Broadcast Systems

RCA

UHF-Television Equipment

UHF Transmitters, Exciters
Remote Control Equipment
Input and Monitoring
Test and Measuring
UHF Filters and Filterplexers
UHF Antennas, Towers, Accessories

World Radio History

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J. FRANK

RCA

About This Catalog

This is one of several catalogs published by RCA Broadcast Systems. It describes RCA products appropriate to the transmitter facility of UHF-TV broadcast systems: transmitter to antenna and tower except for transmission line. (Transmission line is the subject of a separate catalog.)

There are seven other catalogs in the series: VHF-TV Transmitter Equipment; Camera and Telecine Equipment; Video Tape Equipment; Television Control Equipment; Transmission Line Equipment; Broadcast Audio Equipment and, Radio Equipment.

These catalogs are available at all RCA Regional Offices. Each office is staffed with a sales representative of broad experience in the broadcast business. He can help you plan your equipment facilities and supply the product information you need. (See list of offices on next page.)

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catalog TT.3200B

(Replaces TT.3200A)

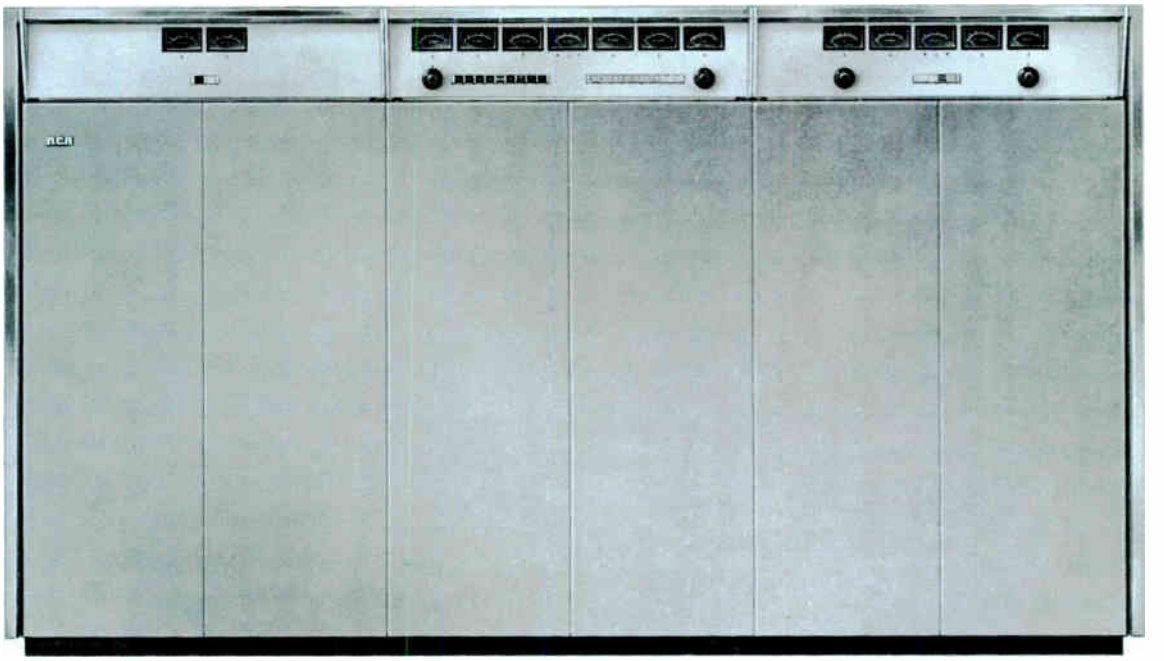
UHF-TV Transmitter, 30kW Visual, 16kW Aural, Type TTU-30C

- Intermediate-frequency modulation
- Solid-state exciter and intermediate power amplifier
- Quick, one-man klystron change
- Vapor-cooled klystron power amplifiers
- Ready for remote control

The Type TTU-30C is a klystron-powered transmitter for UHF-TV systems with up to one megawatt ERP. The transmitter provides 30 kilowatt peak visual power with an aural power capability ranging from 3.3 to 16 kW. The transmitter uses entirely solid-state circuitry for all functions except the four-cavity, klystron power amplifiers.

Ready for remote-control operation, the TTU-30C includes the appropriate metering points, motor-driven operational controls and necessary wiring for interface with remote-control systems.

The TTU-30C is designed for future expansion to higher power through the addition of a second visual klystron amplifier and certain other components. This expansion takes place at minimum investment and is designed to be effected without loss of air time in a normal operating schedule.



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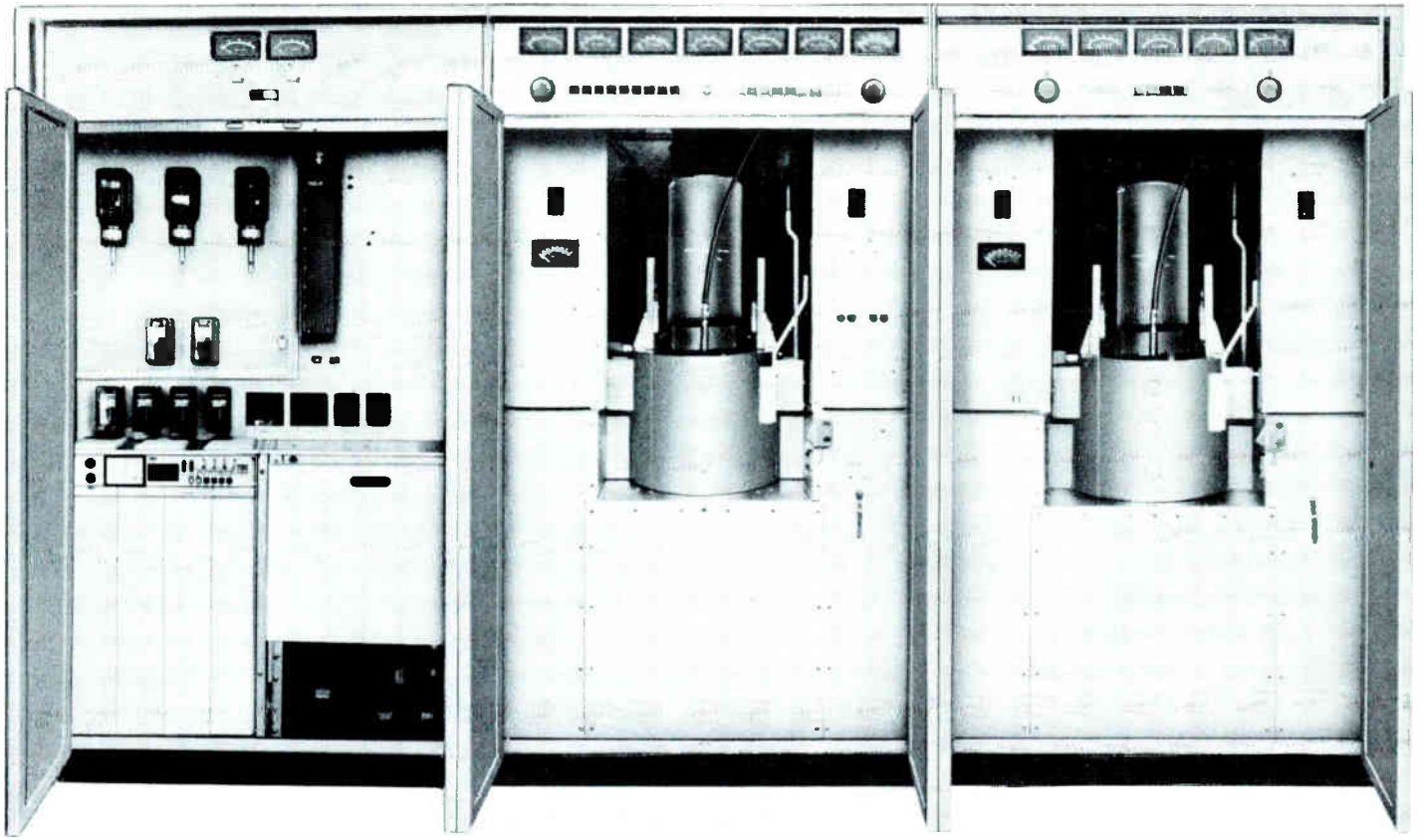

At left is control center and exciter; visual klystron amplifier in center with aural amplifier in right-hand cabinet. Meters along top edge are visible with doors open or closed. Solid-state IPA is in upper right-hand corner of control-center cabinet.

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The TTU-30C Transmitter represents the latest advances in UHF technology. Incorporating all the benefits of reliable solid state devices, broadband amplifier tubes with high gain and power-handling capability, intermediate-frequency modulation and high-level sideband shaping, the transmitter achieves operational simplicity and small physical size for its power capabilities.

Economical Power

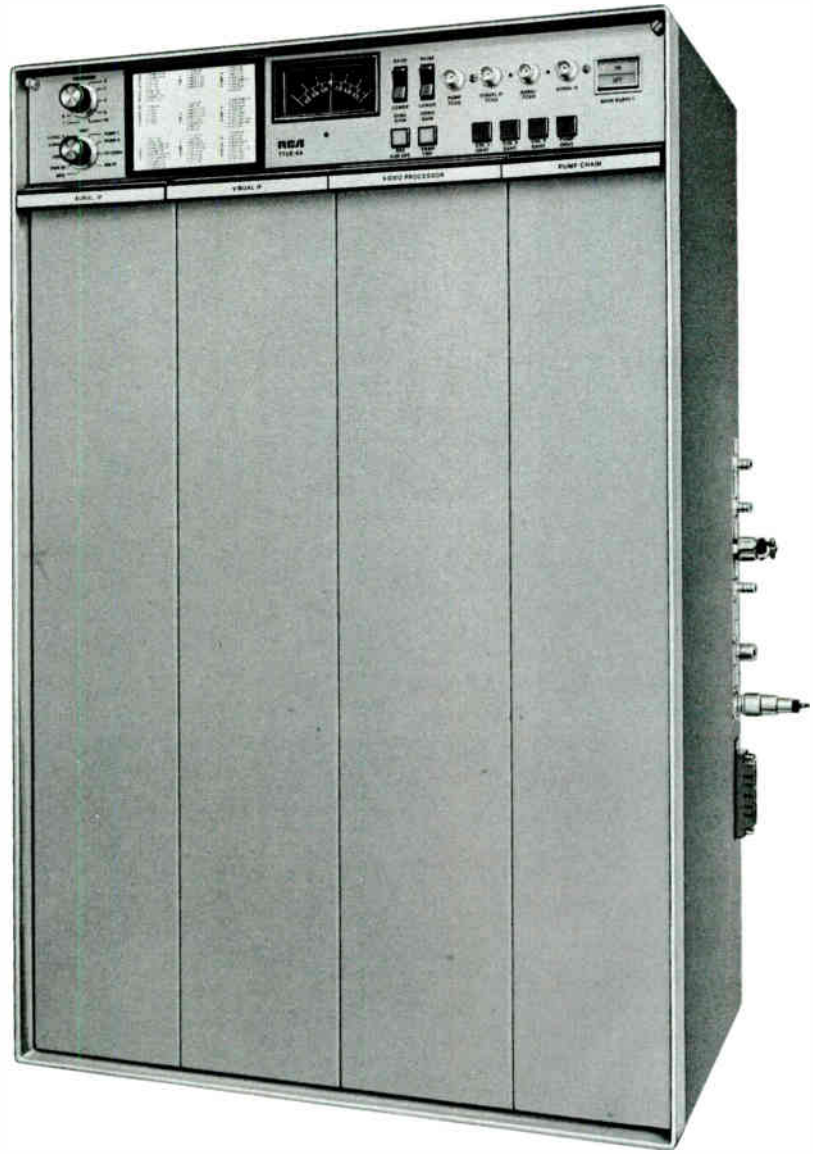
The TTU-30C is economical and easy to operate. Though the physical size is small, effective layout of component placement for maximum accessibility results in ease of maintenance. These features result in direct savings in installation and operating costs. The optional offering of a new development in high-efficiency klystrons results in an even greater savings in operating cost. Every effort has been made to incorporate mechanical and electrical features to simplify operation and maintenance of the transmitter.

The TTU-30C is housed in three, low-profile, 77-inch cabinets with eye-level meters and convenient fingertip controls. Built-in remote-control circuitry, including metering points for remotely monitored operating parameters, permits operation from an auxiliary control console or remote point. All required operating controls are motor driven and may be operated by a remote control system.

Circuit Description

Ease of installation, operation, and maintenance is enhanced by the use of modern, reliable circuitry. The heart of the TTU-30C transmitter is the Type TTUE-4A, an entirely solid-state exciter-modulator employing an advanced method of intermediate-frequency modulation. The visual and aural modulators always operate at 45.75 and 50.25 MHz. Final frequency is achieved by up-conversion of the modulated signals with an RF "pump" frequency chain. Up-conversion occurs at the 15 watt visual, 5 watt aural level, resulting in RF carrier frequency output from the exciter of 4 watts visual and 0.8 watts aural.

This is the fully solid-state exciter/modulator. Each of the four sections rolls out for maintenance and/or other service. All circuitry is modular. See next page for block diagram.



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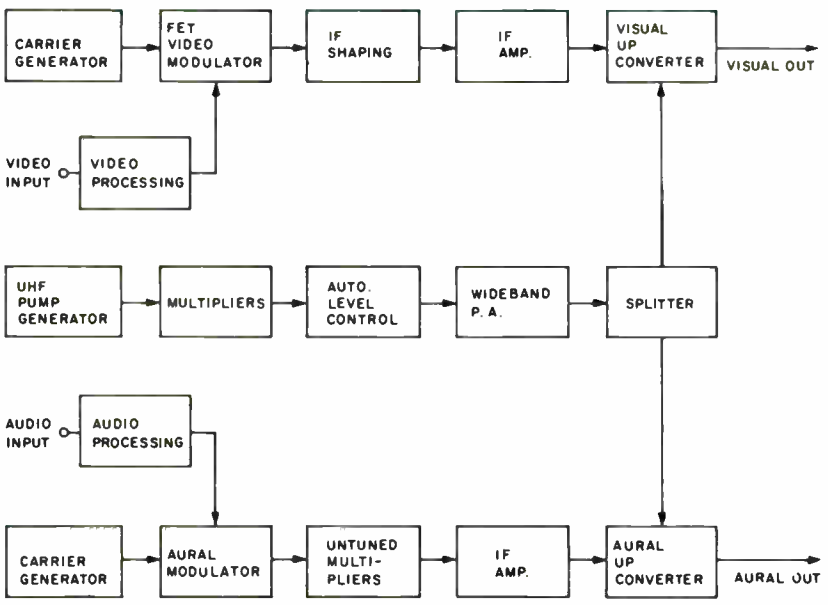


Solid-State Exciter/Modulator Block Diagram.

The TTUE-4A Exciter-Modulator package is an integral part of the TTU-30C Exciter Control cabinet. It consists of a main frame with modularized circuits housed in four vertical, slide-out drawers. By sliding each drawer forward, the associated modules are exposed for visual examination, test, or adjustment without removal from service or the use of a module extender. A comprehensive metering system is incorporated to enable observation of the operating condition of each exciter-modulator module and circuit function individually. Temperature compensated crystal oscillators are employed in the intermediate-frequency sections and in the RF pump chain, eliminating the requirement for crystal heaters or ovens and assuring immediate, on-frequency operation of the transmitter from a cold start.

Solid State Intermediate Power Amplifier

The aural power output of the exciter-modulator unit drives the aural amplifier klystron stage to full rated power output. As a result the aural transmitter contains only one amplifier stage between the exciter-modulator output and the transmitter output.

The visual output of the exciter modulator drives a solid state intermediate power amplifier. This modular IPA unit is a broadband amplifier capable of a minimum of 10 watts output, which is more than adequate to drive the visual klystron power output stage to 30 kW peak visual output power. The solid state IPA is factory-tuned and no operating controls or adjustments are required or available on the unit. The IPA operates from a 24 Vdc power supply incorporated in the Exciter-Control Cabinet.

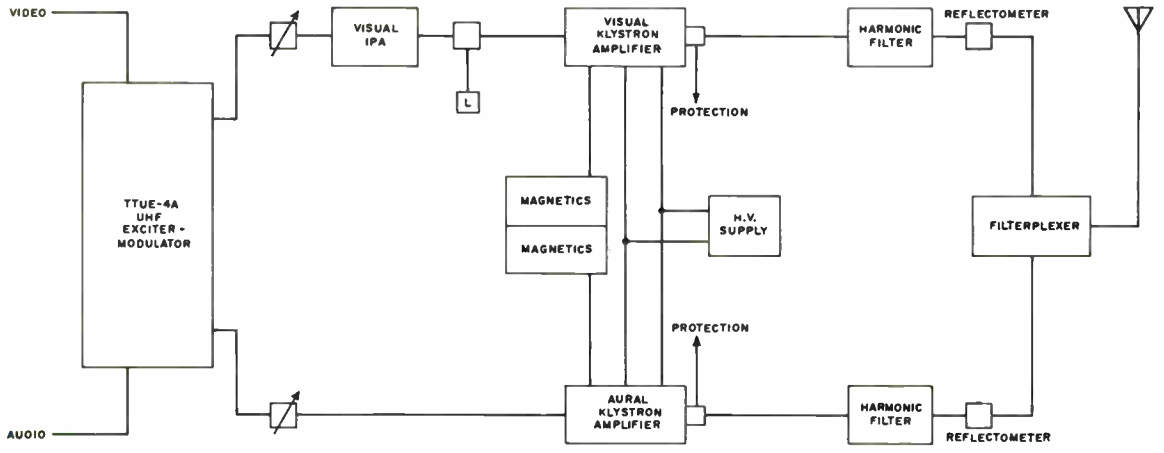
Klystron Power Amplifier

The aural and visual power amplifiers use vapor-cooled, integral-cavity klystrons. RCA pioneered in the development of vapor-cooled UHF television transmitters and many thousands of hours of cumulative operating time have proven their efficiency and reliability. The use of integral cavities eliminates tedious assembly and pre-tuning. The spare klystron is complete and ready for installation in the transmitter when required.

Easy Klystron Change

The integral cavity klystrons are easily removed or installed by one operator. The

TTU-30C Transmitter block diagram. Solid-state visual IPA requires no routine readjustment.



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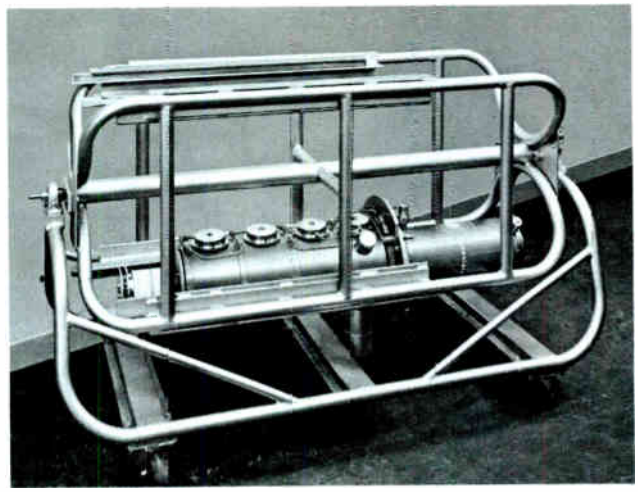
factory-tuned klystron is transferred in a horizontal position directly from the shipping crate to the klystron carriage, which is furnished with the transmitter. By way of a built-in loading device, the klystron is easily installed in the transmitter from the klystron carriage, from the front of the transmitter cabinets. No unusual ceiling height or horizontal clearance is required. The klystron remains in a horizontal position until it is completely installed in the magnet assembly in the transmitter. It is then tilted into the vertical position by a simple device which is a part of the aural or visual amplifier cabinet.

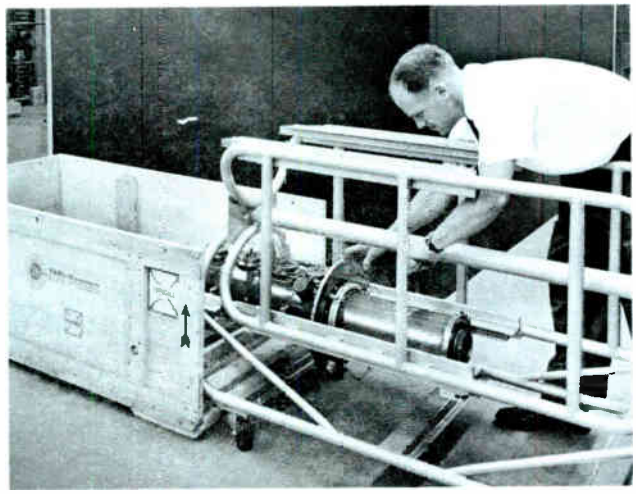
Long Life Power Supplies

Solid state rectifiers are used throughout. These and other power supply components are located on vertical panels which form the transmitter rear enclosure. This arrangement provides ease of accessibility for inspection and maintenance, and effective cooling for long life.

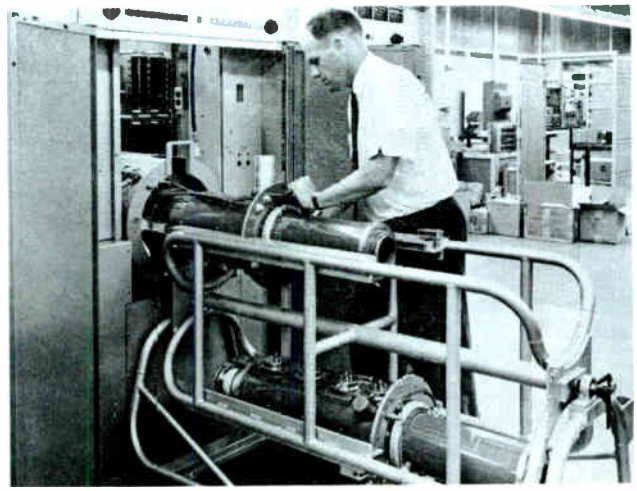
Klystron carriage stores spare klystron safely and securely.



Klystron transfers from crate to carriage quickly and easily.



Transfer from carriage to socket is at table-top height.



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Cooling System

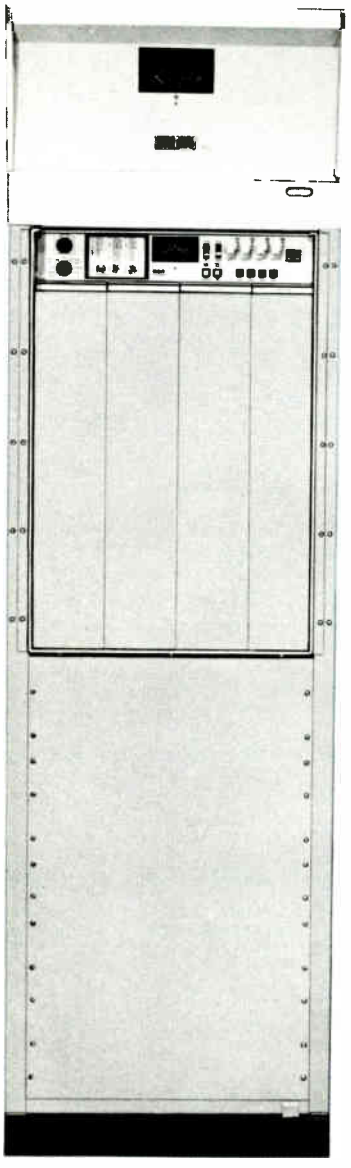
A heat exchanger, equipped with one water and two steam coils and a low-velocity high-capacity blower is furnished with the TTU-30C transmitter. Main and standby water pumps are supplied, with all plumbing material required for installation.

Monitoring and Protection

The TTU-30C transmitter incorporates an electronic, high-speed, fault-protection system capable of removing RF excitation within 20 microseconds in the event of an RF-load disturbance and the klystron amplifiers are protected by instantaneous overload relays which recycle but remain tripped if the fault continues. Instantaneous protection is also provided against excessive water temperature, excessive klystron body current, and failure of magnet current. A system of front panel indicator lamps indicate normal and abnormal conditions. These indicator lamps have a separate reset to provide an indication of an intermittent condition.

Spare Exciter Group

A Spare Exciter Group is available optionally for use with the TTU-30C Transmitter. The spare exciter group consists of a TTUE-4A Exciter-Modulator Unit installed in a cabinet matching the styling of the TTU-30C, with a manual control and metering panel. Also included are fault sensing and automatic switchover equipment providing instant transfer to the spare exciter in the event of a failure in the main exciter.



This is the spare exciter group offered as an option (Door removed to reveal exciter unit). The group includes fault-sensing and automatic switchover facilities. See text.

With door closed, the exciter group appears as shown here.

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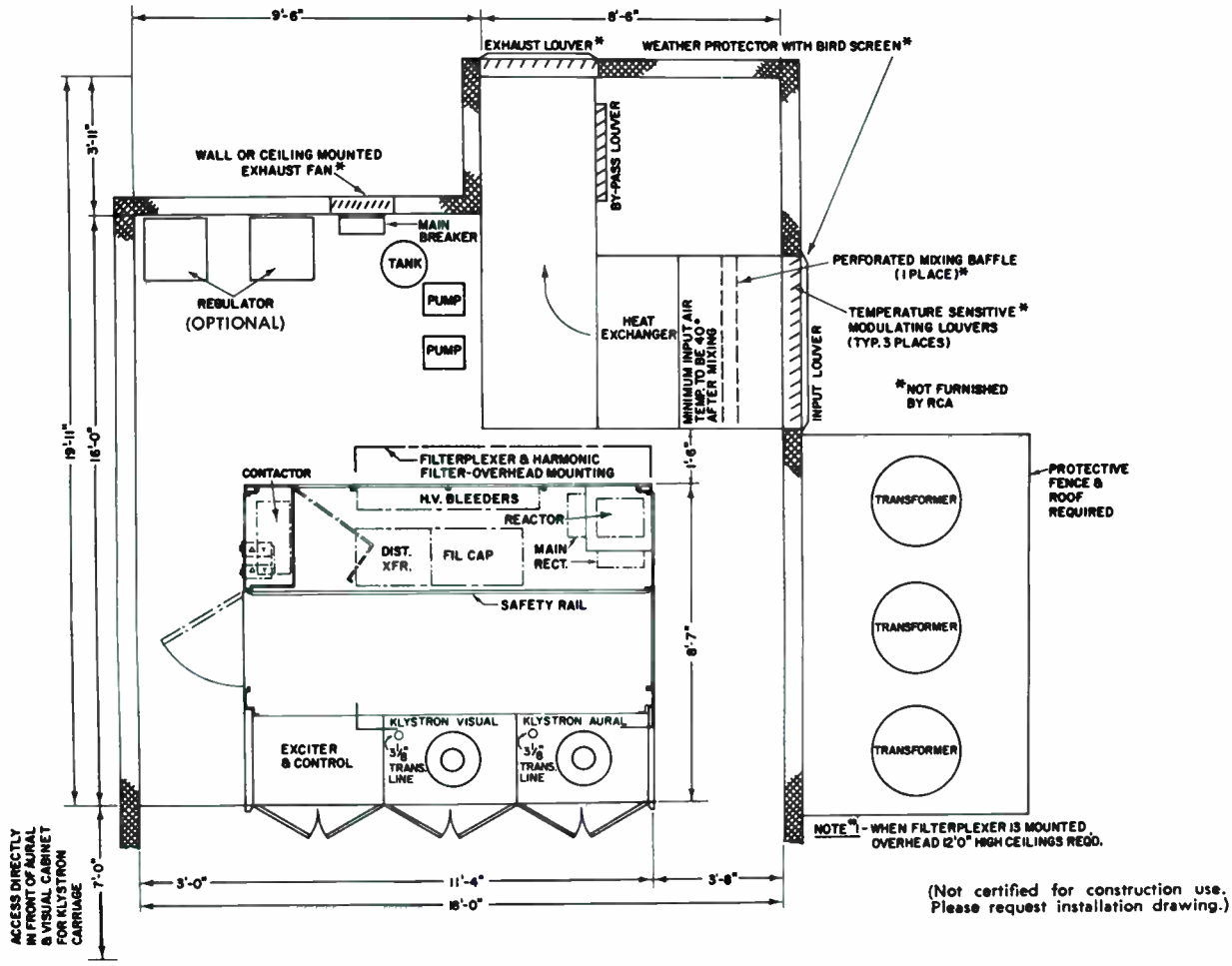

(Not certified for construction use. Please request installation drawing.)

Space Saving Floor Layout for the TTU-30 UHF Television Transmitter.

Specifications

Visual Performance

Type of Emission (FCC Designation) A5

Operating Channel ..... Any channel between 14 and 69 inclusive

Power Output (At filterplexer output) ..... 30 kW

Output Impedances:
- Power Amplifier ..... 50 ohms
- Filterplexer (6⅛" coaxial connection) ..... 75 ohms

Video Input:
- Impedance (unbalanced) ..... 75 ohms
- Level (min., sync positive) ..... 0.7V p-p
- Return Loss (60 Hz to 6 MHz) ..... −35 dB

Carrier Frequency Stability ..... ±500 Hz[1]

Amplitude vs. Frequency Response:[2]
- Upper Sideband Response Characteristic;
  - Between 0.2 and 4.1 MHz above carrier ..... ±1 dB
  - At 3.58 MHz above carrier ..... ±0.5 dB
  - At 4.75 MHz above carrier ..... −20 dB
- Lower Sideband Response Characteristic;
  - At 0.5 MHz below carrier ..... −2 dB
  - At 1.25 MHz below carrier ..... −20 dB
  - At 3.58 MHz below carrier ..... −42 dB

Envelope Delay vs. Frequency:[3]
- Between 0.2 and 2 MHz ..... ±60 ns
- At 3.58 MHz ..... ±30 ns
- At 4.18 MHz ..... ±60 ns

Variation in Frequency Response with Brightness[4] ..... −1, +1.5 dB

(continued, next page)

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Modulation Depth Capability	5%
Amplitude Variation (over one frame, ref. sync peak)	2%
Output Regulation	3%
Pedestal Level Variation[5]	1.5%
Differential Gain[6]	0.75 dB
Low Frequency Linearity	1 dB
Differential Phase[7]	±3°
Subcarrier Amplitude (Color Bars)	0.7 dB
Burst vs. Subcarrier Phase (Color Bars)[8]	±3°
AM Noise (rms below 100% modulation)[9]	–50 dB
Harmonic Attenuation[10]	–60 dB

Aural Performance

Type of Emission (FCC Designation)	F3
Power Output (At filterplexer input)	3.3 to 17 kW
Output Impedances:	
Power Amplifier	50 ohms
Filterplexer	75 ohms
Audio Input:	
Impedance (balanced)	600/150 ohms
Level (for ±25 kHz deviation)	+10 ±2 dBm
Carrier Frequency Stability[1]	±500 Hz
Intercarrier Frequency Stability[11]	±500 Hz
Modulation Capability	±50 kHz
Frequency Response Characteristic (30 Hz - 15 kHz)	±1 dB
Distortion (30 Hz to 15 kHz)	1%
FM Noise (Below ±25 kHz deviation)	–60 dB
AM Noise (rms)	–50 dB
Harmonic Attenuation[10]	–60 dB

Environmental

Operational Altitude (Max. above sea level)	7500 ft. (2286m)
Ambient Operating Temperature:	
At Sea Level	1 to 45°C (34 to 113°F)
At 3300 ft. (1006m)	1 to 40°C (34 to 104°F)
At 5000 ft. (1524m)	1 to 35°C (34 to 95°F)
At 7500 ft. (2286m)	1 to 30°C (34 to 86°F)
Heat Exchanger Inlet Temperature	10 to 45°C (50 to 113°F)

Electrical Requirements

Power Requirements	440/460/480V, 60 Hz, 3-phase, 128 kW (Three- or four-wire connection)
Line Voltage Regulation	3% max.
Slow Variations	±3% max.
Rapid Variations	±3% max.
Power Factor (Approx.)	90%

Mechanical

Dimensions:	
Transmitter Cabinet	136″ L; 105″ D; 77″ H (4.57, 2.66, 1.95m)
Heat Exchanger	102″ L; 62″ D; 66″ H (2.6, 1.6, 1.7m)
Filterplexer	70″ L; 66″ D; 50″ H (1.8, 1.7, 1.3m)
Beam Power Transformers (each)	28″ x 32″ x 49″ (711, 813, 1245 mm)
Weights:	
Transmitter	8230 lbs. (3733 kg)
Heat Exchanger	1450 lbs. (658 kg)
Filterplexer	600 lbs. (272 kg)
Beam Power Transformers (each)	1250 lbs. (567 kg)
Shipping Data:	
Total Weight	13,250 lbs. (6010 kg)
Total Volume	1486 ft.^{3} (42m^3)

[1] Maximum variation for 10 days without circuit adjustment within an ambient temperature range of 10 to 45°C. Meets or exceeds FCC Specs in 1 to 45°C ambient.

[2] With respect to response at visual carrier frequency plus 0.2 MHz as measured with RCA BWU-5C Sideband Response Analyzer. Transmitter operating at mid-characteristic. Measured response at filterplexer output.

[3] Departure from standard curve. Tolerances vary linearly between 2.1 MHz and color subcarrier frequency and between subcarrier frequency and upper sideband limit. A properly terminated phase-correction network is required in the video input of the transmitter while performing measurement. Minor, multi-lobed delay ripples—originating in the correction network—are excluded from this specification.

[4] Maximum change with response at mid-characteristic when measured to brightness levels of 22.5 and 67.5% of sync peak. Peak-to-peak modulation level adjusted to approximately 20 percent of sync level.

[5] Change in blanking level relative to sync peak for change in brightness from all black to all white picture.

[6] Max. variation of 3.58 MHz mod. frequency—20 percent p-p nominal amplitude—when superimposed on "stairstep" or "ramp" signal adjusted for brightness excursion of 20 to 75 percent of sync peak.

[7] Maximum phase difference with respect to burst, measured following the sideband filter, for any brightness level between 75 and 15 percent of sync peak using 10 percent, p-p modulation. This is equivalent to 5 percent p-p modulation indicated on a conventional diode demodulator.

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

[9] Hum and noise, 50 Hz to 15 kHz. Extraneous modulation—unrelated to video—above 15 kHz but within the visual passband: 40 dB below 100% modulation.

[10] Ratio of any single harmonic to peak visual fundamental power.

[11] Maximum variation with respect to separation between aural and visual carriers.

Accessories

Standby Exciter Cabinet Group, Type TTUE-4	ES-560937
Primary Voltage Regulator (Three Required, if used)	MI-560493
Spare Klystron Power Tube (Please Specify channel)	MI-560407
Spare Solid-State IPA (Please specify channel)	MI-560899
Color Phase Equalizer, Type TTS-1	MI-560503

Ordering Information

UHF-TV Transmitter, 30 kW Visual, 17 kW Aural, Type TTU-30C	ES-560958

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RCA

catalog TT.3400A

(Replaces B.5045)

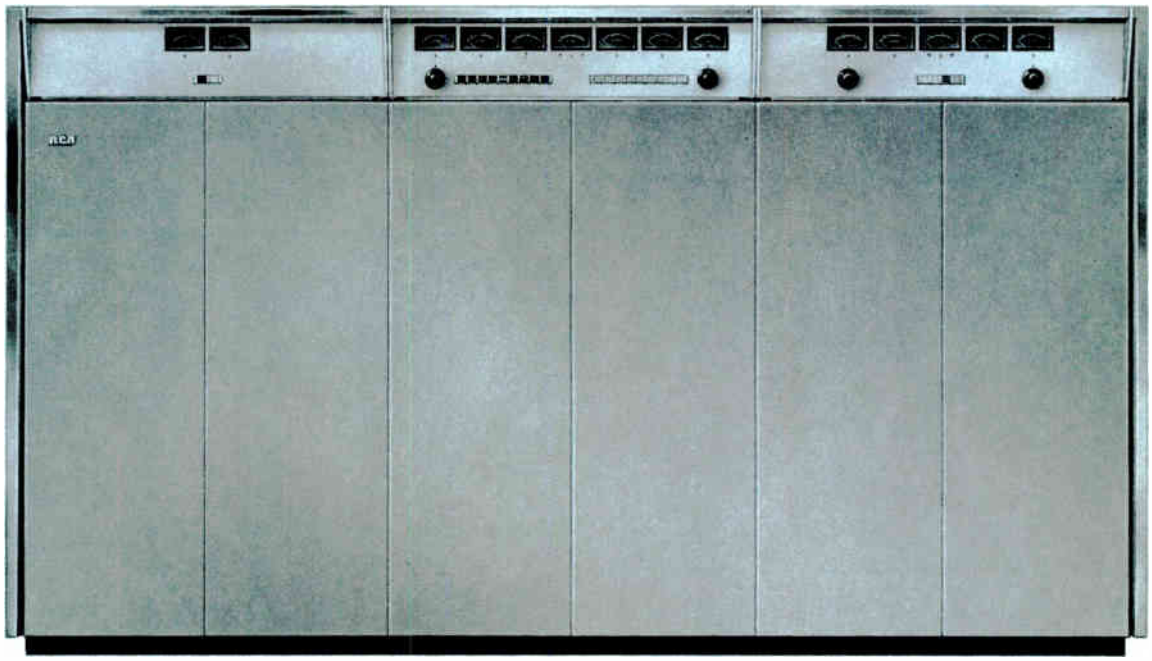
UHF-TV Transmitter, 55 kW Visual, 12 kW Aural, Type TTU-55B

- Vapor-cooled integral cavity klystrons
- Solid-state exciter/modulator
- Intermediate frequency modulation
- Ready for remote-control operation

The TTU-55B is a 55-kilowatt UHF-television broadcast transmitter using integral-cavity, vapor-cooled klystrons as aural and visual power amplifiers. The klystrons are high gain five cavity units arranged for easy interchange when replacement is necessary.

The TTU-55B uses three in-line cabinets for the signal-handling and RF-amplifier circuits plus a rear walk-in enclosure for power supply and control components. This increases accessibilty to all systems for routine maintenance and inspection, and provides more efficient cooling of components.

A standby exciter/modulator is available as an option in a group which includes fault-sensing and automatic switchover to the standby system.



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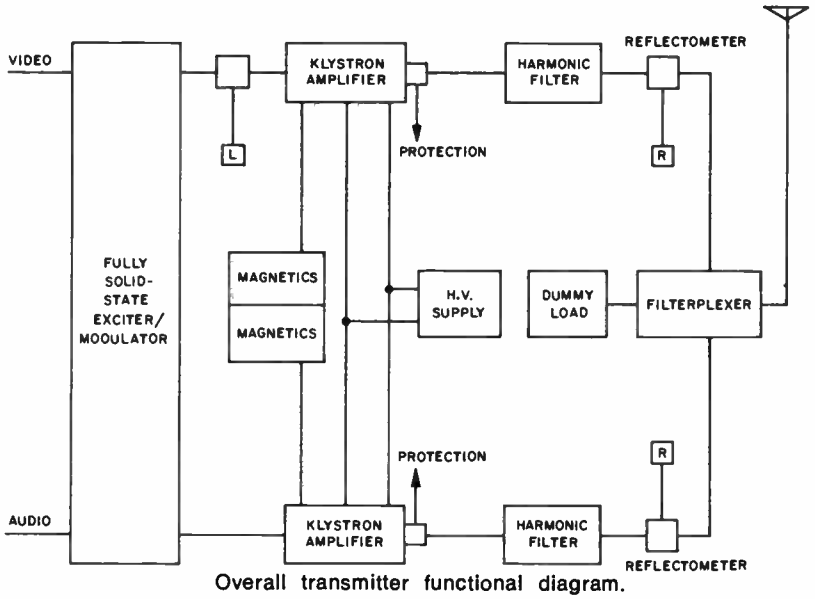
Connected to an antenna system of suitable gain, the TTU-55B transmitter is capable of an effective radiated power of as much as 1.8 megawatts. The transmitter is entirely transistorized except for two klystron power tubes and uses modern solid-state components in an innovative design in both circuitry and packaging. The transmitter features vapor-cooled five-cavity klystrons (in which the cavities are integral to the tube structure), identical aural-visual power stages and built-in readiness for remote control operation.

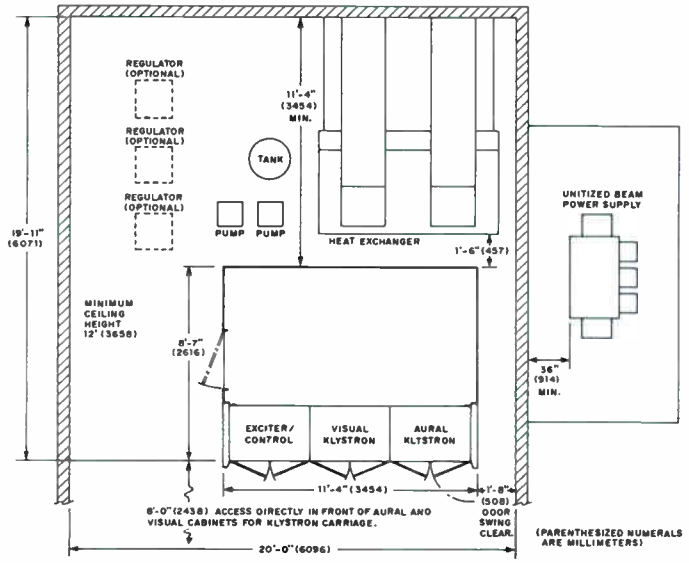
The TTU-55B is designed for future expansion to higher power through the addition of a second visual klystron amplifier and certain other components. This expansion takes place at minimum investment and is designed to be effected without loss of air time in a normal operating schedule.

Modular, Solid-State Exciter/Modulator

Modern, solid-state circuitry in the exciter/modulator unit combines reliability with operating ease. The oscillators use temperature-compensated crystals that eliminate the limitations of crystal heaters or ovens and assure on-frequency operation from the moment of turn-on. A spare oscillator module is provided for the pump-generator section of the unit for use in the event of an outage.



Overall transmitter functional diagram.



Transmitter system needs less than 600 square feet (56m³) of floor area with a 12-foot (3.7m) ceiling.

Aural and visual modulation takes place at an intermediate frequency and is up-converted to carrier frequency at a 15 watt visual and 5 watt aural power level. The exciter/modulator power output is 4W visual and 800 mV aural (see exciter/modulator block diagram). A separate catalog section on the exciter/modulator is available (see Type TTUE-4).

Vapor-Cooled Klystrons

The TTU-55B Transmitter uses identical klystrons in the aural and visual channel. These are vapor-cooled, five-cavity units of integral-cavity design with a reputation for stability, reliability, and long life. Because of their high gain, the aural and visual klystrons are driven directly by the output of the exciter-modulator without the requirement for intermediate power amplification. This results in an all solid-state transmitter with the exception of the visual and aural klystrons, and with no intermediate, linear, RF-amplifier stages.

Easy Klystron Change

Klystron replacement in the TTU-55B Transmitter is accomplished easily by one man, working alone, in a matter of a few minutes. The factory-tuned klystron is transferred in a horizontal position directly from the shipping crate to the klystron carriage, which is furnished with the transmitter. By way of a built-in loading device, the klystron is easily installed from the front of the transmitter cabinet. It remains in a horizontal position until it is completely installed in the magnet assembly, and then tilted into the vertical position by a simple mechanism which is a part of the aural or visual amplifier cabinet.

High-Level Sideband Shaping

Sideband shaping and visual/aural diplexing is accomplished at the transmitter output in a hybrid filterplexer. This is a temperature compensated, passive device employing waveguide cavities and sections of coaxial line in the filter portion. It is pretuned during manufacture and requires no operationl adjustments. The inputs have a constant impedance over the band of frequencies involved.

Efficient Klystron Cooling

Klystron cooling is accomplished with the conversion of water to steam which is, in turn, condensed back to water for re-use. The heat exchanger (condenser) removes the latent heat of the steam and dissipates it to outdoor air. A motor-driven pump circulates the condensed water to the storage tank and thence to the klys-

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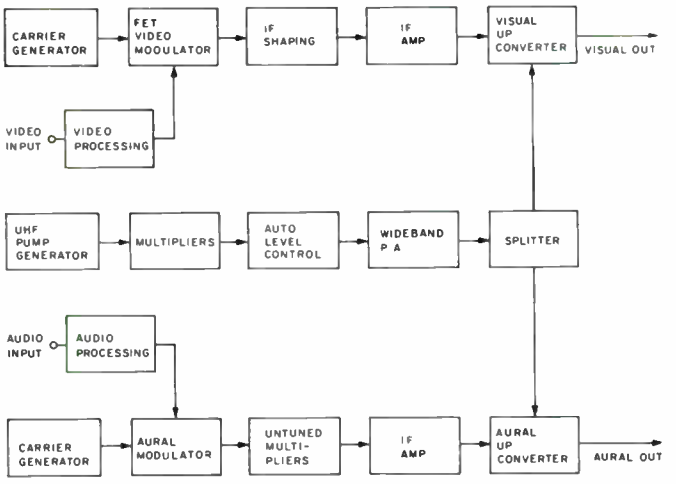
trons. A standby pump and motor is connected in the system for immediate use in the event of pump system failure. A system of manually operated valves effects the pump changeover. These valves make periodic switchover practical to let both pumps share in the hours of use.

Temperature control of the condensate returning to the klystrons and their magnets contributes to the gain and bandwidth stability of the amplifier stages.

The heat exchanger requires ductwork between it and outdoor air. This ductwork is ordinarily provided by the purchaser unless specifically ordered from RCA.

High-Speed Fault Protection

The transmitter incorporates electronic, high-speed fault protection systems capable of removing RF excitation within 20 microseconds in the event of an RF-load disturbance. The klystron amplifiers are protected with instantaneous relays which trip on overload and automatically reset unless the overload continues beyond two reset cycles. Excessive water inlet temperature, excessive klystron body temperature and inordinate magnet current are sensed as indicators of faulty operation. Front-panel indicator lamps identify specific overloads or other abnormal conditions. These remain lit until manually reset, even if the overload reset or the fault cleared, to indicate the source of alarm condition.



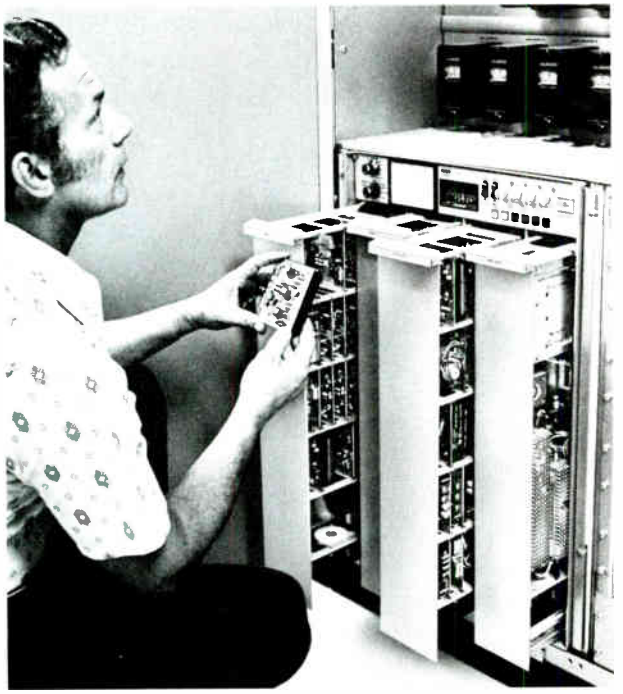
Exciter/modulator functional diagram.

Klystron Power Supply

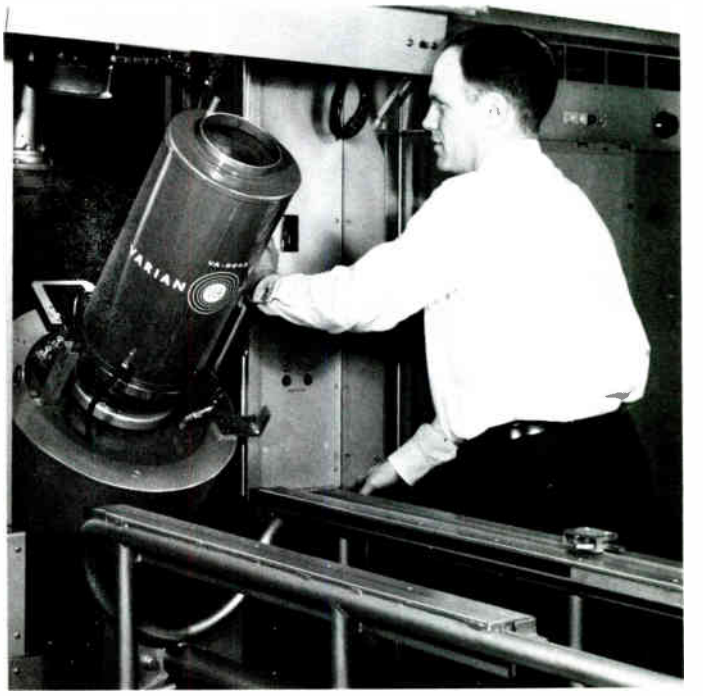
The klystron power supply for the TTU-55B Transmitter is a unitized assembly containing the power transformer, rectifier stacks, filter reactor and a-c snubbing networks in an oil-filled tank. The diode stacks are mounted in modular form, one for each phase, with access through a port at the top of the tank. The power supply unit is designed for outdoor installation.

Optional Spare Exciter Group

For those who want redundancy extended into the exciter/modulator section of the transmitter a spare exciter group is available as an extra-cost option. This group consists of a free-standing cabinet containing an exciter/modulator unit, fault-sensing and automatic switchover equipment and an exciter/modulator power supply. The cabinet matches the style of the transmitter to allow installation adjacent to the exciter/control cabinet of the transmitter. The fault-sensing and switchover equipment monitors main exciter/modulator output and, in the event of outage, automatically switches over to the spare exciter/modulator system.



Modularized exciter/modulator circuits are keyed to prevent inadvertent module interchange.



Integral-cavity klystrons tilt down for easy replacement by one man, working alone.

World Radio History

Specifications

Visual Performance

Type of Emission (FCC Designation)	A5
Operating Channel	Any channel between 14 and 69 inclusive
Power Output (At filterplexer output)	55 kW
Output Impedances:	
Power Amplifier	50 ohms
Filterplexer (6⅛-inch coaxial connection)	75 ohms
Video Input:	
Impedance (Unbalanced)	75 ohms
Level (min., sync positive)	0.7V p-p
Return Loss (60 Hz to 6 MHz)	−35 dB
Carrier Frequency Stability[1]	±500 Hz
Amplitude vs. Frequency Response:[2]	
Upper Sideband Response Characteristic:	
Between 0.2 and 4.1 MHz above carrier	±1 dB
At 3.58 MHz above carrier	±0.5 dB
At 4.75 MHz above carrier	−20 dB
Lower Sideband Response Characteristic:	
At 0.5 MHz below carrier	−2 dB
At 1.25 MHz below carrier	−20 dB
At 3.58 MHz below carrier	−42 dB
Envelope Delay vs. Frequency:[3]	
Between 0.2 and 2 MHz	±60 ns
At 3.58 MHz	±30 ns
At 4.18 MHz	±60 ns
Variation in Frequency Response with Brightness[4]	−1, +1.5 dB
Modulation Depth Capability	5%
Amplitude Variation (Over one frame, ref: sync peak)	2%
Output Regulation	3%
Pedestal Level Variation[5]	1.5%
Differential Gain[6]	0.75 dB
Low Frequency Linearity	1 dB
Differential Phase[7]	±3°
Subcarrier Amplitude (Color Bars)	0.7 dB
Burst vs. Subcarrier Phase (Color Bars)[8]	±3°
AM Noise (rms below 100% modulation)[9]	−50 dB
Harmonic Attenuation[10]	60 dB

Aural Performance

Type of Emission (FCC Designation)	F3
Power Output (At filterplexer input)	6 to 12 kW
Output Impedances:	
Power Amplifier	50 ohms
Filterplexer	75 ohms
Audio Input:	
Impedance (Balanced)	600/150 ohms
Level (For ±25 kHz deviation)	+10 ±2 dBm
Carrier Frequency Stability[1]	±500 kHz
Intercarrier Frequency Stability[11]	±500 Hz
Modulation Capability	±50 kHz
Frequency Response Characteristic (30 Hz to 15 kHz)	±1 dB max.
Distortion (30 Hz to 15 kHz)	1% max.
FM Noise (Below ±25 kHz deviation)	−60 dB max.
AM Noise (rms)	−50 dB max.
Harmonic Attenuation[10]	60 dB max.

Environmental

Operational Altitude (Max. above sea level)	7500 ft. (2286 m)
Ambient Operating Temperatures:	
At Sea Level	1 to 45°C (34 to 113°F)
At 3300 ft. (1006 m)	1 to 40°C (34 to 104°F)
At 5000 ft. (1524 m)	1 to 35°C (34 to 95°F)
At 7500 ft. (2286 m)	1 to 30°C (34 to 86°F)
Heat Exchanger Air Inlet Temperature	10 to 45°C (50 to 113°F)

Electrical Requirements

Power Requirements	440/460/480V, 60 Hz, 3-phase, 218 kW max. (Three- or four-wire connection)
Line Voltage Regulation	3% max.
Variations (Slow or Rapid)	±3% max.
Power Factor (Approx.)	90%

Mechanical

Dimensions:	
Transmitter	136″ L; 105″ D; 77″ H (3.45, 2.67, 1.95 m)
Heat Exchanger	103″ L; 62″ D; 45″ H (262, 1.57, 1.14 m)
Filterplexer (Frequency Dependent)	70-74″ L; 62-66″ D; 40-50″ H (1.78-1.88, 1.58-1.68, 1.02-1.27 m)
Weights of Major Units (Approx.):	
Transmitter	1200 lbs. (5443 kg)
Heat Exchanger	1450 lbs. (658 kg)
Filterplexer	600 lbs. (272 kg)
Beam Supply Transformer	1570 lbs. (712 kg)
Shipping Data:	
Total Weight (Approx.)	22,000 lbs. (10,000 kg)
Total Volume (Approx.)	1600 ft³ (45 m³)

[1] Maximum variation for 10 days without circuit adjustment within an ambient temperature range of 10 to 45°C (50 to 113°F). Meets or exceeds FCC Specs in 1 to 45°C ambient (34 to 113°F).

[2] With respect to response at visual carrier frequency plus 0.2 MHz as measured with RCA BWU-5C Sideband Response Analyzer. Transmitter operating at mid-characteristic. Measured response at filterplexer output.

[3] Departure from standard curve. Tolerances vary linearly between 2.1 MHz and color subcarrier frequency and between color subcarrier frequency and upper sideband limit. A properly terminated phase-correction network is required in the video input of the transmitter while performing the measurement. Minor, multi-lobed delay ripples—originating in the delay network—are excluded from this specification.

[4] Maximum change with response at mid-characteristic when measured to brightness levels of 22.5 and 67.5 percent of sync peak. Peak-to-peak modulation level adjusted to approximately 20 percent of sync level.

[5] Change in blanking level relative to sync peak for change in brightness from all black to all white picture.

[6] Maximum variation of 3.50 MHz modulation frequency —20 percent p-p nominal amplitude—when superimposed on "stairstep" or "ramp" signal adjusted for brightness excursion of 20 to 75 percent of sync peak.

[7] Maximum phase difference with respect to burst, measured following the sideband filter, for any brightness level between 75 and 15 percent of sync peak using 10 percent, p-p modulation. This is equivalent to 5 percent p-p modulation indicated on a conventional diode demodulator.

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

[9] Hum and noise, 50 Hz to 15 kHz. Extraneous modulation—unrelated to video —above 15 kHz but within the visual passband: 40 dB below 100% modulation.

[10] Ratio of any single harmonic to peak visual fundamental power.

[11] Maximum variation with respect to separation between aural and visual carriers.

Accessories

Spare Klystron Power Tube (Specify Channel)	MI-560569
Primary Voltage Regulator (Three req'd if used)	MI-560571
Standby Exciter Cabinet Group, Type TTUE-4	ES-560937

Ordering Information

UHF-TV Transmitter, 55 kW Visual, 12 kW Aural, Type TTU-55B	ES-560927

World Radio History

RCA

catalog TT.3600A

(Replaces B.5040)

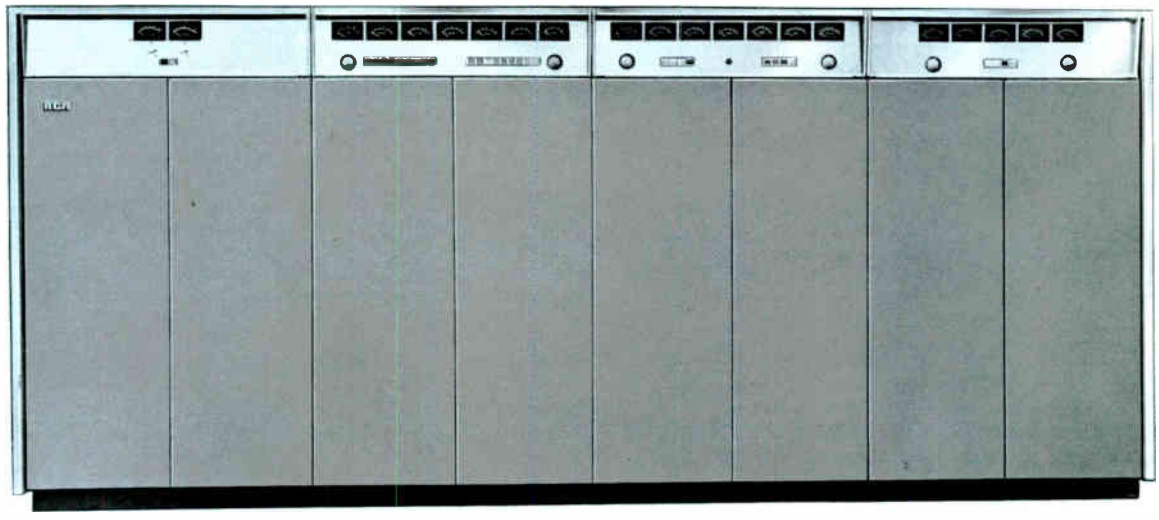
UHF-TV Transmitter, 60 kW Visual, 16 kW Aural, Type TTU-60C

- Redundant visual amplifiers
- Vapor-cooled integral-cavity klystrons
- Solid-state exciter/modulator and IPA
- Ready for remote-control operation
- Intermediate-frequency modulation

The TTU-60C is a 60-kilowatt UHF-television broadcast transmitter using integral-cavity, vapor-cooled klystrons as aural and visual power amplifiers. The klystrons are four-cavity units arranged for easy interchange when replacement is necessary.

The TTU-60C uses four in-line cabinets for the signal-handling and RF-amplifier circuits. Power-supply components are in a walk-in enclosure to the rear of the cabinets. This arrangement assures maximum accessibility and efficient cooling of the power-supply elements.

A standby exciter/modulator is available as an option in a group which includes fault-sensing and automatic switchover to the standby system.



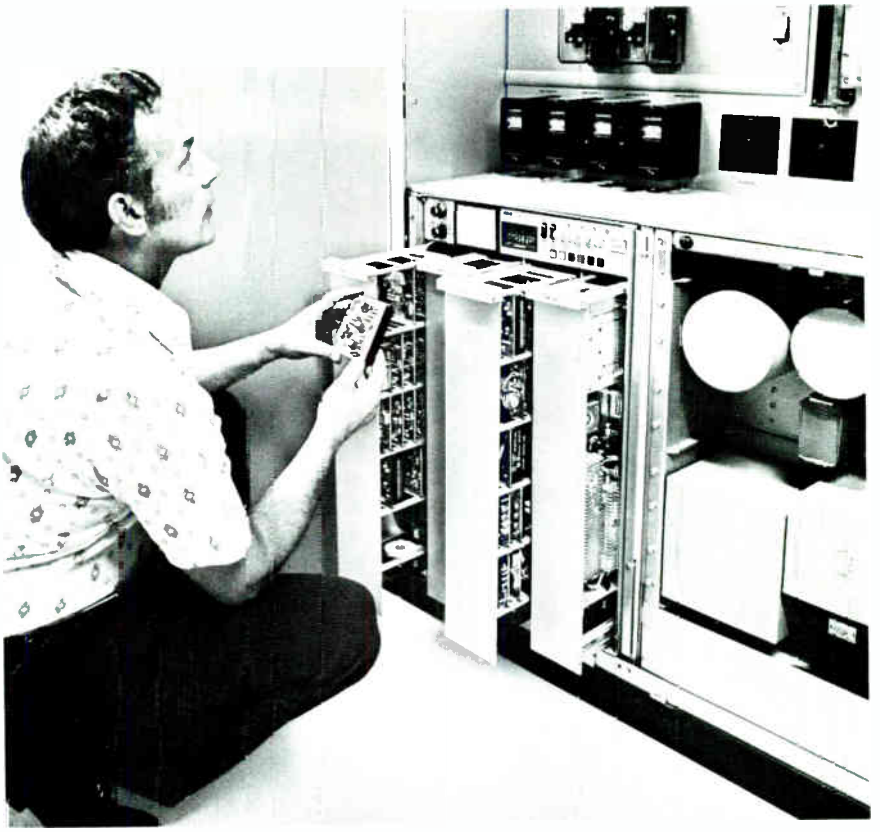
8YB

World Radio History

Transmitter control cabinet at left houses exciter/modulator unit and twin, solid-state intermediate power amplifiers.

World Radio History

This is the fully solid-state exciter/modulator unit.



All exciter/modulator circuits are modularized.

Connected to an antenna system of suitable power gain, the TTU-60C transmitter is capable of an effective radiated power (ERP) of more than two megawatts. The exciter/modulator section is entirely transistorized, using modern solid-state components in an innovative design in both circuitry and packaging. The transmitter features solid-state intermediate power amplifiers, vapor-cooler, four-cavity klystrons (in which the cavities are integral to tube structure), identical aural-visual power stages (redundant visual) and built-in readiness for remote-control operations.

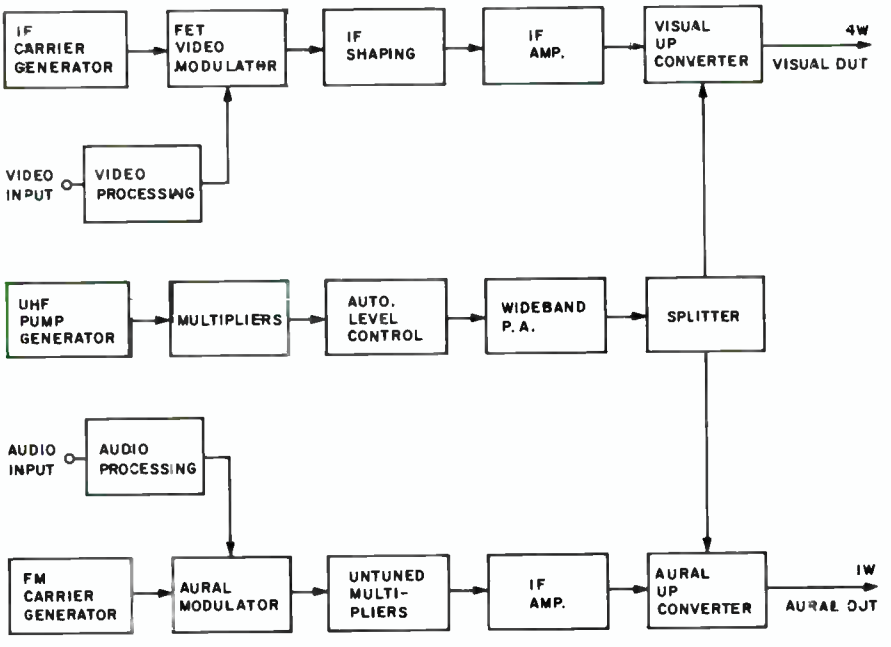
The TTU-60C uses four front-line cabinets and a rear, walk-in enclosure for all power supply and switching components except for three beam-power transformers (see floor layout drawing). This arrangement provides convenient access to the rear of the in-line cabinets and to the power supply rectifiers and filter components during inspection and/or maintenance.

Modular, Solid-State Exciter/Modulator

Modern, solid-state circuitry in the exciter/modulator unit combines reliability with operating ease. The oscillators use temperature-compensated crystals that eliminate the limitations of crystal heaters or ovens and assure on-frequency operation from the moment of turn-on. A spare oscillator module is provided for the pump-generator section of the unit for use in the event of an outage.

Aural and visual modulation takes place at an intermediate frequency and is up-converted to carrier frequency at a 15 watt visual and 5 watt aural power level. The exciter/modulator power output is 4W visual and 800 mW aural (see exciter/modulator block diagram). A separate catalog section on the exciter/modulator is available (see Type TTUE-4).

Exciter/modulator functional diagram.



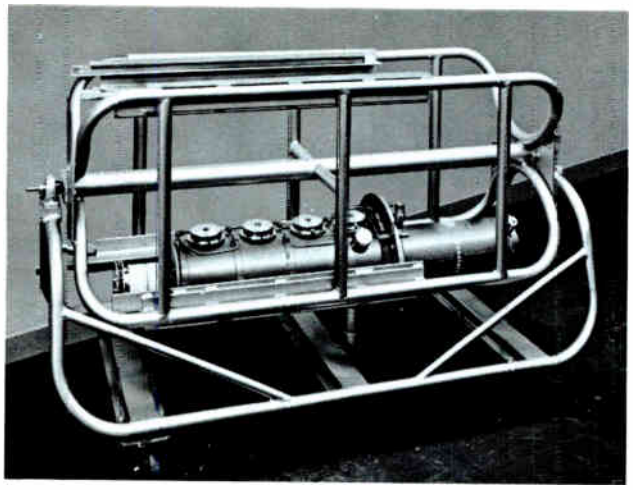
World Radio History

Solid-State Intermediate PA

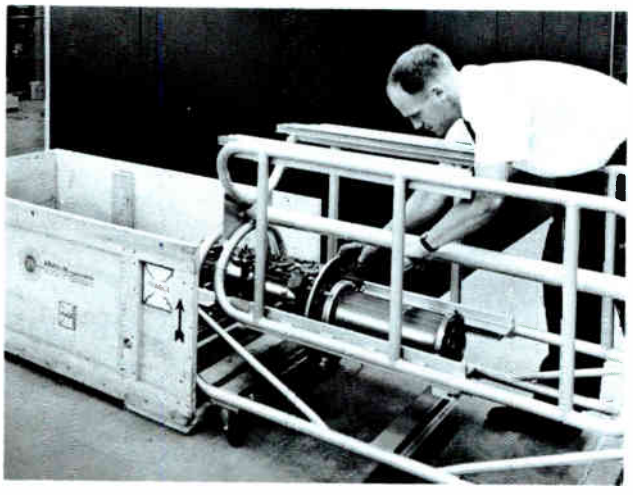
The exciter/madulator aural output drives the aural klystron amplifier directly without intermediate amplification. On the visual side, the modulated carrier is split into two separate outputs and routed to two intermediate power amplifiers. These are solid-state units, each capable of 10 watts power output. The IPA units are tuned to channel during manufacture and require no readjustments or operating controls. The IPA units operate from a 24 volt, dc power supply housed within the exciter/control in the cabinet.

Vapor-Cooled Klystrons

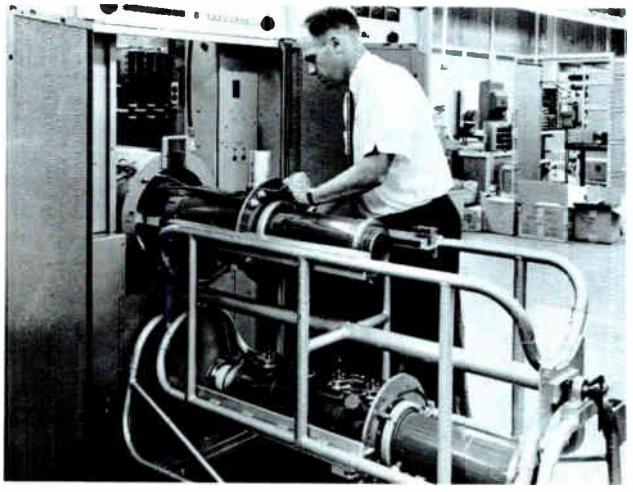
The transmitter uses three identical klystrons: one in the aural channel and two in the visual. These are vapor-cooled, four-cavity units of integral-cavity design with a reputation for stability, reliability and long life. The visual klystrons operate



Klystron carriage stores spare klystron safely and securely.



Klystron transfers from crate to carriage quickly and easily.



Transfer from carriage to socket is at table-top height.

World Radio History

in a diplexed arrangement with each klystron contributing independently to the transmitter power output. The diplex arrangement is such that an outage in either visual amplifier merely reduces transmitter power output. Through an optional co-ax switcher, one of the visual stages can replace a failed aural klystron on a temporary basis while the other visual amplifier serves the visual channel.

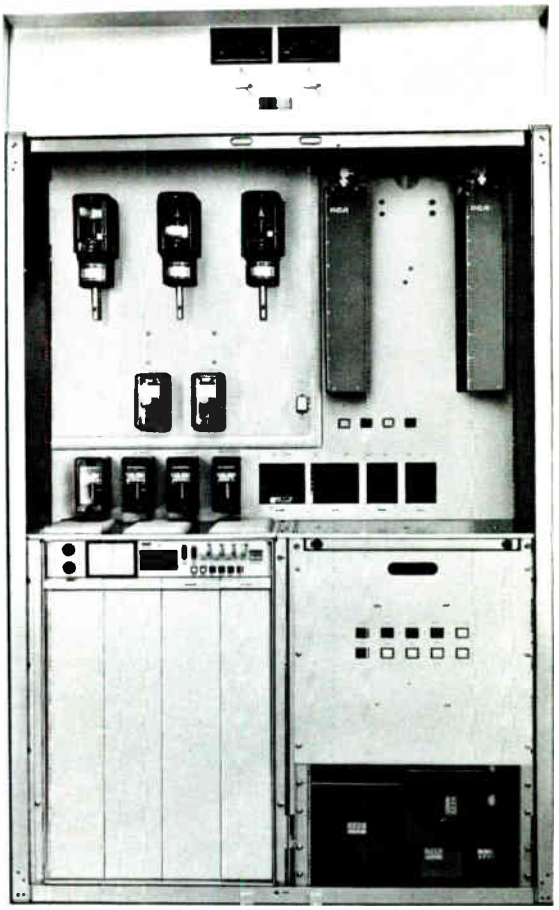
With all three klystrons identical, a single spare serves all three amplifiers. And, the fact that aural and visual tubes are interchangeable allows operation of retired visual tubes as aural amplifiers for extended tube life.

Easy Klystron Change

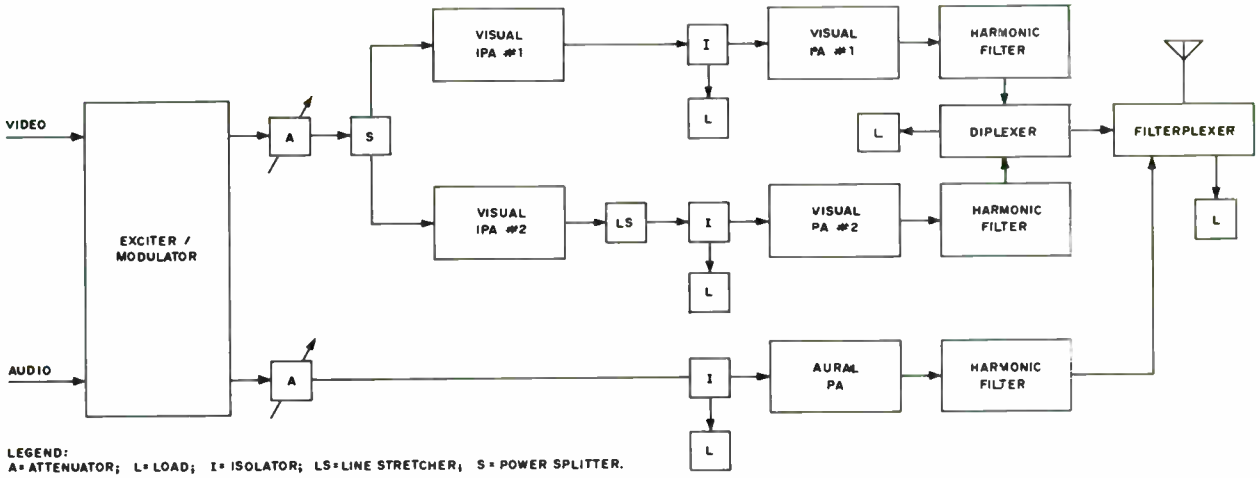
Klystron replacement in the TTU-60C transmitter is accomplished easily by one man, working alone, in a matter of a few minutes. This is the result of several factors: integral cavities, tilt-down magnet construction, quick-disconnect connections and a tube dolly that carries the entire load of the klystron (see photos).

Ghost-Cancelling Final Amplifier

The klystron visual amplifiers operate in parallel, each contributing one-half of the visual power output. A line-stretcher device, in the RF drive to Visual Amplifier Number 2, shifts the relative phase of the RF by 90 degrees. As a result, the



Close-up of control cabinet. Exciter/modulator unit at lower left; solid-state IPA units at upper right.



Simplified functional diagram of signal-handling sections of transmitter.

World Radio History

power output from both amplifiers is in phase-quadrature. The input circuits of the combiner re-establish the in-phase relationship of the energy.

This arrangement makes any reflected power from the load appear at the two klystron outputs with a 90-degree phase difference. When re-reflected toward the load the reflection is shifted another 90 degrees. As a result, the reflected energy appears at the combiner inputs in phase opposition and is dissipated in the combiner reject load. The end result is, essentially, the elimination of any ghosting effect from reflected power due to load discontinuities.

High-Level Sideband Shaping

Sideband shaping and visual/aural diplexing is accomplished at the transmitter output in a hybrid filterplexer. This is a temperature compensated, passive device employing waveguide cavities and sections of coaxial line in the filter portion. It is pretuned during manufacture and requires no operational adjustments. The inputs have a constant impedance over the band of frequencies involved.

Efficient Klystron Cooling

Klystron cooling is accomplished with the conversion of water to steam which is, in turn, condensed back to water for re-use. The heat exchanger (condenser) removes the latent heat of the steam and dissipates it to outdoor air. A motor-driven pump circulates the condensed water to the storage tank and thence to the klystrons. A standby pump and motor is connected in the system for immediate use in the event of pump system failure. A system of manually operated valves effects the pump changeover. These valves make periodic switchover practical to let both pumps share in the hours of use.

Temperature control of the condensate returning to the klystrons and their magnets contributes to the gain and bandwidth stability of the amplifier stages.

The heat exchanger requires ductwork between it and outdoor air. This ductwork is ordinarily provided by the purchaser unless specifically ordered from RCA.

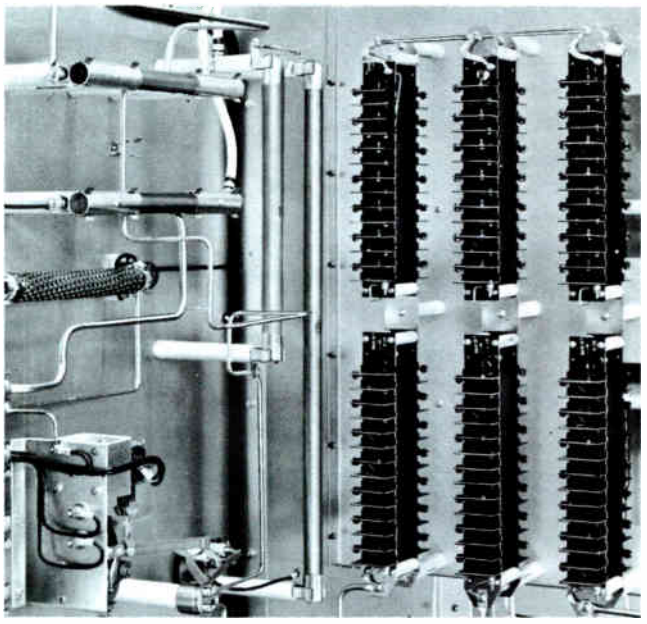
High-Speed Fault Protection

The transmitter incorporates an electronic, high-speed fault protection system capable of removing RF excitation within 20 microseconds in the event of an RF load disturbance. The klystron amplifiers are protected with instantaneous relays which trip on overload and automatically reset unless the overload continues beyond two or three reset cycles. Excessive water inlet temperature, excessive klystron body temperature and inordinate magnet current are sensed as indicators of faulty operation. Front-panel indicator lamps identify specific overloads or other abnormal conditions. These remain lit until manually reset, even if the overload reset or the fault cleared, to indicate the source of alarm condition.

Optional Spare Exciter Group

For those who want redundancy extended into the exciter/modulator section of the transmitter a spare exciter group is available as an extra-cost option. This group consists of a free-standing cabinet containing an exciter/modulator unit, fault-sensing and automatic switchover equipment and an exciter/modulator power supply. The cabinet matches the style

The exciter/modulator is available optionally in a free-standing cabinet for use as a spare exciter/modulator system. The cabinet matches that of the transmitter.



Modularized silicon rectifiers in power supply mount on inside walls of power supply enclosure for easy access and efficient convection cooling.

World Radio History

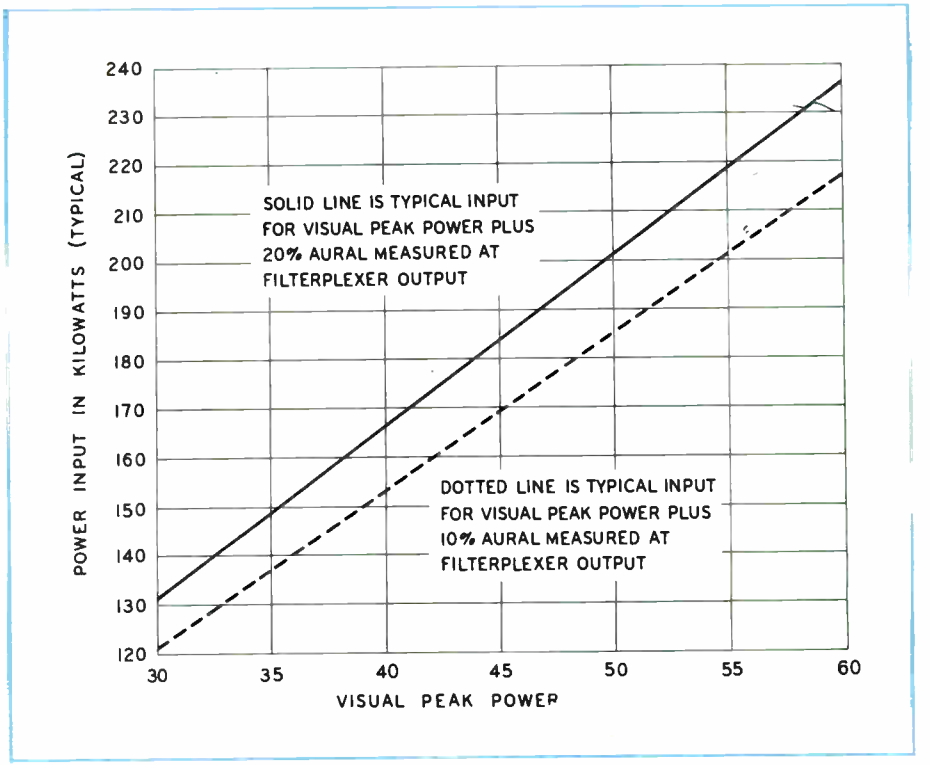
of the transmitter to allow installation adjacent to the exciter/control cabinet of the transmitter. The fault-sensing and switchover equipment monitors main exciter/modulator output and, in the event of outage, automatically switches over to the spare exciter/modulator system.

Standby Power Kit Optional

Offered for those who expect to operate the transmitter under remote control, once-a-week inspection and "20-percent standby power" requirements, the Standby Power Kit includes spare exciter group described above and input/output switching in the klystron amplifier stages to let visual amplifier #2 substitute for a failed aural amplifier.

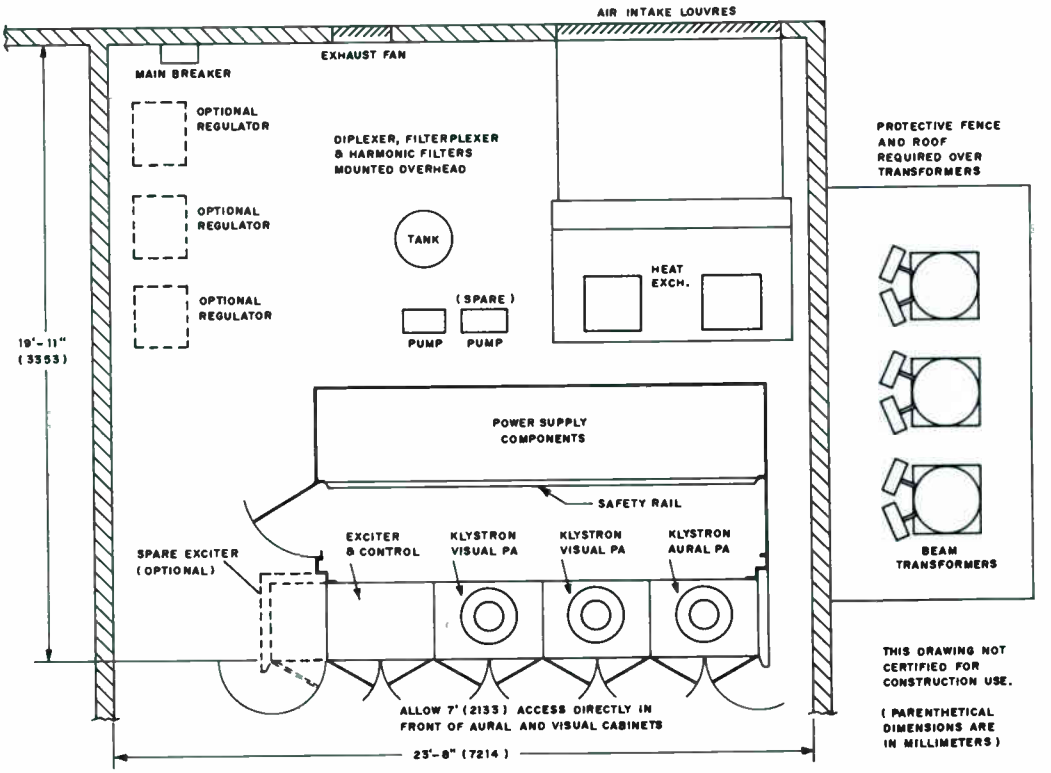
Should one of the visual amplifiers fail, the option allows disconnection of it from the power supply to allow continued operation at reduced power.

The option includes fault-detection facilities that identify a failed amplifier via the remote control system to let the transmiter operator perform the correct switching action. Local alarms and switching control are also included.



Plot of transmitter input power vs. output power under two operational conditions.

Typical floor layout for transmitter. Ductwork between heat exchanger and outside wall not supplied unless ordered specifically.



World Radio History

Specifications

Visual Performance

Type of Emission (FCC Designation)	A5
Operating Channel	Any channel between 14 and 69 inclusive
Power Output (At filterplexer output)	60 kW
Output Impedances:	
Power Amplifier	50 ohms
Filterplexer (6⅛-inch coaxial connection)	75 ohms
Video Input:	
Impedance (Unbalanced)	75 ohms
Level (min., sync positive)	0.7V p-p
Return Loss (60 Hz to 6 MHz)	−35 dB
Carrier Frequency Stability[1]	±500 Hz
Amplitude vs. Frequency Response:[2]	
Upper Sideband Response Characteristic:	
Between 0.2 and 4.1 MHz above carrier	+0.5, −1 dB
At 3.58 MHz above carrier	+0, −0.5 dB
At 4.75 MHz above carrier	−20 dB
Lower Sideband Response Characteristic:	
At 0.5 MHz below carrier	+0, −1.5 dB
At 1.25 MHz below carrier	−20 dB
At 3.58 MHz below carrier	42 dB
Envelope Delay vs. Frequency:[3]	
Between 0.2 and 2 MHz	±60 ns
At 3.58 MHz	±30 ns
At 4.18 MHz	±60 ns
Variation in Frequency Response with Brightness[4]	−1, +1.5 dB
Modulation Depth Capability	5%
Amplitude Variation (Over one frame, ref: sync peak)	2%
Output Regulation	3%
Pedestal Level Variation[5]	1.5%
Differential Gain[6]	0.75 dB
Low Frequency Linearity	1 dB
Differential Phase[7]	±3°
Subcarrier Amplitude (Color Bars)	0.7 dB
Burst vs. Subcarrier Phase (Color Bars)[8]	±3°
AM Noise (rms below 100% modulation)[9]	−50 dB
Harmonic Attenuation[10]	60 dB

Aural Performance

Type of Emission (FCC Designation)	F3
Power Output (At filterplexer input)	6 to 16 kW
Output Impedances:	
Power Amplifier	50 ohms
Filterplexer	75 ohms
Audio Input:	
Impedance (Balanced)	600/150 ohms
Level (For ±25 kHz deviation)	+10 ±2 dBm
Carrier Frequency Stability[1]	±500 Hz
Intercarrier Frequency Stability[11]	±500 Hz
Modulation Capability	±50 kHz
Frequency Response Characteristic (30 Hz to 15 kHz)	±1 dB max.
Distortion (30 Hz to 15 kHz)	1% max.
FM Noise (Below ±25 kHz deviation)	−60 dB max.
AM Noise (rms)	−50 dB max.
Harmonic Attenuation[10]	60 dB max.

Environmental

Operational Altitude (Max. above sea level)	7500 ft. (2286 m)
Ambient Operating Temperatures:	
At Sea Level	1 to 45°C (34 to 113°F)
At 3300 ft. (1006 m)	1 to 40°C (34 to 104°F)
At 5000 ft. (1524 m)	1 to 35°C (34 to 95°F)
At 7500 ft. (2286 m)	1 to 30°C (34 to 86°F)
Heat Exchanger Air Inlet Temperature	10 to 45°C (50 to 113°F)

Electrical Requirements

Power Requirements	440/460/480V, 60 Hz, 3-phase, 218 kW max. (Three- or four-wire connection)
Line Voltage Regulation	3% max.
Variations (Slow or Rapid)	±3% max.
Power Factor (Approx.)	90%

Mechanical

Dimensions:	
Transmitter	180″ L, 105″ D, 77″ H (4.57, 2.66, 1.95 m)
Heat Exchanger	103″ L, 62″ D, 45″ H (2.62, 1.57, 1.14 m)
Filterplexer (Frequency Dependent)	70-74″ L, 62-66″ D, 40-50″ H (1.78-1.88, 1.58-1.68, 1.02-1.27 m)
Beam Supply Transformer (Three used)	57″ H, 41″ W, 33″ D (1.45, 1.04, 0.84 m)
Weights of Major Units (Approx.):	
Transmitter	9450 lbs. (4286 kg)
Heat Exchanger	1450 lbs. (658 kg)
Filterplexer	600 lbs. (272 kg)
Beam Supply Transformer (each)	1570 lbs. (712 kg)
Shipping Data:	
Total Weight (Approx.)	24,300 lbs. (11022 kg)
Total Volume (Approx.)	2174 ft³ (62 m³)

[1]Maximum variation for 10 days without circuit adjustment within an ambient temperature range of 10 to 45°C (50 to 113°F). Meets or exceeds FCC Specs in 1 to 45°C ambient (34 to 113°F).

[2]With respect to response at visual carrier frequency plus 0.2 MHz as measured with RCA BWU-5C Sideband Response Analyzer. Transmitter operating at mid characteristic. Measured response at filterplexer output.

[3]Departure from standard curve. Tolerances vary linearly between 2.1 MHz and color subcarrier frequency and between color subcarrier frequency and upper sideband limit. A properly terminated phase-correction network is required in the video input of the transmitter while performing the measurement. Minor, multi-lobed delay ripples—originating in the delay network—are excluded from this specification.

[4]Maximum change with response at mid-characteristic when measured to brightness levels of 22.5 and 67.5 percent of sync peak. Peak-to-peak modulation level adjusted to approximately 20 percent of sync level.

[5]Change in blanking level relative to sync peak for change in brightness from all black to all white picture.

[6]Maximum variation of 3.50 MHz modulation frequency —20 percent p-p nominal amplitude—when superimposed on "stairstep" or "ramp" signal adjusted for brightness excursion of 20 to 75 percent of sync peak.

[7]Maximum phase difference with respect to burst, measured following the sideband filter, for any brightness level between 75 and 15 percent of sync peak using 10 percent, p-p modulation. This is equivalent to 5 percent p-p modulation indicated on a conventional diode demodulator.

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

[9]Hum and noise, 50 Hz to 15 kHz. Extraneous modulation-unrelated to video —above 15 kHz but within the visual passband: 40 db below 100% modulation.

[10]Ratio of any single harmonic to peak visual fundamental power.

[11]Maximum variation with respect to separation between aural and visual carriers.

Accessories

Spare Klystron Power Tube (Specify Channel)	MI-560407
Spare Solid-State IPA (Specify Channel)	MI-560899
Primary Voltage Regulator (Three Req'd)	MI-560493
Standby Exciter Cabinet Group, Type TTUE-4	ES-560937
Standby Power Option (for 20% Standby Power)	On Request

Ordering Information

UHF-TV Transmitter, 60 kW Visual, 16kW Aural, Type TTU-60C	ES-560961

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catalog TT.3650B

(Replaces TT.3650A)

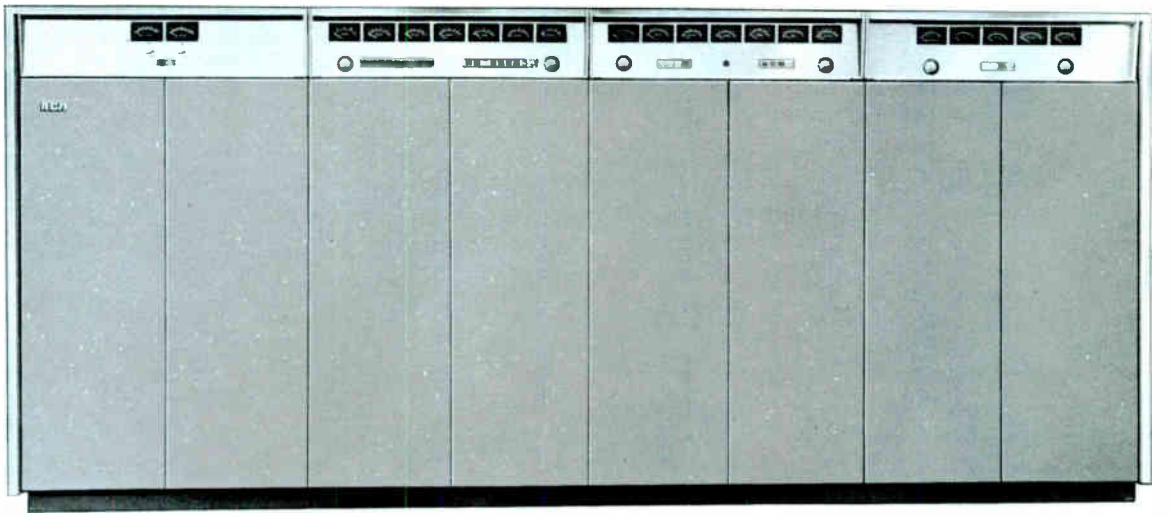
UHF-TV Transmitter 60 kW Visual, 16 kW Aural, Type TTU-60C2

- Redundant visual amplifiers
- Vapor-cooled integral-cavity klystrons
- Solid-state exciter/modulator and IPA
- Ready for remote-control operation
- Intermediate-frequency modulation

The TTU-60C2 is a 60-kilowatt UHF-television broadcast transmitter using integral-cavity, vapor-cooled klystrons as aural and visual power amplifiers. The klystrons are four-cavity units arranged for easy interchange when replacement is necessary.

The TTU-60C2 uses four in-line cabinets for the signal-handling and RF-amplifier circuits plus a separate, walk-in enclosure for power-supply components. This increases accessibility to all systems and increases installation flexibility.

A standby exciter/modulator is available as an option in a group which includes fault-sensing and automatic switchover to the standby system.



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Transmitter control cabinet at left houses exciter/modulator unit and twin, solid-state intermediate power amplifiers.

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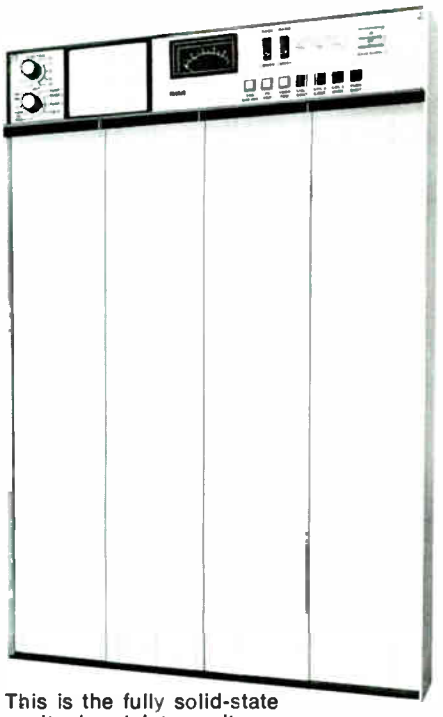
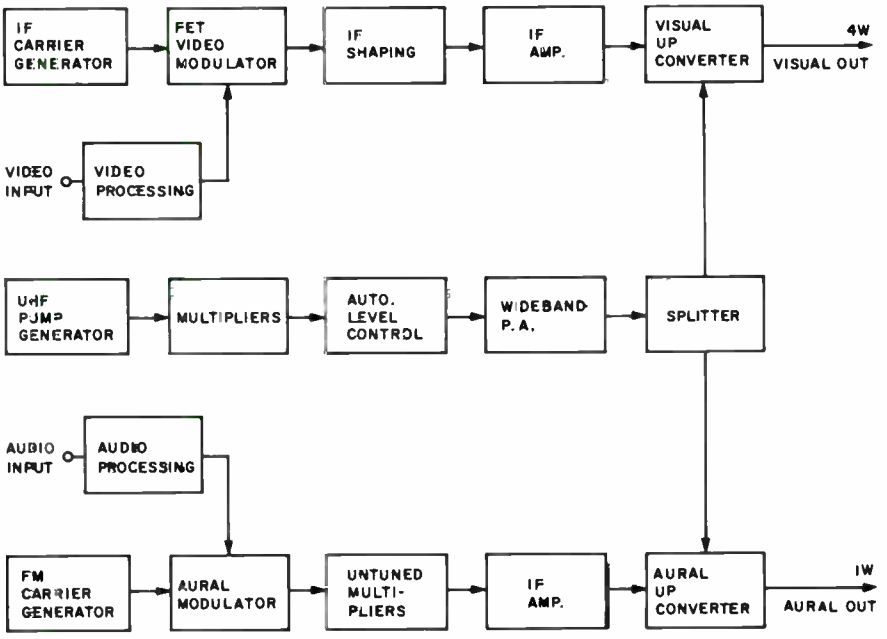


This is the fully solid-state exciter/modulator unit.

All exciter/modulator circuits are modularized.



Exciter/modulator functional diagram.

Connected to an antenna system of suitable power gain, the TTU-60C2 transmitter is capable of an effective radiated power (ERP) of more than two megawatts. The exciter/modulator section is entirely transistorized, using modern solid-state components in an innovative design in both circuitry and packaging. The transmitter features solid-state intermediate power amplifiers, vapor-cooled, four-cavity klystrons (in which the cavities are integral to tube structure), identical aural-visual power stages (redundant visual) and built-in readiness for remote-control operations.

The TTU-60C2 uses a mechanical design that separates the power-supply components from the signal-handling sections (see floor layout). This arrangement increases rear-side access to the transmitter cabinets (even while the transmitter operates) and allows extra installation flexibility as to location of the power-supply components relative to the transmitter circuits. A special switching system—using vacuum switches—disconnects the klystron tubes from the beam-power supply individually to isolate a failed klystron without interrupting program transmission.

Modular, Solid-State Exciter/Modulator

Modern, solid-state circuitry in the exciter/modulator unit combines reliability with operating ease. The oscillators use temperature-compensated crystals that eliminate the limitations of crystal heaters or ovens and assure on-frequency operation from the moment of turn-on. A spare oscillator module is provided for the pump-generator section of the unit for use in the event of an outage.

Aural and visual modulation takes place at an intermediate frequency and is up-converted to carrier frequency at a 15 watt visual and 5 watt aural power level. The exciter/modulator power output is 4W visual and 800 mW aural (see exciter/modulator block diagram). A separate catalog section on the exciter/modulator is available (see Type TTUE-4).

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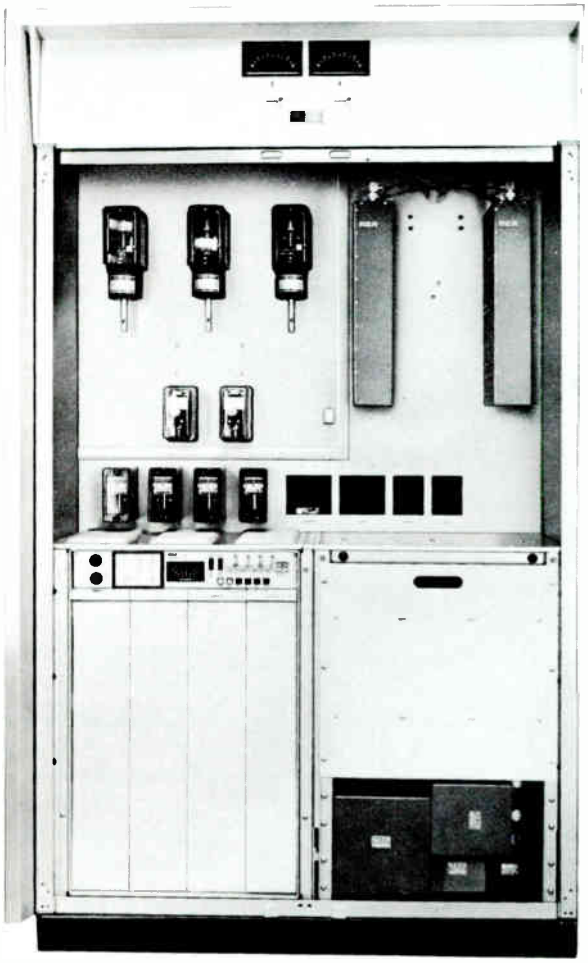
Solid-State Intermediate PA

The exciter/modulator aural output drives the aural klystron amplifier directly without intermediate amplification. On the visual side, the modulated carrier is split into two separate outputs and routed to two intermediate power ampliers. These are solid-state units, each capable of 10 watts power output. The IPA units are tuned to channel during manufacture and require no readjustment or operating controls. The IPA units operate from a 24 volt, dc power supply housed within the exciter/control cabinet.

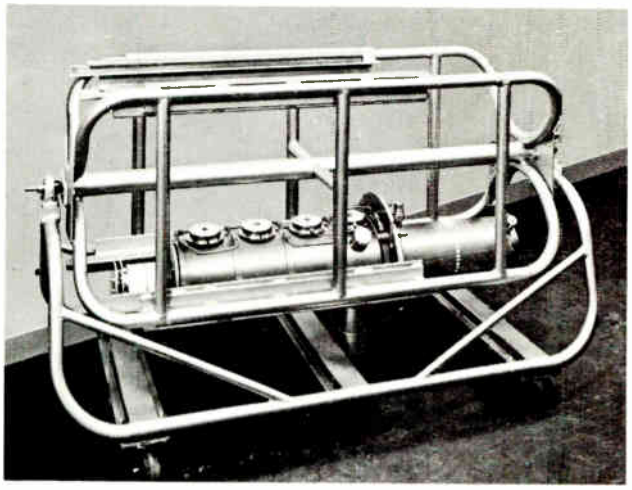
Vapor-Cooled Klystrons

The transmitter uses three identical klystrons: one in the aural channel and two in the visual. These are vapor-cooled, four-cavity units of integral-cavity design with a reputation for stability, reliability and long life. The visual klystrons operate

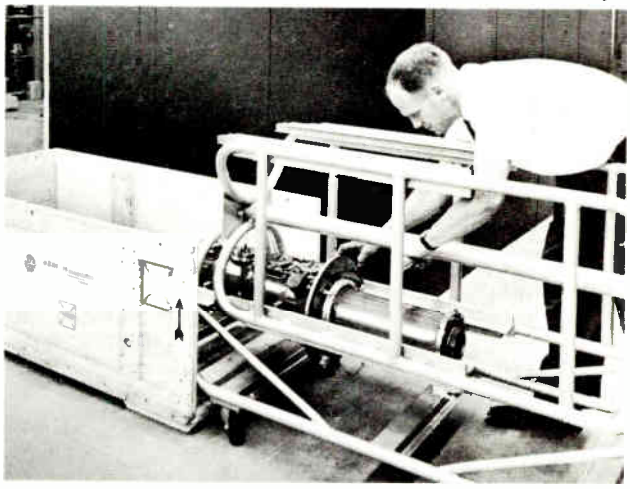
Close-up of control cabinet. Exciter/modulator unit at lower left; solid-state IPA units at upper right.



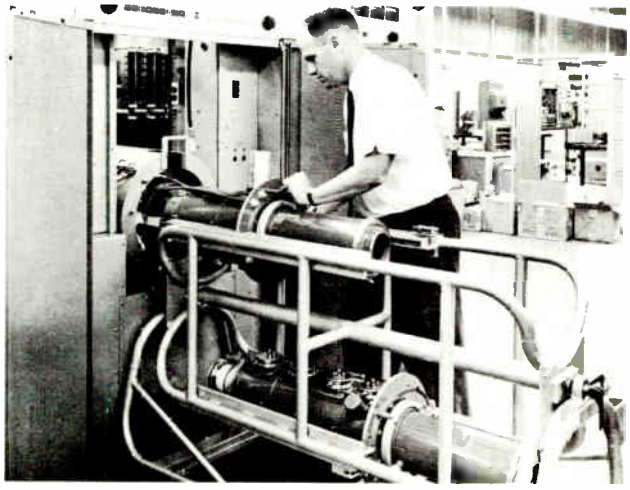
Klystron carriage stores spare klystron safely and securely.



Klystron transfers from crate to carriage quickly and easily.



Transfer from carriage to socket is at table-top height.



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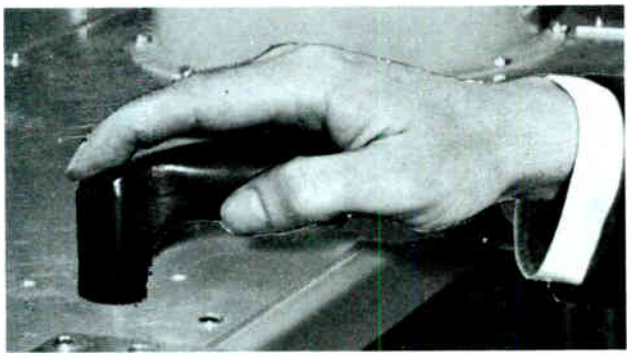
in a diplexed arrangement with each klystron contributing independently to the transmitter power output. The diplex arrangement is such that an outage in either visual amplifier merely reduces transmitter power output. Through an optional co-ax switcher, one of the visual stages can replace a failed aural klystron on a temporary basis while the other visual amplifier serves the visual channel.

With all three klystrons identical, a single spare serves all three amplifiers. And, the fact that aural and visual tubes are interchangeable allows operation of retired visual tubes as aural amplifiers for extended tube life.

Ghost-Cancelling Final Amplifier

The klystron visual amplifiers operate in parallel, each contributing one-half of the visual power output. A line-stretcher device, in the RF drive to Visual Amplifier Number 2, shifts the relative phase of the RF by 90 degrees. As a result, the power output from both amplifiers is in phase-quadrature. The input circuits of the combiner re-establish the in-phase relationship of the energy.

This arrangement makes any reflected power from the load appear at the two klystron outputs with a 90-degree phase difference. When re-reflected toward the load the reflection is shifted another 90 degrees. As a result, the reflected energy appears at the combiner inputs in phase opposition and is dissipated in the combiner's reject load. The end result is, essentially, the elimination of any ghosting effect from reflected power due to load discontinuities.



Built-in switch disconnects individual power amplifier cubicle from operating transmitter.

Easy Klystron Change

Klystron replacement in the TTU-60C2 transmitter is accomplished easily by one man, working alone, in a matter of a few minutes. This is the result of several factors: integral cavities, tilt-down magnet construction, quick-disconnect connections and a tube dolly that carries the entire load of the klystron (see photos).

Stage Isolation Switching Included

Each of the three klystron cabinets includes a "disable switch" that allows effective electrical isolation of that cabinet from the remainder of the transmitter. Operating this switch disconnects the high voltage (through a vacuum relay), automatically adjusts the magnet current and disables the interlocks for that cabinet. A klystron replacement requires closing of a steam-gate valve for that cabinet.

