

Excerpt from the Alpha 9500 user manual

The Alpha 9500 contains the following modules

- 2.1 Cathode (Input-Match) Board
- 2.2 Center-Partition Board
- 2.3 Controls and Display
- 2.4 Display Board
- 2.5 Firmware
- 2.6 Master-Control Board
- 2.7 Output-Tank Circuit
- 2.8 Power Connections
- 2.9 Power Supply
- 2.10 Tube and Tube Deck

The Alpha 9500 uses a single 3CX1500 (8877) high-mu external-anode triode ceramic tube for amplification. The main power supply is an unregulated transformer/rectifier/capacitor power supply for the highvoltage (HV) and heater circuits. All other power supplies are regulated.

The biasing and tank circuits are similar in most respects to those of the Alpha 9500's predecessor, the Alpha 77. The unit has thoroughly modern computer-controlled power supply and control circuitry. Extensive safety measures protect the amplifier against most off-nominal conditions. It has USB and RS-232 interfaces to aid in remote operation. All front-panel features are accessible via these interfaces.

There are six main circuit boards in the amplifier. Communications among these is via an I2C bus. Amplifier components are listed alphabetically and described below.

2.1 Cathode (Input-Match) Board

The cathode board, housed in the tube deck, consists of a set of Pi filters controlled by a set of five relays that are enabled based on the band-switch setting.

2.2 Center-Partition Board

The center-partition board contains the RF decoupling circuit on the B+ line as well as the crowbar safety circuit. When you remove the top cover of the Alpha 9500, the spring metal of this safety device shorts out the B+ line.

2.3 Controls and Display

The Alpha 9500 controls enable you to adjust and monitor the amplifier as needed

IMPORTANT Note that the front panel has, in the upper-right corner, a 7-segment LED display. The display contains 4 digits.

The buttons below the display control what kind of value is displayed: **FLT**, **Fwd**, **Ig**, **Ip**, **SWR**, or **Vp**.

Table 2-1 Amplifier Buttons (listed alphabetically)

Button	Purpose
ANTENNA SELECT	Determines which one or two of the four antenna output ports to use.
BAND	Selects an amateur band, designated in megahertz (MHz).
DEL	Displays the delivered power from the amplifier to the selected antenna port in watts (W).

DIM	Controls the brightness of the display LEDs
FLT	Sets the 7-segment display to show the last fault. Also loads new firmware
Fwd	Sets the 7-segment display to show forward power in W
GAIN	Displays the gain in decibels (dB)
GRID CURRENT	Displays the grid current in milliamperes (mA)
Ig	Sets the 7-segment display to show grid current in mA
Ip	Sets the 7-segment display to show plate current in mA
LOAD	Controls the load capacitor
MEMORY	Selects one of three sets of segment memories
	DEF — factory-default settings
	1, 2 — User 1 and User 2 memories
	AUTO — autotune
ON (AMP)	Turns the amplifier tube and voltage on
ON/OFF (ANT SEL)	Turns antenna select on; the amplifier tube is not on
OPER	Sets the amplifier to the operate position
PEP	Toggles between peak power (PEP) and average power
PLATE CURRENT meter	Displays the plate current in milliamperes (mA)
PLATE VOLTAGE meter	Displays the plate voltage in volts (V)
RCL	(Currently nonfunctional)
RF POWER kW meter	Displays the forward power in W
SAVE	Saves the current settings
SEGMENT	Selects different frequencies within each band
SND	Controls the sound volume (not yet implemented)
STBY	Sets the amplifier to standby (bypass)
SWR meter	Sets the 7-segment display to show SWR
TUNE (UP or DOWN)	Controls the tune capacitor
Vp	Sets the 7-segment display to show plate voltage in V

2.4 Display Board

The display board is the largest board in the amplifier and spans the entire inside front panel. It has three microcontrollers, one each to control the stepper motors; the LEDs and 7-segment display and push buttons; and the sound controller.

