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**ELECTRONIC INSTRUMENTATION, AUTOMATION
AND PROCESS CONTROL DEVELOPMENT**

DP/ALB/84/001

ALBANIA

Technical report: Selection of CAD/CAE equipment for PCB 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,
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Vienna

* This document has not been edited.

1. Introduction

On the basis of the information given by QSPAЕ (see paper from 21.11.88) and several days of studying the availability and functionality of hard- and software components (literature, talks with companies in Vienna and Munich), the following results and recommendations have been worked out (see also App. 1 and 2).

The recommendations take into account the special preconditions under which the equipment will be shipped to and used in Albania (embargo, no maintenance and spare parts, limited budget, extensions in future, etc.).

Abbreviations:

PCB	Workstation for PCB layout
DTP	Workstation for Desk Top Publishing
MPD	Workstation for Microprocessor development
LAB	Workstation for Process Control

2. Hardware

2.1 Microprocessors

The following facts suggest the use of 80386 based workstations (16 and 20 MHz resp.):

- the processor which will represent the state of the art for some time and which allows a troublefree use of UNIX is INTEL 80386
- the difference in price between 80386 and 80286 is less than \$1.000,-
- there is no real difference with export to embargo countries for 80286 and 80386 according to several companies, who have know how in that subject: there is the chance of shipping within 3 months.

These are the manufacturers of hardware which were investigated:

<u>Company</u>	<u>plus</u>	<u>minus</u>
COMPAQ	recommended by all manufacturers of CAD software for PCB layout (COMPAQ is the standard for CAD on PC AT) DESKPRO 386s is an inexpensive alternative for 80286 based PCs (it is based on 80386XS) good support in Vienna	-
TANDON	slightly cheaper than COMPAQ good support in Vienna	80286 based PCs not fully compatible to IBM AT
ACER	high quality PC from Taiwan cheaper than COMPAQ	export is not easier than for COMPAQ or TANDON
BULL, OLIVETTI, SIEMENS		were also checked, but are of less importance in the fields of technical and scientific applications. There is no easier export.

2.2 Screens

There is no standard for high resolution screens and graphic cards at the time being. The troublefree cooperation between screen drivers on one hand and the CAD software on the other hand is not always guaranteed. When using a new version of the software the screen drivers are available often months later and need a special purchase.

The only standard, which will be supported the next time by all the packages is VGA (640x400) and works without troubles with all the packages.

To guarantee a troublefree use and to provide a high redundancy between the workstations, it is recommended to equip all PCs with a VGA card. The PCB and the DTP station should be equipped with a 16" screen (for better readability), the two others will be sufficiently equipped with 14" screens.

This solution certainly is a compromise: there is less comfort for DTP, but

- it is sufficient for the CAD packages,
- it allows safe cooperation between drivers and software,
- it provides high redundancy in the case of breakdown and
- it is much cheaper than a 19"/high res solution (for example for the PCB station \$1.600.- versus \$6.200.-)

At the demo in Vienna, both solutions (VGA/14" and hires/19") will be demonstrated.

2.3 Mouse

It is recommended to use Logitech Bus Mouse on all workstations:

- it leaves free the serial port for the occasional use of the pen plotter
- it is equipped with 3 buttons, which allow faster work with certain CAD packages (ie. CADSTAR)

2.4 Memory

The only CAD package which uses more than 640 KB is P-CAD. In that case the PCB station should be equipped with a minimum of 2 MB RAM (LIM standard!). The other stations need only 1 MB RAM, because most software does not support more memory (for the time being).

2.5 Printer

In general there is no need for a laserprinter with the exception of the DTP station. As a laserprinter is not easily maintained in Albania, a good alternative would be the new HP DeskJet, which allows laser quality (300dpi) for about \$1.300.-.

The PCB station needs a A3 matrix printer with good resolution for control-plots (EPSON LQ 1050)

3. Software

Five CAD packages for PCB layout were checked. Two products (P-CAD, CADSTAR) are recommended for a final selection and will be demonstrated at the demonstration (see details in Appendix 1).

