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ROBOTIZED PRODUCTION FOR  
SURFACE MOUNTING OF ELECTRONIC CIRCUITS

DP/YUG/87/014

YUGOSLAVIA

Technical report: Assistance in Surface Mounted  
Device (SMD) Technology\*

Prepared for the Government of Yugoslavia  
by the United Nations Industrial Development Organization  
acting as executing agency for the United Nations Development Programme

Based on the work of Werner Mainwald, expert in  
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Vienna

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\* This document has not been edited

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1. Introduction

The visit to Yugoslavia took place from 26 - 30 September 1988 and was very well planned by the project manager Mr. Keber. The mission programme is attached as an annex and was followed as planned. The main points on the agenda were:

- Information on the relevant personnel in Kostanjevica regarding SMD technology in general.
- Visit to the Faculty of Electrical Engineering in Ljubljana, lecturing and discussions.
- Lecture on the state-of-the-art and trends of SMT and discussion with representatives from various ISKRA areas in Kranj.

2. Outcome and conclusions

The results of the visit can be set out as follows:

1. From the information available to the author, the range of applications at ISKRA Elementi, whose SMD pilot line is to be installed in Kostanjevica, will typically include low and medium quantities with different, and above all, unknown composition.
2. A flexible, adaptable manufacturing facility is needed for the specified requirements which is also oriented towards the future. The capacity should be a few thousand SMD/h.

A rigid hardware link of units should not be the aim initially, as this results in significant increases in costs and restricts the adaptability of the assembly equipment. Therefore, single units (cells) should be installed and selected such that they permit the processing of a minimum format, have comparable production capacity and can be operated with the same software (e.g. interlinking CAD system and assembly machine).

3. It is recommended that production be started with the existing equipment used for the pilot line, this should be supplemented by the following:
  - screen printing facility
  - equipment for the production of stencils for the application of solder paste
  - manual assembly station for SMDs which cannot be placed with the available automatic machines
  - manual assembly station for components with wire leads
  - a very simply equipped repair station (soldering iron, hot air device)
  - possibly equipment for laying out PCBs. This depends on whether layouts are to be produced in Kostanjevica.
  
4. The construction of the pilot line should be undertaken without delay, since the competitive situation demands it. Comparable sectors of the industry have already started introducing SMD technology. Experience shows that a familiarization period of 1/2 - 1 year should be expected.
  
5. After the introduction of SMD technology (at the latest after 1 year), the expansion of the minimum solution suggested should be carried out with the accent on the assembly equipment. At that point in time, the SMD assembly must be carried out completely by automatic assembly machines. If the robot cell is then available, it must be implemented in the existing assembly station, i.e. the robot cell must be hardware- and software-linked to the assembly machine. If the robot cell is not available, another high-performance system should be installed, which assumes that suitable investment is available.
  
6. Since ISKRA Telematics and/or the Faculty of Electrical Engineering intend to install a CAD system for PCB layouts, consideration must be given to the possibility of interlinking CAD system and automatic assembly machine. This interaction is a requirement for efficient programming of the assembly machine.  
The author presented the existing component library for the CAD system in question (HP EGS).

7. Experience on the technology should be gathered as soon as possible on one or more practical applications, irrespective of the production profitability.
  
8. During the visit and during the discussion at the Faculty of Electrical Engineering, the robot cell project was introduced. According to the author's estimation, the implementation of such an ambitious project requires a longer period of time (at least a few years). Although some equipment has already been developed to the prototype stage, a completely new development for the special requirements of SMD technology must be started. For future applications, for which the processing of ICs with a large number of pins is required (e.g. FP PLCC), a vision system is needed for the PCB as well as for the component.  
  
The development of the SMD robot cell can be carried out at ISKRA independent of the other activities. An assessment of the competitiveness of this cell cannot be given without going much deeper into the whole project.
  
9. The various prerequisites and requirements at ISKRA need individual solutions specifically with regard to the introduction of equipment for SMD production. For example, an SMD production facility at ISKRA Telematica requires a substantially higher degree of automation and a higher capacity than at ISKRA Elementi. Central SMD production is therefore not recommended.
  
10. It is recommended to establish a working group consisting of representatives from the various ISKRA sectors, which will meet regularly or occasionally to exchange experience. Tasks which are the same or similar can then be co-ordinated.

Mission Programme

Monday, September 26 1988

- 08.30 - Reception at the Director of Research and Development Division in ISKRA Elementi.
- 09.15 - Transfer to ISKRA Industrijska Elektronika
- 12.00 - Introduction of UNDP project to the Expert
- 13.00 - Expert's general introduction to the project staff
- 13.30 - Start of the work on SMT technology with the project staff

Tuesday, September 27

- - Work on SMT technology with the project staff

Wednesday, September 28

- - Work on SMT technology with the project staff

Thursday, 29 September

- 08.30 - Visit at the Faculty of Electrical Engineering, discussion about the robotised pick and place equipment development (discussion)
- 13.30 - Reception at the Director of Research and Development division in ISKRA Elementi

Friday, 30 September

- 09.00 - ISKRA Telematika, Kranj  
Presentation about the state of and future trends of SMT introduction in the electronic industry at round table talks for all ISKRA people working on SMT.  
Discussion about SMT

Summary of Lectures

1. Mission in Kostanjevica

The mission was a mixture of lectures and discussions with the SMD staff.

Introduction to the SMD technology

Principle of SMD

Construction of a SMD board

SMD components (passives, discrete semiconductors, integrated circuit, reliability, storage)

Advantages

Processing steps

Apply solder paste (screening, stencil, dosing)

Apply glue

Placement SMD (comparison THC vs. SMD, principle of SMD, limitations, vision system, stand-alone, in-line-equipment, simultaneous, pick-and-place-system, programming, HW-SW-link.

Soldering (theoretical consideration, wave soldering, reflow soldering, soldering equipment, comparison of different methods, preconditions, advantages, disadvantages, inspection, manual soldering, fluxes)

Cleaning (methods, solvents, ultra-sonic)

Testing

Repair

SMD equipment (Hardware, Software)

Demands on PCBs and components

PCB layout recommendations

Tendency in SMD market

2. Visit at the Faculty

Introduction

Principle of SMD assembly

Pick and Place System MS-72

Placement head

Glungi station



Performance

Option and features

Programming

Discussion

3. Presentation and round table talk in Kranj

SMD technology today and tomorrow

Variety of PCB producers

Typical equipment for big and small companies

HW-SW-link

Trend in production

Restrictions today

Construction of SMD boards

SMD components

PCB

processing

screening

glungi

assembling

vision system

soldering

inspection, check of presence

testing (in circuit, functional)

cleaning

HW-SW-link

development of SMD-boards

discussion