Part 1 Definition and documentation

- Introduction
- 1 Scope
- 2 Normative references
- 3 Terms and definitions
    - 3.1 piece of hardware
    - 3.2 Free License
    - 3.3 open source hardware OSH
    - 3.4 four rights of open source hardware
        - 3.4.1 Right to Study
        - 3.4.2 Right to Modify
        - 3.4.3 Right to Make
        - 3.4.4 Right to Distribute
    - 3.5 technology
    - 3.6 technology-specific documentation criteria TSDC
    - 3.7 recipients
    - 3.8 documentation
    - 3.9 documentation release
    - 3.10 lifecycle
- 4 Symbols and abbreviations
- 5 Requirements
    - 5.1 General
    - 5.2 Documentation release
    - 5.3 Access
    - 5.4 Valid Technology-specific documentation criteria
- 6 Lifecycle of Piece of Hardware
- Annex A (informative) - Approved TsDC
- Bibliography

Introduction

An increasing number of initiatives from grassroots, academic and business communities adopt the practice of publicly releasing the design files of products they developed [1]. Altogether, these initiatives framed the concept of open source hardware (OSH) that extends the well-established approach to intellectual property management in open source software to the realms of physical artifacts [2]. This implements an alternative approach to conventional product development that bears a formidable potential for organizational and business innovation [3].

The process of charting a consistent identity based on commonly acknowledged definitions and assessable criteria is made difficult by the multifactorial and partly ill-defined nature of openness and freedom once applied to physical products [4]. In practice, the presupposed information disclosure is applied in very different ways, resulting from a large spectrum of interpretations of the concept of OSH [5]. This document aims to provide a definition that delivers clear criteria allowing to distinguish what is OSH from what it is not. It is the result of a standardization process involving major actors in the field and has been the object of a public consultation.

A significant part of the effort to standardize practices in OSH in the past has been performed by the Open Source Hardware Association (OSHWA). This initiative issued the most widely acknowledged definition of OSH [6] and published a comprehensive set of best practices [7]. Since 2016, it offers a self-certification scheme for OSH originators to signpost their compliance with this definition. The OSHWA Definition 1.0 states [6]:

“Open source hardware is hardware whose design is made publicly available so that anyone can study, modify, distribute, make, and sell the design or hardware based on that design.”

Despite the significant contribution it made to the field of OSH, this definition only focuses on the licensing aspects of product-related information disclosure and does not set concrete requirements regarding the content of the information to be disclosed. Thus it defines what “open” means in the context of technical documentation, but a widely acknowledged reference stating what minimal set of information constitutes the “source” of OSH is yet missing.

The present document addresses this gap by extending the OSHWA Definition 1.0 [6], which itself extends the Open Source Definition [8]. It acknowledges that OSH is not only a matter of licensing but also a matter of documentation contents.

By setting a frame for the documentation of OSH, the authors hope to support the consistent and transparent labelling of OSH, to contribute to the standardization and improvement of OSH practices, and ultimately to enable a more mainstream adoption of the principles of open source in the creation of physical artefacts.

Alongside with DIN SPEC 3105-2 “Open source hardware — Part 2: Community-based assessment” [9] this standard is the first standard published by DIN e.V. under a free/open license. Following the principles of open source, anybody can contribute to its further development online. Please refer to https://gitlab.com/OSEGermany/OHS to review the current state of ongoing processes and to contribute.

1 Scope

This standard delivers an unambiguous and operational definition of the concept of open source hardware and breaks it down into objective criteria for judging the compliance of a piece of hardware with this definition.

This standard sets requirements for technical documentation. It is designed to be complementary to existing standards and guidelines for technical documentation (e.g. VDI 4500) and is not aimed at superseding them. It focuses on the aspects of the technical documentation that are related to its compliance with the principles of open source.

The principles and definitions provided by the DIN SPEC 3105-1 “Open source hardware — Part 1: Requirements for technical documentation” set a frame for the DIN SPEC 3105-2 “Open source hardware — Part 2: Community-based assessment”[9] which in turn sets concrete and practical requirements for the establishment of assessment procedures.

This document builds upon the OSHWA Definition 1.0 [6] and the Open Source Definition [8].

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

DIN and DKE maintain terminological databases for use in standardization at the following addresses:

- DIN-TERMinologieportal: available at https://www.din.de/go/din-term
- DKE-IEV: available at http://www.dke.de/DKE-IEV

3.1 piece of hardware

any discrete (i.e. countable) physical artefact

EXAMPLE A machine, a device, a piece of equipment, or any other tangible object.

