B (unwired)		For UHF Transmitters MI-19237-C (wired)	MI-19237-D (unwired)
1	—	MI-19123-A Monitoring Equipment Rack #1, Left hand, wired	1	—
—	1	MI-30951-B84 Monitoring Equipment Rack #1	—	1
1	—	MI-19124-A Monitoring Equipment Rack #2, Center, wired	1	—
—	2	MI-30951-D84 Monitoring Equipment Racks #2 and #3	—	2
1	—	MI-27158 Monitoring Equipment Rack #3, Right Hand, wired	1	—
2	2	MI-30546-G28 Electrical Shield	2	2
1	1	MI-30546-G21 Electrical Shield	1	1
2	2	MI-30566-G84 Single Trim Strips	2	2
2	2	MI-30568-G84 Double Trim Strip	2	2
1	1	MI-4395-G Type 57-D Switch and Fuse Panel	1	1
2	2	MI-4591-B Blank Panel, 3½" high	2	2
1	1	MI-4594-B Blank Panel, 8¾" high	1	1
1	1	MI-11225 Type BA-6A Limiting Amplifier, including panel, but less shelf and tubes	1	1
1	1	MI-11289 Tube Kit for BA-6A	1	1
1	1	MI-11599 Type BR-2A Shelf for BA-6A	1	1
1	1	MI-11247 Type BA-24A Monitoring Amplifier (less tubes)	1	1
1	1	MI-11481 Tube Kit for BA-24A Amplifier	1	1
1	1	MI-11597 Type BR-22A Shelf for BA-24A Amplifier	1	1
1	1	MI-40205-A Type TA-7B Stabilizing Amplifier (with one set of tubes)	1	1

Equipment Supplied (Cont'd)

INPUT AND MONITORING EQUIPMENT

For VHF Transmitters ES-19237-A (wired)	ES-19237-B (unwired)		For UHF Transmitters MI-19237-C (wired)	MI-19237-D (unwired)
3	3	MI-26085-B Type WP-33B Regulated Power Supply with 1 set tubes	3	3
1	1	MI-26525-2 Blank Chassis, 3½" high	1	1
2	2	MI-26245 Video Jack Panel	2	2
1	1	ES-34006 Type BW-4A Visual Demodulator with 1 set tubes		
—	—	ES-34007 Type BWU-4A Visual Demodulator with 1 set tubes	1	1
1*	1*	General Radio VHF Station Monitoring Equipment, complete with 1 set of tubes as follows: 1 GR-1170-BT-1/or 2 FM Monitor 1 GR-1171-AT-1/or 2 Visual Freq. Monitor 1 GR-1176-AT Visual Frequency Meter	—	—
—	—	Generol Rodio 1183-T3 UHF Station Monitoring Equipment, including: 1 GR-1170-BT-3 FM Monitor 1 GR-1171-AT-3 Visual Frequency Monitor 1 GR-1176-AT Visual Frequency Meter	1*	1*
1	1	ES-34010 Type BW-5A Sideband Response Analyzer	—	—
—	—	ES-34009 Type BWU-5A Sideband Response Analyzer	1	1
1	1	MI-26525-1 Blank Chassis 11¾"	1	1
3	3	MI-4652-2B Audio Patch Cords	3	3
6	6	MI-7233-4 Video Patch Cords	6	6
16	16	MI-19118 Video Dual Connector Plugs	16	16
2	2	MI-26525-3 Blank Chassis 5¼"	2	2
—	3	MI-30526-G84 Pair of Panel Mounting Angles	—	3
—	3	MI-4570-A Terminal Board Brackets	—	3
—	1	MI-4569 Audio Terminal Blocks	—	1
—	5	MI-4568 Power Terminal Blocks	—	5
—	1	MI-11645-A Type BJ-24 Double Jack Panels	—	1
—	1	MI-11647-1 Jack Mat for BJ-24	—	1
—	2	MI-30590-2 Inerlock Switch	—	2
1	1	MI-27407 Program Line Selector	1	1
—	1	MI-26240 Circuit Breaker Chassis	—	1
—	3	MI-26764-1 Circuit Breaker	—	3
—	1	MI-26764-2 Circuit Breaker	—	1
1	1	MI-26525-5 Blank Chassis 8¾"	1	1
1	1	ES-34034-A High and Low Frequency Phase Correction Network	1	1
3	3	MI-26157 Type TA-3A Distribution Amplifier (with one set of tubes)	3	3
*	*	MI-4592-B Blank Panel 5¼" (* Note: Supply one only if Hewlett-Packard Monitor is specified)	*	*
*	*	MI-4593-A Blank Panel 7" (* Note: Supply three only if Hewlett-Packard Monitor is specified)	*	*
—	*	MI-4593-B Blank Panel 7" (* Note: Supply three only if Hewlett-Packard Monitor is specified)	—	*
1	1	Set Installation Drawings	1	1

* The Hewlett-Packard Type 335-ER Station Monitoring Equipment for rack mounting may be specified instead of General Radio equipment.

50-KW POWER CUTBACK KIT

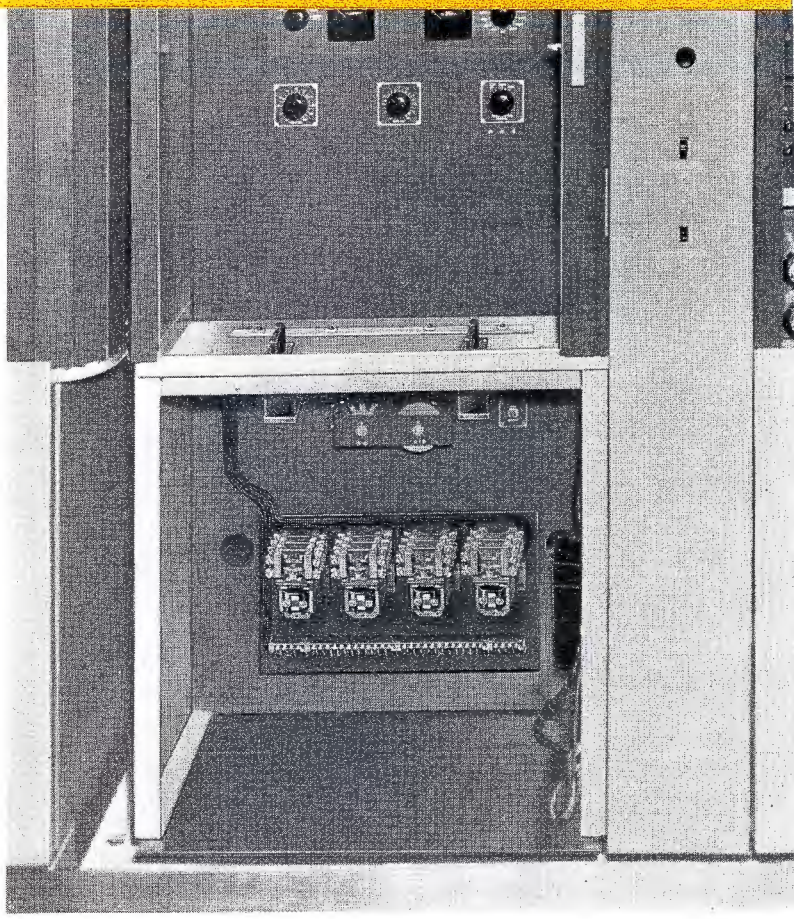
MI-27157

FEATURES

- Removes plate, screen, filament and bias voltages and cooling air from either or both 50-KW amplifiers
- Independent cut back circuits permit by-passing visual and aural amplifiers for quick on-air servicing or repairs
- Easily installed—kit becomes integral part of transmitter providing more versatile operation
- Control lights indicate status of control circuits
- Choice of manual or automatic type coaxial transfer switches

USES

The 50-KW Power Cutback Kit, MI-27157, has been designed to make the RCA 50-KW Television Transmitter, Type TT-50AH, more versatile. The installation of the kit and either Motor Driven Coaxial Switches MI-27330, or Manual Transfer Panels MI-27334, will allow the operator to by-pass either the aural or visual amplifiers or both and operate the driver directly into the side-band filter on the visual side and diplexer on the aural side. This permits tube changes or other work on the amplifiers without going "off air" as the cutback can be achieved in a matter of seconds. The manual r-f transfer panels and automatic r-f coaxial switches are available as accessories and should be ordered separately.



Portion of the Power Cutback Kit, MI-27157, installed in the Regulator Unit of the TT-50AH Television Transmitter, including two main cutback switches and control lights (mounted on shelf) and chassis assembly with auxiliary control relays in bottom of cabinet.

DESCRIPTION

The 50-KW Power Cutback Kit is comprised of items and sub-assemblies used to remove plate, screen, filament and bias voltages and cooling air from either of the 50-KW amplifiers (MI-19370 and MI-19366) or both. Two high voltage contactors, identical to those found in the TT-50AH Switching Cabinet remote plate and screen voltage from the amplifier, and ground the plate and screen leads. Other main items include two control switches similar to the aural-normal-visual switch which serve as main cutback switches; four control lights to indicate the status of the control circuits; two chassis assemblies on which are mounted the auxiliary control relays; two circuit breakers for filaments of the amplifier; two wall mounted blower control switches; escutcheons, terminals, wire, hardware and complete installation and operating information.

The basic design of the kit makes it an integral part of the equipment upon installation. The controls required for quick cut-over are accessible to the operator, and the indicating lamps provide continuous information relating to the control circuits. The mechanical installation can be completed before any wiring is done except for placement of the control switches. In making the installation it will be necessary to reroute bus work and consequently sufficient time must be allowed to complete this phase of the work. A Greenlee punch is supplied with the kit for making the necessary holes in the three center cabinets of the TT-50AH transmitter.

SPECIFICATIONS

Weight	300 lbs. (approx.)
Stock Identification	MI-27157

Accessory Equipment

Manual R-f Transfer Panels (4 required)	MI-27734
Motor Driven R-f Coaxial Switches (4 required)	MI-27330

PHASE EQUALIZER EQUIPMENT

ES-34034-A

FEATURES

- **Permits variable envelope delay correction at both high and low video frequencies**
- **Simple switching system permits selection of optimum delay correction**
- **Employs passive elements only—no tubes or power supplies**
- **No internal adjustments necessary—factory sealed to prevent accidental changes**

USES

The RCA Phase Equalizer Equipment, Type ES-34034-A, is designed to compensate for various distortions introduced in video transmission systems by such components as the color receiver, transmitter, vestigial sideband filter, notch diplexer and terminal equipment. The equipment greatly improves color edges and color transitions, and provides better time correspondence between luminance and chrominance information. It is required by all TV transmitters to meet FCC color specifications.

