

Advanced LIGO Engineering Change Request (ECR)

ECR Title: Replace 18-bit DACs in CDS front-ends with the new LIGO 32-bits DACs

DCC No: E2400409

Date: November, 6th 2024

Requester: Fernando Mera Impacted Subsystem(s): CDS front end systems

Description of Proposed Change(s): Replace remaining 18-bit DAC adapters in front-end control systems with 32-bit LIGO designed DAC (LIGO-E2200440).

This ECR is an alternative to previous ECR (LIGO-E2100485) meant to replace the currently used 18-bit DACs with new 20-bit DACs, instead here a 32-bits LIGO DAC which has been engineered, debugged and tested by LIGO Staff is proposed. The new LIGO DAC card uses one PCIe slot and accepts timing either for sampling and synchronization using a GPS Phase Locked Loop VCXO to provide harmonic noise reduction.

The replacement plan will also consider the A+ needs.

Reason for Change(s) / Motivation: The General Standards 18-bit DACs are on the verge of obsolescence and have presented more failure rate than the 20-bit cards. Also insufficient spares exist to maintain IFO operation for O4 and beyond. Vendor will no longer repair these old adapters. Some have been replaced with 20-bit DACs for performance upgrades, which do not have these issues. General Standards DAC is currently 3 times the cost of the new in house LIGO DAC. Replacement of all 18-bit DACs with the LIGO 32-bit DACs will improve the IFO availability and at the same time will provide the best resolution possible with the actual technology.

Motivation / Projected benefit (check all that apply):

- ☐ Increased Sensitivity
- ☐ Decreased Glitch Rates
- ☒ Re-engineering to cope with obsolescence

- ☐ Re-engineering to cope with sourcing issues
- ☐ Re-engineering for technology insertion
- ☒ Re-engineering for life extension of aging components/subsystems

Rough Estimated Cost (Materials, Supplies, Equipment): Each 32-bit LIGO DAC now costs \$2.500 accessories (connectors, wire sets, adapters). The total quantity consider as follow: 20 units (12 units for changing the old 18-bits DAC and 8 units for spare and test). Hence the total budget is \$50.000.

Rough Estimated Labor (Hours only): Each replacement might take 1 hour, but doing several at once would save time. Requires reconfiguration/build of real-time model and (known) modification of filters to accommodate change in resolution from 18 to 32-bit.

Schedule Impact Estimate: Implement in O4

Nature of Change (check all that apply):

- ☐ Safety
- ☐ Correct Hardware
- ☐ Correct Documentation

- ☒ Improve Hardware
- ☐ Improve Software
- ☐ Improve/Clarify Documentation
- ☐ Change Interface
- ☐ Change Requirement

Advanced LIGO Engineering Change Request (ECR)

Importance:

- ☐ Desirable for ease of use, maintenance, safety
- ☒ Desirable for improved performance, reliability
- ☒ Essential for performance, reliability
- ☐ Essential for function
- ☐ Essential for safety

Urgency:

- ☐ No urgency
- ☒ Desirable by date/event: __Jun, 2025__
- ☒ Essential by date/event: __Jun, 2025__
- ☐ Immediately (ASAP)

Impacted Hardware (select all that apply):

☐ Repair/Modify. List part & SNs: _____

☐ Scrap & Replace. List part & SNs: _____

☐ Installed units? List IFO, part & SNs: _____

☐ Future units to be built

Impacted Documentation (list all dwgs, design reports, test reports, specifications, etc.):

Impacted Software (list all that apply):

Front-end model files, filter files

Disposition of the proposed change(s):

The disposition of this proposed engineering change request is to be completed by Systems Engineering and indicated in the “Notes and Changes” metadata field in the DCC entry for this ECR. The typical dispositions are as follows:

- **Additional Information Required**: in which case the additional information requested is defined. The ECR requester then re-submits the ECR with the new information using the same DCC number for the ECR but with the next version number.
- **Rejected**: in which case the reason(s) for the rejection are to be given
- **Approved**
- **Approved with Caveat(s)**: in which case the caveat(s) are listed
- **TRB**: the ECR is referred to an ad-hoc Technical Review Board for further evaluation and recommendation. It is the System Engineer’s (or designee’s) responsibility to organize the TRB. The System Engineer (or designee) then makes a technical decision based on the TRB’s recommendation. Links to the TRB’s documentation (charge, memos, final report, etc.) are to be added to the “Related Documents” field for this ECR.
- **CCB**: a change request for approval of additional funds or schedule impact is to be submitted to the Configuration Control Board. Links to the CCB’s documentation (CR, etc.) are to be added to the “Related Documents” field for this ECR.

Concurrence by Project Management:

Acknowledgement/acceptance/approval of the disposition is to be indicated by the electronic “signature” feature in the DCC entry for this ECR, by one of the following personnel:

- Systems Scientist
- Systems Engineer
- Deputy Systems Engineer