Process
&
Capability Manual
(Vol. 2 2004)

Procurement Trading Xchange
for Interconnection Carriers B.V
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1 CHAPTER OVERVIEW

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2 PTX-IC – A SHORT PROFILE

2.1 Who we are

PTX-IC is one of the leading independent companies in the PCB industry of Germany, situated in Krefeld, a 25 min. drive away from the Duesseldorf International Airport. Constantly family owned, PTX-IC`s workforce grew slowly but steadily to 90 colleages - strongly attached to the Industrial tradition of the Ruhr area. Powered by one of the most modern production facilities in a charming historical industrial complex of 297.000 sqf we are capable to produce more than 1.200.00 sqf of PCB`s per year.

2.2 Objectives & markets

Our main business activity is focused on the production of single sided up to twelve layer rigid Printed Circuit Boards. Our technological capabilities are described in the following chapters. If we are asked what´s a typical board PTX-IC produces every day („bread and butter“ PCB), it´s a four layer rigid board of 1,5 mm thickness, green solder mask and a track and gap width of 200µ.

A very successful new service we offer since the beginning of 2003 is our RAPID MASS PRODUCTION System (RMP). It is an express production service for middle and volume quantities. The main features are:

Production cycle	RMP	normal cycle time
Standard* single/double sided boards	**7 days**	**12 – 15 days**
Standard* Multilayer boards	**9 days**	**15 – 20 days**

* Standard = 1 – 4 layer PCB in Hot Air Leveling Technology, soldermask, material FR 4, conventional drilling techniques, single sided SMD`s and silk screen printing. Additonal time necessary if other features requested.

Further more our company is known for its intense partnership with our customers and an excellent service that starts with the technical support and ends up at the integration in our customer`s supply chain management.

2.3 Declaration of quality

To achieve a maximum of quality we have to understand precisely the needs of our customers in order to transform them in products they really need. More than this: The results must be better than those of our competitors, therefore we are reaching for

- Superiority in technical and functional quality of the product even under extreme conditions
- Superiority in technical and economical support
- Superiority in delivery on time
- Superiority in the ability to produce with a maximum of efficiency and yield to offer our clients the most reasonable prices.

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3 PRODUCTION DATA & TRANSMISSION

3.1 Production data requirements

Following data formats could be supplied if you want to place an order
ODB++,
Extended Gerber 274X
Gerber (RS 274)
Barco DPF,

Mechanical drawings might be in HPGL or DXF format

Customer specifications – technical and commercial!

If you are unable to use an output file in the described data formats please contact our artwork department or sales engineer.

3.2 Data transmission

The most comfortable way to send your data is by Email. It is advisable to compress them as a „zip file“ (pkzip, arj, lharc or winzip are also accepted). It prevents information from getting lost. Make sure that your data are easily recognisable, i.e. put all data of one type in one zip file. To prevent the inclusion of viruses, do not use ‘self-extracting’ compression software. Before sending your E-mail, please indicate the name of the zip file in the message section. Do not forget to send your commercial order (indicating the zip file name) by E-mail or fax.

3.3 Design rule check

All CAD data supplied to us are checked using a standard design rule check and customized DFM-functions, which has been drawn up in accordance with the required IPC guidelines, our capability matrix and customer´s engineers. If you have any questions regarding this issue, please contact the head of our pre-production office, Mr. Vornholt. Should the CAD data prove not to be suitable for production, the person responsible for the data will be contacted by the pre-production engineer dealing with the order.

3.4 Order confirmation

After the clearance of all technical and commercial details, an order confirmation is sent to the customer. The order confirmation contains the following details (rough outline):

1. Basic technical data (dimensions of pcb; type of multilayer construction etc.)
2. Basic commercial data (ordered quantities; delivery time; pricing etc.)
3. Electrically tested or not electrically tested
4. Terms of delivey
5. Terms of payment.
6. Reference to our Terms of Trade in the Internet

When the order confirmation is completed, the preparation of the production process is finished and production will be started.

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4 QUALITY

4.1 Quality Standards

All boards are produced according to IPC-A-600 C Class 2 standards. Following standards are also in reach of our production capabilities but for this and for all other particular specifications an additional business agreement is necessary.

