Conformance Guide

Conformity of EtherCAT devices, EtherCAT P devices and FSoE devices with the EtherCAT Specification and interoperability with other EtherCAT devices within a network are the main goals of all conformance and interoperability test activities of the EtherCAT Technology Group (ETG).

To find your way easy through the topic you will find the most important details on it below, including how to obtain tools and how to get your device conformance tested. However, a few of the key points asked often are answered right in the beginning:

! Conformity with the specifications is an obligation to all users of the EtherCAT Technology, no matter if devices are sold or only used in-house.
The **EtherCAT Conformance Test Tool** (CTT) implements the protocol specification and hence, shall be used in-house by EtherCAT device vendors to prove conformity for them. All EtherCAT vendors have to maintain a valid subscription of the tool.
The **EtherCAT Conformance Test** proves conformance officially with issuing a certificate after passing the test at an official EtherCAT Test Center.
An **EtherCAT Plug Fest** only intends to be a pragmatic approach to find out issues during the development process and does not lead to an EtherCAT Conformance Tested certificate.

1   Plug Fest

EtherCAT Plug Fests - typically these are two day events - are meetings where MainDevice and SubDevice device suppliers gather to test and improve interoperability, to share implementation hints and tricks and clarify questions regarding the technology. The plug fests have established themselves as pragmatic and effective means to achieve interoperable EtherCAT products. They are typically attended by 20 or more device vendors, representing 50+ different products. The ETG will continue to organize such plug fests in Germany, Asia and North America.

Dates are announced on the event section of ETG website (http://www.ethercat.org/events).

2   Conformance

Conformance is a general goal which is worth to achieve with any EtherCAT device. This ensures problem-free operation in the field no matter in which combination with devices of other vendors the own device is operated.

To ensure conformance the EtherCAT Conformance Test Tool should be used to verify protocol conformance (e.g. ETG.1000). Furthermore, other specifications have to be considered for conformance before a device may be sold to customers. This includes:

ETG.1030   EtherCAT P Specification

ETG.1300   EtherCAT Indicator and Labeling Rules

ETG.2000   EtherCAT SubDevice Information Specification

ETG.9001   EtherCAT Marking Rules

3   Conformance Test Tool (CTT)

DEFINITION of "Conformance Test": Test, in which the conformance of the Device under Test (DuT) with the EtherCAT Specifications is tested with the help of a Conformance Test Tool.

The Conformance Test Tool is a software program running on a Microsoft Windows platform. Only any 100Mbit/s network card is required.

The test cases are developed and maintained by the working group "Conformance" in XML format. The test software parses the files and executes the test cases step by step.

A logger window provides feedback on each test case including hints on possible error reasons.

A passed test case is indicated by a green dot, a failed test case by a red one. Test cases, which are not relevant for the device are skipped and indicated by a white dot. The Conformance Test is passed successfully by the device if all test cases that are included in the tool by default (vendor specific tests may be added which are not part of the EtherCAT Conformance Test) are marked with a green dot.

CTT projects can be generated by the tool for documentation and easy exchange of test results. In conjunction with a network scan of the test and the ESI file (EtherCAT SubDevice Information - device description in XML format) all information required to analyze the executed tests is available.

Test Cases

The test cases are defined and enhanced by the working group "Conformance". Those tests are executed by the Conformance Test Tool.

The WG Conformance (http://www.ethercat.org/memberarea/wg_conformance.asp) shall continuously improve the test specification with the goal of complete coverage of the EtherCAT specifications.

Usage of the Tool

The Conformance Test Tool is licensed on a subscription basis, in order to ensure long term availability of resources for maintenance, support and enhancements. EtherCAT Device Vendors shall maintain a valid subscription of the tool and use it for in-house testing throughout their development.

The test tool which executes the tests provided by a test file is offered by Beckhoff Automation GmbH. Test cases are delivered with the tool.

Updates on the test cases are provided by the ETG, updates on the test tool itself are provided by Beckhoff Automation to all test tool subscribers.

Enhancement of Tests

The task of the Working Group Conformance is to continuously enhance and improve the test set of the Conformance Test Tool.

