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Research Article

THE DESIGN OF PRINTED BOARD DRAWINGS

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ABSTRACT

This article discusses the design of printed circuit board drawings. PCB drawings are made using a coordinate grid, which has its own dimensions. These dimensions further determine the dimensions of the structures.

KEYWORDS

Standard, printed circuit board, layer drawing, coordinate system, coordinate grid, printed elements, conductors, pitch.

INTRODUCTION

The printed circuit board is a specific part and is made in accordance with the requirements of GOST 2 417-91 and OST 4.0.10.019-81. The drawing of single-sided and double-sided printed circuit boards is called "Printed circuit board", it is assigned a class in accordance with the classifier. A drawing of a multilayer printed circuit board is called a "Multilayer printed circuit board", an assembly drawing [1-7]. A drawing of a layer of a multilayer printed circuit board with a conductive pattern located on one or both sides is called a "Layer of a multilayer printed circuit board". Sometimes they make an additional projection of the printed circuit board without conductors, on which they put down

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dimensions for machining the printed circuit board, marking, etc. [8-13].

MATERIALS AND METHODS

PCB drawings are made in scales 1:1, 2:1, 4:1; 5:1,10:1. However, if the grid spacing is 1.25 mm, then a scale of at least 4:1 is used. The drawing shows the main projections. With printed conductors and holes, it is allowed to provide additional views with a partial image of the pattern. The drawing of a layer of a multilayer printed circuit board should be shown on a separate sheet. On the layer drawing dimensions are recommended [14-20].

On the drawing of the printed circuit board, a coordinate grid is applied with thin solid lines 0.2 ... 0.5 mm thick. The lines of the coordinate grid relative to zero are numbered in one or more steps (but not more than five) with numbers. It is allowed to put line numbers on four sides of the board drawing in accordance with GOST 2.303 - 68.

On the printed circuit board drawing, the dimensions must be indicated in one of the following ways (in accordance with the requirements of GOST 2.303-68):

- Drawing a coordinate grid in a rectangular coordinate system (grid lines are numbered);
- Drawing a coordinate grid in the polar coordinate system;
- Combined method using dimension and extension lines and a coordinate grid in a rectangular or polar coordinate system.

GOST 10317-79 *: main pitch 2.50 mm, additional - 1.25 or 0.5 mm.

For zero in a rectangular coordinate system on the main view of the printed circuit board should be taken:

- The center of the leftmost bottom hole located on the board field (including the technological one);
- Lower left corner of the printed circuit board;
- The lower left point formed by the construction lines,

In the drawing of round printed circuit boards, it is allowed to take the center of the printed circuit board as zero in a rectangular coordinate system. If the dimensions and configuration of the printed circuit board drawing are specified in the technical requirements of the drawing, then it is allowed to depict the elements of printed circuit boards conditionally [19-23].

With an automated and semi-automated method of performing documentation, deviations from the scale along one or both axes are allowed. The degree of deviation from the scale is determined by the design of the playback devices.

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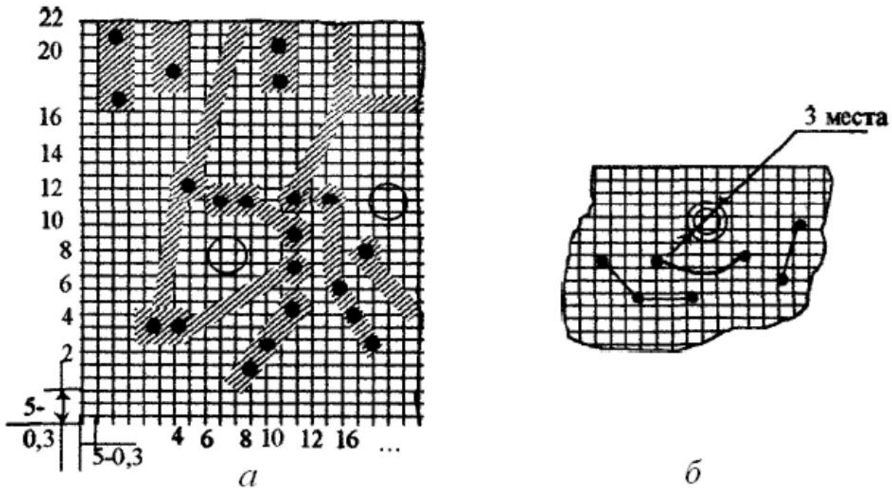

Fig.1. An example of sizing a pad.

If necessary, indicate the boundaries of the sections of the board that are not allowed to be occupied by conductors, a dash-dotted thickened line should be used in the drawing [24-31].

The conductors in the drawing should be depicted as a single line, which is the axis of symmetry of the conductor, while the numerical value of the width of the conductor should be indicated on the drawing. Conductors with a width of more than 2.5 mm can be represented by two lines, while if they coincide with the lines of the coordinate grid, the numerical value of the width is not indicated.

