# ELIMINATION OF PCBA RELATED FUNCTIONAL DEFECTS ON AMBER/OPAL MACHINE BY IMPROVING M03-A13-00 JADEBACK CONNECTOR ASSEMBLY USING SOLDERING ALIGNMENT JIG

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#### ABSTRACT

Functional failure like blade motor do not turn on, no output supply, & USB no communication was commonly encountered upon testing of Amber & Opal machine. Jadeback connector is the highest contributor on functional defects. Soldering of Jadeback connector is highly critical that needs attention. It must be aligned on the Printed Circuit Board (PCB) pad while connector height must be also considered.

One big challenge for us is how to cater the alignment of connector to pad while also considering its height. This process of alignment also consumes additional time during assembly, the mere fact that the assembler is prone to burnt during soldering process because he/she will hold the connector using his/her hands to align the connector on PCB pad.

Considering the requirements, this paper presents the solution to eliminate functional failure (Jadeback connector related) on Amber & Opal by fabricating a jig that caters all the requirements is proven effective with 0% defect encounter.

#### **1.0 INTRODUCTION**

#### 1.1 The Problem

Quality is every company's top priority. Functional failure greatly affects the quality of the product, line productivity and with on time delivery to customer. High occurrence of this functional failure led to low production performances causing additional rework cost, scrap cost and additional rework processes. Jadeback connector assembly is the highest contributor of functional defects, mainly due to difficulty to assemble the unit itself. Assembler requires full attention and dedication on doing connector soldering. Soldering pins has a pitch of 1.05 mm which are very close on each other. In slight overflow of solder will lead to shorted connection. Also, misalignment of spring-loaded pin will cause of no connection to Blade Printed Circuit Board Assembly (PCBA) pads, resulting to no communication.

Previously, assembler used tape to hold the connector during alignment on the pad, see figure 1. It served as temporary holder to initially solder the solder pins. But it has a high risk since it is not fully aligned. On that condition, assembler holds the spring-loaded pin to keep alignment during initial soldering.



Spring Loaded Pin (Housing)

Figure 1. Taped spring-loaded pin (housing) on the pad

Since it has a narrow gap of 1.05mm between each pogo pins it can cause or leads to unintentional defects such as misalignment, solder bridge etc. Consistency during alignment is very important prior to soldering process to avoid / eliminate the common defects encountered in process

assembly. Pogo Pins Soldering Tip Soldering Lead O.6mm PCB Pad A. Mis-alignment Connector pin & pad Alignment B. Solder Bridge Solder Bridge

Figure 2. Common defects encountered during Soldering Process

#### 1.2 Possible Solution

Aside from *product quality, productivity* and *on time delivery, safety* is also a concern on this process. In general, functional failure is caused by poor assembly process of the Jadeback connector. Improvement of this process will cater all concerns including safety and working ergonomically.

To eliminate soldering defects on Jadeback assembly, Alignment jig was fabricated. Using the jig, it is easier to align the spring-loaded pin on the PCB pad. It aids position and height. The connector can be easily adjusted horizontally on the pogo pin to PCB pad.



Figure 3. Top View of Jadeback Connector Alignment Jig

# 2.0 EXPERIMENTAL SECTION

#### 2.1 Materials

Four M3x14 Socket Head Screw Two Cutter Blade (thickness 0.6mm) Acrylic Plate (thickness 11.76mm) Flame Retardant Tape

# 2.2 Procedure

The use of Jadeback connector alignment jig is a huge help for the assemblers and there are a lot of related defects and unsafe process if the jig was not used.

In manual alignment, the assembler holds and align the connector to PCB pad. Next, is to tape the connector to PCB pad. This process is troublesome since the alignment of pogo pin to pad is difficult. See figure 4 for connector's pogo pin and PCB pad.



Figure 4. Pogo pin should be aligned to PCB Pad

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The height of the connector to the PCB is also considered since it needs to be soldered. The approximate height used by the assemblers is **0.6mm**. This height is considered good as the connector is not too far and not to near with the PCB and easy to solder. See figure 5 for approximate height of connector to PCB



Figure 5. 0.6mm height of spring-loaded pin to

In using Jadeback connector alignment jig, all requirements for assembly were considered. The first step in using the jig is to insert the PCB. It can hold the PCB in place unlike in manual alignment. The next step is to place the connector above the PCB. There will be two cutter blades between them which serves as height guide of connector to PCB. Those cutter blades have a height of 0.6mm. Spring loaded pin can be easily adjusted horizontally to align its pogo pins to PCB pads. See figure 3 for the image of blades position in Jadeback connector alignment jig.

The soldering process will be much easier than manual alignment since PCB & spring loaded is kept in place during soldering. In soldering process, the first 4 pins and the last 4 pins were soldered first. If the 8 soldered pins are good, the Jadeback connector can now be removed from the jig and can continue soldering the other pins.





