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RADIO CORPORATION OF AMERICA
BROADCAST & TELEVISION EQUIPMENT **CAMDEN, NEW JERSEY**

TV-13160

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BROADCAST TV TRANSMITTING EQUIPMENT CATALOG

(Third Edition)

PRICE $1.00

Page

RADIO CORPORATION OF AMERICA

Broadcast and Television Equipment 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, video equipment and industrial television 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 also manufactures many other electronic products including: TV tape recorders; two-way radio and microwave radio communication equipment; optical and magnetic film recording equipment; sound systems of all types; 16mm projectors and magnetic recorders; industrial inspection and automation equipment; scientific instruments, such as the electron microscope; industrial television systems; intercoms; and many types of custom-built equipment for industry, the military educational and medical services. Information describing these products 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

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District 7-1260

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2250 1st Avenue, South
SEATTLE 4, WASHINGTON
Main 2-8350

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 325 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, personnel 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 final building layouts should be prepared only from drawings supplied when equipment is purchased. 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-100AL/AH 100 watt transmitter used with two section super-turnstile antennas will provide Effective Radiated Powers up to 240 watts. The TTL-100AL covers channels 2 through 6 and the TTL-100AH covers channels 7 through 13. 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 500 Watts to 6 KW

The TTL-500AL/AH 500 watt transmitter types cover both low and high band channels. This low cost transmitter is applicable for standby service or permits initial low cost "on air" operation. ERP is determined primarily by transmitter power output times antenna gain less line loss.

VHF-ERP Range 2 to 20 KW

An economical arrangement using a Type TT-2BL/BH 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/BH make it an ideal transmitter for a combination studio and transmitter operation. The TT-2BL covers channels 2 through 6 and TT-2BH covers channels 7 through 13.

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

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

VHF-ERP Range 10 to 100 KW

An RCA 11 KW transmitter, when used with a high gain 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 316 KW

25 KW Transmitters are available for low and high band VHF channels. When used with the proper gain super-turnstile or traveling wave antenna these transmitters can provide maximum permissible radiated power.

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

With 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 25 KW to 1 Megawatt

One megawatt of power can be obtained by using 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

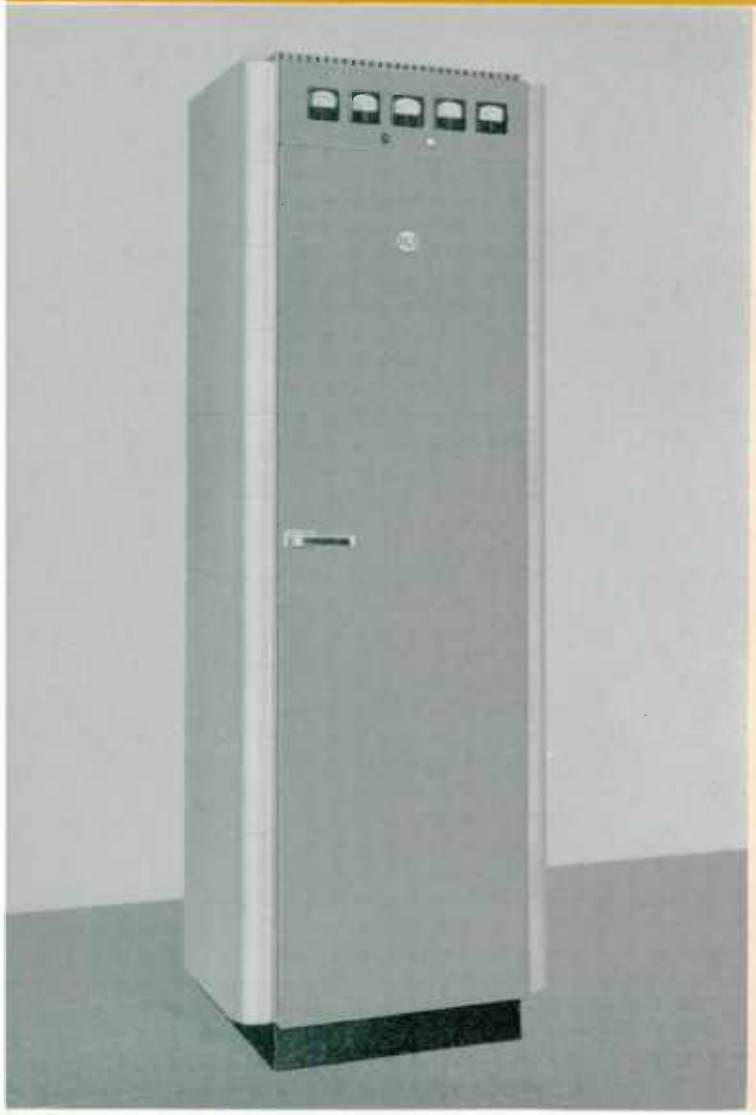
A tabulation of the major characteristics of RCA television transmitters and amplifiers is shown below. More detailed specifications are contained on the pages describing the individual transmitters.

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-100AL/AH	2-13	0.12	0.65	107/117	1	1.4	1.5
TTL-500AL/AH	2-13	0.5	0.25	107/117	1	1.4	1.5
TT-2BL	2-6	2	1.2	208/230	3	10.0	11.0
TT-2BH	7-13	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-11AH	7-13	11	6	208/230	3	34.3	41.1
TT-25CL	2-6	25	15	208/230	3	76.5	91.0
TT-25CH	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-25B	14-83	25	12.5	460	3	108.0	130.0

120 WATT VHF TV TRANSMITTER

Type TTL-100AL/AH



FEATURES

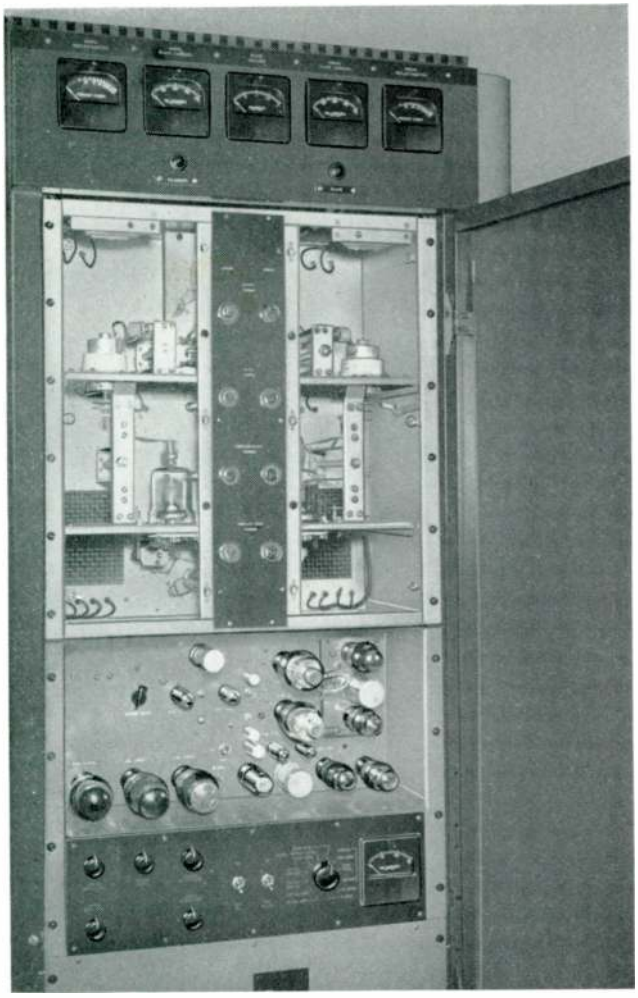
- Economical low powered installation for origination or satellite operation
- Housed in single standard audio rack—extremely compact and lightweight
- Designed for unattended operation
- Air cooled tubes used throughout. 4X250B's used in final amplifier. All tubes used are easily obtainable, inexpensive and dependable
- Designed for color
- Independent circuits for visual and aural sections of transmitter
- Built-in intercarrier frequency control
- All operating controls accessible from front of unit
- Dry rectifiers—25,000 hour minimum life

DESCRIPTION

The TTL-100AL/AH is a complete television transmitter, housed in a single audio rack, capable of developing 120 watts peak visual carrier power and 60 watts of aural carrier power on VHF channels 2 to 13. It is a 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 internal transmitter relay from any convenient location. It provides an economical low power installation for origination of TV programs or for satellite operation.

The TTL-100AL/AH will meet standard FCC color specifications when normal transmitter auxiliaries such as color stabilizing amplifier, video low-pass filter, vestigial sideband filter and phase equalizers are included. The equipment is extremely compact, being housed in a standard audio rack. The circuits employ latest design features and afford economical operation. The equipment features standard, low-cost tubes, all of which are air-cooled and dependable. Separate amplifier stages are used to amplify the visual and aural carriers, resulting in more efficient operation.

RCA's new 120-watt TTL-100AL/AH 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 TTL-100 AL/AH is designed for dependable and stable



Open view of TTL-100AH VHF TV transmitter showing aural and visual r-f cubicles, and modulator chassis and control panel mounted below.

operation for long periods without need for adjustment, and is therefore an ideal transmitter for unattended operation. By controlling the a-c line breaker, an integral transmitter relay, the transmitter 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 120 watts peak visual carrier power and 60 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 five 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.

Exciter Circuits

The TTL-100AL/AH transmitter is driven by a common exciter containing both visual and aural chains. Accurate control of the separation of visual and aural carrier frequencies is the result of precise engineering circuit design. The visual chain is driven by either one of the two crystal controlled 6AK5 oscillator circuits as a primary source of frequency control. Oscillators may be switched by means of a d-c relay, thus making this circuit adaptable for remote control. The crystals operate at one-twelfth of the output frequency of the exciter. The aural master oscillator is a free-running 6V6 oscillator controlled by a pair of 6V6 reactance tubes which are part of the automatic-frequency control circuit used to maintain the 4.5 mc separation between carriers. An off-frequency interlock prevents uncontrolled frequency operation by cutting off plate voltage to the stages that follow the exciter. The aural master oscillator operates at one-twelfth the output of the exciter.

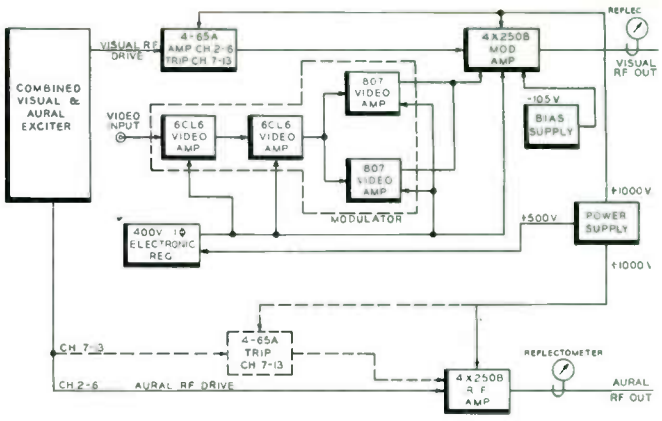
The automatic frequency control of the aural master oscillator is accomplished by feeding a small amount of energy from the aural and visual oscillator, amplifier or tripler into a 6AS6 mixer tube depending on whether it is a AL or AH unit. When the aural oscillator is on frequency the output of this mixer stage will be one-twelfth of the difference frequency between the aural and visual carriers or 375 kc. The 375 kc signal mixes with the output of the 6J6 crystal controlled reference oscillator (1500 kc) in the second 6AS6 mixer stage. The difference frequency is amplified and fed through a chain of three dividers with a total division of 100 to the frequency detector stage. This amount of division is necessary to reduce the swing at the frequency detector so that the carrier will not drop out under any modulation conditions of the aural transmitter. The 6J6 reference oscillator signal is fed through three divider stages with a total division of 80 to the frequency detector stage. By using the 6J6 reference oscillator to excite both the second mixer and the divider chain to furnish a reference frequency, considerable improvement in frequency control accuracy is obtained. Signals from both the difference frequency and the reference frequency chains are fed into the frequency detector. 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.

Aural Modulator

Frequency modulation is accomplished in the TTL-100-AL/AH exciter by a "direct modulation" process requiring less components, fewer tubes and tube types. This process, which eliminates numerous multipliers and converter stages resulting in low noise and minimum distortion, utilizes two push-pull reactance tubes connected across the frequency determining circuit of the master oscillator. The center frequency of this oscillator is precisely maintained by the automatic frequency control circuit described previously in the exciter description.

Frequency modulation is obtained by feeding the audio signal into the reactance tubes which are connected across the oscillator plate tank circuit. R-f energy from the oscillator tank is link coupled to a transformer which has a coil in the grid circuit of each reactance tube. R-f voltages on the push-pull connected grids are 180 degrees out of phase with each other and each is 90 degrees out of phase with respect to the r-f voltage at the plates. Thus, across the oscillator tank one tube appears as a capacitive reactance and the other as an inductive reactance. The magnitude of the reactive plate current in the reactance tubes varies in direct proportion to the value of audio voltage applied to the grids. Therefore, the frequency of the oscillator is varied at an audio rate to furnish the required FM signal. The mean frequency of the

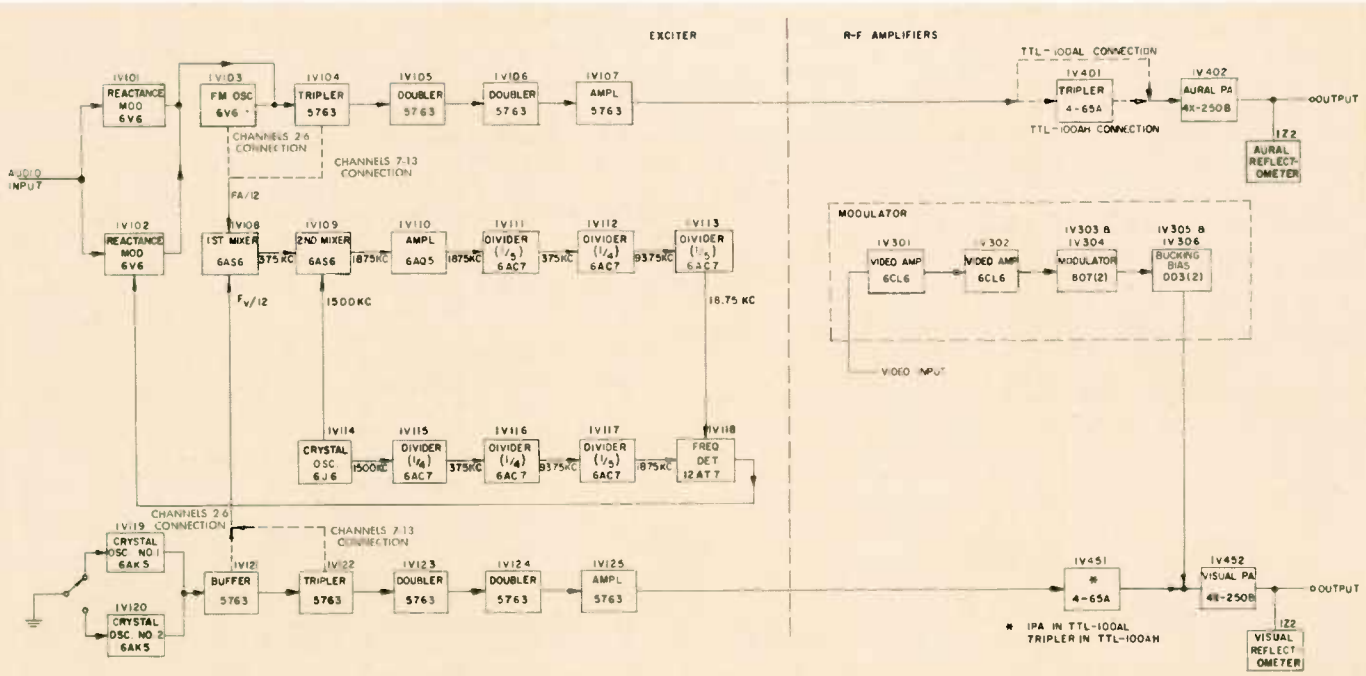


Simplified block diagram of the TTL-100AL/AH Transmitter.

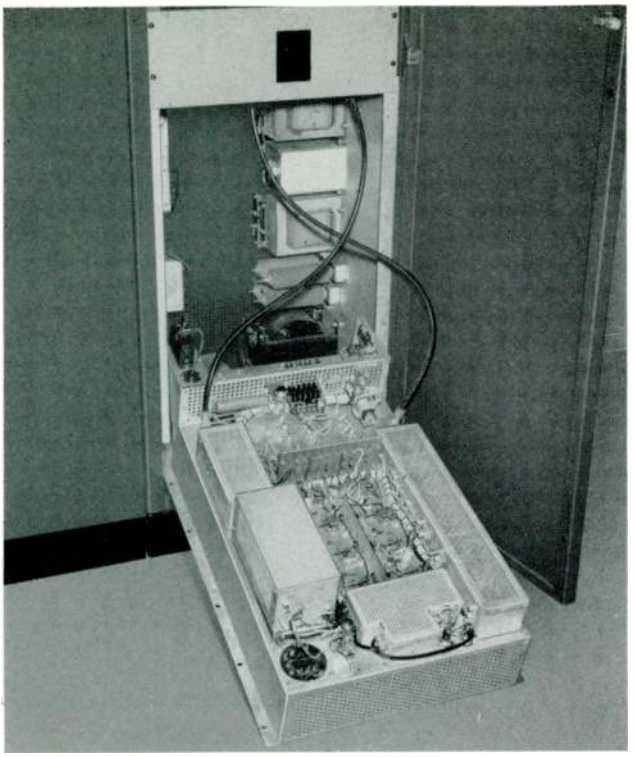
oscillator is controlled by varying the grid bias of one of the reactance tubes. This bias voltage is the d-c output voltage of the frequency detector stage of the exciter.

I. P. A. and Modulated Amplifier Stages

The aural and visual outputs of the common exciter are fed to separate 4-65A triplers for channels 7-13. For channels 2-6 the 4-65A stage is omitted on the aural side but is retained on the visual side where it serves as an amplifier. The output of these stages is at carrier frequency and at a power level sufficient to drive the 4X250B amplifier stages which follow. The 4-65A stages are identical, simplifying maintenance and spare



Block diagram of the TTL-100AL/AH Common Exciter Unit.



Aural and visual exciter circuits of the TTL-100AL/AH are mounted on a single hinged chassis allowing access to transformers, filters and other components housed in bottom of transmitter cabinet.

part requirements. The 4X250B visual amplifier is grid modulated, and has an output circuit bandwidth suitable for color TV transmission. The aural output stage is also a 4X250B and is conventional throughout. A reflectometer is included in each transmission line.

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)	120 W. (Peak)	65 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

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	3
4-65A	Visual I. P. A.	1
4-65A	Aural I. P. A. (Channels 7-13 only)	1
4X250B	Modulator and R-F Amplifier	2
6CL6	Video Amplifier	2
807	Modulator	2
OC3	Regulator	2
6SL7-GT	Regulator Amplifier	1
OA2	Regulator	2
6AS7-G	Voltage Regulator	3

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

Optional and Accessory Equipment

Complete Set of Spare Tubes (for TTL-100AL)	MI-27835
FCC Spare Set of Tubes (for TTL-100AL)	MI-34412
Complete Set of Spare Tubes (for TTL-100AH)	MI-27836
FCC Spare Set of Tubes (for TTL-100AH)	MI-34413

* 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.).

500 WATT VHF TV TRANSMITTER

Type TTL-500 AL/AH

FEATURES

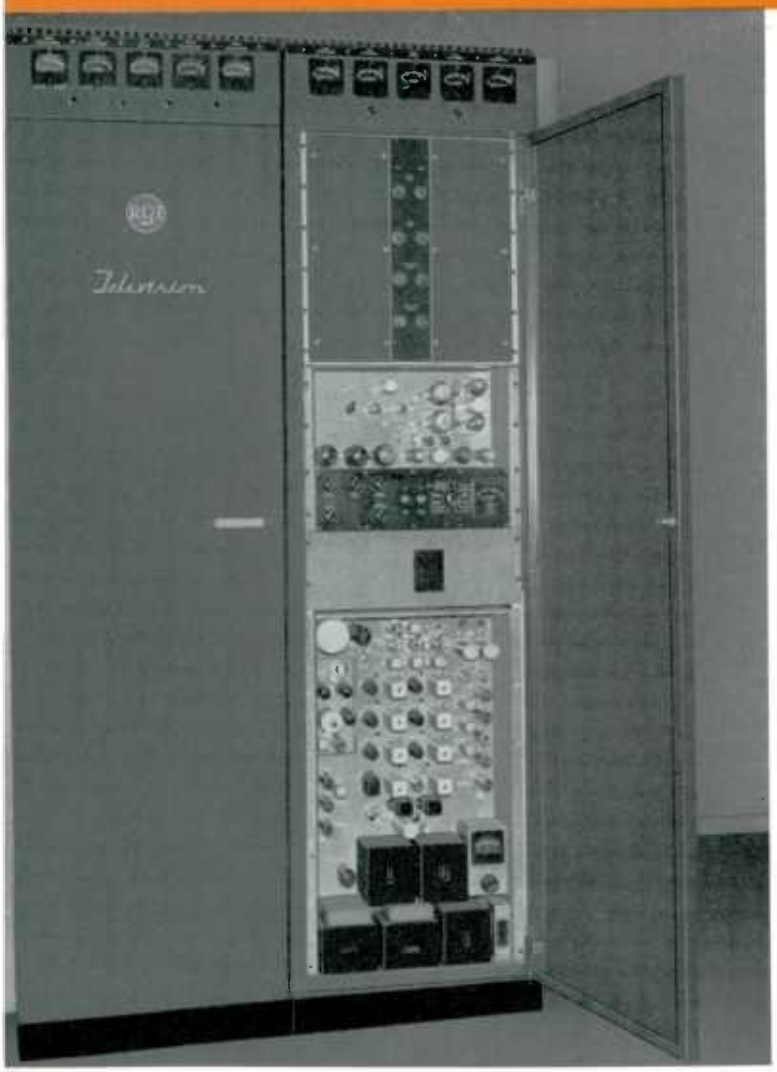
- Economical low powered installation
- Housed in two standard audio racks—extremely compact and lightweight
- Designed for unattended operation
- Air cooled tubes used throughout. 4X500A's used in final amplifier. All tubes used are easily obtainable, inexpensive and dependable
- Designed for color
- Independent circuits for visual and aural sections of transmitter
- Built-in intercarrier frequency control
- All operating controls accessible from front of unit
- Dry rectifiers—25,000 hour minimum life

DESCRIPTION

The TTL-500AL/AH is a complete television transmitter. housed in two audio racks, capable of developing 500 watts peak visual carrier power and 300 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 internal transmitter relay from any convenient location. It provides an economical low power installation for origination of TV programs. When desired the transmitter can be cut back with appropriate switching equipment to provide an interim output of 120 watts peak visual power and 60 watts aural. The new TTL-500AL/AH will meet standard FCC color specifications when normal transmitter auxiliaries such as color stabilizing amplifier, video low-pass filter, and phase equalizers are included.

The equipment is extremely compact and weighs about 1200 pounds. The circuit employs latest design features which permit economical operation. The equipment features standard, low-cost tubes, all of which are air-cooled and dependable. Separate amplifier stages are used to amplify the visual and aural carriers, resulting in more efficient operation.

RCA's new 500-watt TTL-500AL/AH Transmitter is housed in two standard type BR-84 racks 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. The TTL-500AL/AH is therefore designed for dependable and stable operation for long periods without need for adjustment. By controlling the a-c line breaker, an integral transmitter relay, the transmitter may be turned on and off remotely from any convenient location.



TTL-500AL/AH Transmitter with driver cabinet open.

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 500 watts peak visual carrier power and 300 watts of aural carrier power on channels 2 to 13. The steel cabinet housing is 84⅞" high, 50" wide and 20½" deep (less door handle). The transmitter weighs approximately 1200 pounds. All operating controls are accessible from the front, and ten meters, mounted above the hinged front doors, meter all critical circuits.

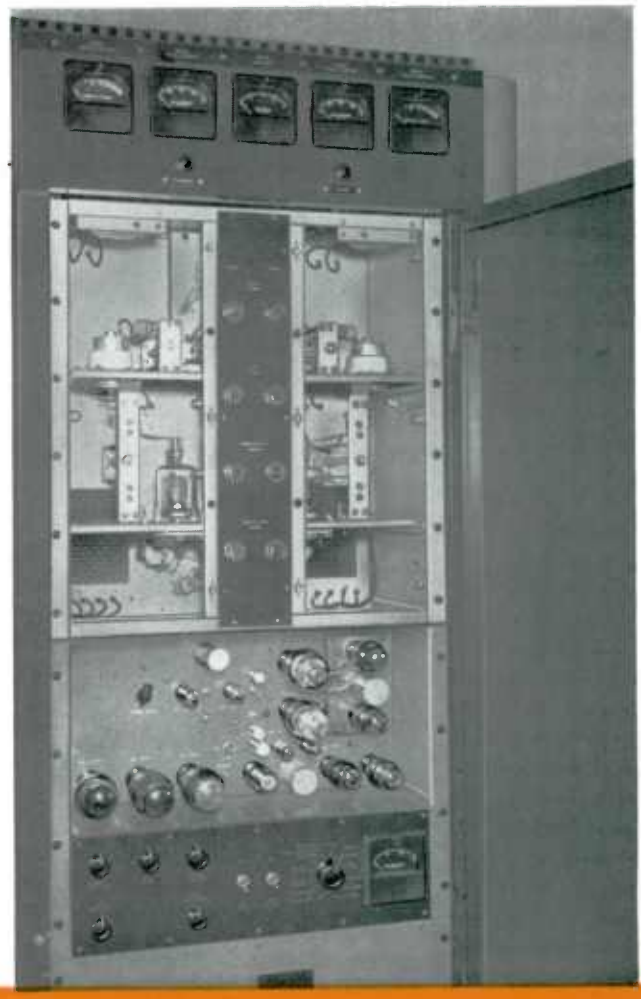
Plate voltage for the transmitter is furnished by dry germanium and selenium rectifiers which are designed for a minimum of 25,000 hours of operation.

Exciter

The TTL-500AL/AH transmitter is driven by a common exciter containing both visual and aural chains. Accurate control of the separation between visual and aural carrier frequencies is the result of precise engineering circuit design. The visual chain is driven by either one of the two crystal controlled 6AK5 oscillator circuits as a primary source of frequency control. Oscillators may be switched by means of a d-c relay, thus making this circuit adaptable for remote control. The crystals operate at one-twelfth of the visual output frequency of the exciter. The aural master oscillator is a free-running 6V6 oscillator controlled by a pair of 6V6 reactance tubes which are part of the automatic-frequency control circuit used to maintain the 4.5 mc separation between carriers. An off-frequency interlock prevents uncontrolled frequency operation by cutting off plate voltage to the stages that follow the exciter. The aural master oscillator operates at one-twelfth the output of the exciter.

The automatic frequency control of the aural master oscillator is accomplished by feeding a small amount of energy from the aural and visual oscillator, amplifier or triplers into a 6AS6 mixer tube depending on whether it is an AL or AH circuit. When the aural oscillator is on frequency the output of this mixer stage will be one-twelfth of the difference frequency between the aural and visual carriers or 375 kc. The 375 kc signal mixes with the output of the 6J6 crystal controlled reference oscillator (1500 kc) in the second 6AS6 mixer stage. The difference frequency is amplified and fed through a chain of three dividers with a total division of 100 to the frequency detector stage. This

View showing high-band driver aural and visual r-f cubicles with modulator chassis and control panel mounted below.



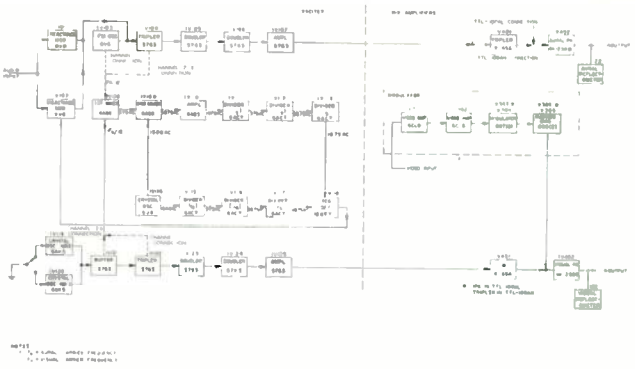
amount of division is necessary to reduce the swing at the frequency detector so that the carrier will not drop out under any modulation conditions of the aural transmitter. The 6J6 reference oscillator signal is fed through three divider stages with a total division of 80 to the frequency detector stage. By using the 6J6 reference oscillator output to excite both the second mixer and the divider chain to furnish a reference frequency, considerable improvement in the frequency control accuracy is obtained. Signals from both the difference frequency and the reference frequency chains are fed into the frequency detector. 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.

Aural Modulator

Frequency modulation is accomplished in the TTL-500-AL/AH exciter by a "direct modulation" process requiring less components, fewer tubes and tube types. This process, which eliminates numerous multipliers and converter stages resulting in low noise and minimum distortion, utilizes two push-pull reactance tubes connected across the frequency determining circuit of the master oscillator. The center frequency of this oscillator is precisely maintained by the automatic frequency control circuit described previously in the exciter description.

Frequency modulation is obtained by feeding the audio signal into the reactance tubes which are connected across the oscillator plate tank circuit. R-f energy from the oscillator tank is link coupled to a transformer which has a coil in the grid circuit of each reactance tube. R-f voltages on the push-pull connected grids are 180 degrees out of phase with each other and each is 90 degrees out of phase with respect to the r-f voltage at the plates. Thus, across the oscillator tank one tube appears as a capacitive reactance and the other as an inductive reactance.

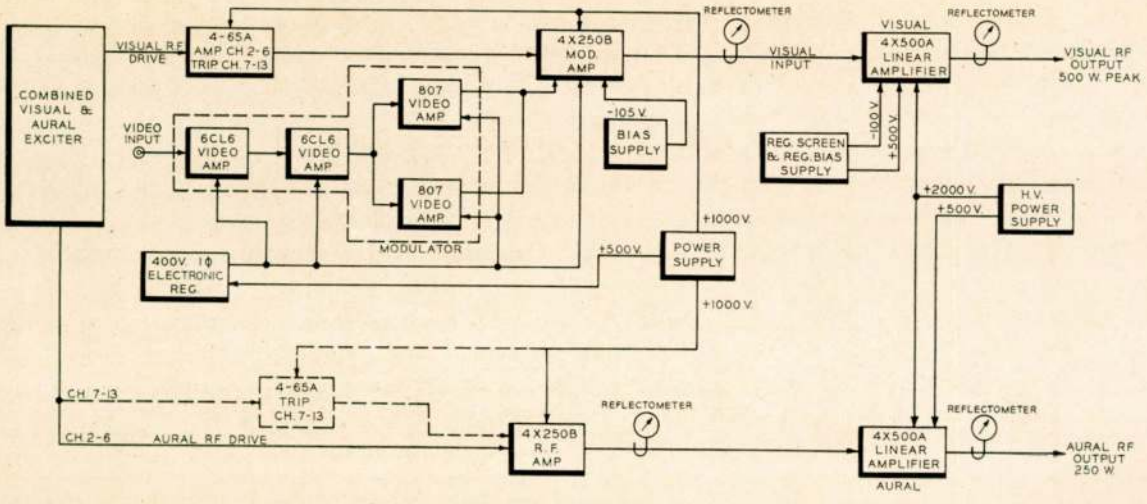
The magnitude of the reactive plate current in the reactance tubes varies in direct proportion to the value of audio voltage applied to the grids. Therefore, the frequency of the oscillator is varied at an audio rate to furnish the required FM signal. The mean frequency of the oscillator is controlled by varying the grid bias of one of the reactance tubes. This bias voltage is the d-c output voltage of the frequency detector stage of the exciter.



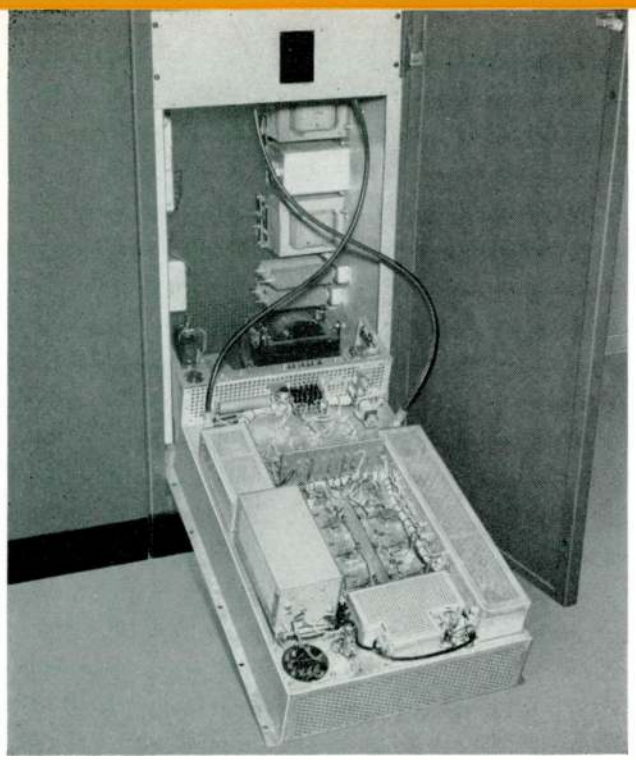
Block diagram of Aural/Visual Exciter Unit.

I. P. A. and Modulated Amplifier Stages

The aural and visual outputs of the common exciter are fed to separate 4-65A triplers for channels 7-13. For channels 2-6 the 4-65A stage is omitted on the aural side. On the visual side the 4-65A stage is an amplifier. The output of these stages is at carrier frequency and at a power level sufficient to drive the 4X250B amplifier stages which follow. The 4-65A stages are identical, simplifying maintenance and spare part requirements. The 4X250B visual modulated amplifier is grid modulated, and has an output circuit bandwidth suitable for color TV transmission. The aural driver output stage is also a 4X250B and is conventional throughout. It utilizes many identical parts used on the visual side, again simplifying maintenance and spare part requirements. A reflectometer is included in each transmission line. Both aural and visual driver outputs appear at a standard 51.5 ohm RG-8/U fitting. Following each 4X250B is a 4X500A in a grounded-grid,



Block diagram of the TTL-500AL/AH Transmitter.



Aural and visual exciter circuits of the TTL-500AL/AH are mounted on a single hinged chassis allowing access to transformers, filter and other components housed in bottom of transmitter cabinet.

grounded-screen linear amplifier circuit. The linear amplifiers are separate and identical, one developing 500 watts peak visual power output, the other 300 watts aural power output. Here again a reflectometer is included in each 1⅝" output transmission line. The r-f cabinet, power supplies, control circuitry and blower for the 500 watt amplifier are contained in one BR-84 cabinet, the driver in the other. 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)	500 W. (Peak)	300 W.
RF Output Impedance (1⅝" 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	208/230 v. 1 ph., 60 cps
Slow Variations	±5%
Rapid Variations	±3%
Power Consumption	Approx. 3000 W.
P.F. (approx.)	90%
Maximum Altitude	7500 ft.
Ambient Temperature	0°C—45°C

Tube Complement

Type	*Function*	*Qty.*
6V6	Reactance Tube Modulator	2
6V6	FM Master Oscillator	1
5763	1st Aural Multiplier	1
5763	2nd Aural Amplifier	1
5763	3rd Aural Amplifier	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 Multipler	1
5763	2nd Visual Multiplier	1
5763	3rd Visual Multiplier	1
5763	Amplifier—Visual Output	1
OD3	Voltage Regulator	3
4-65A	Visual I. P. A.	1
4-65A	Aural I. P. A. (Channels 7-13 only)	1
4X250B	Modulator and R-F Amplifier	2
6CL6	Video Amplifier	2
807	Modulator	2
6SL7-GT	Regulator Amplifier	1
OA2	Regulator	2
6AS7-G	Voltage Regulator	3
OC3	Regulator	2
4X500A	R-F Amplifiers	2
5R4GY	Screen Rectifier	1
6X4	Bias Rectifiers	2
6080	Screen Regulator	1
6BL7-GT	Bias Regulator	1
6AU6	Regulator Amplifiers	2
OC3	Regulators	4
OD3	Regulator	1

Mechanical Specifications

Height	84⅞"
Width	50"
Depth (less door handle)	20½"
Weight	1200 lbs. (approx.)

Equipment Supplied

TTL-500AL/AH Transmitter complete in cabinet. Order as:

ES-27259	For Channels 2-6
ES-27260	For Channels 7-13

Optional and Accessory Equipment

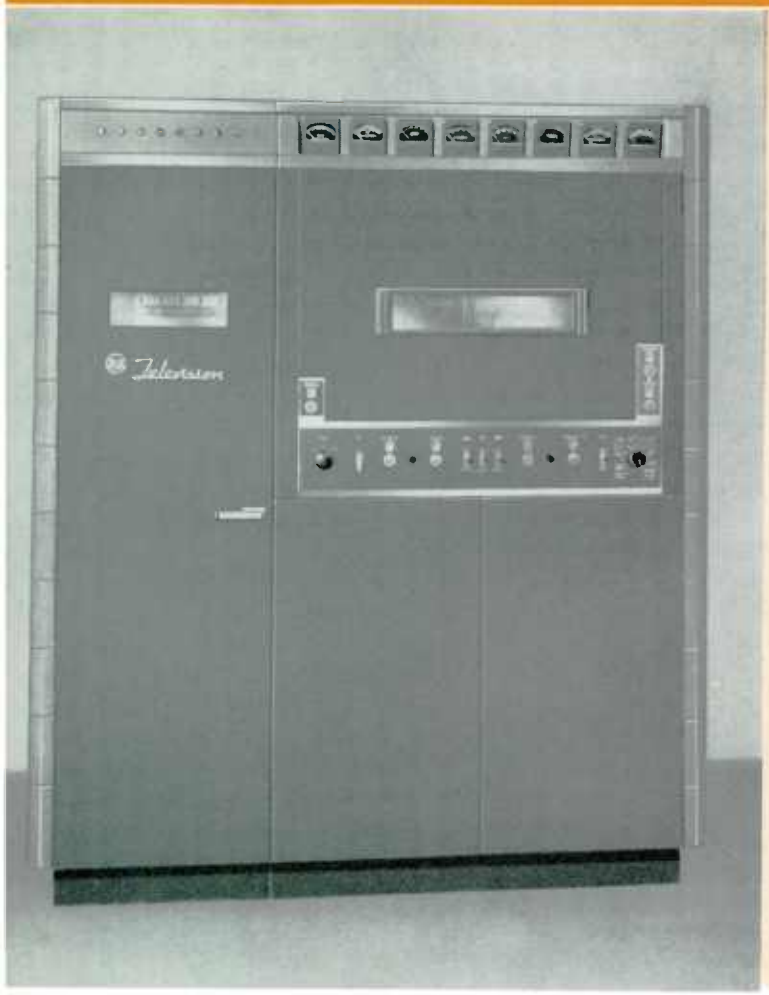
Complete Set of Spare Tubes (for TTL-500AL)	MI-27850/27835
FCC Set of Spare Tubes (for TTL-500AL)	MI-34411/34412
Complete Set of Spare Tubes (for TTL-500AH)	MI-27850/27836
FCC Set of Spare Tubes (for TTL-500AH)	MI-34411/34413

* 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.).

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
- 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 allow operation at low ambient temperatures

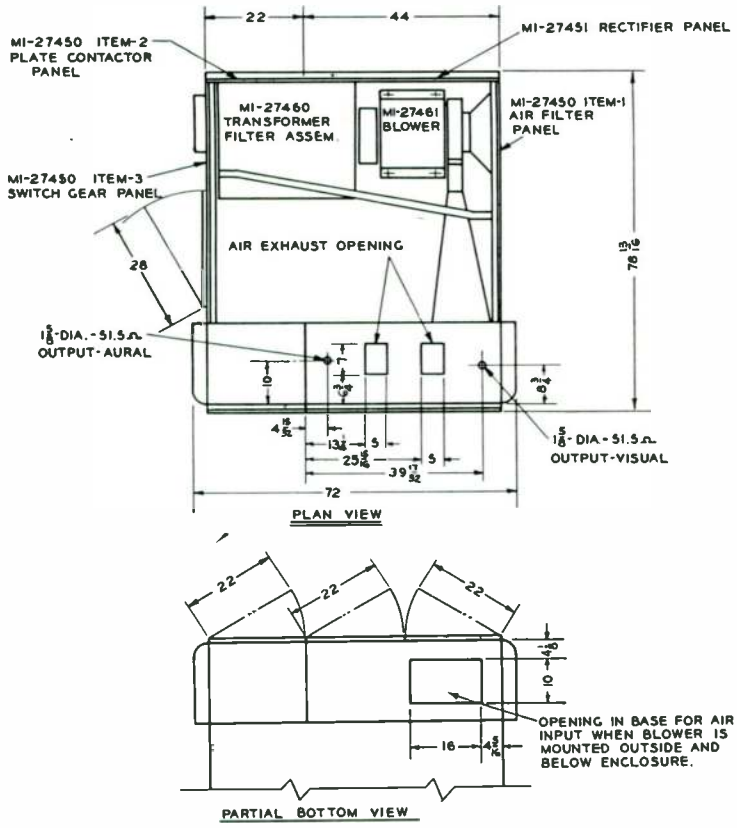
DESCRIPTION

The TT-2BL VHF Television Transmitter is designed for television stations with effective radiated power requirements ranging from 2 to 24 kilowatts. This economical, low-power transmitter will provide adequate signal strength to meet the 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 oscillator 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.

The RCA Type TT-2BL VHF Television Transmitter is designed to conform with all FCC and EIA 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 a minimum of floor space. All r-f circuits and control circuits are located at the front of the enclosure. The rectifier tubes are mounted on the rear wall and the heavy power components are mounted on the floor. The control unit is at the left front corner 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 in the control unit behind a non-interlocked 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 the aural and visual r-f power stages, the exciter and modulator units. The modulator and exciter units are located at the bottom of the rack behind dutch doors, and are 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 circuits. Tuning controls are operated by a crank which is removable to prevent accidental misadjustment of the circuits during operation. Easily read counter dials make possible 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 rack and r-f rack as well as the rectifier mounted on the rear wall of the enclosure. These rectifiers have thermostatically controlled heaters for the rectifier tubes which permit 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 interlock 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 may be seen in the floor plan shown.

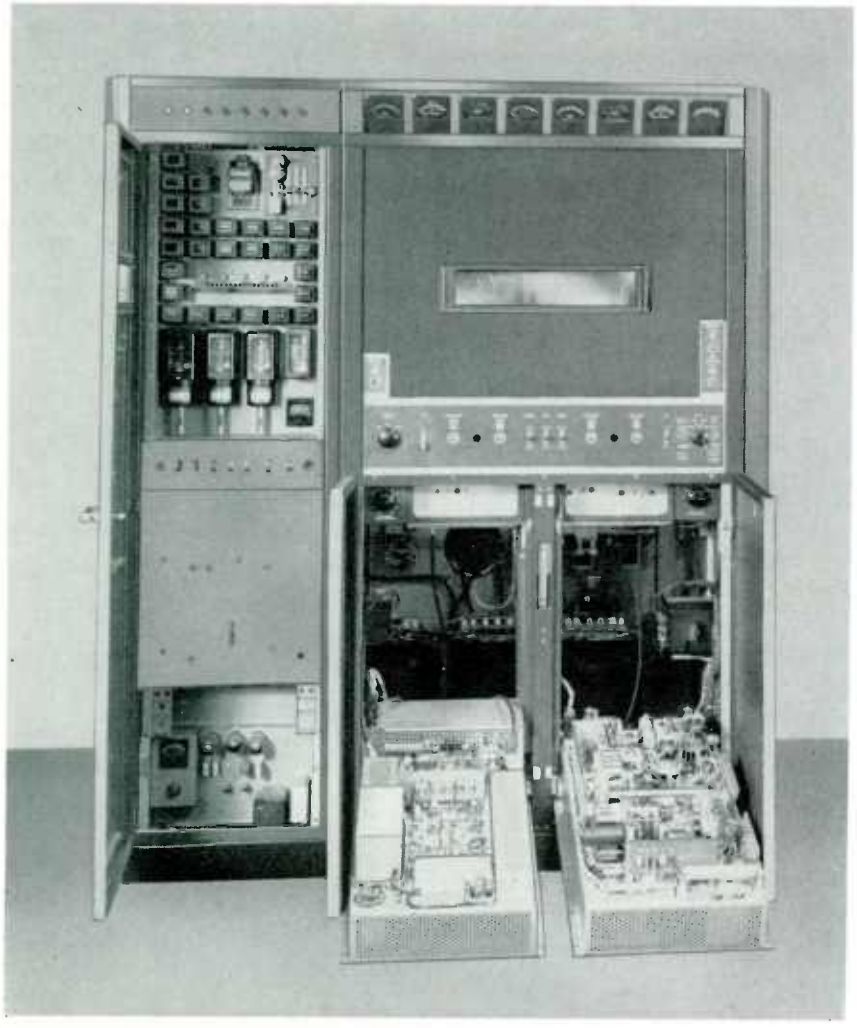
Exciter Circuit

The TT-2BL transmitter is driven by a common exciter containing both visual and aural chains. Accurate control of the separation of visual and aural carrier frequencies is the result of precise engineering circuit design. The visual chain is driven by either one of the two crystal

controlled 6AK5 oscillator circuits as a primary source of frequency control. Oscillators may be switched by means of a d-c relay, thus making this circuit adaptable for remote control. The crystals operate at one-twelfth the visual carrier frequency and one-twelfth of the output frequency of the exciter. The aural master oscillator is a free-running 6V6 oscillator controlled by a pair of 6V6 reactance tubes which are part of the automatic-frequency control circuit used to maintain the 4.5 mc separation between carriers. An off-frequency interlock prevents uncontrolled frequency operation by cutting off plate voltage to the stages that follow the exciter. The aural master oscillator operates at one-twelfth of the carrier frequency with the output of the exciter on the carrier frequency.

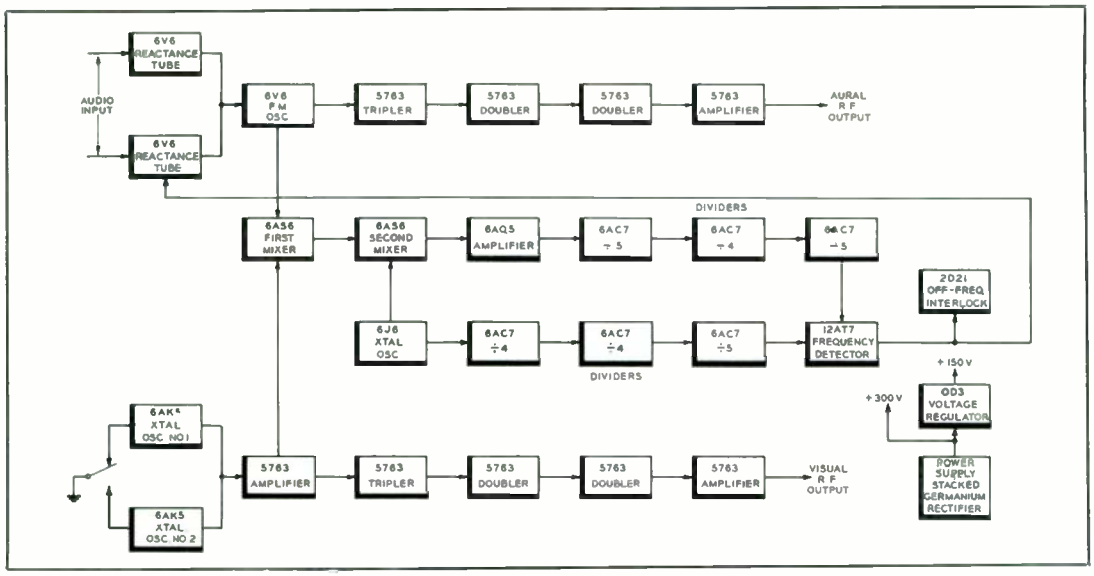
The automatic frequency control of the aural master oscillator is accomplished by feeding a small amount of energy from the aural oscillator and visual crystal oscillator amplifier stage into a 6AS6 mixer tube. When the aural oscillator is on frequency the output of this mixer stage will be one-twelfth of the difference frequency between the aural and visual carriers or 375 kc. The 375 kc signal mixes with the output of the 6J6 crystal controlled reference oscillator (1500 kc) in the second 6AS6 mixer stage. The difference frequency is fed through a chain of three dividers with a total division of 100 to the frequency detector stage. This amount of division is necessary to reduce the swing at the frequency detector so that the carrier will not drop out under any modulation conditions of the aural transmitter. The 6J6 reference oscillator signal is fed through three divider stages with a total division of 80 to the frequency detector stage. By using the 6J6 reference oscillator output to excite both the second mixer and the divider chain for reference frequency, considerable improvement in frequency control accuracy is obtained. Signals from both the difference frequency and the reference frequency chains are fed into the frequency detector. 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.

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. Excitation control of the visual modulated amplifier is accomplished 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.



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

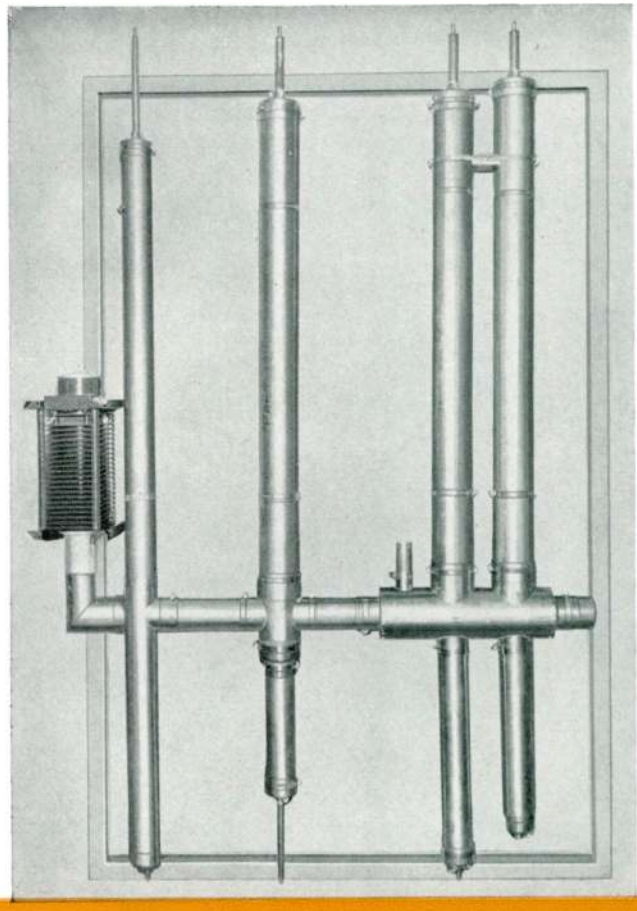
Video Modulator

The modulator of the transmitter is designed to take a standard 0.7 volt video signal and amplify it sufficiently so that it can grid modulate the 6076 stage. This requires about 220 volts peak-to-peak from the modulator. The first stage of the modulator is a conventional shunt-series peaked 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 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 the diode 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 grids of these three tubes are fed with a signal from the plate load of the two cathode follower tubes. This essentially makes the circuit a feedback 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 tube without losing the d-c component. Back porch clamping is employed. A carefully designed sync separator and clipper

The new M-derived vestigial sideband filter, ES-27233, designed for the TT-2BL Transmitter.



circuit provides reliable clamping even with greatly degraded input signal.

A two stage monitor amplifier is employed. It can be seen 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 unwanted video resonances.

Aural Modulator

Frequency modulation is accomplished in the TT-2BL exciter by a "direct modulation" process requiring less components, fewer tubes and tube types. This process, which eliminates numerous multipliers and converter stages resulting in low noise and minimum distortion, utilizes two push-pull reactance tubes connected across the frequency determining circuit of the master oscillator. The center frequency of this oscillator is precisely maintained by the automatic frequency control circuit described previously in the exciter description.

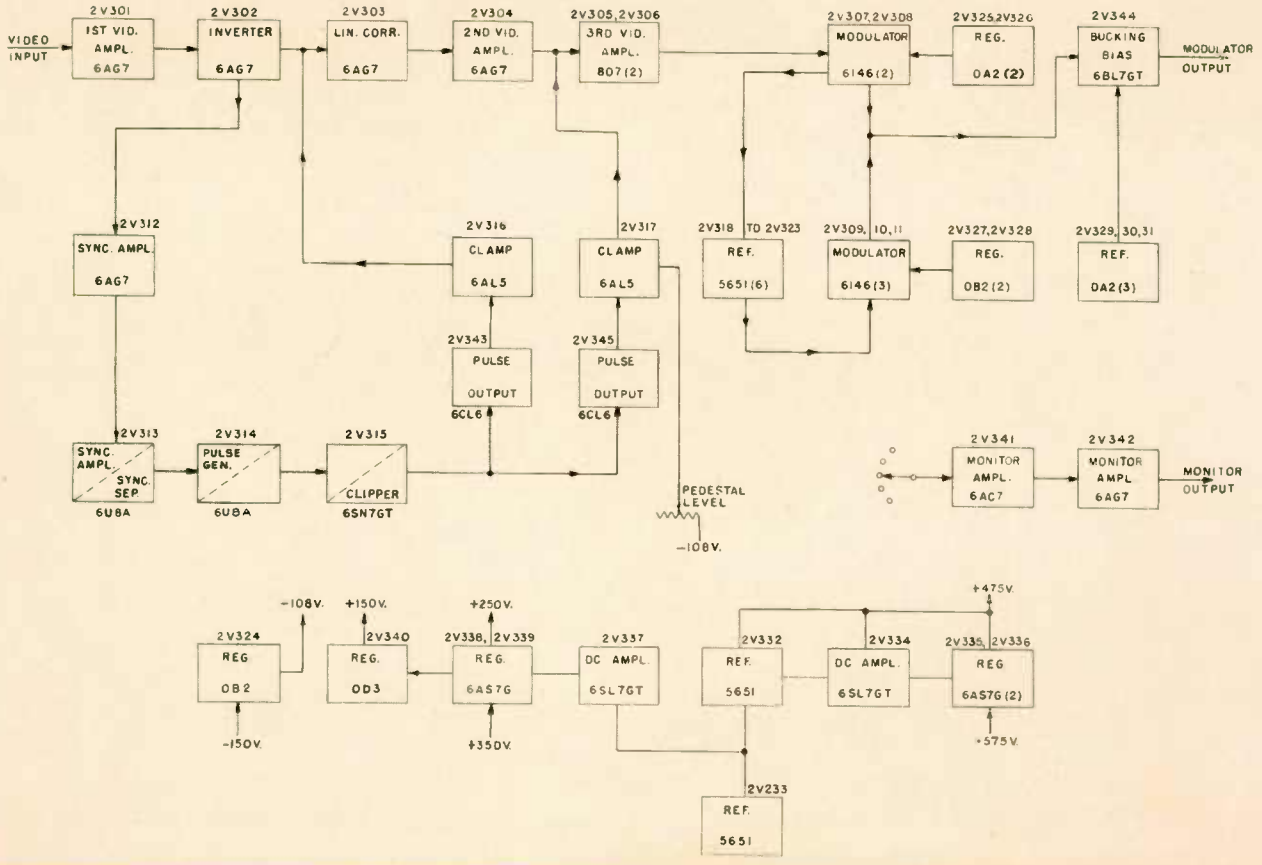
Frequency modulation is obtained by feeding the audio signal into the reactance tubes which are connected across the oscillator plate tank circuit. R-f energy from the oscillator tank is link coupled to a transformer which has a coil in the grid circuit of each reactance tube. R-f voltages on the push-pull connected grids are 180 degrees out of phase with each other and each is 90 degrees out of phase with respect to the r-f voltage at the plates. Thus, across the oscillator tank one tube appears as a capacitive reactance and the other as an inductive reactance.

The magnitude of the reactive plate current in the reactance tubes varies in direct proportion to the value of audio voltage applied to the grids. Therefore, the frequency of the oscillator is varied at an audio rate to furnish the required FM signal. The mean frequency of the oscillator is controlled by varying the grid bias of one of the reactance tubes. This bias voltage is d-c output voltage of the frequency detector stage of the exciter.

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

Block diagram of the TT-2BL Modulator.



with only four power supplies: An exciter supply built into the common exciter unit using stacked germanium diodes; a 700 volt low voltage rectifier, using two 866-A tubes, which supplies the screen voltage for all the r-f power amplifiers; a 3800 volt high voltage supply using six 8008 tubes in a 3 phase full wave circuit; and the modulator and bias supply, using two 866-A tubes and one 5R4-GY tube, which supplies the plate voltage for the modulator and the bias for all r-f stages.

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 breaker are provided. Each incorporates 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 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 may be intermittent.

