How to get a certificate for a PROFINET device

Guideline
for PROFINET IO

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Prepared by the PI Committee C2 "Quality".

In this specification the following key words (in **bold** text) will be used:

may: indicates flexibility of choice with no implied preference.

should: indicates flexibility of choice with a strongly preferred implementation.

shall: indicates a mandatory requirement. Designers **shall** implement such mandatory requirements to ensure interoperability and to claim conformance with this specification.

Content

List of figures

Revision Log

Identification	Version	Originator	Date	Change Note / History / Reason
TC1-05-0006	0.9	Patz	17Oct95	Initial version
TC1-05-0006d	1.0	Patz	18Sept06	Version after TC1 review
	1.10	Wenzel Diedrich	01Feb12 08Jun12	Changes because of harmonization with the Framework document and the Rules for PITLs document Spelling, Content update
	1.2	Wenzel	11Jun12	Re-formatting work
	1.3	Manfred Popp AvE	October 14, 2013	major enhancements Introduction added
	1.4	Diedrich, Popp, AvE	March 14	version after C2 review
	1.4.1	Diedrich, Popp, AvE	March 14	corrections during AB review
	1.4.2	Popp, AvE	March 14	Explanation of Application Classes added.
	1.4.3	Popp	November 3rd	Conformity declarations in chapter 8.2 GSD update Chapter 9.4.2
	1.5	Diedrich	May 18, 2015	8.3.1 Delete that EMC declaration is proved by the PITL 6.1 Regulation of details of EoT
	1.5	Diedrich/Götz	December 11 2015	Update 9. 1 test bundle
	1.5	Uhl	14Jan16	Inclusion of Encoder Profile Certification test and Profidrive update
	1.5	Diedrich et al.	15.Jan. 16	Several adoptions - add encoder profile informationin text and new chapter 15 - references to test bundle, delete 9.1.1 and 9.1.2 - 6.1 - 8.3, and 8.3.1 - consistent list of application class - shift certificate infos from 8.7 to 9.6 and 103 with updated figures - new line in table of chapter 9.4.3 related to bug fixes - several clarifications and corrections in the text
	1.5	Klaus Götz	23.2.2016	- Spelling Replace „shall make a master file" by „shall provide a GSD file" page 28
	1.5	Andreas Uhl, Klaus Götz, Christian Diedrich	July 2016	Clause 10 remove "DAP" relations because a controller has no DAP.

1 Management Summary - Scope of this Document

The test of the fieldbus interface to determine its conformity to the communication specification is of an outstanding significance at each of the equipment involved. At the PROFIBUS & PROFINET International (PI) this test is carried out by accredited PI Test Laboratories (PITL). General rules are fixed in Document 1: "Framework for Testing and Certification of PROFIBUS and PROFINET Products". After having passed the test successfully the equipment manufacturer can apply for a certificate which underlines the quality of its product. With this intention in mind this conformity test is called "certification test" below.

This guideline describes the procedures necessary for the attainment of a certificate for a PROFINET device. Furthermore in sections 7ff it gives hints for the successful preparations for the certification test as well as describing procedures for brand labelling and dealing with equipment variants.

2 Introduction

Since the specifications for PROFIBUS and PROFINET are open and standardized, it is possible for anyone to build and sell devices. However, not all devices are equal and to ensure that users get the quality of product they deserve, PI operates conformance programs. Enacted via the network of independent PITLs and securely administered by PI itself, conformance testing ensures that devices meet relevant specifications and that interoperability is never an issue in the field.

Certified devices are an end user's guarantee of quality.

But not all devices have to be tested and certified. The following table gives an overview for which technology certification is mandatory:

	Mandatory	Strongly Recommended	Not Certifiable
PROFIBUS		X	
PROFINET	X		
PROFIsafe	X[1]		
PROFIdrive		X	
ENCODER Profile		X	
PROFIenergy	X		
Passive Components			X[2]

[1] see PROFIsafe Policy for additional requests!

[2] see www.profibus.com / Products / Product Certification to read about PROFINET Passive Network Component Declarations

3 List of affected patents

There is no affected patent known by the members of the Working Group. The list is empty. No patent search, neither external nor internal, has been done by the members of the Working Group up to now.

PROFIBUS&PROFINET International does not guarantee the completeness of this list.

4 References and related documents

4.1 Reference

Document 1:   Framework for Testing and Certification of PROFIBUS and PROFINET Products

4.2 Related documents

[1]   GSDML, Technical Specification for PROFINET IO (part of the test bundle), www.profinet.com

[2]   PROFINET GSD Checker (part of the test bundle), www.profinet.com

[3]   PROFINET IO Security Level 1 (part of the test bundle), www.profinet.com

[4]   Manufacturer Declaration, available on request at the PI Certification Office

[5]   Application form for PROFINET Certificate, www.profinet.com

[6]   Application form for PROFIsafe Certificate, www.profinet.com

[7]   Application form for PROFIdrive Certificate, www.profinet.com

[8]   Application form for PROFIenergy Certificate, www.profinet.com

[9]   Vendor ID, available on request at the PI Certification Office

[10]   Application form for ENCODER Profile Certificate, www.profinet.com

5 Definitions and Abbreviations

5.1 Definitions

See Document 1: Framework for Testing and Certification of PROFIBUS and PROFINET Products

5.2 Abbreviations

BoT	Begin of Test	First date where a device manufacturer can apply for a certification test
EMC	Electromagnetic Compatibility	The extent to which an electric or electronic device will tolerate electrical interference from other equipment (immunity), and will interfere with other equipment. Within the European Community as well as in other countries it is regulated by law that electric and electronic components and equipment comply with basic standards such as IEC 61000-6-2 or IEC 61326 or corresponding individual product standards.
EoT	End of Test	Last date where a device manufacturer can apply for a certification test
DAP	Device access point	The device access point denotes the device interface and device version and is described in the GSD
DUT	Device under Test	The device to be tested
GSD	General Station Description	A GSD is an electronically readable file that contains both general and device-specific parameters for communication and network configuration for either PROFIBUS or PROFINET devices. The GSD for PROFIBUS is an ASCII text file; the GSD for PROFINET is a GSDML based file.
GSDML	General Station Description Markup Language	General Station Description Markup Language. A GSDML is a XML based language to describe the supported functions and behaviour of a PROFINET IO-Device.
PICO	PROFIBUS & PROFINET International Certification Office	The PICO will grant a certificate on basis of a positive test report.
PITL	PROFIBUS & PROFINET International Test Lab	A PITL is an accredited test laboratory for the corresponding technology, e. g. PROFINET, PROFIsafe, PROFIdrive, ENCODER Profile, PROFIenergy

5.3 Defining the Responsibility and the Scope of a Certification Test

A PROFINET field device has to fulfill a specified functionality within an automation plant. Such devices are configured with an engineering tool. A controller processes the application program and the device itself covers the PROFINET communication as well as the real application to control the correctness of the inputs and outputs. PROFINET itself can only take control of the communication part. Therefore during a certification test only the correct behaviour of the communication according to IEC 61158 and IEC 61784 can be checked.

