

PCBA IC Programming

1.What is PCBA Programming?

PCBA Programming is the process of putting the program into the internal storage space of the chip, which is generally divided into offline programming and online programming.



2.How to choose: Online or Offline Programming?

Off-line Programming:

This production process is common, the chip will first go through the programming process, which can be manually or automatically programmed, then go to SMT placement. This production process is called Off-Line Programming (or parallel programming), it has been widely adopted and well known.

Compatible with different packaged chips through various adapters, and only when the chip and adapter are used together that can be programmed. BTW, the adapter itself is a type of precision fixture. That's to say, different chips and packages requires different adapters.

On-line Programming:

Another production process, which we call the online programming (ISP, the In-the System Programming, the In-Circuit Programming) , which is commonly used in R & D and sometimes in mass production.

Online programming uses the chip's standard communication bus, such as USB, SWD, JTAG, UART, etc. The interface is generally fixed, and there are fewer pins that need to be connected during programming. Since the interface communication rate is not high, the programming can be completed by using a general wire without high consumption.

Also, due to online programming is performed by wire connection, if an error is found during production testing, the PCBA that has the error can be traced back immediately, and the program can be re-programmed without disassembling the chip. By this way, it not only saves production costs, but also increases the efficiency of programming.



3. How to choose the best Programming Solution from above two Methods?

When to Choose Online Programming?

Online programming is typically the best method if you have one high-volume product with a few features. Time-to-produce balance if you have a low production volume, complicated workpieces, or frequent New Product Introductions (NPI).

When to Choose Offline Programming?

In the case of multiple products, complex programs, and frequent NPIs, offline systems provide the most optimal programming method because they are fast and don't occupy the production robot for a long time. The operator can take full advantage of the robot's accuracy and other capabilities, making offline programming optimal for complicated products.

	Off-line Programming	On-line Programming (ISP)
Versatility	Suitable for all types of chips	Applicable only in two cases 1) Chip supports ISP 2) Circuit board is designed for ISP with proper pin access.
Productivity	(1) Programming Speed Programming speed is usually higher in case of offline programming as we have easy access to parallel interface of chips and speed is faster with parallel data transmission. (2) Concurrent Programming SuperBOT-3 is equipped with 32 sockets so concurrent programming of 32 chips is easily possible in most cases. (3) Throughput Automatic programmers can operate at throughput of 1600 UPH (Units per hour) (4) Other Expenses Programming is an independent process, and will not have any effect on testing cost.	(1) Programming Speed. Programming speed is slower in case of serial programming as compared to parallel programming done by automated/parallel programmers as the data bits are transferred sequentially. (2)Concurrent Programming Concurrent programming is decided by the number of channels each ISP programmer supports and size of PCB panel is also a limiting factor. With smaller size PCB, larger panel can be supported. Superpro IS03 can support a panel of 16 PCBs. (3)Throughput: It is not as high as automated programmers. (4)Other Expenses: If programming is done on an ICT then extra time is needed on the tester which may involve additional operating cost.
Investment	Initial Investment is higher and user has to consider operating costs for the socket adapters. The cost is easily recovered if chip programming requirement is very high.	Initial investment is lower and customer should consider cost for pogo pin replacement along with cost of manual operator.
Rework difficulty	For various reasons, such as the incorrect data file, firmware upgrades, and other factors sometimes it is necessary to reprogram the chips. In case of off-line programming, reworking is needed to desolder and solder the chip.	No rework needed for data file changes and field upgrades.
Flexibility	Changeover time from one chip to a different chip is couple of minutes in case of automated programmer. User needs to install correct socket adapter and ready to go after loading project file.	New programming algorithm development and testing might be involved when chip part number or PCB changes. Also there will be a need of designing new test fixture for different PCBs.
Reliability of product and quality	During programming, because the chip has to go in and out of the socket and feeder equipment, careless operation of automatic programming may result in chip pins deformation, resulting in degradation of soldering quality. So some of the aerospace, defense, automotive electronics, medical electronics and other high reliability requirement companies don't prefer offline programming.	Programming is done after surface mounting so no such risks are involved.

PCBA Functional Testing



1 A Brief Introduction on Functional Testing.

Functional testing is the final step of PCBA manufacturing to ensure zero-defect PCBs. At this stage, the design is already tested for, and hence the function of the PCB is checked at length and at various levels. The application environment is simulated; PCBs are connected to similar systems and the same final product. This technique is all about going as close as possible towards the real environment. This step gives the manufacturer a green signal to proceed with further processes. As the name implies, this technique verifies the functionality and behavior of the circuit boards to ensure their flawless performance. Functional testing is unique compared to other testing methods.

2 Why is Functional Testing Important?

Functional testing is important because without it, you may not accurately understand whether your application functions as intended. An application may pass non-functional tests and otherwise perform well, but if it doesn't deliver the key expected outputs to the end-user, the application cannot be considered working.

3 Common Problems Identified Through Testing.

Here is the list of some common problems that can be identified by performing functional testing of PCBs. So, let's have a look at them.

- Power Integrity:** This is one common problem in high-speed boards that run at fast edge rates. Some common power integrity issues are power rail collapse and ground bounce, excessive heat generation, and high AC impedance and/or DC resistance. The PCB functional test identifies factors that contribute to PDN resistance and impedance.
- Inadequate Voltage/Current:** In most cases, the circuit board fails or does not perform as expected due to inappropriate voltage or current supply. Sometimes, PCB components are subjected to more than normal voltage and subsequent overheating. In addition, the incorrect voltage could occur by placing components in the wrong places or missing them somewhere on the board. PCBA manufacturers analyze these problems via functional testing and take proactive steps accordingly.
- Signal Distortion:** Signal integrity issues in the circuit board can also affect its functionality. This signal distortion can occur due to various reasons such as crosstalk, impedance mismatch, and more. PCB functional test checks for excessive signal distortions, signal skew in buses, and other weird behavior in the circuit board that may affect its functionality.

The Current PCBA Functional Testing is Divided into the Following:



Manual Control Function Test



Test of Semi-automatic Control Function



Fully Automatic Control Function Test

PCBA FUNCTIONAL TESTING

AND THE ROLE OF MANUFACTURER COLLABORATION

4 Why is Functional Testing so Popular?

Functional testing is widely used by PCBA manufacturers and service providers owing to its following benefits.

- A functional test detects any faulty or inappropriately placed components. It triggers root cause analysis for any type of fault in the circuit board.
- Compared to other PCB test methods, functional testing is cost-effective and straightforward.
- The individual can document the entire process. This, in turn, acts as a guideline for improving the overall quality.
- This method tests the whole circuit board. So, there are zero chances of defects or errors.
- Functional testing works in sync with other PCB testing methods, such as in-circuit and flying probe testing.
- As mentioned, this testing allows the PCBA manufacturer to take the final call and approval from the client as well.

5 Commonly used flash file formats and programmers.

We accept bin, file and hex. file for programming. Here are some commonly used programmer:



- ST-Link: ST-Link is a programmer burner developed by STMicroelectronics. It is widely used in ST's microcontroller products, ST-Link has an easy-to-use interface and powerful features to support a variety of debugging and burning operations. (software:st-link utility)



- J-Link: J-Link is a more versatile programmer burner developed by SEGGER. It supports a variety of debugging interfaces, including JTAG, SWD and SWIM, etc., and is compatible with a variety of different types of microcontrollers and embedded chips. (software: J-Flash)



- Atmel: Atmel-ICE is Microchip's new powerful debug programming tool for the Atmel SAM and AVR® family of Atmel ARM® Cortex®-M chips. (Atmel Studio)



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August Issue

2024

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