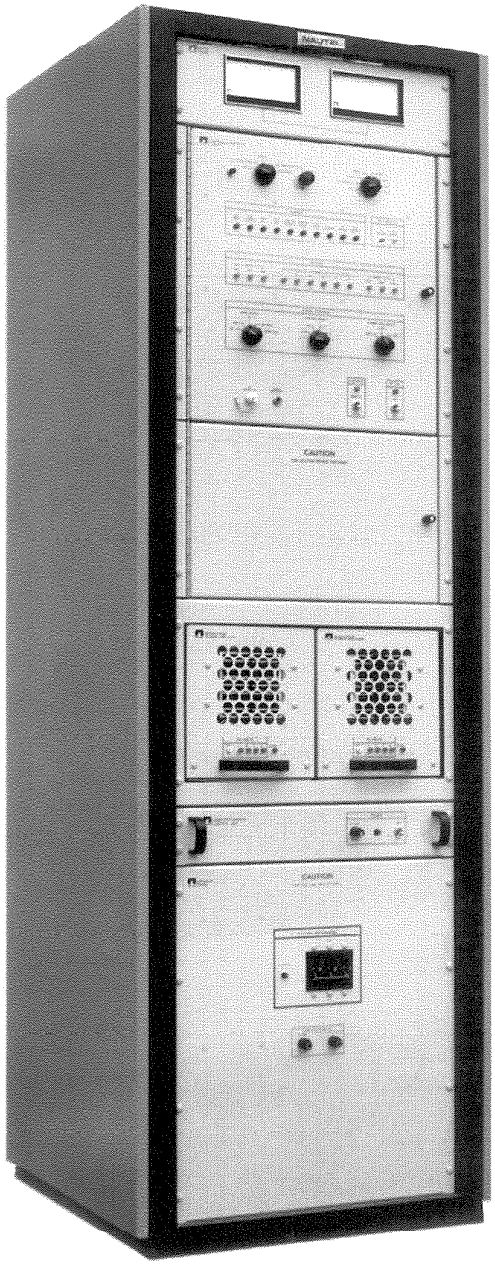
nautel

ND2500TT/6

2.5kW MF Telegraph/Navtex Transmitter

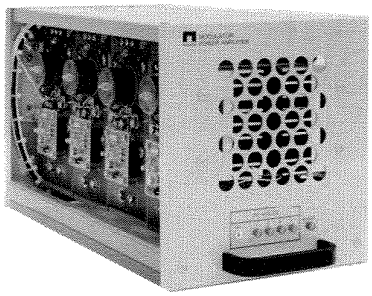


- Totally solid state transmitter with wideband, class D, Power Amplifiers providing an overall efficiency of better than 70%.
- Carrier frequency and FSK, derived by Direct Digital Synthesis in 100 Hz steps, provides operation on any of six channels.
- Remote Control Options, via locally approved modems and a single phone circuit, provide operation from either a Master Operators Unit, with front panel switch controls, or an Operators Personal Computer.
- Antenna Tuning Unit with Automatic fine tuning in unvented outdoor enclosure capable of tuning to all channels within a maximum of 6 seconds.

ND2500TT/6 TRANSMITTER

GENERAL DESCRIPTION

NAUTEL's ND2500TT/6, 2.5 kW totally solid state, 6 channel MF Shore Station Transmitter provides both CW and MCW telegraphy shore to ship communications plus a full NAVTEX service capability.



Power Module

RF POWER STAGES

The final output power of 2.5 kW is the combined output from two 1.25 kW wideband Power Modules, which each contain four switched, class D PDM modulators and four class D RF Power Amplifiers. These use MOSFET semiconductor switches and are similar to Nautel's Non Directional Beacon and AM Broadcast Transmitter technology which has been field proven for over ten years. They provide the advantage of a DC to RF conversion efficiency of over 85%, superb reliability and operating performance.

Additional advantages are provided by the inherent redundancy whereby failure of individual modulators or power amplifiers produces only a proportionate reduction in final output power.