High-Level Sideband Shaping

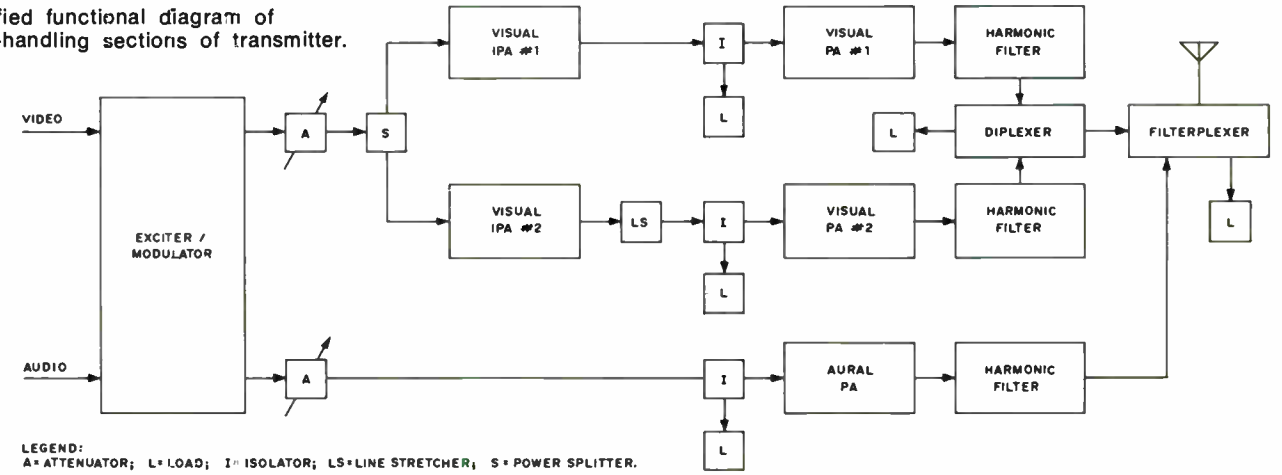
Sideband shaping and visual/aural diplexing is accomplished at the transmitter output in a hybrid filterplexer. This is a temperature compensated, passive device employing waveguide cavities and sections of coaxial line in the filter portion. It is pretuned during manufacture and requires no operational adjustments. The inputs have a constant impedance over the band of frequencies involved.

Efficient Klystron Cooling

Klystron cooling is accomplished with the conversion of water to steam which is, in turn, condensed back to water for re-use. The heat exchanger (condenser) removes the latent heat of the steam and dissipates it to outdoor air. A motor-driven pump circulates the condensed water to the storage tank and thence to the klystrons. A standby pump and motor is connected in the system for immediate use in the event of pump system failure. A system of manually operated valves effects the pump changeover. These valves make periodic switchover practical to let both pumps share in the hours of use.

Temperature control of the condensate returning to the klystrons and their mag-

Simplified functional diagram of signal-handling sections of transmitter.



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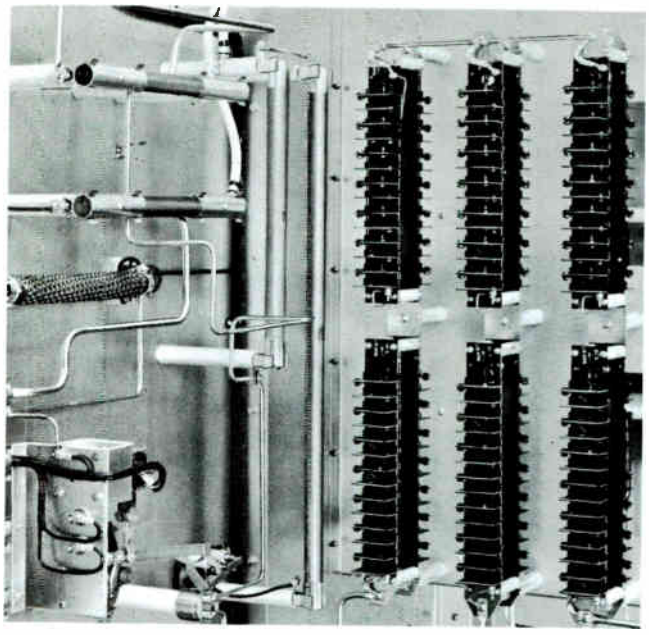
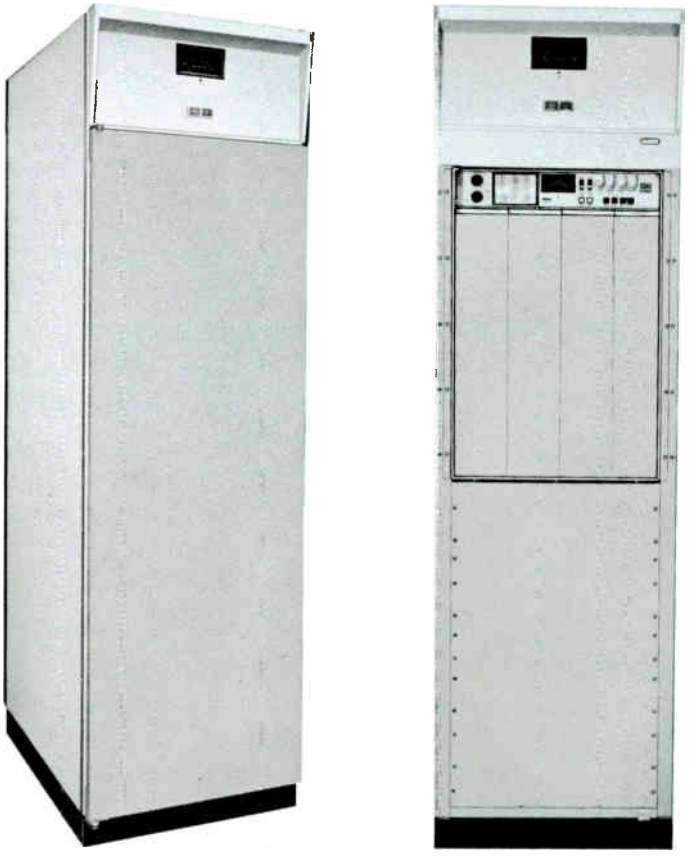


Modularized silicon rectifiers in power supply mount on inside walls of power supply enclosure for easy access and efficient convection cooling.

The exciter/modulator is available optionally in a free-standing cabinet for use as a spare exciter/modulator system. The cabinet matches that of the transmitter.



nets contributes to the gain and bandwidth stability of the amplifier stages.

The heat exchanger requires ductwork between it and outdoor air. This ductwork is ordinarily provided by the purchaser unless specifically ordered from RCA.

High-Speed Fault Protection

The transmitter incorporates an electronic, high-speed, fault protection system capable of removing RF excitation within 20 microseconds in the event of an RF-load disturbance. The klystron amplifiers are protected with instantaneous relays which trip on overload and automatically reset unless the overload continues beyond two or three reset cycles. Excessive water inlet temperature, excessive klystron body temperature and inordinate magnet current are sensed as indicators of faulty operation. Front-panel indicator lamps identify specific overloads or other abnormal conditions. These remain lit unti manually reset, even if the overload reset or the fault cleared, to indicate the source of alarm condition.

Optional Spare Exciter Group

For those who want redundancy extended into the exciter/modulator section of the transmitter a spare exciter group is available as an extra-cost option. This group consists of a free-standing cabinet containing an exciter/modulator unit, fault-sensing and automatic switchover equipment and an exciter/modulator power supply. The cabinet matches the style of the transmitter to allow installation adjacent to the exciter/control cabinet of the transmitter. The fault-sensing and switchover equipment monitors main exciter/modulator output and, in the event of outage, automatically switches over to the spare exciter/modulator system.

Standby Power Kit Optional

Offered for those who expect to operate the transmitter under remote control, once-a-week inspection and "20-percent standby power" requirements, the Standby Power Kit includes spare exciter group described above and input/output switching in the klystron amplifier stages to let visual amplifier #2 substitute for a failed aural amplifier.

Should one of the visual amplifiers fail, the option allows disconnection of it from the power supply to allow continued operation at reduced power.

The option includes fault-detection facilities that identify a failed amplifier via the remote control system to let the transmitter operator perform the correct switching action. Local alarms and switching control are also included.

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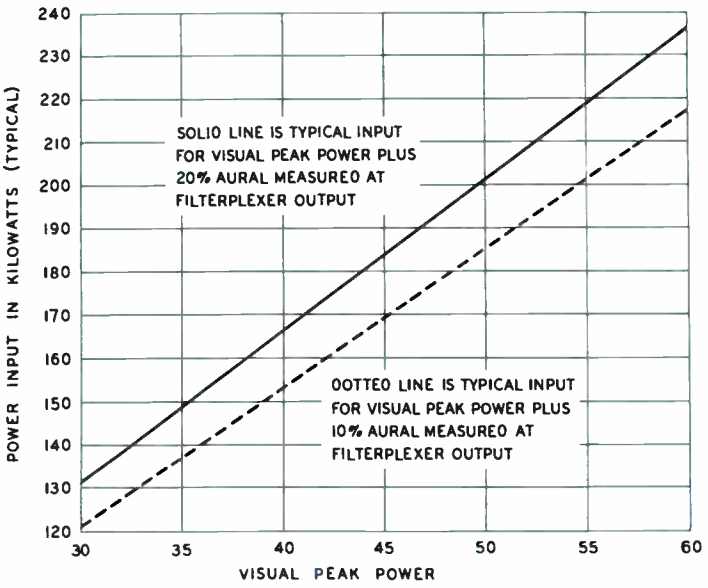
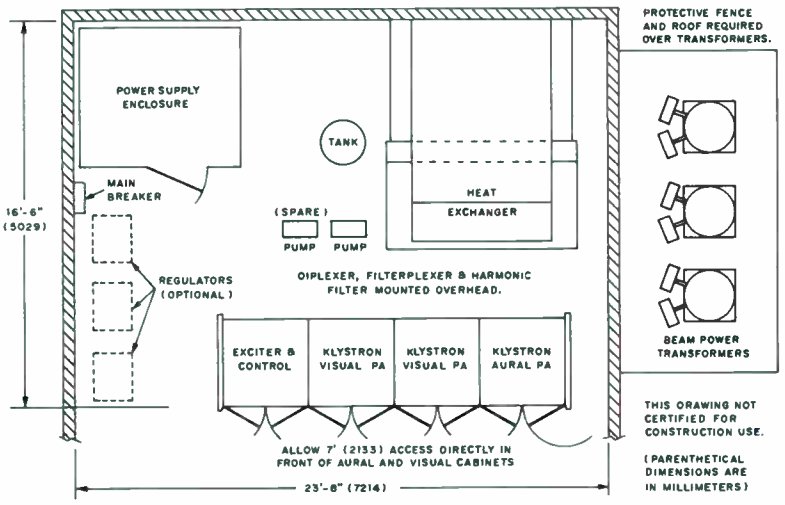


Plot of transmitter input power vs. output power under two operational conditions.



Typical floor layout for transmitter. Ductwork between heat exchanger and outside wall not supplied unless ordered specifically.

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Specifications

Visual Performance

Type of Emission (FCC Designation)	A5
Operating Channel	Any channel between 14 and 69 inclusive
Power Output (At filterplexer output)	60 kW
Output Impedances:	
Power Amplifier	50 ohms
Filterplexer (6⅛-inch coaxial connection)	75 ohms
Video Input:	
Impedance (Unbalanced)	75 ohms
Level (min., sync positive)	0.7V p-p
Return Loss (60 Hz to 6 MHz)	−35 dB
Carrier Frequency Stability[1]	±500 Hz
Amplitude vs. Frequency Response:[2]	
Upper Sideband Response Characteristic:	
Between 0.2 and 4.1 MHz above carrier	+0.5, −1 dB
At 3.58 MHz above carrier	+0, −0.5 dB
At 4.75 MHz above carrier	−20 dB
Lower Sideband Response Characteristic:	
At 0.5 MHz below carrier	+0, −1.5 dB
At 1.25 MHz below carrier	−20 dB
At 3.58 MHz below carrier	−42 dB
Envelope Delay vs. Frequency:[3]	
Between 0.2 and 2 MHz	±60 ns
At 3.58 MHz	±30 ns
At 4.18 MHz	±60 ns
Variation in Frequency Response with Brightness[4]	−1, +1.5 dB
Modulation Depth Capability	5%
Amplitude Variation (Over one frame, ref: sync peak)	2%
Output Regulation	3%
Pedestal Level Variation[5]	1.5%
Differential Gain[6]	0.75 dB
Low Frequency Linearity	1 dB
Differential Phase[7]	±3°
Subcarrier Amplitude (Color Bars)	0.7 dB
Burst vs. Subcarrier Phase (Color Bars)[8]	±3°
AM Noise (rms below 100% modulation)[9]	−50 dB
Harmonic Attenuation[10]	60 dB

Aural Performance

Type of Emission (FCC Designation)	F3
Power Output (At filterplexer input)	6 to 16 kW
Output Impedances:	
Power Amplifier	50 ohms
Filterplexer	75 ohms
Audio Input:	
Impedance (Balanced)	600/150 ohms
Level (For ±25 kHz deviation)	+10 ±2 dBm
Carrier Frequency Stability[1]	±500 Hz
Intercarrier Frequency Stability[11]	±500 Hz
Modulation Capability	±50 kHz
Frequency Response Characteristic (30 Hz to 15 kHz)	±1 dB max.
Distortion (30 Hz to 15 kHz)	1% max.
FM Noise (Below ±25 kHz deviation)	−60 dB max.
AM Noise (rms)	−50 dB max.
Harmonic Attenuation[10]	60 dB max.

Environmental

Operational Altitude (Max. above sea level)	7500 ft. (2286 m)
Ambient Operating Temperature	1 to 45°C (34 to 113°F)
Heat Exchanger Air Inlet Temperature	10 to 45°C (50 to 113°F)

Electrical Requirements

Power Requirements	440/460/480V, 60 Hz, 3-phase, 218 kW max. at 10% aural (Three- or four-wire connection)
Line Voltage Regulation	3% max.
Line Variations (Slow or Rapid)	±3% max.
Power Factor (Approx.)	90%

Mechanical

Dimensions:	
Transmitter ("Front Line") Cabinets	180″ L; 45″ D; 77″ H (4.57, 1.14, 1.95 m)
Heat Exchanger	103″ L; 62″ D; 45″ H (2.62, 1.57, 1.14 m)
Filterplexer (Frequency Dependent)	70-74″ L; 62-66″ D; 40-50″ H (1.78-1.88, 1.58-1.68, 1.02-1.27 m)
Power Supply Enclosure	84″ L; 70″ D; 77″ H (2.13, 1.77, 1.95 m)
Beam Supply Transformer (Three used)	57″ H; 41″ W; 33″ D (1.45, 1.04, 0.84 m)
Weights of Major Units (Approx.):	
Transmitter ("Front Line" cabinets, total)	6440 lbs. (2921 kg)
Heat Exchanger	1450 lbs. (658 kg)
Filterplexer	600 lbs. (272 kg)
Power Supply Enclosure	3300 lbs. (1497 kg)
Beam Supply Transformer	1570 lbs. (712 kg)
Shipping Data:	
Total Weight (Approx.)	25,500 lbs. (11,567 kg)
Total Volume (Approx.)	2350 ft³ (67 m³)

[1] Maximum variation for 10 days without circuit adjustment within an ambient temperature range of 10 to 45°C (50 to 113°F). Meets or exceeds FCC Specs in 1 to 45°C ambient (34 to 113°F).

[2] With respect to response at visual carrier frequency plus 0.2 MHz as measured with RCA BWU-5C Sideband Response Analyzer. Transmitter operating at mid characteristic. Measured response at filterplexer output.

[3] Departure from standard curve. Tolerances vary linearly between 2.1 MHz and color subcarrier frequency and between color subcarrier frequency and upper sideband limit. A properly terminated phase-correction network is required in the video input of the transmitter while performing the measurement. Minor, multi-lobed delay ripples—originating in the delay network—are excluded from this specification.

[4] Maximum change with response at mid-characteristic when measured to brightness levels of 22.5 and 67.5 percent of sync peak. Peak-to-peak modulation level adjusted to approximately 20 percent of sync level.

[5] Change in blanking level relative to sync peak for change in brightness from all black to all white picture.

[6] Maximum variation of 3.50 MHz modulation frequency −20 percent p-p nominal amplitude—when superimposed on "stairstep" or "ramp" signal adjusted for brightness excursion of 20 to 75 percent of sync peak.

[7] Maximum phase difference with respect to burst, measured following the sideband filter, for any brightness level between 75 and 15 percent of sync peak using 10 percent, p-p modulation. This is equivalent to 5 percent p-p modulation indicated on a conventional diode demodulator.

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

[9] Hum and noise, 50 Hz to 15 kHz. Extraneous modulation—unrelated to video—above 15 kHz but within the visual passband: 40 dB below 100% modulation.

[10] Ratio of any single harmonic to peak visual fundamental power.

[11] Maximum variation with respect to separation between aural and visual carriers.

Accessories

Spare Klystron Power Tube (Specify Channel)	MI-560407
Spare Solid-State IPA (Specify Channel No.)	MI-560899
Primary Voltage Regulator (Three req'd if used)	MI-560493
Standby Exciter Cabinet Group, Type TTUE-4	ES-560937
Standby Power Option (for 20% Standby Power)	on Request

Ordering Information

UHF-TV Transmitter, 60 kW Visual, 16 kW Aural, Type TTU-60C2	ES-560961

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RCA

catalog TT.3700A

(Replaces B.5046)

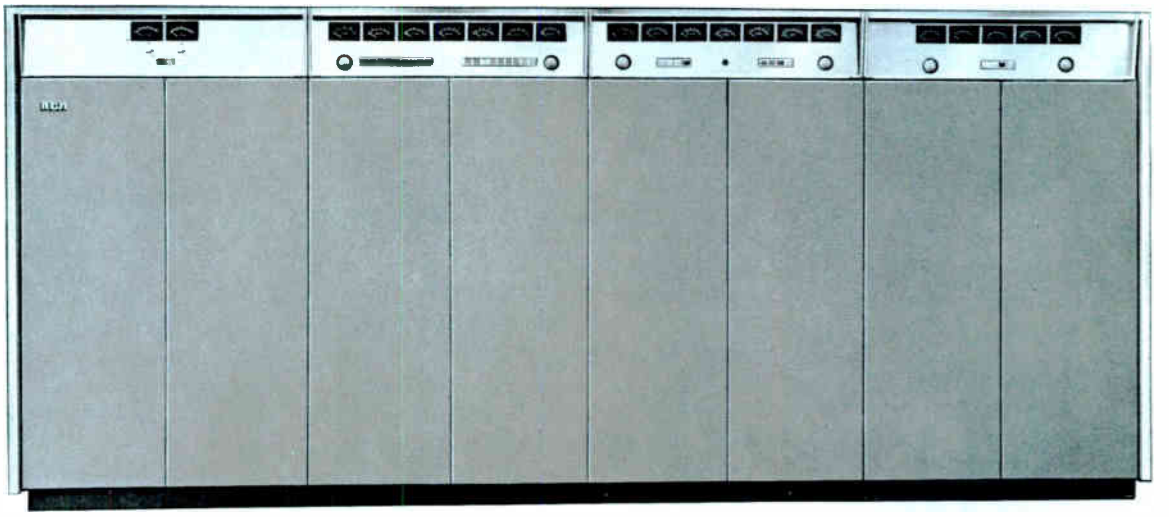
UHF-TV Transmitter, 110 kW Visual, 24 kW Aural, Type TTU-110B

- Redundant visual amplifiers
- Vapor-cooled, integral-cavity klystrons
- Solid-state exciter/modulator
- Ready for remote-control operation
- Intermediate-frequency modulation

The TTU-110B is a 110-kilowatt UHF-Television transmitter using integral-cavity klystrons as aural and visual power amplifiers. The klystrons are five cavity units arranged for easy interchange when replacement is necessary.

The TTU-110B uses four front-line cabinets and a rear walk-in enclosure for the transmitter power supply and switching components with external filterplexer, heat exchanger and unitized beam-voltage supplies. The ensemble is designed for convenient accessibility to all functions.

A standby exciter/modulator is available in a group which includes fault sensing and automatic switchover to the standby system.



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Connected to an antenna of suitable power gain, the TTU-110B transmitter is capable of an effective radiated power (ERP) of 5 megawatts. The exciter/modulator section is entirely transistorized, using modern, solid-state components in an innovative design in both circuitry and packaging. The transmitter features vapor-cooled, five-cavity klystrons (in which the cavities are integral to the tube structure), identical aural and visual power stages (redundant visual) and built-in readiness for remote control operation.

The TTU-110B uses high-gain five-cavity klystrons which operate at full output with the RF drive from the exciter/modulator aural and visual outputs. This extra power gain avoids the need for intermediate power amplifiers in the visual channel which, in turn, results in reduced transmitter complexity and increased transmitter reliability.

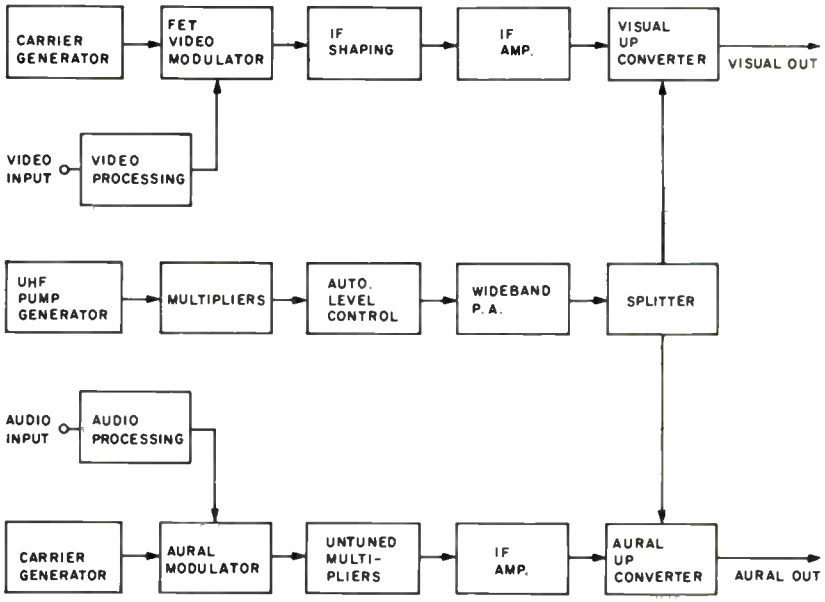
Modular, Solid-State Exciter/Modulator

Modern, solid-state circuitry in the exciter/modulator unit combines reliability with operating ease. The oscillators use temperature-compensated crystals that eliminate the limitations of crystal heaters or ovens and assure on-frequency operation from the moment of turn-on. A spare oscillator module is provided for the pump-generator section for use in the event of an outage.

Aural and visual modulation takes place at an intermediate frequency and is up-converted to carrier frequency at a 15-watt visual and a 5-watt aural power level. As a result of the high level of up-conversion, the exciter/modulator produces output levels of 4W visual and 800mW aural without linear amplification (see exciter/modulator block diagram). A separate catalog section is available on the exciter/modulator (see Type TTUE-4).

Vapor Cooled Klystrons

The transmitter uses three identical klystrons: one in the aural channel and two in the visual. These are vapor-cooled, five-cavity units of integral-cavity design with a reputation for stability, reliability and long life. The visual klystrons operate in a diplexed arrangement with each klystron contributing independently to transmitter output. The diplex arrangement is such that an outage in either visual amplifier merely reduces transmitter power output. Through the optional addition of coaxial switching, one of the visual stages can replace a failed aural klystron temporarily while the other visual amplifier serves the visual channel.



Exciter/modulator functional diagram.

Exciter/modulator control panel.

With all three klystrons identical, a single spare serves all three amplifiers. And, the fact that aural and visual tubes are interchangeable allows operation of retired visual tubes as aural amplifiers for extended tube life.

Ghost Cancelling Final Amplifier

The klystron visual amplifiers operate in parallel, each contributing one-half of the visual power output. The length of the transmission line from each amplifier to the waveguide hybrid combiner is selected so that the power from the two is in phase quadrature for proper combining. A line stretcher is provided in the RF drive to visual amplifier number 2 to precisely establish this relationship.

As a result of this arrangement, any reflected power from transmitter load discontinuities will be divided in the combiner and re-reflected from the klystron output. In this process, the divided reflected power is subjected to relative phase shifts due to the differences in electrical line lengths so that the two halves appear in phase opposition in the combiner and are dissipated in the combiner reject load. Thus any ghosting effect due to load discontinuities is virtually eliminated.

Easy Klystron Change

Klystron replacement in the transmitter is accomplished easily by one man, working alone, in a matter of a few minutes. This is the result of several factors: integral cavities, tilt-down magnet construction, quick-disconnect connections and a tube dolly that carries the entire load of the klystron.

High-Level Sideband Shaping

Sideband shaping and visual/aural diplexing is accomplished at the transmitter output in a waveguide filterplexer. This is a temperature-compensated, passive device, pre-tuned during manufacture and requiring no operational adjustment. The input ports have a constant impedance over the band of frequencies involved. Due to its inherent high power capability, the waveguide filterplexer requires no gassing or pressurization. Free convection cooling is accomplished by the special cavity-fin design, requiring no blowers. (See separate catalog section on waveguide filterplexer.)

Efficient Klystron Cooling

Klystron cooling is accomplished with the conversion of water to steam which is, in turn, condensed back to water for

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re-use. The heat exchanger (condenser) removes the latent heat of the steam and dissipates it to outdoor air. A motor-driven pump circulates the condensed water to the storage tank and thence to the klystrons. A standby pump and motor is connected in the system for immediate use in the event of pump system failure. A system of manually operated valves effects pump changeover. These valves make periodic switchover practical to let both pumps share in the hours of use.

The condensate returning to the klystrons and their magnets is temperature controlled. The resulting temperature stabilization of the magnets and klystrons cavities contributes substantially to the gain and bandwidth stability of the power amplifier stages.

Ductwork required between the heat exchanger and outdoor air is normally provided by the purchaser unless specifically ordered from RCA.

High-Speed Fault Protection

The transmitter incorporates an electronic, high-speed fault protection system capable of removing RF excitation within 20 microseconds in the event of an RF load disturbance. The klystron amplifiers are protected by instantaneous relays which trip on overload and automatically reset unless the overload continues beyond three reset cycles. Excessive water inlet temperature, excessive klystron body temperature and inordinate magnet current are sensed as indicators of faulty operation. Front-panel indicator lamps identify specific overloads or other abnormal conditions. These remain lit until manually reset, even if the overload or the fault cleared, to indicate the source of alarm condition.

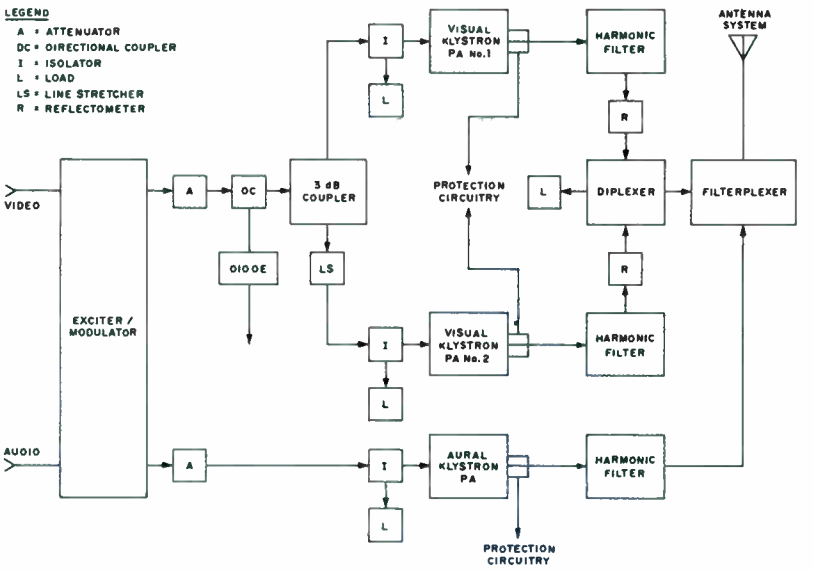
Optional Spare Exciter Group

For additional redundancy and increased system reliability, a spare exciter group is available as an extra-cost option. This group consists of a free-standing cabinet containing an exciter/modulator unit, fault-sensing, automatic switchover equipment and an exciter/modulator power supply. The cabinet matches the style of the transmitter for installation adjacent to the exciter/control cabinet of the transmitter. The fault-sensing and switchover equipment monitors main exciter/modulator output and, in the event of outage, automatically switches over to the spare exciter/modulator system.

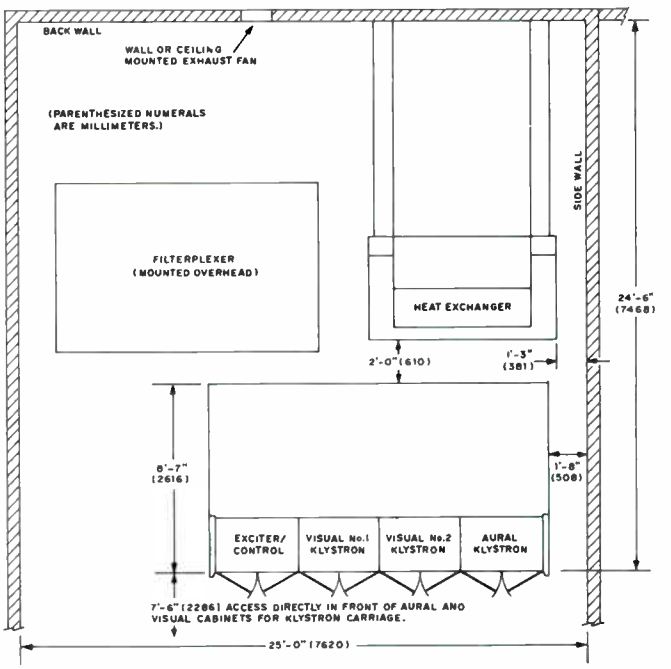
Klystron Power Supply

The klystron power supply for the TTU-110B Transmitter consists of two unitized power supply units, operating from a 440/460/480-volt, three-phase primary power source. Each unit contains the power transformer, rectifier units, filter reactor and a-c snubbing networks in an oil-filled tank. The diode rectifier stacks are mounted in modular form, one for each phase, with access through a port at the top of the tank.

The power supply units are for outdoor installation and are identical except for the transformers. One has a delta-delta and the other a delta-wye primary winding. The output voltages are in parallel in normal operation, but a switching system is provided to operate the transmitter at reduced power from a single supply.



Functional diagram: transmitter system.



Transmitter system needs only 800 square feet (74m²) of floor area with 12-foot (3.7m) headroom.

World Radio History

Specifications

Visual Performance

Type of Emission (FCC Designation)	A5
Operating Channel	Any channel between 14 and 69 inclusive
Power Output (At filterplexer output)	110 kW
Output Impedances:	
Power Amplifier	50 ohms
Filterplexer (6⅛-inch coaxial connection)	75 ohms
Video Input:	
Impedance (Unbalanced)	75 ohms
Level (min., sync positive)	0.7V p-p
Return Loss (60 Hz to 6 MHz)	−35 dB
Carrier Frequency Stability[1]	±500 Hz
Amplitude vs. Frequency Response:[2]	
Upper Sideband Response Characteristic:	
Between 0.2 and 4.1 MHz above carrier	+0.5, −1 dB
At 3.58 MHz above carrier	+0, −0.5 dB
At 4.75 MHz above carrier	−20 dB
Lower Sideband Response Characteristic:	
At 0.5 MHz below carrier	+0, −1.5 dB
At 1.25 MHz below carrier	−20 dB
At 3.58 MHz below carrier	−42 dB
Envelope Delay vs. Frequency:[3]	
Between 0.2 and 2 MHz	±60 ns
At 3.58 MHz	±30 ns
At 4.18 MHz	±60 ns
Variation in Frequency Response with Brightness[4]	−1, +1.5 dB
Modulation Depth Capability	5%
Amplitude Variation (Over one frame, ref: sync peak)	2%
Output Regulation	3%
Pedestal Level Variation[5]	1.5%
Differential Gain[6]	0.75 dB
Low Frequency Linearity	1 dB
Differential Phase[7]	±3°
Subcarrier Amplitude (Color Bars)[8]	0.7 dB
Burst vs. Subcarrier Phase (Color Bars)[8]	±3°
AM Noise (rms below 100% modulation)[9]	−50 dB
Harmonic Attenuation[10]	60 dB

Aural Performance

Type of Emission (FCC Designation)	F3
Power Output (At filterplexer input)	12 to 24 kW
Output Impedances:	
Power Amplifier	50 ohms
Filterplexer	75 ohms
Audio Input:	
Impedance (Balanced)	600/150 ohms
Level (For ±25 kHz deviation)	+10 ±2 dBm
Carrier Frequency Stability[1]	±500 Hz
Intercarrier Frequency Stability[11]	±500 Hz
Modulation Capability	±50 kHz
Frequency Response Characteristic (30 Hz to 15 kHz)	±1 dB max.
Distortion (30 Hz to 15 kHz)	1% max.
FM Noise (Below ±25 kHz deviation)	−60 dB max.
AM Noise (rms)	−50 dB max.
Harmonic Attenuation[10]	60 dB

Environmental

Operational Altitude (Max. above sea level)	7500 ft. (2286 m)
Ambient Operating Temperatures:	
At Sea Level	1 to 45°C (34 to 113°F)
At 3300 ft. (1006 m)	1 to 40°C (34 to 104°F)
At 5000 ft. (1524 m)	1 to 35°C (34 to 95°F)
At 7500 ft. (2286 m)	1 to 30°C (34 to 86°F)
Heat Exchanger Air Inlet Temperature	10 to 45°C (50 to 113°F)

Electrical Requirements

Power Requriements	440/460/480V, 60 Hz, 3-phase 475 kW (Approx.) (Three- or four-wire connection)
Line Voltage Regulation	3% max.
Variations (Slow or Rapid)	±3% max.
Power Factor (Approx.)	90%

Mechanical

Dimensions:	
Transmitter	180″ L; 105″ D; 77″ H (4.57, 2.67, 1.96 m)
Heat Exchanger	142″ L; 75″ D; 87″ H (3.61, 1.91, 2.21 m)
Filterplexer (Frequency Dependent)	214″ L; 140″ D; 26″ H (5.44, 3.56, 0.66 m)
Beam Current Supply (Two Used)	48″ L; 43″ D; 85″ H (1.22, 1.09, 2.16 m)
Weights (Approx.):	
Transmitter	14,350 lbs. (6510 kg)
Heat Exchanger	2,100 lbs. (953 kg)
Filterplexer	1,200 lbs. (544 kg)
Beam Current Supply (Each)	6,700 lbs. (3039 kg)
Shipping Data:	
Total Weight (Approx.)	36,900 lbs. (16,738 kg)
Total Volume (Approx.)	2612 ft³ (74 m³)

[1] Maximum variation for 10 days without circuit adjustment within an ambient temperature range of 10 to 45°C (50 to 113°F). Meets or exceeds FCC Specs in 1 to 45°C ambient (34 to 113°F).

[2] With respect to response at visual carrier frequency plus 0.2 MHz as measured with RCA BWU-5C Sideband Response Analyzer. Transmitter operating at mid-characteristic. Measured response at filterplexer output.

[3] Departure from standard curve. Tolerances vary linearly between 2.1 MHz and color subcarrier frequency and between color subcarrier frequency and upper sideband limit. A properly terminated phase-correction network is required in the video input of the transmitter while performing the measurement. Minor, multi-lobed delay ripples—originating in the delay network—are excluded from this specification.

[4] Maximum change with response at mid-characteristic when measured to brightness levels of 22.5 and 67.5 percent of sync peak. Peak-to-peak modulation level adjusted to approximately 20 percent of sync level.

[5] Change in blanking level relative to sync peak for change in brightness from all black to all white picture.

[6] Maximum variation of 3.58 MHz modulation frequency —20 percent p-p nominal amplitude—when superimposed on "stairstep" or "ramp" signal adjusted for brightness excursion of 20 to 75 percent of sync peak.

[7] Maximum phase difference with respect to burst, measured following the sideband filter, for any brightness level between 75 and 15 percent of sync peak using 10 percent, p-p modulation. This is equivalent to 5 percent p-p modulation indicated on a conventional diode demodulator.

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

[9] Hum and noise, 50 Hz to 15 kHz. Extraneous modulation-unrelated to video —above 15 kHz but within the visual passband: 40 dB below 100% modulation.

[10] Ratio of any single harmonic to peak visual fundamental power.

[11] Maximum variation with respect to separation between aural and visual carriers.

Accessories

Spare Klystron Power Tube (Specify Channel)	MI-560569
Primary Voltage Regulator (Three req'd if used)	MI-560571
Standby Exciter Cabinet Group, Type TTUE-4	ES-560937
Standby Power Option (for 20% Standby Power)	On Request

Ordering Information

UHF-TV Transmitter, 110 kW Visual, 24 kW Aural, Type TTU-110B	ES-560935

World Radio History

RCA

catalog TT.3800B

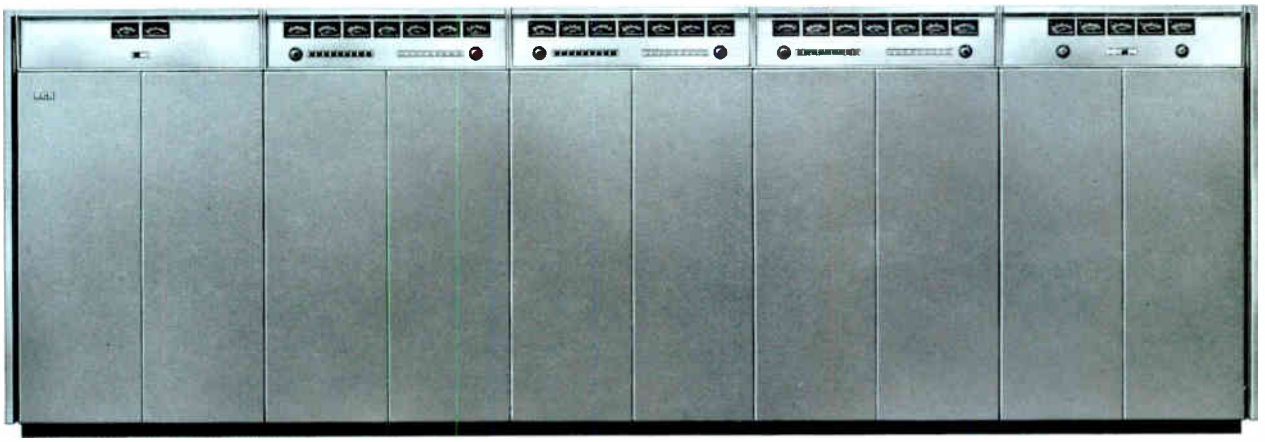
(Replaces TT.3800A)

UHF TV Transmitter, 165kW Visual, 26kW Aural, Type TTU-165C

- Redundant, triplexed visual amplifiers
- Vapor-cooled, integral cavity klystrons
- Solid-state exciter/modulator and IPA
- Ready for remote control operation
- Intermediate-frequency modulation

The TTU-165C is a 165 kilowatt UHF-Television broadcast transmitter capable of producing an effective omnidirectional radiated power of 5 megawatts with an antenna system of practical gain.

The TTU-165C uses integral five-cavity vapor cooled klystrons with an established record of stability and long life. The transmitter is entirely solid-state except for the power amplifier klystrons. The visual power amplifier consists of three klystrons, each contributing independently to the power output by means of a triplexing system. The aural power amplifier is a single klystron, identical to those used as visual power amplifiers.



World Radio History

The TTU-165C uses five in-line cabinets for the signal handling and RF amplifier circuits, and a rear walk-in enclosure for power supply and switching components. This arrangement provides maximum cooling of components and easy access for maintenance.

Modular, Solid-State Exciter/Modulator

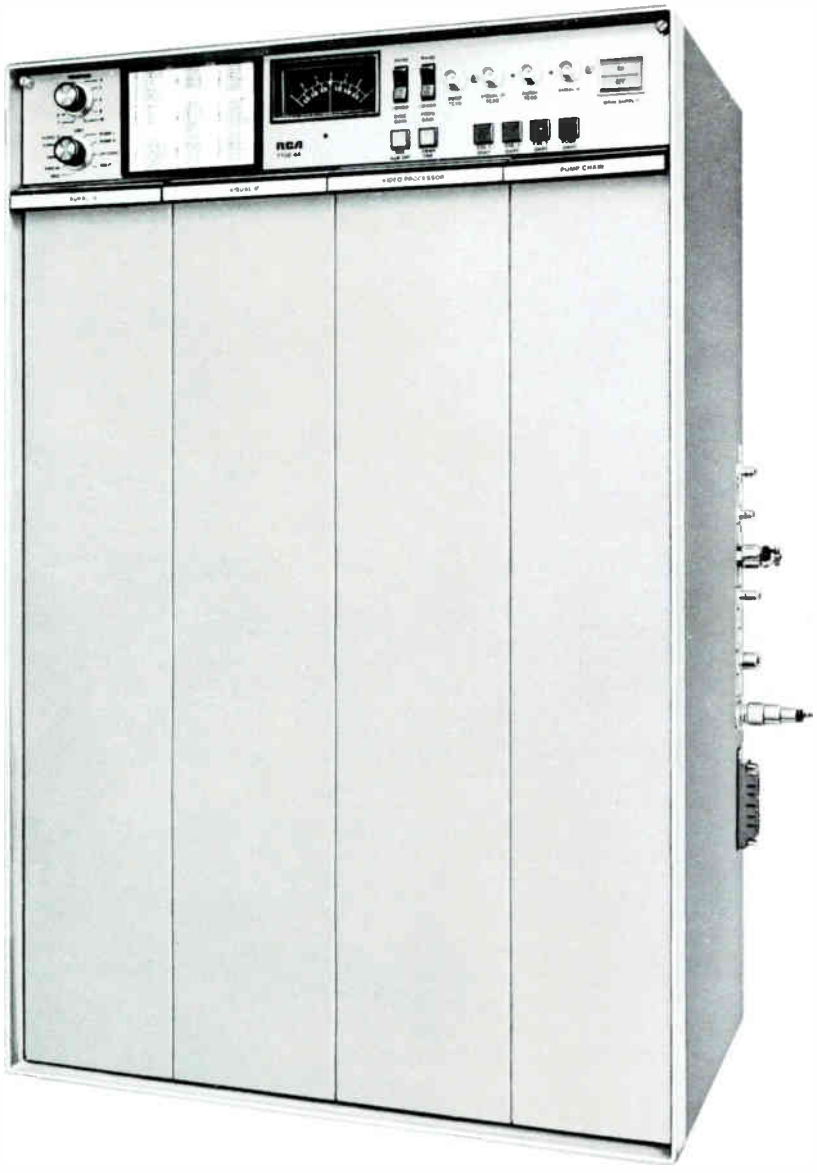
Modern, solid-state circuitry in the exciter/modulator unit combines reliability with operating ease. The oscillators use temperature compensated crystals that eliminate the necessity for heaters or ovens and assure on-frequency operation without warm-up. A spare oscillator module is provided for the pump-generator section of the exciter.

Aural and visual modulation takes place at an intermediate frequency and is up-converted to carrier frequency at a 15 watt visual and 5 watt aural power level. Because of this high level of up-conversion, the exciter/modulator produces output levels of 4 watts visual and 0.8 watts aural without linear amplification. (See exciter/modulator block diagram). A separate catalog section on the exciter/modulator is available (see Type TTUE-4).

Solid-State Intermediate PA

The exciter/modulator aural output drives the aural klystron amplifier directly without intermediate power amplification. The visual output is routed to a solid-state intermediate power amplifier in which the signal is amplified to a 10-watt level. The output of the IPA is split into three equal signal paths to drive each of the three visual power amplifier klystrons. (See functional diagram). The IPA is tuned to the specified channel during manufacture and requires no adjustment or operating controls. It operates from a 24-volt d.c. power supply which is a part of the exciter-control cabinet.

This is the fully solid-state exciter/modulator.



World Radio History

Vapor-Cooled Klystrons

The transmitter uses four identical klystrons; one in the aural channel and three in the visual. These are vapor-cooled, high-gain, five-cavity units of integral cavity design. The three visual klystrons operate in a triplex arrangement with each klystron contributing independently to the transmitter power output. The peak power output of each visual klystron is 55 kilowatts. The power output from the first two visual klystrons is combined in a waveguide hybrid diplexer to produce a power of 110 kilowatts. This power is then combined with the power from the third visual klystron in a 4.8 dB waveguide combiner to produce a power output of 165 kW. This arrangement is such that a failure of any visual amplifier results in only a power output reduction, and not a loss of the visual signal. By the addition of an optional coaxial switching system, one of the visual amplifiers may be used in aural service in the event of an aural amplifier failure.

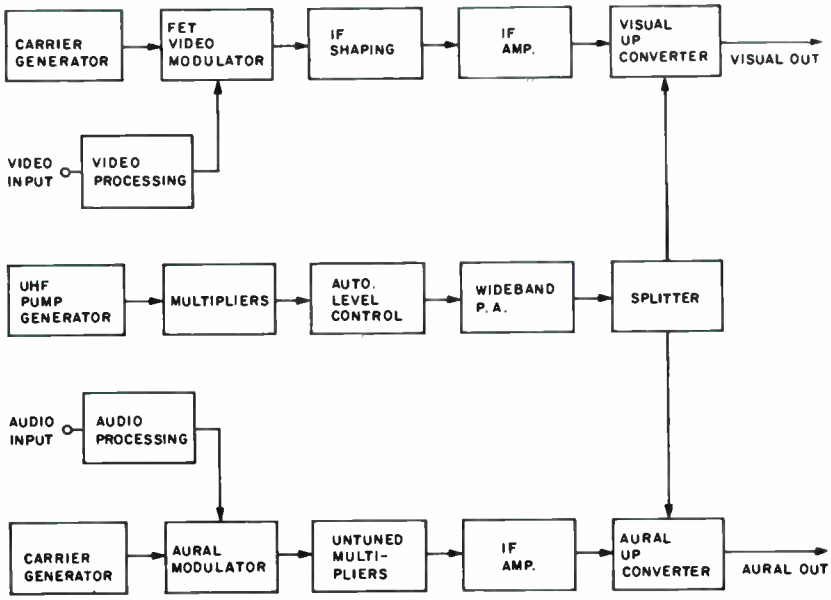
With all klystrons identical, a single spare serves all four amplifiers and, because aural and visual tubes are interchangeable, retired visual tubes may be used in aural service for extended tube life.

Ghost Cancelling Final Amplifier

A line stretcher device is incorporated in the RF drive to the visual #2 amplifier, for proper phasing of the output to the first visual combiner. A second line stretcher is provided in the RF drive to the visual #3 amplifier, for proper phasing of its output to the second combiner. The characteristics of the combining system are such that the two inputs to each combiner are in phase quadrature, with the in-phase relationship re-established at the combiner output.

This arrangement has the advantage that any power reflected from the transmitter load is divided in the RF combiner,

The five-cavity, vapor-cooled klystron.



Exciter/modulator functional diagram.

World Radio History

and each part subjected to a relative phase shift in being re-reflected from the power amplifier outputs, so that they appear in phase opposition at the combiner and are dissipated in the reject load. The result is essentially the elimination of any ghosting effect caused by reflected power from a load mismatch.

Easy Klystron Change

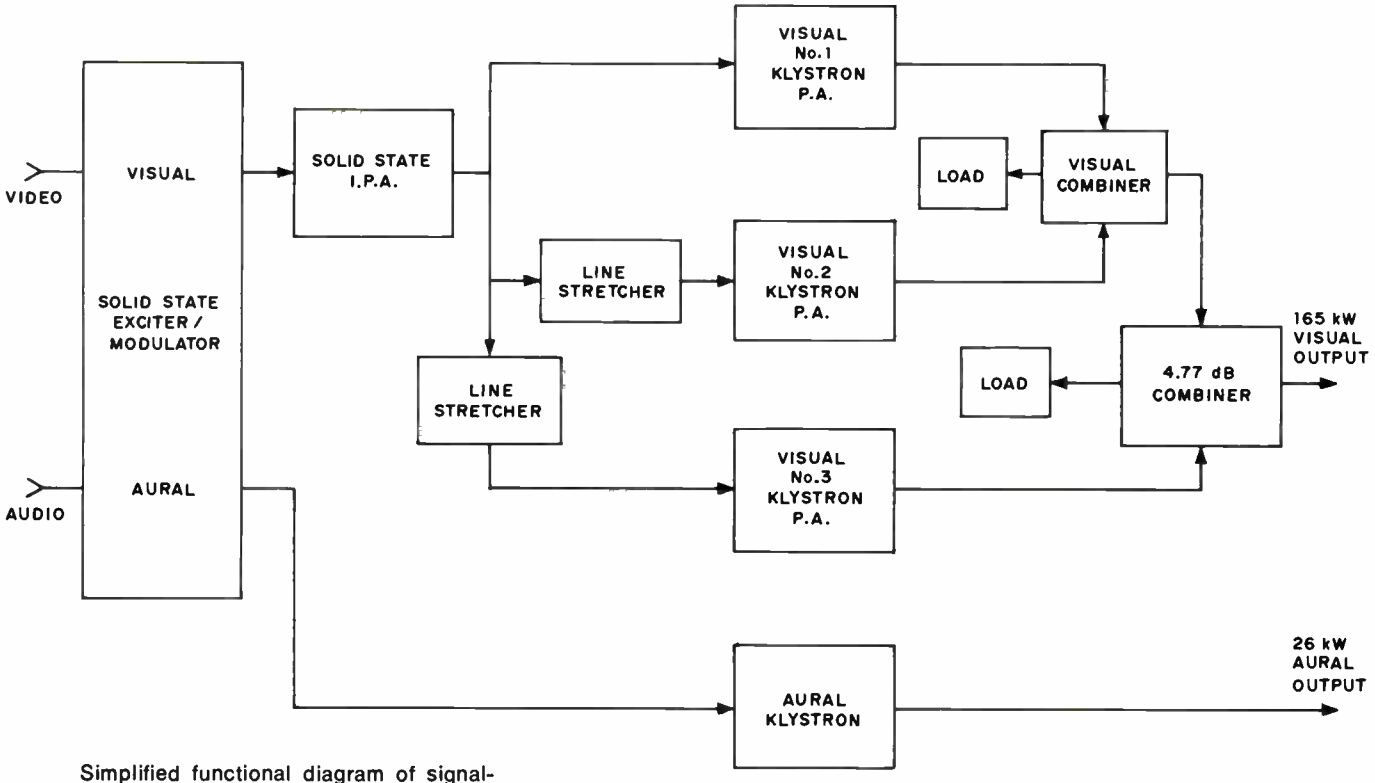
Klystron replacement in the TTU-165C transmitter is accomplished easily by one man, working alone, in a matter of a few minutes. This is the result of several factors: integral cavities, tilt-down magnet construction, quick-disconnect connections and a tube dolly that carries the entire load of the klystron.

Unitized Beam Power Supplies

The klystron power supply for the TTU-165C Transmitter consists of three unitized power supply units, operating from a 440/460/480 volt, 60 Hz, three-phase primary. Each unit contains the power transformer, rectifier stacks, filter reactor and a-c snubbing networks in an oil-filled tank. The diode stacks are mounted in modular form, one for each phase, with access through a port at the top of the tank.

The power supply units are designed for outdoor installation and are identical. Two of the three unitized supplies are connected in a delta-delta configuration and the third is switchable between either a delta-delta or a delta-wye configuration. When the third supply is operated in delta-wye and the other two supplies are disconnected, a reduced beam voltage is produced to facilitate initial klystron tuning.

The power supplies normally operate in parallel, but a switching system is provided to operate the transmitter at reduced power from a one- or two-supply configuration. The filter capacitors for the high-voltage supply are located in the transmitter rear enclosure.



Simplified functional diagram of signal-handling sections of the transmitter.

World Radio History

High Level Sideband Shaping

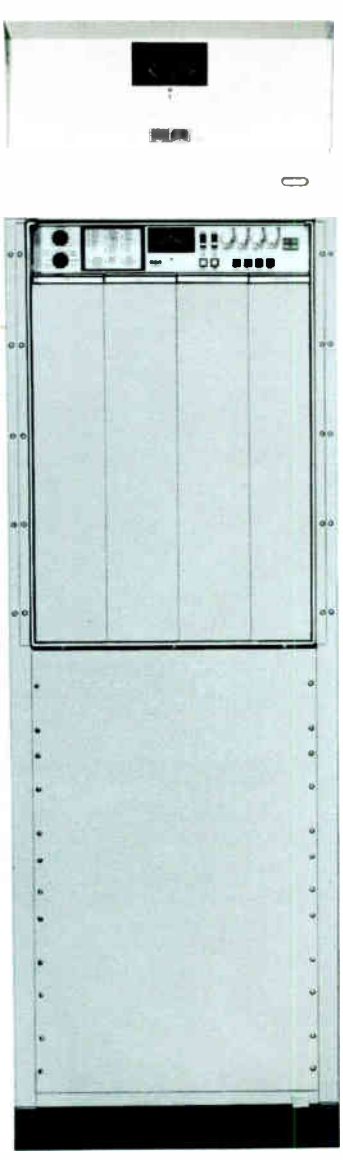
Visual sideband shaping and visual/aural diplexing is accomplished at the transmitter output in a waveguide filterplexer. This is a temperature compensated, passive device, pretuned during manufacture and requiring no operational adjustments. The inputs are designed to have a constant impedance over the band of frequencies produced. (See separate catalog description of waveguide filterplexer.)

Efficient Klystron Cooling

Klystron cooling is accomplished with the conversion of water to steam which is, in turn, condensed back to water for re-use.

The TTU-165C cooling system consists of two identical heat exchangers, each equipped with two steam coils and a water coil. A low-velocity air system is utilized for minimum noise. A spare, on-line water pump is incorporated in the water system,

This is the spare exciter group offered as an option (Door removed to reveal exciter unit). The group includes fault-sensing and automatic switch-over facilities. See text.



With door closed, the exciter group appears as shown here.

World Radio History

with provision for quick changeover. Protection against excessive pressure or surges is provided by pressure regulators and a pump bypass.

The condensate returning to the klystrons and their magnets is temperature controlled. The resulting temperature stabilization of the magnets and klystron cavities contributes substantially to the gain and bandwidth stability of the power amplifier stages.

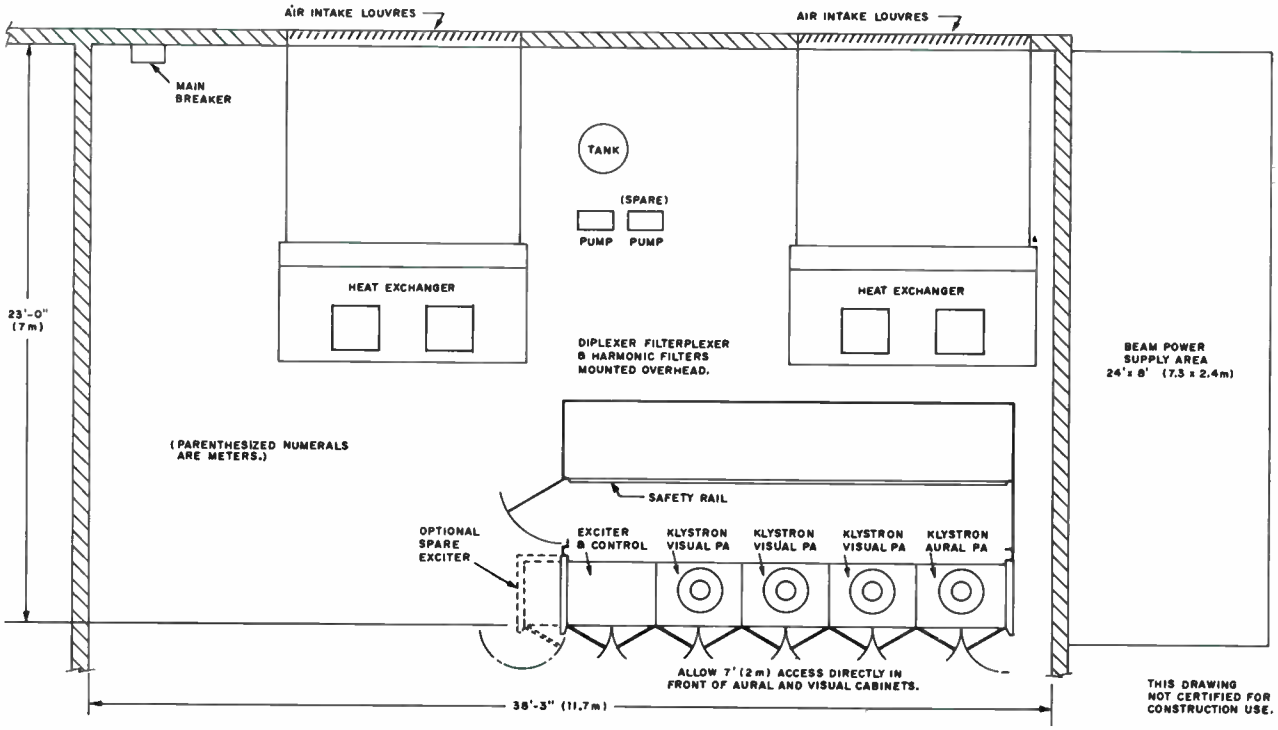
Ductwork required from the heat exchangers to the outdoor air is normally provided by the purchaser unless specifically ordered from RCA.

High-Speed Fault Protection

The TTU-165C transmitter incorporates an electronic, high-speed, fault-protection system capable of removing RF excitation within 20 microseconds in the event of an RF load disturbance. The klystron amplifiers are protected by instantaneous relays which trip on overload and automatically reset unless the overload continues beyond three reset cycles. Excessive water inlet temperature, excessive klystron body temperature and inordinate magnet current are sensed as indicators of faulty operation. Front panel indicator lamps are provided to identify specific overload or other off-normal conditions. These indicators remain lit until manually reset, even if the overload has reset and the fault cleared, to indicate the source of alarm condition.

Optional Spare Exciter Group

For additional redundancy and increased system reliability a spare exciter group is



Typical floor layout for transmitter. Ductwork between heat exchangers and outside wall not supplied unless ordered specifically.

World Radio History

available as an extra-cost option. This group consists of a free-standing cabinet containing an exciter/modulator unit, fault-sensing and automatic switchover equipment and an exciter/modulator power supply. The cabinet matches the style of the transmitter for installation adjacent to the exciter-control cabinet of the transmitter. The fault-sensing and switchover equipment monitors the main exciter/modulator output and, in the event of outage, automatically switches over to the spare exciter/modulator system.

Standby Power Option

This option expands the transmitter facility to meet the requirements for "20-percent standby power" and once-a-week inspection when the transmitter is operated via remote control. It includes the spare exciter group option described above, which provides continuity of service in the event of failure of the main exciter.

Klystron input and output RF switching permits the visual #3 amplifier to be substituted for a failed aural amplifier. In the event of failure of one of the redundant visual amplifiers, the failed stage can be disconnected from the power supply and operation continued at reduced power using the remaining two visual power amplifiers.

Fault-detection circuits are included to provide remote identification of a failed amplifier, enabling the remote operator to initiate the correct switching action. Local alarms and switching control are also provided.

Specifications

Visual Performance

Type of Emission (FCC Designation)	A5
Operating Channel	Any channel between 14 and 69 inclusive
Power Output (At filterplexer output)	165 kW
Output Impedances:	
Power Amplifier	75 ohms
Filterplexer	Note 12
Video Input:	
Impedance (unbalanced)	75 ohms
Level (min., sync positive)	0.7V p-p
Return Loss (60 Hz to 6 MHz)	−35 dB
Carrier Frequency Stability	±500 Hz[1]
Amplitude vs. Frequency Response:[2]	
Upper Sideband Response Characteristic:	
Between 0.2 and 4.1 MHz above carrier	+.05, −1 dB
At 3.58 MHz above carrier	+0, −0.5 dB
At 4.75 MHz above carrier	−20 dB
Lower Sideband Response Characteristic:	
At 0.5 MHz below carrier	+0, −1.5 dB
At 1.25 MHz below carrier	−20 dB
At 3.58 MHz below carrier	−42 dB
Envelope Delay vs. Frequency:[3]	
Between 0.2 and 2 MHz	±60 ns
At 3.58 MHz	±30 ns
At 4.18 MHz	±60 ns
Variation in Frequency Response with Brightness[4]	−1, +1.5 dB
Modulation Depth Capability	5%
Amplitude Variation (over one frame, ref. sync peak)	2%
Output Regulation	3%
Pedestal Level Variation[5]	1.5%
Differential Gain[6]	0.75 dB
Low Frequency Linearity	1 dB
Differential Phase[7]	±3°
Subcarrier Amplitude (Color Bars)	0.7 dB
Burst vs. Subcarrier Phase (Color Bars)[8]	±3°
AM Noise (rms below 100% modulation)[9]	−50 dB
Harmonic Attenuation[10]	−60 dB

Aural Performance

Type of Emission (FCC Designation)	F3
Power Output (At filterplexer input)	16.5 to 26 kW
Output Impedances:	
Power Amplifier	75 ohms
Filterplexer	Note 12
Audio Input:	
Impedance (balanced)	600/150 ohms
Level (for ±25 kHz deviation)	+10 ±2 dBm
Carrier Frequency Stability[1]	±500 Hz
Intercarrier Frequency Stability[11]	±500 Hz
Modulation Capability	±50 kHz
Frequency Response Characteristic (30 Hz - 15 kHz)	±1 dB
Distortion (30 Hz to 15 kHz)	1%
FM Noise (Below ±25 kHz deviation)	−60 dB
AM Noise (rms)	−50 dB
Harmonic Attenuation[10]	−60 dB

Environmental

Operational Altitude (Max. above sea level)	7500 ft. (2286m)
Ambient Operating Temperature	1 to 45°C (34 to 113°F)
Heat Exchanger Inlet Temperature	10 to 45°C (50 to 113°F)

Electrical Requirements

Power Requirements	440/460/480V, 60 Hz, 3-phase, 705 kW (Approx.) (Three- or four-wire connection)
Line Voltage Regulation	3% max.
Slow Line Variations	±3% max.
Rapid Line Variations	±3% max.
Power Factor (Approx.)	90%

(Continued on next page)

World Radio History

Mechanical

Dimensions:

Transmitter Cabinet	242″ L; 105″ D; 77″ H (6.15, 2.66, 1.95m)
Heat Exchanger (Each)	149″ L; 86″ D; 96″ H (3.8, 2.2, 2.4m)
Filterplexer	228″ L; 140″ D; 36″ H (5.8, 3.6, 0.91m)
Beam Power Supply (Each)	74″ x 43″ x 86″ (1.9, 1.1, 2.2m)

Weights:

Transmitter	16,800 lbs. (7620 kg)
Heat Exchanger (Each, Approx.)	1800 lbs. (816 kg)
Filterplexer (Approx.)	1200 lbs. (544 kg)
Beam Power Supply (Each, Approx.)	6700 lbs. (3039 kg)

Shipping Data:

Total Weight	48,000 lbs. (21773 kg)
Total Volume	3,160 ft.^{3} (42m^3)

[1] Maximum variation for 10 days without circuit adjustment within an ambient temperature range of 10 to 45°C. Meets or exceeds FCC Specs in 1 to 45°C ambient.

[2] With respect to response at visual carrier frequency plus 0.2 MHz as measured with RCA BWU-5C Sideband Response Analyzer. Transmitter operating at mid-characteristic. Measured response at filterplexer output.

[3] Departure from standard curve, Tolerances vary linearly between 2.1 MHz and color subcarrier frequency and between subcarrier frequency and upper sideband limit. A properly terminated phase-correction network is required in the video input of the transmitter while performing measurement. Minor, multi-lobed delay ripples—originating in the correction network—are excluded from this specification.

[4] Maximum change with response at mid-characteristic when measured to brightness levels of 22.5 and 65% of sync peak. Peak-to-peak modulation level adjusted to approximately 20 percent of sync level.

[5] Change in blanking level relative to sync peak for change in brightness from all black to all white picture.

[6] Max. variation of 3.58 MHz mod. frequency—20 percent p-p nominal amplitude—when superimposed on "stairstep" or "ramp" signal adjusted for brightness excursion of 20 to 75 percent of sync peak.

[7] Maximum phase difference with respect to burst, measured following the sideband filter, for any brightness level between 75 and 15 percent of sync peak using 10 percent, p-p modulation. This is equivalent to 5 percent p-p modulation indicated on a conventional diode demodulator.

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

[9] Hum and noise, 50 Hz to 15 kHz. Extraneous modulation—unrelated to video—above 15 kHz but within the visual passband: 40 dB below 100% modulation.

[10] Ratio of any single harmonic to peak visual fundamental power.

[11] Maximum variation with respect to separation between aural and visual carriers.

[12] Output of visual diplexers and filterplexer are waveguide. Transition to co-ax line may be selected as required.

Accessories

Standby Exciter Cabinet Group, Type TTUE-4	ES-560937
Primary Voltage Regulator (Three Required, if used)	On Request
Spare Klystron Power Tube (Please specify channel)	MI-561569
Spare Solid-State IPA (Please specify channel)	MI-560899
Video Delay Equalizer, Type TTS-1	MI-560503

Ordering Information

UHF-TV Transmitter, 165 kW Visual, 26 kW Aural, Type TTU-165C	ES-560950

World Radio History

RCA

catalog TT.3900B

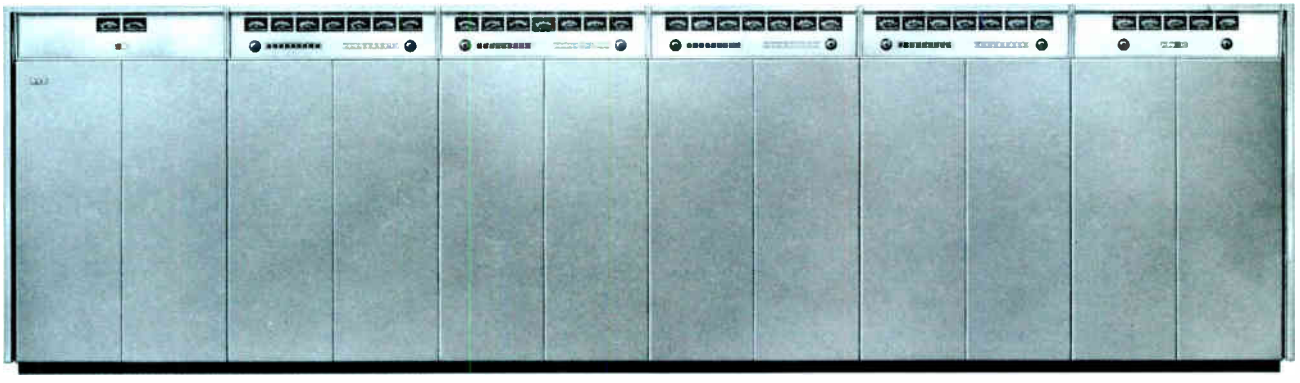
(Replaces TT.3900A)

UHF TV Transmitter, 220kW Visual 24kW Aural, Type TTU-220C

- Redundant, quadruplexed, visual amplifiers
- Vapor-cooled, integral-cavity klystrons
- Solid-state exciter/modulator and IPA
- Ready for remote control operation
- Intermediate frequency modulation

The TTU-220C is a 220-kilowatt UHF-Television broadcast transmitter capable of producing an effective omnidirectional radiated power of 5 megawatts with an antenna system of practical gain.

The TTU-220C uses integral five-cavity vapor cooled klystrons with an established record of stability and long life. The transmitter is entirely solid-state except for the power amplifier klystrons. The visual power amplifier consists of four klystrons, each contributing independently to the power output by means of a quadruplex system. The aural power amplifier is a single klystron, identical to those used as visual power amplifiers.



World Radio History

The TTU-220C uses six in-line cabinets for the signal handling and RF amplifier circuits, and a rear walk-in enclosure for power supply and switching components. This arrangement provides maximum cooling of components and easy access for maintenance.

Modular, Solid-State Exciter/Modulator

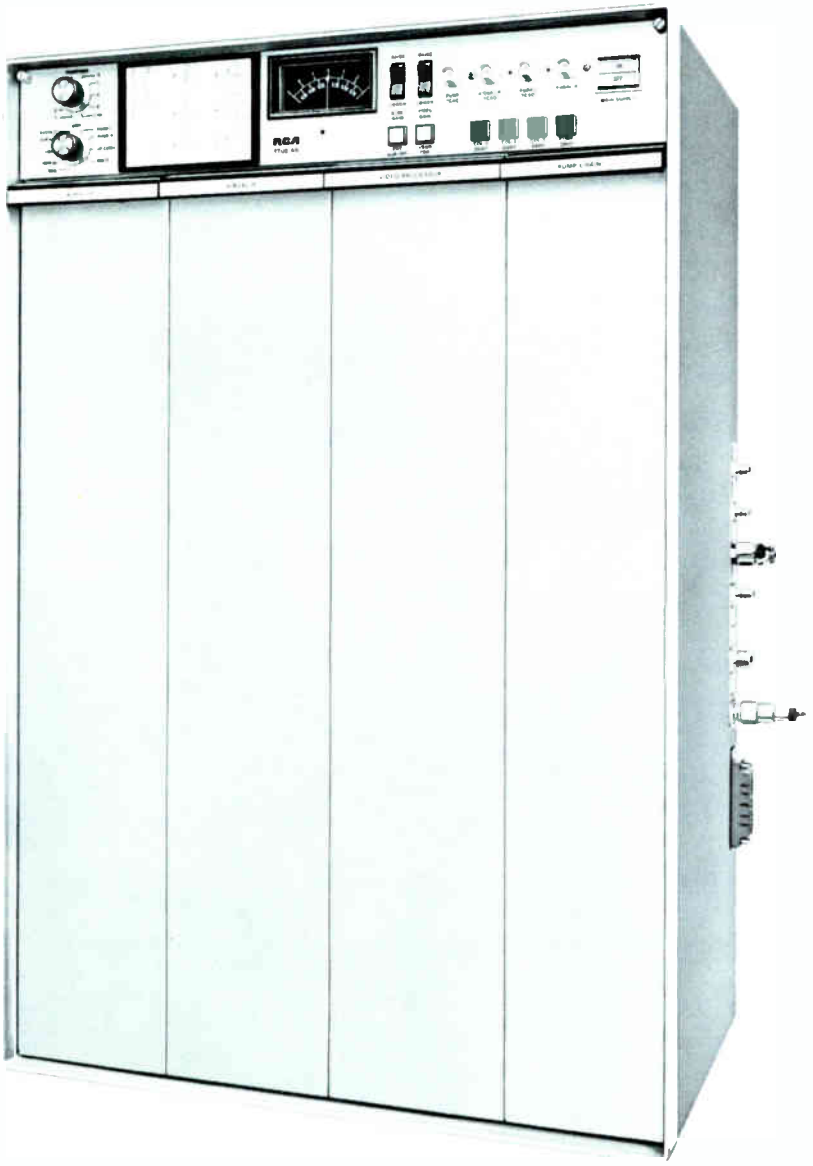
Modern, solid-state circuitry in the exciter/modulator unit combines reliability with operating ease. The oscillators use temperature compensated crystals that eliminate the necessity for heaters or ovens and assure on-frequency operation without warm-up. A spare oscillator module is provided for the pump-generator section of the exciter.

Aural and visual modulation takes place at an intermediate frequency and is up-converted to carrier frequency at a 15 watt visual and 5 watt aural power level. Because of this high level of up-conversion, the exciter/modulator produces output levels of 4 watts visual and 0.8 watts aural without linear amplification. (See exciter/modulator block diagram). A separate catalog section on the exciter/modulator is available (see Type TTUE-4).

Solid-State Intermediate PA

The exciter/modulator aural output drives the aural klystron amplifier directly without intermediate power amplification. The visual output is routed to a solid-state intermediate power amplifier in which the signal is amplified to a 10-watt level. The output of the IPA is split into four equal signal paths to drive each of the four visual power amplifier klystrons. (See functional diagram). The IPA is tuned to the specified channel during manufacture and requires no adjustment or operating controls. It operates from a 24-volt (dc) power supply which is a part of the exciter-control cabinet.

This is the fully solid-state exciter/modulator.



World Radio History

Vapor-Cooled Klystrons

The transmitter uses five identical klystrons; one in the aural channel and four in the visual. These are vapor-cooled, high-gain, five-cavity units of integral cavity design. The four visual klystrons operate in a quadruplex arrangement with each klystron contributing independently to transmitter power output. The peak power output of each visual klystron is 55 kilowatts. The power from each pair of visual klystrons is combined in a waveguide hybrid diplexer to produce a power output of 110 kilowatts. These two power outputs are then combined to produce a 220 kW power output. This arrangement is such that a failure of any visual amplifier results in only a power reduction, not a loss of the visual signal.

With the addition of an optional coaxial switching system, one of the visual amplifiers may be used in aural service in the event of an aural amplifier failure.

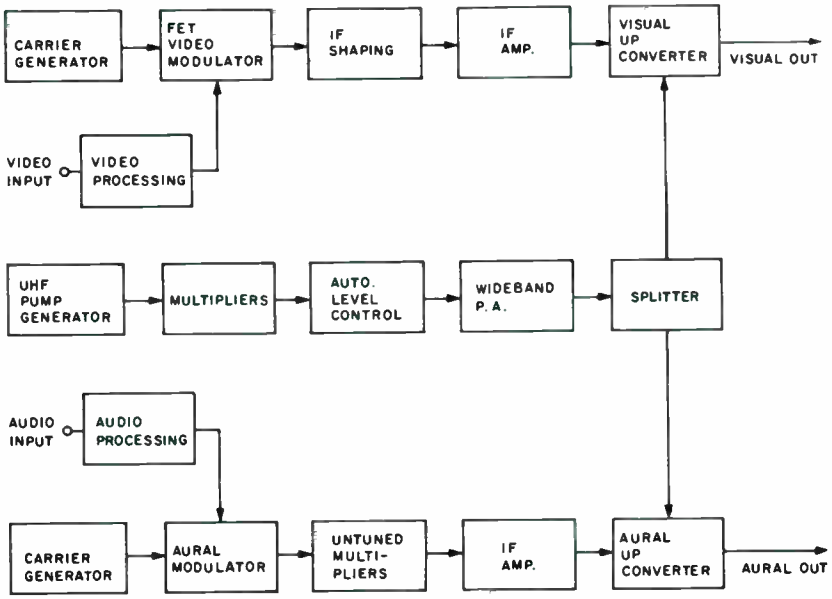
With all klystrons identical, a single spare serves all five amplifiers, and because aural and visual tubes are interchangeable, retired visual tubes may be used in aural service for extended tube life.

Ghost Cancelling Final Amplifier

A line stretcher device is incorporated in the RF drive to one of each pair of visual amplifiers for phasing of the output to the first visual combiners. Another line stretcher is provided in the RF drive to the second pair of visual amplifiers, so that these are driven in phase quadrature with the first pair. The in-phase relationship is re-established at the final combiner output.

This arrangement has the advantage that any power reflected from the transmitter load is divided in the RF combiner, and each part subjected to a relative phase shift in being re-reflected from the power amplifier outputs, so that they appear in phase opposition at the combiner and are

The five-cavity, vapor-cooled klystron.



Exciter/modulator functional diagram.

World Radio History

dissipated in the reject load. The result is essentially the elimination of any ghosting effect caused by reflected power from a load mismatch.

Easy Klystron Change

Klystron replacement in the TTU-220C transmitter is accomplished easily by one man, working alone, in a matter of a few minutes. This is the result of several factors: integral cavities, tilt-down magnet construction, quick-disconnect connections and a tube dolly that carries the entire load of the klystron.

Unitized Beam Power Supplies

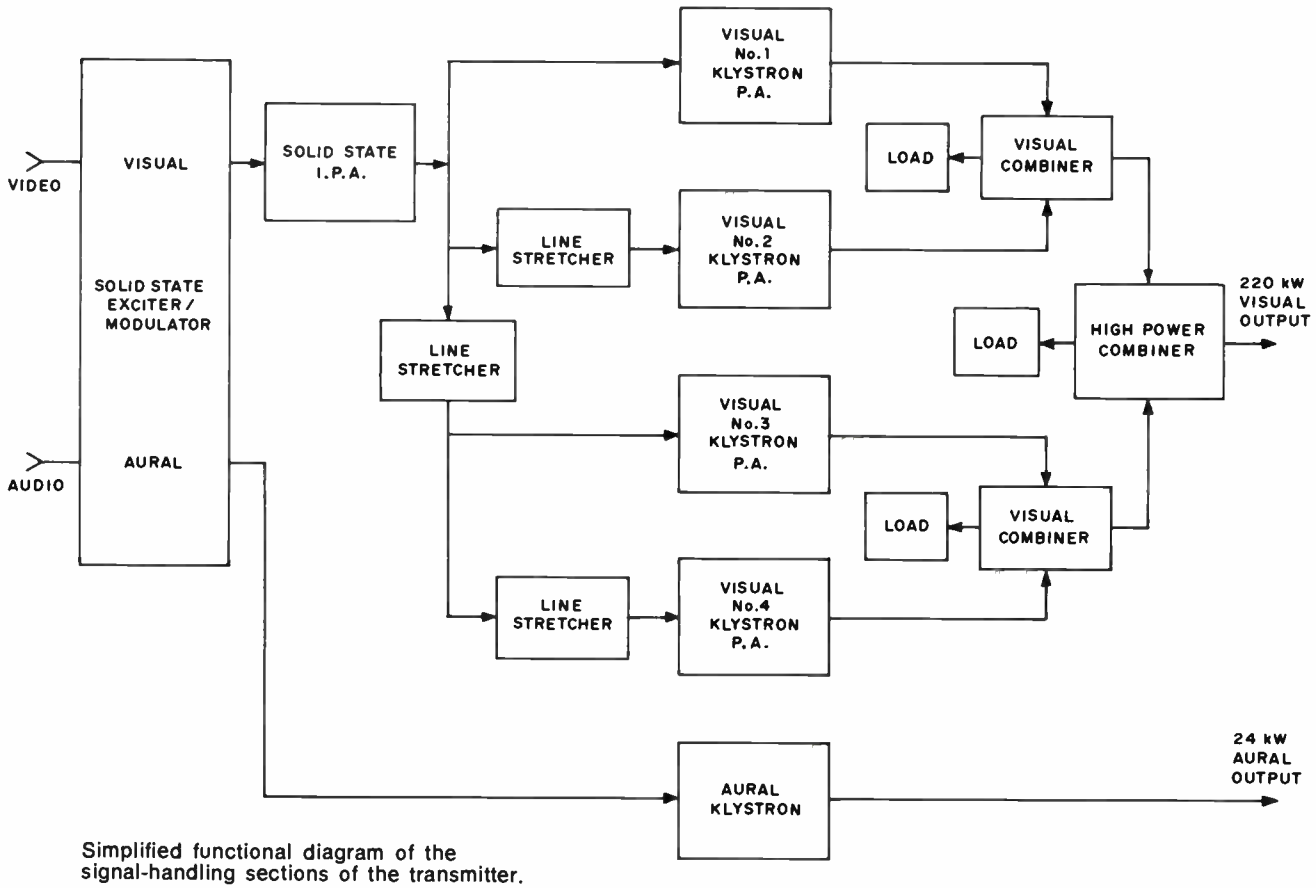
The Klystron Power Supply for the TTU-220C Transmitter consists of four unitized power supply units, operating from a 440/460/480 volt, 60 Hz, three-phase primary. Each unit contains the power transformer, rectifier stacks, filter reactor and a-c snubbing networks in an oil-filled tank. The diode stacks are mounted in modular form, one for each phase, with access through a port at the top of the tank.

The power supply units are designed for outdoor installation and are identical. Three of the four unitized supplies are connected in a delta-delta configuration and the fourth is switchable between a delta-delta or a delta-wye configuration. When the fourth supply is operated in delta-wye and the other three supplies are disconnected, a reduced beam voltage is produced to facilitate initial klystron tuning.

The power supplies normally operate in parallel but, a switching system is provided to operate the transmitter at reduced power from a two or three supply configuration. The filter capacitors for the high-voltage supply are located in the transmitter rear enclosure.

High Level Sideband Shaping

Visual sideband shaping and visual/aural diplexing is accomplished at the



Simplified functional diagram of the signal-handling sections of the transmitter.

World Radio History

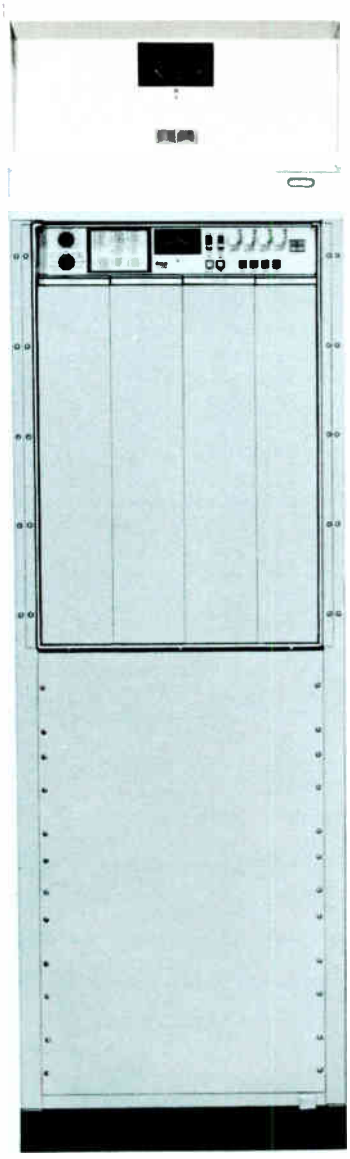
transmitter output in a waveguide filterplexer. This is a temperature compensated, passive device, pretuned during manufacture and requiring no operational adjustments. The inputs are designed to have a constant impedance over the band of frequencies produced. (See separate catalog description of waveguide filterplexer.)

Efficient Klystron Cooling

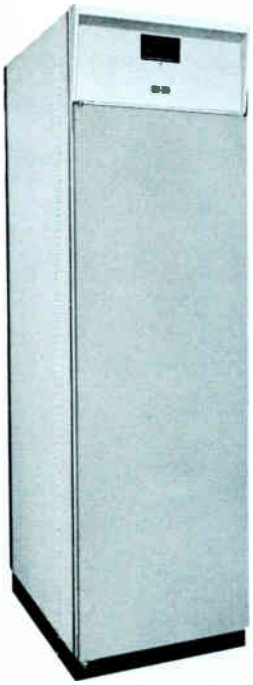
Klystron cooling is accomplished with the conversion of water to steam which is, in turn, condensed back to water for re-use.

The TTU-220C cooling system consists of two identical heat exchangers, each equipped with two steam coils and a water coil. A low-velocity air system is utilized for minimum noise. A spare, on-line water pump is incorporated in the water system, with provision for quick changeover. Pro-

This is the spare exciter group offered as an option (Door removed to reveal exciter unit). The group includes fault-sensing and automatic switch-over facilities. See text.



With door closed, the exciter group appears as shown here.



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tection against excessive pressure or surges is provided by pressure regulators and a pump bypass.

The condensate returning to the klystrons and their magnets is temperature controlled. The resulting temperature stabilization of the magnets and klystron cavities contributes substantially to the gain and bandwidth stability of the power amplifier stages.

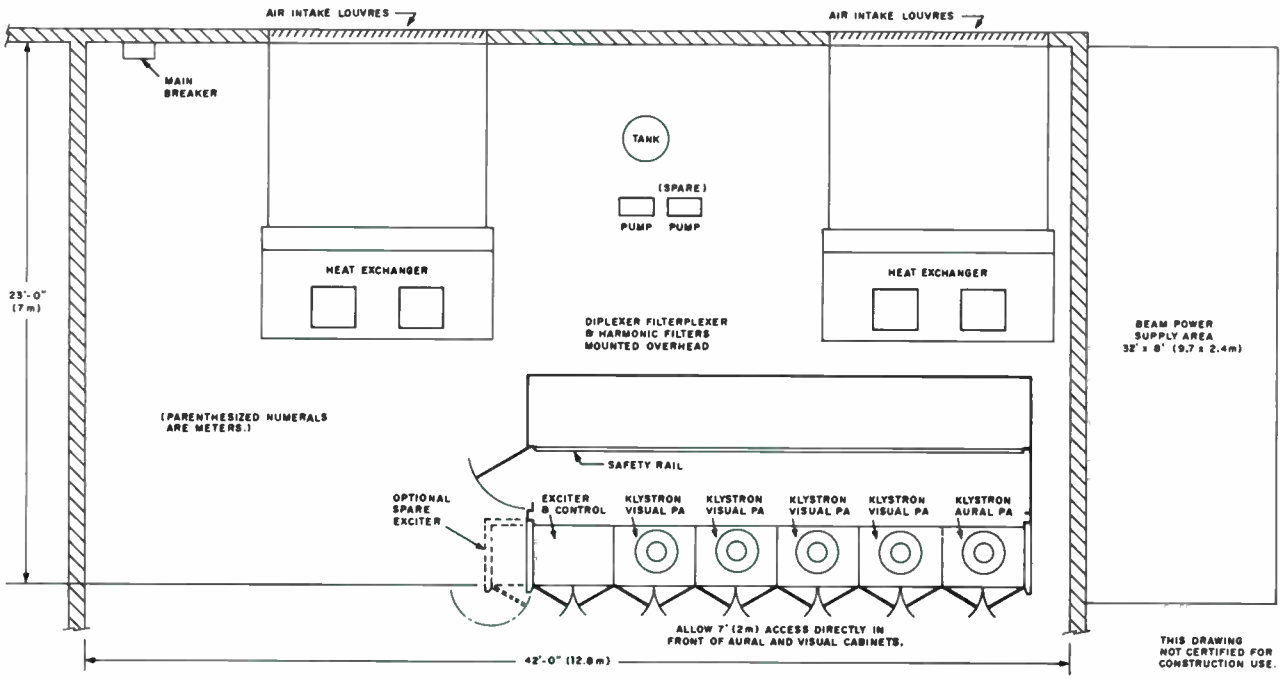
Ductwork required from the heat exchangers to the outdoor air is normally provided by the purchaser unless specifically ordered from RCA.

High-Speed Fault Protection

The transmitter incorporates an electronic, high-speed fault-protection system capable of removing RF excitation within 20 microseconds in the event of an RF load disturbance. The klystron amplifiers are protected by instantaneous relays which trip on overload and automatically reset unless the overload continues beyond three reset cycles. Excessive water inlet temperature, excessive klystron body temperature and inordinate magnet current are sensed as indicators of faulty operation. Front panel indicator lamps are provided to identify specific overload or other off-normal conditions. These indicators remain lit until manually reset, even if the overload has reset and the fault cleared, to indicate the source of alarm condition.

Optional Spare Exciter Group

For additional redundancy and increased



Typical floor layout for transmitter. Ductwork between heat exchanger and outside wall not supplied unless ordered specifically.

World Radio History

system reliability a spare exciter group is available as an extra-cost option. This group consists of a free-standing cabinet containing an exciter/modulator unit, fault-sensing and automatic switchover equipment and an exciter/modulator power supply. The cabinet matches the style of the transmitter for installation adjacent to the exciter-control cabinet of the transmitter (see floor layout). The fault-sensing and switchover equipment monitors the main exciter/modulator output and, in the event of outage, automatically switches over to the spare exciter/modulator system.

Standby Power Option

This option expands the transmitter facility to meet the requirements for "20-percent standby power" and once-a-week inspection when the transmitter is operated via remote control. It includes the spare exciter group option described above, which provides continuity of service in the event of failure of the main exciter.

Klystron input and output RF switching permits visual #4 amplifier to be substituted for a failed aural amplifier. In the event of failure of one of the redundant visual amplifiers, the failed stage can be disconnected from the power supply and operation continued at reduced power with the remaining two power amplifiers.

Fault-detection circuits are included to provide remote identification of a failed amplifier, enabling the remote operator to initiate the correct switching action. Local alarms and switching control are also provided.

Specifications

Visual Performance

Type of Emission (FCC Designation)	A5
Operating Channel	Any channel between 14 and 69 inclusive
Power Output (At filterplexer output)	220 kW
Output Impedances:	
Power Amplifier	75 ohms
Filterplexer	See Note 12
Video Input:	
Impedance (unbalanced)	75 ohms
Level (min., sync positive)	0.7V p-p
Return Loss (60 Hz to 6 MHz)	−35 dB
Carrier Frequency Stability	±500 Hz[1]
Amplitude vs. Frequency Response:[2]	
Upper Sideband Response Characteristic:	
Between 0.2 and 4.1 MHz above carrier	+.05, −1 dB
At 3.58 MHz above carrier	+0, −0.5 dB
At 4.75 MHz above carrier	−20 dB
Lower Sideband Response Characteristic:	
At 0.5 MHz below carrier	+0, −1.5 dB
At 1.25 MHz below carrier	−20 dB
At 3.58 MHz below carrier	−42 dB
Envelope Delay vs. Frequency:[3]	
Between 0.2 and 2 MHz	±60 ns
At 3.58 MHz	±30 ns
At 4.18 MHz	±60 ns
Variation in Frequency Response with Brightness[4]	−1, +1.5 dB
Modulation Depth Capability	5%
Amplitude Variation (over one frame, ref. sync peak)	2%
Output Regulation	3%
Pedestal Level Variation[5]	1.5%
Differential Gain[6]	0.75 dB
Low Frequency Linearity	1 dB
Differential Phase[7]	±3°
Subcarrier Amplitude (Color Bars)	0.7 dB
Burst vs. Subcarrier Phase (Color Bars)[8]	±3°
AM Noise (rms below 100% modulation)[9]	−50 dB
Harmonic Attenuation[10]	−60 dB

Aural Performance

Type of Emission (FCC Designation)	F3
Power Output (At filterplexer input)	24 kW
Output Impedances:	
Power Amplifier	75 ohms
Filterplexer	See Note 12
Audio Input:	
Impedance (balanced)	600/150 ohms
Level (for ±25 kHz deviation)	+10 ±2 dBm
Carrier Frequency Stability[1]	±500 Hz
Intercarrier Frequency Stability[11]	±500 Hz
Modulation Capability	±50 kHz
Frequency Response Characteristic (30 Hz - 15 kHz)	±1 dB
Distortion (30 Hz to 15 kHz)	1%
FM Noise (Below ±25 kHz deviation)	−60 dB
AM Noise (rms)	−50 dB
Harmonic Attenuation[10]	−60 dB

Environmental

Operational Altitude (Max. above sea level)	7500 ft. (2286m)
Ambient Operating Temperature	1 to 45°C (34 to 113°F)
Heat Exchanger Inlet Temperature	10 to 45°C (50 to 113°F)

(Continued on next page)

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Electrical Requirements

Power Requirements	440/460/480V, 60 Hz, 3-phase, 850 kW (Approx.) (Three- or four-wire connection)
Line Voltage Regulation	3% max.
Slow Line Variations	±3% max.
Rapid Line Variations	±3% max.
Power Factor (Approx.)	90%

Mechanical

Dimensions:	
Transmitter Cabinet	356″ L; 105; D; 77″ H (9.1, 2.66, 1.95m)
Heat Exchanger (Each)	149″ L; 86″ D; 96″ H (3.8, 2.2, 2.4m)
Filterplexer	228″ L; 140″ D; 36″ H (5.8, 3.6, 0.91m)
Beam Power Transformers (Each)	74″ x 43″ x 85″ (1.9, 1.1, 2.2m)
Weights:	
Transmitter	18,200 lbs. (8255 kg)
Heat Exchanger (Each, Approx.)	1800 lbs. (816 kg)
Filterplexer (Approx.)	1200 lbs. (544 kg)
Beam Power Supply (Each, Approx.)	6700 lbs. (3039 kg)
Shipping Data:	
Total Weight	55,000 lbs. (2195 kg)
Total Volume	3650 ft.^{3} (103m^3)

[1] Maximum variation for 10 days without circuit adjustment within an ambient temperature range of 10 to 45°C. Meets or exceeds FCC Specs in 1 to 45°C ambient.

[2] With respect to response at visual carrier frequency plus 0.2 MHz as measured with RCA BWU-5C Sideband Response Analyzer. Transmitter operating at mid-characteristic. Measured response at filterplexer output.

[3] Departure from standard curve, Tolerances vary linearly between 2.1 MHz and color subcarrier frequency and between subcarrier frequency and upper sideband limit. A properly terminated phase-correction network is required in the video input of the transmitter while performing measurement. Minor, multi-lobed delay ripples—originating in the correction network—are excluded from this specification.

[4] Maximum change with response at mid-characteristic when measured to brightness levels of 22.5 and 65% of sync peak. Peak-to-peak modulation level adjusted to approximately 20 percent of sync level.

[5] Change in blanking level relative to sync peak for change in brightness from all black to all white picture.

[6] Max. variation of 3.58 MHz mod. frequency—20 percent p-p nominal amplitude—when superimposed on "stairstep" or "ramp" signal adjusted for brightness excursion of 20 to 75 percent of sync peak.

[7] Maximum phase difference with respect to burst, measured following the sideband filter, for any brightness level between 75 and 15 percent of sync peak using 10 percent, p-p modulation. This is equivalent to 5 percent p-p modulation indicated on a conventional diode demodulator.

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

[9] Hum and noise, 50 Hz to 15 kHz. Extraneous modulation—unrelated to video—above 15 kHz but within the visual passband: 40 dB below 100% modulation.

[10] Ratio of any single harmonic to peak visual fundamental power.

[11] Maximum variation with respect to separation between aural and visual carriers.

[12] Output of visual diplexers and filterplexer are waveguide. Transition to co-ax line selected as required.

Accessories

Standy Exciter Cabinet Group, Type TTUE-4	ES-560937
Primary Voltage Regulator (Three Required, if used)	On Request
Spare Klystron Power Tube (Please specify channel)	MI-561569
Spare Solid-State IPA (Please specify channel)	MI-560899
Video Delay Equalizer, Type TTS-1	MI-560503

Ordering Information

UHF-TV Transmitter, 220 kW Visual, 24 kW Aural Type TTU-220	ES-560975

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RCA

catalog TT.4400A

(Replaces B.5090)

UHF-TV Solid-State Exciter-Modulator, Type TTUE-4A

- Full 4-watt visual, 0.8-watt aural output
- Temperature-compensated crystal oscillators
- Modularized plug-in construction
- Comprehensive metering and monitoring system
- Unexcelled performance specifications
- Modern, state-of-the-art components and design
- Modulation at IF with high-level up-conversion

The TTUE-4A UHF Television Exciter-Modulator, an integral part of all new RCA UHF Television Transmitters, represents an entirely new and original design approach. It incorporates modern design techniques and state-of-the-art components to provide a new standard of performance and reliability.

Advanced technology has been applied to the design of the TTUE-4A wherever a definite advantage can be utilized. An advanced method of IF modulation is employed. The visual and aural modulators always operate at 45.75 and 50.25 MHz respectively, regardless of final output frequency. Final frequency is achieved by up-conversion of the modulated IF signals with an RF "pump" frequency chain. Up-conversion occurs at the 15-watt visual, 5-watt aural level resulting in RF carrier frequency output signals of 4 watts visual and 0.8 watt aural.

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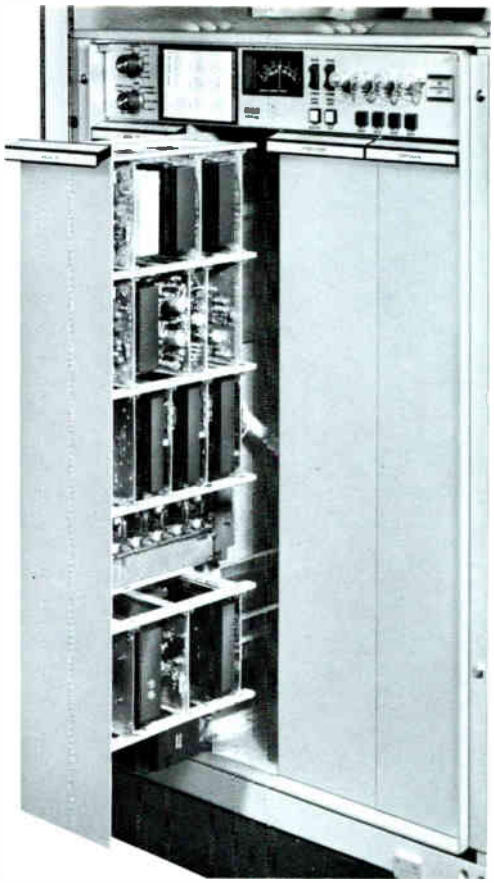


The TTUE-4A Exciter uses a new idea in packaging. Each of the basic circuit functions is contained on an individual circuit module. These plug into "mother boards" which are, in turn, mounted in drawers such as the one shown here. Each is keyed to prevent insertion of a module into any but the correct connector.

Modularized Construction

A new concept in exciter-modulator packaging was developed for the TTUE-4A consisting of a main frame with the modularized circuits housed in four vertical, slide-out drawers. By sliding each drawer forward, the associated modules are exposed for visual examination and test without removal from service or use of an extender board. The plug-in modules employ matched-impedance, edgeboard connectors with an inlaid gold contact design for high reliability and long life. Connectors are keyed to prevent insertion of a module into any but the correct connector.

Integrated Circuits and FET Devices

Junction field-effect transistors are used in an active IF filter, in which any component can be replaced without the requirement for realignment. Integrated circuits are utilized in a unique, untuned FM chain. The use of a dual-gate, field-effect transistor in the visual modulator results in an extremely simple, highly stable and reliable circuit.

Constant impedance, RF stripline circuits are used extensively, to avoid the problems of reliability usually associated with coaxial cables and connectors. Printed-circuit radio-frequency coils are used in the IF power amplifiers, assuring high reliability.

Metal film resistors, used throughout the equipment, achieve a high-reliability, low aging rate and precise temperature-coefficient control.

The exciter-modulator, although only a small part of the complete television transmitter, is where the picture and sound quality is established. The TTUE-4A Exciter-Modulator offers the high-precision performance, stability, and dependability required in this important function.

Separate Power Supply

The TTUE-4A UHF TV Exciter- Modulator consists of two main units; the Exciter-Modulator and the Power Supply unit.

The exciter is divided into five basic sections: Aural Processing, Video Processing, Visual IF Generation, RF Generation and Power Control and Monitoring.

The exciter control and monitoring circuits are contained in the control-and-meter panel drawer in the upper portion of the exciter main frame assembly. The remainder of the exciter circuits are located on the four vertical pull-out drawers located directly below the control and meter panel.

Individual Circuit Board Modules

Each of the basic circuit functions of the aural processing section, the video processing section, and the visual IF section is contained on an individual circuit board module. In addition, the first three stages of the RF section, as well as all of the voltage regulators in the power control and monitoring section are contained on individual modules. These modules are plugged into connectors located on "mother boards", or connector modules. These connector modules are mounted in three of the vertical drawers with the RF pump circuitry mounted in the remaining drawer.

No Crystal Heaters or Ovens

Temperature compensated crystal oscillators (TCXO) are employed in the visual and aural IF sections and as a frequency source for the RF pump chain. The use of the TCXO eliminates the requirement for crystal heaters or ovens and assures immediate on-frequency operation from a cold start. It maintains operating specifications for long periods of time, even when the equipment is cycled over the ambient temperature range of 0° to 45° C.

Convenient Metering System

A comprehensive metering system enables observation of the operating condition of each module and circuit function individually. A nine position function switch selects the circuit function to be metered and a 10 position selector switch provides metering from individual circuits associated with the selected function. Because of the unique and functional mechanical arrangement, each module is accessible without the use of module extenders.

Regulator on Each Connector Module

The Power Supply furnishes unregulated dc voltages to the various circuits. Each circuit incorporates a voltage-reg-

World Radio History

ulator, and, through connector wiring, automatically supplies correct regulated voltages. There are only two types of regulator cards, one for positive voltages and another for negative.

Circuit Description

Aural Processing Section

The audio is amplified, processed, and applied to a series of five modulators. Each modulator consists of a saw-tooth generator and pulse former, the latter fed from a square-wave output of the aural TCXO. The output of each modulator consists of a series of time-positioned, modulated pulses, in accordance with the audio input signal. The four succeeding modulators raise the phase shift to a value required to produce the desired deviation.

The output of the fifth modulator drives a univibrator which produces a square wave varying, in time, with the modulated input pulse rate. This square wave is fed to an integrator, followed by three frequency-doubler circuits. The output of the third doubler is routed through the filter which produces (at its output) a modulated sine-wave at 10.05 MHz. This is applied to a frequency quintupler, providing the aural output frequency of 50.25 MHz. This signal is applied, through a buffer amplifier, to the broadband IF amplifier, which supplies the frequency modulated signal to the aural up-converter.

Visual Processing Section

The video signal is amplified by a differential amplifier and routed to a driver amplifier through the video-gain control. The output of the driver amplifier feeds a differential-gain driver.

A sample of the incoming video signal is applied to the clamp-pulse generator, which generates a pulse coincident with the trailing edge of sync. This clamp pulse is applied to the video clamp amplifier where it develops a bias level for application to the differential-gain driver. The clamp pulse assures that pedestal level remains at a constant amplitude independent of video. The clamped video signal then goes through two separate differential-gain correctors and a differential-phase corrector, to the video-output amplifier.

Visual IF Section

The basic visual IF frequency of 45.75 MHz is generated by the visual-carrier TCXO, and is applied through a buffer amplifier and a two-stage broadband amplifier to become one of two inputs to the visual modulator. The other input is supplied by the video-output amplifier described above. The resultant amplitude-modulated, IF signal is routed through the active filter and linearly amplified to a level suitable to drive the visual up-converter.

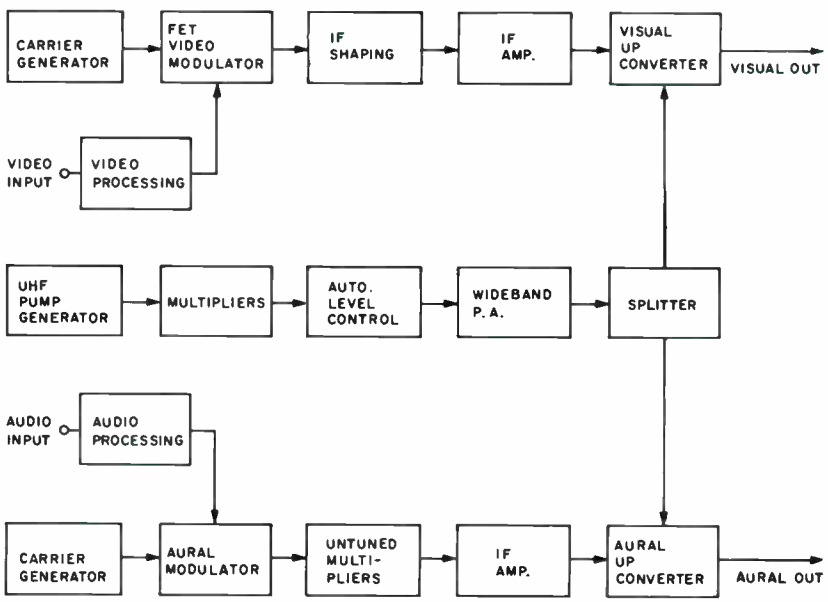
RF Section

The pump TCXO produces the fundamental frequency from which the UHF drive is produced. The exact TCXO frequency depends on the operating channel. The TCXO signal is amplified and frequency multiplied to the final pump frequency. This is the carrier frequency minus the IF frequency. It is applied to the aural and visual up-converters through a directional coupler and circulators to produce the final aural- and visual-UHF output signals. The pump RF power is maintained at a constant level by means of a power sensor (which constantly samples the power level), an automatic level control circuit, and a pin-diode attenuator. Visual power output is 4 watts (peak of sync) and 0.8 watts aural.

For Retrofit or Spare-Exciter Duty

The TTUE-4A Exciter-Modulator, and its companion Power Supply, are an integral part of current RCA UHF Television Transmitters. The TTUE-4A is available for retrofit into previous transmitter types, replacing the original tube-type aural and visual exciter in transmitter types such as the Type TTU-30A, TTU-50C, TTU-60A and TTU-110A. The complete retrofit equipment incorporates the TTUE-4A Exciter-Modulator plus installation material and instructions.

A Spare Exciter Cabinet Group is also available to provide complete exciter redundancy. The spare exciter, with its associated sensing, switchover, and metering circuitry, is mounted in a matching cabinet, which may be installed adjacent to the exciter and control cabinet of the RCA transmitters listed above. The spare exciter cabinet provides automatic switchover to the spare exciter in event of a fault. It also may be switched manually or by means of a remote-control system. It can be used in conjunction with either a tube-type exciter or another TTUE-4A as the main exciter unit.



Solid-State Exciter/Modulator Block Diagram.

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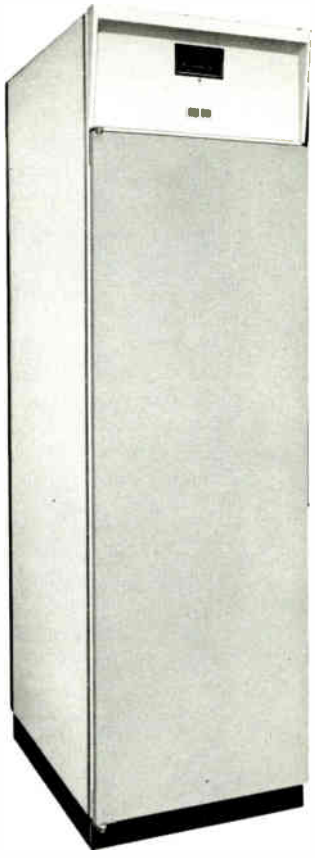

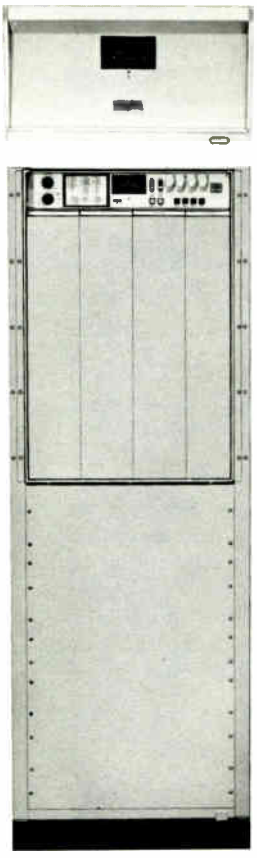

The TTUE-4 is available optionally as illustrated at left in a free-standing cabinet for use as a spare exciter-modulator. This cabinet styling matches the current line of RCA UHF-TV transmitters. (Door removed in photo at right.)

