

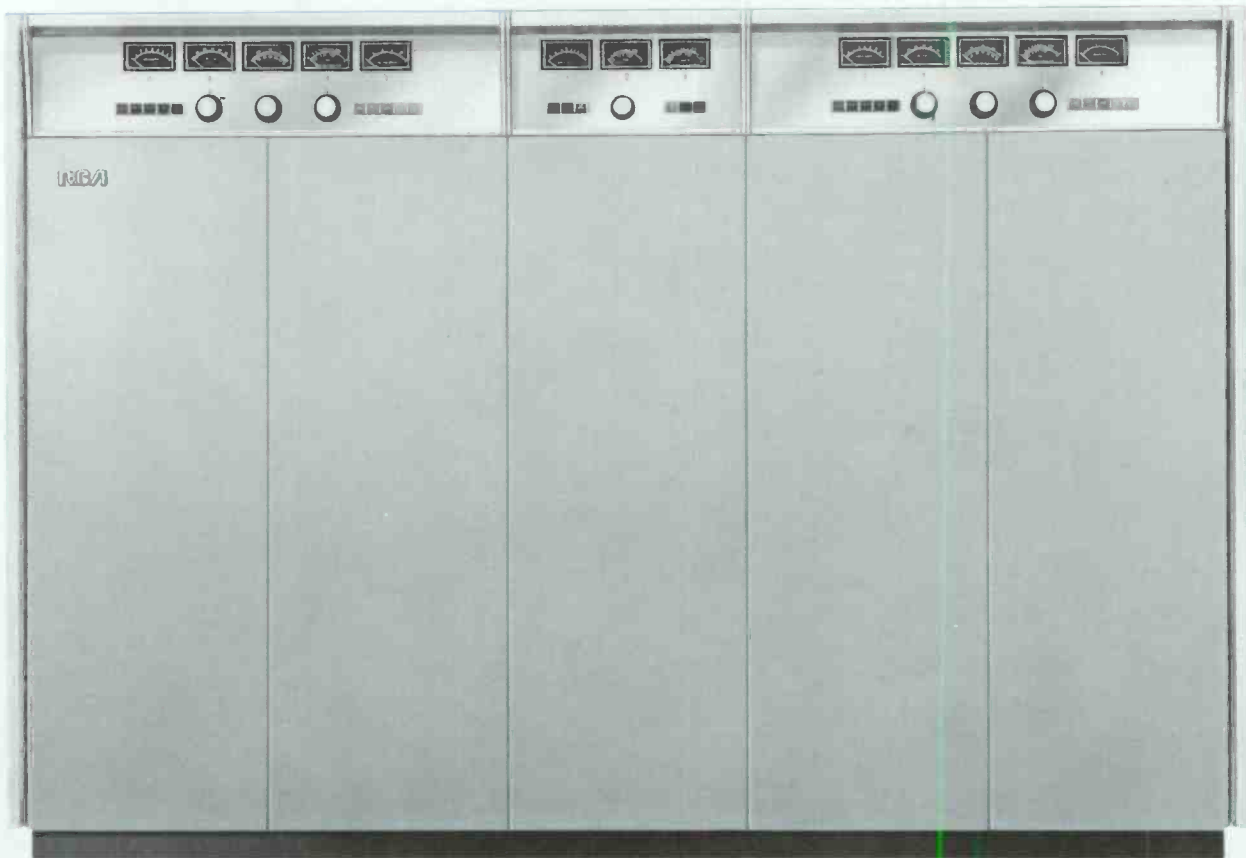


FM Transmitter, 40kW, Type BTF-40ES1

- Parallel Transmitters for High Reliability
- Designed for unattended operation
- Built for continuous operation
- Direct-FM for full-fidelity mono or stereo with or without SCA
- Only two tube types

The Type BTF-40ES1 is a forty-kilowatt transmitter for the maximum-power FM-broadcast station where continuous operation is important. The transmitter combines two identical twenty-kilowatt transmitters to form a redundant forty-kilowatt system. The dual design even allows major maintenance without interruption of air-time.

The BTF-40ES1 is a single-output transmitter. Four mode manual patch or motor driven by-pass output switching can be provided to allow either BTF-20ES1 to be connected directly to the antenna.



The BTF-40ES1 transmitter is actually two complete twenty-kilowatt units, (Type BTF-20ES1) combined to make continuous operation practical. All major components—except the combining equipment and the harmonic filter—are duplicated within the system: dual amplifiers, dual power supplies, etc. (see functional diagrams, on opposite page).

The BTF-40ES1 is intended for operation into a single transmission line and antenna system.

Dual, Switchable Exciters

The BTF-40ES1 includes two solid-state exciter systems arranged so that one of the two serves the transmitter while the other operates as a hot standby. In the event of trouble in the on-air exciter, manual (or Automatic optional) switch-over puts the extra exciter on the line. Lighted indicators on the control panel show the change in status.

The exciter system is the BTE-115 system providing excellent monaural, stereo and SCA performance that more than meets the Industry, FCC regulations and CCIR recommendations as achieved by

the Direct FM solid state units. (See Catalog RA.2020B.)

Interface to the BTF-40ES1 is accomplished through an Exciter/Transmitter interface relay panel to permit deactivating the exciter RF amplifier output when the individual 20 kW amplifier is turned off.

Power-Amplifier Stages

The exciter system delivers 15 watts of modulated carrier to a hybrid-ring power splitter which, in turn, provides two outputs, each to a pair of IPA tetrodes, in each transmitter section. These raise the power level to drive the final power amplifier. The final stage raises the power level to 20 kW. The two 20 kW outputs are combined to 40 kW in a hybrid combiner.

Hybrid Combiner Network

Ordinarily mounted above the transmitter cabinet, almost directly over the center unit, (see floor plan, last page) is the combiner network, a "three-dB hybrid" coaxial unit. This assembly combines the two 20 kW modulated carriers into one 40 kW output. The reject loads

for the combiner are mounted within the center cabinet of the transmitter.

Coaxial Harmonic Filters

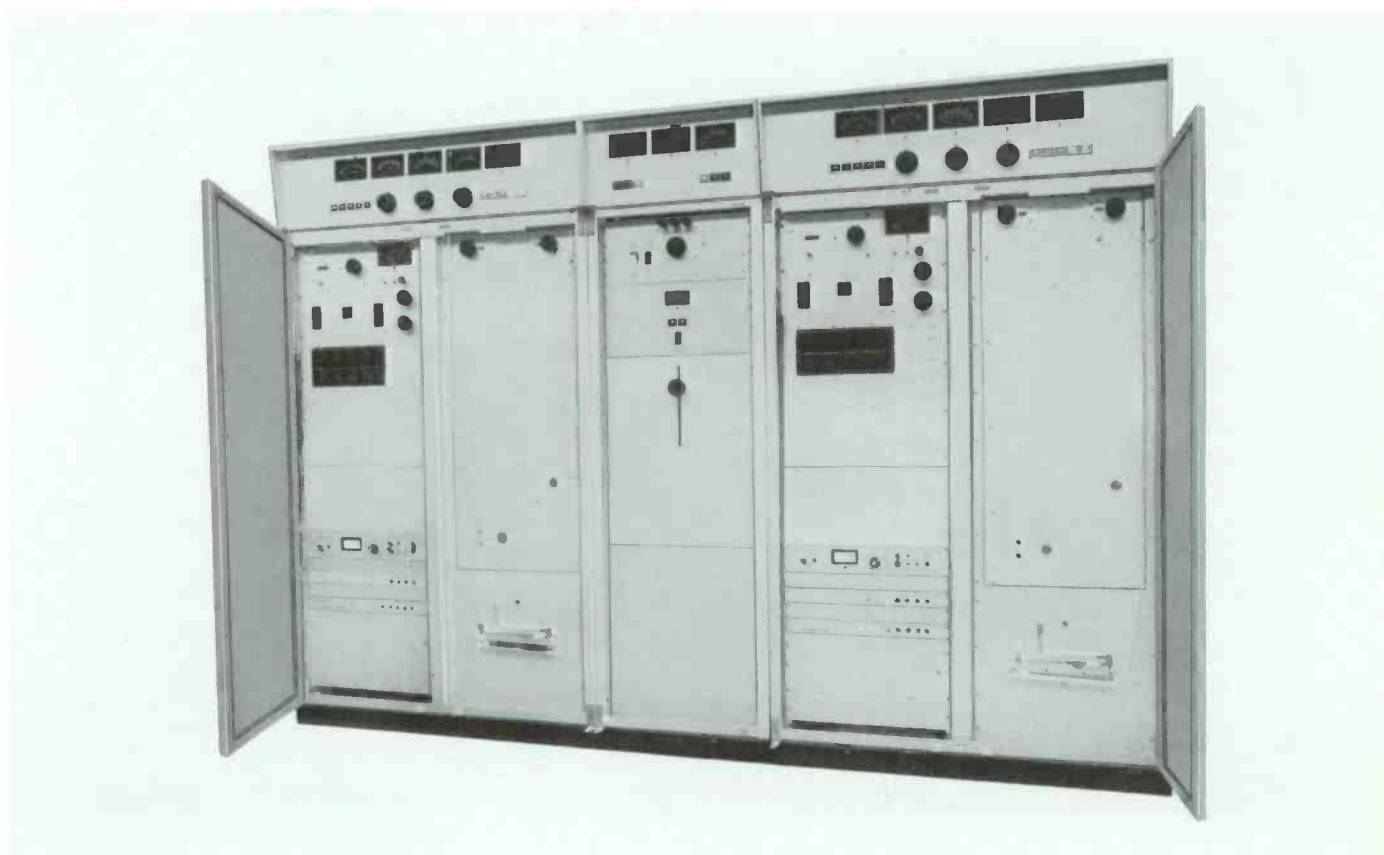
The single harmonic filter is 122" (3100 mm) long and is a series of transmission-line elements with a uniform $6\frac{1}{8}$ -inch outer-conductor diameter, a stepped inner conductor and a shunt stub. Attenuation of all harmonics is accomplished in an M-derived section and a series of constant-K, T sections. The filter has a broad passband with a sharp high-frequency cutoff and excellent attenuation above cutoff frequency.

An optional filter configuration using two $3\frac{1}{8}$ " 61" (1549 mm) filters is available for a transmitter without output switching, but two will be supplied with either the manual or motor driven four mode switching versions. The optional filter consists of a series of transmission line and four shunt stubs. Attenuation of harmonics is accomplished by resonating the stub sections to various harmonic frequencies.

Central Transmitter Control

In the center cabinet are the control and metering functions for the combined

Forty-Kilowatt FM Transmitter, Type BTF-40ES1



transmitters. Push-buttons provide control of combined transmitter on/off and high voltage on/off. Lighted indicators signal d-c overload and output line VSWR overload, and are re-settable. Three meters, at the top panel, display reject power, reflected power and combined power output.

In the area immediately below the meter panel are reflectometer controls and adjustments. Next are the control switches for the exciter systems, a control-ladder circuit-breaker and a meter that displays exciter reject power. Below this is the control knob for adjustment of the "line-stretcher", which compensates the phase of the input circuits to the twin power-amplifier chains.

Relays in this section switch exciter system inputs, outputs and primary power. The audio connections to the stereo and SCA subchannels are switched automatically when the exciters are switched.

Built for Continuous Operation

The BTF-40ES1 transmitter, by virtue of its two independent transmitter systems, is configured so that either twenty-kilowatt system can be shut down for maintenance while the other feeds the antenna.

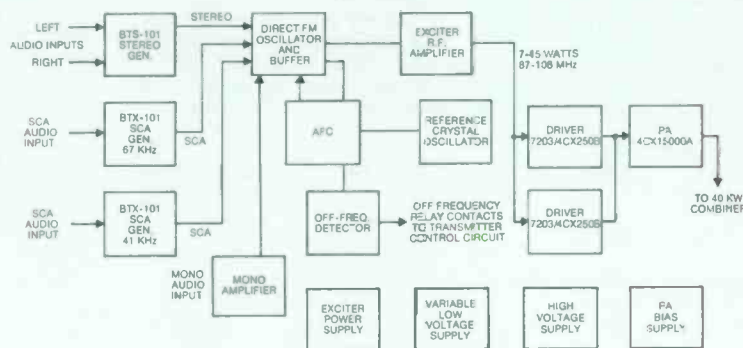
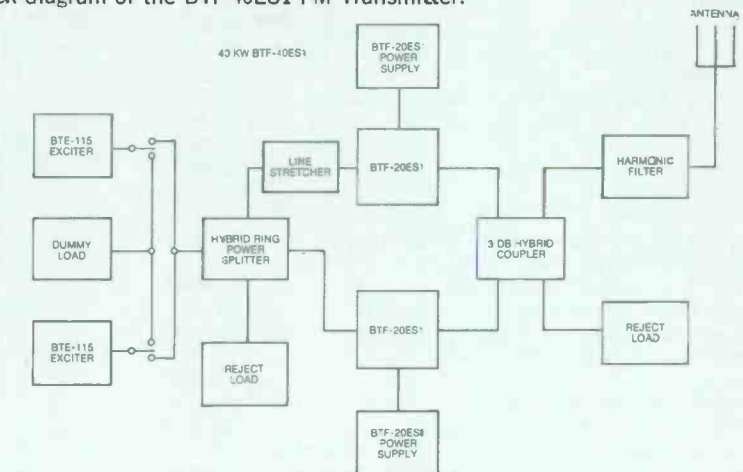
A four mode manual or motor driven by-pass switching system can be provided to allow one of the parallel transmitters to be connected directly to the station's antenna (see switching systems diagrams). This results in a reduced power of one-half instead of one-quarter power as would be experienced through the combining network.

The four modes are: 1.) both dual transmitters into antenna; 2.) both transmitters into dummy load; 3.) one transmitter into antenna and other into dummy load; and 4.) reverse of 3.). Automatic operation of the motor driven by-pass switching system is an optional accessory to the four mode switching system.

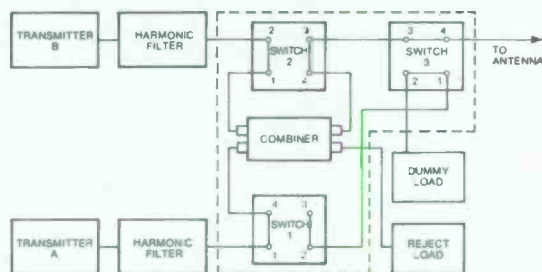
Redundant Power Supplies

The redundancy of the BTF-40ES1 system extends even to separate power supplies for each twenty-kilowatt section. These are units using solid-state rectifiers throughout for reduced maintenance and minimal operating expense. The power supply cabinets need not be located in the same room as the transmitter unit where space is a problem. They might, for example, be located in a basement room or in a shelter external to the transmitter building. More information on the twenty-kilowatt transmitter will be found in the catalog section on the Type BTF-20ES1. (See Catalog RA.2061D.)

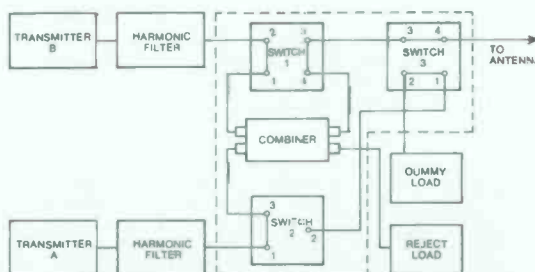
Block diagram of the BTF-40ES1 FM Transmitter.



Block diagram of one of the diplexed 20-kW units of the BTF-40ES1 Transmitter, showing optional Stereo and SCA.



Typical four mode switching system (motor driven) for BTF-40ES1 Dual Transmitter.



Typical four mode switching system (manual) for BTF-40ES1 Dual Transmitter.

Specifications

Performance

Type of Emission F3 and F9
 Frequency Range 87.5 to 108 MHz
 Power Output 40,000 watts
 Output Impedance (6 1/8" O.D. Unflanged Line) 50 Ohms
 Frequency Deviation 100% modulation ±75 kHz
 Modulation Capability ±100 kHz
 Carrier Frequency Stability ±1000 Hz max.
 Audio Input Impedance 600 Ohms
 Audio Input Level—(100% mod.) +10 ±2 dBm¹
 Audio Frequency Response—(30-15,000 Hz) ±1 dB max.²
 Pre-emphasis Network Time Constant 25, 50 or 75 μs.
 Harmonic Distortion (50-15,000 Hz) 0.3% or less³
 FM Noise Level (referred to 100% FM mod.) -65 dB max.
 AM Noise Level (referred to carrier voltage) -50 dB max.⁵
 Subcarrier Input Level (100% mod.) 9 to 30% adjustable
 Subcarrier Input Impedance Resistive 600 Ohms bal.
 Subcarrier Frequency 20-95 kHz
 Main-to-Subchannel Crosstalk -50 dB referred to ±6.0 kHz deviation of the subcarrier by a 400 Hz tone. Main channel modulation 70% by a single tone (50 to 15000 Hz) and 30% by subcarrier, using narrow band detector.
 Sub-to-Main-Channel Crosstalk -60 dB referred to 100% modulation of the main carrier by a 400 Hz tone. Subcarrier modulated ±4.0 kHz by a single tone (30 to 5000 Hz), main channel modulated 30% by subcarrier, using narrow band detector, or 10% by subcarrier when operating in stereo.

Tube Complement

Driver: four 7203/4CX250B; Power Amplifier: two 4CX15000A

Electrical

Power Requirements:
 Line 240/208 Volt, 3 phase, 50/60 Hz
 Combined Line Voltage Variation and Regulation ±10%
 Power Consumption 72,000 Watts (approx.)
 Power Factor (approx.) 90%

Mechanical

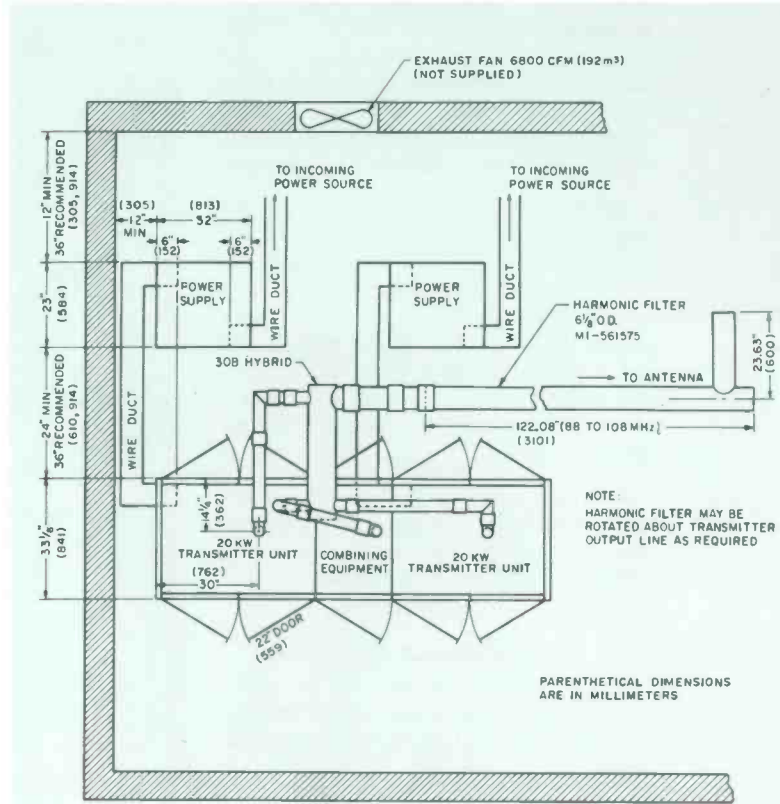
Dimensions (overall):	Each 20 kW Transmitter	Each High-Voltage Power Supply	Combiner Cabinet
Width	48 1/2" (1232 mm)	32" (813 mm)	20 1/2" (521 mm)
Height	77" (1956 mm)	46" (1168 mm)	77" (1956 mm)
Depth	32 1/2" (825 mm)	24" (610 mm)	32 1/2" (825 mm)
Weight (Approx.)	2950 lbs. (1338 kg)	2050 lbs. (936 kg)	686 lbs. (311 kg)
Finish	Textured Vinyl in midnight blue and shadow blue, satin-aluminum trim.		
Altitude	7500 ft. (2290 m) ⁴		
Ambient Temperature Range	-20° to +45°C		

Ordering Information

FM Broadcast Transmitter, Type BTF-40ES1:
 With Single Harmonic Filter (40 kW) ES-560996B
 With Dual Harmonic Filters (20 kW) ES-560996C
 As Above, plus Manual Switching System ES-560996D⁹
 As Above, plus Motor Driven Switching System ES-560996E⁹

Please specify assigned frequency, power line frequency (if other than 60 Hz), ambient temperature and installation altitude if greater than 7500 feet (2300 m) above sea level. Stereo and/or SCA facilities ordered with transmitter are factory installed.

¹Level measured at input to pre-emphasis network, referred to 400 Hz.
²Frequency response referred to 50- or 75-microsecond pre-emphasis curve.
³Distortion includes all harmonics up to 30 kHz and is measured following a standard 50- or 75-microsecond de-emphasis network.
⁴Larger blowers available for operation at higher altitudes.
⁵AM Noise reduction kit required when operating at half power.
⁶For 117V/60 Hz power only; use MI-561018-4 for 117V/50 Hz.
⁷Specify operating frequency.
⁸Catalog RA-7711B.
⁹Includes 3/8 inch coaxial switches (either manual or motor driven), and connecting transmission line pre-cut to proper lengths.



Space-saving floor plan. The separate, unitized power supplies may be installed in a basement, another room or other convenient place. Wire ducts shown are not furnished.

Accessories and Options

Manometer	MI-560307-36
Elapsed-Time Indicator	MI-561018-2 ⁹
AM Noise Reduction Kit	MI-560307-31
Freq. and Mod. Monitor, Type BW-75	MI-560735 ⁷
Stereo Freq. and Mod. Monitor, Type BW-85	MI-560740 ⁷
SCA Freq. and Mod. Monitor, Type BW-95	MI-560745 ⁷
RF Amplifier, Type BW-100 (for off-air mon.)	MI-560738 ⁷
Crystal and Oven Spares Kit (for Exciter)	ES-563026
Service Slider Rails for Exciter (one pair) (Also for Stereo and SCA)	MI-561073
Slider Rails Installation Kit (one for each 20 kW Transmitter)	MI-563516
Electron Tube Spares, Complete Set	ES-560613
Automatic Power Output Control Panel	MI-561343
RF Load and Wattmeter (50 kW)	CB ⁸
Automatic Operation of Motor Driven By-Pass Switching System	CB
Automatic Operation of Exciter Switching System	CB
High Altitude Blower Kit	MI-560347-3
Mounting Kit (for High Altitude Blower only)	MI-560705

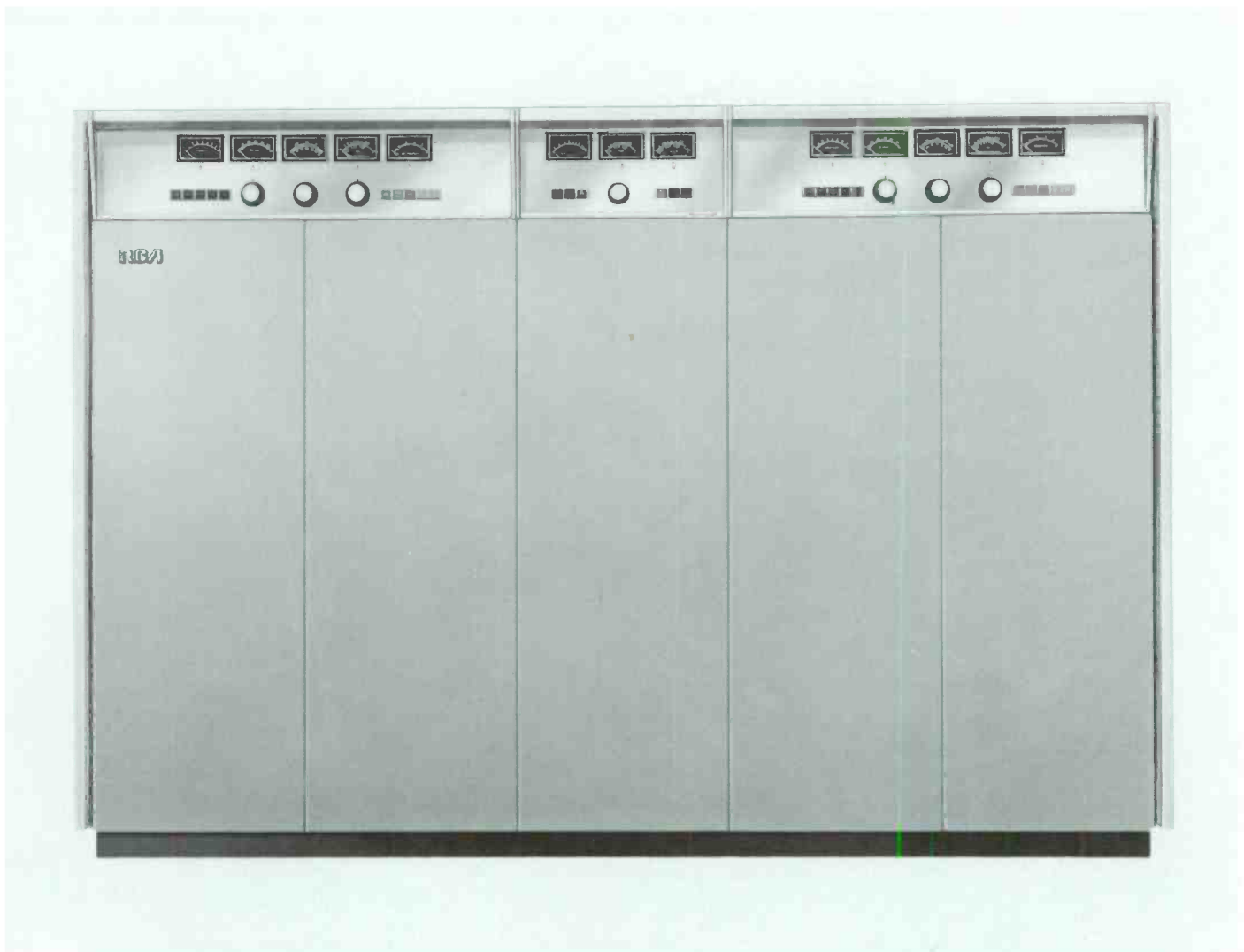


FM Transmitter, 40kW, Type BTF-40ES1

- Parallel Transmitters for High Reliability
- Designed for unattended operation
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- Only two tube types

The Type BTF-40ES1 is a forty-kilowatt transmitter for the maximum-power FM-broadcast station where continuous operation is important. The transmitter combines two identical twenty-kilowatt transmitters to form a redundant forty-kilowatt system. The dual design even allows major maintenance without interruption of air-time.

The BTF-40ES1 is a single-output transmitter. Four mode manual patch or motor driven by-pass output switching can be provided to allow either BTF-20ES1 to be connected directly to the antenna.



The BTF-40ES1 transmitter is actually two complete twenty-kilowatt units, (Type BTF-20ES1) combined to make continuous operation practical. All major components—except the combining equipment and the harmonic filter—are duplicated within the system: dual amplifiers, dual power supplies, etc. (see functional diagrams, on opposite page).

The BTF-40ES1 is intended for operation into a single transmission line and antenna system.

Dual, Switchable Exciters

The BTF-40ES1 includes two solid-state exciter systems arranged so that one of the two serves the transmitter while the other operates as a hot standby. In the event of trouble in the on-air exciter, manual (or Automatic optional) switch-over puts the extra exciter on the line. Lighted indicators on the control panel show the change in status.

The exciter system is the BTE-115 system providing excellent monaural, stereo and SCA performance that more than meets the Industry, FCC regulations and CCIR recommendations as achieved by

the Direct FM solid state units. (See Catalog RA.2020B.)

Interface to the BTF-40ES1 is accomplished through an Exciter/Transmitter interface relay panel to permit deactivating the exciter RF amplifier output when the individual 20 kW amplifier is turned off.

Power-Amplifier Stages

The exciter system delivers 15 watts of modulated carrier to a hybrid-ring power splitter which, in turn, provides two outputs, each to a pair of IPA tetrodes, in each transmitter section. These raise the power level to drive the final power amplifier. The final stage raises the power level to 20 kW. The two 20 kW outputs are combined to 40 kW in a hybrid combiner.

Hybrid Combiner Network

Ordinarily mounted above the transmitter cabinet, almost directly over the center unit, (see floor plan, last page) is the combiner network, a "three-dB hybrid" coaxial unit. This assembly combines the two 20 kW modulated carriers into one 40 kW output. The reject loads

for the combiner are mounted within the center cabinet of the transmitter.

Coaxial Harmonic Filters

The single harmonic filter is 122" (3100 mm) long and is a series of transmission-line elements with a uniform $6\frac{1}{8}$ -inch outer-conductor diameter, a stepped inner conductor and a shunt stub. Attenuation of all harmonics is accomplished in an M-derived section and a series of constant-K, T sections. The filter has a broad passband with a sharp high-frequency cutoff and excellent attenuation above cutoff frequency.

An optional filter configuration using two $3\frac{1}{8}$ " 61" (1549 mm) filters is available for a transmitter without output switching, but two will be supplied with either the manual or motor driven four mode switching versions. The optional filter consists of a series of transmission line and four shunt stubs. Attenuation of harmonics is accomplished by resonating the stub sections to various harmonic frequencies.

Central Transmitter Control

In the center cabinet are the control and metering functions for the combined

Forty-Kilowatt FM Transmitter, Type BTF-40ES1



transmitters. Push-buttons provide control of combined transmitter on/off and high voltage on/off. Lighted indicators signal d-c overload and output line VSWR overload, and are re-settable. Three meters, at the top panel, display reject power, reflected power and combined power output.

In the area immediately below the meter panel are reflectometer controls and adjustments. Next are the control switches for the exciter systems, a control-ladder circuit-breaker and a meter that displays exciter reject power. Below this is the control knob for adjustment of the "line-stretcher", which compensates the phase of the input circuits to the twin power-amplifier chains.

Relays in this section switch exciter system inputs, outputs and primary power. The audio connections to the stereo and SCA subchannels are switched automatically when the exciters are switched.

Built for Continuous Operation

The BTF-40ES1 transmitter, by virtue of its two independent transmitter systems, is configured so that either twenty-kilowatt system can be shut down for maintenance while the other feeds the antenna.

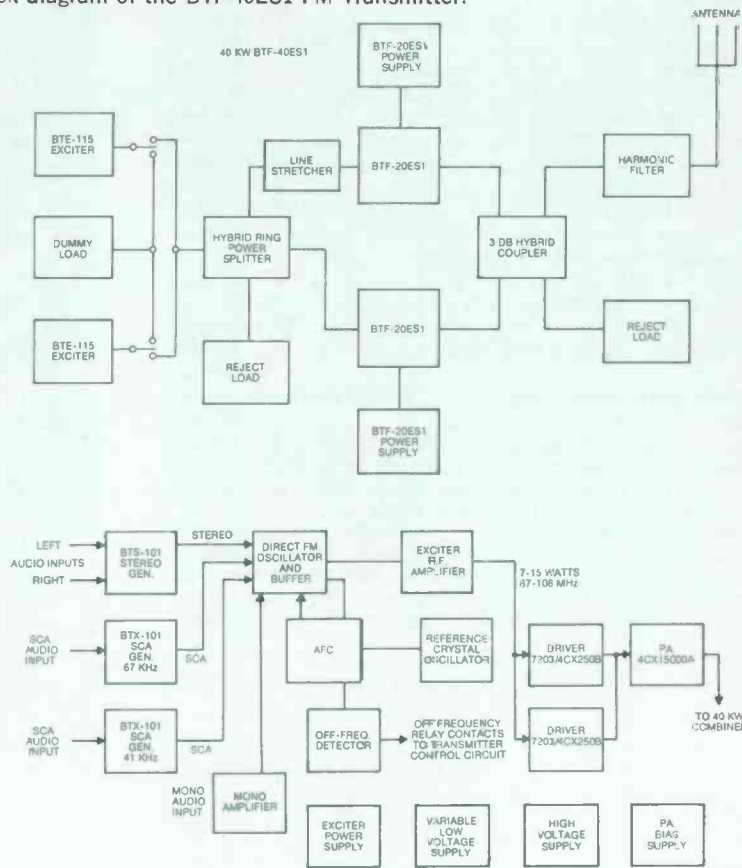
A four mode manual or motor driven by-pass switching system can be provided to allow one of the parallel transmitters to be connected directly to the station's antenna (see switching systems diagrams). This results in a reduced power of one-half instead of one-quarter power as would be experienced through the combining network.

The four modes are: 1.) both dual transmitters into antenna; 2.) both transmitters into dummy load; 3.) one transmitter into antenna and other into dummy load; and 4.) reverse of 3.). Automatic operation of the motor driven by-pass switching system is an optional accessory to the four mode switching system.

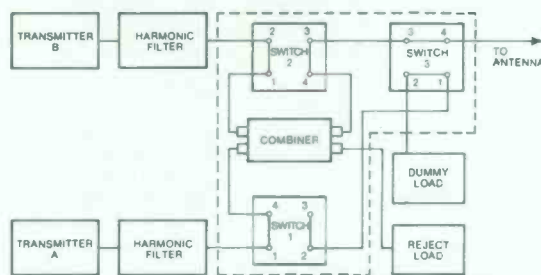
Redundant Power Supplies

The redundancy of the BTF-40ES1 system extends even to separate power supplies for each twenty-kilowatt section. These are units using solid-state rectifiers throughout for reduced maintenance and minimal operating expense. The power supply cabinets need not be located in the same room as the transmitter unit where space is a problem. They might, for example, be located in a basement room or in a shelter external to the transmitter building. More information on the twenty-kilowatt transmitter will be found in the catalog section on the Type BTF-20ES1. (See Catalog RA.2061D.)

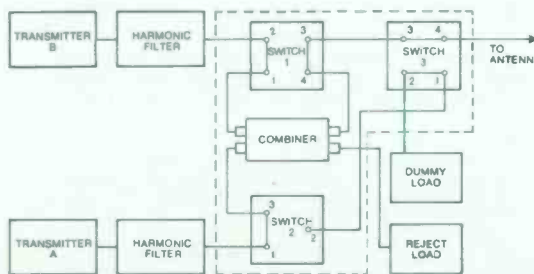
Block diagram of the BTF-40ES1 FM Transmitter.



Block diagram of one of the diplexed 20-kW units of the BTF-40ES1 Transmitter, showing optional Stereo and SCA.



Typical four mode switching system (motor driven) for BTF-40ES1 Dual Transmitter.



Typical four mode switching system (manual) for BTF-40ES1 Dual Transmitter.

Specifications

Performance

Type of EmissionF3 and F9
 Frequency Range87.5 to 108 MHz
 Power Output40,000 watts
 Output Impedance (6 1/8" O.D. Unflanged Line)50 Ohms
 Frequency Deviation 100% modulation±75 kHz
 Modulation Capability±100 kHz
 Carrier Frequency Stability±1000 Hz max.
 Audio Input Impedance600 Ohms
 Audio Input Level—(100% mod.)+10 ±2 dBm¹
 Audio Frequency Response—(30-15,000 Hz)±1 dB max.²
 Pre-emphasis Network Time Constant25, 50 or 75 μs.
 Harmonic Distortion (50-15,000 Hz)0.3% or less³
 FM Noise Level (referred to 100% FM mod.)-65 dB max.
 AM Noise Level (referred to carrier voltage)-50 dB max.⁵
 Subcarrier Input Level (100% mod.)9 to 30% adjustable

Subcarrier Input ImpedanceResistive 600 Ohms bal.
 Subcarrier Frequency20-95 kHz
 Main-to-Subchannel Crosstalk-50 dB referred to ±6.0 kHz deviation of the subcarrier by a 400 Hz tone. Main channel modulation 70% by a single tone (50 to 15000 Hz) and 30% by subcarrier, using narrow band detector.
 Sub-to-Main-Channel Crosstalk-60 dB referred to 100% modulation of the main carrier by a 400 Hz tone. Subcarrier modulated ±4.0 kHz by a single tone (30 to 5000 Hz), main channel modulated 30% by subcarrier, using narrow band detector, or 10% by subcarrier when operating in stereo.

Tube Complement

Driver: four 7203/4CX250B; Power Amplifier: two 4CX15000A

Electrical

Power Requirements:

Line240/208 Volt, 3 phase, 50/60 Hz
 Combined Line Voltage Variation and Regulation±10%
 Power Consumption72,000 Watts (approx.)
 Power Factor (approx.)90%

Mechanical

Dimensions (overall):	Each 20 kW Transmitter	Each High-Voltage Power Supply	Combiner Cabinet
Width	48 1/2" (1232 mm)	32" (813 mm)	20 1/2" (521 mm)
Height	77" (1956 mm)	46" (1168 mm)	77" (1956 mm)
Depth	32 1/2" (825 mm)	24" (610 mm)	32 1/2" (825 mm)
Weight (Approx.)	2950 lbs. (1338 kg)	2050 lbs. (936 kg)	686 lbs. (311 kg)

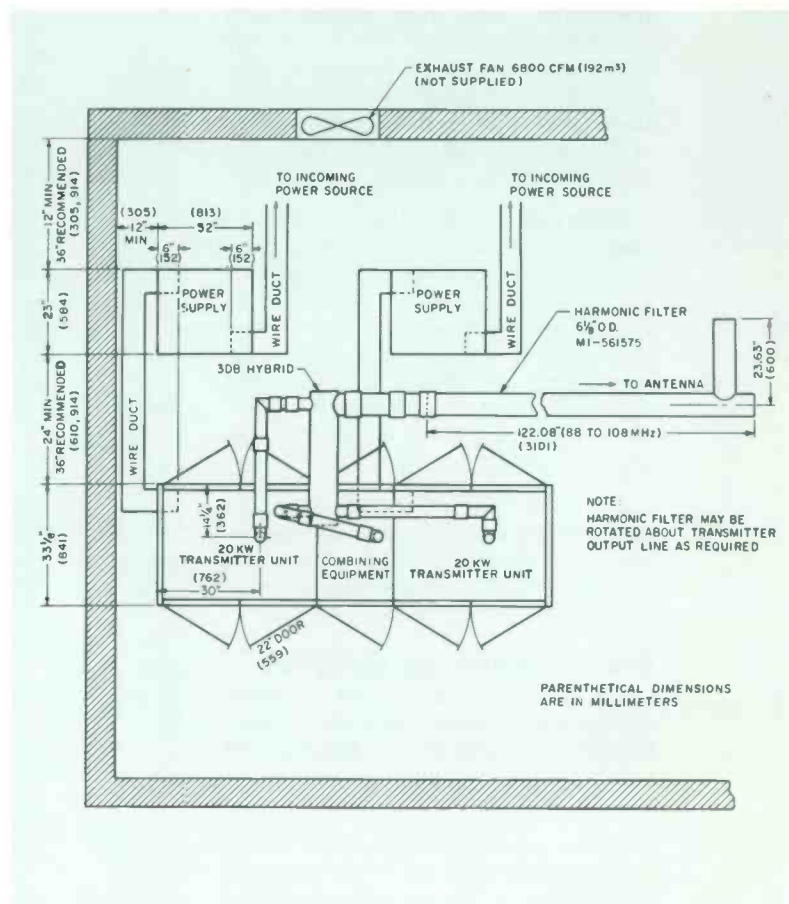
FinishTextured Vinyl in midnight blue and shadow blue, satin-aluminum trim.
 Altitude7500 ft. (2290 m)⁴
 Ambient Temperature Range-20° to +45°C

Ordering Information

FM Broadcast Transmitter, Type BTF-40ES1:
 With Single Harmonic Filter (40 kW) ES-560996B
 With Dual Harmonic Filters (20 kW) ES-560996C
 As Above, plus Manual Switching System ES-560996D⁹
 As Above, plus Motor Driven Switching System ES-560996E⁹

Please specify assigned frequency, power line frequency (if other than 60 Hz), ambient temperature and installation altitude if greater than 7500 feet (2300 m) above sea level. Stereo and/or SCA facilities ordered with transmitter are factory installed.

¹Level measured at input to pre-emphasis network, referred to 400 Hz.
²Frequency response referred to 50- or 75-microsecond pre-emphasis curve.
³Distortion includes all harmonics up to 30 kHz and is measured following a standard 50- or 75-microsecond de-emphasis network.
⁴Larger blowers available for operation at higher altitudes.
⁵AM Noise reduction kit required when operating at half power.
⁶For 117V/60 Hz power only; use MI-561018-4 for 117V/50 Hz.
⁷Specify operating frequency.
⁸Catalog RA.7711B.
⁹Includes 3/8 inch coaxial switches (either manual or motor driven), and connecting transmission line pre-cut to proper lengths.



Space-saving floor plan. The separate, unitized power supplies may be installed in a basement, another room or other convenient place. Wire ducts shown are not furnished.

Accessories and Options

- Manometer MI-560307-36
- Elapsed-Time Indicator MI-561018-2⁰
- AM Noise Reduction Kit MI-560307-31
- Freq. and Mod. Monitor, Type BW-75 MI-560735⁷
- Stereo Freq. and Mod. Monitor, Type BW-85 MI-560740⁷
- SCA Freq. and Mod. Monitor, Type BW-95 MI-560745⁷
- RF Amplifier, Type BW-100 (for off-air mon.) MI-560738⁷
- Crystal and Oven Spares Kit (for Exciter) ES-563026
- Service Slider Rails for Exciter (one pair) MI-561073 (Also for Stereo and SCA)
- Slider Rails Installation Kit (one for each 20 kW Transmitter) MI-563516
- Electron Tube Spares, Complete Set ES-560613
- Automatic Power Output Control Panel MI-561343
- RF Load and Wattmeter (50 kW) CB⁸
- Automatic Operation of Motor Driven By-Pass Switching System CB
- Automatic Operation of Exciter Switching System CB
- High Altitude Blower Kit MI-560347-3
- Mounting Kit (for High Altitude Blower only) MI-560705

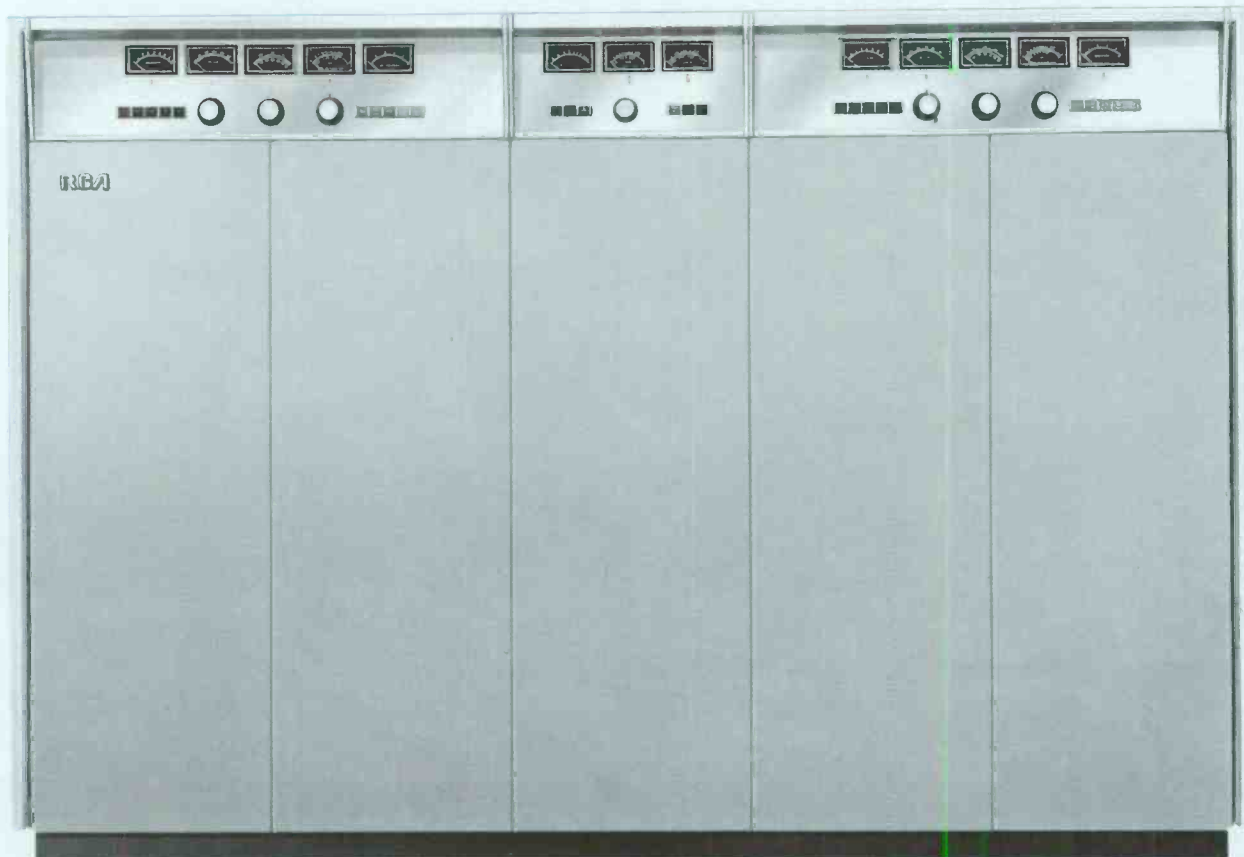


FM Transmitter, 20 kW Type BTF-10 Plus 10ES1

- Parallel Transmitters for High Reliability
- Designed for unattended operation
- Expandable to 40 kW power level
- Direct-FM for full-fidelity mono or stereo with or without SCA
- Only two tube types

The Type BTF-10 plus 10ES1 is a twenty-kilowatt transmitter for the FM-broadcast station where continuous operation is important. The transmitter combines two identical ten-kilowatt transmitters (BTF-10ES1) to form a redundant twenty-kilowatt system. The dual design allows major maintenance without interruption of air-time.

The BTF-10 plus 10ES1 is a single-output transmitter. Four mode manual patch or motor driven by-pass output switching can be provided to allow either BTF-10ES1 to be connected directly to the antenna.



The BTF-10 plus 10ES1 transmitter is actually two complete ten-kilowatt units, (Type BTF-10ES1) combined to make continuous operation practical. All major components—except the combining equipment—are duplicated within the system: twin finals, twin power supplies, etc. (see functional diagrams, on opposite page).

The BTF-10 plus 10ES1 is intended for operation into a single transmission line and antenna system.

Dual, Switchable Exciters

The BTF-10 plus 10ES1 includes two solid-state exciter systems arranged so that one of the two serves the transmitter while the other operates as a hot standby. In the event of trouble in the on-air exciter, manual (or Automatic optional) switchover puts the extra exciter on the line. Lighted indicators on the control panel show the change in status.

The exciter system is the BTE-115 system providing excellent monaural, stereo and SCA performance that more than meets the Industry, FCC regulations and CCIR recommendations as achieved by the "Direct FM" solid state units. (See Catalog RA.2020B).

Interface to the BTF-10 plus 10ES1 is accomplished through an Exciter/Transmitter interface relay panel to permit deactivating the exciter RF amplifier output when the individual 10 kW amplifier is turned off.

Power-Amplifier Stages

The exciter system delivers 15 watts of modulated carrier to a hybrid-ring power splitter which, in turn, provides two outputs, each to a IPA tetrode in each transmitter section. This raises the power level to drive the final power amplifier. The final stage raises the power level to 10 kW. The two 10 kW outputs are combined to 20 kW in a hybrid combiner.

Hybrid-Combiner Network

Ordinarily mounted above the transmitter cabinet, almost directly over the center unit, (see floor plan, last page) is the combiner network, a "three-dB hybrid" coaxial unit. This assembly combines the two 10 kW modulated carriers into one 20 kW output. The reject load for the combiner is mounted within the center cabinet of the transmitter.

Coaxial Harmonic Filters

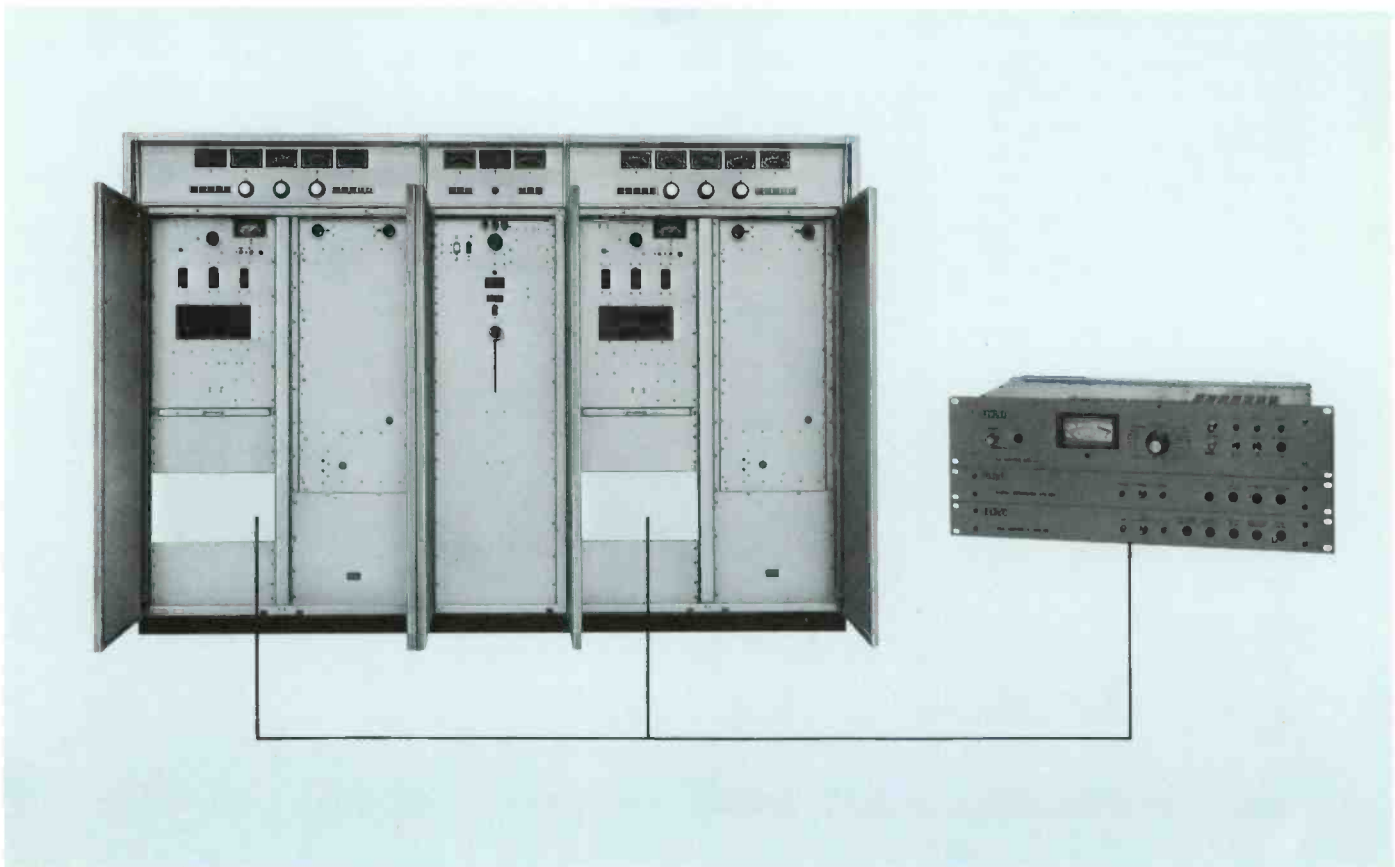
The single harmonic filter is 149" (3784 mm) long at frequencies below 98 MHz and 129" (3277 mm) above 98 MHz and is a series of transmission-line elements with a uniform $3\frac{1}{8}$ inch outer-conductor diameter, a stepped inner conductor and a shunt stub. Attenuation of all harmonics is accomplished in a M-derived section and a series of constant-K, T sections. The filter has a broad passband with a sharp high-frequency cutoff and excellent attenuation above cutoff frequency. A pressurized unit for outside installation is also available.

An optional filter configuration using two $3\frac{1}{8}$ " 61" (1549 mm) filters is available for a transmitter without output switching, and two also will be supplied with either the manual or motor driven four mode switching versions. The optional filter consists of a series of transmission line stubs. Attenuation of harmonics is accomplished by resonating the stub sections to various harmonic frequencies.

Center Transmitter Control

In the center cabinet are the control and metering functions for the combined

Twenty-Kilowatt FM Transmitter, Type BTF-10 plus 10ES1



transmitters. Push-buttons provide control of combined unit on/off and plate power on/off. Lighted indicators signal d-c overload and output line VSWR overload. Three meters, at the top edge, display reject power, reflected power and combined power output.

In the area immediately below the meter panel are reflectometer controls and adjustments. Next are the control switches for the exciter systems, a control-ladder circuit-breaker and a meter that displays exciter reject power. Next is the control knob for adjustment of the "line-strecher", which adjusts the phase of the input circuits of the twin power-amplifier chains.

Relays in this section switch inputs and output power of the exciter system. The audio connections to the stereo and SCA subchannels are switched automatically when the exciters are switched.

By-Pass Switching Operation

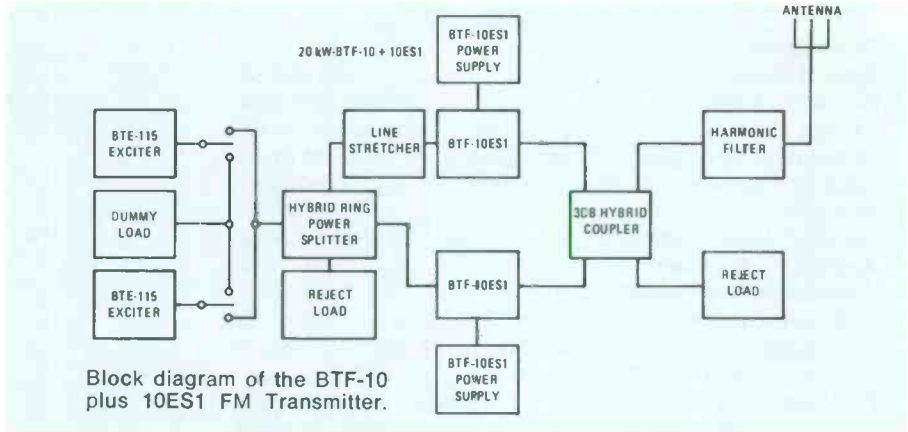
The BTF-10 plus 10ES1 transmitter, by virtue of its two independent transmitter systems, is configured so that either ten-kilowatt system can be shut down for maintenance while the other feeds the antenna.

A four mode manual or motor driven by-pass switching system can be provided to allow either one of the parallel transmitters to be connected directly to the station's antenna (see switching systems diagrams). This results in a reduced power of one-half instead of one-quarter power as would be experienced through the combining network.

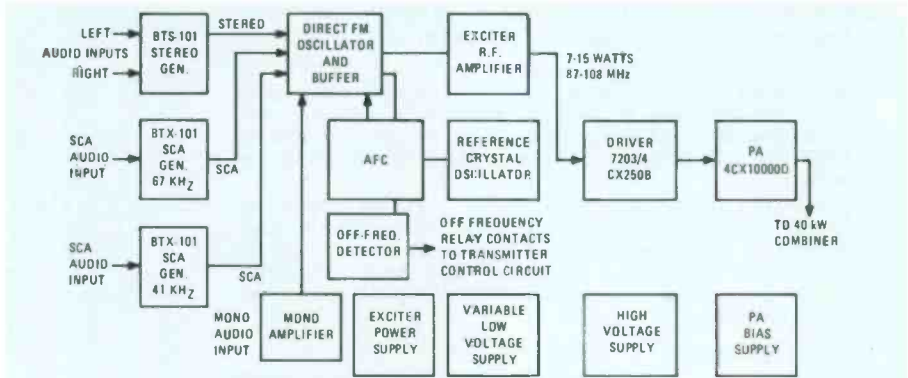
The four modes are: 1) both dual transmitters into antenna; 2) both transmitters into dummy load; 3) one transmitter into antenna and other into dummy load; and 4) reverse of 3). Automatic operation of the motor driven by-pass switching system is an optional accessory to the four mode switching system.

