HARRIS

SX-1

1000 Watt All-Solid-State Medium Wave Broadcast Transmitter

- **100% solid state for highest reliability**
- **Exceptionally high operating efficiency offers direct cost savings over other 1 kW designs**
- **Polyphase PDM* for exceptional audio performance**
- **New concept dual microprocessor control and status monitoring eases operation and simplifies service**
- ***Flat-Pass* output network for exceptional phase and amplitude linearity**
- **Exceptional performance in monaural or stereo (optional)**
- **36 inches of internal rack space provided for ancillary equipment**
- **Unique air handling system lowers maintenance**

*Patented

The Harris SX-1 is based on a rigid design philosophy applied to the entire SX 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-1 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-1 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 new SX 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-1.

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-1, 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-1.

Harris SX-1
High technology in a blend of broadcast and computer science

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

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-1 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 lower harmonic and intermodulation distortion.

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-1 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-1. 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-1 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-1. The 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-1 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. A vast number of useful operating parameters is available at fingertip command at the front panel keypad, making the SX-1 one of the easiest transmitters to monitor, control and service. The controller is preprogrammed at the factory and only requires interrogation by the operator.

The transmitter's control and status functions are shared by two microprocessor controller boards working in tandem. Should one unit fail, the other microprocessor automatically picks up the additional duties without interruption. A simple logic probe is included with the SX-1 to as-

Pushbutton diagnostics!

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

sist the operator in checking simple digital circuitry controlled by the microprocessors.

Operationally, the SX-1 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:

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-1 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.

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

DESIGNED FOR AM STEREO

The SX-1 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-1. 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-1 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-1 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.

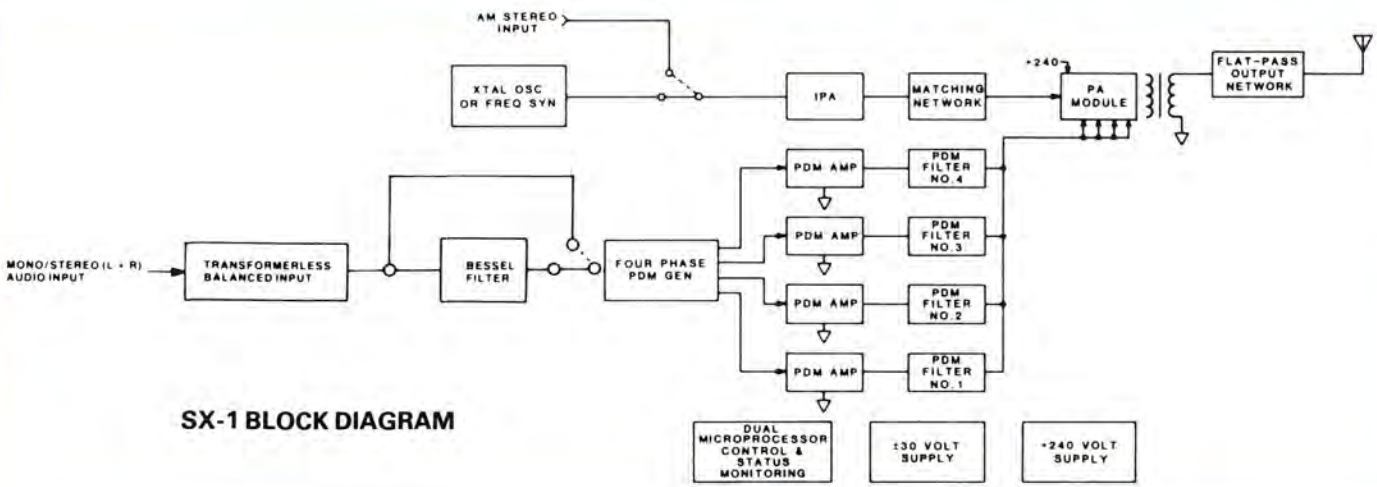
The sidewalls of the transmitter form "chimneys" to which the power amplifier modules are attached. Air enters through a filtered rear entrance and rises through the cabinet walls, cooling the power module's heat sinks. The majority of this convection cooling air passes through the isolated chimneys, with only a small amount of air required to flush the inside of the cabinet. Since no blower is required, and the majority of the air does not come in contact with the electronic components, maintenance and noise are greatly reduced.

EASE OF INSTALLATION AND SERVICE

The SX-1 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-1 and making final AC, RF and audio connections. No special air handling systems are required.

TODAY'S TRANSMITTER FOR TODAY'S BROADCASTER

Exceptionally high overall efficiency; maximum reliability; improved audio performance; full service microprocessor control and status monitoring; *readiness for AM Stereo*—these are just a few of the features in the SX-1 broadcast transmitter. Never before has Harris incorporated so many benefits in one transmitter. The SX-1 is engineered for today's broadcaster... with an advanced design to ensure years of reliable operation.



SX-1 BLOCK DIAGRAM

SX-1 SPECIFICATIONS

POWER OUTPUT: (Rated) 1000 watts. (Capable) 1100 watts. Power reduction through 100 watts.

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

CARRIER FREQUENCY STABILITY: A) Crystal Oscillator — ±20 Hz over temperature range. B) Frequency Synthesizer (optional) — ±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: 95% modulation, 60/7000 Hz, 1:1 or 4:1 ratio: 1.5% or less @ 1 kW; 1.5% or less @ 500W; 2% or less @ 250W; 3% or less @ 100W.

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 phase: 0.2 radian average IPM at 95% envelope modulation at 1 kHz; 0.5 peak radians.

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[1]: 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 × 28"W × 30"D (1830 mm × 712 mm × 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: Black and white.

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.

[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-1 Transmitter, complete with all solid-state devices, crystal oscillator, technical manual.	
Specify frequency	**994-8581-001**
SX-1 Transmitter, complete with all solid-state devices, frequency synthesizer, technical manual.	
Specify frequency	**994-8581-003**
Recommended spare semiconductor kit	**990-1012-001**
Spare crystal	**444-XXXX-000**
ANCILLARY EQUIPMENT	
AM-90 modulation monitor	**994-8424-001**
AF-80 frequency monitor	**994-6698-001**
Potomac AT-51 test set	**700-0499-000**
MSP-90 tri band AGC amplifier	**994-8357-001**
MSP-90 AM limiter	**994-8200-001**

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

CP-2.5M-1183

ADV. 605C PTD. IN U.S.A.