



# MW-50C3

**PowerStar** 

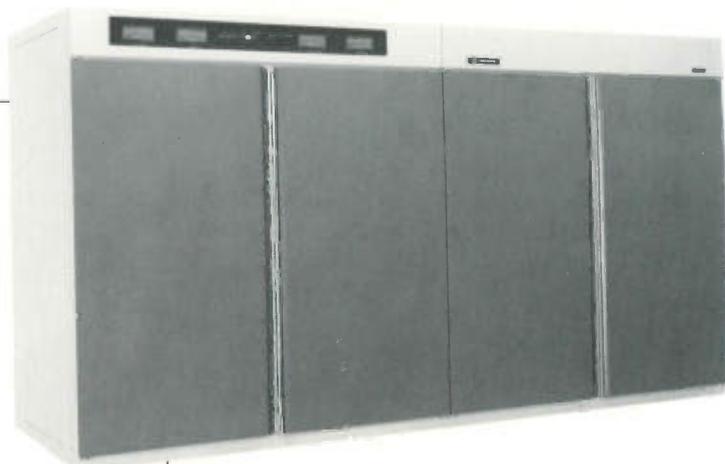
50,000 watt medium wave  
broadcast transmitter



*Shown with optional front doors.*

# Harris MW-50C3...the latest in a line of legendary performers

- **Reduced operating costs compared to other 50 kW designs from an overall efficiency of 60%**
- **Exceptional signal clarity achieved from industry low 2.4% harmonic and 2.4% I.M. distortions at high modulation percentages**
- **Elimination of costly, inefficient modulation transformer and reactor through patented Pulse Duration Modulator**
- **Automatic modulation tracking circuit for minimized operator adjustment**
- **Proven AM stereo performer**
- **Minimized spares inventory from three tube design**
- **Wide cabinet accessibility for easy routine maintenance**



The Harris MW-50C3 delivers overall performance superior to any other 50-kilowatt medium wave broadcast transmitter. The transmitter is high level plate modulated, using Harris' patented, highly efficient Pulse Duration Modulator (PDM). This, in combination with a number of other outstanding features, makes the MW-50C3 the most advanced 50-kilowatt AM transmitter in the world.

## THE MODULATION SYSTEM

Harris' Pulse Duration Modulator is characterized by low plate dissipation and low tube peak currents. Peak cathode currents are about one-half that of comparable transmitters. Average plate dissipation runs substantially below rated levels, and all peak voltages are maintained well below component ratings. Conservative design and incorporation of PDM circuitry allows a continuous 100% sine wave modulation rating.

## INDUSTRY LOW HARMONIC AND INTERMODULATION DISTORTION

Broadcasters can expect exceptional signal clarity from the MW-50C3 on

current generation AM radios or advanced high fidelity AM receivers, either mono or stereo. This performance is gained from continued refinements to the Harris Pulse Duration Modulation system that now results in an exceptionally low 2.4% harmonic and 2.4% I.M. distortion levels at modulation percentages of 95% and 90% respectively. *The MW-50C3 is the leading 50 kW AM design delivering low harmonic and intermodulation distortion.*

## IMPROVED SQUARE WAVE PERFORMANCE

With the addition of a new op-amp audio input stage, the MW-50C3 is now effectively DC coupled from the audio input to the RF power amplifier. The new circuit extends the transmitter's low end frequency response essentially to DC, (approximately 2 Hz).

Consequently, the MW-50C3 enjoys a noticeable improvement in square wave performance, with low frequency tilt nearly non-existent. The MW-50C3's high frequency response can be tailored to meet individual stations' programming needs.

## IMPROVED OVERSHOOT PERFORMANCE

Harris has incorporated circuitry that effectively reduces complex audio overshoots by 30%, without compromising any other audio specification. This improvement allows MW-50C3 users to increase their average modulation over the already high level characteristic of Harris' Pulse Duration Modulation. By selection of a single component the frequency response of the MW-50C3 may be tailored to best suit the station format.

## IMPROVED TRANSIENT RESPONSE

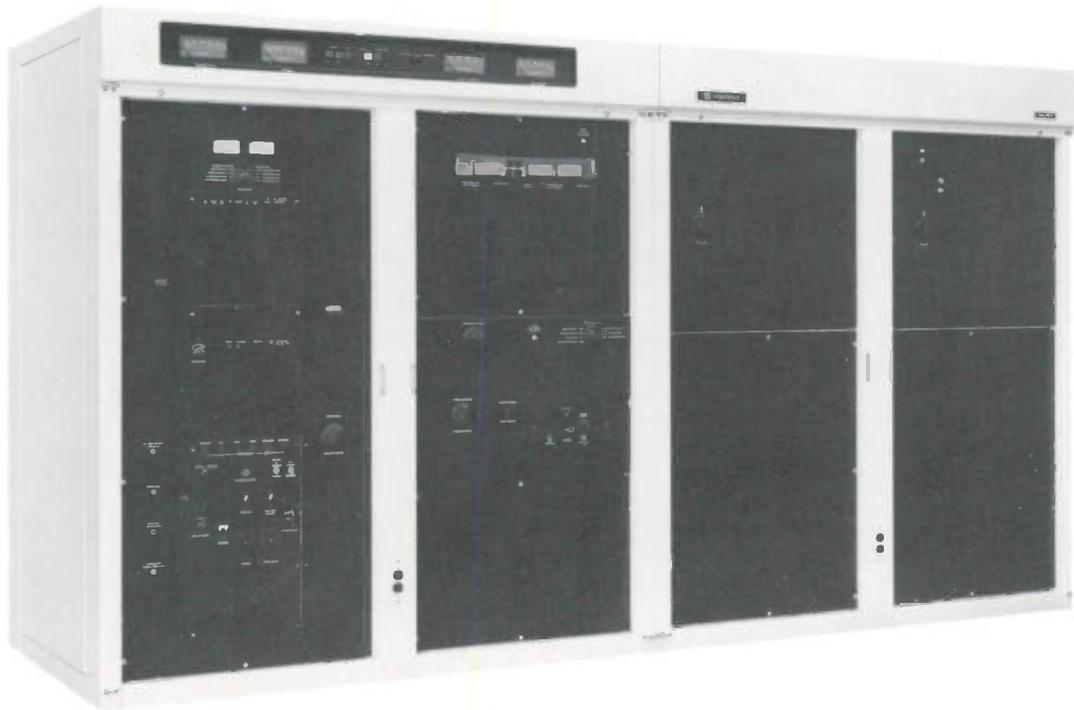
Installation of a high speed op-amp input stage has the same advantages as an audio input transformer—good isolation, impedance matching and common mode rejection. At the same time, the balanced op-amp input stage allows a dramatic improvement in transient response. The result: even more faithful transmission of today's dynamic program material.

## HIGH OVERALL EFFICIENCY

The Pulse Duration Modulator employed in the MW-50C3 approaches 90% efficiency. This impressive modulator efficiency enables the transmitter to achieve an unusually high overall efficiency of greater than 60%. As a result, power consumption is significantly below that of other 50-kilowatt medium wave transmitters currently available, or in service.

## AUTOMATIC MODULATION TRACKING

Since incoming AC line voltages change radically during the course of the broadcast day, there is a direct ef-



MW-50C3, front doors removed.

In a Harris PDM transmitter the modulator operates in a manner similar to a switch. It has two conditions—on and off. Audio information is contained in the duration of the "on" pulse. Thus the name "Pulse Duration Modulation".

The amplitude of the R.F. signal is determined by the percentage of time the modulator tube is conducting (duty cycle). A square-wave signal of approximately 70 kHz is pulse-width-modulated by the audio signal. The amplitude of the audio signal causes the symmetry of the kHz square wave to vary. For instance, a large positive signal will cause the square wave to be "on" most of its cycle. A large negative signal will cause the square wave to be "off" most of the time. The frequency of the audio determines the frequency at which the symmetry of the square wave varies.

The Harris PDM modulation is high-level plate modulation of a class C RF amplifier. The difference is simply the manner in which the audio signal is translated and applied in series with the RF amplifier plate supply. The audio intelligence is superimposed on a 70 kHz pulse train at a low level. It is then amplified by a series of amplifiers to a level sufficient to modulate the final RF amplifier. The 70 kHz component is then filtered out to leave the amplified audio and a dc component that is the modulated plate voltage for the class C final amplifier. This elimi-

nates the need for a modulation transformer and reactor.

Continuous 100 percent modulation capability over a wide frequency range is inherent in this system and thus provides exceptionally good trapezoidal modulation capability with no compromise of cost or complexity. Another feature of this high-efficiency series type modulator is automatic carrier level control and simple power level change. Another is fast acting crowbar protection from flash arcs, accomplished by opening the high-voltage plate line to the power amplifier tube.

The high-efficiency modulator provides carrier level control and fast acting crowbar protection because the modulator is in series with the PA and the voltage applied to the PA tube can be rapidly removed by turning the modulator tube off in case of an arc or other fault or adjusted to any dc level between zero and normal plate voltage. The PA plate voltage is determined by the duty cycle of the PDM. If the duty cycle is zero, there will be zero PA plate voltage. If the duty cycle is 10 percent, the PA plate voltage will be 10 percent of the high voltage (HV) power supply voltage. During normal full power output the duty cycle is about 50 percent and the PA plate voltage is about one-half of the HV power supply voltage.

#### **THEORY OF OPERATION**

How is PDM generated? A PDM pulse

train has a constant repetition rate or frequency. It is a pulse train of variable width pulses, the width of the pulses being a function of the audio amplitude. In the Harris PDM transmitters it is generated by combining a 70-kHz triangle wave with the audio signal at the input of a high-gain amplifier. (See Fig. 1).

The output of a 70 kHz oscillator is clipped to form a square wave and integrated to form a ramp or triangular voltage. This voltage is summed with the audio signal at the input of a threshold amplifier. The output of this amplifier is a modulated rectangular pulse train with a 70 kHz repetition rate pulse-width modulated in accordance with the input audio signal, or, amplitude changes in the audio input signal appear as the duty-cycle change of constant amplitude rectangular waves. Succeeding stages in the modulator chain are simple switches, capable of turning on and off at a 70 kHz repetition rate with not more than 1- or 2/ $\mu$ s rise and fall time.

The resulting rectangular pulses are amplified by the driver and modulator stages and applied to the RF power amplifier cathode through a low-pass filter that removes the 70 kHz signal and its sidebands, thereby recovering the original audio. The modulator tube is connected in series with the cathode of the power amplifier tube to obtain normal amplitude modulation.

## THE PULSE DURATION MODULATOR IN THE MW-50C3

To accomplish 100 percent modulation of the final amplifier of the Harris MW-50C3, average power in the neighborhood of 25 kW is needed. In the MW-50C3 the power gain necessary to raise the level of a +10 dBm audio input signal to the level required to modulate the RF power amplifier is accomplished in four stages: three transistor amplifiers, one tube. The block diagram indicates the relationship of these and other stages.

The modulator tube is connected through a low-pass filter to the cathode of the power amplifier. The low-pass filter provides the necessary function of removing the 70 kHz frequency component and the harmonics thereof and of recovering the audio as a modulating signal for the power amplifier. Note that the modulator is in series with the power amplifier.

The solid state damper diode is connected between the modulator plate and +24 kV and conducts alternately with the modulator, that is, at a 70 kHz rate. The damper diode conducts when the modulator does not, providing a discharge path for the energy stored in the inductors in the low-pass filter. This function is necessary for efficiency and low distortion.

## THE AUDIO SIGNAL

How is the audio recovered so that it can be used to modulate the PA tube? The output of the modulator is a train of variable width rectangular pulses of

70 kHz frequency. Before this signal can be applied to the PA tube it must be converted to audio. This is accomplished by means of a low-pass filter. The filter eliminates all of the 70 kHz switching frequency and leaves the desired audio component.

## NOTABLE FEATURES OF PDM

The most troublesome components in an AM transmitter, the modulation transformer and reactor, have been eliminated by use of the pulse duration modulator. Because the modulator stages operate in a highly reliable saturated switching mode, small changes in component characteristics have negligible effect on the modulator performance. Tube and transistor linearity has almost no effect on the modulator performance. The modulator tubes and transistors operate in a manner similar to a switch. All they have to do is turn on and off. Tube life under this mode of operation will be increased greatly.

## EASE OF MAINTENANCE

Because of the reduced cost of the components and the inherent low fail-

ure rate of the saturated switching mode circuit, maintenance costs are lower.

Troubleshooting procedures are simplified by the fact that the modulator stages are inherently either operating properly or not operating at all. Linearity is not important. Most of the modulator is solid state.

## OPERATING ECONOMY

With an overall efficiency of greater than 60% normally achieved and the lower number of tubes, transmitter operating cost is greatly reduced from that of transmitters using conventional high-level modulation.

## OPERATING CONVENIENCE

Power output can be adjusted to almost any power and maintained at that level. Day/night power change is very simple.

Broadcast transmitters utilizing pulse duration modulators provide unique performance and operational advantages over those of conventional design.

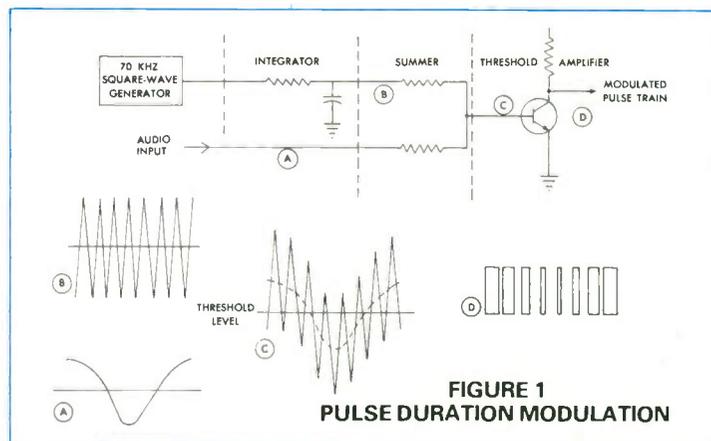
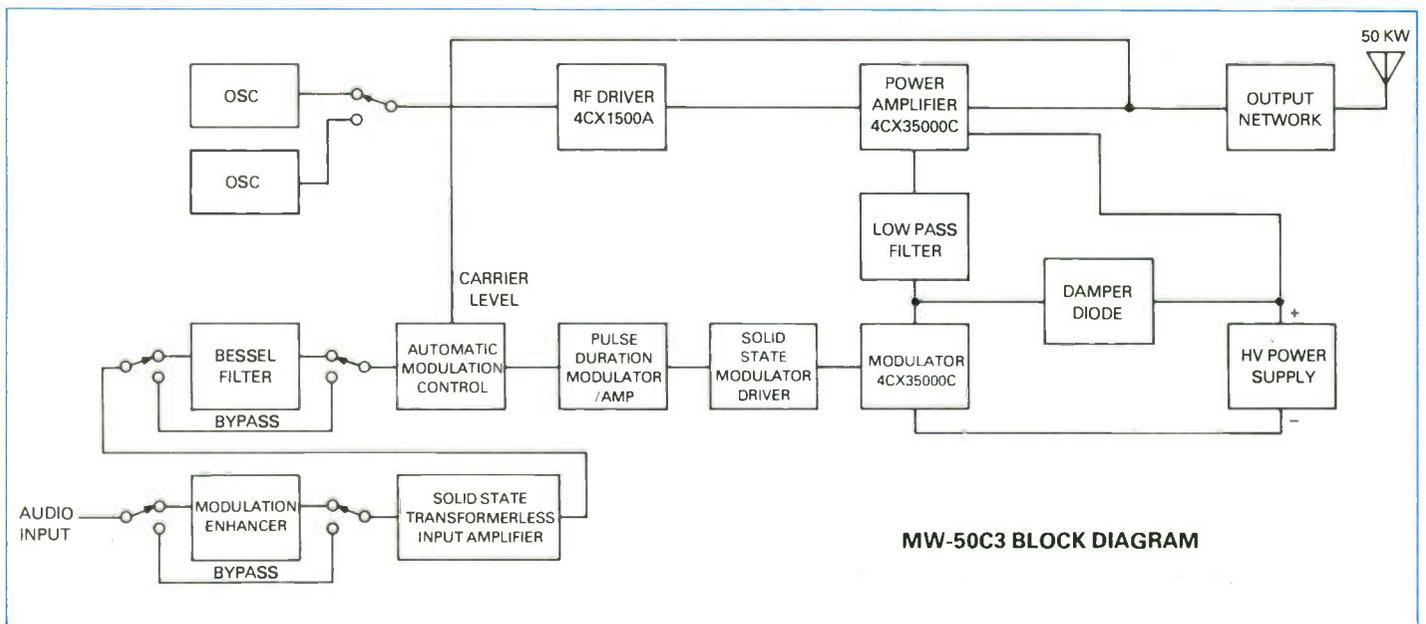


FIGURE 1  
PULSE DURATION MODULATION



MW-50C3 BLOCK DIAGRAM

fect on transmitter DC supply voltage, and hence power output. If the carrier is over or under modulated, output power changes may hinder the transmitter's audio performance. The MW-50C3 Modulation Tracking Circuit eliminates these problems by automatically maintaining the desired modulation level over a  $\pm 20\%$  change in output power. This precision tracking circuit eliminates the need to purchase costly, single-function units requiring system interface.

#### ONLY THREE TUBES..... EXCEPTIONAL TUBE LIFE

The MW-50C3 employs just three tubes. Rugged ceramic 4CX35,000C power tetrodes operating at close to 90% efficiency are used in the power amplifier and modulator. User reported 5 year tube life (40,000 hours) is not uncommon! The Pulse Duration Modulator driver stage is solid state, incorporating a high efficiency MOSFET amplifier. The RF driver consists of a rugged 4CX1500A. Use of only three tubes and two tube types greatly reduces spares stock and the associated costs.

#### CONTINUOUS 100% MODULATION RATING

This continuous sine wave modulation capability permits a higher average modulation to boost signal strength without increasing transmitted carrier power. The MW-50C3 provides 125% positive peak capability at 55 kW.

#### MAXIMUM CARRIER POWER 60 KILOWATTS

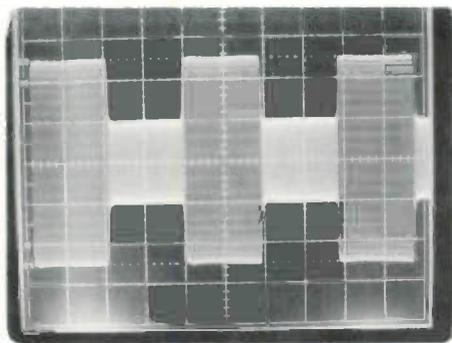
The Harris MW-50C3 provides a maximum carrier power of 60 kilowatts, allowing more reserve for driving directional arrays than any other 50-kilowatt medium wave broadcast transmitter. DC and audio feedback insures overall transmitter stability. The MW-50C3 can be switched smoothly from high to low power (any power from 50 kW to 10 kW) without loss of carrier, thus minimizing annoying off-air power changes.

#### RF SECTION

The RF chain is conventional, utilizing a transistorized oscillator, buffer, emitter follower, and a 4CX1500A tetrode tube amplifier to drive a single high efficiency 4CX35,000 tetrode in a Class D power output stage.

#### PROTECTIVE CIRCUITS, STATUS CHANNELS

All major components of the MW-50C3 are protected by circuit breakers. Tubes and transistors are protected by overload relays or current limiting devices. Overloads are indicated on a LED fault status panel. A quick-acting circuit protects against damage from high voltage arcs by limiting the en-



Wave form monitor showing square wave response of MW-50C3.

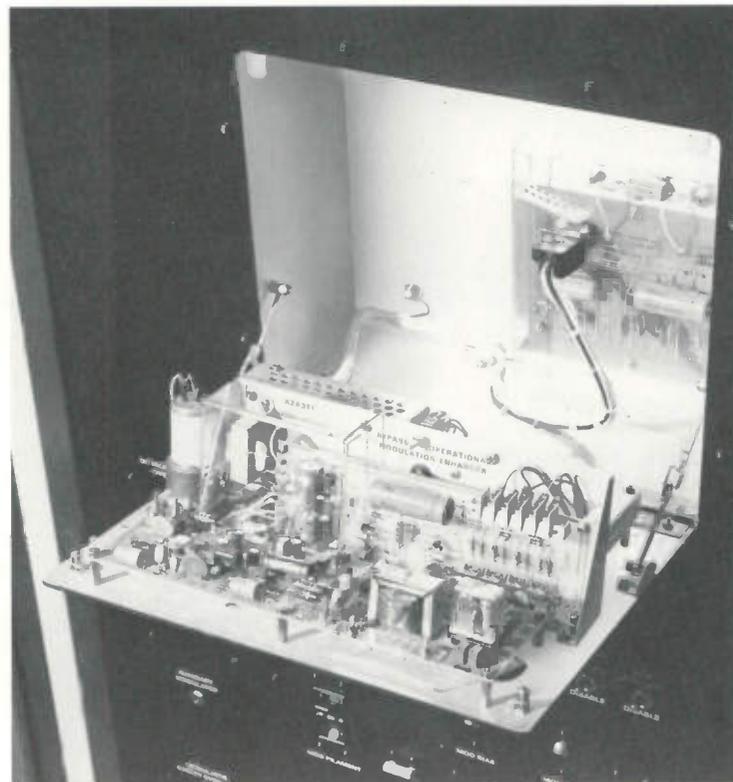
ergy in such arcs to 10 watt seconds. Protection against voltage standing wave ratios of greater than 1.2 to 1.0 is provided. Both forward and reflected power are metered at the front panel.

In case of momentary RF overloads, the MW-50C3 will recycle automatically. Should a repeated overload occur within a 30-second period, the transmitter will remain off until manually reset. However, if the time between overloads is greater than 30 seconds, continuous recycling will occur.

#### QUIET AIR COOLING

Cooling of the MW-50C3 is accomplished by a 5-horsepower direct drive blower, located in the transmitter cabinet, which provides cooling for the power tubes at a low noise level. The transmitter cabinet air is flushed with a low speed fan which also operates at a low noise level. Provisions are made at the top of the transmitter for ducting the exhaust air to the outside of the transmitter building.

Low level Pulse Duration Modulator chassis, showing power control and audio input/control.



#### DESIGNED FOR A WIDE RANGE OF CLIMATES

The MW-50C3 provides top performance in all types of climates, from hot and humid to dry and dusty. All transformers and similar components are hermetically sealed, encased, or vacuum impregnated. Performance at 10,000 feet (3048 meters) is certified by a recognized testing organization.\*

#### EASE OF SERVICE

Maintenance personnel will find performing routine maintenance and service on the MW-50C3 easy. Component access is convenient through large front and rear compartment doors. Interior service lights and convenience outlets are also included for service technicians.

\*Copy of certificate available on request.

## The Harris Pulse Duration Modulator

The Harris Pulse Duration Modulator has been in use by Broadcasters since 1970. Harris' PDM transmitters from 5 kW to 100 kW, around the world are noted for their high efficiency and exceptional signal clarity.

#### HOW PDM WORKS

Pulse Duration Modulation is a high level plate modulation technique, similar to the high level transformer/reactor configuration used for many years.

## MW-50C3 SPECIFICATIONS

**POWER OUTPUT:** 50,000 watts (rated), 60,000 watts (capable). Convenient power reduction through 10,000 watts.

**RF FREQUENCY RANGE:** 535 kHz to 1620 kHz, supplied to frequency as ordered.

**RF OUTPUT IMPEDANCE:** 50 ohms unbalanced (higher on special order).

**RF OUTPUT TERMINAL:** 3/8" EIA 50 ohm flange.

**RF FREQUENCY STABILITY:** ± 10 Hz.

**RF HARMONICS AND SPURIOUS EMISSIONS:** Exceeds FCC and CCIR specifications.

**CARRIER AMPLITUDE REGULATION:** Less than 2% at 100% modulation (measured at 1000 Hz).

**AUDIO INTERMODULATION DISTORTION:** 2.4% or less, 60/7000 Hz 4:1, SMPTE standard @ 55 kW operation @ 90% modulation.

**AUDIO FREQUENCY RESPONSE:** ± 1.0 dB, from 20 to 12,500 Hz referenced to 1,000 Hz at 95% modulation at 55 kW with Besel filter out.

**SQUAREWAVE OVERTHOOT:** Less than 3.0% using 1000 Hz 6 dB clipped sinewave @ 90% modulation.

**TOTAL HARMONIC DISTORTION:** 2.4% or less, 20 to 10,000 Hz at 95% modulation at 55 kW. 3% at 25 to 10 kW.<sup>1</sup>

**SQUAREWAVE TILT:** Less than 8% at 20 Hz @ 60% modulation.

**COMPRESSION RATIO:** 4/1 dB at 3 dB of enhancement; -95%, + 125% modulation. (modulation enhancer operational)

**POSITIVE PEAK CAPABILITY:** + 125% with program modulation at 55 kW.

**NOISE (Unweighted):** -60 dB or better below 100% modulation. Typical -62 dB.<sup>2</sup>

**AM STEREO OPERATION:** Incidental Quadrature Modulation (IQM) is down 25 dB or better at 95% modulation.

**AUDIO INPUT:** 600 ohms at 0 to + 10 dBm for 100% modulation, unenhanced; + 16 dBm with enhancement activated.

**POWER INPUT:** 480V ± 5%, 3 phase, 60 Hz. Available for 380V ± 5%, 3 phase, 50 Hz.

**POWER CONSUMPTION:** 80 kW at 0% modulation; 87 kW at 30% modulation; 110 kW at 100% modulation.<sup>3</sup>

**OVERALL EFFICIENCY:** Better than 60% at average modulation.

**POWER FACTOR:** 95%.

**TUBES USED:** (2) 4CX35,000C; (1) 4CX1500A.

**MONITOR PROVISION:** An unmodulated sample is provided for freq monitor and a modulated sample for modulation monitoring.

**REMOTE CONTROL:** Self-contained interface for extended or remote control.

**AIR FLOW:** 5200 CFM total by internal blowers.

**OPERATING ACOUSTICAL NOISE:** Better than 70 dBA acoustic rating 3 ft. from front of transmitter.

**TEMPERATURE RANGE:** -20°C to +50°C.<sup>4</sup>

**HUMIDITY:** 95%.

**ALTITUDE:** Up to 3,048 meters (10,000 feet) above sea level. Higher on special order.

**SIZE:** 78 inches (2.0 meters) high, 144 inches (3.7 meters) wide, 48 inches (1.2 meters) deep (transmitter cabinet). External components include high voltage power supply and wall mounted circuit breaker assembly.<sup>5</sup>

**FLOOR SPACE:** Main transmitter assembly 48 square feet (4.5 square meters). Power supply 15 square feet (1.4 square meters).

**WEIGHT (Approximate):**

Main Transmitter Assembly	Power Supply
Net unpacked 5,000 lbs. (2268 kg)	Net unpacked 1,370 lbs. (622 kg)
Domestic packed 6,000 lbs. (2722 kg)	Domestic packed 1,500 lbs. (681 kg)
Export packed 7,200 lbs. (3266 kg)	Export packed 1,800 lbs. (817 kg)

1. If transmitter is operated into a bandwidth limited antenna system, distortion at the higher modulation frequencies may degrade.
2. Noise measured over the band 20 Hz to 20 kHz, with line to line voltages of the supply line balanced. Noise may degrade with line voltage unbalance.
3. Typical power consumption figures are for 50 kilowatts output and for optimum transmitter adjustment. For higher output powers and/or transmitter misadjustments, power consumption may be higher.
4. Maximum operating temperature derates linearly to +29°C (84.2°F) at 10,000 feet AMSL (3048 meters).
5. Does not include height of output connector, which may be removed for transport.

*HARRIS MAINTAINS A POLICY OF CONTINUOUS PRODUCT IMPROVEMENT, AND THEREFORE RESERVES THE RIGHT TO CHANGE SPECIFICATIONS WITHOUT NOTICE.*

## ORDERING INFORMATION

Model MW-50C3, with one set of tubes and 2 crystals, 60 Hz .....	.994-8832-004
Model MW-50C3, with one set of tubes and 2 crystals, 50 Hz .....	.994-8832-005
Recommended spare parts kit for MW-50C3 transmitter .....	.994-8909-002

**HARRIS CORPORATION BROADCAST TRANSMISSION DIVISION  
P. O. BOX 4290, QUINCY, ILLINOIS 62305-4290 U.S.A. 217/222-8200**



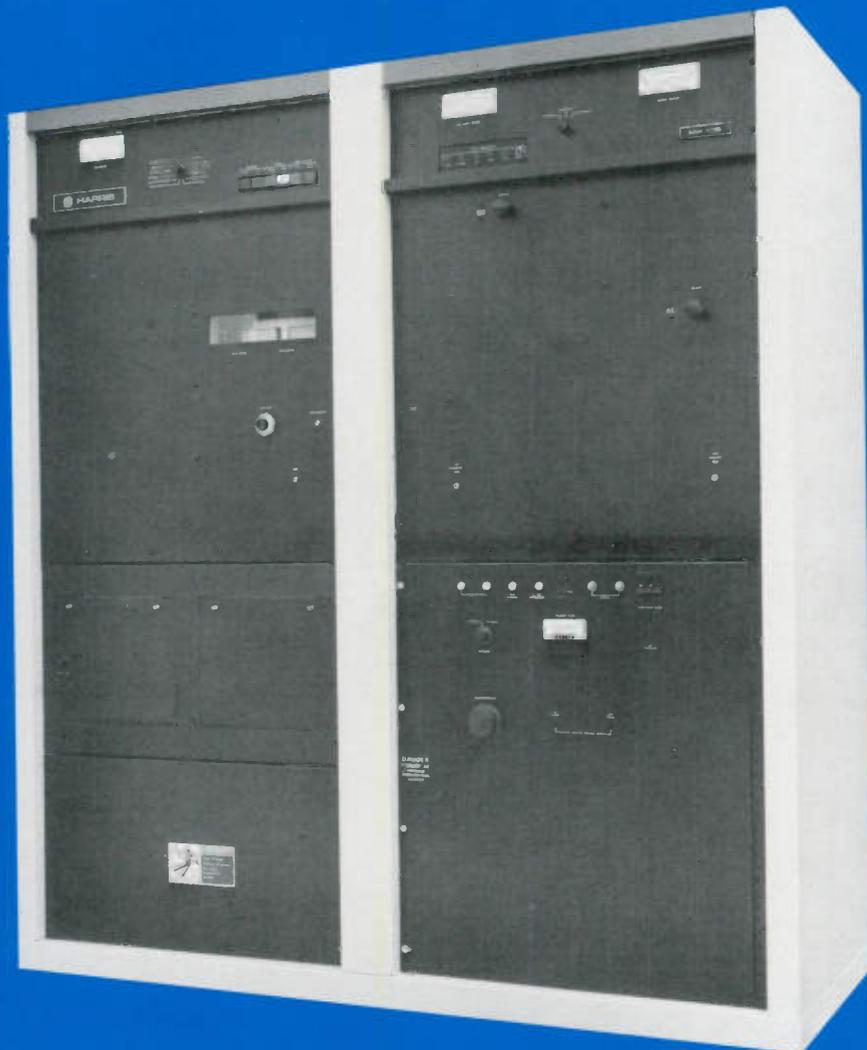
**HARRIS**

## **MW-10B**

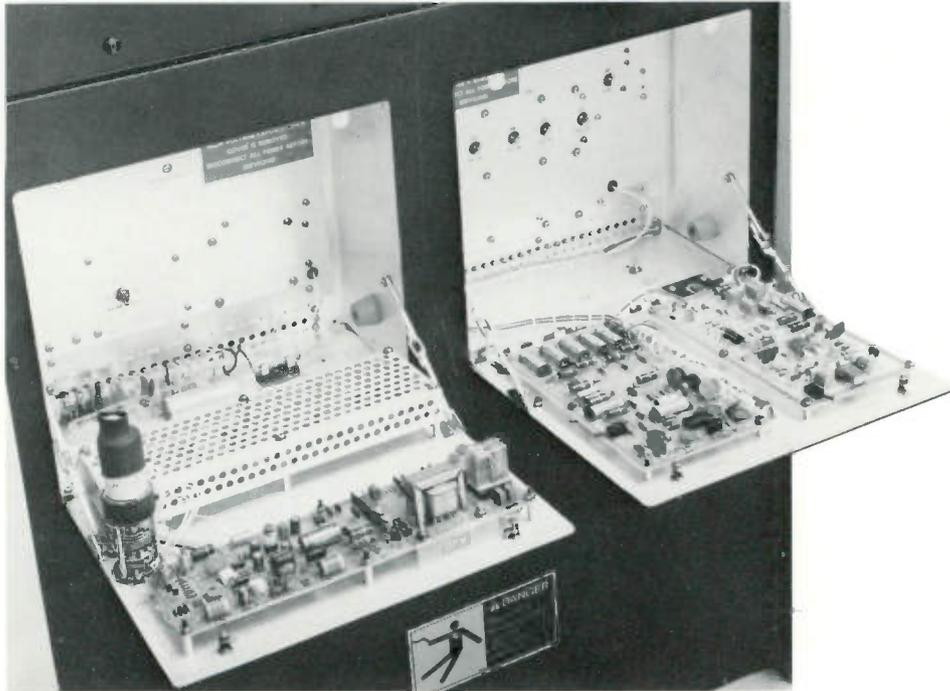
10,000 Watt  
Medium Wave  
Broadcast  
Transmitter

- Pulse Duration Modulation\* (PDM) eliminates costly, inefficient modulation transformer and reactor
- Unsurpassed low frequency square wave performance
- Automatic modulation tracking minimizes adjustments
- No significant overshoot...yielding maximum modulation capability
- No Slew Induced Distortion possible
- High modulator and PA efficiency yields low power consumption
- Only two tube types
- Produces faithful transmission of today's demanding formats in a cost effective manner

\*Patented



# Harris' MW-10B...the world standard in 10 kW AM transmitters



PDM and audio input chassis swing down for easy access

The Harris MW-10B delivers overall performance superior to any other 10-kilowatt medium wave broadcast transmitter. The transmitter is high level plate modulated, using Harris' patented, highly efficient Pulse Duration Modulator (PDM). This, in combination with a number of other outstanding features, makes the MW-10B the most advanced 10-kilowatt AM transmitter in the world.

## IMPROVED TRANSIENT RESPONSE

Installation of a high speed op-amp input stage has the same advantages as an audio input transformer—good isolation, impedance matching and common mode rejection. At the same time, the balanced op-amp input stage allows a dramatic improvement in transient response. The result: even more faithful reproduction of today's dynamic program material.

## THE MODULATION SYSTEM

Harris' Pulse Duration Modulator is characterized by low plate dissipation and low tube peak currents. Peak cathode currents are extremely low. Average plate dissipation runs substantially below rated levels, and all peak voltages are maintained well below component ratings. Conservative design allows a continuous 100% sine wave modulation rating.

## IMPROVED SQUARE WAVE PERFORMANCE

With the addition of a new op-amp audio input stage, the MW-10B is now effectively DC coupled from the audio input to the RF power amplifier. This new circuit extends the transmitter's low end frequency response essentially to DC—approximately 2 Hz. Consequently, the MW-10B enjoys a noticeable improvement in square wave performance, with low frequency tilt nearly nonexistent.

## IMPROVED OVERSHOOT PERFORMANCE

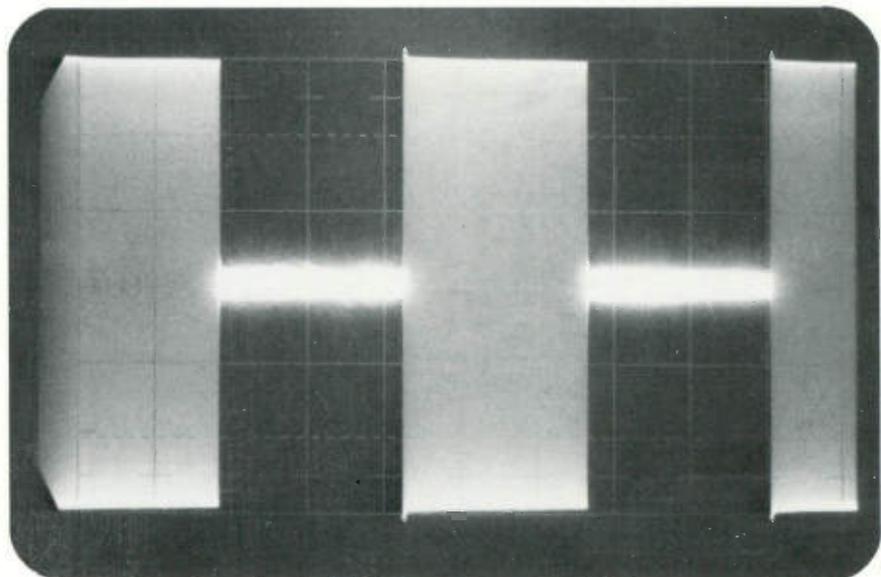
Harris has incorporated an input Bessel filter that effectively reduces complex audio overshoots to a negligible level, without compromising any other audio specification. This improvement allows MW-10B users to increase their average modulation over the already high level characteristic of Harris' Pulse Duration Modulation. By selection of a single component, the high frequency response of the MW-10B may be tailored to best suit the station format.

