

Nautel Limited FM 3.5 kW, 5 kW, 8 kW Totally Solid State FM Broadcast Transmitters

Nautel Solid State Technology for Value

RUGGED SOLID STATE MODULAR DESIGN

- No tubes to replace
- No routine tuning or adjustments
- 65% typical overall efficiency

NAUTEL PATENTED COMBINING TECHNIQUE

- Failure isolation between PA's
- Multiple power amplifier redundancy
- On-air serviceability

RF POWER MODULES

- Each with its own ventilation fan
- Each comprised of four individual PA's
- Easily removable for service

SINGLE OR THREE PHASE POWER SUPPLY

- Maintains stable RF output level
- Safe 50V DC supply

EASY TO OPERATE AND MAINTAIN

- Simple control and status display
- Automatic VSWR foldback
- Automatic AC restart with alarm memory

NE50, 50 WATT DIGITAL FM EXCITER

- Frequency modulated signal created using Direct Digital Synthesis technology
- Accepts AES/EBU format digital audio via electrical or optical connection
- Built-in digital stereo generator
- Available with standard analog composite interface for later upgrade to digital input



Simply the best engineered transmitters



NAUTEL FM5

NAUTEL FM3.5, FM5 and FM8

Transmitters offer FM Broadcasters the many benefits of digital performance and solid state reliability.

High efficiency results in low power consumption and cool reliable operation.

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NAUTEL FM3.5/FM5/FM8 TECHNICAL DESCRIPTION

RF Output

Output power levels of up to 3,850 watts for the FM3.5, 5,500 watts for the FM5 and 8,800 watts for the FM8 are provided by single stage Power Amplifiers (P.A.), four per Power Module. Each transmitter consists of a number of Power Modules plus an IPA. The FM3.5 has three Power Modules, the FM5 four Power Modules and the FM8 seven Power Modules. Outputs of the individual P.A.'s are combined in a patented NAUTEL 60° combiner.

The combiner/output filter assembly is tuned to provide the correct impedance matching and harmonic rejection.

A Power Module may be removed from the transmitter for servicing without shutdown. The VSWR on the remaining P.A.'s will not exceed 1.5:1 and is characterized by a high load impedance condition. The result is no increased heat and no power wastage. This is a significant improvement over conventional designs using balanced hybrids with imbalance loads, which must dissipate half of the rf power imbalance.

Power Module

The Power Module provides mounting and heat sinking for four individual single stage power amplifiers.

Each power amplifier consists of a single stage push-pull configuration with tuned input and output networks. Each amplifier has a bandwidth of over 8.0 MHz, ensuring fidelity. The rf out to dc in efficiency varies from 80% at 88 MHz, to 73% at 108 MHz. A single rf input to each Power Module at 50 ohms is passed through a four way wideband isolating splitter. This provides an individual rf drive to each amplifier stage.

Each Power Module has its own brushless dc ventilation fan and thermal protection. Individual power amplifiers are monitored and local/remote failure alarms provided.

The output power level for each Power Module is controlled by varying its dc supply voltage. Servicing can be safely conducted while on-air by switching off the associated breaker switch, disconnecting the appropriate cables and removing the entire Power Module.

Intermediate Power Amplifier (IPA)

The RF drive signal to the Power Modules is provided from an Intermediate Power Amplifier (IPA) via a broadband splitter. Two amplifiers, identical to the Power Module amplifiers, are used in the IPA. Each amplifier has fifty percent less thermal stress than the Power Module Amplifiers. In the unlikely event that an IPA stage fails, it is possible to utilize a Power Module.



Power Module

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NAUTEL Features and Advantages

Power Supply

Performance features enhance the power supply system. An ac line transformer ensures good overall isolation. Rectifiers give a pulse rectification system with a power factor of 0.9.

Output Power Control and VSWR Protection

The output level of the transmitter is a function of the dc supply voltage fed to the Power Modules. Inputs include two signals: a manual output control and VSWR Protection controls.

At higher reflected power levels, the transmitter output is decremented via a counting circuit to maintain the rf output at the maximum safe level. This prevents damage from working into VSWR's of up to 5:1, beyond which the transmitter shuts down.

