UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Design a Mini Depanelize Jig to Separate PCBA's From Panel into Single Pieces.

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Manufacturing Design) with Honours.

By

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May 2010

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: Design a Mini Depanelize Jig to Separate PCBA from Panel into Single Pieces

SESI PENGAJIAN: 2009/2010 Semester 2

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Date : 10 May 2010

APPROVAL

This thesis submitted to the Senate of Universiti Teknikal Malaysia Melaka (UTeM) and has been accepted as partial fulfillment of the requirement for the degree of Bachelor of Manufacturing Engineering (Manufacturing Design). The members of supervisory committee are as follow:

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Hanizam b. Hashim

(Official Stamp & Date)

ABSTRACT

In order to optimize the productivity in PCBA manufacturing process, PCB's are design in panel form and have to be separated into single pieces before testing. This project is based on industrial problems at Cubic Electronics Sdn. Bhd. to cut the printed circuit board panel. The PCB's are separated by V-groove at top and bottom from one end to another and needs to be cuts in order to use them. The current technique is by using punch and pizza cutters/circular rotating blade and manually done by operators using jig or depanelize machine respectively. From the observations made at the company, the technique takes longer cycle time and difficult to handle for large panels. Although there is an automatic PCB cutter available in the market, the machine is far too expensive compared to the current machine. This project will be focusing on designing and improving the current Depanelize Jig in Cubic Electronic Sdn. Bhd.

ABSTRAK

Dalam meningkatkan proses pengeluaran PCBA, PCB direkabentuk dalam bentuk panel dan perlu diasingkan/dipotong kepada satu satu bahagian litar. Projek ini berdasarkan masalah industri di Cubic Electronic Sdn. Bhd. untuk memotong litar daripada panel. Litar litar PCB ini di asing oleh lurah/alur V di atas dan bawah dan perlu dipotong untuk digunakan. Teknik biasa yang digunakan adalah '*punch'* dan '*pizza cutters/circular rotating blade'* dan dilakukan secara manual oleh pekerja dengan menggunakan mesin pemotong PCB. Daripada pemerhatian yang dibuat di syarikat tersebut, teknik yang digunakan memerlukan masa yang lebih dan sukar untuk menangani panel yang besar. Walaupun dipasaran terdapat pemotong PCB yang automatic, tetapi ia terlalu mahal jika dibandingkan mesin yang ada sekarang. Projek ini akan memfokuskan tentang merekabentuk dan menambahbaikan mesin yang terdapat di syarikat Cubic Electronic Sdn. Bhd.

DEDICATION

For my mother, father and all my family and do not forget also to my friend and lecturer who helps me to complete this project.

ACKNOWLEDGEMENT

First and foremost, I would like to thanks my supervisor of this project, En. Hanizam Hashim. His guidance and advice inspired me greatly to work in this project. His willingness to motivate me contributed tremendously to my project. I also would like to thank him for showing me some example that related to the topic of my project. Besides, I would like to thank the authority of Universiti Teknikal Malaysia Melaka (UTeM) for providing me with a good environment and facilities to complete this project. Also, I would like to take this opportunity to thank to the Cubic Electronic Sdn. Bhd. which provides me valuable information as the guidance of my project. Finally, an honourable mention goes to our families and friends for their understandings and supports on us in completing this project. Without helps of the particular that mentioned above, we would face many difficulties while doing this project.

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LIST OF ABBREVIATIONS

PCB	Printed Circuit Board
SMT	Surface Mount Technology
ICT	In Circuit Test
PCBA	Printed Circuit Board Assembly
CAD	Computer Aided Design
SMD	Surface Mount Device
IR	Infrared
3D	3 Dimensions

CHAPTER 1
INTRODUCTION

1.1 Problem Background

Depanelization is one important process in high volume electronic assembly production i.e. PCBA printed circuit board assembly. In order to increase the output of printed circuit board (PCB) manufacturing and surface mount (SMT) lines, (*Surface-mount technology (SMT) is a method for constructing electronic circuits in which the components, are mounted directly onto the surface of printed circuit boards*) PCB are often designed so that they consist of many smaller PCBs that will be used in the final product. This PCB cluster is called panel or multi block. The large panel is broken up or "depaneled" as a certain step in the process. The depaneling process may happen right after SMT process, after in circuit test (ICT), after soldering of through hole element or even right before the final case-up of the assembly depending on the product or process.

