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EtherCAT SLOW CONTROLS SYSTEM TEST PROCEDURE FOR CM CHASSIS

EtherCAT Slow Controls System Test Procedure

1.0 . 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.

2.0 . REFERENCE DOCUMENTS:

- 2.1. ISC CM Controls Chassis DWG. No. [D1002961-v2](#)
- 2.1. EtherCAT Assembly schematics DWG. No. [D0902552-v3](#)
- 2.2. EtherCAT Front Panel drawing DWG. No. [D0902553-v2](#)
- 2.3. EtherCAT Rear Panel drawing DWG. No: [D0902554-v3](#)
- 2.4. EtherCAT Communication Tester DWG. No. [D1100884-v1](#)
- 2.5. EherCAT Slow Controls Communication tester Front Panel DWG. No. [D1100890-v1](#)

3.0 . 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](#),

EtherCAT /Delay Line Phase Shifter Tester, [D1100472-v1](#),

EtherCAT Low Noise VCO Tester, [D1100545-v1](#).

EtherCAT Slow Controls Communication tester, [D1100884-v1](#)

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

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

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

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

EtherCAT **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 supply positive through 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 to 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.

6.0 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.

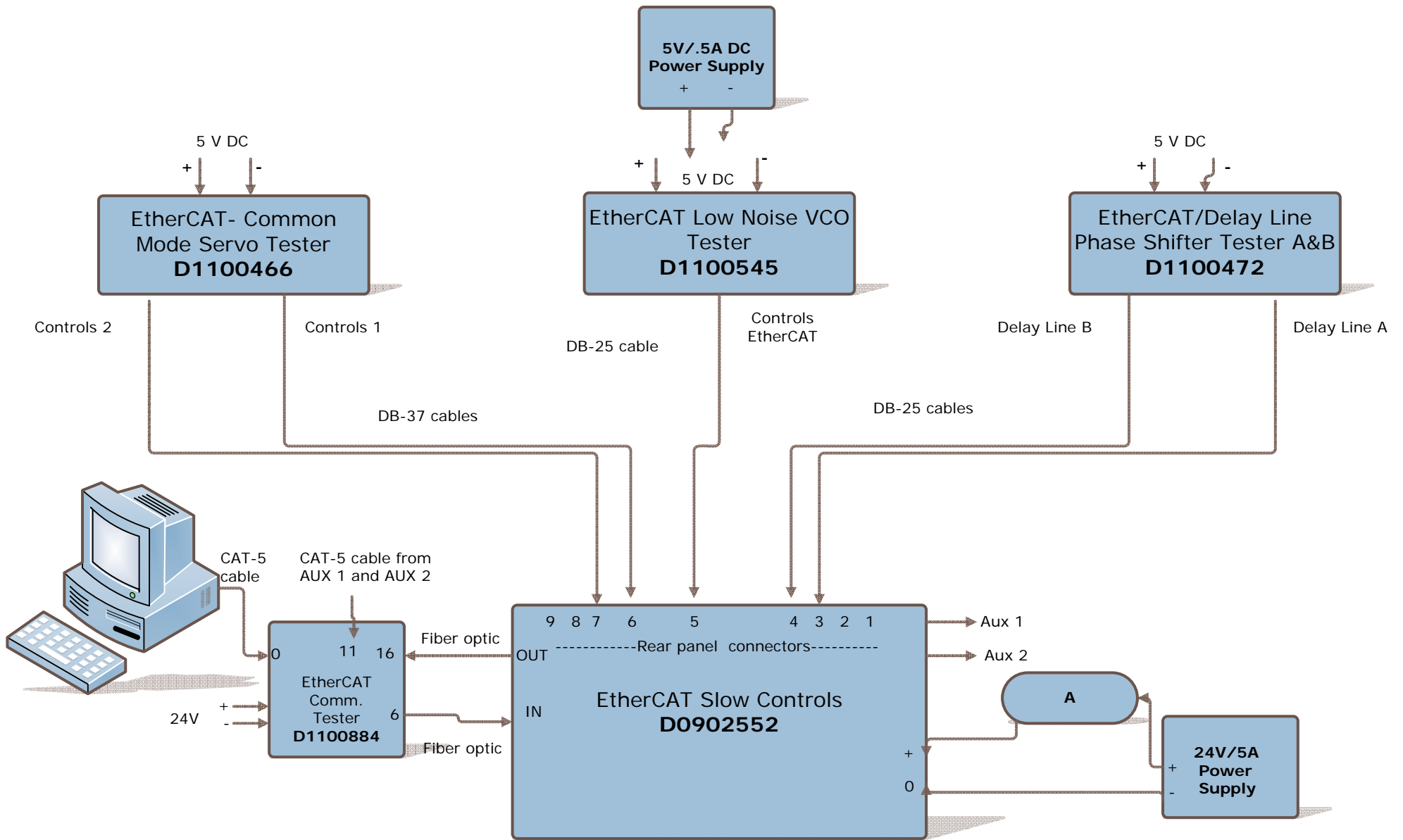


FIG.1 EtherCAT SLOW CONTROLS AND TEST FIXTURES SETUP

COMMON MODE SERVO

Table 1

COMPUTER SCREEN		EtherCAT -COMMON MODE SERVO TESTER					
Step	NAME	FRONT PANEL LED	D No:	REMARKS	CM A P/F	CM B P/F	
1	GAIN IN 1 Slider	"-32"	D5	Step 1,2 and 23: Starting with "Gain IN 1" slider click on computer screen "Gain Slider 1" and monitor the CM tester "Gain Slider 1" LED's. Each LED shall be "ON" according to slider setting. Repeat the same procedure for "Gain IN 2" and "Gain Fast" slider.			
		"+16"	D4				
		"+8"	D3				
		"+4"	D2				
		"+2"	D1				
		"+1"	D0				
2	GAIN IN 2 Slider	"-32"	D11				
		"+16"	D10				
		"+8"	D9				
		"+4"	D8				
		"+2"	D7				
		"+1"	D6				