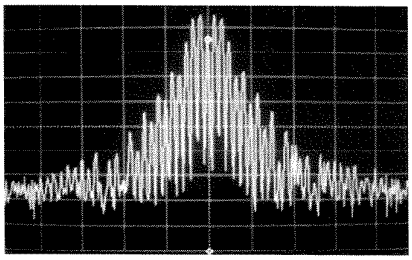
The square wave outputs from the Power Modules are combined, then filtered by a bandpass Harmonic Filter having a flat frequency response over the band 405 - 535 kHz. An rf current probe at the filter input and a FWD/REFLD POWER probe at its output are used for protection and metering.

EXCITER

The transmitter's low level exciter consists of two sections, an rf source which provides the rf drive for the RF Power Amplifiers and a Modulator Driver which provides the controlling input for the Modulators.

The rf source is produced using a state-of-the-art technique known as DIRECT DIGITAL SYNTHESIS. With this technique the rf waveform is digitally generated under the control of a microprocessor which is clocked at 12 MHz from a single crystal oscillator. Amplitude and phase information for the required output is sequentially retrieved from a ROM and passed through a D/A converter to produce an analogue sinewave output. The user can readily program up to six channel frequencies by setting switches on the synthesizer PWB. The frequency accuracy and stability of each channel is directly determined by that of the 12 MHz clock. In the F1B mode the synthesizer shifts ± 85 Hz in multiple incremental steps to limit the occupied bandwidth to comply with CCIR recommendations. The output level and AM modulation depth are all derived and controlled by the Modulator Driver.

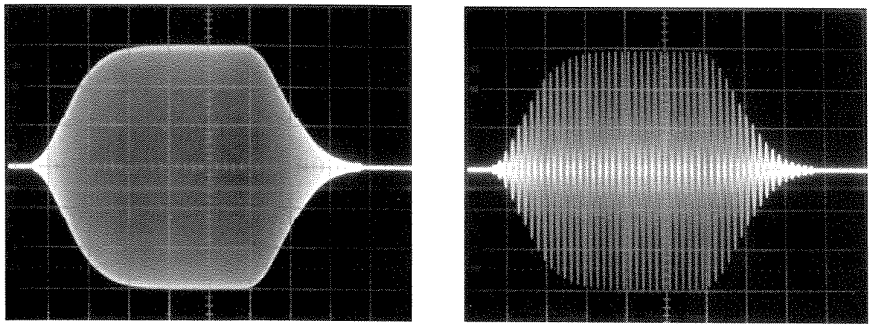
Six independent potentiometers adjust the output power level for each channel. These may be used to set the RF output level for whatever emission mode is selected for that channel. In addition, there are two output level controls, Low 1 and Low 2, common to all six channels. These may be used to set common power reductions on all channels when Low 1 or Low 2 are selected, e.g. 3dB and 6dB below normal operation.



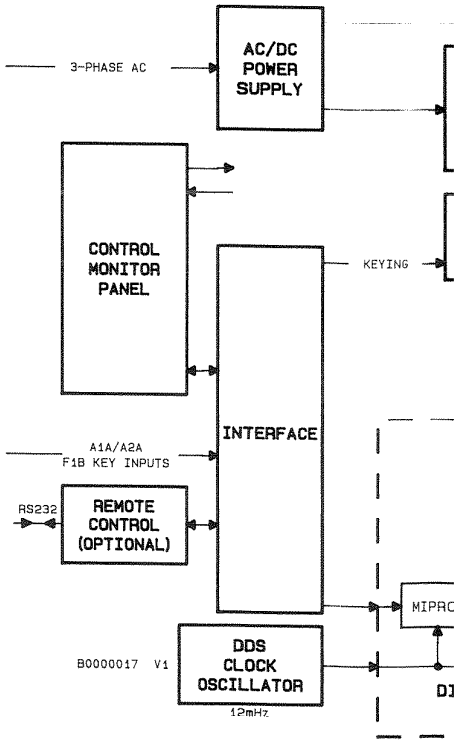
Output Spectrum Operating at 2.5kW
CW with FSK, (F1B), at 100 Bauds
(300 Hz per division horizontal
10 db per division vertical)

An audio oscillator on the board provides a 1000 Hz tone for A2A. A single common modulation depth control is provided.

