BU ETL Cold Box Documentation

Overview

The BU Cold Box is intended to serve as an early production test-stand for ETL modules and readout boards for QA/QC as well as have the capability to operate as a cosmic-ray telescope. To achieve this, the box incorporates liquid cooling, dry air environmental controls, cable and hose management, and safety interlocks. A .step file showing the V1 design is available here.

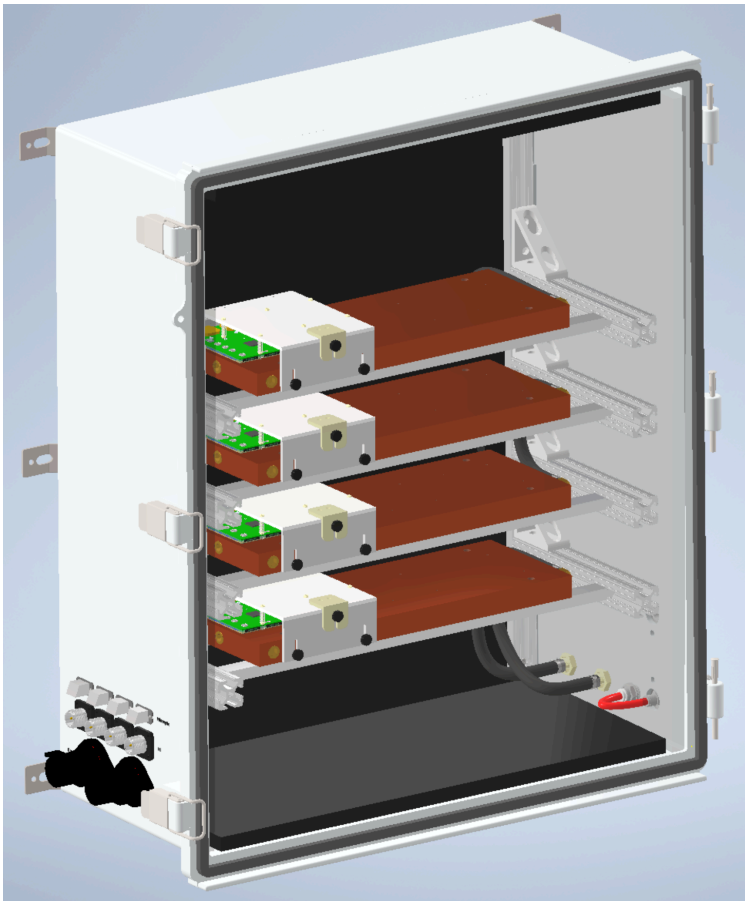

Figure 1. The BU ETL Coldbox. Shown without door for clarity.

Mechanical

The cold box itself is a WQ-80 polycarbonate case with an air-tight seal. It has inner dimensions of approximately 450x580x210mm. It features mounting points on the back wall which will be used to attach two T-slot aluminum profile rails upon which the shelves holding each supermodule will be mounted. The shelves consist of two horizontal aluminum profiles attached to the back supports with an angle bracket and two aluminum cross-members that support the

copper cold block. These are all off-the-shelf components aside from the cross-members which will need to be custom-produced.

The cold-box can support up to 4 cold plates that each can hold one readout board (of either the 3, 6, or 7-module variety). The supermodule can be held against the cold plate with either the standard mounting screws or a spring-frame that presses the supermodule against the cold plate without screws. The spring-frame is intended to make swapping out supermodules easier for the operator and avoids the risk of screws stripping out the soft copper.

During operation the box can be wall-mounted, but it can also simply sit on a worktable. If placed on a table an additional support along the back bottom edge will be required so that it sits level. Lacking this, it will be at risk of tipping over backwards (Which is especially dangerous since each copper block weighs over 6kg so a fully populated box will be quite heavy).

Thermal

The box is insulated with a layer of ½" Polyurethane foam insulation around the entire interior. Additionally, any coolant hoses outside of the box will be insulated as well to prevent condensation/frost on the hoses and fittings. The coolant is chilled using a Dyneo DD 1200F recirculating chiller. The coolant itself is a 50/50 mix of distilled water and propylene glycol (antifreeze). We expect to be able to operate the chiller at -25C. Coolant supply and return connections are on the right side of the box near the bottom.

Dry air must also be supplied which is done by connecting a dry air line to a port on the right side of the box. The flow-rate can be then adjusted using an adjustable flow-meter mounted on the side of the box next to the port.

Electrical and Communications

Both low and high voltage power as well as fiber-optic communication utilizes a patch panel on the left side of the box. LV power supply and ground return use Amphenol ATHD06-series connectors. The interior of the box will have a breakout board splitting the supply into lines leading to each readout board. Each line will be supplied with a fuse to help protect against shorts. Custom cabling will be required both for the interior lines as well as for the exterior lines connecting the box to the LV power supply.

There are four independent HV supply ports utilizing 700VDC rated aviation connectors. Custom cables must be produced for both the interior connections and the exterior lines leading to the HV supply.

Safety Systems and Monitoring

The safety and interlock system will use an Arduino-based system which monitors the ambient temperature and humidity in the box, and temperature of each cold plate. It will also have detectors for liquid pooling in the bottom of the box and whether the door has been opened. A PC application will regularly poll these sensors during operation and automatically take necessary action as required. For example, If the door is opened while the HV is on, it will be turned off. Or if liquid is detected in the bottom of the box, the chiller, LV and HV power will all be disabled. In addition to the Arduino-based system, the testing software will regularly monitor the built-in temperature probes in the electronics and power down if the temperature surpasses a limit.