There are few depaneling cutting techniques that have currently been used in industry nowadays. The techniques have been used are:

a) Hand break
b) V-cut / Pizza cutter (*The use of a pizza cutter to avoid the dislodging of loose toppings through the back-and-forth motion of the blade typical of a knife*.)
c) Punch
d) Router
e) Saw

1.2 Problem Statement

This project is based on industrial problems at Cubic Electronics Sdn. Bhd. to cut the printed circuit board. The PCB comes in a panel form contains from double up to 100 pieces of single PCB's in one panel. The PCBs are separated by V-groove at top and bottom from one end to another and needs to be cuts in order to use them. The current technique is by using punch and pizza cutters and manually done by operators using jig or depanelize machine respectively. From the observations made at the company, the technique takes longer cycle time and difficult to handle for large panels. Although there is an automatic PCB cutter available in the market, the machine is far too expensive compared to the current machine. The current depaneling machines have their own advantages and disadvantages.

Advantages of current depaneling machine

1. Lower cost – low cost because lower money is invested to buy the machine

Disadvantages of current depaneling machine

1. Low productivity – less of outputs with longer cycle time need to operate the machine manually.
2. Cause stress to the circuits within the PCB layers – the current machine is using 2 rotating blades. The blades are used to press the v-cut and force it to be separated. The other process is using punching jig to break the edge breakaway PCB. These stresses that been introduced have very high risk to the internal circuits and components joints and may lead to short and open conditions. In addition, the PCBA will fail functionally and worst have to be scrapped.

1.3 Objectives

The objectives of this study are to design a new PCB cutter machine which:

1. Design a PCB Depanelizing Jig
2. To reduce stress to PCB and chip during cutting process to reduce the reject part.
3. Cost effective – in term of overall performance of the machine and process for examples, reduce reject and cycle time.
4. Easy to handle – The operator easily can handle the machine without specific skills.
5. Improve the Productivity – use method and part that can improve the productivity of the output.

1.4 Scope of Project

In this project, several tools and equipment will be used in order to fulfil the objectives that have been stated. The scopes of this project are as follows:

1. PCB panel used is standard panel 18”x 24” (457mm x 610mm).
2. Using saw as a cutter.

CHAPTER 2

LITERATURE RIVIEW

2.0 Printed Circuit Board (PCB)

In 1950's electronic companies started using Printed Circuit Board (PCB) to reduce cost and errors. A simple PCB contains an insulating substrate (the board) which made of phenolic (a material made from paper and resin), fibreglass or ceramic. Then a thin layer of copper printed/placed on the board in a particular pattern to connect all the components mounted to the board. (Al Williams, 2004)

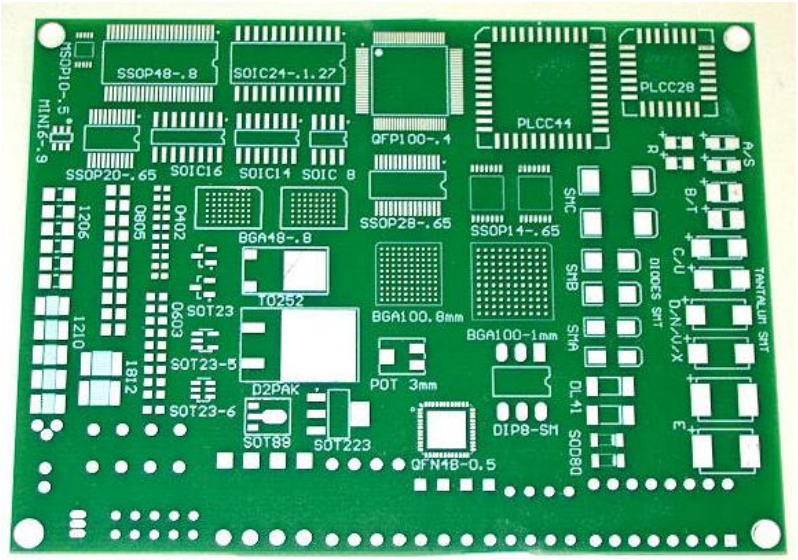

Figure 2.1: Printed Circuit Board

2.1 Panelization

Panelization is required for all SMT boards and smaller boards (whether through-hole or SMT) to increase processing efficiencies. There are some considerations when deciding to panelize or not. From an assembler's perspective, panels are desirable and sometimes necessary to provide the tooling holes and PCB edge clearance requirements. The PCB manufacturer's material utilization and cost of an electrical test fixture should also be considered, which the main priority is often. (Tommy Ewing, 2007. Sibex Electronic)

The following are some considerations for circuits intended for panelization.

