
MLT ISO SPI Board

Mark Wolf, mark.wolf@maleetronic.com

09-15-2016

The isolated SPI module is designed for applications, where SPI signals need to be transferred over longer distances than usually. It is based on Linear's LTC6820. The board is designed as two layer stack-up, with GND plane on the bottom layer and signal traces and components at the top layer. Signals and power are supplied over standard 100mil (2.54mm) pitch IDC header.

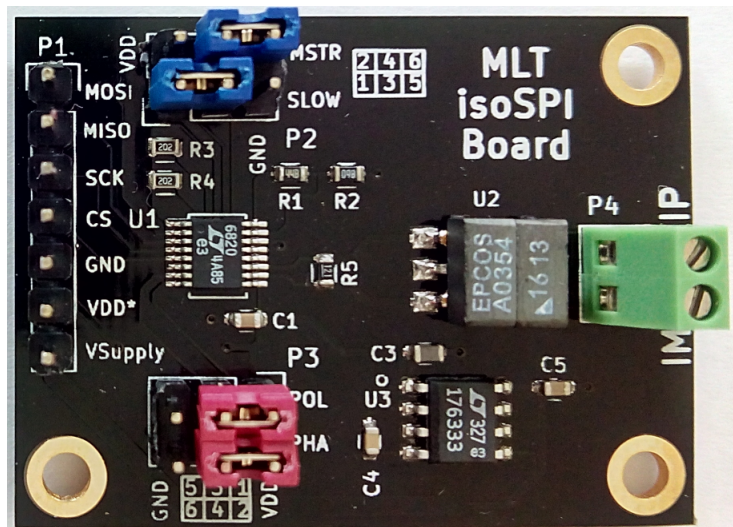


Figure 1: *photo of the board*

License

This board is licensed under the open hardware license CERN OHL v1.2. All documentation are available at www.maleetronic.com for download.

The License is attached at the end of this document as we as a Guide to the CERN OHL v.1.2.

Please feel free to give your highly appreciated feedback, comments and suggestions. Or ask any questions about the product. We'll be glad to answer or help you.

Specification

- Dimension: 40.005 mm x 30.099 mm (1.575" x 1.185")
- 1 Mbps Isolated SPI Data Communication at 10m
- 500 kbps Isolated SPI Data Communication at 100m
- Galvanic Isolation Barrier using standard transformer (1500V)
- Requires no software changes in most SPI systems
- 3.5V to 15V power supply
- SPI mode can be adjust via on-board jumpers
- can act as Master or Slave (adjustable via jumper)
- screw terminal for twisted pair cable (i.e. as in CAT5 Ethernet cable)

For more details and description , please read the data sheet of the LTC 6820. Below is an possible application scenario of the module.

