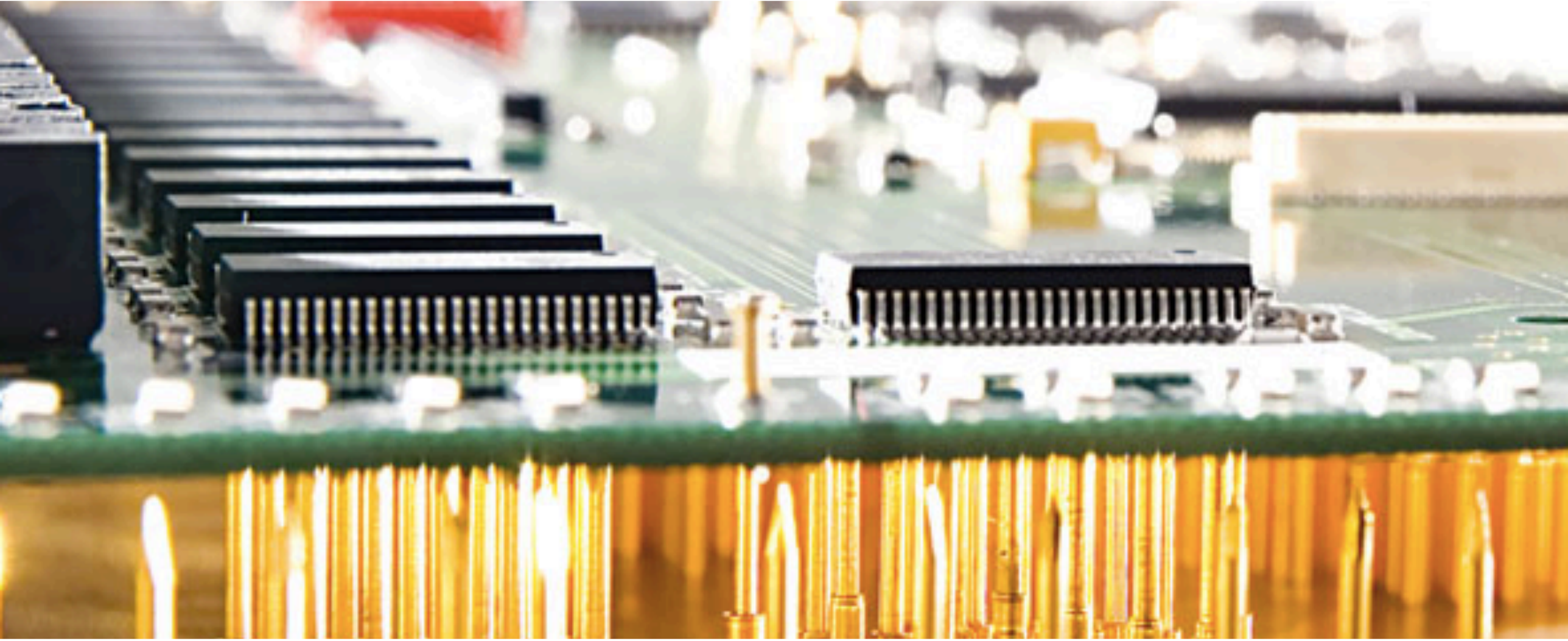


PCB设计之可制造性设计 - 优化器件/系统组装

学技能上 摩尔吧 MOORE8 www.moore8.com

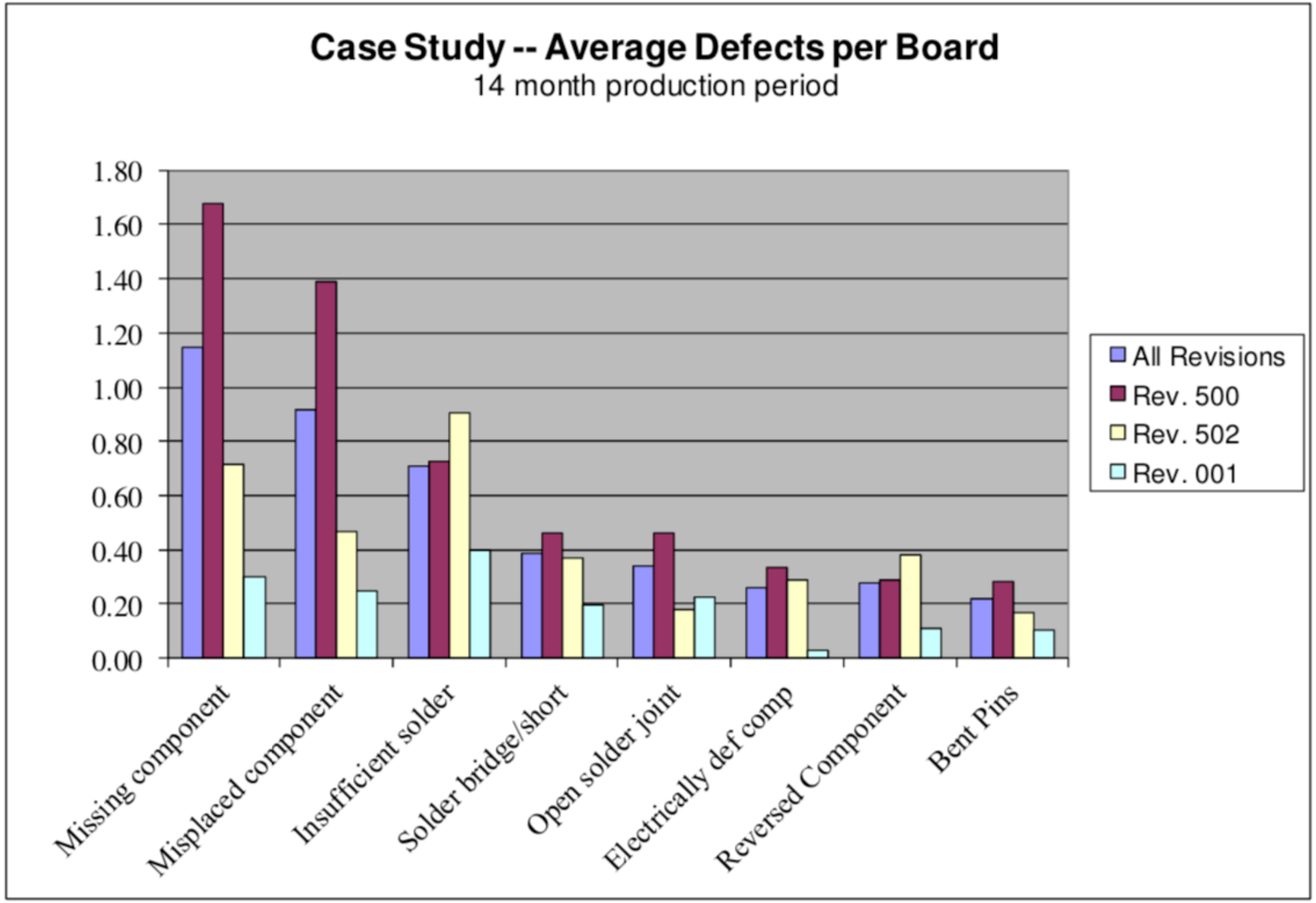
买元器件用 贸泽电子 MOUSER ELECTRONICS www.mouser.cn

产品生命周期

快	三版到位、流程规范	环节少、工艺简单、大规模自动化生产	性价比高
好	性能满足各种设计要求	系统整体性能好、加工容易	稳定性、可靠性高
省	研发成本低、时间短	大批量成本低（产品+生产+测试）	远程诊断、远程升级

学技能上 摩尔吧 MOORE8 www.moore8.com
买元器件用 贸泽电子 MOUSER ELECTRONICS www.mouser.cn

产品常见问题


Case Study -- Average Defects per Board
14 month production period
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
All Revisions
Rev. 500
Rev. 502
Rev. 001
Missing component
Misplaced component
Insufficient solder
Solder bridge/short
Open solder joint
Electrically def comp
Reversed Component
Bent Pins

DFX

- DFF（Fabrication）- 可加工性设计
- DFA（Assembly）- 可装配性设计
- DFR（Reliability）- 可靠性设计
- DFS（Serviceability）- 可服务型设计
- DFT（Testing）- 可测试性设计
- DFM（Manufacturability）- 可制造性设计
- DFMA - DFA + DFM

