APPLICATION NOTE

Calculating temperature rise when mounting remote access units into Oberon's Model 1074 Ceiling Zone enclosures

Introduction to Thermal Considerations

When mounting active (powered) equipment such as DAS access units inside enclosures, the temperature within the enclosure increases over the ambient temperature external to the enclosure, due to the heat dissipation of the equipment inside the enclosure.

The heat flow due to power dissipation can be modeled by analogy to a linear electrical circuit, where heat flow is represented by current, temperatures are represented by voltages, heat sources are represented by constant current sources, and thermal resistances are represented by resistors.

In this case, the thermal resistance of the enclosure, in units of °C/Watt, multiplied by the wattage dissipated inside the enclosure, results in the temperature rise inside the enclosure, in degrees C.

Model 1074 Ceiling Zone Enclosures

Oberon engineers have measured the thermal resistance of two Oberon enclosures, the Model 1074-04-07, and the Model 1074-06-VENT. The thermal resistance will vary as a function of the size and construction of the enclosure, with smaller enclosures having a higher thermal resistance, all other factors being constant. A brief description of each enclosure follows.

The Model 1074-04-07 is a 4" deep zone enclosure, and is constructed of aluminum. The size is 22.7” x 22.7” x 4.4”, equating to a volume of 2267.3 in^3.

The Model 1074-06-VENT is a 6" deep zone enclosure with a vented door, and is constructed of aluminum. The size is 22.7” x 22.7” x 6.1” with a 1.9" tall door, equating to a volume of 3904.7 in^3.

Thermal Measurement Overview

For each of the enclosures above, the enclosure was positioned with the door facing down to simulate the normal mounting environment, from a thermal standpoint.

Using incandescent light bulbs with varying wattage ratings, the enclosures were subjected to 28W, 56W, and 100W of continuous heat generation. The internal and external enclosure temperature was monitored, and the testing continued for multiple hours until a steady state temperature difference was obtained between the temperature inside and outside the enclosure.

The 28W, 56W, and 100W power levels were chosen to approximate the amount of power that remote access units from different vendors could reasonably dissipate.

By simply dividing the temperature rise in degrees C, by the power dissipation in Watts, the thermal resistance is obtained. Note that this is a linear system, and the relative change in inside temperature is independent of starting ambient temperature, for a given power dissipation.

Thermal Measurement Results

Enclosure	Enclosure Volume (in^3)	Thermal Resistance (℃/W)	Internal Temperature Rise (℃) @ 100W
1074-04-07	2267.3	0.253	25.3º C
1074-06-VENT	3904.7	0.205	20.5º C
			Internal Temperature Rise (° C) @ 56W
1074-04-07			14.2
1074-06-VENT			11.5
			Internal Temperature Rise (° C) @ 28W
1074-04-07			7.1
1074-06-VENT			5.7

As an example, the 1074-04-07 enclosure with a remote access unit which dissipates 100W of power continuously (a higher power RAU), the temperature rise inside the enclosure would be 100W * .253 C/W, or 25.3 degrees C.

In this case, if the starting ambient temperature was +18.5C, the internal temperature would rise to +43.8C. If the starting ambient temperature was only 0C, the internal temperature would rise to +25.3C.

Note that the larger enclosure has a lower thermal resistance. All other factors being equal, a larger enclosure leads to a lower temperature rise. This intuitively makes sense. If you placed a remote access unit in an enclosure the size of a large room, would you be able to even detect a temperature rise caused by the RAU?

The power dissipation of the equipment housed in the enclosure can be obtained from the equipment manufacturer, or from measurements conducted by the user. If measurements are made, the RAU should be actively transmitting/receiving data traffic to dissipate a realistic power level. Keep in mind that it is the average or long term power dissipation which is used in the thermal calculations, as opposed to short term peak power dissipation.

