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# ELECTRONIC INSTRUMENTATION, AUTOMATION AND PROCESS CONTROL DEVELOPMENT

DP/ALB/84/001

ALBANIA

## Technical Report: CAE/CAD Selection for PCB Design and Layout*

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

Based on the work of K. Stadler, expert in

CAE/CAD selection

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Vienna

* This document has not been edited.

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# 1.Summary

## 1.1 Purpose

Selection of appropriate hard- and software for the fields of PCB conception, layout and simulation, desktop publishing, microprocessor development and laboratory.

## 1.2 Results

According to the needs of the institute and the available information (provided by UNIDO, QSPAE and the author) the following results have been worked out:

- Hardware configuration for a workstation for PCB design and layout, incorporating the requirements for 3 additional workstations (for desktop publishing (DTP), microprocessor development (MPD) and laboratory (LAB) ). The stress was put on replaceability of components, limited budget, integration of widely used components and sufficient functionality for professional use (Appendix 2,3).
- Selection of 5 CAD packages (out of a range of 12) which match the institute's requirements best (according to the available information about functionality).
- Definition of a requirement paper concerning the required functions of the PCB CAD Tools(Appendix 1).
- Hardware configuration for the CAM System (Appendix 4).
- Software configuration for the desktop publishing station (Appendix 5)

## 1.3 Further Steps

Workstation Hardware (PCB, DTP, MPD, LAB) :

- request for offers on the basis of the defined configuration and price negotiation

PCB Software:

- handing over the requirement paper to distributors, including the request for offers
- evaluation of the returned specifications
- organization of demonstration (2 to 3 products)
- final decission

CAM-Hardware:

- request for an offer (LPKF) and price negotiation

DTP Software:

- request for offer and price negotiation

Additional Hard- and Software for MDP:

- not yet discussed

Additional Hard- and Software for LAB:

- not yet discussed

# 2. Procedure of Cooperation

The institute presented its concepts and requirements for the process of schematic entry, placement, routing and simulation of printed circuit boards (PCB). As there are 3 more workstations to be installed in the field of desktop publishing (DTP), microprocessor development (MPD) and laboratory (LAB), these concepts were also presented and discussed.

First the available information about PCB software, provided by UNIDO, QSPAE and the author, was scanned. The stress was put on those functions which are of high priority for the work in the institute, regarding the special situation of technological availability in Albania.

Information about 12 different packages was available , all different in their completeness.

Five packages were selected, which seem to cover the requirements.

A configuration paper including all required functions has been worked out and will be handed over to the respective distributors for getting more detailed information on the important subjects.

Afterwards the needed hardware was configured under the following aspects:

- as much power and functionality for the given budget
- covering all the interfaces of the software
- usage of standard components which are widely used
- maximum of replaceability combined with the whole equipment including DTP, MPD, LAB.

Finally a strategy for the further proceeding has been discussed.

# 3. PCB - software

With the help of the available information which was not equally complete for every package, the following packages for PCB layout were selected:

| Package | Distributor |
|---|---|
| 1. METADESIGN | a) COMEF/LEANORD, Nanterre/France<br>b) ?/Austria |
| 2. CADSTAR | a) RACAL Elektronik/Vienna/Austria<br>(Tel. 0222/34 45 11 - 435) |
| 3. P-CAD | a) Rekirsch/Vienna/Austria<br>(Tel. 0222/25 36 26 0) |
| 4. ARIADNE | a) CAD-UL/Ulm/Germany<br>b) INTEC/Brunn am Gebirge/Austria<br>(Tel. 02236/33 555) |
| 5. ORCAD | a) COMPWARE/Hamburg/Germany<br>(Tel. (06) 040/81 80 74)<br>b) DAHMS Elektronik/Graz/Austria<br>(Tel. 0316/64 030 0) |

ARIADNE and ORCAD seem to be less flexible in the support of different shapes of pads and via holes, which is a quite sensible subject for the used technology in Albania.