3.1 P-CAD (Personal CAD Systems, USA)

- + provides the highest balance between price and functionality of all the packages, concerning schematic entry, placement, routing and simulation (including interface to PSPICE)
- + it is the most widely used software on PC for PCB layout (and seems to be quite bugfree)
- + the distributor in Vienna has quite a lot of knowhow
- + the distributor tries to reduce the price (\$16.000.- without simulation) in talks with P-CAD
- made in US, so there is the need for export licence which will be provided by the distributor

Distributor: W.Rekirsch, Vienna

3.2 CADSTAR (RACAL REDAC, UK)

- + made in UK, no embargo
- + good functionality for schematic entry, placement and routing
- + special price for universities (\$7.000.- versus \$19.000.-)
- no package for logical simulation (unsupported interface to CADAT)
- no interface to PSPICE
- no support of more than 640 KB
- small number of pad shapes
- no design rule check

Distributor: May Computer, Vienna

3.3 ORCAD (Systems Corp., USA)

- + very cheap (\$3.600.-, excl simulation)
- + integrated package for simulation
- + interface to PSPICE
- very young product (routing), still full of bugs
- no support of more than 640KB
- small number of pad shapes
- no competent know how in Vienna
- no automatic placement
- made in US (embargo)

Distributor: DAHMS Elektronik, Graz

3.4 ARIADNE (CAD-UL, Germany)

- + made in Germany, no embargo
- + good functionality
- very expensive, therefore bad balance between price and functionality
- no simulator
- no interface to PSPICE
- bad interface to DTP

Distributor: INTEC, Bruck an der Leitha, Austria

3.5 METADESIGN (Leanord)

no detailed information was available, though ordered for several times.

4. Distributors

There are 2 distributors in Vienna who offer full configuration of all hard and software components, who have a lot of knowhow about the PCB packages and are experienced in exporting to countries under embargo. They will also be able to demonstrate a complete configuration.

REKIRSCH, Obachgasse 8, A 1220 Vienna, Tel. 0222/25 36 26 0 (Mr. Scherz, Mr. Wiesauer)

Hardware: COMPAQ

Software: P-CAD

MAY Computer, Meiselstraße 66, A 1140 Vienna, Tel. 0222/92 56 30 (Mr. May, Mr. Weißenbrunner)

Hardware: TANDON

Software: CADSTAR

These companies are also able to train the institute's staff for hardware maintenance and CAD software usage.

There is a further company, with a lot of experience in expert, especially for UNIDO projects. But they have no knowledge of CAD software.

DATASERVICE, Landstraßer Hauptstraße 1, A 1030 Vienna, Tel 0222/711 43 0, (Mr. Hoffmann, Mr. Schaaf)

Hardware: COMPAQ

Software: -----

5. Prices

5.1 PCB

Software:

P-CAD	< \$16.000.-
PC-CAPS (log.simulator)	\$2.700.-
PSPICE	\$3.000.-
CADSTAR (no simulator)	\$6.800.-

Hardware (80386, 20 MHz, 2 MB RAM, 110 MB HD, 80387, Mouse, 16" color, VGA, A3 matrix printer, penplotter):

COMPAQ	ca. \$16.500.-
TANDON	ca. \$15.900.-

PCB Plotter

checked separately by UNIDO

5.2 DTP

Software (Word Perfect, Ventura 2.0 incl Prof.Extension, Designer):

ca. \$5.000.-

Hardware (80386, 16MHz, 1 MB RAM, 40 MB HD, Mouse, 16" color, VGA, HP DeskJet):

COMPAQ	ca. \$8.500.-
TANDON	ca. \$8.700.-

5.3 MPD

Software: -----

Hardware (80386, 16MHz, 1 MB RAM, 40 MB HD, Mouse, 14" color, VGA, low cost printer, add. ser/par port):

COMPAQ	ca. \$7.000.-
TANDON	ca. \$7.100.-

Development System: checked separately by UNIDO

5.4 LAB

Software: -----

Hardware (80386, 16MHz, 1 MB RAM, 40 MB HD, Mouse, 14" color, VGA, low cost printer, IEEE, 3.5" FD):

