RCA
UHF TELEVISION EQUIPMENT

TRANSMITTERS • REMOTE CONTROL EQUIPMENT
INPUT & MONITORING • TEST & MEASURING
FILTERS • NOTCH DIPLEXERS
ANTENNAS • TOWERS • ACCESSORIES

J. Franke

RCA

About This Catalog

This catalog is a compilation of current RCA product specification sheets for UHF-TV transmitting systems, including transmitters; remote control; monitoring; antennas, and accessories. Transmission Line Equipment is covered in a separate bound catalog (Form #771215).

Catalog specification data is also available on the complete line of RCA video and aural broadcast equipment:

- Cameras and Telecine
- Video Tape Equipment
- VHF Transmitters and Antennas
- AM-FM Radio Transmitters and Antennas
- Audio

Experienced RCA sales representatives are available to assist in supplying needed product information or in helping to plan your facility. Contact your RCA Regional Office, or write RCA Broadcast Systems Marketing, Bldg. 2-2, Camden, N. J. 08102.

Contents

catalog TT.3210A

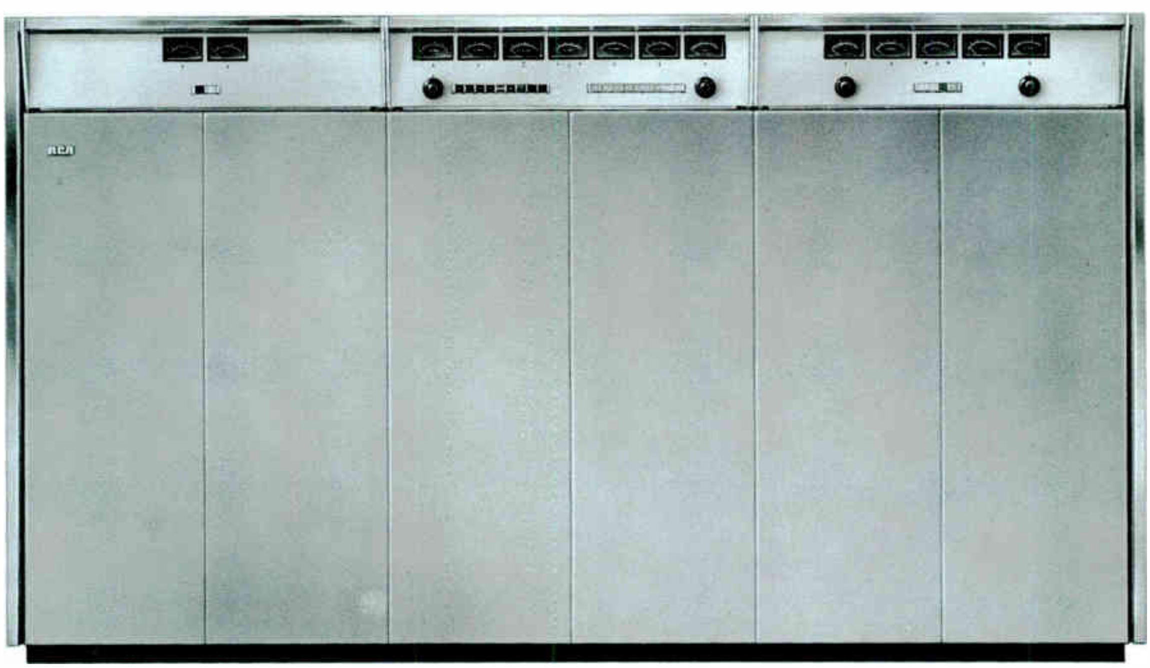
UHF-TV Transmitter, 30kW Visual, 6kW Aural, Type TTU-30D

- Intermediate Frequency (IF) modulation
- Vestigial sideband filtering with Surface Acoustic Wave (SAW) Filter at IF
- IF linearity correction—exceptionally low unwanted distortions
- Separate incidental phase correction for sync and video regions
- Vapor-cooled klystron power amplifiers
- Optional energy-saving pulser

The TTU-30D is a 30-kilowatt UHF-television broadcast transmitter using integral-cavity, vapor-cooled klystrons as aural and visual power amplifiers. The klystrons are arranged for easy interchange when replacement is necessary.

The TTU-30D 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 accessibility 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.



Connected to an antenna system of suitable gain, the TTU-30D transmitter is capable of an effective radiated power of as much as one megawatt. 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 four-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-30D is designed for future expansion to 60 kW 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.

Circuit Description

The heart of the TTU-30D Transmitter is the all new type TTUE-44 Exciter/Modulator. Advanced technology has been applied in the design of the TTUE-44 wherever a definite advantage can be utilized. Vestigial sideband filtering is accomplished using a Surface Acoustic Wave (SAW) Filter. 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 a modulated IF signal with an RF "pump" frequency chain. By using the untuned passive SAW Filter, excellent sideband response can be maintained over long periods of time. Envelope delay characteristics of the SAW Filter require no large delay corrections at band edge. The necessary corrections are accomplished externally at video frequencies by the RCA TTS-2 Video Delay Equalizer, employing a transversal equalizer in conjunction with an all pass network for notch and receiver correction. RCA catalog sheet TT.4410 describes the TTUE-44 exciter/modulator in detail.

To assure optimum system linearity at the output of the klystron transmitter being driven by the exciter, linearity correction is provided at IF after sideband filtering. Full bandwidth phase modulation correction of the visual signal is provided to offset the inherent variation of phase length of the klystron with change in brightness level. This enhances the differential phase performance of the overall transmitter system for both envelope and synchronous detection receivers, and reduces intercarrier noise levels.

Vapor-Cooled Klystrons

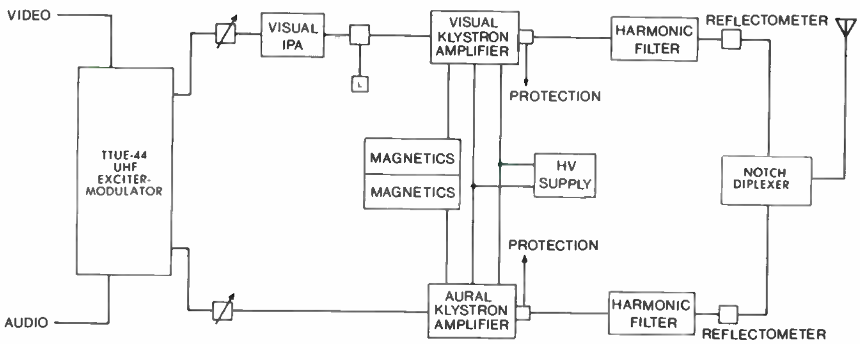
The TTU-30D Transmitter uses identical klystrons in the aural and visual channel. These are vapor-cooled, hi-efficiency four cavity units of integral-cavity design with a reputation for stability, reliability, and long life. The aural klystron is driven directly to full power by the aural output of the exciter. On the visual side, a new design ultra-linear solid state intermediate power amplifier drives the visual klystron. All circuitry up to the visual and aural klystron inputs, is solid state.

Easy Klystron Change

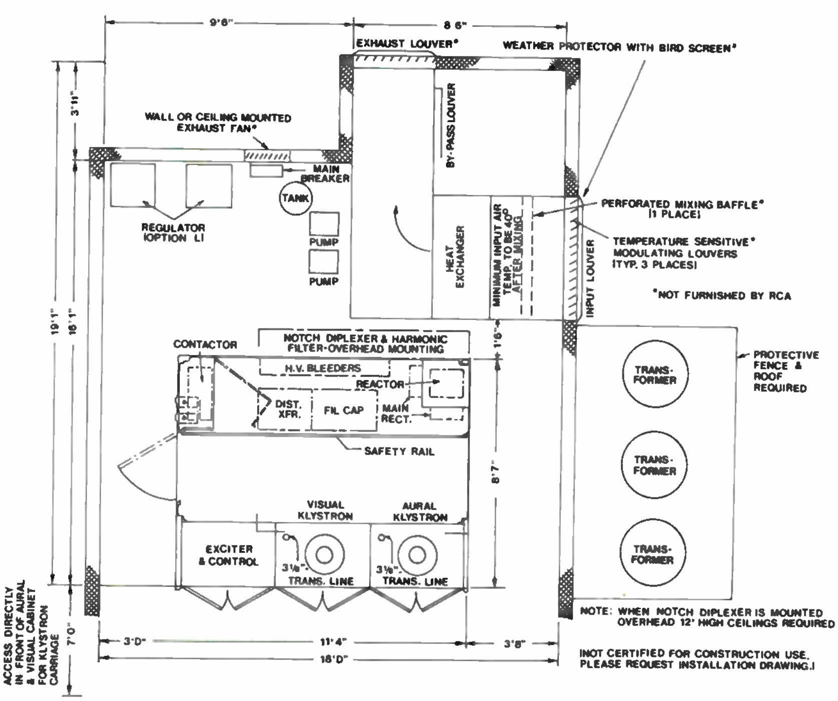
Klystron replacement in the TTU-30D Transmitter is accomplished easily by one man, working alone, in a matter of a few minutes. The factory-tuned klystron is transferred in a horizontal position directly from the shipping crate to the klystron carriage, which is furnished with the transmitter. By way 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.

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



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



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

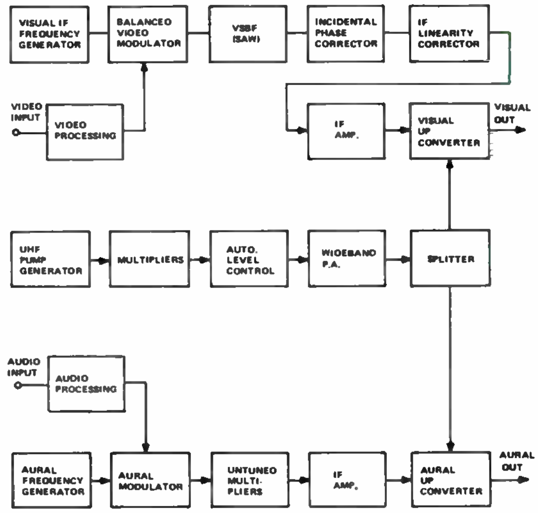
pump circulates the condensed water to the storage tank and thence to the klystrons. A standby pump and motor is connected in the system for immediate use in the event of pump system failure. A system of manually operated valves effects the pump changeover. These valves make periodic switchover practical 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 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 is reset or the fault cleared, to indicate the source of alarm condition.



Solid-State Exciter/Modulator Block Diagram.

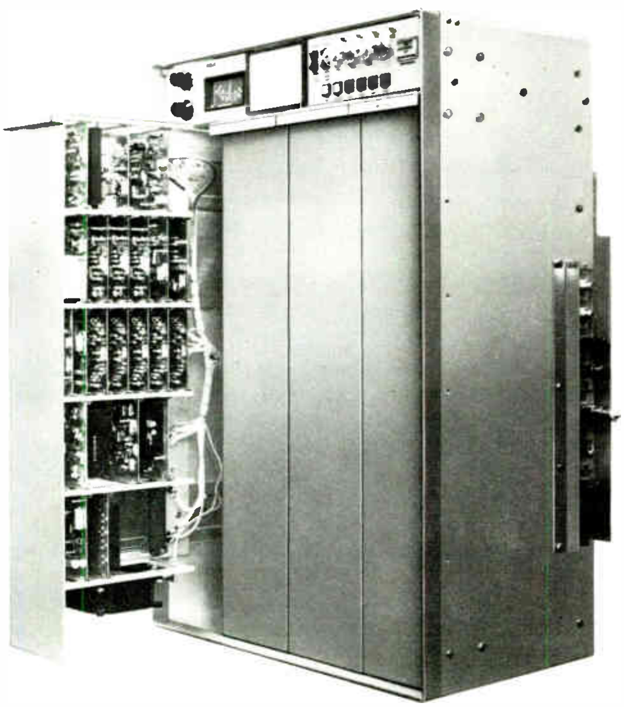
Klystron Power Supply

Solid state rectifiers are used throughout the TTU-30D transmitter. High voltage rectifiers and other components for the klystron power supply are mounted on vertical panels which form the transmitter rear enclosure. This arrangement provides ease of accessibility for inspection and maintenance, and effective cooling for long component life.

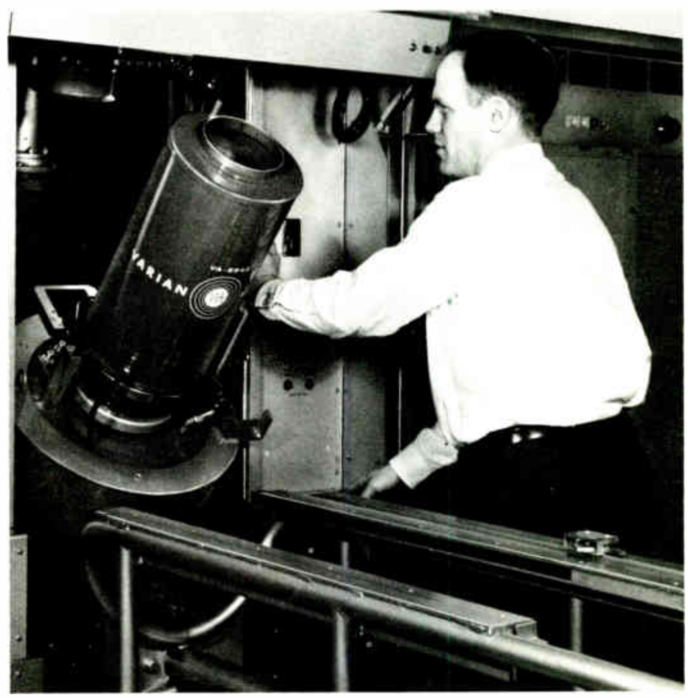
Three high voltage transformers are designed for outdoor mounting.

Optional Spare Exciter

A spare cabinet group is available to provide complete exciter redundancy. The spare exciter with its associated sensing, switch over, and metering circuitry is mounted in a matching cabinet which may be installed adjacent to the exciter control cabinet of the RCA Transmitter. The spare exciter cabinet provides an automatic switchover to the spare exciter in the event of a fault. It also may be switched manually or by means of a remote control 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.

Specifications

Visual Performance

Type of Emission A5
Frequency Range .... 470-806 MHz (Ch. 14-69)
Power Output .... 30 kW
Output Impedance:
  Power Amplifier .... 50 ohms
  Harmonic Filter (6⅛″ Coaxial) .... 75 ohms
Video Input Impedance .... 75 ohms
Video Input Level .... 1.0V Nominal
Carrier Frequency Stability[1] .... ±365 Hz
Amplitude vs. Frequency Response:[2]
  Carrier minus 0.75 MHz to
    Carrier plus 4.2 MHz .... ±0.75 dB *See Note
  Carrier plus 4.75 MHz and Higher ..... –40 dB or better
  Carrier minus 1.25 MHz and Lower .... –20 dB or better
  Carrier minus 3.58 MHz
    (Measured after Notch Diplexer) ..... –42 dB or better
  *Note: With Notch Diplexer, the response at carrier plus 4.0 to 4.2 MHz shall be +0.75 dB, –3.0 dB or better.
Envelope Delay vs. Frequency:[3]
  Between 0.2 and 2 MHz .... ±40 ns
  At 3.58 MHz .... ±25 ns
  At 4.18 MHz .... ±60 ns
Variation in Frequency Response
  with Brightness[4] .... –1, +1.5 dB
Modulation Depth Capability 3%
Amplitude Variation Over One Frame 2%
Output Regualtion 3%
Blanking Level Variation[5] 1.5%
Differential Gain[6] .... 0.5 dB
Low Frequency Linearity[13] .... 1.0 dB
Differential Phase[7] .... ±3.0° Envelope Detection
  ±4.0° Synchronous Detection
Subcarrier Amplitude (Color Bars)[8] .... 0.7 dB
AM Noise (rms beolw 100% mod.)[9] .... –55 dB
Harmonic Attenuation[10] .... –60 dB
"K" Factor:
  2T Pulse 1.5%
  12.5T Pulse .... <8.0%

Aural Performance

Type of Emission F3
Power Output .... 2.4 to 6.6 kW
Output Impedance:
  Power Amplifier .... 50 ohms
  Harmonic Filter .... 50 ohms
Audio Input Impedance .... 600/150 ohms
Audio Input Level .... +10, ±2 dBm
Carrier Frequency Stability[1] .... ±365 Hz
Intercarrier Frequency Stability[11] .... ±100 Hz
Modulation Capability .... ±50 kHz
Frequency Response (30 Hz to 15 kHz) .... ±1.0 dB
Distortion (30 Hz-15 kHz) 1.0%
FM Noise .... –60 dB
AM Noise .... –50 dB
Harmonic Attenuation[10] .... –60 dB

Environmental

Operational Altitude (Max.) .... 7500 feet (2286 m)
Ambient Operating Temperature .... +1 to 45°C.
Heat Exchanger Inlet Temperature .... +10 to 45°C.
Relative Humidity 95%

Electrical

Power Requirement[12] .. 440/460/480V, 3 phase, 60 Hz 93 kW
Line Voltage Regulation[14] .... 3% Max.
Slow Line Voltage Variations[14] .... ±3% Max.
Rapid Line Voltage Variations[14] .... ±3% Max.
Power Factor 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
    (2.62, 1.57, 1.14 m)
  Notch Diplexer (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 .... 8320 lbs. (3733 kg)
  Heat Exchanger .... 1450 lbs. (658 kg)
  Notch Diplexer .... 600 lbs. (272 kg)
  Beam Supply Transformer (each) ..... 1250 lbs. (567 kg)
Shipping Data:
  Total Weight (Approx.) .... 13,250 lbs. (6010 kg)
  Total Volume (Approx.) .... 1486 ft^3 (42 m^3)

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[1] Maximum variation for 30 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 a sideband response analyzer. Exciter operating at mid characteristic. SAW Filter correction external by transversal equalizer in video delay equalizer, TTS-2.

[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 TTS-2 is required at the transmitter video input while performing measurement. Multi-lobed delay ripples originating in the SAW Filter are excluded from this specification. Peak delay excursions do not exceed FCC limits.

[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. Spec is –1, +2 dB with pulser.

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

[6] Maximum variation of 3.58 MHz modulation frequency—20 percent p-p nominal amplitude—when superimposed on "stairstep" to "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.

[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] Typical power input with optional high efficiency klystron, and optional pulser. 10% aural power. Power input under other conditions available on request. Add 15 kW input power for 20% aural.

[13] 1.5 dB with Pulser.

[14] 2% with Pulser.

Accessories

Spare Klystron Power Tube (Specify Channel) MI-560407
Primary Voltage Regulator (Three req'd if used) ... MI-560425
Standby Exciter Cabinet Group, Type TTUE-44 ... ES-563007
Mod Anode Pulser System ES-563000

Ordering Information

UHF-TV Transmitter, 30 kW Visual, 6 kW Aural,
  Type TTU-30D ES-563008

catalog TT.3410A

(Replaces TT.3410)

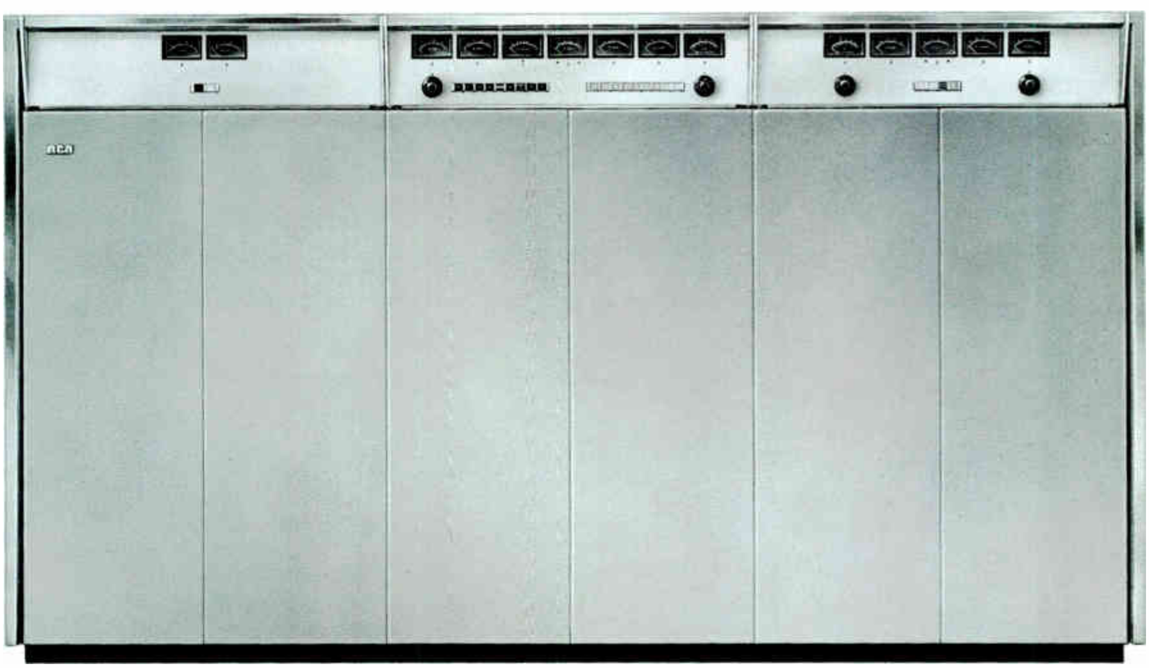
UHF-TV Transmitter, 55kW Visual, 12kW Aural, Type TTU-55C

- Intermediate Frequency (IF) modulation
- Vestigial sideband filtering with Surface Acoustic Wave (SAW) Filter at IF
- IF linearity correction—exceptionally low unwanted distortions
- Separate incidental phase correction for sync and video regions
- Vapor-cooled klystron power amplifiers
- Optional energy saving pulser

The TTU-55C 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-55C 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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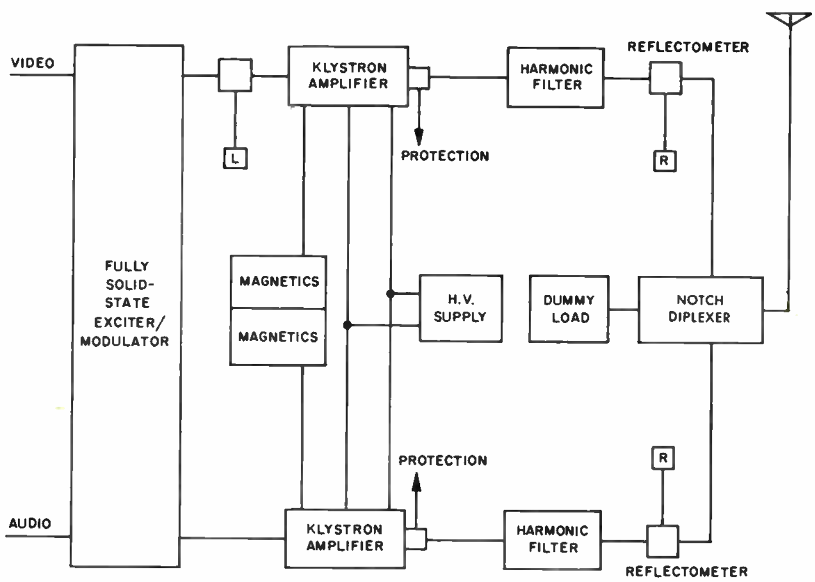
Connected to an antenna system of suitable gain, the TTU-55C transmitter is capable of an effective radiated power of as much as 1.8 megawatts. The transmitter is entirely transistorized except for two klystron power tubes and uses modern solid-state components in an innovative design in both circuitry 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-55C 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.

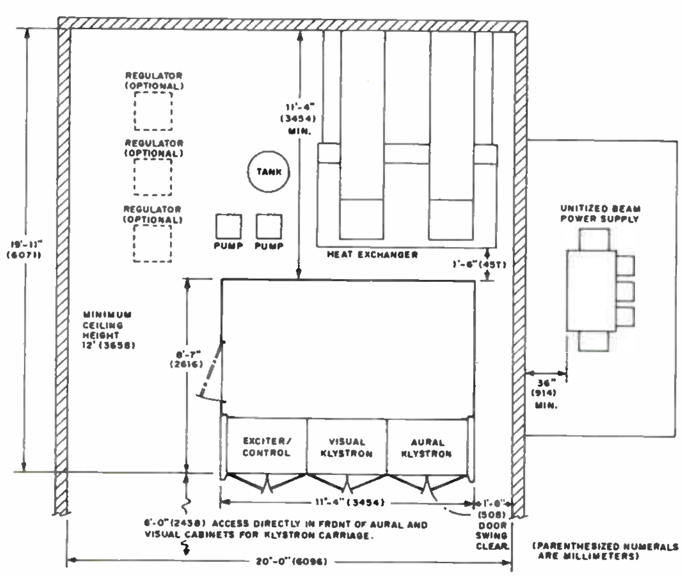
Circuit Description

The heart of the TTU-55C Transmitter is the all new type TTUE-44 Exciter/Modulator. Advanced technology has been applied in the design of the TTUE-44 wherever a definite advantage can be utilized. Vestigial sideband filtering is accomplished using a Surface Acoustic Wave (SAW) Filter. 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 a modulated IF signal with an RF "pump" frequency chain. By using the untuned passive SAW Filter, excellent sideband response can be maintained over long periods of time. Envelope delay characteristics of the SAW Filter require no large delay corrections at band edge. The necessary corrections are accomplished externally at video frequencies by the RCA TTS-2 Video Delay Equalizer, employing a transversal equalizer in conjunction with an all pass network for notch and receiver correction. RCA catalog sheet TT.4410 describes the TTUE-44 exciter/modulator in detail.

To assure optimum system linearity at the output of the klystron transmitter being driven by the exciter, linearity correction is provided at IF after sideband filtering. Full bandwidth phase modulation correction of the visual signal is provided to offset the inherent variation of phase length of the klystron with change in brightness level. This enhances the differential phase performance of the overall transmitter system for both envelope and synchronous detection receivers, and reduces intercarrier noise levels.



Overall transmitter functional diagram.



Transmitter system needs less than 600 square feet ($56m^3$) of floor area with a 12-foot (3.7m) ceiling.

Vapor-Cooled Klystrons

The TTU-55C 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

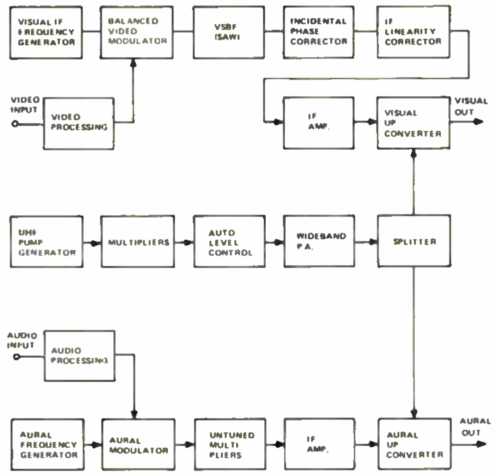
Klystron replacement in the TTU-55C Transmitter is accomplished easily by one man, working alone, in a matter of a few minutes. The factory-tuned klystron is transferred in a horizontal position directly from the shipping crate to the klystron carriage, which is furnished with the transmitter. By way 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.

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.



Exciter/modulator functional diagram.

High-Speed Fault Protection

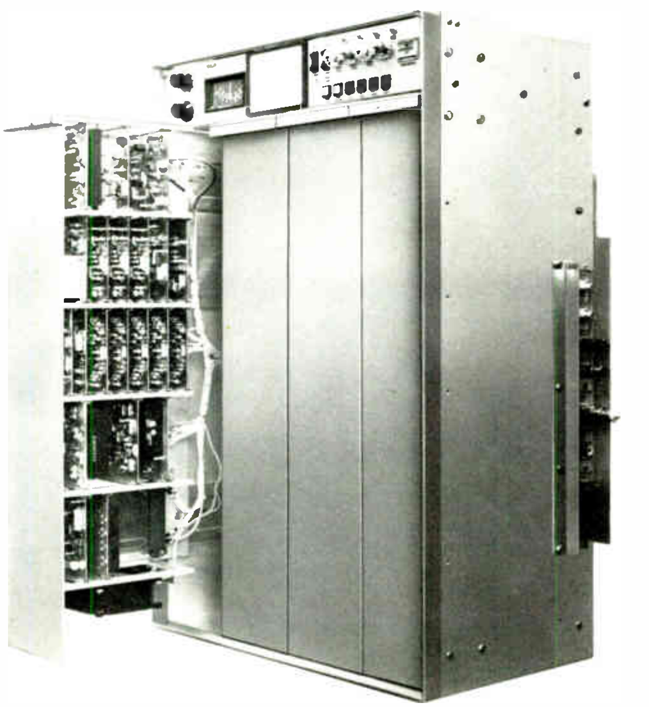
The transmitter incorporates electronic, high-speed fault protection systems capable of removing RF excitation within 20 microseconds in the event of an RF-load disturbance. The klystron amplifiers are protected with instantaneous relays which trip on overload and automatically reset unless the overload 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 is reset or the fault cleared, to indicate the source of alarm condition.

Klystron Power Supply

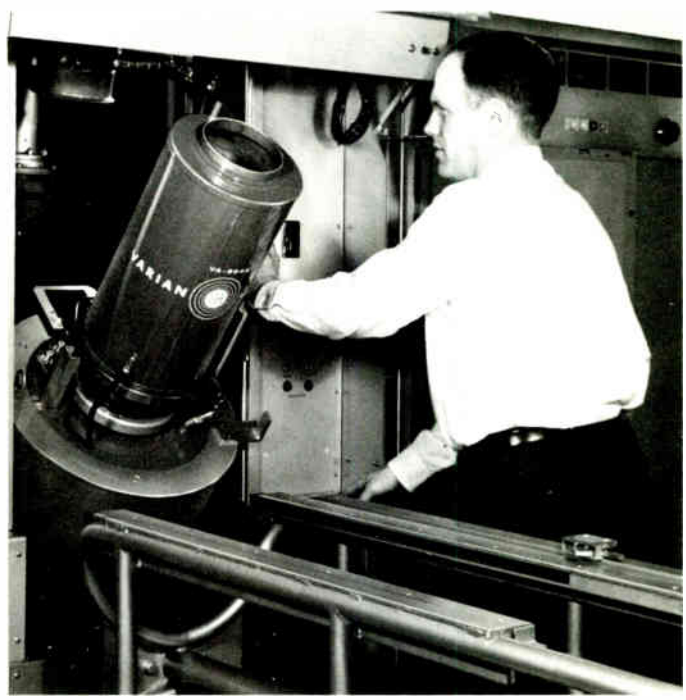
The klystron power supply for the TTU-55C Transmitter is a unitized assembly containing the power transformer, rectifier stacks, filter reactor and a-c snubbing networks in an oil-filled tank. The diode stacks are mounted in modular form, one for each phase, with access through a port at the top of the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

Optional Spare Exciter

A spare cabinet group is available to provide complete exciter redundancy. The spare exciter with its associated sensing, switch over, and metering circuitry is mounted in a matching cabinet which may be installed adjacent to the exciter control cabinet of the RCA Transmitter. The spare exciter cabinet provides an automatic switchover to the spare exciter in the event of a fault. It also may be switched manually or by means of a remote control 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.

Specifications

Visual Performance

Type of Emission	A5
Frequency Range:	
Standard Klystrons	470-806 MHz (Ch. 14-69)
Power Output	55 kW
Output Impedance:	
Power Amplifier	50 ohms
Harmonic Filter (6⅛" Coaxial)	75 ohms
Video Input Impedance	75 ohms
Video Input Level	1.0V Nominal
Carrier Frequency Stability[1]	±365 Hz
Amplitude vs. Frequency Response:[2]	
Carrier minus 0.75 MHz to Carrier plus 4.2 MHz	±0.75 dB *See Note
Carrier plus 4.75 MHz and Higher	−40 dB or better
Carrier minus 1.25 MHz and Lower	−20 dB or better
Carrier minus 3.58 MHz (Measured after Notch Filter)	−42 dB or better

*Note: With Notch Diplexer, the response at carrier plus 4.0 to 4.2 MHz shall be +0.75 dB, −3.0 dB or better.

Envelope Delay vs. Frequency:[3]	
Between 0.2 and 2 MHz	±40 ns
At 3.58 MHz	±25 ns
At 4.18 MHz	±60 ns
Variation in Frequency Response with Brightness[4]	−1, +1.5 dB
Modulation Depth Capability	3%
Amplitude Variation Over One Frame	2%
Output Regulation	3%
Blanking Level Variation[5]	1.5%
Differential Gain[6]	0.5 dB
Low Frequency Linearity[13]	1.0 dB
Differential Phase[7]	±3.0° Envelope Detection ±4.0° Synchronous Detection
Subcarrier Amplitude (Color Bars)[8]	0.7 dB
AM Noise (rms below 100% mod.)[9]	−55 dB
Harmonic Attenuation[10]	−60 dB
"K" Factor:	
2T Pulse	1.5%
12.5T Pulse	<8.0%

Aural Performance

Type of Emission	F3
Power Output	6.0 to 12.0 kW
Output Impedance:	
Power Amplifier	50 ohms
Harmonic Filter	50 ohms
Audio Input Impedance	600/150 ohms
Audio Input Level	+10, ±2 dBm
Carrier Frequency Stability[1]	±365 kHz
Intercarrier Frequency Stability[11]	±100 Hz
Modulation Capability	±50 kHz
Frequency Response (30 Hz to 15 kHz)	±1.0 dB
Distortion (30 Hz-15 kHz)	1.0%
FM Noise	−60 dB
AM Noise	−50 dB
Harmonic Attenuation[10]	−60 dB

Environmental

Operational Altitude (Max.)	7500 feet (2286 m)
Ambient Operating Temperature	+1 to 45°C.
Heat Exchanger Inlet Temperature	+10 to 45°C.
Relative Humidity	95%

Electrical

Power Requirement[12]	440/460/480V, 3 phase, 60 Hz, 158 kW
Line Voltage Regulation[11]	3% Max.
Slow Line Voltage Variations[11]	±3% Max.
Rapid Line Voltage Variations[14]	±3% Max.
Power Factor	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)
Notch Diplexer (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)
Notch Diplexer	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 ft^3 (45 m^3)

[1] Maximum variation for 30 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 a sideband response analyzer. Exciter operating at mid characteristics. SAW Filter correction external by transversal equalizer in video delay equalizer, TTS-2.

[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 TTS-2 is required at the transmitter video input while performing measurement. Multi-lobed delay ripples originating in the SAW Filter are excluded from this specification. Peak delay excursions do not exceed FCC limits.

[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. Spec is −1, +2 dB with pulser.

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

[6] Maximum variation of 3.58 MHz modulation frequency—20 percent p-p nominal amplitude—when superimposed on "stairstep" to "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.

[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] Typical power input with optional high efficiency klystron, pulser and aural output coupler. 10% aural power. Power input under other conditions available on request. Add 20 kW input power for 20% aural.

[13] 1.5 dB with Pulser.

[14] 2% with Pulser.

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-44	ES-563007
Mod Anode Pulser System	ES-563000

Ordering Information

High Efficiency Aural Coupler	
UHF-TV Transmitter, 55 kW Visual, 12 kW Aural, Type TTU-55C	ES-563009
Same with Hi Efficiency Klystrons (Ch. 14-51 only)	ES-563009-H

catalog TT.3610A

RCA

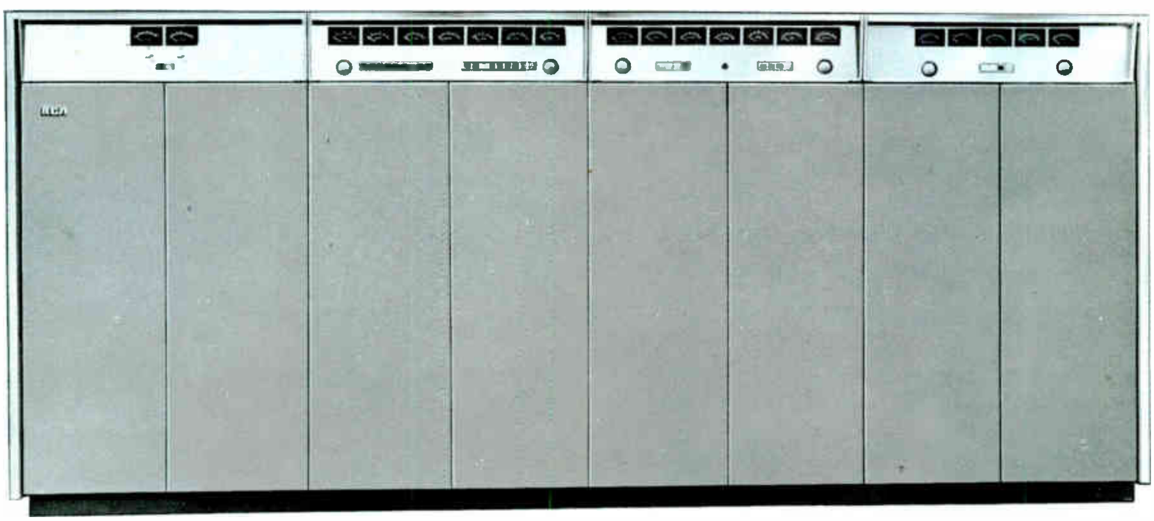
UHF-TV Transmitter, 60 kW Visual, 13kW Aural, Type TTU-60D

- Intermediate Frequency (IF) modulation
- Vestigial sideband filtering with Surface Acoustic Wave (SAW) Filter at IF
- IF linearity correction—exceptionally low unwanted distortions
- Separate incidental phase correction for sync and video regions
- Vapor-cooled klystron amplifiers
- Optional energy-saving pulser

The TTU-60D 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 aranged for easy interchange when replacement is necessary.

The TTU-60D 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 effcient 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.



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

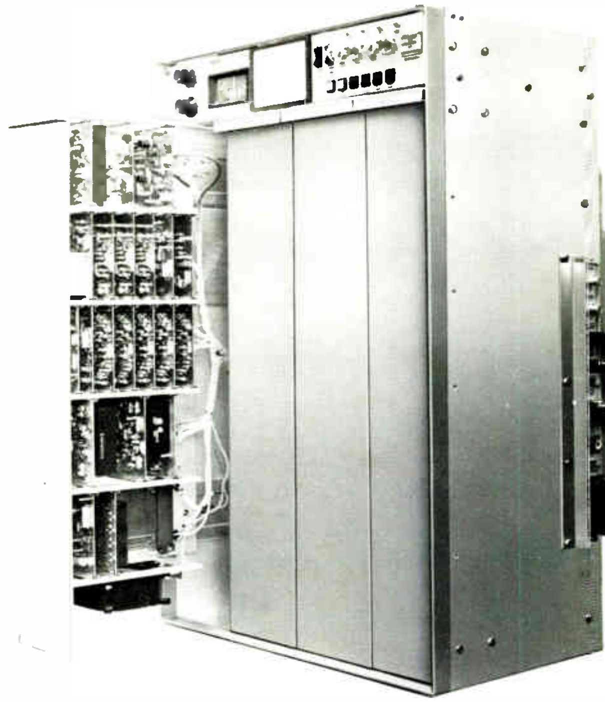
Connected to an antenna system of suitable power gain, the TTU-60D transmitter is capable of an effective radiated power (ERP) of more than two megawatts. The exciter/modulator section is entirely transistorized, using modern solid-state components in an innovative design in both circuitry and packaging. 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-60D 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.

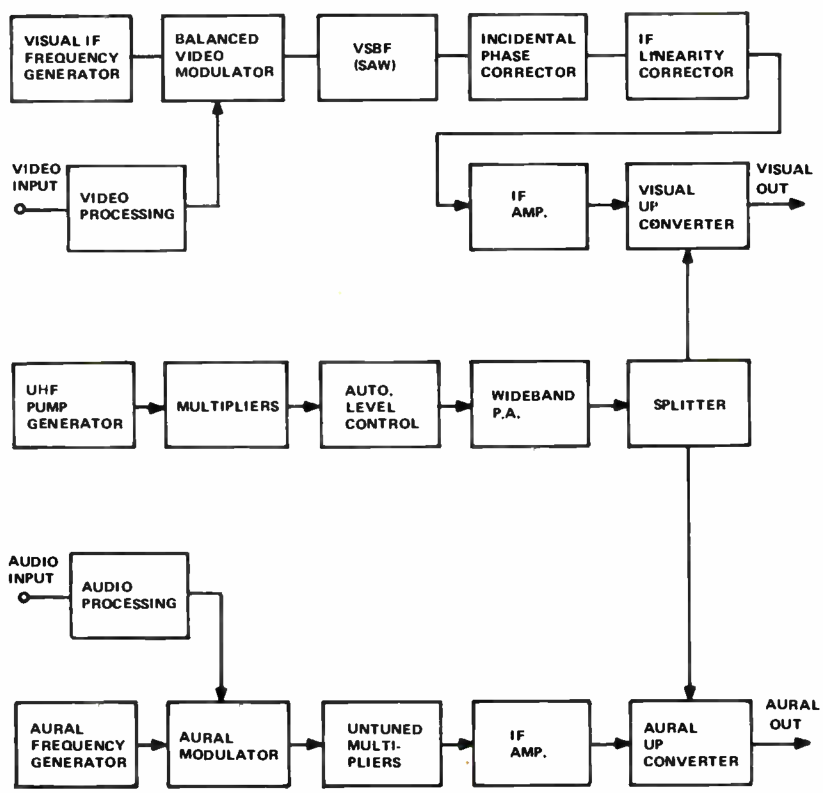
Circuit Description

The heart of the TTU-60D Transmitter is the all new type TTUE-44 Exciter/Modulator. Advanced technology has been applied in the design of the TTUE-44 wherever a definite advantage can be utilized. Vestigial sideband filtering is accomplished using a Surface Acoustic Wave (SAW) Filter. 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 a modulated IF signal with an RF "pump" frequency chain. By using the untuned passive SAW Filter, excellent sideband response can be maintained over long periods of time. Envelope delay characteristics of the SAW Filter require no large delay corrections at band edge. The necessary corrections are accomplished externally at video frequencies by the RCA TTS-2 Video Delay Equalizer, employing a transversal equalizer in conjunction with an all pass network for notch and receiver correction. RCA catalog sheet TT.4410 describes the TTUE-44 exciter/modulator in detail.

To assure optimum system linearity at the output of the klystron transmitter being driven by the exciter, linearity correction is provided at IF after sideband filtering. Full bandwidth phase modulation correction of the visual signal is provided to offset the inherent variation of phase length of the klystron with change in brightness level. This enhances the differential phase performance of the overall transmitter system for both envelope and synchronous detection receivers, and reduces intercarrier noise levels.



The TTUE-44 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.



Solid-State Exciter/Modulator Block Diagram.

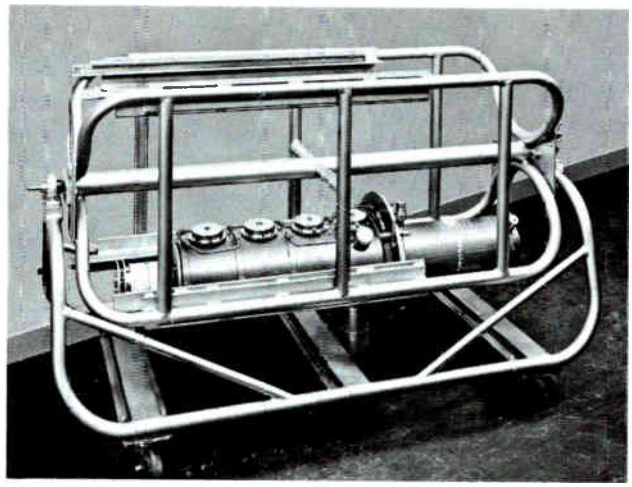
Solid-State Intermediate PA

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 amplifiers. These new RCA solid-state units were designed specifically for use in RCA UHF Transmitters. Each is 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.

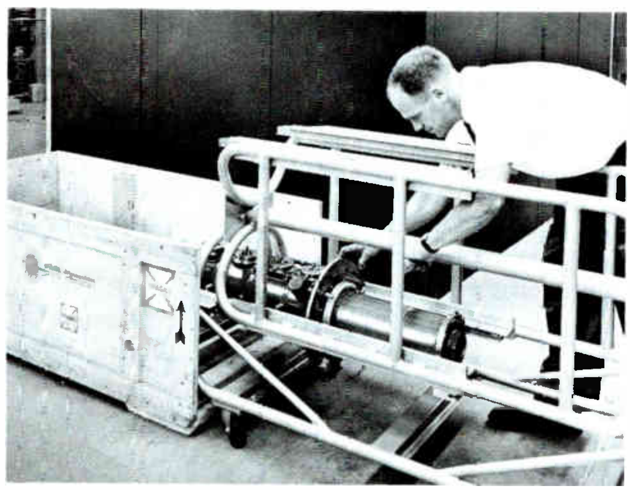
Vapor-Cooled Klystrons

The transmitter uses three identical klystrons: one in the aural channel and two in the visual. These are vapor-cooled,

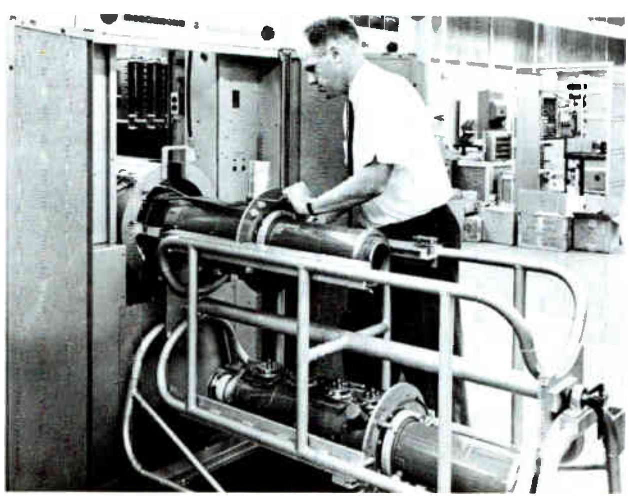
Klystron carriage stores spare klystron safely and securely.



Klystron transfers from crate to carriage quickly and easily.



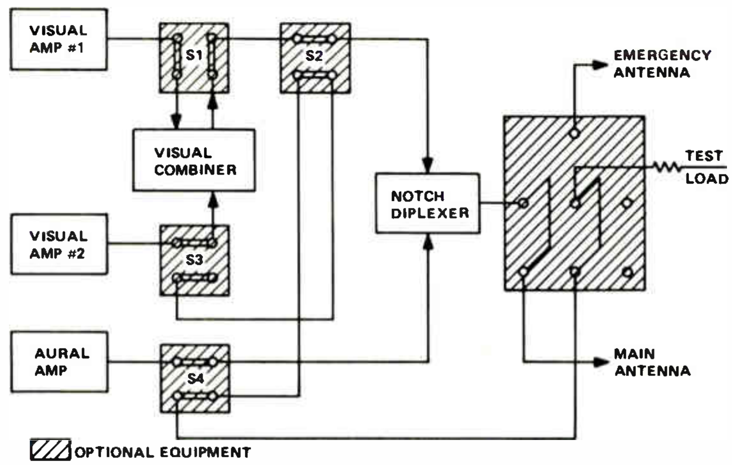
Transfer from carriage to socket is at table-top height.



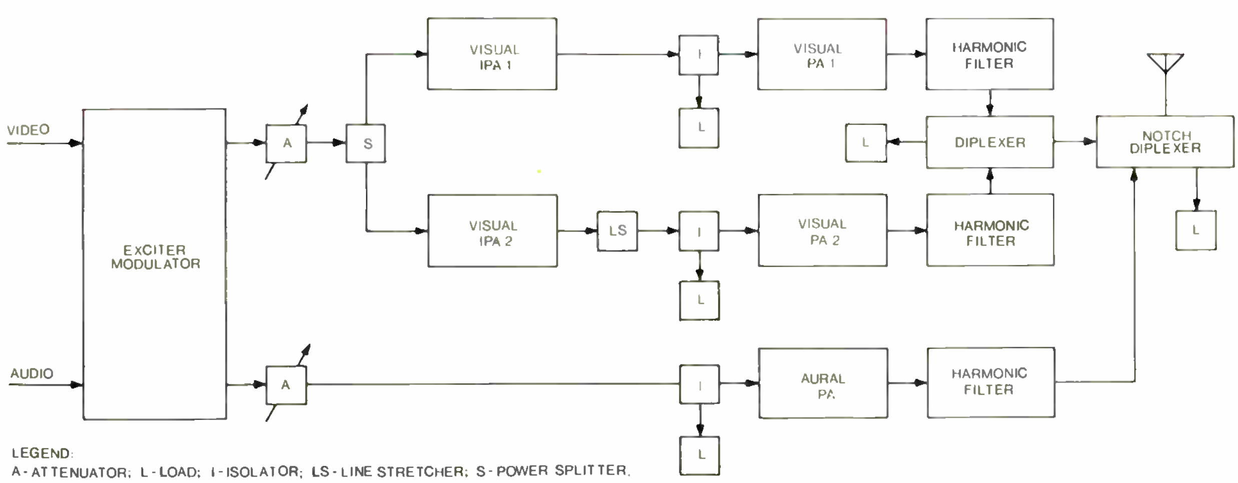
four-cavity units of integral-cavity design with a reputation for stability, reliability and long life. The visual klystrons operate in a diplexed arrangement with each klystron contributing independently to the transmitter power output. The diplex arrangement is such that an outage in either visual amplifier merely reduces transmitter power output. Several output RF switching configurations are possible with the TTU-60D by the addition of optional output switches to enhance the versatility of the TTU-60D system when either locally or remotely controlled.

One possible configuration is shown here. In this example, four optional motor driven and one manual RF switch allow either visual to be routed directly to the notch diplexer, thus eliminating the normal 3 dB loss of the visual combiner in the event of temporary failure of one visual amplifier. As the diagram shows, it is also possible to substitute Visual #2 for temporary use as an aural amplifier or to route any one of the three RF amplifiers to the test load and to feed either with a main or emergency antenna. More or less RF switching may be selected, depending upon individual station requirements.

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



Block Diagram of typical optional RF system.



Simplified functional diagram of signal-handling sections of transmitter.

retired visual tubes as aural amplifiers to extend tube life.

Easy Klystron Change

Klystron replacement in the TTU-60D 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 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 causes any power reflected from the load to 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 as 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.

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.

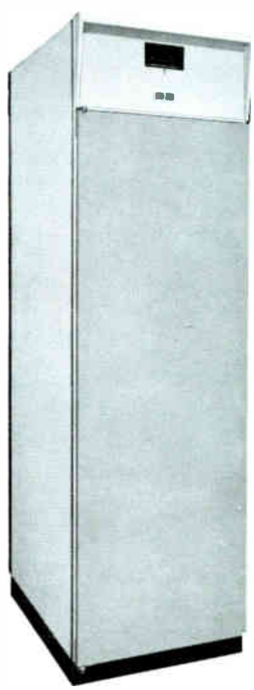
The heat exchanger requires ductwork between it and outdoor air. This ductwork is ordinarily provided by the purchaser unless specifically ordered from RCA.

High-Speed Fault Protection

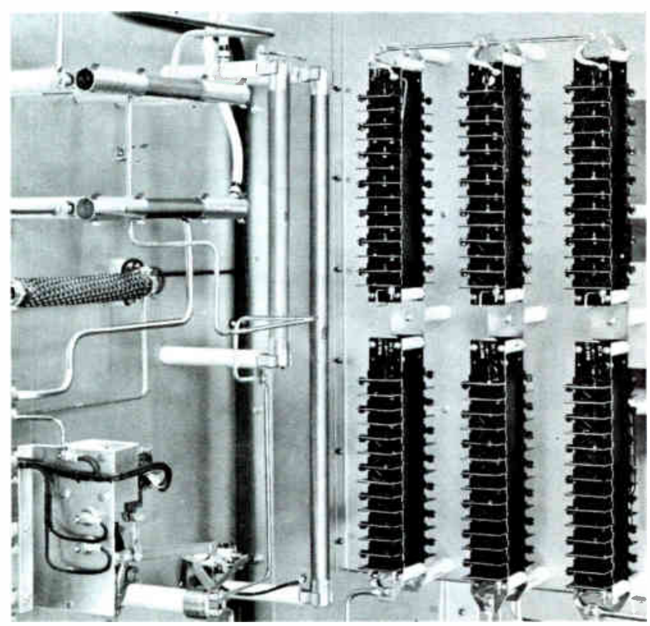
The transmitter incorporates an electronic, high-speed fault protection system capable of removing RF excitation within 20 microseconds in the event of an RF load distrubance. The klystron amplifiers are protected with instantaneous relays which trip on overload and automatically reset unless the overload 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,



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.