The following packages where not chosen because of the mentioned disadvantages:

| | |
|---|---|
| EIE Designer: | cheap, but limited functions |
| Ranger: | no support of high resolution screens |
| KAD 286: | little information was available, seems to have limited functions |
| LPKF: | needs a special acceleration card |
| AUTOPCB: | good functionality but quite expensive. |
| CADDY: | too few functions |
| MIKRON: | very powerful but very expensive |

# 4. Hardware

## 4.1. Criteria for selection

The hardware selection had to respect certain preconditions:

- Spare parts are not easily available in Albania
- Maintenance has to be done by the institute's staff
- Limited budget
- Consumer parts are available only in restricted manner (paper without tractor perforation, no high density floppy diskettes)
- No equipment for preventing cuts in power supply
- Change to UNIX must be possible

Out of these reasons not only the workstation for PCB layout has been defined: all 4 intended workstations were merged into one configuration, which has the following characteristics (see Appendix 2 and 3):

- Only widely used components are integrated
- As much functionality and performance has been put in, which allows professional use and lies within the financial level
- Replaceability for every component (with the exception of the pen plotter) which allows a shorttime substitution without a greater loss of performance.
- Purchase of printers with (additional) fraction mechanism so that local, nonperforated paper can be used.
- Usage of refillable pens for the plotter
- The CAD software package should include a function of automatic data safe after a defined time interval, for holding low the data loss in case of power cut.
- Out of limited budget no local area network (LAN) can be integrated for the moment. As the distance between the workstations will be up to 80m no central usage of periphery (printers, plotter, streamertape) is possible. So the 'high quality' printer and plotter will be attached to the workstation which uses them most. Work with other workstation will be done by means of floppy diskettes. For minimizing those data transfers low cost printers will be used at those workstations.

### 4.2 Distributors

| | |
|---|---|
| Schwaighofer /Vienna (Tel. 0222/505 27 59) | COMPAQ |
| Computer Handels Ges./Vienna (Tel. 0222/55 21 35 0) | ? |
| Dataservice/Vienna (Tel. 0222/71 143 0) | .? |
| AAC/Villach (Tel. 04242/22 700) | Siemens |
| ? | Tandon |

### 4.3 Cost Estimation

The following estimation for the total price of the hardware equipment is made in US$ and on an undiscussed basis (official list prices)

| Component | PCB | DTP | MPD | LAB | Miscellaneous |
|---|---|---|---|---|---|
| **Workstation** 80386 based(*) | 8800 | --- | 8800 | --- | add. 2MB RAM 1600 |
| **Workstation** 80286 based(**) | --- | 5000 | --- | 5000 | Steamer or 40MB 1600 |
| **Mouse** | 300 | 300 | 300 | 300 | |
| **Printer** | 1800 | 1800 | 900 | 900 | **Manuals** |
| **Plotter** | 2600 | --- | --- | --- | 200 |
| **Coprocessor** | 1000 | | | | **Training** |
| **Interfaces** | --- | --- | 300 (ser/par) | 500 (IEEE) | 2800 |
| **Monitor** | 4000 | 2500 | 350 | 1100 | |
| **Graph. Card** | 1500 | | 400 | 400 | |
| **Material** | 1400 | 700 | 500 | 500 | |
| **FD 3.5"** | --- | --- | --- | 500 | |
| **Total** | 21400 | 10300 | 11550 | 9200 | 6200 |
| | | | | | 58650 |
| | | | | min 20% | - 11650 |
| | | | | US$ | 47000 |

(*) Including 2 MB, FD 5.25", 70 MB Harddisc, US Keyboard

(**) Including 1 MB, FD 5.25", 40 MB Harddisc, US Keyboard

### 4.4 Miscellaneous

Distributor for small, low cost equipment for preventing power cuts:

SRS, Edelsinnstraße 5, A1120 Vienna, Tel. 0222/87 25 11-0

# 5. Hardware for CAM (PCB Plotter)

The offer of LPKF/Germany fits the institute's needs quite good, so a detailed configuration has been worked out.

# 6. Software for DTP

The main emphasis is on the following subjects:

- creation of scientific papers and documentation
- creation of technical reports and descriptions
- office work
- interface to CAD tools

Out of the author's experience the most appropriate tool including these requirements is VENTURA Publisher in combination with a wordprocessor (e.g. WORDSTAR) and a powerful graphic tool (e.g. DESIGNER or the graphic editor included in the CAD package, if powerful enough).