Specifications

Frequency Range ..... 470-806 MHz (U.S. Ch. 14-69)
Power Output:
  Visual ..... 4.0 W, Peak of Sync
  Aural ..... 0.8 W, Nominal
RF Output Impedance ..... 50 ohms
Input Impedance:
  Visual ..... 75 ohms
  Aural (balanced or unbalanced) ..... 150/600 ohms
Input Level:
  Visual ..... 0.7 V p-p min.
  Aural ..... +10 ±2 dBm
Frequency Response:
  Visual ..... ±0.25 dB –1 MHz to 5.0 MHz (200 kHz Ref.)
  Aural ..... 60-3,000 Hz, ±0.5 dB; 30-15,000 Hz, ±1.0 dB
Audio Distortion (30-15,000 Hz) ..... 1% Max.
Ambient Temperature ..... 0° to 45° C
Altitude, Operating ..... 10,000 feet (3050 m) max.
Modulation Capability:
  Visual 5%
  Aural ..... ±50 kHz max.
Differential Phase ..... 2° max.
Differential Gain ..... 0.3 dB
Frequency Stability:
  Visual Carrier ..... Better than ±0.5 ppm
  Aural Carrier ..... Better than ±0.5 ppm
  Intercarrier ..... Better than ±500 Hz
FM Noise (Below ±25 kHz) ..... –62 dB
AM Noise:
  Visual (Below 100% modulation) ..... 50 dB rms
  Aural (Below carrier) ..... 55 dB
Power Requirement ..... 240 V, 60 Hz, 2.5 A.
Dimensions:
  Exciter Modulator Unit ..... 18¾" W x 28½" H x 12" D (476, 724, 305 mm)
  Power Supply Unit ..... 19" W x 10½" H x 10⅝" D (483, 267, 270 mm)
  Cabinet ..... 22" W; 77" H; 30" D (559, 1956, 762 mm)
Weights (Approx.):
  Exciter/Modulator Unit ..... 162 lbs. (74 kg)
  Power Supply Unit ..... 128 lbs. (58 kg)
  Cabineted System ..... 310 lbs. (141 kg)

Ordering Information

UHF-TV Retrofit Exciter-Modulator, Type TTUE-4A:
  (For TTU-30, TTU-50, TTU-60, TTU-110 UHF Transmitters) ES-560938
Spare Exciter Cabinet Group, Type TTUE-4 ..... ES-560937

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RCA

catalog TT.5000B

(Replaces TT.5000A)

Planning TV Transmitter Remote Control

- The needs and equipment of TV remote control
- Wireless or telco-line coupled systems
- Test signals and test equipment
- Functional diagrams of typical systems

On the pages following, you'll find information valuable in setting up a remote-control system for a television transmitter: the requirements, the equipment, the operation and maintenance of a system. Included also are functional diagrams of typical systems.

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Planning of remote control facilities for a television transmitter should be based on a careful review of the specific needs of the individual station. After careful analysis of applicable FCC regulations, a logical first step would be to contact your RCA broadcast field sales representative. You will find that he is qualified to assist in planning remote control facilities for current model RCA television transmitters. Exact equipment requirements will vary with the type of television transmitter to be controlled. The following information is intended to provide an introduction to TV transmitter remote control systems rather than a specific equipment list for any one type transmitter or station.

Equipment required for television transmitter remote control includes not only the remote control units but also equipment for remote monitoring of the visual and aural signals and for generation of vertical interval test signals in accordance with applicable regulations.

A brief description of the requirements of each family of equipment is provided in the following paragraphs.

Remote Control System

This is the equipment which handles the basic command functions for operation of the transmitter and the means of returning the necessary metering and alarm signals. The regulations require a sufficient number of remote control functions to perform all transmitter adjustments normally required on a daily basis to assure strict compliance with the technical requirements of the FCC rules. Remote metering is required for all parameters which must be entered in the TV transmitter operating log. Means are required for determining that any required obstruction lighting of the antenna and supporting tower is operating normally.

Fail-safe protection is required to assure that any fault or failure which results in loss of control will cause the transmitter to cease operation. Loss of metering of any of the parameters which are required for transmitter logging must activate an automatic device which will terminate operation of the transmitter not more than one hour after the loss.

Individual stations may wish to provide more control and metering functions than the minimum required. For this reason, and to allow for added functions that may be desired in the future, it is recommended that provision be made for spare control and metering functions.

Interconnection between the transmitter and remote control point is available by a choice of methods. Fig. 1 is a simplified block diagram of a Moseley Type DRS-1 30-function remote control system with interconnection between the studio and transmitter by means of a voice quality telephone circuit. A maximum of 20 dB of line attenuation is allowable between the transmitter and remote control location.

Fig. 2 is a block diagram showing interconnection by means of a TV microwave STL link from the remote control point to the transmitter. A separate audio subcarrier modulator and demodulator are required in the TV microwave system to carry the audio control tones to the transmitter site. Metering and alarm signals are returned to the remote control point by means of a subcarrier on the aural channel of the TV transmitter. The audio tones representing the telemetry information are modulated on a 39 kHz subcarrier and applied to the TV aural transmitter along with aural program. The subcarrier generator is a part of the Type DRS-1 Transmitter Control Unit. At the remote control point, the subcarrier is recovered from the transmitted aural signal at the output of an off-air multiplex receiver containing a subcarrier demodulator. The recovered telemetry information is then applied to the Type DRS-1 Studio Control Unit.

The wireless interconnection system has the obvious disadvantage that metering and status information is unavailable in the event of failure of the TV aural transmitter or, after sign-off. On the other hand, in some transmitter locations it may be difficult to obtain a telephone circuit with sufficient reliability for transmitter remote control purposes, and in this case wireless interconnection will be preferred.

For parallel TV transmitters, consideration should be given to the use of duplicate remote control systems and telephone lines for 100% redundance of the control system as well as the transmitter. An alternate method of achieving system redundancy would be to have one control system interconnected by wire line and another by TV relay and aural channel subcarrier.

Automatic Logging (Optional)

Automatic logging equipment increases the benefits of remote control of the television transmitter by relieving the studio operating personnel of the manual logging task except for observation of the VIT signals and logging of the observations. In the event that automatic logging is provided, the functions which must be logged are the same as those which must be logged in a manually operated transmitter.

Automatic tolerance alarms must be provided for those parameters which are subject to tolerance limitations in accordance with FCC regulations, i.e., visual output power and aural final amplifier plate voltage and current. Transmitter visual and aural carrier frequency need only be measured once each calendar month with not more than 40 days between measurements. Frequency measurements need not be alarmed if logged manually. If logged automatically, they must be alarmed.

Fig. 3 shows a Type DLS-1 Automatic Logging System and a Type TAU-2 Tolerance Alarm Unit used in conjunction with a Type DRS-1 Status Alarm System to provide 24 status or alarm channels which may be used to report any abnormal condition which can be initiated with a contact closure. LED (light-emitting-diode) indicators, at both transmitter and studio sites, indicate an alarm condition on any channel.

The automatic logging equipment uses a separate FSK tone signal to transmit metering and alarm information to the remote control location where the logged digital information is printed in columnar form on an electric typewriter. Logging is initiated at preset intervals by a clock system. The digital control, telemetry and logging signals are combined for transmission over a common telephone line between the DRS-1 Studio and Transmitter Control units.

If preferred, a microwave STL audio channel may be used for the transmission of control information to the transmitter site and a 39 kHz subcarrier on the aural transmitter for the transmission of the telemetry, logging and status information to the studio site, similar to the system depicted in Fig. 2.

Remote Monitoring Equipment

A block diagram indicating the monitoring equipment items required at the remote control location is shown in Fig. 5. A type-approved aural modulation monitor is required with continuous indication of peak and quasi-peak percentage of modulation of the aural signal. Equipment for measuring aural and visual frequency is not required if a hired frequency-measuring service is used and the results of these measurements recorded in the maintenance log at the required intervals. An aural and visual carrier-frequency monitor, located at either the studio or transmitter site, is usually considered desirable. Aural modulation monitors and frequency monitors are available with sufficient sensitivity for off-air monitoring of the transmitted

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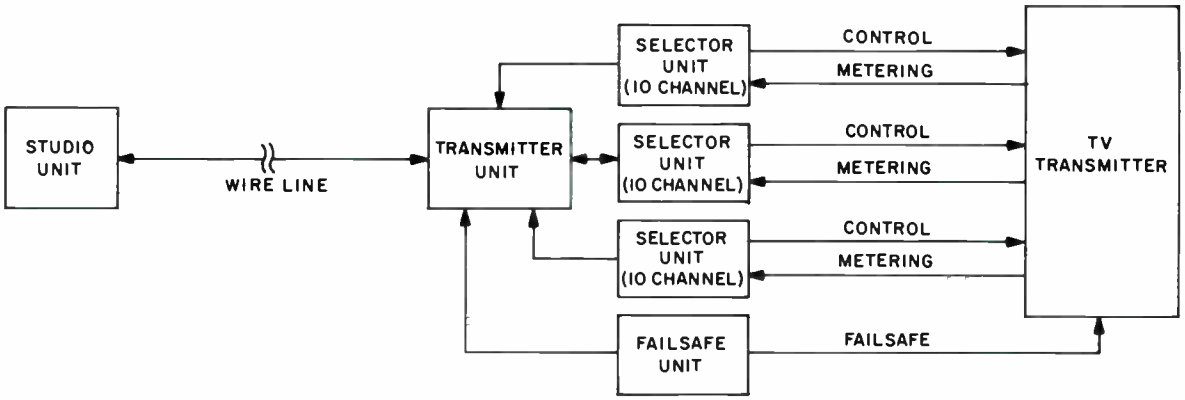


Fig. 1. Remote Control Via Voice-Quality Telephone Wire Line.

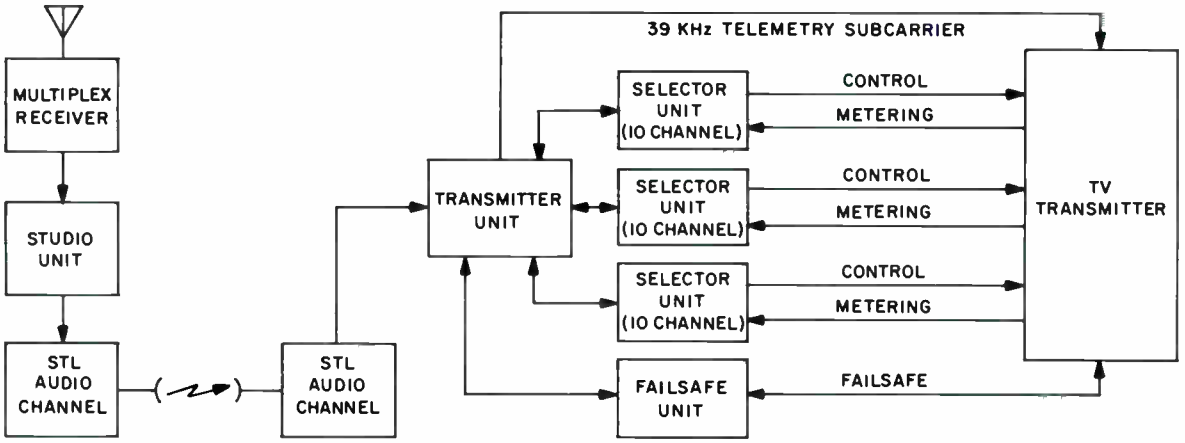


Fig. 2. Control Via Microwave and Metering Via Aural Subcarrier.

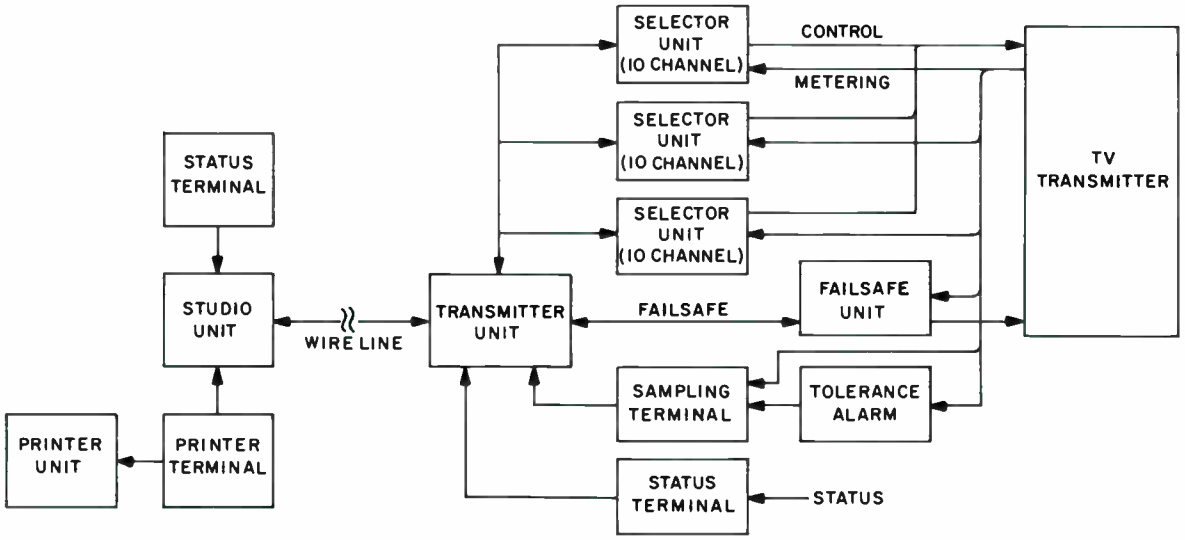


Fig. 3. Remote Control, Automatic Logging and Status Reporting Via Voice-Quality Telephone Wire Line.

World Radio History

signal. Older monitors intended for use at the transmitter location may not have sufficient RF gain for off-air monitoring service. An audio amplifier and loudspeaker are needed for aural monitoring of the received audio signal.

An off-air visual demodulator is required at the remote control location to permit continuous monitoring of the waveform and other characteristics of the transmitted visual signal. As a practical requirement, a separate visual demodulator is needed at the transmitter site for use in making measurements of transmitter performance and for making transmitter setup adjustments.

A video waveform monitor is required for continuous monitoring of the transmitted visual signal. This monitor must be capable of both full field displays and displays of test signals inserted on selected lines in the vertical blanking interval. In addition a vectorscope is required if any portion of the transmission is in color. A picture monitor is recommended for a visual display of the received signal. A color monitor should be provided if color program material is transmitted. It is suggested that both a monochrome and a color picture monitor be provided if space permits.

Vertical Interval Test Generating Equipment

The FCC rules governing remote control require that a series of test signals be generated and inserted in the vertical interval of the visual signal at the remote control point in the feed to the transmitter. The signal must be observed at the remote control point after extraction from the received RF signal. This signal is normally obtained at the output of the off-air visual demodulator and viewed on a video waveform monitor and vectorscope (see *Monitoring Equipment).*

The required test signals consist of multiburst on Field 1, Line 18, color bars on Field 2, Line 18 and a composite signal on Field 1, Line 19. The composite signal contains a stair step with superimposed color subcarrier frequency, a 2T sine squared pulse, a 12.5T sine squared pulse and white bar. Normally the composite signal is also fed to Field 2, Line 19 at the remote control point. However, FCC regulations permit insertion of the composite test signal of field 2 to be inserted at the transmitter to provide a comparison of the degradation of the signal caused by the microwave up-link against that contributed by the transmitter. Alternatively, a licensee may insert any suitable test signal on Field 2, Line 19, either at the transmitter or at the remote control point.

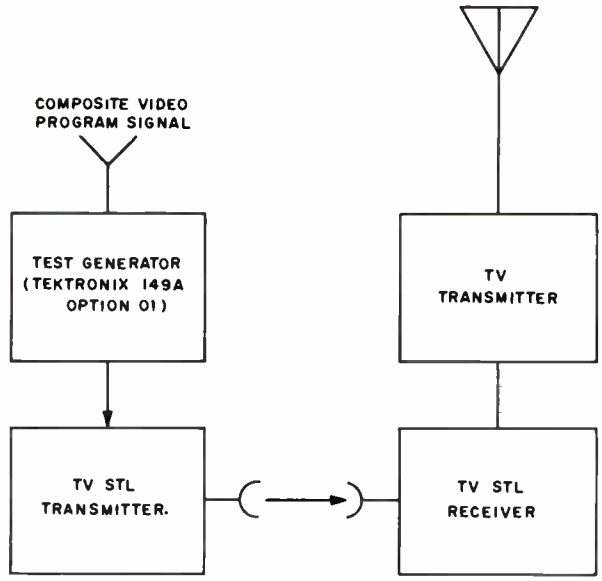
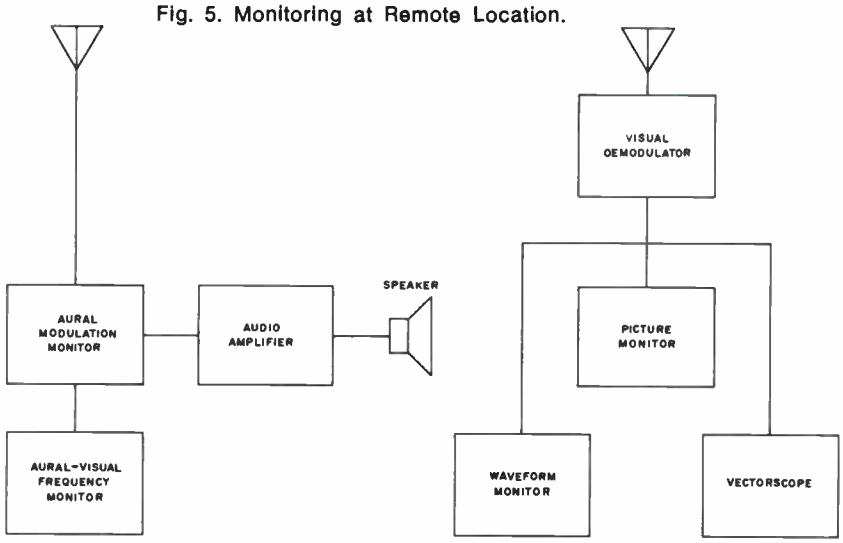


Fig. 4. Vertical Interval Test Signal Generating System.

The alternate test signal should have approximately the same APL as the composite test signal.

A block diagram of a representative vertical interval test signal generating system is shown in Figure 4. The composite video output signal from Studio Master Control is fed to a Tektronix Model 149A Option 01 television signal generator. This unit genlocks to the incoming signal and is capable of deleting an incoming VITS signal. It inserts all of the required test signals. In the event that the composite test signal of Field 2 is inserted at the transmitter input, a second Tektronix 149A Option 01 signal generator is needed at the transmitter location. The monitoring equipment required for observation of the vertical interval test signal at the remote control point is described above under Remote Monitoring Equipment.

Fig. 5. Monitoring at Remote Location.



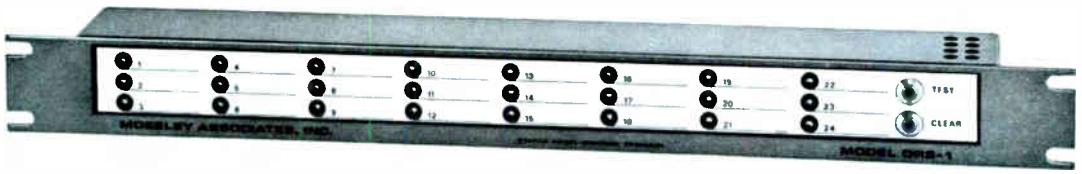
World Radio History

RCA

Digital Remote Control System, Moseley Model DRS-1

- Digital control and telemetry
- Channel capability: 30 channels
- 24 independent status channels
- Automatic logging option
- Wire line or RF subcarrier interconnect

Here is a totally digital control, telemetry, and status-alarm system for remote control of television transmitters. The building-block design permits initial installation of a basic system and expansion at a later date. Interconnection between the studio and transmitter site may be a voice quality telephone line, or an STL Microwave audio channel for control and a TV-aural subcarrier for telemetry return. Use of the optional Type BRF-1 TV Failsafe Unit makes the DRS-1 System fully compliant with the FCC Rules for remote control.



World Radio History

The DRS-1 Digital System has a capability of 30 metering channels and 30 control (30 on/raise; 30 off/lower) channels. The system is composed of a Transmitter Control Terminal and three 10-channel Selector Units at the TV transmitter site, and a Studio Control Terminal at the studio site. A 24-channel status/alarm system is available which is activated by an external contact closure for each channel, providing a separate LED status indication at both the transmitter and studio site. The status/alarm information is sent to the studio along with the telemetry information as a segment of the digital telemetry. The telemetry and status information is updated every 250 milliseconds.

The DRS-1 System is available as a basic 10-channel telemetry and control system, to which additional selector units may be added to increase the capacity in 10-channel increments to the maximum of 30 channels. The status/alarm system also may be added to the remote control system if not required initially.

Digital Command and Telemetry

Selection of the desired control and telemetry channel is accomplished by a two digit thumbwheel selector on the front panel of the Studio Control Terminal. Once the desired channel is selected, a digital display of the metered parameter associated with that channel appears in the readout window. Depressing the raise or lower pushbutton then accomplishes the command function assigned to that channel. Simultaneously, a duplicate digital readout of the parameter value sent to the Studio Control Terminal is displayed at the Transmitter Control Terminal.

Local control of the command and telemetry functions at the transmitter location is accomplished through the local control pushbutton at the Transmitter Control Terminal. This activates the channel-select thumbwheels and control of the raise/lower functions on the Transmitter Control Terminal. This feature permits easy, one-man calibration of the system from the transmitter site.

When local contral is in effect, the raise/lower pushbuttons at the Studio Control Terminal are inoperative, however, the telemetry readout corresponding to the channel selected at the Transmitter Control Terminal is displayed on the Studio Control Terminal. The operator verifies the channel being displayed by pressing the "Channel Echo" pushbutton, which makes the channel number appear in the readout window. Upon release of this pushbutton, the numeric display of the metered parameter will reappear. A visual indication is provided at the Studio Control Terminal by means of the control override lamp, to indicate that the Transmitter Control Terminal has assumed local control.

The telemetry system samples and transmits the selected parameter at intervals of 250 milliseconds. Integrity of transmission is assured through repeated parity checks of the digital telemetry pulses. The accuracy of the telemetry system is 0.1 percent.

Each telemtery input is isolated and floating, and is bipolar with a minus sign preceding the numeric display for reverse-polarity input voltages. A one-volt d-c input produces a full scale (999) display with 100% over-range capability (2 volts d-c for a 1999 display).

Failsafe Operation

The DRS-1 includes protection against the loss of command or telemetry information caused by a failure in the system or an interruption of the transmission facility.

The loss of command data is sensed by failsafe circuitry in the Transmitter Control Terminal at the TV transmitter site. After a delay of 20 seconds, to provide protection against momentary interruptions, relay contacts open which, connected in series with the transmitter interlock circuits, remove the transmitter from the air.

Similarly, any loss of telemetry data is sensed at the Studio Terminal, and this information is sent to the Transmitter Terminal as part of the command data. Relay contacts operate in the Transmitter Terminal which initiate a one-hour, integrated circuit timer in the Type BRF-1 TV Failsafe Unit (see "Accessories"). When this timer fully cycles, the TV transmitter turns off. If the telemetry information is restored before the timer fully cycles, it automatically resets and normal operation resumes.

Wire Line or Subcarrier Service

The DRS-1 Remote Control system is available for operation over a voice grade telephone line or, for utilizing an STL microwave program subcarrier channel for the transmission of command signals to the transmitter, and a 39 kHz subcarrier on the TV aural carrier for telemetry return. In the latter case, the required 39 kHz subcarrier generator and detector are provided as subassemblies which are a part of the DRS-1 System. The 39 kHz SCA output of an aural modulation monitor at the TV studio may be used to feed the Studio Control Terminal for telemetry.

Status/Alarm System

The 24-channel Status System may be ordered with the Remote Control System, or added later to an existing system. The Status System reports any status, fault, or alarm condition that can be initiated by a contact closure to the Status System. A Light Emitting Diode (LED) indicator, for each channel at both the remote (transmitter) and control (studio) terminal, indicates off-normal conditions. Each channel is latched-on when activated until the condition reported is normal and the "Clear" pushbutton is depressed.

Power for the DRS-1 Status System comes from the Remote Control terminal at each location. The status information is transmitted as a part of the digital telemetry information.

Tolerance Alarms

The Type TAU-2 Tolerance Alarm Unit is used in conjunction with the DRS-1 Status System, or the DLS-1 Automatic Parameter Logging System described below, to permit the simultaneous monitoring of up to 10 selected metering samples, and actuating an alarm when the monitored parameter is above or below preset limits. The unit is normally located at the transmitter site, con-

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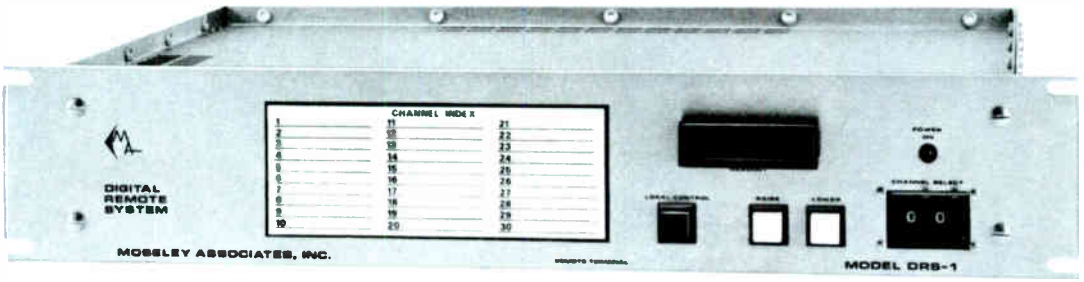
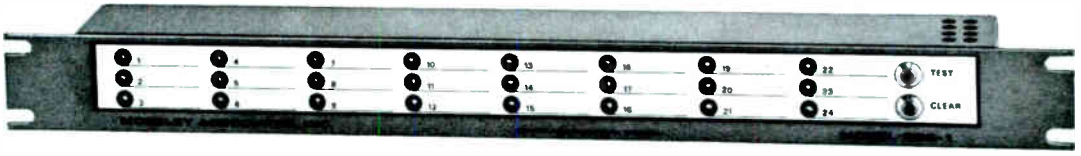


This is the transmitter control unit of the system. It requires only 3.5 inches (89 mm) of rack space.

This is one of three selector units that operate at the transmitter end of the system. It uses only 1.75 inches (44 mm) of rack space.



This is the transmitter unit of the optional Status/Alarm system. It provides 24 channels of monitoring. Indicators are light-emitting diodes.

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sists of a main frame unit and from one to ten plug-in modules, depending on the number of parameters to be monitored and alarmed. An out-of-tolerance condition is displayed visually and, when interfaced with the DLS-1 Status System, is indicated on the control terminal at the studio.

DLS-1 Automatic Parameter Logging

The DLS-1 Automatic Parameter Logging system works with the DLS-1 Remote Control to provide hard-copy logging of 20 selected parameters plus time of entry at preselected intervals. The copy is in the time-proven columnar format The time interval between logging entries may be programmed from 10 minutes to 3 hours.

Used in conjunction with the Type TAU-2 Tolerance Alarm unit, a parameter that is out of tolerance initiates an immediate print-out with the out-of-tolerance parameter printed in red color for extra contrast.

The DLS-1 Parameter Logging System consists of a Logging Transmitter Terminal, a Logging Receiver and an output writer. The logging data is transmitted over the same transmission facility as that used for the DRS-1 Remote Control, without additional subcarrier modem equipment.

TV Transmitter Interface

A comprehensive selection of components and devices is available to meet almost any requirement to interface a TV Transmitter to the remote control system. (See separate catalog section for Remote Control Accessories.)

Specifications

Remote Control System, Moseley Model DRS-1

Telemetry Channels	10, 20, or 30
Control Channels (each with on/raise, off/lower function)	10, 20, or 30
Telemetry Accuracy	0.1%
Telemetry Input Voltage (for 999 dispaly)	1.0 Vdc
Telemetry Update Interval	250 ms
Command Output (Raise/Lower)	Relay Contact Closure; (50W Non-Inductive Load)
Interconnection Requirements:	
Telephone Line	2-wire, 300 Hz to 2600 Hz, 20 dB max. loss
Radio Circuit:	
Control	Separate STL Audio Channel
Telemetry	TV Aural Subcarrier, 39 KHz
Failsafe:	
Control	20 sec delay, NC relay contacts
Telemetry	Used with BRF-1 TV Failsafe (Meets FCC Rules 73.676)
Power Requirements	120/240V, 50-60 Hz, 40W

Specifications

Status System, Moseley Model DRS-1

Status Channels	24
Input Requirements (each channel)	Contact Closure
Response Time	1 sec. max.
Indicator	LED for each channel
Power Requirements	Derived from DRS-1 Remote Control System

Specifications

Automatic Parameter Logging, Moseley Model DLS-1

Type	Digital, Column type Printout
Channels	20, plus time
Interconnection Requirement	Uses modem in DRS-1 Remote Control System
Accuracy	±0.1%
Input	Same as DRS-1
Power Requirements	120/240V, 50-60 Hz, 125W

Accessories

TV Failsafe Unit, Type BRF-1	MI-561484
TV Failsafe Interface Panel	MI-561192
Tolerance Alarm Unit Main Frame, Type TAU-2	MI-561469
Comparator Module for TAU-2	MI-561184
Tower Light Sensing Kit, Type TLK-2	MI-561462-A
Line Voltage Sampling Kit, Type LVK-2	MI-561463-A
Temperature Sensing Kit, Type TSK-3	MI-561465-A
DC Amplifier and Linear Converter, Type PLC-1	MI-561179
Relay, DPDT, 24V DC Coil, with socket	MI-561448-1
Relay, DPDT, 120V AC Coil, with socket	MI-561448-2
Relay, Latching, DPDT, 24V DC Coil, with socket	MI-561448-3
Relay, Time Delay, 24Vdc Coil, 0.1 to 2.0 seconds delay	MI-561448-4

Ordering Information

Digital Remote Control System (Specify for 10, 20, or 30 control and telemetry chanels.)	Moseley Model DRS-1
Status System Option	Moseley Model DRS-1
Automatic Parameter Logging System Option	Moseley Model DLS-1

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RCA

catalog TT.5400A

Remote Control System, Moseley Type DCS-2

- Digital data transmission and readout
- Fail-safe design—expandable control and metering
- Multiple status/alarm channels
- Parameter logging optional
- Computer display optional
- Two-site transmitter control optional

Moseley Associates' Type DCS-2 is a remote-control system for television transmitters. It uses advanced, state-of-the-art digital and computer principles with anticipation of the need for future expansion. The basic system expands from 60 to 120 remote-control functions and from 30 to 60 status-alarm channels.

The DCS-2 basic system includes control, telemetry and status indications. It expands to include automatic parameter logging through options.

Full digital techniques and circuitry result in operational accuracy and stability. The DCS-2 uses three levels of digital encoding, including parity, to assure transmission integrity.

A special feature of an DCS-2 system is the accommodation of two remote terminals. This is particularly useful in situations where one remote control system operates two transmitters at separated locations.

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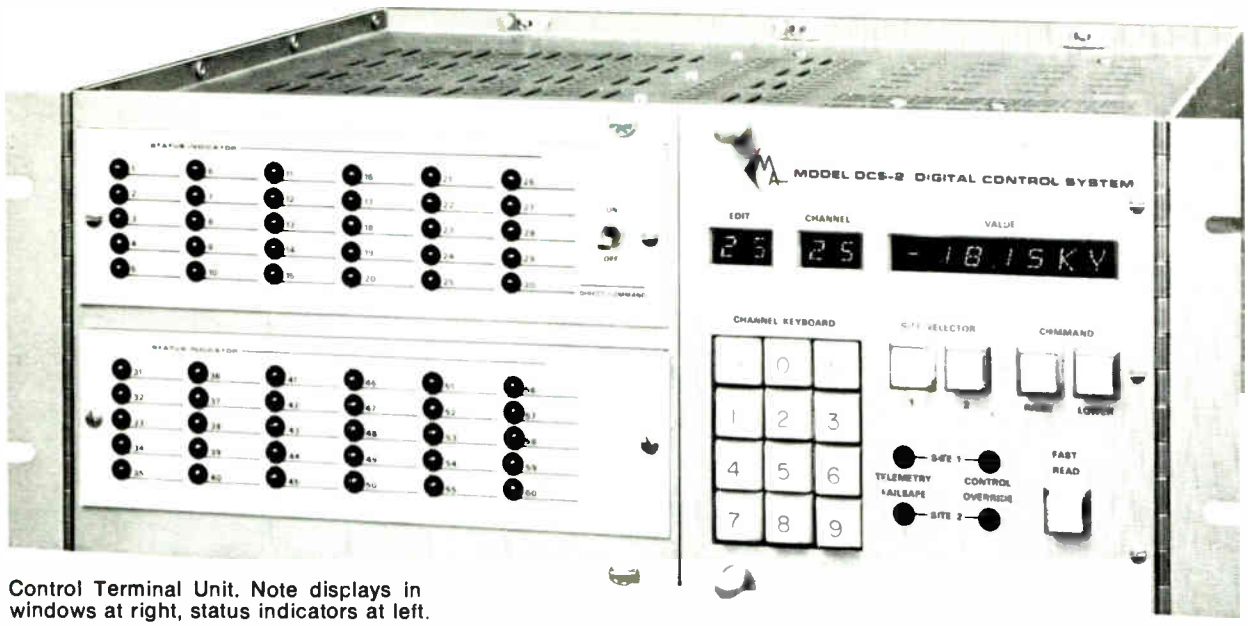

Control Terminal Unit. Note displays in windows at right, status indicators at left.

Capable of totally automated operation, the DCS-2 Digital Remote Control System uses state-of-the-art digital and computer electronic devices. The system offers an expandable approach to the operation of a transmitter plant via remote control. Several levels of capability are available. The first level includes the basic hardware for a fully operative system; the second involves additional hardware to increase the number of control, telemetry and status channels. The third level includes the addition of automatic parameter logging or a computer option which provides a cathode-ray display of telemetry or status parameters along with hard copy and tolerance alarms.

Of particular note is the fact that adding the computer option to the basic system sacrifices none of the operational attributes of the basic system. In the event of an outage in the equipment in the computer option, the basic system operation is unaffected and operates normally under manual control.

The DCS-2 system encompasses control and telemetry capabilities plus status indications. Automatic parameter logging facilities are available optionally in two forms: one with a teleprinter and the other, through a computer.

The DCS-2 uses digital and computer electronics devices and design to assure accuracy and stability. Three levels of digital encoding, including parity, must be satisfied which, in turn, assures transmission integrity. A DCS-2 system accommodates two separate control points with the addition of a second control terminal.

Basic, Three-Unit System

Equipment provided for the basic DCS-2 system consists of a Control Terminal, Remote Terminal, and Selector Unit. This hardware provides telemetry and control, as well as status functions. Channel selection is easily accommodated via a centrally located keyboard. Telemetry information is displayed as a full, four-digit number. A programmable decimal point can be added to each display. Additionally, most standard identification units may be pre-programmed to appear as part of the display (kV, Hz, A, %,etc.). As the system is bipolar, a minus sign appears when appropriate. Provisions are included for independent control and telemetry fail-safe functions as required in the FCC Rules.

Thirty telemetry channels are provided by the DCS-2. Associated with each telemetry channel is a "raise/on", as well as a "lower/off" command function. Each of these command outputs is an isolated, dry-contact closure. The system capabilities described here apply to each transmitter site controlled by the DCS-2.

Each telemetry input accepts a dc sample voltage representing the parameter under scrutiny. These inputs are floating and bipolar. All telemetry inputs are sampled, sequentially, every 1.8 seconds and their data sent to the studio for display. When an actual command function is activated, the telemetry associated with that channel is then interlaced, resulting in an update of the display on the control terminal unit once every 200 milliseconds. A separate function on the system enables the fast updating of any selected channel without the actual activation of a command.

Calibration potentiometers are provided on each telemetry input and enable exact system calibration. Since a digital parameter display is also a part of the remote terminal, one-man calibration of the system is possible. Provisions are incorporated in the remote terminal for acceptance of an external "BCD" input.

Data Connections

In the design of the DCS-2 system, careful consideration was given to the requirements placed on the interconnecting link between the studio and transmitter. This system utilizes either radio or telephone circuits. For the maximum in system reliability, the DCS-2 provides, as standard equipment, automatic switching between main and alternate interconnecting links. As a result, a telephone circuit might serve as the main link, with an RF subcarrier system for backup. Actual command and telemetry functions are transmitted as audio frequency-shift signals. Data modems are included in the terminals. As a precaution against errors the system uses three levels of encoding, including parity.

Status Subsystem

The status subsystem included in the DCS-2 enables exact duplication at the studio of a change-of-state at the transmitter site. Thirty such indications are provided as standard equipment. Expansion is possible to 60 channels from each transmitter site. This subsystem functions separately from the control system.

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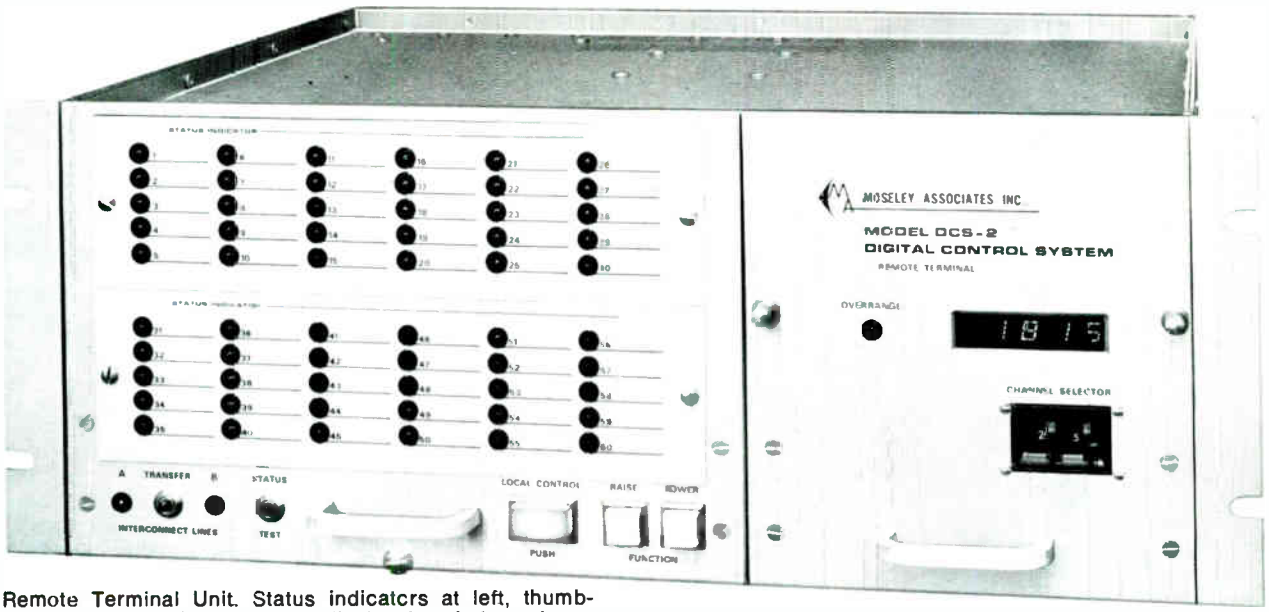


Remote Terminal Unit. Status indicators at left, thumbwheel at lower right controls display in window above.

The data is returned to the studio as a segment of the digital word used for telemetry return. Each channel of the status subsystem in encoded from normally open external contacts. The input is also compatible with TTL logic level signals. At the studio unit, individual LED indicators are provided, as well as a duplicate display at the remote terminal unit. Each channel at the studio may activate external relays, lamps, or other indicating devices through extension.

Direct Command Channel

Included in the DCS-2 system is a single-channel, dedicated-command function not directly associated with the keyboard-selected control channels. This direct-command channel is activated with a toggle switch on the control terminal unit panel, or by parallel terminals on the rear panel for local extension of this function. At the remote terminal, a corresponding output is provided, which can be used to energize an external 24Vdc relay. Possible uses for this direct command channel include emergency program switching, activating an alerting device, or for any often-performed command operation.

System Capability

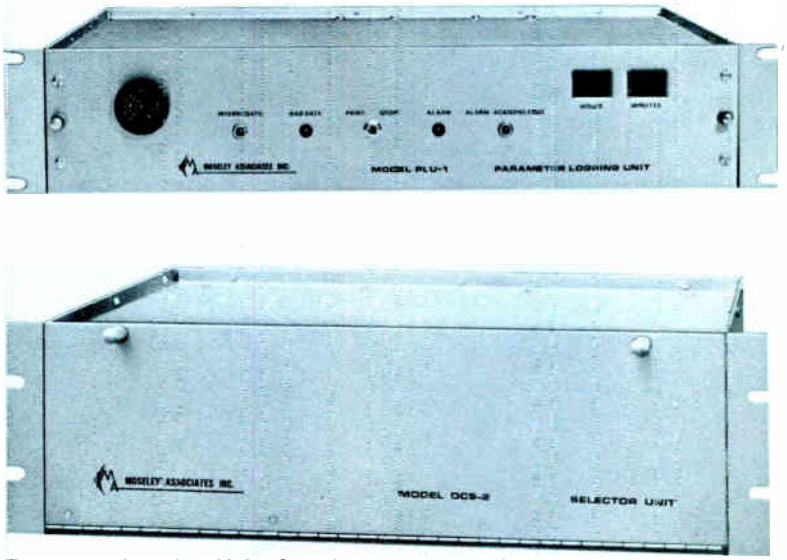
The DCS-2 system provides several levels of system capability which may be selected to meet the immediate and future requirements of the remote-control transmitter plant. The first level provides basic hardware for a fully operative system, consisting of thirty telemetry channels, 60 control channels, providing 30 on/raise and 30 off/lower functions, and a thirty-channel status/alarm system with individual LED indicators.

System Expansion

The second level of capability includes the addition of a selector unit at the transmitter site to increase the number of control and telemetry channels to 60. A status subsystem (optional) increases the number of status/alarm channels to 60.

Automatic Parameter Logging

The Model PLU-1 Parameter Logging Unit is available optionally for use with the DCS-2 Remote Control System. This



Parameter Logging Unit. Samples parameters for automatic logkeeping. Below is Selector Unit for remote control system (see functional diagram).

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logging option records up to 20 preselected telemetry channels. It records each entry as a full-four-digit number. Minus-sign and preprogrammed decimal point are also printed. Time of day is recorded as a part of each line entry. The system programs to make entries at predetermined time intervals. The log format is individual vertical columns for each of the 20 parameters. Selective muting of any channel is provided to prevent inactive channels, such as those associated with standby transmitters, from contributing meaningless entries. Also provided with the PLU-1 Parameter Logging system is a ten-channel tolerance-alarm subsystem. This device, located at the remote terminal, allows adustment of upper and lower tolerance limits on predetermined channels. An out-of-tolerance condition causes that particular log entry to print in red ink.

The teleprinter of the PLU-1 is a Teletype Model 38ASR Data Terminal. Parameter logging may be provided at the transmitter site, as well as at the studio control point, by the addition of a data terminal at each location. (See functional diagram.)

Computer Option

The Computer Option for the DCS-2 includes a central data processing unit, a CRT terminal, a Teletype Model 38ASR Data Terminal, and software. The CRT display provides simultaneous presentation of 30 parameters or status inputs. The central processing unit and all peripheral equipment operate independently of the basic DCS-2 control terminal and remote terminal. Thus, a malfunction in the central processing unit, or other peripheral equipment, causes no outage in the DCS-2. This redundancy is extremely important to

Optional Teleprinter. Connects to Parameter Logging Unit to create hard-copy log, automatically.

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maintain control of the remote-controlled transmitter. In the design of this option, careful consideration was given to the actual location of the central processing unit. The studio, or remote control point was selected because the typical studio environment is much better than that of the transmitter site. The susceptibility to external forces such as lightning, etc., is drastically reduced. Further, any software changes desired are usually more readily accomplished at the studio location. Two transmitter-site operation is possible without the addition of other central processing units.

Computer Option Software

The software provided with the computer option performs a number of functions. It establishes upper and lower limits on every telemetry channel. This provides a continuous check of all parameters under observation. The parameters are displayed on the CRT in page format; any reading beyond preset limits flashes on the CRT, for easy recognition, and sounds an aural alarm.

A Teletype Model 38ASR Data Terminal is provided for hardcopy printout. Each telemetry page accommodates 30 parameters, and each status page accommodates 30 status channels. At any given time the CRT displays 30 parameters or 30 status channels simultaneously. A keyboard is provided with the CRT, and serves initial programming of the CRT display and for the issuance of command functions and channel selection. This is in addition to the command capability provided on the DCS-2 control terminal. The CRT has 16 dedicated displays near

Optional Video Reader. Connects to Central Processing Unit at studio site and includes command capability through keyboard.

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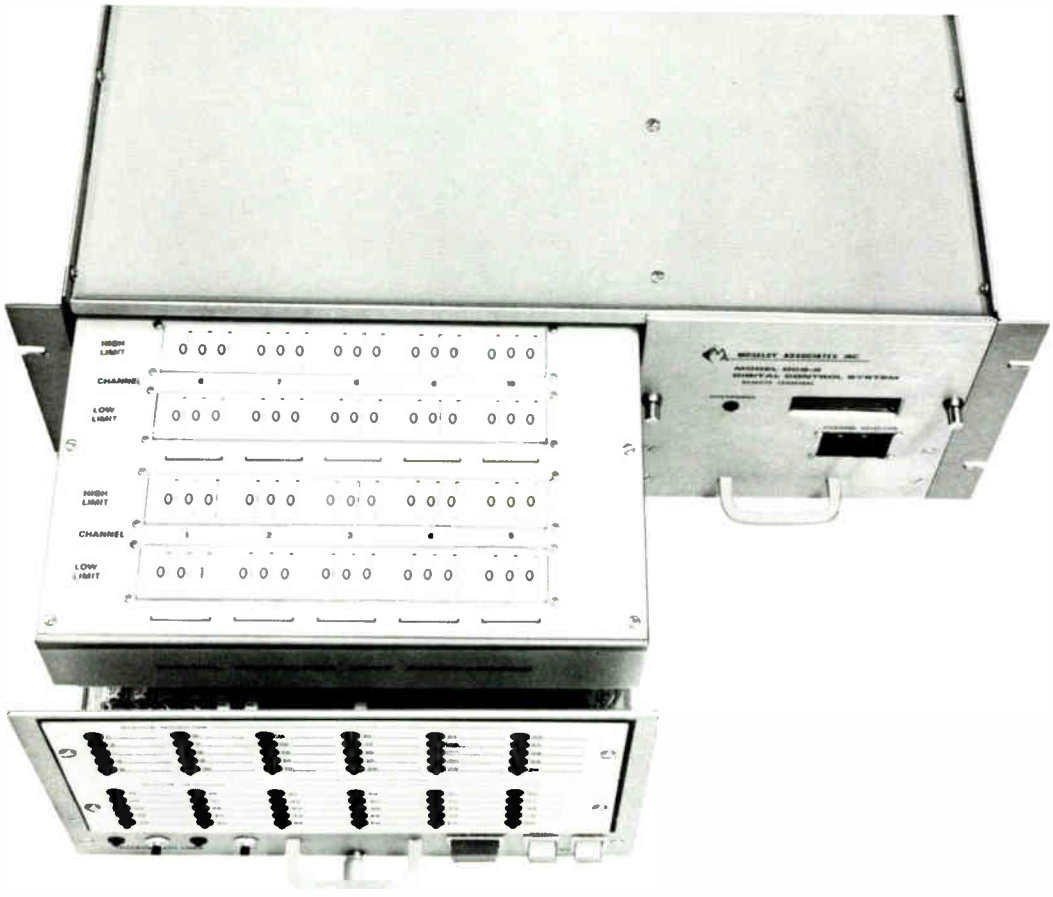
the actual tube face, which are utilized for alerting functions such as out of tolerance conditions and status alarms.

The Model 38ASR Data Terminal provides standard telemetry printout of telemetry information identical to that described for the PLU-1 Parameter Logging Unit. It also includes paper tape punch and read capability. This facility can be used for punching a tape representing all the information stored in the central processing unit, including display information. This tape can then be stored and used for re-programming.

Fail-Safe Features

The DCS-2 system incorporates fail-safe features which fully comply with current regulations for the remote control of television transmitters. The remote terminal continuously monitors the presence of the FSK (Frequency Shift Keyed) digital signal, and in the event this signal is interrupted, a control fail-safe relay is de-energized in approximately 20 seconds, opening contacts which interface with the control circuits of the controlled TV transmitter. This places the TV transmitter in a non-radiating condition.

If the digital telemetry information from the TV transmitter site in interrupted, its absence is sensed by the studio control terminal unit and the telemetry failure is sent to the remote terminal unit as a segment of the digital word, along with control information. At the remote terminal end, the telemetry fail-safe relay is de-energized. Its contacts are interfaced with an external Type BRF-1 Fail-Safe



Drawer in Remote Terminal rolls out for access to the tolerance-alarm thumbwheel presets for all ten channels.

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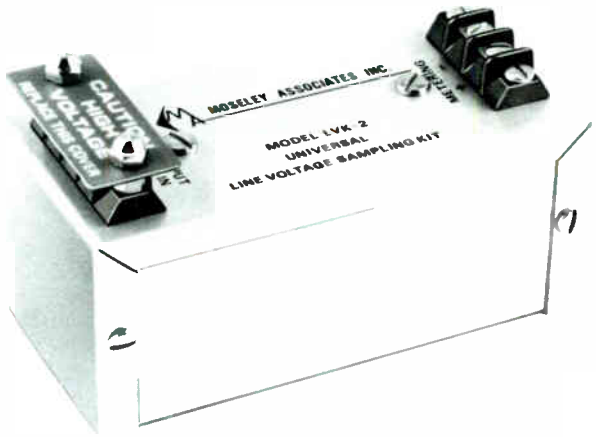
Unit, which is actuated to start a one-hour, integrated-circuit timer. At the end of the one-hour interval, the TV transmitter shuts down unless telemetry is restored during the one-hour interval. In that event the clock resets automatically and normal operation is resumed.

Alarm information indicating a telemetry failure, and the start of the one-hour timing cycle, may be relayed to the control terminal unit through selected channel of the status alarm subsystem.

System Interconnection

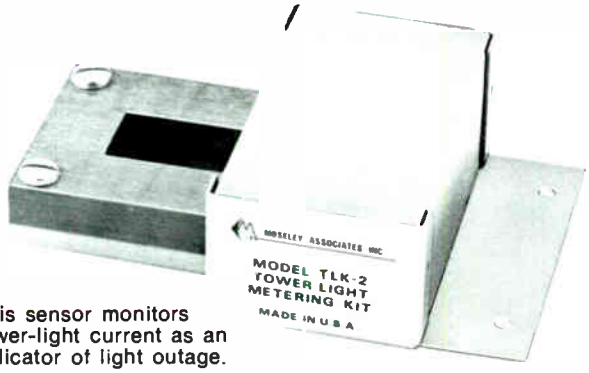
The DCS-2 system remote and control terminals may be interconnected by a communication grade, two-wire telephone line. DC continuity is not essential. Control data may be transmitted to the remote site by means of an additional audio channel on an STL microwave system. If microwave facilities are available from the transmitter site to the studio, the telemetry data may be returned in a similar manner. Alternatively, the telemetry data may get to the studio on a subcarrier on the TV aural carrier through the use of a Type SCG-8 Subcarrier Generator unit.

In this unit, the telemetry data is modulated on a 39kHz subcarrier inserted into the aural transmitter, along with the normal aural program material. Telemetry recovery at the studio is accomplished with an off-air receiver, such as the TMR-2 Multiplex Receiver, or with a Type SCD-2 Subcarrier Detector Unit connected to a TV aural modulation monitor equipped with an SCA output.



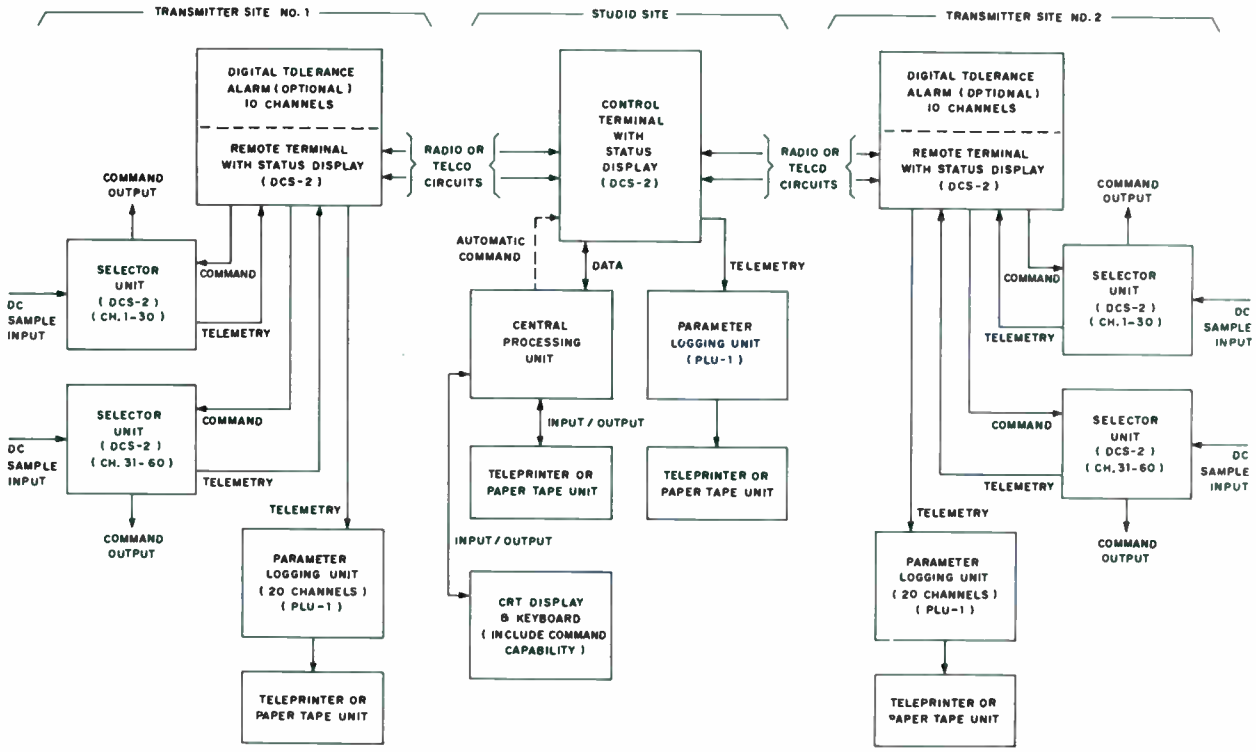
This unit samples power line voltage and converts it to a proportional d-c voltage.

This sensor converts temperature to a sample voltage.



This sensor monitors tower-light current as an indicator of light outage.

World Radio History



Functional diagram, typical two-site system. Some items included are optional units.

Specifications

Control Channels (Expandable to 60) 30
Control Sites (30 Channels min. per site) 2
Control Output:
- Contact Rating (Non-inductive load) ..... 120V, 50W ac/dc
- Connections ..... Isolated and floating
- Fusing ..... Both sides fused

Telemetry Inputs (Each input floating):
- Sensitivity (For full-scale) ..... ±1Vdc
- Maximum Level ..... ±10Vdc max.
- Common-Mode Voltage ..... ±350Vdc max.
- Input Resistance ..... 100k ohms

Telemetry Display:
- Indicators ..... LED Devices
- Significant Figures (Plus polarity indication) 4

Telemetry Accuracy (Per Week) 0.1%
Telemetry Resolution (Excluding cal. potentiometer) 0.01%
Decimal Point ..... Programable at transmitter site
External Digital Input (Parallel, BCD) ..... 16 bit
Status Channels (Expandable to 60) 30
Status Input (For each channel) ..... Contact Closure
Status Display (On both units; control and transmitter):
- Indicators ..... LED Devices
- Indicators per Channel 1
- External Drive ..... 150mA sink to gnd; 28Vdc max.

Fail-Safe Facilities—Control:
Relay contacts, closed in operational position. Open 20 seconds following control failure to remote terminal.

Fail-Safe Facilities—Telemetry:
Provisions for use with BRF-1 Fail-Safe Unit, complying with current FCC requirements for telemetry fail-safe operation.

Response Time (30 Channels):
- Control ..... 0.1 second
- Telemetry Update (0.2s during control or "Fast Read") ..... 1.8 second
- Status (Maximum Update) ..... 2.3 second

Interconnection Requirements:
- Wire ..... Unconditioned Series 3002 Data Circuit[1]
- Radio ..... Two-Way; 3 kHz min. bandwidth

Redundant Interconnection Switching:
- Automatic (After loss of vaild data) ..... 5 seconds
- Manual ..... Pushbutton

Manual Override ..... Switch on Control Terminal
Ambient Operating Temperature ..... 0 to 50°C (32 to 122°F)
Power Requirements (30-Channel Units):
- Control Terminal ..... 120/240V, 50-60 Hz, 120W
- Transmitter Terminal ..... 120/240V, 50-60 Hz, 150W

Dimensions:
- Control Terminal ..... 7″ H, 19″ W, 17″ D (178, 483, 432 mm)
- Remote Terminal ..... 7″ H, 19″ W, 17' D (178, 483, 432 mm)
- Selector Unit ..... 5.25″ H, 19″ W, 12″ D (133, 483, 305 mm)

[1] Control: 150 band; telemetry 1200 band

Accessories

Parameter Logging Unit, Type PLU-1 .....
Computer Option .....

Ordering Information

Type DCS-2 Digital Remote Control Systems are arranged according to the transmitter control situation and your desires. As a result, each package is unique. Your RCA salesman has material that is most useful in arranging a system for your needs, budget and desires.

World Radio History

catalog TT.5600A

RCA

Remote Control Accessories

- Transmitter interface devices
- Current-to-voltage converters
- Overtemperature and overvoltage sensors
- Voltage- and signal-sampling kits
- Status reporting/alarm devices

Here are devices and accessories for use with RCA Type BTR-30 and Moseley Types DRS-1 and DCS-2 Remote Control Systems when they control television transmitters.

The equipment interfaces the transmitter with the remote control system and extends the system scope with telemetry of additional data associated with the operation and security of the transmitter plant.

Individual unit application depends on the transmitter systems involved, the environment of the transmitter plant and user preference based on his knowledge of operating conditions.

The description on the next few pages allow selection of the appropriate devices in the implementation of a new system or the expansion and/or updating of an existing system.

Interface requirements depend largely on the transmitter type involved in the system. Generally, the remote control system provides a single-contact-closure for each control function and a pair of terminals for each sample voltage. If the transmitter control and metering provisions aren't compatible with these requirements, interface relays and/or metering samplers are necessary.

World Radio History

Relays and Sockets

These relays isolate or interface the remote control system and the system under control. Alternatively, these relays increase the current capabilities of the remote control system circuitry. All are double-pole, double-throw (DPDT) with 5 ampere contact rating. (Not illustrated.)

Ordering Information

Relay Type	Coil	Cat. No.
Momentary Contact	24Vdc	MI-561488-1
Momentary Contact	115Vac	MI-561488-2
Latching	24Vdc	MI-561488-3
Time Delay 0.1 to 2s	24Vdc	MI-561488-4

Relay Panels

Aluminum panels for rack mount. Require 3.5 inches (89 mm) rack space. Mount up to eight relays (described above).

Specifications

Dimensions ..... 19″ W, 3.5″ W, ⅛″ D (483, 89, 3 mm)

Ordering Information

Relay Panel (less relays) MI-561449

Direct-Current Amplifier, Type CSA-3

Direct-Current Amplifier, Type CSA-3

A chopper-stabilized, d-c amplifier for voltage amplification and/or isolation of the sensitive meter circuits in frequency monitors and reflectometers without interference to sampled device operation. A "floating" input circuit allows use with positive, negative or isolated-from-ground source circuits.

Accessory

Mounting Panel (described below) MI-561480

Specifications

Voltage Gain (Adjustable) 45
Input Resistance ..... 2200 ohms
Sensitivity (For 1.5V output) 15μA
Ambient Operating Temperature ..... 0-150°F (−18 to 66°C)
Power Requirements ..... 117V, 50-60 Hz, 4W
Dimensions ..... 5.25″ x 7.5″ x 2″ (133, 191,51 mm)
Weight ..... 2 lbs. (910 g)
Shipping Weight ..... 3 lbs. (1.4 kg)

Ordering Information

Chopper-Stabilized DC Amplifier, Type CSA-3 ..... MI-561461

DC Amplifier/Linear Converter, Type PLC-1

Amplifies and converts a non-linear sample voltage to a linear sample for metering a power circuit with a digital readout system such as the Moseley DRS-1 or DCS-2 or ADP-220 systems. The output voltage is proportional to the antilog of the input voltage. (Not illustrated.)

Specifications

Input Impedance ..... 2200 ohms
Input Level ..... 15 to 500 μA
Output Load (minimum) ..... 5000 ohms
Output Level (log. and lin.) ..... 1.5Vdc, 10k ohms
Ambient Operating Temperature ..... 0-150°F (−18 to 66°C)
Power Requirements ..... 120Vac, 50-60 Hz, 5W
Dimensions ..... 5″ x 7½″ x 2″ (127, 191, 51 mm)
Weight (Approx.) ..... 2 lbs. (910g)
Shipping Weight (Approx.) ..... 3 lbs. (1.4 kg)

Ordering Information

DC Amplifier/Linear Converter, Type PLC-1 ..... MI-561179

World Radio History

Amplifier Mounting Panels

Requiring only 5¼ inches (133 mm) rack space, this panel mounts two Type CSA-3 or two Type PLC-1 amplifiers. Alternatively, the panel mounts one of each amplifier types.

Specifications

Dimensions ..... 5¼" H, 19" W (133, 483 mm)

Ordering Information

Amplifier Mounting Panel MI-561480

Plate Current Metering Kits

Used with earlier design transmitter where a plate-current metering sample is unavailable, these kits sample plate current and convert it to a voltage compatible with a remote control system. Available in four ranges.

Ordering Information

Plate Current Metering Kits:
- Range: 0 to 1 Ampere MI-561481-1
- Range: 0 to 2 Amperes MI-561481-2
- Range: 0 to 5 Amperes MI-561481-3
- Range: 0 to 10 Amperes MI-561481-4

Plate Voltage Metering Kits

The voltage counterpart of the unit described above, these kits generate a plate voltage sample compatible with remote control systems. Available in three voltage ranges.

Ordering Information

Plate Voltage Sampling Kits:
- Range: 1 to 3 kV MI-561482-1
- Range: 3 to 10 kV MI-561482-2
- Range: 10 to 20 kV MI-561483

Remote Control Failsafe Module, Type BRF-1

In the event of an outage in the control tone as the result of a malfunction in the remote control equipment or the transmission medium, the BRF-1 circuitry shuts the transmitter down. If any of four logged metering parameters fails or drops below a preset value, or, if telemetry information fails to arrive at the studio control point, a one-hour, integrated-circuit times (in the BRF-1) starts. If this timer completes its cycle, the system dumps the transmitter. Correction of the failure problem before full timer cycle resets the timer and allows resumption of normal operation. (Not illustrated.)

Specifications

Metering Inputs 4
Input Impedance ..... 100k ohm min.
Input Voltage ..... 0.25 to 10Vdc
Metering Voltage Trip Level ..... 0.25V max.
Telemetry Failsafe Input 24Vdc
Failsafe Output (Normally Closed) ..... SPST Contacts
Failsafe Output Delay (Internal Timer) ..... 1 hour
Status Output ..... SPDT Contacts
Status Output Delay ..... 4.1 or 48s
Ambient Operating Temperature ..... 0 to 140°F (−18 to 60°C)
Power Requirements ..... 120/240V, 50/60 Hz, 30W
Dimensions ..... 3½" H; 19" W; 7" D (89, 483, 178 mm)
Weight (Approx.) ..... 15 lb. (6.8 kg)

Ordering Information

Remote Control Failsafe Module, Type BRF-1 ..... MI-561484

Plate-Current/Voltage Metering Kits (MI-561481/82)

World Radio History

Failsafe Interface Panel

Used with the Type BRF-1 Remote Control Failsafe Unit (see above), the Failsafe Interface Panel provides a latching relay to sense transmitter shutdown due to telemetry failure. It operates at the conclusion of the one-hour failsafe cycle the BRF-1 provides and indicates failsafe condition with a lighted, front-panel indicator. Reset button on front panel.

Specifications

Dimensions ..... 3½" H; 19" W; 3½" D (89, 483, 89 mm)
Weight ..... 4 lbs. (1.8 kg)

Ordering Information

Failsafe Interface Panel MI-561192

Aural Subcarrier Insertion Kits

Used to add a 39kHz subcarrier to the aural section of this transmitter to use the aural carrier as a telemetry path. The kits are engineered for specific transmitter models. Dual transmitters require two kits.

Ordering Information

Aural Subcarrier Insertion Kits:
For TT-15FL, TT-25FL, TT-30FL, TT-5EH1S, TT-6ELS, TT-12EHS, TT-25ELS Transmitters MI-560851-15
For TT-17FH, TT-25FH, TT-35FH, TT-50FH Transmitters MI-560851-18
For All "D" and "E" Transmitters equipped with tubed exciter systems MI-34326-30

Tolerance Alarm Unit, Type TAU-2

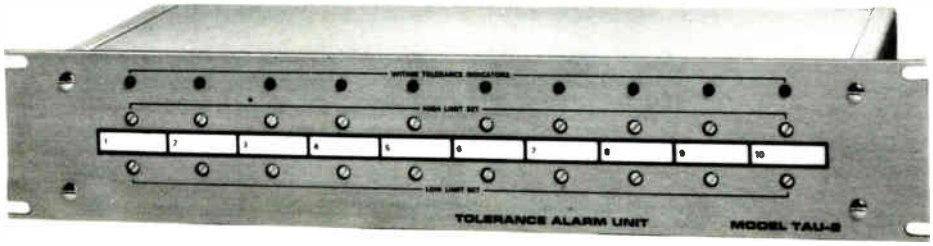
- Monitors parameter limits—upper and lower
- Each frame holds 10 units in 7.5" (191 mm) rack space
- Compatible with ADP-220 automatic logging
- Interfaces with SCS-2 status indicator system

Used in combination with a BTR-30 remote control or an ADP-220 automatic logging system, the TAU-2 simultaneously monitors selected metering samples. When any of the samples exceeds preset limits—upper or lower—the TAU-2 actuates an alarm.

The TAU-2 rack-mounts at the transmitter site and each rack-frame holds up to 10 plug-in units—one unit for each parameter monitored. The TAU-2 is particularly valuable in facilities equipped with automatic logging printers.

Under FCC rules, a system equipped with an automatic logging facility must have an automatic alarm on parameters with defined upper and lower limits (visual and aural power output, for example). The TAU-2 is ideally suited for such duty as well as for monitoring parameters where an alarm of abnormal operation is desirable for system management.

Where an abnormal parameter exists, the TAU-2 displays a visual alarm. When the parameter is logged automatically (via the ADP-220) the TAU-2 instructs the printer to note the beyond-tolerance reading in red and sound an alarm for the transmitter operator.



Tolerance Alarm Unit, Type TAU-2

World Radio History

Interfaced with an SCS-2 status indicator system, the TAU-2 relays an out-of-tolerance condition to the control point, even if automatic logging isn't part of the system.

Specifications

Channels ..... 1 to 10 per frame, plug-in modules
Trip Point Hysteresis (Centered on Input) ..... ±0.005V
Input Requirements (Gnd. ref.) ..... −3 to +3V dc
Input Impedance ..... 30,000 ohms
Indicator (Each Module) ..... Light-Emitting Diode
Outputs:
  Alarm ..... Transistor Switch
  Relay Power (Relay not supplied) .... 16V dc, 600 ohm load
External Reference Voltage
  (If Used) .... Twice Sample Voltage but less than +8V dc
External Ref. Input Impedance ..... 22,000 ohms
Ambient Operating Temperature ..... 0 to 140°F (−18 to 60°C)
Power Requirements ..... 120/240V, 50-60 Hz, 30W max.
Dimensions (Frame) ..... 19" W; 3½" H; 7½" D (483, 89, 191 mm)
Weight (Frame & 10 Modules, approx.) ..... 9 lbs. (4.1 kg)
Shipping Weight (Approx.) ..... 13 lbs. (5.9 kg)

Ordering Information

Tolerance Alarm System, Type TAU-2:
  Module MI-561184
  Main Frame (For 1 to 10 modules) MI-561469

Tolerance Alarm Interface Relay

Interfaces a TAU-2 Tolerance Alarm Unit (see above) and an SCS-2 Status Indicator System (see below) when tolerance alarms are reported to the studio control point via an SCS-2 system. A relay is required for each alarm channel; eight or fewer relays fit the accessory rack-mount panel.

Accessory

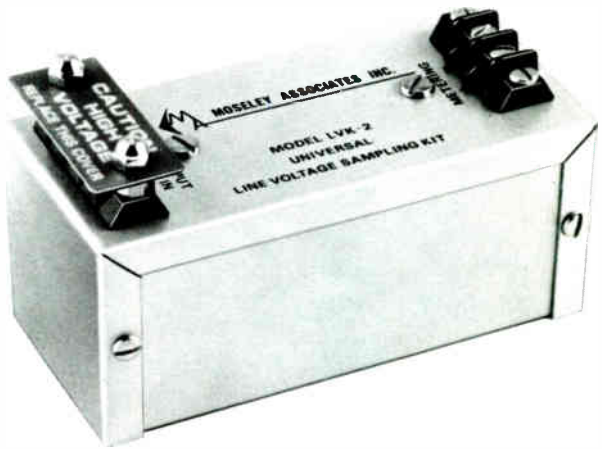
Rack-Mount Relay Panel MI-561449

Ordering Information

Tolerance Alarm Interface Relay MI-561448-5

Line-Voltage Sampling Kit, Type LVK-2

Samples power line voltage for remote monitoring. Converts single-phase voltage into proportional d-c voltage for telemetry. Unit required for each phase in three-phase systems.



Line-Voltage Sampling Kit, Type LVK-2

Specifications

Voltage Range ..... 120 to 440Vac
Dimensions ..... 3" x 5" x 2.5" (76, 127, 64 mm)
Weight (Approx.) ..... 1.5 lbs. (671g)
Shipping Weight (Approx.) ..... 2 lbs. (910g)

Ordering Information

Line-Voltage Sampling Kit, Type LVK-2 ..... MI-561463

World Radio History

Temperature Sensing Kit, Type TSK-3

Provides an accurate measurement of building, air inlet, air exhaust or similar air temperatures. The linear proportional output is compatible with the BTR-30, DRS-1 and DCS-2 remote control systems.

Temperature Sensing Kit, Type TSK-3

Specifications

Temperature Range	0-140°F (–18 to 60°C)
Power Requirements	117V, 50-60 Hz, 3W
Dimensions	3½" x 2" x 7" (89, 51, 178 mm)
Weight (Approx.)	1 lb. (454g)
Shipping Weight	1.5 lbs. (671g)

Ordering Information

Temperature Sensing Kit	MI-561465

Tower Light Monitor Kit, Type TLK-2

Monitors a-c currents in tower-lighting systems. Uses current transformer for inductive sampling and requires no physical connection to the monitored circuit.

Tower Light
Monitor Kit, Type TLK-2

Specifications

Sensitivity Range	2 to 20Aac
Dimensions	4 x 2.25" x 2.25" (102, 57, 57 mm)
Weight (Approx.)	1 lb. (454g)
Shipping Weight (Approx.)	1.5 lbs. (671g)

Ordering Information

Tower Light Monitor Kit, Type TLK-2	MI-561462

World Radio History

Status Indicator System, Type SCS-2

- **Expands the alarm/status capability of BTR-30**
- **Automatically scans 14 on/off functions**
- **Adjustable for "automatic reset" or "latch"**
- **Complete scan every 400 milliseconds**
- **Lighted indicators signal abnormal situation**

The SCS-2 Status Indicator System consists of rack-mounted transmitter and receiver units. It automatically scans fourteen "on-off" functions once every 0.4 seconds. In the event that any or all of the 14 functions are abnormal, the SCS-2 lights an individual panel indicator for each abnormality. The sensing circuit for each function is a simple contact-closure in the appropriate channel. In effect, a short circuit in the external circuit lights the indicator.

A front-panel control sets the indicator system for "automatic reset" or "latch". With automatic reset, the indicator lights as long as the abnormality lasts; in the "latch" condition, the indicator holds until manually reset even if the abnormality was a transient condition.

The SCS-2 ordinarily requires a telephone pair between the transmitter and receiver. However, adding an MSC-1 (30) Combiner (described below) to the system lets it share the interconnection facility of a BTR-30 remote control system.

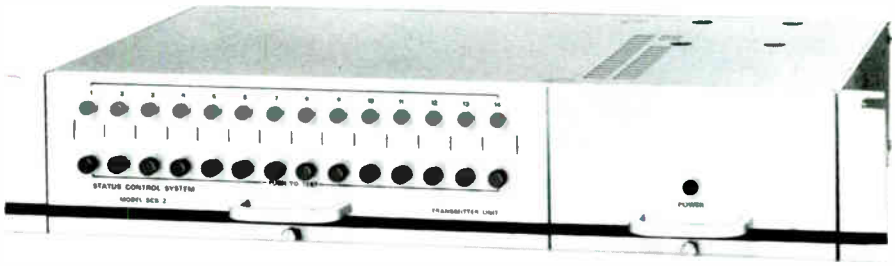
Specifications

Indicator Channels	14
Response Time	0.5s max.
Interconnection Requirements:	
Wire	Voice-grade pair
Radio	Continuous one-way
Response	2 to 3 kHz
Path Loss	20 dB max.
Signal Levels:	
Transmitter Unit (Output)	0 dBm, 600 ohms bal. or 1.5V rms, 600 ohms, unbal.
Receiver (Studio) Unit (Input)	0 dBm, 600 ohms bal. or 0.5V rms, 600 ohms, unbal.
Transmitter Unit Input	Normally closed external contacts. Open circuits for alarm. Reversible in the field by re-strapping.
Receiver Unit Output	Visual (lamps) and rear-apron terminals
External Alarm Output	One set SPDT contacts, rear apron
Ambient Operating Temperature	–20 to 135°F (–7 to 57°C)
Power Requirements (Each unit)	120/240V, 50/60 Hz, 20W
Dimensions (Each unit)	19″ W; 3½″ H; 10½″ D (483, 89, 267 mm)
Weight (each unit, approx.)	19 lbs. (8.6 kg)
Shipping Weight (Approx.)	49 lbs. (12 kg)

Ordering Information

Status Indicator System, Type SCS-2	ES-561156
(Units available only as system, not separately.)	

Transmitter Unit, Status Indicator, Type SCS-2



Receiver Unit, Status Indicator, Type SCS-2

World Radio History

World Radio History

RCA

TV Transmitter Input and Monitoring Equipment

- Audio/video monitoring
- Carrier frequency monitoring
- Suggested equipment lists
- Suggested rack arrangements
- Typical system diagram

The proper selection and use of transmitter input and monitoring equipment helps the station determine compliance with FCC requirements and assure good operating condition of the transmitter. The input and monitoring equipment items listed here mount in two RCA Type BR-77 cabinet racks, which match RCA TV transmitters. They may be used in conjunction with an optional transmitter control console, Type TTC-5B. (The console is described in a separate catalog section).

A recommended list of input and monitoring equipment is included in the accompanying specifications. The suggested rack layout (see drawing, next page) improves operational convenience, grouping unit relationships and ease of connection. The function of each item and typical interconnection is shown in the typical system drawing on Page 3 of this section.

Audio Limiter/Clipper

Sideband Demodulator

Delay Equalizer

Frequency and Aural Modulation Monitor

Audio Monitor Amplifier

Sideband Response Analyzer

World Radio History

Sideband Response Analyzer, Type BW-5

Carrier Frequency and Aural Modulation Monitor, Type TFT-701.

Audio Monitor Amplifier, Type BA-44.

Remote Control Operation

When a TV Transmitter operates via remote control, FCC Rules require certain monitoring equipment (a visual demodulator, aural modulation monitor, waveform monitors, picture monitors, vectorscope, and equipment for vertical-interval test signals) be located at the control location. Even though this equipment permits evaluation of the quality of the radiated signal at the studio site, good engineering practice dictates the availability of appropriate monitoring equipment at the transmitter site to allow quantitative measurements for optimum transmitter adjustment.

Although a visual- and aural-carrier frequency monitors are not required if frequency measurements are made periodically in accordance with current FCC requirements, the use of a carrier frequency monitor is recommended to provide a continuous indication of operation within carrier frequency tolerances.

Input Equipment

The transmitter input processing equipment includes:

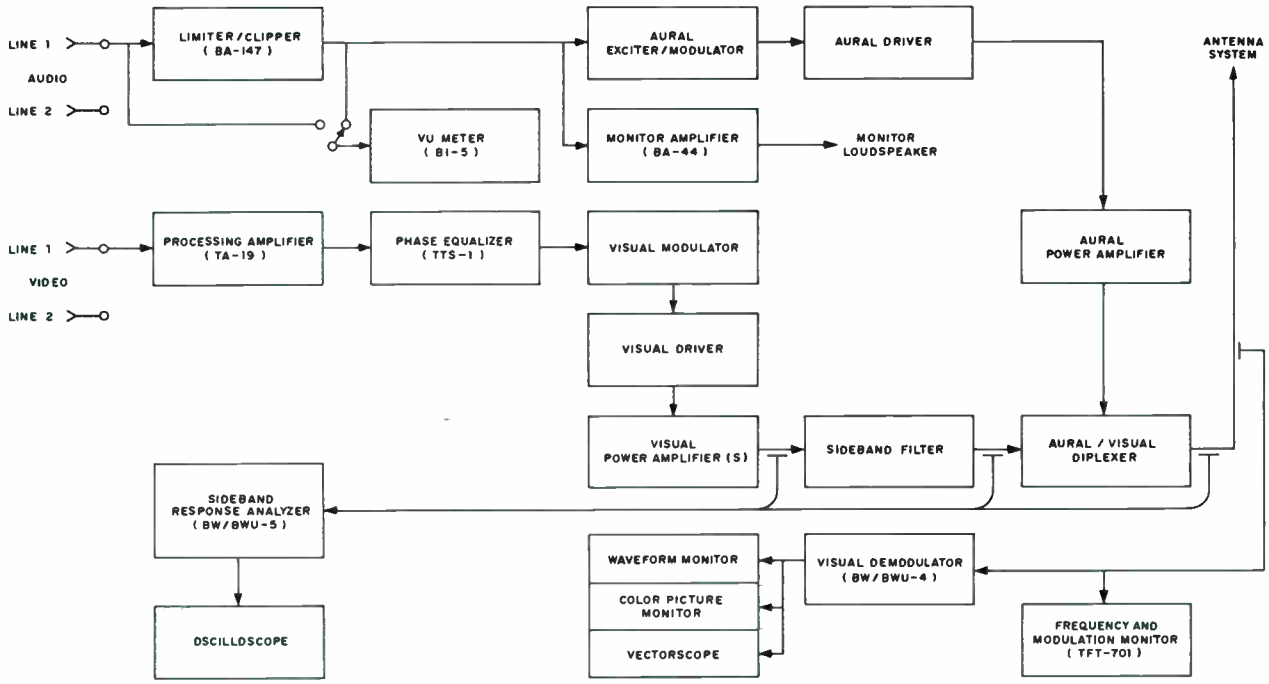
a. Limiter/Clipper Amplifer (Type BA-147) for Audio processing before application to the transmitter.

b. Video Processing Amplifier (Type TA-19) for processing the video input signal.

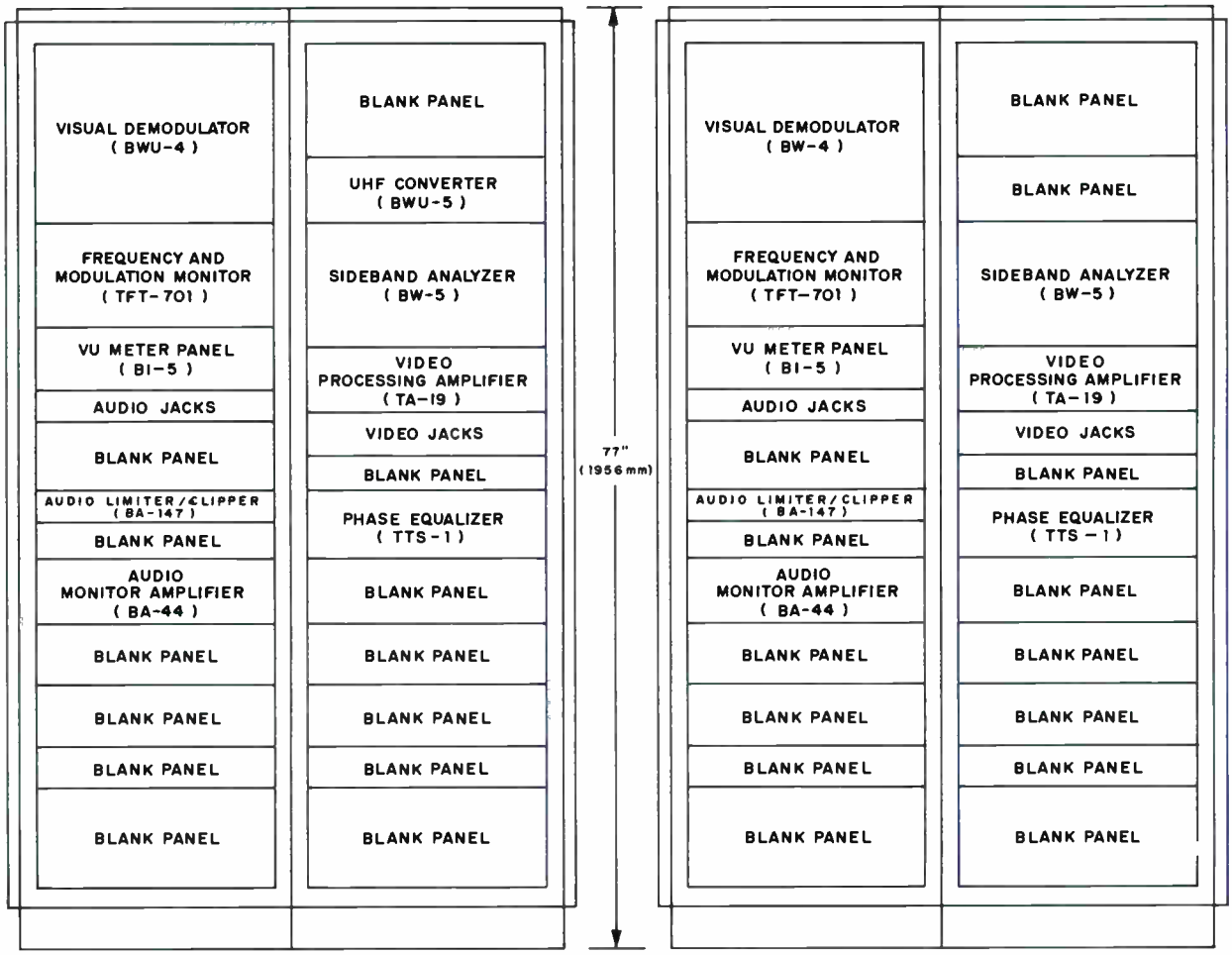
c. Video Delay Equalizer System (Type TTS-1), including video low pass filter and receiver equalizer, to provide envelope delay correction.

This equipment provides complete facilities for automatic control, processing and pre-correction of the audio and video information prior to its application to the transmitter. Control and test points are provided to routinely observe the operation and adjustment of the equipment.

World Radio History



Typical input and monitoring system for television transmitters.



Typical rack arrangements: UHF system on left; VHF on right.

World Radio History

Monitoring Equipment

The transmitter monitoring equipment includes:

a. Monitor Amplifier (Type BA-44) for audio signal monitoring.

b. VU Meter Panel (Type BI-5) for audio level monitoring.

c. TV Frequency and Aural Modulation Monitor (Type TFT-701) to provide a continuous check of visual and aural carrier frequency and aural modulation.

d. Visual Sideband Demodulator (Type BW-4 or BWU-4) for qualitative and quantitative observation of the demodulated RF output of the transmitter.

e. Sideband Response Analyzer (Type BW-5 or BWU-5) and (ES-597267) Sync and Blanking Adder for swept frequency response characteristics of the visual transmitter system.

f. Audio and video jack panels and cords for signal access and routing.

The BW-/BWU-4 Visual Sideband Demodulator and the BW-/BWU-5 Sideband Response Analyzer utilize a sample of the modulated visual RF, which is provided by directional couplers at appropriate points in the coaxial transmission line system. A list of suitable directional couplers and monitoring line sections is included under "Accessories".

For more detailed descriptive information and specifications of the individual items of recommended Input and Monitor-Equipment, refer to the appropriate catalog section for each item.

Ordering Information

Transmitter Input and Monitoring Equipment:

	Quantity UHF	Quantity VHF	Catalog Number
Cabinet Rack, 24", with Rear Door, Side Panels and top cover (Type BR-77P)	1	1	ES-36591-P77
Cabinet Rack, 24", with Rear Door & Top Cover (Type BR-77S)	1	1	ES-36591-S77
Electrical Shield	2	2	MI-36546-A21
Electrical Shield	1	1	MI-36546-A28
Single Trim Strip	2	2	MI-30566-A77
Double Trim Strip	1	1	MI-30568-A77
Pair of Mounting Angles	2	2	MI-30526-A77
Terminal Board Brackets	3	3	MI-4570-A2
Audio Terminal Block	1	1	MI-4569-A4
Power Terminal Block	6	6	MI-4568
Audio Patch Cord (Tip, Ring, Sleeve)	3	3	MI-4652-D2
Jack Panel, 20 Jacks (Type BJ-20TRS)	1	1	MI-11666
Limiter/Clipper Amplifier (Type BA-147)	1	1	ES-11141
Monitor Amplifier with guide (Type BA-44)	1	1	ES-11134
Shelf (Type BR-22)	1	1	MI-11597
Self Normalizing Dual Video Jack Panel, Less Jacks (Type 112)	1	1	MI-556582-8
Dual, Normalled-through Jacks (Type 22T)	22	22	MI-556582-1
Patch Cord (Type 57)	6	6	MI-556582-2
Test Probe, BNC (Type 5B)	2	2	MI-556582-3
VU Meter Panel (Type BI-5)	1	1	MI-12265
Video Processing Amplifier (Type TA-19)	1	1	MI-556630B1
Burst Regenerator (for TA-19)	1	1	MI-556646A
Automatic Video Gain Control (for TA-19)	1	1	MI-556647A
Color Phase Equalizer, Including low-pass filter (Type TTS-1)	1	1	MI-560503
Module Extender for TTS-1	1	1	MI-560541B
TFT-701 TV Frequency and Aural Modulation Monitor	1	1	TFT-701
Rack Adaptor (for TFT-701)	1	1	TFT-701-1
Sideband Response Analyzer (Type BW-5C2)	1	X	MI-34000C2
Sideband Response Analyzer (Type BWU-5C2)	X	1	ES-34009C2
Sync and Blanking Adder (for BW-5C2 or BWU-5C2)	1	1	ES-597267B
Module Frame	1	1	MI-557300
Visual Sideband Demodulator, VHF (Type BW-4C1)	1	X	ES-34048C
Visual Sideband Demodulator, UHF (Type BWU-4C1)	X	1	ES-34049C
Blank Panel, 3½" (89 mm)	3	3	MI-36547-2
Blank Panel 5¼" 133 mm)	7	6	MI-36547-3
Blank Panel 8¾" (222 mm)	3	3	MI-36547-5

Directional Couplers:
(For Use With BW-/BWU-4 or BW-/BWU-5)

VHF/UHF, 50/51.5 ohm, for use with unpressurized 3⅛" line only	MI-19396-1B
VHF/UHF, 50/51.5 ohm, for use with 3⅛" line. May be pressurized	MI-27390
VHF/UHF, 75 ohm, for 6⅛" line. May be pressurized	MI-27389
VHF/UHF, 75 ohm, for 8-3/16" line. May be pressurized	MI-561577
VHF/UHF, 75 ohm, for 9-3/16" line. May be pressurized	MI-561578

Transmission Line Sections:
(For Use With Directional Couplers)

VHF, 51.5-ohm 3⅛", 12" long unflanged	MI-19396-3
UHF, 50-ohm, 3⅛", 12" long EIA flanged	MI-19089-22
VHF/UHF 50-ohm, 3⅛", 12 long flanged, Universal flanges	MI-27791D-9A
VHF, 50-ohm, 3⅛", 12" long unflanged, Universal flanges	MI-27791K-9A
VHF, 51.5-ohm, 6⅛", 12" long unflanged	MI-19314C-25
UHF, 75 ohm, 6⅛", 12" long EIA flanged, Teflon insulated	MI-19387-20
VHF/UHF, 75 ohm, 6⅛", 12" long flanged, Universal flanges	MI-27792D-9A
VHF/UHF, 75 ohm, 8-3/16, 12" long flanged, Universal flanges	MI-561566D-9A
VHF/UHF, 75 ohm, 9-3/16", 12" long flanged, Universal flanges	MI-27793D-9A

World Radio History

RCA

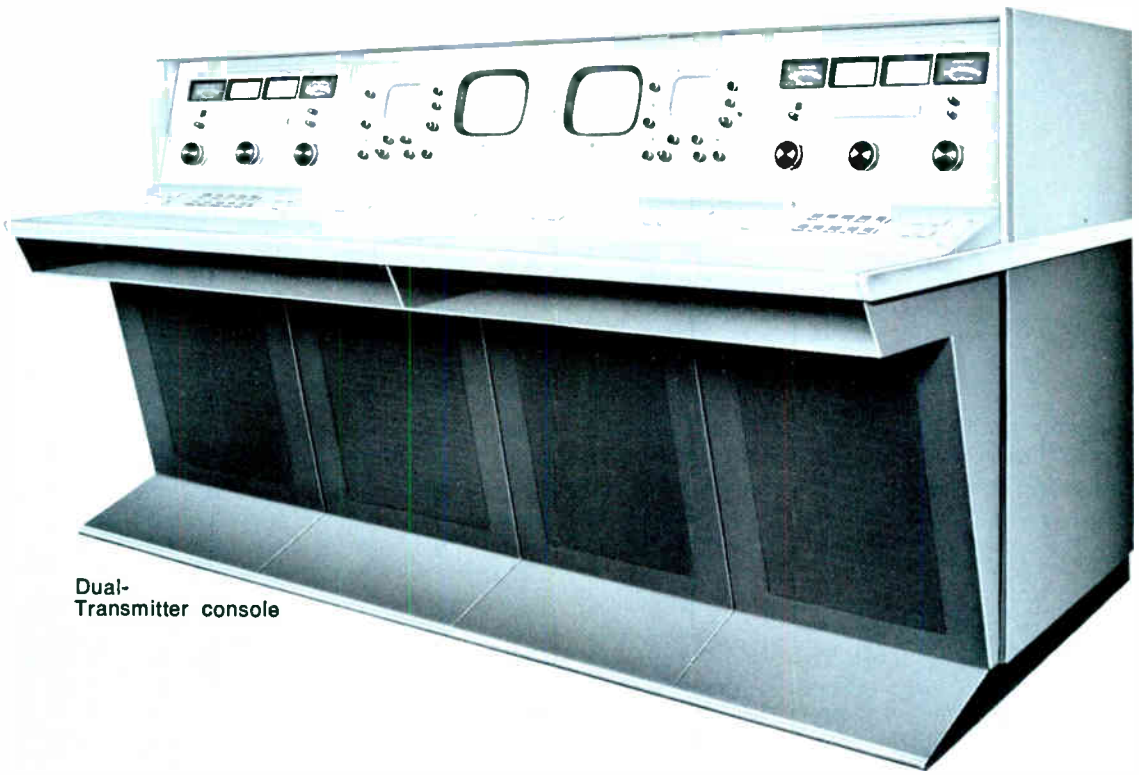
catalog TT.6300A

(Replaces B.4304)

Transmitter Control Console, Type TTC-5

- Centralized transmitter control
- Audio and video monitoring
- Wideband picture and waveform monitors
- Program audio and video input switching
- Transmitter metering display
- For single or parallel transmitters

Type TTC-5 Transmitter Consoles provide central control and monitoring for RCA television transmitters. Used in conjunction with recommended input and monitoring equipment (see separate catalog section) the TTC-5 provides a planned control facility exactly suited to each transmitter. Models are available for VHF or UHF television transmitters in either single or parallel configuration.



Dual-
Transmitter console

World Radio History

The TTC-5 Transmitter Control Console is made up of equipment according to type of transmitter and includes a Transmitter-Control Panel, picture and waveform monitors, a Monitor Control Panel and an attractively styled modular console housing. The console proper is made up of a 40-inch (1016 mm) base section and two 20-inch (508 mm) turret sections for a single transmitter, or two base sections and four turret sections for a parallel transmitter. The upper sections of the console turret contain the Monitor Control Panel and the picture and waveform monitors, while the lower, sloping sections contain the Transmitter Control Panel. For parallel transmitters, a Monitor Control Panel and a Transmitter Control Panel are supplied for each transmitter, as well as facilities for combined power metering, combined visual monitoring, exciter and mode switching and EBS control.

Centralized Transmitter Control

The Transmitter Control Panel contains pushbutton switches for transmitter supervisory control and operation. All operating control functions may be extended to the console such as: "Transmitter on/off", "PA Plate", "Overload Reset", and "Raise/Lower" functions for "RF excitation", "Sync Gain", and "Video Gain". Tally lights operated by voltages from the transmitter indicate functional status. A series of transmitter control panels are available, each designed for a specific transmitter. (See "Ordering Information".) In the case of parallel transmitters, a separate panel is supplied to accomplish exciter switching, EBS control and mode switching ("AB air"; "A air, B test"; "A test, B air").

Monitor Control Panel

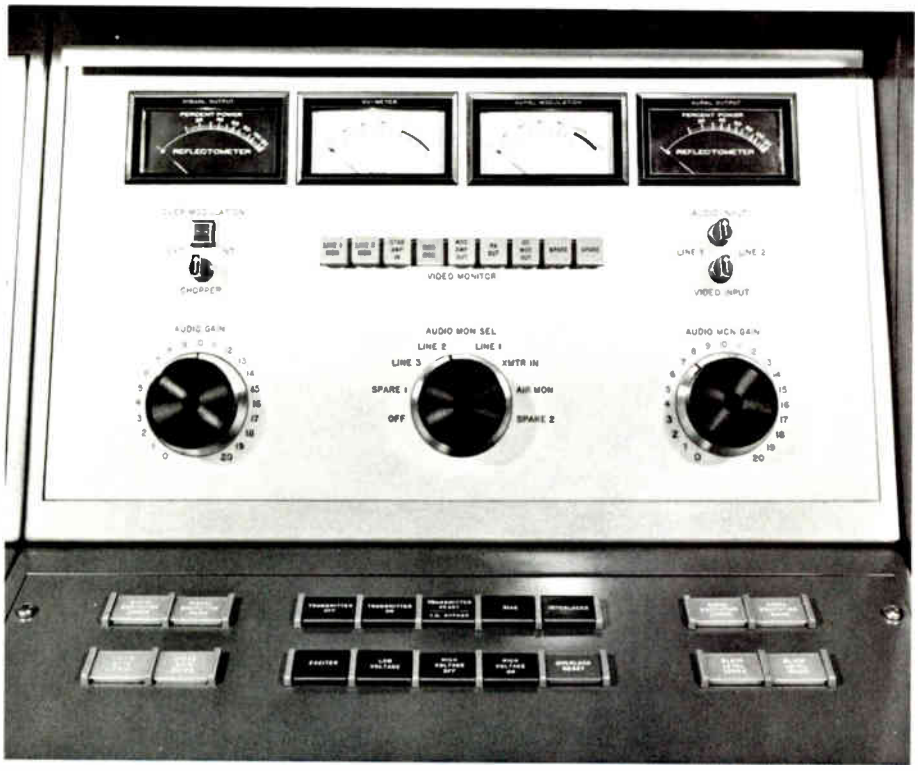
The Monitor Control Panel operates in conjunction with standard input and monitoring equipment associated with the TV transmitter. (See separate catalog section for input and monitoring equipment.) The monitor control panel contains four meters for continuous indication of visual power output, aural power output, audio input level and aural modulation precentage. The power output meters duplicate the reflectometer meters on the transmitter. The audio input level is indicated with a VU meter with a suitable multiplier pad for connection to the input line of the aural transmitter. The aural modulation percentage meter provides a remote indication from the aural modulation monitor which is a part of the Input and Monitoring Equipment. An overmodulation indicator lamp is available for external connection to the aural modulation monitor.

The Monitor Control Panel provides front panel switches for the independent selection of one of two incoming audio and two video lines. Switching of each is controlled by a three position key switch to select "Line 1" or "Line 2", with a center-off position.

Video line switching is accomplished with a Program Line Selector Unit, a 5¼ inch (133 mm) rack-mount unit furnished with the TTC-5 Transmitter Control Console, and should be located in the input equipment rack near the termination of incoming video lines. The Program Line Selector Unit contains video switching relays which the Video Input Selector switch controls. It is equipped with input connectors for video lines "1" and "2" and a program output connector. Tally lights, on the Program Line Selector, indicate the selected line and connectors are available for monitor lines to the Console for observation of the video signal directly from the unused line.

Video and Audio Monitoring

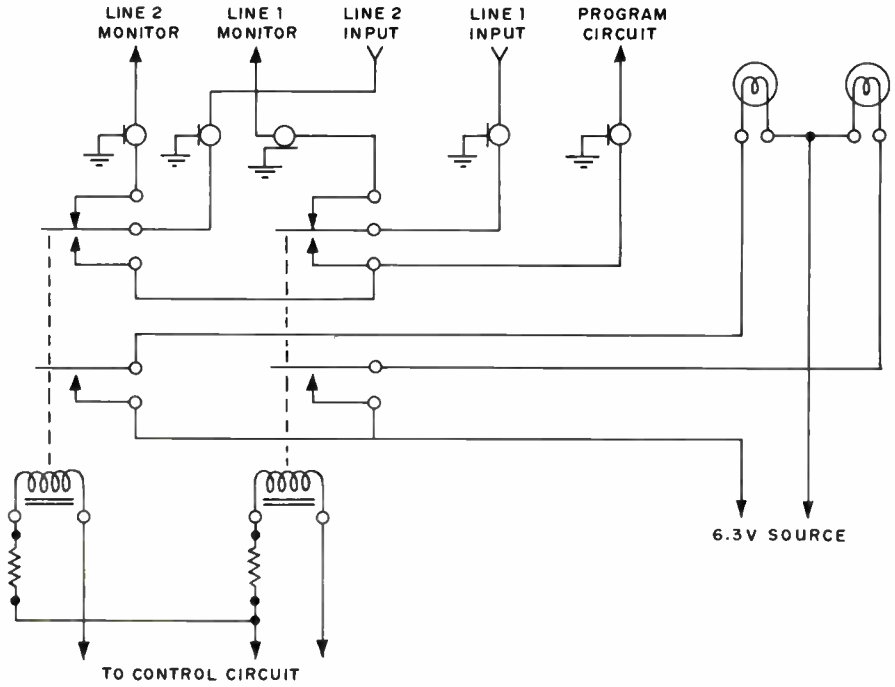
The Monitor Control Panel, in addition to the audio metering described above, includes an Audio Gain Control, adjustable over a 20dB range in 1 dB steps, to control the program audio input level to the transmitter. This control usually connects in the audio line ahead of an audio limiting amplifier. An Audio Monitor Selector switch permits connection of the input of an audio monitoring amplifier and speaker system to any of seven points in the aural system. An Audio Monitor Gain Control provides adjustment of audio monitoring level. A nine position video monitor switcher is provided on the Monitor Control Panel to provide connection of the picture and waveform monitors to selected points in the video system from the video input lines to the monitoring diode or visual demodulator output. Since the video monitoring inputs to the TTC-5 Console terminate, video distribution am-



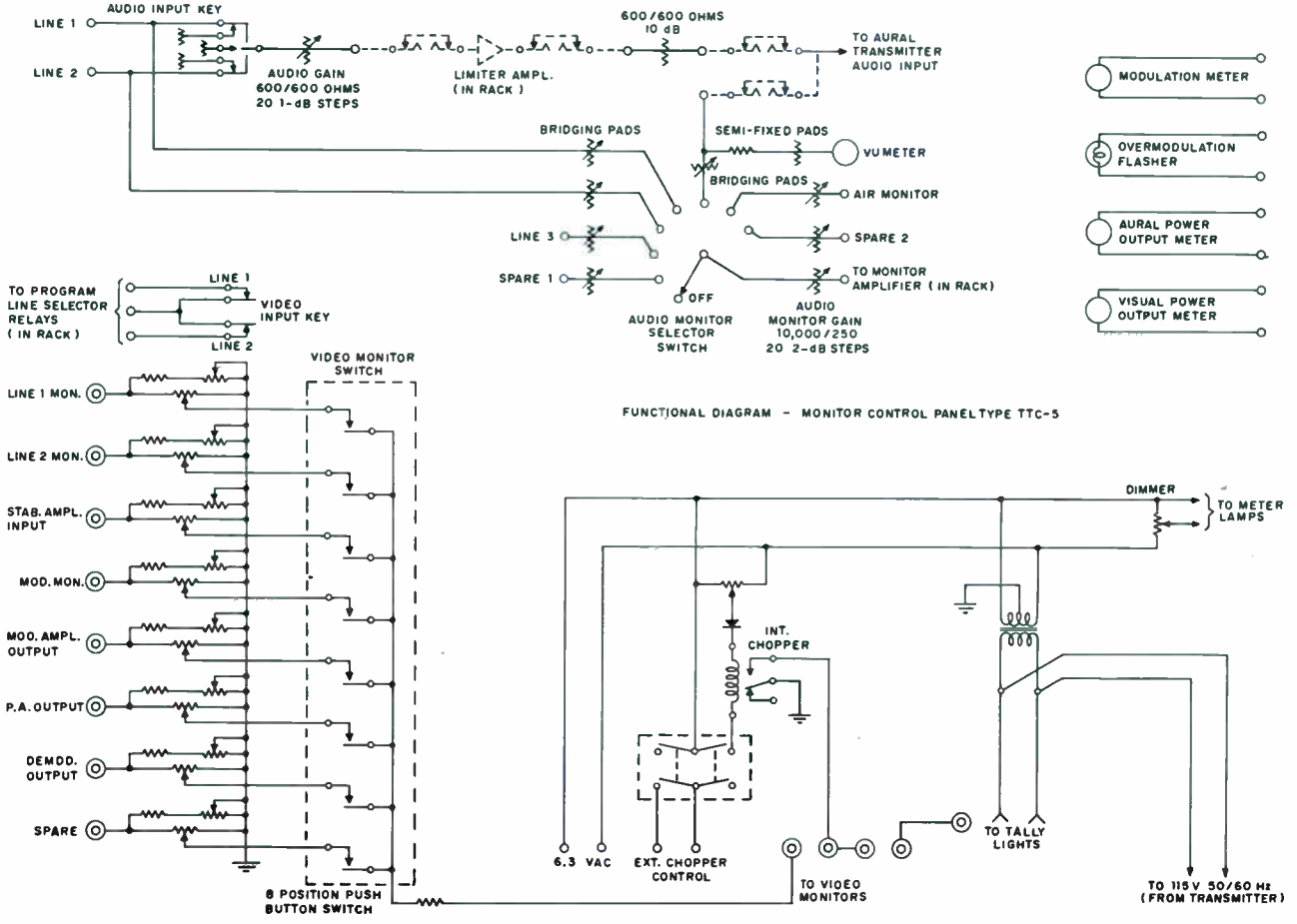
A close-up of the monitor-control and transmitter-control panels. The pushbuttons at the lower edge of the picture control transmitter functions and indicate control status.

World Radio History

plifiers are required (not included) where it is desired to monitor on a bridging basis, such as program video line or transmitter video input. The video monitoring section of the TTC-5 Console consists of a *Tektronix* 529 Waveform Monitor and a *Conrac* 9-inch picture monitor mounted side-by-side. For parallel transmitters, picture and waveform monitors located in the center turret sections are supplied for each transmitter. The video signal from the video Monitor Selector Switch loops through the waveform monitor to the picture monitor where it terminates. The waveform monitor has a graticule calibrated for indicating modulation depth. A switch on the Monitor Control Panel controls an internal relay chopper which may be inserted in the video line to the monitors to establish a white-reference pulse. This switch, in the "External" position provides a contact closure for activation of an external chopper (not supplied) such as the Catalog No. ES-560653 Vertical Interval Chopper (See separate catalog section).