Redundant Power Supplies

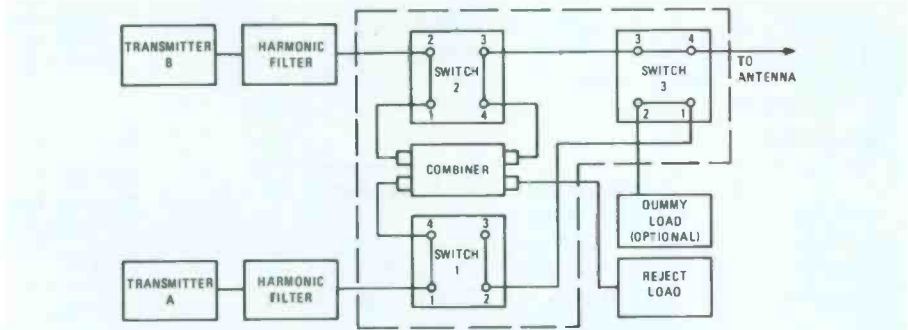
The redundancy of the BTF-10 plus 10ES1 system extends even to separate power supplies for each ten-kilowatt section. These are units using solid-state rectifiers throughout for reduced maintenance and minimal operating expense. The power supply cabinets need not be located in the same room as the transmitter unit where space is a problem. They might, for example, be located in a basement room or in a shelter external to the transmitter building. More information will be found in the catalog section on the Type BTF-10ES1. (See Catalog RA.2051C).



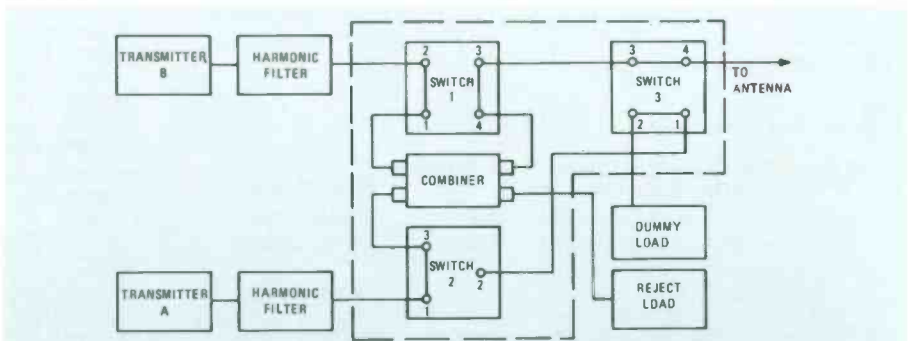
Block diagram of the BTF-10 plus 10ES1 FM Transmitter.



Block diagram of one of the Duplexed 10 kW units of the BTF-10 plus 10ES1 FM Transmitters.



Typical Four-Mode Switching System (motor driven) of the BTF-10 plus 10ES1 Dual FM Transmitters.



Typical Four-Mode Switching System (manual) for the BTF-10 plus 10ES1 Dual Transmitter.

Specifications

Performance

Type of Emission F3 and F9
 Frequency Range 87.5 to 108 MHz
 Power Output 10 kW to 20 kW
 Output Impedance (6 1/8" O.D. Unflanged Line) 50 Ohms
 Frequency Deviation 100% modulation ±75 kHz
 Modulation Capability ±100 kHz
 Carrier Frequency Stability ±1000 Hz max.
 Audio Input Impedance 600 Ohms
 Audio Input Level—(100% mod.) +10 ±2 dBm¹
 Audio Frequency Response—(30-15,000 Hz) +1 dB max.²
 Pre-emphasis Network Time Constant 0, 25, 50 or 75 μs³
 Harmonic Distortion (50-15,000 Hz) 0.3% or less⁴
 FM Noise Level (referred to 100% FM mod.) -68 dB max.
 AM Noise Level (referred to 100% AM mod.) -50 dB max.⁶
 Subcarrier Input Level (100% mod.) 9 to 30% adjustable
 Subcarrier Input Impedance Resistive 600 Ohms bal.
 Subcarrier Frequency 20-95 kHz
 Main-to-Subchannel Crosstalk -50 dB referred to ±6.0 kHz deviation of the subcarrier by a 400 Hz tone.
 Main channel modulation 70% by a single tone (50 to 15000 Hz) and 30% by subcarrier, using narrow band detector.
 Sub-to-Main-Channel Crosstalk -60 dB referred to 100% modulation of the main carrier by a 400 Hz tone.
 Subcarrier modulated ±4.0 kHz by a single tone (30 to 5000 Hz), main channel modulated 30% by a subcarrier, using narrow band detector, or 10% by a subcarrier when operating in stereo.

Tube Complement

Driver Two 7203/4CX250B
 Power Amplifier Two 4CX10000D

Electrical

Power Requirements:
 Line 240/208 Volt, 3 phase, 50/60 Hz
 Combined Line Voltage Variation and Regulation ±10%
 Power Consumption (approx.) 38,000 Watts
 Power Factor (approx.) 90%

Mechanical

Dimensions (overall):

	Transmitter	High-Voltage Power Supply
Width	114 1/4" (2882 mm)	64" (1626 mm)
Height	77" (1956 mm)	49" (1245 mm)
Depth	32 1/2" (825 mm)	23" (585 mm)
Weight (approx.)	2950 lbs. (1336.4 kg)	1680 lbs. (762 kg)

Finish Textured Vinyl in midnight blue and shadow blue, satin-aluminum trim.

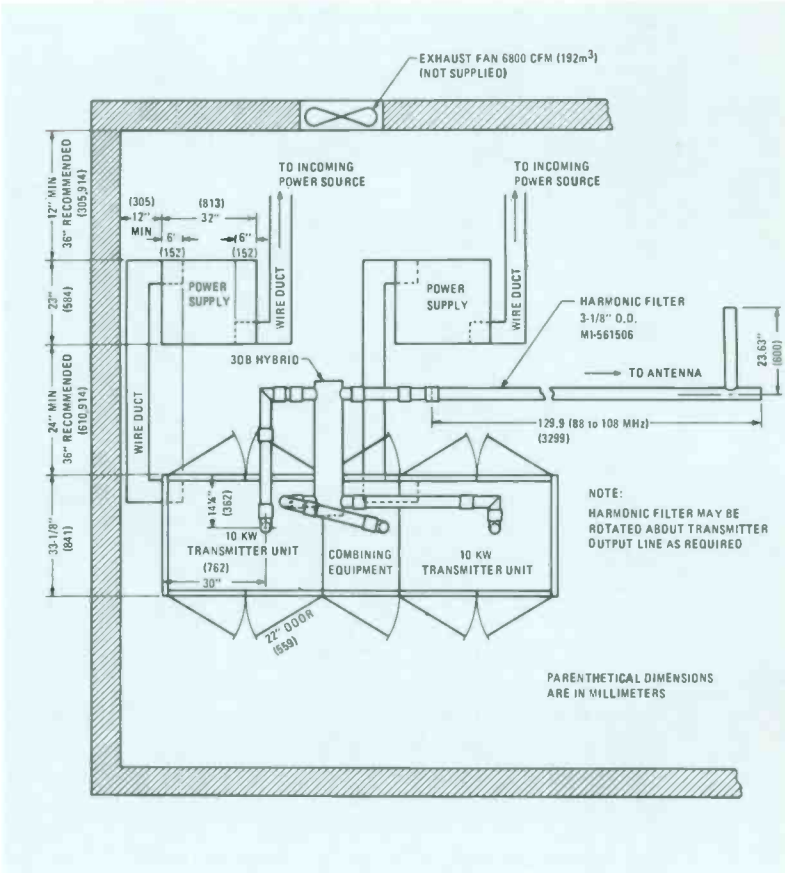
Altitude:
 60 Hz 9000 ft. (2740 m)⁵
 50 Hz 7500 ft. 2286 m)⁵

Ambient Temperature Range -20° to +45°C

Ordering Information

FM Broadcast Transmitter, Type-10 plus 10ES1:
 With Single Harmonic Filter (20 kW) ES-560994B
 With Dual Harmonic Filter (20 kW ea.) ES-560994C
 As Above, plus Manual Switching System ES-560994D¹⁰
 As Above, plus Motor Driven Switching System ES-560994E¹⁰

Please specify assigned frequency, power line frequency (if other than 60 Hz), ambient temperature and installation altitude if greater than 7500 feet (2300 m) above sea level. Stereo and/or SCA facilities ordered with transmitter are factory installed.



Space-saving floor plan. The separate, unitized power supplies may be installed in a basement, another room or other convenient place. Wire ducts shown are not furnished.

Accessories and Options

Manometer MI-560307-36
 Elapsed-Time Indicator MI-561018-27
 AM Noise Reduction Kit MI-560307-31⁶
 Freq. and Mod. Monitor, Type BW-75 MI-560735⁸
 Stereo Freq. and Mod. Monitor, Type BW-85 MI-560740⁸
 SCA Freq. and Mod. Monitor, Type BW-95 MI-560745⁸
 RF Amplifier, Type BW-100 (for off-air mon.) MI-560738⁸
 Crystal and Oven Spare Kit (for Exciter) MI-561066
 Electron Tube Spares, Complete Set ES-560613
 Automatic Power Output Control Panel MI-561343
 Directional Coupler, 3 1/8", 50-ohm, 20 kW (for use with Automatic Power Control, use one for each parallel transmitter) MI-561043-8
 RF Load and Wattmeter (20 kW) CB⁹
 Automatic Operation of Motor Driven By-Pass Switching System CB
 Automatic Operation of Exciter Switching System CB

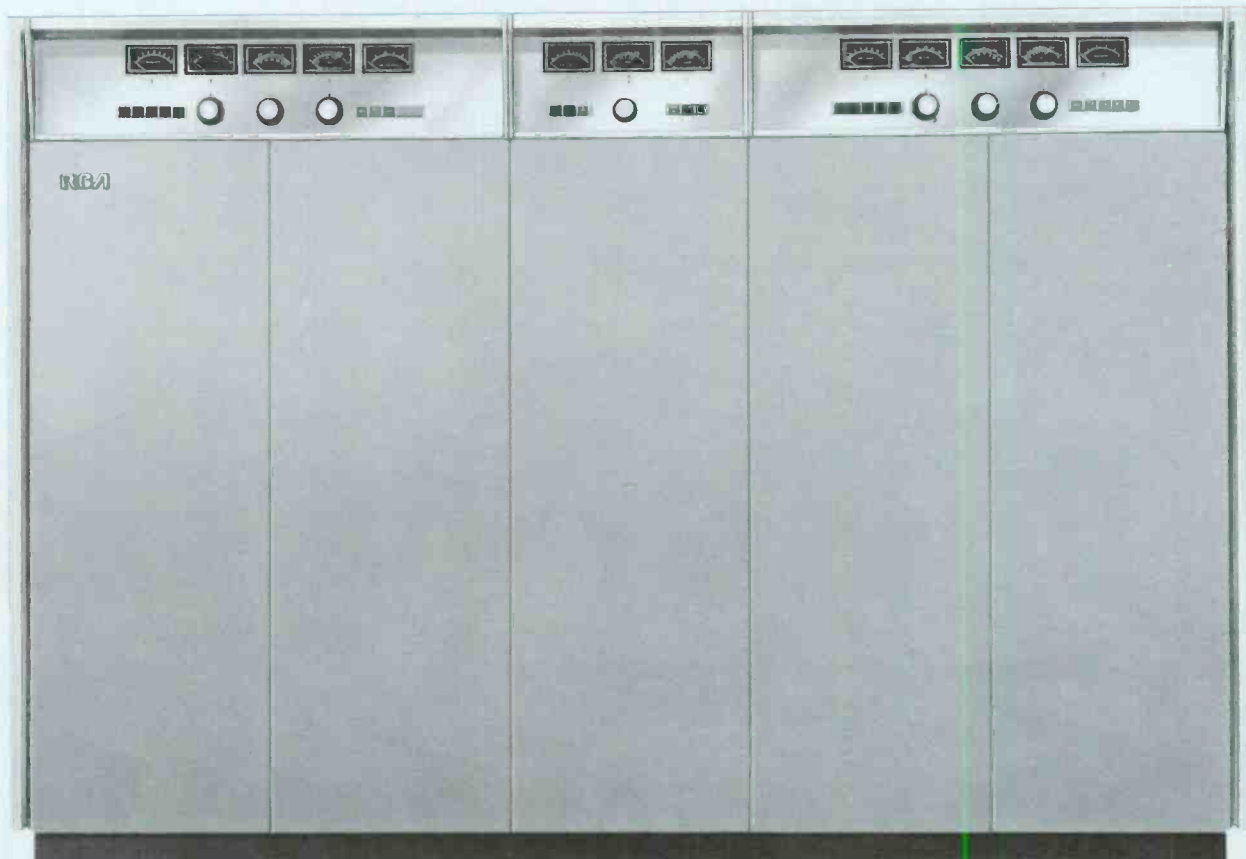
¹Level measured at input to pre-emphasis network, referred to 400 Hz.
²Frequency response referred to 50- or 75-microsecond pre-emphasis curve.
³Other time constants available on request.
⁴Distortion includes all harmonics up to 30 kHz and is measured following a standard 50- or 75-microsecond de-emphasis network.
⁵Larger blowers available for operation at higher altitudes.
⁶AM Noise reduction kit required when operating at half power.
⁷For 117V/60 Hz power only; use MI-561018-4 for 117V/50 Hz.
⁸Specify operating frequency.
⁹Catalog RA.7711B.
¹⁰Includes 3 1/8 inch coaxial switches (either manual or motor driven).

FM Transmitter, 20 kW Type BTF-10 Plus 10ES1

- Parallel Transmitters for High Reliability
- Designed for unattended operation
- Expandable to 40 kW power level
- Direct-FM for full-fidelity mono or stereo with or without SCA
- Only two tube types

The Type BTF-10 plus 10ES1 is a twenty-kilowatt transmitter for the FM-broadcast station where continuous operation is important. The transmitter combines two identical ten-kilowatt transmitters (BTF-10ES1) to form a redundant twenty-kilowatt system. The dual design allows major maintenance without interruption of air-time.

The BTF-10 plus 10ES1 is a single-output transmitter. Four mode manual patch or motor driven by-pass output switching can be provided to allow either BTF-10ES1 to be connected directly to the antenna.



The BTF-10 plus 10ES1 transmitter is actually two complete ten-kilowatt units, (Type BTF-10ES1) combined to make continuous operation practical. All major components—except the combining equipment—are duplicated within the system: twin finals, twin power supplies, etc. (see functional diagrams, on opposite page).

The BTF-10 plus 10ES1 is intended for operation into a single transmission line and antenna system.

Dual, Switchable Exciters

The BTF-10 plus 10ES1 includes two solid-state exciter systems arranged so that one of the two serves the transmitter while the other operates as a hot standby. In the event of trouble in the on-air exciter, manual (or Automatic optional) switchover puts the extra exciter on the line. Lighted indicators on the control panel show the change in status.

The exciter system is the BTE-115 system providing excellent monaural, stereo and SCA performance that more than meets the Industry, FCC regulations and CCIR recommendations as achieved by the "Direct FM" solid state units. (See Catalog RA.2020B).

Interface to the BTF-10 plus 10ES1 is accomplished through an Exciter/Transmitter interface relay panel to permit deactivating the exciter RF amplifier output when the individual 10 kW amplifier is turned off.

Power-Amplifier Stages

The exciter system delivers 15 watts of modulated carrier to a hybrid-ring power splitter which, in turn, provides two outputs, each to a IPA tetrode in each transmitter section. This raises the power level to drive the final power amplifier. The final stage raises the power level to 10 kW. The two 10 kW outputs are combined to 20 kW in a hybrid combiner.

Hybrid-Combiner Network

Ordinarily mounted above the transmitter cabinet, almost directly over the center unit, (see floor plan, last page) is the combiner network, a "three-dB hybrid" coaxial unit. This assembly combines the two 10 kW modulated carriers into one 20 kW output. The reject load for the combiner is mounted within the center cabinet of the transmitter.

Coaxial Harmonic Filters

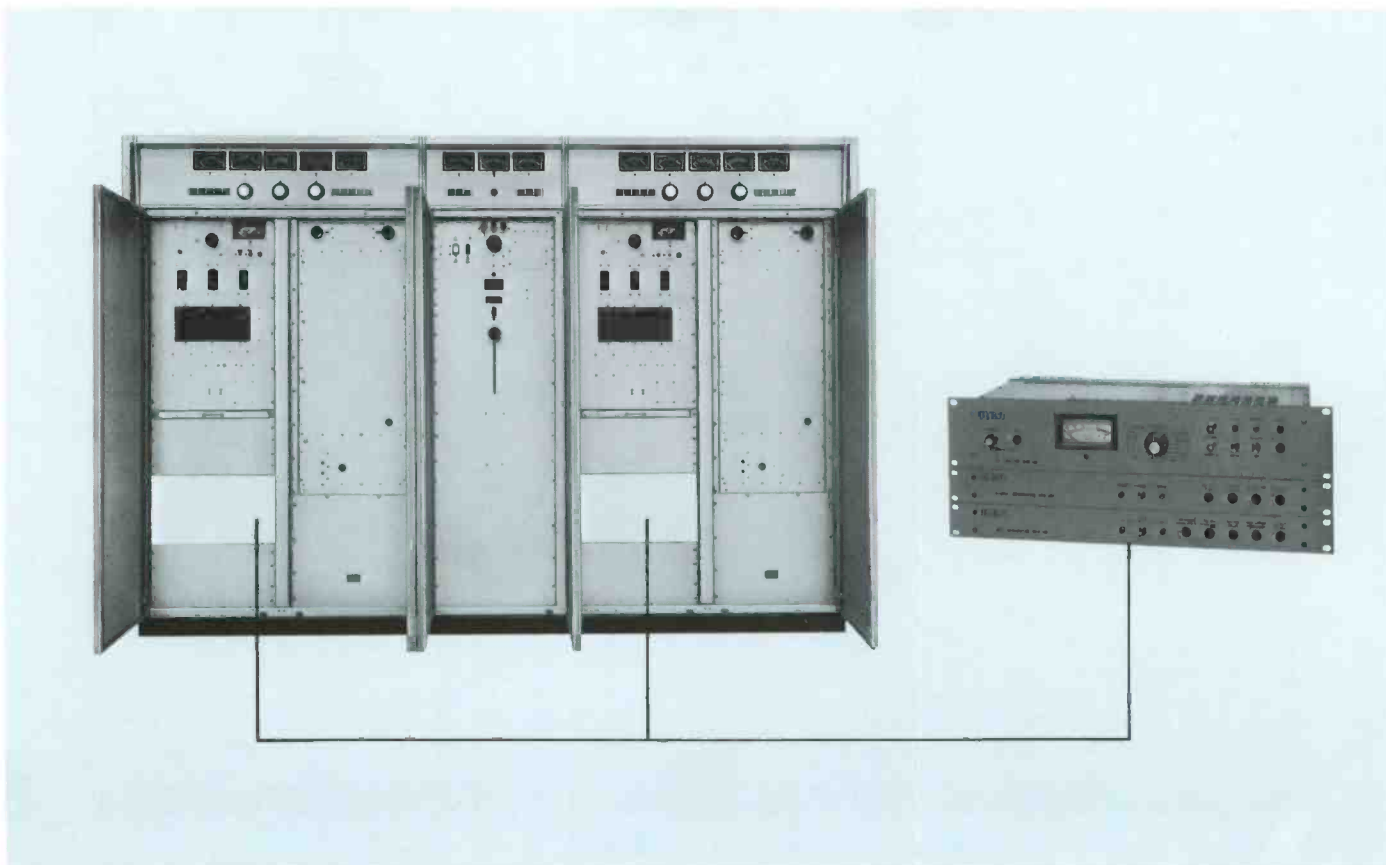
The single harmonic filter is 149" (3784 mm) long at frequencies below 98 MHz and 129" (3277 mm) above 98 MHz and is a series of transmission-line elements with a uniform $3\frac{1}{8}$ inch outer-conductor diameter, a stepped inner conductor and a shunt stub. Attenuation of all harmonics is accomplished in a M-derived section and a series of constant-K, T sections. The filter has a broad passband with a sharp high-frequency cutoff and excellent attenuation above cutoff frequency. A pressurized unit for outside installation is also available.

An optional filter configuration using two $3\frac{1}{8}$ " 61" (1549 mm) filters is available for a transmitter without output switching, and two also will be supplied with either the manual or motor driven four mode switching versions. The optional filter consists of a series of transmission line stubs. Attenuation of harmonics is accomplished by resonating the stub sections to various harmonic frequencies.

Center Transmitter Control

In the center cabinet are the control and metering functions for the combined

Twenty-Kilowatt FM Transmitter, Type BTF-10 plus 10ES1



transmitters. Push-buttons provide control of combined unit on/off and plate power on/off. Lighted indicators signal d-c overload and output line VSWR overload. Three meters, at the top edge, display reject power, reflected power and combined power output.

In the area immediately below the meter panel are reflectometer controls and adjustments. Next are the control switches for the exciter systems, a control-ladder circuit-breaker and a meter that displays exciter reject power. Next is the control knob for adjustment of the "line-strecher", which adjusts the phase of the input circuits of the twin power-amplifier chains.

Relays in this section switch inputs and output power of the exciter system. The audio connections to the stereo and SCA subchannels are switched automatically when the exciters are switched.

By-Pass Switching Operation

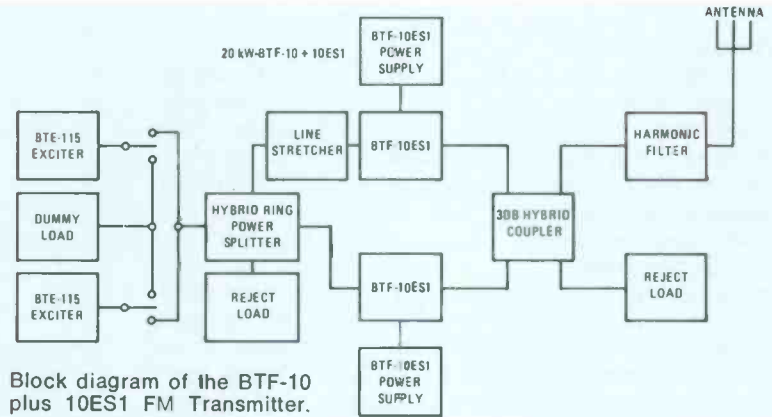
The BTF-10 plus 10ES1 transmitter, by virtue of its two independent transmitter systems, is configured so that either ten-kilowatt system can be shut down for maintenance while the other feeds the antenna.

A four mode manual or motor driven by-pass switching system can be provided to allow either one of the parallel transmitters to be connected directly to the station's antenna (see switching systems diagrams). This results in a reduced power of one-half instead of one-quarter power as would be experienced through the combining network.

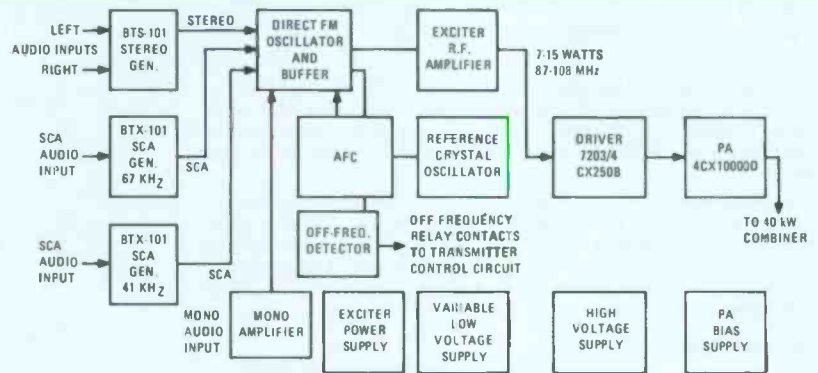
The four modes are: 1) both dual transmitters into antenna; 2) both transmitters into dummy load; 3) one transmitter into antenna and other into dummy load; and 4) reverse of 3). Automatic operation of the motor driven by-pass switching system is an optional accessory to the four mode switching system.

Redundant Power Supplies

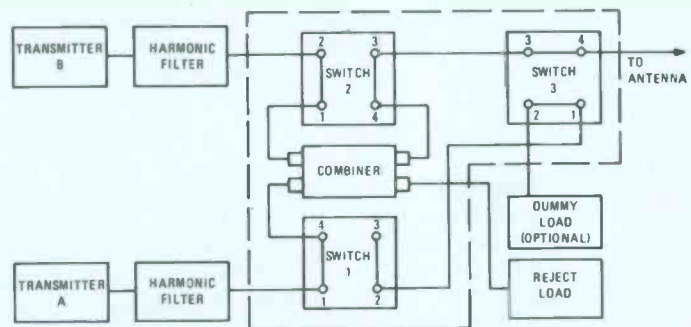
The redundancy of the BTF-10 plus 10ES1 system extends even to separate power supplies for each ten-kilowatt section. These are units using solid-state rectifiers throughout for reduced maintenance and minimal operating expense. The power supply cabinets need not be located in the same room as the transmitter unit where space is a problem. They might, for example, be located in a basement room or in a shelter external to the transmitter building. More information will be found in the catalog section on the Type BTF-10ES1. (See Catalog RA.2051C).



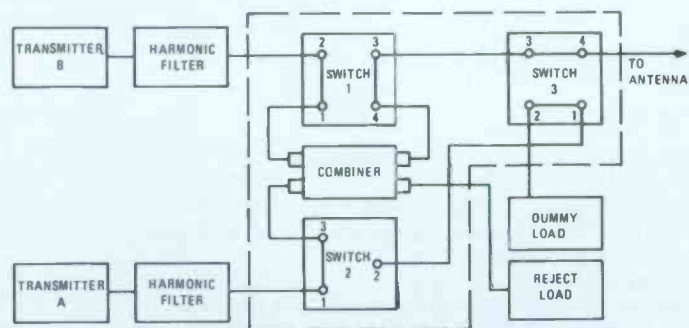
Block diagram of the BTF-10 plus 10ES1 FM Transmitter.



Block diagram of one of the Duplexed 10 kW units of the BTF-10 plus 10ES1 FM Transmitters.



Typical Four-Mode Switching System (motor driven) of the BTF-10 plus 10ES1 Dual FM Transmitters.



Typical Four-Mode Switching System (manual) for the BTF-10 plus 10ES1 Dual Transmitter.

Specifications

Performance

- Type of Emission F3 and F9
- Frequency Range 87.5 to 108 MHz
- Power Output 10 kW to 20 kW
- Output Impedance (6½" O.D. Unflanged Line) 50 Ohms
- Frequency Deviation 100% modulation ±75 kHz
- Modulation Capability ±100 kHz
- Carrier Frequency Stability ±1000 Hz max.
- Audio Input Impedance 600 Ohms
- Audio Input Level—(100% mod.) +10 ±2 dBm¹
- Audio Frequency Response—(30-15,000 Hz) +1 dB max.²
- Pre-emphasis Network Time Constant 0, 25, 50 or 75 μs³
- Harmonic Distortion (50-15,000 Hz) 0.3% or less⁴
- FM Noise Level (referred to 100% FM mod.) -68 dB max.
- AM Noise Level (referred to 100% AM mod.) -50 dB max.⁶
- Subcarrier Input Level (100% mod.) 9 to 30% adjustable
- Subcarrier Input Impedance Resistive 600 Ohms bal.
- Subcarrier Frequency 20-95 kHz
- Main-to-Subchannel Crosstalk -50 dB referred to ±6.0 kHz deviation of the subcarrier by a 400 Hz tone.
- Main channel modulation 70% by a single tone (50 to 15000 Hz) and 30% by subcarrier, using narrow band detector.
- Sub-to-Main-Channel Crosstalk -60 dB referred to 100% modulation of the main carrier by a 400 Hz tone.
- Subcarrier modulated ±4.0 kHz by a single tone (30 to 5000 Hz), main channel modulated 30% by a subcarrier, using narrow band detector, or 10% by a subcarrier when operating in stereo.

Tube Complement

- Driver Two 7203/4CX250B
- Power Amplifier Two 4CX10000D

Electrical

- Power Requirements:
 - Line 240/208 Volt, 3 phase, 50/60 Hz
 - Combined Line Voltage Variation and Regulation ±10%
 - Power Consumption (approx.) 38,000 Watts
 - Power Factor (approx.) 90%

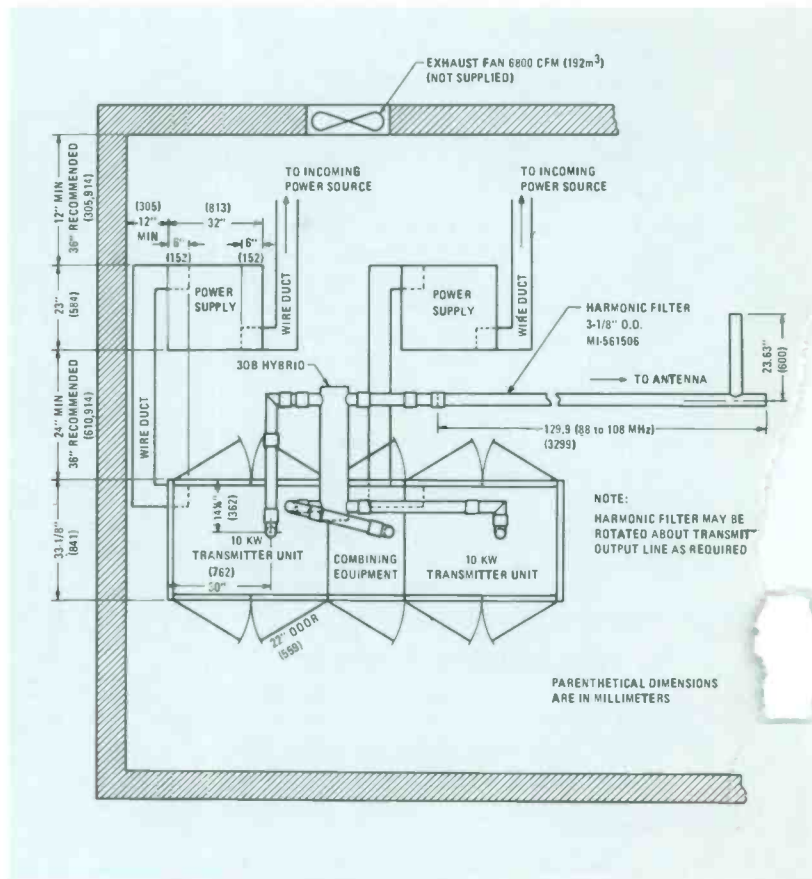
Mechanical

- Dimensions (overall):

	Transmitter	High-Voltage Power Supply
Width	114¼" (2882 mm)	64" (1626 mm)
Height	77" (1956 mm)	49" (1245 mm)
Depth	32½" (825 mm)	23" (585 mm)
- Weight (approx.) 2950 lbs. (1336.4 kg) 1680 lbs. (762 kg)
- Finish Textured Vinyl in midnight blue and shadow blue, satin-aluminum trim.
- Altitude:
 - 60 Hz 9000 ft. (2740 m)⁵
 - 50 Hz 7500 ft. 2286 m)⁵
- Ambient Temperature Range -20° to +45°C

Ordering Information

- FM Broadcast Transmitter, Type-10 plus 10ES1:
 - With Dual Harmonic Filter (20 kW) ES-560994B
 - With Dual Harmonic Filter (20 kW ea.) ES-560994C
 - As Above, plus Manual Switching System ES-560994D¹⁰
 - As Above, plus Motor Driven Switching System ES-560994E¹⁰
- Please specify assigned frequency, power line frequency (if other than 60 Hz), ambient temperature and installation altitude if greater than 7500 feet (2300 m) above sea level. Stereo and/or SCA facilities ordered with transmitter are factory installed.



Space-saving floor plan. The separate, unitized power supplies may be installed in a basement, another room or other convenient place. Wire ducts shown are not furnished.

Accessories and Options

- Manometer MI-560307-36
- Elapsed-Time Indicator MI-561018-27
- AM Noise Reduction Kit MI-560307-31⁹
- Freq. and Mod. Monitor, Type BW-75 MI-560735⁸
- Stereo Freq. and Mod. Monitor, Type BW-85 MI-560740⁸
- SCA Freq. and Mod. Monitor, Type BW-95 MI-560745⁸
- RF Amplifier, Type BW-100 (for off-air mon.) MI-560738⁸
- Crystal and Oven Spare Kit (for Exciter) MI-561066
- Electron Tube Spares, Complete Set ES-560613
- Automatic Power Output Control Panel MI-561343
- Directional Coupler, 3½", 50-ohm, 20 kW (for use with Automatic Power Control, use one for each parallel transmitter) MI-561043-8
- RF Load and Wattmeter (20 kW) CB⁹
- Automatic Operation of Motor Driven By-Pass Switching System CB
- Automatic Operation of Exciter Switching System CB

¹Level measured at input to pre-emphasis network, referred to 400 Hz.
²Frequency response referred to 50- or 75-microsecond pre-emphasis curve.
³Other time constants available on request.
⁴Distortion includes all harmonics up to 30 kHz and is measured following a standard 50- or 75-microsecond de-emphasis network.
⁵Larger blowers available for operation at higher altitudes.
⁶AM Noise reduction kit required when operating at half power.
⁷For 117V/60 Hz power only; use MI-561018-4 for 117V/50 Hz.
⁸Specify operating frequency.
⁹Catalog RA.7711B.
¹⁰Includes 3/8 inch coaxial switches (either manual or motor driven).

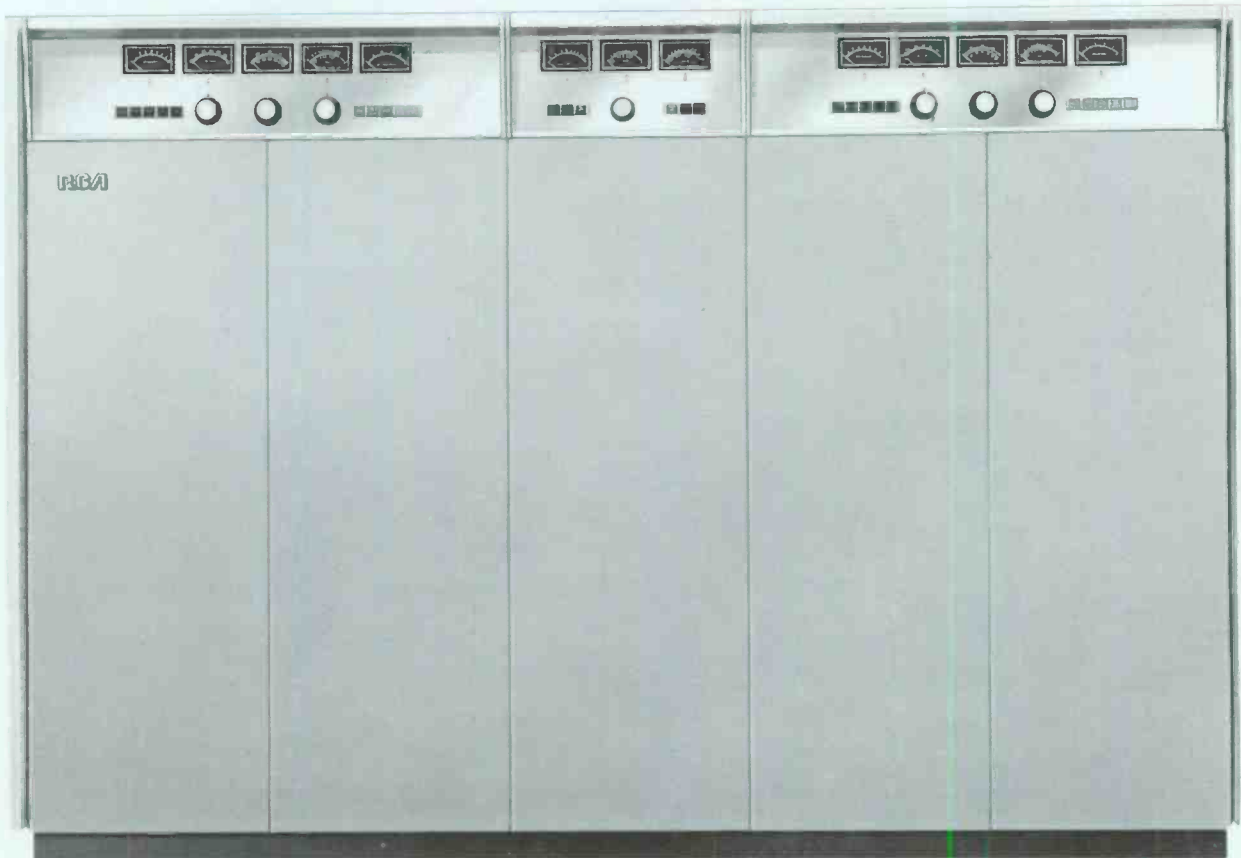


FM Transmitter, 10kW, Type BTF-5 Plus 5ES1

- Parallel Transmitters for High Reliability
- Designed for unattended operation
- Expandable to 40 kW power level
- Direct-FM for full-fidelity mono or stereo with or without SCA
- Only two tube types

The Type BTF-5 plus 5ES1 is a ten-kilowatt transmitter for the FM-broadcast station where continuous operation is important. The transmitter combines two identical five-kilowatt transmitters (BTF-5ES1) to form a redundant ten-kilowatt system. The dual design allows major maintenance without interruption of air-time.

The BTF-5 plus 5ES1 is a single-output transmitter. Four mode manual patch or motor driven by-pass output switching can be provided to allow either BTF-5ES1 to be connected directly to the antenna.



The BTF-5 plus 5ES1 transmitter is actually two complete five-kilowatt units, (Type BTF-5ES1) combined to make continuous operation practical. All major components—except the combining equipment—are duplicated within the system: twin finals, twin power supplies, etc. (see functional diagrams, on opposite page).

The BTF-5 plus 5ES1 is intended for operation into a single transmission line and antenna system.

Dual, Switchable Exciters

The BTF-5 plus 5ES1 includes two solid-state exciter systems arranged so that one of the two serves the transmitter while the other operates as a hot standby. In the event of trouble in the on-air exciter, manual (or Automatic optional) switch-over puts the extra exciter on the line. Lighted indicators on the control panel show the change in status.

The exciter system is the BTE-115 system providing excellent monaural, stereo and SCA performance that more than meets the Industry, FCC regulations and CCIR recommendations as achieved

by the "Direct FM" solid state units. (See Catalog RA.2020B).

Interface to the BTF-5 plus 5ES1 is accomplished through an Exciter/Transmitter interface relay panel to permit deactivating the exciter RF amplifier output when the individual 5kW amplifier is turned off.

Power-Amplifier Stages

The exciter system delivers 15 watts of modulated carrier to a hybrid-ring power splitter which, in turn, provides two outputs, each to a IPA tetrode in each transmitter section. This raises the power level to drive the final power amplifier. The final stage raises the power level to 5 kW. The two 5 kW outputs are combined to 10 kW in a hybrid combiner.

Hybrid Combiner Network

Ordinarily mounted above the transmitter cabinet, almost directly over the center unit, (see floor plan, last page) is the combiner network, a "three-dB hybrid" coaxial unit. This assembly combines the two 5 kW modulated carriers into one 10 kW output. The reject load for the combiner is mounted within the center cabinet of the transmitter.

Coaxial Harmonic Filters

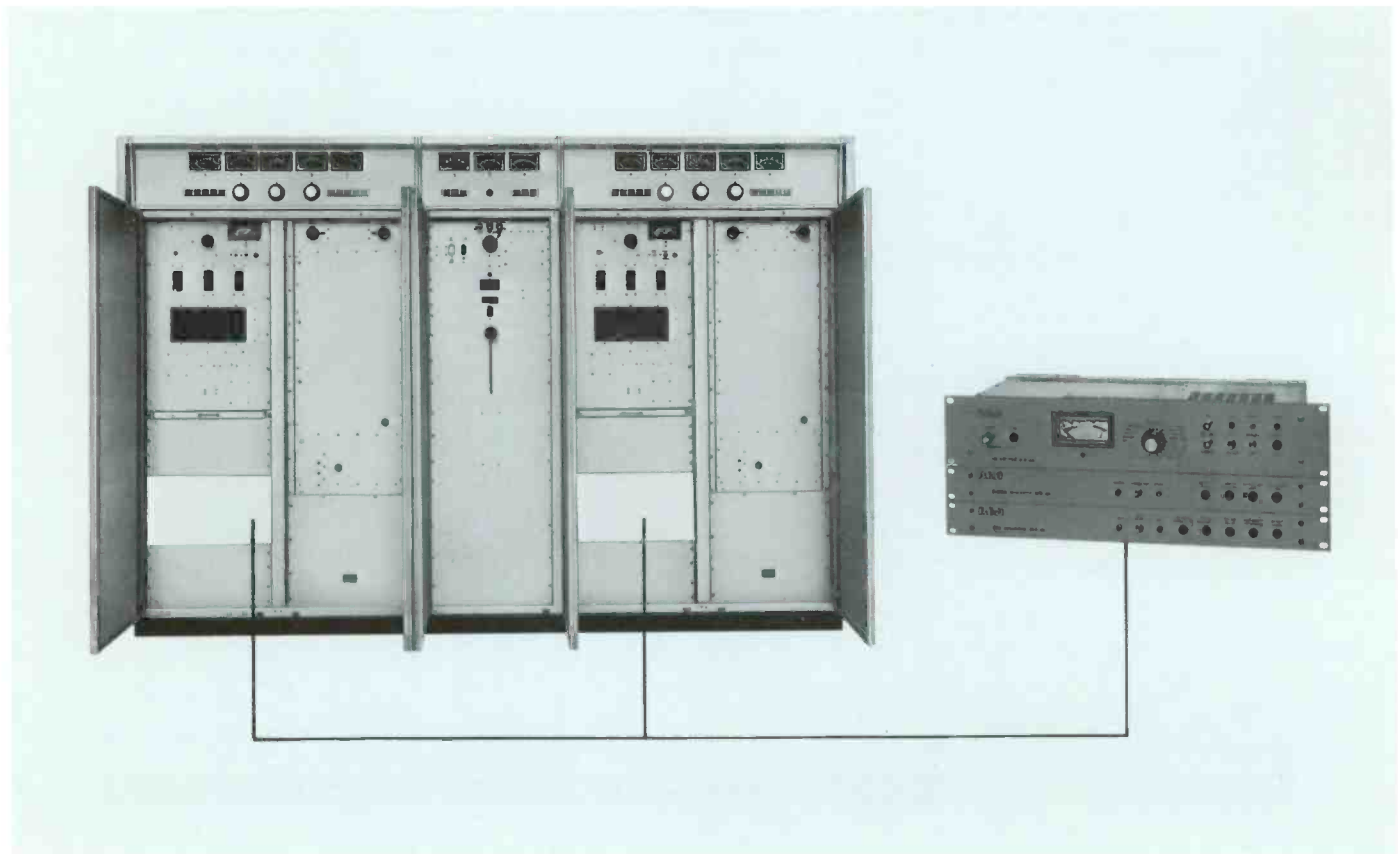
The single harmonic filter is 149" (3784 mm) long at frequencies below 98 MHz and 129" (3277 mm) above 98 MHz, and is a series of transmission-line elements with a uniform $3\frac{1}{8}$ " inch outer-conductor diameter, a stepped inner conductor and a shunt stub. Attenuation of all harmonics is accomplished in a M-derived section and a series of constant-K, T sections. The filter has a broad passband with a sharp high-frequency cutoff and excellent attenuation above cutoff frequency.

An optional filter configuration using two $3\frac{1}{8}$ " 61" (1549 mm) filters is available for a transmitter without output switching and two also will be supplied with either the manual or motor driven four mode switching versions. The optional filter consists of a series of transmission line stubs. Attenuation of harmonics is accomplished by resonating the stub sections to various harmonic frequencies.

Central Transmitter Control

In the center cabinet are the control and metering functions for the combined transmitters. Push-buttons provide control

Ten-Kilowatt FM Transmitter, Type BTF-5 plus 5ES1



of combined unit on/off and plate power on/off. Lighted indicators signal d-c overload and output line VSWR overload. Three meters, at the top edge, display reject power, reflected power and combined power output.

In the area immediately below the meter panel are reflectometer controls and adjustments. Next are the control switches for the exciter systems, a control-ladder circuit-breaker and a meter that displays exciter reject power. Next is the control knob for the adjustment of the "line-stretcher", which adjusts the phase of the input circuits of the twin power-amplifier chains.

Relays in this section switch inputs and output power of the exciter system. the audio connections to the stereo and and SCA subchannels are switched automatically when the exciters are switched.

By-Pass Switching Operation

The BTF-5 plus 5ES1 transmitter, by virtue of its two independent transmitter systems is configured so that either five-kilowatt system can be shut down for maintenance while the other feeds the antenna.

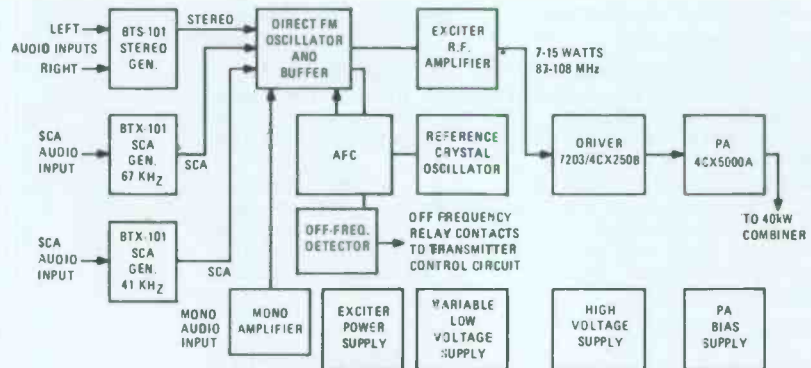
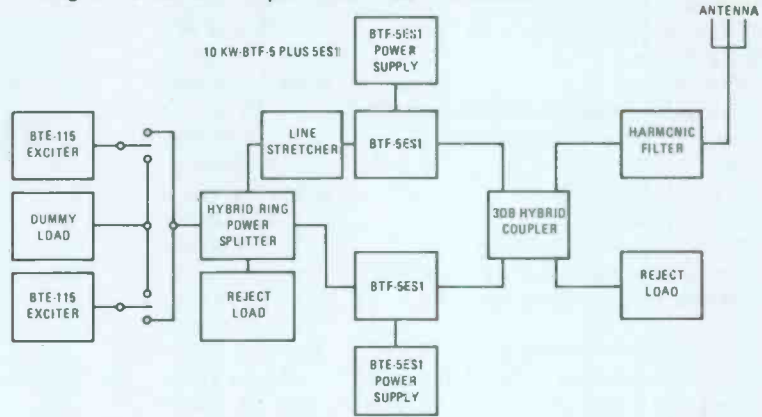
A four mode manual or motor driven by-pass switching system can be provided to allow either one of the parallel transmitters to be connected directly to the station's antenna (see switching systems diagrams). This results in a reduced power of one-half instead of one-quarter power as would be experienced through the combining network.

The four modes are 1) both dual transmitters into antenna; 2) both transmitters into dummy load; 3) one transmitter into antenna and other into dummy load; and 4) reverse of 3). Automatic operation of the motor driven by-pass switching system is an optional accessory to the four mode switching system.

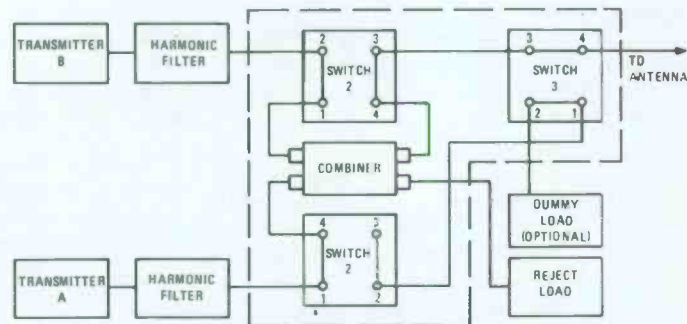
Redundant Power Supplies

The redundancy of the BTF-5 plus 5ES1 system extends even to separate power supplies for each five-kilowatt section. These are units using solid-state rectifiers throughout for reduced maintenance and minimal operating expense. The power supply cabinets need not be located in the same room as the transmitter unit where space is a problem. They might, for example, be located in a basement room or in a shelter external to the transmitter building. More information on the five-kilowatt transmitter will be found in the catalog section on the Type BTF-5ES1. (See Catalog RA. 2041C).

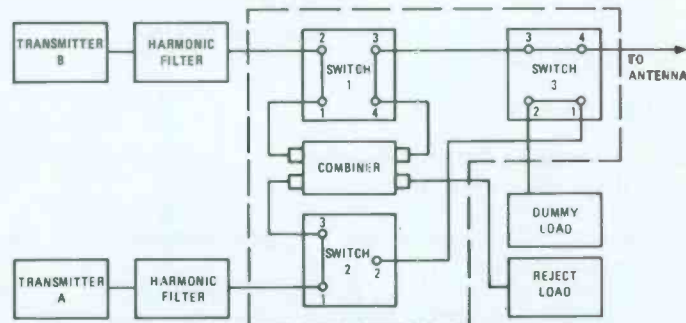
Block diagram of the BTF-5 plus 5ES1 FM Transmitter.



Block diagram of one of the Duplexed 5 kW units of the BTF-5 plus 5ES1 FM Transmitters.



Typical Four Mode Switching System (motor-driven) of the BTF-5 plus 5ES1 Dual Transmitter.



Typical Four Mode Switching System (manual) for the BTF-5 plus 5ES1 Dual Transmitter.

Specifications

Performance

Type of Emission F3 and F9
 Frequency Range 87.5 to 108 MHz
 Power Output 5 kW to 10 kW
 Output Impedance (6 1/8" O.D. Unflanged Line) 50 Ohms
 Frequency Deviation 100% modulation ±75 kHz
 Modulation Capability ±100 kHz
 Carrier Frequency Stability ±1000 Hz max.
 Audio Input Impedance 600 Ohms
 Audio Input Level—(100% mod.) +10 ±2 dBm¹
 Audio Frequency Response—(30-15,000 Hz) +1 dB max.²
 Pre-emphasis Network Time Constant 0, 25, 50 or 75 μs,
 as desired³
 Harmonic Distortion (50-15,000 Hz) 0.3% or less⁴
 FM Noise Level (referred to 100% FM mod.) -68 dB max.
 AM Noise Level (referred to 100% AM mod.) -50 dB max.⁵
 Subcarrier Input Level (100% mod.) 9 to 30% adjustable
 Subcarrier Input Impedance Resistive 600 Ohms bal.
 Subcarrier Frequency 20-95 kHz
 Main-to-Subchannel Crosstalk -50 dB referred to
 ±6.0 kHz deviation of the subcarrier by a 400 Hz tone.
 Main channel modulation 70% by a single tone (50 to
 15000 Hz) and 30% by subcarrier, using narrow band de-
 tector.
 Sub-to-Main-Channel Crosstalk -60 dB referred to
 100% modulation of the main carrier by a 400 Hz tone.
 Subcarrier modulated ±4.0 kHz by a single tone (30 to
 5000 Hz), main channel modulated 30% by a subcarrier,
 using narrow band detector, or 10% by a subcarrier when
 operating in stereo.

Tube Complement

Driver Two 7203/4CX250B
 Power Amplifier Two 4CX5000A

Electrical

Power Requirements:
 Line 240/208 Volt, 3 phase, 50/60 Hz
 Combined Line Voltage Variation and Regulation ±10%
 Power Consumption (approx.) 20,000 Watts
 Power Factor (approx.) 90%

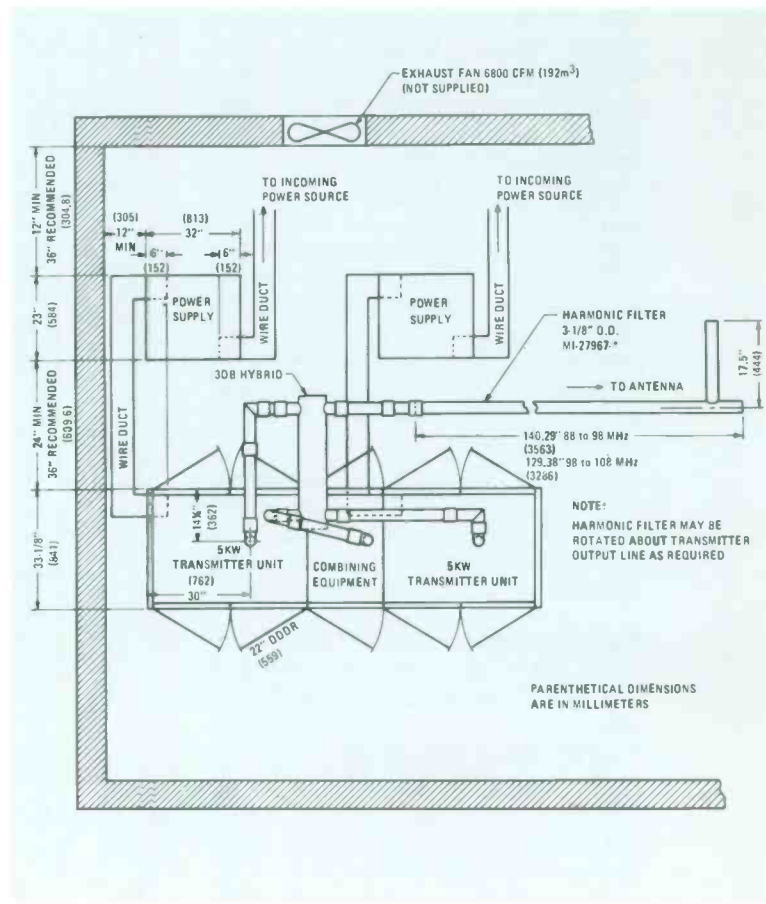
Mechanical

Dimensions (overall): Transmitter	High-Voltage Power Supply
Width 114 1/4" (2882 mm)	64" (1626 mm)
Height 77" (1956 mm)	49" (1245 mm)
Depth 32 1/2" (825 mm)	23" (585 mm)
Weight (approx.) 2850 lbs. (1247 kg)	1680 lbs. (762 kg)
Finish Textured Vinyl in midnight blue and shadow blue, satin-aluminum trim.	
Altitude:	
60 Hz 11,000 ft. (3352.8 m) ⁵	
50 Hz 9000 ft. (2743.2 m) ⁵	
Ambient Temperature Range -20° to +45°C	

Ordering Information

FM Broadcast Transmitter, Type BTF-5 +5ES1
 With Single Harmonic Filter (40 kW) ES-560992B
 With Dual Harmonic Filters (20 kW) ES-560992C
 As Above, plus Manual Switching System ES-560992D¹⁰
 As Above, plus Motor Driven Switching System ES-560992E¹⁰

Please specify assigned frequency, power line frequency (if other than 60 Hz), ambient temperature and installation altitude if greater than 9000 feet (2743 m) above seal level. Stereo and/or SCA facilities ordered with transmitter are factory installed.



Space-saving floor plan. The separate, unitized power supplies may be installed in a basement, another room or other convenient place. Wire ducts shown are not furnished.

Accessories and Option

Manometer	MI-560307-36
Elapsed-Time Indicator	MI-561018-27
AM Noise Reduction Kit	MI-560307-31 ⁶
Freq. and Mod. Monitor, Type BW-75	MI-560735 ⁸
Stereo Freq. and Mod. Monitor, Type BW-85	MI-560740 ⁸
SCA Freq. and Mod. Monitor, Type BW-95	MI-560745 ⁸
RF Amplifier, Type BW-100 (for off-air mon.)	MI-560738 ⁸
Crystal and Oven Spare Kit (for Exciter)	MI-561066
Electron Tube Spares, Complete Set	ES-560613
Automatic Power Output Control Panel	MI-561343
Directional Coupler, 3 1/8", 50-ohm, 20 kW (for use with Automatic Power Control, use one for each parallel transmitter)	MI-561043-12
RF Load and Wattmeter (10 kW)	CB ⁹
Automatic Operation of Motor Driven By-Pass Switching System	CB
Automatic Operation of Exciter Switching System	CB

¹Level measured at input to pre-emphasis network, referred to 400 Hz.
²Frequency response referred to 50- or 75-microsecond pre-emphasis curve.
³Other time constants available on request.
⁴Distortion includes all harmonics up to 30 kHz and is measured following a standard 50- or 75-microsecond de-emphasis network.
⁵Larger blowers available for operation at higher altitudes.
⁶AM Noise reduction kit required when operating at half power.
⁷For 117V/60 Hz power only; use MI-561018-4 for 117V/50 Hz.
⁸Specify operating frequency.
⁹Catalog RA.7711B.
¹⁰Includes 3/8 inch coaxial switches (either manual or motor driven).