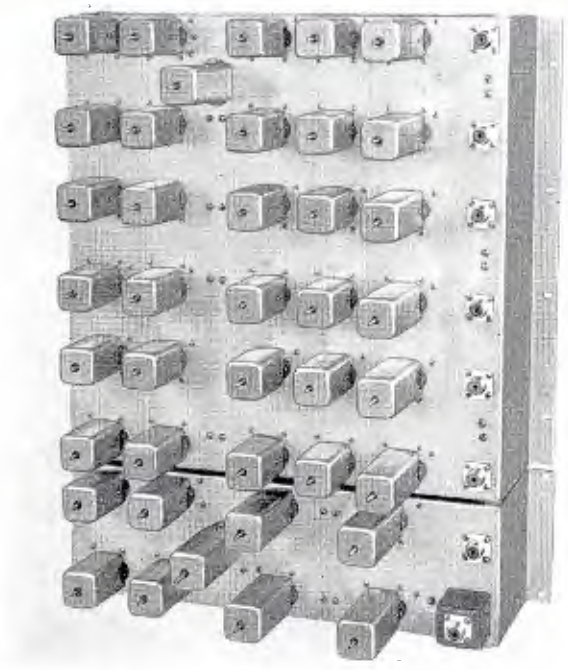
The equipment consists essentially of three elements—a High Frequency Phase Equalizer, MI-34026, a Low Frequency Phase Equalizer, MI-34025, and an Amplitude Equalizer, MI-34035. The High Frequency Equalizer is designed for insertion in the video input to a color television transmitter to compensate for envelope delay distortion due to such factors as high frequency cut-off of a color receiver, a sound notch filter, and for any additional envelope delay distortions in the high video part of the spectrum which is introduced by the transmitter or terminal equipment. The Low Frequency Phase Equalizer rectifies envelope delay distortion at low frequencies caused by the vestigial sideband filter, and improves overall transient response of the entire transmitter-to-receiver system.

DESCRIPTION

Both the High and Low Frequency Phase Equalizers consist of passive, all-pass, constant resistance bridged-T networks composed entirely of reactive elements. Both are mounted on bathtub-type chassis designed for standard 19-inch rack-mounting.

The MI-34025 Low Frequency Phase Equalizer requires 5¼ inches of rack space. The front panel contains only two switches: (1) a rotary switch which enables selection of any one of four envelope delay characteristics, and (2) a toggle switch which connects the equalizer in or out of the video circuit as desired. Four degrees of delay compensation are provided for the region below 2.0 mc. A section of Type RG-11/U 75-ohm coaxial cable is supplied to connect the equalizer into the transmitter video system in series with the Receiver Equalizer section of the High Frequency Phase Equalizer. The unit has been properly adjusted at the factory and all internal adjustments have been sealed in to prevent accidental changes.

The RCA High Frequency Phase Equalizer, MI-34026, consists of three circuit networks requiring 17½ inches of rack space. The first is the receiver equalizer section which provides the envelope delay curve to meet the FCC color specification, and compensates for the high frequency



Rear view of Phase Equalizer Equipment showing Amplitude Equalizer Unit mounted in lower right corner on the low Frequency Chassis.

cut-off of an average color receiver. Correction is required above 3 megacycles. A toggle switch is provided for switching the receiver equalizer in or out of the circuit. The second network is the notch equalizer section which must be used if a sound notch filter (such as a Filterplexer) is used in the transmitter. There are provisions for selection of one or two basic envelope delay curves by means of a toggle switch, and another switch allows cutting the notch equalizer in or out of the circuit. Finally, there is the variable equalizer section which compensates for small system variations. A five-position rotary switch selects one of five degrees of variation in combination with the selection of an optional fixed section. Thus there are ten possible delay curves provided. A separate toggle switch allows this network to be switched in or out of the circuit. All controls, consisting of six switches, are mounted on the front panel. The unit has been carefully adjusted at the factory for correct operation, and the adjustments have been sealed to prevent accidental change.

The notch and variable equalizer networks are designed for insertion in series between distribution amplifiers, whereas, the receiver equalizer should be patched in series with the Low Frequency Phase Equalizer, between distribution amplifiers. The High and Low Frequency Phase Equalizers are supplied with precision 75 ohm ±1% coaxial terminations which are color coded with a red band.

SPECIFICATIONS

Performance Specifications

Type of Circuit.....Non-minimum phase reactance network (No tubes or power supply required)

Impedance.....Input and output: 75 ohms

Type of Signal.....Composite video; color or monochrome

Circuit Attenuation (total for all phase equalizer).....0.5 db

Circuit Attenuation Each Amplitude Equalizer.....2.5 db

Sweep Frequency Each Phasing Equalizer.....—1 db at 4.2 mc

Sweep Frequency Response Each Amplitude Equalizer.....+2.5 db at 4.2 mc

Delay Correction:

Low Frequency Phase Equalizer.....Constant envelope delay from 2.0 mc to 4.2 mc; four envelope delay (curves in frequency range from 0 to 2.0 mc).

High Frequency Phase Equalizer:

Receiver Equalizer.....Follows FCC specified curve

Notch Equalizer.....Constant envelope delay from 0 to 3 mc; choice of 2 curves above 3 mc

Variable Equalizer.....Constant envelope delay from 0 to 2 mc; choice of 10 curves above 2 mc

Mechanical Specifications

Low Frequency Phase Equalizer.....19" wide, 5¼" high, 10" deep; wt. 9 lbs.

High Frequency Phase Equalizers.....19" wide, 17½" high, 10" deep; wt. 22 lbs.

Amplitude Equalizer.....1½" wide, 1½" high, 2½" deep; wt. approx. 5 oz.

Equipment Supplied

Phase Equalize Equipment, complete.....ES-34034-A

Consisting of:

Low Frequency Phase Equalizer on Rack-mounting Chassis, including 1 75-ohm coaxial termination, 2 connectors for RG-11/U coaxial cable, and Instruction Book (IB-36195).....MI-34025

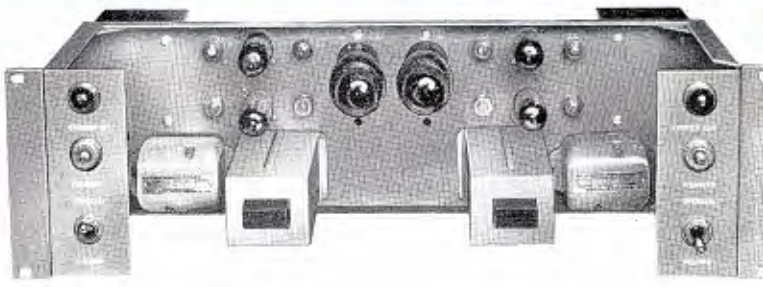
High Frequency Phase Equalizer on Rack-mounting Chassis, including 1 75-ohm coaxial termination, 2 connectors for RG-11/U coaxial cable, and Instruction Book (IB-36196).....MI-34026

Amplitude Equalizer.....MI-34035

CARRIER OFF MONITOR

FEATURES

- Operates transmitter overload circuits when power output drops to preset level and protects in event of arc over
- Adjustable to any desired power level and overload level
- Standard 19" rack mounting—all front panel controls
- Separate circuits provided for aural and visual transmitter sections



USES

The ES-27235 Carrier Off Monitor and Remote Power Indicator is a convenient accessory for use with RCA Television Transmitters. It acts in conjunction with the reflectometer units to trip the transmitter overload circuit for purposes of tune-up, etc.

This unit includes a remote power indicator circuit which also uses the d-c voltage from the reflectometers. This circuit consists of cathode followers and provides a low voltage, low impedance source necessary for remote power output monitoring over telephone lines.

DESCRIPTION

The Carrier Off Monitor is a protective device for television transmitters which is offered as optional equipment of particular value for unattended operation. It is essentially a comparison device and functions from information supplied by the reflectometer units. When used with the RCA 25-KW and 50-KW transmitters it will compare the voltages from the output reflectometer and the driver reflectometer. As long as the input and the output of the amplifiers are proportional to a preset value the monitor will not operate. In the event of an r-f arc inside the amplifier circuit which, in a broadband amplifier does not necessarily detune the circuit enough to operate the overload relays in the cathode circuits of the tubes, this balance will be upset. The monitor will then operate and the sensitive differential relay in its cathode circuit will trip the transmitter overload circuit through an auxiliary relay. If desired, this unit can also be connected to compare the output of the reflectometer to a d-c voltage or to the output of the modulator. In the latter case, it will, of course, be necessary to connect to a circuit in the modulator where the d-c component is maintained. Two complete circuits are provided—one for the aural and one for the visual transmitter. Disabling switches are included with the equipment to disconnect the transmitter overload circuits during tune-up.

The remote power indicator also operates from the output reflectometer circuits. Two cathode follower circuits are used. One provides a voltage reference level, and the other provides a low voltage which varies with the input signal (reflectometer output). The voltage appearing at the output terminals is therefore proportional to the reflectometer voltage and has good linearity due to the cancellation of Edison effects in the tubes.

The monitor and remote indicator is mounted on a bath-tub type chassis designed for standard rack mounting. It occupies 5-7/32 inches of rack space. All operating knobs are located on the front panel, as well as the red carrier-off lights and the amber disabling lights. Screw-driver adjustments are provided for making other adjustments such as input level, sensitivity, power indicator balance.

SPECIFICATIONS

Electrical Specifications

Signal Input Voltage (output from reflectometer)	7 to 70 volts
Differential Voltage to Trip	10 to 25% depending on transmitter power
Input Impedance	5.6 meg.
Output Relay Contacts	2 normally open
Output Impedance (Remote Power Indicator)	5000 ohms
Output Voltage (Remote Power Indicator)	1 volt, max
Tube Complement	4—12AU7, 2—OD3
Power Requirements:	
Filament	208-230 volts, 50/60 cycles, 10 watts
Control	115 volts, 50/60 cycles
D-C Input	350 volt (minimum), 70 ma.

