

AKD2G EtherCAT synchronization error F7011

Overview

W7011 (Warning)

Historically when the EtherCAT timing was determined by the AKD2G drive's synchronization monitoring to be incorrect, it would result in a warning in the drive/axis indicated by the LCD display or in Workbench as W7011. In this case the warning could be defeated or ignored.

Warning			
Warning	Description	Cause	Remedy
W7011	EtherCAT Rx received before preparing Tx data finished.	Within one fieldbus cycle, Rx data from the master was received before the drive finished calculating and copying Tx data. NOTE In order to catch quick glitches in the sync timing, this warning is latched at the first occurrence and must be cleared by clearing faults.	Refer to Synchronization for details on how to validate and adjust EtherCAT synchronization settings or deactivate this warning by setting ECAT.ENRXWARN to 0.

ECAT.ENRXWARN

Description

ECAT.ENRXWARN allows enabling/disabling warning [W7011](#), which is triggered when Rx data is received from the EtherCAT master before the drive finished preparing its TX data within a sync0 cycle.

NOTE

This warning will not be triggered when running at 250 µs cycle times as it is normal for the TX data to be from the prior cycle at this rate..

Value	Description
0	W7011 cannot be triggered
1	W7011 can be triggered

Versions

Action	Version	Notes
Implemented	02-06-03-000	-


For users with older firmware, from an operational perspective, W7011 will not prevent you from getting into OP, but it means the control signals are behind at least some of the time. If it's always behind, then there will be some delay in the motor's position command, but it will move smoothly. If it's sometimes on time and sometimes behind, this may exhibit as noise on the motor. You may hear clicking and observe the position jumping depending on how severe the issue is. In this case it requires shifting where the EtherCAT packet occurs relative to sync0 either via the master (preferred) or via the drive.

F7011 (Fault)

For EtherCAT compliance , per the firmware release notes, the warning (W7011) was changed to a fault (F7011) beginning in firmware 02-10-02-000 and later.

Version 02-10-02-000 : September 21, 2022

PNOS for command type keywords can now be read. The value read will always be 0.

 **NEW FEATURE** EtherCAT - Changed W7011 synch monitoring to a fault F7011

Details:

The warning W7011 was thrown when the SM2 event (Rx-PDO) came prior to send out of the Tx-PDO (SM3). Two counters were implemented to count synchronizations events. One for situation where the cyclic events come earlier then they should, one for missing SM2 events in the cycle time. With each error event an internal counter is increased by three, with a correct update the counter is decreased by one. If a limit is overrun a fault F7011 is created afterwards.

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The official position is the drive is providing the user with an indication the EtherCAT timing isn't correct and should be remedied instead of ignored.

The Fault description is as follows.

Search:				
Fault ^	Description ↕	Cause ↕	Remedy ↕	Reaction ↕
F7011	EtherCAT synchronization error	The error counter limit 10F1h sub 2 (ECAT.MAXSYNCERROR) was exceeded by one of the error counters defined by object 1C33h sub 11 or 13. It is possible, but not recommended, to switch the supervision off by setting a value of 0.	Either change the input shift via object 1C33h sub 3 (ECAT.INPUTSHIFTU) or try to minimize the EtherCAT master's jitter.	Controlled stop

Per the F7011 entry it **IS** possible to switch the supervision off (and defeat the fault occurrence) by setting ECAT.MAXSYNCERROR to a value of 0 (i.e. using Workbench Terminal) but states it is not recommended.

F7011-What does it indicate or mean?

Essentially W7011 means there is too much jitter and/or there is an issue with the EtherCAT timing where generally cyclic events occur earlier in the bus cycle than they should.

For example if the SM2 Event from the master comes before the send out of Tx-PDO (SM3).

The EtherCAT Master sets the timing of the SM2 event relative to Sync0.

The events need to be in the order of: Sync0 – Position loop interrupt – TxPDO – RxPDO (SM2) – next Sync0.

To aid in better understanding of possible scenarios of incorrect EtherCAT timing, a Powerpoint presentation is offered as a supplement to this application note.