## HIGH OVERALL EFFICIENCY

The Pulse Duration Modulator employed in the MW-10B approaches 90% efficiency. This impressive modulator efficiency enables the transmitter to achieve an unusually high overall efficiency.

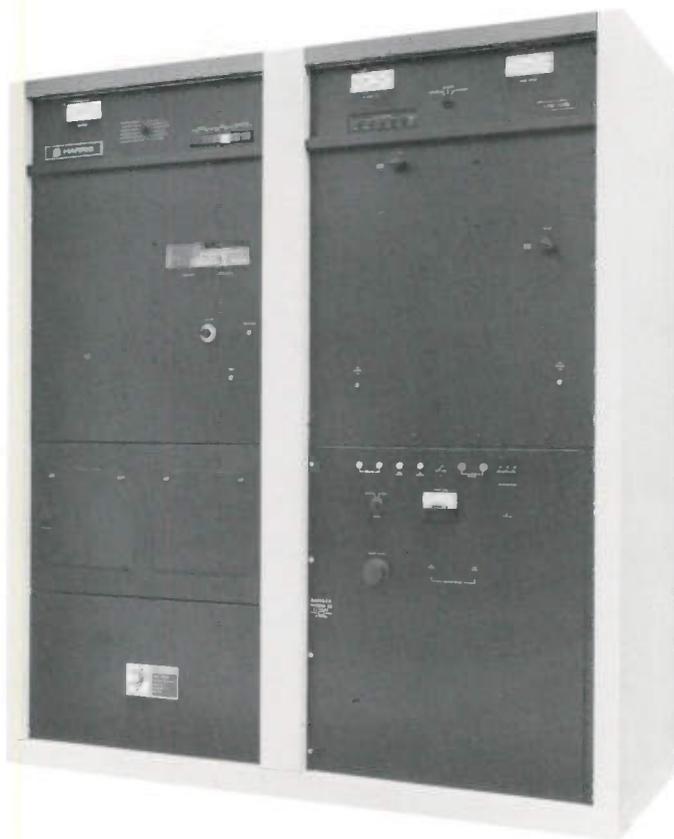
## AUTOMATIC MODULATION TRACKING

Since incoming AC line voltages change radically during the course of the broadcast day, there is a direct effect on transmitter DC supply voltage, and hence power output. If the carrier power changes, over or under modulation may result, thus adversely affecting transmitter audio performance. The new MW-10B Modulation Tracking Circuit eliminates these problems by automatically maintaining the desired modulation level over a  $\pm 20\%$  change in output power. This precision tracking circuit eliminates the need to purchase costly, single-function units requiring system interface.



Wave form monitor showing excellent square wave response of MW-10B - 10 kW - 20 Hz at 95% Modulation

MW-10B features easy controls access.



### **ONLY TWO TUBES... EXCEPTIONAL TUBE LIFE**

The MW-10B employs just two tubes. The rugged ceramic 3CX15,000H3 triode power tube is used in the power amplifier. The Pulse Duration Modulator uses a 4CX15,000A. Use of just two tube types greatly simplifies spares stocking and associated spares costs. Highest quality components, conservatively rated, are used throughout the MW-10B to assure a maximum degree of reliability. Front panel metering and control enables filament voltage maintenance for maximum tube life.

### **CONTINUOUS 100% MODULATION RATING**

This continuous sine wave modulation capability permits a higher average modulation to boost signal strength without increasing transmitted carrier power. The MW-10B provides 125% positive peak capability.

### **MAXIMUM CARRIER POWER 11 KILOWATTS**

The Harris MW-10B provides a maximum carrier power of 11 kilowatts, allowing more reserve for driving directional arrays than other 10-kilowatt medium wave broadcast transmitters. DC and audio feedback insures overall transmitter stability. The MW-10B can be switched smoothly from high power to low power without loss of carrier,

thus minimizing annoying off-air power changes.

### **RF SECTION**

The RF chain consists of two switchable crystals and oscillators, buffer, divider, RF amplifier, IPA, RF driver, and PA. Only 15 transistors are used in the entire RF chain.

The crystals and oscillators, buffer, divider and RF amplifier are located on one printed circuit board. The divider is a single IC which is socket mounted for easy replacement. Status LED indicators on the PC board show if voltage is available and if RF is being generated.

The IPA and RF driver are located on a swing-down chassis, and consist of five **identical**, high efficiency Class D, push-pull amplifier modules. One module is used in the IPA and four in the RF driver. The driver modules are connected so that, should one fail, the remaining three will provide adequate drive to keep the transmitter on the air at full power. Fault lamps indicate which of the modules failed. The PA operates in the highly efficient class D mode, yielding a plate efficiency approaching 90%.

### **PROTECTIVE CIRCUITS, STATUS CHANNELS**

All major components of the MW-10B are protected by circuit breakers. Tubes and transistors are protected by overload relays or current limiting devices. Overloads are indicated on a LED fault status panel. A quick-acting circuit protects against dam-

age from high voltage arcs by limiting the energy in such arcs to 10 watt seconds.

Protection against voltage standing wave ratios of greater than 1.2 to 1.0 is provided. Both forward and reflected power are metered at the front panel. In case of momentary RF overloads, the MW-10B will recycle automatically. Should a repeated overload occur within a 30-second period, the transmitter will remain off until manually reset. However, if the time between overloads is greater than 30 seconds, continuous recycling will occur.

### **QUIET AIR COOLING**

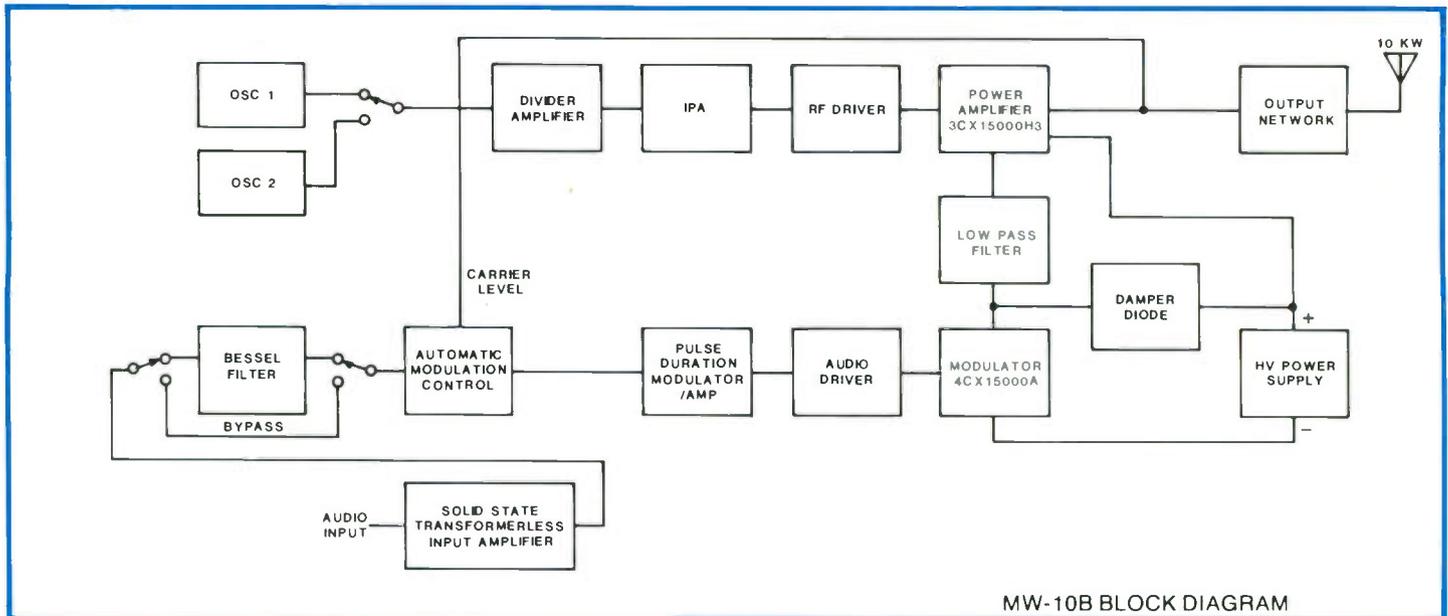
A standard three-quarter horsepower, single phase motor is used with a quiet, low-speed, belt-driven blower. Provisions are made on the top of the transmitter for ducting the exhaust air to the outside of the transmitter building.

### **DESIGNED FOR A WIDE RANGE OF CLIMATES**

The MW-10B provides top performance in all types of climates, from hot and humid to dry and dusty. All transformers and similar components are hermetically sealed, encased, or vacuum impregnated.

### **TRANSMITTER LAYOUT**

The MW-10B is completely self-contained in one cabinet—there are no external components.



## MW-10B SPECIFICATIONS

**POWER OUTPUT:** (Rated) 10,000 watts. (Capable) 11,000 watts. FCC type accepted at 10,000, 5000, 2500 and 1000 watts.

**MODULATION METHOD:** Pulse Duration Modulation.

**CARRIER SHIFT:** (@ 95% modulation with 400 Hz tone) 2% or less.

**AUDIO INPUT:** (For 95% modulation) +10 dBm,  $\pm 2$  dB.

**AUDIO INPUT IMPEDANCE:** 600 ohms balanced.

**AUDIO FREQUENCY RESPONSE:**  $\pm 1$  db, 20 to 10,000 Hz. (Response referred to 1 kHz, 95% modulation, with modulations at other frequencies held to same percentage. Response may degrade at higher modulating frequencies if transmitter is operated into a bandwidth limited antenna system.)

**THD DISTORTION:**<sup>1</sup> 2% or less @ 95% modulation, 20 to 10,000 Hz unenhanced.

**RF HARMONICS:** Meets or exceeds FCC and CCIR requirements.

**SPURIOUS OUTPUT:** -80 dB or better.

**RF FREQUENCY RANGE:** 535 to 1605 kHz. Supplied to one frequency as ordered.

**RF OUTPUT IMPEDANCE:** 50 ohms, unbalanced. Other output impedances available on special order.

**RF OUTPUT CONNECTOR:** 1 $\frac{1}{2}$ -inch male EIA flange. Other types of output connectors available on special order.

**MAXIMUM VSWR:** 1.3 to 1.

**NOISE:**<sup>2</sup> Unweighted, 60 dB below 100% modulation. Weighted (CCIR Rec. 468-1), 70 dB below 100% modulation.

**POSITIVE PEAK CAPABILITY:** 125% at 11 kW output, when modulated with processed program type material.

**NEGATIVE PEAK CAPABILITY:** 95%.

**FREQUENCY STABILITY:**  $\pm 20$  Hz or less over operating temperature range.

**SUPPLY VOLTAGE:** 200/500 volts, 3 phase, 60 Hz, closed delta/wye or 350/430 volts, 3 phase, 50 Hz, 4 wire wye.

**LINE VOLTAGE REGULATION AND VARIATION:** 5% maximum.

**LINE VOLTAGE UNBALANCE:**<sup>2</sup> 4% maximum.

**POWER CONSUMPTION (10 kW Carrier):**<sup>3</sup> (Typical) 20.5 kW, 0% modulation; 22.1 kW, 50% tone modulation; 28.0 kW, 100% tone modulation. (Maximum) 22.1 kW, 0% modulation; 24.3 kW, 50% tone modulation; 30.8 kW, 100% tone modulation.

**POWER FACTOR:** 95% or better.

**AMBIENT TEMPERATURE RANGE:**<sup>4</sup> -20° to +50°C (-4° to +122°F) at sea level. Decreases 3.5° per 1,000 feet of altitude (84°F at 10,000 feet).

**MAXIMUM RELATIVE HUMIDITY:** 95%.

**MAXIMUM ALTITUDE FOR FULL POWER RATING:** 10,000 feet AMSL (3048 meters). Transmitters for operation above 10,000 feet AMSL require special order.

**SIZE:**<sup>5</sup> 78" H x 72" W x 32" D (198 cm x 183 cm x 81.3 cm).

**WEIGHT:** Unpacked, 1500 lbs. (680.4 kg) - approximate. Domestic packed, 1900 lbs. (861.8 kg) - approximate. Export packed, 2150 lbs. (975.2 kg) - approximate.

**CUBAGE:** 120 cu. ft. (3.4 cu. meters) packed - approximate.

**FINISH:** Blue, white and black.

**TUBES USED:** (1) 3CX15,000H3 and (1) 4CX15,000A.

**REMOTE CONTROL:** Normal terminal board interface.

1. Distortion measured at 95% modulation, or less, down to 25%. If transmitter is operated into a bandwidth limited antenna system, distortion at the higher modulating frequencies may degrade.
2. Noise measured over the band 20 Hz to 20 kHz, with line to line voltages of the supply line balanced. Noise may degrade to 56 dB below 100% modulation with line voltage unbalance not exceeding 4%.
3. Typical power consumption figures are for 10 kilowatts output and for optimum transmitter adjustment. For higher output powers and/or transmitter misadjustments, power consumption may be higher.
4. Maximum operating temperature derates linearly to +29°C (84.2°F) at 10,000 feet AMSL (3048 meters).
5. Does not include height of output connector, which may be removed for transport.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

## ORDERING INFORMATION

**MW-10B Transmitter with one set of operating tubes and two crystals, for 200-250 Volts or 350-430 Volts, 3 phase, 60 Hz operation** .....994-8624-004

**MW-10B Transmitter with one set of operating tubes and two crystals, for 200-250 Volts or 350-430 Volts, 3 phase, 50 Hz operation** .....994-8624-006

**Recommended spare semiconductor kit** .....990-1018-001

**Low voltage and filament voltage regulator, and line voltage regulator for MW-10B available.**

**HARRIS CORPORATION BROADCAST GROUP**  
**P. O. BOX 4290, QUINCY, ILLINOIS 62305-4290 U.S.A. 217/222-8200**

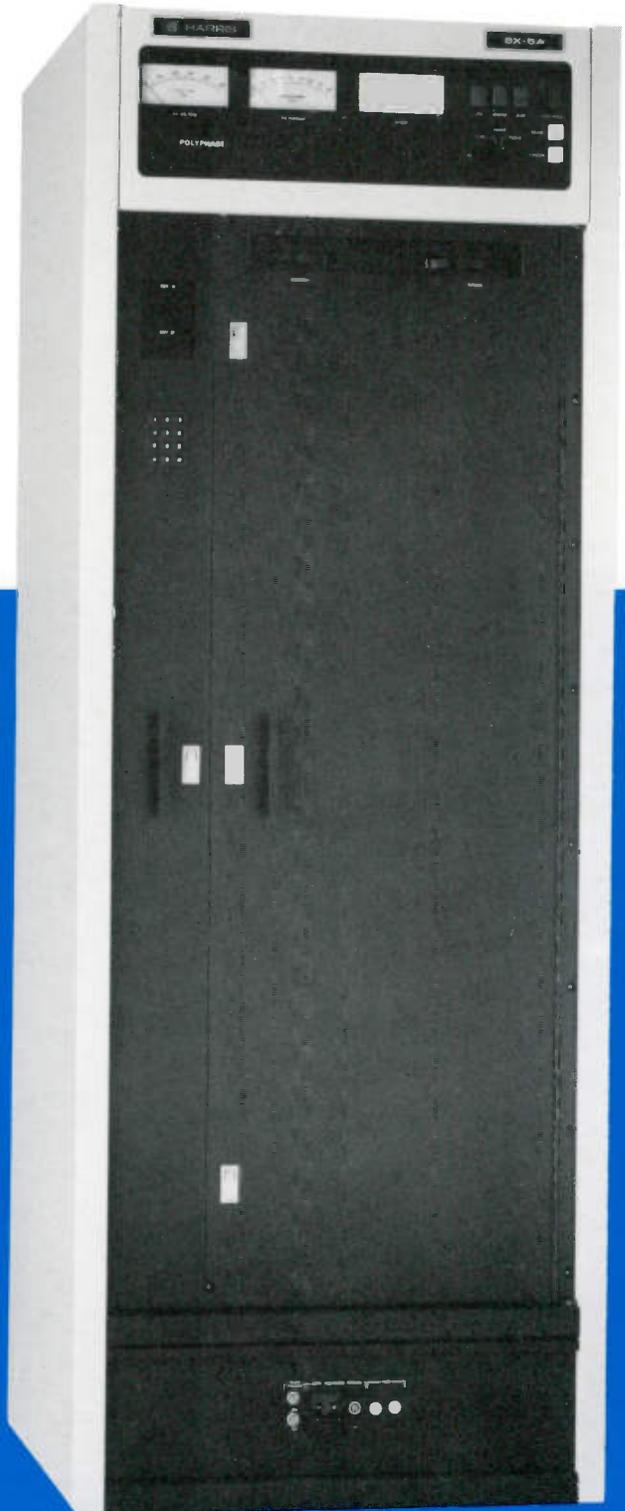


**HARRIS**

**SX-5A 5000 Watt**

**SoundStar** 

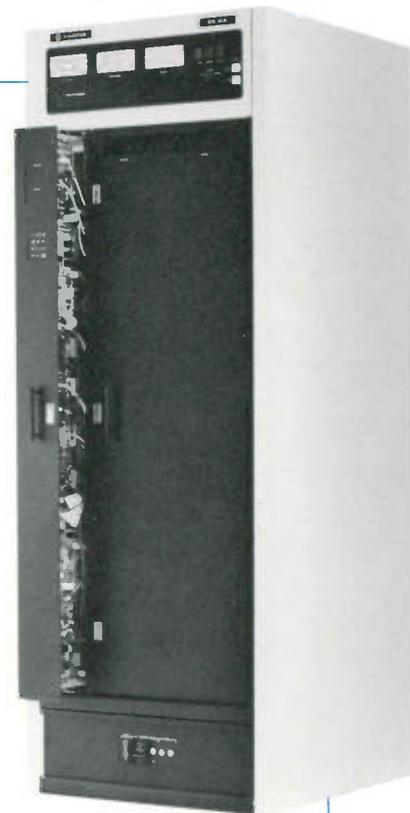
**AM Transmitter**



# SoundStar SX-5A — high technology in an ideal blend of broadcast and computer science

- 100% solid state for highest reliability
- Exceptionally high operating efficiency offers direct cost savings over other 5 kW designs
- Polyphase PDM\* for the best audio performance and exceptional signal clarity
- Dual microprocessor control and status monitoring eases operation and simplifies service
- SunWatch™ programmable time and power level option automatically executes PSA and PSSA schedules
- Flat-Pass output network for exceptional phase and amplitude linearity
- Output power and modulation level held constant regardless of line voltage fluctuations
- Designed for stereo operation (optional)

\*Patented



Low level plug-in circuit boards are conveniently housed on a vertical slide-out drawer for easy maintenance.

The Harris SX-5A is based on a rigid design philosophy applied to the entire SoundStar Series of solid-state AM transmitters. Central to this concept are the commitments to achieve:

- a) The highest possible audio performance
- b) The highest possible overall efficiency
- c) Maximum reliability
- d) Optimum stereo performance

The SX-5A broadcast transmitter is in a class by itself. It is computer designed and computer tested, with its own self-contained dual status and control computers. The SX-5A is 100% solid state and not affected by loss of emission, shorted elements or other problems found in tube type transmitters.

## EFFICIENT POWER DEVICES

With the SoundStar Series of transmitters, Harris introduces new high power semiconductor technology to its broadcast products. State-of-the-art MOSFET transistors, as opposed to bipolar devices, achieve higher efficiency in the SX-5A.

## WHY MOSFETS?

MOSFETS (Metal Oxide Semiconduc-

tor Field Effect Transistors) represent the latest generation of power devices offering significant benefits over bipolar transistor technology. Combined with the circuits used in the SX-5A, MOSFETS prove to be extremely efficient. Unlike bipolar devices, MOSFETS are not subject to thermal runaway damage. Additionally MOSFET transistors are ideal for parallel operation where multiple devices are required. In the Harris design, the transistors in the power amplifier are operated in parallel for DC. But unlike other transmitters, the ferrite combiner places the amplifiers in an RF series configuration. This SX-5A feature does not increase the stress on the remaining transistors should a MOSFET fail, thus allowing continued operation at reduced power with acceptable audio performance. MOSFET transistors are used both in the modulator and PA stages of the Harris SX-5A.

## HIGHLY EFFICIENT POWER AMPLIFIER

The SX-5A contains four RF power amplifier modules conservatively rated to produce 5600 watts output. The MOSFETS are grouped in a quad configuration and combined in a low loss

series configured ferrite combiner. Harris' PA module design efforts have resulted in an overall PA efficiency exceeding 85%.

## POLYPHASE PDM MODULATION

Polyphase PDM is a significant improvement of the Harris Pulse Duration Modulation System. It is a 4-phase system in which the audio input is sampled four times during each PDM cycle, resulting in lowest harmonic and intermodulation distortion of any AM transmitter available today.

The combination of the Harris Polyphase PDM Modulation and MOSFET devices achieves a modulator efficiency exceeding 90%. Polyphase PDM also allows the low pass filter to have a wide audio passband, and with the Bessel filter, reduces overshoot on sharply rising waveforms. This provides the ability to achieve higher levels of modulation density. Should there be a malfunction of one phase of the system, operation continues with a slight reduction in performance until a convenient maintenance action can be scheduled. Harris' Polyphase PDM

## Pushbutton diagnostics!

achieves new levels of AM audio performance and reliability.

### EXCEPTIONALLY HIGH OVERALL EFFICIENCY

The exceptionally high PA and modulator efficiency of the SX-5A combine to yield greater than 65% overall AC to RF efficiency. This represents a 17% to 30% direct power saving compared with other 5 kW transmitters now in use!

### FLAT-PASS OUTPUT NETWORK

After examining various output networks in past and current transmitters, Harris chose an output network/bandpass filter consistent with the design objectives of the SX-5A. The computer designed *Flat-Pass* output network is a Butterworth bandpass filter yielding superb phase and amplitude linearity—two critical requirements for optimum AM Stereo performance.

The innovative design of the *Flat-Pass* network allows modulation monitoring and forward power to be measured at a fixed impedance. The directional coupler is always located at a 50 ohm impedance point. Direct drive tuning and loading controls simply adjust the SX-5A to match a load that can be any value within a 1.5:1 VSWR circle.

### TRANSMITTER AND ANTENNA SYSTEM PROTECTION

High speed lightning protection results from design techniques and devices used in the SX-5A. The transmitter constantly monitors VSWR status and takes action only when operational limits are exceeded. Unwarranted VSWR trips, due to weather, are minimized. *The transmitter is protected when subjected to an open or shorted load even at full output power.*

### DUAL MICROPROCESSOR CONTROL AND STATUS MONITORING

Harris' extensive experience in transmitter technology and digital based products (program automation, automatic camera setup, and facility control) permits the incorporation of powerful control and diagnostic features into the SX-5A transmitter. Should a multiple overload occur, the operator

The SX-5A transmitter brings a wealth of diagnostic information to your fingertips through the microprocessor keypad located on the front panel.

may review stored previous meter readings and sequential status indications to determine the fault. Many useful operating parameters are available at fingertip command at the front panel keypad, making the SX-5A one of the easiest transmitters to monitor, control and service. The controller is pre-programmed at the factory and simply requires interrogation by the operator.

Operationally, the SX-5A consists of three eye-level meters displaying Power Amplifier Volts, Power Amplifier Current and Forward/Reflected Power. To the right of these large, easy-to-read meters are six illuminated switches labeled as follows:

**Off-Fault**—This pushbutton not only turns the transmitter off, but also acts as a master status light in the event of a transmitter malfunction.

**Low, Medium and High**—Independent tri-power levels can be set to any value for each of the three power control buttons. The illuminated button indicates which power level is operating. No contactor or power transformer tap changes are required.

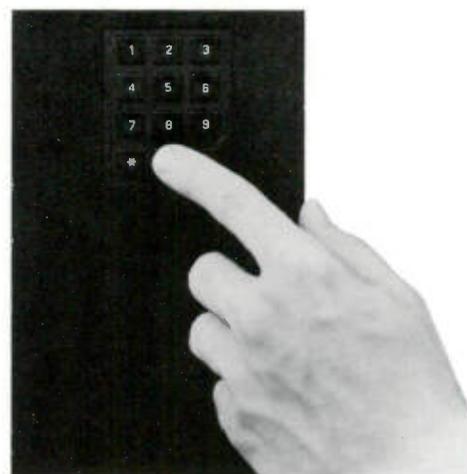
**Raise Power/Lower Power**—These pushbuttons allow the operator to set and adjust the power levels. This is a digital power control and has no moving parts.

### SunWatch™ PROGRAMMABLE TIME AND POWER LEVEL OPTION

This unique SX-5A feature allows stations to automatically execute pre-sunrise and post sunset operating power schedules. The front key pad and display allows you to program in a given month up to 10 power level selections that are executed at the requested time. All of the different 12 month operating schedules may be programmed at once. This schedule may be reviewed or edited at any time. A precision, rack mounted, battery back-up clock is included with this option.

### CUSTOMER INTERFACE PANEL

The Customer Interface Panel provides the user with a centrally located point for all external interface equipment such as remote control, facility control, audio input, etc. The SX-5A transmitter is designed to interface with the majority of remote control and facility control systems. A momentary closure of 15 milliamps rating (TTL or dry contact) will activate the various control functions. All analog samples (Power Amplifier Volts, Power Amplifier current, output power, etc.) are buffered.



### DESIGNED FOR AM STEREO

The SX-5A is designed for AM Stereo, with special consideration paid to incidental quadrature modulation, audio input to RF envelope output phase linearity, and RF channel phase response. The standard high stability crystal oscillator and optional frequency synthesizer are both equipped to accept external AM Stereo RF oscillator signals.

### MECHANICAL DESIGN CONSIDERATIONS

Service accessibility is a major user benefit of the SX-5A. This is accomplished by electronic packaging new to broadcast transmitter products. For example, all low level circuit cards such as the RF oscillator, control logic and Polyphase PDM generator cards are located in a pull-out drawer. Critical low level circuit tests can be made while on the air.

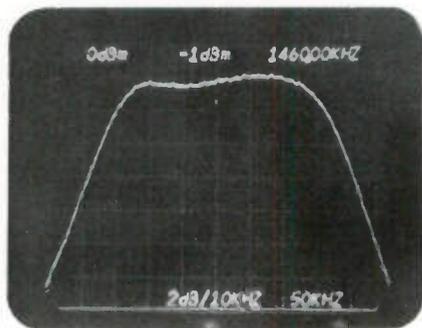
The all aluminum cabinet construction reduces shipping cost, while captive hardware and connectorized module interfaces reduce maintenance time.

### COOLING SYSTEM

The SX-5A incorporates an innovative computer modeled cooling technique that offers significant benefits over conventional transmitter designs. The sidewalls of the transmitter form "chimneys" to which the power modules are attached. Air assisted by 2 quiet, high reliability 250 CFM fans, enters through a filtered rear entrance and rises through the cabinet walls, cooling the power modules' heat sinks.

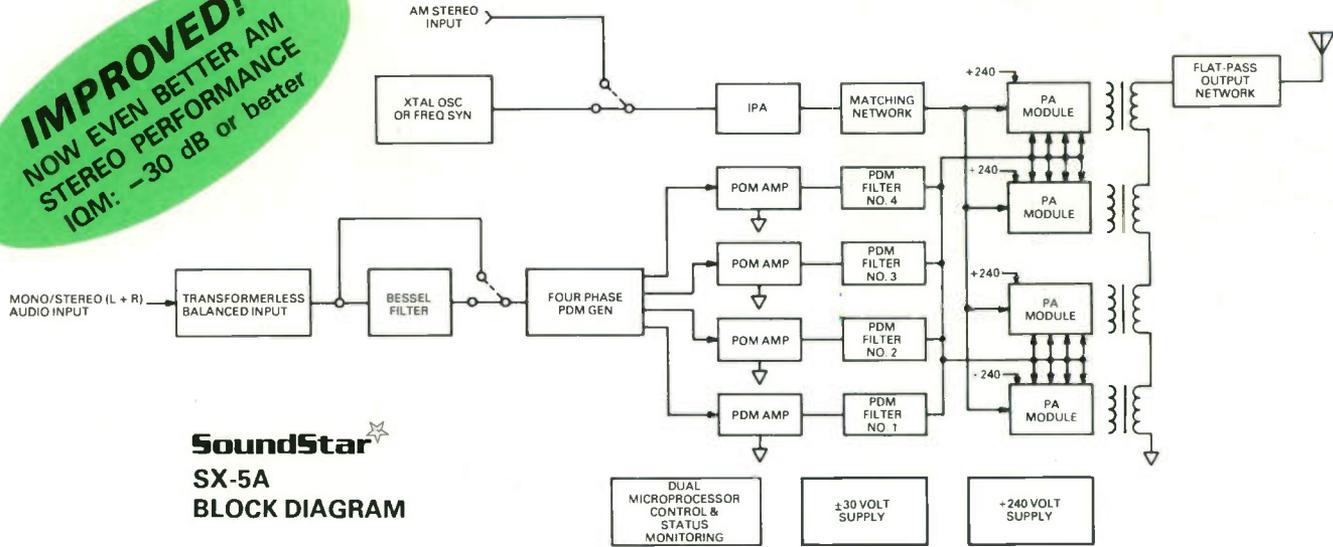
### EASE OF INSTALLATION AND SERVICE

The SX-5A arrives ready for installation. Included is a wall mounted AC disconnect panel designed to interface with the station's electrical distribution system. Installation is essentially positioning the SX-5A and making final AC, RF and audio connections. No special air handling systems are normally required.



Spectrum analyzer response of *Flat-Pass* output network maximizes mono and stereo performance.

**IMPROVED!**  
**NOW EVEN BETTER AM**  
**STEREO PERFORMANCE**  
**IQM: -30 dB or better**



**SoundStar**  
**SX-5A**  
**BLOCK DIAGRAM**

## SX-5A SPECIFICATIONS

**POWER OUTPUT:** (Rated) 5000 watts. (Capable) 5600 watts. Power reduction through 500 watts. Capable of lower power operation.

**RF FREQUENCY RANGE:** 531 KHz through 1620 KHz. Supplied to one frequency as ordered.

**CARRIER FREQUENCY STABILITY:** A) Crystal Oscillator —  $\pm 20$  Hz over temperature range. B) Frequency Synthesizer (optional) —  $\pm 10$  Hz over temperature range.

**RF OUTPUT IMPEDANCE:** 50 ohms unbalanced. Will match into a VSWR of 1.5:1 at carrier.

**RF OUTPUT TERMINAL:** 7/8" EIA male flange connector.

**CARRIER AMPLITUDE VARIATION:** (Carrier Shift): Less than 2% at 100% modulation at 1000 Hz.

**RF HARMONICS AND SPURIOUS EMISSIONS:** Exceeds FCC and CCIR specifications.

**TYPE OF MODULATOR:** Patented Polyphase PDM.

**AUDIO FREQUENCY RESPONSE:** +0.5 dB, -1.5 dB from 20 to 12,500 Hz. Reference 1000 Hz with Bessel filter out.

**AUDIO HARMONIC DISTORTION:** 1.0% or less at 5 kW, 20 to 12,500 Hz @ 95% modulation. 2% or less at 1000 watts operation, 20 to 12,500 Hz @ 95% modulation. 3% or less at 500 watts, 20 to 12,500 Hz @ 95% modulation.

**AUDIO INTERMODULATION DISTORTION:** 1.0% or less, 60/7000 Hz 1:1, 1.5% or less, 60/7000 Hz 4:1, SMPTE standards at 5 kW operation at 95% modulation.

**SQUAREWAVE OVERTHOOT:** 5% or less at 400 Hz.

**SQUAREWAVE TILT:** 5% or less at 20 Hz @ 90% modulation.

**NOISE (UNWEIGHTED):** Better than 60 dB below 100% modulation, 1000 Hz at 5 kW.

**POSITIVE PEAK CAPABILITY:** 125% positive peak program modulation capability at 5600 watts.

**AM STEREO SPECIFICATIONS:** Incidental Quadrature Modulation (IQM): Better than 24 dB below 95% modulation of L+R channel at 1 kHz.

**AUDIO INPUT:** -10 to +10 dBm, transformerless 600 ohms balanced, continuously adjustable.

**AC VOLTAGE INPUT:** 197-251 VAC, 48 to 63 Hz, three phase, 3 wire or 341 to 434 VAC, three phase, 4 wire, 48 to 63 Hz, +5% from nominal line

voltage to maintain full performance.

**OVERALL EFFICIENCY:** Better than 65%.

**POWER CONSUMPTION<sup>1</sup>:** 7.7 kW at 0% modulation at 5000 watts. 11.6 kW at 100% tone modulation at 5000 watts carrier. 10.4 kW under average programming conditions.

**MONITOR PROVISIONS:** 10 volts RF (RMS) modulated output sample at 50 ohms (High/Medium/Low) power.

**REMOTE CONTROL:** Self-contained interface for most remote control or facility control systems.

**AMBIENT TEMPERATURE RANGE:** -20°C to +50°C AMSL (derate upper limit 2°C per 1000 feet altitude).

**AMBIENT HUMIDITY RANGE:** To 95% non condensing.

**AIR FLOW:** 500 CFM fan.

**ALTITUDE:** Sea Level to 13,000 feet (4000 meters).

**OPERATING ACOUSTICAL NOISE:** Better than 64 dBA acoustic rating, 3 feet from transmitter.

**SIZE:** 72"H x 28"W x 30"D (1830 mm x 712 mm x 762 mm).

**WEIGHT:** (Unpacked), 500 lbs. (230 kg) — approximate. Domestic packed, 700 lbs. (320 kg) — approximate. Export packed, 800 lbs. (370 kg) — approximate.

**CUBAGE:** 68.7 cubic feet (2 cubic meters) packed.

**COLORS:** White and black.

**TYPE OF ACTIVE COMPONENTS:** 100% solid state.

**POWER SUPPLY:** Self-contained, dry.

**HARRIS MAINTAINS A POLICY OF CONTINUOUS IMPROVEMENTS ON ITS EQUIPMENT AND THEREFORE RESERVES THE RIGHT TO CHANGE SPECIFICATIONS WITHOUT NOTICE.**

<sup>1</sup>For AC service connection, please provide 14 KVA with a minimum of 5% voltage demand regulation.

**NOTE:** The above specifications apply to operation at 5 kW except where noted. Furthermore, the above audio performance may be degraded should the transmitter be operated into a bandwidth restricted antenna system.