To create mathematical formulas one should await Version 2 of VENTURA (April 1989 ?) which has enhanced features for that purpose. That avoids usage of a further package (e.g. PC TEX) for which training and maintenance would be necessary and for which exists no interface to a DTP-tool.

For the time being there is no high resolution screen on the market satisfieing the needs of DTP in a sound way. In about 4 months things will have changed so that a recommendation should be delayed.

Estimated costs for software: US$ 3000.- plus installation and training.

Distributors:
- EDTZ, Ottobrunn Munich, Germany
- Ueberreuter Media, Vienna, Austria
- Computer 2000, Vienna, Austria

# 7. Installation, Training Maintenance

At the time being there exists only little know how regarding the installation, usage and maintenance of hardware, operating system and CAD tools.

As these are very complex subjects it is highly recommended to send experts for the purpose of installation and training of the staff. Private study will be very inefficient.

**a. Hardware**

The chosen company or distributor must be informed, that there is a chance of starting business in Albania in the future. So they should provide an expert who installs the components and trains the staff in the maintenance of the hardware (minimum 3 days). Set of detailed manuals must also be provided, to allow local maintenance in a proper manner.

**b. Operating system and general tools**

The use and means of troubleshooting on MS-DOS level must be trained. In addition the use of tools (wordprocessor, graphic user interface,DTP - Tools) has to be taught.

This job could be done by a UNIDO expert (3 to 5 days). Available literature must be provided.

**c. Software for PCB**

A minimum of 3 days training by an expert of the company should be provided.

# APPENDIX 1

## Software Configuration for CAD Tools in the fields of PCB design, layout and simulation

### 1.Prices:

We kindly request to state the price for each of the following items covering the functionality described in point 2

- Schematic capture
- Placement / Routing
- Logical simulation
- PSPICE
- Demonstration Package
- Training for PCB-Software

### 2. Functional Requirements

Please answer the following questions as detailed as possible.

The following hardware configuration will be provided:

AT-compatible, 80386, 20 MHZ, 2-4 MB RAM, 70 MB Disc, Bus Mouse, Color monitor, 19", min. 1024* 768 resolution, monochrome text monitor (if necessary), MS-DOS (UNIX later on)

### 2.1. System Dependancy

a) No 640kB limitation in MS-DOS (the minimum of supported memory should be 4 MB)

b) Is UNIX portability provided

c) Computing time per connection in auto routing (min. max)

d) Graphic card: - is Metheus/Omega 1024*768 supported

- which card do you suggest

e) How easy can one switch between Hi-res and EGA

f) Is documentation in English available covering the whole functionality

g) Is there the need of an accelerator or coprocessor

h) Which tablets are supported

i)Which bus mouse is supported

j)Do you support or recommend double-monitor configuration (one text/one graphic).

k) which HW components do you rcommend, which do you sell and maintain

l) where and how can a detailed demonstration be organized

## 2.2 Schematic Capture

a) Libraries:
- CMOS/TTL included
- extendable by a graphic editor
- which editor is supported
- which output format is supported by the editor (interface to DTP)

b)Editingfunct.:
- Grid, which is freely changeable
- Rubberband technique
- Zoom/pan/rotation/copy/etc
- Swap mode (clipping)
- Input by coordinates

c) Automatic safe of the edited data (time interval must be chooseable)

d) Design rule check: what is checked

e) Which reports and statistics can be done

f) Limitation of the number of components/connections only be memory

g) Graphic output is supported for which matrix printers

h) Interfaces to
- Placement / Routing
- Logic simulator (which?)
- PSPICE
- DTP

## 2.3 Placement/Routing

a) Automatic and interactive placement

b) Automatic and interactive routing

c) Reentrant ability: can placement/routing be interrupted and taken up again

d) Which algorithms are used for placement/routing

e) Multipass routing with different sets of parameters

Parameters are:
- limitation of vias per connection
- concentration on certain areas of the board