学技能上 摩尔吧 MOORE8 www.moore8.com
买元器件用 贸泽电子 MOUSER ELECTRONICS. www.mouser.cn

DFM的目标

① 保证产品质量和可靠性

② 缩短开发和生产周期

③ 降低产品成本

④ 提高加工效率

学技能上 摩尔吧 MOORE8 www.moore8.com
买元器件用 贸泽电子 MOUSER ELECTRONICS. www.mouser.cn

DFM设计原则

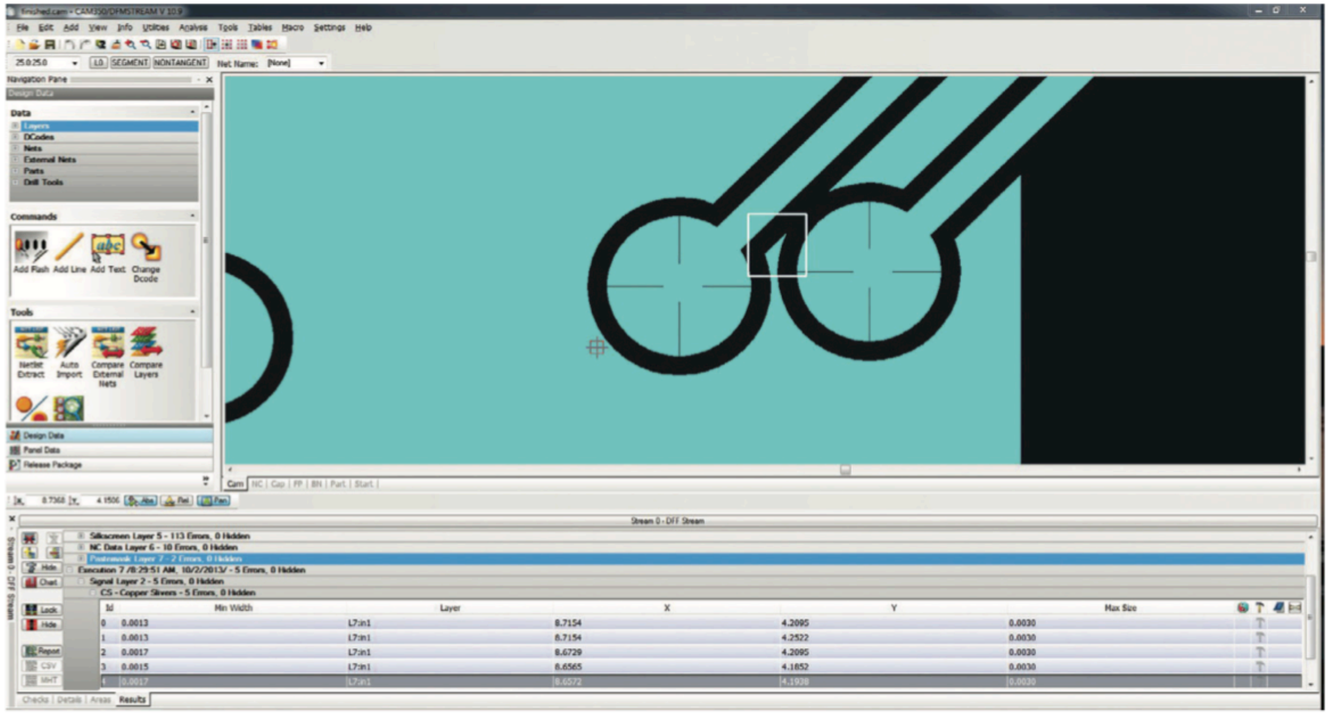
- 尽量少出错，减少上市时间！
- 了解PCB加工、组装工艺要求
- 从机械、电子两方面共同考虑对设计的要求和限制
- 对其它系统的影响以及其它系统带来的影响
- 预测加工误差导致的风险 - 线间距、孔距、孔间距等

