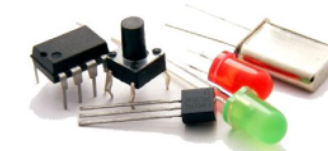
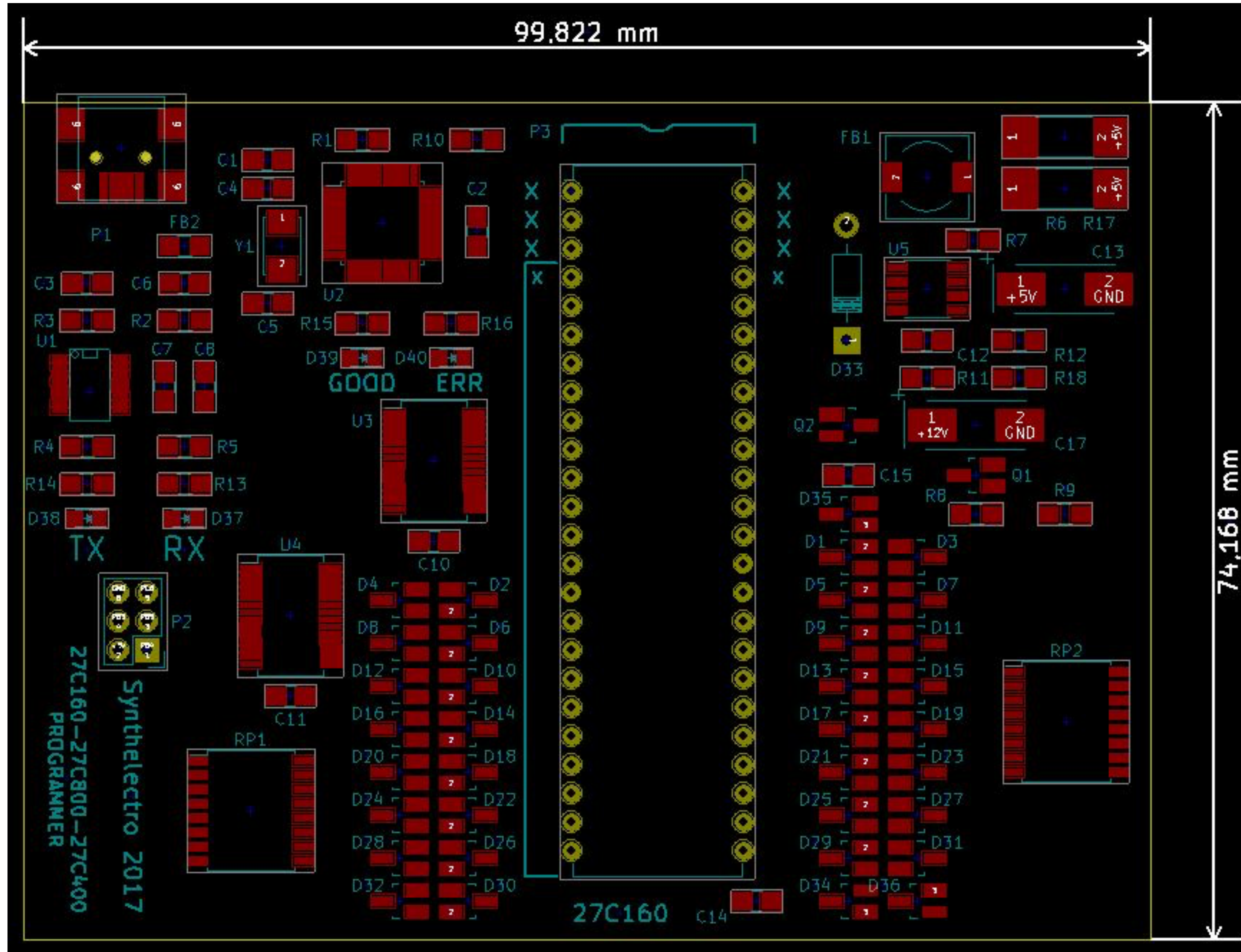


# PCB封装库的建立

对应物理器件

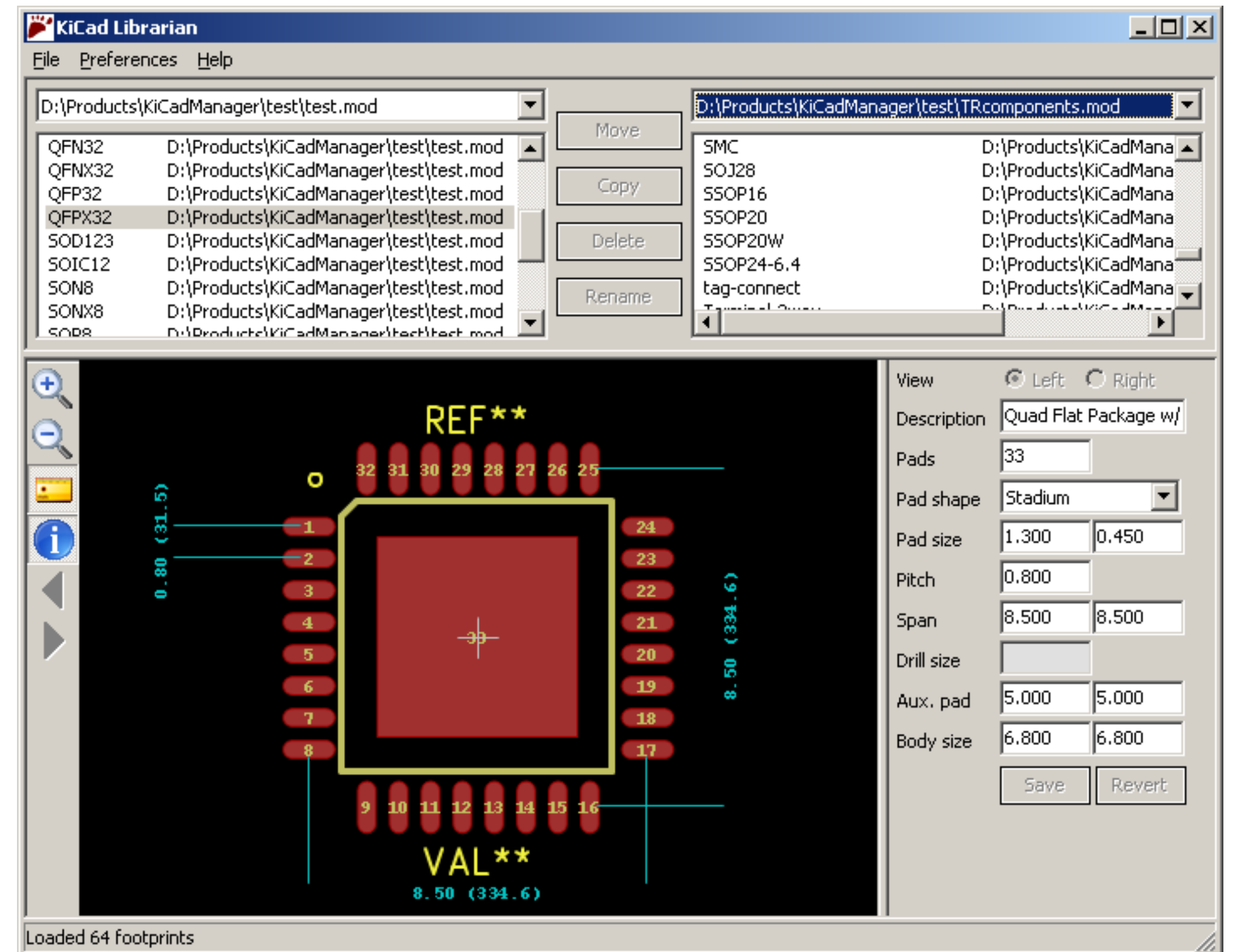


# 封装库 (Footprint) - 器件通过封装库的焊盘安装在PCB板上



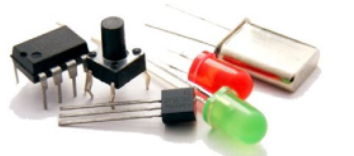
# 重要的事情再说一遍 - 建库要仔细!

