

# Open DC Grid Project

2020 February

James Gula - [jlgula@papugh.com](mailto:jlgula@papugh.com)  
Martin Jäger - [martin@libre.solar](mailto:martin@libre.solar)

# Agenda

- ❖ Project Tour
- ❖ System Architecture
- ❖ 48V Bus Link – Initial Thoughts
- ❖ DC-DC Converter Implementation
- ❖ Open Issues / Feedback

# Web Site Project Page

<https://open-dc-grid.org>



[Project](#) [Standard](#) [Implementation](#)

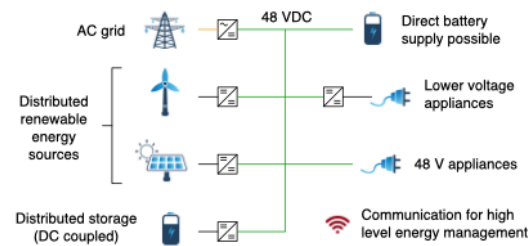
## Project

- [Subscribe](#)
- [How to Participate](#)
- [Meetings](#)
- [Team Members](#)
- [References](#)

## Open DC Grid

### TIP

The next project teleconference will be Tuesday, February 11 at 15:00 UTC. Details on our [meetings page](#). Also [subscribe](#) to our freshly launched newsletter.



## DC Microgrid

The Open DC Grid is a microgrid architecture to permit devices to exchange electric power using DC (direct current). The architecture is defined by the [Open DC Grid Standard](#), a document that can be freely accessed and used by anyone at no charge. The architecture defined by the standard permits devices to be connected using several kinds of link technology but the most commonly used link is an electrical bus operating at a nominal 48 V. The 48V bus

# Web Site Standard Page

<https://open-dc-grid.org/standard/>



Open DC Grid



Project

Standard

Implementation

## Standard

[Introduction](#)

[Overview: Scope, Purpose and Access](#)

[Normative References](#)

[Terms and Definitions](#)

[System Architecture](#)

[Grid Communications](#)

[48V Bus Link](#)

[Annex A: Wiring Recommendations](#)

[Annex B: Bibliography](#)

## Grid Standard

This standard is developed collaboratively in the GitHub repository [open-dc-grid/standard](#).

The website [open-dc-grid.org/standard](#) is only updated after each release. If you want to participate in the development, post [issues](#) or send [pull-requests](#) on GitHub.

It is planned to auto-generate PDF documents from the markdown source files in the future.

## License

All material provided in this document is licensed under the [Creative Commons Attribution-ShareAlike 4.0 International](#) license. Feel free to reuse, revise, remix and redistribute it.

Last Updated: 1/14/2020, 8:48:23 PM

# Web Site Implementation Page

<https://open-dc-grid.org/implementation/>



[Project](#) [Standard](#) [Implementation](#)

## Implementation

- [Devices and Appliances](#)
- [Grid Infrastructure](#)
- [Stability and Control](#)

## Grid Implementation

This implementation section describe ideas for actual implementation of devices for the grid and gives recommendations regarding wire thickness, etc. It is developed collaboratively in the GitHub repository [open-dc-grid/implementation](#).

The website [open-dc-grid.org/implementation](#) is only updated after each release. If you want to participate in the development, post [issues](#) or send [pull-requests](#) on GitHub.

It is planned to auto-generate PDF documents from the markdown source files in the future.

## License

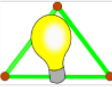
All material provided in this document is licensed under the [Creative Commons Attribution-ShareAlike 4.0 International](#) license. Feel free to reuse, revise, remix and redistribute it.

Last Updated: 1/14/2020, 8:56:04 PM

# GitHub Project Page

<https://github.com/open-dc-grid>

Search or jump to... Pull requests Issues Marketplace Explore

 **Open DC Grid**  
Project to create an open standard for sharing DC power.  
<https://open-dc-grid.org> [opendcgrid@gmail.com](mailto:opendcgrid@gmail.com)

Repositories 3 Packages People 2 Teams Projects 1 Settings


Find a repository... Type: All Language: All Customize pins [New](#)

**open-dc-grid.github.io**  
Content and build tools for the Open DC Grid web site  
Shell CC-BY-SA-4.0 0 stars 0 issues 0 forks Updated 3 hours ago

