

# Technical Advances In Solid State AM & FM Transmitters

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# AM - Improved Technical Performance



NX800 – 800kW AM Transmitter

- **Modes now integrated: Analog, C-Quam, DRM & HD Radio AM**
- **Super high efficiency – up to 90% typical, AC in to RF Out.**
- **Space efficient – up to 74% less volume than competing products**
- **High performance – Direct DSP Digital RF and Modulator Drive**
- **Dynamic Adaptive Pre-correction for: Amplitude Modulation-Amplitude Modulation , Amplitude Modulation-Phase Modulation, Modulation Equalization, and Antenna Equalization.**

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# Digital Modulation Technology



Separate power processing stages for Envelope Modulation and RF Amplification are employed. This approach offers the following benefits:

- Digitally controlled RF Transistor switching has **nearly eliminated switching loss across the AM band**
- Allows for high current capability transistors to **reduce conduction loss**
- Results in **ultra high efficiency RF amplifier** (up to 98% at 1710 kHz)
- Control of the RF amp DC supply input **improves robustness into VSWR**
- RF Amplifier DC Supply **can be shut down during transient events** to further improve robustness

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# Integral Digital (Inside the Cabinet)



- **AM Analog** – AES/EBU or L&R analog inputs.
- **C-Quam AM Stereo** – AES/EBU or L&R analog inputs.
- **DRM Integrated** – DRM Exciter internal, including content server. AUI configures the DRM exciter. Feeds I&Q (= magnitude and phase ) inputs.
- **HD Radio Integrated** – Engine installed internally which feeds the I&Q inputs



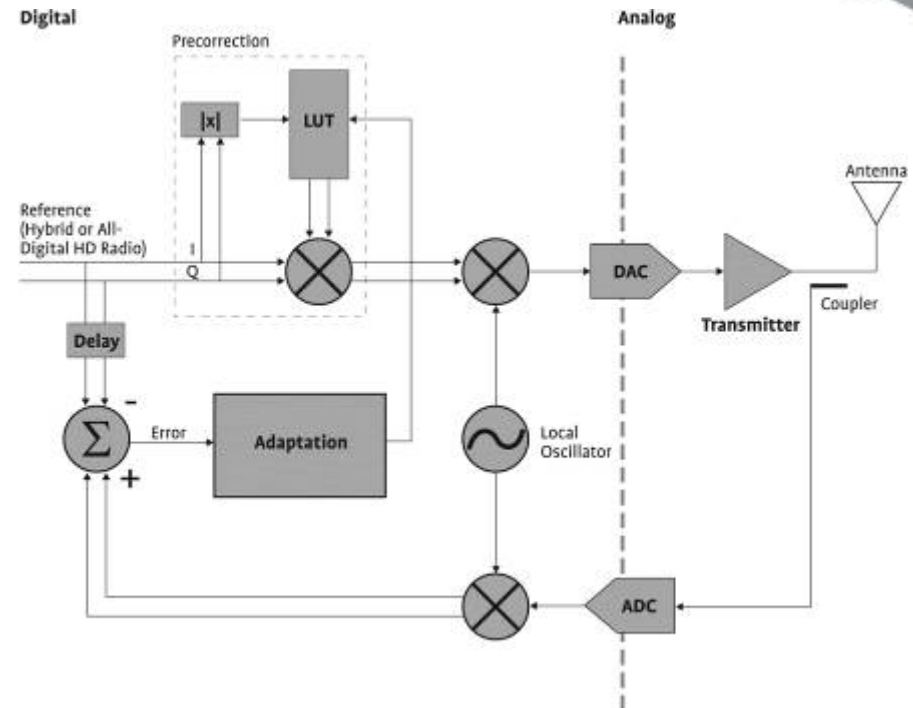
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# Dynamic Pre-Correction



Dynamic Pre-correction corrects for all primary forms of distortion which typically affect **both analog and digital AM broadcasting**:

- **More Linear – Clean Spectrum**
- **Adaptive envelope equalization**
- **Adaptive Amplitude Modulation-Amplitude Modulation correction [AM-AM]**
- **Adaptive Amplitude Modulation-Phase Modulation correction [AM-PM]**



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# Main / Alternate Supervision & Control



- Dual AES/EBU inputs, Analog L&R, and I&Q inputs.
- GPS input card, optional, for ultimate frequency accuracy.
- Provides standard parallel remote control facility as well as full web server control.
- Failsafe manual basic control.



