

## *MEMORANDUM*

DATE: July 16, 2025  
TO: Slow controls team  
FROM: Daniel Sigg  
SUBJECT: Modifications to the Beckhoff chassis  
Refer to: LIGO-E2000499-v5

Due to the elimination of the end station computers the remote access chassis in the end stations can be simplified. A set of terminals is removed including the bridge terminal that was used to communicate between computers.

### **Change 1: Remote Access End**

Drawing: D1100619-v3  
Wiring diagram: E1100455-v3  
Work: Combined the terminals into a single rail and  
remove terminals that are no longer needed  
Needed: 2x D1100095-v2 per end station (4 total/site)

### **Change 2: Remote Access Corner**

Drawing: D1100618-v2  
Work: Verify the position of the EL9400 terminal

The rotation stages are put on a separate rail that can be independently power cycled. As part of the A+ upgrade a picomotor controller for the PSL is added.

### **Change 3: PSL/IO/TCS Controls Chassis**

Drawing: D1101114-v6  
Wiring diagram: E1100530-v8  
Work: Separate rotation stage onto separate rails, add relay for power on/off  
Add picomotor interface terminals for A+  
Needed by rotation stage upgrade:  
1x EK1122  
1x EK1101  
1x EL1094  
1x EL2612



Needed by A+ upgrade:

- 1x D2000017-v1 (superseded by version 2)
- 2x D1100419-v3
- 1x EL9410
- 1x EL3102
- 1x EL1014
- 1x EL1872
- 1x EL2872

Controls and readbacks for the T-SAMS and the P-SAMS are needed for A+.

#### **Change 4: PSL/IO/TCS Controls Chassis**

Drawing: D1101114-v7

Wiring diagram: E1100530-v9

Work: Add terminals for a new middle rail for the P-SAMS

Add terminals to the end of the right rail for the T-SAMS

Needed for the new middle rail:

- 1x D2000017-v2
- 2x D0902567-v1
- 1x EK1100
- 4x EL3104
- 1x EL9190
- 1x EL9011

Needed for the right rail upgrade:

- 2x D0902568-v1
- 1x EL9410
- 2x EL3104
- 2x EL3692
- 1x EL4132



Additional picomotor controller interfaces are added to the corner chassis 2 for A+.

### **Change 5: EtherCAT Corner 2**

Drawing: D1100680-v3

Wiring diagram: E1101126-v3

Work: Add 3 picomotor controller interfaces

Needed by A+ upgrade:

- 1x D1102268-v2

- 1x EL9410

- 3x EL3102

- 3x EL1014

- 3x EL1872

- 3x EL2872

- 1x D1100419-v3

The EtherCAT chassis near HAM8 may require picomotor controllers as well.

Needed by A+ upgrade:

- 2x D1100419-v3

Two sets of controls for the AM modulated AOM amplifiers are added to the EtherCAT chassis squeezer 3 for A+. Also, added are interfaces for the DC PD concentrator 9 and an additional auxiliary concentrator 1.

### **Change 6: EtherCAT Squeezer 3**

Drawing: D1600509-v4

Wiring diagram: E1600386-v4

Work: Add controls for an AM modulated AOM amplifiers to the middle rail

Add a new right rail for another AM modulated AOM amplifiers, and the two new concentrators.

Needed by A+ upgrade for the middle rail:

- 1x D1700036-v2

- 1x D0902569-v1

- 1x Omron S82S-7305

- 1x EL9410

- 1x EL3104

- 1x EL4134

- 1x EL1124

- 4x EL2124

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Needed by A+ upgrade for the right rail:

- 3x D0902569-v1
- 3x Omron S82S-7305
- 1x EK1100
- 2x EL9410
- 4x EL3104
- 1x EL3102
- 2x EL4134
- 2x EL1124
- 8x EL2124

A new EtherCAT chassis squeezer 4 is needed for the additional controls of the filter cavity.

#### **Change 7: EtherCAT Squeezer 4**

Drawing: D2000504-v1

Wiring diagram: E2100047-v1

Work: Install new chassis

May require additional +24V power supply.



