Calibration Process of Capillaries and Blade on Wire Bonding Machine

Final Project

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STATEMENT OF AUTHENTICITY OF FINAL PROJECT

I, the undersigned, certify that the contents of part or all of my Final Project entitled: "Calibration Process of Capillaries and Blade on Wire Bonding Machine" is my own work, completed without the use of materials that are not permitted , and is not the work of other parties which I acknowledge as my own work. All references cited or referred to have been written in full in the bibliography. If it turns out that my statement is not true, I am willing to accept sanctions in accordance with applicable regulations..

Cegléd,25 Juni 2024

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APPROVAL

The Final Project was prepared to fulfill one of the requirements to obtain the degree of Associate Expert in Engineering (AMd.T.)

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Calibration Process of Capillaries and Blade on Wire Bonding Machine

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***Abstract*—** Blade and capillary is one of the main components located in a wire bonding machine system with a process using the HK-116 type which can affect productivity in the bonding process. this study aims to analyze the frequent occurrence of rejects caused by calibration limits which include blade and capillary replacement. the analytical method used in this study is a qualitative analysis method. this type of research uses a qualitative descriptive approach, namely describing and analyzing the problems found.

Keywords: Defect,wirebonding,Dual Module

INTRODUCTION

The world's population is growing, and more and more megacities are emerging. Energy demand continues to spiral across the globe. At the same time, the rising need for climate mitigation calls for new solutions in many areas of everyday life. At Infineon Technologies, they make a semiconductor module that aligns with their goals to make the world easier, safer, and greener [1].

PT. Infineon Technology Cegled (IFCE) is one of the companies that focuses on several production processes carried out by this company. The production process at Infineon Technologies uses complex tools, making the process very good. There are some processes to complete one module, and there is a process known as riveting. In the riveting process, we should check many things, such as whether it is appropriately Bonded, whether there is any scratch in the baseplate,competence,stability,etc. So, the authors did this project with the title "Calibration Process of Capillaries and blade on Wire Bonding Machine" to analyze the Bond process.

I. METHOD

Design of the Research

The test method in designing this system is as follows: the test method in designing this system is as follows:

1. Literacy studies.
2. Formulation of the problem.
3. Data collection.
4. Actions taken.
5. Implementation.
6. Result and Conclusion.

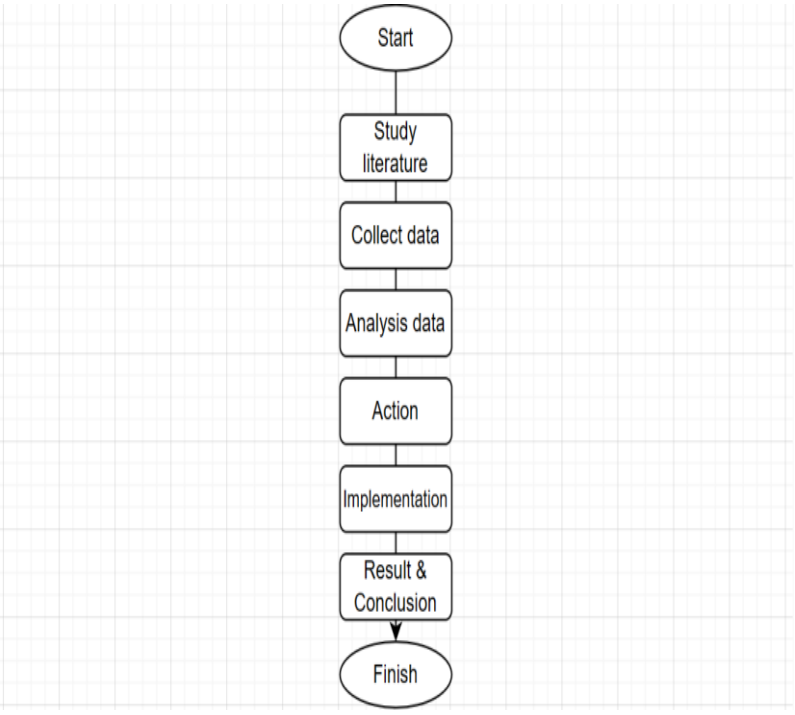


Fig. 1. Flowchart of test design

First step is to study the the literature in order to know the informations that related to the data that we want to analyze. Then we collect data so we can obtained the real data for the analyze. In the analyze data we divide the data to the type of defect. After that what kind of action and implementation it like use the appropriate method and material, following the work instruction, checking every module after the machine maintenance, and etc. Last we can take the result and conclusion