PERFAG 1 C
PERFAG 2 E
PERFAG 3 C
IPC-SM-840 B
IPC-R-700 C
IPC-A-600 Class 3

4.2 Quality procedures

PTX-IC follows the standards of DIN/ISO 9002. Production parameters, conditions of production and raw materials are evaluated and registered by the use of calibrated measuring equipment.

non-destructive testing

Automatic and optical inspection routines follow the guidelines of IPC-A 600, class 2. Specific inspection procedures can be adapted to other specifications on demand.

destructive testing

Micro section to accertain plating precipitation and surface protection thickness
plating adhesion tests
Multilayer boards are submitted to regular and steady thermal shock tests

Documentation of parameters

- Production parameters
- time-stamps, involved staff members
- and quality linked results

are automatically documented and electronically recorded in archives for at least 3 years.

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4.3 Electrical testing

The final test procedure of a PCB is the electrical testing to detect cuts and shorts. Our engineers generate a test programm discribing a network, including all signal lines (start and endings) generated out of the gerber data of the customer. As a middle and high volume manufacturer we use an adapter testing system that simultaneously tests all network lines and points of a PCB. The basic technology of adapter testing is, that conductive needles linked to the test machine are lead by an adapter to the test points of the PCB. The test result is then compared to the electrical network. A failure is detected if a network resistance is measured

- **bigger than 50 Ohm (cut)**
- **smaller 10 MOhm (short)**

PCB`s tested without failure are marked by a green line on the edge of the PCB or by a stamp mark.
Rejected PCB`s are separated, repaired and retested or finally rejected if repair is not feasible.

The electrical test is not standard but we recommend it to the customer if the following features are given:

- high circuit complexity
- trace/gap smaller 200µ
- embedding circuits in ground layers (thieving)
- Multilayer Boards

Although we assist our clients in the decision finding, it`s up to our customer to balance out the extra testing costs (adapter assembling costs, test procedure) against costs of failure of assemblied PCB`s, complaint procedures etc.

5 RANGE OF PRODUCTION FACILITIES

5.1 Raw (base) materials

Quality of base materials (Designation according to the standard „NEMA“)

- **FR 4**
- **FR 4 CTI > 400**
- **CEM 1**
- **CEM 3**
-

Quality of Prepregs:

Designation	Thickness
1080	**60 µ**
2125	**100 µ**
2116	**120 µ (on demand)**
7628	**180 µ**

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Thicknesses of copper foils (before plating):

- **18 µ**
- **35 µ**
- **50 µ**
- **70 µ**
- **105 µ**

other copper thicknesses on request

Copper Clad Laminates

(* Multilayer core material thickness is exclusive copper thickness)

FR 4 in mm	Copper clad in µ
0,10*	35
0,20*	35/70
0,36*	35/70
0,41*	35/70
0,51*	35
0,71*	35/70/105
0,80	18/35/70
1,00	18/35/70
1,08*	35
1,50	18/35/70/105
2,00	18/35/70
2,40	18/35/70
3,00	35
FR 4 CTI > 400	**Copper clad in µ**
1,00	18
1,50	18
CEM 1	**Copper clad in µ**
1,00	35
1,50	35/70
CEM 3	**Copper clad in µ**
1,50	18

If other materials are requested please contact our sales department.

Tolerances of bow and twist

Single Sided	Double Sided	Multilayer
1,5 %	1 %	1%

It has to be pointed out that the phenomenon of bow and twist strongly depends on the copper balance of the layout and/or build-up of a multilayer board. Especially if the PCB layout consists of unequally dispersed mass and line structures or the build-up of a

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multilayer is asymmetrical, twist and bow values within the mentioned tolerances are sometimes not feasible. In this case please contact our sales department to get advise.

5.2 Available production panel sizes

With the objective in mind to handle as little different panel formats as possible (less machine set ups and stock costs) and to avoid material waste, we apply a continuous review of the most used panel sizes with regard to the degree of utilization.