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# Redundant DSP DDS Exciters



- Embedded DSP/FPGA based system
  - Full digital system from source through to modulator/power amplifier
  - Accepts I&Q signals from integrated DRM exciter or HD Radio Engine card.
- Adaptive transmitter linearization
  - AM/AM Correction
  - AM/PM Correction
  - Envelope equalization
- Novel IBOC signal conditioning system, reduces out-of-band emissions by moderating high frequency phase transitions inherent in the IBOC signal.



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# RF Amplifier / Modulator Module



- Broadband
- Heat sink 2.5 times required size
- Front panel modulator input RJ45
- Front panel tri-color LED module status
- Modulator bandwidth: 2.5 mega-samples per second



LED

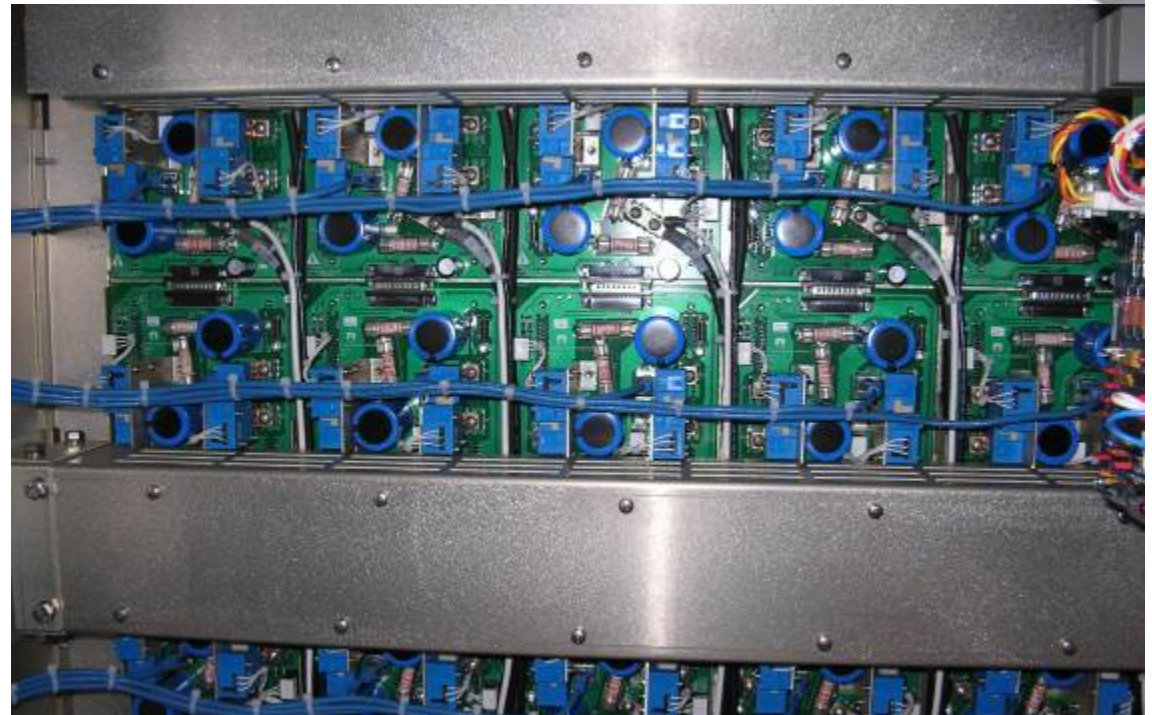
RJ45

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# Series Combiner



- Consists of a two parallel copper pipes with ferrite cores which couple the RF output.
- Can handle many times the required power.
- Broadbanded.
- Module isolation relay is one of only two moving parts in the NX, the other is the fans.