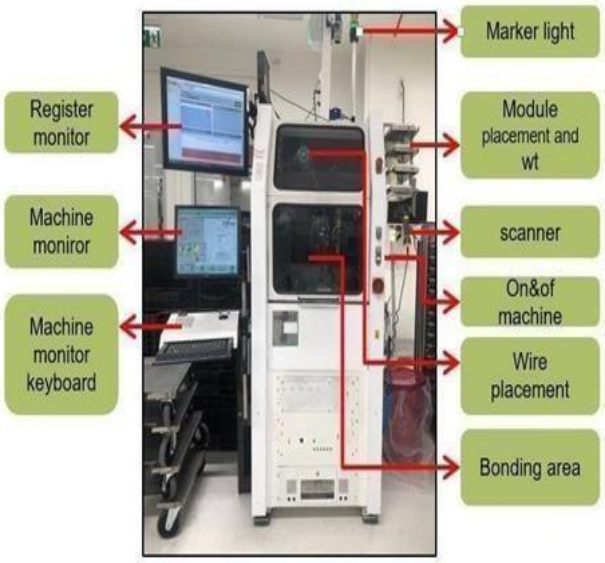
A. Method Research

The method used by researchers is a qualitative method by analyzing problems and describing what happens in the internship workplace.
The things I did with this method were:

- Observation, I identify and make some notes on the things I observe
- Interviews, ask several questions about the WireBond process, what defects most occur and their causes.

B. WireBond

One of the processes in PT Infineon Cegled hungary is the wire bonding process.The wire bonding process is the process of attaching bonds to modules that aim to connect the circuits that have been installed. This wire bonding process uses 3 types of wire namely copper, aluminum and gold .This wire functions asa conductor of electricity to



the circuit in the module. when the wire bonding process has been completed, a check and visual inspection is carried out which aims to see and check the feasibility of the bonded module.

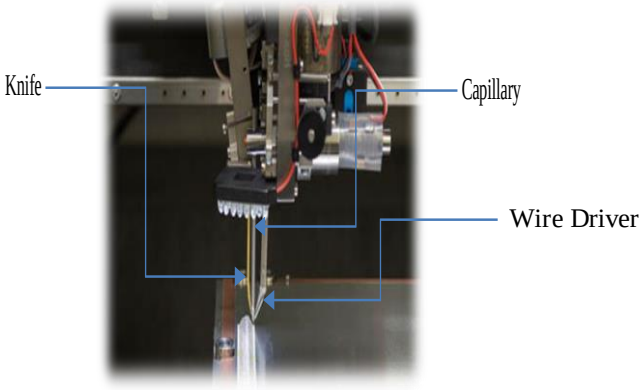
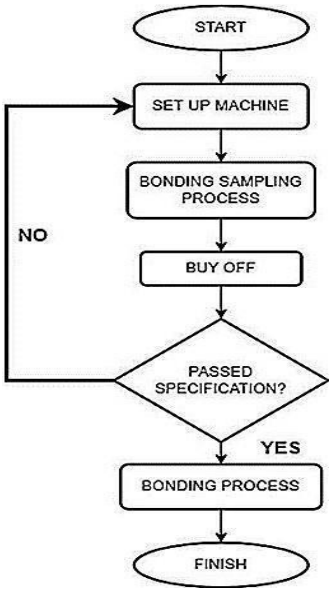


Figure 2. Bonding Head

C. Set Up Process

Figure 4. Flowchart Calibration Process



Defect Analysis In WireBond Process :