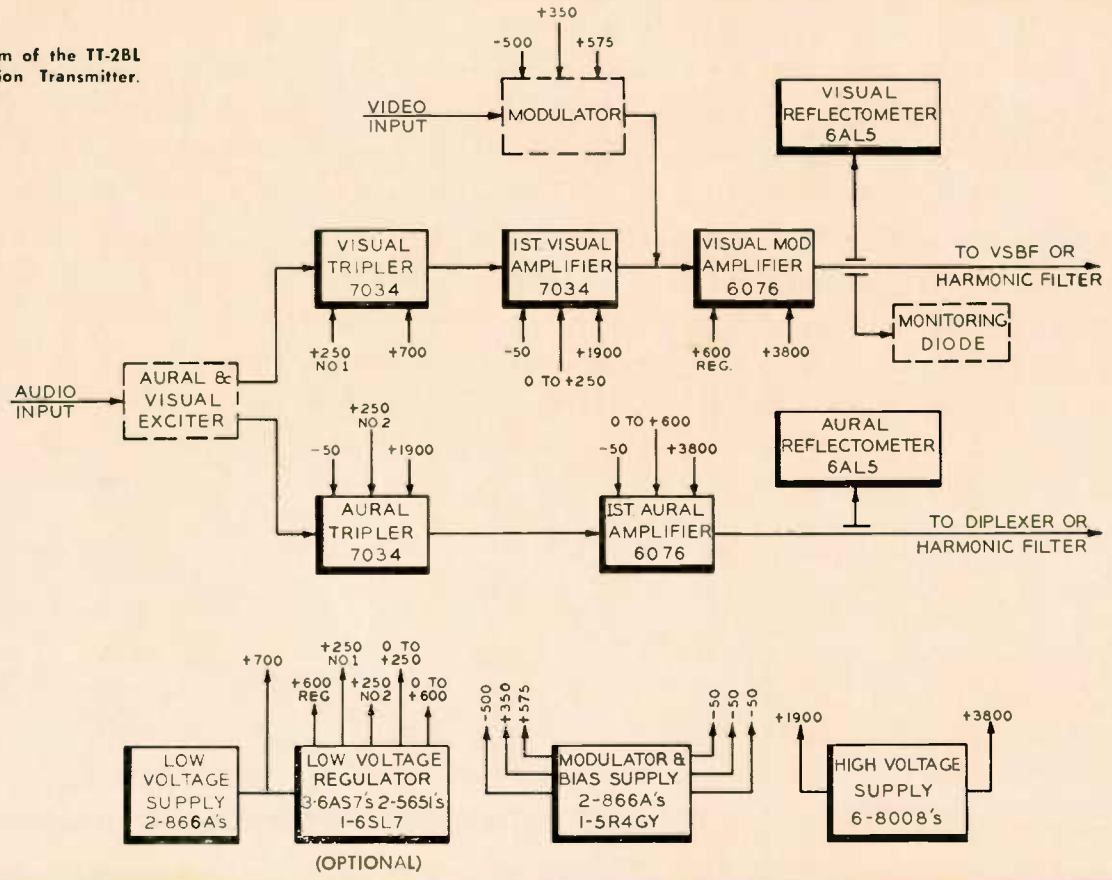
The equipment includes a line corrector which provides an adjustable line voltage to the filament primaries, the exciter, the modulator, and the low voltage rectifiers. Automatic filament line voltage regulators and automatic regulators capable of handling the complete transmitter are available as optional items. In localities troubled with excessive instantaneous line voltage fluctuation, an electronically controlled regulator for the low voltage supply is available as optional equipment.

Special Protective Circuits

The TT-2BL has reflectometer units for use 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 checked 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.

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



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 of 51.5 ohms at one end of the filter. 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 the phase distortion which is 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.

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 ahms	51.5 ahms
Input Impedance	75 ohms	600/150 ohms
Input Level	.7 v. pk. ta pk. min.	+10 ±2 dbm
Amplitude vs. Frequency Response		Unifarm ±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.	45 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-5B 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-5B Sideband Response Analyzer at brightness levels of 22.5% and 67.5% of sync peak, using approximately 20% (peak to peak) modulation.

	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]	±1.5 db max.	
Envelope Delay vs. Frequency[11]	±.08 μsec. fram 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

[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 diade demadulator. In addition, the total differential phase between any two levels shall not exceed 10°.

[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 fram standard curve. The tolerances vary linearly between 2.1 and 3.58 mc and between 3.58 and 4.18 mc. To meet the specification a properly terminated phase correction netwark, ES-34034-B, 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	Buffer 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	Visual Modulated Amplifier	6076
1	Visual Reflectometer	6AL5
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	1st Sync Amplifier	6AG7
1	2nd Sync Amplifier-Sync Separator	6U8A
1	Pulse Generator	6U8A
1	Clipper	6SN7-GT
1	1st Clamp Diode	6AL5
2	2nd Clamp Diode	6AL5
6	Voltage Reference Tubes (D-C Coupling)	5651
1	Bias Regulator	OB2
2	Regulators (Modulator Screens)	OA2
2	Regulators (Modulator Screens)	O82
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	High Voltage Regulators	6AS7-G
1	D-C Amplifier (Low Voltage Regulator)	6SL7-GT
2	Low Voltage Regulators	6AS7-GT
1	150 V Regulator	OD3
1	Monitor Amplifier	6AC7
1	Monitor Amplifier (Output)	6AG7
1	1st Clamp Pulse Output	6CL6
1	Bucking Bias	6BL7-GT
1	2nd Clamp Pulse Output	6CL6

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	Aural Output Amplifier	5763
1	1st Mixer	6AS6
1	2nd Mixer	6AS6
1	Difference Frequency Amplifier	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-A
2	Modulated Rectifiers	866-A
1	Modulated Rectifier	5R4-GY
6	High Voltage Rectifiers	8008

Qty.	Function	Type
†1	D-C Amplifier (Low Voltage Regulator)	6SL7-GT
†2	Voltage Reference Tubes (Low Voltage Regulator)	5651
†3	Series Regulators (Low Voltage Rectifier)	5651
†2	Regulators (Carrier-Off Monitor)	OD3
†4	Amplifiers (Carrier-Off Monitor)	5814-A

Mechanical Specifications

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

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

Equipment Supplied

TT-28L TELEVISION TRANSMITTER (ES-19286)

Qty.	Description	Stock No.
1	Control Unit	MI-27180-A
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-A
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	Hormonic Filter	MI-27317[2]
1	Vestigol Sideband Filter	ES-27233[2]
1	4.75 MC Low Pass Filter	MI-27132
2	Side Panels (End Shields)	MI-30541-G84
1	Finish Touch-Up Kit	MI-7499-A
1	Miscelloneous 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 (*Soles order must specify size and quantity for installation requirements)	MI-19112/19113-C
1	Line Corrector	MI-27478[3]
1	Nameplate	MI-28180-1
1	Tool Kit	MI-27088
2	Set of Installotion Drawings	8924946-501
2	Instruction Book	IB-36280

Optional or Accessory Equipment

TTC-5A Control Console Equipment, with master monitor but less master monitor power supply	MI-27274-1
R-F Load and Wattmeter	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-G/E
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-27235
BW-58 Sideband Response Analyzer	ES-34910-B
Plate Current Meter	MI-21200-C1
WM-71A Distortion and Noise Meter	MI-30071-A
WA-28A Audio Oscillotor	MI-30028-A
Exciter Tuning Indicator	MI-27487
BW-4B VHF Visuol Demodulator	MI-34057
TO-524-AD Oscilloscope	MI-26500-A

† 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.

[3] Not supplied if Automatic Voltage Regulator MI-27471 and 27472 are ordered as accessory equipment.

2 KW VHF TV TRANSMITTER

TYPE TT-2BH

FEATURES

- Excellent performance—for both monochrome and color
- New compact, floor-saving cabinet design—yet offering excellent accessibility to all components
- Simplified tuning
- Single ended r-f circuits reduce number of tubes and circuit components
- 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 allow operation at low ambient temperatures
- Only two tube types in r-f stages following exciter

DESCRIPTION

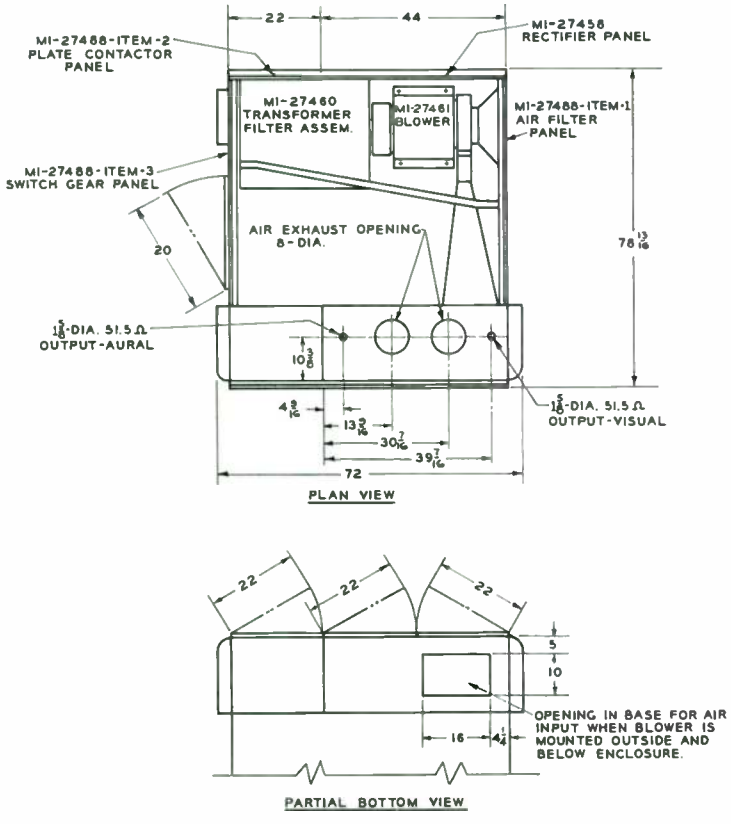
The TT-2BH VHF Television Transmitter is designed for high band television stations. Effective radiated powers of 2 to approximately 36 kilowatts can be obtained. This economical low-power transmitter will provide adequate signal strength to meet a wide range of television broadcast requirements either in color or monochrome. It is designed for operation on any channel from 7 through 13 and works equally well with both low and high gain type RCA antennas.

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-2BH can, with the addition of suitable terminal equipment, be operated from a remote location. All the necessary operating functions such as starting and stopping the transmitter, resetting overloads, switching in the spare crystal oscillator 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.

General Description

The RCA Type TT-2BH VHF Television Transmitter is designed to conform with all FCC and EIA 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 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 a minimum of floor space. All r-f circuits and control circuits are located at the front of the enclosure. The rectifier tubes are mounted on the rear wall and the heavy power components are mounted on the floor. The control unit is at the left front corner 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 in the control unit behind a non-interlocked 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-2BH VHF Transmitter showing compact equipment unit and rectifier enclosure.

To the right of the control unit is the r-f rack. It contains aural and visual r-f power stages, 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-2BH 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 circuits. Tuning controls are operated by a crank which is removable to prevent accidental misadjustment of the circuits during operation. Easily read counter dials make possible 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 rack and r-f rack as well as the rectifiers mounted on the rear wall of the enclosure. These rectifiers have thermostatically controlled heaters for the rectifier tubes which permit 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 interlock 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 may be seen in the floor plan shown.

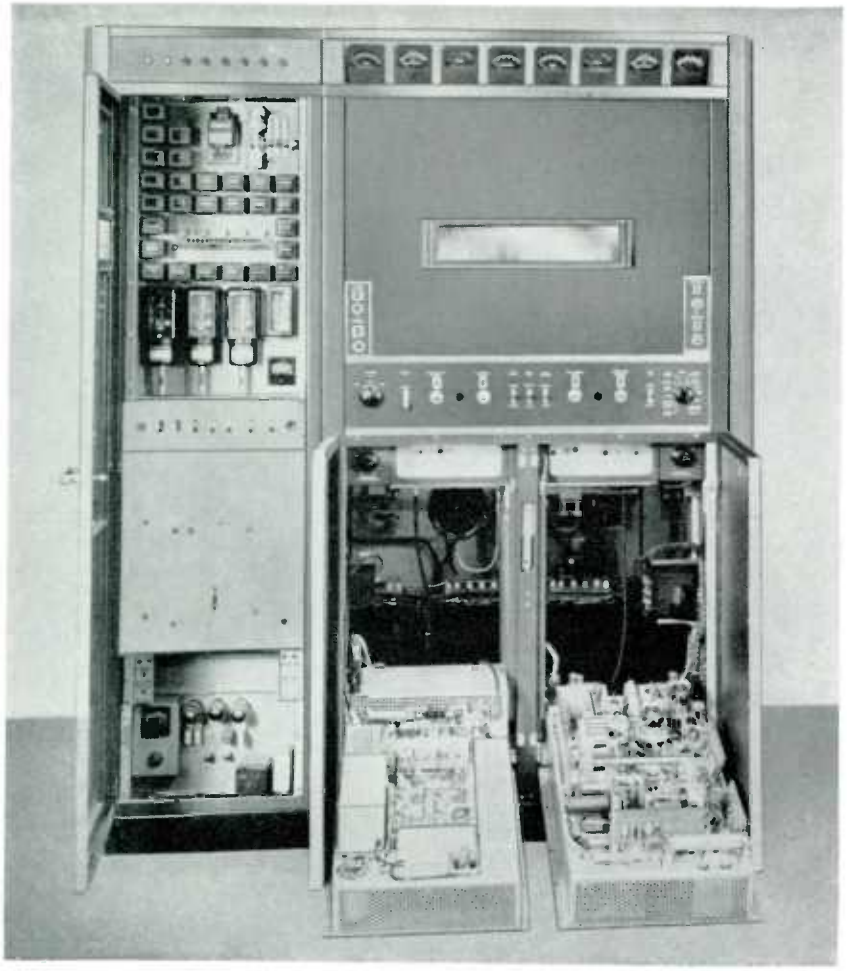
Exciter Circuit

The TT-2BH transmitter is driven by a common exciter containing both visual and aural chains. Accurate control of the separation of visual and aural carrier frequencies is the result of precise engineering circuit design. The visual chain is driven by either one of the two crystal controlled 6AK5 oscillator circuits as a primary source

of frequency control. Oscillators may be switched by means of a d-c relay, thus making this circuit adaptable for remote control. The crystals operate at one-thirty-sixth the visual carrier frequency and one-twelfth of the output frequency of the exciter. The aural master oscillator is a free-running 6V6 oscillator controlled by a pair of 6V6 reactance tubes which are part of the automatic-frequency control circuit used to maintain the 4.5 mc separation between carriers. An off-frequency interlock prevents uncontrolled frequency operation by cutting off plate voltage to the stages that follow the exciter. The aural master oscillator operates at one-thirty-sixth of the carrier frequency with the output of the exciter being one-third the carrier frequency.

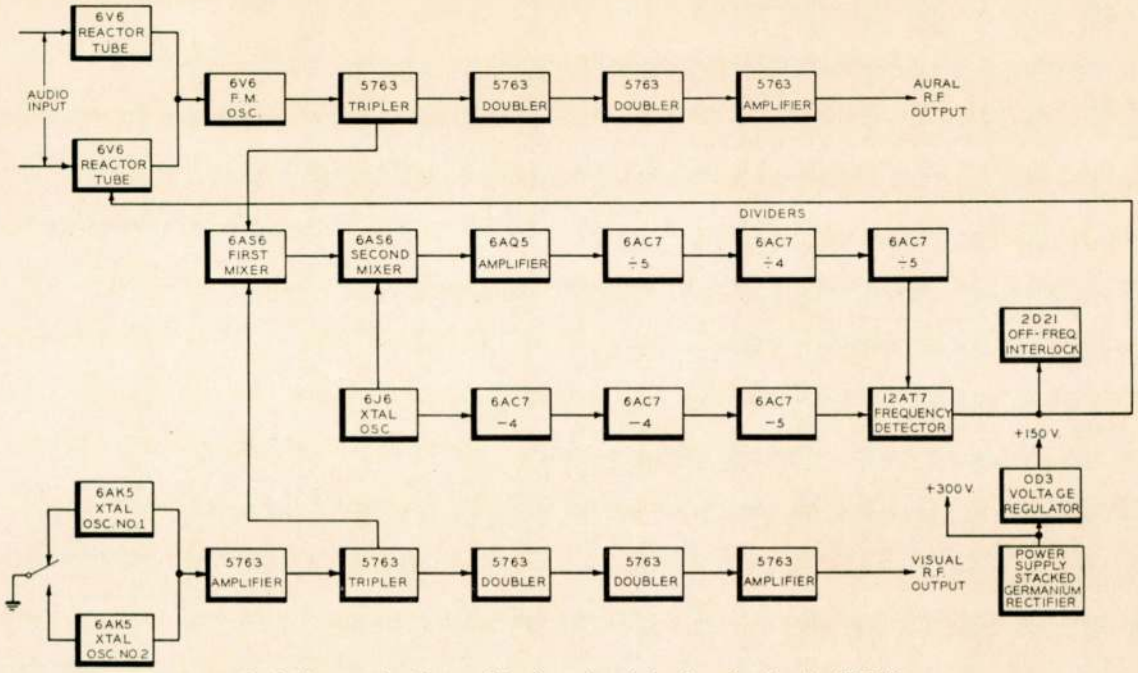
The automatic frequency control of the aural master oscillator is accomplished by feeding a small amount of energy from the aural and visual triplers into a 6AS6 mixer tube. When the aural oscillator is on frequency the output of this mixer stage will be one-twelfth of the difference frequency between the aural and visual carriers or 375 kc. The 375 kc signal mixes with the output of the 6J6 crystal controlled reference oscillator (1500 kc) in the second 6AS6 mixer stage. The difference frequency is fed through a chain of three dividers with a total division of 100 to the frequency detector stage. This amount of division is necessary to reduce the swing at the frequency detector so that the carrier will not drop out under any modulation conditions of the aural transmitter. The 6J6 reference oscillator signal is fed through three divider stages with a total division of 80 to the frequency detector stage. By using the 6J6 reference oscillator output to excite both the second mixer and the divider chain for reference frequency, considerable improvement in frequency control accuracy is obtained. Signals from both the difference frequency and the reference frequency chains are fed into the frequency detector. 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.

Front view of the TT-2BH 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 multipliers and amplifiers. In the visual chain a 7034 tube operates as a tripler driving a 7034 amplifier which in turn drives a type 6076 grid modulated power amplifier. The aural chain consists of a type 7034 tripler driving a type 6076 class "C" power amplifier. Excitation control for the visual modulated amplifier is accomplished by varying the screen voltage on the 7034 amplifier stage. Power output of the aural transmitter is adjusted by varying the screen voltage on the 6076 stage. Both these controls are operated by motors and therefore can be adjusted from a remote position.



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

Video Modulator

The modulator of the transmitter is designed to take a standard 0.7 volt video signal and amplify it sufficiently so that it can grid modulate the 6076 stage. This requires about 220 volts peak-to-peak from the modulator. The first stage of the modulator is a conventional shunt-series peaked 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 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 the diode 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 similar to a conventional cathode follower stage. The cathode resistor has been replaced by three 6146 tubes operating in parallel. The grids of these three tubes are fed with a signal from the plate load of the two cathode follower tubes. This essentially makes the circuit a feedback 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 tube 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 seen 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 unwanted video resonances.

Aural Modulator

Frequency modulation is accomplished in the TT-2BH exciter by a "direct modulation" process requiring less components, fewer tubes and tube types. This process, which eliminates numerous multipliers and converter stages resulting in low noise and minimum distortion, utilizes two push-pull reactance tubes connected across the frequency determining circuit of the master oscillator. The center frequency of this oscillator is precisely maintained by the

automatic frequency control circuit described previously in the exciter description.

Frequency modulation is obtained by feeding the audio signal into the reactance tubes which are connected across the oscillator plate tank circuit. R-f energy from the oscillator tank is link coupled to a transformer which has a coil in the grid circuit of each reactance tube. R-f voltages on the push-pull connected grids are 180 degrees out of phase with each other and each is 90 degrees out of phase with respect to the r-f voltage at the plates. Thus, across the oscillator tank one tube appears as a capacitive reactance and the other as an inductive reactance. The magnitude of the reactive plate current in the reactance tubes varies in direct proportion to the value of audio voltage applied to the grids. Therefore, the frequency of the oscillator is varied at an audio rate to furnish the required FM signal. The mean frequency of the oscillator is controlled by varying the grid bias of one of the reactance tubes. This bias voltage is d-c output voltage of the frequency detector stage of the exciter.

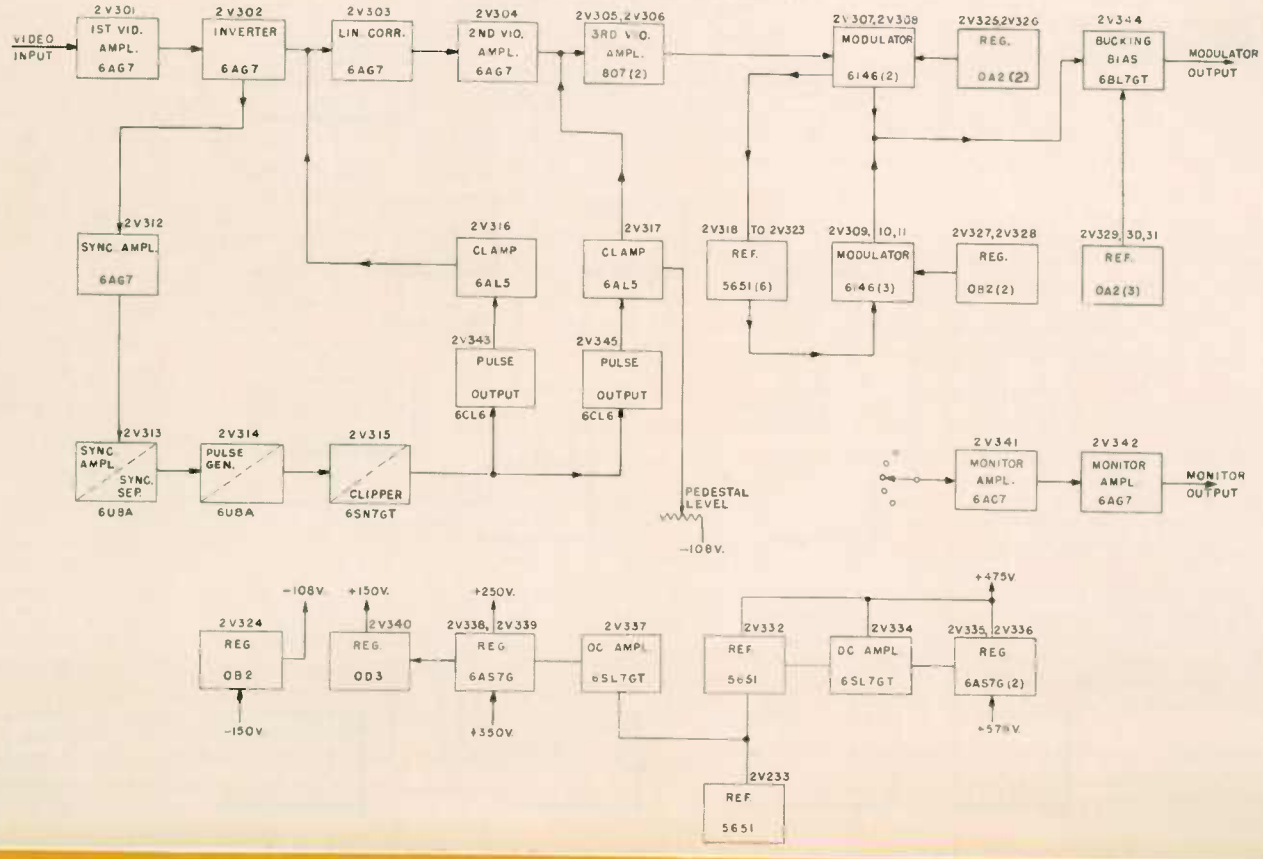
Power and Control Equipment

Wherever possible in this transmitter, the same d-c power supplies 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: An exciter supply built into the common exciter unit using stacked germanium diodes; a 700 volt low voltage rectifier, using two 866-A tubes, which supplies the screen voltage for all the r-f power amplifiers; a 3800 and 1900 volt high voltage supply using six 8008 tubes in a 3 phase full wave circuit; and the modulator and bias supply, using two 866-A tubes and one 5R4-GY tube, which supplies the plate voltage for the modulator and the bias for all r-f stages.

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 breaker are provided. Each incorporates both thermal and magnetic trips. The high voltage rectifier and each power amplifier tube including the 7034 stages are protected by instantaneous 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 may be 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. Auto-

Block diagram of the TT-2BH Modulator.



SPECIFICATIONS (Cont'd)

Tube Complement

VISUAL SECTION

Qty.	Function	Type
1	Visual Crystal Oscillator #1	6AK5
1	Visual Crystal Oscillator #2	6AK5
1	Buffer Amplifier	5763
1	1st Visual Multiplier	5763
1	2nd Visual Multiplier	5763
1	3rd Visual Multiplier	5763
1	Visual Output Amplifier	5763
1	Visual Tripler	7034
1	1st Visual Amplifier	7034
1	Visual Modulated Amplifier	6076
1	Visual Reflectometer	6AL5
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	1st Sync Amplifier	6AG7
1	2nd Sync Amplifier-Sync Separator	6U8A
1	Pulse Generator	6U8A
1	Clipper	6SN7-GT
1	1st Clamp Diode	6AL5
1	2nd 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 Regulator 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	High Voltage Regulators	6AS7-G
1	D-C Amplifier (Low Voltage Regulator)	6SL7-GT
2	Low Voltage Regulators	6AS7-GT
1	150 V Regulator	OD3
1	Monitor Amplifier	6AC7
1	Monitor Amplifier (Output)	6AG7
1	1st Clamp Pulse Output	6CL6
1	Bucking Bias	6BL7-GT
1	2nd Clamp Pulse Output	6CL6

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	Aural Output Amplifier	5763
1	1st Mixer	6AS6
1	2nd Mixer	6AS6
1	Difference Frequency Amplifier	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	Aural Tripler	7034
1	1st Aural Amplifier	6076
1	Aural Reflectometer	6AL5

COMMON POWER SUPPLY, ETC.

1	Voltage Regulator	OD3
1	Off-Frequency Interlock Control	2D21
2	Low Voltage Rectifiers	866-A
2	Modulated Rectifiers	866-A
1	Modulator Rectifier (Bias)	5R4-GY
6	High Voltage Rectifiers	8008

Qty.	Function	Type
†1	D-C Amplifier (Low Voltage Regulator)	6SL7-GT
†2	Voltage Reference Tubes (Law Voltage Regulatar)	5651
†3	Series Regulators (Low Voltage Rectifier)	5651
†2	Regulators (Carrier-off Monitor)	OD3
†4	Amplifiers (Carrier-off Monitor)	5814-A

Mechanical Specifications

Dimensions:

Overall Length (front line cabinets only)	72"
Overall Height (front line cabinets only)	84"
Depth (front line cabinets only)	20"
Overall Depth	78 13/16"
Weight	3800 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-2BH TELEVISION TRANSMITTER (ES-19287)

Qty.	Description	Stock No.
1	Control Unit	MI-27180-A
1	2-KW Unit	MI-27191
1	Set of Panels	MI-27488
1	Rectifier Panel	MI-27458
1	Transformer-Filter Assembly	MI-27460
1	Transformer	MI-27479-A
1	Blower	MI-27461
1	Installation Material	MI-27193
1	Wiring Material	MI-27194
1	Monitoring Diode	MI-19051-B
2	Harmonic Filter	MI-27317[2]
1	Vestigial Sideband Filter	MI-19114-B[2]
1	4.75 MC Low Pass Filter	MI-27132
2	Side Panels (End Shields)	MI-30541-G84
1	Finish Touch-Up Kit	MI-7499-A
1	Miscellaneous Hardware Kit	MI-7474
2	Crystal Unit (Visual)	MI-27492[2]
1	Set of Operating Tubes	ES-27203
1	Line Corrector	MI-27478[3]
1	Nameplate	MI-28180-1
1	Tool Kit	MI-27088
*	Transmission Line (*Sales order must specify type and quantity for installation requirements)	MI-19112/19113-C
2	Set of Installation Drawings	8958115-501
2	Instruction Book	IB-30257

Optional or Accessory Equipment

TTC-5A Control Console Equipment, with master monitor but less master monitor power supply	ES-27274-1
R-F Load and Wattmeter	MI-19196-H
Complete Set of Spare Tubes	ES-27203
FCC Spare Set of Tubes	ES-27204
Input and Monitoring Equipment, Wired/Unwired	ES-19237-E/G
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	ES-27235
BW-5B Sideband Response Analyzer	ES-34010
Plate Current Meter	MI-21200-C1
WM-71A Distortion and Noise Meter	MI-30071-A
WA-28A Audio Oscillator	MI-30028-A
Exciter Tuning Indicator	MI-27487
BW-4B VHF Visual Demodulator	MI-34057
TO-524-AD Oscilloscope	MI-26500-A

† Tubes for optional Low Voltage Regulator.

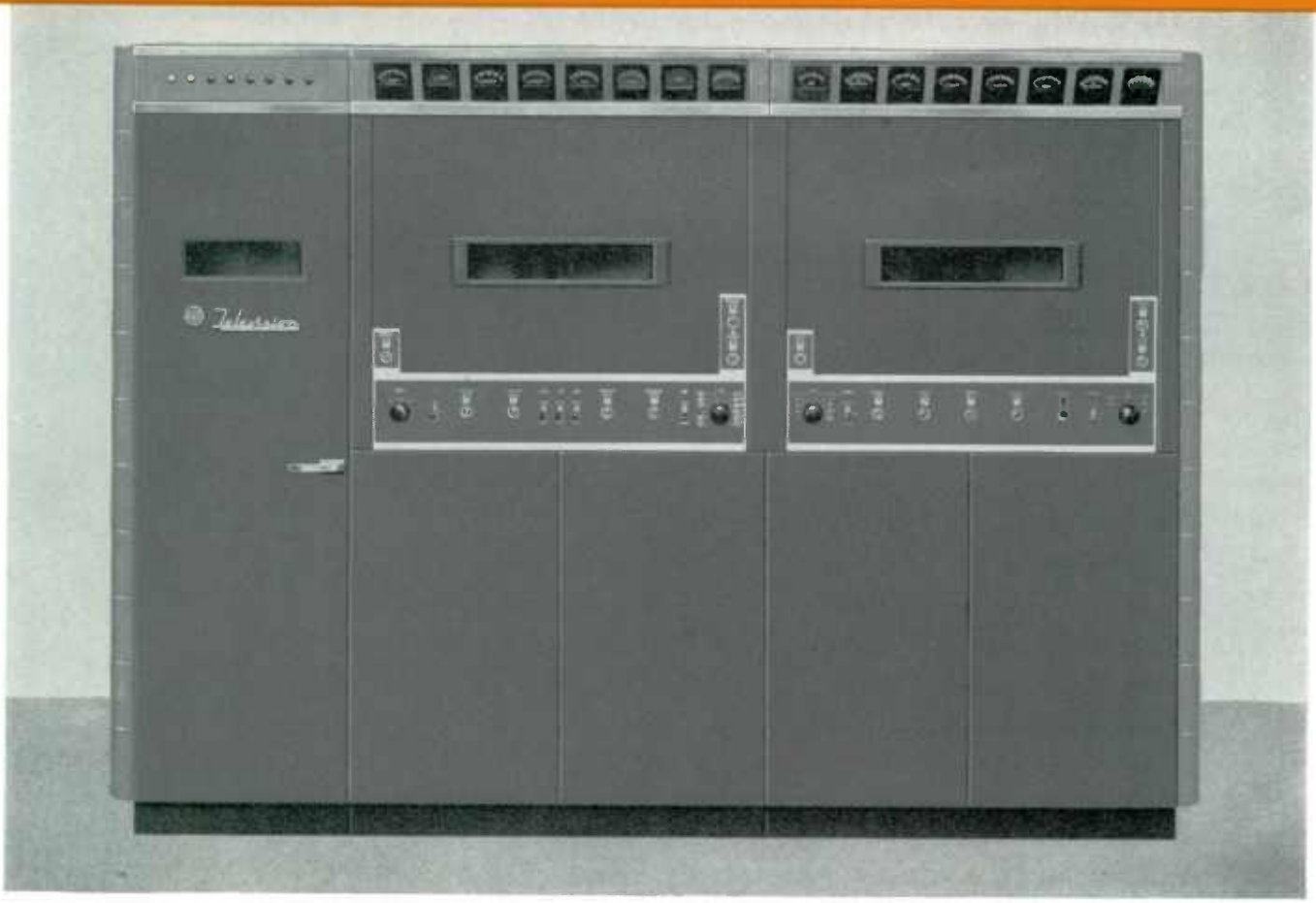
[1] For operation at rated power and normal plate voltage.

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

[3] Not supplied if Automatic Voltage Regulator MI-27471/MI-27472 are ordered as accessory equipment.

6 KW VHF TV TRANSMITTER

TYPE TT-6AL



FEATURES

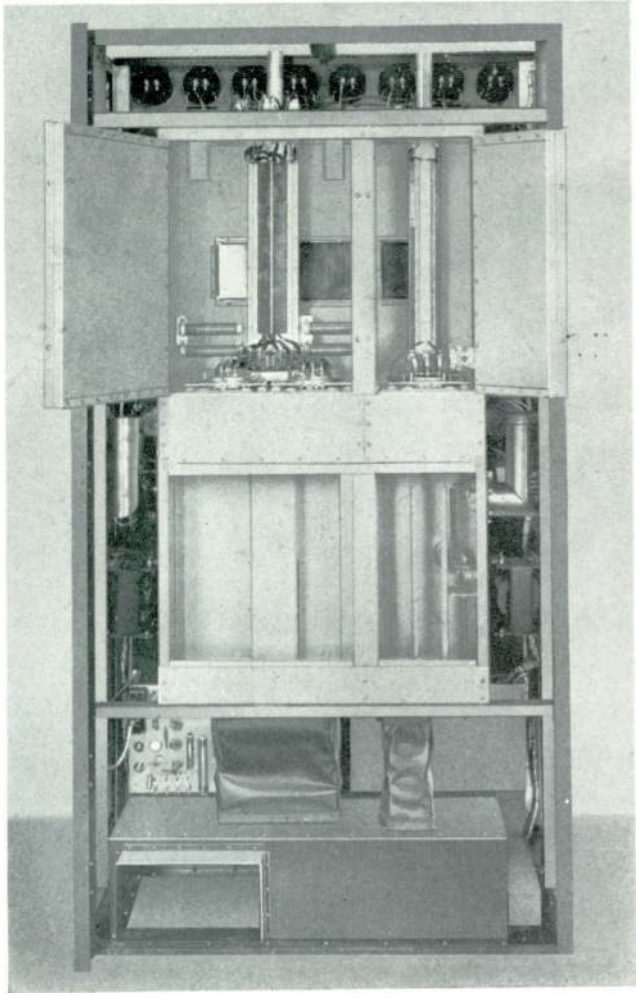
- Compact floor plan — new design cuts floor space required for transmitting stations
- Designed for color—linearity correction circuits built into modulator
- Low cabinet radiation—all leads from R-F compartment coupled through specially designed feed-through capacitors
- Uses Type 5762 air-cooled tubes, 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
- Thermostatically controlled heaters provided for rectifier tubes allow operation at low ambient temperature
- Excellent accessibility
- Circuitry included for use of remote control
- Sloping and illuminated meter panels
- Complete overload protection with indicating lights grouped for quick location of faulty circuits

DESCRIPTION

The new RCA Type TT-6AL VHF Television Transmitter is designed for television stations with effective radiated power requirements ranging from 5 to 70 kilowatts. 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 TT-6AL 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 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-

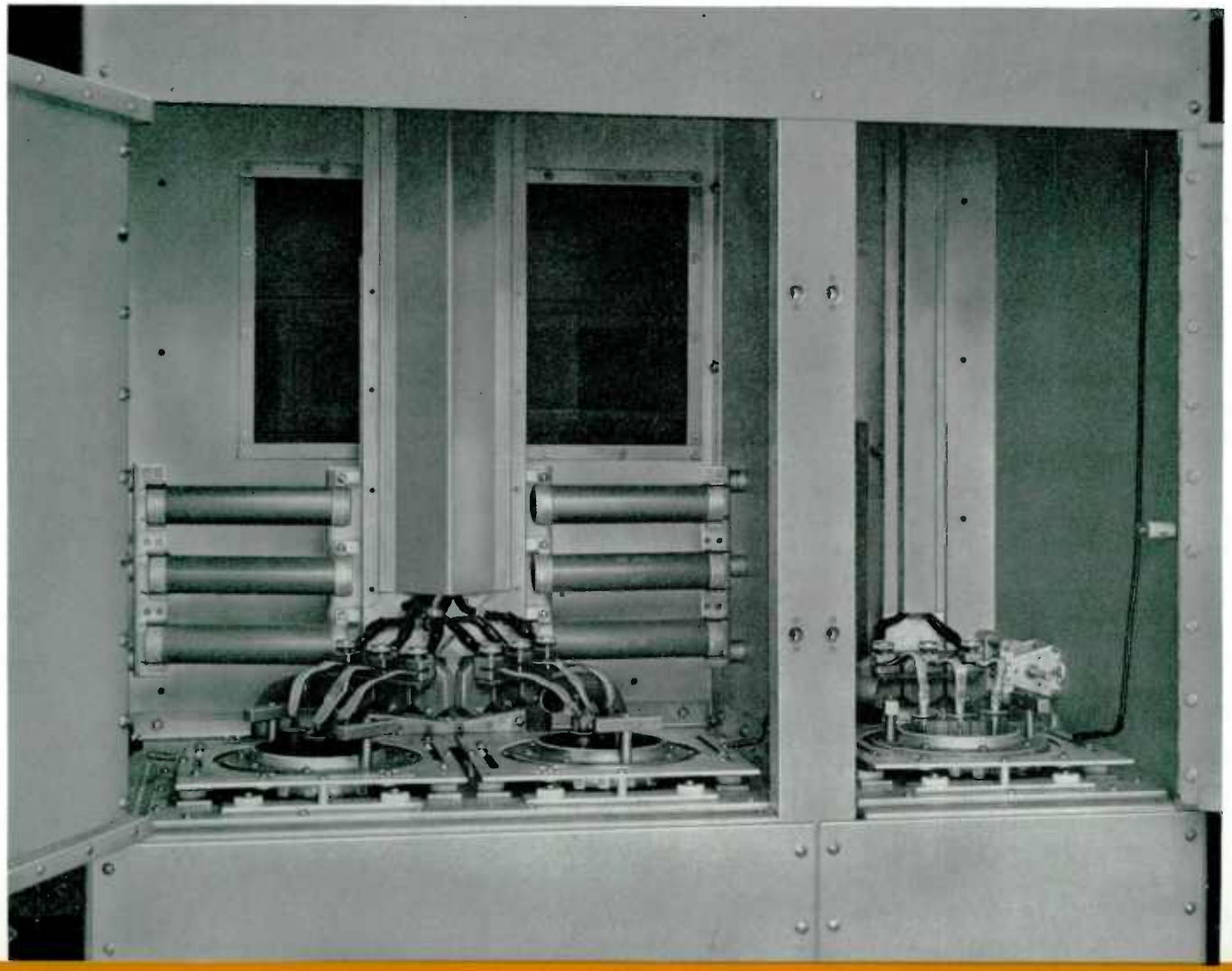
ment, be operated from a remote location over a single telephone line. All the necessary operating functions such as starting and stopping the transmitter, resetting overloads, switching in the spare crystal or spare exciter, metering all power circuits and reflectometers, controlling power output (including 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.

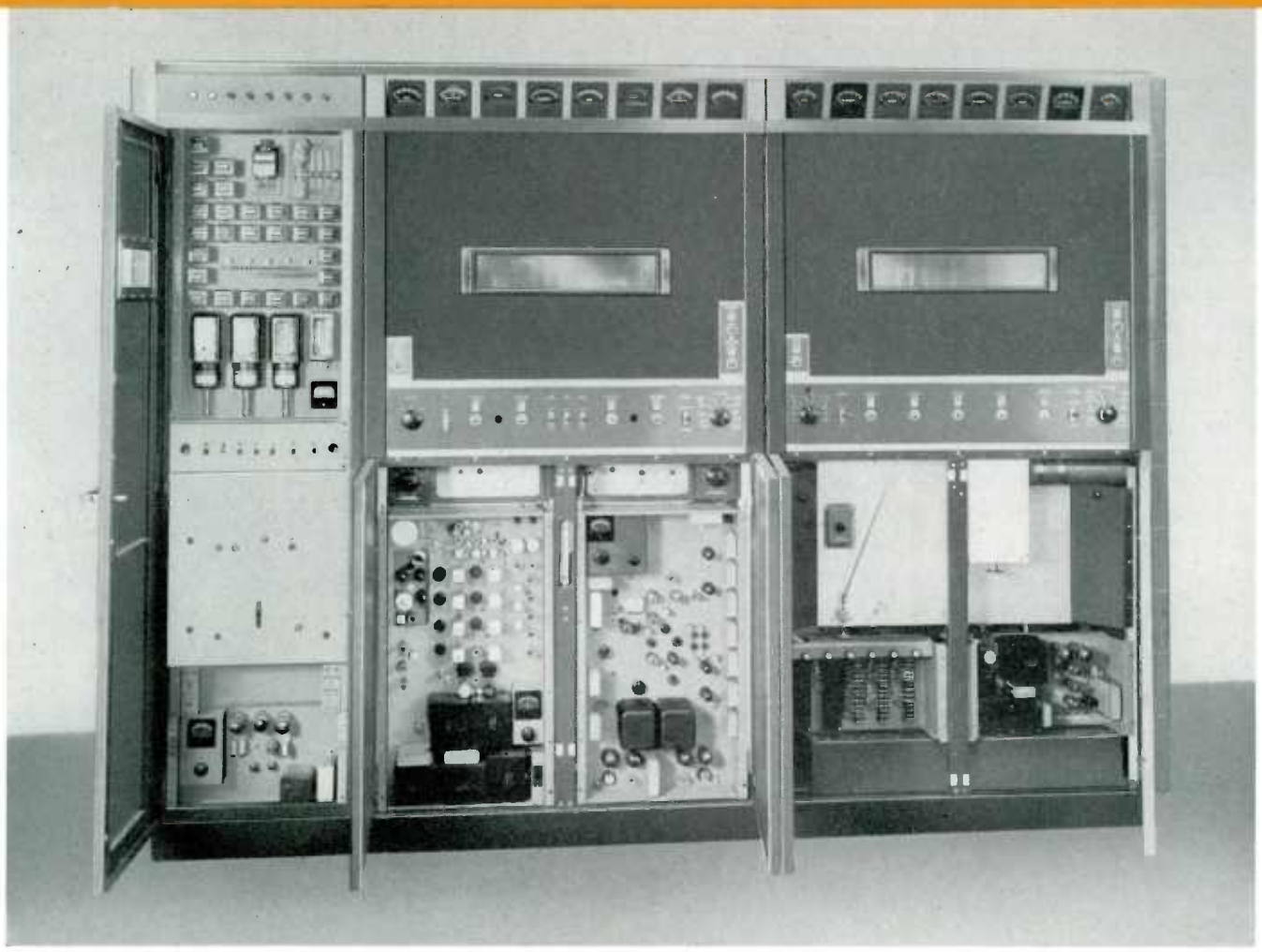
The Type TT-6AL VHF Television Transmitter is designed to conform with all FCC and EIA standards. It will provide a nominal power output of 6 kilowatts peak visual power measured at the output of the sideband filter or filterplexer and 3.15 KW aural power. It is designed to operate on any specified channel 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 circuits are grouped at the extreme left of the front 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-interlocked door. Overload

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 controls and bias supply among lower components (right).

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 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 boards, 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 circuits. 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 switches 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 rack and r-f racks as well as the rectifier mounted on the rear wall of the enclosure. This rectifier has thermostatically controlled heat-

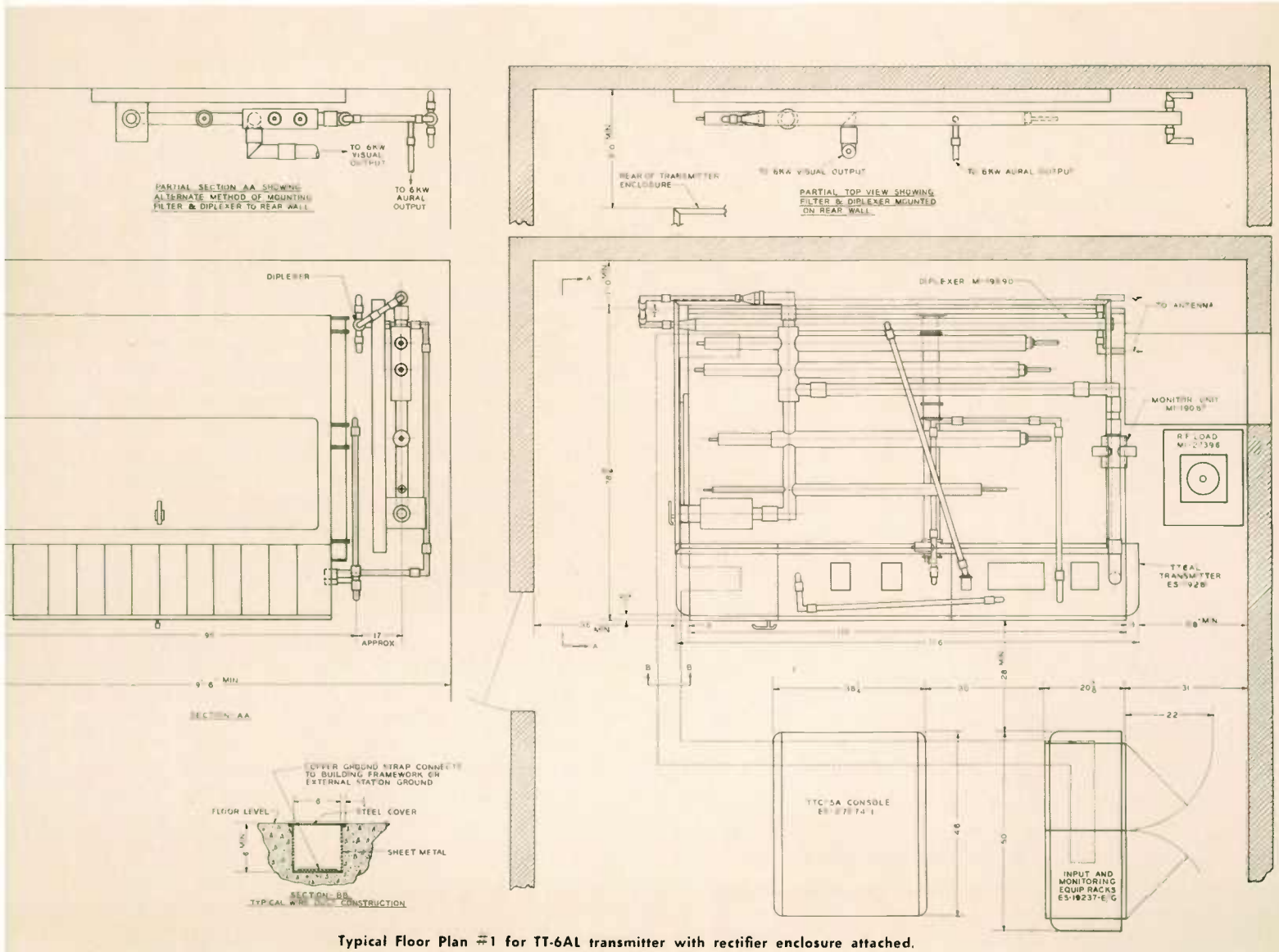
ers for the rectifier tubes which permit operation of the transmitter in ambient temperatures as low as 0° C. Heavy units such as the plate transformers and large reactors are mounted on a base plate on the floor. This makes them easily accessible for servicing.

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.

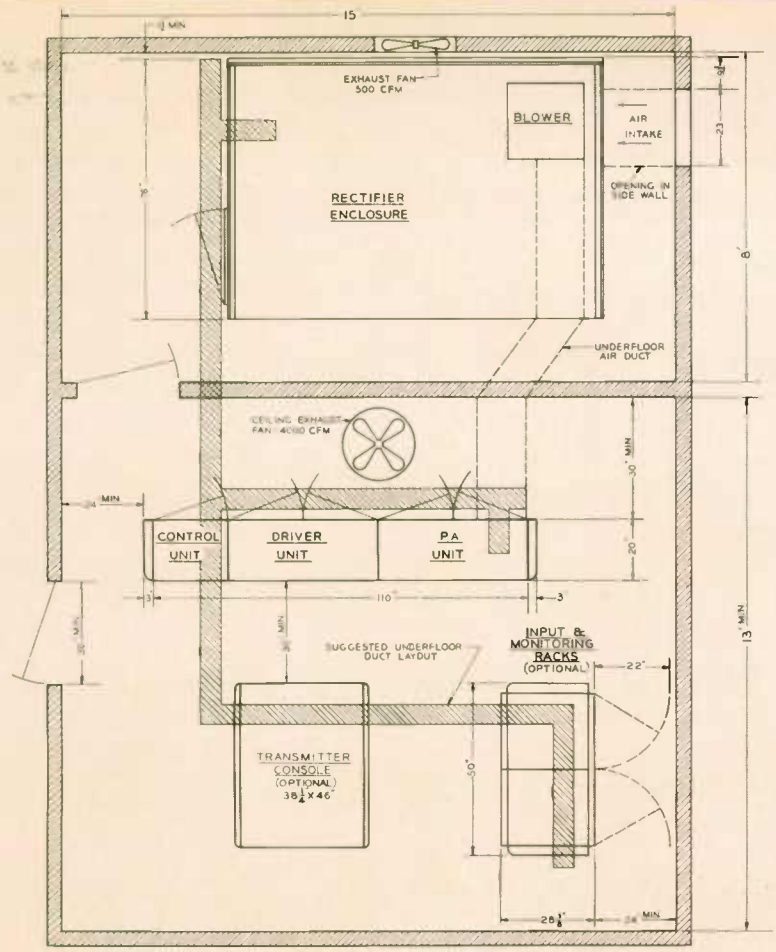
The versatility of the new transmitter cabinets is seen in floor plans No. 1 and No. 2. The latter shows an arrangement of the TT-6AL in which doors have been added to the rear of the control and r-f racks and a front wall added to the rectifier enclosure. Since this enclosure now contains no meters, operating controls or adjustments, it can be located conveniently 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.

Exciter Description

The TT-6AL transmitter is driven by a common exciter containing both visual and aural chains. Accurate control of



Typical Floor Plan #1 for TT-6AL transmitter with rectifier enclosure attached.



Alternate floor plan #2 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.

the separation of visual and aural carrier frequencies is the result of precise engineering circuit design. The visual chain is driven by either one of the two crystal controlled 6AK5 oscillator circuits as a primary source of frequency control. Oscillators may be switched by means of a d-c relay, thus making this circuit adaptable for remote control. The crystals operate at one-twelfth the visual carrier frequency and one-twelfth of the output frequency of the exciter. The aural master oscillator is a free-running 6V6 oscillator controlled by a pair of 6V6 reactance tubes which are part of the automatic-frequency control circuit used to maintain the 4.5 mc separation between carriers. An off-frequency interlock prevents uncontrolled frequency operation by cutting off plate voltage to the stages that follow the exciter. The aural master oscillator operates at one-twelfth of the carrier frequency with the output of the exciter being on the carrier frequency.

The automatic frequency control of the aural master oscillator is accomplished by feeding a small amount of energy from the aural FM oscillator and the visual 5763 amplifier following the crystal oscillator stage into a 6AS6 mixer tube. When the aural oscillator is on frequency the output of this mixer stage will be one-twelfth of the difference frequency between the aural and visual carriers or 375 kc. The 375 kc signal mixes with the output of the 6J6 crystal controlled reference oscillator (1500 kc) in the second 6AS6 mixer stage. The difference frequency is fed through a chain of three dividers with a total division of 100 to the frequency detector stage. This amount of division is necessary to reduce the swing at the frequency detector so that the carrier will not drop out under any modulation conditions of the aural transmitter. The 6J6 reference oscillator signal is fed through three divider stages with a total division of 80 to the frequency detector stage. By using the 6J6 reference oscillator output to excite both the second mixer and the divider chain for reference frequency, considerable improvement in frequency control accuracy is obtained. Signals from both the difference frequency and the reference frequency chains are fed into the frequency detector. 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.

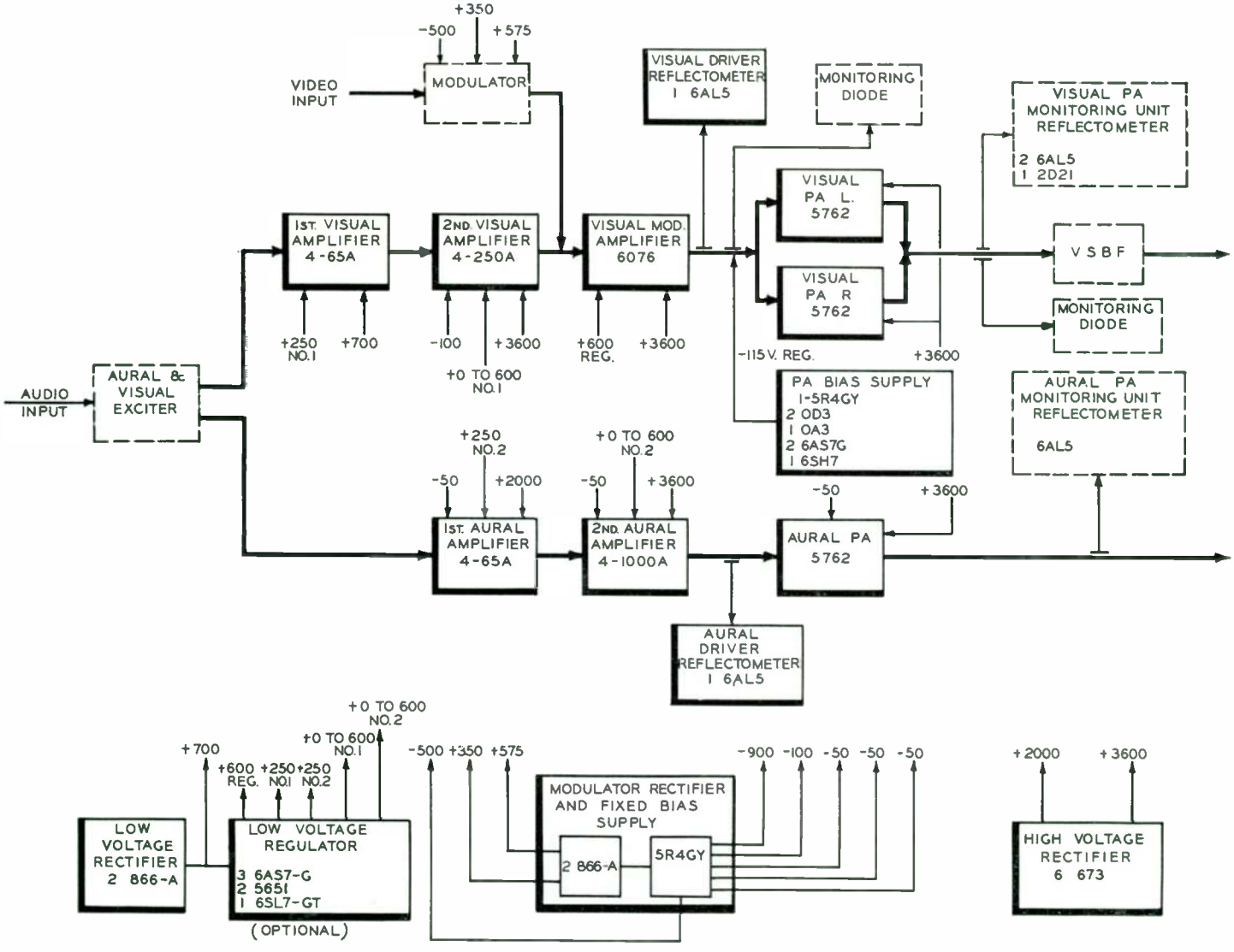
R-F Circuits

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. Excitation control of the visual modulated amplifier is accomplished 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 stacked 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; the modulator rectifier 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 the r-f stages except for the visual linear amplifier; and a bias supply for the visual linear amplifier.