The result is an increasing test coverage which may lead to the situation that a device passes the conformance test using the test tool in the first place but does not so after adding additional tests which then uncover mistakes within a device which had remained unseen before.

For conformance it is important that a device passes the protocol test using the Conformance Test Tool at the time of its first release to a customer.

Of course vendors are encouraged to keep up with the latest version of the Conformance Test Tool and also fix those problems which only have been revealed after the initial release of their device.

Test Enhancements (http://www.ethercat.org/memberarea/ct_enhancements.asp) or Test Exceptions (http://www.ethercat.org/memberarea/ct_exceptions.asp) are provided for review and information on the ETG homepage.

4   EtherCAT Test Center (ETC)

DEFINITION of "EtherCAT Test Center": Test laboratory either operated by ETG or officially authorized by ETG to perform the EtherCAT Conformance Test.

The EtherCAT Test Centers (ETC) do not only perform the official conformance test, but also provide qualified feedback and implementation support for ETG members. Furthermore, the ETCs provide facilities for the interoperability test.

Official EtherCAT Test Centers are approved by the ETG.

There are accredited official EtherCAT Test Centers (ETC) in Germany, Japan, China and North America. ETCs do not only perform the official EtherCAT Conformance Test, but also provide qualified feedback and implementation support for ETG members.

Contacted details are listed in clause 10.2.

5 EtherCAT Conformance Test

DEFINITION "EtherCAT Conformance Test": Conformance Test, Interoperability Test and Physical Layer Test carried out by an ETC.

Using the Conformance Test Tool already ensures a high degree of conformity. However, test tool results are not independent and the EtherCAT Conformance Test executed by the ETC encompasses further tests, too.

Vendors submitting devices for the EtherCAT Conformance Test shall have and use a valid EtherCAT Vendor ID. Application for an EtherCAT Vendor ID is possible within the Member area of the ETG homepage.

Results of the EtherCAT Conformance Test are confidential; however ETG may publish a list of devices that have passed the EtherCAT Conformance Test.

Motivation

While passing the conformance test with the test tool in-house satisfies the formal conformance requirements of the ETG Vendor ID usage agreement, it does not lead to a conformance certificate. The certificate and thereby the right to use the conformance test mark is obtained by passing the enhanced EtherCAT Conformance Test at the ETC. End users are encouraged to demand conformance certificates from their suppliers.

Test Agenda

- EtherCAT Protocol

  - ESI
    Checks validity of the ESI file including SyncManager Length, Overlapping of SyncManager areas, etc.
    The ESI is checked against the EEPROM content and the object dictionary of the SubDevice. There shall be no inconsistencies between them.

    ESI Tests include testing of EtherCAT P relevant information, too.

  - SII (EEPROM)
    Integrity and consistency of the SII is checked and validated against the ESI and the object dictionary.

  - EtherCAT State Machine
    The EtherCAT State Machine according to IEC 61158-6-12 is tested. The EtherCAT Communication Specification ETG.1000 is identical with the IEC 611158-6-12. The test cases check all possible combinations of state transition and setting, e.g. correct and wrong SyncManager settings.

  - EtherCAT Explicit Device Identification
    Test of the "Requesting Mechanism as described in ETG.1020

  - Mailbox Communication incl. CoE (CANopen over EtherCAT) and SoE (Servo drive profile according to IEC 61491 over EtherCAT) if supported
    All mandatory and if applicable optional CoE and SoE services are tested including a repeated mailbox request.

  - Further tests shall be added by the Working Group Conformance

- ETG.1300 Indicator Specification

- ETG.9001 Marking Rules

- CiA402 Drive Profile (if supported)

- Interoperability Test

Interoperability Test

The interoperability test relies on a network with a broad range of different devices from different vendors. Thus, the ETCs encourage all vendors to donate products for inclusion in the EtherCAT Interoperability Test.

Vendors who have devices in the interoperability test get qualified feedback on their device's behavior.

Certificate

With passing the EtherCAT Conformance Test successfully at one of the EtherCAT Test Centers a pass notice is given to the ETG Headquarter. An "EtherCAT Conformance Tested" certificate is then issued and sent to the device vendor. Having obtained the Conformance Tested certificate the vendor may label the device with the official conformance test mark and use the term for advertisement for the certified device exclusively.