- 严格参照元器件数据手册中的封装规格来建
- 与原理图要严格对应 - 封装的命名、管脚的编号
- 适合焊接、生产
- 打印出来跟实物对比验证



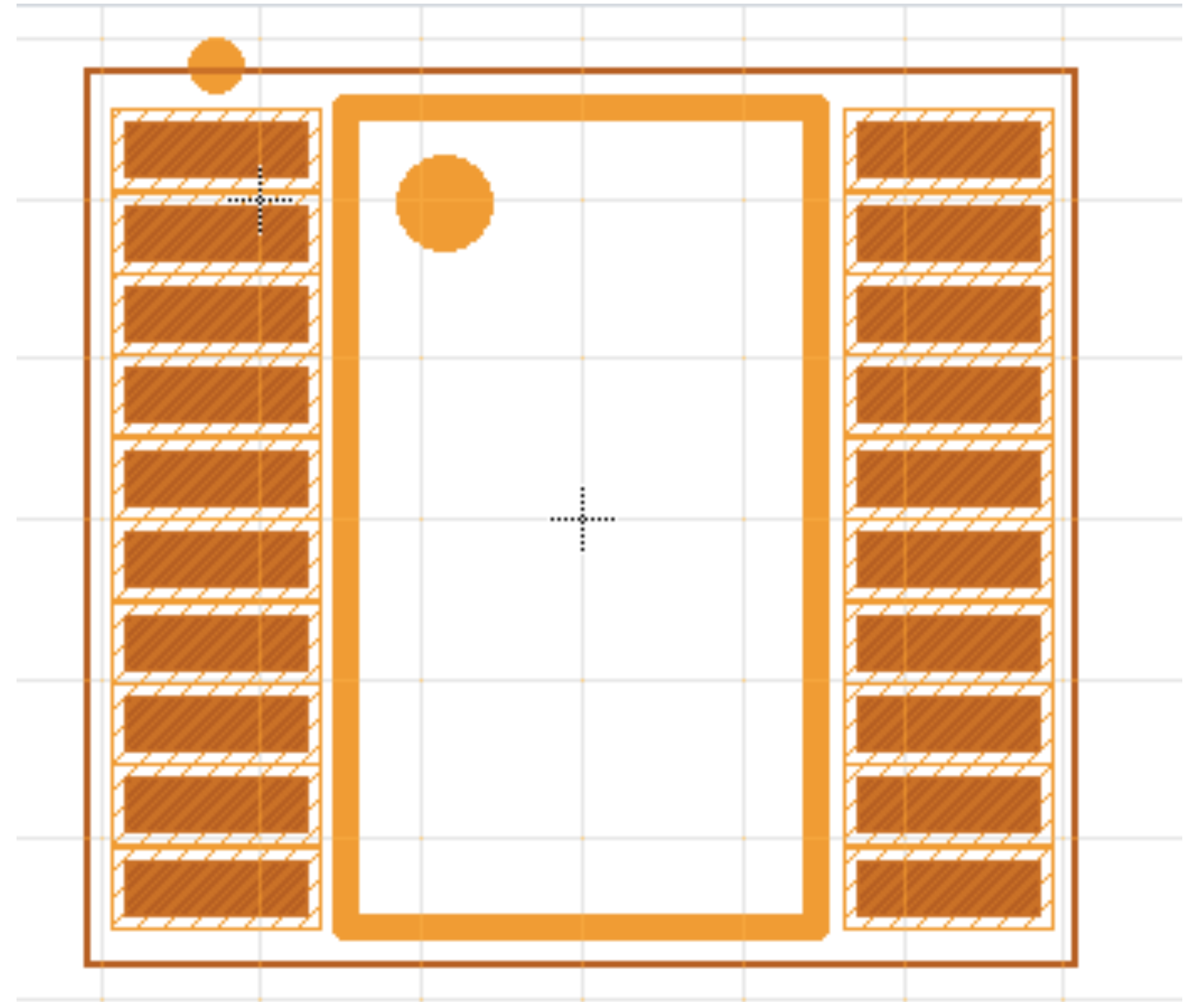
# PCB封装库的来源

- CAD工具自带的标准库（安装选装或官网下载）
- 现有参考设计源图中提取
- 半导体原厂（TI、ADI等）设计文件下载
- 第三方网站下载 - Ultra Librarian、SamsacSys
- 自己创建



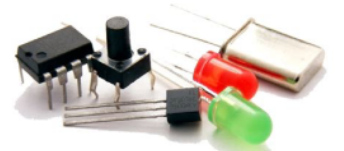
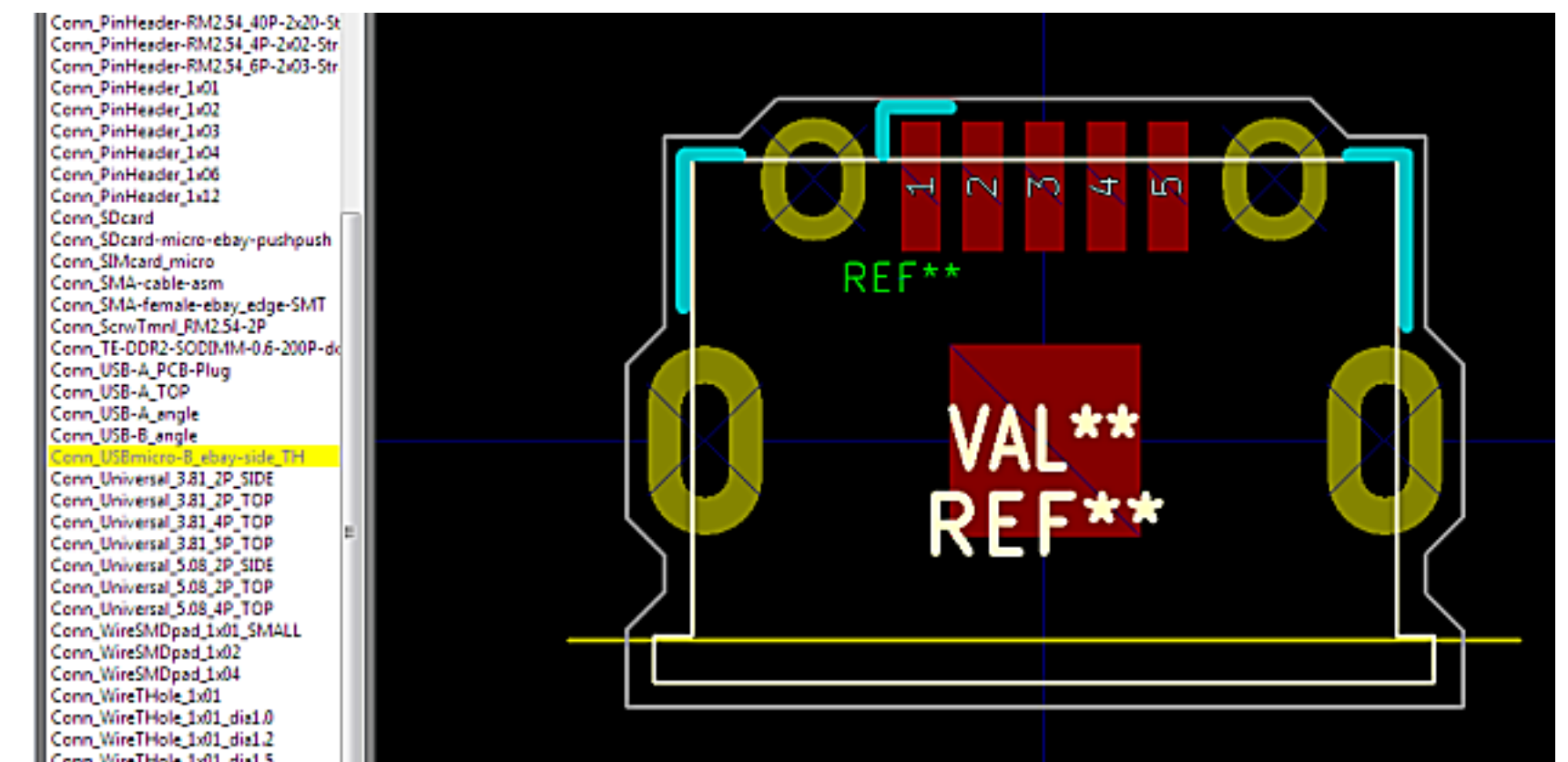
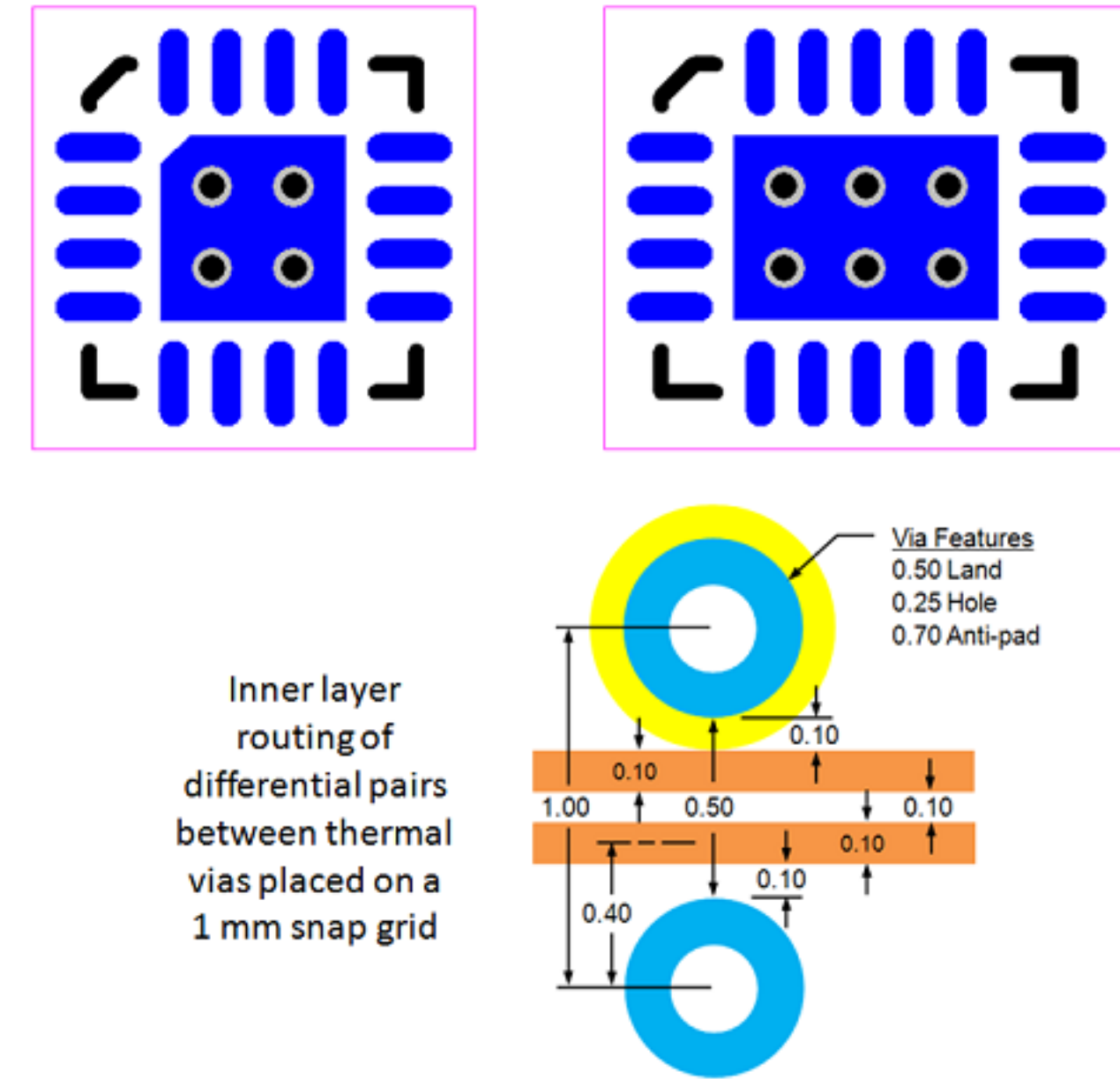
# 元器件封装库的构成三元素