NAUTEL FM broadcast transmitters capitalize on NAUTEL's more than 25 years experience designing and building solid state transmitters. Early solid state FM transmitters were primarily used as multichannel reserve transmitters because of high cost and poor operating efficiency. NAUTEL FM transmitters are the first cost-effective solid state designs with emphasis on performance and efficiency required for continuously operated main transmitters.

NAUTEL Reliability

NAUTEL FM solid state transmitters have exceptional efficiency compared with other designs. Semiconductor devices are mounted directly on the module heat sink rather than resorting to pallets to overcome critical thermal interfaces. Simply put, these solid state transmitters have up to 40% less waste heat to dissipate than other solid state designs.

Power Amplifiers use NAUTEL original soft failure techniques. Loss or removal of a complete module only results in a small reduction of output. This, coupled with on-air serviceability, means repairs can be carried out during the day, minimizing nighttime or emergency service calls.

NAUTEL Savings

The high overall rf out to ac in efficiency produces less waste power than other solid state designs, and results in significant direct energy savings and indirect savings in cooling the transmitter building.

The solid state design provides measurable savings over a vacuum tube transmitter. Vacuum tubes wear out, MOSFET's do not. Neither do MOSFET's age, so routine monthly adjustments and emergency tube replacements become things of the past.

NE50 Exciter



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Power Amplifier repairs can be made by direct replacement of the MOSFET's while remaining on -air.

NAUTEL Digital Performance

The FM3.5, FM5 and FM8 transmitters are supplied with an integral NAUTEL Exciter, Model NE50, featuring the exceptional performance provided by Direct Digital Synthesis. This technique eliminates the voltage controlled oscillator (VCO) normally used to generate frequency modulation. Such circuits have critical biasing for linearity and are more susceptible to microphonics. The transmitter performance is specified as a complete system with the NE50 Exciter operating with a direct digital AES/EBU format input signal. Connection may be via either XLR electrical or optical interface.

The system FM signal to noise and distortion specifications provide on-air signals without compromise.

Analog composite input is also available. This may be field upgraded to an AES/EBU digital input at the broadcasters convenience.

ISO 9001

NAUTEL Limited has successfully implemented a quality system in conformance with the requirements of, and currently maintains ISO9001 Quality System Registration.

Is your concern:

- Performance and Sound Quality?
- Reliability and Reduced Maintenance?
- Efficiency and Power Savings?
- Going All-Digital?
- All of the above?

A **NAUTEL FM3.5, FM5** or **FM8** transmitter with NE50 Exciter is the system that provides the best value solution!

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FM3.5, FM5 and FM8 SPECIFICATIONS

Operating with NE50 50 Watt Digital FM Exciter

FM3.5 SPECIFICATIONS

Configuration: 3 RF Power Modules and 1 IPA Module

Power Output: 1750-3850 Watts

Output Connector: 1 5/8 inch EIA flange, female

AC Power Supply: 200-250V, 50/60Hz, single phase

Power Consumption (typical):

5380 watts at 3500 watts output

Size: Centimeters 74W x 80D x 186H

Inches 29W x 31.5D x 73.5H

0.59 sq.m, 6.3 sq.ft. of floor space

Weight: 364 kg, 800 lbs.

FM5 SPECIFICATIONS

Configuration: 4 RF Power Modules and 1 IPA Module

Power Output: 2500-5500 Watts

Output Connector: 1 5/8 inch EIA flange, female

AC Power Supply: 200-250V, 50/60Hz, single phase 193-248V or 361-460V, 50/60Hz, three phase

Power Consumption (typical):

7690 Watts at 5000 Watts output

Size: Centimeters 74W x 80D x 186H

Inches 29W x 31.5D x 73.5H

0.59 sq. m, 6.3 sq.ft. of floor space

Weight: 397 kg, 860 lbs.

FM8 SPECIFICATIONS

Configuration: 7 RF Power Modules and 1 IPA Module

Power Output: 4000-8800 Watts

Output Connector: 1 5/8 inch EIA flange, female

AC Power Supply: 200-250V, 50/60Hz, single phase 193-248V or 361-460V, 50/60Hz, three phase

Power Consumption (typical):

12300 Watts at 8000 Watts output

Size: Centimeters 74W x 80D x 186H

Inches 29W x 31.5D x 73.5H

0.59 sq. m, 6.3 sq.ft. of floor space

Weight: 435 kg, 960 lbs.