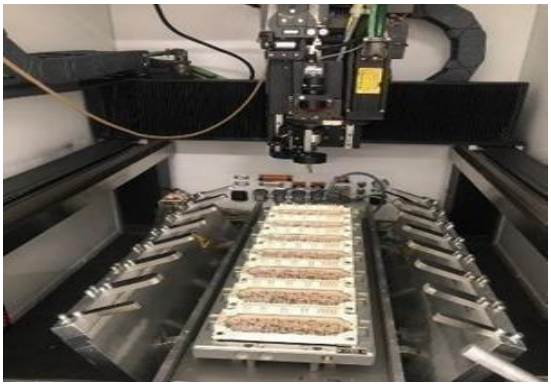
1. **Start** Register on wt, ten wt is entered into the machine along withthe module.
2. Set up machine see the suitability of the parameters or files that have been specified by the company, if they are correct and appropriatethenpress enter to run the machine.
3. Bonding sampling procces Take a bonded module to check in visual inspection whether themodule is good or not.
4. Passed specificationIf the module is damaged, it will return to the initialprocess for re-bonding and if the module is ok, it willgo to the next process.
5. Bonding procces If the module is ok then all modules will bebonded.
   Finish After the module has been bonded, it will then enter the nextstageto check whether the module is all bonded or not.

II. RESULT AND DISCUSSION

Starting in the early twentieth century and continuing until about 1920, the concept of mass production came with the Industrial Revolution. Then, the period from about 1920 to 1940 saw the next phase, the evolution of quality control. Products and processes became more complicated, and production volume increased. Then, standards were set, and inspectors compared the quality of the items that had been produced. So, there is quality control as it was quality control has its meaning as a system that maintains a desired level of quality through feedback from products or services. Quality Control can also be defined as a procedure or a set of guidelines intended to ensure that a manufactured product meets the set quality criteria or the requirements of the client or the customers. So, quality control aims to ensure that product quality is maintained or improved (Feigenbaum 1983) [2].

1.Machine

Figure 5. picture of machine



The following is the process of changing capillaries and blades that are carried out as maintenance forthe machine to produce good and standard modules.

Description of how the wire bonding machine works or process:

1. The process of inserting goods into the machine in the form of modules placedin a WT or jig
2. proses The register uses a scan tool to record each module that will beprocessed
3. Running machine
4. After the module is ready for bonding, the operator will check again whether the module is fully bonded or not

Then, when all the modules are ready, the next step is that the module will enter the inspection process, which is the process where the module will be re-checked using a microscope

In the Wire bonding process for dual modules, several critical data points are essential for optimal results. These include:

1.Current air pressure: 2.72 bar
2.Set air pressure: 2.72 bar
3.Current tool position: 52.24 mm
4.Hydraulic pressure: 127.9 bar
5.Pressing force: 16.4 kN
6.Maximum pressing force: 16.45 kN
7.Adjusted pressing force: 17 kN

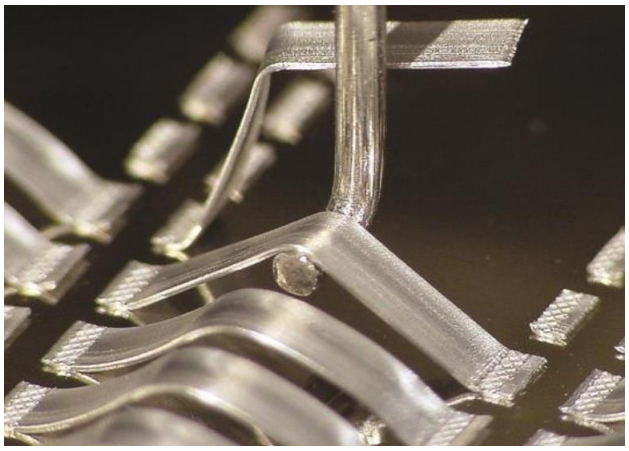
These parameters are carefully monitored and controlled to ensure precise and effective Bonding, guaranteeing the structural integrity and reliability of the final product.

2.Type Of Scrap

A.Broken Wire

As time passes, wires can be subject to wear and tear - or other problems such as dry rot, rodent damage, and loose connection points - that can lead to wire breaks or shorts. Older homes are especially susceptible because of wear-and-tear from age and rodents; newer homes tend to fare much better in this regard because of advances in technology.Sometimes when there are problems with wiring, there will also be smoke or sparks coming from it. The sparks may come about for several reasons; one being that the wires have been fried due to improper wire and cable selection.The following is a picture of a broken wire defect [4].