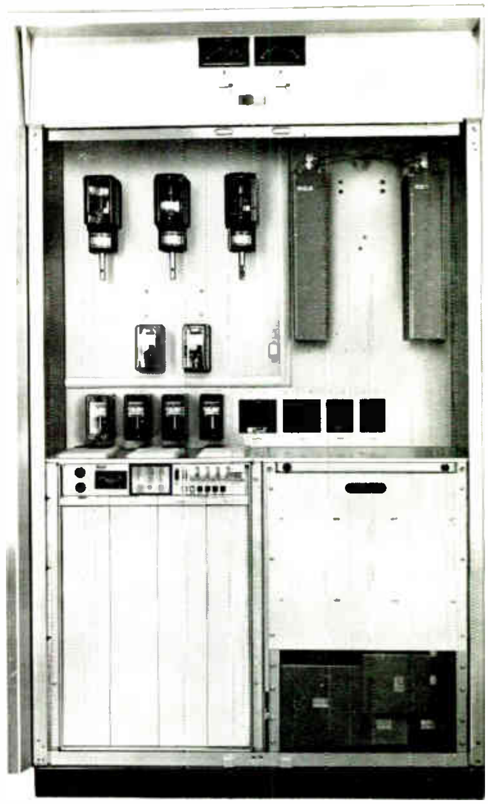


Modularized silicon rectifiers in power supply mount on inside walls of power supply enclosure for easy access and efficient convection cooling.

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.

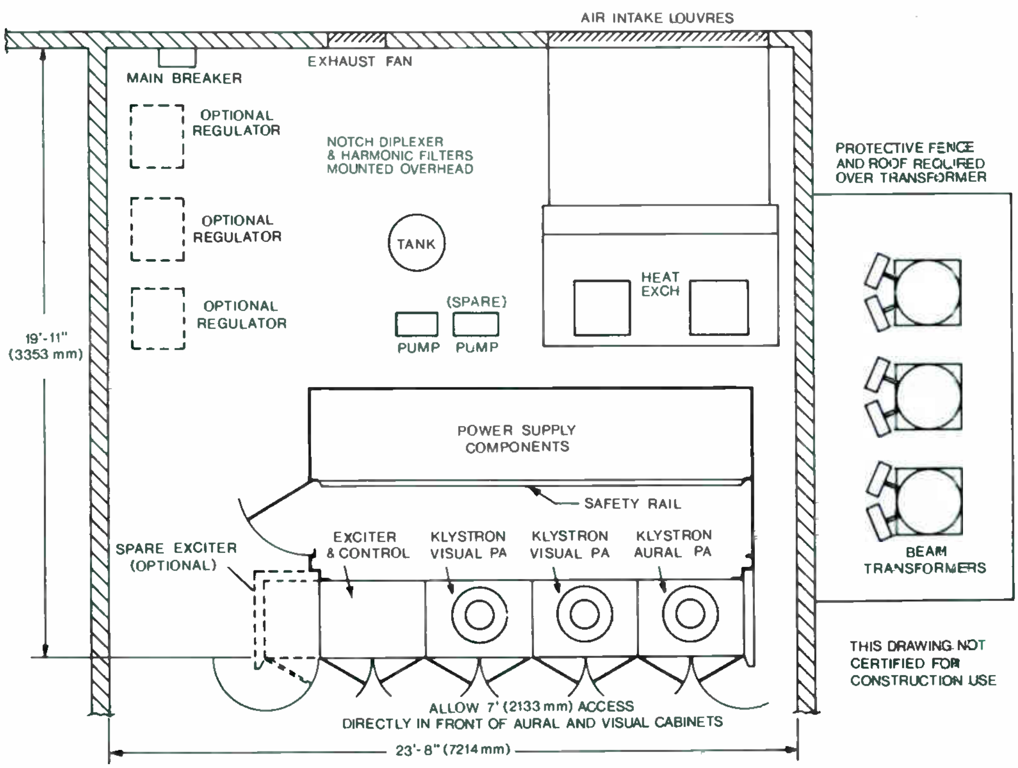
Optional Power-Saving Pulser

Available as an optional item for the TTU-60D transmitter is the newly developed RCA Mod Anode Pulser. Utilizing proven radar pulsing techniques, this pulser has been designed to provide pulses to the modulating anode of the visual klystron amplifiers during the sync portion of the visual signal only. This permits the klystrons to operate at reduced beam current during the video portion of the TV signal and at a high beam current only during the sync interval. The resulting operation reduces beam power input by approximately 32 kW in a TTU-60D Transmitter, resulting in AC power input savings of a similar amount. This device is described in detail in Catalog TT.4500.



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

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



Specifications

Visual Performance

Type of Emission A5
Frequency Range:
  Standard Klystrons .... 470-806 MHz (Ch. 14-69)
Power Output .... 60 kW
Output Impedance:
  Power Amplifier .... 50 ohms
  Harmonic Filter (6⅛" Coaxial) .... 75 ohms
Video Input Impedance .... 75 ohms
Video Input Level .... 1.0V Nominal
Carrier Frequency Stability[1] .... ±365 Hz
Amplitude vs. Frequency Response:[2]
  Carrier minus 0.75 MHz to
    Carrier plus 4.2 MHz .... ±0.75 dB *See Note
  Carrier plus 4.75 MHz and Higher .... −40 dB or better
  Carrier minus 1.25 MHz and Lower .... −20 dB or better
  Carrier minus 3.58 MHz
    (Measured after Notch Diplexer) .... −42 dB or better
  *Note: With Notch Diplexer, the response at carrier plus 4.0 to 4.2 MHz shall be +0.75 dB, −3.0 dB or better.
Envelope Delay vs. Frequency:[3]
  Between 0.2 and 2 MHz .... ±40 ns
  At 3.58 MHz .... ±25 ns
  At 4.18 MHz .... ±60 ns
Variation in Frequency Response
  with Brightness[4] .... −1, +1.5 dB
Modulation Depth Capability 3%
Amplitude Variation Over One Frame 2%
Output Regulation 3%
Blanking Level Variation[5] 1.5%
Differential Gain[6] .... 0.5 dB
Low Frequency Linearity[13] .... 1.0 dB
Differential Phase[7] .... ±3.0° Envelope Detection
  ±4.0° Synchronous Detection
Subcarrier Amplitude (Color Bars)[8] .... 0.7 dB
AM Noise (rms below 100% mod.)[9] .... −55 dB
Harmonic Attenuation[10] .... −60 dB
"K" Factor:
  2T Pulse 1.5%
  12.5T Pulse .... <8.0%

Aural Performance

Type of Emission F3
Power Output (Rated) .... 3.0 to 13.2 kW
Output Impedance
  Power Amplifier .... 50 ohms
  Harmonic Filter .... 50 ohms
Audio Input Impedance .... 600/150 ohms
Audio Input Level .... +10, ±2 dBm
Carrier Frequency Stability[1] .... ±365 kHz
Intercarrier Frequency Stability[11] .... ±100 Hz
Modulation Capability .... ±50 kHz
Frequency Response (30 Hz to 15 kHz) .... ±1.0 dB
Distortion (30 Hz-15 kHz) 1.0%
FM Noise .... −60 dB
AM Noise .... −50 dB
Harmonic Attenuation[10] .... −60 dB

Environmental

Operational Altitude (Max.) .... 7500 feet (2286 m)
Ambient Operating Temperature .... +1 to 45°C.
Heat Exchanger Inlet Temperature .... +10 to 45°C.
Relative Humidity 95%

Electrical

Power Requirement[12] .... 440/460/480V, 3 phase, 60 Hz, 178 kW
Line Voltage Regulation[14] .... 3% Max.
Slow Line Voltage Variations[14] .... ±3% Max.
Rapid Line Voltage Variations[14] .... ±3% Max.
Power Factor 90%

Mechanical

Dimensions:
  Transmitter .... 180" L; 105" D; 77" H (4.57, 2.67, 1.95m)
  Heat Exchanger .... 103" L; 62" D; 45" H (2.62, 1.57, 1.14 m)
  Notch Diplexer (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 .... 9450 lbs. (4286 kg)
  Heat Exchanger .... 1450 lbs. (658 kg)
  Notch Diplexer .... 600 lbs. (272 kg)
  Beam Supply Transformer .... 1570 lbs. (712 kg)
Shipping Data:
  Total Weight (Approx.) .... 24,300 lbs. (11,022 kg)
  Total Volume (Approx.) .... 2174 ft³ (62 m³)

[1] Maximum variation for 30 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 a sideband response analyzer. Exciter operating at mid characteristic. SAW Filter correction external by transversal equalizer in video delay equalizer, TTS-2.

[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 TTS-2 is required at the transmitter video input while performing measurement. Multi-lobed delay ripples originating in the SAW Filter are excluded from this specification. Peak delay excursions do not exceed FCC limits.

[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. Spec is −1, +2 dB with pulser.

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

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

[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.

[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] Typical power input with high efficiency klystron and pulser, with 10% aural power. Power input under other conditions available on request. Add 20 kW input power for 20% aural.

[13] 1.5 dB with Pulser.

[14] 2% with Pulser.

Accessories

Spare Klystron Power Tube (Specify Channel) MI-560407
Primary Voltage Regulator (Three req'd if used) .. MI-560493A
Standy Exciter Cabinet Group, Type TTUE-44 .... ES-563007
Mod Anode Pulser ES-563000

Ordering Information

UHF-TV Transmitter, 60 kW Visual, 13 kW Aural,
  Type TTU-60D ES-563010

catalog TT.3710A

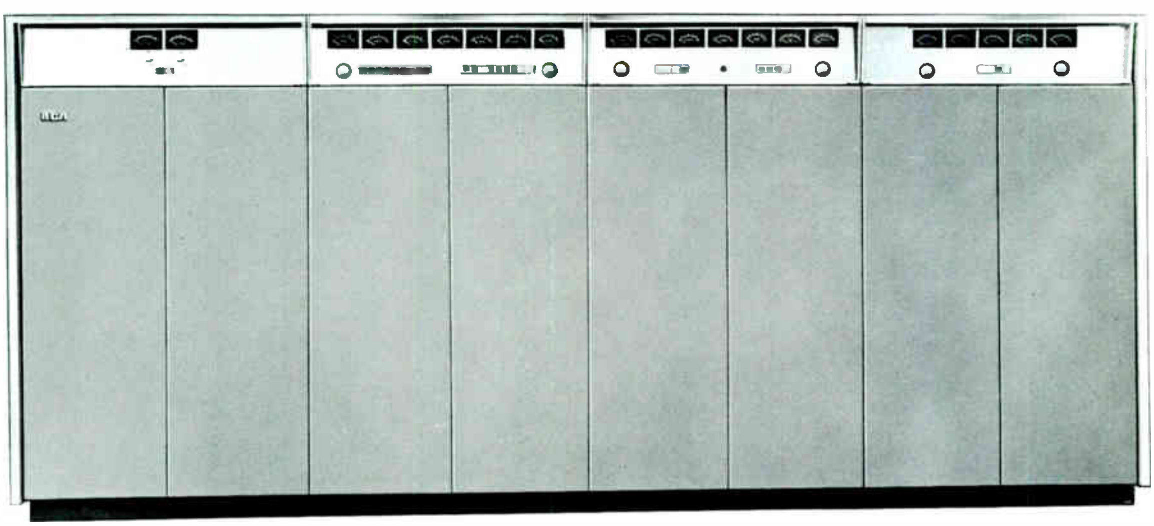
UHF-TV Transmitter, 110kW Visual, 24 kW Aural, Type TTU-110C

- Intermediate Frequency (IF) modulation
- Vestigial sideband filtering with Surface Acoustic Wave (SAW) Filter at IF
- IF linearity correction—exceptionally low unwanted distortions
- Separate incidental phase correction for sync and video regions
- Vapor-cooled klystron power amplifiers
- Optional energy-saving pulser
- Redundant visual amplifiers

The TTU-110C 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-110C uses four in-line cabinets and a rear walk-in enclosure for the transmitter power supply and switching components with external notch diplexer, 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 switch-over to the standby system.



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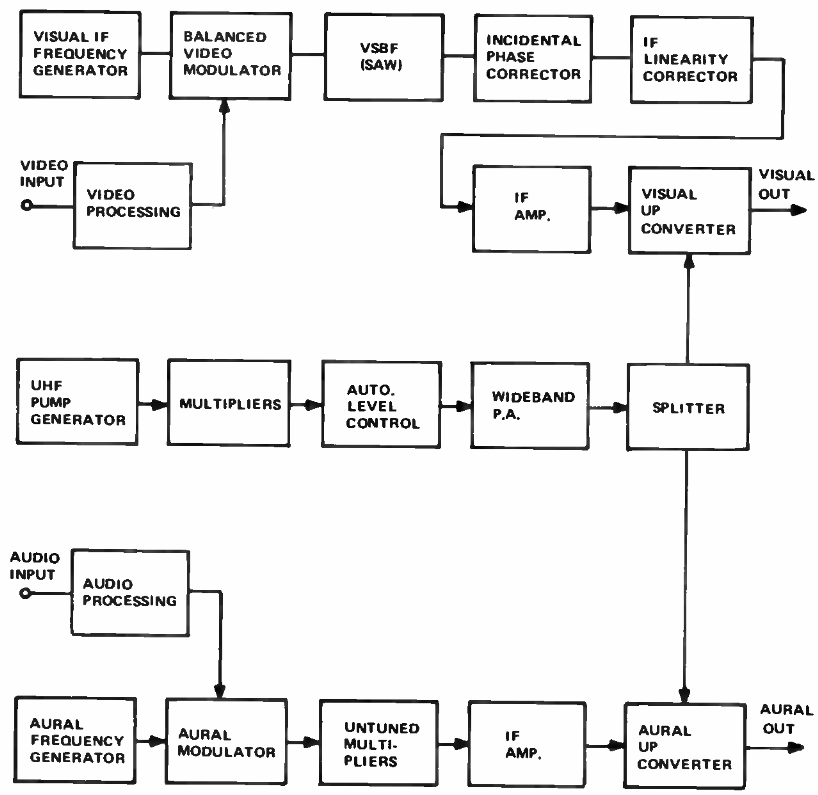
Connected to an antenna of suitable power gain, the TTU-110C transmitter is capable of an effective radiated power (ERP) of 5 megawatts. The exciter/modulatod section is entirely transistorized, using modern, solid-state components in an innovative design in both circuitry and packaging. The transmitter 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-110C 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.

Circuit Description

The heart of the TTU-110C Transmitter is the all new type TTUE-44 Exciter/Modulator. Advanced technology has been applied in the design of the TTUE-44 wherever a definite advantage can be utilized. Vestigial sideband filtering is accomplished using a Surface Acoustic Wave (SAW) Filter. 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 a modulated IF signal with an RF "pump" frequency chain. By using the untuned passive SAW Filter, excellent sideband response can be maintained over long periods of time. Envelope delay characteristics of the SAW Filter require no large delay corrections at band edge. The necessary corrections are accomplished externally at video frequencies by the RCA TTS-2 Video Delay Equalizer, employing a transversal equalizer in conjunction with an all pass network for notch and receiver correction. RCA catalog sheet TT.4410 describes the TTUE-44 exciter/modulator in detail.

To assure optimum system linearity at the output of the klystron transmitter being driven by the exciter, linearity correction is provided at IF after sideband filtering. Full bandwidth phase modulation correction of the visual signal is provided to offset the inherent variation of phase length of the klystron with change in brightness level. This enhances the differential phase performance of the overall transmitter system for both envelope and synchronous detection receivers, and reduces intercarrier noise levels.



Solid-State Exciter/Modulator Block Diagram.

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.

Klystron Power Supply

The klystron power supply for the TTU-110C 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.

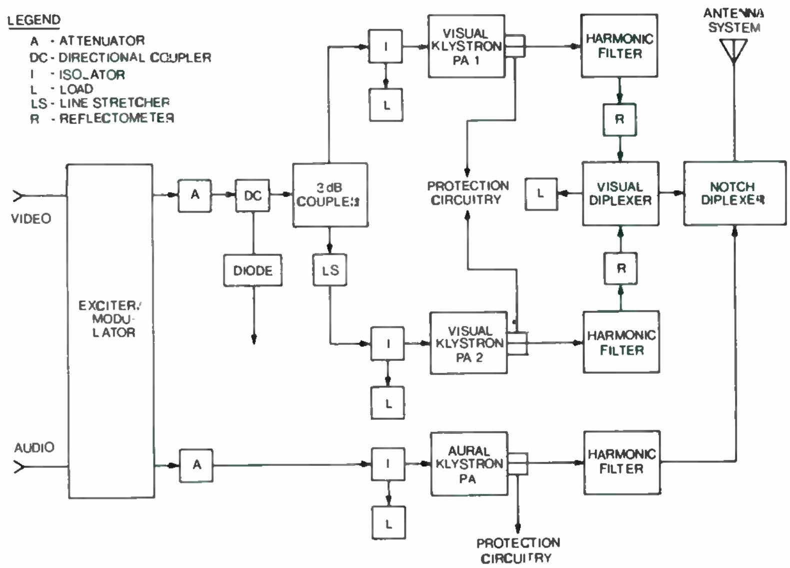
The power supply units are for outdoor installation and are identical except for the transformers. One has a delta-delta and the other a delta-wye primary winding. The output voltages are in parallel in normal operation, but a switching system is provided to operate the transmitter at reduced power from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

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.

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.



Functional diagram: transmitter system.

High-Speed Fault Protection

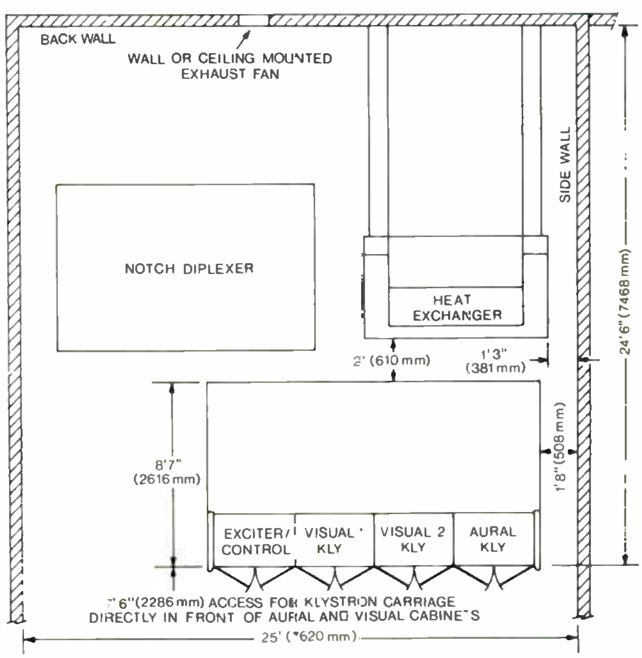
The transmitter incorporates an electronic, high-speed fault protection system capable of removing RF excitation within 20 microseconds in the event of an RF load distrubance. The klystron amplifiers are protected by instantaneous relays which trip on overload and automatically reset unless the overload 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.

Energy-Saving Options

The use of optional high efficiency klystrons (available for Ch. 14 through 51 only) plus the new RCA Mod Anode Pulser offer typical power savings of up to 120 kW in a TTU-110C transmitter. Complete details of the Mod Anode Pulser are available in Catalog TT.4500. Further power savings are possible by the use of a high efficiency aural coupler, provided that desired aural output power is 12½ kW or less.



Transmitter system needs only 800 square feet (74m³) of floor area with 12-foot (3.7m) headroom.

Specifications

Visual Performance

Type of Emission A5

Frequency Range:
  Standard Klystrons .... 470-806 MHz (Ch. 14-69)

Power Output .... 110 kW

Output Impedance:
  Power Amplifier .... 50 ohms
  Harmonic Filter (6⅛" Coaxial) .... 75 ohms

Video Input Impedance .... 75 ohms

Video Input Level .... 1.0V Nominal

Carrier Frequency Stability[1] .... ±365 Hz

Amplitude vs. Frequency Response:[2]
  Carrier minus 0.75 MHz to
    Carrier plus 4.2 MHz .... ±0.75 dB *See Note
  Carrier plus 4.75 MHz and Higher .... −40 dB or better
  Carrier minus 1.25 MHz and Lower .... −20 dB or better
  Carrier minus 3.58 MHz
    (Measured after Notch Diplexer) ..... −42 dB or better

*Note: With Notch Diplexer, the response at carrier plus 4.0 to 4.2 MHz shall be +0.75 dB, −3.0 dB or better.

Envelope Delay vs. Frequency:[3]
  Between 0.2 and 2 MHz .... ±40 ns
  At 3.58 MHz .... ±25 ns
  At 4.18 MHz .... ±60 ns

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

Modulation Depth Capability 3%

Amplitude Variation Over One Frame 2%

Output Regulation 3%

Blanking Level Variation[5] 1.5%

Differential Gain[6] .... 0.5 dB

Low Frequency Linearity[13] .... 1.0 dB

Differential Phase[7] .... ±3.0° Envelope Detection
  ±4.0° Synchronous Detection

Subcarrier Amplitude (Color Bars)[8] .... 0.7 dB

AM Noise (rms below 100% mod.)[9] .... −55 dB

Harmonic Attenuation[10] .... −60 dB

"K" Factor:
  2T Pulse 1.5%
  12.5T Pulse .... <8.0%

Aural Performance

Type of Emission F3

Power Output .... 8.0 to 24 kW

Output Impedance
  Power Amplifier .... 50 ohms
  Harmonic Filter .... 50 ohms

Audio Input Impedance .... 600/150 ohms

Audio Input Level .... +10, ±2 dBm

Carrier Frequency Stability[1] .... ±365 kHz

Intercarrier Frequency Stability[11] .... ±100 Hz

Modulation Capability .... ±50 kHz

Frequency Response (30 Hz to 15 kHz) .... ±1.0 dB

Distortion (30 Hz-15 kHz) 1.0%

FM Noise .... −60 dB

AM Noise .... −50 dB

Harmonic Attenuation[10] .... −60 dB

Environmental

Operational Altitude (Max.) .... 7500 feet (2286 m)

Ambient Operating Temperature .... +1 to 45°C.

Heat Exchanger Inlet Temperature .... +10 to 45°C.

Relative Humidity 95%

Electrical

Power Requirement[12] .. 440/460/480V, 3 phase, 60 Hz, 315 kW

Line Voltage Regulation[14] .... 3% Max.

Slow Line Voltage Variations[14] .... ±3% Max.

Rapid Line Voltage Variations[14] .... ±3% Max.

Power Factor 90%

Mechanical

Dimensions:
  Transmitter .... 180" L; 105" D; 77" H (4.57, 2.67, 1.95m)
  Heat Exchanger .... 142" L; 75" D; 87" H (3.61, 1.91, 2.21 m)
  Notch Diplexer (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)
  Notch Diplexer .... 1,200 lbs. (544 kg)
  Beam Current Supply (Each) .... 6,700 lbs. (3039 kg)

Shipping Data:
  Total Weight (Approx.) .... 36,000 lbs. (16,738 kg)
  Total Volume (Approx.) .... 2612 ft³ (74 m³)

[1] Maximum variation for 30 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 a sideband response analyzer. Exciter operattng at mtd characteristic. SAW Filter correction external by transversal equalizer in video delay equalizer, TTS-2.

[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 TTS-2 is required at the transmitter video input while performing measurement. Multi-lobed delay ripples originating in the SAW Filter are excluded from this specification. Peak delay excursions do not exceed FCC limits.

[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. Spec is −1, +2 dB with pulser.

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

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

[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.

[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] Typical power input with optional high efficiency klystron, pulser and aural output coupler. 10% aural power. Power input under other conditions available on request. Add 20 kW input power for 20% aural.

[13] 1.5 dB with Pulser.

[14] 2% with Pulser.

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-44 ... ES-563007

Mod Anode Pulser System ES-563000

Ordering Information

UHF-TV Transmitter, 110 kW Visual, 24 kW Aural,
  Type TTU-110C ES-563011

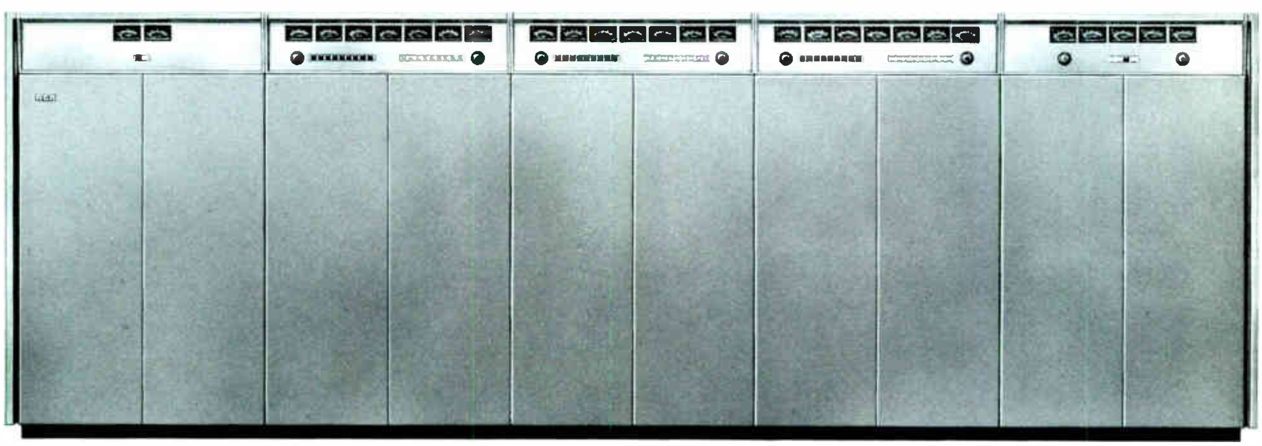
RCA

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

- Intermediate Frequency (IF) modulation
- Vestigial sideband filtering with Surface Acoustic Wave (SAW) Filter at IF
- IF linearity correction—exceptionally low unwanted distortions
- Separate incidental phase correction for sync and video regions
- Vapor-cooled klystron power amplifiers
- Optional energy saving pulser system

The TTU-165D 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-165D 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.



3CTT

The TTU-165D 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.

Circuit Description

The heart of the TTU-165D Transmitter is the all new type TTUE-44 Exciter/Modulator. Advanced technology has been applied in the design of the TTUE-44 wherever a definite advantage can be utilized. Vestigial sideband filtering is accomplished using a Surface Acoustic Wave (SAW) Filter. 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 a modulated IF signal with an RF "pump" frequency chain. By using the untuned passive SAW Filter, excellent sideband response can be maintained over long periods of time. Envelope delay characteristics of the SAW Filter require no large delay corrections at band edge. The necessary corrections are accomplished externally at video frequencies by the RCA TTS-2 Video Delay Equalizer, employing a transversal equalizer in conjunction with an all pass network for notch and receiver correction. RCA catalog sheet TT.4410 describes the TTUE-44 exciter/modulator in detail.

To assure optimum system linearity at the output of the klystron transmitter being driven by the exciter, linearity correction is provided at IF after sideband filtering. Full bandwidth phase modulation correction of the visual signal is provided to offset the inherent variation of phase length of the klystron with change in brightness level. This enhances the differential phase performance of the overall transmitter system for both envelope and synchronous detection receivers, and reduces intercarrier noise levels.

Temperature controlled oscillators (TCXO) assure on-frequency operation without warm-up. A spare oscillator module is provided for the pump-generator section of the exciter.

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 28-volt d.c. power supply which is a part of the exciter-control cabinet.

Vapor-Cooled Klystrons

The transmiter 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 4.77 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.

Easy Klystron Change

Klystron replacement in the TTU-165D 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.

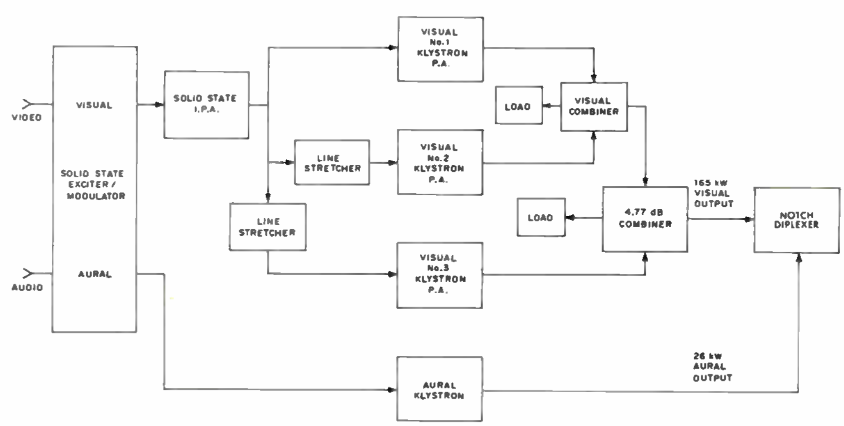
Ghost Cancelling Final Amplifier

A line stretcher device is incorporated in the RF drive to the visual amplifiers for proper phasing of the output to the visual combiners. 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, 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 the elimination of any ghosting effect which could otherwise be caused by reflected power from a load mismatch.

High-Speed Fault Protection

The TTU-165D 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.



Simplified functional diagram of signal-handling sections of the 165 kW transmitter.

These indicators remain lit until manually reset, even if the overload has reset and the fault cleared, to indicate the source of alarm condition.

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-165D 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. 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.

Unitized Beam Power Supplies

The klystron power supply for the TTU-165D 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.

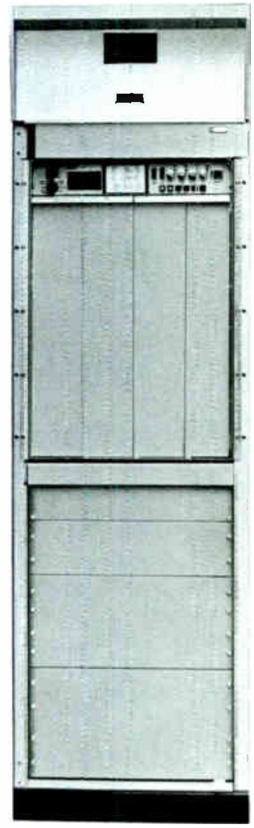
The power supplies normally operate in parallel, but a switching system is provided to operate the transmitter at reduced power from a one- or two-supply configuration. The filter capacitors for the high-voltage supply are located in the transmitter rear enclosure.

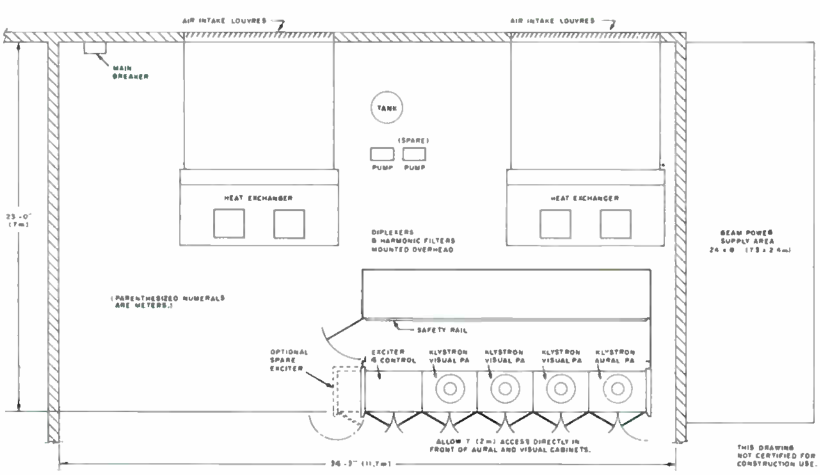
Optional Spare Exciter

A spare cabinet group is available to provide complete exciter redundancy. The spare exciter with its associated sensing, switch over and metering circuitry is mounted in a matching cabinet which may be installed adjacent to the exciter control cabinet of the RCA Transmitter. The spare exciter cabinet provides an automatic switchover to the spare exciter in the event of a fault. It also may be switched manually or by means of a remote control system.

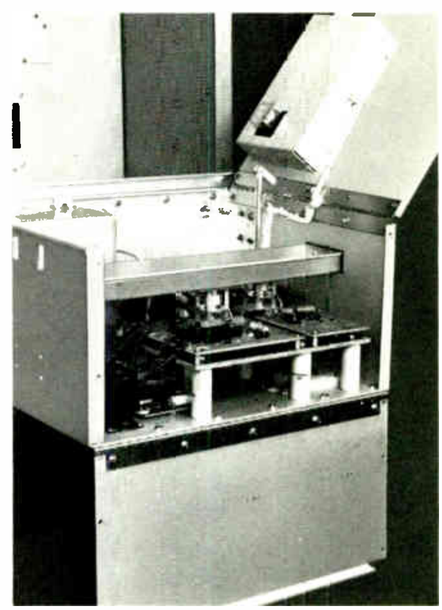
Energy-Saving Options

The use of optional high efficiency klystrons (available for Ch. 14 through 51 only) offers significant power savings. If high-efficiency klystrons are used, the optional RCA Mod Anode Pulser system offers a further power saving of 90 kW or more in a TTU-165 transmitter. Complete details on the Mod Anode Pulser are available in RCA Catalog Sheet TT.4500.





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



Specifications

Visual Performance

Type of Emission A5
Frequency Range:
Standard Klystrons .... 470-806 MHz (Ch. 14-69)
Power Output .... 165 kW
Output Impedance:
Power Amplifier .... 50 ohms
Harmonic Filter (6⅛″ Coaxial) .... 75 ohms
Video Input Impedance .... 75 ohms
Video Input Level .... 1.0V Nominal
Carrier Frequency Stability[1] .... ±365 Hz
Amplitude vs. Frequency Response:[2]
Carrier minus 0.75 MHz to
Carrier plus 4.2 MHz .... ±0.75 dB *See Note
Carrier plus 4.75 MHz and Higher .... –40 dB or better
Carrier minus 1.25 MHz and Lower .... –20 dB or better
Carrier minus 3.58 MHz
(Measured after Notch Filter) .... –42 dB or better
*Note: With Notch Diplexer, the response at carrier plus 4.0 to 4.2 MHz shall be +0.75 dB, –3.0 dB or better.
Envelope Delay vs. Frequency:[3]
Between 0.2 and 2 MHz .... ±40 ns
At 3.58 MHz .... ±25 ns
At 4.18 MHz .... ±60 ns
Variation in Frequency Response
with Brightness[4] .... –1, +1.5 dB
Modulation Depth Capability 3%
Amplitude Variation Over One Frame 2%
Output Regulation 3%
Blanking Level Variation[5] 1.5%
Differential Gain[6] .... 0.5 dB
Low Frequency Linearity[13] .... 1.0 dB
Differential Phase[7] .... ±3.0° Envelope Detection
±4.0° Synchronous Detection
Subcarrier Amplitude (Color Bars)[8] .... 0.7 dB
AM Noise (rms below 100% mod.)[9] .... –55 dB
Harmonic Attenuation[10] .... –60 dB
"K" Factor:
2T Pulse 1.5%
12.5T Pulse .... < 8.0%

Aural Performance

Type of Emission F3
Power Output .... 26.3 kW
Output Impedance:
Power Amplifier .... 50 ohms
Harmonic Filter .... 50 ohms
Audio Input Impedance .... 600/150 ohms
Audio Input Level .... +10, ±2 dBm
Carrier Frequency Stability[1] .... ±365 kHz
Intercarrier Frequency Stability[11] .... ±100 Hz
Modulation Capability .... ±50 kHz
Frequency Response (30 Hz to 15 kHz) .... ±1.0 dB
Distortion (30 Hz-15 kHz) 1.0%
FM Noise .... –60 dB
AM Noise .... –50 dB
Harmonic Attenuation[10] .... –60 dB

Environmental

Operational Altitude (Max.) .... 7500 feet (2286 m)
Ambient Operating Temperature .... +1 to 45°C.
Heat Exchanger Inlet Temperature .... +10 to 45°C.
Relative Humidity 95%

Electrical

Power Requirements[12] .... 440/460/480V, 3 phase, 60 Hz, 485 kW
Line Voltage Regulation[14] .... 3% Max.
Slow Line Voltage Variations[14] .... ±3% Max.
Rapid Line Voltage Variations[14] .... ±3% Max.
Power Factor 90%

Mechanical

Dimensions:
Transmitter
Cabinet .... 224″ L; 105″ D; 77″ H (5.69, 2.66, 1.95m)
Heat Exchanger
(Each) .... 149″ L; 86″ D; 96″ H (3.8, 2.2, 2.4m)
Notch Diplexer .... 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.) .... 2100 lbs. (953 kg)
Notch Diplexer .... 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} (89.5m^3)

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[1] Maximum variation for 30 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 a sideband response analyzer. Exciter operating at mid characteristics. SAW Filter correction external by transversal equalizer in video delay equalizer, TTS-2.
[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 TTS-2 is required at the transmitter video input while performing measurement. Multi-lobed delay ripples originating in the SAW Filter are excluded from this specification. Peak delay excursions do not exceed FCC limits.
[4] Maximum change with respect to 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. Spec is –1, +2 dB with pulser.
[5] Change in blanking level relative to sync peak for change in brightness from all black to all white pictures.
[6] Maximum variation of 3.58 MHz modulation frequency—20 percent p-p nominal amplitude—when superimposed on "stairstep" to "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.
[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] Typical power input with optional high efficiency klystron and pulser with 10% aural power. Power input under other conditions available on request.
[13] 1.5 dB with Pulser.
[14] 2% with Pulser.

Accessories

Spare Klystron Power Tube (Specify Channel) MI-560569
Primary Voltage Regulator .... On Request
Standby Exciter Cabinet Group, Type TTUE-44 .... ES-563007
Mod Anode Pulser System .... (2) ES-563000
High Efficiency Aural Coupler

Ordering Information

UHF-TV Transmitter, 165 kW Visual, 26 kW Aural,
Type TTU-165D ES-563021
Same with Hi Efficiency Klystrons
(Ch. 14-51 only) ES-563021-H

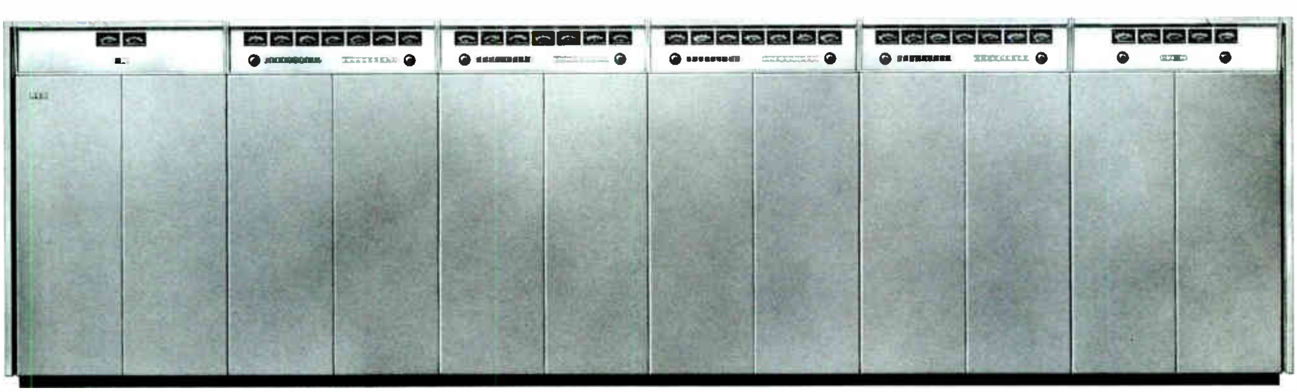
catalog TT.3910A

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

- Intermediate Frequency (IF) modulation
- Vestigial sideband filtering with Surface Acoustic Wave (SAW) Filter at IF
- IF linearity correction—exceptionally low unwanted distortions
- Separate incidental phase correction for sync and video regions
- Vapor-cooled klystron power amplifiers
- Optional energy saving pulser system

The TTU-220D 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-220D uses inetgral 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.



3CTT

The TTU-220D 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.

Circuit Description

The heart of the TTU-220D Transmitter is the all new type TTUE-44 Exciter/Modulator. Advanced technology has been applied in the design of the TTUE-44 wherever a definite advantage can be utilized. Vestigial sideband filtering is accomplished using a Surface Acoustic Wave (SAW) Filter. 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 a modulated IF signal with an RF "pump" frequency chain. By using the untuned passive SAW Filter, excellent sideband response can be maintained over long periods of time. Envelope delay characteristics of the SAW Filter require no large delay corrections at band edge. The necessary corrections are accomplished externally at video frequencies by the RCA TTS-2 Video Delay Equalizer, employing a transversal equalizer in conjunction with an all pass network for notch and receiver correction. RCA catalog sheet TT.4410 describes the TTUE-44 exciter/modulator in detail.

To assure optimum system linearity at the output of the klystron transmitter being driven by the exciter, linearity correction is provided at IF after sideband filtering. Full bandwidth phase modulation correction of the visual signal is provided to offset the inherent variation of phase length of the klystron with change in brightness level. This enhances the differential phase performance of the overall transmitter system for both envelope and synchronous detection receivers, and reduces intercarrier noise levels.

Temperature controlled oscillators (TCXO) assure on-frequency operation without warm-up. A spare oscillator module is provided for the pump-generator section of the exciter.

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 28-volt d.c. power supply which is a part of the exciter-control cabinet.

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.

Easy Klystron Change

Klystron replacement in the TTU-220D 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.

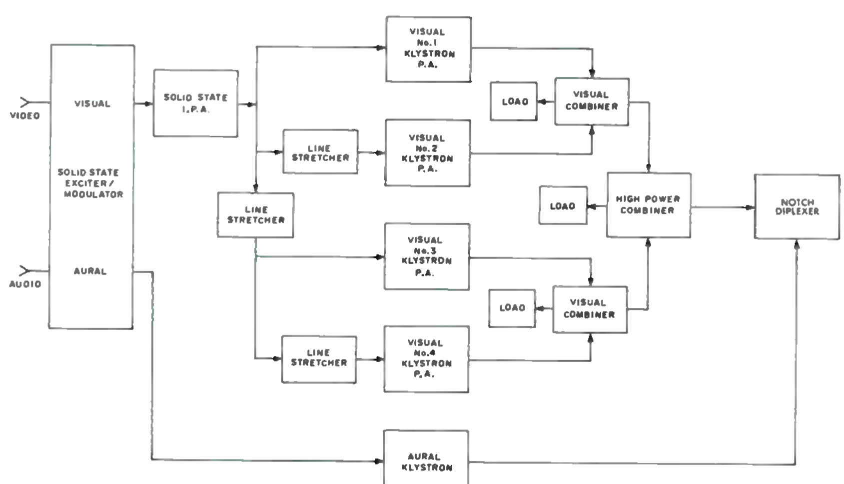
Ghost Cancelling Final Amplifier

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

High-Speed Fault Protection

The TTU-220D 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



Simplified functional diagram of the signal-handling sections of the 220 kW transmitter.

reset, even if the overload has reset and the fault cleared, to indicate the source of alarm condition.

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-220D 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. 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.

Unitized Beam Power Supplies

The klystron power supply for the TTU-220D 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 either 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.

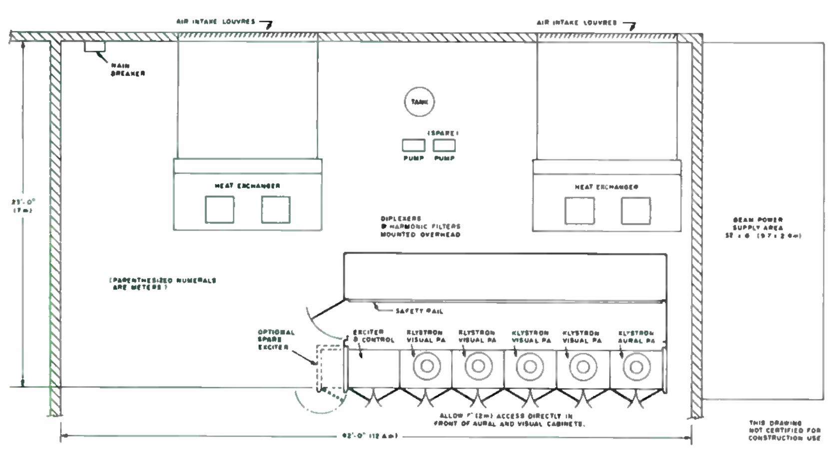
The power supplies normally operate in parallel, but a switching system is provided to operate the transmitter at reduced power from a two or three supply configuration. The filter capacitors for the high-voltage supply are located in the transmitter rear enclosure.

Optional Spare Exciter

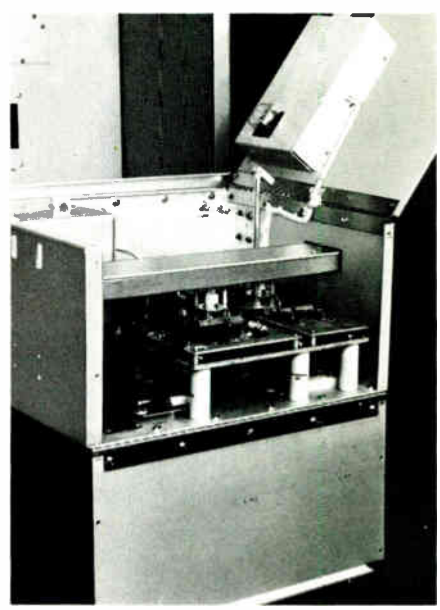
A spare cabinet group is available to provide complete exciter redundancy. The spare exciter with its associated sensing, switch over and metering circuitry is mounted in a matching cabinet which may be installed adjacent to the exciter control cabinet of the RCA Transmitter. The spare exciter cabinet provides an automatic switchover to the spare exciter in the event of a fault. It also may be switched manually or by means of a remote control system.

Energy-Saving Options

The use of optional high efficiency klystrons (available for CH. 14 through 51 only) offers significant power savings. If high efficiency klystrons are used, the optional RCA Mod Anode Pulser system offers a further power saving of 120 kW or more in a TTU-220 transmitter. Complete details on the Mod Anode Pulser are available in RCA Catalog Sheet TT.4500.



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



Specifications

Visual Performance

Type of Emission ... A5
Frequency Range:
  Standard Klystrons ... 470-806 MHz (Ch. 14-69)
Power Output ... 220 kW
Output Impedance:
  Power Amplifier ... 50 ohms
  Harmonic Filter (6⅛" Coaxial) ... 75 ohms
Video Input Impedance ... 75 ohms
Video Input Level ... 1.0V Nominal
Carrier Frequency Stability[1] ... ±365 Hz
Amplitude vs. Frequency Response:[2]
  Carrier minus 0.75 MHz to
    Carrier plus 4.2 MHz ... ±0.75 dB *See Note
  Carrier plus 4.75 MHz and Higher ... −40 dB or better
  Carrier minus 1.25 MHz and Lower ... −20 dB or better
  Carrier minus 3.58 MHz
    (Measured after Notch Filter) ... −42 dB or better
  *Note: With Notch Diplexer, the response at carrier plus 4.0 to 4.2 MHz shall be +0.75 dB, −3.0 dB or better.
Envelope Delay vs. Frequency:[3]
  Between 0.2 and 2 MHz ... ±40 ns
  At 3.58 MHz ... ±25 ns
  At 4.18 MHz ... ±60 ns
Variation in Frequency Response
  with Brightness[4] ... −1, +1.5 dB
Modulation Depth Capability ... 3%
Amplitude Variation Over One Frame ... 2%
Output Regulation ... 3%
Blanking Level Variation[5] ... 1.5%
Differential Gain[6] ... 0.5 dB
Low Frequency Linearity[13] ... 1.0 dB
Differential Phase[7] ... ±3.0° Envelope Detection
  ±4.0° Synchronous Detection
Subcarrier Amplitude (Color Bars)[8] ... 0.7 dB
AM Noise (rms below 100% mod.)[9] ... −55 dB
Harmonic Attenuation[10] ... −60 dB
"K" Factor:
  2T Pulse ... 1.5%
  12.5T Pulse ... < 8.0%

Aural Performance

Type of Emission ... F3
Power Output ... 24 kW
Output Impedance:
  Power Ampliler ... 50 ohms
  Harmonic Filter ... 50 ohms
Audio Input Impedance ... 600/150 ohms
Audio Input Level ... +10, ±2 dBm
Carrier Frequency Stability[1] ... ±365 kHz
Intercarrier Frequency Stability[11] ... ±100 Hz
Modulation Capability ... ±50 kHz
Frequency Response (30 Hz to 15 kHz) ... ±1.0 dB
Distortion (30 Hz-15 kHz) ... 1.0%
FM Noise ... −60 dB
AM Noise ... −50 dB
Harmonic Attenuation[10] ... −60 dB

Environmental

Operational Altitude (Max.) ... 7500 feet (2286 m)
Ambient Operating Temperature ... +1 to 45°C.
Heat Exchanger Inlet Temperature ... +10 to 45°C.
Relative Humidity ... 95%

Electrical

Power Requirements[12] ... 440/460/480V, 3 phase, 60 Hz, 610 kW
Line Voltage Regulation[14] ... 3% Max.
Slow Line Voltage Variations[14] ... ±3% Max.
Rapid Line Voltage Variations[14] ... ±3% Max.
Power Factor ... 90%

Mechanical

Dimensions:
  Transmitter
    Cabinet ... 268" L; 105" D; 77" H (6.80, 2.66, 1.95m)
  Heat Exchanger
    (Each) ... 149" L; 86" D; 96" H (3.8, 2.2, 2.4m)
  Notch Diplexer ... 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)
  Notch Diplexer (Approx.) ... 1200 lbs. (544 kg)
  Beam Power Supply (Each, Approx.) ... 6700 lbs. (3039 kg)
Shipping Data:
  Total Weight ... 55,000 lbs. (2495 kg)
  Total Volume ... 3650 ft.^{3} (103m^3)

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[1] Maximum variation for 30 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 a sideband response analyzer. Exciter operating at mid characteristics. SAW Filter correction external by transversal equalizer in video delay equalizer, TTS-2.
[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 TTS-2 is required at the transmitter video input while performing measurement. Multi-lobed delay ripples originating in the SAW Filter are excluded from this specification. Peak delay excursions do not exceed FCC limits.
[4] Maximum change with respect to 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. Spec is −1, +2 dB with pulser.
[5] Change in blanking level relative to sync peak for change in brightness from all black to all white pictures.
[6] Maximum variation of 3.58 MHz modulation frequency—20 percent p-p nominal amplitude—when superimposed on "stairstep" to "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.
[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] Typical power input with optional high efficiency klystron and pulser with 10% aural power. Power input under other conditions available on request.
[13] 1.5 dB with Pulser.
[14] 2% with Pulser.