Note 1 to entry: A piece of hardware can be either a freestanding single component, an assembly that includes two or more components, or a component belonging to an assembly.

Note 2 to entry: The term piece of hardware indifferently refers to a unique physical artefact (e.g. a one-off prototype) or to the concept of a physical artefact that has been physically realized one or more times (e.g. a product model produced in series). Concepts of physical artefacts do not qualify as pieces of hardware as long as they have not been realized at least once.

Note 3 to entry: This document refers to physical objects as pieces of hardware since the word “hardware” is not countable in English. It is thus incorrect to write “a hardware”. Because this document refers to specific products, prototypes, or artefacts that qualify as OSH, it needs to make the word “hardware” countable. Using “piece of” allows to make of “hardware” a countable quantity. It makes it possible to write sentences like “how many pieces of hardware have been certified?”

3.2 Free License

Open license

license agreement that grants anyone with the right to reuse another creator’s work, giving four major freedoms: use, study, modify and distribute

EXAMPLE CC-BY 4.0[10], CC-BY-SA 4.0[11], GPLv3[12], CERN OHL v2[13]

Note 1 to entry: In this standard, a license complying with the requirements of at least one of the following definitions is considered a free/open license:

- Free Software Definition [14];
- Devian Free Software Guidelines [15];
- Open Source Definition [8];
- Definition of Free Cultural Works [16];
- The Open Definition [17];
- OSHWA Definition [6].

3.3 open source hardware OSH

hardware for which a free right of any use belongs to the general public and whose *documentation* (3.8) is completely available and freely accessible on the Internet

Note 1 to entry: A *piece of hardware* (3.1) is qualified as open source when it's *documentation* (3.8)

1. has been released under licensing terms complying with the OSHWA Definition 1.0 [6] (e.g. CERN OHL v2 [13]) and therewith granting anyone with the *four rights of open source hardware* (3.4);
2. provides enough information to enable *recipients* (3.6) to exercise these rights.

Note 2 to entry: Such a *piece of hardware* (3.1) is therewith referred to as a piece of open source hardware (OSH), may be certified under terms defined by DIN SPEC 31052, and labelled accordingly.

3.4 four rights of open source hardware

the *right to study* (3.4.1), to *modify* (3.4.2), to *make* (3.4.3), and to *distribute* (3.4.4)

Note 1 to entry: Granting these rights requires releasing the *documentation* (3.8) under a license complying with the requirements of the OSWHA Definition 1.0 [6]. Exercising these rights is bound to requirements regarding the content of the *documentation* (3.8). The four rights of open source hardware are detailed in the following subsections.

Note 2 to entry: The four rights of open source hardware are a translation of the “four essential freedoms” stated in the Free Software Definition [14] to the context of physical artefacts. These freedoms have been reinterpreted by the Open Source Hardware Association (OSHWA) as the possibility to “study, modify, distribute, make, and sell” hardware. This document reproduces the wording of the OSHWA, where selling is seen as a way of distribution among others.

3.4.1 Right to Study

effective possibility to access sufficient information to understand the design rationale of the piece of *open source hardware* (3.3) and its expected behaviour along its *life cycle* (3.10)

Note 1 to entry: The right to study includes access to the *documentation* (3.8) of the considered piece of *open source hardware* (3.3)

3.4.2 Right to Modify

effective possibility to edit the *documentation* (3.8) and therewith to alter the design of the piece of *open source hardware* (3.3)

Note 1 to entry: The right to modify presupposes the *right to study* (3.4.1).

3.4.3 Right to Make

effective possibility to operate all activities belonging to the *life cycle* (3.10) of the piece of *open source hardware* (3.3)

EXAMPLE To manufacture the piece of *open source hardware* (3.3), to operate it, to carry out maintenance or to process it at its end-of-life.

Note 1 to entry: The right to make presupposes the *right to study* (3.4.1).