IMPORTANT: Only devices which have passed the official EtherCAT Conformance Test performed by one of the authorized ETCs may be marked with a Conformance Tested logo. The same applies for any kind of advertisement making use of this attribute in any way (see also ETG.9001 EtherCAT Marking Rules).

6   How To Get Your Device Conformance Tested

If you intend to get your EtherCAT device Conformance Tested at an ETC perform the following two steps.

6.1   Meet Prerequisites

Before requesting an appointment for the EtherCAT Conformance Test at one of the ETCs check the items below:

☑	Item
☐	EtherCAT Vendor ID available
☐	Successful in-house test with latest Conformance Test Tool (check different features, e.g. flexible PDO mapping/assign, different synchronization modes)
☐	ETG.1300 Indicator and Labeling Specification applied Download from ETG Website → Downloads → Members only → EtherCAT Specification
☐	ETG.9001 Marking Rules applied Download from ETG Website → Downloads → Members only → EtherCAT Specification
☐	Device checked successfully against official EtherCAT Conformance Test Record (includes test with CTT) Download from ETG Website → Conformance → Related Content
☐	For family tests: If family members support a different set of features (e.g. DCs supported/ not supported), one of the DuTs shall support the full feature set.

! Note that the ETC performs the EtherCAT Conformance Test based on the device as it is available on the test date. Ensure that all items must be available to the ETC before the test date. It is NOT possible to hand in missing items (e.g. documentation) afterwards.

6.2 Arrange Appointment at ETC

If you are interested in the official EtherCAT Conformance Test to get an "EtherCAT Conformance Tested" certificate and logo for your device, if you want to get your EtherCAT P physical layer implementation tested (this is mandatory for EtherCAT P devices) or if you want to get your FSoE implementation tested (FSoE implementation conformance tested (this is mandatory for FSoE SubInstance and MainInstance devices) the following steps have to be done:

1. Download Request Form (ETG.7030 EtherCAT or ETG.7031 FSoE SubInstance or MainInstance or ETG.7032 EtherCAT P) from www.ethercat.org/etg7000 and send to ETG (conformance@ethercat.org)

2. ETG checks Vendor ID and CTT subscription, assigns test number and forwards the request to the desired ETC or FSoE Service Provider (usually within few days)

3. The ETC / FSoE Test Service Provider sends an offer for the EtherCAT Conformance Test / EtherCAT P / FSoE Conformance Test and further information

   o Send all correspondence according the test to the ETC / FSoE Service Provider

   o Test prices are provided by the ETC / FSoE Service Provider (see 10.2), not by ETG

   o Contact your ETC of choice to ask for current lead times

4. ETC / FSoE Service Provider performs EtherCAT/ EtherCAT P / FSoE Conformance Test

5. ETC / FSoE Service Provider sends pass / fail notice to ETG

6. In case of a pass notice for an EtherCAT Conformance Test, ETG issues a free-of-charge "EtherCAT Conformance Tested" certificate and provides logos. In case of an FSoE Conformance Test the FSoE Test Service Provider may issue a statement for a passed FSoE Conformance Test. In case of an EtherCAT P Conformance Test the ETC provides the Test Record.