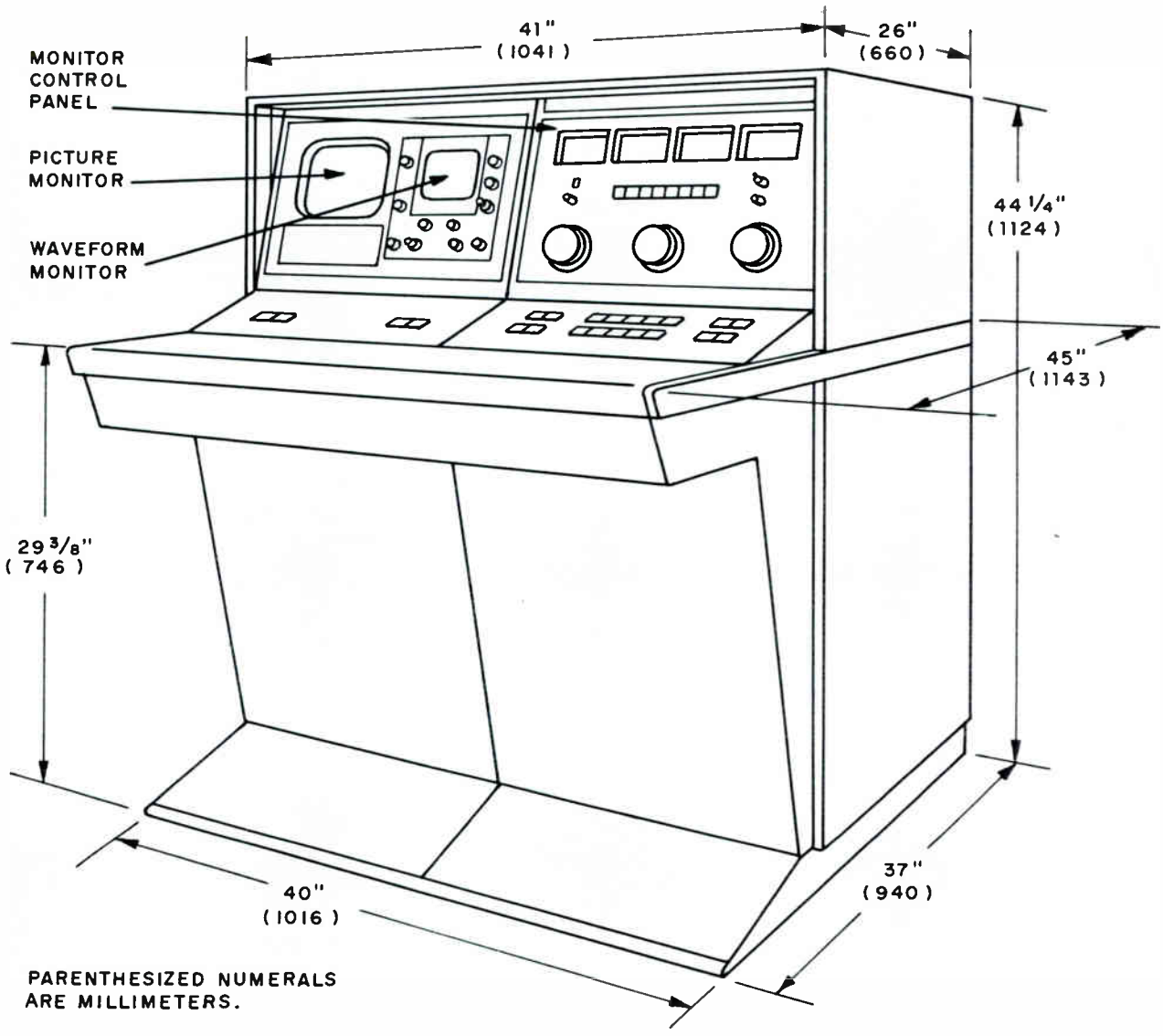


Functional diagram of the visual program line selector unit.



Functional diagram of the monitor-control panel.

World Radio History



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
VU Meter Circuit (across transmitter input)	7,500 ohms
Video Monitor Inputs (8)	75 ohms, unbalanced

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; last step infinite; 38 dB insertion loss

Power Requirements:

Indicator Lights	115V (from transmitter)
Meter Lights	115V, 50/60 Hz

Dimensions (overall):

Width	41" (1041 mm)
Depth	44½" (1130 mm)
Height	45¼" (1150 mm)

Weight (Approx.) 500 lbs. (227 kg)

Ordering Information

Transmitter Control Console, Type TTC-5 ES-561900

(Please specify transmitter type number and whether single or parallel. For RCA Transmitters only.)

World Radio History

RCA

catalog TT.6400A

(Replaces B.4714)

Carrier-Frequency and Aural Modulation Monitors, Types TFT-701, TFT-702

- For any designated VHF or UHF channel
- On-site or off-air monitoring capability
- Digital carrier-frequency-error readout
- Optional SCA output facility
- Aural modulation calibrator built-in

The Types TFT-701 and TFT-702 are instruments for monitoring visual and aural carrier frequencies and aural modulation of television broadcast transmitters.

The TFT-701 monitors carrier frequencies and aural modulation; the TFT-702 monitors aural modulation only.

As a result of excellent input sensitivity and selectivity, these two monitors can use an off-air signal, if convenient.

In a situation where a transmitter operates via remote control, the monitor operates at the control point from an off-air signal picked up with a rooftop receiving antenna. For transmitter site monitoring, a sample of transmitter output is used.

TFT-701

TFT-702

World Radio History

The two instruments described here monitor certain television-transmitter operating parameters. The TFT-701 monitors aural modulation plus the frequency of the aural and visual carriers plus the intercarrier frequency. The TFT-702 mon itors aural modulation only. Both units are FCC Type-Approved for use as aural modulation monitors on TV transmitters operating in the U.S.A.

Available for VHF or UHF

Each TFT-701 and -702 Monitor is factory tuned and optimized to the frequencies it is to monitor. The instruments have ample selectivity to reject strong, undesired signals and the sensitivity to allow monitoring at a remote location.

On-Site or Off-Air Monitoring

As a result of the sensitivity built into the TFT-701 and TFT-702, both instruments operate equally well as on-site or off-air monitors. As an on-site monitor, the instrument requires a small RF sample derived from transmitter output. As a remote, off-air monitor, the instrument uses a common rooftop receiving antenna with a 75-ohm transmission line. An RF input signal of 250 microvolts is required.

The monitor input consists of a channel filter and a double-balanced, Schottky barrier-diode mixer, providing increased immunity from intermodulation products caused by strong, undesired signals.

Precision Frequency Reference

The TFT-701 monitors visual, aural and intercarrier frequencies using a precision, five-megahertz, oven-controlled, crystal oscillator to synthesize the local oscillators. It has an aging rate of one part per million per year and normally requires frequency recalibration only every six months for UHF and once in 18 months on VHF. The frequency counters may be used as a six-digit, 10-MHz, general-purpose frequency counter.

The frequency errors are displayed as direct digital readouts with "plus" or "minus" sign for both aural and visual carriers. The aural or intercarrier frequency error may be selected with a front-panel pushbutton.

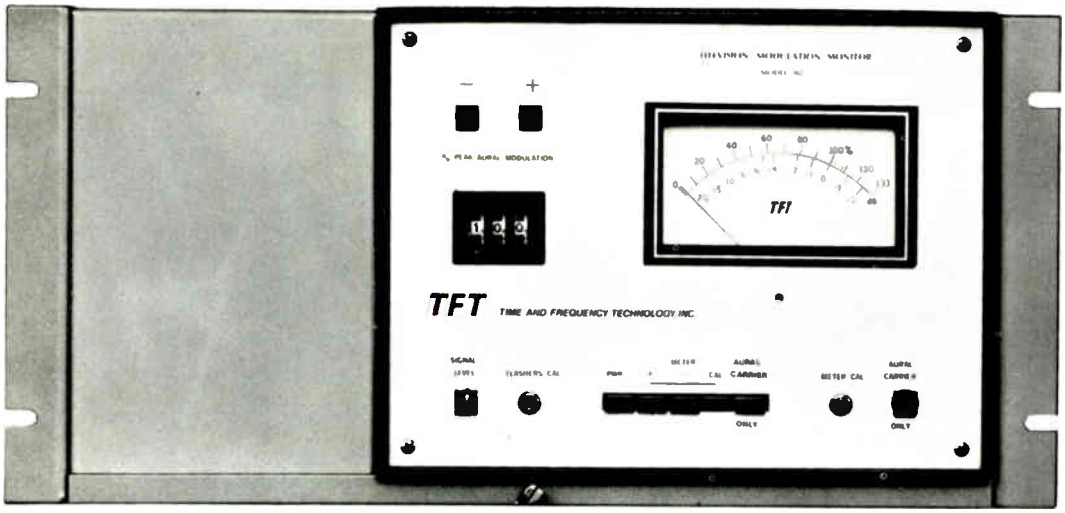
SCA and Alarm Option

For use with a remote control system using an aural subcarrier for telemetry, the TFT-701 and -702 are available with an SCA demodulator. This option is a plug-in printed-circuit assembly. It provides the 39 kHz output which feeds the subcarrier detector, a part of the remote-control system equipment.

The monitors are also available with an alarm option which actuates an external aural or visual alarm device when a preset limit is exceeded in frequency deviation or modulation percentage.

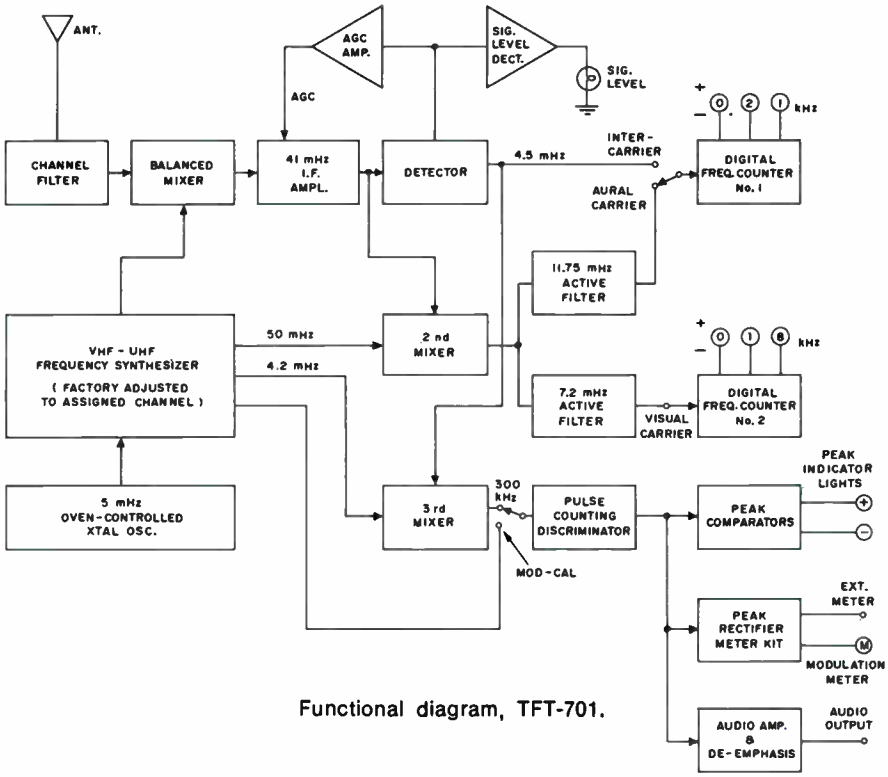
Peak-Reading Meter; Two Flashers

The aural modulation monitor uses a peak-reading meter and two flasher-type indicators. The flashers indicate positive and negative modulation peaks simultaneously and adjust, through a thumbwheel register on the front panel, to any threshold between 50 and 129 percent modulation in increments of one percent. A special feature allows a check on the intercarrier noise as the result of visual carrier modulation.

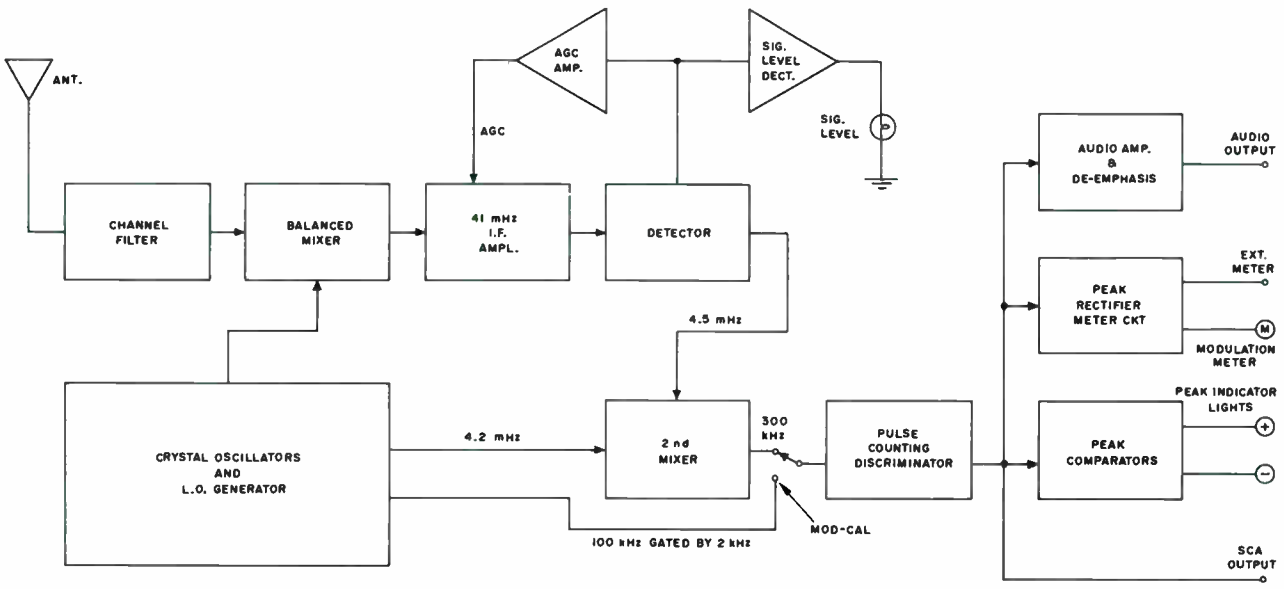


TFT-702 mounted in accessory rack-mount adapter.

World Radio History



Functional diagram, TFT-701.



Functional diagram, TFT-702.

World Radio History

Specifications

Frequency Range ..... Tuned to any U.S. Channel between Ch. 2 and 69 (Factory tuned to your channel; not field retunable to another channel)
Input Sensitivity (Approx.) ..... 250 μV[1]
Image Rejection ..... 60 db
Spurious Response ..... −80 dB
Input Impedance ..... 75 ohms
Input Connector ..... Type BNC

Carrier Frequency Measurement
Deviation Display Range ..... 0 to ±9.99 kHz
Readout Increments ..... 1 or 10 Hz
Accuracy:
VHF Channels ..... ±500 Hz/18 months
UHF Channels ..... ±500 Hz/6 months
Internal Frequency Standard ..... 5 MHz xtal osc.[2]
External Frequency Standard ..... 5 MHz[3]

Intercarrier Frequency Measurement
Deviation Display Range ..... 0 to ±9.99 kHz
Readout Increments ..... 1 or 10 Hz
Intercarrier Accuracy ..... ±100 Hz/60 months

Aural Modulation Meter
Modulation Range ..... 0-133%; 0-33.3 kHz deviation[4]
Frequency Response (50 Hz to 15 kHz) ..... ±0.2 dB
Monitor Accuracy (50 Hz to 15 kHz) ..... ±4%
Meter Characteristic ..... Peak Reading[5]

Aural Peak-Modulation Indicator
Indicator ..... Flasher
Indicator Threshold Range ..... 50 to 129% mod.
Threshold Adjustment Increments 1%
Response Time[6] ..... 5 μs

Modulation Calibrator Accuracy ..... ±2%[7]

Audio Output Characteristics
Level (100% modulation) ..... 2V rms
Impedance ..... 600 ohms
Distortion (100% modulation) ..... 0.25% max.
Signal-Noise Ratio ..... 65 dB min.
De-emphasis Network Time Constant ..... 75 μs

Frequency Counter Section
Range ..... 10 Hz to 10 MHz
Input Level Range ..... 200 mV to 2V rms
Input Impedance ..... 500k ohms; 15 pf shunt
Resolution ..... 1 Hz
Display Accuracy ..... ±1 count
Time-Base Aging Rate ..... 1 x 10^{-8} per day
Power Requirements:
Type TFT-701 ..... 115/230V, 50-400 Hz, 300W
Type TFT-702 ..... 115/230V, 50-400 Hz, 45W
Dimensions ..... 8″ H, 11″ W, 15″ D (203, 279, 381 mm)
Weight (Approx.) ..... 22 lbs. (10 kg)

[1] Automatic gain-control range 60 dB. Fixed 40-dB attenuator included for on-site monitoring.
[2] High-precision, oven-controlled crystal. A 1-MHz output is included for calibration against WWVB or other precision frequency standard.
[3] Input connector at rear of unit.
[4] Meter includes dB scale with 0 dB equal to 100% modulation or 25 kHz deviation.
[5] True peak indication with ballistics to FCC requirement.
[6] Shortest pulse indicator can resolve. Pulse rise and fall times 1μs or less.
[7] At 100% deviation.

Accessories

For TFT-701:
Rack-Mount Adapter ..... Option 01
Alarm Option ..... Option 02
SCA Option ..... Option 03
AGC Meter Option ..... Option 04
Remote Meter and Peak Flasher ..... Type TFT-704

For TFT-702:
Rack-Mount Adapter ..... Option 01
Alarm Option ..... Option 02
SCA Option ..... Option 03
AGC Meter Option ..... Option 04
Remote Meter and Peak Flasher ..... Type TFT-704

Ordering Information

TV Frequency and Aural Modulation Monitor ..... Type TFT-701[8]
Aural Modulation Monitor ..... Type TFT-702[8]

[8] Please specify channel and frequency offset.

World Radio History

catalog TT.6410A

RCA

Frequency and Modulation Monitor Systems, Belar Types TVM-1-2-3 and RFA-3

- Aural modulation monitor, Type TVM-1
- VHF carrier frequency monitor, Type TVM-2
- UHF carrier frequency monitor, Type TVM-3
- RF amplifier unit, Type RFA-3

These are instruments for accurate monitoring and observation of television transmitter aural modulation and carrier frequencies, including the intercarrier frequency. A solid-state amplifier is available that allows monitoring operations from an off-air pickup. Each monitor includes built-in calibration facilities and is tuned to a specific operating frequency during manufacture.

World Radio History

Aural Modulation Monitor, Belar Type TVM-1

- Built-in calibration facilities
- Measures positive and negative peaks
- Peak-reading meter and flasher
- Lamps indicate instantaneous peak polarity
- For on-site or off-air monitoring

A wideband, all solid-state unit for aural channel monitoring, the TVM-1 monitors both positive and negative peaks simultaneously and automatically selects the greater of the two for display on a peak-reading meter and flasher. "Positive" and "Negative" lamps indicate the instantaneous polarity of the displayed peak. Built-in calibration facilities, actuated through a front-panel pushbutton switch, allow calibration recheck at any time.

The TVM-1 input sensitivity is for use at the transmitter site. Using an external RF amplifier (see Type RFA-3 in this section) increases the sensitivity for use as an off-air monitor.

Specifications

Input Sensitivity (rms)	1-10 V
Input Impedance	50 ohms
Modulation Meter Range (100% = 25 kHz dev.)	0-133%
Modulation Meter Accuracy	±5% max.
Peak Modulation Indicator Range (Adj)	50-120%
Audio Freqeuncy Response (50-75,000 Hz)	±0.5 dB
Audio Distortion (50-15,000 Hz)	0.1% max.
Signal-Noise Ratio (75 µs de-emphasis)	70 dB min.
Audio Output Level (600 ohms)	+10 dBm
Remote Metering Loop Resistance	5k ohms max.
Dimensions	5.25" H, 19" W, 10.5" D (133, 483, 267 mm)
Weight (Approx.)	14 lbs. (6.5 kg)
Shipping Weight	17 lbs. (7.8 kg)

Accessories

RF Amplifier, Type RFA-3	MI-560548

Ordering Information

Aural Modulation Monitor, Belar Type TVM-1	MI-560544

(Please specify operating channel and frequency offset, if any.)

World Radio History

Carrier Frequency Monitor, Belar Types TVM-2, TVM-3

- Digital readout aural and visual carrier deviation
- Monitors intercarrier frequency as alternative to aural
- Built-in off-frequency alarm circuits
- Monitors carriers independently
- Optional telemetry output for remote control systems

The TVM-2 and TVM-3 are frequency monitors for the aural and visual carriers of television transmitters. The TVM-2 monitors VHF carriers while the TVM-3 operates with UHF carriers.

The two digital displays readout aural and visual carrier deviation from assigned frequency, indicating positive or negative with appropriate signs. A built-in off-frequency alarm system requires three successive frequency errors to signal an alarm condition. This, of course, prevents false off-frequency alarms.

The units use true frequency-counter circuits to monitor carrier frequencies. Each carrier is monitored independently. As a result, the monitor displays frequency error even when one carrier or the other is disabled. If error is beyond tolerance, the unit sends out an off-frequency alarm in addition to a carrier-off alarm.

For remote-control situations, both monitors offer a telemetry output as an extra cost option. This output is a buffered, parallel "BCD" or analog. Both units include a 1 MHz output for comparison with a frequency standard.

The TVM-2 and TVM-3 input sensitivity requires transmitter site use. Adding an RF amplifier (see RFA-3, below) increases input sensitivity to allow use as an off-air monitor.

Specifications

Time Base Accuracy:	
0-30°C Ambient	$\pm 1 \times 10^{-7}$
0-55°C Ambient	$\pm 1 \times 10^{-6}$
Per Year	$\pm 1 \times 10^{-6}$
Off-Frequency Alarm Sensitivity (Selectable)	±500 or ±1000 Hz
Carrier-Off Alarm Gate Time	2 SGC
Dimensions	3.5″ H, 19″ W, 10.5″ D (89, 483, 267 mm)
Weight (Approx.)	12 lbs. (5.5 kg)
Shipping Weight (Approx.)	15 lbs. (6.8 kg)

Accessories

RF Amplifier, Type RFA-3	MI-560548

Ordering Information

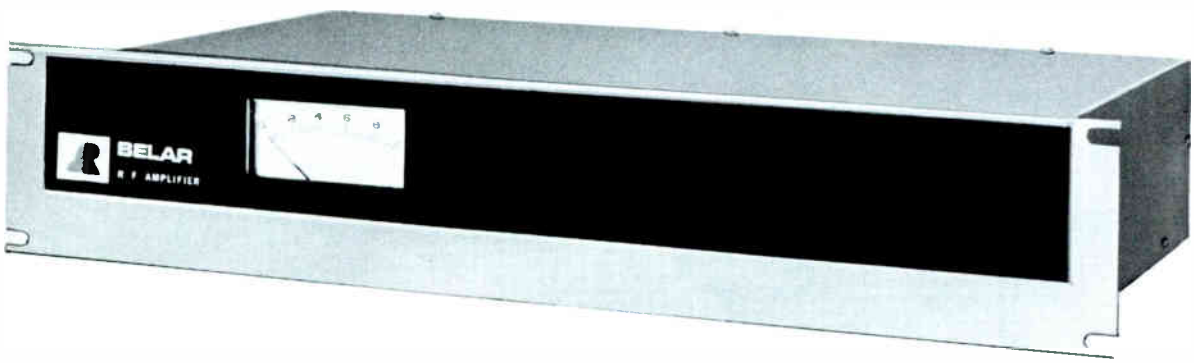
Carrier Frequency Monitor:	
For VHF Operations, Type TVM-2	MI-560545
For UHF Operations, Type TVM-3	MI-560546

(Please specify operating channel and frequency offset, if any.)

World Radio History

RF Amplifier, Belar Type RFA-3

- Excellent input sensitivity
- Wide dynamic range
- Remarkable adjacent-channel rejection
- Front-panel output meter



A sensitive, high-gain, solid-state radio frequency amplifier for use with the TVM-1, -2 and -3 as off-air monitors, the RFA-3 utilizes separate intermediate-frequency amplifiers for the aural and visual channels. This design minimizes crosstalk, improves selectivity and reduces selective fading of either carrier. It is tuned to operating frequency at time of manufacture and requires no operating adjustments. One amplifier is capable of serving two units: a modulation monitor and a carrier frequency monitor.

Specifications

Input Sensitivity	100 µV min.
Input Impedance	50-75 ohms
Adjacent Channel Rejection	70 dB min.
Dynamic Range	100 to 500,000 µV
Intermediate Frequency Rejection	90 dB min.
Power Requirements	117/234V, 50-60 Hz, 5W
Dimensions	3.5" H, 19" W, 7" D (89, 483, 178 mm)
Weight (Approx.)	5 lbs. (2.5 kg)
Shipping Weight (Approx.)	10 lbs. (4.5 kg)

Ordering Information

RF Amplifier, Belar Type RFA-3	MI-560548

(Please specify operating channel and frequency offset, if any.)

World Radio History

RCA

catalog TT.6500A

(Replaces B.4932)

Visual Sideband Demodulator, Types BW-4C1/BWU-4C1

- Provides video source for high quality monitoring
- High quality envelope detector—linear phase-and-amplitude characteristics
- Built-in, integrated-circuit, vertical interval chopper
- Makes possible accurate measurements for system evaluation
- Available for any channel (54-890 MHz)

The RCA BW-4C1/BWU-4C1 Visual Demodulator is designed for use at the television transmitter location as a means of deriving a video signal from the output of a visual transmitter. This signal can be regarded as an accurate representation of the video information contained in the modulated picture carrier as it exists in the feed line to the antenna system. The demodulator is used as a measuring instrument to allow vestigial sideband amplitude and delay measurements (including differences at various luminance levels) on the transmitter facility; as a video source for continuous, accurate waveform monitoring; and as a video source for driving a color monitor to provide a high quality color receiver for viewing the transmitted signal.

The Models BW-4C1 and BWU-4C1 Demodulators are identical with the exception of the built-in converters used for VHF or UHF channels. They are basically superheterodyne receivers with controlled IF and RF characteristics. A sound notch is provided for monitoring the transmitted signal with aural carrier present in the transmission line. Insertion of the notch provides delay characteristics compatible with industry standard receiver delay characteristics. With the notch operating, the aural carrier is rejected by 50 dB and inter-modulation products with 75% saturated colors are typically better than 40 dB down.

Delay Corrected

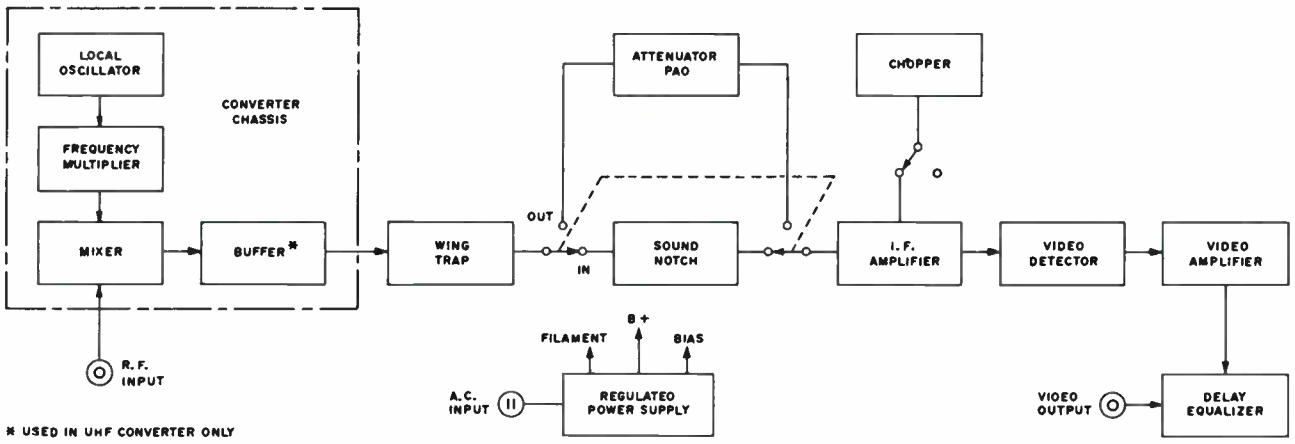
The IF frequency is 25.0 MHz for visual carrier and 20.5 MHz for sound carrier. The maximally flat IF amplifier cascade provides uniform frequency response. Low and high frequency video delay errors introduced in the lower skirt and nyquist slope regions of the IF passband are delay corrected in an allpass network in the video output circuity.

Series Tuned Wing Trap

A series tuned trap is adjusted to provide maximum skew symmetry on the nyquist slope. This allows optimum frequency response in the video frequency region around 0.75 MHz, the frequency at which the vestigial sideband recedes. The wing trap, as this circuit is named, precedes the IF amplifier and sound rejection circuits and is driven by the mixer output of either the VHF or UHF converter.

Each converter contains a crystal controlled oscillator, multipliers, and mixer. The converter receives power from the main IF power chassis on which the reg-

World Radio History



ulated dc supply is located. A single-phase, full-wave bridge rectifier utilizing silicon diodes is employed.

A vertical interval electronic chopper provides reference information synchronously in the vertical blanking interval.

Standard Rack Mounting

The BW-4C1/BWU-4C1 is designed for rack mounting in a standard 19-inch equipment rack. It connects to the transmission line through a directional coupler (not supplied, see separate catalog section). The coupler must be compatible with the transmission line used. Normally, the coupler is installed at a point following the vestigial sideband filter or filterplexer, where the lower sideband attenuation has been established.

The video output of the demodulator is adjustable by the use of an attenuator located on the delay equalizer assembly at the rear of the unit. In the "out" position, 2.0 volts of video is obtained for use with measuring equipment such as the BW-8A or BW-8A1 Envelope Delay Measuring Set. For routine monitoring, (when the unit is used as a high quality receiver with the sound notch turned on) the video attenuator switch is placed in the "in" position to provide 0.8 to 1 volt peak-to-peak output.

Specifications

Electrical

Frequency Range:
BW-4C1 ..... Channels 2 to 13 (54-216 MHz)
BWU-4C1 ..... Channels 14 to 83 (470-890 MHz)

RF Input Required ..... Approximately 1.0V (rms)

Video Output ..... 2.0 volt max. peak-to-peak across 75 ohms from chopper zero reference to sync peak (sync negative)

Amplitude vs. Frequency Response
With sound notch out ..... ±0.5 dB from 0.20 MHz to 4.5 MHz
With sound notch in ..... ±0.7 dB from 0.20 MHz to 4.0 MHz

Differential Gain ..... 10% between reference white, 12.5% and peak of sync, 100%

Phase vs. Amplitude ..... Three (3.0) degrees or less for modulating signals having luminance levels from 12.5% to 75% of sync peak

Low Frequency Response ..... Less than 2% tilt on 50 Hz square wave

Envelope Delay
With sound notch out ..... Flat within ±30 ns up to 4.18 MHz compared to the average delay between 0.05 MHz and 0.20 MHz
With sound notch in ..... Follows within ±30 ns of standard receiver curve over chrominance sideband frequencies to 3.8 MHz. The tolerance increases linearly with respect to frequency to +200, −0 ns at 4.0 MHz. Fixed low frequency delay of 50 ±15 ns present

Output Hum and Noise ..... 50 dB rms below 2 volts peak-to-peak output

Intermodulation ..... 40 dB below 2 volts peak-to-peak output

Sound Rejection ..... More than 50 dB aural signal rejection at ±25 kHz deviation from carrier frequency

Power Source Required ..... 105 to 125 volts AC, 50/60 Hz, 250 Watts (3A slo-blo fuse)

Mechanical

IF, Video and Power Supply Chassis:
Dimensions (overall) ..... 19" wide, 14" high, 14" deep (483 x 356 x 356 mm)
Weight ..... 43 lbs. (19.5 kg)

Environment:
Ambient Temperature ..... 15°C to 45°C
Relative Humidity ..... 0 to 95%

Accessories

Directional Couplers:
For unpressurized 3⅛" transmission line MI-19396-1B
For pressurized 3⅛" transmission line MI-27390
For 6⅛" transmission line MI-27389

Transmission-Line Sections, 12" (305 mm) long:
For MI-19396-1B in MI-19113NF T/L (VHF) MI-19396-3
For MI-19396-1B or MI-27390 in MI-19089 T/L (UHF) MI-19089-22
For MI-27389 in MI-193140 T/L (VHF) MI-19314C-25
For MI-27389 in MI-19389 T/L (UHF) MI-19387-20

(See catalog section on "Diodes, Directional Couplers" for details on above and other combinations of couplers and line sections).

Ordering Information

VHF Visual Sideband Demodulator, Type BW-4C1
Requires directional coupler and coupler mounting. Specify type of transmission line used, channel number (7-13) and offset, if any ES-34048-C

UHF Visual Sideband Demodulator, Type BWU-4C1
Requires directional coupler and coupler mounting. Specify type of transmission line used, channel number (14-82) and offset, if any ES-34049-C

World Radio History

RCA

catalog TT.6510A

(Replaces B.4933)

Vertical Interval Electronic Chopper

- Aids in modulation-depth measurement
- For demodulator, diode or tuner systems
- Establishes accurate zero-modulation level
- Short-term chop unobtrusive yet precise

The Vertical Interval Electronic Chopper (VIEC) is an all-electronic device used to establish a "zero-modulation" reference point in the measurement of television-transmitter modulation depth. It is an accessory for the RCA Types BW-4 and BWU-4 Visual Sideband Demodulators. It installs in the demodulator to replace the mechanical chopper, A kit, supplied with the chopper, simplifies conversion.

The VIEC also works with RF-monitoring diodes and tuners (such as the Conrac AV-12E). For such application, it is available with a suitable power supply (see *Ordering Information*).

World Radio History

Aids in Modulation-Depth Measurement

In effect, the VIEC creates three successive "white" pulses—one on each of three lines—near the end of the vertical blanking interval. Displayed on a CRO, the three white "pulses" serve as a zero-modulation (or zero-signal) reference point on the CRO screen (see drawing and off-CRO-screen photo). With such a reference, the relationship of various modulation parameters become quantitative.

Chops Only During Vertical Blanking

Unlike mechanical choppers, the VIEC chops a video waveform but three times during each picture field, between successive H-sync pulses, just prior to the end of the vertical blanking interval (see drawing). Since the chopper short-circuits the demodulated video waveform, it generates — in effect — a *zero*-modulation, " white" pulse some 7 microseconds long during three successive lines in each field during blanking.

Chop Unobtrusive Yet Precise

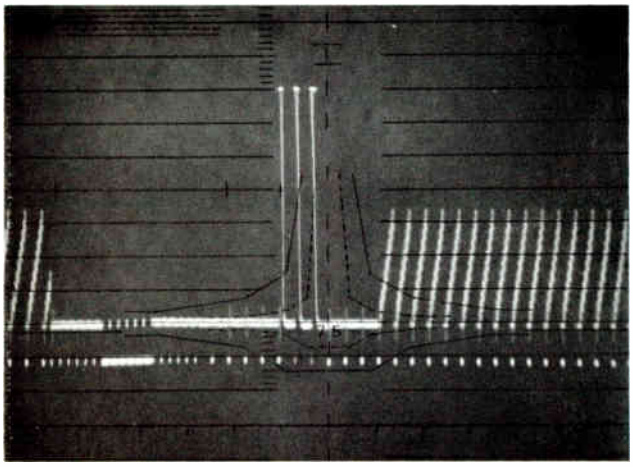
As a result of the chopper's short duty cycle in the blanking interval, its use has no effect on the demodulator's sync-triggering or sync-tip and backporch-clamp circuits. This increases measurement precision demonstrably.

Adjustable Chopper Timing

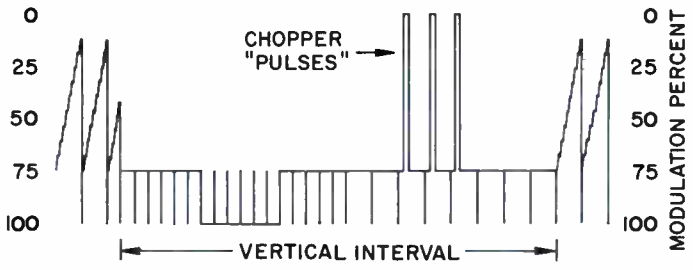
Ordinarily adjusted so that the three pulses fall on the last three lines of vertical blanking, the timing adjustment range allows placement of the pulses somewhat "earlier" than usual for whatever occasion warrants it.

All Electronic—Fully Solid State

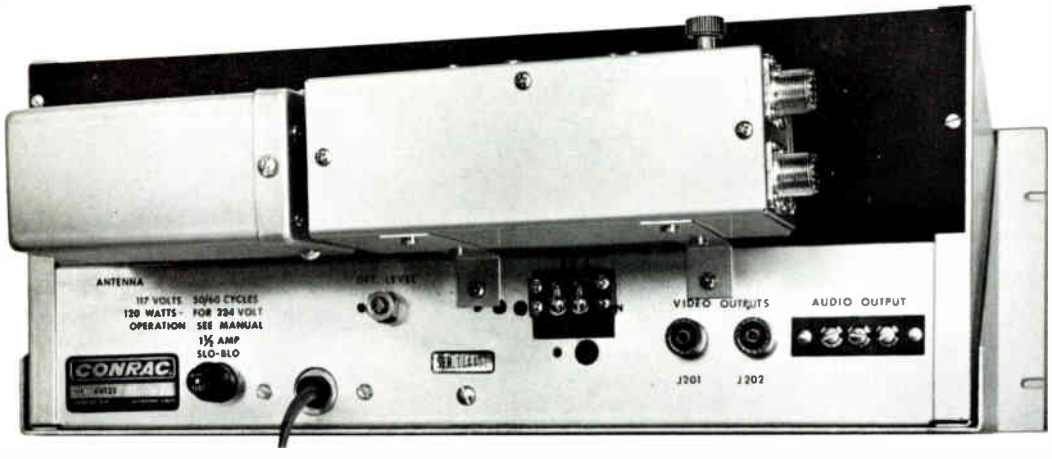
The VIEC is an electronic device, using integrated and discrete circuitry, with many advantages over a mechanical chopper. The VIEC allows continous display of modulation depth whether or not the waveform is monitored at the field or line rate.



Oscillographic reproduction of vertical interval with chopper in operation. See drawing below.



Line representation of "chopped" vertical interval.



VIEC installed at rear of Conrac AV-12E Tuner. Chopper unit at left; power supply unit at right.

Specifications

Number of Pulses per Cycle	3
Pulse Duration (nominal)	7 μs
Pulse Timing (nominal)	7 μs later than trailing edge of H-sync pulse
Power Requirements	117 V, 60 Hz, 5 W

Ordering Information

Vertical Interval Electronic Chopper:
For use with BW/BWU-4 Sideband Demodulator ES-560654
For use with monitoring diodes or Conrac AV-12E Tuner (includes power-supply assembly) ES-560653

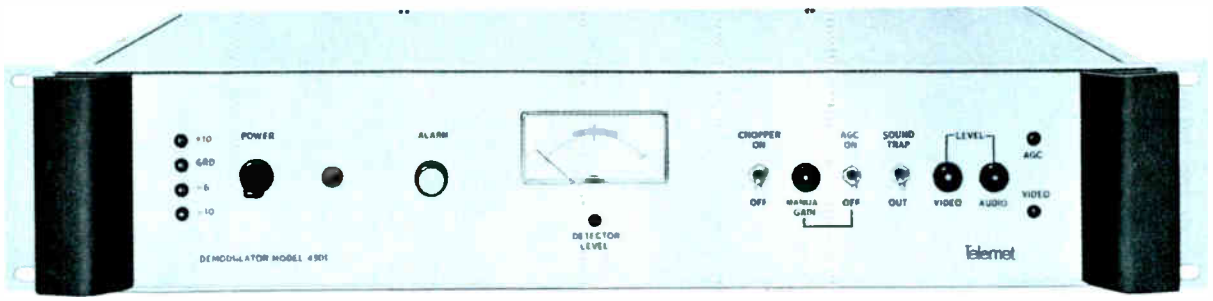
World Radio History

RCA

Television Demodulator,
Telemet Model 4501

- RF sensitivity 5 mV
- Loss-of-signal alarm
- Envelope-delay corrected
- Internal, synchronous chopper

The Telemet Model 4501 Broadcast Demodulator produces a demodulated video and audio signal which is representative of the modulation characteristics of the television transmitter. These signals may be used for evaluation of chrominance gain and delay, "K" factor, modulation depth, and differential phase and gain, as well as continuous monitoring of the video and audio signal.



World Radio History

The Model 4501 Demodulator is supplied for any one selected channel in the VHF or UHF television band. It is usable over a wide range of input levels, from 5 millivolts for use at a studio or other remote point for off-air applications, to 5 volts with suitable attenuators from an RF sampling point in the transmitter plant.

Sound traps preceding the main IF circuit switch in or out. With the sound traps switched out, video response is within ±0.5 dB to 4.5 MHz, and envelope delay within ±25 nanoseconds. With the sound traps switched in, the envelope delay is inversely proportional to the required delay characteristic of the television transmitter.

A video chopper provides a zero reference pulse, which is synchronous to line frequency, to assist in transmitter modulation-depth measurements. A front-panel alarm lamp indicates loss of input signal.

Specifications

Frequency Range (Specify Channel and Offset):	
Model 4501A1	Any VHF channel (2 to 13)
Model 4501A2	Any UHF channel (14 to 69)
Frequency Stability	±.002%
Ambient Operating Temperature	5 to 50°C (41 to 122°F)
Frequency Response:	
Sound Trap out, 0 to 4.5 MHz	±0.5 dB
Sound Trap in, 0 to 3.6 MHz	±0.5 dB
Sound Trap in, at 4.08 MHz	−3.0 dB max.
Group Delay Response:	
Sound Trap out, 0 to 4.5 MHz	±25 ns
Sound Trap in:	
0 to 3.0 MHz	±25 ns
At 3.58 MHz	170, ±25 ns
Differential Gain	5% max.
Differential Phase	±1.0° max.
AGC Range	20 dB
Video Output Level (Peak-to-peak, adjustable)	1.0V
Video Output Impedance	75 ohms
Audio Output Level (Adjustable)	0 dBm
Audio Output Impedance (Balanced)	600 ohms
Power Requirements	115V, 50/60 Hz, 25W
Dimensions	3½″ H; 19″ W; 15″ D (89, 483, 381 mm)
Weight (Approx.)	15 lbs. (6.8 kg)

Ordering Information

Telemet Television Demodulator:	
For VHF-TV Channels*	Telemet Model 4501A1
For UHF-TV Channels*	Telemet Model 4501A2

*(Specify Channel No. and frequency offset.)

World Radio History

RCA

Television Demodulator, Rohde and Schwarz Type AMF

- Quality visual and aural demodulation
- Vestigial sideband with Nyquist slope
- Switchable sound trap
- Synchronous zero reference pulse
- RF or IF input

The Type AMF Television Demodulator is a high quality monitoring and measuring instrument for the demodulation of the visual and aural signal from the TV transmitter. It is a vestigial sideband receiver with Nyquist slope, having response and group delay characteristics to very close tolerances. It may be used at the transmitter location for precise quality observation and measurement of the transmitted signal or, with the optional RF Receiver Type HS-2064, at a point remote from the transmitter.

The Type AMF Television Demodulator operates on any specific channel in the VHF or UHF TV bands (see "Ordering Information"). The unit consists of an RF section, picture IF section, filter and sound section plus a power supply. In addition to the RF input, the AMF Demodulator accepts an IF frequency input of 45.75 MHz, selectable by a front-panel switch which is used for measurement and observation of the visual IF signal in transmitters using IF modulation at that frequency.

The RF or IF signals to be demodulated are applied to the input via individually adjustable dividers. The crystal-controlled RF oscillator is followed by a frequency multiplier appropriate to the operating channel, so that the final multiplier frequency is offset from the visual carrier by 45.75 MHz. This signal and the visual carrier go to the mixer.

World Radio History

The IF signals pass through a low-pass filter and an IF buffer amplifier, after which the visual and aural IF signals are separated and amplified individually. The visual IF signal goes to a filter sub-assembly incorporating a high-pass filter section, two all-pass filters (for delay correction) and a filter for the Nyquist slope. A front-panel, sound-trap on/off switch selects the filters for the desired characteristic. After amplification, the visual IF signal is demodulated and applied to a low-pass filter that removes any residual IF voltages. The video signal is amplified by d-c coupled amplifiers and is available at two isolated outputs on switch selectable front or rear panel connectors.

A line-synchronous, zero-reference pulse provides for the determination of visual modulation depth. The pulse width is 3 to 4 microseconds and can be shifted within the duration of one-third of a line.

The aural intercarrier signal is derived by diode mixing the visual and aural IF in the sound section. It is then amplified, limited and demodulated. The audio output level is +6 dBm and is available on three output connectors on the rear panel.

RF Receiver Unit, Type HS-2064

An RF receiver is a companion unit to the Demodulator and provides the required sensitivity to permit operation of the demodulator unit at a location remote from the transmitter site. Like the Demodulator, it employs a crystal-controlled local oscillator and an RF section factory-tuned to a specific channel in the VHF or UHF spectrum. The HS-2064 offers excellent frequency stability and image rejection, and low local oscillator radiation. It operates on an RF input voltage greater than 350 microvolts. The HS-2064 down-converts the RF input signal to an intermediate frequency, which is amplified and corrected for group delay and then applied to the IF input of the Demodulator. Thus, the HS-2064 RF Receiver and the RF section of the AMF Demodulator may be specified for different TV channels providing the utility of a receiver system for one channel and a demodulator for another channel.

The Type AMF Television Demodulator is a precision instrument suitable for quantitative measurements of transmitter performance. It is designed and manufactured to close performance tolerances which assure long-term stability and reliability. Its characteristics make it suitable for use in a closed-loop feedback system for automatic correction of video signal parameters.

For off-air use of the demodulator, a receiver unit is available. It is the lower unit in this photo.

Specifications

Type AMF Television Demodulator

Frequency Range (Specify Channel and offset):	
Model 100.7593.51	VHF Channels 2-6
Model 100.7606.51	VHF Channels 7-13
Model 100.7612.51	UHF Channels 14-69
Frequency Stability	2×10^{-5}
RF Input Level	1.0V rms, ±6 dB
IF Input Level	200 MV rms +6 dB
Input Impedance	50 ohms
Picture IF Frequency	45.75 MHz
Video Output Impedance	75 ohms
Video Output Level	1.0V, p-p
Differential Gain	0.5 dB max.
Differential Phase	±1.0°
Signal to Noise (unweighted)	60 dB rms noise
Group Delay (without sound trap)	±15 nsec, 0-5.5 MHz
Audio Frequency Response (30 Hz to 15 KHz)	±1.0 dB
Dimensions	7" H; 19" W; 16.5" D (177, 483, 420 mm)
Power Requirements	115/230V, 47-63 Hz, 50W

Specifications

HS-2064 RF Receiver

Frequency Range (Specify Channel and offset):	
Type HS-2064-1	VHF Channels 2-6
Type HS-2064-3	VHF Channels 7-13
Type HS-2064-5	UHF Channels 14-69
Noise Figure:	
VHF	9.0 dB
UHF	11.0 dB
Preselection	Three Circuit Bandpass Filter
Image Rejection	60 dB
Oscillator Radiation	200μv max.
Frequency Stability (per month)	350 Hz
Picture IF Frequency	45.75 MHz
Sound IF Frequency	41.25 MHz
RF Input Impedance (unbalanced)	50 ohms
RF Input Voltage	350 μV to 10 mV
IF Output Impedance (BNC connector, unbalanced)	50 ohms
IF Output Voltage	250mV, +0.5, −1.0 dB
Dimensions	5.3" H; 19" W; 16.5" D (134, 483, 420 mm)
Power Requirements	115/230V, 47-63 Hz, 40W

Ordering Information

Television Demodulator, Rohde & Schwarz, Type AMF:	
VHF Channels 2-6 (Model 100.7593.51)	MI-560534L
VHF Channels 7-13 (Model 100.7606.51)	MI-560534H
UHF Channels 14-69 (Model 100.7612.51)	MI-560534U
RF Receiver, Rohde & Schwarz, Type HS-2064:	
VHF Channels 2-6 (Model HS-2064/1)	MI-560536L
VHF Channels 7-13 (Model HS-2064/3)	MI-560536H
UHF Channels 14-69 (Model HS-2064/5)	MI-560536U

World Radio History

RCA

catalog TT.6700A

(Replaces B.4510, B.4726, B.5510)

Diode Demodulators and Directional Couplers

- For TV transmitter monitoring
- Easily installed and adjusted
- Facilitates transmitter testing
- Models available for UHF and VHF
- For line sizes from 1-5/8" to 9-3/16"

Diode Demodulators, Directional Couplers and accessory devices provide RF sampling and monitoring facilities for tune-up adjustments and operational performance monitoring of the television signal. They locate at strategic points in the transmission line system between the output of the visual amplifier to the output of the sideband filter or filterplexer. Directional Couplers provide an RF sample voltage to indicate forward or reflected power or a proportional voltage for use as an input signal to transmitter monitoring or test equipment such as a visual demodulator, sideband response analyzer, or TV frequency and modulation monitor.

Diode Demodulators demodulate an RF sample from the transmission line system to provide a video signal which accurately represents the modulation characteristics of the TV transmitter. A series of these demodulators, in combination with picture and waveform monitors and a video switcher, allows observation of the demodulated video signal at various points in the signal path.

World Radio History

Diode Demodulators

Diode Demodulators are available in several versions for applications depending on the operating TV Channel (UHF or VHF) and the transmission line diameter.

VHF Diode Demodulators operate on TV Channels 2 through 13, and mount directly to either a 1⅝" or 3⅛" diameter transmission line. A separate directional coupler is not required. The unit mounts to the line in which a coupling hole is cut or, to a monitoring line section which is supplied with coupling holes already cut. (See "Monitoring Line Sections," on opposite page.)

The demodulator consists of a dual-diode with cathodes capacitively coupled, through the probe, to the inner conductor of the transmission line. The diode anodes connect, through a load resistor network, to a 75-ohm output circuit.

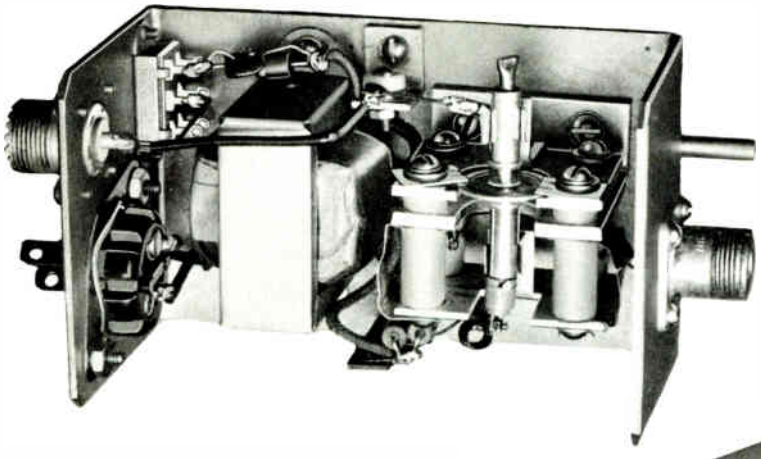
UHF Diode Demodulators operate on UHF-TV Channels 14 through 69. Each demodulator consists of a diode unit and a directional coupler furnished for a specific transmission line diameter. Clamps are provided for mounting the diode unit on the transmission line adjacent to the directional coupler. The input circuit is compensated for uniform RF response on all UHF channels. A UHF "pencil" triode, (diode-connected), serves as the RF demodulator.

UHF Diode Demodulators are available for line sizes from 3⅛" to 9-3/16" diameter.

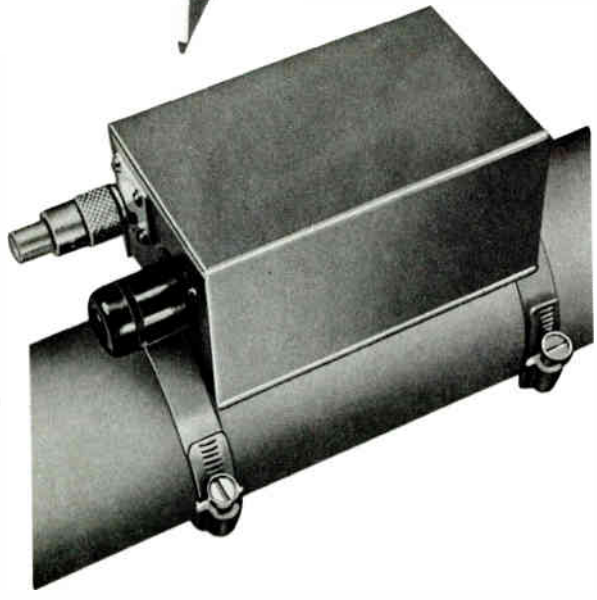
Ordering Information

Diode Demodulators:

VHF Diode Demodulator for 1⅝" or 3⅛" line (Includes RF pickup probe)	MI-19051B
UHF Diode Demodulator for 3⅛" line (Includes MI-27390 Directional Coupler)	MI-19364
UHF Diode Demodulator for 6⅛" line (Includes MI-27389 Directional Coupler)	MI-560486
UHF Diode Demodulator for 8¾6" line (Includes MI-561577 Directional Coupler)	MI-560529
UHF Diode Demodulator for 9¾6" line (Includes MI-561578 Directional Coupler)	MI-561269



UHF Diode Demodulator, Cat. No. MI-19364, with cover removed. Typical of UHF diode demodulators listed.



VHF Diode Demodulator, Cat. No. MI-19051B, on 3⅛-inch co-ax line. Typical of VHF diode demodulators listed.

World Radio History

Monitoring Diodes

UHF Monitoring Diodes are for use with separate directional couplers. The diode is a solid-state device, and requires no external power. The small physical size increases its usefulness for monitoring the video signal at various points in the system. These diodes are not intended for precise measurement of signal parameters but are useful for providing a visual signal check at convenient points in the RF system, such as the low-power stages of a TV transmitter. (Not illustrated.)

Ordering Information

Monitoring Diode:
UHF Monitoring Diode, less Directional Coupler MI-560010

Directional Couplers

VHF/UHF Directional Couplers couple external monitoring equipment to the output lines of either VHF or UHF television transmitters to allow measurements required for tuning, test and maintenance of the transmitter system. The coupling loop may be set in positions to intercept either incident or reflected power.

With the installation of several couplers, at appropriate points in the output transmission lines, measuring or monitoring equipment may be coupled to the output of each visual amplifier, the visual diplexer, or the sideband filter or filterplexer.

The couplers include etched scales for setting precisely the penetration depth and the angular position of the coupling loop for accurate output voltage calibration.

The directional property of the couplers permit sampling from a transmitter output line without any of the attendant variations in frequency response observed with non-directional couplers. The monitor voltage obtained represents the amplitude of either the incident or reflected wave, as chosen by the angle of the coupling loop. The couplers present a source impedance of 50 ohms to the monitor cable.

Reflectometers for the indication of power output and VSWR require two directional couplers: one for the indication of incident power, and another for reflected power.

The directional couplers install easily with the proper holes cut in the transmission line at the points where the couplers are placed. Monitoring line sections are also available in various line sizes. These line sections are 12 inches (305 mm) long, with pre-cut mounting holes for the directional coupler.

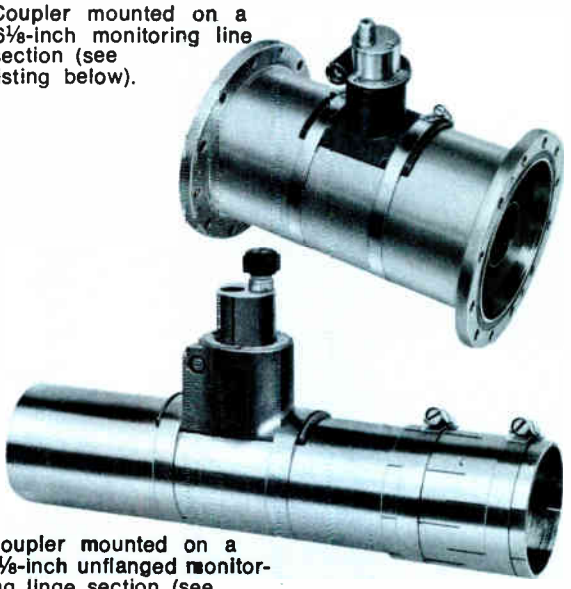
Ordering Information

Directional Couplers:

VHF/UHF, 50/51.5 ohm, for use with 3⅛" unpressurized line MI-19396-1
VHF/UHF, 50/51.5 ohm, for use with 3⅛" pressurized line MI-27390
VHF/UHF, 75-ohm, for use with 6⅛" pressurized line MI-27389
VHF/UHF, 75-ohm, for use with 8⅜" pressurized line MI-561577
VHF/UHF, 75-ohm, for use with 9⅜" pressurized line MI-561578

Unmounted directional coupler for 3⅛-inch co-ax line. Typical of couplers listed.

Coupler mounted on a 6⅛-inch monitoring line section (see listing below).



Coupler mounted on a 3⅛-inch unflanged monitoring linge section (see listing below).

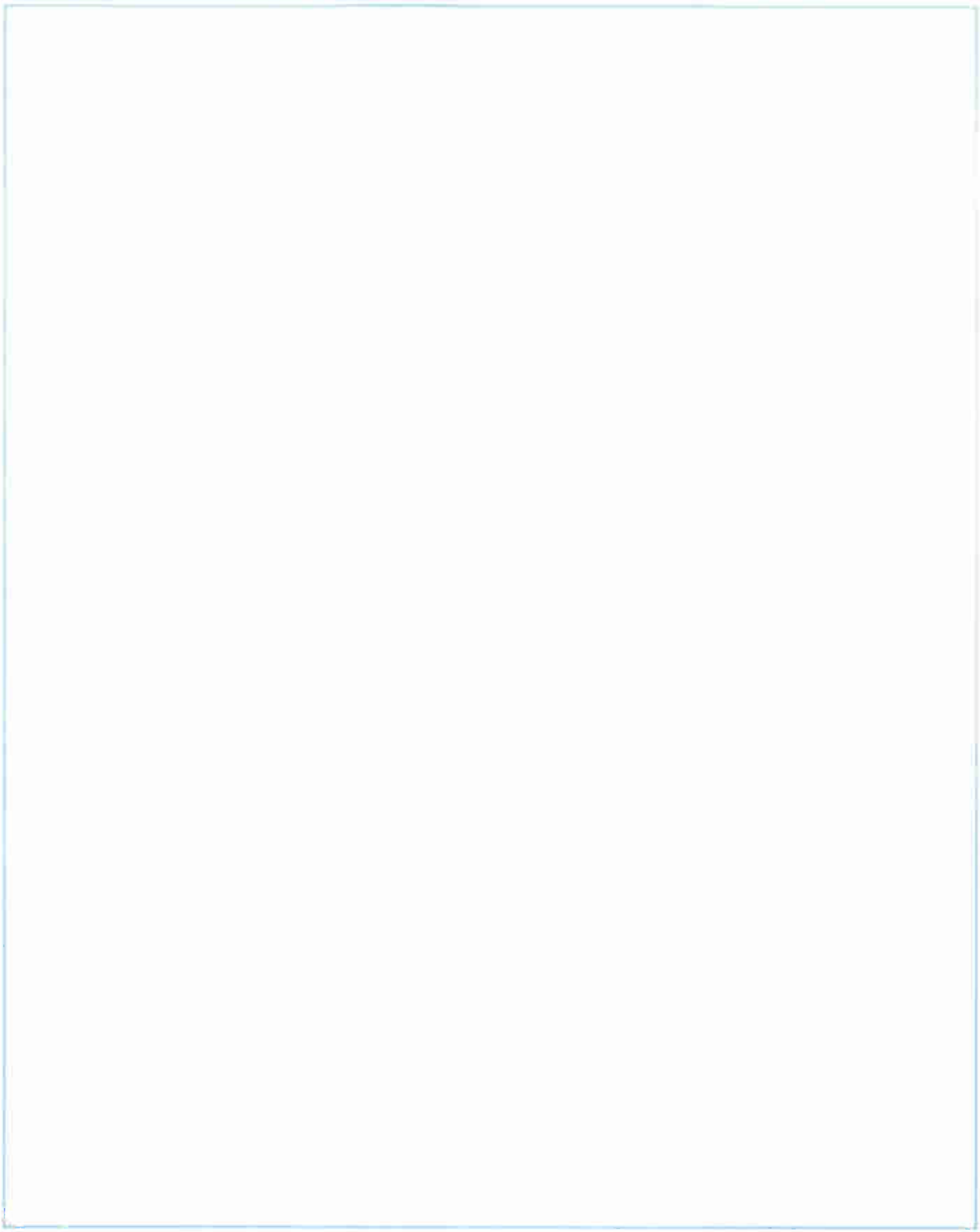
Monitoring Line Sections

Sections of flanged or unflanged transmission line 12 inches (305 mm) long predrilled to accommodate the diode demodulators and directional couplers described above.

Ordering Information

VHF, 51.5-ohm, 3⅛" unflanged MI-19396-3
UHF, 50-ohm, 3⅛" EIA flange MI-19089-22
VHF/UHF, 50-ohm, 3⅛" Universal flange ... MI-27791D-9A
VHF, 50-ohm, 3⅛" Universal unflanged MI-37791K-9A
VHF, 51.5-ohm, 6⅛" unflanged MI-19314C-25
UHF, 75-ohm, 6⅛" Teflon EIA flange MI-19387-20
VHF/UHF, 75-ohm, 6⅛" Universal flange ... MI-27792D-9A
VHF/UHF, 75-ohm, 8⅜" Universal flange ... MI-561566D-9A
VHF/UHF, 75-ohm, 9⅜" Universal flange ... MI-27793D-9A

World Radio History



World Radio History

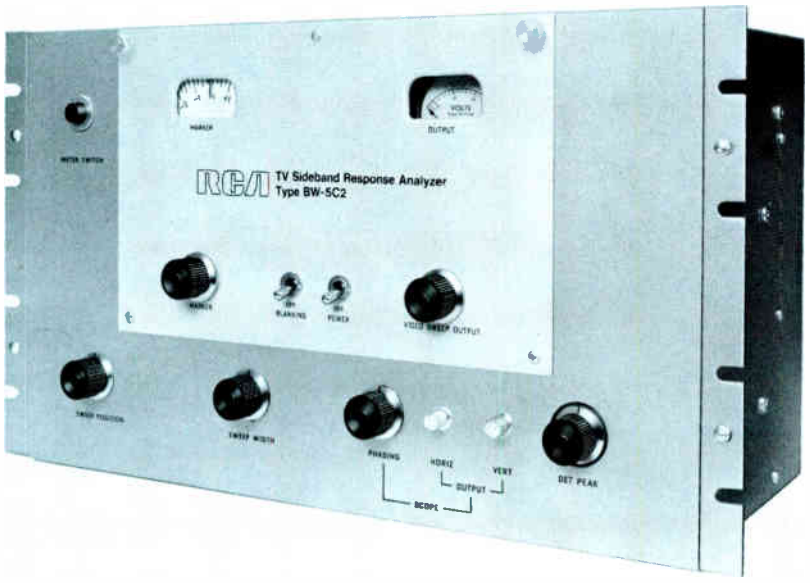
RCA

catalog TT.6800A

(Replaces B.4720, B.4722)

TV Sideband Response Analyzers, Types BW-5C2/BWU-5C2

- Measures transmitter system amplitude vs. frequency response
- Indispensable broadband RF circuits
- Continuously variable frequency marker
- Used with optional sync and blanking adder, measures response at predetermined brightness levels
- Solid-state sweep oscillator



The TV Sideband Response Analyzers BW-5/BWU-5 measure the overall amplitude-versus-frequency characteristic of a television transmitter. In conjunction with an oscilloscope it visually presents the upper and lower sideband response. Its primary use is for tuning the over-coupled broadband RF circuits of television transmitters and measuring their amplitude response characteristic. Since it includes a video sweep oscilator, it can also be used in adjusting video amplifiers, modulators, etc. The Type BW-5 Analyzer is for VHF-TV while the Type BWU-5 Analyzer is for UHF-TV frequencies.

The Sideband Response Analyzers provide for the display, on a suitable oscilloscope, of the entire sideband frequency response characteristics of any TV transmitter including the sideband filter. Such visual presentation permits immediate evaluation of transmitter adjustment without laborious point-by-point curve plotting. This facilitates transmitter tuning. The BW-5 tunes to 45.75 MHz for use with transmitters equipped with intermediate-frequency exciter-modulators.

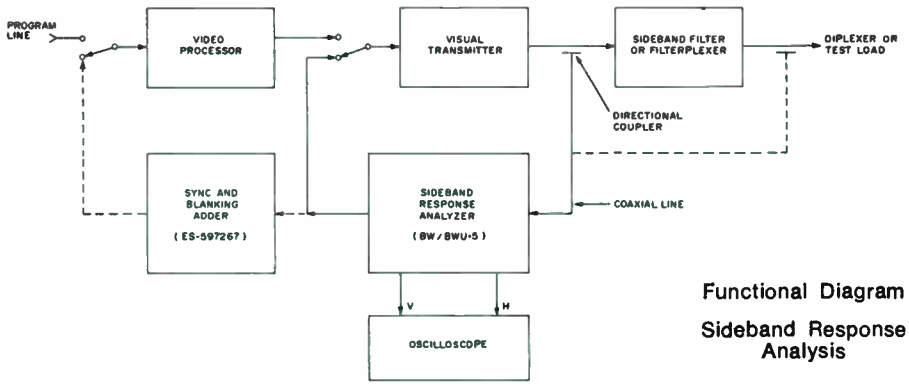
World Radio History

Quality Video Sweep Oscillator

The BW-5 includes a video sweep-frequency generator for transmitter modulation; a calibrated, variable-frequency marker generator, a synchronized receiver system for high definition sideband response; a retrace blanker circuit and a baseline generator for the associated oscilloscope. The unit is packaged in a recessed-box ("bathtub") chassis suitable for rack mounting. The front panel swings down for access to the unit's interior. Two BNC- type connectors, on the front panel, provide for the oscilloscope vertical and horizontal input connections. Power cord and transmitter connections are at the rear of the unit.

Available for UHF-TV Too

The BW-5 instrument is a VHF-only unit. For UHF-TV operations, it is available with an outboard unit that interfaces the VHF input of the BW-5 to the frequencies of UHF. This ensemble is designated the Type BWU-5, see "Ordering Information", below. The only difference between the two is the outboard unit and the additional 5.25 inches (133 mm) of rack space required for the UHF system.



Functional Diagram

Sideband Response Analysis

Specifications

Analyzer

RF Input:

Frequency	45.75-83.25 MHz (channels 2 to 6) 174-212 MHz (channels 7 to 13)
Voltage	100 mV
Impedance	50/51.5 ohms

Outputs:

Receiver Signal

Output Termination.....High impedance oscilloscope input

Linearity .....Error referred to 14-V carrier pip

Indicated	Actual Response
−25 dB	−24 dB
−30 dB	−28 dB
−35 dB	−33 dB

Noise Level (below 14V)	50 dB min.
Receiver Gain Control Range	10 dB

Video Sweep:

Voltage	0 to 2V p-p
Frequency	10-0-10 MHz sweep width continuously adjustable
Center Frequency	Adjustable ±4 MHz
Sweep Rate	Power line frequency
Repetition Rate	2 times power line frequency
Frequency Response	70 kHz to 5 MHz ±0.5 dB 50 kHz to 7 MHz ±1.0 dB
Distortion (at 2V p-p)	3% max.

Oscilloscope Sweep:

Open Circuit Voltage	4.5V p-p
Frequency	Same as power line
Wave Form	Same as power line
Internal Impedance	12,000 ohms
Phase Adjustment	±70°
Operating Conditions	5°C to 45°C, 0-95% RH
Supply Voltage	105-125/208-250V ac
Supply Frequency	50-60 Hz
Power Consumption	200W
Power Receptacle (power cord supplied)	1" male motor-plug
Mounting—Relay Rack	10½" H, 19" W, 14½" D (267, 483, 368 mm)
Weight	58 lbs. (27 kg)

UHF Converter

Input and Output Impedances	50 ohms
Frequency Range	450 to 900 MHz
Response (−1.5 to +6 MHz of center freq.)	±½ dB of center frequency
Linearity	Within ±1 dB for input signals to the attenuator ranging from 0.1 to 3.0V. (Normal converter input is 1V with input of 2.0V to the attenuator).
Output	0.3V across 50 ohm load with 2.0V rms input to attenuator
Power Requirements	110/220V, 50/60 Hz, 35W

UHF Converter:

Dimensions	19" W, 5¼" H, 7¾" D (483, 133, 197 mm)
Weight	14 lbs. (6 kg)

Accessories

Directional Coupler for 3⅛" Line	MI-19396-1B
Directional Coupler for Pressurized 3⅛" Line	MI-27390
Directional Coupler for 6⅛" Line	MI-27389
VHF Line Section (12" long, 3⅛" dia.)	MI-19396-3
UHF Line Section (12" long, 3⅛" dia.)	MI-19089-22
UHF Line Section (12" long, 6⅛" dia.)	MI-19387-20

Ordering Information

Sideband Response Analyzer, Type BW-5C2: VHF Channels 2-13	MI-34000-C2
Sideband Response Analyzer, Type BWU-5C2: UHF Channels 14-83	ES-34009-C2

Less directional coupler and transmission-line section.

Please specify assigned channel.

World Radio History

Sync and Blanking Adder

- Facilitates TV transmitter tests
- Mounts in standard module frame
- Self-contained power supply
- Regenerated pulses—bridging inputs

The Sync and Blanking Adder module increases the capabilities of an RCA Type BW-5/BWU-5 Sideband Response Analyzer: it allows convenient sideband response measurements with the transmitter modulator clamp circuit in normal operation; it permits rapid frequency response vs. brightness level measurements and it provides switched selection of standard-black and standard-picture level for observation of output regulation and blanking-level stability. Used with an external audio oscillator set at 59 Hz, it provides test for low frequency dynamic video characteristics.

Modularized, Plug-In Packaging

Requiring only 1.8 inches (46 mm) of rack-module space, the Adder mounts in an RCA module frame with other similarly packaged equipment such as video amplifiers, pulse amplifiers and the like.

Built-In Regenerator

The unit regenerates sync and blanking as part of its function. This makes it insensitive to pulse input-level variations and prevents distorted pulses from reaching the transmitter during test. The sync and blanking inputs are a-c coupled with an impedance exceeding 6000 ohms. As a result, the Adder conects in any loop-through circuit to other operating equipment. (Specifications and Ordering Information, next page.)

World Radio History

Specifications

Input Characteristics:
- Video Input ..... 0.25V peak-to-peak to 0.50V peak-to-peak nominal of video sweep from Sideband Response Analyzer

Input Impedances:
- Video Connection ..... 75 ohms
- Sync Connection (Min.) ..... 6000 ohms
- Blanking Connection (Min.) ..... 6000 ohms

Sync Level (Nominal) ..... 4V p-p
Blanking Level (Nominal) ..... 4V p-p
Audio Input Level (Nominal) ..... 1V p-p
Audio Input Impedance ..... 600 ohms (unbalanced)

Output Characteristics:
- Output Level (Nominal) ..... 1V p-p composite

Power Requirements 115V, 60Hz, 2W
Dimensions ..... 4.7" H, 1.8" W, 13.2" D (119, 46, 34 mm)
Weight ..... 2 lbs. (910g)

Accessories

Module Mounting Frame MI-557300

Ordering Information

Sync and Blanking Adder ES-597267

World Radio History

RCA

catalog TT.6900A

(Replaces B.4721)

Envelope Delay Measuring Equipment, Type BW-8A

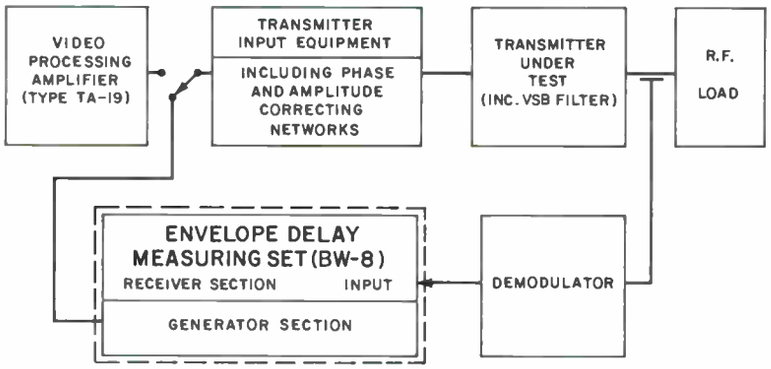
- Convenient and simple to operate
- Single frequency method of measurement
- Direct reading dial
- Excellent performance—Envelope delay 0 to 670 ns; accuracy ±3 percent, ± 10 nanoseconds

The BW-8A Envelope Delay Measuring Equipment is designed for field measurement of the incremental slope of the phase-versus-frequency characteristic (usually referred to as envelope delay) of television transmitter systems. It can also be used to measure the absolute delay of video equipment. By maintaining proper phase relationship between the various frequencies in the TV system, such effects as leading white, trailing smear, ringing and misregristration can be corrected.

The BW-8 equipment is a rack-mounted unit, easy to use. It provides a low frequency phase reference in order to measure the relative envelope delay in the region from 1.3 MHz to 4.3 MHz defined as the average delay between 0 and 189 kHz (F_A). The instrument is direct reading. All operating controls are located on the front panel for ease of operation. The unit mounts in a standard rack mounting where it occupies only 10½ inches (267 mm).

When measuring a video system or any other equipment having input and output at video frequencies, no auxiliary equipment is required. When a complete transmitter is being measured the only auxiliary unit required is an RF demodulator to provide video signal feed to the receiver portion of the BW-8. The RCA BW-4 Series of Visual Sideband Demodulators or MI-19051-B/19364 Diode Demodulator can be used for this purpose. When sync and blanking are desired, they may be obtained from a studio sync generator, fed to the BW-8 generator section and combined with the BW-8 generator signal components to supply a composite test signal.

World Radio History



Built-in Power Supply

The BW-8 consists of a generator that feeds the system to be measured, and a receiver section which evaluates the envelope delay of the signals after they have passed through the system under test. The generator section provides two signal sources. One is a reference frequency (F_A) derived from an internal crystal oscillator or from the twelfth harmonic of the horizontal sync frequency supplied from an external source. The second is a carrier signal (F_C) which may be varied. The receiver section contains two amplifier-limiter chains to detect and amplify video from the unit under test. A phase shifter consisting of an RLC network may be switched into either amplifier chain to permit compensation of either positive or negative time delay. It is calibrated to read delay in microseconds. The generator section occupies the left section of the chassis, the receiver chains are on the right. An electronically regulated power supply is built in on the rear of the chassis.

Front Panel Control

All controls of the BW-8 Envelope Delay Measuring Set are located on the front panel, those of the generator being on the left side and those of the receiver on the right. The output and input connectors, as well as the external sync input, the power connector and the fuse holder, are located on the rear of the chassis. The dial on the left controls the carrier frequency F_C and is directly calibrated. The right-hand dial drives a precision 3-turn potentiometer that controls the phase shifter. The dial is calibrated in delay, from 10 to 670 nanoseconds and may be measured with an accuracy of ±3 percent (±10 nanoseconds).

The VTVM (null indicator) is connected to a 5-position switch. Position 1 measures peak amplitude of the output test signal fed to the transmitter. Position 2 measures the amplitude of the signal at the input of the receiver. Position 3 is for balancing the VTVM and positions 4 and 5 are for use as a null indicator for the phase detector. Position 4 is of lower sensitivity for initial balancing of the phase detector. By means of another switch, the phase shifter network can be introduced into either one of the two receiver chains, allowing matching of positive or negative phase delay encountered in the system under test.

Other controls located on the front panel include an AC line switch; "Sync Amplitude" which regulates the amount of sync incorporated in the test signal; a "Zero Set" used to balance the VTVM when its switch is in position 3; and a "Delay Set", used to balance the delay of the measuring set when the operation switch is in the "direct" position.

Specifications

Performance

Envelope Delay	0 to ±0.67 microseconds
Frequency Range	1.3 to 4.3 MHz
Reference Frequency	Average Envelope Delay between 0 and 0.189 kHz
Delay Accuracy	±3% ±0.01 microseconds
Carrier Frequency Accuracy	±2% ±0.05 MHz
Output Test Signal	0 to 2 Volt, peak-to-peak
Output Impedance	75 Ohms
Input Test Signal	0.1 Volt, peak-to-peak min.
Input Impedance	75 Ohms ±2%
Horizontal Sync and Blanking	1 Volt peak-to-peak, min.
Input Impedance (Sync)	75 Ohms ±1%
Power Requirements	105-125V, 50/60Hz, 180W

Mechanical

Mounting	Standard 19" (483 mm) rack
Operating Conditions	5°C to 45° C (41°F to 113°F), 0-95% relative humidity
Dimensions	10½" H, 19" W, 14½" D (267, 483, 368 mm)
Weight (Approx.)	35 lbs. (16 kg)

Accessories

VHF Visual Sideband Demodulator, Type BW-4C1	ES-34048
UHF Visual Sideband Demodulator, Type BWU-4C1	ES-34049
VHF Monitoring Diode	MI-19051-B
UHF Monitoring Diode	MI-19364

Ordering Information

Envelope Delay Measuring Set (1.3 to 4.3 MHz), Type BW-8A	MI-34063

World Radio History

RCA

catalog TT.7200A

(Replaces B.5514)

Harmonic Filters for UHF-TV Transmitters

- Effective harmonic suppression
- Pretuned during manufacture for optimum VSWR
- Easy installation—small relative size, light weight
- Standard equipment on RCA UHF-TV transmitters

Essentially bandpass filters using resonant cavities instead of lumped-constant circuits, these harmonic filters provide effective harmonic suppression for UHF-TV transmitters. Harmonic attenuation is accomplished in a series of radial cavities in a reflective-type circuit. The cavities are fabricated of high tensile-strength aluminum with a precision-machined interior. The individual cavities are assembled into a series of fixed-tuned sections terminated with standard transmission-line flanges.

Harmonic filters operate with power flow in either direction and should connect as close as practical to the transmitter output.

World Radio History

Four harmonic filters in use in an RCA transmitter.

Specifications

Power Rating:
- Average ..... 18 kW
- Peak ..... 30 kW

VSWR ..... 1.05:1 max.

Harmonic Suppression[1] ..... 60 dB min.

Connections:
- Input & Output ..... 50 ohm, 3⅛" flanged co-ax[2]

Mounting Position ..... Any

Ambient Operating Temperature ..... 0-45°C (32-113°F)

Dimensions:
- Ch. 14-43 Filter ..... 8" dia; 24¾" L (203, 629 mm)
- Ch. 44-83 Filter ..... 8" dia; 19⅛" L (203, 486 mm)

Weight (Approx.) ..... 30 lbs. (13.6 kg)

[1] With RCA transmitter and filterplexer.
[2] Mates with RCA Cat. No. MI-19089 transmission line.

Ordering Information

Harmonic Filter:
- For U.S. Ch. 14-43 incl. MI-561549L
- For U.S. Ch. 44-83 incl. MI-561549H

Please specify channel number.

World Radio History

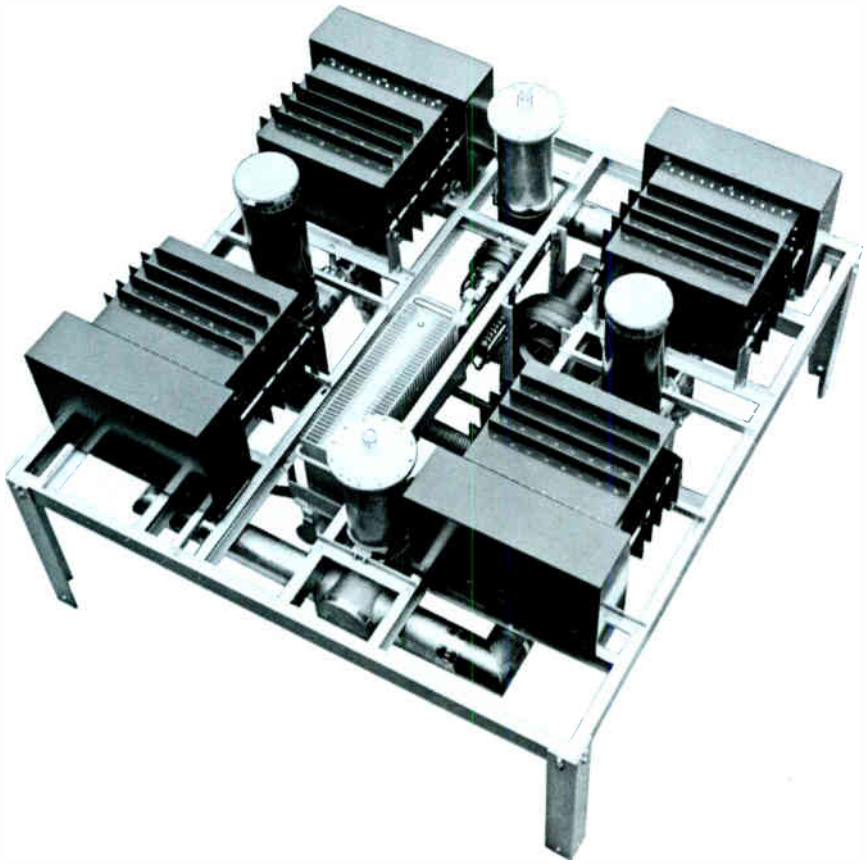
RCA

catalog TT.7600A

(Replaces B.5516)

60 kW UHF Hybrid Filterplexer

- Combines functions of sideband filter and diplexer
- Non-pressurized — no gassing required
- Insertion loss 0.5 dB or less at visual and aural carriers
- Fully assembled and pretuned
- Temperature compensated
- Constant input impedance over channel



This filterplexer connects aural and visual outputs of a UHF television transmitter to a common antenna feedline with negligible interaction and crosstalk and shapes the frequency response to conform to vestigial sideband television transmission standards.

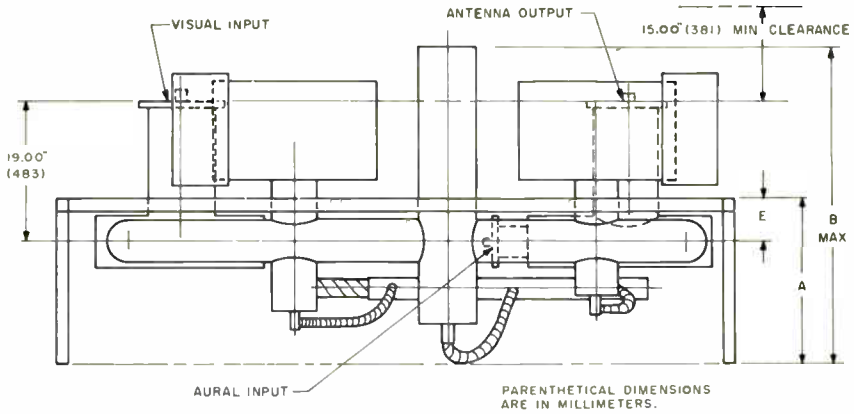
The filterplexer combines the high quality performance characteristics of both a sideband filter and a diplexer. The inputs have a constant input impedance over the band of frequencies in the channel.

Since resonant circuits of the lumped inductive-capacitance type are impractical at UHF frequencies, the filter sections consist of lengths of probe-excited waveguide and sections of coaxial transmission line making it a hybrid filterplexer. The system uses an ungassed, unpressurized design.

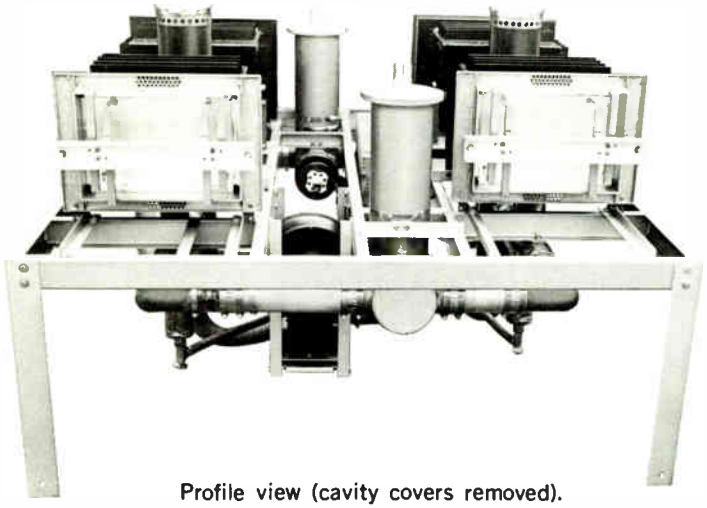
The filterplexer is suitable for floor or ceiling mounting (horizontal position with 6⅛-inch connections upwards only). The filterplexer is fully factory assembled.

World Radio History

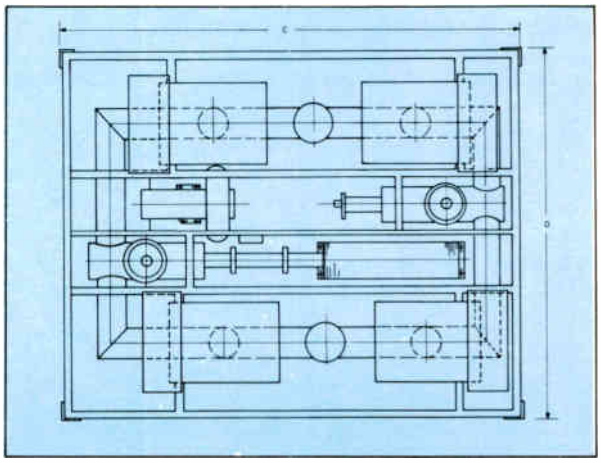
Outline drawings show dimensions in inches and millimeters for channels 14 through 70.



Outline drawing. Letters refer to chart at left below.



Profile view (cavity covers removed).



Letters refer to chart at left below.

Dimension Chart
Inches (mm)

Dimensions	A	B	C	D	E
Ch. 14 thru 22	26.00(660)	49.50(1257)	77.36(1965)	66.36(1686)	6.61(168)
Ch. 23 thru 30	25.00(635)	46.50(1181)	73.30(1862)	69.71(1771)	5.59(142)
Ch. 31 thru 41	24.00(610)	44.50(1130)	68.36(1736)	63.95(1624)	5.59(142)
Ch. 42 thru 54	23.00(584)	40.50(1029)	74.36(1889)	63.36(1609)	5.59(142)
Ch. 55 thru 70	23.00(584)	40.50(1029)	73.36(1863)	64.36(1635)	5.59(142)

Shipping container increases dimensions thus:
C: 9.62"(244 mm); B: 4.5"(114 mm); D: 6.75"(171 mm).

Specifications

Operating Frequency ..... Any 6 MHz channel between 470-812 MHz
Power Rating (Peak Visual) ..... 60 kW
Aural to Visual Power Ratio ..... 20% max.
Minimum Efficiency:[1]
Aural and Visual ..... 90% (0.46 dB loss)
Visual Input VSWR (Ref. visual carrier frequency):
—4.5 MHz to —1.25 MHz ..... 1.3:1 max.
—1.25 MHz to +4.2 MHz ..... 1.15:1 max.
+4.2 MHz to +4.5 MHz ..... 1.3:1 max.
Aural Input VSWR (Ref. visual carrier frequency):
4.5 MHz ±100 kHz ..... 1.3:1 max.
Ambient Temperature Range ..... 0 to 45°C (32-113°F)
Blower Power Requirements ..... 230V, 50/60 Hz, single phase
Interlock Circuit ..... 230V, 5A max.
Dimensions ..... See Chart and Outline Drawings
Access Clearance (all sides) ..... 18" (457 mm) min.
Mounting ..... Floor or ceiling[2]
Coaxial Connections and Impedance:
Input (Aural) ..... 3⅛", 50 Ohm flanged (MI-19089)
Input (Visual) ..... 6⅛", 75 Ohm flanged (MI-19387)
Output ..... 6⅛", 75 Ohm flanged (MI-19387)
Weight (Approximate) ..... 850 lbs. (386 kg)
Shipping Container Dimensions ..... See Chart note

[1] Visual losses (not aural) included in transmitter peak power rating.
[2] Horizontal position with 6⅛" connections facing upward only.

Ordering Information

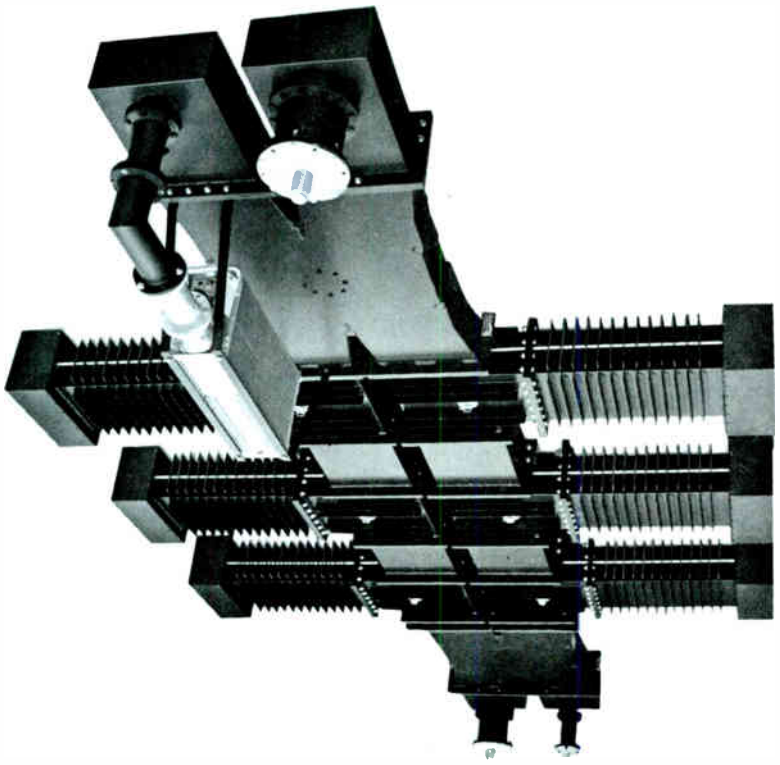
UHF Hybrid Filterplexer, 60 kW MI-561543
Please specify operating channel. Shipped fully assembled.

World Radio History

catalog TT.7650A
(Replaces B.5530)

Waveguide Filterplexers, 60 and 120 kW Visual

- High Efficiency—90% and greater
- Ceiling mount saves floor space
- No pressurization required
- Topside or bottomside connections
- Combined sideband filter and aural/visual diplexer



Waveguide filterplexers connect aural and visual transmitter outputs to a single antenna feedline with high efficiency and negligible interaction between the two transmitter outputs. The filterplexer also shapes visual carrier sidebands to conform with vestigial sideband transmission standards.

Designed for Ceiling Mount

Constructed of high conductivity aluminum, the filterplexer is designed for ceiling mount to save floor space. Dimensions in all three planes are a function of operating frequency (see *Specifications*).

Pretuned During Manufacture

All waveguide filterplexers are fully assembled and pretuned to operating frequency. They are, however, disassembled to facilitate shipment.

Combines Sideband Filter with Diplexer

Waveguide filterplexers combine the high-quality performance characteristics of a well-designed sideband filter and an efficient visual/aural diplexer. The filter attenuates the lower sideband of the visual carrier more than 20 dB from the lower edge of the channel (carrier minus 1.25 MHz) to a frequency 4.25 MHz below visual carrier frequency. So the transmitter outputs "see" a constant load, the filterplexer inputs are designed for constant impedance over the frequency bands produced by the transmitter carriers.

Convection Cooled, Unpressurized System

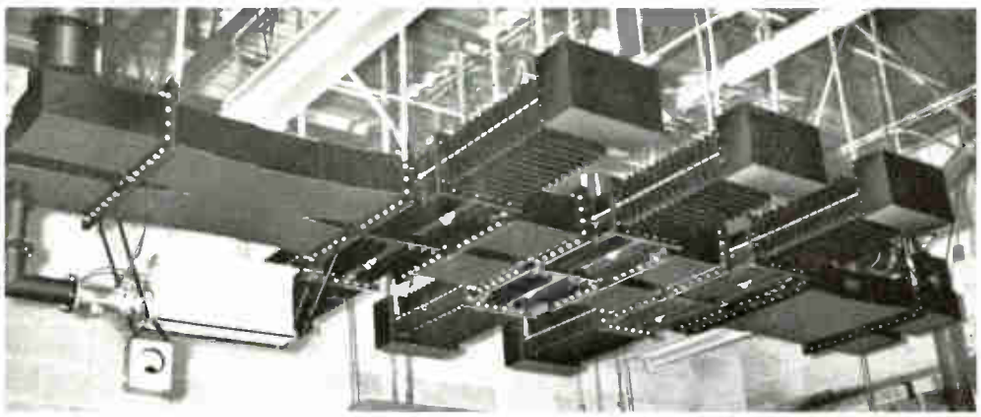
The filterplexer consists of two identical waveguide transmission lines with three waveguide cavities. Hybrid junctions at the inputs and output provide for connection of coaxial transmission line components. The waveguides operate without pressurization and are cooled with convection currents in the surrounding air. Special cooling fins on the cavities eliminate the need for any active cooling system.

(Specs and ordering information, next page.)

World Radio History

Typical installation of 60-kW, Channel 48 filterplexer.

Note: Coaxial connections made from above the filterplexer.



Specifications

Catalog Number	MI-561550		MI-561551		MI-561552		MI-561553	
Frequency Range	Ch. 14-42		Ch. 43-69		Ch. 14-42		Ch. 43-69	
Power Rating	Visual	Aural	Visual	Aural	Visual	Aural	Visual	Aural
	60 kW	12 kW	60 kW	12 kW	120 kW[1]	24 kW	120 kW[1]	20 kW
Efficiency (Min.)	94%	92%	93%	90%	94%	92%	93%	90%
Visual Input VSWR (Max.)								
−4.5 to −1.2 MHz	1.2:1	—	1.2:1	—	1.2:1	—	1.2:1	—
−1.2 to +4.2 MHz	1.15:1	—	1.15:1	—	1.15:1	—	1.15:1	—
+4.2 to +4.5 MHz	1.2:1	—	1.2:1	—	1.2:1	—	1.2:1	—
Aural Input VSWR (Max.)	—	1.2:1	—	1.2:1	—	1.2:1	—	1.2:1
Connections								
Input								
Nominal Diameter (inches)	6⅛	3⅛	6⅛	3⅛	WR-1500	6⅛	WR-1150	6⅛
Impedance (ohms)	75	50	75	50	—	75	—	75
Mating Components (Cat. No.)	MI-19387	MI-19089	MI-19387	MI-19089	WR-1500	MI-19387	WR-1150	MI-19387
Output								
Nominal Diameter (inches)	6⅛		6⅛		WR-1500		WR-1150	
Impedance (ohms)	75		75		—		—	
Mating Components (Cat. No.)	MI-19387		MI-19387		WR-1500		WR-1150	
Dimension in Inches (mm)								
Length[2]	228-195 (5791-4953)		198-168 (5029-4267)		228-195 (5791-4953)		198-168 (5029-4267)	
Width[2]	140-100 (3556-2540)		105-81 (2667-2057)		140-100 (3556-2540)		105-81 (2667-2057)	
Depth	36 (914)		36 (914)		36 (914)		36 (914)	
Weight (Approx.) in Pounds (kg)	1200 (544)		900 (408)		1200 (544)		900 (408)	

[1] Visual power rating increases with a reduction in aural power level.
[2] Dimensions vary with operating frequency: Lower channel no. = larger dimensions.

Ordering Information (Please specify visual and aural carrier frequencies)

Waveguide Filterplexers:

Channels 14-42, 60 kW Rating MI-561550
Channels 43-69, 60 kW Rating MI-561551
Channels 14-42, 120 kW Rating MI-561552
Channels 43-69, 120 kW Rating MI-561553

World Radio History

RCA

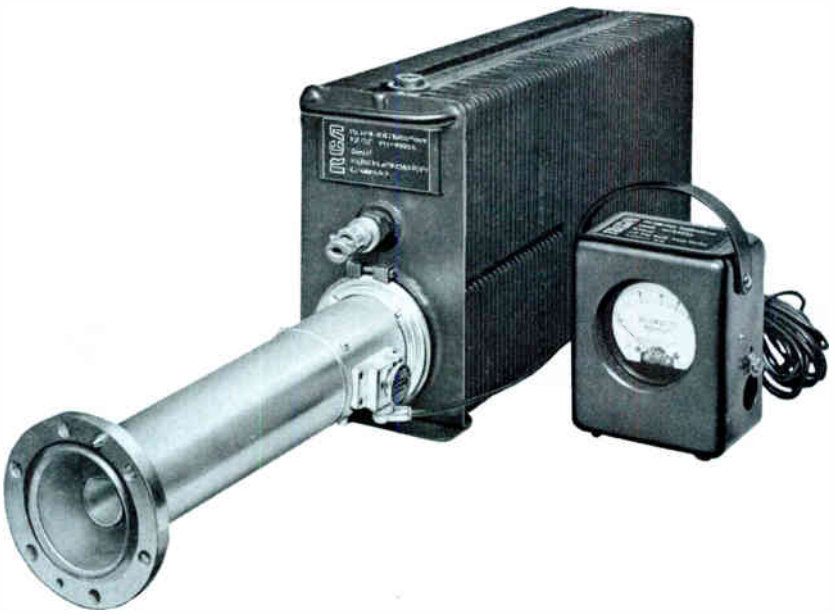
catalog TT.8200A

(Replaces B.5520, B.5522, B.5524)

RF Loads and Wattmeters for UHF-TV

- Combination dummy antenna and power meter
- Indicate incident or reflected power
- Air-cooled and water-cooled systems
- Power levels to 110 kW TV power (80 kW CW)

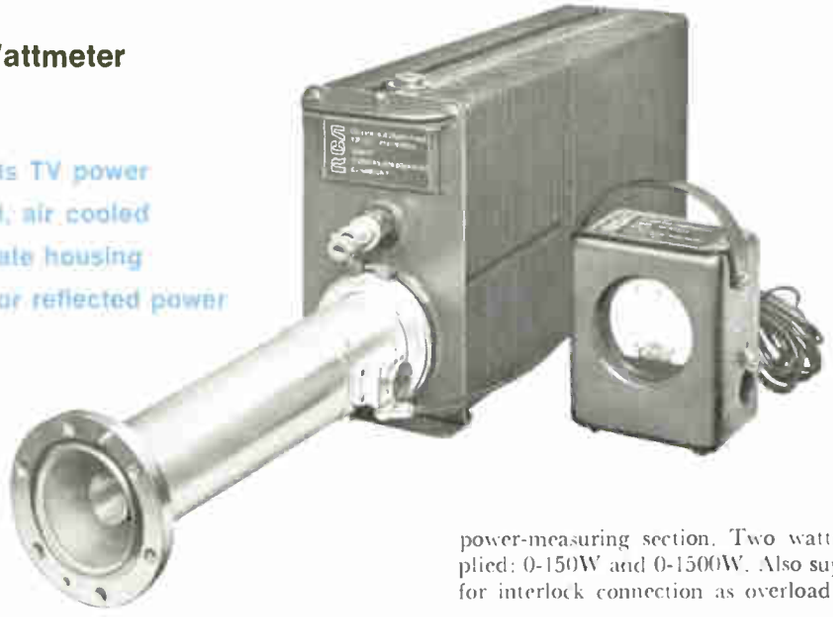
Here are four RF load and indicator devices for UHF-television broadcast operations. The smallest is a 1200-watt, air-cooled unit suitable as a reject load in a diplexer or as a test load for TV power stages up to 2000 watts; the largest is an 80-kilowatt device suitable for use with a 110-kilowatt UHF-television transmitter.



World Radio History

Air-Cooled, 1200-Watt Load/Wattmeter

- For up to 2000 watts TV power
- Fully self-contained, air cooled
- Wattmeter in separate housing
- Measures incident or reflected power



An air-cooled device for measuring the power output of the aural and visual sections of UHF-television transmitters. The load terminates the transmitter output and the wattmeter indicates the average power dissipated in the load.

Air Cooled Load Resistor

The load resistor is immersed in a liquid which transfers the heat from the resistor to the finned case which, in turn, dissipates the heat to the surrounding air. The liquid volume is only 1.7 gallons (6.4 liter) and ordinarily requires no maintenance.

Reflectometer Wattmeter Element

A coupling loop, a semi-conductor detector and a filter network make up the wattmeter element. The element is reversible in its socket to allow measurement of reflected as well as incident power. The element fits into a recess in the length of transmission line (see photo) that serves as the power-measuring section. Two wattmeter elements are supplied: 0-150W and 0-1500W. Also supplied is a thermo switch for interlock connection as overload protection for the load.

Specifications

Operating Frequency Range	470 to 890 MHz
Power Rating (Average)	1200W max.
Input Impedance	50 ohms
Mating Connection	3⅛", 50-ohm Flanged[1]
Operational Altitude	7500 ft. (2286m) ASL max.
Ambient Operating Temperature	10 to 45°C
Minimum Storage Temperature	10°C
Mounting	Horizontal
Dimensions	36⅝" L; 6⅜" W; 10¾" H (930, 162, 273 mm)
Weight	48 lbs. (22 kg)

[1] Matches RCA Cat. No. MI-19089 components.

Accessories

Reducer, 50-ohm, 3⅛" to Type N	MI-19089-17
Adapter, Type N to Type HN Connector	MI-19089-19
Inner Connector, Anchor Insulator	MI-19089-10A

Ordering Information

Air-Cooled, 1200-Watt Load and Wattmeter	MI-19197

Water-Cooled, 15/25-kW Load-Wattmeter

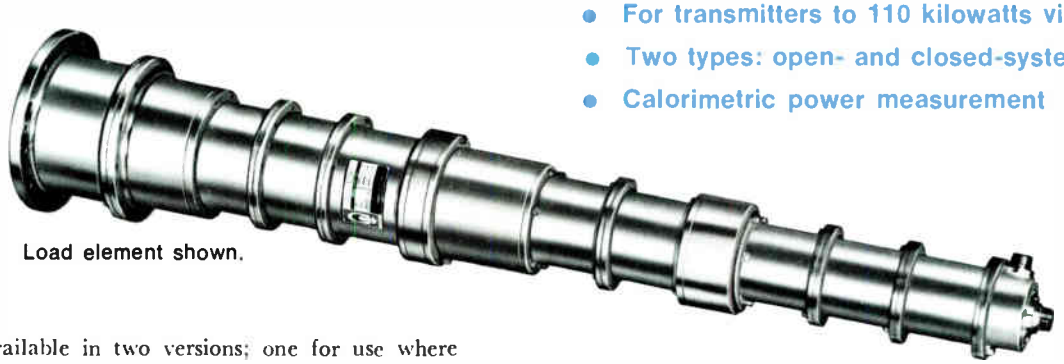
- Uses ordinary tap water as coolant
- Indicates power level directly in kilowatts
- For transmitters to 30 kW TV power
- Choice of two wattmeter ranges

Recommended for use with transmitters with up to 30 kilowatts of TV power, this load and wattmeter uses running water as coolant. It is equipped with a 3⅛-inch, 50-ohm flanged component that mates with RCA Catalog No. MI-19089 transmission line components. An accessory reducer-transformer adapts the connection to 6⅛-inch, 75-ohm components. (See "Accessories".)

World Radio History

Water-Cooled, 80-kW Load

- For transmitters to 110 kilowatts visual power
- Two types: open- and closed-system cooling
- Calorimetric power measurement



Load element shown.

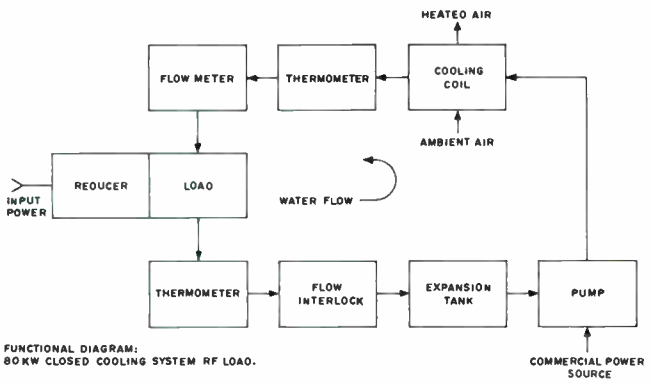
The load is available in two versions; one for use where a potable tap water supply and a drain are available, the other uses a closed water system that recirculates the coolant in a coil attached to the heat exchanger of an RCA Type TTU-110 transmitter.

Open Water System

The system consists of an RF load, a calorimetric measurement kit, a flow interlock and a reducer. No interconnecting water plumbing items supplied.

Closed Water System

The system consists of the same items as supplied with the open-water system plus the items shown in the "Functional Diagram" and water plumbing fittings for a typical system. Straight lengths of water tubing and elbows are not supplied.



FUNCTIONAL DIAGRAM:
80 KW CLOSED COOLING SYSTEM RF LOAD.

Specifications

Operating Frequency	Any 6 MHz-channel between 470 and 728 MHz
Power Rating (CW)	80 kW
Input Impedance	75 ohms
Operational Altitude	8000 ft. (2438m) ASL max.
Mating Connection	6⅛", Bolt Flange[1]
Ambient Operating Temperature	5-45°C min.-max.
Mounting	Any Position
Water Flow Rate	10 U.S. Gal/min. (630 ml/s)[2]
Weight (Load only, approx.)	26 lbs. (12 kg)

[1] Matches RCA Cat. No. MI-19387 components. Reducer included for either 8⅞" (RCA MI-561566) or 9⅞" (RCA MI-27793) "Universal" line. Please specify which reducer you require.

[2] Water of potable quality; requirement varies with inlet water temperature. (Water hardness not to exceed 200 PPM or 11.8 grains per gallon.)

Ordering Information

Water-Cooled, 80-kW Load:	
Open-Water System	ES-561800
Closed-Water System	ES-561812

(Please specify operating channel and either 8⅜ or 9⅜-inch reducer, male or female.)

Wattmeter Range Choice

The load and wattmeter are sold separately to allow a choice of two wattmeters: one for 0-15 kW range and another for 0-25 kW. The inner conductor connector, see "Accessories", is required to connect the Thruline to the load. Both wattmeter options measure incident as well as reflected power.

Specifications

Operating Frequency Range	470 to 890 MHz
Power Rating (Average)	25 kW max.
Input Impedance	50 ohms
Operational Altitude	8000 ft. (2438m) ASLmax.
Mating Connection	3⅛", 50-ohm Flanged[1]
Ambient Operating Temperature	5 to 45°C min.-max.
Mounting	Horizontal, water outlet upwards
Water Requirements[2]	5 U.S. Gal/min. (315 ml/s)
Water Connections	¾-inch FPT
Dimensions (Approx.)	104" L; 5¾" dia. (2641, 146 mm)
Weight (Approx.)	50 lbs. (23 kg)

[1] Matches RCA Cat. No. MI-19089 components.