Figure 6. picture of Broken Wire



B.Double Bond

Double Bonding : Two foot ties tied to each other are pieces.The bond drawing must match with bond plans, it is critical that a the number of bond legs must be the same.

This defect can occur due to various reasons during the Bonding process, such as:

1. Dirty wire height detection sensor
2. The blade installation parameters do not match the calibration line
3. The clamp does not hold the module in a tight position
4. Operator Error

5. Tool Damage: If the riveting tool is damaged or worn, it may create scratches on the baseplate as it comes into contact with the surface during the riveting process.

6.Foreign Objects: Presence of foreign objects or debris between the baseplate and the workpiece can cause scratching during riveting.

How To Check Bonding Results:

1. Visual Inspection: Visual inspection is the most common method of detecting broken wires. The operator or production supervisor can use a microscope or other visual inspection device to check the wireties. They should look for signs of a physically disconnected wire, such as a wire tip that is not connected to the pad or a broken bond.
2. Process Monitoring: Modern wire bonding machines are equipped with a process monitoring system that can detect broken wires automatically.Optical or electrical sensors are installed in the machineto monitor wire continuity during the bonding process. If the sensor detects a loss of continuity, the machine will give a warning or stop the bonding process automatically.
3. Reliability Testing: After the bonding process is complete, components bonded with wire bonding must undergo reliability testing. Tests such as a pull test ora shear test can be used to check whether the wire remains firmly bonded to the intended pad or component. If the wire breaks during the test,it indicates bond failure.
4. Use of the Camera System: The camera system can be used to monito rthe bonding process in real-time and detect broken wires. The camera can take pictures or record videos of wirebonding during the bondin gprocess. Image processing or video analysis software can be used to detect abnormalities or broken wires in images or recordings

Figure 7. Scrap Code

C.How to Make Minimum Reject

Based on the analysis, has Four recommendation steps to solve the problems of wire breaks.

1. Check the staple or head again for bonding wire, if it does not match the reference, make sure it returns to the reference position
2. Check again whether the product to be processed has finished bonding or whether the product is not finished
3. Clean the wire bonding tool after replacing the tool
4. Stop the engine if you encounter a serious problem until engineering comes to repair the engine

The company replaced the clamp and table where the module was bonded because it was no longer precise in holding the module and only employees who were experts could set the machine to minimize the occurrence of scrabbling due to wire breaking.

Figure 8.scrap of reject module

3.Type Of Good Module

Products that have gone to the process and succeeded without any damage are good quality products. The Econo products have a long service life and are able to last for a long period of time without suffering significant deterioration. The products are designed to withstand daily use and diverse environments. They are able to perform their functions well without any interruptions or breakdowns.

Figure 9. Good module

3.1 Quantitative Data Results

Based on the research that has been carried out, data on cable breaks is presented in Table.

This formula is used to determine the total number of wire breaks before and after tool replacement. This formula can be a reference for the quantities needed to make improvements to obtain results that comply with specifications. The wire break reduction value uses the following calculation:

Formula

$$\frac{Before\ Reject - After\ Reject}{Total\ Before\ Reject} \times 100\%$$

$$\frac{(1332-77)}{1332} \times 100\% = \mathbf{94.21\%}$$

3.1 Quantitative Data Results

Based on the research that has been carried out, data on cable breaks is presented in Table.