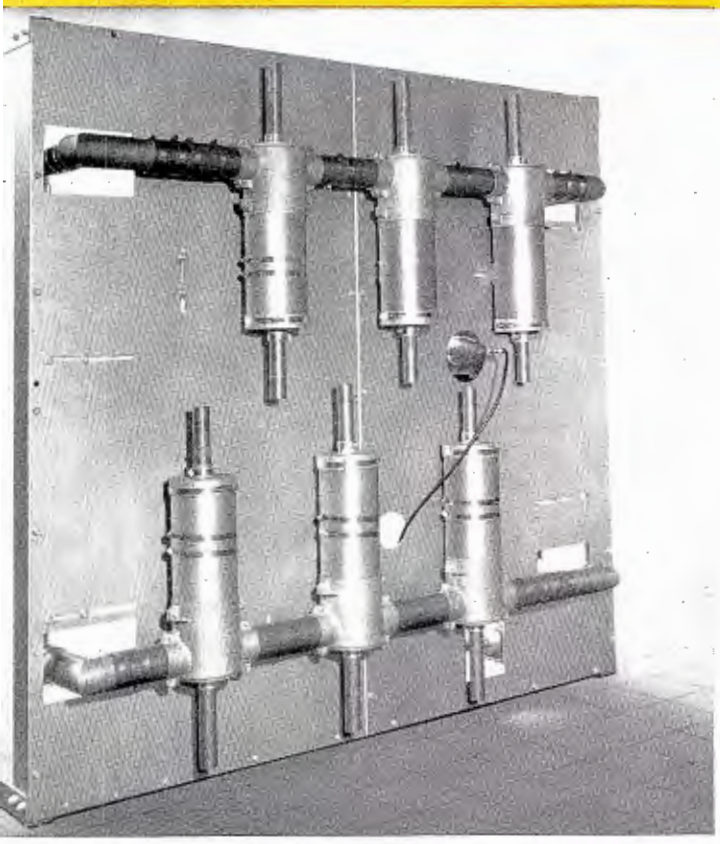
Mechanical Specifications

Dimensions (overall)	19" wide, 5-7/32" high, 9½" deep
Weight	10 lbs., approx.
Finish	Dark umber gray
Stock Identification	ES-27235

Accessories

Spare Set of Tubes	MI-27825
Set of FCC Spare Tubes	MI-27831

TV VESTIGIAL SIDEBAND FILTERS



FEATURES

- Especially engineered for each channel and power rating
- Attenuation of at least 20 db or more below channel limit
- Provides constant input impedance to the transmitter
- No operating adjustments necessary—pre-tuned in factory
- Choice of ceiling, floor, or wall mounting areas
- Suitable for color transmission

USE

An RCA Vestigial Sideband Filter is an integral part of each VHF Television Transmitter. It serves to attenuate the lower sidebands of the visual transmitter and provides a constant impedance load for the output stage of the visual power amplifier. The filter also protects the services in the frequency band below the television channel against interference. Several type sideband filters are designed for the various power ratings of transmitters; they are specially engineered for each channel. These fixed-tuned, factory adjusted filters eliminate many operating adjustments on the transmitter.

The sideband filters are identified as follows:

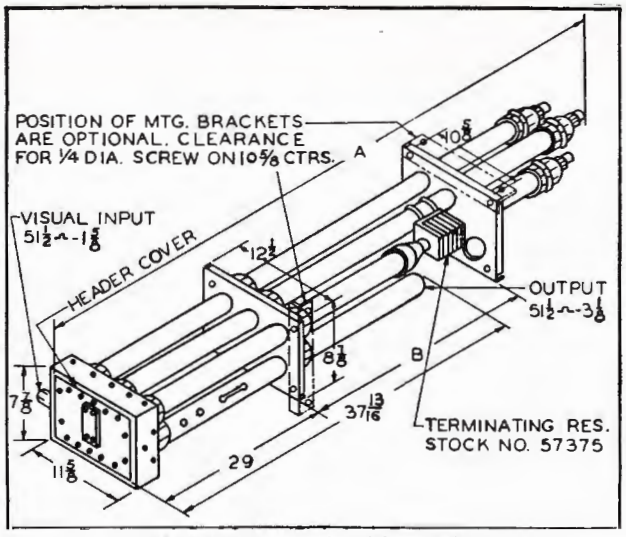
Stock No.	*Power*	*Chan.*	*Part of RCA Transmitter*
ES-27233	2 kw	2-6	TT-2AL, TT-2BL
MI-19114-B*	5 kw	7-13	TT-2AH, TT-5A
ES-27234	12½ kw	2-6	TT-5A, TT-6AL, TT-10AL
MI-19085-L*	25 kw	2-6	TT-25BL
MI-19085-HA*	25 kw	7-13	TT-10AH
MI-27315-H*	50 kw	7-13	TT-25BH, TT-50AH, TT-100AH

* Sales order must add customer's assigned channel number following letter.

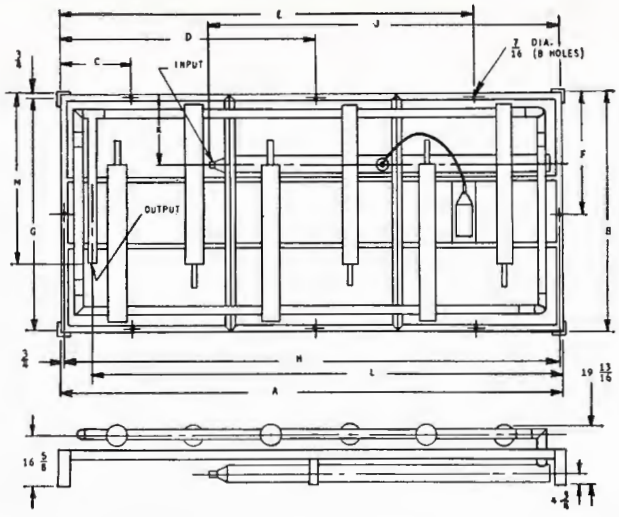
DESCRIPTION

The vestigial sideband filter passes the visual upper sideband signal energy of the television channel from the power amplifier to the antenna feed system. The small amount of energy that falls below the assigned visual carrier is dissipated in an absorbing resistor. Several types of filters are now in use. MI-19114-B, ES-27233 and ES-27234 are a combination of a low pass and a high pass filter to give constant impedance characteristics, while MI-19085-L, MI-19085-HA and MI-27315-H use a bridge arrangement with balanced high pass filters. The combination of the high pass and the low pass filters in parallel presents a constant input impedance to the radio frequency energy.

The filters are coaxial transmission line networks. The input and output connections have standard dimensions for 3⅛ inch and 1⅝ inch transmission lines. The units have a characteristic impedance of 51.5 ohms. The power amplifier of the visual transmitter is matched with a standing wave ratio of 1.1 to 1 or better. The sidebands that fall below the television channel are attenuated by 20 db or more when used with RCA transmitters. The sideband filters may be mounted in various positions, but should be located near the transmitter. The ambient temperature of the air about the filter should not exceed a maximum of 45° C. Blower motors provide cooling air for filters operating in the higher power ratings.



MI-19114-B Vestigial Sideband Filter

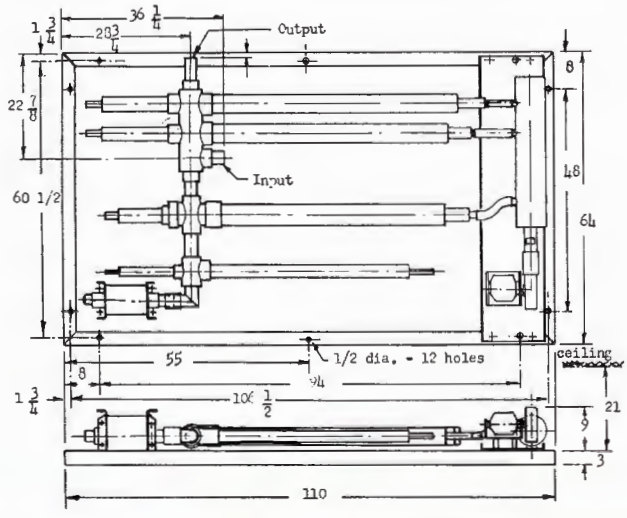


MI-19085-L/HA Vestigial Sideband Filter

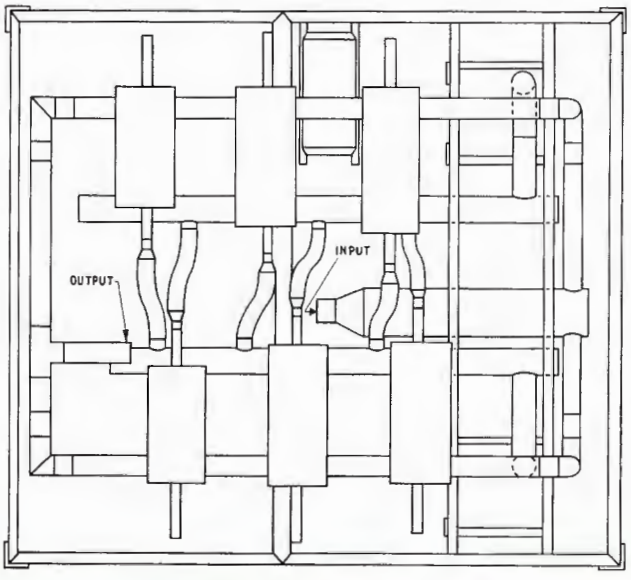
SPECIFICATIONS

	MI-19114-B	ES-27233	ES-27234	MI-19085-L/HA	MI-27315-H
ELECTRICAL SPECIFICATIONS					
Frequency	54-216 mc	54 to 88 mc	54 to 88 mc	54 to 88 mc/ 174-216 mc	174-216 mc
Maximum Power	5 kw	2 kw	12.5 kw	25 kw	50 kw
Input and Output Impedance	51½ ohms, 1⅝" coax. input 3⅛" coax. output	51.5 ohms, 3⅛" coaxial line	51.5 ohms, 3⅛" coaxial line	51.5 ohms, 3⅛" coaxial line	51.5 ohms, 3⅛" coaxial line
VSWR	1.1 or better	1.1 or better	1.1 or better	1.1 or better	1.1 or better
Blower	———	———	230 v., ¼ h.p., 2850 rpm, 50/60 cy.	———	230 v., 1.6 a., 60 cy.
Interlock	———	———	5 amp. @ 250 v. a-c	———	5 amp @ 230 v. a-c
MECHANICAL SPECIFICATIONS					
Overall Dimensions, Max.:					
Length	108½"	110"	110"	165"	150"
Width	12½"	64"	64"	79"	89"
Height	8⅞"	12"	12"	12"	31⅞"
Weight, Approx.	200 lbs.	300 lbs.	300 lbs.	930 lbs.	1600 lbs.
Mounting	Ceiling or horiz.	Ceiling or horiz.	Ceiling or horiz.	Ceiling or horiz.	Ceiling or horiz.
Ambient Temperature	45° C. max.	45° C. max.	45° C. max.	45° C. max.	45° C. max.

