

G3-PLC User Guidelines

Important considerations for G3-PLC certification (version 1.0, December 2020)

Executive Summary

This document provides some important considerations for G3-PLC Certification. The objective of this document is to make manufacturers aware of certain aspects related to the G3-PLC certification *early* in their product development process. When manufacturers are not aware of these aspects, it may lead to rework after the manufacturers came to the test laboratories for certification.

The strong certification program of the G3-PLC Alliance allows for the sourcing of interoperable products from multiple suppliers and therefore is a good choice for DSO's.

The certification procedures have been documented in detail and this document is not intended to replace or duplicate the certification documents.

An important aspect product manufacturers should be aware of before starting the G3-PLC certification testing, is the inband background electrical noise of their product. A high level of such background noise in the product can have a bad impact on the certification tests.

G3-PLC certification testing includes performance testing to ensure that all certified products meet a minimum level of performance. Manufacturers have the possibility to declare that the performance of their product is better than these minimum requirements for which they need to provide PICS in the required format. Products also must be able to work with both 50-Ohm and 2-Ohm LISNs sustainably and reliably.

The time needed for certification depends very much on the maturity of the implementation. To help in the early stages of product development and to confirm that the technical choices made are the correct ones, the accredited test labs can provide pre-test services.

In case you have any questions related to the G3-PLC Certification or G3-PLC in general, please contact generalsecretary@g3-plc.com.

Content

- EXECUTIVE SUMMARY1**
- CONTENT2**
- 1. OBJECTIVE OF THIS DOCUMENT3**
- 2. IMPORTANCE OF CERTIFICATION3**
- 3. DOCUMENTATION FOR CERTIFICATION3**
- 4. REQUIREMENTS FOR CERTIFICATION TESTING4**
 - 4.1. GENERAL REQUIREMENTS4
 - 4.2. BACKGROUND NOISE LIMITATION FOR PRODUCTS4
 - 4.3. PERFORMANCE EVALUATION5
- 5. TEST DURATION AND PRE-TESTING6**

1. Objective of this document

The objective of this document is to make manufacturers aware of certain aspects related to the G3-PLC certification *early* in the product development process. When manufacturers are not aware of these aspects, it can lead to some rework of their product - either hardware or software - after the manufacturers came to the test laboratories for certification testing. This is especially applicable for product manufacturers who did not get prepared through pre-testing and could face issues in the testing quite late in the process. A good example is the limitation for background noise in products as described in paragraph 4 of this guideline.

The certification procedures have been documented in detail in the test procedures and the test specifications (see paragraph 3), but these documents are only available to members of the G3-PLC Alliance. Therefore, manufacturers may have access to them only when they are already well on their way in their product development and when they start preparing for their certification.

This document is not intended to replace or duplicate the certification documents of the G3-PLC Alliance. The only objective is to help manufacturers and make them aware of several important considerations as early as possible in the process for the preparation of for their G3-PLC certification.

2. Importance of certification

As smart grid implementations require major investments, the issuing of certificates is very important. High-quality certificates will give both vendors and customers assurance that their meters, data concentrators and other devices have the correct implementation of the G3-PLC standard, that they are interoperable with other certified devices and meet the specified performance levels.

Therefore, many G3-PLC Alliance members have been working closely together to define the G3-PLC certification program, leveraging all available expertise to meet the needs of all stakeholders.

A strong and proven certification program greatly reduces interoperability issues and provides an important first conformity level. A certification program sets the minimum level of quality and conformity of a supplier before the customer starts his own testing. Suppliers are therefore encouraged to be compliant and certified by the G3-PLC Alliance as soon as possible, before entering the qualification process of the DSO. The strong certification program of the G3-PLC Alliance allows for the sourcing of interoperable products from multiple suppliers and therefore is a good choice for DSO's.

During a smart meter roll-out, any problem that cannot be solved remotely through a firmware upgrade leads to a meter replacement, requiring people, time & money. In case of a generic problem, this can cause the business case to collapse and this is a major risk of an industrial project such as a massive smart meter roll-out. This illustrates how critical the telecommunication part is and that certification by an independent third-party authority such as the G3-PLC Alliance is an important cornerstone of a successful smart metering program.

Basic information regarding G3-PLC Certification is available on the G3-PLC website: <http://www.g3-plc.com/g3-plc-certification/>.

