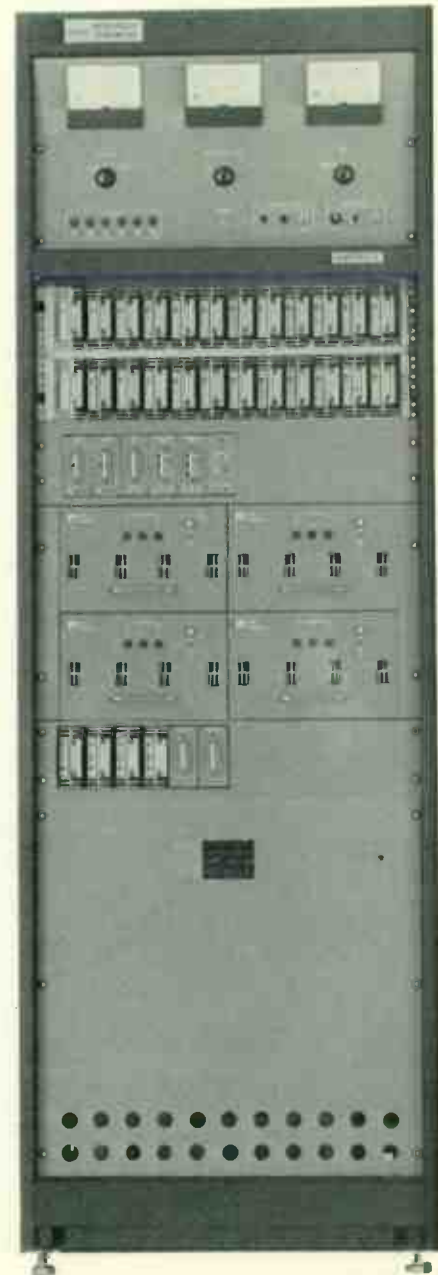


5 kW AMPFET 5

AMPFET 5

- 74% OVERALL EFFICIENCY
- 100% SOLID STATE
- POWER FET PA's AND MODULATORS
- SWITCHING MODE PA's AND MODULATORS
- 10% RESERVE POWER CAPABILITY
- 125% POSITIVE PEAK CAPABILITY
- DUAL OSCILLATORS AND RF DRIVERS
- DUAL AUDIO AND MODULATOR DRIVERS
- FAILURE RESERVE FEATURES



AMPFET 5 SPECIFICATIONS

CONFIGURATION	4 - 1.25 kW Power Blocks Main/Standby Audio and RF Drivers
POWER OUTPUT	(Rated) 5,000 watts (Capable) 5,500 watts. Two preset power levels between 500 and 5,500 watts are selectable via LOCAL or REMOTE control. (Reduction to 250 watts available on special order)
RF FREQUENCY RANGE	535 kHz to 1705 kHz Prefitted to one frequency as ordered
RF TERMINATING IMPEDANCE	50 ohms, unbalanced
AUDIO FREQUENCY RESPONSE	±0.5dB from 50 Hz to 10,000 Hz
AUDIO HARMONIC DISTORTION	Better than 2% (THD) at 95% modulation 50-10,000 Hz (Reduced antenna bandwidth may degrade specification)
AUDIO INTERMODULATION DISTORTION	1.0% or less at 5 kW, 60 7000 Hz 1:1 ratio at 5 kW output 2.0% or less at 5 kW, 60 7000 Hz 4:1 ratio at 5 kW output SMPTE Standards at 85% modulation
AM STEREO (RF PHASE SHIFT)	Less than 2° = 0.035 radians (1 radian = 57.29°) Incidental phase at 1 kHz
MODULATION CAPABILITY	125% positive peak modulation capability.
CARRIER SHIFT	Not exceeding 3% (typically 1%)
RF HARMONICS	80 dB or more below 5 kW output
SPURIOUS OUTPUTS	80 dB or more below 5 kW output
NOISE AND HUM (Uweighted) (Weighted)	60 dB or more below 100% modulation at 5 kW Typically 70 dB below 100% modulation
FREQUENCY STABILITY	±5 Hz or ±5ppm whichever is greater over temperature range
AUDIO INPUT	600/150 ohms + 10 dBm nominal, adjustable -10 to +12 dBm
POWER INPUT	4 wire 198 - 242 volts (5 steps) 3 phase 50/60 Hz or 385 - 465 volts (5 steps) 3 phase 50/60 Hz
PERMISSIBLE POWER SUPPLY VARIATION	-10% + 20% voltage, ±5% frequency
POWER CONSUMPTION	6.8 kW at 0% modulation at 5 kW 10.0 kW at 100% modulation at 5 kW
POWER FACTOR	0.98 (typical)
OVERALL EFFICIENCY	74% (typical)
METERING	Forward/Reflected Output Power DC Input Current/Voltage to modulators/PA's Test meter facility
REMOTE CONTROL	Transmitter ON/OFF Output Power level Remote Status of critical parameters Remote RF output power
AMBIENT TEMPERATURE/ HUMIDITY RANGE	0 - 50°C 0 - 95%
ALTITUDE	0 - 10,000 ft.
SIZE	Rack: 26 × 25 × 78" (66 × 63.5 × 198cm)
WEIGHT	Rack: 872 lbs. (395.5 kg.)
TYPE APPROVAL	DOC (CANADA) Type Approval No. 276501059 FCC Type Accepted 5 kW to 500 W FCC ID: B3W8GAMPFET5

FEDERAL COMMUNICATIONS COMMISSION

WASHINGTON, D.C. 20554

GRANT OF EQUIPMENT AUTHORIZATION

TYPE ACCEPTANCE

Nautel Maine Inc
201 Target Industrial Circle
Bangor, ME 04401

Date of Grant: May 05, 1982

File No.: 31010/EQU-17.3

Attn: John Pinks

Application dated: February 15, 1982

NOT TRANSFERABLE

EQUIPMENT AUTHORIZATION is hereby issued to the named GRANTEE, and is VALID ONLY for the equipment identified hereon for use under the Commission's Rules and Regulations listed below.

FCC IDENTIFIER B3W8GAAMPFET 5
Name of Grantee Nautel Maine Inc
Manufacturer Nautical Electronic Laboratories Ltd (Canada)

Equipment Class: Broadcast Transmitter

<u>Note(s)</u>	<u>Rule(s) Part Number(s)</u>	<u>Frequency Ranges(MHz)</u>	<u>Input Watts</u>	<u>Output Watts</u>	<u>Frequency Tolerance</u>	<u>Emission</u>
-	73	.535-1.605	-	5000	-	A3
-	73	.535-1.605	-	2500	-	A3
-	73	.535-1.605	-	1000	-	A3
-	73	.535-1.605	-	500	-	A3

REDUNDANCY

In addition to the previously mentioned redundancy incorporated in the AMPFET 5 and AMPFET 10, these transmitters include two 24/15 volt DC Power Supply Modules operating in an isolated parallel configuration. Multiple fans provide redundancy in the cooling system and are designed to supply sufficient air flow such that a failure on any one fan will not cause overheating within the transmitter. Only those passive components with very high reliability, such as mains transformers, chokes and the RF output filters are not provided with some form of redundancy.

SERVICEABILITY AND ACCESSIBILITY

Full field servicing and parts replacement was kept in mind when the physical layout was designed. Access to all plug-in modules is via the front door of the transmitter cabinet. Visual indication, metering and module test points are available to isolate a faulty module which may then be serviced at a regularly scheduled maintenance period. Module replacement may be carried out at any scheduled maintenance shut-down WITHOUT any unexpected OFF-AIR time and without ANY additional stress on the remaining operational modules in the meantime; or by going 'off the air' during a 30 second station break.

PERSONNEL SAFETY

The total elimination of tubes substantially reduces the hazard to personnel when servicing the AMPFET series of broadcast transmitters. The AC input voltage is transformed "DOWN" not "UP" to provide the high power DC supplies. The highest DC supply voltage of the AMPFET series is a

nominal 72 volts DC. Access for normal servicing is via the cabinet front door which, when open, exposes NO hazardous voltages. Finally, the transmitter interlock circuit which is fitted to the cabinet rear panels also includes terminals for external activation.

REMOTE CONTROL

Selection of local or remote control of the AMPFET series is provided on the control panel. Remote control, when fitted, provides for a transmitter ON/OFF function as well as a carrier output level selection. Remote status outputs are provided for all critical monitor functions.

AM STEREO

The AMPFET 5 and AMPFET 10 both offer the utmost flexibility to accommodate AM STEREO with their standard dual RF DRIVER configuration, without sacrificing any of the inherent redundancy of this AMPFET series. For AM STEREO, NAUTEL will provide a plug-in STEREO interface to replace the main RF DRIVER Module. This will not affect the changeover facility to the standby RF DRIVER Module in the event of the loss of RF DRIVE from either the AM STEREO generator or the STEREO interface. Changeover to the standard MONO standby RF DRIVER can be effected manually to allow for servicing of the STEREO generator. Alternatively, both RF DRIVER units may be replaced by STEREO interfaces to allow for dual AM STEREO generators. However, it must be kept in mind that changeover from main to standby is activated by loss of RF drive from the stereo interface. Loss of phase modulation, would simply result in a MONO transmission, without automatic changeover to either the standby RF DRIVER or the standby STEREO interface.