CAN Emergency messages for W7011 and F7011 in the master

Sometimes the issue is first observed in the EtherCAT master either in the Error Code objects (see below) and/or received as a CAN Emergency message.

Objects 0x603F and 0x683F hold the last error for Axis 1 and Axis 2 respectively.

You are here: AKD2G EtherCAT > [CANopen over EtherCAT \(CoE\)](#) > CANopen Object Dictionary > 603Fh, 683Fh Error code - Axis #



603Fh, 683Fh Error code - Axis

This object provides the error code of the last error which occurred in the drive device. This is the same information as the lower 16-bit of sub-index 01h of the pre-defined error field (1003h).

Axis 1

Parameter	Index	Sub-Index	Data Type	Float Scale	Units	Access	PDO Mappable
Error code - Axis 1	603Fh	0h	Unsigned16	-	-	Read only	Yes

Axis 2

Parameter	Index	Sub-Index	Data Type	Float Scale	Units	Access	PDO Mappable
Error code - Axis 2	683Fh	0h	Unsigned16	-	-	Read only	Yes

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Error Code 0x878C was the warning W7011 in firmware prior to 02-10-02-000.

Error Code 0x878E is the fault F7011 in firmware beginning in 02-10-02-000 and later.

Resolving EtherCAT timing issues

As previously stated the events in the EtherCAT cycle need to be in the order of: Sync0 – Position loop interrupt – TxPDO – RxPDO (SM2) – next Sync0.

To correct the EtherCAT timing issue (and cycle event timing, the adjustments that can be made are:

- Rx shift offset in the master (SM2 shift offset).
- ECAT.INPUTSHIFTU and ECAT.PLLOFFSET in the drive.

Some issues we've seen is when the customer can't set the RxPDO (SM2) shift offset in the master, and/or when the master has so much jitter that the RxPDO (SM2) timing jumps around such that it occurs prior to the Tx or after the next Sync0.

In some cases adjusting ECAT.INPUTSHIFTU and ECAT.PLLOFFSET in the drive wasn't enough to resolve the timing issues. Additionally the SM2 shift offset in the master for each drive along the network chain had to be adjusted. The first drive needs little or no shift. The last drive needs the most shift. It all depends on how much delay there is in each device when transferring data through the device on to the next device. And it also depends on how many EtherCAT devices there are on the network. The EtherCAT cycle rate is also a factor. For example, 1 or 2 ms is a long enough cycle time that you normally won't see sync issues. But running at 250us doesn't give much room for error.

The AKD2G Web Help provides details on synchronization and also how to use the Workbench scope as a tool to diagnose and remedy EtherCAT timing issues.

From the AKD2G Help:

[Synchronization \(kollmorgen.com\)](http://kollmorgen.com)

Synchronization Behavior with Distributed Clocks (DC) Enabled

With DC enabled by the EtherCAT master, the drive synchronizes to the master's Sync0 signal.

Below is an example of a synchronized fieldbus cycle with 4kHz cycle time:

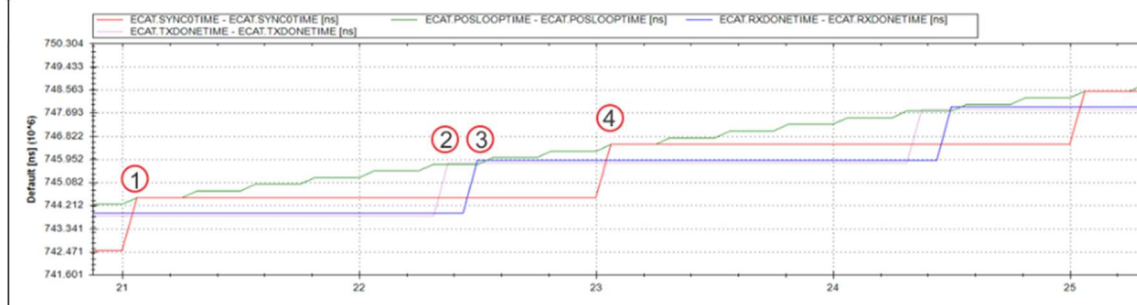


These two keywords/EtherCAT objects can be used to influence the synchronization behavior of the drive.