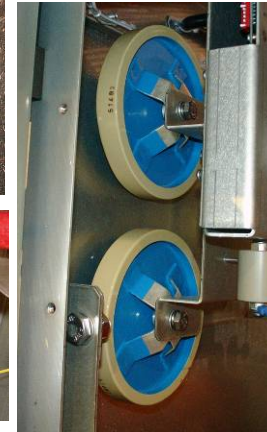
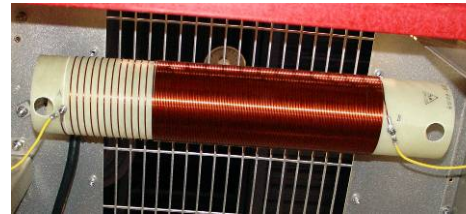


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# Lightning / Transient / AC Protection



- ~10 uS Active VSWR Shutdown
- Series Capacitor/High Pass Stage
- Carbon Adjustable Ball Gap
- Static Discharge Choke
- Calibrated Fast Spark Gap (Pressurized Tritium)
- MOV Protection on Incoming AC
- Transient Attenuator Capacitors on AC Transformer Secondary (Common Mode)
- AC Surges Corrected by Phase Controlled B+ Rectifiers (Differential Mode)



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# Lightning and Surge Suppression



- The AC mains are protected by MOV banks before the mains transformer, both differentially and common mode.
- The mains transformer isolates all common mode spikes.
- The HV rectifier bank can correct for dynamic over voltage conditions.
- The antenna is protected with long life carbon spark gaps in the output network, as well as by a high speed tritium gap.



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# Control / Interface Card



AUI Interface

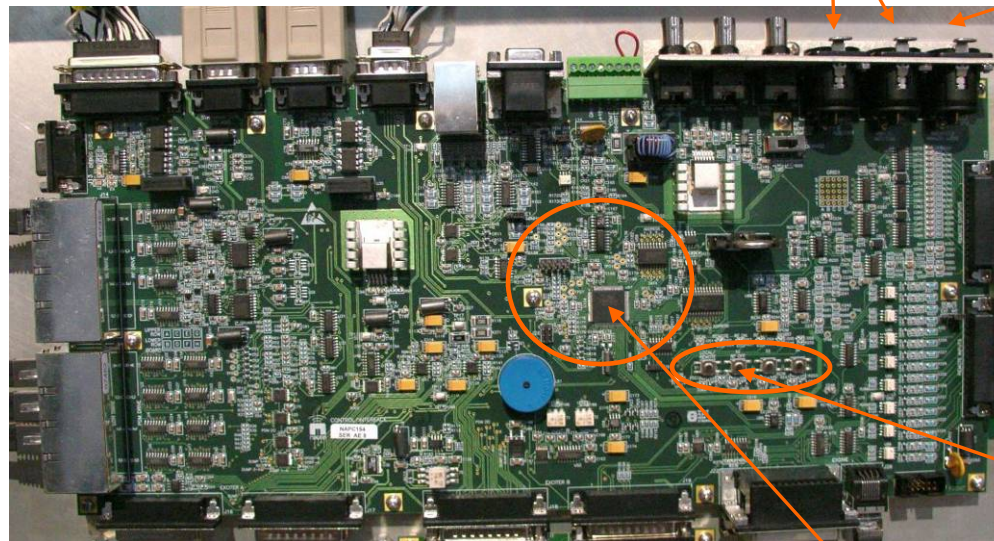
Dual AES/EBU Inputs: Audio or I,Q (mag & phase)

Balance Analog Audio Input

Digital Modulation Outputs to Power Modules

Ports for Parallel Remote Control Interface

Backup Control Switches



Dual (standard) DSP Exciter Slots

Transmitter Master Control Processor

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# Parallel Remote Interface



- Darlington outputs for status
- Outputs have a configurable (red/green) LED for visual indication of status
- Optically Isolated Inputs for Control
- Inputs have a switch for testing or backup local control**
- All inputs and outputs can be re-configured through the GUI
- Connections are made with pluggable terminal block connectors