[2] Water of potable quality; requirement varies with inlet water temperature. (Water hardness not to exceed 200 PPM or 11.8 grains per gallon.)

Accessories

Reducer-Transformer	MI-19387-4-CH
Inner Conductor Connector	MI-19089-10A
Wattmeter, "Thruline", 0-15 kW	MI-27350[3]
Wattmeter, "Thruline", 0-25 kW	MI-27363[4]

[3] Includes line section, wattmeter and two wattmeter elements: 0-1.5 kW and 0-15 kW.

[4] Includes line section, wattmeter and one 0-25 kW wattmeter element.

Ordering Information

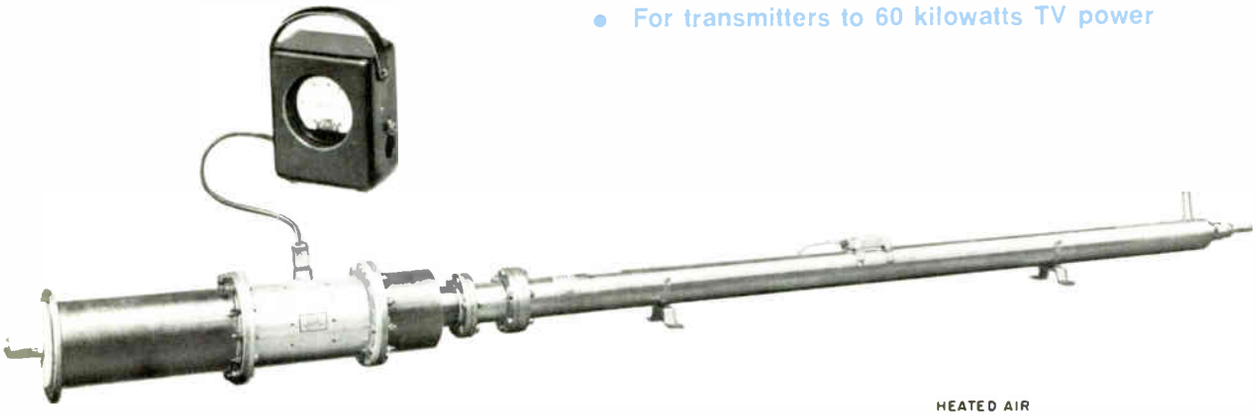
Water-Cooled 15/25-kW Load	MI-561733

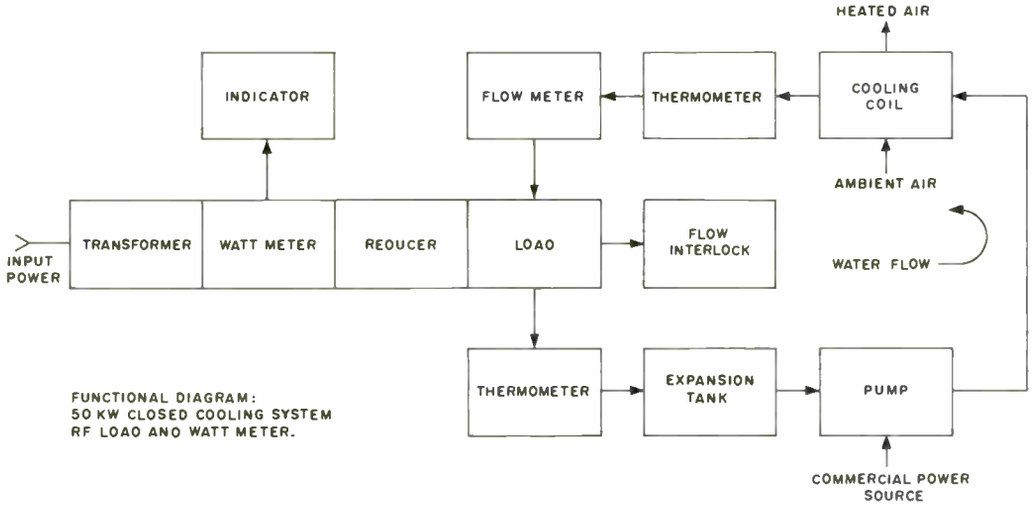
(Wattmeter, wattmeter element and "Thruline" line section not included. Select appropriate ensemble from "Accessories", above.)

World Radio History

Water-Cooled, 50-kW Load-Wattmeter

- Two types: open- and closed-system water cooling
- Measures incident or reflected power
- Three-range wattmeter: 10, 25, 50-kW
- For transmitters to 60 kilowatts TV power





FUNCTIONAL DIAGRAM:
50 KW CLOSED COOLING SYSTEM
RF LOAD AND WATT METER.

The load wattmeter is available in two versions; one for use where a potable tap water supply and a drain are available, the other uses a closed water system that recirculates the coolant in a coil attached to the heat exchanger of an RCA Type TTU-55 or TTU-60 transmitter.

Open Water System

The system consists of a transformer, a Thruline/Wattmeter, three wattmeter elements, a reducer and an RF Load equipped with a thermo switch. No interconnecting water plumbing items supplied.

Closed Water System

The system consists of the same items as supplied with the open-water system plus the remaining items shown in the "Functional Diagram" and water plumbing fittings for a typical system. Straight lengths of water tubing and elbows are not supplied.

Specifications

Operating Frequency	Any 6 MHz channel between 470 and 842 MHz
Power Rating (Average)	50 kW max.
Operational Altitude	8000 ft. (2438m) ASL max.
Mating Connection	6⅛", 75 ohm Bolt-Flanged[1]
Ambient Operating Temperature	5-45°C min.-max.
Mounting	Horizontal, water outlet upwards
Water Flow Rate	10 U.S. Gal/min. (630 ml/s)[2]
Weight (Approx., open-water system)	80 lbs. (36 kg)

[1] Matches RCA Cat. No. MI-19387 components.

[2] Water of potable quality; requirement varies with inlet water temperature. (Water hardness not to exceed 200 PPM or 11.8 grains per gallon.)

Accessories

Reducer-Transformer	MI-19387-4[3]

[3] Please specify channel number.

Ordering Information

Water-Cooled 50-kW Load-Wattmeter:	
Open-Water System	ES-561813
Closed-Water System	ES-561810

(Please specify channel number.)

World Radio History

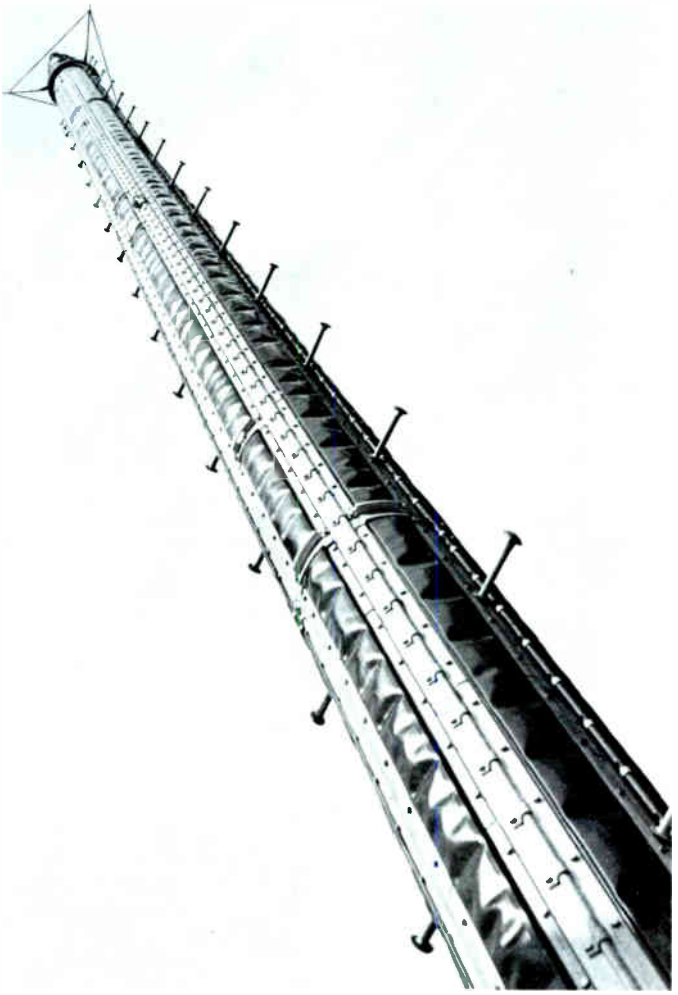
RCA

catalog TT.9200A

(Replaces B.5102)

"UHF-Pylon" Antennas, Type TFU- Series

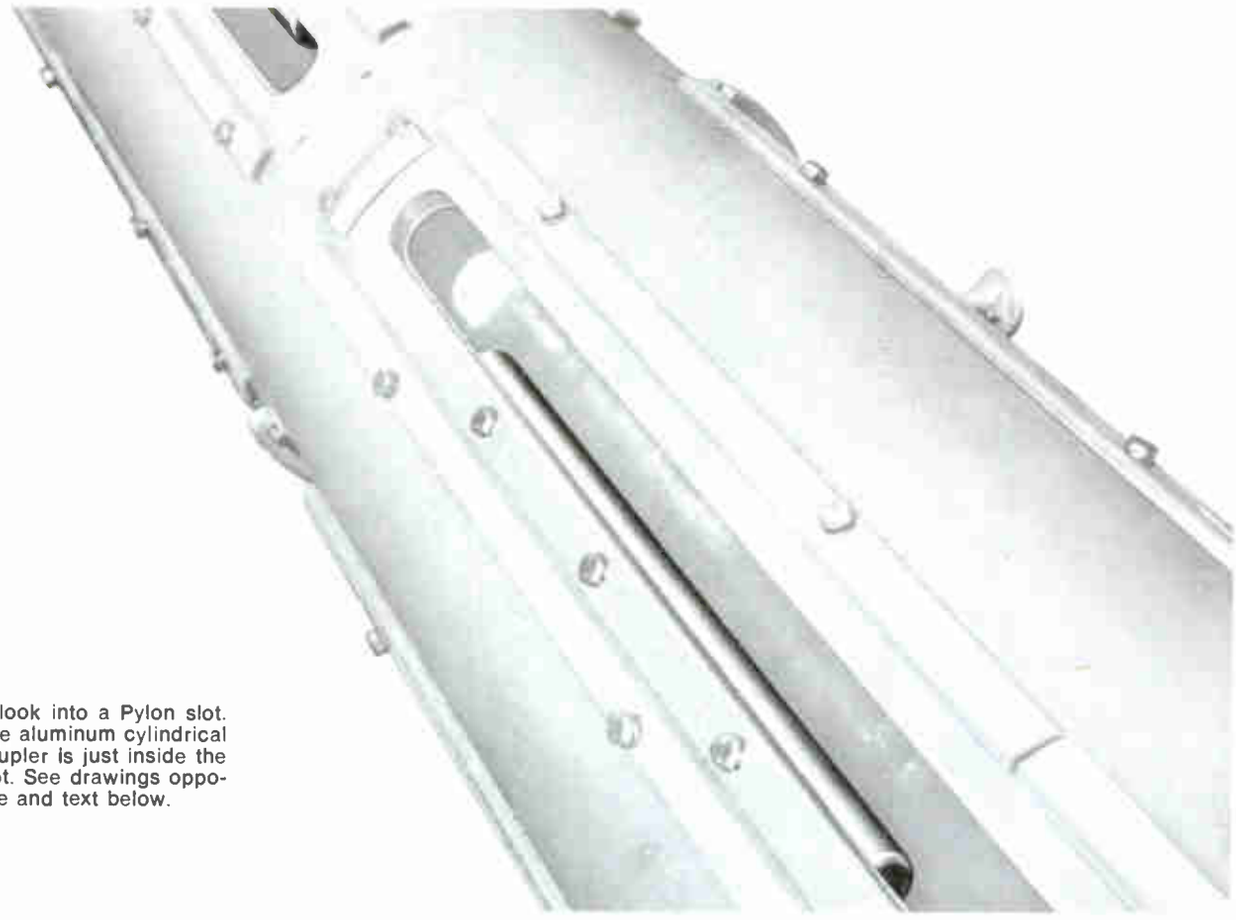
- Slotted cylinder design
- Low relative windload and weight
- High aperture efficiency
- Single feedpoint — 220 kW power capability
- Available in omni or directional pattern types
- Vertical patterns smooth or null-filled



The reliable standard of UHF-TV broadcasting for more than 20 years, the UHF-Pylon antenna is the choice of more than 400 stations. Available in many vertical and horizontal pattern combinations, the Pylon antenna design lends itself to almost any market coverage requirement. Each antenna is built to order. Special antenna requirements are incorporated routinely.

Every antenna is tested for radiation pattern and impedance characteristics during manufacture. Data recorded during these tests is furnished to the purchaser. Pylon antennas are shipped completely assembled with respect to radiation and impedance-determining components. Antennas are ground-checked, after delivery, by RCA, to confirm shipment integrity.

World Radio History



A look into a Pylon slot. The aluminum cylindrical coupler is just inside the slot. See drawings opposite and text below.

The UHF Pylon Antenna is basically a coaxial transmission line with radiating slots in outer conductor fed by simple aluminum-bar couplers bolted to the inside edge of each slot.[1] The number of slots (per layer) around the circumference is determined by the horizontal pattern such as one slot for a skull-shaped pattern, two for a peanut-shaped pattern, three for a "trilobe" pattern and four or more slots, depending on outer cylinder diameter, for an omnidirectional pattern. The layers are located at one wavelength spacings along the antenna with the number of layers determined by the vertical gain and pattern. The radiation parameters of phase and amplitude are determined basically by a combination of slot length and coupler bar diameter. This feature allows discreet control of the illumination along the antenna aperture at every wavelength resulting in the ultimate in vertical pattern control and shaping. It also allows for maximum aperture efficiency and, in conjunction with the extremely low cross-polarized radiation component of a slot, produces the highest vertical gain for a given antenna length.

Feed System

All UHF Pylons use a single feed point. In a "center-fed" Pylon, the inner conductor is a harness-type feed system with a Teflon end-seal feed point at the electrical center of the antenna. The end seal is at the end of a coaxial transmission line input to the antenna, the harness ranges, nominally, from 3 1/8 to 9-3/16 inches (79 to 233 mm) in diameter as a function of antenna input-power capability. End-fed, high-power Pylon directional antennas use a "tee" feed system with a standard transmission line gas stop at the "tee" input. All input-impedance shaping, broadbanding and matching is accomplished in the coaxial feed portions of the harness and "tee" feed systems and is independent of antenna radiation parameters.

Mechanical Design

The UHF Pylon uses a flange-mounted, seamless-steel pipe as its structural member. The pipe is slotted and serves as the outer conductor of the antenna. The inner conductor is of copper tubing, positioned concentrically within the outer conductor by ceramic, Teflon-capped, centering pins and locked in place vertically with a clamping spoke short at the base of the antenna. A sliding spoke short at the antenna top allows movement of the inner conductor with respect to the steel outer owing to temperature changes. (Steel and copper have different coefficients of expansion.) Should the inner conductor and/or the feed point require servicing, they can be lowered out of the antenna without antenna removal from the tower. Subsequent reinstallation results in negligible changes in the antenna pattern and impedance characteristics. These are determined primarily by the slots, coupler bars and feed-point position.

Pole steps, installed on the outer surface, provide a means of ascent for servicing the antenna and the beacon on top. A standard 300 millimeter beacon mount is provided at the top of the antenna and a factory-installed cable connects the beacon to a tower-top junction box. The beacon is not supplied with the antenna since it is normally part of the tower-lighting equipment.

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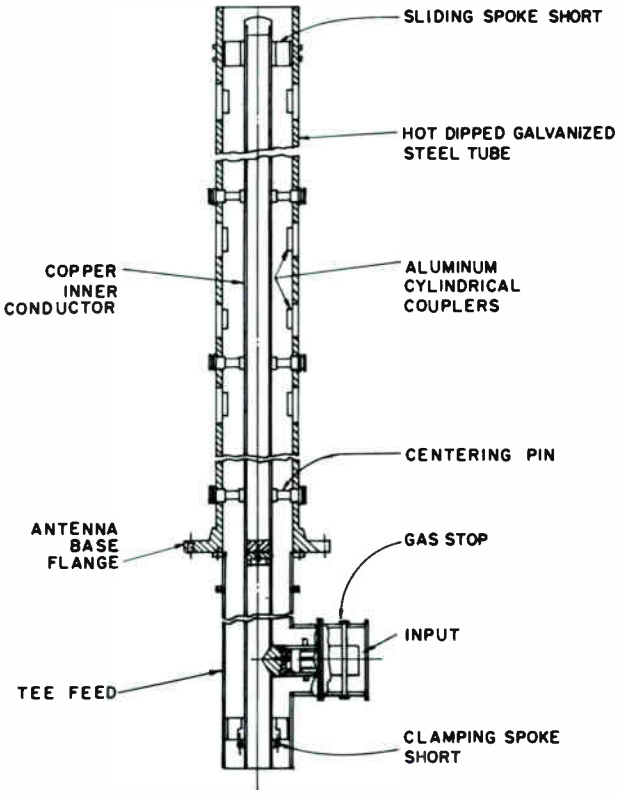
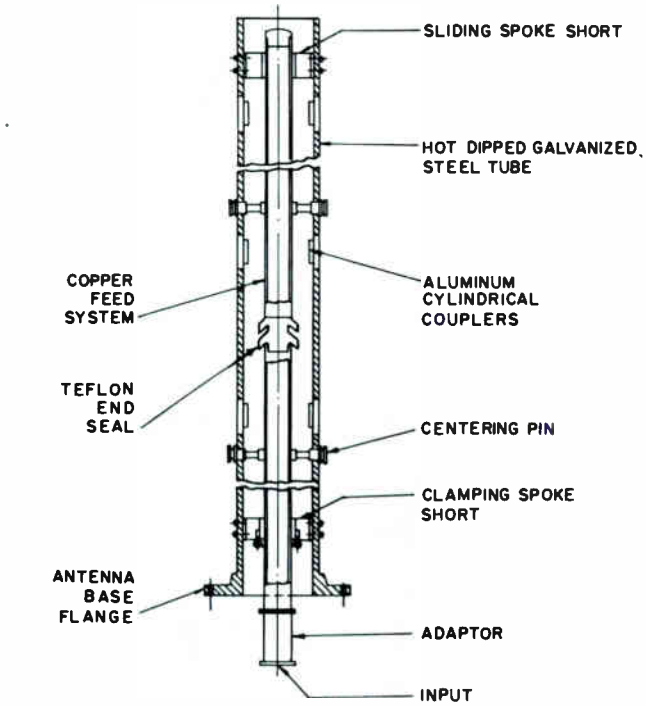
[1] "DL" and "DM" type Pylon antennas use loop couplers instead of bar couplers.

World Radio History



Cross-section drawings of two Pylon types: "end-fed" (above) and "center-fed" (below).



Anti-Corrosion Measures

Thorough consideration is given to all aspects of weather corrosion. The slotted cylinder is hot dip galvanized after fabrication; the inner conductor is of copper. Slot covers are virgin polyethylene or fiberglass, as required, both compounded with anti-oxident and ultra-violet inhibitors. Pylon hardware and metal parts are of corrosion-resistant metals such as hot-dip galvanized pole steps, lightning rods, mounting bolts, trim strips, de-icer covers and clamps; corrosion resistant aluminum coupler bars and de-icer power junction boxes; brass and bronze spoke shorts, tinned where they contact the galvanized pipe; leveling shims and small bolts of stainless steel.

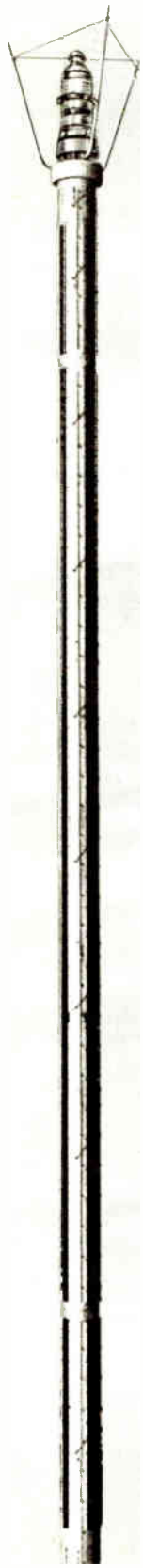
Lightning Protection

A branching lightning protector, at the top of the antenna, protects the beacon and antenna. With a well-grounded tower, it is highly improbable that lightning can damage the antenna since the steel pole is grounded to the tower through the mounting flange, the coupler bars are bolted to the steel pole and the inner conductor is short-circuited to the outer steel pole (from a d-c viewpoint) through the spoke shorts at the top and bottom of the antenna. The steel outer jacket of the de-icer elements contacts the pole full length. Power to the beacon and de-icer elements is fed through circuits and cables isolated from the antenna and tower structure.

"Calrod" De-icers

When the antenna serves areas or at heights where icing is likely, we recommend that the antenna be equipped with a factory-installed de-icing system. The de-icing system, operated properly, prevents or removes ice from the Pylon. The ice, if allowed to build up, increases antenna windload and increases tower load. De-icing also provides for a more stable operation of the antenna during adverse weather conditions. The de-icing system uses "Calrod" heaters, clamped longitudinally to the outside of the Pylon under asbestos-lined steel covers and heavy, galvanized-steel clamps. Power connections use weatherproof junction boxes and connectors. A thermostatic de-icer control, or ice detector de-icer control (see separate catalog sections) is supplied, as ordered, to activate the de-icer system power control. The necessary power-control contactor is not supplied unless ordered specifically. The ice detector control is recommended since it operates the de-

World Radio History



icers only as required during actual icing conditions—at the antenna—for a considerable saving in power consumption. Manual operation of the de-icer system is not recommended as a normal operating procedure since it is unreliable, does not take into account conditions at the antenna and, could result in damaged de-icers or antenna slot covers if operated at ambient temperatures in excess of 36 degrees F. (2.2°C).

Windload Specifications

The windload data listed in this catalog is calculated for a wind pressure of 50 lbs/ft² (pounds per square foot) (244 kg/m²) on flats and 33.3 lbs/ft² (161 kg/m²) on round surfaces. This pressure is equivalent to approximately a 110 mph (177 km/h) wind velocity with no ice. Data for other conditions is available on request. The Pylon product line is designed in accordance with EIA Standards, Section RS-222 and is independently certified as to structural integrity for rated condition.

Input Power Specifications

The input power ratings listed here are calculated for normal operating conditions for a temperature rise of 80°C (176°F) over a 40°C (104°F) ambient. Sufficient safety factor is included for FCC-allowable operating power fluctuations and normal VSWR variations. The rated input power is based on peak TV power (visual power at sync peak) using 20% aural power.

Pattern and Gain Specifications

RCA Pylon antennas have one of three basic vertical-pattern characteristics:

Left, a TFU-24J antenna in close -up. A "G"-type antenna is shown on the cover page of this section.

Below, a close-up of the input and mounting flange of a typical Pylon antenna. Box at center right is part of the optional de-icer system.

World Radio History

1. Null-filled vertical pattern ("D" and "J" types)
2. Smooth vertical pattern ("G" and "K" types)
3. Smooth vertical pattern ("DAS" type)

The azimuthal pattern of the antenna is either omnidirectional (calculated circularity of ±1.0 dB max. to min.) or directional with a so-called "skull", "peanut" or "trilobe" pattern.

Electrical beam-tilt is built into each Pylon as desired by the customer and is determined with respect to the center of the main vertical lobe at its half-power point (i.e. 0.707 relative voltage).

Pylon antenna power gain is based on the rms value of the azimuthal pattern and takes into account:

1. Radiation at all vertical angles from +90° to −90°.
2. Radiation at all azimuthal angles.
3. Vertically polarized radiation.
4. Antenna feed-system losses.

At time of manufacture, when each Pylon is pattern tested, the actual gain is determined in accordance with the above and is not less than that shown on the calculated pattern.

Pattern Demonstration Option

This extra-cost option is specified at the time of antenna purchase. During the demonstration, all recorded measurements may be inspected and reviewed for compliance with contract specifications. Demonstration measurements will be performed for the customer or his representative of a typical vertical pattern and horizontal pattern values in the principal azimuths at mid-channel frequency.

Input VSWR Specifications

Input VSWR is tuned and optimized during manufacture to minimize reflections to a specification of 3% or less, measured with a 0.25 microsecond RF pulse at visual carrier frequency.

The antenna input VSWR specification for UHF Pylons is:

Frequency	*VSWR*
Visual carrier +0.5 MHz	1.05:1
Chrominance subcarrier	1.08:1
Remainder of Channel[2]	1.10:1

[2] The "K" and "DAS" Pylon antennas have a VSWR specification of 1.20:1 at channel edges.

UHF-Pylon antenna loaded for transport.

World Radio History

Input Power Ratings By Antenna Feed Types

The input-power rating of a UHF-Pylon antenna is a function of the antenna's inner-conductor diameter. There are two types of feed system: "Harness" and "Tee". The harness type is used in the center-fed antenna types while the tee-type serves the end-fed antenna. See "Feed System" on Page 2 and drawings on Page 3 of this catalog section.

PEAK TV INPUT POWER RATING

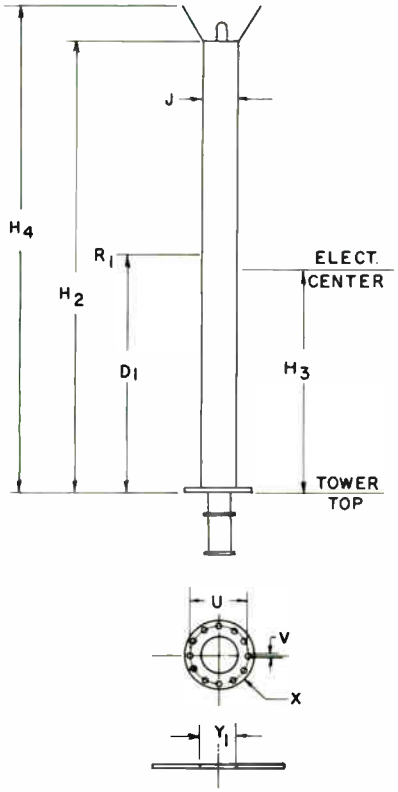
(Based on black level visual power and 20 percent aural power for 40°C ambient temp.)

	ANTENNA FEED TYPES																					
	"HARNESS" FEED														"TEE" FEED							
Ch. No.	3⅛" kW	3⅛" dBk	4⅛" kW	4⅛" dBk	5" kW	5" dBk	6⅛" kW	6⅛" dBk	7½" kW	7½" dBk	8-3/16" kW	8-3/16" dBk	9-3/16" kW	9-3/16" dBk	6⅛" kW	6⅛" dBk	CUSTOM kW	CUSTOM dBk	8-3/16" kW	8-3/16" dBk	9-3/16" kW	9-3/16" dBk
14	19	12.79	39	15.91	60	17.78	80	19.03	N/A		136	21.34	157	21.96	80	19.03	N/A		110	20.41	110	20.41
15	18	12.55	38	15.80	59	17.71	79	18.98	N/A		134	21.27	155	21.90	79	18.98	N/A		110	20.41	110	20.41
16	18	12.55	38	15.80	58	17.63	78	18.92	N/A		133	21.24	154	21.88	78	18.92	N/A		110	20.41	110	20.41
17	18	12.55	38	15.80	58	17.63	77	18.86	N/A		133	21.24	153	21.85	77	18.86	N/A		110	20.41	110	20.41
18	18	12.55	37	15.68	57	17.56	77	18.86	N/A		132	21.21	152	21.82	77	18.86	N/A		110	20.41	110	20.41
19	18	12.55	37	15.68	57	17.56	76	18.81	N/A		131	21.17	150	21.76	76	18.81	N/A		110	20.41	110	20.41
20	18	12.55	37	15.68	56	17.48	75	18.75	N/A		130	21.14	149	21.73	75	18.75	N/A		110	20.41	110	20.41
21	18	12.55	37	15.68	56	17.48	75	18.75	N/A		129	21.11	148	21.70	75	18.75	N/A		110	20.41	110	20.41
22	18	12.55	36	15.56	55	17.40	74	18.69	N/A		128	21.07	147	21.67	74	18.69	N/A		110	20.41	110	20.41
23	18	12.55	36	15.56	55	17.40	74	18.69	N/A		127	21.04	146	21.64	74	18.69	N/A		110	20.41	110	20.41
24	18	12.55	36	15.56	54	17.32	73	18.63	N/A		126	21.00	145	21.61	73	18.63	N/A		110	20.41	110	20.41
25	18	12.55	36	15.56	54	17.32	72	18.57	N/A		125	20.97	144	21.58	72	18.57	N/A		110	20.41	110	20.41
26	18	12.55	35	15.44	54	17.32	72	18.57	N/A		125	20.97	143	21.55	72	18.57	N/A		110	20.41	110	20.41
27	18	12.55	35	15.44	53	17.24	71	18.51	N/A		124	20.93	142	21.52	71	18.51	N/A		110	20.41	110	20.41
28	18	12.55	35	15.44	53	17.24	71	18.51	N/A		123	20.90	141	21.49	71	18.51	N/A		110	20.41	110	20.41
29	17	12.30	35	15.44	52	17.16	70	18.45	N/A		122	20.86	141	21.49	70	18.45	N/A		110	20.41	110	20.41
30	17	12.30	34	15.31	52	17.16	70	18.45	N/A		121	20.83	140	21.46	70	18.45	N/A		110	20.41	110	20.41
31	17	12.30	34	15.31	51	17.08	69	18.39	N/A		120	20.79	139	21.43	69	18.39	N/A		110	20.41	N/A	
32	17	12.30	34	15.31	51	17.08	69	18.39	N/A		120	20.79	138	21.40	69	18.39	N/A		110	20.41	N/A	
33	17	12.30	34	15.31	50	16.99	68	18.33	N/A		119	20.76	137	21.37	68	18.33	N/A		110	20.41	N/A	
34	17	12.30	33	15.19	50	16.99	68	18.33	N/A		118	20.72	136	21.34	68	18.33	N/A		110	20.41	N/A	
35	17	12.30	33	15.19	50	16.99	68	18.33	N/A		118	20.72	136	21.34	68	18.33	N/A		110	20.41	N/A	
36	17	12.30	33	15.19	49	16.90	67	18.26	N/A		117	20.68	135	21.30	67	18.26	N/A		110	20.41	N/A	
37	17	12.30	33	15.19	49	16.90	67	18.26	N/A		116	20.64	134	21.27	67	18.26	N/A		110	20.41	N/A	
38	17	12.30	33	15.19	48	16.81	66	18.20	N/A		116	20.64	133	21.24	66	18.20	N/A		110	20.41	N/A	
39	16	12.04	32	15.05	48	16.81	66	18.20	N/A		115	20.61	133	21.24	66	18.20	N/A		110	20.41	N/A	
40	16	12.04	32	15.05	48	16.81	66	18.20	N/A		114	20.57	132	21.21	66	18.20	N/A		110	20.41	N/A	
41	16	12.04	32	15.05	47	16.72	65	18.13	N/A		113	20.53	N/A		65	18.13	83	19.19	N/A		N/A	
42	16	12.04	31	14.91	47	16.72	65	18.13	N/A		113	20.53	N/A		65	18.13	82	19.14	N/A		N/A	
43	16	12.04	31	14.91	46	16.63	64	18.06	N/A		112	20.49	N/A		64	18.06	82	19.14	N/A		N/A	
44	16	12.04	31	14.91	46	16.63	64	18.06	N/A		112	20.49	N/A		64	18.06	81	19.08	N/A		N/A	
45	16	12.04	31	14.91	46	16.63	64	18.06	N/A		111	20.45	N/A		64	18.06	81	19.08	N/A		N/A	
46	16	12.04	30	14.77	45	16.53	63	17.99	N/A		110	20.41	N/A		63	17.99	80	19.03	N/A		N/A	
47	16	12.04	30	14.77	45	16.53	63	17.99	N/A		110	20.41	N/A		63	17.99	80	19.03	N/A		N/A	
48	16	12.04	30	14.77	45	16.53	63	17.99	N/A		109	20.37	N/A		63	17.99	80	19.03	N/A		N/A	
49	16	12.04	30	14.77	44	16.43	62	17.92	N/A		109	20.37	N/A		62	17.92	79	18.98	N/A		N/A	
50	15	11.76	30	14.77	44	16.43	62	17.92	N/A		108	20.33	N/A		62	17.92	79	18.98	N/A		N/A	
51	15	11.76	29	14.62	44	16.43	62	17.92	N/A		107	20.29	N/A		62	17.92	79	18.98	N/A		N/A	
52	15	11.76	29	14.62	44	16.43	61	17.85	N/A		106	20.25	N/A		61	17.85	78	18.92	N/A		N/A	
53	15	11.76	29	14.62	43	16.33	61	17.85	N/A		106	20.25	N/A		61	17.85	78	18.92	N/A		N/A	
54	15	11.76	29	14.62	43	16.33	61	17.85	N/A		105	20.21	N/A		61	17.85	78	18.92	N/A		N/A	
55	15	11.76	28	14.47	43	16.33	60	17.78	N/A		105	20.21	N/A		60	17.78	77	18.86	N/A		N/A	
56	15	11.76	28	14.47	42	16.23	60	17.78	N/A		104	20.17	N/A		60	17.78	77	18.86	N/A		N/A	
57	15	11.76	28	14.47	42	16.23	60	17.78	93	19.68	N/A		N/A		60	17.78	76	18.81	N/A		N/A	
58	15	11.76	28	14.47	41	16.13	59	17.71	93	19.68	N/A		N/A		59	17.71	76	18.81	N/A		N/A	
59	15	11.76	27	14.31	41	16.13	59	17.71	92	19.64	N/A		N/A		59	17.71	76	18.81	N/A		N/A	
60	15	11.76	27	14.31	41	16.13	59	17.71	92	19.64	N/A		N/A		59	17.71	75	18.75	N/A		N/A	
61	15	11.76	27	14.31	41	16.13	59	17.71	91	19.59	N/A		N/A		59	17.71	75	18.75	N/A		N/A	
62	14	11.46	27	14.31	40	16.02	58	17.63	91	19.59	N/A		N/A		58	17.63	74	18.69	N/A		N/A	
63	14	11.46	26	14.15	40	16.02	58	17.63	90	19.54	N/A		N/A		58	17.63	N/A		N/A		N/A	
64	14	11.46	26	14.15	40	16.02	58	17.63	90	19.54	N/A		N/A		58	17.63	N/A		N/A		N/A	
65	14	11.46	26	14.15	39	15.91	57	17.56	90	19.54	N/A		N/A		57	17.56	N/A		N/A		N/A	
66	14	11.46	26	14.15	39	15.91	57	17.56	89	19.49	N/A		N/A		57	17.56	N/A		N/A		N/A	
67	14	11.46	25	13.98	39	15.91	57	17.56	89	19.49	N/A		N/A		57	17.56	N/A		N/A		N/A	
68	14	11.46	25	13.98	38	15.80	57	17.56	89	19.49	N/A		N/A		57	17.56	N/A		N/A		N/A	
69	14	11.46	25	13.98	38	15.80	56	17.48	88	19.44	N/A		N/A		56	17.48	N/A		N/A		N/A	
70	14	11.46	25	13.98	38	15.80	56	17.48	88	19.44	N/A		N/A		56	17.48	N/A		N/A		N/A	

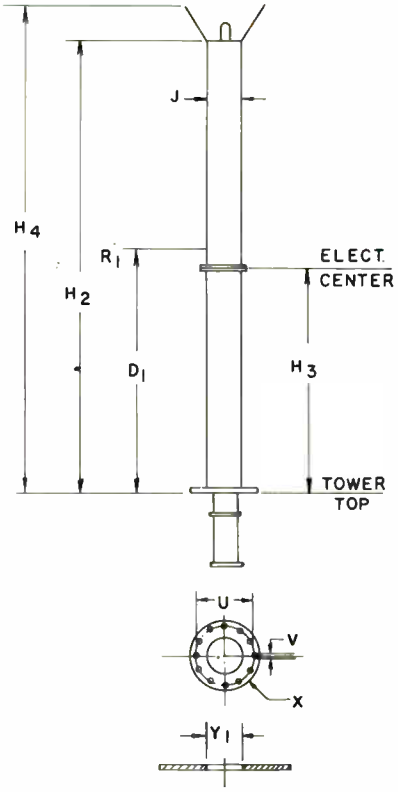
N/A = Not Applicable

World Radio History

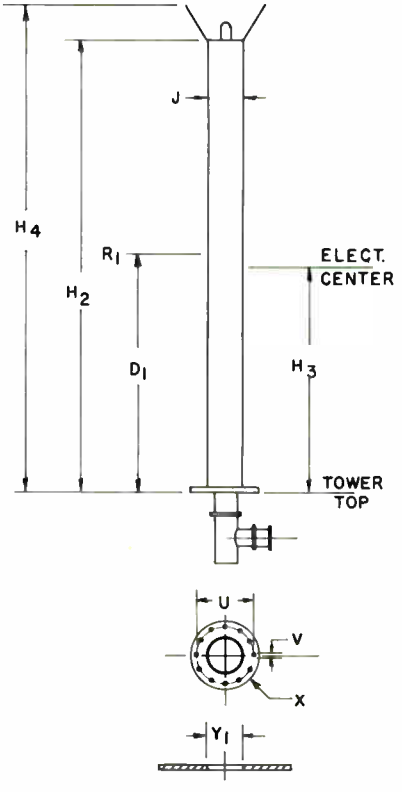
Mechanical Specifications



Outline Drawing A



Outline Drawing B



Outline Drawing C

Mechanical Symbol Definitions

SYMBOL	UNIT	DEFINITION
D_1	feet or meters	Distance from tower top to center of wind-loaded area of antenna.
H_2	feet or meters	Height of pole (only) above tower top.
H_3	feet or meters	Height of electrical center above tower top. ($H_3 = 0.5H_2$)
H_4	feet or meters	Height of antenna above tower top including lightning protector.
J	inches or millimeters	Pole diameter excluding slot covers.
M	foot-pounds or meter-kilograms	Overturn moment.
N		Number of sections in which pole is shipped.
R_1	pounds or kilograms	Wind reaction at center of wind-loaded area.
U	inches or millimeters	Diameter of bolt circle of base flange.
V	inches or millimeters	Bolt diameter used in base flange.
W	tons or metric tons	Weight of complete antenna including inner conductor.
X		Number of equally spaced bolts used in base flange.
Y_1	inches or millimeters	Clearance hole diameter required in tower top.

World Radio History

Standard Omnidirectional UHF Pylon Antennas

The antenna types are listed in the table below in increasing gain value by null filled and smooth vertical pattern categories. The null-filled types have vertical patterns derived from high aperture efficiency uniform illuminations. The illuminations are modified to provide desired null fill while retaining relatively high gain. In the smooth vertical pattern types, the illumination is intricately shaped to produce a pattern in which the nulls and peaks are smoothed out. The smooth pattern provides for more uniform signal especially desirable for antennas located in metropolitan areas or close to their principal coverage area.

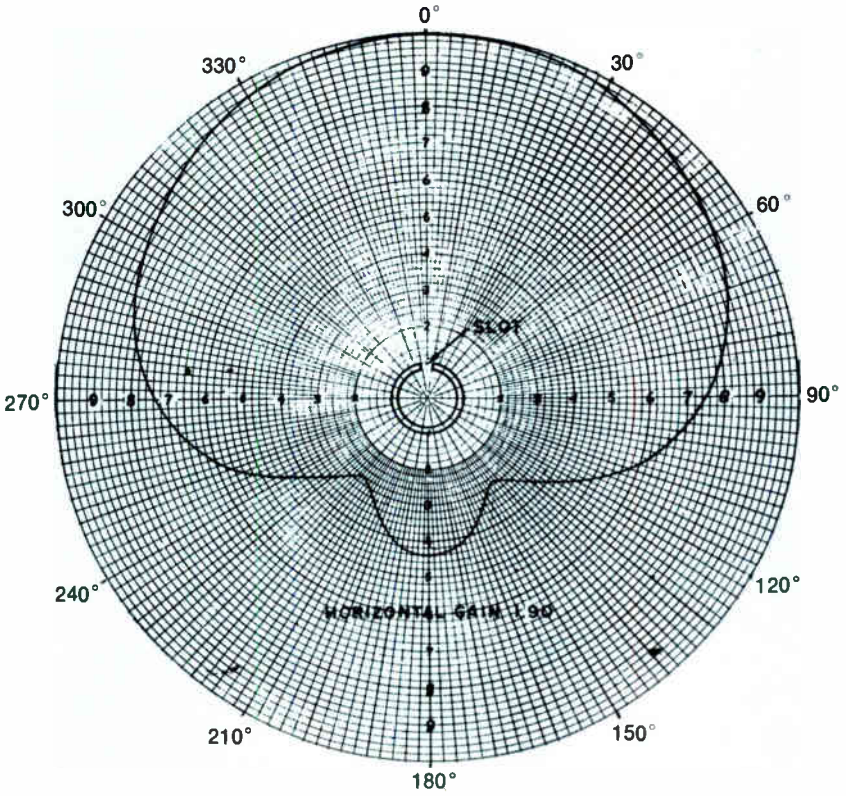
Omnidirectional Pattern Antennas

(See outline drawings, preceding page.)

Antenna Type	Channel Range	Harness Diameter	Vertical Gain		Vertical Pattern Type	Outline Drawing	N No. of Sections	J Pole Diameter	U Bolt-Circle Diameter	V Bolt Diameter	X No. of Bolts	Y_t Clearance Hole Diameter
			Beam Tilt	Gain								
TFU-6D	14-57	3⅛″ (79)	0.0°	6	Null Filled	A	1	4″ (102)	8″ (203)	⅝″ (16)	8	6″ (152)
TFU-24DL	14-30	3⅛″ (79)	0.0°	24	Null Filled	A	1	10¾″ (273)	15¼″ (387)	1⅛″ (29)	16	10″ (254)
TFU-24DM	31-50	3⅛″ (79)	0.0°	24	Null Filled	A	1	8⅝″ (219)	13″ (330)	1″ (25)	12	8″ (203)
TFU-24J	14-70	5″ (127)	0.0°	24	Null Filled	A	1	10¾″ (273)	15¼″ (387)	1⅛″ (29)	16	10″ (254)
TFU-30J	14-50	6⅛″ (155)	0.0°	30	Null Filled	A	1	12¾″ (324)	17¾″ (451)	1¼″ (32)	16	12″ (305)
TFU-30J	51-70	6⅛″ (155)	0.0°	30	Null Filled	A	1	10¾″ (273)	15¼″ (387)	1⅛″ (29)	16	10″ (254)
TFU-36J	14-50	6⅛″ (155)	0.0°	36	Null Filled	A	1	12¾″ (324)	17¾″ (451)	1¼″ (32)	16	12″ (305)
TFU-36J	51-70	6⅛″ (155)	0.0°	36	Null Filled	A	1	10¾″ (273)	15¼″ (387)	1⅛″ (29)	16	10″ (254)
TFU-42J	14-25	6⅛″ (155)	0.0°	42	Null Filled	B	2	14″ (356)	20¼″ (514)	1¼″ (32)	20	15¼″ (387)
TFU-42J	26-50	6⅛″ (155)	0.0°	42	Null Filled	A	1	12¾″ (324)	17¾″ (451)	1¼″ (32)	16	12″ (305)
TFU-42J	51-60	6⅛″ (155)	0.0°	42	Null Filled	A	1	11¾″ (298)	17¾″ (451)	1¼″ (32)	16	12″ (305)
TFU-42J	61-70	6⅛″ (155)	0.0°	42	Null Filled	A	1	10¾″ (273)	15¼″ (387)	1⅛″ (29)	16	10″ (254)
TFU-45J	14-34	6⅛″ (155)	0.0°	45	Null Filled	B	2	14″ (356)	20¼″ (514)	1¼″ (32)	20	15¼″ (387)
TFU-45J	35-50	6⅛″ (155)	0.0°	45	Null Filled	A	1	12¾″ (324)	17¾″ (451)	1¼″ (32)	16	12″ (305)
TFU-45J	51-70	6⅛″ (155)	0.0°	45	Null Filled	A	1	14″ (356)	20¼″ (514)	1¼″ (32)	20	15¼″ (387)
TFU-50J	14-50	6⅛″ (155)	0.0°	50	Null Filled	B	2	14″ (356)	20¼″ (514)	1¼″ (32)	20	15¼″ (387)
TFU-50J	51-70	6⅛″ (155)	0.0°	50	Null Filled	A	1	14″ (356)	20¼″ (514)	1¼″ (32)	20	15¼″ (387)
TFU-25G	14-56	8³⁄₁₆″ (208)	All	25	Smooth	A	1	14″ (356)	20¼″ (514)	1¼″ (32)	20	15¼″ (387)
TFU-25G	57-70	7½″ (191)	All	25	Smooth	A	1	14″ (356)	20¼″ (514)	1¼″ (32)	20	15¼″ (387)
TFU-25GA	14-50	6⅛″ (155)	All	25	Smooth	A	1	12¾″ (324)	17¾″ (451)	1¼″ (32)	16	12″ (305)
TFU-25GA	51-70	6⅛″ (155)	All	25	Smooth	A	1	10¾″ (273)	15¼″ (387)	1⅛″ (29)	16	10″ (254)
TFU-35G	14-50	8³⁄₁₆″ (208)	All	35	Smooth	B	2	16″ (406)	23¾″ (603)	1¾″ (44)	20	15¼″ (387)
TFU-35G	51-56	8³⁄₁₆″ (208)	All	35	Smooth	A	1	16″ (406)	23¾″ (603)	1¾″ (44)	20	15¼″ (387)
TFU-35G	57-70	7½″ (191)	All	35	Smooth	A	1	14″ (356)	20¼″ (514)	1¼″ (32)	20	15¼″ (387)
TFU-40/46K	14-40	9³⁄₁₆″ (233)	All	40/46	Smooth	B	2	18″ (457)	25¾″ (654)	1¾″ (44)	20	18″ (457)
TFU-40/46K	41-56	8³⁄₁₆″ (208)	All	40/46	Smooth	B	2	16″ (406)	23¾″ (603)	1¾″ (44)	20	15¼″ (387)
TFU-40/46K	57-70	7½″ (191)	All	40/46	Smooth	B	2	14″ (356)	20¼″ (514)	1¼″ (32)	20	15¼″ (387)

(Parenthetical dimensions are millimeters)

World Radio History



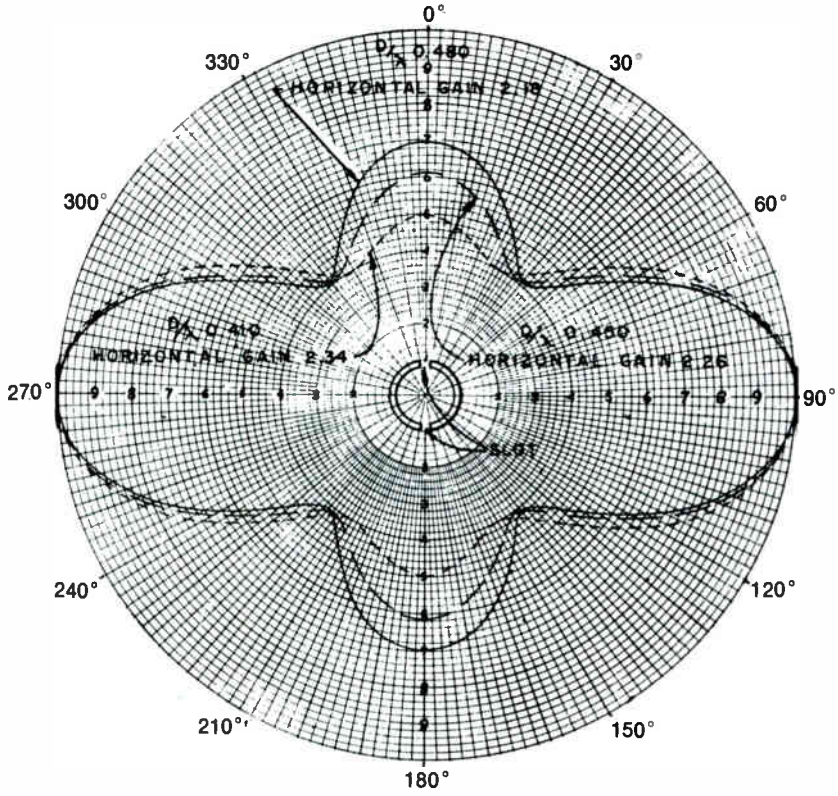
Skull Shaped Pattern Antennas

(Outline drawings on Page 7, this section.)

Antenna Type	Channel Range	Harness or Tee Diameter	Vertical Gain		Vertical Pattern Type	Outline Drawing	N No. of Sections	J Pole Diameter	U Bolt-Circle Diameter	V Bolt Diameter	X No. of Bolts	Y_1 Clearance Hole Diameter
			Beam Tilt	Gain								
TFU-30JDA	14-30	4⅛″ (105)	0.0°	30	Null Filled	A	1	8⅝″ (219)	13¾″ (349)	1⅛″ (29)	12	10″ (254)
TFU-36JDA	14-18	4⅛″ (105)	0.0°	36	Null Filled	A	1	10¾″ (273)	15¼″ (387)	1⅛″ (29)	16	10″ (254)
TFU-36JDA	19-23	4⅛″ (105)	0.0°	36	Null Filled	A	1	9⅝″ (244)	15¼″ (387)	1⅛″ (29)	16	10″ (254)
TFU-36JDA	24-30	4⅛″ (105)	0.0°	36	Null Filled	A	1	8⅝″ (219)	13¾″ (349)	1⅛″ (29)	12	10″ (254)
TFU-30JDAS	14-30	6/8/9″ Tee (152/203/229)	0.0°	30	Null Filled	C	1	10¾″ (273)	15¼″ (387)	1⅛″ (29)	16	10″ (254)
TFU-30JDAS	14-40	6/8″ Tee (152/203)	0.0°	30	Null Filled	C	1	9⅝″ (244)	15¼″ (387)	1⅛″ (29)	16	10″ (254)
TFU-30JDAS	31-50	6/8″ Tee (152/203)	0.0°	30	Null Filled	C	1	8⅝″ (219)	13¾″ (349)	1⅛″ (29)	12	10″ (254)
TFU-30JDAS	51-70	6″ Tee (152)	0.0°	30	Null Filled	C	1	6⅝″ (168)	10⅝″ (270)	⅞″ (22)	12	8⅝″ (219)
TFU-28DAS	14-30	6/8/9″ Tee (152/203/229)	All	28	Smooth	C	1	10¾″ (273)	15¼″ (387)	1⅛″ (29)	16	10″ (254)
TFU-28DAS	20-40	6/8″ Tee (152/203)	All	28	Smooth	C	1	9⅝″ (244)	15¼″ (387)	1⅛″ (29)	16	10″ (254)
TFU-28DAS	31-52	6/8″ Tee (152/203)	All	28	Smooth	C	1	8⅝″ (219)	13¾″ (349)	1⅛″ (29)	12	10″ (254)

(Parenthetical dimensions are millimeters)

World Radio History



Symbol Definitions: D = Pole outer diameter; λ = Mid-channel wavelength.
(Note: Gain and pattern vary with D/λ ratio.)

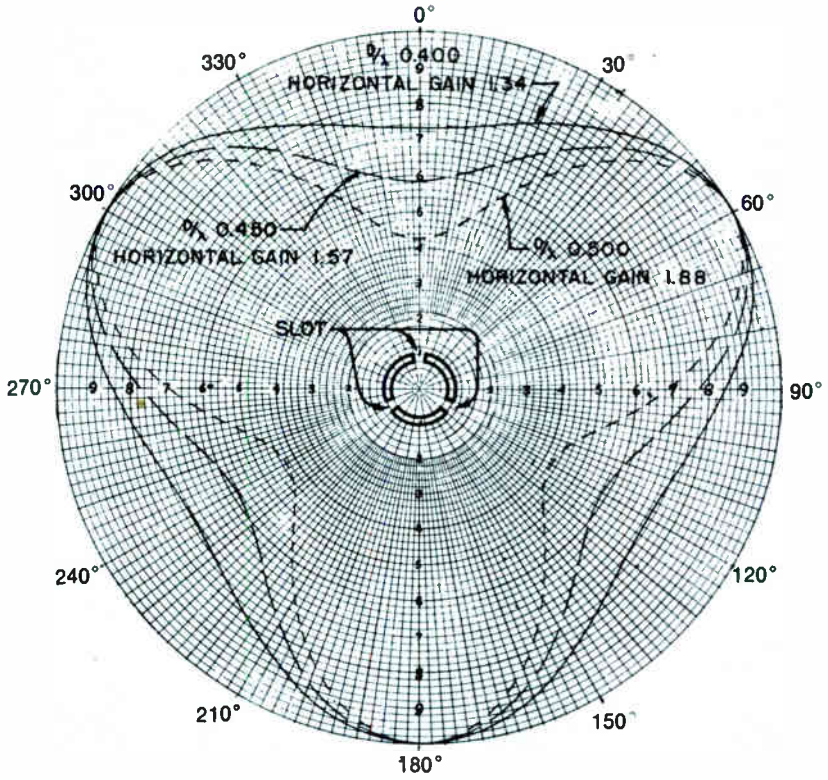
Peanut Shaped Pattern Antennas

(Outline drawings on Page 7, this section.)

Antenna Type	Channel Range	Harness or Tee Diameter	Vertical Gain		Vertical Pattern Type	Outline Drawing	N No. of Sections	J Pole Diameter	U Bolt-Circle Diameter	V Bolt Diameter	X No. of Bolts	Y_1 Clearance Hole Diameter
			Beam Tilt	Gain								
TFU-30JDA	14-25	5″ (127)	0.0°	30	Null Filled	A	1	10¾″ (273)	15¼″ (387)	1⅛″ (29)	16	10″ (254)
TFU-30JDA	14-36	5″ (127)	0.0°	30	Null Filled	A	1	9⅝″ (244)	15¼″ (387)	1⅛″ (29)	16	10″ (254)
TFU-30JDA	37-50	4⅛″ (105)	0.0°	30	Null Filled	A	1	8⅝″ (219)	13¾″ (349)	1⅛″ (29)	12	10″ (254)
TFU-30JDA	51-70	3⅛″ (79)	0.0°	30	Null Filled	A	1	6⅝″ (168)	10⅝″ (270)	⅞″ (22)	12	8⅝″ (219)
TFU-30JDAS	14-25	6/8/9″ Tee (152/203/229)	0.0°	30	Null Filled	C	1	10¾″ (273)	15¼″ (387)	1⅛″ (29)	16	10″ (254)
TFU-30JDAS	14-36	6/8″ Tee (152/203)	0.0°	30	Null Filled	C	1	9⅝″ (244)	15¼″ (387)	1⅛″ (29)	16	10″ (254)
TFU-30JDAS	27-50	6/8″ Tee (152/203)	0.0°	30	Null Filled	C	1	8⅝″ (219)	13¾″ (349)	1⅛″ (29)	12	10″ (254)
TFU-30JDAS	51-70	6″ Tee (152)	0.0°	30	Null Filled	C	1	6⅝″ (168)	10⅝″ (270)	⅞″ (22)	12	8⅝″ (219)
TFU-28DAS	14-25	6/8/9″ Tee (152/203/229)	All	28	Smooth	C	1	10¾″ (273)	15¼″ (387)	1⅛″ (29)	16	10″ (254)
TFU-28DAS	26-36	6/8″ Tee (152/203)	All	28	Smooth	C	1	9⅝″ (244)	15¼″ (387)	1⅛″ (29)	16	10″ (254)
TFU-28DAS	37-50	6/8″ Tee (152/203)	All	28	Smooth	C	1	8⅝″ (219)	13¾″ (349)	1⅛″ (29)	12	10″ (254)

(Parenthetical dimensions are millimeters)

World Radio History



Symbol Definitions: D = Pole outer diameter; λ = Mid-channel wavelength.
(Note: Gain and pattern vary with D/λ ratio.)

Trilobe Pattern Antennas

(Outline drawings on Page 7, this section.)

Antenna Type	Channel Range	Harness or Tee Diameter	Vertical Gain		Vertical Pattern Type	Outline Drawing	N No. of Sections	J Pole Diameter	U Bolt-Circle Diameter	V Bolt Diameter	X No. of Bolts	Y_1 Clearance Hole Diameter
			Beam Tilt	Gain								
TFU-30JDA	14-22	6⅛″ (156)	0.0°	30	Null Filled	A	1	12¾″ (324)	17¾″ (451)	1¼″ (32)	16	12″ (305)
TFU-30JDA	14-35	5″ (127)	0.0°	30	Null Filled	A	1	10¾″ (273)	15¼″ (387)	1⅛″ (29)	16	10″ (254)
TFU-30JDA	22-50	5″ (127)	0.0°	30	Null Filled	A	1	9⅝″ (244)	15¼″ (387)	1⅛″ (29)	16	10″ (254)
TFU-30JDA	30-62	4⅛″ (105)	0.0°	30	Null Filled	A	1	8⅝″ (219)	13¾″ (349)	1⅛″ (29)	12	10″ (254)
TFU-30JDAS	14-35	6/8/9″ Tee (152/203/229)	0.0°	30	Null Filled	C	1	10¾″ (273)	15¼″ (387)	1⅛″ (29)	16	10″ (254)
TFU-30JDAS	22-50	6/8″ Tee (152/203)	0.0°	30	Null Filled	C	1	9⅝″ (244)	15¼″ (387)	1⅛″ (29)	16	10″ (254)
TFU-30JDAS	30-62	6/8″ Tee (152/203)	0.0°	30	Null Filled	C	1	8⅝″ (219)	13¾″ (349)	1⅛″ (29)	12	10″ (254)
TFU-28DAS	14-35	6/8/9″ Tee (152/203/229)	All	28	Smooth	C	1	10¾″ (273)	15¼″ (387)	1⅛″ (29)	16	10″ (254)
TFU-28DAS	22-50	6/8″ Tee (152/203)	All	28	Smooth	C	1	9⅝″ (244)	15¼″ (387)	1⅛″ (29)	16	10″ (254)
TFU-28DAS	35-62	6/8″ Tee (152/203)	All	28	Smooth	C	1	8⅝″ (219)	13¾″ (349)	1⅛″ (29)	12	10″ (254)

(Parenthetical dimensions are millimeters)

World Radio History

Omnidirectional, UHF Pylon, Type TFU-6D

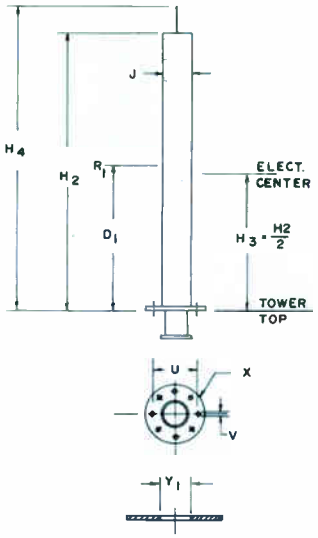
- Low gain for local, satellite or standby service
- Radome included - no de-icer power required
- Lightning rod equipped — grounded through tower
- Mounting flange attachment to tower top
- Maximum input power 10 kW

The TFU-6D is a low gain, light weight, broad-beam, omnidirectional antenna. The input power rating is 10 kW peak visual with 2 kW aural.

The basic antenna design is similar to the end-fed Pylon (see drawing opposite) except that the input is directly into the bottom of the antenna instead of through a gas stop and tee as shown in the drawing on Page 3. The antenna is protected and made pressure-tight with a tubular radome. No provision is made for beacon mount on the antenna since obstruction lighting at the tower top is sufficient for antenna length in the TFU-6D range. A rod at the top of the antenna provides lightning protection.

Shown here without the tubular radome included as standard equipment, the TFU-6D Antenna is excellently suited for local service or as a satellite station antenna.

World Radio History



Symbol	Unit	Definition
H_2	Feet or meters	Height of pole (only) above tower top
D_1	Feet or meters	Distance from tower top to center of wind-loaded area of antenna
R_1	Pounds or kilograms	Wind reaction at center of wind-loaded area

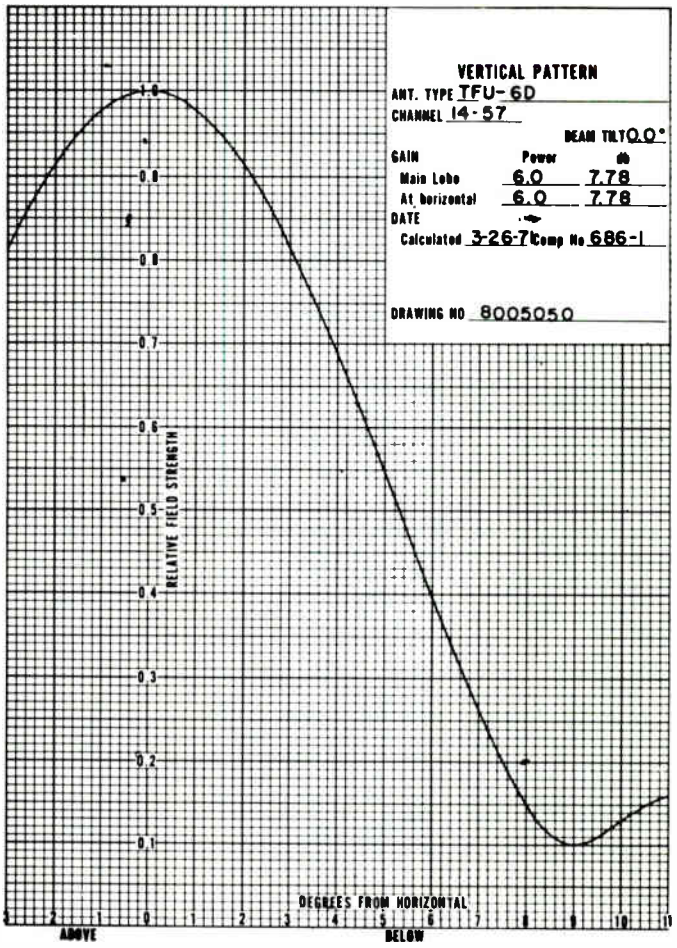
(For other definitions, see Page 7 of this section)

Mechanical Specifications
Type TFU-6D Omnidirectional Pattern

Ch. No.	H_2 Ft	H_2 M	D_1 Ft	D_1 M	R_1 Lbs	R_1 Kg	Moment Ft-Lbs	Moment M-Kg	Weight Lbs	Weight Kg
14	15.6	4.7	7.9	2.4	176	80	1390	192	101	46
15	15.4	4.7	7.8	2.4	174	78	1357	187	100	45
16	15.2	4.6	7.7	2.3	172	80	1324	184	99	45
17	15.0	4.6	7.6	2.3	170	78	1292	179	99	45
18	14.8	4.5	7.5	2.3	168	76	1260	175	98	44
19	14.7	4.5	7.5	2.3	165	75	1238	172	97	44
20	14.5	4.4	7.4	2.2	163	76	1206	167	97	44
21	14.3	4.4	7.3	2.2	161	74	1175	163	96	44
22	14.2	4.3	7.2	2.2	161	73	1159	161	95	43
23	14.0	4.3	7.1	2.2	159	71	1129	156	95	43
24	13.9	4.2	7.1	2.1	156	73	1108	153	94	43
25	13.7	4.2	7.0	2.1	154	71	1078	149	93	42
26	13.6	4.1	6.9	2.1	154	70	1063	147	93	42
27	13.4	4.1	6.8	2.1	152	68	1034	143	92	42
28	13.3	4.1	6.8	2.1	150	67	1020	141	92	42
29	13.2	4.0	6.7	2.0	150	69	1005	138	91	41
30	13.0	4.0	6.6	2.0	147	67	970	134	91	41
31	12.9	3.9	6.6	2.0	145	66	957	132	90	41
32	12.8	3.9	6.5	2.0	145	65	943	130	89	41
33	12.6	3.9	6.4	2.0	143	63	915	126	89	40
34	12.5	3.8	6.4	1.9	141	66	902	125	88	40
35	12.4	3.8	6.3	1.9	141	65	888	123	88	40
36	12.3	3.7	6.3	1.9	138	63	869	120	87	40
37	12.2	3.7	6.2	1.9	138	62	856	118	87	39
38	12.1	3.7	6.2	1.9	136	61	843	116	87	39
39	11.9	3.6	6.1	1.8	134	63	817	113	86	39
40	11.8	3.6	6.0	1.8	134	62	804	112	86	39
41	11.7	3.6	6.0	1.8	132	61	792	110	85	39
42	11.6	3.5	5.9	1.8	132	60	779	108	85	38
43	11.5	3.5	5.9	1.8	130	59	767	106	84	38
44	11.4	3.5	5.8	1.8	130	58	754	104	84	38
45	11.3	3.5	5.8	1.8	127	57	737	103	84	38
46	11.2	3.4	5.7	1.7	127	59	724	100	83	38
47	11.1	3.4	5.7	1.7	125	58	712	99	83	38
48	11.0	3.4	5.6	1.7	125	57	700	97	82	37
49	10.9	3.3	5.6	1.7	123	56	689	95	82	37
50	10.8	3.3	5.5	1.7	123	55	677	93	82	37
51	10.8	3.3	5.5	1.7	123	55	677	93	81	37
52	10.7	3.3	5.5	1.7	121	54	666	92	81	37
53	10.6	3.2	5.4	1.6	121	56	653	90	81	37
54	10.5	3.2	5.4	1.6	118	55	637	88	80	36
55	10.4	3.2	5.3	1.6	118	54	625	86	80	36
56	10.3	3.2	5.3	1.6	116	53	615	85	79	36
57	10.3	3.1	5.3	1.6	116	53	615	85	79	36

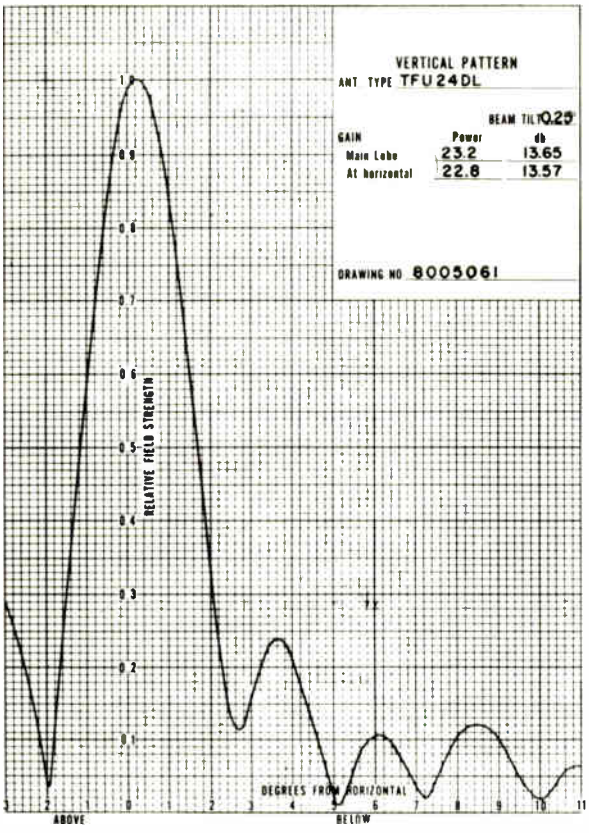
$H_1 = H_2 + 1.5'$ (4.57 mm)

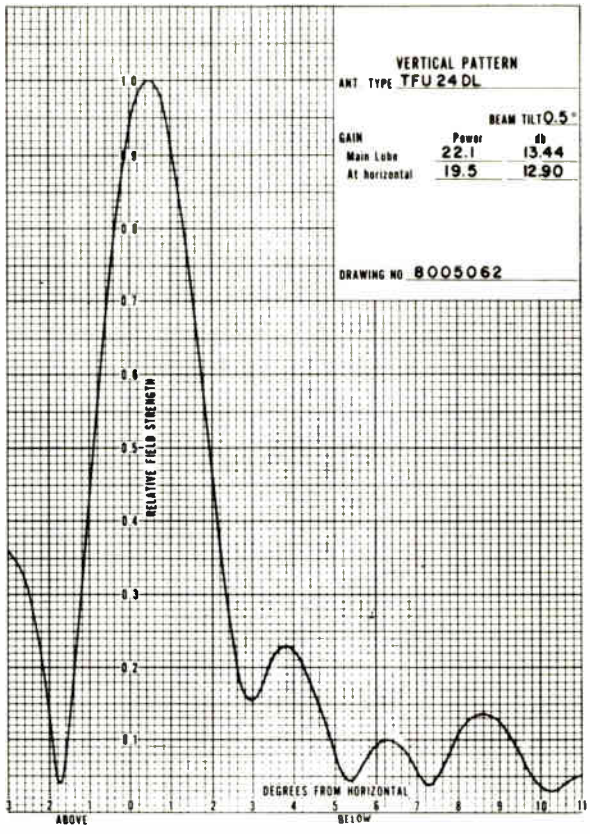
Calculated Vertical Pattern, Type TFU-6D

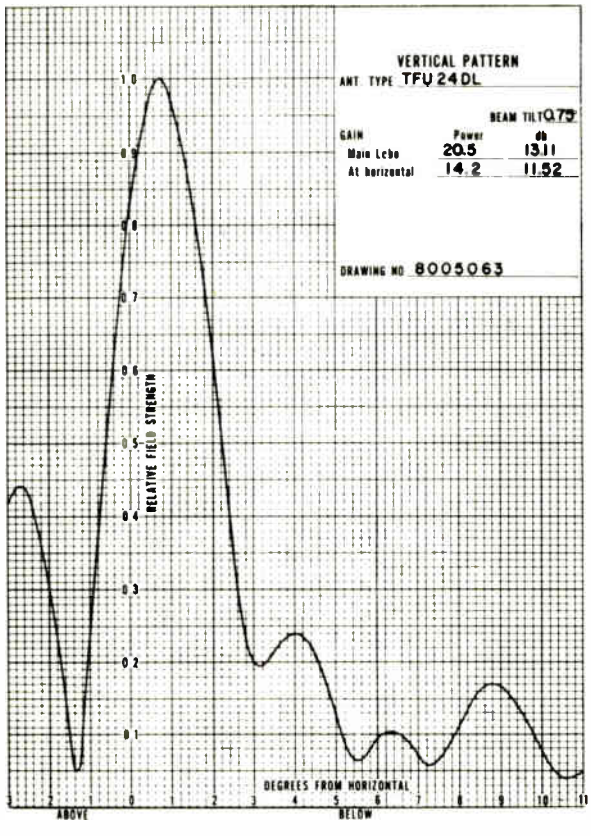


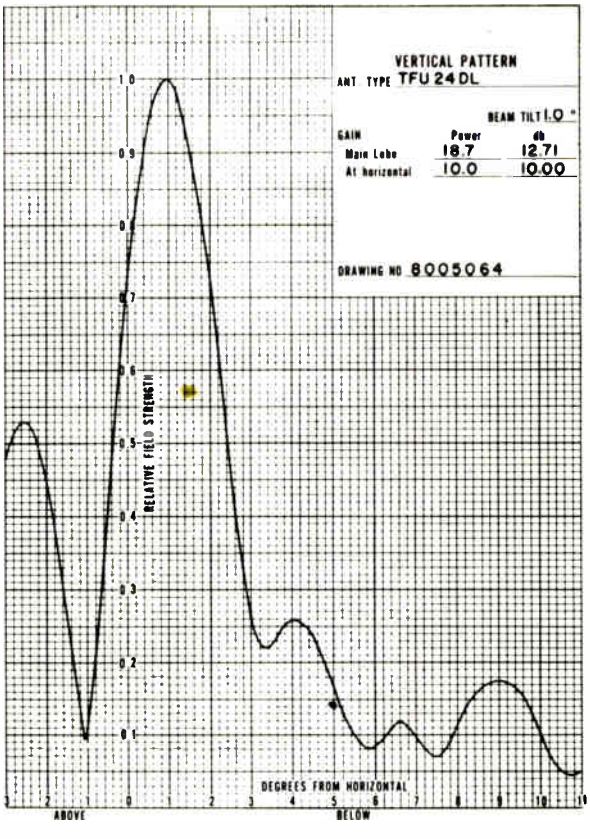
World Radio History

Calculated Vertical Patterns: Omnidirectional Pylon, TFU-24DL or TFU-24DM



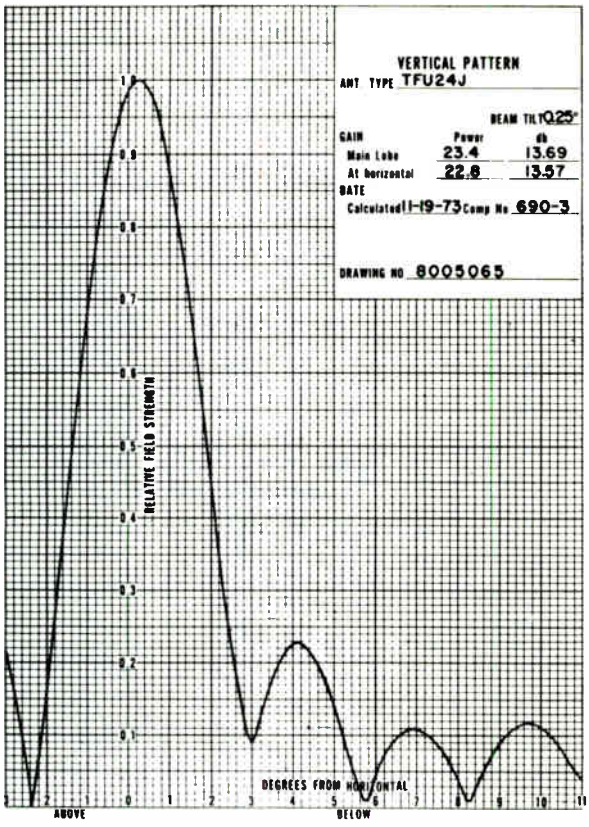


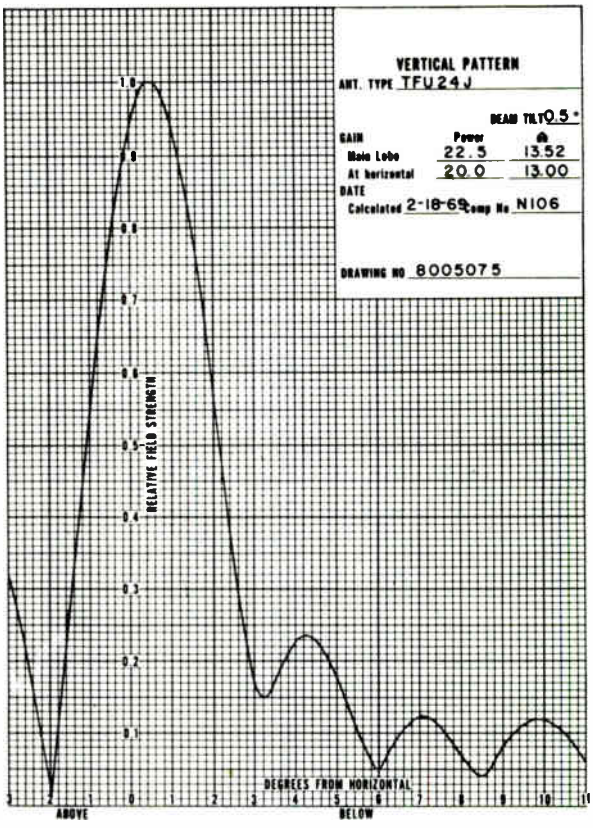


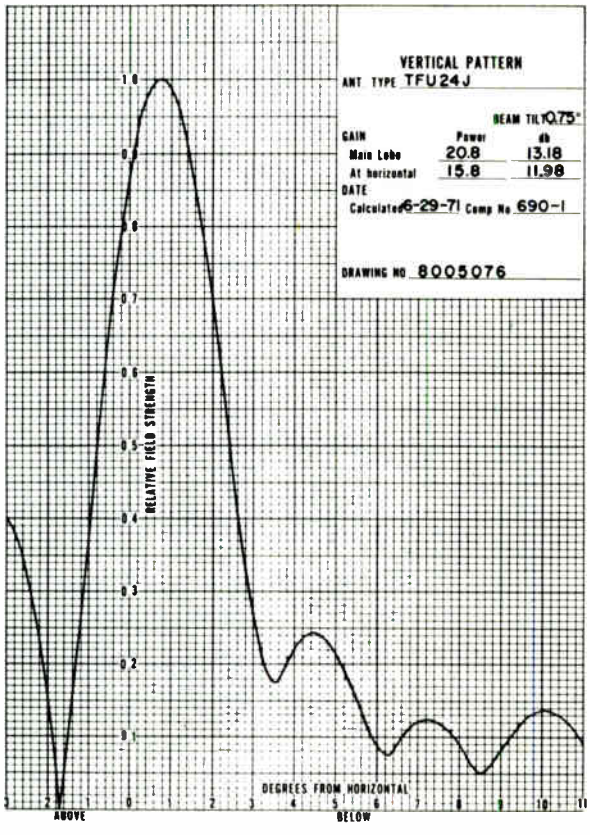


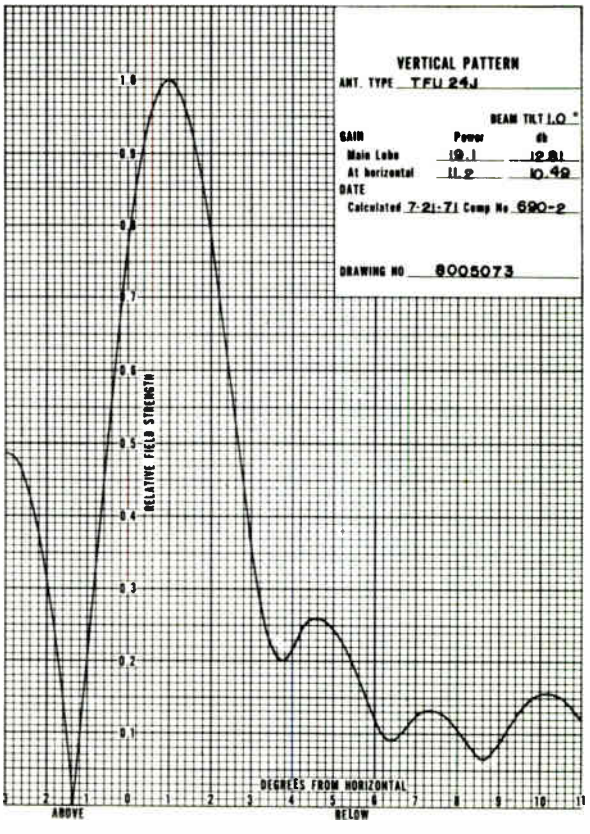
World Radio History

Calculated Vertical Patterns: Omnidirectional Pylon, Type TFU-24J



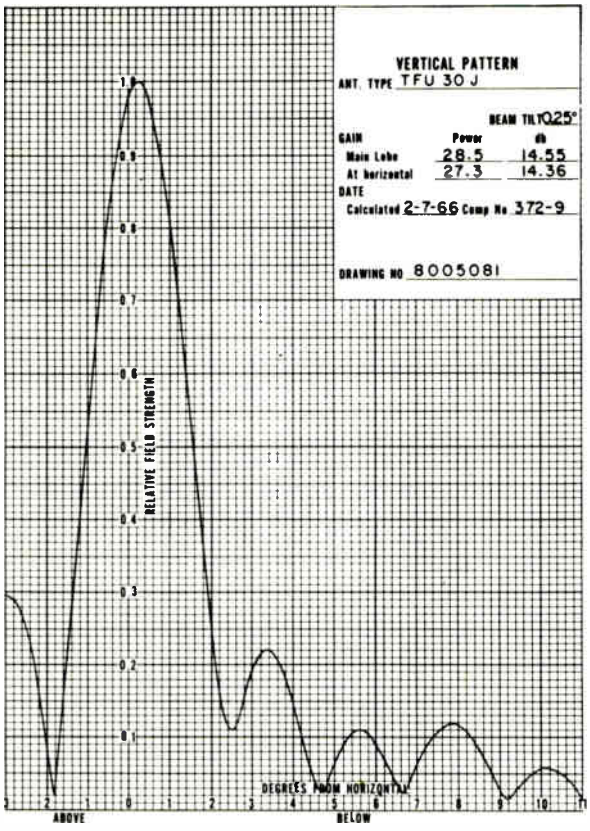


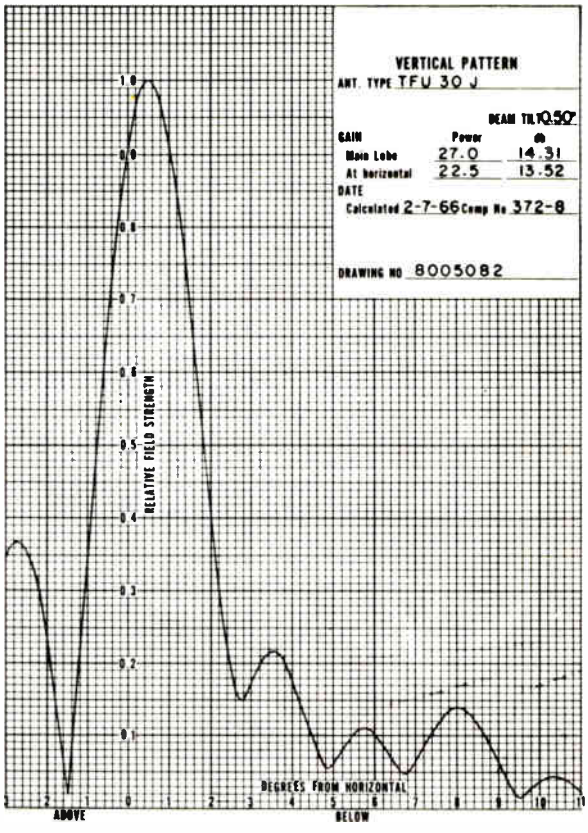


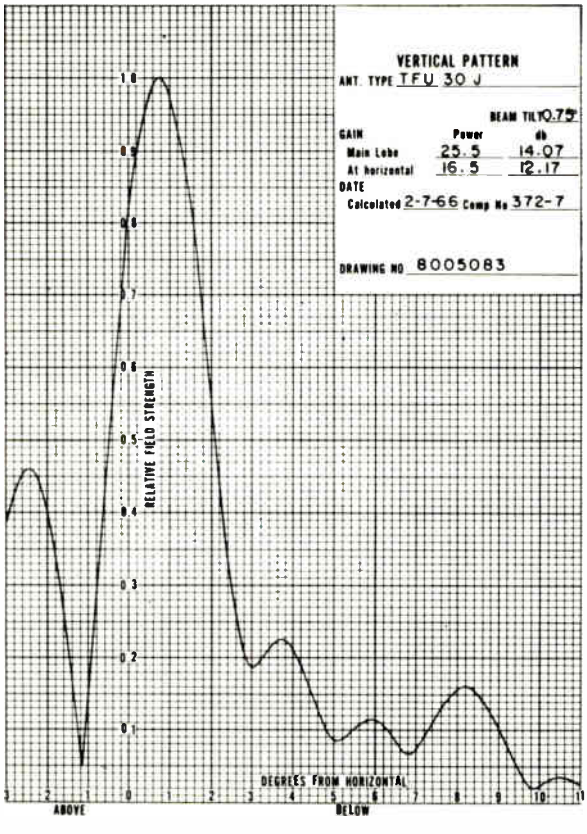


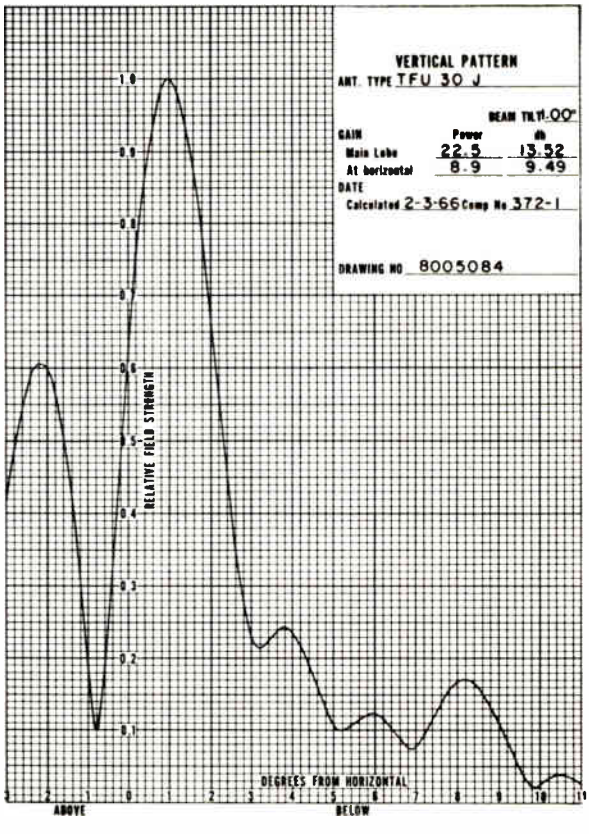
World Radio History

Calculated Vertical Patterns: Omnidirectional Pylon, Type TFU-30J Directional Pylons, Type TFU-30JDA - 30JDAS (Type 30JDA Skull on Page 22)



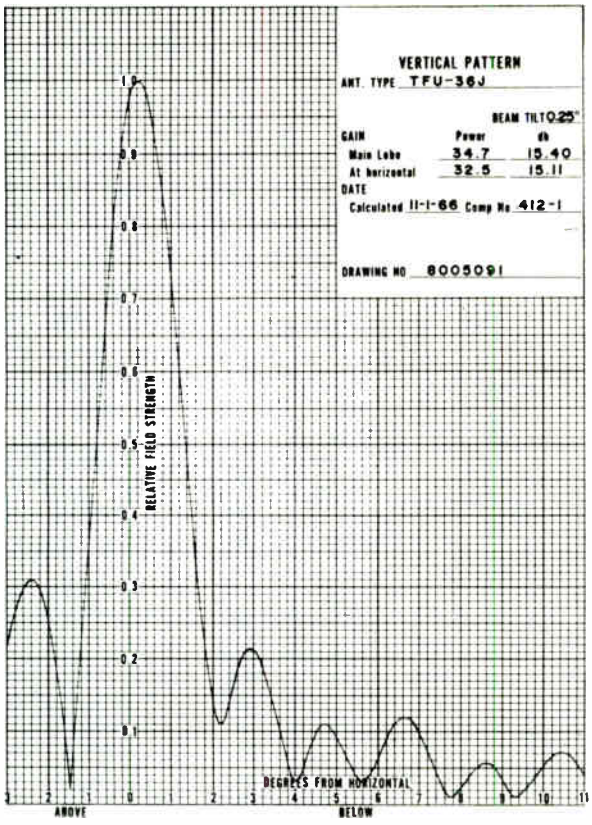


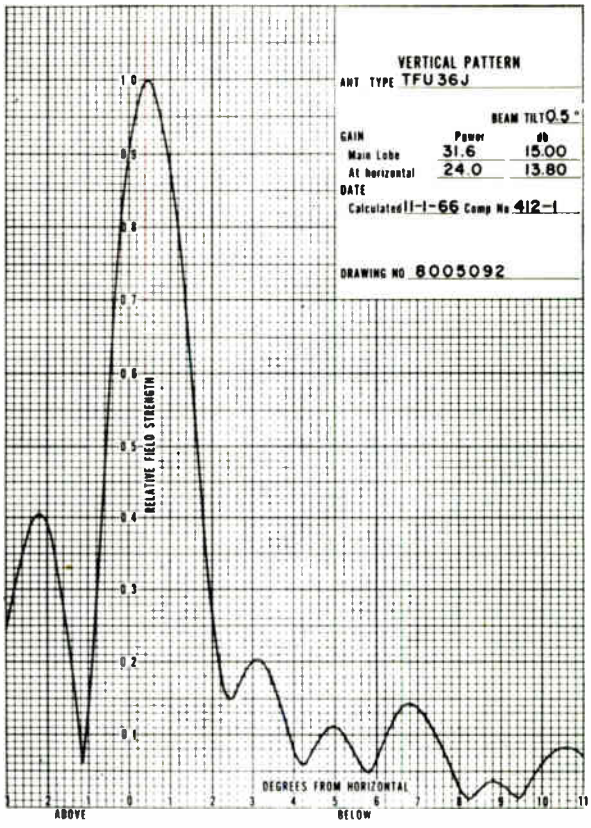


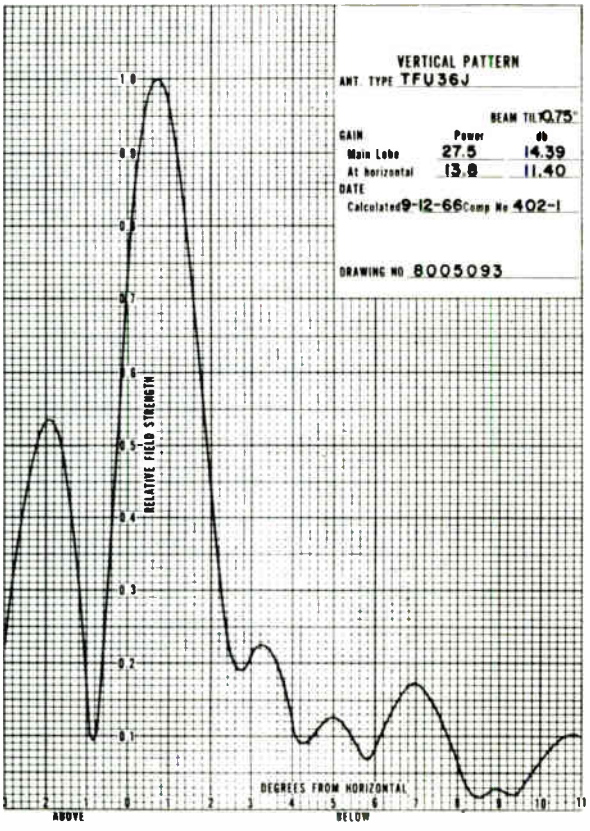


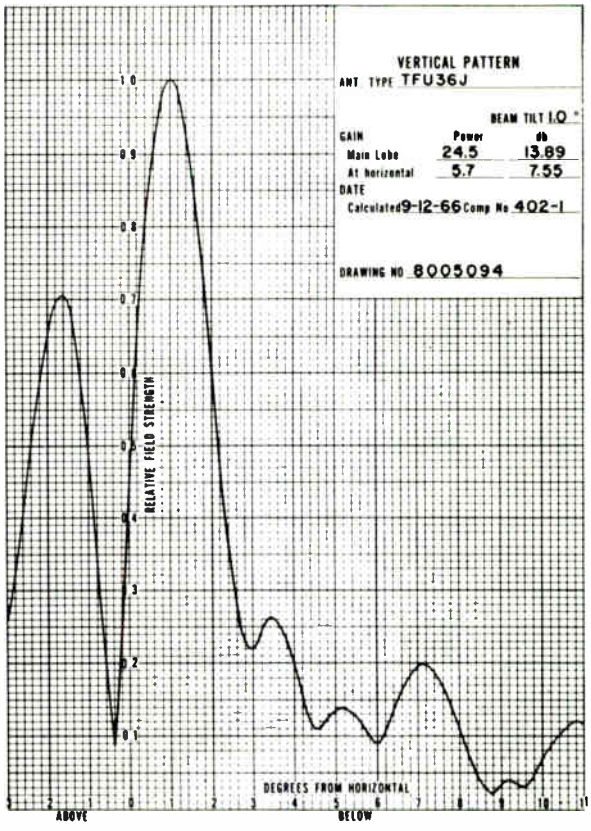
World Radio History

Calculated Vertical Patterns:
Omnidirectional Pylon, Type TFU-36J, Directional Pylon, Type TFU-36JDA, 36JDAS



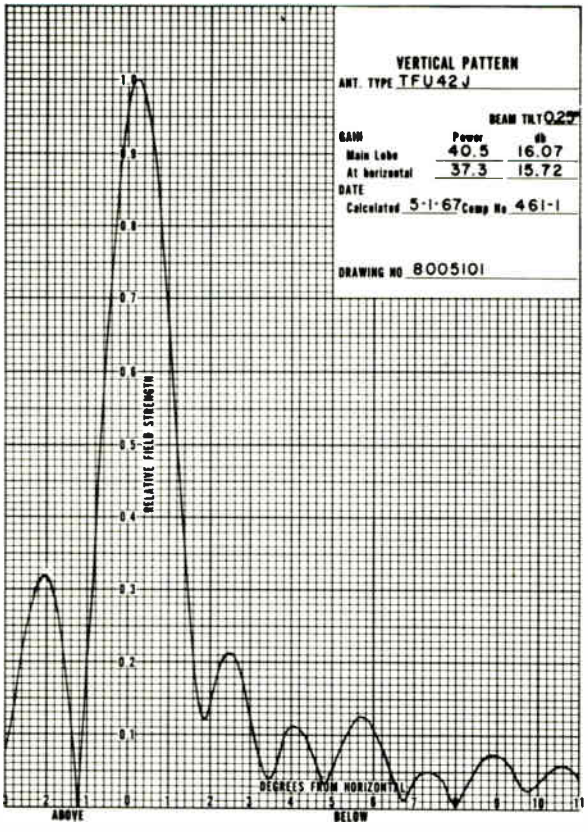


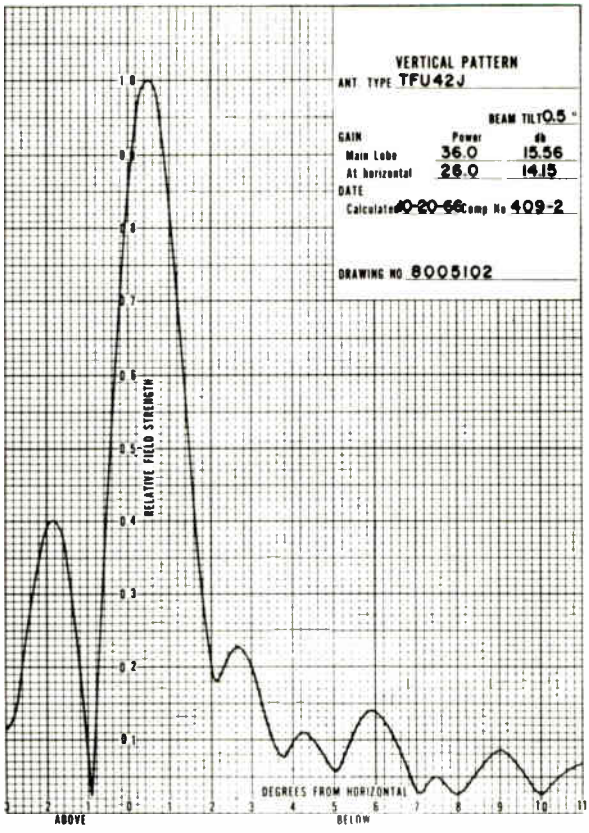


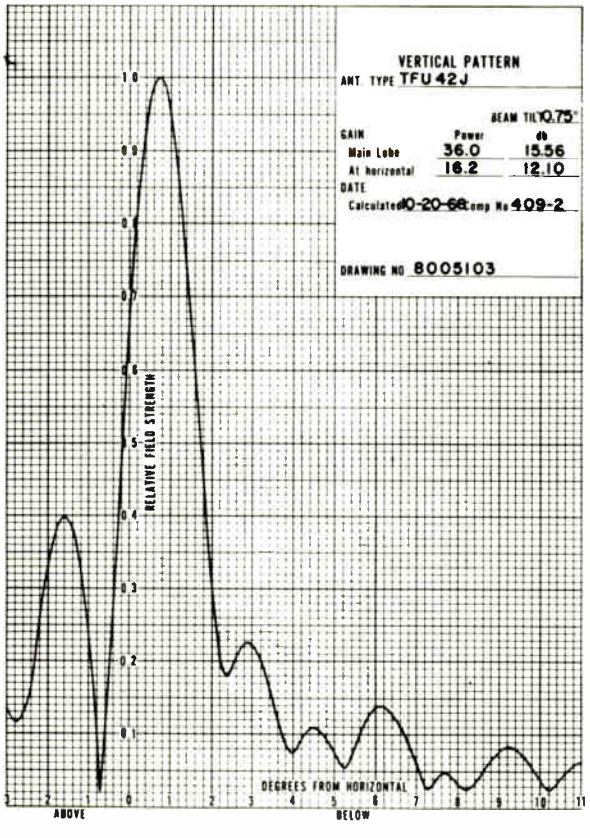


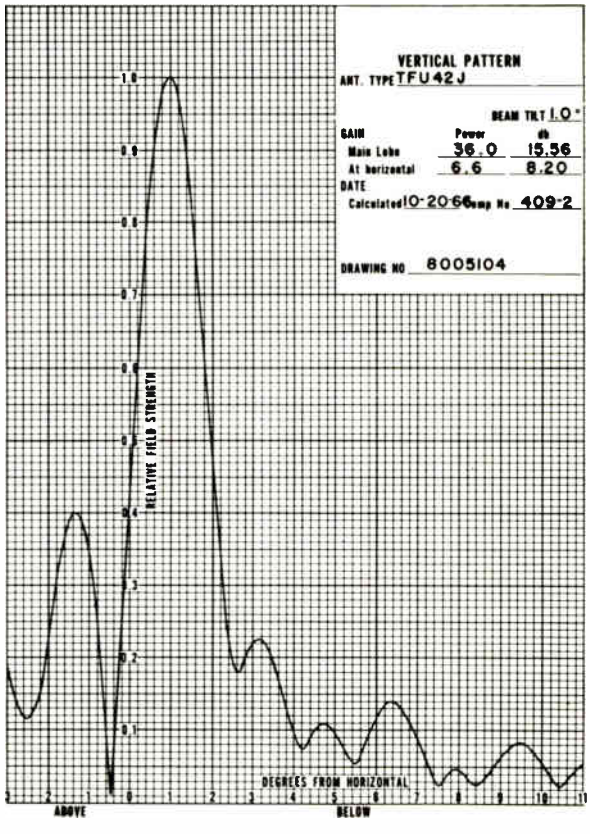
World Radio History

Calculated Vertical Patterns: Omnidirectional Pylon, Type TFU-42J



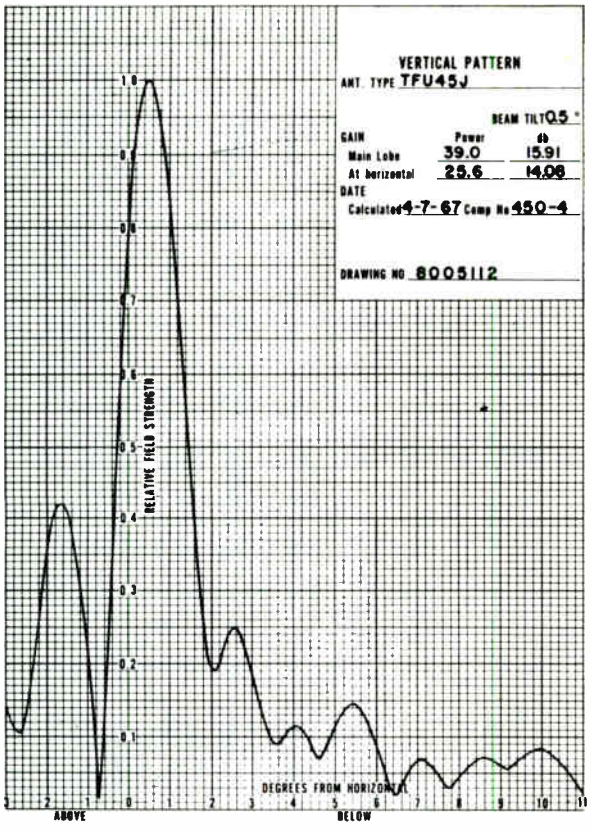


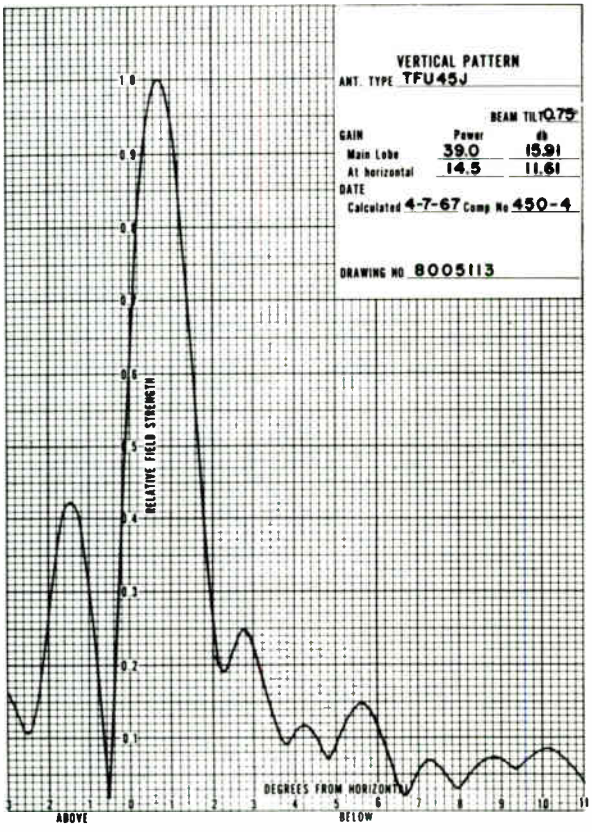




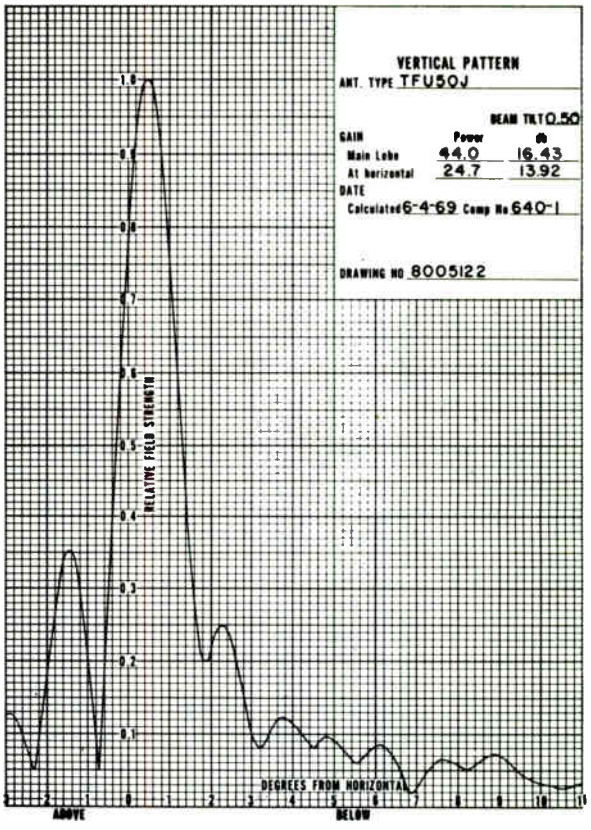
World Radio History

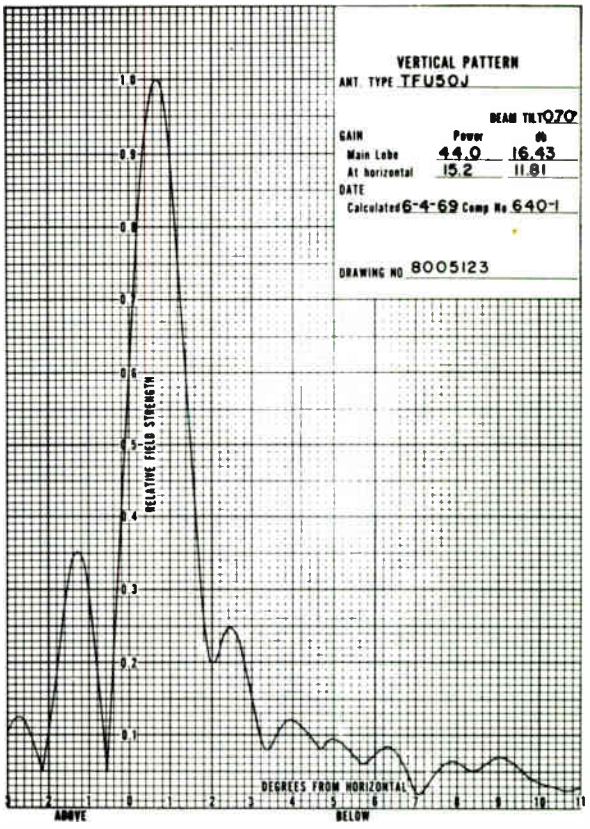
Calculated Vertical Patterns: Omnidirectional Pylon, Type TFU-45J