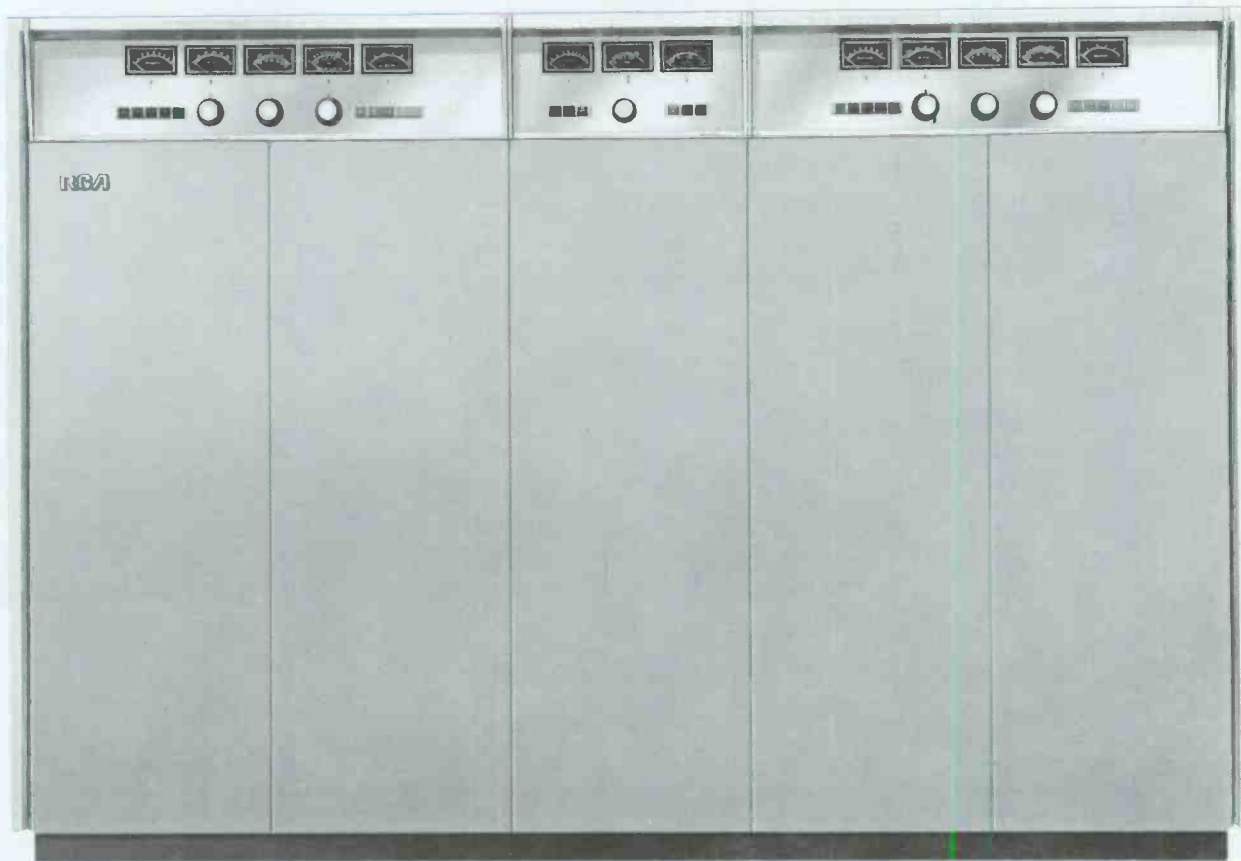


FM Transmitter, 10kW, Type BTF-5 Plus 5ES1

- Parallel Transmitters for High Reliability
- Designed for unattended operation
- Expandable to 40 kW power level
- Direct-FM for full-fidelity mono or stereo with or without SCA
- Only two tube types

The Type BTF-5 plus 5ES1 is a ten-kilowatt transmitter for the FM-broadcast station where continuous operation is important. The transmitter combines two identical five-kilowatt transmitters (BTF-5ES1) to form a redundant ten-kilowatt system. The dual design allows major maintenance without interruption of air-time.

The BTF-5 plus 5ES1 is a single-output transmitter. Four mode manual patch or motor driven by-pass output switching can be provided to allow either BTF-5ES1 to be connected directly to the antenna.



The BTF-5 plus 5ES1 transmitter is actually two complete five-kilowatt units, (Type BTF-5ES1) combined to make continuous operation practical. All major components—except the combining equipment—are duplicated within the system: twin finals, twin power supplies, etc. (see functional diagrams, on opposite page).

The BTF-5 plus 5ES1 is intended for operation into a single transmission line and antenna system.

Dual, Switchable Exciters

The BTF-5 plus 5ES1 includes two solid-state exciter systems arranged so that one of the two serves the transmitter while the other operates as a hot standby. In the event of trouble in the on-air exciter, manual (or Automatic optional) switch-over puts the extra exciter on the line. Lighted indicators on the control panel show the change in status.

The exciter system is the BTE-115 system providing excellent monaural, stereo and SCA performance that more than meets the Industry, FCC regulations and CCIR recommendations as achieved

by the "Direct FM" solid state units. (See Catalog RA.2020B).

Interface to the BTF-5 plus 5ES1 is accomplished through an Exciter/Transmitter interface relay panel to permit deactivating the exciter RF amplifier output when the individual 5kW amplifier is turned off.

Power-Amplifier Stages

The exciter system delivers 15 watts of modulated carrier to a hybrid-ring power splitter which, in turn, provides two outputs, each to a IPA tetrode in each transmitter section. This raises the power level to drive the final power amplifier. The final stage raises the power level to 5 kW. The two 5 kW outputs are combined to 10 kW in a hybrid combiner.

Hybrid Combiner Network

Ordinarily mounted above the transmitter cabinet, almost directly over the center unit, (see floor plan, last page) is the combiner network, a "three-dB hybrid" coaxial unit. This assembly combines the two 5 kW modulated carriers into one 10 kW output. The reject load for the combiner is mounted within the center cabinet of the transmitter.

Coaxial Harmonic Filters

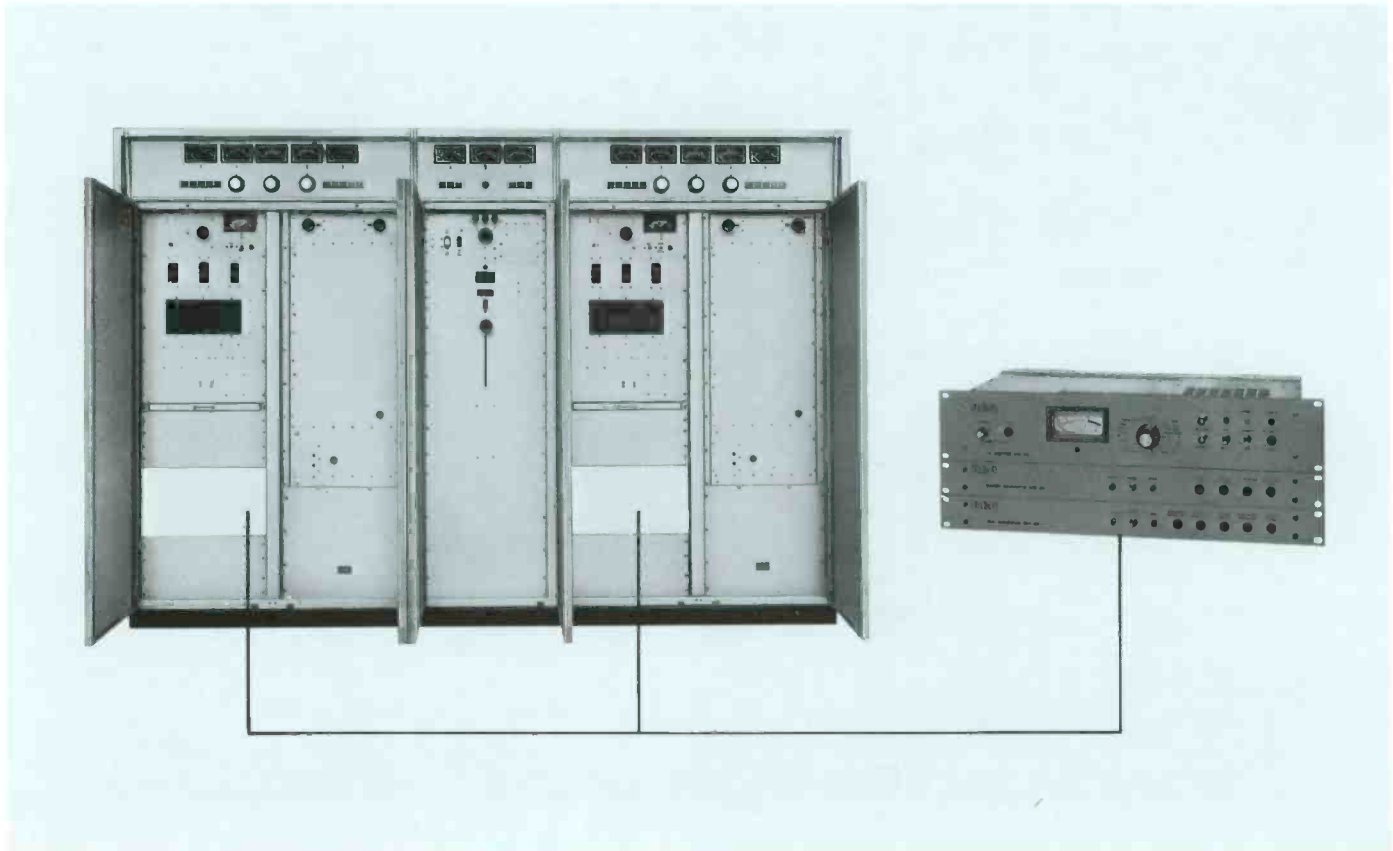
The single harmonic filter is 149" (3784 mm) long at frequencies below 98 MHz and 129" (3277 mm) above 98 MHz, and is a series of transmission-line elements with a uniform $3\frac{1}{8}$ " inch outer-conductor diameter, a stepped inner conductor and a shunt stub. Attenuation of all harmonics is accomplished in a M-derived section and a series of constant-K, T sections. The filter has a broad passband with a sharp high-frequency cutoff and excellent attenuation above cutoff frequency.

An optional filter configuration using two $3\frac{1}{8}$ " 61" (1549 mm) filters is available for a transmitter without output switching and two also will be supplied with either the manual or motor driven four mode switching versions. The optional filter consists of a series of transmission line stubs. Attenuation of harmonics is accomplished by resonating the stub sections to various harmonic frequencies.

Central Transmitter Control

In the center cabinet are the control and metering functions for the combined transmitters. Push-buttons provide control

Ten-Kilowatt FM Transmitter, Type BTF-5 plus 5ES1



of combined unit on/off and plate power on/off. Lighted indicators signal d-c overload and output line VSWR overload. Three meters, at the top edge, display reject power, reflected power and combined power output.

In the area immediately below the meter panel are reflectometer controls and adjustments. Next are the control switches for the exciter systems, a control-ladder circuit-breaker and a meter that displays exciter reject power. Next is the control knob for the adjustment of the "line-stretcher", which adjusts the phase of the input circuits of the twin power-amplifier chains.

Relays in this section switch inputs and output power of the exciter system. the audio connections to the stereo and and SCA subchannels are switched automatically when the exciters are switched.

By-Pass Switching Operation

The BTF-5 plus 5ES1 transmitter, by virtue of its two independent transmitter systems is configured so that either five-kilowatt system can be shut down for maintenance while the other feeds the antenna.

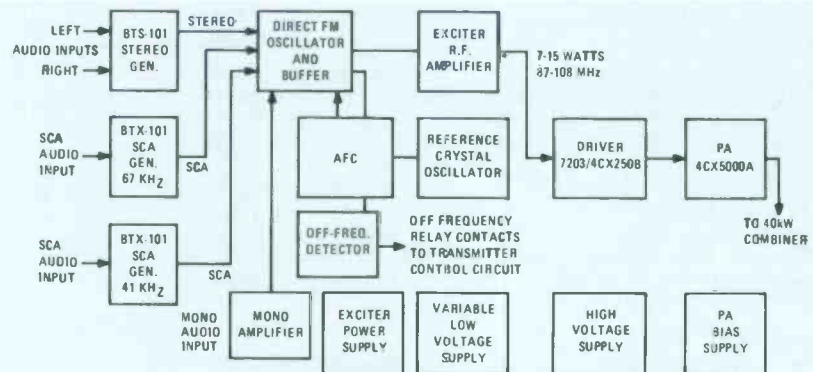
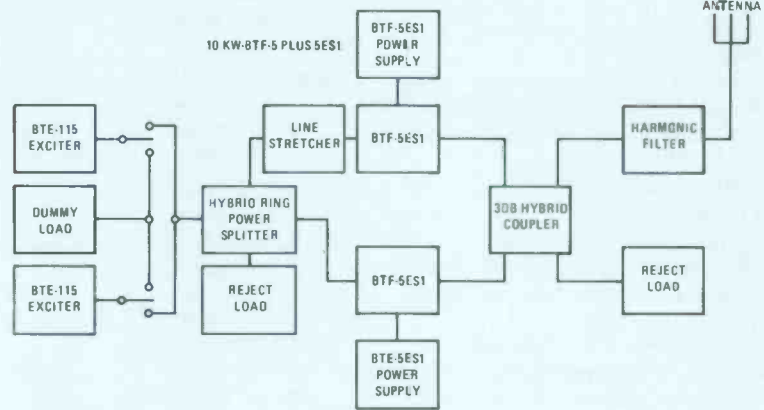
A four mode manual or motor driven by-pass switching system can be provided to allow either one of the parallel transmitters to be connected directly to the station's antenna (see switching systems diagrams). This results in a reduced power of one-half instead of one-quarter power as would be experienced through the combining network.

The four modes are 1) both dual transmitters into antenna; 2) both transmitters into dummy load; 3) one transmitter into antenna and other into dummy load; and 4) reverse of 3). Automatic operation of the motor driven by-pass switching system is an optional accessory to the four mode switching system.

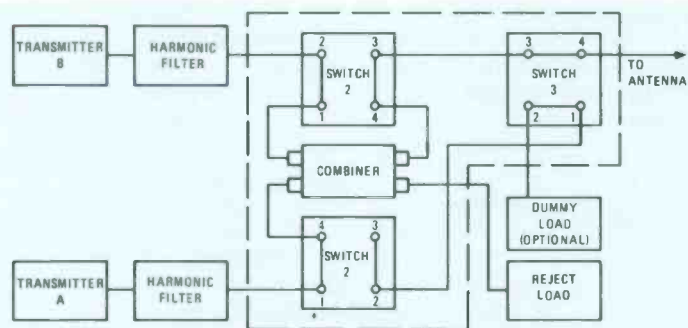
Redundant Power Supplies

The redundancy of the BTF-5 plus 5ES1 system extends even to separate power supplies for each five-kilowatt section. These are units using solid-state rectifiers throughout for reduced maintenance and minimal operating expense. The power supply cabinets need not be located in the same room as the transmitter unit where space is a problem. They might, for example, be located in a basement room or in a shelter external to the transmitter building. More information on the five-kilowatt transmitter will be found in the catalog section on the Type BTF-5ES1. (See Catalog RA. 2041C).

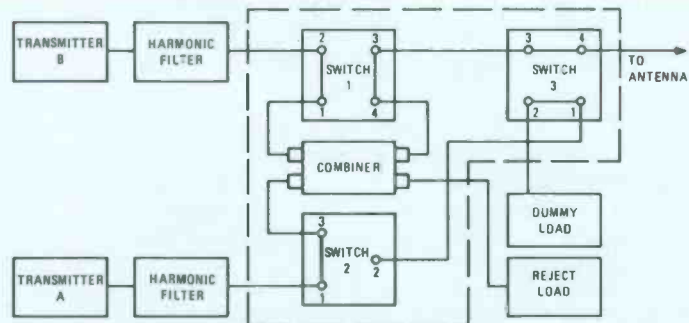
Block diagram of the BTF-5 plus 5ES1 FM Transmitter.



Block diagram of one of the Duplexed 5 kW units of the BTF-5 plus 5ES1 FM Transmitters.



Typical Four Mode Switching System (motor-driven) of the BTF-5 plus 5ES1 Dual Transmitter.



Typical Four Mode Switching System (manual) for the BTF-5 plus 5ES1 Dual Transmitter.

Specifications

Performance

- Type of Emission F3 and F9
- Frequency Range 87.5 to 108 MHz
- Power Output 5 kW to 10 kW
- Output Impedance (6 1/8" O.D. Unflanged Line) 50 Ohms
- Frequency Deviation 100% modulation ±75 kHz
- Modulation Capability ±100 kHz
- Carrier Frequency Stability ±1000 Hz max.
- Audio Input Impedance 600 Ohms
- Audio Input Level—(100% mod.) +10 ±2 dBm¹
- Audio Frequency Response—(30-15,000 Hz) +1 dB max.²
- Pre-emphasis Network Time Constant 0, 25, 50 or 75 µs, as desired³
- Harmonic Distortion (50-15,000 Hz) 0.3% or less⁴
- FM Noise Level (referred to 100% FM mod.) -68 dB max.
- AM Noise Level (referred to 100% AM mod.) -50 dB max.⁵
- Subcarrier Input Level (100% mod.) 9 to 30% adjustable
- Subcarrier Input Impedance Resistive 600 Ohms bal.
- Subcarrier Frequency 20-95 kHz
- Main-to-Subchannel Crosstalk -50 dB referred to ±6.0 kHz deviation of the subcarrier by a 400 Hz tone. Main channel modulation 70% by a single tone (50 to 15000 Hz) and 30% by subcarrier, using narrow band detector.
- Sub-to-Main-Channel Crosstalk -60 dB referred to 100% modulation of the main carrier by a 400 Hz tone. Subcarrier modulated ±4.0 kHz by a single tone (30 to 5000 Hz), main channel modulated 30% by a subcarrier, using narrow band detector, or 10% by a subcarrier when operating in stereo.

Tube Complement

- Driver Two 7203/4CX250B
- Power Amplifier Two 4CX5000A

Electrical

- Power Requirements:
- Line 240/208 Volt, 3 phase, 50/60 Hz
- Combined Line Voltage Variation and Regulation ... ±10%
- Power Consumption (approx.) 20,000 Watts
- Power Factor (approx.) 90%

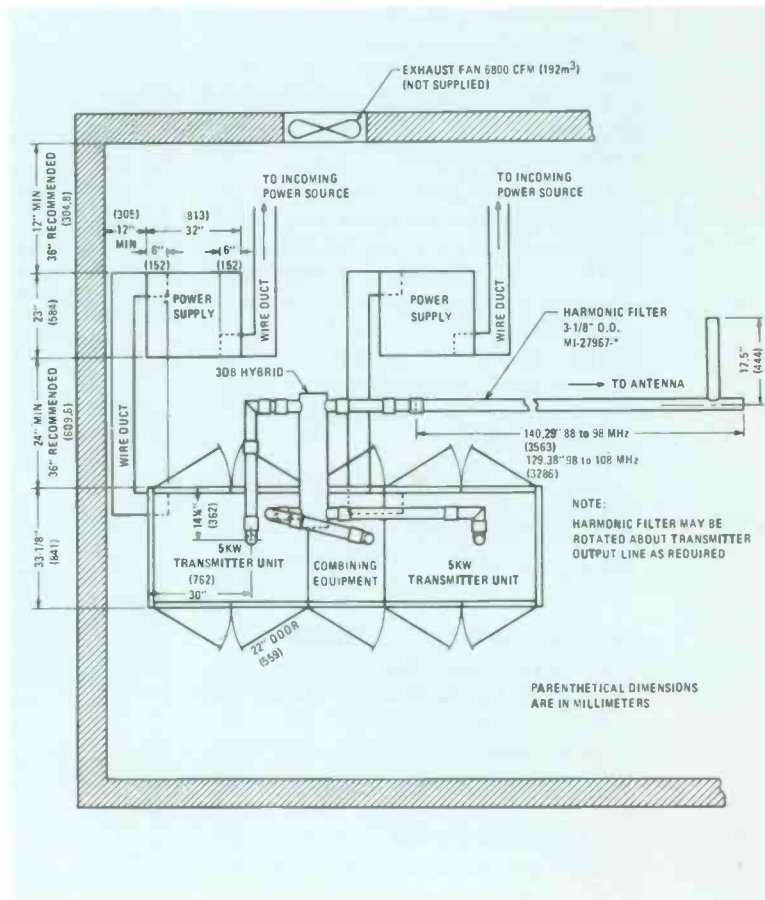
Mechanical

- | | |
|--|----------------------------------|
| Dimensions (overall): Transmitter | High-Voltage Power Supply |
| Width 114 1/4" (2882 mm) | 64" (1626 mm) |
| Height 77" (1956 mm) | 49" (1245 mm) |
| Depth 32 1/2" (825 mm) | 23" (585 mm) |
| Weight (approx.) 2850 lbs. (1247 kg) | 1680 lbs. (762 kg) |
| Finish Textured Vinyl in midnight blue and shadow blue, satin-aluminum trim. | |
| Altitude: | |
| 60 Hz 11,000 ft. (3352.8 m) ⁵ | |
| 50 Hz 9000 ft. (2743.2 m) ⁵ | |
| Ambient Temperature Range -20° to +45° C | |

Ordering Information

- FM Broadcast Transmitter, Type BTF-5 +5ES1
- With Single Harmonic Filter (40 kW) ES-560992B
- With Dual Harmonic Filters (20 kW) ES-560992C
- As Above, plus Manual Switching System ES-560992D¹⁰
- As Above, plus Motor Driven Switching System ES-560992E¹⁰

Please specify assigned frequency, power line frequency (if other than 60 Hz), ambient temperature and installation altitude if greater than 9000 feet (2743 m) above seal level. Stereo and/or SCA facilities ordered with transmitter are factory installed.



Space-saving floor plan. The separate, unitized power supplies may be installed in a basement, another room or other convenient place. Wire ducts shown are not furnished.

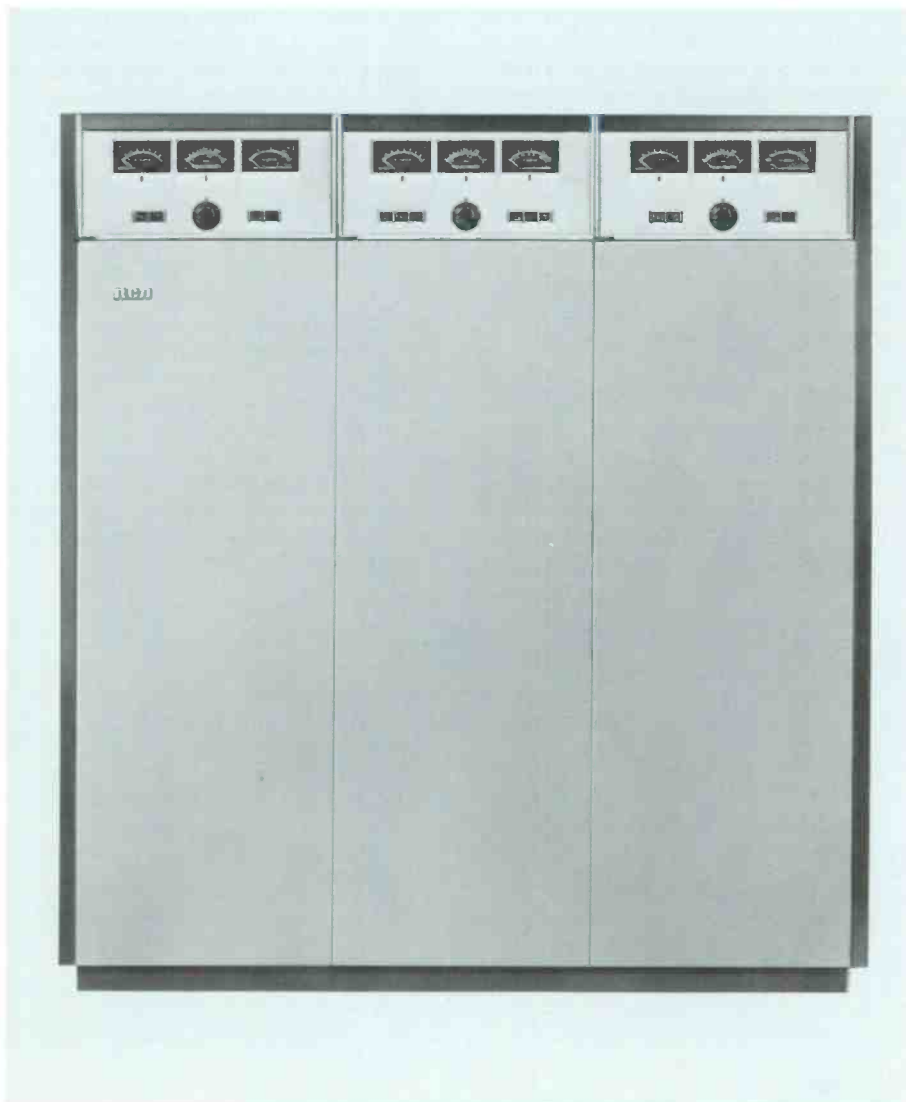
Accessories and Option

- Manometer MI-560307-36
- Elapsed-Time Indicator MI-561018-27
- AM Noise Reduction Kit MI-560307-31⁶
- Freq. and Mod. Monitor, Type BW-75 MI-560735⁸
- Stereo Freq. and Mod. Monitor, Type BW-85 ... MI-560740⁸
- SCA Freq. and Mod. Monitor, Type BW-95 ... MI-560745⁸
- RF Amplifier, Type BW-100 (for off-air mon.) .. MI-560738⁸
- Crystal and Oven Spare Kit (for Exciter) MI-561066
- Electron Tube Spares, Complete Set ES-560613
- Automatic Power Output Control Panel MI-561343
- Directional Coupler, 3 1/8", 50-ohm, 20 kW (for use with Automatic Power Control, use one for each parallel transmitter) MI-561043-12
- RF Load and Wattmeter (10 kW) CB⁹
- Automatic Operation of Motor Driven By-Pass Switching System CB
- Automatic Operation of Exciter Switching System CB

¹Level measured at input to pre-emphasis network, referred to 400 Hz.
²Frequency response referred to 50- or 75-microsecond pre-emphasis curve.
³Other time constants available on request.
⁴Distortion includes all harmonics up to 30 kHz and is measured following a standard 50- or 75-microsecond de-emphasis network.
⁵Larger blowers available for operation at higher altitudes.
⁶AM Noise reduction kit required when operating at half power.
⁷For 117V/60 Hz power only; use MI-561018-4 for 117V/50 Hz.
⁸Specify operating frequency.
⁹Catalog RA.7711B.
¹⁰Includes 3/8 inch coaxial switches (either manual or motor driven).

FM Broadcast Transmitters, 10kW, Type BTF-5 Plus 5ES2

- Parallel Transmitter for high reliability
- All solid-state, "Direct-FM" exciter with or without Stereo and SCA
- Designed for unattended operation
- Only two tube types
- Grounded-grid power amplifier
- Compact and self-contained



The type BTF-5 plus 5ES2 is a ten kilowatt Broadcast transmitter for operation at any frequency from 87.5 to 108 MHz. It is designed to provide the finest performance and reliability and is specially built to handle the demanding requirements of multiplex transmission. The combined transmitter is designed to meet all FCC requirements for harmonic and spurious radiation.

The transmitter uses one or two solid state exciters (as ordered), employing time tested and field proven direct FM system of modulation.

The combined transmitter is housed in three cabinets and occupies less than sixteen square feet of floor space. The combining coaxial cable and coupler can be mounted or suspended above the cabinets to provide easy installation.

This four tube grounded grid parallel Power Amplifier configuration comes fully tested to your individual frequency with all remote controls and ATS (Automatic Transmitter System) interface circuitry brought to a single location. The self-contained power supplies further simplify the installation.

With the BTF-5 plus 5ES2 10 kW FM Parallel Transmitter four mode manual patch or motor driven by-pass output switching can be provided to allow a single BTF-5ES2 of the BTF-5 plus 5ES2 to be connected directly to the antenna resulting in reduced power of one-half, instead of one-quarter power. The four modes are: 1) both transmitters parallel into the antenna; 2) both transmitters into dummy load; 3) one transmitter into antenna and second into the dummy load; and 4) reverse of 3). Automatic operation of the motor driven by-pass switching system is an optional accessory to the four mode switching system.

(See switching systems diagrams inside.)

The BTF-5+5ES2 transmitter is actually two complete five kilowatt transmitter units (Type BTF-5ES2) combined to make continuous operation practical at the 10 kW power level. All major components except the combining equipment, are duplicated within the system; dual exciters (if desired), power amplifiers, and power supplies etc.

Dual Switchable Exciters

The basic configuration of the BTF-5+5ES2 contains only one exciter (BTE-115) which can be expanded to include two exciters and exciter switching, so that a back-up exciter system is always available with the push of a button either locally or by remote control. The single exciter system can be purchased initially and the second exciter and switching system can be added at a later date if desired.

With the purchase of two exciters the system is so arranged so that one of the two serves the combined transmitter while the other operates as a "hot" stand-by. In the event of trouble in the on-the-air exciter, manual (or automatic optional) switch-over puts the extra exciter on the line.

Grounded Grid Power Amplifier Stages

The exciter system delivers 15 watts of modulated carrier to a hybrid-ring power splitter which, in turn provides two outputs, each to a 8122 IPA tetrode tube. This raises the power to the required level to drive the final power amplifier to 5 kW power output. The two 5 kW outputs are then combined to provide a full 10 kW out of the combiner coupler. The output configuration uses a grounded grid tube, a ceramic triode 3CX3000A7 tube type.

Harmonic Filters and Directional Couplers

The harmonic filter supplied with the BTF-5 plus 5ES2 transmitter is not a simple harmonic trap. The filter consists of two M-derived half-sections in series and these constant-K half-sections configured in a 50 ohm 1 $\frac{5}{8}$ " coax cable in line harmonic filter. The M-derived sections at the input and output provide cut-off in the second harmonic region and above. This filter consists of a series of transmission line elements and several shunt stubs tuned to the second harmonic. The Directional Coupler is also a coax cable component to provide reliable forward power and VSWR indications that are read on the transmitter power/reflected power front panel meter.

The harmonic filter and directional coupler supplied with the BTF-5ES2 are two separate units in a 50 ohm 1 $\frac{5}{8}$ " coax line configuration so as to be compatible with the output combining network supplied with the combined transmitter.

Hybrid Combiner Network

Ordinarily mounted above the transmitter, almost directly over the center combining cabinet is the hybrid combiner coupler network, a "three-dB hybrid" coaxial unit. This assembly combines the two 5 kW modulated carriers into one 10 kW output. The reject load for the combiner is mounted within the center combiner equipment cabinet of the transmitter.

When the two 5 kW transmitters are each of equal power out and are properly phased by the line stretcher, the system will easily achieve the full 10 kW to the antenna system. If one transmitter is reduced in power or is completely disabled the power output will be less than 10 kW and can be as low as 2500 watts if one transmitter is completely shut down. The uniqueness of the parallel transmitter configuration is that program service can be maintained on a reduced power basis even if one of the parallel transmitters is disabled. When one transmitter is disabled the 3 dB hybrid coupler splits the power from the remaining active transmitter so that half the power input goes to the antenna and half to the reject load unless an output switching system is employed (see 4 mode switching).

Adjustable Power-Output Control

Power output is controlled by means of a variable resistor which controls the screen voltage supplied to the IPA. Power output is adjustable from zero to a full 5 kW in each 5 kW transmitter unit or 10 kW in the combined transmitter.

Self-Protected Against Overload

Power circuits in each 5 kW transmitter are protected by magnetically tripped circuit breakers in addition to overload relays. An automatic sequencing system prevents turn-on of the plate power until all cathodes have heated sufficiently. In addition, a stepping relay automatically cycles power-off three times before locking out in the event of brief overloads and power interruptions. The overloads are reset by pushbuttons on the front panel or by remote control.

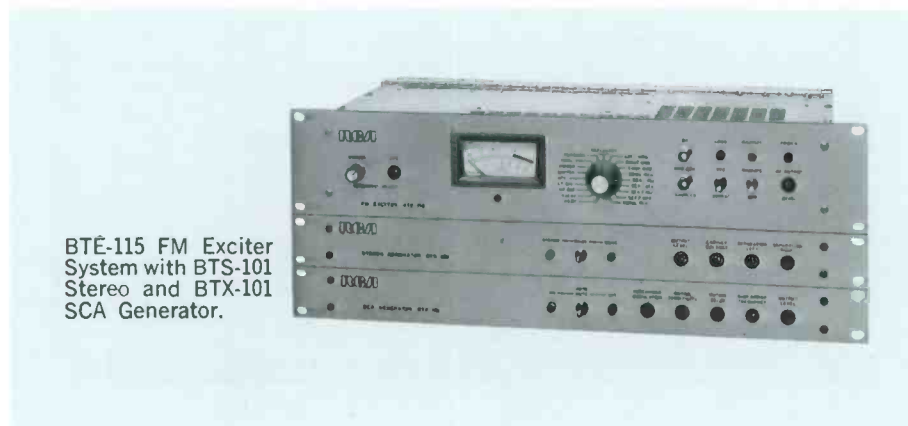
All tuning controls are located on the front panels for easy accessibility. The variable power control is also mounted on the front as are the overload indicators, plate power on-off and overload reset buttons.

Remote Control

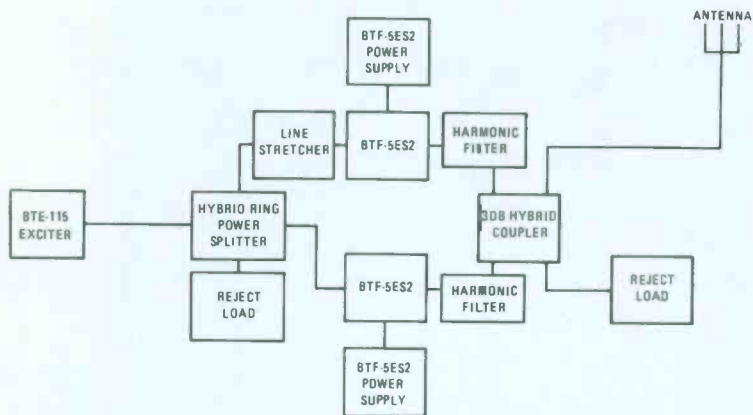
The BTF-5+5ES2 transmitter incorporates connections for remote control and for ATS (Automatic Transmitter System) and remote reading when used with a remote control system. Terminals for transmitter on-off, plate on-off, overload reset, and reading remotely-plate voltage, cathode current, and power output are conveniently found inside the transmitter rear lift off doors on each 5 kW unit.

Output Configurations

The basic BTF-5+5ES2 parallel transmitter comes with either one exciter and no switching system or with two exciters and a exciter switching system, but with no output by-pass switching, as shown in Floor Plan and Coaxial Cable and Combining Configuration Diagrams illustrated in this catalog. Other switching configurations such as manual output patch, and motor driven output by-pass switching are also available. These latter systems are both 4 mode switching systems described as follows:

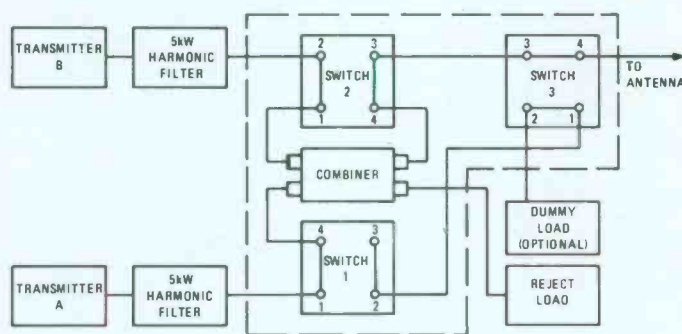


BTE-115 FM Exciter System with BTS-101 Stereo and BTX-101 SCA Generator.



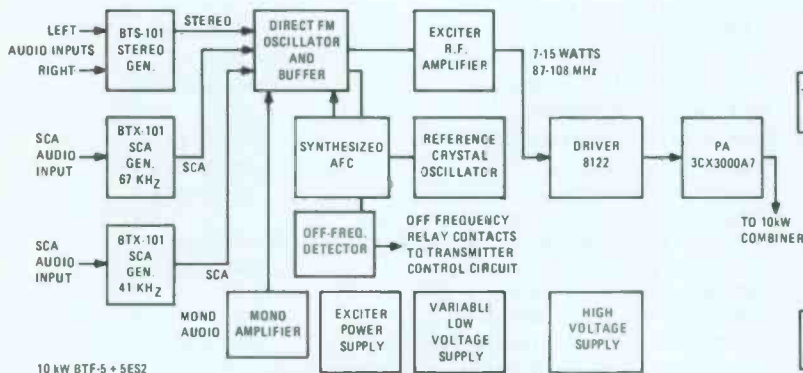
Block diagram of the BTF-5 plus 5ES2 FM Transmitter.

Fig. 1



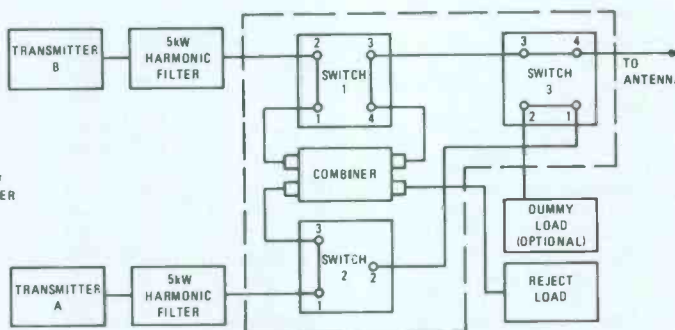
Typical Four Mode Switching System (motor-driven) of the BTF-5 plus 5ES2 Dual Transmitter.

Fig. 2



Block diagram of one of the Duplexed 5 kW units of the BTF-5 plus 5ES2 FM Transmitter.

Fig. 3



Typical Four Mode Switching System (manual) for the BTF-5 plus 5ES2 Dual Transmitter.

Fig. 4

Four Mode Manual Patch

A method of achieving a interim power of 5 kW to the station's antenna during periods when one of the individual BTF-5ES2 transmitters is shut-down for repairs or routine maintenance is to bypass the shut-down transmitter using a manual coax patching system as shown in Figure 4. If Transmitter B for example is shut-down the coaxial "U" bend patch of Switch #2 is changed to make connection between Jacks 1 and 2, and the U bend patch of Switch #3 is changed to make connection between Jacks 1 and 4 with the U bend connections between Jacks 3 and 4 removed. Thus the RF continuity from the Transmitter A to the antenna is complete and Transmitter B is taken off the antenna feed. If Transmitter A is disabled the "U" bend patch of Switch 1 is connected to Jacks 2 and 3 with Jacks 3 and 4 removed. Transmitter B is then connected to the station's antenna.

The manual patch switches are 1 3/8" coaxial in 3 pole and 4 pole configurations and are mounted in the output coax combining network above the transmitter and combining cabinets. All coax, 90° elbows, fittings and couplers are pre-tested and cut to exact lengths so that the installation can be efficiently and quickly assembled.

The four mode patching will allow for 1) both transmitters to be fed into the antenna, 2) or into a (optional) dummy load 3) Transmitter A into antenna and B into dummy load or 4) reverse of 3).

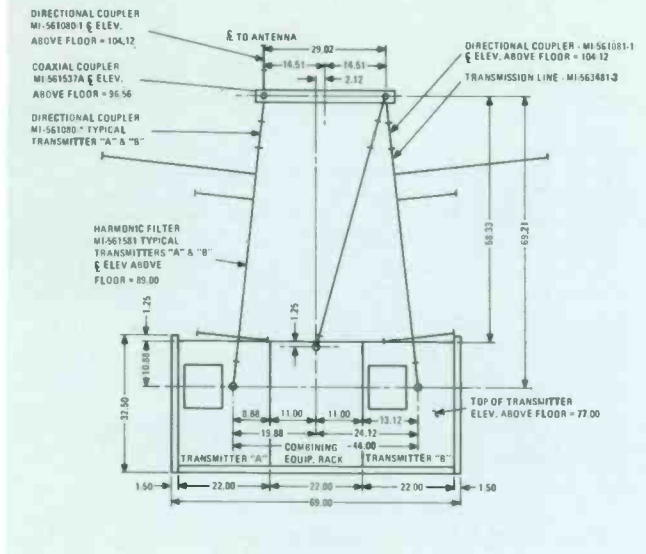
Four Mode Motor Driven Switching

A method of achieving a interim power of 5 kW to the station's antenna and bypassing one complete BTF-5ES2 transmitter unit of the parallel system is to install a 4 mode motor driven coaxial switching system as shown in Figure 2 above. The motor driven switching system has the advantage over the manual

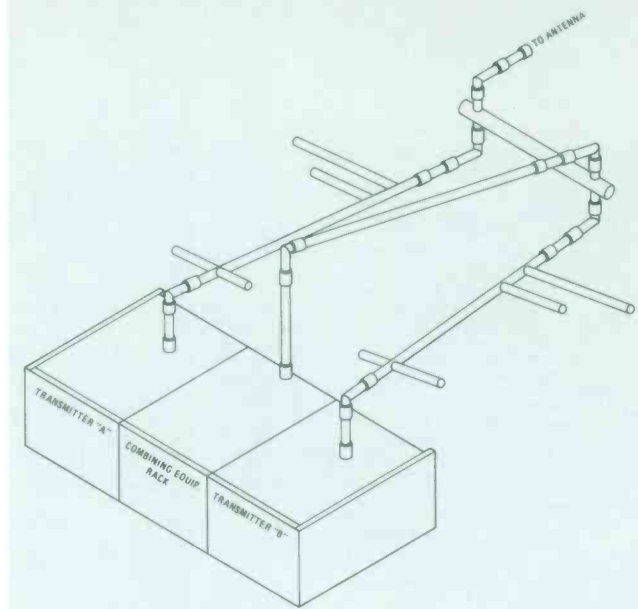
patch system that the output mode can be quickly changed by a single pushbutton action, and can be adapted to automatic logic for complete automatic operation (optional).

The motor driven coaxial switches are 1 3/8" in a Double Pole Double Throw (DPDT) configuration and are mounted in the output coax combining network above the transmitter and combining cabinets. All coax 90° elbows, fittings and couplers are pretested and cut to exact lengths to assist in the installation of the system.

The four modes of the motor driven by-pass switching system are; 1) both fed into the antenna 2) both transmitters into a dummy load (optional) 3) Transmitter A into the antenna while B is fed into the dummy load, and 4) Transmitter B into the antenna with A into the dummy load.



Floor plan for BTF-5 plus 5ES2 Transmitter.



BTF-5 plus 5ES2 Transmitter. Transmission line and combiner configuration for non-switching output system.

Specifications

Performance

Power Output	1000-10,000 watts
Output Impedance (1 1/8" O.D. unflanged)	50 ohms
Frequency Deviation, 100% modulation	±75 kHz
Modulation Capability	±100 kHz
Carrier Frequency Stability	±1000 Hz max.
Audio Input Impedance	600 ohms
Audio Input Level (100% mod.)	+10 ±2 dBm ¹
Audio Frequency Response (50 Hz-15 kHz)	±1 dB max. ²
Pre-emphasis Network Time Constant	0, 25, 75 or 50 μs ³
Harmonic Distortion (50 Hz-15 kHz)	0.3% max. ⁴
FM Noise Level (referred to 100% FM mod.)	-68 dB max.
AM Noise Level (referred to 100% AM mod.)	-50 dB max.
Subcarrier Input Level (100% mod.)	9 to 30% adjustable
Subcarrier Input Impedance	Resistive 600 ohms bal.
Subcarrier Frequency	20-95 kHz
Main-to-Subchannel Crosstalk	-50 dB referred to +6.0 kHz deviation of the main carrier by a 400 Hz tone.
Main channel modulation 70% by a single tone (50 to 15,000 Hz) and 30% by subcarrier, using narrow band detector.	
Sub-to-Main-Channel Crosstalk	-60 dB referred to 100% modulation of the main carrier by a 400 Hz tone.
Subcarrier modulated ±4.0 kHz by a single tone (30 to 5000 Hz), main channel modulated 30% by subcarrier, using a narrow band detector, or 10% by subcarrier when operating in stereo.	

Electrical

Power Requirements:	
Line	240/108V, 3 phase, 50/60 Hz
Combined Voltage Variation and Regulation	±10%
Power Consumption (approx.)	18,000W
Power Factor (approx.)	90%

Mechanical

Dimensions (overall)	69"W, 77"H, 32 1/2"D (1753, 1956, 826 mm)
Weight	2700 lbs. (1225 kg)
Finish	Textured vinyl in charcoal gray and shadow blue, satin aluminum trim
Altitude:	
60 Hz	6000 ft. max. (1829 m) ⁵
50 Hz	4000 ft. max. (1219 m) ⁵
Ambient Temperature Range	-20° to +45°C

Accessories

Remote Power Output Control	MI-561023
Directional Coupler (for Exciter output)	MI-561026

Spare Crystal and Oven (Specify operating frequency)	MI-561066
Service Slider Rails for Exciter	MI-561073
Spare Transmitter Tubes	ES-560920
RF Load and Wattmeter	CB ⁶
Elapse Time Meter for 115V/60 Hz	MI-561018-2
Elapse Time Meter for 115V/50 Hz	MI-561018-4
Automatic Power Output Control Panel	MI-561353
Directional Coupler, 5 kW, 1 1/8", 50 ohm, for use with Automatic Power Control	MI-561080-2
Exciter Switching System	MI-561090
Automatic Operation of Motor Driven By-Pass Switching System	CB
Low Power/VSWR Protection Module	MI-561086
Automatic Operation of Exciter Switching System	CB
Type BW-75A FM Frequency and Modulation Monitor (Specify Frequency)	MI-560735
Type BW-100B RF Amplifier (Specify Frequency)	MI-560738
Type BW-85A FM Stereo Frequency and Modulation Monitor	MI-560740
Type BW-95A SCA Frequency and Modulation Monitor (Specify Frequency)	MI-569745

¹Level measured at input to pre-emphasis network.

²Frequency response referred to 75- or 60-microsecond pre-emphasis curve.

³Other time constants available on request.

⁴Distortion includes all harmonics up to 30 kHz and is measured following a standard 75- or 50-microsecond de-emphasis network.

⁵Modifications available for higher altitudes.

⁶Catalog RA.7711B.

Ordering Information

Parallel, 10 kW FM Transmitter	
Type BTF-5+5ES2 with one Exciter, No Output Switching	ES-563020A*
Parallel, 10 kW FM Transmitter	
Type BTF-5+5ES2 with two Exciters, Exciter Switching, No Output Switching	ES-563020B**
Parallel, 10 kW FM Transmitter	
Type BTF-5+5ES2 with two Exciters, Exciter Switching and manual or motor driven output switching	ES-563020C***

*Includes one Solid State Exciter (Type BTE-115) equipped for main-channel operation; stereo and SCA subcarrier generators as ordered. Also includes power dividing and combining equipment. No output switching.

**Includes two Solid State Exciter (Type BTE-115) equipped for main channel operation and/or stereo and SCA as ordered. Also includes exciter switching, power dividing and combining equipment. No output switching.

***Includes two exciter systems equipped for main channel and stereo/SCA as ordered, power dividing and combining equipment, manual or motor driven by-pass switching network, two coax type harmonic filters and switching control panel.



FM Broadcast Transmitters, 10kW, Type BTF-5 Plus 5ES2

- Parallel Transmitter for high reliability
- All solid-state, "Direct-FM" exciter with or without Stereo and SCA
- Designed for unattended operation
- Only two tube types
- Grounded-grid power amplifier
- Compact and self-contained



The type BTF-5 plus 5ES2 is a ten kilowatt Broadcast transmitter for operation at any frequency from 87.5 to 108 MHz. It is designed to provide the finest performance and reliability and is specially built to handle the demanding requirements of multiplex transmission. The combined transmitter is designed to meet all FCC requirements for harmonic and spurious radiation.

The transmitter uses one or two solid state exciters (as ordered), employing time tested and field proven direct FM system of modulation.

The combined transmitter is housed in three cabinets and occupies less than sixteen square feet of floor space. The combining coaxial cable and coupler can be mounted or suspended above the cabinets to provide easy installation.

This four tube grounded grid parallel Power Amplifier configuration comes fully tested to your individual frequency with all remote controls and ATS (Automatic Transmitter System) interface circuitry brought to a single location. The self-contained power supplies further simplify the installation.

With the BTF-5 plus 5ES2 10 kW FM Parallel Transmitter four mode manual patch or motor driven by-pass output switching can be provided to allow a single BTF-5ES2 of the BTF-5 plus 5ES2 to be connected directly to the antenna resulting in reduced power of one-half, instead of one-quarter power. The four modes are: 1) both transmitters parallel into the antenna; 2) both transmitters into dummy load; 3) one transmitter into antenna and second into the dummy load; and 4) reverse of 3). Automatic operation of the motor driven by-pass switching system is an optional accessory to the four mode switching system.

(See switching systems diagrams inside.)

The BTF-5+5ES2 transmitter is actually two complete five kilowatt transmitter units (Type BTF-5ES2) combined to make continuous operation practical at the 10 kW power level. All major components except the combining equipment, are duplicated within the system; dual exciters (if desired), power amplifiers, and power supplies etc.

Dual Switchable Exciters

The basic configuration of the BTF-5+5ES2 contains only one exciter (BTE-115) which can be expanded to include two exciters and exciter switching, so that a back-up exciter system is always available with the push of a button either locally or by remote control. The single exciter system can be purchased initially and the second exciter and switching system can be added at a later date if desired.

With the purchase of two exciters the system is so arranged so that one of the two serves the combined transmitter while the other operates as a "hot" stand-by. In the event of trouble in the on-the-air exciter, manual (or automatic optional) switch-over puts the extra exciter on the line.

Grounded Grid Power Amplifier Stages

The exciter system delivers 15 watts of modulated carrier to a hybrid-ring power splitter which, in turn provides two outputs, each to a 8122 IPA tetrode tube. This raises the power to the required level to drive the final power amplifier to 5 kW power output. The two 5 kW outputs are then combined to provide a full 10 kW out of the combiner coupler. The output configuration uses a grounded grid tube, a ceramic triode 3CX3000A7 tube type.

Harmonic Filters and Directional Couplers

The harmonic filter supplied with the BTF-5 plus 5ES2 transmitter is not a simple harmonic trap. The filter consists of two M-derived half-sections in series and these constant-K half-sections configured in a 50 ohm 1 $\frac{1}{8}$ " coax cable in line harmonic filter. The M-derived sections at the input and output provide cut-off in the second harmonic region and above. This filter consists of a series of transmission line elements and several shunt stubs tuned to the second harmonic. The Directional Coupler is also a coax cable component to provide reliable forward power and VSWR indications that are read on the transmitter power/reflect-power front panel meter.

The harmonic filter and directional coupler supplied with the BTF-5ES2 are two separate units in a 50 ohm 1 $\frac{1}{8}$ " coax line configuration so as to be compatible with the output combining network supplied with the combined transmitter.

Hybrid Combiner Network

Ordinarily mounted above the transmitter, almost directly over the center combining cabinet is the hybrid combiner coupler network, a "three-dB hybrid" coaxial unit. This assembly combines the two 5 kW modulated carriers into one 10 kW output. The reject load for the combiner is mounted within the center combiner equipment cabinet of the transmitter.

When the two 5 kW transmitters are each of equal power out and are properly phased by the line stretcher, the system will easily achieve the full 10 kW to the antenna system. If one transmitter is reduced in power or is completely disabled the power output will be less than 10 kW and can be as low as 2500 watts if one transmitter is completely shut down. The uniqueness of the parallel transmitter configuration is that program service can be maintained on a reduced power basis even if one of the parallel transmitters is disabled. When one transmitter is disabled the 3 dB hybrid coupler splits the power from the remaining active transmitter so that half the power input goes to the antenna and half to the reject load unless an output switching system is employed (see 4 mode switching).

Adjustable Power-Output Control

Power output is controlled by means of a variable resistor which controls the screen voltage supplied to the IPA. Power output is adjustable from zero to a full 5 kW in each 5 kW transmitter unit or 10 kW in the combined transmitter.

Self-Protected Against Overload

Power circuits in each 5 kW transmitter are protected by magnetically tripped circuit breakers in addition to overload relays. An automatic sequencing system prevents turn-on of the plate power until all cathodes have heated sufficiently. In addition, a stepping relay automatically cycles power-off three times before locking out in the event of brief overloads and power interruptions. The overloads are reset by pushbuttons on the front panel or by remote control.

All tuning controls are located on the front panels for easy accessibility. The variable power control is also mounted on the front as are the overload indicators, plate power on-off and overload reset buttons.

Remote Control

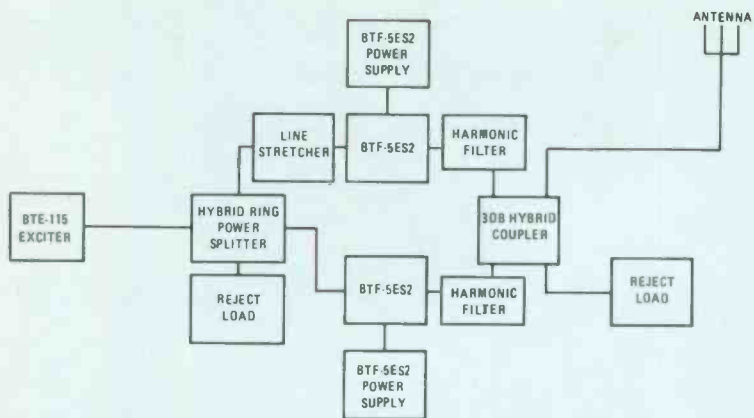
The BTF-5+5ES2 transmitter incorporates connections for remote control and for ATS (Automatic Transmitter System) and remote reading when used with a remote control system. Terminals for transmitter on-off, plate on-off, overload reset, and reading remotely-plate voltage, cathode current, and power output are conveniently found inside the transmitter rear lift off doors on each 5 kW unit.

Output Configurations

The basic BTF-5+5ES2 parallel transmitter comes with either one exciter and no switching system or with two exciters and a exciter switching system, but with no output by-pass switching, as shown in Floor Plan and Coaxial Cable and Combining Configuration Diagrams illustrated in this catalog. Other switching configurations such as manual output patch, and motor driven output by-pass switching are also available. These latter systems are both 4 mode switching systems described as follows:

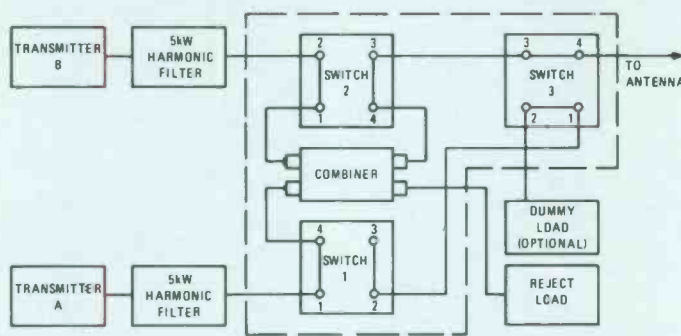


BTE-115 FM Exciter System with BTS-101 Stereo and BTX-101 SCA Generator.



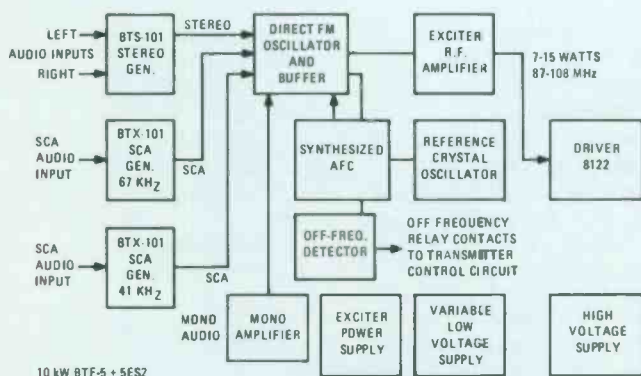
Block diagram of the BTF-5 plus 5ES2 FM Transmitter.

Fig. 1



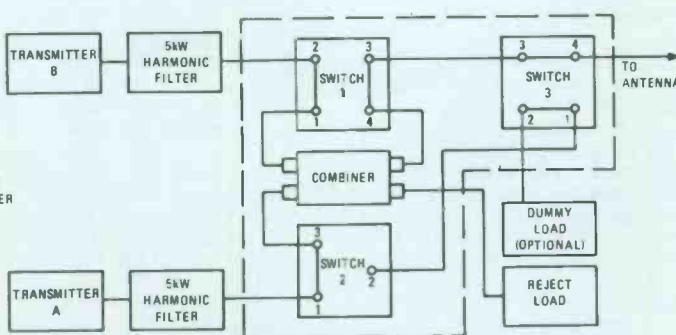
Typical Four Mode Switching System (motor-driven) of the BTF-5 plus 5ES2 Dual Transmitter.

Fig. 2



Block diagram of one of the Duplexed 5 kW units of the BTF-5 plus 5ES2 FM Transmitter.