The certification test therefore checks the correct implementation of

- the hardware interface,
- the PROFINET mandatory and optional functionality
- the GSD-file
- the reaction on faulty behaviour
- the robustness against net load
- the proper working in a reference automation plant in a test laboratory
- the state machine

It is not goal of the PROFINET certification test to check the functionality of an engineering tool and the correct working of the real application (Controller and/or Device) e.g. the nominal rotation speed is intended to be 3000 rpm but the measured rpm is 2800.

This guideline describes the procedures necessary for the attainment of a certificate for a **PROFINET Device** and a **PROFINET Controller** which is always the basis for the additionally supported profiles like

- **PROFIdrive** for drives and motion control
- **ENCODER Profile for encoders and motion control**
- **PROFIenergy** which supports energy saving and measurements
- **PROFIsafe** for functional safety

It is highly recommended for every manufacturer of a PROFINET field device with or without supported profiles to read this document before the development starts. It helps to save time, money and trouble. The responsible bodies of PI keep this document up to date and give useful hints to be kept in mind to have a ready field device which meets the requirements of the market.

6 PROFINET PITL

A certification test is exclusively offered by an accredited PITL. A list of PROFINET PITLs and the contact information can be obtained from the PI Website www.profinet.com. Just get in contact with one of the mentioned PITL and they will guide you through the certification process.

6.1 Quotation and order of test services

The test effort depends to a high extent on the numbers of errors. The guidance how to perform a test is regulated by the quality documents of PI. The quote of the PI Test Laboratory is regulated by the PITL itself. Double check in advance that the PITL, where you would like to have the DUT tested, is allowed to offer the test. Then fill out a test contract and fix a date for the test rather early to make sure you can launch your field device just in time

A PROFINET certificate is granted based on a successfully passed certification test. The test content is described in the latest version of the test system. The validity period of a test system is defined by PI starting with the Begin of Test (BoT) and the End of Test (EoT). The test system version is documented in the PITL test report as well as on the certificate.

To register for a test a legally binding application at a PITL is necessary. The actual test date may not be scheduled at this point. The test application must be received by the PITL not later than the last day of the expiration of the EoT of the currently valid test system. The date of receipt will apply. The certificate is granted only if the test was successfully completed not later than 6 month after the EoT. The date on the test report is essential.

7 Before you start the development

It is natural to take into account the requirements of the test specification already at the beginning of a development of a field device. At uncertainties the experts of the PITLs can be asked for advice. As a matter of fact, changes at the device can be performed considerably much easier at the beginning of a device development. Therefore a first verification test saves a lot of effort in the early developmental stages.

A comprehensive test of the fieldbus interface at the manufacturer labs (in-house test) is indispensable for the preparations for the certification test. As an optimum the test systems used by the PI Test Laboratories are also used for the in-house test.

PI offers a PROFINET test bundle which can be downloaded from:

www.profinet.com → downloads → software and tools → PROFINET test bundle.

It is free of charge for PI members and consists of all the relevant documents and tools you need to prepare for a certification test. But please take into account that not all the tests that will be performed during a certification test can also be tested in advance.

If you plan to develop a PROFINET device (DAP) which will be extended to communicate also with separate modules with PROFIsafe, PROFIdrive, ENCODER Profile and/or PROFIenergy then take care that the profile specific functionality (e.g. PROFIsafe driver) is located on the module itself.

8 The Way to the PI Certificate

8.1 Formal Sequence of the Certification Procedure

The formal sequence of the certification procedure is represented in Figure 1. Starting out from an enquiry of a field device manufacturer a PI Test Laboratory supplies a written quotation for the execution of a certification test. After placing an application for a certification test order for a device that should be tested (DUT) as well as the accompanying documents are submitted to the PITL. The PITL will check the documents and will get into contact with the applicant to guide him on his way. Please take into account that only a complete interface (Hardware, communication software and the application software) is tested.
If necessary, the applicant provides additional support to the personnel of the PITL during a certification test. Within a reasonable extent, the applicant also provides its own testing means. If required, the staff of the applicant must be available to operate these testing.