- 焊盘 (形状、位置、编号)
- 外形轮廓
- 丝印标注
- 3D模型 (STEP)

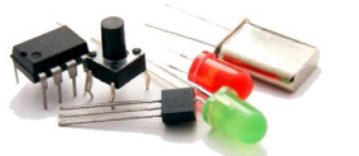
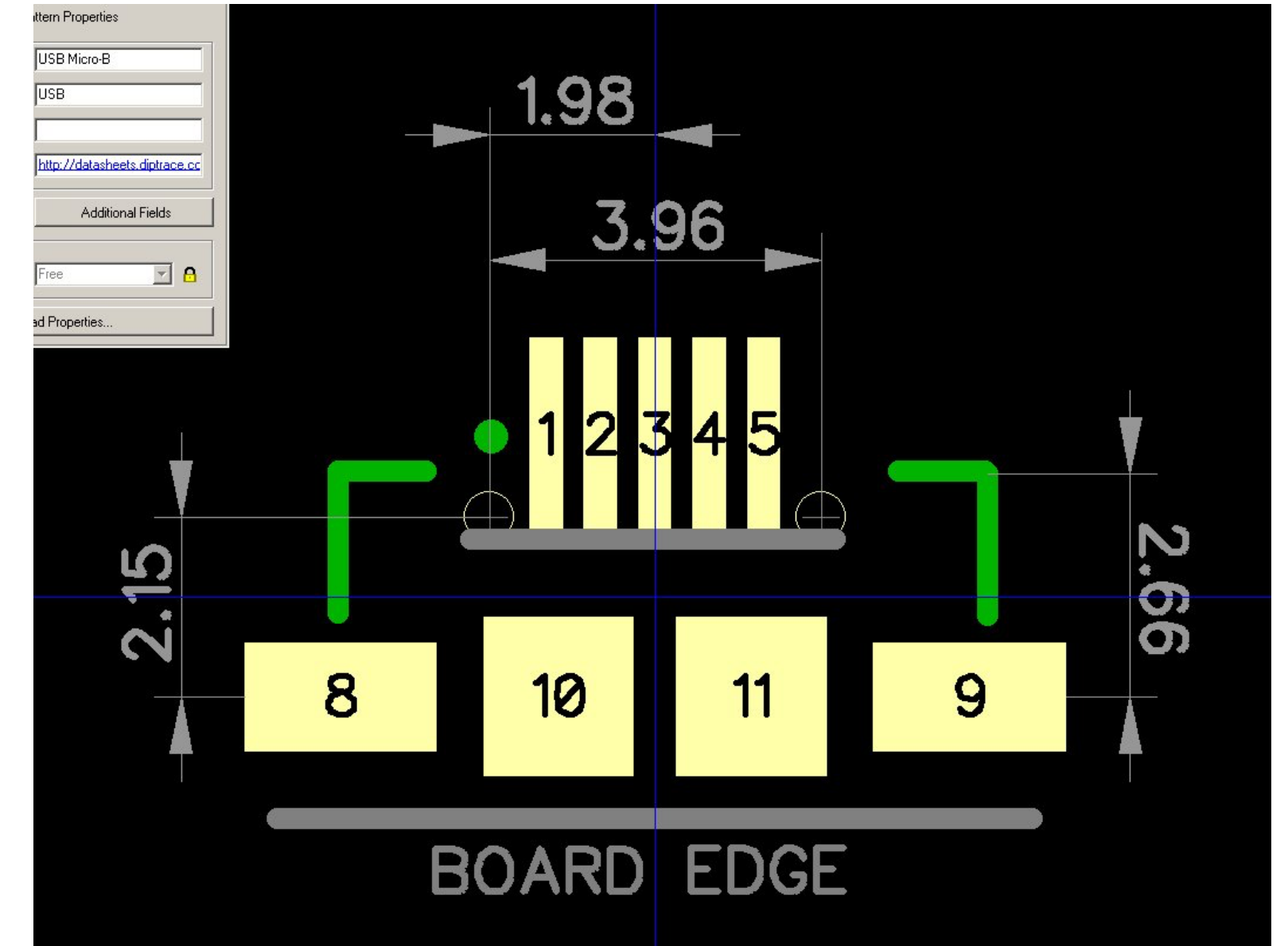
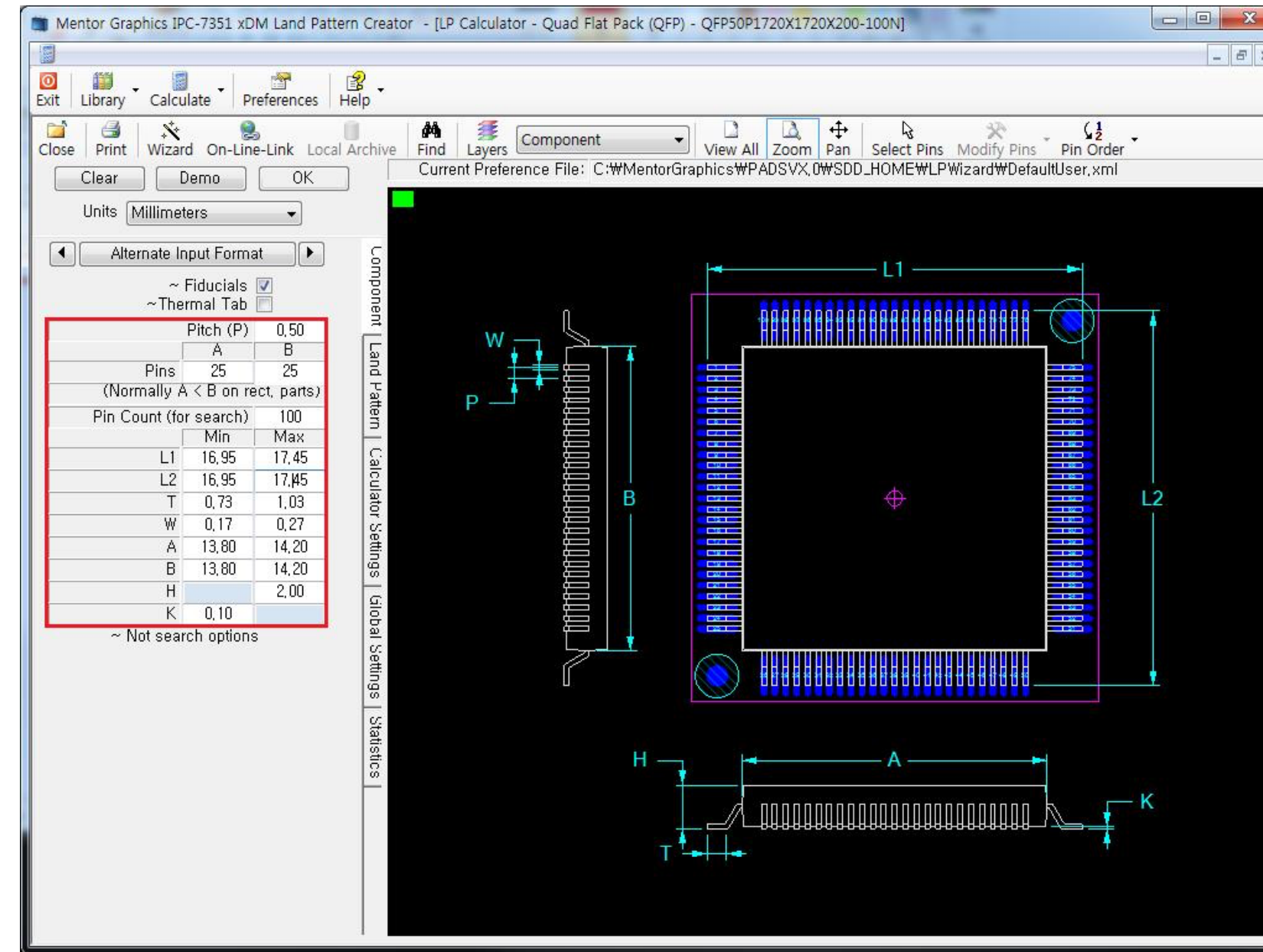
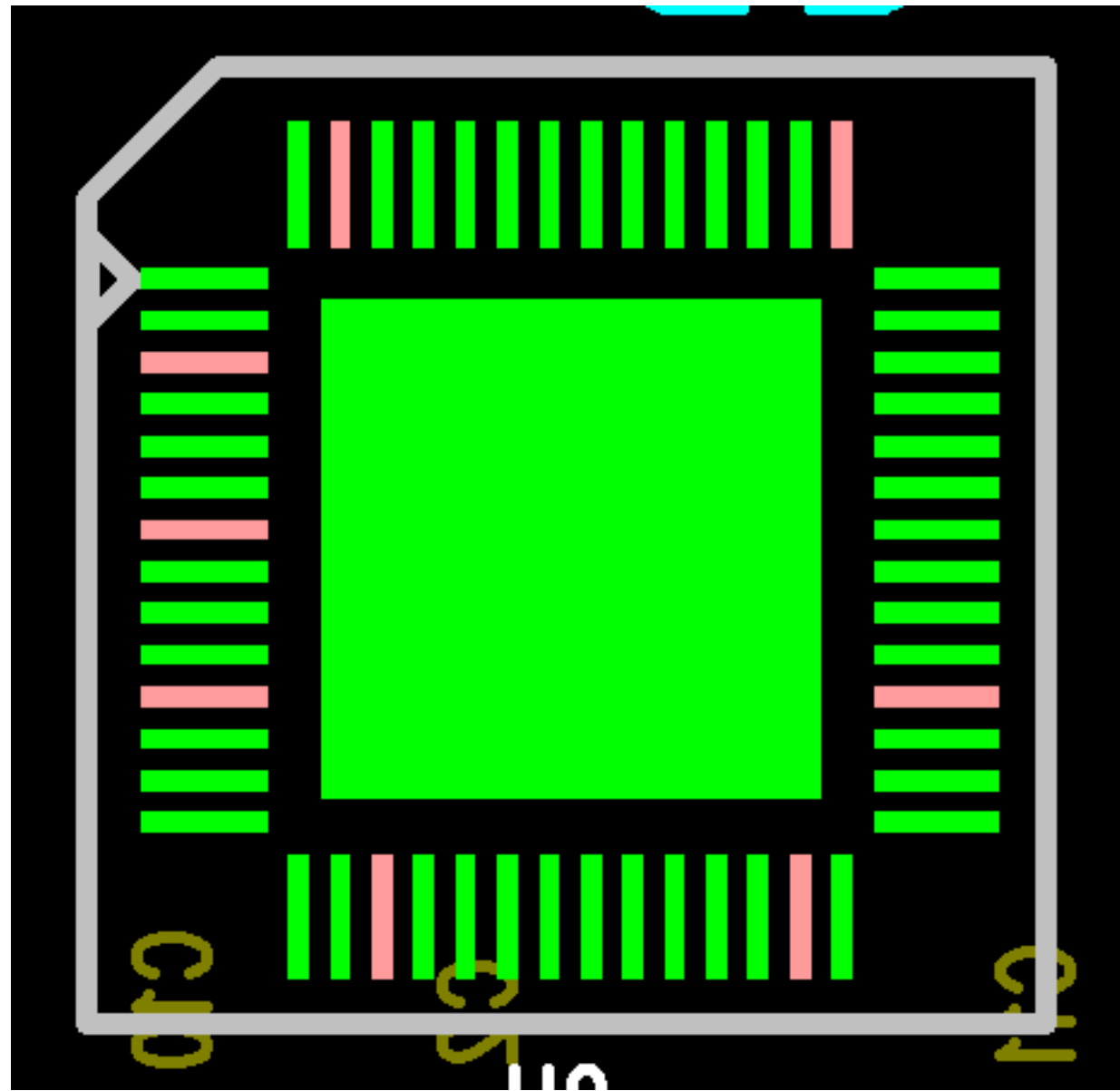


# 焊盘 - Pad/Land

- 选择焊盘类型 - 器件形状、大小、布置形式、振动、受热、受力等因素
- 泪滴状焊盘 - 发热且受力较大、电流较大
- 各元件焊盘孔的大小要按照元件引脚粗细分别编辑确定
- 注意焊盘和焊盘中心间距是否与器件管脚中心间距一致