Fig. 3



Typical Four Mode Switching System (manual) for the BTF-5 plus 5ES2 Dual Transmitter.

Fig. 4

Four Mode Manual Patch

A method of achieving a interim power of 5 kW to the station's antenna during periods when one of the individual BTF-5ES2 transmitters is shut-down for repairs or routine maintenance is to bypass the shut-down transmitter using a manual coax patching system as shown in Figure 4. If Transmitter B for example is shut-down the coaxial "U" bend patch of Switch #2 is changed to make connection between Jacks 1 and 2, and the U bend patch of Switch #3 is changed to make connection between Jacks 1 and 4 with the U bend connections between Jacks 3 and 4 removed. Thus the RF continuity from the Transmitter A to the antenna is complete and Transmitter B is taken off the antenna feed. If transmitter A is disabled the "U" bend patch of Switch 1 is connected to Jacks 2 and 3 with Jacks 3 and 4 removed. Transmitter B is then connected to the station's antenna.

The manual patch switches are 1 5/8" coaxial in 3 pole and 4 pole configurations and are mounted in the output coax combining network above the transmitter and combining cabinets. All coax, 90° elbows, fittings and couplers are pre-tested and cut to exact lengths so that the installation can be efficiently and quickly assembled.

The four mode patching will allow for 1) both transmitters to be fed into the antenna, 2) or into a (optional) dummy load 3) Transmitter A into antenna and B into dummy load or 4) reverse of 3).

Four Mode Motor Driven Switching

A method of achieving an interim power of 5 kW to the station's antenna and bypassing one complete BTF-5ES2 transmitter unit of the parallel system is to install a 4 mode motor driven coaxial switching system as shown in Figure 2 above. The motor driven switching system has the advantage over the manual

patch system that the output mode can be quickly changed by a single pushbutton action, and can be adapted to automatic logic for complete automatic operation (optional).

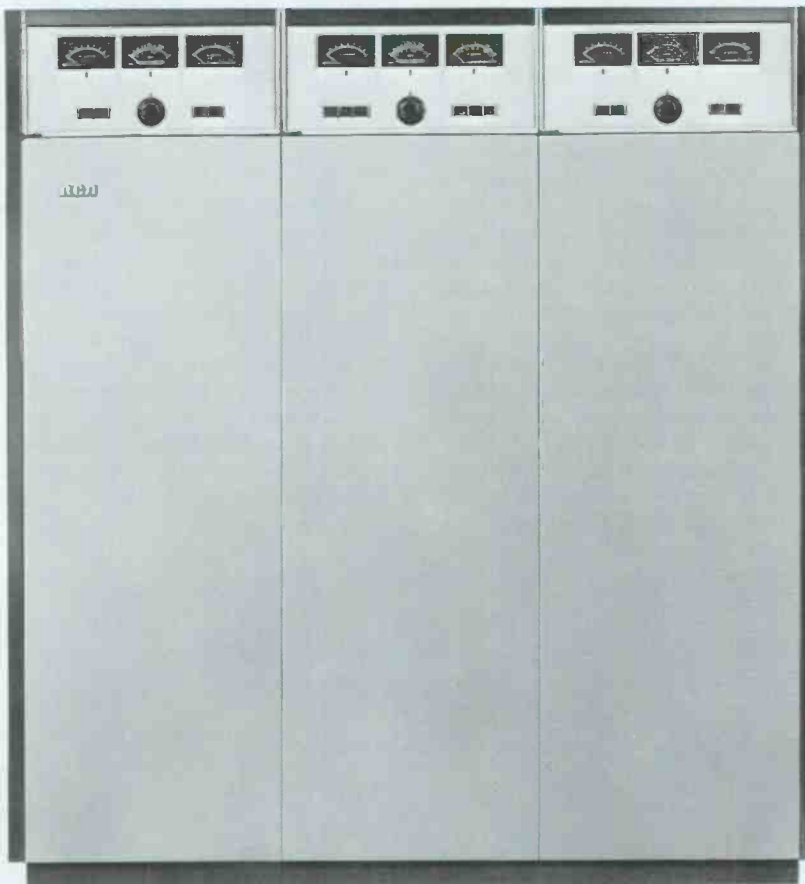
The motor driven coaxial switches are 1 5/8" in a Double Pole Double Throw (DPDT) configuration and are mounted in the output coax combining network above the transmitter and combining cabinets. All coax 90° elbows, fittings and couplers are pretested and cut to exact lengths to assist in the installation of the system.

The four modes of the motor driven by-pass switching system are; 1) both fed into the antenna 2) both transmitters into a dummy load (optional) 3) Transmitter A into the antenna while B is fed into the dummy load, and 4) Transmitter B into the antenna with A into the dummy load.



FM Broadcast Transmitter, 6kW, Type BTF-3 plus 3ES1

- Parallel transmitter for high reliability
- All solid-state, "Direct-FM" exciter with or without Stereo and SCA
- Designed for unattended operation
- Only two tube types
- Grounded-grid power amplifier
- Compact and self-contained



The type BTF-3 plus 3ES1 is a six kilowatt Broadcast Transmitter for operation at any frequency from 87.5 to 108 MHz. It is designed to provide the finest performance and reliability and is specially built to handle the demanding requirements of Multiplex Transmission. The combined transmitter is designed to meet all FCC requirements for harmonic and spurious radiation.

The transmitter uses one or two Solid State Exciters, (as ordered) employing time tested and field proven direct-FM system of modulation.

The combined transmitter is housed in three cabinets and occupies less than sixteen square feet of floor space. The combining coaxial cable and coupler can be mounted or suspended above the cabinets to provide easy installation.

This four tube, grounded grid parallel power amplifier configuration comes fully tested to your individual frequency with all remote control and ATS (Automatic Transmitter System) interface circuitry brought to a single location. The self-contained power supplies further simplify the installation.

With the BTF-3 plus 3ES1 6 kW FM Parallel Transmitter, four mode manual patch or motor driven by-pass output switching can be provided to allow a single BTF-3ES1 of the BTF-3 plus 3ES1 to be connected directly to the antenna resulting in reduced power of one-half, instead of one-quarter power. The four modes are: 1) both transmitters parallel into the antenna; 2) both transmitters into dummy load; 3) one transmitter into antenna and second into the dummy load; and 4) reverse of 3). Automatic operation of the motor driven by-pass switching system is an optional accessory to the four mode switching system.

(See switching systems diagrams inside.)

The BTF-3+3ES1 transmitter is actually two complete three kilowatt transmitter units (Type BTF-3ES1) combined to make continuous operation practical at the 6 kW power level. All major components except the combining equipment, are duplicated within the system; dual exciters (if desired), power amplifiers, and power supplies, etc.

Dual Switchable Exciters

The basic configuration of the BTF-3+3ES1 contains only one exciter (BTE-115) which can be expanded to include two exciters and exciter switching, so that a back-up exciter system is always available with the push of a button either locally or by remote control. The single exciter system can be purchased initially and the second exciter and switching system can be bought at a later date if desired.

With the purchase of two exciters the system is so arranged so that one of the two serves the combined transmitter while the other operates as a "hot" stand-by. In the event of trouble in the on-the-air exciter, manual (or automatic optional) switch-over puts the extra exciter on the line.

Grounded Grid Power Amplifier Stages

The exciter system delivers 15 watts of modulated carrier to a hybrid-ring power splitter which, in turn provides two outputs, each to a 8122 IPA Tetrode Tube. This raises the power to the required level to drive the final power amplifier to 3 kW power output. The two 3 kW outputs are then combined to provide a full 6 kW transmitter power out of the combiner coupler. The output configuration uses a grounded grid tube, a ceramic triode 3CX3000A7 tube type.

Harmonic Filters/Directional Couplers

The standard harmonic filter supplied with the BTF-3ES1 transmitter is not a simple harmonic trap. The filter consists of two M-derived half-sections in series and three constant-K half-sections configured into a lumped inductive-capacitive network and is installed inside the transmitter cabinet. The M-derived sections at the input and output provide cut-off in the second harmonic region and above and a 50 ohm termination impedance at each end of the filter.

A built-in directional coupler is an integral part of the harmonic filter and provides reliable forward and VSWR power indications that are read on the

transmitter power/reflected front panel meter.

The harmonic filter/directional coupler supplied with the BTF-3+3ES1 are two separate units in a 50 ohm 1 $\frac{5}{8}$ " unflanged coax fitting input so as to be compatible with the parallel output combining network supplied with the combined transmitter.

Hybrid Combiner Network

Ordinarily mounted above the transmitter, almost directly over the center combining cabinet is the hybrid combiner coupler network, a "three-dB hybrid" coaxial unit. This assembly combines the two 3 kW modulated carriers into one 6 kW output. The reject load for the combiner is mounted within the center combiner equipment cabinet of the transmitter.

When the two 3 kW transmitters are each of equal power out and are properly phased by the line stretcher, the system will easily achieve the full 6 kW to the antenna system. If one transmitter is reduced in power or is completely disabled the power output will be less than 6 kW and can be as low as 1500 watts if one transmitter is completely shut-down. The uniqueness of the parallel transmitter configuration is that program service can be maintained on a reduced power basis even if one of the parallel transmitters is disabled. When one transmitter is disabled the 3dB hybrid coupler splits the power from the remaining active transmitter so that half the power input goes to the antenna and half to the reject load unless an output switching system is employed (see 4 mode switching).

Adjustable Power-Output Control

Power output is controlled by means of a variable resistor which controls the screen voltage supplied to the IPA. Power output is adjustable from zero to a full 3 kW in each 3 kW transmitter unit or 6 kW in the combined transmitter.

Self-Protected Against Overload

Power circuits in each 3 kW transmitter are protected by magnetically tripped circuit breakers in addition to overload relays. An automatic sequencing system prevents turn-on at the plate power until all filaments have heated sufficiently. In addition, a stepping relay automatically cycles power-off three times before locking out in the event of brief overloads and power interruptions. The overloads are reset by pushbuttons on the front panel or by remote control.

All tuning controls are located on the front panels for easy accessibility. The variable power control is also mounted on the front as are the overload indicators, plate power on-off and overload reset buttons.

Remote Control

The BTF-3+3ES1 transmitter incorporates connections for remote control and for ATS (Automatic Transmitter System) and remote meter readings when used with a remote control system. Terminals for transmitter on-off, plate on-off, overload reset, and reading remotely plate voltage, cathode current, and power output are conveniently found inside the transmitter's rear lift off doors on each 3 kW unit.

Output Configurations

The basic BTF-3+3ES1 parallel transmitter comes with either one exciter and no switching system or with two exciters and a switching system, but with no output by-pass switching, as shown in Floor Plan and Coaxial Cable and Combiner Configuration diagrams on the last page of this catalog. Other switching configurations such as manual output patch, and motor driven output by-pass switching are also available. These latter systems are both 4 mode switching systems described as follows:



Four Mode Manual Patch

A method of achieving an interim power of 3 kW to the station's antenna during periods when one of the individual BTF-3ES1 transmitters is shut-down for repair or routine maintenance is to by-pass the shut-down transmitter using a manual coax patching system as shown in Figure 4. On the bottom right side of this page. If Transmitter B for example is shut-down the coaxial "U" bend patch of Switch #2 is changed to make connection between Jacks 1 and 2, and the U bend patch of Switch #3 is changed to make connection between Jacks 1 and 4 with the U bend patch connections between Jacks 3 and 4 removed. Thus, the RF continuity from the Transmitter A to the antenna is complete and Transmitter B is taken off the antenna feed. If Transmitter A is disabled the U bend patch of Switch 1 is connected to Jacks 2 and 3 with Jacks 3 and 4 removed. Transmitter B is then connected to the station antenna.

The manual patch switches are 1 5/8" coaxial in 3 poles and 4 pole configurations and are mounted in the output coax combining network above the transmitter and combining cabinets. All coax, 90° elbows, fittings and couplers are pre-tested and cut to exact lengths so that the network can be efficiently and quickly assembled.

The four mode patching will allow for 1) both transmitters to be fed into the antenna, 2) or into a (optional) dummy load, 3) Transmitter A into antenna and B into dummy load or 4) reverse of 3).

Four Mode Motor Driven Switching

Another method of achieving an interim power of 3kW to the station's antenna and by-passing one complete BTF-3ES1 transmitter unit of the parallel system is to install a 4 mode motor driven coaxial switching system as shown in Figure 3. The motor driven switching system has the advantage over the manual patch system that the output mode can be quickly changed by a single pushbutton action, and can be adapted to automatic logic for complete automatic operation (optional).

The motor driven coaxial switches are 1 5/8" in a Double Pole Double Throw (DPDT) configuration and are mounted in the output coax combining network above the transmitter and combining cabinets. All coax 90° elbows, fittings and couplers are pre-tested and cut to exact lengths to assist in the installation of the system.

The four modes of the motor driven by-pass switching are: 1) both transmitters

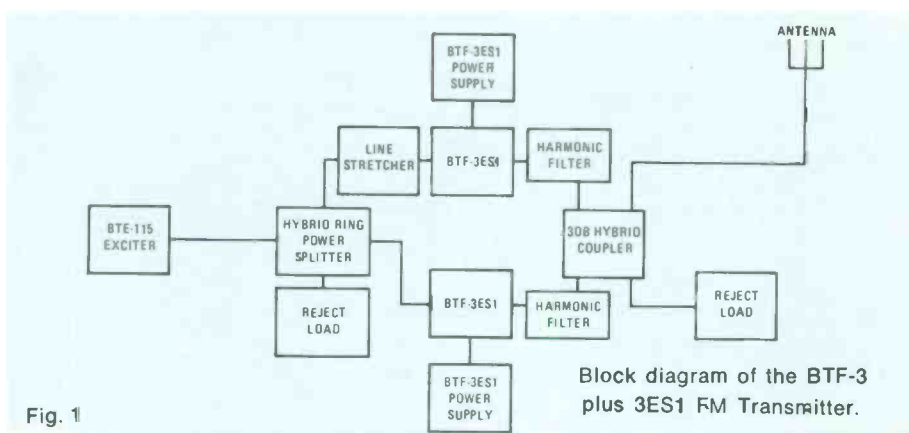


Fig. 1

Block diagram of the BTF-3 plus 3ES1 FM Transmitter.

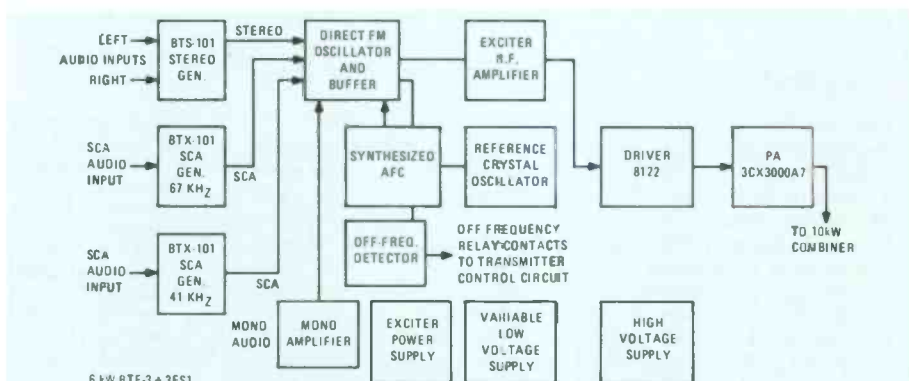


Fig. 2

Block diagram of one of the Duplexed 3 kW units of the BTF-3 plus 3ES1 FM Transmitter.

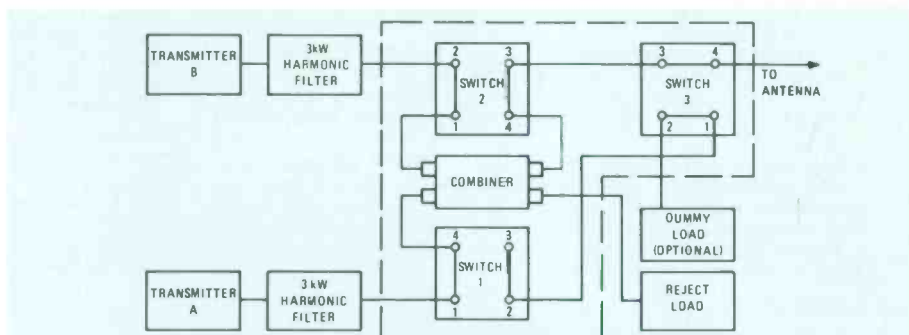


Fig. 3

Typical Four Mode Switching System (motor-driven) of the BTF-3 plus 3ES1 Dual Transmitter.

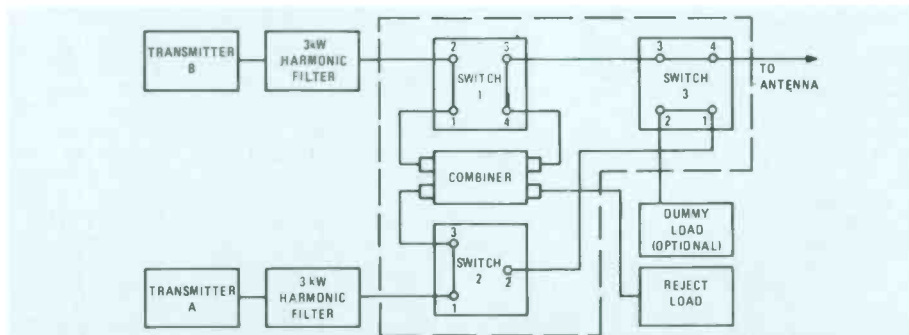
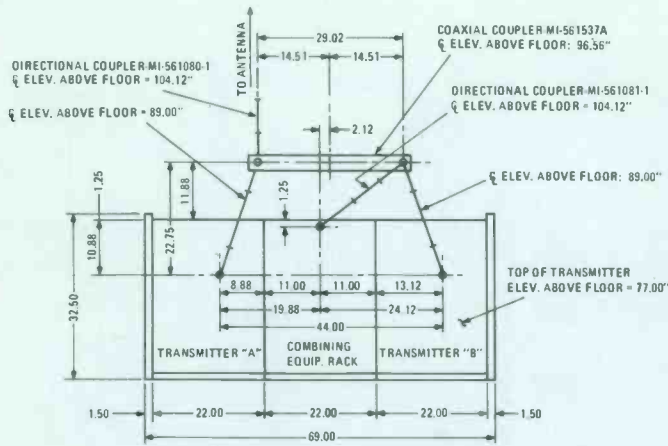


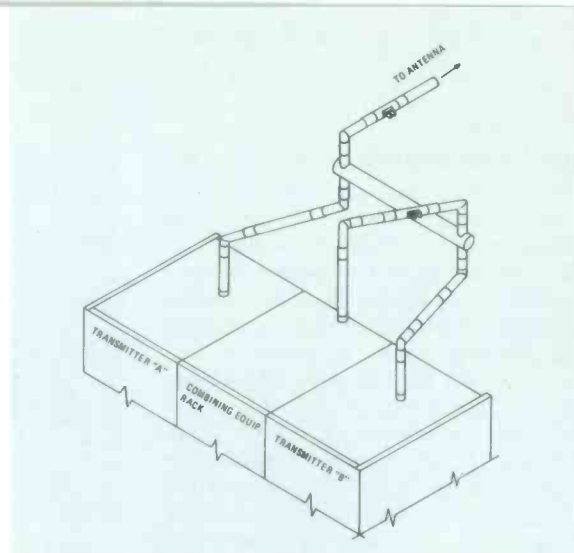
Fig. 4

Typical Four Mode Switching System (manual) for the BTF-3 plus 3ES1 Dual Transmitter.

fed into the antenna 2) both transmitters into a dummy load (optional) 3) Transmitter A into the antenna while B is fed into the dummy load, and 4) Transmitter B into the antenna with A into the dummy load.



Floor plan for BTF-3 plus 3ES1 Transmitter.



BTF-3 plus 3ES1 Transmitter. Transmission line and combiner configuration for non-switching output system.

Specifications

Performance

Power Output	1000-6000 watts
Output Impedance (1 1/2" O.D. unflanged)	50 ohms
Frequency Deviation, 100% modulation	±75 kHz
Modulation Capability	±100 kHz
Carrier Frequency Stability	±1000 Hz max.
Audio Input Impedance	600 ohms
Audio Input Level (100% mod.)	+10 ±2 dBm ¹
Audio Frequency Response (50 Hz-15 kHz)	±1 dB max. ²
Pre-emphasis Network Time Constant	0, 25, 75 or 50 μs ³
Harmonic Distortion (50 Hz-15 kHz)	0.3% max. ⁴
FM Noise Level (referred to 100% FM mod.)	-68 dB max.
AM Noise Level (referred to 100% AM mod.)	-50 dB max.
Subcarrier Input Level (100% mod.)	.9 to 30% adjustable
Subcarrier Input Impedance	Resistive 600 ohms bal.
Subcarrier Frequency	20-95 kHz
Main-to-Subchannel Crosstalk	-50 dB referred to ±6.0 kHz deviation of the subcarrier by a 400 Hz tone.
Main channel modulation 70% by a single tone (50 to 15,000 Hz) and 30% by subcarrier, using narrow band detector.	
Sub-to-Main-Channel Crosstalk	-60 dB referred to 100% modulation of the main carrier by a 400 Hz tone.
Subcarrier modulated ±4.0 kHz by a single tone (30 to 5000 Hz), main channel modulated 30% by subcarrier, using a narrow band detector, or 10% by subcarrier when operating in stereo.	

Electrical

Power Requirements:	
Line	240/208V, 50/60 Hz ⁶
Combined Voltage Variation and Regulation	±10%
Power Consumption (approx.)	12,000W
Power Factor (approx.)	.90%

Mechanical

Dimensions (overall)	69"W, 77"H, 22 1/2"D (1753, 1956, 826 mm)
Weight	2100 lbs. (953 kg)
Finish	Textured vinyl in charcoal gray and shadow blue, satin aluminum trim
Altitude:	
60 Hz	7500 ft. max. (2290 m) ⁵
50 Hz	5000 ft. max. (1520 m) ⁵
Ambient Temperature Range	-20° to +45°C

Accessories

Remote Power Output Control	MI-561023
Directional Coupler (for Exciter output)	MI-561026
Spare Crystal and Oven (Specify operating frequency)	MI-561066
Service Slider Rails for Exciter	MI-561073

Spare Transmitter Tubes	ES-560920
RF Load and Wattmeter	CB ⁷
Elapse Time Meter for 115V/60 Hz	MI-561018-2
Elapse Time Meter for 115V/50 Hz	MI-561018-4
Automatic Power Output Control Panel	MI-561353
Directional Coupler, 5 kW, 1 1/2", 50 ohm, for use with Automatic Power Control	MI-561080-6
Exciter Switching System	MI-561090
Automatic Operation of Motor Driven By-Pass Switching System	CB
Low Power/VSWR Protection Module	MI-561086
Automatic Operation of Exciter Switching System	CB
Type BW-75A FM Frequency and Modulation Monitor (Specify Frequency)	MI-560735
Type BW-100B RF Amplifier (Specify Frequency)	MI-560738
Type BW-85A FM Stereo Frequency and Modulation Monitor	MI-560740
Type BW-95A SCA Frequency and Modulation Monitor (Specify Frequency)	MI-569745

¹Level measured at input to pre-emphasis network.

²Frequency response referred to 75- or 50-microsecond pre-emphasis curve.

³Other time constants available on request.

⁴Distortion includes all harmonics up to 30 kHz and is measured following a standard 75- or 50-microsecond de-emphasis network.

⁵Modifications available for higher altitudes.

⁶Ordinarily three-phase power. Unit for single-phase power available. See "Ordering Information" below.

⁷Catalog RA.7711B.

Ordering Information

Parallel 6 kW-FM Transmitter (three phase) Type BTF-3+3ES1 with one Exciter (BTE-115), Combing and Dividing Equipment	ES-563016A
Parallel 6 kW FM Transmitter (single phase) Type BTF-3+3ES1 with one Exciter (BTE-115), Combing and Dividing Equipment	ES-563018A
Parallel 6 kW FM Transmitter (three phase) Type BTF-3+3ES1 with two Exciters, Exciter Switching, Combing and Dividing Equipment. No output switching	ES-563016B
Parallel 6 kW FM Transmitter (single phase) Type BTF-3+3ES1 with two Exciters, Exciter Switching, Combing and Dividing Equipment. No output switching	ES-563018B
Parallel 6 kW FM Transmitter (three phase) Type BTF-3ES1 with two Exciters, Exciter Switching, Combing and Dividing Equipment and manual or motor driven power output switching	ES-563016D/E
Parallel 6 kW FM Transmitter (single phase) Type BTF-3+3ES1 with two Exciters, Exciter Switching, Combing and Dividing Equipment and manual or motor driven power output switching and control panel	ES-563018D/E



FM Broadcast Transmitter, 6kW, Type BTF-3 plus 3ES1

- Parallel transmitter for high reliability
- All solid-state, "Direct-FM" exciter with or without Stereo and SCA
- Designed for unattended operation
- Only two tube types
- Grounded-grid power amplifier
- Compact and self-contained



The type BTF-3 plus 3ES1 is a six kilowatt Broadcast Transmitter for operation at any frequency from 87.5 to 108 MHz. It is designed to provide the finest performance and reliability and is specially built to handle the demanding requirements of Multiplex Transmission. The combined transmitter is designed to meet all FCC requirements for harmonic and spurious radiation.

The transmitter uses one or two Solid State Exciters, (as ordered) employing time tested and field proven direct-FM system of modulation.

The combined transmitter is housed in three cabinets and occupies less than sixteen square feet of floor space. The combining coaxial cable and coupler can be mounted or suspended above the cabinets to provide easy installation.

This four tube, grounded grid parallel power amplifier configuration comes fully tested to your individual frequency with all remote control and ATS (Automatic Transmitter System) interface circuitry brought to a single location. The self-contained power supplies further simplify the installation.

With the BTF-3 plus 3ES1 6 kW FM Parallel Transmitter, four mode manual patch or motor driven by-pass output switching can be provided to allow a single BTF-3ES1 of the BTF-3 plus 3ES1 to be connected directly to the antenna resulting in reduced power of one-half, instead of one-quarter power. The four modes are: 1) both transmitters parallel into the antenna; 2) both transmitters into dummy load; 3) one transmitter into antenna and second into the dummy load; and 4) reverse of 3). Automatic operation of the motor driven by-pass switching system is an optional accessory to the four mode switching system.

(See switching systems diagrams inside.)

The BTF-3+3ES1 transmitter is actually two complete three kilowatt transmitter units (Type BTF-3ES1) combined to make continuous operation practical at the 6 kW power level. All major components except the combining equipment, are duplicated within the system; dual exciters (if desired), power amplifiers, and power supplies, etc.

Dual Switchable Exciters

The basic configuration of the BTF-3+3ES1 contains only one exciter (BTE-115) which can be expanded to include two exciters and exciter switching, so that a back-up exciter system is always available with the push of a button either locally or by remote control. The single exciter system can be purchased initially and the second exciter and switching system can be bought at a later date if desired.

With the purchase of two exciters the system is so arranged so that one of the two serves the combined transmitter while the other operates as a "hot" stand-by. In the event of trouble in the on-the-air exciter, manual (or automatic optional) switch-over puts the extra exciter on the line.

Grounded Grid Power Amplifier Stages

The exciter system delivers 15 watts of modulated carrier to a hybrid-ring power splitter which, in turn provides two outputs, each to a 8122 IPA Tetrode Tube. This raises the power to the required level to drive the final power amplifier to 3 kW power output. The two 3 kW outputs are then combined to provide a full 6 kW transmitter power out of the combiner coupler. The output configuration uses a grounded grid tube, a ceramic triode 3CX3000A7 tube type.

Harmonic Filters/Directional Couplers

The standard harmonic filter supplied with the BTF-3ES1 transmitter is not a simple harmonic trap. The filter consists of two M-derived half-sections in series and three constant-K half-sections configured into a lumped inductive-capacitive network and is installed inside the transmitter cabinet. The M-derived sections at the input and output provide cut-off in the second harmonic region and above and a 50 ohm termination impedance at each end of the filter.

A built-in directional coupler is an integral part of the harmonic filter and provides reliable forward and VSWR power indications that are read on the

transmitter power/reflected front panel meter.

The harmonic filter/directional coupler supplied with the BTF-3+3ES1 are two separate units in a 50 ohm 1½" unflanged coax fitting input so as to be compatible with the parallel output combining network supplied with the combined transmitter.

Hybrid Combiner Network

Ordinarily mounted above the transmitter, almost directly over the center combining cabinet is the hybrid combiner coupler network, a "three-dB hybrid" coaxial unit. This assembly combines the two 3 kW modulated carriers into one 6 kW output. The reject load for the combiner is mounted within the center combiner equipment cabinet of the transmitter.

When the two 3 kW transmitters are each of equal power out and are properly phased by the line stretcher, the system will easily achieve the full 6 kW to the antenna system. If one transmitter is reduced in power or is completely disabled the power output will be less than 6 kW and can be as low as 1500 watts if one transmitter is completely shut-down. The uniqueness of the parallel transmitter configuration is that program service can be maintained on a reduced power basis even if one of the parallel transmitters is disabled. When one transmitter is disabled the 3dB hybrid coupler splits the power from the remaining active transmitter so that half the power input goes to the antenna and half to the reject load unless an output switching system is employed (see 4 mode switching).

Adjustable Power-Output Control

Power output is controlled by means of a variable resistor which controls the screen voltage supplied to the IPA. Power output is adjustable from zero to a full 3 kW in each 3 kW transmitter unit or 6 kW in the combined transmitter.

Self-Protected Against Overload

Power circuits in each 3 kW transmitter are protected by magnetically tripped circuit breakers in addition to overload relays. An automatic sequencing system prevents turn-on at the plate power until all filaments have heated sufficiently. In addition, a stepping relay automatically cycles power-off three times before locking out in the event of brief overloads and power interruptions. The overloads are reset by pushbuttons on the front panel or by remote control.

All tuning controls are located on the front panels for easy accessibility. The variable power control is also mounted on the front as are the overload indicators, plate power on-off and overload reset buttons.

Remote Control

The BTF-3+3ES1 transmitter incorporates connections for remote control and for ATS (Automatic Transmitter System) and remote meter readings when used with a remote control system. Terminals for transmitter on-off, plate on-off, overload reset, and reading remotely plate voltage, cathode current, and power output are conveniently found inside the transmitter's rear lift off doors on each 3 kW unit.

Output Configurations

The basic BTF-3+3ES1 parallel transmitter comes with either one exciter and no switching system or with two exciters and a switching system, but with no output by-pass switching, as shown in Floor Plan and Coaxial Cable and Combiner Configuration diagrams on the last page of this catalog. Other switching configurations such as manual output patch, and motor driven output by-pass switching are also available. These latter systems are both 4 mode switching systems described as follows:



Four Mode Manual Patch

A method of achieving a interim power of 3 kW to the station's antenna during periods when one of the individual BTF-3ES1 transmitters is shut-down for repair or routine maintenance is to by-pass the shut-down transmitter using a manual coax patching system as shown in Figure 4. On the bottom right side of this page. If Transmitter B for example is shut-down the coaxial "U" bend patch of Switch #2 is changed to make connection between Jacks 1 and 2, and the U bend patch of Switch #3 is changed to make connection between Jacks 1 and 4 with the U bend patch connections between Jacks 3 and 4 removed. Thus, the RF continuity from the Transmitter A to the antenna is complete and Transmitter B is taken off the antenna feed. If Transmitter A is disabled the U bend patch of Switch 1 is connected to Jacks 2 and 3 with Jacks 3 and 4 removed. Transmitter B is then connected to the station antenna.

The manual patch switches are 1 5/8" coaxial in 3 poles and 4 pole configurations and are mounted in the output coax combining network above the transmitter and combining cabinets. All coax, 90° elbows, fittings and couplers are pre-tested and cut to exact lengths so that the network can be efficiently and quickly assembled.

The four mode patching will allow for 1) both transmitters to be fed into the antenna, 2) or into a (optional) dummy load, 3) Transmitter A into antenna and B into dummy load or 4) reverse of 3).

Four Mode Motor Driven Switching

Another method of achieving an interim power of 3kW to the station's antenna and by-passing one complete BTF-3ES1 transmitter unit of the parallel system is to install a 4 mode motor driven coaxial switching system as shown in Figure 3. The motor driven switching system has the advantage over the manual patch system that the output mode can be quickly changed by a single pushbutton action, and can be adapted to automatic logic for complete automatic operation (optional).

The motor driven coaxial switches are 1 5/8" in a Double Pole Double Throw (DPDT) configuration and are mounted in the output coax combining network above the transmitter and combining cabinets. All coax 90° elbows, fittings and couplers are pre-tested and cut to exact lengths to assist in the installation of the system.

The four modes of the motor driven by-pass switching are: 1) both transmitters

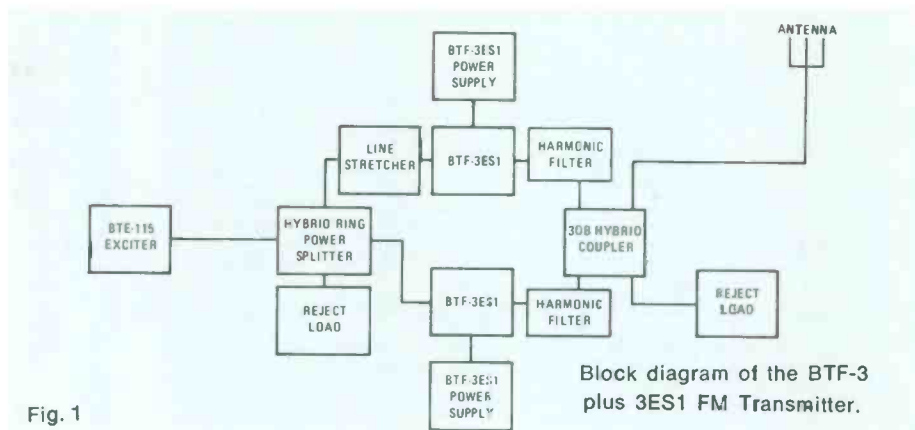


Fig. 1

Block diagram of the BTF-3 plus 3ES1 FM Transmitter.

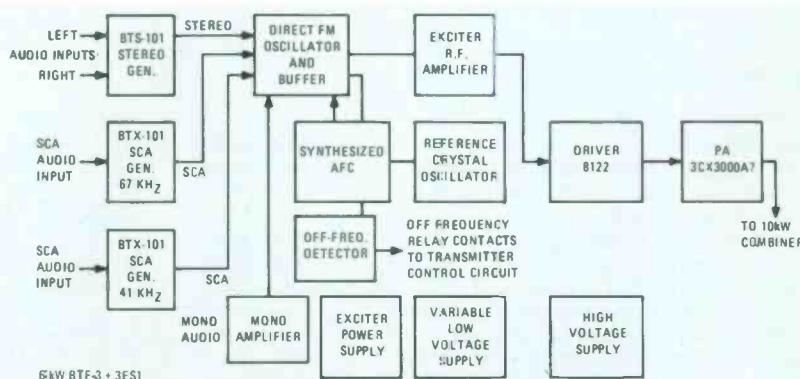


Fig. 2

Block diagram of one of the Duplexed 3 kW units of the BTF-3 plus 3ES1 FM Transmitter.

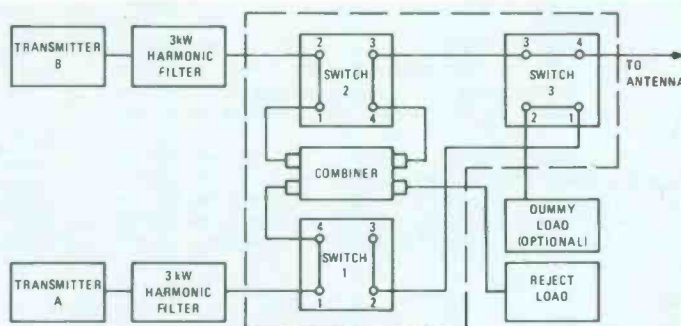


Fig. 3

Typical Four Mode Switching System (motor-driven) of the BTF-3 plus 3ES1 Dual Transmitter.

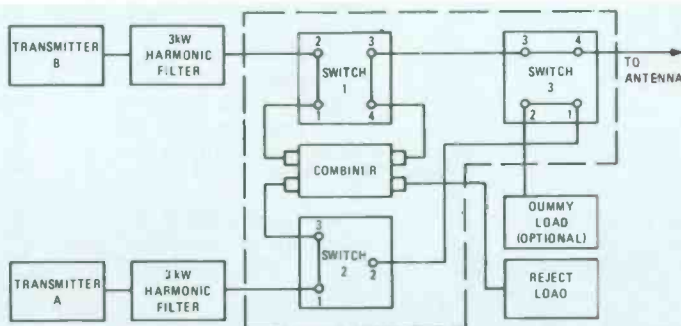
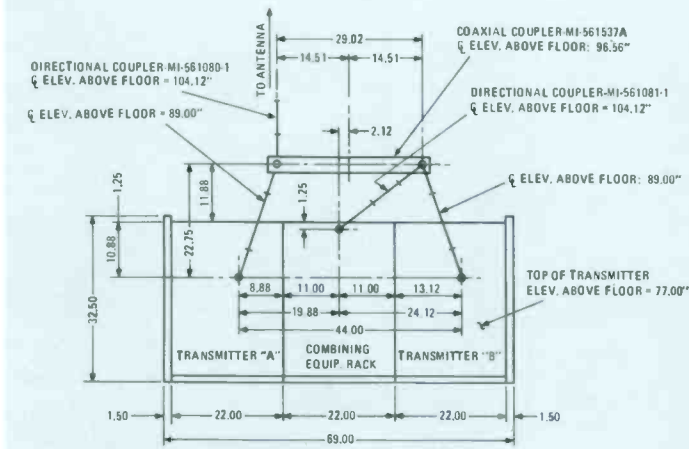


Fig. 4

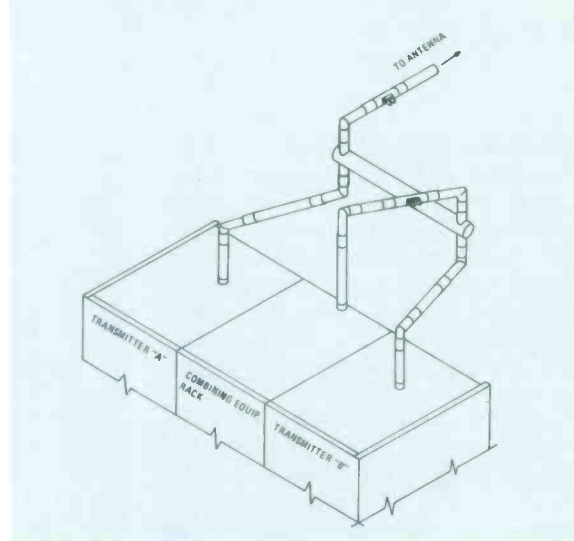
Typical Four Mode Switching System (manual) for the BTF-3 plus 3ES1 Dual Transmitter.

fed into the antenna 2) both transmitters into a dummy load (optional) 3) Transmitter A into the antenna while B is fed

into the dummy load, and 4) Transmitter B into the antenna with A into the dummy load.



Floor plan for BTF-3 plus 3ES1 Transmitter.



BTF-3 plus 3ES1 Transmitter. Transmission line and combiner configuration for non-switching output system.

Specifications

Performance

Power Output	1000-6000 watts
Output Impedance (1 5/8" O.D. unflanged)	50 ohms
Frequency Deviation, 100% modulation	±75 kHz
Modulation Capability	±100 kHz
Carrier Frequency Stability	±1000 Hz max.
Audio Input Impedance	600 ohms
Audio Input Level (100% mod.)	+10 ±2 dBm ¹
Audio Frequency Response (50 Hz-15 kHz)	±1 dB max. ²
Pre-emphasis Network Time Constant	0, 25, 75 or 50 μs ³
Harmonic Distortion (50 Hz-15 kHz)	0.3% max. ⁴
FM Noise Level (referred to 100% FM mod.)	-68 dB max.
AM Noise Level (referred to 100% AM mod.)	-50 dB max.
Subcarrier Input Level (100% mod.)	.9 to 30% adjustable
Subcarrier Input Impedance	Resistive 600 ohms bal.
Subcarrier Frequency	20-95 kHz
Main-to-Subchannel Crosstalk	-50 dB referred to ±6.0 kHz deviation of the subcarrier by a 400 Hz tone.
Main channel modulation 70% by a single tone (50 to 15,000 Hz) and 30% by subcarrier, using narrow band detector.	
Sub-to-Main-Channel Crosstalk	-60 dB referred to 100% modulation of the main carrier by a 400 Hz tone.
Subcarrier modulated ±4.0 kHz by a single tone (30 to 5000 Hz), main channel modulated 30% by subcarrier, using a narrow band detector, or 10% by subcarrier when operating in stereo.	

Electrical

Power Requirements:	
Line	240/208V, 50/60 Hz ⁶
Combined Voltage Variation and Regulation	±10%
Power Consumption (approx.)	12,000W
Power Factor (approx.)	.90%

Mechanical

Dimensions (overall)	.69"W, 77"H, 22 1/2"D (1753, 1956, 826 mm)
Weight	2100 lbs. (953 kg)
Finish	Textured vinyl in charcoal gray and shadow blue, satin aluminum trim
Altitude:	
60 Hz	7500 ft. max. (2290 m) ⁵
50 Hz	5000 ft. max. (1520 m) ⁵
Ambient Temperature Range	-20° to +45°C

Accessories

Remote Power Output Control	MI-561023
Directional Coupler (for Exciter output)	MI-561026
Spare Crystal and Oven (Specify operating frequency)	MI-561066
Service Slider Rails for Exciter	MI-561073

Spare Transmitter Tubes	ES-560920
RF Load and Wattmeter	CB ⁷
Elapse Time Meter for 115V/60 Hz	MI-561018-2
Elapse Time Meter for 115V/50 Hz	MI-561018-4
Automatic Power Output Control Panel	MI-561353
Directional Coupler, 5 kW, 1 5/8", 50 ohm, for use with Automatic Power Control	MI-561080-6
Exciter Switching System	MI-561090
Automatic Operation of Motor Driven By-Pass Switching System	CB
Low Power/VSWR Protection Module	MI-561086
Automatic Operation of Exciter Switching System	CB
Type BW-75A FM Frequency and Modulation Monitor (Specify Frequency)	MI-560735
Type BW-100B RF Amplifier (Specify Frequency)	MI-560738
Type BW-85A FM Stereo Frequency and Modulation Monitor	MI-560740
Type BW-95A SCA Frequency and Modulation Monitor (Specify Frequency)	MI-569745

¹Level measured at input to pre-emphasis network.

²Frequency response referred to 75- or 50-microsecond pre-emphasis curve.

³Other time constants available on request.

⁴Distortion includes all harmonics up to 30 kHz and is measured following a standard 75- or 50-microsecond de-emphasis network.

⁵Modifications available for higher altitudes.

⁶Ordinarily three-phase power. Unit for single-phase power available. See "Ordering Information" below.

⁷Catalog RA.7711B.

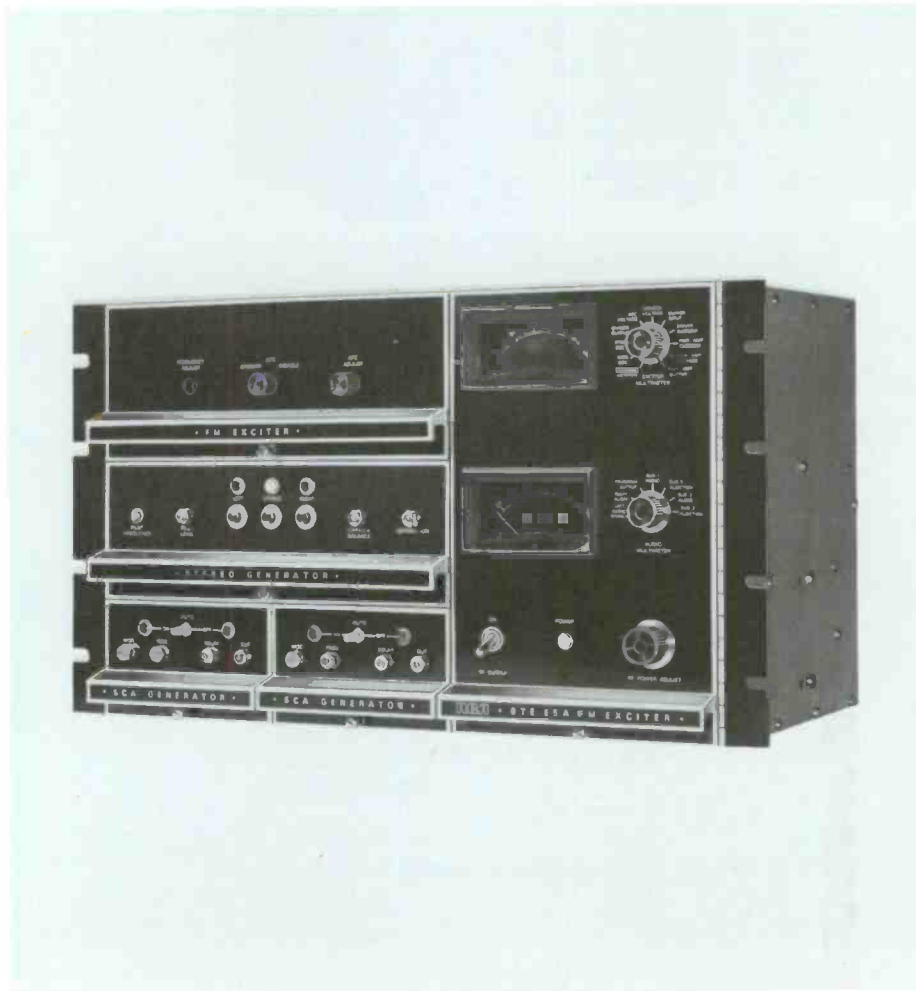
Ordering Information

Parallel 6 kW-FM Transmitter (three phase) Type BTF-3+3ES1 with one Exciter (BTE-115), Combing and Dividing Equipment	ES-563016A
Parallel 6 kW FM Transmitter (single phase) Type BTF-3+3ES1 with one Exciter (BTE-115), Combing and Dividing Equipment	ES-563018A
Parallel 6 kW FM Transmitter (three phase) Type BTF-3+3ES1 with two Exciters, Exciter Switching, Combing and Dividing Equipment. No output switching	ES-563016B
Parallel 6 kW FM Transmitter (single phase) Type BTF-3+3ES1 with two Exciters, Exciter Switching, Combing and Dividing Equipment. No output switching	ES-563018B
Parallel 6 kW FM Transmitter (three phase) Type BTF-3ES1 with two Exciters, Exciter Switching, Combing and Dividing Equipment and manual or motor driven power output switching	ES-563016D/E
Parallel 6 kW FM Transmitter (single phase) Type BTF-3+3ES1 with two Exciters, Exciter Switching, Combing and Dividing Equipment and manual or motor driven power output switching and control panel	ES-563018D/E



FM Exciter System, Type BTE-15A
Stereo Generator, Type BTS-1B
SCA Generator, Type BTX-1B

- Modular, integrated design
- Direct-FM modulation
- Built-in multimeters
- Automatic SCA subcarrier muting
- Built-in, off-frequency (phase-lock) detector



The BTE-15A is a completely solid-state, integrated-circuit exciter system for FM broadcast transmitters, using direct frequency modulation of the carrier for excellent frequency response, low noise.

The system is available in several configurations of mono or stereophonic with or without one or two subsidiary communications (SCA) channels. The basic exciter system handles monophonic programming only. Adding plug-in modules to the basic system expands it to handle stereophonic or SCA programming (see Ordering Information). Stations equipped with SCA facilities offer background music or other subscriber services while they maintain mono or stereo mass-market programming.

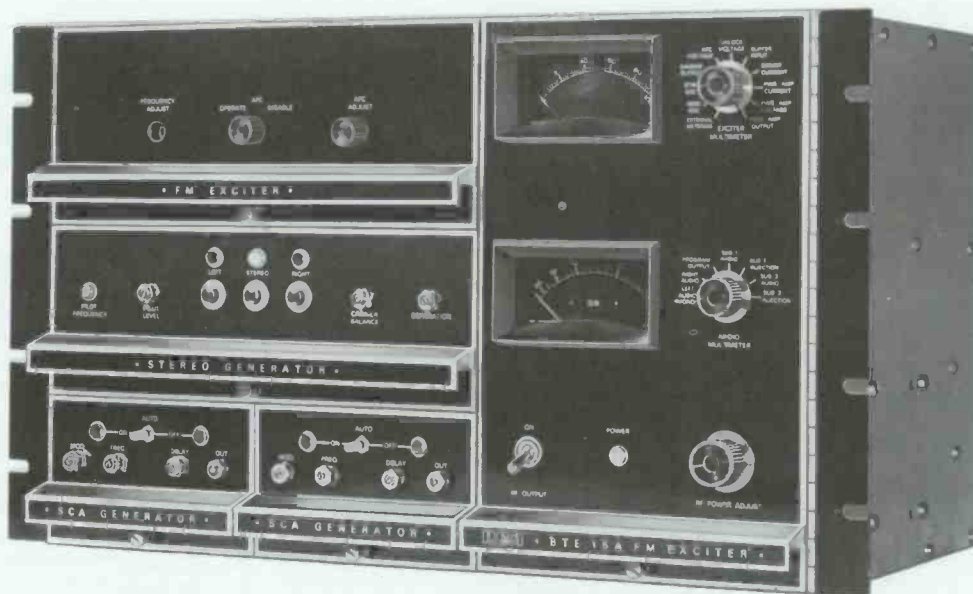
An important operational feature of this exciter system is its metering facility that uses two separate meters. One indicates operating parameters while the other indicates peak modulating-signal levels.

The main frame of the system houses the power-supply equipment and the two built-in multimeters. Into this main frame plug four individual modules: FM Exciter; Stereo Generator and one or two SCA Subcarrier Generators. When the system serves a transmitter operating only the monophonic main channel, an input module occupies the stereo module space. When subcarrier generators are not part of the system, the module space set aside is covered with blank panels. Description of each module begins on the next page.

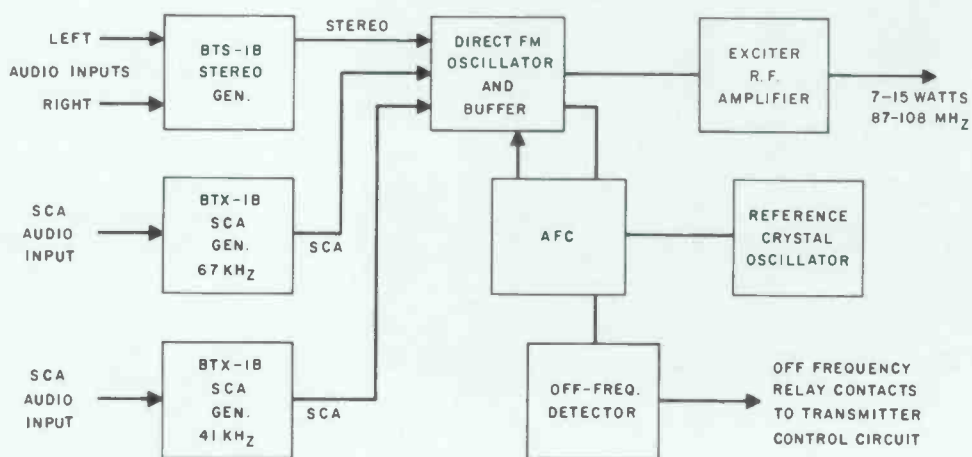
For the low-power, educational-FM station the BTE-15A is available as a packaged, 10-watt transmitter.

FM Exciter System, Type BTE-15A

- Entirely solid-state
- Direct FM applied at carrier frequency
- Easily adjustable power output
- Plug-in subcarrier generators
- Built-in d-c and peak-reading-audio multimeters



Solid-state exciter system as it appears equipped for stereo and two SCA subchannels. Stereo and SCA generators are optional.



Simplified block diagram, Type BTE-15 Exciter equipped for stereo and two SCA subchannels.

The BTE-15A is a completely solid-state exciter system for FM broadcast transmitters. It employs a principle of direct frequency modulation that results in an FM signal of wide frequency response, low distortion and low noise.

The BTE-15A is used in all current RCA FM transmitters and it is directly interchangeable with the earlier, tube-powered exciter (Type BTE-10C) used in RCA FM transmitters. Minor connector rewiring in the transmitter allows substitution for the even earlier Type BTE-10B exciter. The system is fully self-contained, even when fitted with stereo and/or SCA subcarrier generators. The entire system operates directly from single phase, commercial power.

The system's main frame houses the power-supply equipment and the two built-in multimeters: one, a d-c meter for exciter parameters and another, a peak-reading a-c meter, for the audio sections.

In a mono-only configuration, the exciter system consists of a main frame, an FM generator module and an audio-input module (which plugs into the space otherwise occupied by the stereo module).

Equipped for stereo, the main frame holds two modules: the FM generator module and a stereo generator module. The two spaces at the lower left are covered with blank panels. Adding one or two SCA subchannels is a simple matter of adding one or two SCA generator modules. A special circuit within

the main frame precludes automatic simultaneous operation of a 41-MHz SCA subcarrier while the exciter operates in stereo mode.

Carrier Oscillator

A temperature-compensated, solid-state oscillator circuit generates the exciter signal at carrier frequency. True frequency modulation of this oscillator is performed with variable-capacitance diodes in a push-pull connection to the oscillator tank circuit. A 10dB resistive attenuator isolates the oscillator from the input of a solid-state buffer amplifier. The buffer amplifier raises carrier level to about 500 milliwatts for the RF amplifiers that follow and provides a sample for the AFC system as well.

RF Amplifier Chain

In three solid-state stages, the RF amplifier raises the 500mW carrier to a 15-watt level. The output level is adjustable between 7 and 15 watts while the output circuit tolerates load mismatches from dead-short to open-circuit for a reasonable time without damage to the output transistor.

AFC System

The automatic frequency control portion of the system uses an oven-heated crystal as the frequency reference. This crystal oscillates at 1/1024 of the carrier frequency and its frequency is divided by 16 in a binary divider. A sample of the carrier generator oscillator, (taken at

the buffer stage), is divided in a binary divider chain to a frequency that matches the reference oscillator subharmonic (at a 100.1 MHz carrier, the frequency is approximately six kHz). These two signals are phase detected in a time-sharing comparator. When an error between the two exists, the AFC system applies a correction to the carrier-generator oscillator through a pair of variable-capacitance diodes connected to the tank circuit. Thus, the carrier oscillator is phase locked to a low-frequency oven-controlled crystal through the binary chains.

Off-Frequency, Phase-Lock Detector

The BTE-15A includes a detector that senses a loss of phase lock between the carrier oscillator and the reference oscillator. This condition operates a relay in the exciter system which can be connected to the transmitter control circuit to shut down the transmitter should such an event take place.

Built-in Multimeters

The main frame of the exciter system houses the regulated power supply and the system's two built-in multimeters. The uppermost meter is a d-c unit and is connected, through a rotary selector switch, to monitor 11 exciter parameters; the lower meter is an audio-measuring, peak-reading device calibrated in dB (-20 to +5) which measures 7 audio parameters through a rotary selector.

Specifications

Carrier Frequency Range	87.5 to 108 MHz
Power Output (Adjustable level at 50 ohms)	7 to 15W
Output Connector	Type BNC
Modulation Capability	±125 kHz max.
Carrier Frequency Stability	±250 Hz
Audio Input Level (For 75kHz deviation, 400Hz)	10 ±2 dBm
Frequency Response (75µs pre-emphasis):	
50-10,000 Hz	Flat ±0.5 dB
10,000-15,000 Hz	Flat ±1.0 dB
Pre-emphasis Net Time Constants	50 or 75µs
Harmonic Distortion (50-15,000 Hz)	0.5% max.
Noise Level, FM (ref: 100% mod, 400 Hz)	-68dB max.
Noise Level, AM (ref: carrier)	-60dB max.
Power Requirements	117, 208, 240V; 50-60 Hz; 80W max.
Power Line Regulations (Slow voltage variation)	±5% max.
Dimensions	19" W; 10½" H; 9" D (483, 267, 229 mm)
Weight (Approx.)	40 lbs. (18kg)
Shipping Weight (Approx.)	50 lbs. (23 kg)
Operating Altitude (Above sea level)	12,500 ft. (3812 m)
Ambient Operating Temperature	-20 to 60°C (-10 to 140°F)

Accessories and Spares

Input/Output Plugs and Connectors, Set	MI-560734
Recommended Semiconductor Spare Kits for:	
Main Frame	RO-390

Exciter Module	RO-391
Stereo Generator Module	RO-392
SCA Generator Module	RO-393
Mono Input Adapter Module	RO-394
RF Portion of Exciter Module*	RO-381
Crystal, with Oven (Please specify carrier freq.)	MI-560717
Crystal Oven, less crystal	MI-560717A
FM Generator Module (Please specify carrier freq.)	MI-560712
Stereo Generator Module, Type BTS-1B	MI-560713
SCA Subcarrier Generator Module, Type BTX-1B (Specify Subcarrier freq.)	MI-560714

*Five in kit; duplicated in Exciter Module Spares Kit (RO-391). Order "RO" kits from RCA Parts and Accessories, Deptford, N. J.

