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Response to the Pre-Production UIM Unit Evaluation Report,
T0900014

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This is an internal working note
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RESPONSE TO THE UIM EVALUATION REPORT TO900014-V1

INTRODUCTION

The relevant comments from the Caltech Evaluation Report, TO900014-V1, are listed, followed by the University of Birmingham responses.

Response to the Evaluation Report

Comment 1

1.2 Executive Summary

The UIM Pre-Production Prototype chassis supplied to AdL for test represents a large step forward from the original prototype chassis supplied earlier in 2008. The chassis appears to meet all requirements set forth in LIGO document number T060067-00-C, "AdL Quad Suspension UK Coil Driver Design Requirements".

Response to Comment 1

The production units will be produced to the same standards.

Comment 2

The only deficiencies noted are:

The channel order for the voltage, current and r.m.s current monitor is reversed from the channel order for all other connections. On most connections to the chassis, channel 1 connections start at pin 1 of the connector and proceed sequentially up through channel 4.

On the J1 connector of the monitor board this order is reversed with channel 4 starting on pin 1, followed by channel 3, channel 2 and channel 1. While the order of channels is somewhat arbitrary this deviation from what may be considered the nominal order should be noted and may cause some confusion during operation in the future.

Response to Comment 2

The layout of the monitor board will be revised to incorporate this change.

Comment 3

The jumper wires on the monitor board used to correct a layout problem represents a possible failure mechanism. If the layout of the monitor board is not corrected prior to production, a more robust means of attaching and securing the jumper wires needs to be devised.

Response to Comment 3

The track error which made this jumper wire necessary in the pre-production monitor boards will be corrected, and the jumper wires will not be necessary on the production units.

Comment 4

The schematics provided with the chassis appear to document the UIM board and the monitor board. A test plan for the UIM board itself was supplied, but no test results for the boards or the chassis were supplied. No test plan for the monitor board or the fully assembled chassis was supplied.

Response to Comment 4

Test reports for both the Driver and Monitor boards were supplied with each subsequent unit delivered. Discussion on the provision of subsequent test results in an efficient way (electronic or paper copies) could be time well spent.

Comment 5

Neither a quick start guide nor a description of the operation of the chassis was supplied. Prior to production a full set of documentation including these items, a complete bill of materials and all design files need to be provided.

Response to Comment 5

In addition to this document, we plan to supply the following documents:

Design Document.

Users' Guide.

Test Plans:

Driver
Monitor
Complete Unit.

Circuit Diagrams:

Driver
Monitor

BOMs:

Driver
Monitor

Comment 6

Manufacturing

Quality of Manufacture

The UIM Driver chassis provided to LIGO for testing and evaluation is a pre-production prototype.

Once it has been determined that the pre-production prototype has met the requirements and that all deficiencies noted in this report are corrected the design can be declared frozen and the UK can begin production of all UIM units required for AdL.

Response to Comment 6

The University of Birmingham is ready to proceed with the PBB layout updates necessary for the production units.

Comment 7

The Monitor board was manufactured in a similar fashion and the only circuit board issues observed are the wires added from TP8 to R24 of each channel. These wires were added after circuit board manufacture to correct an omission. It should be noted that one of these wires was broken free on the R24 end of the connection during shipment from the UK to the US. Prior to testing this connection was repaired. Production models of the Monitor board should be corrected so that these wires are not necessary. Both boards (driver and monitor) are identified in the space provided with the drawing number, revision number and serial number for the board. The circuit board (PCB artwork) revision number is included on the silkscreen for each board.

Response to Comment 7

The track errors will be corrected on the production artwork (see response to comment 3)

Comment 8

Although a complete bill of materials was not provided, a check of the availability of the capacitors used in the critical portions of the circuit showed that they may not be readily available in the US. If this is the case, then an adequate number of spares need to be provided with the production units. The same can be said of any other components used in the designs. This possibility will need to be evaluated when a complete set of documentation is supplied.

Response to Comment 8

The best solution may be to ensure that suitable components with the same footprint are available on both sides of the Atlantic. Where this is not possible, an agreed number of spares may need to be provided. It is also likely that in all cases the same components will be available, though with a longer delivery time.

Comment 9

The circuit boards are attached to the chassis using standoffs that stick to the bottom panel of the chassis. These temporary standoffs were used in place of the permanently mounted standoffs planned for the production chassis. Permanently mounted standoffs are a requirement for production units as previous experience has shown that the adhesive used for the temporary standoffs will give way during shipping and/or over the life of the chassis.

Response to Comment 9

Metal standoffs could be used for the production units, though extra drilling of the boxes would be necessary.

Comment 10

2.3 Adequacy of Documentation

A complete set of paper schematics was provided for the driver and monitor boards. No bill of materials, chassis test plans, test results, quick start guide or other documentation was provided. Prior to production, all materials listed in Electronics Requirements document (T060067) and LIGO document T000053-04-D, "Universal Suspension Subsystem Design Requirements Document" will need to be evaluated. Additionally it is preferred that all Altium schematics, Gerber files, and other documentation be provided electronically.

Response to Comment 10

The documentation requested in the above comment will be provided. The Quick Start guide will be a section of the Users' Guide. Test results will be supplied with each unit delivered.

Documentation required by T060067 – no documentation is listed in T060067

Documentation required by T000053-04-D:-

All designs require the following:

- (A) Test Plan for the module or subsystem being designed. This test plan should fully test the function of the circuit or system and should include, but not be limited to transfer functions, channel-to-channel crosstalk, nominal currents and voltages, list of necessary test equipment and test fixtures. In addition to the "standard" functional tests, the plan should include tests for out of band noise and oscillations. An excellent example of a test plan for a module can be found in LIGO T040189-00, "Common Mode Servo Board Test Procedure".
- (B) Test Report and Electronics Travellers for each component supplied
- (C) Functional description and block diagrams. For more complex components or subsystems, a complete user manual including a troubleshooting guide and maintenance manual should be supplied.
- (D) Bill of Materials
- (E) Schematics for board and system level

(A): Test Plans have been produced.

(B): A test report will be supplied with each unit.

(C): Functional descriptions and block diagrams are included in the Test Plan and Users' Guide.

(D): Bills of Materials will be supplied

(E): Schematics of all the Drive Unit circuits will be supplied.

Comment 11

3.2 Test Inputs and Monitoring

One observation worthy of mentioning is that when links W2 and W6 are left open and the test input switch in the normally closed position, there is no bias return path for op amps IC4 and IC8. This leads to amplifier offsets and drifts that may not be acceptable in AdL. It is recommended that W2 and/or W6 be installed during production.

Response to Comment 11

In large, complex systems, noise from the ground connections is a common problem. LIGO is a very large, very complex system with an extremely tight noise specification. The Coil drive amplifiers are therefore designed as four terminal modules, isolated from ground. The link to ground has been added to allow the option of referring the units to ground if required.

It is recognised that if the test input is not connected to anything, the test inputs will be floating, and large offsets will occur. It is recommended that a dummy connector is always fitted to the test input when it is not being used, with all pins connected together. This effectively grounds the test inputs, preventing offsets.