CHAPTER 5

Heat & Thermal Management Issues

HEAT MUST BE REMOVED FROM THE OEM300

The OEM300 will operate over a broad range of ambient temperatures. As it delivers power to connected equipment, it also produces heat internally. During load conditions where the OEM300 is supplying its maximum output power, internally generated heat can be as much as 35 watts. In the small space enclosed by the Power Module, 35 watts is a significant amount of heat! To keep the Power Module within its operating temperature limits, you must use two methods to remove this heat: heatplate cooling and convection cooling.

HEATPLATE COOLING

The OEM300 uses a HEATPLATE technique to provide a heat dissipation path. The heatplate is the entire back surface of the OEM300; it is the unpainted metal plate you see when you look at the back of the Power Module.

Internally, many of the components that produce the most heat are thermally bonded to the heatplate. The heat they produce can be removed through the heatplate pathway. This means that if you can cool the heatplate, these components will stay cool, too.

To cool the heatplate, you must mount it to a thermal mass, such as a heatsink or a heat sinking surface. Make sure that the surface of the heatsink is clean and flat (not warped). There should be good contact between the heatplate and heatsink, with no voids or empty spaces between them. Use silicone thermal joint compound or a thermal gasket to ensure good heat transfer across the thermal interface.

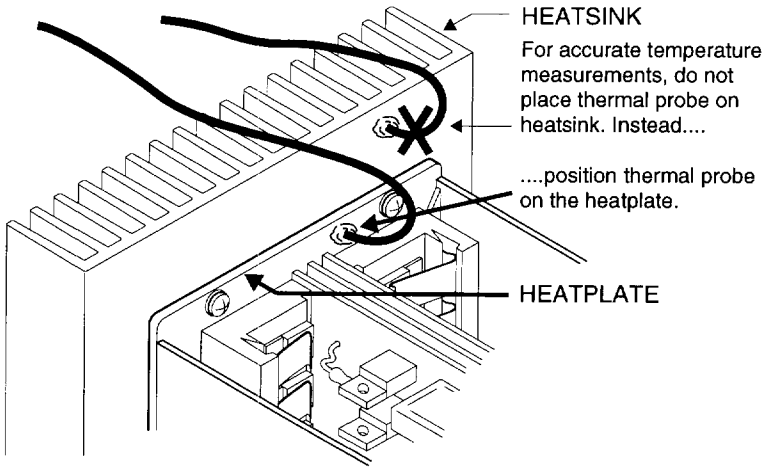
CAUTION

The heatplate must be mounted to a heatsink or proper heat sinking surface. Ensure good contact between the heatplate and the mounting surface. Use silicone thermal joint compound or a thermal gasket to ensure heat transfer from the heatplate to the mounting surface.

HEATPLATE TEMPERATURE LIMIT

Maximum Heatplate Temperature: 60°C (140°F)

To check the heatplate temperature in your system, take measurements after the system has run long enough to reach steady temperatures. As the next drawing shows, place your thermal probe directly on the heatplate, not the heatsink to which it is attached.



Measuring Heatplate Temperature

Do not assume that the heatplate and heatsink are at the same temperature. If the thermal interface between them is not good, heat may not transfer from the heatplate to the heatsink. If heat is not leaving the heatplate, its temperature can become very high, while just a few inches away the heatsink is much cooler.

In this situation, if you place a thermal probe on the heatsink, you might read an acceptable temperature. This could lead you to think your system is within limits, but it is not. Therefore, make sure you place the probe on the heatplate. This will give you the most accurate temperature information about your system.

HEATSINK CALCULATIONS

To cool the heatplate of the OEM300, mount the Power Module to a heatsink. Or, you may prefer to mount the Power Module directly to a heat sinking surface, such as the metal wall of an equipment cabinet.

Your heatsink or heat sinking surface should satisfy this equation:

$$R_{th_{SA}} \leq \frac{60°C - T_A}{20W}$$

where:

T_A is the ambient temperature

$R_{th_{SA}}$ is your heatsink's thermal resistance to ambient conditions, in °C/W

20W in this equation is the amount of heat the Power Module will dissipate through its heatplate, when it operates at its maximum continuous output power. This is a worst-case condition. If your application uses less power, the Power Module will dissipate less heat. In this case, you can use a number smaller than 20W in the equation above.

HEATSINK PROBLEMS

Several problems with heatsinks can cause poor heat transfer.