学技能上 摩尔吧 MOORE8 www.moore8.com
买元器件用 贸泽电子 MOUSER ELECTRONICS. www.mouser.cn

DRC和DFM的关系

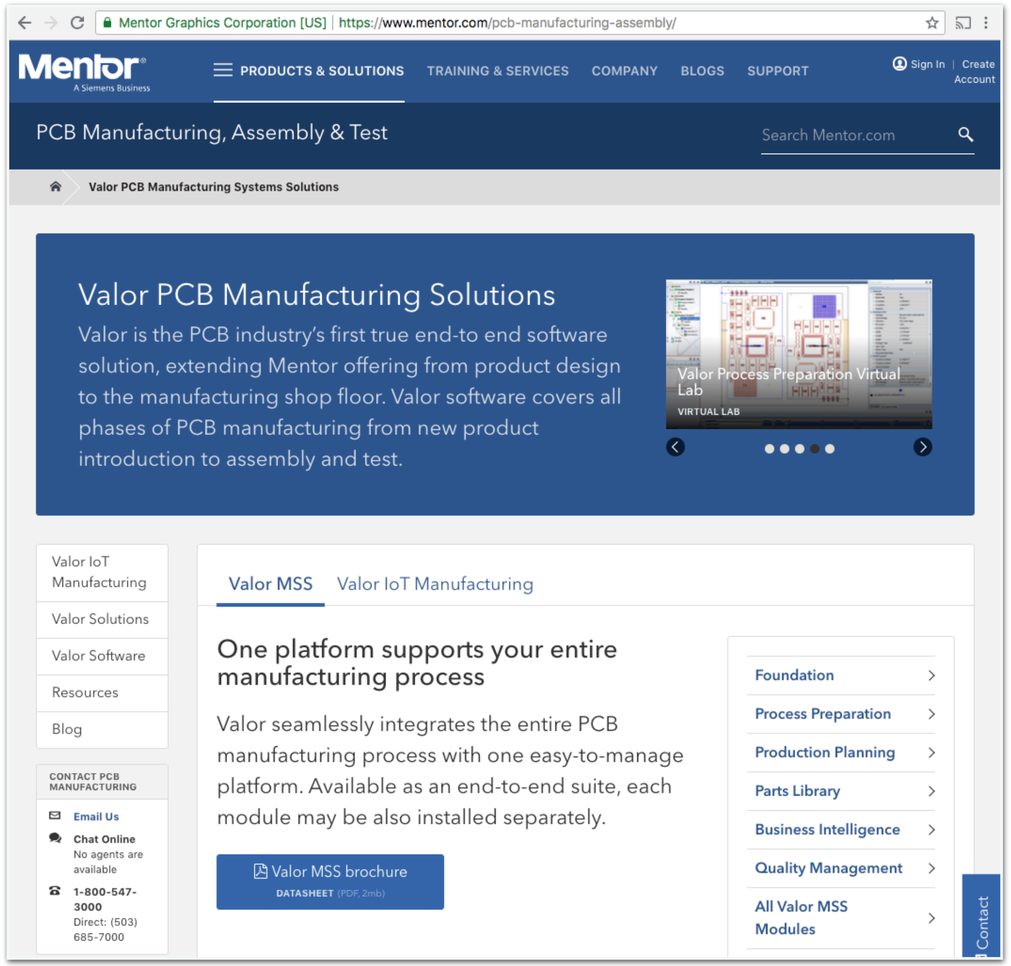
- **DRC - Design Rule Check，能帮助DFM**
- 导通孔、元器件孔径设计、焊盘环宽设计、隔离环宽设计、线宽、线间距设计
- 通过了DRC并不意味着能够满足DFM要求
- DFM分析工具非常贵，需要加强同PCB制造厂商工程师的沟通

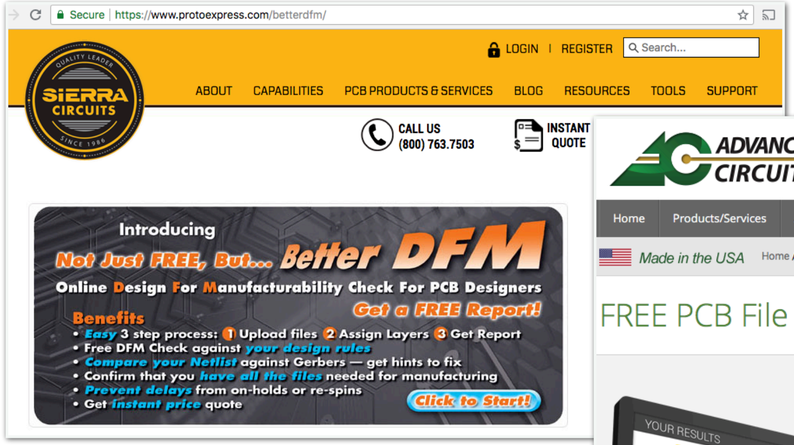
DFM Defect	Description
Starved Thermals	Plane connections that are tied correctly to a plane layer in a CAD system but inadvertently isolated from the rest of the plane.
Acid Traps	Acute angles that allow acid to build up in the fabrication process and over-etch a trace, potentially creating an open in the circuit.
Slivers	Narrow wedges of copper or soldermask that can peel off and either reconnect to other pieces of copper or expose copper that should be covered with soldermask.
Insufficient Annular Ring	A drill size is specified that exceeds the size of the pad being drilled and can result in a disconnect of the pin or short in a voltage plane.
Missing Clearance Pads on Planes	Pins that are missing a clearance pad will be connected to a plane layer. If clearance pads are missing from all plane layers for the pin, it will tie together all of the voltage planes as well.
Copper too close to board edge	When there is insufficient clearance of plane layers from board edges it's very likely that the voltage planes will be connected together when the PCB form factor is routed. The copper on each voltage layer is inadvertently "mashed" together.
Missing Solder-mask Pads	End user failed to define a soldermask pad for a pin or component. This exposes more copper and creates the potential for bridging pins together during assembly.