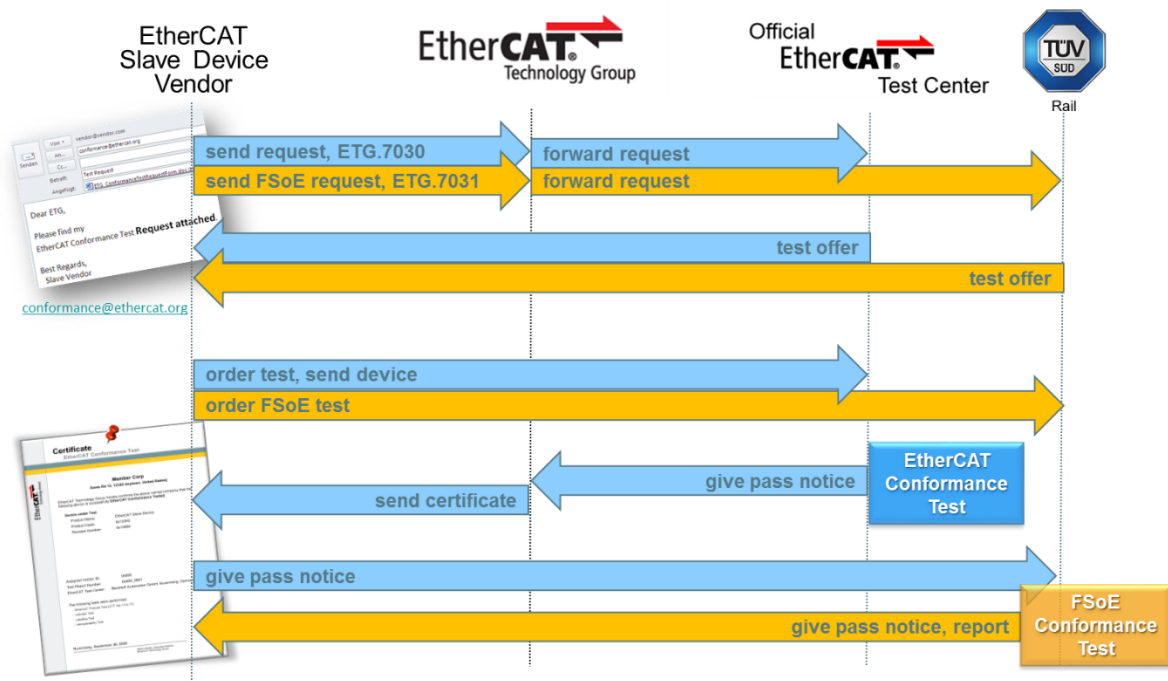See also Figure 1 for the process:

Figure 1: Test request, quote, test, certificate, and pass statement

6.2.1 FSoE Conformance Test

If you are requesting an EtherCAT Conformance Test and FSoE Conformance Test at the same time just send both request forms, ETG.7030 and ETG.7031, to conformance@ethercat.org. FSoE

Conformance Testing Services are provided by TÜV Süd Rail. It is planned that other insitutions will offer FSoE Test Services in the future.

The FSoE Conformance Test can only be performed for devices that have passed the EtherCAT Conformance Test.

ETC Nuremberg and TÜV Süd Rail cooperate to offer "one stop shopping": arrange a date for the EtherCAT Test in Nuremberg and, if passed, the FSoE Test can be performed on the following day in Nuremberg, too. This option can be chosen in the FSoE Test Request Form.

7 EtherCAT P Testing

7.1 General

For EtherCAT P devices the EtherCAT P Conformance Test is mandatory.

In the introductory phase the EtherCAT P physical layer test is available in Germany – **free of charge** – retesting as well. Testing at other ETCs is also planned for the future.

7.2 Automated Testing and CTT

The test file set for the EtherCAT Conformance Test Tool (CTT) has been be enhanced to support testing of the ESI syntax and for plausibility.

NOTE: In the starting-phase, the Test Files for EtherCAT P elements in the ESI file are available via download from www.ethercat.org/cttdownload (not yet included in CTT V2.1).

In addition, a semi-automated hardware test is under development to test the EtherCAT P Physical Layer implementation. It will also check for communication issues induced by the power supplies.

7.3 Contact for EtherCAT P Testing

As with EtherCAT and Safety over EtherCAT, contact conformance@ethercat.org for EtherCAT P conformance testing.

7.4 Request EtherCAT P Testing

To request an EtherCAT P Conformance Test just send the request form ETG.7032 (www.ethercat.org/etg.7000) to conformance@ethercat.org.

During the introductory phase the EtherCAT P Conformance Test is offered by ETC Germany, only. It is planned to provide it also in other ETCs in the future.

7.5 References

Also see the EtherCAT SubDevice Implementation Guide – Section III for more information (www.ethercat.org/etg2200).