Accessories

Spare Klystron Power Tube (Specify Channel) ... MI-560569
Primary Voltage Regulator ... On Request
Standby Exciter Cabinet Group, Type TTUE-44 ... ES-563007
Mod Anode Pulser System ... (2) ES-563000
High Efficiency Aural Coupler

Ordering Information

UHF-TV Transmitter, 220 kW Visual, 24 kW Aural,
  Type TTU-220D ... ES-563022
Same with Hi Efficiency Klystrons
  (Ch. 14-51 only) ... ES-563022-H

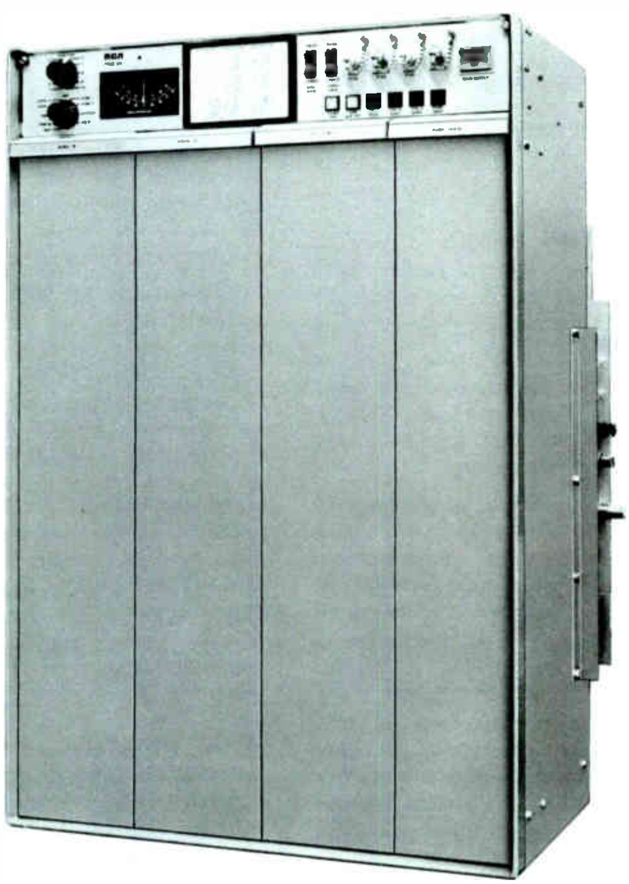
catalog TT.4410

(Preliminary)

RCA

UHF-TV Solid-State Exciter-Modulator, Type TTUE-44

- Full 4-watt visual, 0.8 watt aural output
- Modulation at IF with high-level up-conversion
- Vestigial sideband filtering using Surface Acoustic Wave (SAW) Filter
- IF linearity correction with exceptionally low unwanted distortions
- Separate incidental phase modulation correction for sync and video regions
- Temperature-compensated crystal oscillators—no crystal ovens
- Modularized plug-in construction
- Comprehensive metering and monitoring system

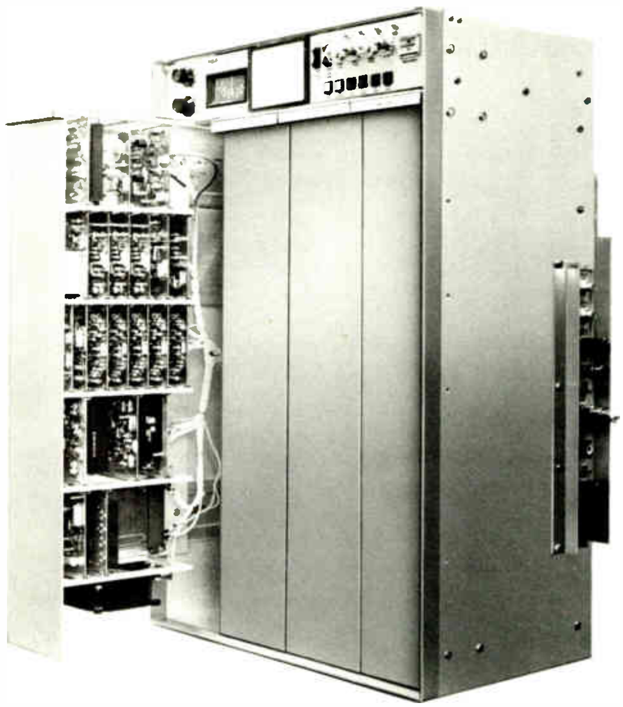


The TTUE-44 UHF Television Exciter-Modulator, an integral part of all new RCA UHF Television Transmitters, represents a new and original design approach. It incorporates modern design techniques and state-of-the-art components to provide a new standard of performance and reliability.

Advanced technology has been applied to the design of the TTUE-44 wherever a definite advantage can be utilized. Vestigial sideband fitering is accomplished using a Surface Acoustic Wave (SAW) Filter. 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.

The RF carrier frequency output signal levels are 4 watts visual and 0.8 watt aural.

3BTT



The TTUE-44 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

The TTUE-44 consists 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. 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 Hybrid Amplifiers

Integrated circuits are utilized in a unique, untuned FM chain to process the aural carrier. A balanced visual modulator followed by modern, high gain hybrid amplifiers result in an extremely simple, highly stable and reliable visual IF circuit.

Constant impedance, RF stripline circuits are used extensively, to avoid the problems of reliability usually associated with coaxial cables and connectors.

Separate Power Supply

The TTUE-44 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 Control and Monitoring.

The exciter control and monitoring circuits are contained in the horizontal panel at the top of the exciter. The remainder of the exciter circuits are located on the four vertical pull-out drawers located directly below the control and meter panel.

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.

Regulator on Each Connector Module

The Power Supply furnishes unregulated dc voltages to the various circuits. Each circuit incorporates a voltage-regulator, 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 clamp insertion amplifier.

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 clamp insertion amplifier. The clamp pulse assures that pedestal level remains at a constant amplitude independent of video. The clamped video signal then goes through 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 VSB filter, incidental phase corrector and IF linearity corrector before being linearly amplified to a level suitable to drive the visual up-converter.

Surface Acoustic Wave (SAW) VSB Filter

The IF vestigial sideband filter employs a surface acoustic wave device. By using the untuned passive device, excellent sideband response can be maintained for long periods of time. Envelope delay characteristics of the SAW filter require no large delay corrections at band edge. The necessary corrections are accomplished externally at video frequencies by the RCA TTS-2 video delay equalizer employing a transversed equalizer in conjunction with an all-pass network for notch and receiver correction.

IF Linearity Correction

To assure optimum system linearity at the output of the klystron transmitter being driven by the exciter, linearity correction is provided at IF after sideband filtering.

Incidental Phase Modulation Correction

Full bandwidth phase modulation correction of the visual signal is provided to offset the inherent variation of phase length of the klystron with change in brightness level. This enhances the differential phase performance of the overall transmitter system for both envelope and synchronous detection receivers and reduces intercarrier noise levels.

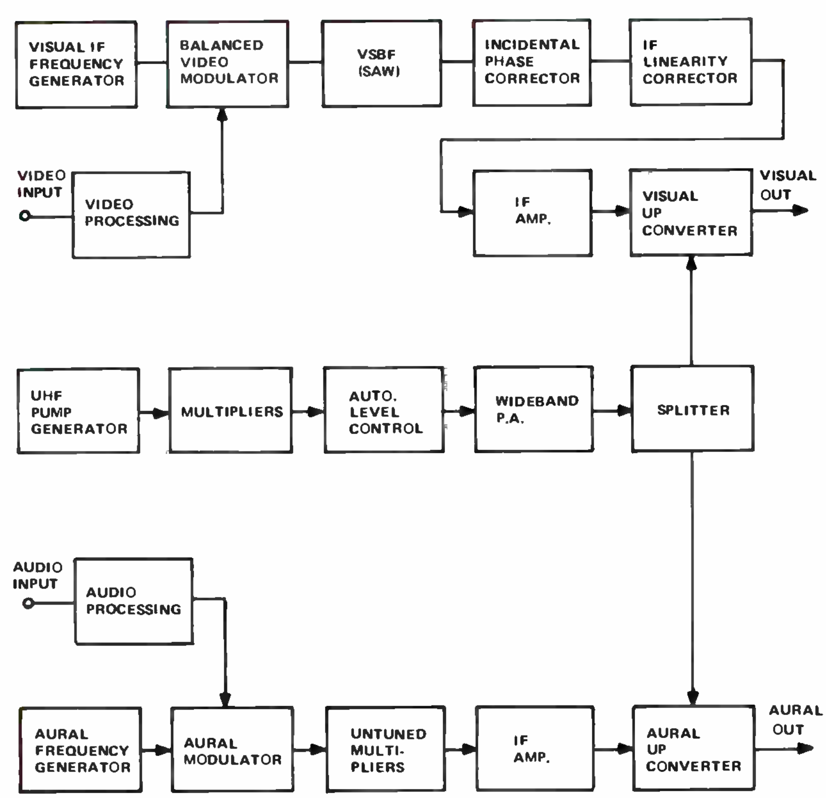
RF Section

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 watt aural.

Available for Spare-Exciter Duty

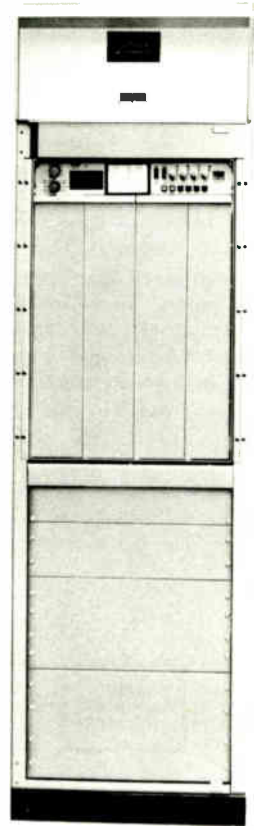
The TTUE-44 Exciter-Modulator, and its companion Power Supply, are an integral part of current RCA UHF Television Transmitters.

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-control cabinet of the RCA transmitter. 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.



Solid-State Exciter/Modulator Block Diagram.

The TTUE-44 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 dBm ±2 dB

Frequency Response:
- Visual (Carrier plus 200 kHz Ref.):
  - Between 0.5 and 4.0 MHz Above Carrier ....±0.5 dB
  - At 4.75 MHz Above Carrier ....Better than −20 dB
  - At 4.18 MHz Above Carrier ....+0.0, −1.5 dB
  - At 0.75 MHz Below Carrier ....+0.0, −1.5 dB
  - At 1.25 MHz Below Carrier ....Better than −20 dB
- 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 ....±3° max.
Differential Gain ....0.3 dB max.
Frequency Stability:
- Visual Carrier ....Better than ±500 Hz
- Aural Carrier ....Better than ±500 Hz
- Intercarrier ....Better than ±150 Hz

FM Noise (Below ±25 kHz) ....−62 dB
AM Noise:
- Visual (Below 100% modulation) ....58 dB rms
- Aural (Below carrier) ....55 dB rms

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)
- Cabinet Group ....310 lbs. (141 kg)

Ordering Information

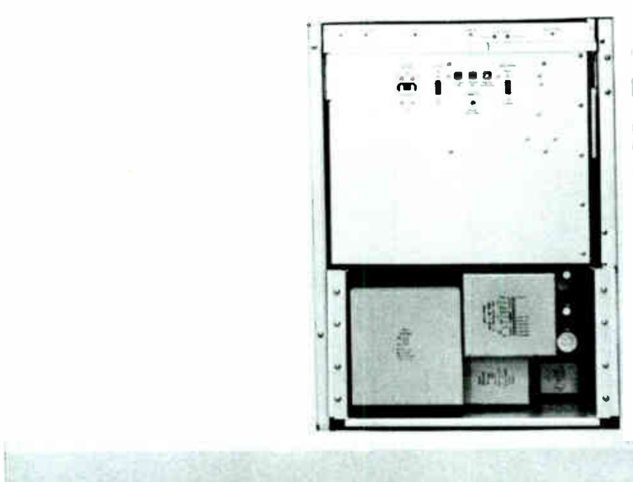
UHF-TV Exciter-Modulator, Type TTUE-44 (To mount in Exciter-Control Cabinet of TTU-30, TTU-55, TTU-60, TTU-110, TTU-165 or TTU-220 UHF Transmitter) ES-563006
Spare Exciter Cabinet Group, Type TTUE-44 ....ES-563007

catalog TT.4500

Mod Anode Pulser for UHF Klystron Transmitters

The mod anode pulser provides a means of reducing the power consumption of RCA UHF transmitters through a direct increase in operating efficiency of the visual power amplifier.

- Reduces power consumption
- Increases visual klystron operating efficiency
- Updates RCA Klystron Transmitters
- Produces significant energy savings



Mod Anode Pulser mounted in exciter-control cabinet of a typical Klystron Transmitter.

Total accessibility of the pulser is typical of RCA transmitter design.

The Pulser Function

The function of the pulser is to provide pulses with an amplitude of up to 2 kV to the modulating anode of the visual kylstron amplifier tube during the sync portions of the visual signal. This permits the klystron to operate at reduced beam current during the video portion of the signal and at a higher beam current during the sync interval.

The purpose of operating the visual klystron in this mode is to achieve a reduction of the beam power consumption of the klystron in the order of 16 kW for each 30 kW klystron and 30 kW for each 55 kW klystron. The resulting reduction in total transmitter power input depends upon the specific type of transmitter in use.

The pulser is designed to be supplied as an optional accessory for new RCA UHF klystron transmitters and as a field modification for existing RCA klystron transmitters. The transmitter must be equipped with an RCA type TTUE-4A solid state exciter and "high efficiency" klystrons as a prerequisite for the anode pulser.

One pulser will operate one or two visual klystrons. Thus a single pulser is required for an RCA TTU-30, TTU-55, TTU-60 or TTU-110 series UHF transmitter. Two pulsers are required for a TTU-165 or TTU-220 series transmitter.

Principle of Operation

The mod anode pulser utilizes a unique characteristic of the klystron power amplifier tube, which is the ability to control the amount of klystron beam current by varying the amount of voltage applied to the modulating anode. By pulsing the mod anode voltage between two levels, the beam current is shifted from the maximum value required during the sync interval to a smaller value during the video interval.

Thus the power consumption of the visual klystron is held to a minimum between sync pulses and is raised only during the actual period of peak signal output. The result is a reduction in average beam power to the klystron.

As shown in the block diagram, timing information is provided to the pulser by means of a synchronizing signal supplied from the TTUE-4A UHF exciter. This controls the timing of keying pulses supplied to a pair of switch tubes. The lower tube is turned on at the start of sync while the upper tube is turned off, placing the klystron mode anode at the sync mode voltage. At the trailing edge of sync the lower tube is turned off and the upper tube is turned on, placing the klystron mode anode at the video mode voltage where it remains until the start of the next sync interval. Timing controls are provided to make the RF drive sync coincide with the contribution from mod anode pulsing.

A side effect caused by the change in mode anode voltage is a phase shift in the RF output of the klystron. A shift in mod anode voltage from —3 kV to —4 kV will typically cause a phase change of approximately 10 degrees at a given drive level. This phase shift is cancelled by an equal and opposite phase change introduced by a phase modulator incorporated in the exciter IF (45.75 MHz) stages. A delay adjustment provides time coincidence of this correction with the phase change in the klystron.

Equipment Supplied

Remotely controllable relay switching is provided to restore the klystron operation to normal (constant mod anode voltage) at any time. This is accomplished by switching the mod anode to a direct connection to the sync mode voltage while simultaneously removing sync drive from the pulser and the phase modulator. It is then only necessary to reduce the RF drive level and adjust sync stretch to return the transmitter to near-normal operation.

The pulser unit operates from a +28, +300 volt power supply and requires an input power in the order of only 100 watts. All high voltage is obtained from the existing high voltage supply of the transmitter.

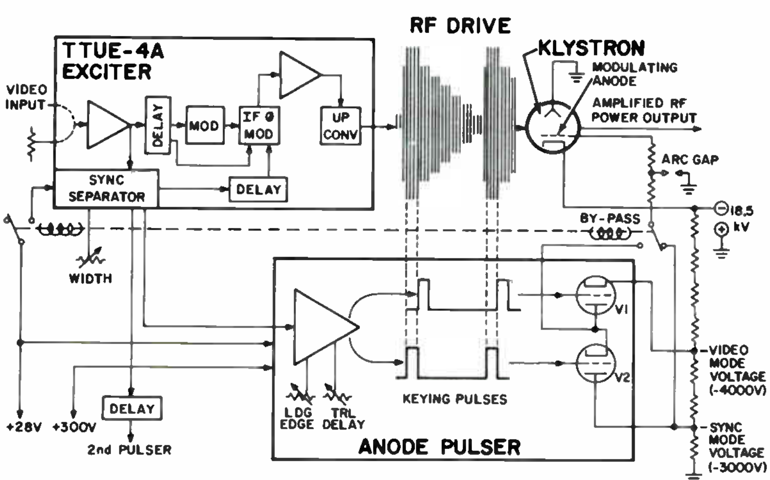
The mod anode pulser equipment consists of three basic items. The pulser chassis is slide mounted in the exciter/control cabinet and is accessible from the cabinet front. A zener assembly is mounted in the walk-in enclosure to the rear of the amplifier cabinets. The power supply chassis is also installed in the exciter/control cabinet.

A mod anode pulser installation kit is required to provide electrical and mechanical interface between the pulser and transmitter. In addition an exciter modification kit is required to adapt the TTUE-4A exciter for operation with the pulser. The exciter modifications include the addition of circuitry to provide the required synchronizing signal feed to the pulser. Also included is a phase modulation circuit which provides phase correction of the drive signal during the sync interval when operating the klystrons in the pulsed mode.

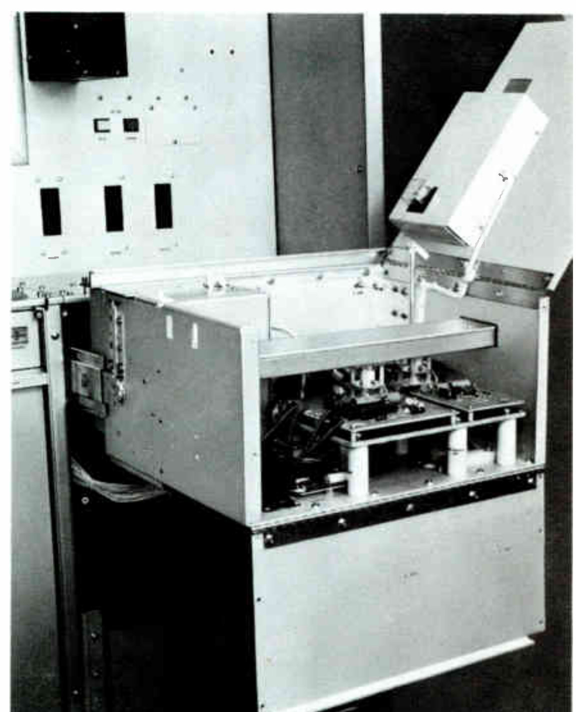
In this era of steadily increasing power costs, the mod anode pulser offers a timely method of significantly reducing operating costs of RCA klystron transmitters.

Ordering Information

Modulating Anode Pulser ... ES-5633000



ANODE PULSER SYSTEM



Total accessibility of the pulser is typical of RCA transmitter design.

catalog TT.5000C

(Replaces TT.5000B)

Planning TV Transmitter Remote Control

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

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.

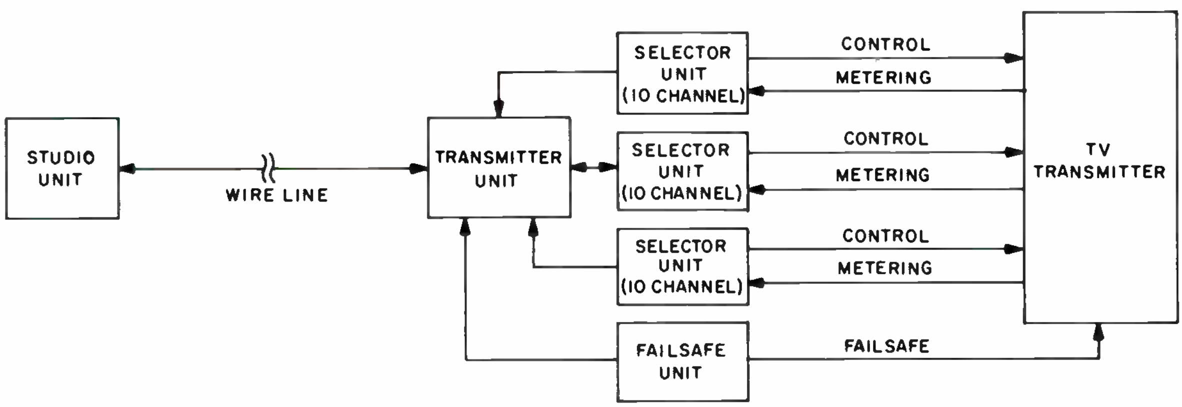


Fig. 1. Remote Control Via Voice-Quality Telephone Wire Line.

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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 requires immediate corrective action by the licensee to restore legal operation.

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 an optional part of the 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 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-3 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. 4. 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 commercial 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

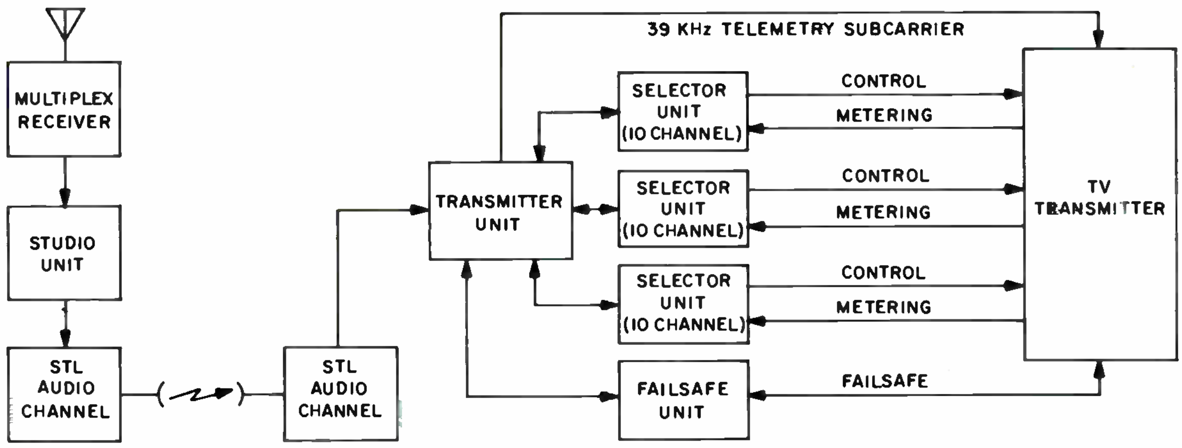


Fig. 2. Control Via Microwave and Metering Via Aural Subcarrier.

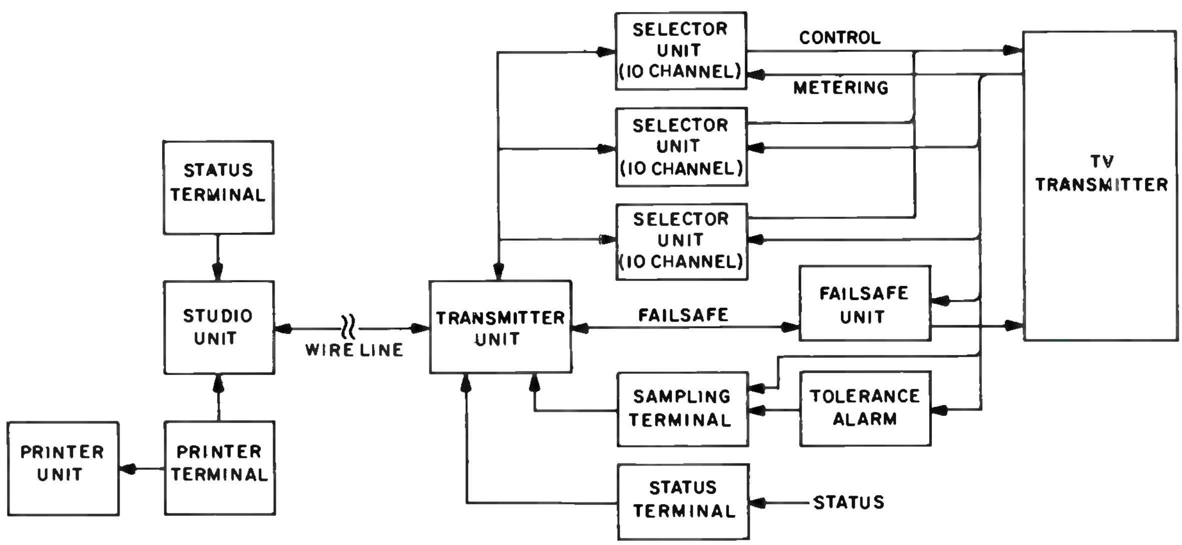
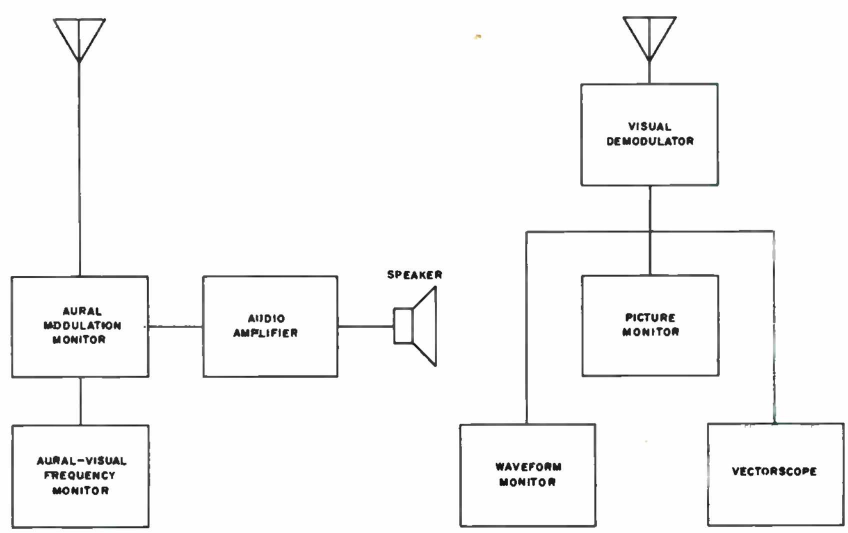


Fig. 3. Remote Control, Automatic Logging and Status Reporting Via Voice-Quality Telephone Wire Line.

Fig. 4. Monitoring at Remote Location.



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.

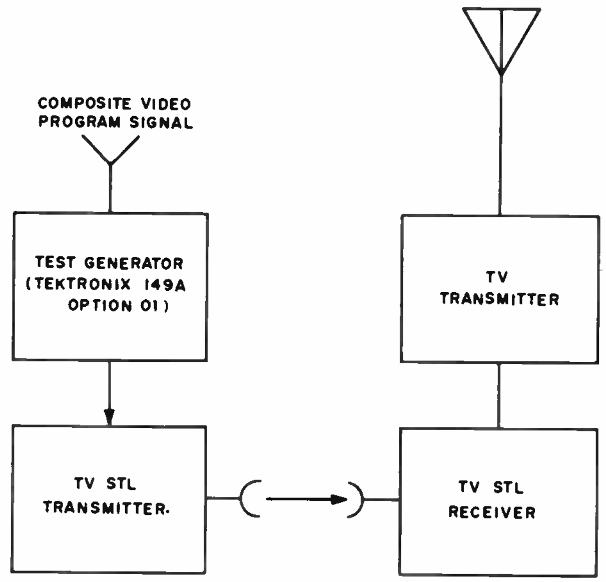


Fig. 5. Vertical Interval Test Signal Generating System.

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. 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 5. The composite video output signal from Studio Master Control is fed to a Tektronix Model 149A 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 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.

catalog TT.5300B

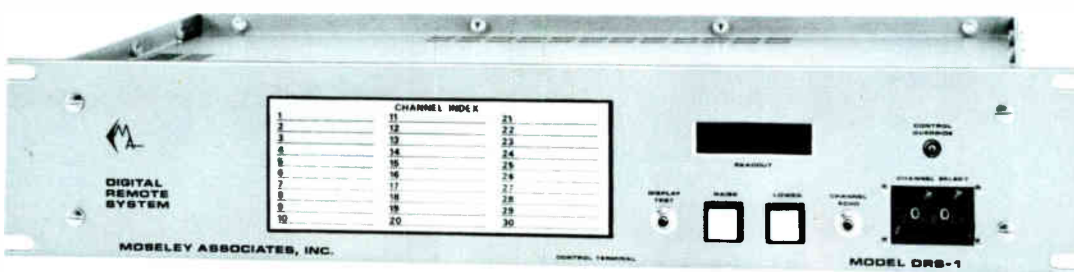
(Replaces TT.5300A)

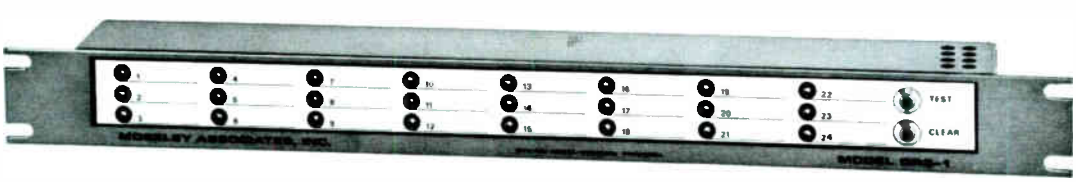
RCA

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 FSU-1 TV Failsafe Unit makes the DRS-1 System fully compliant with the FCC Rules for remote control.





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 System

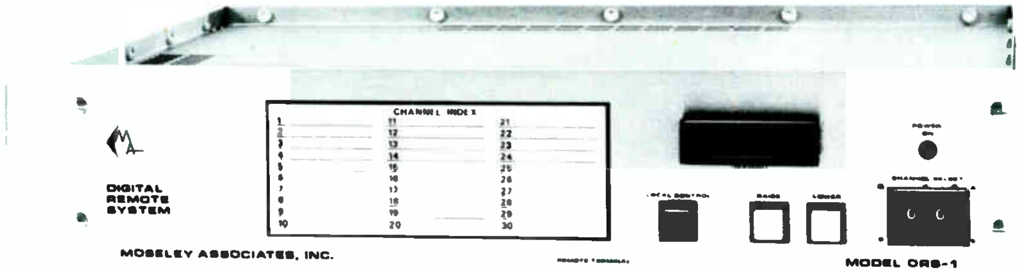
The 24-channel Status System may be ordered with the Remote Control System, or added later to an existing system. The Status System reports any status, fault, or alarm condition that can be initiated by a contact closure to the Status System. A Light Emitting Diode (LED) indicator, for each channel at 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.

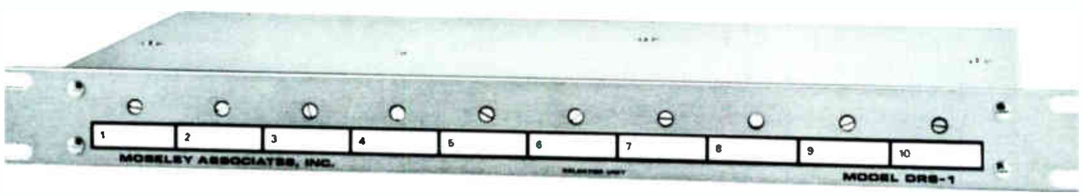
Tolerance Alarms

The Type TAU-3 Tolerance Alarm Unit is designed to be used with Moseley Associates Automatic Logging Systems, functioning as an out-of-tolerance alarm system.

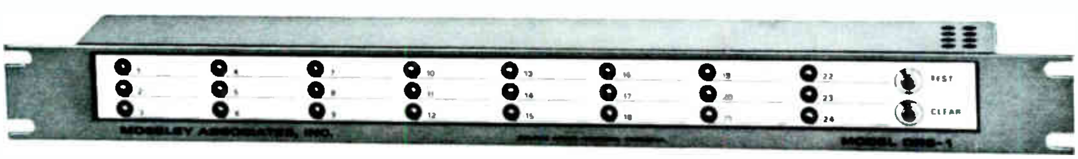
The DC samples used for the logging



The transmitter control unit of the system 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.



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

The TAU-3 Tolerance Alarm Unit can be used with the status system when remote indication is desired.

system are paralleled with the TAU-3 inputs, and the outputs from the TAU-3 fed to the logging system. When a metered parameter exceeds the preset limits, a relay is activated, indicating an alarm condition.

By utilizing an external reference voltage, the TAU-3 becomes a Ratio Alarm. Connectors are provided on the back of the TAU-3 for feeding an external reference voltage to each comparator module.

When a change occurs in the ratio of the DC sample, the TAU-3 signals an alarm.

The TAU-3 can be utilized in conjunction with Moseley Associates status systems when a remote indication is desired.

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 FSU-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

Tolerance Alarm Unit, Moseley Model TAU-3

Channels .... Up to 8; plug-in modules
External Connectors .... Sub-miniature 9-pin connectors, mating connector supplied with each plug-in module
Input Requirements .... 0.1 VDC minimum, 4 VDC maximum, floating
Input Impedance .... 100KΩ, floating
Out-of-Tolerance Indicator .... Front-panel, light-emitting diode (LED) for each channel. Illuminated when parameter is out-of-tolerance.
Output .... Relay Contacts, Form C (SPDT)
External Reference Voltage (If Used) .... Greater than the DC voltage presented to the input, not to exceed 8 VDC
External Reference Input Impedance .... 50KΩ, floating, one lead shared with input signal
Ambient Operating Temperature Cycle .... −20°C to +60°C
Duty Cycle .... Continuous
Power Requirements .... 120/240 VAC, ±10%, 50-60 Hz, 2 watts per channel, 16 watts maximum
Dimensions .... 3½″ H x 19″ W x 9″ D (8.9 x 48.3 x 22.9 cm)
Weight (Approx.):
Net .... 6 lbs. (2.7 kg)
Shipping .... 15 lbs. (6.8 kg)

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 FSU-1 .... MI-561199
TV Failsafe Interface Panel MI-561192-A
Tolerance Alarm Unit Main Frame, Type TAU-3 .... MI-561213
Comparator Module for TAU-3 .... MI-561214
Tower Light Sensing Kit, Type TLK-2 .... MI-561462-A
Line Voltage Sampling Kit, Type LVK-3 .... LVK-3
Temperature Sensing Kit, Type TSK-3A MI-561465-A
DC Amplifier and Linear Converter, Type DC-1A DC-1A
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 .... Moseley Model DRS-1
(Specify for 10, 20, or 30 control and telemetry channels.)
Status System Option .... Moseley Model DRS-1
Automatic Parameter Logging System Option .... Moseley Model DLS-1

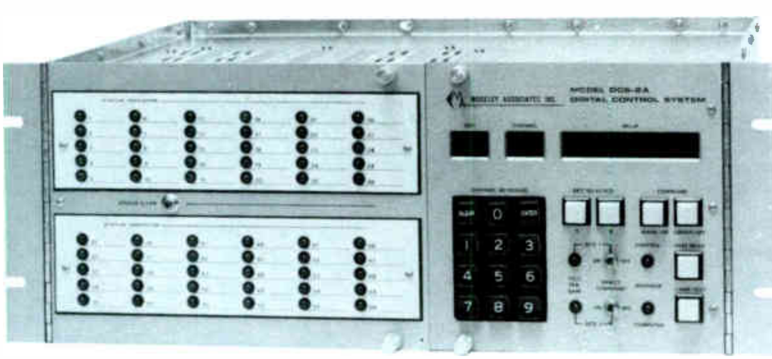
RCA

catalog TT.5400B

(Replaces TT.5400A)

Digital Remote Control System, Mosley Model DCS-2A

- Fully integrated system concept
- Multiple-transmitter-site operation
- Telemetry/command—to 180 channels
- Status/alarm—to 180 channels
- Internal data modems provided
- Telemetry accuracy: 0.1%
- Automatic parameter logging
- Computer option; total automatic control possible



With the capability of facilitating truly automated operation, the Moseley Associates Model DCS-2A Digital Control System utilizes the latest state-of-the-art digital techniques and allows computer-assisted operation. Designed to permit field expansion of all capabilities, the DCS-2A enables accurate operation of a remotely-located plant or multiple plants such as broadcast transmitting facilities. The system enables the remote execution of a command and the telemetering of analog and status parameters while requiring only the most basic interconnecting facilities.

Three levels of system operation are available with the DCS-2A. Level One provides the basic system which gives a fully operational manual system providing command capability as well as the telemetering of analog and status parameters. The second level permits computer-assisted operation of the DCS-2A. This level involves the addition of a mini-computer and incudes simultaneous multiparameter displays via a cathode-ray tube (CRT) display terminal, and other operating aids. Software permits upper and lower tolerance checking of all analog parameters, multiple-level status alerting, and automatic parameter logging. Of special importance is that the addition of the DCS-2A Computer Option does not affect operation of the basic system. Should a failure occur in any of the equipment constituting the Computer Option, the basic DCS-2A system will continue to function properly. The third and final level involves the addition of software to the DCS-2A Computer Option to allow totally automated operation of the remotely-located facility.

The DCS-2A enables operation of two remotely-located facilities.

10CTT

Basic System

Equipment provided for the basic DCS-2A consists of a Control Terminal, Remote Terminal and Selector Unit. The Control Terminal is positioned at that location to be used for supervision of the remotely-located plant. The Remote Terminal and Selector Unit are located at the actual remote site. The DCS-2A will provide up to 180 command functions, 90 analog parameters, and 90 status functions from any given remote site. All functions are identified by means of a channeling technique. A centrally-located keyboard provides easy access to command and analog telemetry channels. These command/telemetry channels are provided in groups of 30. Each channel provides two actual commands and one analog telemetry value.

CONTROL POINT

DCS-2A CONTROL TERMINAL, with 60 channels of status displayed. Full manual control is provided from control panel at right.

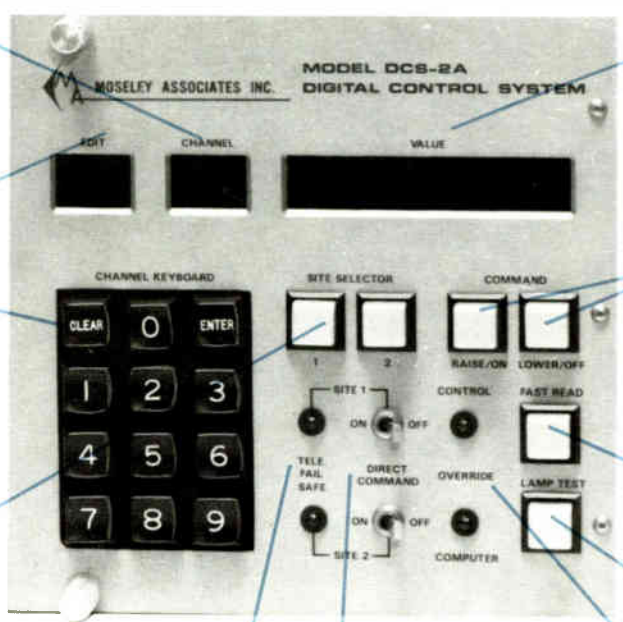
DCS-2A CONTROL PANEL OPERATION

4. The CHANNEL window displays the number of the analog telemetry / command channel selected. This number is generated from a true-tally of the actual relay energized in the DCS-2A Selector Unit.

3. The EDIT window displays the channel selected by the keyboard.

2. Select Analog Telemetry / Command Channel. Each such channel is identified by an individual channel number. As each number is entered, register automatically shifts the previous digit to the left in the EDIT window. The CLEAR button clears the EDIT display (see Number 3 above). To actually enter the Select Channel, the ENTER button is depressed.

1. Select site to be controlled. If only one site is used, system will be factory strapped to Site 1.



5. The value of the analog telemetry channel selected is numerically displayed as a four-digit number. The decimal point and units are pre-programmed in the DCS-2A Selector Unit. When a negative parameter is monitored, a minus sign appears. Should an error exist in the returning data, an "E" will precede the telemetry display.

6. All command functions for the selected channel are activated by depressing the RAISE /ON or LOWER / OFF switches. These switches are illuminated by a true-tallyback acknowledging that a command has been accomplished. Also, a rapid update of telemetry information on the selected channel is provided when either of these switches is activated.

7. When a rapid update of an analog telemetry channel is required, the FAST READ switch is depressed resulting in an update time of 180 milliseconds of the selected channel.

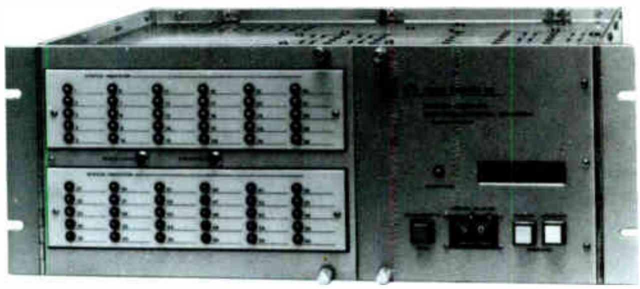
8. To verify that all light-emitting diode displays and lamps are functioning, the LAMP TEST switch may be depressed.

9. Front-panel indicators are provided when the DCS-2A control panel operation has been overridden. Indicators are provided to show when command capability has been seized either by the Remote Terminal or by the computer in a Computer Option.

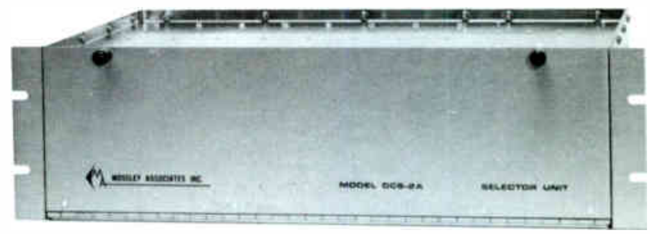
11. The Tele-Fail-Safe Lamps are provided to give a front-panel indication of the features in the DCS-2A complying with current FCC requirements for remote control operation of a broadcast television transmitter. One indicator is provided for each of the two possible sites. These LED's will be illuminated approximately 15 seconds after the loss of correct telemetry information from the indicated site. At this time, a command is sent by the DCS-2A to the Remote Terminal to facilitate activation of the external Model FSU-1 Fail-Safe Unit.

10. Front-panel toggle switches provide for activation of the dedicated single-channel DIRECT COMMAND to each of the two possible sites of the standard Control Terminal.

REMOTE SITE



DCS-2A REMOTE TERMINAL. Front-panel controls provide selection of analog telemetry channels and command functions. LOCAL CONTROL switch provides local command override capability.



DCS-2A SELECTOR UNIT. Hinged front door provides access to interior modules.

Command

The two commands on a given telemetry/command channel are referred to as Raise/On or Lower/Off functions. These names are assigned as they classically describe commands to be issued. Front-panel push buttons on the Control Terminal provide access to these functions on each channel. A true tally-back verification of command is provided by illumination of these buttons. Only when a command function is received at the remote site will an echo-back occur illuminating the depressed button. Local command capability on the Remote Terminal also provides access on a local basis at the remote site to initiate all command functions. Command outputs at the remote site appear from the Selector Unit. Each DCS-2A Selector Unit provides 60 command functions (30 Raise/On and 30 Lower/Off). Each of these command outputs is an isolated dry contact closure.

The DCS-2A provides a single dedicated command function to each of the two remote sites. This function, referred to as a direct command, relays a command from the Control Terminal to the Remote Terminal. A toggle switch positioned on the front panel allows activation. Further contacts are provided on the rear of the Control Terminal to allow external activation of the direct command function. At the remote site, a corresponding output is provided on the rear of the Remote Terminal. This output is a Form C (SPDT) relay contact. Possible uses of the direct command function include dedicated video switching functions, emergency programming switching, or other often-performed high-priority command functions.

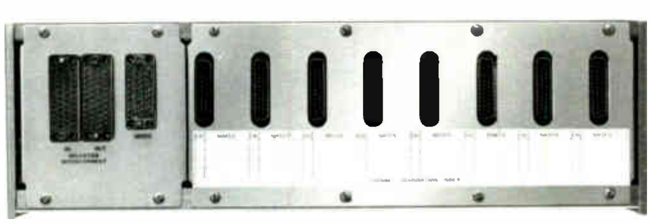
Interconnection Requirements

In the design of the DCS-2A, careful consideration has been given to the requirements to be placed on interconnecting circuits between Remote Terminal and Control Terminal. The DCS-2A can utilize either radio or telephone circuits for this interconnection.

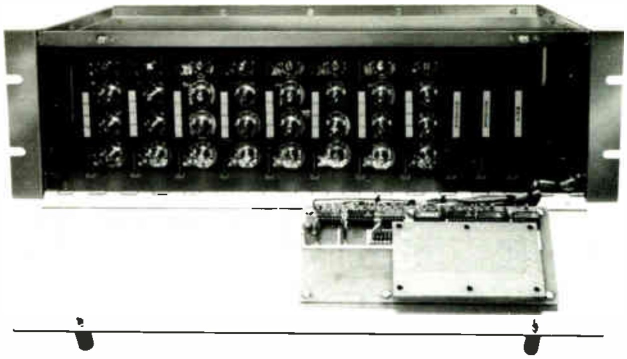
Data modulator/demodulator (modem) circuits are an integral part of the DCS-2A Control and Remote Terminals. The modems are designed and manufactured by Moseley Associates, Inc., expressly for the requirements of the DCS-2A. The data rates used by the modem have been carefully selected to place a minimum requirement on the interconnecting circuits while allowing maximum bidirectional data flow. Pulse-code modulation (PCM) data is actually transmitted via frequency-shift keyed (FSK) techniques by these modems. Data rates for command information are 150 baud, and for telemetry, 1250 baud. These speeds permit the use of an unconditioned Bell Series 3002 two-wire circuit for leased telephone circuit interconnect or full-duplex 3 kHz circuits in the case of radio interconnection.

Three levels of digital encoding, including parity, are utilized to ensure error-free operation of the DCS-2A. All commands are multiple-bit encoded to ensure that no invalid commands can occur. Further, all data transmissions are secured by a multiple-word verification system which requires that a valid command be transferred flawlessly three times to the Remote Terminal before it is activated. In addition, even parity is encoded with each data transmission in order to trap serious data distortion errors.

As one final precaution, the DCS-2A includes *automatic transfer of data connections.* Circuitry is included in the modems of the DCS-2A as standard equipment to provide automatic switching between main and alternate interconnecting circuits. Provisions are included to allow any combination of radio or telephone as main and backup facilities.



Rear View, DCS-2A SELECTOR UNIT. All inputs/outputs to the DCS-2A, including mute inputs, are provided by multi-pin connectors. Mating connectors are supplied.



Interior View — DCS-2A SELECTOR UNIT. As with other DCS-2A units, modular construction is used throughout the Selector Unit. Four telemetry/command channels exist on each individual plug-in module. The individual analog telemetry channel calibration potentiometers can easily be seen. Access is provided to each module via the hinged front door. Mounted on this door is a diode pin matrix. This matrix is utilized for assigning decimal points to each analog telemetry channel. Further, the units display for each channel that appears on the Control Terminal is also pre-programmed on this matrix. The DCS-2A accepts two external parallel BCD digital inputs. These inputs can be substituted in place of any analog telemetry channel. The top rows on the diode pin matrix are utilized for assigning these external digital inputs.

Analog Telemetry

The analog telemetry inputs to the DCS-2A are accessed by the Selector Units. Each DCS-2A Selector Unit will accommodate 30 analog telemetry inputs. All telemetry inputs are isolated, floating and bipolar in nature. The DCS-2A is a scanning-type system as far as the data relating to analog and status telemetry functions is concerned. In the basic 30-channel system, all analog telemetry inputs are sequentially scanned every 1.8 seconds. This data is then returned to the Control Terminal for display or processing should the Computer Option be added to the system. The standard DCS-2A is designed to accept a DC sample voltage representing the actual parameter to be observed. Calibration potentiometers are provided on each input to facilitate exact calibration. These calibration potentiometers will accept DC sample voltages from 1 VDC to 10 VDC to produce a full-scale display. Actual display capability is provided on both the Remote and Control Terminals. These displays have a full four-digit capability (9999) and will present a minus sign when appropriate. The Control Terminal display also has the capability of presenting a pre-programmed decimal point and six separate engineering units. The standard DCS-2A provides for unit display of %, V, kV, A, Hz, and ° (degree) symbols. The display on the Remote Terminal provides for one-man calibration of the system.

The DCS-2A has also been designed to accept parallel BCD data. Two such digital inputs are provided on the DCS-2A Remote Terminal. These two inputs may be pre-programmed to appear in place of any analog telemetry channel. This pre-programming is accomplished by a diode pin matrix.

As it is recognized that, in many cases, command and analog telemetry functions may be related, a rapid update mode, referred to as "Fast Read" is provided on the DCS-2A. This Fast Read function allows a given analog telemetry channel to be updated on the display of the Control Terminal every 180 milliseconds. This capability is provided by the interleaving of a selected channel with the scanning of all other channels. Not only does this provide the fast update of a given channel, but all other analog telemetry and status channels continue to return to the Control Terminal. The Fast Read function is accomplished on a given telemetry/command channel when an actual command function is initiated. Further, a separate FAST READ button is provided on the Control Terminal which will enable this 180-millisecond update without the need to actually issue a command function.

Status Subsystem

The *Status Subsystem* provided in the DCS-2A enables exact duplication of each change-of-state (go/no-go) condition at the remote location. Thirty such indications are provided with the basic DCS-2A system. Status channels can be expanded in groups of 30 to a total of 90 such indications from each remote location. The Status Subsystem, while functioning separately from the telemetry/command channels of the DCS-2A, has its data returned to the Control Terminal as a segment of the digital word used for actual telemetry return. Each channel is displayed as an individual light-emitting diode (LED) on the Remote Terminal and Control Terminal. The DCS-2A Control and Remote Terminals provide for display of 60 status channels. When more than 60 status channels are required at any given location, a Status Expansion Chassis is added to accommodate the additional channels.

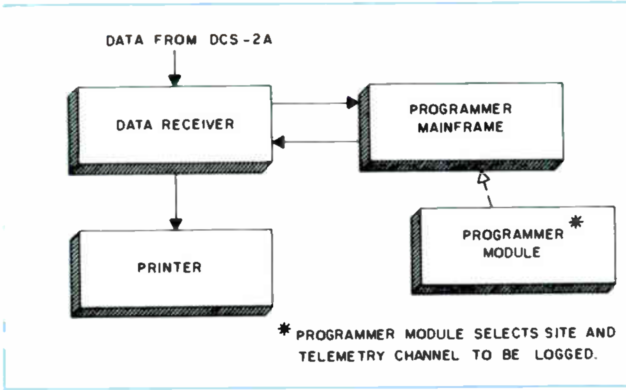
Each of the channels of the Status Subsystem is encoded to the Remote Terminal from either normally-open or normally-closed external contacts. Within the Remote Terminal of the DCS-2A, each channel can then be pre-programmed to be either activated or deactivated (illumination or non-illumination) from a given input. Further, each channel may be pre-programmed to be either latching or non-latching. When activated in the latching mode, that channel will remain illuminated until manually reset by the STATUS CLEAR switches located on the Remote Terminal or Control Terminal. Depression of either switch will extinguish all latched channels whose inputs are in the de-energized mode at that point in time.

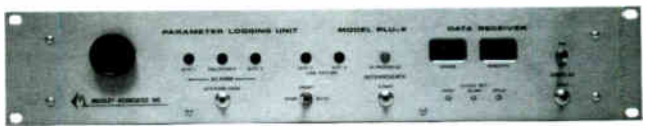
The input required to produce status display can be one of two modes. External dry contact closures in either the normally-open or normally-closed mode may be used. Likewise, the system is compatible with TTL-level logic signals. While all status inputs are filtered, it is recommended that dry contact closures be utilized in environments with high RF fields, such as broadcast transmitter facilities. On the Control Terminal, an additional output is provided on the rear which corresponds to each status channel. This output provides for external displays or alarming that may be required.

Light-emitting Diode (LED) Display is provided on Control Terminal and Remote Terminal for Status Subsystem.

Model PLU-2 Parameter Logging Unit

Automatic recording of analog telemetry channels of the DCS-2A is provided by the Model PLU-2 Parameter Logging Unit. This logging option will record up to 20 preselected analog telemetry channels. Each analog telemetry channel is recorded as a full, four-digit number. Minus sign and pre-programmed decimal points also can be printed. Time of day is recorded as part of each line entry. The system is programmed to make entries at predetermined intervals. The log format utilized is comprised of individual vertical columns for each of the 20 parameters. This format has been time-proven by previous Moseley Associates automatic logging systems to be both clear and easily read. The PLU-2 consists of a Data Receiver, Programmer Main Frame, and Printer. The Programmer Main Frame is made to accommodate individual Programmer Modules. One Programmer Module is required for each of up to 20 parameters to be recorded by the PLU-2. This Programmer Module is used for selecting the site and actual analog telemetry channel to be recorded in a given position or column on the printed format. Further, leverwheels are included on the Programmer Module to establish both upper and lower limits for that channel. These leverwheels permit the setting of the three most significant digits and the digital establishment of absolute limits. When a parameter exceeds these limits, a full line entry is taken and that parameter is signified by a unique printing character. Selective muting is possible for any channel being recorded by the PLU-2. This muting is accomplished by applying external dry contact closures to the appropriate input on the Remote Terminal of the DCS-2A. When a channel is muted, tolerance limits and logging of that channel are automatically overridden. This selective muting is particularly useful in situations where main and standby equipment exist. Only the parameters of the actual unit on line can automatically be recorded. The PLU-2 may be positioned at either the Control Terminal or the Remote Terminal allowing automatic logging at either the remote site or control point.





Model PLU-2 DATA RECEIVER. Time base is displayed on the front panel of the Data Receiver.

The Teletype Model 43 Printer is typically supplied with the PLU-2 as the Printer.