ES-27233 Vestigial Sideband Filter 2KW
ES-27234 Vestigial Sideband Filter 12.5 KW Illustrated



ES-27233/27234 Vestigial Sideband Filter



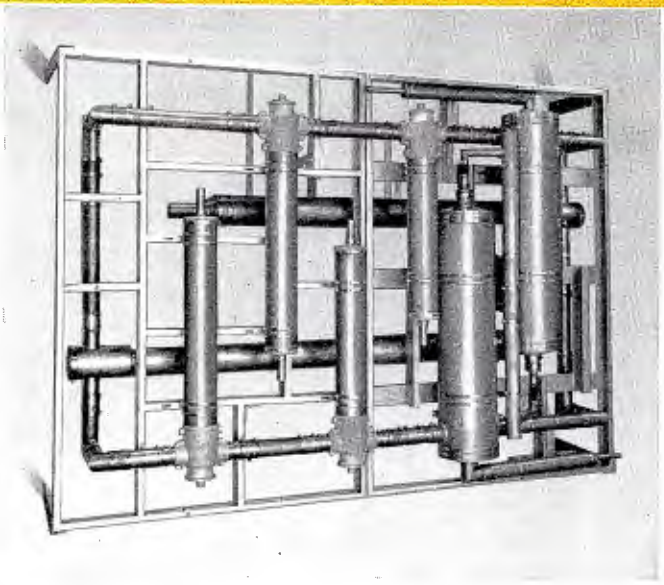
MI-27315H - VESTIGIAL SIDEBAND FILTER

VHF FILTERPLEXERS

25 KW, MI-19179

FEATURES

- Requires only a single transmission line to antenna
- Reduces windload on tower
- Economical—combines functions of vestigial sideband filter and constant-impedance notch diplexer
- Insertion loss less than 1 db
- No operating adjustments necessary—pre-tuned at factory
- Choice of ceiling, floor or wall mounting
- Suitable for color transmission



USES

RCA's VHF Filterplexer, MI-19179, represents a combination vestigial sideband filter and constant-impedance notch diplexer, assembled as a single unit which features diplexing and vestigial sideband filter characteristics. It is used to attenuate the lower sideband of a double sideband visual transmitter and to feed the outputs from the visual transmitter and the aural transmitter simultaneously through a single coaxial line to an antenna. Appreciable savings are realized when they are used with TV installations with single line feed into the antenna. Further savings are also realized where long transmission runs are needed to reach tower or antenna, since only one line is required. The single line also greatly reduces wind load on the tower.

The filterplexer may be used with 10 to 25 kw transmitters or with lower powered transmitters using VHF amplifiers in the 10 to 25 kw output range. Its use is also specified with the newer type antennas requiring a single line input, such as the RCA Super-gain antenna series.

DESCRIPTION

The 25-KW Filterplexer consists essentially of two bridge-baluns connected by two equal lengths of interconnecting coaxial transmission line and three filter circuits (cavities) on each of the two interconnecting coaxial transmission lines. The first and second cavities are used to obtain the vestigial response characteristics of the visual input while the third is tuned to the sound frequency. As in the constant-impedance notch diplexer and the vestigial sideband filter, the visual signal is fed into the bridge-balun circuit and travels directly to the antenna input terminals.

The filterplexer combines the high quality performance characteristics of both a sideband filter and a diplexer. The insertion loss is less than 1 db out to a point 4 megacycles above the picture carrier frequency. The vestigial sideband characteristics are also maintained by having the lower sideband frequencies attenuated to more than 20 db from the low edge of the channel (1.25 megacycles) to 4.25 megacycles below the picture carrier. The inputs are designed to have a constant input impedance over the band of frequencies produced.

The size of the filterplexer is determined by the channel, so that the channel frequency must be specified when ordering the equipment. The maximum dimensions of the channel 2 unit (which is the lowest in frequency and the largest in physical size) are 130 inches long, 100 inches wide, and 35 inches high. The unit is designed for either floor, ceiling or wall mounting.

SPECIFICATIONS

Frequency	VHF channels 2 to 6 as specified, pretuned and tested at the factory
Maximum Power	25 kw (peak visual) 15 kw (peak aural) at 7500 ft. elevation
Efficiency:	
Aural	95%
Visual	Visual losses included in transmitter peak power rating
Input Impedance (aural and visual)	51.5 ohms
Output Impedance	51.5 ohms
Maximum Visual Input Standing Wave Ratio	1.1/1
Minimum Input Bandwidth (both sidebands)	9 megacycles
Maximum Ambient Temperature	45° C
Blower	230 volts, 0.8 amp., 60 cycle, connect in parallel with aural PA blower
Interlock Actuator	100 μa with 4000 ohm load
Interlock, Air	5 A, 230 volts, aural transmitter connection
Weight	1200 lbs. (max.)
Stock Identification	MI-19179

VHF FILTERPLEXERS

50 KW, MI-27316

USES

RCA's 50-KW VHF Filterplexer, MI-27316, represents a combination vestigial sideband filter and constant-impedance notch diplexer, assembled as a single unit which features diplexing and vestigial sideband filter characteristics. It is used to attenuate the lower sideband of a double sideband visual transmitter and to feed the outputs from the visual transmitter and the aural transmitter simultaneously through a single coaxial line to an antenna. Appreciable savings are realized where long transmission runs are needed to reach tower or antenna, since only one line is required. The single line also greatly reduces wind load on the tower.

The filterplexer may be used with 50-KW transmitters or with lower powered transmitters in the 25-KW to 50-KW output range. Its use is also specified with the newer type antennas requiring a single line input, such as the RCA Super-gain antenna series.

DESCRIPTION

The 50-KW Filterplexer consists essentially of two bridge-baluns connected by two equal lengths of interconnecting coaxial transmission line and three filter circuits (cavaties) on each of the two interconnecting coaxial transmission lines. The first and second cavities are used to obtain the vestigial response characteristics of the visual input while the third is tuned to the sound frequency. As in the constant-impedance notch diplexer and the vestigial sideband filter, the visual signal is fed into the bridge-balun circuit and travels directly to the antenna input terminals.

The filterplexer combines the high quality performance characteristics of both a sideband filter and a diplexer. The insertion loss is less than 1 db out to a point 4 megacycles above the picture carrier frequency. The inputs are designed to have a constant input impedance over the band of frequencies produced. No operating adjustments are necessary as the unit is pretuned at the factory.

The size of the filterplexer is determined by the channel, so that the channel frequency must be specified when ordering the equipment. The maximum dimensions of the channel 7 unit (which is the lowest in frequency and the largest in physical size) are 98" long, 83" wide and 52" high (or 24" high with separately mounted heat exchanger). The unit is designed for either floor or ceiling mounting. Wall mounting may be used with specific restrictions.

SPECIFICATIONS

Frequency	VHF channels 7-13, as specified, pretuned and tested at the factory
Maximum Power	50 KW (peak visual) 30 KW (peak aural) at 5000 ft. elevation
Efficiency:	
Aural	92%
Visual	Visual losses included in transmitter peak power rating

Connections:	*Size*	*Impedance*
Visual Input	3⅛"	51.5 ohms
Aural Input	3⅛"	51.5 ohms
Absorbing Load	3⅛"	51.5 ohms
Output	6⅛"	51.5 ohms

Maximum Visual Input Voltage Standing Wave Ratio:	
Lower band edge to 5 mc above lower band edge	1.1/1
5 mc above lower band edge to 5.43 mc above lower band edge	1.15/1
Maximum Aural Input VSWR at Aural Carrier	1.3/1
Interlock, Water	5 A, 230 V, aural transmitter connection
Blower Requirements	230 volts, 60 cycles, single phase, 5 A
Dimensions (maximum for Channel 7)	98" long, 83" wide, 52" high (incl. heat exchanger)
Weight	1500 lbs. approx.
Stock Identification	MI-27316

UHF FILTERPLEXERS

1 KW and 12½ KW

FEATURES

- Economical—combines functions of sideband filter and diplexer
- Suitable for color transmission
- Insertion loss less than 1 db
- Pretuned—no adjustments necessary

USES

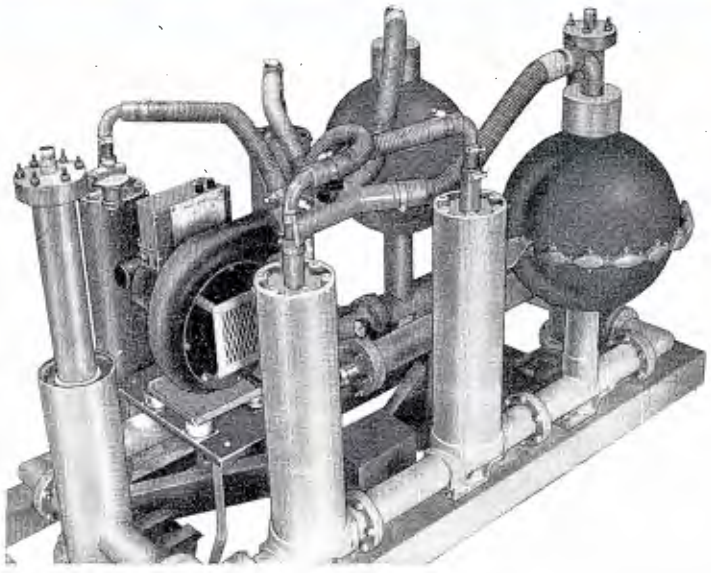
The RCA UHF Filterplexers connect the aural and visual transmitters to a common antenna feedline with negligible interaction or crosstalk, and shape the transmitter frequency response to conform to RETMA and FCC standards for vestigial sideband television transmission. A choice of two equipments is provided: the MI-19086-C has a peak visual power of 1 kw; the MI-19086-D of 12.5 kw. It is possible to convert the 1 kw filterplexer for higher power operation by use of conversion kit ES-19263.

DESCRIPTION

The UHF Filterplexer is assembled in an open frame providing maximum ventilation and is suitable for convenient floor or ceiling mounting. The unit is pressurized with sulphurhexafluoride gas to prevent deterioration and changes in tuning caused by variations in absolute humidity. It consists essentially of two bridge-baluns connected to two equal lengths of interconnecting coaxial transmission line and filter circuits (cavities) on each of the two interconnecting coaxial lines.

The equipment combines the high quality performance characteristics of both a sideband filter and a diplexer. The insertion loss is less than 1 db out to a point 4 mc above the picture carrier frequency. The vestigial sideband characteristics are obtained by having the lower sideband frequencies attenuated to more than 20 db from the low edge of the channel (1.25 mc) to 4.25 mc below the picture carrier. The inputs are designed to have a constant input impedance over the band of frequencies produced.

Channel frequency must be specified when ordering the equipment. The size of the filterplexer is determined by the channel. The minimum dimensions (equipments supplied for channel 83) and maximum dimensions (units used on channel 14) are shown in the specifications under dimensions. Units used on other channels vary in size between these two extremes. A blower kit is included with the MI-19086-D unit to cool the coaxial and spherical cavities.



SPECIFICATIONS

	MI-19086-C	MI-19086-D
Frequency	Ch. 14 to 83	Ch. 14 to 83
Power Rating*	1 kw	12.5 kw
Minimum Efficiency: (Aural)	90%	90%
(Visual)	Visual losses included in transmitter peak power rating	
Input Impedance (Aural and Visual)	50 ohms	50 ohms
Output Impedance	50 ohms	50 ohms
Maximum Visual Input VSWR (referred to visual carrier frequency):		
−4.5 mc to −1.25 mc	1.5/1	1.5/1
−1.25 mc to +4.2 mc	1.15/1	1.15/1
+4.2 mc to +4.5 mc	1.5/1	1.5/1
Maximum Aural Input VSWR (referred to visual carrier frequency):		
4.5 mc ±100 kc	1.5/1	1.5/1
Max. Ambient Temperature	45° C	45° C
Blower Line Requirements	None	230 v., 1 ph., 50/60 cps
Length (Frame)	72" to 78¾"	72" to 78¾"
Width	37" to 45⅛"	37" to 45⅛"
Height (extended)	28⅛" to 40⅛"	35⅛" to 47⅛"
Weight (approx.)	450 lbs.	500 lbs.