## ORDERING INFORMATION

SX-5A Transmitter, complete with all solid-state devices, crystal oscillator or synthesizer, technical manual.	
Specify frequency .....	994-8583-004
SunWatch <sup>SM</sup> programmable time and power level option .....	994-8974-001
Recommended spare semiconductor kit .....	990-1014-002
Spare crystal .....	444-XXXX-000
<b>ANCILLARY EQUIPMENT</b>	
AM-90 modulation monitor .....	994-8424-001
Potomac AT-51 test set .....	700-0499-000

**HARRIS CORPORATION BROADCAST TRANSMISSION DIVISION**  
**P. O. BOX 4290, QUINCY, ILLINOIS 62305-4290 U.S.A. 217/222-8200**

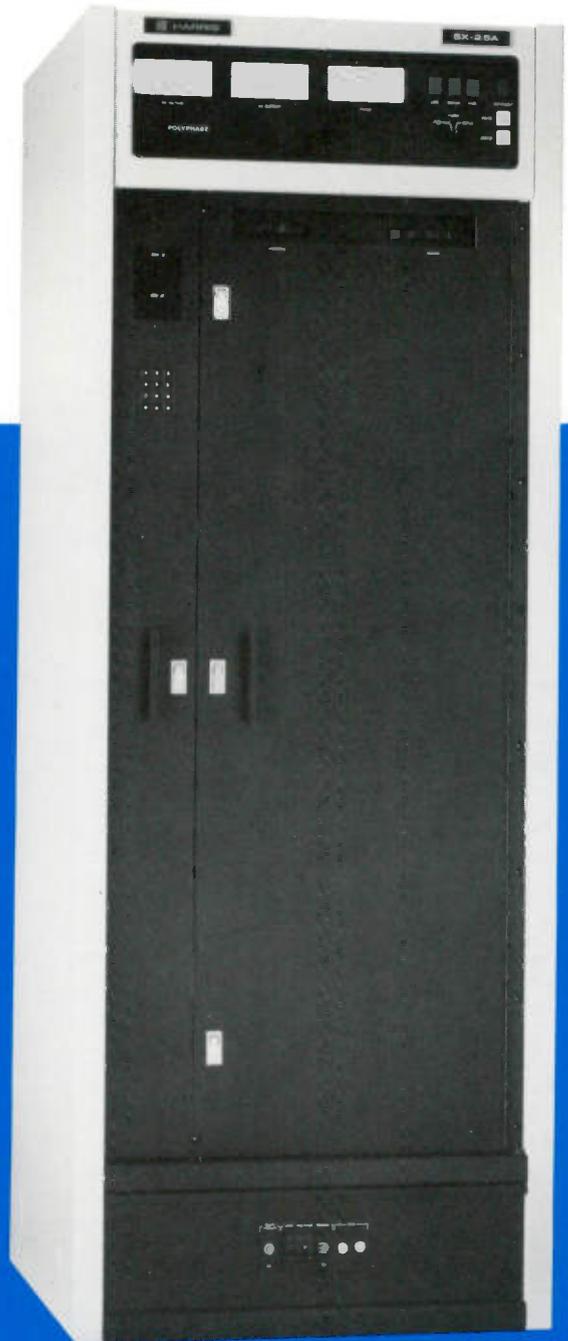


**HARRIS**

**SX-2.5A 2500 Watt**

**SoundStar<sup>TM</sup>**

**AM Transmitter**



# SoundStar SX-2.5A — high technology in an ideal blend of broadcast and computer science

- 100% solid state for highest reliability
- Exceptionally high operating efficiency offers up to 42% direct power cost savings over other 2.5 kW designs
- Polyphase PDM\* for the best audio performance and exceptional signal clarity
- Dual microprocessor control and status monitoring eases operation and simplifies service
- SunWatch™ programmable time and power level option automatically executes PSA and PSSA schedules
- Flat-Pass output network for exceptional phase and amplitude linearity
- Output power and modulation level held constant regardless of line voltage fluctuations
- Designed for stereo operation (optional)

\*Patented



Low-level plug-in circuit boards are conveniently housed on a vertical slide-out drawer for easy maintenance.

The Harris SX-2.5A is based on a rigid design philosophy applied to the entire SoundStar Series of solid-state AM transmitters. Central to this concept are the commitments to achieve:

- a) The highest possible audio performance
- b) The highest possible overall efficiency
- c) Maximum reliability

The SX-2.5A broadcast transmitter is in a class by itself. It is computer designed and computer tested, with its own self-contained dual status monitoring and control computers. The SX-2.5A is 100% solid state and not affected by loss of emission, shorted elements or other problems found in tube type transmitters.

## EFFICIENT POWER DEVICES

With the SoundStar Series of transmitters, Harris introduces new high power semiconductor technology to its broadcast products. State-of-the-art MOSFET transistors, as opposed to bipolar devices, achieve higher efficiency in the SX-2.5A.

## WHY MOSFETS?

MOSFETS (Metal Oxide Semiconductor Field Effect Transistors) represent a second generation of power devices having significant advantages over bipolar transistor technology. Combined with the circuits used in the SX-2.5A, MOSFETS prove to be extremely efficient. Unlike bipolar devices, MOSFETS are not subject to thermal runaway damage. Additionally, MOSFET transistors lend themselves well to parallel operation where multiple devices are required. In the Harris design, the transistors in the power amplifier modules are operated in parallel for DC. But unlike other transmitters, the ferrite combiner places the amplifiers in an RF series configuration, permitting graceful degradation without increasing the stress on the remaining transistors. MOSFETS are used in both the modulator and PA stages of the SX-2.5A.

## HIGHLY EFFICIENT POWER AMPLIFIER

The SX-2.5A contains two RF power amplifier modules conservatively rated to produce 2750 watts output. The MOSFETS are grouped in a quad configuration and combined in a low

loss series configured ferrite combiner. Harris' PA module design efforts have resulted in an overall PA efficiency exceeding 85%.

## POLYPHASE PDM MODULATION

Polyphase PDM is a significant improvement of the Harris Pulse Duration Modulation System. It is a 4-phase system in which the audio input is sampled four times during each PDM cycle, resulting in lowest harmonic and intermodulation distortion of any AM transmitter currently offered.

The combination of the Harris Polyphase PDM Modulation and MOSFET devices achieves a modulator efficiency exceeding 90%. Polyphase PDM also allows the low pass filter to have a wide audio passband, and with the Bessel filter, reduces overshoot on sharply rising waveforms. This provides the ability to achieve higher levels of modulation density. Should there be a malfunction of one phase of the system, operation continues with a slight reduction in performance until a convenient maintenance action can be performed. Harris' Polyphase PDM

achieves new levels of AM audio performance and reliability.

### EXCEPTIONALLY HIGH OVERALL EFFICIENCY

The exceptionally high PA and modulator efficiency of the SX-2.5A combine to yield greater than 65% overall AC to RF efficiency. This represents a 34% to 42% direct power saving compared with other 2.5 kW transmitters now in use!

### FLAT-PASS OUTPUT NETWORK

After examining various output networks in past and current transmitters, Harris chose an output network/bandpass filter consistent with the design objectives of the SX-2.5A. The computer designed *Flat-Pass* output network is a Butterworth bandpass filter yielding superb phase and amplitude linearity—two critical requirements for optimum AM Stereo performance.

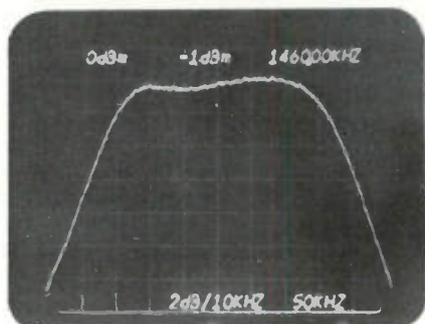
The innovative design of the *Flat-Pass* network allows modulation monitoring and forward power to be measured at a fixed impedance. The directional coupler is always located at a 50 ohm impedance point. Direct drive tuning and loading controls simply adjust the SX-2.5A to match a load that can be any value within a 1.5:1 VSWR circle.

### TRANSMITTER AND ANTENNA SYSTEM PROTECTION

High speed lightning protection results from design techniques and devices used in the SX-2.5A. The SoundStar transmitter constantly monitors VSWR status and takes action only when operational limits are exceeded. Unwarranted VSWR trips, due to environmental factors, are kept to a minimum. *The transmitter will not be damaged when operated into an open or shorted load even at full output power!*

### DUAL MICROPROCESSOR CONTROL AND STATUS MONITORING

Harris' extensive experience in transmitter technology and digital based products (program automation, automatic camera setup, facility control) permits the incorporation of powerful control and diagnostic features into the SX-2.5A transmitter. For example, should a high module temperature condition exist, the microprocessor simply reduces output power to a tolerable level, thus keeping the transmitter



Spectrum analyzer response of *Flat-Pass* output network maximizes mono and stereo performance.

The SX-2.5A transmitter brings a wealth of diagnostic information to your fingertips through the microprocessor keypad located on the front panel.

on the air. Should a multiple overload occur, the operator may review stored previous meter readings and sequential status indications to determine the fault. Many useful operating parameters are available at fingertip command at the front panel keypad, making the SX-2.5A one of the easiest transmitters to monitor, control and service. The controller is pre-programmed at the factory and simply requires interrogation by the operator.

Operationally, the SX-2.5A consists of three eye-level meters displaying PA Volts, PA Current and Forward/Reflected Power. To the right of these large, easy-to-read meters are six illuminated switches labeled as follows:

**Off-Fault**—This switch not only turns the transmitter off, but also acts as a master status light in the event of a transmitter malfunction. Extensive control module LED indicators assist the operator in isolating the fault.

**Low, Medium and High**—Independent tri power levels can be set to any value for each of the three power control switches. The illuminated button indicates which power level is operating. No contactor or power transformer tap changes are required.

**Raise Power/Lower Power**—These pushbuttons allow the operator to set and adjust the power levels. This is a digital power control and has no moving parts.

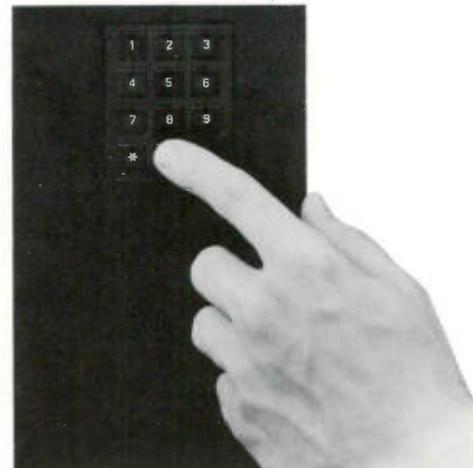
### SunWatch™ PROGRAMMABLE TIME AND POWER LEVEL OPTION

This unique SX-2.5A feature allows stations to automatically execute pre-sunrise and post sunset operating power schedules. The front key pad and display allows you to program in a given month up to 10 power level selections that are executed at the requested time. All of the different 12 month operating schedules may be programmed at once. This schedule may be reviewed or edited at any time. A precision, rack mounted, battery back-up clock is included with this option.

### CUSTOMER INTERFACE PANEL

The Customer Interface Panel provides the user with a centrally located point for all external interface equipment such as remote control, facility control, audio input, etc. The SX-2.5A transmitter is designed to interface with the majority of remote control and facility control systems. A momentary closure of 15 milliamps rating (TTL or dry contact) will activate the various control functions. All analog samples (PA

## Pushbutton diagnostics!



volts, PA current, output power, etc.) are buffered.

### DESIGNED FOR AM STEREO

The SX-2.5A is designed for AM Stereo, with special consideration paid to incidental phase modulation, audio input to RF envelope output phase linearity, and RF channel phase response. The standard high stability crystal oscillator and optional frequency synthesizer are both equipped to accept external AM Stereo RF oscillator signals.

### MECHANICAL DESIGN CONSIDERATIONS

Service accessibility is a major user benefit of the SX-2.5A. This is accomplished by novel electronic packaging new to broadcast transmitter products. For example, all low level circuit cards such as the RF oscillator, control logic and Polyphase PDM generator cards are located in a pull-out drawer. Critical low level circuit tests can be made while on the air.

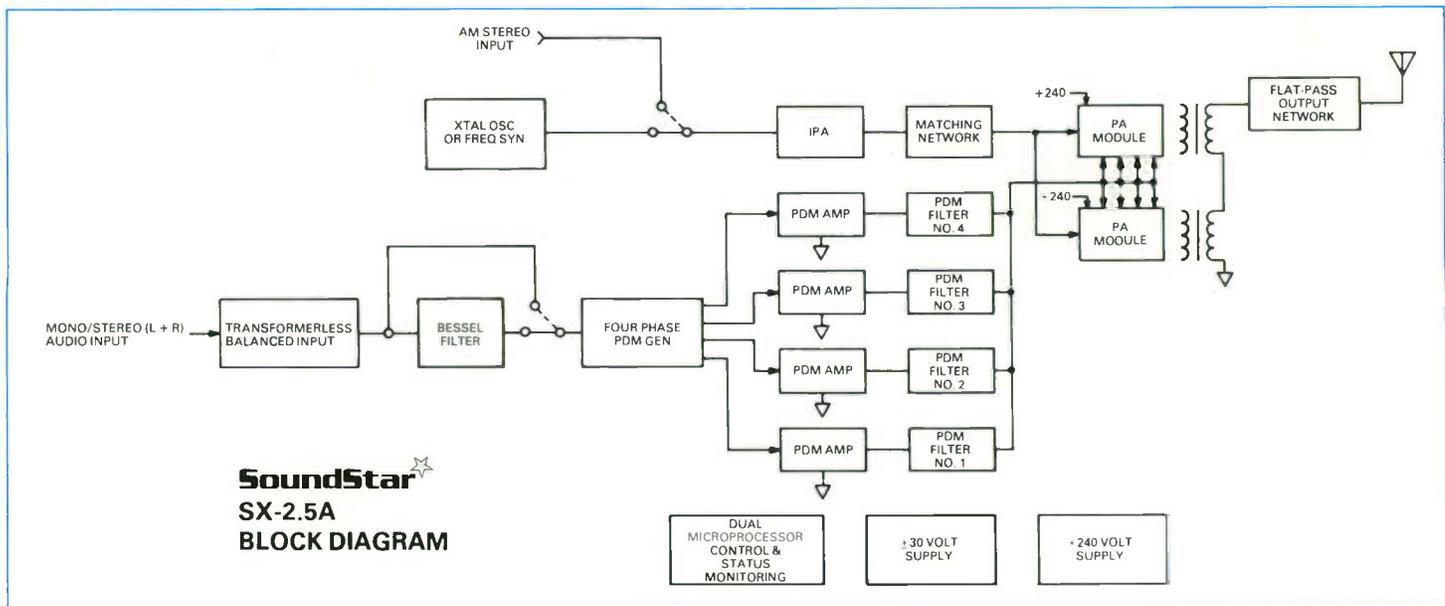
The all aluminum cabinet construction reduces shipping cost, while captive hardware and connectorized module interfaces reduce maintenance time.

### COOLING SYSTEM

The SX-2.5A incorporates an innovative computer modeled cooling technique that offers significant benefits over conventional transmitter designs. The sidewalls of the transmitter form "chimneys" to which the power modules are attached. Air assisted by a quiet, high reliability 250 CFM fan enters through a filtered rear entrance and rises through the cabinet walls, cooling the power modules' heat sinks.

### EASE OF INSTALLATION AND SERVICE

The SX-2.5A arrives ready for installation. Included is a wall mounted AC disconnect panel designed to interface with the station's electrical distribution system. Installation is essentially positioning the SX-2.5A and making final AC, RF and audio connections. No special air handling systems are required.



## SX-2.5A SPECIFICATIONS

**POWER OUTPUT:** (Rated) 2500 watts. (Capable) 2750 watts. Power reduction through 250 watts. Capable of lower power operation.

**RF FREQUENCY RANGE:** 531 KHz through 1620 KHz. Supplied to one frequency as ordered.

**CARRIER FREQUENCY STABILITY:** A) Crystal Oscillator:  $\pm 20$  Hz over temperature range. B) Frequency Synthesizer (optional):  $\pm 10$  Hz over temperature range.

**RF OUTPUT IMPEDANCE:** 50 ohms unbalanced. Will match into a VSWR of 1.5:1 at carrier.

**RF OUTPUT TERMINAL:**  $\frac{3}{4}$ " EIA male flange connector.

**CARRIER AMPLITUDE VARIATION:** (Carrier Shift): Less than 2% at 100% modulation at 1000Hz.

**RF HARMONICS AND SPURIOUS EMISSIONS:** Exceeds FCC and CCIR specifications.

**TYPE OF MODULATOR:** Patented Polyphase PDM.

**AUDIO FREQUENCY RESPONSE:** +0.5 dB, -1.5 dB from 20 to 12,500 Hz at 95% modulation with Bessel filter out, ref. 1000 Hz.

**AUDIO HARMONIC DISTORTION:** @ 95% modulation: 1.0% or less at 2.5 kW, 20 to 12,500 Hz; 1.5% or less at 1000 watt operation, 20 to 12,500 Hz; 3% or less at 250 W, 20 to 12,500 Hz.

**AUDIO INTERMODULATION DISTORTION:** 1.0% or less, 60/7000 Hz 1:1; 1.5% or less, 60/7000 Hz 4:1; SMPTE standards at 2500 watt output @ 95% modulation.

**SQUAREWAVE OVERSHOOT:** Less than 5% at 400 Hz @ 90% modulation with Bessel filter.

**SQUAREWAVE TILT:** Less than 5% at 20 Hz @ 90% modulation.

**NOISE (UNWEIGHTED):** Better than 60 dB below 100% modulation.

**POSITIVE PEAK CAPABILITY:** 125% positive peak program modulation capability at 2750 watts.

**AM STEREO SPECIFICATIONS:** Incidental Quadrature Modulation (IQM): Better than 24 dB below 95% modulation of L+R channel at 1 kHz.

**AUDIO INPUT:** -10 to +10 dBm, transformerless 600 ohms balanced, continuously adjustable.

**AC VOLTAGE INPUT:** 197-251 VAC, 48 to 63 Hz, single phase.

**OVERALL EFFICIENCY:** 65% or better at 2500 W.

**POWER CONSUMPTION<sup>1</sup>:** 3.85 kW at 0% modulation at 2500 watts. 5.8 kW at 100% tone modulation at 2500 watts carrier. 5.4 kW under average programming conditions.

**MONITOR PROVISIONS:** 10 volts RF (RMS) modulated output sample at 50 ohms (High/Medium/Low) power.

**REMOTE CONTROL:** Self-contained interface for most remote control or facility control systems.

**AMBIENT TEMPERATURE RANGE:** -20°C to +50°C AMSL (derate upper limit 2°C per 1000 feet altitude).

**AMBIENT HUMIDITY RANGE:** To 95% non condensing.

**AIR FLOW:** 250 CFM fan.

**ALTITUDE:** Sea Level to 13,000 feet (4000 meters).

**OPERATING ACOUSTICAL NOISE:** Better than 64 dBA acoustic rating, 3 feet from transmitter.

**SIZE:** 72"H x 28"W x 30"D (1830 mm x 712 mm x 762 mm).

**WEIGHT:** (Unpacked), 450 lbs. (204 kg) — approximate. Domestic packed, 650 lbs. (298 kg) — approximate. Export packed, 750 lbs. (343 kg) — approximate.

**CUBAGE:** 68.7 cubic feet (2 cubic meters) packed.

**COLORS:** White and black.

**TYPE OF ACTIVE COMPONENTS:** 100% solid state.

**POWER SUPPLY:** Self-contained, dry.

**HARRIS MAINTAINS A POLICY OF CONTINUOUS IMPROVEMENTS ON ITS EQUIPMENT AND THEREFORE RESERVES THE RIGHT TO CHANGE SPECIFICATIONS WITHOUT NOTICE**

<sup>1</sup>For AC service connection, please provide 8.2 KVA with a minimum of 5% voltage demand regulation.

**NOTE:** The above audio performance may be degraded should the transmitter be operated into a bandwidth restricted antenna system. Also, all specifications are referenced to operation at 2500 watts except when noted.

## ORDERING INFORMATION

<b>SX-2.5A Transmitter, complete with all solid-state devices, crystal oscillator or synthesizer, technical manual.</b>	
Specify frequency .....	.994-8582-004
SunWatch <sup>®</sup> programmable time and power level option .....	.994-8974-001
Recommended spare semiconductor kit .....	.990-1013-002
Spare crystal .....	.444-XXXX-000
<b>ANCILLARY EQUIPMENT</b>	
AM-90 modulation monitor .....	.994-8424-001
Potomac AT-51 test set .....	.700-0499-000

**HARRIS CORPORATION BROADCAST TRANSMISSION DIVISION**  
P. O. BOX 4290, QUINCY, ILLINOIS 62305-4290 U.S.A. 217/222-8200

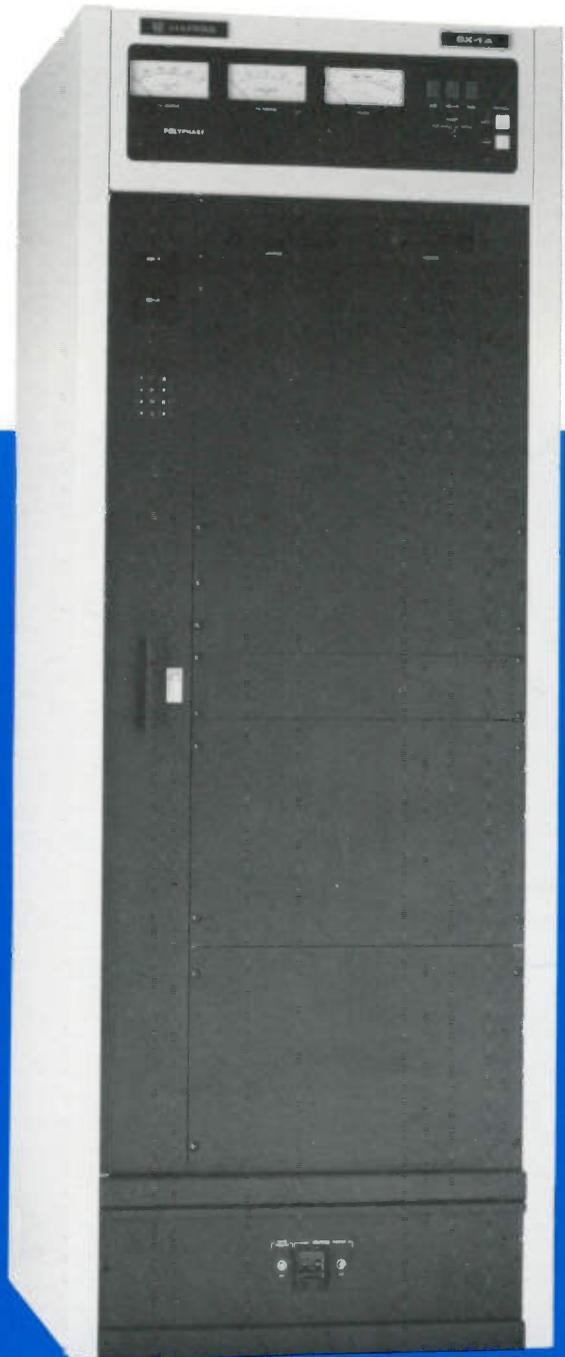


**HARRIS**

**SX-1A 1000 Watt**

**SoundStar<sup>TM</sup>**

**AM Transmitter**



# SoundStar SX-1A — high technology in an ideal blend of broadcast and computer science

- 100% solid state for highest reliability
- Exceptionally high operating efficiency offers direct cost savings over other 1 kW designs
- Polyphase PDM\* for the best audio performance and exceptional signal clarity
- Dual microprocessor control and status monitoring eases operation and simplifies service
- SunWatch™ programmable time and power level option automatically executes PSA and PSSA schedules
- Flat-Pass output network for exceptional phase and amplitude linearity
- Output power and modulation level held constant regardless of line voltage fluctuations
- 36 inches of internal rack space provided for ancillary equipment

\*Patented



Low level plug-in circuit boards are conveniently housed on a vertical slide-out drawer for easy maintenance.

The Harris SX-1A is based on a rigid design philosophy applied to the entire SoundStar Series of solid-state AM transmitters. Central to this concept are the commitments to achieve:

- a) The highest possible audio performance
- b) The highest possible overall efficiency
- c) Maximum reliability

The SX-1A broadcast transmitter is an outstanding performer in a class by itself. It is computer designed and computer tested, with its own self-contained dual status and control computers. The SX-1A is 100% solid state and not affected by loss of emission, shorted elements or other related problems found in tube type transmitters.

## EFFICIENT POWER DEVICES

With the SoundStar Series of transmitters, Harris introduces new high power semi-conductor technology to its broadcast products. State-of-the-art MOSFET transistors, as opposed to bipolar devices, achieve higher efficiency in the SX-1A.

## WHY MOSFETS?

MOSFETs (Metal Oxide Semiconductor Field Effect Transistors) represent a second generation of power devices

offering significant benefits over bipolar transistor technology. Combined with the circuits used in the SX-1A, MOSFETs prove to be extremely efficient. Unlike bipolar devices, MOSFETs are not subject to thermal runaway damage and are used both in the modulator and PA stages of the SX-1A.

Additionally, MOSFET transistors lend themselves to parallel operation where multiple devices are required. In the Harris design, the transistors in the power amplifier modules are operated in parallel for DC. But unlike other transmitters, the ferrite combiner places the amplifiers in series, permitting graceful degradation without increasing the stress on the remaining transistors.

## HIGHLY EFFICIENT POWER AMPLIFIER

The SX-1A contains one RF power amplifier module conservatively rated to produce 1100 watts output. The MOSFETs are grouped in a quad configuration and combined in a low loss series configured ferrite combiner. Harris' PA module design efforts have resulted in an overall PA efficiency typically exceeding 85%.

## POLYPHASE PDM MODULATION

Polyphase PDM is a significant im-

provement of the Harris Pulse Duration Modulation system. It is a 4-phase system in which the audio input is sampled four times during each PDM cycle, resulting in the lowest harmonic and intermodulation distortion of any AM transmitter currently offered.

The combination of the Harris Polyphase PDM Modulation and MOSFET devices achieves a modulator efficiency typically exceeding 90%. Polyphase PDM also allows the low pass filter to have a wide audio pass-band, and with the Bessel filter, reduces overshoot on sharply rising waveforms. This provides the ability to achieve higher levels of modulation density. Should there be a malfunction of one phase of the system, operation continues at reduced power until a convenient maintenance period can be scheduled. Harris' Polyphase PDM achieves new levels of AM audio performance and reliability.

## EXCEPTIONALLY HIGH OVERALL EFFICIENCY

The exceptionally high PA and modulator efficiency of the SX-1A combine to yield typically 70% overall AC to RF efficiency. This represents a 29% to 46% direct power saving compared

with other 1 kW transmitters now in use!

### FLAT-PASS OUTPUT NETWORK

After examining various output networks in past and current transmitters, Harris chose an output network/bandpass filter consistent with the design objectives of the SX-1A. The computer designed *Flat-Pass* output network is a Butterworth bandpass filter yielding superb phase and amplitude linearity—two critical requirements for optimum AM Stereo performance.

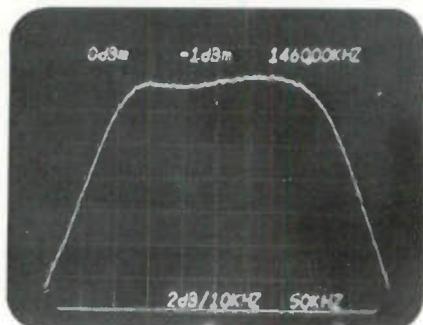
The innovative design of the *Flat-Pass* network allows modulation monitoring and forward power to be measured at a fixed impedance. The directional coupler is always located at a 50 ohm impedance point. Direct drive tuning and loading controls simply adjust the SX-1A to match a load that can be any value within a 1.5:1 VSWR circle.

High speed lightning protection results from design techniques and devices used in the SX-1A. The SoundStar transmitter constantly monitors VSWR status and takes action only when operational limits are exceeded. Unwarranted VSWR trips, due to station problems or other environmental factors, are minimized. *The transmitter is protected when subjected to an open or shorted load even at full output power!*

### DUAL MICROPROCESSOR CONTROL AND STATUS MONITORING

Harris' extensive experience in transmitter technology and digital based products (program automation, automatic camera setup, facility control) permits the incorporation of powerful control and diagnostic features into the SX-1A transmitter. Should a multiple overload occur, the operator may review stored previous meter readings and sequential status indications to determine the fault. A vast number of useful operating parameters is available at fingertip command at the front panel keypad, making the SX-1A one of the easiest transmitters to monitor, control and service. The controller is pre-programmed at the factory and only requires interrogation by the operator.

Operationally, the SX-1A consists of three eye-level meters displaying PA



Spectrum analyzer response of *Flat-Pass* output network maximizes mono and stereo performance.

The SX-1A transmitter brings a wealth of diagnostic information to your fingertips through the microprocessor keypad located on the front panel.

Volts, PA Current and Forward/Reflected Power. To the right of these large, easy-to-read meters are six illuminated pushbuttons labeled as follows:

**Off-Fault**—This pushbutton not only turns the transmitter off, but also acts as a master status light in the event of a transmitter malfunction. Extensive control module LED indicators assist the operator in isolating the fault.

**Low, Medium and High**—Independent tri power levels can be set to any value for each of the three power control buttons. The illuminated button indicates which power level is operating. No contactor or power transformer tap changes are required.

**Raise Power-Lower Power**—These pushbuttons allow the operator to set and adjust the power levels. This is a digital power control and has no moving parts.

### CUSTOMER INTERFACE PANEL

The Customer Interface Panel provides the user with a centrally located point for all external interface equipment such as remote control, facility control, audio input, etc. The SX-1A transmitter is designed to interface with the majority of remote control and facility control systems. A momentary closure of 15 milliamps rating (TTL or dry contact) will activate the various control functions. All analog samples (PA volts, PA current, output power, etc.) are buffered.

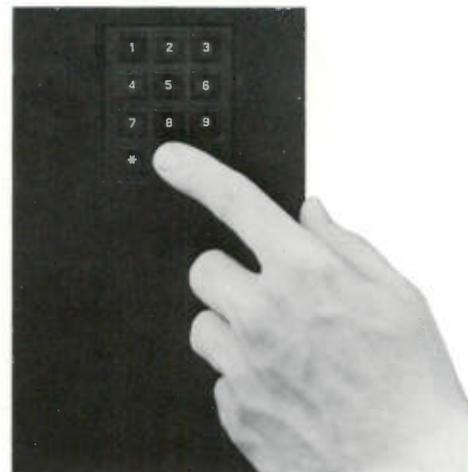
### SunWatch™ PROGRAMMABLE TIME AND POWER LEVEL OPTION

This unique SX-1A feature allows stations to automatically execute pre-sunrise and post sunset operating power schedules. The front key pad and display allows you to program in a given month up to 10 power level selections that are executed at the requested time. All of the different 12 month operating schedules may be programmed at once. This schedule may be reviewed or edited at any time. A precision, rack mounted, battery back-up clock is included with this option.

### DESIGNED FOR AM STEREO

The SX-1A is designed for AM Stereo, with special consideration paid to incidental quadrature modulation, audio input to RF envelope output phase linearity, and RF channel phase response. The standard high stability crystal oscillator and optional frequency synthesizer are both equipped to accept external AM Stereo RF oscillator signals.

## Pushbutton diagnostics!



### MECHANICAL DESIGN CONSIDERATIONS

Service accessibility is a major user benefit of the SX-1A. This is accomplished by novel electronic packaging new to broadcast transmitter products. For example, all low level circuit cards such as the RF oscillator, control logic and Polyphase PDM generator cards are located in a pull-out drawer. Critical low level circuit measurements can be made while on the air.

The all aluminum cabinet construction reduces shipping cost, while captive hardware and connectorized module interfaces reduce maintenance time.

### PROVISION FOR ANCILLARY EQUIPMENT

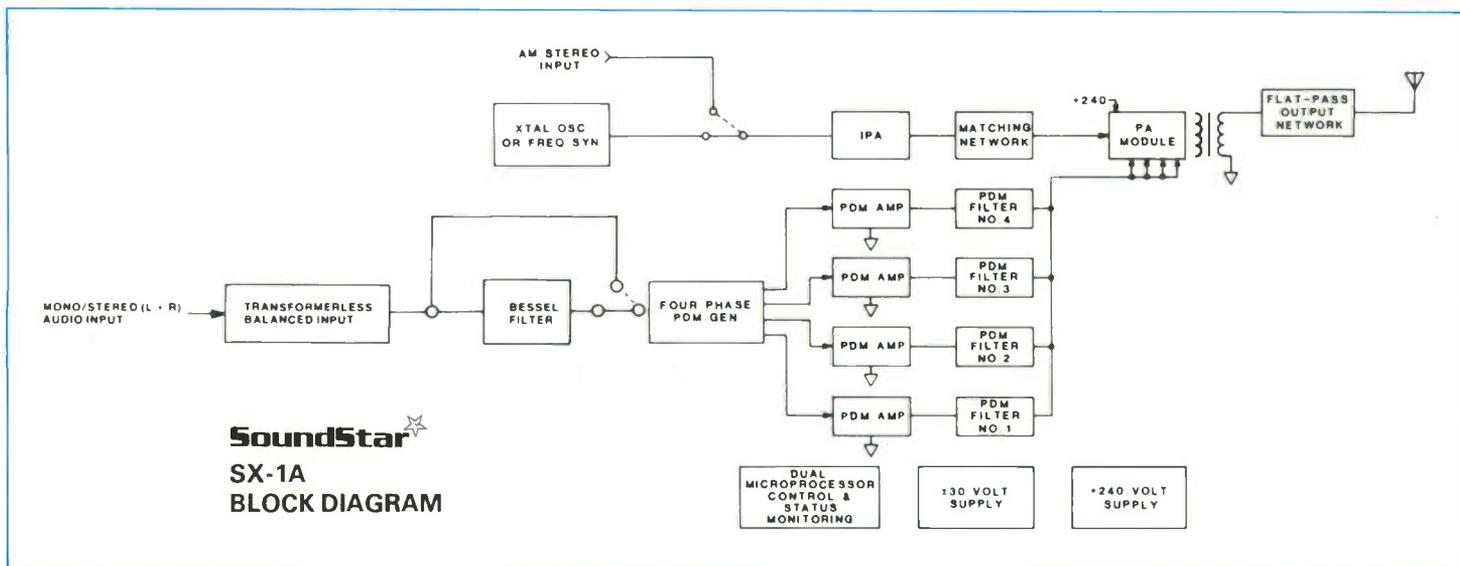
State-of-the-art technology has reduced component size, allowing the SX-1A to house all the equipment typically found at a 1 kW transmitter site. 36¾ inches of 19-inch rack space is available for ancillary equipment, which may include modulation monitor, audio processing, facilities controls, etc. Segregated low level and power wiring to this equipment is available through the top, bottom and sides.

### COOLING SYSTEM

The SX-1A is the first broadcast transmitter incorporating innovative cooling techniques eliminating the need for a blower or fan. The transmitter dissipates only 700 watts of heat. This has allowed Harris to utilize a computer modeled convection cooling technique that offers significant benefits over conventional cooling methods.

### EASE OF INSTALLATION AND SERVICE

The SX-1A arrives ready for installation. Included is a wall mounted AC disconnect panel designed to interface with the station's electrical distribution system. Installation is as simple as positioning the SX-1A and making final AC, RF and audio connections. No special air handling systems are required.



## SX-1A SPECIFICATIONS

**POWER OUTPUT:** (Rated) 1000 watts. (Capable) 1100 watts. Power reduction through 100 watts. Capable of lower power operation.

**RF FREQUENCY RANGE:** 535 KHz through 1620 KHz. Supplied to one frequency as ordered.

**CARRIER FREQUENCY STABILITY:** A) Crystal Oscillator —  $\pm 20$  Hz over temperature range. B) Frequency Synthesizer (optional) —  $\pm 10$  Hz over temperature range.

**RF OUTPUT IMPEDANCE:** 50 ohms unbalanced. Will match into a VSWR of 1.5:1 at carrier.

**RF OUTPUT TERMINAL:** Female N connector.

**CARRIER AMPLITUDE VARIATION:** (Carrier Shift): Less than 2% at 100% modulation at 1000 Hz.

**RF HARMONICS:** Exceeds FCC and CCIR specifications.

**TYPE OF MODULATOR:** Patented Polyphase PDM.

**AUDIO FREQUENCY RESPONSE:** +0.5 dB, -1.5 dB from 20 to 12,500 Hz at 95% modulation with Bessel filter out, ref. 1000 Hz.

**AUDIO HARMONIC DISTORTION:** 95% modulation, 20 Hz to 12.5 kHz: 1% or less @ 1 kW; 1.5% or less @ 500W; 2.0% or less @ 250W; 3.0% or less @ 100W.

**AUDIO INTERMODULATION DISTORTION:** 1.0% or less, 60/7000 Hz 1:1; 1.5% or less, 60/7000 Hz 4:1; SMPTE standards @ 1 kW, 95% modulation.

**SQUAREWAVE OVERSHOOT:** 5% or less at 400 Hz and 90% modulation with Bessel filter.

**SQUAREWAVE TILT:** 5% or less at 20 Hz at 90% modulation.

**NOISE (UNWEIGHTED):** Better than 60 dB below 100% modulation.

**POSITIVE PEAK CAPABILITY:** 125% positive peak program modulation capability at 1.1 kW.

**AM STEREO SPECIFICATIONS:** Incidental Quadrature Modulation (IQM): Better than 24 dB below 95% modulation of L+R channel at 1 kHz.