- max length of diagonal routes
- allocation of horizontal and vertical layers

f) Angle of routing (45 deg or free)

g) Number and shapes of pads and vias

h) Rubberbanding for interactive work

i) Zooming, paning, etc.

j) What are the limitations .or the shape of the PCB / can areas be protected

k) Minimum Grid: 0.01 mm / gridless routing possible

l) Back annotation

m) Can the minimum of clearance space be set

n) Support of SMD

o) Which text features are available

p) Which reports, statistics and lists can be created

q) Output:
- control plots on matrix printer (which?)
- HPGL - format for pen plotter
- GERBER - format for mechanical plotter
- solder stop mask
- output on files
- Is the thickness of plotter pens controllable

**2.4 Simulation**

a) Logic simulator: specification of the functions

b) Is PSPICE available

c) Output of logic simulator and PSPICE possible on matrix printer and/or file

d) Interfaces to DTP

# APPENDIX 2

## Hardware Configuration for Workstations in the fields of PCB Design, DTP, Microprocessor Development and Laboratory

We kindly request to state the prices separately for every of the following items.

The offered microcomputers must be fully AT-compatible and should be produced by one of the following companies:

- COMPAQ
- SIEMENS
- TANDON

| 1. Workstation for Schematic Capture and PCB Layout | | | Price |
|---|---|---|---|
| CPU: | - | 80386 (Frequency: _____MHz) | _____ |
| RAM: | - | 2MB | _____ |
| Harddisc: | - | 70 MB minimum/30 ms maximum access time | _____ |
| FD Drive: | - | 5 1/4", 360KB/1.2 MB | _____ |
| Keyboard: | - | international (US) | _____ |
| Mouse: | - | Logitech Bus Mouse | _____ |
| Coprocessor: | - | 80387 | _____ |
| Interfaces: | - | one RS232 serial port | _____ |
| | - | one parallel printer port | _____ |
| Monitors: | - | monochrome, 14" | _____ |
| | - | color, 19", resolution 1024* 768 min | _____ |
| Graphic Card: | - | 16 colors, resolution 1024* 768 min.(e.g. Metheus Omega or Galaxy 1024) including SW-Driver for Autocad, GEM, Windows, Ventura, Pagemaker | _____ |
| Printer: | - | matrix, 24 pins, DIN A3, 264 char/sec minimum draft,tractor and friction,parallel interface cable (e.g. EPSON LQ-1050) | _____ |
| Plotter: | - | pen, 6 or 8 colors, DINA3 ,serial interface cable, HPGL format (e.g. HP 7475 A) | _____ |

| | | | |
|---|---|---|---|
| Material: | - | Pens, refillabe, different thicknesses from 0.1 mm to 1 mm, 1.5 mm, 2mm | _____ |
| **TOTAL for PCB:** | - | | _____ |
| optional: | - | additional 2 MB RAM | _____ |
| | - | additional hard disk drive, 40 MB | _____ |
| | - | Backupstreamer 60 MB plus 10 cartridges | _____ |

**2.Workstation for Desktop publishing**

| | | | |
|---|---|---|---|
| CPU: | - | 80286 (Frequency: _____ MHz) | _____ |
| RAM: | - | 1MB | _____ |
| Hard disc: | - | 40 MB, 30 ms access time maximum | _____ |
| Floppy: | - | as in 1) | _____ |
| Keyboard: | - | as in 1) | _____ |
| Mouse: | - | as in 1 | _____ |
| Interfaces: | - | as in 1) | _____ |
| Monitor: | - | monochrome, 16"/19", resolution 1024 * 1024 min | _____ |
| Graphic Card: | - | resolution 1024*1024 min, including SW-Driver for MS-Windows, GEM, Autocad,Ventura, Pagemaker, (PC-TEX ?) | _____ |
| Printer: | - | as in 1) | _____ |
| **TOTAL for DTP** | - | | _____ |