2.5 Firmware

The Alpha 9500 firmware controls and implements most amplifier features and functions. You can upgrade the master firmware via a serial or USB connection to a Microsoft Windows PC.

2.6 Master-Control Board

The master-control board monitors all critical voltages and currents in the amplifier, as well as the input power and output forward and reflected power. It uses these converted values to control the amplifier's operation and to send data to the front panel, so that the correct LEDs are lit and the stepper motors move to the correct positions. A standard 9-pin RS-232 serial port is provided for control and monitoring and is found on the back of the Alpha 9500. A USB port is also provided. Either port may be used, but only one may be active at any one time.

The amplifier automatically senses when a PC is attached to the USB port, and uses that port. If nothing is connected to the USB, the amplifier automatically switches back to the RS-232 serial port.

2.7 Output-Tank Circuit

The output-tank circuit provides reliable high-efficiency, low-distortion performance in a very compact volume. The basic topology is “pi-L”, which provides harmonic attenuation adequate to meet the requirements of all countries globally that permit power outputs of 1500 W.

Band switching is under automatic control, accomplished by a 4-wafer band switch. These wafers are used as multifunction tap selectors, which simultaneously select band taps on the inductors and include varying amounts of capacitance to provide band spread on the tune and load capacitors. The wafers are in the RF tank area. The band-switch position is controlled by a stepper motor in the front subchassis.

2.8 Power Connections

When the Alpha 9500 is powered up, it measures the line voltage and chooses, then sets the appropriate tap setting for the transformer primary. After it is powered up, it does not reset the tap. The amplifier can be set to override autotaps election and use any primary tap; it may be useful to do so if your line voltage is unsteady or on the edge of a tap setting.

2.9 Power Supply

The power supply has two major sections: a switch-mode supply for the logic circuitry and a conventional transformer supply for all other voltages.

When the amplifier is plugged into the AC line, the switch-mode supply is always on and all the microprocessors are active. It is usual for some of the front panel LEDs to blink momentarily when the unit is first plugged in.

The remaining voltages are produced by the mains and HV boards, described below.

Mains board

Power-supply functions are split between the mains board and the HVboard. The mains board deals mostly with the primary side of the transformer. The various taps for the transformer primary are routed through this board and so is the AC line input. Relays on the mains board connect the AC line to the appropriate taps on the transformer primary.

When the **ON (AMP)** button is pressed, the microprocessor on the mains board samples the line voltage and determines which tap to select. That voltage tap remains selected until the amplifier is turned off, and does not change even if the line voltage fluctuates.

If you install your amplifier in a location where the line voltage is not steady, you can force the tap selection via the serial or USB port

Also on the mains board is a step-start circuit. This circuit consists of a relay and a resistor, which are time-sequenced to limit the inrush current into the amplifier when it is first turned on.

HV Board

The main high voltage for the amplifier is created on the HV board using a full-wave bridge rectifier and a bank of capacitors. This power supply has two 10-ohm resistors, one in the positive (B+) lead and one in the negative return to the tube cathode. This combination of resistors limits the surge current in the case of a B+ arc.

When the power-supply current exceeds about 2.5 amps, a latching relay opens the coil circuit of the mains tap relays on the mains board, causing the amplifier to go to the power-off state. This hard-fault circuit operates independently of microprocessor control.

All power-supply filter capacitors on this board have bleeder resistors that discharge the capacitors in less than 60 seconds. If you must work on this board, confirm the discharged condition with a voltmeter, due to the remote possibility of bleeder resistor failure.

2.10 Tube and Tube Deck

The Alpha 9500 uses a single 8877 triode tube. The tube operates well within its published ratings. It is operated in Class AB1, with a plate voltage of 3300 V (nominal, full output, key down) and a cathode voltage of 9.4 V.

The tube deck is a mechanical assembly that houses the tube socket and the cathode (or input match) printed circuit board (PCB).

A temperature sensor mounted on the cathode PCB measures the temperature of the air immediately below the tube socket. This temperature measurement is used by the master controller as part of the fault-detection software.