# Process
# &
# Capability Manual
## (Vol. 04-2011)



| MicroCirtec Micro Circuit Technology GmbH mit Sitz in 47877 Willich |
| Registergericht: Amtsgericht Krefeld | Reg.-Nr.: HRB 2703 | Ust-Id-Nr.: DE 120 151 127 |
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MOODY INTERNATIONAL CERTIFICATION
ZERT
Zertifiziertes QM-System

# 1 CHAPTER OVERVIEW





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# 2 MICROCIRTEC – A SHORT PROFILE

## 2.1 Who we are

Microcirtec 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, Microcirtec`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 Microcirtec 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 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
PERFAG 2
PERFAG 3
IPC-SM-840
IPC-R-700
IPC-A-600 Class 3

## 4.2 Quality procedures

Microcirtec follows the standards of DIN/ISO 9000. 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

Microsection 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 on demand**
-

### 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**
- **85 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 |
| 1,55 | 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% |



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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 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** | **499** |
| Size 2 **610 x 532** (gross) Active PCB area: | **not avail.** | **not avail.** | **584** | **508** | **575** | **499** |
| Size 3 **610 x 460** (gross) Active PCB area: | **584** | **436** | **not avail.** | **not avail.** | **not avail.** | **not avail.** |

### 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 single & double sided boards | Technical limit Multilayer |
|---|---|---|---|---|
| **Max. panel thickness** | 1,55 | 2,4 | 3,2 | 2,8 |
| **Min. panel thickness** | 1,55 | 0,8 | 0,4 | 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 |
| 85 µ | ca. 20 µ | ca. 105 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 | 60 |
| Minimum (mask) dam width | 80 | 60 | 50 |
| Min. SMD to SMD spacing* | 260 | 200 | 170 |

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

## 5.7 Metallic finishing techniques

| | Thickness | characteristics |
|---|---|---|
| Electrolytic copper | 20µ - 25µ | depends on exposure time |
| Hot air leveling | 2µ – 20µ | leadfree |
| Electrolytic nickel/gold* | 1µ – 3µ gold | up to 8µ nickel |
| Immersion nickel/ (flash) gold* | 0,05µ – 0,1µ gold | up to 8µ nickel |
| Immersion nickel/ (bond) gold* | 0,3µ gold | up to 8µ 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

Outerline-Contouring is performed by two 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 separate machine set-ups and 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 | +/- 120 |
| Offset layout to contouring | +/- 200 | +/- 150 | +/- 120 |

## 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 | 0,40 mm |
| 1,10 mm to 1,60 mm | 0,45 mm |
| 1,70 mm to 2,00 mm | 0,60 mm |
| 2,10 mm to 2,50 mm | 0,70 mm |
| 2,60 mm to 3,20 mm | 0,90 mm |



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