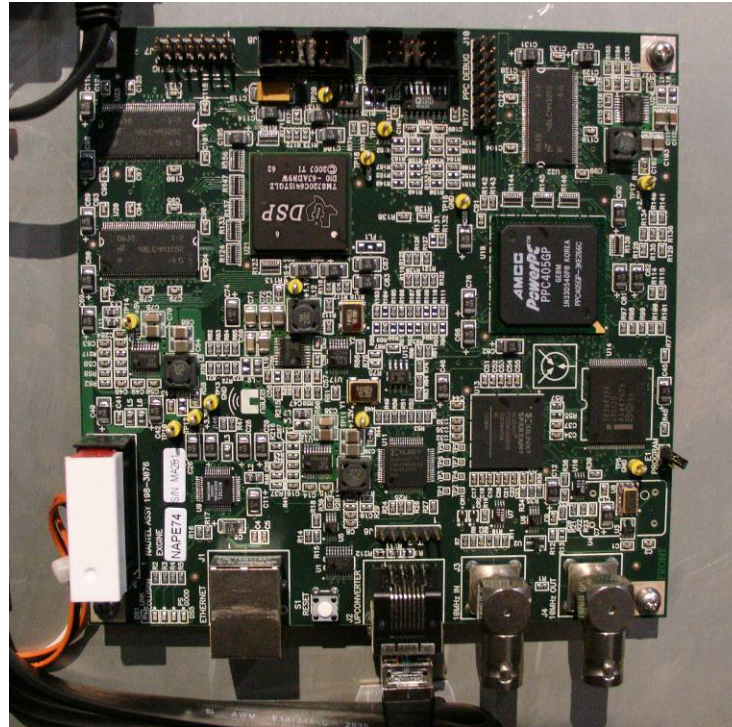


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# Embedded IBOC Generator



- TCP/IP input stream from Exporter
- Digital I,Q output stream to NX exciter
- Fully embedded – no hard-drive or fans
- Operates from dual LVPS in NX transmitter
- No fans or hard disk



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# Advanced User Interface - AUI



**NAUTEL NX and NV Series AM and FM Transmitters feature a 17 inch COLOR LCD TOUCHSCREEN with a wide range of configurable displays.**

- The AUI can be controlled by **touchscreen** or via a mouse and keyboard.
- Features include:
  - **Network analyzer** for antenna cusp analysis.
  - **Spectrum analyzer** for spectral mask compliance.
  - Complete **monitor and control of all functions to module level.**
  - Logging of all functions
- The display is also available as a flash graphic display on any **web-interfaced PC or handheld device via the internal web server.**

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# Real Time Network Analysis

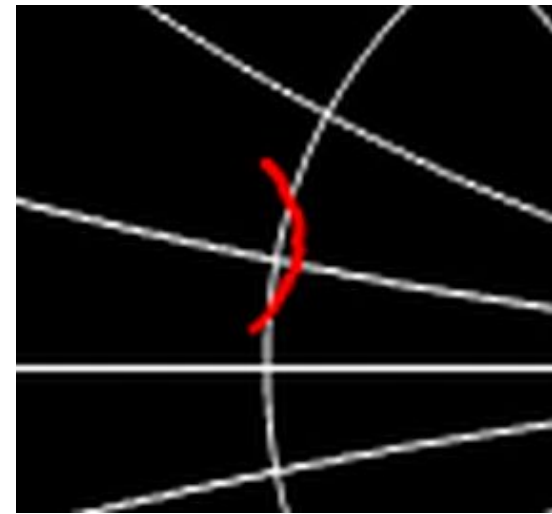


Allows measurement of the impedance seen by the RF amplifiers while the transmitter is operating normally

No tones are required, the measurement is made using the normal broadcast signal

This information can be used to ensure impedance symmetry allowing optimal performance