After execution of the certification test, the applicant will receive a test report from the PITL. With the original of the test report the applicant can then apply for a certificate at the PI Certification Office (PICO). The PICO is established at the PI Business Office of PROFIBUS Nutzerorganisation e.V., Germany (PNO). PNO is responsible for the certification on behalf of PI.
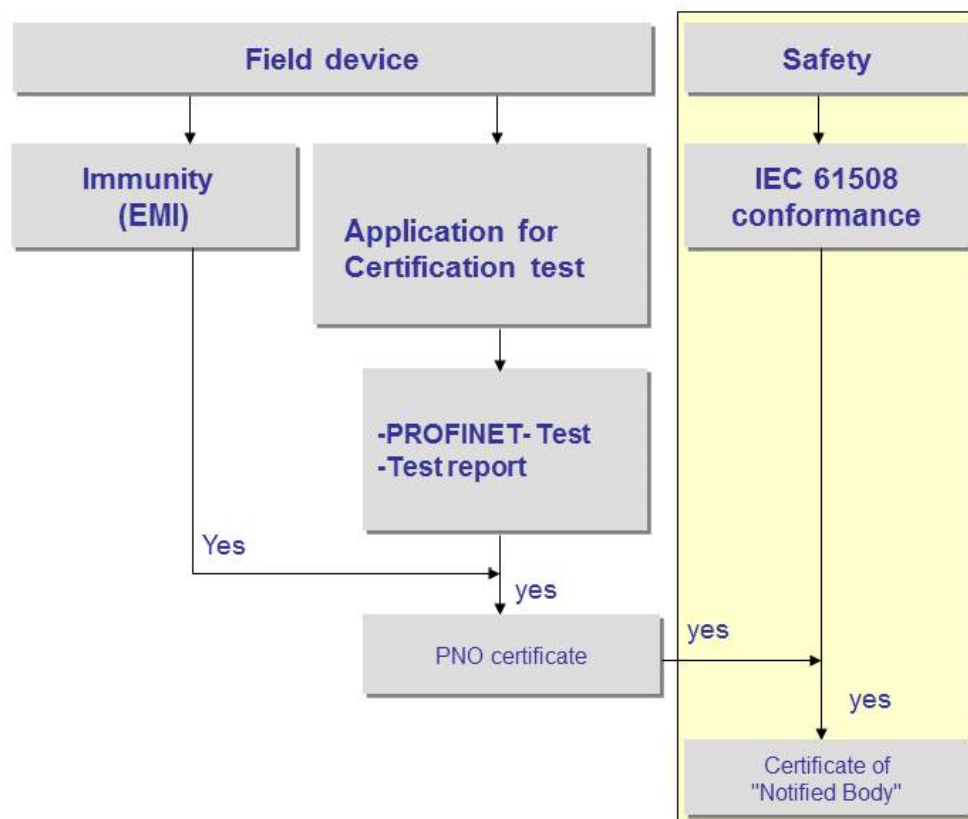
Figure 1: Formal sequence of certification

For PROFINET and PROFIsafe products certification is mandatory. The granted certificate is valid for a period of 3 years. It can be prolonged if certain criteria are fulfilled (see 8.8).

By any modification of the device the certificate gets invalid. In this case a retest is necessary. This can be done either in a PITL or in responsibility of the manufacturer. (See special regulations for retests of the corresponding technologies in the chapters 9.4 and 10).

8.2 Conformity according to IEEE/IEC-standards

The following chapter is an overview of the various IEEE and IEC standards that all PROFINET nodes (Devices, Controllers and Supervisors) must adhere to. Conformance with these standards is not verified by the PITL during a PROFINET certification test.

8.2.1 Confirmation for Copper Transmission

- IEEE802-2001 defines the clearness of the MAC-Addresses
- IEEE802.1D-2004 for Switching
- IEEE802.1Q-2011 for VLAN-Priority
- IEEE802.1AB-2005 / IEEE802.1AB-2009 "version 1 mode" – for neighborhood detection
- (IEEE802.1AS-2011 – for time synchronization e.g. for PA (in the future))
- IEEE802.3-2008 – for Ethernet
- Clause 25: 100BaseTX (Fast Ethernet - full duplex – on copper)
- Additionally (optional) e.g.
  - Clause 34: 100BaseT (Gigabit Ethernet - full duplex – on copper)
  - Clause xx: (if additional physics are supportedIEC62439-2 MRP – for media redundancy if supported

8.2.2 Confirmation for Fiber Optic Transmission

- IEEE802-2001 defines the clearness of the MAC-Addresses
- IEEE802.1D-2004 (mandatory) for switching
- IEEE802.1Q-2011 (mandatory) for VLAN-Priority
- IEEE802.1AB-2005 / IEEE802.1AB-2009 "version 1 mode" – for neighborhood detection
- (IEEE802.1AS-2011 – for time synchronisation e.g. for PA (in the future))
- IEEE802.3-2008 – for Ethernet
- That belongs to the supported MAUType e.g.
  - Clause 26: 100BaseFX (Fast Ethernet - full duplex – on fiber glass)
- additionally (optional) e.g.
  - Clause xx: (if a different fiber physics is supported)
  - IEC62439-2 MRP, if supported

8.2.3 Confirmation for POF Transmission

- IEEE802-2001 defines the clearness of the MAC-Addresses
- IEEE802.1D-2004 (mandatory) for switching
- IEEE802.1Q-2011 (mandatory) for VLAN-Priority
- IEEE802.1AB-2005 / IEEE802.1AB-2009 "version 1 mode" – for neighborhood detection

- (IEEE802.1AS-2011 – for time synchronisation e.g. for PA (in the future))
- IEEE802.3-2008 – for Ethernet
- Clause 25: 100BaseTX (internal for the connection of a „650nm fibre optics" transceiver)
- Physical Layer Medium dependent sublayer on 650nm fibre optics (e.g. for POF)
- IEC62439-2 MRP, if supported

8.2.4 Confirmation for Wireless Ethernet

- IEEE802-2001 defines the clearness of the MAC-Addresses
- IEEE802.1Q-2011 (mandatory) for VLAN-Priority
- (IEEE802.1AS-2011 (mandatory) for time synchronization for PA (in the future))
- IEEE802.11-2012 – for wireless Ethernet

8.2.5 Confirmation for Wireless Bluetooth

- IEEE802-2001 defines the clearness of the MAC-Addresses
- IEEE802.1Q-2011 (mandatory) for VLAN-Priority
- (IEEE802.1AS-2011 (mandatory) for Time Synchronization for PA (in the future))
- IEEE802.15.1-2005 – for Bluetooth

8.3 Manufacturer statement for Security Level 1 Tests

Starting PROFINET Test as of version V 2.3 or newer, the security level 1 tests are mandatory during the certification test. The security level 1 test suite is part of the test bundle. So the manufacturer can do the tests in advance to evaluate the achieved net load class and record the netload class in the GSD. The test lab will then execute the security level 1 tests according to the net load class stated in the GSD.
Independent from the stated net load class the manufacturer is responsible that the required technological function is also fulfilled under netload test conditions, e.g. update time of the inputs and outputs..
If a malfunction of the device functionality is detected a certificate is not granted.

8.3.1 Necessary Documents at the Beginning of a Test

The device documentation shall describe the PROFINET specific communication functions of the device as well as the configuration of the DUT and how to get into operation. PI has not defined any formal regulations for the structure and the contents of the documentation.

- Documentation/ user manual of the DUT.
- GSD-file (including the referenced graphic files)
- Description of the alarms within the GSD-file if supported from the device.
- Description how to change the input data if supported.