3.4.4 Right to Distribute

effective possibility to give or sell the piece of open source hardware (3.3) made based on the original or a modified version of the documentation (3.8)

1. the original or a modified version of the *documentation* (3.8) and
2. the piece of *open source hardware* (3.3) made based on the original or a modified version of the *documentation* (3.8)

3.5 technology

category of production processes used to make the piece of *open source hardware* (3.3) or a set of physical features embedded in a function of the piece of *open source hardware* (3.3)

3.6 technology-specific documentation criteria TSDC

document that specifies requirements applying to the *documentation* (3.8) of *open source hardware* (3.3) from a given *technology* (3.5)

3.7 recipients

group of people addressed by the *documentation* (3.8)

Note 1 to entry: This group is characterized by a common state of knowledge and set of abilities enabling its members to use the *documentation* (3.8) in order to exercise the four rights of *open source hardware* (3.3). By default, the recipients are specialists in the fields of *technologies* (3.5) embedded in the piece of *open source hardware* (3.3), i.e. the persons skilled in the art corresponding to this *technology* (3.5). The *documentation* (3.8) can define recipients alternatively to include a larger group of people. However, in any case, the *documentation* (3.8) provides no less information than what specialists in the fields of *technologies* (3.5) embedded in the piece of *open source hardware* (3.3) would require exercising the four rights of *open source hardware* (3.3).

Note 2 to entry: In order to account for the contribution of multiple specialists required by the development and production of complex pieces of *open source hardware* (3.3), different recipients can eventually be defined for different parts of the *documentation* (3.8).

3.8 documentation

technical documentation; constitutes the “source code” of a piece of *open source hardware* (3.3)

3.9 documentation release

clearly identifiable version of the *documentation* (3.8) that can be accessed in its entirety even after further modifications brought to the *documentation* (3.8)

3.10 lifecycle

network of successive and parallel activities required or implied by the realization of the piece of *open source hardware* (3.3)

4 Symbols and abbreviations

Abb.	Term
OSH	Open Source Hardware
TsDC	Technology-specific Documentation Criteria

5 Requirements

5.1 General

The documentation is the set of digital documents enabling recipients to execute all activities of the life cycle of a piece of OSH resulting from the original contribution of the authors. The documentation of a piece of OSH contains sufficient and necessary information for the recipients to understand and operate all these activities without requiring any external document that is not publicly available. Required information can be partly provided by a reference to a publicly available document as long as it provides no less information than originally required.

The Documentation of a piece of OSH bears references of:

1. its authors;
2. its licensing terms;
3. a functional description of the piece of OSH, e.g. what functions it is supposed to deliver, what is the problem it solves, for whom, etc.;
4. a mention of all applying Technology-specific Documentation Criteria;
5. all documents required by the mentioned Technology-specific Documentation Criteria;
6. a name or working title given to the Piece of Hardware;

A piece of hardware can only qualify as OSH if all the technologies it contains are covered by technology-specific documentation criteria.

In case a piece of hardware contains a technology that is not covered by any TsDC yet, documentation is to be created to the best knowledge of the authors.

NOTE Paper documents do not qualify as documentation. The first reason is that they are not editable and shareable in the same way as original digital documents (without further processing). Making modifications to paper documents requires reproducing the whole document. The second reason is that OSH is an internet phenomenon and only really make sense in this context.

5.2 Documentation release

A Documentation Release makes mention of:

1. a release date;
2. a release number unambiguously identifying a version of the documentation;
3. a version of the piece of OSH to which the documentation release applies.

5.3 Access

The Documentation is deemed as accessible when:

- it is published
  - in its original editable file format and,
  - in an export file format that
    - is of well-established use in the corresponding field of technology,
    - can be processed by software that is generally accessible to the recipients, and#
    - contains no less information than the original editable file format[1].
- the means of downloading it via the Internet is well-publicized[2] and neither involve any charge or any moderation potentially conflicting with the principles of non-discrimination against persons or groups and non-discrimination against fields of endeavour.
- the means of downloading it via the Internet is constantly active from the Release date and without interruption.

---

[1] Conversion from a file format to another (especially conversion from edition formats (e.g. docx) to export formats (e.g. pdf) is often bound to information losses. Converting a FreeCAD file into STEP is transforming a fully parametrized constraints- and feature-based model into a static network of points (mesh) and losing the ability to edit the shape that is represented by the model or the mesh.

[2] In this context, well-publicized means that, inter alia, patent offices worldwide will be able to find and retrieve the documentation via the internet.

5.4 Valid Technology-specific documentation criteria

Valid TsDCs:

- clearly refer to and extends DIN SPEC 31051 without superseding it;
- provide technology-specific requirements for all phases of the Life Cycle;
- are released under a free/open license;
- appear in the list of approved TsDC in Annex A.