8 References and Links

Topics and Tools	Description and Access
EtherCAT Conformance & Interoperability	http://www.ethercat.org/conformance
EtherCAT Vendor ID	http://www.ethercat.org/vendorID
All documents, tools, and their versions	http://www.ethercat.org/cttdownload
EtherCAT Conformance Test Tool	http://www.beckhoff.de/german/ethercat/et9400.htm

9   FAQs

What is the difference between Conformance Test and EtherCAT Conformance Test?

Within the context of the ETG Conformance Test Policy:

- Conformance Test is the Test, in which the conformance of the Device under Test (DuT) with the EtherCAT Specifications is tested with the help of a Conformance Test Tool.

- EtherCAT Conformance Test: Conformance Test, Interoperability Test and Physical Layer Test carried out by an EtherCAT Test Center.

- So the EtherCAT Conformance Test is a superset of the Conformance Test.

I am an EtherCAT device vendor. Do I have to license the conformance test tool?

Yes. The ETG takes conformance very seriously, and the availability of the conformance test tool at each and every device vendors R&D lab is an important cornerstone in this process

Do I have to submit my EtherCAT device to the EtherCAT Test Center for testing?

No. Conformance Testing with the Test Tool „at home" is sufficient to meet the minimum requirements of the Vendor ID agreement.

Can I get a Conformance Certificate based on the test results obtained in my R&D lab?

No. The Conformance Certificate can only be issued after successfully passing the test at an accredited EtherCAT Test Center.

Does the test in the EtherCAT Test Center exceed the test done with the Conformance Test Tool (at home)?

Yes. The test in the EtherCAT Test Center also includes an interoperability test, checking for conformance regarding the indicator and labeling spec, the marking rules etc.

I know about the EtherCAT Test Center in Nuremberg, Germany. Are there other locations, too?

Yes. There are accredited official EtherCAT Test Centers (ETC) in Germany, Japan, China and North America. Further test centers in Europe, Asia and North America are intended.

How much is charged for the EtherCAT Conformance Test at the EtherCAT Test Center?

Please contact your preferred EtherCAT Test Center for pricing information – pricing is not within the scope of ETG.

Does the Certificate expire?

No. The Certificate confirms that a device of a certain release has passed the current test version in the EtherCAT Test Center. Of course the Certificate can neither confirm that all future releases of the device will also pass, nor that the current device release will pass all future enhancements of the EtherCAT Conformance Test.

Do I have to submit my device again once I released a newer version?

No. However, according to the Vendor ID agreement, you will have to test future releases of your product against the conformance test tool in your R&D lab. Of course you may also submit your device again to the EtherCAT Test Center and obtain a new certificate!

10 Addresses

10.1 EtherCAT Technology Group (ETG)

EtherCAT Technology Group
Headquarters
Germany

Phone: +49 (911) 5 40 56 20
Fax: +49 (911) 5 40 56 29
Email: conformance@ethercat.org
Internet: www.ethercat.org

10.2 EtherCAT Test Center (ETC), Nuremberg

Beckhoff Automation GmbH & Co. KG
Ostendstraße 196
90482 Nuremberg, Germany

Phone: +49 (911) 5 40 56 18
Fax: +49 (911) 5 40 56 29
Email: etc@beckhoff.com
Internet: www.beckhoff.com/etc

10.3 EtherCAT Test Center (ETC), Japan

Beckhoff Automation K.K.

Phone: +81 50 5783 7777
Email: etc-jp@beckhoff.co.jp

10.4 EtherCAT Test Center (ETC), Beijing

Beihang University
Laboratory of Numerical Control and Automation (LNC)
37 Xueyuan Road Haidian District
100191 Beijing, China

Phone: +86 10 82 33 97 17
Email: etc-china@buaa.edu.cn

10.5 EtherCAT Test Center (ETC), Savage, MN

Beckhoff Automation LLC
13130 Dakota Ave
Savage, MN 55378, USA

Phone: +1 952-428-7399
Email: etc-na@beckhoff.com

10.6 FSoE Service Provider - TÜV Süd Rail, Munich

(FSoE Test Service is also provided at ETC Nuremberg, Germany)

TÜV SÜD Rail GmbH
80339 Munich, Germany

Email: Uwe.Kremer@tuev-sued.de