Nautel has filed a provisional patent application for this technology



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Date & Time

Tue Aug 14

11:56:23 AM

Sched:  
Disabled

Forward Power

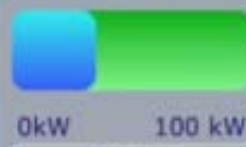


40.5 kW

Inc

Dec

Reflected Power



1kW

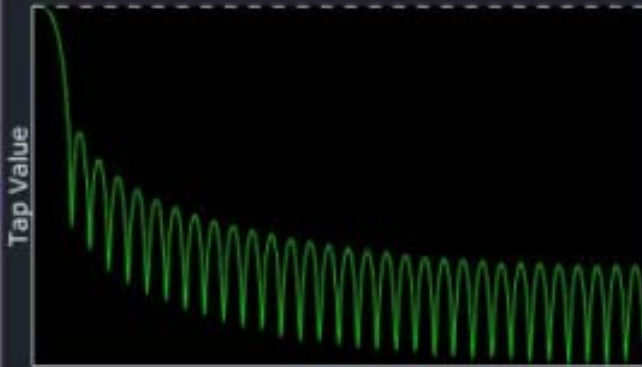
Preset: None

10kW

1MHz

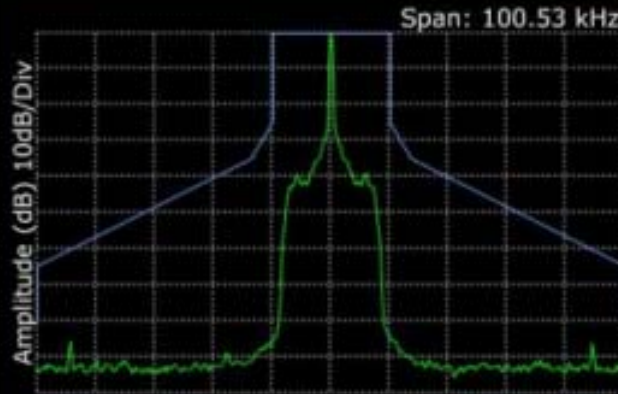
AM

Max Pre-Correction Filter (Freq) Close



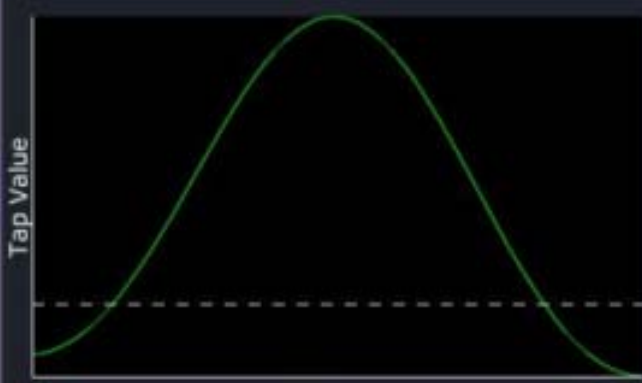
Frequency

Max Spectrum Analyser Close



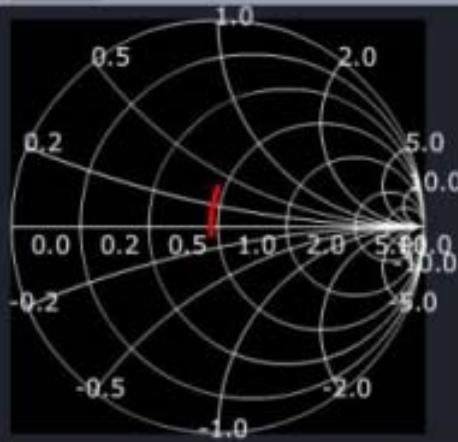
Frequency (kHz)

Max Pre-Correction Filter (Time) Close



Time

Max Smith Chart Close



On

Off

Event

Connected to 192.168.1.74  
Host Connection Closed...  
Attempting to connect to Host:  
192.168.1.74 Po.

