High power solid state RF amplifiers seem to be good at making a deafening amount of audible noise, so how is it the RF2K+ is so quiet?

I recall almost 20 years ago on a DX trip to activate Tristan da Cunha (ZD9ZM) a friend loaned me a Yaesu FL7000 SSPA. It weighed 30kg and according to its spec sheet, consumed around 1.9kVA to produce a modest 500W output. After a few minutes use, its cooling system fully ramped up to make a deafening roar, reminiscent of a jet plane taking off. At that time the experience convinced me high power amplification was better left to tubes.

Since then SSPA technology has developed apace but improvements in cooling system efficiency seem to have lagged far behind. Manufacturers and amateur builders alike have for the most part continued to base their designs upon use of classic extruded aluminium sinks sporting a number of modest height, open fins. While this type of heatsink can be very effective in sinking heat they are not nearly so effective in giving up that heat to the passing air intended to evacuate it from the equipment enclosure.

I purchased my first commercially manufactured SSPA 6 years ago and remain its happy owner today. My KPA500 has travelled with me to various DX locations around the world and has never let me down. I consider it a first class piece of equipment in every respect bar one. Its fan noise can be deafening. Without remoting the amplifier, I find its use is only practical with resort to noise cancelling headphones. This is what I do and will continue to do because the KPA500 has proven itself small, reliable and robust enough to survive air travel inside a standard hard suitcase.

With the KPA500 in standby and its fans not running, my shack ambient noise level is around 20dBA when measured 60cm in front of the KPA500. While producing 500W CW output with the cooling fans operating at max speed this increases to above 50dBA. The KPA500 cooling system is quite typical of those used in modern SSPAs. It employs a classic extruded aluminium heatsink with 14 fins 185 x 35mm (7.3 x 1.38”) providing a potential 1813 sq.cm (281 sq.in) of surface area over which cooling air may be moved. A single 90 x 90 x 35mm fan is mounted on the rear of the amplifier blowing air into that part of the enclosure which houses the RF pallet, heatsink and LPF module.

I carried out the same audible noise test on my RF2K+. With the amplifier turned on but not driven, my shack ambient noise level measured 20dBA at a distance of 60cm from the front of the amplifier. While producing 1500W CW output with the cooling fans operating at maximum speed this increased to just 30dBA.

https://www.noisehelp.com/noise-level-chart.html defines 30dBA as a whisper and 50dBA as light traffic. That’s a huge difference in noise level. I imagine most can cope with someone whispering in their shack but many will draw the line at the noise equivalent of a minor road running through.

So let us return to the question: “How is it the RF2K+ is so quiet?”

Instead of following the pack and specifying a one piece extruded aluminium heatsink for the RF2K+, Reinhard opted for one assembled using multiple extruded parts to create a box type assembly. This provides for a significant increase in surface area, over which cooling air can flow, while its box construction lends itself to direct attachment of fans providing for improved control of flow.

Surface Area

The RF2K+ heatsink comprises 27 vertical fins providing 52 surfaces over which cooling air flows. Each of these surfaces measures 225 x 85mm or 191.25 sq.cm (29.64 sq.in) but wait a moment…. These surfaces are not smooth aluminium but instead are ridged to provide an approximate 25% increase in surface area to 239 sq.cm or 37 sq.in. With 52 such surfaces the RF2K+ heatsink provides a massive 12,428 sq.cm or 1,924 sq.in of surface area over which cooling air may be moved. This creates significant advantage in the disposal of sinked heat. The RF2K+ heatsink has almost 7 x the surface area of the KPA500 sink. A similar heatsink to that used in the KPA500 would need to be much larger in a 1500W amp. Let’s assume the number of fins is increased to 20 and their length increased to 11.5 inches, the surface area available to cooling air would be 640 sq.in only 1/3rd that of the RF2K+ heatsink. Further increases in size would be met with rapidly diminishing returns as the further the extremes of the sink are from the source(s) of heat the less they can contribute to its disposal.

Air Flow

A limitation of the open fin extruded heatsink is that it doesn’t lend itself to well controlled airflow. In some cases this type of sink is installed with the fins resting upon a plain metal surface to create a box through which air may be blown. In others the open fin design simply relies upon a high enough volume of air passing through the amplifier enclosure such that enough of it passes over the open fins.

The cooling system design of the RF2K+ provides for much greater control over airflow. The 120mm fan pushing air through the sink is directly attached to it ensuring its full output goes exactly where intended – across the fins. A second 120mm extractor fan and associated decavitation chamber are attached to the opposite (output) end of the assembly. These reduce the back pressure on the input fan and significantly reduce unproductive cavitation, significantly improving flow.

A host of factors influence how well unwanted heat from devices is absorbed by a heatsink with yet more influencing how well that absorbed heat may then be dispatched. The above discussion concerns the RF2K+ approach to the latter and hopefully goes some way to explaining how the “whisper quiet” nature of the RF2K+ has been achieved.

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