Hint:
Normally the PITLs are working with a power supply of 230 V AC, 380 V AC or low voltage of 30 V DC. Please take care to supply the necessary equipment.

8.4 Preparation for a PROFINET Certification Test

The **Vendor_ID** shall be obtained for the manufacturer via PI one time. This Vendor_ID then can be used for every device. The **Device_ID** is manufacturer specific (see GSDML specification [1]). The device to be tested shall be a series production device.

For the execution of a smooth certification test it is useful that the applicant performs the following tests in advance.

8.4.1 Test the GSD-File

Every manufacturer has to provide a GSD-file for the DUT. The entries of the GSD shall describe the qualities of the device correctly. The entries Vendor ID, Device_ID as well as the name of the GSD have to be identical with those on the registration confirmation. The GSD file shall represent a unique reference to the DUT itself. It shall include the structure and the meaning of manufacturer specific parameters and diagnosis. Furthermore the configurable data which are transferred cyclically shall be explained in agreement with the module definition of the GSD. The GSD-file shall include the mandatory keywords for the respective PROFINET conformance class for which it is registered to be tested. Optional keywords may be defined as well. Then the functionality which is described by the optional keywords is also tested. If the applicant does not support the functionality of the defined optional keywords then they shall be removed from the GSD-file. The correctness of the GSD-file shall be tested in advance by the manufacturer.
A GSD-file can be created with every available XML-editor. It can be tested with the PROFINET GSD Checker [2].

Take care that you always have the latest version of the GSD-file to be equipped for future installation. Refer to the document „*Versions of Documents"* within the PROFINET test bundle**.**

If you reference a "Graphic File", the file shall be shipped together with the DUT.

> The *GraphicFile* size is 70 x 40 Pixel.

> The *GraphicFile Name* has the form:

GSDML-<VendorID>-<DeviceID>-<manufacturer specific data>

8.4.2 Inputs, Alarms

If the application supports input data then describe how the PITL may change the input data during the cyclic data exchange.

If the application supports manufacturer specific alarms then describe how the alarms can be activated.

Hint:
A comprehensive description as well as the required hardware components shall be supplied from the applicant. If this is not fulfilled the PITL is not able to execute a corresponding test. This is then stated in the hint field of the test report.

8.5 Execution of the Certification Test

The scope of the test to be performed is derived from the relevant entries within the corresponding GSD-file. These mandatory entries entries shall cover:

- **Conformance Class: t**he value shall comply with the following regular expression: **A, B, or C**

- **Application Class:** "**Isochronous", "Process Automation", "High Performance", "Functional Safety", and "Dynamic Reconfiguration"**

- **Net load Class:** The value shall comply with the following regular expression: **I**, **II** or **III**. It is recommended that the manufacturer performs the Security Level 1 tests (net load test) in advance and states the net load class which should be tested within a certification test. Security Level 1 tests are mandatory starting with the PROFINET standard V 2.3 or newer.

The device shall correspond to those produced in series. A test of prototypes is possible at most PITL, but the test of a prototype doesn't result in a test report with which a certificate can be applied for. The scope of the certification test is documented in test specifications, which is included in the PROFINET test bundle. It can be downloaded from the PI Website by members free of charge. Non-members can order the test specifications from the PI Business Office.

The manufacturer of the field device has the possibility of being present in the PITL during the certification test. Thus, he can benefit from the expertise of the tester. Furthermore stated deviations of the DUT from the communication standard can be immediately discussed and explained. All test results are archived in electronic form and/or as hard copy by the PI Test Laboratory.

The test setup for each functionality is specified in detail within the test specification and security level 1 specification.

Any failure during the test is reported to the applicant.

In case of conflicts between PITL and applicant following options exist:
- Test Exception (see Framework for Testing chapter 5.14)
- Arbitration procedure (see Framework for Testing chapter 5.8)

8.5.1 Testing of Profiles and Enhanced Features

A profile or enhanced feature test always requires a PROFINET testing in advance. Presently there is a certification test established for the profiles PROFIsafe, PROFIdrive, ENCODER and PROFIenergy.

8.6 Test Report

Based on the result of a test, a test report is generated by the PITL. The test report documents all test results together with the version of the test bundle and the version of the GSD-file as well the device identification (Vendor-ID, Device-ID, DAP-Module-ID) to the real DUT. Observations which differ from the relevant PROFINET specifications are adhered. Furthermore the test report contains a recommendation for the PI Certification Office (PICO) whether or not a certificate should be issued.

The test report is sent to the applicant. The PI Test Laboratory shall hold the test results and the test report in strict confidence.

8.7 Application for a Certificate

After receiving a positive test report, the device manufacturer can apply for a certificate for his device. The manufacturer passes the original of the test report together with the correspondent application form (see [5], [6], [7]) to the PI Certification Office (PICO). This shall be done within 3 years after the test report is issued, otherwise a certificate can only be granted with a new test at a PI Test Laboratory.

PICO issues the certificate based on the test report according to the rules of this document. The validity of 3 years starts with the date of the test report.

In case of a positive test result, PICO will provide the certificate to the applicant. Is the test result negative and the applicant does not agree with the result the applicant may start the arbitration procedure according to Document 2: "Framework for Testing and Certification of PROFIBUS and PROFINET Products".

8.8 Prolongation of a Certificate

A certificate is valid for 3 years. It will expire 3 years after the test report is issued.

The manufacturer can ask for prolongation of the validity of the certificate. For this purpose, it is necessary to provide the PICO not later than three months after the certificates validity expires with a manufacturer declaration. This declaration must contain the following statements:
- Declaring the unchanged conformance of the product with the tested prototype in hardware and software in accordance with the test report (the last favorable test).

- That there is no newer version of the device that uses the same device identification, i.e. Vendor-ID, Device-ID, DAP-Module-ID.

.
Otherwise the prolongation requires a retest.
The text for the manufacturer declaration (see [4]) can be obtained from the PICO.

On the basis of the existing test report, of the new application form and of the manufacturer declaration the PICO grants the prolongation of the certificate.