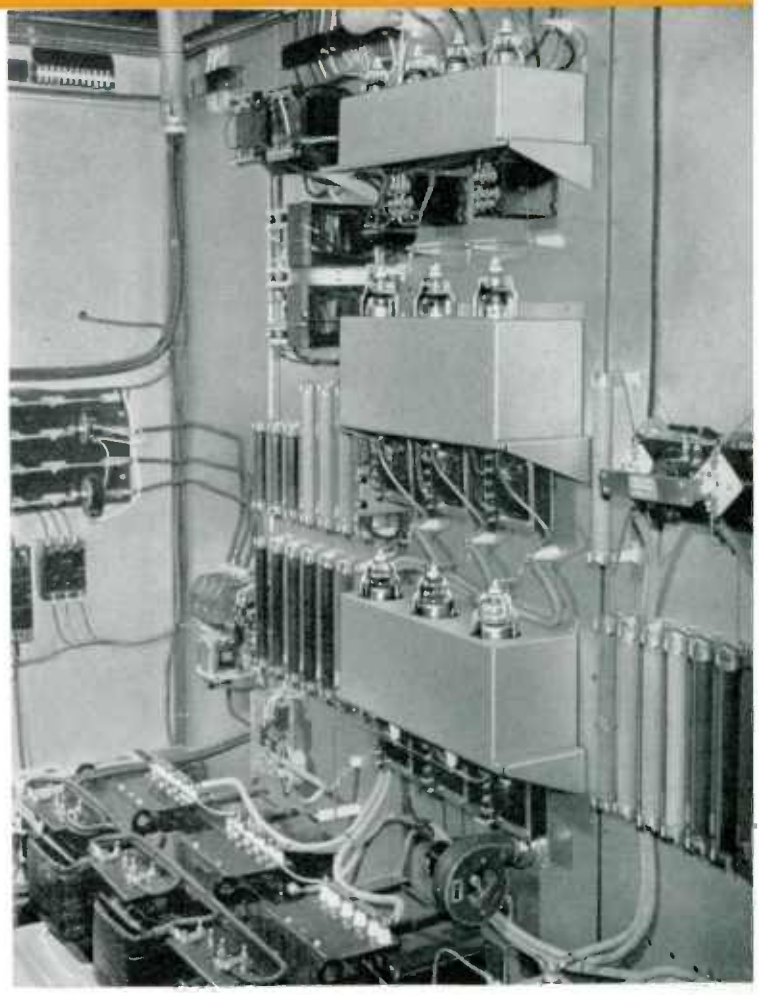
BLOCK DIAGRAM OF THE TT-6AL VHF TELEVISION TRANSMITTER



A single integrated control circuit is provided for both the visual and aural transmitters. The blower, filaments, and each rectifier are protected by thermal overloads which can be adjusted to reset automatically. In addition, a main line breaker and an auxiliary are provided. Each 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 overloads. The overload circuit automatically recycles 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, exciter, modulator, low voltage rectifiers and bias supply. Automatic filament line voltage regulators and automatic regulators capable of handling the complete transmitter are available as optional items.

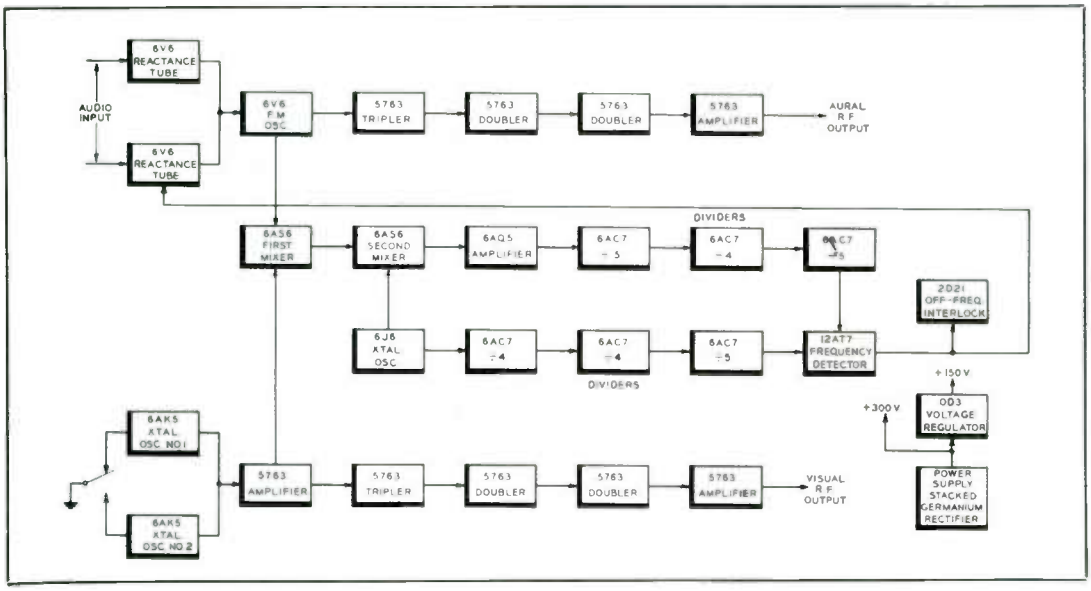
Video Modulator

The modulator of the transmitter is designed to take a standard 0.7 volt video signal and amplify it sufficiently so that it can grid modulate the 6076 stage. This requires about 220 volts peak-to-peak from the modulator. The first stage of the modulator is a conventional shunt-series peaked 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 occurs in a grid modulated stage, and



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



takes the form of four diodes connected in the cathode circuit of that stage. The bias voltage on each diode is separately adjustable and the diode 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 of 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.

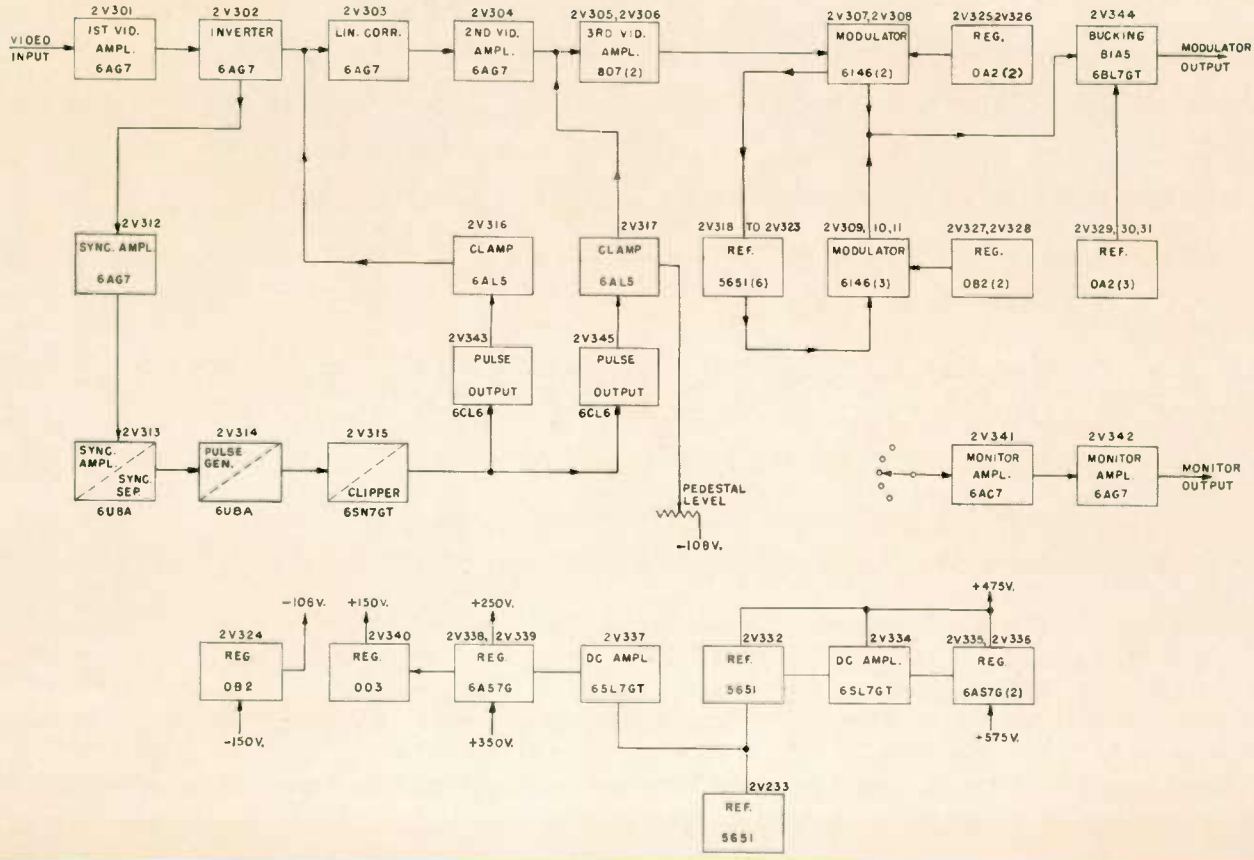
The modulator stage is followed by a bucking bias supply consisting of one 6BL7-GT and three OA2 tubes. This serves to transfer the signal from the positive voltage present in the output of the modulator stage to the negative voltage required to modulate the 6076 stage without losing the d-c component. 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 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 unwanted video resonances.

Aural Modulator

Frequency modulation is accomplished in the TT-6AL exciter by a "direct modulation" process requiring less components, fewer tubes and tube types. This process, which eliminates numerous multipliers and converter stages resulting in low noise and minimum distortion, utilizes two push-pull reactance tubes connected across the frequency determining circuit of the master oscillator. The center frequency of this oscillator is precisely maintained by the

BLOCK DIAGRAM OF THE TT-6AL MODULATOR



automatic frequency control circuit described previously in the exciter description.

Frequency modulation is obtained by feeding the audio signal into the reactance tubes which are connected across the oscillator plate tank circuit. R-f energy from the oscillator tank is link coupled to a transformer which has a coil in the grid circuit of each reactance tube. R-f voltages on the push-pull connected grids are 180 degrees out of phase with each other and each is 90 degrees out of phase with respect to the r-f voltage at the plates. Thus, across the oscillator tank one tube appears as a capacitive reactance and the other as an inductive reactance.

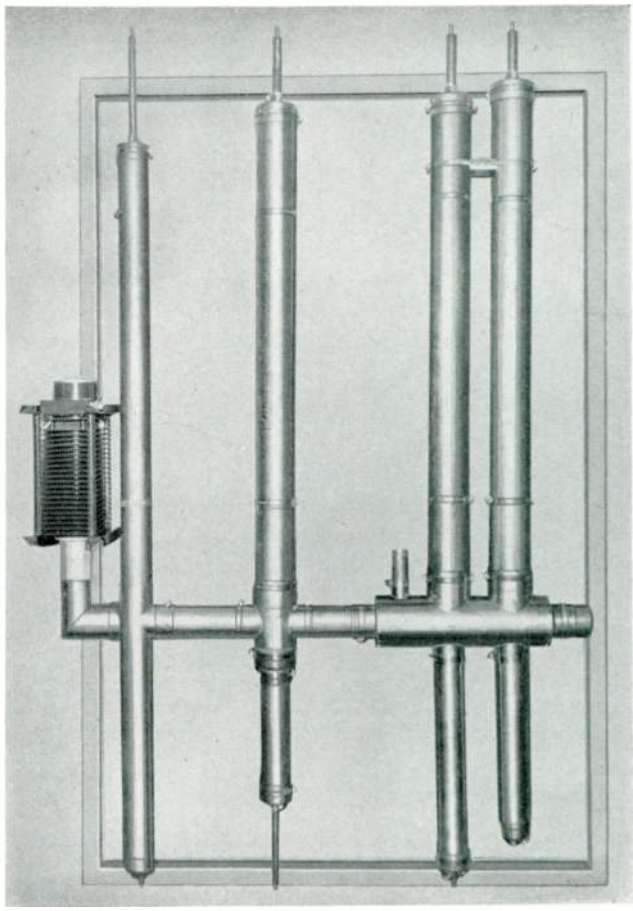
The magnitude of the reactive plate current in the reactance tubes varies in direct proportion to the value of audio voltage applied to the grids. Therefore, the frequency of the oscillator is varied at an audio rate to furnish the required FM signal. The mean frequency of the oscillator is controlled by varying the grid bias of one of the reactance tubes. This bias voltage is the d-c output voltage of the frequency detector stage of the exciter.

Special Protective Circuits

Included as part of the TT-6AL is a MI-19087 Monitoring Unit for use 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 either forward or 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 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 following the monitoring unit.

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.



The new M-derived vestigial sideband filter, ES-27234, designed for the TT-6AL transmitter.

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 the phase distortion which is introduced as a result of the sharp cut-off.

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	50/51.5 Ohms	50/51.5 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.	45 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 mox.	
Subcorrier Phase vs. Brightness[9]	±7 degrees max.	
Subcarrier Amplitude[8]	±10% max.	
Lineority (Differential Gain)[10]	1.5 db 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

[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 ot 200 kc, as meosured by the BW-5B 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-5B 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. In addition, the total differential phase between ony two levels shall not exceed 10°.

[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 indicoted by a conventional diode demodulator connected after the VSBF.

[11] Maximum departure from standard curve. The tolerances vary linearly 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-B is required in the video input circuit of the transmitter.

Tube Complement

VISUAL SECTION

Qty.	Function	Type
1	Visual Crystal Oscillator #1	6AK5
1	Visual Crystal Oscillator #2	6AK5
1	Buffer 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	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
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	1st Sync Amplifier	6AG7
1	2nd Sync Amplifier-Sync Separator	6U8A
1	Pulse Generator	6U8A
1	Clipper	6SN7-GT
1	1st Clamp Diode	6AL5
1	2nd 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	High Voltage Regulators	6AS7-G
1	D-C Amplifier (Low Voltage Regulator)	6SL7-GT
2	Low Voltage Regulators	6AS7-GT
1	150 V Regulator	OD3
1	Monitor Amplifier	6AC7
1	Monitor Amplifier (Output)	6AG7
1	1st Clamp Pulse Output	6CL6
1	Bucking Bias	6BL7-GT
1	2nd Clamp Pulse Output	6CL6

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	Aural Output Amplifier	5763
1	1st Mixer	6AS6
1	2nd Mixer	6AS6
1	Difference Frequency Amplifier	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 Driver	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 (PA Bias Supply)	6SH7
2	Bias Regulators (PA Bias Supply)	6AS7-G
2	Low Voltage Rectifiers	866-A
2	Modulator Rectifiers	866-A
1	Modulator Rectifier (Bias)	5R4GY
6	High Voltage Rectifiers	673

Qty.	Function	Type
†1	D-C Amplifier (Low Voltage Regulator)	6SL7-GT
†2	Voltage Reference Tubes (Low Voltage Regulator)	5651
†3	Series Regulators (Low Voltage Regulator)	5651
†2	Regulators (Carrier-Off Monitor)	OD3
†4	Amplifiers (Carrier-Off Monitor)	5814-A

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.)	4300 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-A
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 Material	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-7499-A
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
5	Transmission Line Coupling (90° Miter Elbow)	MI-19112-18NF
12	Transmission Line (Ungassed, Straight)	MI-19112-8
1	Nameplate	MI-28180-1
1	Line Corrector	MI-27478[3]
1	Low Voltage Regulator	MI-27469
1	Tool Kit	MI-27088
2	Set of Installation Drawings	8924927-501
2	Installation Instructions	IB-30266
2	Instruction Book	IB-36279
*	Transmissin Line (*Sales order must specify quantity for installation requirements)	MI-19113-B

Optional or Accessory Equipment

TTC-5A Control Console Equipment, with master monitor but less master monitor power supply	MI-27274-1
R-F Laad and Wattmeter	MI-27396
Complete Set of Spare Tubes	ES-27205
FCC Spare Set of Tubes	ES-27206
Input and Monitoring Equipment, Wired/Unwired	ES-19237-G/E
50 Cycle Conversion Kit	MI-27486
Line Regulator (3 phase)	MI-27473-A
Line Regulator Control Panel	MI-27471
Rectifier Enclosure	ES-19279
Carrier-Off Monitor	ES-27235
BW-5B Sideband Response Analyzer	ES-34010-B
Plate Current Meter	MI-21200-C1
WM-71A Distortion and Noise Meter	MI-30071-A
TO-524-AD Oscilloscope	MI-26500-A
WA-28A Audio Oscillator	MI-30028-A
Exciter Tuning Indicator	MI-27487
BW-4B VHF Visual Demodulator	MI-34057

† 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.

[3] Not supplied if Line Regulator, MI-27473-A is ordered.

11 KW VHF TV TRANSMITTER

TYPE TT-10AL

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 EIA 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

DESCRIPTION

The TT-10AL Television Transmitter is 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. The 11-kw transmitter works equally well with both RCA low or high-gain type antennas. High power amplifiers may be added to the TT-10AL with minimum changes to convert it to a 25-kw transmitter.

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

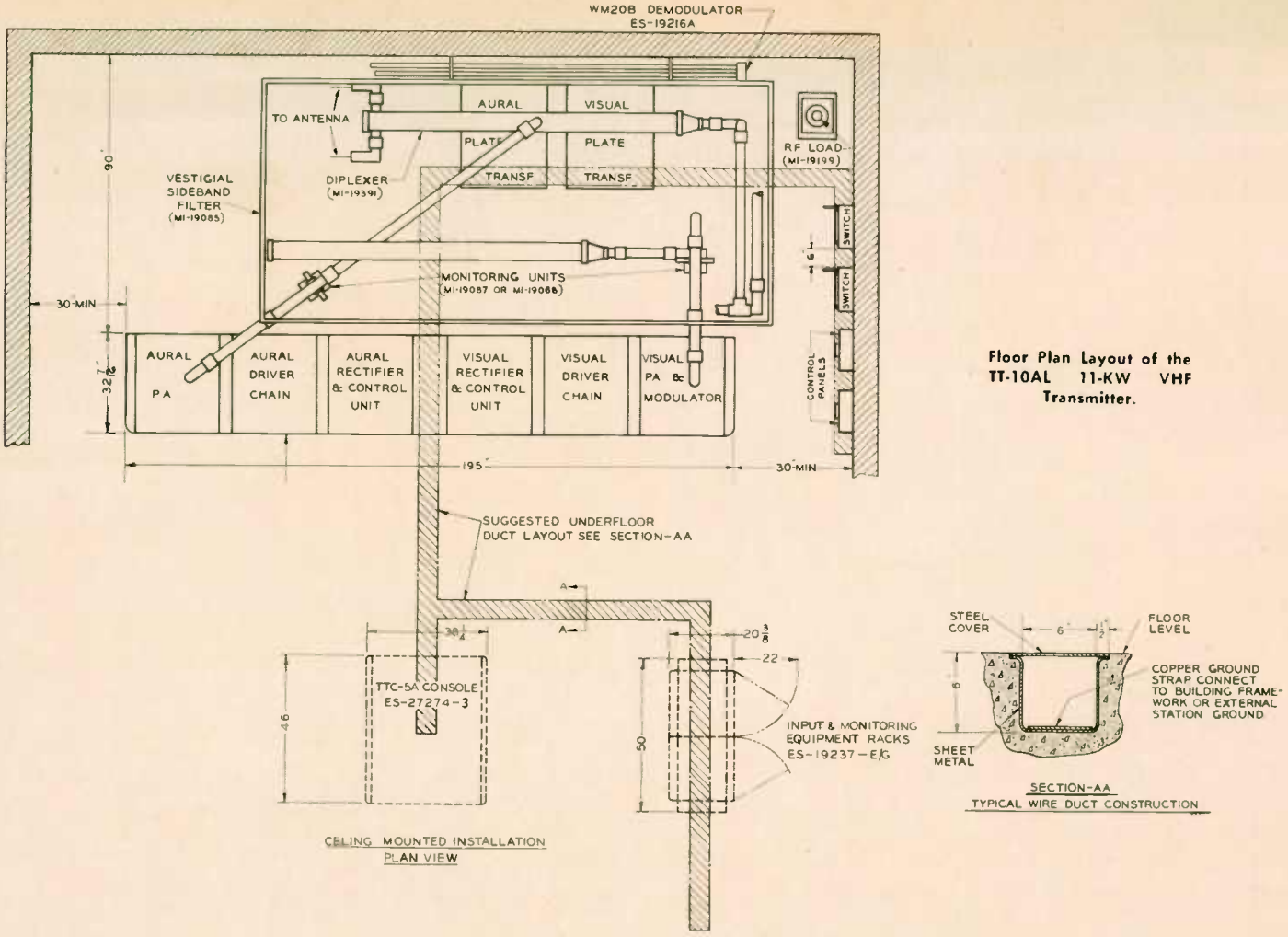
The TT-10AL is a high-level modulated, air-cooled television broadcast transmitter. The Type TT-10AL provides a nominal power output of 11 kilowatts peak visual power measured at the output of the sideband filter or filterplexer, and 6 kw aural power, in conformance with FCC and EIA Standards. The TT-10AL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

The transmitter, except for two external plate power transformers, is 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. This type of door greatly adds to the compactness and convenience of the equipment and effects great saving in required floor space.

The components and circuitry of the aural and visual sections of the TT-10AL have been kept identical as far as possible, allowing considerable savings 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 with sliding panel doors open. All tubes and other components are easily accessible through front and rear doors.



Floor Plan Layout of the TT-10AL 11-KW VHF Transmitter.

The r-f exciter and driver stages are straightforward narrow band Class C amplifiers which can be quickly and accurately tuned by meter indications. An improved clamp circuit is used in the visual modulator.

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 can be 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 VHF power tetrode tube, RCA type 6166, which is a single ended tube of 11-kw plate power dissipation. This tube is used in the output stage of both aural and visual 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 TV transmission standards. This system provides the greatest possible simplicity in operation since the only transmitter tuning adjustments which affect the frequency response characteristic are 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 consists of a crystal oscillator followed by two frequency multipliers and an amplifier.

TT-10AL Visual Exciter Unit.

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 1/6 of the assigned frequency of the TT-10AL.

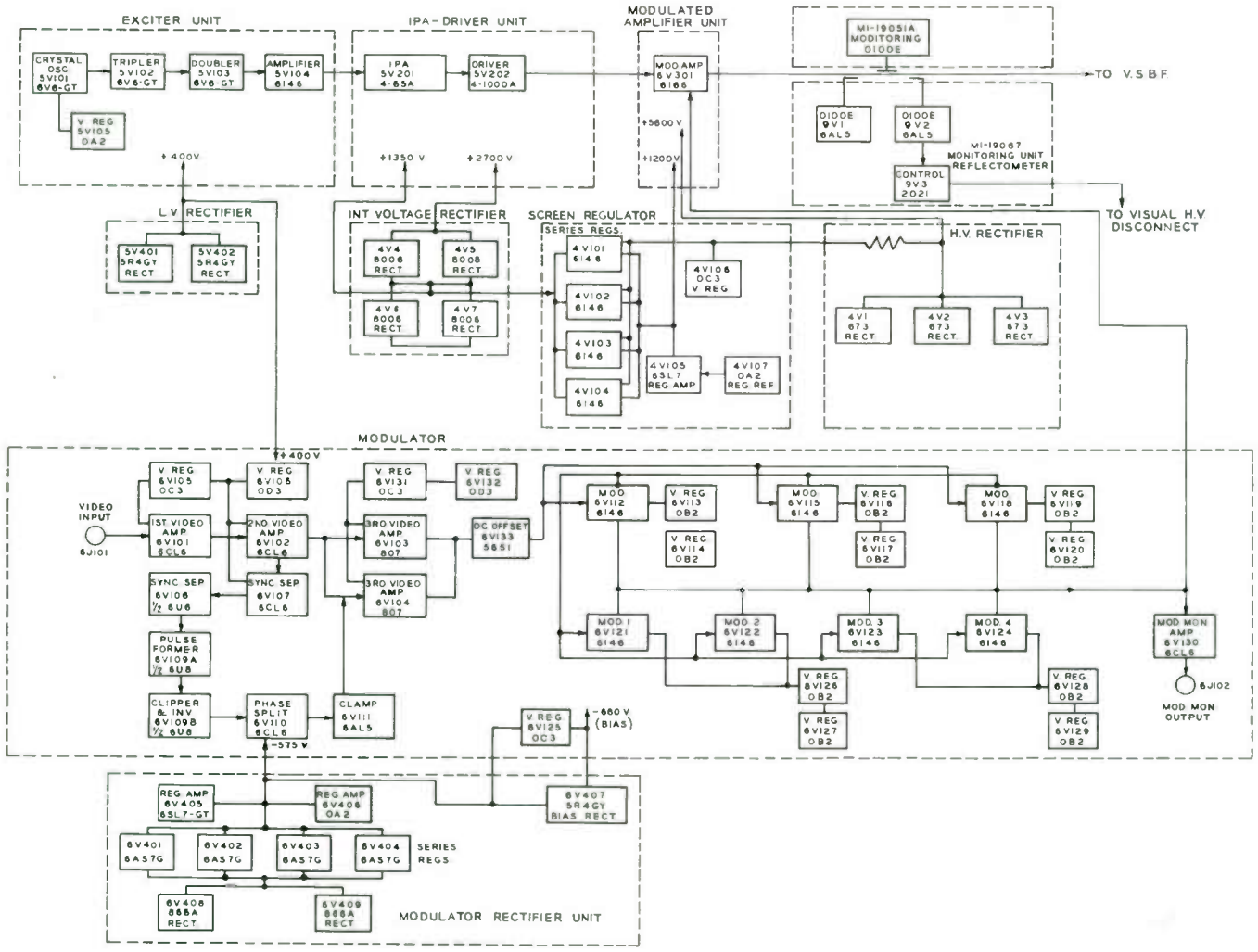
Power output and frequency range of the aural exciter are nearly the same as for the visual exciter, hence the succeeding amplifier stages are similar. The aural exciter is phase modulated. The crystal oscillator and pulse shaper are used to drive a linear sawtooth generator at the crystal frequency. 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.

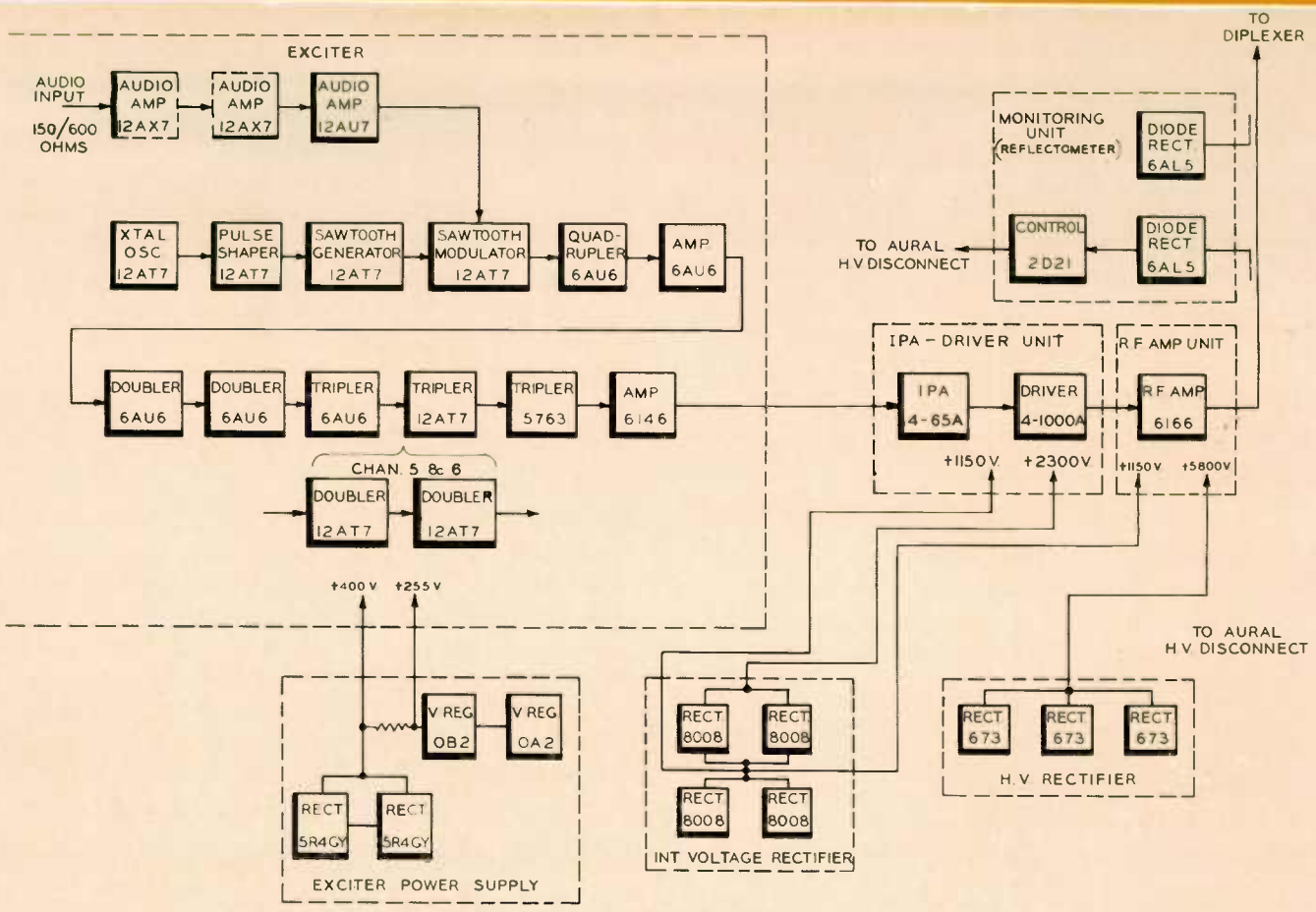
The cathode bias of the sawtooth modulator is varied by the audio voltage and the square wave output is differentiated to form phase modulated pulses. The resulting phase modulated signal, after an appropriate amount of frequency multiplication through several stages, results in an output at carrier frequency for channels 2-6.

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.

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.

Block diagram of TT-10AL Visual Transmitter.





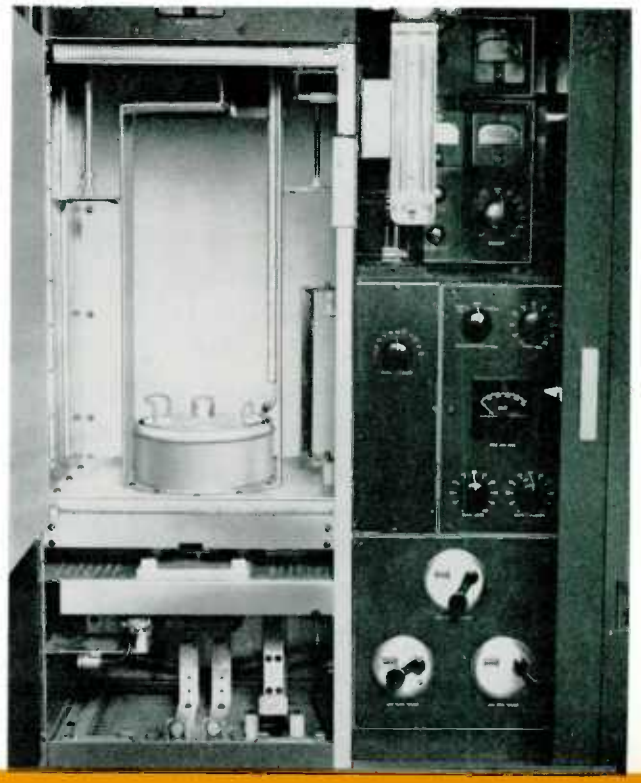
Block diagram of TT-10AL Aural Transmitter.

The power amplifier tube 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 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.

Power output indication and SWR protection of the transmitter 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.

TT-10AL Modulated 6166 Amplifier and Controls.



Visual and Aural Driver Stages for TT-10AL Transmitter.

The TT-10AL modulator is particularly designed for color usage, with low differential phase and high sub-carrier handling ability. The modulator unit includes a back-porch clamp circuit which features a high degree of stability even when operated with degraded input signals.

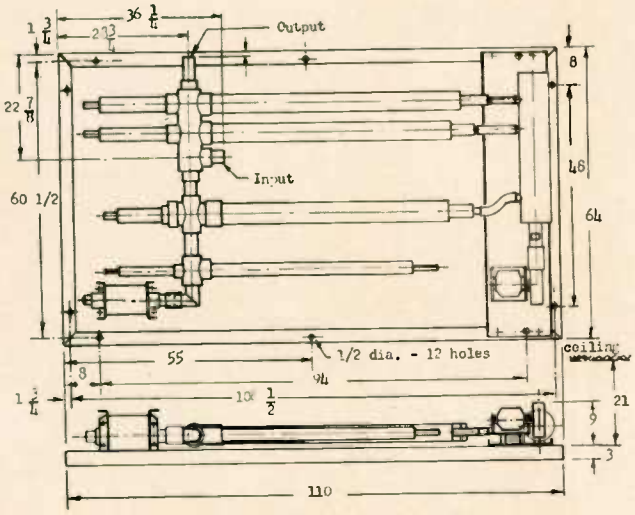
The modulator accepts an input signal as low as 0.7 volt peak-to-peak and is designed to give maximum output signal level of approximately 425 volts, peak-to-peak.

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 relatively high impedance of the third video amplifier and the variable impedance of the r-f amplifier grid network.

11 KW Sideband Filter

The ES-27234 Vestigial Sideband Filter is furnished completely assembled and adjusted for any 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 sideband visual transmitter in conformance with 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 pretuned at the factory to the channel stamped on the nameplate, no operating adjustments are necessary.

ES-27234 VESTIGIAL SIDEBAND FILTER



ES-27234 Vestigial Sideband Filter.

SPECIFICATIONS

Frequency	54-88 mcs
Maximum Power (5000 ft. elevation)	12.5 kw
Input and Output Impedance	50/51.5 ohms, 3⅛" coaxial line
VSWR	Less than 1.1
Ambient Temperature	45° C max.
Overall Dimensions	110" x 64" x 12"
Weight	300 lbs. max.
Mounting	Wall or ceiling
Clearance	12"

SPECIFICATIONS

Performance Specifications

	Aural	Visual
Type of Emission	A5	F3
Frequency Range	Chan. 2 thru 6	Chan. 2 thru 6
Rated Power Output	11 kw[1]	6 kw[2]
Minimum Power Output	2.5 kw[1]	1.5 kw[2]
R-F Output Impedance	50/51.5 ohms	50/51.5 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

[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-5B Sideband Response Analyzer at transmitter mid-characteristic. 4.75 mc attenuation requires use of MI-27132 LP filter in the video input circuit.

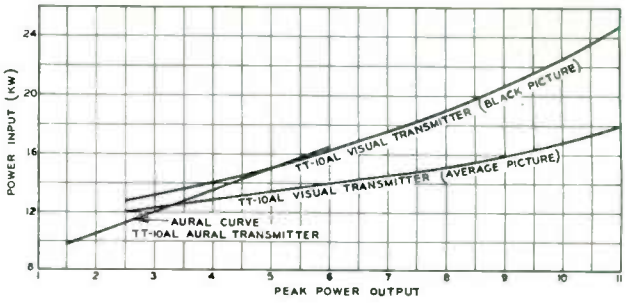
[4] With respect to the response at 200 kc at transmitter mid-characteristic.

[5] Maximum variation with respect to the response at mid-characteristic measured with the BW-5B 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-9 Stabilizing Amplifier is required in the video input circuit.



	Aural	Visual
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]	1.5 db 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

[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. In addition, the total differential phase between any two levels shall not exceed 10 degrees.

[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-9 Stabilizing Amplifier is required in the video input circuit.

[11] Maximum departure from standard curve. The tolerances vary linearly 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-B is required in the video input circuit of the transmitter.

SPECIFICATIONS (Continued)

Tube Complements

VISUAL SECTION

Qty.	Function	Type
1	Crystal Oscillator	6V6-GT
1	Tripler	6V6-GT
1	Doubler	6V6-GT
1	Amplifier	6146
1	IPA—Tripler	4-65A
1	Driver	4-1000A
1	Modulated Amplifier	6166
1	1st Video Amplifier	6CL6
1	2nd Video Amplifier	6CL6
2	3rd Video Amplifier	807
1	D-C Off Set	5651
7	Modulator	6146
1	Video Monitor	6CL6
1	Sync Separator	6U8
1	Sync Amplifier	6CL6
1	Clipper-Pulse Former	6U8
1	Phase Splitter	6CL6
1	Clamp Diode	6AL5
4	Voltage Regulator	6AS7-G
4	Voltage Regulator	6146
2	Regulator Control Amp.	6SL7-GT
3	Voltage Regulator	OA2
10	Voltage Regulator	OB2
4	Voltage Regulator	OC3
2	Voltage Regulator	OD3
3	Rectifier	673
4	Rectifier	8008
2	Rectifier	866-A
3	Rectifier	5R4-GY
2	Reflectometer	6AL5
1	Reflectometer	2D21

AURAL SECTION

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 or Two Doublers	12AT7
1	Tripler	5763
1	Amplifier	6146
1	Audio Amplifier	12AX7
1	Audio Amplifier	12AU7
1	IPA	4-65A
1	Driver	4-1000A
1	Power Amplifier	6166
1	Voltage Regulator	OA2
1	Voltage Regulator	OB2
3	High Voltage Rectifier	673
4	Rectifier	8008
2	Rectifier	5R4-GY
2	Reflectometer	6AL5
1	Reflectometer	2D21

* This tube is used as a tripler for channels 2-4. For channel 5-6 it is used as two doublers.

Mechanical Specifications

Dimensions:
- Overall Length ..... 195"
- Overall Height ..... 84"
- Overall Depth ..... 32 9/16"

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.	Description	Stock No.
1	R-F Aural Amplifier	MI-19320
1	R-F Visual Amplifier and Modulator	MI-19325-C
1	Aural Driver Chain	MI-19321
1	Visual Driver Chain	MI-19324
1	Aural Control Unit	MI-19322
1	Visual Control Unit	MI-10323-A
2	Transformers	MI-19329-B
2	Blower Units	MI-19346
2	Motor Starters	MI-19335
1	Set of End Shields (2 per set)	MI-28061
2	Monitoring Units	MI-19087
1	Monitoring Diode	MI-19051-B
1	Set of Installation Material	MI-19337
1	Set of Wiring Material	MI-19336
1	Finish Touch-Up Kit	MI-7499-A
2	Type TMV-129-G Aural Crystal Units (1 spare)	MI-19450-A[2]
2	Type TMV-129-P Visual Crystal Units (1 spare)	MI-19400-L4[2]
1	Set of Operating Tubes	ES-19233-B
1	Vestigial Sideband Filter	MI-27234[2]
*	Transmission Line (*Sales order to specify quantity to suit installation requirements)	MI-19113-B
2	Harmonic Filters	MI-27317[2]
1	Low Pass Video Filter	MI-27132
1	Miscellaneous Hardware Kit	MI-7474
1	Nameplate	MI-28180-1
2	Installation Instruction Books and Color Supplements	IB-36119/ IB-36119-CS
2	Instruction Books and Color Supplements	IB-36101/ IB-36101-CS

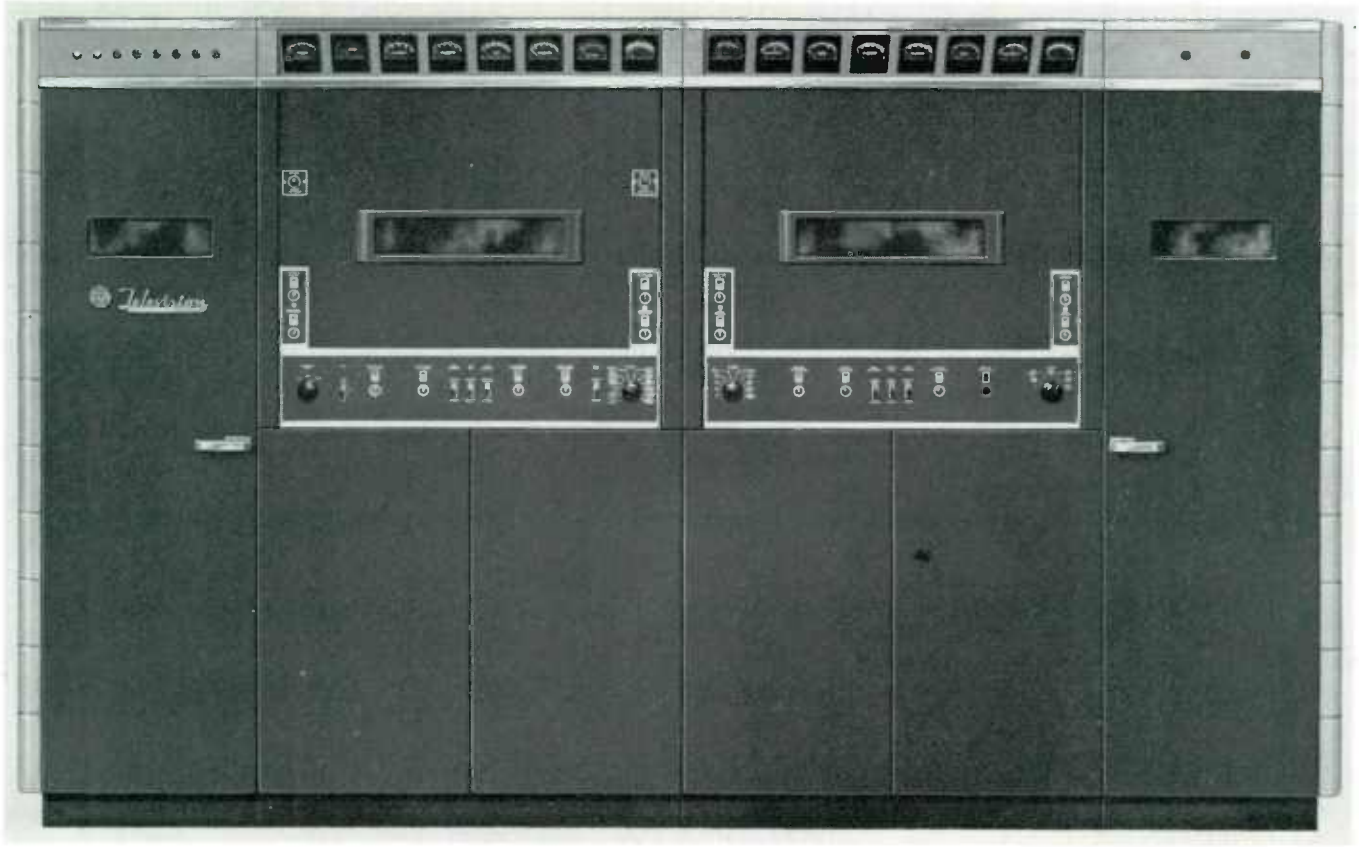
Optional or Accessory Equipment

TTC-5A Console with Master Monitor, but less Master Monitor Power Supply	ES-27274-3
R-F Load and Wattmeter	MI-19199-L
Color Input and Monitoring Equipment Wired/Unwired	ES-19237-E/G
Diplexer	MI-19391[2]
50 Cycle Conversion Kit	MI-19339
Set of Complete Spare Tubes	ES-19233-B
Set of FCC Spare Tubes	ES-19234-B
BW-5B Sideband Response Analyzer	ES-34010-B
FM Exciter Modulator and Power Supply	MI-19326
Tube Kit for Exciter and Power Supply	MI-27117
Voltage Regulator	EM-6245Y
Carrier-Off Monitor	ES-27235
WM-71A Distortion and Noise Meter	MI-30071-A
WA-28A Audio Oscillator	MI-30028-A
TO-524-AD Oscilloscope	MI-26500-A
BW-4B Visual Demodulator	ES-34048

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

11 KW VHF TV TRANSMITTER

TYPE TT-11AH



FEATURES

- Intercarrier frequency control automatically maintains carrier separation within ±500 cycles
- DC filament supply—AM hum on visual carrier now better than 45 db below 100% modulation
- Space saving cabinet design—up to 40% saving over previous 10 kw transmitter space requirements
- Extensive metering and overload circuits afford complete supervisory control of operation
- Compatability with power amplifiers makes power increase easier than ever
- Lower tube costs—same proven tube types used in aural and visual circuits
- Designed for color — built-in linearity correction circuits
- Remote operation—Tuning motors and remote metering facilities are built-in features

DESCRIPTION

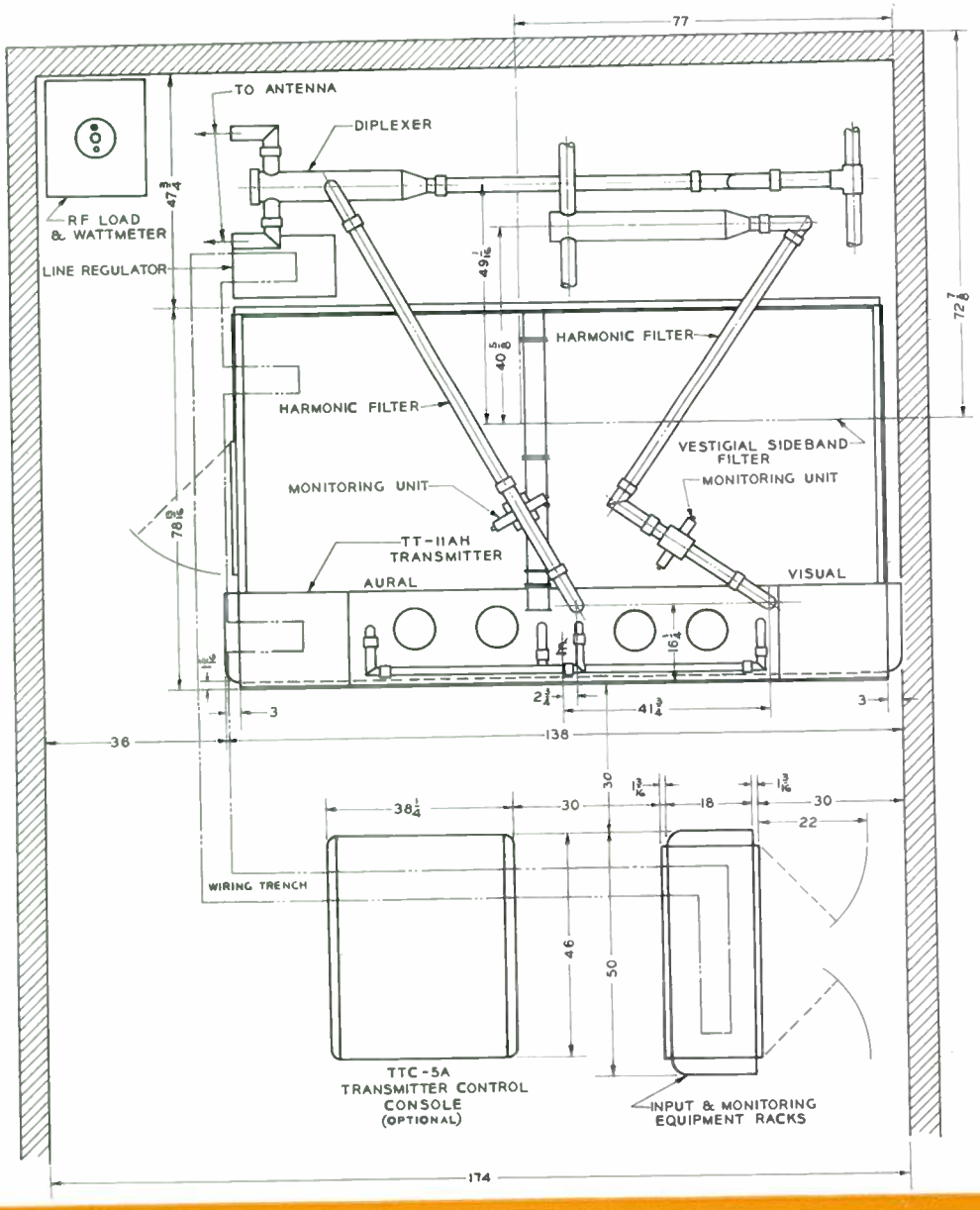
The RCA Type TT-11AH VHF Television Transmitter is a newly designed medium-power television transmitter for channels 7 to 13. It will, in combination with RCA antennas, provide ERP ranging from 2 KW to 18 KW for effective coverage of large urban areas. The TT-11AH provides an excellent low cost standby transmitter for existing high power stations.

A medium power station with plans for future expansion will find the TT-11AH an excellent choice since the transmitter may later be complemented with an RCA TT-25BH amplifier for reaching high power status with a minimum of expense and conversion.

The transmitter operates from a 208-230 volt, 3-phase, 60-cycle power source, and the heaters from a single-phase, 117-volt, 60 cycle line. Operation from a 50-cycle source can be provided with slight modification.

The Type TT-11AH VHF Television Transmitter is designed to conform with all FCC and EIA standards. It will provide a nominal power output of 11 kilowatts peak visual power measured at the output of the sideband filter or filterplexer and 6 KW aural power.

The 11-KW transmitter has been completely restyled to afford a compact unit requiring a minmum 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 allows the broadcaster utmost latitude in arrangement layout. A typical installation is shown, but numerous variations will suggest themselves to the station engineer.



Typical floor plan arrangement for the TT-11AH Transmitter. The rectifier enclosure is shown placed immediately behind the front line of cabinets; however, it may be placed in other convenient locations to meet specific building requirements.

Visual r-f driver unit on the left and aural r-f driver unit on the right emphasize complete accessibility and straightforward unitized construction of the TT-11AH Transmitter.

The TT-11AH's circuits employ the latest design features and represent economy in operation. Highlighted features include air-cooled tubes such as the 6166, 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.

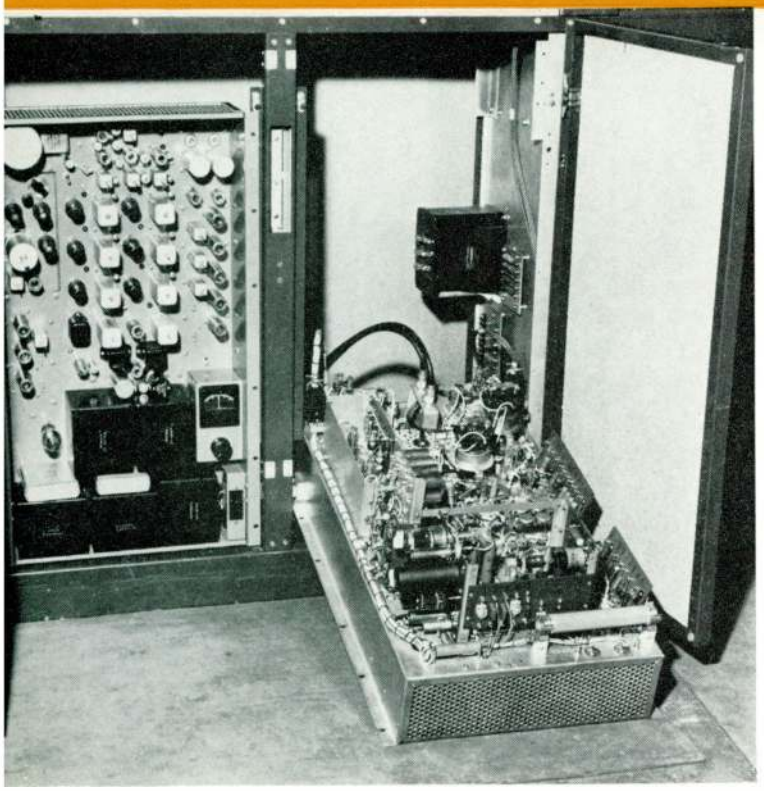
Remote control as well as local operation is an added feature of the new RCA transmitter. If and when the FCC authorizes remote control for television transmitters, the TT-11AH can, with the addition of suitable terminal equipment, be operated from a remote location over a single telephone line. All the necessary operating functions such as starting and stopping the transmitter, resetting overloads, switching in the spare crystal oscillator 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 RCA TTC-5A Transmitter Console.

The type of enclosure employed for the TT-11AH 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 and control circuits 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 panel 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 adjacent to the filter.

The control unit is located at the left front corner 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-interlocked 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 the video and r-f circuits of the complete TT-2BH 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 third cabinet contains both the aural and visual amplifier units. In the right-hand rack is located the PA regulated bias supply for the visual amplifier, terminal boards, DC filament voltage controls and other auxiliary controls. Space is reserved in this rack for a spare exciter. 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 circuits. The tuning controls are operated by cranks which are removable to prevent accidental



Transmitter exciter unit (left), and modulator unit (right) are mounted on hinged chassis which tilt forward for ease of servicing.

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 switches and metering switches.

All important meters of the TT-11AH 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 side 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. These rectifiers have thermostatically controlled heaters for the rectifier tubes which permit 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 interlock 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.

Compactness and Accessibility

The compactness of the TT-11AH Transmitter is indicated in the typical floor plan. A reduction of required floor area of as much as 40 percent under previous 10-kw transmitter installations may be realized. This is made possible by the use of the common power supplies, the new-style walk-in cabinetry and the use of uncased power-supply transformers. Cases are not required on the transformers since they are located inside an enclosure with an interlocked door.

It might be expected that accessibility has been sacrificed to obtain such a savings in floor area; however, accessibility has been greatly improved over many previous transmitter designs. A wide aisle is provided inside the enclosure between the front-line racks and the power supply components to the rear. All components are readily accessible from this aisle. Furthermore, the modulator and exciter chassis can be tilted out from the front of the transmitter for ease of servicing.

The rectifier enclosure can be separated from the front-line cabinets and placed in an adjoining room or in a basement, if desired. This feature makes the TT-11AH Transmitter readily adaptable to existing buildings where there is no single room large enough to accommodate a complete transmitter of this power level. In such a case, all meters, operating controls, and tubes, except rectifier tubes are located in the operating room.

Circuit Description

The visual and aural exciter circuits of the TT-11AH are mounted on a single chassis. Two separate crystal oscillators are employed. This allows switching from a remote point by a relay in a 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 ⅓ the carrier frequency. 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 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 triplers to a 6AS5 mixer tube. When the aural oscillator is on frequency the output of this mixer will be 1/12 of the difference 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 controlled 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 another frequency detector will prevent the application of plate power to the power amplifiers until the frequency control circuit is locked in.

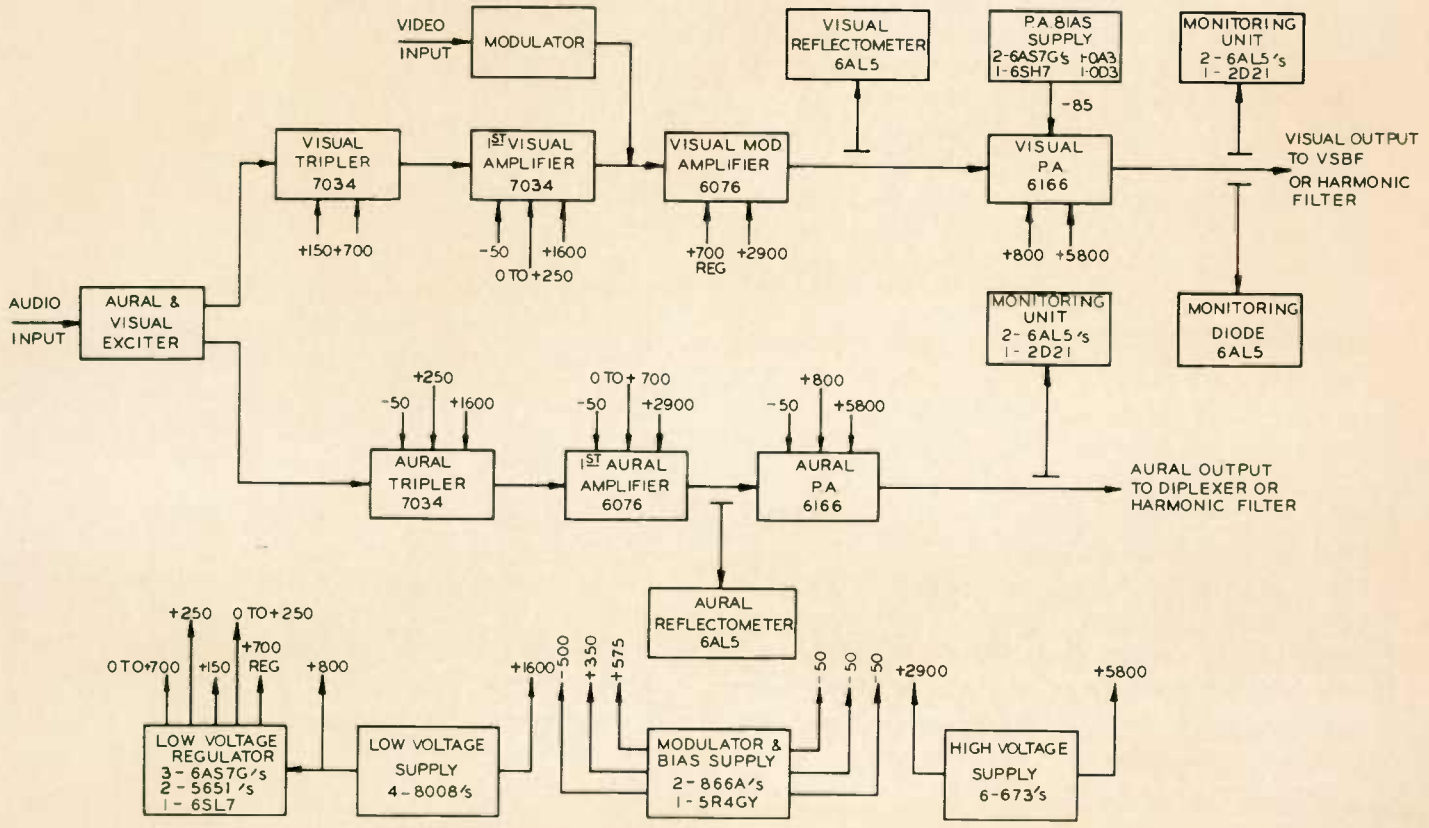
R-F Circuits

The r-f circuits employ a chain of amplifiers. In the visual chain a 7034 tripler driver drives a 7034 amplifier which in turn drives a type 6076 grid modulated stage. This is followed by a single type 6166 class "B" linear amplifier.

In the aural chain the exciter output is fed to a type 7034 tripler stage. This stage is followed by a type 6076 class "C" amplifier which then drives a type 6166 also operating class "C."

Plate voltage for the 6166 tubes is furnished from a high voltage supply employing six type 673 mercury vapor rectifiers. This same rectifier supplies plate voltage for the two type 6076 tubes. A voltage supply using four 8008 tubes supplies plate voltage for the type 7034 tubes. Regulated supplies are used for screen and bias voltages.