6 Lifecycle of Piece of Hardware

The following activities are part of the Lifecycle[3]:

1. Realization, spanning from raw material extraction, production of semi-finished products, final assembly. Activities in this phase are aimed at establishing the functionality of the piece of *open source hardware* (3.3).
2. Operation and maintenance, including activities centered on delivering or maintaining the functionality of the piece of *open source hardware* (3.3)
3. End-of-life, including reuse, refurbishment, reconditioning, recycling, disposal. Activities in this phase are aimed at making the physical components or a subset of functions available for other *pieces of hardware* (3.1).

---

[3] *Documentation* (3.8) does not only facilitate hardware replication or "making". It also facilitates hardware operation, maintenance, repair, recycling, etc. This standard makes no difference between the relative importance of these activities and considers them as equal. Therefore, in this standard, the four rights of *open source hardware* (3.3) are not restricted to the sole hardware production phase and cover the whole hardware life cycle.

Annex A (informative) - Approved TsDC

The TsDC listed in table A.1 have been approved by the DIN SPEC 3105 consortium which created the present version of this standard. Unless otherwise specified, always the latest release of these TsDC apply.

Table A.1 — Approved TsDC

Title	issued by	Reference/Repository
Open Hardware Standards – TsDC	Open Source Ecology Germany e. V. (2020)	https://gitlab.com/OSEGermany/oh-tsdc

Bibliography

[1] J. Bonvoisin, T. Buchert, M. Preidel, and R. Stark, "How collaborative is open source hardware? Insights from repository mining," *Design Science Journal*, 2018.

[2] A. Powell, "Democratizing production through open source knowledge: from open software to open hardware," *Media, Culture & Society*, Aug. 2012.

[3] Redlich, T., & Moritz, M. (2016). Bottom-up Economics. Foundations of a Theory of Distributed and Open Value Creation. In The decentralized and networked future of value creation (pp. 27-57). Springer, Cham.

[4] J. Bonvoisin and R. Mies, "Measuring Openness in Open Source Hardware with the Open-o-Meter," *Procedia CIRP*, vol. 78, pp. 388–393, Jan. 2018.

[5] J. Bonvoisin, R. Mies, R. Stark, and J.-F. Boujut, "What is the 'Source' of Open Source Hardware?," *Journal of Open Hardware*, vol. 1, no. 1, p. 18, 2017.

[6] Open Source Hardware Association, "Open Source Hardware (OSHW) Statement of Principles 1.0," 2016. [Online]. Available: http://www.oshwa.org/definition/. [Accessed: 30-Jun-2019].

[7] Open Source Hardware Association, "Best Practices for Open-Source Hardware 1.0," 18-Apr-2013. [Online]. Available: http://www.oshwa.org/sharing-best-practices/. [Accessed: 30-Mar-2016].

[8] Open Source Initiative, "The Open Source Definition 1.9," 22-Mar-2007. [Online]. Available: https://opensource.org/osd-annotated. [Accessed: 30-Mar-2016].

[9] DIN SPEC 31052, *Open Source Hardware — Part 2: Community-based assessment*

[10] Creative Commons Corporation, "Attribution 4.0 International," 25-Nov-2013 [Online]. Available: https://creativecommons.org/licenses/by/4.0/ [Accessed: 31-Mar-2020]

[11] Creative Commons Corporation, "Attribution ShareAlike 4.0 International," 25-Nov-2013 [Online]. Available: https://creativecommons.org/licenses/by-sa/4.0/ [Accessed: 31-Mar-2020]

[12] GNU Project, “GNU General Public Liense – Version 3”, 29-Jun-2007 [Online]. Available: https://www.gnu.org/licenses/gpl-3.0.en.html [Accessed: 31-Mar-2020]

[13] CERN, “Open Hardware License Version 2”, 12-Mar-2020 [Online]. Available: https://kt.cern/ohlv2 [Accessed: 31-Mar-2020]

[14] Free Software Foundation, Inc., “The Free Software Definition,” 30-Jul-2019. [Online]. Available: https://www.gnu.org/philosophy/free-sw.en.html [Accessed: 21-Aug-2019].

[15] The Debian Project, “Free Software Guidelines version 1.1”, 26-Apr-2004 [Online]. Available: https://www.debian.org/ [Accessed: 31-Mar-2020]

[16] Freedom defined moderators, “Definition of Free cultural Works version 1.1”, 17-Feb-2015 [Online]. Available: https://freedomdefined.org/Definition [Accessed: 31-Mar-2020]

[17] Open Knowledge Foundation “The Open Definition version 2.1”, Nov-2015 [Online]. Available: https://opendefinition.org/ [Accessed: 31-Mar-2020]

[18] VDI 4500, *Technische Dokumentation*