In order to limit the occupied bandwidth in A1A and A2A modes, the incoming keying signal, at up to 30 baud, is shaped by a low pass filter and then applied to linear keying gates which vary the control signal for the PDM generator in the final stages of the Modulator Driver PWB. A unique feature of the PDM generation circuitry is



Output Waveforms at 2.5kW PEP in keyed CW, (A1A) and keyed MCW, (A2A), at 30 Bauds



Nautel's patented circuit which compensates for AC line variations and reduces hum and voltage sag as the transmitter is keyed ON and OFF. The technique in effect subjects the PDM control signal to dynamic division by the DC supply voltage and cancels DC supply imperfections.

In order to achieve an on/off keying ratio in excess of 120 dB, the rf drive signal is turned off in the trough of the rf waveform.

POWER SUPPLY

The transmitter operates from a three phase AC supply which is full wave rectified to provide a nominal - 60 V unregulated DC supply to the modulators in the Power Modules.

Additional low level supplies are derived by separate rectifiers and regulators in the Low Voltage Power Supply which generates +24 V, ±15 V and ±5 V DC.

All supply voltages are metered by a switched front panel meter which is also used to measure the - 60 V DC current.

PROTECTION AND ALARMS

All alarms have red front panel LED's.

HIGH SWR - The FWD/REFLD Power probe generates a dc signal that is proportional to the reflected power. Each time this signal exceeds a level corresponding to a VSWR of 1.5:1 at full output power, a clock input is applied to a counter which reduces the transmitter's output power in 150 watt steps. The counter is automatically reset by one step every 60 milliseconds. Hence, if the SWR condition is constant, the transmitter is turned down to a safe level, but if it is a transient SWR, the transmitter will come back up to its operating power. In the event the VSWR corresponds to more than 2:1 at 2.5 kW, the transmitter immediately shuts back to zero output to avoid damage.

HIGH RF CURRENT - A second output probe monitors current from the Power Amplifiers into the Harmonic Filter and shuts back the transmitter if safe levels are exceeded.

LOW CARRIER - An adjustable threshold may be set to alarm if carrier output drops below a certain level.

HIGH AC AND LOW AC - Transmitter shuts down if AC line voltage is outside of ± 10% of nominal. If AC line returns to within ± 10% of nominal, transmitter returns to normal operation.

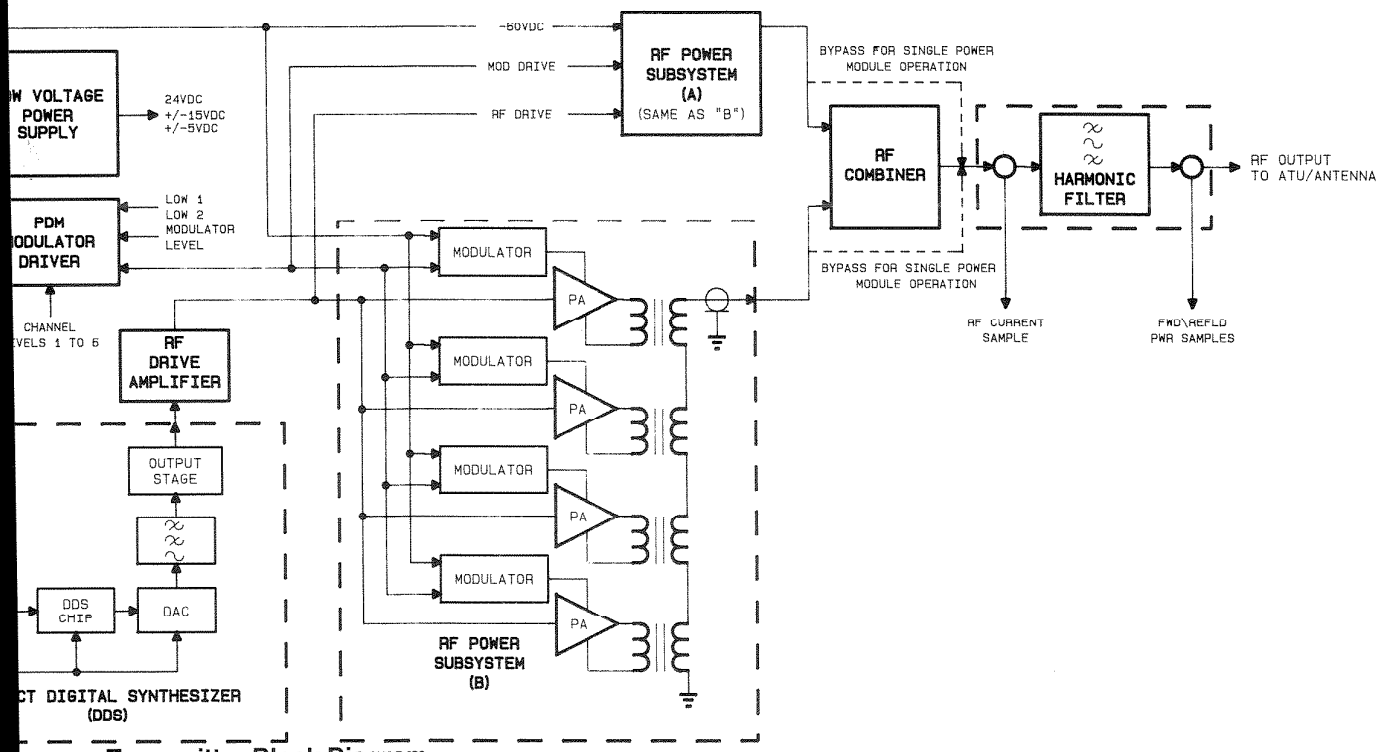
LOW RF DRIVE - Shuts back transmitter if RF drive signal to Power Amplifiers is too low.