GENERAL SPECIFICATIONS

RF Terminating Impedance: 50 ohms resistive, unbalanced

VSWR: 1.5:1 (automatic power reduction into higher VSWR's)

RF Harmonics/Spurious Outputs:

Exceeds FCC/DOC/CCIR requirements

Excitation: NAUTEL NE50 Exciter

Asynchronous AM Noise: 60dB

minimum below reference carrier with 100% amplitude modulation using 75 μ s de-emphasis (no FM modulation present)

Synchronous AM Noise: 50dB

minimum below reference carrier with 100% amplitude modulation at 400 Hz using 75 μ s de-emphasis

Frequency Range: 87.5 to 108 MHz, tuned to specific carrier frequency.

Frequency Stability: \pm 250Hz, 0°C to 50°C ambient temperature range

Modulation Type: Direct Digital Synthesis using a 32-bit NCO (numerically controlled oscillator)

Exciter Display: Backlit 4½ digit and 32 character displays for control, monitor and status. Alarm log holds up to 99 entries in reverse chronological order.

Modulation Capability: 150% (\pm 75 kHz reference standard)

Modulation Indication: Colour coded LED bargraph indicating total modulation depth in 5% increments

Overall Efficiency: 65% typical rf out to ac in

Total Power Factor: 0.9

Temperature Range: 0°C to 50°C, Derate 2°C/1000 ft., 3°C/500m

Altitude: To 13,000 feet (4000 meters)

Relative Humidity: To 95%, non-condensing

STEREO PERFORMANCE WITH DIGITAL INPUT MODULE (Standard)

Input Connector: Two total; one XLR female, one optical input receiver

XLR Input Impedance: 110 ohms, nominal

Input Level: -4.0dB full scale reference, factory programmed

Data Format: AES/EBU (reference standards; AES5-1984, ANSI S4.28-1984, AES3-1985, ANSI S4.40-1992 and AES3-1992)

Data Rate: Any in range 25kHz to 55kHz (32, 44.1 or 48kHz typically)

Digital Stereo Generator: The digital input module generates the composite stereo baseband signal from the left and right digital audio present in the AES/EBU data

Pre-Emphasis: 0, 25, 50 or 75 μ s, locally selectable

Pilot Carrier: 19kHz \pm 0.1Hz. 9% injection level, factory programmed. Locally Selectable on or off. Available on rear panel BNC jack, as TTL or 1vpp sine for RBDS operation.

38kHz Suppression: 80dB below \pm 75Hz deviation reference

Stereo Separation: Better than 60dB, 30Hz to 15kHz

Amplitude Response (L or R): \pm 0.2dB, 30Hz to 15kHz, referenced to 0dB at 400Hz

FM Signal to Noise Ratio (L or R): 80dB below 100% modulation (Reference 400Hz, measured in a 22Hz to 22kHz bandwidth with 75 μ s de-emphasis and DIN 'A' weighting)

Stereo Total Harmonic Distortion (L or R): 0.025% or less, 30Hz to 15kHz, measured in 22Hz to 22kHz bandwidth with 75 μ s de-emphasis

Intermodulation Distortion (L or R): CCIF: 0.008% or less (14/15kHz 1:1); SMPTE: 0.025% or less (60 and 7000Hz 1:1)

Transient Intermodulation Distortion (DIM) (L or R): 0.05% or less (2.96kHz square wave/14kHz sine wave)

Stereophonic Crosstalk: 60dB below 100% (30Hz-15kHz) modulation reference: L+R to L-R and L-R to L+R

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Stereo/Monaural Mode Control:

Local control. Configures the digital audio receiver to accept both L and R (Channel A and B) in stereo mode or L only (Channel A) in monaural mode

Backup Analog Composite Mode:

Local/Remote control. Disables digital stereo generator and reconfigures digital input module to accept analog composite stereo on existing composite input connector located on rear panel. All SCA inputs remain valid.