8.9 How to continue

PROFINET Device	→chap 9
PROFINET Controller	→chap 10
PROFIdrive	→chap 11
ENCODER	→chap 15
PROFIenergy	→chap 12
PROFIsafe Device	→chap 13
PROFIsafe F-Host	→chap 14

9 PROFINET Device Certification

The test of PROFINET is based on the international standard IEC 61158 part 10 and IEC 61784. A PROFINET certification test is always necessary according to the PI quality policy (see chapter 2). The Device under Test (DUT) is always a **D**evice **A**ccess **P**oint (DAP) which is described in a GSD file. A certain amount of modules can be defined for a DAP. That means only a complete application can be tested. A complete application consists always of the communication part and the real application. The test is performed with an arbitrary number of the defined modules in the GSD-file. The test is performed according to the GSD-entry PNIO_Version = "V x.y"

A PROFINET device test always consists of a

- GSD-Test

- DAP-Test (including Hardware, State machine, functionality, negative tests and integration test)

- Net load Test

A PROFINET certificate is given by PICO for a certain DAP which is referenced in the GSD-file. The tests to be performed are based on the test specifications and test cases. These documents are part of the PROFINET test bundle.

9.1 The PROFINET Test Bundle

The PROFINET test bundle consists of the relevant specifications, test specifications, test case specifications, other relevant documents, and tools, and the definition of BoT and EoT of the valid test system versions which are needed for preparation of a certification test. The test bundle can be downloaded free of charge for PI members from www.profinet.com → downloads → software and tools → test bundle.

The PN test bundle is usually released in April and October of a year. The PN test bundle release in April is an upgrade with new content. The October release is provided for maintenance purposes only (e.g. bug fixing).

All documents, tools (software) and the test bundle itself is developed and released based on a quality assurance process of PI.

The content of the test bundle is described in the "Readme" file provided with the test bundle.

9.2 Forms

The following forms are needed:

- Application for a Vendor_ID if not yet available [9]

- Application for a certificate [5]

9.3 Brand Labeling

Brand labelled products are functional identical devices distributed by different companies. There are differences in the outer design, the GSD-file and the I&M records.
Differences are by all means:
- Name of the GSD-file
- GSD file in the case of Vendor_ID, Device_ID, DAP identification and maybe module or sub module ident numbers
- Content of the I&M records
- End Point Mapper

The manufacturer shall test the changes internally and give a statement to PICO about the compatibility of the changes.

At least the following tests have to be done by the manufacturer:
- Check of the GSD file including Vendor_ID, Device_ID and the uniqueness of the module and sub module ident numbers
- Check of the I&M records and the EndPointMapper
- Short start-up and data exchange test

The vendor of a brand labelled product delivers a declaration about identity of the devices to PICO. In the declaration the vendor shall clearly state the devices differ not in PROFINET functionality, software or hardware.

9.4 Additional Procedure regarding Retests for PROFINET

9.4.1 General Approach

This chapter describes the regulations for retests when changes have been made at an already certified PROFINET device. A full test or a part test has to be performed within a PITL. This leads to a new test report. A PITL will only issue a new test report when tests have been carried out. The goal is to have a uniform and unique understanding whether a PITL is involved for a retest or not.

There are mainly two different product variants on the market which have to be taken into account. These are 1 µC-systems and 2-µC systems. Due to the increasing complexity of device variants the following chapter can only cope with the cardinal changes within a PROFINET device. Other changes should be discussed bilateral between manufacturer and a PITL.

9.4.2 One µC Systems

The characteristic of a 1-µC-system is:

- The communication program including the operating system as well as the application software which is running on the same µC.

- The complete software is running also on the same HW (communication part as well as the application part)

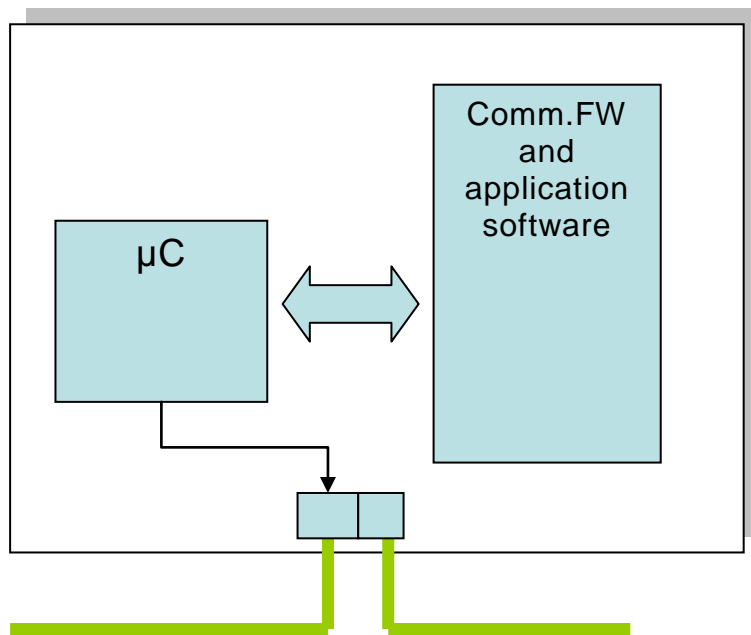- Any change in software or hardware may influence the application as well

Figure 2: the construction of a 1 µC PROFINET device

Item / test	Full or Part test 1)	Manufacturer declaration 2)	OEM declaration3)	No test
HW changes which may influence the communication part	x			
HW changes which do not influence the communication part		x	x	
Bug fix in the communication software	x			
New functions in the communication software	X 4)			
Bug fix in the application software	x			
New functions in the application software	X 4)			
New GSD modules 5)				x
Variants of products (FW is identical)		x	x	
Variants of products (FW has been modified)	x			
Brand labeling retest			x	

1) in case of a part test the manufacturer of a PROFINET device should contact a PI Test Laboratory and discuss the changes.

2) at least the manufacturer has to give a statement to the PI Certification Office that he tested the product with the PROFINET-Tester. The result does not show any faulty behavior.

3) an in-house test with the PROFINET tester is recommended by the manufacturer (there are no specific test cases defined for this kind of in-house test). A positive result can then be forwarded as a written statement (manufacturer declaration) to the PI Certification Office to extend the duration of the certificate.