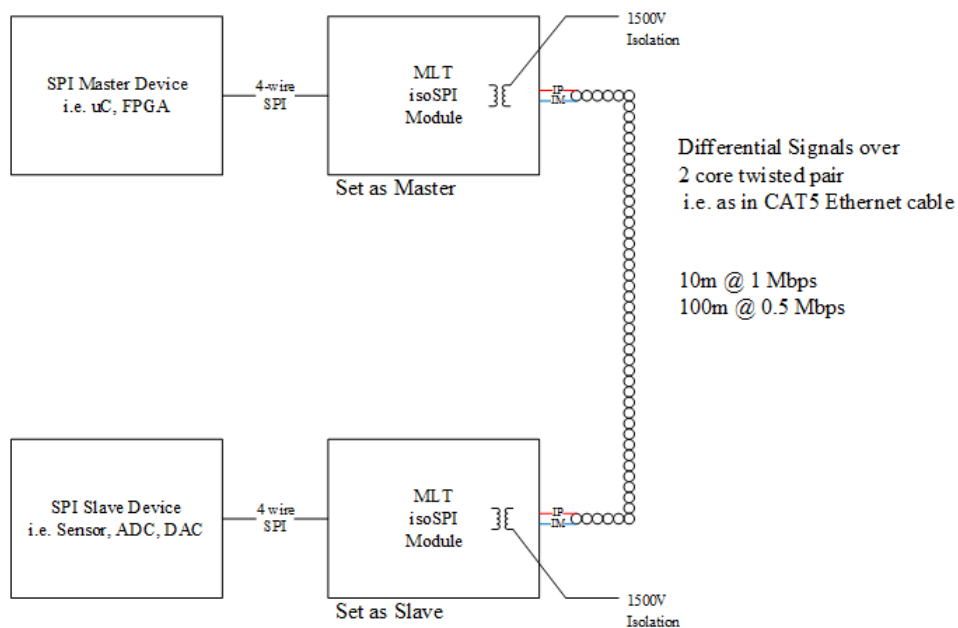


Figure 2: *Application*

Jumper Settings & Pin header

Pin Header P1

P1 is the pin header for the SPI signals and power supply. It has an standard pitch of 100 mils (2.45 mm).

Table 1: *Pin Header P1*

PIN	SIGNAL	FUNCTION
1	MOSI	SPI Signals
1	MISO	SPI Signals
1	SCK	SPI Signals
1	CS	SPI Signals
1	GND	
1	VDD	Digital Supply Voltage (Output U3)
1	VS	Supply Voltage (Input U3)

You can supply about 3.5V to 15V to the board. The on-board LDO LTC1763 will generate 3.3V for supply the LTC 6820. For more details, see the specification for the LTC 1763.

In case you need different voltage levels for the SPI signals, you can supply 2.7V to 5.5V to the board via VDD pin(P1[6]). In this case you should remove U3 (LTC1763). It is also possible to use any other pin compatible power supply with 8-SOIC footprint or ones from the same family. See the data sheet for the LTC1763 for more details.

It is also possible to use the board with two different SPI signal levels(level shifting).

Jumper P2, Master & clock speed

With P2 you adjust the clock frequency and the Master/Slave mode.

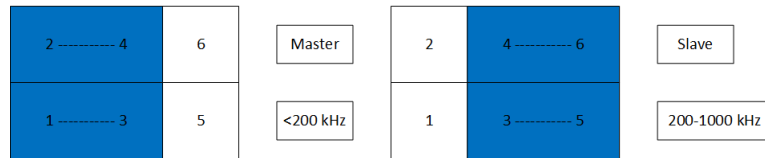


Figure 3: *Jumper Settings Master, Slow*

SLOW pin

For clock speeds below 200 kHz, the jumper must be in position 1-3(VDD). For clock frequencies 200-1000 kHz, the jumper must be in position 3-5(GND).

Table 2: *Jumper P2, SLOW pin*

POSITION	VOLTAGE LEVEL	CLOCK FREQUENCY
1-3	VDD	<200 kHz
3-5	GND	200-1000 kHz

MSTR pin

For using this board as SPI Master, the jumper must be in position 2-4 (VDD). For using this board as SPI Slave, the jumper must be in position 4-6 (GND). The default position is 4-6 (Slave).

Table 3: *Jumper P2, MSTR pin*

POSITION	VOLTAGE LEVEL	FUNCTION
2-4	VDD	Master
4-6	GND	Slave

Jumper P3, SPI MODE

With P3 you adjust the SPI mode. Phase and Polarity.