**AUDIO INPUT:** -10 to +10 dBm (adjustable) transformerless, 600 ohms balanced.

**AC VOLTAGE INPUT:** 197-251 VAC, 48 to 63 Hz, single phase.

**PA EFFICIENCY:** 85% or better.

**OVERALL EFFICIENCY:** 535-1200 kHz, 66% +2%; 1200-1620 kHz, 70% +2%.

**POWER CONSUMPTION<sup>1</sup>:** 1.5 kW at 0% modulation at 1000 watts. 2.2 kW at 100% tone modulation at 1000 watts carrier. 1.9 kW under average programming conditions.

**SPURIOUS OUTPUT:** Exceeds FCC and CCIR requirements.

**MONITOR PROVISIONS:** 10 volts RF (RMS) modulated output sample at 50 ohms (High/Medium/Low) power.

**REMOTE CONTROL:** Self-contained interface for most remote control or facility control systems.

**AMBIENT TEMPERATURE RANGE:** -20°C to +50°C (derate upper limit 2°C per 1000 feet altitude).

**AMBIENT HUMIDITY RANGE:** To 95% non condensing.

**AIR FLOW:** Free convection.

**ALTITUDE:** Sea Level to 13,000 feet (4000 meters).

**OPERATING ACOUSTICAL NOISE:** Better than 45 dBA.

**SIZE:** 72"H x 28"W x 30"D (1830 mm x 712 mm x 762 mm).

**WEIGHT:** (Unpacked), 400 lbs. (181 kg) — approximate. Domestic packed, 600 lbs. (275 kg) — approximate. Export packed, 700 lbs. (320 kg) — approximate.

**CUBAGE:** 68.7 cubic feet (2 cubic meters) packed.

**COLORS:** White and black.

**TYPE OF ACTIVE COMPONENTS:** 100% solid state.

**POWER SUPPLY:** Self-contained, dry.

**HARRIS MAINTAINS A POLICY OF CONTINUOUS IMPROVEMENT ON ITS EQUIPMENT AND THEREFORE RESERVES THE RIGHT TO CHANGE SPECIFICATIONS WITHOUT NOTICE.**

<sup>1</sup>A/C Mains requirements of 3.5 kVA with a minimum of 5% voltage regulation.

**NOTE:** The above audio performance may be degraded should the transmitter be operated into a bandwidth restricted antenna system.

## ORDERING INFORMATION

<b>SX-1A Transmitter, complete with all solid-state devices, crystal oscillator or frequency synthesizer, technical manual.</b>	
Specify frequency .....	.994-8581-004
SunWatch <sup>™</sup> programmable time and power level option .....	.994-8974-001
Recommended spare semiconductor kit .....	.990-1012-002
Spare crystal .....	.444-XXXX-000
<b>ANCILLARY EQUIPMENT</b>	
AM-90 modulation monitor .....	.994-8424-001
Potomac AT-51 test set .....	.700-0499-000

**HARRIS CORPORATION BROADCAST TRANSMISSION DIVISION**  
P. O. BOX 4290, QUINCY, ILLINOIS 62305-4290 U.S.A. 217/222-8200



# HARRIS

## STX-1

### AM Stereo Exciter

- Generates Harris Linear AM Stereo signal for exceptional audio quality
- Pre-emphasis compatible
- Stereo separation to 15 KHz
- Easy transmitter interface included
- Audio peak limiter maintains legal stereo modulation levels
- Incidental Phase Modulation Compensation Circuit for high quality stereo performance.
- Separation Corrector optimizes performance into a narrow band antenna system

The Harris STX-1 AM Stereo Exciter generates the Harris Linear AM Stereo signal to convert AM transmitters to stereo service. Appropriate interface hardware is included with each unit.

Harris Linear AM Stereo is the only system that produces high quality AM Stereo audio. Additionally, the Harris STX-1 AM Stereo Exciter includes several features which optimize stereo performance through the transmitter and antenna system.

#### TRANSFORMERLESS AUDIO INPUT AND PEAK LIMITER

The STX-1 incorporates a solid-state transformerless input stage providing excellent transient response for faithful transmission of today's dynamic program material. A stereo audio peak limiter maintains Left, Right (L+R) and (L-R) modulation levels within legal

limits. This built-in limiter includes automatic 125% asymmetrical switching to assure maximum modulation levels. And the entire limiter may be bypassed to accommodate future advancements in AM Stereo audio processing equipment.

#### SEPARATION CORRECTOR

Older AM transmitters and narrow band antenna systems can degrade stereo separation. The Harris STX-1 AM Stereo Exciter is designed with a correction circuit to optimize separation.

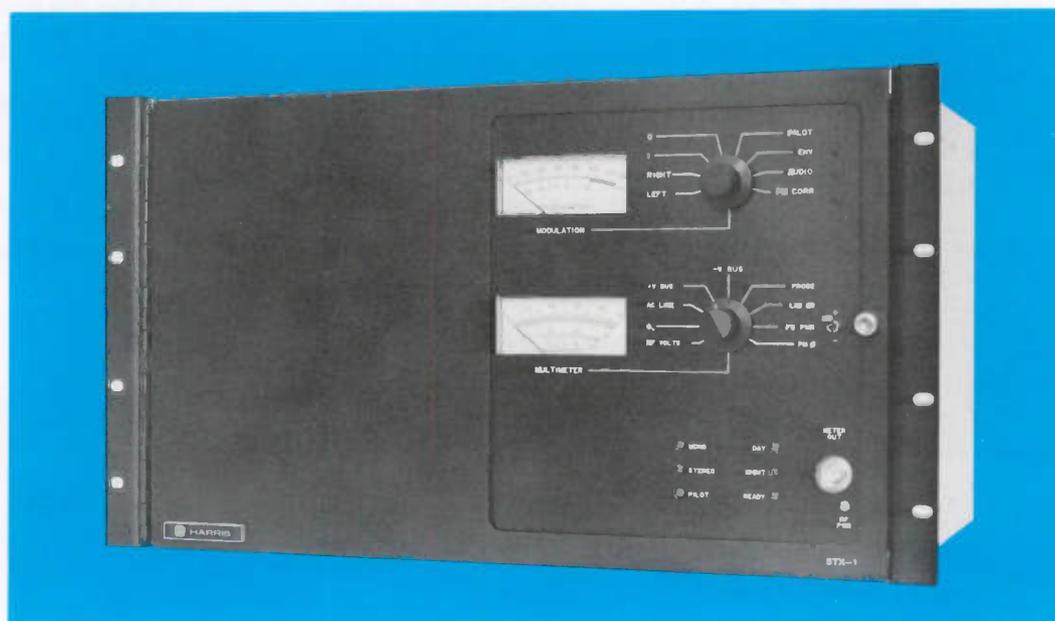
#### INCIDENTAL PHASE MODULATION COMPENSATION

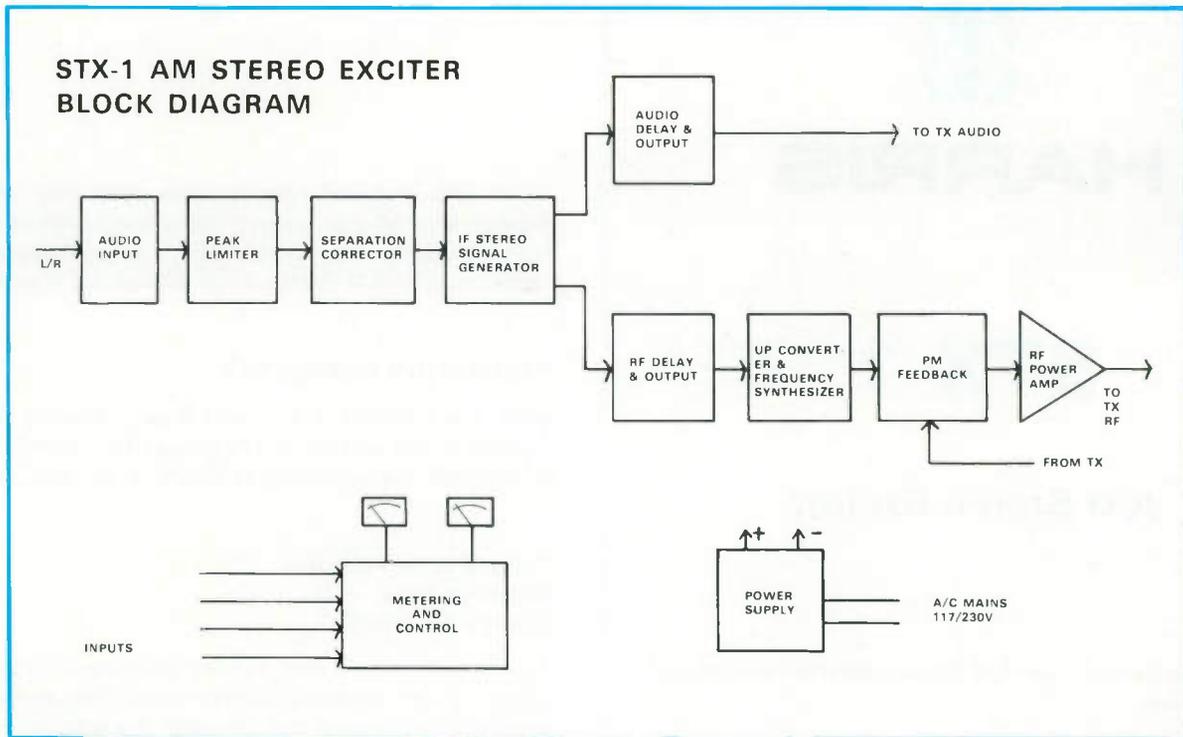
All AM transmitters have varying amounts of undesirable Incidental Phase Modulation, (IPM) which degrades stereo performance. Addressing this inherent characteristic, the STX-1 Exciter incorporates an innovative Incidental Phase Feedback Circuit to reduce IPM.

#### ADDITIONAL OPERATIONAL BENEFITS

A day and night operational mode is provided for stations switching power and/or antenna patterns. Independent adjustments are automatically selected for the two modes. Day/night and stereo/mono modes are selected locally or via remote control terminals.

A front panel peak reading modulation multimeter accurately monitors several selectable signals for easy setup and operation. These signals also appear on a front panel BNC test jack. A convenient multimeter allows quick AC, DC and RF level checks. The included test probe converts the multimeter into a handy voltmeter for diagnostics.





## STX-1 AM STEREO EXCITER SPECIFICATIONS

#### FREQUENCY RANGE:

Synthesized operation from 535 KHz to 1710 KHz in 1 KHz increments.

#### FREQUENCY STABILITY:

$\pm 10$  Hz or less over operating temperature range

#### RF OUTPUT:

Adjustable from 0 to 7.5 watts into 50 ohms (0 to 20 volts RMS)

#### RF LOAD IMPEDANCE:

50 ohms at rated power (BNC output jack)

#### OPERATING TEMPERATURE RANGE:

0°C to 50°C (usable from -20°C to 50°C)

#### OPERATING ALTITUDE RANGE:

Up to 13,000 feet (4,000 meters)

#### AC POWER REQUIREMENTS:

100 to 130 volts or 200 to 260 volts, 50 or 60 Hz AC (125 watts maximum)

#### AUDIO INPUT IMPEDANCE:

Left and Right channels 600 ohms resistive, balanced, transformerless

#### AUDIO INPUT LEVELS:

+10 dBm ( $\pm 1$  dB) for 100% envelope modulation at 400 Hz (Left and Right channels.) (Peak limiter gain reduction begins at +10 dBm input). Switchable to 0 dBm or -10 dBm.

#### AUDIO DRIVE TO TRANSMITTER:

Adjustable to +16 dBm into 600 ohm balanced input

#### MODULATION CAPABILITY:

LEFT OR RIGHT CHANNEL:

$\pm 80\%$

LEFT + RIGHT (L+R)

+135%/-100%

LEFT - RIGHT (L-R):

$\pm 100\%$

#### MONO/STEREO AUDIO FREQUENCY RESPONSE:

$\pm 1$  dB, 50 Hz to 15 KHz

#### STEREO SEPARATION:

30 dB minimum 400 Hz to 5 KHz

25 dB minimum 5 KHz to 15 KHz

#### STEREO HARMONIC DISTORTION:

1% or less

#### MAXIMUM MONO AM ENVELOPE

HARMONIC DISTORTION:

4%

#### AUDIO OUTPUT SIGNAL TO NOISE:

Greater than 60 dB

#### REAR CHASSIS CONNECTORS:

Barrier strip and BNC jacks

#### SIZE:

10½"H x 19"W x 13.38"D

#### WEIGHT:

30 lbs.

### SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

NOTE: Specifications reflect operation of STX-1 Exciter only. Actual system performance may vary due to transmitter and antenna system characteristics.

## ORDERING INFORMATION

STX-1 AM Stereo Exciter ..... 994-8730-001

**HARRIS CORPORATION      BROADCAST DIVISION**  
**P. O. BOX 4290, QUINCY, ILLINOIS 62305-4290 U.S.A. 217/222-8200**



**HARRIS**  
COMMUNICATION AND  
INFORMATION PROCESSING

# AM-90

## Medium Wave Modulation Monitor

The new Harris AM-90 Modulation Monitor is designed for continuous monitoring of the amplitude modulation envelope in the 450 KHz to 30 MHz frequency range. This sensitive instrument assures strict compliance with FCC rules and regulations. The AM-90 Modulation Monitor is an all solid-state self-contained rack mounted unit consisting of compact mainframe and two printed circuit cards. All controls are front panel mounted. Connections to a remote unit, primary power and RF inputs are mounted on the rear of the chassis.

### NEON BAR GRAPH DISPLAY

A first in innovative technology is represented by the AM-90's highly accurate neon bar display for measuring carrier and modulation levels. The flat panel indicator displays two separate bar graphs, each containing 201 elements for 1/2% resolution. Display segments are printed on 0.002-inch center spacing. At normal viewing distances, the glow blends into a continuous, precisely controlled bar length. This unique analog display with no moving parts offers distinct advantages over previous designs incorporating electromechanical meters. Now the station operator has a choice of meter ballistics, including FCC specified or peak reading. An additional metering function can be selected which gives the RMS value of the absolute value of modulation. A rotary meter amplifier switch provides up to 50 dB of gain to the bar graph display. This switch, with amplification selectable in 10 dB increments, enables the operator to measure low amplitude modulation or transmitter signal-to-noise ratio with a built-in 20 Hz to 20 KHz noise filter.

### FLASHERS

Two fixed flashers are factory adjusted to +125% & -100% modulation, allowing constant monitoring of modulation levels. These indicators are triggered whenever the monitored RF signal modulation exceeds the preset value. A separate digitally programmable flasher offers

- Exclusive self-scan neon bar graph display
- Exclusive RMS sideband power
- Exclusive modulation metering with no overshoot
- Digitally programmable selectable peak flasher
- All electronic indicators - no panel meters
- Internal AGC maintains accuracy even with carrier drift
- Built-in carrier and modulation alarm units
- Self-calibration feature

positive or negative polarity selection with a usable range of 1% modulation to +200% or -100% modulation. Flasher accuracy is  $\pm 1\%$  at 1 KHz.

### CARRIER AND MODULATION ALARMS

Carrier and modulation alarms illuminate when carrier amplitude drops below 50% of the preset level, or when modulation remains under 10% for 10 seconds.

### GENERAL

No tuning is required at the monitor. The AM-90 Modulation Monitor incorporates an expanded scale carrier level meter for accurate carrier level deviation measurements. The wideband linear phase filter design is capable of passing 20 Hz to 20 KHz with no measurable overshoot from square wave modulation. The AM-90 features three separate high fidelity audio outputs: 1) electronically balanced, +10 dBm (into 600 ohms); 2) 5-volt RMS instrumentation output (into 10k ohms); 3) auxiliary audio output amplified through the metering circuit. The AM-90 Modulation Monitor incorporates high RF input impedance to facilitate connection of other instruments to the same RF source. A mode indicator provides non-FCC prescribed meter operation (RMS or peak modulation). An optional remote meter panel duplicates most of these functions for measurements at distant locations.



## SPECIFICATIONS

**FREQUENCY RANGE:** 450 KHz to 30 MHz

**RF INPUT:** 1.0 Vrms to 10.0 Vrms

**POWER INPUT:** 115 Vac  $\pm$  15%, 50-60 Hz (230 Vac  $\pm$  15% available)

### MODULATION INDICATION

**DISPLAY METER:** 0% to 100% on negative peaks.  
0% to 140% on positive peaks.

**FLASHER FREQUENCY RESPONSE:** +0%, -5%; 20 Hz to 20 KHz

**FLASHER ACCURACY:**  $\pm$ 1% at 1 KHz

### AUDIO TEST OUTPUTS

**FREQUENCY RESPONSE:** +0 dB, -0.5 dB; 20 Hz to 20 KHz

**DISTORTION:** 0.15% maximum at 99% modulation, 1 KHz audio, 450 KHz to 1.8 MHz carrier; 0.50% maximum, 1.8 MHz to 30 MHz carrier

**SIGNAL-TO-NOISE:** 75 dB minimum referenced to 100% sine wave modulation

### ELECTRONICALLY BALANCED OUTPUT

**OUTPUT IMPEDANCE:** 75 ohms balanced

**OUTPUT LEVEL:** +10 dBm into 600 ohms at 100% sine wave modulation

### INSTRUMENT OUTPUT

**OUTPUT IMPEDANCE:** 1k ohms (unbalanced)

**OUTPUT LEVEL:** 5 volts RMS into 10k ohms at 100% sine wave modulation

**MODULATION CALIBRATION:** Built-in calibration, digitally synthesized RF source, +125% and -100% modulation, RMS value 111%  $\pm$  0.1%

**REMOTE OUTPUT:** For meter and flasher indications at another location, use Harris' remote meter panel 994-8487-001

### GENERAL

**SIZE:** 19" long x 3.5" high x 13.5" deep (48 cm x 9 cm x 34 cm). Mounts in standard relay rack

**WEIGHT:** 15 pounds (6.82 kg). Export Packed: apx. 20 pounds (9 kg)

**AMBIENT TEMPERATURE RANGE:** -20°C to +55°C (-4°F to 131°F)

**HUMIDITY:** 95% maximum (non-condensing)

**ALTITUDE:** 10,000 feet maximum (3048 meters)

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

## ORDERING INFORMATION

AM-90 Solid-State AM Modulation Monitor ..... 994-8424-001  
AM-90 Remote Meter Panel ..... 994-8487-001

**HARRIS CORPORATION** Broadcast Products Division  
P. O. Box 4290, Quincy, Illinois 62301 U.S.A. 217/222-8200

VOTED  
TOP 10  
BEST  
RADIO PROBLEM  
SOLVING PRODUCT  
1985 NAB CONVENTION  
BROADCAST ENGINEERING MAGAZINE



SX SOUNDSTAR TRANSMITTERS

# SunWatch™

PROGRAMMABLE OPTION FOR AUTOMATIC  
EXECUTION OF PRE-SUNRISE, DAYTIME,  
AND MULTIPLE POST SUNSET  
OPERATING SCHEDULES



REVISED PARAMETERS FOR OPERATION UNDER POST-SUNSET AUTHORITY (PSSA)  
(Post this letter with your current authorization)

THIS AUTHORIZATION SUPERSEDES ANY PREVIOUS POST-SUNSET AUTHORITY

\*\*\*\*\*

On December 10, 1984, Post-Sunset operation as set forth below can begin.  
These values may not be exceeded, but operation at lower power is permitted.

\*\*\*\*\*

CALL: FREQUENCY:	CITY: KHZ	STATE: ANTENNA:	DAYTIME	CALCULATIONS BASED ON: LICENSED FACILITIES			
MONTH	TIME PERIOD	POWER WATTS	CONV. FACTOR	MONTH	TIME PERIOD	POWER WATTS	CONV. FACTOR
JAN	5:30- 6:00	184.2	0.6070	JULY	8:30- 9:00	283.1	0.7524
	6:00- 6:30	100.5	0.4483		9:00- 9:30	121.4	0.4927
	6:30- 7:30	71.0	0.3769		9:30-10:30	72.2	0.3800
FEB	6:00- 6:30	199.2	0.6312	AUG	8:15- 8:45	259.0	0.7197
	6:30- 7:00	103.1	0.4541		8:45- 9:15	115.9	0.4814
	7:00- 8:00	71.0	0.3769		9:15-10:15	71.8	0.3789
MAR	6:30- 7:00	217.3	0.6592	SEP	7:30- 8:00	229.6	0.6777
	7:00- 7:30	106.1	0.4606		8:00- 8:30	108.9	0.4666
	7:30- 8:30	71.0	0.3769		8:30- 9:30	71.2	0.3774
APR	7:00- 7:30	246.3	0.7019	OCT	6:45- 7:15	207.3	0.6438
(STD.)	7:30- 8:00	112.9	0.4752	(ADV.)	7:15- 7:45	104.5	0.4571
(TIME)	8:00- 9:00	71.6	0.3783	(TIME)	7:45- 8:45	71.0	0.3769
APR	8:00- 8:30	246.3	0.7019	OCT	5:45- 6:00	207.3	0.6438
(ADV.)	8:30- 9:00	112.9	0.4752	(STD.)	6:00- 6:15	207.3	0.6438
(TIME)	9:00- 9:30	71.6	0.3783	(TIME)	6:15- 6:45	207.3	0.6438

The Harris SunWatch option can be programmed to automatically handle the year's entire pre-sunrise (PSA), daytime and post sunset (PSSA) operating schedule.

### Easy To Program

Programming the Harris SunWatch option is easy and straight forward. A simple programming worksheet is provided where you can consolidate PSA, daytime and PSSA schedules by month for the entire year. Next, enter two digits on the SX transmitter's keypad to gain access to the SunWatch program. Starting with month one (January) through month 12 (December), simply adjust output power to the level desired and enter the time for the event. SunWatch will accommodate up to ten programmed events per month for an effective 120 events per year. Programming errors or changes are easy to correct as the entire program or portions of it can be reviewed and edited by simple front keypad commands. Battery backup prevents loss of memory due to power outages.

### Operating Range

The Harris SX SoundStar transmitter series offers one of the widest operating power ranges of any AM transmitter and can accommodate most PSA and PSSA power levels.

For extremely low PSA or PSSA power levels, Harris recommends the use of a 100 watt RF attenuator that can be automatically switched into the output line. The RF attenuator allows the SX SoundStar transmitter to deliver a quality audio signal to your listeners even at extremely low power levels.

### System Switching

SunWatch can be easily programmed to automatically control a phasor or antenna switch to insure the correct operating mode (non-directional, directional, etc.) for the desired time of day.

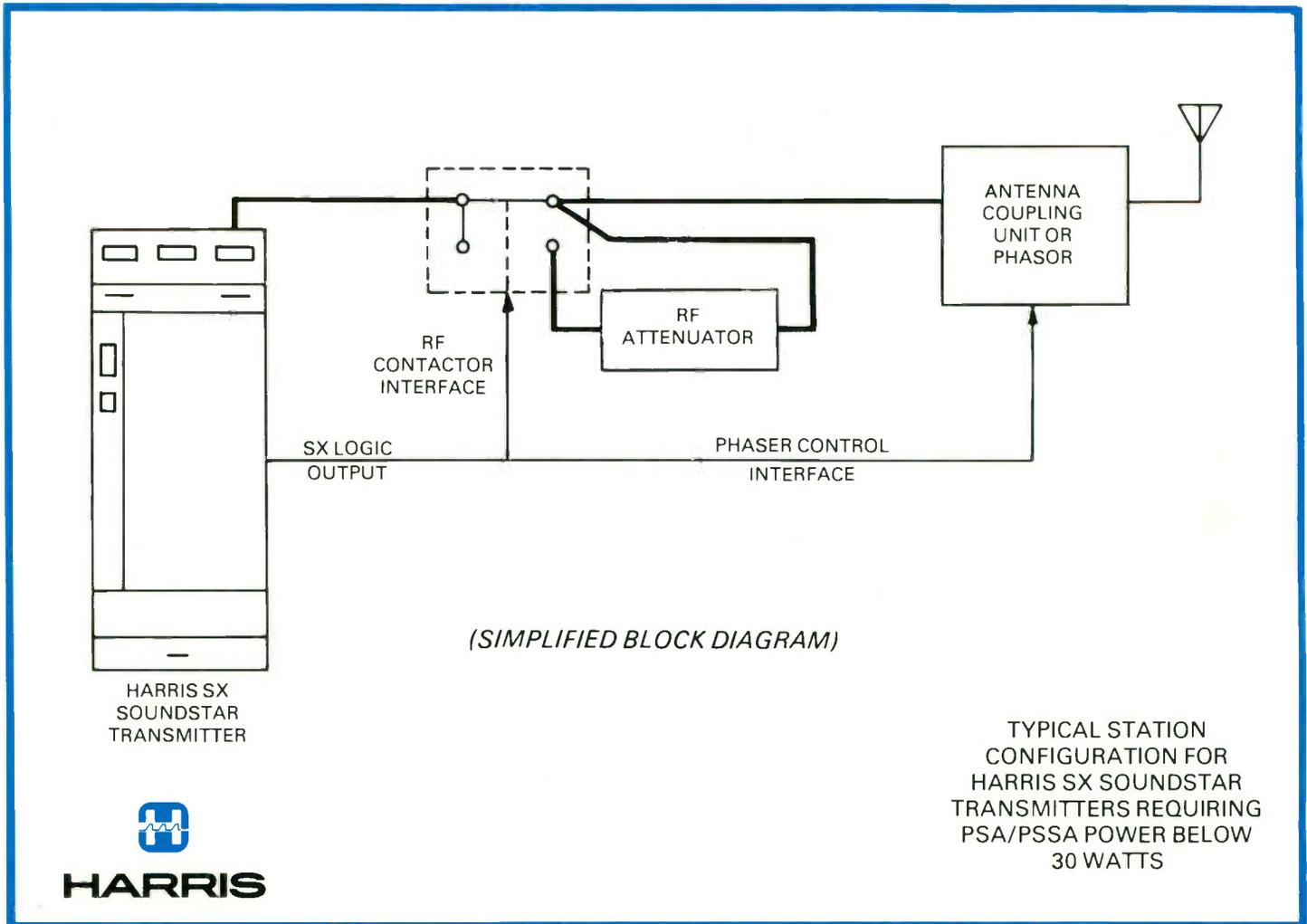
### What's Provided

SunWatch comes complete with required software, simple programming worksheet, instructions, external rack mounted precision day-date time clock and interface cable. Optional accessory items such as low current RF antenna ammeters, RF contactors, cable, etc. are readily available from Harris.

## ORDERING INFORMATION

SunWatch Option factory installed  
in SX SoundStar Transmitter .....994-8974-001

SunWatch Option Kit for existing  
SX Transmitters installed at a station .....994-8974-002



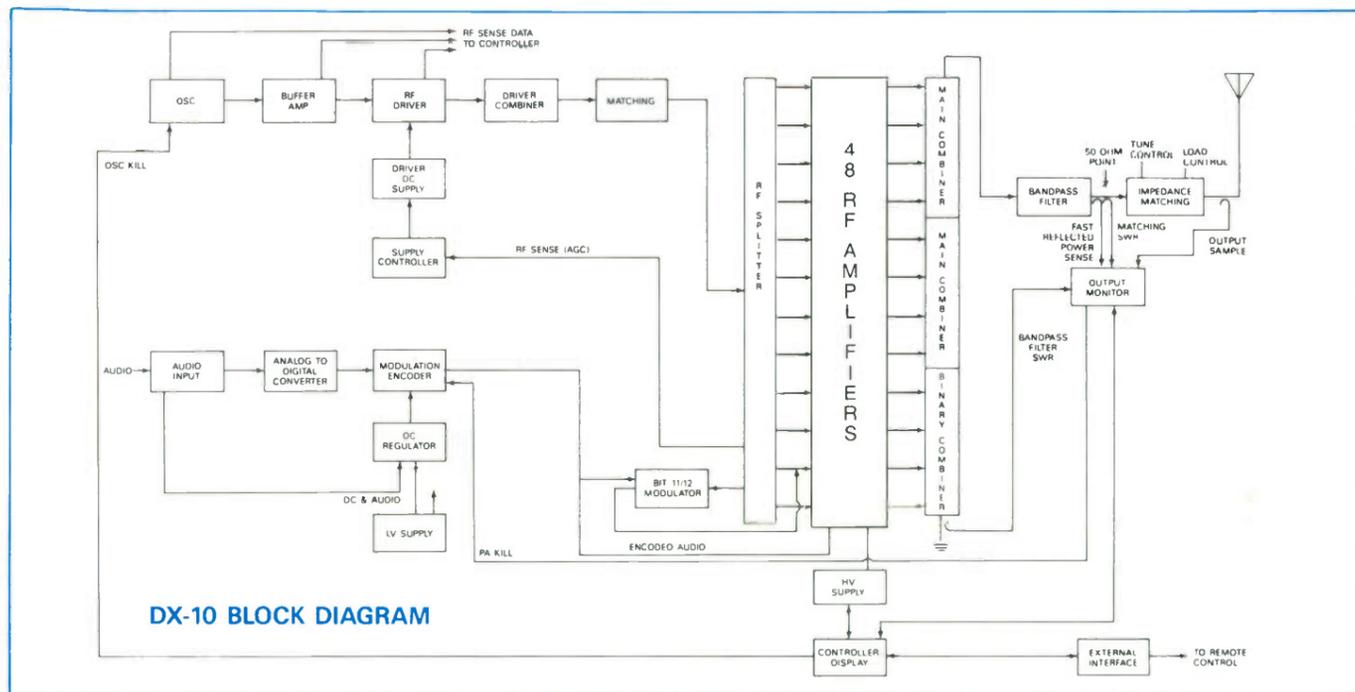
**HARRIS CORPORATION BROADCAST TRANSMISSION DIVISION**  
P. O. BOX 4290, QUINCY, ILLINOIS 62305-4290 U.S.A. 217/222-8200



# HARRIS

## DX-10

### 10 kW SOLID STATE DIGITAL AM BROADCAST TRANSMITTER



### SPECIFICATIONS

**POWER OUTPUT:** (Rated) 10 kilowatts. (Capable) 11 kilowatts. Power reduction through 1 kilowatt. Three front panel power selection switches.

**RF FREQUENCY RANGE:** 531 through 1620 kHz. Supplied to one frequency as ordered.

**CARRIER FREQUENCY STABILITY:** Crystal oscillator,  $\pm 10$  Hz over 0 to 50°C temperature range. (Typically  $\pm 2$  Hz over constant ambient temperature.)

**RF OUTPUT IMPEDANCE:** 50 ohms unbalanced. Will match into a load VSWR of 1.5:1 at carrier frequency.

**RF OUTPUT TERMINAL:** 1" EIA flange connector.

**CARRIER AMPLITUDE VARIATION:** (Carrier Shift): Less than 2% at 100% modulation at 1 kHz. (Typically 0.5% with programming.)

**RF HARMONICS AND SPURIOUS EMISSIONS:** Exceeds FCC or CCIR specifications.

**TYPE OF MODULATOR:** Patented Harris Digital Modulator.

**AUDIO FREQUENCY RESPONSE:** +0.1 dB, -0.9 dB or less from 30 to 10,000 Hz. (Reference 1000 Hz.)

**AUDIO HARMONIC DISTORTION:** 1.0% or less 2.5 kW thru 10 kW, from 30 to 10,000 at 95% modulation, 1.5% or less at 1 kilowatt through 2.5 kilowatts, from 30 to 10,000 Hz at 95% modulation.

**AUDIO INTERMODULATION DISTORTION:** 1.8% or less 4:1; 0.8% or less 1:1, 60/7000 Hz SMPTE standards at 10 kW operation at 95% modulation.

**SQUAREWAVE OVERSHOOT:** 2% or less at 400 Hz at 95% modulation.

**SQUAREWAVE TILT:** 5% or less at 40 Hz at 90% modulation.

**HUM AND NOISE:** Better than 60 dB below 100% modulation at 1 kHz at 10 kW.

**POSITIVE PEAK CAPABILITY:** 125% positive peak program modulation capabilities at 11 kilowatts.

**AM STEREO OPERATION:** Incidental quadrature modulation (I.Q.M.) 33 dB or less (typically 35 dB) below 95% modulation of main carrier from 30 to 10 kHz.

**AUDIO INPUT:** -10 to +10 dBm, adjustable, with transformerless 600 ohm balanced input. 50 and 150 ohm terminations also provided.

**AC VOLTAGE INPUT:** 192-251 VAC, 3-wire delta, or 340 to 440 VAC 4-wire wye, 48 to 63 Hz, three phase. 5% variation from nominal line voltage and  $\pm 2.5$  Hz line frequency variation, to maintain full performance.

**PA EFFICIENCY:** 85% or better.

**OVERALL EFFICIENCY:** 75% or better (typically 80%) at 10 kW operation. 73% or better at 5 kW operation.

**POWER CONSUMPTION:** 13.3 kW or less @ 10 kW with 0% modulation. 19 kW or less @ 10 kW with 100% tone modulation.

**MONITOR PROVISIONS:** 10 volts r (RMS) max modulated output sample at 50 ohms (High, Medium, or Low power) adjustable. 10 volts r (RMS) max into 50 ohms, unmodulated frequency monitor sample.

**REMOTE INTERFACE:** Self-contained interface for most remote control or facility control systems.

**AMBIENT TEMPERATURE RANGE:** 0°C to +50°C at sea level (derate upper limit 2°C per 1000 feet of altitude).

**AMBIENT HUMIDITY RANGE:** To 95% non condensing.

**AIR FLOW SYSTEM:** Forced air.

**ALTITUDE:** Sea level to 13,000 feet (4000 meters).

**SIZE:** 78"H x 72"W x 30"D (2.0 m x 1.83 m x 0.76 m).

**WEIGHT:** Domestic packed 1500 lbs.

**TYPE OF ACTIVE COMPONENTS:** 100% solid state.

**POWER SUPPLY:** Self-contained dry.

**NOTE:** The above specifications apply to operation at 10 kW except where noted. Audio performance may be degraded should the transmitter be operated into a bandwidth restricted antenna system.

**HARRIS MAINTAINS A POLICY OF CONTINUOUS IMPROVEMENTS ON ITS EQUIPMENT AND THEREFORE RESERVES THE RIGHT TO CHANGE SPECIFICATIONS WITHOUT NOTICE.**

### ORDERING INFORMATION

DX-10 Transmitter, complete with all solid-state devices, crystal oscillator, technical manual. Specify frequency (FCC harmonic suppression) .....	994-8906-001
DX-10 Transmitter, complete with all solid-state devices, crystal oscillator, technical manual. Specify frequency (CCIR harmonic suppression) .....	994-8906-003
Recommended Spare Semiconductor Kit .....	990-1070-001
Recommended Spare Parts Kit .....	994-9060-001
Recommended Spare Module Kit .....	994-9061-001
Spare Crystal .....	444-XXXX-000



HARRIS CORPORATION BROADCAST DIVISION  
P. O. BOX 4290, QUINCY, ILLINOIS 62305-4290 U.S.A. 217/222-8200



# DX-10 — The only all solid state, digital AM transmitter offering new levels in audio performance and operating efficiency

- Features Harris' exclusive all digital modulator\* for new levels in AM performance.
- Excellent signal clarity from low harmonic and intermodulation distortion ...essentially no audio overshoot, tilt or ringing.
- Typical 80% overall AC to RF efficiency represents thousands of dollars in operating cost savings over older transmitters now in use.
- Excellent AM stereo performance
- Unique soft failure design with built-in **FLEXPatch™** capability.
- **COLORStat™** front panel signal flow diagram immediately identifies problem stage.

\*patented



The Harris DX-10, all solid state 10,000 watt broadcast transmitter now offers broadcasters new standards in AM transmitter performance. From excellent audio quality to high operating efficiency, the Harris DX-10 transmitter is your best choice.

## Digital AM Modulator

Harris now offers broadcasters the first truly digital AM broadcast transmitter. The Harris digital modulator yields excellent audio performance and high operating efficiency.

Audio is applied to an ultra fast analog to digital (A/D) converter. The digitized audio signal and a carrier level control signal is summed and applied to the modulation encoder which provides DC control to 48 RF amplifiers which are turned on and off at an audio rate with modulation. The output of each of the 48 amplifiers are summed at proportioned power levels in a master RF combiner.

There is no high power modulator section in the DX-10 with inherent power losses. The Harris DX-10 simply consists of 48 RF power amplifiers operating at close to 90% efficiency and individually being controlled by low level DC voltages.