3	Input 1 Enable	"Enable"	D12	Step 3 to 5, 8 to 22 and 24 to 29: Test each binary output ,one at a time. Select each listed tab on the computer screen monitoring tester LED's. Each LED shall be "ON" when the associated tab is selected.			
4	Input 2 Enable	"Enable"	D13				
5	Output Switch	Enable IN 2/IN1	D14				
6	Boost Stage	"Boost +1"	D15				
7	Boost Stage	"Boost +2"	D16				
8	Common Comp.	"Comp."	D17				
9	Com. Exc. Enable	"Exc."	D18				
10	Com. Option	"Option"	D19				
11	Slow Polarity	"Sign + -"	D11		Step 6,7: Select "Boost Stage" gain slider on computer screen and monitor the Boost Off" LED's on CM Tester front panel. LED's" shall be "ON" according to slider setting.		
12	Com. Filter	"Filter"	D21				
13	Fast Enable	"Enable"	D22				
14	Fast Polarity	"Sign + -"	D23				
15	Slow Option	"Option"	D24				
16	Slow Bypass	"Bypass"	D25				
17	Slow 5V Offset	"Fixed"	D26				
18	Slow Ofs. Enable	"Enable"	D27				
19	Slow Comp.	"Comp."	D28				
20	Slow Boost	"Boost"	D29				
21	Slow Filter	"Filter"	D30				

COMMON MODE SERVO

Table 1

COMPUTER SCREEN		EtherCAT -COMMON MODE SERVO TESTER					
Step	NAME	FRONT PANEL LED	D No:	REMARKS	CM A P/F	CM B P/F	
22	Fast Limiter	"Limiter"	D31				
23	GAIN FAST	"-32"	D46				
		" +16"	D45				
		" +8"	D44				
		" +4"	D43				
		" +2"	D42				
		" +1"	D41				
24	Split Exc. Enable	"Excitation"	D47				
25	Fast Option	"Option"	D48				
26	Slow Exc.	"Fast-Slow"	D49				
27	Polarity IN 1	"Sign + -"	D50				
28	Polarity IN 2	"Sign + -"	D51				
29	Latch enable	"LE"	LE				
Step	DISPLAYED	FRONT PANEL SWITCH	D No:		Step 30,31: Test each binary input one at a time. Turn the listed tester switches on and off, monitoring the computer screen. " Fast Limit " and " OK " LED's on computer screen shall switch on and off according to each switch setting.		
30	Fast Limit	"Limiter"	35				
31	OK	"OK"	OK				
Step	DISPLAYED	FRONT PANEL BNC	D No:	Step 32 to 34: Test each analog input, one at a time. Connect a DVM to the BNC connectors. Type 9.00V then press "Enter". The DVM shall read 9.00V DC +/- 1%. Type -9.00V then press "Enter". The DVM shall read -9.00V DC +/- 1%. Type 0.00V and press "Enter". The DVM shall read 0.00V .			
32	-	Common Offset	36				
33	-	Slow Offset	37				
34	-	Slow Output Offset	38				