* Ratings are based on peak visual power plus aural power not to exceed 60% of peak visual power.

Equipment Supplied

1 KW Filterplexer, SF_6 gassed, without blower, 80 watt absorbing load MI-19086-C

12.5 KW Filterplexer, SF_6 gassed, with blower, 1200 watt absorbing load MI-19086-D

Accessory Equipment

12.5 KW Conversion Kit ES-19263

Gassing Kit MI-27328

Blower Kit MI-27329

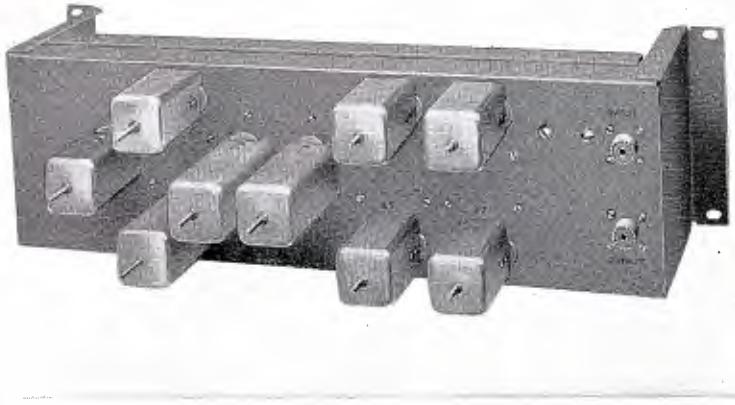
1200 Watt R-F Lood and Wattmeter MI-19197

LOW PASS VIDEO FILTER

MI-27132

FEATURES

- **Attenuates all video frequencies above visual carrier (4.75 mc) 20 db or more**
- **Insertion loss less than 0.5 db**
- **Can be inserted anywhere in 75 ohm line**
- **No degradation of either monochrome or color picture**
- **No adjustments necessary**
- **Mounts in standard studio equipment rack**



USES

The Low Pass Video Filter, MI-27132, is used to reduce adjacent channel interference between television stations. The filter will attenuate video frequencies above 4.2 mc so that the video response is down at least 20 db at 4.75 mc. This unit when inserted in the video section of a television transmitter will permit operation of the equipment in conformance with a recent FCC ruling. The filter will pass all frequencies from 0 to 4.2 mc with no more than 1 db attenuation. An all-pass phase equalizer corrects any phase distortion which is introduced as a result of the sharp cutoff.

DESCRIPTION

The MI-27132 Low Pass Video Filter is a passive network consisting of a series of nine coils wound on standard coilforms and mounted on a chassis suitable for standard rack mounting. The circuit is an M-derived low-pass filter followed by a four-section bridge T, phase equalizer. The insertion loss of the filter is never greater than 0.5 db.; and the envelope delay vs. frequency characteristics remains flat to within ±.04 microseconds in the frequency range from 0 to 4.2 mc. The amplitude vs. frequency response is flat within ±1 db in the video frequency range from 0 to 4.2 mc, and is 20 db or more in the frequency range from 4.75 to 10 mc. The low pass video filter requires that the impedance of the signal source be 75 ohms, non-reactive. No adjustments to the circuit or equipment are necessary at any time, and no power supply is required.

The filter conforms in appearance to other RCA rack-mounted terminal equipment. It is mounted on a standard 19" wide chassis and finished in umber gray. One operating control, an in and out switch, is located on the front panel. The equipment is provided with input and output plugs and a load resistor assembly necessary for connecting the filter into the 75-ohm line between camera output and the input of the transmitter. The filter is usually inserted in the line following the stabilizing amplifier and can be mounted in the same rack with the stabilizing amplifier, phase equalizer and other studio equipment.

SPECIFICATIONS

Electrical:
- Input:
  - Source Impedance ..... 75 ohms, non-reactive
  - Input Impedance ..... 75 ohms, non-reactive
- Output:
  - Load Impedance ..... 75 ohms, ±1%
  - Output Impedance ..... 75 ohms, ±1%
- Insertion Loss (from 75 ohm source to 75 ohm load) ..... 0.5 db max.
- Frequency Response ..... Flat within ±1 db from 0 to 4.2 mc
  —20 db or more from 4.75 to 10 mc

Mechanical:
- Overall Dimensions ..... 19" wide, 5¼" high, 10" deep
- Weight ..... 5 lbs. (approx.)
- Finish ..... Two tone umber gray

Equipment Supplied

4.75 mc Low Pass Filter, complete MI-27132
including the following items:
- 1 Low Pass Video Filter
- 2 Plugs, Input and Output
- 1 Load Resistor Assembly (75 ohms)
- 1 Instruction Book IB-36197

PRE-EMPHASIS FILTER

MI-4926-A

FEATURES

- Accurate within 1.5 db from 30 to 15,000 cycles
- Minimum insertion loss
- Operation for levels up to +30 dbm
- Compact design—completely shielded

Compact MI-4926-A Filter produces FCC standard 75 microsecond audio pre-emphasis characteristic.

USES

The MI-4926-A filter is used in FM transmission to produce the FCC standard 75 microsecond audio pre-emphasis characteristic. It may also be used in conjunction with disc recorders to obtain recordings having the same pre-emphasis characteristic.

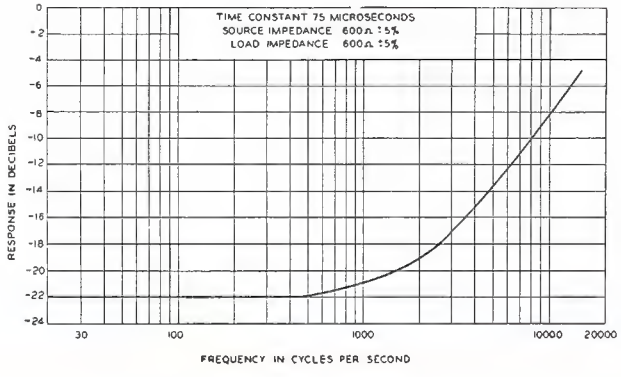
The filter may be inserted at any point in the audio system where the signal does not exceed +30 db, and may be mounted in any convenient place so long as the magnetic fields of transformers and similar equipment are avoided.

DESCRIPTION

The MI-4926-A filter is of the constant impedance, balanced, "bridge T" type. The characteristic frequency curve of the filter follows a 75-microsecond curve in accordance with RETMA and FCC recommendations.

Mechanically, the filter consists of two reactors, two capacitors and eight resistors sealed inside a metal can. Connections are made to the filter by means of solder terminals on top of the can.

Frequency response of MI-4926-A.



SPECIFICATIONS

Electrical:

Input:

Source Impedance	600 ohms ±5%
Input Impedance	600 ohms ±5%
Maximum Input Level	+30 dbm

Output:

Load Impedance	600 ohms ±5%
Output Impedance	600 ohms ±5%

Insertion Loss (fram 600 ohm source to 600 ohm load):

Minimum Loss at 15,000 cps	Approx. 5 db.
Maximum Loss Below 500 cps	Approx. 22 db.
Frequency Response	Corresponds to FCC 75 microsecond pre-emphasis curve within ±1.5 db from 30 to 15,000 cycles
Attenuation Characteristic	Fixed (See curve)

Mechanical:

Diameter	3 inches
Height	4⅜ inches
Weight (unpacked)	2¼ pounds
Base Plate	3¼ x 3¼ inches
Mounting	Faur holes with center lines 2¾ x 2¾ inches
Stock Identification	MI-4926-A

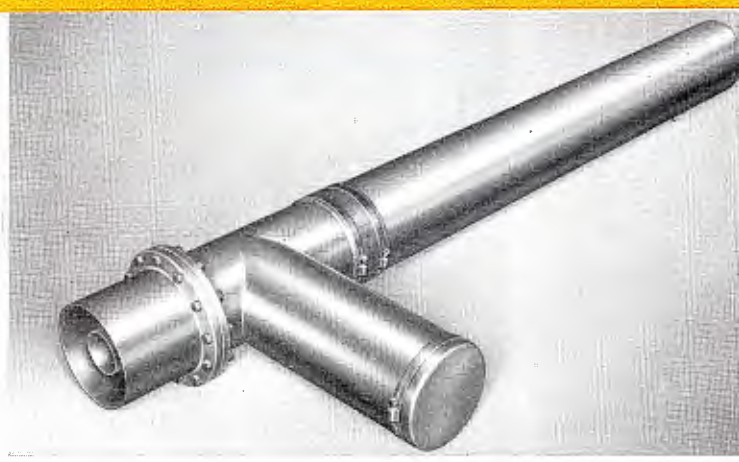
*0 db = .001 watt.

VHF HARMONIC FILTERS

MI-27317 AND MI-27318

FEATURES

- **Effective suppression of harmonic radiation when used with RCA VHF transmitters**
- **Performance complies with all FCC requirements**
- **Pretuned at factory for optimum VSWR**
- **Attenuation 30 db or greater 2nd thru 4th harmonics of channel, 20 db or greater 5th thru 7th harmonics of channel**



USE

The VHF Harmonic Filter in conjunction with other R-F components, suppresses all harmonic radiation, 3 mc above VHF channel limits to —60 db or more in conformity with FCC requirements. The MI-27317-L/H filter is used with all RCA transmitters with a TV peak power output of 12.5 kw or less, the MI-27318-L/H filter is specified for RCA transmitters of more than 12.5-kw TV peak power rating. Two filters are required for VHF transmitters, one for the aural, and one for the visual section of the equipment.

DESCRIPTION

The VHF Harmonic Filters, MI-27317 and 27318 consist of a series of transmission line elements with a uniform outer diameter conductor, a stepped inner conductor, and one shunt stub. The conductors are both fabricated of copper. The terminals are the same as unflanged transmission line. Attenuation of all harmonic radiation 3mc above channel limits is accomplished in an M derived section, a series of T sections and a constant K section made up of transmission line constants. This type of design provides a broad-band within the desired pass band with a sharp high frequency cutoff and high attenuation of frequencies above the pass band.

The harmonic filters are of the reflective type rather than dissipative type, and should be inserted in series with the transmission system. While the units can be mounted in any position, the horizontal position is recommended. They are designed for insertion ahead of the sideband filter. If used after the diplexer the 90° quadrature phasing should be checked electrically. Insertion of the filter immediately after the power amplifier will preclude a high VSWR at harmonic frequencies in the associated filter and diplexing equipment.