学技能上 摩尔吧 MOORE8 www.moore8.com
买元器件用 贸泽电子 MOUSER ELECTRONICS www.mouser.cn

DFM工具





学技能上 摩尔吧 MOORE8 www.moore8.com
买元器件用 贸泽电子 MOUSER ELECTRONICS www.mouser.cn

DFM工具检查的内容

Better DFM does a comprehensive Design For Manufacturability analysis on your files.
Our 40-Point Checklist includes the following DFM checks:

Signal Checks

- Conductor Width
- Spacing
- Annular Ring
- Drill to Copper
- Hole Registration
- Text Features
- Missing Copper
- Features Connection
- Missing Holes
- Unconnected Lines
- Rout to Copper

Plane Checks

- Drill to Copper
- Annular Ring
- Spacing
- Conductor Width
- Thermal Air gap / Spoke Width
- Missing Copper
- Rout to Copper
- Drill Registration
- Clearance smaller than hole

Solder Mask Checks

- Solder Mask Clearance
- Coverage
- Rout to Mask
- Spacing
- Missing Solder Mask Clearance
- Exposed Lines
- Partial Clearances

Silk Screen Checks

- Silk Screen to Mask Spacing
- Silk Screen to Copper Spacing
- Silk Screen to Hole Spacing
- Silk Screen to Rout Spacing
- Line Width
- Text Height
- Silk Screen Over Copper Text

Drill Checks

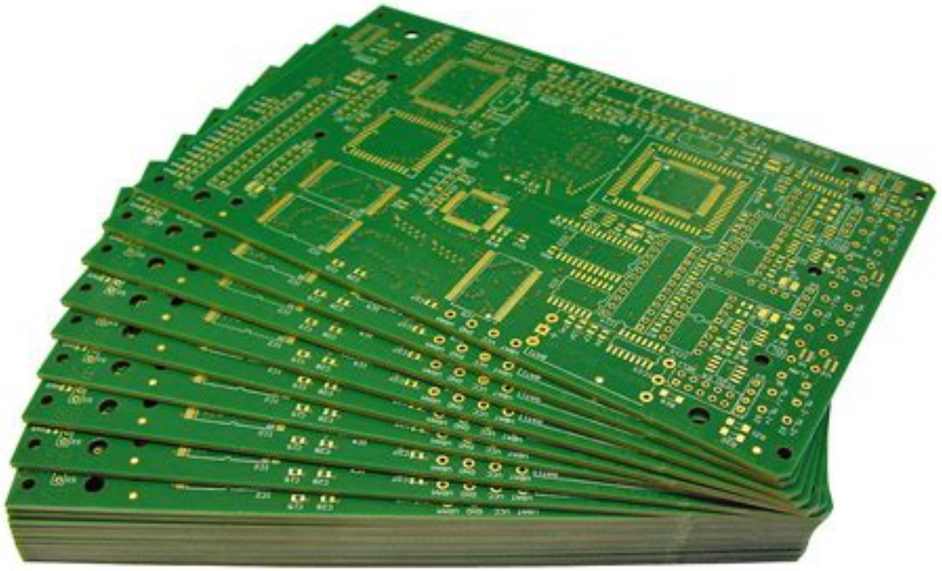
- Hole Size
- Duplicate Holes
- Hole Spacing
- Touching Holes
- Plane Shorts
- Holes to Rout
- Missing Holes

