Electronics System

The entire system is made up of a set of electronics chassis described below, some timing chassis, the "Blue Box" and computer system. The system schematic that shows the interconnection of all of the electronics chassis is found here: BSC_ISI.pdf [LIGO-D0901301-v1].

ISI Interface Chassis – This chassis gathers all of the signals from the GS-13 seismometers, the L4C Geophones and the Capacitive Position Sensors and interfaces them with the computer via an Anti-Alias filter chassis. The chassis contains three main boards, the GS-13 Interface Board: D070115 Rev.B1, the L4C Interface Board, D070126 and the Capacitive Position Sensor Interface Board: D070132. This design is installed in the LASTI ISI system, but some modification is needed for use in Advanced LIGO. All three boards will have their own power switch, so each can be cycled independently. The GS-13 board and the L4C board will, most likely, become the same design because we no longer use the GS-13 lockers, and we have never used the L4C calibration coils. These two features were the main differences in the design thus far. Some of the electronics will be reworked to use better, and more readily available parts. For example, the AD620 chips will be replaced with a lower-noise, and much more readily available LT1125 configuration, and the THS4131 output stage will be replaced with an AD8672 chip. The Capacitive position sensor board will have to be re-done to interface with the new ADE chassis, but the board is really simple, and this should be a relatively easy rework.

ISI Coil Driver – This high-current driver receives signals from the computer via an Anti-Image filter chassis. It provides these high current signals to the ISI actuators. The current Coil Driver Schematics are here: D060454 Rev.D2. The design works well, but some minor internal changes are being done to make the chassis easier to put into production

Binary I/O Chassis – This chassis is essentially a patch-panel that takes one connector that goes to the Binary I/O card, and distributes the signals to the right places. Binary Out signals go to the ISI Interface chassis to control gain and filter settings, and Binary In signals come from fault monitors in the Coil Driver chassis. It is a simple board, but it will have to be redesigned to interface with the newer style of Binary In and Binary Out boards that we will be getting.

Anti-Alias Chassis – This chassis is a low-pass filter for all incoming signals, the cutoff frequency of which is set so that signal frequencies higher than the Nyquist frequency (determined as half the sample frequency) are greatly attenuated so that they don't alias down into the passband. The filters themselves will remain the same as they have been for a while now, the only difference in the BSC ISI version will be its arrangement of frontpanel connectors. All of the boards have 32 channels of available filtration, which correspond to the 32-channel Analog to Digital Converters to which they connect. For the Rev. 12 chassis, these will be split up into 3 25-pin connectors with varying number of signals to each, and one 9-pin connector with two spare channels on it. The 25-pin connectors of one chassis go to one Coil Driver, one ISI Interface chassis, and one Trillium T240 Interface chassis, and distribute the signals to the ADC. The schematic for the filters is here: D070081-01.

Trillium T240 Interface Chassis – This chassis needs to be designed, but it should resemble the STS-2 Interface chassis in use in the HEPI system. It will interface with

the Trillium T24 tri-axial seismometer, and send its signals to the computer via an Anti-Alias filter, and an ADC board. It will also receive binary output signals that switch some of the seismometer's functionality.

Manufacture and Production

All chassis will be manufactured at a turn-key external company. They will order the parts, stuff the boards, assemble the chassis, and deliver the whole thing ready for testing, and then delivery to the sites. We are currently examining several of these companies for the manufacture of HEPI electronics, and will select one at the end of a bidding cycle.

Setup and Testing of the Electronics

In testing the system, two boxes and several small boards have been made to help with the task. The first box is the STS-2/GS-13 Tester box. This box is used when a particular seismometer is in an unknown state of health. By plugging this box into a STS-2 or GS-13 pod, one can assess whether the seismometer is working or not. This is helpful during construction, as it means that we can test the expensive seismometer without hooking it up to an untested control system. The GS-13 Controller schematic is here: GS13_L4C_Controller.pdf. This box gets connected in the place of an in-vacuum seismometer, and allows us to test all of the wiring, and computer system without endangering an expensive seismometer. The Emulator has power supply LEDs that allow you to see, at a glance, if the incoming power is correct before tuning on the Emulator. Once it is on, it outputs a fake seismometer signal that can be detected on the control room screen. There are also LEDs and frontpanel BNC connectors to allow you to check the rest of the computer system functionality. The Emulator schematic is here: GS13_L4C_Emulator.pdf. There are also several boards that help in testing. One is a switch board that emulates the functionality of the binary I/O modules, so gains and whitening can be set right at the rack, and several inline breakout boards that go inline with the cables, and allow you to clip onto any wire inside, and check the health of the signal there. Along with the hardware, we will have good documentation system that provides a system test procedure, and a set of "quick start guides" that let people who might be receiving, or using the electronics have a quick overview of its functionality and "care and feeding". A sample system test procedure from the HAM ISI system can be found here: HAM_ISI_test, and some examples of Quick-Start guides are in these places: GS-3_L4C_Emulator_Quick_start, GS-13_L4C_Controller_Quick_start.pdf, and STS-2_Quick_Guide.pdf.