SPECIFICATIONS

Electrical Specifications

Frequency	Channels 2-13
Maximum Power:	
MI-27317-L	Ch. 2-6, 12.5 kw peak (7500 ft. max. altitude)
MI-27317-H	Ch. 7-13, 12.5 kw peak (7500 ft. max. altitude)
MI-27318-L	Ch. 2-6, 50 kw peak (7500 ft. max. altitude)
MI-27318-H	Ch. 7-13, 50 kw peak (7500 ft. max. altitude)
Input and Output:	
MI-27317-L/H	51.5 ohms, 3⅛" coaxial line, MI-19113†
MI-27318-L/H	51.5 ohms, 6⅛" coaxial line, MI-19314†
VSWR	1.10 max.
Attenuation	30 db or greater, 2nd thru 4th harmonics of the channel 20 db or greater, 5th thru 7th harmonics of the channel

Mechanical Specifications

Mounting	Horizontal position recommended
Recommended Location	Between power amplifier and monitor unit
Alternate Locations	Visual output filter may be located between vestigial sideband filter and diplexer
Ambient Temperature	45° C. maximum
Dimensions:	
MI-27317-L/H	56 to 175 inches long (depending on channel) x 3⅛" O.D. with 11" to 26½" stub approx. 8" from one end
MI-27318-L/H	56 to 176 inches long (depending on channel) x 6⅛" O.D. with 14" to 27" stub 11 3/16" from one end
Stock Identification:	
12.5 kw VHF Harmonic Filter, Ch. 2-6	MI-27317-L *
12.5 kw VHF Harmonic Filter, Ch. 7-13	MI-27317-H*
50 kw VHF Harmonic Filter, Ch. 2-6	MI-27318-L *
50 kw VHF Harmonic Filter, Ch. 7-13	MI-27318-H*

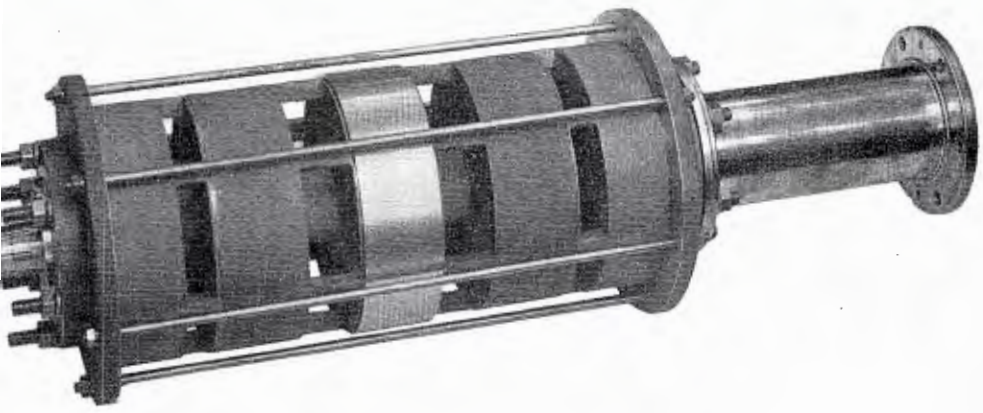
Optional or Accessory Equipment

1⅝" Transformer 72 ohms to 51.5 ohms, no flange	MI-19111-10*
3⅛" Transformer 72 ohms to 51.5 ohms, no flange	MI-19111-11*
Reducer, 3⅛" to 1⅝", 72 ohms coaxial line	MI-19111-5
Reducer, 3⅛" to 1⅝", 51.5 ohms coaxial line	MI-19113-B6
Reducer, 3⅛" to 1⅝", 51.5 ohms coaxial line	MI-19112-7
Reducer, 6⅛" to 3⅛", MI-19113 coaxial line	MI-19314-13
Reducer, 6⅛" to 3⅛", MI-19313 coaxial line	MI-19313-13
Straight Coupling, 6⅛" coaxial line	MI-19314-7
Coupling, Straight, 3⅛" coaxial line	MI-19113-8
Adaptor, Inner Conductor, for MI-19313 coaxial line	MI-19313-10

† Reducers and elbows must be ordered separately.
* Sales order to specify customer's assigned channel.

UHF HARMONIC FILTER

MI-27327-L/H



FEATURES

- Effective suppression of harmonic radiation when used with RCA UHF transmitters
- Meets all FCC performance requirements
- Small size, compact, light-weight
- Equipment is easily installed, requires no maintenance
- Pretuned at factory for optimum VSWR

USE

The UHF Harmonic Filter provides effective suppression by 60 db or more of harmonic radiations in conformance with all FCC requirements when used with RCA UHF television transmitters. The MI-27327-L filter is required for channels 14 to 43, and the MI-27327-H filter is specified for channels 44 to 83 respectively.

The filter should be inserted directly in the transmission line between the filterplexer and the antenna. Only one filter is required with the 1 KW or 12½ KW RCA UHF Transmitter but two are required with the TTU-25B model to provide effective filtering of both visual and aural carrier harmonics and their sidebands.

DESCRIPTION

The UHF Harmonic Filter is essentially a band pass filter wherein cavities are used instead of lumped circuit components to provide the requisite pass and rejection characteristics at UHF frequencies. Attenuation of 60 db or more of all radiation 3 mc above channel limits is accomplished in a series of radial cavities in a reflective type circuit. The radial cavity sections are made from cast high tensile strength aluminum with a precision machined interior finish. The individual sections are assembled into a series of fixed-tuned cavities terminated with standard bronze flanges.

The filter may be installed at any point in the transmission line system and may be mounted in any position; however, it is recommended that the filter be connected directly to the flanged antenna output of the filterplexer for best performance. Any vertical or horizontal mounting position may be used. The filter may be installed and used for transmission in either direction. The terminations are standard RETMA 3⅛"-50 ohm coaxial flanges, one male, and one female. The female terminal end may be connected directly to the filterplexer flanged outlet with the bronze hardware furnished for that purpose. This avoids the use of added short-line sections or extra flanges. A short section of transmission line approximately 8 inches in length is used at one terminal end. A compensating ring is mounted on the inner conductor of the short section to tune the filter to optimum VSWR for a given channel.

SPECIFICATIONS

Electrical:	
Moximum Power	15 kw
Input ond Output Impedance	50 ohms, 3⅛" coaxial line
VSWR	1.10 or better
Attenuation	60 db or greater*
Mechanical:	
Mounting	Horizontal or Verticol
Recommended location	Between filterplexer and antenna
Ambient temperature	45° C. maximum
Dimensions:	
MI-27327-L	24¾" long x 8" largest diameter
MI-27327-H	19⅛" long x 8" largest diameter
Weight	30 lbs.
Stock Identification:	
MI-27327-L	Channels 14-43
MI-27327-H	Channels 44-83

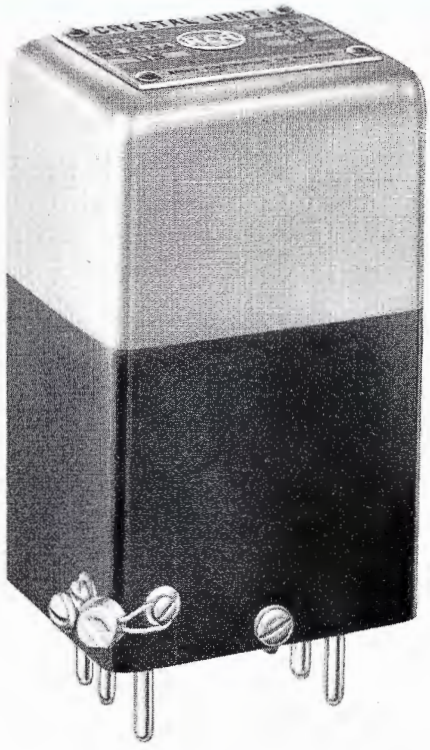
* When used with RCA UHF Transmitters and filterplexers.

TV CRYSTAL UNITS

TMV-129 SERIES

FEATURES

- Operate directly from 115 volt source without need for step-down transformer
- Heater adequate to keep crystal at constant temperature—even when room temperatures are 80° C below crystal operating temperature
- Excellent frequency stability and freedom from aging effects
- Frequencies available from 80 kc to 60 mc for AM, FM, or TV broadcasting purposes
- Precision type bi-metal thermostat
- External contact for pilot light to indicate thermostat cycling
- Plug-in units, impossible to insert incorrectly in sockets



USES

The RCA type TMV-129 Series of Crystal Units was designed especially for stable frequency control of transmitters operating in the various AM, FM, TV-VHF and TV-UHF frequency bands. The units may be employed in any type of equipment, within the applicable frequency range, where maximum frequency precision and high crystal activity are essential.

Each crystal is a plug-in unit which may quickly be inserted in its oscillator circuit. The units are unusually reliable, operating with great frequency stability, and providing years of trouble-free service without attention. Suitable crystal units are normally supplied with every RCA type transmitter as part of the equipment. Spare crystal units may be ordered as required.

DESCRIPTION

The TMV-129 series of precision temperature controlled crystal units includes several types of quartz plate mountings each within a 14-watt heater and employing the same type thermostat, patented temperature compensator, six-pin base, and outer aluminum case.

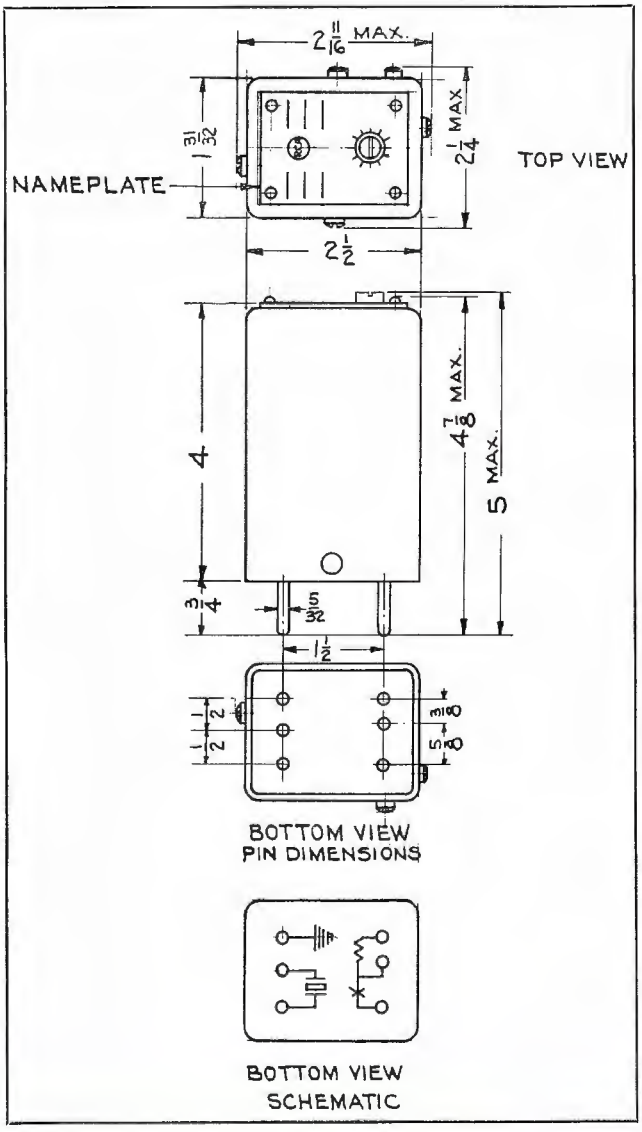
The crystals are made from the highest quality Brazilian quartz, very carefully oriented, and fabricated to precise manufacturing tolerances. The crystals are approximately one inch square, in most cases, and are available for frequencies from 80 kc to 60 mc. They are variously mounted and secured firmly within the heater oven. The internal construction holds all component parts against moderate vibration and shock so that the units may be mounted in any position, except for the TMV-129B which must be mounted vertically.