Simplified block diagram of the TT-11AH Television Transmitter.



Control Equipment

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 breaker are provided. Each incorporates both thermal and magnetic trips. The high voltage rectifier and each power amplifier tube including the 7034 stages are protected by instantaneous 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 may be intermittent. A three phase line regulator which automatically regulates the line input to the entire transmitter is supplied as standard equipment.

Visual Modulator

The modulator of the transmitter is designed to take a standard 0.7 volt video signal and amplify it sufficiently so that it can grid modulate the 6076 stage. This requires about 220 volts peak-to-peak from the modulator. The first stage of the modulator is a conventional shunt-series peaked 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 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 the diode 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 similar to a conventional cathode follower stage. The cathode resistor has been replaced by three 6146 tubes operating in parallel. The grids of these three tubes are fed with a signal of opposite polarity from the plate load of 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 output 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 tube 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 seen 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 unwanted video resonances.

Proved R-F Circuits

The tube line-up of the TT-11AH Transmitter is indicated in the block diagram shown. The TT-2BH, with reduced voltages on the r-f stages, is used as a driver for the type 6166 output stages. Since the driving power required is only approximately 600 watts aural and 1-kw peak visual, the TT-2BH voltages were reduced to permit combining of its power supplies with those of the power amplifiers.

The aural and visual power amplifier stages each utilize a Type 6166 Tube operating grounded-grid and grounded-screen. This type of operation with the 6166 tube not only gives high stability and long life, as has been proven in the TT-50AH Transmitter, but also permits simplification of the circuit design since the screen and control grids can be bypassed directly to a common ground plane. The input and output circuits can then be constructed on opposite sides of the ground plane. By using rectangular cavities so that one side can be removed, all parts of the cavity are made readily accessible.

No Neutralization Adjustment

The power amplifiers are effectively neutralized over the entire band and require no neutralizing adjustment. The simplified circuitry makes the amplifiers very easy to tune to any high-band channel, and the quality of either color or monochrome picture reproduction is excellent. The picture quality is further enhanced by the use of d-c on the power amplifier filaments to reduce the AM hum to a level where it is not noticeable in a color picture.

Special Protective Circuits

Included as part of the TT-11AH are two MI-19088 Monitoring Units for use in the output transmission line of the visual and aural amplifiers. The transmission line probes are installed so as to give an indication of the amount of forward or 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 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 carrier-off monitor, ES-27235, 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-11AH 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 of 51.5 ohms at one end of the filter. 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 by at least 20 db. An all-pass phase equalizer is also included as part of the low pass filter. This equalizer corrects the phase distortion which is introduced as a result of the sharp cut-off.

Sideband Filter

A vestigial sideband filter, is furnished completely assembled and adjusted for any one of the high 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 consists of lengths of coaxial line (resonant cavities), which are adjustable for tuning purposes. As the filter is pre-tuned at the factory to the desired channel, no operating adjustments are necessary.

SPECIFICATIONS

Performance Specifications

	Visual	*Aural*
Type of Emission	A5	F3
Frequency Range	Ch. 7-13	Ch. 7-13
Rated Power Output	11 KW[1]	6 KW[2]
Minimum Power Output	2 KW[1]	1 KW[2]
R-F Output Impedance	50/51.5 Ohms	50/51.5 Ohms
Input Impdeance	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 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 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.	45 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-5B 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-5B 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 variction with respect to the standard 4.5 mc separation between aural and visual carriers.

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[8]	±5 degrees max.	
Subcarrier Phase vs. Brightness[9]	±7 degrees max.	
Subcarrier Amplitude[8]	±10% max.	
Linearity (Differential Gain)[10]	1.5 db 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 ta peak visual fundamental	At least 60 db	At least 60 db

Electrical Specifications

Power Line Requirements:

Transmitter:

Line	208/230 volts, 3 phase, 50/60 cycles
Slow Line Variations	±5% max.
Rapid Line Variations	±3% max.
Regulation	3% max.
Power Consumption	42 KW (Black Pix) 38 KW (Ave. Pix)
Power Factor (approx.)	90%

Crystal Heaters:

Line	117 volts, single phase, 50/60 cycles
Power Consumption	28 watts

Tube Complement

Exciter Unit:		
3—6V6	6—6AC7	2—6AK5
9—5763	1—6J6	1—OD3
3—6AS6	1—12AT7	1—2D21
1—6AQ5		
Modulator Unit:		
6—6AG7	2—6AL5	5—OA2
2—807	2—6U8A	2—6SL7-GT
5—6146	2—6CL6	4—6AS7-G
1—6BL7-GT	8—5651	1—OD3
1—6SN7-GT	3—OB2	1—6AC7
IPA & Power Amplifier:		
3—7034	2—6076	2—6166
Rectifier Panel:		
2—866-A	1—5R4-GY	6-673
Reflectometers:		
2—6AL5		
Resistor Panel:		
4—8008		
Bias Supply:		
1—5R4-GY	1—OA3	2—6AS7-G
2—OD3	1—6SH7	
L.V. Regulator:		
1—6SL7-GT	2—5651	3—6AS7-G
Monitoring Units:		
4—6AL5	2—2D21	

[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. In addition, the total differential phase between any two levels shall not exceed 10°.

[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 linearly 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-B is required in the video input circuit of the transmitter.

Mechanical Specifications

Dimensions:	
Overall Length (front line cabinets only)	138"
Overall Height (front line cabinets only)	84"
Depth (front line cabinets only)	20"
Overall Depth	78 13/16"
Weight (approx.)	7000 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-11AH 11-KW VHF Television Transmitter, Channels 7-13 (ES-19282)

Qty.	Description	Stock No.
1	Control Unit	MI-27180-A
1	2-KW Unit	MI-27191
1	11-KW Unit	MI-27192
1	Auxiliary Control Unit	MI-27190
1	Set of Panels	MI-27198
1	Blower Enclosure & Filter Panel	MI-27199
1	Rectifier Panel	MI-27459
1	Resistor Panel	MI-27196
1	Transformer Filter Assembly	MI-27197
1	H.V. Plate Transformer	MI-27187
1	Blower	MI-27195
1	Low Voltage Regulator	MI-27469
1	Installation Material	MI-27185
1	Wiring Material	MI-27186
1	line Regulator Control Panel	MI-27471
1	Line Regulator, 3-Phase, 25 KVA	MI-27473-A
2	Crystal Unit (Visual) *Select Type to suit customer's channel.	MI-27492*
2	Side Panel (End Shield)	MI-30541-G84
1	Monitoring Diode	MI-19051-B
2	Monitoring Unit	MI-19088
1	4.75 mc Low Pass Filter	MI-27132
2	Harmonic Filter (Select to suit customer's channel):	
	Channels 7, 8 or 9	MI-27317-7
	Channels 10, 11, 12 or 13	MI-27317-10
1	Vestigial Sideband Filter (Select to suit customer's channel)	MI-27799
1	Finish Touch-Up Kit	MI-7499-A
1	Miscellaneous Hardware Kit	MI-7474
1	Tool Kit	MI-27088
1	Set of Operating Tubes	ES-27207
1	Nameplate	MI-28180-1
8	90° Mitre Elbow Couplings	MI-19112-18C
12	Couplings, Sleeve with Clamps	MI-19112-8
*	Transmission Line (*Sales order to specify quantity to meet installation requirements)	MI-19113-C

Optional or Accessory Equipment

TTC-5A Control Console Equipment	ES-27274-1
R-F Load and Wattmeter	MI-27396
Complete Set of Spare Tubes	ES-27207
FCC Spare Set of Tubes	ES-27208
Input and Monitoring Equipment, Wired/Unwired	ES-19237-G/E
50 Cycle Conversion Kit	MI-34418
Separate Rectifier Enclosure	ES-27299
Carrier-Off Monitor	ES-27235
BW-5B Sideband Response Analyzer	ES-34010-B
BW-4B VHF Visual Sideband Demodulator	MI-34057
Plate Current Meter	MI-21200-C1
WM-71A Distortion and Noise Meter	MI-30071-A
TO-524-AD Oscilloscope	MI-26500-A
Tuning Indicator for MI-27475/H Exciter	MI-27487
WA-28A Audio Oscillator	MI-30028-A
Spare Exciter	MI-27475-H

25 KW VHF AMPLIFIERS

TYPE TT-25BL/BH

FEATURES

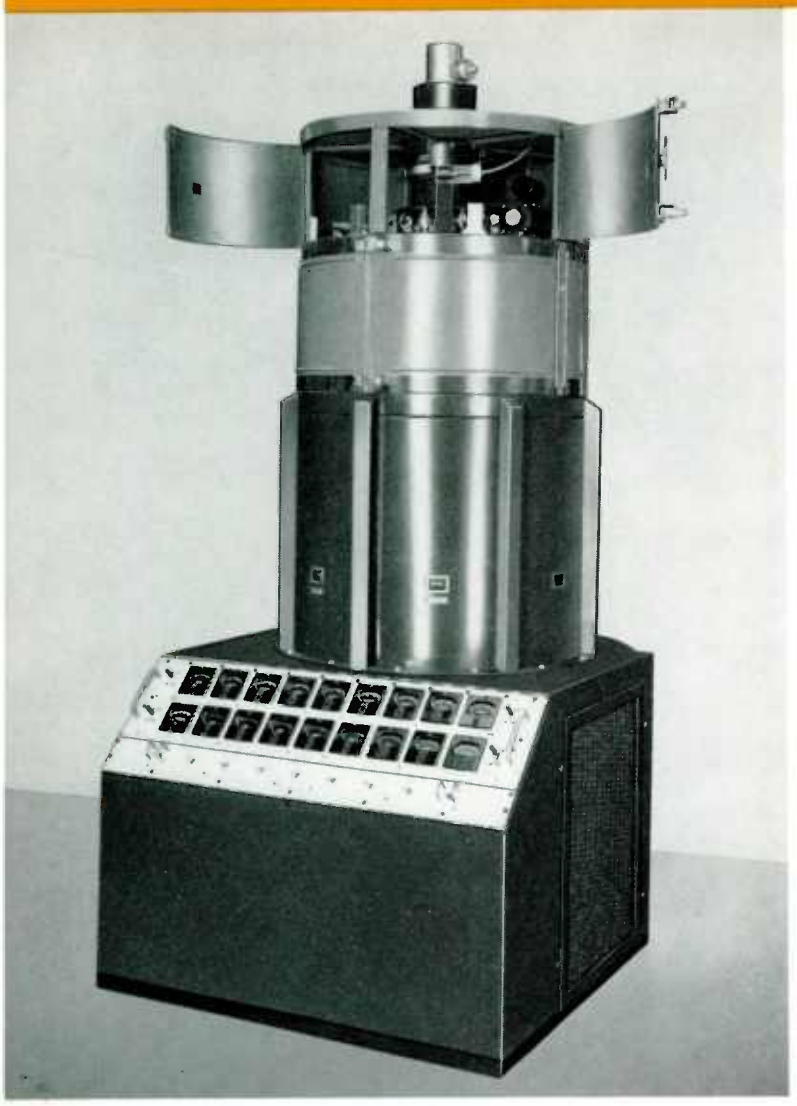
- Visual power output 25 kw peak measured at output of sideband filter or Filterplexer
- Air-cooled tubes—air-cooled transformer
- Low tube cost—easy tube change
- Utmost accessibility
- Flexible location of individual units to meet specific customer requirements
- Complete metering for all amplifier 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 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 other 5 to 10 kw television transmitters meeting FCC and EIA 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

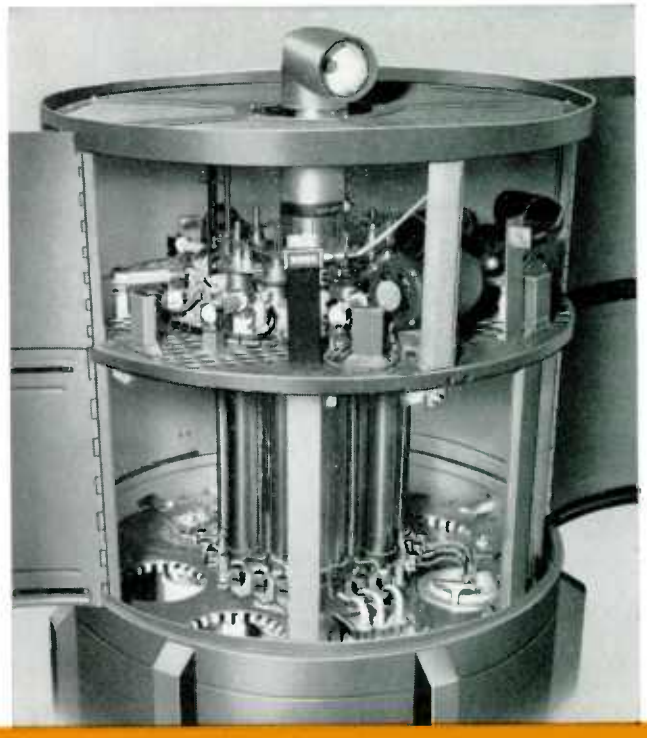
RCA VHF TV amplifier equipments include air-cooled linear broad-band amplifiers for the visual carrier, and air-cooled class "C" amplifiers for the aural carrier. Each amplifier consists of a single power stage utilizing a cluster of seven air-cooled RCA type 5762 Triodes in a grounded-grid circuit. 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.

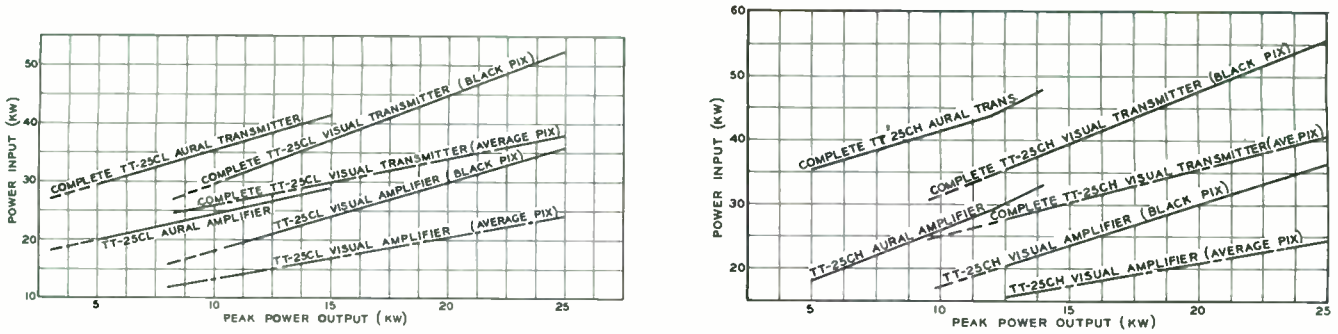
The amplifiers are housed in cylindrical cabinets which provide complete accessibility to all tubes as well as their circuit components. The amplifier base houses the blower, filament transformers, meters, and tuning controls. Air for cooling the tubes is drawn in through two filters on the sides of 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. These cabinets may be placed either in line with or away from the driver transmitter. 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 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. ▶

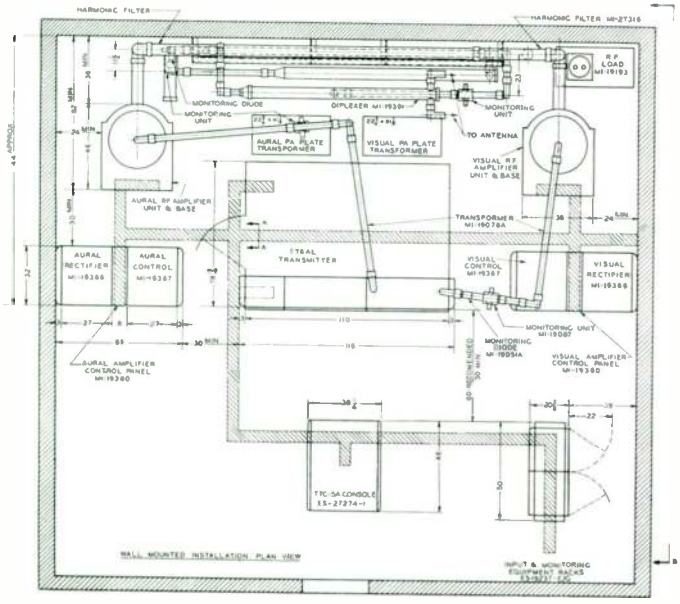


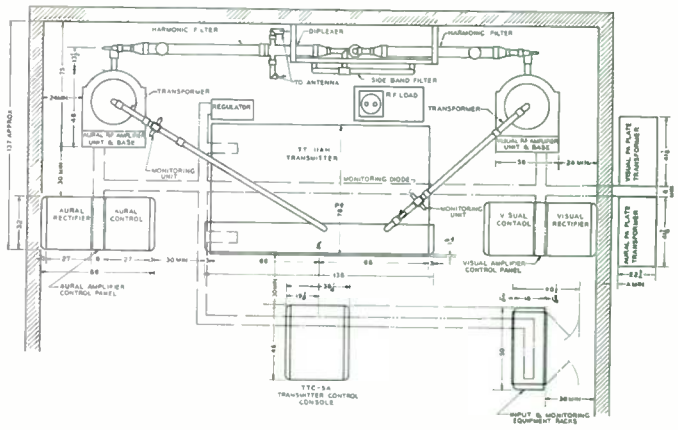
Power consumption curves showing approximate Power Input vs. Peak Power Output of the TT-25CL and the TT-25CH Visual and Aural Transmitters.

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 power output, 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 leak resistors with just enough fixed bias to protect the tubes when there is no drive.





▲ **Typical floor plan of TT-11AL Transmitter with TT-25BH amplifier.**

◀ **Typical floor plan of TT-6AL Transmitter with TT-25BL amplifier conversion equipment.**

SPECIFICATIONS

Performance Specifications[1]

	Visual	Aural
Type of Emission	A5	F3
Frequency Range:		
ES-19247	Chonnels 2-6	Chonnels 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	50/51.5 ohms	50/51.5 ohms
R-F Input Impedance	50/51.5 ohms	50/51.5 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 Frome	Less than 2% of the peak of sync level	
Regulation of Output	4% max.	
Linearity (Differentiol Gain)[4]	1.5 db	

Electrical Specifications

Power Line Requirements:

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

Tube Complement

VISUAL SECTION — ES-19247 AMPLIFIER / VISUAL SECTION — ES-19248 AMPLIFIER

Qty.	Type #	Function	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	Monitor	1	2D21

AURAL SECTION — AURAL SECTION

Qty.	Type #	Function	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 Visual 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 mox., 10°C min.

Equipment Supplied

ES-19247 AMPLIFIER (Chonnels 2-6) Qty.	Stock #	Description	ES-19248 AMPLIFIER (Chonnels 7-13) Qty.	Stock #
2	MI-19065	R-F Amplifier Units	2	MI-19066
2	MI-19067	R-F Amplifier Bose Units	2	MI-19067
2	MI-19068	Blower Units	2	MI-19068
2	MI-19367	Control Units	2	MI-19367
1	MI-19368	Visuol Rectifier Unit	1	MI-19368
1	MI-19369	Aural Rectifier Unit	1	MI-19369
2	MI-19072/A	High Voltage Tronsformers	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]	Hormonic Filters	2	MI-27318[6]
2	MI-19181-A	Driver Reflectometer Meters (0-20 micro-amp.)	2	MI-19181-A
1	MI-19380	Set of Instollotion Moteriol	1	MI-19380
1	MI-19076	Set of Wiring Materiol	1	MI-19076
*	MI-19113-B	Tronsmission Line (*Supply quantity to suit installotion requirements os specified on sales order)	*	MI-19113-B
—	———	Tronsformers	2	MI-19111-11[6]
*	MI-19314-18NF	Elbows (*Supply 2 if specified on sales order)	2	MI-19111-2
*	MI-19314-7	Coupling (*Supply 2 if specified on sales order)	—	———
1	MI-19078-A/B[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 Hardwore 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-B	BW-5B Sidebond Response Anolyzer	ES-34010-B
ES-19229	Set of Complete Spore 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-5B)	MI-19057-A
MI-21200-C1	Plate Current Meter	MI-21200-C1
MI-19085-L[6]	25 kw Vestigiol Sideband Filter	MI-27799[6]
MI-27132	Low Pass Video Filter	MI-27132
EM-6270-D	Voltoge Regulator	EM-6270-D

[1] The overoll performonce of a TV transmitter using the ES-19247/19248 amplifier is necessarily dependent upon and governed by the performance of those portions of the tronsmitter preceding the amplifier.

[2] With respect to the response at 200 kc, os measured by the BW-5B Sidebond Response Anolyzer ot transmitter mid-charocteristic. 4.75 mc attenuation requires use of MI-27132 LP Filter in the video input circuit.

[3] Maximum voriotion with respect to the response at mid-characteristic meosured with the BW-5B Sidebond Response Anolyzer ot brightness levels of 22.5% and 67.5% of sync peak, using approximotely 20% (peak to peok) modulation.

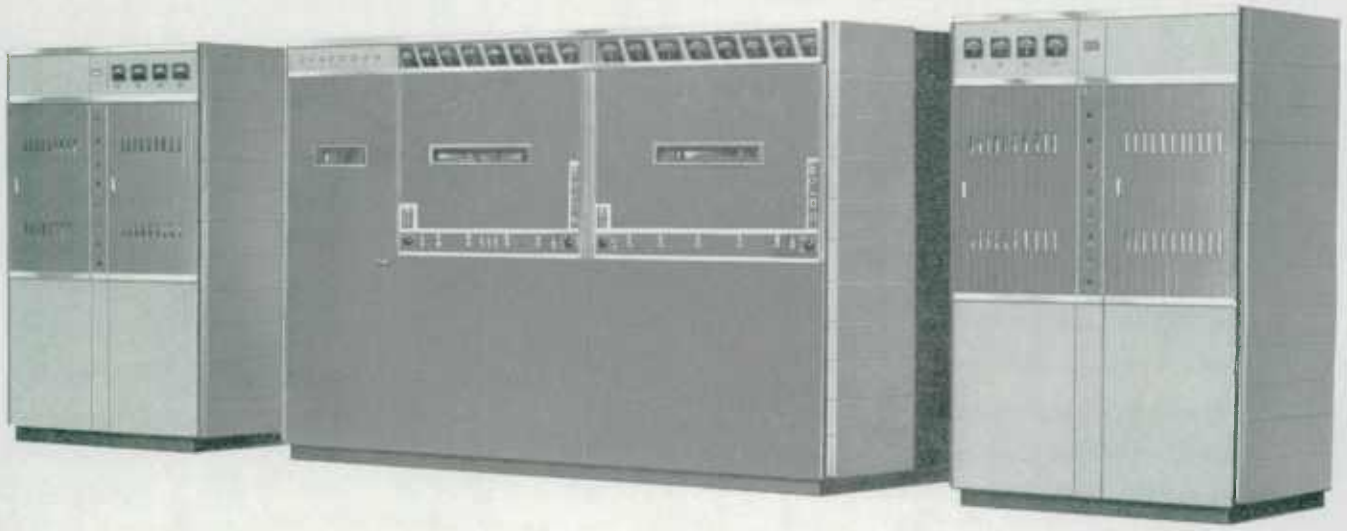
[4] Without correction. The correction circuits are normally applied in or ahead of the video modulator in the driver. Measured at 3.58 mc with increments not larger than 10% between 15% and 75% of peak of sync voltage.

[5] For operotion at rated power and normal plote voltage.

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

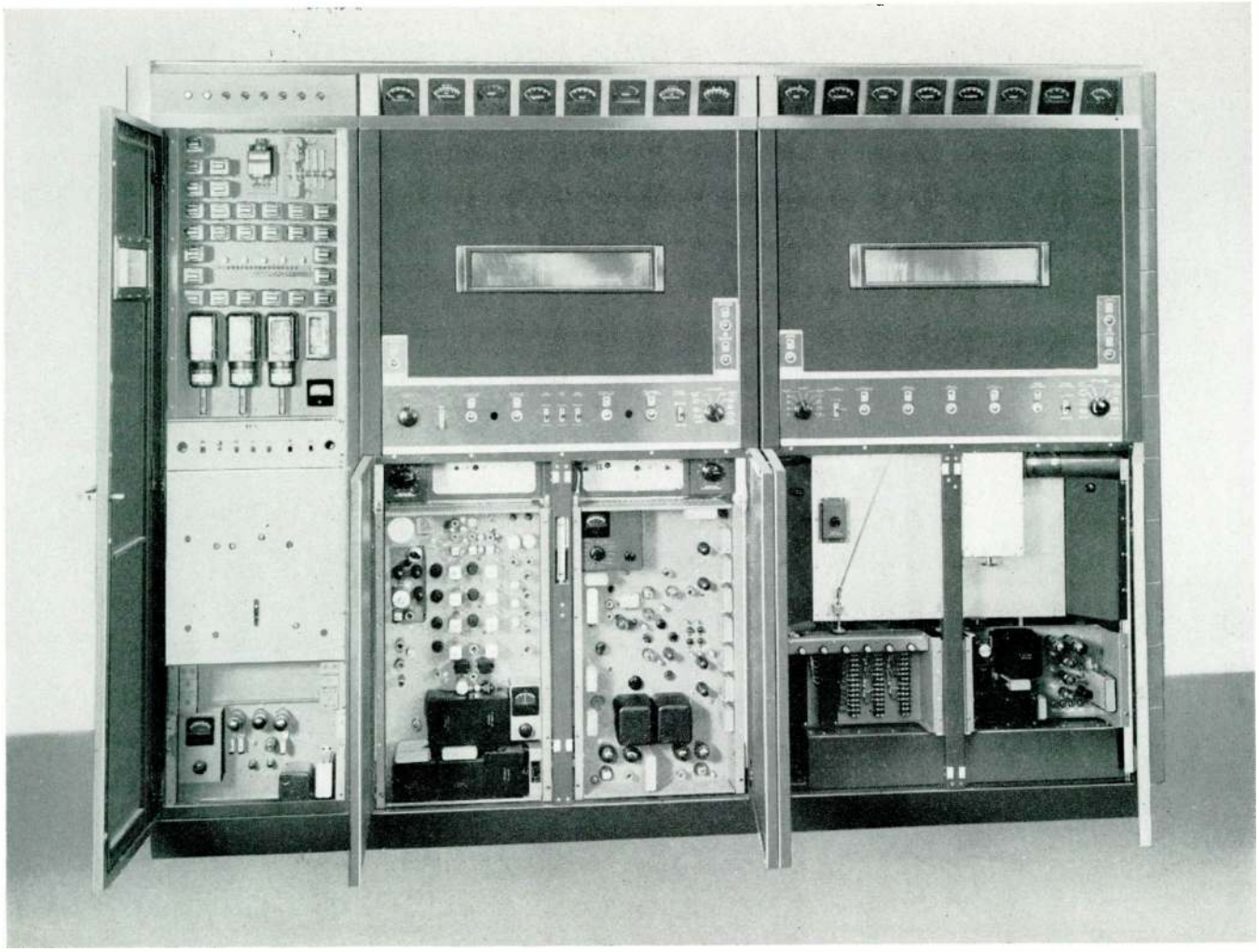
25 KW VHF TV TRANSMITTER

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
- 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
- Excellent accessibility
- Includes provisions for remote control
- Important amplifier meters repeated on control unit
- Complete overload protection with driver indicating lights grouped for quick location of faulty circuits



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

DESCRIPTION

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.

The Type TT-25CL VHF Television Transmitter is designed to conform with all FCC and EIA 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 measured at the amplifier output. 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 exciter are completely adjusted from the front of the transmitter. The unitized construction of the transmitter allows 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.

Equipment Features

The TT-25CL circuits employ the latest design features and allow economical 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.

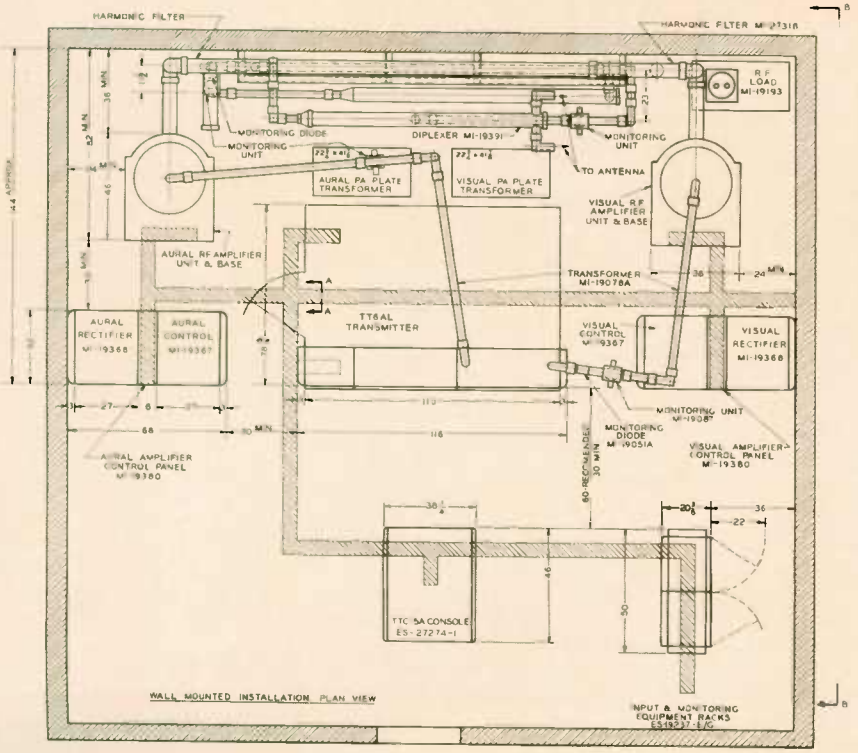
Remote control as well as local operation is an added feature of the new RCA transmitter. If and when the FCC authorizes remote control for television transmitters, the TT-25CL can, with the addition of suitable terminal equipment, be operated from a remote location over a single telephone line. All the necessary operating functions such as starting and stopping the transmitter, resetting overloads, switching in the spare crystal oscillator 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.

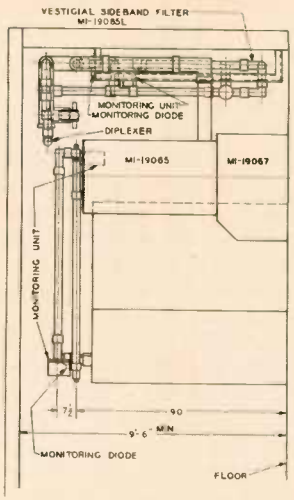
The equipment provides separate visual and aural amplifiers for use with the driver. This equipment includes air-cooled linear broad-band amplifiers for the visual signal, and air-cooled class "C" amplifiers for the aural carrier. Each amplifier consists of a single power stage utilizing a cluster of 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 by switching off filament power on desired number of tubes.

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. The equipment is housed in cabinets which are divided so that flexibility is afforded in arranging the components.

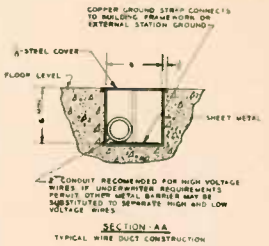
The amplifiers are housed in cylindrical cabinets which provide complete accessibility to all tubes as well as their circuit components. The amplifier base houses the blower, filament transformers, meters, and tuning controls. Air for cooling the tubes is drawn in through two filters on the sides of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

TT-25CL TYPICAL FLOOR PLAN





WALL MOUNTED INSTALLATION SIDE VIEW B-B



SECTION AA
TYPICAL WIRE DUCT CONSTRUCTION

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.

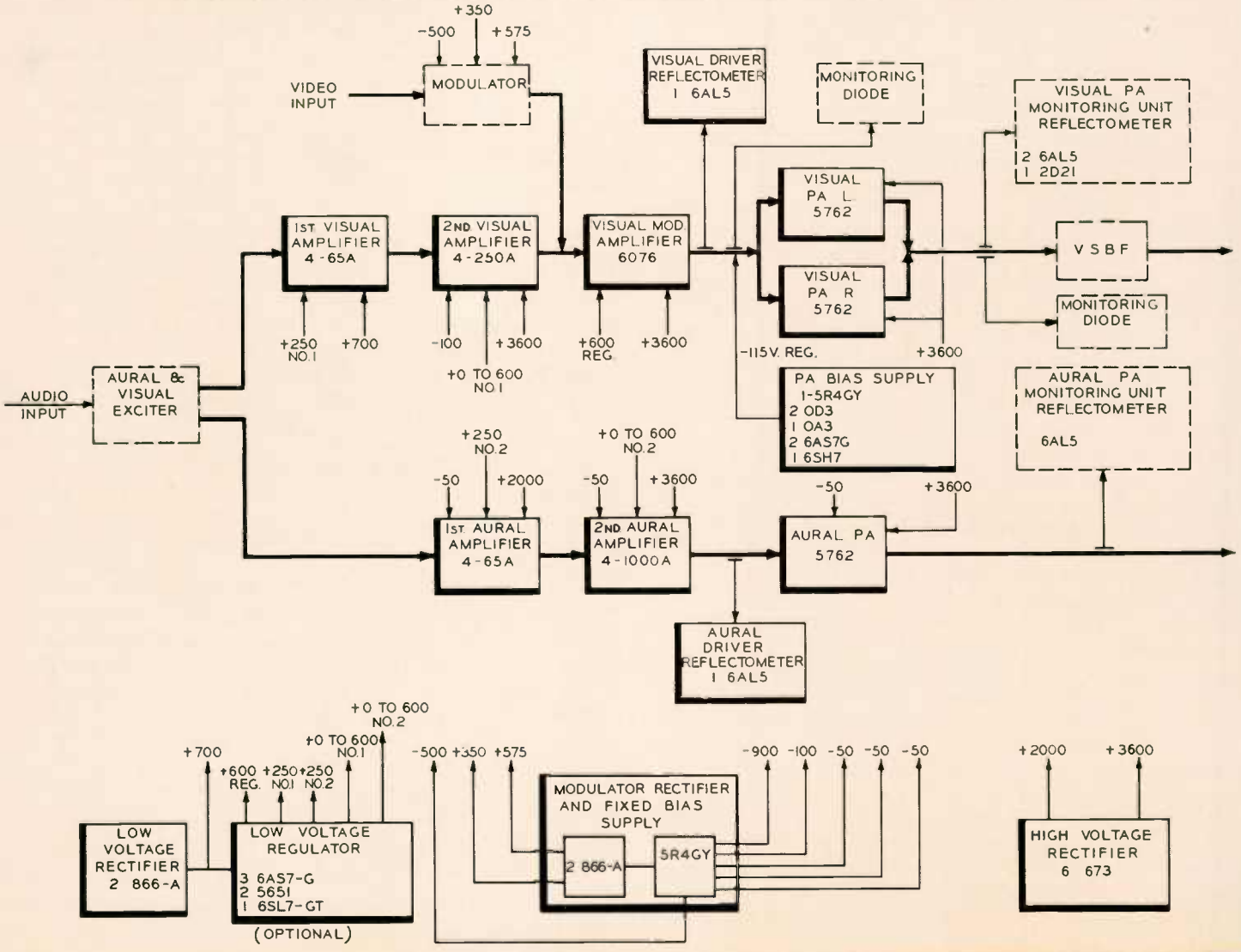
TT-6AL Driver

The TT-6AL Transmitter is used as a completely self-contained driver for the TT-25CL Transmitter. This arrangement permits fast cutback with the use of coaxial switches, listed as optional equipment for reduced power operation. Details of the TT-6AL Transmitter are described in the TT-6AL Catalog.

Basically the driver has a common visual and aural exciter controlled by one of two crystal-controlled oscillators. Precise carrier separation, well within FCC specs, is maintained by special designed frequency control circuits. Frequency modulation is accomplished in the exciter by a "direct modulation" process requiring less components, fewer tubes and tube types.

The aural driver chain consists of three stages: a 4-65A, a 4-1000A and a type 5762 tube all operating as class "C" amplifiers. The visual modulator output modulates the grid of the 6076 tetrode tube operating at a nominal 2 kilowatt peak visual power output. The 6076 stage drives two 5762 tubes which are the finals of the TT-6AL visual chain. Reflectometers in both visual PA and aural PA circuits allow monitoring the output from the TT-6AL driver.

BLOCK DIAGRAM OF THE TT-25CL VHF TELEVISION TRANSMITTER DRIVER

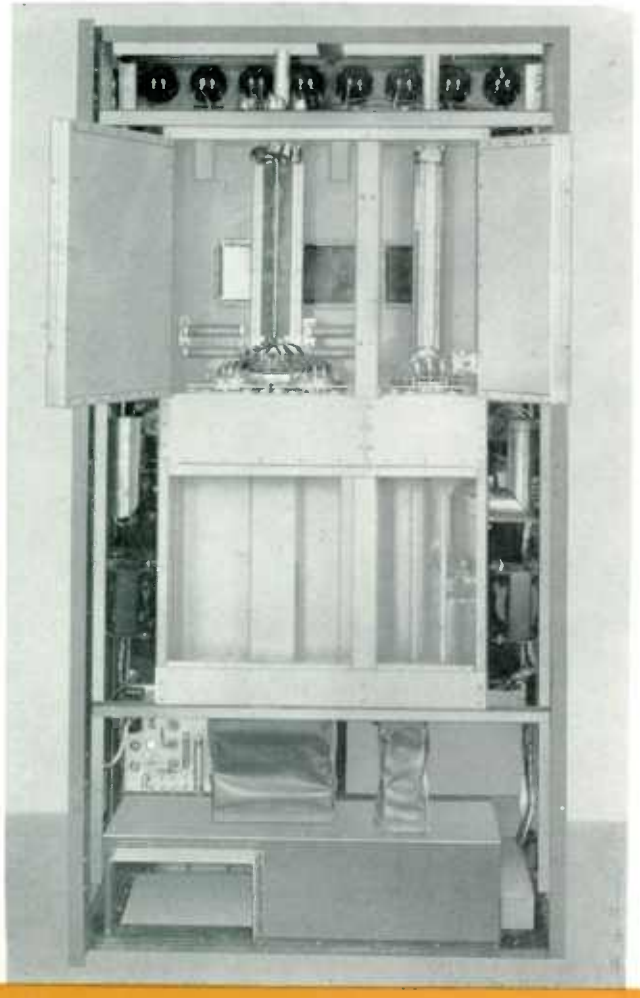


25 KW Power Amplifier

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. Monitoring diodes are included so that tuning and monitoring may be accomplished at both the input and output levels. A monitor unit 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.

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

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



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 leak resistors with just enough fixed bias to protect the tubes when there is no drive.

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 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 occurred 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.

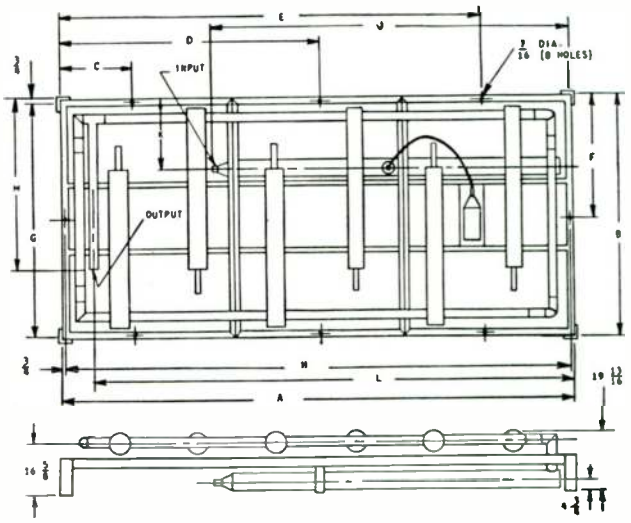
Vestigial Sideband Filter

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.

MI-19085-L VESTIGIAL SIDEBAND FILTER

SPECIFICATIONS

Frequency	54-88 mcs
Maximum Power (5000 ft. elevation)	25 kw
Input and Output Impedance	50/51.5 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	50/51.5 ohms	50/51.5 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 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 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.	45 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-5B 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-5B 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]	1.5 db	
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, 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.
Power Consumption	(Black Pix) 97 kw (Ave. Pix) 80 kw
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	Buffer 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	Visual Modulated Amplifier	6076
1	Visual Driver Reflectameter	6AL5
2	Visual PA	5762
1	Visual PA Forward Power Detector	6AL5
1	Visual PA Reflected Power Detector	6AL5
1	Reflectometer Thyratron	2D21
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	1st Sync Amplifier	6AG7
1	2nd Sync Amplifier-Sync Separator	6U8A
1	Pulse Generator	6U8A

Tube Complement (Continued)

Qty.	Function	Type No.
1	Clipper	6SN7-GT
1	1st Clamp Diode	6AL5
1	2nd 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	High Voltage Regulator	6AS7-G
1	D-C Amplifier (Low Voltage Regulator)	6SL7-GT
2	Low Voltage Regulator	6AS7-GT
1	150 V Regulator	OD3
1	Monitor Amplifier	6AC7
1	Monitor Amplifier (Output)	6AG7
1	1st Clamp Pulse Output	6CL6
1	Bucking Bias	6BL7-GT
1	2nd Clamp Pulse Output	6CL6

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 Reflectameter	6AL5
1	Aural PA	5762

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[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 conventional diode demodulator. In addition, the total differential phase between any two levels shall not exceed 10°.

[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 linearly 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-B is required in the video input circuit of the transmitter.

SPECIFICATIONS (Continued)

DRIVER COMMON POWER SUPPLY, ETC.

1	Voltage Regulator	OD3
1	Off-Frequency Interlock Control	2D21
1	Bias Rectifier	5R4-GY
2	Voltage Regulators (PA Bias Supply)	OD3
1	Voltage Regulator (PA Bias Supply)	OA3
1	D-C Amplifier (PA Bias Supply)	6SH7
2	Series Regulators (PA Bias Supply)	6AS7-G
2	Low Voltage Rectifiers	866-A
2	Modulator Rectifiers	866-A
1	Modulator Rectifier	5R4-GY
6	High Voltage Rectifiers	673
1	D-C Amplifier (Low Voltage Regulator)	6SL7-GT
2	Voltage Reference Tubes(Low Voltage Regulator)	5651
3	Series Regulators (Low Voltage Regulator)	5651
†2	Regulators (Carrier-Off Monitor)	OD3
†4	Amplifiers (Carrier-Off Monitor)	5814-A

AMPLIFIER VISUAL SECTION

7	Visual Linear Amplifier	5762
6	High Voltage Rectifiers	673
1	Bios Rectifier	5R4-GY
7	Bias Regulators	6AS7-G
1	D-C Amplifier (Bias Supply)	6SH7
2	Regulators (Bias Supply)	OD3
1	Regulator (Bias Supply)	OA3
2	Detectors (Monitoring Unit)	6AL5
1	Thyratron (Monitoring Unit)	2D21

AMPLIFIER AURAL SECTION

7	Aural Amplifier	5762
6	High Voltage Rectifier	673
1	Bias Rectifier	5R4GY
2	Detectors (Monitoring Unit)	6AL5
1	Thyratron (Monitoring Unit)	2D21

Mechanical Specifications

Dimensions	(For dimensions see floor plans)
Weight (approx.):	
6-KW Driver	4300 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., 10° C. min.

Equipment Supplied

TT-25CL TELEVISION TRANSMITTER (ES-19288)

Qty.	*Description*	*Stock No.*
1	Control Unit	MI-27180-A
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
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

Equipment Supplied (Continued)

Qty.	*Description*	*Stock No.*
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	Low Voltage Regulator	MI-27469
1	Regulator (Three Phase)	MI-27473-A
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 Bose 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	High Voltage Transformers (50 cycles)	MI-19072-1/-A1
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/MI-19314
*	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/B[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
1	Set of Installation Drawings	8926818-501
2	Instruction Books (25-KW Amplifier)	IB-36150
2	Installation Instruction Books (25-KW Amplifier)	IB-36151
2	Instruction Books (6-KW Driver)	IB-36279
2	Installation Instruction Books (6-KW Driver)	IB-30266
1	Coupling Reducer, 3⅛" to 1⅝"	MI-19113-C7
2	Monitoring Diodes	MI-19051-B

Optional or Accessory Equipment

TTC-5A Control Console Equipment, with master monitor but less master monitor power supply	ES-27274-2
R-F Load and Wattmeter	MI-19193-L
Complete Set of Spare Tubes (for 6-KW Driver)	ES-27205
Complete Set of Spare Tubes (for 25-KW Amplifier)	ES-19229
FCC Spare Set of Tubes (for TT-25CL Transmitter)	ES-27240
Spare Exciter	MI-27475
Spare Modulator	MI-27476-B
Input and Monitoring Equipment, Wired/Unwired	ES-19237-G/E
50 Cycle Conversion Kit (for TT-6AL Driver)	MI-27486
Rectifier Enclosure (for TT-6AL Driver)	ES-19279
Carrier-Off Monitor	ES-27235
BW-5B Sideband Response Analyzer	ES-34010-B
Plate Current Meter	MI-21200-C1
WM-71A Distortion and Noise Meter	MI-30071-A
TO-524-AD Oscilloscope	MI-26500-A
Diplexer	MI-19391[2]
Set of End Shields (2 per set for 25 kw Amplifier)	MI-28061
Set of 4-inch Channels (for 25 kw Amplifiers, 1 front and 1 rear)	MI-19365
Coupling Unit (for use with BW-5B)	MI-19057-A
Voltage Regulator	EM-6270-D
Transmission Line 6⅛, 51.5 Ohms	MI-19314
WA-28A Audio Oscillator	MI-30028-A
50 Cycle Conversion Kit (TT-25BL Amplifier)	MI-34414

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

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

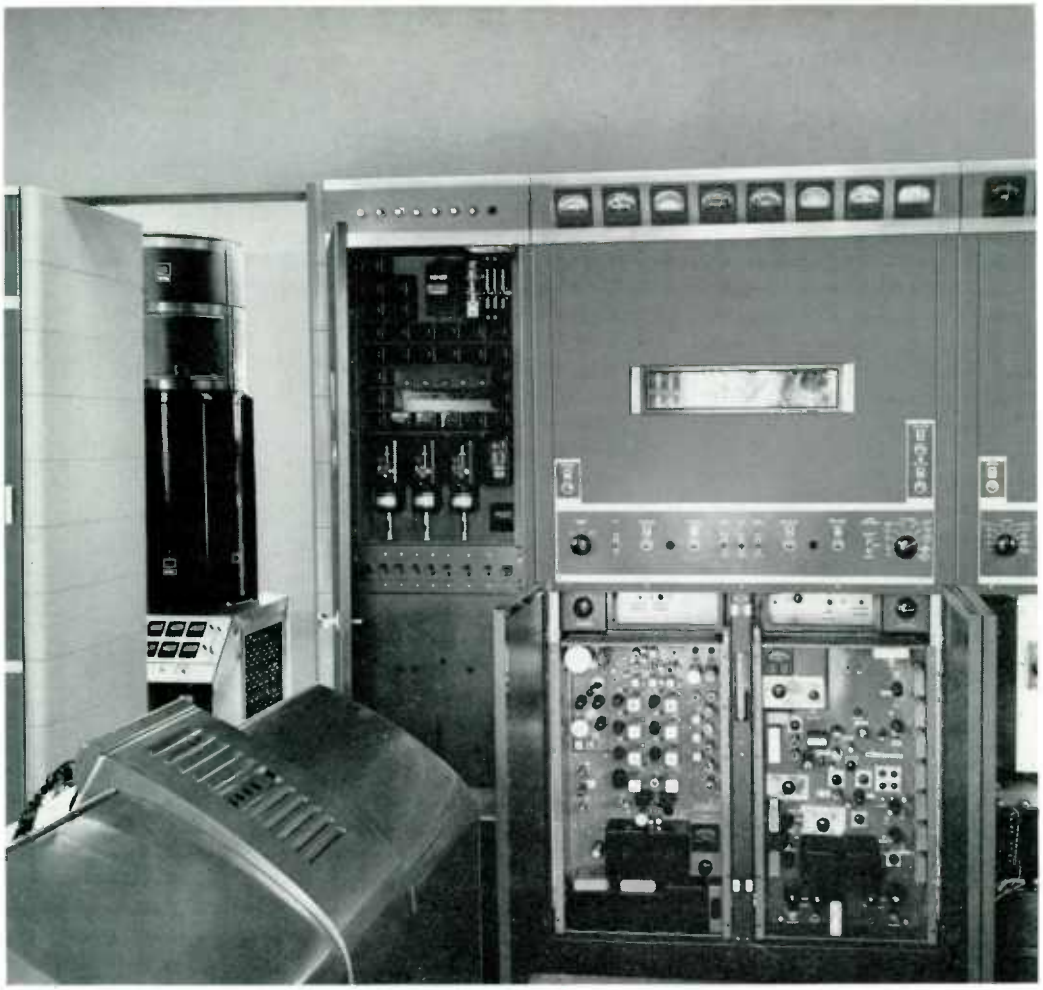
[2] Order to suit customer's assigned channel.

25 KW VHF TV TRANSMITTER

TYPE TT-25CH

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
- Low operating costs
- Uses Type 5762 tubes, famous for long life and reliability
- Broadbanding tuning controls accessible without opening any doors
- All tubes and components of transmitter are 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
- Excellent accessibility
- Includes provisions for remote control
- Important amplifier meters repeated on control unit
- Complete overload protection with driver indicating lights grouped for quick location of faulty circuits



DESCRIPTION

The TT-25CH Television Transmitter operates on VHF channels 7 through 13, with a peak visual power output of 25 kw. When used with one of the current VHF antennas, it is possible to obtain the maximum allowable 316,000 watts effective radiated power. The TT-25CH may be purchased as a complete 25 kw high-power transmitter, or may be the result of a building-block program starting with a 2 kw transmitter (TT-2BH), then adding an 11 kw amplifier (TT-11AH), and finally adding the 25 kw amplifiers. A minimum of conversion is necessary to change from one power level to the next as the station grows.

The TT-25CH 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.

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, by switching off filaments of one or two tubes.

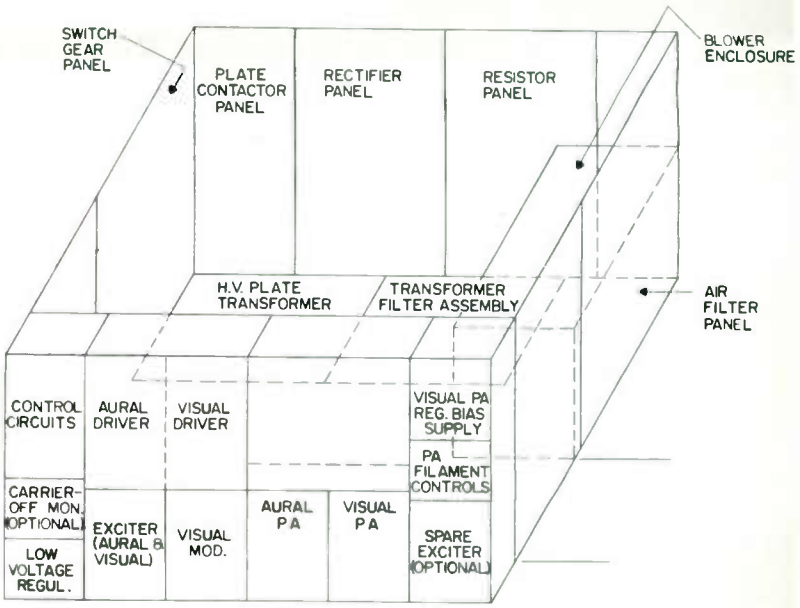
The complement of equipment includes dual r-f amplifier and blower units, power supplies, control units, and plate transformers—one of each for both the aural and visual sections. The equipment is housed in cabinets which are divided so that flexibility is afforded in arranging the components.

Design Features

The TT-25CH was designed with reliability and ease of operation and maintenance in mind. Access to components is better because of new improved mechanical design. Space requirements have been reduced as much as 30 percent over previous designs to allow for installation in existing building. Reduction of required floor space is effected by a walk-in enclosure design of the driver portion of the TT-25CH.

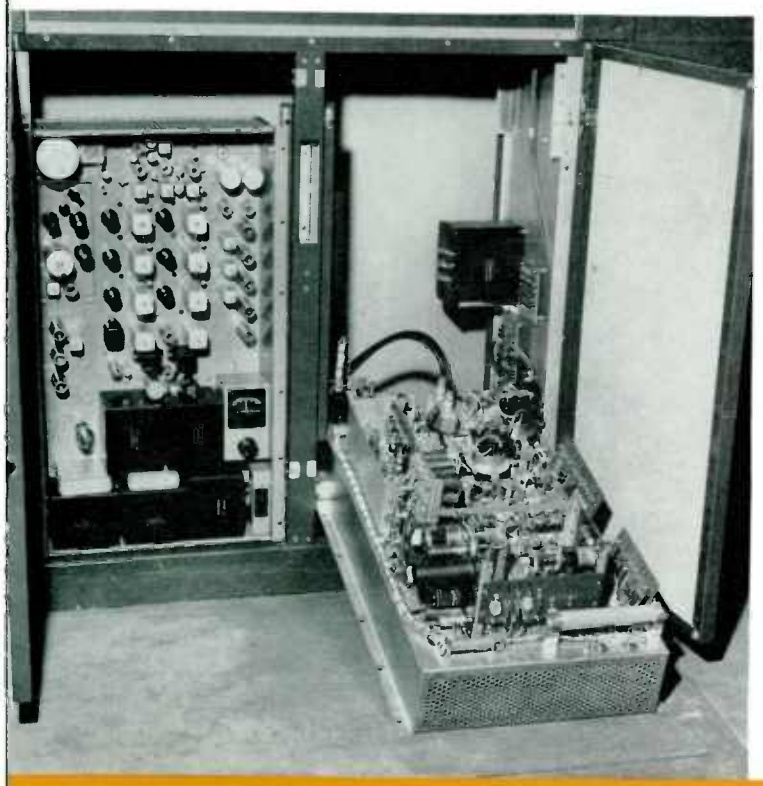
This type of construction eliminates the need for external access space at the rear of the enclosure. The enclosure may be placed directly against a wall or even in a corner of the room if an air intake opening is provided. Access to all components of the driver is possible from within the enclosure. The modulator and exciter may be serviced by tilting the chassis forward, without removal from the cabinet.

Where space is at an extreme premium, it is possible to locate the rectifier equipment in a basement room by using a separate rectifier enclosure, as optional equipment. Use of the completely self-contained TT-11AH as a driver provides for cutback to the driver in case of amplifier or antenna system problems which may require temporary reduction of power. Coaxial switches or manual patch panels are required for fast cutback.



Walk-in type construction of the driver permits easy servicing. Rectifiers and cooling equipment are at the rear of the enclosure. The remaining portions of the driver are in the front line of cabinets.

Complete accessibility is feature of Transmitter exciter (left) and Modulator unit (right). Hinged chassis allow units to tilt forward.



Standardized Aural-Visual Exciter

The TT-25CH utilizes a standardized aural-visual exciter similar to that of the RCA TT-2, TT-6 and TT-11 Series of transmitters. Both the aural and visual carriers are locked to a single crystal. Carrier separation, well within FCC specifications, is automatically adjusted by frequency control circuitry. The modulator output is used to grid modulate a type 6076 tetrode operating at a nominal 2 kw peak visual power. All r-f stages preceding this are operated as regular class "C" amplifiers.

The visual linear amplifier following the modulated stage employs a 6166 tetrode in a grounded grid, grounded screen circuit. This type of operation is used in the RCA 50 kw television transmitter, and it is extremely stable. Circuit design is simplified, since the grid and screen may be by-passed to a common ground plane. Input and output circuits are then constructed on opposite sides of the ground plane. The newly designed 6166 cavity is fabricated in rectangular shape so that removal of one panel exposes the entire cavity for cleaning or preventative maintenance. No neutralizing adjustments are required, since the 6166 stage is effectively neutralized over the entire band. D-c is used for the filaments of the 6166 to reduce hum modulation to a level where it is not noticeable in the picture. A similar tube complement is used for the aural signal.