## New Levels In AM Audio Quality

The Harris digital modulator incorporated in the DX-10

introduces new levels in AM broadcast transmission quality. The modulated RF envelop waveforms (to the right) demonstrate the DX-10's audio capability.

Equally impressive is total harmonic distortion of typically 0.5% from 30 to 10 kHz. Also, SMPTE 4:1 intermodulation distortion is typically 1.5% or less.

## Save Thousands Of \$ In Operating Costs

Older inefficient AM transmitters are eroding your bottom line as power costs continue to increase. The Harris DX-10 will make a direct bottom line impact by saving your station thousands of dollars each year in operating costs.

For example, the DX-10 can save your station typically \$3,500 a year in power costs compared to a 1950's vintage transmitter. An additional savings of \$1,800 a year in tube costs can typically be realized.

## Excellent AM Stereo Performance

Critical design attention has been paid to all circuits affecting AM stereo performance. Unlike other solid state designs, incidental Quadrature Modulation (IQM) is typically -35 dB for good stereo performance.

## FLEXPatch™ Capability

The DX-10 utilizes an inherent soft failure design. Should one or more of the high power RF amplifiers fail, safe operation continues with only a slight loss in output power and slight increase in audio distortion. The DX-10 automatically detects and displays these failures. The station's technician has three options available when a PA failure occurs. **ONE:** Safe operation can continue at slightly reduced power and increased distortion until a convenient repair time. **TWO:** Quick substitution of a modular plug-in PA amplifier. **THREE:** Operation of FlexPatch™.

FlexPatch™ simply substitutes one of the continuously used power amplifier/steps with a power amplifier/step used for +125% positive audio peaks. Due to the low level switching of FlexPatch™, PA substitutions can be made even while the DX-10 remains on the air!

## Bandpass Output Network

A computer-designed bandpass output network is featured in the DX-10. A bandpass design offers several advantages over other designs:

- Excellent suppression of upper and lower frequency harmonic and spurious emission products.
- Improved suppression of strong co-located transmitter signals which may cause undesired intermodulation interference.
- Suppression of induced broadband lightning energy. The DX-10's output network has been optimized for good stereo performance.

Standard broadcast antenna systems are not perfect 50 ohm resistive loads. Recognizing this fact, Harris has incorporated a standard "tee" network to permit convenient tuning capable of matching a load value within a 1.5:1 VSWR circle at the carrier frequency. This important and desirable feature is not available in all other transmitter designs.

## COLORStat™ Signal Flow Diagram

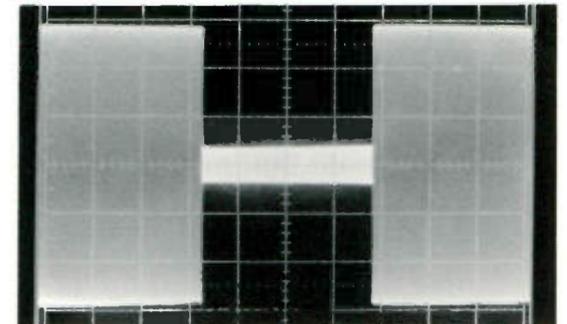
Operators and technicians will appreciate the handy information the DX-10's ColorStat™ signal flow diagram displays. Twenty-eight separate LEDs monitor key operational stages on a front panel signal flow diagram. Should a problem develop, the normally green LED turns red signifying a problem exists.

## Convenient Interface

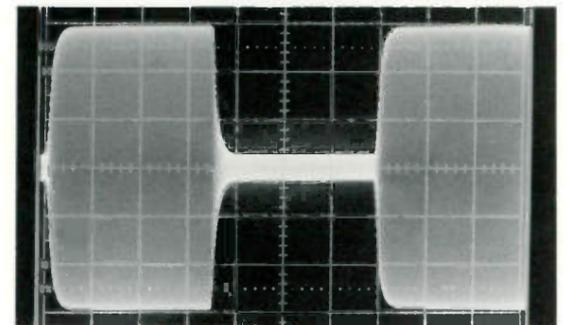
All small signal input and output connections on the DX-10 are made on a conveniently located interface panel for easy connection to a remote control system.

## Your Best Choice

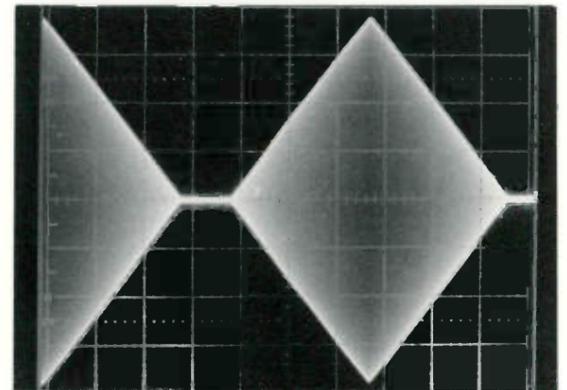
From excellent audio quality to high operating efficiency, the Harris DX-10 transmitter is your best choice.



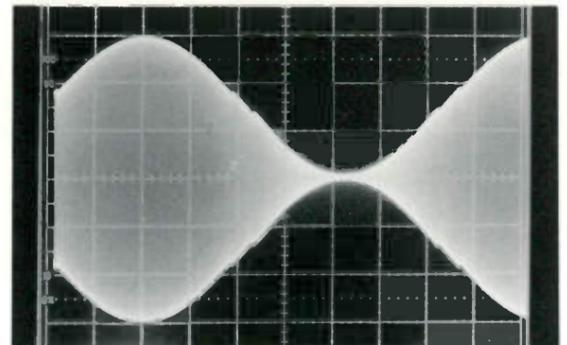
20 Hz squarewave response with no tilt or overshoot.



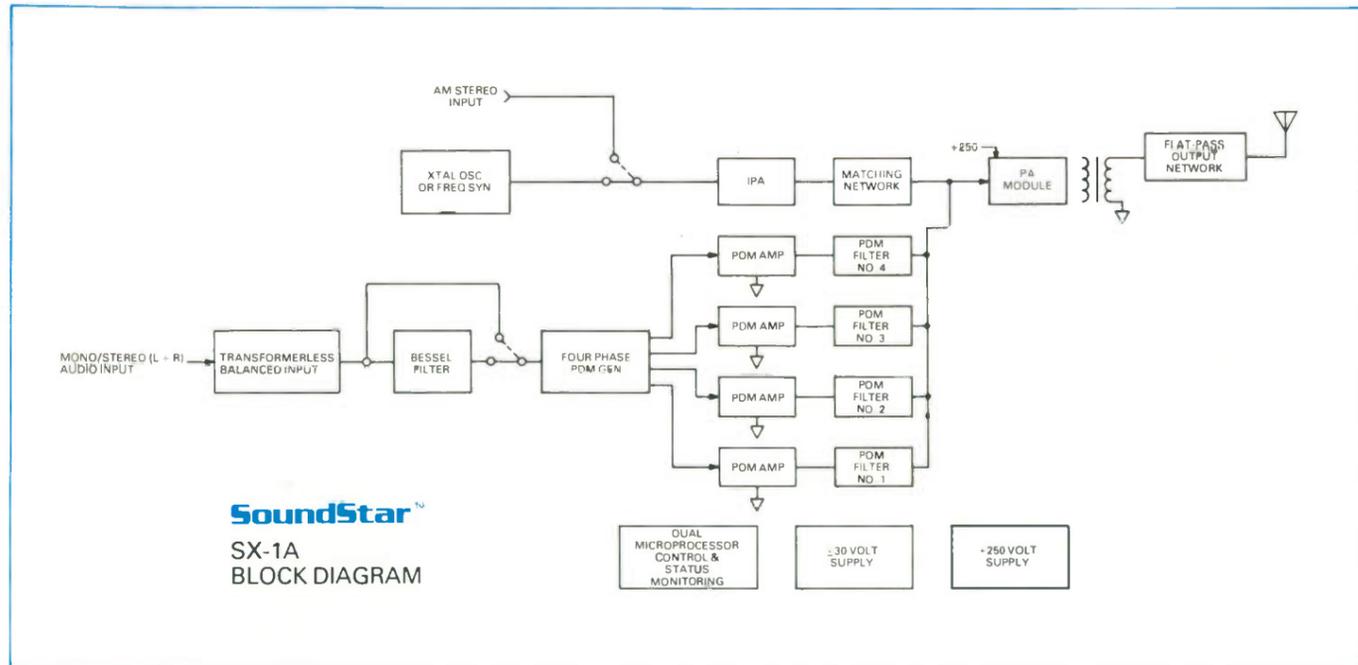
Excellent 5 kHz squarewave response with no tilt or overshoot.



100 Hz triangular waveform demonstrating excellent modulation linearity.



Simulated failure of two high power steps. Operation safely continued with a small decrease in power and a slight increase in distortion.



### SX-1A SPECIFICATIONS

**POWER OUTPUT:** (Rated) 1000 watts. (Capable) 1100 watts. Power reduction through 100 watts. Capable of lower power PSA/PSSA operation.

**RF FREQUENCY RANGE:** 535 KHz through 1620 KHz. Supplied to one frequency as ordered.

**CARRIER FREQUENCY STABILITY:** A) Crystal Oscillator —  $\pm 20$  Hz over temperature range. B) Frequency Synthesizer (optional) —  $\pm 10$  Hz over temperature range.

**RF OUTPUT IMPEDANCE:** 50 ohms unbalanced. Will match into a VSWR of 1.5:1 at carrier.

**RF OUTPUT TERMINAL:** Female N connector.

**CARRIER AMPLITUDE VARIATION:** (Carrier Shift): Less than 2% at 100% modulation at 1000 Hz.

**RF HARMONICS:** Exceeds FCC and CCIR specifications.

**TYPE OF MODULATOR:** Patented Polyphase PDM.

**AUDIO FREQUENCY RESPONSE:** +0.5 dB, -1.5 dB from 20 to 12,500 Hz at 95% modulation with Bessel filter out, ref. 1000 Hz.

**AUDIO HARMONIC DISTORTION:** 95% modulation, 20 Hz to 12.5 kHz: 1% or less @ 1 kW; 1.5% or less @ 500W; 2.0% or less @ 250W; 3.0% or less @ 100W.

**AUDIO INTERMODULATION DISTORTION:** 1.0% or less, 60/7000 Hz 1:1; 1.5% or less, 60/7000 Hz 4:1; SMPTE standards @ 1 kW, 95% modulation.

**SQUAREWAVE OVERSHOOT:** 5% or less at 400 Hz and 90% modulation with Bessel filter.

**SQUAREWAVE TILT:** 5% or less at 20 Hz at 90% modulation.

**NOISE (UNWEIGHTED):** Better than 60 dB below 100% modulation.

**POSITIVE PEAK CAPABILITY:** 125% positive peak program modulation capability at 1.1 kW.

**INCIDENTAL QUADRATURE MODULATION (IQM):** 25 dB or better below 95% modulation of L+R channel at 1 kHz.

**AUDIO INPUT:** -10 to +10 dBm (adjustable) transformerless, 600 ohms balanced.

**AC VOLTAGE INPUT:** 197-251 VAC, 48 to 63 Hz, single phase.

**OVERALL EFFICIENCY:** 535-1200 kHz, 66% +2%; 1200-1620 kHz, 70% +2%.

**POWER CONSUMPTION:** 1.5 kW at 0% modulation at 1000 watts. 2.2 kW at 100% tone modulation at 1000 watts carrier. 1.9 kW under average programming conditions.

**SPURIOUS OUTPUT:** Exceeds FCC and CCIR requirements.

**MONITOR PROVISIONS:** 10 volts RF (RMS) modulated output sample at 50 ohms (High/Medium/Low) power.

**REMOTE CONTROL:** Self-contained interface for most remote control or facility control systems.

**AMBIENT TEMPERATURE RANGE:** -20°C to +50°C (derate upper limit 2°C per 1000 feet altitude).

**AMBIENT HUMIDITY RANGE:** To 95% non condensing.

**AIR FLOW:** Free convection.

**ALTITUDE:** Sea Level to 13,000 feet (4000 meters).

**OPERATING ACOUSTICAL NOISE:** Better than 45 dBA.

**SIZE:** 72"H x 28"W x 30"D (1830 mm x 712mm x 762mm).

**WEIGHT:** (Unpacked), 400 lbs. (181 kg) — approximate. Domestic packed, 600 lbs. (275 kg) — approximate. Export packed, 700 lbs. (320 kg) — approximate.

**CUBAGE:** 68.7 cubic feet (2 cubic meters) packed.

**COLORS:** White and black.

**TYPE OF ACTIVE COMPONENTS:** 100% solid state.

**POWER SUPPLY:** Self-contained, dry.

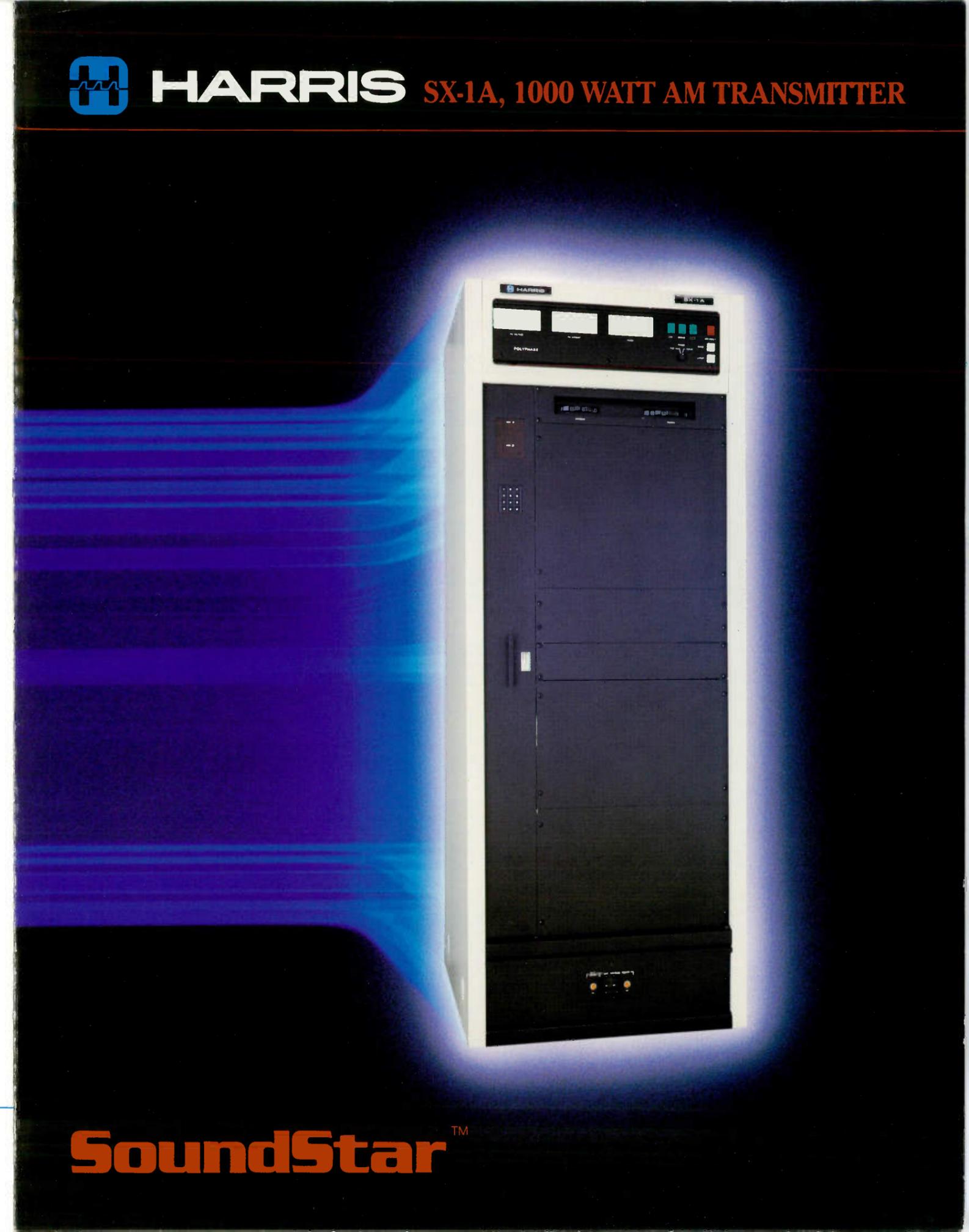
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**1**/A/C Mains requirements of 3.5 kVA with a minimum of 5% voltage regulation.

**NOTE:** The above audio performance may be degraded should the transmitter be operated into a bandwidth restricted antenna system.

### ORDERING INFORMATION

SX-1A Transmitter, complete with all solid-state devices, crystal oscillator or frequency synthesizer, technical manual.	
Specify frequency .....	994-8581-004
SunWatch™ programmable time and power level option .....	994-8974-001
Recommended spare semiconductor kit .....	990-1012-002
Spare crystal .....	444-XXXX-000
<b>ANCILLARY EQUIPMENT</b>	
AM-90 modulation monitor .....	994-8424-001
Potomac AT-51 test set .....	700-0499-000

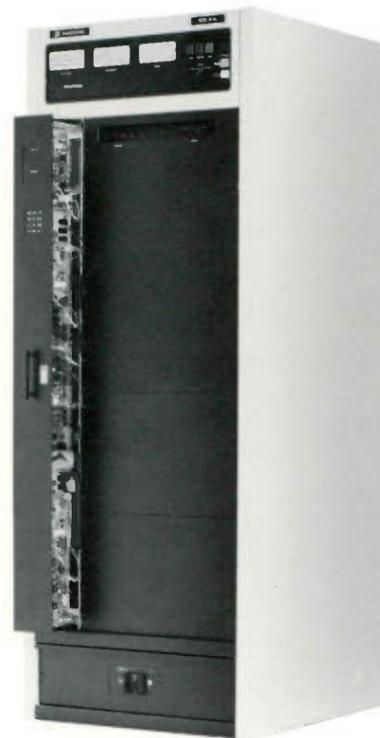


# Soundstar™ SX-1A — high technology in an ideal blend of broadcast and computer science

- 100% solid state for highest reliability
- Exceptionally high operating efficiency offers direct cost savings over other 1 kW designs
- Polyphase PDM\* for the best audio performance and exceptional signal clarity
- Dual microprocessor control and status monitoring eases operation and simplifies service
- SunWatch™ programmable time and power level option automatically executes PSA and PSSA schedules
- Flat-Pass output network for exceptional phase and amplitude linearity
- Output power and modulation level held constant regardless of line voltage fluctuations
- 36 inches of internal rack space provided for ancillary equipment

\*Patented

Low-level plug-in circuit boards are conveniently housed on a vertical slide-out drawer for easy maintenance.



The Harris SX-1A is based on a rigid design philosophy applied to the entire SoundStar Series of solid-state AM transmitters. Central to this concept are the commitments to achieve:

- The highest possible audio performance
- The highest possible overall efficiency
- Maximum reliability

The SX-1A broadcast transmitter is an outstanding performer in a class by itself. It is computer designed and computer tested, with its own self-contained dual status monitoring and control computers. The SX-1A is 100% solid state and not affected by loss of emission, shorted elements or other related problems found in tube type transmitters.

#### Efficient Power Devices

With the SoundStar Series of transmitters, Harris introduces new high power semiconductor technology to its broadcast products. State-of-the-art MOSFET transistors, as opposed to bipolar devices, achieve higher efficiency in the SX-1A.

#### Why MOSFETS?

MOSFETs (Metal Oxide Semiconductor Field Effect Transistors) represent a second generation of power devices offering significant benefits over bipolar transistor technology. Combined with the circuits

used in the SX-1A, MOSFETs prove to be extremely efficient. Unlike bipolar devices, MOSFETs are not subject to thermal runaway damage and are used in both the modulator and PA stages of the SX-1A.

Additionally, MOSFET transistors lend themselves to parallel operation where multiple devices are required. In the Harris design, the transistors in the power amplifier modules are operated in parallel for DC. But unlike other transmitters, the ferrite combiner places the amplifiers in series, permitting graceful degradation without increasing the stress on the remaining transistors.

#### Highly Efficient Power Amplifier

The SX-1A contains one RF power amplifier module conservatively rated to produce 1100 watts output. The MOSFETs are grouped in a quad configuration and combined in a low loss series configured ferrite combiner. Harris' PA module design efforts have resulted in an overall PA efficiency typically exceeding 85%.

#### Polyphase PDM Modulation

Polyphase PDM is a significant improvement of the Harris Pulse Duration Modulation system. It is a 4-phase system in which the audio input is sampled four times during each PDM cycle, resulting in the lowest harmonic and intermodulation

distortion of any AM transmitter currently offered.

The combination of the Harris Polyphase PDM Modulation and MOSFET devices achieves a modulator efficiency typically exceeding 90%. Polyphase PDM also allows the low pass filter to have a wide audio passband, and with the Bessel filter, reduces overshoot on sharply rising waveforms. This provides the ability to achieve higher levels of modulation density. Should there be a malfunction of one phase of the system, operation continues at reduced power until a convenient maintenance period can be scheduled. Harris' Polyphase PDM achieves new levels of AM audio performance and reliability.

#### Exceptionally High Overall Efficiency

The exceptionally high PA and modulator efficiency of the SX-1A combine to yield typically 70% overall AC to RF efficiency. This represents a 29% to 46% direct power saving compared with other 1 kW transmitters now in use!

#### Flat-Pass Output Network

After examining various output networks in past and current transmitters, Harris chose an output network/bandpass filter consistent with the design objectives of the SX-1A. The computer designed Flat-Pass output network is a Butterworth bandpass filter yielding superb phase and amplitude

linearity—two critical requirements for optimum AM Stereo performance.

The innovative design of the Flat-Pass network allows modulation monitoring and forward power to be measured at a fixed impedance. The directional coupler is always located at a 50 ohm impedance point. Direct drive tuning and loading controls simply adjust the SX-1A to match a load that can be any value within a 1.5:1 VSWR circle.

High speed lightning protection results from design techniques and devices used in the SX-1A. The SoundStar transmitter constantly monitors VSWR status and takes action only when operational limits are exceeded. Unwarranted VSWR trips, due to station problems or other environmental factors, are minimized. The transmitter is protected when subjected to an open or shorted load even at full output power!

#### Dual Microprocessor Control and Status Monitoring

Harris' extensive experience in transmitter technology and digital based products (program automation, automatic camera setup, facility control) permits the incorporation of powerful control and diagnostic features into the SX-1A transmitter. Should a multiple overload occur, the operator may review stored previous meter readings and sequential status indications to determine the fault. A vast number of useful operating parameters is available at fingertip command at the front panel keypad, making the SX-1A one of the easiest transmitters to monitor, control and service. The controller is preprogrammed at the factory and simply requires interrogation by the operator.

Operationally, the SX-1A consists of three eye-level meters displaying PA Volts, PA Current and Forward/Reflected Power. To the right of these large, easy-to-read meters are six illuminated pushbuttons labeled as follows:



Spectrum analyzer response of Flat-Pass output network maximizes mono and stereo performance.

**Off-Fault**—This pushbutton not only turns the transmitter off, but also acts as a master status light in the event of a transmitter malfunction. Extensive control module LED indicators assist the operator in isolating the fault.

**Low, Medium and High**—Independent tri power levels can be set to any value for each of the three power control buttons. The illuminated button indicates which power level is operating. No contactor or power transformer tap changes are required.

**Raise Power/Lower Power**—These pushbuttons allow the operator to set and adjust the power levels. This is a digital power control and has no moving parts.

#### Customer Interface Panel

The Customer Interface Panel provides the user with a centrally located point for all external interface equipment such as remote control, facility control, audio input, etc. The SX-1A transmitter is designed to interface with the majority of remote control and facility control systems. A momentary closure of 15 milliamps rating (TTL or dry contact) will activate the various control functions. All analog samples (PA Volts, PA current, output power, etc.) are buffered.

#### SunWatch™ Programmable Time and Power Level Option

This unique SX-1A feature allows stations to automatically execute presunrise and post sunset operating power schedules. The front key pad and display allow you to program in a given month up to 10 power level selections that are executed at the requested time. All of the different 12 month operating schedules may be programmed at once. This schedule may be reviewed or edited at any time. A precision, rack mounted, battery back-up clock is included with this option.

#### Designed For AM Stereo

The SX-1A is designed for AM Stereo, with special consideration paid to incidental quadrature modulation (typically 30 dB or better), audio input to RF envelope output phase linearity, and RF channel phase response. The standard high stability crystal oscillator and optional frequency synthesizer are both equipped to accept external AM Stereo RF oscillator signals.

#### Mechanical Design Considerations

Service accessibility is a major user benefit of the SX-1A. This is accomplished by novel electronic packaging new to broadcast transmitter products. For example, all low level circuit cards such as the RF

## Pushbutton diagnostics!



The SX-1A transmitter brings a wealth of diagnostic information to your fingertips through the microprocessor keypad located on the front panel.

oscillator, control logic and Polyphase PDM generator cards are located in a pull-out drawer. Critical low level circuit measurements can be made while on the air.

The all aluminum cabinet construction reduces shipping cost, while captive hardware and connectorized module interfaces reduce maintenance time.

#### Provision For Ancillary Equipment

State-of-the-art technology has reduced component size, allowing the SX-1A to house all the equipment typically found at a 1 kW transmitter site. 36¾ inches of 19-inch rack space is available for ancillary equipment, which may include modulation monitor, audio processing, facilities controls, etc. Segregated low level and power wiring to this equipment is available through the top, bottom and sides.

#### Cooling System

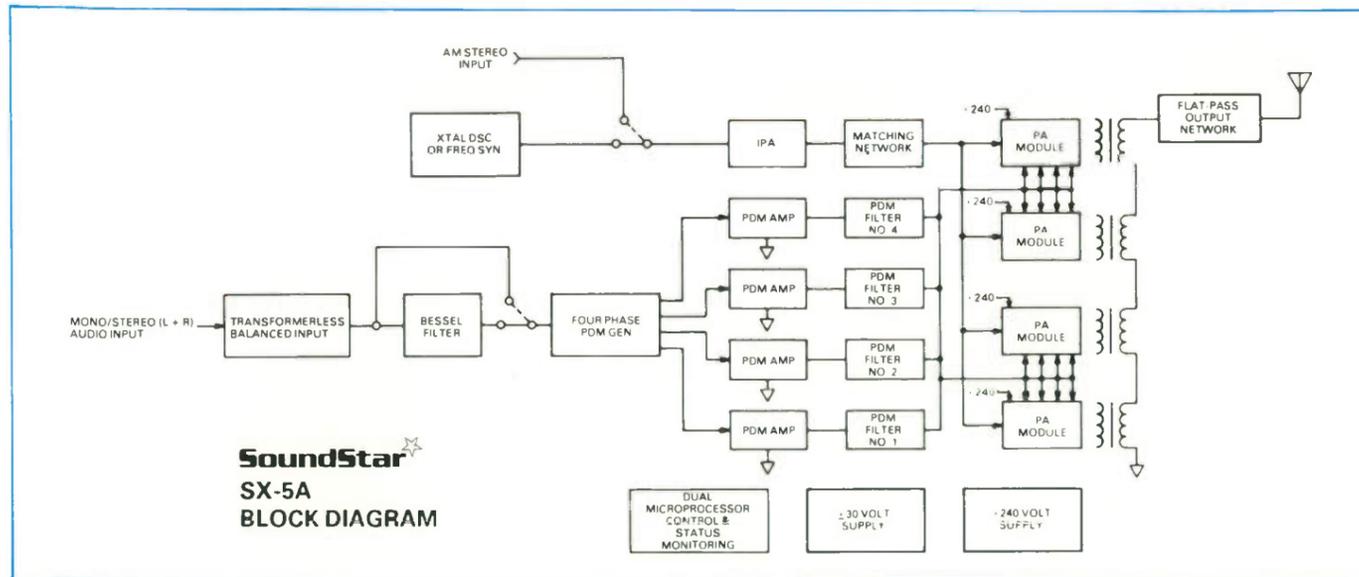
The SX-1A is the first broadcast transmitter incorporating innovative cooling techniques eliminating the need for a blower or fan. The transmitter dissipates only 700 watts of heat. This has allowed Harris to utilize a computer modeled convection cooling technique that offers significant benefits over conventional cooling methods.

#### Ease of Installation and Service

The SX-1A arrives ready for installation. Included is a wall mounted AC disconnect panel designed to interface with the station's electrical distribution system. Installation is as simple as positioning the SX-1A and making final AC, RF and audio connections. No special air handling systems are required.



# HARRIS SX-5A, 5000 WATT AM TRANSMITTER



## SX-5A SPECIFICATIONS

**POWER OUTPUT:** (Rated) 5000 watts. (Capable) 5600 watts. Power reduction through 500 watts. Capable of lower power operation.

**RF FREQUENCY RANGE:** 531 KHz through 1620 KHz. Supplied to one frequency as ordered.

**CARRIER FREQUENCY STABILITY:** A) Crystal Oscillator —  $\pm 20$  Hz over temperature range. B) Frequency Synthesizer (optional) —  $\pm 10$  Hz over temperature range.

**RF OUTPUT IMPEDANCE:** 50 ohms unbalanced. Will match into a VSWR of 1.5:1 at carrier.

**RF OUTPUT TERMINAL:**  $\frac{7}{8}$ " EIA male flange connector.

**CARRIER AMPLITUDE VARIATION:** (Carrier Shift): Less than 2% at 100% modulation at 1000 Hz.

**RF HARMONICS AND SPURIOUS EMISSIONS:** Exceeds FCC and CCIR specifications.

**TYPE OF MODULATOR:** Patented Polyphase PDM.

**AUDIO FREQUENCY RESPONSE:** +0.5 dB, -1.5 dB from 20 to 12,500 Hz. Reference 1000 Hz with Bessel filter out.

**AUDIO HARMONIC DISTORTION:** 1.0% or less at 5 kW, 20 to 12,500 Hz @ 95% modulation. 2% or less at 1000 watts operation, 20 to 12,500 Hz @ 95% modulation. 3% or less at 500 watts, 20 to 12,500 Hz @ 95% modulation.

**AUDIO INTERMODULATION DISTORTION:** 1.0% or less, 60/7000 Hz 1:1, 1.5% or less, 60/7000 Hz 4:1, SMPTE standard at 5 kW operation at 95% modulation.

**SQUAREWAVE OVERTHOOT:** 5% or less at 400 Hz.

**SQUAREWAVE TILT:** 5% or less at 20 Hz @ 90% modulation.

**NOISE (UNWEIGHTED):** Better than 60 dB below 100% modulation, 1000 Hz at 5 kW.

**POSITIVE PEAK CAPABILITY:** 125% positive peak program modulation capability at 5600 watts.

**AM STEREO SPECIFICATIONS:** Incidental Quadrature Modulation (IQM): Better than 30 dB below 95% modulation of L+R channel at 1 kHz.

**AUDIO INPUT:** -10 to +10 dBm, transformerless 600 ohms balanced, continuously adjustable.

**AC VOLTAGE INPUT:** 197-251 VAC, 48 to 63 Hz, three phase, 3 wire or 341 to 434 VAC, three phase, 4 wire, 48 to 63 Hz, +5% from nominal line voltage to maintain full performance.

**OVERALL EFFICIENCY:** Better than 65%.

**POWER CONSUMPTION<sup>1</sup>:** 7.7 kW at 0% modulation at 5000 watts. 11.6 kW at 100% tone modulation at 5000 watts carrier. 10.4 kW under average programming conditions.

**MONITOR PROVISIONS:** 10 volts RF (RMS) modulated output sample at 50 ohms (High/Medium/Low) power.

**REMOTE CONTROL:** Self-contained interface for most remote control or facility control systems.

**AMBIENT TEMPERATURE RANGE:** -20°C to +50°C AMSL (derate upper limit 2°C per 1000 feet altitude).

**AMBIENT HUMIDITY RANGE:** To 95% non condensing.

**AIR FLOW:** 500 CFM fan.

**ALTITUDE:** Sea Level to 13,000 feet (4000 meters).

**OPERATING ACOUSTICAL NOISE:** Better than 61 dBA sound rating, 3 feet from transmitter.

**SIZE:** 72"H x 28"W x 30"D (1830 mm x 712mm x 762mm).

**WEIGHT:** (Unpacked), 500 lbs. (230 kg) — approximate. Domestic packed, 700 lbs. (320 kg) — approximate. Export packed, 800 lbs. (370) kg — approximate.

**CUBAGE:** 68.7 cubic feet (2 cubic meters) packed.

**COLORS:** White and black.

**TYPE OF ACTIVE COMPONENTS:** 100% solid state.

**POWER SUPPLY:** Self-contained, dry.

**HARRIS MAINTAINS A POLICY OF CONTINUOUS IMPROVEMENTS ON ITS EQUIPMENT AND THEREFORE RESERVES THE RIGHT TO CHANGE SPECIFICATIONS WITHOUT NOTICE.**

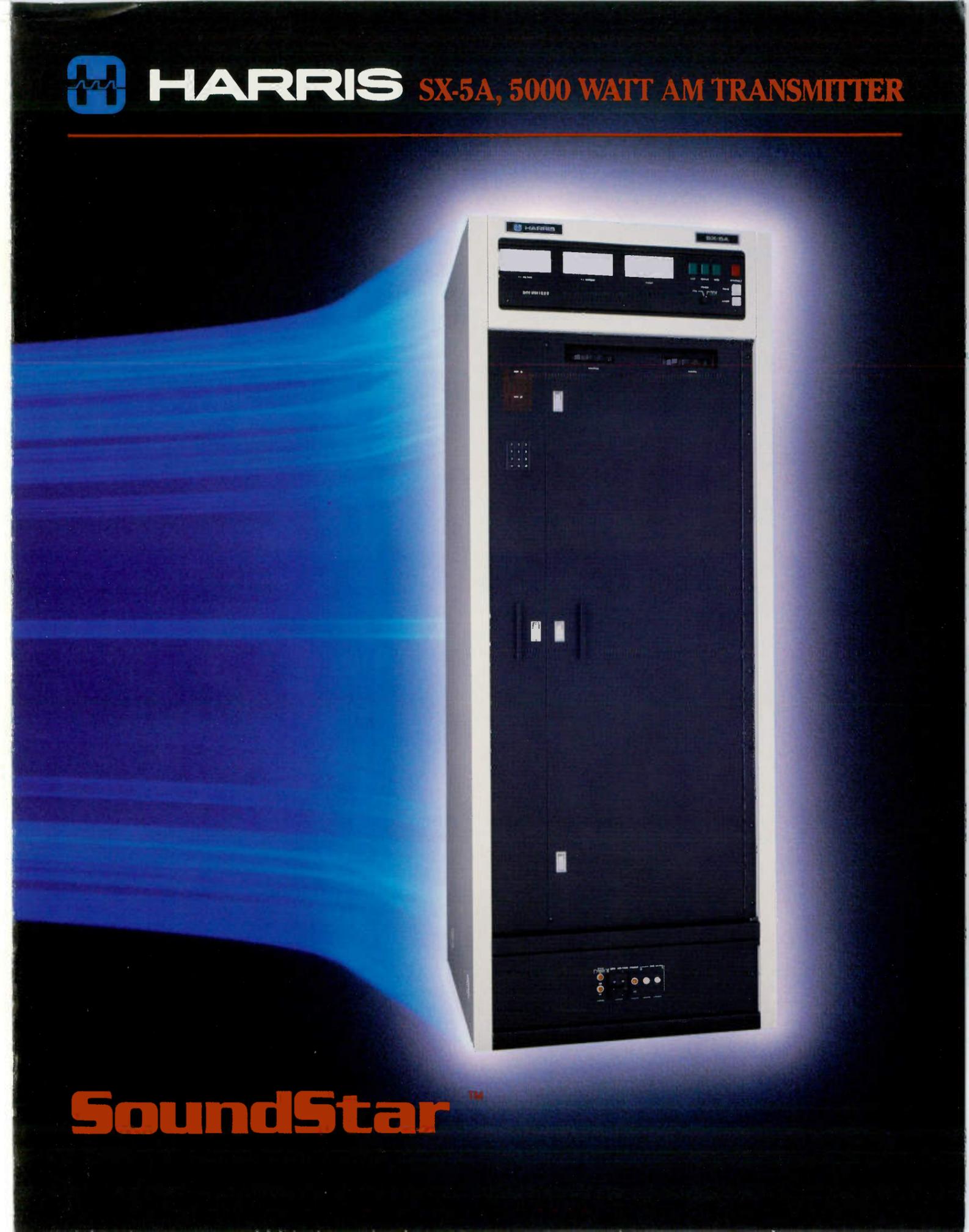
<sup>1</sup>For AC service connection, please provide 14 KVA with a minimum of 5% voltage demand regulation.