The 14-watt heater oven is energized from an a-c/d-c 110-115 volt source. It comprises a single layer of resistance wire separated from the inner aluminum case by multiple layers of varnished cambric. One corner of the heater case is carefully formed to accommodate the Edison bi-metal thermostat type S1-1A which has a rating of 1°C accuracy. By means of a patented thermal compensator strip, the actual temperature variation of the quartz plate rarely exceeds ½°C. Normal operating temperatures for each type crystal unit vary, but the heater generates 14.5 watts which is adequate to keep the crystal at a substantially constant temperature even in ambients down to 80°C below the operating temperature. No auxiliary relays are required in the heater circuit, making this an entirely self-contained unit.

The holder has six external contact pins in a polarized arrangement. It is impossible to insert the units in their sockets incorrectly. Two of the pins are provided for the 110 volt source to energize the heater, and the pin located between these two may be used as a pilot lamp indicator of thermostat action. At the other side of the base, two pins are connected to the two crystal electrodes while the third pin should be connected to ground, since it is internally connected to the aluminum shield.

The crystal units have an outer case fabricated of drawn sheet aluminum. The overall dimensions and bottom view schematic are shown in outline. Weights of the various units differ slightly, but average about 12½ ounces.

When ordering please specify crystal unit type, frequency desired, tolerance permissible, type of equipment in which the crystal unit is to be used, and other pertinent operating specifications. If the crystal is intended for specially designed equipment, give compete electrical details of the circuit. For maximum accuracy in calibration a physical sample of the oscillator (to be returned, of course) should be provided.



TYPE TMV-129-C, CRYSTAL UNIT

This RCA TMV-129-C Crystal Unit is designed to provide stable frequency control for commercial applications from 2 to 20 mc and for low aging units. It is used for visual channels of VHF television broadcast transmitters. By use of carefully processed AT-cut quartz plates designed to operate at the third harmonic mode, the TMV-129-C units may be used at frequencies as high as 20 mc. The units also may be employed in certain types of receivers for precision fixed-frequency reception.

The quartz plates are about 1-inch square AT-cut crystals, processed to provide constant frequency control with low aging effects. The crystals are pressure air-gap mounted between nickel silver electrodes. This assembly is mounted in low-loss ceramic steatite brackets which are secured firmly to a sturdy, metal riser located centrally within the heater oven. The heater maintains the crystal at a normal operating temperature of 60°C. Where conditions may require a higher temperature in order to maintain positive temperature control, this operating temperature may be increased to any value up to 85°C without incurring any additional expense.

SPECIFICATIONS

Frequency Range	2,000 to 20,000 kc
Ambient Temperature Range	−20°C to +55°C
Operating Temperature	+60°C (other temperatures on special order)
Frequency Stability	±.005% or better
Heater Power	14 watts from 110 volts ac/dc source
Stock Identification	MI-19400

TYPE TMV-129-G, CRYSTAL UNIT

The TMV-129-G Crystal Units are specifically designed for low frequencies between 70 kc and 350 kc as required for aural exciter units. Many years of experience have proved the 129-G so dependable that they are used both in VHF and UHF RCA television transmitters. The unit is widely employed in frequency modulation transmitters and for low-frequency, precision electronic equipment of all types. Although optimum performance is realized at frequencies between 70 and 125 kc, this unit may be employed with very satisfactory performance as high as 350 kc. The frequency stability approaches that of a primary frequency standard and under normal operating conditions the maximum frequency variation will not exceed one or two cycles.

The TMV-129-G employs a silver plated CT- or DT-cut quartz crystal mounted in a glass-bonded mica yoke by centrally located pressure pins. The pins are fabricated with extreme care and have lapped contacting surfaces to avoid pin-point contacts, which might cause microscopic crystal fractures. The mounting yoke and crystal assembly are thermally insulated from the heater oven base by a specially treated thermosetting bracket. The entire assembly is mounted within an air-tight compartment consisting of a metal base and a steel cylindrical shell. Although not hermetically sealed, the crystal and its mounting yoke are protected from contamination by the metal cover with its effective gasket seal. The normal operating temperature of this low-frequency crystal unit is 70°C. However, it is available for operation at any temperature between 50° and 85°C. It is recommended, however, that the specified operating temperature be as low as possible.

SPECIFICATIONS

Frequency Range	70 to 350 kc using either CT-cut or DT-cut quartz plates
Ambient Temperature Range	−10°C to +65°C
Operating Temperature	+70°C
Frequency Stability	±2 cycles
Frequency Calibration	Zero beat in customer's circuit with trimmer capacitor
Heater Power	14 watts from 110 volt ac/dc source
Stock Identification	MI-19450-A

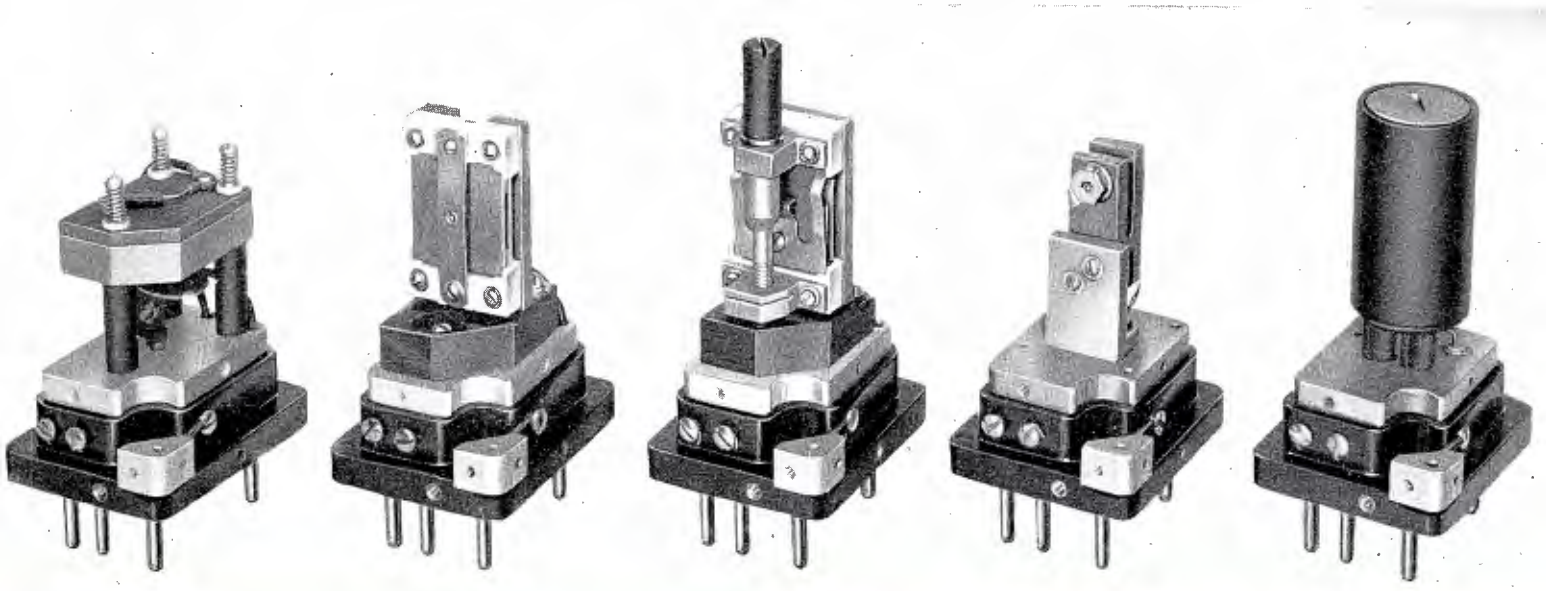
TYPE TMV-129-P, CRYSTAL UNIT

The RCA type TMV-129-P Crystal Units are especially designed for UHF television transmitters and monitors. The frequency controlling element is an AT-cut quartz plate fashioned to operate at its third overtone. The units are so closely controlled, processed and pre-aged that it is not unusual to experience a frequency deviation of less than one part in a million in a year's continuous operation. The frequency range extends from 20 mc to 45 mc employing the third overtone.

The TMV-129-P employs an AT-cut quartz plate designed to operate at its third overtone. In place of forming the crystal electrodes in the conventional manner by plating films directly on the quartz faces, this unit has two separate discs of quartz, each recessed and gold plated. The frequency controlling crystal is firmly clamped between these two quartz electrodes. The whole assembly is supported by looped coil springs which are firmly secured to the two holder pins.

This feature of using plated-quartz electrodes is justified by the freedom from sliding motion between the electrodes and the oscillating quartz plate when the units are exposed to wide temperature ranges. In this particular unit, since both the electrodes and the oscillating quartz plate are of the same material and oriented in the same manner, there

The TMV-129 series of precision temperature controlled crystal units reveal several types of quartz plate mountings after removal of 14-watt heater and outer aluminum case. Shown below, left to right are the RCA types TMV-129-B, 129-C, 129-F, 129-G and 129-P/Q.



is practically no movement between the three elements of this assembly since all three parts have almost identical temperature coefficients. Also, since the metallic film electrodes do not touch the oscillating element, far higher activity is obtained at the high frequencies.

The frequency controlling quartz plate and electrode assembly are so small that they are enclosed in a hermetically sealed metal envelope having a glass base. This assembly forms the RCA Crystal Unit type VC-1-F (MI-19439-14). This special construction stabilizes the crystal temperature to such a high degree that there is no perceptible frequency variation as a function of thermostat cycling.

SPECIFICATIONS

Frequency Range.....20 mc to 45 mc, 3rd overtone
Ambient Temperature Range.....—5°C to +70°C
Operating Temperature.....+75°C (temperature controlled)
Frequency Stability.....±.0001% for 10 days or more
Heater Power.....14 watts from 110 volt ac/dc source
Stock Identification MI-19400-H

TYPE TMV-129-Q4, CRYSTAL UNIT

This new RCA type TMV-129-Q4 Crystal Unit is designed specially to furnish high stability frequency control in RCA TV transmitters. It is equally suitable for other similar applications where high output and reliable operation are essential. The hermetically sealed crystal unit within the 14 watt heater is carefully processed and tested for low aging properties and yet is ruggedly mounted to withstand the hazards of normal transportation and service, even in field equipment.