Ordering Information

Exciter System, Type BTE-15A (Please specify assigned frequency):	
Mono only	ES-560631†
Mono & 1 SCA Channel†	ES-560632†
Mono & 2 SCA Channels†	ES-560633†
Stereo	ES-560634†
Stereo & 1SCA Channel†	ES-560635†
Stereo & 2 SCA Channel†	ES-560636†

†Less input-output plugs and connectors. See Accessories.

‡Please specify subcarrier frequency or frequencies.

Plug-In Stereo Generator, Type BTS-1B

- Identical audio channels
- Choice of pre-emphasis time constant
- Low distortion pilot signal
- Built-in 19-kHz program filter
- Negligible 76-kHz harmonic content



Entire generator contained in this plug-in module.



Generator module in rack mount unit for use external to BTE-15

The BTS-1B Stereo Generator is a plug-in module for the Type BTE-15A FM Exciter System. However, it is offered separately in a self-powered rack-mount assembly for use with RCA exciters and transmitters of earlier design. The self-powered generator is also useful to form a composite stereo signal for an STL system. (See *Ordering Information*, below.)

Among the many features of the BTS-1B are the identical left and right audio channels, the efficient 19-kHz program filters, the buffered 38-kHz switching signal, the negligible 38-kHz second harmonic in the output, the field-reconnectable pre-emphasis time-constant network and a built-in, phase-linear filter.

Identical Audio Channels

The "left" and "right" audio channels in the BTS-1B are essentially identical in all respects. For example, the gain differential between the two is adjustable to within one-half percent and the phase shift to within one-half degree at all frequencies between 30 and 15,000Hz. Each amplifier includes a resistive input termination, an isolation transformer, a 15-kHz low-pass filter, an operational amplifier and a pre-emphasis network. This network is connected for 75- μ s time constant and may be field reconnected for 50- μ s or "flat" (zero pre-emphasis). The low-pass filter in each channel attenuates 15-kHz program content less than one-half dB but response at 19kHz and higher is down at least 50dB. This assures minimum audible beatnotes between program and pilot/subcarrier frequencies.

Symmetrical Switching Signal

The left and right audio signals are switched at a 38kHz rate in the switching modulator. The switching signal is a buffered, balanced and symmetrical waveform from a bi-stable counter with minimum second and higher-order har-

monics in the output. The counter is driven by a crystal-controlled 76-kHz oscillator to assure a frequency stable 38-kHz subcarrier.

Low Distortion Pilot Signal

The switching modulator output and the 19-kHz sinusoidal pilot frequency (distortion less than one percent) are stripped of 38-kHz third and all higher-order harmonics in a phase-linear filter.

Pushbutton Switching

Front-panel pushbuttons operate internal relays that switch the generator's operating mode: left mono; stereo or right mono. Lighted indicators, immediately above the pushbuttons, indicate

operating mode. Additional front-panel controls adjust pilot frequency, pilot level, carrier balance and stereo separation.

Available in Two Forms

The BTS-1B Stereo Generator is available as a plug-in module for the exciter system from which it draws operating power. For use with earlier RCA exciter units, the BTS-1B is offered in a combination with a rack-mount frame. The module plugs into the frame in the same manner: it does into the exciter system. The rack-mount frame includes a power supply for operation from commercial power lines. Requires 3½ inches (89 mm) rack space.

Specifications

Pilot Carrier Stability (19kHz)	±1Hz
Subcarrier Suppression	45dB min.
Frequency Response Characteristic:	
30 to 10,000Hz	Flat ±0.5dB
30 to 15,000Hz	Flat ±1.0dB
Pre-emphasis Time Constants	50 or 75 μ s
Channel Separation (L to R and R to L)	35dB min.
Crosstalk:	
L+R to L-R	-45dB max.
L-R to L+R	-45dB max.
Stereo Harmonic Distortion	1% max.
Dimensions	
(Rack-Mount Unit)	3½" H, 19" W; 10⅝" D (89, 483, 270 mm)
Weight, Rack-Mount Unit (Approx.)	19 lbs. (9 kg)
Shipping Data:	
Dimensions (Approx.)	5½" x 20" x 13"
Dimensions (mm)	140 x 508 x 130
Weight (Approx.)	24 lbs. (11kg)

Accessories and Spares

Recommended Semiconductor Spares	RO-392
Frame and Power Supply, less Stereo Module	MI-560711A
Module Extender	MI-560719

Ordering Information

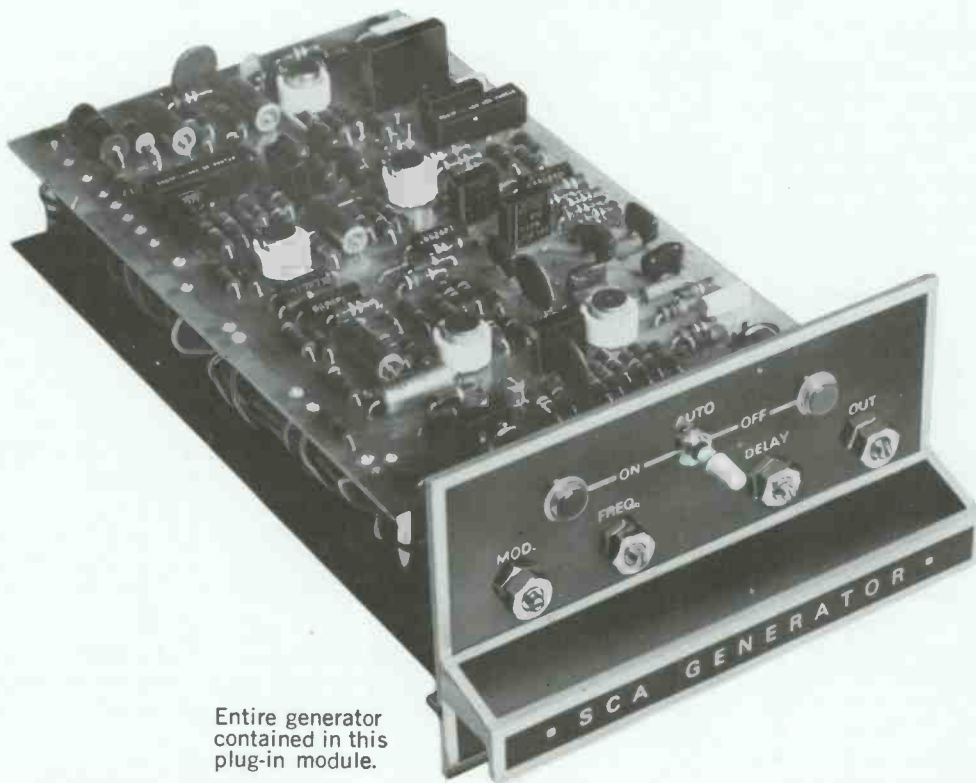
Stereo Generator Module, Type BTS-1B	MI-560713
As Above, for Rack-Mount (Includes Power Supply & Module Extender)	ES-560639

Plug-In SCA Subcarrier Generator, Type BTX-1B

- Adjustable pre-emphasis time constant
- Subcarrier harmonic filter built-in
- Automatic subcarrier mute
- Front-panel vernier frequency control



Rack-mount unit holds two generators and a power supply.



Entire generator contained in this plug-in module.

The BTX-1B SCA Subcarrier Generator is a plug-in module for the Type BTE-15A FM Exciter System. However, it is offered separately in a self-powered, rack-mount assembly for use with RCA exciters and transmitters of earlier design.

Among the many features of the BTX-1B is a resistive-terminating pad at the audio input, an adjustable pre-emphasis network and extra audio input, sensitivity that usually precludes the need for a line amplifier between the program source and the audio input.

Audio Portions

Program audio enters the BTX-1B through a resistive terminating pad and an isolation transformer before reaching the amplifier. A 5-kHz low-pass filter is included for use when the generator operates in a system which includes a stereo facility. The filter minimizes the generation of SCA sidebands that interfere with the L-R portion of the stereo information.

Active Pre-Emphasis Network

The audio amplifier includes an active pre-emphasis network that reconnects for 75 or 150 microsecond time constants or for no pre-emphasis at all which results in a "flat" characteristic for situations where the input audio is pre-emphasized earlier. Also included is a "telemetry input" which bypasses the pre-emphasis network to allow the transmission of subaudible 20 to 30 Hz metering information.

Integrated Circuit Modulator

The subcarrier is generated by a temperature compensated, solid-state oscillator. A front-panel frequency vernier provides touchup frequency control whenever appropriate. The subcarrier is frequency modulated in an intergraded circuit which provides both "coarse" and "fine" frequency control via potentiometers. The "fine" control is a front-panel control.

Automatic SCA Muting

The modulated oscillator drives a muting gate which is closed automatically when no modulation is present. A "mute-delay" circuit provides an adjustable time delay between the end of modulation and the muting of the subcarrier. A front-panel indicator lights as long as subcarrier is "on". Two buffers and a filter couple the modulated subcarrier to the adjustable output. An additional buffer amplifier connects a sample of the output to the metering circuit.

Built-In Subcarrier Harmonic Filter

The subcarrier harmonic filter is connected between the two buffer amplifiers

which couple the modulated oscillator to the module output.

Available in Two Forms

The BTX-1B SCA Subcarrier Generator is available as a plug-in module for the exciter system from which it draws operating power. For use with earlier RCA exciter units, the BTX-1B is offered in combination with a rack-mount frame. The module plugs into the frame in the same manner it does into the exciter system. The rack-mount frame accommodates two modules and includes a power supply for operation from commercial power lines. Requires 3½ inches (89 mm) rack space.

Specifications

Frequency Range of Subcarrier	Any SCA frequency between 30 to 75kHz
Output Level (Adjustable)	0-4V, 10k ohms
Modulation Capability	±15% of carrier frequency
Subcarrier Frequency Stability	±0.2%
Audio Input Impedance (Balanced)	600 ohms
Audio Input Level (Adjustable)	-15 to +10 dBm
Audio Frequency Response	50-10,000Hz ±1dB*
Harmonic Distortion (50-10,000 Hz)	1% max.
Noise Level, FM (Below 100% Mod)	-60dB max.
Noise Level, AM (Below Subcarrier Level)	-50dB max.
Dimensions (Rack-Mount Unit) (Approx.)	3½" H; 19" W; 10½" D (89, 483, 270 mm)
Weight (Approx.)	17 lbs. (8kg)
Shipping Data (Approx.):	
Dimensions	5½" x 20" x 13" (140, 508, 330 mm)
Weight	22 lbs. (10kg)

*50 or 150µs pre-emphasis, without low-pass filter, measured via wideband frequency discriminator.

Accessories and Spares

Recommended Semiconductor Spares	RO-393+
Rack-Mount Frame (Incl. Power Supply)	MI-560720
Low-Pass Audio Filter	MI-560721
Module Extender	MI-560719

†Order "RO" kits from RCA Parts and Accessories, Deptford, N. J.

Ordering Information

SCA Subcarrier Generator Module, Type BTX-1B (Includes low-pass audio filter)	MI-560714
Rack-Mount SCA Subcarrier Generator, Type BTX-1B (Includes above plus module extender and Blank Panel)	ES-560640
As Above, with two SCA Modules	ES-560641

Please specify subcarrier frequency or frequencies

Educational FM Transmitter, Type BTE-10AT

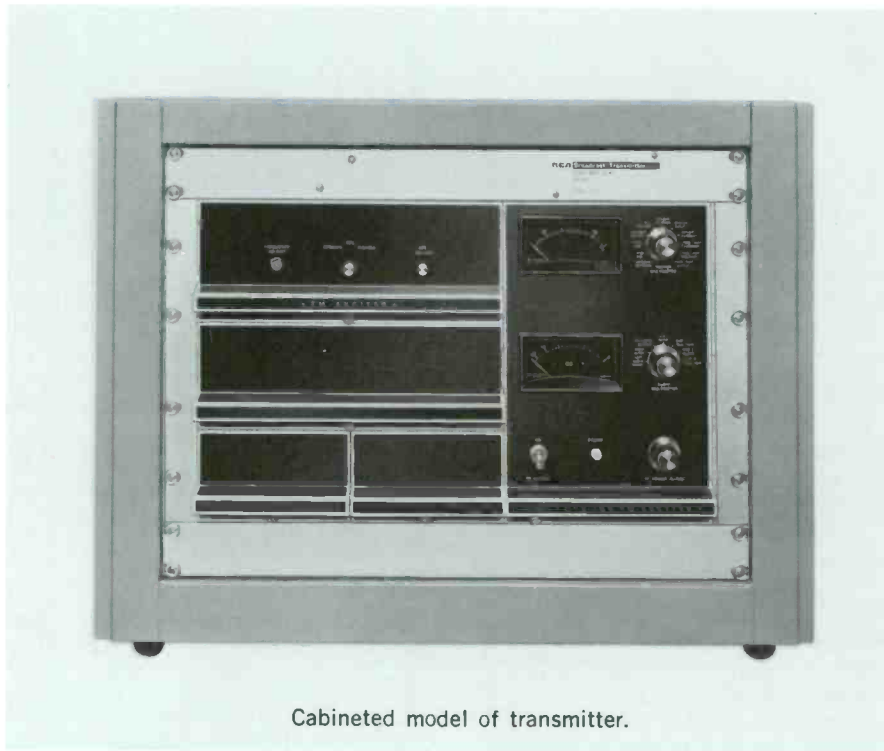
- Mono or stereo, one or two SCA subcarriers
- Fully self-contained all solid state
- Rack-mount or desk-top cabinet
- Plug-in module construction
- Built-in power-output control

The BTE-10AT Educational FM Transmitter uses a standard Type BTE-15A Exciter System with facilities for determination of power output. It is available in two forms: one, housed in a metal cabinet for desk- or table-top mount and, two, less cabinet, for mounting in ordinary 19-inch (483 mm) equipment racks.

All specifications are identical to those of the exciter system except for power output. The output of the BTE-10AT is limited to 10 watts, in accordance with the limitations of (FCC) Class D stations.

With the addition of a stereo module (see *Accessories*), the BTE-10AT transmits programming in stereo. SCA programming or telemetry return requires the addition of an SCA subcarrier generator module (see *Accessories*).

Although termed an "educational" transmitter, the BTE-10AT is useful as an STL transmitter wherever local rules allow. In such duty, it provides up to 15 watts of power output from its transistorized power amplifier.



Cabineted model of transmitter.

Specifications

Identical to those of BTE-15A Exciter except for:

Power Output 10W¹

Dimensions:

Cabineted Model 17¼" H; 23½" W; 17¼" D
(438, 596, 438 mm)

Rack-Mount Model 12¼" H; 19" W; 12½" D
(311, 483, 321 mm)

Weight Incl. Cabinet: 60 lbs. (27kg)
Less Cabinet: 40 lbs. (18kg)

Shipping Data:

	Less Cabinet	Incl. Cabinet
Dimensions (Approx.)	19" x 25" x 18" (483, 635, 457)	22" x 28" x 24" (559, 711, 610)
Weight (Approx.)	59 lbs. (25kg)	75 lbs. (33kg)

¹ Operable at 15W output where local rules allow.

Accessories

Input/Output Plugs and Connectors, Set MI-560734

Recommended Semiconductor Spare Kits for:

Main Frame RO-390

Exciter Module	RO-391
Stereo Generator Module	RO-392
SCA Generator Module	RO-393
Mono Input Adapter Module	RO-394
RF Portion of Exciter Module*	RO-381
Crystal, with Oven (Please specify carrier freq.)	MI-560717
Crystal Oven, less crystal	MI-560717A
FM Generator Module (Please specify carrier frequency)	MI-560712
Stereo Generator Module, Type BTS-1B	MI-560713
SCA Subcarrier Generator Module, Type BTX-1B (Please specify Subcarrier frequency)	MI-560714

*Five in kit; duplicated in Exciter Module Spares Kit (RO-391). Order "RO" kits from RCA Parts and Accessories, Deptford, N. J.

Ordering Information

Educational FM Transmitter, Type BTE,10AT:

Cabineted Model ES-560698

Rack-Mount Model ES-560698A

(Please specify carrier frequency)



1-kW FM Broadcast Transmitters, Types BTF-1E2, BTF-1+1E2, BTF-1/1E2

- All solid-state exciter
- For mono or stereo
—with or without SCA
- Designed for remote control
- Direct FM exciter



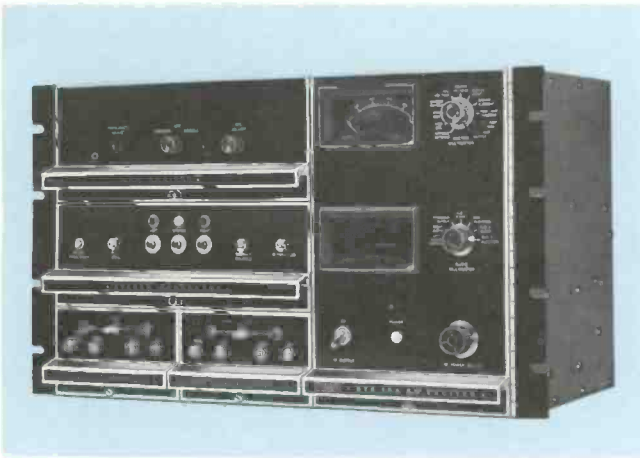
The Type BTF-1E2 is a one-kilowatt FM Broadcast Transmitter for any frequency between 87.5 and 108 MHz. It is designed to provide the finest possible performance and reliability and is specifically built to handle the stringent requirements of multiplex transmission. The transmitter is FCC type accepted and meets all requirements for harmonic and spurious radiation.

The transmitter uses a solid-state exciter that employs the time-tested and field-proven direct-FM system of modulation. This modulation principle gives the transmitter the wide frequency response and extra stability needed for stereo and other multiplex transmission.

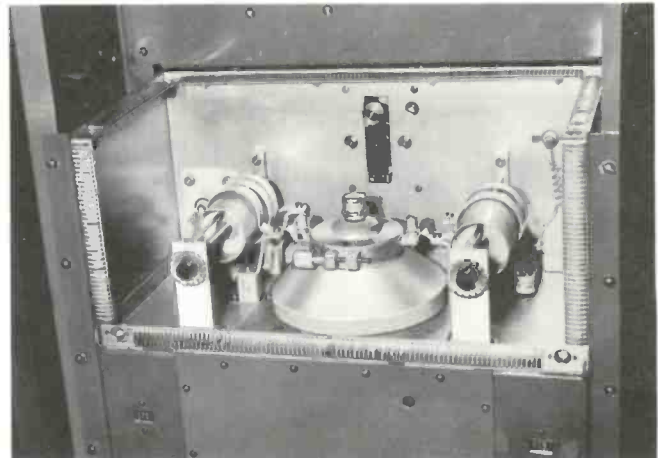
The entire transmitter is housed in a single cabinet which occupies less than four square feet of floor space. All meters and operating controls are conveniently located on a panel near the top of the transmitter. The exciter unit includes a multimeter for monitoring its circuitry.

The Types BTF-1+1E2 and BTF-1/1E2 are expansions of the basic transmitter. The BTF-1+1E2 is a 2-kilowatt transmitter using the combined outputs of two 1-kW power amplifiers identical to the PA of the BTF-1E2. This arrangement results in a 2-kW transmitter with redundant power amplifiers.

The BTF-1/1E2 is a transmitter with two separate, 1-kW outputs for situations where separate antennas are used for vertical and horizontal polarization. The transmitter is essentially two BTF-1E2 units with a common-to-both exciter.



Entirely solid-state exciter system, showing "Direct FM" exciter housed with optional stereo generator and SCA generator units in place at the lower left.



BTF-1E2 power-amplifier cavity with shield covers removed. Note well-spaced layout and component accessibility. The Type 4CX1000 tube is at center.

The Type BTF-1E2 FM Transmitter provides 1000 watts output for stations operating in the 87.5 to 108 MHz band. It is designed to provide the finest possible performance and reliability, and is specifically built to meet the stringent requirements of multiplex and stereo service transmission. It is a simple and compact unit, easy to install.

The BTF-1E2 Transmitter supplies the latest in FM broadcast techniques. Only one tube beyond the exciter is required to supply 1000 watts output. No IPA stage is required. The transmitter is extremely stable because it incorporates RCA's time-proven "Direct FM" Exciter. This exciter has all solid-state components. Cross-talk and noise are kept to an absolute minimum.

Easy to Install and Operate

Other features incorporated in the BTF-1E2 include silicon rectifiers which provide long life with a minimum of maintenance. Accessibility is assured through plug-in, modular design and relatively uncrowded circuit assemblies, and hinged mounting of the exciter. Mechanical and electrical overload protection is provided. To assure performance in accordance with FCC requirements, the transmitter is supplied with harmonic filter. Provisions for remote control have been provided in the transmitter.

Solid-State FM Exciter

Excellent monaural, stereo and SCA performance that more than meets industry and FCC standards are achieved by the new modular, solid-state "Direct FM" exciter.

High quality FM stereo transmission can be obtained by the addition of a Type BTS-1B Stereo Generator. SCA

programming may be transmitted simultaneously with stereo by the use of the optional BTX-1B subcarrier generator. The BTF-1E2 is type accepted for such simultaneous program transmission.

Single Cabinet

The Type BTF-1E2 FM Transmitter is completely housed in one cabinet with total floor dimensions of only 26 by 21 inches. The cabinet is functionally styled to present a pleasing appearance. All meters and operating controls are conveniently located. Front and rear hinged doors give easy access to all portions of the transmitter.

Located at the front are the overload relays and the tuning dials for the power amplifier. A control panel and screen supply are located next, followed by the hinged mounted exciter. Concealed in the bottom of the transmitter are the high voltage rectifier and power transformer. The rear of the transmitter gives access to the bias resistors, metering circuitry and blower, followed by the rear of the control panel and screen supply. A voltage regulating filament transformer is mounted on the control panel.

Simplified Circuits

Modulation of the temperature compensated basic on-frequency oscillator is achieved by applying the composite stereo or SCA signals from the BTS-1B and BTX-1B Generator modules, respectively, to a pair of push-pull variable-capacitance diodes which are coupled to the basic oscillator frequency determining resonant circuit. The output of the basic oscillator is isolated from the following buffer amplifier by a 10 dB resistive attenuator. Thus, the stability and modulation characteristics of the direct-FM oscillator

are not disturbed by following power amplifiers.

The output of the buffer amplifier, approximately 500 mW, is used to drive the 15-watt, three-stage amplifier as well as the binary divider chain in the AFC circuit. The basic oscillator, buffer amplifier, and AFC circuit are mounted inside an enclosure. The power amplifier is also completely shielded.

Automatic frequency control (AFC) for the on-frequency basic oscillator is achieved by taking a sample of the buffer output frequency and dividing it by two, 14 times. A low-frequency reference crystal operating at 1/1024th of the desired output frequency is divided by two, 4 times. Integrated circuits operating in the saturated mode are used in both binary dividing chains. The outputs from the reference and basic oscillator binary dividers are phase compared in a time-sharing IC comparator. The output of the circuit, which represents the AFC error voltage, is filtered and applied to another pair of variable-capacitance diodes coupled to the basic oscillator tuned circuit. Thus, the basic oscillator is phase locked to the 1024th harmonic of the oven controlled reference crystal.

An off-frequency detector is incorporated in the design of the BTE-15A FM Exciter. When the basic oscillator frequency is not phase locked to the reference crystal, an AC component appears at the AFC output. This voltage operates a relay whose contacts can be used to turn off the FM transmitter.

Two multimeters are located on the hinged door of the exciter in front of the regulated power supply section. One of these meters is used to indicate power supply and operating voltages within the

exciter and 15-watt RF Amplifier. The second meter is a peak-reading voltmeter that is used to indicate all modulating signal levels.

The RF power output of the BTE-15A can be continuously adjusted from the front panel control from 7 to 15 watts. The primary power is turned on with a circuit breaker. RF output is turned on with a front panel switch or through a 208/240-volt relay operated from the transmitter filament supply. The exciter will tolerate load mismatches from short circuit to open circuit for a reasonable time without damaging the output transistor. Another important feature prevents automatic operation of the 41 kHz SCA subcarrier when the BTS-1B Stereo Generator is in stereo mode.

Power Amplifier

The output of the exciter is fed to the input of the ceramic 4CX-1000A amplifier tube. The amplifier input circuit is a simple parallel resonant circuit, tuned by a variable inductance with resistance swamping for stability of operation. This stage is neutralized by varying inductance in series with the screen. The output circuit is a modified π network using variable inductors for plate tuning and loading. All capacitors in the final stage are of the fixed ceramic type. A blower mounted on the back of the RF compartment provides sufficient filtered air for cooling at stations operating below 7500 feet altitude. The filament transformer is of the automatic regulator type and keeps filament voltage constant within one percent.

The power amplifier is new in many respects. The variable inductors use no sliding contacts. There are no variable

capacitors in the power amplifier. A single tube, the 4CX1000A, is used in the BTF-1E2 power amplifier and it is driven directly by the output of the exciter.

Neutralizing Probe

A neutralizing probe is furnished with the transmitter. It utilizes the multimeter to indicate correct neutralization of the power amplifier.

The high voltage and screen power supplies make use of silicon rectifiers in a bridge circuit. This combined with choke input and adequate filtering results in a well-regulated power source. A variable transformer is used in the primary of the screen power supply to control power output of the transmitter. Filament voltage regulation is provided for the 4CX1000A power amplifier tube.

Harmonic Filter

The harmonic filter supplied with all RCA FM transmitters is more than a simple harmonic trap. The filter consists of two M -derived half- T sections and three constant- K , half- T sections. The M -derived sections at the input and output provide rapid cut-off in the second harmonic region, and a termination impedance at each end of the filter of 50 ohms. The use of such a filter assures compliance with FCC requirements regarding spurious and harmonic radiation.

Protective Circuits

Power circuits are protected by magnetically tripped circuit breakers as well as overload relays. An interlock relay prevents application of plate power until the filament has heated. Overload relays are used in the plate and screen

power supplies. There is also an interlock in the air-blower circuit. If the blower should fail or airflow be reduced below the proper level, the transmitter is shut down to avoid possible damage.

The overload relays are reset remotely or by means of a pushbutton switch on the front panel. An overload indicator lamp signals when an overload has taken place. All relays are easily accessible. Access to high voltage areas is protected by built-in high voltage shorting devices.

Control Features

The exciter includes a self-contained multimeter. In the amplifier, provision is made for metering plate current, plate voltage, output power and vswr; a probe is furnished for neutralizing the transmitter and is used in connection with the multimeter. All tuning controls are located on the front panel for easy accessibility. They include key switches for filament on-off, plate on-off, and overload reset. The variable power control is also mounted on the front as are the overload indicator and plate power-on lights. The use of latching relays make it possible to control the transmitter with one button.

Remote Control Provisions

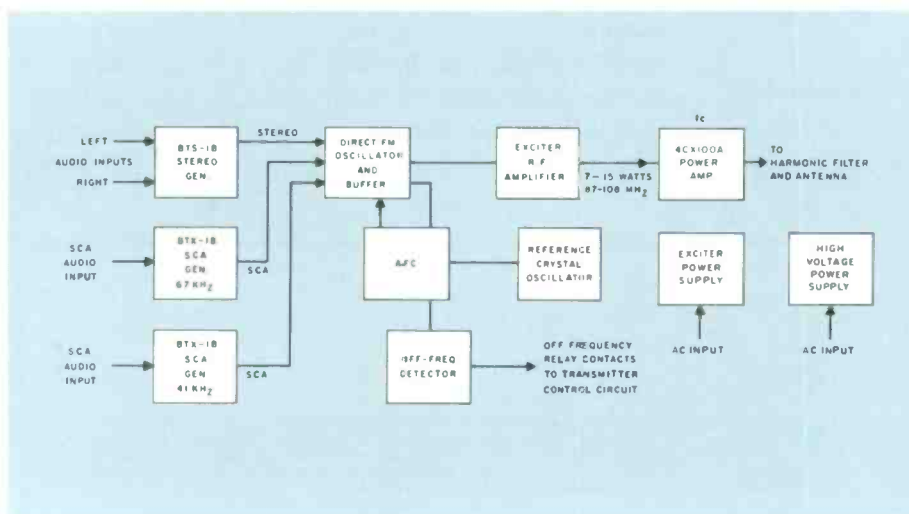
The BTF-1E2 transmitter incorporates connections for remote control and remote meter reading when combined with a remote control system such as the Types BTR-15 or BTR-30. Terminals for transmitter on-off, plate on-off, overload reset, plate voltage, cathode current, and power output are provided. To control transmitter power output remotely, an accessory motor drive may be connected to the screen supply control.

Dual-Amplifier Units

The BTF-1E2 is available also as a 2-kW dual-power-amplifier transmitter in two versions: a "BTF-1-plus-1E2" and a "BTF-1-slash-1E2". The BTF-1+1E2 combines dual identical 1-kW outputs to result in a 2-kW transmitter with redundant power amplifiers. In the BTF-1/1E2, the dual amplifiers are equipped with individual harmonic filters and individual outputs. This configuration is useful in two ways: to power separate circularly-polarized antenna systems for increased on-air dependability or to power separate vertical and horizontal polarization antenna arrays.

The BTF-1+1E2 and BTF-1/1E2 units use separate power supplies for each power amplifier. This redundancy enhances on-air reliability. A redundant exciter is available at extra cost. See BTE-15A exciter catalog pages for ordering information.

Simplified Block Diagram of BTF-1E2 Transmitter, showing optional stereo and SCA subcarrier generators.



Specifications

Power Output (BTF-1E2)	250-1000 watts
Output Impedance (1 5/8" O.D. Unflanged Line)	50 ohms
Frequency Deviation, 100% modulation	±75 kHz
Modulation Capability	±100 kHz
Carrier Frequency Stability	±250 Hz max.
Audio Input Impedance	600/150 ohms
Audio Input Level— ¹ (100% mod.)	+10±2 dBm
Audio Frequency Response— ² (50 Hz-15 kHz)	±1 dB max.
Pre-emphasis Network Time Constant	75 or 50 μs or flat as desired
Harmonic Distortion— ³ (50 Hz-15 kHz)	0.5% or less
FM Noise Level (referred to 100% FM mod.)	-65 dB max.
AM Noise Level (referred to 100% AM mod.)	-50 dB max.
Subcarrier Input Level (100% mod.)	-15 to +10 dBm adjustable
Subcarrier Input Impedance	600/150 ohms bal.
Subcarrier Frequency	20-67 kHz
Main-to-Subchannel Crosstalk	-50 dB referred to ±6 kHz deviation of the subcarrier by a 400 Hz tone. Main channel modulation 70% by 50-15,000 Hz tones.
Sub-to-Main-Channel Crosstalk	-60 dB referred to ±75 kHz deviation of the main carrier by a 400 Hz tone. Subchannel modulated 100% (±6 kHz/s) by 50-5000 Hz tones. Subcarrier modulated 30% on main carrier.
Power Line Requirements:	
Line	240/208 volts, single phase, 60 or 50 Hz ⁴
Slow Voltage Variation	±5%
Power Consumption (BTF-1E2)	2800 watts (approx.)
Power Factor (approx.)	80%
Dimensions	
	H (mm) W (mm) D (mm) Weight (kg)
BTF-1E2	77" (1956) 26" (660) 20 5/8" (524) 790 lbs. (360)
BTF-1+1E2	77" (1956) 56" (1422) 20 5/8" (524) 1630 lbs. (739)
BTF-1/1E2	77" (1956) 48" (1219) 20 5/8" (524) 1580 lbs. (717)
Altitude	7500 ft. max. (2290 m)
Ambient Temperature Range	-20° to +45°C

¹ Level measured at input to pre-emphasis network.
² Audio Frequency response referred to 75 or 50 micro-second pre-emphasis curve.
³ Distortion includes all harmonics up to 30 kHz and is measured following a standard 75 or 50 micro-second de-emphasis network.
⁴ 50-Hz operation requires constant-voltage transformer (MI-34319-2).

Ordering Information

1-kW FM Broadcast Transmitter, Type BTF-1E2	ES-27279C*
2-kW FM Broadcast Transmitter, Type BTF-1+1E2	ES-560647*
2-kW FM Broadcast Transmitter, Type BTF-1/1E2	ES-560646*



The BTF-1+1E2 consists of two transmitter cabinets plus a center section which houses the combiner network. The BTF-1/1E2 uses no center section. See text, preceding page.

Accessories

Remote Power Control	MI-27558
Recommended Spare Transistors for Exciter	MI-560718
Spare Crystal and Oven (Specify carrier frequency)	MI-560717
Spare Power Amplifier Tube	MI-34709
Remote Control System, Type BTR-15	ES-561150/1/2
Remote Control System, Type BTR-30	ES-561446
FM Freq. and Mod. Monitor, Type BW-75	MI-560735
Stereo Monitor, Type BW-85	MI-560740
SCA Monitor, Type BW-95	MI-560745
FM RF Amplifier, Type BW-100	MI-560738
Low-Pass Audio Filter (for SCA)	MI-560721
1-kW RF Load and Wattmeter	MI-19196L/H
Matching Transmission Line (Series)	MI-561565

*Includes one Solid-State Exciter (Type BTE-15A), equipped for main-channel operation only. Stereo and/or SCA subcarrier-generator modules optional. Please specify assigned frequency, power-line frequency, operational altitude (above sea level) and subcarrier-generator modules desired. Modules ordered with transmitter are factory installed.

nuw



FM Broadcast Transmitter, 6kW, Type BTF-3 plus 3ES1

- Parallel transmitter for high reliability
- All solid-state, "Direct-FM" exciter with or without Stereo and SCA
- Designed for unattended operation
- Only two type tubes
- Grounded-grid power amplifier
- Compact and self-contained



The type BTF-3 plus 3ES1 is a six kilowatt Broadcast Transmitter for operation at any frequency from 87.5 to 108 MHz. It is designed to provide the finest performance and reliability and is specially built to handle the demanding requirements of Multiplex Transmission. The combined transmitter is designed to meet all FCC requirements for harmonic and spurious radiation.

The transmitter uses one or two Solid State Exciters, (as ordered) employing time tested and field proven direct-FM system of modulation.

The combined transmitter is housed in three cabinets and occupies less than sixteen square feet of floor space. The combining coaxial cable and coupler can be mounted or suspended above the cabinets to provide easy installation.

This four tube, grounded grid parallel power amplifier configuration comes fully tested to your individual frequency with all remote control and ATS (Automatic Transmitter System) interface circuitry brought to a single location. The self-contained power supplies further simplifies the installation.

With the BTF-3 plus 3ES1 6 kW FM Parallel Transmitter, four mode manual patch or motor driven by-pass output switching can be provided to allow a single BTF-3E1 of the BTF-3 plus 3ES1 to be connected directly to the antenna resulting in reduced power of one-half, instead of one-quarter power. The four modes are: 1) both transmitters parallel into the antenna; 2) both transmitters into dummy load; 3) one transmitter into antenna and second into the dummy load; and 4) reverse of 3). Automatic operation of the motor driven by-pass switching system is an optional accessory to the four mode switching system.

(See switching systems diagrams inside.)

The BTF-3+3ES1 transmitter is actually two complete three kilowatt transmitter units (Type BTF-3ES1) combined to make continuous operation practical at the 6 kW power level. All major components except the combining equipment, are duplicated within the system; dual exciters (if desired), power amplifiers, and power supplies, etc.

Dual Switchable Exciters

The basic configuration of the BTF-3+3ES1 contains only one exciter (BTF-115) which can be expanded to include two exciters and exciter switching, so that a back-up exciter system is always available with the push of a button either locally or by remote control. The single exciter system can be purchased initially and the second exciter and switching system can be bought at a later date if desired.

With the purchase of two exciters the system is so arranged so that one of the two serves the combined transmitter while the other operates as a "hot" stand-by. In the event of trouble in the on-the-air exciter, manual (or automatic optional) switch-over puts the extra exciter on the line.

Grounded Grid Power Amplifier Stages

The exciter system delivers 17 watts of modulated carrier to a hybrid-ring power splitter which, in turn provides two outputs, each to a 8122 IPA Tetrode Tube. This raises the power to the required level to drive the final power amplifier to 3 kW power output. The two 3 kW outputs are then combined to provide a full 6 kW transmitter power out of the combiner coupler. The output configuration uses a grounded grid tube a ceramic triode 3CX3000A7 tube type.

Harmonic Filters/Directional Couplers

The standard harmonic filter supplied with the BTF-3ES1 transmitter is not a simple harmonic trap. The filter consists of two M-derived half-sections in series and three constant-K half-sections configured into a lumped inductive-capacitive network and is installed inside the transmitter cabinet. The M-derived sections at the input and output provide cut-off in the second harmonic region and above and a 50 ohm termination impedance at each end of the filter.

A built-in directional coupler is an integral part of the harmonic filter and provides reliable forward and VSWR power indications that are read on the

transmitter power/reflected front panel meter.

The harmonic filter/directional coupler supplied with the BTF-3+3ES1 are two separate units in a 50 ohm 1½" coax configuration so as to be compatible with the parallel output combining network supplied with the combined transmitter.

Hybrid Combiner Network

Ordinarily mounted above the transmitter, almost directly over the center combining cabinet is the hybrid combiner coupler network, a "three-dB hybrid" coaxial unit. This assembly combines the two 3 kW modulated carriers into one 6 kW output. The reject load for the combiner is mounted within the center combiner equipment cabinet of the transmitter.

When the two 3 kW transmitters are each of equal power out and are properly phased by the line stretcher, the system will easily achieve the full 6 kW to the antenna system. If one transmitter is reduced in power or is completely disabled the power output will be less than 6 kW and can be as low as 1500 watts if one transmitter is completely shut-down. The uniqueness of the parallel transmitter configuration is that program service can be maintained on a reduced power basis even if one of the parallel transmitters is disabled. When one transmitter is disabled the 3dB hybrid coupler splits the power from the remaining active transmitter so that half the power input goes to the antenna and half to the reject load unless an output switching system is employed (see 4 mode switching).

Adjustable Power-Output Control

Power output is controlled by means of a variable resistor which controls the screen voltage supplied to the IPA. Power output is adjustable from zero to a full 3 kW in each 3 kW transmitter unit or 6 kW in the combined transmitter.

Self-Protected Against Overload

Power circuits in each 3 kW transmitter are protected by magnetically tripped circuit breakers in addition to overload relays. An automatic sequencing system prevents turn-on at the plate power until all filaments have heated sufficiently. In addition, a stepping relay automatically cycles power-off three times before locking out in the event of brief overloads and power interruptions. The overloads are reset by pushbuttons on the front panel or by remote control.

All tuning controls are located on the front panels for easy accessibility. The variable power control is also mounted on the front as are the overload indicators, plate power on-off and overload reset buttons.

Remote Control

The BTF-3+3ES1 transmitter incorporates connections for remote control and for ATS (Automatic Transmitter System) and remote meter readings when used with a remote control system. Terminals for transmitter on-off, plate on-off, overload reset, and reading remotely plate voltage, cathode current, and power output are conveniently found inside the transmitter's rear lift off doors on each 3 kW unit.

Output Configurations

The basic BTF-3+3ES1 parallel transmitter comes with either one exciter and no switching system or with two exciters and a switching system, but with no output by-pass switching, as shown in Floor Plan and Coaxial Cable and Combiner Configuration diagrams on the last page of this catalog. Other switching configurations such as manual output patch, and motor driven output by-pass switching are also available. These latter systems are both 4 mode switching systems as described following:

Solid state FM Exciter System, Type BTE-115, with optional BTS-101 Stereo and BTX-101 SCA Generator.



Four Mode Manual Patch

A method of achieving a interim power of 3 kW to the station's antenna during periods when one of the individual BTF-3ES1 transmitters is shut-down for repair or routine maintenance is to by-pass the shut-down transmitter using a manual coax patching system as shown in the diagram in the bottom right side of this page. If Transmitter B for example is shut-down the coaxial "U" bend patch of Switch #2 is changed to make connection between Jacks 1 and 2, and the U bend patch of Switch #3 is changed to make connection between Jacks 1 and 4 with the U bend patch connections between Jacks 3 and 4 removed. Thus, the RF continuity from the Transmitter A to the antenna is complete and Transmitter B is taken off the antenna feed. If Transmitter A is disabled the U bend patch of Switch 1 is connected to Jacks 2 and 3 with Jacks 3 and 4 removed. Transmitter B is then connected to the station antenna.

The manual patch switches are 1 5/8" coaxial in 3 pole and 4 pole configurations and are mounted in the output coax combining network above the transmitter and combining cabinets. All coax, 90° elbows, fittings and couplers are pre-tested and cut to exact lengths so that the network can be efficiently and quickly assembled.

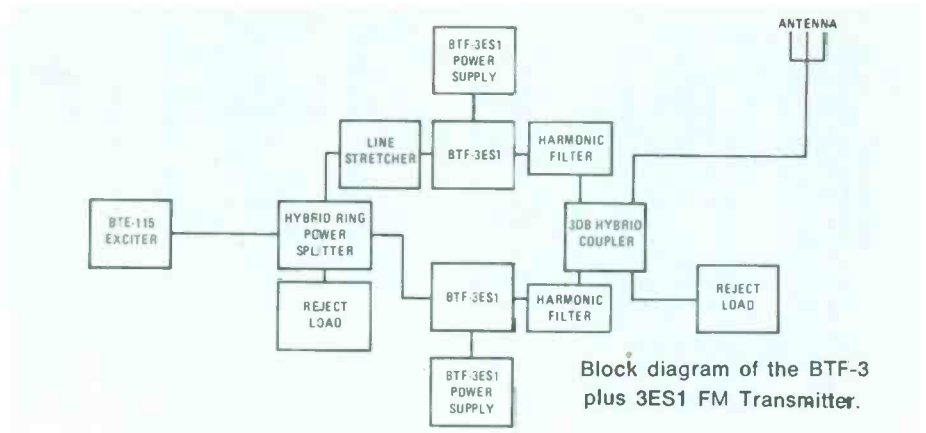
The four mode patching will allow for 1) both transmitters to be fed into the antenna, 2) or into a (optional) dummy load, 3) Transmitter A into antenna and B into dummy load or 4) reverse of 3).

Four Mode Motor Driven Switching

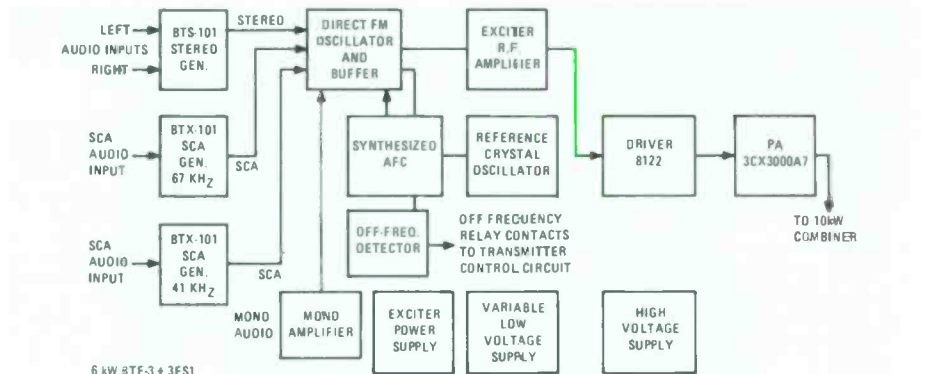
Another method of achieving an interim power of 3kW to the station's antenna and by-passing one complete BTF-3ES1 transmitter unit of the parallel system is to install a 4 mode motor driven coaxial switching system as shown in the diagram above. The motor driven switching system has the advantage over the manual patch system that the output mode can be quickly changed by a single pushbutton action, and can be adapted to automatic logic for complete automatic operation (optional).

The motor driven coaxial switches are 1 5/8" in a Double Pole Double Throw (DPDT) configuration and are mounted in the output coax combining network above the transmitter and combining cabinets. All coax 90° elbows, fittings and couplers are pre-tested and cut to exact lengths to assist in the installation of the system.

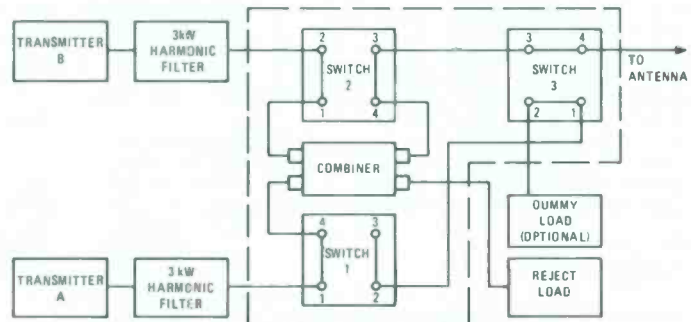
The four modes of the motor driven by-pass switching are: 1) both transmitters



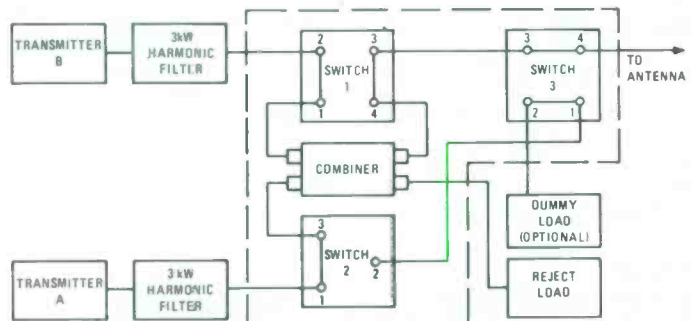
Block diagram of the BTF-3 plus 3ES1 FM Transmitter.



Block diagram of one of the Duplexed 3 kW units of the BTF-3 plus 3ES1 FM Transmitter.



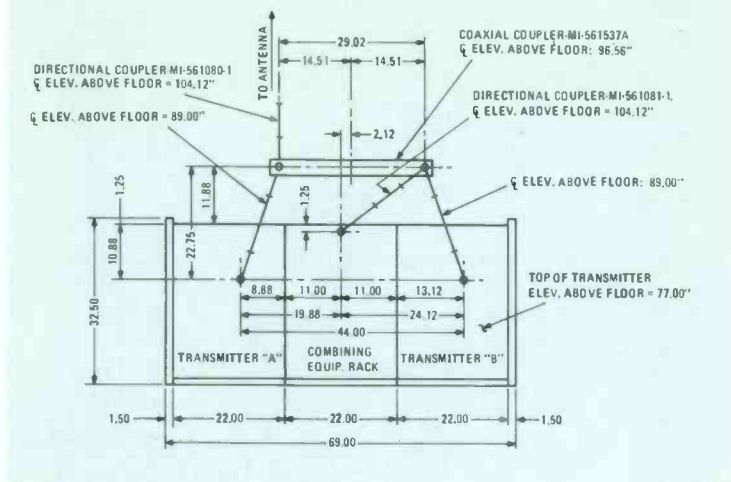
Typical Four Mode Switching System (motor-driven) of the BTF-3 plus 3ES1 Dual Transmitter.



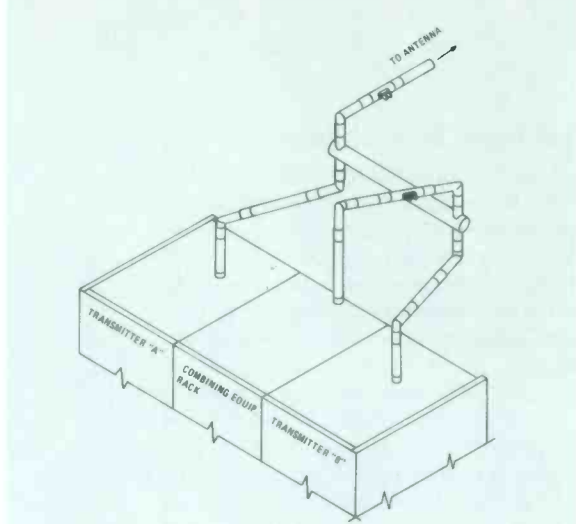
Typical Four Mode Switching System (manual) for the BTF-3 plus 3ES1 Dual Transmitter.

fed into the antenna 2) both transmitters into a dummy load (optional) 3) Transmitter A into the antenna while B is fed

into the dummy load, and 4) Transmitter B into the antenna with A into the dummy load.



Floor plan for BTF-3 plus 3ES1 Transmitter.



BTF-3 plus 3ES1 Transmitter. Coaxial cable and combiner configuration for non-switching output systems.

Specifications

Performance

- Power Output 1000-6000 watts
- Output Impedance (1 1/8" O.D. unflanged) 50 ohms
- Frequency Deviation, 100% modulation ±75 kHz
- Modulation Capability ±100 kHz
- Carrier Frequency Stability ±1000 Hz max.
- Audio Input Impedance 600 ohms
- Audio Input Level (100% mod.) +10 ±2 dBm¹
- Audio Frequency Response (50 Hz-15 kHz) ±1 dB max.²
- Pre-emphasis Network Time Constant 0, 25, 75 or 50 μs³
- Harmonic Distortion (50 Hz-15 kHz) 0.3% max.⁴
- FM Noise Level (referred to 100% FM mod.) -68 dB max.
- AM Noise Level (referred to 100% AM mod.) -50 dB max.⁵
- Subcarrier Input Level (100% mod.) 9 to 30% adjustable
- Subcarrier Input Impedance Resistive 600 ohms bal.
- Subcarrier Frequency 20-95 kHz
- Main-to-Subchannel Crosstalk -50 dB referred to ±6.0 kHz deviation of the subcarrier by a 400 Hz tone. Main channel modulation 70% by a single tone (50 to 15,000 Hz) and 30% by subcarrier.
- Sub-to-Main-Channel Crosstalk -60 dB referred to ±75 kHz deviation of the main carrier by a 400 Hz tone. Subcarrier modulated ±4.0 kHz by a single tone (30 to 5000 Hz), main channel modulated 30% by subcarrier.

Electrical

- Power Requirements:
 - Line 240/208V, 50/60 Hz⁷
 - Combined Voltage Variation and Regulation ±10%
 - Power Consumption (approx.) 12,000W
 - Power Factor (approx.) 90%

Mechanical

- Dimensions (overall) 69"W, 77"H, 22 1/2"D (1753, 1956, 826 mm)
- Weight 2100 lbs. (953 kg)
- Finish Textured vinyl in charcoal gray and shadow blue, satin aluminum trim
- Altitude:
 - 60 Hz 7500 ft. max. (2290 m)⁵
 - 50 Hz 5000 ft. max. (1520 m)⁵
- Ambient Temperature Range -20° to +45°C

Accessories

- Remote Power Output Control MI-561023
- Directional Coupler (for Exciter output) MI-561026
- Spare Crystal and Oven (Specify operating frequency) MI-561066
- Service Slider Rails for Exciter MI-561073
- Spare Transmitter Tubes ES-560920
- RF Load and Wattmeter⁸ MI-561029

- Elapse Time Meter for 115V/60 Hz MI-561018-2
- Elapse Time Meter for 115V/50 Hz MI-561018-4
- Automatic Power Output Control Panel MI-561353
- Directional Coupler, 5 kW, 1 1/8", 50 ohm, for use with Automatic Power Control MI-561080-9
- for use with Automatic Power Control MI-561080-5
- Exciter Switching System MI-561090
- Automatic Operation of Motor Driven By-Pass Switching System MI-561085
- Low Power/VSWR Protection Module MI-561086
- Automatic Operation of Exciter Switching System MI-561089
- Type BW-75A FM Frequency and Modulation Monitor (Specify Frequency) MI-560735⁶
- Type BW-100B RF Amplifier (Specify Frequency) MI-560738⁶
- Type BW-85A FM Stereo Frequency and Modulation Monitor MI-560740⁶
- Type BW-95A SCA Frequency and Modulation Monitor (Specify Frequency) MI-569745⁶

¹Level measured at input to pre-emphasis network.
²Frequency response referred to 75- or 50-microsecond pre-emphasis curve.
³Other time constants available on request.
⁴Distortion includes all harmonics up to 30 kHz and is measured following a standard 75- or 50-microsecond de-emphasis network.
⁵Modifications available for higher altitudes.
⁶Specify operating frequency.
⁷Ordinarily three-phase power. Unit for single-phase power available. See "Ordering Information" below.
⁸Catalog RA.7711B.

Ordering Information

- Parallel 6 kW FM Transmitter (three phase) Type BTF-3+3ES1 with one Exciter (BTE-115), Combining and Dividing Equipment ES-563016A
- Parallel 6 kW FM Transmitter (single phase) Type BTF-3+3ES1 with one Exciter (BTE-115), Combining and Dividing Equipment ES-563018A
- Parallel 6 kW FM Transmitter (three phase) Type BTF-3+3ES1 with two Exciters, Exciter Switching, Combining and Dividing Equipment. No output switching ES-563016B
- Parallel 6 kW FM Transmitter (single phase) Type BTF-3+3ES1 with two Exciters, Exciter Switching, Combining and Dividing Equipment. No output switching ES-563018B
- Parallel 6 kW FM Transmitter (three phase) Type BTF-3ES1 with two Exciters, Exciter Switching, Combining and Dividing Equipment and manual or motor driven power output switching ... ES-563016D/E
- Parallel 6 kW FM Transmitter (single phase) Type BTF-3+3ES1 with two Exciters, Exciter Switching, Combining and Ewitching Equipment and manual or motor driven power output switching and control panel ES-563018D/E

Specifications subject to change without notice.

FM Broadcast Transmitters, 10kW, Type BTF-5 Plus 5ES2

- Parallel Transmitter for high reliability
- All solid-state, "Direct-FM" exciter with or without Stereo and SCA
- Designed for unattended operation
- Only two type tubes
- Grounded-grid power amplifier
- Compact and self-contained



The type BTF-5 plus 5ES2 is a ten kilowatt Broadcast transmitter for operation at any frequency from 87.5 to 108 MHz. It is designed to provide the finest performance and reliability and is specially built to handle the demanding requirements of multiplex transmission. The combined transmitter is designed to meet all FCC requirements for harmonic and spurious radiation.

The transmitter uses one or two solid state exciters (as ordered), employing time tested and field proven direct FM system of modulation.

The combined transmitter is housed in three cabinets and occupies less than sixteen square feet of floor space. The combining coaxial cable and coupler can be mounted or suspended above the cabinets to provide easy installation.

This four tube grounded grid parallel Power Amplifier configuration comes fully tested to your individual frequency with all remote controls and ATS (Automatic Transmitter System) interface circuitry brought to a single location. The self-contained power supplies further simplifies the installation.

With the BTF-5 plus 5ES2 10 kW FM Parallel Transmitter four mode manual patch or motor driven by-pass output switching can be provided to allow a single BTF-5E2 of the BTF-5 plus 5ES2 to be connected directly to the antenna resulting in reduced power of one-half, instead of one-quarter power. The four modes are: 1) both transmitters parallel into the antenna; 2) both transmitters into dummy load; 3) one transmitter into antenna and second into the dummy load; and 4) reverse of 3). Automatic operation of the motor driven by-pass switching system is an optional accessory to the four mode switching system.

(See switching systems diagrams inside.)

The BTF-5+5ES2 transmitter is actually two complete five kilowatt transmitter units (Type BTF-5ES2) combined to make continuous operation practical at the 10 kW power level. All major components except the combining equipment, are duplicated within the system; dual exciters (if desired), power amplifiers, and power supplies etc.

Dual Switchable Exciters

The basic configuration of the BTF-5+5ES2 contains only one exciter (BTE-115) which can be expanded to include two exciters and exciter switching, so that a back-up exciter system is always available with the push of a button either locally or by remote control. The single exciter system can be purchased initially and the second exciter and switching system can be bought at a later date if desired.

With the purchase of two exciters the system is so arranged so that one of the two serves the combined transmitter while the other operates as a "hot" stand-by. In the event of trouble in the on-the-air exciter, manual (or automatic optional) switch-over puts the extra exciter on the line.

Grounded Grid Power Amplifier Stages

The exciter system delivers 17 watts of modulated carrier to a hybrid-ring power splitter which, in turn provides two outputs, each to a 8122 IPA tetrode tube. This raises the power to the required level to drive the the final power amplifier to 5 kW power output. The two 5 kW outputs are then combined to provide a full 10 kW out of the combiner coupler. The output configuration uses a grounded grid using a ceramic triode, 3CX3000A7 tube type.