COMPAQ	ca. \$8.500.-
TANDON	ca. \$8.600.-

5.5 General

Backupstreamer \$2.300.-

10 Cartridges \$900.-

Material (paper, ribbons, FD, ...) \$2.800.-

Training: depending on duration and location,
approx. \$700.- to \$900.- per day

hires screen for PCB plus \$4.600.-

hires screen for DTP plus \$1.600.-

PCB: 25MHz plus \$2.100.-

80286 instead of 80386: minus \$900.- (excl. PCB)

minus \$2.500.- (for PCB)

APPENDIX 1 (Software)

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

Code:	1	2	3	4	5
Company:	CAD-UL /Germany	RACAL REDAC / UK	??	Systems Corp. /USA	Personal CAD Systems / US
Distributor:	INTEC	MAY	?	DAHMS Elek- tronik / MBA	REKIRSCH
Name of the Package:	<u>ARIADNE</u>	<u>CADSTAR</u>	<u>METADESIGN</u>	<u>ORCAD</u>	<u>P-CAD</u>
Characteristics:	high price, no simulation, low resolution	no simulation, no DRC, special price	no answer	bugs, less functionality, cheap	complete functionality, expensive

Underlined entries show functions which are poorly or not supported by the package. All information was provided by the company.

Code:	1	2	3	4	5
1.Prices (In \$) for PCB					
Schematic capture	1.750.-	625.-		975.-	1995.-
Placement / Routing	23.000.-	4.690.- + 1.500.-		2.600.-	14000.-
Logical simulation	?	N.A.		1.500.-	2700.-
PSPICE	N.A.	N.A.		2.608.-	3050.-
<u>Total for PCB software</u>	24.750.-	6.800.-		7.683.-	21.745.-
Demonstration Package		30.-			free
Training for PCB-Software					666.-/day

Code:	1	2	3	4	5
2. Functional Requirements (PCB)					
2.1. System Dependency					
a) No 640kB limitation in MS-DOS (the minimum of supported memory should be 4 MB)	yes	<u>NO</u>		<u>NO</u> (next version)	yes
b) Is UNIX portability provided	yes	yes		<u>NO</u>	1989
c) Computing time per connection in auto routing (min. max)	?	?		?	?
d) Graphic card: - Is Methus/Omega 1024*768 supported	<u>NO</u>	yes		yes	yes
- which card do you suggest	GENOA	EGA/VGA/ VERMONT		several	40 different
e) Can one switch between Hi-Res and EGA easily	?	config.usr		yes	yes
f) Is documentation in English available covering the whole functionality	yes	yes		yes	yes
g) Is there the need of an accelerator or coprocessor	no	80387		no (not supported)	no(?)
h) Which tablets are supported	nor..	none		none	several
i) Which bus mouse is supported (MS, Logitech, Mouse Sytems)?	yes	yes		yes	yes
j) Do you support or recommend double-monitor configuration (one text/one graphic).	no	no		no	yes
k) which HW components do you recommend, which do you sell and maintain	COMPAQ	--		--	COMPAQ

Code:

1

2

3

4

5

2.2 Schematic Capture

a) Libraries:	- CMOS/TTL included	yes	yes		yes	yes (ca.8000)
	- extendable by a graphic editor	yes	yes		yes	yes
	- which editor is supported	own	REDLOG		own	PCAD
	- which output format is supported by the editor (Interface to DTP)	ASCII	DXF/HPGL		HPGL	DXF/HPGL
b) Editing funct.:	- Grid, which is freely changeable	yes	yes		?	yes
	- Rubberband technique	yes	yes		yes	yes
	- Zoom/pan/rotation/copy/etc	yes	yes		yes	yes
	- Swap mode (clipping)	yes	yes		?	yes
	- Input by coordinates	yes	?		yes	yes
c) Automatic save of the edited data (time interval must be chooseable)		yes	1' to 20'		NQ	yes
d) Design rule check: what is checked		yes	NQ		yes	clearance, line width, pads,
e) Which reports and statistics can be done		several	several		several	wire, material, packing,
f) Limitation of the number of components/connections only be memory		yes	1023/3500		(hierarchy)	yes
g) Graphic output is supported for which matrix printers		yes	EPSON		several	several
h) Interfaces to	- Placement / Routing	yes	yes		yes	yes
	- Logic simulator (which?)	yes	NQ		yes	yes
	- PSPICE	NQ	NQ		yes	yes
	- DTP	NQ	DXF/HPGL		yes	yes