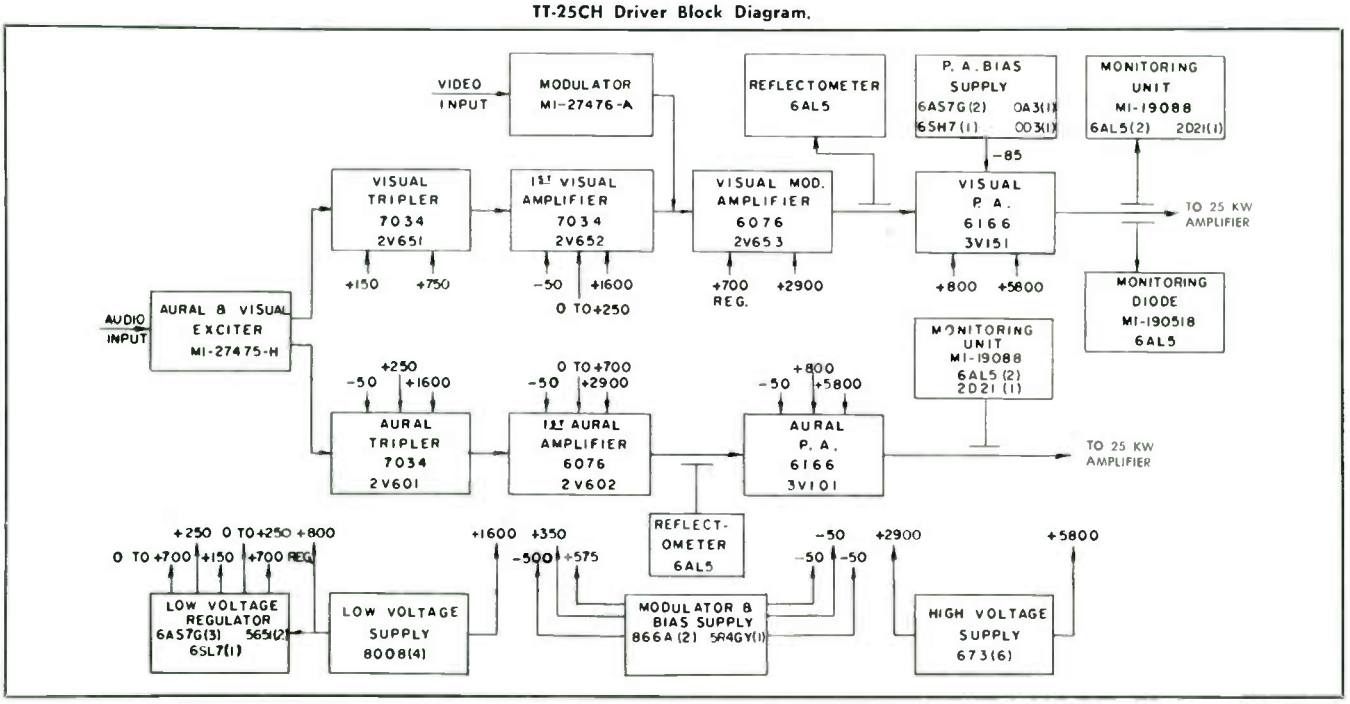
High Power PA Amplifiers

Each 6166 stage, aural and visual, drives an amplifier using seven 5762 tubes paralleled in a grounded grid circuit to produce outputs of 25 kw peak visual power and 14 kw aural power. Two coaxial tank circuits are employed with one of these tanks placed inside the other. These function as parallel inductances, thus raising 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. The 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 at a low impedance point, the capacitor is located approximately one-half 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 with a band pass essentially flat over six megacycles.

The cathode circuit cannot be made a conventional quarter wave tank because the first low impedance point would occur at the tube straps. To compensate for this extra inductance of the straps, coaxial capacitors are connected in series with the tube leads. The capacitors are variable, and when mechanically ganged become the input tuning control. This cathode circuit is matched to the 51.5 ohm input from the 6166 driver, by two quarter-wave transformers in series. Input coupling is provided by

TT-25CH Amplifier.

TT-25CH Driver Block Diagram.



making one of these transformers variable in characteristic impedance as the outer shell is rotated through 90 degrees. With few exceptions, identical components are used for aural and visual circuits throughout the TT-25CH transmitter. It is therefore possible to reduce spare tube and parts inventory as much as 50 percent.

Complete Protection

Extensive metering and protective multiple trip circuits are provided. A supervisory overload circuit indicates the circuit in which an overload occurs. Monitoring units, which continuously monitor standing wave ratio in the output lines are included as standard equipment. If the reflected power rises above a pre-determined level, the transmitter is automatically turned off to prevent damage.

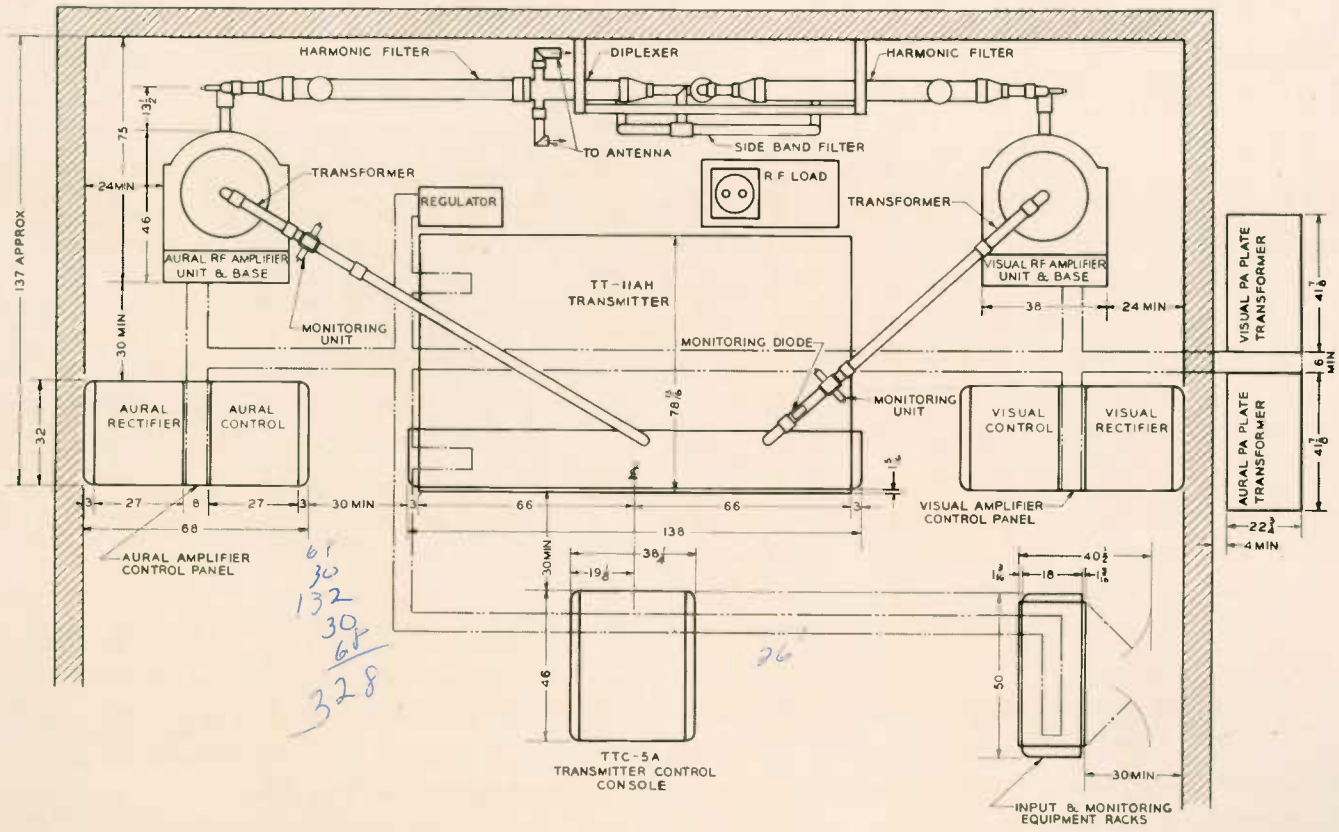
Vestigial Sideband Filter

The MI-27799 Vestigial Sideband Filter is furnished completely assembled and adjusted for any one of the high 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 sideband visual transmitter. It consists essentially of series and parallel lumped impedances which act as resonant circuits at their respective frequencies. The elements are so chosen that the reactance is balanced out and the input resistance is constant. The filter sections consist of lengths of coaxial line (lumped impedances), which are adjustable for tuning purposes. As the filter is pretuned at the factory to the channel stamped on the nameplate, no tuning adjustments are necessary.

Reflections are kept to a minimum when transmission line specified in the transmitter schedule of equipment is used between the transmitter and sideband filter.

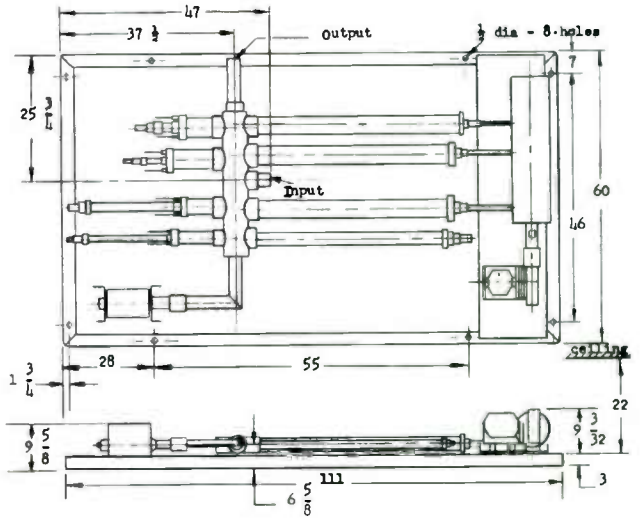
Typical floor plan for the TT-25CH Transmitter. Many variations of this floor plan are possible to meet requirements of existing buildings.



MI-27799 VESTIGIAL SIDEBAND FILTER

SPECIFICATIONS

Frequency	174-216 mc
Maximum Power (5000 ft. elevation)	25 kw
Input and Output Impedance	50/51.5 ohms, 3 1/8" coaxial line
VSWR	1.1 or better
Blower	230 volt, 1/4 hp, 2850 rpm, 50/60 cycle
Air Interlock	5 amp. @ 250 volts, a-c
Ambient Temperature	45° C max.
Weight	532 lbs.
Mounting	Woll or ceiling
Clearance	12"



SPECIFICATIONS

Performance Specifications

	Visual	*Aural*
Type of Emission	A5	F3
Frequency Range	Ch. 7-13	Ch. 7-13
Rated Power Output	25 kw[1]	14 kw[2]
Minimum Power Output	12.5 kw[1]	6.2 kw[2]
R-F Output Impedance	50/51.5 ohms	50/51.5 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 ot carrier plus 2.0 mc.
+1, −1.5 db at carrier plus 3.0 mc.
+1, −1.5 db ot 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 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-5B Sideband Response Analyzer at transmitter mid-choracteristic. 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 ot transmitter mid-characteristic.

[5] Maximum variation with respect to the response at mid-characteristic measured with the BW-5B 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 voriation 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]	±10% max.	
Linearity (Differential Gain)[3]	1.5 db 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, 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.
Power Consumption (25 kw Visual & 14 kw Aural)	(Black Pix) 104 kw (Ave. Pix) 89 kw
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	Buffer Amplifier	5763
1	1st Visual Multiplier	5763
1	2nd Visual Multiplier	5763
1	3rd Visual Multiplier	5763
1	Visual Output Amplifier	5763
1	Visual Tripler	7034
1	1st Visual Amplifier	7034
1	Visual Modulator Amplifier	6076
1	Visual Driver Reflectometer	6AL5
1	Visual PA	6166
1	Visual PA Forward Power Detector	6AL5
1	Visual PA Reflected Power Detector	6AL5
1	Reflectometer Thyratron	2D21
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	1st Sync Amplifier	6AG7
1	2nd Sync Amplifier-Sync Separator	6U8A
1	Pulse Generator	6U8A
1	Clipper	6SN7-GT
1	1st Clamp Diode	6AL5
1	2nd 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 Regulator 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	H.V. Regulators	6AS7-G
1	D-C Amplifier (Low Voltage Regulator)	6SL7-GT
2	L.V. Regulators	6AS7-GT
1	150 V Regulator	OD3
1	Monitor Amplifier	6AC7
1	Monitor Amplifier (Output)	6AG7
1	1st Clamp Pulse Output	6CL6
1	Bucking Bias	6BL7-GT
1	2nd Clamp Pulse Output	6CL6

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 Driver	12AT7
1	Aural Tripler	7034
1	1st Aural Amplifier	6076
1	Aural Driver Reflectometer	6AL5
1	Aural PA	6166
1	Aural PA Forward Power Detector	6AL5
1	Aural PA Reflected Power Detector	6AL5
1	Reflectometer Thyratron	2D21

[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 conventional diode demodulator. In addition, the total differential phase between any two levels shall not exceed 10 degrees.

[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 linearly 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-B is required in the video input circuit of the transmitter.

SPECIFICATIONS (Continued)

DRIVER COMMON POWER SUPPLY, ETC.

1	Voltage Regulator	OD3
1	Off-Frequency Interlock Control	2D21
1	Bias Rectifier	5R4-GY
2	Voltage Regulators (PA Bias Supply)	OD3
1	Voltage Regulator (PA Bias Supply)	OA3
1	D-C Amplifier (PA Bias Supply)	6SH7
2	Series Regulators (PA Bias Supply)	6AS7-G
4	Low Voltage Rectifiers	8008
2	Modulator Rectifier	866-A
1	Modulator Rectifier (Bias)	5R4-GY
6	High Voltage Rectifiers	673
1	D-C Amplifier (Low Voltage Regulator)	6SL7-GT
2	Voltage Reference Tubes (Low Voltage Regulator)	5651
3	Series Regulators (Low Voltage Regulator)	5651
†2	Regulators (Carrier-Off Monitor)	OD3
†4	Amplifiers (Carrier-Off Monitor)	5814-A

AMPLIFIER VISUAL SECTION

7	Visual Linear Amplifier	5762
6	High Voltage Supply Rectifiers	673
1	Bias Supply Rectifier	5R4-GY
7	Bias Supply Regulators	6AS7-G
1	Bias Supply D-C Amplifier	6SH7
2	Bias Supply Voltage Reference	OD3
1	Bias Supply Voltage Reference	OA3
1	Forward Power Detector	6AL5
1	Reflected Power Detector	6AL5
1	Reflectometer Thyratron	2D21

AMPLIFIER AURAL SECTION

7	Aural Amplifier	5762
6	High Voltage Supply Rectifiers	673
1	Bias Supply Rectifier	5R4-GY
1	Forward Power Detector	6AL5
1	Reflected Power Detector	6AL5
1	Reflectometer Thyratron	2D21

Mechanical Specifications

Dimensions ..... (For dimensions see floor plans)
Weight (approx.):
- 11-KW Driver ..... 7000 lbs.
- Aural and Visual Power Amplifier and Blower, each ..... 1100 lbs.
- Aural and Visual Power Supply and Filter, each ..... 1100 lbs.
- Aural and Visual Control Unit, each ..... 1100 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., 10° C. min.

Equipment Supplied

TT-25CH TELEVISION TRANSMITTER ES-19289

Qty.	Description	Stock No.
1	Control Unit	MI-27180-A
1	2-KW Unit	MI-27191
1	11-KW Unit	MI-27192
1	Auxiliary Control Unit	MI-27190
1	Set of Panels	MI-27198
1	Blower Enclosure & Filter Panel	MI-27199
1	Rectifier Panel	MI-27459
1	Resistor Panel	MI-27196
1	Transformer Filter Assembly	MI-27197
1	H. V. Plate Transformer	MI-27187
1	Blower	MI-27195
1	Low Voltage Regulator	MI-27469
1	Installation Material	MI-27185
1	Wiring Material	MI-27186
1	Line Regulator Control Panel	MI-27471

Equipment Supplied (Continued)

Qty.	Description	Stock No.
1	Line Regulator, 3 phase, 25 KVA	MI-27473-A
2	Crystal Unit (Visual)	MI-27492[2]
2	Side Panels (End Shields for driver)	MI-30541-G84
8	Elbow	MI-19112-18C
12	Coupling, consisting of 1 outer sleeve, 1 inner connector and 2 clamps	MI-19112-B
2	RF Amplifier Unit	MI-19066
2	RF Amplifier Base Unit	MI-19067
2	Blower Unit	MI-19068
2	Control Unit	MI-19367
1	Rectifier Unit (Visual)	MI-19368
1	Rectifier Unit (Aural)	MI-19369
2	H.V. Transformer, 60 cycle	MI-19072-A
2	Meter for Driver Reflectometer (0-20 Micro-Amp.)	MI-19181-A
1	Installation Material	MI-19380
1	Wiring Material	MI-19076
2	Transformers	MI-19111-11[2]
2	Elbows	MI-19111-2
1	4.75 mc Low Pass Filter	MI-27132
4	Monitoring Unit	MI-19088
2	Monitoring Diode	MI-19051-B
2	Harmonic Filter	MI-27318[2]
1	Vestigial Sideband Filter	MI-27799[2]
1	Set of Operating Tubes	ES-34205
1	Miscellaneous Hardware Kit	MI-7474
1	Tool Kit	MI-27088
1	Finish Touch-Up Kit	MI-28153
1	Nameplate (TT-25CH)	MI-34419
1	Set of Installation Drawings	8976381
2	Instruction Book (TT-11AH Driver)	IB-30265
2	Instruction Book (TT-25BH Amplifiers)	IB-36152
2	Installation Instruction Book (TT-11AH Driver)	IB-30267
2	Installation Instruction Book (TT-25BH Amplifiers)	IB-36153
*	Transmission Line	MI-19113-C*

(*Soles order must specify quantity for installation requirements)

Optional or Accessory Equipment

TTC-5A Control Console Equipment, with master monitor but less master monitor power supply	ES-27274-2
Set of Spare Tubes	ES-34205
Set of FCC Spare Tubes	ES-34204
R-F Load and Wattmeter	MI-19193-H
Input and Monitoring Equipment, Wired/Unwired	ES-19237-G/E
Carrier-Off Monitor	ES-27235
Set of End Shields (2 per set)	MI-28061
Set of 4" Channels (1 front and 1 rear)	MI-19365
Tuning Indicator for MI-27475-H Exciter	MI-27487
Separate Rectifier Enclosure for Driver	ES-27299
50 Cycle Conversion Equipment	MI-34418/34414/19072-A1
BW-5B Sideband Response Analyzer	MI-34000-B
Plate Current Meter	MI-21200-C1
WM-71A Distortion and Noise Meter	MI-30071-A
WA-28A Audio Oscillator	MI-30028-A
TO-524-AD Oscillator	MI-26500-A
BW-4B Visual Demodulator	ES-34048

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

50 KW VHF TELEVISION AMPLIFIER

TYPE TT-50AH

FEATURES

- Provides a power gain of 8.5 and operates with any 5 to 10 kw driver transmitter meeting FCC and EIA specifications
- Excellent performance
- Low operating costs
- Visual power output 50 kw peak measured at output of sideband filter or filterplexer
- 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

DESCRIPTION

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 EIA 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. 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 offers maximum high-band effective power increase for broadcast stations in major market areas, and for those stations faced with either expanding or strengthening signal in their areas.

The RCA TT-50AH VHF Amplifier equipment units are housed in cabinets which harmonize with those of the RCA low-powered VHF TV transmitters. The units include the

Rear view of the 50-KW Power Amplifier showing RCA type 6166 tetrodes with protecting air ducts above, and circuit components below.

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.

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 visual PA.

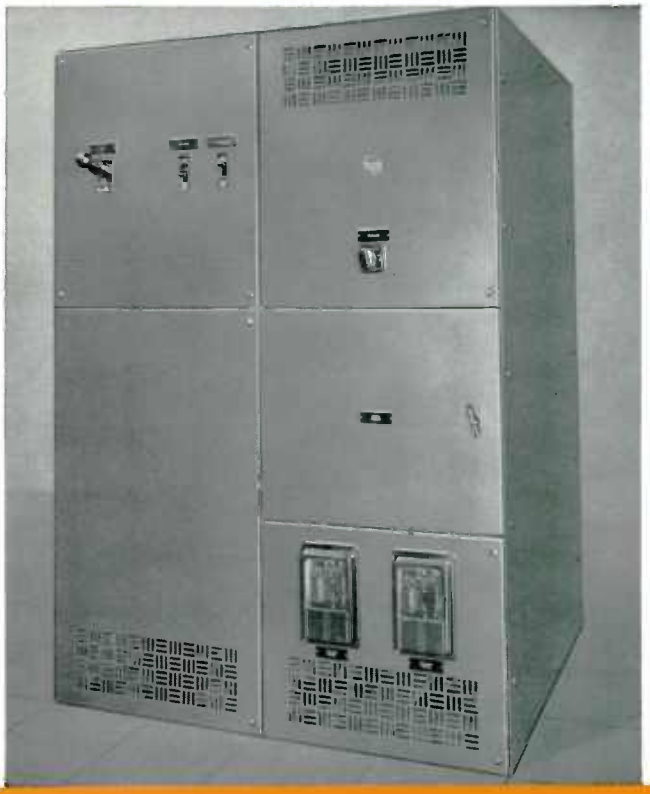
The input to the amplifier contains a variable transformer in order to match the output of the driver to the low impedance of the amplifier input circuit and is controlled from the front panel of the amplifier. The input circuit consists of the tube elements, a short section of fixed line, and a variable 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.

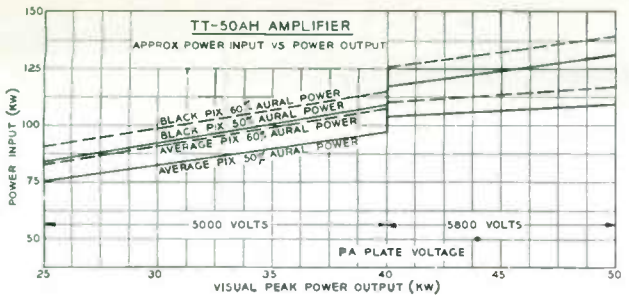
The plate circuit, which is also tuned by means of a reversible motor, consists of the tube elements and two variable lines which act as inductors. In order to reach the top frequency limit and maintain components large enough to handle the required power, the variable lines operate in parallel. The 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

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



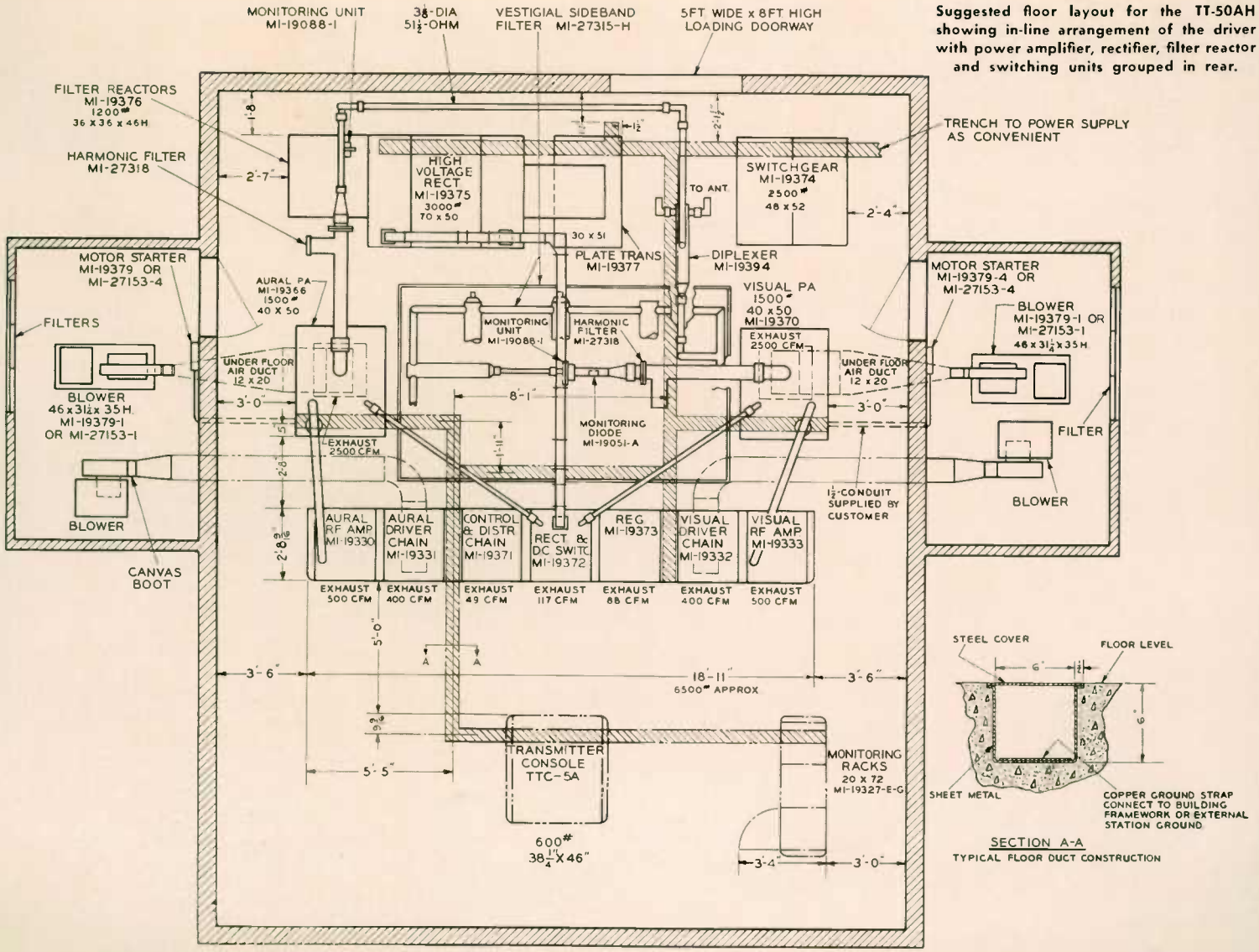


regulator to take care of small line variations. Bias supplies are electronically regulated. Protection is supplied both for d-c overloads and nominal a-c overloads.

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-5A console, designed for operation with the TT-50AH.

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

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	50/51.5 ohms	50/51.5 ohms
R-F Input Impedance	50/51.5 ohms	50/51.5 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	7% max.	
Linearity (Differential Gain)[4]	1.5 db max.	

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-5B 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-5B 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-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
1	Vestigial Sideband Filter	MI-27315-H[6]

Optional and Accessory Equipment

TTC-5A Control Console Equipment, with master monitor but less master monitor power supply	MI-27274-5
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-5B Sideband Response Analyzer	MI-34010-B
Plate Current Meter	MI-21200-C1
WM-71A Distortion and Noise Meter	MI-30071-A
TO-524-AD Oscilloscope	MI-26500-A
Carrier-Off Monitor	MI-27470
Installation Kit (for MI-27470)	MI-27484-A

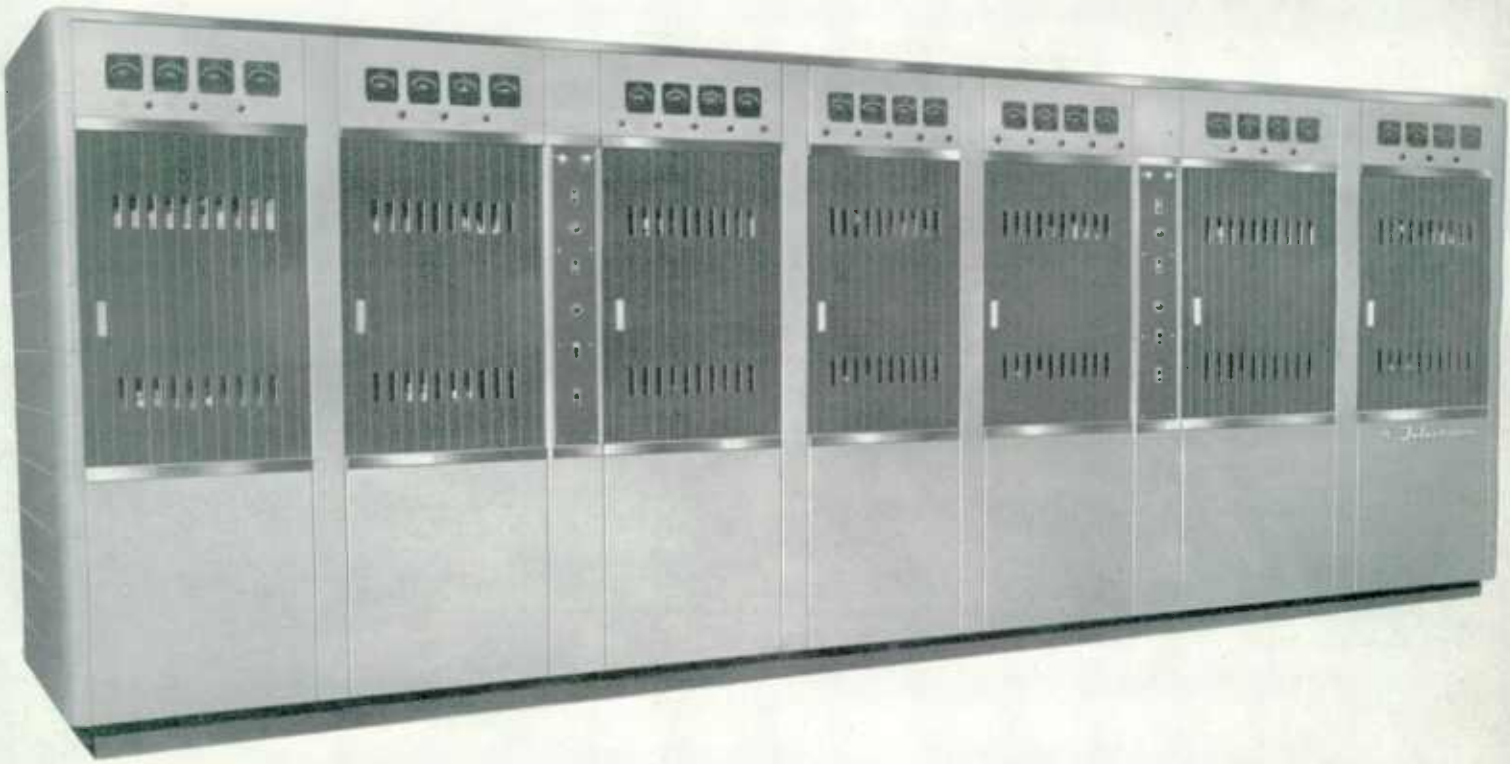
[4] Without correction. The correction circuits are normally applied in or ahead of the video modulator in the driver. Measured at 3.58 mc with increments not larger than 10% between 15% and 75% of peak of sync voltage.

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

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

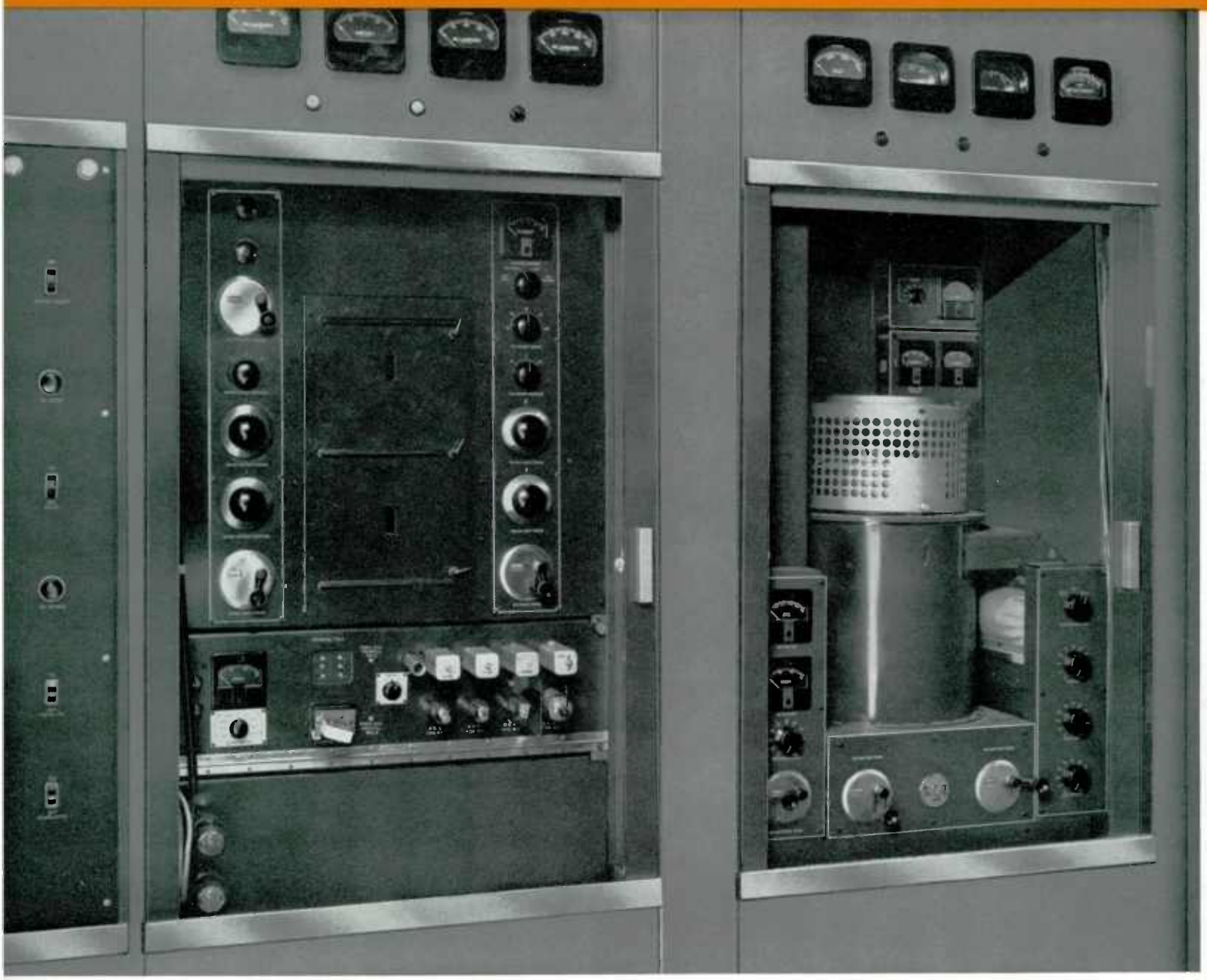
50 KW VHF TELEVISION TRANSMITTER

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 EIA 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
- Compact, 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.

DESCRIPTION

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 EIA 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 proper gain RCA antennas, easily provides the maximum of 316 kw e.r.p. with plenty of power to spare.

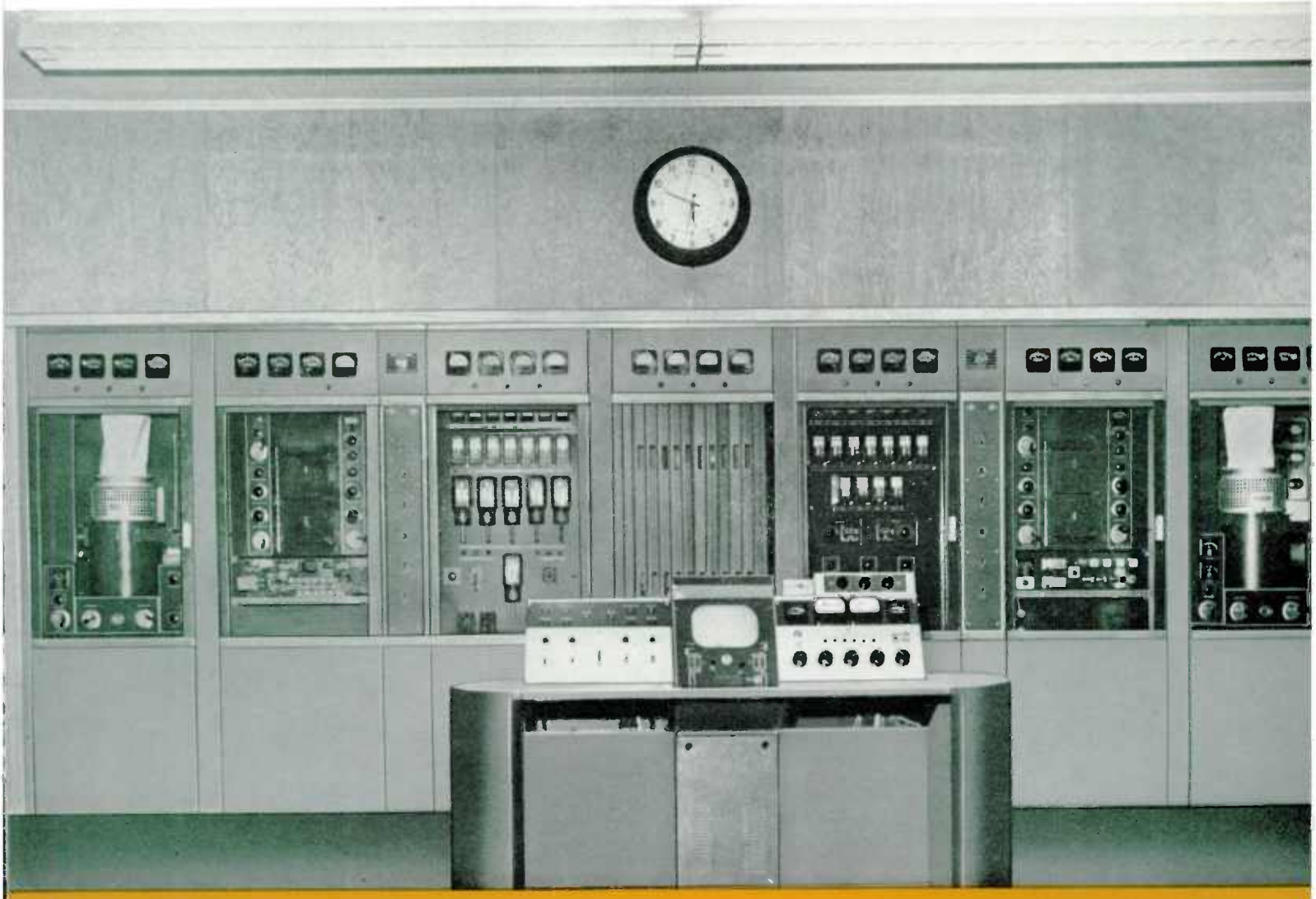
The equipment thus offers maximum high-band effective radiated power for broadcast stations in major market areas. It provides "saturation" coverage and conservative, reliable operation with power in reserve. Better linearity, finer pictures, good frequency response, low phase shift maintained as tubes 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 TT-50AH transmitter has been designed for use in

stations requiring a medium power transmitter with an RCA superturnstile antenna to meet ERP requirements. It is recommended for all major broadcast stations planning overall deluxe facilities.

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, consist of five RCA Type 6166 tubes operating in parallel in each amplifier. The d-c power supplies and the a-c switchgear are common to both the visual and aural sections of the transmitter, 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/driver. This driver 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.



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. The reflectometers and associated 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. The reflectometers also tie into the transmitter control circuit and remove power in the event that the VSWR exceeds the predetermined value.

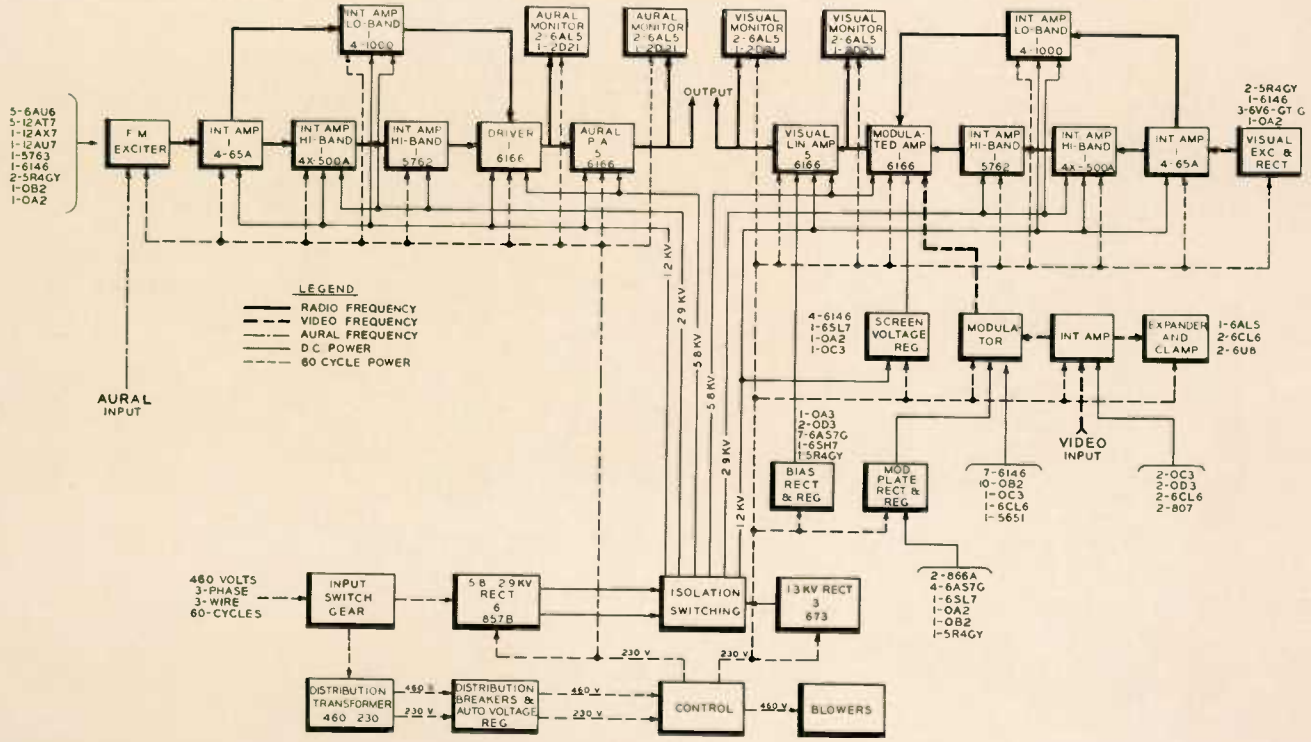
Facilities are provided to permit continuous picture monitoring at various points in the system, including diodes before the linear amplifier and at the input of the sideband filter. All essential transmitter operating controls are duplicated at the control panel of the RCA type TTC-5A console, designed as an accessory equipment for operation with the TT-50AH.

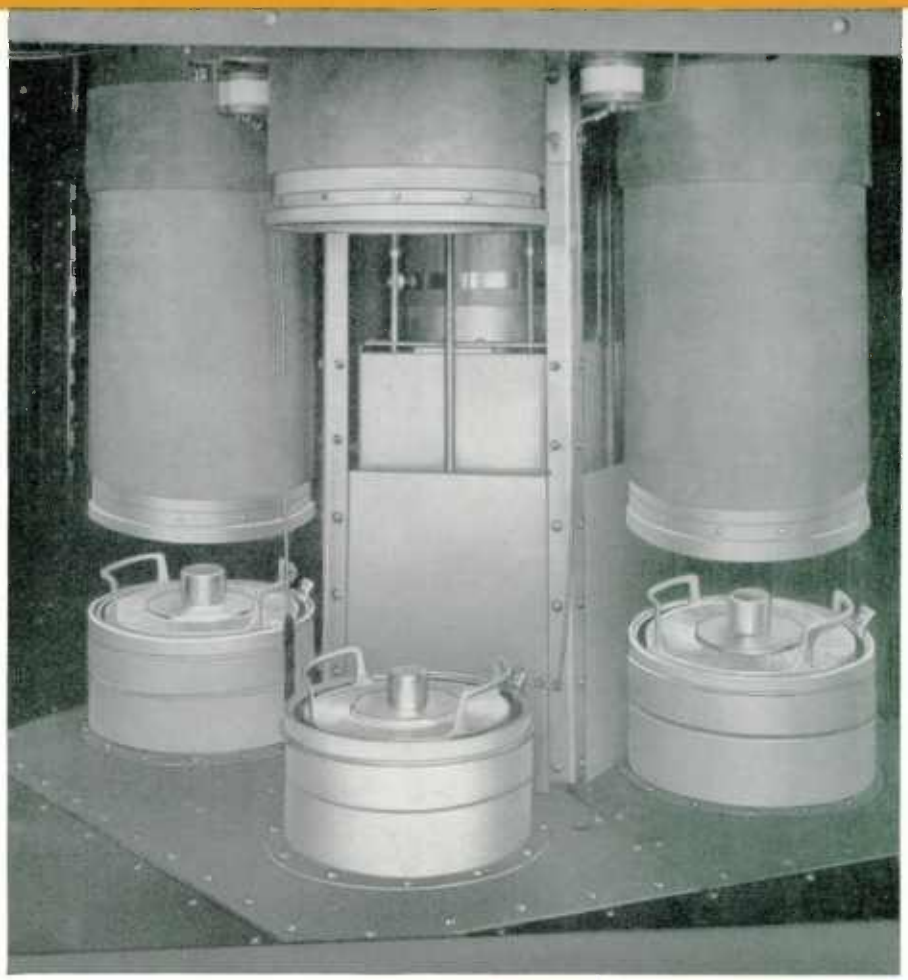
TT-50AH Circuits

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.





RCA type 6166 air-cooled tetrode, five of which are used in parallel in a grounded grid circuit in the TT-50AH transmitter's power amplifier. 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. Tubes, located behind hinged access doors, are of plug-in type for rapid change.

Power amplifier of the TT-50AH showing front panel with tuning motor switches, individual tube meters, tuning indicators, switches and status lamps.

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.

Intermediate R-F Amplifiers

The R-F power tube line-up for the TT-50AH 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.

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.

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.

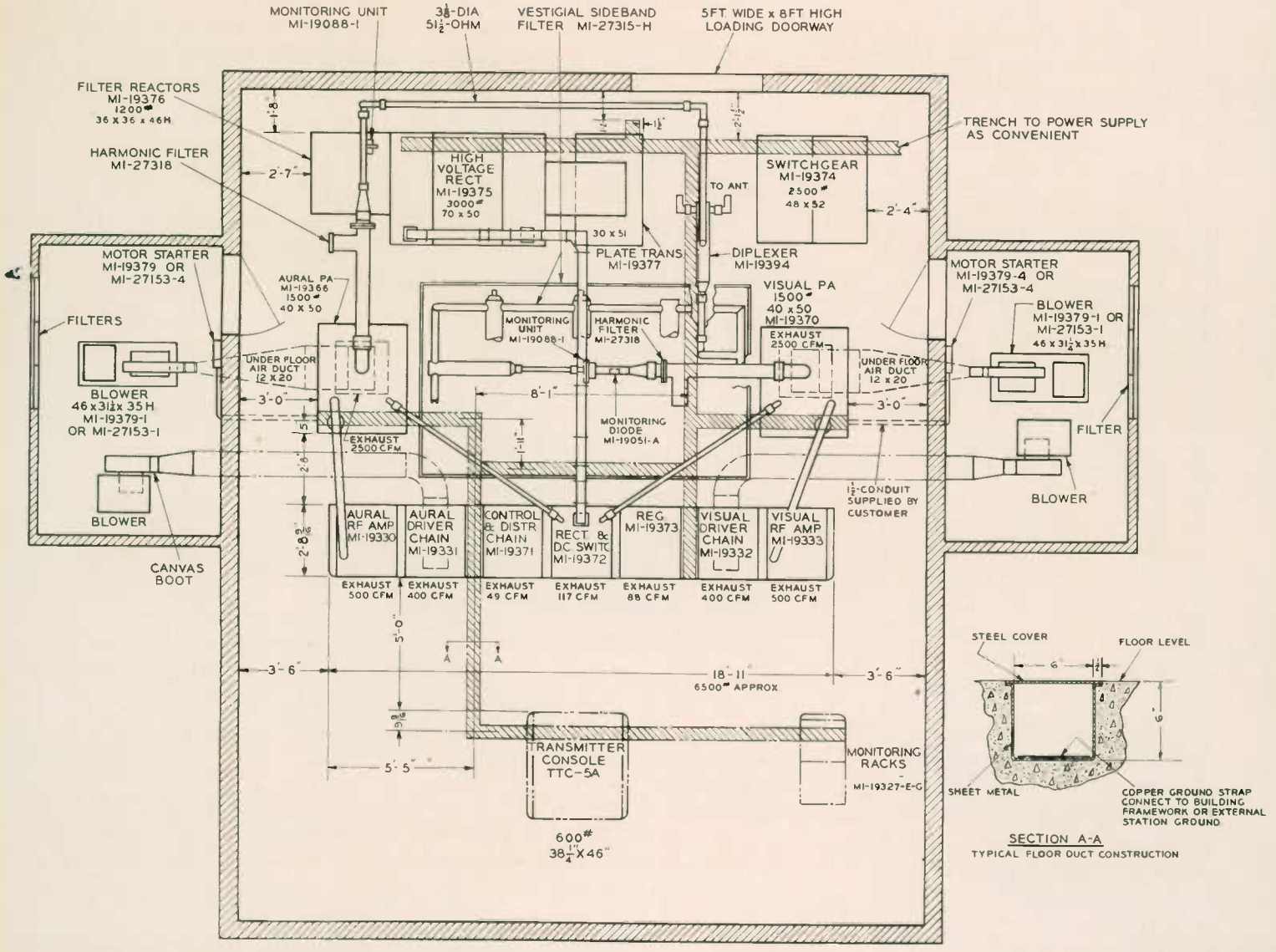
The front panel of the amplifier contains the tuning motor switches, individual tube meters, tuning indicators, plate ON switches and status lamps. The tubes are located at approximately waist height behind hinged access doors, and are of the plug-in type so that rapid changes can be made. The resistors, 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.

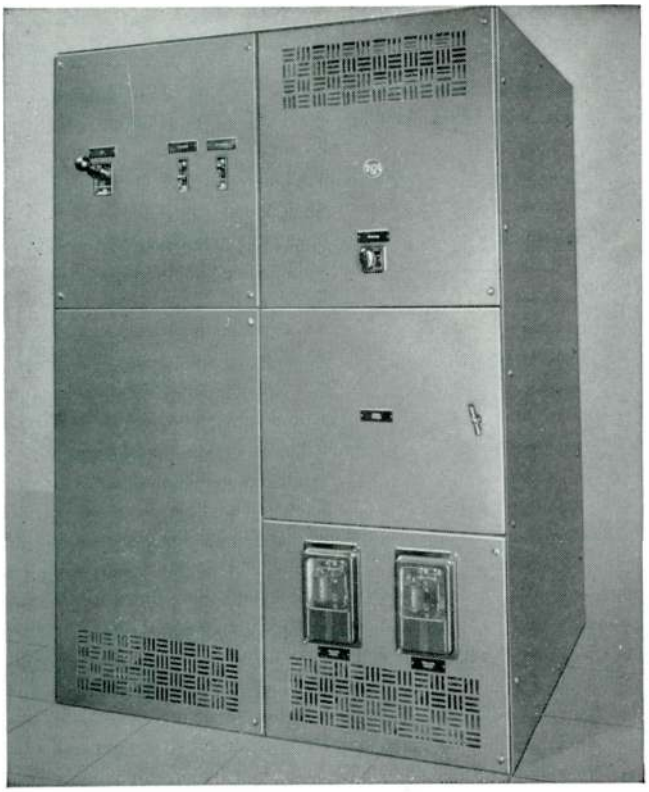


Suggested floor layout for the TT-50AH showing in-line arrangement of the driver with power amplifier, rectifier, filter reactor and switching units grouped in rear.

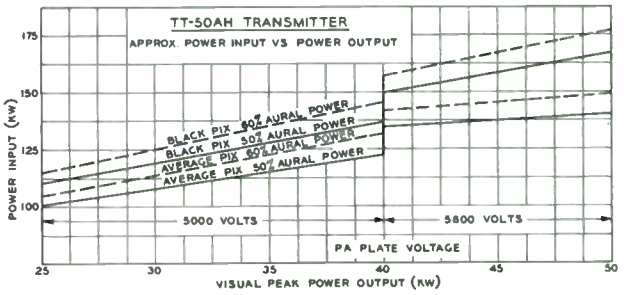
50 KW Vestigial Side Band Filter

The MI-27315-H Vestigial Side Band Filter is furnished completely assembled and adjusted for any one of the VHF television channels 7 through 13. It is an integral unit designed for ceiling mounting near the 50 kw visual transmitter so that the input transmission line is as short as possible. The coaxial connection between the transmitter and the side band filter should not be more than 15 feet long.

The purpose of the filter is to attenuate the lower side-band output of a double side band visual transmitter. It 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.



Switching cabinet of TT-50AH 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 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. 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 filter is achieved when both sides are balanced.

Power Cutback (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. 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	50 kw[1]	30 kw[2]
Minimum Power Output	30 kw[1]	15 kw[2]
R-f Output Impedance	50/51.5 ohms	50/51.5 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 cyycles
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% modulation	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-5B 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-5B 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.

	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]	1.5 db 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 harmanic 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:

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.

[8] Maximum departure from the theoretical when reproducing saturated primary colors and their complements at 75% amplitude. A properly terminated TA-9 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-9 Stabilizing Amplifier is required in the video input circuit.

[11] Maximum departure from standard curve. The tolerances vary linearly 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

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 Regulotor	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

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	Tube Socket Alignment Gauge	MI-27578
1	DC Filament Supply for Modulated Amplifier	ES-27272
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

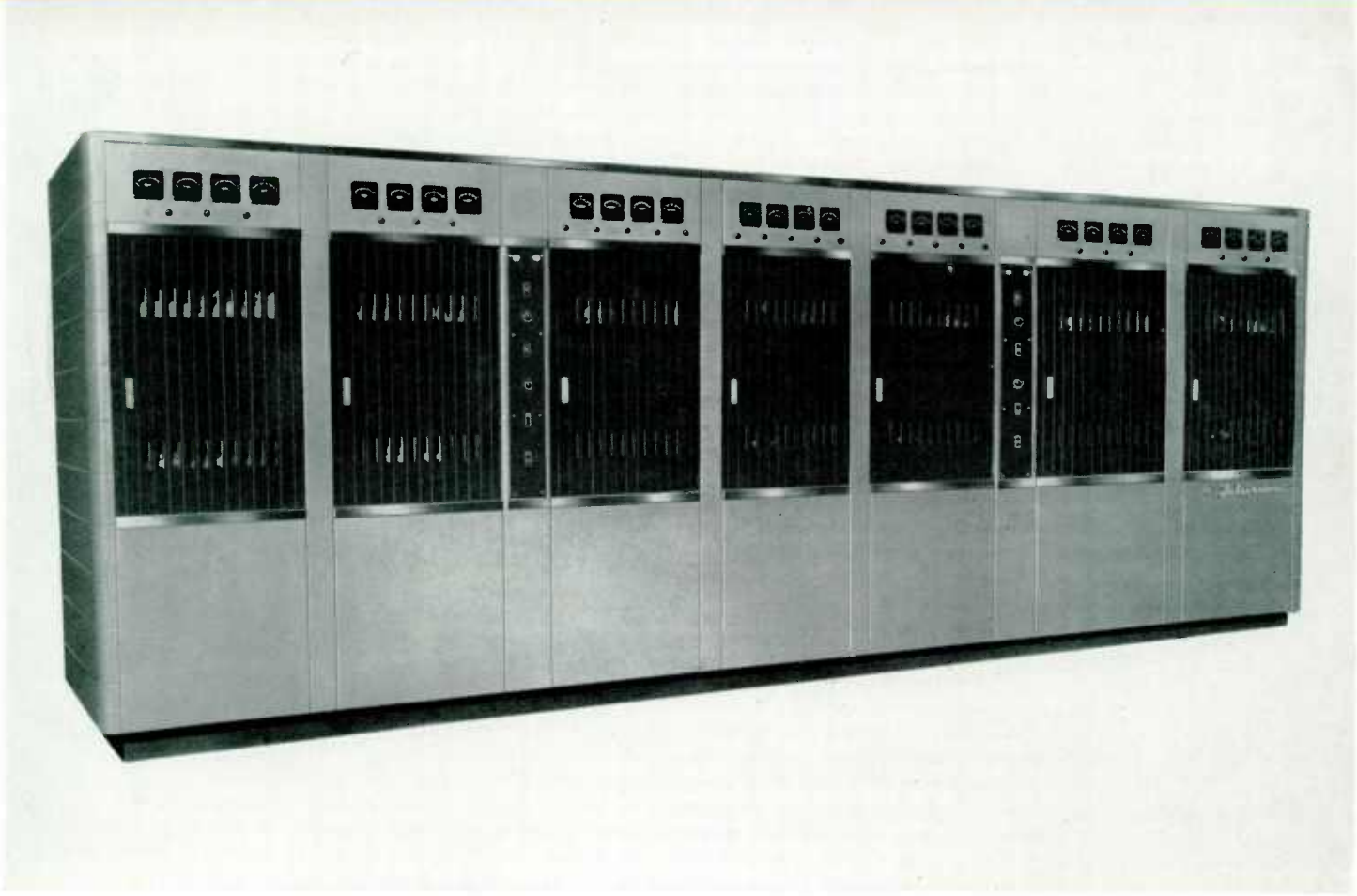
Optional or Accessory Equipment

TTC-5A Control Console Equipment, with master monitor but less master monitor power supply	MI-27274-5
Diplexer (* Order to suit customer's assigned channel)	MI-19394*
R-F Load and Wattmeter	MI-19191-H
Color TV Station Monitoring Equipment Wired/Unwired	ES-19237-G/E
Complete Set of Spare Tubes	ES-19274-B
FCC Spare Set of Tubes	ES-19275-B
50 KW Cut Back Kit	MI-27157
Carrier-Off Monitor	ES-27235
Motor Driven Coaxial Switch	MI-27330
Manual Transfer Panel	MI-27734
Motor Contactor	MI-27832
Tripler Conversion Kit	MI-34407
BW-5B Sideband Response Analyzer	ES-34010-B
Plate Current Meter	MI-21200-C1
WM-71A Distortion and Noise Meter	MI-30071-A
TO-524-AD Oscilloscope	MI-26500-A

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

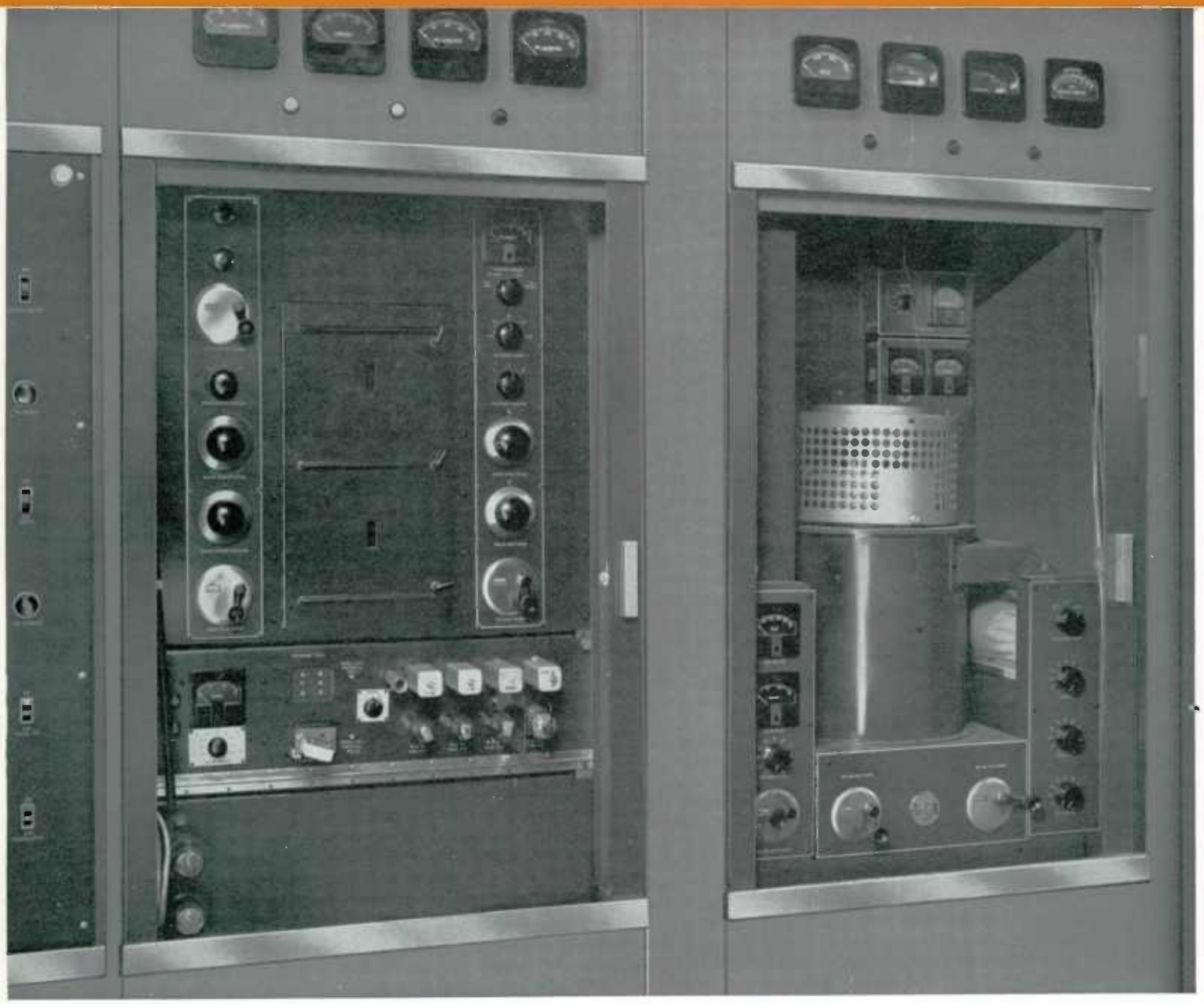
100 KW VHF TV TRANSMITTER

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 EIA 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.