4) previous HW test can be accepted gray column indicates PITL is involved

5) GSD-file: Updating a GSD-file to a new version by ensuring 100% compatibility with the old one can be done under responsibility of by the manufacturer. The manufacturer has to give a statement directly to the PICO. In any case the manufacturer is responsible that at any time only one valid GSD file is existing for a product family. If the device vendor would like to update their certificate with a new GSD file name they could get an updated certificate from PICO.

9.4.3 Two µC Systems

The characteristic of a 2-µC-system is:

- The communication program including the OS is separated and is running on different HW parts/boards.

- The communication between application and communication part is normally realized via dual ported memory.

- Any changes in the software or hardware of the communication part do not influence the application if the interface is compatible.
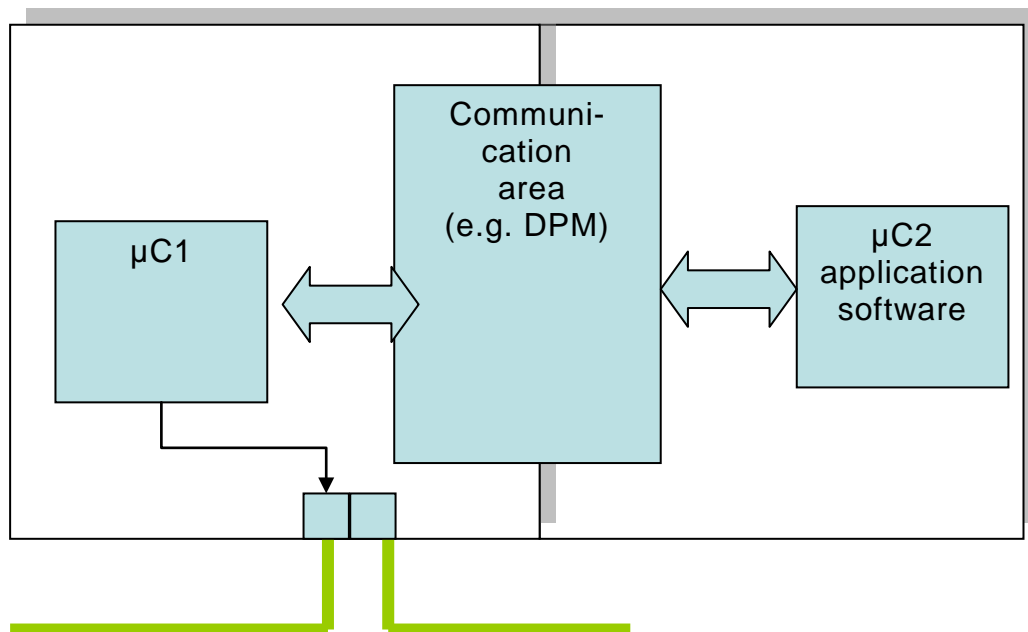

Figure 3: construction of a2-µC system (e.g. piggy back solution)

Item / test	Full or Part test 1)	Manufacturer declaration 2)	OEM declaration 3)	No test
HW changes which may influence the communication part	x			
HW changes which do not influence the communication part		x	x	
Bug fix in the communication software	x			
New functions in the communication software	x			
Bug fix in the application software which may influence the communication part	x			
Bug fix in the application software which does not influence the communication part		x	x	

New functions in the application software which may influence the communication part	x			
New functions in the application software which does not influence the communication part		x	x	
New GSD modules 4)				x
Variants of products (FW is identical)		x	x	
Variants of products (FW has been modified)	x			
Brand labeling retest			x	

1) in case of a part test the manufacturer of a PROFINET communication module should contact a PI Test Laboratory and discuss the changes. If only the communication part has been changed a test of the communication part is necessary. If the manufacturer of the basic module (original module) declares the 100% compatibility of the successor module (compatible substitute module) the application part and also the certificate of the complete device is not influenced

2) at least the manufacturer has to give a statement to the PI Certification Office that he tested the product with the PROFINET-Tester. The result does not show any faulty behavior.

3) an in house test with the PROFINET tester is recommended by the manufacturer (there are no specific test cases defined for this kind of in house test). A positive result can then be forwarded as a written statement (manufacturer declaration) to the PI Certification Office to extend the duration of the certificate.

4) GSD-file: Updating a GSD-file to a new version by ensuring 100% compatibility with the old one can be done under responsibility of by the manufacturer. The manufacturer has to give a statement directly to the PICO. In any case the manufacturer is responsible that at any time only one valid GSD file is existing for a product family.

9.5 Test Procedure regarding Product Naming (Device Families)

If a vendor manufactures an IO-Device which is represented by several product names on the market, there are two options and corresponding procedures to enable him to advertise the product names of the IO-Device) in the certificate:

- **Vendor declaration:** Vendor delivers declaration about identity of product variants to the PI Test Laboratory. In the declaration, vendor shall clearly state the product variants differ not in PROFINET functionality, software or hardware implementation but in other technical or technological parts which are out of scope of PI certification requirements. All relevant vendor declarations shall be part of the Test Report in this case.

- **Test of all product variants:** Vendor delivers all product variants to PI Test Laboratory. All are tested and the test results are summarized in one IO-Device Test Report.

All product names are stated in the test report and will be published on the certificate afterwards.

9.6 PROFINET Device Certificate

The following data is shown on the certificate:
- Company
- Model Name
- Revision
- Identnumber
- GSD (name)
- DAP

- PN Version
- Conformance Class
- Netload Class
- PNIO_Tester-Version
- Authorized test lab (Tester) and Test report number
- Validity of the certificate

Typically a certificate is issued within two weeks with a certificate document.

Two kinds of PROFINET certificates exist: one for products (Figure 4) and one for reference implementations (Figure 5).

Figure 4: Outline of the PROFINET certificate

The certificate for reference implementations indicates clearly PN implementations which are used as basis for PN devices (Figure 5).

Figure 5: Outline of the PROFINET certificate for reference implementations

9.6.1 Application Classes

PROFINET has defined user oriented application classes. The following table shows the different possibilities:

Application classes	Conformance classes		
	A	B	C
Isochronous application	—	—	Optional
Process automation	Optional [a]	Optional	Optional
High performance	—	—	Optional
Dynamic Reconfiguration	—	Optional	Optional
Functional safety	Optional [a]	Optional	Optional
[a] Not recommended			

Isochronous application (optional): field devices which support the application class „isochronous" can be used for isochronous applications (e..g. Motion Control).

