“High power, digitally controlled, efficient, RF designs and solutions”

Introduction to Nautel and NS Series LF High Power Amplifier

SONAR Applications

High Power RF Solutions
About Nautel

- 42 Years
- 250 employees
- 40 designers/engineers
- Stable self funded growth
- Privately held/zero debt
- RF Design, Prototyping, Manufacturing
- ISO 9001 USA and Canada Plants
- Award winning exporter

High Power RF Solutions
Nautel Standard Products:

**AM**
- J1000
- XR3 & XR6
- XR12
- NX25
- NX50
- NX100-NX800

**FM**
- VS Series
- NV3.5, NV5, NV7.5, NV10, NV15, NV20, NV30, NV40

**Navigation**
- Vector Series NDB/DGPS/Navtex
- NDB/DGPS/Navtex Antenna Tuning Units
- NL Series Next Generation Loran
- LF Antennas

**RF Power**
- HF Amplifier
- Custom Impedance Matcher
- Plasma RF Power Sources
- NS Series LF High Power Amplifier
- NG Series Weather Radio Transmitters

**High Power RF Solutions**
What NautelPower does...

RF Amplifiers
- High power
- Compact
- Ultra-reliable
- Efficient
- Digitally controlled

RF solutions:
- SI
- OEM
- Custom
- Manufacture
- Prototype

Industries
- Aerospace
- Defense
- Oil & Gas
- Research
- Navigation
- Industrial
- Broadcast

High Power RF Solutions
Specific Design Capabilities

- Solid state amplifier design from 100 kHz to 200 MHz
- Antenna Design and Computer Simulation
- Analog and Digital Communications theory
- RF matching, combining, filtering at high power/voltages
- RF Magnetics
- Power Supplies
- Digital Hardware Design
- Digital Signal Processing
- Data Communications Systems
- Networking and TCP development
Example: Plasma Rocket RF Amplifier

Rocket manufacturer subcontracted Nautel to build high powered and high efficiency amplifiers for space

- Ad Astra required extremely efficient, high power amplifiers for plasma rocket engine prototype
- Contacted Nautel to develop and build 50kW and 180kW amplifiers for first and second stage of the rocket
- Amplifiers are solid-state, water cooled with efficiency over 97% DC to RF conversion
- Status: working prototype in vacuum chamber
- Space station testing planned for 2013
Example: VHF Transmitters

US Government contracted Nautel to build VHF transmitters

- Agency used older transmitter technology
- Requirement: efficient systems with new functionality
- Close collaboration with the customer on design, requirements, manufacture/delivery and training
Elements of a **NautelPower** Solution

“High Power Digitally Controlled RF Solutions”

- IP Based User Interfaces
- Control, Protection and Instrumentation
  - Digital/Analog I/O
  - Signal Generation
  - High Power Amplifiers
  - Power Combining
- Matching Network
- ISO 9001 Canada + USA + Manufacturing
- Nautel Worldwide Service and Support

**High Power RF Solutions**
Local and Web Interface Options

Interface Options:

• Advanced User Interfaces
• Deep drill-down diagnostics
• Remote/local identical
• Extensive data logging
• Traditional character display options
• Built-in instrumentation
• SNMP
• HTML/XML
Control, Instrumentation, Protection

Extensive Control:
- Temperature
- Fan speed
- Phase angle
- Reverse loop
- Power, voltages
- Redundant controls
- Outputs for local site control

High Power RF Solutions
Digital and/or Analog I/O

Broad I/O options:

- Digital
- IP Protocols
- Analog protocols
- Input redundancy/failover
- Balanced lines
Signal Generation and Analysis

**Precision signal control:**
- Adaptive pre and post processing
- Signal shaping
- Digital signal processing
- Nanosecond precision
- Fast Protection
- Output matching compensation
Power Distribution

- Redundant architectures
- Combiner networks
- Modular design
- Extreme reliability
- Phase angle balancing
- Minimize THD (Total Harmonic Distortion)
Efficient Power Amplifiers

- Frequencies: 5Hz – 200MHz
- Amplifier Efficiencies: Up to 98%
- Watts to megawatts
- Modular
- Hot swappable

Thermal Analysis

Power Module

High Power RF Solutions
ISO 9001 Manufacturing

• ISO 9001
• Integrated:
  – Sheet metal to completed racked solution
• Manufacture in US or Canada
• Fast prototyping
• Milspec design

High Power RF Solutions
Nautel Production...