Harmonic Filters and Directional Couplers

The harmonic filter supplied with the BTF-5 plus 5ES2 transmitter is not a simple harmonic trap. The filter consists of two M-derived half-sections in series and these constant-K half-sections configured in a 50 ohm 1 $\frac{5}{8}$ " coax cable in line harmonic filter. The M-derived sections at the input and output provide cut-off in the second harmonic region and above. This filter consists of a series of transmission line elements and several shunt stubs tuned to the offending harmonic. Directional coupler is also a coax cable component to provide reliable forward and VSWR power indications that are read on the transmitter power/reflect-

The harmonic filter and directional coupler supplied with the BTF-5ES2 are two separate units in a 50 ohm 1 $\frac{5}{8}$ " coax line configuration so as to be compatible with the output combining network supplied with the combined transmitter.

Hybrid Combiner Network

Ordinarily mounted above the transmitter, almost directly over the center combining cabinet is the hybrid combiner coupler network, a "three-dB hybrid" coaxial unit. This assembly combines the two 5 kW modulated carriers into one 10 kW output. The reject load for the combiner is mounted within the center combiner equipment cabinet of the transmitter.

When the two 5 kW transmitters are each of equal power out and are properly phased by the line stretcher, the system will easily achieve the full 10 kW to the antenna system. If one transmitter is reduced in power or is completely disabled the power output will be less than 10 kW and can be as low as 2500 watts if one transmitter is completely shut down. The uniqueness of the parallel transmitter configuration is that program service can be maintained on a reduced power basis even if one of the parallel transmitters is disabled. When one transmitter is disabled the 3 dB hybrid coupler splits the power from the remaining active transmitter so that half the power input goes to the antenna and half to the reject load unless an output switching system is employed (see 4 mode switching).

Adjustable Power-Output Control

Power output is controlled by means manual coax patching system as shown of a variable resistor which controls the screen voltage supplied to the IPA. Power output is adjustable from zero to a full 5 kW in each 5 kW transmitter unit or 10 kW in the combined transmitter.

Self-Protected Against Overload

Power circuits in each 5 kW transmitter are protected by magnetically tripped circuit breakers in addition to overload relays. An automatic sequencing system prevents turn-on of the plate power until all filaments have heated sufficiently. In addition, a stepping relay automatically cycles power-off three times before locking out in the event of brief overloads and power interruptions. The overloads are reset by pushbuttons on the front panel or by remote control.

All tuning controls are located on the front panels for easy accessibility. The variable power control is also mounted on the front as are the overload indicators, plate power on-off and overload reset buttons.

Remote Control

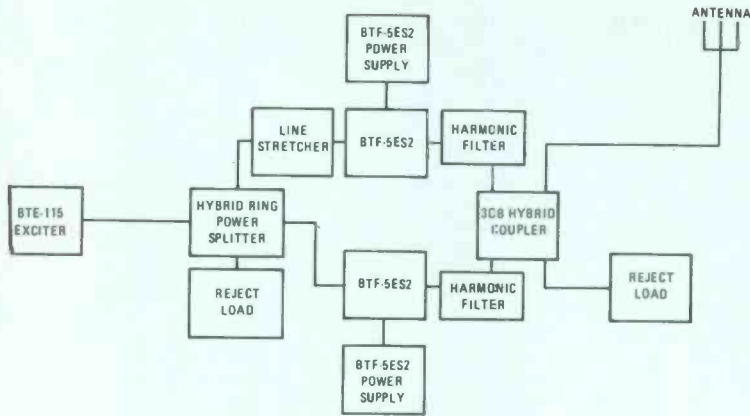
The BTF-5+5ES2 transmitter incorporates connections for remote control and for ATS (Automatic Transmitter System) and remote reading when used with a remote control system. Terminals for transmitter on-off, plate on-off, overload reset, and reading remotely plate voltage, cathode current, and power output are conveniently found inside the transmitter rear lift off doors on each 5 kW unit.

Output Configurations

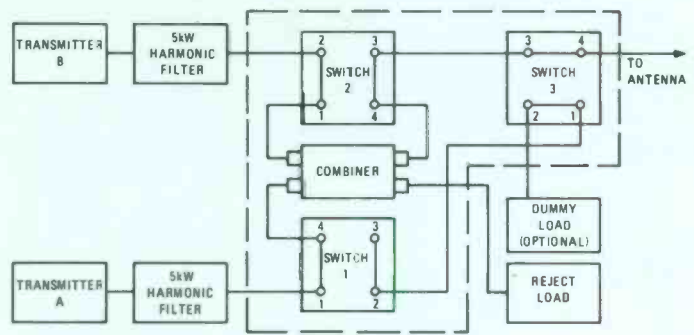
The basic BTF-5+5ES2 parallel transmitter comes with either one and no exciter switching system or with two exciters and a exciter switching system, but with no output by-pass switching, as shown in Floor Plan and Coaxial Cable and Combining Configuration Diagrams on the last page of this catalog. Other switching configuration such as manual output patch, and motor driven output by-pass switching are also available. These latter systems are both 4 mode switching systems as described following:

BTE-115 FM Exciter System with BTS-101 Stereo and BTX-101 SCA Generator.

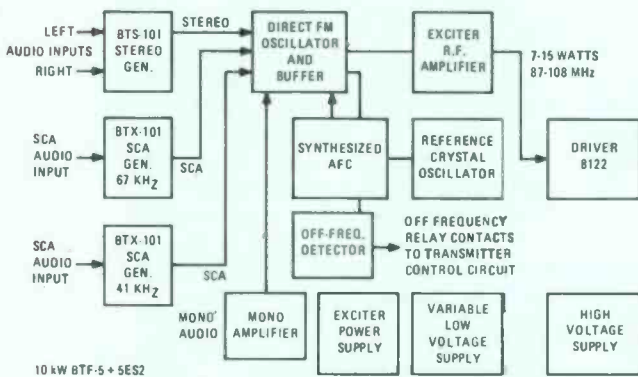




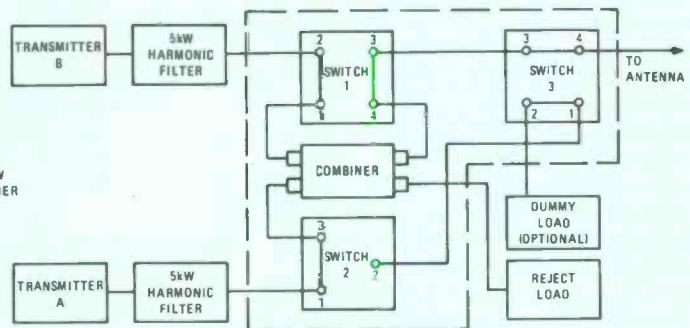
Block diagram of the BTF-5 plus 5ES2 FM Transmitter.



Typical Four Mode Switching System (motor-driven) of the BTF-5 plus 5ES2 Dual Transmitter.



Block diagram of one of the Duplexed 5 kW units of the BTF-5 plus 5ES2 FM Transmitter.



Typical Four Mode Switching System (manual) for the BTF-5 plus 5ES2 Dual Transmitter.

Four Mode Manual Patch

A method of achieving a interim power of 5 kW to the station's antenna during periods when one of the individual BTF-5ES2 transmitters is shut-down for repairs or routine maintenance is to by-pass the shut-down transmitter using a manual coax patching system as shown in the diagram in the middle right side of this page. If Transmitter B for example is shut-down the coaxial "U" bend patch of Switch #2 is changed to make connection between Jacks 1 and 2, and the U bend patch of Switch #3 is changed to make connection between Jacks 1 and 4 with the U bend connections between Jacks 3 and 4 removed. Thus the RF continuity from the Transmitter A to the antenna is complete and Transmitter B is taken off the antenna feed. If transmitter A is disabled the "U" bend patch of Switch 1 is connected to Jacks 2 and 3 with Jacks 3 and 4 removed. Transmitter B is then connected to the station's antenna.

The manual patch switchers are 1 5/8" coaxial in 3 pole and 4 pole configurations and are mounted in the output coax combining network above the transmitter and combining cabinets. All coax, 90° elbows, fittings and couplers are pre-tested and cut to exact lengths so that the installation can be efficiently and quickly assembled.

The four mode patching will allow for 1) both transmitters to be fed into the antenna, 2) or into a (optional) dummy load 3) Transmitter A into antenna and B into dummy load or 4) reverse of 3).

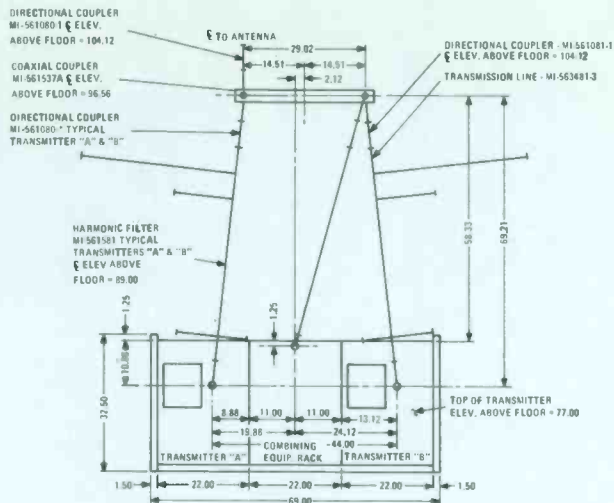
Four Mode Motor Driven Switching

A method of achieving an interim power of 5 kW to the station's antenna and by-passing one complete BTF-5ES2 transmitter unit of the parallel system is to install a 4 mode motor driven coaxial switching system as shown in the diagram above. The motor driven switching system has the advantage over the manual

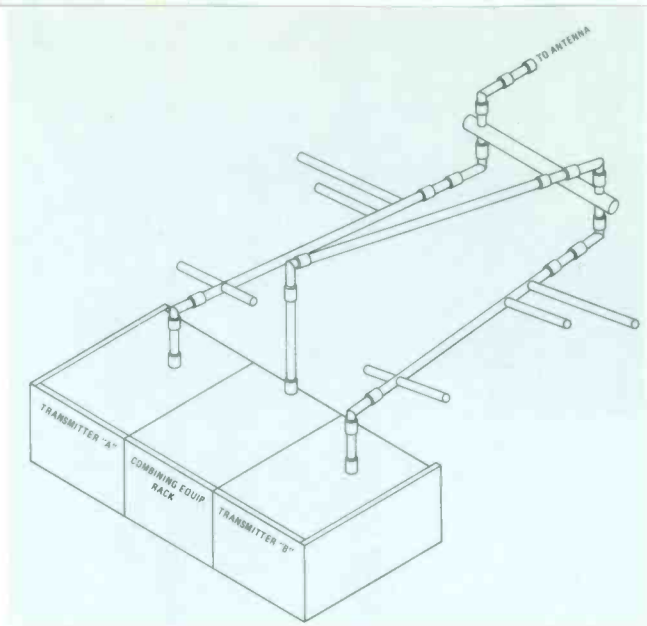
patch system that the output mode can be quickly changed by a single pushbutton action, and can be adapted to automatic logic for complete automatic operation (optional).

The motor driven coaxial switchers are 1 5/8" in a Double Pole Double Throw (DPDT) configuration and are mounted in the output coax combining network above the transmitter and combining cabinets. All coax 90° elbows, fittings and couplers are pretested and cut to exact lengths to assist in the installation of the system.

The four modes of the motor driven by-pass switching system are; 1) both fed into the antenna 2) both transmitters into a dummy load (optional) 3) Transmitter A into the antenna while B is fed into the dummy load, and 4) Transmitter B into the antenna with A into the dummy load.



Floor plan for BTF-5 plus 5ES2 Transmitter.



BTF-5 plus 5ES2 Transmitter. Coaxial cable and combiner configuration for non-switching output systems.

Specifications

Performance

Power Output	1000-10,000 watts
Output Impedance (1 1/2" O.D. unflanged)	50 ohms
Frequency Deviation, 100% modulation	±75 kHz
Modulation Capability	±100 kHz
Carrier Frequency Stability	±1000 Hz max.
Audio Input Impedance	600 ohms
Audio Input Level (100% mod.)	+10 ±2 dBm ¹
Audio Frequency Response (50 Hz-15 kHz)	±1 dB max. ²
Pre-emphasis Network Time Constant	0, 25, 75 or 50 μs ³
Harmonic Distortion (50 Hz-15 kHz)	0.3% max. ⁴
FM Noise Level (referred to 100% FM mod.)	-68 dB max.
AM Noise Level (referred to 100% AM mod.)	-50 dB max. ⁵
Subcarrier Input Level (100% mod.)	9 to 30% adjustable
Subcarrier Input Impedance	Resistive 600 ohms bal.
Subcarrier Frequency	20-95 kHz
Main-to-Subchannel Crosstalk	-50 dB referred to ±6.0 kHz deviation of the subcarrier by a 400 Hz tone.
	Main channel modulation 70% by a single tone (50 to 15,000 Hz) and 30% by subcarrier.
Sub-to-Main-Channel Crosstalk	-60 dB referred to ±75 kHz deviation of the main carrier by a 400 Hz tone.
	Subcarrier modulated ±4.0 kHz by a single tone (30 to 5000 Hz), main channel modulated 30% by subcarrier.

Electrical

Power Requirements:	
Line	240/108V, 50/60 Hz
Combined Voltage Variation and Regulation	±10%
Power Consumption (approx.)	18,000W
Power Factor (approx.)	90%

Mechanical

Dimensions (overall)	69"W, 77"H, 32 1/2"D (1753, 1956, 826 mm)
Weight	2700 lbs. (1225 kg)
Finish	Textured vinyl in charcoal gray and shadow blue, satin aluminum trim
Altitude:	
60 Hz	6000 ft. max. (1829 m) ⁵
50 Hz	4000 ft. max. (1219 m) ⁵
Ambient Temperature Range	-20° to +45°C

Specifications subject to change without notice.

Accessories

Remote Power Output Control	MI-561023
Directional Coupler (for Exciter output)	MI-561026

Spare Crystal and Oven (Specify operating frequency)	MI-561066
Service Slider Rails for Exciter	MI-561073
Spare Transmitter Tubes	ES-560920
RF Load and Wattmeter ⁷	MI-561029
Elapse Time Meter for 115V/60 Hz	MI-561018-2
Elapse Time Meter for 115V/50 Hz	MI-561018-4
Automatic Power Output Control Panel	MI-561353
Directional Coupler, 5 kW, 1 1/2", 50 ohm, Exciter Switching System	MI-561090
Automatic Operation of Motor Driven By-Pass Switching System	MI-561085
Low Power/VSWR Protection Module	MI-561086
Automatic Operation of Exciter Switching System	MI-561089
Type BW-75A FM Frequency and Modulation Monitor (Specify Frequency)	MI-560735 ⁶
Type BW-100B RF Amplifier (Specify Frequency)	MI-560738 ⁶
Type BW-85A FM Stereo Frequency and Modulation Monitor	MI-560740 ⁶
Type BW-95A SCA Frequency and Modulation Monitor (Specify Frequency)	MI-569745 ⁶

¹Level measured at input to pre-emphasis network.
²Frequency response referred to 75- or 60-microsecond pre-emphasis curve.
³Other time constants available on request.
⁴Distortion includes all harmonics up to 30 kHz and is measured following a standard 75- or 50-microsecond de-emphasis network.
⁵Modifications available for higher altitudes.
⁶Specify operating frequency.
⁷Catalog RA.7711B.

Ordering Information

Parallel, 10 kW FM Transmitter Type BTF-5+5ES2 with one Exciter, No Output Switching	ES-563020*
Parallel, 10 kW FM Transmitter Type BTF-5+5ES2 with two Exciters, Exciter Switching, No Output Switching	ES-563020**
Parallel, 10 kW FM Transmitter Type BTF-5+5ES2 with two Exciters, Exciter Switching and manual or motor driven output switching	ES-563020***

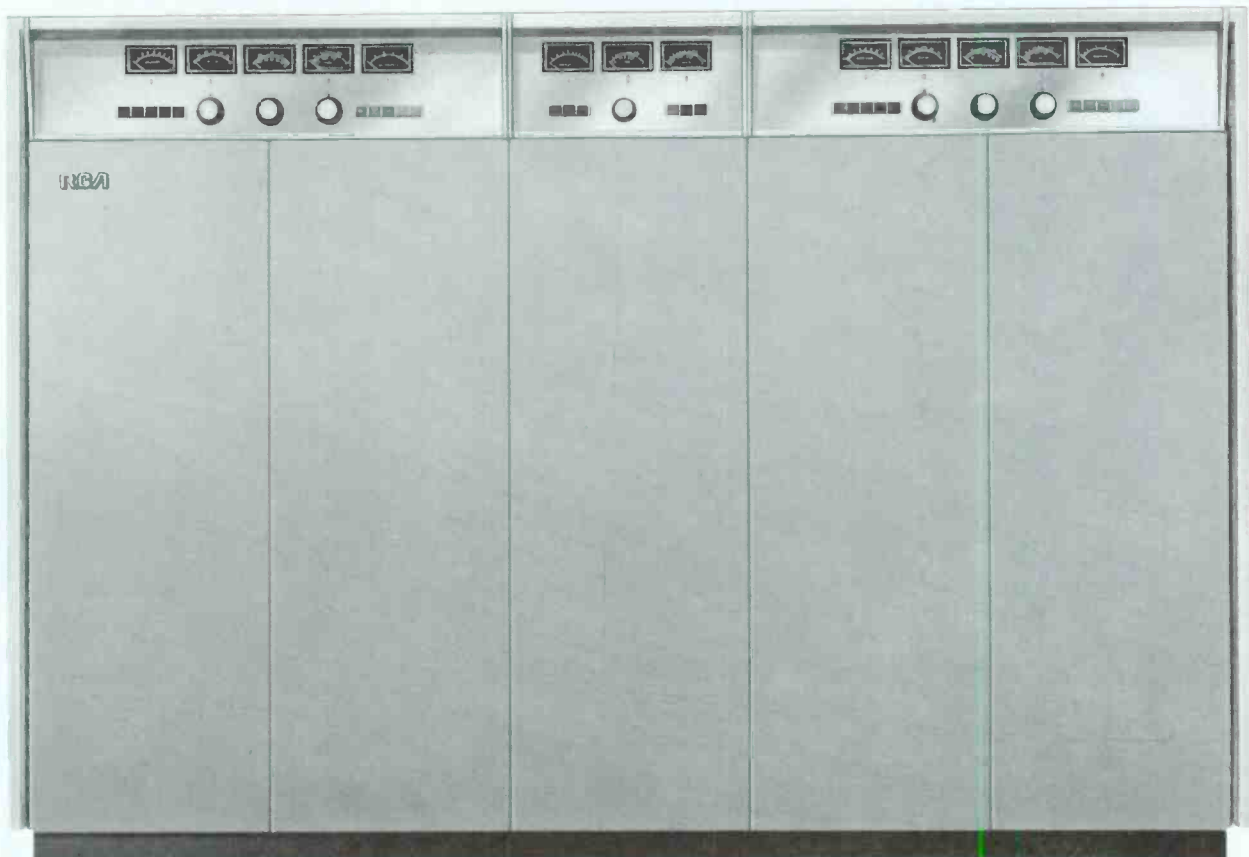
*Includes one Solid State Exciter (Type BTE-115) equipped for main-channel operation; stereo and SCA subcarrier generators as ordered. Also includes power dividing and combining equipment. No output switching.
**Includes two Solid State Exciter (Type BTE-115) equipped for main channel operation and/or stereo and SCA as ordered. Also includes exciter switching, power dividing and combining equipment. No output switching.
***Includes two exciter systems equipped for main channel and stereo/SCA as ordered, power dividing and combining equipment, manual or motor driven by-pass switching network, two coax type harmonic filters and switching control panel.

FM Transmitter, 10kW, Type BTF-5 Plus 5ES1

- Parallel Transmitters for High Reliability
- Designed for unattended operation
- Expandable to 40 kW power level
- Direct-FM for full-fidelity mono or stereo with or without SCA
- Only two tube types in entire transmitter

The Type BTF-5 plus 5ES1 is a ten-kilowatt transmitter for the FM-broadcast station where continuous operation is important. The transmitter combines two identical five-kilowatt transmitters (BTF-5ES1) to form a redundant ten-kilowatt system. The dual design allows major maintenance without interruption of air-time.

The BTF-5 plus 5ES1 is a single-output transmitter. Four mode manual patch or motor driven by-pass output switching can be provided to allow either BTF-5ES1 to be connected directly to the antenna.



The BTF-5 plus 5ES1 transmitter is actually two complete five-kilowatt units, (Type BTF-5ES1) combined to make continuous operation practical. All major components—except the combining equipment—are duplicated within the system: twin finals, twin power supplies, etc. (see functional diagrams, on opposite page).

The BTF-5 plus 5ES1 is intended for operation into a single transmission line and antenna system.

Dual, Switchable Exciters

The BTF-5 plus 5ES1 includes two solid-state exciter systems arranged so that one of the two serves the transmitter while the other operates as a hot standby. In the event of trouble in the on-air exciter, manual (or Automatic optional) switch-over puts the extra exciter on the line. Lighted indicators on the control panel show the change in status.

The exciter system is the BTE-115 system providing excellent monaural, stereo and SCA performance that more than meets the Industry, FCC regulations and CCIR recommendations as achieved

by the "Direct FM" solid state units. (See Catalog RA.2020A).

Interface to the BTF-5 plus 5ES1 is accomplished through an Exciter/Transmitter interface relay panel to permit deactivating the exciter RF amplifier output when the individual 5kW amplifier is turned off.

Power-Amplifier Stages

The exciter system delivers 17 watts of modulated carrier to a hybrid-ring power splitter which, in turn, provides two outputs, each to a IPA tetrode in each transmitter section. This raises the power level to drive the final power amplifier. The final stage raises the power level to 5 kW. The two 5 kW outputs are combined to 10 kW in a hybrid combiner.

Hybrid Combiner Network

Ordinarily mounted above the transmitter cabinet, almost directly over the center unit, (see floor plan, last page) is the combiner network, a "three-dB hybrid" coaxial unit. This assembly combines the two 5 kW modulated carriers into one 10 kW output. The reject load for the combiner is mounted within the center cabinet of the transmitter.

Coaxial Harmonic Filters

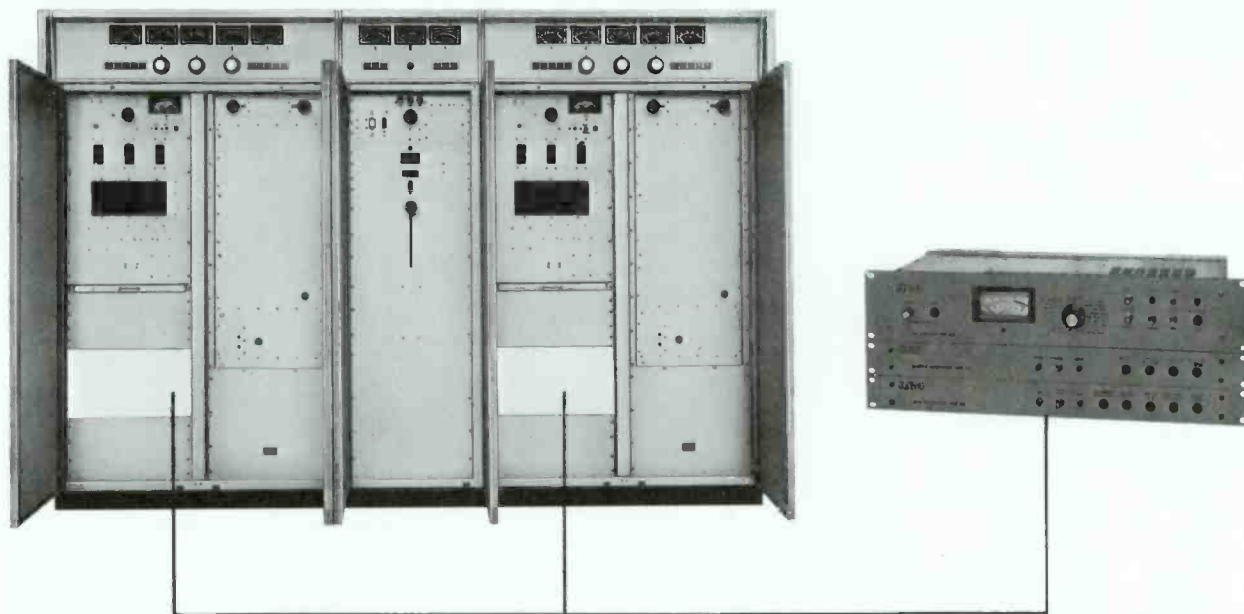
The single harmonic filter is 149" (3784 mm) long at frequencies below 98 MHz and 129" (3277 mm) above 98 MHz, and is a series of transmission-line elements with a uniform $3\frac{1}{8}$ " inch outer-conductor diameter, a stepped inner conductor and a shunt stub. Attenuation of all harmonics is accomplished in a M-derived section and a series of constant-K, T sections. The filter has a broad passband with a sharp high-frequency cutoff and excellent attenuation above cutoff frequency.

An optional filter configuration using two $3\frac{1}{8}$ " 61" (1549 mm) filters is available for a non-switching transmitter and two also will be supplied with either the manual or motor driven four mode switching versions. The optional filter consists of a series of transmission line stubs. Attenuation of harmonics is accomplished by resonating the stub sections to various harmonic frequencies.

Central Transmitter Control

In the center cabinet are the control and metering functions for the combined transmitters. Push-buttons provide control

Ten-Kilowatt FM Transmitter, Type BTF-5 plus 5ES1



of combined unit on/off and plate power on/off. Lighted indicators signal d-c overload and output line VSWR overload. Three meters, at the top edge, display reject power, reflected power and combined power output.

In the area immediately below the meter panel are reflectometer controls and adjustments. Next are the control switches for the exciter systems, a control-ladder circuit-breaker and a meter that displays exciter reject power. Next is the control knob for the adjustment of the "line-stretcher", which adjusts the phase of the input circuits of the twin power-amplifier chains.

Relays in this section switch inputs and output power of the exciter system. The audio connections to the stereo and SCA subchannels are switched automatically when the exciters are switched.

By-Pass Switching Operation

The BTF-5 plus 5ES1 transmitter, by virtue of its two independent transmitter systems, can be arranged so that either five-kilowatt system can be shut down for major (or minor) maintenance while the other feeds the antenna.

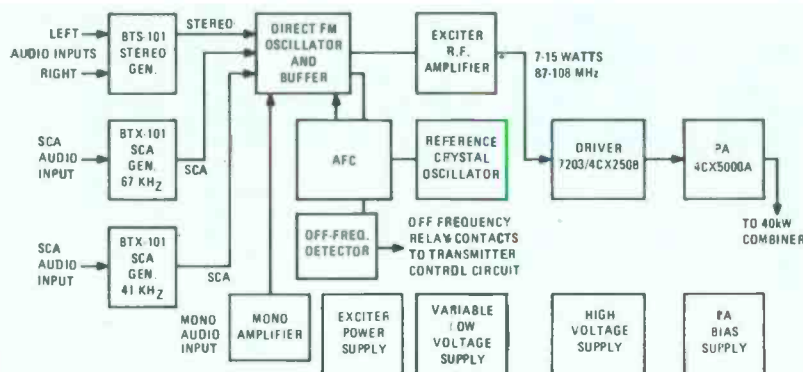
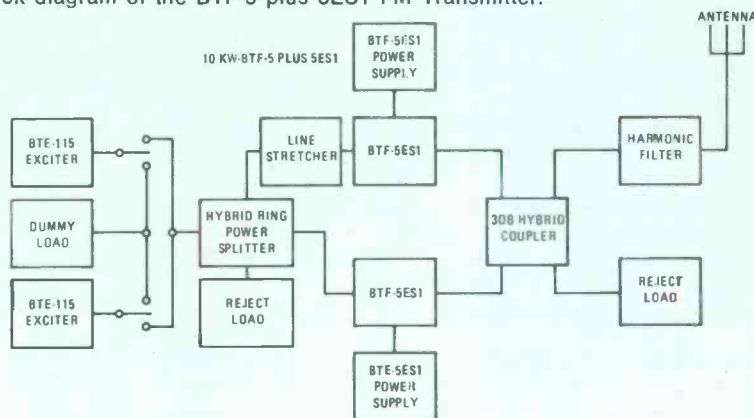
A four mode manual or motor driven by-pass switching system can be provided to allow either one of the parallel transmitters to be connected directly to the station's antenna (see switching systems diagrams). This results in a reduced power of one-half instead of one-quarter power as would be experienced through the combining network.

The four modes are 1) both dual transmitters into antenna; 2) both transmitters into dummy load; 3) one transmitter into antenna and other into dummy load; and 4) reverse of 3). Automatic operation of the motor driven by-pass switching system is an optional accessory to the four mode switching system.

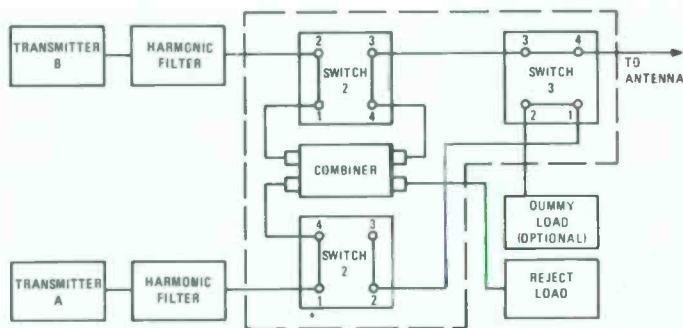
Redundant Power Supplies

The redundancy of the BTF-5 plus 5ES1 system extends even to separate power supplies for each five-kilowatt section. These are units using solid-state rectifiers throughout for reduced maintenance and minimal operating expense. The power supply cabinets need not be located in the same room as the transmitter unit where space is a problem. They might, for example, be located in a basement room or in a shelter external to the transmitter building. More information on the five-kilowatt transmitter will be found in the catalog section on the Type BTF-5ES1. (See Catalog RA. 2041C).

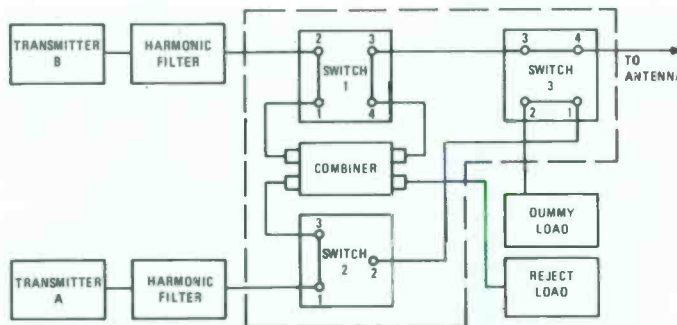
Block diagram of the BTF-5 plus 5ES1 FM Transmitter.



Block diagram of one of the Duplexed 5 kW units of the BTF-5 plus 5ES1 FM Transmitters.



Typical Four Mode Switching System (motor-driven) of the BTF-5 plus 5ES1 Dual Transmitter.



Typical Four Mode Switching System (manual) for the BTF-5 plus 5ES1 Dual Transmitter.

Specifications

Performance

Type of Emission	F3 and F9
Frequency Range	87.5 to 108 MHz
Power Output	5 kW to 10 kW
Output Impedance (6 1/8" O.D. Unflanged Line)	50 Ohms
Frequency Deviation 100% modulation	±75 kHz
Modulation Capability	±100 kHz
Carrier Frequency Stability	±1000 Hz max.
Audio Input Impedance	600 Ohms
Audio Input Level—(100% mod.)	+10 ±2 dB ¹
Audio Frequency Response—(30-15,000 Hz)	+1 dB max. ²
Pre-emphasis Network Time Constant	0, 25, 50 or 75 μs, as desired ³
Harmonic Distortion (50-15,000 Hz)	0.3% or less ⁴
FM Noise Level (referred to 100% FM mod.)	-68 dB max.
AM Noise Level (referred to 100% AM mod.)	-50 dB max. ⁵
Subcarrier Input Level (100% mod.)	9 to 30% adjustable
Subcarrier Input Impedance	Resistive 600 Ohms bal.
Subcarrier Frequency	20-95 kHz
Main-to-Subchannel Crosstalk	-50 dB referred to ±6.0 kHz deviation of the subcarrier by a 400 Hz tone.
Main channel modulation 70% by a single tone (50 to 15000 Hz) and 30% by subcarrier, using narrow band detector.	
Sub-to-Main-Channel Crosstalk	-60 dB referred to ±75 kHz deviation of the main carrier by a 400 Hz tone.
Subcarrier modulated ±4.0 kHz by a single tone (30 to 5000 Hz), main channel modulated 30% by a subcarrier, using narrow band detector.	

Tube Complement

Driver	Two 7203/4CX250B
Power Amplifier	Two 4CX5000A

Electrical

Power Requirements:

Line	240/208 Volt, 3 phase, 50/60 Hz
Combined Line Voltage Variation and Regulation	±10%
Power Consumption (approx.)	20,000 Watts
Power Factor (approx.)	90%

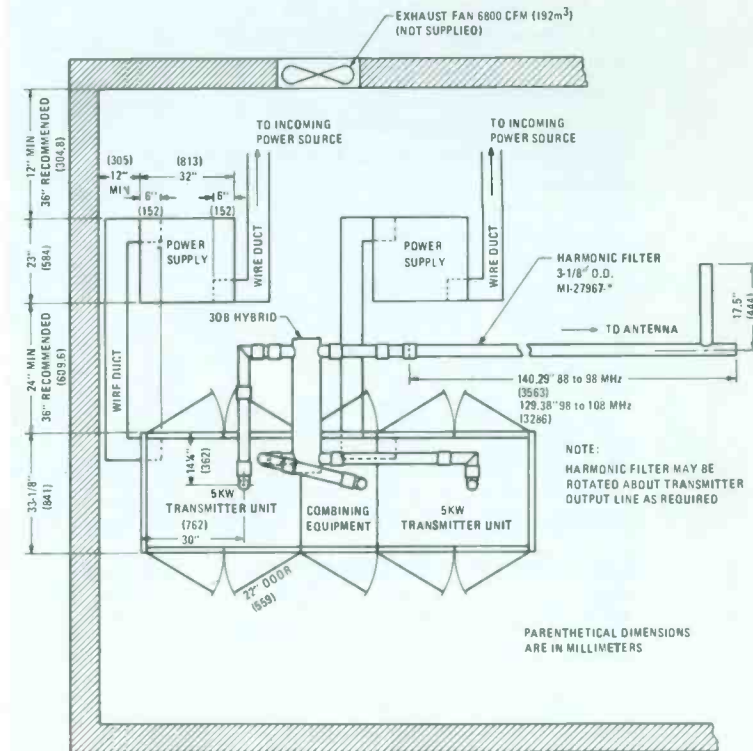
Mechanical

Dimensions (overall): Transmitter	High-Voltage Power Supply
Width	64" (1626 mm)
Height	49" (1245 mm)
Depth	23" (585 mm)
Weight (approx.)	1680 lbs. (762 kg)
Finish	2850 lbs. (1247 kg)
Textured Vinyl in midnight blue and shadow blue, satin-aluminum trim.	
Altitude:	
60 Hz	11,000 ft. (3352.8 m) ⁵
50 Hz	9000 ft. (2743.2 m)
Ambient Temperature Range	
-20° to +45°C	
Specifications subject to change without notice.	

Ordering Information

FM Broadcast Transmitter, Type BTF-5 +5ES1	
With Single Harmonic Filter (40 kW)	ES-560992B
With Dual Harmonic Filters (20 kW)	ES-560992C
As Above, plus Manual Switching System	ES-560992D ¹⁰
As Above, plus Motor Driven Switching System	ES-560992E ¹⁰

Please specify assigned frequency, power line frequency (if other than 60 Hz), ambient temperature and installation altitude if greater than 9000 feet (2743 m) above seal level. Stereo and/or SCA facilities ordered with transmitter are factory installed.



Space-saving floor plan. The separate, unitized power supplies may be installed in a basement, another room or other convenient place. Wire ducts shown are not furnished.

Accessories and Option

Manometer	MI-560307-36
Elapsed-Time Indicator	MI-561018-27
AM Noise Reduction Kit	MI-560307-31 ⁹
Freq. and Mod. Monitor, Type BW-75	MI-560735 ⁸
Stereo Freq. and Mod. Monitor, Type BW-85	MI-560740 ⁸
SCA Freq. and Mod. Monitor, Type BW-95	MI-560745 ⁸
RF Amplifier, Type BW-100 (for off-air mon.)	MI-560738 ⁸
Crystal and Oven Spare Kit (for Exciter)	MI-561066
Electron Tube Spares, Complete Set	ES-560613
Automatic Power Output Control Panel	MI-561343
Directional Coupler, 3/8", 50-ohm, 20 kW (for use with Automatic Power Control, use one for each parallel transmitter)	MI-561043-12
RF Load and Wattmeter (10 kW)	CB ⁹
Automatic Operation of Motor Driven By-Pass Switching System	MI-561085
Automatic Operation of Exciter Switching System	MI-561089

¹Level measured at input to pre-emphasis network, referred to 400 Hz.

²Frequency response referred to 50- or 75-microsecond pre-emphasis curve.

³Other time constants available on request.

⁴Distortion includes all harmonics up to 30 kHz and is measured following a standard 50- or 75-microsecond de-emphasis network.

⁵Larger blowers available for operation at higher altitudes.

⁶AM Noise reduction kit required when operating at half power.

⁷For 117V/60 Hz power only; use MI-561018-4 for 117V/50 Hz.

⁸Specify operating frequency.

⁹Catalog RA.7711B.

¹⁰Includes 3/8 inch coaxial switches (either manual or motor driven).

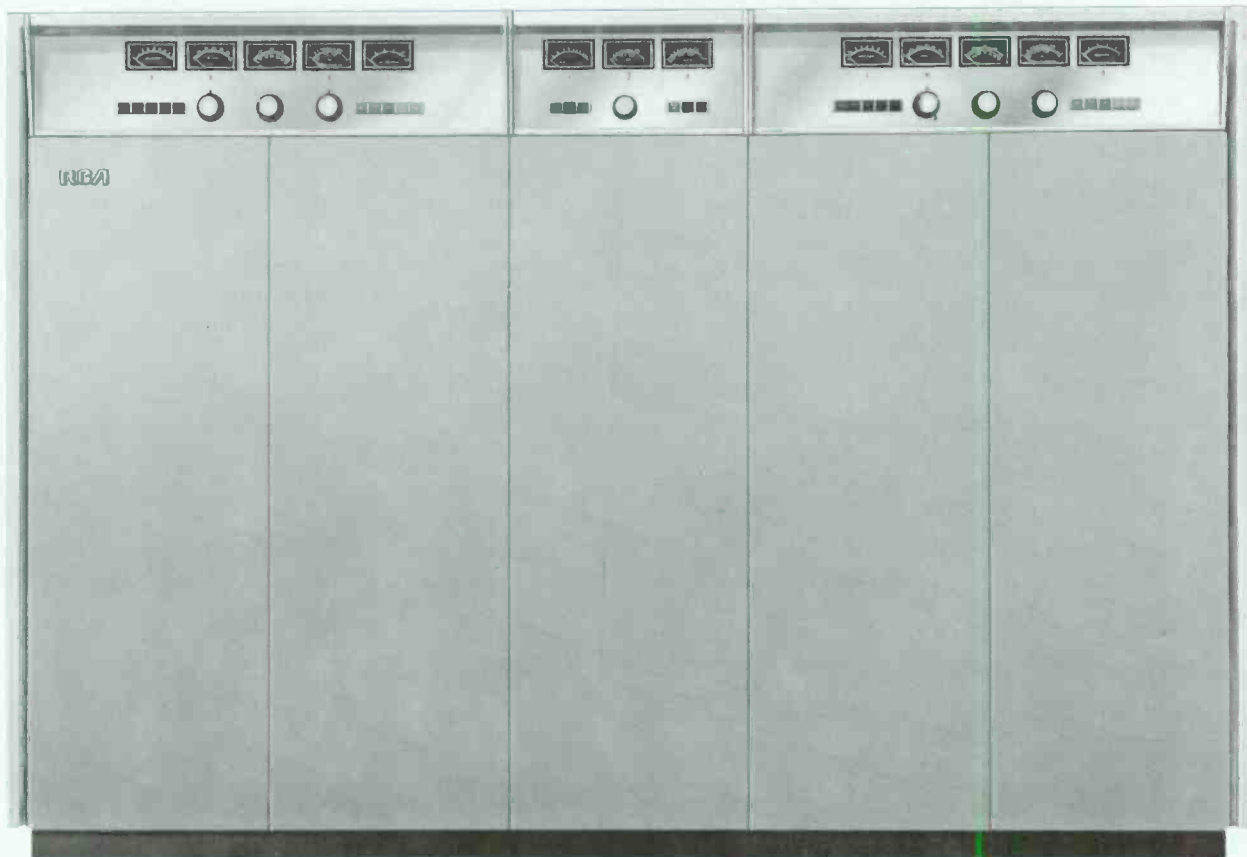


FM Transmitter, 20 kW Type BTF-10 Plus 10ES1

- Parallel Transmitters for High Reliability
- Designed for unattended operation
- Expandable to 40 kW power level
- Direct-FM for full-fidelity mono or stereo with or without SCA
- Only two tube types in entire transmitter

The Type BTF-10 plus 10ES1 is a twenty-kilowatt transmitter for the FM-broadcast station where continuous operation is important. The transmitter combines two identical ten-kilowatt transmitters (BTF-10ES1) to form a redundant twenty-kilowatt system. The dual design allows major maintenance without interruption of air-time.

The BTF-10 plus 10ES1 is a single-output transmitter. Four mode manual patch or motor driven by-pass output switching can be provided to allow either BTF-10ES1 to be connected directly to the antenna.



The BTF-10 plus 10ES1 transmitter is actually two complete ten-kilowatt units, (Type BTF-10ES1) combined to make continuous operation practical. All major components—except the combining equipment—are duplicated within the system: twin finals, twin power supplies, etc. (see functional diagrams, on opposite page).

The BTF-10 plus 10ES1 is intended for operation into a single transmission line and antenna system.

Dual, Switchable Exciters

The BTF-10 plus 10ES1 includes two solid-state exciter systems arranged so that one of the two serves the transmitter while the other operates as a hot standby. In the event of trouble in the on-air exciter, manual (or Automatic optional) switchover puts the extra exciter on the line. Lighted indicators on the control panel show the change in status.

The exciter system is the BTE-115 system providing excellent monaural, stereo and SCA performance that more than meets the Industry, FCC regulations and CCIR recommendations as achieved by the "Direct FM" solid state units. (See Catalog RA.2020A).

Interface to the BTF-10 plus 10ES1 is accomplished through an Exciter/Transmitter interface relay panel to permit deactivating the exciter RF amplifier output when the individual 10 kW amplifier is turned off.

Power-Amplifier Stages

The exciter system delivers 17 watts of modulated carrier to a hybrid-ring power splitter which, in turn, provides two outputs, each to a IPA tetrode in each transmitter section. This raises the power level to drive the final power amplifier. The final stage raises the power level to 10 kW. The two 10 kW outputs are combined to 20 kW in a hybrid combiner.

Hybrid-Combiner Network

Ordinarily mounted above the transmitter cabinet, almost directly over the center unit, (see floor plan, last page) is the combiner network, a "three-dB hybrid" coaxial unit. This assembly combines the two 10 kW modulated carriers into one 20 kW output. The reject load for the combiner is mounted within the center cabinet of the transmitter.

Coaxial Harmonic Filters

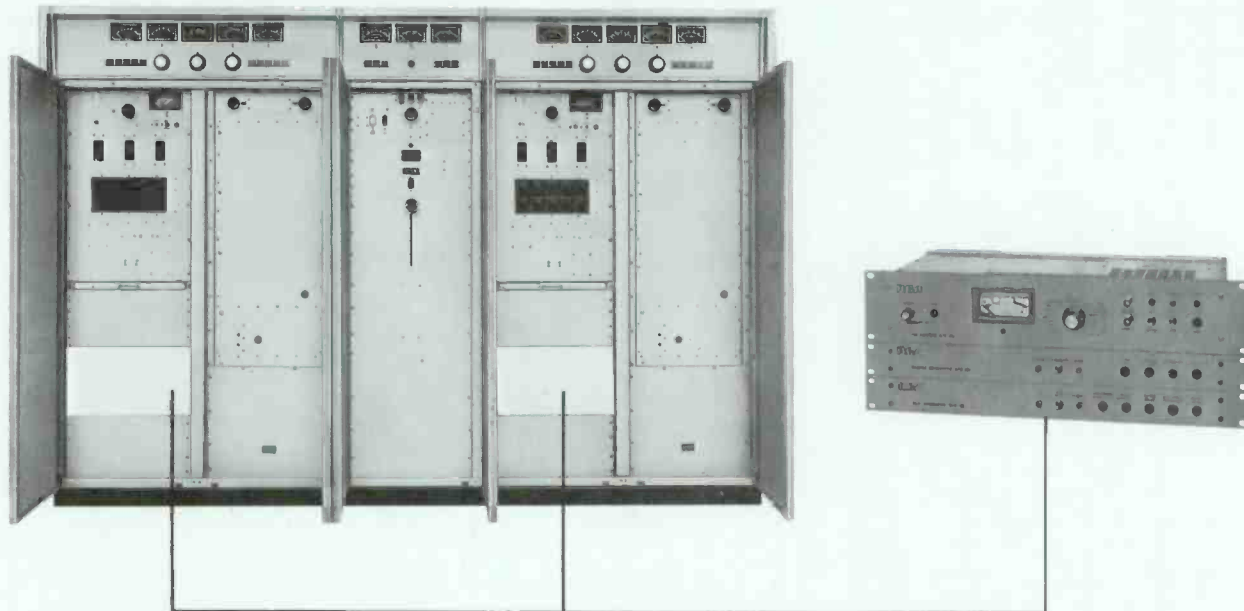
The single harmonic filter is 122" (3101 mm) long and is a series of transmission-line elements with a uniform $3\frac{1}{8}$ inch outer-conductor diameter, a stepped inner conductor and a shunt stub. Attenuation of all harmonics is accomplished in a M-derived section and a series of constant-K, T sections. The filter has a broad passband with a sharp high-frequency cutoff and excellent attenuation above cutoff frequency. A pressurized unit for outside installation is also available.

An optional filter configuration using two $3\frac{1}{8}$ " 61" (1549 mm) filters is available for a non-switching transmitter and two also will be supplied with either the manual or motor driven four mode switching versions. The optional filter consists of a series of transmission line stubs. Attenuation of harmonics is accomplished by resonating the stub sections to various harmonic frequencies.

Center Transmitter Control

In the center cabinet are the control and metering functions for the combined transmitters. Push-buttons provide control

Twenty-Kilowatt FM Transmitter, Type BTF-10 plus 10ES1



of combined unit on/off and plate power on/off. Lighted indicators signal d-c overload and output line VSWR overload. Three meters, at the top edge, display reject power, reflected power and combined power output.

In the area immediately below the meter panel are reflectometer controls and adjustments. Next are the control switches for the exciter systems, a control-ladder circuit-breaker and a meter that displays exciter reject power. Next is the control knob for adjustment of the "line-strecher", which adjusts the phase of the input circuits of the twin power-amplifier chains.

Relays in this section switch inputs and output power of the exciter system. The audio connections to the stereo and SCA subchannels are switched automatically when the exciters are switched.

By-Pass Switching Operation

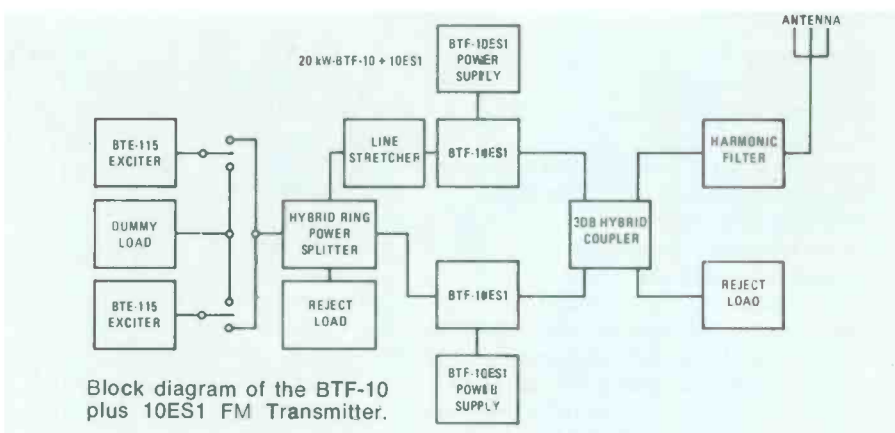
The BTF-10 plus 10ES1 transmitter, by virtue of its two independent transmitter systems, can be arranged so that either ten-kilowatt system can be shut down for major (or minor) maintenance while the other feeds the antenna.

A four mode manual or motor driven by-pass switching system can be provided to allow either one of the parallel transmitters to be connected directly to the station's antenna (see switching systems diagrams). This results in a reduced power of one-half instead of one-quarter power as would be experienced through the combining network.

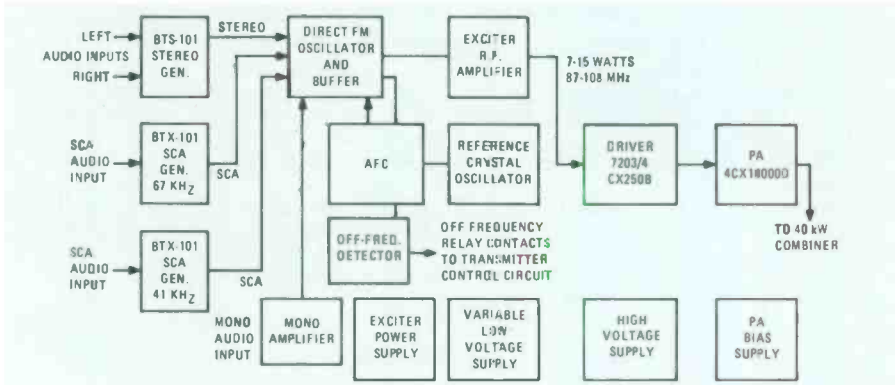
The four modes are: 1) both dual transmitters into antenna; 2) both transmitters into dummy load; 3) one transmitter into antenna and other into dummy load; and 4) reverse of 3). Automatic operation of the motor driven by-pass switching system is an optional accessory to the four mode switching system.

Redundant Power Supplies

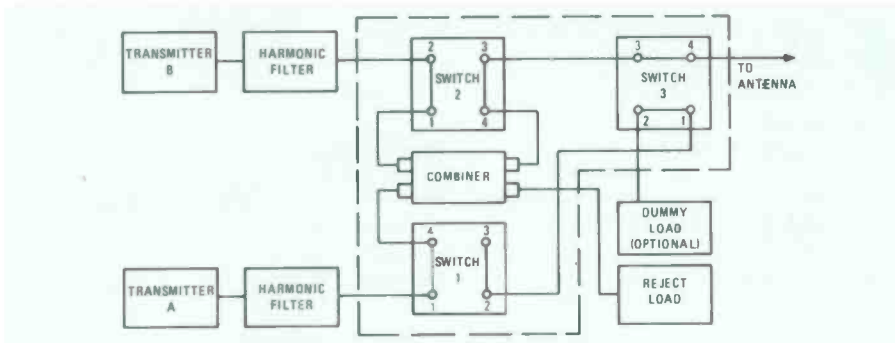
The redundancy of the BTF-10 plus 10ES1 system extends even to separate power supplies for each ten-kilowatt section. These are units using solid-state rectifiers throughout for reduced maintenance and minimal operating expense. The power supply cabinets need not be located in the same room as the transmitter unit where space is a problem. They might, for example, be located in a basement room or in a shelter external to the transmitter building. More information will be found in the catalog section on the Type BTF-10ES1. (See Catalog RA.2051C).



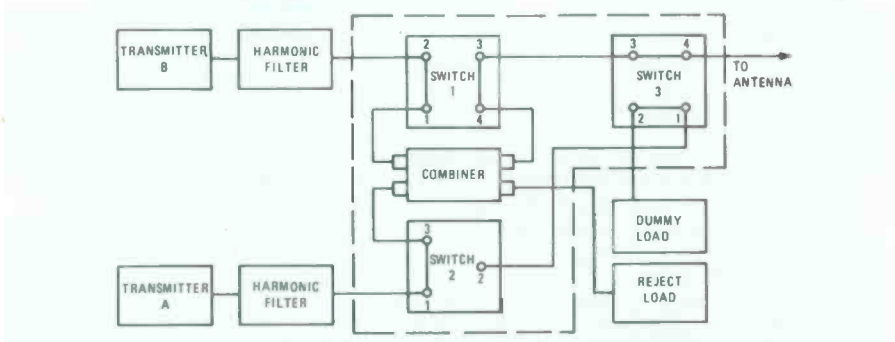
Block diagram of the BTF-10 plus 10ES1 FM Transmitter.



Block diagram of one of the Duplexed 10 kW units of the BTF-10 plus 10ES1 FM Transmitters.



Typical Four-Mode Switching System (motor driven) of the BTF-10 plus 10ES1 Dual FM Transmitters.



Typical Four-Mode Switching System (manual) for the BTF-10 plus 10ES1 Dual Transmitter.

Specifications

Performance

Type of Emission	F3 and F9
Frequency Range	87.5 to 108 MHz
Power Output	10 kW to 20 kW
Output Impedance (6 1/8" O.D. Unflanged Line)	50 Ohms
Frequency Deviation 100% modulation	±75 kHz
Modulation Capability	±100 kHz
Carrier Frequency Stability	±1000 Hz max.
Audio Input Impedance	600 Ohms
Audio Input Level—(100% mod.)	+10 ±2 dBm ¹
Audio Frequency Response—(30-15,000 Hz)	+1 dB max. ²
Pre-emphasis Network Time Constant	0, 25, 50 or 75 μs ³
Harmonic Distortion (50-15,000 Hz)	0.3% or less ⁴
FM Noise Level (referred to 100% FM mod.)	-68 dB max.
AM Noise Level (referred to 100% AM mod.)	-50 dB max. ⁶
Subcarrier Input Level (100% mod.)	9 to 30% adjustable
Subcarrier Input Impedance	Resistive 600 Ohms bal.
Subcarrier Frequency	20-95 kHz
Main-to-Subchannel Crosstalk	-50 dB referred to ±6.0 kHz deviation of the subcarrier by a 400 Hz tone. Main channel modulation 70% by a single tone (50 to 15000 Hz) and 30% by subcarrier, using narrow band detector.
Sub-to-Main-Channel Crosstalk	-60 dB referred to ±75 kHz deviation of the main carrier by a 400 Hz tone. Subcarrier modulated ±4.0 kHz by a single tone (30 to 5000 Hz), main channel modulated 30% by a subcarrier, using narrow band detector.

Tube Complement

Driver	Two 7203/4CX250B
Power Amplifier	Two 4CX10000D

Electrical

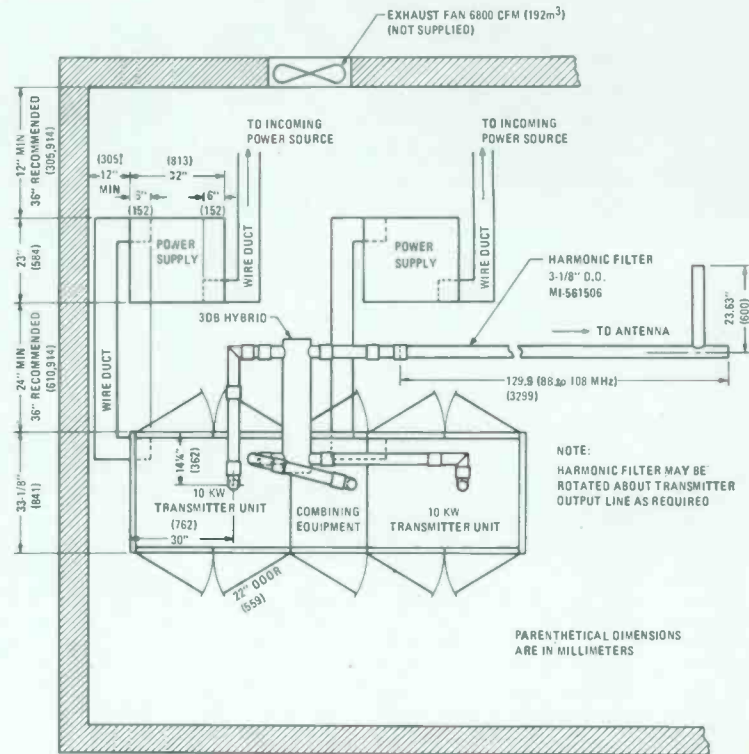
Power Requirements:	
Line	240/208 Volt, 3 phase, 50/60 Hz
Combined Line Voltage Variation and Regulation	±10%
Power Consumption (approx.)	38,000 Watts
Power Factor (approx.)	90%

Mechanical

Dimensions (overall):		High-Voltage Power Supply
	Transmitter	
Width	114 1/4" (2882 mm)	64" (1626 mm)
Height	77" (1956 mm)	49" (1245 mm)
Depth	32 1/2" (825 mm)	23" (585 mm)
Weight (approx.)	2950 lbs. (1336.4 kg)	1680 lbs. (762 kg)
Finish	Textured Vinyl in midnight blue and shadow blue, satin-aluminum trim.	
Altitude:		
60 Hz	9000 ft. (2740 m) ⁵	
50 Hz	7500 ft. (2286 m) ⁵	
Ambient Temperature Range	-20° to +45°C	
	Specifications subject to change without notice.	