De-rating the operating temperature range

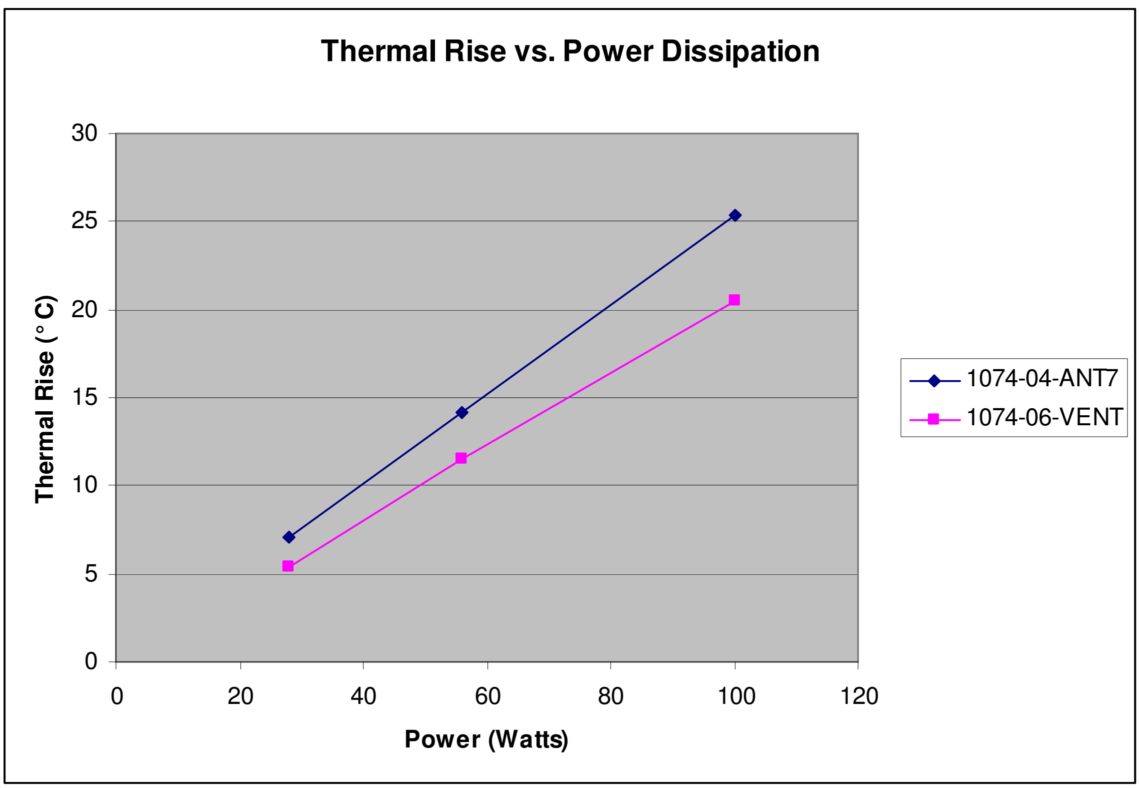
When placed in enclosures, the access points operating temperature range should be *de-rated* from the operating temperature range specified by the manufacturer by an amount equivalent to the expected temperature rise. As in the example, using the model 1074-04-07 enclosure, a temperature rise of 14.2 degrees C is anticipated with 56W of power dissipation.

If the access unit's specified operating temperature range is +5C to +40C, then the upper temperature limit should be *de-rated* to +25.8C. This means that if the external, ambient temperature is higher than +25.8C, the access point inside the enclosure will be at a temperature higher than the manufacturers' specified maximum operating temperature (+40C). On the low temperature side, the RAU *may* be warmer inside the enclosure, but not necessarily by 14.2C, depending on data traffic and power dissipation. Caution must be applied when attempting to extend the low side operating temperature of the AP in the enclosure.

Sun loading and other external factors may also de-rate the operating range even further. Access points (whether in an enclosure or not) placed in direct sunlight *may get very hot*. Access points and their enclosure should be protected from direct sun to avoid overheating.

Recommended De-rating

Temperature rise can be compared linearly with varying levels of power dissipation. As the power dissipation within the enclosure increases, the internal temperature rise also increases.



In the absence of measured power dissipation for the remote access unit, Oberon recommends de-rating the RAU manufacturer's operating temperature range by using the following equation based on the power dissipated, for the respective zone enclosures.

$$P_{max\ continuous\ power\ dissipated}\ (W) \times P_{thermal\ resistance}\ (°C/W) = T_{rise}\ (°C)$$