PLU-2 Parameter Logging Unit

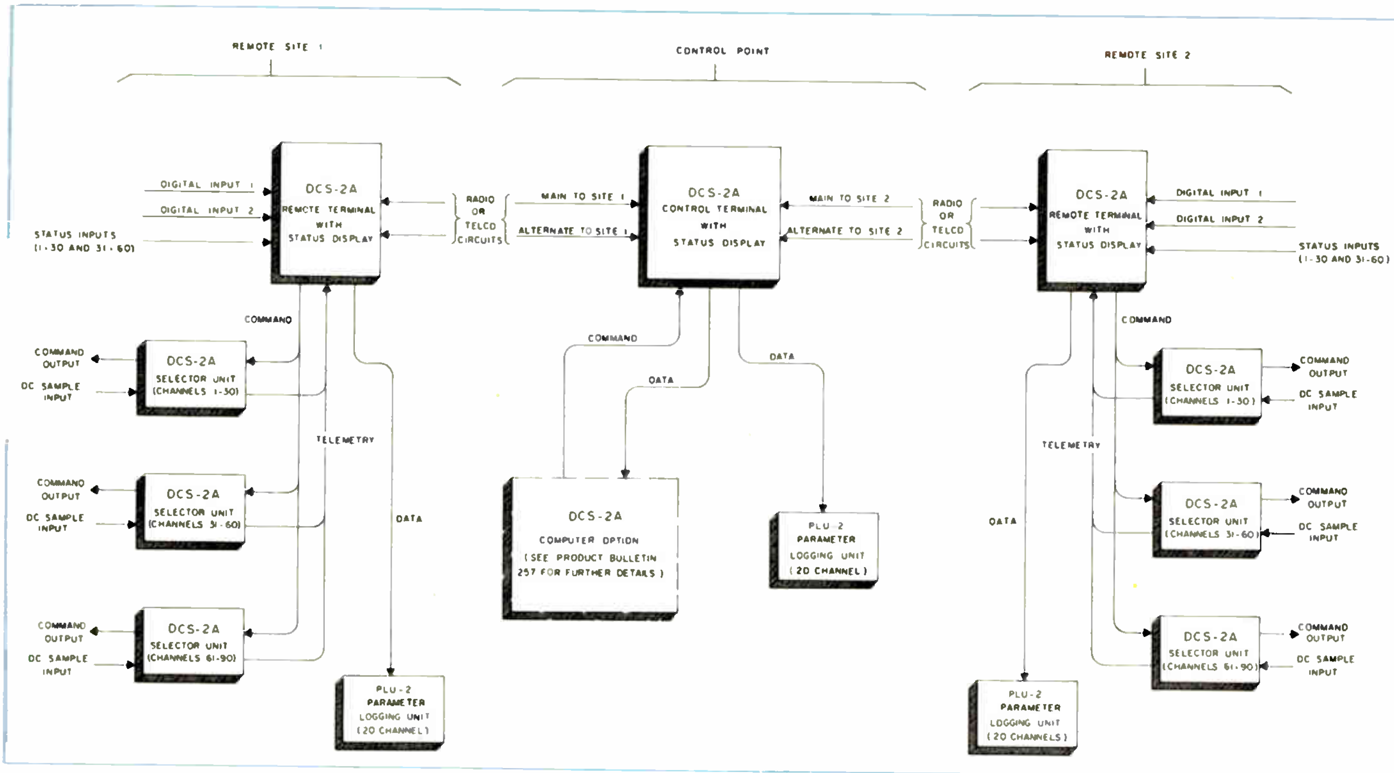
The Model PLU-2 Parameter Logging Unit enables hard copy recording of up to 20 analog telemetry channels of the DCS-2A. The PLU-2 consists of Data Receiver, Programmer Main Frame and Printer. Additionally, Programmer Modules are required. These modules will be shipped mounted in the Programmer Main Frame. One Programmer Module is required for each parameter to be recorded by the PLU-2. When ordering a PLU-2, be sure to specify the number of Programmer Modules required.

PLU-2

Position	Can be located with Remote or Control Terminals
Data Input	Accepts serial data output provided on DCS-2A Remote or Control Terminals
Channel Capacity	Records up to 20 DCS-2A telemetry channels plus time of day as four-digit number Exact number of channels determined by number of parameters recorded containing decimal points and polarity
Parameter Tolerance	Digital Three most significant digits programmed by thumbwheels located on Programmer Module for both upper and lower limits Out-of-tolerance parameters printed with unusual character to signify condition

Size	
Data Receiver	8.9 cm high, 48.4 cm wide, 36.8 cm deep (3½ inches, 19 inches, 14½ inches)
Programmer Mainframe	17.8 cm high, 48.4 cm wide, 14 cm deep) (7 inches, 19 inches, 5½ inches)

MODEL DCS-2A DIGITAL CONTROL SYSTEM



— DCS-2A —

Number of Remote Sites	Two (2) standard; with minimum of 30 telemetry/command and 30 status channels per site. Up to 99 sites on special order.
Telemetry/Command Channels	30, expandable to 60 or 90 per remote site by addition of Selector Unit(s)
Command Output	Dry relay contacts, Form A (SPST), isolated and floating. Contacts rated to switch up to 120V AC or DC, 50 watts non-inductive maximum. Each output individually fused.
Telemetry Input	1 VDC differential for full-scale display (±9999), 10 VDC maximum, ±350 VDC maximum common mode voltage. Each input fully floating. Input resistance 100k Ω
Telemetry Display	Digital LED display, 4-digit, with polarity
Telemetry Accuracy	0.1% per week
Telemetry Resolution	0.01% (excluding calibration potentiometer)
Decimal Point	Each telemetry channel may be programmed with a decimal point.
External Digital Inputs	Two (2), each parallel, 16-bit BCD, TTL compatible. Either input may be pre-programmed to appear in place of any telemetry channel.
Status Channels	30, expandable to 60 or 90
Status Input	Dry contact closure for each channel
Status Display	Light-Emitting Diode (LED) displays on Control Terminal and Remote Terminal. One LED per channel. Multi-pin connector on Control Terminal to drive external relays or lamps (100 MA sink to ground, +24 VDC maximum).
Fail-Safe — Control	Relay contacts, closed in energized (operational) position. De-energized (opened) 20 seconds after command failure to Remote Terminal.
Fail-Safe — Telemetry	Provisions for use with independent Model FSU-1 Fail-Safe Unit, complying with current FCC broadcast requirements for telemetry fail-safe operation.
Response Time (30 channels)	
Command	0.18 second
Telemetry	1.8 second update (0.18 second during control or Fast Read)
Status	1.8 seconds maximum update
Interconnection Requirement	
Wire	2-wire unconditioned, half-duplex, Series 3002 Data Circuit (Command 150 baud, Telemetry 1250 baud)
Radio	Full-Duplex (two-way) 3 kHz minimum B.W. channels
Redundant Interconnection Switching	Automatic after 5-second loss of valid data. Can be switched manually for test.
Manual Override	Local Control Switch on Remote Terminal activates indicators at control and remote sites.
Operating Temperature Range	0° — 50° C
Power Requirements (30 channels)	
Remote Terminal	120/240 VAC, 50-60 Hz, 120 watts nominal
Control Terminal	120/240 VAC, 50-60 Hz, 150 watts nominal
Size	
Control Terminal	17.8 cm high, 48.4 cm wide, 43.2 cm deep (7 inches, 19 inches, 17 inches)
Remote Terminal	17.8 cm high, 48.4 cm wide, 43.2 cm deep (7 inches, 19 inches, 17 inches)
Selector Unit	13.4 cm high, 48.4 cm wide, 30.5 cm deep (5¼ inches, 19 inches, 12 inches)

Ordering Information

DCS-2A Digital Control System

The basic Model DCS-2A consists of one Control Terminal, one Remote Terminal, and one Selector Unit. This system provides 30 telemetry/command channels and 30 status channels. This capability can be increased to 90 telemetry/command channels and 90 status channels.

Status expansion is accomplished by addition of the DCS-2A Status Subsystem. To increase this capacity to 60 status channels, the 30-Channel Status Subsystem should be ordered.

Expansion of telemetry/command channels is accomplished through the addition of Selector Units. Each DCS-2A Selector Unit provides 30 telemetry/command channels. To increase the system capacity to 60 channels, order one (1) additional Selector Unit. Where 90 telemetry/command channels are required, two (2) Selector Units should be ordered.

The telemetry and status inputs and command outputs from the DCS-2A are accommodated by multi-pin connectors. Mating connectors are supplied with the system for these connections.

COMPUTER OPTION, MODEL DCS-2A

- Computer-assisted operation of DCS-2A system
- Standard software included; custom software optional
- Provides automatic parameter logging of up to 20 telemetry channels
- Page format CRT display

The DCS-2A Computer Option enables computer-assisted operation of the DCS-2A Digital Control System. With computer-assisted operation, should a malfunction occur in any segment of the Computer Option, it will not result in an outage of service to the DCS-2A. Items making up the basic DCS-2A Computer Option include a Central Processing Unit (CPU), CRT Terminal, Data Printing Terminal, Model DRU-1 Data Recorder Interface Unit, and Standard Software.

The CPU functions directly with the DCS-2A Control Terminal and processes all data consisting of telemetry values, status channels, channel identification, and all command tally-back information. Operator interface to the entire system is provided by the CRT Terminal. It displays all telemetry channels annd status channels and its keyboard is utilized for all functions including the issuing of commands via the DCS-2A Digital Control System. Automatic logging of telemetry values is accomplished with the Printing Terminal. Multiple-site operation is easily accomplished with the DCS-2A Computer Option. The DRU-1 Data Recorder Interface Unit provides a means of inputting and outputting all software programming to the Central Processing Unit from a cartridge-type audio record/playback unit. Unlike many computer-assisted or based systems, the Moseley Associates Model DCS-2A Computer Option is provided with Standard Software. This software permits operation in a manner described on the next page, and serves as a starting point from which additional custom software may be added to fulfill specific requirements.

Central Processing Unit normally supplied with DCS-2A Computer Option, is provided with 16,384-word memory.

Model DRU-1 Data Recorder Interface Unit provides input/output access to Central Processing Unit.

Standard Software

Programming or software, included in the DCS-2A single-site or dual-site Computer Option, provides the functions described below.

Telemetry/Status Displays

The first of these functions is the CRT display capability. These displays are presented in a page-type format. The number of CRT pages is determined by the capacity of the companion DCS-2A Digital Control System. Each page simultaneously displays 30 telemetry values or 30 status channels. As an example, should the companion DCS-2A Digital Control System operate to a single remote site having a capacity of 90 telemetry/command channels and 60 status channels, a total of five CR pages would be provided.

An important feature of the DCS-2A Computer Option standard software is the ability to easily alter the texts making up each of these standard pages. Subroutines are included that allow the operator to pre-program each of these pages from the keyboard of the CRT. These subroutines function in a series of questions. The operator, by depressing the appropriate keys, can answer each question in plain language, thus, establishing programming of all CRT pages. One important feature of the DCS-2A Computer Option is that, should any channels ever be reassigned, it is a simple matter for the operator to again re-program proper identification of these channels from the keyboard. No software or computer programming knowledge or experience is necessary . . . only the ability to perform simple keyboard functions in response to automatically-generated questions.

Each telemetry channel can be programmed with an upper and lower limit. Tolerance checking is continuously applied to all telemetry channels. Should any telemetry chanel exceed these limits, an aural alarm is activated and a visual flag positioned near the CRT screen is activated to alert the operator to the CRT page containing the alarm.

Automatic Parameter Logging

Automatic parameter logging is also provided by the DCS-2A Computer Option for up to 20 telemetry channels. The Printing Terminal records these telemetry channels in the standard Moseley Associates columnar format. This columnar format consists of the printing of time (24-hour format) in the left-hand column followed by up to 20 four-digit telemetry values. Automatic log entries are initiated from a time-base, out-of-tolerance condition, or manually by the operator.

Command

Any command function existing on the companion DCS-2A Digital Control System may be accessed from the keyboard of the CRT. The channel requested for control appears at the bottom of the CRT. A tally-back of the selected command channel is also displayed. This double display technique is identical to that utilized on the control panel of the DCS-2A Control Terminal. Commands from the keyboard of the CRT can be either momentary activations or continuous. Momentary activations will have a time duration of 200 milliseconds.

Options

The DCS-2A Computer Option can be supplied with a number of options. Peripheral hardware available includes remotely-located CTR's and printers, color CRT, and various types of printers. Custom software can be supplied to fulfill any requirement within the telemetry, status and command capabilities of the companion DCS-2A system. Automatic process control, special CRT displays, including graphic presentations, and automatic logging variations are but some of the possibilities.

Data Printing Terminal provides hard copy printout of telemetry channels.

catalog TT.5600B

(Replaces TT.5600A)

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 Moseley Types DRS-1 and DCS-2 and other 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.

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.

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

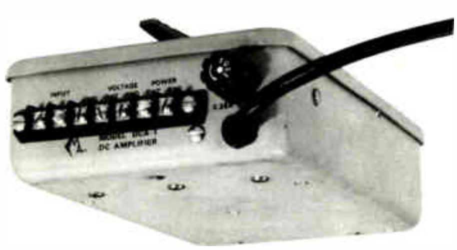
Aluminum panels for rack mount. Require 3.5 inches (89 mm) rack space. Mount up to eight relays (described above).

Specifications

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

Ordering Information

Relay Panel (less relays) MI-561449



Model DCA-1 DC Amplifier

The DCA-1 DC Amplifier enables the sampling of low-level or sensitive DC circuits such as are found in monitoring equipment and RF reflectometers. Having a floating input, the DCA-1 can accept a positive, negative, or isolated-from-ground input.

Two separate outputs are provided by the DCA-1. The first of these is simply a linear amplification of the input. Gain of the DCA-1 is such that 15μA applied to the 4700Ω input will produce an output of 1.5 VDC. The second output has been processed by amplitude-squaring circuitry to perform the necessary linearity conversion to enable direct reading of power on digital or linear-scale equipment. Gain and zero (bias or offset) controls are provided.

The operating temperature range of the DCA-1 is −20°C to +60°C, with power requirements of 120/240 VAC, 50-60 Hz. The DCA-1 is small-sized; 20 cm (8″) x 11 cm (5″) x 5 cm (2″).

Amplifier Mounting Panels

Requiring only 5¼ inches (133 mm) rack space, this panel mounts two CSA-3 or two Type DCA-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

FSU-1 Remote Control Fail-Safe Unit

The purpose of the Model FSU-1 Fail-Safe Unit is two-fold. The first is to observe the presence of the DC sample voltages. These DC sample voltages, four in number, represent the parameters required to be logged by Paragraph 73.671(a). Should any of the DC sample voltages fail (have no output), the FSU-1 Fail-Safe Unit is initiated. The second purpose of telemetry fail-safe involves verification that the telemetry information is present at the remote control point. Presence of the metering signal is determined by a telemetry fail-safe detector in the Control Terminal of the DRS-1 Digital Remote System. Should telemetry information not be present, an additional telemetry fail-safe code is relayed to the transmitter site with the other control information. Should either the DC sample voltages fail, or the telemetry information not arrive at the remote control point, the Model FSU-1 Fail-Safe Unit is activated to start a one-hour integrated circuit timer. At the end of this one-hour time period, the fail-safe output from the FSU-1 operates a relay whose contacts are used to place the TV transmitter in a non-radiating mode.

Failsafe Interface Panel

Used with the Type FSU-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 FSU-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-561192A

Plate Current Metering Kits

Used with earlier design transmitters 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

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 PVK-1A/MI-561482-1
- Range: 3 to 10 kV PVK-1B/MI-561482-2
- Range: 10 to 20 kV PVK-2/MI-561483

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

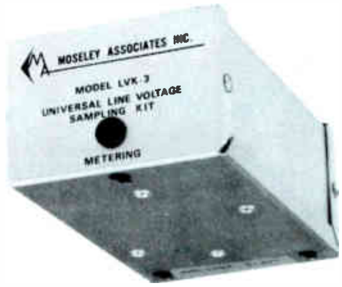
Aural Subcarrier Insertion Kits

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

Line Voltage Sampling Kit - Type LVK-3



Model LVK-3 Line Voltage Kit

The LVK-3 enables observation of AC power mains or other AC power circuits. AC voltages in the range of 120 VAC to 440 VAC may be sampled by the LVK-3.

Temperature Sensing Kit, Type TSK-3A

Providing an accurate means of measuring transmitter building inlet, exhaust, or similar air temperatures, the TSK-3A functions with all current Moseley Associates Remote Control and Automatic Logging Systems. A truly linear indication of temperature is provided — no conversion table or graph is required when read on an appropriate analog meter scale or digital system. The TSK-3A senses air temperatures of −20°C to +60°C. The temperature sensing element within the TSK-3A is socketed enabling extension from the unit up to 25 feet. A single-conductor shielded cable with RCA phono connector are used for this extension. When the sensing element is extended, temperatures of −40°C to +80°C may be observed. A power supply is included for operation from a 120/240 VAC 50-60 Hz power source.

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 TSK-3A/MI-561465-A

Model TLK-2 Tower Light Kit

Designed to monitor AC currents, this sampling kit can be used for observation of tower light circuits or any other AC current. Inductive sampling by means of a current transformer enables sampling over a wide current range. As a current transformer is used, it is not necessary to make a physical connection to the circuit being sampled.

Specifications

Sensitivity Range .... 2 to 20 Aac
Dimensions .... 4 x 2.25″ (102, 57 mm)
Weight (Approx.) .... 1 lb. (464 g)
Shipping Weight (Approx.) .... 1.5 lbs. (671 g)

Ordering Information

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

catalog TT.6400B

(Replaces TT.6400A)

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

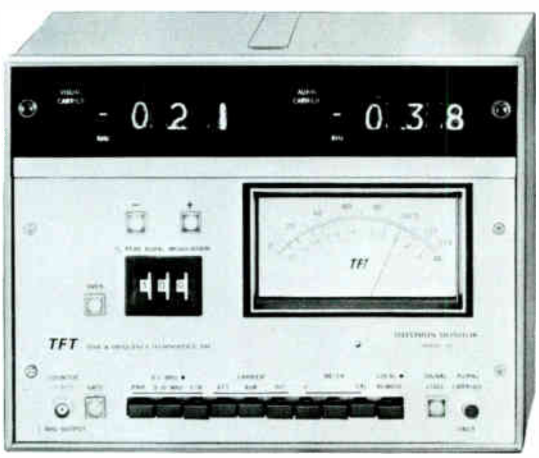
- For any designated VHF or UHF channel
- On-site or off-air monitoring capability
- Digital carrier-frequency-error readout
- Optional SCA output facility
- Aural modulation calibrator built-in

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.

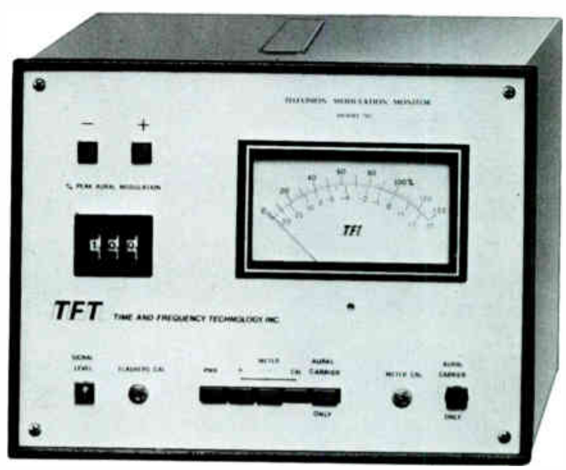
As a result of excellent input sensitivity and selectivity, these two monitors can use an off-air signal, if convenient.

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



10CTT

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 monitors 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.

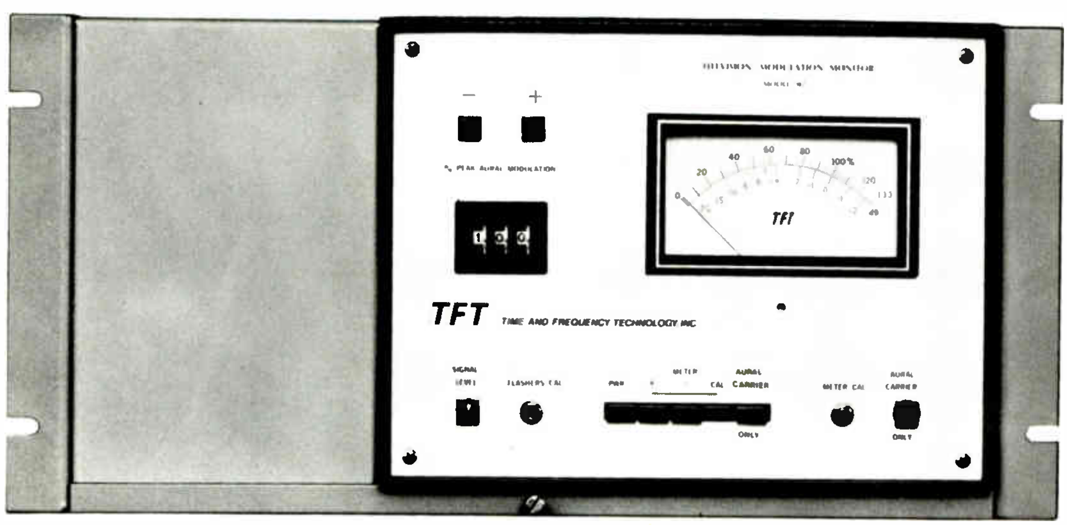
SCA and Alarm Option

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.

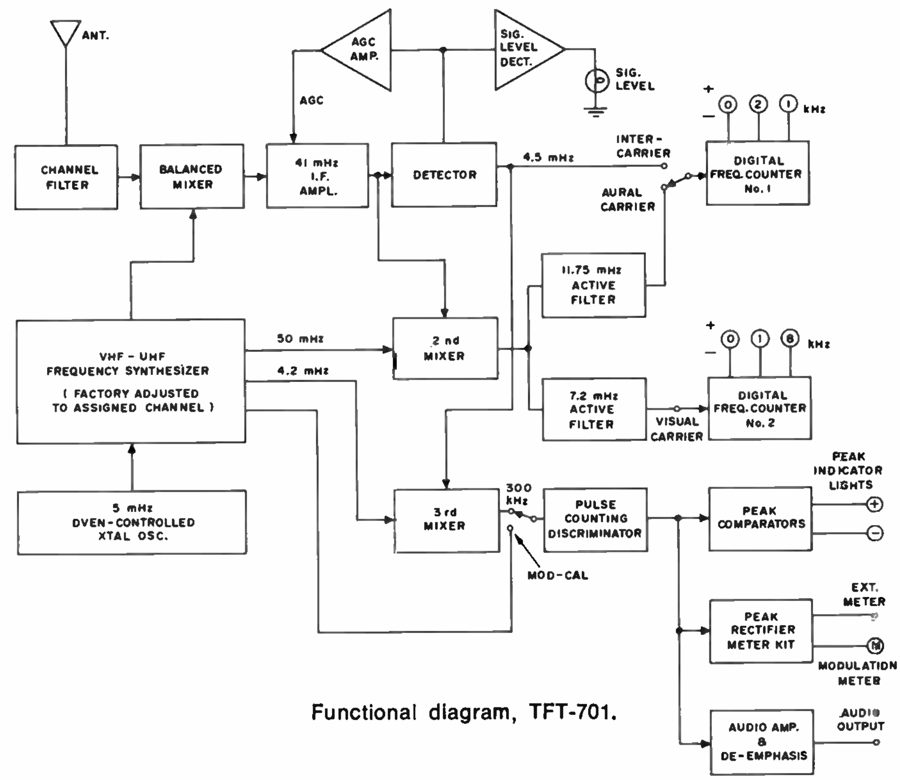
The monitors are also available with an alarm option which actuates an external aural or visual alarm device when a preset limit is exceeded in frequency deviation or modulation percentage.

Peak-Reading Meter; Two Flashers

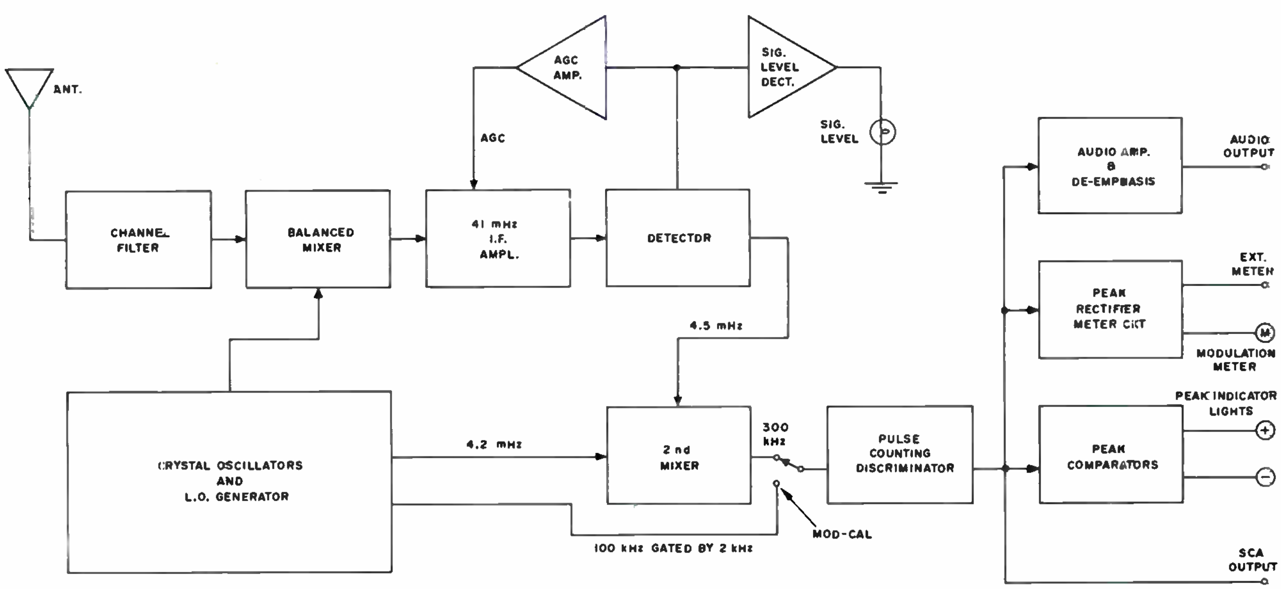
The aural modulation monitor uses a peak-reading meter and two flasher-type indicators. The flashers indicate positive and negative modulation peaks simultaneously and adjust, through a thumbwheel register on the front panel, to any threshold between 50 and 129 percent modulation in increments of one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



TFT-702 mounted in rack-mount adapter.



Functional diagram, TFT-701.



Functional diagram, TFT-702.

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	1×10^{-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 (Includes Rack Mount Adapter):

Alarm Option	Option 02
SCA Option	Option 03
AGC Meter Option	Option 04
Auto Logging (BCD) Output	Option 06
Remote Meter and Peak Flasher	Type TFT-704

For TFT-702 (Includes Rack Mount Adapter):

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.

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.

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.)

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 .... $\pm 1\times10^{-7}$
- 0-55°C Ambient .... $\pm 1\times10^{-6}$
- Per Year .... $\pm 1\times10^{-6}$

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.)

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

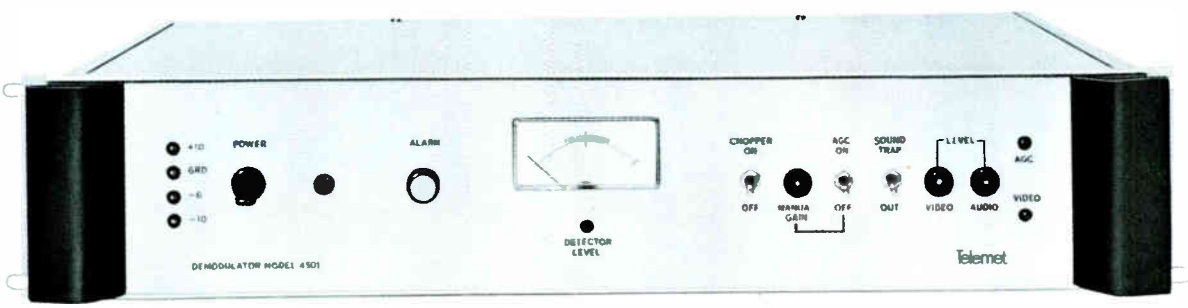
(Please specify operating channel and frequency offset, if any.)

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.



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

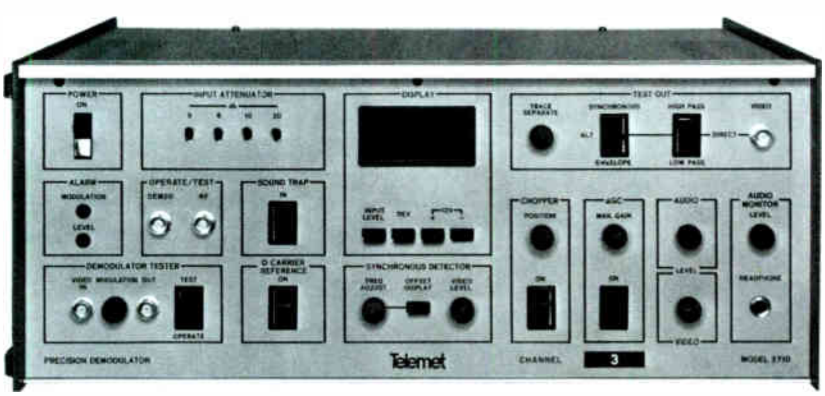
*(Specify Channel No. and frequency offset.)

RCA

catalog TT.6540A

Broadcast Demodulator,
Telemet Model 3710

- Synchronous and envelope detectors
- Multiplexed output with built-in HI/LO filter. See both synchronous and envelope outputs on a single trace scope.
- Built-in Demod Tester
- Built-in input attenuator
- Digital display
- Sound traps switchable in/out
- Local and remote alarms for level and modulation



Broadcast Demodulator Model 3710 is a precision testing instrument for checking video quality of the television broadcast signal; and it has its own built-in tester for self checking calibration.

Although it is comprehensive enough to include all the features listed, the 3710 is simple to operate.

The Model 3710 is usable over a wide range of input levels. For example: studio and remote off-air low level signals, from 5 millivolts to 50 millivolts rms are served with a BNC connector input. Transmitter signal levels 50 to 500 millivolts rms which can be extended to 5 volts by using an optional external attenuator are served with an "N" connector input. On special order, high sensitivity units are available that require only one millivolt input.

The 3710 is supplied for any one selected channel 2 to 13 in the VHF band or 14 to 83 in the UHF band; the channel must be specified when ordering. Channels are changed by replacing the front end down-converter. This is normally a factory change.

Sound traps preceding the main IF circuit can be switched in or out. With the sound traps switched out, video response is flat to 4.5 MHz ±0.5 dB, and envelope delay is flat within ±15 nanoseconds. Switching in the sound traps also produces an envelope delay inversely proportional to the FCC's required delay characteristic predistortion of 170 nanoseconds at 3.58 MHz for signal origination.

Specifications

Inputs

Power ....115 Vac ±10%, 40 watts nominal
VHF Input Levels:
Input A (75 ohm) .....5 mV to 50 mV (rms at sync tip level)
Input B (50 ohm) ...50 mV to 500 mV (rms at sync tip level)
Option on Input B .....External 20 dB attenuator required to extend the input level range to 5 Volts rms
Special Front End ....1 mV (0 dBmV) to 34 mV
UHF Input ....1 input at 50 ohms by N connector; 1-BNC to N adapter and 1-20 dB attenuator is supplied with each UHF 3710 Demodulator.
Input Level ....5 mV to 50 mV rms @ sync tip

Video Characteristics

Frequency Range ....VHF channels 2 through 13; UHF channels 14-83
Frequency Stability ....±0.002% per channel, +5°C to +50°C
Output Level ....1 Vp-p ±3 dB (adjustable)
Frequency Response (Switch selectable):
A. Sound Trap Out ....0 to 4.5 MHz ±.5 dB
B. Sound Trap In ....0 to 3.6 MHz ±.5 dB, @ 4.08 MHz< −3 dB
Group Delay Response:
With Sound Trap Out ....±15 ns from 0 to 4.5 MHz
With Sound Trap In ......According to FCC requirements ±25 ns from 0 to 3 MHz, 170 ±25 ns at 3.58 MHz
Differential Gain ....Synchronous ≤2%; Envelope ≤5%
Differential Phase ....Synchronous ≤1°; Envelope ≤1°
Modulation Depth Measurement .....Zero reference chopper, 35 μs blanking pulse. Position adjustable in the vertical interval by front panel control.
AGC Range ....20 dB
Outputs ....4 separate rear BNC 75 ohm video outputs (2 Synchronous, 2 Envelope). 1 Front BNC 75 ohm video output as selected by "Test Out" for scope display. 1 Zero carrier reference to feed Tektronix Video Corrector.
Alarm ......(a) Low RF detection with threshold adjustment (b) Loss of modulation. Also connections for remote indicators. Variable delay .1 to 5 seconds internally adjustable.

Audio Characteristics

Frequency Response...According to FCC requirements in the range of 30 Hz to 15 kHz (75 microsecond de-emphasis).
Output Level .....600 ohms balanced adjustable to +8 dBm; 8 ohm speaker output 2 watts; Headphone output bridged from speaker output.
1 4.5 MHz Sound Output ....Not less than 300mV rms in 75 ohms

Front Panel Indicators

Digital Display ....For RF input level; FM deviation; plus and minus regulated dc lines. Separate alarm lamps for RF level and modulation loss. Power on (lighted rocker switch).

Front Panel Controls

Input Attenuator ....3, 6, 10, 20 dB
Sound Trap ....In/Out
Synchronous Detector ....Offset display on; Frequency adjust; Video level
Video Output Scope Display ....Trace Separation; Synchronous/Envelope/Both; High pass filter/Low pass filter/Direct.
AGC ....On/Off with manual gain control
Chopper ....On with position control/Off
Zero Carrier Reference ....On/Off
Video Output Level:
Audio ....600 ohm output level
Audio ....Speaker and headphone level
Demodulator Tester ....On/Off

Front Panel/Connectors

Video Output ....BNC
Video IN to Demod Tester ....BNC
Headphone ....Phone Jack

Rear Panel Connectors

RF Input A ....75 ohms BNC (VHF channels)
RF Input B ....50 ohm type N (VHF channels)
UHF Input ....50 ohm type N
Video Output ....4 BNC 75 ohms
4.5 MHz Sound Output ....BNC 75 ohms
Zero Carrier Reference ....BNC
Audio Frequency Outputs ....Terminal block
Alarm ....7 pin Winchester M7S-LRN, mating connector supplied for remote indicators

RF Threshold Control ....On rear panel

Mechanical Characteristics

Width ....17"
Height ....7"
Depth ....16¾"
Weight (Approx.) ....25 pounds, portable with carrying handle and supplied with rack mounting brackets

Ordering Information

Freq. Band	Model No.	Information Required
VHF	3710-A1	Channel & offset if any
UHF	3710-A2	Channel & offset if any
CCIR	3710-F1	Channel & offset if any

Options must be requested at time of order:

1. 20 dB RF input attenuator (allows 5 V input).
2. Super sensitive front end (allows 0 dBmV input).

catalog TT.6570

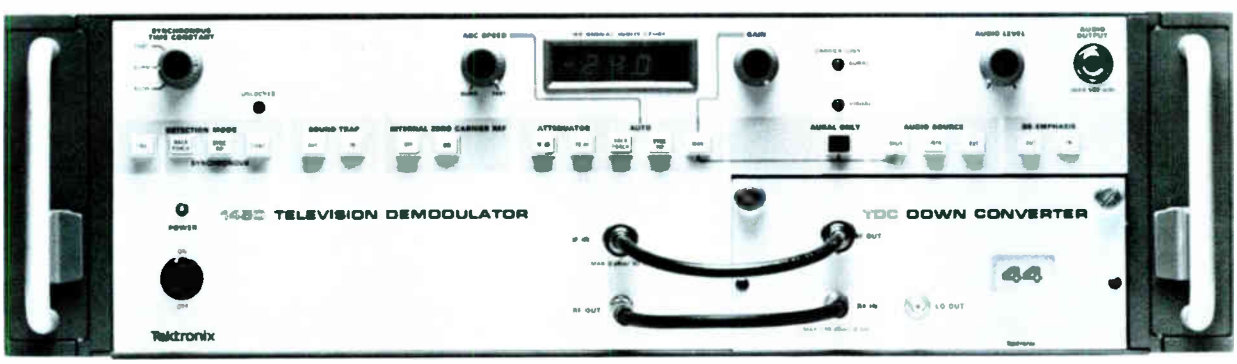
RCA

NTSC Television Demodulator, Tektronix Model 1450

- Measurement-quality performance; negligible distortion
- Synchronous detection
- Envelope detection
- Surface acoustic wave filter; precise Nyquist slope; excellent long- and short-term stability
- Digital readout of input power level; field strength readings
- Constant-bandpass characteristics over a wide dynamic range 69 dBm to 3 dBm; 30 dB of additional attenuation available to shift input range
- Any single UHF or VHF channel operation

Vital to the process of measuring the quality of the transmitted signal and performance of the television transmitter is a high-quality demodulator. As the major link between the transmitted signal and the baseband (video) measuring equipment, the ideal demodulator should not introduce distortion as a result of a demodulation process.

The Tektronix Model 1450 Demodulator incorporates new technology design and new components to provide measurement quality performance with negligible distortion.



Quadrature distortion occurs when a single sideband signal is demodulated with an envelope detector.

In terms of picture impairment, quadrature distortion most severely affects the chrominance signal causing a loss of brightness in highly saturated colors, especially those at high luminance levels (figure 3 and 4). Narrow white picture elements against the dark backgrounds are reproduced at reduced brightness. Note reduced pulse width in figure 2 and reduced pulse amplitude in figure 4.

Synchronous detection of the television RF signal eliminates quadrature distortion allowing the true performance of the transmitter itself to be determined.

ENVELOPE DETECTION

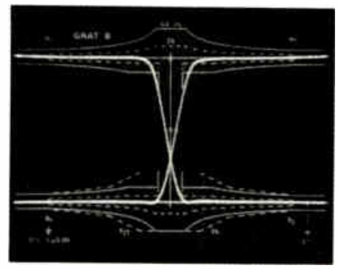


Figure 1. Quadrature distortion causes asymmetrical bar corners making transmitter equalization difficult.

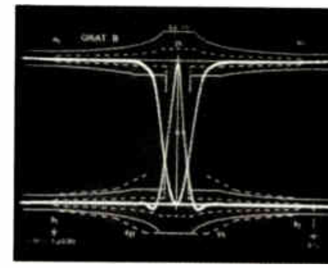


Figure 2. Asymmetry of the normal and inverted 2T sine squared pulses caused by quadrature distortion.

SYNCHRONOUS DETECTION

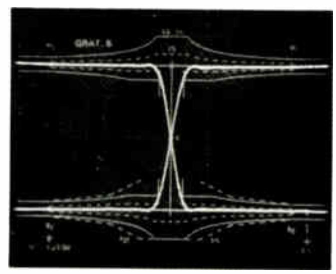


Figure 5.

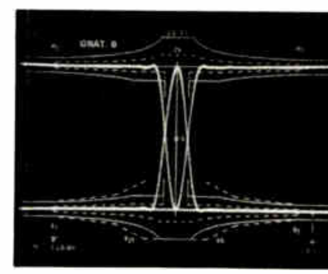


Figure 6.

Three of the most serious problems that occur in all other demodulators are quadrature distortion, which is caused by envelope detection, poor long- and short-term stability of tuned circuits caused by thermal changes and mechanical shock, and changes in bandwidth characteristics with wide dynamic range input signals. Examining the new TEKTRONIX 1450 Demodulator you will see how these problems have been overcome with new technology and new components.

Synchronous Detection and Envelope Detection

The 1450 provides for a selection of either synchronous or envelope detection. Both types are required for a full program of measurement capability. It is generally known today that quadrature distortion, which is caused by envelope detection, can be eliminated with synchronous detection. Figures 1 and 2 show an example of the improvement in half amplitude duration when synchronous detection is used instead of envelope detection. The 1450 has two synchronous video detectors operating in phase quadrature. One detects the in-phase signal; the other detects the quadrature component of the video signal. (The quadrature component is a measure of the change in visual carrier phase that results from a change of video level.)

If incidental phase modulation is present on the picture carrier, the amount of differential phase measured on a synchronously detected signal will be erroneous. Therefore, an envelope detector is necessary to accurately determine the actual differential phase present.

Tektronix-Developed Surface Acoustic Wave Filter

A surface acoustic wave filter developed by Tektronix plays a key role in this new demodulator. Some of the benefits derived from this new component are more precise Nyquist slope characteristics without group delay distortion, improved long- and short-term stability and lower maintenance cost.

In conventional demodulators, the more precisely the bandpass characteristics approach that of an ideal Nyquist curve, the more complex the filter network required. In the 1450, the bandpass char-

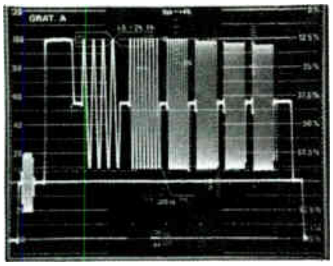


Figure 3. The Tektronix 1450 has a flat IF response and wide band phase equalized video response to minimize the effects of quadrature distortion in the envelope detected signal.

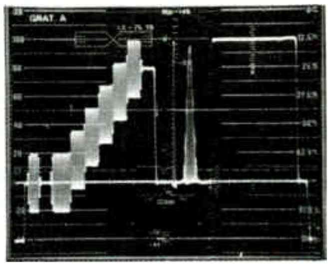


Figure 4. The Tektronix 1450 has a flat IF response and wide band phase equalized video response to minimize the effects of quadrature distortion in the envelope detected signal.

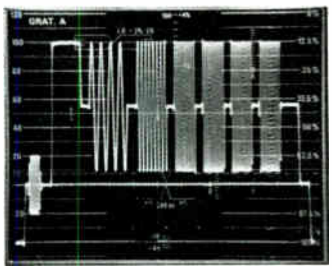


Figure 7.

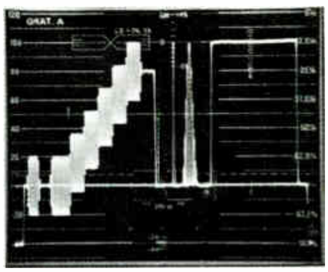


Figure 8.

Note in figures 5 through 8 how synchronous detection eliminates the quadrature distortion errors introduced in the envelope detection process. True transmitter performance may now be ascertained.

teristics are determined by one component, the surface-acoustic-wave filter.

A second and cost saving feature that results from the use of a surface-acoustic-wave filter is lower maintenance cost. Unlike conventional tuned circuitry, which must be meticulously adjusted and is subject to change with mechanical and thermal shock, the surface acoustic wave filter in a sealed unit provides the critical selectivity characteristics of the demodulator —no adjustments.

Constant-Bandpass Characteristics

Our advanced demodulator offers constant-bandpass characteristics over the entire dynamic range of input signal level. Amplifiers in the 1450 operate at a constant gain; pin-diode attenuators are used to adjust the over-all sensitivity of the demodulator. This is a more sophisticated approach to AGC, but an approach necessary to maintain constant-bandpass characteristics over the entire dynamic range of input power (—69 dBm to —3 dBm). 30 dB of attenuation, available in 10 dB steps, can shift the range for higher input power levels.

Digital Reading of Input Power

An added advantage of the 1450 AGC system is that it is calibrated in .1 dB steps. With a calibrated AGC the TEKTRONIX demodulator can provide an accurate, digital readout of input power. Whether you use this demodulator for monitoring at a transmitter site, a remote site, or for calibrated field strength measurements, you will have an accurate, digital readout of input power to depend on.

Split and Intercarrier Sound

Both split and intercarrier sound channels are standard on the 1450. The split carrier channel will operate without the presence of picture carrier. You should find this handy when making measurements or adjustments on your aural transmitter.

A number of audio outputs are available for your convenience: A 600-Ω output, two low-impedance outputs for driving a speaker or headphones, and a calibrated output for making deviation measurements with an AC VTVM, or an oscilloscope.

Specifications

RF Characteristics

RF Input ....Z:50Ω (N)
Return Loss ....≥20 dB at high sensitivity; ≥34 dB with 20 dB or greater attenuation
RF Frequency ....Single Channel System M ±20 kHz from carrier frequencies (Plug-in)
RF Input Level ....−69 dBm to −3 dBm
(Range shifts with RF attenuator ....−39 dBm to +27 dBm with 30 dB attenuation)
RF Attenuator Range ....30 dB in 10 dB steps
AGC Range ....−66 dB
Noise Figure:
VHF ....10 dB
UHF ....11 dB
Image Rejection Ratio ....≥60 dB
IF Rejection Ratio ....≥60 dB
Adjacent Channel Rejection Ratio ....≥50 dB
2nd Adjacent Channel Rejection Ratio ....≥60 dB
Intermodulation of Adjacent Channel ....≥60 dB
Variation in RF-IF Video Frequency Response with Signal Level ....≤±0.1 dB
Baseband Video Output Variation for Any Portion of AGC Range ....≤±0.1 dB
Readout Accuracy ....±1 dB
Readout Resolution ....±0.1 dB

IF Characteristics

IF Input ....Z_{in}:50Ω (BNC). Return Loss ≥26 dB with external 10 dB pad (sensitivity is then −10 dBm).
IF Level Range ......−20 dBm to −65 dBm (Signal to Noise Ratio deteriorates as signal decreases)
IF Frequency ....45.75 MHz ±100 kHz Visual IF; 41.25 MHz ±100 kHz Aural IF
IF Output ....Z_o:50Ω (BNC)
Level ....−20 dBm
Frequency ....45.75 MHz Visual IF; 41.25 MHz Aural IF

Video Characteristics

Video Output ....Z_o:75Ω (BNC 2 each)
Return Loss ....≥34 dB
Level ....1 Volt P-P Sync tip to peak white
DC Level Back Porch Clamp ....Blanking Level at 0 Volt
DC Level Sync Tip Clamp ....Sync Tip at −286 mV
Line Time Distortion ....2T k=0.5% in wideband synchronous mode only. 2T k=1% in all other modes.
Field Time Distortion ....k=0.5%
Line Time Nonlinearity...Synchronous ≤1%; Envelope ≤1%
Differential Gain ....Synchronous ≤1%; Envelope ≤4%
Differential Phase ....Synchronous ≤1°; Envelope ≤1°
Chrominance/Luminance Delay ....≤±20 ns
Chrominance/Aural/Carrier Intermod ....≥50 dB
Aural Signal Rejection ....≥46 dB
Video Signal To Noise Ratios:
Low Frequency (P-P Video/ P-P Hum) ....≥60 dB
Mid Frequency Coherent (P-P Video/P-P Noise) ...≥50 dB
White Noise (P-P Video/RMS Noise) ....≥60 dB (10 kHz to 5 MHz)
Quadrature Output ....Z_o:75Ω (BNC)
Return Loss ....≥34 dB
Quadrature Phase ...90° ±2° (with respect to VIDEO OUT)

Zero Carrier Reference Pulse:
Width ....30 μs ±10%
Amplitude ....120 IRE ±0.5 IRE
Carrier Cutoff ....≥50 dB
Timing .....Both fields, line selectable from 10 through 25
External Zero Carrier Reference
Drive Input ....Z_{in}:Approx. 5kΩ (BNC)
Level Required ....Approx. 1.0V (accepts input from TEKTRONIX 1440)

Audio Characteristics

Frequency Response ....±0.4 dB (30 Hz to 15 kHz)
Harmonic Distortion ....≤0.2% (50 Hz to 15 kHz at full output with ±25 kHz deviation.
Audio Signal To Noise Ratio:
Intercarrier Mode ....≥75 dB with ±25 kHz deviation and 1 kHz modulation
Split Carrier ....≥75 dB with ±25 kHz deviation and 1 kHz modulation
EXT 4.5 IN ....≥75 dB with ±25 kHz deviation and 1 kHz modulation
Deviation Output ....Z_o:600Ω (BNC)
Level 50mV/kHz
4.5 MHz IN ....Z_{in}:50Ω (BNC)
Return Loss ....≥30 dB
Level ....−30 dBm
Frequency ....4.5 MHz ±1 kHz
4.5 MHz Output ....Z_o:50Ω (BNC)
Return Loss ....≥30 dB
Level ....Nominal −6 dBm up to 0 dBm
600Ω Balanced Line Output:
Level ....−10 dBm to 10 dBm (internally adj.)
Connector ....XLR
8Ω Speaker Output:
Level ....Up to 5 Watts rms
Connector ....Barrier Block
Headphone Output:
Level ....Up to 375 mW into 8Ω headphone
Connector (Stereo or mono style) ....Phone Jack
Remote Connector:
Alarm Output ....SPDT relay contact rated at 28 V, 3A
External Synchronous/Envelope Switch ....Ground for Envelope detection
Electromagnetic Susceptibility ....10 V/Meter
Damage Level at RF Input ....1 Watt Maximum (any attenuator setting)

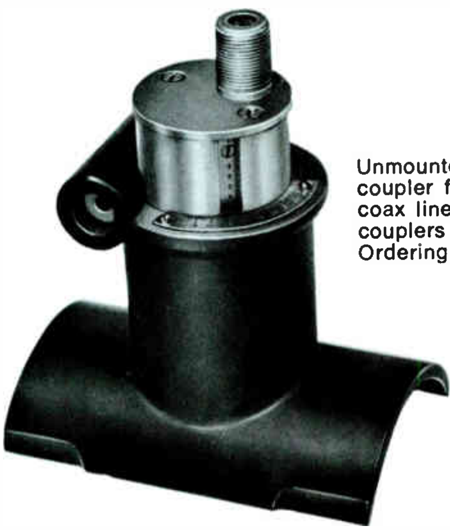
Note in 50 Ohms:
+27 dBm = 5 V rms
− 3 dBm = 158 mV rms
−69 dBm = 80 μV rms

Rear Panel Outputs ....Video, BNC 2 each Quadrature, BNC Deviation, BNC 4.5 MHz, BNC 600 Ohm (balanced) 8-Ohm speaker
Rear Panel Inputs ....50-Ohm RF, N 75-Ohm RF, BNC 4.5 MHz, BNC External zero carrier, BNC Remote alarm jack

catalog TT.6700B

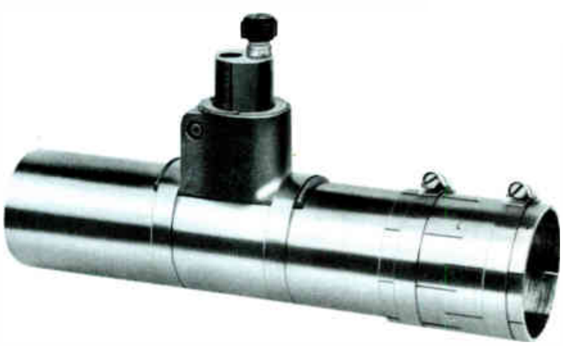
(Replaces TT.6700A)

Directional Couplers



Unmounted directional coupler for 3⅛-inch coax line. Typical of couplers listed. (See Ordering Information.)

Coupler mounted on a 6⅛-inch monitoring section.



Coupler mounted on a 3⅛-inch unflanged monitoring line section.

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.

10CTT

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.

