



HARRIS

SX-5 5000 Watt All-Solid-State Medium Wave Broadcast Transmitter



- 100% solid state for highest reliability
- Exceptionally high operating efficiency offers direct power cost savings over other 5 kW designs
- Polyphase Pulse Duration Modulation* (PPDM) for exceptional audio performance
- New concept dual microprocessor control and status monitoring simplifies operation and service
- *Flat-Pass* output network for exceptional phase and amplitude linearity
- Designed for stereo operation (optional)
- Unique air handling system lowers maintenance time

*Patented

The Harris SX-5 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
- d) Optimum stereo performance

The SX-5 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-5 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 SX 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-5.

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-5, 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

Harris SX-5

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.

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-5 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-5.

HIGHLY EFFICIENT POWER AMPLIFIER

The SX-5 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 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 lower harmonic and intermodulation distortion.

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 modu-

lator efficiency of the SX-5 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-5. 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-5 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-5. 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-5 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-5 one of the easiest transmitters to monitor, control and service.

Pushbutton diagnostics!

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



The controller is pre-programmed at the factory and simply requires interrogation by the operator.

The transmitter's control and status functions are shared by two high reliability microprocessor controller boards working in tandem. Should one unit fail, the other microprocessor automatically picks up the additional duties without interruption. A logic probe is included with the SX-5 to assist the operator in checking simple digital circuitry controlled by the microprocessors.

Operationally, the SX-5 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.



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

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-5 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-5 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-5. 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-5 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 500 CFM fan enters through a filtered rear entrance and rises through the cabinet walls, cooling the power modules' heat sinks. The majority of this cooling air passes through the isolated wall chimneys, with only a small amount of air required to flush the inside of the cabinet. SX-5 users will spend significantly less cleaning and maintenance time since the majority of the air does not come in direct contact with components.

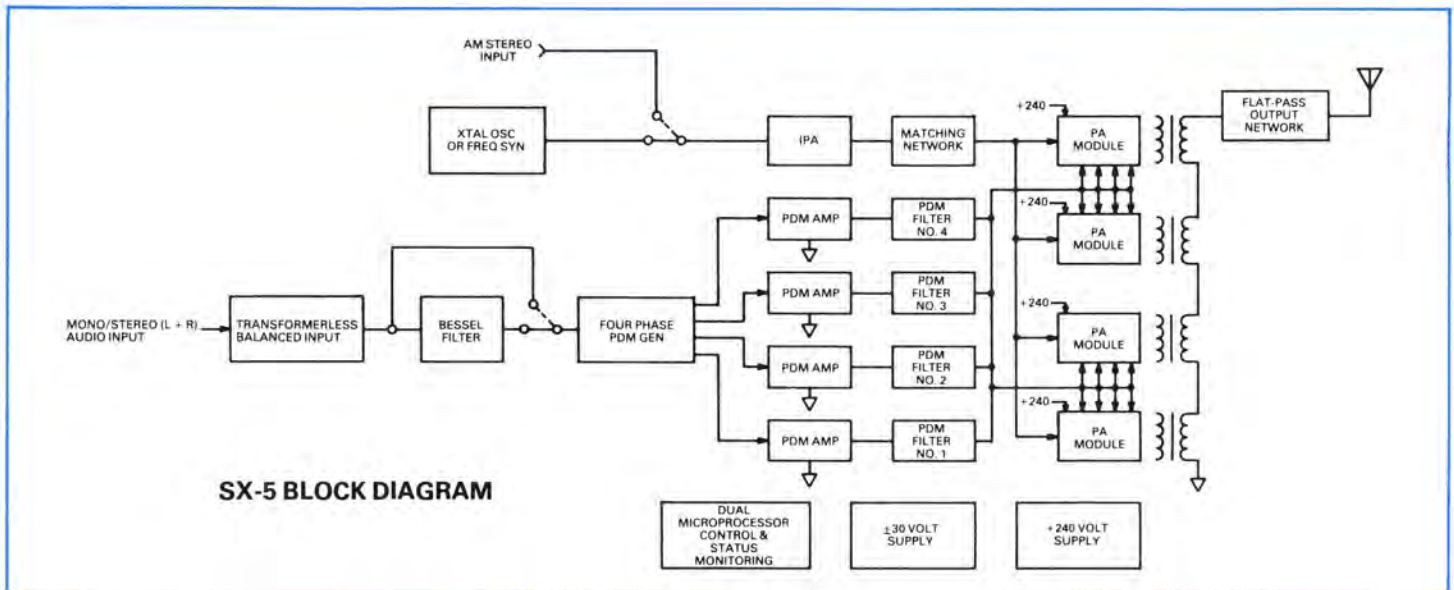
Furthermore, the SX-5's high operating efficiency results in up to 30% less dissipated heat than other transmitter designs, which lowers building air conditioning installation and operating costs.

EASE OF INSTALLATION AND SERVICE

The SX-5 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-5 and making final AC, RF and audio connections. No special air handling systems are normally 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-5 broadcast transmitter. Never before has Harris incorporated as many benefits in one transmitter. The SX-5 is engineered for today's broadcaster...with an advanced design to ensure years of reliable operation.



SX-5 BLOCK DIAGRAM

SX-5 SPECIFICATIONS

POWER OUTPUT: (Rated) 5000 watts. (Capable) 5600 watts. Power reduction through 500 watts.

RF FREQUENCY RANGE: 531 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: 1/8" EIA male flange connector.

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

RF HARMONICS AND SPOURIOUS 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: 1.5% 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, 3% or less, 60/7000 Hz 4:1, SMPTE standards at 5 kW operation at 80% modulation.

SQUAREWAVE OVERSHOOT: Less than 5% at 400 Hz.

SQUAREWAVE TILT: Less than 5% 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 Phase: 0.2 Average (Radians) at 95% Envelope Modulation @ 1 kHz; 0.5 Peak (Radians).

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.

OVERALL EFFICIENCY: Better than 65%.

POWER CONSUMPTION¹: 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: Black and white.

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.

¹For 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-5 Transmitter, complete with all solid-state devices, crystal oscillator, technical manual.	
Specify frequency	994-8583-001
SX-5 Transmitter, complete with all solid-state devices, frequency synthesizer, technical manual.	
Specify frequency	994-8583-003
Recommended spare semiconductor kit	990-1014-001
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

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