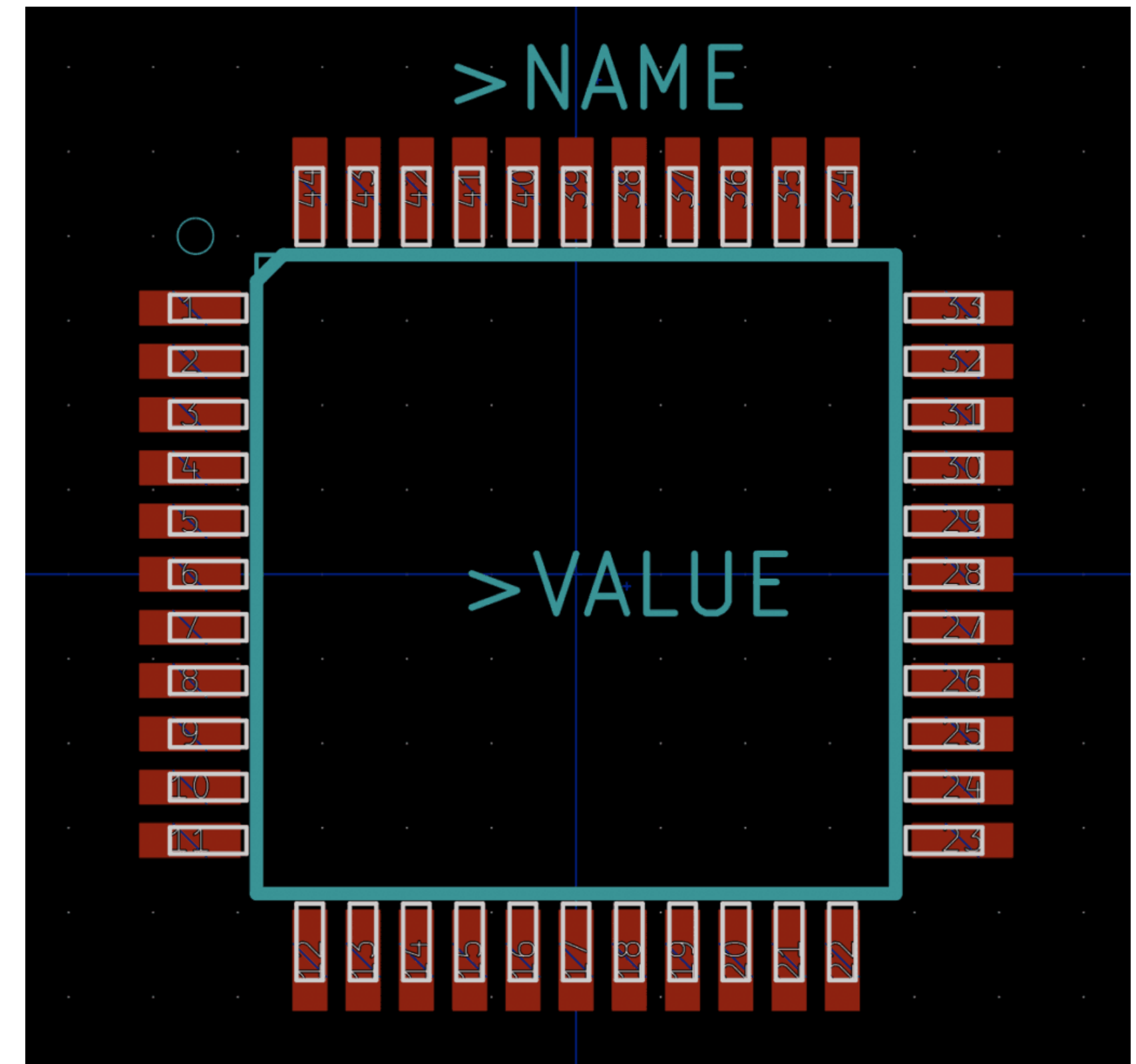
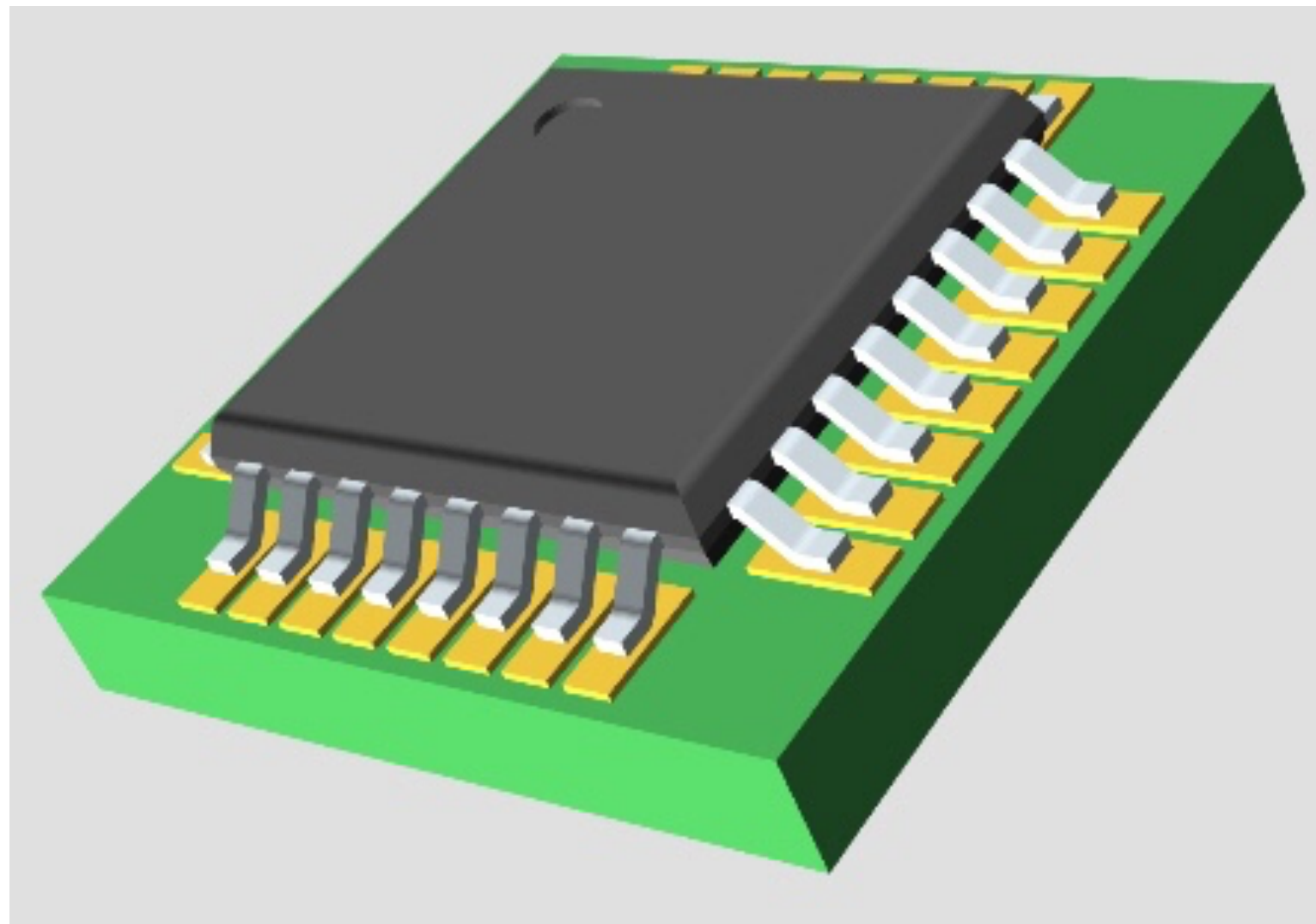