FCC AND DOC (CANADA) TYPE ACCEPTED
MEETS OR EXCEEDS APPLICABLE IEC REQUIREMENTS

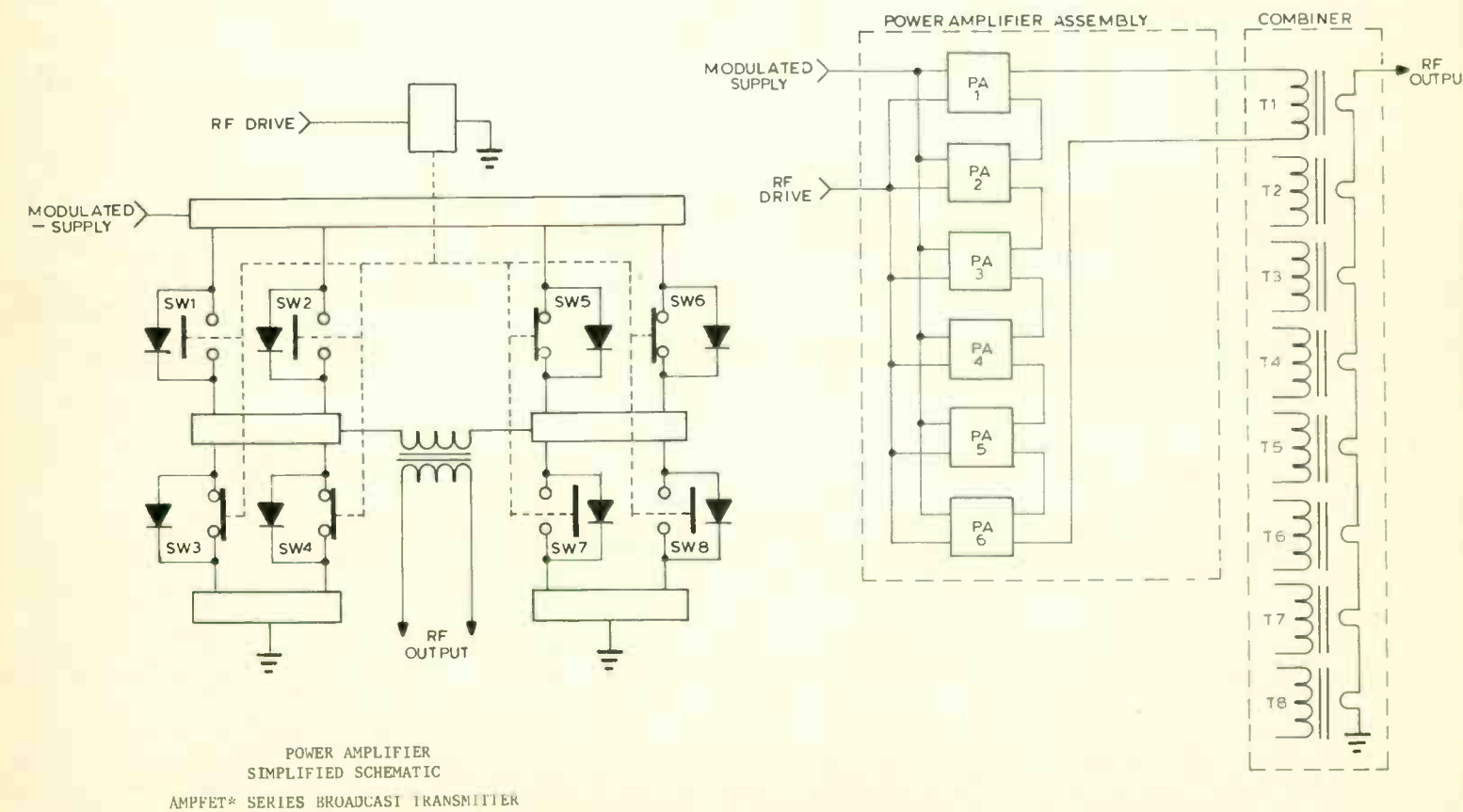
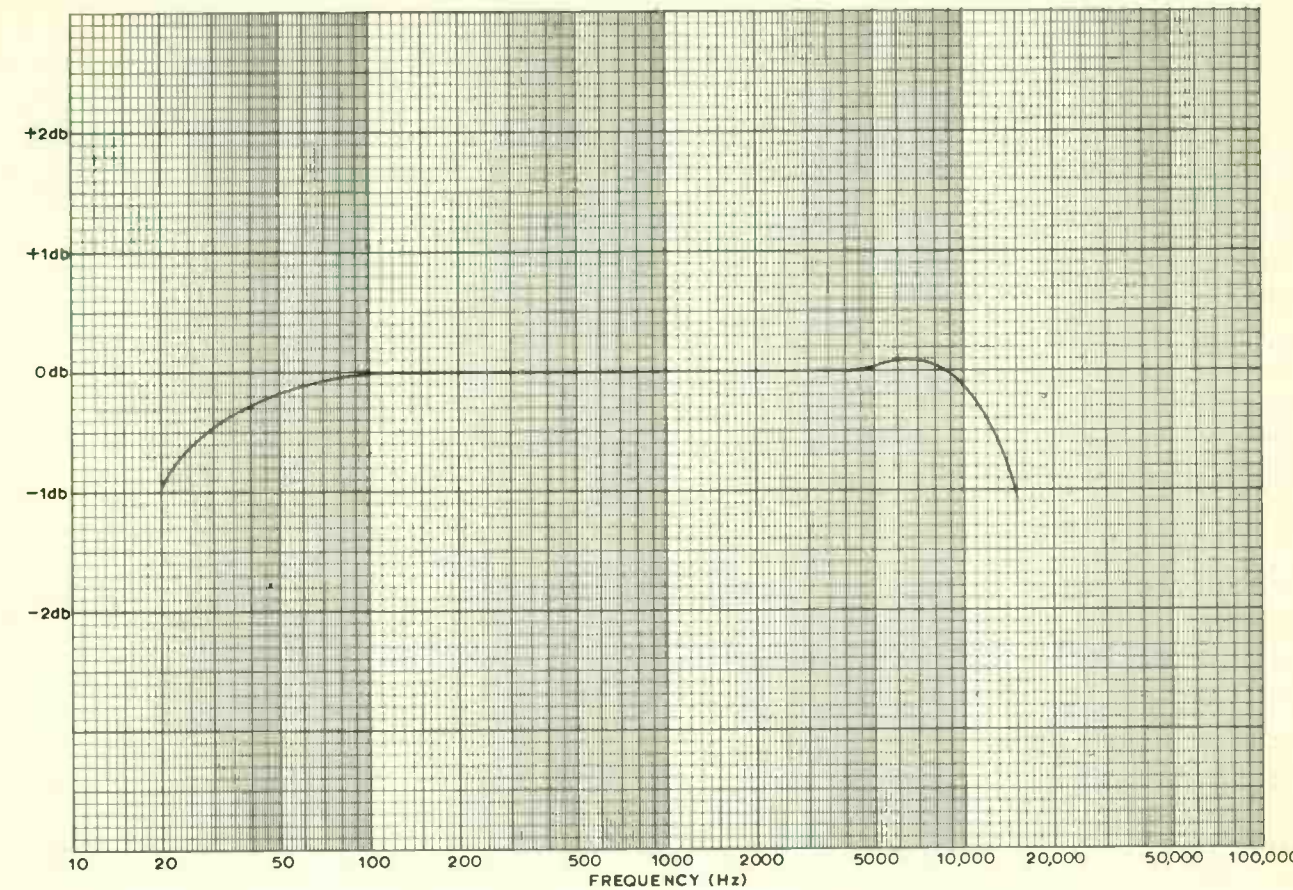
FOR FURTHER DETAILS PLEASE CONTACT

Nautical Electronic Laboratories Limited
R.R. #1, Tantallon, Halifax County,
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Nautel Maine Inc.
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Bangor, Maine 04401 U.S.A.

Phone (207) 947-8200
Telex: 944466



AMPFET[®] SERIES

TOTALLY SOLID STATE
MEDIUM WAVE
BROADCAST TRANSMITTERS

5 kW AMPFET 5
10 kW AMPFET 10

GENERAL

These transmitters bring together NAUTEL's exclusive 15 year experience with the design of totally solid state high power LF/MF transmitters, some of the recent circuit design from our research laboratories, and the exciting capabilities of the new Power MOSFET devices now available. The result is a 100% solid state Modular transmitting system which is remarkably efficient, basically very simple, and with some truly unique features which management and engineering will readily appreciate.

CONFIGURATION

The exceptionally high overall transmitter efficiency, nominally 74% AC in to RF out, has resulted in very low waste heat generation. This has enabled NAUTEL to achieve a remarkably compact mechanical design for both the overall transmitter and the individual modules, WITHOUT compromising component accessibility which is so necessary for field servicing.

The 5 kW & 10 kW AMPFET AM Broadcast transmitters are housed in standard 24" panel width cabinets. The 5 kW AMPFET 5 is completely self contained in a standard 24" panel cabinet 78" high. The 10 kW AMPFET 10 electronics are completely self contained in an identical cabinet, but the STEP-DOWN power transformer is separately housed immediately adjacent to the transmitter (see specifications). In both transmitters, a metering and control panel is mounted above the plug-in modules. A hinged door, which can be locked for additional security, covers the plug-in modules.



AMPFET 5

*Trade Mark

CONTROL AND METERING

Comprehensive metering facilities have been incorporated in the AMPFET 5 and AMPFET 10 transmitters for all operating voltages, currents, and power levels. Status lamps show the operator at a glance whether the transmitter is operating normally or in a "RESERVE" mode. Any module failure is visually pin-pointed for rapid identification. Furthermore, a built-in test meter facility is provided for detailed checks of all test points on each individual module. Each transmitter contains interfaces for EXTENDED OPERATION and/or REMOTE CONTROL. In addition to the ON/OFF and POWER LEVEL control functions, remote status outputs are provided for all critical monitor functions.

The RF Power meters of the AMPFET series provide a true RF Power output measurement derived from both RF output voltage and RF output current probes. These meters are the FCC approved indirect method for measuring the RF output of AMPFET transmitters. This measurement replaces the traditional technique for tube transmitters of multiplying together the plate voltage, plate current and efficiency. Thus the meter reading provides direct measurement of RF output power.

BLOCK DIAGRAM

The overall simplicity of the AMPFET design is readily apparent from the block diagram. It should be particularly noted that the RF and Modulator Driver stages are duplicated. Automatic changeover in the event of a failure provides full, built-in, redundancy in these low level stages. All other stages in the AMPFET 5 and AMPFET 10 transmitters feature NAUTEL's Integral Modular Reserve (IMR) design, which provides for continued operation at slightly reduced output in the event of a module failure. Operation under these conditions does not degrade the overall efficiency or place any additional stress on the remaining operational modules, so that repair or replacement may be effected at the next regularly scheduled maintenance period.

RF DRIVER MODULES

The AMPFET 5 and AMPFET 10 transmitters have two RF Driver Modules which are arranged in a Main/Standby configuration. Each unit contains an RF oscillator which runs at $4 \times F_c$ for carrier frequencies below 1MHz and $2 \times F_c$ for carrier frequencies above 1MHz. In order to minimize the number of different solid state devices, the output circuit employs POWER MOSFETS of the same type as those used in the MOSFET POWER AMPLIFIERS.

Visual indication of any changeover to the Standby RF Driver Module is displayed on the monitor panel and via the remote control system, if fitted.

MODULATOR DRIVER MODULES

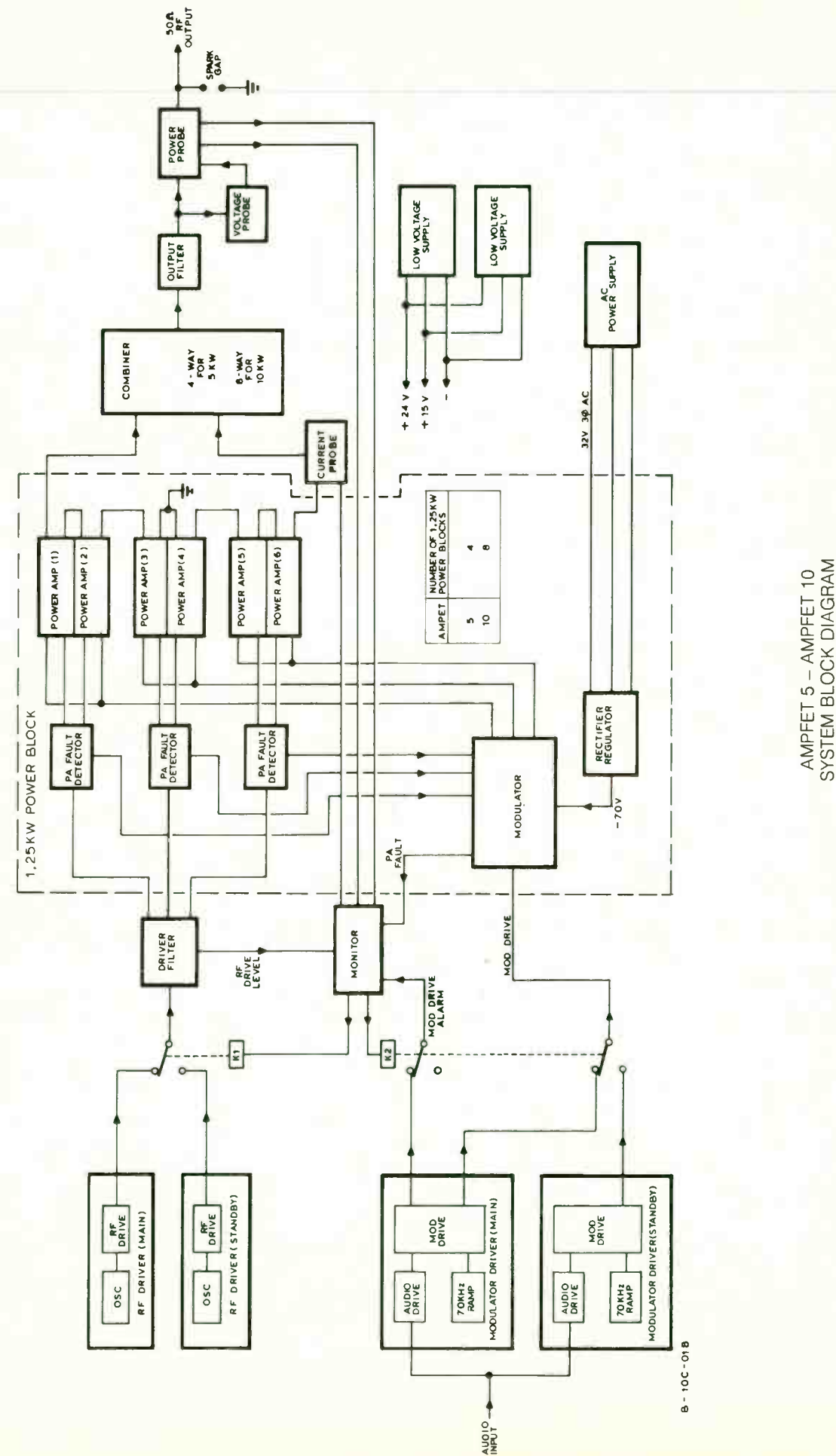
The low level Modulator Driver Modules provide incoming audio level control as well as generating the modulator drive signals. Again, the Modulator Driver Modules are duplicated in the AMPFET 5 and AMPFET 10 transmitters with automatic switch-over in the event of a failure. Visual indication of a changeover is displayed on the monitor panel and remotely with the remote control system, if fitted. Modulator output level is screwdriver adjusted on the low level Modulator Driver Module. Access to the adjustment control is from the front of the transmitter.