## **Change 8: EtherCAT Corner 6**

Drawing: D1300745-v6

Wiring diagram: E1300689-v8

Work: Add controls for the 3.125 MHz squeezer pickoff and the DCPD relays

Needed by A+ upgrade for the middle rail:

- 1x EL9410 (replace M9, reuse EL9190)

Needed by A+ upgrade for the right rail:

- 1x D1500088-v2 (rear panel)

- 1x D0902567-v1 (DB25M adapter)

- 1x D0902569-v1 (DB37M adapter)

- 1x Omron S82S-7305

- 1x EL9410 (replace R10, reuse EL9190)

- 1x EL3104

- 1x EL1124

- 2x EL2004

A new EtherCAT chassis to the filter cavity end station.

## **Change 9: EtherCAT Filter Cavity End**

Drawing: D2200006-v1

Wiring diagram: E2200004-v1

Work: Install new chassis in filter cavity end station

- Requires installation of an EtherCAT media converter for single-mode fiber optic, CU1521-0010, in the MSR.

A new EtherCAT chassis squeezer 5 is needed for the squeezer PMC.

## **Change 10: EtherCAT Squeezer 5**

Drawing: D2300323-v1

Wiring diagram: E2300329-v1

Work: Install new chassis.



Double up the EL3692 resistance terminals.

### **Change 11: EtherCAT Squeezer 2, 3, and 4**

Drawing: D1600507-v2, D1600509-v5, and D2000504-v2

Wiring diagram: E1600384-v4, E1600386-v5, and

Work: Double up the EL3692 resistance terminal.

- 1x EL3692 (replace R11 in D1600507)

- 2x EL3692 (replace L20/L22 in D1600509)

- 2x EL3692 (replace M14/M23 in D2000504)

Make sure that wires for digital step attenuator in PLL integration have been added (D2000504).

Add support for BHD.

### **Change 12: EtherCAT Corner 4 (implement together with change 14)**

Drawing: D1101266-v4

Wiring diagram: E1101222-v5

Work: Add readbacks for another WFS and LSC demodulator concentrators

Needed by BHD upgrade for the left rail:

- 2x EL9410 (replace M5 and add M15)

Needed by BHD upgrade for the middle rail:

- 2x EL9410 (replace M5 and add M15, reuse EL9190)

- 4x EL3104

Needed by BHD upgrade for the right rail:

- 1x EL9410

- 6x EL3104

- 1x EL1124

- 1x D2400266-v1 (rear panel)

- 1x D0902557-v1 (blank rear panel)

- 2x D0902569-v1 (DB37M adapter)

- 1x Omron S82S-7305 or Mean Well DDR-15G-5



### **Change 13: EtherCAT Corner 6**

Drawing: D1300745-v6

Wiring diagram: E1300689-v9

Work: Update wiring to incorporate second fast shutter and DCPD whitening

Needed by BHD upgrade for the middle rail:

No new terminals, just wire changes for fast shutter interface.

Add grey wires as indicated in the wiring diagram between terminal M2 and adapter in slot 8.

Add support for JAC.

### **Change 14: EtherCAT Corner 4 (implement together with change 12)**

Drawing: D1101266-v4

Wiring diagram: E1101222-v5

Work: Add shutter controls

Needed by JAC upgrade for the middle rail:

1x EL9410

1x EL1094

1x EL2008

1x EL3104

1x EL4134

### **Change 15: EtherCAT Corner 5**

Drawing: D1200132-v4

Wiring diagram: E1200077-v4

Work: Add resistance terminals to read JAC temperature

Needed by A+ upgrade for the left rail:

2x EL9410 (replace L5)

Needed by JAC upgrade for the middle rail:

2x EL9410 (replace M8, and add M15)

2x EL3692

1x EL3104

1x EL4134

1x EL1124

1x D2500231-v1 (rear panel)

1x D0902575-v2 (Double DB15M adapter)

1x Omron S82S-7305 or Mean Well DDR-15G-5