

Exhibit V Operational description HO82WUALS13

ALS-1300 Technical and Operational Overview

The ALS-1300 is an amateur radio multiband radio frequency linear power amplifier. This device requires certification. This device complies with technical standards of CFR Title 47 part 97.317(a) and (b).

General Operation

This linear amplifier covers the 160, 80, 40, 20, 17 and 15-meter amateur bands. Up to 100 watts exciter power is applied to relay RLY1 on circuit board RLY. When power is on and the standby switch is in the operate position, and when the rear panel RELAY control line is held low (below 1 volt), exciter power is routed through RLY1 to the PD8 power divider board.

Power Division

The PD8 power divider board splits the signal path equally between two 600-watt power amplifier modules. The PD8 circuit board consists of a conventional T power divider, components T2 and R7. This T splits the signal into two equal level signals. Each signal path has a 5 dB attenuator consisting of high power resistors R1 through R6. The 5-dB attenuators on each output port terminate the T in 50 ohms and provide an additional 10 dB of input port isolation between the two PA modules. With a 50-ohm source, in excess of 30 dB port-to-port isolation occurs between PA module inputs. A minimum of 16 dB isolation occurs regardless of input port termination. The attenuators also work in concert with the magic-T to provide a 50-ohm input termination for each PA module. The 50-ohm termination and input port isolation results in unconditionally stable PA modules.

PA Amplifiers

Power amplification comes from two 600-watt power amplifier modules. Each PA module (PAM-600) consists of four MFR-150 field effect transistors. Each MRF-150 has between 200 mA to 400 mA quiescent current. Transistor conduction angle is slightly over 180 degrees, providing linear class AB operation. The normal dc drain operating voltage is approximately 50 volts with four FET's per module in push-pull parallel. Both modules employ significant negative feedback to improve linearity and stability. The FET's have direct resistive voltage feedback across each individual transistor from drain to gate, as well as push-pull transformer (T2) coupled feedback common to the push-pull circuit. These feedback circuits improve gain flatness, linearity, and stability. Push-pull operation, negative feedback, and linear biasing of FET's provide significant pre-filter harmonic suppression.

Cooling and Temperature

The four power FET's in each module mount on a forced-air cooled aluminum heatsink. Four dc fans cool the heatsink. Two thermistors (R1 heatsink, R2 transistor) sense the temperature of the power amplifier transistors and their heat sinks. Transistor temperature sensor R2 regulates bias voltage, reducing bias voltage when transistor temperature increases. This bias feedback system keeps transistor quiescent current stable independent of transistor junction temperatures. These thermistors also feed a comparator that removes drive when transistor temperature becomes unsafe.

The second set of thermistors, R1, monitor heatsink temperatures. Voltage from thermistor R1 regulates fan speed, increasing airflow as the heat sink warms.

Combiner CMB

Each PAM-600 delivers a rated maximum of 600 watts peak envelope power into a 50-ohm load. Each PA module feeds a 50-ohm high power combiner CMB that isolates the two outputs. A 50-watt 100-ohm power resistor dissipates signal level errors between the PA modules.

Voltage step down transformer T1 senses voltage across combiner dump resistor R1. *T1 is located on the 2KWF lowpass filter board.* This voltage, representing PA combiner unbalance, appears on the front panel multimeter as a “PAB” (power amplifier balance) indication. PA unbalance sample voltage also feeds a comparator on the CB1 control board. This comparator disables the PA in the event the power amplifiers become significantly unbalanced, and illuminates the PA front panel light.

2KWF Lowpass Filter Assembly

The output of the high power combiner goes into the 2KWF lowpass filter assembly. Power enters through a directional coupler consisting of T2, C28, 98 and 99, and R2. This system detects power amplifier termination errors. Any significant error will trip the power amplifiers off. A comparator on the CB1 control board monitors directional coupler termination errors. Such errors normally come from selecting the wrong filter for the exciter’s operating band, or having a poor load SWR on the amplifier.

5-pole lowpass filter 2KWF further reduces harmonics. Harmonic levels are significantly below levels mandated by FCC rules governing amateur radio service.

The CB1 control board contains all protection comparators (U1) and latches (U3). In the event of an operational fault, latches lock out the amplifier and illuminate a warning light on the front panel. CB1 also contains bias, relay sequencing, and fan speed controls.

Frequencies above 21.5 MHz are disabled in units sold in the United States and possessions.

SWR

The SWR board is a standard 50-ohm directional coupler. It samples line current and line voltage, vectorially summing them before detection. The resulting voltages represent forward and reflected power, or mismatch of the ideal 50 ohm load.