**3. Workstation for microprocessor development**

| | | | |
|---|---|---|---|
| CPU: | - | 80386 (Frequency: ____ MHz) | _____ |
| RAM: | - | 1 MB | _____ |
| Hard disc: | - | as in 2) | _____ |
| FD: | - | as in 1) | _____ |
| Keyboard: | - | as in 1) | _____ |
| Mouse: | - | as in 1) | _____ |

| | | | |
|---|---|---|---|
| Interfaces: | - | 2 serial RS 232 ports | _____ |
| | - | 2 parallel ports | _____ |
| Monitor: | - | monochrom, 14" | _____ |
| Graphic Card: | - | EGA/Hercules/VGA | _____ |
| Printer: | - | Matrix (low cost), DIN A4, friction (and tractors,parallel interface cable | _____ |
| **Total for MPD:** | - | | _____ |

**4. Workstation for Laboratory**

| | | | |
|---|---|---|---|
| CPU: | - | 80286 (Frequency: ____) | _____ |
| RAM: | - | 1MB | _____ |
| Hard disc: | - | as in 2) | _____ |
| FD: | - | as in 1) | _____ |
| | - | plus 1 drive 3.5", 760 kB/1.4 MB | _____ |
| Keyboard: | - | as in 1) | _____ |
| Interfaces: | - | as in 1) | _____ |
| Monitor: | - | color, 14" | _____ |
| Graphic card: | - | EGA/Hercules | _____ |
| Printer: | - | as in 3) | _____ |
| Add on: | - | IEEE 488 card | _____ |
| **TOTAL for LAB:** | - | | _____ |