DDS RESET - Supervisory circuit which monitors correct operation of Direct Digital Synthesizer.

AC PHASE - Alarms and shuts back transmitter if any one phase of the three phase supply is lost.

CONTROL FAULT - Monitors and shuts back transmitter if either Local or Remote Control information requests more than one mode, more than one channel or more than one power level at a time.

ATU INTERLOCK - Safety circuit shuts back transmitter from AATU to prevent rf transmission when personnel are working on antenna or AATU.



Transmitter Block Diagram

PHYSICAL DESCRIPTION

The transmitter is housed in a standard equipment rack, less than two meters high, with a rear access door and removable side panels to facilitate maintenance.

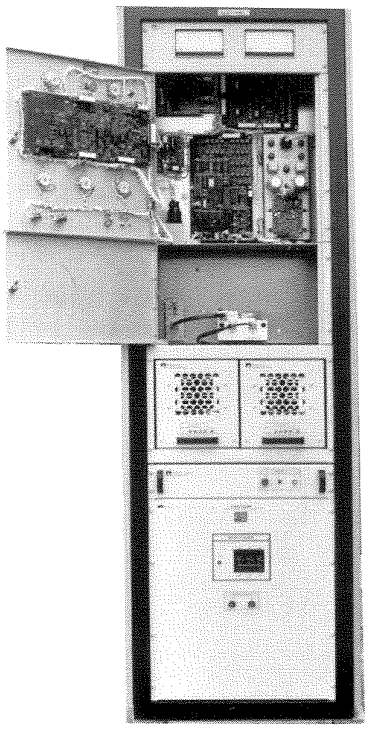
All level controls and frequency selection switches are readily accessible with hinged monitor panel open (see photograph).

Power Modules may be withdrawn from the front after switching off the transmitter and undoing rear connectors. Patching around the combiner, to operate with one Power Module only, is accomplished by opening the hinged panel above the Power Modules, undoing two type N coax connectors and reconnecting one of them to the Harmonic Filter Input.

Connectors on the transmitter are an RF output coax, which exits from the top, remote control lines and keying, which enter from top front right corner, AC power, which enters under the rack or through the rear lower left hand corner when viewing transmitter from the front. Cable knockouts are provided for the control and power cables.

OPTIONAL EQUIPMENT

Remote Control Options include a Remote Slave, Model NAX51, shown installed below the Power Modules in the transmitter. This unit may be driven directly by a Personal Computer or Video Display Terminal via an RS232 interface. Alternatively it can be driven by a Master Operators Unit, Model NAX128, which provides an RS232 output controlled by operator switches on the front panel.



ND2500TT/6
with panels open