

AUTOMATION OF THE PROCESS FOR OBTAINING THE SAFETY PANEL USED ON A ROAD VEHICLE

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Abstract: Industrial automation focused on the manufacture of component boards in the construction of the car's electrical panel is necessary to achieve high productivity at the lowest possible cost without compromising on quality, because an error or failure of the fuse panel can cause significant material damage .

Keywords: automation, PCB, car fuseboard.

1. Introduction

The fuses or safety panel on motor vehicles, have the role of protecting the electrical network and the powered instruments from the occurrence of voltage shocks. For protection and appearance, the fuses and the corresponding plate are integrated in the fuse box.

The safety panel is designed to provide extra safety to the car's electrical circuits and to avoid exposure to various problems and even short circuits.

The role of fuses is to control and protect consumers from electrical currents flowing through the wires to electrical components.

When fuses burn out, drivers may encounter difficulties with energy consumers such as radios, headlights, ceiling lights, etc. Each time several fuses burn, there may be a problem in the fuse box [1].

If the vehicle is not equipped with a safety panel, a shock from electric overload could damage the cables and cause a fire.

An electric shock to any mechanism will instantly cause a malfunction. The role of fuses is to limit electricity, protecting consumers without problems. However, sometimes the shock is too great even for safety, leading to its destruction [1].

Many cars have two safety boxes: one in the engine compartment and the other inside the car. Each box is designed for a different purpose.

To protect the engine, use the safety box in the engine compartment and aim to protect: the brake pump to prevent anti-lock, the engine control unit and the cooling system.

The inner fuse box is used to protect the electrical elements inside the cab.

Given the importance of safety in the correct operation of the vehicle and not only, special importance is given to the way the plates are made.



Fig. 1. Safety box [1]

2. The Technological Flow for Obtaining the Fuse Panel Plate

PCB Design is located at the intersection of mechanics and electricity. Between these two, there is technology that is specific to printed circuit boards.

The combination of components and the integration of a function are at the heart of PCB production.

Electronics are experiencing a major expansion with the advent of digitalization. Defects that may occur in parts used in the manufacture of electronic equipment may shorten the service life.

The most common malfunctions of electronic components include: mechanical stress, thermal stress, environmental stress, electrical stress, packaging stress and aging stress. These defects disrupt the proper operation of the device. It is important to identify and prevent such failures in order to have an optimal product.

PCBs are made up of several components: components with mounting holes and surface mounting devices (SMD).

A number of defects can occur on the circuits for several reasons: defective production, poor assembly and transport. By analyzing areas with a high degree of quality rebate, the emphasis should be on finding ways to increase quality.

To analyze the main causes that lead to the destruction of components we need some information:

- What are the data that formed the basis of the circuit board design: dimensions, voltages, loads, etc.
- What technical specifications for parts do we need: process, materials, etc
- Reports of chemical and mechanical analysis tests
- Analysis of the manufacturing process
- The results of performance tests
- Analysis of vibrations and previous failures, caused by the use of plates.

When checking the board we use:

- Checking for PCB faults. For this verification we use a digital multimeter (fig.2)
- To find any hidden circuit faults or solder defects, we use automatic X-ray inspection (AXI). This inspection is also useful for detecting BGA errors, BGA short circuits and open circuit connections (fig.3).
- Another method of verification is surface imaging. Optical microscopy or surface imaging is most often used. The imaging method is often used for finding problems with gluing and assembling. It is a method often used due to its efficiency and accuracy. (fig.4)

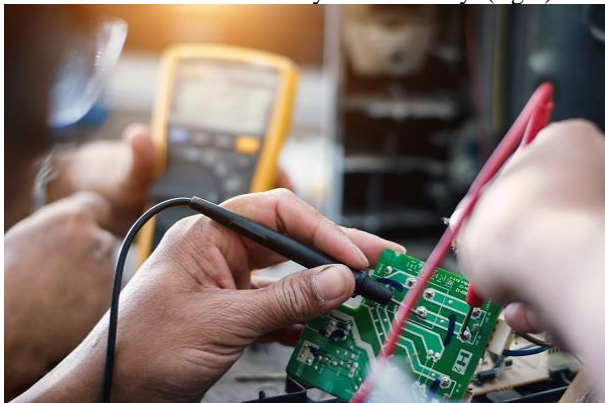


Fig. 2. Checking PCB faults using a digital multimeter [2]

