Verification of BGA type FPGA logic applied to a control equipment with Safety Class using the special socket.

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1. Introduction

This article aims to provide the verification method for BGA-type FPGA of Programmable Logic Controller (PLC) developed as Safety Class. The logic of FPGA in the control device with Safety Class is the circuit to control overall logic of PLC.

This device converts to the different module from the input signals for both digital and analogue of the equipment in the field and outputs their data. In addition, it should perform the logical controls such as backplane communication control and data communication. We suggest acquiring method of the data signal with efficient logic using the socket in this article.

2. Verification of FPGA logic in the control equipment with Safety Class

Each module of PLC should perform the independent functions according to the principle of split functions and should be designed by cascading principle. Unnecessary delay should not be occurred when it performs the logic by optimization and verification processes of Hardware Description Language (HDL) logic. Also, the development and verification processes should be performed for the firmware with Safety Class for nuclear power according to IEEE 1074 in Fig. 1.

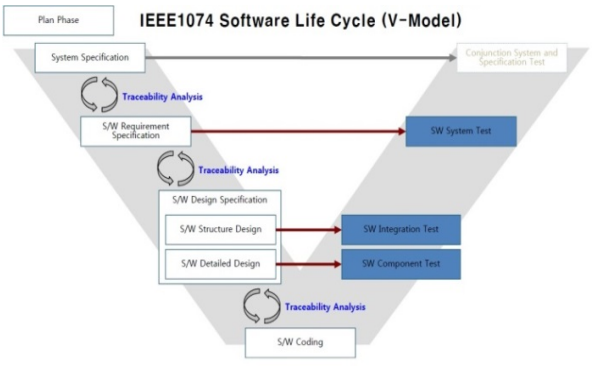

Fig.1. IEEE 1074 Software Life Cycle(V-Model)

Among the following processes, the direct verification with FPGA, which is required for the last verification process, is the process of live data verification, and it should measure the signals related to the roles of blocks.

Therefore, a complex wiring process is required and it must go through a process to identify and verify multiple data.

3. Problems of BGA-type

The BGA (Ball Grid Array) is a solution to the problem of producing a miniature package for an integrated circuit with many hundreds of pins. Pin grid arrays and dual-in-line surface mount packages were being produced with more and more pins, and with decreasing spacing between the pins, but this was causing difficulties for the soldering process. As package pins got closer together, the danger of accidentally bridging adjacent pins with solder grew

(BGA) type IC is arrayed by the terminals of IC, which are Balls, on the whole surface of the IC plate, minimizing the size and thickness of IC innovatively. Because Pin is not exposed in BGA Type IC, its data acquisition is challenging. Accessing each Pin data of the device to the circuit line directly, it analyzed the data by analyzer. Due to this, it had the problem on the data reliability, moreover, it took a long time to detect the signal. Also, because of the multiple disconnections, there were many cases to get damages on IC directly while acquiring the data.

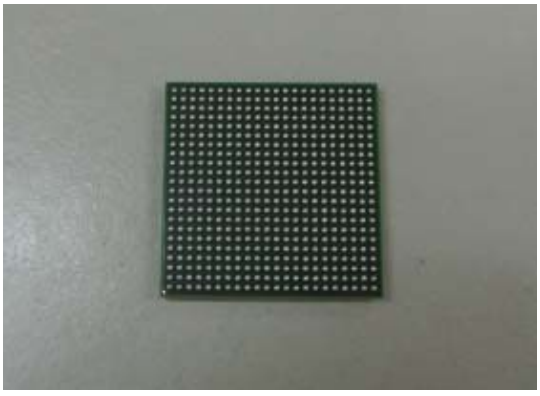

Fig 2. FPGA of BGA-type

4. BGA-type FPGA socket

The socket is equipped in the test board or burn-in board, and connected to the separate test devices, which

are to measure the features of the accessory devices and IC, to input and output the required power and electric signal for the operation of IC by their in/out (I/O) terminals near these boards. This is how socket is utilized in a series of IC test systems.

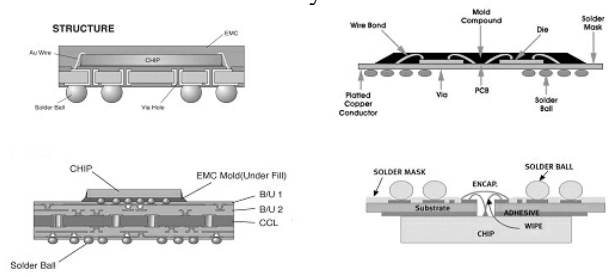

Fig. 3. BGA Structure

5.0 Implementation

We produced the pilot product and installed it to the live module. Then, we tested it whether all the signals were properly operated.
The below picture is the module installed with BGA using by socket of the produced module.

Fig.4. FPGA SOCKET

Using Vertex-6 Specifications of the socket consist of 240 In/Output pins.

Fig.5. verification of Logic

6. Conclusion

Proposed test socket is made by simpler process than former one, and the process is done in batches by which cost can be reduces, and the test socket can be quickly produced in response to any request. Also, it is possible to reduce the wear by reducing the contact force of the ball phenomenon.

The structure on the basis of silicon can be reduced the modification, and it has excellent linearity.

At the logic verification, the operation that state data block is designed in the FPGA could be easily confirmed by using a socket.

REFERENCES

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