To set the dimensions of the contact pad for multi-pin elements, the contact group is isolated on the board or placed on the drawing field (Fig. 1 a, b). Holes, the distances between which are multiples of the coordinate grid step, are located at its nodes, the rest according to the installation dimensions [32-39]. A callout is used to make the drawing easier to read. Printed elements (conductors, screens, contact pads, etc.) are supposed to be hatched (Fig. 1 a, b). With a conductor width in the drawing of less than 2 mm (and sometimes more, if the actual width is indicated in the technical requirements), they are depicted as a solid contour line. If the conductor has a variable width along its length, then it is indicated on each section. If a conductor with a variable width passes from one layer to another, then its dimensions are indicated on the image of these layers as well.

There are many PCB design software solutions available. The software you use should be able to draw both schematics and printed circuit boards. Below I've compiled a list of three free cross-platform programs available for Linux, Windows and Mac OS. I have copied their own description of themselves from each of their websites. Just to give you an idea of what they are about (or at least how they like to present themselves).

"KiCad is an open source software suite for electronic design automation (EDA) made for designing schematics of electronic circuits and printed circuit boards (PCB). KiCad is developed by the KiCad Developers Team, and features an integrated environment with schematic capture, bill of materials list, PCB layout and much more.

Compared to the other free software alternatives, KiCad solves all stages with the same interface: Schematic Capture, PCB layout, Gerber generation/visualization and library editing [38-41].

KiCad is cross-platform, written with WxWidgets and runs on FreeBSD, Linux, Microsoft Windows and Mac OS X. A lot of component libraries are available. Also

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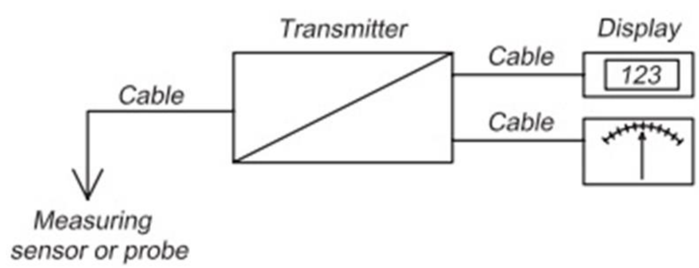
migrating tools for components are available (from other EDA software tools). The construction of measuring instruments depends on the measuring principles used and the signal transfer. One classification is mechanical, hydraulic, pneumatic, electrical and electronic, where the last is being increasingly used.

In some instruments the three major parts are connected within the same unit, while in other instruments the parts are separate and connected via cables for electric signals or another principle for transfer of the measured values. Measuring equipment can either give continuous signals (analogues), or on/off signals (digital). An example of the first case is an oxygen meter that shows the concentration of oxygen. Flow indicators that register if there is water flow or not (on/off) are an example of the latter case [42-49].

The sensor in the unit is used to record the physical conditions in the medium, such as the probe in an oxygen meter. The transmitter can either be electrical or mechanical and translates the signal coming from the sensor to a scaled signal that as is further transported to the display or indicator where the results are shown in an understandable way. In the display the physical conditions of the medium are shown. Signals may also go directly to a recording unit such as a computer for storing the results, or can be used to control a regulator.



Equipment for measuring and recording of various parameters is more and more commonly used in aquaculture, especially in intensive aquaculture. Such equipment controls and adjusts the environ-mental conditions to obtain optimal production results. Until now several of the measurements have been taken manually, which is normally more time consuming and labor intensive, and therefore results in fewer measurements. During the past few years, there has been rapid development in the automation of instruments and monitoring systems that can also be used in the aquaculture industry, mainly based on developments in electronics and computer science [50-55]. Therefore many of the trivial manual measurements are now carried out by specially designed instruments, releasing manpower for more important intellectual tasks and to improve the production results, especially in intensive aquaculture.

One reason for using instruments is to automate the management of fish farming as much as possible. For example, video cameras and image analysis can be used to monitor fish and give alarm signals if odd behavior is observed. The biological processes underlying fish production are, however, both complex and difficult, unlike the production of nails. Even with today's knowledge, it is only a dream to believe that it is possible to fully replace the fish farmer with instruments and robots.

When buying and installing instruments, the requirements for maintenance and calibration, adjusted for special circumstances must be taken into account. The values read from the measuring equipment must be reliable; otherwise the result can be more damaging than if no measuring equipment were used at all. This implies that maintenance and

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running costs must be included in the price of an instrument, not just the purchase cost. Extra effort must be given to maintenance of instruments used to monitor water quality. This also includes frequent calibration according to the manufacturer's instructions so that the values shown are reliable. Depending on the type of instrument, the sensors may have a limited duration, so must be exchanged at fixed intervals.

CONCLUSION

Measurement of biological performance has also increased during the past few years as a result of the increased focus on profitability in intensive fish farming. By automatically measuring development in terms of weight and total fish biomass, it is possible to control the development and intervene if something does not correspond to the production plans.

Due to the large expense involved and the amount of technical equipment that can fail, it is increasingly common to have a total monitoring system on the farm, which also includes a significant use of computer tools. On land-based farms using pumps for the water supply or in farms with re-use of water such systems are essential.

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