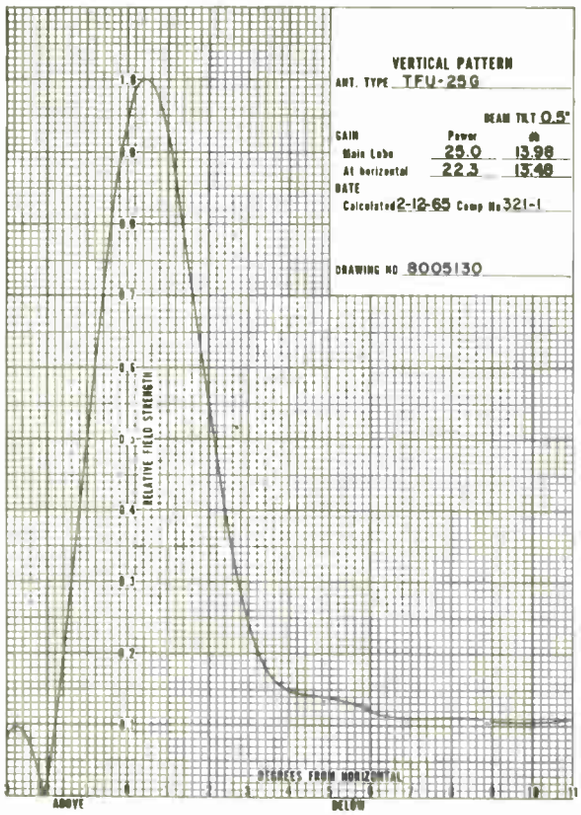
Omnidirectional Pylon, Type TFU-50J

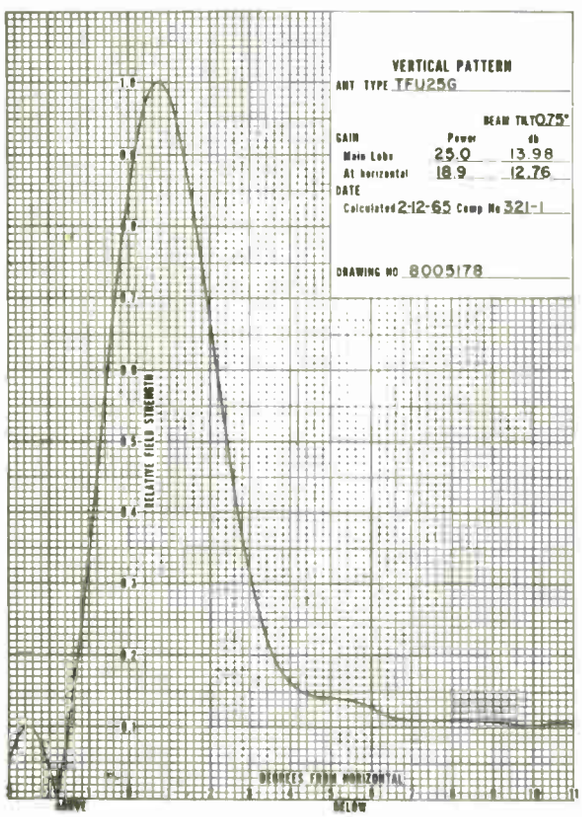




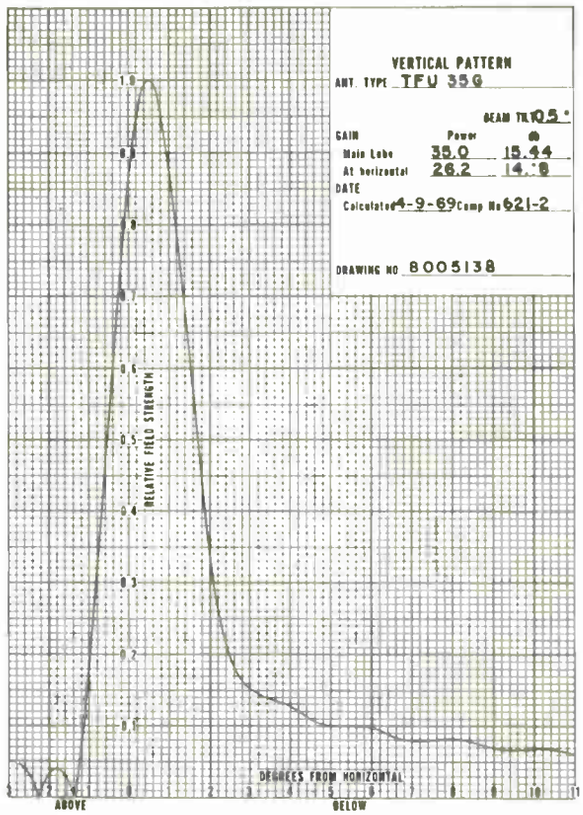
World Radio History

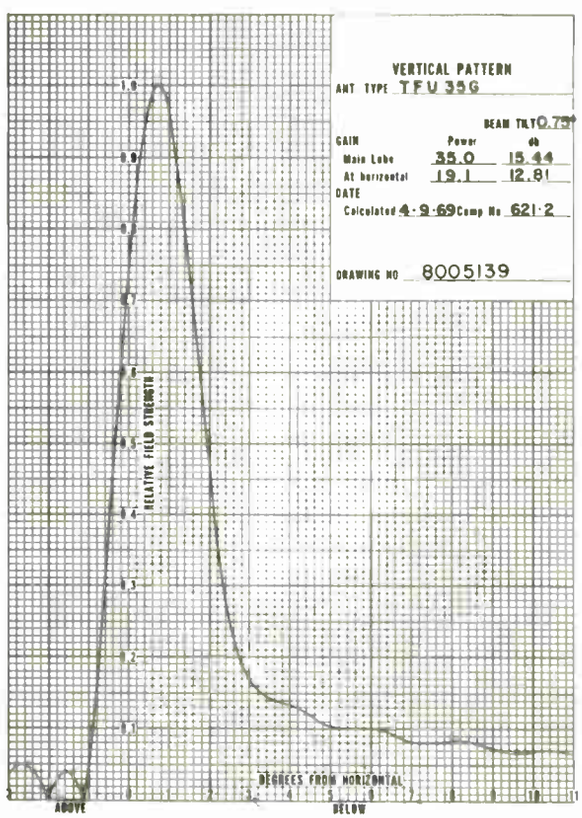
Calculated Vertical Patterns:
Omnidirectional Pylon, Types TFU-25G/25GA





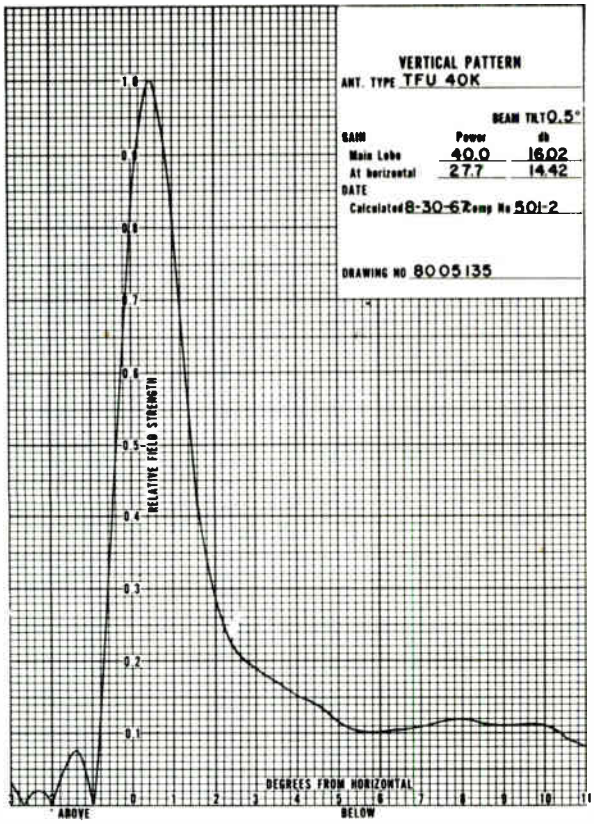
Omnidirectional Pylon, Type TFU-35G

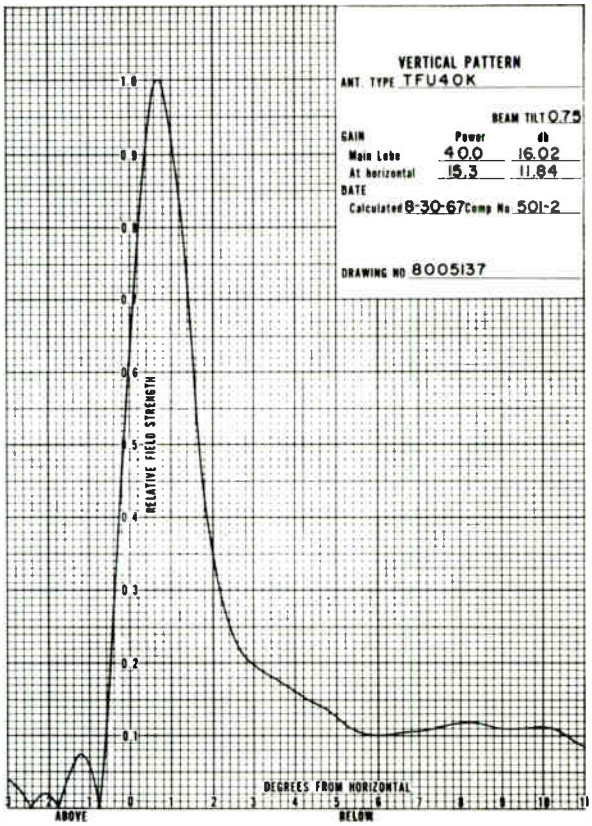




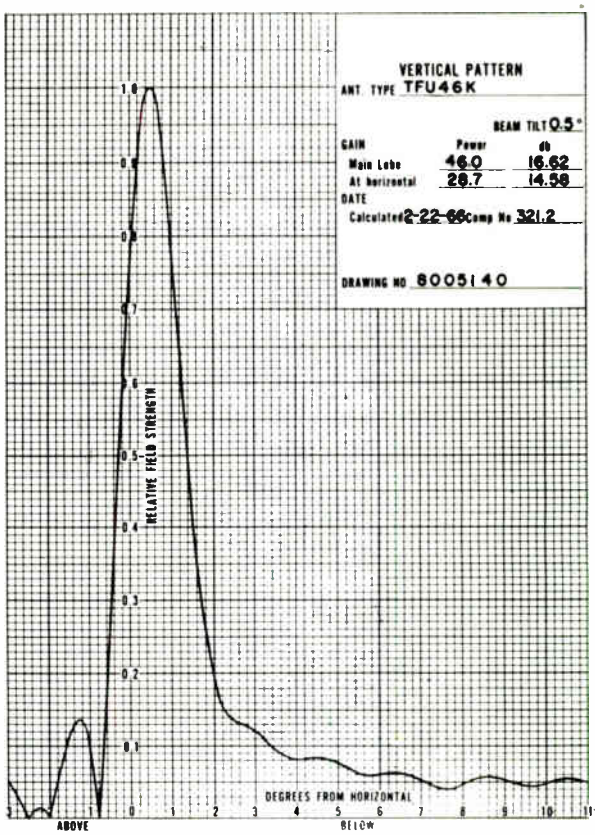
World Radio History

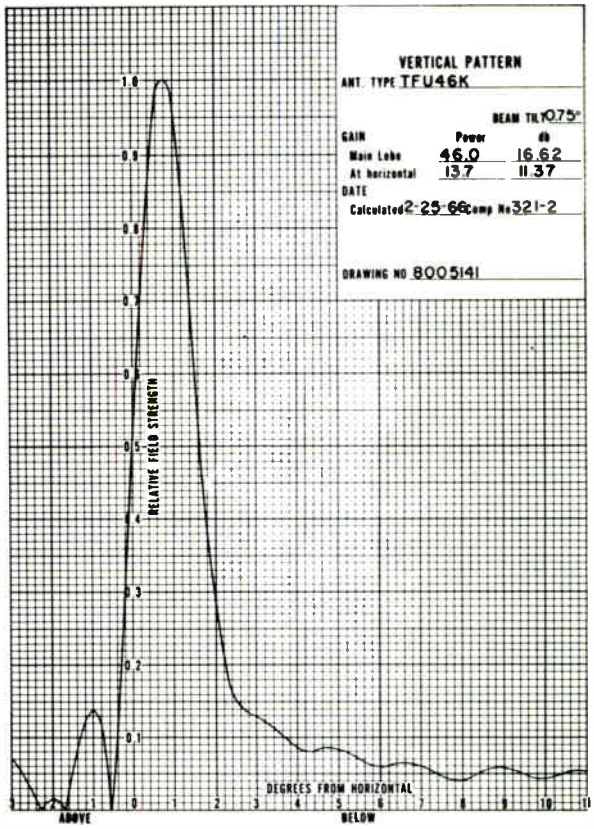
Calculated Vertical Patterns: Omnidirectional Pylon, Type TFU-40K





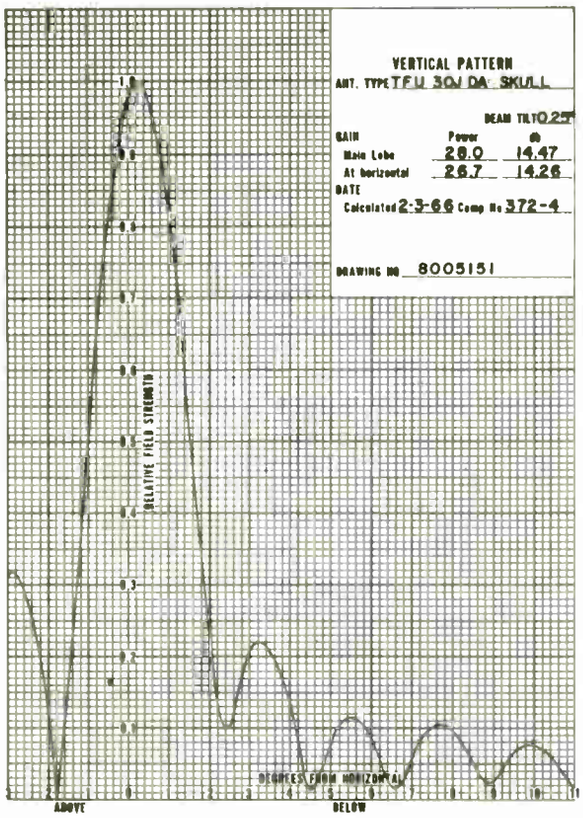
Omnidirectional Pylon, Type TFU-46K

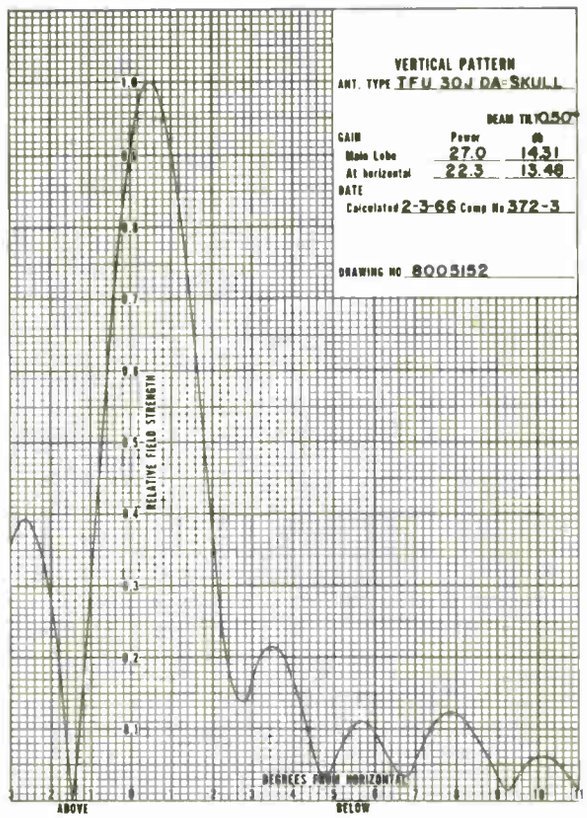


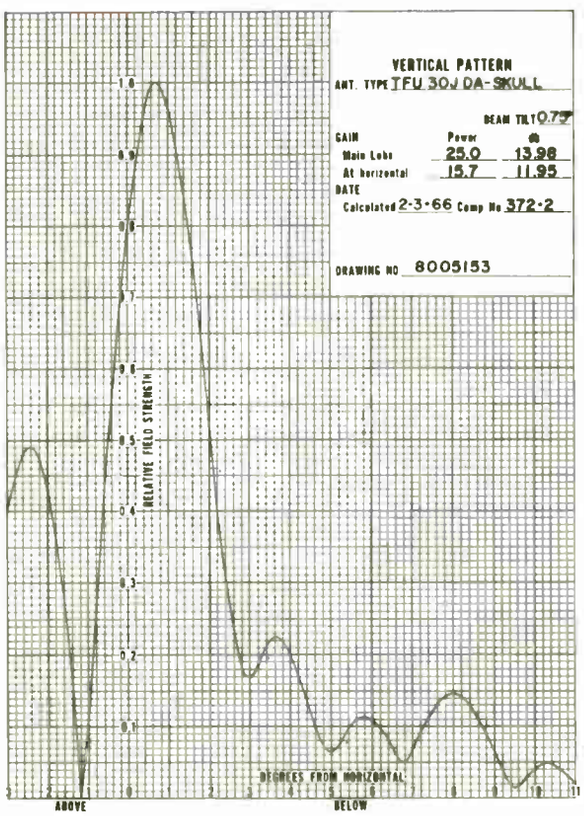


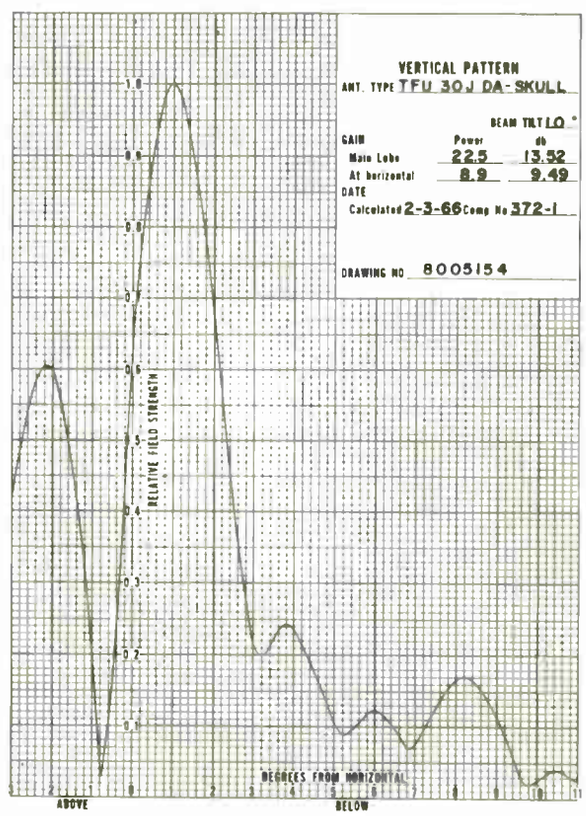
World Radio History

Calculated Vertical Patterns: Skull Pattern Directional Pylon, Type TFU-30JDA



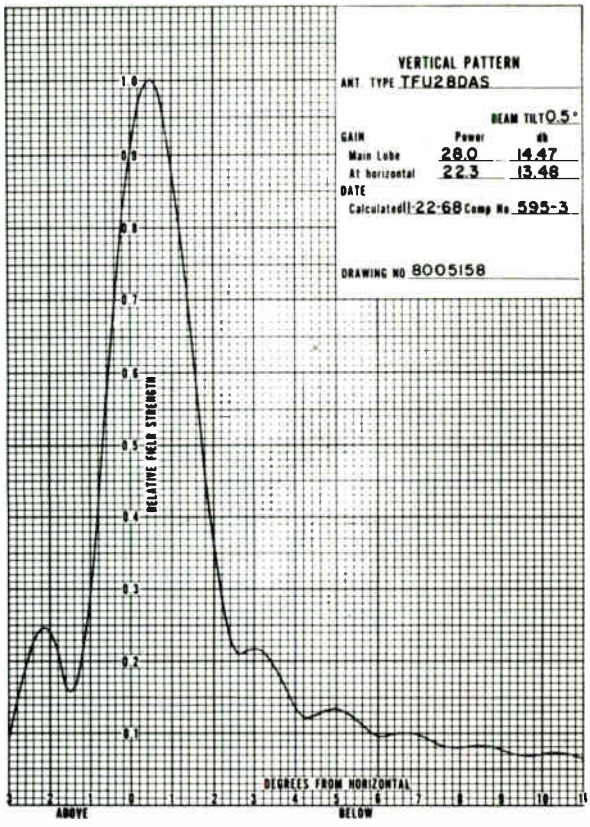


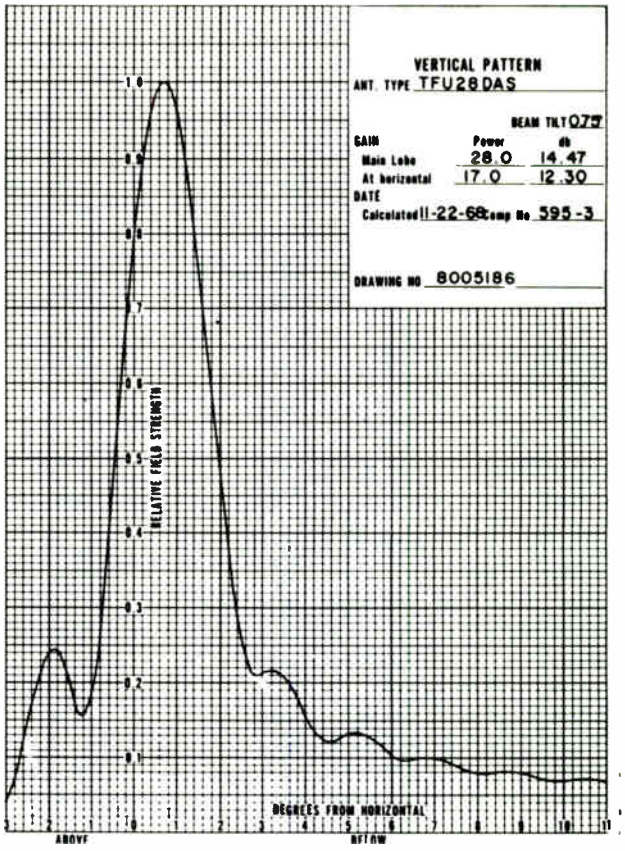




World Radio History

Calculated Vertical Patterns: Directional Pylon, Type TFU-28DAS





Mechanical Symbol Definitions

(See outline drawings on Page 7, this section.)

SYMBOL	UNIT	DEFINITION
D_1	feet or meters	Distance from tower top to center of wind-loaded area of antenna.
H_2	feet or meters	Height of pole (only) above tower top.
H_3	feet or meters	Height of electrical center above tower top. ($H_3 = 0.5H_2$)
H_4	feet or meters	Height of antenna above tower top including lightning protector.
J	inches or millimeters	Pole diameter excluding slot covers.
M	foot-pounds or meter-kilograms	Overturn moment.
N		Number of sections in which pole is shipped.
R_1	pounds or kilograms	Wind reaction at center of wind-loaded area.
U	inches or millimeters	Diameter of bolt circle of base flange.
V	inches or millimeters	Bolt diameter used in base flange.
W	tons or metric tons	Weight of complete antenna including inner conductor.
X		Number of equally spaced bolts used in base flange.
Y_1	inches or millimeters	Clearance hole diameter required in tower top.

World Radio History

Mechanical Specifications

Here and on pages following are tabulations of the various mechanical parameters for the several Pylon antenna types listed in this catalog section. For definition of the symbols at the head of each column refer to the chart on Page 23 and the outline drawings on Page 7 of this catalog section.

Mechanical Specifications
Type TFU-24DL Omnidirectional Pylon

Ch. No.	H_2 Ft	H_2 M	D_1 Ft	D_1 M	R_1 Lbs	R_1 Kg	Moment Ft-Lbs	Moment M-Kg	Weight Ton	Weight MT
14	52.9	16.1	28.3	8.6	1931	879	54647	7559	1.6	1.5
15	52.3	15.9	28.0	8.5	1910	870	53480	7395	1.6	1.5
16	51.7	15.8	27.7	8.5	1890	851	52353	7234	1.6	1.5
17	51.1	15.6	27.4	8.4	1869	843	51211	7081	1.6	1.4
18	50.5	15.4	27.1	8.3	1849	835	50108	6930	1.6	1.4
19	49.9	15.2	26.8	8.2	1829	826	49017	6773	1.5	1.4
20	49.3	15.0	26.5	8.1	1808	818	47912	6626	1.5	1.4
21	48.8	14.9	26.3	8.0	1788	813	47024	6504	1.5	1.4
22	48.3	14.7	26.0	7.9	1774	807	46124	6375	1.5	1.4
23	47.7	14.5	25.7	7.8	1754	799	45078	6232	1.5	1.3
24	47.2	14.4	25.5	7.8	1733	783	44192	6107	1.5	1.3
25	46.7	14.2	25.2	7.7	1720	778	43344	5991	1.5	1.3
26	46.2	14.1	25.0	7.6	1699	773	42475	5875	1.4	1.3
27	45.7	13.9	24.7	7.5	1686	768	41644	5760	1.4	1.3
28	45.3	13.8	24.5	7.5	1672	755	40964	5663	1.4	1.3
29	44.8	13.7	24.3	7.4	1652	750	40144	5550	1.4	1.3
30	44.3	13.5	24.0	7.3	1638	745	39312	5438	1.4	1.3

$H_1 = H_2 + 4'$ (1.2 m)

Mechanical Specifications
Type TFU-24DM Omnidirectional Pylon

Ch. No.	H_2 Ft	H_2 M	D_1 Ft	D_1 M	R_1 Lbs	R_1 Kg	Moment Ft-Lbs	Moment M-Kg	Weight Ton	Weight MT
31	43.6	13.3	24.0	7.3	1357	617	32568	4504	1.8	1.6
32	43.1	13.1	23.8	7.2	1340	613	31892	4414	1.8	1.6
33	42.7	13.0	23.6	7.2	1329	602	31364	4334	1.8	1.6
34	42.3	12.9	23.4	7.1	1317	600	30818	4260	1.8	1.6
35	41.9	12.8	23.2	7.1	1306	590	30299	4189	1.7	1.6
36	41.5	12.6	23.0	7.0	1295	588	29785	4116	1.7	1.6
37	41.1	12.5	22.8	6.9	1284	586	29275	4043	1.7	1.6
38	40.7	12.4	22.6	6.9	1272	576	28747	3974	1.7	1.5
39	40.3	12.3	22.4	6.8	1261	574	28246	3903	1.7	1.5
40	40.0	12.2	22.2	6.8	1255	567	27861	3856	1.7	1.5
41	39.6	12.1	22.0	6.7	1244	565	27368	3785	1.7	1.5
42	39.3	12.0	21.9	6.7	1233	557	27003	3732	1.6	1.5
43	38.9	11.9	21.7	6.6	1222	555	26517	3663	1.6	1.5
44	38.6	11.8	21.5	6.6	1216	548	26144	3617	1.6	1.5
45	38.2	11.7	21.3	6.5	1205	546	25666	3549	1.6	1.4
46	37.9	11.6	21.2	6.5	1193	538	25292	3497	1.6	1.4
47	37.6	11.5	21.0	6.4	1188	539	24948	3450	1.6	1.4
48	37.3	11.4	20.9	6.4	1176	531	24578	3398	1.6	1.4
49	36.9	11.3	20.7	6.3	1165	529	24115	3333	1.5	1.4
50	36.6	11.2	20.5	6.3	1160	522	23780	3289	1.5	1.4

$H_1 = H_2 + 4'$ (1.2 m)

Mechanical Specifications
Type TFU-24J Omnidirectional Pylon

Ch. No.	H_2 Ft	H_2 M	D_1 Ft	D_1 M	R_1 Lbs	R_1 Kg	Moment Ft-Lbs	Moment M-Kg	Weight Ton	Weight MT
14	46.4	14.1	25.1	7.6	1706	779	42821	5920	1.5	1.4
15	45.8	14.0	24.8	7.6	1686	761	41813	5784	1.5	1.4
16	45.3	13.8	24.5	7.5	1672	755	40964	5663	1.5	1.4
17	44.7	13.6	24.2	7.4	1652	747	39978	5528	1.5	1.3
18	44.2	13.5	24.0	7.3	1631	741	39144	5409	1.5	1.3
19	43.7	13.3	23.7	7.2	1618	736	38347	5299	1.5	1.3
20	43.2	13.2	23.5	7.2	1597	721	37530	5191	1.4	1.3
21	42.7	13.0	23.2	7.1	1584	715	36749	5076	1.4	1.3
22	42.3	12.9	23.0	7.0	1570	713	36110	4991	1.4	1.3
23	41.8	12.7	22.8	6.9	1549	708	35317	4885	1.4	1.3
24	41.3	12.6	22.5	6.9	1536	693	34560	4782	1.4	1.3
25	40.9	12.5	22.3	6.8	1522	690	33941	4692	1.4	1.2
26	40.5	12.3	22.1	6.7	1508	688	33327	4610	1.4	1.2
27	40.0	12.2	21.9	6.7	1488	673	32587	4509	1.3	1.2
28	39.6	12.1	21.7	6.6	1475	670	32007	4422	1.3	1.2
29	39.2	12.0	21.5	6.5	1461	668	31412	4342	1.3	1.2
30	38.8	11.8	21.3	6.5	1447	656	30821	4264	1.3	1.2
31	38.4	11.7	21.1	6.4	1434	654	30257	4186	1.3	1.2
32	38.1	11.6	20.9	6.4	1427	644	29824	4122	1.3	1.2
33	37.7	11.5	20.7	6.3	1413	642	29249	4045	1.3	1.2
34	37.3	11.4	20.5	6.3	1400	630	28700	3969	1.3	1.1
35	37.0	11.3	20.4	6.2	1386	630	28274	3906	1.3	1.1
36	36.6	11.2	20.2	6.1	1372	628	27714	3831	1.2	1.1
37	36.3	11.1	20.0	6.1	1365	619	27300	3776	1.2	1.1
38	35.9	11.0	19.8	6.0	1352	617	26770	3702	1.2	1.1
39	35.6	10.9	19.7	6.0	1338	608	26359	3648	1.2	1.1
40	35.3	10.8	19.5	5.9	1331	608	25955	3587	1.2	1.1
41	35.0	10.7	19.4	5.9	1318	599	25569	3534	1.2	1.1
42	34.7	10.6	19.2	5.9	1311	590	25171	3481	1.2	1.1
43	34.4	10.5	19.1	5.8	1297	591	24773	3428	1.2	1.1
44	34.1	10.4	18.9	5.8	1290	581	24381	3370	1.2	1.1
45	33.8	10.3	18.8	5.7	1277	582	24008	3317	1.2	1.0
46	33.5	10.2	18.6	5.7	1270	573	23622	3266	1.1	1.0
47	33.2	10.1	18.5	5.6	1256	574	23236	3214	1.1	1.0
48	32.9	10.0	18.3	5.6	1250	565	22875	3164	1.1	1.0
49	32.6	9.9	18.2	5.5	1236	566	22495	3113	1.1	1.0
50	32.4	9.9	18.1	5.5	1229	559	22245	3075	1.1	1.0
51	32.1	9.8	17.9	5.5	1222	550	21874	3025	1.1	1.0
52	31.8	9.7	17.8	5.4	1209	551	21520	2975	1.1	1.0
53	31.6	9.6	17.7	5.4	1202	545	21275	2943	1.1	1.0
54	31.3	9.5	17.5	5.3	1195	546	20913	2894	1.1	1.0
55	31.1	9.5	17.4	5.3	1188	539	20671	2857	1.1	1.0
56	30.8	9.4	17.3	5.3	1175	530	20327	2809	1.1	1.0
57	30.6	9.3	17.2	5.2	1168	534	20090	2777	1.1	1.0
58	30.4	9.3	17.1	5.2	1161	528	19853	2746	1.1	1.0
59	30.1	9.2	16.9	5.2	1154	519	19503	2699	1.0	1.0
60	29.9	9.1	16.8	5.1	1147	523	19270	2667	1.0	0.9
61	29.7	9.0	16.7	5.1	1140	516	19038	2632	1.0	0.9
62	29.5	9.0	16.6	5.1	1133	510	18808	2601	1.0	0.9
63	29.2	8.9	16.5	5.0	1120	511	18480	2555	1.0	0.9
64	29.0	8.8	16.4	5.0	1113	505	18253	2525	1.0	0.9
65	28.8	8.8	16.3	5.0	1106	499	18028	2495	1.0	0.9
66	28.6	8.7	16.2	4.9	1100	503	17820	2465	1.0	0.9
67	28.4	8.7	16.1	4.9	1093	496	17597	2430	1.0	0.9
68	28.2	8.6	16.0	4.9	1086	490	17376	2401	1.0	0.9
69	28.0	8.5	15.9	4.8	1079	494	17156	2371	1.0	0.9
70	27.8	8.5	15.8	4.8	1072	488	16938	2342	1.0	0.9

$H_1 = H_2 + 4'$ (1.2 m)

World Radio History

Mechanical Specifications

Omnidirectional Patterns, Types TFU-30J, -36J

(For 0.0° to 0.75° beam tilt; data for other values of beam tilt available on request.)

Mechanical Specifications
Type TFU-30J Omnidirectional Pylon

Ch. No.	H_2 Ft	H_2 M	D_1 Ft	D_1 M	R_1 Lbs	R_1 Kg	Moment Ft-Lbs	Moment M-Kg	Weight Ton	Weight MT
14	56.3	17.2	29.8	9.1	2355	1066	70179	9701	3.4	3.1
15	55.6	16.9	29.4	9.0	2332	1053	68561	9477	3.4	3.1
16	54.9	16.7	29.1	8.9	2300	1040	66930	9256	3.3	3.0
17	54.3	16.5	28.8	8.8	2276	1030	65549	9064	3.3	3.0
18	53.6	16.3	28.4	8.7	2253	1017	63985	8848	3.3	3.0
19	53.0	16.1	28.1	8.6	2229	1007	62635	8660	3.2	2.9
20	52.4	16.0	27.8	8.5	2205	997	61299	8475	3.2	2.9
21	51.8	15.8	27.5	8.4	2181	987	59978	8291	3.2	2.9
22	51.2	15.6	27.2	8.3	2158	978	58698	8117	3.1	2.8
23	50.6	15.4	26.9	8.2	2134	968	57405	7938	3.1	2.8
24	50.1	15.3	26.7	8.1	2110	962	56337	7792	3.1	2.8
25	49.5	15.1	26.4	8.0	2087	952	55097	7616	3.0	2.8
26	49.0	14.9	26.1	8.0	2071	934	54053	7472	3.0	2.7
27	48.5	14.8	25.9	7.9	2047	928	53017	7331	3.0	2.7
28	48.0	14.6	25.6	7.8	2031	922	51994	7192	3.0	2.7
29	47.5	14.5	25.4	7.7	2007	915	50978	7045	2.9	2.7
30	47.0	14.3	25.1	7.7	1991	897	49974	6907	2.9	2.6
31	46.5	14.2	24.9	7.6	1968	891	49003	6772	2.9	2.6
32	46.0	14.0	24.6	7.5	1952	885	48019	6638	2.8	2.6
33	45.6	13.9	24.4	7.4	1936	883	47238	6534	2.8	2.6
34	45.1	13.8	24.2	7.4	1913	865	46295	6401	2.8	2.5
35	44.7	13.6	24.0	7.3	1896	862	45504	6293	2.8	2.5
36	44.2	13.5	23.7	7.2	1881	856	44580	6163	2.7	2.5
37	43.8	13.4	23.5	7.2	1865	842	43828	6062	2.7	2.5
38	43.4	13.2	23.3	7.1	1849	839	43082	5957	2.7	2.4
39	43.0	13.1	23.1	7.1	1833	825	42342	5857	2.7	2.4
40	42.6	13.0	22.9	7.0	1817	822	41609	5754	2.6	2.4
41	42.2	12.9	22.7	6.9	1802	819	40905	5651	2.6	2.4
42	41.8	12.7	22.5	6.9	1786	805	40185	5554	2.6	2.4
43	41.5	12.6	22.4	6.8	1770	806	39648	5481	2.6	2.3
44	41.1	12.5	22.2	6.8	1754	792	38939	5386	2.6	2.3
45	40.7	12.4	22.0	6.7	1738	789	38236	5286	2.5	2.3
46	40.4	12.3	21.8	6.7	1730	778	37714	5213	2.5	2.3
47	40.0	12.2	21.6	6.6	1715	776	37044	5122	2.5	2.3
48	39.7	12.1	21.5	6.5	1698	777	36507	5051	2.5	2.3
49	39.3	12.0	21.3	6.5	1683	762	35848	4953	2.5	2.2
50	39.0	11.9	21.1	6.4	1675	763	35342	4883	2.4	2.2
51	39.0	11.9	21.4	6.5	1454	662	31116	4303	1.3	1.2
52	38.7	11.8	21.2	6.5	1447	653	30676	4245	1.3	1.2
53	38.4	11.7	21.1	6.4	1433	653	30236	4179	1.3	1.2
54	38.1	11.6	20.9	6.4	1427	644	29824	4122	1.3	1.2
55	37.8	11.5	20.8	6.3	1413	645	29390	4063	1.3	1.2
56	37.5	11.4	20.6	6.3	1406	636	28964	4007	1.3	1.2
57	37.2	11.3	20.5	6.2	1392	637	28536	3949	1.3	1.2
58	36.9	11.2	20.3	6.2	1386	627	28136	3887	1.3	1.2
59	36.6	11.1	20.2	6.1	1372	628	27714	3831	1.3	1.2
60	36.3	11.1	20.0	6.1	1365	619	27300	3776	1.3	1.1
61	36.0	11.0	19.9	6.1	1352	610	26905	3721	1.3	1.1
62	35.8	10.9	19.8	6.0	1345	614	26631	3684	1.2	1.1
63	35.5	10.8	19.6	6.0	1338	604	26225	3624	1.2	1.1
64	35.2	10.7	19.5	5.9	1325	605	25838	3569	1.2	1.1
65	35.0	10.7	19.4	5.9	1318	599	25569	3534	1.2	1.1
66	34.7	10.6	19.2	5.9	1311	590	25171	3481	1.2	1.1
67	34.5	10.5	19.1	5.8	1304	594	24906	3445	1.2	1.1
68	34.2	10.4	19.0	5.8	1291	584	24529	3387	1.2	1.1
69	34.0	10.4	18.9	5.7	1283	588	24249	3352	1.2	1.1
70	33.7	10.3	18.7	5.7	1277	579	23880	3300	1.2	1.1

$H_1 = H_2 + 4'$ (1.2 m)

Mechanical Specifications
Type TFU-36J Omnidirectional Pylon

Ch. No.	H_2 Ft	H_2 M	D_1 Ft	D_1 M	R_1 Lbs	R_1 Kg	Moment Ft-Lbs	Moment M-Kg	Weight Ton	Weight MT
14	66.7	20.3	35.0	10.7	2767	1251	96845	13386	4.0	3.6
15	65.9	20.1	34.6	10.5	2735	1246	94631	13083	4.0	3.6
16	65.1	19.8	34.2	10.4	2704	1229	92477	12782	3.9	3.6
17	64.3	19.6	33.8	10.3	2672	1212	90314	12484	3.9	3.5
18	63.5	19.4	33.4	10.2	2641	1195	88209	12189	3.8	3.5
19	62.8	19.1	33.0	10.1	2617	1182	86361	11938	3.8	3.4
20	62.1	18.9	32.7	10.0	2585	1169	84529	11690	3.8	3.4
21	61.4	18.7	32.3	9.9	2561	1155	82720	11434	3.7	3.4
22	60.7	18.5	32.0	9.7	2529	1154	80928	11194	3.7	3.3
23	60.0	18.3	31.6	9.6	2506	1140	79190	10944	3.6	3.3
24	59.3	18.1	31.3	9.5	2474	1127	77436	10707	3.6	3.3
25	58.7	17.9	31.0	9.4	2450	1117	75950	10500	3.6	3.2
26	58.0	17.7	30.6	9.3	2427	1104	74266	10267	3.5	3.2
27	57.4	17.5	30.3	9.2	2403	1094	72811	10065	3.5	3.2
28	56.8	17.3	30.0	9.2	2379	1073	71370	9872	3.5	3.1
29	56.2	17.1	29.7	9.1	2356	1063	69973	9673	3.4	3.1
30	55.6	17.0	29.4	9.0	2332	1053	68561	9477	3.4	3.1
31	55.1	16.8	29.2	8.9	2308	1047	67394	9318	3.4	3.0
32	54.5	16.6	28.9	8.8	2284	1037	66008	9126	3.3	3.0
33	54.0	16.5	28.6	8.7	2268	1031	64865	8970	3.3	3.0
34	53.4	16.3	28.3	8.6	2245	1021	63533	8781	3.3	3.0
35	52.9	16.1	28.1	8.6	2221	1003	62410	8626	3.2	2.9
36	52.4	16.0	27.8	8.5	2205	997	61299	8475	3.2	2.9
37	51.9	15.8	27.6	8.4	2182	991	60223	8324	3.2	2.9
38	51.4	15.7	27.3	8.3	2166	985	59132	8175	3.1	2.9
39	50.9	15.5	27.1	8.3	2142	967	58048	8026	3.1	2.8
40	50.5	15.4	26.9	8.2	2126	964	57189	7905	3.1	2.8
41	50.0	15.2	26.6	8.1	2110	958	56126	7760	3.1	2.8
42	49.5	15.1	26.4	8.0	2087	952	55097	7616	3.0	2.8
43	49.1	15.0	26.2	8.0	2071	938	54260	7504	3.0	2.7
44	48.6	14.8	25.9	7.9	2055	931	53224	7355	3.0	2.7
45	48.2	14.7	25.7	7.8	2039	929	52402	7246	3.0	2.7
46	47.8	14.6	25.5	7.8	2023	914	51587	7129	2.9	2.7
47	47.4	14.4	25.3	7.7	2007	912	50777	7022	2.9	2.6
48	47.0	14.3	25.1	7.7	1991	897	49974	6907	2.9	2.6
49	46.6	14.2	24.9	7.6	1976	895	49202	6802	2.9	2.6
50	46.2	14.1	24.7	7.5	1960	892	48412	6690	2.9	2.6
51	46.0	14.0	24.9	7.6	1692	767	42131	5829	1.6	1.4
52	45.6	13.9	24.7	7.5	1679	764	41471	5730	1.5	1.4
53	45.2	13.8	24.5	7.5	1665	752	40793	5640	1.5	1.4
54	44.9	13.7	24.3	7.4	1658	753	40289	5572	1.5	1.4
55	44.5	13.6	24.1	7.4	1645	741	39644	5483	1.5	1.4
56	44.1	13.5	23.9	7.3	1631	738	38981	5387	1.5	1.4
57	43.8	13.3	23.8	7.2	1617	739	38485	5321	1.5	1.4
58	43.4	13.2	23.6	7.2	1604	727	37854	5234	1.5	1.3
59	43.1	13.1	23.4	7.1	1597	728	37370	5169	1.5	1.3
60	42.8	13.0	23.3	7.1	1583	718	36884	5098	1.5	1.3
61	42.4	12.9	23.1	7.0	1570	716	36267	5012	1.4	1.3
62	42.1	12.8	22.9	7.0	1563	707	35793	4949	1.4	1.3
63	41.8	12.7	22.8	6.9	1549	708	35317	4885	1.4	1.3
64	41.5	12.6	22.6	6.9	1543	699	34872	4823	1.4	1.3
65	41.2	12.5	22.5	6.8	1529	699	34403	4753	1.4	1.3
66	40.9	12.5	22.3	6.8	1522	690	33941	4692	1.4	1.3
67	40.6	12.4	22.2	6.8	1508	681	33478	4631	1.4	1.3
68	40.3	12.3	22.0	6.7	1502	682	33044	4569	1.4	1.3
69	40.0	12.2	21.9	6.7	1488	672	32587	4502	1.4	1.2
70	39.7	12.1	21.7	6.6	1481	673	32138	4442	1.4	1.2

$H_1 = H_2 + 4'$ (1.2 m)

World Radio History

Mechanical Specifications

Omnidirectional Patterns, Types TFU-42J, -45J

Mechanical Specifications
Type TFU-42J Omnidirectional Pylon

Ch.	H_2		D_1		R_1		Moment		Weight	
No.	Ft	M	Ft	M	Lbs	Kg	Ft-Lbs	M-Kg	Ton	MT
14	77.1	23.5	40.1	12.2	3443	1565	138064	19093	7.1	6.5
15	76.1	23.2	39.6	12.1	3401	1539	134680	18622	7.1	6.4
16	75.2	22.9	39.1	11.9	3366	1529	131611	18195	7.0	6.3
17	74.3	22.7	38.7	11.8	3323	1507	128600	17783	6.9	6.3
18	73.4	22.4	38.2	11.6	3289	1497	125640	17365	6.8	6.2
19	72.6	22.1	37.8	11.5	3254	1479	123001	17009	6.7	6.1
20	71.7	21.9	37.4	11.4	3211	1457	120091	16610	6.7	6.0
21	70.9	21.6	37.0	11.3	3177	1438	117549	16249	6.6	6.0
22	70.1	21.4	36.6	11.1	3142	1432	114997	15895	6.5	5.9
23	69.3	21.1	36.2	11.0	3108	1414	112510	15554	6.5	5.9
24	68.6	20.9	35.8	10.9	3082	1399	110336	15249	6.4	5.8
25	67.8	20.7	35.4	10.8	3048	1381	107899	14915	6.3	5.7
26	67.1	20.4	35.2	10.7	2783	1266	97962	13546	4.0	3.7
27	66.4	20.2	34.8	10.6	2759	1252	96013	13271	4.0	3.6
28	65.7	20.0	34.5	10.5	2727	1239	94082	13010	4.0	3.6
29	65.0	19.8	34.1	10.4	2704	1226	92206	12750	3.9	3.6
30	64.3	19.6	33.8	10.3	2672	1212	90314	12484	3.9	3.5
31	63.6	19.4	33.4	10.2	2648	1199	88443	12230	3.8	3.5
32	63.0	19.2	33.1	10.1	2625	1189	86887	12009	3.8	3.5
33	62.4	19.0	32.8	10.0	2601	1179	85313	11790	3.8	3.4
34	61.7	18.8	32.5	9.9	2569	1166	83493	11543	3.7	3.4
35	61.1	18.6	32.2	9.8	2546	1156	81981	11329	3.7	3.4
36	60.5	18.5	31.9	9.7	2522	1147	80452	11126	3.7	3.3
37	60.0	18.3	31.6	9.6	2506	1140	79190	10944	3.6	3.3
38	59.4	18.1	31.3	9.6	2482	1119	77687	10742	3.6	3.3
39	58.8	17.9	31.0	9.5	2459	1109	76229	10536	3.6	3.2
40	58.3	17.8	30.8	9.4	2435	1103	74998	10368	3.5	3.2
41	57.7	17.6	30.5	9.3	2411	1093	73536	10165	3.5	3.2
42	57.2	17.4	30.2	9.2	2395	1087	72329	10000	3.5	3.2
43	56.7	17.3	30.0	9.1	2371	1081	71130	9837	3.4	3.1
44	56.2	17.1	29.7	9.1	2355	1063	69943	9673	3.4	3.1
45	55.7	17.0	29.5	9.0	2332	1057	68794	9513	3.4	3.1
46	55.2	16.8	29.2	8.9	2316	1050	67627	9345	3.4	3.1
47	54.9	16.7	29.1	8.9	2300	1040	66930	9256	3.3	3.0
48	54.4	16.6	28.8	8.8	2284	1034	65779	9099	3.3	3.0
49	54.0	16.4	28.6	8.7	2268	1031	64865	8970	3.3	3.0
50	53.5	16.3	28.4	8.7	2245	1013	63758	8813	3.3	3.0
51	53.1	16.2	28.3	8.6	2083	947	58949	8144	2.0	1.8
52	52.6	16.0	28.0	8.5	2068	942	57904	8007	2.0	1.8
53	52.2	15.9	27.8	8.5	2053	928	57073	7888	1.9	1.8
54	51.8	15.8	27.6	8.4	2038	926	56249	7778	1.9	1.8
55	51.3	15.6	27.4	8.4	2017	909	55266	7636	1.9	1.7
56	50.9	15.5	27.2	8.3	2002	907	54454	7528	1.9	1.7
57	50.5	15.4	27.0	8.2	1987	905	53649	7421	1.9	1.7
58	50.1	15.3	26.8	8.2	1972	891	52850	7306	1.9	1.7
59	49.7	15.2	26.6	8.1	1958	889	52083	7201	1.9	1.7
60	49.3	15.0	26.4	8.0	1943	887	51295	7096	1.8	1.7
61	48.9	14.9	26.3	8.0	1795	816	47208	6528	1.6	1.5
62	48.6	14.8	26.2	8.0	1781	806	46662	6448	1.6	1.5
63	48.2	14.7	26.0	7.9	1767	804	45942	6352	1.6	1.5
64	47.8	14.6	25.8	7.9	1754	792	45253	6257	1.6	1.5
65	47.5	14.5	25.6	7.8	1747	793	44723	6185	1.6	1.5
66	47.1	14.4	25.4	7.8	1734	780	44044	6084	1.6	1.4
67	46.8	14.3	25.3	7.7	1720	781	43516	6014	1.6	1.4
68	46.4	14.2	25.1	7.6	1706	779	42821	5920	1.6	1.4
69	46.1	14.1	24.9	7.6	1699	770	42305	5852	1.6	1.4
70	45.8	14.0	24.8	7.6	1686	760	41813	5776	1.5	1.4

$H_4 = H_2 + 4'$ (1.2 m)

Mechanical Specifications
Type TFU-45J Omnidirectional Pylon

Ch.	H_2		D_1		R_1		Moment		Weight	
No.	Ft	M	Ft	M	Lbs	Kg	Ft-Lbs	M-Kg	Ton	MT
14	83.3	25.4	43.2	13.2	3710	1679	160272	22163	7.7	7.0
15	82.3	25.1	42.7	13.0	3667	1665	156581	21645	7.6	6.9
16	81.3	24.8	42.2	12.9	3624	1639	152933	21143	7.5	6.8
17	80.3	24.5	41.7	12.7	3581	1626	149328	20650	7.4	6.7
18	79.4	24.2	41.2	12.6	3547	1603	146136	20198	7.3	6.7
19	78.4	23.9	40.7	12.4	3504	1590	142613	19716	7.3	6.6
20	77.5	23.6	40.3	12.3	3461	1568	139478	19286	7.2	6.5
21	76.6	23.4	39.8	12.1	3426	1558	136355	18852	7.1	6.4
22	75.8	23.1	39.4	12.0	3392	1540	133645	18480	7.0	6.4
23	74.9	22.8	39.0	11.9	3349	1517	130611	18052	6.9	6.3
24	74.1	22.6	38.6	11.8	3314	1499	127920	17688	6.9	6.2
25	73.3	22.3	38.2	11.6	3280	1493	125296	17319	6.8	6.2
26	72.5	22.1	37.8	11.5	3246	1475	122699	16963	6.7	6.1
27	71.7	21.9	37.4	11.4	3211	1457	120091	16610	6.7	6.0
28	70.9	21.6	37.0	11.3	3177	1438	117549	16249	6.6	6.0
29	70.2	21.4	36.6	11.2	3151	1424	115327	15949	6.5	5.9
30	69.5	21.2	36.3	11.1	3116	1409	113111	15640	6.5	5.9
31	68.8	21.0	35.9	10.9	3091	1407	110967	15336	6.4	5.8
32	68.1	20.7	35.6	10.8	3056	1393	108794	15044	6.3	5.8
33	67.4	20.5	35.2	10.7	3030	1378	106656	14745	6.3	5.7
34	66.7	20.3	34.9	10.6	2996	1364	104560	14458	6.2	5.6
35	66.1	20.1	34.7	10.6	2743	1241	95182	13155	4.0	3.6
36	65.4	19.9	34.3	10.5	2720	1228	93296	12894	3.9	3.6
37	64.8	19.7	34.0	10.4	2696	1218	91664	12667	3.9	3.5
38	64.2	19.6	33.7	10.3	2672	1209	90046	12453	3.9	3.5
39	63.6	19.4	33.4	10.2	2648	1199	88443	12230	3.8	3.5
40	63.0	19.2	33.1	10.1	2624	1189	86854	12009	3.8	3.5
41	62.4	19.0	32.8	10.0	2601	1179	85313	11790	3.8	3.4
42	61.8	18.8	32.5	9.9	2577	1170	83753	11583	3.7	3.4
43	61.2	18.7	32.2	9.8	2554	1160	82239	11368	3.7	3.4
44	60.7	18.5	32.0	9.7	2530	1154	80960	11194	3.7	3.3
45	60.2	18.3	31.7	9.7	2514	1136	79694	11019	3.6	3.3
46	59.6	18.2	31.4	9.6	2490	1126	78186	10810	3.6	3.3
47	59.3	18.1	31.3	9.5	2474	1127	77436	10707	3.6	3.3
48	58.8	17.9	31.0	9.5	2458	1109	76198	10536	3.6	3.2
49	58.3	17.8	30.8	9.4	2435	1103	74998	10368	3.5	3.2
50	57.8	17.6	30.5	9.3	2419	1097	73780	10202	3.5	3.2
51	57.3	17.5	30.2	9.2	2592	1176	78278	10819	2.8	2.5
52	56.8	17.3	29.9	9.1	2575	1170	76992	10647	2.8	2.5
53	56.4	17.2	29.7	9.1	2557	1154	75943	10501	2.8	2.5
54	55.9	17.0	29.5	9.0	2531	1147	74665	10323	2.7	2.5
55	55.4	16.9	29.2	8.9	2514	1141	73409	10155	2.7	2.5
56	55.0	16.8	29.0	8.8	2497	1138	72413	10014	2.7	2.5
57	54.5	16.6	28.8	8.8	2471	1118	71165	9838	2.7	2.4
58	54.1	16.5	28.6	8.7	2454	1115	70184	9700	2.7	2.4
59	53.7	16.4	28.4	8.6	2437	1113	69211	9572	2.6	2.4
60	53.3	16.2	28.2	8.6	2419	1097	68216	9434	2.6	2.4
61	52.9	16.1	28.0	8.5	2402	1094	67256	9299	2.6	2.4
62	52.5	16.0	27.8	8.5	2385	1078	66303	9163	2.6	2.4
63	52.1	15.9	27.6	8.4	2368	1076	65357	9038	2.6	2.3
64	51.7	15.7	27.4	8.3	2351	1073	64417	8906	2.6	2.3
65	51.3	15.6	27.2	8.3	2333	1057	63458	8773	2.5	2.3
66	50.9	15.5	27.0	8.2	2316	1054	62532	8643	2.5	2.3
67	50.5	15.4	26.8	8.2	2299	1039	61613	8520	2.5	2.3
68	50.1	15.3	26.6	8.1	2282	1036	60701	8392	2.5	2.3
69	49.8	15.2	26.4	8.0	2273	1037	60007	8296	2.5	2.2
70	49.4	15.1	26.2	8.0	2256	1022	59107	8176	2.5	2.2

$H_4 = H_2 + 4'$ (1.2 m)

World Radio History

Mechanical Specifications

Omnidirectional Patterns, Types TFU-50J, -25G

Mechanical Specifications
Type TFU-50J Omnidirectional Pylon

Ch. No.	H_2 Ft	H_2 M	D_1 Ft	D_1 M	R_1 Lbs	R_1 Kg	Moment Ft-Lbs	Moment M-Kg	Weight Ton	Weight MT
14	94.5	28.8	48.8	14.9	4192	1898	204570	28280	8.7	7.9
15	93.4	28.5	48.2	14.7	4149	1881	199982	27651	8.6	7.8
16	92.2	28.1	47.6	14.5	4097	1860	195017	26970	8.5	7.7
17	91.1	27.8	47.1	14.3	4046	1842	190567	26341	8.4	7.6
18	90.1	27.5	46.6	14.2	4003	1816	186540	25787	8.3	7.5
19	89.0	27.1	46.0	14.0	3960	1799	182160	25186	8.2	7.4
20	88.0	26.8	45.5	13.9	3917	1773	178224	24645	8.1	7.4
21	87.0	26.5	45.0	13.7	3874	1759	174330	24098	8.0	7.3
22	86.0	26.2	44.5	13.6	3831	1733	170480	23569	7.9	7.2
23	85.1	25.9	44.1	13.4	3787	1723	167007	23088	7.8	7.1
24	84.1	25.6	43.6	13.3	3745	1697	163282	22570	7.8	7.0
25	83.2	25.4	43.1	13.1	3710	1688	159901	22113	7.7	7.0
26	82.3	25.1	42.7	13.0	3667	1665	156581	21645	7.6	6.9
27	81.4	24.8	42.2	12.9	3633	1643	153313	21195	7.5	6.8
28	80.6	24.6	41.8	12.7	3598	1637	150396	20790	7.4	6.8
29	79.7	24.3	41.4	12.6	3555	1615	147177	20349	7.4	6.7
30	78.9	24.1	41.0	12.5	3521	1597	144361	19963	7.3	6.6
31	78.1	23.8	40.6	12.4	3487	1578	141572	19567	7.2	6.6
32	77.3	23.6	40.2	12.2	3452	1573	138770	19191	7.2	6.5
33	76.6	23.3	39.8	12.1	3426	1558	136355	18852	7.1	6.4
34	75.8	23.1	39.4	12.0	3392	1540	133645	18480	7.0	6.4
35	75.1	22.9	39.1	11.9	3357	1525	131259	18147	7.0	6.3
36	74.3	22.7	38.7	11.8	3323	1507	128600	17783	6.9	6.3
37	73.6	22.4	38.3	11.7	3297	1492	126275	17456	6.8	6.2
38	72.9	22.2	38.0	11.6	3263	1478	123994	17145	6.8	6.1
39	72.3	22.0	37.7	11.5	3237	1467	122035	16871	6.7	6.1
40	71.6	21.8	37.3	11.4	3211	1453	119770	16564	6.7	6.0
41	70.9	21.6	37.0	11.3	3177	1438	117549	16249	6.6	6.0
42	70.3	21.4	36.7	11.2	3151	1427	115642	15982	6.5	5.9
43	69.6	21.2	36.3	11.1	3125	1413	113437	15684	6.5	5.9
44	69.0	21.0	36.0	11.0	3099	1402	111564	15422	6.4	5.8
45	68.4	20.9	35.7	10.9	3074	1392	109742	15173	6.4	5.8
46	67.8	20.7	35.4	10.8	3048	1381	107899	14915	6.3	5.7
47	67.2	20.5	35.1	10.7	3022	1371	106072	14670	6.3	5.7
48	66.7	20.3	34.9	10.6	2996	1364	104560	14458	6.2	5.6
49	66.1	20.1	34.6	10.5	2970	1353	102762	14207	6.2	5.6
50	65.5	20.0	34.3	10.4	2945	1343	101013	13967	6.1	5.5
51	65.0	19.8	34.0	10.4	2927	1323	99518	13759	6.0	5.4
52	64.4	19.6	33.7	10.3	2902	1313	97797	13524	5.9	5.4
53	63.9	19.5	33.5	10.2	2876	1306	96346	13321	5.9	5.3
54	63.4	19.3	33.2	10.1	2858	1299	94886	13120	5.8	5.3
55	62.9	19.2	33.0	10.0	2833	1292	93489	12920	5.8	5.3
56	62.4	19.0	32.7	10.0	2815	1273	92050	12730	5.8	5.2
57	61.9	18.9	32.5	9.9	2789	1266	90643	12533	5.7	5.2
58	61.4	18.7	32.2	9.8	2772	1259	89258	12338	5.7	5.1
59	60.9	18.6	32.0	9.7	2747	1253	87904	12154	5.6	5.1
60	60.4	18.4	31.7	9.7	2730	1233	86541	11960	5.6	5.1
61	60.0	18.3	31.5	9.6	2712	1230	85428	11808	5.5	5.0
62	59.5	18.1	31.3	9.5	2686	1224	84072	11628	5.5	5.0
63	59.1	18.0	31.1	9.5	2669	1208	83006	11476	5.5	5.0
64	58.6	17.9	30.8	9.4	2652	1201	81682	11289	5.4	4.9
65	58.2	17.7	30.6	9.3	2635	1199	80631	11151	5.4	4.9
66	57.8	17.6	30.4	9.3	2617	1183	79557	11002	5.3	4.8
67	57.3	17.5	30.2	9.2	2592	1176	78278	10819	5.3	4.8
68	56.9	17.3	30.0	9.1	2575	1173	77250	10674	5.3	4.8
69	56.5	17.2	29.8	9.1	2557	1158	76199	10538	5.2	4.7
70	56.1	17.1	29.6	9.0	2540	1155	75184	10395	5.2	4.7

$H_4 = H_2 + 4'$ (1.2 m)

Mechanical Specifications
Type TFU-25G Omnidirectional Pylon

Ch. No.	H_2 Ft	H_2 M	D_1 Ft	D_1 M	R_1 Lbs	R_1 Kg	Moment Ft-Lbs	Moment M-Kg	Weight Ton	Weight MT
14	69.1	21.1	36.1	11.0	3099	1406	111874	15466	3.7	3.3
15	68.2	20.8	35.6	10.9	3065	1384	109114	15086	3.6	3.3
16	67.4	20.5	35.2	10.7	3031	1378	106691	14745	3.6	3.3
17	66.6	20.3	34.8	10.6	2996	1360	104261	14416	3.5	3.2
18	65.8	20.1	34.4	10.5	2962	1342	101893	14091	3.5	3.2
19	65.0	19.8	34.0	10.4	2927	1323	99518	13759	3.5	3.1
20	64.3	19.6	33.7	10.3	2893	1309	97494	13483	3.4	3.1
21	63.6	19.4	33.3	10.2	2867	1294	95471	13199	3.4	3.1
22	62.9	19.2	33.0	10.0	2832	1292	93456	12920	3.4	3.0
23	62.2	18.9	32.6	9.9	2807	1278	91508	12652	3.3	3.0
24	61.5	18.7	32.3	9.8	2772	1263	89536	12377	3.3	3.0
25	60.8	18.5	31.9	9.7	2747	1249	87629	12115	3.3	3.0
26	60.2	18.3	31.6	9.6	2721	1238	85984	11885	3.2	2.9
27	59.5	18.1	31.3	9.5	2686	1224	84072	11628	3.2	2.9
28	58.9	17.9	31.0	9.4	2660	1213	82460	11402	3.2	2.9
29	58.3	17.8	30.7	9.3	2635	1202	80894	11179	3.1	2.8
30	57.7	17.6	30.4	9.3	2609	1179	79314	10965	3.1	2.8
31	57.1	17.4	30.1	9.2	2583	1168	77748	10746	3.1	2.8
32	56.5	17.2	29.8	9.1	2557	1158	76199	10538	3.0	2.8
33	56.0	17.1	29.5	9.0	2540	1151	74930	10359	3.0	2.7
34	55.4	16.9	29.2	8.9	2514	1140	73409	10146	3.0	2.7
35	54.9	16.7	29.0	8.8	2488	1134	72152	9979	3.0	2.7
36	54.3	16.6	28.7	8.7	2463	1123	70688	9770	2.9	2.7
37	53.8	16.4	28.4	8.7	2445	1104	69438	9605	2.9	2.6
38	53.3	16.2	28.2	8.6	2420	1097	68244	9434	2.9	2.6
39	52.8	16.1	27.9	8.5	2402	1090	67016	9265	2.9	2.6
40	52.3	15.9	27.7	8.4	2377	1084	65843	9106	2.8	2.6
41	51.8	15.8	27.4	8.4	2360	1064	64664	8938	2.8	2.5
42	51.4	15.7	27.2	8.3	2342	1061	63702	8806	2.8	2.5
43	50.9	15.5	27.0	8.2	2316	1054	62532	8643	2.8	2.5
44	50.5	15.4	26.8	8.2	2299	1039	61613	8520	2.7	2.5
45	50.0	15.2	26.5	8.1	2282	1032	60473	8359	2.7	2.5
46	49.6	15.1	26.3	8.0	2265	1029	59569	8232	2.7	2.4
47	49.1	15.0	26.1	7.9	2239	1023	58438	8082	2.7	2.4
48	48.7	14.8	25.9	7.9	2222	1007	57550	7955	2.7	2.4
49	48.3	14.7	25.7	7.8	2205	1004	56668	7831	2.6	2.4
50	47.9	14.6	25.5	7.8	2187	989	55769	7714	2.6	2.4
51	47.5	14.5	25.3	7.7	2170	986	54901	7592	2.6	2.4
52	47.1	14.4	25.1	7.6	2153	983	54040	7471	2.6	2.3
53	46.7	14.2	24.9	7.6	2136	967	53186	7349	2.6	2.3
54	46.3	14.1	24.7	7.5	2119	965	52339	7238	2.5	2.3
55	46.0	14.0	24.5	7.5	2110	953	51695	7148	2.5	2.3
56	45.6	13.9	24.3	7.4	2093	950	50860	7030	2.5	2.3
57	45.2	13.8	24.1	7.3	2076	947	50032	6913	3.4	3.1
58	44.9	13.7	24.0	7.3	2058	935	49392	6825	3.4	3.1
59	44.5	13.6	23.8	7.2	2041	933	48576	6718	3.4	3.1
60	44.2	13.5	23.6	7.2	2032	921	47955	6631	3.4	3.0
61	43.8	13.4	23.4	7.1	2015	918	47151	6518	3.3	3.0
62	43.5	13.3	23.3	7.1	1998	907	46553	6440	3.3	3.0
63	43.2	13.2	23.1	7.0	1989	908	45946	6356	3.3	3.0
64	42.9	13.1	23.0	7.0	1972	896	45356	6272	3.3	3.0
65	42.5	13.0	22.8	6.9	1955	893	44574	6162	3.2	2.9
66	42.2	12.9	22.6	6.9	1946	881	43980	6079	3.2	2.9
67	41.9	12.8	22.5	6.8	1929	883	43403	6004	3.2	2.9
68	41.6	12.7	22.3	6.8	1921	871	42838	5923	3.2	2.9
69	41.3	12.6	22.2	6.8	1903	859	42247	5841	3.2	2.9
70	41.0	12.5	22.0	6.7	1895	860	41690	5762	3.1	2.8

$H_4 = H_2 + 4'$ (1.2 m)

World Radio History

Mechanical Specifications

Omnidirectional Patterns, Types TFU-25GA, -35G

Mechanical Specifications
Type TFU-25GA Omnidirectional Pylon

Ch. No.	H_2 Ft	H_2 M	D_1 Ft	D_1 M	R_1 Lbs	R_1 Kg	Moment Ft-Lbs	Moment M-Kg	Weight Ton	Weight MT
14	69.1	21.1	36.2	11.0	2862	1302	103604	14322	4.2	3.8
15	68.2	20.8	35.7	10.9	2830	1282	101031	13974	4.1	3.7
16	67.4	20.5	35.3	10.8	2799	1265	98805	13662	4.1	3.7
17	66.6	20.3	34.9	10.6	2767	1260	96568	13356	4.0	3.6
18	65.8	20.1	34.5	10.5	2735	1243	94358	13052	4.0	3.6
19	65.0	19.8	34.1	10.4	2704	1226	92206	12750	3.9	3.6
20	64.3	19.6	33.8	10.3	2672	1212	90314	12484	3.9	3.5
21	63.6	19.4	33.4	10.2	2648	1199	88443	12230	3.8	3.5
22	62.9	19.2	33.1	10.1	2616	1186	86590	11979	3.8	3.4
23	62.2	18.9	32.7	10.0	2593	1172	84791	11720	3.8	3.4
24	61.5	18.7	32.4	9.9	2561	1159	82976	11474	3.7	3.4
25	60.8	18.5	32.0	9.8	2538	1146	81216	11231	3.7	3.3
26	60.2	18.3	31.7	9.7	2514	1136	79694	11019	3.6	3.3
27	59.5	18.1	31.4	9.6	2482	1122	77935	10771	3.6	3.3
28	58.9	17.9	31.1	9.5	2458	1113	76444	10574	3.6	3.2
29	58.3	17.8	30.8	9.4	2435	1103	74998	10368	3.5	3.2
30	57.7	17.6	30.5	9.3	2411	1093	73536	10165	3.5	3.2
31	57.1	17.4	30.2	9.2	2387	1083	72087	9964	3.5	3.2
32	56.5	17.2	29.9	9.1	2364	1074	70684	9773	3.4	3.1
33	56.0	17.1	29.6	9.0	2347	1067	69471	9603	3.4	3.1
34	55.4	16.9	29.3	8.9	2324	1058	68093	9416	3.4	3.1
35	54.9	16.7	29.1	8.9	2300	1040	66930	9256	3.3	3.0
36	54.3	16.6	28.8	8.8	2277	1030	65578	9064	3.3	3.0
37	53.8	16.4	28.5	8.7	2261	1024	64439	8909	3.3	3.0
38	53.3	16.2	28.3	8.6	2237	1018	63307	8755	3.3	3.0
39	52.8	16.1	28.0	8.5	2221	1012	62188	8602	3.2	2.9
40	52.3	15.9	27.8	8.5	2197	994	61077	8449	3.2	2.9
41	51.8	15.8	27.5	8.4	2182	987	60005	8291	3.2	2.9
42	51.4	15.7	27.3	8.3	2165	985	59104	8175	3.1	2.9
43	50.9	15.5	27.1	8.3	2142	967	58048	8026	3.1	2.8
44	50.5	15.4	26.9	8.2	2126	964	57189	7905	3.1	2.8
45	50.0	15.2	26.6	8.1	2110	958	56126	7760	3.1	2.8
46	49.6	15.1	26.4	8.1	2094	944	55282	7646	3.0	2.8
47	49.1	15.0	26.2	8.0	2071	938	54260	7504	3.0	2.7
48	48.7	14.8	26.0	7.9	2055	935	53430	7386	3.0	2.7
49	48.3	14.7	25.8	7.9	2039	921	52606	7276	3.0	2.7
50	47.9	14.6	25.6	7.8	2023	918	51789	7160	2.9	2.7
51	47.5	14.5	25.6	7.8	1747	793	44723	6185	1.6	1.5
52	47.1	14.4	25.4	7.8	1733	780	44018	6084	1.6	1.4
53	46.7	14.2	25.2	7.7	1720	778	43344	5991	1.6	1.4
54	46.3	14.1	25.0	7.6	1706	776	42650	5898	1.6	1.4
55	46.0	14.0	24.9	7.6	1692	767	42131	5829	1.6	1.4
56	45.6	13.9	24.7	7.5	1679	764	41471	5730	1.5	1.4
57	45.2	13.8	24.5	7.5	1665	752	40793	5640	1.5	1.4
58	44.9	13.7	24.3	7.4	1658	753	40289	5572	1.5	1.4
59	44.5	13.6	24.1	7.4	1645	741	39644	5483	1.5	1.4
60	44.2	13.5	24.0	7.3	1631	741	39144	5409	1.5	1.4
61	43.8	13.4	23.8	7.2	1618	739	38508	5321	1.5	1.4
62	43.5	13.3	23.6	7.2	1611	730	38020	5256	1.5	1.3
63	43.2	13.2	23.5	7.2	1597	721	37530	5191	1.5	1.3
64	42.9	13.1	23.3	7.1	1590	721	37047	5119	1.5	1.3
65	42.5	13.0	23.1	7.0	1577	719	36429	5033	1.5	1.3
66	42.2	12.9	23.0	7.0	1563	710	35949	4970	1.4	1.3
67	41.9	12.8	22.8	7.0	1556	701	35477	4907	1.4	1.3
68	41.6	12.7	22.7	6.9	1543	702	35026	4844	1.4	1.3
69	41.3	12.6	22.5	6.9	1536	692	34560	4775	1.4	1.3
70	41.0	12.5	22.4	6.8	1522	693	34093	4712	1.4	1.3

$H_1 = H_2 + 4'$ (1.2 m)

Mechanical Specifications
Type TFU-35G Omnidirectional Pylon

Ch. No.	H_2 Ft	H_2 M	D_1 Ft	D_1 M	R_1 Lbs	R_1 Kg	Moment Ft-Lbs	Moment M-Kg	Weight Ton	Weight MT
14	98.7	30.1	50.7	15.5	4923	2226	249596	34503	11.0	9.9
15	97.5	29.7	50.1	15.3	4865	2202	243736	33691	10.8	9.8
16	96.3	29.4	49.5	15.1	4807	2178	237947	32888	10.7	9.7
17	95.1	29.0	48.9	14.9	4749	2155	232226	32109	10.6	9.6
18	94.0	28.7	48.3	14.7	4700	2135	227010	31384	10.5	9.5
19	92.9	28.3	47.8	14.6	4642	2101	221888	30675	10.4	9.4
20	91.8	28.0	47.2	14.4	4593	2081	216790	29966	10.3	9.3
21	90.8	27.7	46.7	14.2	4544	2066	212205	29337	10.1	9.2
22	89.8	27.4	46.2	14.1	4496	2037	207715	28722	10.0	9.1
23	88.8	27.1	45.7	13.9	4447	2021	203228	28092	9.9	9.0
24	87.8	26.8	45.2	13.8	4399	1992	198835	27490	9.8	8.9
25	86.8	26.5	44.7	13.6	4350	1977	194445	26887	9.7	8.8
26	85.9	26.2	44.3	13.5	4302	1952	190579	26352	9.6	8.7
27	85.0	25.9	43.8	13.4	4263	1926	186719	25808	9.5	8.6
28	84.1	25.6	43.4	13.2	4214	1916	182888	25291	9.4	8.6
29	83.2	25.4	42.9	13.1	4175	1890	179107	24759	9.3	8.5
30	82.3	25.1	42.5	13.0	4127	1865	175398	24245	9.3	8.4
31	81.5	24.8	42.1	12.8	4088	1859	172105	23795	9.2	8.3
32	80.6	24.6	41.6	12.7	4049	1834	168438	23292	9.1	8.2
33	79.8	24.3	41.2	12.6	4010	1813	165212	22844	9.0	8.2
34	79.0	24.1	40.8	12.5	3972	1792	162058	22400	8.9	8.1
35	78.3	23.9	40.5	12.3	3932	1790	159246	22017	8.8	8.0
36	77.5	23.6	40.1	12.2	3894	1769	156149	21582	8.8	7.9
37	76.8	23.4	39.7	12.1	3864	1753	153401	21211	8.7	7.9
38	76.0	23.2	39.3	12.0	3826	1732	150362	20784	8.6	7.8
39	75.3	23.0	39.0	11.9	3787	1716	147693	20420	8.5	7.7
40	74.6	22.7	38.6	11.8	3758	1699	145059	20048	8.5	7.7
41	73.9	22.5	38.3	11.7	3719	1683	142438	19691	8.4	7.6
42	73.2	22.3	37.9	11.6	3690	1667	139851	19337	8.3	7.5
43	72.6	22.1	37.6	11.5	3661	1655	137654	19033	8.2	7.5
44	71.9	21.9	37.3	11.4	3622	1638	135101	18673	8.2	7.4
45	71.3	21.7	37.0	11.3	3593	1626	132941	18374	8.1	7.4
46	70.6	21.5	36.6	11.2	3564	1610	130442	18032	8.0	7.3
47	70.0	21.3	36.3	11.1	3534	1598	128284	17738	8.0	7.2
48	69.4	21.2	36.0	11.0	3505	1586	126180	17446	7.9	7.2
49	68.8	21.0	35.7	10.9	3476	1574	124093	17157	7.9	7.1
50	68.2	20.8	35.4	10.8	3447	1562	122024	16870	7.8	7.1
51	67.3	20.5	35.0	10.7	3398	1537	118930	16446	7.4	6.7
52	66.7	20.3	34.7	10.6	3369	1525	116904	16165	7.3	6.7
53	66.2	20.2	34.4	10.5	3350	1517	115240	15929	7.3	6.6
54	65.6	20.0	34.1	10.4	3321	1505	113246	15652	7.2	6.5
55	65.1	19.8	33.9	10.3	3292	1498	111599	15429	7.2	6.5
56	64.6	19.7	33.6	10.3	3272	1476	109939	15203	7.1	6.4
57	64.1	19.5	33.6	10.2	2884	1313	96902	13393	4.8	4.3
58	63.6	19.4	33.3	10.2	2867	1294	95471	13199	4.7	4.3
59	63.1	19.2	33.1	10.1	2841	1287	94037	12999	4.7	4.3
60	62.6	19.1	32.8	10.0	2824	1281	92627	12810	4.7	4.2
61	62.1	18.9	32.6	9.9	2798	1274	91215	12613	4.6	4.2
62	61.6	18.8	32.3	9.8	2781	1267	89826	12417	4.6	4.2
63	61.1	18.6	32.1	9.8	2755	1248	88435	12230	4.6	4.1
64	60.7	18.5	31.9	9.7	2738	1245	87342	12076	4.5	4.1
65	60.2	18.4	31.6	9.6	2721	1238	85984	11885	4.5	4.1
66	59.8	18.2	31.4	9.6	2703	1222	84874	11731	4.5	4.0
67	59.3	18.1	31.2	9.5	2678	1216	83554	11552	4.4	4.0
68	58.9	17.9	31.0	9.4	2660	1213	82460	11402	4.4	4.0
69	58.5	17.8	30.8	9.4	2643	1197	81404	11252	4.4	4.0
70	58.0	17.7	30.5	9.3	2626	1191	80093	11076	4.3	3.9

$H_1 = H_2 + 4'$ (1.2 m)

World Radio History

Mechanical Specifications

Omnidirectional Patterns, Types TFU-40K/-46K

Mechanical Specifications
Types TFU-40/-46K Omnidirectional Pylon

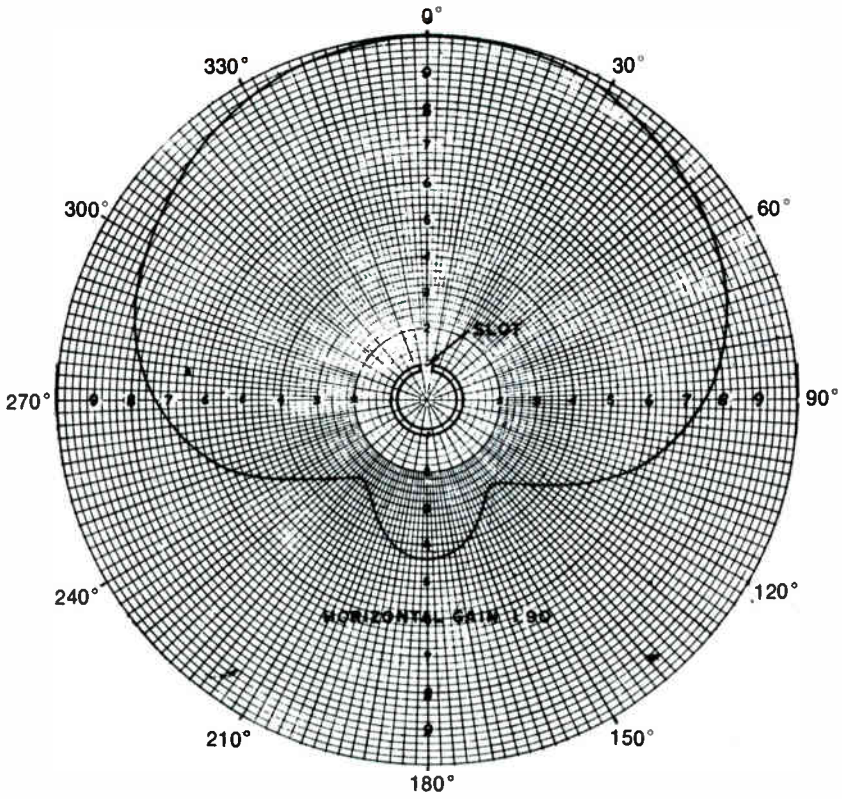
Ch. No.	H_2 Ft	H_2 M	D_1 Ft	D_1 M	R_1 Lbs	R_1 Kg	Moment Ft-Lbs	Moment M-Kg	Weight Ton	Weight MT
14	123.7	37.7	63.1	19.2	6820	3099	430342	59501	14.3	13.0
15	122.1	37.2	62.3	19.0	6734	3053	419528	58007	14.2	12.8
16	120.6	36.8	61.5	18.7	6658	3027	409467	56605	14.0	12.7
17	119.2	36.3	60.8	18.5	6582	2991	400186	55334	13.8	12.5
18	117.8	35.9	60.1	18.3	6506	2954	391011	54058	13.7	12.4
19	116.4	35.5	59.4	18.1	6430	2918	381942	52816	13.5	12.3
20	115.0	35.1	58.7	17.9	6355	2881	373038	51570	13.4	12.1
21	113.7	34.7	58.1	17.7	6279	2850	364810	50445	13.2	12.0
22	112.4	34.3	57.4	17.5	6214	2818	356684	49315	13.1	11.9
23	111.1	33.9	56.8	17.3	6138	2786	348638	48198	13.0	11.7
24	109.9	33.5	56.2	17.1	6073	2760	341303	47196	12.8	11.6
25	108.7	33.1	55.6	16.9	6008	2733	334045	46188	12.7	11.5
26	107.5	32.8	55.0	16.8	5944	2690	326920	45192	12.6	11.4
27	106.4	32.4	54.4	16.6	5889	2668	320362	44289	12.4	11.3
28	105.2	32.1	53.8	16.4	5825	2642	313385	43329	12.3	11.2
29	104.1	31.7	53.3	16.2	5760	2620	307008	42444	12.2	11.1
30	103.1	31.4	52.8	16.1	5705	2587	301224	41651	12.1	10.9
31	102.0	31.1	52.2	15.9	5651	2565	294982	40783	12.0	10.8
32	101.0	30.8	51.7	15.8	5597	2532	289365	40006	11.8	10.7
33	99.9	30.5	51.2	15.6	5532	2510	283238	39156	11.7	10.6
34	98.9	30.2	50.7	15.4	5478	2494	277735	38408	11.6	10.5
35	98.0	29.9	50.2	15.3	5435	2465	272837	37714	11.5	10.4
36	97.0	29.6	49.7	15.2	5381	2432	267436	36966	11.4	10.3
37	96.1	29.3	49.3	15.0	5327	2420	262621	36300	11.3	10.3
38	95.2	29.0	48.8	14.9	5283	2392	257810	35641	11.2	10.2
39	94.3	28.7	48.4	14.7	5229	2380	253084	34986	11.1	10.1
40	93.4	28.5	47.9	14.6	5186	2352	248409	34339	11.0	10.0
41	92.5	28.2	47.6	14.5	4622	2098	220007	30421	10.3	9.4
42	91.6	27.9	47.1	14.4	4583	2073	215859	29851	10.2	9.3
43	90.8	27.7	46.7	14.2	4544	2066	212205	29337	10.1	9.2
44	90.0	27.4	46.3	14.1	4506	2045	208628	28834	10.1	9.1
45	89.2	27.2	45.9	14.0	4467	2025	205035	28350	10.0	9.0
46	88.4	26.9	45.5	13.9	4428	2004	201474	27856	9.9	9.0
47	87.6	26.7	45.1	13.8	4389	1983	197944	27365	9.8	8.9
48	86.9	26.5	44.8	13.7	4350	1967	194880	26948	9.7	8.8
49	86.1	26.2	44.4	13.5	4311	1960	191408	26460	9.7	8.8
50	85.4	26.0	44.0	13.4	4282	1944	188408	26050	9.6	8.7
51	84.6	25.8	43.6	13.3	4244	1923	185038	25576	9.5	8.6
52	83.9	25.6	43.3	13.2	4205	1907	182076	25172	9.4	8.6
53	83.2	25.4	42.9	13.1	4175	1890	179107	24759	9.4	8.5
54	82.5	25.2	42.6	13.0	4137	1874	176236	24362	9.3	8.4
55	81.9	25.0	42.3	12.9	4107	1862	173726	24020	9.2	8.4
56	81.2	24.8	41.9	12.8	4078	1846	170868	23629	9.1	8.3
57	80.5	24.6	41.8	12.7	3590	1634	150062	20752	5.9	5.4
58	79.9	24.4	41.5	12.6	3564	1623	147906	20450	5.9	5.3
59	79.3	24.2	41.2	12.5	3538	1612	145766	20150	5.8	5.3
60	78.6	24.0	40.8	12.4	3512	1598	143290	19815	5.8	5.3
61	78.0	23.8	40.5	12.3	3487	1587	141224	19520	5.7	5.2
62	77.4	23.6	40.2	12.3	3461	1564	139132	19237	5.7	5.2
63	76.8	23.4	39.9	12.2	3435	1553	137056	18947	5.7	5.1
64	76.3	23.2	39.7	12.1	3409	1546	135337	18707	5.6	5.1
65	75.7	23.1	39.4	12.0	3383	1536	133290	18432	5.6	5.1
66	75.1	22.9	39.1	11.9	3357	1525	131259	18147	5.5	5.0
67	74.6	22.7	38.8	11.8	3340	1518	129592	17912	5.5	5.0
68	74.0	22.6	38.5	11.7	3314	1508	127589	17644	5.5	5.0
69	73.5	22.4	38.3	11.7	3288	1488	125930	17410	5.4	4.9
70	72.9	22.2	38.0	11.6	3263	1478	123994	17145	5.4	4.9

$H_1 = H_2 + 4'$ (1.2 m)

World Radio History

Mechanical Specifications

Skull Directional Patterns, Types TFU-30JDA, -36JDA



Mechanical Specifications
Type TFU-30JDA Skull Pattern

Ch. No.	H_2 Ft	H_2 M	D_1 Ft	D_1 M	R_1 Lbs	R_1 Kg	Moment Ft-Lbs	Moment M-Kg	Weight Ton	Weight MT
14	57.1	17.4	30.8	9.4	1735	786	53438	7388	2.4	2.2
15	56.4	17.2	30.4	9.3	1718	776	52227	7217	2.4	2.2
16	55.7	17.0	30.1	9.2	1695	767	51019	7056	2.4	2.1
17	55.1	16.8	29.8	9.1	1678	760	50004	6916	2.3	2.1
18	54.4	16.6	29.4	9.0	1662	750	48863	6750	2.3	2.1
19	53.8	16.4	29.1	8.9	1644	743	47840	6613	2.3	2.1
20	53.2	16.2	28.8	8.8	1628	736	46886	6477	2.3	2.1
21	52.6	16.0	28.5	8.7	1611	729	45914	6342	2.2	2.0
22	52.0	15.9	28.2	8.6	1594	723	44951	6218	2.2	2.0
23	51.5	15.7	28.0	8.5	1577	718	44156	6103	2.2	2.0
24	50.9	15.5	27.7	8.4	1560	711	43212	5972	2.2	2.0
25	50.4	15.3	27.4	8.4	1548	698	42415	5863	2.2	2.0
26	49.8	15.2	27.1	8.3	1532	691	41517	5735	2.1	1.9
27	49.3	15.0	26.9	8.2	1515	687	40753	5633	2.1	1.9
28	48.8	14.9	26.6	8.1	1504	683	40006	5532	2.1	1.9
29	48.3	14.7	26.4	8.0	1487	678	39257	5424	2.1	1.9
30	47.8	14.6	26.1	8.0	1475	665	38497	5320	2.0	1.9

$H_4 = H_2 + 4'$ (1.2 m)

Mechanical Specifications
Type TFU-36JDA Skull Pattern

Ch. No.	H_2 Ft	H_2 M	D_1 Ft	D_1 M	R_1 Lbs	R_1 Kg	Moment Ft-Lbs	Moment M-Kg	Weight Ton	Weight MT
14	67.5	20.6	35.6	10.9	2428	1096	86437	11946	4.3	3.9
15	66.7	20.3	35.2	10.7	2400	1092	84480	11684	4.2	3.8
16	65.9	20.1	34.8	10.6	2373	1077	82580	11416	4.2	3.8
17	65.1	19.8	34.4	10.5	2346	1063	80702	11162	4.1	3.7
18	64.3	19.6	34.0	10.4	2319	1048	78846	10899	4.1	3.7
19	63.6	19.4	33.9	10.3	2092	952	70919	9806	3.2	2.9
20	62.9	19.2	33.5	10.2	2073	941	69446	9598	3.2	2.9
21	62.2	18.9	33.2	10.1	2048	931	67994	9403	3.2	2.9
22	61.5	18.7	32.8	10.0	2030	920	66584	9200	3.1	2.8
23	60.8	18.5	32.5	9.9	2005	910	65163	9009	3.1	2.8
24	60.1	18.3	32.3	9.8	1819	829	58754	8124	2.5	2.3
25	59.5	18.1	32.0	9.8	1802	814	57664	7977	2.5	2.3
26	58.8	17.9	31.7	9.6	1780	813	56426	7805	2.5	2.3
27	58.2	17.7	31.4	9.6	1763	797	55358	7651	2.5	2.2
28	57.6	17.6	31.1	9.5	1746	790	54301	7505	2.4	2.2
29	57.0	17.4	30.8	9.4	1729	783	53253	7360	2.4	2.2
30	56.4	17.2	30.5	9.3	1712	776	52216	7217	2.4	2.2

$H_4 = H_2 + 4'$ (1.2 m)

World Radio History

Mechanical Specifications

Skull Directional Patterns, Types TFU-30JDAS, -28DAS

Mechanical Specifications
Type TFU-30JDAS Skull Pattern

Ch. No.	H_2 Ft	H_2 M	D_1 Ft	D_1 M	R_1 Lbs	R_1 Kg	Moment Ft-Lbs	Moment M-Kg	Weight Ton	Weight MT
14	58.2	17.7	31.0	9.4	2108	961	65348	9033	3.7	3.4
15	57.5	17.5	30.6	9.3	2087	949	63862	8826	3.7	3.3
16	56.8	17.3	30.3	9.2	2060	938	62418	8630	3.6	3.3
17	56.1	17.1	29.9	9.1	2040	927	60996	8436	3.6	3.3
18	55.4	16.9	29.6	9.0	2013	915	59585	8235	3.6	3.2
19	54.8	16.7	29.3	8.9	1992	907	58366	8072	3.5	3.2
20	54.1	16.5	28.9	8.8	1972	895	56991	7876	3.5	3.2
21	53.5	16.3	28.6	8.7	1951	887	55799	7717	3.4	3.1
22	52.9	16.1	28.3	8.6	1931	878	54647	7551	3.4	3.1
23	52.3	15.9	28.0	8.5	1910	870	53480	7395	3.4	3.1
24	51.7	15.8	27.7	8.5	1890	852	52353	7242	3.3	3.0
25	51.2	15.6	27.5	8.4	1869	846	51398	7106	3.3	3.0
26	50.6	15.4	27.2	8.3	1849	838	50293	6955	3.3	3.0
27	50.1	15.3	26.9	8.2	1835	832	49361	6822	3.2	2.9
28	49.6	15.1	26.7	8.1	1815	827	48460	6699	3.2	2.9
29	49.0	14.9	26.4	8.0	1795	819	47388	6552	3.2	2.9
30	48.5	14.8	26.1	8.0	1781	803	46484	6424	3.1	2.9
31	48.0	14.6	26.1	7.9	1609	735	41995	5806	2.5	2.3
32	47.6	14.5	25.8	7.9	1603	724	41357	5720	2.5	2.3
33	47.1	14.3	25.6	7.8	1584	719	40550	5608	2.5	2.2
34	46.6	14.2	25.4	7.7	1566	714	39776	5498	2.5	2.2
35	46.2	14.1	25.1	7.7	1559	703	39131	5413	2.4	2.2
36	45.7	13.9	24.9	7.6	1541	698	38371	5305	2.4	2.2
37	45.3	13.8	24.7	7.5	1529	696	37766	5220	2.4	2.2
38	44.8	13.7	24.5	7.5	1510	682	36995	5115	2.4	2.1
39	44.4	13.5	24.2	7.4	1504	680	36397	5032	2.3	2.1
40	44.0	13.4	24.0	7.3	1492	678	35808	4949	2.3	2.1
41	43.6	13.3	24.0	7.3	1357	617	32568	4504	1.9	1.7
42	43.2	13.2	23.8	7.3	1346	607	32035	4431	1.9	1.7
43	42.8	13.0	23.6	7.2	1334	605	31482	4356	1.9	1.7
44	42.4	12.9	23.4	7.1	1323	603	30958	4281	1.9	1.7
45	42.0	12.8	23.2	7.1	1312	593	30438	4210	1.9	1.7
46	41.7	12.7	23.1	7.0	1300	593	30030	4151	1.8	1.7
47	41.3	12.6	22.9	7.0	1289	583	29518	4081	1.8	1.7
48	41.0	12.5	22.7	6.9	1283	584	29124	4030	1.8	1.6
49	40.6	12.4	22.5	6.9	1272	574	28620	3961	1.8	1.6
50	40.3	12.3	22.4	6.8	1261	574	28246	3903	1.8	1.6
51	39.9	12.2	22.7	6.9	1028	467	23336	3222	1.1	1.0
52	39.6	12.1	22.5	6.9	1023	461	23018	3181	1.1	1.0
53	39.3	12.0	22.3	6.8	1018	462	22701	3142	1.1	1.0
54	38.9	11.9	22.1	6.8	1009	454	22299	3087	1.1	1.0
55	38.6	11.8	22.0	6.7	1000	454	22000	3042	1.1	1.0
56	38.3	11.7	21.8	6.7	996	448	21713	3002	1.1	1.0
57	38.0	11.6	21.7	6.6	987	448	21418	2957	1.1	1.0
58	37.7	11.5	21.5	6.6	982	442	21113	2917	1.1	1.0
59	37.4	11.4	21.4	6.5	973	443	20822	2880	1.0	1.0
60	37.1	11.3	21.2	6.5	968	437	20522	2841	1.0	0.9
61	36.8	11.2	21.1	6.4	959	437	20235	2797	1.0	0.9
62	36.5	11.1	20.9	6.4	955	431	19959	2758	1.0	0.9
63	36.3	11.1	20.8	6.3	950	434	19760	2734	1.0	0.9
64	36.0	11.0	20.7	6.3	941	427	19479	2690	1.0	0.9
65	35.7	10.9	20.5	6.3	937	421	19209	2652	1.0	0.9
66	35.5	10.8	20.4	6.2	932	424	19013	2629	1.0	0.9
67	35.2	10.7	20.3	6.2	923	418	18737	2592	1.0	0.9
68	34.9	10.6	20.1	6.1	918	418	18452	2550	1.0	0.9
69	34.7	10.6	20.0	6.1	914	414	18280	2525	1.0	0.9
70	34.4	10.5	19.9	6.1	905	408	18009	2489	1.0	0.9

$H_4 = H_2 + 4'$ (1.2 m)

Mechanical Specifications
Type TFU-28DAS Skull Pattern

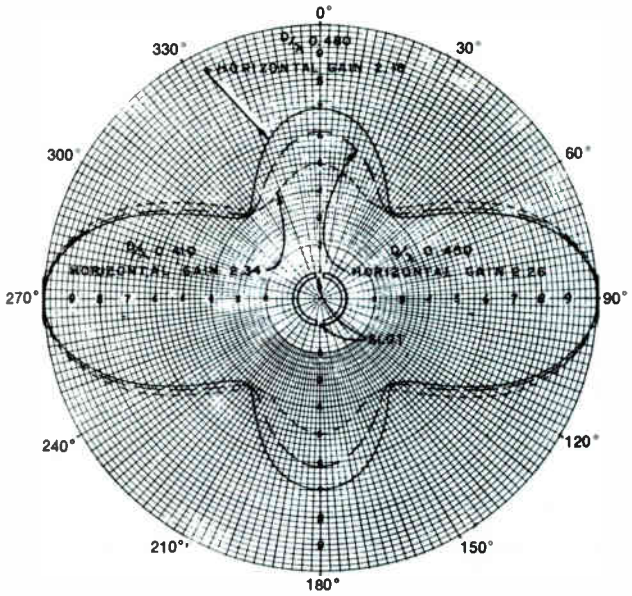
Ch. No.	H_2 Ft	H_2 M	D_1 Ft	D_1 M	R_1 Lbs	R_1 Kg	Moment Ft-Lbs	Moment M-Kg	Weight Ton	Weight MT
14	68.6	20.9	36.2	11.0	2462	1120	89124	12320	4.3	3.9
15	67.7	20.6	35.7	10.9	2435	1102	86929	12012	4.3	3.9
16	66.9	20.4	35.3	10.8	2407	1088	84967	11750	4.2	3.8
17	66.1	20.1	34.9	10.6	2380	1083	83062	11480	4.2	3.8
18	65.3	19.9	34.5	10.5	2353	1069	81179	11225	4.1	3.7
19	64.5	19.7	34.1	10.4	2326	1054	79317	10962	4.1	3.7
20	63.8	19.4	33.8	10.3	2298	1043	77672	10743	4.0	3.7
21	63.1	19.2	33.4	10.2	2278	1031	76085	10516	4.0	3.6
22	62.4	19.0	33.1	10.1	2250	1020	74475	10302	4.0	3.6
23	61.7	18.8	32.7	10.0	2230	1008	72921	10080	3.9	3.6
24	61.0	18.6	32.4	9.9	2203	997	71377	9870	3.9	3.5
25	60.3	18.4	32.0	9.8	2183	985	69856	9653	3.8	3.5
26	59.7	18.2	31.7	9.7	2162	977	68535	9477	3.8	3.4
27	59.0	18.0	31.4	9.6	2135	965	67039	9264	3.8	3.4
28	58.4	17.8	31.1	9.5	2115	957	65776	9092	3.7	3.4
29	57.8	17.6	30.8	9.4	2094	949	64495	8921	3.7	3.3
30	57.2	17.4	30.5	9.3	2074	940	63257	8742	3.7	3.3
31	56.6	17.2	30.4	9.3	1875	847	57000	7877	2.9	2.6
32	56.0	17.1	30.1	9.2	1857	840	55896	7728	2.9	2.6
33	55.5	16.9	29.8	9.1	1844	835	54951	7598	2.9	2.6
34	54.9	16.7	29.5	9.0	1826	827	53867	7443	2.8	2.6
35	54.4	16.6	29.3	8.9	1807	822	52945	7316	2.8	2.6
36	53.8	16.4	29.0	8.8	1789	815	51881	7172	2.8	2.5
37	53.3	16.3	28.7	8.8	1776	801	50971	7049	2.8	2.5
38	52.8	16.1	28.5	8.7	1758	796	50103	6925	2.7	2.5
39	52.3	15.9	28.2	8.6	1745	791	49209	6803	2.7	2.5
40	51.8	15.8	28.0	8.5	1727	786	48356	6681	2.7	2.4
41	51.3	15.6	27.9	8.5	1571	713	43831	6061	2.2	2.0
42	50.9	15.5	27.7	8.4	1560	711	43212	5972	2.2	2.0
43	50.4	15.4	27.4	8.4	1549	698	42443	5863	2.2	2.0
44	50.0	15.2	27.2	8.3	1537	696	41806	5777	2.2	2.0
45	49.5	15.1	27.0	8.2	1520	692	41040	5674	2.1	1.9
46	49.1	15.0	26.8	8.2	1509	682	40441	5592	2.1	1.9
47	48.6	14.8	26.5	8.1	1498	678	39697	5492	2.1	1.9
48	48.2	14.7	26.3	8.0	1487	676	39108	5408	2.1	1.9
49	47.8	14.6	26.1	8.0	1475	665	38497	5320	2.1	1.9
50	47.4	14.4	25.9	7.9	1464	664	37918	5246	2.1	1.9
51	47.0	14.3	25.7	7.8	1453	662	37342	5164	2.0	1.9
52	46.6	14.2	25.5	7.8	1442	652	36771	5086	2.0	1.8

$H_4 = H_2 + 4'$ (1.2 m)

World Radio History

Mechanical Specifications

Peanut Directional Patterns, Type TFU-30JDA



Symbol Definitions (Drawing above):

D = Pole outer diameter

λ = Mid-channel wavelength

Note: Gain and pattern vary with D/λ ratio.