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 8 3/16″ pressurized line	MI-561577
VHF/UHF, 75-ohm, for use with 9 3/16″ pressurized line	MI-561578

Ordering Information

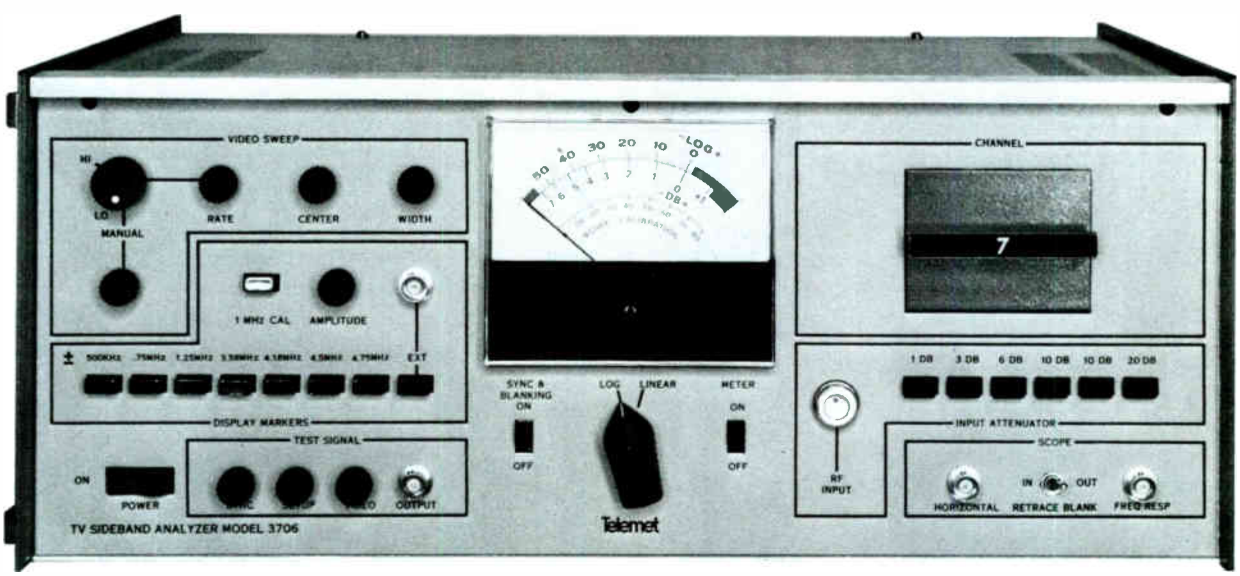
Monitoring Line Sections

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-27791K-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, 8 3/16″ Universal flange	MI-561566D-9A
VHF/UHF, 75-ohm, 9 3/16″ Universal flange	MI-27793D-9A

RCA

Vestigial Sideband Analyzer, Telemet Model 3706-A1

- Crystal control for fast setup on frequency
- Single channel plug-in crystal controlled VHF tuner
- Crystal filtered dual conversion IF
- Final IF bandwidth 40 kHz
- 50 dB scope display
- Composite or noncomposite outputs
- H sync and blanking internally generated
- Variable sweep rates including manual control
- Point to point response readout on front panel meter
- 7 discrete crystal markers to check FCC specifications



Description

Sideband Analyzer 3706 by direct display permits thorough examination of the entire sideband response of television transmitters and sideband filters. It can also be used for the examination, evaluation, and adjustments of video circuits. Spurious emissions, low level sidebands, and frequency deviations are accurately pinpointed with the use of 7 crystal markers whose frequencies are of the most interest in a television transmitter's VSB passband. Discrete frequency marking is augmented by a 1 MHz crystal comb frequency marker which provides markers at 1 MHz intervals across the swept band on display.

With the use of a 5 position rotary "Sweep Rate" switch and an overlapping continuous vernier, the sweep speed can be smoothly varied from a slow moving one (1) Hz spot to an apparent fixed response curve display at about 60 Hz. The slower sweeps often provide more accurate examination than can be obtained with the more normal 50/60 Hz sweep and are especially revealing when displayed on a long persistence CRT screen.

Front Panel Controls

Meter Scale: Log, Linear.

Spot Markers*: 500 kHz, 0.75 MHz, 1.25 MHz, 3.58 MHz, 4.18 MHz, 4.5 MHz, 4.75 MHz (crystals) amplitude adjustable.

1 MHz comb. frequency marker.

External Marker: Amplitude adjustable.

Video Sweep

Sweep Rate: 1 to 60 Hz repetition rate in four ranges continuously variable or manual sweep. Manual sweep enables spot readouts in dB on front panel meter.

*Different markers to suit PAL or SECAM units.

Width: Varies the sweep frequency width 7-0-7 MHz.

Center: Adjusts zero beat in center of sweep so that the sweep is symmetrical each side of zero.

Test Signal

Video: Adjusts video sweep level.

Setup: Adjusts setup level.

Sync: Adjusts sync level.

Input Attenuator

50 dB in pushbutton pads of 1, 3, 6, 10, 10, 20 dB. Pads can be used in any combination.

Channel Selection: Channels are changed simply by interchanging fixed frequency crystal oscillators.

Sync and Blanking Switch: On/off.

Power Switch: On/off.

Meter Switch: On/off.

Specifications

Inputs

Channel Coverage:

VHF Channels 2-13 .... By interchangeable fixed plug-in local oscillators

UHF Channels .... By fixed external converter 3707 and plug-in 45.75 MHz IF oscillator

RF Input Level .... 100mV to 1 volt rms

RF Input Impedance .... 50 ohms

Input Attenuator .... 50 dB in steps 1-3-6-10-10-20 dB

External Marker Input .... 1 volt

Receiver IF

Dual Conversion IF .... Final stage 455 kHz, bandwidth ±20 kHz

Test Signal Outputs

Output Impedance .... 75 ohms

Sweep Frequency Output Level .... 0.1 to 1.5 Vp-p composite

Sync .... Variable 0-50 IRE

Set-up .... Variable 10%-90% APL

Sweep Width .... Symmetrical, variable up to 7-0-7 MHz

Sweep Frequency Response .... ±0.2 dB

Harmonic Distortion .... −34 dB

Sweep Control .... Automatic or manual

Automatic Sweep Rates .... Variable from 1 Hz to 60 Hz in 4 overlapping ranges

Outputs to Display Unit

Detector Linearity .... A change of 20 dB in input level can be measured within 1 dB

Detector Response .... −50 dB

Hum and Noise: .... −55 dB

Output Impedance (Approx.):

Vertical Deflection .... 1000 ohms

Horizontal Sweep .... 1000 ohms

Horizontal Sweep Output Level .... 10 Vp-p

Power Input ..... 115 Vac 50-60 Hz (230 Vac where required)

Connectors .... BNC; RF: N type

Mechanical

Width .... 17″

Height .... 7″

Depth .... 16¾″

Weight (Approx.) ...... 25 lbs., portable with carrying handle and supplied with rack mounting brackets

UHF Inputs

Order Model 3707 UHF external converter.

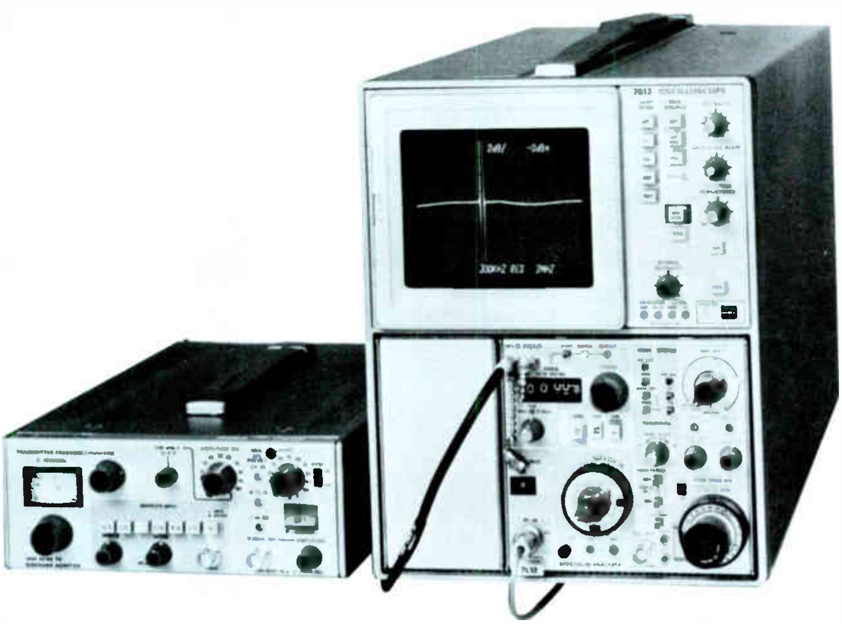
Ordering Information

Telemet Sideband Analyzer .... Model 3706-A1

catalog TT.6850A

Television Sideband Adapter, Tektronix Model 1405; 1405 Option 01

- Response of transmitter under test within 0.2 dB
- Frequency response of RF and IF circuits for transmitters with frequency to 1 GHz
- Video circuits can be swept (0-15 MHz)
- For in-service testing, use of external blanking allows either full-field or single-line operation
- Check aural FM deviation with built-in Bessel NULL Technique
- Flexible marker system will accept standard crystals



Television Sideband Analyzer System includes 7L12 Spectrum Analyzer, 7613 Variable Persistence Mainframe, and 1405 Television Sideband Adapter. NOTE: The Model 1405 is a Sideband Adapter only. The required Spectrum Analyzer and Mainframe must be ordered separately unless already available.

Television Sideband Analyzer

To analyze the sideband response of a television transmitter, the 1405 is used with a spectrum analyzer, such as the 7L12 or 7L13. The 1405 generates a composite video signal, the "picture" portion of which is a constant-amplitude sinusoidal signal that sweeps 15-0-15 MHz. This signal is applied as modulation to a television transmitter; the output is then displayed on the spectrum analyzer, and appears as the response curve of the transmitter under test. The 1405/spectrum analyzer combination will display the frequency response characteristics of RF and IF circuits for transmitters with frequencies to 1 GHz. Video circuits (zero frequency offset) can also be analyzed.

The swept portion of the 1405 output signal is generated by offsetting the 7L12 or 7L13 first local oscillator signal. The first local oscillator signal depends on the analyzer input frequency, which is tuned to the transmitter frequency. Sync and pedestal pulses and cw blanking are combined with the sweep to form the composite output signal. The internal sync can be defeated for pure sinusoidal sweep. In this mode, the use of external blanking allows either full-field or single-line operation, a feature useful for in-service testing.

The output amplitude of the cw portion of the composite video signal can be varied from 0 to 100 IRE in 10 IRE steps. The average picture level (APL) can also be varied in 10 IRE steps from 0 to 100 IRE. Three variable APL levels are provided for rapid checks at preset levels. If a combination of cw amplitude and APL exceeds normal tv transmitter modulation limits, internal logic will clamp the APL to 50 IRE and light an UNCAL indicator as a caution.

Five marker frequencies related to tv transmission standards are provided; a sixth marker oscillator is available for a user-provided crystal. The intensity and width of the displayed markers are adjustable.

Another feature of the 1405 is the variable amplitude 10.396 kHz (9.058 kHz, Opt. 01) signal output, which can be used to check the aural FM deviation. When this signal is applied to a transmitter's aural input at the amplitude that produces the first (second, Opt. 01) carrier null, it corresponds to ±25 kHz (±50 kHz) of frequency deviation, or 100% modulation.

Specifications

Characteristics

The following characteristics apply to the 1405 and 1405/7L12 or 7L13 combination. They are applicable over the environment specification limits for the 1405 and 7000-Series Mainframes.

Frequency (Frequency Offset)

Range ......Will tune and provide a swept video output for a 7L12 or 7L13 center frequency range of 0 to 1 GHz

Frequency Dial Accuracy .....Dial reading is within 10 MHz of transmitter frequency when properly tuned

Fine Tuning Range ....From ±0.5 MHz to ±1.25 MHz, depending upon transmitter frequency setting

Tuned Frequency Drift ....Less than 1 MHz per hour after a 30 minute warm-up

Output Signal Level

Amplitude (Sync Off) ....100 IRE equals 0.714 V p-p when terminated in 75Ω

Output Impedance ....75Ω ±1% at 100 IRE and ±2% from 0 to 90 IRE

Variable ....0 to 100 IRE in 10 IRE steps

Accuracy (at 200 kHz) ....±1 IRE at 100 IRE; ±2 IRE from 10 IRE to 90 IRE

Output Level During Blanking ....0 V ±0.01 V at 0 IRE; 0 V ±0.04 V at 100 IRE from 0 to 1 MHz; 0 V ±0.02 V at 100 IRE above 1 MHz.

CW Output Harmonics ....Down 40 dB or more

Flatness

1405 ....Within ±0.1 dB from 100 kHz to 10 MHz, within ±0.2 dB from 10 MHz to 15 MHz, within ±0.4 dB from 50 kHz to 20 MHz.

1405 plus 7L12 or 7L13:

For transmitter frequency greater than 20 MHz — Within ±0.2 dB from 100 kHz to 10 MHz of picture carrier, increasing to ±0.3 dB at 15 MHz; within ±0.5 dB from 50 kHz to 20 MHz.

For transmitter frequency of 0 to 20 MHz — Within ±0.5 dB from 100 kHz to 15 MHz.

System Span ....>200 kHz per division

Video Frequency Range ....15-0-15 MHz

Average Picture Level (APL)

Variable ....0 to 100 IRE in 10 IRE steps

Accuracy ....±2 IRE

Three Preset Levels:

PRESET A ....0 to 50 IRE

PRESET B ....25 IRE to 75 IRE

PRESET C ....50 IRE to 100 IRE

Horizontal Sync, Blanking, and Pedestal Duration — Within NTSC (PAL, Opt. 01) limits (no vertical interval is provided). Transition time is 0.24 μs ±10%, from 10% to 90% points.

Composite Sync Source Blanking ....0 V turns cw on, greater than −5 V turns cw off

Line Strobe ....TTL pulse from 0 to 5 V turns cw on

Markers and Z-Axis Output

Marker Frequencies ....0.75 MHz, 1.25 MHz, 3.58 MHz (color subcarrier), 4.18 MHz, and 4.75 MHz. Opt. 01: 0.75 MHz, 1.25 MHz, 1.75 MHz, 2.25 MHz, 4.43 MHz (color subcarrier), 5.0 MHz, 5.5 MHz, 5.75 MHz, and 6.25 MHz.

Accuracy ....±0.01% of frequency selected (crystal controlled). Additional marker oscillator accepts user-supplied crystal*.

External Marker Input ....Accepts 0.2 MHz to 10 MHz, 1V RMS nominal

Z-Axis Output Amplitude ......Up to about +10 V and −3 V into 500 Ω. Minus voltage intensifies markers.

Aural Output

Output Frequency ....10.396 kHz, 0.01% (crystal controlled). Opt. 01, 9.058 kHz

CW Output ....Amplitude variable up to at least +12 dBm into 600 Ω

Harmonics ....Down 45 dB or more

*Crystal Requirements—Series resonant; Rs less than 2000 Ω; Q greater than 5000; Case, HC/6U or HC/25U.

1405 Option 01

The 1405 Option 01 is used with PAL television systems. Features and operation are the same as the NTSC instrument except that the sync rate, blanking time, marker frequencies, and aural oscillator frequency are different as required by the PAL system.

The 1405 Option 01 differs mechanically from the 1405 in that the front panel reflects the changes noted, and the dial tape does not include the US television channel numbers.

1405 Option 01 Characteristics

Except as noted, all specifications for the 1405 also apply to the Option 01.

Horizontal Sync and Blanking Duration

Blanking Time ......12.05 μs ±0.25 μs, internally adjustable

Sync Rate ....64 μs ±1.5 μs, internally adjustable

Sync Pulse Length ....4.7 μs ±0.20 μs

Front Porch ....1.55 μs ±0.25 μs

Markers and Z-Axis Output

Marker Frequencies ....0.75 MHz, 1.25 MHz, 1.75 MHz, 2.25 MHz, 4.43 MHz, 5.0 MHz, 5.5 MHz, 5.75 MHz, 6.25 MHz. Some crystals are installed and all may be relocated as explained in Marker Crystal Installation.

Aural Output

Output Frequency ....9.058 kHz ±0.01% (crystal controlled)

Marker Crystal Installation

Because of the various international standards, the 1405 Option 01 is shipped with the marker crystals installed as indicated. The remaining crystals are shipped with the unit. Any combination of crystals may be installed.

Marker Crystals (Frequencies in MHz)

Installed When Shipped	Frequencies Used in System B	System G	System I
0.75	0.75	0.75	1.25
1.25	1.25	2.25	1.75
2.25			
4.43	4.43	4.43	4.43
5.0	5.0	5.0	5.5
5.75	5.75	5.75	6.25

Note: Option 01 instruments are connected for a nominal power line voltage of 240 V.

Ordering Information

TV Sideband Adapter (NTSC Markers) ....Model 1405
TV Sideband Adapter (International)...Model 1405 Option 01
Rack Adapter 016-0489-00
Spectrum Analyzer 7L12
Spectrum Analyzer 7L13
Mainframe 7603
Phosphor and Internal S.A. Graticule ....Option 77 P7
Internal S.A. Graticule ....Option 06
Variable Persistence Mainframe 7613
Internal S.A. Graticule .... Option 06

catalog TT.7200A

(Replaces B.5514)

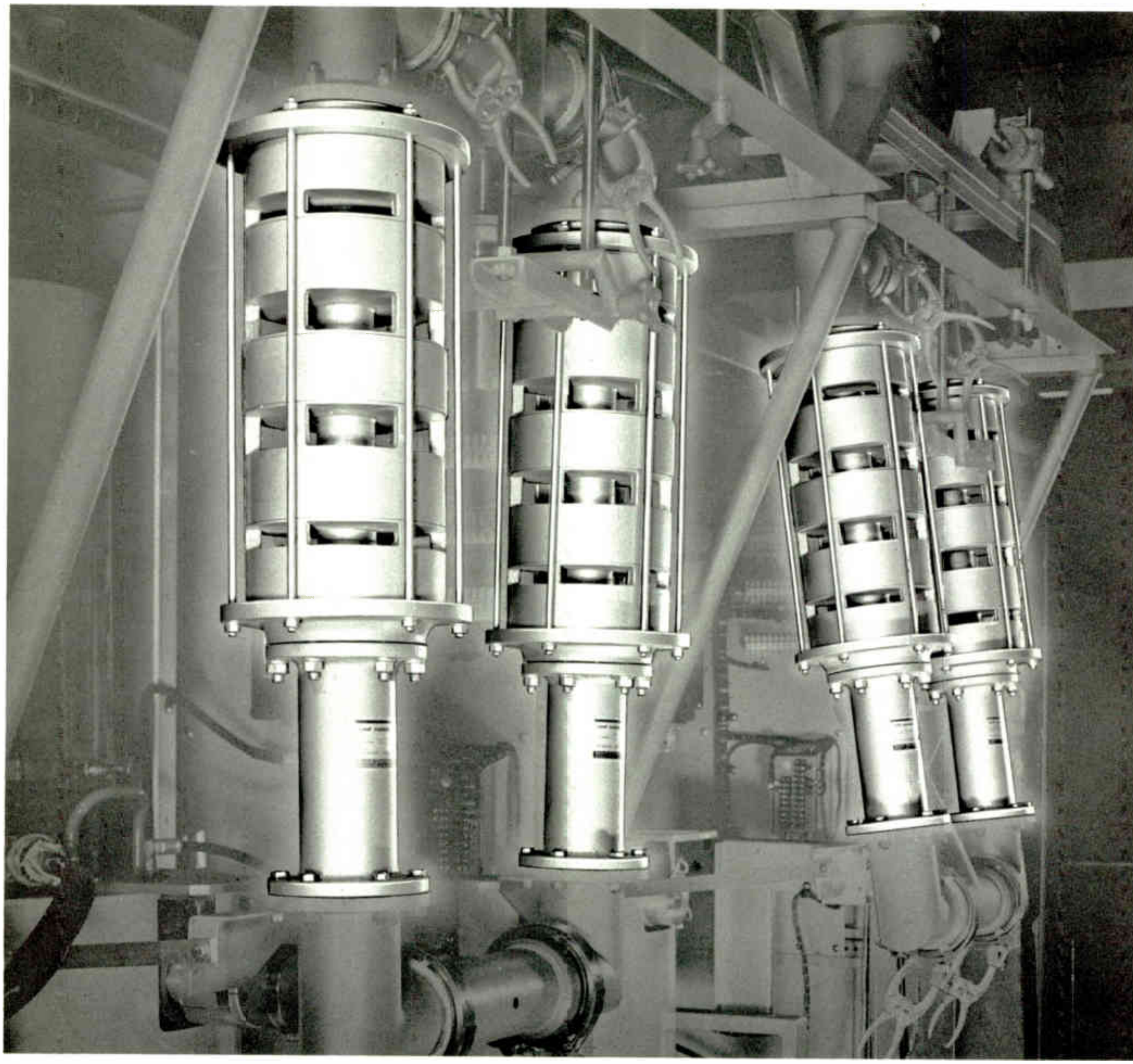
Harmonic Filters for UHF-TV Transmitters

- 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.

7YB



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.

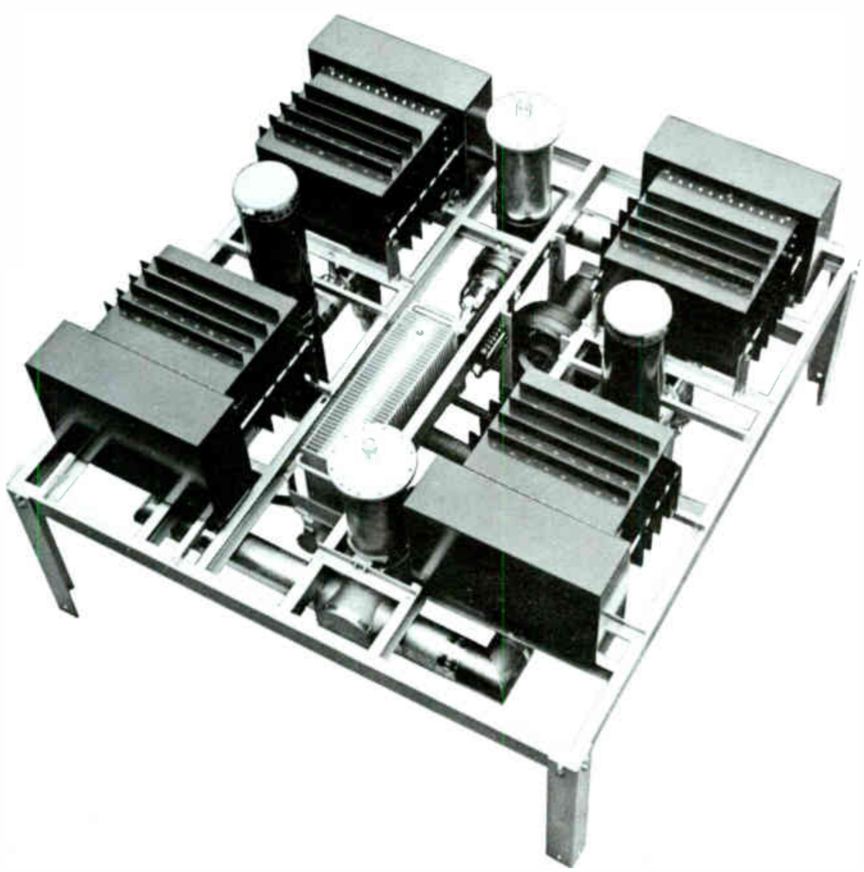
catalog TT.7600A

(Replaces B.5516)

RCA

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.

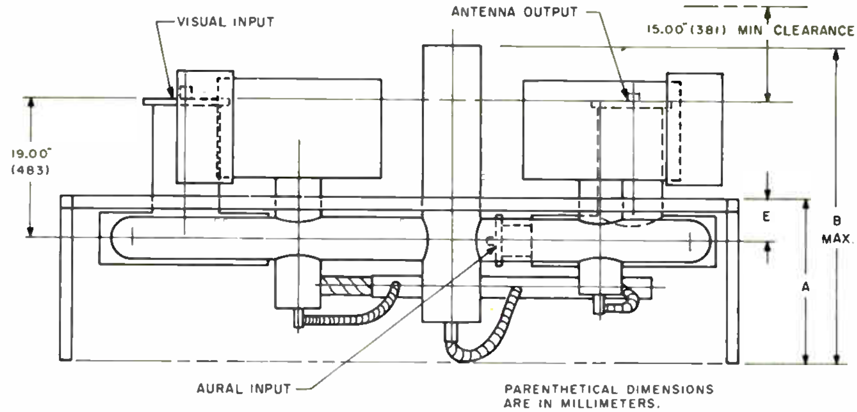
The filterplexer combines the high quality performance characteristics of both a sideband filter and a diplexer. The inputs have a constant input impedance over the band of frequencies in the channel.

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.

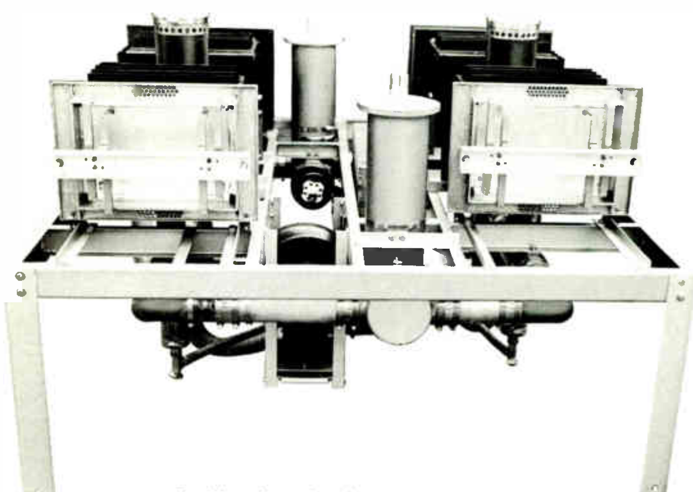
The filterplexer is suitable for floor or ceiling mounting (horizontal position with 6⅛-inch connections upwards only). The filterplexer is fully factory assembled.

1YB

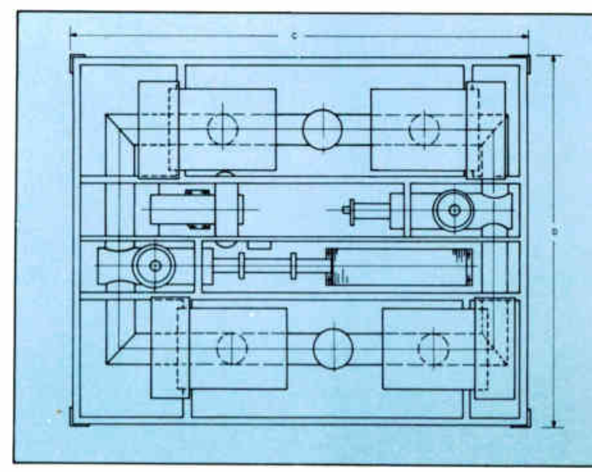
Outline drawings show dimensions in inches and millimeters for channels 14 through 70.



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.

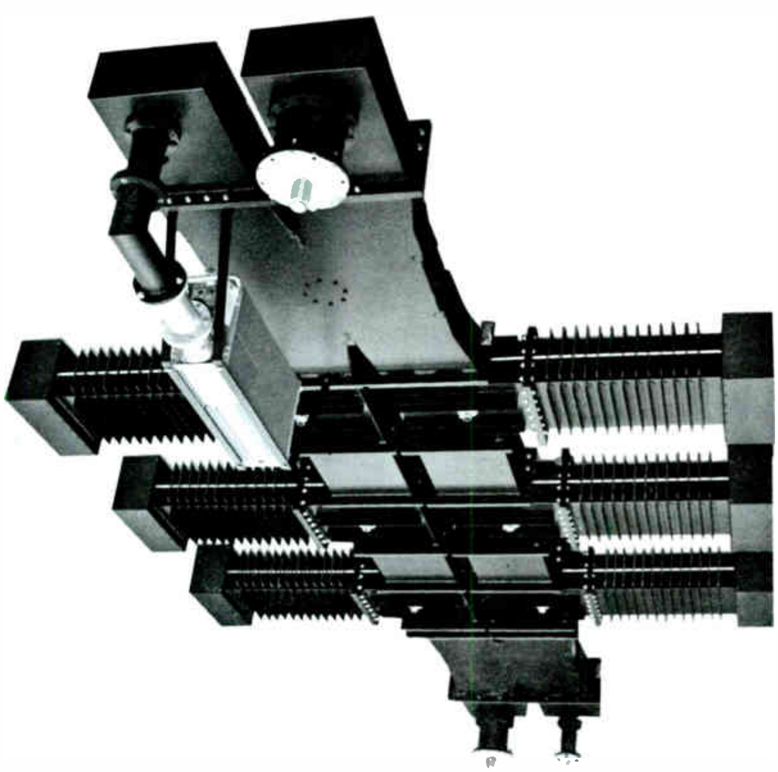
catalog TT.7650A

(Replaces B.5530)

RCA

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

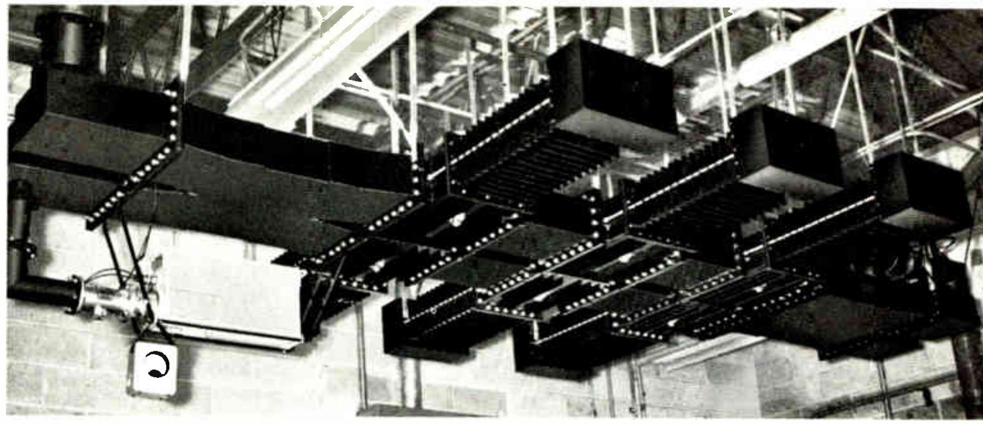
The filterplexer consists of two identical waveguide transmission lines with three waveguide cavities. Hybrid junctions at the inputs and output provide for connection of coaxial transmission line components. The waveguides operate without pressurization and are cooled with convection currents in the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

(Specs and ordering information, next page.)

2Y8

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:

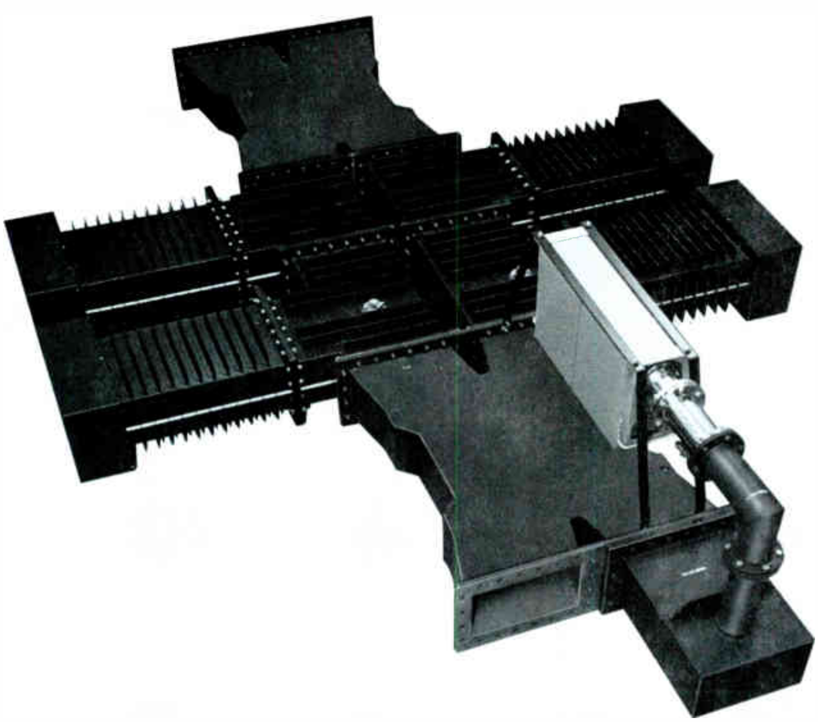
Channels 14-42, 60 kW Rating MI-561550
Channels 43-69, 60 kW Rating MI-561551
Channels 14-42, 120 kW Rating MI-561552
Channels 43-69, 120 kW Rating MI-561553

catalog TT.7701

RCA

Waveguide Notch Diplexers, 60 thru 220 kW Visual

- High Efficiency—90% and greater
- Ceiling mount saves floor space
- No pressurization required
- Topside or bottomside connections
- Combines visual and aural signals



Waveguide notch diplexers connect aural and visual transmitter outputs to a single antenna feedline with high efficiency and negligible interaction between the two transmitter outputs.

Designed for Ceiling Mount

Constructed of high conductivity aluminum, the notch diplexer 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 notch diplexers are fully assembled and pretuned to operating frequency. They are, however, disassembled to facilitate shipment.

The notch diplexer inputs are designed for constant impedance over the frequency bands produced by the transmitter carriers, so the transmitter outputs "see" a constant load.

Convection Cooled, Unpressurized System

The notch diplexer consists of two identical waveguide transmission lines with two waveguide cavities. Hybrid junctions at the inputs and output provide for connection of waveguide 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.

(Specifications and ordering information, next page.)

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Power Ratings When Used With Indicated Terminations

	Power Rating kW		Input and Output Terminations		
Channel	Visual	Aural	Visual Input	Aural Input	Output
14-69	60	12	6⅛″ 75 ohm	3⅛″ 50 ohm	6⅛″ 75 ohm
14-52	120	24	Waveguide	6⅛″ 75 ohm	8³⁄₁₆″ 75 ohm
14-32	165	17	Waveguide	6⅛″ 75 ohm	9³⁄₁₆″ 75 ohm
14-69	165	17	Waveguide	6⅛″ 75 ohm	Waveguide
14-42	220	22	Waveguide	6⅛″ 75 ohm	Waveguide

For input and output transitions—see Waveguide Catalog.

Specifications

MI Number	MI-561792		MI-561793	
Frequency Range	**Ch. 14-42**		**Ch. 43-69**	
Power Rating	Dependent on Waveguide Transitions used at Inputs and Outputs			
Efficiency (Min.)	94%	92%	93%	90%
Visual Input VSWR (Max.) −4.5 to −1.2 MHz −1.2 to +4.2 MHz +4.2 to +4.5 MHz	 1.2:1 1.15:1 1.2:1	 — — —	 1.2:1 1.15:1 1.2:1	 — — —
Aural Input VSWR (Max.)	—	1.2:1	—	1.2:1
Input and Output Connections	WR-1500	WR-1500	WR-1500	WR-1500
Dimension in Inches (mm) Length[2] Width[2] Depth	 *228-195 (5791-4953) 140-100 (3556-2540) 36 (914)		 124-111 (5029-4267) 105-81 (2667-2057) 36 (914)	
Weight (Approx.) in Pounds (kg)	1050 (478)		750 (341)	

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

Ordering Information (Please specify visual and aural carrier frequencies)

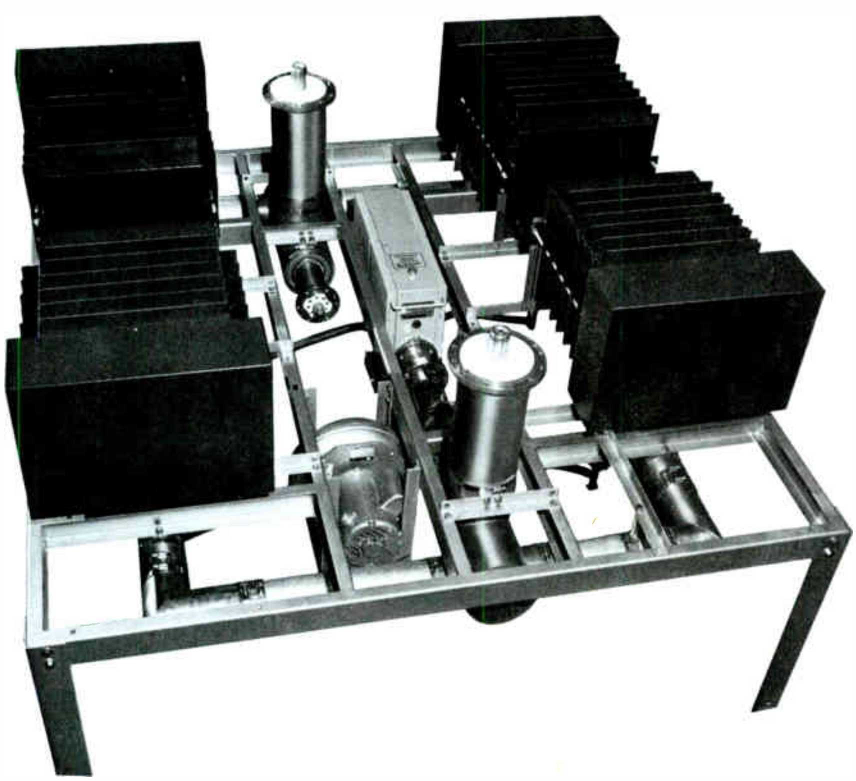
Waveguide Notch Diplexers:
- Channels 14-42 .... MI-561792
- Channels 43-69 .... MI-561793

catalog TT.7720A

RCA

60 kW UHF Hybrid Notch Diplexer

- Combines visual and aural signals
- 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 notch diplexer connects aural and visual outputs of a UHF television transmitter to a common antenna feedline with negligible interaction and crosstalk.

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 connected by sections of coaxial transmission line. The system uses an ungassed, unpressurized design.

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

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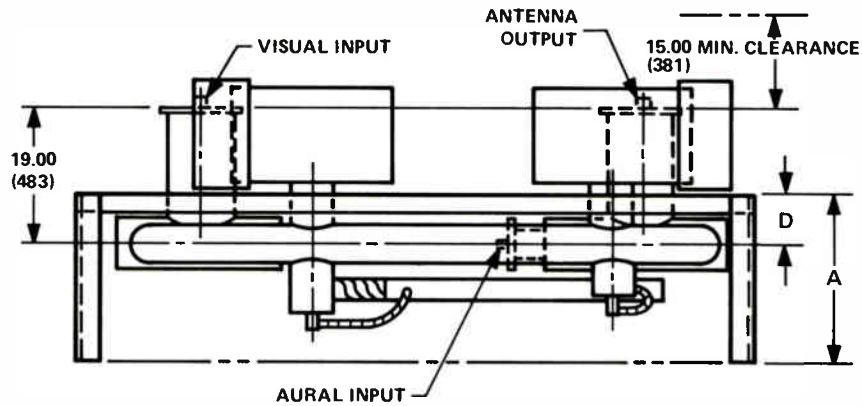
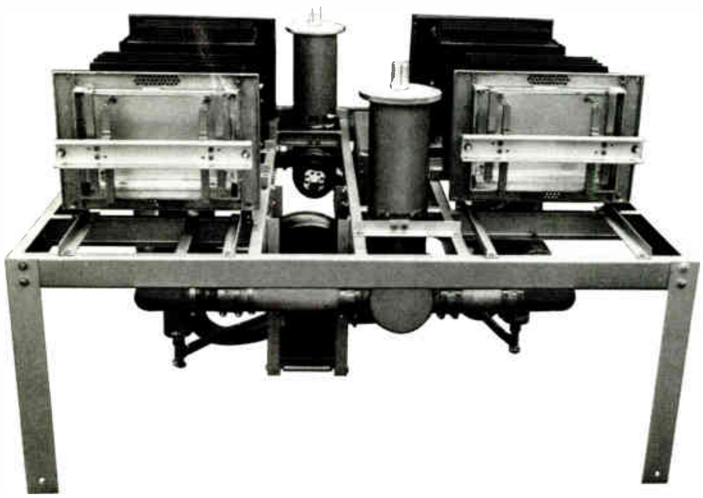
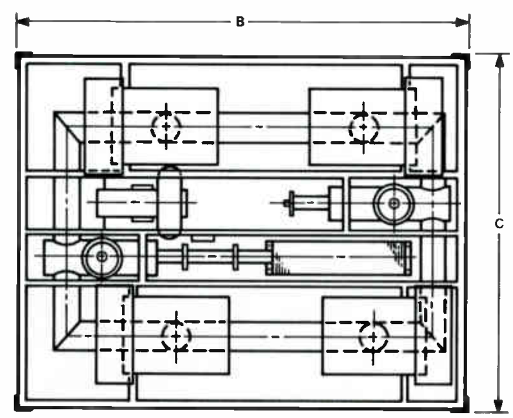
Outline drawings show dimensions in inches and millimeters for channels 14 through 69.



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	As Packed Dimensions
Ch. 14 thru 22	26.00(660)	77.36(1965)	66.36(1686)	6.61(168)	71½x54x87H
Ch. 23 thru 30	25.00(635)	73.30(1862)	69.71(1771)	5.59(142)	74⅞x51x83H
Ch. 31 thru 41	24.00(610)	68.36(1736)	63.95(1624)	5.59(152)	69⅛x49x78H
Ch. 42 thru 54	23.00(584)	74.36(1889)	63.36(1609)	5.59(142)	68½x45x84H
Ch. 55 thru 69	23.00(584)	78.36	66.36	5.59(142)	71½x45x88H

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) ....800 lbs.
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 Notch Diplexer MI-561791-CH
Please specify operating channel. Shipped fully assembled.

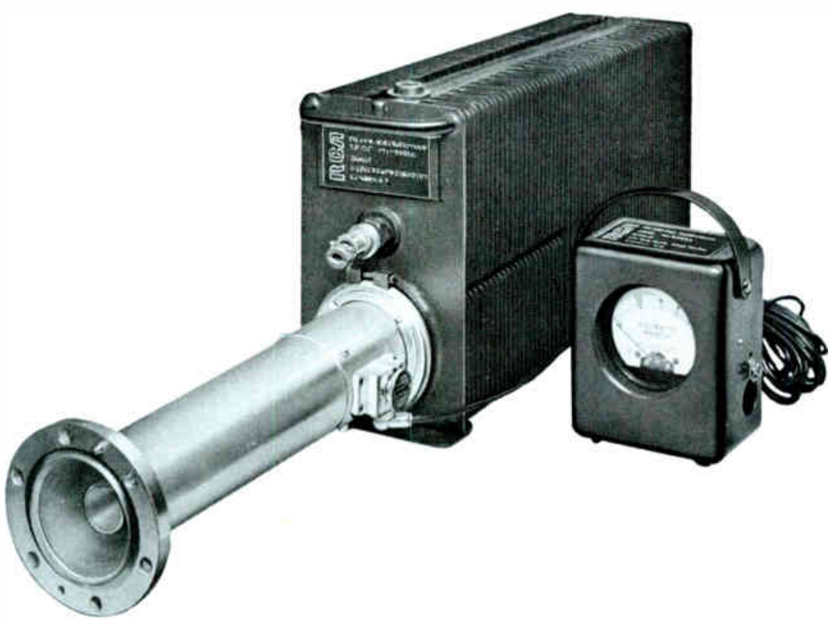
catalog TT.8200B

(Replaces TT.8200A)

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.



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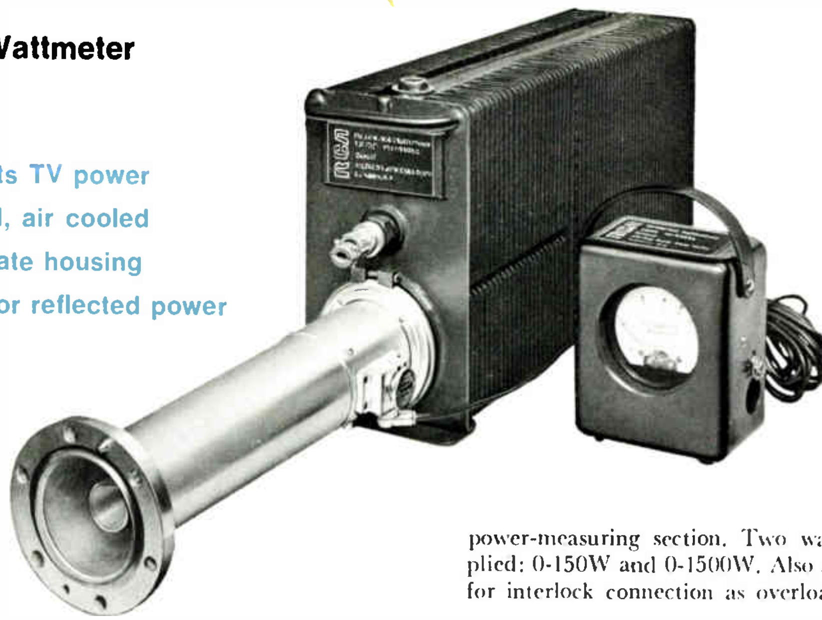
Air-Cooled, 1200-Watt Load/Wattmeter

- 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

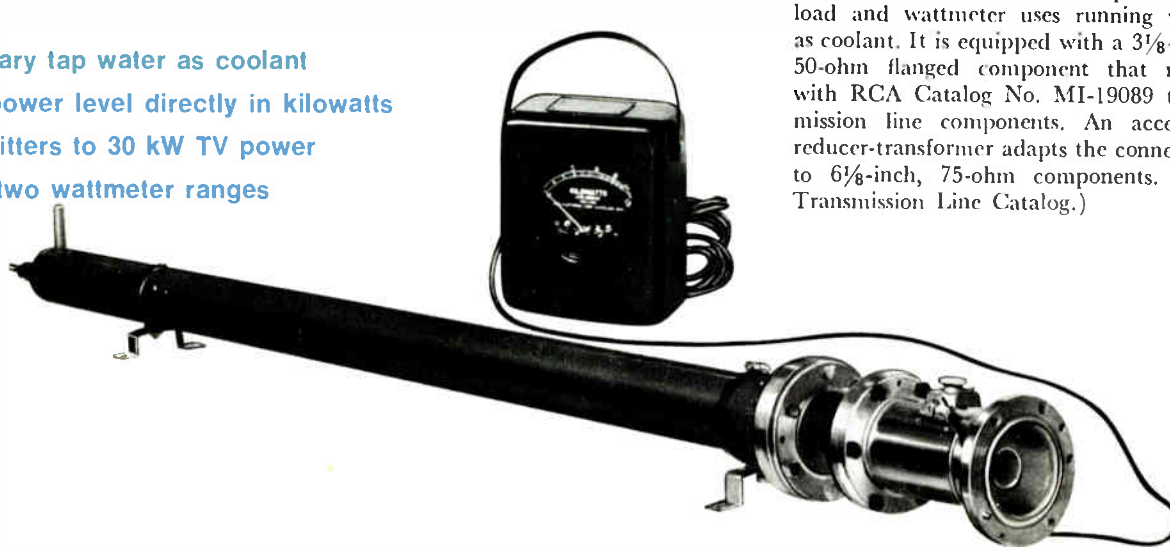
Ordering Information

Air-Cooled, 1200-Watt Load and Wattmeter	MI-19197

Water-Cooled, 25-kW Load-Wattmeter

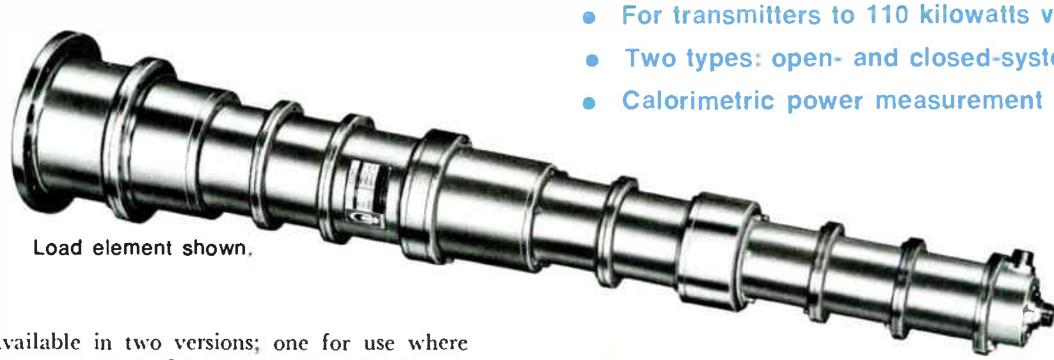
- Uses ordinary tap water as coolant
- Indicates power level directly in kilowatts
- For transmitters to 30 kW TV power
- Choice of two wattmeter ranges

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 Transmission Line Catalog.)



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.

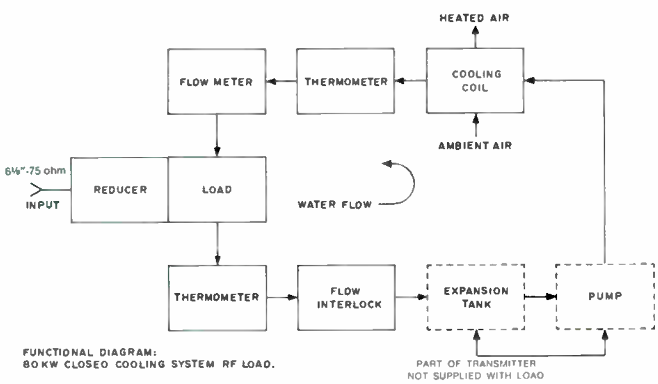
The load is available in two versions; one for use where a potable tap water supply and a drain are available, the other uses a closed water system that recirculates the coolant in a coil attached to the heat exchanger of an RCA Type TTU-110 transmitter.

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



FUNCTIONAL DIAGRAM:
80 KW CLOSED COOLING SYSTEM RF LOAD.

Diagram water plumbing fittings for a typical systems, and a calorimetric power measuring system. Straight lengths of water tubing and elbows are not supplied.

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. Available adapters for other line types must be ordered separately.

[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-561812B-3-CH

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.)

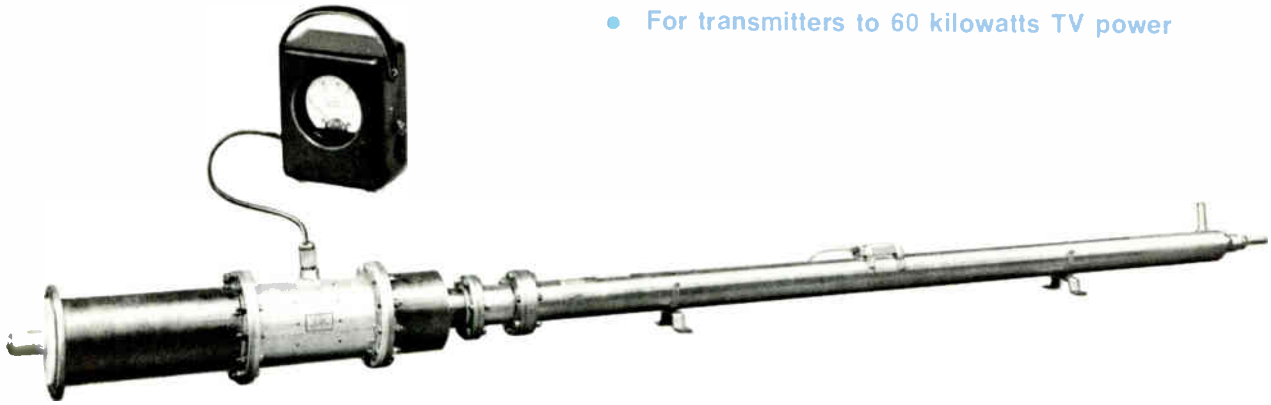
Ordering Information

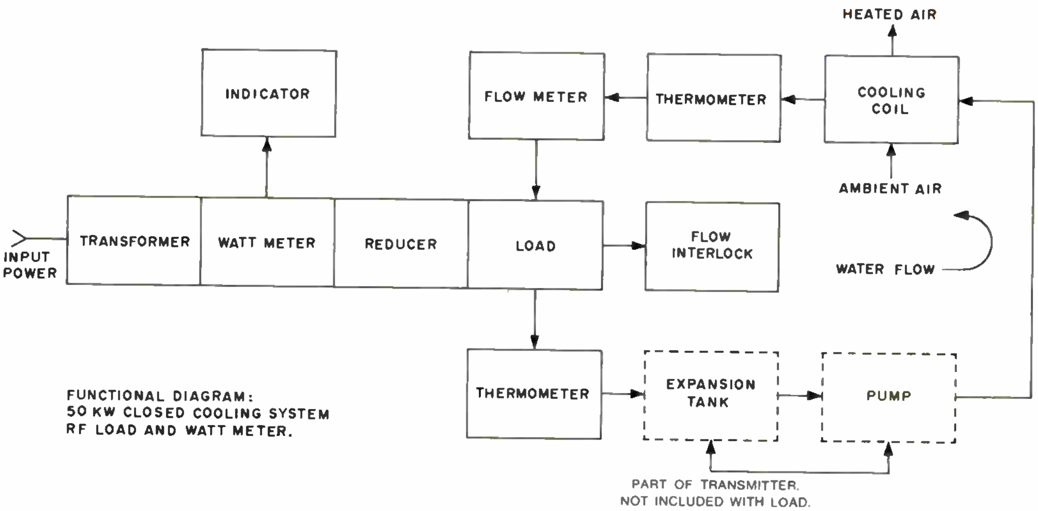
Water-Cooled 15/25-kW Load

Open-Water System	ES-563003-1-CH
Closed-Water System	ES-561812B-1-CH

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 water plumbing fittings for a typical system and a calorimetric power measuring system.

