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Hardware & Firmware Development

OBJECTIVES

- check of pinouts of all components
- check of footprints of all components
- check of part numbers of all components
- functional assessment according to the schematics
- PCB layout review
- manufacturability check and tips on how to improve it



PREAMBLE

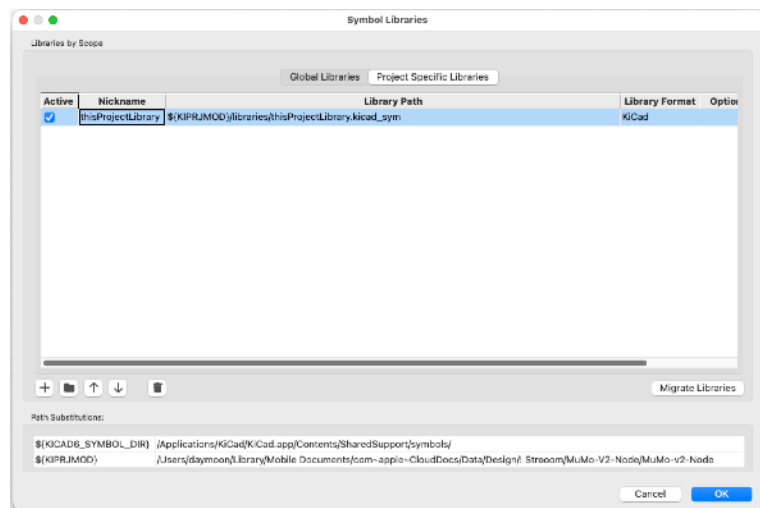
-  means a severe finding
-  implies a recommendation or a tip or a mild important finding
-  represents a correct point


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PROJECT SPECIFIC LIBRARIES










-  General recommendation for the project libraries (symbol and footprint) placement is inside the project folder.
-  The reason is that for the folders inside the project folder, KiCAD can use Path substitution strings:








-  For folders outside of the KiCAD project folder, Path substitution strings cannot be used, and the paths to both symbol and footprint libraries are not valid (+ this way, KiCAD disclose details of your computer, which is not wanted)



























CORRECT PIN-OUT ON COMPONENTS

-  U1 pinout is correct.
-  J1 pinout is correct.
-  U3 pinout is correct.
-  D4 pinout is correct.
-  U2 pinout is correct.
-  U5 pinout is correct.
-  U6 pinout is correct.
-  U7 pinout is correct.
-  Q1 pinout is correct.













CORRECT COMPONENT PACKAGE SPECIFICATION

















-  U1 footprint is correct.
-  C1 footprint is correct.
-  C2 footprint is correct.
-  R1 footprint is correct.
-  CONN2 footprint is correct.

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-  R2 footprint is correct.
 -  R3 footprint is correct.
 -  R4 footprint is correct.
 -  R5 footprint is correct.
 -  R7 footprint is correct.
 -  C3 footprint is correct.
 -  C4 footprint is correct.
 -  C5 footprint is correct.
 -  C6 footprint is correct.
 -  R2 footprint is correct.
 -  D4 footprint is correct.
 -  U2 footprint is correct.
 -  R6 footprint is correct.
 -  CONN6 footprint is correct.
 -  CONN5 footprint is correct.
 -  Reset+Boot buttons footprint is correct.
 -  C16-C21, and C22-C27 footprint is correct.
 -  R10-R12 footprint is correct.
 -  U5 footprint is correct.

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-  U6 footprint is correct.
 -  U7 footprint is correct.
 -  D1-D3 footprint is correct.
 -  Q1 footprint is correct.
 -  L1 footprint is correct.

PART NUMBERS

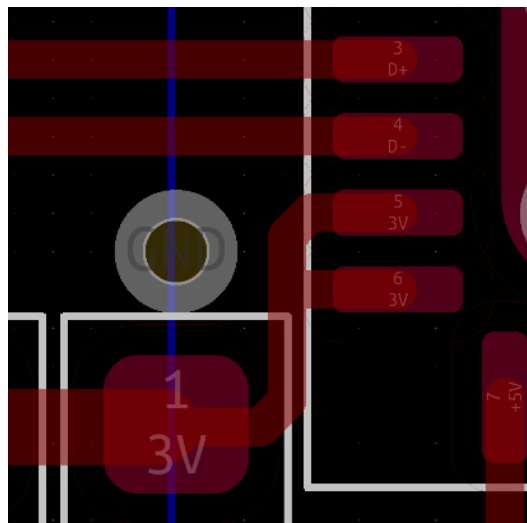
-  U1 part number is correct.
-  C1 part number is correct.
-  C2 part number is correct.
-  R1 part number is correct.
-  CONN2 part number is correct.
-  J1 Value field is wrong — it still refers to the GCT part.
-  J1 part number is correct.
-  U3 part number is correct.
-  C3 part number is correct.
-  C4 part number is correct.
-  C5 part number is correct.
-  C6 part number is correct.