DESCRIPTION

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 EIA 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 TT-100AH Transmitter has been specifically designed

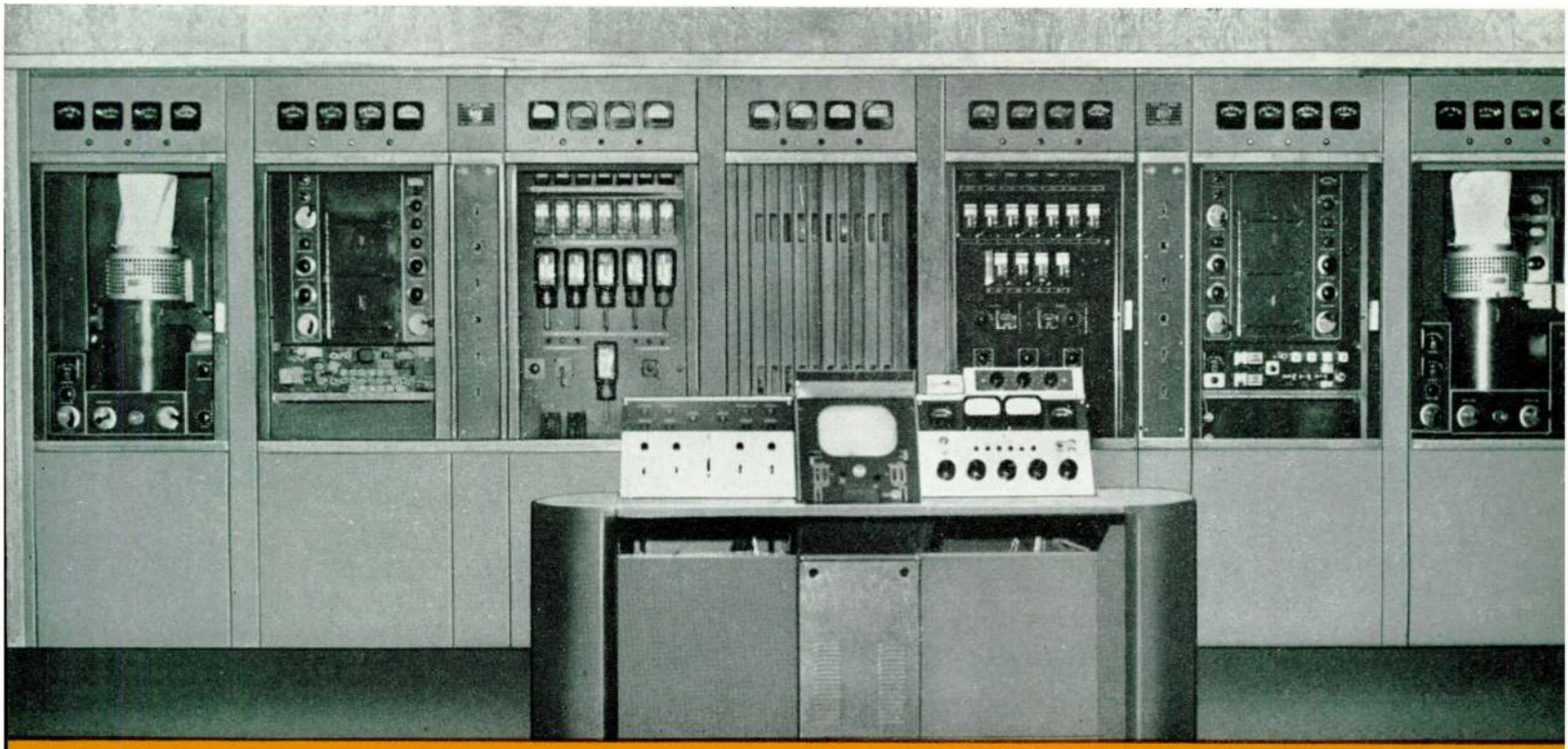
for stations located in areas that choose to operate with a high powered transmitter and low gain antenna to obtain coverage in mountainous or extremely hilly locations. It is also recommended for stations planning deluxe facilities.

The RCA Type TT-100AH Transmitter consists of a TT-10AH driver which includes visual and aural modulators followed by paralleled amplifiers of the TT-50AH type which have been redesigned to supply a peak output power of 100 kw with plenty of reserve power. 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 following each of the 50 kw amplifiers 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.



B.4017

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 exceeds the predetermined value.

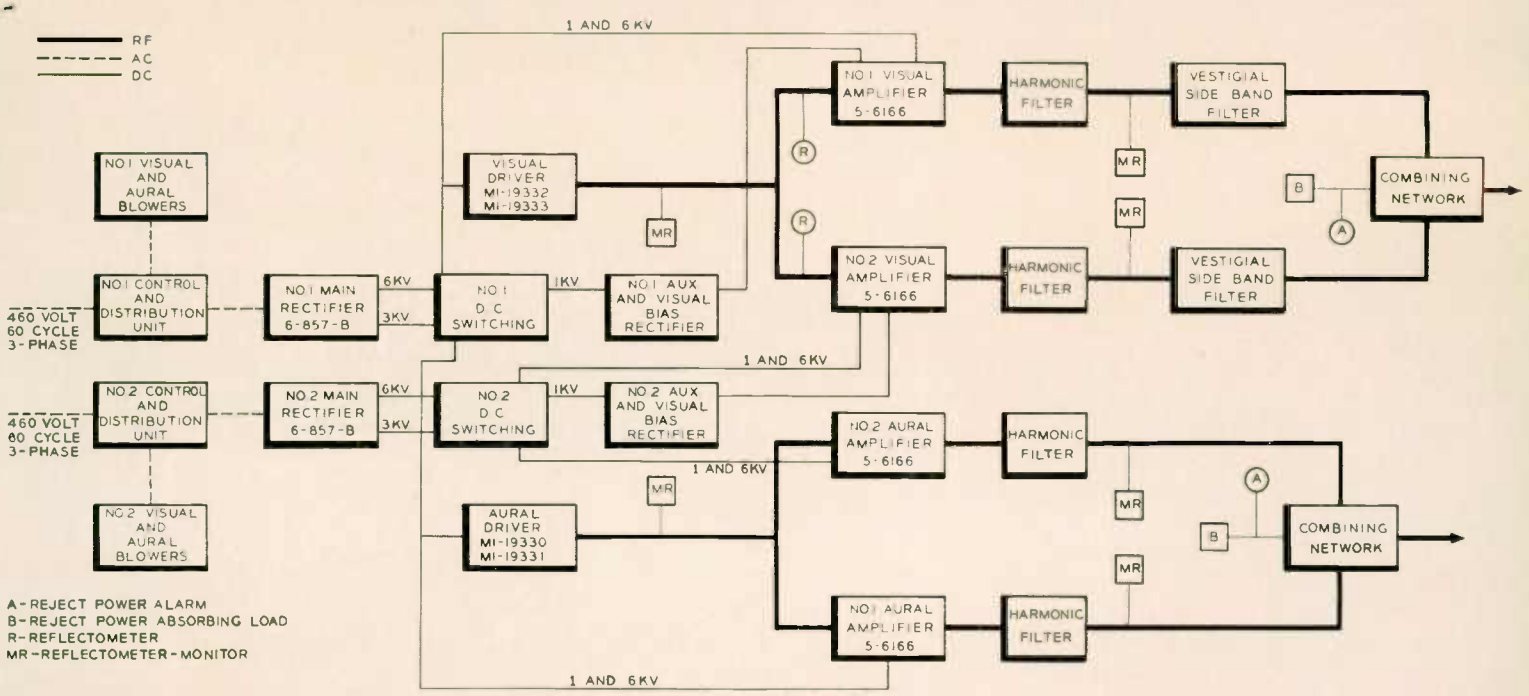
Facilities are provided to permit continuous picture monitoring at various points in the system, including diodes before the linear amplifier and at the input of the sideband filter. All essential transmitter operating controls are dupli-

cated at the control panel of the RCA type TTC-5A 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 driver 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.

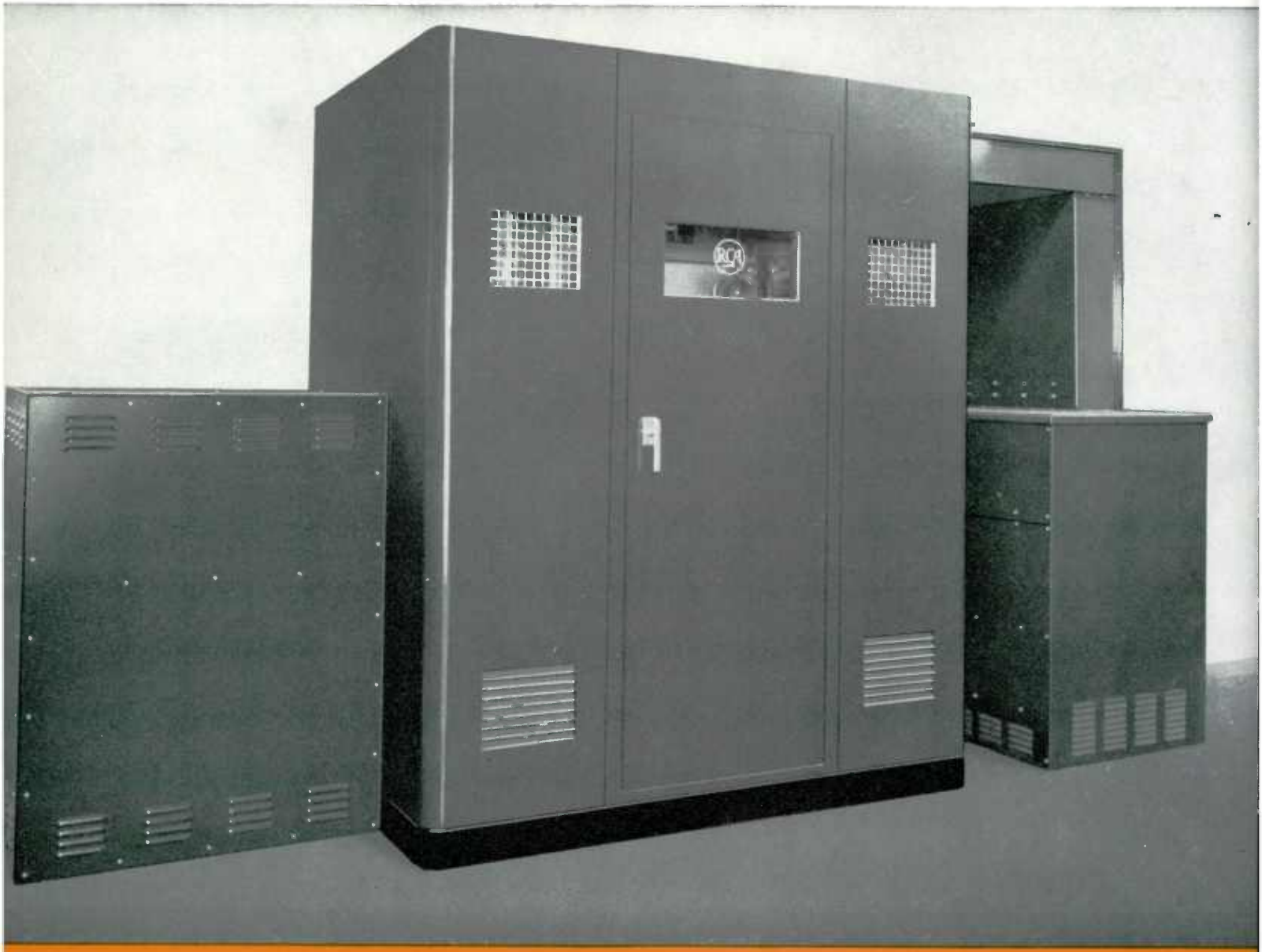
Simplified block diagram of the TT-100AH Transmitter.

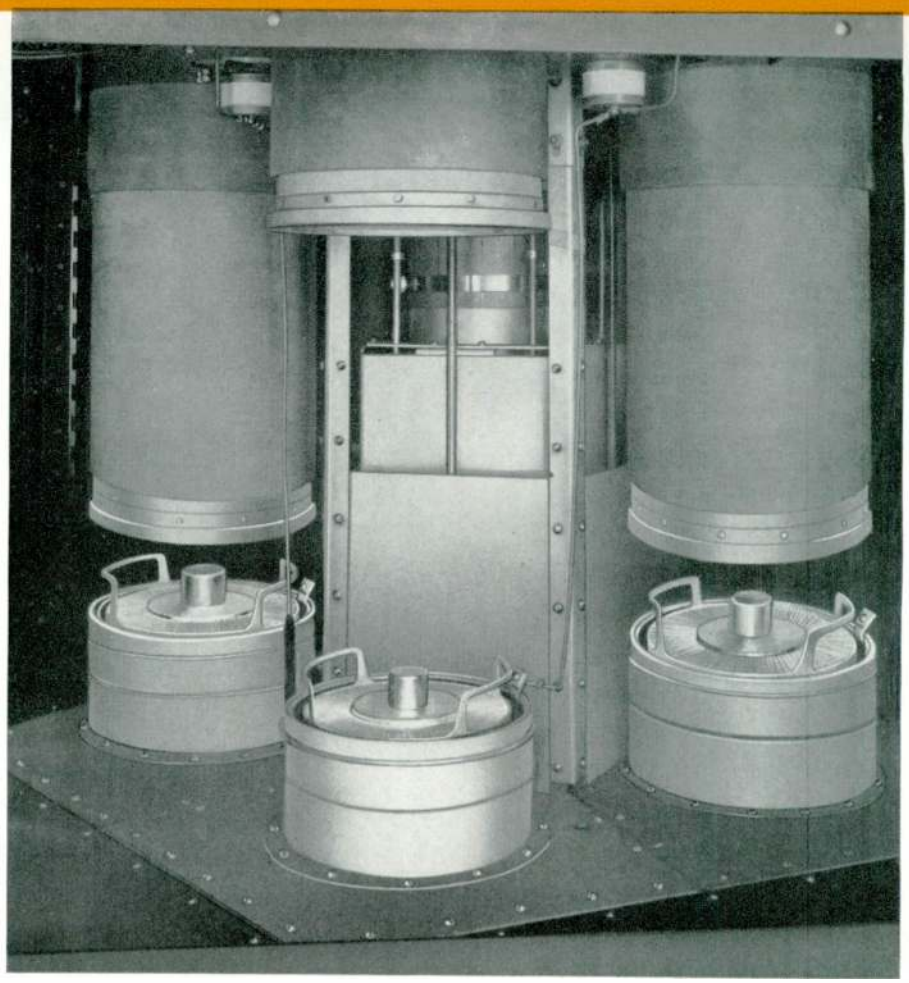


Aural Exciter

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.





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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 method 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 diplexer 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 diplexer 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.

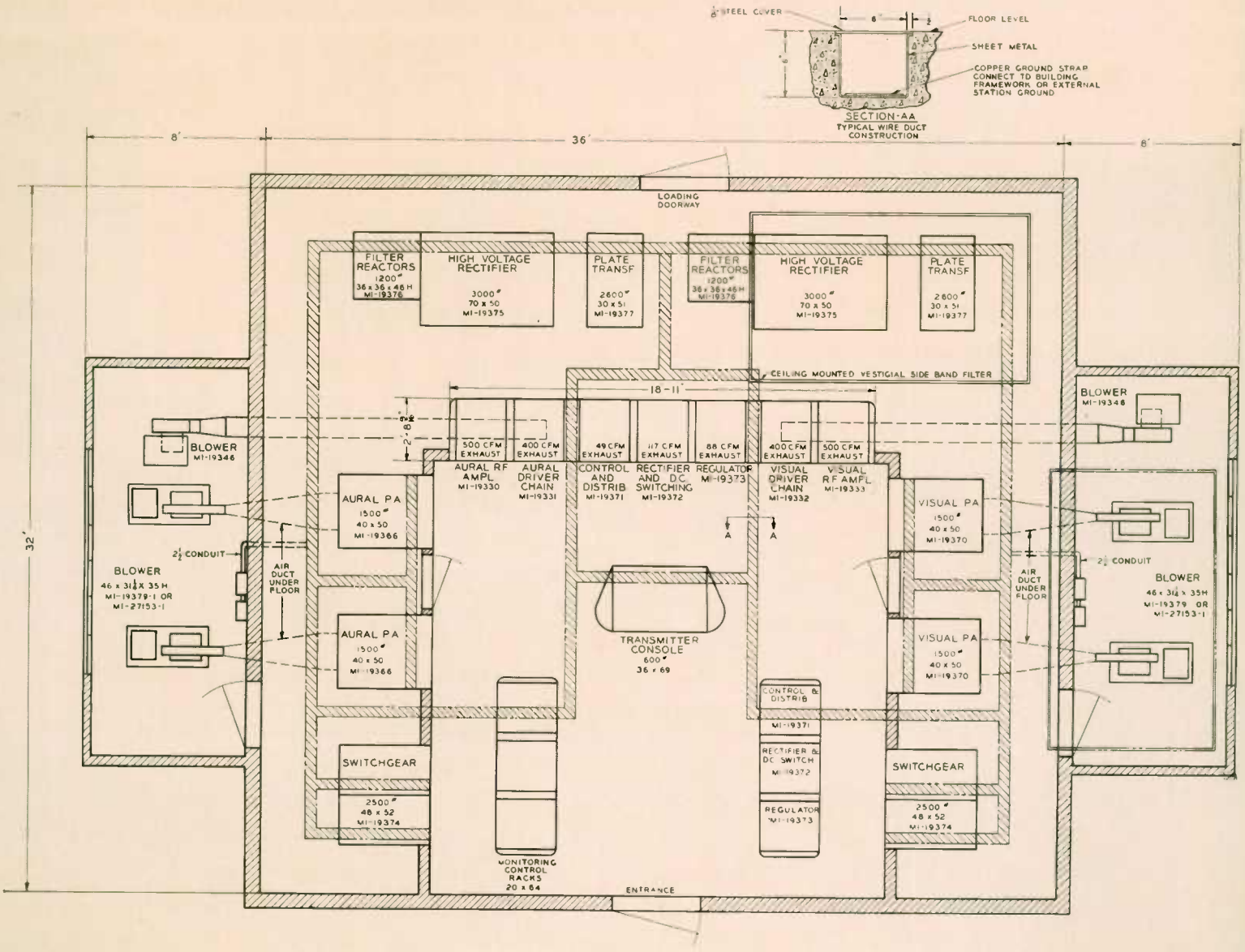
The front panel of the amplifier contains the tuning motor switches, individual tube meters, tuning indicators, plate ON switches and status lights. The tubes are located at approximately waist height behind hinged access doors, and are of the plug-in type so that rapid changes can be made. The resistors, 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.

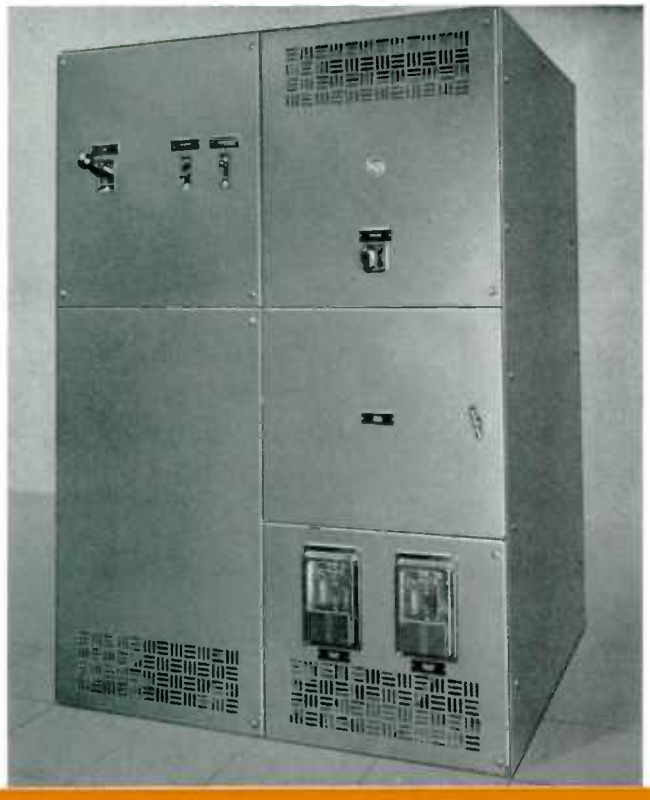
that might be developed during mixing from the associated amplifiers. An interlock protective circuit is incorporated with the transmitter utilizing a reflectometer if the unbalance of power becomes excessive.

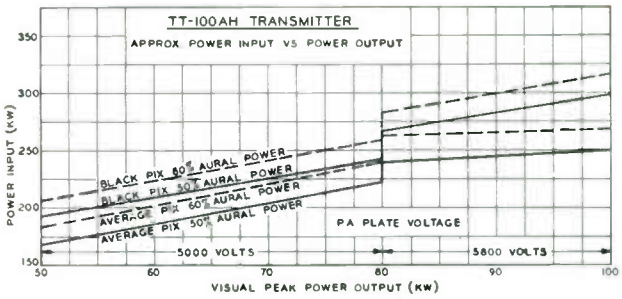
Vestigial Side Band Filter

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	50/51.5 ahms	50/51.5 ahms
Input Impedance	75 ahms	600/150 ahms
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]
Madulation Capability	12.5 ±2.5% (reference white)	±50 kc
Audio Frequency Distortian		1.5% max. 50-100 cy. 1.0% max. 100-7500 cy. 1.5% max. 7500-15,000 cy.
FM Noise, belaw ±25 kc Swing		60 db
AM Noise, rms	40 db belaw 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 ta the response at 200 kc, as measured by the BW-5B 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-5B 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.

[8] Maximum departure from the thearetical when reproducing saturated primary colors and their complements at 75% amplitude. A properly terminated TA-9 Stabilizing Amplifier is required in the video input circuit.

	Visual	Aural
Amplitude Variatian Over One Picture Frame	Less than 5% af the peak of sync level	
Regulatian af 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]	1.5 db at max.	
Envelope Delay vs. Frequency[11]	±.08 μsec. fram 0.2 ta 2.1 mc ±.04 μsec. at 3.58 mc ±.08 μsec. at 4.18 mc	
Harmanic Attenuatian (ratio of any single harmonic to peak visual fundamental)	at least 60 db	at least 60 db

Electrical Specifications

Pawer Line Requirements:

Transmitter:

Line	460 valts, 3 phase, 60 cycles
Slow Line Variatians	±5% max.
Rapid Line Variatians	±3% max.
Regulation	3% max.
Pawer Consumptian	See curve
Power Factar (apprax.)	90%

Crystal Heaters:

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

Mechanical Specifications

Dimensians:

Overall Length (front line cabinets anly)	18′ 11″
Overall Height (front line cabinets only)	84″
Overall Depth (front line cabinets only)	32 5/16″
Weight (apprax.)	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. In addition, the total differential phase between any two levels shall not exceed 10°.

[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) madulation as indicated by a conventional diade demodulatar cannected after the VSBF. A properly terminated TA-9 Stabilizing Amplifier is required in the video input circuit.

[11] Maximum departure from standard curve. The talerances vary linearly 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-B 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 Regulator	6146
2	Voltage Regulator	6SH7
2	Regulator Control Amplifier	6SL7-GT
13	Voltage Regulator	6AS7-G
2	Voltage Regulator	OA3
3	Voltage Regulator	OA2
10	Voltage Regulator	OB2
4	Voltage Regulator	OC3
6	Voltage Regulator	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 Reactors	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	Power Splitting Monitor Units	MI-27807
1	Power Splitting Diplexer	MI-27393-1/2*
1	R-F Load and Wattmeter	MI-19196-H
2	Total Power Reflectometers	MI-34404
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
*	3 1/8" Transmission Line (*Sales order must specify quantity for installation requirements)	MI-19313
*	6 1/8" 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-27394-1/2*
1	Power-Splitting Tee (PA Input)	MI-27808
2	RF Load and Wattmeter, 6 kw (Reject Power)	MI-19196-H
1	Instruction Book	IB-36158
1	Instruction Book (100 kw)	IB-30246

(*Specify assigned channel)

Optional or Accessory Equipment

TTC-5A Control Console Equipment, with master monitor	Custom
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 Set of Spare Tubes	ES-27231
50 KW Power Cutback Kit	MI-27157
Switching System	Custom
BW-5B Sideband Response Analyzer	ES-34010-B
Plate Current Meter	MI-21200-C1
WM-71A Distortion and Noise Meter	MI-30071-A
TO-524-AD Oscilloscope	MI-26500-A

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

DESCRIPTION

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 EIA 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-1B 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 25 kw or 12½ kw UHF transmitter and broadcasters can increase UHF power at a later date with RCA "add-on" amplifiers.

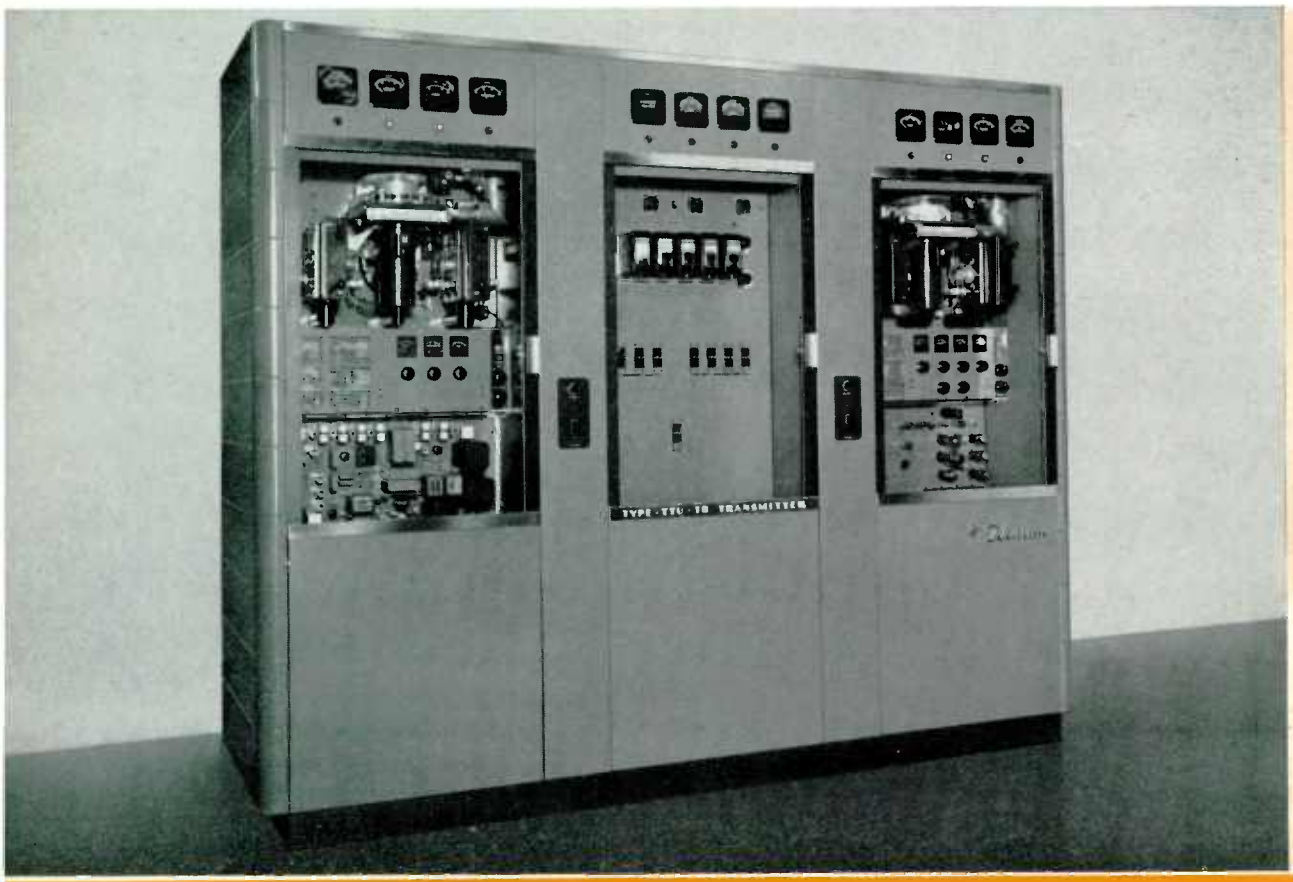
The TTU-1B's circuits employ the latest design features and represent the ultimate in simplicity and economy. The highest degree of black and white or color visual transmission fidelity is attained. The aural and visual transmitters and their control circuits operate independently, giving a maximum of 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-5A, 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.

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 units, and the final stages 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



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.

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. 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.

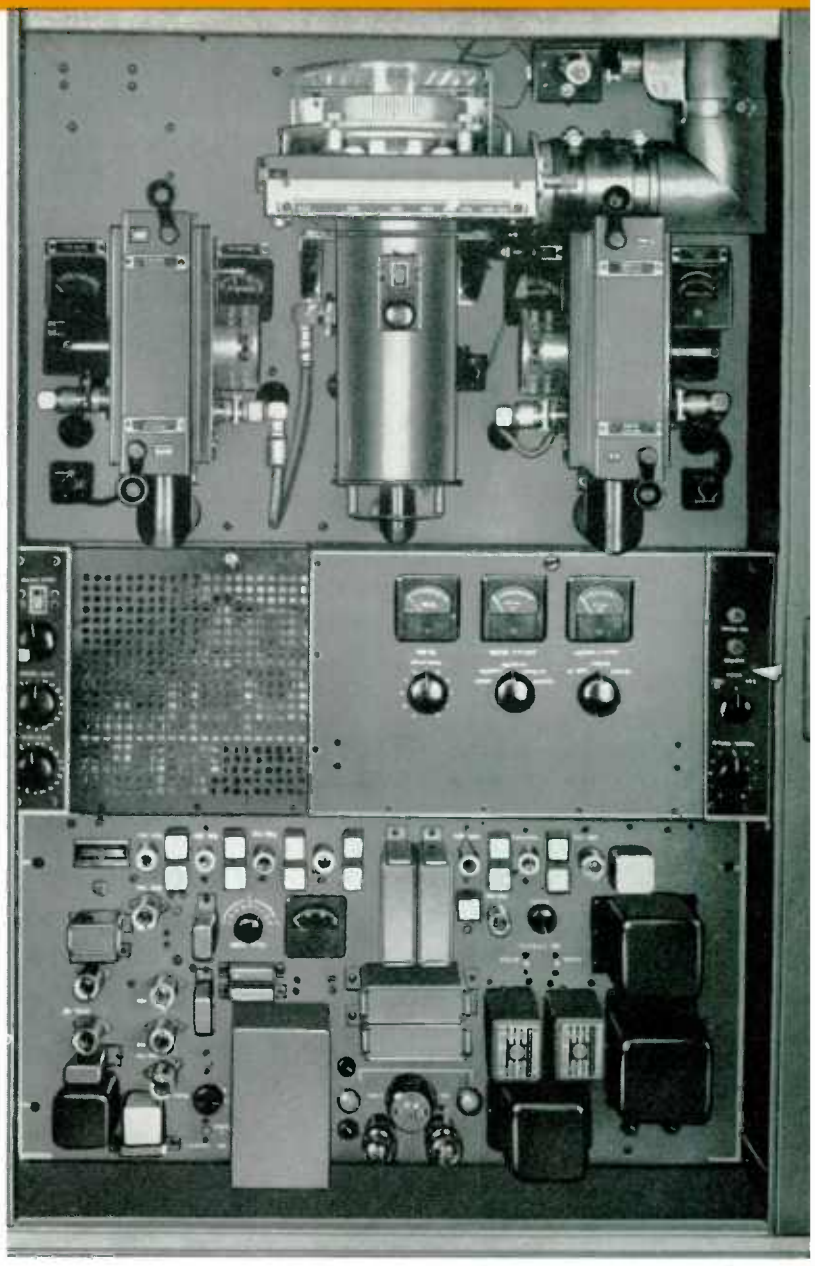
The visual transmitter modulator circuit employs the latest design features for both color and black and white and represents the ultimate in simplicity and economy. Power output meters are supplied for both picture and sound transmitters. These meters also indicate VSWR. Facilities are provided to permit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

R-f 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.

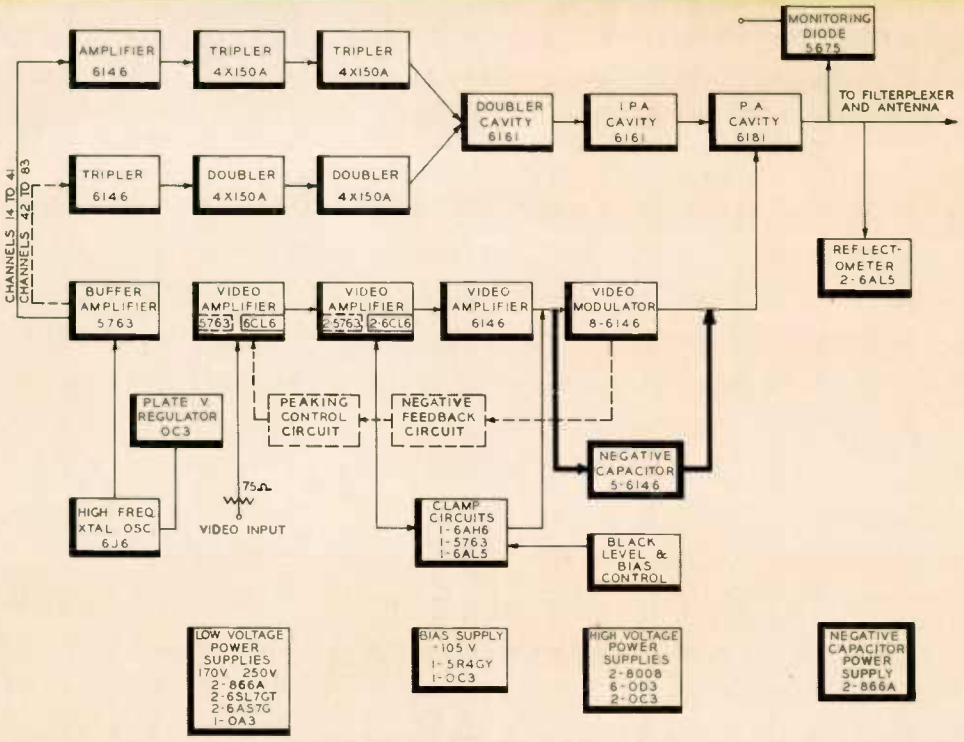
The output of the visual crystal buffer stage is coupled to an RCA 6146 amplifier for channels 14 to 41 or tripler for channels 42 to 85. The 6146 is followed by two stages using RCA 4X150A tubes which triple or double respectively for the above mentioned channels. Including a 6161 doubler stage, the 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



R-f circuits of the aural transmitter.

tuned circuits depart from conventional lumped constants. Thus the anode circuit consists of a pair of parallel plates with a movable shortening bar.

The doubler and ipa stages use RCA 6161 triode tubes, operated grounded grid, in special tuned cavity circuits. The final amplifier is an air cooled cavity which uses the type 6181 tetrode tube. 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.



Block diagram of TTU-1B Visual Transmitter.

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-9 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.

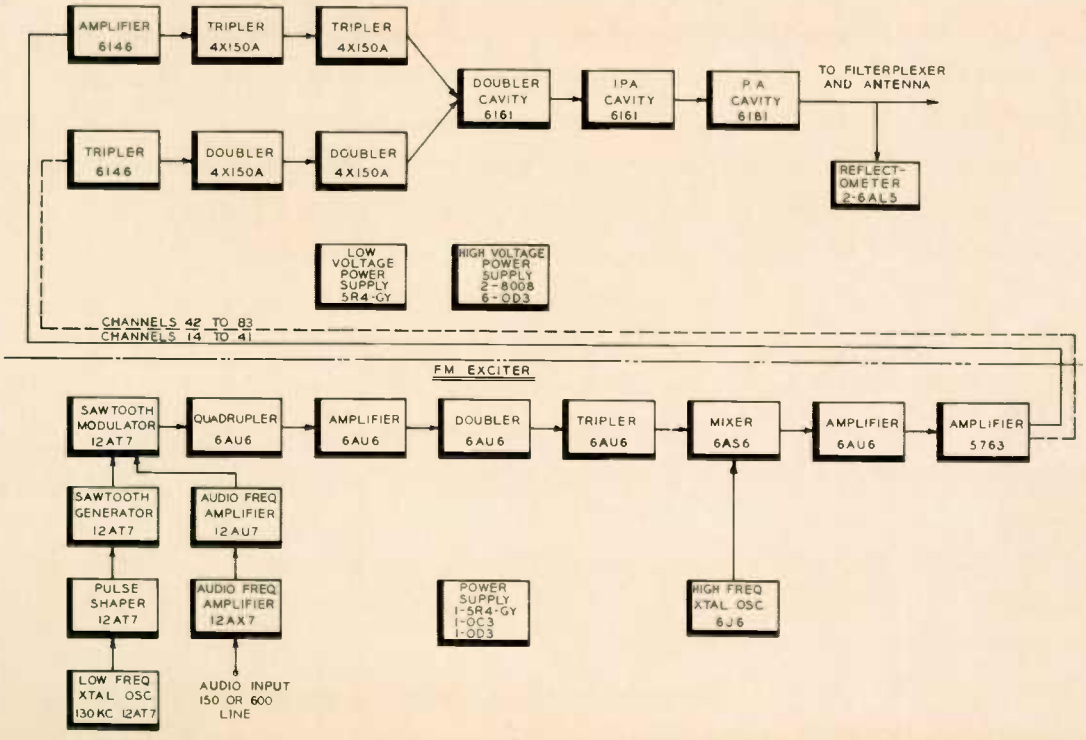
Flexible coaxial cables are used to couple the ultra high frequency energy from the output of one cavity to the input circuit of the following cavity. Impedance matching is accomplished by adjusting the coupling and the tuning of the input circuit until the cable is properly terminated. A plug-in reflectometer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

UHF Filterplexer

The RCA MI-19086-C 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 pur-

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



poses. 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.

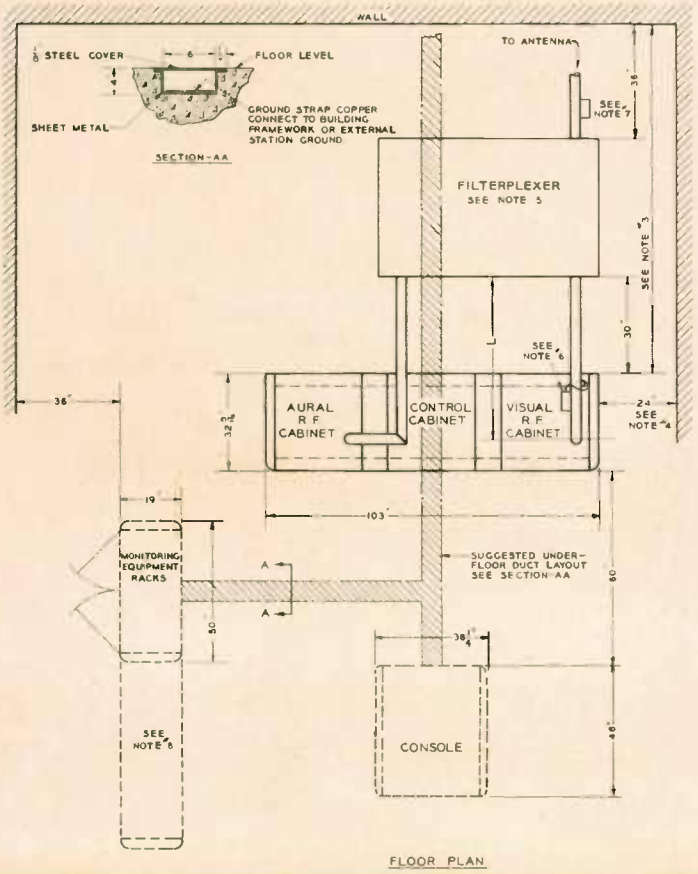
The insertion loss is less than 1 db to 4 megacycles above picture carrier frequency, which represents a very desirable band pass characteristic. The vestigial side band characteristics are also maintained by having the lower side-band frequencies attenuated to more than 20 db from the low end of the 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 effort. The equipment is housed in three modernly styled aluminum cabinets having space-saving sliding front and rear doors which are properly interlocked. Vertical chassis type



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-27274-3 and monitoring equipment rack, MI-19237-F/H 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-C 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-4B 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."

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-5A console for power control and monitoring, an r-f load and wattmeter for test measurements, and the MI-19237-H/F monitoring rack equipment for routine operation.

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]	2 db 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

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

[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-5B 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 BWU-5B 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-9 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-9 Stabilizing Amplifier is required in the video input circuit.

[11] Maximum departure from standard curve. The tolerances vary linearly 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-B is required in the video input circuit of the transmitter.

SPECIFICATIONS (Continued)

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

AURAL SECTION

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	Doubler-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 1/16"
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-C[2]
2	6161 Doubler Cavities	MI-27150
2	6161 IPA Cavities	MI-27151
3	6181 PA Cavities	MI-27152
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
1	Miscellaneous Hardware	MI-7474
2	Installation Instruction Books	IB-36131
2	Instruction Books	IB-36130
2	Instruction Books	IB-36130-CS

* Supplied if and as specified on sales order.

Optional or Accessory Equipment

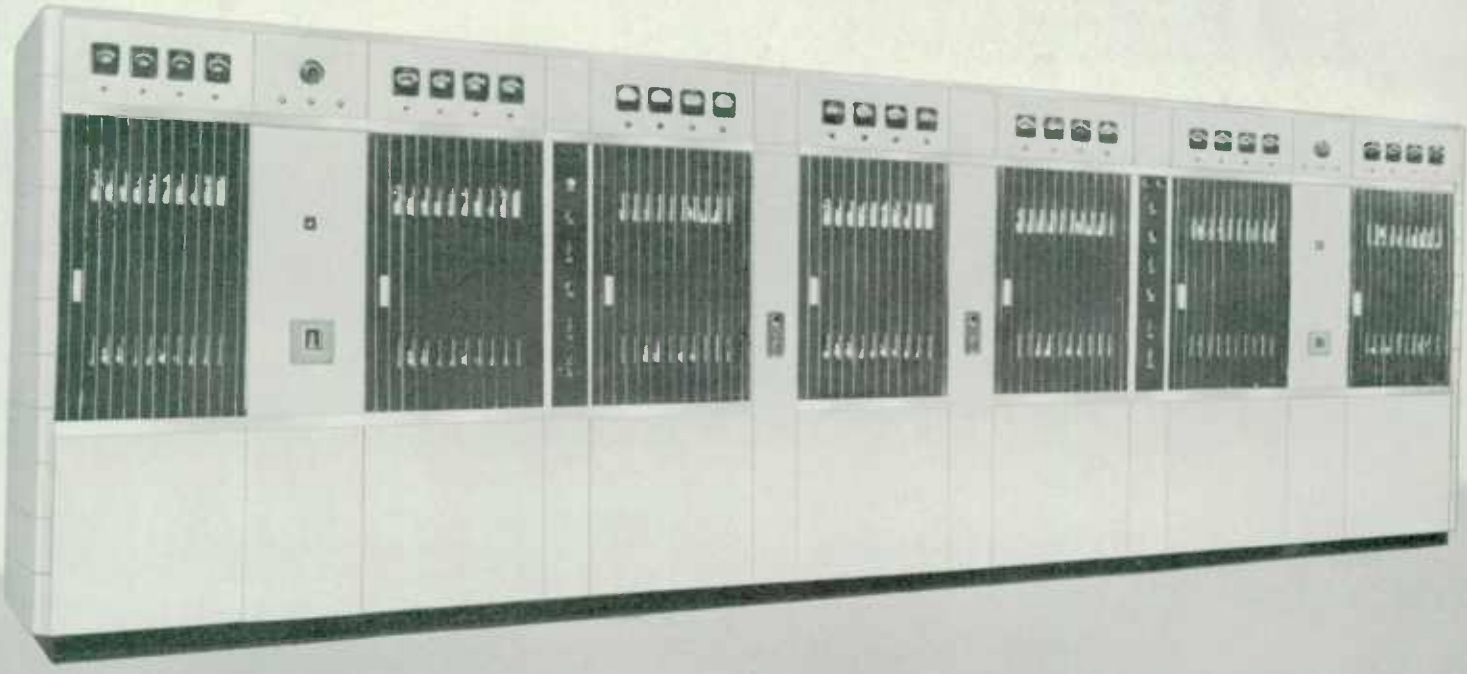
Complete Spare Set of Tubes	ES-19251-A
FCC Spare Set of Tubes	ES-19252-A
UHF Housing for MI-19364 Monitoring Diode & BW-4B Demodulator	MI-19396-2
TTU-12A UHF TV Amplifier (Channels 14-83)	ES-27277
TTC-5A Console with Master Monitor, but less Monitor Power Supply	ES-27274-3
UHF FM Exciter-Modulator and Power Supply	MI-19363
Tube Kit for UHF Exciter and Power Supply MI-19363	MI-27102
8WU-5B Sideband Response Analyzer	ES-34009-B
Color Input and Monitor Racks, Wired/Unwired	ES-19237-H/F
RF Load and Wattmeter	MI-19197
BWU-4B Demodulator	ES-34049-B
BW-8A Envelope Delay Measuring Set	MI-34063

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

[2] Sales order must specify customer's assigned frequency.

25 KW UHF TV TRANSMITTER

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
- Conventional 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

DESCRIPTION

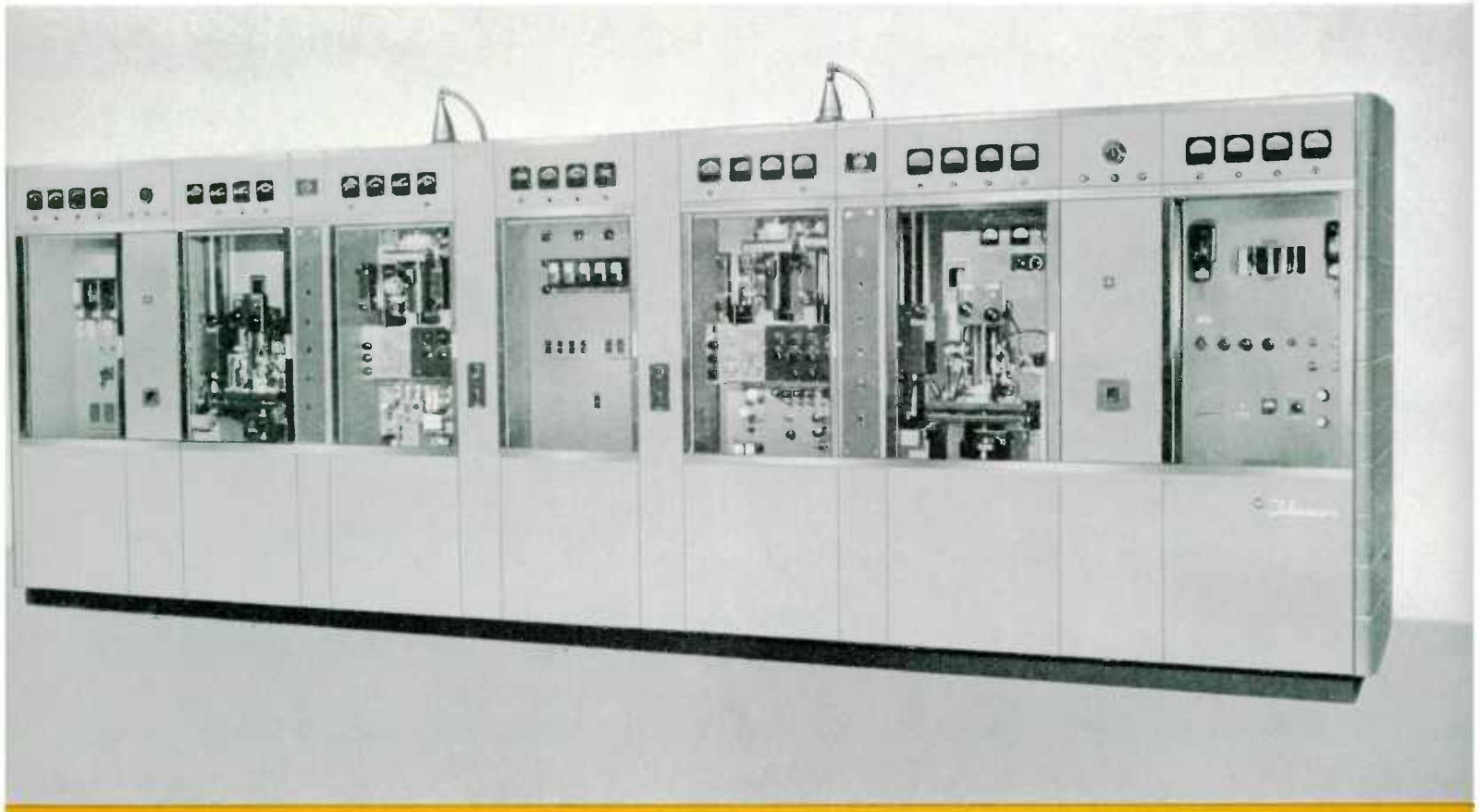
RCA's new TTU-25B UHF Television Broadcast Transmitter provides reliable and economical high-power TV operation for stations operating on any specified channel between 14 and 83. The transmitter has a nominal rated power output of 25 kilowatts from the visual transmitter and 12½ kilowatts from the aural. 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 EIA 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.

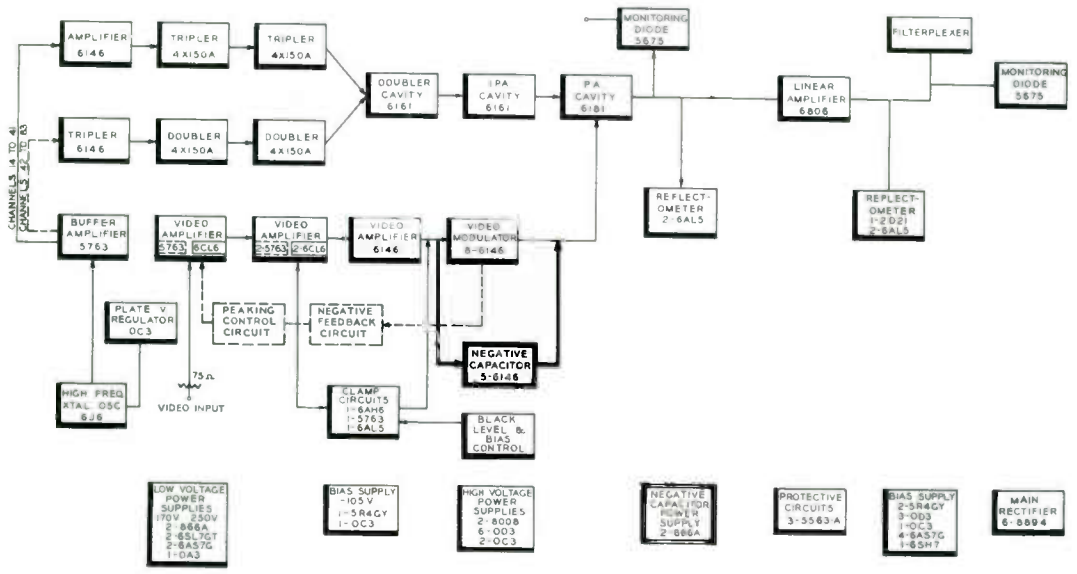
The TTU-25B transmitter is a companion to the popular RCA 1KW model. Television stations now operating with this lower powered transmitter, can achieve higher powers by block-building with additional equipment. The TTU-25B transmitter is flexible in its uses in that it may be operated as a 12½ kw transmitter by simple equipment changes and deletions.

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 minimum 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

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



SIMPLE BLOCK DIAGRAM OF 25 KW TRANSMITTER (VISUAL PORTION)



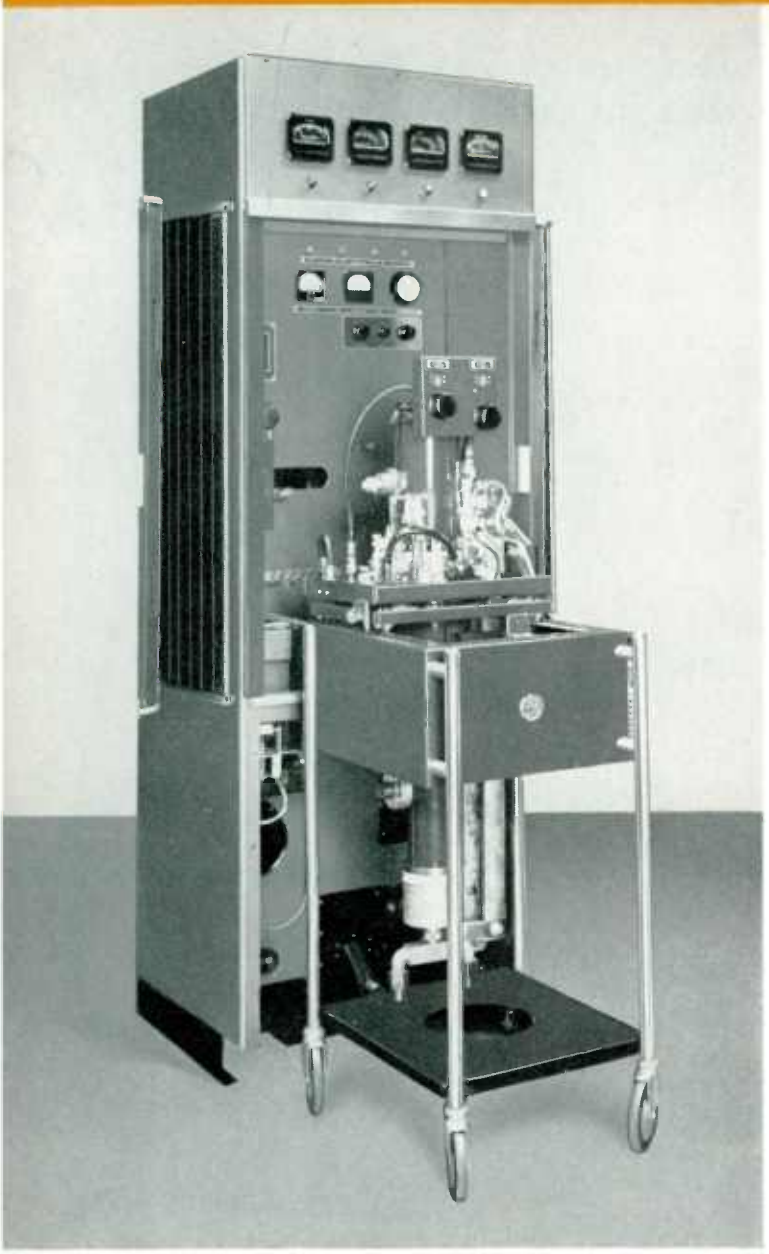
and metering of all important circuits. Operation can practically be reduced to turning "on and off" at the transmitter. Power output meters are supplied for both picture and sound transmitters. These meters also indicate VSWR. Facilities are provided to permit continuous picture monitoring (which is 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 amplifier 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 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.

