750 Watt Electric Cabin Heater

My current project is a Velocity XL RG and normally, cabin heat is provided by a nose mounted oil cooler heat exchanger. These suffer from low heat output in the winter, and no heat if the oil by-pass valve stays closed. In any case, it is intended to use the ATPI turbine engine in this airframe, and bleed air is not available. I have always been reluctant to use exhaust based cabin heat systems, so an electric solution seemed a good choice.

The cabin heater shown in the photos was built using ceramic heating elements removed from three 250W/12V Ceramic Heaters. These were purchased from the C-ME Marine Sales Inc web site at http://www.C-MESALES.com/. Look under the sub-menus "Marine electrical/12v marine/12v products/12V Ceramic Heater", order # 62313. Their phone number is 800 659 4262. Cost was $22.95 each.

I removed the heating elements with their plastic carrier and also the heavy duty relay.
All the other parts were discarded.
The computer cooling fan was found at Radio Shack and it is a high volume brushless type. I also bought an additional relay for the fan and a few silicone diodes, 1/4W resistors, npn switching transistors, a 3-pole 4-way rotary switch, a SPST switch and a ten-led bar-graph display, some ribbon cable, and one set of male and female 9-pin D-Type connectors. Total cost was less than $90.

The ceramic heating element carriers were trimmed to minimize the width and height of each unit and to just provide enough electrical insulation between adjacent units.
Each heater unit consists of a continuous resistive element with a spade terminal at the physical mid point and one at each end. I connected the center terminal to -ve and the two outer terminals to +ve. This generates about 200-250 Watts of heat for each element.

The heater frame is made from pieces of flat three ply glass fiber sheet which were held together initially with blobs of 5-minute epoxy until I was happy with the layout. Two plies of bid tape were then used to permanently hold all the parts together.

Outside air is provided through an adjustable NACA duct which when fully closed, allows cabin air to be re-circulated through the heater.
The two lower heater ducts are directed to the feet, while the top two go to the face level eyeball vents, unless these are closed in which case the flow is diverted to the windshield.

The temporary wiring in the photos is automotive and will be replaced for the final version.

A small circuit board is used behind the led bar-graph to hold the transistors and resistors which turn on the leds. The resistor values work well to provide good illumination in bright sunshine. The led circuit is supplied from a dimmer for reduced brightness at night.

The main features of the control circuit are as follows;

- The circuit breaker cuts all power to the heater.
- Only low current passes through the control panel,
- The led bar-graph display will dim with the instrument panel lights.
- The fan can recirculate air or blow fresh air without heat.
- The fan must be on for the heating elements to be switched on.
- The ceramic elements do not glow red hot unlike some coiled wire types.
- It is possible to use heater de-mist without the other elements being switched on.
- A thermal fuse will disable the heating elements if the temperature of the heated air exceeds 150 F.

The NACA inlet is controlled by a pull-push Bowden cable with a "twist to lock" feature.

The current draw is estimated to be approximately 55 Amps at 14 volts, which is VERY heavy, but is only expected to be used for a short time at that level.
Bench testing with the temporary wiring showed good volume flow and excellent temperature rise.

This heater is a bit of an experiment. I expect to find some alternative heat source, and may even risk welding a heat muff on the turbine exhaust pipe. You can bet that a carbon monoxide detector will be installed in the inlet to the cabin. Either way, the electric heater will be installed and probably will only be used as a backup.

The only failure mode I can see that is of concern, is when the fan stops working with the heating elements on.
The thermal fuse should take care of that situation without too much smoke in the cabin ☺. A thermal switch would be a better option allowing for a reset from an over temperature condition. If you know of a small device for this purpose, please let me know.

If you have any alternative wiring suggestions, or you want to express any safety concerns, please let me know at andreasc@ix,netcom.com