COMMON MODE SERVO

Table 1

COMPUTER SCREEN		EtherCAT -COMMON MODE SERVO TESTER				
Step	DISPLAYED	FRONT PANEL LED	D No:	REMARKS	CM A P/F	CM B P/F
35	(-9.00V), 9.00V	Input Mon	32	Step 35 to 39: Test each analog output one at a time. Apply -9.00V DC to each BNC connector. The voltage applied shall be displayed on the computer screen. Apply 9.00 V DC to each BNC connector. The voltage applied shall be displayed on the computer screen. Remove the input voltage. On computer screen shall be displayed 0.00V . The voltage tolerance shall be +/- 1%.		
36	(-9.00V), 9.00V	Split Mon	33			
37	(-9.00V) 9.00V	Fast Mon	34			
38	(-9.00V) 9.00V	Slow FB Monitor	39			
39	(-9.00V) 9.00V	Slow Mon	40			

VOLTAGE CONTROLLED OSCILLATOR

Table 1

COMPUTER SCREEN		EtherCAT LOW NOISE VCO TESTER		
Step	Displayed	FRONT PANEL BNC	D No:	REMARKS
40	9.00V, (-9.00V)	RF Pwr Mon. M1	-	<p>Step 40 to 46: Apply 9.00V DC to each BNC connector. 9.00 V DC shall be displayed on the computer screen.</p> <p>Apply -9.00V DC. The applied voltage shall be displayed on the computer screen.</p> <p>The tolerance shall be +/- 1%.</p> <p>Step 47:</p> <p>Connect a DVM to the "Man. Freq. Tuning" BNC connector. Type 9.00V and press "ENTER". DVM shall read 9.00V +/- 1%. Type - 9.00V and press "ENTER". DVM shall read -9.00V +/- 1%. Type 0.00V and press "Enter" DVM shall read 0.00 V.</p>
41	9.00V, (-9.00V)	RF Pwr Mon. M2	-	
42	9.00V, (-9.00V)	RF Pwr Mon. M3	-	
43	9.00V, (-9.00V)	Temp. Mon. M1	-	
44	9.00V, (-9.00V)	Temp. Mon. M2	-	
45	9.00V, (-9.00V)	Temp. Mon. M3	-	
46	9.00V, (-9.00V)	VCO Tune Mon.	-	
47	-	Man.Freq.Tuning	-	
Step	COMPUTER SCREEN	FRONT PANEL SWITCH	D No:	REMARKS
48	EXCSW	" Exc Readback"	-	<p>Step 48,49: Turn the listed switches on and off monitoring computer screen. "EXCSW" and "OK" on computer screen shall switch between on and off according to each switch setting.</p>
49	OK	"OK"	-	
Step	COMPUTER SCREEN	FRONT PANEL LED	D No:	REMARKS
50	Exc. Enable	"Exc Enable"	-	Select " Exc Enable " on the computer screen monitoring "Exc Enable" LED on the tester front panel. LED shall be ON when "Exc Enable" is selected.

DELAY LINE PHASE SHIFTER

Table 1

COMPUTER SCREEN		EtherCAT -DELAY LINE PHASE SHIFTER TESTER		
Step	NAME	FRONT PANEL LED	D No:	REMARKS
51	Delay A	"1/16"	-	Click on the " Delay Line A " gain slider on computer screen and monitor tester front panel LED's. Each LED shall be "ON" according to gain slider setting. Select " LE A " tab on computer screen. " LE " LED shall be ON when tab is selected.
		"1/8"	-	
		"1/4"	-	
		"1/2"	-	
		"1"	-	
		"2"	-	
		"4"	-	
		"8"	-	
		"16"	-	
52	LE A	"LE"	-	
53	Delay B	"1/16"	-	Click on the " Delay Line B " gain slider on computer screen and monitor tester front panel LED's. Each LED shall be "ON" according to gain slider setting. Select " LE B " tab on computer screen. " LE " LED shall be ON when tab is selected.
		"1/8"	-	
		"1/4"	-	
		"1/2"	-	
		"1"	-	
		"2"	-	
		"4"	-	
		"8"	-	
		"16"	-	
54	LE B	"LE"	-	