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.

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. A purification system is included for maintaining a high degree of water purity which aids in obtaining longer tube life.

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.

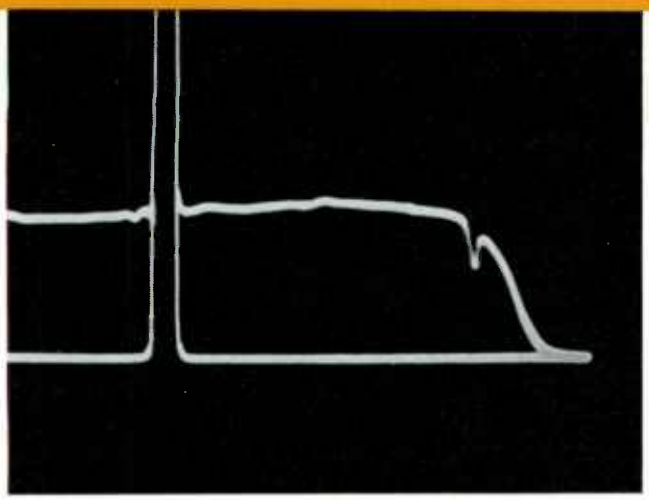
Vertical chassis type construction is used for convenience and accessibility with heavy transformers and reactor units supported by a steel base. The vertical chassis is flanged and fastened directly to side panels allowing maximum use of the volume of the transmitter cabinets.

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

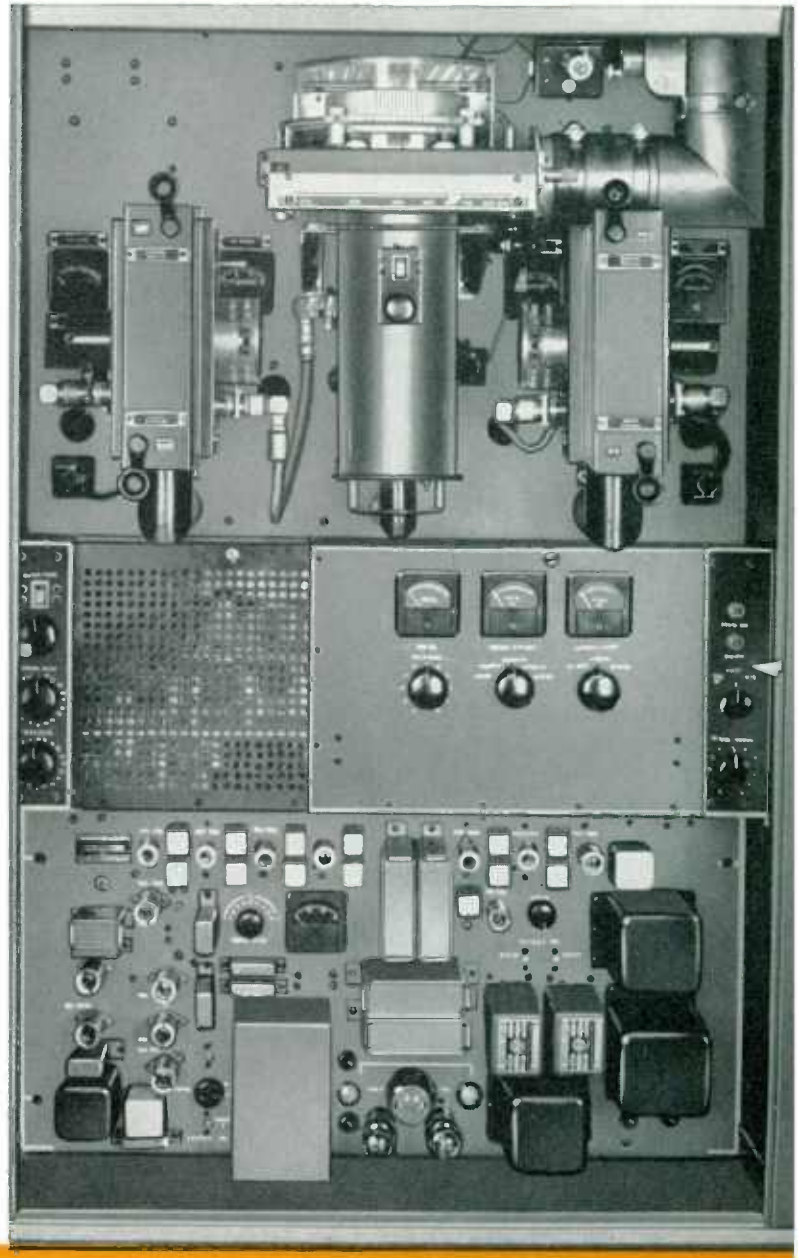
	Visual (Black picture)	*Aural (C.W.)*
Filament voltage, per phase	1.35	1.35
Grid voltage	—140	—180
Grid current, amperes	.01	.01
Screen voltage	1000	1000
Screen current, amperes	0.160	0.220
Plate voltage	8000	8000
Plate current, amperes	6.25	5.5
Power output, filterplexer, KW	25	12.5
Plate efficiency,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

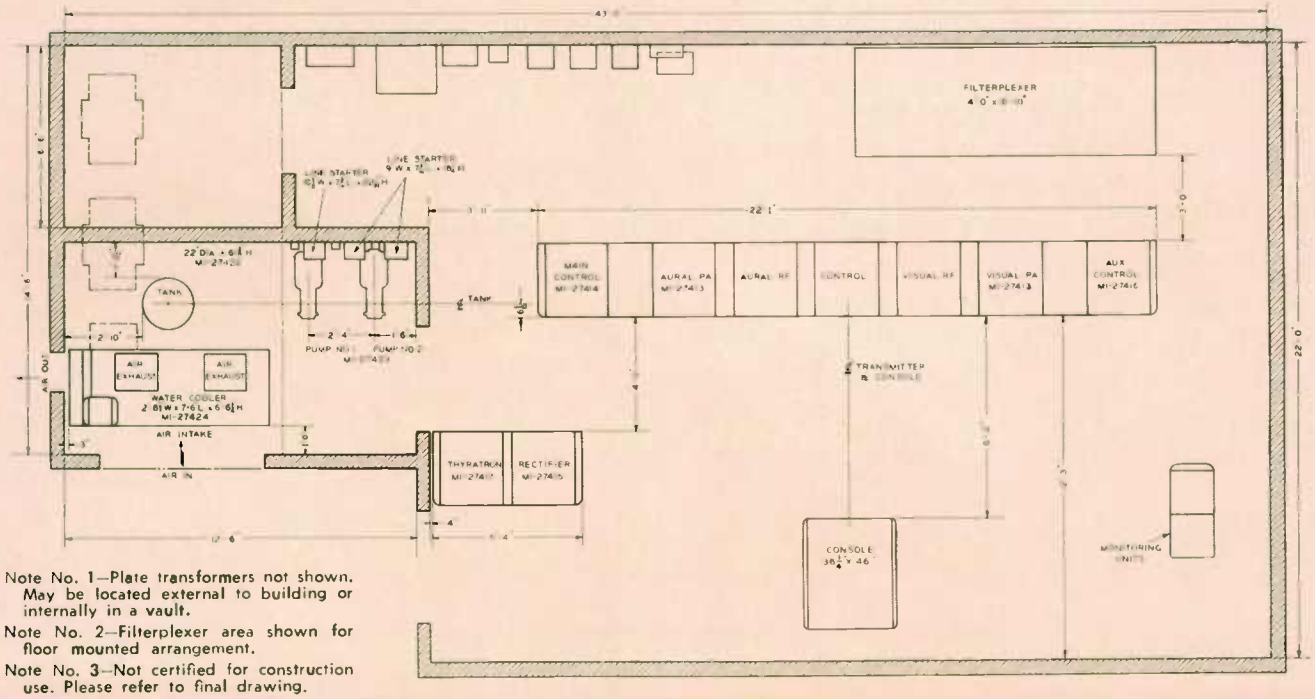
The MI-27323 UHF Filterplexer unit is supplied completely assembled and adjusted for operation in any one of the UHF television channels from channel 14 to channel 83. The unit is required to suppress the undesired sideband as well as to combine the aural and visual transmitter outputs to satisfy both 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.

UHF Filterplexer, MI-27323.

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]	1.5 db max.	
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-5B 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 BWU-5B 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: 460 volts, 60 cycles, 3-phase
- Slow Line Variations: ±5% max.
- Rapid Line Variations: ±3% max.
- Regulation: 3% max.
- Power Consumption: 120 kw black picture, 80 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 9/16"
- 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	6894
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-9 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 indi- VSBF. A properly terminated TA-9 Stabilizing Amplifier is required in the video input circuit.

[11] Maximum departure from standard curve. The tolerances vary linearly 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-B 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	Regulotor
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	Cooling Water Bypass Equipment	MI-27445
1	Finish Touch-Up Kit	MI-7499-A
3	Distribution Transformer	MI-27427
3	Grid Cavities	MI-27443
1	Induction Regulator	MI-27447
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	Demineralizer Installation Equipment	MI 27872
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-5A Control Console with Master Monitor, but less Master Power Supply	ES-27274-6
Low Pass Video Filter	MI-27132
R-F Load	MI-27366
R-F Wattmeter	MI-27363
Color Input and Monitor Racks, Wired/Unwired	ES-19237-H/F
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-5B Sideband Response Analyzer	ES-34009-B
BWU-4B Demodulator	ES-34007-B
Recommended Station Spare Parts	8904397-501
Carrier Off Monitor	ES-27235

TRANSMITTER CONTROL CONSOLE

TYPE TTC-5A

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
- Optional 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 long life mercury contacts
- Hinged monitor control panel provides easy accessibility for maintenance and service of equipment
- Uniform styling to harmonize with RCA transmitters and auxiliary TV equipment

DESCRIPTION

The TTC-5A Transmitter Control Console provides a complete monitoring and operating control for RCA UHF and VHF broadcast television transmitters. The console provides custom planned control exactly suited to each transmitter with no unused functions and without the compromises necessary in a "universal" console.

The console contains audio and video gain and monitoring circuits and all necessary indicating lights, switches and meters for normal transmitter operation. It also houses a Type TM-6C Master Monitor for viewing the picture, and the waveform of the video signal at various points throughout the transmitter. The TTC-5A has provisions for switching between two program channels, aural as well as visual. It permits previewing of the unused program line, or both lines when neither is in use. The audio lines can be monitored at any time.

Closeup view of indicator, monitor control and transmitter control panels mounted in 22 inch console housing.

The console is assembled at the time of installation from standard console housings and special custom built panels for the various type transmitters. The console housings have available additional panel and internal space so that special requirements for custom switching, monitoring, amplifying or indicating devices can be added. Thus the console affords utmost flexibility to suit different requirements of operation and provides for possible improvements in the art, or expansion of station facilities.

Where desired, the TTC-5A 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.

General

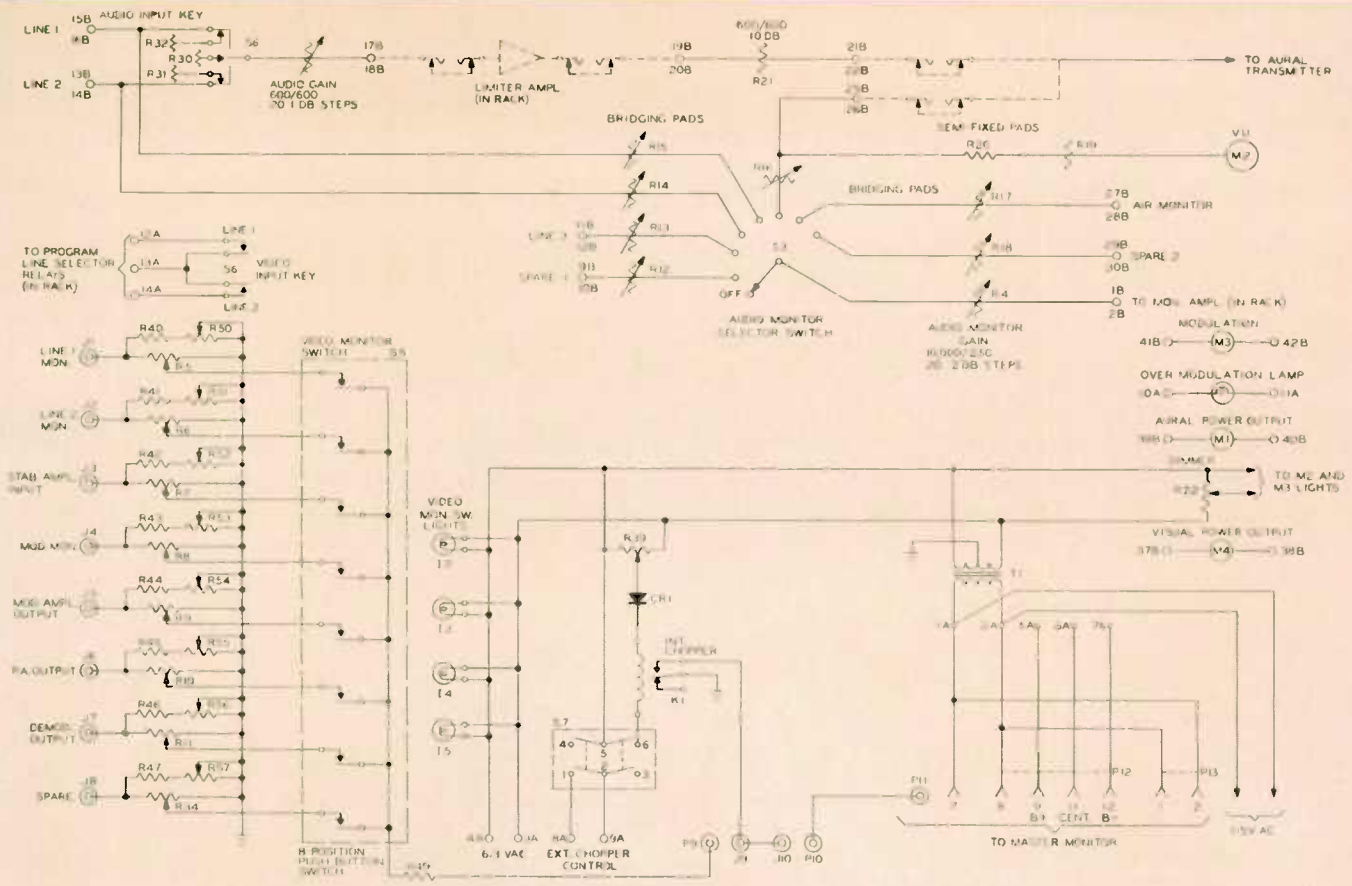
The TTC-5A Transmitter Control Console is a custom equipment made up of four major units: a Set of Panels and Accessories that must be ordered according to the type of Transmitter and consisting of a Transmitter Control Panel, Indicator Panel and Installation instructions and drawings; a Type TM-6C Master Monitor; a Monitor Control Panel; and the Console proper which is made up of a 13¼" console housing, 22-inch console housing, panels, end panels. Other items include a Program Line Selector, an Aural Modulation Monitor Meter for use with either the GR-1184-A-A General Radio TV Station Monitor or the Type 335-ER Hewlett-Packard Monitor, and set of installation hardware.

The Transmitter Control Panel contains switches and overload reset pushbuttons for transmitter supervisory control and operation. The Indicator Panel houses the supervisory indicator lamps. All panel indicating lamps operate on 115 or 230 volts a-c which is obtained from the transmitter, while a 115 volt step-down transformer supplies 6.3 volts for the meter lights and chopper. Connections to all console items are made at terminal boards and jacks when the equipment is installed. Wiring to the console may be installed in conduit, or in a duct terminating below the desk.

The TTC-5A is equipped with a TM-6C Master Monitor, mounted in the left of the console housing. It receives its power from a 280 volt d-c power supply mounted in an external rack, while its input signals come from the monitor control panel 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 front panel of the TM-6C 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 Panel 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



Functional diagram of the TTC-5A Transmitter Console.

Closeup of TTC-5A console showing "block-build" console desk construction and convenient slide and hinge arrangements for accessibility to transmitter control panels.

Monitor Control Panel includes four major circuit functions and other related ones, namely, meter circuits, audio monitor circuits, video monitor circuits, and aural 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. Suitable meters are available for the General Radio 1184-A-A or Hewlett Packard series of monitors. The correct meter must be specified on the order. In addition to the audio metering described above the aural monitor circuits provide means of connecting the input of an audio monitoring amplifier through adjustable bridging networks 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 connecting the input to the master monitor to any of eight monitoring points 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 and level adjustment.

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. Full remote controls for a stabilizing amplifier, which is normally used ahead of the visual transmitter, are available as an optional item 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.

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)	7500 ohms

Volume Controls:

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.

Electrical Specifications

Console Power Requirements:

Indicator Lights (from transmitter)	115 or 230 volts, a-c (as required)
Meter Lights (6.3 volts from transformer)	115 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

Mechanical Specifications

Dimensions:

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

Equipment Supplied

TTC-5A Transmitter Control Console Equipment (order as follows):

For Type TT-2BL, TT-2BH, TT-6AL and TT-11AH Transmitters	ES-27274-1
For Type TT-25CL or TT-25CH Transmitters	ES-27274-2
For Type TT-10AL, TT-10AH or TTU-1B Transmitter	ES-27274-3
For Type TT-25BL or TT-25BH Transmitter	ES-27274-4
For Type TT-50AH Transmitter	ES-27274-5
For Type TTU-12A or TTU-25B Transmitter	ES-27274-6
For Other Transmitters	Custom Built

Consoles include items as follows:

1	Transmitter Control Panel	
	For TT-2BL/BH, TT-6AL and TT-11AH	MI-27866
	For TT-25CL/CH	MI-27867
	For TT-10AL/AH and TTU-1B	MI-27868
	For TT-25BL/BH	MI-27869
	For TT-50AH	MI-27870
	For TTU-12A/25B	MI-27576
1	Indicator Panel	
	For TT-2BL/BH, TT-6AL and TT-11AH	MI-27580
	For TT-25CL/CH	MI-27581
	For TT-10AL/AH and TTU-1B	MI-27582
	For TT-25BL/BH	MI-27583
	For TT-50AH	MI-27584
	For TTU-12A/25B	MI-27577
1	Monitor Control Panel	MI-27865
1	Blank Panel 6-31/32 inch high	MI-4593-A
1	Blank Panel 1-23/32 inch high	MI-4590-A
1	Blank Panel for 22-inch console housing	MI-26846-1
1	Blank Panel for 22-inch console housing	MI-26846-2
1	Console housing 22-inches wide	MI-26787
1	Master Monitor, Type TM-6C	ES-26957-A
1	Meter, Aural Modulation Monitor:	
	For use with Type GR-1184-A-A TV Monitor	MI-19116-3
	Or, for use with Type 335-ER TV Monitor	MI-19116-6
1	Console Housing 13¼" wide	MI-26786
1	Left Hand End Panel	MI-26788-1
1	Right Hand End Panel	MI-26788-2
1	Set of Installation Hardware	MI-27579
1	Program Line Selector	MI-27407
2	Installation Drawings	644367
2	Instruction Books	IB-30259

Optional and Accessory Equipment

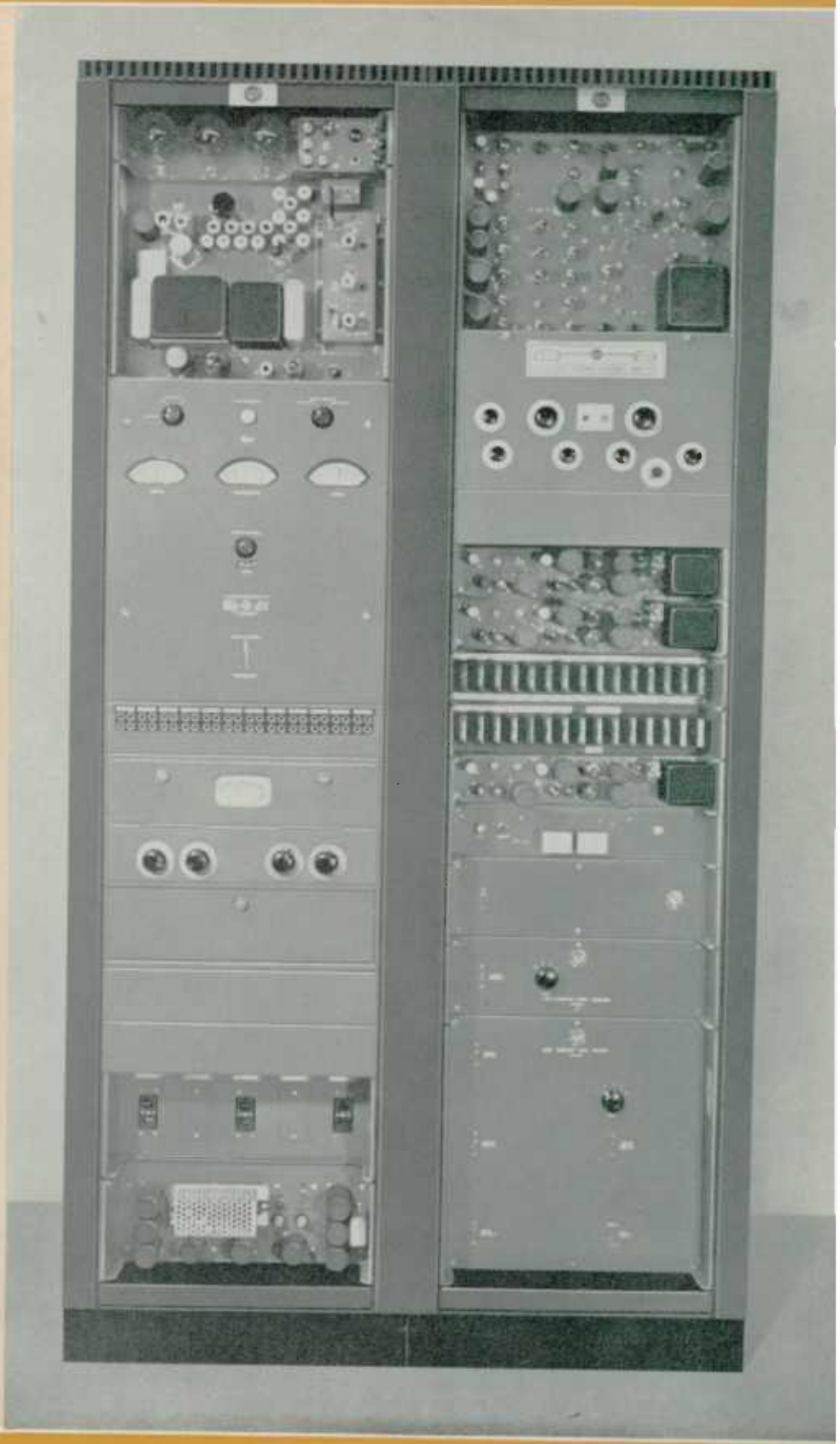
Television Station Input and Monitoring Equipment	ES-19237 Series
Calibration Meter	MI-21200-C1
580-D Power Supply	MI-21523-C
WP-15B Power Rectifier and Regulator	MI-26087/26088

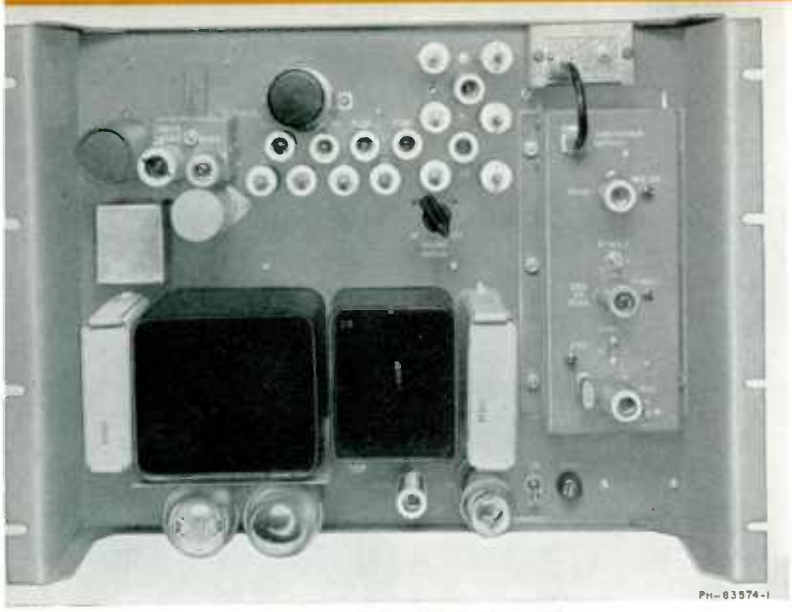
INPUT AND MONITORING EQUIPMENT

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
- Custom wired racks available
- Compact, lightweight cabinets—easily installed
- Rack components arranged with regard to operating convenience
- BW-5B sideband response analyzer permits adjusting transmitter broad band response
- Provides continuous check on transmitter performance
- Plug and socket connectors for all power, video, audio, and r-f connections





View of the BW-4B Demodulator.

USES

The RCA type ES-19237 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 two standard mounting racks which are intended to be used in conjunction with an RCA TTC-5A Transmitter Console as a central monitoring and control center.

The ES-19237 Series of monitoring equipment is supplied in four different arrangements:

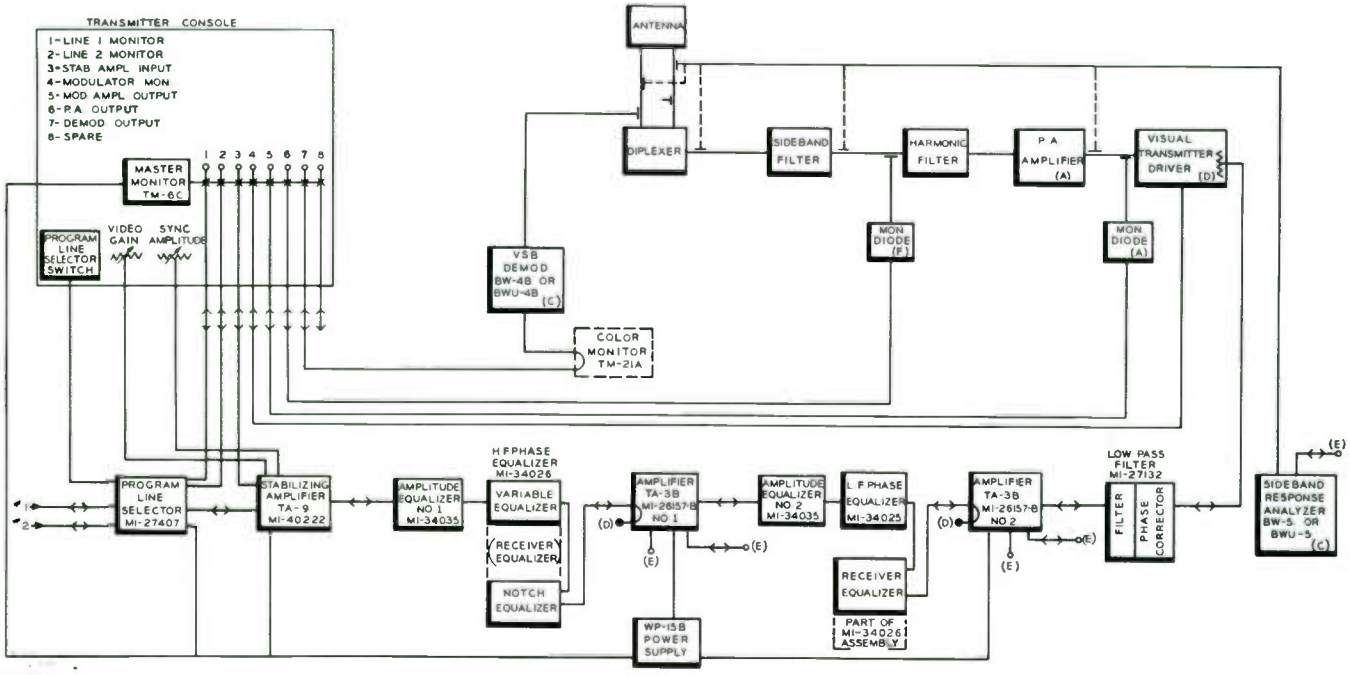
1. ES-19237-G Wired VHF monochrome and color
2. ES-19237-E Unwired VHF monochrome and color
3. ES-19237-H Wired UHF monochrome and color
4. ES-19237-F Unwired UHF monochrome and color

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.

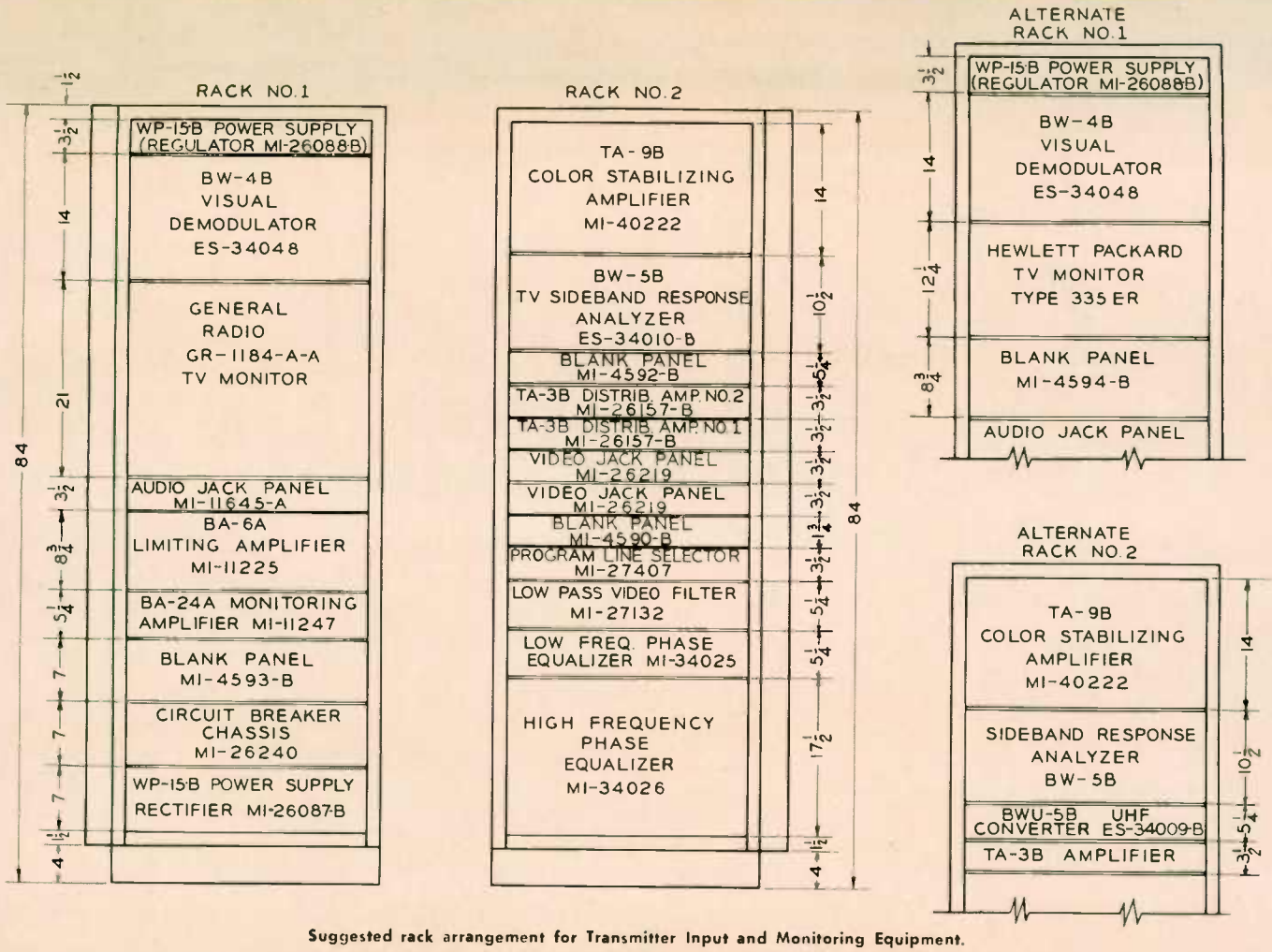
When RCA monitoring equipment racks are used with a TTC-5A console, they provide everything required for routine TV station monitoring. The functions monitored are:

Visual Carrier Frequency,
Aural Carrier Frequency,
Aural Modulation. (This meter is on GR-1184-A-A or HP-335ER and is repeated on the TTC-5A console),
Visual Modulation (CRO on Console),
Aural Signals at all points where aural signals are available. Level of Transmitter input signal by VU meter;



NOTES:-
(A) ITEMS REQUIRED ONLY IF AMPLIFIER IS PRESENT
(B) 1—BOTH ANTENNA LINES MUST BE EQUIPPED WITH MONITOR PICKUPS, ONE TO SERVE DAILY, THE OTHER AS CHECK POINT
2—IF DEMODULATOR DOES NOT REJECT AURAL SIGNAL, ITS PICKUP POINT MUST PRECEDE THE DIPLEXER
(C) USE DIRECTIONAL COUPLERS TO SUPPLY SIGNAL TO THE BW-4B AND BW-5B
(D) PRECISION TERMINATIONS REQUIRED (75Ω ±1%)
(E) TERMINATIONS REQUIRED (75Ω ±5%)
(F) NOT USED WITH SOME TRANSMITTERS

Line diagram showing video input control and monitoring functions of ES-19237 equipment.



Suggested rack arrangement for Transmitter Input and Monitoring Equipment.

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.

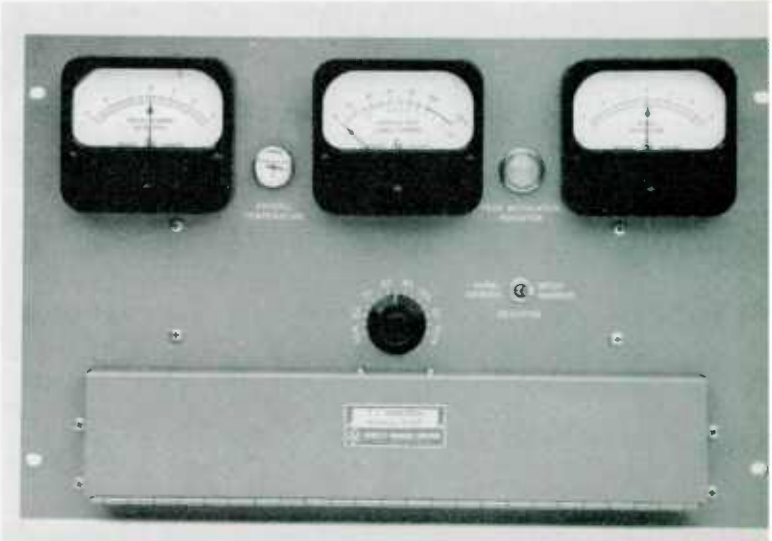
In addition to the monitoring functions listed, the racks provide:

A. Limiting amplifier BA-6A for the aural signal before application to the transmitter.

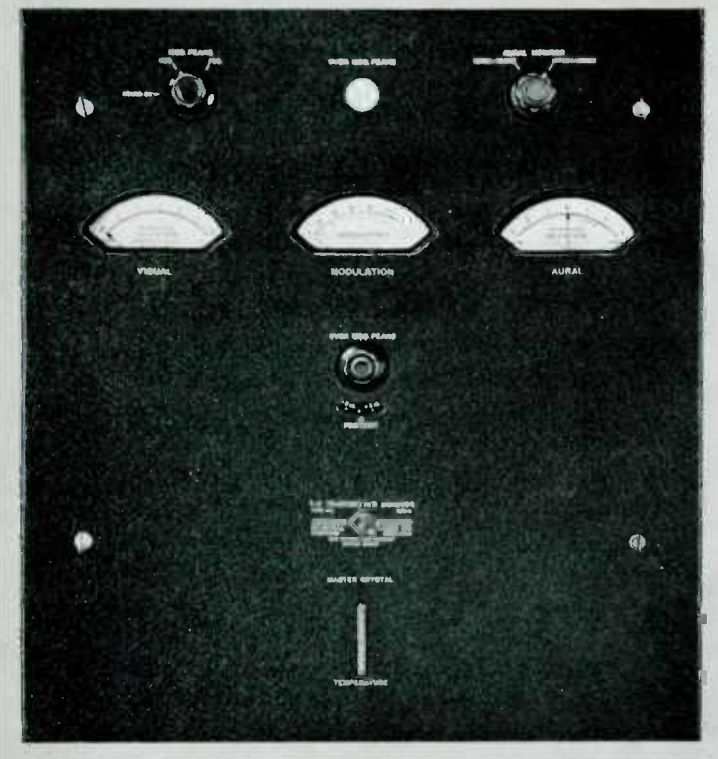
B. Stabilizing amplifier for visual signal to transmitter.

C. Sideband response analyzer BW-5B 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 CRO 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.



Television Monitor, Type 335ER. ▶

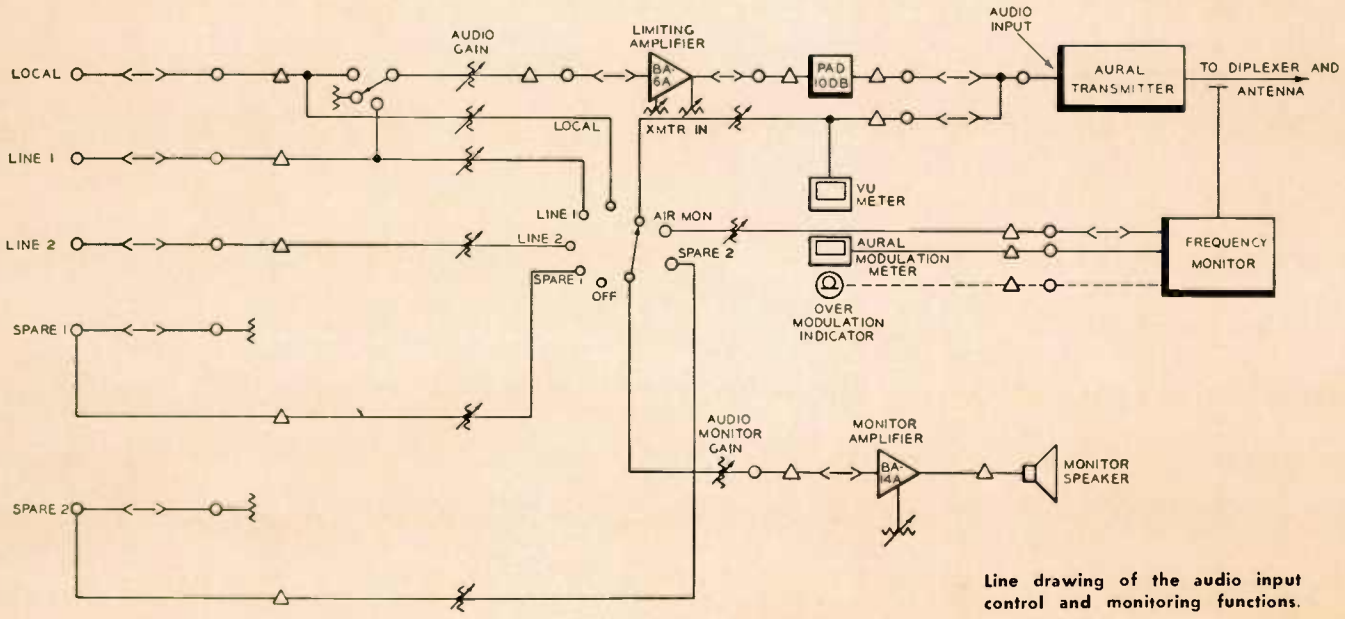


The GR-1184-A-A Monitor Equipment is removable from the front of the rack for servicing and inspection.

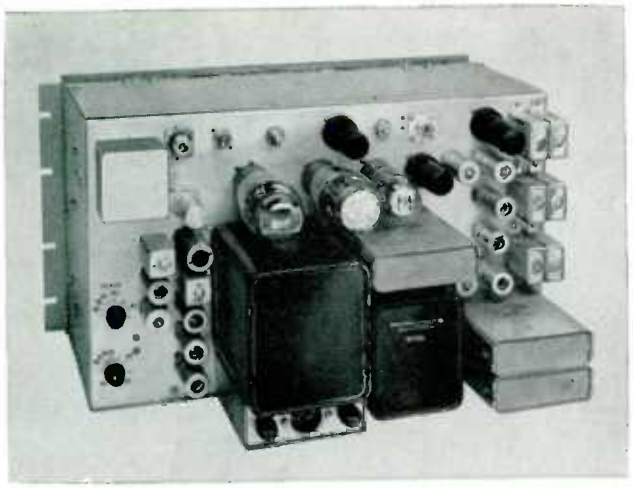
A choice of Monitoring units is available, either the GR-1184-A-A or the HP-335ER, both of which are described in the following paragraphs.

A General Radio Transmitter Monitor Unit, Type 1184-A-A provides continuous indication of center-frequency and percentage modulation (frequency deviation) from FCC assigned values of visual carrier, and aural carrier or intercarrier separation. It also furnishes a high-fidelity output for measuring distortion and noise, and a 600-ohm output for audio monitoring. The monitoring system may be used by TV stations operating on any channel and broadcasting either color or monochrome signals. The monitor also has provision for complete audio-fidelity tests and residual AM and FM noise measurements on aural and visual transmitters respectively. An external distortion and noise meter may be used to measure the audio fidelity of the aural transmitter as required for FCC proof-of-performance tests. An output signal of 10.8 volts at 100% modulation is available for this purpose. No external detector is required for measurement of the existing mixer stage. Modulation distortion can be measured at any frequency from 50 to 15,000 cycles at 100% modulation or less. By operating the station-monitoring speaker from this system, an audible warning for loss of either carrier is constantly available.

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, without adjustment, and with dependability and accuracy. It is equally useful in monochrome or color broadcasting. In addition to continuous, precise



Line drawing of the audio input control and monitoring functions.



Top-of-chassis view of the BW-5B Sideband Response Analyzer.

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.

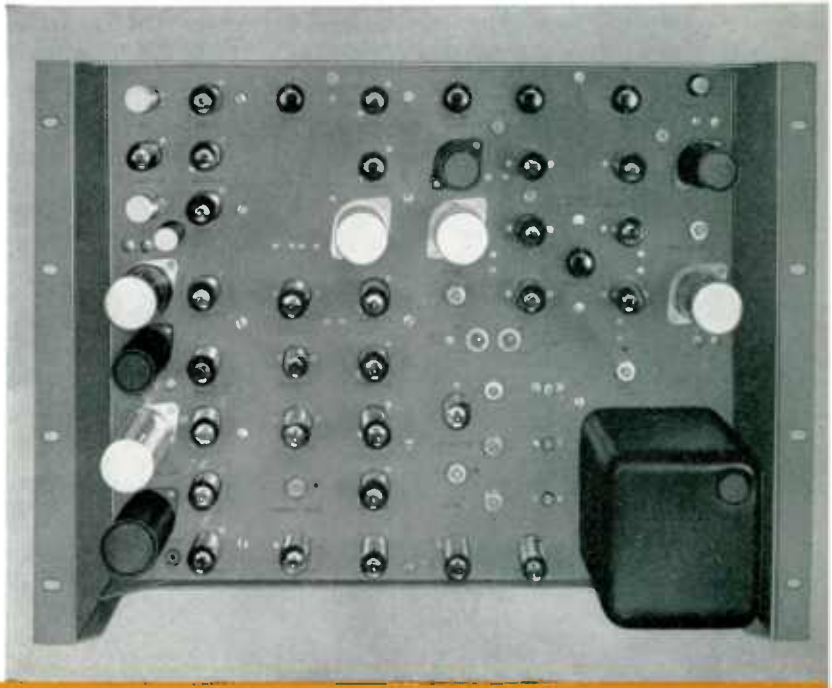
The three panel meters monitor visual and aural carrier frequency and percent modulation of the aural carrier with 100% modulation equal to 25 kc deviation. A peak modulation indicator lamp is included as standard equipment; the instrument also has provision for remote indicating meters, remote peak 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 mounted in two sturdy metal cabinet racks 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-9 Stabilizing Amplifier.



SPECIFICATIONS

Performance Specifications

GENERAL RADIO-TV STATION MONITOR

Frequency Range.....50-890 mc (TV channels 2-83)

RF Input:
- Impedance.....Low-impedance, loop coupling
- Level.....For use with standard EIA transmitter monitoring outputs (10 volts, 50 ohms)
- Sensitivity.....One volt for all functions except the measurement of residual AM noise on the aural transmitter, which requires a minimum of 4 volts r-f input and the visual transmitter input which requires 2 volts
- Indication.....Direct indication an front panel meter

Frequency (Crystal Stability):
- Master Reference.....±1.4 ppm/30 days or ±0.35 ppm/10 days
- Secondary reference.....±5 ppm/30 days (= 21.5 cycles)
- Interpolating reference oscillator....±5 ppm/30 days (= 22.5 cycles)

Accuracy (overall):
- Aural and Visual.....500c/30 days VHF or 500c/10 days UHF
- Intercarrier.....250c/30 days at all frequencies

Aural Modulation (FM):
- Meter Scale.....0 to 100% + 3 db, full scale
- Meter Ballistics.....As required by FCC specifications
- Meter Calibration.....100% = 25 kc deviation; selection switch for 100% = 50 kc to permit wide-deviation type tests.
- Polarity Response.....Panel switch for positive or negative peaks, for both meter and flashing lamp

Peak Indicator.....Flashing lamp indicates peaks in excess of dial setting
- Dial.....Calibrated from 0 to 100% and to +3 db above 100%
- Meter Frequency Response.....±0.25 db from 50 to 15,000 cycles; ±0.5 db from 30 to 20,000
- Peak Indicator Freq. Response.....0.5 db from 100 to 15,000 cycles

Aural FM Transmitter Fidelity Measurements:
- Audio Outputs (at low frequencies with 100% modulation)....10.8 volts into 100 ohms or 0 db into 600 ohms
- Residual Distortion (50 to 15,000 cycles).....0.15% for 25 kc modulation deviation and 0.25% for 50 kc deviation
- Residual FM Noise.....—70 db below 25 kc modulation deviation
- Audio Response.....follows 75-μsec de-emphasis curve within ±0.5 db from 50 to 15,000 cycles, ±3 db from 15 to 30 kc
- AM Noise Reference Level (at low Frequencies).....4 volts into 100 ohms
- Residual Noise AM.....—70 db below carrier level

Visual AM Transmitter Fidelity Measurements:
- Noise (FM) Measuring Output (at low frequencies and 25 kc deviation).....1.5 volts into 100 ohm load, 75-μsec de-emphasis circuit included
- Residual (FM) Noise.....—65 db below 25 kc deviation with normal video modulation on transmitter (—70 db without video modulation)

Intercarrier Fidelity Measurements:
- Same as for aural transmitter except Residual (FM) noise is —63 db below 25 kc deviation of aural transmitter with video modulation applied to visual transmitters.

Power Supply:
- Standby Operation.....15 watts, with master crystal oven operating 115/230 volts; 50/60 cycles
- Normal Operation.....Max. demand 265 watts, with all thermostats on. Min. demand 240 watts, with all thermostats off. 115/230 volts; 50/60 cycles.

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.....37.5/150/600 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-4B.....Channels 2-13
- BWU-4B.....Channels 14-83

Output Impedance.....75 ohms, unbalanced

Input Impedance.....50 ohms, unbalanced

Polarity of Sync Pulses.....Negative

Output Voltage.....2.0 volts, peak-to-peak (max.)

SPECIFICATIONS (Cont'd)

BW-5B/BWU-5B 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)
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-5B 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 Impedance:		
Picture	75 ohms (±1%)	1 meg, 35 mmf
Sync	Bridging	1 meg, 35 mmf
Blanking	Bridging	1 meg, 35 mmf

Output Impedance:	(Source)	(Load)
Line Picture	75 ohms	75 ohms
Monitor Picture	75 ohms	75 ohms
Sync	2100 ohms	75 ohms

Input Signal Requirements:
Composite Video (Black Negative).....0.25 v. min.; 2.0 v. max.
Sync-to-Picture Ratio (min.).....15% of input picture signal
Local Sync.....3.5—5.0 volts, negative
Local Blanking.....3.5—5.0 volts, negative

Output Signal Range:
Picture Component.....0-1.0 volt, peak-to-peak
Sync Component (output video signal).....0—.8 volt, peak-to-peak
Sync Output.....4 volts, peak-to-peak
Frequency Response.....Flat ±0.5 db to 7.0 mc
Tilt (60 cycle square wave).....2% max.
Differential Gain.....0.25 db
Differential Phase.....Less than 1°
Isolation Between Outputs.....Better than 40 db @ 3.58 mc

Power Rquirements:
Heater Supply.....117 volts, 50/60 cycles, 120 watts
Plate Supply.....280 volts, regulated 400 ma with white stretch
280 volts, regulated 375 mc without white stretch

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 of 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 130 volts, 50/60 cycles, 265 watts
Limiting Amplifier.....105, 115, 125 volts, transformer taps provided for, 50/60 cycles, 125 watts
Monitoring Amplifier.....105-125 volts, 50/60 cycles, 70 watts
Visual Sideband Demodulator....105-125 volts, 50/60 cycles, 250 watts
Sideband Response 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, 120 watts
D-c 280 volts, 400 ma
WP-15-B Power Supply.....105-129 volts, 50/60 cycles, 850 watts
Video Distribution Amplifier.....105-125 volts, 50/60 cycles, 55 watts

Tube Complement

1184-A-A TV Transmitter Monitor
13—6AU6, 3—6AL6, 4—6BE6, 4—6CL6, 3—6J6, 2—6U8, 6—12AT7, 2—12AX7, 2—12BH7, 2—5651, 6—5727, 2—9005 (UHF only)

BA-6A Limiting Amplifier
2—6SK7, 2—6J7, 2—6V6-GT, 1—6H6, 1—OD3, 1—5R4GY

BA-24A Monitoring Amplifiers
1—12AX7, 2—6V6-GT/G, 1—MI-11299 (Selected 12AY7), 1—5Y3-GT/G

Rack #2:
BW-4B/BWU-4B Visual Demodulator
2—6C4, 4—6CB6, 1—6J6, 1—6AG7, 1—6AK6, 1—5V4, 1—6AS6/6CB6, 1—6AS7, 1—OC3, 1—6BC6/6BQ7 (Ch 7-84 only)

BW-5B VHF Sideband Response Analyzer*
2—6J6, 3—12AU7, 1—6SQ6, 2—6BA6, 3—6AS6, 2—6AH6, 1—6AK6, 1—5R4G, 1—6C4, 1—6AS7G, 1—6SJ7, 1—OD3

TA-9 Stabilizing Amplifier
8—6CL6, 3—6AH6, 3—6AL5, 3—6AU6, 1—12B4, 2—12AT7, 1—12AU7, 1—12AX7, 1—6AS6

(2) WP-33B Regulated Power Supplies
8—5R4GY, 2—6SL7-GT, 6—6AS7-G, 4—OD3, 2—NE-32

(2) TA-3B Video Distribution Amplifiers
2—6BQ7-A, 4—6BX7, 2—5687, 4—OB2, 2—6X4, 4—6U8

WP-15-B Regulated Power Supply
3—6336, 1—12AX7, 1—12AT7, 1—5651

(* The BWU-5B utilizes all the tubes listed above under the BW-5B 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
BA-6A Limiting Amplifier	7 5/8"	16 3/16"	14"	37 lbs.
BA-24A Monitoring Amplifier	42 1/32"	8 3/8"	10 3/8"	16 1/4 lbs.
BWU-4B Visual Demodulator	14"	19"	9"	35 lbs.
BW-4B Visual Demodulator	14 1/2"	19"	10 1/2"	58 lbs.
BW-5B VHF Sideband Response Anolyzer	10 1/2"	19"	14 1/2"	58 lbs.
BWU-5B UHF Sideband Response Analyzer R-F Input Unit	5 1/4"	19"	7 3/4"	11 lbs.
TA-9 Stabilizing Amplifier	12 1/4"	19"	5"	20 lbs.
TA-3B Video Distribution Ampli.	3 1/2"	19"	10 3/8"	12 1/2 lbs.
High Frequency Equalizer	17 1/2"	19"	10"	23 lbs.
Low Frequency Equalizer	5 1/4"	19"	10"	9 lbs.
WP-15-B Rectifier	7"	19"	11"	59 lbs.
WP-15-B Regulator	3 1/2"	19"	10 3/8"	12 lbs.
BR-84 Standard Cobinet Racks	84"	22"	18"	225 lbs.
Overoll Equipment (Tondem Cobinets)	84"	50"	18"	525 lbs. (approx.)

Equipment Supplied

INPUT AND MONITORING EQUIPMENT

For VHF Tronsmitters ES-19237-G (wired)	ES-19237-E (unwired)		For UHF Tronsmitters MI-19237-H (wired)	MI-19237-F (unwired)
1	—	MI-30951-B84 Monitoring Equipment Rack #1, wired	1	—
—	1	MI-30951-B84 Monitoring Equipment Rack #1	—	1
1	—	MI-30951-D84 Monitoring Equipment Rack #2, wired	1	—
—	1	MI-30951-D84 Monitoring Equipment Rack #2	—	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
1	1	MI-30568-G84 Double Trim Strip	1	1
1	1	MI-4593-B Blank Panel 7"	1	1
1	1	MI-4590-B Blank Panel, 1 3/4"	1	1
1	1	MI-4592-B Blank Panel, 5 1/4" high	—	—
1	1	MI-11225 Type BA-6A Limiting Amplifier, including panel, but less shelf ond 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-40222 Type TA-9 Stabilizing Amplifier (with one set of tubes)	1	1

Equipment Supplied (Cont'd)

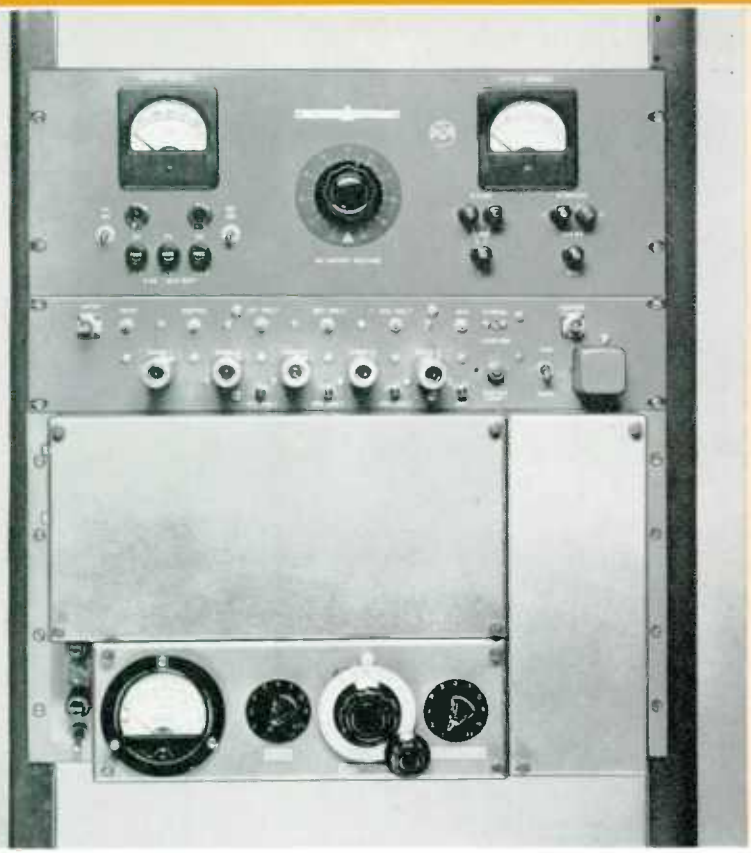
INPUT AND MONITORING EQUIPMENT

For VHF Transmitters ES-19237-G (wired)	ES-19237-E (unwired)		For UHF Transmitters MI-19237-H (wired)	MI-19237-F (unwired)
1	1	MI-26087-B WP-15-B Power Supply Rectifier	1	1
1	1	MI-26088-B WP-15-B Power Supply Regulator (with one set of tubes)	1	1
2	2	MI-26219 Video Jack Panel	2	2
1	1	ES-34048 Type BW-4B Visual Demodulator with 1 set tubes		
—	—	ES-34049-B Type BWU-4B Visual Demodulator with 1 set tubes	1	1
1†	1†	General Radio Type 1184-A-A TV Station Monitoring Equipment, complete with 1 set of tubes	1†	1†
1	1	ES-34010-B Type BW-5B Sideband Response Analyzer	—	—
—	—	ES-34009-B Type BWU-5B Sideband Response Analyzer	1	1
3	3	MI-4652-2B Audio Patch Cords	3	3
6	6	MI-26771 Video Potch Cords	6	6
23	23	MI-26784 Video Dual Connector Plugs	23	23
2	2	MI-30526-GB4 Pair of Panel Mounting Angles	2	2
3	3	MI-4570-A Terminal Board Brackets	3	3
1	1	MI-4569 Audio Terminal Blocks	1	1
6	6	MI-4568 Power Terminal Blocks	6	6
1	1	MI-11645-A Type BJ-24 Double Jack Panels	1	1
1	1	MI-11647-2 Jack Mat for BJ-24	1	1
2	2	MI-30590-2 Interlock Switch	2	2
1	1	MI-27407 Program Line Selector	1	1
1	1	MI-26240 Circuit Breaker Chossis	1	1
2	2	MI-26764-1 Circuit Breaker	2	2
1	1	MI-26764-2 Circuit Breaker	1	1
1	1	ES-34034-B High and Low Frequency Phase Correction Network	1	1
2	2	MI-26157-B Type TA-3B Distribution Amplifier (with one set of tubes)	2	2
*	*	MI-4594-B Blank Panel 8 1/4" high (* Note: Supply one only if Hewlett-Packard Monitor is specified)	*	*
1	1	MI-27862 Mounting Hardwore	1	1
1	1	Set Installation Drowings	1	1

† The Hewlett-Packard Type 335-ER Station Monitoring Equipment for rack mounting may be specified instead of General Radio equipment.