**5. General**

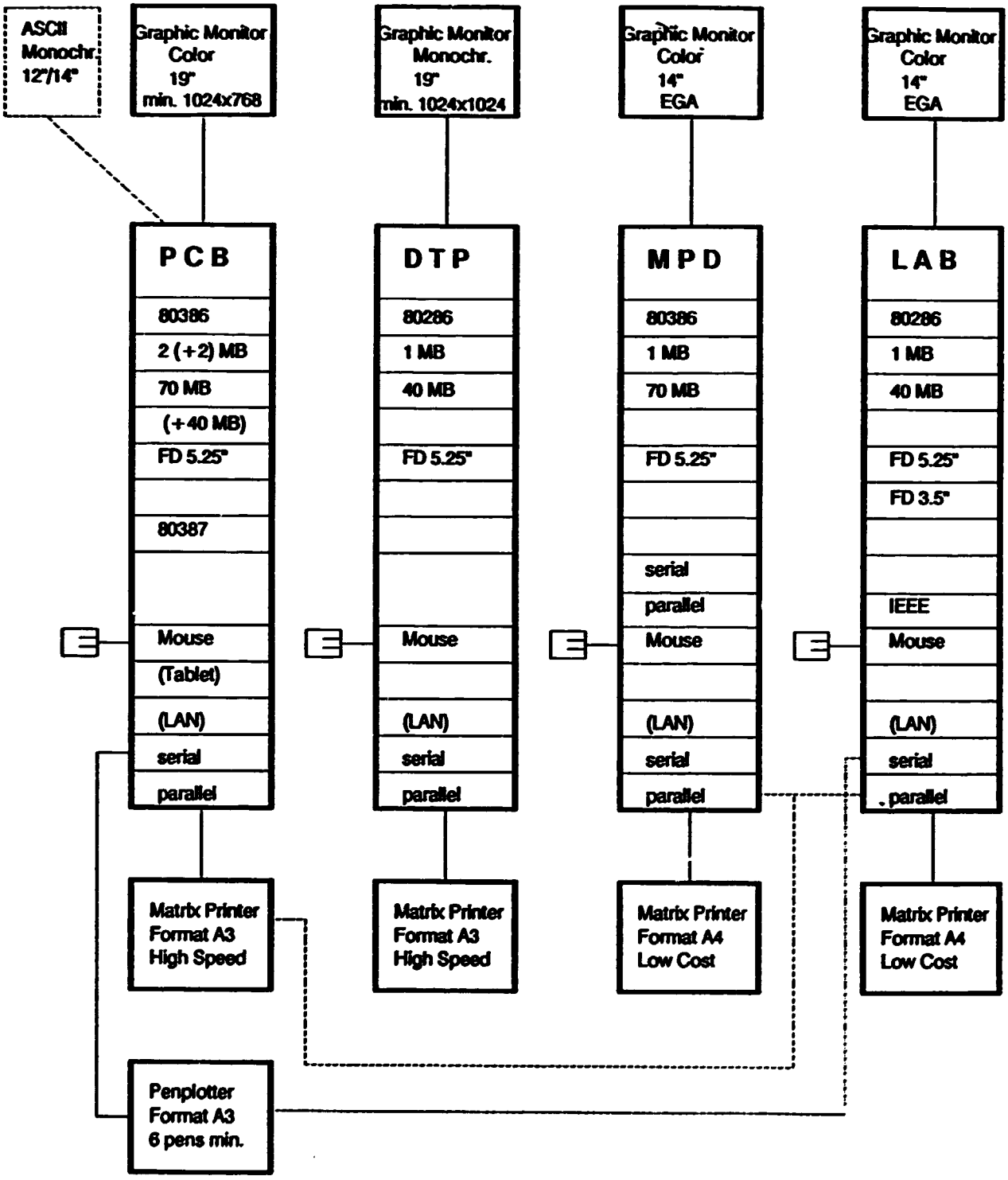
Power supply: - 220 V, +/- 10%, 50 HZ

Number of free slots after complete installation of the above described configuration must be approx. 5 (AT, XT)

| | | | |
|---|---|---|---|
| Software: | - | MS-DOS V3.3 , GEM and/or MS WINDOWS | _____ |
| Material: | - | Floppy DS/HD (1.2 MB): 30 packas a 10 | _____ |
| | - | Ribbons(printer) : 20 per printer | _____ |
| | - | Paper: 2 boxes per printer/plotter | _____ |
| | - | all necessary connection cables | _____ |

| | | | |
|---|---|---|---|
| | - | FD Boxes | _____ |
| | | | _____ |
| Manuals: | - | all necessary documentation for system's use. Complete hardware description which allows maintenance in a proper manner. | _____ |
| Training: | - | for transferring maintenance know how (approx. 2-3 days) | _____ |
| Guarantee: | | | |
| Maintenance: | | | |
| Spare Parts: | | | |

# Appendix 3: Hardware Configuration

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Stadler/11/11/1988

# APPENDIX 4

## CIRCUIT BOARD PLOTTER (Comp. LPKF CAD/CAM Systeme GmbH.)

### Software

1. Software ISOLATE with RUBOUT
2. Software Gerber interpreter

### Machine

1. Circuit board plotter LPKF 101 HI-P (High Precision)
2. Compressor include 90 l container

### Special Equipment and Accessories

1. Machine caps for noise reduction and dust prevention
2. Vacuum cleaner
3. Silencer for vacuum cleaner
4. Pilot pice, 3mm dia. for fitting holes in the machine table tap - 20 pieces
5. Baseplate for film-engraving: 2 pieces

### Mill/Drilling Tools - Union Carbide Tools

1. LPKF universal milling drilling cutter
   - 0.2 mm 50 pieces
   - 0.3 mm 100 pieces
   - 0.5 mm 30 pieces
   - 0.7 mm20 pieces
2. LPKF film cutter
   - 0.3 mm dia20 pieces
3. Spiral drill for drilling PC-Boards
   - 0.6 mm 20 pieces
   - 0.8 mm 40 pieces
   - 0.9 mm 40 pieces
   - 1.0 mm 20 pieces
   - 1.2 mm10 pieces
   - 1.4 mm10 pieces

4. Contour router to mill PCB contours
   - 1.0 mm dia.10 pieces
   - 2.0 mm dia.10 pieces
   - 3.0 mm dia.10 pieces
5. Tool for aluminium engraving: 10 pieces
6. Film engraving foil 220 x 310 mm: 50 pieces
7. Drill underlay material phenol DIN A3: 10 pieces

**Training**

1. Necessary training days
2. Price per day

**Installation**

1. Necessary installation days
2. Price per day

**Note**

Our request is based on the LPKF CAD/CAM Systeme GmbH.

# APPENDIX 5

## Software Configuration for DTP:

WORDSTAR (english version)

Graphic editor eg. REDCAD, Designer

VENTURA(english version) V1.2, Upgrade to V2.0 as soon as available