MODULATOR MODULES

The NAUTEL Modulator Module is a unique design which uses the same POWER FET's as the other AMPFET transmitter stages. Generically, it is a development of the switched mode modulator and utilizes a highly linear switched regulator with a nominal 70 kHz switching frequency. It has excellent frequency response and achieves an efficiency of 95%. Multiple Modulator Modules provide IMR in the AMPFET 5 and AMPFET 10 Transmitters.

MOSFET POWER AMPLIFIER MODULES

A simplified circuit diagram of the MOSFET Power Amplifier Module is shown on the back page. Each Power FET is represented by a switch in parallel with a reverse biased diode. These switches are controlled by the RF Drive which in practice, is applied to the gates of the diametrically opposite Power FET's via push-pull transformers. This bridge arrangement of paralleled Power FET's, with push-pull drive, yields an alternating polarity square wave voltage across the RF output transformer, at the frequency of the RF drive signal, with peak to peak voltages of twice the value of the



AMPFET 5 - AMPFET 10 SYSTEM BLOCK DIAGRAM

modulated supply voltage. The very low forward resistance of the Power FET devices has made it possible to achieve a PA module efficiency of 88% at a power output of 250 watts. The outputs of six 250 watt PA Modules are combined as shown in the block diagram which together with their associated Modulator and Rectifier/Regulator assemblies, form a "POWER BLOCK" very conservatively rated at 1.25 kW.

OUTPUT POWER STAGE

The modular "POWER BLOCK" design concept described above, forms the basis of the AMPFET Series of broadcast transmitters. The AMPFET 5 and AMPFET 10 transmitters consist of 4 and 8 "POWER BLOCKS" respectively, operated in series with their outputs added in the RF combining unit.

The AMPFET series transmitters are designed to withstand both open and short circuit antenna conditions.

PROTECTIVE CIRCUITS

THE AMPFET series is protected by a circuit breaker located on the Power Transformer unit, which also serves as an emergency shut down. Each Modulator Module is protected by three load isolation relays controlled by the PA Fault Detectors.

The Rectifier/Regulator Modules incorporate fuses, high voltage sensors and control systems which protect the transmitter from short term surges on the AC input supply, and provide regulation for high AC voltages. Low AC inputs will not damage these transmitters. RF output is held within stated specifications as long as the AC input does not fall below a pre-determined minimum value. If the AC input continues to fall below this value, then the RF output will fall, without degradation of other specifications, in proportion, until a low RF drive condition causes a complete shut down. The RF

Output Filter design includes an RF Power Probe and an RF Voltage Probe, as well as a spark gap which is located at the transmitter output terminal.

When a transient high reflected VSWR condition occurs, the System Monitor Module responds to signals generated by the RF Power and RF Voltage probes and initiates a 1.5 second shutdown followed by a return to full output. This recycling under transient high VSWR conditions e.g. static arcing of the antenna system, is not limited to a finite number of cycles, but will recycle indefinitely.

Should the reflected power level be of a continuous nature, the System Monitor Module will automatically reduce the RF output. This fully automatic 'POWER FOLDBACK' will maintain the RF output at a maximum level consistent with a safe reflected power level under all variations of antenna mismatch.

The AMPFET series RF Power Probe also initiates recycling when the average power output exceeds a safe level.

SYSTEM MONITOR MODULE

In addition, the System Monitor Module senses any malfunction in the following circuits and initiates the corresponding alarm; PA Failure, RF Drive Failure, Modulation Failure, High Reflected RF Power and High Temperature. The System Monitor Module also initiates the changeover in the AMPFET 5 and AMPFET 10 transmitters between main and standby low level RF and Modulator Driver Modules; in the unlikely event of any malfunction within these units.

TUNING

The AMPFET series output filter network is supplied pre-tuned to the customer's operating frequency. The only adjustment required on site is fine tuning the low level RF drive to the Power Amplifier Blocks.

MODULATOR DRIVER MODULE AND MODULATOR

The NAUTEL MODULATOR is a unique design which uses the same POWER FET's as the other AMPFET transmitter stages. Generically, it is a development of the switched mode modulator and utilizes a highly linear switched regulator with a nominal 70 kHz switching frequency, which has excellent frequency response and achieves an efficiency of 95%.

The Modulator Driver converts the incoming audio modulation signal into a pulse duration modulation signal which is fed to the modulator. Visual indication of a malfunction is displayed on the monitor panel.

High and low power operation (day-night levels) of the RF output is screwdriver adjusted on the Modulator Driver module. Access to this adjustment control is from the front of the transmitter.

MOSFET POWER AMPLIFIER

A simplified circuit diagram of the MOSFET Power Amplifier is shown on the centre page. The power FET's, each represented by a switch in parallel with a reverse biased diode, are connected in a cascade bridge configuration between the modulated negative supply voltage and ground with an RF output transformer connected at the centre. The phase of the push-pull RF drive signal, which controls the switching of each Power FET is arranged so that SW3, SW4, SW5 and SW6 conduct on one RF half cycle and SW1, SW2, SW7 and SW8 conduct on the other RF half cycle.

The result is a square wave RF current in the primary winding of the output transformer. The very low forward resistance of the Power FET devices has made it possible to achieve a PA module efficiency of 88% with an output power rating in excess of 250 watts.

RF POWER COMBINING

The outputs of six PA modules are combined as shown in the simplified RF Output Schematic, and together with an associated Modulator and a Rectifier/Regulator module, form a "POWER BLOCK" which is conservatively rated at 1375 watts. The AMPFET 1 uses one of these POWER BLOCKS. In the AMPFET 2.5 the outputs from two POWER BLOCKS are combined to provide an RF output capability of 2.75 kW.

The RF power combining process features NAUTEL's Integral Modular Reserve (IMR) design which provides for continued operation at reduced power in the event of a PA module failure. Operation under these conditions does not degrade the overall efficiency or place any additional stress on the remaining operational modules. Repairs or module replacement may be effected at any convenient time with only a 20 second interruption in operation.

TUNING

The AMPFET Series output filter networks and the drive filters are supplied pre-tuned to the customer's operating frequency. No tuning adjustments are required on site.

SERVICEABILITY AND ACCESSIBILITY

Full field servicing and parts replacement was kept in mind when the physical layout was designed. Access to all plug-in modules is via the front door of the transmitter cabinet. Visual indication, metering and module test points are available to isolate a faulty module which can then be serviced at the regularly scheduled maintenance period. At no time are there any dangerous voltages exposed during testing. The highest voltage generated in an AMPFET transmitter other than RF, is a nominal 75V DC.

PERSONNEL SAFETY

The total elimination of tubes substantially reduces the hazard to personnel when servicing the AMPFET series of broadcast transmitters. The AC input voltage is transformed "DOWN" not "UP" to provide the high power DC supplies. The highest DC supply voltage of the AMPFET series is a nominal 72 volts DC. Access for normal servicing is at the front of the cabinet where NO hazardous voltages are present.

OPTIONAL AUDIO INTERFACE

This unit is designed to plug-in to the transmitter from the front and provides basic clipping and

limiting functions in the event that speech processing equipment is not used on the audio feed. It is not intended that this replace speech processing equipment, but ensures that any transient signals of undesirable characteristics on the audio feed line are suitably attenuated.

AM STEREO

For AM STEREO, NAUTEL will provide a plug-in STEREO INTERFACE which will replace the RF DRIVER unit and is fully interchangeable without the necessity for any adjustment or tuning.

FOR FURTHER DETAILS PLEASE CONTACT

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Exclusive Agents for Polestar Antenna Systems



AMPFET* SERIES

TOTALLY SOLID STATE
MEDIUM WAVE
BROADCAST TRANSMITTERS

1 kW AMPFET 1
2.5 kW AMPFET 2.5

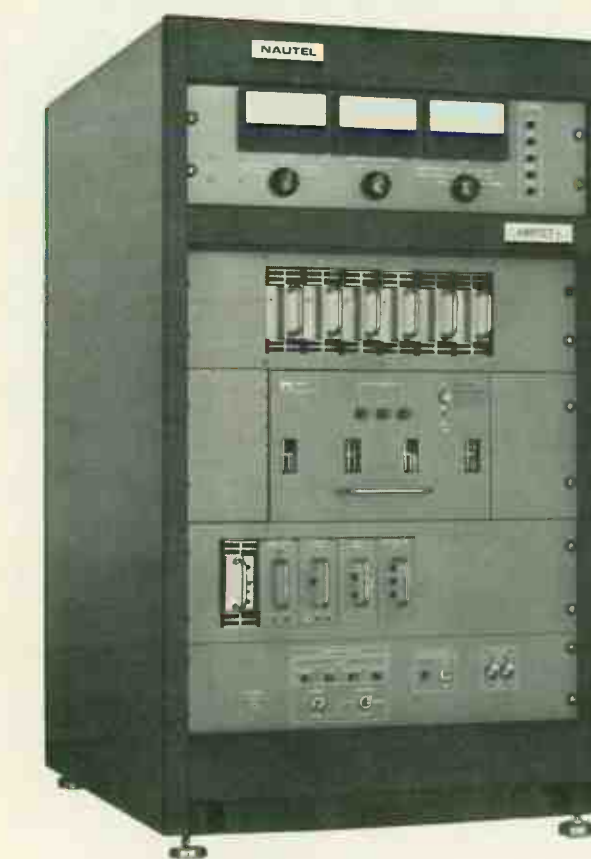
GENERAL

The AMPFET 1 and AMPFET 2.5 are part of NAUTEL's new family of AM broadcast transmitters which bring together our 15 year experience with the design of totally solid state high power LF/MF transmitters, some of the recent circuit design from our research laboratories, and the exciting capabilities of the new Power MOSFET devices now available. The result is a 100% solid state Modular transmitting system which is remarkably efficient and basically very simple, with some truly unique features which management and engineering will readily appreciate.

EQUIPMENT RELIABILITY

Solid state devices, unlike their vacuum tube equivalents, have no inherent wearout characteristics. Their average lifespan can be expected to be well in excess of 1 million hours (114 years) providing certain critical stress ratings are never exceeded. Conversely they can be destroyed in a fraction of a second if one of these ratings is exceeded.

In order to achieve the reliability which is inherent in a totally solid state design it is necessary to afford meticulous attention to avoiding component overstress. Transients induced into the AC line supply and the transmitting antenna, from both atmospheric and man made sources, are the most significant factors which cause premature component failure. It is also vitally important to maintain low operating temperatures within the semiconductor



AMPFET 1

*Trade Mark

junctions of the power transistors. A glance at the cooling surface area of our RF power amplifier modules, with the transistors bolted directly to the heatsink, will demonstrate the amount of attention we have paid to this facet of the design.

The thousands of NAUTEL solid state transmitters which have been operating for up to thirteen years in some of the harshest conditions in the world demonstrate our "know how" in providing the necessary safe environment for each semiconductor.

PROTECTIVE CIRCUITS

Unlike most high power transmitters, the DC supply voltage for the Modulators/RF Amplifiers is regulated in the AMPFET series. This not only protects the RF power transistors from AC line transients and variations but also produces a transmitter RF output power level which is more constant than in conventional equipment. Should the AC line supply fall below a critical minimum low value the RF output will fall in proportion, without degradation of other equipment performance specifications, until a low RF drive condition causes a complete shutdown.

The RF output transistors are able to produce the high RF output power with extreme efficiency because they operate in a Class D switched mode, where significant transistor dissipation occurs only during the switching transitions. To ensure that these transitions occur sufficiently rapidly it is crucial that the RF drive input signal does not fall below a critical low level. The monitor module continuously samples the RF drive level and will allow transmitter operation only if it exceeds this critical level.

Each Modulator is protected by three load isolation relays which are controlled by fault detectors for each pair of PA modules. If a module fails, the DC supply to that pair of modules is removed, leaving their output transformers to "free wheel" in the series chain of operating PA modules.

When a transient high VSWR condition occurs the Modulator Driver module responds to a signal generated by the RF Power Probe and initiates a 1.5 second RF power shutdown, followed by a return to full output.