Warped Heatsink

Many heatsinks are made from aluminum extrusions. During the extrusion process, the aluminum is hot. When it cools, it sometimes warps. A warped heatsink will not make good contact with the Power Module. Heat transfer may be inadequate. Ensure that your heatsink is flat.

Voids in Thermal Interface
The heatsink should be in full contact with the Power Module's heatplate. Use silicone thermal joint compound or a thermal gasket to ensure full contact. Make sure that there are no air pockets, empty spaces, or voids in the thermal grease. Voids can severely reduce the amount of surface area available for heat transfer.

Paint
Paint on a heat sinking surface can cause poor thermal transfer. If you attach the Power Module to the wall of an equipment cabinet, make sure that any paint has been removed from the area where the Power Module attaches to the wall.

Thermal Contact Only Around Fasteners
Flexible or non-rigid heat sinking surfaces, such as equipment cabinet walls, are prone to a particular problem. The pressure of the bolts or screws that attach the Power Module to the wall can cause the wall to warp slightly. There may be thermal contact in the circular area immediately surrounding the bolt, but nowhere else. If you use the wall of an equipment cabinet for a heat sinking surface, make sure there is good thermal contact everywhere between the heatplate and your surface, not just around the bolts.

CONVECTION COOLING

Several heat producing components inside the OEM300 are not attached to the heatplate. They must dissipate their heat to the surrounding air. The open top and bottom of the OEM300 allow air to circulate and carry heat away from these components.

If the openings are blocked, air cannot circulate through the Power Module. Heated air is not replaced by cooler air; instead, the air is motionless, and heat builds up around the hot components.

Mount the OEM300 properly to ensure adequate air circulation, and to keep temperatures within acceptable limits. Refer to *Chapter ② Installation & Operation* for information on recommended mounting patterns, spacing between the Power Module and adjacent equipment, and other issues. Make sure the open top and bottom of the OEM300 are not obstructed.

CAUTION

Do not obstruct the openings in the top and bottom of the OEM300. Ensure adequate space for air circulation between the OEM300 and other equipment.

AMBIENT AIR TEMPERATURE LIMITS

The ambient air temperature must remain below these limits to adequately cool internal components:

STILL AIR:	35°C (95°F)	with a 200W load
	40°C (104°F)	with a 170W load
MOVING AIR:	45°C (113°F)	with a 200W load
	50°C (122°F)	with a 170W load

To measure ambient air temperature, position your thermal probe below the OEM300, approximately one inch away from it. Make measurements after your system has run long enough to reach a stable operating temperature.

PROVIDING ADDITIONAL VENTILATION

If you have heat-producing equipment near the OEM300, you may need to provide additional ventilation to keep the ambient air temperature within limits. Additional ventilation can be provided by vent holes in the equipment cabinet, a fan to move air in the cabinet, a combination of fans and ventilation ducts, or some other method.

Simply by moving air past the OEM300, you can raise the maximum ambient temperature limit by 10°C (18°F), from 35°C to 45°C for a 200 watt load, or from 40°C to 50°C for a 170 watt load. (95°F to 113°F at 200W, or 104°F to 122°F at 170W.)

You may wish to include a fan in your system, to take advantage of this extended temperature range. The fan should be rated at approximately 20 cfm (cubic feet/minute) or more. It should be 5 to 10 inches away from the OEM300, and positioned so that it blows air from the bottom up through the OEM300.

EXAMPLE: Suppose you want to power a 170 watt system with an OEM300, and you need to place your equipment in a sealed equipment cabinet. You mount the Power Module in a cabinet that has no fan or ventilation holes. After you power up your system and let it run long enough to reach stable temperatures, you check the temperature in the still air near the OEM300. You find it is 45°C (113°F), which is higher than the 40°C (104°F) recommended limit for still air.

So, you install a fan in the cabinet, and verify that it circulates air through the Power Module. Once again you measure the air temperature near the OEM300, and find that it is still 45°C (113°F). But, because the air is moving, the ambient air temperature is now within recommended limits. You can still use a sealed cabinet without ventilation holes!

OVER-TEMPERATURE PROTECTION

The OEM300 has a circuit that protects the Power Module from damage due to over-temperature conditions. This circuit shuts down the Power Module if the heatplate temperature rises above 60°C (140°F).

For more information about the over-temperature circuit, refer to *Chapter ④ Protective Circuits in the OEM300.*