Figure 6. First and last 4 pins in the connector that should be soldered

#### 3.0 RESULTS AND DISCUSSION

Positive response has been received; consistent mounting has been achieved same with the specified height requirement. Some benefits are raised since the Jadeback Connector Alignment Jig was made. Process assembler is more focused on soldering rather than manual mounting with the use of yellow tape. It makes the soldering process of pogo pin easier and this alignment jig is user friendly. Furthermore, all the risk of possible defects was minimized. These are composed of existing materials and even scrap with a little cost.

#### 3.1 Tact Time

Before, the assembler manually tapes the connector to the PCB and takes time to align it. The assembler then proceeds to solder after verifying the alignment. It took an average of 90 mins for the whole process to finish. At present, with the use of the alignment jig, the whole process took an average of 33.44 mins. This is over 60% reduction in aligning and soldering time. See table 1 for the tact time summary.

Table 1. Tact Time comparison between manual alignment and with using alignment jig.

| Tact Time<br>Trial      | Manual Alignment<br>(With Soldering)<br>In Minutes | Using Alignment Jig<br>(With Soldering)<br>In Minutes |  |
|-------------------------|--|---|--|
| 1                       | 89.5   | 33.53   |  |
| 2                       | 90.2   | 34.39   |  |
| 3                       | 90.31  | 32.4  |  |
| Average                 | 90   | 33.44   |  |
| Tact Time<br>Difference | 56.56 mins or 0.94 hours Faster                    |   |  |

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#### 3.2 Eliminate Risk of Related Errors

Alignment is particularly important in Jadeback connector, and the alignment jig sole purpose is to eliminate the related functional error of the machine.

Jadeback connectors are placed at the back part of the blade slot of the machine, see figure 7 for blade slot image. Amber/Opal blades are inserted to the blade slot. These blades have PCB at the back that should be aligned with the Jadeback connector. See figure 8 for the PCB at the back of the blade.



Figure 7. Jadeback connector at the back of the blade slot



Figure 8. Blade backplane for transmitting signal communication Blade PCBA

So, it is especially important for Jadeback connector to be aligned. There will be connection problem in supply and signals and will cause functional error in the machine if the pins are not properly aligned.





#### 3.3 Quality

Using Jadeback Connector Alignment Jig, different types of defects were minimized compared to the previous method. Mounting consistency has been achieved during process. It has a punctual assignment that both assembler and jig know the purpose of its use. It is proven that through this jig, assembly process is easier and safer.

Table 2. Defects Comparison. Before and after using Jadeback Connector Alignment Jig with same skilled Assembler.

| Defects             | Before | After |
|---------------------|--------|-------|
| Shorted Pin         | 5%     | 0     |
| Misaligned POGO Pin | 4%     | 0     |
| Reverse Connector   | 0.05%  | 0     |
| Uneven Lead Height  | 10%    | 0     |
| Burnt Connector     | 0.05%  | 0     |

#### <u>3.4 Cost</u>

The cost was based on the tact time done. From the table 1, the time saved for the process is 56.56 mins or 0.94 hours. With an hourly rate of **72 Php/hr**, cost saved is **67.68Php**. If multiplied to the total Jadeback connector done of **422 units** from 2021 to Present, the cost saved was, **28,560.96Php**. Overall cost savings is Cost save 28,560.96 less fabrication cost of **1815.84Php** which is **26,745.12Php** in total.

# Table 3. Quantity of Jadeback connector since 2021 to Present

| PROJECT     | QTY | QPA | TOTAL |
|-------------|-----|-----|-------|
| Amber       | 15  | 5   | 75    |
| Opal        | 24  | 6   | 144   |
| Spare Parts | 203 | 1   | 203   |
| Т           | 422 |     |       |



# 7.0 ABOUT THE AUTHOR

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#### **4.0 CONCLUSION**

Knowing the process requirement, simple yet effective alignment jig can be designed to aid process improvement.

Use of jig serving as guides is an effective action to aid consistent pin position and height during soldering. This help save time & money, minimize scrap, and achieve a safer process for assemblers.

#### **5.0 RECOMMENDATIONS**

This study recommends for other PCB assemblies that requires manual alignment and manual soldering process to achieve good alignment, quality, and safety.

# 6.0 ACKNOWLEDGEMENT

The authors would like to express their appreciation to the whole SDE Engineering and Manufacturing section for their support in this project. To Mr. Rico Vega and Mr. Wilhelm Yanto for guiding and sharing valuable insights. To Mr. Allen Jone Lazaro and Ms. Ercie Valenzuela for continuous support and pointers. And most of all our creator, from whom all wisdom and strength flow.



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