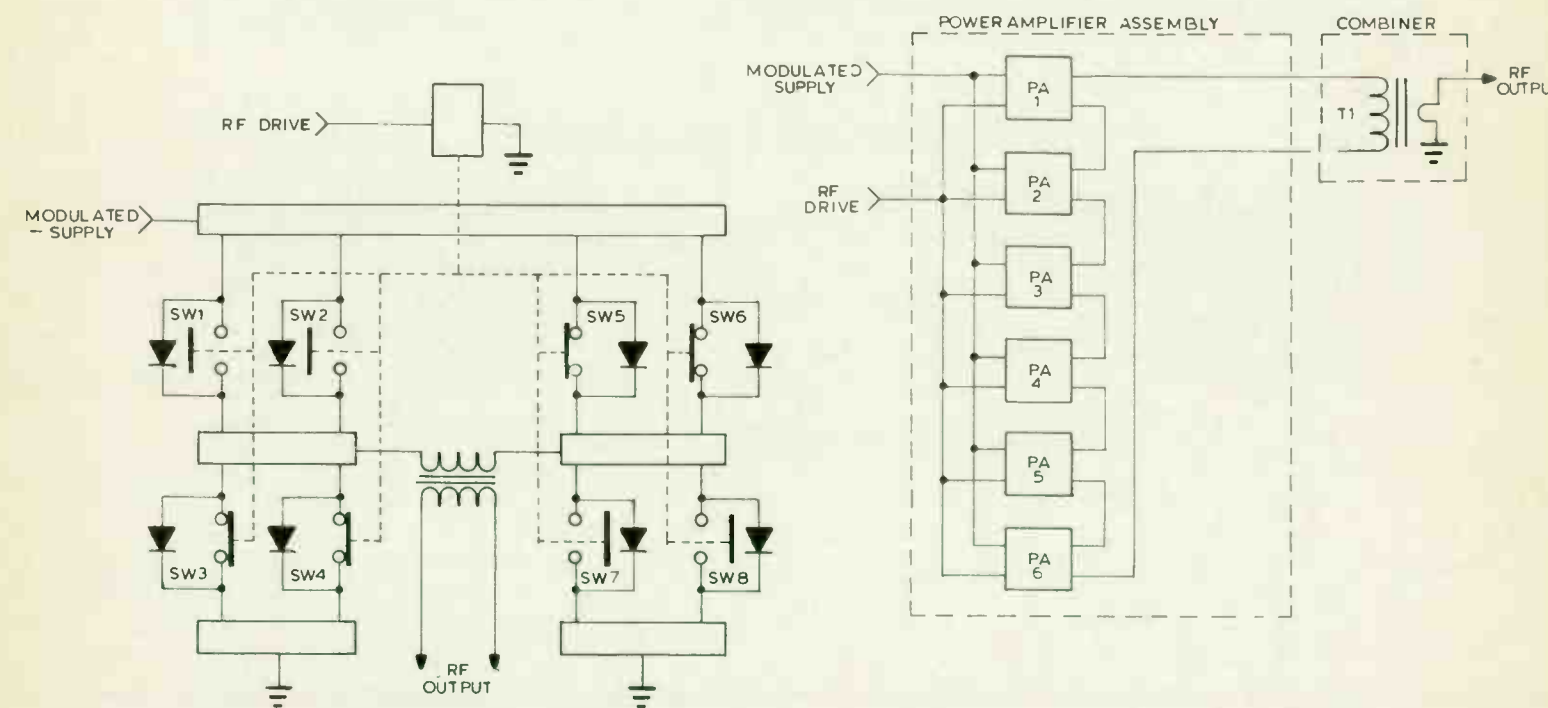
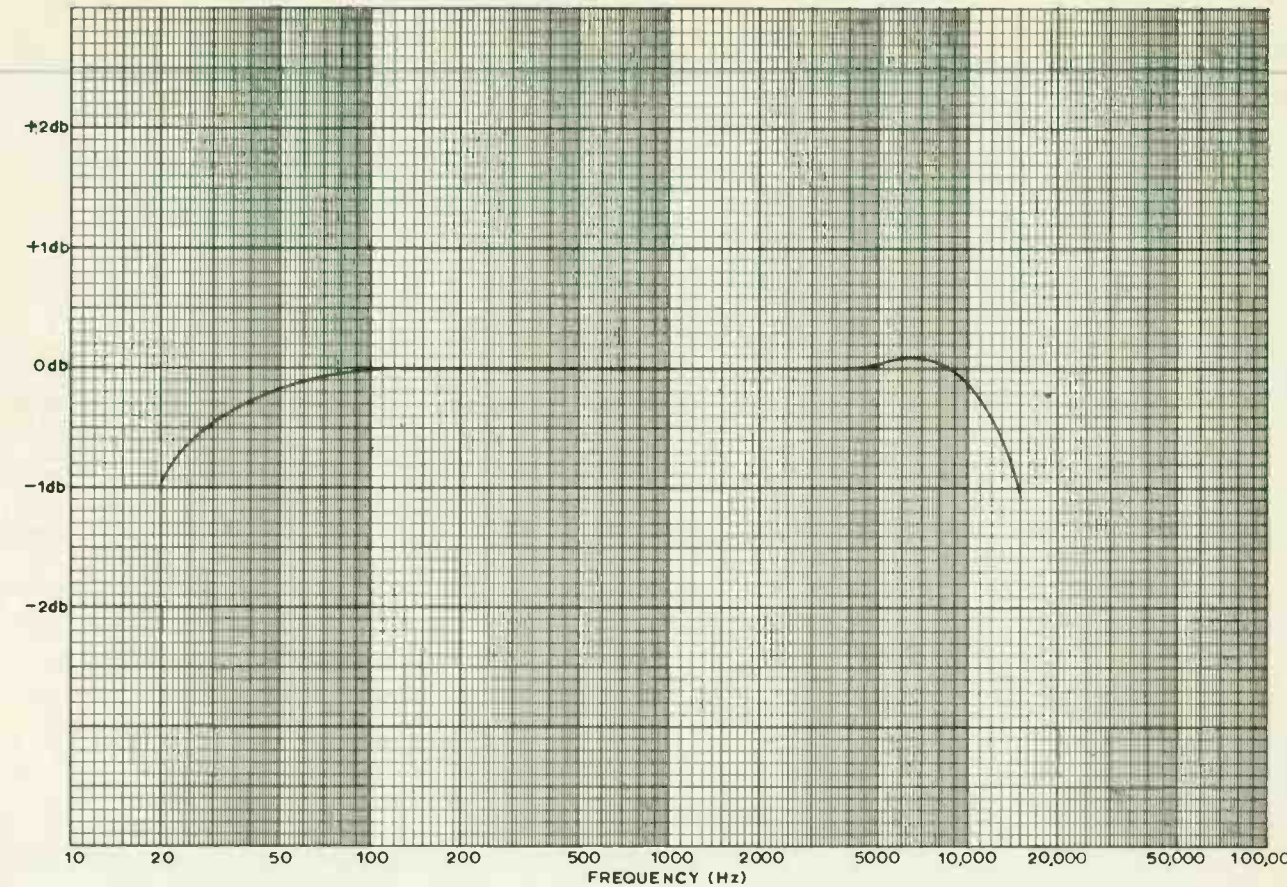
Should the VSWR be of a continuous nature, the Modulator Driver automatically reduces the output power to maintain the reflected power within safe operating limits. If the VSWR subsequently decreases then the RF output is automatically allowed to increase to maintain the maximum safe operating power level. THIS VSWR PROTECTION CIRCUIT ENABLES THE TRANSMITTER TO WITHSTAND BOTH OPEN AND SHORT CIRCUIT ANTENNA CONDITIONS WITHOUT EQUIPMENT DAMAGE.

AMPFET transmitters are designed to operate at full power with a VSWR of at least 1.4:1 (1.2 at full modulation). A greater tolerance to high VSWR is obtained when operating at lower power levels.

A spark gap is provided in the RF output filter to absorb voltage transients originating in the transmitter's antenna system.

Fuses/circuit breakers are provided for each module and sub-assembly.

In the Rectifier/Regulator a high temperature sensor switches OFF the transmitter's voltage supply should the internal temperature exceed a safe level.



POWER AMPLIFIER SIMPLIFIED SCHEMATIC
AMPFET® SERIES BROADCAST TRANSMITTER

SIMPLIFIED RF OUTPUT SCHEMATIC
AMPFET® SERIES BROADCAST TRANSMITTERS

CONFIGURATION

These lower power members of the AMPFET family are constructed from the same basic modules as the higher power systems. The number of RF Power Amplifier modules and Modulator modules are simply reduced in proportion to the transmitter output power rating. Integral Modular Reserve (IMR) is retained in the PA's but the low power modules are not duplicated at these power levels.

The exceptionally high overall transmitter efficiency, nominally 70% AC-in to RF-out, has resulted in very low waste heat generation. This has enabled NAUTEL to achieve a remarkably compact mechanical design for both the overall transmitters and the individual modules, WITHOUT compromising component accessibility which is so necessary for field servicing.

MONITOR PANEL

Comprehensive metering facilities provide direct meter indication of the following operational parameters:

- Forward/Reflected Power at the transmitter output on high and low range settings.
- DC voltage to Modulator/RF amplifiers.
- DC current to Modulator/RF amplifiers.
- Modulator DC output voltage.
- 24 volt DC supply voltage.
- 15 volt regulated DC supply voltage.
- AC line supply voltage (bracketed limits indicate correct tap selection on the AC line transformer).

Alarm indicator lamps used to pinpoint the cause of a system malfunction include:

- Transmitter fault (RF output below an adjustable threshold).
- High VSWR (mismatch condition of transmitter terminating impedance).
- RF drive (RF drive below a safe operating level causing transmitter shutdown).
- Mod Drive (failure of the modulator driver module).
- Interlock (discontinuity in the safety interlock circuit).

REMOTE CONTROL & MONITORING

When REMOTE CONTROL is selected by a switch on the control panel, the transmitter ON/OFF and HIGH/LOW power switching functions are transferred to a remote location.

Output signals which are available for remote status monitoring include:

- Transmitter fault.
- High VSWR.
- Forward Power at transmitter output.
- Reflected power at transmitter output.

RF DRIVER MODULE

The RF Driver module contains an RF oscillator which runs at $4 \times F_c$ for Carrier frequencies below 1MHz and $2 \times F_c$ for carrier frequencies above 1MHz. In order to minimize the number of different solid state devices, the output circuit employs POWER MOSFETS of the same type as those used in the POWER AMPLIFIERS. Visual indication of any malfunction of the RF Driver is displayed on the meter panel.

SERVICEABILITY

As all modules plug-in from the front of the transmitter and all operational adjustments are on the front of the modules, servicing of all units, with the exception of passive components, such as the output filter, rack cabling and power supply chokes, is via the front door of the transmitter cabinet. Metering and test points are available on the front of each module. Module replacement may be carried out at any scheduled maintenance shut-down without any unexpected off-air time and without ANY additional stress on the remaining operational modules in the meantime; or by going 'off the air' during a 30 second station break.

At no time are there any dangerous voltages exposed during the testing and removal of modules via the front of the cabinet.

AM STEREO

The NAUTEL AMPFET series are fully compatible with all proposed stereo systems, and set an industry standard for both Incidental RF Phase and Intermodulation Distortion minimums.

