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Печатные платы со встроенными компонентами

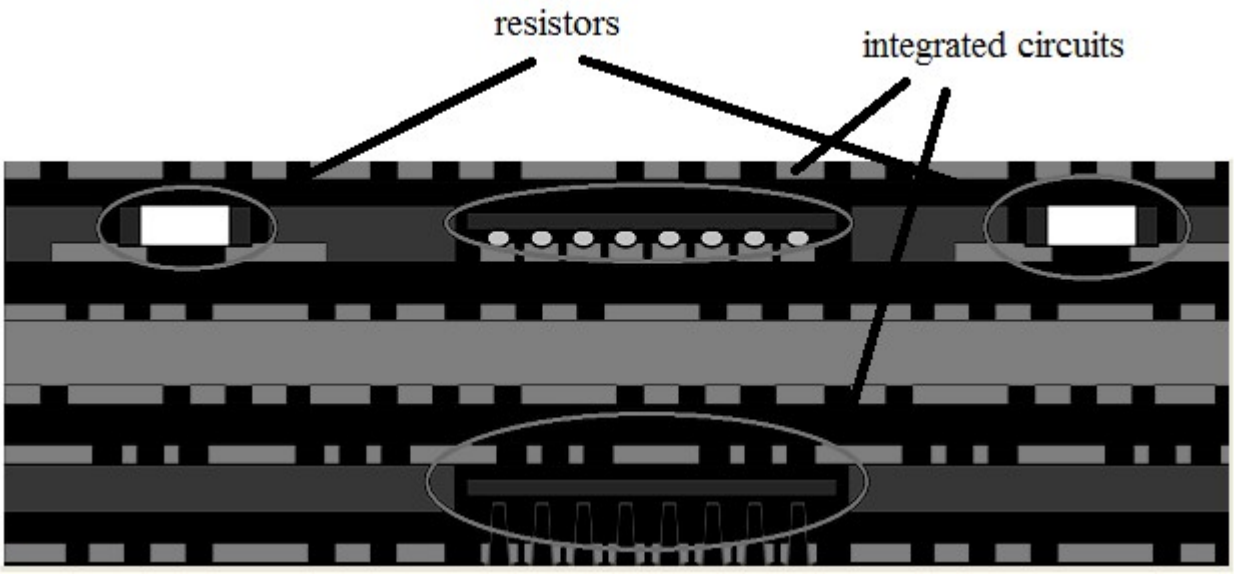
В данной статье описывается одно из современных направлений проектирования и производства плат со встроенными компонентами. Данная технология позволяет размещать чип-компоненты на внутренних слоях платы. Такая технология позволяет увеличить плотность монтажа и расширяет функциональное предназначение устройства.

В настоящее время технология изготовления печатей со встроенными компонентами широко развивается в Юго-Восточной Азии, в таких странах, как Япония и Китай. В России технология только начала развиваться, но уже имеются опытные образцы.

Эта статья описывает общие понятия о технологии изготовления плат со встроенными компонентами и основные ее преимущества.

Printed circuit boards with built-in components

Due to the decrease in the dimension and mass characteristics the major problem is how to minimize connection nets between the elements. We connect different function elements and this helps us to increase the mounting density. To solve this problem, manufactures are trying to produce crystals with specific functions for the circuits and micro assemblies. Such crystals allow us to combine different functionalities together. But the production of such devices requires highly skilled personnel and expensive equipment. Unfortunately, only a few of manufactures have such resources, so this solution is not suitable for us and we need to use a different one, namely to produce printed circuit boards with built-in components.



Pic. 1. Example of PCB with Build-in components.

One of the modern trends of electronic device production and manufacturing is a circuit board with built-in components. This technology allows us to place chip-components on the inner layers of the PCB.