学技能上 摩尔吧 MOORE8 www.moore8.com
买元器件用 贸泽电子 MOUSER ELECTRONICS. www.mouser.cn

器件的选择

- 影响成本及焊接合格率
- 穿孔器件还是贴片器件?
- 值尽可能统一
- 封装尽可能统一

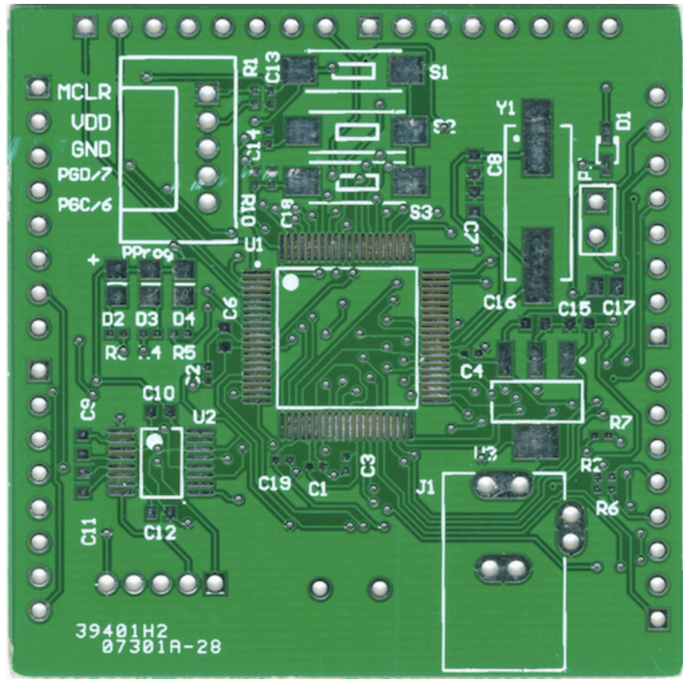
板材的选择



- 层数的选择
- 板材料的选择
- 工艺的选择

丝印

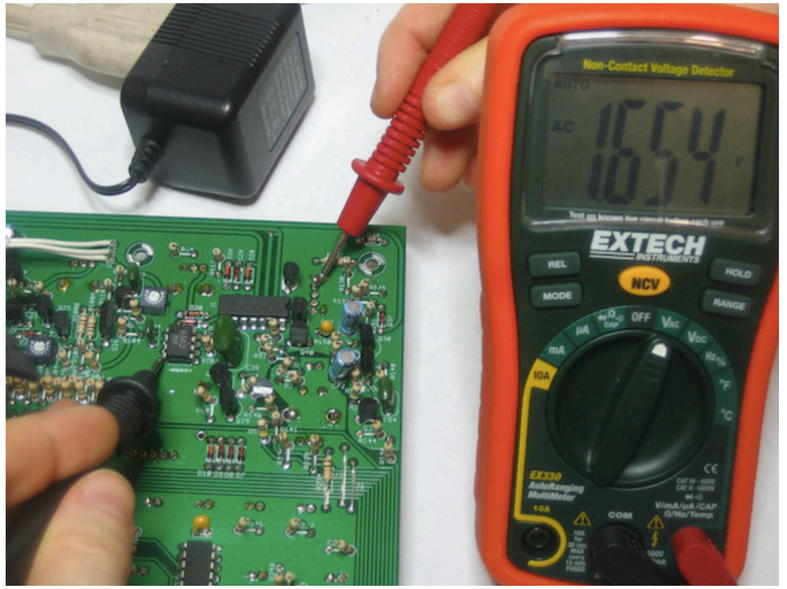
- 板上的文字是你同加工工人之间唯一的沟通手段
- 一个小小的错误有可能造成整个板子或整盘板子都无效
- 与装配、调试、接线有关 - 型号、外型、版本
- 元器件编号的放置 - 器件安装后不能遮挡



学技能上 摩尔吧 MOORE8 www.moore8.com
买元器件用 贸泽电子 MOUSER ELECTRONICS. www.mouser.cn

测试

- 问题消灭在产品送给客户前，根据客户的环境进行充分的可靠性测试
- 做测试夹具
- 反复测试、老化试验
- 抽样压力测试



学技能上 摩尔吧 MOORE8 www.moore8.com
买元器件用 贸泽电子 MOUSER ELECTRONICS www.mouser.cn

其它与工艺相关的设计

- 自动化生产需要的传送边、定位孔、光学定位符号
- 拼板
- 与检查、维修、测试有关的元器件间距、测试焊盘设计
- 与压接、焊接、螺装、铆接工艺有关的孔径、安装空间

学技能上 摩尔吧 MOORE8 www.moore8.com
买元器件用 贸泽电子 MOUSER ELECTRONICS. www.mouser.cn

关于贸泽电子 - www.mouser.cn

- 与非网/摩尔吧多年合作伙伴
- 全球领先的电子元器件授权分销商
- 700家原厂/500万现货库存
- 小批量采购，170元免邮费
- 1-2周交货