WIDEBAND COMPOSITE OPERATION WITH ANALOG INPUT MODULE

Inputs: One balanced (floating BNC jack), one unbalanced (BNC jack), one unbalanced front panel test input (BNC jack)

Input Impedance: Balanced - 10 k/50 ohm selectable Unbalanced - 10 k ohm

Input Level: 3.5V p-p nominal for ± 75 kHz deviation

Amplitude Response: ± 0.05 dB 30Hz to 53kHz

FM Signal to Noise Ratio: 90dB below 100% modulation (Reference 400Hz at ± 75 kHz deviation with 75 μ s de-emphasis and DIN 'A' weighting 20Hz to 80kHz bandwidth)

Harmonic Distortion: 0.005% or less at 400Hz measured in a 22Hz to 80kHz bandwidth with 75 μ s de-emphasis

CCIF Intermodulation Distortion: 0.009% or less (15kHz/14kHz 1:1 ratio)

SMPTE Intermodulation

Distortion: 0.015% or less (60Hz/7kHz 1:1 ratio)

Transient Intermodulation

Distortion: 0.015% or less (2.96kHz square wave/14kHz sine wave)

Composite Phase Response: $\pm 0.5^\circ$ from linear phase 30Hz to 53kHz

Stereo Separation: Better than 50dB, 30Hz to 15kHz when measured in conjunction with a high quality stereo generator and demodulator

MONAURAL PERFORMANCE WITH ANALOG INPUT MODULE

Input Impedance: 600 ohms balanced, resistive, transformerless

Input Level: +10 dBm nominal for ± 75 kHz deviation at 400Hz (adjustable)

Frequency Response: ± 0.5 dB (30Hz to 15kHz) selectable flat, 25, 50, or 75 μ s pre-emphasis

FM Signal to Noise Ratio: 90dB below 100% modulation (Reference 400Hz at ± 75 kHz deviation with 75 μ s de-emphasis and DIN 'A' weighting in a 22Hz to 22kHz bandwidth)

Harmonic Distortion: 0.005% or less at 400Hz measured in a 22Hz to 22kHz bandwidth with 75 μ s de-emphasis

CCIF Intermodulation Distortion: 0.009% or less (15kHz/14kHz 1:1 ratio)

SMPTE Intermodulation Distortion: 0.015% or less (60Hz/7kHz 1:1 ratio)

Transient Intermodulation Distortion: 0.015% or less (2.96kHz square wave/14kHz sine wave)

SCA (RBDS/RDS) PERFORMANCE

Inputs: 3 Unbalanced (BNC jack)

Input Impedance: 10 K ohm

Input Level: 2.8V p-p nominal for ± 7.5 kHz deviation

Amplitude Response: ± 0.5 dB 20kHz to 100kHz

Subcarrier Frequency Range: 57kHz to 92kHz (25kHz to 92kHz monaural)

ANALOG BACKUP OPERATION WITH DIGITAL INPUT MODULE

Input Connector: One unbalanced (BNC jack)

Input Impedance: 10K ohm

Input Level: 3.5V p-p nominal for ± 75 kHz deviation

Amplitude Response: ± 0.2 dB, 30Hz to 53kHz

FM Signal to Noise Ratio: 85dB below 100% modulation (Reference 400Hz at ± 75 kHz deviation with 75 μ s de-emphasis and DIN 'A' weighting 20Hz to 80kHz bandwidth)

Harmonic Distortion (plus noise): 0.02% or less, 30Hz to 53kHz, measured in 22Hz to 80kHz bandwidth with 75 μ s de-emphasis

Stereo Separation: Better than 38dB, 20Hz to 15kHz when measured in conjunction with a high quality stereo generator and demodulator.

CCIF Intermodulation Distortion: 0.009% or less (15kHz/14kHz 1:1 ratio)

SMPTE Intermodulation Distortion: 0.02% or less (60Hz/7kHz 1:1 ratio)

Transient Intermodulation Distortion: 0.015% or less (2.96kHz square wave/14kHz sine wave)

Specifications established at rated power unless otherwise noted. All measurements at 50 ohms resistive load; AC input voltage at nominal level. Specifications subject to change without notice.



Simply the best engineered transmitters

For further information, please contact us at:

Nautel Limited, Hackett's Cove, RR#1 Tantallon, Nova Scotia, Canada B0J 3J0
Phone: (902) 823-2233 Fax: (902) 823-3183 **ISO9001 Registered**

Nautel Maine, Inc., 201 Target Industrial Circle, Bangor, Maine, USA 04401
Phone: (207) 947-8200, Fax: (207) 947-3693 **ISO9002 Registered**

E-Mail: info@nautel.com or visit us on the Web at www.nautel.com