3. Documentation for certification

The following documents regarding the certification are available for members of the G3-PLC Alliance:

- G3-PLC Certification Program: provides an overview of the tests for certification, describes the prerequisites for certification and outlines the steps to achieve G3-PLC certification
- Certification Tests Procedures for G3-PLC Certification: describes all the procedures applicable to the certification testing and provides details on the prerequisites for devices. It also explains how

the G3-PLC Tests Plans are used in the context of the G3-PLC certification of platforms and products

- Tests specifications: describe all the certification tests as well as the test set-up and tests requirements used for testing conformance, interoperability and performance

These documents are available for members of the G3-PLC Alliance on the website: <http://www.g3-plc.com/g3-plc-certification/g3-plc-certification-program/> and <http://www.g3-plc.com/g3-plc-certification/g3-plc-certification-tests/>.

4. Requirements for certification testing

4.1. General requirements

The company submitting a device for certification must be the manufacturer of the device and is required to be a member in good standing of the G3-PLC Alliance.

To be eligible for certification, platforms¹ must previously have successfully participated in the interoperability testing by the G3-PLC Alliance: <http://www.g3-plc.com/g3-plc-certification/g3-plc-certification-program/>.

Products must be based on a G3-PLC certified platform. An overview of all certified platforms can be found on the G3-PLC website: <http://www.g3-plc.com/certified-products-platforms/g3-plc-certified-platforms/>.

Vendors must provide G3-PLC devices compliant with G3-PLC specifications (recommendation ITU-T G.9903 Narrowband orthogonal frequency division multiplexing power line communication transceivers for G3-PLC networks reference). The device (platform or product) must implement G3-PLC PHY, MAC and 6LoWPAN specifications and for ARIB also network and transport layers. The device must have all necessary interfaces, tests points, and configuration capabilities as described in the G3-PLC test specifications.

4.2. Background noise limitation for products

An important aspect product manufacturers should be aware of before starting the G3-PLC certification testing, is the background electrical noise of their product. Such noise may be either an inband or an outband² noise, or even both, and typically a high level of such background noise in the product can have a negative impact on their certification tests.

Typically, such electrical noises may be introduced by the switching mode power supplies that are coupled together with the G3-PLC signal interface of the product under test. Product Manufacturers should take great care about such potential noises when designing their power supplies and when it comes to connect together the power supply of the product and its G3-PLC analogue line.

One other potential source of out-of-band noise is the G3-PLC transmission itself, therefore care must be taken during product development to mitigate its impact³.

Although out-of-band noises contribute to such a potential negative impact, out-of-band noises are not investigated during the G3-PLC certification tests. Investigations about such noises should be addressed prior to G3-PLC certification tests during other certification tests, like CE or FCC markings measurement campaigns. Such campaigns are not covered by the G3-PLC certification tests. Product vendors need however to take great care of such outband noises and make sure they respect the level limits imposed by the applicable standards & national regulations.

¹ A solution providing an implementation of the G3-PLC stack. It allows to build G3-PLC products and is based on one or several chips. It includes PHY, MAC and 6LoWPAN.

² Inband noise: noise within the G3-PLC frequency used band. Outband noise : noise outside the G3-PLC frequency used band.

³ The maximum output levels and outband noise limits for Europe are defined in EN-50065-1.

G3-PLC certification tests investigate the background noise power levels within the G3-PLC band (inband background noise). Typically, inband noise power levels of 50 dB μ V and below⁴ allow performing the certification tests without problems. Higher values will not necessarily prevent products from being tested successfully, but such levels of noise potentially harm the product performance and may delay the certification process.

These background noise levels can easily be verified with the methodologies detailed in the G3-PLC Performance Tests specification. Such verification can be done internally by the manufacturers themselves or by the certification test laboratories using their pre-test services.

A high level of background noise negatively impacts the running of certification tests in two ways.

First, such noise can harm the PLC communication between the product and another PLC device. This can also happen with the test tool, especially because strong attenuation is used in the test setup during the certification testing. A high level of such background noise strongly degrades the reception sensitivity of the product, resulting in much less reliable communication and, in extreme cases, even no communication in the setup.

Products with a limited level of background noise normally do not have such issues and pass for instance injection measurements under low impedance more easily, without running into frame losses or communication disruption during this test.