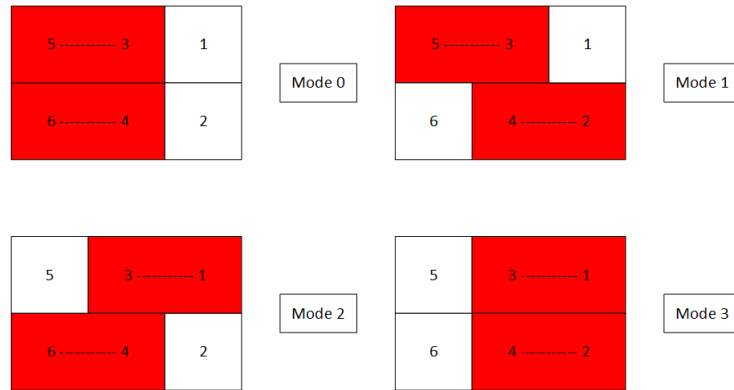


Figure 4: Jumper Settings SPI Mode

Table 4: Jumper P3, SPI mode

MODE	POL	PHA	POSITION	DESCRIPTION
0	0	0	5-3, 6-4	SCK Idles Low, Latches on Rising Edge
1	0	1	5-3, 4-2	SCK Idles Low, Latches on Falling Edge
2	1	0	3-1, 6-4	SCK Idles High, Latches on Rising Edge
3	1	1	3-1, 4-2	SCK Idles High, Latches on Falling Edge

Screw Terminal P4

The screw terminal P4 is the connector for the twisted pair cable. The differential signal pulses are transferred or received over this connector on IP and IM.

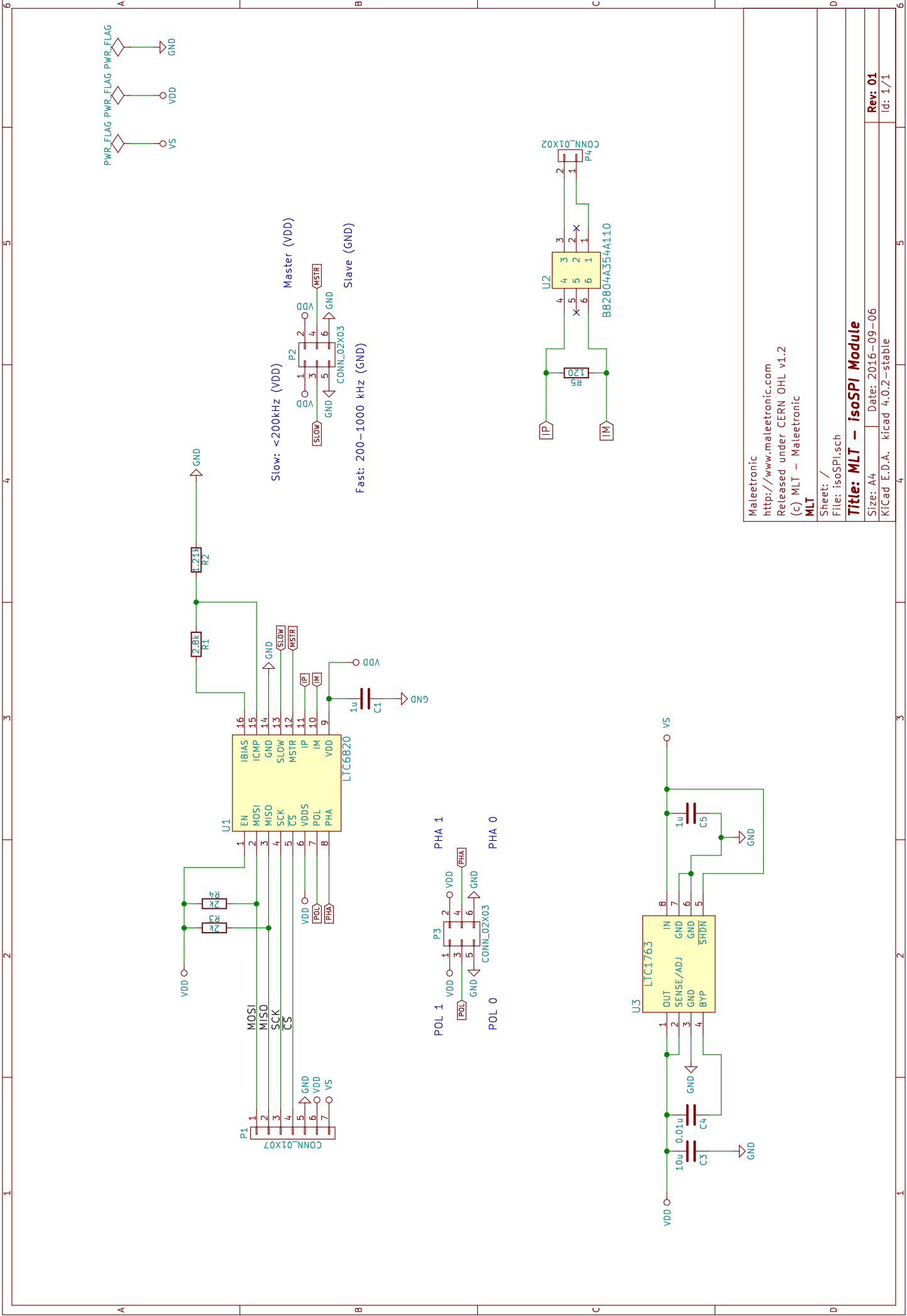
Connect IP with IP and IM with IM respectively.