**standard**  
Content of the Open DC Grid standard (work in progress)  
CC-BY-SA-4.0 0 stars 0 issues 0 forks Updated 7 hours ago

**implementation**  
Implementation details and reference designs for the Open DC Grid standard (in progress).  
CC-BY-SA-4.0 1 star 0 issues 1 fork Updated 21 days ago

Top languages  
Shell

People 2 >  
  
Invite your teammates...  
[Invite](#)



# Repository "standard"

<https://github.com/open-dc-grid/standard>

The screenshot shows the GitHub interface for the repository `open-dc-grid / standard`. The repository is in the `master` branch and has 2 commits, 2 branches, 0 packages, 0 releases, 2 contributors, and a CC-BY-SA-4.0 license. The repository is currently in an "Early snapshot" state. The file list includes:

File Name	Commit Type	Time Ago
<code>images</code>	Initial commit	27 days ago
<code>0_introduction.md</code>	Early snapshot	8 hours ago
<code>1_scope_and_purpose.md</code>	Early snapshot	8 hours ago
<code>2_normative_references.md</code>	Early snapshot	8 hours ago
<code>3_terms_definitions.md</code>	Early snapshot	8 hours ago
<code>4_system_architecture.md</code>	Early snapshot	8 hours ago
<code>5_grid_communications.md</code>	Early snapshot	8 hours ago
<code>6_48V_bus.md</code>	Early snapshot	8 hours ago
<code>7_annex_wiring.md</code>	Early snapshot	8 hours ago
<code>8_annex_bibliography.md</code>	Early snapshot	8 hours ago
<code>LICENSE</code>	Initial commit	27 days ago
<code>README.md</code>	Initial commit	27 days ago

# Normative References Page

[https://github.com/open-dc-grid/standard/blob/master/2\\_normative\\_references.md](https://github.com/open-dc-grid/standard/blob/master/2_normative_references.md)

Search or jump to... Pull requests Issues Marketplace Explore

open-dc-grid / standard Watch 1 Star 0 Fork 0

Code Issues 0 Pull requests 0 Actions Projects 0 Wiki Security Insights Settings

Branch: master standard / 2\_normative\_references.md Find file Copy path

jigula Early snapshot 9e4e5fd 8 hours ago

2 contributors

16 Lines (12 sloc) 970 Bytes Raw Blame History

## Normative References

::: warning In Progress This chapter is incomplete - still being written/defined. :::

When practical, this standard attempts to harmonize with existing global standards. Some of those standards are only available from proprietary sources that require them to be purchased. This conflicts with the goal of this standard to provide free access to information. To resolve this conflict, this standard attempts to provide enough information for developers to create conforming products without requiring reference to proprietary standards. Nevertheless, in cases where this standard is not sufficiently clear, it may be useful to reference such a proprietary standard to which this standard is harmonized. The developers welcome feedback to further clarify this standard and minimize any dependencies on proprietary standards.

## Harmonized Standards

ISO/DIS 21780 - Road vehicles — Supply voltage of 48 V — Electrical requirements and tests.





# 2\_normative\_references.md

*Note: standard written in markdown*

```
2_normative_references.md •
1 # Normative References
2 ::: warning In Progress
3 This chapter is incomplete – still being written/defined.
4 :::
5
6
7 When practical, this standard attempts to harmonize with existing global standards.
8 Some of those standards are only available from proprietary sources that require them to be purchased.
9 This conflicts with the goal of this standard to provide free access to information.
10 To resolve this conflict, this standard attempts to provide enough information for developers to
11 create conforming products without requiring reference to proprietary standards.
12 Nevertheless, in cases where this standard is not sufficiently clear, it may be
13 useful to reference such a proprietary standard to which this standard is harmonized.
14 The developers welcome feedback to further clarify this standard and minimize any
15 dependencies on proprietary standards.
16
17 ## Harmonized Standards
18
19 ISO/DIS 21780 – Road vehicles – Supply voltage of 48 V – Electrical requirements and tests.
20
```

# Example of change to standard

- \* Create login on GitHub
- \* Fork repository standard
- \* Clone to your machine
- \* Create a new branch
- \* Make changes to local copy
- \* Push changes to your account
- \* Select "Create Pull Request"
  