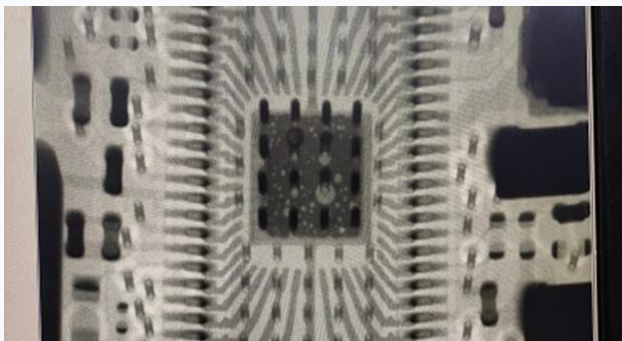


Fig. 3. Inspection of BGA using X-ray[2]



Fig. 4. Optical microscopy [2]

In order to obtain a high-quality plate, the following technological flow is currently used to make the safety panel used in a road vehicle in order to protect against short circuits.

The flow includes the following steps:

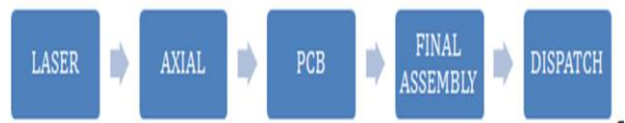


Fig. 5. Technological flow

2.1. Laser

It is the stage in which the part is stereographed with a unique code marked DMC (Data matrix code) on the PCB according to fig. 6.

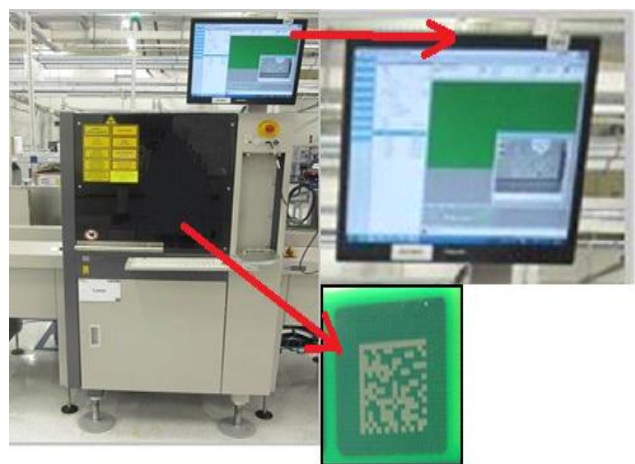


Fig. 6. Laser

At the beginning of production each PCB is serialized with Data Matrix Code (DMC) depending on the car company using the product selected on the line.

The Engineering Department is responsible for creating the operating instructions for this machine. Each piece of equipment is accompanied by the operating instructions and parameters, which are provided by the manufacturer.

The electrical panel, popularly called the switchboard, has the most important role in an electrical installation. The electrical panel protects the internal electrical circuits by means of circuit breakers (also known as automatic fuses).

There are several types of circuit breakers (circuit breakers) that can be mounted in an electrical panel:

- monopolar circuit breakers
- bipolar circuit breakers
- three-pole circuit breakers
- differential circuit breakers
- circuit breakers with minimum voltage trigger

Also, in an electrical panel, can be mounted ringers, stair switches, timer switches, meters and other modules.

2.2. The Axial Machine

The Axial is a "Pick and Place" technology machine where the diodes and resistors will be mounted on the PCB.

AXIAL (fig.7) - is a machine that automatically inserts resistors and diodes in electronic boards. It is an automatic process where the operator is committed to supervising the machine and / or feeding it when one of the materials used has run out.