THE AMPFET* SERIES OF
BROADCAST TRANSMITTERS
ARE MANUFACTURED EXCLUSIVELY
BY:

Nautical Electronic Laboratories Limited,
R.R. #1, Tantallon,
Halifax County,
Nova Scotia, Canada
B0J 3J0

AND

Nautel Maine Inc.
201 Target Industrial Circle,
Bangor, Maine
04401

Nova Scotia, Canada
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Maine, U.S.A.
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AMPFET* SERIES

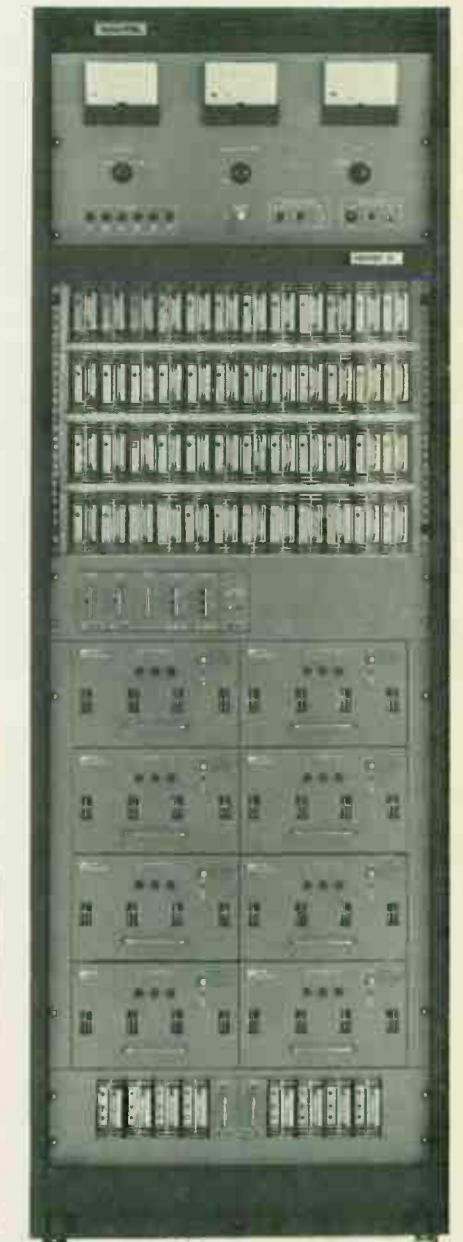
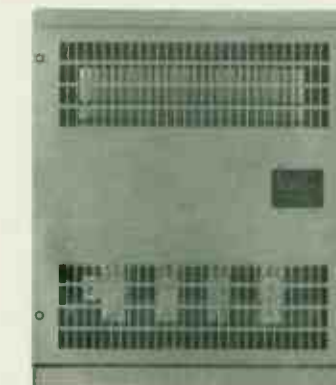
TOTALLY SOLID STATE
MEDIUM WAVE
BROADCAST TRANSMITTERS

1 kW 2.5 kW 5 kW 10 kW

AMPFET 10

DESIGN FEATURES

- 74% OVERALL EFFICIENCY (AMPFET 1, AMPFET 2.5 - 70%)
- 100% SOLID STATE
- POWER FET PA's AND MODULATORS
- SWITCHING MODE PA's AND MODULATORS
- 10% RESERVE POWER CAPABILITY
- 125% POSITIVE PEAK CAPABILITY
- DUAL OSCILLATORS AND RF DRIVERS (AMPFET 5, AMPFET 10 only)
- DUAL AUDIO AND MODULATOR DRIVERS (AMPFET 5, AMPFET 10 only)
- FAILURE RESERVE FEATURES



*Trade Mark

In 1970 NAUTEL announced a significant technological breakthrough from their design laboratories – the world's very first, wholly solid-state, LF/MF Transmitter at a 2000 watt peak power level. These early NAUTEL transmitters, when delivered to the customers and installed, very soon shattered established concepts as to how long a transmitter (operating 24 hours per day) could continue without breakdown or attention. The technical press paid due homage to that achievement and, inevitably, other Corporations started hurried programs in an effort to follow this clear lead into the transmitter design field.

Since 1970, NAUTEL has taken this same basic technology – with progressive improvements of course – into related transmitter application areas, including navigation, broadcasting, and communications, over the frequency spectrum from 200 to 25,000 kHz. A global total of more than 2,000 transmitters, designed and manufactured by NAUTEL, operate continuously in more than 50 countries at the present time. The fact that many of the orders which NAUTEL receives are repeat orders from the same customer bears mute testimony to the superior reliability and performance of these transmitters.

In 1981 NAUTEL were proud to once again usher a further technological breakthrough into the market place and the world's first totally solid state 10 kW AM Broadcast transmitter, a NAUTEL AMPFET 10, went 'ON THE AIR' on February 19, 1982. The new product was named the NAUTEL AMPFET* (AM POWER FET) as it is particularly intended for AM Broadcasting. It represents NAUTEL's contribution towards solving the energy crisis and the rapidly growing strain on the AM Broadcaster's power budget, because:

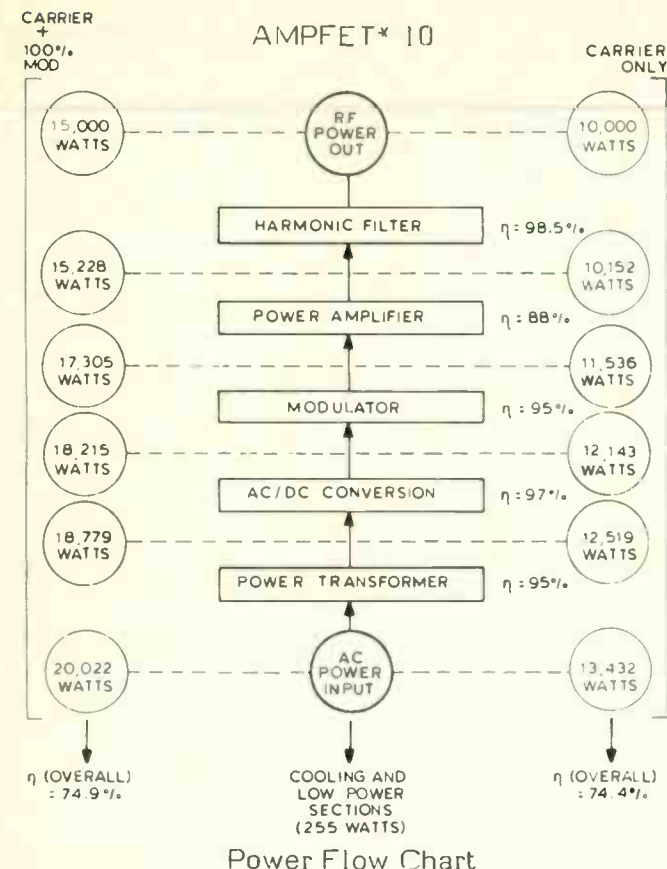
AN AMPFET* TRANSMITTER IS OVER 70% EFFICIENT AC POWER-IN TO RF POWER-OUT

This is the moment to get out the competitor's data sheets on his latest super-efficient 10 kW AM Transmitter and compare on the graph below. Please do this because only against our competitor's state of the art transmitter can NAUTEL's achievement to be seen in proper perspective.

The new AMPFET* Series is available in 1 kW, 2.5 kW, 5 kW and 10 kW Models. They are all TOTALLY SOLID STATE. Not Bipolar solid-state but Power FET Solid State. Recent introductions of competitive lower power totally solid state AM Broadcast transmitters have confirmed NAUTEL's predictions that their competitors would observe, and again start hurried programs to follow the leader.

These transmitter designs are the culmination of several year's intensive research and design effort with supporting stress and reliability analysis and prolonged prototype evaluation under severe environmental, supply voltage and antenna loading conditions. The resulting product is not just incredibly efficient but also very rugged, remarkably compact and basically very simple.

Except for the few watts required for the cooling fans and the low power sections the power losses are proportional to the output power, hence the AMPFET* Series maintains an efficiency in excess of 70% for output powers as low as 1.0 kW.



Administration to be equivalent to two separate transmitters in a Main/Standby configuration. Repair and/or replacement of a faulty module can be effected at any subsequently scheduled transmitter shut down.

The RF Driver and Audio Driver modules are duplicated in the AMPFET 5 and AMPFET 10 models; and operate in a Main/Standby configuration such that a failure of the Main module will automatically switch in the Standby module.

SOLID STATE RELIABILITY

The same stringent design criteria used by NAUTEL on their Solid State MF Aeronautical Beacon Transmitters has been applied to the AMPFET* Series Broadcast transmitters. The combination of basic reliability, redundancy and standby features, incorporated in the AMPFET* Series eliminates the need for a back-up transmitter in most applications.

The Totally Solid State AMPFET* Series eliminates the requirement for scheduled tube replacement whilst the inherent high reliability of the MOS Power FET's used throughout the high power sections results in a remarkably reliable equipment.

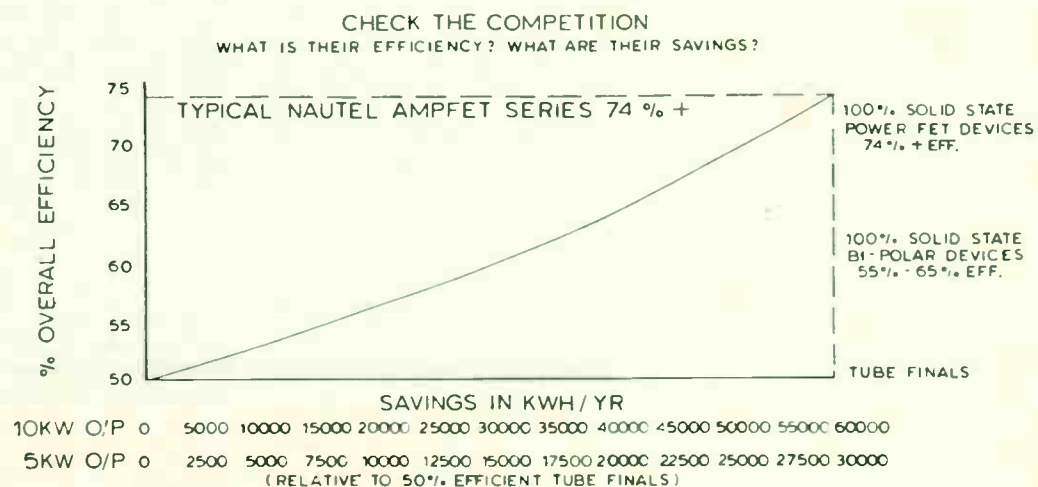
Use of the AMPFET* Series AM Broadcast transmitters means a significant reduction in power consumption, cooling requirements and operating costs.

REDUNDANCY

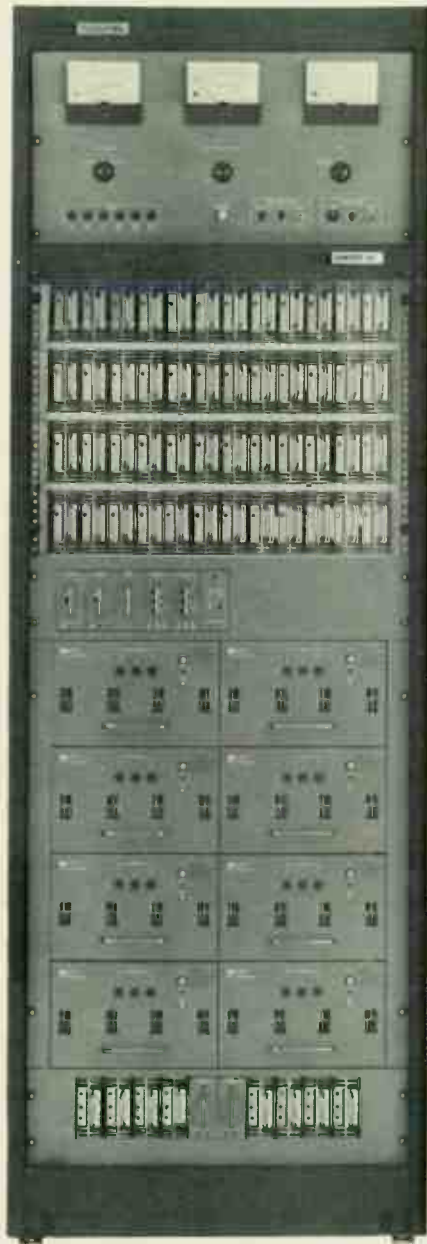
NAUTEL's Integral Modular Reserve (IMR) design of the AMPFET* Series provides inherent redundancy in the high power amplifier stages. A failure in one or more of the power amplifier modules causes a reduction in power but no OFF-AIR condition. In the AMPFET 5 and AMPFET 10, the IMR design concept is also extended to the Modulator and Rectifier/Regulator modules. NAUTEL Aeronautical and Marine Radiobeacons, which use the same basic IMR design concept, are considered by such bodies as the International Civil Aviation Organization and the U.S. Federal Aviation

PERSONNEL SAFETY

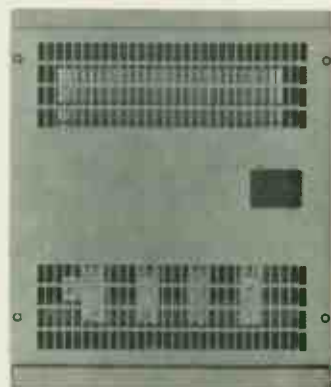
The use of all Solid State devices substantially reduces the hazard to personnel when servicing a high power transmitter. The input AC supply voltage is transformed "Down" not "Up" to provide the transmitter's High Power DC supplies. The highest DC supply voltage of the AMPFET* Series is a nominal -72 volts. Access for normal servicing is via the cabinet front door which, when open, exposes no hazardous voltages. Access to the rear of the transmitter is only required for occasional fan filter cleaning etc.