Bias Resistors R1, R2

The bias resistors are selected for a good compromise between power consumption and noise immunity. Ib is set to 0.5mA, which is good for most application and allow for 50m cable length with a normal CAT5 twisted pair. If you need/want to change these resistors, read the data sheet the section "Application Information" for more details how to calculate these resistors.

Attachments

1. Board Schematics
2. CERN OHL v1.2
3. CERN OHL v1.2 How-to-Guide



CERN Open Hardware Licence v1.2

Preamble

Through this CERN Open Hardware Licence ("CERN OHL") version 1.2, CERN wishes to provide a tool to foster collaboration and sharing among hardware designers.

The CERN OHL is copyright CERN. Anyone is welcome to use the CERN OHL, in unmodified form only, for the distribution of their own Open Hardware designs. Any other right is reserved. Release of hardware designs under the CERN OHL does not constitute an endorsement of the licensor or its designs nor does it imply any involvement by CERN in the development of such designs.

1 Definitions

In this Licence, the following terms have the following meanings:

"Licence" means this CERN OHL.

"Documentation" means schematic diagrams, designs, circuit or circuit board layouts, mechanical drawings, flow charts and descriptive text, and other explanatory material that is explicitly stated as being made available under the conditions of this Licence. The Documentation may be in any medium, including but not limited to computer files and representations on paper, film, or any other media.

"Documentation Location" means a location where the Licensor has placed Documentation, and which he believes will be publicly accessible for at least three years from the first communication to the public or distribution of Documentation.

"Product" means either an entire, or any part of a, device built using the Documentation or the modified Documentation.

"Licensee" means any natural or legal person exercising rights under this Licence.

"Licensor" means any natural or legal person that creates or modifies Documentation and subsequently communicates to the public and/ or distributes the resulting Documentation under the terms and conditions of this Licence.

A Licensee may at the same time be a Licensor, and vice versa.

Use of the masculine gender includes the feminine and neuter genders and is employed solely to facilitate reading.

2 *Applicability*

- 2.1 This Licence governs the use, copying, modification, communication to the public and distribution of the Documentation, and the manufacture and distribution of Products. By exercising any right granted under this Licence, the Licensee irrevocably accepts these terms and conditions.
- 2.2 This Licence is granted by the Licensor directly to the Licensee, and shall apply worldwide and without limitation in time. The Licensee may assign his licence rights or grant sub-licences.
- 2.3 This Licence does not extend to software, firmware, or code loaded into programmable devices which may be used in conjunction with the Documentation, the modified Documentation or with Products, unless such software, firmware, or code is explicitly expressed to be subject to this Licence. The use of such software, firmware, or code is otherwise subject to the applicable licence terms and conditions.