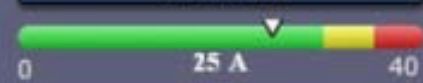
Menu

Status

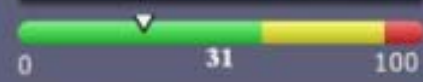
Help

Mode: Local

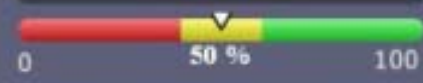
Rack Test / Cube # DC Current



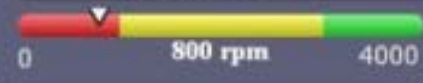
Rack Test / Cube # Modulation (PDM)



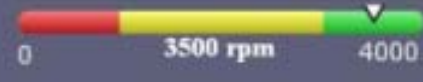
Rack Test / Cube # RF Drive Level



Rack Test / Cube # Fan One - Speed



Rack Test / Cube # Fan Two - Speed



Review





Date & Time

Tue Aug 14

12:00:20 PM

Sched:  
Disabled

Forward Power



0kW 100 kW  
**40.5 kW**

Inc

Dec

Reflected Power



0kW 100 kW  
**1kW**

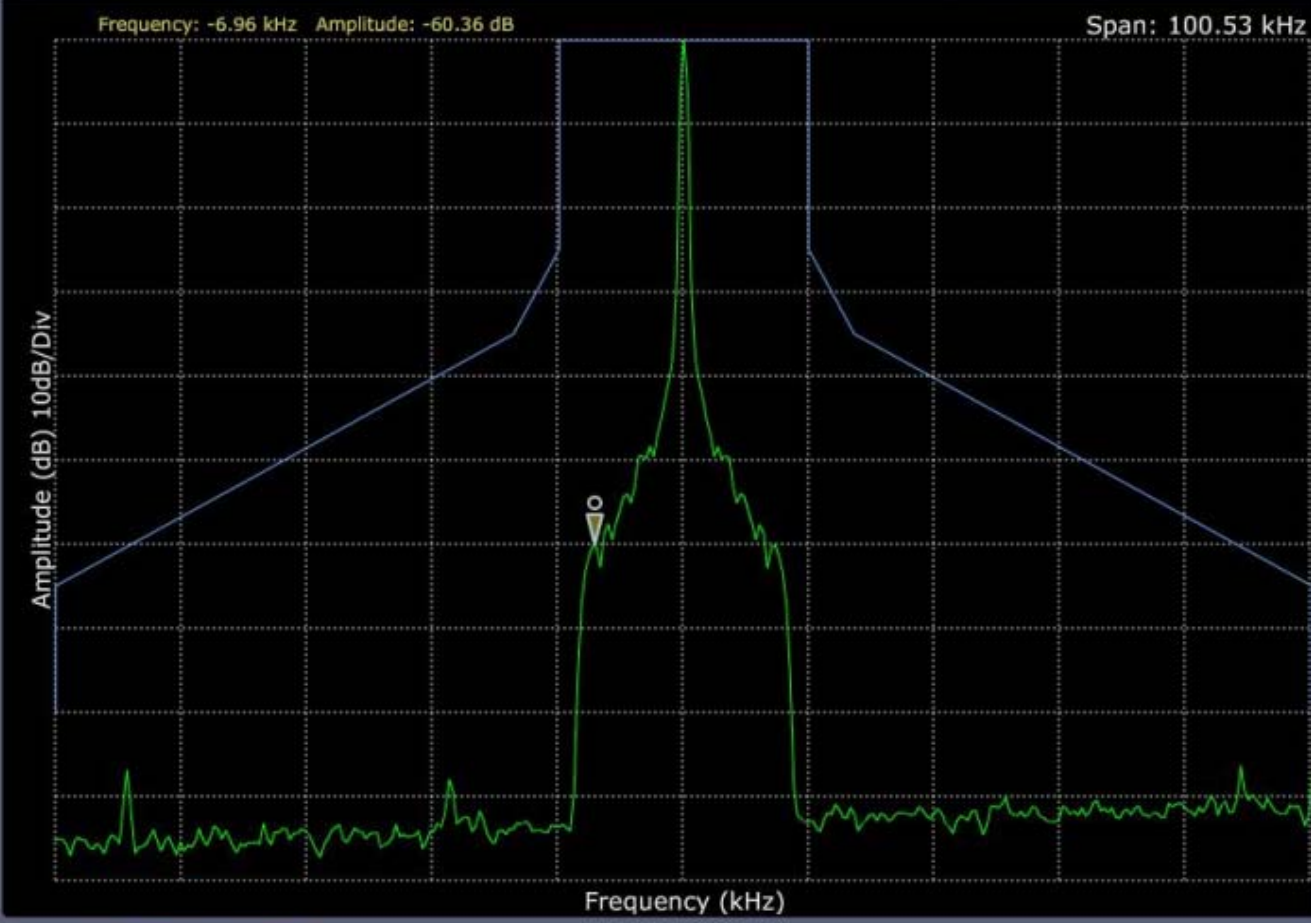
Preset: None

- 10kW
- 1MHz
- AM

Min Zoom

Spectrum Analyser

Peak - + Close



Rack Test / Cube #  
DC Current  
0 25 A 40

Rack Test / Cube #  
Modulation (PDM)  
0 11 100

Rack Test / Cube #  
RF Drive Level  
0 50 % 100

Rack Test / Cube #  
Fan One - Speed  
0 800 rpm 4000

Rack Test / Cube #  
Fan Two - Speed  
0 3500 rpm 4000

Review [Shield Icon] [Home Icon]

On Off Event GUI Interface Ver 0.3 Host IP: 192.168.1.74 Connected to 192.168.1.74 Menu Status Help Mode: Local



Date & Time

Tue Aug 14

12:04:00 PM

Sched:  
Disabled

Forward Power



0kW

100 kW

40.5 kW

Inc

Dec

Reflected Power



0kW

100 kW

1kW

Preset: None

10kW

1MHz

AM

Preset Name:

Morning

Preset Settings



Name Morning

Power Level 100 kW

[-] Channel A

[-] Mode

[+] Analog AM

[+] DRM

[-] IBOC

[-] MA-1 Hybrid

Analog Bandwidth 5k

Enhanced Carriers 5k

Carrier Level 8k

MA-3 All Digital

Scroll

Scroll

Save Preset

Apply Changes

On

Off

Event

GUI Interface Ver 0.3  
Host IP: 192.168.1.74  
Connected to 192.168.1.74

Menu

Status

Help

Mode: Local

# NV40 – 40kW Digital FM Transmitter



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<b>Date &amp; Time</b> Mon Mar 31 2008 17:05:50 Verbose Mode: Disabled	<b>Forward Power</b> 32000W 32W	<b>Modulation</b> 100% Peak 02.02 1Peak: 02.02 140% Vagn Base 0.75: 02.04	<b>Mode</b> FM + IBOC 32000W
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**Spectrum** | **Signal Constellation**

Normalized to Carrier | Window Type: Blackman-Harris  
Center Freq: 98100kHz

Amplitude: 20dB, 10dB  
Frequency: 97500kHz, 98700kHz

**L/R Cartesian Plot** | **AM/PM Correction**

Table Index

**Meters** | **Select**

- TX\_MASTER TX\_B\_PLLU\_CONTROL\_SETPoint (0-100)
- TX\_MASTER TX\_FORWARD\_RMS\_POWER (0-100)
- TX\_MASTER TX\_REFLECTED\_RMS\_POWER (0-100)
- TX\_MASTER TX\_AMBIENT\_TEMPERATURE (0-70)

RF On | RF Off | Welcome to the Horizon J1  
Not Connected to : 92.110.1.07 1921  
Connected to : 92.110.1.07 1921