AMPFET 10



- 74% OVERALL EFFICIENCY
- 100% SOLID STATE
- POWER FET PA's AND MODULATORS
- SWITCHING MODE PA's AND MODULATORS
- 10% RESERVE POWER CAPABILITY
- 125% POSITIVE PEAK CAPABILITY
- DUAL OSCILLATORS AND RF DRIVERS
- DUAL AUDIO AND MODULATOR DRIVERS
- FAILURE RESERVE FEATURES



AMPFET* 10 SPECIFICATIONS

CONFIGURATION	8 - 1.25 kW Power Blocks Main/Standby Audio and RF Drivers
POWER OUTPUT	(Rated) 10,000 watts. (Capable) 10,600 watts. Two preset power levels between 1,000 and 10,600 watts are selectable via LOCAL or REMOTE control. (Reduction to 500 watts available on special order.)
RF FREQUENCY RANGE	535 kHz to 1705 kHz Prefitted to one frequency as ordered.
RF TERMINATING IMPEDANCE	50 ohms, unbalanced.
AUDIO FREQUENCY RESPONSE	± 0.5 dB from 50 Hz to 10,000 Hz
AUDIO HARMONIC DISTORTION	Better than 2% (THD) at 95% modulation 50-10,000 Hz (Reduced antenna bandwidth may degrade specification)
AUDIO INTERMODULATION DISTORTION	1.0% or less at 10 kW; 60/7000 Hz 1:1 ratio at 10 kW output 2.0% or less at 10 kW; 60/7000 Hz 4:1 ratio at 10 kW output SMPTE Standards at 85% modulation
AM STEREO (RF PHASE SHIFT)	Less than 2° = 0.035 radians (1 radian = 57.29°) Incidental phase at 1 kHz
MODULATION CAPABILITY	125% positive peak modulation capability.
CARRIER SHIFT	Not exceeding 3%
RF HARMONICS	80 dB or more below 10 kW output
SPURIOUS OUTPUTS	80 dB or more below 10 kW output
NOISE AND HUM (Unweighted)	60 dB or more below 100% modulation at 10 kW
FREQUENCY STABILITY	± 5 Hz or ± 5ppm whichever is greater over temperature range
AUDIO INPUT	600-150 ohms + 10 dBm nominal, adjustable ± 2 dBm
POWER INPUT	Delta 198 - 242 volts (5 steps) 3 phase 60 Hz or 385 - 465 volts (5 steps) 3 phase 50 Hz
POWER CONSUMPTION	13.5 kW at 0% modulation at 10 kW 20.0 kW at 100% modulation at 10 kW
OVERALL EFFICIENCY	74% typical
METERING	Forward/Reflected Output Power DC Input Current/Voltage to modulators/PA's Test meter facility
REMOTE CONTROL	Transmitter ON/OFF Output Power Level Remote Status of critical parameters Remote RF output power
AMBIENT TEMPERATURE/ HUMIDITY RANGE	0 - 50°C 0 - 95%
ALTITUDE	0 - 10,000 ft.
SIZE	Main Rack: 26 × 25 × 78" (66 × 63.5 × 198cm) Power Txfrmr: 20 × 19 × 24" (50.8 × 48 × 61cm)
WEIGHT	Main Rack: 734 lbs. (333 kg) Power Transformer (184 kg)
TYPE APPROVAL	DOC (CANADA) Type Approval No. 276501060 FCC Type Accepted 10 kW to 1 kW FCC Id: B3W-8A AMPFET 10

FEDERAL COMMUNICATIONS COMMISSION

WASHINGTON, D.C. 20554

GRANT OF EQUIPMENT AUTHORIZATION

TYPE ACCEPTANCE

Nautel Maine Inc
201 Target Industrial Circle
Bangor, ME 04401

Date of Grant: September 08, 1982

File No.: 31010/EQU 17.1

Attn: John Pinks

Application dated: June 02, 1982

NOT TRANSFERABLE

EQUIPMENT AUTHORIZATION is hereby issued to the named GRANTEE, and is VALID ONLY for the equipment identified hereon for use under the Commission's Rules and Regulations listed below.

FCC IDENTIFIER

B3W8GAAMPFET10

Name of Grantee

Nautel Maine Inc

Manufacturer

Nautical Electronic Laboratories Ltd (Canada)

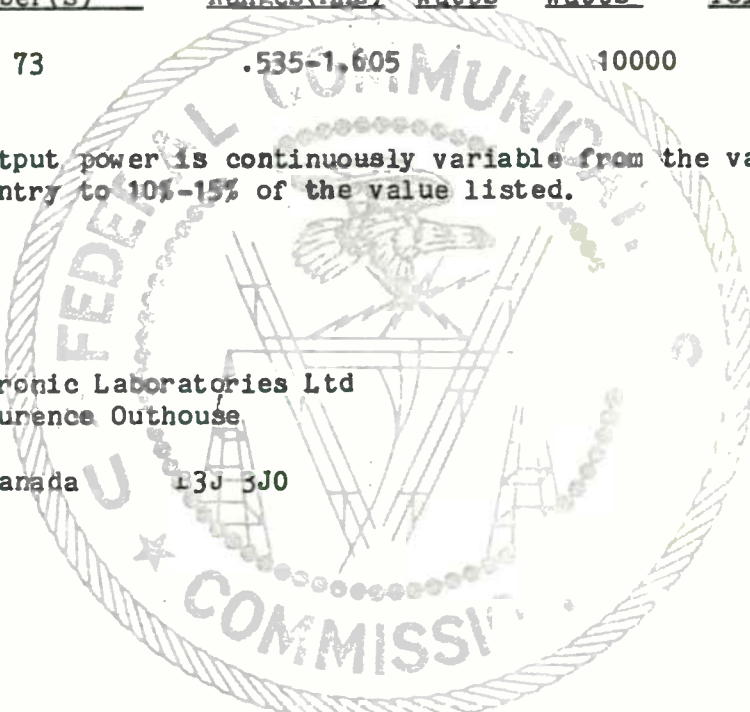
Equipment Class: Broadcast Transmitter

<u>Note(s)</u>	<u>Rule(s) Part Number(s)</u>	<u>Frequency Ranges(MHz)</u>	<u>Input Watts</u>	<u>Output Watts</u>	<u>Frequency Tolerance</u>	<u>Emission</u>
BD	73	.535-1.605		10000	-	A3

BD: The output power is continuously variable from the value listed in this entry to 10%-15% of the value listed.

MAIL TO:
Nautical Electronic Laboratories Ltd
Attention: Laurence Outhouse
Hackett's Cove
Nova Scotia, Canada

13J 3J0



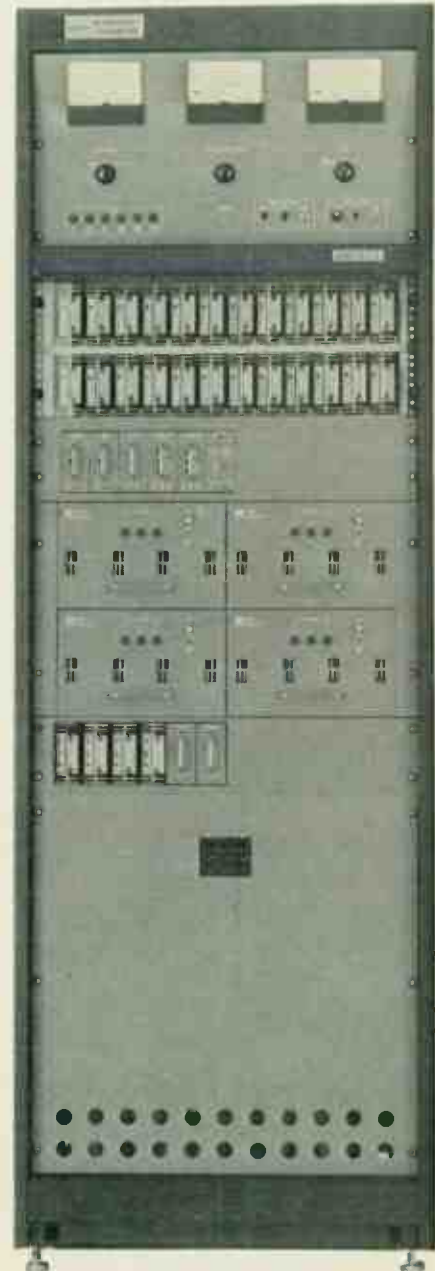
AMPFET^{*} SERIES

TOTALLY SOLID STATE
MEDIUM WAVE
BROADCAST TRANSMITTERS

5 kW AMPFET 5

AMPFET 5

- 74% OVERALL EFFICIENCY
- 100% SOLID STATE
- POWER FET PA's AND MODULATORS
- SWITCHING MODE PA's AND MODULATORS
- 10% RESERVE POWER CAPABILITY
- 125% POSITIVE PEAK CAPABILITY
- DUAL OSCILLATORS AND RF DRIVERS
- DUAL AUDIO AND MODULATOR DRIVERS
- FAILURE RESERVE FEATURES



*Trade Mark

AMPFET* 5 SPECIFICATIONS

CONFIGURATION	4 - 1.25 kW Power Blocks Main/Standby Audio and RF Drivers
POWER OUTPUT	(Rated) 5,000 watts. (Capable) 5,500 watts. Two preset power levels between 500 and 5,500 watts are selectable via LOCAL or REMOTE control. (Reduction to 250 watts available on special order.)
RF FREQUENCY RANGE	535 kHz to 1705 kHz. Prefitted to one frequency as ordered.
RF TERMINATING IMPEDANCE	50 ohms, unbalanced.
AUDIO FREQUENCY RESPONSE	±0.5dB from 50 Hz to 10,000 Hz
AUDIO HARMONIC DISTORTION	Better than 2% (THD) at 95% modulation 50-10,000 Hz (Reduced antenna bandwidth may degrade specification)
AUDIO INTERMODULATION DISTORTION	1.0% or less at 5 kW; 60/7000 Hz 1:1 ratio at 5 kW output 2.0% or less at 5 kW; 60/7000 Hz 4:1 ratio at 5 kW output SMPTE Standards at 85% modulation
AM STEREO (RF PHASE SHIFT)	Less than 2° = 0.035 radians (1 radian = 57.29°) Incidental phase at 1 kHz
MODULATION CAPABILITY	125% positive peak modulation capability.
CARRIER SHIFT	Not exceeding 3%
RF HARMONICS	80 dB or more below 5 kW output
SPURIOUS OUTPUTS	80 dB or more below 5 kW output
NOISE AND HUM (Unweighted)	60 dB or more below 100% modulation at 5 kW
FREQUENCY STABILITY	±5 Hz or ±5ppm whichever is greater over temperature range
AUDIO INPUT	600/150 ohms + 10 dBm nominal, adjustable ±2 dBm
POWER INPUT	Delta 198 - 242 volts (5 steps) 3 phase 60 Hz or 385 - 465 volts (5 steps) 3 phase 50 Hz
POWER CONSUMPTION	6.8 kW at 0% modulation at 5 kW 10.0 kW at 100% modulation at 5 kW
OVERALL EFFICIENCY	74% typical
METERING	Forward/Reflected Output Power DC Input Current/Voltage to modulators/PA's Test meter facility
REMOTE CONTROL	Transmitter ON/OFF Output Power level Remote Status of critical parameters Remote RF output power
AMBIENT TEMPERATURE/ HUMIDITY RANGE	0 - 50°C 0 - 95%
ALTITUDE	0 - 10,000 ft.
SIZE	Rack: 26 × 25 × 78" (66 × 63.5 × 198cm)
WEIGHT	Rack: 872 lbs. (395.5 kg.)
TYPE APPROVAL	DOC (CANADA) Type Approval No. 276501059 FCC Type Accepted 5 kW to 500 W FCC Id: B3W8A AMPFET 5

FEDERAL COMMUNICATIONS COMMISSION

WASHINGTON, D.C. 20554

GRANT OF EQUIPMENT AUTHORIZATION

TYPE ACCEPTANCE

Nautel Maine Inc
201 Target Industrial Circle
Bangor, ME 04401

Date of Grant: May 05, 1982

File No.: 31010/EQU-17.3

Attn: John Pinks

Application dated: February 15, 1982

NOT TRANSFERABLE

EQUIPMENT AUTHORIZATION is hereby issued to the named GRANTEE, and is VALID ONLY for the equipment identified hereon for use under the Commission's Rules and Regulations listed below.