Process automation Field devices which support the application class „process automation", may support the following functionality:

- Time synchronization (optional)
- MRP with loop prevention (optional)
- MRPD (optional)
- Dynamic reconfiguration (optional)
- System Redundancy.

High performance Field devices which support the application class "high performance" also support

- Send Clock Factor < 8 (for bus cycle times < 250µs)
- Fast Forwarding
- Fragmentation of UDP/IP Frames
- Preamble shortening
- Data Frame Packaging.

Dynamic Reconfiguration (DR) Field devices which support the application class DR also support

- Controller functionality
- Device functionality
- Controller to Controller records
- IO-Controller Record Data CR 16588 Octets
- Shared Device
- Shared Input
- 4 Application Relations.

Functional safety: PROFIsafe- Field devices which support the application class "functional safety also support

- I&M0 record read support
- I&M4 record read support
- Upload&Retrieval alarm (optional for storage of the data within the iPar-Server).

9.6.2 Net load Class

See Guideline Security Level 1

9.6.3 Media Redundancy Class

The following redundancy classes are defined::

- RED_CLASS_1: Ring redundancy with "loop prevention"
- RED_CLASS_3: seamless ring redundancy

10 PROFINET Controller Certification

The test of PROFINET is based on the international standard IEC 61158 Type 10 and IEC 61784-2. A PROFINET certification test is always necessary according to the PI policy. The Device under Test (DUT) is always a Controller which is described in the test contract and the Test Report, maybe with additional files. The test is performed according to the manual and the additional files from the manufacturer with the described PNIO_Version = "V x.y" Currently only Controller according to Conformance Class A and B can be tested.

That means only a complete application can be tested. A PROFINET certification test always consists of a

- Controller-Test (including Hardware, State machine, functionality and topology, negative tests and integration test)
- Net load Test

A PROFINET certificate is given by PICO for a certain Controller described in the Test Report. The tests to be performed are based on the test specifications and test cases. These documents are part of the PROFINET test bundle. It is recommended that the manufacturer assists during a certification test in order to assist during the configuration.

10.1 Relevant PI documents

The current documents as well as useful test tools are available in the test bundle to be downloaded free of charge for PI members from www.profinet.com → downloads → software and tools → test bundle.

The scope of the test is described in the

- **Test Specification for PROFINET**

How the tests are performed is described in the

- **PROFINET Test cases for Controller**

The net load tests are described in the

- **Test Specification PROFINET IO Security Level 1 / Net load [3]**

The version of the test to be performed is described in the document "**Versions of Documents**".

10.2 Relevant Tools

To assist a device manufacturer during his development the following specifications and tools are provided by PI:

- **Bus monitor:** The bus monitor wireshark is a free available tool which can be downloaded from www.wireshark.com. With this tool most of the tests to be performed in a test lab can also be performed in advance by the manufacturer.
- **Security Level1** tester is a tool to perform load tests in advance.

10.2.1 Forms

The following forms are needed:

- Application for a certificate [5]

10.2.2 Retests

see chapter 9.4

10.2.3 Brand Labeling

see chapter 9.3

10.3 PROFINET Controller Certificate

The following data is shown on the certificate:
- Company
- Model Name
- Order Number
- Revision
- Identnumber
- PN Version
- Conformance Class
- Netload Class
- PNIO_Tester-Version
- Authorized test lab (Tester) and Test report number
- Validity of the certificate

Typically a certificate is issued within two weeks with a certificate document (Figure 6).

Certificate

PROFIBUS Nutzerorganisation e.V. grants to

Muster AG
Muster Str. 25, 12345 Musterstadt, Germany

the Certificate No: **Z10102** for the PROFINET IO Controller:

Model Name:	**Musterdevice**
Order Number:	**A12B34C56D78**
Revision:	**1.0; SW/FW: 1.0 HW: 1.0**
Identnumber:	**0x0101; 0x1010**

This certificate confirms that the product has successfully passed the certification tests with the following scope:

☑	PNIO_Version	V2.31
☑	Conformance Class	C
		Optional Features: Legacy, MRP, DeviceAccess
☑	Netload Class	III
☑	PNIO_Tester_Version	V2.3.5
☑	Tester	Testlab AG, Germany
		PN-00-0

This certificate is granted according to the document:
"Framework for testing and certification of PROFIBUS and PROFINET products".

For all products that are placed in circulation by January 31, 2019 the certificate is valid for life.

Karlsruhe, February 19, 2016

Board of PROFIBUS Nutzerorganisation e. V.

(Official in Charge)

(1.Vorsitzender)

(2. Vorsitzender)

Figure 6: Outline of the PROFINET certificate

11 PROFdrive on PROFINET

PROFIdrive is an application profile which can be used in combination with PROFINET for an interoperable application interface for drive and motion control. Therefore it is necessary to use a certified PROFINET DAP with which a PROFIdrive module can be tested. The rules for a PROFINET certification do apply here. This profile is tested when the following entry in the GSD-file is defined: **ProfileName** "PROFIdrive".

11.1 Available Specifications

The test of a PROFIdrive module is based on the PI-documents

- Profile Drive Technology PROFIdrive; Order No.: 3.172
- Amendment PROFIdrive on PROFIsafe; Order No.: 3.272

The tests to be performed is based on the PI-document

- Test Specification for PROFIdrive Profile V4.1

To be sure you have the actual documents please refer to the document "Versions of documents".

11.2 Preparations for the Certification Test

see PROFINET chapter 9.4

11.2.1 General Station Description (GSD)

- For unique identification of the DUT see 8.4.1.

The use of the PROFINET GSD Checker [2] for a PROFINET GSD is recommended to ensure comfortable and syntax correct editing of the GSD.