Menu | Status | Remote | Help

Spectrum Mask

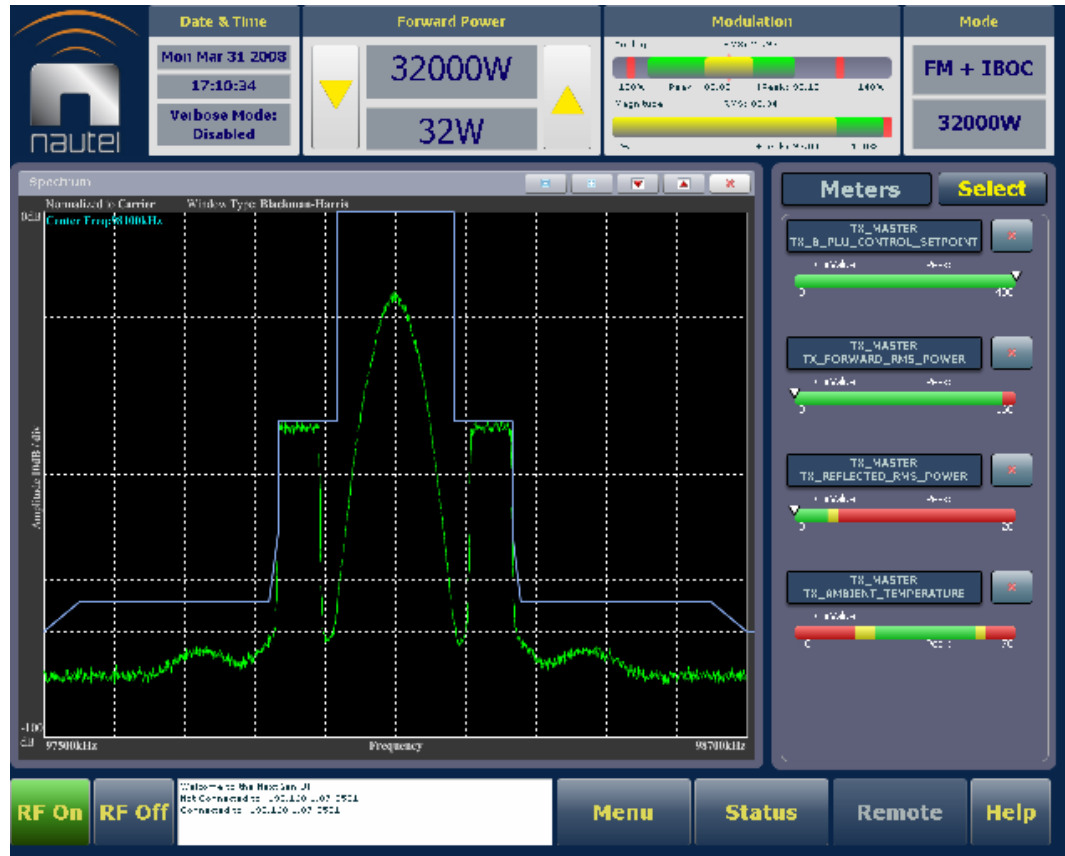
Digital Constellation

L/R Separation

Linearity Correction

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# Adaptive Pre-Correction



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Date & Time

Mon Mar 31 2008

17:06:52

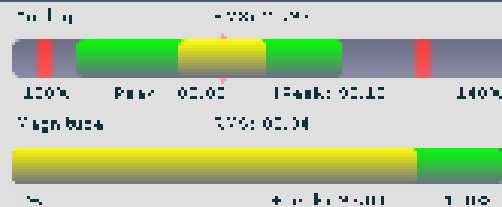
Verbose Modes:  
Disabled

Forward Power

32000W

32W

Modulation



Mode

FM + IBOC

32000W

Mode :



Activate

Reload

- Power Level: 32000W
- Frequency: 98100kHz
- Mode: FM + IBOC
- IBOC Level: -20dB

Main Audio Settings

- Input Select: AES1
- Input Level: -5dBFS
- Mode: Mono L
- Pre-emphasis: 0uS
- 15kHz Lowpass: On

SCA Audio Settings

- Composite SCA Enable: On
- Composite SCA Input Level: 2Vpp
- SCA1 Enable: On
- SCA1 Input Level: 6dBu
- SCA1 Frequency: 0kHz
- SCA1 Injection Level: 50%

Presets

Load

Save

# Thank you



***Thank you*** for your time. I can be reached easily:

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