Tabel 1. Collective Data

F4-75R12KS4_B11							
BEFORE				AFTER			
No	LOT	DATE	UNIT MODULE	No	LOT	DATE	UNIT MODULE
1	U76270P0	3/1/2024	42	1	U76270P0	18/3/2024	2
2	U76271P0	3/1/2024	54	2	U76271P0	18/3/2024	3
3	U76272P0	3/1/2024	27	3	U76272P0	18/3/2024	2
4	U76273P0	3/1/2024	66	4	U76273P0	18/3/2024	3
5	U76274P0	3/1/2024	39	5	U76274P0	18/3/2024	1
6	H78823P0	4/1/2024	44	6	H78823P0	19/3/2024	3
7	H78824P0	4/1/2024	48	7	H78824P0	19/3/2024	4
8	H78825P0	4/1/2024	24	8	H78825P0	19/3/2024	3
9	H78826P0	4/1/2024	79	9	H78826P0	19/3/2024	2
10	H78827P0	4/1/2024	43	10	H78827P0	19/3/2024	1
11	U47894P0	5/1/2024	62	11	U47894P0	20/3/2024	4
12	U47895P0	5/1/2024	51	12	U47895P0	20/3/2024	3
13	U47896P0	5/1/2024	24	13	U47896P0	20/3/2024	5
14	U47897P0	5/1/2024	74	14	U47897P0	20/3/2024	5
15	U47898P0	5/1/2024	29	15	U47898P0	20/3/2024	2
16	U76270P0	6/1/2024	23	16	U76270P0	23/3/2024	1
17	U76271P0	6/1/2024	20	17	U76271P0	23/3/2024	2
18	U76272P0	6/1/2024	35	18	U76272P0	23/3/2024	2
19	U76273P0	6/1/2024	24	19	U76273P0	23/3/2024	1
20	U76274P0	6/1/2024	32	20	U76274P0	23/3/2024	3

IV. CONCLUSION

From the analysis that has been carried out it can be concluded that a broken wire occurred because the tool used is damaged but is still being used in production, causing failure, the wire is always disconnected. After replacing the tool, it was found that the number of broken wires was reduced by 94.21%. Addressing these factors through proper material selection, maintenance of riveting tools, and optimization of process parameters is essential to minimize defects and enhance the quality and reliability of wirebond joints.continous monitoring and improvement of the riveting process are recommended to ensure consistent and reliable performance. Collaboration between engineering, production, and quality assurance teams is vital to implementing effective solutions and driving ongoing improvements in product quality and manufacturing efficiency.

Overall, this defect analysis serves as a valuable tool for identifying opportunities for enhancement within the riveting process, ultimately contributing to improved product quality, customer satisfaction, and operational excellence.

ACKNOWLEDGMENT

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I would also like to give my big thanks to Supervisor and the entire team in my work area for their assistance and guidance during the internship. Every experience that I obtaine were crucial in the world of work. thank you.

References

[1] (Infineon, 2021)

[2] Amitaya, M. (2016). *Fundamental of Qualitz Control and Improvement* , 6.

[3]https://www.kns.com/Products/Consumables/Capillaries/ACS-Pro

[4] (NOYAFA, 2024)

FORMULIR LOOGBOOK BIMBINGAN DAN PENGAJUAN SEMINAR PROPOSAL/SIDANG TUGAS AKHIR*

Nama : Taufik Qurahman

NIM 3222101041

Pembimbing I : Muhammad Arifin, S.Si, M.Si.

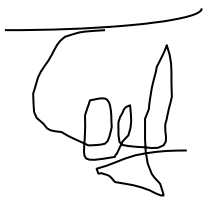
Judul : Calibration Process Blade and Capillaries on Wire Bonding Machine

No	Hari/Tgl	Rincian Kegiatan	TTD Pembimbing I	
1	29 Februari 2024	Bimbingan melalui aplikasi zoom bersama dosen pembimbing.		
2	07 Maret 2024	Bimbingan melalui aplikasi zoom bersama dosen pembimbing.		
3	21 Maret 2024	Bimbingan melalui aplikasi zoom bersama dosen pembimbing.		
4	28 Maret 2024	Bimbingan melalui aplikasi zoom bersama dosen pembimbing.		
5	05 April 2024	Laporan progress pengerjaan Tugas Akhir.		
6	22 April 2024	Laporan progress pengerjaan Tugas Akhir.		
7	06 Mei 2024	Laporan progress pengerjaan Tugas Akhir.		
8	09 Mei 2024	Revisi laporan progress pengerjaan Tugas Akhir.		
9	15 Mei 2024	Bimbingan melalui aplikasi zoom bersama dosen pembimbing.		
10	31 Mei 2024	Revisi laporan progress pengerjaan Tugas Akhir dan mengajukan F-II .		

Berdasarkan hasil bimbingan yang telah dilaksanakan selama_____bulan dan telah disetujui oleh dosen pembimbing, maka dengan ini saya mengajukan diri sebagai peserta Seminar Proposal /Sidang Tugas Akhir*.

Cegled, 01 July 2024

Peserta



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