Mechanical Specifications
Type TFU-30JDA Peanut Pattern

Ch. No.	H_2 Ft	H_2 M	D_1 Ft	D_1 M	R_1 Lbs	R_1 Kg	Moment Ft-Lbs	Moment M-Kg	Weight Ton	Weight MT
14	57.1	17.4	30.4	9.3	2074	937	63050	8714	3.6	3.3
15	56.4	17.2	30.1	9.2	2047	926	61615	8519	3.6	3.3
16	55.7	17.0	29.7	9.1	2026	914	60172	8317	3.6	3.2
17	55.1	16.8	29.4	9.0	2006	906	58976	8154	3.5	3.2
18	54.4	16.6	29.1	8.9	1979	894	57589	7957	3.5	3.2
19	53.8	16.4	28.8	8.8	1958	886	56390	7797	3.4	3.1
20	53.2	16.2	28.5	8.7	1938	878	55233	7639	3.4	3.1
21	52.6	16.0	28.2	8.6	1917	869	54059	7473	3.4	3.1
22	52.0	15.9	27.9	8.5	1897	861	52926	7319	3.3	3.0
23	51.5	15.7	27.6	8.4	1883	855	51971	7182	3.3	3.0
24	50.9	15.5	27.3	8.3	1863	847	50860	7030	3.3	3.0
25	50.4	15.3	27.1	8.3	1842	832	49918	6906	3.2	2.9
26	49.8	15.2	27.0	8.2	1665	758	44955	6216	2.6	2.3
27	49.3	15.0	26.7	8.1	1653	753	44135	6099	2.6	2.3
28	48.8	14.9	26.5	8.1	1634	739	43301	5986	2.5	2.3
29	48.3	14.7	26.2	8.0	1622	734	42496	5872	2.5	2.3
30	47.8	14.6	26.0	7.9	1603	729	41678	5759	2.5	2.3
31	47.3	14.4	25.7	7.8	1591	725	40889	5655	2.5	2.2
32	46.9	14.3	25.5	7.8	1578	713	40239	5561	2.4	2.2
33	46.4	14.1	25.3	7.7	1560	709	39468	5459	2.4	2.2
34	46.0	14.0	25.0	7.6	1553	706	38825	5366	2.4	2.2
35	45.5	13.9	24.8	7.6	1535	693	38068	5267	2.4	2.2
36	45.1	13.7	24.6	7.5	1522	690	37441	5175	2.4	2.1
37	44.7	13.6	24.6	7.5	1385	628	34071	4710	1.9	1.7
38	44.2	13.5	24.3	7.4	1374	624	33388	4618	1.9	1.7
39	43.8	13.4	24.1	7.4	1363	614	32848	4544	1.9	1.7
40	43.4	13.2	23.9	7.3	1352	612	32313	4468	1.9	1.7
41	43.0	13.1	23.7	7.2	1340	610	31758	4392	1.9	1.7
42	42.7	13.0	23.6	7.2	1329	602	31364	4334	1.8	1.7
43	42.3	12.9	23.4	7.1	1317	600	30818	4260	1.8	1.7
44	41.9	12.8	23.2	7.1	1306	590	30299	4189	1.8	1.6
45	41.6	12.7	23.0	7.0	1300	591	29900	4137	1.8	1.6
46	41.2	12.6	22.8	7.0	1289	581	29389	4067	1.8	1.6
47	40.8	12.4	22.6	6.9	1278	579	28883	3995	1.8	1.6
48	40.5	12.3	22.5	6.8	1267	579	28508	3937	1.8	1.6
49	40.2	12.2	22.3	6.8	1261	572	28120	3890	1.7	1.6
50	39.8	12.1	22.1	6.7	1250	570	27625	3819	1.7	1.6
51	39.5	12.0	22.4	6.8	1023	466	22915	3169	1.0	0.9
52	39.2	11.9	22.3	6.8	1014	460	22612	3128	1.0	0.9
53	38.9	11.8	22.1	6.7	1009	460	22299	3082	1.0	0.9
54	38.6	11.8	22.0	6.7	1000	454	22000	3042	1.0	0.9
55	38.3	11.7	21.8	6.7	995	448	21691	3002	1.0	0.9
56	38.0	11.6	21.7	6.6	986	448	21396	2957	1.0	0.9
57	37.7	11.5	21.5	6.6	982	442	21113	2917	1.0	0.9
58	37.4	11.4	21.4	6.5	973	443	20822	2880	1.0	0.9
59	37.1	11.3	21.2	6.5	968	437	20522	2841	1.0	0.9
60	36.8	11.2	21.1	6.4	959	437	20235	2797	1.0	0.9
61	36.5	11.1	20.9	6.4	955	431	19959	2758	1.0	0.9
62	36.3	11.0	20.8	6.3	950	434	19760	2734	1.0	0.9
63	36.0	11.0	20.7	6.3	941	427	19479	2690	1.0	0.9
64	35.7	10.9	20.5	6.3	937	421	19209	2652	0.9	0.9
65	35.5	10.8	20.4	6.2	932	424	19013	2629	0.9	0.9
66	35.2	10.7	20.3	6.2	923	418	18737	2592	0.9	0.8
67	35.0	10.7	20.2	6.1	918	420	18544	2562	0.9	0.8
68	34.7	10.6	20.0	6.1	914	414	18280	2525	0.9	0.8
69	34.5	10.5	19.9	6.1	909	410	18089	2501	0.9	0.8
70	34.2	10.4	19.8	6.0	900	411	17820	2466	0.9	0.8

$H_4 = H_2 + 4'$ (1.2 m)

World Radio History

Mechanical Specifications

Peanut Directional Patterns, Types TFU-30JDAS, -28DAS

Mechanical Specifications
Type TFU-30JDAS Peanut Pattern

Ch. No.	H_2 Ft	H_2 M	D_1 Ft	D_1 M	R_1 Lbs	R_1 Kg	Moment Ft-Lbs	Moment M-Kg	Weight Ton	Weight MT
14	58.7	17.9	31.2	9.5	2128	966	66394	9177	3.7	3.4
15	58.0	17.7	30.9	9.4	2101	955	64921	8977	3.7	3.4
16	57.3	17.5	30.5	9.3	2080	943	63440	8770	3.7	3.3
17	56.6	17.2	30.2	9.2	2053	932	62001	8574	3.6	3.3
18	55.9	17.0	29.8	9.1	2033	920	60583	8372	3.6	3.2
19	55.3	16.8	29.5	9.0	2012	912	59354	8208	3.5	3.2
20	54.6	16.6	29.2	8.9	1985	901	57962	8019	3.5	3.2
21	54.0	16.5	28.9	8.8	1965	892	56788	7850	3.5	3.1
22	53.4	16.3	28.6	8.7	1944	884	55598	7691	3.4	3.1
23	52.8	16.1	28.3	8.6	1924	875	54449	7525	3.4	3.1
24	52.2	15.9	28.0	8.5	1904	867	53312	7370	3.4	3.1
25	51.6	15.7	27.7	8.4	1883	859	52159	7216	3.3	3.0
26	51.1	15.6	27.6	8.4	1708	776	47141	6518	2.7	2.4
27	50.5	15.4	27.3	8.3	1690	768	46137	6374	2.6	2.4
28	50.0	15.2	27.1	8.2	1671	764	45284	6265	2.6	2.4
29	49.5	15.1	26.8	8.2	1659	749	44461	6142	2.6	2.3
30	49.0	14.9	26.6	8.1	1640	745	43624	6034	2.6	2.3
31	48.5	14.8	26.3	8.0	1628	740	42816	5920	2.5	2.3
32	48.0	14.6	26.1	7.9	1609	735	41995	5806	2.5	2.3
33	47.5	14.5	25.8	7.9	1597	721	41203	5696	2.5	2.3
34	47.0	14.3	25.6	7.8	1578	716	40397	5585	2.5	2.2
35	46.6	14.2	25.3	7.7	1572	714	39772	5498	2.4	2.2
36	46.1	14.1	25.1	7.7	1554	700	39005	5390	2.4	2.2
37	45.7	13.9	25.1	7.6	1413	645	35466	4902	2.0	1.8
38	45.2	13.8	24.8	7.6	1402	633	34770	4811	2.0	1.8
39	44.8	13.7	24.6	7.5	1391	631	34219	4733	2.0	1.8
40	44.4	13.5	24.4	7.4	1379	629	33648	4655	1.9	1.8
41	44.0	13.4	24.2	7.4	1368	619	33106	4581	1.9	1.8
42	43.6	13.3	24.0	7.3	1357	617	32568	4504	1.9	1.7
43	43.2	13.2	23.8	7.3	1346	607	32035	4431	1.9	1.7
44	42.8	13.0	23.6	7.2	1334	605	31482	4356	1.9	1.7
45	42.4	12.9	23.4	7.1	1323	603	30958	4281	1.9	1.7
46	42.0	12.8	23.2	7.1	1312	593	30438	4210	1.9	1.7
47	41.7	12.7	23.1	7.0	1300	593	30030	4151	1.8	1.7
48	41.3	12.6	22.9	7.0	1289	583	29518	4081	1.8	1.7
49	41.0	12.5	22.7	6.9	1283	584	29124	4030	1.8	1.6
50	40.6	12.4	22.5	6.9	1272	574	28620	3961	1.8	1.6
51	40.3	12.3	22.8	7.0	1041	469	23735	3283	1.1	1.0
52	39.9	12.2	22.7	6.9	1028	467	23336	3222	1.1	1.0
53	39.6	12.1	22.5	6.9	1023	461	23018	3181	1.1	1.0
54	39.3	12.0	22.3	6.8	1018	462	22701	3142	1.1	1.0
55	39.0	11.9	22.2	6.8	1009	455	22400	3094	1.1	1.0
56	38.6	11.8	22.0	6.7	1000	454	22000	3042	1.1	1.0
57	38.3	11.7	21.8	6.7	996	448	21713	3002	1.1	1.0
58	38.0	11.6	21.7	6.6	987	449	21418	2963	1.1	1.0
59	37.7	11.5	21.5	6.6	982	442	21113	2917	1.1	1.0
60	37.4	11.4	21.4	6.5	973	443	20822	2880	1.0	1.0
61	37.2	11.3	21.3	6.5	968	439	20618	2854	1.0	0.9
62	36.9	11.2	21.1	6.4	964	439	20340	2810	1.0	0.9
63	36.6	11.2	21.0	6.4	955	433	20055	2771	1.0	0.9
64	36.3	11.1	20.8	6.4	950	427	19760	2733	1.0	0.9
65	36.0	11.0	20.7	6.3	941	428	19479	2696	1.0	0.9
66	35.8	10.9	20.6	6.3	936	423	19282	2665	1.0	0.9
67	35.5	10.8	20.4	6.2	932	424	19013	2629	1.0	0.9
68	35.2	10.7	20.3	6.2	923	418	18737	2592	1.0	0.9
69	35.0	10.7	20.2	6.1	918	420	18544	2562	1.0	0.9
70	34.7	10.6	20.0	6.1	914	414	18280	2525	1.0	0.9

$H_1 = H_2 + 4'$ (1.2 m)

Mechanical Specifications
Type TFU-28DAS Peanut Pattern

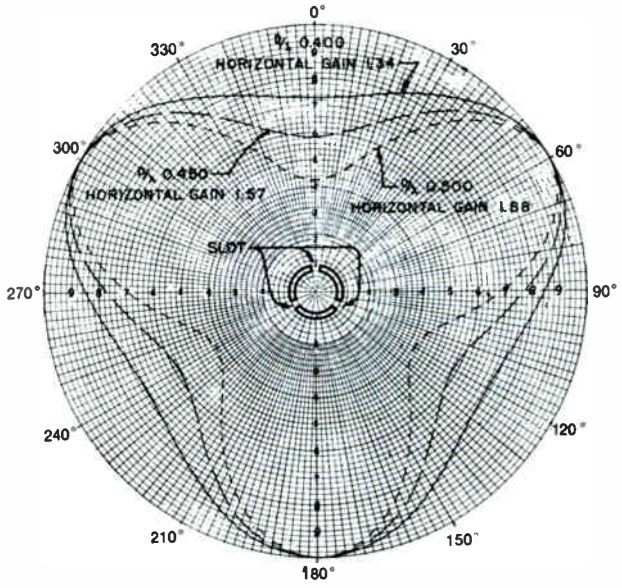
Ch. No.	H_2 Ft	H_2 M	D_1 Ft	D_1 M	R_1 Lbs	R_1 Kg	Moment Ft-Lbs	Moment M-Kg	Weight Ton	Weight MT
14	69.1	21.1	36.4	11.1	2482	1125	90345	12487	4.4	3.9
15	68.2	20.8	36.0	11.0	2448	1108	88128	12188	4.3	3.9
16	67.4	20.5	35.6	10.8	2421	1103	86188	11912	4.3	3.9
17	66.6	20.3	35.2	10.7	2394	1089	84269	11652	4.2	3.8
18	65.8	20.1	34.8	10.6	2366	1074	82337	11384	4.2	3.8
19	65.0	19.8	34.4	10.5	2339	1060	80462	11130	4.1	3.7
20	64.3	19.6	34.0	10.4	2319	1048	78846	10899	4.1	3.7
21	63.5	19.4	33.6	10.3	2292	1034	77011	10650	4.0	3.7
22	62.8	19.1	33.3	10.1	2264	1032	75391	10423	4.0	3.6
23	62.1	18.9	32.9	10.0	2244	1021	73828	10210	3.9	3.6
24	61.4	18.7	32.6	9.9	2217	1009	72274	9989	3.9	3.5
25	60.8	18.5	32.3	9.8	2196	1001	70931	9810	3.9	3.5
26	60.1	18.3	32.1	9.8	1987	900	63783	8820	3.1	2.8
27	59.5	18.1	31.8	9.7	1968	892	62582	8652	3.0	2.8
28	58.8	17.9	31.5	9.6	1943	882	61205	8467	3.0	2.7
29	58.2	17.7	31.2	9.5	1925	874	60060	8303	3.0	2.7
30	57.6	17.6	30.9	9.4	1906	866	58895	8140	3.0	2.7
31	57.0	17.4	30.6	9.3	1888	859	57773	7989	2.9	2.7
32	56.4	17.2	30.3	9.2	1869	851	56631	7829	2.9	2.6
33	55.9	17.0	30.0	9.1	1857	846	55710	7699	2.9	2.6
34	55.3	16.9	29.7	9.1	1838	829	54589	7544	2.9	2.6
35	54.8	16.7	29.5	9.0	1819	825	53661	7425	2.8	2.6
36	54.2	16.5	29.2	8.9	1801	817	52589	7271	2.8	2.5
37	53.7	16.4	29.1	8.9	1639	741	47695	6595	2.3	2.1
38	53.2	16.2	28.8	8.8	1628	736	46886	6477	2.3	2.1
39	52.7	16.1	28.6	8.7	1611	732	46075	6368	2.3	2.1
40	52.2	15.9	28.3	8.6	1599	728	45252	6261	2.2	2.0
41	51.7	15.8	28.1	8.6	1583	715	44482	6149	2.2	2.0
42	51.3	15.6	27.9	8.5	1571	713	43831	6061	2.2	2.0
43	50.8	15.5	27.6	8.4	1560	709	43056	5956	2.2	2.0
44	50.3	15.3	27.4	8.3	1543	704	42278	5843	2.2	2.0
45	49.9	15.2	27.2	8.3	1532	694	41670	5760	2.2	2.0
46	49.4	15.1	26.9	8.2	1521	690	40915	5658	2.1	1.9
47	49.0	14.9	26.7	8.1	1509	688	40290	5573	2.1	1.9
48	48.6	14.8	26.5	8.1	1498	677	39697	5484	2.1	1.9
49	48.2	14.7	26.3	8.0	1486	676	39082	5408	2.1	1.9
50	47.8	14.6	26.1	8.0	1475	665	38497	5320	2.1	1.9

$H_1 = H_2 + 4'$ (1.2 m)

World Radio History

Mechanical Specifications

Trilobe Directional Pattern, Type TFU-30JDA



Symbol Definitions (Drawing above):

D = Pole outer diameter

λ = Mid-channel wavelength

Note: Gain and pattern vary with D/λ ratio.

Mechanical Specifications
Type TFU-30JDA Trilobe Pattern

Ch. No.	H_2 Ft	H_2 M	D_1 Ft	D_1 M	R_1 Lbs	R_1 Kg	Moment Ft-Lbs	Moment M-Kg	Weight Ton	Weight MT
14	57.1	17.4	30.2	9.2	2387	1083	72087	9964	5.0	4.5
15	56.4	17.2	29.8	9.1	2364	1070	70447	9737	4.9	4.5
16	55.7	17.0	29.5	9.0	2332	1057	68794	9513	4.9	4.4
17	55.1	16.8	29.2	8.9	2308	1047	67394	9318	4.8	4.4
18	54.4	16.6	28.8	8.8	2285	1034	65808	9099	4.8	4.3
19	53.8	16.4	28.5	8.7	2261	1024	64439	8909	4.7	4.3
20	53.2	16.2	28.2	8.6	2237	1014	63083	8720	4.7	4.2
21	52.6	16.0	27.9	8.5	2213	1004	61743	8534	4.6	4.2
22	52.0	15.9	27.6	8.4	2190	995	60444	8358	4.6	4.1
23	51.5	15.7	27.6	8.4	1883	855	51971	7182	3.3	3.0
24	50.9	15.5	27.3	8.3	1863	847	50860	7030	3.3	3.0
25	50.4	15.3	27.1	8.3	1842	832	49918	6906	3.2	2.9
26	49.8	15.2	26.8	8.2	1822	823	48830	6749	3.2	2.9
27	49.3	15.0	26.5	8.1	1808	818	47912	6626	3.2	2.9
28	48.8	14.9	26.3	8.0	1788	813	47024	6504	3.1	2.9
29	48.3	14.7	26.0	7.9	1774	807	46124	6375	3.1	2.8
30	47.8	14.6	25.8	7.9	1754	792	45253	6257	3.1	2.8
31	47.3	14.4	25.5	7.8	1740	787	44370	6139	3.1	2.8
32	46.9	14.3	25.3	7.7	1726	784	43668	6037	3.0	2.7
33	46.4	14.1	25.1	7.6	1706	779	42821	5920	3.0	2.7
34	46.0	14.0	24.9	7.6	1692	767	42131	5829	3.0	2.7
35	45.5	13.9	24.6	7.5	1679	761	41303	5708	2.9	2.7
36	45.1	13.7	24.6	7.5	1522	690	37441	5175	2.4	2.1
37	44.7	13.6	24.4	7.4	1510	688	36844	5091	2.3	2.1
38	44.2	13.5	24.2	7.4	1492	675	36106	4995	2.3	2.1
39	43.8	13.4	24.0	7.3	1479	672	35496	4906	2.3	2.1
40	43.4	13.2	23.8	7.2	1467	670	34915	4824	2.3	2.1
41	43.0	13.1	23.6	7.2	1455	659	34338	4745	2.3	2.0
42	42.7	13.0	23.4	7.1	1448	660	33883	4686	2.2	2.0
43	42.3	12.9	23.2	7.1	1436	649	33315	4608	2.2	2.0
44	41.9	12.8	23.0	7.0	1424	647	32752	4529	2.2	2.0
45	41.6	12.7	22.8	7.0	1417	638	32308	4466	2.2	2.0
46	41.2	12.6	22.6	6.9	1405	636	31753	4388	2.2	2.0
47	40.8	12.4	22.4	6.8	1393	634	31203	4311	2.1	1.9
48	40.5	12.3	22.3	6.8	1380	626	30774	4257	2.1	1.9
49	40.2	12.2	22.1	6.7	1374	626	30365	4194	2.1	1.9
50	39.8	12.1	21.9	6.7	1362	615	29828	4120	2.1	1.9
51	39.5	12.0	22.0	6.7	1238	562	27236	3765	1.7	1.6
52	39.2	11.9	21.8	6.7	1233	555	26879	3718	1.7	1.5
53	38.9	11.8	21.7	6.6	1221	555	26496	3663	1.7	1.5
54	38.6	11.8	21.5	6.6	1216	547	26144	3610	1.7	1.5
55	38.3	11.7	21.4	6.5	1204	548	25766	3562	1.7	1.5
56	38.0	11.6	21.2	6.5	1199	540	25419	3510	1.7	1.5
57	37.7	11.5	21.1	6.4	1187	541	25046	3462	1.6	1.5
58	37.4	11.4	20.9	6.4	1182	534	24704	3418	1.6	1.5
59	37.1	11.3	20.8	6.3	1171	534	24357	3364	1.6	1.5
60	36.8	11.2	20.6	6.3	1165	527	23999	3320	1.6	1.5
61	36.5	11.1	20.5	6.2	1154	527	23657	3267	1.6	1.4
62	36.3	11.0	20.4	6.2	1148	522	23419	3236	1.6	1.4

$H_4 = H_2 + 4'$ (1.2 m)

World Radio History

Mechanical Specifications

Trilobe Directional Patterns, Types TFU-28DAS, -30JDAS

Mechanical Specifications
Type TFU-30JDAS Trilobe Pattern

Ch. No.	H_2 Ft	H_2 M	D_1 Ft	D_1 M	R_1 Lbs	R_1 Kg	Moment Ft-Lbs	Moment M-Kg	Weight Ton	Weight MT
14	58.7	17.9	31.2	9.5	2128	966	66394	9177	3.7	3.4
15	58.0	17.7	30.9	9.4	2101	955	64921	8977	3.7	3.4
16	57.3	17.5	30.5	9.3	2080	943	63440	8770	3.7	3.3
17	56.6	17.2	30.2	9.2	2053	932	62001	8574	3.6	3.3
18	55.9	17.0	29.8	9.1	2033	920	60583	8372	3.6	3.2
19	55.3	16.8	29.5	9.0	2012	912	59354	8208	3.5	3.2
20	54.6	16.6	29.2	8.9	1985	901	57962	8019	3.5	3.2
21	54.0	16.5	28.9	8.8	1965	892	56788	7850	3.5	3.1
22	53.4	16.3	28.6	8.7	1944	884	55598	7691	3.4	3.1
23	52.8	16.1	28.3	8.6	1924	875	54449	7525	3.4	3.1
24	52.2	15.9	28.0	8.5	1904	867	53312	7370	3.4	3.1
25	51.6	15.7	27.7	8.4	1883	859	52159	7216	3.3	3.0
26	51.1	15.6	27.4	8.4	1869	843	51211	7081	3.3	3.0
27	50.5	15.4	27.1	8.3	1849	835	50108	6930	3.3	3.0
28	50.0	15.2	26.9	8.2	1829	829	49200	6798	3.2	2.9
29	49.5	15.1	26.6	8.1	1815	824	48279	6674	3.2	2.9
30	49.0	14.9	26.4	8.0	1794	819	47362	6552	3.2	2.9
31	48.5	14.8	26.1	8.0	1781	803	46484	6424	3.1	2.9
32	48.0	14.6	25.9	7.9	1760	798	45584	6304	3.1	2.8
33	47.5	14.5	25.6	7.8	1747	793	44723	6185	3.1	2.8
34	47.0	14.3	25.4	7.7	1727	787	43866	6060	3.1	2.8
35	46.6	14.2	25.2	7.7	1713	775	43168	5967	3.0	2.8
36	46.1	14.1	25.1	7.7	1554	700	39005	5390	2.4	2.2
37	45.7	13.9	24.9	7.6	1541	698	38371	5305	2.4	2.2
38	45.2	13.8	24.7	7.5	1523	693	37618	5198	2.4	2.2
39	44.8	13.7	24.4	7.5	1516	682	36990	5115	2.4	2.1
40	44.4	13.5	24.2	7.4	1504	680	36397	5032	2.3	2.1
41	44.0	13.4	24.0	7.3	1492	678	35808	4949	2.3	2.1
42	43.6	13.3	23.8	7.3	1479	667	35200	4869	2.3	2.1
43	43.2	13.2	23.6	7.2	1467	665	34621	4788	2.3	2.1
44	42.8	13.0	23.4	7.1	1454	663	34024	4707	2.3	2.1
45	42.4	12.9	23.2	7.1	1442	652	33454	4629	2.3	2.0
46	42.0	12.8	23.0	7.0	1430	650	32890	4550	2.2	2.0
47	41.7	12.7	22.9	7.0	1417	641	32449	4487	2.2	2.0
48	41.3	12.6	22.7	6.9	1405	639	31893	4409	2.2	2.0
49	41.0	12.5	22.5	6.9	1399	631	31478	4354	2.2	2.0
50	40.6	12.4	22.3	6.8	1386	629	30908	4277	2.2	2.0
51	40.3	12.3	22.4	6.8	1261	574	28246	3903	1.8	1.6
52	39.9	12.2	22.2	6.8	1250	564	27750	3835	1.8	1.6
53	39.6	12.1	22.0	6.7	1244	565	27368	3785	1.8	1.6
54	39.3	12.0	21.9	6.7	1233	557	27003	3732	1.8	1.6
55	39.0	11.9	21.7	6.6	1227	558	26626	3683	1.7	1.6
56	38.6	11.8	21.5	6.6	1216	548	26144	3617	1.7	1.6
57	38.3	11.7	21.4	6.5	1205	548	25787	3562	1.7	1.6
58	38.0	11.6	21.2	6.5	1199	541	25419	3517	1.7	1.5
59	37.7	11.5	21.1	6.4	1188	541	25067	3462	1.7	1.5
60	37.4	11.4	20.9	6.4	1182	534	24704	3418	1.7	1.5
61	37.2	11.3	20.8	6.3	1176	537	24461	3383	1.7	1.5
62	36.9	11.2	20.7	6.3	1165	529	24115	3333	1.7	1.5
63	36.6	11.2	21.0	6.4	955	433	20055	2771	1.0	0.9
64	36.3	11.1	20.8	6.4	950	427	19760	2733	1.0	0.9
65	36.0	11.0	20.7	6.3	941	428	19479	2696	1.0	0.9
66	35.8	10.9	20.6	6.3	936	423	19282	2665	1.0	0.9
67	35.5	10.8	20.4	6.2	932	424	19013	2629	1.0	0.9
68	35.2	10.7	20.3	6.2	923	418	18737	2592	1.0	0.9
69	35.0	10.7	20.2	6.1	918	420	18544	2562	1.0	0.9
70	34.7	10.6	20.0	6.1	914	414	18280	2525	1.0	0.9

$H_4 = H_2 + 4'$ (1.2 m)

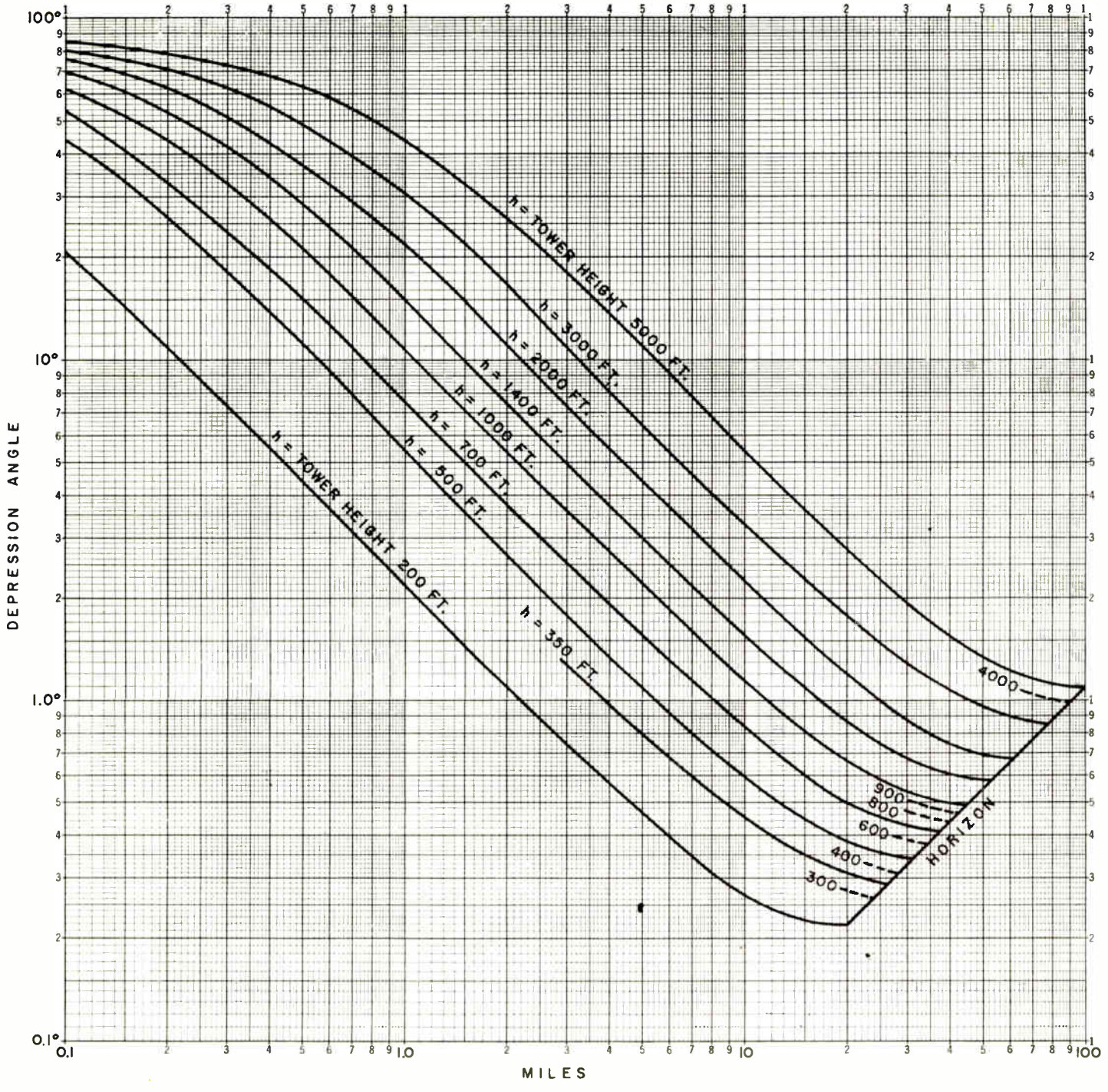
Mechanical Specifications
Type TFU-28DAS Trilobe Pattern

Ch. No.	H_2 Ft	H_2 M	D_1 Ft	D_1 M	R_1 Lbs	R_1 Kg	Moment Ft-Lbs	Moment M-Kg	Weight Ton	Weight MT
14	69.1	21.1	36.4	11.1	2482	1125	90345	12487	4.4	3.9
15	68.2	20.8	36.0	11.0	2448	1108	88128	12188	4.3	3.9
16	67.4	20.5	35.6	10.8	2421	1103	86188	11912	4.3	3.9
17	66.6	20.3	35.2	10.7	2394	1089	84269	11652	4.2	3.8
18	65.8	20.1	34.8	10.6	2366	1074	82337	11384	4.2	3.8
19	65.0	19.8	34.4	10.5	2339	1060	80462	11130	4.1	3.7
20	64.3	19.6	34.0	10.4	2319	1048	78846	10899	4.1	3.7
21	63.5	19.4	33.6	10.3	2292	1034	77011	10650	4.0	3.7
22	62.8	19.1	33.3	10.1	2264	1032	75391	10423	4.0	3.6
23	62.1	18.9	32.9	10.0	2244	1021	73828	10210	3.9	3.6
24	61.4	18.7	32.6	9.9	2217	1009	72274	9989	3.9	3.5
25	60.8	18.5	32.3	9.8	2196	1001	70931	9810	3.9	3.5
26	60.1	18.3	31.9	9.7	2176	989	69414	9593	3.8	3.5
27	59.5	18.1	31.6	9.6	2155	981	68098	9418	3.8	3.4
28	58.8	17.9	31.3	9.5	2128	969	66606	9206	3.8	3.4
29	58.2	17.7	31.0	9.4	2108	961	65348	9033	3.7	3.4
30	57.6	17.6	30.7	9.4	2087	943	64071	8864	3.7	3.3
31	57.0	17.4	30.4	9.3	2067	934	62837	8686	3.6	3.3
32	56.4	17.2	30.1	9.2	2047	926	61615	8519	3.6	3.3
33	55.9	17.0	29.8	9.1	2033	920	60583	8372	3.6	3.2
34	55.3	16.9	29.5	9.0	2013	912	59384	8208	3.5	3.2
35	54.8	16.7	29.3	8.9	1992	907	58366	8072	3.5	3.2
36	54.2	16.5	29.2	8.9	1801	817	52589	7271	2.8	2.5
37	53.7	16.4	28.9	8.8	1789	812	51702	7146	2.8	2.5
38	53.2	16.2	28.7	8.7	1770	807	50799	7021	2.9	2.5
39	52.7	16.1	28.4	8.7	1758	793	49927	6899	2.7	2.5
40	52.2	15.9	28.2	8.6	1739	788	49040	6777	2.7	2.5
41	51.7	15.8	27.9	8.5	1727	784	48183	6664	2.7	2.4
42	51.3	15.6	27.7	8.4	1714	782	47478	6569	2.7	2.4
43	50.8	15.5	27.5	8.4	1696	768	46640	6451	2.6	2.4
44	50.3	15.3	27.2	8.3	1684	763	45805	6333	2.6	2.4
45	49.9	15.2	27.0	8.2	1671	761	45117	6240	2.6	2.4
46	49.4	15.1	26.8	8.2	1653	747	44300	6125	2.6	2.3
47	49.0	14.9	26.6	8.1	1640	745	43624	6034	2.6	2.3
48	48.6	14.8	26.4	8.0	1628	743	42979	5944	2.5	2.3
49	48.2	14.7	26.1	8.0	1621	731	42308	5848	2.5	2.3
50	47.8	14.6	25.9	7.9	1609	729	41673	5759	2.5	2.3
51	47.3	14.4	25.9	7.9	1459	661	37788	5222	2.1	1.9
52	47.0	14.3	25.7	7.8	1453	662	37342	5164	2.0	1.9
53	46.6	14.2	25.5	7.8	1441	651	36746	5078	2.0	1.8
54	46.2	14.1	25.3	7.7	1430	650	36179	5005	2.0	1.8
55	45.8	14.0	25.1	7.7	1419	639	35617	4920	2.0	1.8
56	45.4	13.8	24.9	7.6	1408	638	35059	4849	2.0	1.8
57	45.1	13.7	24.8	7.6	1396	630	34621	4788	2.0	1.8
58	44.7	13.6	24.6	7.5	1385	628	34071	4710	2.0	1.8
59	44.4	13.5	24.4	7.4	1379	629	33648	4655	1.9	1.8
60	44.0	13.4	24.2	7.4	1368	619	33106	4581	1.9	1.8
61	43.7	13.3	24.1	7.3	1357	619	32704	4519	1.9	1.7
62	43.3	13.2	23.9	7.3	1346	609	32169	4446	1.9	1.7

$H_4 = H_2 + 4'$ (1.2 m)

World Radio History

Depression Angle vs. Distance For Various Tower Heights



Accessories

Antenna De-Icer System	Custom Built
Rosemount Ice Detector	MI-561572
Thermostatic Sleetmaster Control	MI-27369A

Ordering Information

UHF-Pylon Antennas are, of necessity, custom built to order. Your RCA Broadcast Equipment Sales Representative is equipped to help you and your engineering consultant in the details of placing your order.

World Radio History

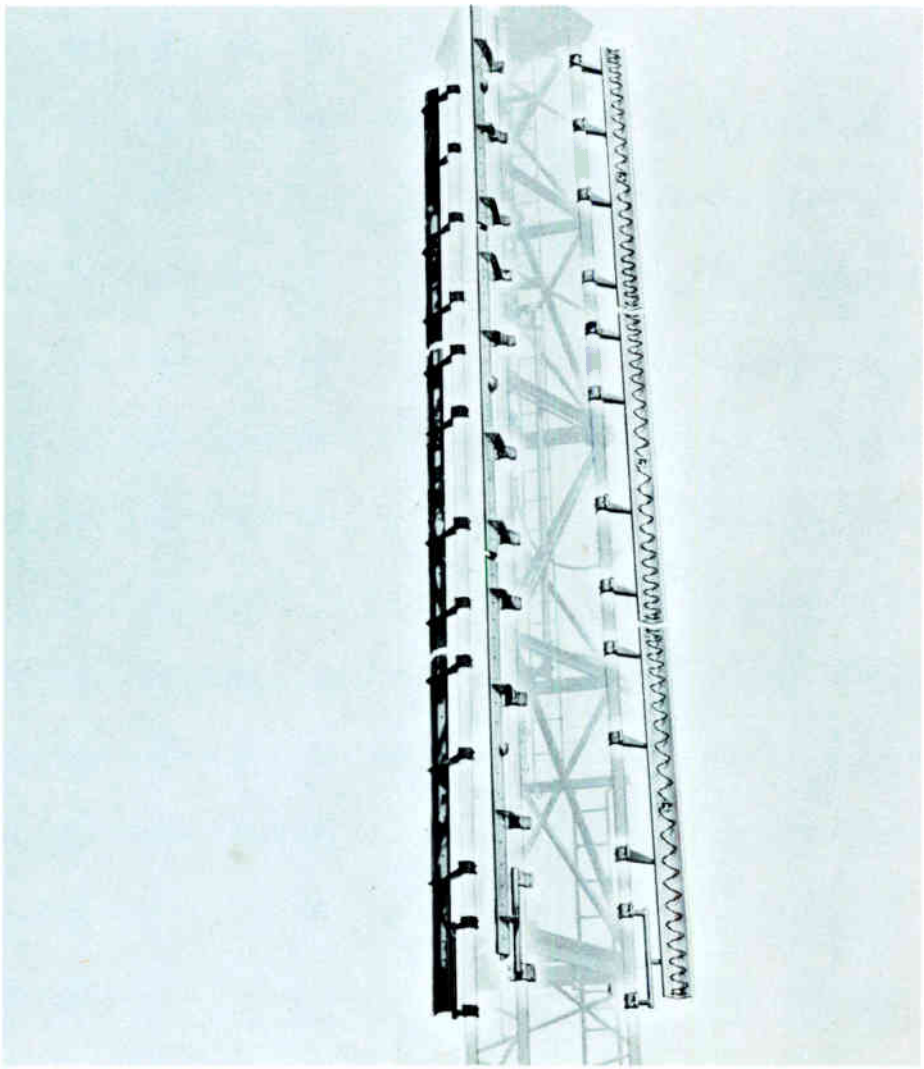
RCA

catalog TT.9220A

(Replaces B.5110)

Panel-Type Antennas, "Vee-Zee" and "Zee-Panel"

- For omni- or directional situations
- VSWR stability — end loaded radiators
- Simple, rugged construction — radomes included
- Side- or top-mount — increased gain with stacked arrays
- Lightning protected — grounded through tower



"Vee-Zee" and "Zee-Panel" antennas are side- or top-mount units for either omni- or directional antenna arrays. Antenna arrangements allow close control of the radiation pattern in both planes: vertical and horizontal. Vee-Zee and Zee-Panel antenna arrays are useful side-mounted supplements to the top-mounted "UHF-Pylon" antenna RCA has manufactured for some time.

World Radio History

Vee Zee and Zee Panel Type UHF Antennas meet requirements for either an omnidirectional or directional array that sidemounts on a tower which supports antennas for other services. They are also useful as top-mounted directional antennas where it is desirable to control closely or "sculpture" horizontal and vertical patterns. Either type antenna is, therefore, a useful supplement to the standard UHF Pylon antenna that proved ideal for both omnidirectional and certain other types of directional patterns in top-mounted situations.

With each element complete and electrically independent, a great flexibility in application is achieved through a building-block approach. Almost any desired antenna pattern can be achieved by the proper placement of one antenna panel relative to other panels and by varying the relative power input and phase of signal. The large aperture of each element, fed from a single end seal, strikes a balance between the mechanical complexity of many feedpoints and a lack of flexibility in pattern shaping resulting from too few feedpoints.

Radiating Elements

These UHF antennas employ two types of radiating elements—the Zee Panel and the Vee Zee Panel. The Zee antenna comprises zig-zag radiating elements branching two ways from a central feedpoint along a flat reflecting plane. The Vee Zee has the same configuration except that both the elements and the reflecting plane are bent in a *V* along a central longitudinal line. (See photo, preceding page).

The basic radiator operates on the proven traveling wave principle. To assure that the antenna rigorously conforms to this principle, a unique end loading design is incorporated, one at each end of the radiating elements. This strict adherence to the traveling wave principle provides inherent VSWR stability.

While both types of radiating elements are identical in electrical concept, their physical shapes offer advantages for particular requirements. Thus, where several services are stacked requiring relatively large size tower structures, excellent circularity for omnidirectional use and flexibility for directional use, is obtained at UHF frequencies by mounting three Vee Zee radiators, one on each of the three tower legs, so as to fire tangentially around the tower. (See drawings on Page 3 of this section.)

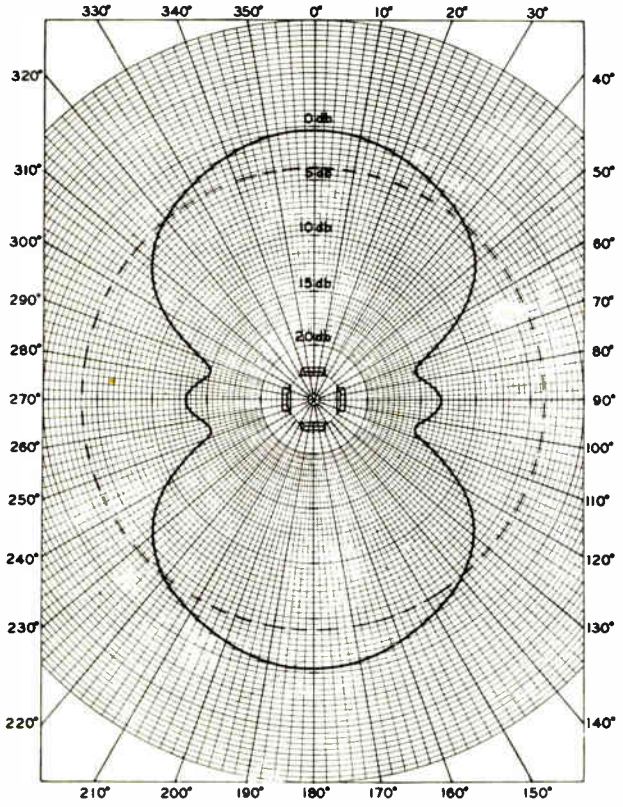
Where the antenna is mounted on top of the tower, either Vee Zee radiators (usually three in number) firing tangentially or Zee Panels (normally four) firing radially can be used.

"ZEE" PANEL

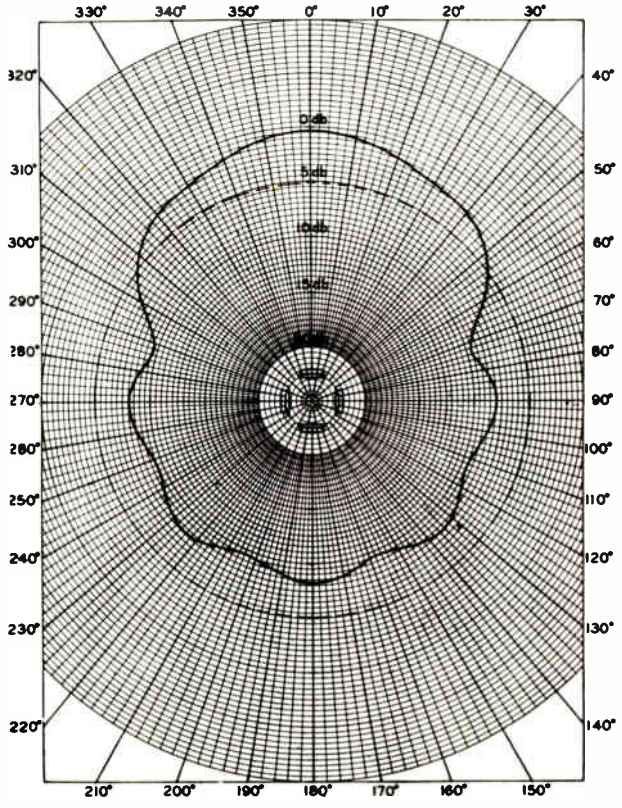
"VEE-ZEE" PANEL

Cross-section drawings point up the difference between "Vee-Zee" and "Zee-Panel" antennas.

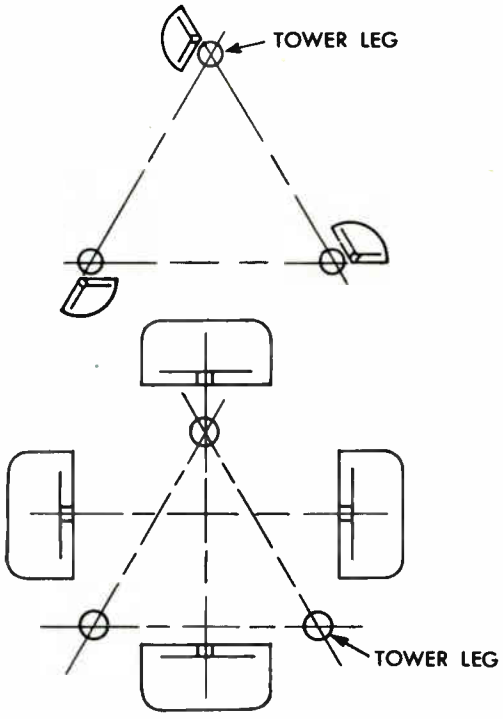
Directivity pattern obtainable with a top-mounted, four-around Zee-Panel array on a square tower. (Gain 2.39 or 3.8 dB.)



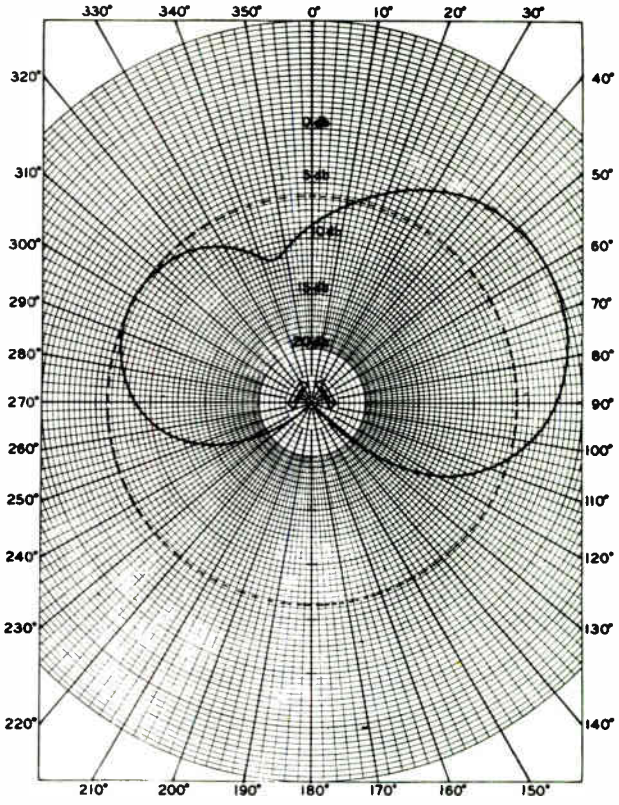
Directivity pattern obtainable with a top-mounted, four-around Zee-Panel array on a square tower. (Gain 3.24 or 5.1 dB.)



World Radio History

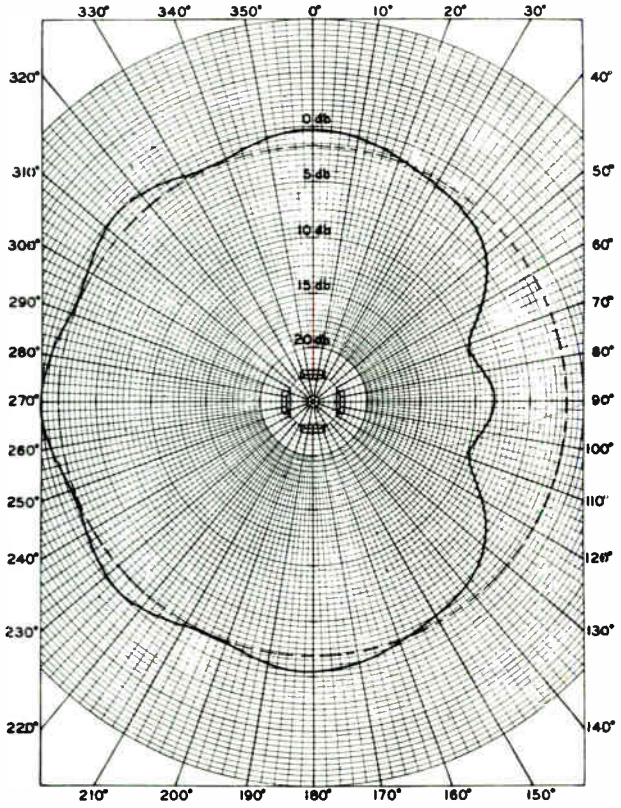


Panel antennas mount in three-around or four-around arrangements as shown here in line drawing.

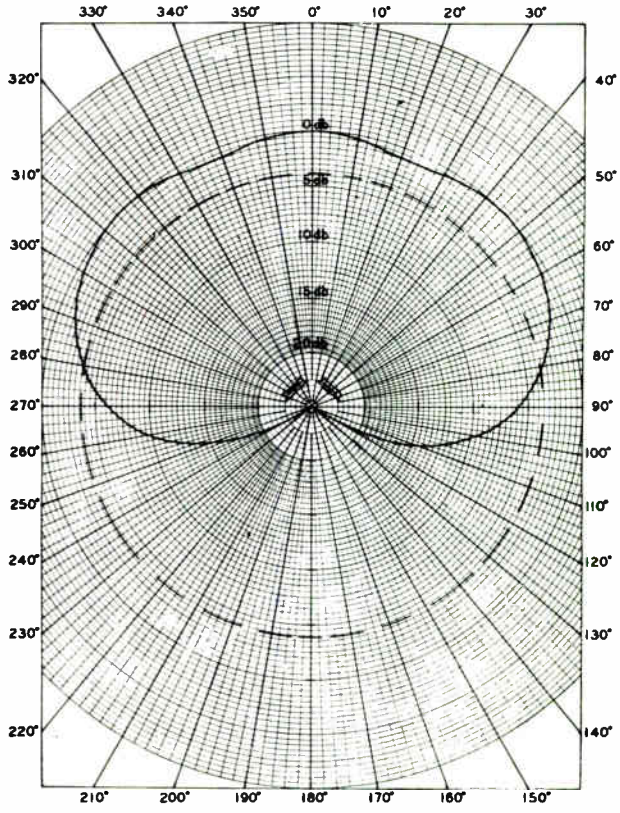


Directivity pattern obtainable with a top-mounted, two-panel Zee-Panel array on a triangular tower. (Gain 4.21 or 6.2 dB.)

Directivity pattern obtainable with a top-mounted, four-around Zee-Panel array on a square tower. (Gain 1.49 or 1.7 dB.)



Directivity pattern obtainable with a top-mounted, two-panel Zee-Panel array on a square tower. (Gain 2.42 or 3.8 dB.)



World Radio History

Horizontal Patterns

Excellent circularities varying between ±1 and ±3 dB (depending on application) are achieved by feeding equal power to all elements in a horizontal plane. Directional patterns are obtained by varying the amplitude and phase of the signals radiated and by changing relative spacings and wiring directions of the various elements. Examples of horizontal patterns obtained from Zee panels are shown on Pages 2 and 3 of this section.

These typical, calculated, horizontal patterns are plotted in terms of dB. The broken-line circle on each pattern represents the relative field (in dB) of an omni-directional antenna fed the same power as the directional having the same vertical gain. A great variety of other patterns are available to meet UHF omni-directional or directional requirements.

Vertical Patterns

The number of elements stacked vertically and the amplitudes and phases of the signals radiated by the elements will determine vertical patterns. Sculpturing can be done to either have zero nulls where distant coverage and maximum gain are desired or, filled nulls where thorough, close-in coverage is necessary.

Beam tilt can be achieved in all directions or in selective directions by tilting individual panels, by electrical phasing of successive radiators or both. Typical calculated vertical patterns obtained by stacking three, four, five, or six-layer standard panels are shown on Pages 4 and 5 of this section.

Electrical Characteristics

Electrical data for the standard Vee Zee antenna is listed under "Specifications" on Page 8 of this section. If desired, antennas with other power gains and power ratings can be supplied on application.

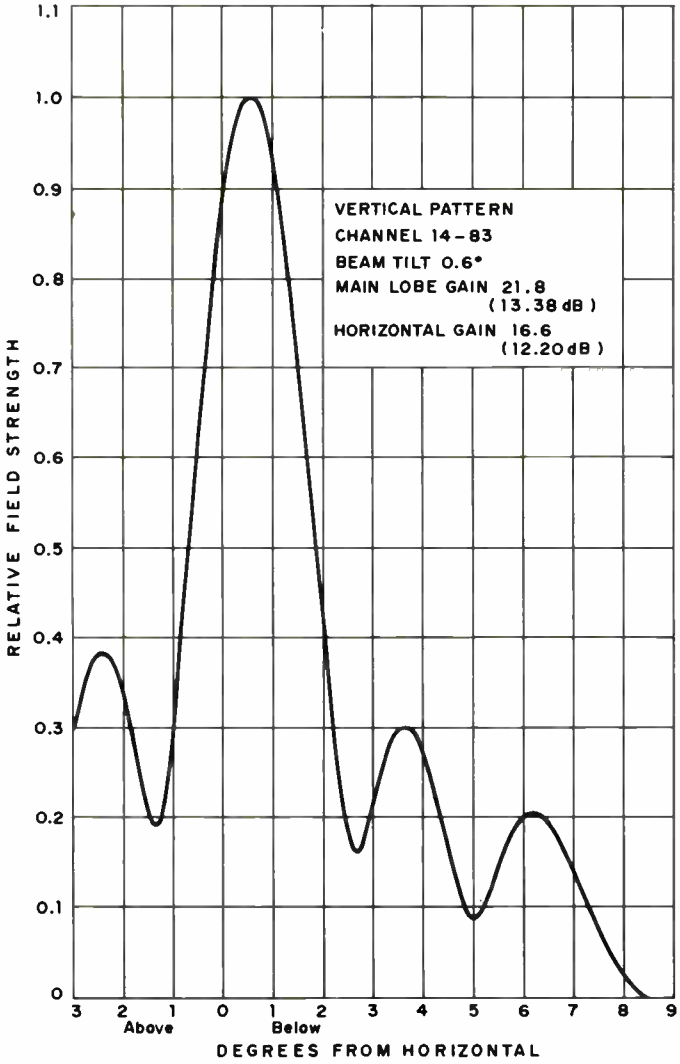
Mechanical Characteristics

Size, weight and wind loading of these antennas varies by channel. The charts on Pages 6 and 7 of this section list mechanical and windload data on the standard Vee Zee panel antennas at 50/33 PSF (244/161 kg/m²). Data at other wind loadings is available on request.

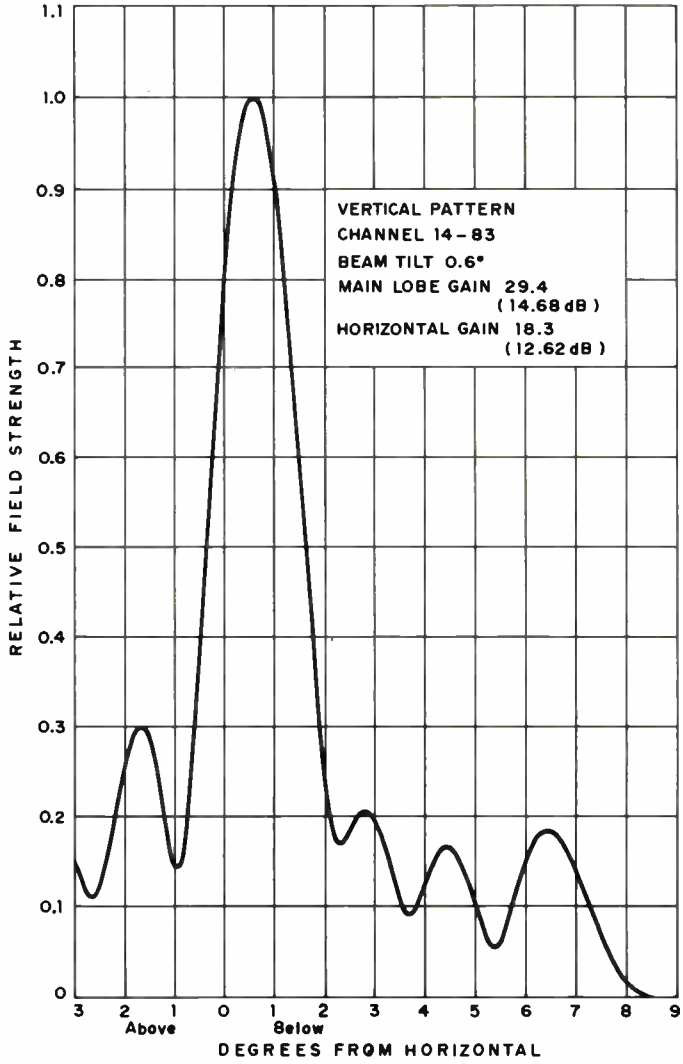
Zee-Panel and Vee-Zee antennas are supplied with top-hat lightning protectors. Whether top- or side-mounted, both ends of each radiating element are grounded. This reduces to a minimum the possibility of lightning damage.

Radome Supplied

An easily removable radome is supplied for protection from atmospheric conditions and possible climbing damage.



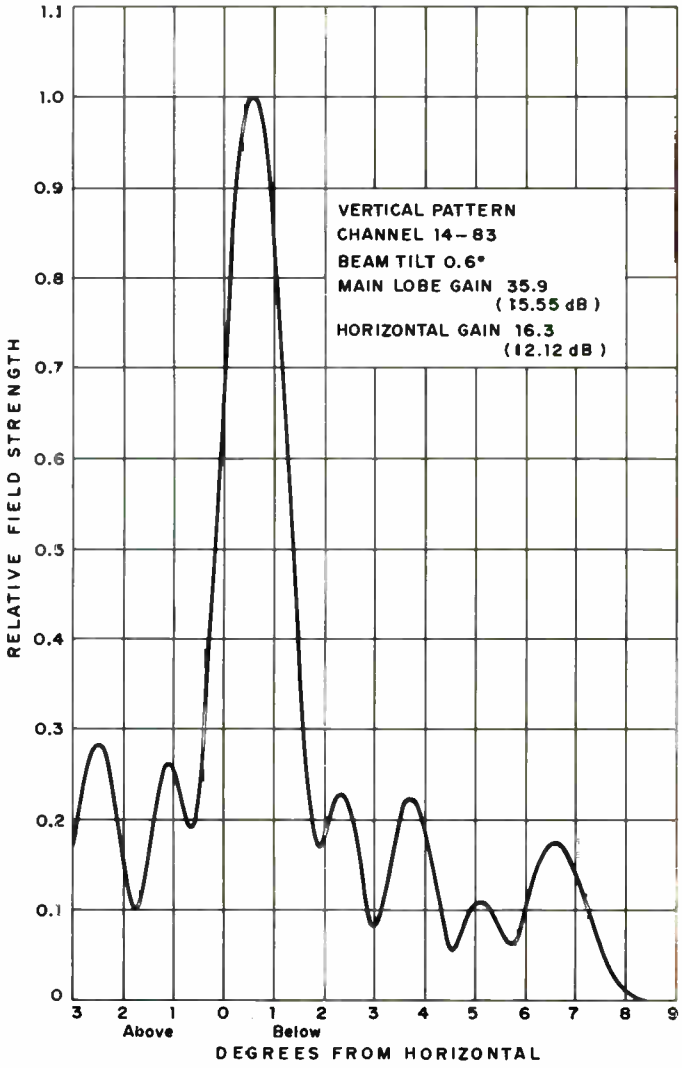
Calculated vertical pattern for a three-layer Vee-Zee Panel array.



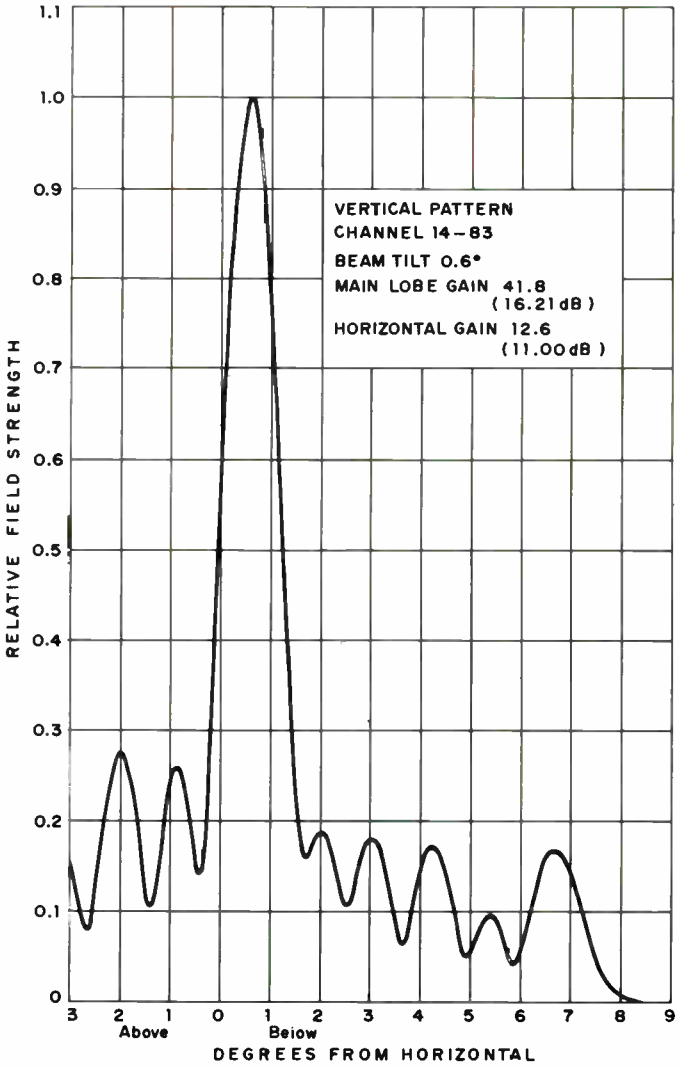
Calculated vertical pattern for a four-layer Vee-Zee Panel array.

World Radio History

A three-layer Vee-Zee array undergoing pattern tests.



Calculated vertical pattern for a five-layer Vee-Zee Panel array.



Calculated vertical pattern for a six-layer Vee-Zee Panel array.

World Radio History

Mechanical Data: "Vee-Zee" Antenna

Channel	THREE LAYER ARRAY					
	Aperture		Weight[8]		Reaction[8, 9]	
	Ft	Mtrs[7]	Tons[4]	Tons[5]	Lbs	Kg[6]
14	57.7	17.59	1.71	1.55	11480	5207
15	57.0	17.37	1.69	1.53	11230	5094
16	56.2	17.13	1.66	1.51	10990	4985
17	55.5	16.91	1.64	1.49	10760	4881
18	54.9	16.73	1.62	1.47	10540	4781
19	54.2	16.52	1.59	1.44	10330	4686
20	53.6	16.34	1.57	1.43	10130	4595
21	52.9	16.12	1.55	1.41	9940	4509
22	52.4	15.97	1.53	1.39	9750	4423
23	51.8	15.79	1.51	1.37	9570	4341
24	51.2	15.61	1.50	1.36	9400	4264
25	50.6	15.42	1.48	1.34	9230	4187
26	50.1	15.27	1.46	1.33	9060	4110
27	49.5	15.09	1.44	1.31	8890	4033
28	48.9	14.90	1.43	1.30	8730	3960
29	48.4	14.75	1.41	1.28	8570	3887
30	47.8	14.57	1.39	1.26	8420	3819
31	47.3	14.41	1.38	1.25	8280	3756
32	46.8	14.26	1.36	1.23	8140	3692
33	46.3	14.11	1.35	1.23	8000	3629
34	45.8	13.95	1.34	1.22	7870	3570
35	45.3	13.81	1.32	1.20	7740	3511
36	44.8	13.66	1.31	1.19	7620	3456
37	44.4	13.53	1.30	1.18	7500	3402
38	43.9	13.38	1.28	1.16	7390	3352
39	43.5	13.26	1.27	1.15	7270	3298
40	43.1	13.14	1.26	1.14	7160	3248
41	42.7	13.01	1.25	1.13	7060	3202
42	42.3	12.89	1.24	1.13	6950	3153
43	41.9	12.77	1.23	1.12	6850	3107
44	41.5	12.65	1.22	1.11	6760	3066
45	41.1	12.53	1.21	1.10	6660	3021
46	40.7	12.41	1.20	1.09	6570	2980
47	40.3	12.28	1.19	1.08	6480	2939
48	40.0	12.19	1.18	1.07	6390	2899
49	39.6	12.07	1.17	1.06	6310	2862
50	39.2	11.95	1.16	1.05	6220	2821
51	38.9	11.86	1.15	1.04	6140	2785
52	38.5	11.73	1.14	1.03	6060	2749
53	38.2	11.64	1.14	1.03	5980	2713
54	37.8	11.52	1.13	1.03	5900	2676
55	37.5	11.43	1.12	1.02	5830	2644
56	37.2	11.34	1.11	1.01	5750	2608
57	36.8	11.22	1.10	1.00	5680	2576
58	36.5	11.13	1.10	1.00	5620	2549
59	36.2	11.03	1.09	0.99	5550	2517
60	35.9	10.94	1.08	0.98	5480	2486
61	35.6	10.85	1.08	0.98	5420	2459
62	35.3	10.76	1.07	0.97	5360	2431
63	35.1	10.70	1.06	0.96	5300	2404
64	34.8	10.61	1.06	0.96	5240	2377
65	34.5	10.52	1.05	0.95	5180	2350
66	34.2	10.42	1.04	0.94	5120	2322
67	33.9	10.33	1.04	0.94	5060	2295
68	33.6	10.24	1.03	0.94	5010	2273
69	33.3	10.15	1.03	0.94	4950	2245
70	33.0	10.06	1.02	0.93	4890	2218

Channel	FOUR LAYER ARRAY					
	Aperture		Weight		Reaction[8, 9]	
	Ft	Mtrs[7]	Tons[4]	Tons[5]	Lbs	Kg[6]
14	77.0	23.47	2.39	2.17	15700	7121
15	76.0	23.16	2.35	2.13	15360	6967
16	75.0	22.86	2.32	2.11	15030	6818
17	74.0	22.56	2.28	2.07	14720	6677
18	73.1	22.28	2.25	2.04	14420	6541
19	72.3	22.04	2.22	2.02	14140	6414
20	71.4	21.76	2.19	1.99	13870	6291
21	70.6	21.52	2.17	1.97	13600	6169
22	69.8	22.28	2.14	1.94	13350	6056
23	69.0	21.03	2.11	1.92	13110	5947
24	68.2	20.79	2.09	1.90	12870	5838
25	67.5	20.57	2.06	1.87	12640	5734
26	66.7	20.33	2.04	1.85	12410	5629
27	66.0	20.12	2.02	1.83	12190	5529
28	65.2	19.87	1.99	1.81	11970	5430
29	64.4	19.63	1.97	1.79	11750	5330
30	63.7	19.42	1.95	1.77	11550	5239
31	63.0	19.20	1.93	1.75	11350	5148
32	62.3	18.99	1.91	1.73	11160	5062
33	61.6	18.76	1.89	1.72	10980	4981
34	61.0	18.59	1.87	1.70	10800	4899
35	60.4	18.41	1.85	1.68	10630	4822
36	59.7	18.20	1.83	1.66	10460	4745
37	59.1	18.01	1.82	1.65	10300	4672
38	58.5	17.83	1.80	1.63	10140	4600
39	57.9	17.65	1.78	1.62	9990	4531
40	57.4	17.50	1.77	1.61	9840	4463
41	56.8	17.31	1.75	1.59	9690	4395
42	56.3	17.16	1.74	1.58	9550	4332
43	55.7	16.98	1.72	1.56	9420	4273
44	55.2	16.82	1.71	1.55	9280	4209
45	54.7	16.67	1.69	1.53	9150	4150
46	54.2	16.52	1.68	1.53	9030	4096
47	53.7	16.37	1.67	1.52	8910	4042
48	53.2	16.22	1.65	1.50	8790	3987
49	52.7	16.06	1.64	1.49	8670	3933
50	52.2	15.91	1.63	1.48	8550	3878
51	51.7	15.76	1.62	1.47	8440	3828
52	51.2	15.61	1.60	1.45	8330	3778
53	50.8	15.48	1.59	1.44	8220	3729
54	50.3	15.33	1.58	1.43	8120	3683
55	49.9	15.21	1.57	1.43	8020	3638
56	49.4	15.06	1.56	1.42	7920	3593
57	49.0	14.94	1.55	1.41	7820	3547
58	48.6	14.81	1.54	1.40	7730	3506
59	48.2	14.69	1.53	1.39	7640	3466
60	47.8	14.57	1.52	1.38	7550	3425
61	47.4	14.45	1.51	1.37	7460	3384
62	47.0	14.33	1.50	1.36	7380	3348
63	46.6	14.20	1.49	1.35	7300	3311
64	46.3	14.11	1.48	1.34	7220	3275
65	45.9	13.99	1.47	1.33	7140	3239
66	45.5	13.87	1.47	1.33	7050	3198
67	45.1	13.75	1.46	1.33	6970	3162
68	44.7	13.62	1.45	1.32	6890	3125
69	44.3	13.50	1.44	1.31	6820	3094
70	43.9	13.38	1.43	1.30	6740	3057

World Radio History

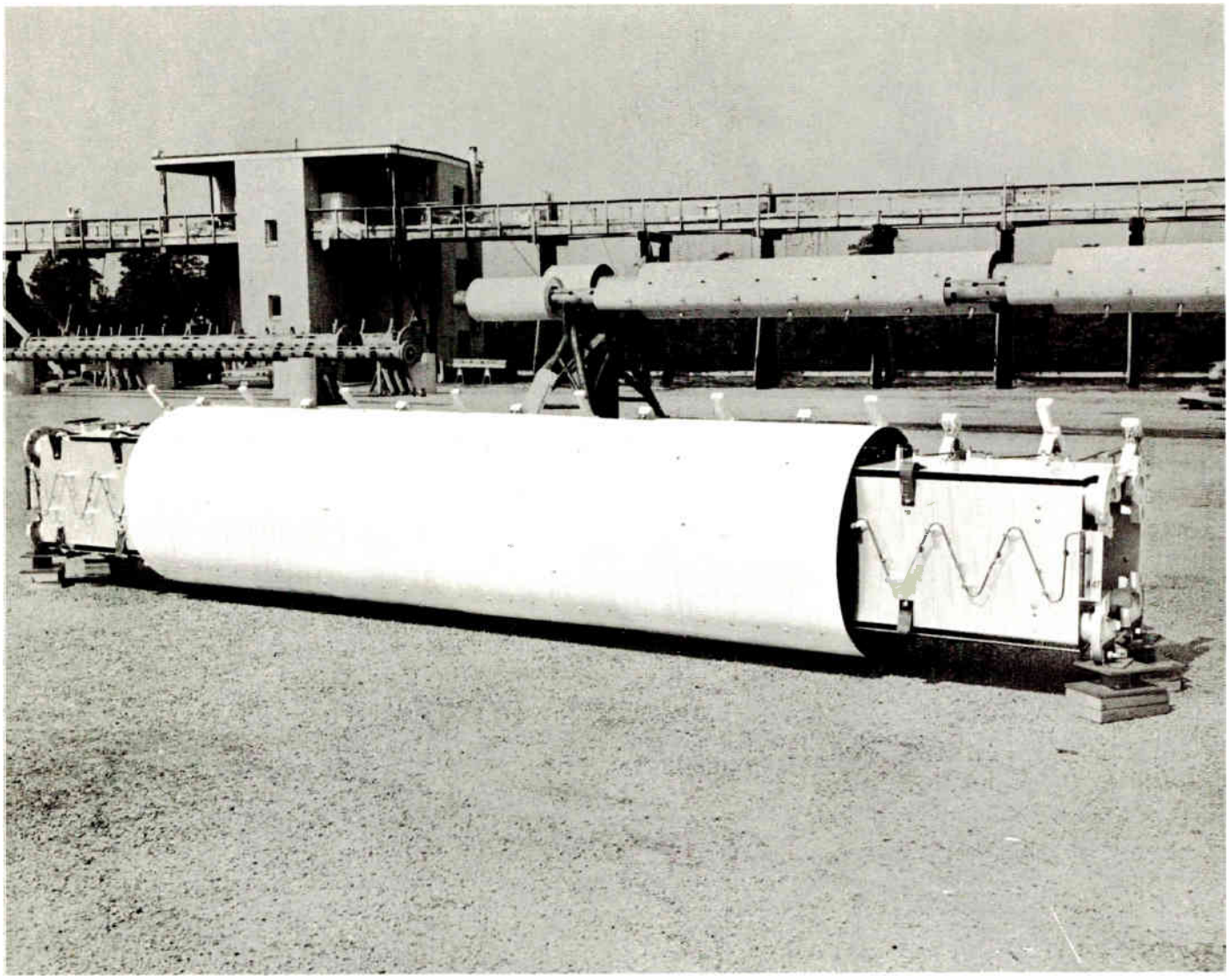
Channel	FIVE LAYER ARRAY					
	Aperture		Weight		Reaction[8,9]	
	Ft	Mtrs[7]	Tons[4]	Tons[5]	Lbs	Kg[6]
14	96.3	29.35	3.18	2.87	20298	9207
15	95.0	28.96	3.13	2.84	19860	9008
16	93.7	28.56	3.09	2.81	19450	8823
17	92.6	28.22	3.04	2.76	19050	8641
18	91.4	27.86	3.00	2.72	18670	8469
19	90.3	27.52	2.96	2.69	18310	8305
20	89.3	27.22	2.93	2.66	17960	8147
21	88.2	26.88	2.89	2.62	17620	7992
22	87.2	26.58	2.86	2.60	17300	7847
23	86.2	26.27	2.82	2.56	16990	7701
24	85.3	26.00	2.79	2.53	16680	7566
25	84.3	25.69	2.76	2.51	16390	7435
26	83.4	25.42	2.73	2.48	16100	7303
27	82.4	25.12	2.69	2.44	15810	7171
28	81.5	24.84	2.66	2.41	15530	7044
29	80.5	24.54	2.63	2.39	15260	6922
30	79.6	24.26	2.61	2.37	14990	6799
31	78.7	23.99	2.58	2.34	14740	6686
32	77.9	23.74	2.55	2.31	14500	6577
33	77.0	23.47	2.53	2.30	14260	6468
34	76.2	23.23	2.50	2.27	14030	6364
35	75.4	22.98	2.48	2.25	13810	6264
36	74.6	22.74	2.45	2.22	13590	6164
37	73.9	22.52	2.43	2.21	13390	6074
38	73.1	22.28	2.41	2.19	13180	5978
39	72.4	22.07	2.39	2.17	12990	5892
40	71.7	21.85	2.37	2.15	12800	5806
41	71.0	21.64	2.35	2.13	12610	5720
42	70.3	21.43	2.33	2.12	12430	5638
43	69.6	21.21	2.31	2.10	12250	5557
44	68.9	21.00	2.29	2.08	12080	5479
45	68.3	20.82	2.27	2.06	11920	5407
46	67.7	20.63	2.25	2.04	11760	5334
47	67.0	20.42	2.24	2.03	11600	5262
48	66.4	20.24	2.22	2.02	11450	5194
49	65.8	20.06	2.20	2.00	11300	5126
50	65.2	19.87	2.19	1.99	11150	5058
51	64.6	19.69	2.17	1.97	11000	4990
52	64.0	19.51	2.15	1.95	10860	4926
53	63.4	19.32	2.14	1.94	10720	4863
54	62.8	19.14	2.12	1.92	10580	4799
55	62.3	18.99	2.11	1.92	10450	4740
56	61.7	18.81	2.09	1.90	10330	4686
57	61.2	18.65	2.08	1.89	10200	4627
58	60.7	18.50	2.07	1.88	10080	4572
59	60.2	18.35	2.05	1.86	9970	4522
60	59.7	18.20	2.04	1.85	9850	4468
61	59.2	18.04	2.03	1.84	9740	4418
62	58.7	17.89	2.02	1.83	9630	4368
63	58.2	17.74	2.01	1.82	9530	4323
64	57.7	17.59	1.99	1.80	9420	4273
65	57.3	17.47	1.98	1.80	9320	4228
66	56.8	17.31	1.97	1.79	9210	4178
67	56.3	17.16	1.96	1.78	9110	4132
68	55.8	17.00	1.95	1.77	9010	4087
69	55.3	16.86	1.94	1.76	8910	4042
70	54.8	16.70	1.92	1.74	8800	3992

[4]Short tons (2000 lbs).
[5]Metric tons (1000 kg) rounded to two decimal places.
[6]Rounded to eliminate decimals.

Channel	SIX LAYER ARRAY					
	Aperture		Weight		Reaction[8,9]	
	Ft	Mtrs[7]	Tons[4]	Tons[5]	Lbs	Kg[6]
14	115.5	35.20	3.95	3.59	26030	11087
15	114.0	34.74	3.89	3.53	25480	11558
16	112.5	34.29	3.84	3.49	24970	11326
17	111.1	33.86	3.79	3.44	24470	11100
18	109.7	33.44	3.73	3.39	24000	10886
19	108.4	33.04	3.69	3.35	23540	10678
20	107.1	32.64	3.64	3.31	23100	10478
21	105.9	32.28	3.59	3.26	22680	10288
22	104.7	31.91	3.55	3.22	22270	10102
23	103.5	31.55	3.51	3.19	21880	9925
24	102.3	31.18	3.47	3.15	21500	9752
25	101.2	30.85	3.43	3.11	21130	9585
26	100.1	30.51	3.39	3.08	20770	9421
27	98.9	30.14	3.35	3.04	20440	9272
28	97.7	29.78	3.31	3.00	20050	9095
29	96.6	29.44	3.27	2.97	19710	8940
30	95.5	29.11	3.24	2.94	19380	8791
31	94.4	28.77	3.20	2.90	19060	8646
32	93.4	28.47	3.17	2.88	18750	8505
33	92.4	28.16	3.14	2.85	18450	8369
34	91.4	27.86	3.11	2.82	18160	8237
35	90.5	27.58	3.08	2.80	17880	8110
36	89.5	27.28	3.05	2.78	17610	7988
37	88.6	27.01	3.02	2.74	17350	7870
38	87.7	26.73	2.99	2.71	17090	7752
39	86.8	26.46	2.97	2.70	16840	7639
40	86.0	26.21	2.94	2.67	16600	7530
41	85.1	25.94	2.91	2.64	16370	7425
42	84.3	25.69	2.89	2.62	16140	7321
43	83.5	25.45	2.86	2.60	15910	7217
44	82.7	25.21	2.84	2.58	15700	7122
45	81.9	24.96	2.82	2.56	15490	7026
46	81.2	24.75	2.80	2.54	15290	6936
47	80.4	24.51	2.77	2.51	15090	6845
48	79.7	24.29	2.75	2.50	14890	6754
49	78.9	24.05	2.73	2.48	14700	6668
50	78.2	23.84	2.71	2.46	14510	6582
51	77.4	23.59	2.69	2.44	14320	6495
52	76.7	23.38	2.67	2.42	14140	6414
53	76.0	23.16	2.65	2.41	13960	6332
54	75.3	22.95	2.63	2.39	13790	6255
55	74.7	22.77	2.61	2.37	13620	6178
56	74.0	22.55	2.60	2.36	13460	6105
57	73.4	22.37	2.58	2.34	13310	6037
58	72.7	21.16	2.56	2.32	13150	5965
59	72.1	21.98	2.55	2.31	13000	5897
60	71.5	21.79	2.53	2.30	12860	5833
61	70.9	21.61	2.51	2.28	12720	5770
62	70.3	21.43	2.50	2.27	12580	5706
63	69.8	21.28	2.48	2.35	12440	5643
64	69.2	21.09	2.47	2.24	12310	5584
65	68.6	21.91	2.45	2.22	12170	5520
66	68.0	20.73	2.44	2.22	12040	5461
67	67.4	20.54	2.42	2.20	11910	5402
68	66.8	20.36	2.41	2.19	11770	5339
69	66.2	20.18	2.40	2.18	11640	5280
70	65.6	19.99	2.38	2.16	11510	5221

[7]Rounded to two decimal places.
[8]Subject to minor revision if special mounting hardware is required.
[9]Reaction in pounds/kilograms for windload 50/33 PSF (244/161 kg/m²).

World Radio History



Fiber glass racome surrounds four-sided Zee-Panel array. Photo taken during assembly.

Specifications

Electrical Data: Vee-Zee Antenna:

Horizontal Circularity (Omni)	±3 dB
VSWR	1.1:1 max.
Power Gain	See Chart
Peak Power Rating	See Chart
Input Connection Diameter	6⅛-inch[1]

[1] Connection type to your order.
[2] Rms value. For nominal null fill and 0.6° beam tilt.
[3] With 20% aural power, omnidirectional (three panels each layer). Limitation is 1-5/8-inch feedlines to individual panels.

Antenna Layers	Power[2] Gain	Inputs	Peak Power Rating in Kilowatts[3]			
			Ch. 14-29	Ch. 30-44	Ch. 45-59	Ch. 60-70
3	21.8	1	59	54	50	48
4	29.4	1	59	54	50	48
5	35.9	2	99	90	84	80
6	41.8	2	99	90	84	80

Ordering Information

Vee-Zee and Zee-Panel Antennas are supplied on a custom basis since the size and number of panels employed to form an array vary with each station's requirements.

World Radio History

RCA

"Polygon" UHF-TV Antennas, Type TZP-500

- ERP to 5,000,000 watts; grounded structure
- Power gain 14 to 55 (rms)
- Available for directional or omnidirectional service
- Stack-able: either supporting or top-mount
- Radome standard equipment

Polygon antennas are for maximum-power UHF-television broadcast. The combination of a 110-kW transmitter and a Polygon antenna of suitable power gain provides 5 megawatts of effective radiated power (ERP) in directional or omni-directional radiation patterns from towers up to 1500 feet (457 m) tall.

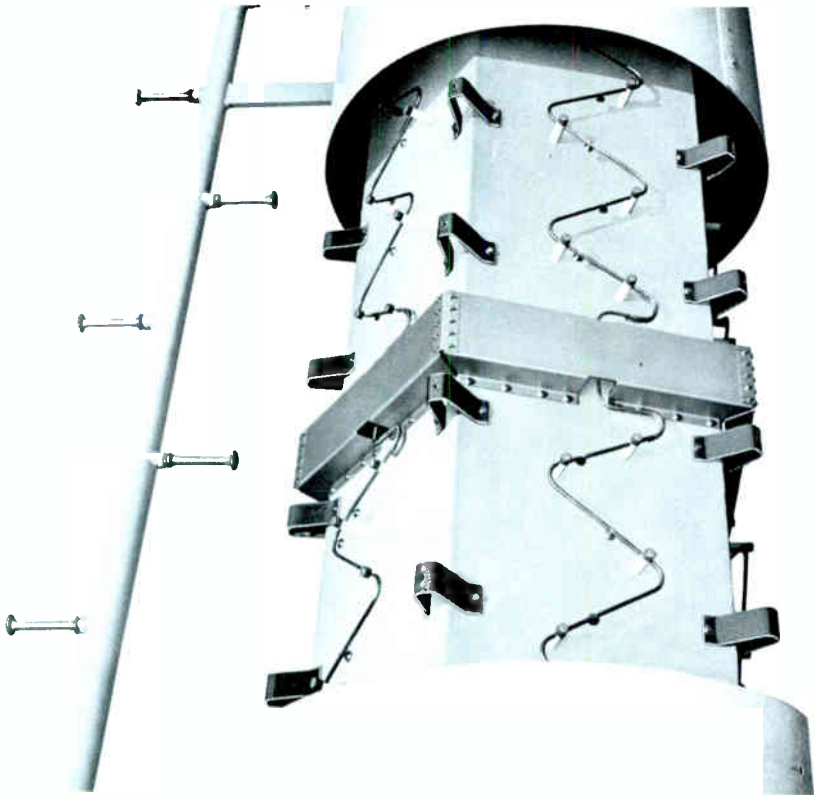
Pentagonal Cross-Section

A Polygon antenna is, basically, a series of panel antennas arranged to form a cylinder with a pentagonal cross-section. Each layer of the antenna consists of five panels; a complete antenna comprises three to eleven layers with power gain proportional to the number of antenna layers.

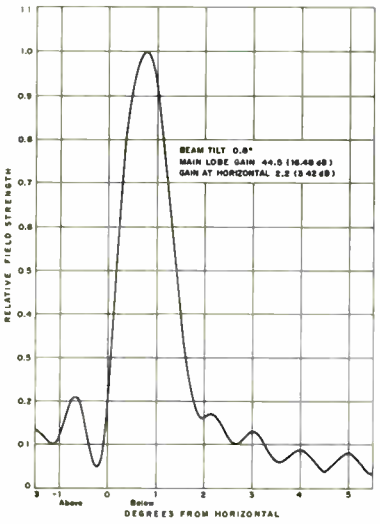
Rigid Structure

Polygon antennas, as a result of the strength built into the faces, require no internal bracing or other structural members. Fabricated of zinc-sprayed, Cor-Ten[1] steel plates, welded at the edges, Polygon antennas minimize the effects of weathering with corrosion-resistant hardware and components.

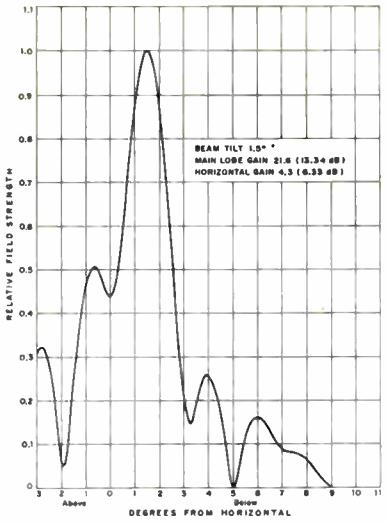
[1] U.S. Steel trademark.



World Radio History



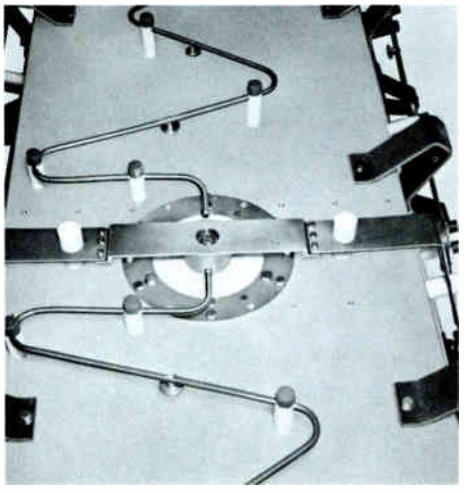
Typical seven-layer vertical pattern.



Special null-filled vertical pattern.

Pentagonal cross-section: excellent structural strength.

A close-up of radiator feedpoint.



Internal Power Distribution

Since the Polygon antenna uses no internal bracing, this space encloses the system that distributes transmitter power to the several panels. Each antenna layer uses a single connection to the internal system and distributes the power to each panel in the layer through a "beltline" which encircles the layer at about the midpoint. A metal cover encloses the beltline (see photo). The system uses a traveling-wave distribution principle.

Fiberglass Radome Standard

All Polygon antennas include a removable radome fabricated of fiberglass-reinforced resin. The radome eliminates the need for de-icer equipment and protects the radiating elements from weather and damage while climbing the external "ladder" for beacon or other maintenance. Built-in bosun's chair supports are included at antenna top.

Grounded Structure

Polygon antennas operate with an uninsulated structure. This means that the antenna operates at a d-c ground potential through the tower. The great conductivity of the structure and the tower channels lightning discharges harmlessly to ground. A "top hat" lightning rod protects the top beacon from such discharges.

The radiating elements, too, operate at a ground potential from a d-c viewpoint: each element is bonded to the structure at the "far" end, away from the feedpoint.

Omni- or Directional Radiation Patterns

With five radiating surfaces per layer, the Polygon antenna is both directional and omnidirectional. If all five faces receive equal power, the antenna operates with an omnidirectional pattern; reducing the power to one or more faces reduces the radiation from that face and makes the pattern directional.

Omnidirectional pattern circularity exceeds ±1.5 dB. With slight directionalization, we can obtain the equivalent of an omni pattern over a large area with, what many broadcast consultants regard as more than, ample signal strength over the remaining area. Such a pattern reduces, considerably, the length of the antenna over that for full omni service and yet attains a 5 megawatt ERP with a 110 kW transmitter.

Null-Fill and Beam Tilt Available

Polygon antenna vertical patterns are adjustable, during manufacture, for null fill and beam tilt. A typical seven-layer vertical pattern is shown. Such a pattern is available with an omni or directional horizontal pattern. Various vertical patterns in the five principal azimuthal planes are available, too. The other vertical pattern was designed for a market that needed null fill above the horizon in one principal plane.

Suitable for Diplexed Operation

Two stations can share a Polygon antenna provided they operate within six channels of one another through a system of diplexed operation. Sharing an antenna in this way reduces original investment and maintenance expense for both stations.

For stations with more than a six-channel separation, Polygon antennas are "stack-able" to share a tower.

Economical Erection Costs

Polygon antennas are manufactured with two or three layers per section and the sections flanged. These lengths improve handling convenience during shipment and erection while the flanges simplify antenna assembly at tower site.

Ordering Information

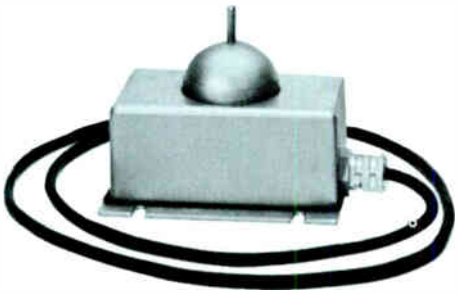
Polygon Antennas are supplied on a custom basis since the size and number of panels employed to form an array vary with requirements.

World Radio History

RCA

Rosemount Antenna Ice Detector

- Dependable ice detection
- Active only when icing conditions exist
- Anticipates antenna ice formation
- Improves de-icer economy and efficiency
- Detects end of icing conditions



Active only during antenna-icing weather, the Rosemount Antenna Ice Detector senses buildup of broadcast antenna ice and generates a signal which, with appropriate power-contactor equipment (not supplied), automatically energizes an antenna's sleetmelters. At the conclusion of icing conditions, the device automatically de-energizes the heaters after an adjustable time-delay period expires.

Dependable Ice Detection

Insensitive to almost everything but ice formation, the detector ignores cold, wind, rain, dry snow, soot, grease, insects and birds. As a result, the detector prevents unnecessary de-icer operation and thus increases the useful life of de-icer equipment by operating it only when necessary.

Active Only When Icing Conditions Exist

Since antenna ice cannot form under any weather condition at temperatures above 50°F. (10°C.), the Antenna Ice Detector ceases to operate. As soon as the ambient temperature drops below 50°F., a thermostat puts the system into operation, automatically.

Anticipates Ice-Forming Conditions

Because the ice-sensing element bears low thermal mass, it cools faster and begins to collect ice earlier than the larger thermal mass of the antenna it protects. As a result, the detector "sees" ice before it begins to form on the antenna surfaces. Because the heaters are warm before ice begins to form, they get a head start on the ice and avoid the burden of a backlog ice accumulation. Only completely still air—extremely rare during icing weather—can shorten materially the detector's ice anticipation.

Improves De-Icer Economy and Efficiency

Since the ice detector ignores all conditions except icing conditions, it never operates de-icer heaters unnecessarily in the way a thermostatic control does. Consequently, the ice detector eliminates needless use of kilowatt hours which increase power costs. Further, because the heater operates only when really required, the device materially extends heater life.

World Radio History

Detects End of Icing Conditions, Too

Unlike most other deicer control systems, the Rosemount Antenna Ice Detector senses the *end* of ice-forming conditions and sends out an electrical command that ceases de-icer power.

Magnetostrictive Sensor

The sensing element—the probe—of the detector is a ¼-inch (6 mm) diameter tube precisely 1.10 inches (28 mm) long of a nickel alloy which responds, physically, to a magnetic force in an increase or decrease in axial length. Under the influence of an alternating magnetic field, the tube vibrates at a frequency proportionate to its physcial length—its resonant frequency. If the frequency of the alternating field is adjusted to coincide with the resonant frequency of the little nickel tube, a tuned circuit results.

In the ice detector circuitry, the probe serves as a link in the feedback circuit of an oscillator.

As ice forms on the sensing element, it restricts the magnetostrictive motion and lowers the resonant frequency of the little nickel tube. As the frequency approaches a pre-determined value, solid-state circuitry detects the changes in frequency and energizes a relay which controls a de-icing heater-current contactor. This relay holds for a period of 8 to 150* minutes (adjustable manually).

Self-Recycling

During the "hold" period, the ice detector probe de-ices itself and its supporting dome. Because of the low mass of the probe, de-icing takes but a few seconds. Once de-iced, the probe begins the sensing cycle again. If the ice coating accumulates to a thickness of a half millimeter or more, it issues a "sustaining" command for antenna de-icing. This sequence repeats until ice no longer forms.

Fail-Safe Design

In the extremely unlikely event of probe damage or failure, the system automatically issues a continuous de-icing command.

Specifications

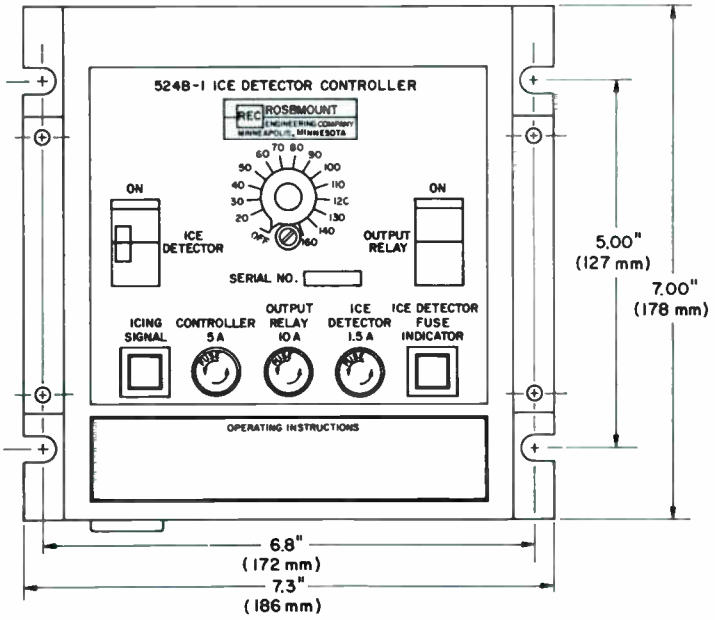
Ice Detector Unit

Ice Sensing Range	0.02 to 0.25 inches on probe (0.5 to 6 mm)
Sensing Element Material	Ni-Span C
Maximum Length of Interconnecting Cable	Unlimited
Power Requirements:	
Sensing	115 V, 50/60 Hz, 10W
Signalling	115 V, 50/60 Hz, 1.5A
Output Signal	115 V, 50/60 Hz, 60W max.
Sensing Element De-Ice Time	90 seconds, nominal
Ambient Temperature:	
Operating	–40 to 50°F (–40 to +10°C)
Storage	–50 to 160°F (–45 to 72°C)
Ambient Electromagnetic Field Intensity	50V/m max.
Physical Dimensions	See drawing
Weight	3.5 lbs. (1.6 kg)

Detector Control Unit

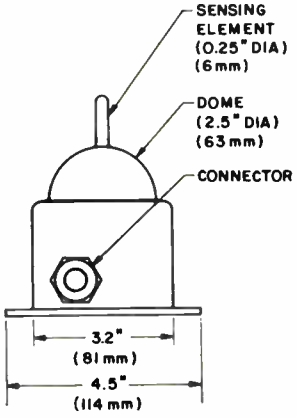
Power Requirements:	
Sensing	115 V, 50/60 Hz, 5W
Signalling	115 V, 50/60 Hz, 15W
Output Signal	115 V, 50/60 Hz, 500W
Time-Delay Timer	8 to 150* min., adj.
Power Relay Current Capacity	10 A, max. non-inductive load
Ambient Operation Temperature	40 to 120°F (4.4 to 49°C)
Connections	Barrier strip and connector
Physical Dimensions	See drawing
Weight	4 lbs. (1.8 kg)

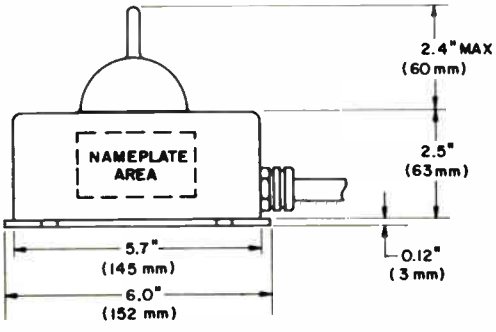
*180 on 50 Hz power.

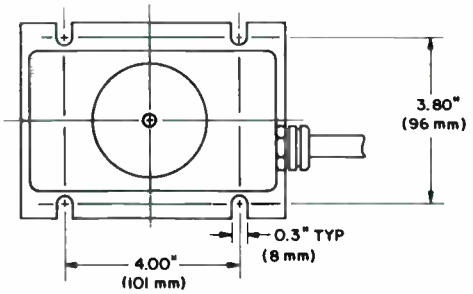


Ordering Information

Rosemount Antenna Ice Detector System (for 115 V, 50/60 Hz Power) MI-561572
(Interconnecting cable and contactor not supplied)







World Radio History

catalog TT.9340A

RCA

Automatic Sleet Melter Control Unit

- Automatic temperature monitoring at actual antenna location
- Adjustable temperature ranges to suit local weather conditions
- Waterproof aluminum housing
- Antenna deicing prevents severe damage to transmission systems

The Automatic Sleet Melter Control Unit prevents severe damage to transmission equipment through automatic thermostatic control of antenna de-icers. The control allows de-icers to be left unattended. Furthermore, the antenna will be in condition for immediate operation following possible icing conditions during the night.

The control unit has adjustable temperature ranges so that it can cut off above and below the temperatures chosen to conserve power when temperatures are higher than ice-forming range. A "stay-on" control is incorporated for added protection where rime ice is a problem.

World Radio History

Senses at Antenna Altitude

The control unit mounts in the vicinity of the tower top. Considerable temperature variations often exist between the antenna at the tower top and the ground level, so that ice may form on the antenna while the temperature on the ground remains above the freezing point.

Weather-Tight Construction

The control unit is housed in a small cast-aluminum box. A waterproof cover, sealed with a neoprene gasket and a convenient mounting bracket are furnished. Adjustable terminal connections for selection of temperature ranges are provided.

Only Four Connections

A four-conductor cable, six feet long, is furnished. The cable should terminate in an appropriate junction box where connections are made to the main cable run down the tower. Two of these four conductors connect to 117 volts (ac) for the relay coils; the other two are for the control circuit. The station is required to furnish the connecting cable from the transmitter building to the termination of the six-foot cable furnished with the control unit, as well as the actual relay contactors to switch power to the sleet melters.

Various types of antennas, methods of de-icer connections, etc., make it impractical to furnish the power relay contactors required with the Control Unit. The contacts of the MI-27369 are rated at 10 amperes which is more than adequate for contactor control.

Specifications

Automatic Temperature Limits (Adjustable):	
Upper Limit	32° or 40°F (0°C or 4.5°C)
Lower Limit	10° or 20°F, or no-cut-off (–12.6°C or –6.6°C)
Power Line Requirements	117 V, 60 Hz
De-icer Control Contact Rating	10 A
Dimensions	6½" x 4½" x 3" (165, 114, 76 mm)
Weight (approx.)	5 lbs. (2.27 kg)
Finish	Weatherproof cast-aluminum enclosure

Ordering Information

Automatic Sleet Melter Control	MI-27369A

World Radio History

RCA

catalog TT.9400A

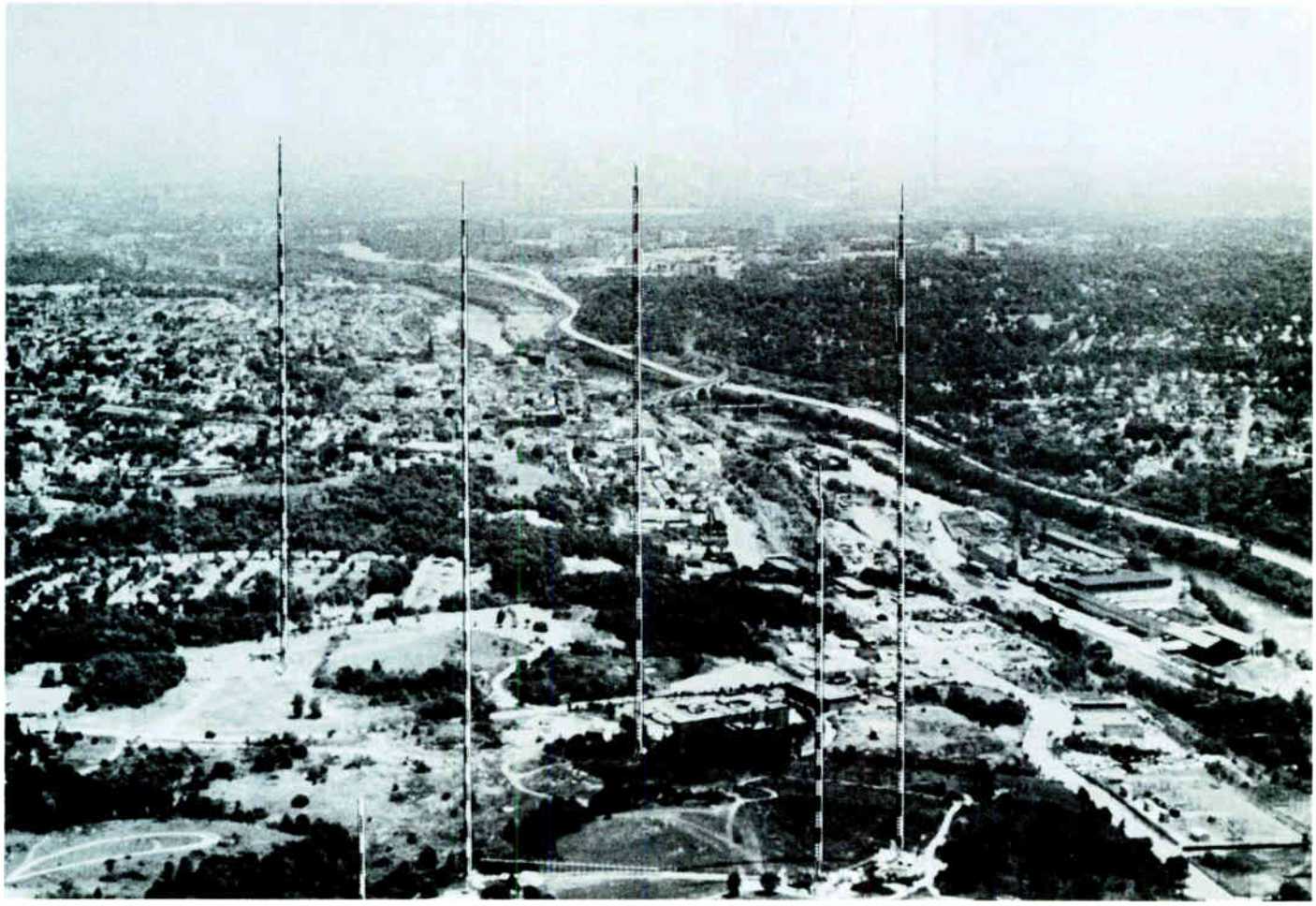
(Replaces B.5800)

Antenna Towers for Television; Strobe Tower Lighting

- Designs by experienced tower engineers
- Single contract service—complete tower planning, design fabrication, installation and inspection, one responsibility
- Variety of types and heights to fit site, antenna, accessory and load requirements
- Custom designed structures to meet special or unusual requirements
- Complete range of tower accessories

RCA offers a wide selection of towers to support various UHF and VHF television antennas for all situations. Included in the line are self-supporting and guyed designs. Towers for multiple-antenna situations are also part of this line.

RCA, as a representative of several tower manufacturers, is qualified to assist in the planning and selection of the proper tower design and a qualified tower erector for the task at hand. RCA offers a single-contract, single responsibility service that is hard to duplicate.



World Radio History

Tower Design Considerations

Relatively flat country with low surrounding hills lends itself well to the installation of tall supporting structures. Towers over 500 feet (152m) in height are usually guyed and the usual cross-section shape is triangular so that thrre-point guying can be used. Guyed tower costs are lower than for self-supporting structures because less steel is used and erection labor is less costly. The availability of land and the area involved for guy anchorage, however, increases costs of this type of tower. A useful method for estimating the land required for a guyed structure is to consider the distance to the farthest guy anchorage as being approximately 70 percent the tower height. For self-supporting tower the distance between tower legs is usually 10 percent of tower height.

Guyed Towers

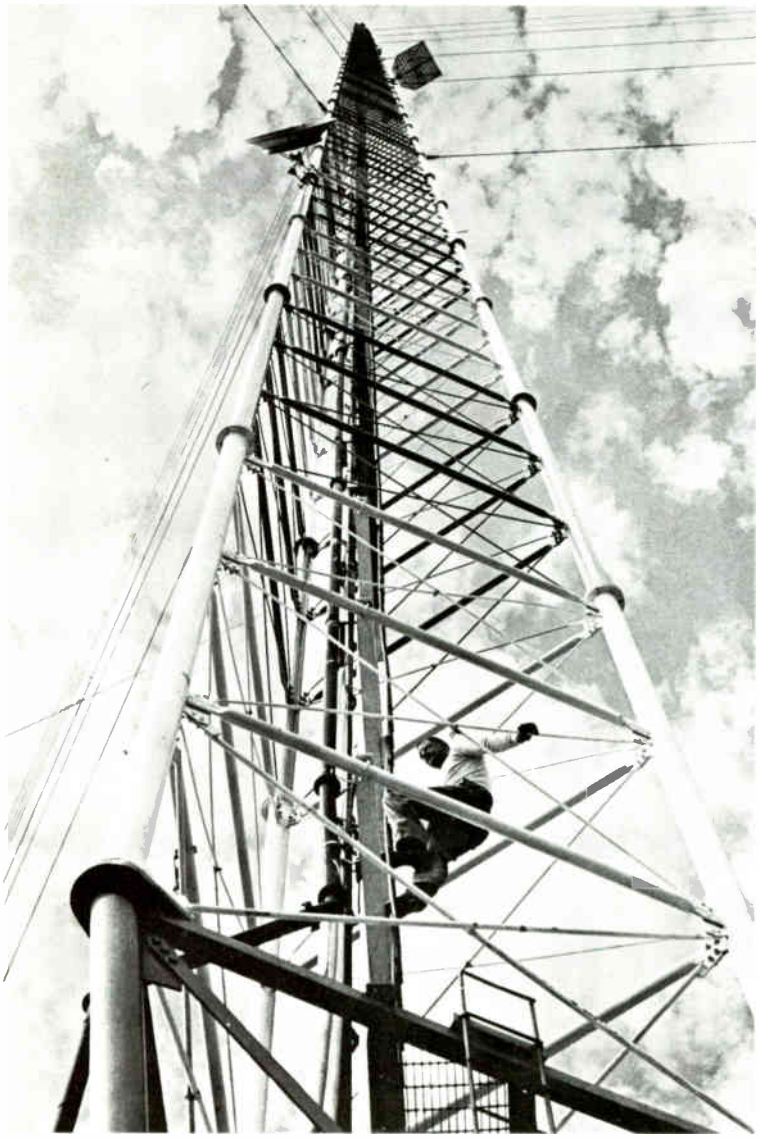
Guyed towers normally use a constant cross-section dimension along their entire height. Supported by steel guy cables which span out to steel-reinforced, concrete anchors buried in the earth, such towers are available with either fixed or pivoted bases. Each design has advantages. A pivoted-base tower tapers to a point at the bottom. The tower and the foundation are connected at this single point. The tower remains upright and plumb even if the foundation shifts unevenly. Because of this, pivoted base towers are normally used when the soil at the site has unknown load-bearing qualities.

Each leg of a fixed base tower is bolted to the foundation making the tower-to-foundation connection rigid. Fixed-base towers permit direct installation of transmission lines at the ground level. They also allow installation of the elevator bottom-landing closer to the ground.

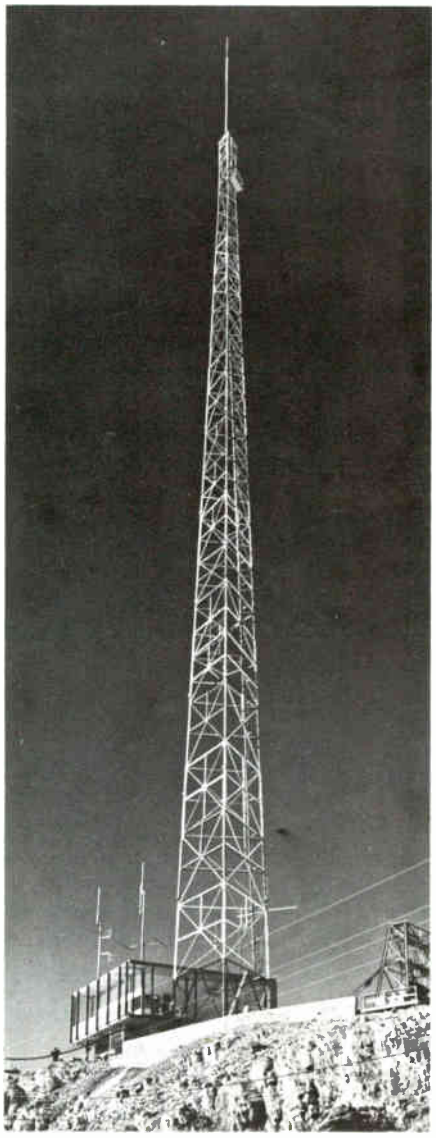
Self-Supporting Towers

Self-supporting towers are wide at the base and taper gradually to the top. They depend upon their tapered silhouette for stability. Such towers are especially advantageous in city and other congested districts where availability of land is limited.

The use of towers atop tall buildings is often quite practical. This normally results in a smaller tower and shorter transmission lines, especially if the build-



Guyed television towers can achieve great height at less cost than self-supporting structures where land value is not a determining factor. Towers are triangular and are available with either fixed or pivoted base.



Ranger Peak, 1900 feet above average terrain, near El Paso, Texas is an ideal site for KTSM-TV's self-supporting type antenna tower.

World Radio History

ing height is close to the desired antenna height. Building frameworks usually must be reinforced to support the extra load and erection problems sometimes become quite complex.

Mountain-top sites, in general, do not lend themselves to guyed towers due to limited land area available for guy points. As a result, most mountaintop towers are self-supporting. Since market coverage is usually proportional to antenna height, a strategically located mountaintop site is often desirable. A short tower is often acceptable to keep the antenna above close-in reflecting objects.

Multiple-Antenna Towers

Towers carrying a number of antennas, either in a "stacked" arrangement or with all antennas on a top platform at the same height or, with a combination of platform and side mounted antennas are feasible. Multiple antenna towers save each station using the tower land cost and let all use the area's best site. Such towers simplify air-space clearance problems and greatly reduce home-receiver antenna orientation problems.

Tower Foundations

Tower foundation design is based upon a laboratory analysis of the load-bearing capacity of the soil in which the foundation will be placed, along with a determination of the uplift the foundation is required to withstand. It is sometimes necessary to reinforce foundations with piling of steel, wood or concrete. Swampy land is a poor foundation base. Sand, gravel and clay soils are usually satisfactory. Shale or rock are good. A steel-reinforced, concrete foundation supports and fixes the base of most towers. Anchor bolts for the tower are cast right into the foundation with just the threaded ends protruding.

Weather Protection

The steel superstructure may be hot-dip galvanized steel where corrosion due to fumes, salt air, etc. are known to exist. Galvanizing can be omitted if the tower sections are heavy and painting is done frequently. Ladders should be located inside the tower if at all possible and preferably near one of tower legs. Rungs are spaced for easy ascent or descent.

Tower Elevators

Tower elevators are recommended on towers of 1000 feet (305m) or more in height. An elevator can save much air time during an outage in the antenna system by delivering the repairman to the faulty component fresh and efficient. Elevators also allow the station engineer or

San Francisco's Mt. Sutro Tower stands 977 feet (298m) to place its twelve antennas (five "V's"; three "U's" and four "FM's") 1811 feet (552m) above sea level. See "Broadcast News" (Vol. 150, P21-31 and Vol. 152, P35-41) for other pictures and many facts about the structure and its antennas.

World Radio History

manager to give on-the-spot supervision to work performed on the tower. Elevators also greatly simplify routine maintenance. Conventional passenger elevator safety devices should be included in the tower elevator system.