3 *Copying, modification, communication to the public and distribution of the Documentation*

- 3.1 The Licensee shall keep intact all copyright and trademarks notices, all notices referring to Documentation Location, and all notices that refer to this Licence and to the disclaimer of warranties that are included in the Documentation. He shall include a copy thereof in every copy of the Documentation or, as the case may be, modified Documentation, that he communicates to the public or distributes.
- 3.2 The Licensee may copy, communicate to the public and distribute verbatim copies of the Documentation, in any medium, subject to the requirements specified in section 3.1.
- 3.3 The Licensee may modify the Documentation or any portion thereof provided that upon modification of the Documentation, the Licensee shall make the modified Documentation available from a Documentation Location such that it can be easily located by an original Licensor once the Licensee communicates to the public or distributes the modified Documentation under section 3.4, and, where required by section 4.1, by a recipient of a Product. However, the Licensor shall not assert his rights under the foregoing proviso unless or until a Product is distributed.
- 3.4 The Licensee may communicate to the public and distribute the modified Documentation (thereby in addition to being a Licensee also becoming a Licensor), always provided that he shall:
 - a) comply with section 3.1;

- b) cause the modified Documentation to carry prominent notices stating that the Licensee has modified the Documentation, with the date and description of the modifications;
- c) cause the modified Documentation to carry a new Documentation Location notice if the original Documentation provided for one;
- d) make available the modified Documentation at the same level of abstraction as that of the Documentation, in the preferred format for making modifications to it (e.g. the native format of the CAD tool as applicable), and in the event that format is proprietary, in a format viewable with a tool licensed under an OSI-approved license if the proprietary tool can create it; and
- e) license the modified Documentation under the terms and conditions of this Licence or, where applicable, a later version of this Licence as may be issued by CERN.

3.5 The Licence includes a non-exclusive licence to those patents or registered designs that are held by, under the control of, or sub-licensable by the Licensor, to the extent necessary to make use of the rights granted under this Licence. The scope of this section 3.5 shall be strictly limited to the parts of the Documentation or modified Documentation created by the Licensor.

4 *Manufacture and distribution of Products*

- 4.1 The Licensee may manufacture or distribute Products always provided that, where such manufacture or distribution requires a licence under this Licence the Licensee provides to each recipient of such Products an easy means of accessing a copy of the Documentation or modified Documentation, as applicable, as set out in section 3.
- 4.2 The Licensee is invited to inform any Licensor who has indicated his wish to receive this information about the type, quantity and dates of production of Products the Licensee has (had) manufactured

5 *Warranty and liability*

- 5.1 DISCLAIMER - The Documentation and any modified Documentation are provided "as is" and any express or implied warranties, including, but not limited to, implied warranties of merchantability, of satisfactory quality, non-infringement of third party rights, and fitness for a particular purpose or use are disclaimed in respect of the Documentation, the modified Documentation or any Product. The Licensor makes no representation that the Documentation, modified Documentation, or any Product, does or will not infringe any patent, copyright, trade secret or other proprietary right. The entire risk as to the use, quality, and performance of a Product shall be with the Licensee and not the Licensor. This disclaimer of warranty is an

essential part of this Licence and a condition for the grant of any rights granted under this Licence. The Licensee warrants that it does not act in a consumer capacity.

- 5.2 LIMITATION OF LIABILITY - The Licensor shall have no liability for direct, indirect, special, incidental, consequential, exemplary, punitive or other damages of any character including, without limitation, procurement of substitute goods or services, loss of use, data or profits, or business interruption, however caused and on any theory of contract, warranty, tort (including negligence), product liability or otherwise, arising in any way in relation to the Documentation, modified Documentation and/or the use, manufacture or distribution of a Product, even if advised of the possibility of such damages, and the Licensee shall hold the Licensor(s) free and harmless from any liability, costs, damages, fees and expenses, including claims by third parties, in relation to such use.

6 General

- 6.1 Except for the rights explicitly granted hereunder, this Licence does not imply or represent any transfer or assignment of intellectual property rights to the Licensee.
- 6.2 The Licensee shall not use or make reference to any of the names (including acronyms and abbreviations), images, or logos under which the Licensor is known, save in so far as required to comply with section 3. Any such permitted use or reference shall be factual and shall in no event suggest any kind of endorsement by the Licensor or its personnel of the modified Documentation or any Product, or any kind of implication by the Licensor or its personnel in the preparation of the modified Documentation or Product.
- 6.3 CERN may publish updated versions of this Licence which retain the same general provisions as this version, but differ in detail so far this is required and reasonable. New versions will be published with a unique version number.
- 6.4 This Licence shall terminate with immediate effect, upon written notice and without involvement of a court if the Licensee fails to comply with any of its terms and conditions, or if the Licensee initiates legal action against Licensor in relation to this Licence. Section 5 shall continue to apply.