Code:	1	2	3	4	5
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2.3 Placement/Routing

a) Automatic and Interactive placement	yes	yes		<u>INTERACTIVE</u>	yes
b) Automatic and Interactive routing	yes	yes		yes	yes
c) Reentrant ability: can placement/routing be interrupted and taken up again	yes	yes		<u>NO</u>	yes
d) Which algorithms are used for placement/routing	Lee, etc.	see paper		?	?
e) Multipass routing with different sets of parameters	yes	<u>YES</u>		yes	yes
Parameters are:					
- limitation of vias per connection	yes	yes		?	yes
- concentration on certain areas of the board	yes	yes		yes	yes
- max length of diagonal routes	<u>NO</u>	<u>NO</u>		<u>NO</u>	yes
- allocation of horizontal and vertical layers	yes	yes		yes	yes
f) Angle of routing (45 deg or free)	<u>45(automatic)</u> <u>free(interactive)</u>	<u>45(automatic)</u> <u>free(interactive)</u>		<u>45 deg</u>	free
g) Number and shapes of pads and vias	unlimited	8		8	256
h) Rubberbanding for interactive work	yes	yes		<u>NO</u>	yes
i) Zooming, panning, etc.	yes	yes			yes
j) What are the limitations for the shape of the PCB / can areas be protected	32°/yes	32°/yes		32°/yes	60°/yes
k) Minimum Grid: 0.01 mm / gridless routing possible	<u>0.0254mm/yes</u>	<u>0.0254mm/yes</u>		<u>0.0254mm/yes</u>	yes/yes
l) Back annotation	yes	yes		yes	yes
m) Can the minimum of clearance space be set	yes	yes		yes	yes

n) Support of SMD		yes	yes	yes	yes
o) Which text features are available		all(?)	normal	normal	normal
p) Which reports, statistics and lists can be created		several	several	several	several
q) Output:					
	- control plots on matrix printer (which?)	yes	yes	is planned	yes
	- HPGL - format for pen plotter	yes	yes	yes	yes
	- GERBER - format for mechanical plotter	yes	yes	yes	yes
	- solder stop mask	yes	yes	yes	yes
	- output on files	yes	yes	yes	yes
	- is the thickness of plotter pens controllable	yes	yes	yes	yes

Code:	1	2	3	4	5
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2.4 Simulation

a) Logic simulator: specification of the functions	(FUTURE NET / WORK VIEW)	N.A.		12 state	12 state
b) Is PSPICE available	N.A.	N.A.		yes	yes
c) Output of logic simulator and PSPICE possible on matrix printer and/or file		N.A.		yes	yes
d) Interfaces to DTP	?	N.A.		yes	yes

APPENDIX 2 (Selection of Hardware Prices)

	<u>REKIRSCH</u> COMPAQ	<u>MAY</u> TANDON	<u>SOLID</u> ACER
80286/40 MB	4.400.-	3.500.-	3.800.-
80386/16MHz/40MB	5.310.-	5.000.-	4.900.-
80386/20MHz/110MB	8.300.-	7.500.-	7.300.-
80386/25MHz/110MB	10.300.-	—	8.900.-
1 MB RAM (80286)	550.-	500.-	550.-
1 MB RAM (80386)	900.-	1.000.-	?
Coproc. 80387/16MHz	500.-	600.-	?
Coproc. 80387/20MHz	1.600.-	?	?
VGA graphic card	included	500.-	
14" color screen	800.-	800.-	
16" color screen	1.500.-	1.500.-	
Bus Mouse	150.-		
Printer (Epson LQ1050, DINA3)	1.300.-		
Printer (Epson LX800, DINA4)	400.-		
Printer (HP Desk Jet)	1.300.-		
Plotter (HP 7475A)	2.500.-		
IEEE (HP)	1.100.-		
ser/par port	200.-		
FD Drive 3.5"	730.-		

Prices are stated in US\$, (1 US\$ = 12 AS). Not all prices were available when writing that report. The non stated prices are more or less the same as Rekirsch