How to Cool Satellite Uplink Amplifiers

by Brad Lindseth

Handle cooling by yourself?

Although CPI recommends that a heating, ventilation, and air conditioning (HVAC) engineer be consulted before installation, it is possible, particularly with smaller amplifiers, to do it yourself. Make sure to read the specific information on cooling in the manual provided with your amplifier. There are various ways of measuring and maintaining back-pressure and airflow levels specified in the manual to prevent overheating.

Environment

Satcom amplifiers are forced air-cooled. The temperature and airflow of the room usually dictate what kind of ducting system is needed. If the amplifier has an intake from or an outlet into the room, the heating, ventilation, and air conditioning systems should be properly sized to compensate for the amplifier cooling system. For example, Klystron High Power Amplifier exhaust flowing into a room will add 27,000 BTU per hour.

If the amplifier takes in air from the room and exhausts outside, you must be careful not to create a vacuum situation. So if the amplifier pumps out 300 cubic feet of air per minute (CFM), you must make sure there is a 300 CFM intake from outside located somewhere in the room (through an air conditioner, window, etc.).

Humidity can also be a problem. Particularly with an outdoor intake, in an air conditioned room, and the amplifier is shut off. Even though fans are shut off, humid outside air can condense on metal surfaces inside the amplifier. This may cause oxidation of metal parts, and possible electrical failure. One solution to this problem is an indoor intake. Another solution is to put a damper in the intake to prevent airflow when the unit is off.

Ducts

When the intake is from dusty outdoors or indoors, clogged intake filters can block airflow, causing overheating of amplifier components. Depending on your environment, you may have to check filters often. The duct used at your transmitter installation affects airflow. Ideally, cooling duct should be of large diameter, short length, and no bends or obstructions. Small intake and outlet duct sizes can reduce airflow enough to cause overheating. Smooth metal duct is recommended over corrugated flexible because it has less airflow resistance.

Duct Back Pressure

Any duct resistance to airflow is called back pressure, measured in inches (or centimeters) of water. If you wish to measure back pressure it can be done with a manometer purchased from Dwyer.

Duct Tradeoffs

An exhaust duct is usually recommended to take hot air outside of the cabinet, and to prevent recirculation of exhaust to the intake. Whether to have an intake duct is not such an easy choice. If clean, dry, outside air is a short distance away, then the intake duct should be added. Really dusty or humid outside air may require an indoor intake. An indoor intake may require resizing of room air conditioner / blowers.

Specific Equipment

- **Rack Mount Equipment**

  Although all CPI rack mount equipment can be cooled using intake and exhaust ducting, the higher power CMPA's (Compact Medium Power Amplifiers) are most likely to need additional cooling. Most critical to CMPA cooling is the transfer of heat to the surrounding environment. If the rack mount cabinet does not allow exhaust heat out, then the exhaust should be ducted outdoors, or into the room.

- **Outdoor Mount Equipment**

  Since there is hopefully more airflow outdoors, cooling is made a bit easier. There are still a couple considerations.

  1. Care should be taken not to block the intake and exhaust ports,
  2. Not to direct exhaust air into the intake,
  3. Preferably, orient the unit in such a way that the cooling fins are vertical.

- **HPA Cabinets**

  Most HPA cabinets usually have both intake and exhaust ducts. HPA cabinets usually have 8-inch diameter ducting. Use of smaller ducting may restrict airflow. To decrease duct resistance, shorter lengths of duct should be used. If a longer length must be used, smooth metal duct is preferred.

Multiple Amp Airflow

In a multiple amplifier configuration, the goal is to have a clever way to deal with intake and exhaust. A "series" type configuration with exhausts linked to intakes causes too much hot air on the intake and is not recommended.

Summary

In summary, there are a number of amplifier cooling factors: air temperature, humidity, cleanliness, and duct specifications. Knowing about each factor will improve on-site cooling techniques, thereby prolonging transmitter tube life. The name of the game is to keep the tube cool.

References

Fluid mechanics for engineering technology, Irving Granet, 1981.
Cooling of Electronic Equipment, Allan W. Scott, 1974.
Equipment Fans for Electronic Cooling, Siegfried Harmsen, 1991.

Note

Watts to BTU conversion: 1 W = 1 Btu * (.2928)

Please contact CPI for any questions regarding this paper or the amplifiers it discusses.