

AKD EtherCAT Troubleshooting List

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This list is provided to expedite the troubleshooting process by efficiently gathering system data required to troubleshoot common EtherCAT issues such as scaling, PDO mapping, SDO errors, and cycle timing.

1. What is the ECAT master?
2. DRV.INFO (for each drive on the network)
 - Includes: Drive model number
 - Includes: Drive Firmware version
3. Revision of ESI file currently being used.
 - “AKD.xml version” and “generated with firmware” version:

```
<?xml version="1.0"?>
<!-- edited with XMLSpy v2006 sp2 U (http://www.altova.com) by -->
<!-- file AKD.xml version 2.59 -->
<!-- Generated with firmware M_01-20-04-000-->
<!-- Last changes in firmware -->
<EtherCATInfo xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:n
  <Vendor FileVersion="259">
    <Id>106</Id>
    <Name>Kollmorgen</Name>
```

4. Revision of Workbench
5. Does the issue occur when running the same motion profile or command sequence within Workbench (without EtherCAT control)?
 - Unplug EtherCAT cable and reboot the drive.
6. Master startup script and PDO mappings
7. Mode of Operation used (object 6060h)
 - If object 6060h is not set, it will use the default value of 7 – Interpolated Position Mode.
 - Or read object 6061h
8. Object numbers related to the problem
 - Are they used over SDO or PDO?

9. EtherCAT master's ECAT update rate.

10. Is Distributed Clocks (DC) enabled in master?

11. Save new *.akd parameter files.

12. Read-only parameters – read in Workbench Terminal

- ECAT.DIAG
 - Note: Diagnostics Report
- FBUS.STATE
 - Returns ECAT State Machine
- DS402.CONTROLWORD
 - DS402 state machine command
- DS402.STATUSWORD
 - DS402 state machine status
- ECAT.INPUTHANDLING

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	34D1h/0	M_01-19-03-001

Feature Changes

- **EtherCAT input delay configurable via new object 34D1h sub 0 (S-21305)**

Issue:

A customer wanted to close the velocity loop over the fieldbus. He found that the reaction time of the drive, i.e. visible actual position changes, with his 250 microsecond cycle rate was more than 500 microseconds.

Solution:

Measures have been taken to reduce the reaction time. It is linked to the object 34D1 sub 0. The default value for the old behaviour is a 1. An InitCmd has been added to the ESI-file to enable the new behavior. It can be switched off by handling this InitCmd.

- FBUS.PLLSTATE
 - Returns if the PLL is locked or not
- FBUS.SYNCACT

13. Parameters of special interest – saved in parameter file

- ECAT.LEGACYREV
 - Handles restriction to 20 or 32 bytes for RxPDO.
- FBUS.PARAM02
 - =1: PLL lock enabled for DC masters

- FBUS.PARAM03
 - =1: Sync supervision enabled
 - F125 (Sync loss) if 7 ECAT frames have not been received.
- FBUS.PARAM05
 - Bit 4 and Bit 9 related to units/scaling
- FBUS.SYNCDIST
 - Sync timing of PDO packet
- ECAT.ENEMCYREQ
 - Enables emergency messages
- Related to scaling
 - DS402.POSFCFEED
 - DS402.POSFCSHAFTREV
 - DS402.POSGEARMOTORREV
 - DS402.POSGEARSHAFTREV
 - DS402.VELSCALENUM
 - DS402.VELSCALEDENOM

14. Objects of Special Interest – used in the EtherCAT Master

- 6060h – mode of operation
- 6061h – read mode of operation
- 6040h - controlword
- 6041h - statusword
- 6091h subindex 1 – gear ratio numerator
- 6091h subindex 2 – gear ratio denominator
- 6092h subindex 1 – feed constant numerator
- 6092h subindex 2 – feed constant denominator

15. Scope plots

- CSV format is needed, so it can be analyzed in the Workbench scope tool.
- Images (.bmp or .jpg) are useful when several scope plots need to be opened at the same time for quick comparison (just make sure the image shows the pertinent information).

General Motion: (case sensitive)

- CMotion.m_s64_fb_pos_cmd Note: Position counts before interpolation
- CMotion.pspeed
- PL.CMD
- PL.ERR
- IL.CMD

- IL.FB
- VL.CMD
- VL.FB

EtherCAT State: (case sensitive)

- CEtherCAT.m_u8_ecat_phase Note: Same as FBUS.STATE
- DS402.CONTROLWORD
- DS402.STATUSWORD

Other traces that may be needed or helpful: (case sensitive)