- \* *Many GUI tools easier*

```
James-iMac:WS3 Jim$ git clone https://github.com/jlgula/standard.git
Cloning into 'standard'...
remote: Enumerating objects: 26, done.
remote: Counting objects: 100% (26/26), done.
remote: Compressing objects: 100% (23/23), done.
remote: Total 26 (delta 6), reused 20 (delta 1), pack-reused 0
Unpacking objects: 100% (26/26), done.
James-iMac:WS3 Jim$ cd standard
James-iMac:standard Jim$ git checkout -q -b new
James-iMac:standard Jim$ git push origin new
Total 0 (delta 0), reused 0 (delta 0)
remote:
remote: Create a pull request for 'new' on GitHub by visiting:
remote:   https://github.com/jlgula/standard/pull/new/new
remote:
To https://github.com/jlgula/standard.git
 * [new branch]      new -> new
James-iMac:standard Jim$ ed 2_normative_references.md
970
$a
Another reference.
.
w
989
q
James-iMac:standard Jim$ git add 2_normative_references.md
James-iMac:standard Jim$ git commit -m "Added new reference"
[new 9df1fa4] Added new reference
1 file changed, 1 insertion(+)
James-iMac:standard Jim$ git push origin new
Enumerating objects: 5, done.
Counting objects: 100% (5/5), done.
Delta compression using up to 8 threads
Compressing objects: 100% (3/3), done.
Writing objects: 100% (3/3), 303 bytes | 303.00 KiB/s, done.
Total 3 (delta 2), reused 0 (delta 0)
remote: Resolving deltas: 100% (2/2), completed with 2 local objects.
To https://github.com/jlgula/standard.git
 9e4e5fd..9df1fa4 new -> new
James-iMac:standard Jim$ █
```

# Publishing Tools and Admin

- \* Markdown files are the "source code" of the standard
  - \* Can be edited on any text editor
  - \* Many tools visualize markdown as formatted text eg. [Atom](#) editor
- \* Open DC Grid Standard published as web site and PDF
  - \* [VuePress](#) compiles the files to a web site
  - \* [Pandoc](#) compiles the files to a PDF
- \* A local version of the web site can be created with additional tools like yarn
- \* Revisions use semantic versioning like a.b.c
  - \* a revisions are incompatible changes
  - \* b revisions are compatible enhancements
  - \* c revisions are minor corrections
  - \* Everything prior to 1.0.0 subject to major changes
  - \* There may never be a 2.x.y

# System Architecture

*Note: just beginning definition*

- \* Microgrid is a wired network of devices
  - \* Single administrative control to manage energy flow
  - \* Can potentially operate independently from national AC grid
- \* Devices connected with wired links between ports
- \* Ports can source power, sink power or both
- \* Links can be many types such as:
  - \* 48V bus
  - \* USB-C
- \* Energy flows between devices at slow time scale (5 min?)
- \* Power flows across links with fast changes (ms)
  - \* Power management is a link concern
  - \* Links can be self-configuring with no administration required
- \* Microgrids can be hierarchical – no pico, nano etc
  - \* Potentially difference administrative policies at each level of hierarchy

# 48V Bus Link

*Note: just beginning definition*

- \* Managed version of P2030.10
- \* Arbitrary wiring topology
  - \* Peer-to-peer, star, spine and branch, tree etc
- \* Voltages harmonize with ISO 21780 (36V – 52V)
  - \* P2030.10 extension 52V – 58V OK
- \* No overall link current limit in standard – wiring issue
- \* Earthing TBD – possibly multiple isolated domains
- \* Over-current and over-voltage protection required (details TBD)
- \* Multiple forms of physical communications
  - \* CAN bus – hardwired
  - \* Power line networking (IEEE 1901.2?)
- \* Bus has single logical master for power control
  - \* Any node can potentially assume master role – 1<sup>st</sup> to join
  - \* Sources sample voltage and comm to request to join (bootstrap?)
  - \* Loads normally request before consuming power
  - \* Provision for static dumb load if administratively configured

# Next Meeting

## ❖ Next Meeting:

- 10 March 2020 – note moves to 1400 UTC
- [FreeConferenceCall.com](https://www.freeconferencecall.com) meeting ID: jlgula

## ❖ Sharing Portals

- ❖ Web site: <https://open-dc-grid.org/>
- ❖ GitHub: <https://github.com/open-dc-grid>