11.2.2 Useful Tools

The PROFIdrive PROFINET Profile Tester supports the development of PROFINET IO devices with PROFIdrive or ENCODER Profile application interfaces. It can be used as a means for preparation of the PROFIdrive certification and also as test tool to run self programmed test scripts. The tool can be downloaded free of charge for PI members from www.profinet.com → downloads → software and tools → PROFIdrive PROFINET Profile Tester

11.2.3 Forms

The following forms are needed

- Application for a certificate [7]

11.2.4 Retests

see chapter 9.4

11.2.5 Brand Labeling

see chapter 9.3

11.3 PROFIdrive Certificate

The following data is shown on the certificate

- Certificate Number

- Model_name
- Order_ID
- Revision SW-Version, HW-Version
- PROFIdrive Applicaton Classes
- Tested optional PROFIdrive functionality
- Test report number
- Authorized Test Laboratory
- Validity of the Certificate

12 PROFIenergy on PROFINET

PROFIenergy is an application profile which can be used in combination with PROFINET. Therefore it is necessary to use a certified PROFINET DAP with which a PROFIenergy module can be tested. This profile is tested when the following entry in the GSD-file is defined: **ProfileName** "PROFIenergy"

The rules for a PROFINET certification do apply here.

12.1 Available Specifications

The test of PROFIenergy modules is based on the PI-document

- Common Application Profile PROFIenergy; Order No.: 3.802.

The test to be performed is based on the PI-document

- Test Specification and Test Cases for PROFIenergy; Order No.: 2.472

To be sure you have the actual documents please refer to the document "Versions of documents".

12.2 Preparations for the Certification Test
see PROFINET chapter 8.4
12.2.1 General Station Description (GSD)
For unique identification of the DUT see 8.4.1.

The use of the PROFINET GSD Checker [2] for a PROFINET GSD is recommended to ensure comfortable and syntax correct editing of the GSD.

12.2.2 Useful Tools
The relevant tests are defined within the PN-Tester

12.2.3 Forms
The following forms are needed:
- Application for a certificate [8]

12.2.4 Retests

see chapter 9.4

12.2.5 Brand Labeling

see chapter 9.3

12.3 PROFIenergy Certificate

The following data is shown on the certificate
- Certificate Number
- Model_name
- Order_ID
- Revision SW-Version, HW-Version
- Scope of the Test (PROFIenergy – Energy Saving Function)
- Test report number
- Authorized Test Laboratory
- Validity of the Certificate

13 PROFIsafe Device on PROFINET

A PROFIsafe module is always tested in combination with an already certified PROFINET head station. If only the PROFIsafe module should be tested a certified head station shall be available to perform the test. If the head station is not yet certified a separate certification test with the head station has to be performed in advance.
If you intend to test a so called compact station (the PROFINET DAP and the PROFIsafe module are seen as one unit then the DAP and the PROFIsafe module are tested together). This profile is tested when the following entry in the GSD-file is defined: **ProfileName** "PROFIsafe".
In case of a compact station the DAP and the PROFIsafe part refer to the same certificate. In case of a modular station the DAP as well as the PROFIsafe module have seperate certificates. Modifications of the DAP do not lead to withdrawal of the PROFIsafe certificate.

13.1.1 Available Specifications

The test of PROFIsafe on PROFINET is based on the international standard IEC 61158 part 3. The tests to be performed is based on the PI-documents
- PROFIsafe – Profile for Safety Technology on PROFIBUS DP and PROFINET IO
- PROFIsafe Test & Certification
- Test cases: are only available as software (test program)

To be sure you have the actual documents please refer to the document "Versions of documents"

13.1.2 Preparations for the Certification Test
see PROFINET in chapter 8.4

13.1.3 General Station Description (GSD)
The device manufacturer shall provide a GSD file in accordance with the GSD specification [1] for its product. The entries of the GSD shall describe the qualities of the device correctly. For unique identification of the DUT see 8.4.1.

The use of the PROFINET GSD Checker [2] for a PROFINET GSD is recommended to ensure comfortable and syntax correct editing of the GSD.

13.1.4 Useful Tools
PN-Test Bundle see PROFINET chapter 9.1
Plus PROFIsafe Layer Tester *)

*) The PROFIsafe Layer tester can be ordered only in combination with a PROFIsafe certification test from your chosen PITL.

13.1.5 Forms

The following forms are needed:
- Application for an Vendor_ID [9]
- Application for a certificate [6]

13.1.6 Retests

see chapter 9.4

13.2 PROFIsafe Certificate

The following data is shown on the certificate
- Certificate Number
- Model_name
- Order_ID
- Revision SW-Version, HW-Version
- Application CRC for each channel
- Scope of the Test (functionality V2)
- Test report number
- Authorized Test Laboratory
- Validity of the Certificate
- Reference to the used DAP and GSD file

14 PROFIsafe F-Host on PROFINET

This is planned for the near future.

15 ENCODER Profile on PROFINET

The ENCODER Profile is an application profile which can be used in combination with PROFINET for an interoperable application interface for encoders, linear skales and motion control. Therefore it is necessary to use a certified PROFINET DAP with which a ENCODER Profile module can be tested. The rules for a PROFINET certification do apply here. This profile is tested when the following entry in the GSD-file is defined: **ProfileName** "ENCODER".

15.1 Available Specifications

The test of an ENCODER Profile module is based on the PI-document
- Profile Encoder for PROFIBUS and PROFINET V4.1; Order No: 3.162

The tests to be performed is based on the PI-document

- Test Specification for Encoder V1.0; Order No.: 2.542

To be sure you have the actual documents please refer to the document "Versions of documents".

15.2 Preparations for the Certification Test

see PROFINET chapter 9.4

15.2.1 General Station Description (GSD)

For unique identification of the DUT see 8.4.1.

The use of the PROFINET GSD Checker [2] for a PROFINET GSD is recommended to ensure comfortable and syntax correct editing of the GSD.

15.2.2 Useful Tools

The PROFIdrive PROFINET Profile Tester supports the development of PROFINET IO devices with PROFIdrive or ENCODER Profile application interfaces. It can be used as a means for preparation of the ENCODER Profile certification and also as test tool to run self programmed test scripts. The tool can be downloaded free of charge for PI members from www.profinet.com → downloads → software and tools → PROFIdrive PROFINET Profile Tester

15.2.3 Forms

The following forms are needed

- Application for a certificate [10]

15.2.4 Retests

see chapter 9.4

15.2.5 Brand Labeling

see chapter 9.3

15.3 ENCODER Profile Certificate

The following data is shown on the certificate
- Certificate Number
- Model_name
- Order_ID
- Revision SW-Version, HW-Version
- ENCODER Classes
- Tested optional ENCODER Profile functionality
- Test report number
- Authorized Test Laboratory
- Validity of the Certificate