PRECISE FREQUENCY CONTROL

TYPE TFC-1A



FEATURES

- Offers precise control of visual carrier frequency
- Extends station coverage to area now lost due to co-channel interference
- Frequency variation less than 1 cycle per 100 mc over 7-day period
- Reduction in co-channel interference of up to 15 db may be obtained
- Self-contained power supply
- Standard rack mounting
- Provisions for checking frequency measurement
- Ease of installation—coupling head directly interchangeable with crystal holder in RCA transmitters

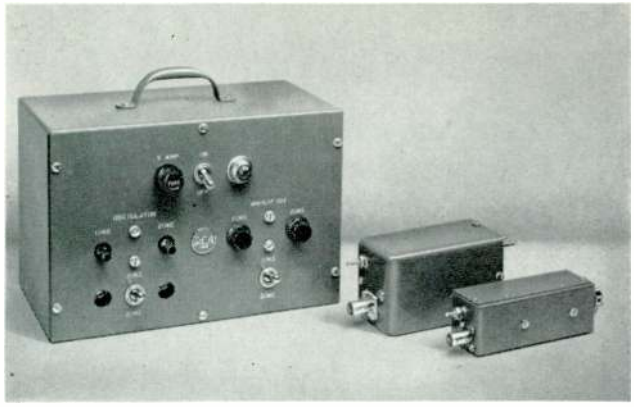
DESCRIPTION

The RCA Type TFC-1A Precise Frequency Control System is designed to reduce interference between co-channel television stations and thus extend station program coverage to fringe areas now lost due to signal degeneration. Interference between two or more co-channel television stations is reduced if their picture carrier frequencies are off-set by a fixed amount, and if this difference is held constant within very small tolerances. The TFC-1A system makes use of recent developments in crystal techniques and oscillator circuits to maintain carrier frequencies at precisely their assigned off-set frequencies. It also has provisions for checking the difference frequency between co-channel stations.

Better spectrum usage through off-set carrier operation requires that one TFC-1A Precise Frequency Control System be installed at each participating station and a stable source of frame frequency be supplied. In addition, auxiliary equipment consisting of good oscilloscope, field intensity meter and frequency counter are required for determining the proper beat or offset frequency and for periodic testing of the system.

The RCA TFC-1A Precise Frequency Control System consists of four equipment units: the Crystal Oscillator, MI-34053; R-F Multiplier Unit, MI-34054 comprised of multiplier, coupling head, and two coaxial cables; a Power Supply, MI-34055; and a Selective Amplifier, MI-34056. The system is designed to fit standard racks, requiring approximately 21 inches of space, excluding the Selective Amplifier. The latter is a portable unit used only during a frequency measurement.

Co-channel stations using precise frequency control must have an offset frequency which is an even multiple of the frame frequency, (nominally 29.97 cps). Optimum improvement of co-channel interference is obtained when this condition exists. The multiplier selected is 332 to 334 for 10 kc off-set station and 664-668 for 20 kc off-set. To assure positive control of separation, an extremely stable frequency source is required. The TFC-1A supplies the equipment necessary to control offset operation with the required frequency stability. Maximum variation over a seven-day period is less than 1 part in 10^8.



MI-34056 Selective Amplifier and MI-34060 and MI-34059 Coupling Heads.

To off-set the frequency of two co-channel stations, the transmitting antenna may be used to receive the picture carrier of the co-channel station. This received signal is added to the proper harmonic of the local crystal frequency. The two signals are then mixed in the field intensity meter. The beat between the two carriers, available at the ouput of the field intensity meter, is amplified through a narrow band amplifier and applied to the vertical plates of an oscilloscope. The sweep circuits of the oscilloscope are triggered by vertical drive obtained from a sync generator which is locked to a color subcarrier. With this system it is possible to set the beat or off-set frequency to an even multiple of frame frequency. To determine whether the desired even multiple has been reached it is necessary to use a frequency counter.

The TFC-1A system is easily installed in any RCA transmitter. The present crystal is removed from the transmitter and the R-F Coupling Head simply inserts in the crystal socket. It may be necessary in some cases to remove certain components in order to tune the R-F Amplifier to the proper crystal frequency. However, no soldering or wiring is necessary. For tuning, only a scope, a d-c voltmeter, and grid-dip meter are required.

The MI-34053 Crystal Oscillator Unit is so designed that its frequency is almost independent of circuit constants. Crystal oven temperature is maintained at better than .002°C. per degree change in ambient. Frequency of oscillation of this super-stable unit will be between .834 mc to 1.217 mc. A self-contained power supply is provided.

The R-F Multiplier, MI-34054 is a shielded unit which multiplies and amplifies the super-stable oscillator output to the frequency of the crystal in use at present. The output is connected to the transmitter by a special coupling head which plugs directly into the crystal socket. Also available from the R-F Amplifier is the picture carrier frequency. This is provided as a convenience in measuring and adjusting the frequency of the picture carrier for optimum off-set operation. The MI-34055 Power Supply provides necessary power for the R-F Amplifier. The portable Selective Amplifier, MI-34056 is connected into the system only when making periodic frequency checks. It selects the proper low frequency beat necessary for precise frequency measurement.

The MI-34056 Selective Amplifier is a high gain, highly selective audio amplifier. Its purpose is to amplify the audio beat frequency which is produced by the picture carrier signals of two or more co-channel television transmitters being adjusted for proper off-set frequency operation. It has a self-contained power supply and its own fuse protection. The unit is contained in a portable cabinet. Output and input connectors are standard 75 ohm video connectors. It operates from a 110 V 60 cps source.

SPECIFICATIONS

Frequency Stability.....Frequency variation less than one part in 10^8 over 7 day period

Output.....Output of multiplier is sufficient to drive transmitter crystal stage to full output

	10 kc amplifier	*20 kc amplifier*
Tuning Range	9800-10200	19000-21000
6 db bandwidth at 10010 cps	60 cps	—
6 db bandwidth at 20020 cps	—	350 cps

Ambient Temperature.....18°-40°C.; ambient temperature not to change more rapidly than 6 degrees per hour while in operation

Ambient Humidity.....0-95% RH

Power Requirements.....117 volts, 60 cycles, a-c, 150 watts. Line regulation not to exceed 5%

Size.....All units are standard 19" rack mounting, occupying approximately a total of 21" vertical space

Weight.....65 lbs. total (approx.)

Tube Complement

Precise Oscillator (Knight Unit): 4—6AU6, 1—12AX7, 2—OC3, 1—2C51, 1—6BL7GT, 1—12AV7, 1—5Y3GT
Power Supply: 2—5R4GT
Oscillator Multiplier: 2—6AU6, 2—6AN5, 1—6AQ5
10-20 kc Amplifier: 1—6U8A

Equipment Supplied

TFC-1A Precise Frequency Control System, complete.....ES-34052
comprising the following equipment:
- 1 Crystal Oscillator.....MI-34053
- 1 R-F Multiplier Unit.....MI-34054
- 1 Power Supply (for MI-35054).....MI-34055
- 1 10-20 kc Selective Amplifier.....MI-34056
- 1 Coupling Head (order as follows)
  - For use with TT-2BL, TT-2BH, TT-6AL and TT-11AH Transmitters.....MI-34059
  - For use with all other Transmitters.....MI-34060

Accessory & Optional Equipment

Oscilloscope, Type TO-524-AD.....MI-26500-A
R-F Test Set & Field Intensity Meter, Type BW-7B.....MI-19384
Field Intensity Meter, Jerrold Model.....704-B
Frequency Counter.....HP-521-A
D-C Voltmeter
Grid-Dip Meter
TO-500 "Scope-mobile".....MI-26501

50-KW POWER CUTBACK KIT

MI-27157

FEATURES

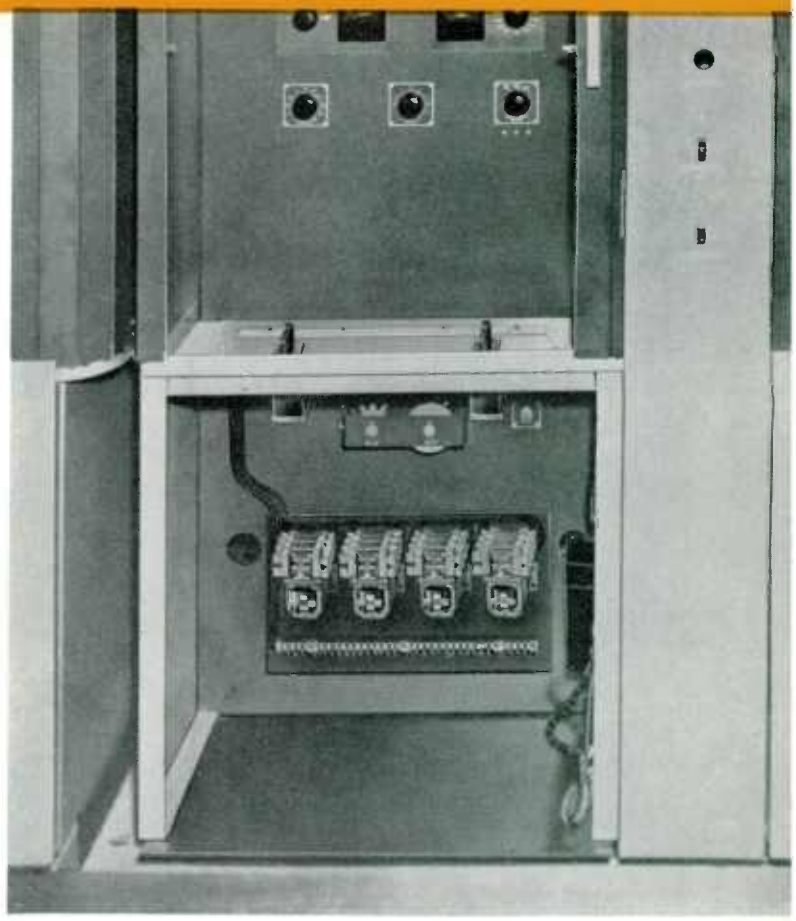
- Removes plate, screen, filament and bias voltages and cooling air from either or both 50-KW amplifiers
- Independent cut back circuits permit by-passing visual and aural amplifiers for quick on-air servicing or repairs
- Easily installed—kit becomes integral part of transmitter providing more versatile operation
- Control lights indicate status of control circuits
- Choice of manual or automatic type coxaial transfer switches

DESCRIPTION

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 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 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 remove 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.

To complete the installation, four accessory MI-27330 coaxial switches are required and a MI-27832 contactor for each switch. With the inclusion of the aforementioned equipment either the aural or visual power can be cut back to the driver output by rotation of one switch.



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.

Rotation of both switches will cut back both visual and aural transmitters. If separate control of the coax switches is desired two MI-27727 manual controllers should be used with four MI-27330 coaxial switches. Manual r-f transfer panels may be used if desired, but are not recommended when fast cutback of power is desired. Cost of coaxial switches, contactors or manual r-f transfer panels are not included in the price of the kit.

SPECIFICATIONS

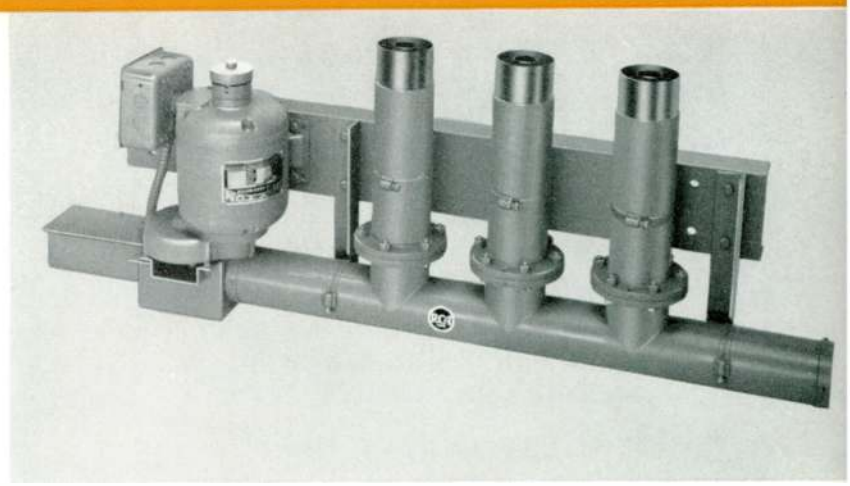
Weight	300 lbs. (approx.)
Stock Identification	MI-27157

Accessory Equipment

Manual R-f Transfer Panels (4 required)	MI-27734
Motor Driven R-f Coaxial Switches (4 required)	MI-27330
Manual Controller	MI-27727
Automatic Contactor	MI-27832

VHF AUTOMATIC COAXIAL SWITCHES

MI-27330, MI-27335 & MI-27335-1



FEATURES

- Motor driven—permits rapid remote-control R-F circuit switching in less than one second
- Useful for power cut-back, emergency transmitter or antenna switching. Avoids time loss common to manual switching systems
- Micro-switches facilitate external position indicating and high voltage interlock circuits for R-F protection during switching cycle
- 30 KW average power rating for all VHF channels

DESCRIPTION

The motor driven VHF coaxial switch is useful for R-F switching in emergency power cut-back systems: switching of standby transmitters or standby antennas; switching between a transmitter and divided antenna with emergency diplexer connections; or other R-F switching systems to meet individual station requirements. An additional function is rapid switching of transmitter outputs or diplexer outputs to permanently mounted R-F load-/wattmeters for maintenance periods or emergency adjustments.

The Automatic Coaxial Switch is a single-pole, two-position switch for use with 3⅛" transmission line. The switch consists of a manifold assembly with three parallel branches, the center being the common connection, a motor driven system and its associated limiting switches. This entire assembly is mounted on an aluminum base suitable for mounting in any convenient position.

Switching from one position to another is accomplished by means of a piston rod provided with alternate-conducting and insulated sections that engage conducting sleeves attached to the inner conductors of the three parallel coaxial lines. As this piston moves back and forth, adjacent coaxial lines are either electrically-interconnected or insulated from each other. Means are provided for grounding the particular input connection that is not interconnected. One end of this piston is connected to a rack which, in turn, engages a pinion gear driven by the motor. Pins mounted on this rack engage micro-switches to control the length of time voltage is applied to the drive motor. A double pole, double throw toggle switch capable of handling 11 amperes at 220 a-c is suitable for controlling the drive motor. Terminals are unflanged. Maximum VSWR is 1.04 to 1.0 or better at all VHF channels.

Micro-switches are available at each position in order to operate external position indicating devices, such as signal lamps. These micro-switches are also available for operation of power interlock circuits and associated functions such as the shut down of high power amplifiers in power cutback systems. Removal of R-F power is a necessary precaution during operation of the switch. Since the circuitry, control, and indicating devices and their location will vary widely in different applications, these accessory items are not provided with the switch.

SPECIFICATIONS

Impedance	51.5 ohms
Maximum VSWR	1.04 to 1.0
Power Rating	30 kw average
Driving Motor	220 v., 1 phase, 60 cycle, 11 amps. locked rotor
Micro-Switch Contacts	15 amps. at 125 or 250 v.
Weight	Approx. 107 lbs.
Dimensions, Overall	48" long, 9" wide, 16" high
Stock Identification:	
Coaxial Switch for use with 51.5 Ohm Line	MI-27330
Coaxial Switch for use with 50 Ohm Flanged Line	MI-27335
Coaxial Switch for use with 50 Ohm Unflanged Line	MI-27335-1

Accessory Equipment

Motor Control Switch, hand operated, 3 stage, 2 positions	MI-27727
Motor Contactor	MI-27832

Switch	MI-27330			
Line	MI-19113		MI-19313	
Adaotor	Flanged MI-19113-C60	Unflanged ———	Flanged MI-19113-C60	Unflanged ———
Coupling	———	MI-19113-C8NB	———	MI-19313-8
Coupling	———	———	MI-19313-9	———

Switch	MI-27335-1	
Line	MI-27912	MI-27791
Adaptor	———	MI-27912-7
Coupling	MI-27912-4	———

PHASE EQUALIZER EQUIPMENT

ES - 34034 - B

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

DESCRIPTION

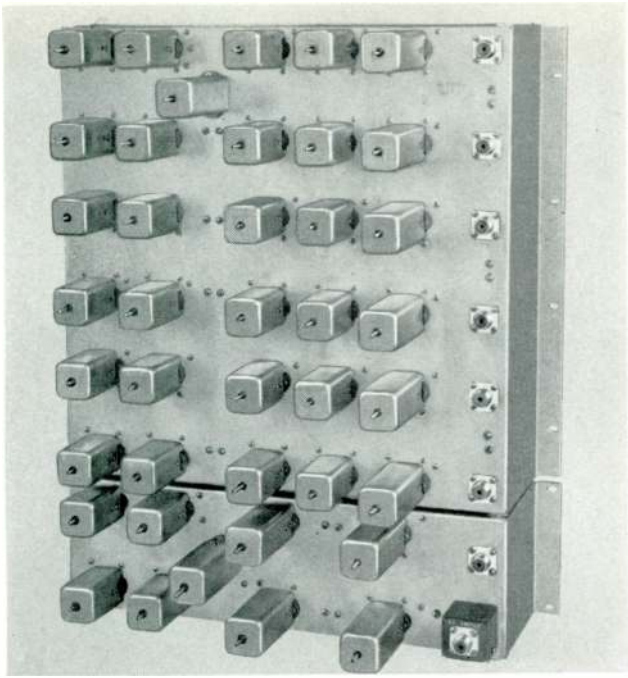
The RCA Phase Equalizer Equipment, Type ES-34034-B, is designed to compensate for various distortions introduced in video transmission systems by such components as the color receiver, transmitter, vestigial sideband filter, notch diplexer and terminal equipment. The equipment greatly improves color 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 two Amplitude Equalizers, 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.

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 one 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 Equalizer Equipment, complete.....ES-34034-B

Consisting of:

1 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

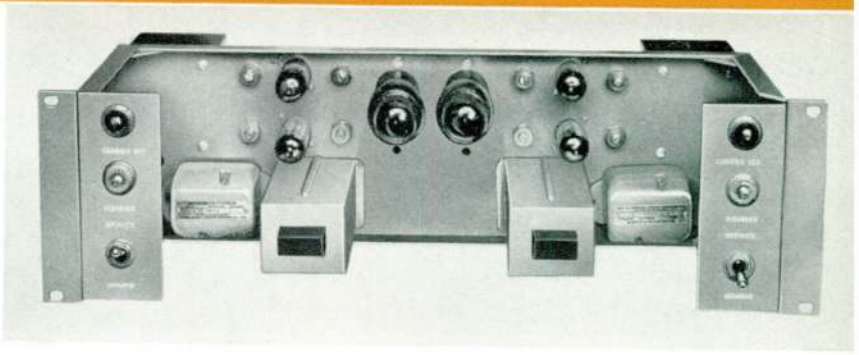
1 High Frequency Phase Equalizer on Rack-mounting Chassis, including 1 75-ohm coaxial termination, 2 connectors for RG-11/U coaxial cable, and Instruction Book (IB-36196).....MI-34026

2 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



DESCRIPTION

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 in the event of arc over in the amplifier circuit.

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.

The Carrier Off Monitor is a protective device for television transmitters which is offered as optional equipment of particular value in high power installations. It is essentially a comparison device and functions from information supplied by the reflectometer units. When used with 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. Should an arc occur in the amplifier circuit the output power will be reduced, thereby upsetting the balance. The monitor will then operate and the sensitive differential relay in the cathode circuit of the comparison tube will trip the transmitter overload circuit through an auxiliary relay. The Carrier Off Monitor is designed to operate in either of two ways. In addition to the method already outlined, the Carrier Off Monitor may be connected so that it will compare the voltage from the transmitter output reflectometer to a d-c reference voltage. 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 effect in the tubes.

The monitor and remote indicator are mounted on a bathtub 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 "Disabled" 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)	50 to 150 volts (less than 50 volts at reduced sensitivity)
Differential Voltage to Trip	15% min. (depending on transmitter power)
Input Impedance:	
Driver	3.7 meg., min.
Amplifier	2.16 meg., min.
Output Relay Contacts	2 normally open
Output Impedance (Remote Power Indicator)	5000 ohms
Output Voltage (Remote Power Indicator)	1.2 volt, max.
Tube Complement	4—5314A, 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), 94 ma

Mechanical Specifications

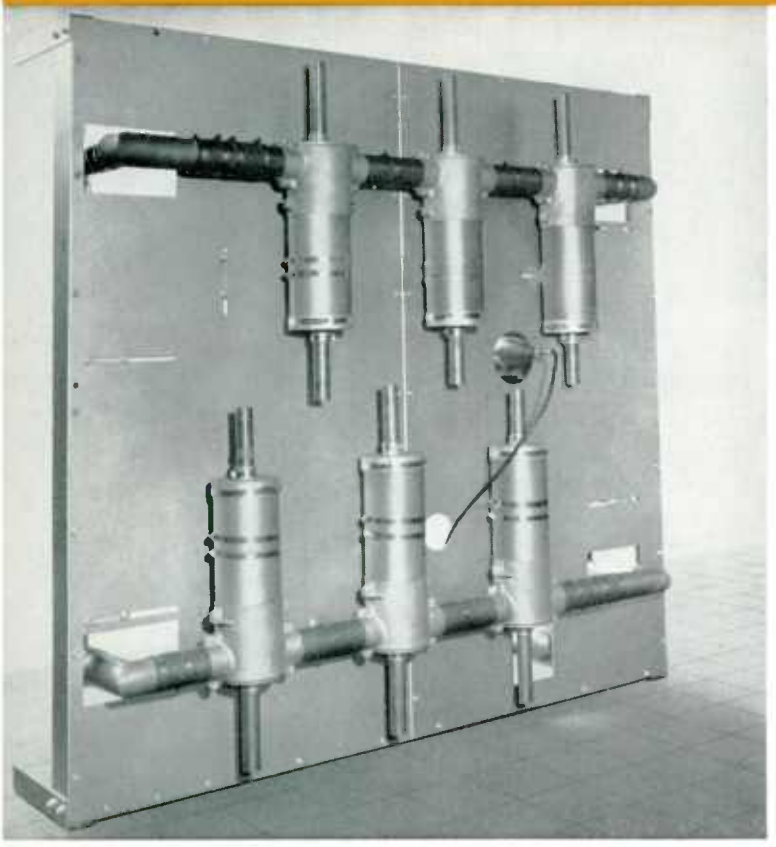
Dimensions (overall)	19" wide, 5-7/32" high, 9½" deep
Weight	10 lbs., approx.
Finish	Dark umber gray
Carrier Off Monitor (Complete)	ES-27235
Comprising the following:	
1 Carrier Off Monitor	MI-27470
1 Set of Operating Tubes	MI-27825
1 Installation Material Kit	MI-27484*

Accessories

Set of Spare Tubes	MI-27825
Set of FCC Spare Tubes	MI-27831

* Sales order must specify type of transmitter with which Monitor is to be used.

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:

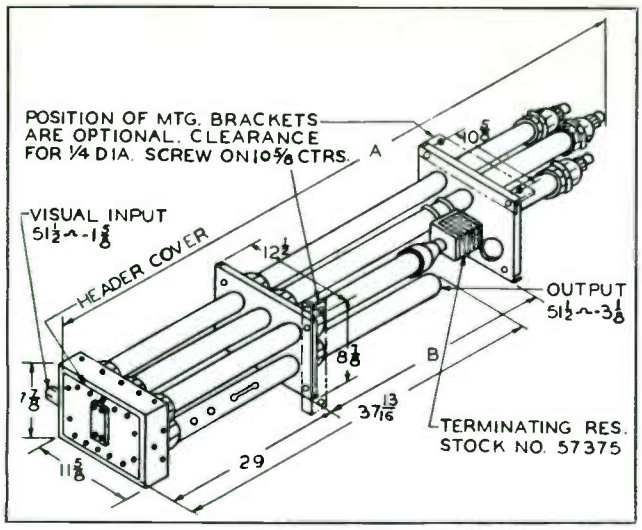
Stock No.	Power	Chan.	Part of RCA Transmitter
ES-27233*	2 kw	2-6	TT-2BL
MI-19114-B*	5 kw	7-13	TT-2BH
ES-27234*	12½ kw	2-6	TT-6AL, TT-10AL
MI-19085-L*	25 kw	2-6	TT-25CL
MI-27799*	25 kw	7-13	TT-11AH, TT-25CH
MI-27315-H*	50 kw	7-13	TT-50AH, TT-100AH

* Sales order must add customer's assigned channel number following letter.

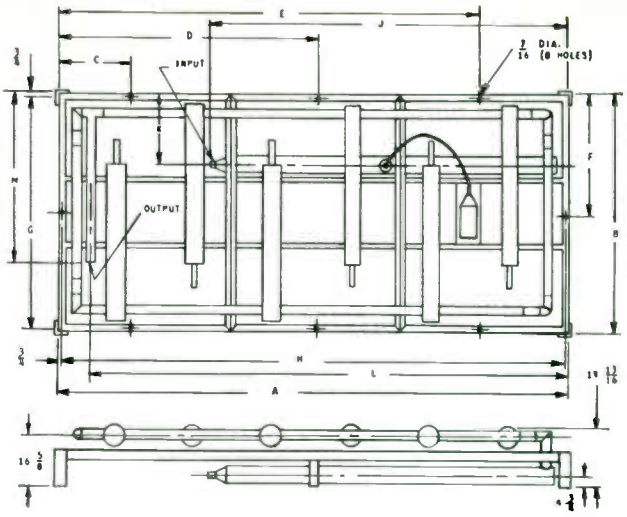
DESCRIPTION

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, ES-27234 and MI-27799 are a combination of a low pass and a high pass filter to give constant impedance characteristics, while MI-19085-L, 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 50/51.5 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

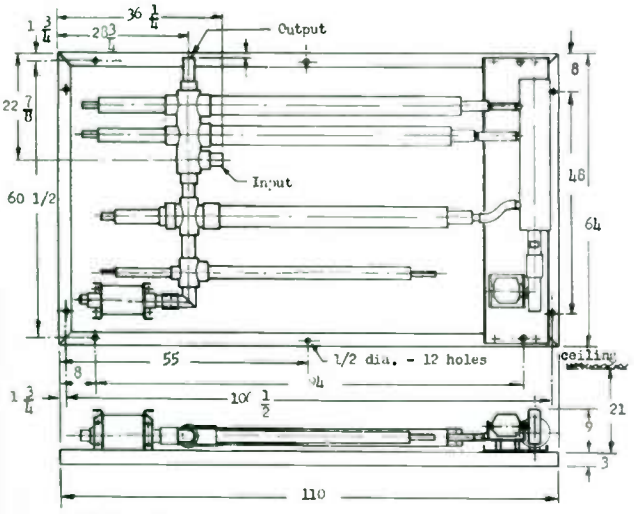


MI-19085-L Vestigial Sideband Filter

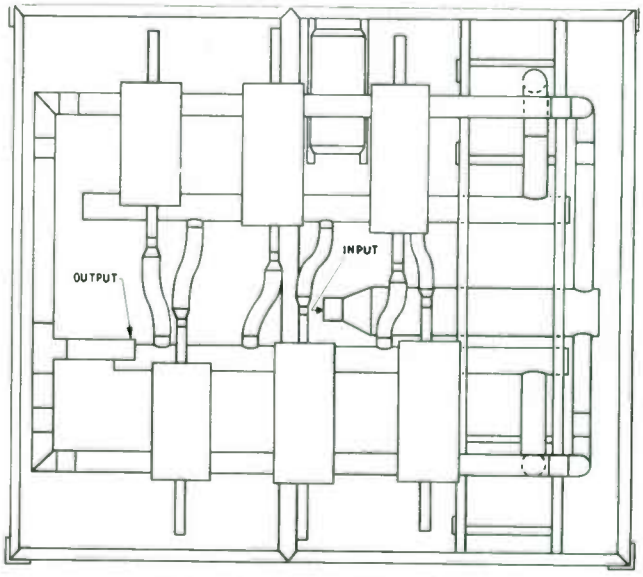
SPECIFICATIONS

	MI-19114-B	ES-27233	ES-27234	MI-19085-L	MI-27799	MI-27315-H
ELECTRICAL SPECIFICATIONS						
Frequency	174-216 mc	54 to 88 mc	54 to 88 mc	54 to 88 mc	174 to 216 mc	174 to 216 mc
Maximum Power	5 kw	2 kw	12.5 kw	12.5 kw / 25 kw	25 kw peak of sync	50 kw
Input and Output Impedance	51½ ohms, 1 5/8" coax. input 3 1/8" coax. output	51.5 ohms, 3 1/8" coaxial line	51.5 ohms, 3 1/8" coaxial line	51.5 ohms, 3 1/8" coaxial line	50 ohms, 3 1/8" coaxial line	51.5 ohms, 3 1/8" coaxial line
VSWR	1.1 or better	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., 1/8 h.p., 3450 rpm	230 v., ¼ h.p., 2850 rpm, 50/60 cycle	230 v., 1.6 a., 60 cy.
Interlock	———	———	5 amp. @ 250 v. a-c	———	5 amp. @ 250 v. a-c	5 amp @ 230 v. a-c
MECHANICAL SPECIFICATIONS						
Overall Dimensions, Max.:						
Length	105"	110"	110"	165"	111"	150"
Width	12½"	64"	64"	79"	60"	89"
Height	8 7/8"	12"	12"	12"	9 5/8"	31 7/8"
Weight, Approx.	200 lbs.	300 lbs.	300 lbs.	930 lbs.	532 lbs.	1600 lbs.
Mounting	Ceiling or horiz.	Ceiling or horiz.	Ceiling or horiz.	Ceiling or horiz.	Wall or ceiling	Ceiling or horiz.
Ambient Temperature	45° C. max.	45° C. max.	45° C. max.	45° C. max.	45° C. max.	45° C. max.

ES-27233 Vestigial Sideband Filter 2 KW
ES-27234 Vestigial Sideband Filter 12.5 KW Illustrated
MI-27799 Vestigial Sideband Filter 25 KW



ES-27233/27234/MI-27799 Vestigial Sideband Filter



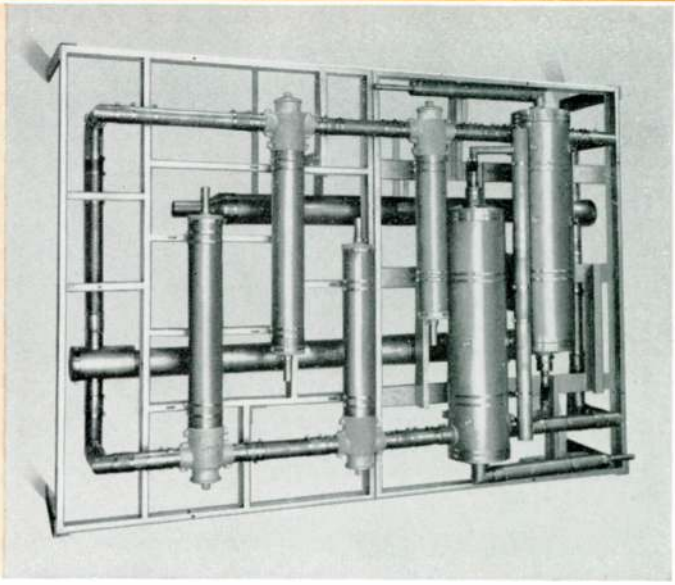
MI-27315-H Vestigial Sideband Filter

25 KW VHF FILTERPLEXERS

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



DESCRIPTION

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 antennas requiring a single line input.

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.

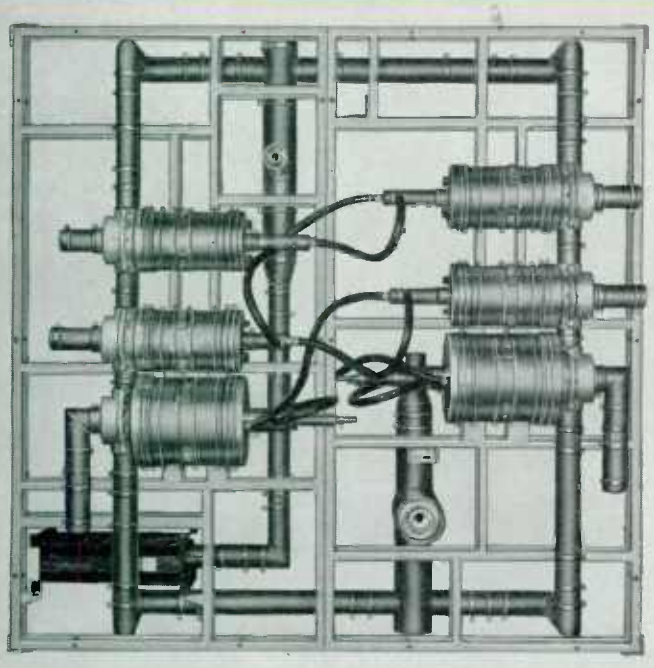
The size of the filterplexer is determined by the channel, so that the channel frequency must be specified when ordering the equipment. The maximum dimensions of the channel 2 unit (which is the lowest in frequency and the largest in physical size) are 130 inches long, 100 inches wide, and 35 inches 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	50/51.5 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

50 KW VHF FILTERPLEXER

MI-27316-H



USES

RCA's 50-KW VHF Filterplexer, MI-27316-H, combines the vestigial sideband filter and constant-impedance notch diplexer function in a single complete unit. It is used to properly 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.

The filterplexer may be used with 50-KW transmitters or with lower powered transmitters. The MI-27316-H is recommended for use with the newer antennas requiring a single line input, such as the RCA Traveling Wave type.

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.

DESCRIPTION

The 50-KW Filterplexer consists essentially of two bridge-baluns connected by two equal lengths of interconnecting coaxial transmission line each incorporating three filter circuits or cavities. 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 dimensions of the channel 7 Filterplexer (which is the lowest in frequency and the largest in physical size) are: 90" long, 87½" wide and 33" high. This unit is designed for either floor, ceiling or wall mounting. However, mounting requirements must be specified before factory assembly and test is completed.

SPECIFICATIONS

Frequency	VHF channels 7-13, as specified, pretuned and tested at the factory		
Maximum Power	50 KW (peak visual) 30 KW (aural) at 8000 ft. elevation		
Efficiency:			
Aural	92%		
Visual	Visual losses included in RCA transmitter peak power rating (94% when used with other than RCA transmitters)		
Connections:		*Size*	*Impedance**
Visual Input		3⅛"	50/51.5 ohms
Aural Input		3⅛"	50/51.5 ohms
Reject Load		3⅛"	50/51.5 ohms
Output		6⅛"	50/51.5 ohms
Maximum Visual Input Voltage Standing Wave Ratio:			
Lower band edge to 5.25 mc above lower band edge	1.1/1		
5.25 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		
Isolation:			
Visual Input to Aural Input at Visual Carrier	30 db		
Aural Input to Visual Input at Aural Carrier	30 db		
Weight:			
Filterplexer	955 lbs.		
Fluid Cooler	210 lbs.		
Dimensions (maximum for Channel 7)	90" long, 87½" wide, 33" high (incl. heat exchanger)		
Power Requirements:			
Fan Motor	230 V, 60 cycles, 2.1 amp.		
Pump Motor	230 V, 60 cycles, 2.1 amp.		
Fluid Cooler	Uses distilled water in a closed system (capacity approximately 7 gallons)		
Stock Identification	MI-27316-H		

* Customer to specify impedance either 50 or 51.5 ohms.

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

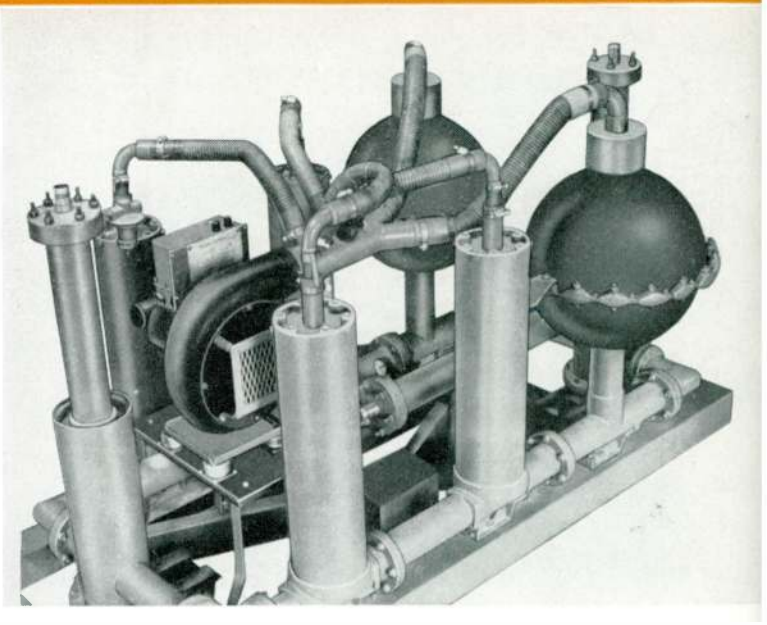
DESCRIPTION

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 EIA 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.

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

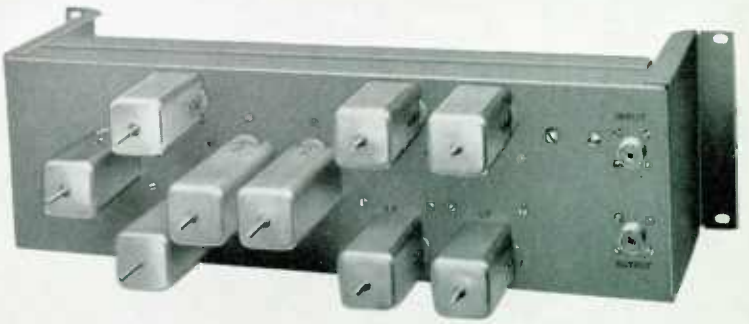
1200 Watt R-F Load and Wattmeter MI-19197

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
- No degradation of either monochrome or color picture
- No adjustments necessary
- Mounts in standard studio equipment rack



DESCRIPTION

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 FCC rules. 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.

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 studio output and the input of the transmitter. The filter should be inserted in the line immediately preceding the modulator input and may be mounted in the same rack with the stabilizing amplifier, phase equalizer and other transmitter input 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 including the following items:	MI-27132
1 Low Pass Video Filter	
2 Plugs, Input and Output	
1 Load Resistor Assembly (75 ohms)	
1 Instruction Book	18-36197

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.

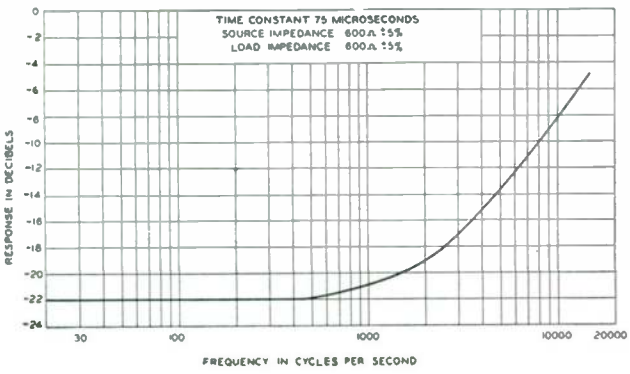
DESCRIPTION

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 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 EIA 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.



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.

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 (from 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	Four holes with center lines 2¾ x 2¾ inches
Stock Identification	MI-4926-A

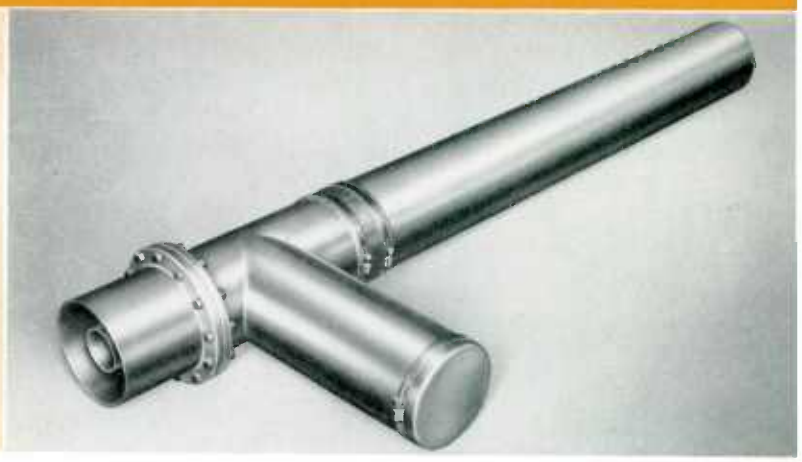
*0 db = .001 watt.

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



DESCRIPTION

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.

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 above channel limits is accomplished in an M derived section, and series of constant KT sections made up of transmission line constants. This type of design provides a broadband 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 ane 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 ane 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, far 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

DESCRIPTION

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.

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 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 EIA 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:	
Maximum Power	15 kw average
Input and Output Impedance	50 ohms, 3⅛" coaxial line
VSWR	1.10 or better
Attenuation	60 db or greater*
Mechanical:	
Mounting	Horizontal or Vertical
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, AM and FM CRYSTAL UNITS

FEATURES

- Frequencies available for all broadcasting purposes
- Excellent frequency stability and freedom from aging effects
- Operate directly from 115 volt source
- Heater keeps crystal at constant temperature
- Precision type bi-metal thermostat
- Plug-in units, impossible to insert incorrectly in sockets

Disassembled view of an MI-27492 television crystal showing base assembly with heater oven and thermostat at left, can housing, crystal unit in two-prong cartridge case, and at right the crystal holder and semi-circular oven cover with mounting screws.

DESCRIPTION

A series of Crystal Units designed especially for stable frequency control of transmitters operating in the various AM, FM and TV frequency bands is made available by RCA. The units operate directly from a 115-volt source without need for step-down transformers. Each crystal is a plug-in unit which may quickly be inserted in its oscillator circuit. Suitable crystal units are normally supplied with every RCA type transmitter as part of the equipment. Spare crystal units may be ordered as required.

TV Crystals, MI-27492 Series

Crystals of the MI-27492 Series, used in the current line of television transmitters which use the TT-2BL/BH as a basic transmitter or driver, are of an improved, plug-in type. The unit contains the crystal, heater, heat chamber, heat control unit and housing. The plug-in base is similar to an octal tube base except that it has a nine pin base to prevent accidental insertion into an octal tube socket. The nine pin crystal socket also prevents accidental insertion of a standard octal tube.

The crystal is metal plated and mounted in a wire holder inside a hermetically sealed cartridge. It is designed to operate at anti-resonnace into a load capacitance of 32 $\pm 0.5 \mu\mu f$ on the fundamental frequency under controlled temperature conditions. The cartridge is mounted inside a temperature-control chamber. It can be removed by removing the plate on top of the oven which has clips around the catridge. Two screws hold the plate in a fixed position and form a cover for the crystal chamber oven. The oven has a 10-watt, 115-volt element surrounding it and an Edison Type S1-1 thermostat to control the heat at 75°C ±2°C. The entire assembly is covered by an aluminum cylindrical cap that is mounted on the base with three screws.

MI-27492 Television Crystals are available for any VHF channel, including ±10 kc assigned frequencies. In ordering specify MI-27492 followed by dash and channel number followed by symbol L, O or H; H for channel +10 kc, O for on frequency, and L for channel −10 kc.

AM Crystals, MI-27493

The crystals of the MI-27493 series are used in the latest design of RCA AM transmitters. In design, they are similar

to the MI-27492 crystals for TV except that physically the base of the unit is an octal key type base rather than a nine pin base. The basic operating temperature is 60°C ±5°C for the crystal oven, and the capacitor reactance is greater.

FM Crystals, MI-34509

Crystals used in the current line of RCA FM transmitters are similar to the TV crystals except for frequency of operation. MI-34509 is the basic frequency crystal; a dash number following the MI number is used to indicate the FM channel number.

Crystal, MI-34520

A crystal, MI-34520, is used for the BTX-1A subcarrier generator. It is mounted in a twin pin hermetically sealed crystal cartridge similar to the basic crystal for TV except that it is not temperature controlled. The frequency of the subcarrier should be indicated by the dash number following the MI number, such as MI-34520-32.5 to 67. The 32.5 number would indicate that the subcarrier would be 32.5 kc removed from the center operating frequency.

The following table details specifications of MI-27492, 27493, 34509 and 34520:

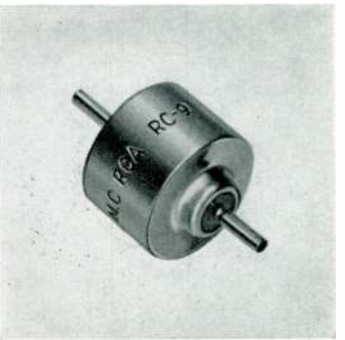
SPECIFICATIONS

	TV	AM	FM	FM Subcarrier
Stock Identification	MI-27492-*	MI-27493-*	MI-34509-*	MI-34520-*
Frequency Range — Frequency	4.5 to 7.0 mc *Channels 2 thru 13 and −10, 0, +10	535 to 1620 kc *Specify assigned frequency	100 to 125 kc *Specify channel no. or frequency	*Specify subcarrier frequency
Frequency Stability	±4PPM	±3PPM	±4PPM	±.005%
Crystal Operating Temperature	75°C ±2°C	60°C ±5°C	75°C ±2°C	−55°C to +90°C
Ambient Temperature Range	0°C to +55°C	0°C to +55°C	0°C to +55°C	−55°C to +90°C
Minimum Period	30 days	30 days ,	30 days ,	30 days ,
Load Capacity	32μμf	48μμf	20μμf	32μμf
Heater Power Spec.	10 watts 115V	12 watts 115V	10 watts 115V	———
Crystal Holder Pin Arrangement	Key type nine pins	Key type eight pins	Key type nine pins	Twin pin

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 5/16" in diameter and 3/8" 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

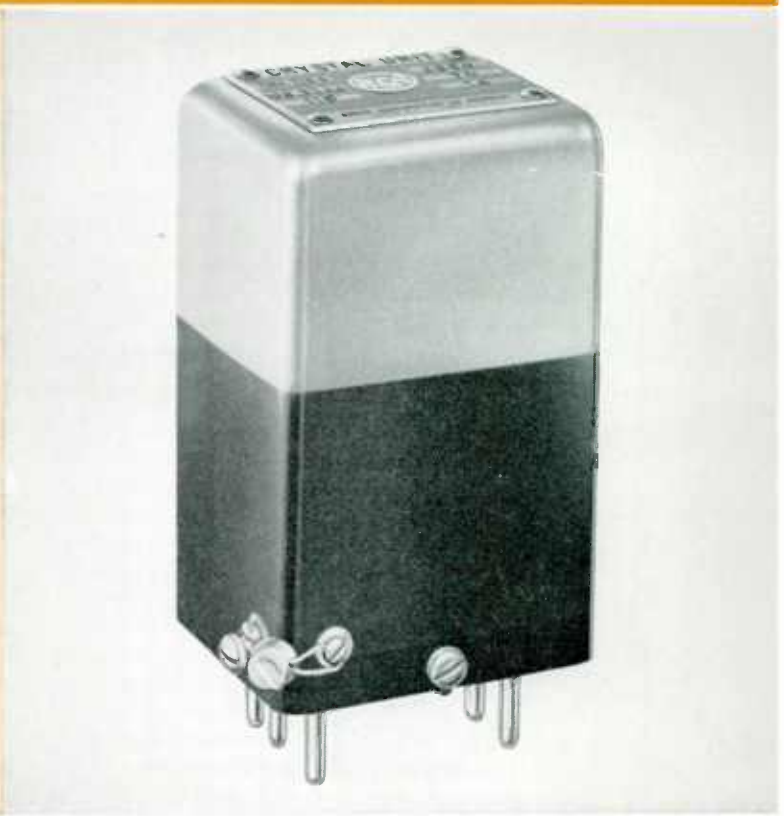
Frequency Range	15mc to 50 mc
Temperature Range	−55°C to +90°C
Frequency Stability	±.005% or ±.01% max.
Stock Identification	MI-16263-B

CRYSTAL UNITS

TYPE 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



DESCRIPTION

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.

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 (which will be returned) should be provided.

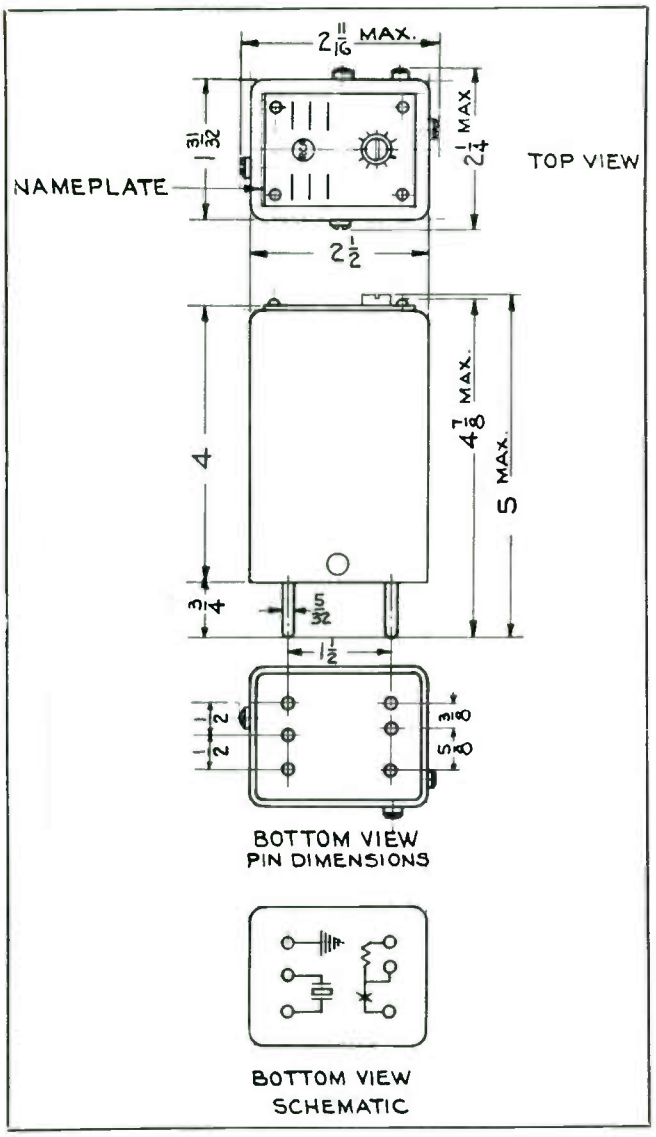
The TMV-129 series of precision temperature controlled crystal units includes several types of quartz plate mountings each within a 14-watt heater and employing the same type thermostat, patented temperature compensator, six-pin base, and outer aluminum case. The crystals are made from the highest quality Brazilian quartz, very carefully oriented, and fabricated to precise manufacturing tolerances.

The 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. 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.

TYPE TMV-129-B, CRYSTAL UNIT

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.



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

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-F, CRYSTAL UNIT

The RCA type TMV-129-F Crystal Unit was designed for use in such applications as international broadcast transmitters or medium frequency communications equipment. It 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.

The quartz plates are approximately 1-inch square, pressure air-gap mounted between nickel silver electrodes. This assembly is mounted centrally within the heater oven. The air-gap between the upper face of the quartz plate and the top electrode is variable 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.

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

TYPE TMV-129-G, CRYSTAL UNIT

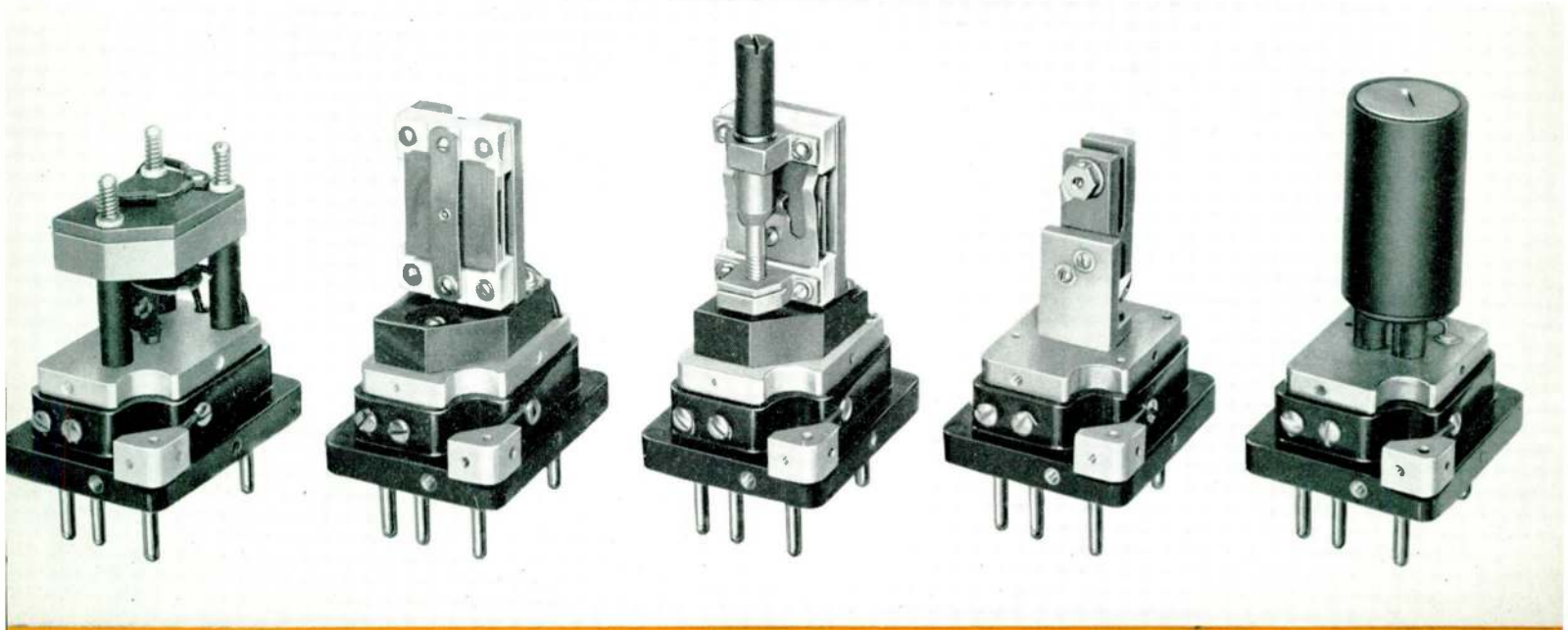
The TMV-129-G Crystal Units are specifically designed for low frequencies between 70 kc and 350 kc as required for aural exciter units in VHF and UHF television transmitters. The unit is also employed in FM transmitters and for low-frequency, precision electronic equipment of all types.

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. The frequency stability approaches that of a primary standard and under normal operating conditions the maximum frequency variation will not exceed one or two cycles.

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

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.



TYPE TMV-129-P, CRYSTAL UNIT

The RCA type TMV-129-P Crystal Units are especially designed for UHF television transmitters and monitors. The unit 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.

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. It is ruggedly mounted.

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.

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 aural 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 overtone	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.

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VHF TELEVISION TRANSMITTERS

VHF TELEVISION TRANSMITTERS (Continued)

UHF TELEVISION TRANSMITTERS

TRANSMITTER CONTROL CONSOLES

INPUT AND MONITORING EQUIPMENT

INPUT AND MONITORING EQUIPMENT (Continued)

FILTERS

CRYSTAL UNITS