Ordering Information

FM Broadcast Transmitter, Type-10 plus 10ES1:	
With Single Harmonic Filter (20 kW)	ES-560994B
With Dual Harmonic Filter (20 kW ea.)	ES-560994C
As Above, plus Manual Switching System	ES-560994D ¹⁰
As Above, plus Motor Driven Switching System	ES-560994E ¹⁰
Please specify assigned frequency, power line frequency (if other than 60 Hz), ambient temperature and installation altitude if greater than 7500 feet (2300 m) above sea level. Stereo and/or SCA facilities ordered with transmitter are factory installed.	



Space-saving floor plan. The separate, unitized power supplies may be installed in a basement, another room or other convenient place. Wire ducts shown are not furnished.

Accessories and Options

Manometer	MI-560307-36
Elapsed-Time Indicator	MI-561018-27
AM Noise Reduction Kit	MI-560307-31 ⁶
Freq. and Mod. Monitor, Type BW-75	MI-560735 ⁸
Stereo Freq. and Mod. Monitor, Type BW-85	MI-560740 ⁸
SCA Freq. and Mod. Monitor, Type BW-95	MI-560745 ⁸
RF Amplifier, Type BW-100 (for off-air mon.)	MI-560738 ⁸
Crystal and Oven Spare Kit (for Exciter)	MI-561066
Electron Tube Spares, Complete Set	ES-560613
Automatic Power Output Control Panel	MI-561343
Directional Coupler, 3 1/8", 50-ohm, 20 kW (for use with Automatic Power Control, use one for each parallel transmitter)	MI-561043-8
RF Load and Wattmeter (20 kW)	CB ⁹
Automatic Operation of Motor Driven By-Pass Switching System	MI-561085
Automatic Operation of Exciter Switching System	MI-561089

¹Level measured at input to pre-emphasis network, referred to 400 Hz.
²Frequency response referred to 50- or 75-microsecond pre-emphasis curve.
³Other time constants available on request.
⁴Distortion includes all harmonics up to 30 kHz and is measured following a standard 50- or 75-microsecond de-emphasis network.
⁵Larger blowers available for operation at higher altitudes.
⁶AM Noise reduction kit required when operating at half power.
⁷For 117V/60 Hz power only; use MI-561018-4 for 117V/50 Hz.
⁸Specify operating frequency.
⁹Catalog RA.7711B.
¹⁰Includes 3 1/8 inch coaxial switches (either manual or motor driven).

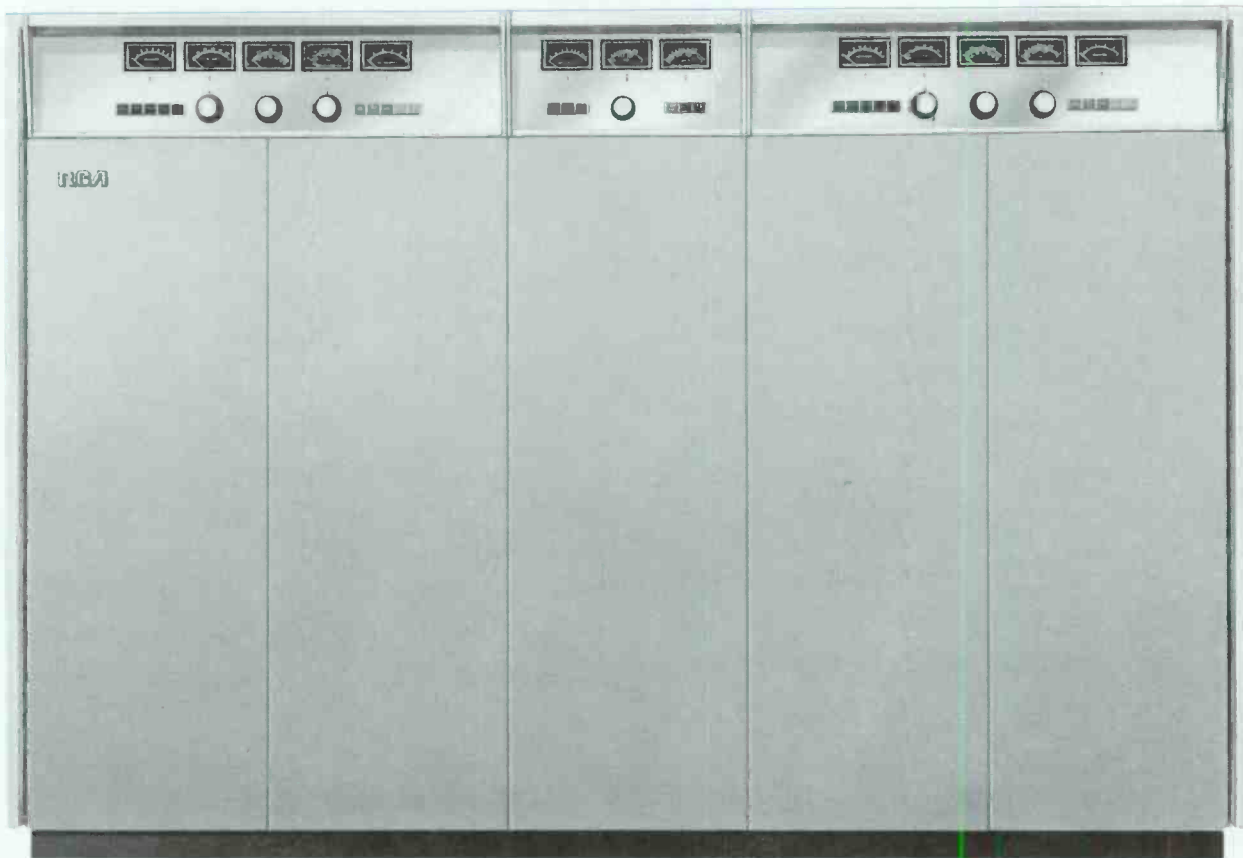


FM Transmitter, 40kW, Type BTF-40ES1

- Dual-system exciters, amplifiers, power supplies
- Ready for remote control
- Built for continuous operation
- Direct-FM for full-fidelity mono or stereo with or without SCA
- Only two tube types in entire transmitter

The Type BTF-40ES1 is a forty-kilowatt transmitter for the maximum-power FM-broadcast station where continuous operation is important. The transmitter combines two identical twenty-kilowatt transmitters to form a redundant forty-kilowatt system. The dual design even allows major maintenance without interruption of air-time.

The BTF-40ES1 is a single-output transmitter. Four mode manual patch or motor driven by-pass output switching can be provided to allow either BTF-20ES1 to be connected directly to the antenna.



The BTF-40ES1 transmitter is actually two complete twenty-kilowatt units, (Type BTF-20ES1) combined to make continuous operation practical. All major components—except the combining equipment and the harmonic filter—are duplicated within the system: twin finals, twin power supplies, etc. (see functional diagrams, on opposite page).

The BTF-40ES1 is intended for operation into a single transmission line and antenna system.

Dual, Switchable Exciters

The BTF-40ES1 includes two solid-state exciter systems arranged so that one of the two serves the transmitter while the other operates as a hot standby. In the event of trouble in the on-air exciter, manual (or Automatic optional) switch-over puts the extra exciter on the line. Lighted indicators on the control panel show the change in status.

The exciter system is the BTE-115 system providing excellent monaural, stereo and SCA performance that more than meets the Industry, FCC regulations and CCIR recommendations as achieved by

the "Direct FM" solid state units. (See Catalog RA.2020A)

Interface to the BTF-40ES1 is accomplished through an Exciter/Transmitter interface relay panel to permit deactivating the exciter RF amplifier output when the individual 20 kW amplifier is turned off.

Power-Amplifier Stages

The exciter system delivers 17 watts of modulated carrier to a hybrid-ring power splitter which, in turn, provides two outputs, each to a pair of IPA tetrodes, in each transmitter section. These raise the power level to drive the final power amplifier. The final stage raises the power level to 20 kW. The two 20 kW outputs are combined to 40 kW in a hybrid combiner.

Hybrid Combiner Network

Ordinarily mounted above the transmitter cabinet, almost directly over the center unit, (see floor plan, last page) is the combiner network, a "three-dB hybrid" coaxial unit. This assembly combines the two 20 kW modulated carriers into one 40 kW output. The reject loads

for the combiner are mounted within the center cabinet of the transmitter.

Coaxial Harmonic Filters

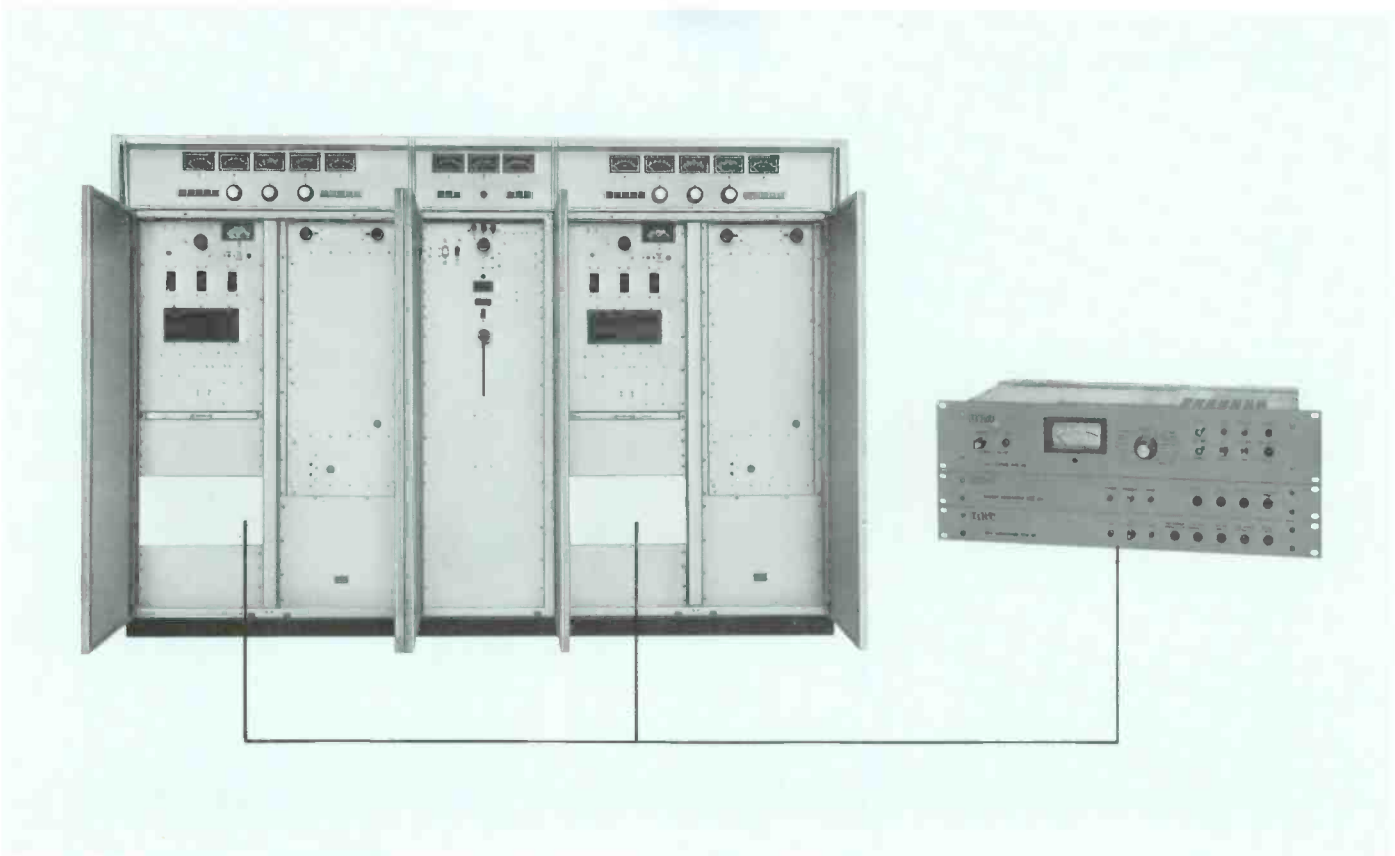
The single harmonic filter is 122" (3101 mm) long and is a series of transmission-line elements with a uniform 6 $\frac{1}{8}$ -inch outer-conductor diameter, a stepped inner conductor and a shunt stub. Attenuation of all harmonics is accomplished in an M-derived section and a series of constant-K, T sections. The filter has a broad passband with a sharp high-frequency cutoff and excellent attenuation above cutoff frequency.

An optional filter configuration using two 3 $\frac{1}{8}$ " 61" (1549 mm) filters is available for a non-switching transmitter but two will be supplied with either the manual or motor driven four mode switching versions. The optional filter consists of a series of transmission line stubs. Attenuation of harmonics is accomplished by resonating the stub sections to various harmonic frequencies.

Central Transmitter Control

In the center cabinet are the control and metering functions for the combined

Forty-Kilowatt FM Transmitter, Type BTF-40ES1



transmitters. Push-buttons provide control of combined unit on/off and plate power on/off. Lighted indicators signal d-c overload and output line VSWR overload. Three meters, at the top edge, display reject power, reflected power and combined power output.

In the area immediately below the meter panel are reflectometer controls and adjustments. Next are the control switches for the exciter systems, a control-ladder circuit-breaker and a meter that displays exciter reject power. Next is the control knob for adjustment of the "line-stretcher", which adjusts the phase of the input circuits of the twin power-amplifier chains.

Relays in this section switch exciter system inputs, outputs and primary power. The audio connections to the stereo and SCA subchannels are switched automatically when the exciters are switched.

Built for Continuous Operation

The BTF-40ES1 transmitter, by virtue of its two independent transmitter systems, is arranged so that either twenty-kilowatt system can be shut down for major (or minor) maintenance while the other feeds the antenna.

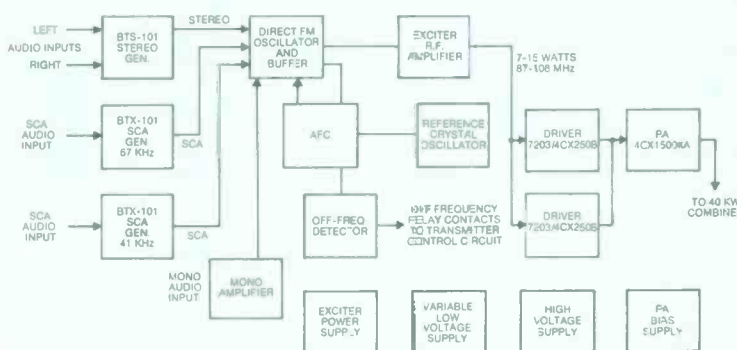
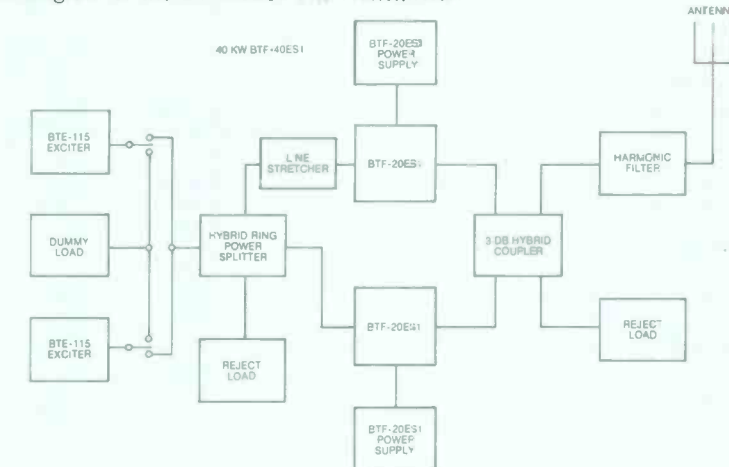
A four mode manual or motor driven by-pass switching system can be provided to allow one of the parallel transmitters to be connected directly to the station's antenna (see switching systems diagrams). This results in a reduced power of one-half instead of one-quarter power as would be experienced through the combining network.

The four modes are: 1.) both dual transmitters into antenna; 2.) both transmitters into dummy load; 3.) one transmitter into antenna and other into dummy load; and 4.) reverse of 3.). Automatic operation of the motor driven by-pass switching system is an optional accessory to the four mode switching system.

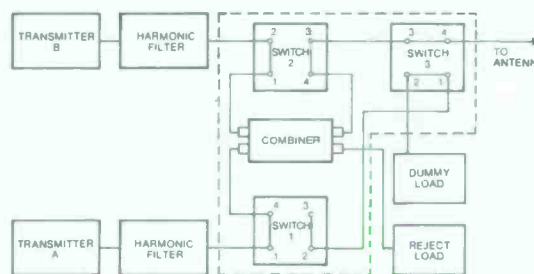
Redundant Power Supplies

The redundancy of the BTF-40ES1 system extends even to separate power supplies for each twenty-kilowatt section. These are units using solid-state rectifiers throughout for reduced maintenance and minimal operating expense. The power supply cabinets need not be located in the same room as the transmitter unit where space is a problem. They might, for example, be located in a basement room or in a shelter external to the transmitter building. More information on the twenty-kilowatt transmitter will be found in the catalog section on the Type BTF-20ES1. (See Catalog RA.2061C)

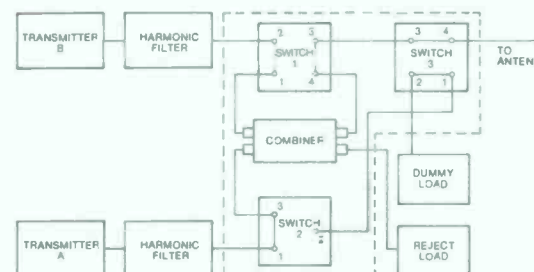
Block diagram of the BTF-40ES1 FM Transmitter.



Block diagram of one of the diplexed 20-kW units of the BTF-40ES1 Transmitter, showing optional Stereo and SCA.



Typical four mode switching system (motor driven) for BTF-40ES1 Dual Transmitter.



Typical four mode switching system (manual) for BTF-40ES1 Dual Transmitter.

Specifications

Performance

Type of Emission F3 and F9
 Frequency Range 87.5 to 108 MHz
 Power Output 40 kW
 Output Impedance (6 1/8" O.D. Unflanged Line) 50 Ohms
 Frequency Deviation 100% modulation ±75 kHz
 Modulation Capability ±100 kHz
 Carrier Frequency Stability ±1000 Hz max.
 Audio Input Impedance 600 Ohms
 Audio Input Level—(100% mod.) +10 ±2 dBm¹
 Audio Frequency Response—(30-15,000 Hz) ±1 dB max.²
 Pre-emphasis Network Time Constant...75 or 50 μs, as desired³
 Harmonic Distortion (50-15,000 Hz) 0.3% or less⁴
 FM Noise Level (referred to 100% FM mod.) -68 dB max.
 AM Noise Level (referred to 100% AM mod.) -50 dB max.⁶
 Subcarrier Input Level (100% mod.) 9 to 30% adjustable

Subcarrier Input Impedance Resistive 600 Ohms bal.
 Subcarrier Frequency 20-95 kHz
 Main-to-Subchannel Crosstalk -50 dB referred to ±6.0 kHz deviation of the subcarrier by a 400 Hz tone. Main channel modulation 70% by a single tone (50 to 15000 Hz) and 30% by subcarrier, using narrow band detector.
 Sub-to-Main-Channel Crosstalk.....-60 dB referred to ±75 kHz deviation of the main carrier by a 400 Hz tone. Subcarrier modulated ±4.0 kHz by a single tone (30 to 5000), main channel modulated 30% by subcarrier, using narrow band detector.

Tube Complement

Driver: four 7203/4CX250B; Power Amplifier: two 4CX15000A

Electrical

Power Requirements:

Line 240/208 Volt, 3 phase, 50/60 Hz
 Combined Line Voltage Variation and Regulation ±10%
 Power Consumption 72,000 Watts (approx.)
 Power Factor (approx.) 90%

Mechanical

Dimensions (overall):	Transmitter	High-Voltage Power Supply
Width	114 1/4" (2882 mm)	64" (1626 mm)
Height	77" (1956 mm)	49" (1245 mm)
Depth	32 1/2" (825 mm)	23" (585 mm)
Weight (approx.)	2950 lbs. (1336.4 kg)	2050 lbs. (329.8 kg.)
Finish	Textured Vinyl in midnight blue and shadow blue, satin-aluminum trim.	
Altitude	7500 ft. (2290 m) ⁵	
Ambient Temperature Range	-20° to +45°C	

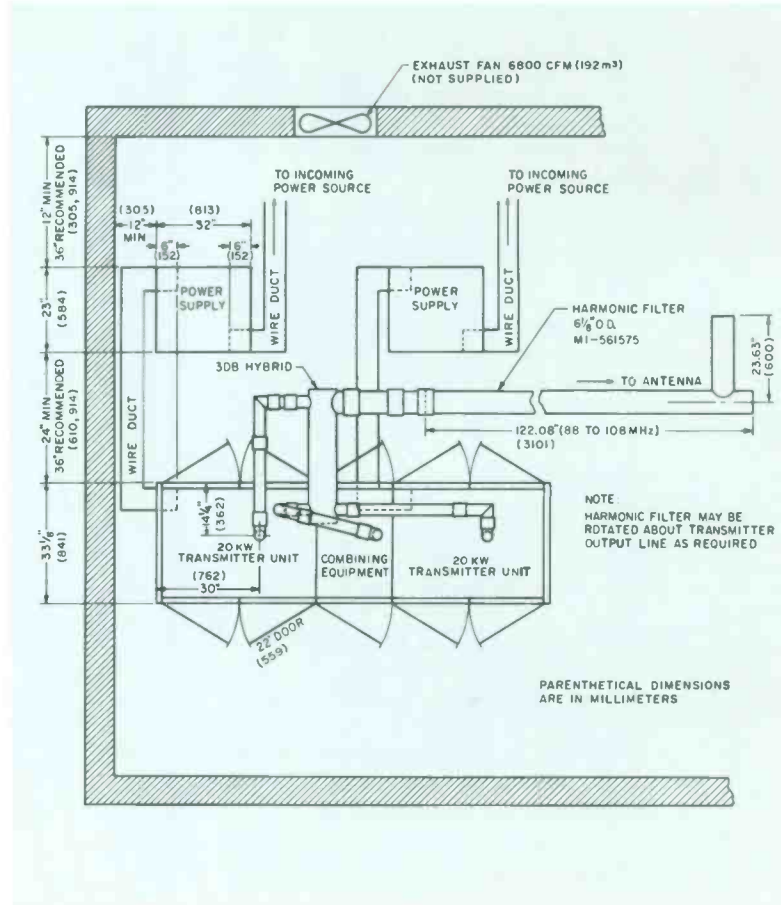
Specifications subject to change without notice.

Ordering Information

FM Broadcast Transmitter, Type BTF-40ES1:
 With Single Harmonic Filter (40 kW) ES-560996B
 With Dual Harmonic Filters (20 kW) ES-560996C
 As Above, plus Manual Switching System ES-560996D¹⁰
 As Above, plus Motor Driven Switching System ES-560996E¹⁰

Please specify assigned frequency, power line frequency (if other than 60 Hz), ambient temperature and installation altitude if greater than 7500 feet (2300 m) above sea level. Stereo and/or SCA facilities ordered with transmitter are factory installed.

¹ Level measured at input to pre-emphasis network, referred to 400 Hz.
² Frequency response referred to 50- or 75-microsecond pre-emphasis curve.
³ Other time constants available on request.
⁴ Distortion includes all harmonics up to 30 kHz and is measured following a standard 50- or 75-microsecond de-emphasis network.
⁵ Larger blowers available for operation at higher altitudes.
⁶ AM Noise reduction kit required when operating at half power.
⁷ For 117V/60 Hz power only; use MI-561018-4 for 117V/50 Hz.
⁸ Specify operating frequency.
⁹ Catalog RA.7711B.
¹⁰ Includes 3/8 inch coaxial switches (either manual or motor driven) and 50 kW dummy load and wattmeter.



Space-saving floor plan. The separate, unitized power supplies may be installed in a basement, another room or other convenient place. Wire ducts shown are not furnished.

Accessories and Options

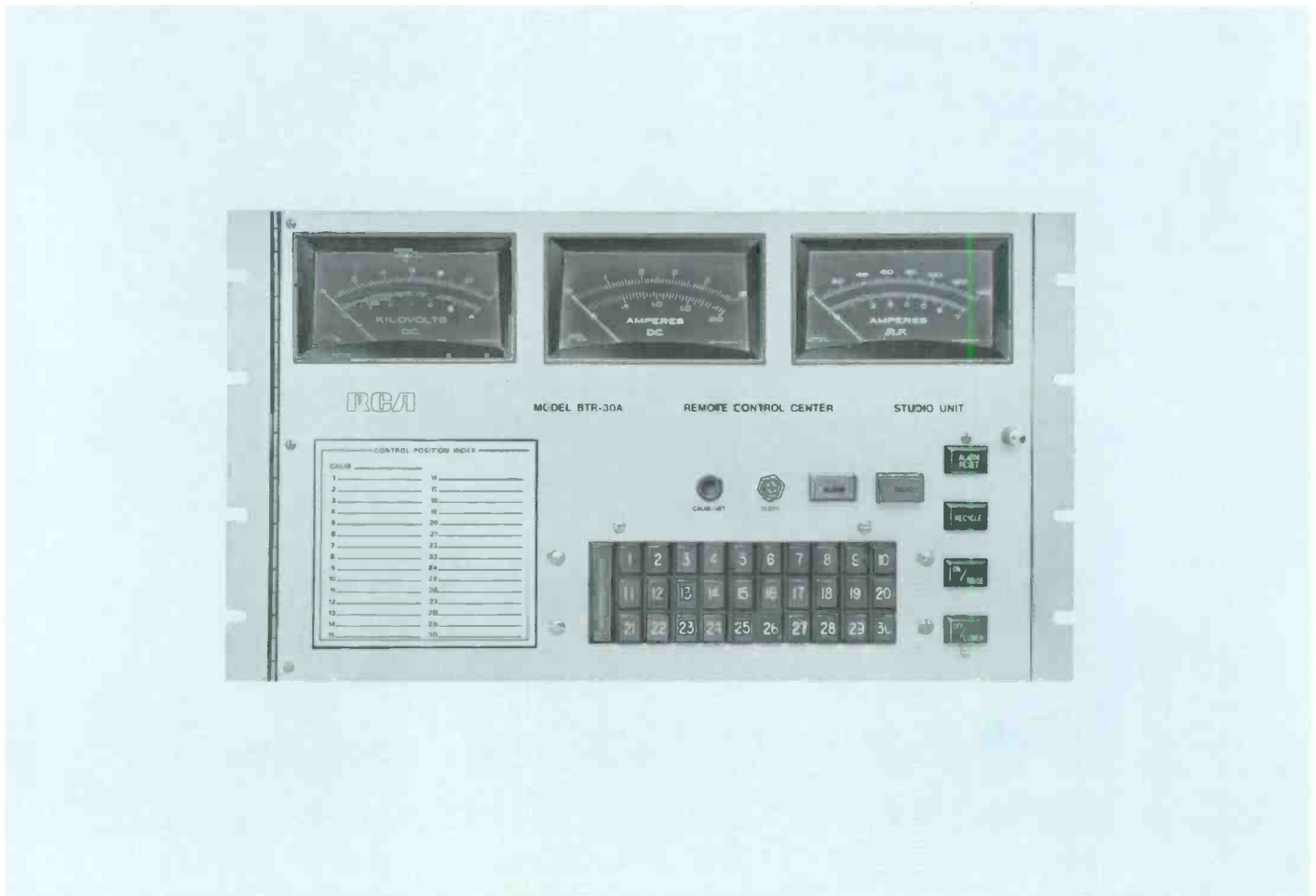
Manometer	MI-560307-36
Elapsed-Time Indicator	MI-561018-27
AM Noise Reduction Kit	MI-560307-31
Freq. and Mod. Monitor, Type BW-75	MI-560735 ⁸
Stereo Freq. and Mod. Monitor, Type BW-85	MI-560740 ⁸
SCA Freq. and Mod. Monitor, Type BW-95	MI-560745 ⁸
RF Amplifier, Type BW-100 (for off-air mon.)	MI-560738 ⁸
Crystal and Oven Spares Kit (for Exciter)	MI-561066
Electron Tube Spares, Complete Set	ES-560613
Automatic Power Output Control Panel	MI-561343
Directional Coupler, 3 1/8", 50-ohm, 20 kW (for use with Automatic Power Control, use one for each parallel transmitter)	MI-561043-4
RF Load and Wattmeter (50 kW)	CB ⁹
RF Load 40/50 kW	CB ⁹
Automatic Operation of Motor Driven By-Pass Switching System	MI-561085
Automatic Operation of Exciter Switching System	MI-561089
Directional Couplers (Mounted on 11" sections of unflanged 50-ohm line):	
Forty Kilowatt (6 1/8" line)	MI-560708A
Forty Kilowatt (3 1/8" line)	MI-560708E
Twenty Kilowatt (3 1/8" line)	MI-560708B



Transmitter Remote Control System, Type BTR-30A1

- For AM or FM transmitters
- Fail-safe design
- Thirty metering channels
- Sixty control functions
- Computer-type logic circuitry

With 30 metering channels and 60 individual control functions, the all solid-state Type BTR-30A1 Remote Control System handles most of today's remote control requirements. Designed explicitly for the broadcaster, it incorporates many new features. Flexibility and adaptability are easily obtained with the BTR-30A1. Wire or radio (STL) service is selected by simply plugging in the appropriate printed-circuit modules. Audible or subaudible telemetry return is chosen in the same manner. No rewiring is necessary.



All Solid State

The circuitry of the BTR-30A1 is of modular construction, using carefully chosen combinations of integrated circuits and discrete components. Only one stepper relay is used in the transmitter unit. Separate switching decks are provided on the stepper relay to provide complete isolation between the controlled circuits and between the metered circuits in the transmitter. Solid-state, computer-type logic circuitry is used in the studio unit in place of a stepper relay or mechanical logic devices thus increasing reliability. The studio unit is essentially noiseless.

Quick Access to Circuitry

Some features of the Model BTR-30A1 are of special interest. An indication of the stepper relay position is provided on the front panel of the transmitter unit. This is especially useful during calibration. Color-coded, push-button switches on the transmitter unit are used for local control.

The Local Remote buttons are illuminated red and green for quick indication of system status. Swing-away front panels on both units provide access to all printed circuit modules, and all initial and routine adjustments are made from the front of the equipment. An extension board is provided for testing each module.

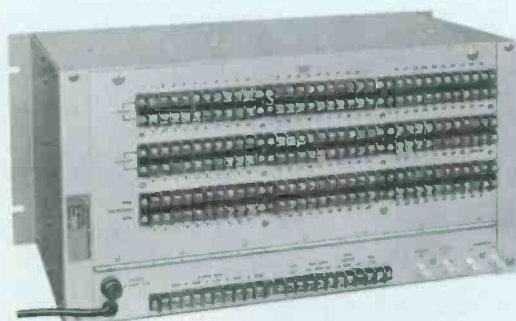
Five-Input Alarm System

Included with the BTR-30A1 is a five input alarm system. A contact closure is used to activate any one of the five inputs. This can be utilized for continuous surveillance, sensing such things as illegal entry, temperature, flooding and the like. The alarm signals are returned to the studio unit as part of the telemetry information. When an alarm condition exists, a visual indication is given at the control point by the amber *Alarm* lamp.

Fail-Safe Design

The Model BTR-30A1 requires one

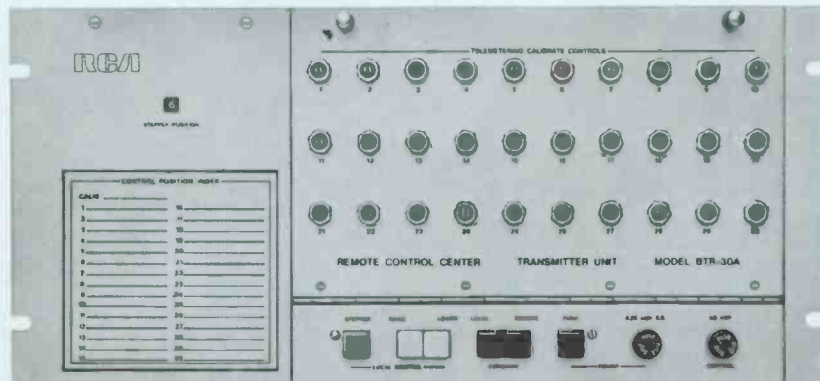
two-way, communications-grade signal circuit between the control point and the transmitter site. Fail-safe provisions meet all existing FCC requirements for AM and FM broadcast and function with the loss of primary power or control information reception to the transmitter unit or malfunction of the equipment itself. The fail-safe tone generated in the studio unit also actuates the stepper relay at the transmitter unit. The tone is momentarily interrupted, creating, in effect, short-duration pulses which control the stepper. An interruption of approximately 15 seconds trips the fail-safe circuitry. Two functions, designated *On/Raise* and *Off/Lower*, can be performed on each of 30 control channels selected via individually numbered pushbuttons. A metered indication of the parameter being controlled can be observed simultaneously. The frequencies used are *Fail/Safe* 920 Hz, *On/Raise* 790 Hz, and *Off/Lower* 670 Hz. High-Q temperature-stabilized toroidal inductors



Rear view of transmitter-control unit showing barrier-strip connections for the 60 control and 30 metering function.



Fold-down front panel in transmitter-control unit provides quick access to all modules. Note 10-turn potentiometers on panel.



Transmitter-control unit, Type BTR-30A1. Note window at upper left which displays position of stepper relay. (See preceding page for Studio Unit.)

and capacitors are used in all oscillator and tone detector circuits to assure drift-free operation. Control outputs are available from the BTR-30A1 in the form of normally-open, isolated relay contacts. These contacts are rated for 50-watt non-inductive loads.

Voltage-Controlled Oscillator

Telemetry is accomplished by converting the DC sample voltages from the transmitter to a frequency in the 20 Hz to 30 Hz spectrum by means of a linear, voltage-controlled oscillator. This signal is relayed to the studio unit and converted back to a dc voltage proportional to the input sample for display on any of the 4-inch taut-band, panel-mounted meters. Multiturn calibration controls are provided on the transmitter unit.

For Wire or Radio Link

Two basic versions of the Type BTR-30A1 are available; one for wire interconnection and one for radio (STL) service.

Wire Service

For wire service, only a single voice-grade telephone line (full duplex) is required for interconnection, dc continuity in *not* required. The 20 Hz to 30 Hz telemetry information is returned to the studio unit by means of an amplitude-modulated 1280 Hz signal. Thus, all audio signals appearing on the telephone line are confined to 670 Hz to 1310 Hz spectrum.

Radio (STL) Service

For radio service, the BTR-30A1 is designed to mate with STL equipment. Control information is transmitted to the transmitter unit on subcarriers multiplexed on the STL. Included in the BTR-30A1 are a control subcarrier generator and detector. These are printed circuit modules. A 26-kHz control subcarrier frequency is used for monaural or dual-stereo aural STL systems and 110-kHz for composite-stereo aural STL. Telemetry information is sinusoidal and subaudible, 20 Hz to 30 Hz. The return path of the telemetry information can be via a 67-kHz SCA channel of the FM transmitter, the main channel of an AM transmitter or other radio circuit capable of handling 20 Hz to 30 Hz. The information may be recovered with a Type TMR-1 FM Multiplex Receiver. For AM situations, metering telemetry comes back via a subaudible signal modulated on the carrier using MIU-1 and MRU-1 units (see *Accessories*). Audible telemetry information is available on special order for voice radio circuits.

Ordering Information

The BTR-30 system is adaptable to virtually any transmitter remote-control situation. The several systems listed below are engineered to satisfy most situations in AM, FM mono or FM stereo broadcasting.

AM Radio Systems

Land Lines	Control via		Telemetry via		System Catalog Identification
	STL Subcarrier		Land Lines	Transmitter ³	
	26 kHz ¹	External Generator ²			
•			•		ES-561446-1
	•		•		ES-561446-5
	•			•	ES-561446-6
		•	•		ES-561446-15
		•		•	ES-561446-16

¹Subcarrier generator included in studio unit.

²External subcarrier generator not included.

³Subaudible telemetry equipment not included. See "Remote Control Accessories" section of catalog.

FM Mono Radio Systems

Land Lines	Control via		Telemetry via			System Catalog Identification
	STL Subcarrier		Land Lines	Transmitter Subcarrier		
	26 kHz ¹	External Generator ²		67 kHz ¹	External Generator ²	
•			•			ES-561446-1
	•			•		ES-561446-3
	•				•	ES-561446-4
	•		•			ES-561446-5
		•		•		ES-561446-13
		•			•	ES-561446-14
		•	•			ES-561446-15

¹Subcarrier generator included in system.

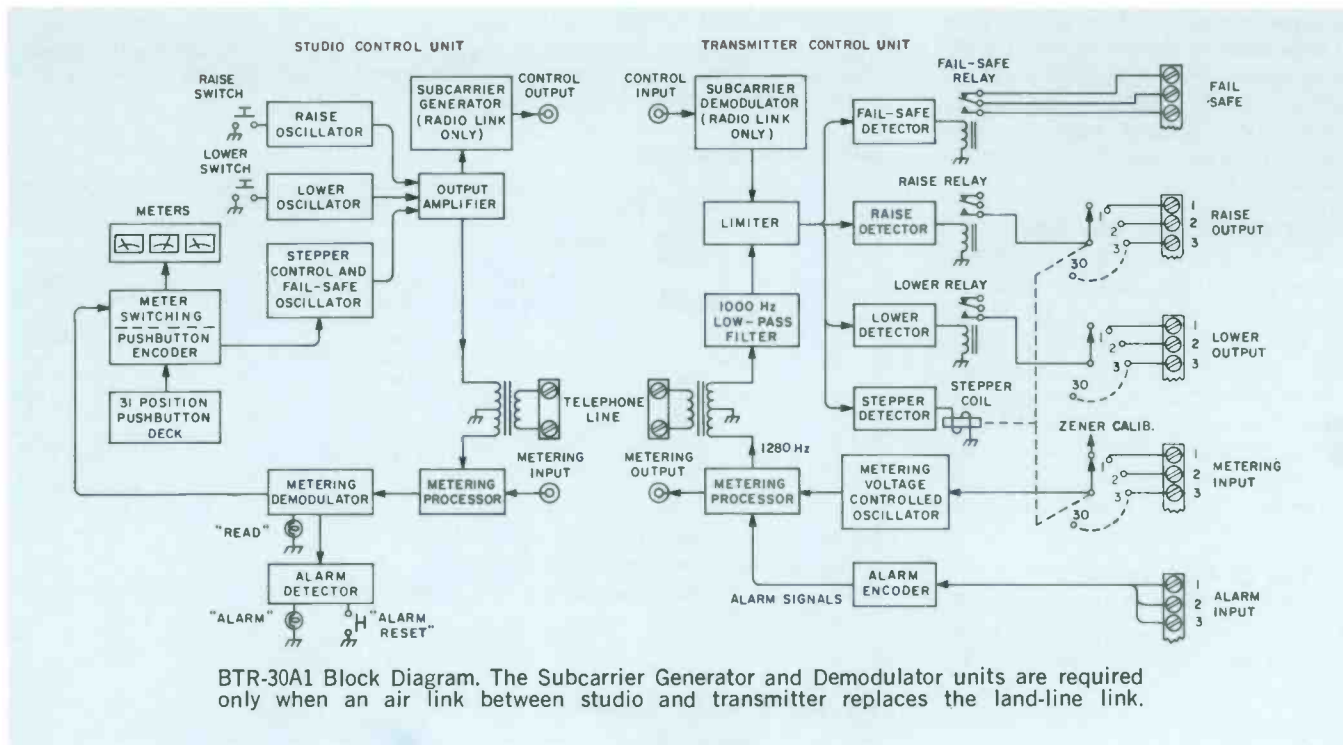
²Subcarrier generator not included in system.

FM-Stereo Radio Systems

Land Lines	Control via		Telemetry via			System Catalog Identification
	STL Subcarrier		Land Lines	Transmitter Subcarrier		
	110 kHz ¹	External Generator ²		67 kHz ¹	External Generator ²	
•			•			ES-561446-1
	•			•		ES-561446-8
	•				•	ES-561446-9
	•		•			ES-561446-10
		•		•		ES-561446-13
		•			•	ES-561446-14
		•	•			ES-561446-15

¹Subcarrier generator included in system.

²Subcarrier generator not included in system.



BTR-30A1 Block Diagram. The Subcarrier Generator and Demodulator units are required only when an air link between studio and transmitter replaces the land-line link.

Specifications

- Metering30 telemetry channels, plus calibration
- Control Functions60; 30 On/Raise, 30 Off/Lower
- Meters3, taut-band with carefully controlled ballistics. Provisions for 7 external meters
- Metering StabilityBetter than 1% with weekly checks
- Telemetry Input Voltage1-10Vdc
- Telemetry Input Impedance20,000 ohms
- Telemetry Frequencies:
 - Audible1280 Hz
 - Subaudible20-30 Hz
- Control FrequenciesFail-Safe—920 Hz; On/Raise—790 Hz; Off/Lower—670 Hz
- Control Subcarrier Frequencies26 kHz or 110 kHz
- Interconnection Requirements:
 - WireOrdinary voice-grade two-way telephone line, 600 ohms, 20 dB allowable loss from 650 Hz-1350 Hz. (DC continuity not required)
- Radio:
 - Control CircuitControl subcarrier generator and detector provided. Input and output 0.5V rms, 2,000 ohms nominal
 - Telemetry CircuitTelemetry return path capable of handling 20 Hz-30 Hz, sinusoidal
 - Transmitter Control Unit Output0 dBm, 500 ohms
 - Studio Unit Input0 dBm, 8,000 ohms nominal
- Calibration ReferenceZener diode
- Semiconductor DevicesAll silicon diodes, integrated circuits and JEDEC registered transistors
- Operating Temperature Range-10°F to +140°F (-12°C to 60°C)
- Power Requirements120/240 V, 50/60 Hz, Studio Control Unit—15W, Transmitter Control Unit—25W
- Dimensions:
 - Studio Unit10½" (267mm) H, 19" (483mm) W, 8½" (216mm) D
 - Transmitter Unit8¾" H, 19" W, 10½" D (222 x 483 x 267 mm)
- Weight (shipping, approx.)60 lbs. (27 kg)
- Shipping Volume (approx.)2.2 cu. ft. (0.67m³)

Accessories

- Voltage Pickup, 115/230VacMI-27516
- Tower Light Monitor and Control UnitMI-27519
- Tower Light MonitorMI-27544
- Power to Linear Converter, Type PLC-1MI-561179
- Relay, DPDT, 120Vac CoilMI-561471
- Panel Relay (For 8 MI-561471 Relays)MI-561470
- Sampling Kit, Plate Voltage, 10 kV max., Type PVK-1MI-561482
- Sampling Kit, Plate Voltage, 10-20 kV, Type PVK-2MI-561483
- Relay, DPDT, 24Vdc Coil (socket included)MI-561448-1
- Relay, DPDT, 120Vac Coil (socket included)MI-561448-2
- Relay, Latching, DPDT, 24Vdc Coil (socket included)MI-561448-3
- Relay, Time-Delay, DPDT, 24Vdc Coil (socket included)MI-561448-4
- Panel, Relay (For 8 MI-561448 Relays)MI-561449
- Metering Insertion Unit, Type MIU-1MI-561458
- Metering Recovery Unit, Type MRU-1MI-561459
- Monitor Adapter, Modulation, Type MMA-1MI-561460
- Chopper-Stabilized DC Amplifier, Type CSA-3MI-561461
- Tower-Light Monitor Kit, Type TLK-1MI-561462
- Line-Voltage Monitor Kit, Type LVK-1MI-561463
- Sampling Kit, Plate Circuit, Type MBB-1MI-561464
- Temperature Sensing Kit, Type TSK-1MI-561465
- Indicator, Status-Studio System, Type SCS-2ES-561156
- Alarm, Tolerance, Type TAU-2 (Frame only)MI-561469
- Alarm, Tolerance, Type TAU-2 (Module for above)MI-561184
- Combiner, Multi-System, Type MSC-1MI-561479
- Receiver, Telemetry, Type TMR-1MI-561182



Transmitter Remote Control System, Type BTR-15B Series

- Wired or wireless control
- Noiseless studio unit
- Fail-safe design
- Provision for 4 external meters
- Convertible, accessible design



Studio Unit



Transmitter Unit

With 15 metering channels and 30 individual control functions, the entirely solid-state Type BTR-15B Series Remote Control Systems handle most of today's radio transmitter remote control requirements. Designed explicitly for broadcast operations, these systems incorporate many features not available in earlier designs.

Wired or Wireless Control

The BTR-15B is offered in two basic forms: one uses an a-c coupled, voice-grade, duplex telephone pair (Type BTR-15BW) and a second, (Type BTR-15BR) for use with a subcarrier on an STL or other suitable wireless link (see *Specifications*). Further, any of these are easily convertible at any time through certain module changes.

Noiseless Operation

In consideration that the studio unit might need to operate near an on-air microphone, it is designed to be essentially noiseless. The entire system is almost noiseless in operation, no stepper relay is used in either unit.

Fail-Safe Design

Meeting or exceeding all FCC requirements for AM/FM, the fail-safe facilities of the BTR-15B function automatically when either of two circumstances takes place: loss of commercial (primary) power; or a failure in the interconnecting circuitry (wired or wireless).

Provision for 4 External Meters

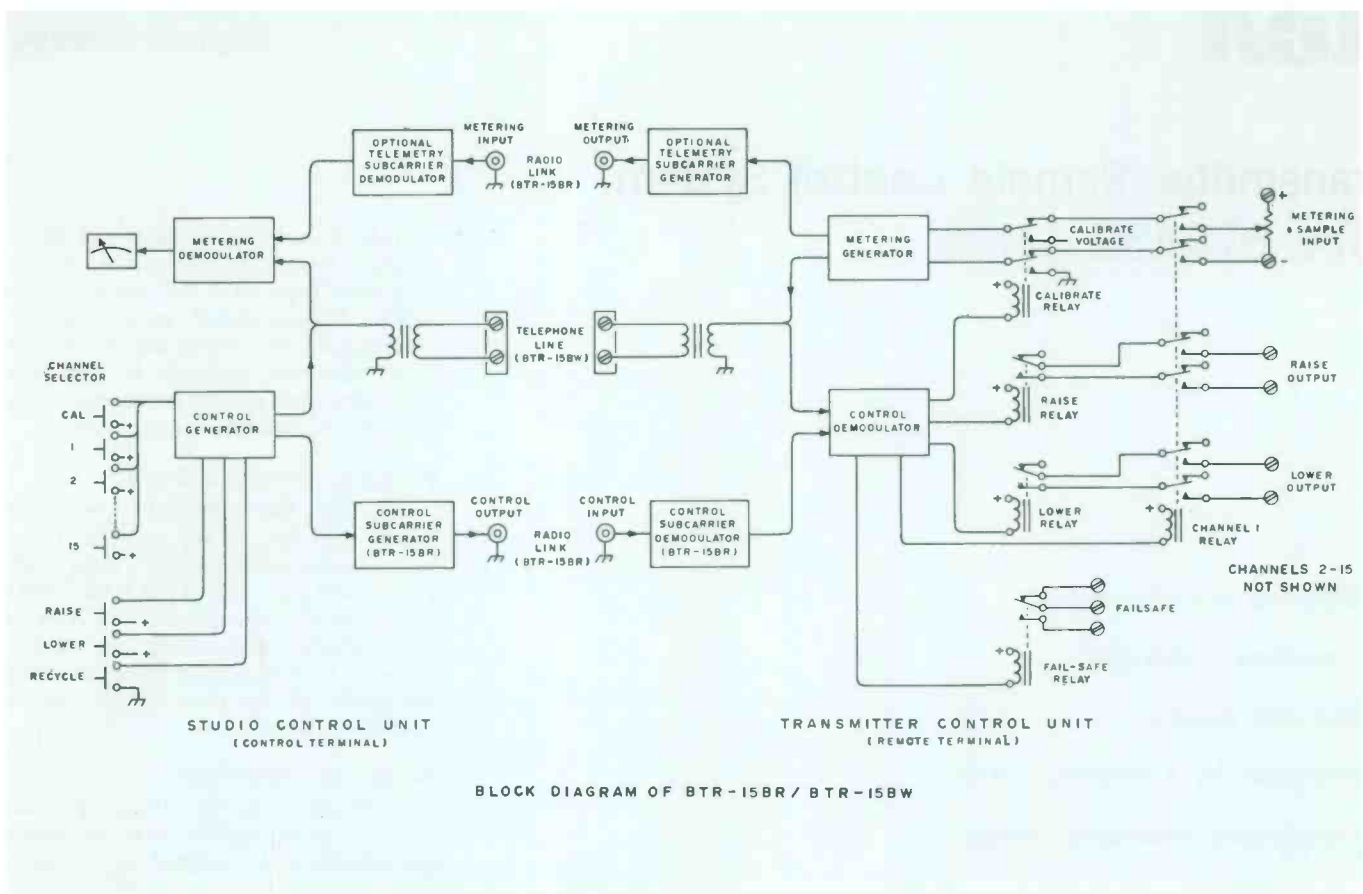
For those who want the extra convenience of a separate meter for each telemetry function, the BTR-15B includes provisions for the connection of up to 4 external meters. Each meter circuit is independent of the others to eliminate the common-return limitation.

Each external meter can be labelled and scaled according to its function (Requires additional meter panels, see *Accessories*).

Convertible, Accessible Design

Each model is convertible to the other through the changeover of certain plug-in modules. Consequently, the BTR-15B sidesteps premature obsolescence because of changing conditions at studio or transmitter.

As a result of the unit's excellent accessibility, changeover is extremely simple.



BLOCK DIAGRAM OF BTR-15BR / BTR-15BW

Specifications

- Telemetry Channels15 (plus calibration channel)
- Control Functions30 (15 on/raise; 15 off/lower)
- Metering ProvisionsOne time-shared meter; provision for up to 4 external meters
- Metering StabilityWithin $\pm 1\%$ (with weekly transmitter-unit checks and daily studio-unit checks, exclusive of operator setting or reading error).
- Telemetry Source Voltage Requirements.....1 to 10 V, positive or negative
- Telemetry Input IsolationUp to 350 V to ground
- Telemetry Input Impedance20,000 ohms
- Telemetry Tone Frequencies (Approx.)800-1200 Hz or 20-30 Hz
- Control Frequencies (Approx.)300 to 400 Hz
- Sub-carrier Frequencies (nominal)26 kHz or 110 kHz

Interconnection Requirements

Type BTR-15BW: Ordinary voice-grade, duplex telephone circuit, 600-ohm impedance; up to 30 dB loss of frequencies between 400 and 1200 Hz. D-c continuity unnecessary.

Type BTR-15BR: Control sub-carrier and detector included. Input and output levels 0.5V rms @ 2,000 ohms nominal. Telemetry return path handles 20 to 30 Hz sinusoidal waveform. Transmitter Control Unit telemetry output: Up to 6V p-p behind 600 ohms, unbalanced. Studio Control Unit telemetry input: 1.5V p-p, bridging, unbalanced.

Power Requirements

- Transmitter Unit120/240 V; 50/60 Hz, 20 W. nom.
- Studio Unit120/240 V; 50/60 Hz, 20 W. nom.

Dimensions

- Transmitter Unit5 1/4" H; 19" W; 13 5/8" D. (133 x 483 x 346 mm)
- Studio Unit5 1/4" H; 19" W; 13 5/8" D. (133 x 483 x 346 mm)

- Weight (approx.)20 lbs. (9 kg)
- Shipping Weight (each unit, approx.)60 lbs. (27 kg)
- Cube5.7 ft.³ (0.16 m³)

Accessories

- Extra MetersMI-561444*
- Meter Panels:
 - One MeterES-561443-1
 - Two MeterES-561443-2
 - Three MeterES-561443-3
- Subcarrier Generator (67 kHz; for telemetry)MI-560191-16
- Subcarrier Demodulator (67 kHz; for telemetry)MI-560141-17

Ordering Information

- Transmitter Remote Control System, Type BTR-15B Series:
 For use with voice-grade, two-way telephone circuit, (d-c continuity unnecessary):
 Type BTR-15BWES-561157
 For use with Studio-Transmitter Link (STL):
 Type BTR-15BR:
 (26 kHz sub-carrier)ES-561158-26
 (110 kHz sub-carrier)ES-561158-110

*Please specify desired range(s)

Remote Control Accessories

- Sampling kits
- Temperature alarm
- Tolerance alarm
- Motor kit
- Converters



Here are devices and accessories to expand the telemetry and control functions of transmitter remote-control systems.

- Voltage Pickup—MI-27516
- Tower Light Monitor and Control Unit—MI-27519
- Tower Light Monitor—MI-27544
- Power to Linear Converter—MI-561179
- Relays and Relay Panels—MI-561470, 71, -561448, 49
- Plate Voltage Sampling Kits—MI-561482, 83
- Remote Power Output Control—MI-561023
- Reversible Motor Kit—Type RMK-1
- Transmission Line Sampling Kits—Types RFK-1, -2, -3
- Metering Insertion Unit—MI-561458
- Metering Recovery Unit—MI-561459
- Modulation Monitor Adapter—MI-561460
- Chopper-Stabilized DC Amplifier—MI-561461
- Tower-Light Monitor Kit—MI-561462
- Line-Voltage Sampling Kit—MI-561463
- Plate-Circuit Sampling Kit—MI-561464
- Temperature Sensing Kit—MI-561465
- Tolerance Alarm—MI-561469, 184

Note:

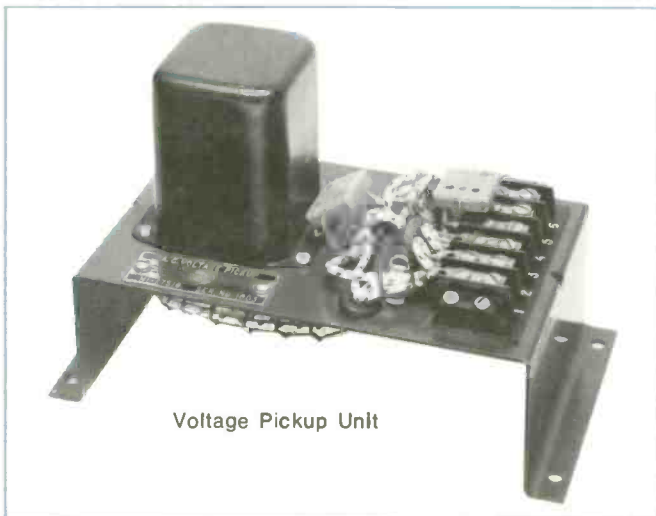
See "AM Antenna Accessories" RA.6311B for RF Ammeters and remote control accessories. For phase monitors see the AM phase monitor catalog RA.6411B.

Voltage Pickup Unit

Installed at the transmitter, this device senses the presence of a-c voltage—115 or 230V—and converts it into a signal compatible with the remote-control system.

Ordering Information

Voltage Pickup MI-27516



Voltage Pickup Unit

Tower Light Monitor Unit

Incorporating only the monitoring functions of the unit above, the Tower Light Monitor is intended for lighting circuits where control is separate. Handles up to 20A of a-c current.