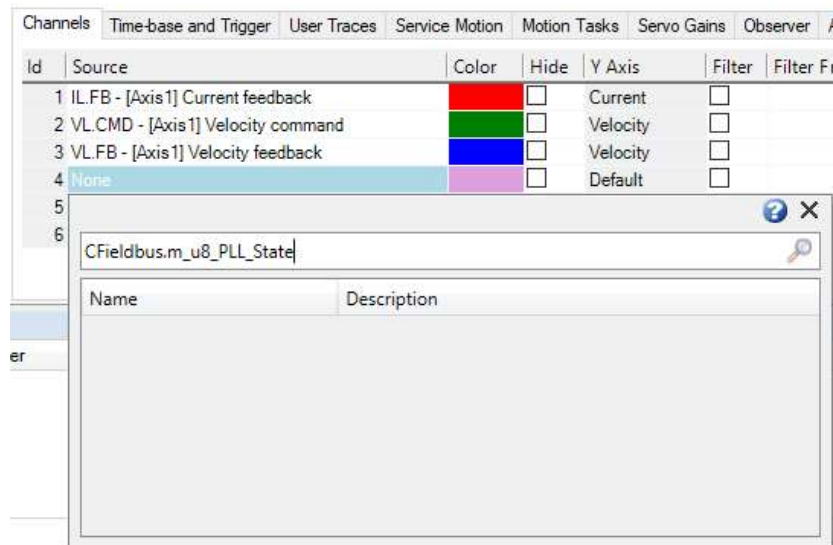
- CMotion.trajectory Note: Position counts after interpolation
- CControl.pcmd
- CEthercat.m_u8_ecat_phase Note: same as FBUS.STATE

EtherCAT PLL and Cycle Timing: (case sensitive) (use 16kHz sample rate)

- CFieldbus.m_u8_PLL_State Note: Same as FBUS.PLLSTATE
- CFieldbus.m_u32_cycle_time_counter
- CFieldbus.m_u32_64bit_interpol_counter

Note: Count of the calculated position point. Example: 2 msec update rate, the position loop will execute 8 times ($0.002 \text{ s} / (1/4000 \text{ s}) = 8$)

Note: The trace names listed here that are not normal drive parameters must be typed (or copy/paste) into the parameter selector. They are case sensitive. If they are typed incorrectly, they will show up in red.



Id	Source
1	IL.FB - [Axis1] Current feedback
2	VL.CMD - [Axis1] Velocity command
3	VL.FB - [Axis1] Velocity feedback
4	CFieldbus.m_u8_PLL_State
5	None
6	None

Id	Source
1	IL.FB - [Axis1] Current feedback
2	VL.CMD - [Axis1] Velocity command
3	VL.FB - [Axis1] Velocity feedback
4	CFieldbus.m_u8_PLL_State
5	CFieldbus.m_u8_pll_state
6	None

Scope Sample Rate:

Depending on the ECAT update rate the Scope Time-Base and Trigger tab will need to be setup such that the Scope is sampled fast enough to capture the issue.

In this example the ECAT update rate was 500usec, so the Sampling Frequency was adjusted such that the Sampling Interval was 250usec. The setup goal should be such that the Sampling Interval is at least at the EtherCAT fieldbus rate or faster. The number of samples can be any number but 10,000 is typically a good value.

Channels	Time-base and Trigger	User Traces	Service Motion	Motion Tasks	Servo Gains	Observer																																																	
<table border="0"> <tr> <td colspan="3">Sampling</td> <td colspan="4">Trigger</td> </tr> <tr> <td>Recording time:</td> <td><input type="text" value="2500.0000"/></td> <td>ms</td> <td>Type:</td> <td colspan="3"><input type="text" value="0 - Immediate"/></td> </tr> <tr> <td>Sampling Frequency:</td> <td><input type="text" value="4,000.000"/></td> <td>Hz</td> <td>Source:</td> <td colspan="3"><input type="text" value="IL.FB"/></td> </tr> <tr> <td>Number of samples:</td> <td><input type="text" value="10,000"/></td> <td></td> <td>Level:</td> <td colspan="3"><input type="text" value="0.000"/></td> </tr> <tr> <td>Sampling Interval:</td> <td><input type="text" value="250"/></td> <td>µs</td> <td>Position:</td> <td colspan="3"><input type="text" value="10"/></td> </tr> <tr> <td></td> <td></td> <td></td> <td>Slope:</td> <td colspan="3"><input type="text" value="0 - Negative"/></td> </tr> <tr> <td colspan="2"><input type="button" value="Less <<"/></td> <td colspan="5"><input type="checkbox"/> Repeat Arming</td> </tr> </table>							Sampling			Trigger				Recording time:	<input type="text" value="2500.0000"/>	ms	Type:	<input type="text" value="0 - Immediate"/>			Sampling Frequency:	<input type="text" value="4,000.000"/>	Hz	Source:	<input type="text" value="IL.FB"/>			Number of samples:	<input type="text" value="10,000"/>		Level:	<input type="text" value="0.000"/>			Sampling Interval:	<input type="text" value="250"/>	µs	Position:	<input type="text" value="10"/>						Slope:	<input type="text" value="0 - Negative"/>			<input type="button" value="Less <<"/>		<input type="checkbox"/> Repeat Arming				
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If the DS402.CONTROLWORD and DS402.STATUSWORD traces do not show a change of state when the issue occurs these can be eliminated and those channels can be set for IL.FB and VL.CMD and the trace ran again and exported to CSV file.

16. Wireshark

- A Wireshark capture is sometimes needed to determine the sequence and timing of events.