Author: Victor Bigea

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**EtherCAT SLOW CONTROLS SYSTEM**

 **TEST PROCEDURE FOR CM CHASSIS**

**EtherCAT Slow Controls System Test Procedure**

1. **. SCOPE**

This test procedure provides functional and verification tests that check the operational features and all input and output functions of the Ether CAT Slow Controls System. The test set up is presented in Figure 1. The initial inspection and test procedure, the adjustments, and the functional test of the Ether CAT system are outlined in the “Preliminary Test” section and in Table 1 of this document. This test procedure is to be used to test every unit before shipment from the factory.

1. **. REFERENCE DOCUMENTS:**

2.1. ISC CM Controls Chassis DWG. No. [­­­­­­D1002961-v2](https://dcc.ligo.org/public/0025/D1002961/002/D1002961-v2.pdf)

2.1. EtherCAT Assembly schematics DWG. No. ­­­­­­[D0902552-v3](https://dcc.ligo.org/public/0006/D0902552/003/D0902552-v3.pdf)

2.2. EtherCAT Front Panel drawing DWG. No. [D0902553-v2](https://dcc.ligo.org/public/0006/D0902553/002/D0902553-v2.pdf)

2.3. EtherCAT Rear Panel drawing DWG. No: [D0902554-v3](https://dcc.ligo.org/public/0006/D0902554/003/D0902554-v3.pdf)

2.4. EtherCAT Communication Tester DWG. No. [D1100884-v1](https://dcc.ligo.org/public/0060/D1100884/001/D1100884-v1.pdf)

2.5. EherCAT Slow Controls Communication tester Front Panel DWG. No. [D1100890-v1](https://dcc.ligo.org/public/0060/D1100890/001/D1100890-v1.pdf)

1. **. TEST EQUIPMENT AND SOFTWARE:**

3.1. To perform the tests of the EtherCAT Slow Controls system use the following equipment:

EtherCAT Common Mode Servo Tester, [**D1100436-v1**](https://dcc.ligo.org/public/0039/D1100436/001/D1100436-v1.pdf)**,**

EtherCAT /Delay Line Phase Shifter Tester, [**D1100472-v1**](https://dcc.ligo.org/public/0040/D1100472/001/D1100472-v1.pdf)**,**

EtherCAT Low Noise VCO Tester, [**D1100545-v1**](https://dcc.ligo.org/public/0057/D1100545/001/D1100545-v1.pdf)**.**

EtherCAT Slow Controls Communication tester, [**D1100884-v1**](https://dcc.ligo.org/public/0060/D1100884/001/D1100884-v1.pdf)

Power supply, **0-30V/10**A

Power supply, **0-30V/5A**

Power supply, **0-5**V**/0.5**A

Computer loaded with the “**TwinCAT**”,**v** 2.11 software.

Digital multimeter

Standard Computer cables (for connecting test fixtures to the EtherCAT System):

Two DB-37 Male/DB-37 Female

Three DB-25 Male/DB-25 Female

Two 3’ Ethernet cables (e.g. Newark, 21M 5874).

Multimode fiber optic cable (e.g. L-Comm, FODSC50-LC-01).

Banana Plug patch cords (e.g. Pomona B-36-x)

**4.0. PRELIMINARY TEST**

 4.1. Pre-Connection Check and Setup Instructions.

 4.2. Conduct a visual inspection on the wires that deliver +24V DC and + 5V DC to the Ether CAT Beckhoff couplers and the Omron DC to DC converters. Make sure that the +24V and ground (0V), +5V and 5V return from the DC to DC converters are wired properly.

4.3. Perform “Ground Separation Test” with all test fixtures disconnected from the Ether CAT

Use an ohm-meter to check the “ground separation” between the 24V ground and the DC to DC converters power return wire (-V) .The ohmmeter should not read an “open”. (The 5V return **must** not be connected to ground. It is connected to the ground wire provided by the interface adapter.)

4.4. Reference the front and the rear panel drawings listed on the appropriate Ether CAT Slow Control System and Ether CAT test fixtures.