1. If components overhang the edge of the PCB, adequate space between circuits to allow all components to be installed on the panelized PCBs is necessary. The layout may allow for component clearance on the adjacent PCB so that material usage is not sacrificed.
2. Panels can be either scored or routed or a combination of each depending on the application. For routed PCB's the breakaway tabs should be drilled for inside breakaway. Copper Trace or plane clearance at the location of the breakaway tabs should be at least 0.10" from the PCB edge. For V-Score, see below guideline.
3. Component weight and panel size should be considered to reduce the possibility of warpage and/or breakage. Panels that are wave soldered (i.e. Through Hole Components) will tend to sag in the center when subjected to preheat and reflow temperatures.

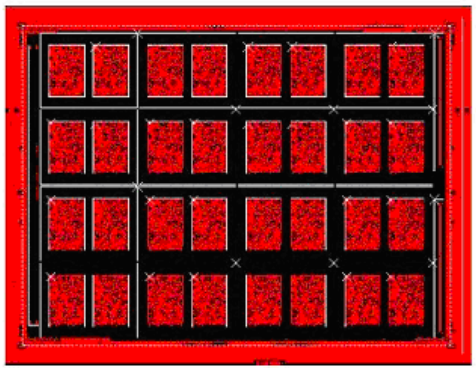

Figure 2.2: 18" x 24" (457mm x 610mm) panel example

2.2 V-Groove

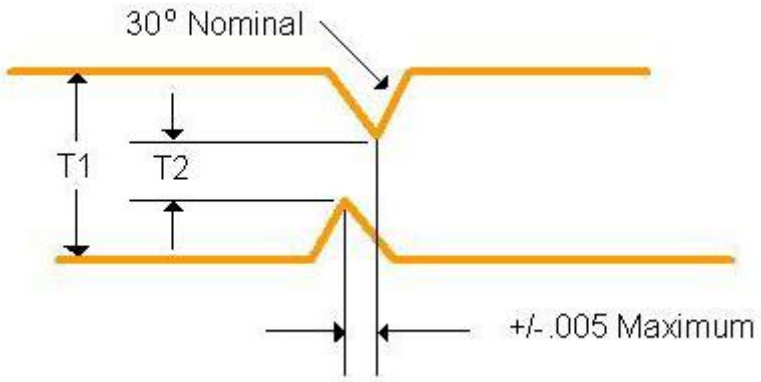

Figure 2.3: V- Groove

(Sanmina-SCI Company, http://www.Sanmina-SCI.com Copyright 2001 – 2007 Sanmina-SCI Corporation)

- Minimum / maximum panel thickness (T1): 0.020” / 0.080” (0.5mm/2mm).
- Maximum score distance: 25”.
- Standard web thickness tolerance: +/- 0.005” (0.1mm).
- Preferred score angle: 30 +/- 2 degrees.
- The standard/maximum web thickness (T2 in “Scoring diagram” figure): 0.012”/0.020” (0.3mm/0.5mm).
- Traces should be ≥ 0.040” away from the score line center on all outer and inner layers.
- Score line width should be 1.15 times the depth.
- One score test coupon per score line should be included in the net list; these score coupons will be designed as opens No board-to-board spacing is required.

2.3 Surface Mount Technology (SMT)

Surface mounts technology (SMT) which component leads are attached directly on the surface of the board. The component that suitable with this technology called surface mount device (SMD). (Clive Maxfield, 2002).

In surface mount technology, the traditional component lead through is replaced with solder paste to hold the component on the surface of the PCB. A solder paste template is made that's allowing the placement of the components at required area. Then all the required components is placed manually or usually automatically placed onto the solder paste. A baking process allows the solder paste liquefies and the components remain soldered to the PCB. (David A. Madsen 2001 Ed. 3)

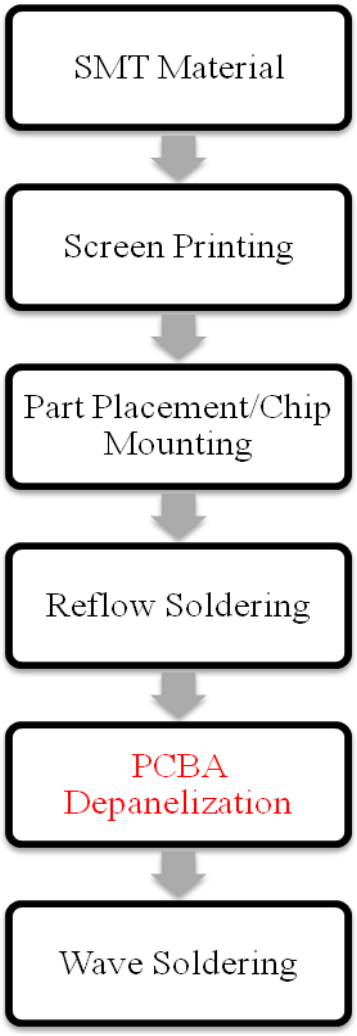

Figure 2.4: SMT Flow Process

2.3.1 SMT Tool/Material

The main raw material for screen printing is solder paste and the tool used are solder paste screen or pattern, solder paste and PCB.