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-56300B-2-CH
- Closed-Water System ES-561812B-2-CH

(Please specify channel number.)

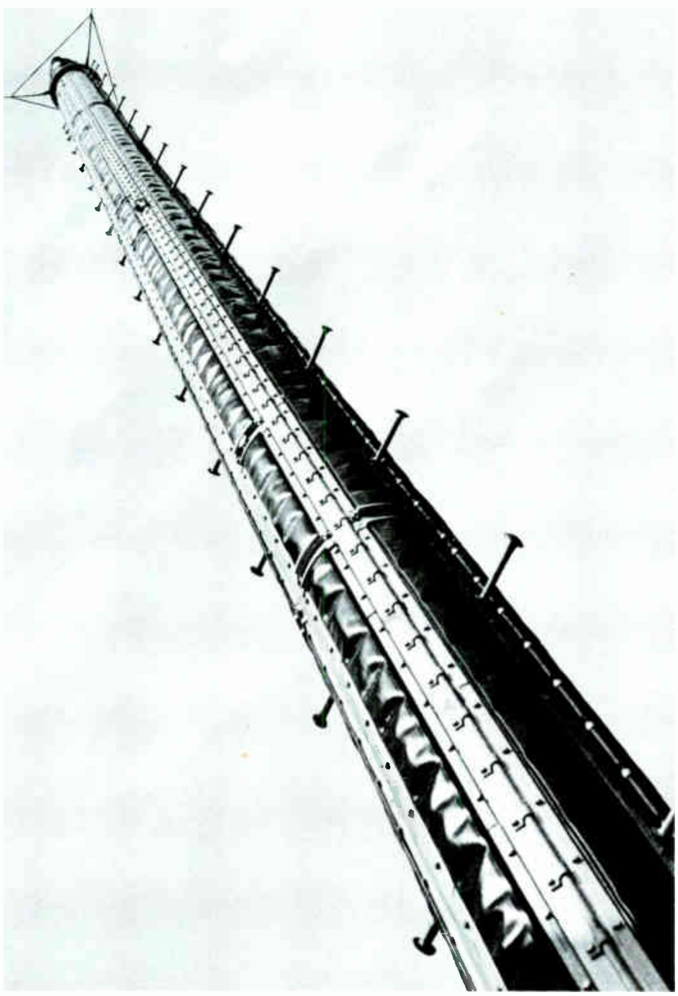
catalog TT.9200B

(Replaces TT.9200A)

RCA

"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
- Custom Pylon can be fitted with Radomes



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.

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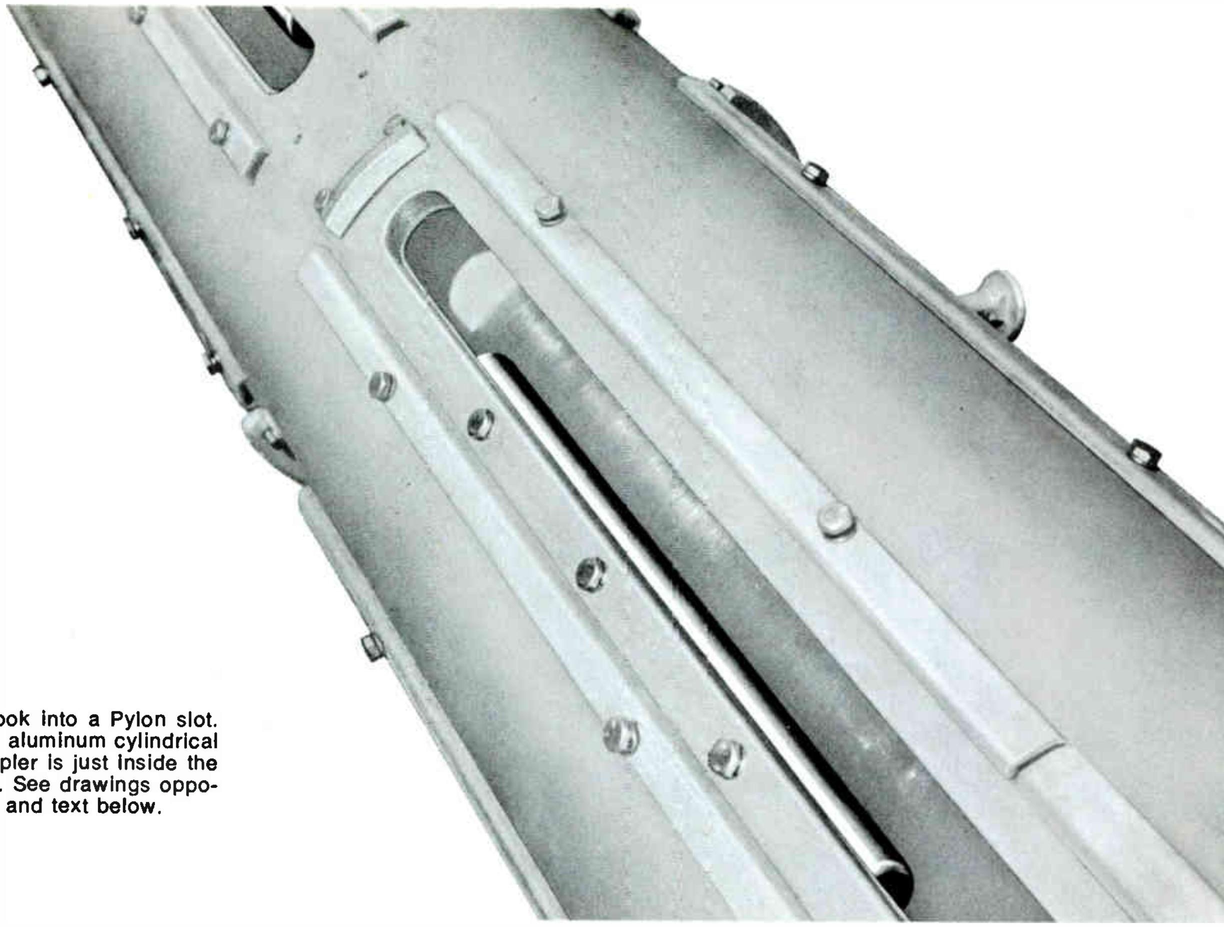


A look into a Pylon slot. The aluminum cylindrical coupler is just inside the slot. See drawings opposite and text below.

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 omidirectional 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

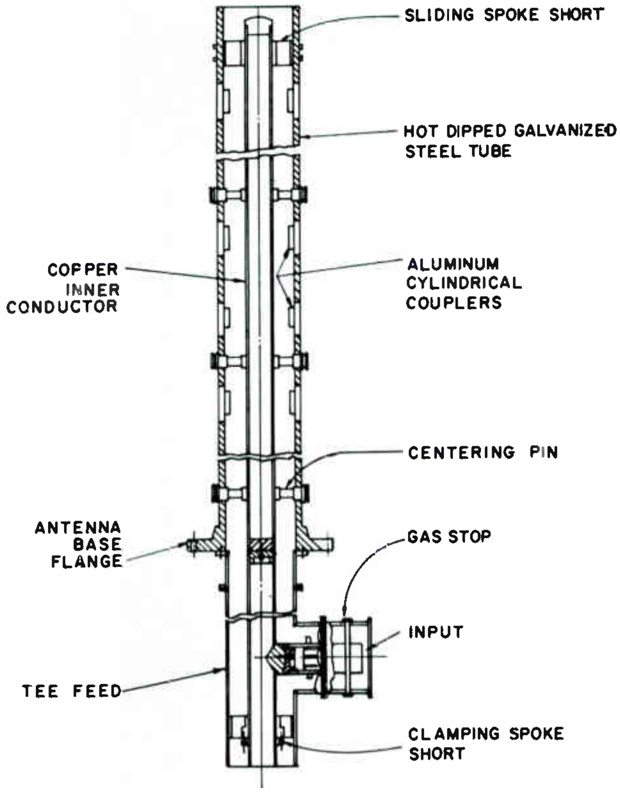
All UHF Pylons use a single feed point. In a "center-fed" Pylon, the inner conductor is a harness-type feed system with a Teflon end-seal feed point at the electrical center of the antenna. The end seal is at the end of a coaxial transmission line input to the antenna, the harness ranges, nominally, from 3⅛ 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

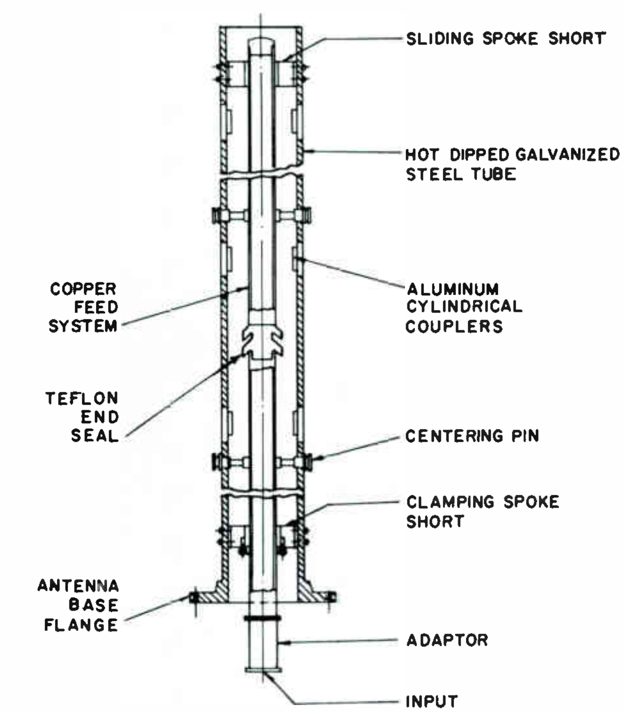
The UHF Pylon uses a flange-mounted, seamless-steel pipe as its structural member. The pipe is slotted and serves as the outer conductor of the antenna. The inner conductor is of copper tubing, positioned concentrically within the outer conductor by ceramic, Teflon-capped, centering pins and locked in 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.

[1] "DL" and "DM" type Pylon antennas use loop couplers instead of bar couplers.



Cross-section drawings of two Pylon types: "end-fed" (above) and "center-fed" (below).



Anti-Corrosion Measures

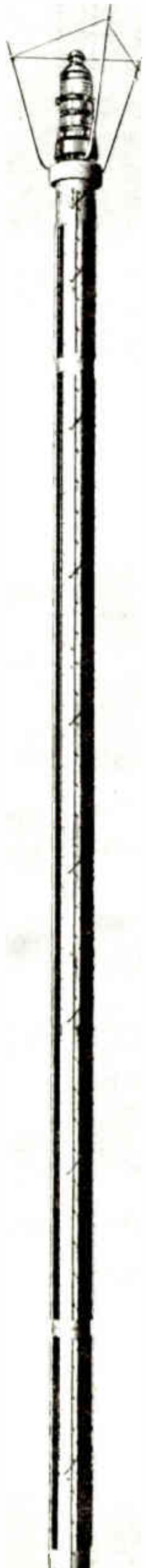
Thorough consideration is given to all aspects of weather corrosion. The slotted cylinder is hot dip galvanized after fabrication; the inner conductor is of copper. Slot covers are virgin polyethylene or fiberglass, as required, both compounded with anti-oxident and ultraviolet inhibitors. Pylon hardware 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-



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/ft^2 (pounds per square foot) (244 kg/m^2) on flats and 33.3 lbs/ft^2 (161 kg/m^2) 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

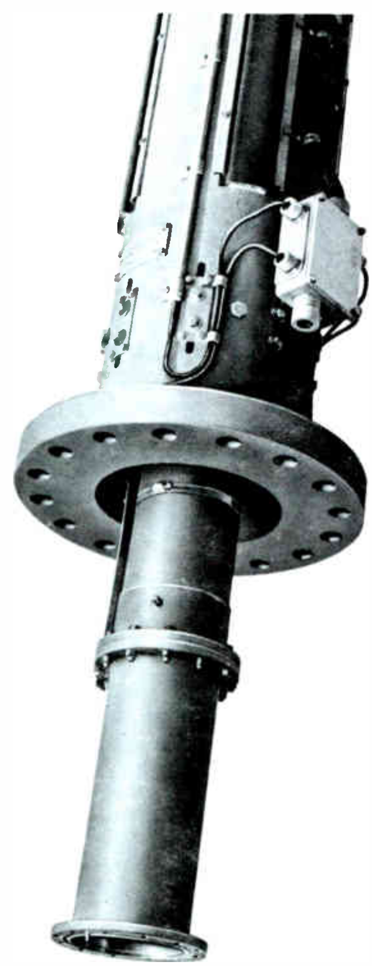
The input power ratings listed here are calculated for normal operating conditions for a temperature rise of 80°C (176°F) over a 40°C (104°F) ambient. Sufficient safety factor is included for FCC-allowable operating power fluctuations and normal VSWR variations. The rated input power is based on peak 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.



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", "trilobe" or cardioid 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

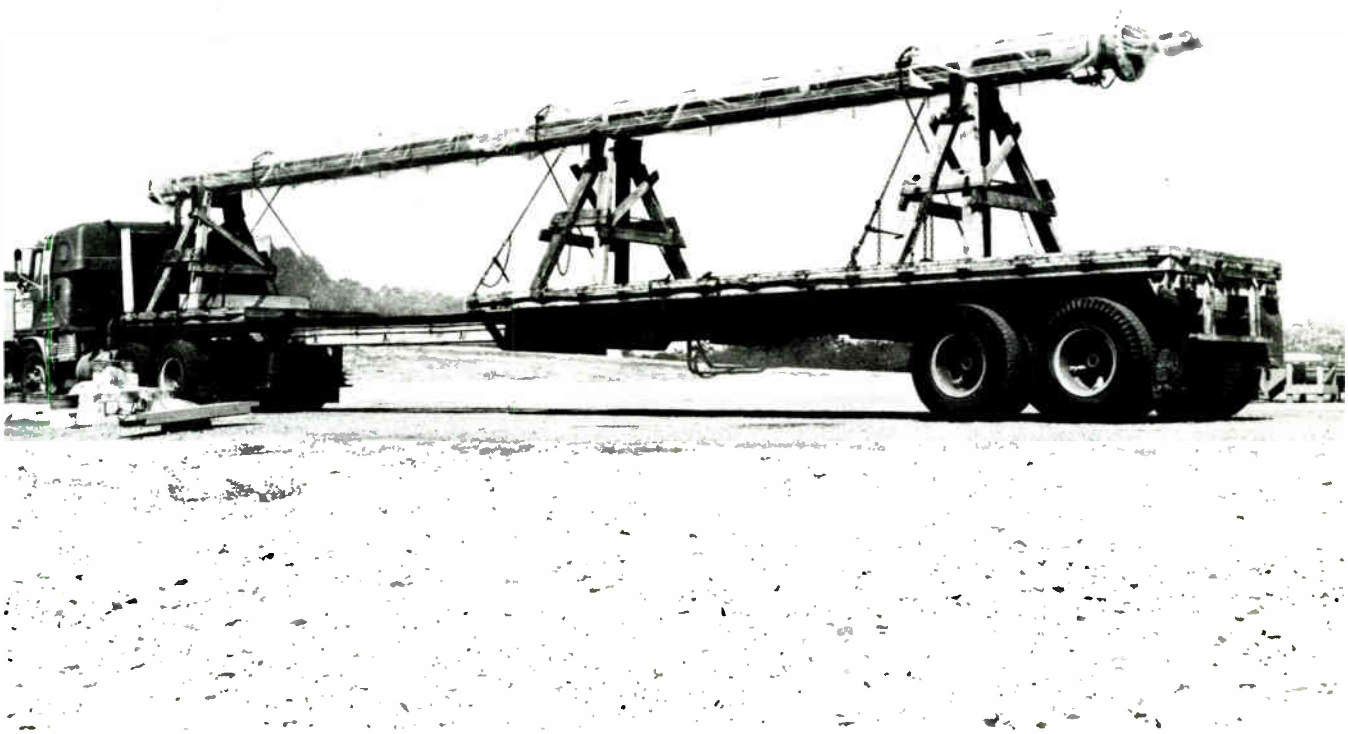
Input VSWR is tuned and optimized during manufacture to minimize reflections to a specification of 3% or less, measured with a 0.25 microsecond RF pulse at visual carrier frequency.

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.



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.

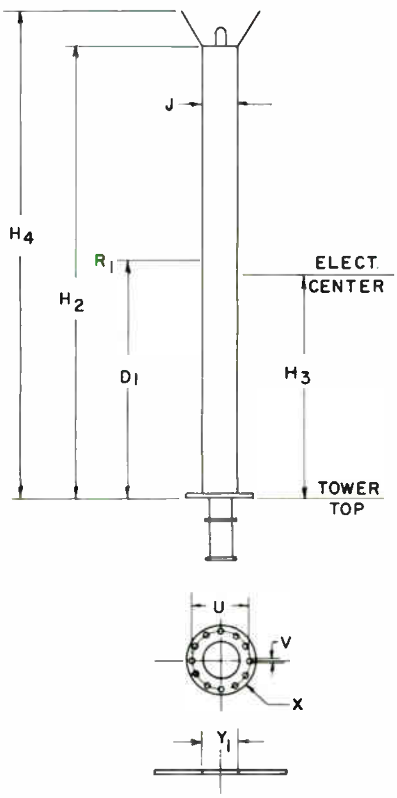
PEAK TV INPUT POWER RATING

(Based on black level visual power and 20 percent aural power for 40°C ambient temp.)

	ANTENNA FEED TYPES																					
	"HARNESS" FEED														"TEE" FEED							
Ch.	3⅛"		4⅛"		5"		6⅛"		7½"		8-3/16"		9-3/16"		6⅛"		CUSTOM		8-3/16"		9-3/16"	
No.	kW	dBk	kW	dBk	kW	dBk	kW	dBk	kW	dBk	kW	dBk	kW	dBk	kW	dBk	kW	dBk	kW	dBk	kW	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	23	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

Mechanical Specifications



Outline
Drawing
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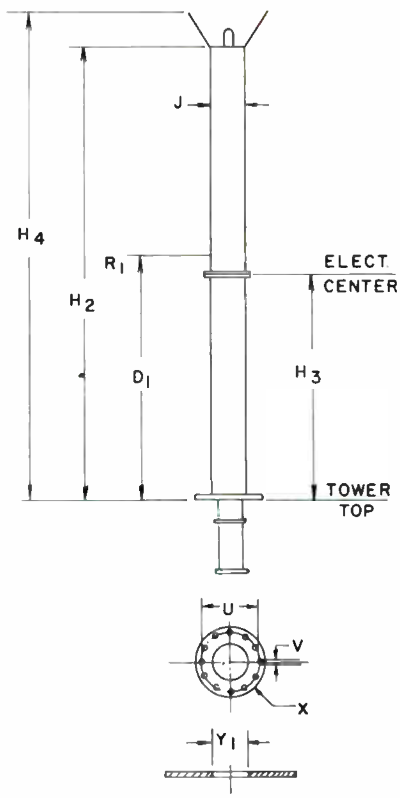

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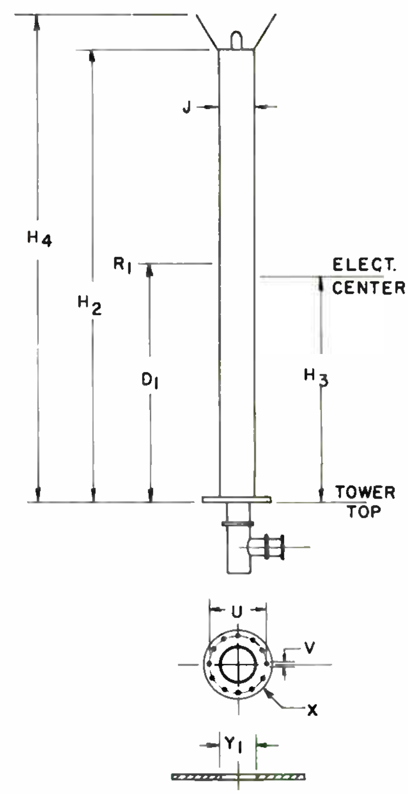

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Mechanical Symbol Definitions

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.

Standard Omnidirectional UHF Pylon Antennas

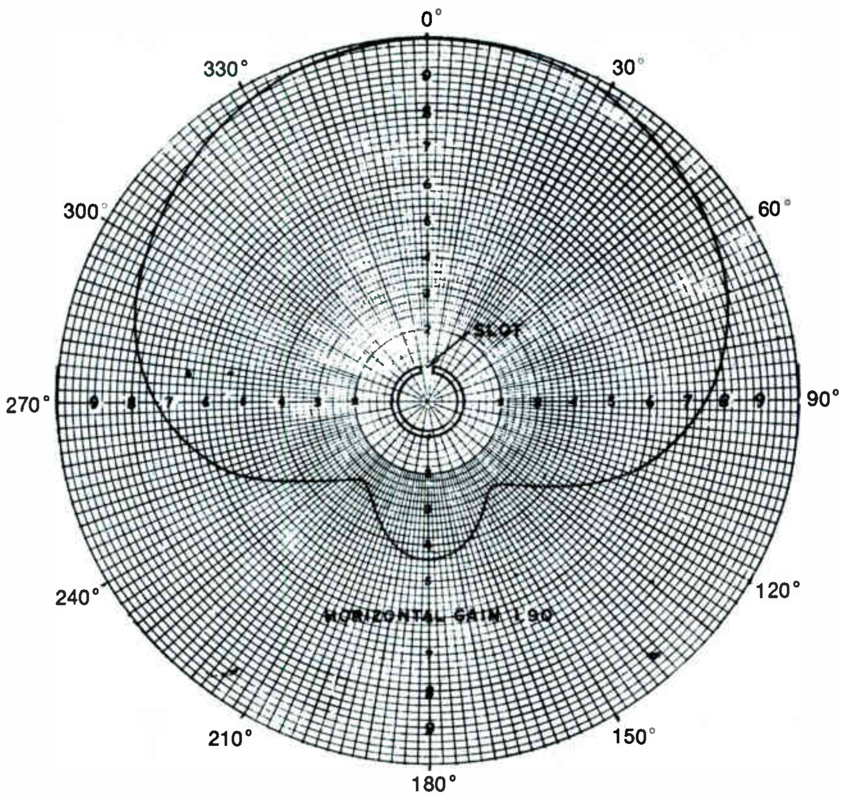
The antenna types are listed in the table below in increasing gain value by null filled and smooth vertical pattern categories. The null-filled types have vertical patterns derived from high aperture efficiency uniform illuminations. The illuminations are modified to provide desired null fill while retaining 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_1 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	8-3/16" (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	8-3/16" (208)	All	35	Smooth	B	2	16" (406)	23¾" (603)	1¾" (44)	20	15¼" (387)
TFU-35G	51-56	8-3/16" (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	9-3/16" (233)	All	40/46	Smooth	B	2	18" (457)	25¾" (654)	1¾" (44)	20	18" (457)
TFU-28G	14-21		All	28	Smooth	B	2					
TFU-40/46K	41-56	8-3/16" (208)	All	40/46	Smooth	B	2	16" (406)	23¾" (603)	1¾" (44)	20	15¼" (387)
TFU-28G	22-70		All	28	Smooth	A	1					
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)

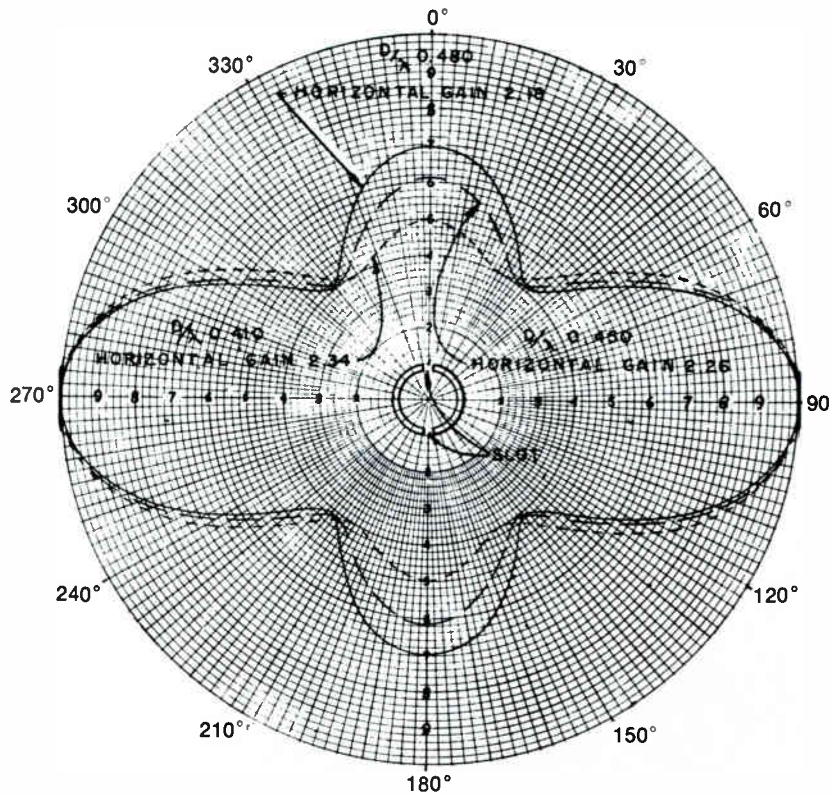


Skull Shaped Pattern Antennas

(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	12" (305)
TFU-30JDAS	14-40	6/8" Tee (152/203)	0.0°	30	Null Filled	C	1	9⅝" (244)	15¼" (387)	1⅛" (29)	16	12" (305)
TFU-30JDAS	31-50	6/8" Tee (152/203)	0.0°	30	Null Filled	C	1	8⅝" (219)	13¾" (349)	1⅛" (29)	12	12" (305)
TFU-30JDAS	51-70	6" Tee (152)	0.0°	30	Null Filled	C	1	6⅝" (168)	10⅝" (270)	⅞" (22)	12	10" (254)
TFU-28DAS	14-30	6/8/9" Tee (152/203/229)	All	28	Smooth	C	1	10¾" (273)	15¼" (387)	1⅛" (29)	16	12" (305)
TFU-28DAS	20-40	6/8" Tee (152/203)	All	28	Smooth	C	1	9⅝" (244)	15¼" (387)	1⅛" (29)	16	12" (305)
TFU-28DAS	31-52	6/8" Tee (152/203)	All	28	Smooth	C	1	8⅝" (219)	13¾" (349)	1⅛" (29)	12	12" (305)

(Parenthetical dimensions are millimeters)



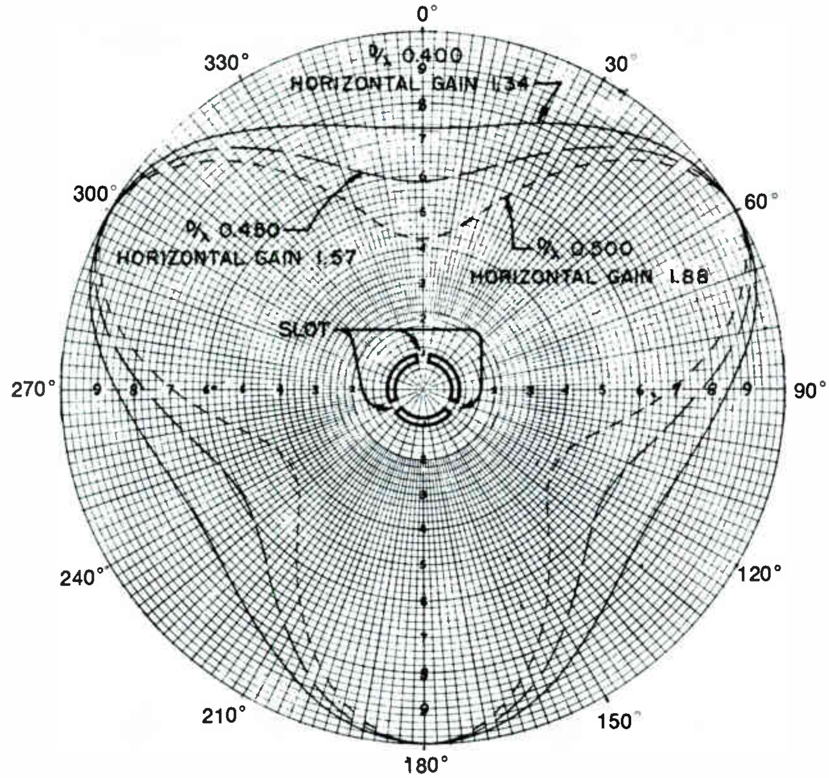
Symbol Definitions: D = Pole outer diameter; λ = Mid-channel wavelength.
(Note: Gain and pattern vary with D/λ ratio.)

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	12″ (305)
TFU-30JDAS	14-36	6/8″ Tee (152/203)	0.0°	30	Null Filled	C	1	9⅝″ (244)	15¼″ (387)	1⅛″ (29)	16	12″ (305)
TFU-30JDAS	27-50	6/8″ Tee (152/203)	0.0°	30	Null Filled	C	1	8⅝″ (219)	13¾″ (349)	1⅛″ (29)	12	12″ (305)
TFU-30JDAS	51-70	6″ Tee (152)	0.0°	30	Null Filled	C	1	6⅝″ (168)	10⅝″ (270)	⅞″ (22)	12	10″ (254)
TFU-28DAS	14-25	6/8/9″ Tee (152/203/229)	All	28	Smooth	C	1	10¾″ (273)	15¼″ (387)	1⅛″ (29)	16	12″ (305)
TFU-28DAS	26-36	6/8″ Tee (152/203)	All	28	Smooth	C	1	9⅝″ (244)	15¼″ (387)	1⅛″ (29)	16	12″ (305)
TFU-28DAS	37-50	6/8″ Tee (152/203)	All	28	Smooth	C	1	8⅝″ (219)	13¾″ (349)	1⅛″ (29)	12	12″ (305)

(Parenthetical dimensions are millimeters)



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	12″ (305)
TFU-30JDAS	22-50	6/8″ Tee (152/203)	0.0°	30	Null Filled	C	1	9⅝″ (244)	15¼″ (387)	1⅛″ (29)	16	12″ (305)
TFU-30JDAS	30-62	6/8″ Tee (152/203)	0.0°	30	Null Filled	C	1	8⅝″ (219)	13¾″ (349)	1⅛″ (29)	12	12″ (305)
TFU-28DAS	14-35	6/8/9″ Tee (152/203/229)	All	28	Smooth	C	1	10¾″ (273)	15¼″ (387)	1⅛″ (29)	16	12″ (305)
TFU-28DAS	22-50	6/8″ Tee (152/203)	All	28	Smooth	C	1	9⅝″ (244)	15¼″ (387)	1⅛″ (29)	16	12″ (305)
TFU-28DAS	35-62	6/8″ Tee (152/203)	All	28	Smooth	C	1	8⅝″ (219)	13¾″ (349)	1⅛″ (29)	12	12″ (305)

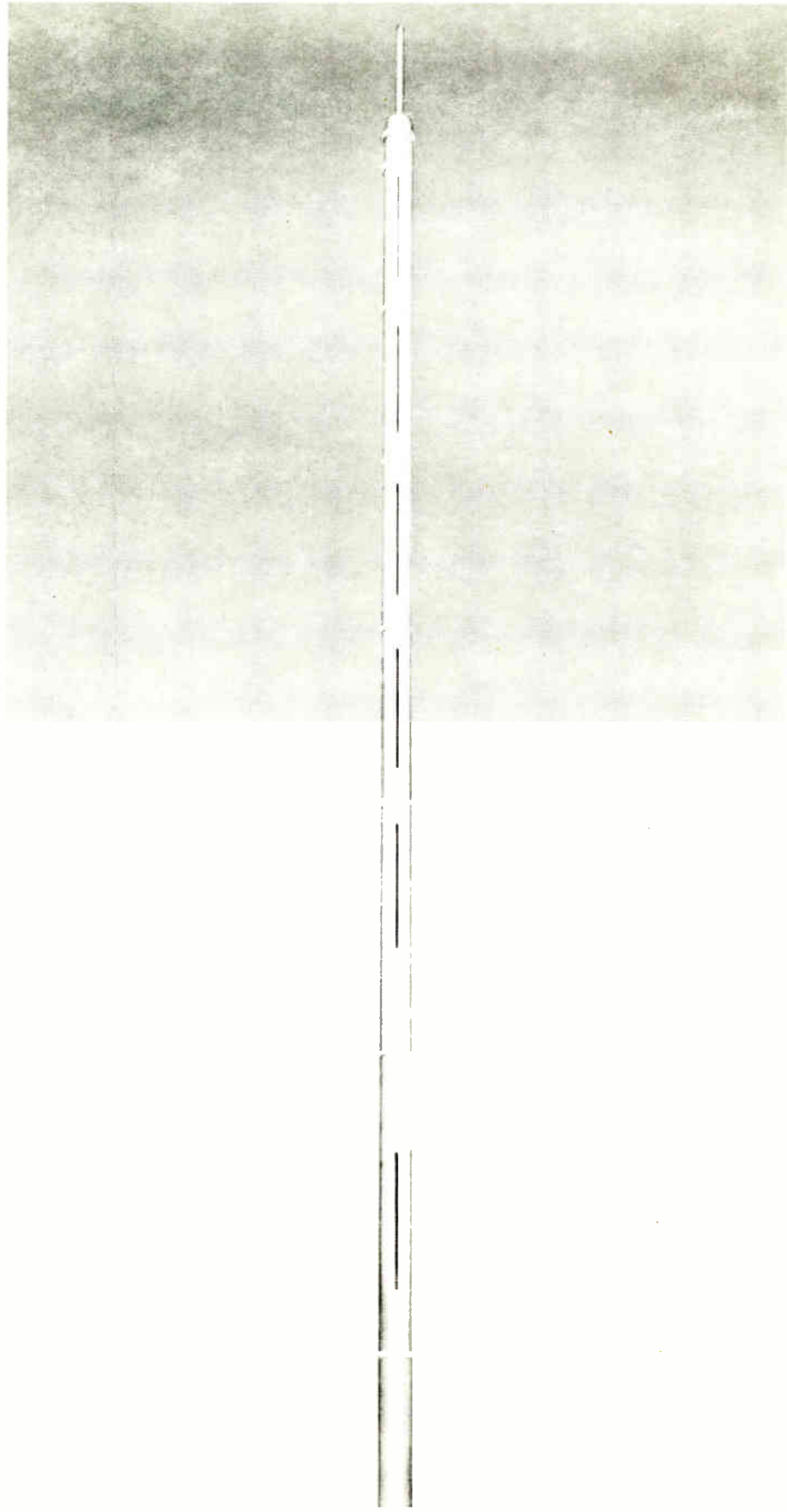
(Parenthetical dimensions are millimeters)

Omnidirectional, UHF Pylon, Type TFU-6D

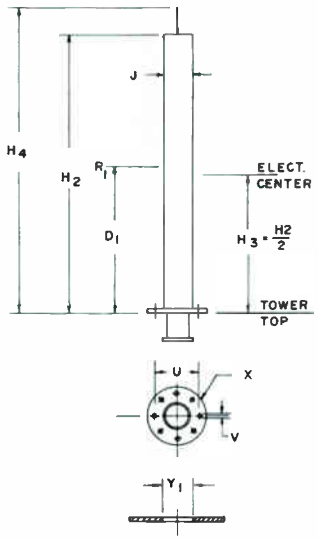
- Low gain for local, satellite or standby service
- Radome included — no de-icer power required
- Lightning rod equipped — grounded through tower
- Mounting flange attachment to tower top
- Maximum input power 10 kW

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.



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)

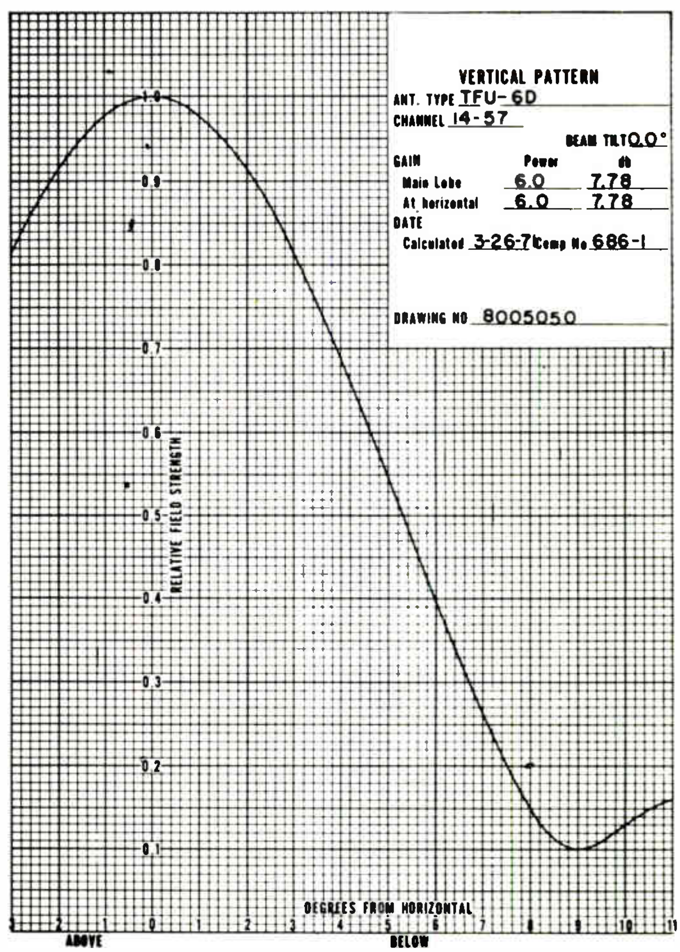
Mechanical Specifications

Type TFU-6D Omnidirectional Pattern

Ch.	H_2		D_1		R_1		Moment		Weight	
No.	Ft	M	Ft	M	Lbs	Kg	Ft-Lbs	M-Kg	Lbs	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

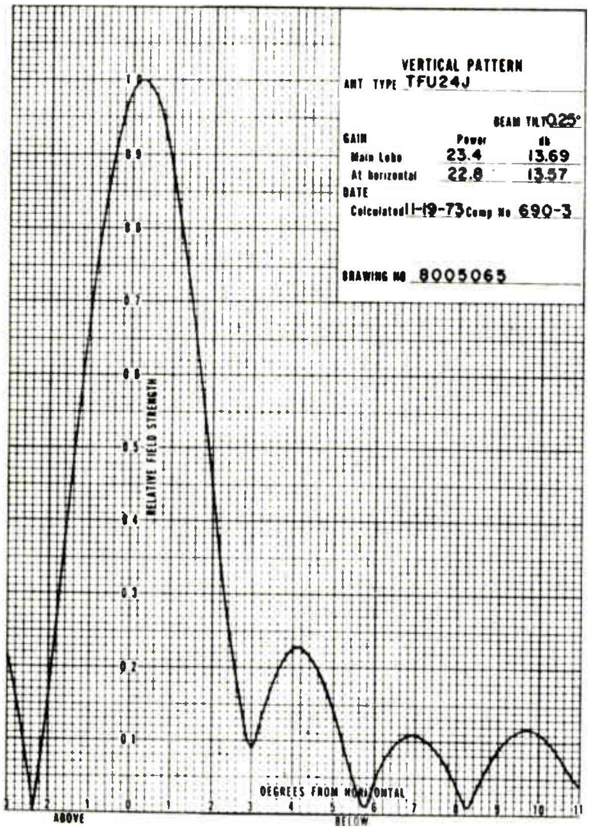
$H_4 = H_2 + 1.5'$ (4.57 mm)

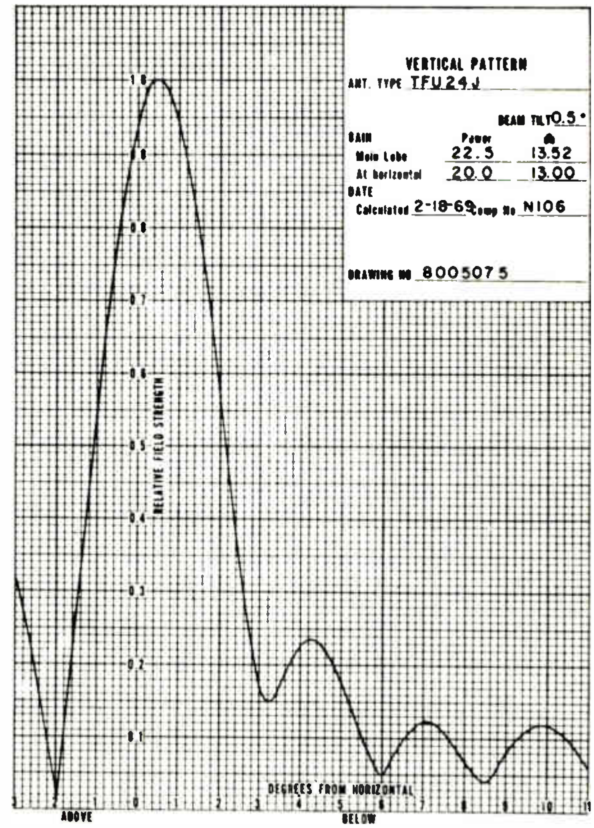
Calculated Vertical Pattern, Type TFU-6D

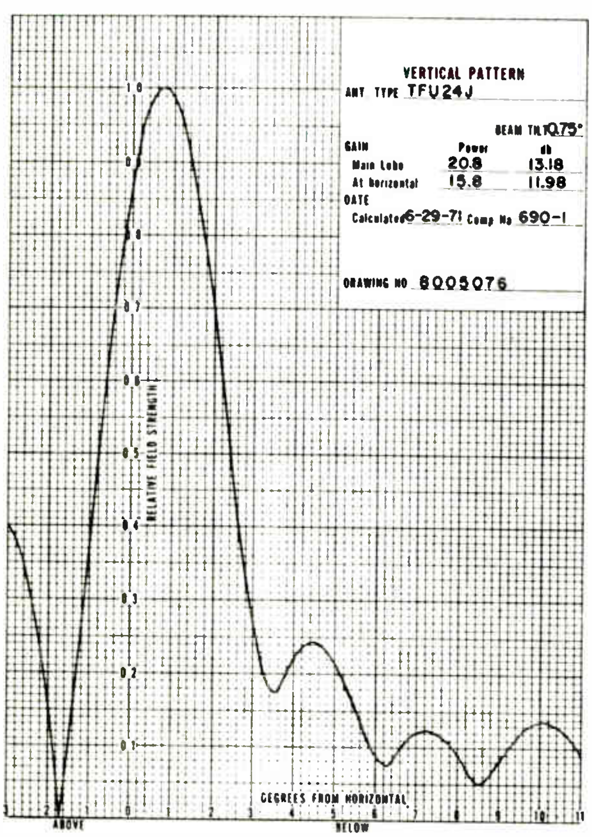


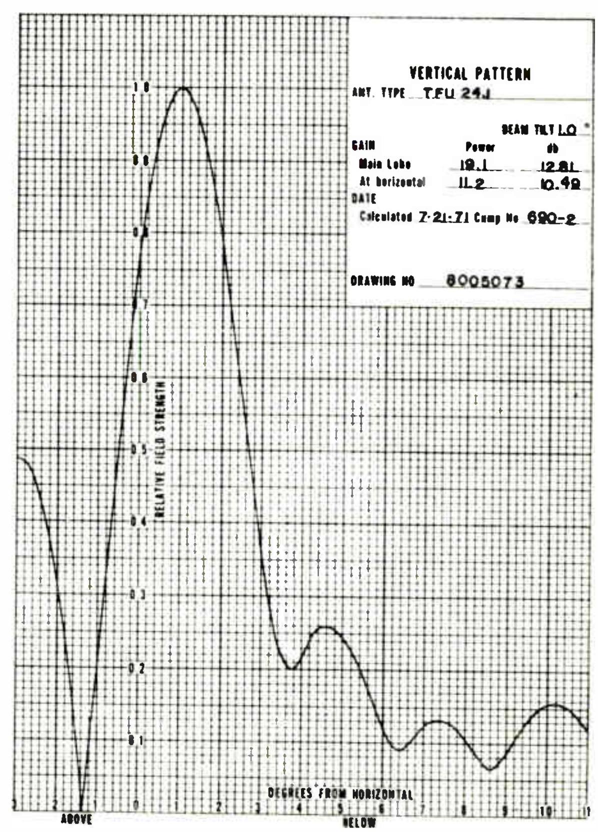
Calculated Vertical Patterns: Omnidirectional Pylon, Type TFU-24J

Patterns may be used as typical for TFU-24DL and 24DM.