4.5. Use standard computer cables to connect the test fixtures connectors to the EtherCAT System rear panel connectors, see **Fig.1.**

**TEST FIXTURE / CONNECTOR**  **EtherCAT SYSTEM**

EtherCAT **EtherCAT A** -------------------------------------------- Connector **# 3** (Delay A)

DL Tester **EtherCAT B** ----------------------------------------------Connector **# 4** (Delay B)

 EtherCAT

 Low noise **Controls EtherCAT** -------------------------------------Connector **#5**(VCO)

 VCO Tester

EtheCAT **Controls 1**-------------------------------------------- Connector # **6** (CA/1Servo)

CM Servo **Controls 2---------------------------------------------**Connector **# 7** (CM A/2 Servo)

 Tester

4.6. **Prior to start of tests set the 24V DC power supply to 0 V.**

4.7. Ensure that the EtherCAT System power switch is set to ON**.**

4.8. Set all physical switches on test fixtures front panels to OFF.

4.9**.** Connect the +24V DC power supplypositive trough an ammeter set on A range. Gradually increase power supply voltage from 0 to +24 V DC observing the ammeter current reading.

The current drawn from the 24V DC power supply should be between\_\_\_\_\_\_\_A and \_\_\_\_\_\_A.

4.10. Verify the “ON” green LED lighting on the EtherCAT front panel.

4.11. Verify power supply voltage settings using a digital voltmeter. Voltages must be within the specified values with a tolerance of +/- 5%.

4.12. Check the Omron DC-to Dc converters LED’s; the “DC out ON” LED’s should be ON.

4.13. Measure the DC convertor output voltage and use a screwdriver the set the “V adjust” output voltage to +5V DC +- 0.25V.

4.14. Lower the 24V DC power supply voltage output from +24V DC to +12V DC. The voltage measured at the output of the DC convertors should still read + 5V DC +- 0.2V.

4.15. Set the power supply voltage output back to +24V DC.

4.16. Use Banana plug patch cords to apply + 5.00V to the banana connectors on the rear panels of the test fixtures.

**5.0 COMMUNICATION TEST**

Reference the EtherCAT Communication Tester and Front panel drawings when performing this test. Make sure that the tester power switch is off.

5.1. Connect the Ethernet cable to the Communication tester D110088 (the first EtherCAT

 coupler EK1100 at position **0**.

5.2. Connect the other end of the Ethernet cable to the PCI network card on the computer.

5.3. Use a MM fiber optic cable to connect the EtherCAT Slow Controls system input

 to the EK 1521 coupler on position **#6.**

5.4. Use a MM fiber optic cable to connect the EtherCAT Slow Controls system output to the

 EK 1501 coupler on position **#16**.

5.5. Use a 3’ EtherCAT cable to connect EtherCAT Slow Controls system AUX1

 to the EK1101 coupler on position **#11**.

5.6. Turn the Communication Tester power switch on.

5.7. Toggle the EtherCAT Communication Tester switch #2 on the front panel and monitor LED

 #2. LED shall follow the switch.

5.8. Flip switch # 1 on the Communication tester front panel and monitor LED #1. LED shall

 follow the switch.

5.9. Disconnect the Ethernet cable from AUX 1 and connect it to AUX 2. Repeat step # 5.7.

1. **FUNTIONAL TEST**:

6.1. To perform a complete functional test, perform each step of the **Table 1**. When configured

as shown in Figure 1, test sets will provide the connections necessary to fully test

the EtherCAT Slow Controls System through the use of the L.E.D. indicators and switches on

test sets and the test equipment listed in section 3.0.

Mark “P” or “F” (pass or fail) in the boxes **CM A P/F** on the right hand column after testing each step.

6.2. **After performing the last step (Step 54) of Table 1**: Turn the EtherCAT 24V power supply off.

6.3. Disconnect test cables from the EtherCAT connectors #6 (CM A/1 Servo) and #7 (CM A/2

Servo) and connect them to the EtherCAT connectors #8 (CM B/1 Servo) and #9 (CM B/2

Servo).

6.4. Turn the 24V power supply to ON.

6.5. Perform step #1 through step #39 (Common Mode Servo) in table 1.

6.6. Mark the boxes on the second column when testing the CM Servo B (step 1 through 39).

6.7. Turn the power supplies OFF and disconnect all the cables from the EtherCAT system.

This procedure completes the EtherCAT System bench test.