**NOTE:** The above specifications apply to operation at 5 kW except where noted. Furthermore, the above audio performance may be degraded should the transmitter be operated into a bandwidth restricted antenna system.

## ORDERING INFORMATION

SX-5A Transmitter, complete with all solid-state devices, crystal oscillator or synthesizer, technical manual.	
Specify frequency .....	994-8583-004
SunWatch™ programmable time and power level option .....	994-0974-001
Recommended spare semiconductor kit .....	990-1014-002
Spare crystal .....	444-XXXX-000
<b>ANCILLARY EQUIPMENT</b>	
AM-90 modulation monitor .....	994-8424-001
Potomac AT-51 test set .....	700-0499-000

**HARRIS CORPORATION BROADCAST DIVISION**  
P. O. BOX 4290, QUINCY, ILLINOIS 62305-4290 U.S.A. 217/222-8200

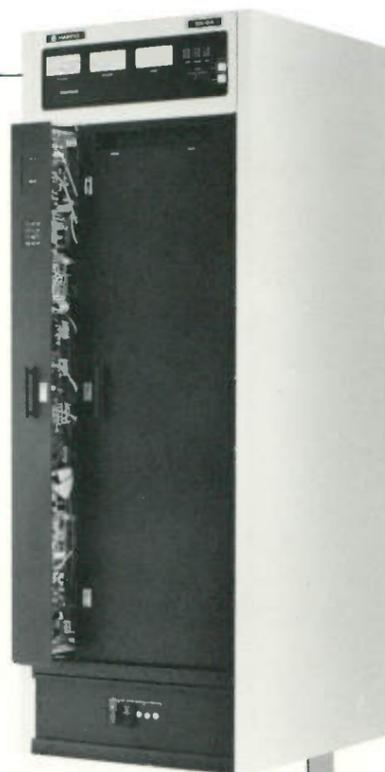


**SoundStar**™

# SoundStar SX-5A — high technology in an ideal blend of broadcast and computer science

- 100% solid state for highest reliability
- Exceptionally high operating efficiency offers direct cost savings over other 5 kW designs
- Polyphase PDM\* for the best audio performance and exceptional signal clarity
- Dual microprocessor control and status monitoring eases operation and simplifies service
- SunWatch™ programmable time and power level option automatically executes PSA and PSSA schedules
- Flat-Pass output network for exceptional phase and amplitude linearity
- Output power and modulation level held constant regardless of line voltage fluctuations
- Designed for stereo operation (optional)

\*Patented



Low level plug-in circuit boards are conveniently housed on a vertical slide-out drawer for easy maintenance.

The Harris SX-5A is based on a rigid design philosophy applied to the entire SoundStar Series of solid-state AM transmitters. Central to this concept are the commitments to achieve:

- The highest possible audio performance
- The highest possible overall efficiency
- Maximum reliability
- Optimum stereo performance

The SX-5A broadcast transmitter is in a class by itself. It is computer designed and computer tested, with its own self-contained dual status and control computers. The SX-5A is 100% solid state and not affected by loss of emission, shorted elements or other problems found in tube type transmitters.

## Efficient Power Devices

With the SoundStar Series of transmitters, Harris introduces new high power semiconductor technology to its broadcast products. State-of-the-art MOSFET transistors, as opposed to bipolar devices, achieve higher efficiency in the SX-5A.

## Why MOSFETS?

MOSFETS (Metal Oxide Semiconductor

Field Effect Transistors) represent the latest generation of power devices offering significant benefits over bipolar transistor technology. Combined with the circuits used in the SX-5A, MOSFETS prove to be extremely efficient. Unlike bipolar devices, MOSFETS are not subject to thermal runaway damage. Power amplifier MOSFETS are rugged and reliable devices, designed to withstand high magnitudes of transient energy. The result is an extremely low failure rate. In the Harris design, the transistors in the power amplifier are operated in parallel for DC. But unlike other transmitters, the ferrite combiner places the amplifiers in an RF series configuration. This SX-5A feature does not increase the stress on the remaining transistors should a MOSFET fail, thus allowing continued operation at reduced power with acceptable audio performance. MOSFET transistors are used both in the modulator and PA stages of the Harris SX-5A.

## Highly Efficient Power Amplifier

The SX-5A contains four RF power amplifier modules conservatively rated to produce 5600 watts output. The MOSFETS are grouped in a quad configuration and

combined in a low loss series configured ferrite combiner. Harris' PA module design efforts have resulted in an overall PA efficiency exceeding 85%.

## Polyphase PDM Modulation

Polyphase PDM is a significant improvement of the Harris Pulse Duration Modulation System. It is a 4-phase system in which the audio input is sampled four times during each PDM cycle, resulting in lowest harmonic and intermodulation distortion of any AM transmitter available today.

The combination of the Harris Polyphase PDM Modulation and MOSFET devices achieves a modulator efficiency exceeding 90%. Polyphase PDM also allows the low pass filter to have a wide audio passband, and with the Bessel filter, reduces overshoot on sharply rising waveforms. This provides the ability to achieve higher levels of modulation density. Should there be a malfunction of one phase of the system, operation continues with a slight reduction in performance until a convenient maintenance action can be scheduled. Harris' Polyphase PDM achieves new levels of AM audio performance and reliability.

**Exceptionally High Overall Efficiency**  
The exceptionally high PA and modulator efficiency of the SX-5A combine to yield greater than 65% overall AC to RF efficiency. This represents a 17% to 30% direct power savings compared with other 5 kW transmitters now in use!

## Flat-Pass Output Network

After examining various output networks in past and current transmitters, Harris chose an output network/bandpass filter consistent with the design objectives of the SX-5A. The computer designed Flat-Pass output network is a Butterworth bandpass filter yielding superb phase and amplitude linearity—two critical requirements for optimum AM Stereo performance.

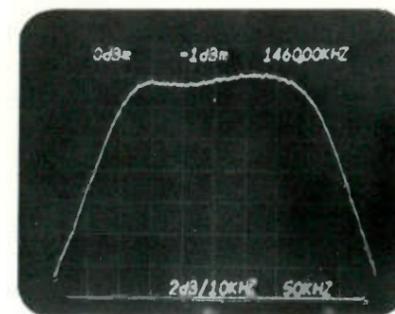
The innovative design of the Flat-Pass network allows modulation monitoring and forward power to be measured at a fixed impedance. The directional coupler is always located at a 50 ohm impedance point. Direct drive tuning and loading controls simply adjust the SX-5A to match a load that can be any value within a 1.5:1 VSWR circle.

## Transmitter and Antenna System Protection

High speed lightning protection results from design techniques and devices used in the SX-5A. The transmitter constantly monitors VSWR status and takes action only when operational limits are exceeded. Unwarranted VSWR trips, due to weather, are minimized. The transmitter is protected when subjected to an open or shorted load even at full output power.

## Dual Microprocessor Control and Status Monitoring

Harris' extensive experience in transmitter technology and digital based products (program automation, automatic camera setup, and facility control) permits the incorporation of powerful control and diagnostic features into the SX-5A transmitter. Should a multiple overload occur, the operator may review stored previous meter readings and sequential status indications to determine the fault. Many useful operating parameters are available at fingertip command at the front panel keypad, making the SX-5A one of the easiest transmitters to monitor, control and service. The con-



Spectrum analyzer response of Flat-Pass output network maximizes mono and stereo performance.

The SX-5A transmitter brings a wealth of diagnostic information to your fingertips through the microprocessor keypad located on the front panel.

troller is preprogrammed at the factory and simply requires interrogation by the operator.

Operationally, the SX-5A consists of three eye-level meters displaying Power Amplifier Volts, Power Amplifier Current and Forward/Reflected Power. To the right of these large, easy-to-read meters are six illuminated switches labeled as follows:

**Off-Fault**—This pushbutton not only turns the transmitter off, but also acts as a master status light in the event of a transmitter malfunction.

**Low, Medium and High**—Independent tri-power levels can be set to any value for each of the three power control buttons. The illuminated button indicates which power level is operating. No contactor or power transformer tap changes are required.

**Raise Power/Lower Power**—These pushbuttons allow the operator to set and adjust the power levels. This is a digital power control and has no moving parts.

## SunWatch™ Programmable Time and Power Level Option

This unique SX-5A feature allows stations to automatically execute presunrise and post sunset operating power schedules. The front key pad and display allows you to program in a given month up to 10 power level selections that are executed at the requested time. All of the different 12 month operating schedules may be programmed at once. This schedule may be reviewed or edited at any time. A precision, rack mounted, battery back-up clock is included with this option.

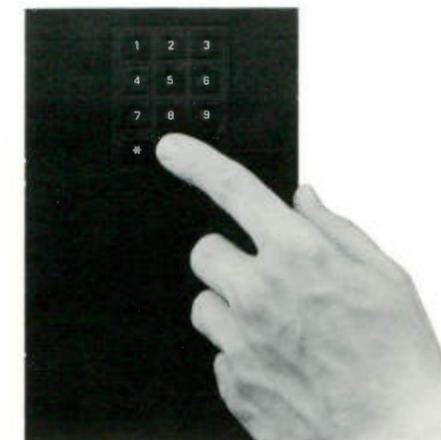
## Customer Interface Panel

The Customer Interface Panel provides the user with a centrally located point for all external interface equipment such as remote control, facility control, audio input, etc. The SX-5A transmitter is designed to interface with the majority of remote control and facility control systems. A momentary closure of 15 milliamps rating (TTL or dry contact) will activate the various control functions. All analog samples (Power Amplifier Volts, Power Amplifier current, output power, etc.) are buffered.

## Designed For AM Stereo

The SX-5A is designed for AM Stereo, with special consideration paid to incidental quadrature modulation, audio input to RF envelope output phase linearity, and RF channel phase response. The standard high stability crystal oscillator and optional fre-

## Pushbutton diagnostics!



quency synthesizer are both equipped to accept external AM Stereo RF oscillator signals.

## Mechanical Design Considerations

Service accessibility is a major user benefit of the SX-5A. This is accomplished by electronic packaging new to broadcast transmitter products. For example, all low level circuit cards such as the RF oscillator, control logic and Polyphase PDM generator cards are located in a pull-out drawer. Critical low level circuit tests can be made while on the air.

The all aluminum cabinet construction reduces shipping cost, while captive hardware and connectorized module interfaces reduce maintenance time.

## Cooling System

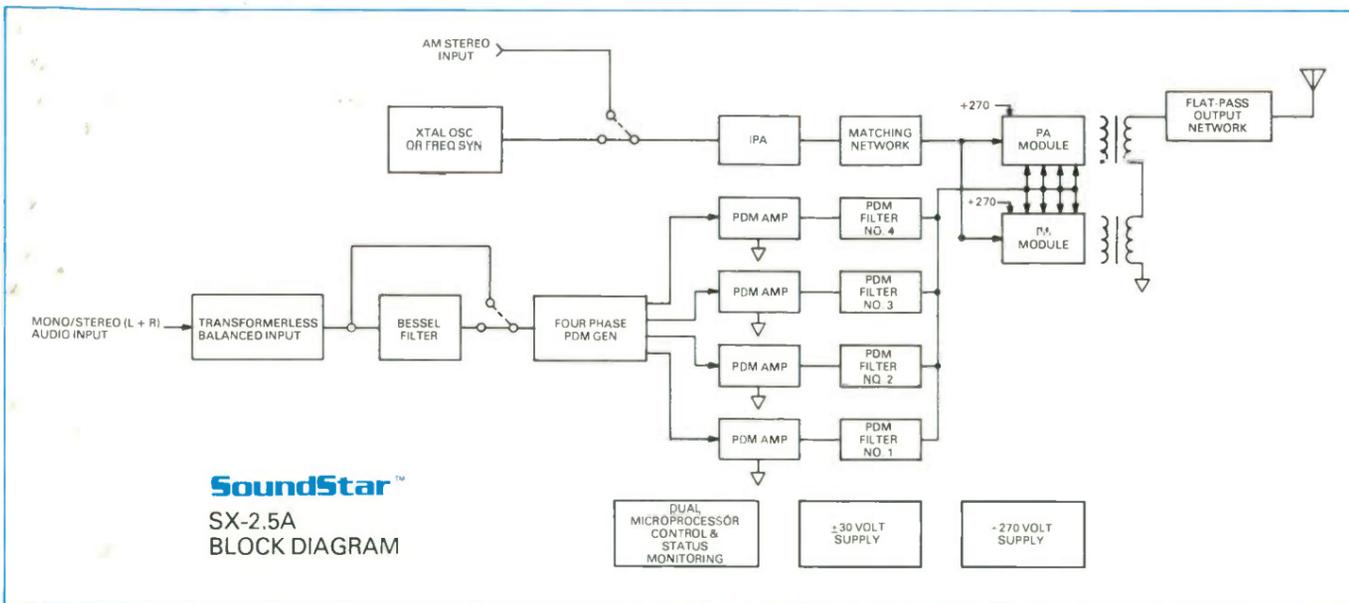
The SX-5A incorporates an innovative computer modeled cooling technique that offers significant benefits over conventional transmitter designs. The sidewalls of the transmitter form "chimneys" to which the power modules are attached. Air assisted by 2 quiet, high reliability 250 CFM fans, enters through a filtered rear entrance and rises through the cabinet walls, cooling the power modules' heat sinks.

## Ease of Installation and Service

The SX-5A arrives ready for installation. Included is a wall mounted AC disconnect panel designed to interface with the station's electrical distribution system. Installation is essentially positioning the SX-5A and making final AC, RF and audio connections. No special air handling systems are normally required.



# HARRIS SX-2.5A, 2500 WATT AM TRANSMITTER



## SX-2.5A SPECIFICATIONS

**POWER OUTPUT:** (Rated) 2,500 watts. (Capable) 2750 watts. Power reduction through 250 watts, Capable of lower power PSA/PSSA operation.

**RF FREQUENCY RANGE:** 531 KHz through 1620 KHz. Supplied to one frequency as ordered.

**CARRIER FREQUENCY STABILITY:** A) Crystal Oscillator —  $\pm 20$  Hz over temperature range. B) Frequency Synthesizer (optional) —  $\pm 10$  Hz over temperature range.

**RF OUTPUT IMPEDANCE:** 50 ohms unbalanced. Will match into a VSWR of 1.5:1 at carrier.

**RF OUTPUT TERMINAL:**  $\frac{3}{8}$ " EIA male flange connector.

**CARRIER AMPLITUDE VARIATION:** (Carrier Shift): Less than 2% at 100% modulation at 1000 Hz.

**RF HARMONICS AND SPURIOUS EMISSIONS:** Exceeds FCC and CCIR specifications.

**TYPE OF MODULATOR:** Patented Polyphase PDM.

**AUDIO FREQUENCY RESPONSE:** +0.5 dB, -1.5 dB from 20 to 12,500 Hz at 95% modulation with Bessel filter out, ref. 1000 Hz.

**AUDIO HARMONIC DISTORTION:** @95% modulation: 1.0% or less at 2.5 kW, 20 to 12,500 Hz; 1.5% or less at 1000 watt operation, 20 to 12,500 Hz; 3% or less at 250W, 20 to 12,500 Hz.

**AUDIO INTERMODULATION DISTORTION:** 1.0% or less, 60/7000 Hz 1:1, 1.5% or less, 60/7000 Hz 4:1, SMPTE standards at 2500 watt output at 95% modulation.

**SQUAREWAVE OVERSHOOT:** Less than 5% at 400 Hz @90% modulation with Bessel filter.

**SQUAREWAVE TILT:** Less than 5% at 20 Hz @ 90% modulation.

**NOISE (UNWEIGHTED):** Better than 60 dB below 100% modulation.

**POSITIVE PEAK CAPABILITY:** 125% positive peak program modulation capability at 2750 watts.

**INCIDENTAL QUADRATURE MODULATION (IQM):** 30 dB or better below 95% modulation of L+R channel at 1 kHz.

**AUDIO INPUT:** -10 to +10 dBm, transformerless 600 ohms balanced, continuously adjustable.

**AC VOLTAGE INPUT:** 197-251 VAC, 48 to 63 Hz, single phase.

**OVERALL EFFICIENCY:** 65% or better at 2500 W.

**POWER CONSUMPTION<sup>1</sup>:** 3.85 kW at 0% modulation at 2500 watts. 5.8 kW at 100% tone modulation at 2500 watts carrier. 5.4 kW under average programming conditions.

**MONITOR PROVISIONS:** 10 volts RF (RMS) modulated output sample at 50 ohms (High/Medium/Low) power.

**REMOTE CONTROL:** Self-contained interface for most remote control or facility control systems.

**AMBIENT TEMPERATURE RANGE:** -20°C to +50°C AMSL (derate upper limit 2°C per 1000 feet altitude).

**AMBIENT HUMIDITY RANGE:** To 95% non condensing.

**AIR FLOW:** 250 CFM fan.

**ALTITUDE:** Sea Level to 13,000 feet (4000 meters).

**OPERATING ACOUSTICAL NOISE:** Better than 64 dBA acoustic rating, 3 feet from transmitter.

**SIZE:** 72"H x 28"W x 30"D (1830 mm x 712mm x 762mm).

**WEIGHT:** (Unpacked), 450 lbs. (204 kg) — approximate. Domestic packed, 650 lbs. (298 kg) — approximate. Export packed, 750 lbs. (343) kg — approximate.

**CUBAGE:** 68.7 cubic feet (2 cubic meters) packed.

**COLORS:** White and black.

**TYPE OF ACTIVE COMPONENTS:** 100% solid state.

**POWER SUPPLY:** Self-contained, dry.

**HARRIS MAINTAINS A POLICY OF CONTINUOUS IMPROVEMENTS ON ITS EQUIPMENT AND THEREFORE RESERVES THE RIGHT TO CHANGE SPECIFICATIONS WITHOUT NOTICE.**

<sup>1</sup>For AC service connection, please provide 8.2 KVA with a minimum of 5% voltage demand regulation.

**NOTE:** The above audio performance may be degraded should the transmitter be operated into a bandwidth restricted antenna system. Also, all specifications are referenced to operation at 2500 watts except when noted.

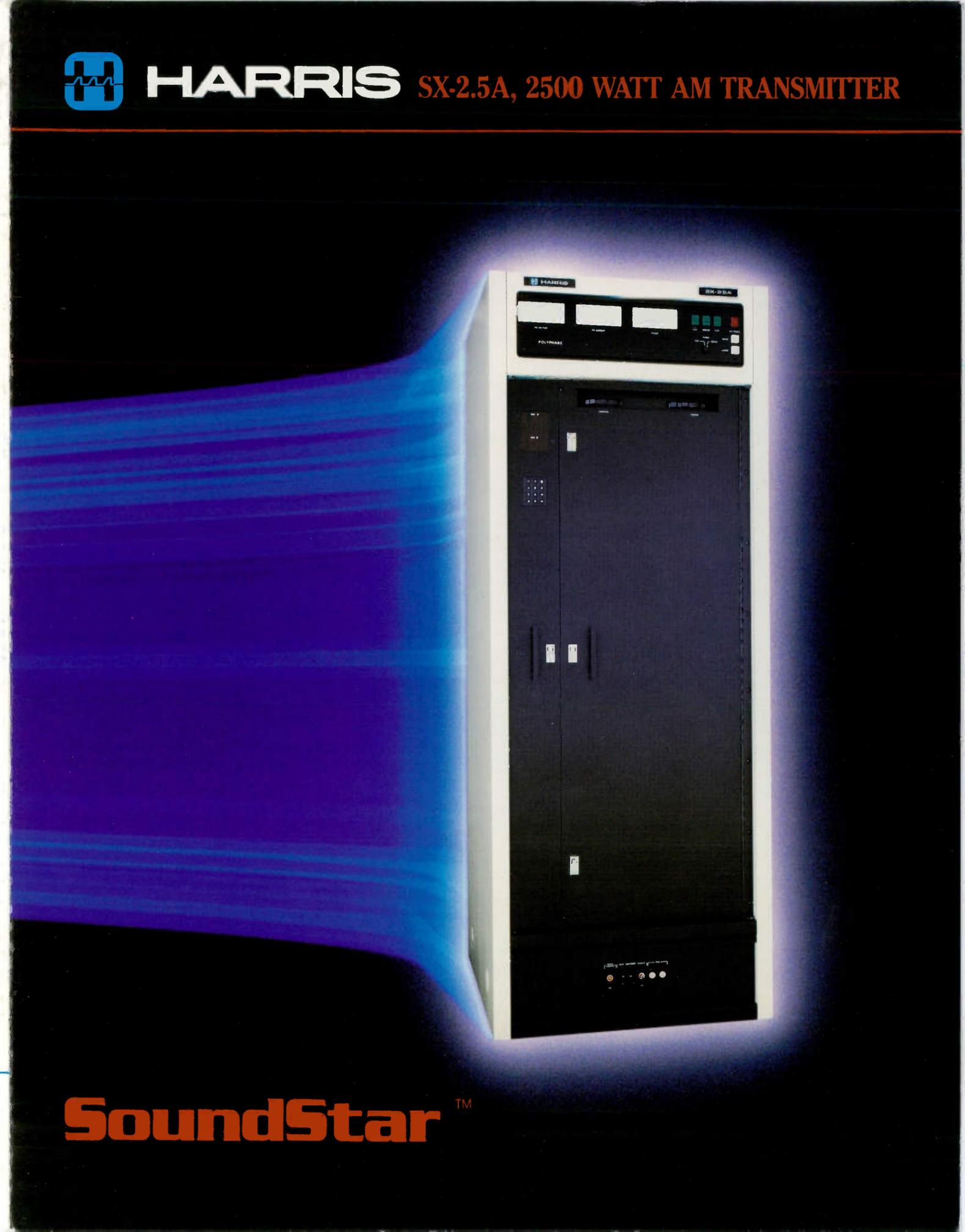
## ORDERING INFORMATION

SX-2.5A Transmitter, complete with all solid-state devices, crystal oscillator or synthesizer, technical manual.	
Specify frequency .....	994-8582-004
SunWatch™ programmable time and power level option .....	994-8974-001
Recommended spare semiconductor kit .....	990-1013-002
Spare crystal .....	444-0000-000
<b>ANCILLARY EQUIPMENT</b>	
AM-90 modulation monitor .....	994-8424-001
Potomac AT-51 test set .....	700-0499-000

HARRIS CORPORATION BROADCAST DIVISION  
P. O. BOX 4290, QUINCY, ILLINOIS 62305-4290 U.S.A. 217/222-8200



**SoundStar™**



# SoundStar™ SX-2.5A — high technology in an ideal blend of broadcast and computer science

- 100% solid state for highest reliability
- Exceptionally high operating efficiency offers up to 42% direct power cost savings over other 2.5 kW designs
- Polyphase PDM\* for the best audio performance and exceptional signal clarity
- Dual microprocessor control and status monitoring eases operation and simplifies service
- SunWatch™ programmable time and power level option automatically executes PSA and PSSA schedules
- Flat-Pass output network for exceptional phase and amplitude linearity
- Output power and modulation level held constant regardless of line voltage fluctuations
- Designed for stereo operation (optional)

\*Patented

Low-level plug-in circuit boards are conveniently housed on a vertical slide-out drawer for easy maintenance.



The Harris SX-2.5A is based on a rigid design philosophy applied to the entire SoundStar Series of solid-state AM transmitters. Central to this concept are the commitments to achieve:

- a) The highest possible audio performance
- b) The highest possible overall efficiency
- c) Maximum reliability

The SX-2.5A broadcast transmitter is in a class by itself. It is computer designed and computer tested, with its own self-contained dual status monitoring and control computers. The SX-2.5A is 100% solid state and not affected by loss of emission, shorted elements or other problems found in tube type transmitters.

#### Efficient Power Devices

With the SoundStar Series of transmitters, Harris introduces new high power semiconductor technology to its broadcast products. State-of-the-art MOSFET transistors, as opposed to bipolar devices, achieve higher efficiency in the SX-2.5A.

#### Why MOSFETS?

MOSFETS (Metal Oxide Semiconductor Field Effect Transistors) represent a second generation of power devices having significant advantages over bipolar transistor technology. Combined with the circuits used in the SX-2.5A, MOSFETS prove to be

extremely efficient. Unlike bipolar devices, MOSFETS are not subject to thermal runaway damage. Additionally, MOSFET transistors lend themselves well to parallel operation where multiple devices are required. In the Harris design, the transistors in the power amplifier modules are operated in parallel for DC. But unlike other transmitters, the ferrite combiner places the amplifiers in an RF series configuration, permitting graceful degradation without increasing the stress on the remaining transistors. MOSFETS are used in both the modulator and PA stages of the SX-2.5A.

#### Highly Efficient Power Amplifier

The SX-2.5A contains two RF power amplifier modules conservatively rated to produce 2750 watts output. The MOSFETS are grouped in a quad configuration and combined in a low loss series configured ferrite combiner. Harris' PA module design efforts have resulted in an overall PA efficiency exceeding 85%.

#### Polyphase PDM Modulation

Polyphase PDM is a significant improvement of the Harris Pulse Duration Modulation System. It is a 4-phase system in which the audio input is sampled four times during each PDM cycle, resulting in lowest harmonic and intermodulation

distortion of any AM transmitter currently offered.

The combination of the Harris Polyphase PDM Modulation and MOSFET devices achieves a modulator efficiency exceeding 90%. Polyphase PDM also allows the low pass filter to have a wide audio passband, and with the Bessel filter, reduces overshoot on sharply rising waveforms. This provides the ability to achieve higher levels of modulation density. Should there be a malfunction of one phase of the system, operation continues with a slight reduction in performance until a convenient maintenance action can be performed. Harris' Polyphase PDM achieves new levels of AM audio performance and reliability.

#### Exceptionally High Overall Efficiency

The exceptionally high PA and modulator efficiency of the SX-2.5A combine to yield greater than 65% overall AC to RF efficiency. This represents a 34% to 42% direct power saving compared with other 2.5 kW transmitters now in use!

#### Flat-Pass Output Network

After examining various output networks in past and current transmitters, Harris chose an output network/bandpass filter consistent with the design objectives of the SX-2.5A. The computer designed Flat-Pass output network is a Butterworth bandpass

filter yielding superb phase and amplitude linearity—two critical requirements for optimum AM Stereo performance.

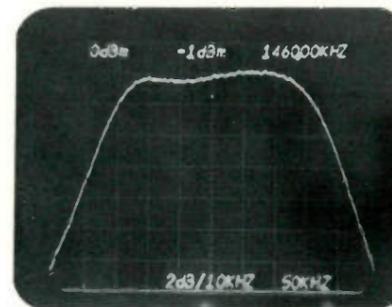
The innovative design of the Flat-Pass network allows modulation monitoring and forward power to be measured at a fixed impedance. The directional coupler is always located at a 50 ohm impedance point. Direct drive tuning and loading controls simply adjust the SX-2.5A to match a load that can be any value within a 1.5:1 VSWR circle.

#### Transmitter and Antenna System Protection

High speed lightning protection results from design techniques and devices used in the SX-2.5A. The SoundStar transmitter constantly monitors VSWR status and takes action only when operational limits are exceeded. Unwarranted VSWR trips, due to environmental factors, are kept to a minimum. *The transmitter will not be damaged when operated into an open or shorted load even at full output power!*

#### Dual Microprocessor Control and Status Monitoring

Harris' extensive experience in transmitter technology and digital based products (program automation, automatic camera setup, and facility control) permits the incorporation of powerful control and diagnostic features into the SX-2.5A transmitter. For example, should a high module temperature condition exist, the microprocessor simply reduces output power to a tolerable level, thus keeping the transmitter on the air. Should a multiple overload occur, the operator may review stored previous meter readings and sequential status indications to determine the fault. Many useful operating parameters are available at fingertip command at the front panel keypad, making the SX-2.5A one of the easiest transmitters to monitor, control and service. The controller is



Spectrum analyzer response of Flat-Pass output network maximizes mono and stereo performance.

preprogrammed at the factory and simply requires interrogation by the operator.

Operationally, the SX-2.5A consists of three eye-level meters displaying PA Volts, PA Current and Forward/Reflected Power. To the right of these large, easy-to-read meters are six illuminated switches labeled as follows:

**Off-Fault**—This switch not only turns the transmitter off, but also acts as a master status light in the event of a transmitter malfunction. Extensive control module LED indicators assist the operator in isolating the fault.

**Low, Medium and High**—Independent tri-power levels can be set to any value for each of the three power control switches. The illuminated button indicates which power level is operating. No contactor or power transformer tap changes are required.

**Raise Power/Lower Power**—These pushbuttons allow the operator to set and adjust the power levels. This is a digital power control and has no moving parts.

#### SunWatch™ Programmable Time and Power Level Option

This unique SX-2.5A feature allows stations to automatically execute presunrise and post sunset operating power schedules. The front key pad and display allow you to program in a given month up to 10 power level selections that are executed at the requested time. All of the different 12 month operating schedules may be programmed at once. This schedule may be reviewed or edited at any time. A precision, rack mounted, battery back-up clock is included with this option.

#### Customer Interface Panel

The Customer Interface Panel provides the user with a centrally located point for all external interface equipment such as remote control, facility control, audio input, etc. The SX-2.5A transmitter is designed to interface with the majority of remote control and facility control systems. A momentary closure of 15 milliamps rating (TTL or dry contact) will activate the various control functions. All analog samples (PA Volts, PA current, output power, etc.) are buffered.

#### Designed For AM Stereo

The SX-2.5A is designed for AM Stereo, with special consideration paid to incidental phase modulation, audio input to RF envelope output phase linearity, and RF channel phase response. The standard high stability crystal oscillator and optional fre-

## Pushbutton diagnostics!



The SX-2.5A transmitter brings a wealth of diagnostic information to your fingertips through the microprocessor keypad located on the front panel.

quency synthesizer are both equipped to accept external AM Stereo RF oscillator signals.

#### Mechanical Design Considerations

Service accessibility is a major user benefit of the SX-2.5A. This is accomplished by novel electronic packaging new to broadcast transmitter products. For example, all low level circuit cards such as the RF oscillator, control logic and Polyphase PDM generator cards are located in a pull-out drawer. Critical low level circuit tests can be made while on the air.

The all aluminum cabinet construction reduces shipping cost, while captive hardware and connectorized module interfaces reduce maintenance time.

#### Cooling System

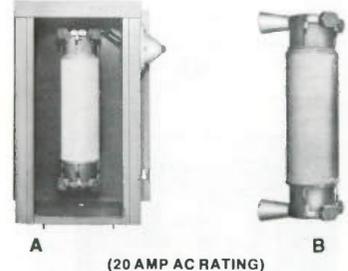
The SX-2.5A incorporates an innovative computer modeled cooling technique that offers significant benefits over conventional transmitter designs. The sidewalls of the transmitter form "chimneys" to which the power modules are attached. Air assisted by a quiet, high reliability 250 CFM fan enters through a filtered rear entrance and rises through the cabinet walls, cooling the power modules' heat sinks.

#### Ease of Installation and Service

The SX-2.5A arrives ready for installation. Included is a wall mounted AC disconnect panel designed to interface with the station's electrical distribution system. Installation is essentially positioning the SX-2.5A and making final AC, RF and audio connections. No special air handling systems are required.

## ADDITIONAL MEDIUM WAVE ANTENNA ACCESSORIES

### TOWER LIGHT ISOLATION CHOKES



Most popular of all tower light isolation chokes. Available in 2 or 3 wire models and in open type, or weatherproof as illustrated. Wound on heavy triple X tubing with mica-by-pass condensers on each circuit end. Inductance approximately 350 uH. 3" stand-off insulators are part of coil. (Weatherproof type), 24" high, 17 3/4" wide, 10 1/4" deep. Illustration on left shows weatherproof unit with front cover removed.

#### ORDERING INFORMATION

Tower Choke, 2 wire, weatherproof, Fig. A .....994-3937-001  
 Tower Choke, 3 wire, weatherproof, Fig. A .....994-3938-001  
 Tower Choke, 2 wire, open type, Fig. B .....994-3935-001  
 Tower Choke, 3 wire, open type, Fig. B .....994-3936-001

### FEED-THRU BOWLS



#### FEED-THRU BOWL ASSEMBLY

A large feed-thru bowl with 50 kW modulated rating. Available in single and double units and with solid or hollow studs as listed below. Bowls are Alsimag. Hardware, heavy brass. Velutex seals are provided for weathertight installation.

#### ORDERING INFORMATION

Solid stud, 2 bowls, for walls to 1 1/2" thick .....994-2870-001  
 Same as above but hollow stud .....994-3254-001  
 Solid stud, single bowl, for walls 1" thick .....994-5280-001  
 Same as above but hollow stud .....994-5281-001

### RF CONTACTORS

Harris offers a complete line of RF contactors of both the mechanical and vacuum variety.

The popular mechanical contactors, that handle a wide range of medium wave antenna applications, are available from stock.

### DIODE TYPE REMOTE METER EQUIPMENT



For remote indication of RF current. Consists of a carefully constructed pickup loop attached through a short coaxial cable to a solid-state rectifier assembly. RF current is measured without breaking the main lead. No AC power is required. May be used with any good 1 MA DC meter. Power range: 250 watts to 50,000 watts. Frequency range: 540 kHz to 1600 kHz.

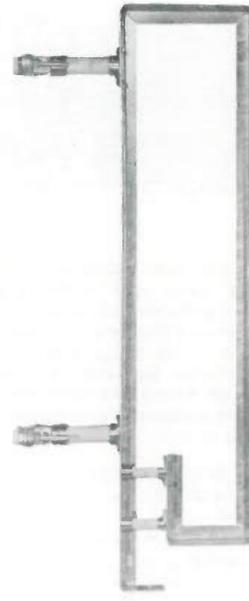
#### ORDERING INFORMATION

Diode remote meter unit, less meter .....994-6112-001

#### 0-1 MA METERS

Meter 3" sq. case, scale 0-3 R.F. amperes .....632-0418-000  
 Meter 3" sq. case, scale 0-6 R.F. amperes .....632-0405-000  
 Meter 3" sq. case, scale 0-8 R.F. amperes .....632-0420-000  
 Meter 3" sq. case, scale 0-10 R.F. amperes .....632-0421-000  
 Meter 4" sq. case, scale 0-3 R.F. amperes .....632-0424-000  
 Meter 4" sq. case, scale 0-8 R.F. amperes .....632-0426-000  
 Meter 4" sq. case, scale 0-10 R.F. amperes .....632-0361-000  
 Meter 4" sq. case, scale 0-15 R.F. amperes .....632-0428-000  
 NOTE: Other meter scale ranges available at extra cost. Above for use with diode remote unit, not thermocouple.

### HEAVY DUTY SAMPLING LOOP



This is a very rugged fixed non-shielded RF sampling loop. It is heavily galvanized after welding, and is fitted with large steatite insulators and heavy duty tower leg clamps for easy and positive mounting. Complete with type female "N" jack. For 50 to 70 ohm sampling line.

#### ORDERING INFORMATION

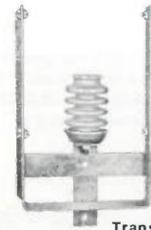
Heavy duty sampling loop .....994-6126-001

### ISOLATION COILS

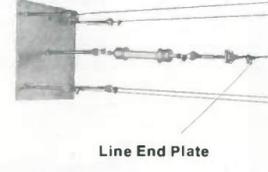
Harris manufactures several types of sampling loop isolation coils to meet the needs of the directional array and associated monitoring system.

Standard units available use either 1/2 inch or 3/8 inch phase stabilized foam transmission line. The isolation coils are available with an optional resonating capacitor. The unit can be mounted on a flat aluminum wall panel or housed in a weatherproof enclosure.

## OPEN WIRE TRANSMISSION LINE ACCESSORIES



Transmission Line Bracket



Line End Plate



Horn Gap



Center Post Assembly

**TRANSMISSION LINE BRACKET.** For 5 or 6 wire transmission line. Rating up to 150 kW modulated. Made of 1/4" steel 3" wide with welded L section on each side to fully prevent twisting under ice or wind load. Supplied with 8 1/4" ribbed insulator, wire guides and all hardware. Galvanized throughout.