# 外形轮廓 - 元器件不能冲突，尤其是焊接、安装



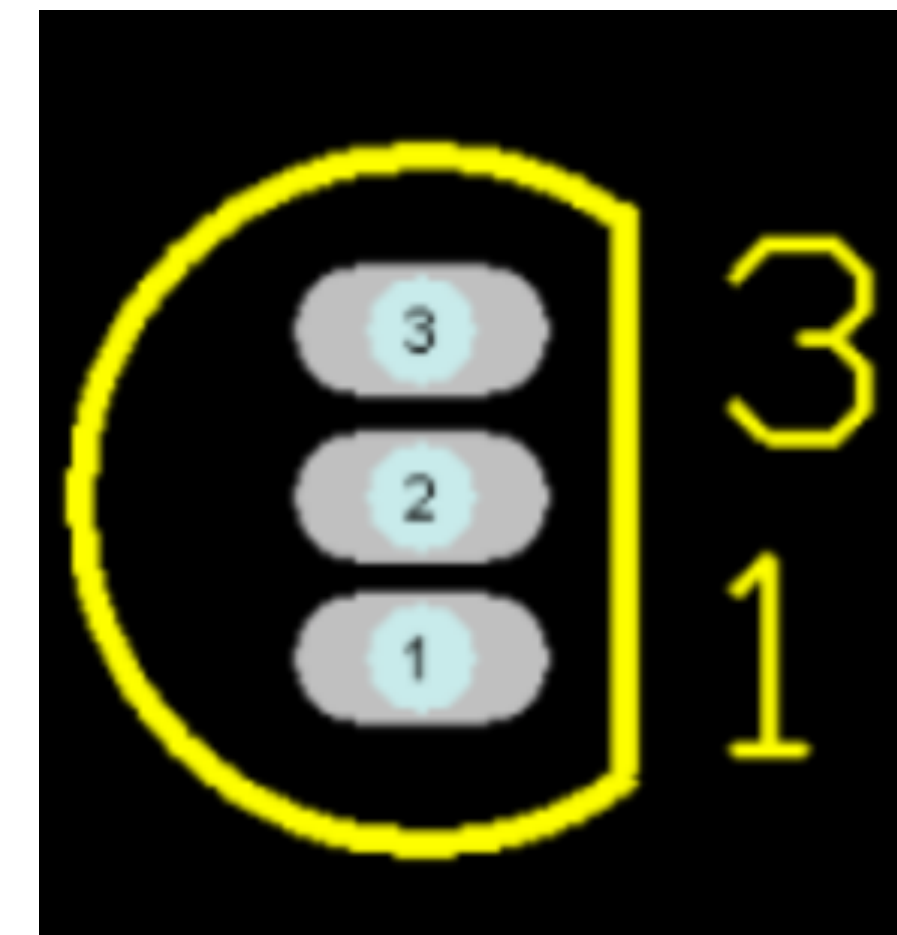
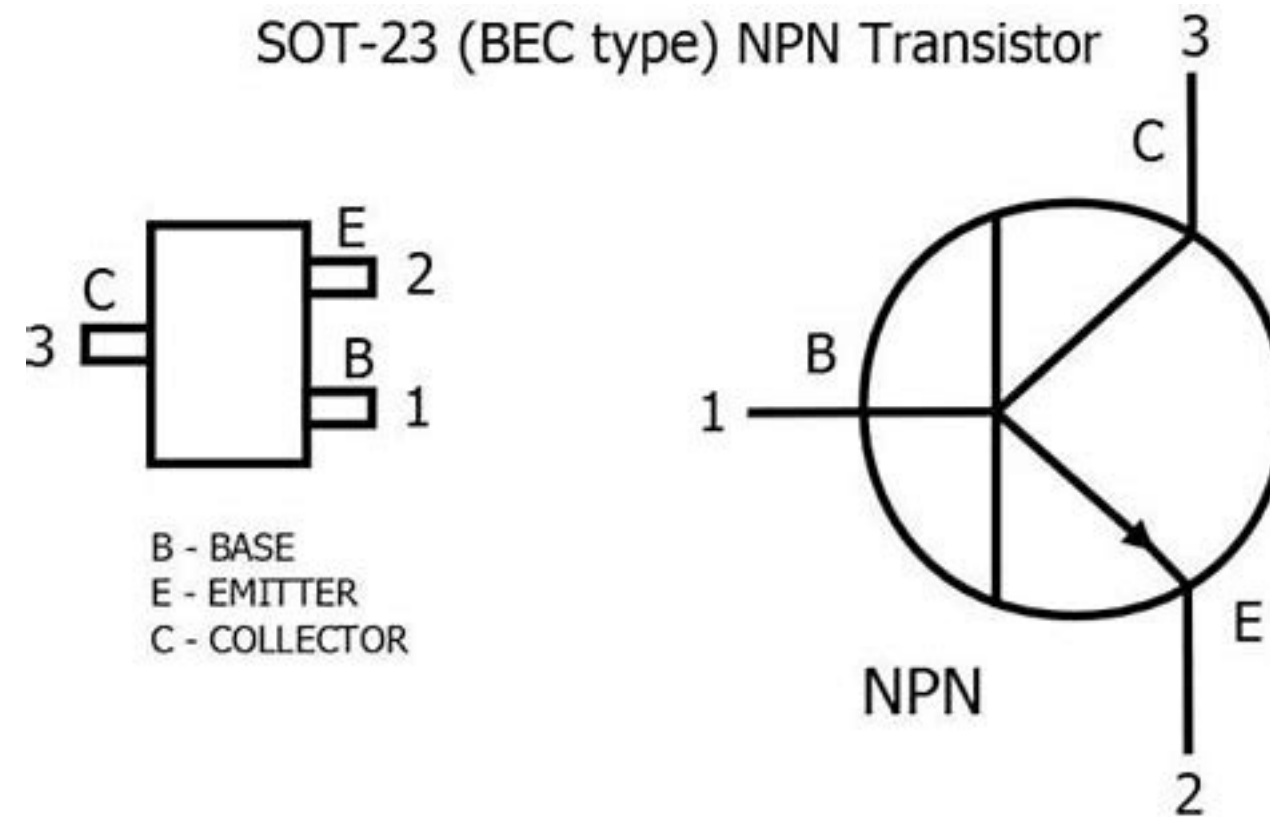
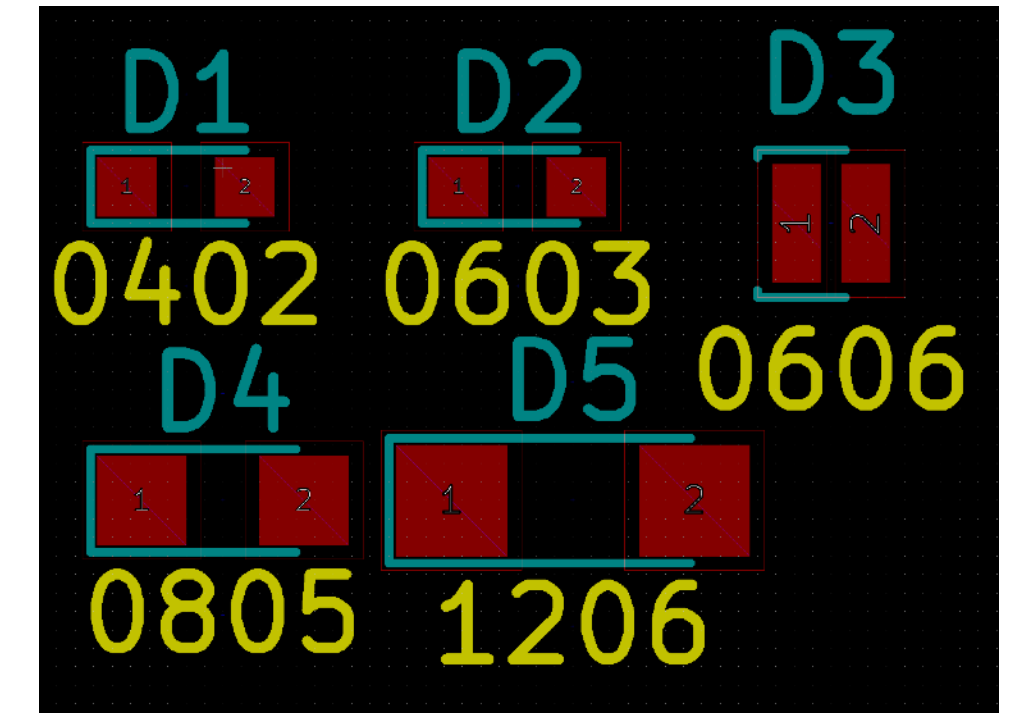