-
-  R2 part number is correct.
 -  D4 part number is correct.
 -  U2 part number is correct.
 -  R6 part number is correct.
 -  CONN6 part number is correct.
 -  CONN5 part number is correct, but the part was designed to be used on 1.6 mm PCB. The PCB layout is placed on a 1.0-1.1 mm PCB.
 -  Reset+Boot buttons part number is correct.
 -  CONN3 part number is correct
 -  C16-C21 and C22-C27 part number are correct.
 -  R10-R12 part number is correct.
 -  U5 part number is correct.
 -  U6 part number is correct.
 -  U7 part number is correct.
 -  D1-D3 part number is correct.
 -  Q1 part number is correct.
 -  L1 part number is correct.

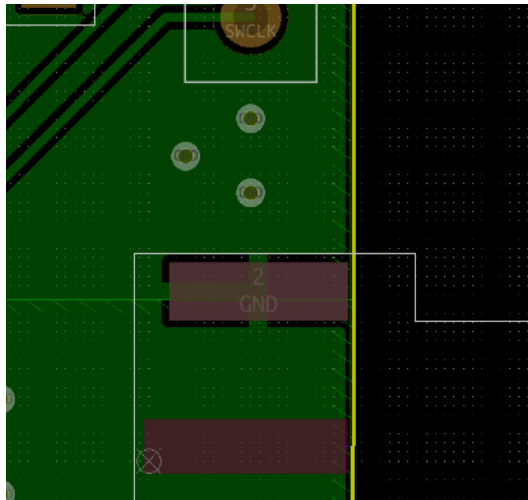
PCB LAYOUT REVIEW

-  U5 is placed on the bottom side for an unknown reason.

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- ● U6 is placed on the bottom side for an unknown reason.
 - ● The D+/D- differential pair is not impedance-controlled. The recommendation is a minimal clearance of 0.127 mm (at JLCPCB without a negative price impact). The trace width is about 0.8 mm. The pair is short, so this can be omitted.
 - ● The CONN5 edge SMA was designed to be used on 1.6 mm PCBs. The used PCB layout is designed on a 1.0-1.1 mm thick board.
 - ● PCB constraints corrected set for most of the low-cost PCB manufacturers.
 - ● It is recommended to lay out routes from U3.5 and U3.6 the following way:



- ● Missing stitching VIAs between the top and bottom ground planes. An example is in the following picture:








- ● The overall PCB routing quality is very good.

MANUFACTURABILITY CHECK

- ● No manufacturability issues were found, but the SMA connector was.

GENERAL RECOMMENDATIONS

- ● To synchronise references of connectors - CONNx vs J1.
- ● Reference R6 is missing. This is not an issue but can be corrected to a better form of the schematic.
- ● Signal RST from CP2102 is not connected. A recommendation is to connect it through a jumper or OR resistor with the /RESET signal.
- ● Signal \RESET uses a backslash sign instead of a normal slash sign.
- ● To remove a blank wire from CONN1.1.
- ● The RFIO of U2 is missing the impedance-matching network. It can be (and usually is) replaced with a 0R resistor, but the full form is a PI-cell of CLC components. The recommendation is to keep the impedance-matching network in its full form to enable the end user to change the impedance.

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-  R9 value of 10k is too low for its purpose. This value will cause unwanted power consumption. The manufacturer's recommendation is a value of 1MΩ.
 -  L1+R2 values are different from the manufacturer's recommendation values, <https://od.lk/f/NDVfMjgyMzg1NjRf>
 -  CONN3 symbol was modified from the Generic connector symbol but is not present in the project-specific symbol library.
 -  BME680 symbol was modified from the original symbol but is not present in the project-specific symbol library.
 -  TSL2591 symbol was modified from the original symbol but is not present in the project-specific symbol library.

USED LITERATURE

- e-ink display datasheet <https://od.lk/f/NDVfMjgyMzg1NjRf>

CONCLUSION

All issues and findings are marked with 

All tips and recommendations are marked with 

DISCLAIMER

I always do my absolute best to review the design from all points of view while considering all aspects of a perfect design. Besides all these facts, I happen to be human, so that I can miss a detail in the complex design.

 The HW review results do not create any security of a 100% flawless design.