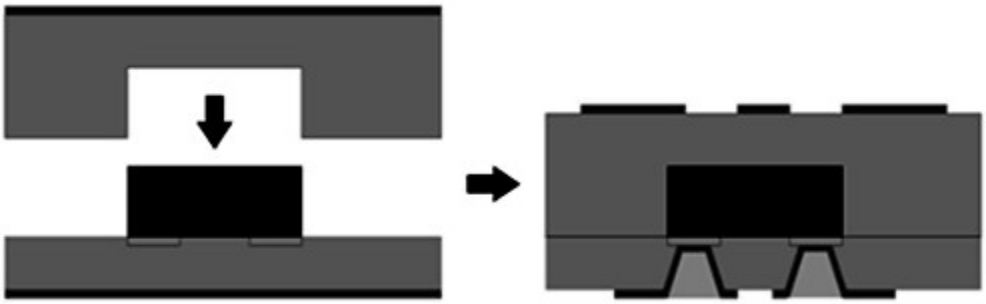
This solution enables us to create compact modules and combine functional units. Currently the main technology development center is the South-East Asia, in countries such as Japan (production share is about 30%), China (40%) and Korea (17%). This is due to the fact that the major electronics manufacturing center is located there. In Russia specialists have also begun to develop this technology, but the production share is lower than 1%.

There are two methods of creating PCBs with build-in components: forming components during manufacturing of the printed circuit board and embedding discrete components in a printed circuit board body. The formation of the components means that the components of the production process take place simultaneously with other PCB elements. The second method uses traditional components, which is in large quantities used around the world and fairly ready to be set in PCB.

The built-in component in the plate is much better protected from external factors such as vibration, heat radiation, moisture and some other factors. Also there was the possibility of placing the crystals of the active components without body. This helps us not only to reduce the dimensions of the components, but also to reduce the connection nets.

But this method has also some limitations. When we place components into the internal board layers, in the next step we need to close the PCB from top to a new layer and compress all the layers. Pressing temperature usually reaches 150-170ºC, when the peak of operating

temperature of the components is about 120ºC. This means that we can just burn out our integrated components and get a defective board in the end. To solve this problem it is necessary to use a glass fiber with a pressing temperature less than 120°C, making it difficult to the manufacturing processes, because such material needs to be developed. Then the pressing process needs to be controlled, because we can just break some sensitive elements, so we need to consider the height of each component. Today special elements for mounting on an internal board have not been developed yet, so the final thickness of the boards can be more than the ordinary. This problem does not apply to the method of forming components, but the process is more time-consuming and expensive.



Pic. 2. Example of the steps of pressing layers.

And of course in addition to these weaknesses, there are several advantages of this technology. Firstly, as we have mentioned above, the connection nets substantially reduced between the components, which have been built into the board. Function elements that previously could be created only as micro-assemblies are combined in one unit with the board and there is more space to install other components on the board surface. Also there are no any changes in the PCB fabrication technology itself, the stages of its manufacturing are exactly the same as in the ordinary multilayer printed circuit board manufacturing. Glass fiber also helps to remove heat from the components; therefore we cannot worry about overheating of our components.

In conclusion we would like to sum up some results about the new technology of creating PCB with built-in components. Of course, an individual approach of designing is required for each PCB. The board is not designed for rework, in case of failure of an internal component in the PCB, board cannot be fixed, and all the PCB should be replaced.

Список литературы

1. Технология изготовления печатных плат : [учеб. пособие] / Л.А. Брусницына, Е.И. Степановских ; [науч. ред. В.Ф. Марков] ; М-во образования и науки Рос. Федерации, Урал. федер. ун-т. — Екатеринбург : Изд-во Урал. ун-та, 2015. — 200 с.

2. Встраивание пассивных и активных компонентов в печатные платы – альтернатива печатному монтажу. Научный журнал «Новые Технологии», №6 январь 2011 – 92 с.

3. Васильев А.Н., Овчинников В.А., Лебедев В.В. Проектирование печатных плат: Учебное пособие. 1-е изд. Тверь: ТГТУ, 2005. 116 с.

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Исследование средств тестирование систем на устойчивость к (D) DoS-атакам

В статье рассмотрены основные инструменты для проведения тестирования информационных сервисов на устойчивость к (D)DoS-атакам. Проведено исследование наиболее эффективных и универсальных средств.

(D) DoS-testing

A Denial-of-Service (DoS) attack is an attack in which one or more machines target a victim and attempt to prevent the victim from doing useful work. The victim can be a network server, client or router, a network link or an entire network, an individual Internet user or a company doing business using the Internet, an Internet Service Provider, country, or any combination of or variant on these.