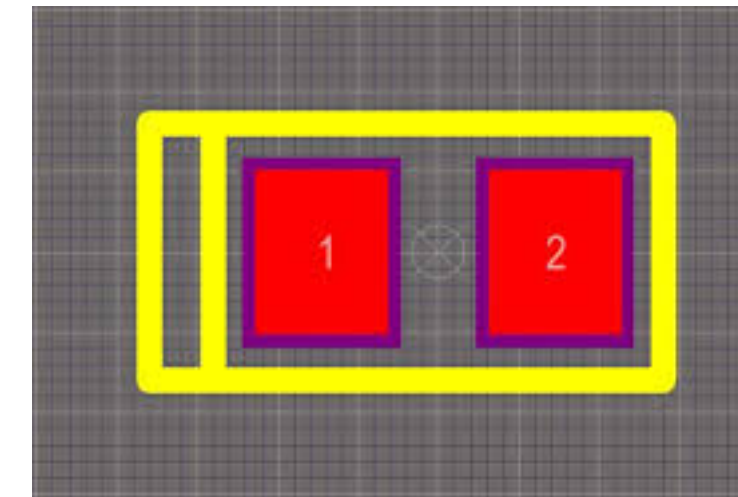
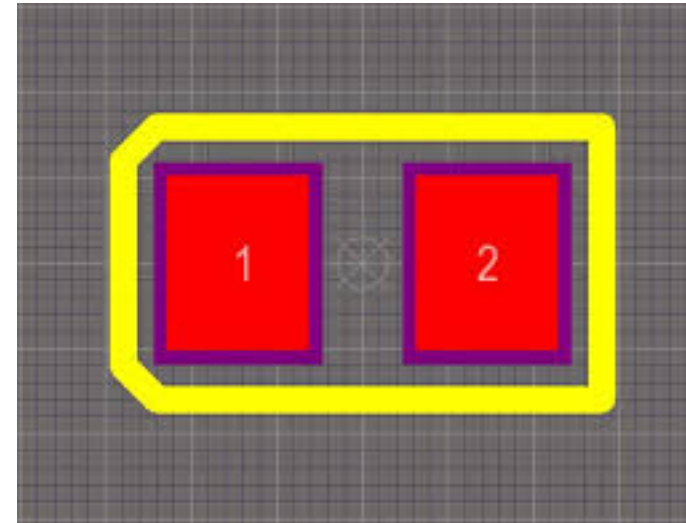
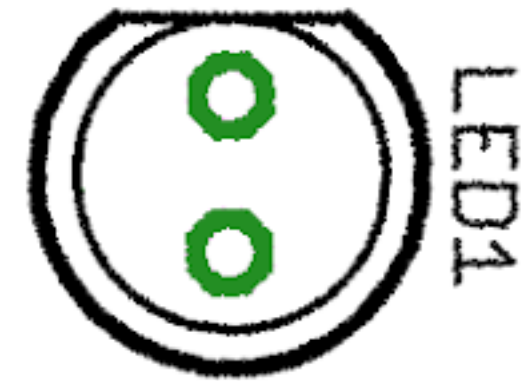
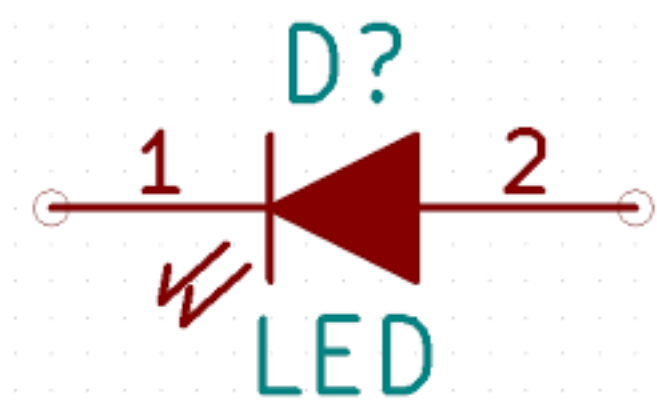
焊盘大小：管脚焊盘宽度同数据手册中一致或略宽