Type and size of Panel	Single sided boards		Double sided boards		Multilayer boards	
	Length	Width	Length	Width	Length	Width
Size 1 **640 x 532** (gross) Active PCB area:	**614**	**508**	**614**	**508**	**600**	**493**
Size 2 **610 x 532** (gross) Active PCB area:	**not avail.**	**not avail.**	**584**	**508**	**575**	**493**
Size 3 **610 x 460** (gross) Active PCB area:	**584**	**436**	**584**	**436**	**575**	**414**

Panel thickness

We accept a range of different board thicknesses irrespective of the number of layers. But be aware of the fact that due to the „exotic“ character of different thicknesses some of them need a longer lead time as they are not always on stock.

	Standard (mm)	Special (mm)	Technical limit
Max. panel thickness	1,5	2,4	3,2
Min. panel thickness	1,5	0,8	0,5

Maximum number of layers

Our multilayer production line is designed to manufacture up to 24 layers. The most applied build-ups are highlighted on our web-side in the topic „Technologies & Processes“.

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5.3 Drilling

Plated Through Holes	Standard	Special	Technical limit
Min. drill size	0,40 mm	0,15 mm	0,10 mm
Max. drilled hole size	5,80 mm	5,80 mm	5,80 mm
Min. spacing drill edge to drill edge*	0,20 mm	0,15 mm*	0,15 mm
Min. spacing drill edge to track/Pad outer layer*	0,20 mm	0,15 mm	0,15 mm
Min. spacing drill edge to track/Pad inner layer*	0,30 mm	0,25 mm*	0,20 mm
Finished size tolerance PTH Hot Air Leveling	0,15 mm	0,15 mm	0,15 mm
Finished size tolerance PTH immersion Sn/Au	0,10 mm	0,10 mm	0,10 mm

*Please consider that a plated through hole must be drilled with an oversize of 200µ to compensate the plating within the hole. E.g. if you wish a finished plated through hole size of 0,6mm the applied drill tool is 0,8mm.

Not Plated Through Holes	Standard	Special	Technical limit
Min. drill size	0,60 mm	0,30 mm	0,20 mm
Max. drilled hole size	5,80 mm	5,80 mm	5,80 mm
Min. spacing drill edge to drill edge**	0,20 mm	0,15 mm	0,10 mm
Min. spacing drill edge to track/Pad outer layer	0,20 mm	0,15 mm	0,15 mm
Min. spacing drill edge to track/Pad inner layer	0,35 mm	0,30 mm	0,25 mm
Finished size tolerance NPTH <= 2,0 mm	0,05 mm	0,05 mm	0,05 mm
Finished size tolerance NPTH <= 5,8 mm	0,10 mm	0,05 mm	0,05 mm

**depending on drill size

Offset PTH to NPTH	+/- 0,20 mm	+/-0,07 mm***	0,07 mm***

***Provided that the drilling process is performed in one mashine set up (NPTH must be processed by Tenting)

5.4 Plating and aspect ratio

The thickness of copper plating is a result of exposure time and amperage in the electrolytic plating process. Basically 20 to 25 µ are plated during the process on surface and in hole. Plating of thicker copper is possible but it needs advisory service of the technical department.

Copper clad laminate	Electrolytic copper plating	Final copper thickness
18 µ	ca. 20 µ	ca. 38 µ
35 µ	ca. 20 µ	ca. 55 µ
50 µ	ca. 20 µ	ca. 70 µ
70 µ	ca. 20 µ	ca. 90 µ
105 µ	ca. 20 µ	ca. 125 µ

The capability of the electrolytic plating process is expressed in aspect ratio = maximum aspect ratio of board thickness/smallest drilled hole diameter that can be plated.

Standard	Special	technical limit
5,5	8	10

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5.5 Exposure

Our technical range of line structuring theoretically reaches the level of 50µ track width due to collimated light exposure systems. But with regard to the restrictions of material quality and the copper balance of the PCB-design we have to distinguish three levels of capability: Standard, special and technical limit

5.5.1 finished copper thickness 35 µ

	Standard (µ)	Special (µ)	Technical limit (µ)
Track width	150	130	100
Track to track spacing	170	130	100
Annular ring	250	200	100

5.5.2 finished copper thickness 70 µ

	Standard (µ)	Special (µ)	Technical limit (µ)
Track width	200	150	130
Track to track spacing	270	230	180
Annular ring	250	200	150