FCC IDENTIFIER: B3W8GAAMPFET 5
Name of Grantee: Nautel Maine Inc
Manufacturer: Nautical Electronic Laboratories Ltd (Canada)

Equipment Class: Broadcast Transmitter

<u>Note(s)</u>	<u>Rule(s) Part Number(s)</u>	<u>Frequency Ranges(MHz)</u>	<u>Input Watts</u>	<u>Output Watts</u>	<u>Frequency Tolerance</u>	<u>Emission</u>
-	73	.535-1.605	-	5000	-	A3
-	73	.535-1.605	-	2500	-	A3
-	73	.535-1.605	-	1000	-	A3
-	73	.535-1.605	-	500	-	A3

REDUNDANCY

In addition to the previously mentioned redundancy incorporated in the AMPFET 5 and AMPFET 10, these transmitters include two 24/15 volt DC Power Supply Modules operating in an isolated parallel configuration. Multiple fans provide redundancy in the cooling system and are designed to supply sufficient air flow such that a failure on any one fan will not cause overheating within the transmitter. Only those passive components with very high reliability, such as mains transformers, chokes and the RF output filters are not provided with some form of redundancy.

SERVICEABILITY AND ACCESSIBILITY

Full field servicing and parts replacement was kept in mind when the physical layout was designed. Access to all plug-in modules is via the front door of the transmitter cabinet. Visual indication, metering and module test points are available to isolate a faulty module which may then be serviced at a regularly scheduled maintenance period. Module replacement may be carried out at any scheduled maintenance shut-down WITHOUT any unexpected OFF-AIR time and without ANY additional stress on the remaining operational modules in the meantime; or by going 'off the air' during a 30 second station break.

PERSONNEL SAFETY

The total elimination of tubes substantially reduces the hazard to personnel when servicing the AMPFET series of broadcast transmitters. The AC input voltage is transformed "DOWN" not "UP" to provide the high power DC supplies. The highest DC supply voltage of the AMPFET series is a

nominal 72 volts DC. Access for normal servicing is via the cabinet front door which, when open, exposes NO hazardous voltages. Finally, the transmitter interlock circuit which is fitted to the cabinet rear panels also includes terminals for external activation.

REMOTE CONTROL

Selection of local or remote control of the AMPFET series is provided on the control panel. Remote control, when fitted, provides for a transmitter ON/OFF function as well as a carrier output level selection. Remote status outputs are provided for all critical monitor functions.

AM STEREO

The AMPFET 5 and AMPFET 10 both offer the utmost flexibility to accommodate AM STEREO with their standard dual RF DRIVER configuration, without sacrificing any of the inherent redundancy of this AMPFET series. For AM STEREO, NAUTEL will provide a plug-in STEREO interface to replace the main RF DRIVER Module. This will not affect the changeover facility to the standby RF DRIVER Module in the event of the loss of RF DRIVE from either the AM STEREO generator or the STEREO interface. Changeover to the standard MONO standby RF DRIVER can be effected manually to allow for servicing of the STEREO generator. Alternatively, both RF DRIVER units may be replaced by STEREO interfaces to allow for dual AM STEREO generators. However, it must be kept in mind that changeover from main to standby is activated by loss of RF drive from the stereo interface. Loss of phase modulation, would simply result in a MONO transmission, without automatic changeover to either the standby RF DRIVER or the standby STEREO interface.

FCC AND DOC (CANADA) TYPE ACCEPTED
MEETS OR EXCEEDS APPLICABLE IEC REQUIREMENTS

FOR FURTHER DETAILS PLEASE CONTACT

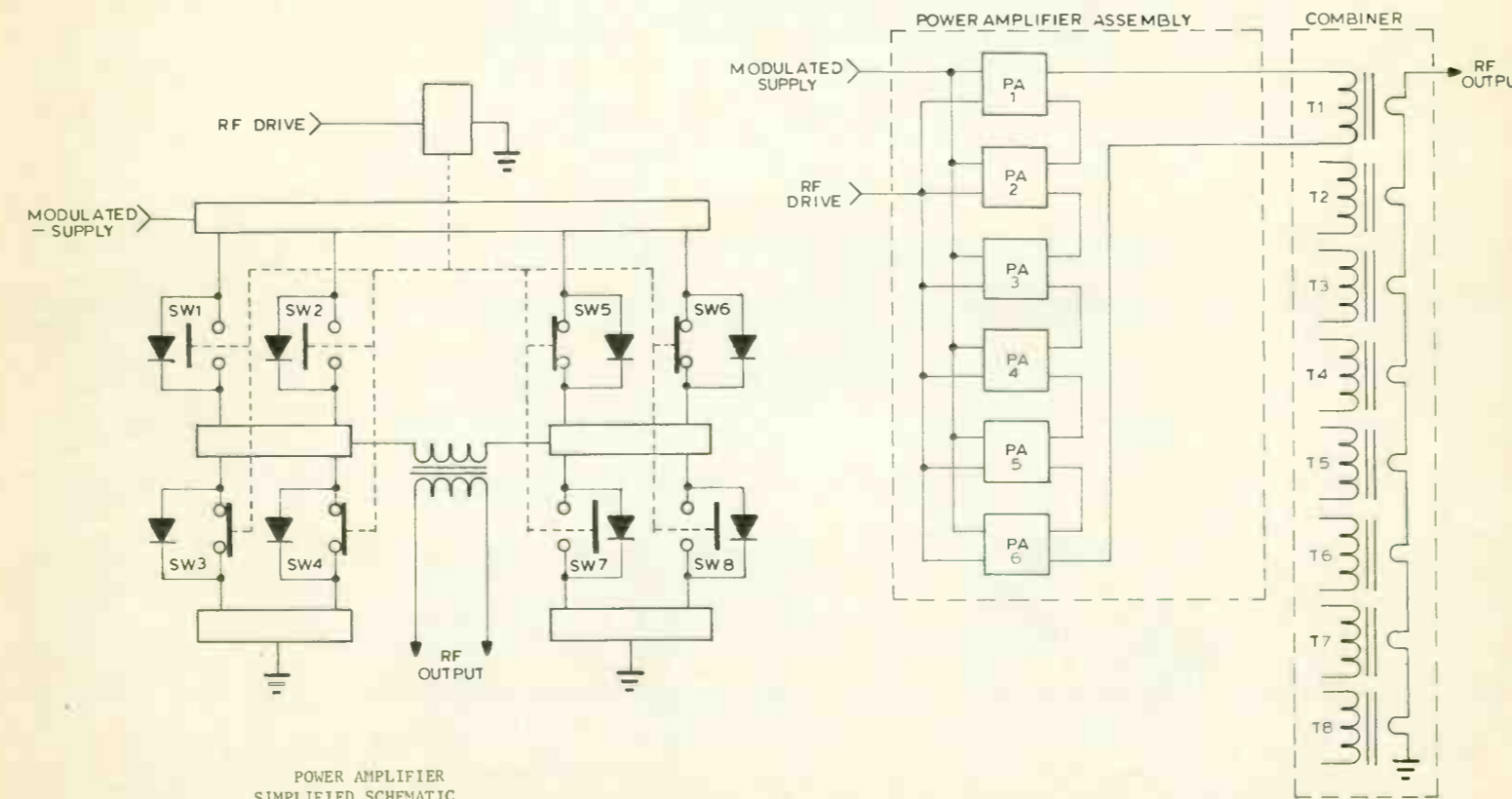
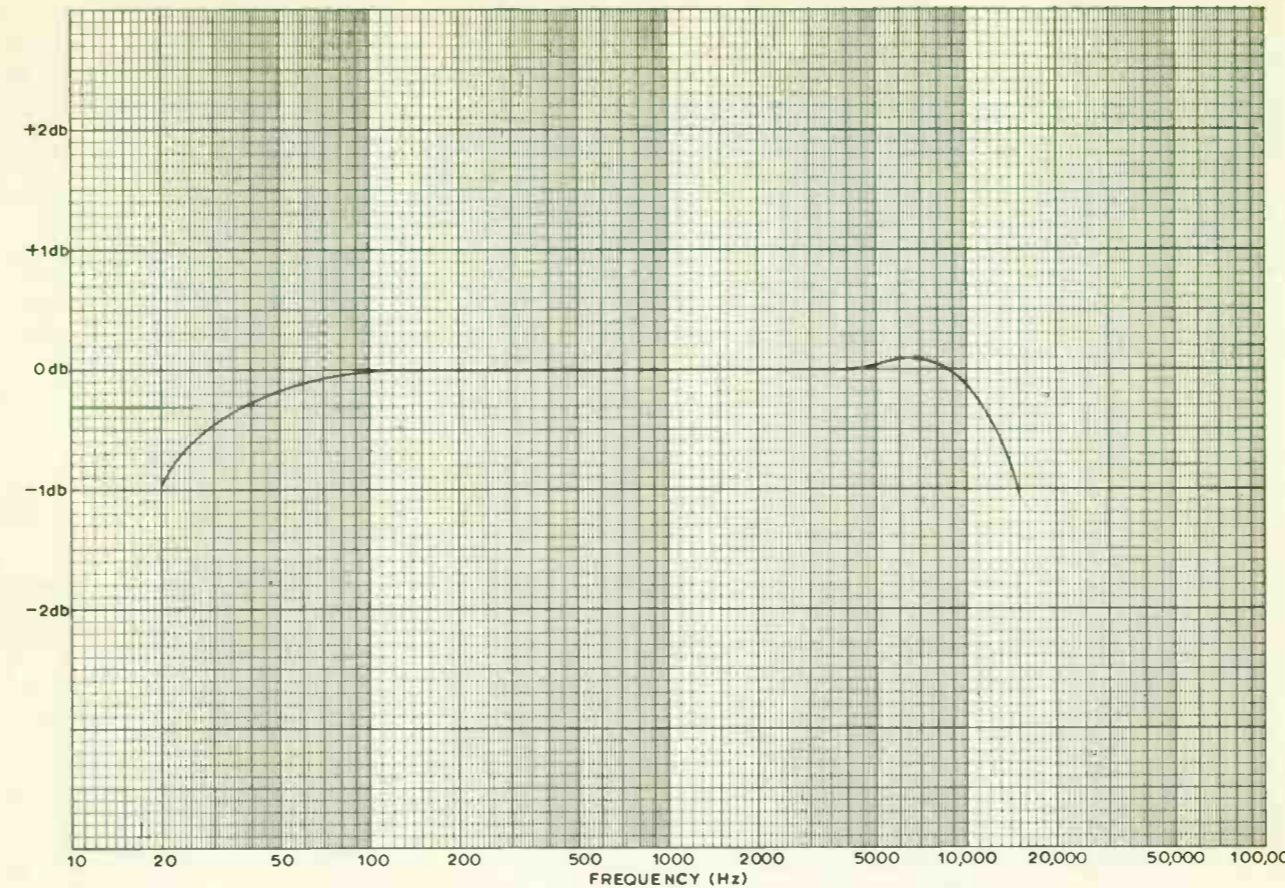
Nautical Electronic Laboratories Limited
R.R. #1, Tantallon, Halifax County,
Nova Scotia, Canada B0J 3J0

Phone (902) 823-2233
Telex: 019-22552

Nautel Maine Inc.
201 Target Industrial Circle
Bangor, Maine 04401 U.S.A.