The TMV-129-Q4 crystal unit employs a BT-cut quartz plate operating at its fundamental mode, heavily etched for low aging and provided with evaporated gold electrodes for high reliability. Each unit is given an effective 5 day pre-aging cycle before final calibration to specified frequency. Excellent frequency stability is further assured by mounting the hermetically sealed crystal unit within a heavy walled cylindrical housing, which acts as a thermal fly wheel preventing even minor temperature variations at the crystal itself.

This modernized construction is employed in only one other RCA unit, the TMV-129-P, as shown in the illustration of the TMV-129 series. The complete assembly is identified as MI-19400-L4, while the internal crystal unit alone is MI-19439-22.

SPECIFICATIONS

Frequency Range.....9 mc to 14 mc, fundamental
Ambient Temperature Range.....—10°C to 70°C
Operating Temperature.....+75°C (temperature controlled)
Frequency Stability.....±.0037% in 10 days or more
Heater Power.....14 watts from 110 volt ac/dc source
Stock Identification MI-19400-L4

Convenient Summary of RCA Type TMV-129 Crystal Units

Type	*Use*	*Frequency*	*Stock Identification*
*TMV-129-B	AM Broadcast transmitters Any type equipment requiring maximum frequency precision and high crystal activity within frequency range	325 kc to 3000 kc	MI-7467
TMV-129-C	VHF television broadcast transmitters High frequency transmitters Receivers requiring precision fixed frequency reception	2000 kc to 20000 kc	MI-19400
*TMV-129-F	International broadcast transmitters Medium frequency communications equipment Equipment requiring variable frequency control within range indicated	1.8 mc to 8.5 mc	MI-19400-A
TMV-129-G	VHF and UHF television transmitters as oural exciter units FM aural transmitters Low-frequency, precision electronic equipment of all types	70 kc to 350 kc	MI-19450-A
TMV-129-P	UHF television transmitters High frequency monitors	20 mc to 45 mc employing 3rd avertone	MI-19400-H
TMV-129-Q4	RCA TV Transmitters, Type TT-10AL, TT-10AH, TT-25BL, TT-25BH and TT-50AH. Other high frequency transmitters in frequency range indicated.	9 mc to 14 mc fundamental	MI-19400-L4

* For description of TMV-129-B and TMV-129-F Crystals, see under FM, AM and STL Crystals.

FM, AM and STL CRYSTAL UNITS

TMV-129 and RC SERIES

CRYSTAL UNIT, TMV-129-F

USES

The RCA type TMV-129-F Crystal Unit was designed for use in such applications as international broadcast transmitters or medium frequency communications equipment. The unit is very similar to the TMV-129-C series except that it has been provided with a variable frequency control. This feature has been found most valuable in international and foreign broadcast transmitters where intentional jamming of signals has been encountered. The transmitter channel may be cleared instantly by a slight rotation of the adjustment shaft. The RCA TMV-129-F unit is primarily intended for use with fundamental AT-cut or BT-cut crystals only. Hence, the recommended frequency range is limited to 1.8 mc to 8.5 mc.

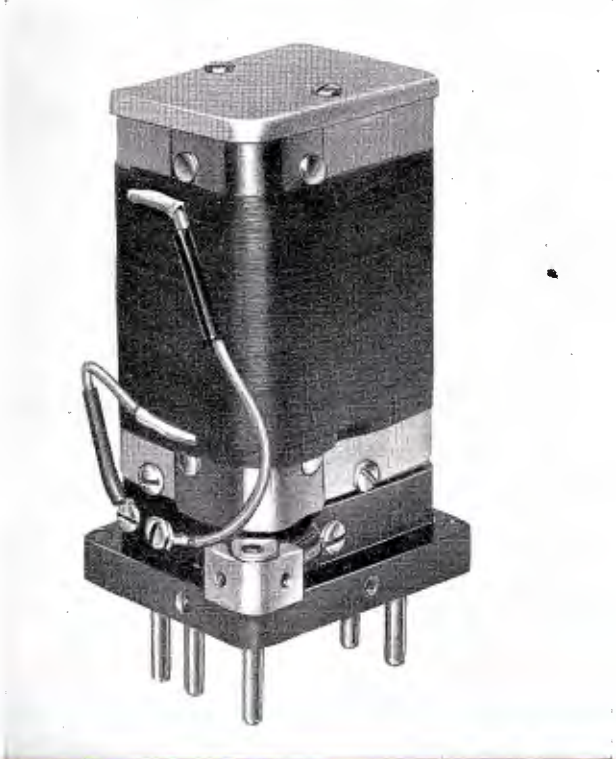
DESCRIPTION

The quartz plates employed in the TMV-129-F units are approximately 1-inch square, pressure air-gap mounted between nickel silver electrodes. This assembly is mounted in low-loss ceramic steatite brackets which are in turn firmly secured to a sturdy metal riser located centrally within the heater oven. The airgap between the upper face of the quartz plate and the top electrode is variable, and operable by rotation of a specially designed shaft provided with a screw-driver slot to facilitate adjustment under actual operating conditions. As the air-gap is varied to change the operating frequency, the crystal activity is also slightly affected. The recommended usable range of this variation in frequency is in terms of a crystal activity variation not exceeding 10% from the maximum.

A micrometer scale on the cover permits exact setting of the adjustment shaft. This provision is useful either to set the oscillator circuit to exact frequency, or deliberately to shift the frequency by a sufficient amount to avoid carrier interference with another station. The user also may employ the adjusting shaft at will to compensate for aging effects.

Where maximum frequency adjustment is desired, such as between ±.03% to ±.04%, an AT-cut quartz plate must be employed. In the higher frequency range between approximately 4 and 8.5 mc, a BT-cut crystal is normally employed where the desired frequency shift does not exceed ±.01%. Even in this higher frequency range a large percentage increase may be realized by specifying the use of an AT-cut crystal. Even greater shift is possible if crystal activity can be sacrificed more than the conventional 10% from the maximum.

A TMV-129 type Crystal Unit with outer case removed to show 14-watt heater and mounting base.



SPECIFICATIONS

Frequency Range	1.8 to 8.5 mc
Ambient Temperature Range	−20°C to +55°C
Operating Temperature	+60°C (other temperatures on special order)
Frequency Adjustment:	
AT-cut Plates	Nominal ±.03%
BT-cut Plates	Nominal ±.01%
Frequency Stability	±.005% or better
Crystal Mounting	Variable pressure air gap
Heater Power	14 watts from 110 volt a-c/d-c source
Stock Identification	MI-19400-A

CRYSTAL UNIT, Type TMV-129-B

USES

The RCA Type TMV-129-B Crystal Unit was designed especially for stable frequency control of transmitters operating in the AM broadcast band. However, in addition to covering the standard range from 550 to 1600 kc, these precision units are also available for frequencies as low as 325 kc and as high as 3000 kc. The units may be employed in any type of equipment within the applicable frequency range, where maximum frequency precision and high crystal activity are essential.

DESCRIPTION

Each TMV-129-B unit employs an AT-cut low-temperature coefficient quartz plate. The crystals are pre-dimensioned to provide the maximum freedom from spurious responses. Each plate is nearly one-inch square and has a thickness depending upon frequency. In the low portion of the frequency range the crystals are relatively heavy, as much as ⅛ inch thick. In spite of this they oscillate with excellent freedom.

A patented lower electrode is employed in each TMV-129-B crystal unit, furnishing a small fixed air gap beneath the central area of each crystal. This construction minimizes the wear of the very hard quartz plate on its seating surface, and gives assurance of positive starting and long life. The two electrodes are of low-porosity monel metal. The crystal unit also contains a patented feature comprising a blocking condenser and shunting 10-megohm resistor to avoid accumulation of d-c charges on the crystal faces, which otherwise would cause frequency jumps.

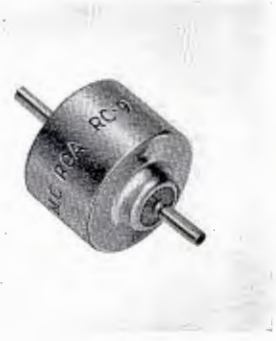
SPECIFICATIONS

Frequency Range	325 to 3000 kc
Ambient Temperature Range	−20°C to +55°C
Operating Temperature	+60°C (temperature controlled)
Frequency Stability	±10 cycles maximum (normally within ±2 cycles)
Quartz Plate Size	1.000" x .938", predimensioned
Heater Power	14 watts from a 110 volt a-c/d-c source
Stock Identification	MI-7467

CRYSTAL UNIT, Type RC-9

USES

The RCA type RC-9 Crystal Unit was designed for use in high frequency communications equipment and other electronic equipment of all types, both government and commercial. Output frequencies as high as 1000 mc may be obtained by use of not more than three frequency multiplier stages.



Excellent frequency stability is feature of RCA's Type RC-9 Crystal Unit used in high frequency communications equipment.

DESCRIPTION

The RC-9 crystal unit comprises a cylindrical metal case containing a circular, unplated AT-cut crystal, pressure air-gap mounted between low-loss ceramic electrodes which are silver plated to provide the essential conducting areas. The main cylindrical body is only ⅝" in diameter and ⅜" long. The two concentric end terminals are each 1/16" diameter by 3/16" long. The two end bells are shaped to contain a generous volume of glass insulation between the central pins and the metal case, making for low capacitance and freedom from mechanical strains within the glass beads themselves. The entire unit length, from tip to tip, is 1 1/16".

SPECIFICATIONS

Frequency Range	15mc to 50 mc
Temperature Range	−55°C to +90°C
Frequency Stability	±.005% or ±.01% max.
Stock Identification	MI-16263-B

INDEX

VHF TELEVISION TRANSMITTERS

UHF TELEVISION TRANSMITTERS

STL EQUIPMENT

TRANSMITTER CONTROL CONSOLES

INPUT AND MONITORING EQUIPMENT

INPUT AND MONITORING EQUIPMENT (Continued)

FILTERS

CRYSTAL UNITS

RCA REGIONAL OFFICES

Atlanta 3, Ga.
522 Forsyth Bldg., Jackson 4-7703

Boston 16, Mass.
200 Berkeley St., Hubbard 2-1700

Camden 2, N. J.
Front & Cooper Sts., Woodlawn 3-8000

Chicago 54, Ill.
1186 Merchandise Mart Plaza, Delaware 7-0700

Cleveland 15, Ohio
1600 Keith Bldg., Cherry 1-3450

Dallas 1, Texas
1907-11 McKinney Ave., Riverside 1371

Hollywood 28, Cal.
1560 N. Vine St., Hollywood 9-2154

Kansas City 6, Mo.
1006 Grand Ave., Harrison 1-6480

New York 20, N. Y.
36 W. 49th St., Judson 6-3800

San Francisco 2, Cal.
420 Taylor St., Ordway 3-8027

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2250 First Avenue, South, Main 8350

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1625 K St., N. W., District 7-1260

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