5.5.3 finished copper thickness 105 µ

	Standard (µ)	Special (µ)	Technical limit (µ)
Track width	300	250	180
Track to track spacing	360	300	250
Annular ring	300	250	200

5.5.4 finished copper thickness 140 µ

	Standard (µ)	Special (µ)	Technical limit (µ)
Track width	350	300	250
Track to track spacing	400	360	320
Annular ring	350	300	250

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5.6 Soldermask

	Standard (µ)	Special (µ)	Technical limit (µ)
Annular oversize of Pads	90	70	50
Minimum (mask) bridge width	120	100	75
Min. SMD to SMD spacing*	300	240	175

* Minimum spacing between Pads or SMD`s`s required to print a solder mask bridge

5.7 Metallic finishing techniques

	Thickness	characteristics
Electrolytic copper	20µ - 25µ	depends on exposure time
Hot air leveling	2µ – 20µ	37 % lead/63 % tin
Electrolytic nickel/gold*	1µ – 3µ gold	up to 5µ nickel
Immersion nickel/ (flash) gold*	0,05µ – 0,1µ gold	up to 5µ nickel
Immersion nickel/ (bond) gold*	0,3µ gold	up to 5µ nickel
Immersion chemical tin*	1µ	very high planarity
Organic surface protection (OSP)	organic coating of copper	ENTEK PLUS Cu - 106

5.8 Text printing, additional printing techniques

Silk screen printing

	Standard µ	Special µ	Technical limit µ
Silk screen to Pads spacing	300	250	200
Silk screen to PTH spacing	300	250	200
Line width	200	175	140
Minimum size of letters	1250	1000	800

Carbon key pad printing

	Standard (µ)	Special (µ)	Technical limit (µ)
Track to track spacing	500	400	400
Minimum track width	500	400	300

Peelable mask

	Standard	Special	Technical limit
Max diameter of covered holes	1,8 mm	2,0 mm	2,6*mm
Thickness of peelable mask	300µ	400µ	500µ

*coverage cannot be guaranteed

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5.9 Contour machining

Contouring is performed by three possible techniques:

- Routing
- V-cutting

These techniques allow contouring within the standard „DIN 7168 mittel“ (medium accuracy) and „fein“ (precise accuracy). Dependant on the size of the board following tolerances are given:

Board size:			fine	middle
0,5 mm	up to	6 mm	+/- 0,05 mm	+/- 0,10 mm
6 mm	up to	30 mm	+/- 0,10 mm	+/- 0,20 mm
30 mm	up to	120 mm	+/- 0,15 mm	+/- 0,30 mm
120 mm	up to	400 mm	+/- 0,20 mm	+/- 0,50 mm
400 mm	up to	1000 mm	+/- 0,30 mm	+/- 0,80 mm
1000 mm	up to	2000 mm	+/- 0,50 mm	+/- 1,20 mm

5.10 Routing

As a result of the given Coefficient of Thermal Expansion (CTE) of the base material a certain offset from the PTH-drill to the NPTH-drill or routing is inevitably, since the material has been exposed several times to thermal procedures like solder mask burn in, HAL etc.

	Standard µ	Special µ	Technical limit µ
Offset PTH-drill to contouring*	+/- 200	+/- 150	+/- 100
Offset layout to contouring	+/- 200	+/- 150	+/- 100

5.11 V-cutting (scoring)

Regarding V-cutting the same dimension tolerances are to be considered as for routing. Please pay attention to the fact that a certain circuit-free space depending on material thickness must be available around the outlines.

E.g. using material of 1,5 mm thickness by considering a dimension tolerance of +/- 0,2 mm tracks/pads etc. must have a spacing around the outlines of 0,40 mm. If the dimension tolerance is required to be without plus values the applied minus tolerance has to be added to the respective circuit-free spacing.

Material Thickness	circuit-free spacing at the outlines
up to 1,00 mm	0,35 mm
1,10 mm to 1,60 mm	0,40 mm
1,70 mm to 2,00 mm	0,55 mm
2,10 mm to 2,50 mm	0,65 mm
2,60 mm to 3,20 mm	0,80 mm

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