Line Bracket .....994-3327-001

**LINE END PLATE.** To terminate the open wire line at each end. Plate is 1/4" thick, 20" square. Fully galvanized. Includes turnbuckles, 25 1/2" strain insulator and all hardware. Rating up to 150 kW modulated.

End Plate .....994-3328-001

**HORN GAP.** A very desirable item where higher power is employed. Connects to hot side of line and ground to drain off lightning and heavy static discharges. Usually one is employed for each 200 feet of line. Insulator for 150 kW. Arc gaps heavy chrome plate. Galvanized throughout.

Horn Gap .....994-3322-001

**CENTER POST ASSEMBLY.** Has variety of uses such as end or corner angling of transmission line, support insulator for two wire line or rhombic antennas, and a guide insulator such as end of building or coupling unit. Rating 150 kW. Galvanized throughout.

Center Post Insulator .....994-3864-001

### MODEL OIB-1 Operating Impedance Bridge



The Delta Model OIB-1 Operating Impedance Bridge measures the operating impedance of the individual radiators, networks, transmission line sections and common point of directional antennas while they are functioning under normal power. The OIB-1 has a frequency range of 500 kHz to 5 MHz, with a power rating up to 10 kW. Several optional accessories are available for the OIB-1.

Basic OIB-1 .....700-0063-000

### MODELS CPB-1/CPB-1A Common Point Impedance Bridges



The Delta Models CPB-1 or CPB-1A Common Point Impedance Bridges can be custom installed in your Harris phasor or sold separately. The CPB-1 will handle common point powers up to 5 kW with 100% modulation on a continuous basis, while the CPB-1A is designed for 50 kW operation. Both instruments have two 4-inch dials calibrated directly in resistance and reactance. A front panel meter provides a null condition.

CPB-1 .....700-0055-000  
 CPB-1A .....700-0056-000

### MODELS TCA/TCA-XM RF Ammeter Systems



The Delta Models TCA and TCA-XM are radio frequency current measuring instruments designed for broadcast antenna systems. These instruments are intended for applications where conventional thermocouples have been used in the past. The units meet the FCC's requirement of 2% accuracy and are calibrated at RF frequencies to insure application accuracy. These units can be incorporated into your custom Harris antenna network or sold separately. Contact us for the various models and configurations available.

Specifications subject to change without notice.

HARRIS CORPORATION Broadcast Products Division  
 P. O. Box 4290, Quincy, Illinois 62301 U. S. A.



HARRIS  
 COMMUNICATION AND  
 INFORMATION PROCESSING

## MEDIUM WAVE ANTENNA PHASING EQUIPMENT AND ACCESSORIES

- Network design experience and capability that are recognized and accepted throughout the industry
- Highest construction standards in the industry
- Highest quality long-life components with conservative ratings to maximize reliability
- Wide network adjustment range for easy tune-up
- Modern control circuitry provides full transmitter and RF contactor protection, direct remote control interface
- Highest quality design and construction at affordable prices



# HARRIS' CUSTOMIZED MEDIUM WAVE PHASING AND ANTENNA NETWORKS...SUPERIOR DESIGN TECHNIQUES

Harris phasors and medium wave antenna networks are custom built to the highest standards in the industry. Our network design experience is well known throughout the broadcast community. From 250 watts to 200 kilowatts, Harris phasors and medium wave antenna networks are in use around the world. Superior design and construction techniques, and the use of quality components are providing customers years of stable and reliable performance.

The key to our phasor capability is our highly experienced antenna design engineering staff, which is available to tailor networks for your specific requirements. Recognized as experts in the medium wave antenna field, Harris engineers' field experience gives them the perspective to understand the problems associated with installation and adjustment of medium wave antenna networks.

Innovative network designs for special requirements such as distortion reduction and broadband compensation can be provided. Computer design techniques aid in providing an optimum component configuration for your station. Experienced technicians assemble and test each phasor and antenna unit to assure a quality product. Many of the design and construction practices are unique to Harris and are not found in competitive units.

A modern control circuit is used with every phasor equipped with multiple antenna mode operation. A simple, straightforward 24-volt DC relay logic circuit is housed on one printed circuit board. Clean printed circuit board construction eliminates problems normally associated with hand wired control logic panels, thus improving reliability.

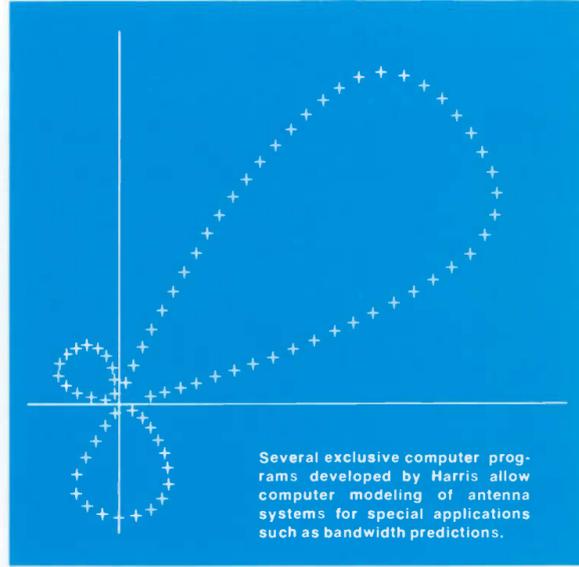
All relays, components, and terminal strips on the control logic board are permanently labeled for quick and easy reference.

This modern control circuit includes features not found in many competitive phasor designs. For example, a time delay is provided for RF to be completely removed before contactor switching - thus avoiding burned contacts. An automatic high voltage restart command is given to the transmitter after pattern switch. This eliminates a manual operator step and reduces annoying "off the air" pattern switch time to one second. Remote control commands are momentary, low current contact closures enabling direct connection to most remote control and ATS systems. Remote mode status indication is also provided for station use.

These Harris control circuit features will extend component life, minimize listener annoyance, and eliminate remote control and transmitter interface equipment. This means direct savings to your station.

## COMPARE THESE CONSTRUCTION FEATURES

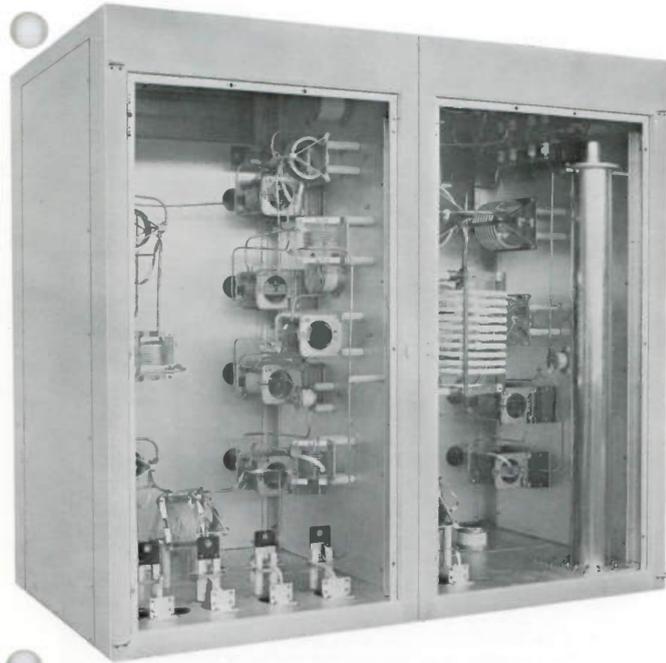
- Easily operated cyclometers with counter dials are used on front panel controlled components. Positive stop action is provided on these controls.
- Cabinet interconnections are mechanically solid and electrically continuous to provide a well integrated system. Phasor cabinet side plates are made of aluminum, and separate cabinet assemblies are connected with copper strap.



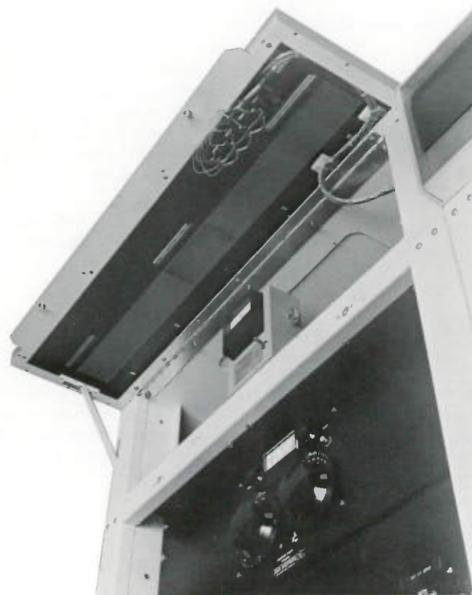
Several exclusive computer programs developed by Harris allow computer modeling of antenna systems for special applications such as bandwidth predictions.

- All tubing coils are connected to other components with tubing the same size as that used in the coil. Parallel tapping straps with a minimum of excess length are used. These features minimize the risk of arcing or overheating.
- Permanent stencilling is used to identify components and no stick on labels are placed across capacitor insulation.
- The phasor cabinets can be matched to the styling of your Harris transmitter. Optional front and rear doors and hinged meter panels are available. All cabinet doors are equipped with interlocks to remove power from the equipment when the doors are opened. All phasor components are removable from inside the cabinet, facilitating quick servicing. Thus, cabinets may be mounted flush against a sidewall to conserve space.
- Test jacks are provided at all phasor input and output ports and ACU input locations. Thermocouple ammeter switches are make-before-break with a compensating loop and are double throw to completely remove the meter from the circuit. Toroidal ammeters are also available. Other switches are available with provision to accept plug-in meters and to provide "cold" attachment points for operating bridge measurements without loss of air time.
- All insulators are chosen to provide at least one inch per 5 kV separation to ground. All coils are spaced at least one coil radius from walls to minimize induced wall currents. Insulator material is selected on the basis of dielectric strength and dissipation factor, so that RF voltage gradients will not overstress the material.
- Harris maintains a 24-hour Service Department to assist you with your emergency parts requirements.

Harris phasor engineers are eager to work with station personnel and consulting engineers to provide a quality antenna system. For more information, contact your Harris sales representative or call the Radio Sales Department at our home office in Quincy, Illinois (217-222-8200).



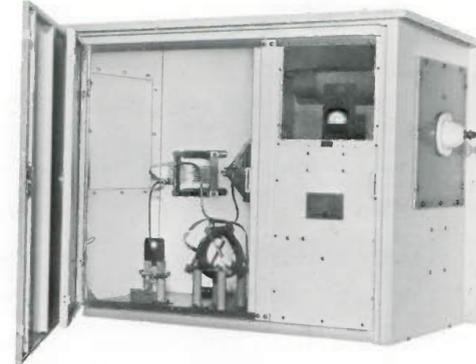
A close look at Harris' phasor construction reveals many important features that add not only to the reliability, but to the convenience of setup and maintenance.



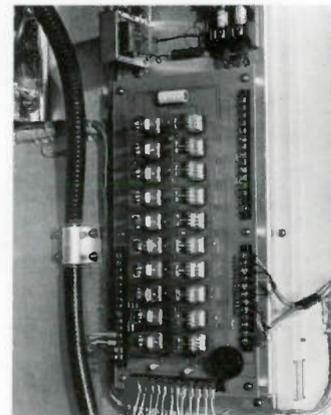
A simple, yet modern control logic board provides several key features for stations with multiple antenna modes.

The optional custom phasor cabinet shown here includes hinged front panels for common point meter access.

Harris has been manufacturing custom medium wave antenna networks for over 25 years. This experience and outstanding craftsmanship guarantees many years of reliable service.

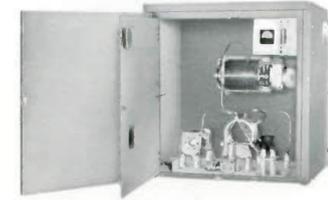


Antenna Coupling Unit networks can be housed in rugged all aluminum weatherproof enclosures as shown, or on flat aluminum panels for mounting in existing tower buildings.



# AM ANTENNA COUPLERS AND ACCESSORIES

## WEATHERPROOF 5-10 KW ANTENNA COUPLING UNITS



Housed in aluminum cabinet with double front doors. Large coils combined with capacitors of generous voltage and current ratings to assure a lifetime of service under extreme heat or cold. A large antenna lead in bowl is provided. Mounting is with metal flanges on the back of the tuning unit for attachment to wooden poles set in ground or for mounting on wall.

### SPECIFICATIONS

**CARRIER POWER:** 5,000 watts or 10,000 watts AM, as ordered.  
**FREQUENCY:** 525-1,700 kHz as ordered.  
**LINE IMPEDANCE:** 50 ohms  
**TO MATCH:** Series fed tower of from 70° to 100° electrical length.  
**CIRCUIT:** Full Tee Network.  
**WEIGHT:** Approximately 200 lbs.  
**SIZE:** 38" high, 37" wide, 21½" deep.

### ORDERING INFORMATION

Antenna Coupling Unit, 5 kW ... 994-5309-001  
 Antenna Coupling Unit, 10 kW ... 994-5309-002  
**NOTE:** When ordering, state carrier frequency, transmission line impedance, power, tower height and tower measurements, if known. Couplers to match unusual loads such as short or tall towers, shunt feed, etc., are available on special order, at extra cost.

## RF ANTENNA METERS

Internal thermocouple standard scale. Weston Model 308, three-inch square case. Other ranges not listed below are available with many carried in stock. Also expanded scale meters in inventory.

### ORDERING INFORMATION

Meter, 0-3 R.F. amperes ... 634-0206-000  
 Meter, 0-6 R.F. amperes ... 634-0238-000  
 Meter, 0-8 R.F. amperes ... 634-0209-000  
 Meter, 0-10 R.F. amperes ... 634-0210-000

## TEST JACKS



Harris manufactures both a medium power and high power RF test jack for use in several medium wave antenna network applications. The medium power test jack (shown at left) is rated for 35 amperes while the high power version (shown at right) is rated for 100 amperes. These units are constructed to assure maintenance free operation.

### ORDERING INFORMATION

Medium Power Test Jack ... 994-3280-002  
 High Power Test Jack ... 994-3280-003

## METER SHORTING SWITCH

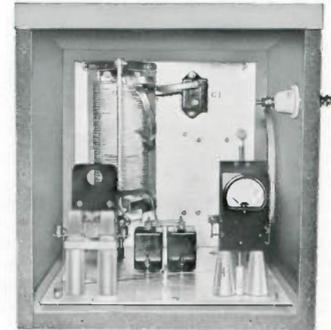


A heavy duty, make-before-break meter shorting switch of the plunger or push type. Heavy bronze tempered spring grips on both sides assure accuracy and durability.

### ORDERING INFORMATION

Meter Shorting Switch, rating 15 amperes ... 994-3493-001  
 Meter Shorting Switch, rating 40 amperes (shown above) ... 994-6527-001

## WEATHERPROOF SERIES—FED ANTENNA COUPLER, 1250 WATTS



Recommended for broadcast transmitter powers of 1,000, 500 and 250 watts, 100% modulated. Heavy edgewound coil has generous inductance for a Tee network along with fixed mica capacitors supplied. Extra room is provided to install either diode or thermocouple remote metering equipment. Heavy duty meter shorting switch eliminates antenna meter from the circuit when not in use for lightning protection. Meter is observed through plexiglass porthole. Front door of cabinet has been removed for illustrative purposes.

### SPECIFICATIONS

**CARRIER POWER:** Up to 1250 watts AM.  
**FREQUENCY:** 525-1700 kHz as ordered.  
**LINE IMPEDANCE:** 50 ohms.  
**TO MATCH:** Series-fed tower of from 70° to 100° electrical length.  
**CIRCUIT:** Full Tee Network.  
**WEIGHT:** 98 lbs.  
**SIZE:** 20" high, 20¼" wide, 18¾" deep.

### ORDERING INFORMATION

Antenna Coupler with antenna meter ... 994-3494-001  
**NOTE:** When ordering, state transmission line impedance, frequency, tower height, and tower measurements, if known. Couplers to match unusual loads such as short or tall towers, shunt feed, etc., are available on special order at extra cost.

PLACE  
STAMP  
HERE

**A SUCCESS STORY**

# **Bringing Back AM Listeners**

**HARRIS CORPORATION**  
Broadcast Division  
P. O. Box 9601  
Mission Hill, California 91346-9601

 **HARRIS**  
Broadcast Division, P. O. Box 4290  
Quincy, IL 62305-4290

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**A SUCCESS STORY**

# **Bringing Back AM Listeners**

**A SUCCESS STORY**

# **Bringing Back AM Listeners**



 **HARRIS**

**"Within our service area, it would be hard to convince me that AM radio is losing listeners to FM. Our increasing community involvement and recent investment to improve our signal has paid off with more listeners and, most importantly, increased ad revenue."**

**Steven Brock**  
President and General Manager  
KNCO Grass Valley, California

At a time when some AM stations are bemoaning a loss of listeners to FM, KNCO, which serves Grass Valley and surrounding communities in Nevada County, California, offers a refreshingly simple formula for success—"All the best".

Since its 1978 sign-on as a 500 watt directional daytimer on 1250 kHz, KNCO has focused on providing first-rate local and regional programming, and has demonstrated a deep commitment to community service.

Today, with the installation of a Harris SX-5A 5 kW SoundStar™ transmitter, the station has a quality signal to match its programming.

It wasn't always that way.

Early in its operation, KNCO's signal stopped just three miles south of Grass Valley. With more than 30 percent of the town's 7,500 residents commuting south on Highway 49 to and from Sacramento

60 to 90 minutes away, the signal limited the number of listeners who could be reached and cultivated.

The situation was somewhat improved in 1982 when KNCO was granted a Class A FM license and began simulcasting with AM. A Harris all solid-state FM-300K, 300 watt transmitter provided excellent coverage. Yet while simulcasting did provide further signal reach, some holes in FM coverage existed as a result of the natural "shadowing" effect of the mountainous terrain.

During 1982, a regional 830 kHz frequency became available. KNCO applied for and received a 5 kW non-directional day and 1 kW directional night permit.

When the time came to select a 5 kW transmitter, KNCO did its homework. An operating cost comparison on various models gave Harris the edge.

"Power costs are high in our area, and

kilowatts count," Brock says. "The more efficient solid state designs showed considerable power cost savings over tube transmitters."

After narrowing the selection to two solid state units, KNCO chose Harris. "We selected Harris for technical performance and because of its total service reputation," Brock says.

Since switching to its new frequency and power level in November 1985, KNCO has experienced fantastic results. "We're now a full regional station with an excellent signal and sound quality," Brock says.

"Our sales staff is getting the most out of our new coverage and sponsorship potential, and our improved AM coverage has allowed us to separate FM and offer alternate programming."

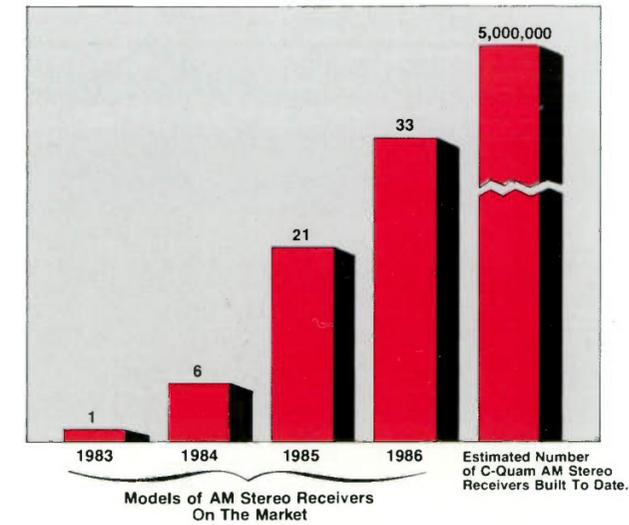
"Losing AM listeners?" Brock queries. "We never lost them to begin with. We only attracted more."

## Bringing Back AM Listeners...

Harris SoundStar™ or PowerStar™ AM transmitters are going to help you bring back AM listeners. Here's why:

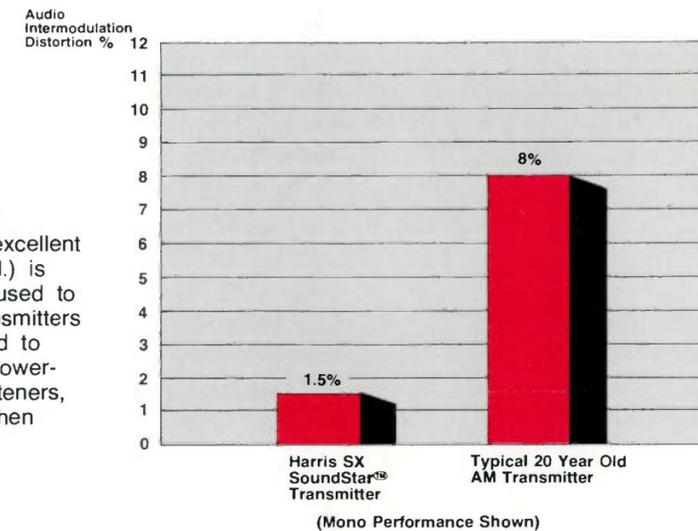
### AM Stereo Now!

AM stereo is part of the total solution to bring back AM listeners. Availability and quality of AM stereo receivers have grown dramatically in recent years. In fact, Chrysler now includes AM stereo with every FM stereo receiver ordered.



### Compare Audio Performance

Listeners do differentiate between fair and excellent audio quality. Intermodulation distortion (I.M.) is an overall quality benchmark that can be used to judge audio quality. Twenty-year-old AM transmitters offer only fair audio performance, compared to current generation Harris SoundStar™ or PowerStar™ AM transmitters. Along with your listeners, you'll notice a dramatic audio difference when you put a Harris AM transmitter to work!

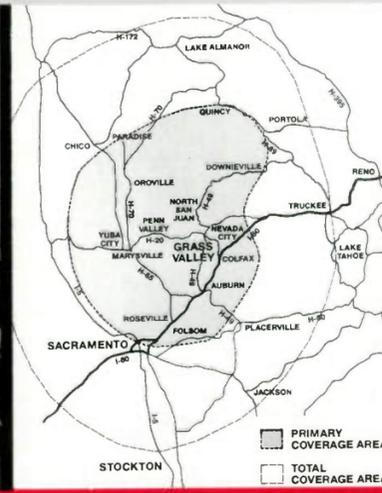


### Fits Within Your Budget

Bringing back AM listeners is going to require an investment from all of us in the industry. Harris is doing its part by arranging special leasing packages that will make a Harris SoundStar™ or PowerStar™ AM transmitter and equipment package fit within your monthly budget.



The above Lease America monthly rates are based on typical equipment packages recently sold by Harris. These rates are based on a 60-month plan and subject to change. Rates reflect first and last payments in advance. Investment tax credit passed to lessee. The equipment may be purchased for Fair Market Value at the end of the lease. The buyout will fall between 8% and 12%. Proper credit information must be forwarded to Lease America, and upon approval, proper documentation must be signed.



I'd like to learn more about Harris SoundStar™ and PowerStar™ AM transmitters!

Power Level Required (Please Circle):  
 1 kW    2.5 kW    5 kW    10 kW    50 kW    Other

NAME \_\_\_\_\_ TITLE \_\_\_\_\_  
 STATION \_\_\_\_\_ ADDRESS \_\_\_\_\_  
 CITY \_\_\_\_\_ STATE \_\_\_\_\_ ZIP \_\_\_\_\_  
 PHONE \_\_\_\_\_

Best Time To Phone (Please Circle):  
 M    T    W    TH    F    AM    PM

Please detach this card and return it or call 1-800-4-HARRIS, Extension 3000.

**YES!**  
**I'M REALLY INTERESTED...**  
 ...in learning more about Harris' SoundStar™ and PowerStar™ AM transmitters.

# HARRIS DX-50

## 50 kW DIGITAL SOLID-STATE AM TRANSMITTER

Your new Harris DX-50 will give you:

- 85% typical overall AC to RF operating efficiency for economical on-air operation and reduced power costs
- FM-like sound with superb signal transparency — virtually no audio overshoot, tilt or ringing
- Rugged engineering for real-world broadcasting — extensive status information, output tuning, modularity
- Exclusive Harris FlexPatch™ maintains full-performance on-air operation in emergencies
- High average modulation capability. In fact, you can modulate continuously with 100% sine wave tone modulation
- High peak modulation capability of +145% at 50 kW

The Harris DX-50 combines two leading technologies — digital and solid-state — to give you a level of reliability, performance, and efficiency that is unsurpassed in any 50 kW AM transmitter.

At the heart of the DX-50 is Harris' patented digital modulator. The modulator utilizes the 128 identical output RF power amplifiers. Each amplifier is individually controlled by low level DC voltages. Class D operation yields typical PA efficiency of 90 percent.

Harris' digital modulator applies audio to an ultra-fast analog-to-digital (A/D) converter. Digitized audio and a carrier level control signal are applied to the modulation encoder which provides control to each power amplifier. Power amplifiers are turned on and off according to the audio input signal and carrier level requirements. Their output is totaled in a master RF combiner.

The result is typical overall efficiency of 85% for dramatic reductions in power costs, and new levels of AM transmission quality. Total harmonic distortion at 50 kW is typically 1% or less at 95% modulation from 30 Hz to 10 kHz. Also, SMPTE 1:1 intermodulation distortion is typically .8% or less at 50 kW, 95% modulation; and 4:1 intermodulation distortion is typically 1.3% or less at 50 kW, 95% modulation. Because Harris has paid critical attention to circuitry affecting stereo performance, incidental quadrature modulation typically is -35dB.

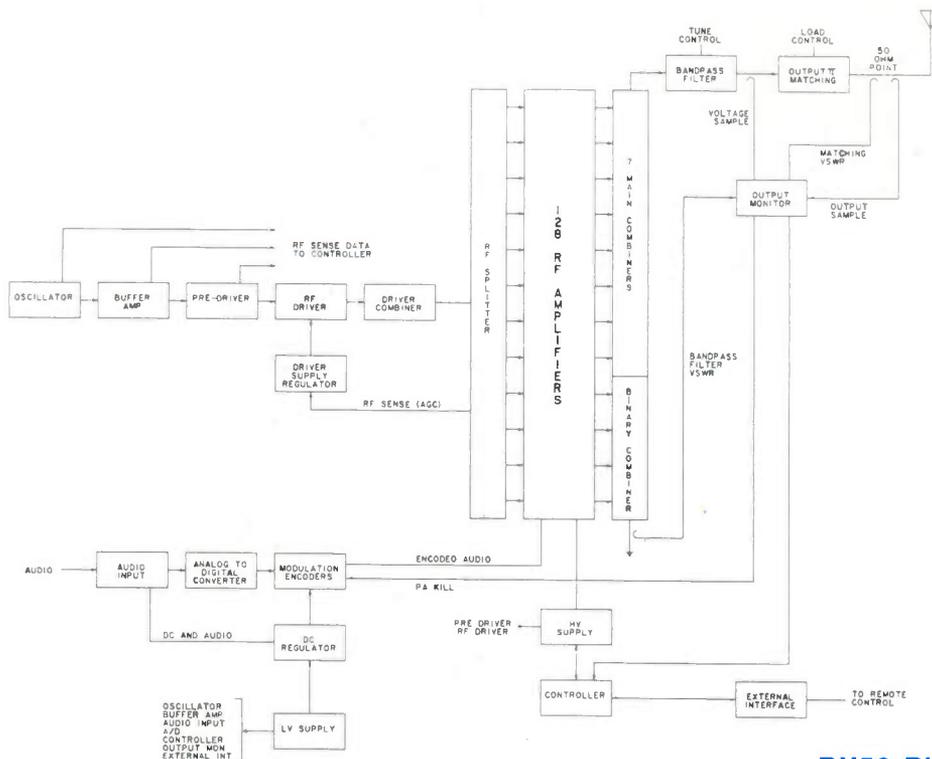


Confident on-air operation is ensured with another Harris exclusive, FlexPatch™. This feature provides for continued full performance operation with only slight peak power capability reduction should a power amplifier module fail. FlexPatch simply substitutes one of the high peak capability (145%) modules for a lower step number. For example, PA amplifier number 123 can substitute for any lower PA amplifier number while the DX-50 remains on the air. It's like having built-in spare PA modules.

The Harris DX-50 is ruggedly engineered to provide for easy system interface, service and maintenance. The DX-50 provides:

- An easily accessible remote control interface panel.
- Standard output tuning and loading controls to assure maximum performance into real-world loads.
- Harris' ColorStat™, a front-panel signal flow diagram using 28 separate LEDs to continuously monitor key operating stages.
- Modular construction with plug-in RF power amplifiers which are interchangeable and can easily be removed for service.





**DX50 BLOCK DIAGRAM**

## HARRIS DX-50 SPECIFICATIONS

<b>Type of Modulation:</b>	Harris patented AM digital modulation.	<b>Altitude:</b>	Up to 13,000 ft.
<b>Output Power:</b>	10 kW to 60 kW (adjustable). Three customer preset power levels are provided. Transmitter is capable of combined operation.	<b>Humidity Range:</b>	0 to 95%, non-condensing.
<b>Frequency Range:</b>	531 kHz to 1620 kHz (one frequency per customer order).	<b>Cabinet Radiation:</b>	Meets FCC, DOC, and CCIR requirements.
<b>High Voltage Supply Input:</b>	Any voltage between 363 and 502 VAC 3 phase 50/60 Hz 3 wire.	<b>RF Load:</b>	50 ohms nominal. Front panel tune and load adjustments. Antenna matching range 1.2:1 VSWR minimum.
<b>Control Voltage Supply Input:</b>	190 to 260 VAC single phase, 1 kVA, 50/60 Hz. Optional 480/240 VAC step down transformer available.	<b>Audio Frequency Response:</b>	+0.1 dB, -0.9 dB, 30 Hz to 10 kHz. 1 kHz Ref.
<b>Power Supply Variation:</b>	±5% voltage, ±5% frequency.	<b>Total Harmonic Distortion:</b>	1% or less THD at 95% modulation, 30 Hz to 10 kHz (10-50 kW). <sup>1</sup>
<b>Transient Protection:</b>	MOV's on all AC input lines.	<b>Intermodulation Distortion:</b>	0.8% or less 1:1 60/7000 Hz; 1.3% or less 4:1, 60/7000 Hz; SMPTE at 50 kW, at 95% modulation. <sup>1</sup>
<b>Power Factor:</b>	.98 typical.	<b>TIM:</b>	1% at 95% modulation. <sup>1</sup>
<b>Frequency Stability:</b>	±10 Hz, 0 to 50° C, ±2 Hz at typical conditions.	<b>Square-Wave Overshoot:</b>	1% or less at 400 Hz, 80% modulation (no filter).
<b>Audio Input:</b>	-10 to +10 dBm, adjustable transformerless input. 600, 150, and 50 ohm terminations provided.	<b>Square-Wave Tilt:</b>	2% or less at 40 Hz 80% modulation.
<b>RF Output:</b>	3-1/8 EIA flange (female).	<b>Carrier Shift:</b>	Less than 1%.
<b>RF Monitor Provisions:</b>	Up to 10V RMS RF modulated output sample (constant sample level over 6/1 power range). 5V RMS RF frequency monitor sample.	<b>Hum and Noise:</b>	-65 dB or better below 100% modulation (unweighted). <sup>2</sup>
<b>Power Consumption:</b>	59 kW or less (typical) at 50 kW, 0% modulation, 88 kW or less (typical) at 50 kW, 100% tone modulation.	<b>IQM:</b>	-35 dB at 1 kHz, 95% modulation.
<b>Overall Efficiency:</b>	83% or better. Typically 85% at 50 kW.	<b>Positive Peak Capability:</b>	+145% at 50 kW, +135% at 55 kW, 125% at 60 kW (pgm mod).
<b>Harmonic/Spurious Radiation:</b>	Meets FCC, DOC and CCIR requirements.	<b>Size:</b>	Unpacked: 78" H, 120" W, 33" D; Packed (three pieces): PA Cabinet: 81" L, 46" W, 85" H; output cabinet: 57" L, 41" W, 85" H; step-start assembly: 48" L, 36" W, 17" H. (3)
<b>Ambient Temperature:</b>	0° C to +50° C (derate 2° C/1000 ft. of altitude).	<b>Weight:</b>	Unpacked: 3770 lbs. (1710 kg.); Packed: 4670 lbs. (2123 kg.)

NOTES: 1. If transmitter is operated into a bandwidth limited antenna system, distortion at the higher modulation frequencies may degrade. 2. Noise may degrade if AC main lines are unbalanced. 3. Allow 81 3/16" H to accommodate for crossover bar on top of PA cabinet. Size of crossover bar is 3 3/16" H, 25 1/2" L, 3 5/8" W.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

**HARRIS CORPORATION** BROADCAST DIVISION  
P.O. BOX 4290, QUINCY, ILLINOIS 62305-4290 U.S.A. 217/222-8200





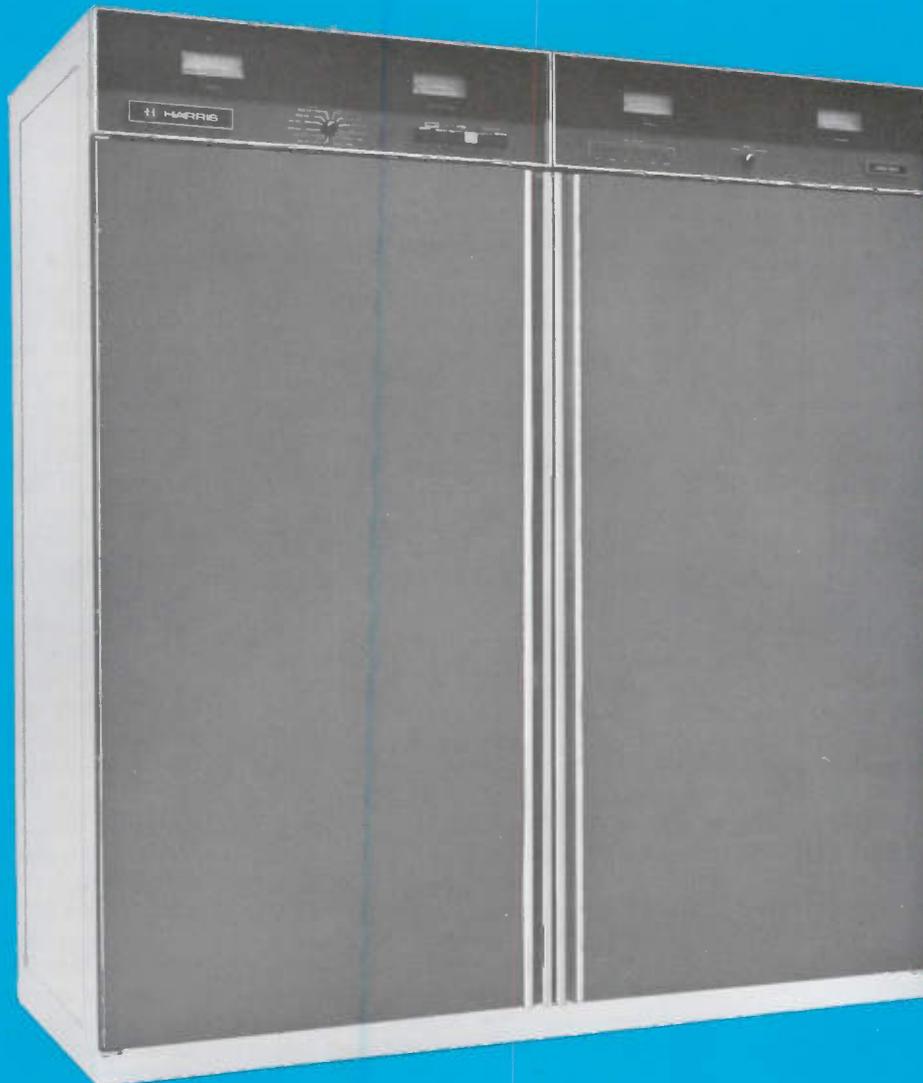
**HARRIS**  
COMMUNICATIONS AND  
INFORMATION HANDLING

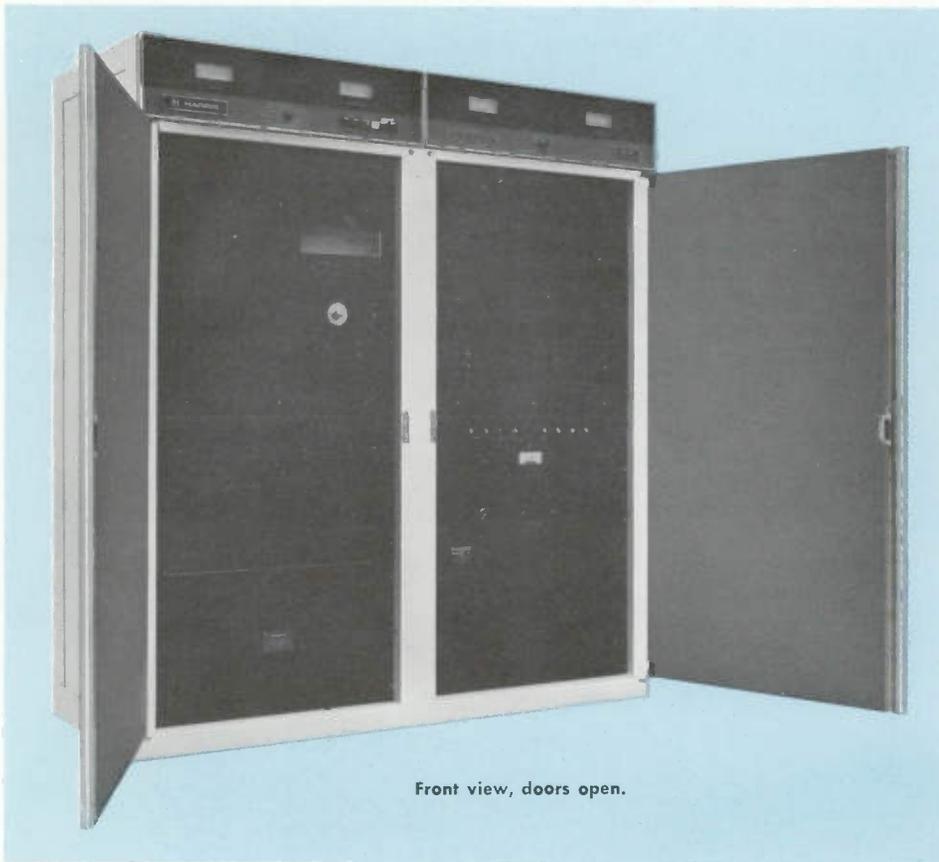
## MW-5A

5000 Watt  
Medium Wave  
Broadcast  
Transmitter

- High level plate modulation, using a Pulse Duration Modulator (PDM)\*
- Built-in audio processing circuit allows greater modulation density
- High overall efficiency—low power consumption
- 125% positive peak modulation capability at 5600 watts
- Excellent accessibility to all components
- Extremely quiet air-cooled operation, using a low-speed blower
- No modulation transformer or reactor
- Automatic return to full power after power failure
- All remote control accessories built in
- Power level is adjusted in low level PDM stage. No PA loading adjustment required

\*Patented





Front view, doors open.