Fig. 7. The axial machine

2.3. BOM (bill of material) stage

A PCB (Printed Circuit Board) panel consists of the following components: Relays, Diodes, Zener Diodes, Fuses, Resistors, Metal Grid (Silver Copper Alloy Connecting Electrical Circuits) and Pins, according to fig. 8.

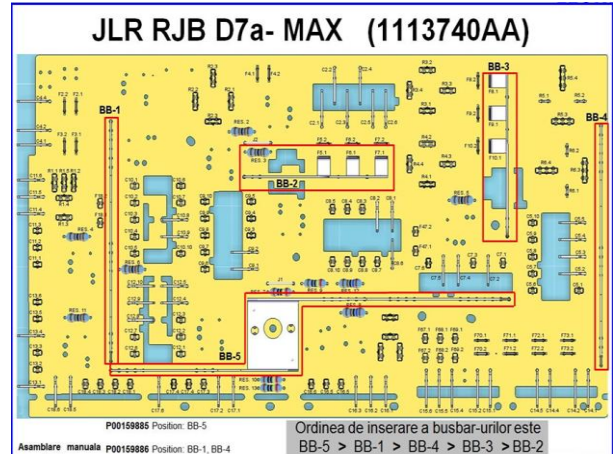


Fig. 8. Fuse panel

The electronic components used to create the panel part are:

- Electronic component relay that opens / closes an electrical circuit using a switch
- Diode - Electronic component
- PCB - Printed circuit board
- Resistor - an electronic component which has as main property the electrical resistance
- Jumper wire - The electronic component that connects the elements of the PCB
- Solder-tin, Sn (symbol in periodic table) - tin, element with which we tin the above elements
- Route-Route of the necessary transitional equipment to go through the process (similarity process flow)

For satisfactory results it is important to apply the FIFO system for the raw material (First in first out). It is not allowed for more than 6 months to pass between the first component entered and the first component exit due to international standards such as ISO 9001 standards.

Once the PCBs have been populated by the Axial station with diodes, resistors, jumper wires they will be automatically loaded into racks and transported on the PCB line, fig.9.



Fig. 9. In-line plate feeding machine

2.4. Final Assembly

EBERHARD - is an automatic machine that inserts terminals into electronic boards at a very high speed. There are different models of Eberhard cars. (fig.10).

The operator of the machines in question supervises the work processes, in case the machines give errors, the operator must cancel the errors, and in case a roll of material (respectively pins) ends the operator must refuel the machine according to the work instructions.



Fig. 10. Eberhard - the machine used to insert the pins

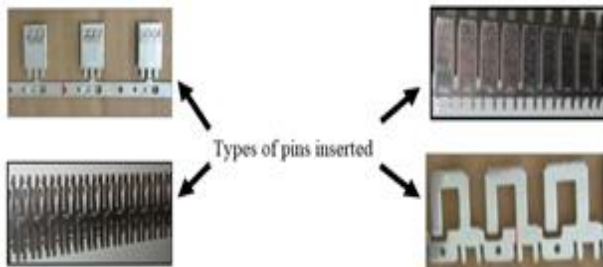


Fig. 11. Type of pins inserted

The pins are inserted automatically by means of pneumatic movable metal arms, which operate through the respective program of the machine in a certain order established by the program developer. The insertion is done both horizontally and vertically. An oblique insert is impossible with straight pine elements.

2.5. Verification and Shipping

At this station the PCBs are checked by the quality operator.

It consists of component testing, which is done using a titanium template consisting of counter-test pins for testing the perpendicularity of the pins on the board, testing the electrical circuit and labeling the part with a unique label generated by the FORS system.



Fig. 12. Checking PCB

The safety panels are checked for any tin residue or incorrect or shorted soldering, they are checked both automatically and visually to provide the necessary safety for mounting on vehicles.

3. Conclusions

Regardless of the field we are talking about, automation plays an important role. If we refer to the field of automobiles, the creation of the safety panel with the help of automations helps us to obtain high quality products avoiding the appearance of defects that could lead to damage to the car. It's trying to automate the whole process, which includes hardware design, supply, production, testing, all being coordinated and monitored by specialized software.

4. References

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