Phone (207) 947-8200
Telex: 944466

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE



POWER AMPLIFIER
SIMPLIFIED SCHEMATIC
AMPFET® SERIES BROADCAST TRANSMITTER

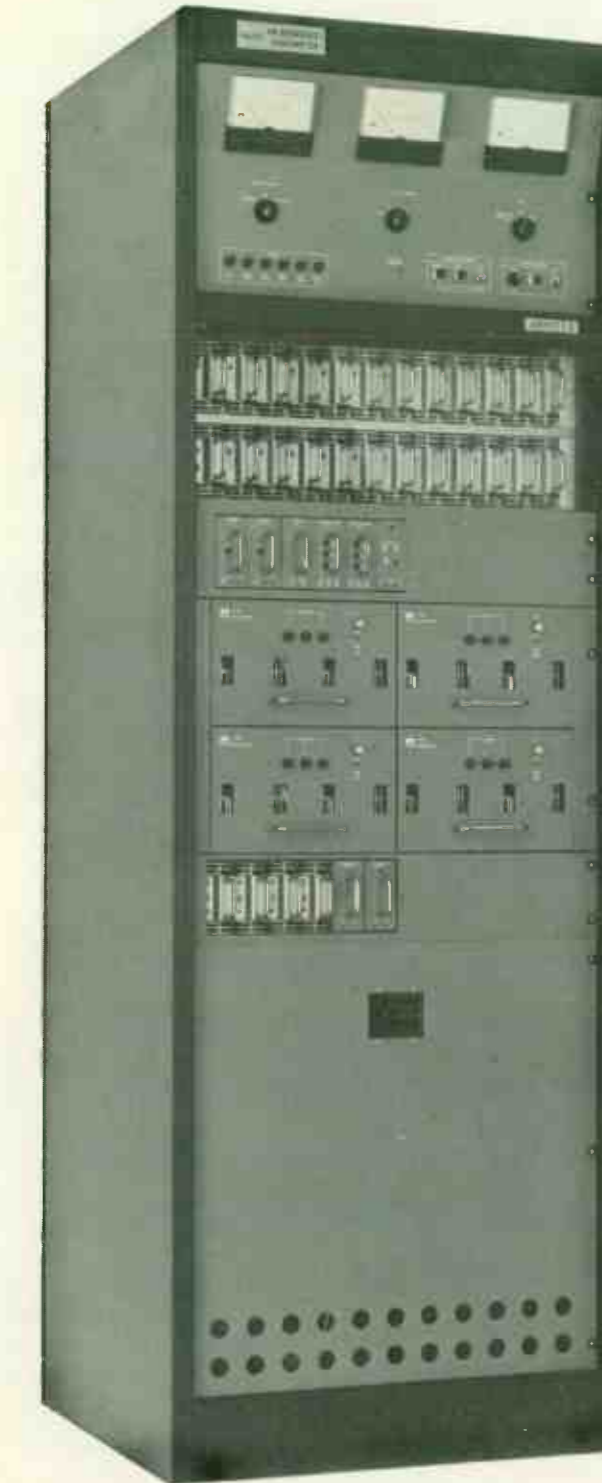
SIMPLIFIED RF OUTPUT SCHEMATIC
AMPFET® SERIES BROADCAST TRANSMITTERS



AMPFET[®] SERIES

TOTALLY SOLID STATE
MEDIUM WAVE
BROADCAST TRANSMITTERS

5 kW AMPFET 5
10 kW AMPFET 10



AMPFET 5

GENERAL

These transmitters bring together NAUTEL's exclusive 15 year experience with the design of totally solid state high power LF/MF transmitters, some of the recent circuit design from our research laboratories, and the exciting capabilities of the new Power MOSFET devices now available. The result is a 100% solid state Modular transmitting system which is remarkably efficient, basically very simple, and with some truly unique features which management and engineering will readily appreciate.

CONFIGURATION

The exceptionally high overall transmitter efficiency, nominally 74% AC in to RF out, has resulted in very low waste heat generation. This has enabled NAUTEL to achieve a remarkably compact mechanical design for both the overall transmitter and the individual modules, WITHOUT compromising component accessibility which is so necessary for field servicing.

The 5 kW & 10 kW AMPFET AM Broadcast transmitters are housed in standard 24" panel width cabinets. The 5 kW AMPFET 5 is completely self contained in a standard 24" panel cabinet 78" high. The 10 kW AMPFET 10 electronics are completely self contained in an identical cabinet, but the STEP-DOWN power transformer is separately housed in its own small cabinet. This is normally situated immediately adjacent to the transmitter (see specifications). In both transmitters, a metering and control panel is mounted above the plug-in modules. A hinged door, which can be locked for additional security, covers the plug-in modules.

*Trade Mark

CONTROL AND METERING

Comprehensive metering facilities have been incorporated in the AMPFET 5 and AMPFET 10 transmitters for all operating voltages, currents, and power levels. Status lamps show the operator at a glance whether the transmitter is operating normally or in a "RESERVE" mode. Any module failure is visually pin-pointed for rapid identification. Furthermore, a built-in test meter facility is provided for detailed checks of all test points on each individual module. Each transmitter contains interfaces for EXTENDED OPERATION and/or REMOTE CONTROL. In addition to the ON/OFF and POWER LEVEL control functions, remote status outputs are provided for all critical monitor functions.

BLOCK DIAGRAM

The overall simplicity of the AMPFET design is readily apparent from the block diagram. It should be particularly noted that the RF and Modulator Driver stages are duplicated. Automatic changeover in the event of a failure provides full, built-in, redundancy in these low level stages. All other stages in the AMPFET 5 and AMPFET 10 transmitters feature NAUTEL's Integral Modular Reserve (IMR) design, which provides for continued operation at slightly reduced output in the event of a module failure. Operation under these conditions does not degrade the overall efficiency or place any additional stress on the remaining operational modules, so that repair or replacement may be effected at the next regularly scheduled maintenance period.

RF DRIVER MODULES

The AMPFET 5 and AMPFET 10 transmitters have two RF Driver Modules which are arranged in a Main/Standby configuration. Each unit contains an RF oscillator which runs at $4 \times F_c$ for carrier frequencies below 1MHz and $2 \times F_c$ for carrier frequencies above 1MHz. In order to minimize the number of different solid state devices, the output circuit employs POWER MOSFETS of the same type as those used in the MOSFET POWER AMPLIFIERS.

Visual indication of any changeover to the Standby RF Driver Module is displayed on the monitor panel and via the remote control system, if fitted.

MODULATOR DRIVER MODULES

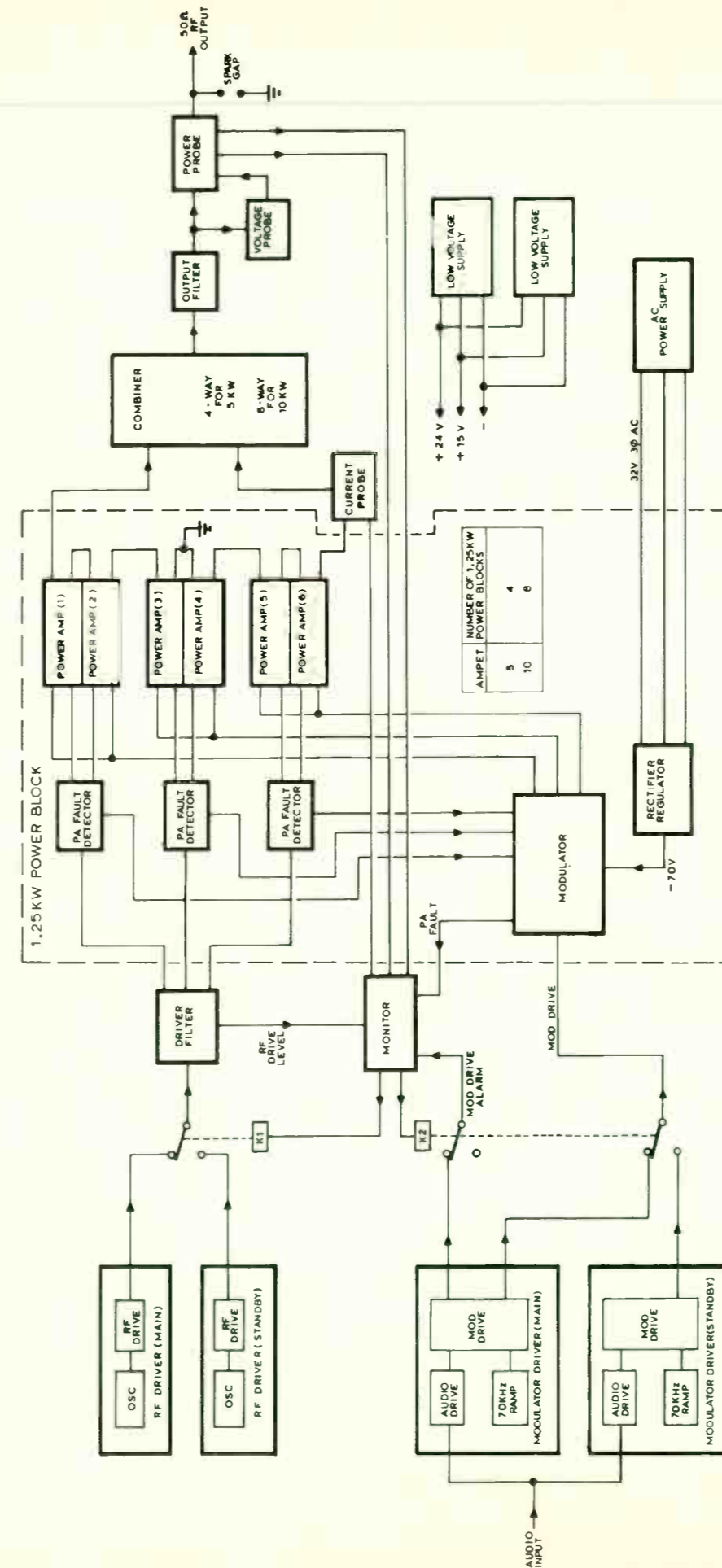
The low level Modulator Driver Modules provide incoming audio level control as well as generating the modulator drive signals. Again, the Modulator Driver Modules are duplicated in the AMPFET 5 and AMPFET 10 transmitters with automatic switch-over in the event of a failure. Visual indication of a changeover is displayed on the monitor panel and remotely with the remote control system, if fitted. Modulator output level is screwdriver adjusted on the low level Modulator Driver Module. Access to the adjustment control is from the front of the transmitter.

MODULATOR MODULES

The NAUTEL Modulator Module is a unique design which uses the same POWER FET's as the other AMPFET transmitter stages. Generically, it is a development of the switched mode modulator and utilizes a highly linear switched regulator with a nominal 70 kHz switching frequency. It has excellent frequency response and achieves an efficiency of 95%. Multiple Modulator Modules provide IMR in the AMPFET 5 and AMPFET 10 Transmitters.

MOSFET POWER AMPLIFIER MODULES

A simplified circuit diagram of the MOSFET Power Amplifier Module is shown on the back page. Each Power FET is represented by a switch in parallel with a reverse biased diode. These switches are controlled by the RF Drive which in practice, is applied to the gates of the diametrically opposite Power FET's via push-pull transformers. This bridge arrangement of paralleled Power FET's, with push-pull drive, yields an alternating polarity square wave voltage across the RF output transformer, at the frequency of the RF drive signal, with peak to peak voltages of twice the value of the



AMPFET 5 - AMPFET 10
SYSTEM BLOCK DIAGRAM

modulated supply voltage. The very low forward resistance of the Power FET devices has made it possible to achieve a PA module efficiency of 88% at a power output of 250 watts. The outputs of six 250 watt PA Modules are combined as shown in the block diagram which together with their associated Modulator and Rectifier/Regulator assemblies, form a "POWER BLOCK" very conservatively rated at 1.25 kW.

OUTPUT POWER STAGE

The modular "POWER BLOCK" design concept described above, forms the basis of the AMPFET Series of broadcast transmitters. The AMPFET 5 and AMPFET 10 transmitters consist of 4 and 8 "POWER BLOCKS" respectively, operated in series with their outputs added in the RF combining unit.

The AMPFET series transmitters are designed to withstand both open and short circuit antenna conditions.

PROTECTIVE CIRCUITS

THE AMPFET series is protected by a circuit breaker located on the Power Transformer unit, which also serves as an emergency shut down. Each Modulator Module is protected by three load isolation relays controlled by the PA Fault Detectors.

The Rectifier/Regulator Modules incorporate fuses, high voltage sensors and control systems which protect the transmitter from short term surges on the AC input supply, and provide regulation for high AC voltages. Low AC inputs will not damage these transmitters. RF output is held within stated specifications as long as the AC input does not fall below a pre-determined minimum value. If the AC input continues to fall below this value, then the RF output will fall, without degradation of other specifications, in proportion, until a low RF drive condition causes a complete shut down. The RF

Output Filter design includes an RF Power Probe and an RF Voltage Probe, as well as a spark gap which is located at the transmitter output terminal.

When a transient high reflected VSWR condition occurs, the System Monitor Module responds to signals generated by the RF Power and RF Voltage probes and initiates a 1.5 second shutdown followed by a return to full output. This recycling under transient high VSWR conditions e.g. static arcing of the antenna system, is not limited to a finite number of cycles, but will recycle indefinitely.

Should the reflected power level be of a continuous nature, the System Monitor Module will automatically reduce the RF output. This fully automatic 'POWER FOLDBACK' will maintain the RF output at a maximum level consistent with a safe reflected power level under all variations of antenna mismatch.

The AMPFET series RF Power Probe also initiates recycling when the average power output exceeds a safe level.

SYSTEM MONITOR MODULE

In addition, the System Monitor Module senses any malfunction in the following circuits and initiates the corresponding alarm; PA Failure, RF Drive Failure, Modulation Failure, High Reflected RF Power and High Temperature. The System Monitor Module also initiates the changeover in the AMPFET 5 and AMPFET 10 transmitters between main and standby low level RF and Modulator Driver Modules; in the unlikely event of any malfunction within these units.

TUNING

The AMPFET series output filter network is supplied pre-tuned to the customer's operating frequency. The only adjustment required on site is fine tuning the low level RF drive to the Power Amplifier Blocks.