- **ECAT.PLLOFFSET** (Index 1C32h Sub-Index 3): Configures a delay between the Sync0 signal (2) and the 16kHz interrupt that runs the position loop (3) up to 250 uS. If the SM2 event has too much jitter or occurs too close the Sync0, the position loop may run before processing updated data. This offset can be adjusted to shift the position loop to allow more time to process the data.
 - After modifying this value, the EtherCAT state machine must be reset back to PREOP to resynchronize the Phase-Locked Loop (PLL).
- **ECAT.INPUTSHIFTU** (Index 1C33h Sub-Index 3): Configures the offset between the first 16kHz after the Sync0 signal and the 16kHz interrupt that triggers the TxPDO. A value of -1 means the drive calculates the offset automatically once the drive synchronizes in OP to be 125 to 187 uS before the drive expects the SM2 event. If the packet jitter is low and consistent, the default timing should be sufficient to provide the latest feedback data in the input packet. If packet jitter is too large, the input time may need to be shifted to account for the jitter.
 - The diagram above shows timing with ECAT.INPUTSHIFTU set to 62,500 ns. If ECAT.INPUTSHIFTU was the default -1, the input packet is triggered in 16kHz tick 0 because it calculates two 16kHz samples from when the SM2 event occurs at (1).
 - The value, while in ns, is required to be written by a factor of 62,500 ns (16kHz intervals)
 - When writing ECAT.INPUTSHIFTU, the value does not account for the PLL offset, while reading [ECAT.INPUTSHIFT](#) includes the PLL offset in the time.
 - The EtherCAT object, when written, writes the user offset time (ECAT.INPUTSHIFTU). When read, it reads the actual offset time (ECAT.INPUTSHIFT) and may not match the written value exactly.

As aforementioned, in the help there are details on capturing the timing using Workbench Scope which can help troubleshoot the issue.

For example here's the timing captured in the Workbench Scope.





















Note: It's important the drive's CANOPEN.SAMPLEPERIOD is set equal to the master's bus rate.

These are some additional parameters to check in Workbench Terminal and provide a report of.

ECAT Parameters

This section describes the ECAT parameters.

-  ECAT.ALIAS
-  ECAT.ENEMCY
-  ECAT.ENRXWARN
-  ECAT.INFO
-  ECAT.INPUTSHIFT
-  ECAT.INPUTSHIFTU
-  ECAT.MAXSYNCERROR
-  ECAT.PLLMODE
-  ECAT.PLLOFFSET
-  ECAT.PLLOFFSETNODC
-  ECAT.PLLSTATE
-  ECAT.POSLOOPTIME
-  ECAT.PRINTESI
-  ECAT.RXDONETIME
-  ECAT.RXIRQTIME
-  ECAT.STATE
-  ECAT.SYNC0TIME
-  ECAT.TXDONETIME
-  ECAT.USEPLL

DRV.INFO

Description

DRV.INFO returns general information about the drive. It includes:

- Hardware characteristics (e.g., peak current)
- Drive identifying information (e.g., serial numbers)
- Loaded artifacts (e.g., firmware version)
- Network information (TCP/IP address)
- Fieldbus information (e.g.: EoE for EtherCAT, PROFINET/EIP IP address settings)
- Safety information (e.g., certification)
- Feedback information (e.g., SFA details)

Please include this information when requesting support from Kollmorgen.

Versions

Action	Version	Notes
Implemented	02-00-00-000	
Updated with SFA# INFO	02-07-02-000	

General Information

Type	Read Only
Units	N/A
Range	N/A
Default Value	N/A
Data Type	String
Stored in Non-Volatile Memory	No

For the AKD2G EtherCAT Troubleshooting List navigate to the following support page.
The document provides a list of information and data needed to provide Technical Support related to AKD2G EtherCAT issues.

[AKD2G EtherCAT and CANopen Landing Page | Kollmorgen](#)