Similar in design to its big brother, Harris' 50,000-watt MW-50A, the MW-5A provides an overall performance superior to other AM broadcast transmitters in the 5-kilowatt power range—at an unusually low operating cost. The MW-5A uses Harris' patented Pulse Duration Modulator (PDM) to obtain conventional high level plate modulation, and a built-in audio processing circuit to allow greater modulation density. Designed to handle the highly processed audio used in today's competitive market, the MW-5A provides low distortion, excellent transient response, wide frequency response, and high positive peak capability for the loudest, cleanest possible signal.

**HIGH EFFICIENCY—EXCEEDS 52%.** The Pulse Duration Modulator employed in the MW-5A is nearly 90% efficient (instead of the usual 50% or 60%), enabling the transmitter to achieve an unusually high overall efficiency of greater than 52%. This means less power consumption than other 5-kilowatt AM transmitters.

**125% POSITIVE PEAK MODULATION CAPABILITY.** The MW-5A is capable of providing the maximum positive modulation peaks allowed by the FCC (125%), with reserve for great reliability. This can mean higher average modulation levels for louder, clearer signals, with no increase in transmitter carrier power and no increase in distortion. A wide frequency range is possible, as large reactive components are not used in the modulation system.

**AUDIO PROCESSING.** In the MW-5A, an adjustable audio processing circuit is built in. This circuit is designed to reduce the small modulation peaks, which have little power and are holding the average level down, and allow the larger and more powerful levels of the audio signal to modulate the transmitter at the maximum limit. Front panel controls include separate adjustments for both positive and negative peaks; a pushbutton for disabling and calibrating; and one pushbutton each to increase loudness by 1, 2 or 3 dB.

**ONLY TWO TUBES.** The entire transmitter employs just two tubes—a 3CX2500F3 PA and a 4CX3000A modulator—both operating well below manufacturer's dissipation ratings. All power supplies use long-life solid-state silicon rectifiers. Highest quality components, conservatively rated, are used throughout the MW-5A to assure a maximum degree of reliability.

**MAXIMUM CARRIER POWER 5600 WATTS.** The Harris MW-5A provides a maximum carrier power of 5600 watts, which allows more reserve for driving directional arrays. The transmitter uses DC feedback for power output stability, which insures a minimum of RF power output change with a change of the power line voltage. This is especially important where brownouts occur, and where transmitters are only logged every three hours. The MW-5A provides for easy power reduction to one kilowatt—and power may be switched from high to low

with carrier on. The PA utilizes 3rd harmonic wave shaping for improved efficiency.

**EASY TUNING.** Tuning is similar to that for a conventional Class C amplifier. Just peak the "relative efficiency" meter on the front panel, using the grid and plate efficiency resonator controls, for proper tuning and maximum efficiency.

**EASY ACCESSIBILITY.** Accessibility is quick and easy to all components—front, rear, inside and out. For instance, the oscillator, RF driver, PDM exciter and audio driver are all immediately available through swing down front panels. The two low voltage power supplies may be lifted out by removing four screws and a few wires. Front and rear doors remove in an instant for ease of maintenance.

The entire control circuit panel swings out, allowing relays to be easily cleaned. And meter panels lift up for quick access. Fault indicating devices and a spacious overall transmitter layout will also help the engineer isolate and repair problems in a minimum time.

**RF SECTION.** The RF chain consists of two switchable crystals and oscillators, a buffer, divider, RF amplifier, IPA, RF driver, and PA. Only 15 transistors are used in the entire RF chain.

The crystals and oscillators, buffer, divider and RF amplifier are located on one printed circuit board. The divider is a single IC which is socket mounted for easy replacement. Indicating lamps on the PC board show if voltage is available and if RF is being generated.

The IPA and RF driver are on a swing-down chassis, and consist of five identical Class D, push-pull amplifier modules. One module is used in the IPA and four modules are used in the RF driver. The four RF driver modules are connected so that if one should fail, the remaining three will provide adequate drive to keep the transmitter on the air at full power. Fault lamps indicate which one of the modules failed.

The PA is a standard Class C amplifier and the output network is a conventional Pi/L.

**PROTECTIVE CIRCUITS.** All major components of the MW-5A are protected by circuit breakers, which are easily resettable from the front panel.

Protection against voltage standing wave ratios of greater than 1.2 to 1.0 is provided. Both forward and reflected power are metered at the front panel.

In case of momentary RF overloads, the MW-5A will recycle automatically. Should a repeated overload occur within a thirty-second period, the transmitter will remain off until manually reset. However, if the time between overloads is greater than thirty seconds, continuous recycling will occur.

Five resettable status/overload indicators are located on the meter panel. Remote readout and reset of these indicators are also provided to help the engineer determine if a trip to the transmitter site is required when the transmitter has recycled. For example, VSWR recycles (as determined at the remote control point) may be caused by lightning or icing of the transmission line. A switch to low power may be all that is necessary, and can be accomplished by remote control.

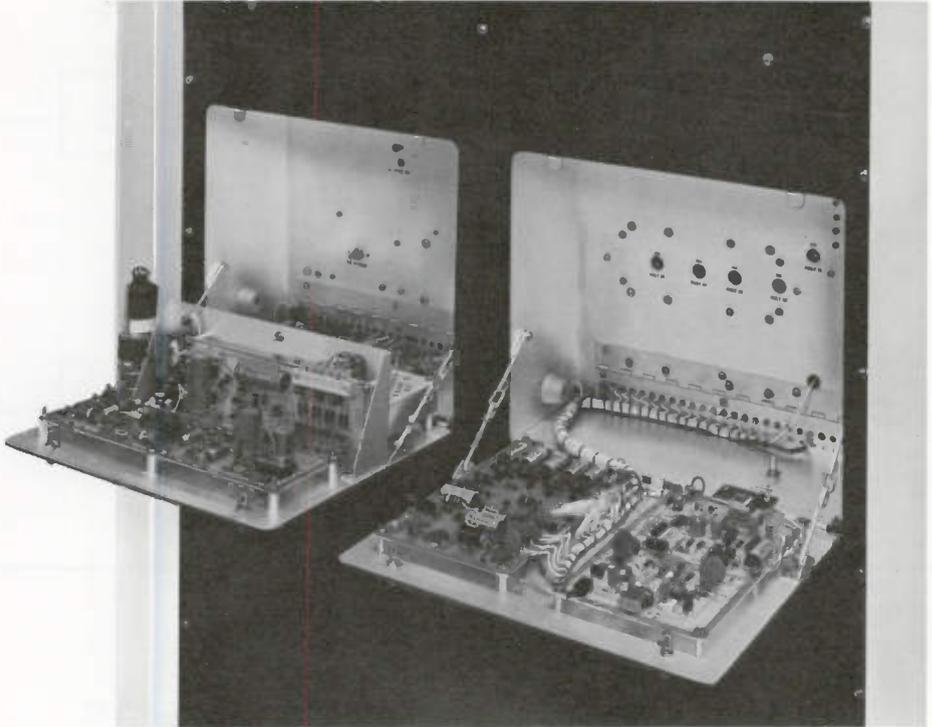
**QUIET AIR COOLING.** A standard one-half horsepower, single phase motor is used on a quiet, low-speed, belt-driven blower. Provisions are made on the top of the transmitter for ducting the exhaust air to the outside of the transmitter building.

**GENERAL.** An ovenless crystal oscillator is used in the MW-5A, allowing all voltages to be removed from the transmitter during maintenance periods or power failures without having an off-frequency condition, due to a cold crystal, when the power is restored.

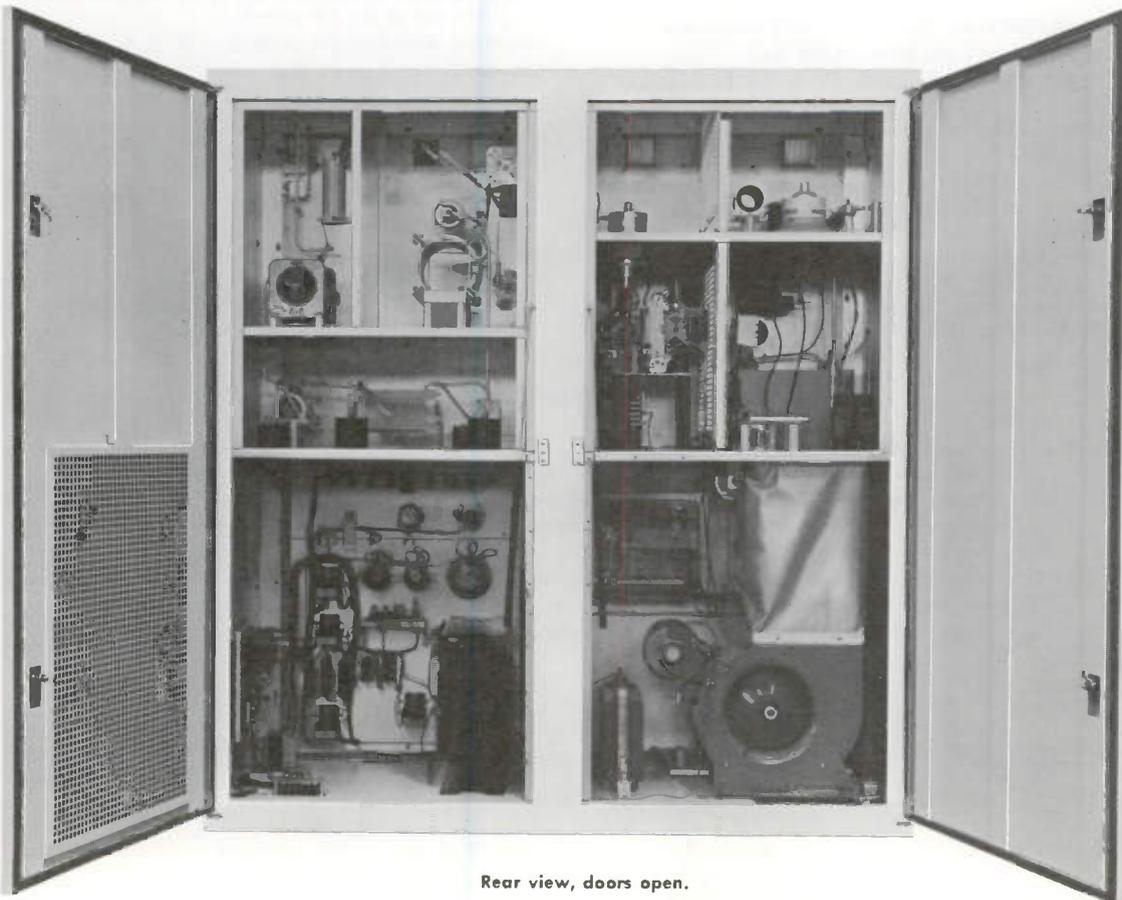
Lighted front panel pushbuttons indicate operation and power mode of the transmitter.

Operation of the MW-5A at 10,000 feet is certified by a recognized testing organization.

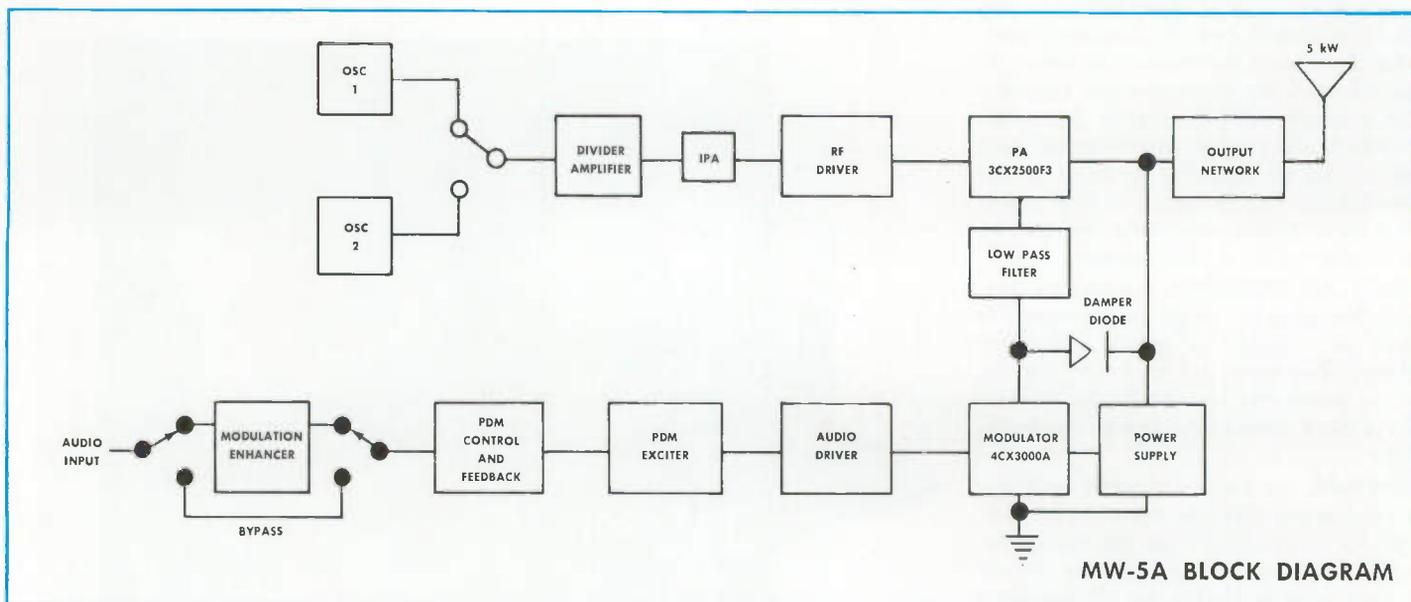
**TRANSMITTER LAYOUT.** The MW-5A is completely self-contained in one cabinet —there are no external components.



PDM and RF Driver Chassis swing down for easy access.



Rear view, doors open.



## MW-5A SPECIFICATIONS

**POWER OUTPUT:** (Rated) 5000 watts. (Capable) 5600 watts. Type accepted at 5000, 2500, and 1000 watts. High and low power modes can be set between 1000 and 5600 watts.

**RF FREQUENCY RANGE:** 535 kHz to 1620 kHz. Supplied to one frequency as ordered.

**RF OUTPUT IMPEDANCE:** 50 ohms, unbalanced. 40 to 250 ohms available on special order.

**CARRIER AMPLITUDE REGULATION:** Less than 2% at 100% modulation.

**AUDIO FREQUENCY RESPONSE:**  $\pm 1$  dB, 20 to 10,000 Hz.

**AUDIO FREQUENCY DISTORTION (Unenhanced):** 2% or less 20 to 10,000 Hz at 95% modulation.

**COMPRESSION RATIO:** 4/1 dB at 3 dB of enhancement; -95%, +125% modulation.

**NOISE (Unweighted):** 60 dB or better below 100% modulation.

**AUDIO INPUT:** 600 ohms at +10 dBm,  $\pm 2$  dB, unenhanced; +16 dBm with enhancement activated.

**POWER INPUT:** 208/230 volts, 3 phase, 60 Hz and 208/230/380 volts, 3 phase, 50 Hz.

**POWER CONSUMPTION:** 9.5 kW at 0% modulation; 10.0 kW at 40% modulation; 13.0 kW at 100% modulation.

**PLATE EFFICIENCY:** 90% or better.

**OVERALL EFFICIENCY:** Better than 52%.

**POWER FACTOR:** 95%.

**RF HARMONICS:** Meets or exceeds FCC specifications.

**SPURIOUS OUTPUT:** 80 dB or more below 5 kW output.

**POSITIVE PEAK CAPABILITY:** 125% positive peak modulation capability at 5 kW and at 5.6 kW output.

**AMBIENT TEMPERATURE RANGE:**  $-20^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$ .

**ALTITUDE:** Sea level to 3048 meters (10,000 feet).

**SIZE:** 78"H x 72"W x 32"D. (198.12cm x 182.88cm x 81.28cm.)

**WEIGHT:** Unpacked, 1200 lbs. (567 kg) — approximate. Domestic packed, 1600 lbs. (726 kg) — approximate. Export packed, 1850 lbs. (840 kg) — approximate.

**CUBAGE:** 120 cubic feet packed. (3.4 cubic meters.)

**FINISH:** Blue and white.

**TUBES USED:** (1) 3CX2500F3 and (1) 4CX3000A.

**MONITOR PROVISIONS:** 10 RF volts output at 50/70 ohms for frequency monitor. 10 RF volts output at 50/70 ohms for modulation monitor.

**REMOTE CONTROL:** Normal interface.

## ORDERING INFORMATION

MW-5A Transmitter with one set of tubes and two crystals, for 208/230 volts, 3 phase, 60 Hz operation. [Specify high and low power desired]	994-7965-001
MW-5A Transmitter with one set of tubes and two crystals, for 208/230/380 volts, 3 phase, 50 Hz operation. [Specify high and low power desired]	994-7965-003
100% set spare tubes for MW-5A	990-0764-001
100% set spare transistors for MW-5A (diodes not included)	990-0765-001
100% set spare diodes (includes HV rectifiers, but no transistors)	990-7067-001
Low voltage and filament regulator, and line regulator for MW-5A available.	

**HARRIS CORPORATION** Broadcast Products Division  
P. O. Box 290, Quincy, Illinois 62301 U.S.A.



**HARRIS**  
COMMUNICATIONS AND  
INFORMATION HANDLING

## MW-1A

### 1000 Watt Medium Wave Broadcast Transmitter



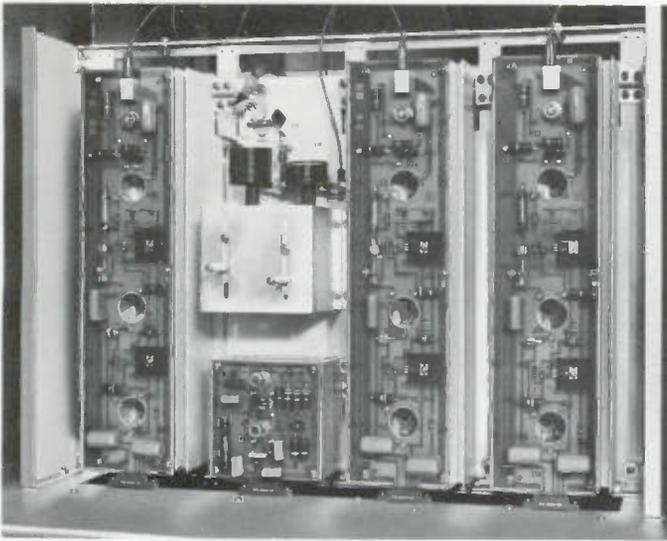
- 100% solid-state, including PA and modulator
- High level modulation, using a Progressive Series Modulator [PSM]
- Built-in audio processing circuit allows greater modulation density
- 125% positive peak modulation capability at 1100 watts
- Redundant power amplifier and modulator
- Automatic return to air after power failure
- DC feedback and voltage regulator are standard
- Carrier-on switching from high-to-low or low-to-high power, with no loss of programming
- No modulation transformer, modulation reactor or filter inductor
- Excellent transient response
- All remote control accessories built in
- VSWR protection
- Extensive use of plug-in modules for easy maintenance
- High overall efficiency—low power consumption
- Status/overload indicators on front meter panel with remote readout and reset built in
- Instant "on"—no warmup time
- Resettable front panel circuit breakers to protect all power supplies
- Power level is adjusted in low level PSM stage. No PA loading adjustment is required

\*Patented

Harris' MW-1A is the most advanced one-kilowatt AM (medium wave) transmitter on the market today, offering such state-of-the-art features as total solid-state design, Progressive Series Modulator, and a built-in audio processing circuit to increase your modulation density. Designed to handle the highly processed audio used in today's competitive market, the MW-1A provides low distortion, excellent transient response, wide frequency response, and 125% positive peak capability for the loudest, cleanest signal available in this power range.

**100% SOLID-STATE.** Twelve transistorized power amplifier modules (which include modulators) are operated in parallel to provide 1100 watts output at 125% modulation. Failure of one module will not affect the transmitter's rated performance. Even in the unlikely event that several modules should fail, the transmitter still stays on the air, although at a reduced power level. All other active devices in the MW-1A are also solid state.

**POWER AMPLIFIER.** The PA of each module consists of two transistors operating Class D push-pull (square wave switching mode). This method allows a typical efficiency of 85%



From left to right: one of the PA/Modulator modules, IPA module, RF Driver module, and another PA/Modulator module—all easily accessible from the front of the transmitter.

without the use of special shaping circuits used in tube designs. Each of the twelve PA modules is capable of at least 100 watts carrier and 500 watts peak, to provide full carrier power and modulation capability even with the failure of one modulator or PA.

**PROGRESSIVE SERIES MODULATOR.** The modulator used in the MW-1A is a simple series regulator, connected in such a way as to provide efficient high level modulation without the use of a modulation transformer, modulation reactor, power supply choke or 70 kHz filter. This eliminates components which have limited transmitter performance in the past. Control of the transmitter power over a wide range is accomplished in a low-level stage of the modulator by means of a convenient front panel vernier control. No adjustment is necessary in any high power RF circuit, including the loading coil.

**125% POSITIVE PEAK MODULATION CAPABILITY.** The MW-1A is capable of providing the maximum positive modulation peaks allowed by the FCC (125%). This can mean higher average modulation levels for louder, clearer signals, with no increase in transmitter carrier power and no increase in distortion.

**AUDIO PROCESSING.** In the MW-1A, an adjustable audio processing circuit is built-in. This circuit is designed to reduce the small modulation peaks, which have little power and are holding the average level down, and allow the larger and more powerful levels of the audio signal to modulate the transmitter at the maximum limit. Front panel controls include separate adjustments for both positive and negative peaks; a pushbutton for disabling and calibrating; and one pushbutton each to increase loudness by 1, 2 or 3 dB.

**EASY TUNING.** Tuning is as easy as that of a conventional Class C amplifier. Just dip the PA voltage, and load for the proper current. No grid or plate efficiency resonators are required for maximum efficiency.

**MAXIMUM CARRIER POWER 1100 WATTS.** The Harris MW-1A provides a maximum carrier power of 1100 watts, which allows more reserve for driving directional antenna arrays. The transmitter uses DC feedback and a power supply regulator for power output stability, which insures a minimum of RF power output change with a change of the power line voltage. This is especially important where brownouts occur,

and where transmitters are only logged every three hours. The MW-1A provides for easy power reduction to 500 or 250 watts—and power may be switched with carrier and program on!

**EASY ACCESSIBILITY.** Accessibility to all components is quick and easy through front and rear of transmitter. The following modules are plug-in design for easy maintenance: PA/modulator (12 modules), RF driver (identical to PA/modulator modules), IPA, oscillator, audio driver, and audio input and overload. The two low voltage power supplies may be lifted out by removing four screws and a few wires. Front and rear doors remove in an instant. The entire control circuit panel swings out allowing relays to be easily cleaned. And meter panels lift up for quick access.

Fault indicating devices and a spacious overall transmitter layout will also help the engineer isolate and repair problems in a minimum time.

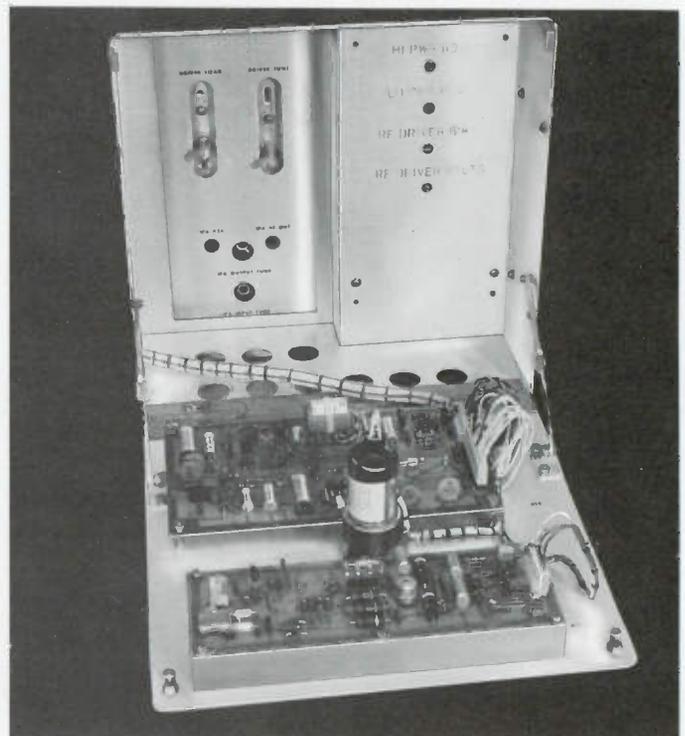
**RF SECTION.** The RF chain consists of a crystal oscillator, divider, amplifier plug-in module, a plug-in IPA module, a plug-in RF driver module and 12 plug-in PA/modulator modules. Fault indicator lamps are located on the oscillator, IPA, and audio input and overload. Fault indicator lamps for the 12 PA modules are located at eye level on the front panel of the MW-1A for easy visual trouble-shooting.

The RF driver module is identical to the PA modules for redundancy. Should the driver fail, a PA module can be placed in the RF driver location, and the PA allowed to operate with one module short while the failed module is repaired at the engineer's convenience.

The oscillator module is located on a swing-down chassis for easy access.

**PROTECTIVE CIRCUITS.** The two power supplies of the MW-1A are protected by circuit breakers, which are easily reset from the front panel.

Protection against voltage standing wave ratios of greater



Oscillator and audio input/overload modules, and the remote power control are located on a swing-down panel on the front of the transmitter.

than 1.2 to 1.0 is provided. Both forward and reflected power are metered at the front panel.

In case of an overvoltage condition, the MW-1A will recycle automatically. Should a repeated overload occur within a thirty-second period, the transmitter will remain off until manually reset. However, if the time between overloads is greater than thirty seconds, continuous recycling will occur. VSWR overload will recycle continuously.

Resettable status/overload indicators are located on the meter panel. Remote readout and reset of these indicators are also provided to help the engineer determine if a trip to the transmitter site is required when the transmitter has recycled. For example, VSWR recycles (as determined at the remote control point) may be caused by lightning or icing of the transmission line. A switch to low power may be all that is necessary, and can be accomplished by remote control. Advanced circuit design provides lightning protection.

**QUIET AIR COOLING.** A single, small fan cools the entire transmitter. No noisy blower is required.

**BUILT-IN DUMMY LOAD.** The MW-1A may be tested at a full kilowatt output with 100% sine wave or full program modulation, using this built-in feature.

**REMOTE CONTROL.** All functions required for remote control are built in, including raise/lower power control, and PA voltage and current metering. A local/remote switch is provided on the control panel so the remote control point cannot turn the transmitter on while being operated locally. All electrical connections for remote control are brought out to a single terminal board.

**GENERAL.** Normally, no components are removed from the MW-1A for shipment—on delivery, just connect the main AC, audio input and the antenna to the transmitter, make a few adjustments and you are on the air!

An ovenless crystal oscillator is used in the MW-1A, allowing all voltages to be removed from the transmitter during maintenance periods or power failures without having an off-frequency condition, due to a cold crystal, when power is restored.

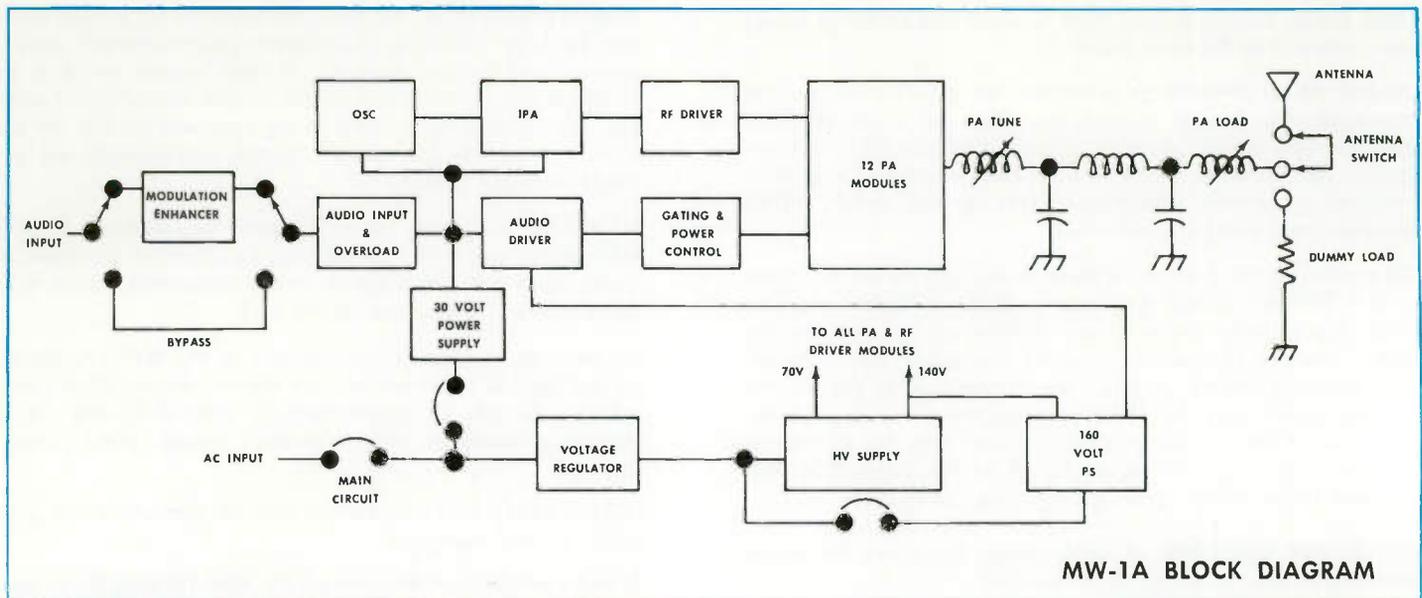
Lighted front panel pushbuttons indicate operation and power mode of the transmitter.

A large air filter at the rear of the MW-1A may be removed for cleaning while the transmitter is in operation.

The MW-1A is completely self-contained in one cabinet—there are no external components.



Front view of MW-1A, door and swing-down panel open.



**MW-1A BLOCK DIAGRAM**

## MW-1A SPECIFICATIONS

### ELECTRICAL

**POWER OUTPUT:** (Rated) 1000 watts. (Capable) 1100 watts. Power reduction to 500 watts or 250 watts.

**RF FREQUENCY RANGE:** 535 kHz to 1620 kHz. Supplied to one frequency as ordered.

**RF OUTPUT IMPEDANCE:** 50 ohms, unbalanced.

**CARRIER AMPLITUDE REGULATION:** Less than 2% at 100% modulation.

**RF HARMONICS:** Meets or exceeds FCC and CCIR specifications.

**AUDIO FREQUENCY RESPONSE:**  $\pm 1$  dB, from 20 to 10,000 Hz.

**AUDIO FREQUENCY DISTORTION (Unenhanced):** 1.5% or less at 1 kW, 20 to 10,000 Hz, 95% modulation. 2% or less at 500 and 250 watts, 20 to 10,000 Hz, 95% modulation.

**COMPRESSION RATIO:** 4/1 dB at 3 dB of enhancement; -95%, +125% modulation.

**NOISE (Unweighted):** 60 dB or better below 100% modulation.

**AUDIO INPUT:** 10 dBm,  $\pm 2$  dB, 600 ohms balanced, unenhanced; +16 dBm with enhancement activated.

**POWER INPUT:** 208-260 VAC, 50 or 60 Hz balanced or unbalanced.

**EFFICIENCY:** PA—typically 85%; overall transmitter—50% or greater.

**POWER CONSUMPTION:** 2.0 kW at 0% modulation at 1000 watts carrier. 3.0 kW at 100% modulation at 1000 watts carrier.

**SPURIOUS OUTPUT:** Meets or exceeds FCC and CCIR requirements.

**POSITIVE PEAK CAPABILITY:** 125% positive peak program modulation capability at 1.0 kW and at 1.1 kW.

**MONITOR PROVISIONS:** 10 volts RF (RMS) modulated output sample at 50 ohms and High/Low balance control.

**REMOTE CONTROL:** Self-contained interface for all standard systems.

**TYPE OF MODULATION:** Progressive Series Modulation (PSM).

**IM DISTORTION:** 2% or less 4/1 or 1/1, 60/2000 Hz or 60/7000 Hz.

### MECHANICAL

**AMBIENT TEMPERATURE RANGE:**  $-20^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$ .

**AMBIENT HUMIDITY RANGE:** 95%.

**ALTITUDE:** Sea level to 10,000 feet.

**SIZE:** 72"H x 31½"W x 31½"D. (183cm x 80cm x 80cm.)

**WEIGHT:** Unpacked, 595 lbs. (270 kg.) — approximate. Domestic packed, 785 lbs. (356 kg.) — approximate. Export packed, 895 lbs. (406 kg.) — approximate.

**CUBAGE:** 68.7 cubic feet (2 cubic meters), packed.

**FINISH:** Blue and white.

**TYPE OF ACTIVE COMPONENTS:** 100% solid state.

**POWER SUPPLY:** Self-contained, dry.

## ORDERING INFORMATION

MW-1A transmitter, complete with all solid-state devices and one crystal, single phase, 60 Hz or 50 Hz operation [specify input AC voltage]	994-7966-002
Spare PA Module	992-4201-001
Spare plug-in IPA module	992-4202-001
Spare plug-in oscillator module	992-4207-001
Spare plug-in audio driver module	992-4206-001
Spare plug-in audio input/overload module	992-4205-001
100% spare rectifier kit	990-0810-001
Recommended spare rectifier kit	990-0807-001
100% spare transistor kit	990-0811-001
Recommended spare transistor kit	990-0812-001
Spare crystal	444-xxxx-000

**HARRIS CORPORATION** Broadcast Products Division  
P. O. Box 290, Quincy, Illinois 62301 U.S.A.