One kilowatt
MW-1
The World's First FCC Type
Accepted All Solid State
AM Broadcast Transmitter

HARRIS

COMMUNICATIONS AND
INFORMATION HANDLING
One kilowatt
MW-1
The World’s First FCC Type
Accepted All Solid State
AM Broadcast Transmitter
Model MW-1

Featuring 100% solid-state design and the Progressive Series Modulator (PSM)*

* Patent Pending

Features:

- 100% solid state, including PA and modulator
- High level modulation, using a Progressive Series Modulator (PSM)
- 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, for stable power output in the event of varying line voltage or brownouts
- 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
- Excellent accessibility to all components
- Extensive use of plug-in modules for easy maintenance
- High overall efficiency—low power consumption
- Quiet, air-cooled operation, using a single fan
- 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
- Low voltage used (160 volts)

The newest model in Harris' widely acclaimed MW Series of AM (medium wave) broadcast transmitters, the MW-1 represents another breakthrough from Harris in transmitter design. The one-kilowatt MW-1 introduces two entirely new state-of-the-art features never before included in any FCC type accepted AM transmitter—total
solid-state design and a Progressive Series Modulator! Built to handle the highly processed audio used in today's competitive market, the MW-1 provides low distortion, excellent transient response, wide frequency response, and high 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-1 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 an efficiency of close to 90% 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-1 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.

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.
125% POSITIVE PEAK MODULATION CAPABILITY. The MW-1 is capable of providing the maximum positive modulation peaks allowed by the FCC (125%), with plenty of 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.

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-1 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-1 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-1 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-1 are protected by circuit breakers, which are easily reset 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-1 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.

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-1 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-1 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-1, 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-1 may be removed for cleaning while the transmitter is in operation.

The MW-1 is completely self-contained in one cabinet—there are no external components.

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Oscillator and audio input/overload modules, and the remote power control, are located on a swing-down panel on the front of the transmitter.

Swing-up meter panel and transmitter control panel are located at eye level on the front of the MW-1, with PA module fault indicator lamps directly below.

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**MW-1 Block Diagram**
**PROGRESSIVE SERIES MODULATOR.** Up to now, series modulators—which have the advantage of great operational simplicity—have been too inefficient to be used effectively. Now, with the introduction of Harris' Progressive Series Modulator, simplicity and high efficiency have been combined into one excellent high-level modulation method.

A conventional series modulator is shown in Figure A. It has one active device, Q1 (modulator), which regulates the 100 volt power supply to provide the proper voltage at carrier and the modulation voltage to the PA. Its only drawback is its inefficiency. Under carrier conditions, only 50 volts is required at the PA. This means 50 volts is also across the modulator, Q1. Whatever current is required at the PA must flow through Q1.

Assume 24 amps and 50 volts is required at the PA to achieve the 1000-watt carrier. This means 24 amps is also flowing in Q1 and the power lost in Q1 is 1200 watts (all heat). This is much too inefficient, even for a one kilowatt transmitter. The PA and output network operate at about 85%, so the loss in the PA and output network is only 200 watts. (1200 watts input and 1000 watts rf output = 85% efficiency.)

If the advantages of a DC coupled series modulator are to be utilized, a more efficient method must be found—hence a Progressive Series Modulator (PSM). PSM is two series modulators, in series, as shown in Figure B. Two power supply voltages are now used. One is a little higher than that required to produce the proper PA voltage at carrier conditions, and the second is high enough to provide the positive peak required.

Now, during carrier, all the PA voltage comes from the 52-volt supply through CR1 and Q1. Only about 2 volts is lost across the modulator, so the required 50 volts, 24 amps is provided the PA. The loss across the modulator at carrier is now 2 x 24, or 48 watts, and the power to the PA is 50 x 24, or 1200 watts.

During the positive peak the PA voltage is supplied from the 104-volt supply through Q2 and Q1 (CR1 disconnects the 52-volt supply when Q2 turns on). During the negative peak Q2 is open, and the voltage is supplied from the 52-volt supply through CR1 and Q1.

Thus PSM—a Progressive Series Modulator which is highly efficient, is DC coupled, has excellent transient response, and requires no modulation transformer or reactor or filter inductor.

**NOTE:** Voltages used in the MW-1 vary slightly from the example above, to provide 125% positive peak modulation capability.
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 SHIFT: Less than 2% at 100% modulation.
RF HARMONICS: Meets or exceeds FCC and CCIR specifications.
AUDIO FREQUENCY RESPONSE: ±1 dB, from 20 to 10,000 Hz.
AUDIO FREQUENCY DISTORTION: 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.
NOISE (Unweighted): 60 dB or better below 100% modulation.
AUDIO INPUT: 10 dBm, ±2 dB, 600 ohms balanced.
POWER INPUT: 208/230 volts, 50 or 60 Hz balanced or unbalanced.
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.
IM DISTORTION: 2% or less 4/1 or 1/1, 60/2000 Hz or 60/7000 Hz.
EFFICIENCY: PA—approaches 90%; overall transmitter—50% or greater.

MECHANICAL
AMBIENT TEMPERATURE RANGE: -20° C to +50° C.
AMBIENT HUMIDITY RANGE: 95%.
ALTITUDE: Sea level to 10,000 feet.
SIZE: 72” H x 31½” W x 31½” D. (183 cm x 80 cm x 80 cm.)
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: Beige gray.
TYPE OF ACTIVE COMPONENTS: 100% solid state.
POWER SUPPLY: Self-contained, dry.
EXTERNAL COMPONENTS: None.

ORDERING INFORMATION
MW-1 transmitter, complete with all solid-state devices and one crystal, for 208/230 volts, single phase, 60 Hz or 50 Hz operation (specify if 208 or 230-volt primary service) .... 994-7707-001
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

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