- Computerised Fabrication Shop
- PWB Assembly
- Light Assembly
- Final Assembly
- Final Production Test
- Packing and Shipment

High Power RF Solutions
Nautel Quality...

• ISO9001:2008 registered/certified
• products built to stringent quality standards
• industry leading features, performance, and reliability
• pride and craftsmanship of dedicated professionals
• assembled by a team of individual people - no assembly robots
• production staff with an average of 15 years experience
• Nautel controls every aspect of production
  ….from workmanship to electrical components to sheet metal fabrication
Worldwide operations

- 177 countries
- Over 10,000 deployed transmitters
- Dedicated support team
- Support for even 30 year old products

High Power RF Solutions
Naval customer subcontracted Nautel to build high power amplifier for sonar system

- Navy challenged to find product that could meet strict operational requirements
- Nautel, partnered with a transducer manufacturer
- Designing and built 22kW sonar amplifier
- Hot swappable power supplies
- Over 90% efficient
- Broadband capabilities

“the most compact 22kW we have ever seen!”
Software Controlled Sonar Amplifiers

3kW – 100kW

Over 40 years experience building solid state switch mode power amplifiers

Nautel Innovations
- Designed for Testability: Built-in Test Equipment/Built-in Self Test
- High operating efficiency
- Sophisticated Remote Control and Monitoring
- Redundant Architecture
- State-of-the-art Digital Exciter

Quick Specs
- Models range from 3kW to 100kW
- 200Hz to 4000Hz
- High density power amplifiers
- Solid State Reliability
- Robust and Flexible
- Modular Serviceability
- Built-in Protection
- Shock Mount Option
- Optimal Air Cooling
- Small Footprint
- High Redundancy
- 0°C to 60°C Operating Temperature
- Designed and Tested to MIL-SPECS
- MTBF > 100,000 hours
- Power and Cost Savings
- Easy maintenance

High Power RF Solutions
NS Series: High Power Low Frequency Amplifier Technology

SYSTEM OVERVIEW

Input: Analog/Digital

External Interface

Control Group

Power Distribution Control

Signal Input System

Signal Generation Exciter

Power Amplifiers N+1

BIST/BITE

System Output

Nautel has experience both in-water and on-air specializing in simple, reliable, robust solutions to meet our customers demands.

Nautel's design team is dedicated to providing advanced, flexible, affordable power amplifiers to customers seeking anything from off-the shelf equipment to completely custom solutions.

High Power RF Solutions
Benefits of a NautelPower solution…

Enhanced Capabilities

- Challenging RF requirements
- Extreme operational demands
- Harsh environments
- Precise signal control
- Enhanced data gathering
Nautel Lightweight Sonar Module

High Power RF Solutions
Benefits of a **NautelPower** solution…

**Lower Cost**
- Increased efficiency
- Increased reliability
- Reduced maintenance
- Remote maintenance
- No tube replacements
- Outsourced manufacturing

**Strategic Focus**
Focus on your core value add, while Nautel does RF

High **Power** RF Solutions
Your Solution:

**What Can Nautel Do for You?:**
- Design and manufacture RF equipment
  - Transmitters, Receivers, Antennas
  - High Power amplifiers and Power Conversion Devices
  - DSP and FPGA based systems

Learn more:  [www.nautelpower.com](http://www.nautelpower.com)  info@nautelpower.com
Industry Solutions: Navigation

Solutions:
• High Power RF and audio frequency power systems
• Withstand environment requirements
• Extreme reliability, highly efficient

Applications:
• Aeronautical and marine radio beacons
• DGPS, MF Telegraph, NAVTEX transmitters
• LF/MF transmitting antennas and tuning units
• Position/timing alternatives to satellite navigation
• Tactical navigation/positioning

High Power RF Solutions
Industry Solutions: Broadcast

Solutions:
- High Power RF and audio frequency power systems
- Withstand environment requirements
- Fit desired form factor
- Highly efficient
- Milspec

Products:
- MW transmitters: 1kW – 2MW
- FM transmitters: 300W - 88kW
- Digital and analog exciters