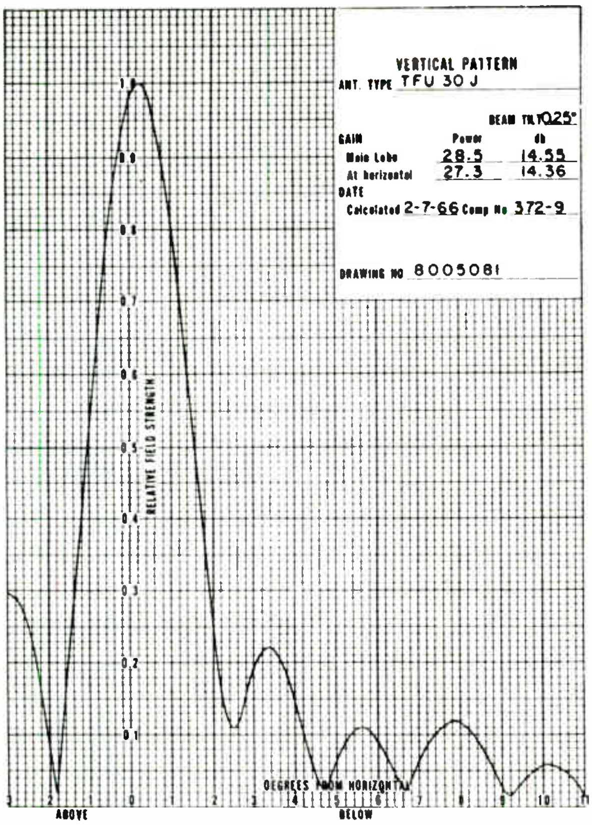


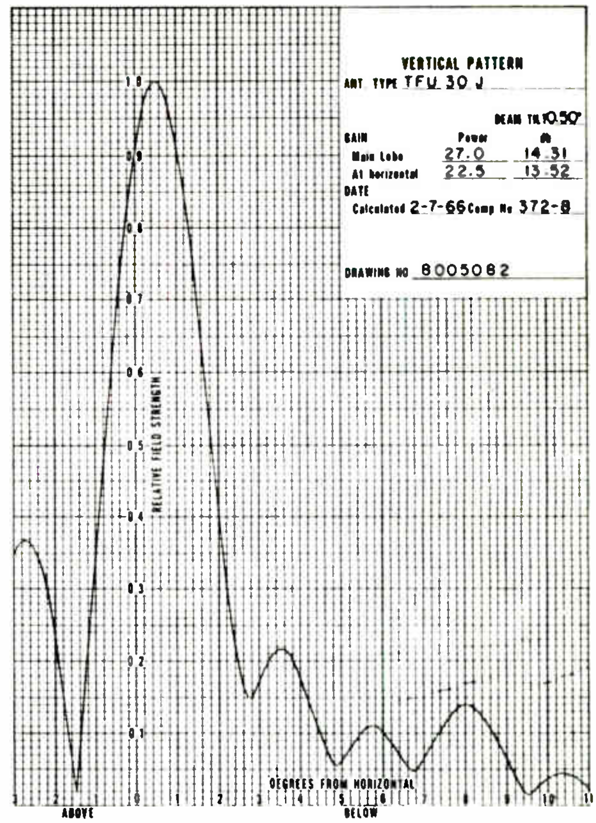


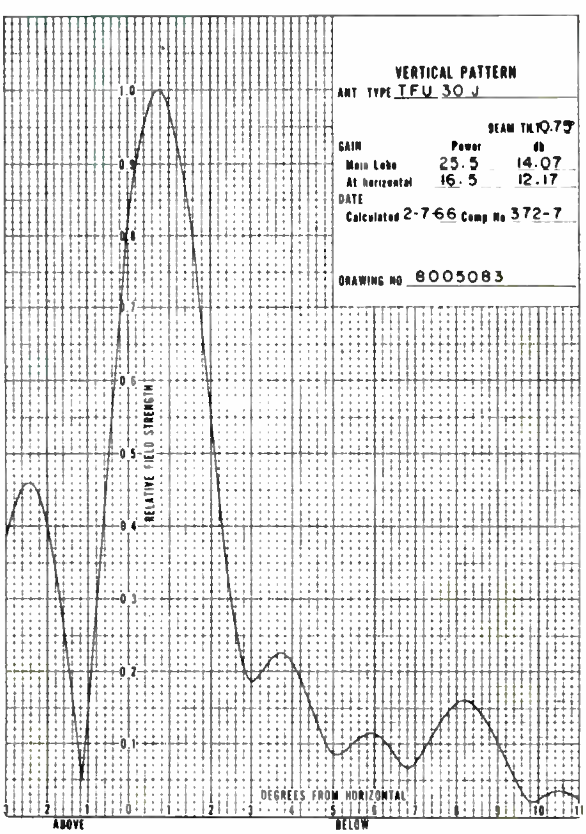


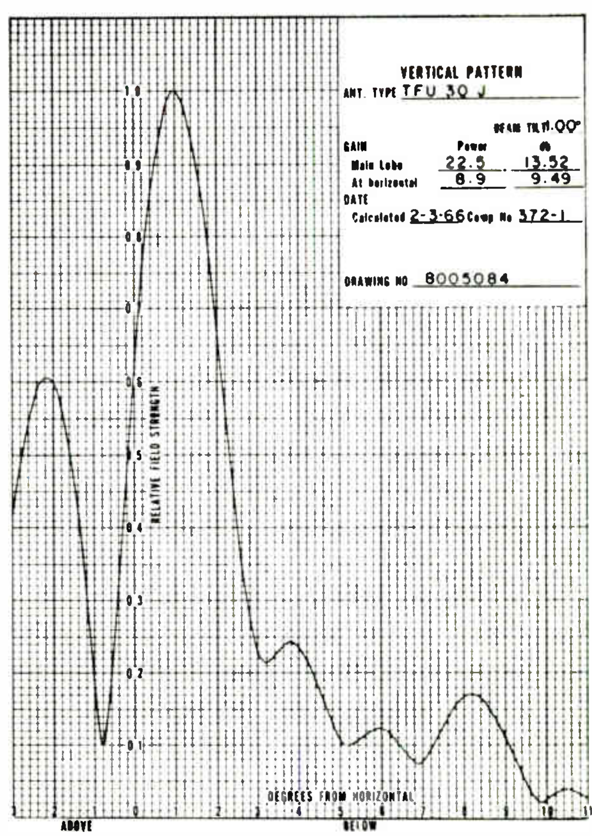


Calculated Vertical Patterns: Omnidirectional Pylon, Type TFU-30J Directional Pylons, Type TFU-30JDA - 30JDAS and Cardioid

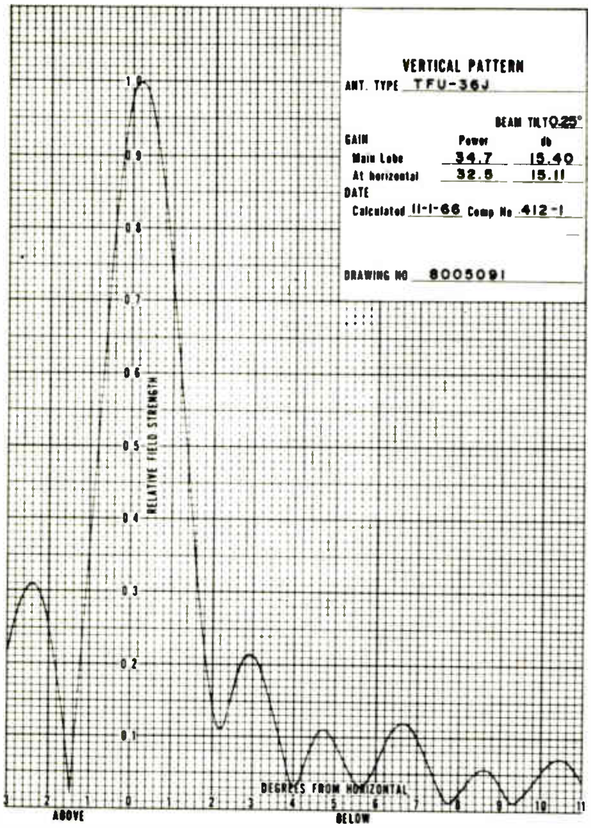


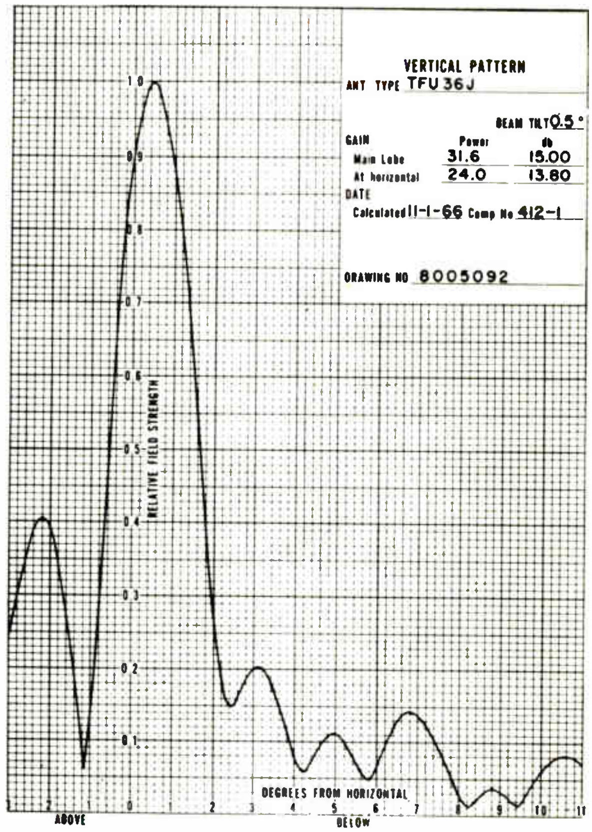


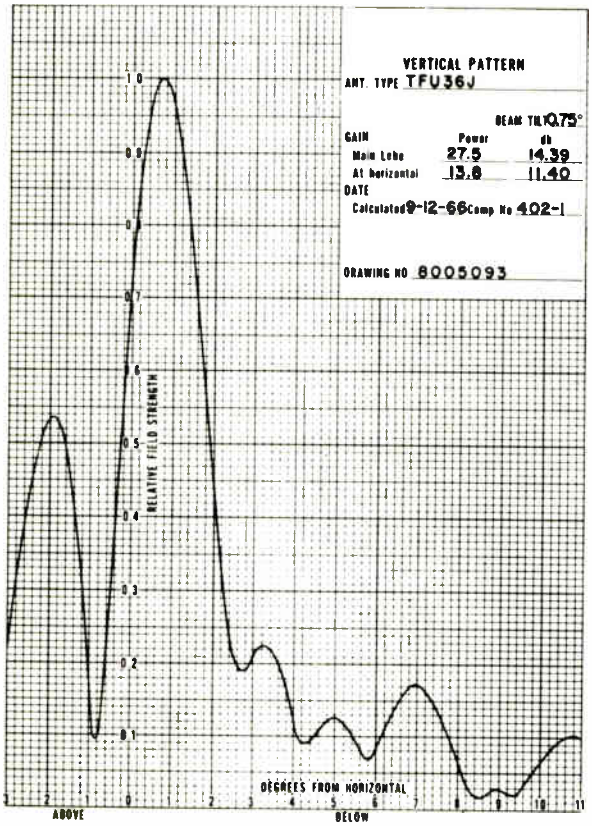


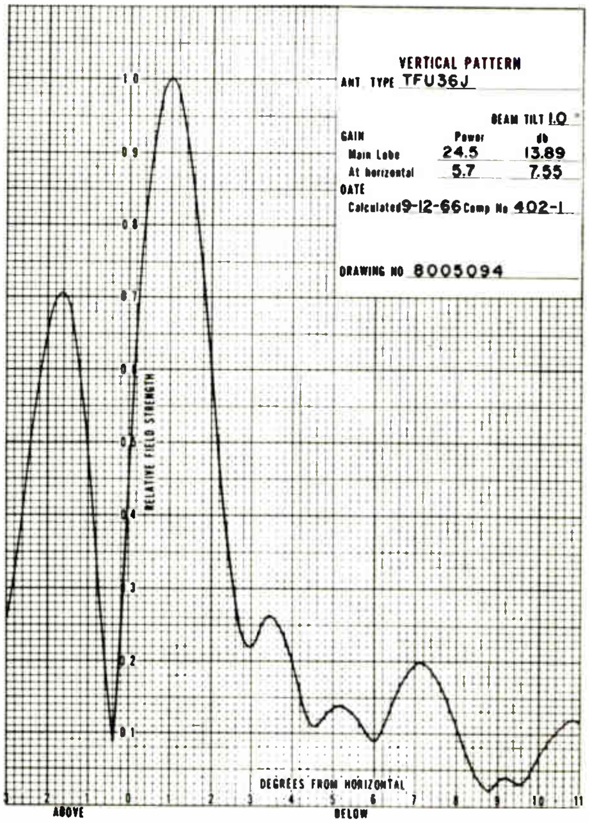


Calculated Vertical Patterns:
Omnidirectional Pylon, Type TFU-36J, Directional Pylon, Type TFU-36JDA, 36JDAS

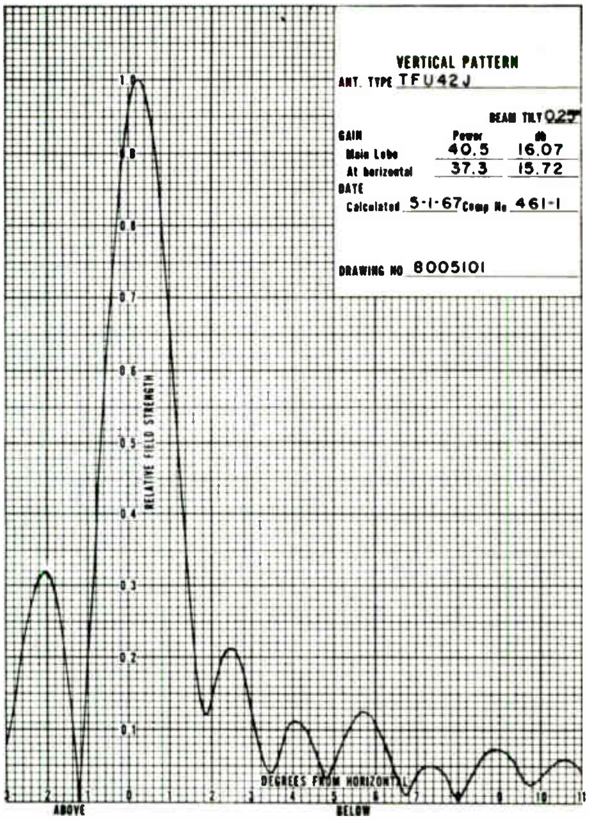


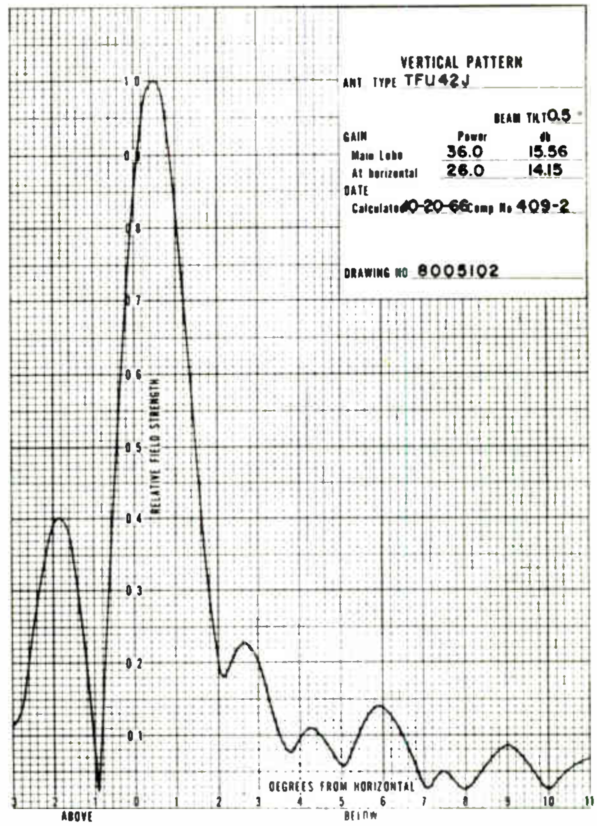


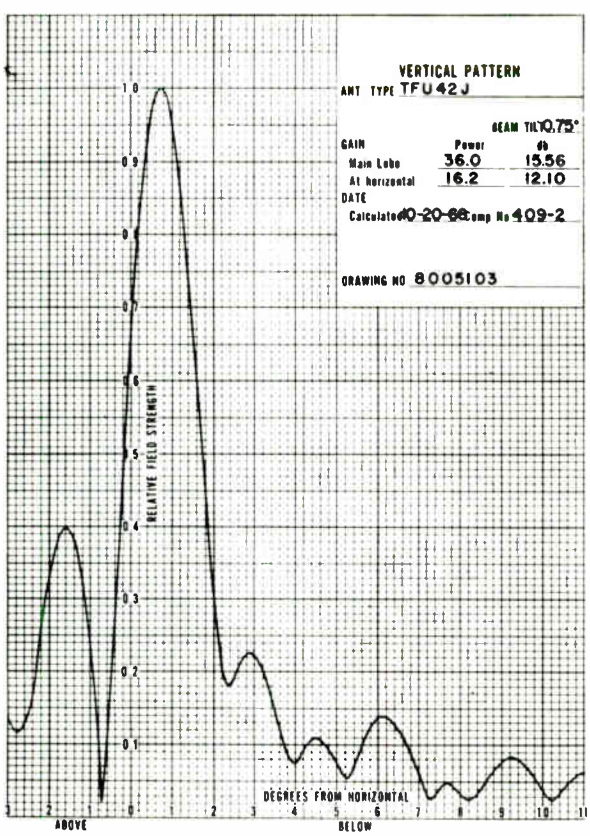


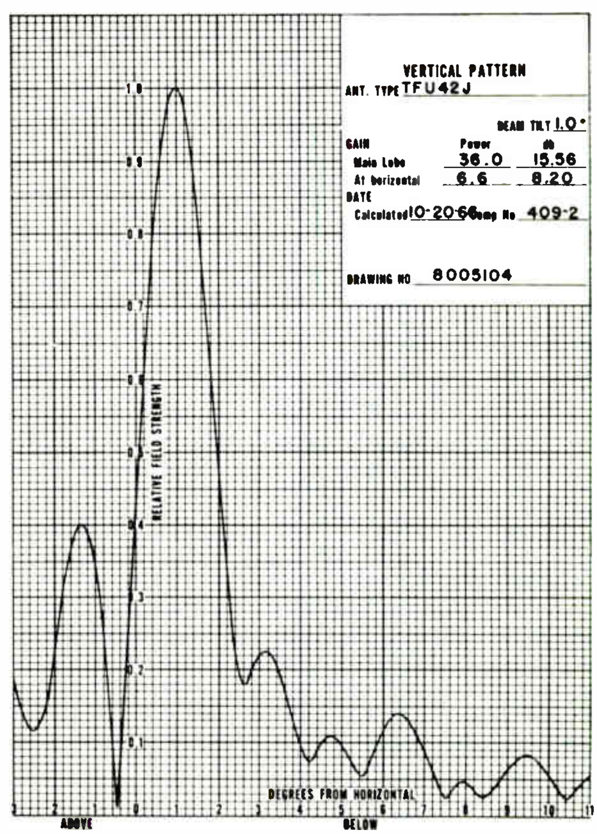


Calculated Vertical Patterns: Omnidirectional Pylon, Type TFU-42J

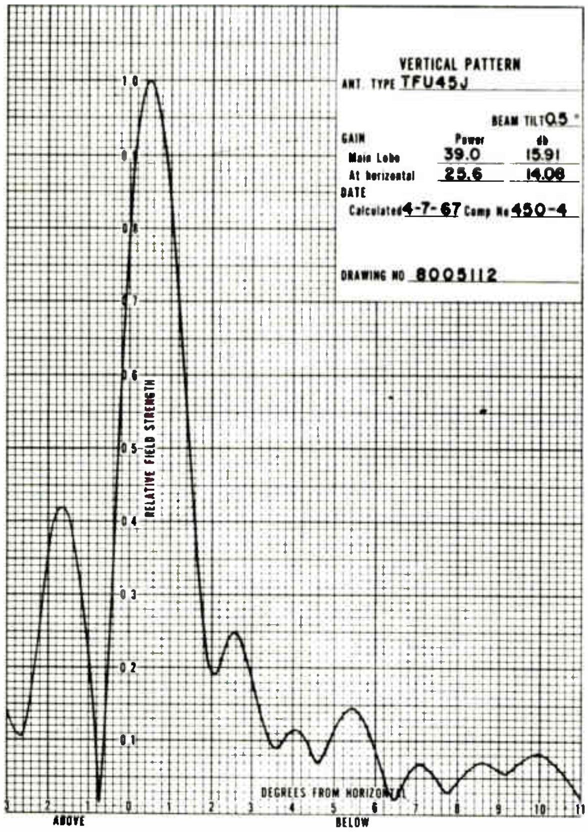


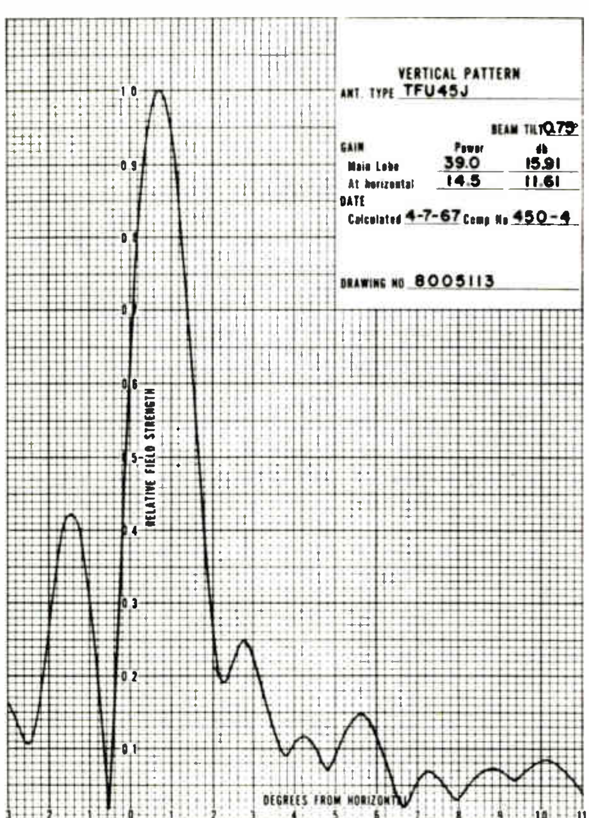




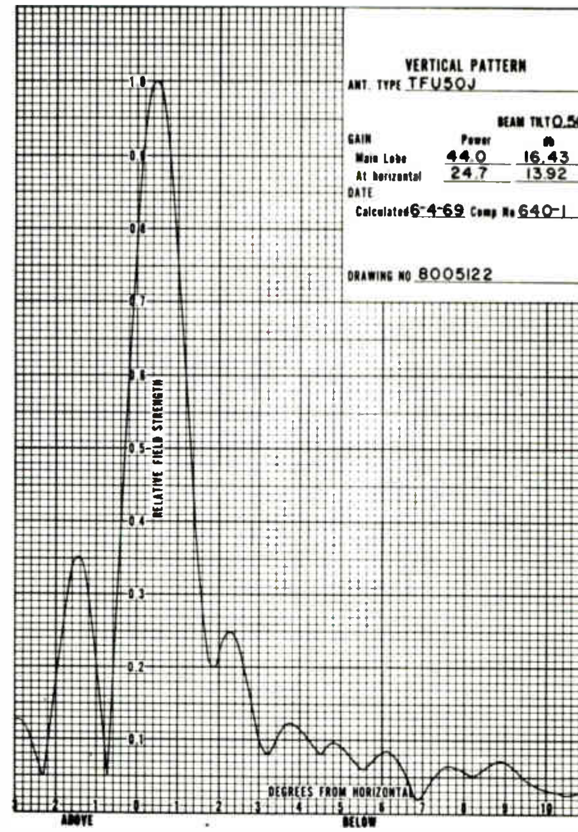


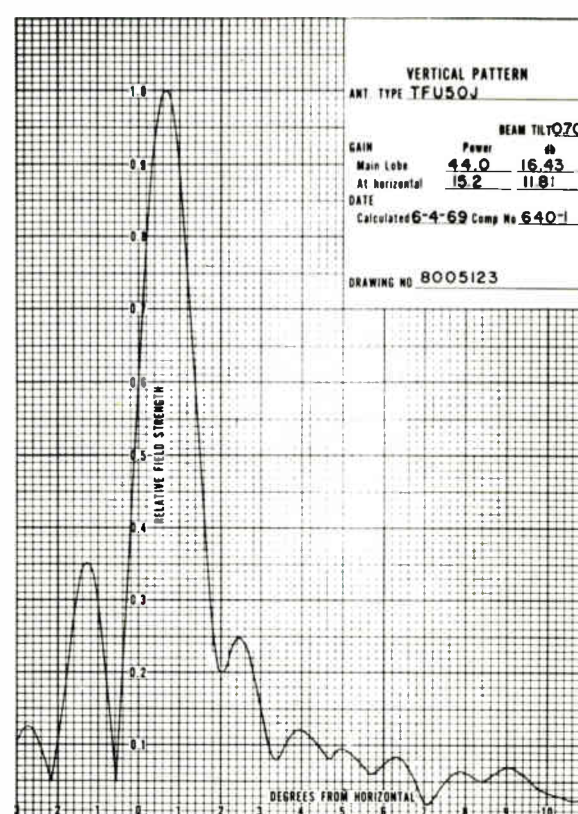
Calculated Vertical Patterns:
Omnidirectional Pylon, Type TFU-45J



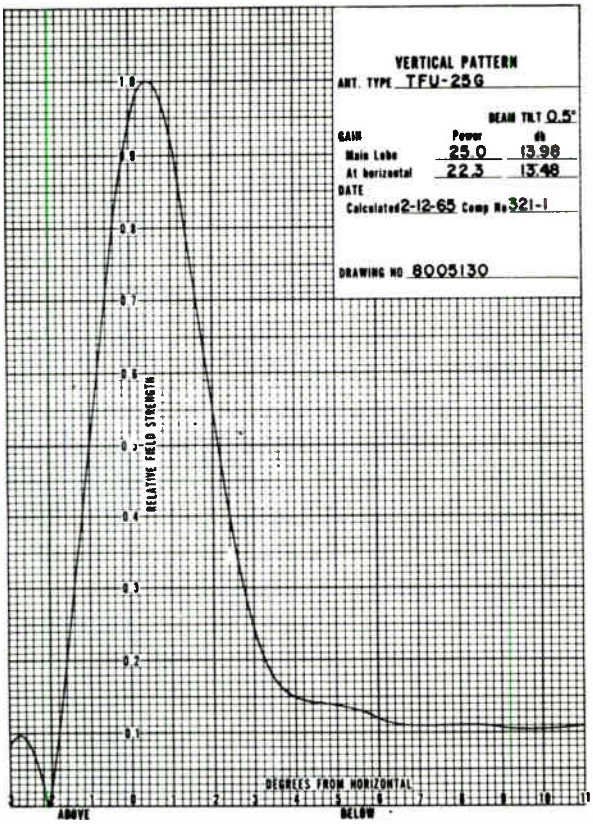


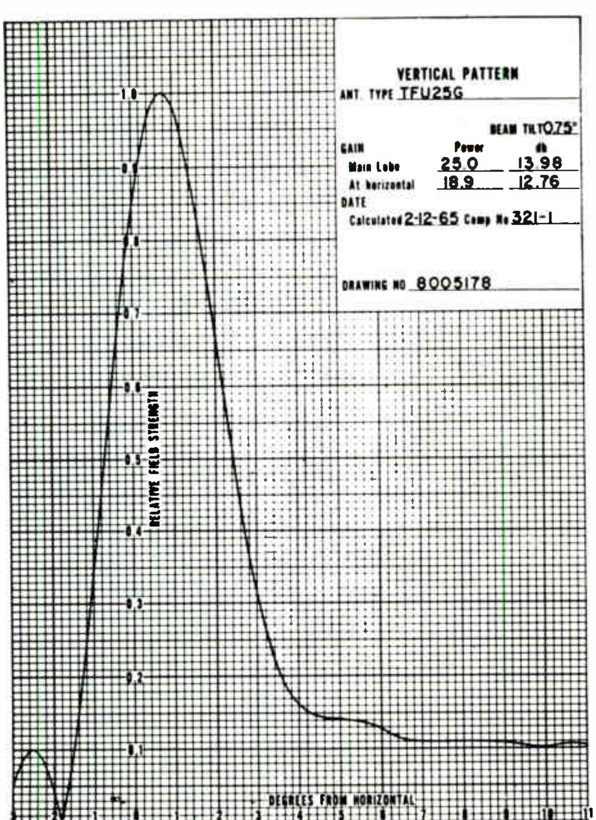
Omnidirectional Pylon, Type TFU-50J



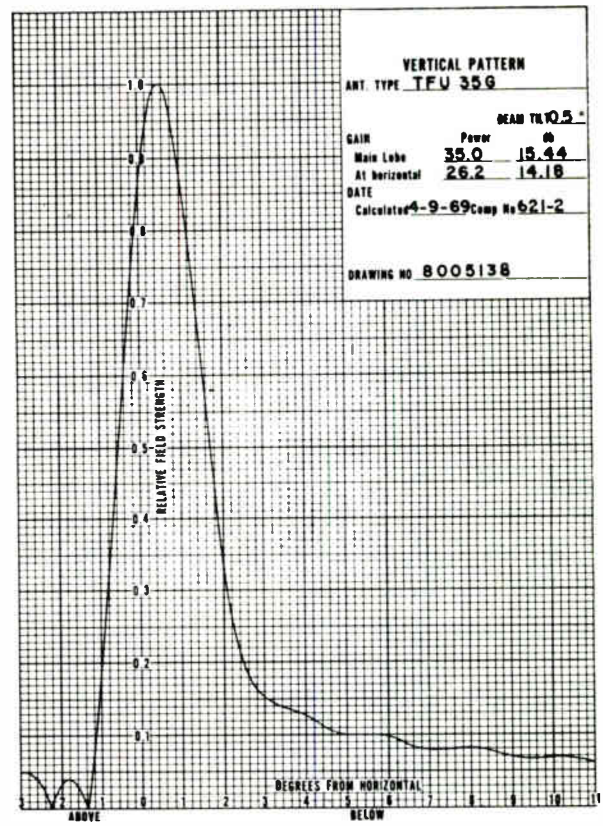


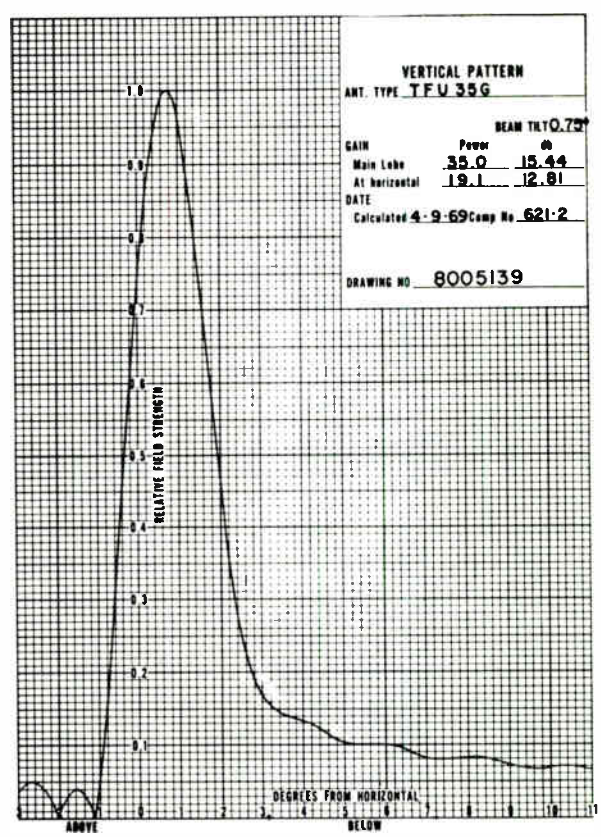
Calculated Vertical Patterns:
Omnidirectional Pylon, Types TFU-25G/25GA



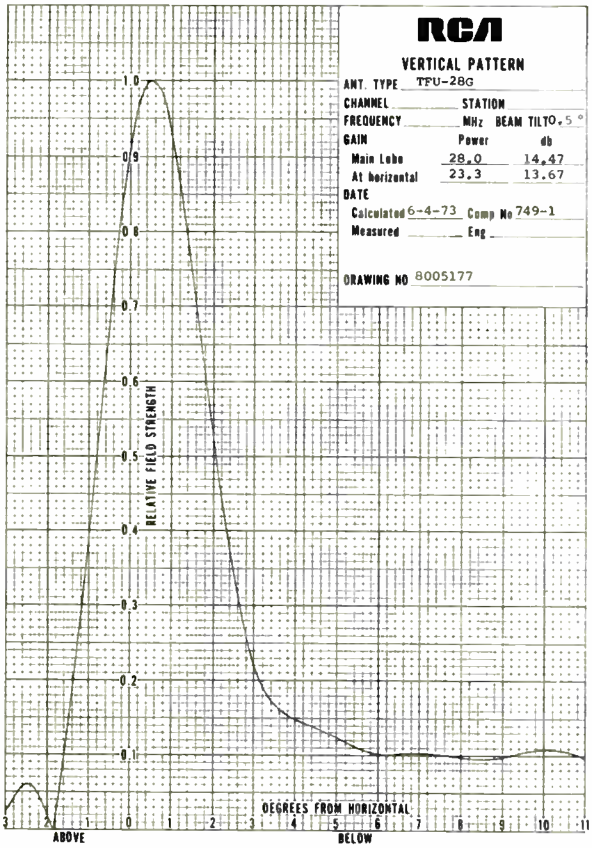


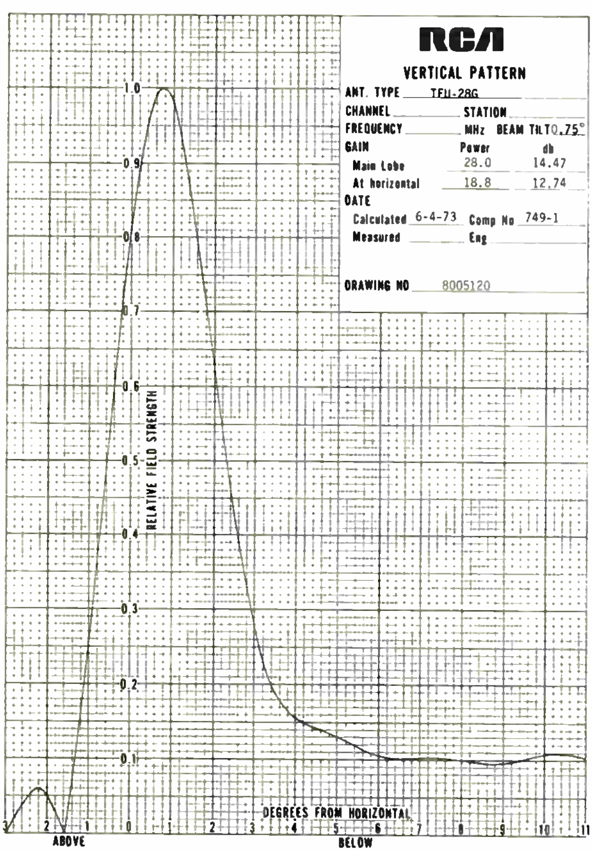
Omnidirectional Pylon, Type TFU-35G



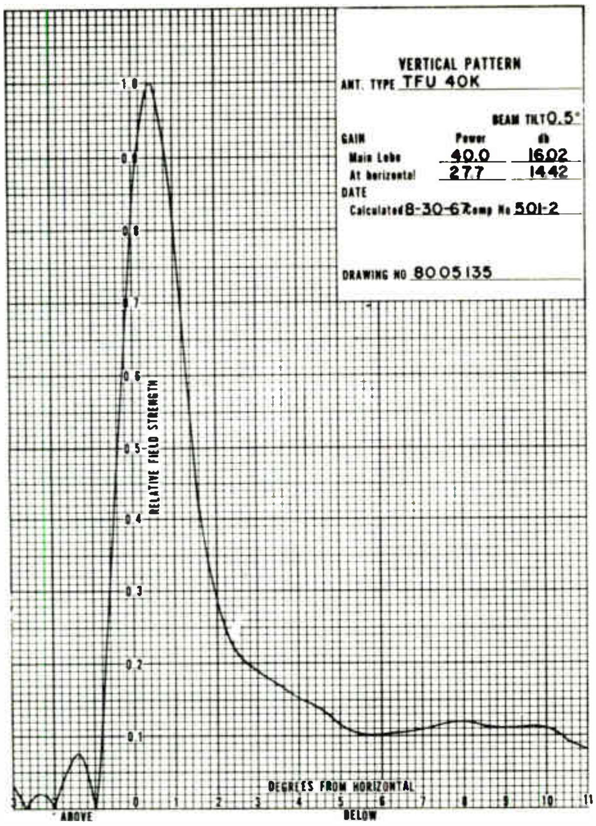


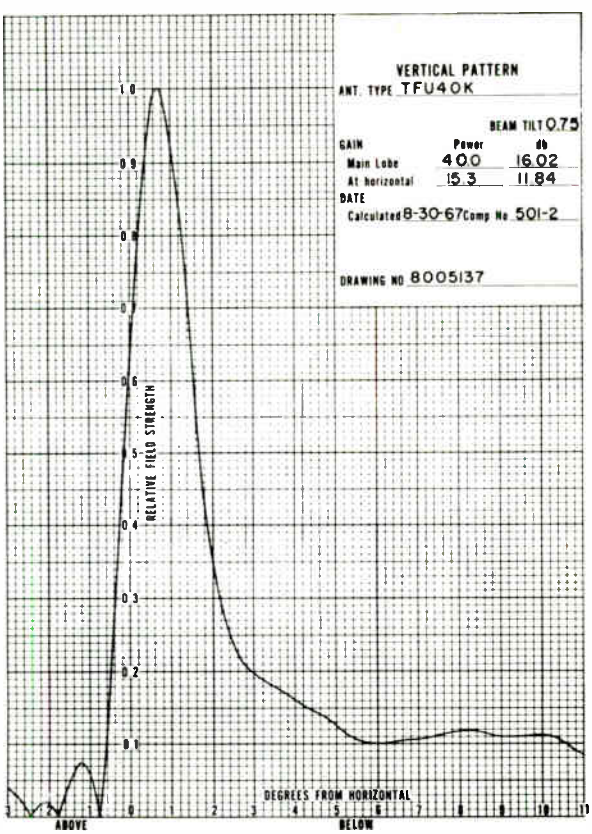
Calculated Vertical Patterns: Omnidirectional Pylon, Type TFU-28G



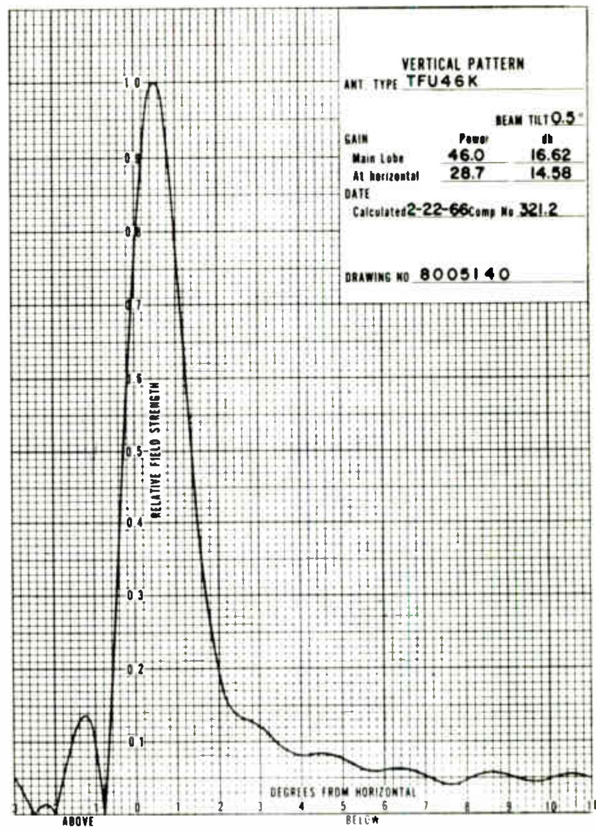


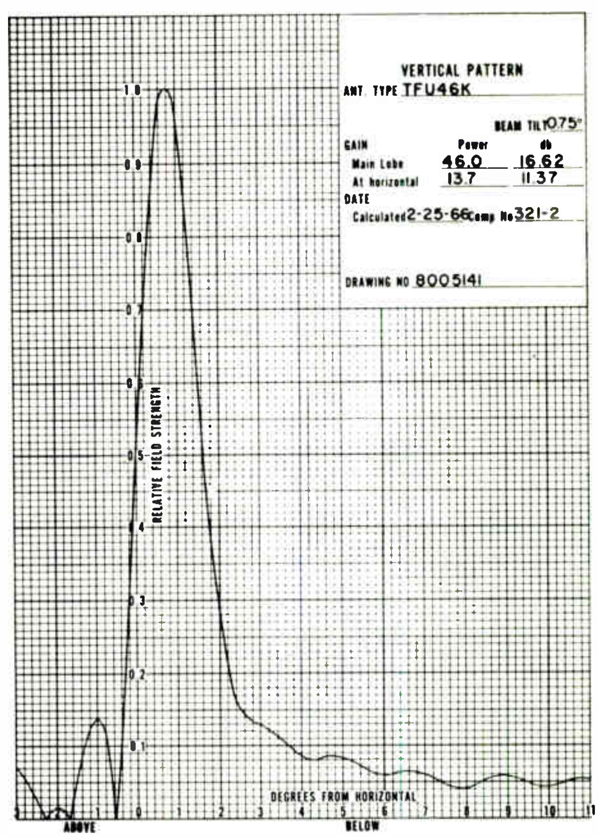
Calculated Vertical Patterns:
Omnidirectional Pylon, Type TFU-40K



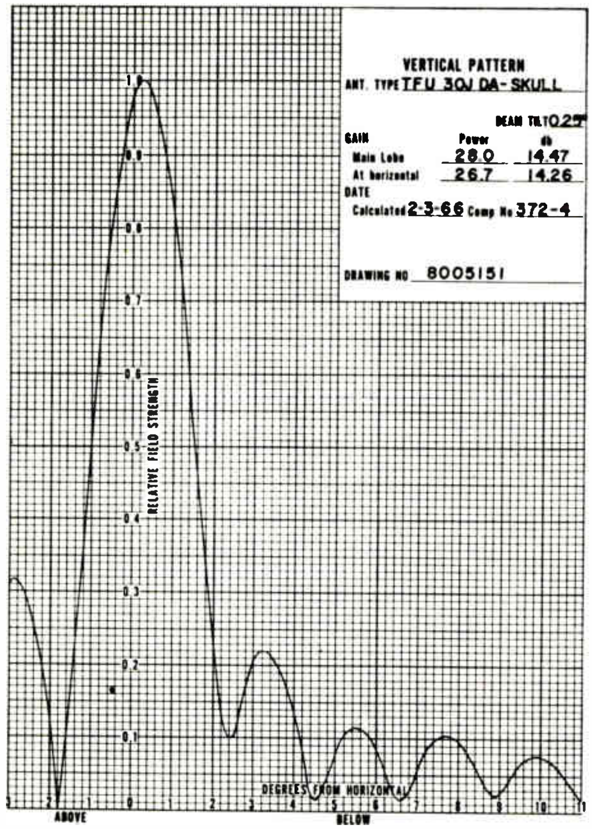


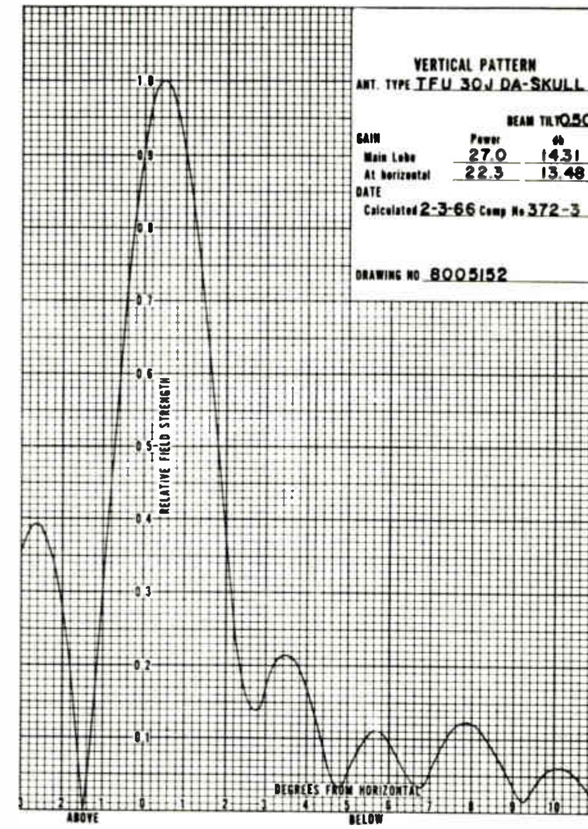
Omnidirectional Pylon, Type TFU-46K

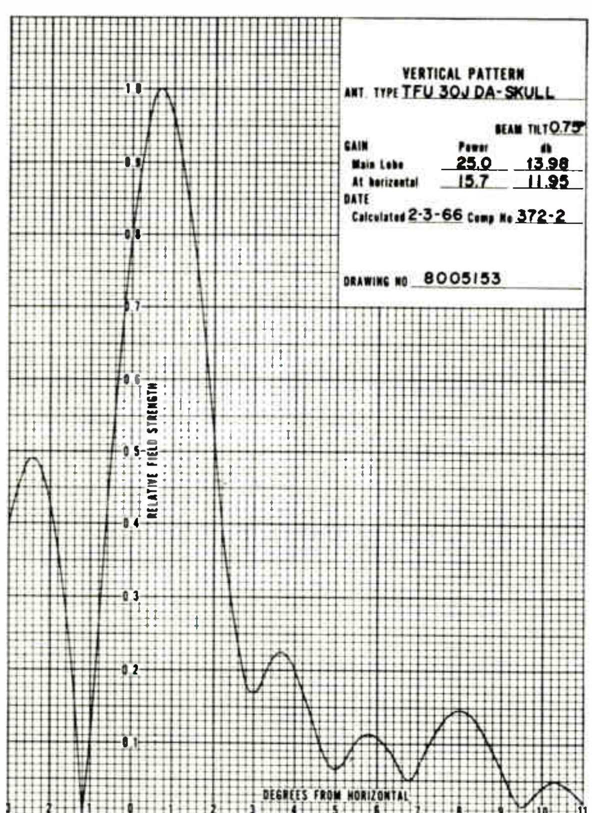


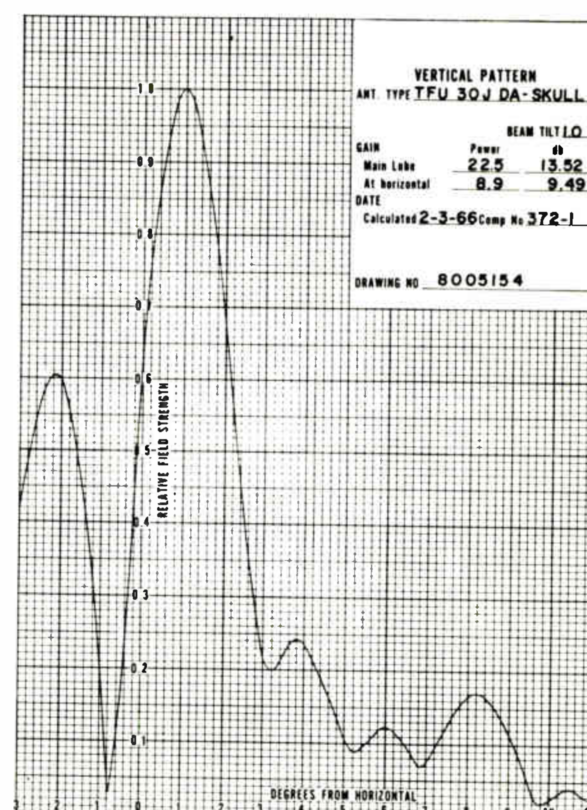


Calculated Vertical Patterns: Skull Pattern Directional Pylon, Type TFU-30JDA

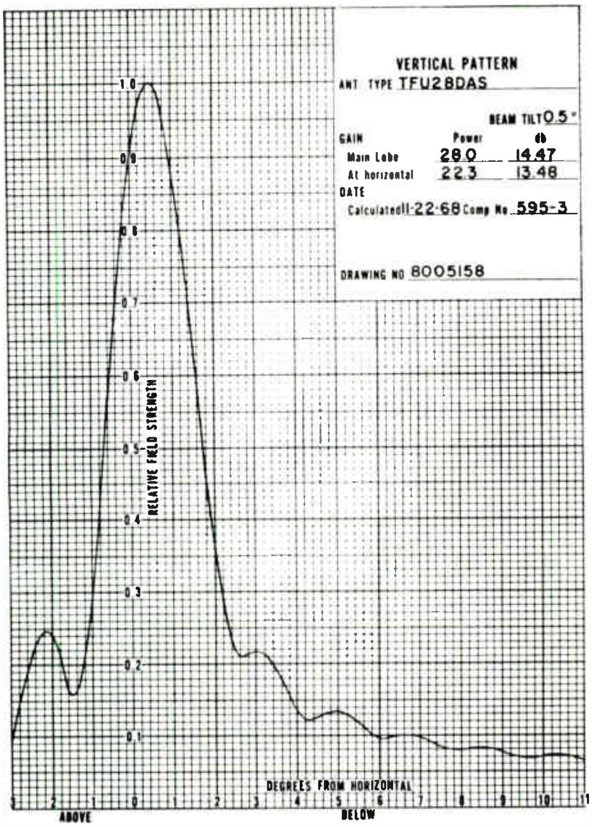


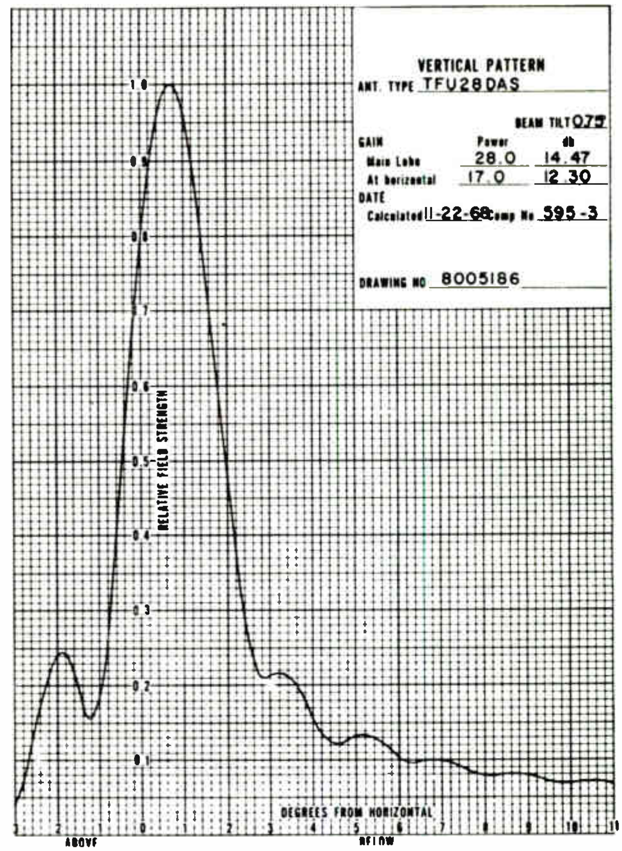


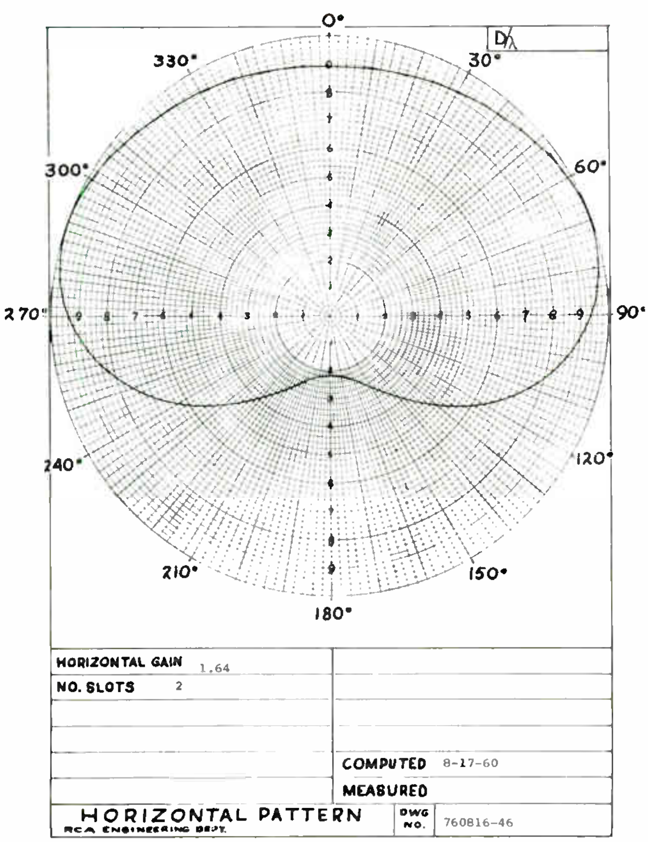




Calculated Vertical Patterns: Directional Pylon, Type TFU-28DAS







TFU-30JDAS and 36JDAS Lightweight Pylon Antennas (Cardioid)

In response to the need for a lightweight pylon antenna which can be side mounted off a standard tower, RCA now provides a lightweight cardioid pattern pylon antenna. The cardioid pattern permits closer mounting to the tower while minimizing serrations in the horizontal pattern, which is essentially omni-directional for more than 180 degrees.

The antenna is of RCA's proven pylon design and consists of slotted arrays in a lightweight aluminum pylon. The maximum antenna weight is 1.5 tons and is protected by a radome.

Standard input is 6⅛″, 75 Ohm center feed and the input rating is 60 kW.

Beam tilt, null fill and horizontal pattern directivity can be provided to meet most requirements.

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 and the outline drawings on Page 7 of this catalog section.

Omnidirectional Patterns, Types TFU-24J/TFU-30J

Mechanical Specifications
Type TFU-24J 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	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

$H_4 = H_2 + 4'$ (1.2 m)

Mechanical Specifications
Type TFU-30J 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	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

$H_4 = H_2 + 4'$ (1.2 m)

Mechanical Specifications

Omnidirectional Patterns, Types TFU-36J/42J

(For 0.0° to 0.75° beam tilt; data for other values of beam tilt available on request.)