管脚长度略长于数据手册中器件的管脚长度

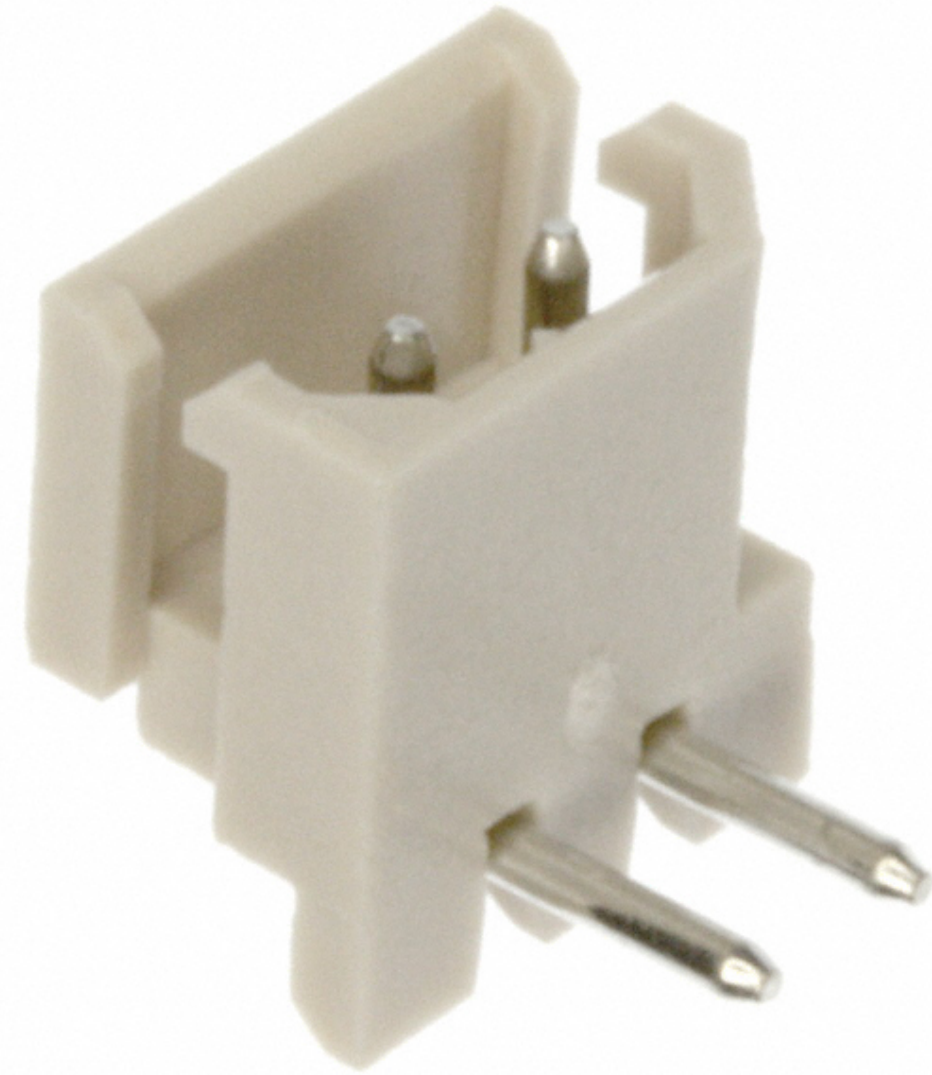




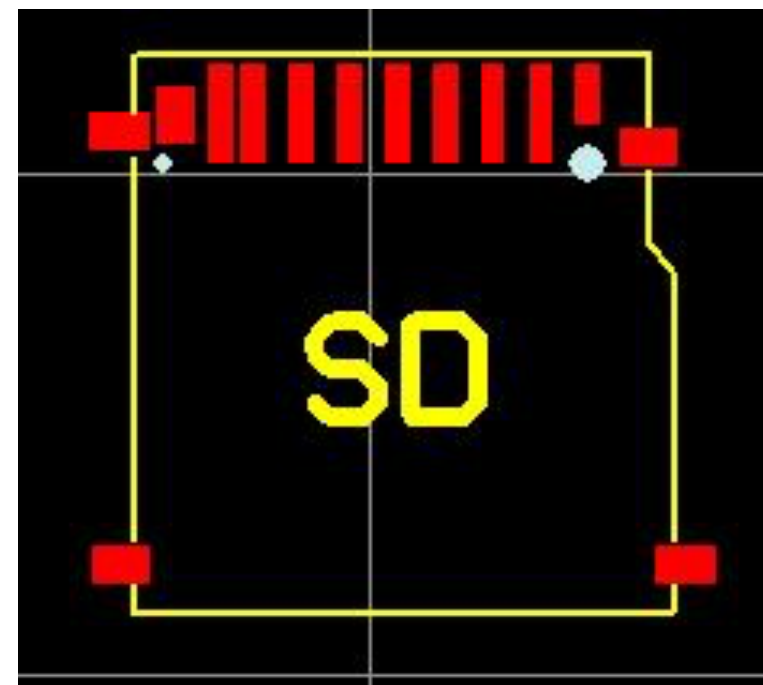
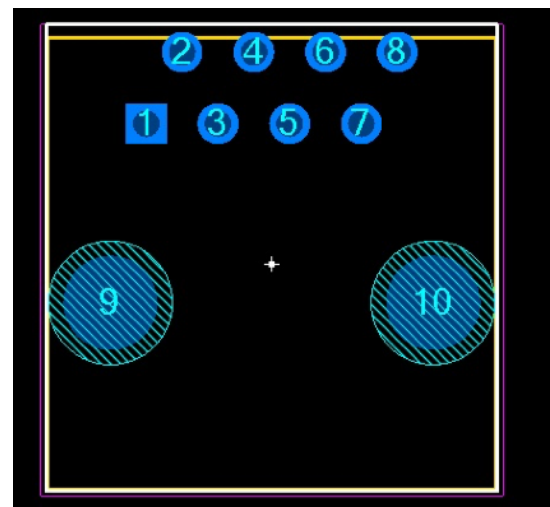
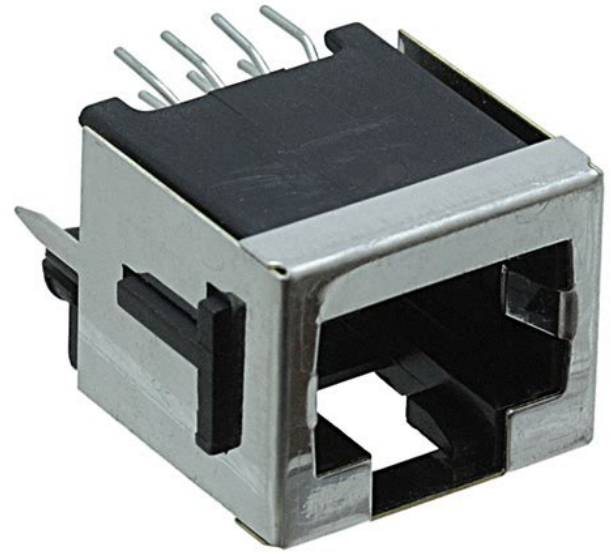
# 封装库和原理图符号库的管脚编号要对应并有丝印标记