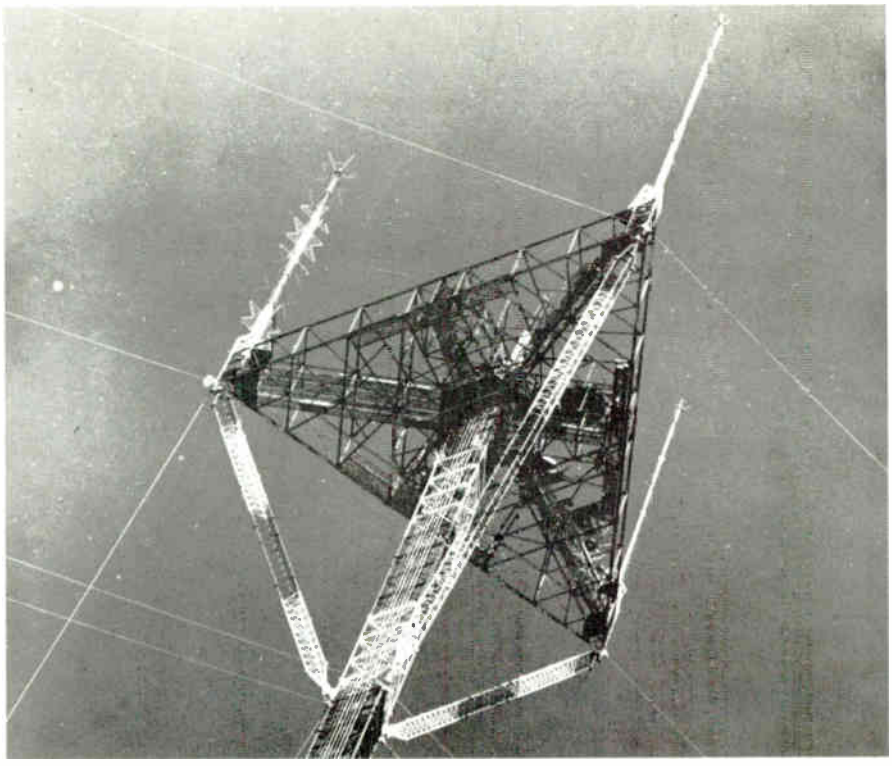
Service Platforms

Tower platforms are used in most tower designs. Inside platforms, at each light level, provide a safe rest-and-work area for tower maintenance people. Outside platforms with railings install at any level required to provide convenient access to side-mounted equipment. Top platforms that carry multiple-antenna systems use catwalks, railings and ladders to provide easy access to antennas and transmission lines.

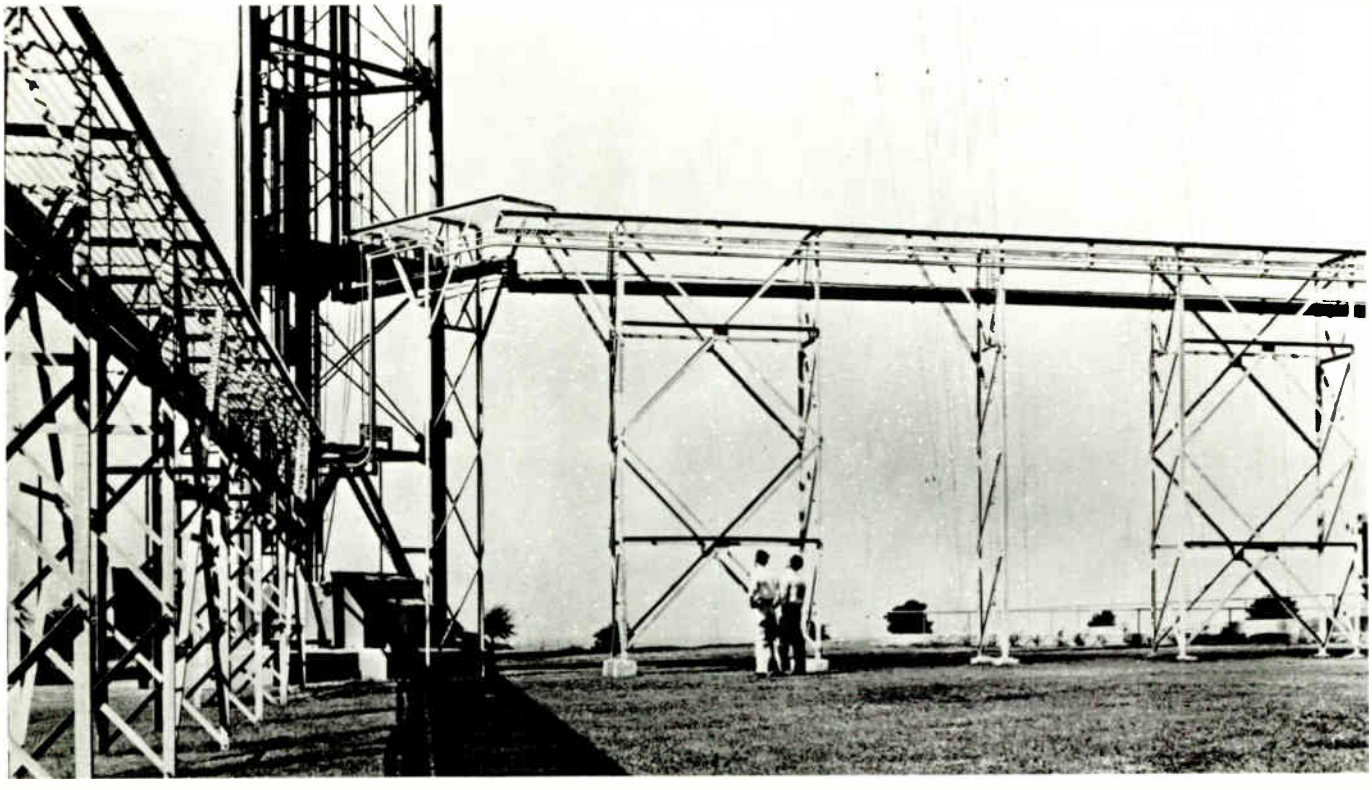
Telephone lines and jack boxes installed on the tower provide quick communication between maintenance workers on the tower and ground level.

Lightning Protection

All RCA antennas mounted on the top of a tower are provided with branching type lightning protectors. These consist of four rods disposed symmetrically about the 300mm beacon and extend above it. The parts are ruggedly built and

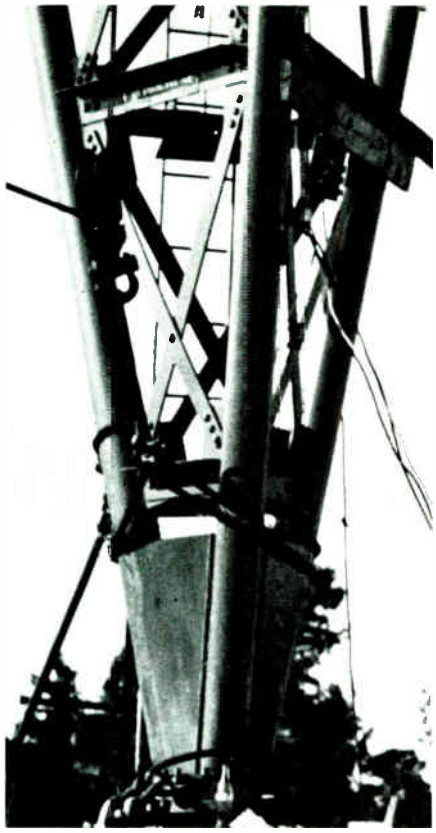


1500-foot top platform multiple antenna support tower affords substantially increased coverage for Stations KCRA, KOVR and KXTV in Stockton-Sacramento area. The economies afforded through a single tower, as opposed to three separate structures, are obvious.



TV tower showing horizontal transmission line runs protected by ice shields.

World Radio History



Typical anchorage for pivoted base type of guyed tower. Connected at a single point, the tower will remain upright and plumb even if the foundation shifts unevenly.

are hot-dip galvanized. The branching type design has been used on hundreds of antennas and is highly effective on tall towers in areas of high lightning incidence.

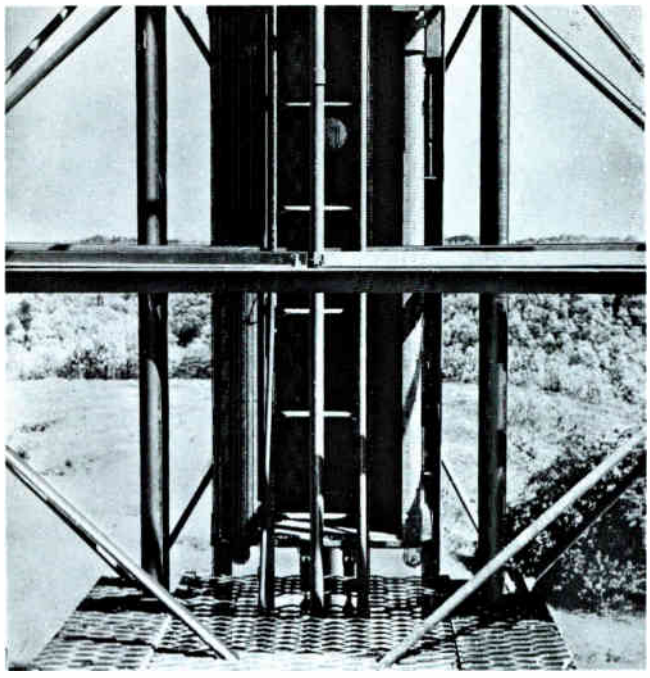
Tower Lighting

Complete tower lighting systems, designed in accordance with FCC and FAA requirements, are supplied with each tower. Lighting systems contain a series of flashing beacons and obstruction lights at intermediate levels. The number of beacons and lights required is proportional to tower height. A photo-electric lighting control, that automatically turns the tower lights on at sunset and off at sunrise, is supplied as a part of each lighting system. A lamp-failure indicator panel installs in the transmitter building as optional equipment.

A pole-socket and guide flange is used to support and steady Superturnstile antennas of the so-called "bury" type. The guide flange mounts at the tower top to keep the antenna perpendicular to the ground. The pole-socket supports the weight of the antenna. It mounts fifteen percent of the pole length below the tower top. RCA furnishes the pole socket and

Vertical run of transmission line inside a triangular cross-section tower. Spring-tensioned hangers allow movement of the line due to thermal expansion and contraction.

World Radio History



Tower elevators greatly simplify maintenance and should be considered for all towers of great height.

WIND VELOCITY AND CORRESPONDING WIND PRESSURE ON TOWERS—EIA STANDARD SPECIFICATION

Actual Wind Velocity mi/hr	(km/hr)	Wind Pressure On Flat Surfaces ($P = 0.004\ V^2$) lbs/ft²	(kg/m²)	Wind Pressure On Round Surfaces lbs/ft²	(kg/m²)	Estimated Survival Velocity (F.S. 1.65) mi/hr	(km/hr)
10	16.1	0.4	1.95	0.266	1.29	12.9	20.8
20	32.2	1.6	7.80	1.067	5.21	25.8	41.5
30	48.3	3.6	17.57	2.40	11.71	38.6	62.1
40	64.4	6.4	31.23	4.27	20.83	51.5	82.9
50	80.5	10.0	48.80	6.67	32.55	64.4	103.6
60	96.5	14.4	70.27	9.60	46.85	77.3	124.4
70.7	113.8	20.0	97.60	13.33	65.05	91.1	146.6
80	128.7	25.6	124.9	17.10	83.45	103.0	165.7
86.6	139.3	30.0	146.4	20.00	97.60	111.5	179.4
90	144.8	32.4	158.1	21.60	105.4	115.9	186.5
100	160.9	40.0	195.2	26.70	130.3	128.8	207.2
110	176.9	48.4	236.2	32.30	157.6	141.7	228.0
111.8	179.9	50.0	244.0	33.30	162.5	144.0	231.7
120	193.1	57.6	281.1	38.50	187.9	154.6	248.8
122.5	197.1	60.0	292.8	40.00	195.2	157.8	253.9
130	209.2	67.6	329.9	45.00	219.6	167.4	269.3
132.3	212.9	70.0	341.6	46.67	227.7	170.4	274.2
140	225.3	78.4	382.6	52.33	255.3	180.3	290.1
141.4	227.5	80.0	390.4	53.33	260.3	182.1	293.0
150	241.4	90.0	439.2	60.00	292.8	193.2	310.9
160	257.4	102.2	498.7	68.20	332.8	206.1	331.6
170	273.5	115.6	564.1	77.00	375.8	219.0	352.4
180	289.6	129.6	632.4	86.60	419.7	231.8	373.0
190	305.7	144.4	704.7	96.30	469.9	244.7	393.7
200	321.8	160.0	780.8	106.66	520.5	257.6	414.5

guide flange with each Superturnstile antenna except the Types TF-12AM and TF-12AL. For these two types, tower manufacturers fabricate the pole socket and guide flange.

Where necessary, arrangements may be made to provide a pedestal-type mount that mounts the antenna effectively on the tower top and eliminates the "bury" section.

Twelve-section Superturnstiles have an RF combining network which the tower accommodates below the top. Provisions are made so that tower cross-bracing does not interfere with the network. Mounting provisions for hangers are supplied to support this network.

Traveling Wave antennas are furnished with a flange at the base for mounting on the tower top.

UHF Antenna Mountings

The standard UHF transmitting antenna is the UHF Pylon. It is flange mounted directly to the tower top plate. Tapered wedges are supplied with the antenna to obtain mechanical beam tilting of the antenna where specified.

Transmission Lines

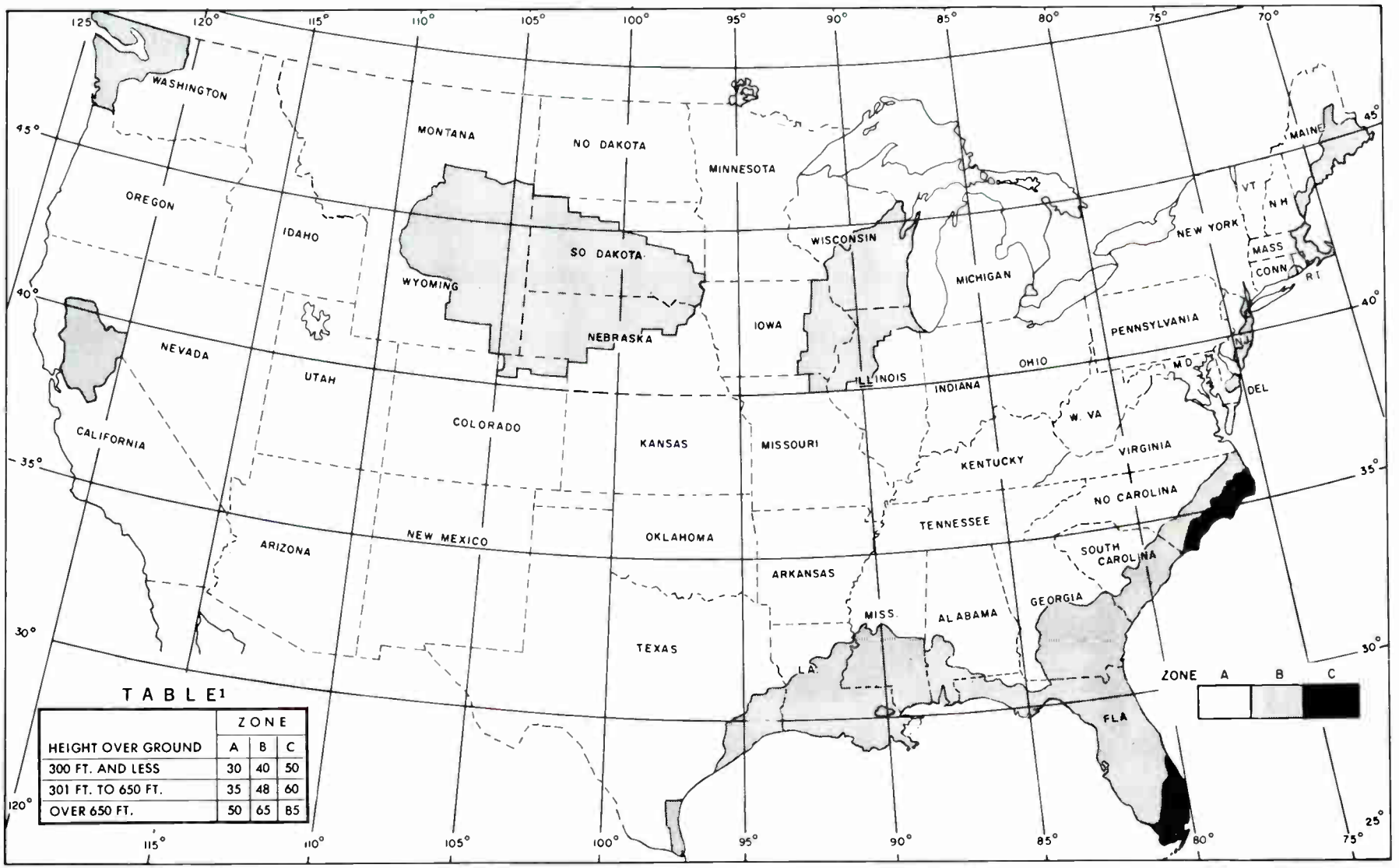
Careful consideration is given to the layout and support of transmission line on the tower to allow for expansion and contraction of line and ease of maintenance. The tower manufacturer consults with RCA engineers to assure adequate support for the line and that a minimum number of elbows are used between the antenna input and the vertical run down the tower. The tower company supplies supports for tensioned hangers from the tower top to the base. Outline drawings with dimensions are availble for all types of transmission lines and are used in the layout. These drawings are reproduced in the transmission line catalog section.

Wind Load

Most towers are currently built to 50/33 pound loading. This means that tower members are designed to resist a horizontal wind pressure of 50 pounds per square foot (244 kg/m²) of projected area on all flat surfaces and 33 pounds (162 kg/m²) on round surfaces.

Provision is made for all additional loadings caused by antenna, ladders, transmission and power lines, etc. and is applied to the projected area of the structure. The total load specified is applied in the direction which will cause the maximum stress in the various members. Where high winds or heavy icing is prevalent higher loading is often specified.

World Radio History



TABLE[1]

HEIGHT OVER GROUND	ZONE A	B	C
300 FT. AND LESS	30	40	50
301 FT. TO 650 FT.	35	48	60
OVER 650 FT.	50	65	85

This map and table, extracted from EIA Standard RS-222B, gives minimum horizontal design windload pressures in pounds per square foot, on flat surfaces and with no ice for the zones indicated. The map, as well as the table, must be interpreted in view of local knowledge and applicable building codes. See RS-222B for zone boundaries defined by state and county.

[1]Wind pressure specified in pounds per square foot only shall be assumed to be uniform over the entire height of the tower. Wind pressures specified by both zone and pressures, in pounds per square foot shall be designed for the more severe loading. (From Page 3 of RS-222B.)

World Radio History

Every tower is custom built to meet station requirements. RCA is equipped to supply a tower completely designed to meet those requirements. By specifying RCA as your tower contractor, you are assured a satisfactory installation.

Towers are designed in accordance with EIA Specifications.*

Consultation with RCA Broadcast Representatives helps to determine requirements. Call or write your nearest RCA regional representative.

Tower Considerations

These thoughts may be helpful as a check list for tower requirements.

1. Determine station location with respect to service area. This study, which involves, among other things, joint operation with other stations, FAA approval, cost of land, zoning restrictions, local regulations, etc., results in a decision to use:
   a. A self-supporting tower where land is unavailable as in city limits or on top of a building; or:
   b. A guyed tower where land is available and a greater height is desired; or:
   c. A multiple-antenna tower.
2. Determine these design parameters:
   a. Wind load for area in which tower is located;
   b. Deflection at tower top for type of service required;
   c. Type of antenna to be supported;
   d. Future additions to the tower.
3. Determine tower accessories such as:
   a. Ladders;
   b. Platforms;
   c. Railings;
   d. Lighting;
   e. Microwave dishes;
   f. Circuits.
4. Determine method of routing transmission line, considering:
   a. Line accessibility;
   b. Relationship of structural members;
   c. Requirements of special networks below tower top.

Accessories

RCA can furnish, in addition to the antenna supporting tower itself, tower lighting equipment, installation and erection assistance.

*EIA Standard "Structure Standards for Steel Transmitting Antennas, Supporting Steel Towers" RS-222B.

Antenna Tower Questionnaire

1. Organization _____ Address _____
2. Tower Location _____ Tower Height _____
3. Nature of Terrain:
   ☐ Flat ☐ Hilly ☐ Atop Building
4. Type of Tower: ☐ Guyed ☐ Self Supporting
   ☐ Candelabra ☐ Stacked antenna
5. Adequate access to tower base?
   ☐ Yes ☐ No If "No", describe situation.
   Guy anchor points provided?
   ☐Yes ☐ No If "No", describe solution.
   Tagline path provided?
   ☐Yes ☐ No If "No", describe solution.
6. Adequate space to unload and arrange tower steel available? ☐ Yes ☐ No
7. Adequate space and security for the unloading and storage of the antenna(s) and transmission line?
   ☐ Yes ☐ No If "No", describe solution.
8. Elevator? ☐ Yes ☐ No ☐ Later
9. Top Antenna: Type_____ Channel_____
10. Transmission Line? Diameter_____
    Ml_____ Number of Lines_____
11. FM Antennas and Transmission Lines:
    a. Type_____ Line_____ Height_____
       Install: ☐ Now ☐ Later
    b. Type_____ Line_____ Height_____
       Install: ☐ Now ☐ Later
    c. Type_____ Line_____ Height_____
       Install: ☐ Now ☐ Later
12. Microwave Reflectors:
    a. Size_____ Height_____
       Install: ☐ Now ☐ Later
    b. Size_____ Height_____
       Install: ☐ Now ☐ Later
    c. Size_____ Height_____
       Install: ☐ Now ☐ Later
13. Required circuits (in addition to lighting system):
    Deicing_____; Deicer control_____; Communications_____; Auxiliary power_____;
    Other (describe) _____
14. Design windload: _____ lbs. (_____ kg)
15. Who will install foundations?
    ☐ Customer ☐ RCA Corporation
16. Anticipated construction:
    Start _____ (date) Finish _____ (date)

Notes:

A. Price will not include horizontal bridge nor horizontal transmission-line installation. If included, advise length _____ ft., height _____ ft. (Bridge foundation responsibility is same as in query 15 above.)

B. Price includes standard FAA lighting unless indicated otherwise here: ☐ Please describe.

C. Price includes standard FAA color-stripe painting unless indicated here: ☐ (painting is not required.) Unless otherwise advised below, galvanized ladders and horizontal bridge are not painted.

World Radio History

High Intensity Strobe Tower Lighting

- Three light intensities: 200,000, 20,000 and 40,000 candelas
- Automatic intensity reduction at twilight and nightfall
- Eliminates tower candy-stripe painting and repainting*
- All lamps flash simultaneously, 40 flashes per minute
- Economical: Power per luminaire only 210 watts (daytime)

High-intensity strobe tower lighting is the latest in tall-structure air-hazard warning systems.

The lighting operates day and night in flashes of very intense light similar to the familiar electronic photoflash photographers use. The flashes are highly conspicuous to air navigators operating under visual flight rules, day or night.

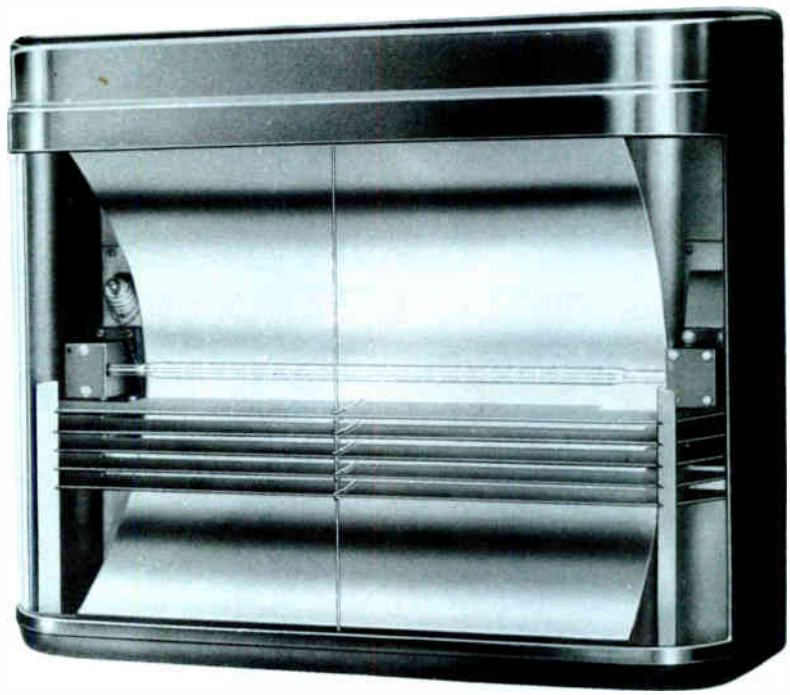
Multiple Flash Intensities

There are three light intensities from each luminaire: 200,000 candelas for daylight operation; 20,000 candelas for twilight and 4000 candelas for after-dark operation. Intensity reduction at sunset and increase at sunup is completely automatic. The system senses ambient light level with photo sensitive elements located strategically nearby to monitor northlight. As sunlight diminishes below an adjustable level, the system switches over to the lower light levels. At sunup, the process is reversed.

Eliminates Tower Painting and Repainting*

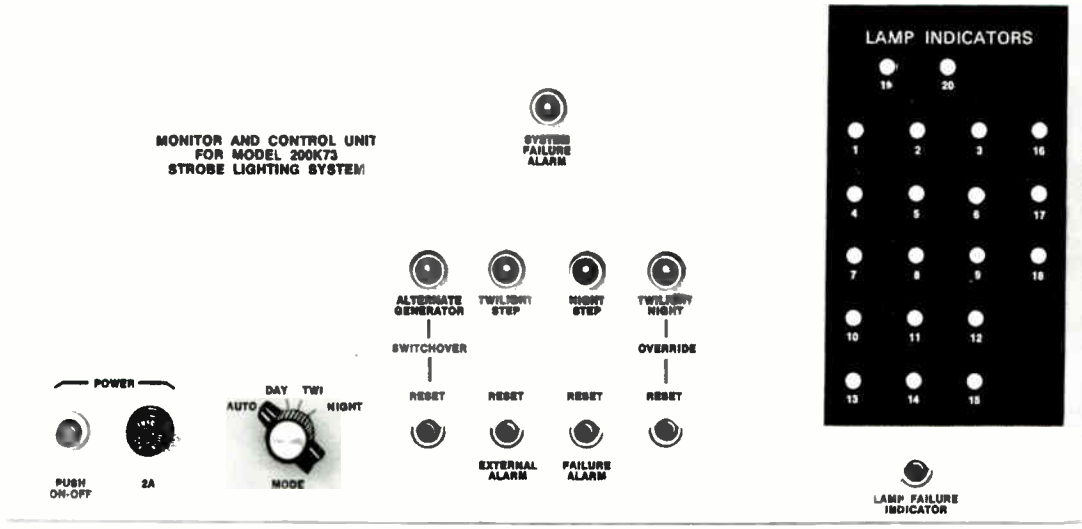
As a result of the high visibility of strobe lighting, even in daylight, the familiar candy stripe tower paint is unnecessary. This can represent a considerable reduction in tower expense initially and subsequently if the tower is corrosion resistant at the outset.

*Subject to government approval.



Strobe Lighting Luminaire

World Radio History



Control and monitor unit for typical strobe lighting system. Note individual luminaire monitors in dark panels at right. See text.

Luminaire Construction

Heavy gauge, corrosion-resistant stainless steel housings and Pyrex* window give the luminaire excellent resistance to the effects of weather. For highly corrosive environments, a fiberglass housing is available instead of the stainless steel. The xenon flash tube has an average life exceeding 18 months of operation at an intensity that exceeds the 200,000, 20,000 and 4000 candela brightness level.

The horizontal beam of each luminaire is adjustable from 0 to 8° above the horizon through an adjustment on the side of the unit. The mounting bracket is integral to the housing for extra installation convenience. Flash tube mounts are quick disconnect for easy tube replacement.

*Corning Glass trademark.

Luminaire Power Supply

Compact, all solid-state power supplies are part of every system. Modular design speeds component replacement when the occasion arises and interlock circuitry is included for the protection of servicing personnel. The power supply units usually mount at the base of the lighted structure indoors or out.

Control and Monitor Unit

Lighting system status is monitored with a flashing green indicator on the monitor panel. A separate indicator monitors each luminaire in the system. In the event of luminaire failure (there are three at each level), the flashing green changes to continuous red. Indicators also show operational mode: daylight, twilight or night. Manual override of operational mode uses a four-position switch (see photo). Another indicator monitors alternate timing generator operation. When the built-in spare generator automatically goes into operation, this lamp lights to indicate the switchover and that the main timing generator is inoperative for some reason.

In the event of an outage in the twilight or night operational modes, the system automatically switches the next brighter mode: from night to twilight and so on. As switchover takes place, a panel indicator signals the event and the need for attention.

The control and monitor unit includes an audible system of failure alarm for local announcement. Connections are provided for wiring external alarm systems.

The Control and Monitor Panel usually mounts in the same enclosure with the power supply. However, it mounts in an ordinary equipment rack if so desired.

Ordering Information

Strobe tower-lighting systems are arranged to suit the situation at hand and, for this reason, need an exchange of information between you and our engineers. If you can tell us your requirements on the questionnaire below, we'll work up a suitable system for you and include a cost estimate. Please contact your RCA salesman for further details.

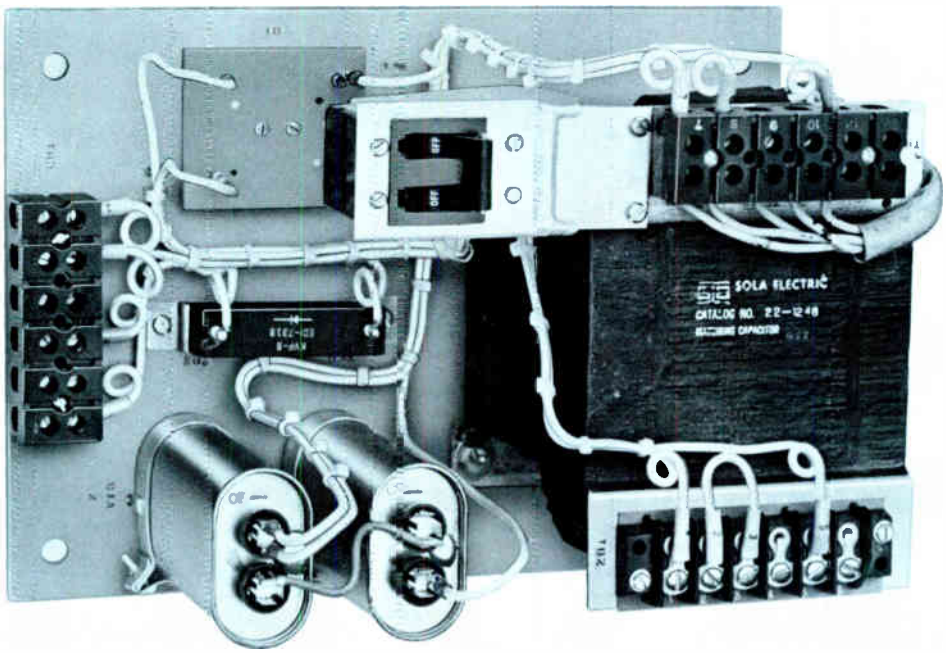
Name _____

Location _____

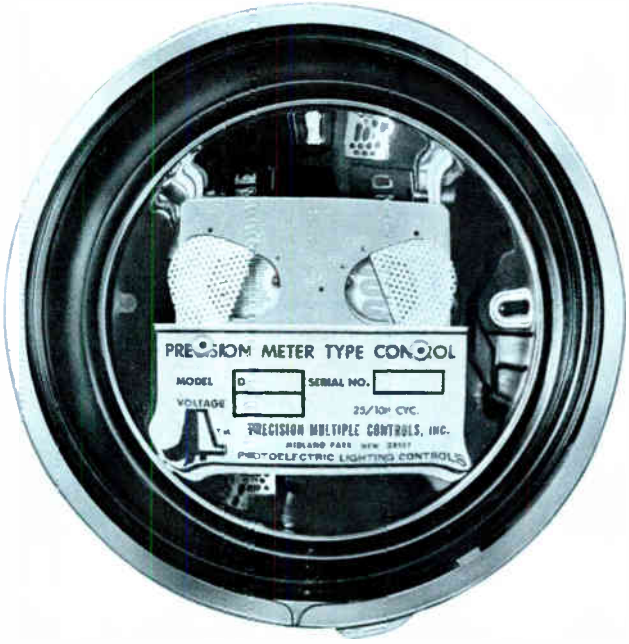
Tower Type _____ Height _____

Luminare Mounting Preferred: Tower Face ☐ Tower Leg ☐
Luminaire Housing Preferred: Fiberglass ☐ Stainless Steel ☐
Beacon Required? Yes ☐ No ☐

World Radio History



Typical strobe-lighting power supply. Transformer is saturable-core regulated. Unit mounts at or near base of lighted structure.



This dual-unit light sensor monitors daylight level to control strobe-lighting level for daytime, twilight and after dark. Note adjustable shutter on each sensor.

World Radio History

World Radio History

RCA

UHF-TV BROADCAST TRANSMITTER EQUIPMENT DOMESTIC PRICE LIST

Issued January 1, 1975

Reference Number
TT.9990U

All sales are subject to RCA's Standard Terms and Conditions of Sale which are available upon request from your Broadcast Equipment Field Sales Representative.

Prices subject to change without notice.

World Radio History

Catalog Number	Type Number	Product Description	Price
		UHF TRANSMITTER, 30 kW VISUAL, 16 kW AURAL—Section TT.3200	
ES-560958	TTU-30C	UHF Transmitter, 30 kW Visual, 16 kW Aural	$257,500.00
ES-560937	TTUE-4	Standby Exciter Cabinet Group	35,900.00
MI-560925	—	Primary Voltage Regulator (Two required if used)	2,500.00
MI-560407-1	VA-890H	Spare Klystron Power Tube, Ch. 14-29	13,440.00
MI-560407-2	VA-891H	Spare Klystron Tube, Channels 30-51	13,440.00
MI-560407-3	VA-892H	Spare Klystron Power Tube, Ch. 52-70	13,990.00
MI-560899	—	Spare Solid-State IPA	2,950.00
		UHF-TV TRANSMITTER, 55 kW VISUAL, 12 kW AURAL—Section TT.3400	
ES-560927	TTU-55B	UHF-TV Transmitter, 55 kW Visual, 12 kW Aural	312,500.00
MI-560569-1	VA-953B	Spare Klystron Power Tube, Channels 14-29	18,065.00
MI-560569-2	VA-954B	Spare Klystron Tube, Channels 30-51	18,065.00
MI-560569-3	VA-955C	Spare Klystron Power Tube, Channels 52-70	18,950.00
MI-560571	—	Primary Voltage Regulator (Three required if used)	5,000.00
ES-560937	TTUE-4	Standby Exciter Cabinet Group	35,900.00
		UHF-TV TRANSMITTER, 60 kW VISUAL, 16 kW AURAL—Section TT.3600	
ES-560961	TTU-60C	UHF-TV Transmitter, 60 kW Visual, 16 kW Aural	352,500.00
MI-560407-1	VA-890H	Spare Klystron Tube, Channels 14-29	13,440.00
MI-560407-2	VA-891H	Spare Klystron Tube, Channels 30-51	13,440.00
MI-560407-3	VA-892H	Spare Klystron Tube, Channels 52-70	13,990.00
MI-560889	—	Spare Solid-State IPA	2,950.00
MI-560493	—	Primary Voltage Regulator (Three required if used)	5,000.00
ES-560937	TTUE-4	Standby Exciter Cabinet Group	35,900.00
—	—	Standby Power Option	On Request
		UHF-TV TRANSMITTER, 60 kW VISUAL, 16 kW AURAL—Section TT.3650	
ES-560961	TTU-60C2	UHF-TV Transmitter, 60 kW Visual, 16 kW Aural	365,000.00
MI-560407-1	VA-890H	Spare Klystron Power Tube, Ch. 14-29	13,440.00
MI-560407-2	VA-891H	Spare Klystron Tube, Channels 30-51	13,440.00
MI-560407-3	VA-892H	Spare Klystron Power Tube, Ch. 52-70	13,990.00
MI-560899	—	Spare Solid-State IPA	2,950.00
MI-560493	—	Primary Voltage Regulator (Three required if used)	5,000.00
ES-560937	TTUE-4	Standby Exciter Cabinet Group	35,900.00
On Request	—	Standby Power Option	On Request
		UHF TRANSMITTER, 110 kW VISUAL, 24 kW AURAL—Section TT.3700	
ES-560935	TTU-110B	UHF-TV Transmitter, 110 KW Visual, 24 kW Aural	477,500.00
MI-560569-1	VA-953B	Spare Klystron Power Tube, Ch. 14-29	18,065.00
MI-560569-2	VA-954B	Spare Klystron Tube, Channels 30-51	18,065.00
MI-560569-3	VA-955B	Spare Klystron Power Tube, Ch. 52-70	18,950.00
MI-560571	—	Primary Voltage Regulator (Three required if used)	7,500.00
ES-560937	TTUE-4	Standby Exciter Cabinet Group	35,900.00
—	—	Standby Power Option	On Request
		UHF TRANSMITTER, 165 kW VISUAL, 26 kW AURAL—Section TT.3800	
ES-560950	TTU-165C	UHF-TV Transmitter, 165 kW Visual, 26 kW Aural	On Request
ES-560937	TTUE-4	Standby Exciter Cabinet Group	35,900.00
—	—	Primary Voltage Regulator	On Request
MI-560569-1	VA-953B	Spare Klystron Power Tube, Ch. 14-29	18,065.00
MI-560569-2	VA-954B	Spare Klystron Tube, Channels 30-51	18,065.00
MI-560569-3	VA-955B	Spare Klystron Power Tube, Ch. 52-70	18,950.00
MI-560899	—	Spare Solid-State IPA	2,950.00
		UHF TRANSMITTER, 220 kW VISUAL, 24 kW AURAL—Section TT.3900	
ES-560975	TTU-220C	UHF-TV Transmitter, 220 kW Visual, 24 kW Aural	On Request
ES-560937	TTUE-4	Standby Exciter Cabinet Group	35,900.00
—	—	Primary Voltage Regulator	On Request
MI-560569-1	VA-953B	Spare Klystron Power Tube, Ch. 14-29	18,065.00
MI-560569-2	VA-954B	Spare Klystron Tube, Channels 30-51	18,065.00
MI-560569-3	VA-955B	Spare Klystron Power Tube, Ch. 52-70	18,950.00
MI-560899	—	Spare Solid-State IPA	2,950.00
		SOLID-STATE EXCITER-MODULATOR—Section TT.4400	
ES-560938	TTUE-4	UHF-TV Retrofit Exciter-Modulator	30,985.00
ES-560937	TTUE-4	Spare Exciter Cabinet Group	35,900.00

World Radio History

Catalog Number	Type Number	Product Description	Price
		DIGITAL REMOTE CONTROL SYSTEM—Section TT.5300	
—	DRS-1	Digital Remote Control System, Moseley:	
—	—	For Ten Metering and Control Channels	$ 3,400.00
—	—	For Twenty Metering and Control Channels	3,970.00
—	—	For Thirty Metering and Control Channels	4,540.00
—	—	Status System Option, for Type DRS-1	800.00
—	DLS-1	Automatic Parameter Logging Option for Type DRS-1	7,350.00
MI-561484	BRF-1	TV Failsafe Unit (Replaced with Type FSU-1, see below)	Discontinued
—	FSU-1	TV Failsafe Unit	475.00
MI-561192	—	TV Failsafe Interface Panel	200.00
MI-561469	TAU-2	Tolerance Alarm Unit Main Frame	395.00
MI-561184	TAU-2	Comparator Module (for above)	65.00
MI-561462	TLK-2	Tower Light Sensing Kit	60.00
MI-561463	LVK-2	Line Voltage Sampling Kit	35.00
MI-561465	TSK-3	Temperature Sensing Kit	90.00
MI-561179	PLC-1	DC Amplifier and Linear Converter	235.00
MI-561448-1	—	Relay, DPDT, 24V DC Coil, with Socket	15.00
MI-561448-2	—	Relay, DPDT, 240V AC Coil, with Socket	15.00
MI-561448-3	—	Relay, Latching, DPDT, 24V DC Coil, with Socket	29.00
MI-561448-4	—	Relay, Time Delay, 24Vdc Coil	62.00
		REMOTE CONTROL SYSTEM—Section TT.5400	
—	DCS-2	Digital Remote Control System, Moseley (Single transmitter site)	15,350.00
—	DCS-2	As Above but for two transmitter sites	26,250.00
—	PLU-1	Parameter Logging Option	6,400.00
—	—	Computer Option (Single transmitter site) (for Type DCS-2)	22,750.00
—	—	As Above but for two transmitter sites	23,950.00
		REMOTE CONTROL ACCESSORIES—Section TT.5600	
MI-561448-1	—	Relay, 24Vdc	15.00
MI-561448-2	—	Relay, 115Vac	15.00
MI-561448-3	—	Relay, Latching, 24Vdc	29.00
MI-561448-4	—	Relay, Time-Delay, 24Vdc	62.00
MI-561449	—	Relay Panel	20.00
MI-561461	CSA-3	Direct-Current Amplifier	135.00
MI-561480	—	Mounting Panel	15.00
MI-561179	PLC-1	DC Amplifier/Linear Converter	235.00
MI-561480	—	Amplifier Mounting Panel	15.00
MI-561481-1	—	Plate Current Metering Kit	250.00
MI-561481-2	—	Plate Current Metering Kit	250.00
MI-561481-3	—	Plate Current Metering Kit	250.00
MI-561481-4	—	Plate Current Metering Kit	250.00
MI-561482-1	—	Plate Voltage Sampling Kit	30.00
MI-561482-2	—	Plate Voltage Sampling Kit	30.00
MI-561483	—	Plate Voltage Sampling Kit	60.00
MI-561484	BRF-1	Remote Control Failsafe Module (Replaced with Type FSU-1)	Discontinued
—	FSU-1	TV Failsafe Unit	475.00
MI-561192	—	Failsafe Interface Panel	200.00
MI-560851-15	—	Aural Subcarrier Insertion Kit	75.00
MI-560851-18	—	Aural Subcarrier Insertion Kit	75.00
MI-34326-30	—	Aural Subcarrier Insertion Kit	10.00
MI-561184	TAU-2	Tolerance Alarm System Module	65.00
MI-561469	TAU-2	Main Frame	395.00
MI-561448-5	—	Tolerance Alarm Interface Relay	20.00
MI-561449	—	Rack-Mount Relay Panel	20.00
MI-561463	LVK-2	Line-Voltage Sampling Kit	35.00
MI-561465	TSK-3	Temperature-Sensing Kit	90.00
MI-561462	TLK-2	Tower Light Monitor Kit	60.00
ES-561156	SCS-2	Status Indicator System	Discontinued

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Catalog Number	Type Number	Product Description	Price
		TV TRANSMITTER INPUT AND MONITORING EQUIPMENT—Section TT.6000	
ES-36591-P77	BR-77P	Cabinet Rack	$ 440.00
ES-36591-S77	BR-77S	Cabinet Rack	315.00
MI-36546-A21	—	Electrical Shield	16.00
MI-36546-A28	—	Electrical Shield	22.00
MI-30566-A77	—	Single Trim Strip	32.00
MI-30568-A77	—	Double Trim Strip	38.00
MI-30526-A77	—	Mounting Angles	35.00
MI-4570-A2	—	Terminal Board Brackets	15.00
MI-4569-A4	—	Audio Terminal Block	12.00
MI-4568	—	Power Terminal Block	12.00
MI-4652-D2	—	Audio Patch Cord	14.00
MI-11666	BJ-20TRS	Jack Panel	75.00
ES-11141	BA-147	Limiter/Clipper Amplifier	995.00
ES-11134	BA-44	Monitor Amplifier	396.00
MI-11597	BR-22	Shelf	70.00
MI-556582-8	112	Self-Normalling Dual Video Jack Panel	42.00
MI-556582-1	22T	Dual, Normalled-Through Jacks	27.50
MI-556582-2	57	Patch Cord	16.50
MI-556582-3	5B	Test Probe	16.50
MI-12265	BI-5	VU Meter Panel	295.00
MI-556630B1	TA-19	Video Processing Amplifier	4,500.00
MI-556646A	TA-19	Burst Regenerator	595.00
MI-556647A	TA-19	Automatic Video Gain Control	595.00
MI-560503	TTS-1	Color Phase Equalizer	6,500.00
—	TFT-701	TV Frequency and Aural Modulation Monitor	4,750.00
—	TFT-701-1	Rack Adapter	55.00
MI-34000C2	BW-5C2	Sideband Response Analyzer, VHF	3,600.00
ES-34009C2	BWU-5C2	Sideband Response Analyzer, UHF	4,500.00
ES-597267B	—	Sync and Blanking Adder	975.00
MI-557300	—	Module Frame	95.00
ES-34048C	BW-4C1	Visual Sideband Demodulator, VHF	Discontinued
ES-34049C	BWU-4C1	Visual Sideband Demodulator, UHF	Discontinued
MI-36547-2	—	Blank Panel	8.00
MI-36547-3	—	Blank Panel	10.00
MI-36547-5	—	Blank Panel	13.00
MI-19396-1B	—	Directional Coupler	180.00
MI-27390	—	Directional Coupler	220.00
MI-27389	—	Directional Coupler	230.00
MI-561577	—	Directional Coupler	285.00
MI-561578	—	Directional Coupler	285.00
MI-19396-3	—	Transmission Line Section	57.50
MI-19089-22	—	Transmission Line Section	89.00
MI-27791D-9A	—	Transmission Line Section	76.50
MI-27791K-9A	—	Transmission Line Section	28.50
MI-19314C-25	—	Transmission Line Section	71.50
MI-19387-20	—	Transmission Line Section	195.00
MI-27792D-9A	—	Transmission Line Section	154.00
MI-561566D-9A	—	Transmission Line Section	290.00
MI-27793D-9A	—	Transmission Line Section	295.00
		TRANSMITTER CONTROL CONSOLE—Section TT.6300	
ES-561900	TTC-5	Transmitter Control Console, Single Transmitter	7,871.00
ES-561900	TTC-5	As Above, but for dual transmitter	15,928.00
		CARRIER-FREQUENCY AND AURAL MODULATION MONITORS—Section TT.6400	
—	TFT-701	TV Frequency and Aural Modulation Monitor	4,750.00
—	TFT-702	Aural Modulation Monitor	2,673.75
Option 01	—	Rack Mount Adapter	55.00
Option 02	—	Alarm Adapter	172.50
Option 03	—	SCA Option	172.50
Option 04	—	AGC Meter Option	143.75
—	TFT-704	Remote Meter and Peak Flasher	287.50

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Catalog Number	Type Number	Product Description	Price
		FREQUENCY AND MODULATION MONITOR SYSTEMS—Section TT.6410	
MI-560544	TVM-1	Belar Aural Modulation Monitor	$ 1,500.00
MI-560548	RFA-3	Belar RF Amplifier	550.00
MI-560545	TVM-2	Belar Carrier Frequency Monitor, VHF	1,500.00
MI-560546	TVM-3	Belar Carrier Frequency Monitor, UHF	1,750.00
MI-560548	RFA-3	Belar RF Amplifier	550.00
		VERTICAL INTERVAL ELECTRONIC CHOPPER—Section TT.6510	
ES-560654	—	Vertical Interval Electronic Chopper	375.00
ES-560653	—	Vertical Interval Electronic Chopper	495.00
		TELEVISION DEMODULATOR, TELEMET MODEL 4501—Section TT.6550	
—	4501A1	Telemet Demodulator, for VHF	3,600.00
—	4501A2	Telemet Demodulator, for UHF	3,750.00
		TELEVISION DEMODULATOR, ROHDE & SCHWARZ TYPE AMF—Section TT.6560	
MI-560534L	AMF	Television Demodulator for Ch. 2-6	8,625.00
MI-560534H	AMF	Television Demodulator for Ch. 7-13	8,625.00
MI-560534U	AMF	Television Demodulator for Ch. 14-69	8,625.00
MI-560536L	HS-2064	RF Receiver, for Ch. 2-6	4,315.00
MI-560536H	HS-2064	RF Receiver, for Ch. 7-13	4,315.00
MI-560536U	HS-2064	RF Receiver, for Ch. 14-69	4,830.00
		DIODE DEMODULATORS, DIRECTIONAL COUPLERS—Section TT.6700	
MI-19051B	—	VHF Diode Demodulator	144.00
MI-19364	—	UHF Diode Demodulator	436.00
MI-560486	—	UHF Diode Demodulator	575.00
MI-560529	—	UHF Diode Demodulator	625.00
MI-561269	—	UHF Diode Demodulator	625.00
MI-560010	—	Monitoring Diode	66.00
MI-19396-1	—	Directional Coupler	180.00
MI-27390	—	Directional Coupler	220.00
MI-27389	—	Directional Coupler	230.00
MI-561577	—	Directional Coupler	285.00
MI-561578	—	Directional Coupler	285.00
MI-19396-3	—	Monitoring Line Section	57.50
MI-19089-22	—	Monitoring Line Section	89.00
MI-27791D-9A	—	Monitoring Line Section	76.50
MI-27791K-9A	—	Monitoring Line Section	28.50
MI-19314C-25	—	Monitoring Line Section	71.50
MI-19387-20	—	Monitoring Line Section	195.00
MI-27792D-9A	—	Monitoring Line Section	154.00
MI-561566D-9A	—	Monitoring Line Section	290.00
MI-27793D-9A	—	Monitoring Line Section	295.00
		TV SIDEBAND RESPONSE ANALYZERS—Section TT.6800	
MI-34000C-2	BW-5C2	Sideband Response Analyzer, VHF	3,600.00
ES-34009C-2	BWU-5C2	Sideband Response Analyzer, UHF	4.500.00
MI-19396-1B	—	Directional Coupler, 3⅛-inch	180.00
MI-27390	—	Directional Coupler, 3⅛-inch, pressurized	220.00
MI-27389	—	Directional Coupler, 6⅛-inch	230.00
MI-19396-3	—	VHF Line Section	57.50
MI-19089-22	—	UHF Line Section	89.00
MI-19387-20	—	UHF Line Section	195.00
ES-597267	—	Sync and Blanking Adder	975.00
MI-557300	—	Module Mounting Frame	95.00
		ENVELOPE DELAY MEASURING EQUIPMENT—Section TT.6900	
MI-34063	BW-8A	Envelope Delay Measuring Set	1,595.00
ES-34048	BW-4C1	VHF Visual Sideband Demodulator	Discontinued
ES-34049	BWU-4C1	UHF Visual Sideband Demodulator	Discontinued
MI-19051B	—	VHF Monitoring Diode	144.00
MI-19364	—	UHF Monitoring Diode	436.00

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Catalog Number	Type Number	Product Description	Price
		HARMONIC FILTERS FOR UHF-TV TRANSMITTERS—Section TT.7200	
MI-561549L	—	Harmonic Filter, Ch. 14-43 incl. (Not Sold Separately)	←
MI-561549H	—	Harmonic Filter, Ch. 44-83 incl. (Not Sold Separately)	←
		60 kW HYBRID FILTERPLEXER—Section TT.7600	
MI-561543	—	UHF Hybrid Filterplexer, 60 kW (Not Sold Separately)	←
		WAVEGUIDE FILTERPLEXERS—Section TT.7650	
MI-561550	—	Waveguide Filterplexer, Ch. 14-42, 60 kW (Not Sold Separately)	←
MI-561551	—	Waveguide Filterplexer, Ch. 43-69, 60 kW (Not Sold Separately)	←
MI-561552	—	Waveguide Filterplexer, Ch. 14-42, 120 kW (Not Sold Separately)	←
MI-561553	—	Waveguide Filterplexer, Ch. 43-69, 120 kW (Not Sold Separately)	←
		RF LOADS AND WATTMETERS FOR UHF-TV—Section TT.8200	
MI-19197	—	Air-Cooled, 1200-Watt Load and Wattmeter	$ 825.00
MI-19089-17	—	Reducer, 50-ohm 3⅛-Inch to Type N	150.00
MI-19089-19	—	Adapter, Type N to Type HN Connector	40.00
MI-19089-10A	—	Inner Connector, Anchor Insulator	28.00
ES-561800	—	Water-Cooled, 80 kW Load, Open-Water System	5,700.00
ES-561812	—	Water-Cooled, 80 kW Load, Closed-Water System	8,250.00
MI-561733	—	Water-Cooled, 15/25-kW Load	1,390.00
MI-19387-4	—	Reducer-Transformer	330.00
MI-19089-10A	—	Inner Conductor Connector	28.00
MI-27350	—	Wattmeter, 0-15 kW	525.00
MI-27363	—	Wattmeter, 0-25 kW	525.00
MI-561813	—	Water-Cooled, 50 kW Load-Wattmeter, Open Water System	4,400.00
MI-561810	—	Water-Cooled, 50 kW Load-Wattmeter, Closed Water System	6,625.00
MI-19387-4	—	Reducer-Transformer	330.00
		UHF-PYLON ANTENNAS—Section TT.9200	
		Since all UHF-Pylon Antennas are built to order, the prices listed here are approximate. We list prices here as an aid in the selection of an antenna suitable for your needs and desires.	
Custom	TFU-6D	UHF-Pylon Antenna, Ch. 14-52, Radome included	13,145.00
Custom	TFU-24DL	UHF-Pylon Antenna, Ch. 14-30, less de-icers	47,750.00
Custom	TFU-24DL	As Above, with 460V, 3-phase de-icers	51,050.00
Custom	TFU-24DL	As Above, with 230V, 3-phase de-icers	51,300.00
Custom	TFU-24DM	UHF-Pylon Antenna, Ch. 31-50, less de-icers	46,500.00
Custom	TFU-24DM	As Above, with 460V, 3-phase de-icers	49,325.00
Custom	TFU-24DM	As Above, with 230V, 3-phase de-icers	49,575.00
Custom	TFU-24J	UHF-Pylon Antenna, Ch. 14-70, less de-icers	53,725.00
Custom	TFU-24J	As Above, with 460V, 3-phase de-icers	57,225.00
Custom	TFU-24J	As Above, with 230V, 3-phase de-icers	57,475.00
Custom	TFU-25G	UHF-Pylon Antenna, Ch. 14-70, less de-icers	130,175.00
Custom	TFU-25G	As Above, with 460V, 3-phase de-icers	135,725.00
Custom	TFU-25G	As Above, with 230V, 3-phase de-icers	136,425.00
Custom	TFU-25GA	UHF-Pylon Antenna, Ch. 14-50, less de-icers	118,650.00
Custom	TFU-25GA	As Above, with 460V, 3-phase de-icers	123,800.00
Custom	TFU-25GA	As Above, with 230V, 3-phase de-icers	124,525.00
Custom	TFU-25GA	UHF-Pylon Antenna, Ch. 51-70, less de-icers	107,800.00
Custom	TFU-25GA	As Above, with 460V, 3-phase de-icers	111,950.00
Custom	TFU-25GA	As Above, with 230V, 3-phase de-icers	112,650.00
Custom	TFU-28DAS	UHF-Pylon Antenna, Ch. 14-52, 110-106 kW Skull Directional less de-icers	133,425.00
Custom	TFU-28DAS	As Above, with 460V or 230V, 3-phase de-icers	138,575.00
Custom	TFU-28DAS	UHF-Pylon Antenna, Ch. 14-52, 80-61 kW, Skull Directional, less de-icers	130,575.00
Custom	TFU-28DAS	As Above, with 460V or 230V, 3-phase de-icers	135,725.00
Custom	TFU-28DAS	UHF-Pylon Antenna, Ch. 14-50, 110-108 kW, Peanut Directional, less de-icers	154,325.00
Custom	TFU-28DAS	As Above, with 460V or 230V, 3-phase de-icers	158,675.00

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Catalog Number	Type Number	Product Description	Price
		UHF-PYLON ANTENNAS—Section TT.9200 (Cont.)	
Custom	TFU-28DAS	UHF-Pylon Antenna, Ch. 14-50, 80-56 kW, Peanut Directional, less de-icers	$151,000.00
Custom	TFU-28DAS	As Above, with 460V or 230V, 3-phase de-icers	155,325.00
Custom	TFU-28DAS	UHF-Pylon Antenna, Ch. 14-62, 110-91 kW, Trilobe Directional, less de-icers	162,200.00
Custom	TFU-28DAS	As Above, with 460V or 230V, 3-phase de-icers	167,700.00
Custom	TFU-28DAS	UHF-Pylon Antenna, Ch. 14-62, 80-58 kW, Trilobe Directional, less de-icers	158,775.00
Custom	TFU-28DAS	As Above, with 460V or 230V, 3-phase de-icers	164,250.00
Custom	TFU-30J	UHF-Pylon Antenna, Ch. 14-70, 80-56 kW, Omnidirectional, less de-icers	77,150.00
Custom	TFU-30J	As Above, with 460V, 3-phase de-icers	81,825.00
Custom	TFU-30J	As Above, with 230V, 3-phase de-icers	82,325.00
Custom	TFU-30JDA	UHF-Pylon Antenna, Ch. 14-30, 39-34 kW, Skull Directional, less de-icers	64,525.00
Custom	TFU-30JDA	As Above, with 460V, 3-phase de-icers	67,000.00
Custom	TFU-30JDA	As Above, with 230V, 3-phase de-icers	67,425.00
Custom	TFU-30JDA	UHF-Pylon Antenna, Ch. 14-36, 60-49 kW, Peanut Directional, less de-icers	84,775.00
Custom	TFU-30JDA	As Above, with 460V, 3-phase de-icers	88,200.00
Custom	TFU-30JDA	As Above, with 230V, 3-phase de-icers	88,625.00
Custom	TFU-30JDA	UHF-Pylon Antenna, Ch. 37-50, 33-30 kW, Peanut Directional, less de-icers	76,725.00
Custom	TFU-30JDA	As Above, with 460V, 3-phase de-icers	79,575.00
Custom	TFU-30JDA	As Above, with 230V, 3-phase de-icers	80,000.00
Custom	TFU-30JDA	UHF-Pylon Antenna, Ch. 14-50, 80-44 kW, Trilobe Directional, less de-icers	88,350.00
Custom	TFU-30JDA	As Above, with 460V, 3-phase de-icers	92,375.00
Custom	TFU-30JDA	As Above, with 230V, 3-phase de-icers	92,800.00
Custom	TFU-30JDA	UHF-Pylon Antenna, Ch. 30-62, 34-27 kW, Trilobe Directional, less de-icers	79,575.00
Custom	TFU-30JDA	As Above, with 460V, 3-phase de-icers	83,275.00
Custom	TFU-30JDA	As Above, with 230V, 3-phase de-icers	83,725.00
Custom	TFU-30JDAS	UHF-Pylon Antenna, Ch. 14-70, 110-88 kW, Skull Directional, less de-icers	105,650.00
Custom	TFU-30JDAS	As Above, with 460V, 3-phase de-icers	110,225.00
Custom	TFU-30JDAS	As Above, with 230V, 3-phase de-icers	110,650.00
Custom	TFU-30JDAS	UHF-Pylon Antenna, Ch. 14-70, 80-56 kW, Skull Directional, less de-icers	102,800.00
Custom	TFU-30JDAS	As Above, with 460V, 3-phase de-icers	107,375.00
Custom	TFU-30JDAS	As Above, with 230V, 3-phase de-icers	107,800.00
Custom	TFU-30JDAS	UHF-Pylon Antenna, Ch. 14-70, 110-88 kW, Peanut Directional, less de-icers	112,850.00
Custom	TFU-30JDAS	As Above, with 460V, 3-phase de-icers	118,575.00
Custom	TFU-30JDAS	As Above, with 230V, 3-phase de-icers	119,000.00
Custom	TFU-30JDAS	UHF-Pylon Antenna, Ch. 14-70, 80-56 kW, Peanut Directional, less de-icers	110,000.00
Custom	TFU-30JDAS	As Above, with 460V, 3-phase de-icers	115,725.00
Custom	TFU-30JDAS	As Above, with 230V, 3-phase de-icers	116,150.00
Custom	TFU-30JDAS	UHF-Pylon Antenna, Ch. 14-62, 110-91 kW, Trilobe Directional, less de-icers	115,550.00
Custom	TFU-30JDAS	As Above, with 460V, 3-phase de-icers	122,025.00
Custom	TFU-30JDAS	As Above, with 230V, 3-phase de-icers	122,600.00
Custom	TFU-30JDAS	UHF-Pylon Antenna, Ch. 14-62, 80-58 kW, Trilobe Directional, less de-icers	112,675.00
Custom	TFU-30JDAS	As Above, with 460V, 3-phase de-icers	119,175.00
Custom	TFU-30JDAS	As Above, with 230V, 3-phase de-icers	119,750.00
Custom	TFU-35G	UHF-Pylon Antenna, Ch. 14-70, 136-88 kW, Omnidirectional, less de-icers	213,600.00
Custom	TFU-35G	As Above, with 460V, 3-phase de-icers	223,550.00

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Catalog Number	Type Number	Product Description	Price
		UHF-PYLON ANTENNAS—Section TT.9200 (Cont.)	
Custom	TFU-36J	UHF-Pylon Antenna, Ch. 14-70, 80-56 kW, Omnidirectional, less de-icers	$ 81,725.00
Custom	TFU-36J	As Above, with 460V, 3-phase de-icers	87,100.00
Custom	TFU-36J	As Above, with 230V, 3-phase de-icers	87,550.00
Custom	TFU-36JDA	UHF-Pylon Antenna, Ch. 14-23, 39-36 kW, Skull Directional, less de-icers	83,375.00
Custom	TFU-36JDA	As Above, with 460V, 3-phase de-icers	86,150.00
Custom	TFU-36JDA	As Above, with 230V, 3-phase de-icers	86,575.00
Custom	TFU-36JDA	UHF-Pylon Antenna, Ch. 24-30, 36-34 kW, Skull Directional, less de-icers	69,650.00
Custom	TFU-36JDA	As Above, with 460V, 3-phase de-icers	72,350.00
Custom	TFU-36JDA	As Above, with 230V, 3-phase de-icers	73,050.00
Custom	TFU-42J	UHF-Pylon Antenna, Ch. 14-25, 80-72 kW, Omnidirectional, less de-icers	125,925.00
Custom	TFU-42J	As Above, with 460V, 3-phase de-icers	132,375.00
Custom	TFU-42J	As Above, with 230V, 3-phase de-icers	132,950.00
Custom	TFU-42J	UHF-Pylon Antenna, Ch. 26-70, 72-56 kW, Omnidirectional, less de-icers	102,925.00
Custom	TFU-42J	As Above, with 460V, 3-phase de-icers	108,350.00
Custom	TFU-42J	As Above, with 230V, 3-phase de-icers	108,925.00
Custom	TFU-45J	UHF-Pylon Antenna, Ch. 14-34, 80-68 kW, Omnidirectional, less de-icers	155,400.00
Custom	TFU-45J	As Above, with 460V, 3-phase de-icers	162,275.00
Custom	TFU-45J	As Above, with 230V, 3-phase de-icers	162,850.00
Custom	TFU-45J	UHF-Pylon Antenna, Ch. 35-50, 68-62 kW, Omnidirectional, less de-icers	134,000.00
Custom	TFU-45J	As Above, with 460V, 3-phase de-icers	139,425.00
Custom	TFU-45J	As Above, with 230V, 3-phase de-icers	140,000.00
Custom	TFU-45J	UHF-Pylon Antenna, Ch. 51-70, 62-56 kW, Omnidirectional, less de-icers	138,950.00
Custom	TFU-45J	As Above, with 460V, 3-phase de-icers	145,325.00
Custom	TFU-45J	As Above, with 230V, 3-phase de-icers	145,875.00
Custom	TFU-46K	UHF-Pylon Antenna, Ch. 14-70, 157-88 kW, Omnidirectional, less de-icers	243,475.00
Custom	TFU-46K	As Above, with 460V, 3-phase de-icers	258,425.00
Custom	TFU-50J	UHF-Pylon Antenna, Ch. 14-70, 80-56 kW, Omnidirectional, less de-icers	161,150.00
Custom	TFU-50J	As Above, with 460V, 3-phase de-icers	168,825.00
		PANEL-TYPE ANTENNAS—Section TT.9220	
—	—	"Vee-Zee" and "Zee-Panel" antennas are supplied on a custom basis since the size and number of panels employed to form an array vary with requirements. This affects purchase price.	
		POLYGON UHF-TV ANTENNAS—Section TT.9240	
—	TZP-500	Polygon Antennas are supplied on a custom basis since the size and number of panels employed to form an array vary with requirements. This affects purchase price.	
		ROSEMOUNT ANTENNA ICE DETECTOR—Section TT.9320	
MI-561572	—	Rosemount Antenna Ice Detector System	926.00
		AUTOMATIC SLEET MELTER CONTROL UNIT—Section TT.9340	
MI-27369A	—	Automatic Sleet Melter Control	300.00
		ANTENNA TOWERS; STROBE LIGHTING—Section TT.9400	
Custom Built	200K73-1A3	Single-Level Strobe Lighting System	10,526.00
Custom Built	200K73-2A3	Two-Level Strobe Lighting System	17,845.00
Custom Built	200K73-3A3	Three-Level Strobe Lighting System	25,178.00
Custom Built	200K73-4A3	Four-Level Strobe Lighting System	32,513.00
Custom Built	200K73-5A3	Five-Level Strobe Lighting System	39,846.00
Custom Built	200K73	Beacon (If purchased separately)	2,300.00
Custom Built	200K73	Beacon (If purchased as part of strobe system)	1,725.00

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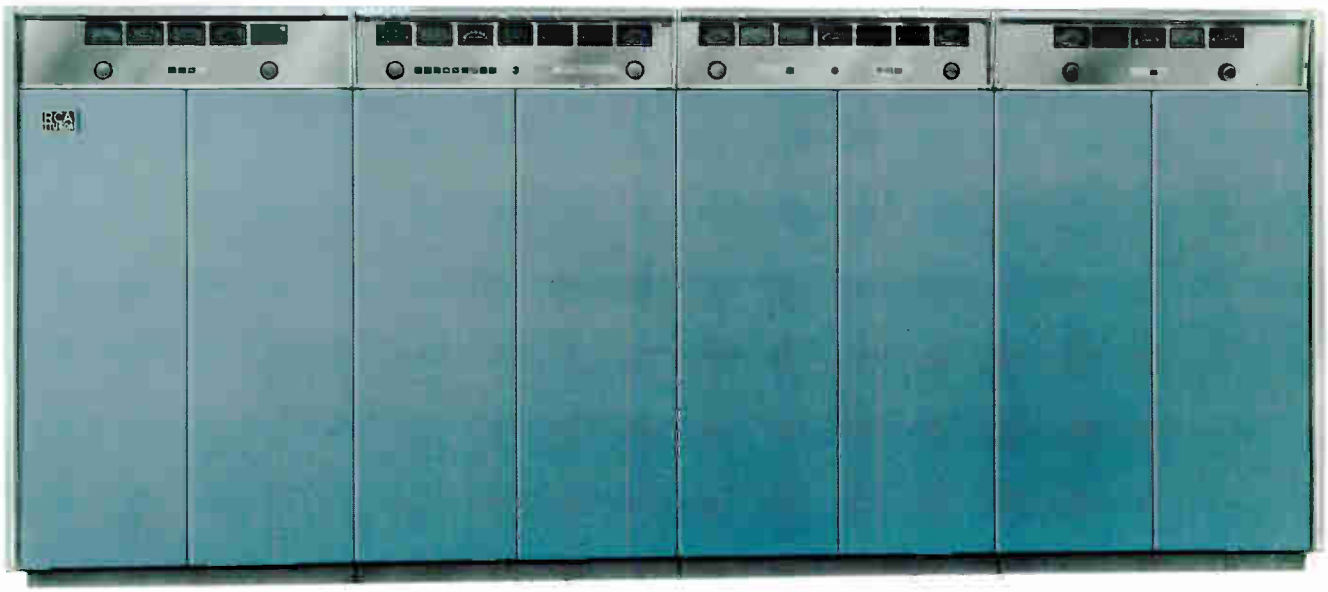
S-2268

catalog B.5040

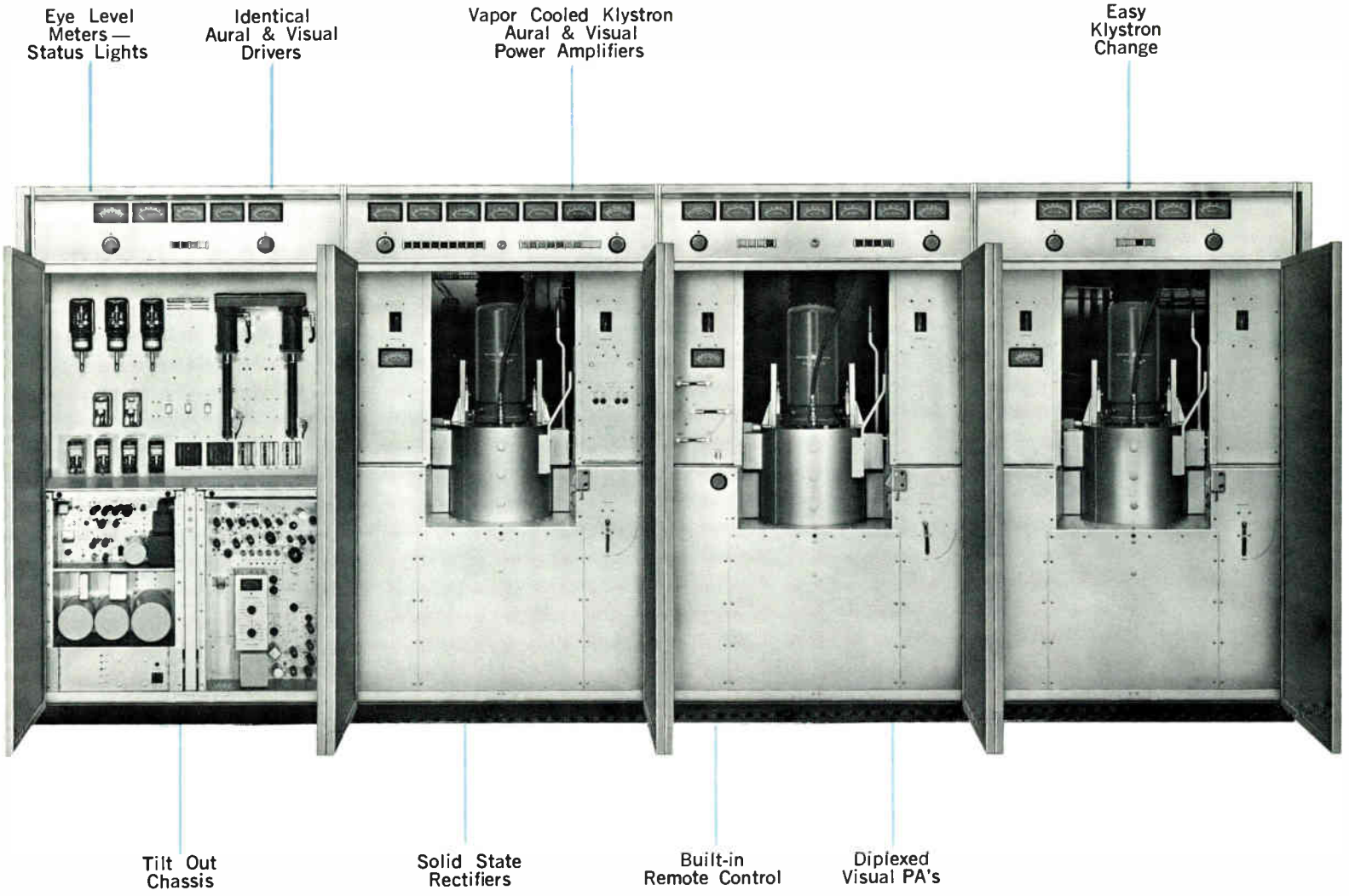
RCA 60 KW UHF TV Transmitter, Type TTU-60A



Diplexed Output • Vapor-Cooled Klystrons • Quick Tube Change

3SB

World Radio History



World Radio History

Modern High Power UHF Transmitter

The TTU-60A UHF Television Transmitter is a 60-kilowatt klystron-powered equipment offering broadcasters the latest techniques in UHF design. Included are features such as the integral cavity, vapor cooled klystron, low profile styling, solid state circuitry, built in provisions for remote control, and diplexed output for added reliability. The increased efficiency and high power sensitivity of the new klystron offers considerable savings in operating costs.

The transmitter provides effective radiated powers of more than two megawatts for metropolitan markets. It meets FCC or CCIR specifications. Model ES-560292 should be specified for FCC standards and 440/460/480 Volt, 60 Hz input. For CCIR standards and 380/400/415 Volt, 50 Hz input, order ES-560293.

The TTU-60A is economical and easy to operate. Though the space required is small, components are located for maximum accessibility. Small physical size and ease of maintenance result in direct savings in installation and operation. New mechanical and electrical features permit one-man operation of this high power transmitter either locally or from a remote point.

Overall reliability is enhanced by use of a diplexed output stage. Redundancy can be further increased by addition of a standby exciter/modulator and RF switching units available as optional accessories.

Description

The transmitter is housed in four new low profile 77-inch cabinets with eye-level meters and convenient finger-tip controls. Built-in remote control circuitry, including metering points for remotely monitoring operating parameters, permits operation at an auxiliary control console or remote point. All normal operating controls are motor-driven and may also be operated from a remote location.

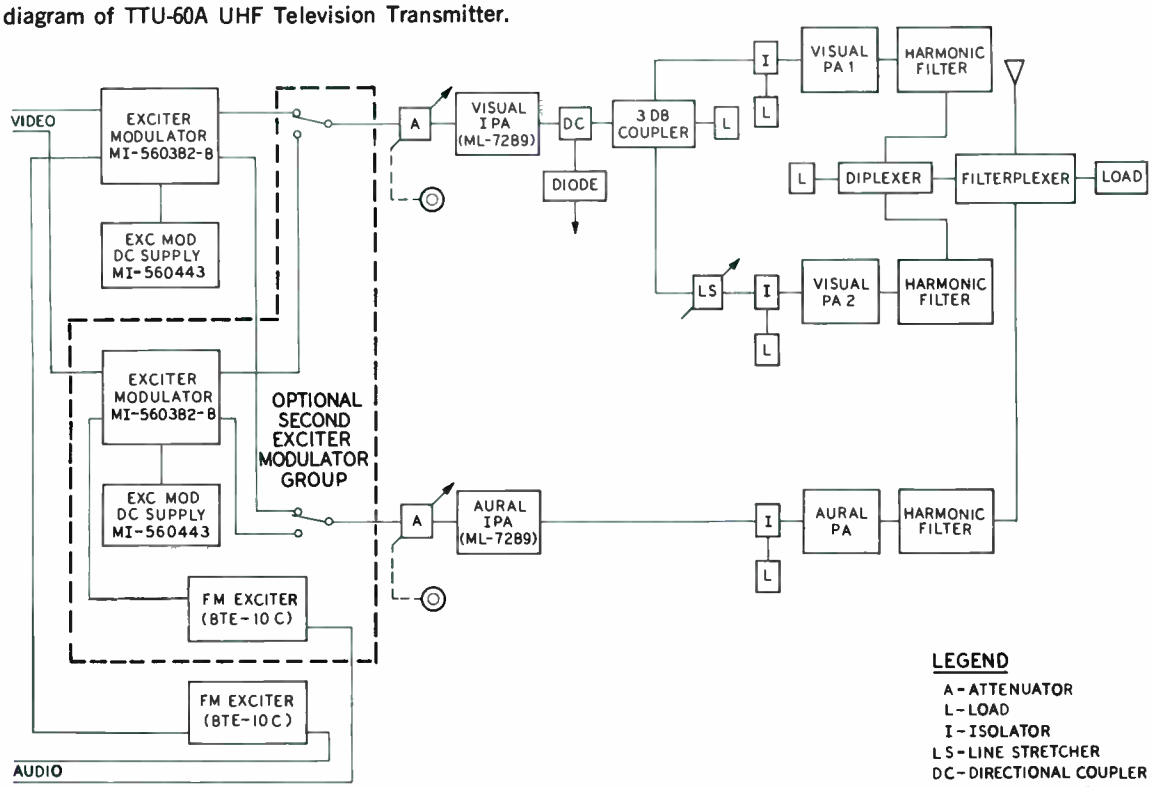
Circuit Description

Ease of installation, operation and maintenance is enhanced by use of modern, reliable circuitry. Video and audio modulation takes place at a low level, thus eliminating the need for a high power modulator. Use of high gain klystron tubes makes it possible to effect a high amplification in a single, pre-tuned RF stage.

Direct-FM Exciter

The modern circuitry used in the TTU-60A transmitter utilizes the standard BTE-10C FM exciter to develop a stable, high quality, direct frequency modulated aural signal.

Block diagram of TTU-60A UHF Television Transmitter.



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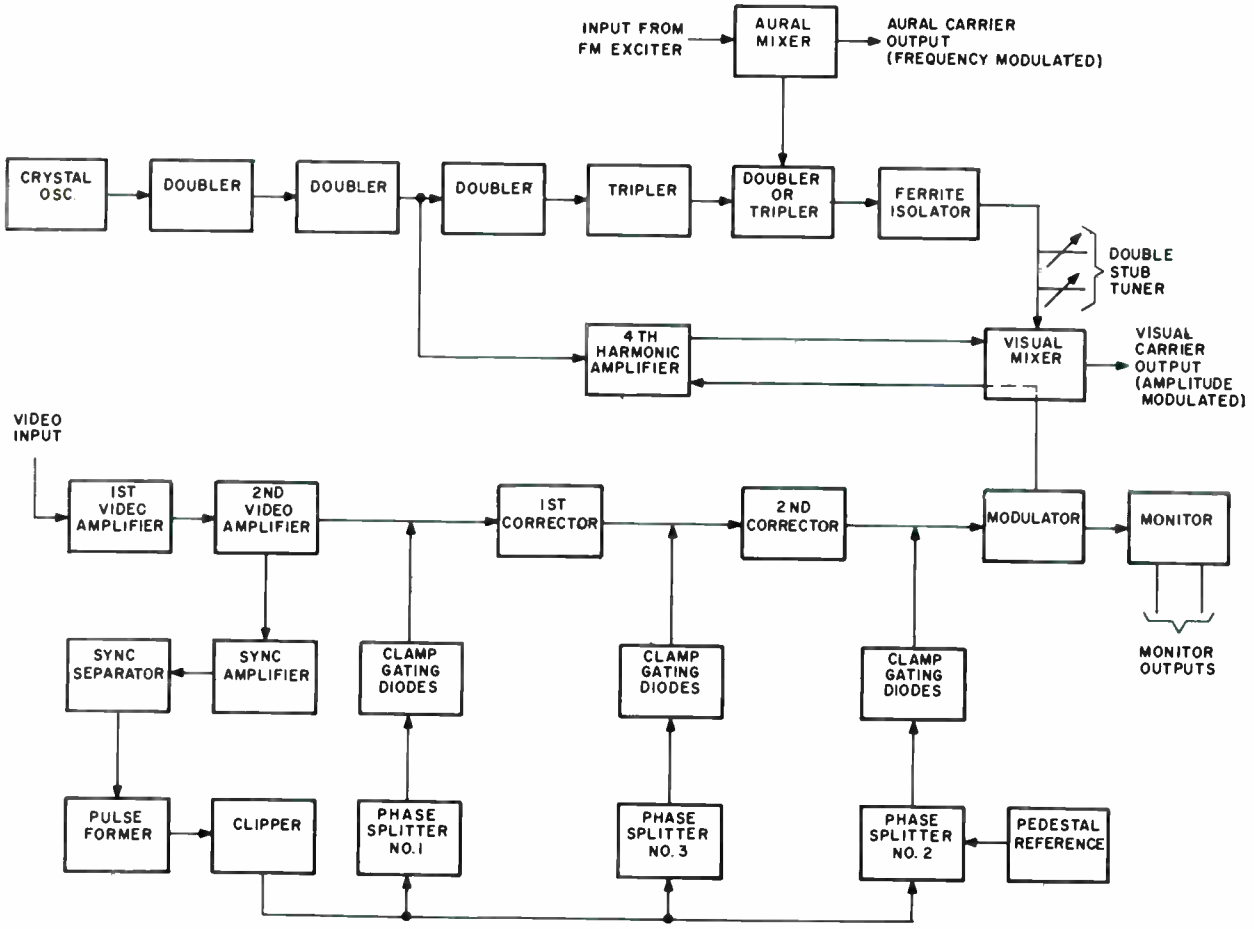


Aural/Visual Exciter/Modulator Block Diagram.

The newly designed FM exciter uses a total of nine tubes—half as many as used in the previous model. Only four tubes are required to maintain an aural output signal, an indication of the reliability built into the entire transmitter.

The design retains RCA's "Direct-FM" modulation which features ease of adjustment and reliable operation. All RF stages use single-tuned circuits. A built-in meter, and easily accessible test points allow metering and checking during operation. An AFC on-off toggle switch and simplified controls including the power on-off switch are all easily accessible on the chassis of the exciter.

A self-contained silicon power supply is used in the exciter. Premium tubes, carrying a 10,000 hour guarantee are used in the RF circuits for reliability and long life. The BTE 10C lends itself particularly well to unattended and remote operation.

Simplified Exciter Modulator

The exciter/modulator develops a highly stable, crystal-controlled frequency which is heterodyned with both the modulated video and aural signals, resulting in aural and visual output carriers separated by 4.5 MHz (5.5 MHz for CCIR Standards). The aural signal is then fed through a variable motor-driven attenuator to an RF amplifier using a single type 7289 tube. The output of this stage drives the aural klystron to an output of 16 kW.

Visual modulation takes place at the grid of a pencil triode, type 4055. All RF stages preceding this are operated Class "C" and are simply tuned by meter indications for maximum output. The output of the mixer stage is a double-tuned cavity. The video modulated output of this stage, a nominal 2 Watts peak, is fed through a variable attenuator, then amplified in the following cavity tuned amplifier using a single type 7289 tube. The variable attenuator is motor-driven and, in addition to providing a good load impedance on the modulated stage, serves as the visual excitation control.

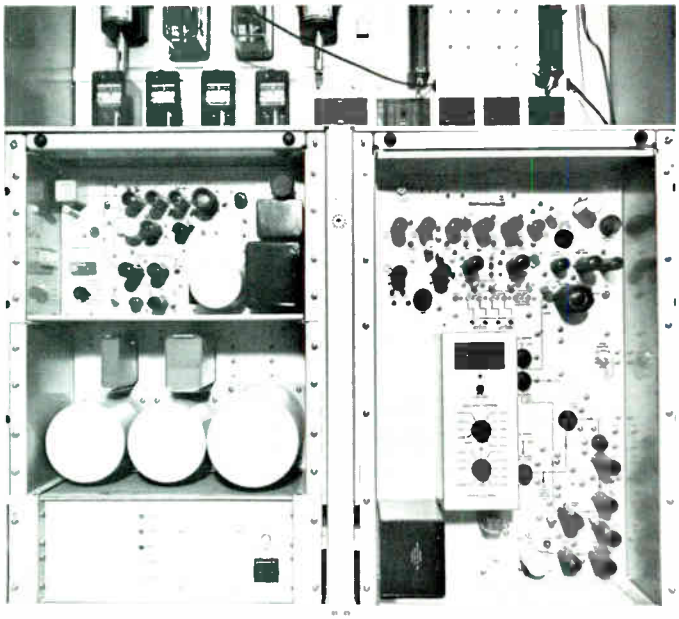
IPA Stages

Following the exciter, the aural and visual signals are amplified separately by identical cavity tuned IPA stages, each employing a Type 7289 triode. The signals are then fed to their respective klystron output stages. Both IPA stages are broadband tuned and capable of operating as a visual amplifier. Therefore, should the need arise, a simple change of small coaxial connectors at the front of the transmitter will permit the visual signal to be fed through either IPA stage while the aural signal may be fed directly to the aural klystron.

World Radio History

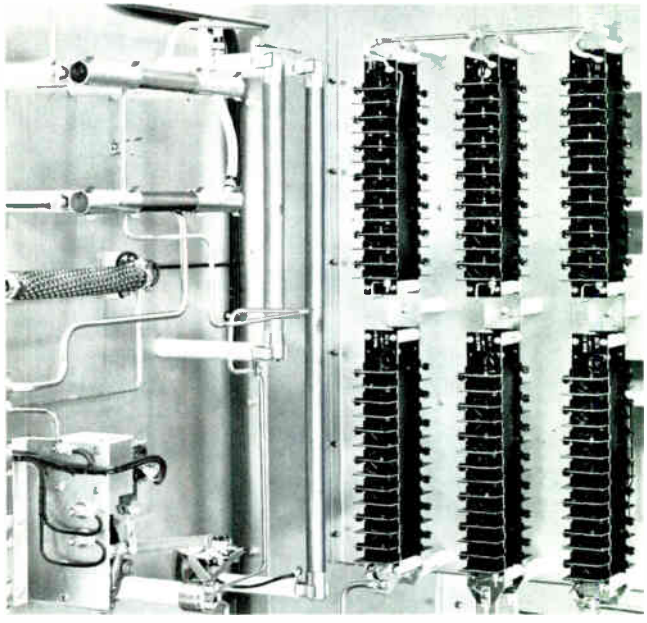
Design Features

SIMPLE, PROVED DIRECT FM



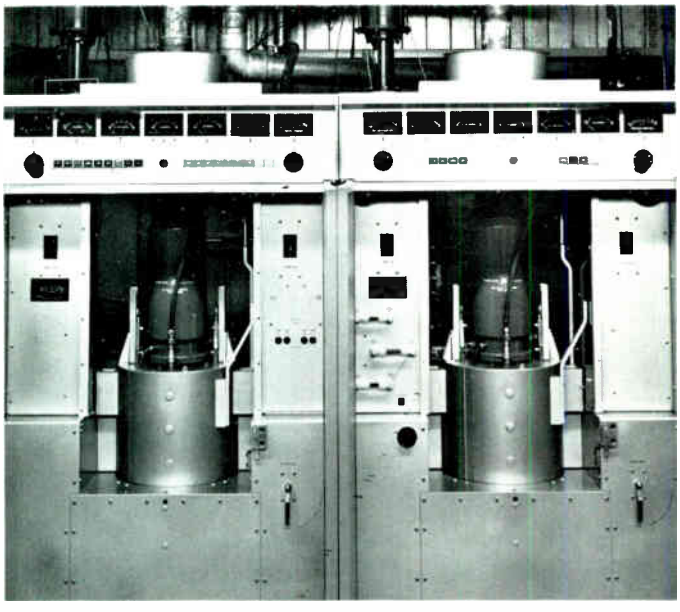
Reliable exciter/modulator employs 10,000 hour premium tubes.

LONG LIFE SOLID STATE RECTIFIERS



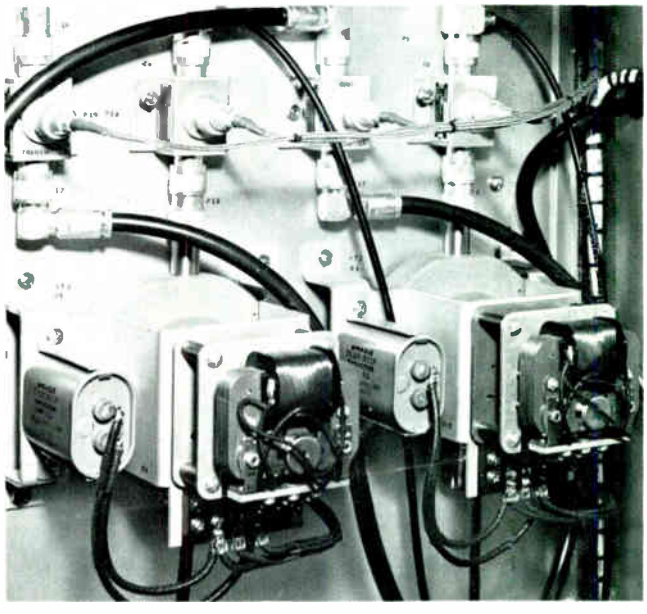
Silicon rectifiers are modularized for easy maintenance.

DIPLEXED VISUAL POWER AMPLIFIER



Vapor-cooled klystrons contribute independently to output.

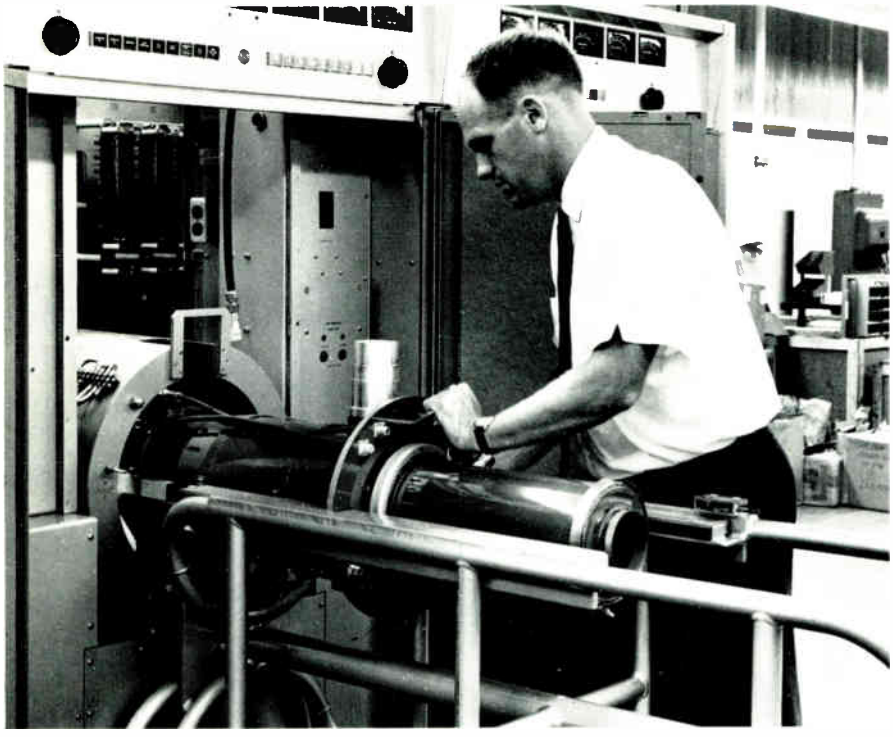
BUILT-IN MOTOR DRIVEN CONTROLS



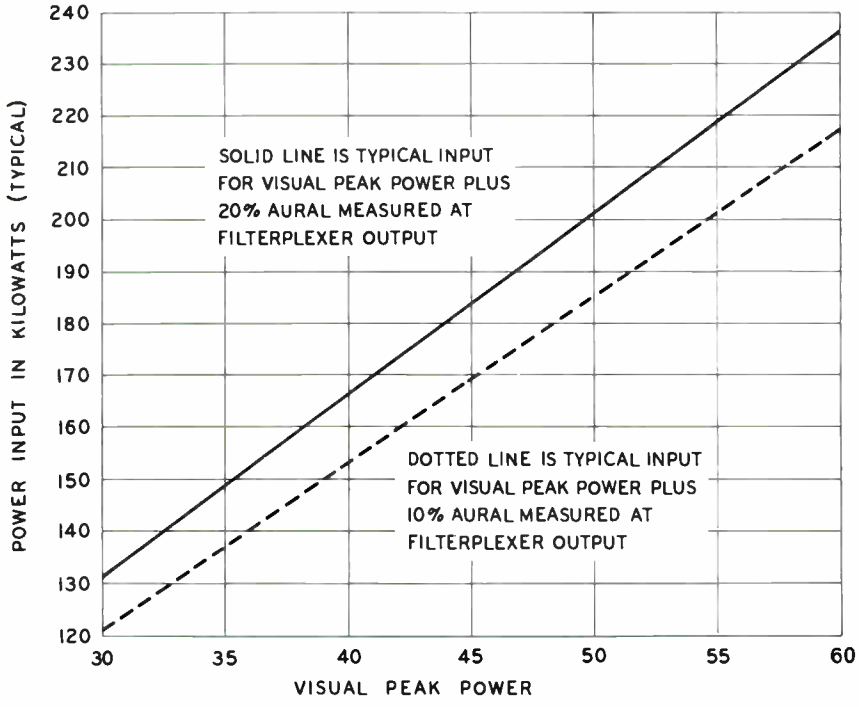
Standard equipment in readiness for remote control.

World Radio History

Diplexed, Pre-Tuned Klystrons



Klystron is easily changed by tilting and sliding into four wheel carriage, then revolving carriage, and easing replacement into transmitter.



Curve showing power consumption for given power output values.

Klystron Power Amplifiers

Aural and visual power amplifiers in the TTU-60A each use vapor cooled, integral cavity klystrons of the Varian Type VA-890 Series. Use of integral cavities means that the klystrons are tuned at the factory, eliminating the station site preparation which is required by external cavity designs. Three identical klystrons are used in the transmitter.

The TTU-60A is the first 60 kW television broadcast transmitter to use the new vapor cooled klystrons. The increased efficiency of a vapor cooling system over either air or water cooled systems results in a considerable saving in operating costs.

The integral cavity klystron is easily installed by one operator. It is transferred in a horizontal position directly from the shipping container into a four-wheel carriage, then by an ingenius loading device, is rolled into the transmitter. The tube remains in a horizontal position until completely installed, after which it is tilted to a vertical position and locked. No unusually high ceilings are required as with some klystrons.

Diplexing Increases Reliability

One of the three klystrons is employed in the aural PA. The visual PA uses two klystrons in a diplexed arrangement. Diplexing is more than just paralleling two tubes. Each tube contributes independently to the output. If either tube fails, the other tube continues to operate unaffected. Diplexing achieves an increased reliability, which according to studies, improves 150 percent in any redundant system employing identical elements. The design also offers the possibility, in an emergency, of patching in one of the diplexed visual amplifiers to take over for a disabled aural PA, and thus keep the transmitter on the air.

These features, plus the interchangeable drivers and optional spare exciter represent a great forward step in design to achieve the dependability required in today's television transmitter operations.

World Radio History

Specifications

Performance*

	FCC Specs.	CCIR Specs.
Type of Emission:		
Visual	A5	A5
Aural	F3	F3
Frequency Range	470-890 MHz (Ch. 14-83)	470-890 MHz
Rated Power Output:		
Visual[1]	60 kW	40 kW
Aural[2]	6.0 to 16 kW	6.0 to 16 kW
RF Output Impedance[3]	50 Ohms, 3⅛" flanged	50 Ohms, 3⅛" flanged
Input Impedance:		
Visual	75 Ohms	75 Ohms
Aural	600/150 Ohms	600/150 Ohms
Input Level:		
Visual	0.7 Volt peak-to-peak min.	0.7 Volt peak-to-peak min.
Aural	+10 ±2 dBm for ± 25 kHz deviation	+16 ±2 dBm for 50 kHz deviation
Amplitude vs. Frequency Response	Uniform ±1 dB from 50 to 15,000 kHz	——

Upper Sideband Response at Carrier:	FCC[4]	CCIR[5] 5.0 MHz Carrier Separation	CCIR[5] 5.5 MHz Carrier Separation
+0.5 MHz	+1, −1.5 dB	+0.5, −1.5 dB	+0.5, −1.5 dB
+1.25 MHz	+1, −1.5 dB	——	——
+1.5 MHz	+1, −1.5 dB	——	Reference
+2.0 MHz	+1, −1.5 dB	——	——
+3.0 MHz	+1, −1.5 dB	+1.0 −1.0 dB	+1.0 −1.0 dB
+3.58 MHz	+1, −1.5 dB	——	——
+4.18 MHz	+1, −3.0 dB	——	——
+4.43 MHz	——	+0.5, −1.5 dB	+0.5, −1.5 dB
+4.75 MHz	−20 dB max.	——	——
+5.0 MHz	——	+1.0, −4.0 dB	+0.5, −1.5 dB
+5.5 MHz	——	——	+1.0, −4.0 dB
+5.75 MHz	——	−20 dB max.	——
+6.25 MHz	——	——	−20 dB max.
Lower Sideband Response at Carrier:			
−0.5 MHz	+1, −1.5 dB	+0.5, −1.5 dB	+1.0, −1.0 dB
−0.75 MHz	——	+0.5, −4.0 dB	+1.0, −1.0 dB
−1.0 MHz	——	——	+0.5, −1.5 dB
−1.25 MHz	−20 dB max.	−20 dB max.	+0.5, −4.0 dB
−2.25 MHz	——	——	−20 dB max.
−3.58 MHz	−42 dB max.	——	——
−4.43 MHz	——	−42 dB max.	−42 dB max.

Variation in Frequency Response with Brightness[6]	±1.5 dB	±1.0 dB
Carrier Frequency Stability:[7]		
Visual	±500 Hz	±500 Hz
Aural	±500 Hz[8]	±200 Hz[8]
Modulation Capability:		
Visual	12.5 ±2.5% (reference white)	12.5 ±2.5% (reference white)
Aural	±50 kHz	±100 kHz
Audio Frequency Distortion	1% max. 30 Hz to 15 kHz	1% max., 30 Hz to 15 kHz
FM Noise	−58 dB below ±25 kHz swing	−64 dB below ±50 kHz deviation
AM Noise, r.m.s.:		
Visual[9]	48 dB r.m.s. below 100% mod.	48 dB r.m.s. below 100% mod.
Aural	50 dB below carrier	50 dB below carrier

* Specifications shown are measured and stated in terms of meeting United States FCC requirements. This transmitter can meet various foreign standards.

	FCC Specs.	CCIR Specs.
Amplitude Variation Over One Picture Frame	Less than 3% of the peak of sync level	Less than 3% of the peak of sync level
Regulation of Output	3% max.	3% max.
Burst vs. Subcarrier Phase[10]	±6° max.	±6° max.
Subcarrier Phase vs. Brightness[11]	±7° max. total less than 10°	±7°, total less than 10°
Subcarrier Amplitude[10]	±10% max.	±10% max.
Linearity (Differential Gain)[12]	1.5 dB max.	See Note[12]
Envelope Delay vs. Frequency[13]	±80 ns from 0.2 to 2.0 MHz ±40 ns at 3.58 MHz ±80 ns at 4.18 MHz	±80 ns, 0.2 to 2.0 MHz ±40 ns, at 4.43 MHz ±80 ns, 4.43 MHz to upper sideband limit
Harmonic Attenuation, ratio of any single harmonic to peak visual fundamental[14]	At least −60 dB	At least −60 dB

Electrical

AC Line Input	440/460/480 V, 3-phase, 60 Hz 4 wire	380/400/415 V, 3-phase, 50 Hz 4 wire
Slow Line Variations	±3% max.	±3% max.
Rapid Line Variations	±3% max.	±3% max.
Regulation	3% max.	3% max.
Power Consumption	See Power Curve	240 kW
Power Factor (approx.)	90%	90%
Crystal Heaters:		
Line	115 V, 1-phase 50/60 Hz	220 V, 1-phase 50/60 Hz
Power Consumption	7½ Watts	7½ Watts

[1]Measured at the output of the filterplexer.

[2]Measured at the input to the filterplexer.

[3]Output of RF Amplifier. Output of visual diplexer and filterplexer are 6⅛" 75 Ohm EIA flange.

[4]With respect to the response at 200 kHz, as measured by the RCA BWU-5C Sideband Response Analyzer and with the transmitter adjusted for mid-characteristics. An MI-27132-A Low Pass Video Filter is required in the input circuit.

[5]With respect to the response at 1.5 MHz as measured by the RCA BWU-5C Sideband Response Analyzer and with the transmitter adjusted for mid-characteristics. Use of a 5.75 MHz Video Low Pass Filter is required.

[6]Maximum variation with respect to the response at mid-characteristic measured with the BWU-5C Sideband Response Analyzer using approximately 20 percent (peak to peak) modulation at brightness levels of 22.5 percent and 67.5 percent of peak for FCC specifications and for brightness levels of 25 percent and 60 percent for CCIR specifications.

[7]Maximum variation for a period of 10 days without circuit adjustment over an ambient temperature range of +10°C to +45°C. (Meets FCC specifications over an ambient range of +1°C to +45°C.)

[8]Maximum variation with respect to separation between aural and visual carriers.

[9]RMS hum and noise level 50 Hz to 15 kHz. Extraneous modulation (unrelated to video modulation) above 15 kHz within the visual passband 40 dB below 100% modulation.

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

[11]Maximum phase difference with respect to burst, measured after the sideband filter, 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 as indicated by a conventional diode demodulator. In addition, the total differential phase between any two levels shall not exceed 10°.

[12]Maximum variation of amplitude of the sine wave modulation frequency when superimposed on stairstep or ramp modulation which is adjusted for brightness excursion stated. Modulation depth of the sine wave to be 20% peak to peak. CCIR Linearity is 0.85 at 0.2 MHz, 1.5 MHz and 4.43 MHz with Brightness excursion 65 to 17% for 0.2 and 1.5 MHz and 75 to 17% at 4.43 MHz.

[13]Maximum departure from standard curve. The tolerances vary linearly between 2.1 and color subcarrier frequency and between color subcarrier frequency and upper sideband limit. To meet the specification a properly terminated phase correction network is required in the video input circuit of the transmitter.

[14]Referenced to peak visual power.

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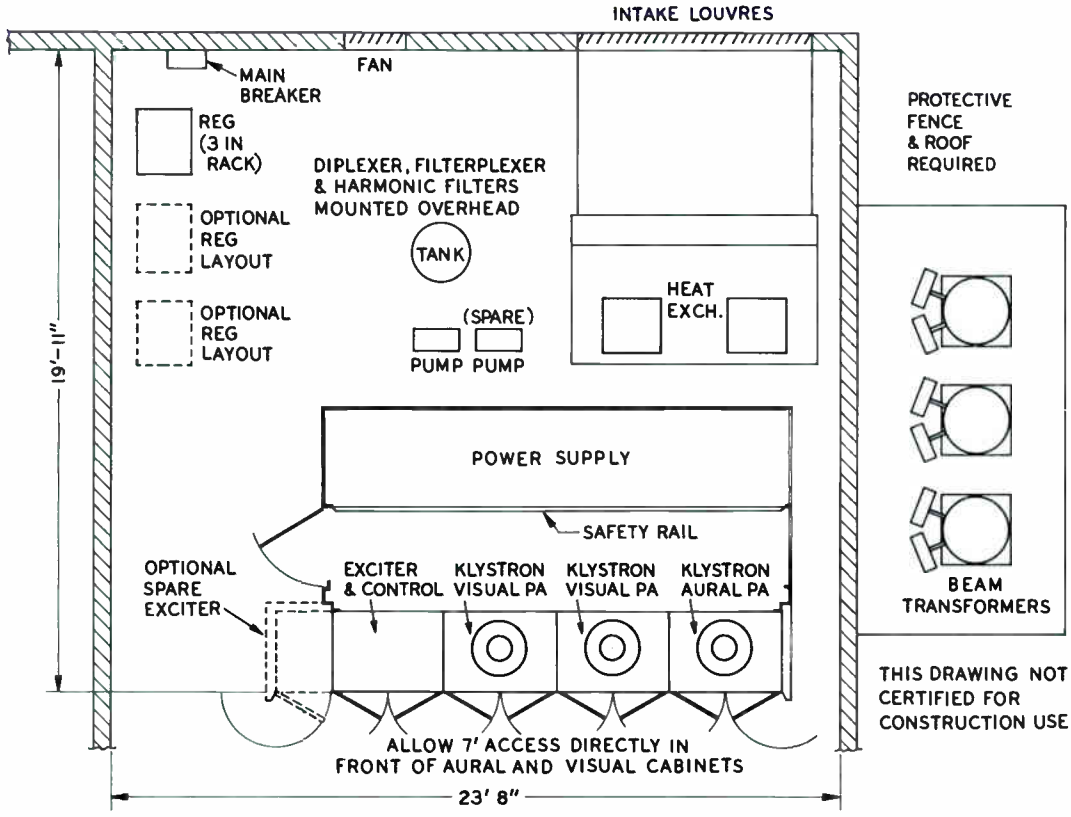

Space Saving Floor Plan of TTU-60A UHF Television Transmitter.

Mechanical

	FCC Specs.	CCIR Specs.
Dimensions Overall: Transmitter Cabinet	180" long, 105"" deep, 77" high	457 cm long, 266.7 cm deep, 195.6 cm high
Finish: Transmitter	Powder and Midnight blue, aluminum trim	Powder and Midnight blue, aluminum trim
Maximum Altitude	7500 feet	2286 meters
Ambient Temperature[15]	+1°C. to +45°C. max.	+1°C. to +45°C. max.

[15]Air Input Temperature to Heat Exchanger +10°C. to +45°C. to 7500 ft. (2286 meters.)
Air Temperature in transmitter area:
45°C. at Sea level; 40°C. to 3300 ft. (1005.84 meters); 35°C. to 5000 ft. (1524 meters) 30°C. to 7500 ft. (2286 meters).

Accessories

Complete Set of Spare Tubes	ES-560279
Minimum Set of Spare Tubes	ES-560252
Spare Exciter Group	ES-560281
BWU-4C Demodulator	ES-34049
BWU-5C Sideband Response Analyzer	ES-34009-B
BW-8A Envelope Delay Measuring Set	MI-34063
BW-8A1 Envelope Delay Measuring Set	MI-34068
Transmitter Control Console	ES-561900

Ordering Information

For 440/460/480 Volt, 60 Hz input and FCC standards order ES-560292

TTU-60A UHF TV Transmitter 60 kW visual 6.0 to 16 kW aural with tubes, hybrid filterplexer, two sets crystals, two harmonic filters and low pass filter

For 380/400/415 Volt, 50 Hz input and CCIR standards order ES-560293

Output power and required filters to be determined in accordance with required operating standards

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