Figure 2.5: Solder Paste

Figure 2.6: solder paste screen or pattern

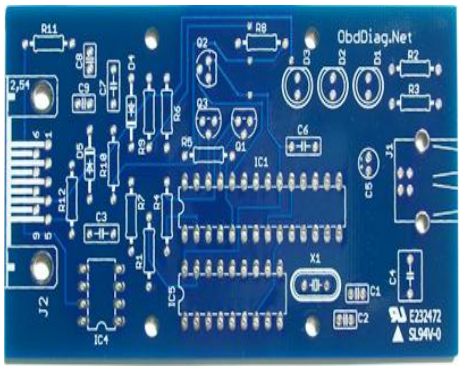

Figure 2.7: Printed Circuit Board (PCB)

2.3.2 Screen Printing

The most commonly used solder paste disposition is stencil printing although the other technology also is being use like dispensing, pin-transferring and roller coating. A stencil usually made from metal foil with a pattern similar to footprint of PCB where deposition of solder paste desired. The solder paste will be deposited onto the stencil and will be wiped with squeegee across the stencil. The stencil then will be detached from the surface of the PCB with solder paste on top of the corresponding pads. The printing process normally being used because of the higher speed, higher through-put, better patterns registration and better solder paste volume control. (Ning-Cheng Lee, 2002)

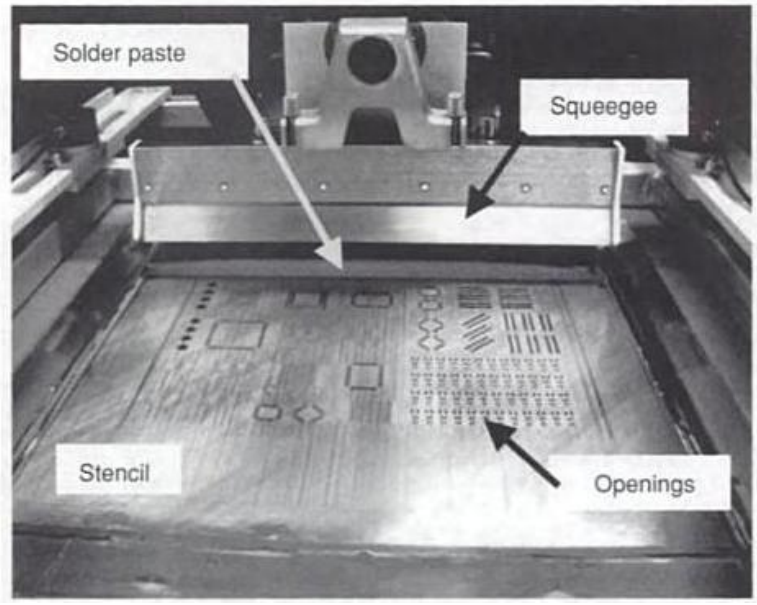

Figure 2.8: Stencil Printing

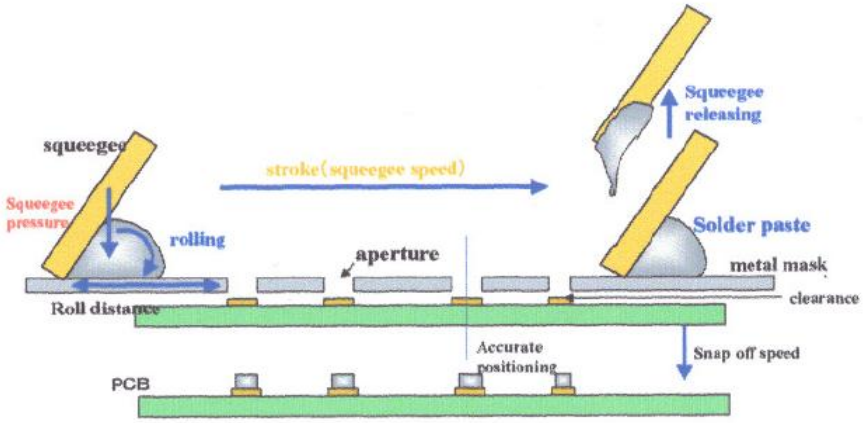

Figure 2.9: Printing Process Illustration