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

$H_4 = H_2 + 4'$ (1.2 m)

Mechanical Specifications
Type TFU-42J 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	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	81931	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

Omnidirectional Patterns, Types TFU-45J/50J

Mechanical Specifications
Type TFU-45J 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	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)

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

Omnidirectional Patterns, Types TFU-25G/25GA

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)

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

$H_4 = H_2 + 4'$ (1.2 m)

Mechanical Specifications

Omnidirectional Patterns, Types TFU-28G/35G

Mechanical Specifications
Type TFU-28G Omnidirectional Pylon

Ch.	H_2		H_1		D_1		R_1		Moment		Weight	
No.	Ft	M	Ft	M	Ft	M	Lbs	Kg	Ft-Lbs	M-Kg	Ton	MT
14	78.4	23.9	82.4	25.1	40.4	12.3	4374	1986	176710	24428	9.4	8.5
15	77.5	23.6	81.5	24.8	40.0	12.2	4320	1958	172800	23888	9.3	8.4
16	76.5	23.3	80.5	24.5	39.5	12.0	4266	1942	168507	23304	9.2	8.3
17	75.6	23.0	79.6	24.2	39.0	11.9	4223	1913	164697	22765	9.1	8.2
18	74.7	22.8	78.7	24.0	38.6	11.8	4169	1885	160923	22243	9.0	8.1
19	73.9	22.5	77.9	23.7	38.2	11.6	4125	1878	157575	21785	8.9	8.1
20	73.0	22.3	77.0	23.5	37.7	11.5	4082	1850	153891	21275	8.8	8.0
21	72.2	22.0	76.2	23.2	37.3	11.4	4039	1827	150655	20828	8.7	7.9
22	70.9	21.6	74.9	22.8	36.7	11.2	3963	1795	145442	20104	8.2	7.4
23	70.1	21.4	74.1	22.6	36.3	11.1	3920	1772	142296	19669	8.1	7.3
24	69.4	21.1	73.4	22.3	35.9	10.9	3887	1770	139543	19293	8.0	7.3
25	68.6	20.9	72.6	22.1	35.5	10.8	3844	1747	136462	18868	7.9	7.2
26	67.9	20.7	71.9	21.9	35.2	10.7	3801	1729	133795	18500	7.8	7.1
27	67.2	20.5	71.2	21.7	34.8	10.6	3768	1710	131126	18126	7.8	7.0
28	66.5	20.3	70.5	21.5	34.5	10.5	3725	1692	128513	17766	7.7	7.0
29	65.8	20.0	69.8	21.2	34.1	10.4	3693	1674	125931	17410	7.6	6.9
30	65.1	19.8	69.1	21.0	33.8	10.3	3649	1656	123336	17057	7.5	6.8
31	64.4	19.6	68.4	20.8	33.4	10.2	3617	1638	120808	16708	7.5	6.8
32	63.8	19.4	67.8	20.6	33.1	10.1	3584	1624	118630	16402	7.4	6.7
33	63.2	19.3	67.2	20.5	32.8	10.0	3552	1611	116506	16110	7.3	6.7
34	62.5	19.1	66.5	20.3	32.5	9.9	3509	1593	114043	15771	7.3	6.6
35	61.9	18.9	65.9	20.1	32.2	9.8	3476	1579	111927	15474	7.2	6.5
36	61.3	18.7	65.3	19.9	31.9	9.7	3444	1566	109864	15190	7.1	6.5
37	60.8	18.5	64.8	19.7	31.6	9.6	3422	1557	108135	14947	7.1	6.4
38	60.2	18.3	64.2	19.5	31.3	9.5	3390	1544	106107	14668	7.0	6.4
39	59.6	18.2	63.6	19.4	31.0	9.5	3357	1515	104067	14393	6.9	6.3
40	59.1	18.0	63.1	19.2	30.8	9.4	3325	1506	102410	14156	6.9	6.2
41	58.5	17.8	62.5	19.0	30.6	9.3	2971	1352	90913	12574	6.5	5.9
42	58.0	17.7	62.0	18.9	30.3	9.2	2952	1344	89446	12365	6.4	5.8
43	57.5	17.5	61.5	18.7	30.1	9.2	2922	1322	87952	12162	6.4	5.8
44	57.0	17.4	61.0	18.6	29.8	9.1	2903	1314	86509	11957	6.3	5.7
45	56.5	17.2	60.5	18.4	29.6	9.0	2874	1307	85070	11763	6.3	5.7
46	56.0	17.1	60.0	18.3	29.3	8.9	2854	1299	83622	11561	6.2	5.6
47	55.5	16.9	59.5	18.1	29.1	8.9	2825	1277	82207	11365	6.2	5.6
48	55.0	16.8	59.0	18.0	28.8	8.8	2806	1270	80813	11176	6.1	5.5
49	54.6	16.6	58.6	17.8	28.6	8.7	2786	1266	79680	11014	6.1	5.5
50	54.1	16.5	58.1	17.7	28.4	8.7	2757	1244	78299	10823	6.0	5.5
51	53.7	16.4	57.7	17.6	28.2	8.6	2738	1241	77212	10673	6.0	5.4
52	53.2	16.2	57.2	17.4	27.9	8.5	2719	1234	75860	10489	5.9	5.4
53	52.8	16.1	56.8	17.3	27.7	8.5	2699	1216	74762	10336	5.9	5.3
54	52.4	16.0	56.4	17.2	27.5	8.4	2680	1213	73700	10189	5.8	5.3
55	51.9	15.8	55.9	17.0	27.3	8.3	2651	1205	72372	10001	5.8	5.3
56	51.5	15.7	55.5	16.9	27.1	8.3	2631	1188	71300	9860	5.7	5.2
57	51.1	15.6	55.1	16.8	27.1	8.2	2325	1062	63007	8708	4.9	4.4
58	50.7	15.5	54.7	16.7	26.9	8.2	2308	1047	62085	8585	4.8	4.4
59	50.3	15.3	54.3	16.5	26.7	8.1	2291	1044	61170	8456	4.8	4.4
60	49.9	15.2	53.9	16.4	26.5	8.1	2273	1028	60235	8327	4.8	4.3
61	49.5	15.1	53.5	16.3	26.3	8.0	2256	1026	59333	8208	4.7	4.3
62	49.2	15.0	53.2	16.2	26.1	8.0	2247	1014	58647	8122	4.7	4.3
63	48.8	14.9	52.8	16.1	25.9	7.9	2230	1011	57757	7987	4.7	4.2
64	48.4	14.8	52.4	16.0	25.7	7.8	2213	1008	56874	7862	4.6	4.2
65	48.1	14.7	52.1	15.9	25.6	7.8	2196	996	56218	7769	4.6	4.2
66	47.7	14.5	51.7	15.7	25.4	7.7	2179	994	55347	7654	4.6	4.1
67	47.4	14.4	51.4	15.6	25.2	7.7	2170	982	54684	7561	4.5	4.1
68	47.0	14.3	51.0	15.5	25.0	7.6	2153	979	53825	7440	4.5	4.1
69	46.7	14.2	50.7	15.4	24.9	7.6	2136	967	52186	7349	4.5	4.1
70	46.4	14.1	50.4	15.3	24.7	7.5	2127	968	52537	7260	4.4	4.0

Mechanical Specifications
Type TFU-35G 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	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	1593	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

$H_4 = H_2 + 4'$ (1.2 m)

Mechanical Specifications

Omnidirectional Patterns, Types TFU-40K/-46K

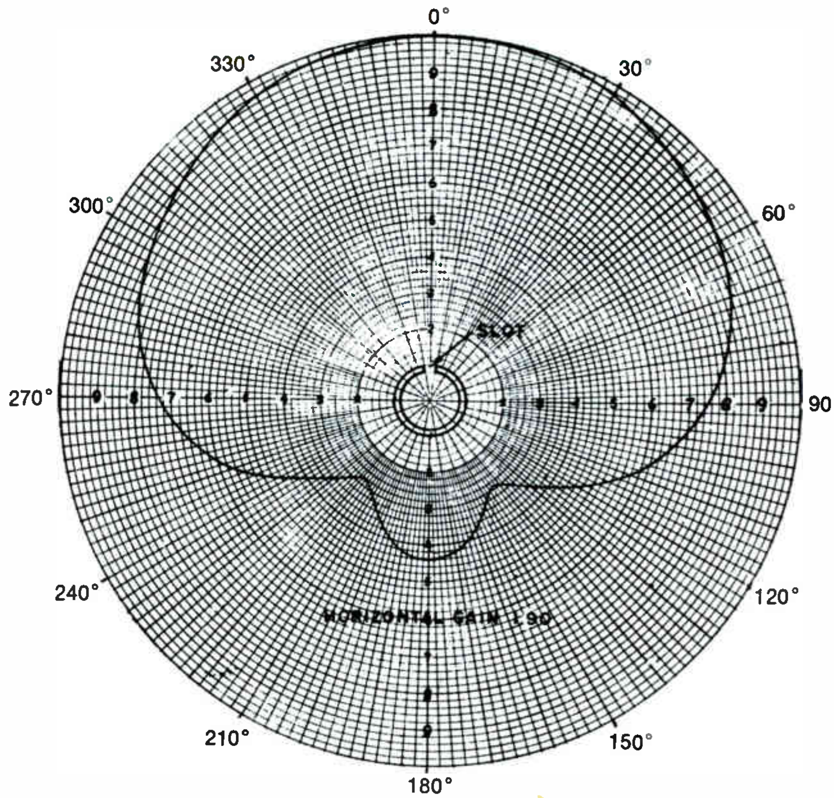
Mechanical Specifications
Types TFU-40/-46K Omnidirectional Pylon

Ch.	H_2		D_1		R_1		Moment		Weight	
No.	Ft	M	Ft	M	Lbs	Kg	Ft-Lbs	M-Kg	Ton	MT
14	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)

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)

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)

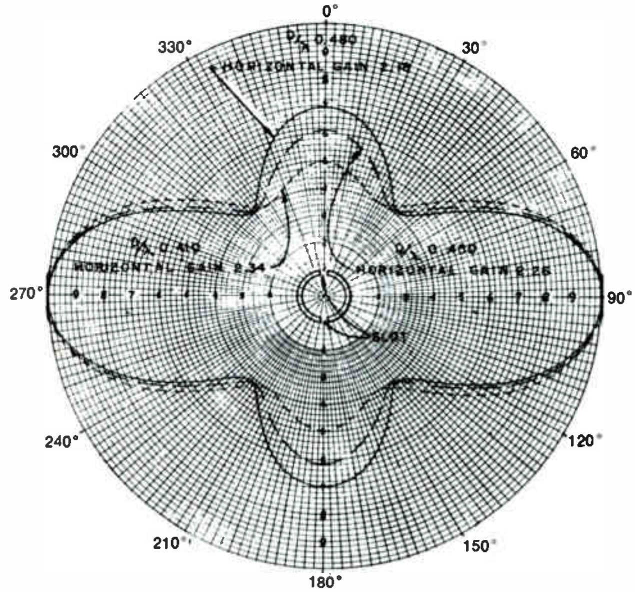
Mechanical Specifications
Type TFU-28DAS Skull Pattern

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)

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

$H_1 = H_2 + 4'$ (1.2 m)

Mechanical Specifications

Peanut Directional Patterns, Types TFU-30JDAS, -28DAS

Mechanical Specifications
Type TFU-30JDAS Peanut Pattern

Ch.	H_2		D_1		R_1		Moment		Weight	
No.	Ft	M	Ft	M	Lbs	Kg	Ft-Lbs	M-Kg	Ton	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

$H_4 = H_2 + 4'$ (1.2 m)

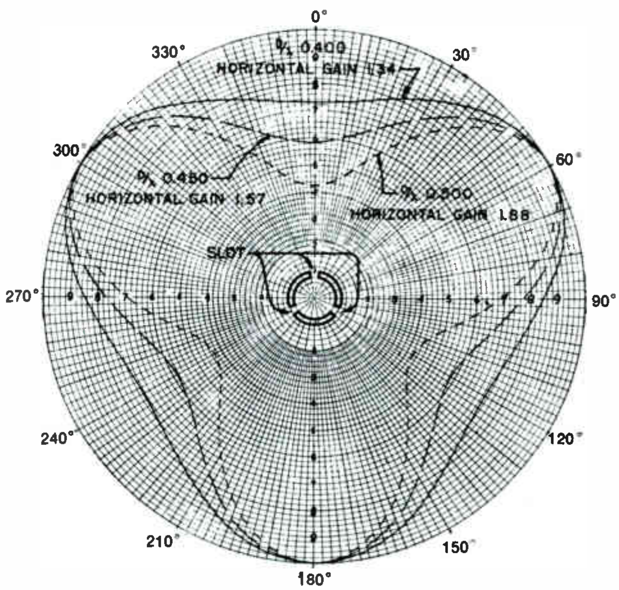
Mechanical Specifications
Type TFU-28DAS Peanut Pattern

Ch.	H_2		D_1		R_1		Moment		Weight	
No.	Ft	M	Ft	M	Lbs	Kg	Ft-Lbs	M-Kg	Ton	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

$H_4 = H_2 + 4'$ (1.2 m)

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)

Mechanical Specifications

Trilobe Directional Patterns, Types TFU-28DAS, -30JDAS

Mechanical Specifications
Type TFU-30JDAS Trilobe Pattern

Ch.	H_2		D_1		R_1		Moment		Weight	
No.	Ft	M	Ft	M	Lbs	Kg	Ft-Lbs	M-Kg	Ton	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

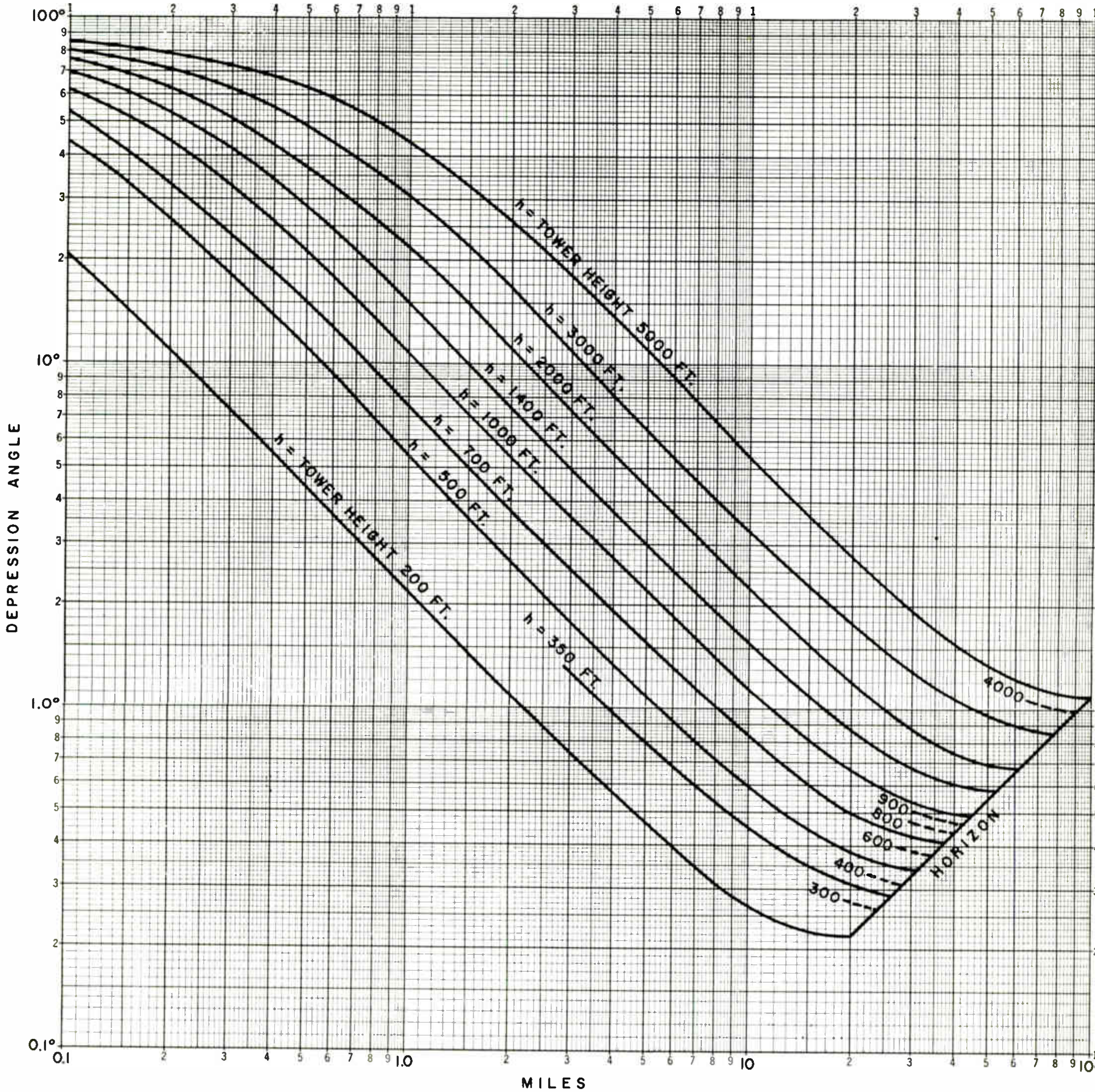
$H_4 = H_2 + 4'$ (1.2 m)

Mechanical Specifications
Type TFU-28DAS Trilobe Pattern

Ch.	H_2		D_1		R_1		Moment		Weight	
No.	Ft	M	Ft	M	Lbs	Kg	Ft-Lbs	M-Kg	Ton	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)

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

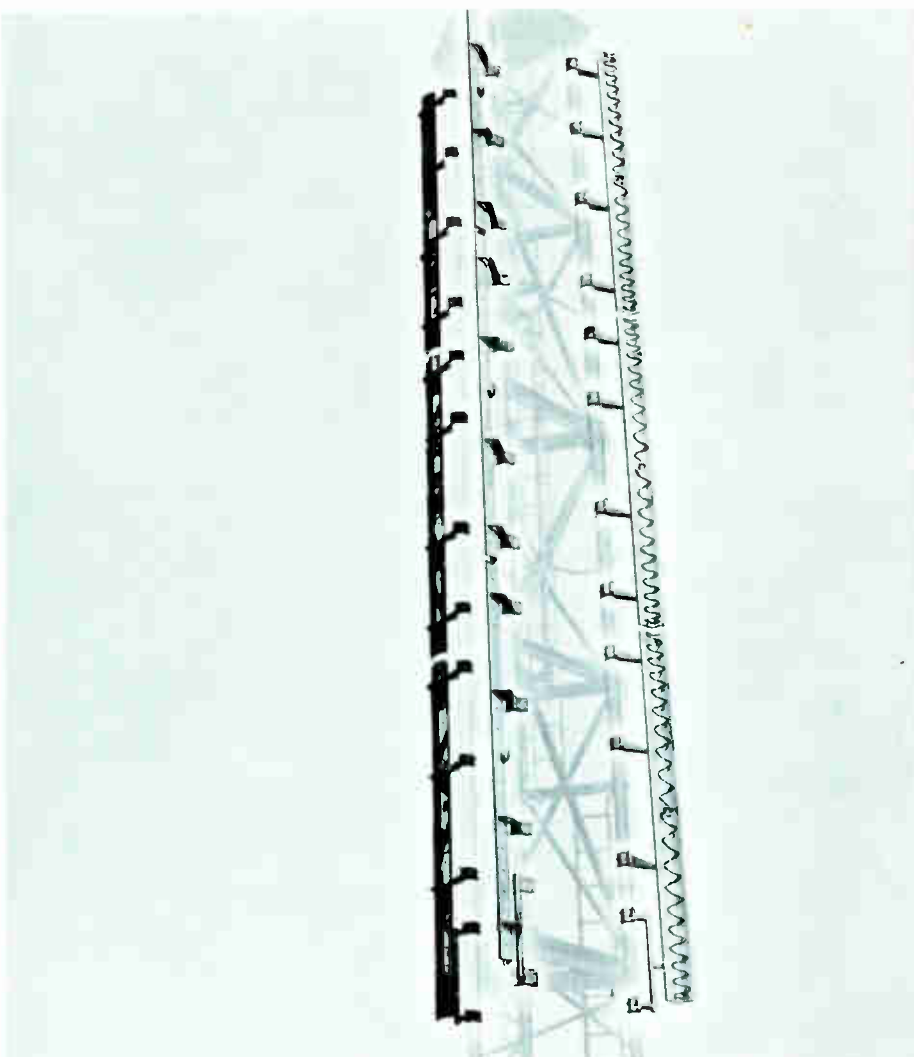
UHF-Pylon Antennas are, of necessity, custom built to order. Your RCA Broadcast Equipment Sales Representative is equipped to help you and your engineering consultant in the details of placing your order.

catalog TT.9220B

(Replaces TT.9220A)

Panel-Type Antennas, "Vee-Zee" and "Zee-Panel"

- For omni- or directional situations
- VSWR stability — and 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.

9CTT

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 feed-point 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 cross-section of panel on this 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.)

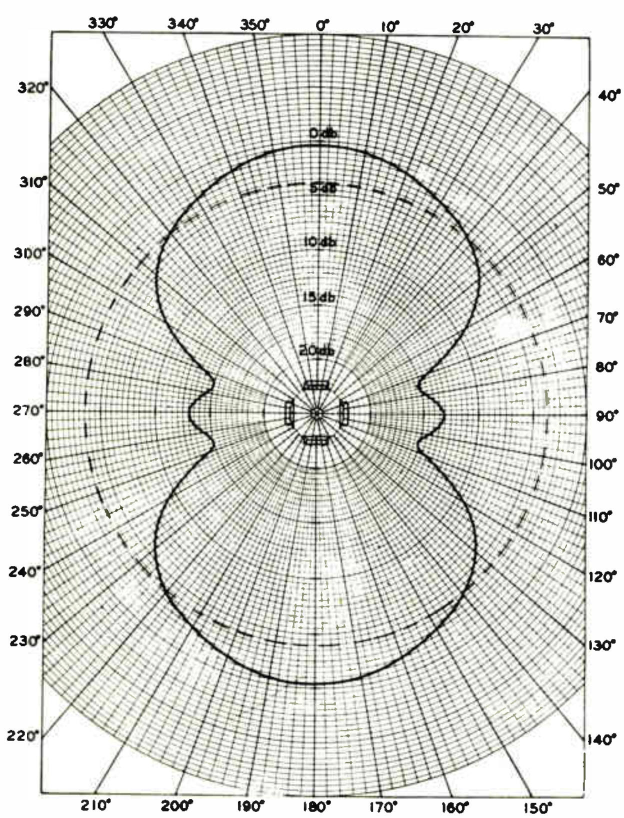
Where the antenna is mounted on top of the tower, either Vee Zee radiators (usually three in number) firing tangentially or radially or Zee Panels (normally four) firing radially can be used.

"ZEE" PANEL

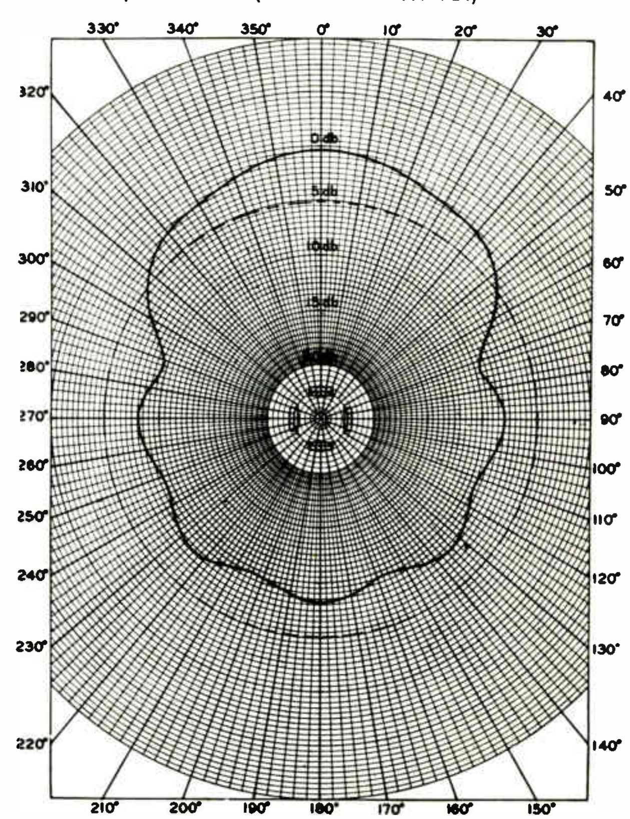
"VEE-ZEE" PANEL

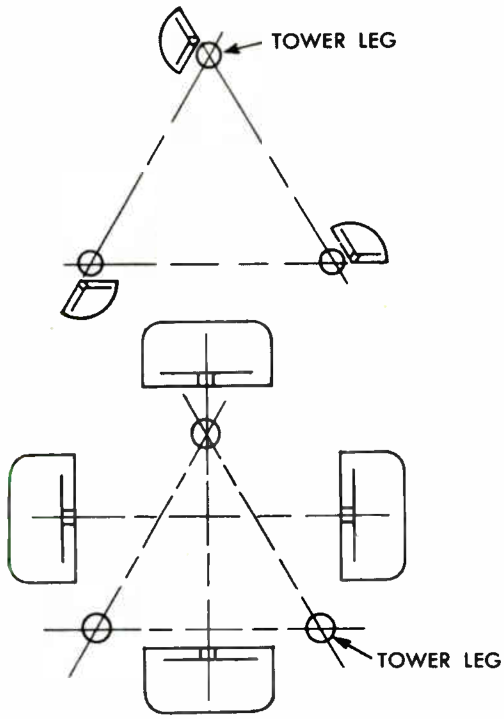
Cross-section drawings point up the difference between "Vee-Zee" and "Zee-Panel" antennas.

Directivity pattern obtainable with a top-mounted, four-around Zee-Panel array on a square tower. (Gain 2.39 or 3.8 dB.)

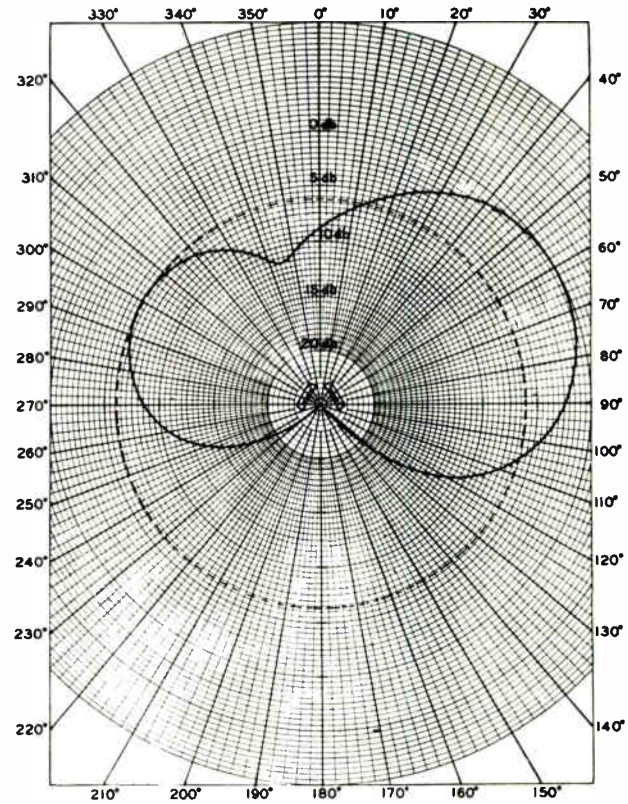


Directivity pattern obtainable with a top-mounted, four-around Zee-Panel array on a square tower. (Gain 3.24 or 5.1 dB.)



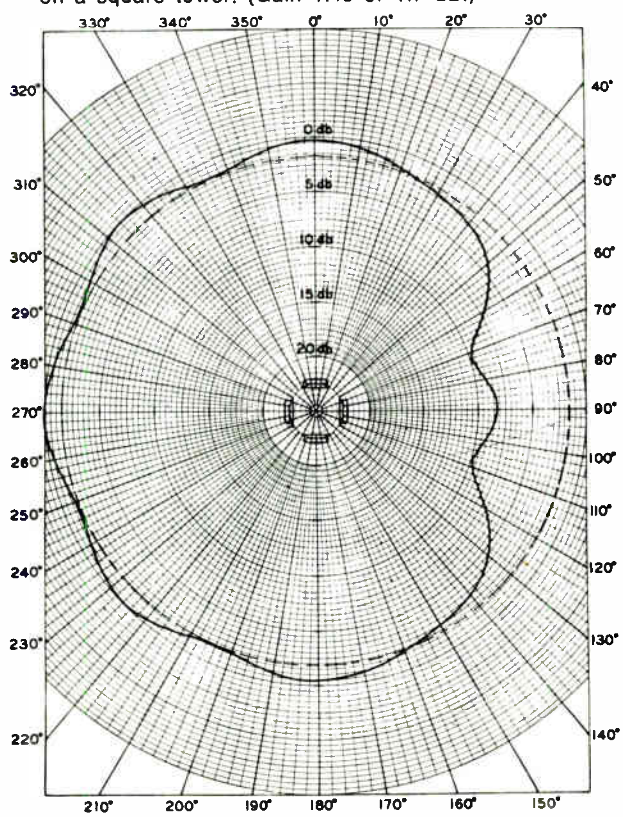


Panel antennas mount in three-around or four-around arrangements as shown here in line drawing.

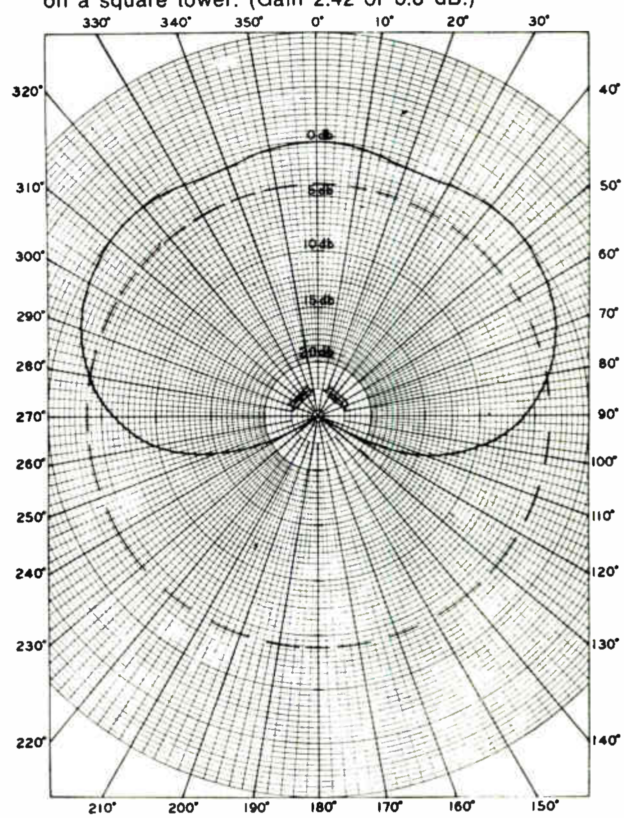


Directivity pattern obtainable with a top-mounted, two-panel Zee-Panel array on a triangular tower. (Gain 4.21 or 6.2 dB.)

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.)



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 omnidirectional 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 the vertical pattern, and hence the RMS gain, beam tilt and null fill. Beam tilt can be achieved in all directions or in selective directions by electrical phasing of successive radiators or by tilting individual panels or both. Typical calculated vertical patterns for Vee Zee panel antennas, obtained by stacking three, four, five or six layers of standard panels are shown on pages 4 and 5 of this section.

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. Panels of shorter than standard lengths are utilized to provide null fill beyond 8°. Since the antennas are supplied on a custom basis, the size and number of panels to and from an antenna array vary with each customer's requirement and can be provided as required.

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.

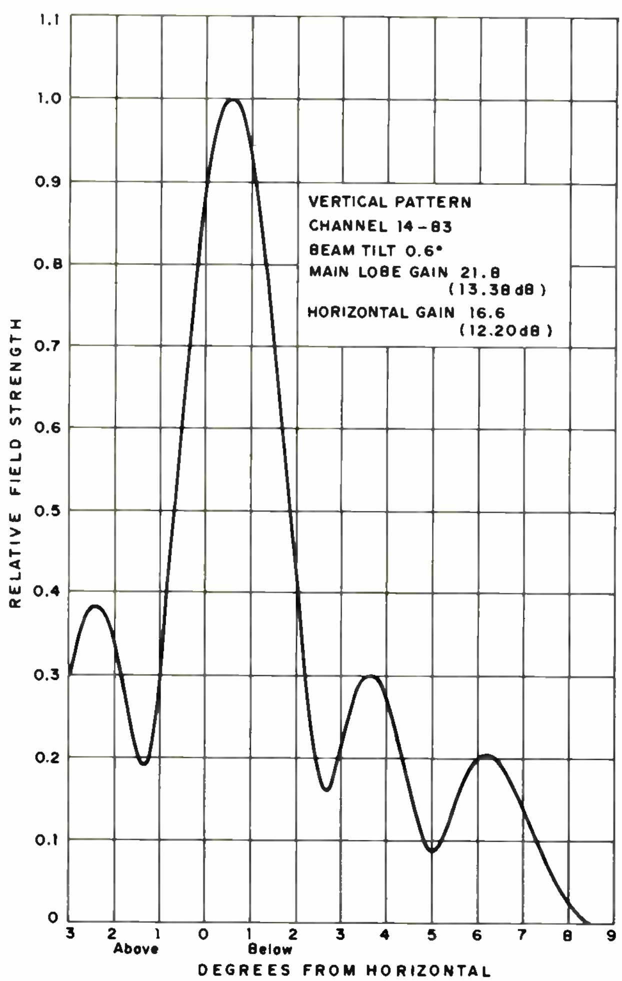
Mechanical Characteristics

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.

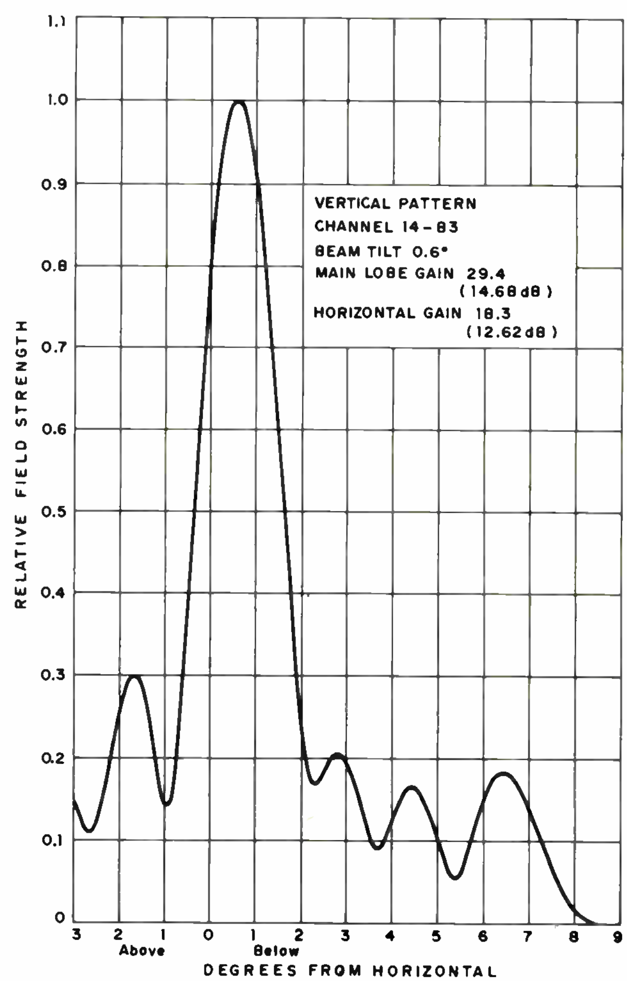
Zee-Panel and Vee-Zee antennas are supplied with top-hat lightning protectors. Whether top- or side-mounted, both ends of each radiating element are grounded. This reduces to a minimum the possibility of lightning damage.

Radome Supplied

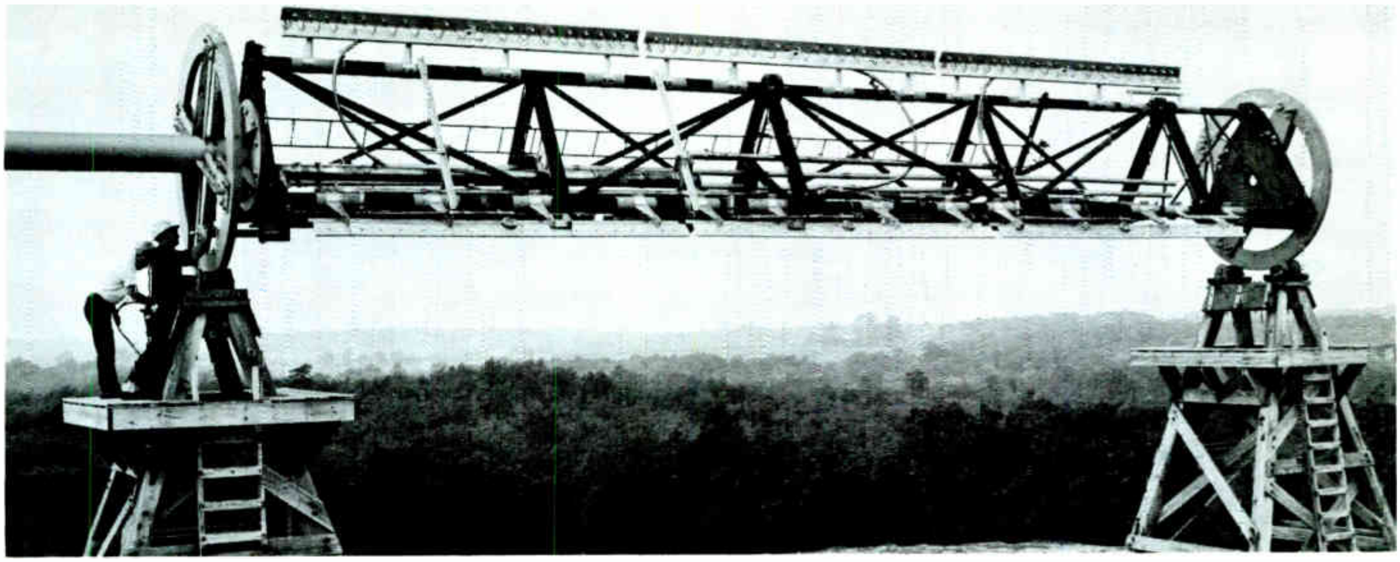
An easily removable radome is supplied for protection from atmospheric conditions and possible climbing damage.



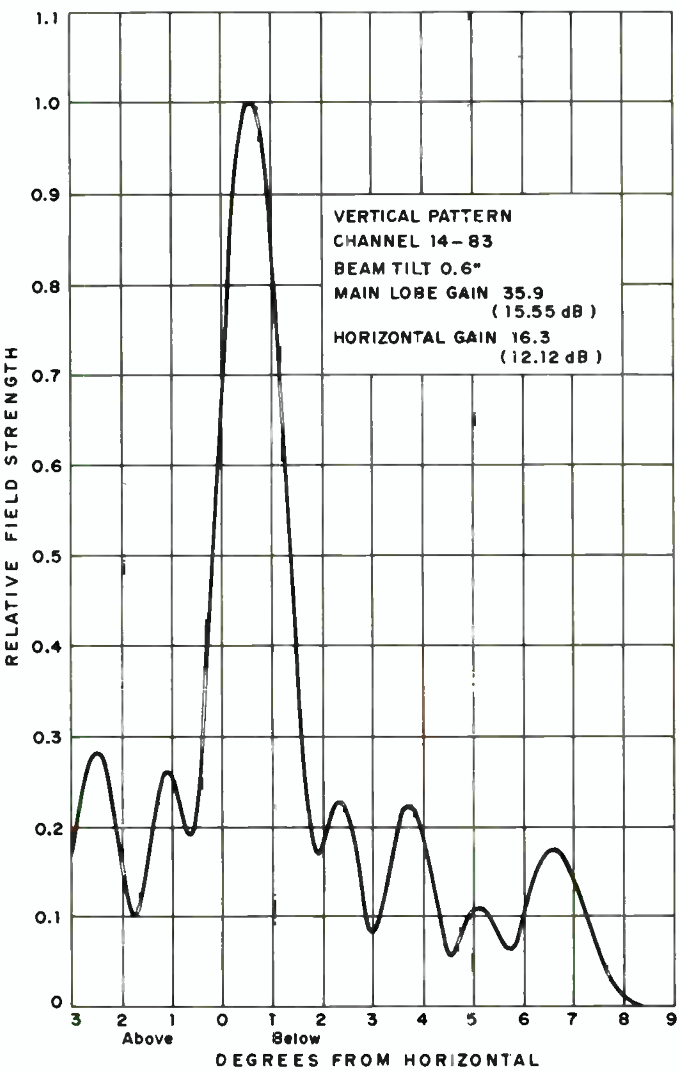
Calculated vertical pattern for a three-layer Vee-Zee Panel array.



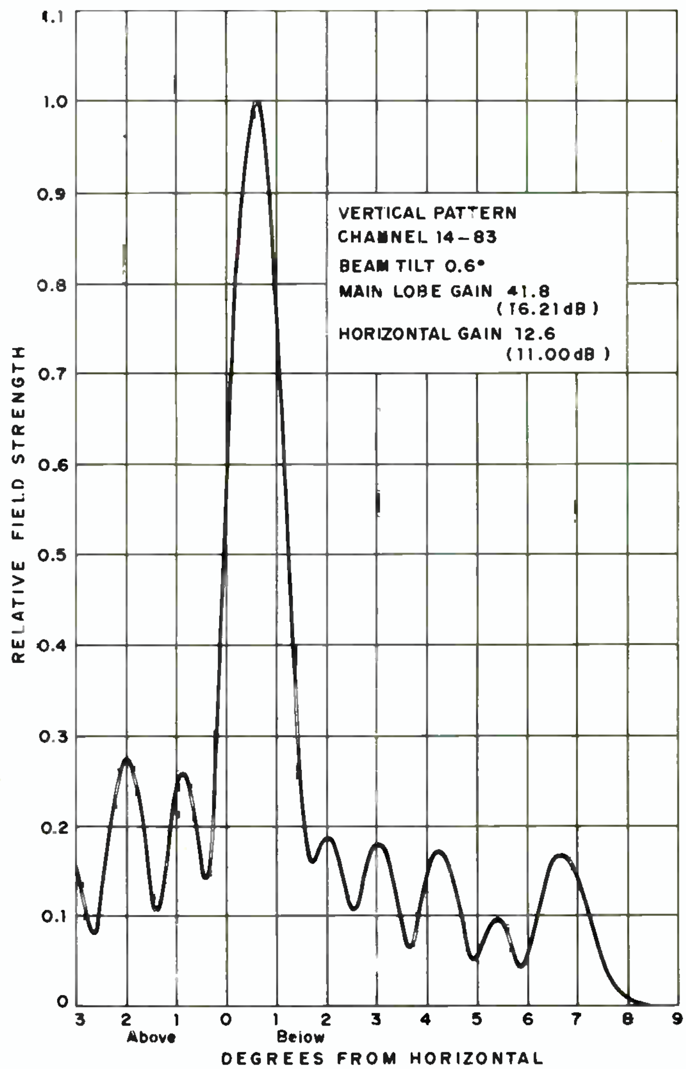
Calculated vertical pattern for a four-layer Vee-Zee Panel array.



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.

Mechanical Data: "Vee-Zee" Antenna

THREE LAYER ARRAY

Channel	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

FOUR LAYER ARRAY

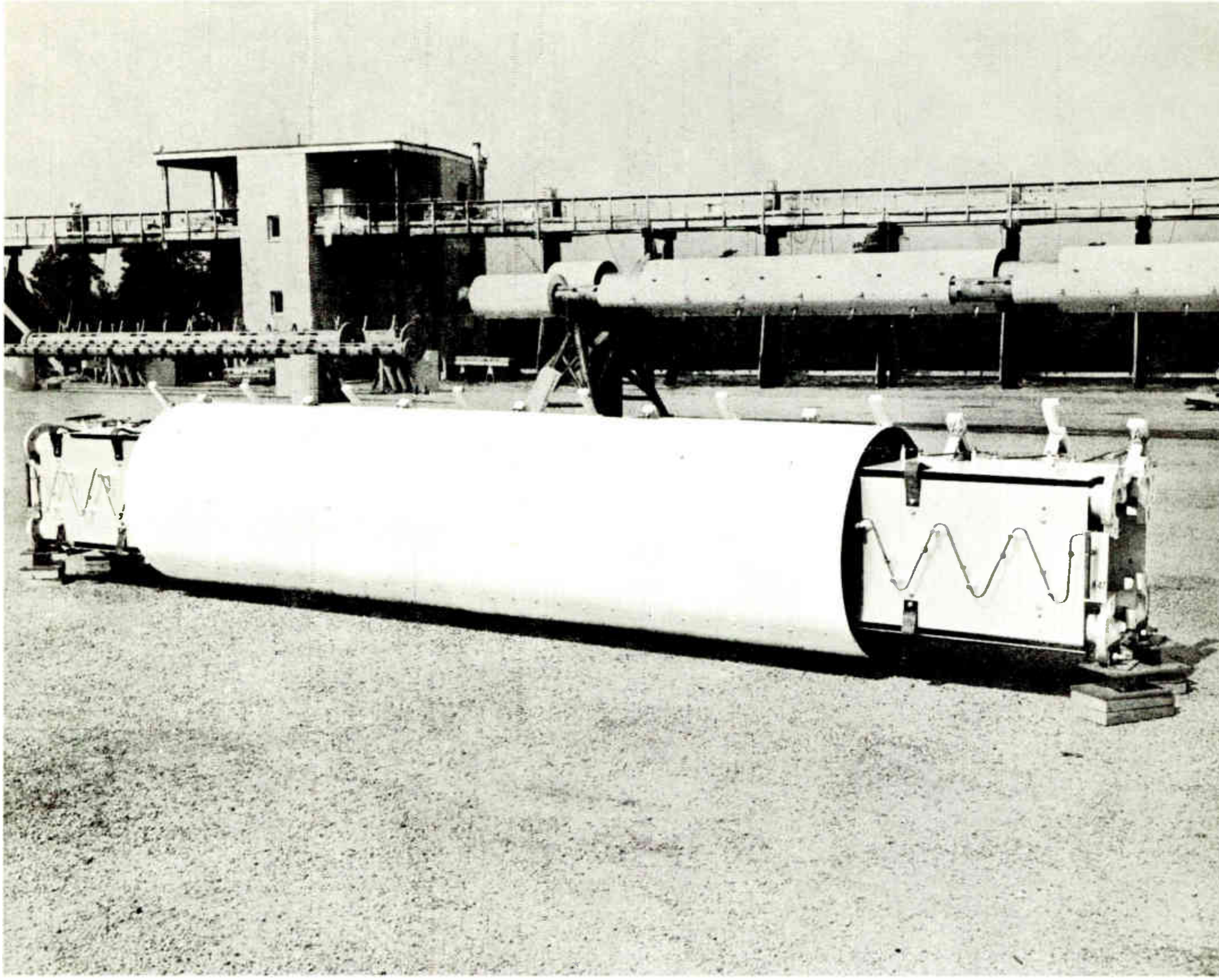
Channel	Aperture		Weight		Reaction[8,9]	
	Ft	Mtrs[7]	Tons[4]	Tons[5]	Lbs	Kg[6]
14	77.0	23.47	2.39	2.17	15700	7121
15	76.0	23.16	2.35	2.13	15360	6967
16	75.0	22.86	2.32	2.11	15030	6818
17	74.0	22.56	2.28	2.07	14720	6677
18	73.1	22.28	2.25	2.04	14420	6541
19	72.3	22.04	2.22	2.02	14140	6414
20	71.4	21.76	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

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).



Fiber glass radome 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	6⅛" 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.

catalog TT.9240B

(Replaces TT.9240A)

"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.

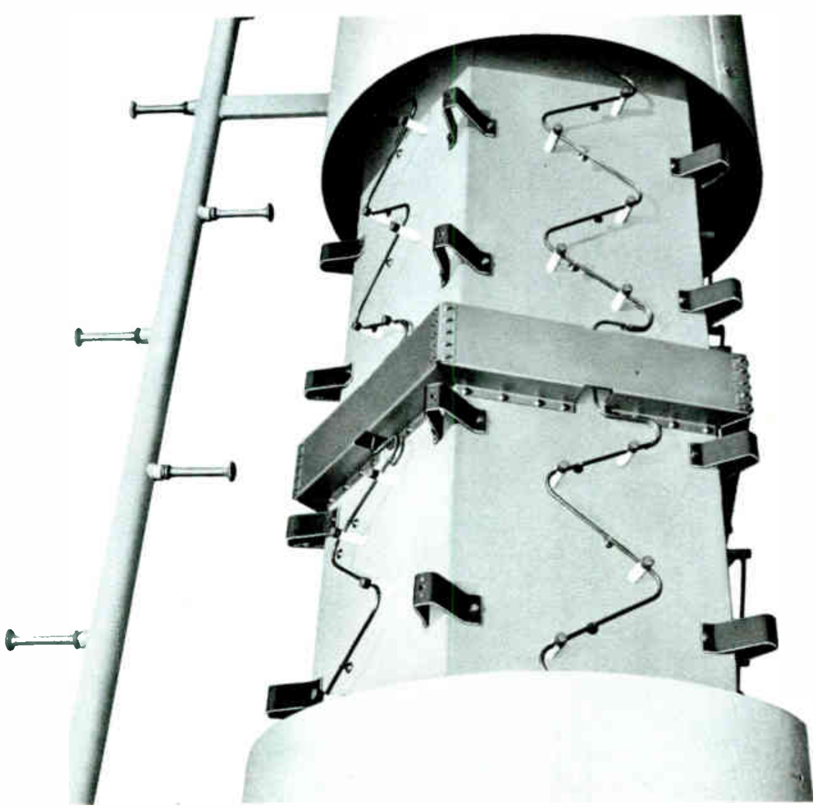
Pentagonal Cross-Section

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.

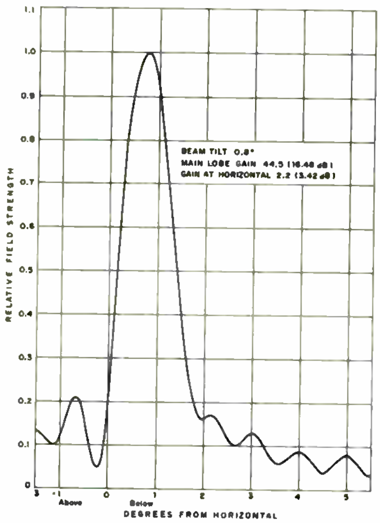
Rigid Structure

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.

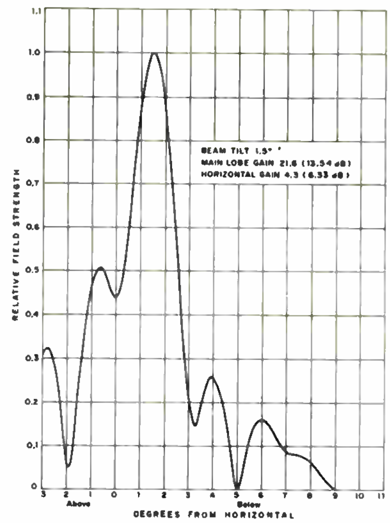
[1] U.S. Steel trademark.



9CTT

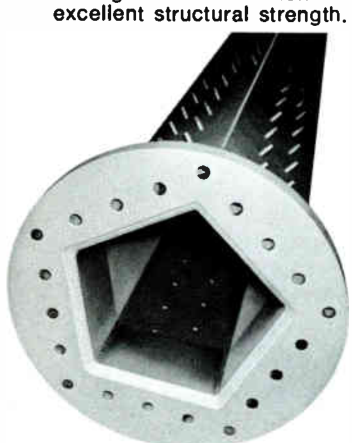


Typical seven-layer vertical pattern.

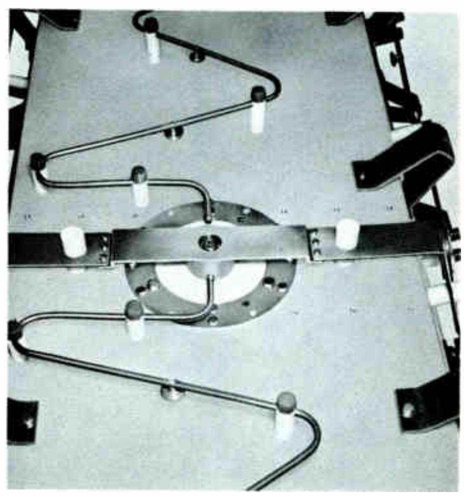


Special vertical pattern (null-filled above the horizon.)

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.

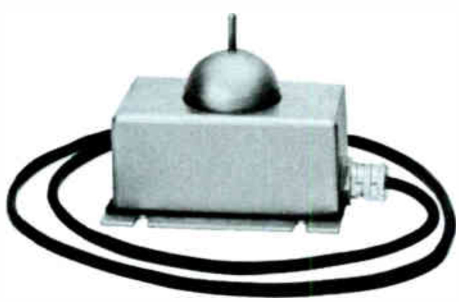
RCA

catalog TT.9320B

(Replaces TT.9320A)

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.

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.

It is recommended that the Rosemount Antenna Ice Detector be used in conjunction with the RCA Automatic Sleet Melter Control Unit.

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

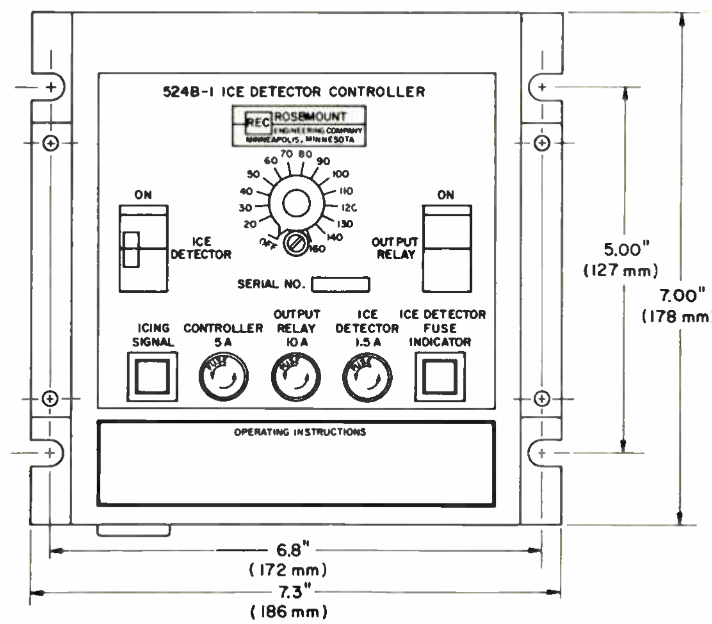
Ice Detector Unit

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

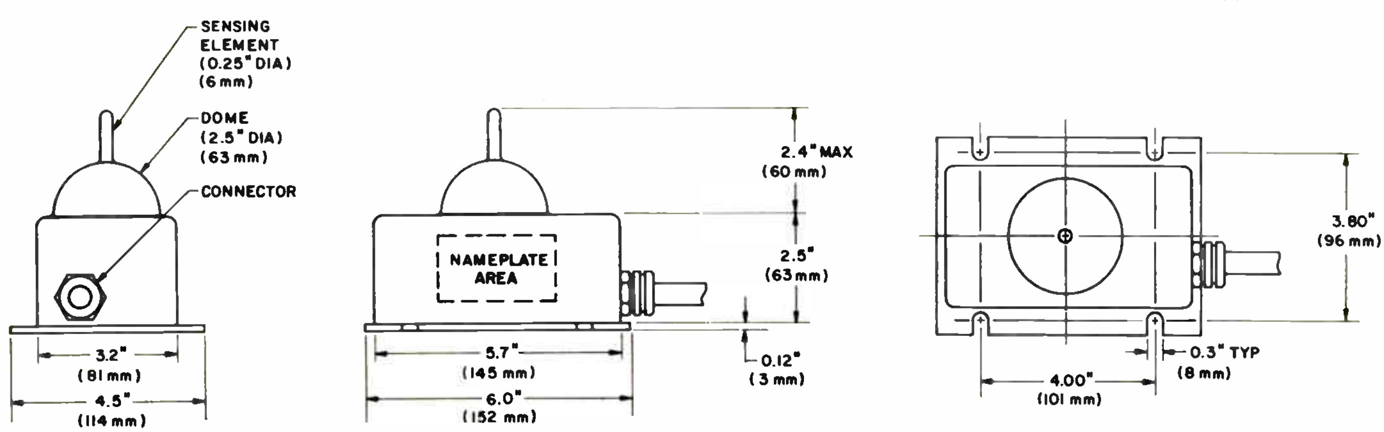
Power Requirements:
 Sensing ....115 V, 50/60 Hz, 5W
 Signalling ....115 V, 50/60 Hz, 15W
Output Signal ....115 V, 50/60 Hz, 500W
Time-Delay Timer ....8 to 150* min., adj.
Power Relay Current
 Capacity ....10 A, max. non-inductive load
Ambient Operation Temperature ....40 to 120°F (4.4 to 49°C)
Connections ....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)



catalog TT.9340B

(Replaces TT.9340A)

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.

11CTT

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.

It is recommended that the RCA Automatic Sleet Melter Control Unit be used in conjunction with the Rosemount Antenna Ice Detector.

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

RCA Broadcast Systems

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TTU 11178

Printed in U.S.A.