A second drawback of the presence of a high level of background noise resides in the fact that such background noise adds to the noises injected in the certification test setup. To ensure the reliability of the performance tests conducted by the certification test laboratories and to ensure the added noise is meaningful compared to the background noise from the product, some margins must be taken and the added noise in the certification tests must be substantially above the product noise. Whenever these two types of noise mix at comparable levels, the performance test results are not meaningful and the certification tests will result in an inconclusive verdict. The test laboratories are required to monitor these margins and to make sure the injected noises are substantially above the background noise during the certification testing. Here again, products with a limited level of background noise would not face such issues during certification tests, whereas products showing a high background noise might require a hardware change to reduce such an unwanted noise.

For all these reasons, product manufacturers are encouraged to check the level of the background noise of their product early in the development phase. This pre-check will avoid hardware re-design or modifications of their product after they started certification testing and will ease the path to obtaining their G3-PLC certificate.

4.3. Performance evaluation

Protocol Implementation Conformance Statement (PICS)

The objective of performance testing is to make sure that all certified products meet a minimum level of performance.

For each performance test in the certification testing, performance indicators have been defined. The list of these indicators, defined as PICS (Protocol Implementation Conformance Statement), can be found in the G3-PLC Performance Tests specification and for most PICS a limit has been set.

Product manufacturers have the possibility to declare that the performance of their product is better than these minimum requirements. To do so, they need to provide the PICS to the test laboratory in the required format, and then the test laboratory will verify that the product can reach the performance level provided in these PICS.

When a PICS value is declared by a product manufacturer, it is measured and verified by the test laboratory to assert the level of performance of the device under test and it is compared to the declared PICS as well as the validity range of the PICS. This evaluation results either in a successful execution (PASS) or in an unsuccessful execution (FAIL).

Certain PICS do not have a limit, and their PASS assertion and declared value are taken directly from the measurement performed by the test laboratory (given some margin).

⁴ measured under a CISPR-16 50-Ohm LISN.

Capability for 50-Ohm and 2-Ohm LISN's

Each G3-PLC PICS is evaluated and verified by the certification test laboratories using calibrated test benches and standardized measurement methodologies specified and described in the G3-PLC Performance Tests specification.

Such measurement methodologies are derived from the EN-50065 European norm⁵. The EN-50065 norm specifies signalling measurement methodologies for CENELEC A & B frequency bands only, however, the G3-PLC Performance Tests specification extends these methodologies to the G3-PLC frequency bands ARIB & FCC.

The G3-PLC test benches use the transmission of the G3-PLC signalling in a controlled and stabilized electrical environment through standard CISPR-16 50-Ohm Line Impedance Stabilization Networks (a.k.a. 50-Ohm LISNs). All the G3-PLC certification tests, except one single measurement, use these standard calibrated 50-Ohm LISNs. This one other measurement uses instead a 2-Ohm LISN which hardware design is described and specified in the G3-PLC Performance Tests specification.

Therefore, manufacturers submitting products for G3-PLC certification need to make sure their product can work with both 50-Ohm and 2-Ohm LISNs sustainably and reliably against test time.

It is important to keep in mind that the G3-PLC calibrated test benches and the standard methodologies ensure the replicability and the reliability of the G3-PLC PICS determinations: no matter where or when these measurements are performed, the PICS values of a given product will remain the same by any test operator in the world who is following the G3-PLC Performance Tests specification.

5. Test duration and pre-testing

A question often asked by manufacturers is how long the certification will take. There is no single answer to that as this depends very much on the maturity of the implementation. Running all official tests for a product will take about 4-5 days when there are no issues during the testing. But if the product fails some tests, rework is needed and retesting after that. Especially for performance problems, the rework can take a lot of time. After the testing is completed, it normally takes 1-2 weeks to get all the paperwork done and to issue the certificate.

To help in the early stages of product development and to confirm that the technical choices made are the correct ones, the accredited test laboratories can provide pre-test services. Instead of running the full set of official certification tests, in pre-testing the labs can run a subset of the tests and manufacturer engineers can attend and debug their implementation or test different releases. During pre-testing, the labs can check whether the prerequisites are well implemented, verify the correct integration of platforms in the product, check the behaviour of the product with regard to the performance test scripts and methodologies, evaluate/determine the PICS and identify and solve any potential issue together with the manufacturer. To discuss all test services, manufacturers can contact one of the accredited test laboratories.

Members of the G3-PLC Alliance also have the possibility to buy the test tools from Trialog so they can perform the testing by themselves.

- End of Document -

⁵ EN 50065 : Signalling on low-voltage electrical installations in the frequency range 3 kHz to 148,5 kHz.