Ordering Information

Tower Light Monitor MI-27544



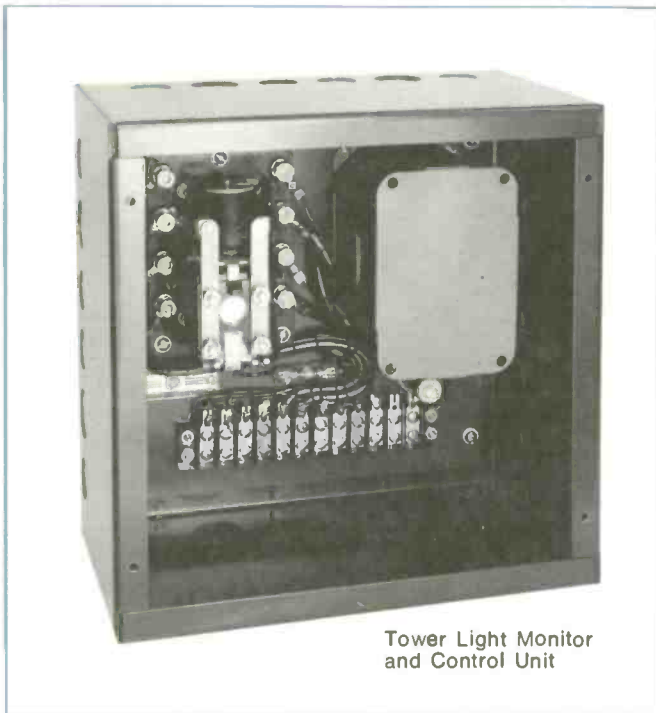
Tower Light Monitor Unit

Tower-Light Monitor and Control Unit

Connected to the tower-lighting circuit of an antenna array, this unit provides metering and control of the circuit via the remote-control system. It provides a d-c voltage proportionate to the current (up to 20A) in the lighting circuit and includes a relay for on-off control of the lighting circuit.

Ordering Information

Tower Light Monitor and Control Unit MI-27519



Tower Light Monitor and Control Unit

Power-to-Linear Converter, Type PLC-1

Amplifies low-level d-c current sample (which represents the transmitter power output via reflectometer) and amplifies it to a level compatible with the TCR-15. Remote Control System and/or automatic logging equipment. The unit includes both logarithmic and linear outputs.

Specifications

Input Impedance 2200 ohms¹
 Input Level 15 to 500 μ A
 Output Load 5000 ohms (min.)
 Output Levels (log. and lin.) 1.5V dc, 10k ohms
 Temperature Range 0 to 150°F (-18 to 66°C)
 Power Requirements 120V ac, 50-480 Hz, 5W
 Dimensions 5" x 7½" x 2" (127, 191, 51 mm)
 Weight (Approx.) 2 lbs. (910g)
 Shipping Weight (Approx.) 3 lbs. (1.4 kg)

¹ Input impedance convertible in the field to any value less than 4700 ohms.

Ordering Information

Power-to-Linear Converter, Type PLC-1 (Not shown) MI-561179

Relays and Relay Panels

For use with any remote control system, these relays and relay panels provide isolated control circuitry. Panels hold up to eight relays and require eight inches (203 mm) clearance behind. Relays are all double-pole, double-throw units with momentary or latching action available.

Specifications

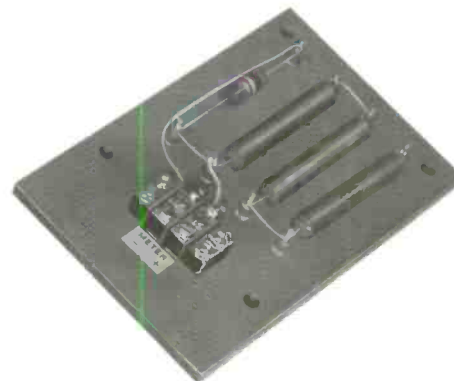
Panel Dimensions 5¼" H, 19" W (133, 483 mm)
 Weight (Panel and eight relays, approx.) 10 lbs. (4.5 kg)
 Shipping Weight (Approx.) 12 lbs. (5.5 kg)

Ordering Information

Relay, DPDT, 120V coil MI-561471-1
 Relay Panel (for MI-561471-1 above) MI-561470

Plate Voltage Sampling Kits, Type PVK-1, -2

Samples plate voltage for telemetry via remote control. PVK-1 kit for all voltages below to 3 kV; PVK-2 for voltages above 3 kV and less than 20 kV.



Ordering Information

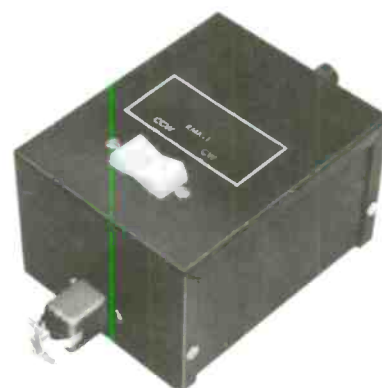
Plate Voltage Sampling Kits (Please specify nominal plate voltage):

- For Voltages 1 to 3 kV, Type PVK-1 MI-561482-1¹
- For Voltages 3 to 10 kV, Type PVK-1 MI-561482-2¹
- For Voltages between 10 and 20 kV, Type PVK-2 MI-561483

¹Please specify plate voltage.

Reversible Motor Kit, Type RMK-1

A 120-volt, a-c, reversible motor for operation of transmitter controls. A flexible 6-inch (152 mm) shaft (included) couples the motor to any 1/4-inch (6 mm) control shaft. Motor operates at one rpm and is equipped with an adjustable clutch to prevent control-stop damage. Power connectors and local-control switch included.



Specifications

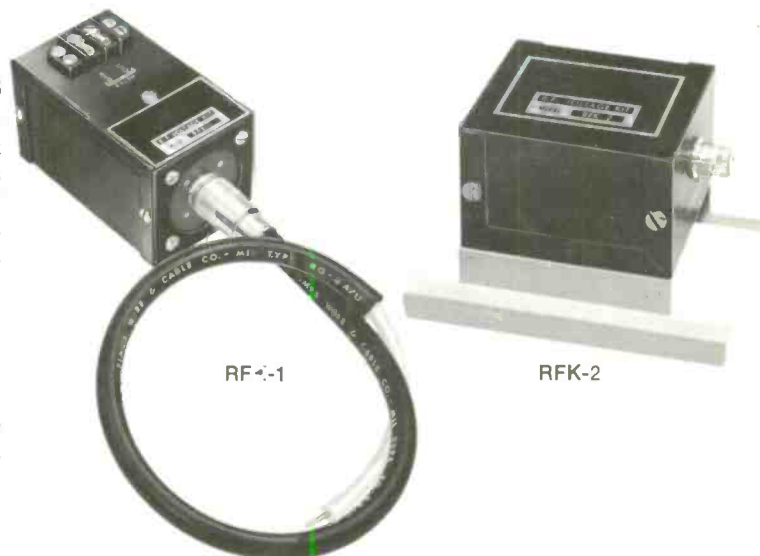
- Motor Torque 120 inch-oz.
- Shaft Velocity 1 rpm
- Power Requirements 120V, 50-60 Hz, 5W
- Dimensions 3" x 4" x 7" (76, 02, 178 mm)
- Weight (Approx.) 1.5 lbs. (681g)
- Shipping Weight (Approx.) 2 lbs. (910g)

Ordering Information

- Reversible Motor Kit Type RMK-1

Transmission Line Sampling Kits, Type RFK-1,-2,-3

Converts RF voltage to d-c for telemetry of transmission line or common-point currents. RFK-1 is for AM-broadcast frequencies and uses an input coaxial cable that functions as one leg of a capacitive voltage-divider network; the RFK-2 and -3 are for FM-broadcast operations and use samples from an unpressurized coaxial transmission line. Connector is BNC-type. Attaches to line with stainless-steel straps.



Ordering Information

- Transmission Line Sampling Kits:
- For AM Broadcast Frequencies Type RFK-1
 - For FM Broadcast, 3/8-inch T/L Type RFK-2
 - For FM Broadcast, 1/8-inch T/L Type RFK-3

Modulation Monitor Adaptor, Type MMA-1

Develops a d-c voltage proportional to the audio output of any modulation monitor. Functioning as a peak-reading audio detector, the response of the system is limited only by the ballistics of the meter the unit drives. Internal strapping provides pre-emphasis for accurate modulation indication. The MMA-1 can drive local extension meters or an RCA remote control system. Powered from current production Remote Control Systems.

Specifications

Input Requirements:	
Level	-20 to +10 dBm
Impedance	600 ohms, balanced
Output Level	2V dc max.
Power Requirements (Regulated)	+10; -10V dc, 15 mA
Dimensions	2" x 9" x 3.5" (51, 229, 89 mm)
Weight (Approx.)	1 lb. (454g)
Shipping Weight (Approx.)	2 lbs. (910g)

Ordering Information

Modulation Monitor Adaptor, Type MMA-1 MI-561460



Chopper-Stabilized DC Amplifier, Type CSA-3

Allows sampling of sensitive d-c circuits in frequency monitors, reflectometers and the like without affecting the usual operation of the sampled device. The amplifier uses a floating input so that the sampled circuit can be positive, negative or isolated by as much as 400V above ground. Gain and bias (zero-adjust controls included (screw-driver adjustments)).

Specifications

Gain Characteristics (Adjustable, voltage)	45
Input Termination	2200 ohms ²
Input Sensitivity (1.5V output)	15 μ A
Ambient Temperature Range	0 to 150°F (-18 to 66°C)
Power Requirements	120V, 50-60 Hz, 10W
Dimensions	5.25" x 7.5" x 2" (133, 191, 51 mm)
Weight (Approx.)	2 lbs. (910g)
Shipping Weight (Approx.)	3 lbs. (1.4 kg)

² Input resistor field convertible to any value up to 4700 ohms.

Ordering Information

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



Metering Insertion Unit, Type MIU-1

Connects between the program line and transmitter audio input to inject telemetry information as subaudible tones into the modulation envelope. Performs three additional functions: one, it filters out program audio in the spectrum used for telemetry; two, provides and on/off function for the subaudible metering signal; three, provides an audio pad for adjustment of total modulation to the 110-percent point when operating without subaudible telemetry. (not illustrated.)

Specifications

Subaudible Frequency Range	20 to 30 Hz
Insertion Loss	.5 dB
Filter Attenuation (20-30 Hz)	.50 dB min.
Power Requirements	None
Dimensions	3.75" x 19" x 4" (89, 483, 102 mm)
Weight (Approx.)	3 lbs. (1.4 kg)
Shipping Weight (Approx.)	6 lbs. (2.7 kg)

Ordering Information

Metering Insertion Unit, Type MIU-1 (not shown) ... MI-561458

Tower Light Monitor Kit, Type TLK-2

Monitors a-c currents in tower-lighting systems. Provides a means of sampling current for display on remote metering. Responsive to flash rate of the beacon and to the number of obstruction lights in operation.

Specifications

Sensitivity Range 2 to 50 A ac
 Dimensions 4" x 2.25" x 2.25" (102, 57, 57 mm)
 Weight (Approx.) 1 lb. (454g)
 Shipping Weight (Approx.) 1.5 lbs. (671g)

Ordering Information

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



Line Voltage Sampling Kit, Type LVK-2

Samples power line voltage for remote monitoring. Contains transformer rectifier and filter for conversion of single-phase a-c voltage into proportional d-c voltage for telemetry.

Specifications

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

Ordering Information

Line Voltage Sampling Kit, Type LVK-1 MI-561463



Metering Recovery Unit, Type MRU-1

A complementary device to the Metering Insertion Unit described above. The Type MRU-1 recovers the subaudible telemetry information from a demodulated air signal. Connects between the audio output of a modulation monitor and the telemetry input of a transmitter remote-control system unit. (Not illustrated.)

Specifications

Input:
 Impedance 600 ohms
 Level (at 100% mod.) -20 to +10 dBm
 Power Requirements None
 Dimensions 3.75" x 19" x 7" (89, 483, 118 mm)
 Weight (Approx.) 8 lbs. (3.6 kg)

Ordering Information

Metering Recovery Unit (Not shown) Type MRU-1

Remote Power-Output Controls

A reversible, 120V a-c motor for operation of the power-output control of RCA low-power FM transmitters. Includes mounting brackets and all necessary hardware. (Not illustrated.)

Specifications

Weight (Approx.) 1 lb. (454g)
 Shipping Weight (Approx.) 2 lbs. (910g)

Ordering Information

Remote Power-Output Control:
 For RCA Type BTF-3E1, -5E2 Transmitters MI-561023

Plate Circuit Sampling Kit, Type MBB-1

Samples plate current (or plate voltage using an external, series resistor). Particularly useful in circuits operating above ground potential or with a positive ground. External shunt or series resistors are required but not included. Shunt required when sample current exceeds 5mA.

Specifications

Sensitivity (1V output) 3 mA
 Insulation Potential (Max. peak) 10,000V dc
 Dimensions 4" x 4" x 7" (102, 102, 178 mm)
 Weight (Approx.) 1 lb. (454g)
 Shipping Weight (Approx.) 2 lbs. (910g)

Ordering Information

Plate Circuit Sampling Kit, Type MBB-1 MI-561464



Temperature Sensing Kit, Type TSK-3

Providing an accurate means for monitoring building, air-inlet, exhaust or similar temperatures, the kit converts a temperature into a d-c potential which may be indicated on a remote-control and/or automatic logging systems. Features a linear transfer characteristic and needs no conversion tables or graphs for interpretation. Operating power available from BTR-15 or -30 Remote Control System.

Specifications

Temperature Range 0 to 140°F (-18 to 60°C)
 Dimensions 3½" x 2" x 7" (89, 51, 178 mm)
 Weight (Approx.) 1 lb. (454g)
 Shipping Weight (Approx.) 1.5 lbs. (671g)

Ordering Information

Temperature Sensing Kit Type TSK-3



Tolerance Alarm, Type TAU-3

Monitors telemetry sample voltages and triggers alarm when samples exceed preset limits. Handles one to eight samples per rack frame, is entirely electronic without moving parts, calibrates easily and provides visual indication of out-of-tolerance condition. Used with an external reference voltage, the tolerance alarm modules function as ratio-alarm units.

Specifications

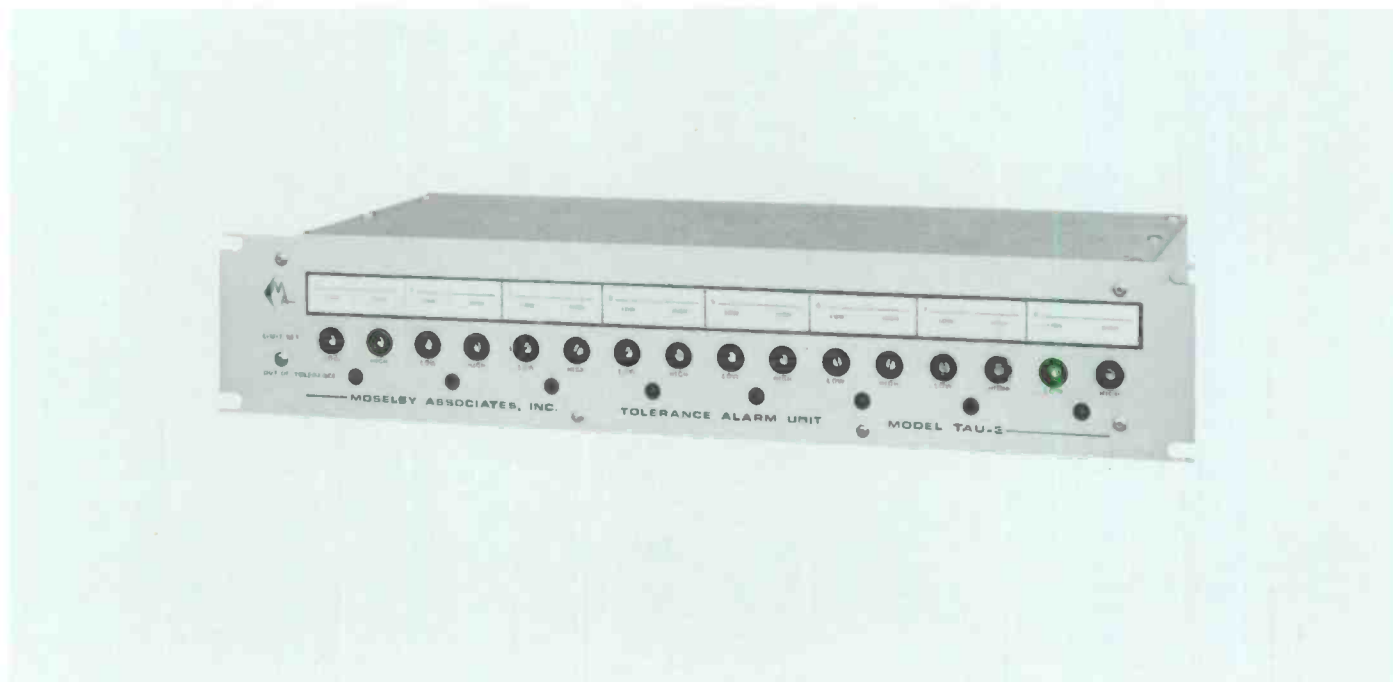
Channels 1 to 8 per frame, plug-in modules
 Trip Point Hysteresis (Centered on Input) $\pm 0.005V$
 Input Requirements (Gnd. ref.) -3 to $+3V$ dc
 Input Impedance 30,000 ohms
 Indicator (Each Module) Light-Emitting Diode

Outputs:

Alarm Transistor Switch
 Relay Power (Relay not supplied) ... 16V dc, 600 ohm load
 External Reference Voltage
 (If Used) ... Twice Sample Voltage but less than $+8V$ dc
 External Ref. Input Impedance 22,000 ohms
 Ambient Operating Temperature 0 to 140°F (-18 to $60^{\circ}C$)
 Power Requirements 120/240V, 50-60 Hz, 30W max.
 Dimensions (Frame) ... 19" W; 3½" H; 7½" D (483, 89, 191 mm)
 Weight (Frame & 10 Modules, approx.) 9 lbs. (4.1 kg)
 Shipping Weight (Approx.) 15 lbs. (7 kg)

Ordering Information

Tolerance Alarm System, Type TAU-3:
 Module MI-561184
 Main Frame (For 1 to 10 modules) MI-561469





Automatic Power Output Control, Type BTC-100

- Use with AM, FM, and TV Transmitters
- Any power output
- Voltage comparator solid state circuitry
- Fail Safe protection

The Type BTC-100 Automatic Power Output Control is a transmitter accessory used to increase or decrease automatically and to maintain a constant transmitter power output of any AM, FM, or aural portion of a TV Transmitter.



As a transmitter accessory, the BTC-100 can be an important component of a total automatic transmitter and is operated independently of other controlled parameters. It is a system that is simply installed either in a 8¾" x 19" panel space directly in the transmitter being controlled or in an adjacent equipment rack.

The BTC-100 samples the RF power through a calibrated directional coupler or other stable RF source and compares this power with a standard reference voltage generated internally. Any change in

power will cause the BTC-100 to actuate relays that operate the raise or lower circuitry of the transmitter.

A double set point type power indicating meter on the BTC-100 Control Panel provides fail safe operation.

The meter contains adjustable indicators that can be set to give a high and low trip point for disabling the automatic power control should the indicated operating power go above or below the preset limits. A "dead band" adjustment for

narrow or broadened comparative range of power governs the constancy of the automatic control unit. The BTC-100 allows for delayed operation to permit the transmitter to come up to power after a cold start.

Extensions of the automatic or manual switching mode give the operation of the BTC-100 the capability of remote control, providing main transmitter to auxiliary switching, transmitter shut-down and reset after the power is adjusted to the proper level, status indication and alarm.

Specifications

Current Input (100% power)	133 micro amps
Power Stability (at a constant ambient temperature with range of 0-45°C)	±3%
Power Requirements	120/240V, 50/60 Hz, 30 watts
Weight	25 lbs. (11 kg)
Dimensions	8¾" H x 19" W x 6" D (222 x 483 x 152 mm)

Accessories

For AM	
BW-51 Modulation Monitor	MI-561042

For FM	
Directional Coupler	MI-561043*
CSA-3 DC Chopper-Stabilized Amplifier	MI-561461
PLC-1 Power to Linear Converter	MI-561179
TAU-2 Tolerance Alarm	MI-561469
Modules for TAU-2	MI-561184

*For BTF-20E/20E1 use MI-561043-4. For BTF-5E/5E1 use MI-561043-12.
For BTF-10E/10E1 use MI-561043-8. For Aural TV, on request.

Ordering Information

BTC-100 Automatic Power Control	MI-561353
Installation Material	MI-561358

but

catalog RA.4011B

(Replaces RA.4011A)

RCA

Studio-Transmitter Links and Remote-Pickup Links ("STL" and "RPL")

- STL equipment for 150, 220, 300, 450 and 960 MHz
- RPL equipment for 150 and 450 MHz
- All systems entirely solid-state
- Receivers and transmitters of matched characteristics



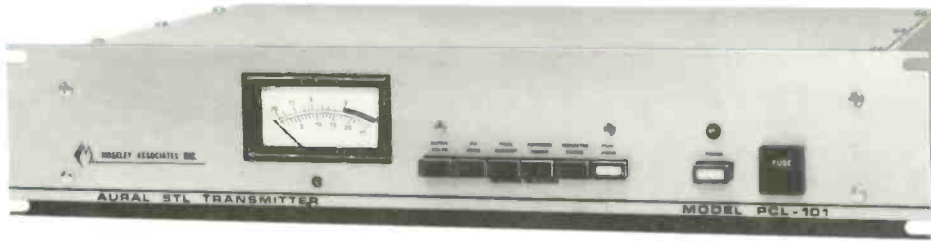
Here are abridged specifications, in tabular form, for several studio-to-transmitter links and equipment for remote program pickup.

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RPL equipment is used for the relay of programming, produced on-location, to the studio or transmitter sites via frequency-modulated radio. The equipment operates from an automotive electrical system (12V) or from commercial power lines.

RCA distributes the STL and RPL products as well as the appropriate accessories of two manufacturers: "Marti" and "Moseley". Marti gear is made by Marti Electronics, Inc., of Cleburne, Texas. Moseley equipment comes from Moseley Associates, Inc., of Goleta, California.

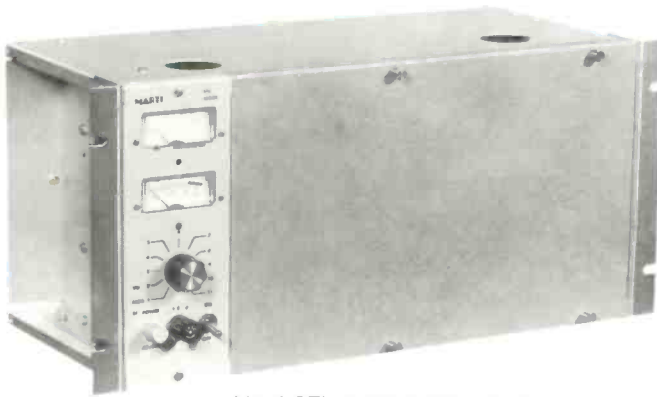
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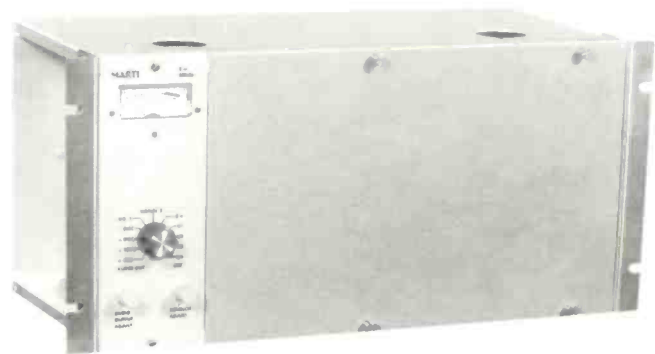
Moseley STL transmitter, PCL-101. Requires only 3.5 inches of rack space and turns out 10 to 15 watts of RF power. Available for 148-174, 215-240 or 300-330, 450-470 and 890-960 MHz operation.



Moseley STL Receiver, PCL-101. Companion to transmitter above. Occupies only 1.75 inches of rack space and uses only 15 watts of power.



Marti STL-8 transmitter. Typical of Marti STL equipment. Operates in the 890-950 MHz radio spectrum at five watts output. Requires only 5.25 inches of rack space.



Marti R-200. Companion to transmitter at left. Occupies only 5.25 inches of rack space and requires only 15 watts of power.



Moseley STL Transmitter, PCL-505. Provides up to 15 watts power output in 890-950 MHz spectrum. Available for composite stereo as PCL-505/C.

Moseley STL receiver, PCL-505. Companion to transmitter at left. Requires only 5.25 inches of rack space and only 15 watts power.



Abridged Specifications—Studio Transmitter Links (STL)

Manufacturer & Model Number	SYSTEM CHARACTERISTICS										TRANSMITTER CHARACTERISTICS										TRANSMITTER CHARACTERISTICS									
	Frequency Range (MHz)	Freq. Resp. (Hz)	Distortion (%)	S/N Ratio (dB)	Power Out (W)	Devia- tion (kHz)	Freq. Stability (%)	Spurious	AM Noise (dB)	Temp. Range	Input (600Ω)	Power Requirements			Dimensions			Millimeters			Weight									
												Volts	Watts	Hz.	H"	W"	D"	H	W	D	lbs	kg								
Moseley PCL-101 ¹	148-174	±1.5 dB 50-15k	1%	60	10-15	±5	±.0005	-65	-70	-20 to +60	+10	120/240	50/60	45	3 1/2	19	14	89	483	356	12	5.4								
	215-240	±1.5 dB 50-15k	1%	60	10-15	±5	±.0005	-65	-70	-20 to +60	+10	120/240	50/60	45	3 1/2	19	14	89	483	356	12	5.4								
	300-330	±1.5 dB 50-15k	1%	60	10-15	±10	±.0005	-65	-70	-20 to +60	+10	120/240	50/60	45	3 1/2	19	14	89	483	356	12	5.4								
	450-470	±1.0 dB 50-15k	1%	60	10-15	±12	±.0005	-65	-70	-20 to +60	+10	120/240	50/60	45	3 1/2	19	14	89	483	356	12	5.4								
	890-960	±1.0 dB 50-15k	1%	60	10-15	±40	±.0005	-65	-70	-20 to +60	+10	120/240	50/60	45	3 1/2	19	14	89	483	356	12	5.4								
	148-174	±.4 dB 30-15k	.4%	68	10-15	±40	±.0005	-60	-70	-20 to +60	+10	120/240	50/60	80	3 1/2	19	16	89	483	406	15	6.8								
Moseley PCL-505	215-240	±.4 dB 30-15k	.4%	68	10-15	±40	±.0005	-60	-70	-20 to +60	+10	120/240	50/60	80	3 1/2	19	16	89	483	406	15	6.8								
	300-330	±.4 dB 30-15k	.4%	68	10-15	±40	±.0005	-60	-70	-20 to +60	+10	120/240	50/60	80	3 1/2	19	16	89	483	406	15	6.8								
	450-470	±.4 dB 30-15k	.4%	68	10-15	±40	±.0005	-60	-70	-20 to +60	+10	120/240	50/60	80	3 1/2	19	16	89	483	406	15	6.8								
	890-960	±.4 dB 30-15k	.4%	68	10-15	±40	±.0005	-60	-70	-20 to +60	+10	120/240	50/60	80	3 1/2	19	16	89	483	406	15	6.8								
	148-174	±.5 dB 30-75k	.4% 30-60k	68	10-15	±60	±.0005	-60	-70	-20 to +60	Note 4	120/240	50/60	80	3 1/2	19	16	89	483	406	15	6.8								
	215-240	±.5 dB 30-75k	.4% 30-60k	68	10-15	±60	±.0005	-60	-70	-20 to +60	Note 4	120/240	50/60	80	3 1/2	19	16	89	483	406	15	6.8								
Marri STL-25/100	148-174	±1.0 dB 30-15k	1.0% 50-15k	60	21-25	±8	±.0005	-60	-55	-30 to +60	+10	115/230	50/60	110	8.75	19	8.25	222	483	210	20	9.1								
	215-240	±1.0 dB 30-15k	0.6% 50-15k	60	21-25	±8	±.0005	-60	-55	-30 to +60	+10	115/230	50/60	110	8.75	19	8.25	222	483	210	20	9.1								
	300-330	±0.5 dB 30-15k	0.6% 50-15k	60	15-18	±17.5	±.0005	-60	-55	-30 to +60	+10	115/230	50/60	110	8.75	19	8.25	222	483	210	20	9.1								
	450-470	±0.5 dB 30-15k	0.6% 50-15k	62	15-18	±17.5	±.0005	-60	-55	-30 to +60	+10	115/230	50/60	110	8.75	19	8.25	222	483	210	20	9.1								
	890-960	±0.5 dB 30-15k	0.5% 50-15k	64	12-15	±22.5	±.0005	-60	-55	-30 to +60	+10	115/230	50/60	110	8.75	19	8.25	222	483	210	20	9.1								
	148-174	±0.5 dB 30-15k	0.5% 50-15k	66	6-8	±52.5	±.0005	-60	-55	-30 to +60	+10	115/230	50/60	110	8.75	19	8.25	222	483	210	20	9.1								

Manufacturer & Model Number	RECEIVER CHARACTERISTICS										RECEIVER CHARACTERISTICS										RECEIVER CHARACTERISTICS									
	Frequency Range (MHz)	Sensitivity ¹	Stability %	Selectivity	Output (dBm 600Ω)	Power Requirements			Dimensions			Millimeters			Weight															
						Volts	Watts	Hz.	H"	W"	D"	H	W	D	lbs	kg														
Moseley PCL-101 ¹	148-174	1.5 @ 20	±.0005	90	+10	120/240	50/60	15	1.75	19	45	483	279	8	36															
	215-240	1.5 @ 20	±.0005	90	+10	120/240	50/60	15	1.75	19	45	483	279	8	36															
	300-330	1.5 @ 20	±.0005	90	+10	120/240	50/60	15	1.75	19	45	483	279	8	36															
	450-470	1.5 @ 20	±.0005	90	+10	120/240	50/60	15	1.75	19	45	483	279	8	36															
	890-960	25 @ 60	±.0005	90	+10	120/240	50/60	15	1.75	19	45	483	356	8	36															
	148-174	2 @ 20	±.0005	180	+10	120/240	50/60	15	1.75	19	45	483	356	8	36															
Moseley PCL-505 ²	215-240	2 @ 20	±.0005	180	+10	120/240	50/60	15	1.75	19	45	483	356	8	36															
	300-330	2 @ 20	±.0005	180	+10	120/240	50/60	15	1.75	19	45	483	356	8	36															
	450-470	2 @ 20	±.0005	180	+10	120/240	50/60	15	1.75	19	45	483	356	8	36															
	890-960	15 @ 60	±.0005	180	+10	120/240	50/60	15	1.75	19	45	483	356	8	36															
	148-174	2 @ 20	±.0005	330	Note 6	120/240	50/60	15	1.75	19	45	483	356	8	36															
	215-240	2 @ 20	±.0005	330	Note 6	120/240	50/60	15	1.75	19	45	483	356	8	36															
Marri STL-25/100	148-174	0.7 @ 20	±.0005	100	+10	115/230	50/60	30	8.75	19	222	483	210	16	7.3															
	215-240	0.7 @ 20	±.0005	100	+10	115/230	50/60	30	8.75	19	222	483	210	16	7.3															
	300-330	20 @ 60	±.0005	100	+15	115/230	50/60	30	8.75	19	222	483	210	16	7.3															
	450-470	20 @ 60	±.0005	100	+15	115/230	50/60	30	8.75	19	222	483	210	16	7.3															
	890-960	32 @ 60	±.0005	220	+18	115/230	50/60	30	8.75	19	222	483	210	16	7.3															
	148-174	0.7 @ 20	±.0005	100	+10	115/230	50/60	30	8.75	19	222	483	210	16	7.3															

¹Other frequencies in 148-470 MHz spectrum available on special order.
²(AM Noise) below carrier level.
³(Temp. Range) for frequency stability (°C).
⁴(Input) 3.5V P-P, 2000Ω, resistive, unbalanced, type BNC connector.
⁵(Sensitivity) microvolts (RMS) at quieting level.
⁶(Output) 3.5V P-P, 1000Ω unbalanced, type BNC connector.

Abridged Specifications—Remote Pickup Links (RPL)

Manufacturer and Model Number	SYSTEM CHARACTERISTICS										TRANSMITTER CHARACTERISTICS						TRANSMITTER CHARACTERISTICS					
	Freq. Range (MHz)	Freq. Resp.	Dist.	S/N Ratio (dB)	Power Out (W)	Deviation (kHz)	Freq. Stab. (%)	Spurious ¹	Temp. Range	Input Load	Primary Power			Dimensions			Millimeters			Weight		
											Volts	Freq.	Power	H"	W"	D"	H	W	D	lbs	kg	
Moseley RPL-3	148-174	30-10k ±1.5 dB	30-10k 1.3%	55	10-13	±5	±.0005	-60	-20 to 60°C	-60 to +10 dBm	120/240 11-15 DC	50/60 45W (AC) 2A (DC)	4	14.5	11	102	863	279	16	72		
Moseley RPL-4	450-470	30-10k ±1.5 dB	30-10k 1.3%	55	10-13	±12	±.0005	-60	-20 to 60°C	-60 to +10 dBm	120/240 11-15 DC	50/60 45W (AC) 2A (DC)	4	14.5	11	102	863	279	16	72		
Marti RPT-40/R30	150-172	30 to 7.5k ±1.5 dB	2% max.	50	36-40 ¹	±5	±.0005	-60	-20 to 45°C	-70 to 4 dBm ²	115/230 13.6 DC	50/60 155 7A	6.25	15	12	159	381	305	20	9.1		
Marti RPT-25/R-50	450-470	30 to 12k ±1.5 dB	2% max.	50	20-25 ³	±9	±.0005	-60	-20 to 45°C	-70 to 4 dBm ²	115/230 11-15 DC	50/60 155 7A	6.25	15	12	159	381	305	20	9.1		
Marti RTP-1/150	150-172	60 to 7.5k ±2.0 dB	2.75% max.	45	1	±5	±.0005	FCC	-10 to 50°C	-65 to 2 volts	11 to 12.6 DC	250ma	10	2 3/4	8	25	6.9	20	5 1/4	2.4		
Marti RTP-1/450	450-470	60 to 7.5k ±2.0 dB	2.75% max.	45	1	±9	±.0005	FCC	-10 to 50°C	-65 to 2 volts	11 to 12.6 DC	350ma	10	2 3/4	8	25	6.9	20	7 1/2	3.3		

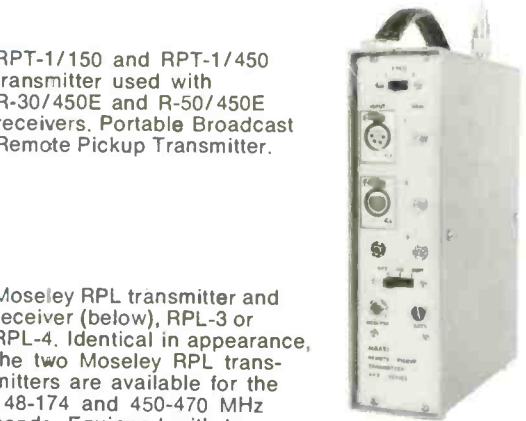
Manufacturer and Model Number	RECEIVER CHARACTERISTICS										RECEIVER CHARACTERISTICS						RECEIVER CHARACTERISTICS					
	Freq. Range (MHz)	Stability %	Sensitivity ¹ (%)	Selectivity	Spurious ²	Output (dBm at 600Ω)	Power Requirements			Dimensions			Millimeters			Weight						
							Volts	Freq.	Power (W)	H"	W"	D"	H	W	D	lbs	kg					
Moseley RPL-3	148-174	±.0005	1.0 @ 20	±22 kHz	-65	+10	120/240	50/60	10	1.75	19	10	45	483	452	8	3.6					
Moseley RPL-4	450-470	±.0005	1.0 @ 20	±44 kHz	-65	+10	120/240	50/60	10	1.75	19	10	45	483	452	8	3.6					
Marti RPT-40/R-30	148-170	±.0005	0.5 @ 20	±17.5 kHz	-95	+10	115/230	50/60	30	8.75	19	8.25	222	483	210	16	7.3					
Marti RPT-25/R-50	450-470	±.0005	0.5 @ 20	±22.5 kHz	-95	+10	115/230	50/60	30	8.75	19	8.25	222	483	210	16	7.3					

¹Two 50-150 mike inputs one 50,000 ohms unbalanced input. Mike input level -60 to -40 dBm; line level -15 to 10 dBm, 600 ohm source.
²Audio response extended to 15,000 Hertz on special order.
³(Spurious) Below carrier level (dB).

⁴Nominal 36W, 40W max.
⁵Nominal 20W, 25W max.
⁶Microphone at quieting level, measured through 4 kHz filter (low pass audio).
⁷(Sensitivity) Microvolts at dB of quieting.



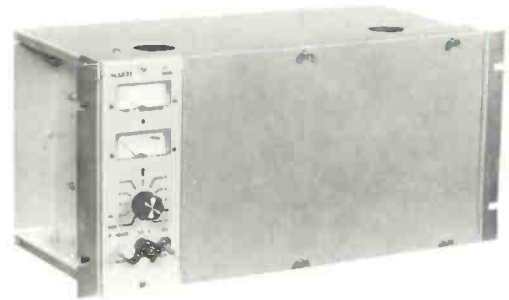
Moseley RPL transmitter and receiver (below), RPL-3 or RPL-4. Identical in appearance, the two Moseley RPL transmitters are available for the 148-174 and 450-470 MHz bands. Equipped with two low-level inputs.



RPT-1/150 and RPT-1/450 transmitter used with R-30/450E and R-50/450E receivers. Portable Broadcast Remote Pickup Transmitter.



Marti remote-pickup transmitter. Four audio inputs and a multi-purpose front-panel meter. Available for 150-172 and 450-470 MHz bands.



Marti STL transmitter, STL-25. Typical in appearance of all Martin STL and RPL transmitters. Available for 88-108, 148-174, 215-240, 300-340, 450-470 and 942-960 MHz bands.



Studio-Transmitter Links and Remote-Pickup Links ("STL" and "RPL")

- STL equipment for 150, 220, 300, 450 and 960 MHz
- RPL equipment for 150 and 450 MHz
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- Receivers and transmitters of matched characteristics



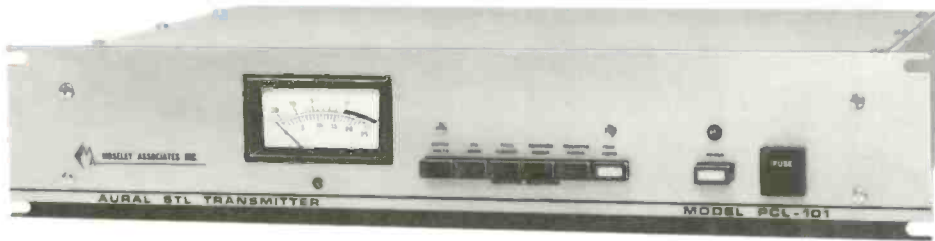
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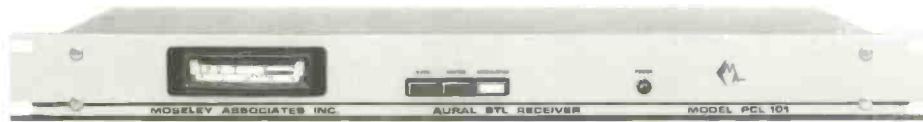
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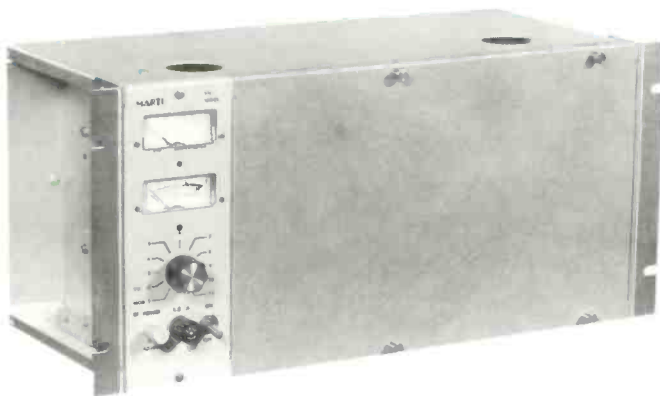
The specifications reproduced here are abridged and arranged tabularly for your convenience. The manufacturer's literature used as the source for this chart is available from any RCA Broadcast Sales Representative or Radio Station Equipment Product Management, RCA Building 2-5, Camden, N.J. 08102. We recommend that you review the manufacturer's literature before placing your order for systems and accessories.



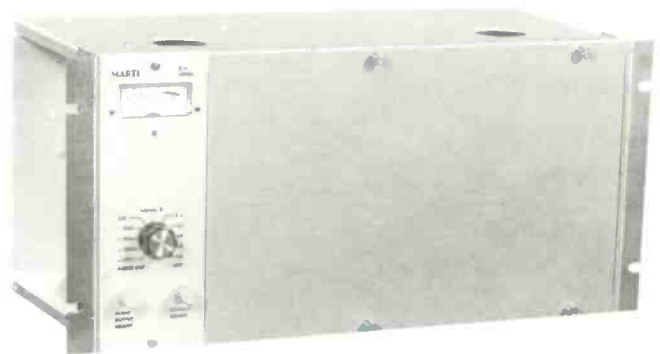
Moseley STL transmitter, PCL-101. Requires only 3.5 inches of rack space and turns out 10 to 15 watts of RF power. Available for 148-174, 215-240 or 300-330, 450-470 and 890-960 MHz operation.



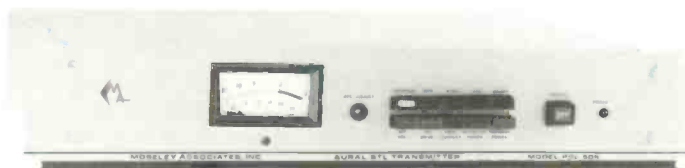
Moseley STL Receiver, PCL-101. Companion to transmitter above. Occupies only 1.75 inches of rack space and uses only 15 watts of power.



Marti STL-8 transmitter. Typical of Marti STL equipment. Operates in the 890-950 MHz radio spectrum at five watts output. Requires only 5.25 inches of rack space.



Marti R-200. Companion to transmitter at left. Occupies only 5.25 inches of rack space and requires only 15 watts of power.



Moseley STL Transmitter, PCL-505. Provides up to 15 watts power output in 890-950 MHz spectrum. Available for composite stereo as PCL-505/C.

Moseley STL receiver, PCL-505. Companion to transmitter at left. Requires only 5.25 inches of rack space and only 15 watts power.



Abridged Specifications—Studio Transmitter Links (STL)

Manufacturer & Model Number	SYSTEM CHARACTERISTICS										TRANSMITTER CHARACTERISTICS										TRANSMITTER CHARACTERISTICS									
	Frequency Range (MHz)	Freq. Resp. (Hz)	Distortion (%)	S/N Ratio (dB)	Power Out (W)	Devia- tion (kHz)	Freq. Stability (%)	Spurious	AM ² Noise (dB)	Temp. ³ Range	Input (600 ¹)	Power Requirements		Dimensions				Millimeters				Weight								
												Volts	Watts	H"	W"	D"	H	W	D	H	W	D	lbs	kg						
Moseley PCL-101 ¹	148-174	±1.5 dB 50-15k	1%	60	10-15	±5	±.0005	-65	-20 to +60	+10	120/240	50/60	45	3 1/2	19	14	89	483	356	12	5.4									
	215-240	±1.5 dB 50-15k	1%	60	10-15	±10	±.0005	-65	-20 to +60	+10	120/240	50/60	45	3 1/2	19	14	89	483	356	12	5.4									
	300-330	±1.5 dB 50-15k	1%	60	10-15	±12	±.0005	-65	-20 to +60	+10	120/240	50/60	45	3 1/2	19	14	89	483	356	12	5.4									
	450-470	±1.0 dB 50-15k	1%	60	10-15	±40	±.0005	-65	-20 to +60	+10	120/240	50/60	45	3 1/2	19	14	89	483	356	12	5.4									
	890-960	±1.0 dB 50-15k	1%	60	10-15	±40	±.0005	-60	-20 to +60	+10	120/240	50/60	80	3 1/2	19	16	89	483	406	15	6.8									
Moseley PCL-505	148-174	±4 dB 30-15k	.4%	68	10-15	±40	±.0005	-60	-20 to +60	+10	120/240	50/60	80	3 1/2	19	16	89	483	406	15	6.8									
	215-240	±4 dB 30-15k	.4%*	68	10-15	±40	±.0005	-60	-20 to +60	+10	120/240	50/60	80	3 1/2	19	16	89	483	406	15	6.8									
	300-330	±4 dB 30-15k	.4%	68	10-15	±40	±.0005	-60	-20 to +60	+10	120/240	50/60	80	3 1/2	19	16	89	483	406	15	6.8									
	450-470	±4 dB 30-15k	.4%	68	10-15	±40	±.0005	-60	-20 to +60	+10	120/240	50/60	80	3 1/2	19	16	89	483	406	15	6.8									
	890-960	±4 dB 30-15k	.4%	68	10-15	±40	±.0005	-60	-20 to +60	+10	120/240	50/60	80	3 1/2	19	16	89	483	406	15	6.8									
Moseley PCL-505/C (composite input)	148-174	±5 dB 30-75k	.4% 30-60k	68	10-15	±60	±.0005	-60	-20 to +60	Note 4	120/240	50/60	80	3 1/2	19	16	89	483	406	15	6.8									
	215-240	±5 dB 30-75k	.4% 30-60k	68	10-15	±60	±.0005	-60	-20 to +60	Note 4	120/240	50/60	80	3 1/2	19	16	89	483	406	15	6.8									
	300-330	±5 dB 30-75k	.4% 30-60k	68	10-15	±60	±.0005	-60	-20 to +60	Note 4	120/240	50/60	80	3 1/2	19	16	89	483	406	15	6.8									
	450-470	±5 dB 30-75k	.4% 30-60k	68	10-15	±60	±.0005	-60	-20 to +60	Note 4	120/240	50/60	80	3 1/2	19	16	89	483	406	15	6.8									
	890-960	±5 dB 30-75k	.4% 30-60k	68	10-15	±60	±.0005	-60	-20 to +60	Note 4	120/240	50/60	80	3 1/2	19	16	89	483	406	15	6.8									
Marti STL-25/100	88-108	±1.0 dB 30-15k	1.0% 50-15k	60	21-25	±8	±.0005	-60	-30 to +60	+10	115/230	50/60	110	8.75	19	8.25	222	483	210	20	9.1									
	148-174	±1.0 dB 30-15k	0.6% 50-15k	60	21-25	±8	±.0005	-60	-30 to +60	+10	115/230	50/60	110	8.75	19	8.25	222	483	210	20	9.1									
	215-240	±0.5 dB 30-15k	0.6% 50-15k	60	15-18	±17.5	±.0005	-60	-55	-30 to +60	+10	115/230	50/60	110	8.75	19	8.25	222	483	210	20	9.1								
	300-340	±0.5 dB 30-15k	0.6% 50-15k	62	15-18	±17.5	±.0005	-60	-55	-30 to +60	+10	115/230	50/60	110	8.75	19	8.25	222	483	210	20	9.1								
	450-470	±0.5 dB 30-15k	0.6% 50-15k	64	12-15	±22.5	±.0005	-60	-55	-30 to +60	+10	115/230	50/60	110	8.75	19	8.25	222	483	210	20	9.1								
942-960	±0.5 dB 30-15k	0.5% 50-15k	66	6-8	±52.5	±.0005	-60	-55	-30 to +60	+10	115/230	50/60	110	8.75	19	8.25	222	483	210	20	9.1									

Manufacturer & Model Number	RECEIVER CHARACTERISTICS										RECEIVER CHARACTERISTICS										RECEIVER CHARACTERISTICS									
	Frequency Range (MHz)	Sensitivity ²	Stability %	Selectivity	Output (dBm 600 ³)	Power Requirements		Dimensions				Millimeters				Weight														
						Volts	Watts	H"	W"	D"	H	W	D	H	W	D	lbs	kg												
Moseley PCL-101 ¹	148-174	1.5 @ 20	±.0005	90	+10	120/240	50/60	15	1.75	19	11	45	483	279	8	36														
	215-240	1.5 @ 20	±.0005	90	+10	120/240	50/60	15	1.75	19	11	45	483	279	8	36														
	300-330	1.5 @ 20	±.0005	90	+10	120/240	50/60	15	1.75	19	11	45	483	279	8	36														
	450-470	1.5 @ 20	±.0005	90	+10	120/240	50/60	15	1.75	19	11	45	483	279	8	36														
	890-960	25 @ 60	±.0005	90	+10	120/240	50/60	15	1.75	19	14	45	483	356	8	36														
Moseley PCL-505 ¹	148-174	2 @ 20	±.0005	180	+10	120/240	50/60	15	1.75	19	14	45	483	356	8	36														
	215-240	2 @ 20	±.0005	180	+10	120/240	50/60	15	1.75	19	14	45	483	356	8	36														
	300-330	2 @ 20	±.0005	180	+10	120/240	50/60	15	1.75	19	14	45	483	356	8	36														
	450-470	2 @ 20	±.0005	180	+10	120/240	50/60	15	1.75	19	14	45	483	356	8	36														
	890-960	15 @ 60	±.0005	180	+10	120/240	50/60	15	1.75	19	14	45	483	356	8	36														
Moseley PCL-505 ¹ (composite input)	148-174	2 @ 20	±.0005	330	Note 6	120/240	50/60	15	1.75	19	14	45	483	356	8	36														
	215-240	2 @ 20	±.0005	330	Note 6	120/240	50/60	15	1.75	19	14	45	483	356	8	36														
	300-330	2 @ 20	±.0005	330	Note 6	120/240	50/60	15	1.75	19	14	45	483	356	8	36														
	450-470	2 @ 20	±.0005	330	Note 6	120/240	50/60	15	1.75	19	14	45	483	356	8	36														
	890-960	70 @ 60	±.0005	330	Note 6	120/240	50/60	15	1.75	19	14	45	483	356	8	36														
Marti STL-25/100	88-108	0.7 @ 20	±.0005	100	+10	115/230	50/60	30	8.75	19	8.25	222	483	210	16	7.3														
	148-174	0.7 @ 20	±.0005	100	+10	115/230	50/60	30	8.75	19	8.25	222	483	210	16	7.3														
	215-240	0.7 @ 20	±.0005	100	+15	115/230	50/60	30	8.75	19	8.25	222	483	210	16	7.3														
	300-330	20 @ 60	±.0005	100	+15	115/230	50/60	30	8.75	19	8.25	222	483	210	16	7.3														
	450-470	20 @ 60	±.0005	100	+18	115/230	50/60	30	8.75	19	8.25	222	483	210	16	7.3														
942-960	32 @ 60	±.0005	220	+18	115/230	50/60	30	8.75	19	8.25	222	483	210	16	7.3															

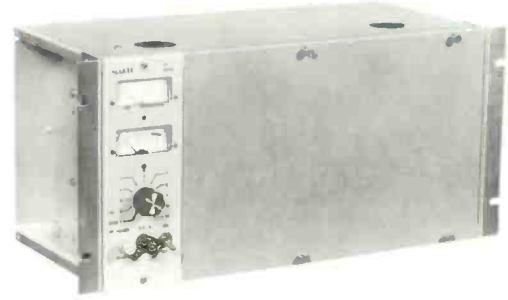
¹Other frequencies in 148-470 MHz spectrum available on special order.
²(AM Noise) below carrier level.
³(Temp. Range) for frequency stability (°C).
⁴(Input) 3.5V P-P, 2000 Ω , resistive, unbalanced, type BNC connector.
⁵(Sensitivity) microvolts (RMS) at quieting level.
⁶(Output) 3.5V P-P, 1000 Ω unbalanced, type BNC connector.

Abridged Specifications—Remote Pickup Links (RPL)

Manufacturer and Model Number	SYSTEM CHARACTERISTICS				TRANSMITTER CHARACTERISTICS				TRANSMITTER CHARACTERISTICS				TRANSMITTER CHARACTERISTICS						
	Freq. Range (MHz)	Freq. Resp.	S/N Ratio (dB)	Power Out (W)	Deviation (kHz)	Freq. Stab. (%)	Spurious ³	Temp. Range	Input Load	Primary Power		Dimensions		Millimeters		Weight			
										Volts	Freq.	H"	W"	D"	H	W	D	lbs	kg
Moseley RPL-3	148-174	30-10k ±1.5 dB	55	10-13	±5	±.0005	-60	-20 to 60°C	-60 to +10 dBm	120/240 11-15 DC	50/60 2A (DC)	4	14.5	11	102	863	279	16	72
Moseley RPL-4	450-470	30-10k ±1.5 dB	55	10-13	±12	±.0005	-60	-20 to 60°C	-60 to +10 dBm	120/240 11-15 DC	50/60 2A (DC)	4	14.5	11	102	863	279	16	72
Marti RPT-40/R30	150-172	30 to 7.5k ±1.5 dB max.	50	36-40 ⁴	±5	±.0005	-60	-20 to 45°C	-70 to 4 dBm ⁵	115/230 13.6 DC	155 7A	6.25	15	12	159	381	305	20	9.1
Marti RPT-25/R-50	450-470	30 to 12k ±1.5 dB max.	50	20-25 ⁶	±9	±.0005	-60	-20 to 45°C	-70 to 4 dBm ⁵	115/230 11-15 DC	155 7A	6.25	15	12	159	381	305	20	9.1
Marti RTP-1/150	150-172	60 to 7.5k ±2.0 dB max.	45	1	±5	±.0005	FCC	-10 to 50°C	-65 to 2 volts	11 to 12.6 DC	250ma	10	2 3/4	8	25	6.9	20	5 1/4	2.4
Marti RTP-1/450	450-470	60 to 7.5k ±2.0 dB max.	45	1	±9	±.0005	FCC	-10 to 50°C	-65 to 2 volts	11 to 12.6 DC	350ma	8	2 3/4	8	25	6.9	20	7 1/2	3.3

Manufacturer and Model Number	RECEIVER CHARACTERISTICS				RECEIVER CHARACTERISTICS				RECEIVER CHARACTERISTICS				RECEIVER CHARACTERISTICS			
	Freq. Range (MHz)	Stability %	Sensitivity ¹ (%)	Selectivity	Spurious ²	Output (dBm at 600:1)	Power Requirements		Dimensions		Millimeters		Weight			
							Volts	Freq.	H"	W"	D"	H	W	D	lbs	kg
Moseley RPL-3	148-174	±.0005	1.0 @ 20	±22 kHz	-65	+10	120/240	50/60	1.75	19	10	45	483	452	8	3.6
Moseley RPL-4	450-470	±.0005	1.0 @ 20	±44 kHz	-65	+10	120/240	50/60	1.75	19	10	45	483	452	8	3.6
Marti RPT-40/R-30	148-170	±.0005	0.5 @ 20	±17.5 kHz	-95	+10	115/230	50/60	8.75	19	8.25	222	483	210	16	7.3
Marti RPT-25/R-50	450-470	±.0005	0.5 @ 20	±22.5 kHz	-95	+10	115/230	50/60	8.75	19	8.25	222	483	210	16	7.3

¹Two 50-150 mike inputs one 50,000 ohms unbalanced input. Mike input level -60 to -40 dBm; line level -15 to 10 dBm, 600 ohm source.
²Audio response extended to 15,000 Hertz on special order.
³(Spurious) Below carrier level (dB).
⁴Nominal 36W, 40W max.
⁵Nominal 20W, 25W max.
⁶Microphone at quieting level, measured through 4 kHz filter (low pass audio).
⁷(Sensitivity) Microvolts at dB of quieting.

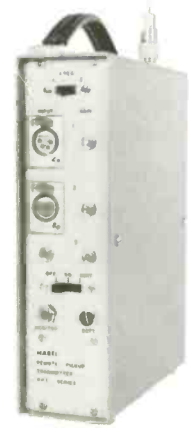


Marti STL transmitter, STL-25. Typical in appearance of all Martin STL and RPL transmitters. Available for 88-108, 148-174, 215-240, 300-340, 450-470 and 942-960 MHz bands.



Marti remote-pickup transmitter. Four audio inputs and a multi-purpose front-panel meter. Available for 150-172 and 450-470 MHz bands.

RPT-1/150 and RPT-1/450 transmitter used with R-30/450E and R-50/450E receivers. Portable Broadcast Remote Pickup Transmitter.



Moseley RPL transmitter and receiver (below), RPL-3 or RPL-4. Identical in appearance, the two Moseley RPL transmitters are available for the 148-174 and 450-470 MHz bands. Equipped with two low-level inputs.