Guide to the CERN OHL v.1.2

This document contains guidelines on how to apply the CERN OHL v.1.2 to a given hardware design, and on the use of hardware designs licensed under the CERN OHL v.1.2.

How to apply the CERN OHL v.1.2 to a hardware design

Pre-requisite:

Authorship/ownership of the design must be clear and undisputed. Only the legal owner of the rights in the hardware design may decide under what conditions to make it available. If ownership is vested in more than one person/entity, there must be an agreement among the owners to release the hardware design as open hardware, and under the CERN OHL in particular.

The hardware design documentation and files package

Pack all your hardware design documentation files (schematics, layout...) as well as the documents listed below in an archive file. This will ensure the licensee downloads everything in one go. It is best to archive the files using a format everybody can open. Schematics and layouts should be included in both source form and a format readable by everybody, such as pdf.

The following documents must be distributed together with the hardware design documentation:

- Document containing the CERN OHL v.1.2 (e.g. LICENSE.PDF)
- This Guide
- Text files (plain ASCII file), where information can be added to but not removed from, listing:
 - o Contact point wishing to receive information about manufactured Products (see section 4.2) (e.g. PRODUCT.TXT);
 - o Modifications made by Licensee (see section 3.4.b) (e.g. CHANGES.TXT)

What to do with the hardware design documentation

Include in the hardware design documentation, for instance as a header, the following elements (see section 3.1 CERN OHL v.1.2):

- a copyright notice reflecting actual ownership;
- a notice that the hardware design documentation is licensed under the CERN OHL v.1.2, possibly with a link to <http://ohwr.org/cernohl> where the licence texts are hosted:
 - o “Licensed under CERN OHL v.1.2 or later”
 - o “Licensed under CERN OHL v.1.2”;
- a disclaimer of warranties;
- a Documentation Location if you wish to specify one;

The following is an example of header if CERN is the Licensor:

Copyright CERN 2013.

This documentation describes Open Hardware and is licensed under the CERN OHL v. 1.2.

You may redistribute and modify this documentation under the terms of the CERN OHL v.1.2. (<http://ohwr.org/cernohl>). This documentation is distributed WITHOUT ANY EXPRESS OR IMPLIED WARRANTY, INCLUDING OF MERCHANTABILITY, SATISFACTORY QUALITY AND FITNESS FOR A PARTICULAR PURPOSE. Please see the CERN OHL v.1.2 for applicable conditions

Include in a part of the Documentation corresponding to a visible part of the Product (e.g. silkscreen or top copper for a Printed Circuit Board):

- the licence notice: “Licensed under CERN OHL v.1.2”
 - o Do **not** include the CERN logo or the copyright notice
- the Documentation Location if you wish it to appear on the Product, thus enabling all subsequent recipients of the Products to find the Documentation.

How to deal with hardware designs licensed under the CERN OHL v.1.2

Generally speaking, you must always comply with any obligations applying to a particular design (detailed in a contract or accompanying licence). If you receive hardware designs licensed under the CERN OHL v.1.2, the obligations are to:

- Keep intact all the copyright and trademark notices and Documentation Location notices that are on the hardware design documentation;
- Keep intact the references to the CERN OHL v.1.2;
- Keep intact the disclaimer of warranties.

If you modify hardware design that you received from someone else that is licensed under the CERN OHL v.1.2, you must

- Keep intact all the notices referred to above;
- Include notices that you have modified the hardware designs, detailing what modifications were made (e.g. in a CHANGES.TXT file);
- Add the appropriate copyright notice and Documentation Location to the modifications that were made;
- license the modifications under the CERN OHL v.1.2 if you distribute them.