EDGES MEMO #147

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To: EDGES Group

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Subject: Laboratory tests of air circulation cooling

The proposed method of thermal control of the EDGES-2 electronics is to use a plate to air LIARD DA-075-12-02 thermoelectric assembly with best sealed elements option for the best protection against damage by moisture.

To minimize the complexity of the pit box installation under the antenna and avoid interference from the DC fan on the DA-075-12-02 was removed and replaced with a cowling which is shown in Figure 1. The use of a cowling allows the air circulation needed to remove heat from the thermoelectric "hot" plate fins to be circulated from the hut with the fan to drive this circulation in the hut.

For a test in the lab the circulation fan was placed a short distance away connection with 2.5m long plastic pipes to the cowling.

These pipes have an internal diameter of 1" and were connected via some temporary adapters made with 3" pipe and flat end plates to the fan as shown in Figure 2. The fan is a Delta GFC0812DS-CMA8 (digi key part 603-1824-ND). For the tests it was powered with a mean well R5-50-15 110-230V 15V DC supply rated at 3.4 amps. This supply was adjusted to its minimum voltage of 12.5v.

1] Fan tests

Differential pressure vs voltage

Voltage (V)	Current (a)	Difference pressure Difference water
12.5	2.6	2.0
10		1.5
8		1.0

While there was no instrument to measure the air flow the technical data from the manufacture gives a curve showing a flow rate of about 1.5 m^3/min at 12V and 2 inch H_2O pressure. 1.5 m^3/min is calculated to remove 20 W/degC based on its specific heat.

2] Cooling test

With a room temperature of 22 deg C the thermoelectric assembly was able to keep the cold plate at 12 degC with 70% of its cooling power.

3] Extrapolation to installation at MWA.

a) Air flow

The pressure drop for a fixed air flow rate is proportional to the proportional to the length and inversely proportional to the pipe inner diameter raised to the fifth power. If the 2 PVC pipes bringing the air to and from the electronics box have a diameter of 3" and length 100 m one-way the pipe fraction is equivalent to adding 0.4 m of 1" pipe so that the same air flow should result if the 2 lengths of 2.5 m flexible pipe used in the test are deduced to 2m each. It is estimated that no more than about 1.8 m of flexible pipe will be needed for each connection from the cowling to the PVC pipe.

b) MWA climate

The biggest challenge is the cooling of the electronics box to a cold plate temperature of 25 C in January when the mean maximum is 39.3 C and the mean minimum is 22.4 C from the climate statistics of Murchison, W.A. The PVC pipe is deep enough that the temperature of the soil should be the average of the maximum and minimum or about 31 C requiring a differential of about 6 C. Heating, when required in the winter months, should not be a problem as there will be a very large margin.

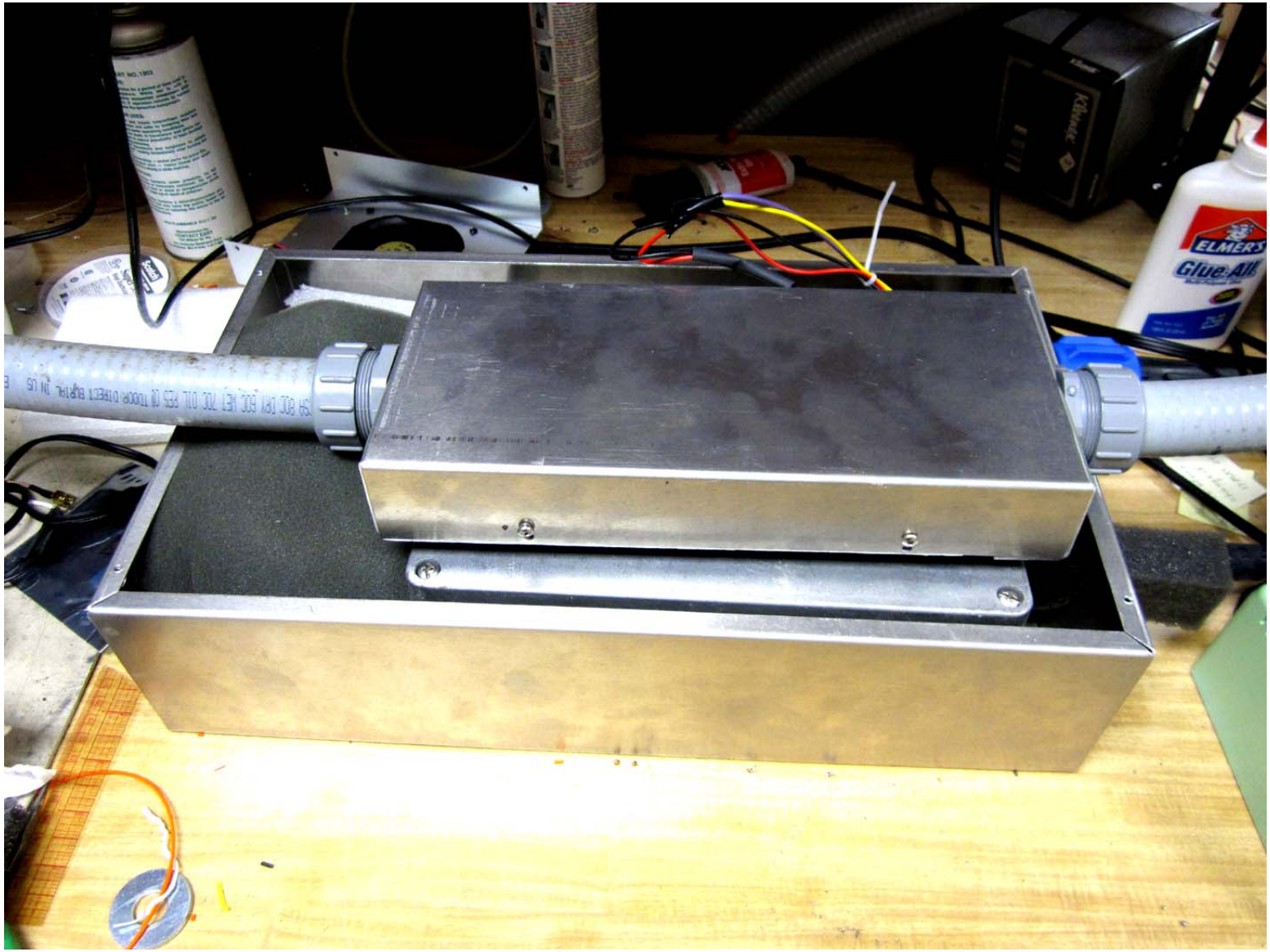

Figure 1. Cowling around hot plate fins of DA-075-12-02

Figure 2. Delta fan air pump with temporary connections to 1 inch flexible pipe.