# 通孔的器件封装库 - 注意管脚的粗细和形状



# 注意定位用的管脚 - 位置、编号、孔径、接地与否?



**GCT**

**USB3135-30-A**

USB3100 Series 5 Pin SMT Right Angle Top Mount Micro USB Receptacle w/ Peg

Availability: **In Stock**

Package Type: **N/A (Add Suggestion)**

Average Price: **\$0.39 USD**

CAD Models: **Symbol and Footprint**

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Symbol and Footprint Library /

2D Model  3D Model

GCT Approved by GCT

Symbol

Footprint (Unlink Footprint)

VBUS  
D-  
D+  
ID  
GND  
SHIELD

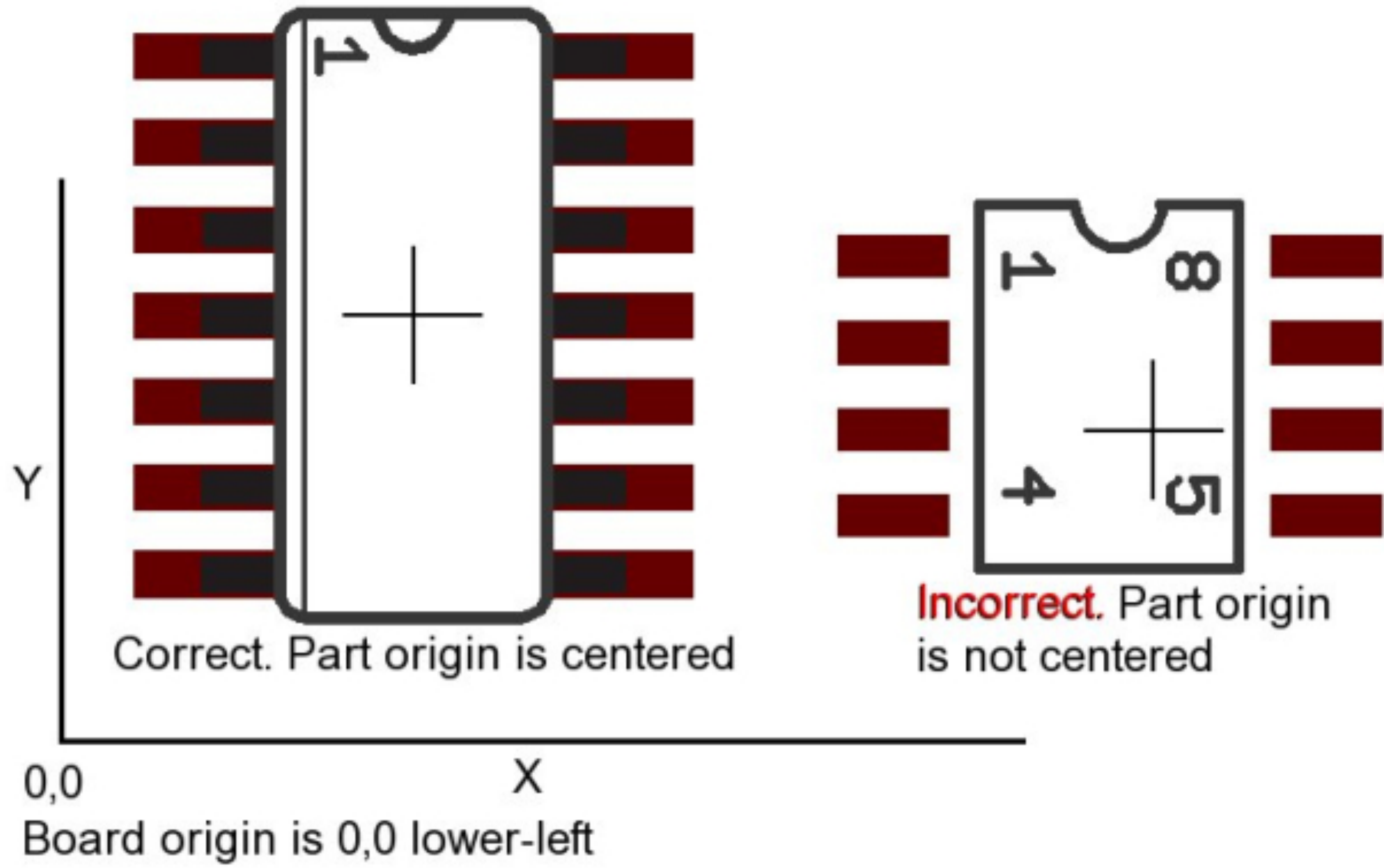
USB3135-XX-X\_REVB

GCT\_USB3135-XX-X\_REVB

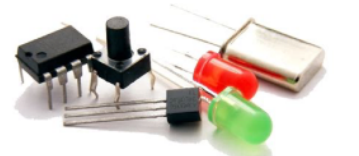
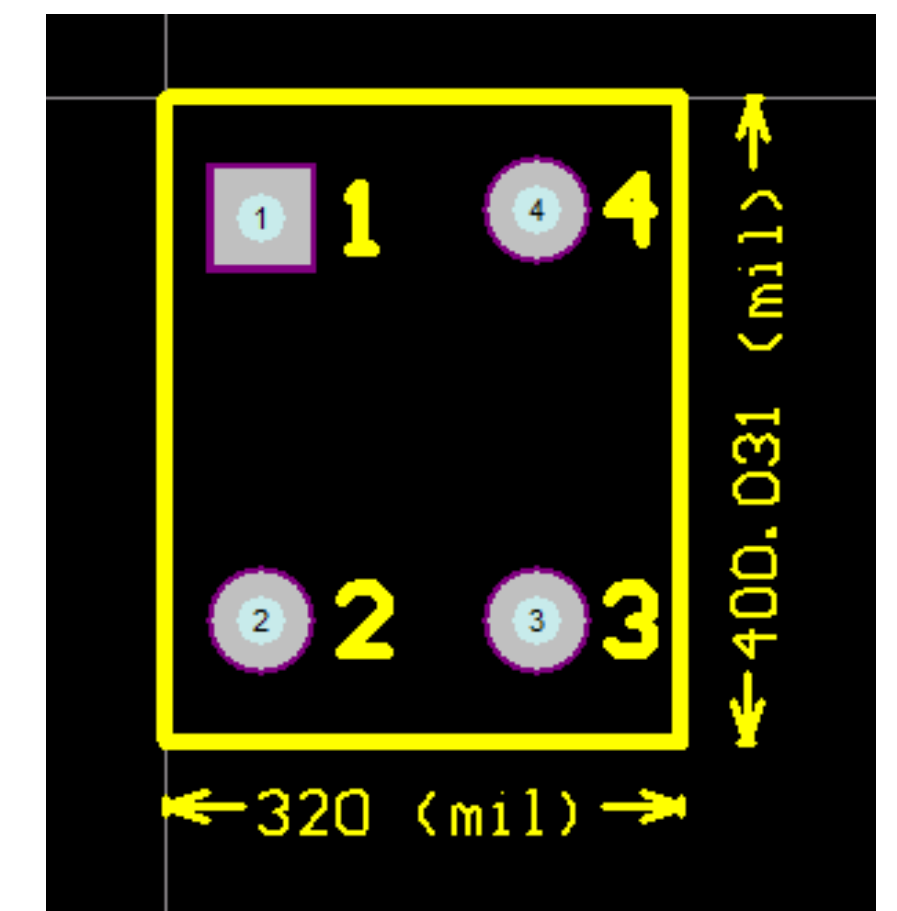
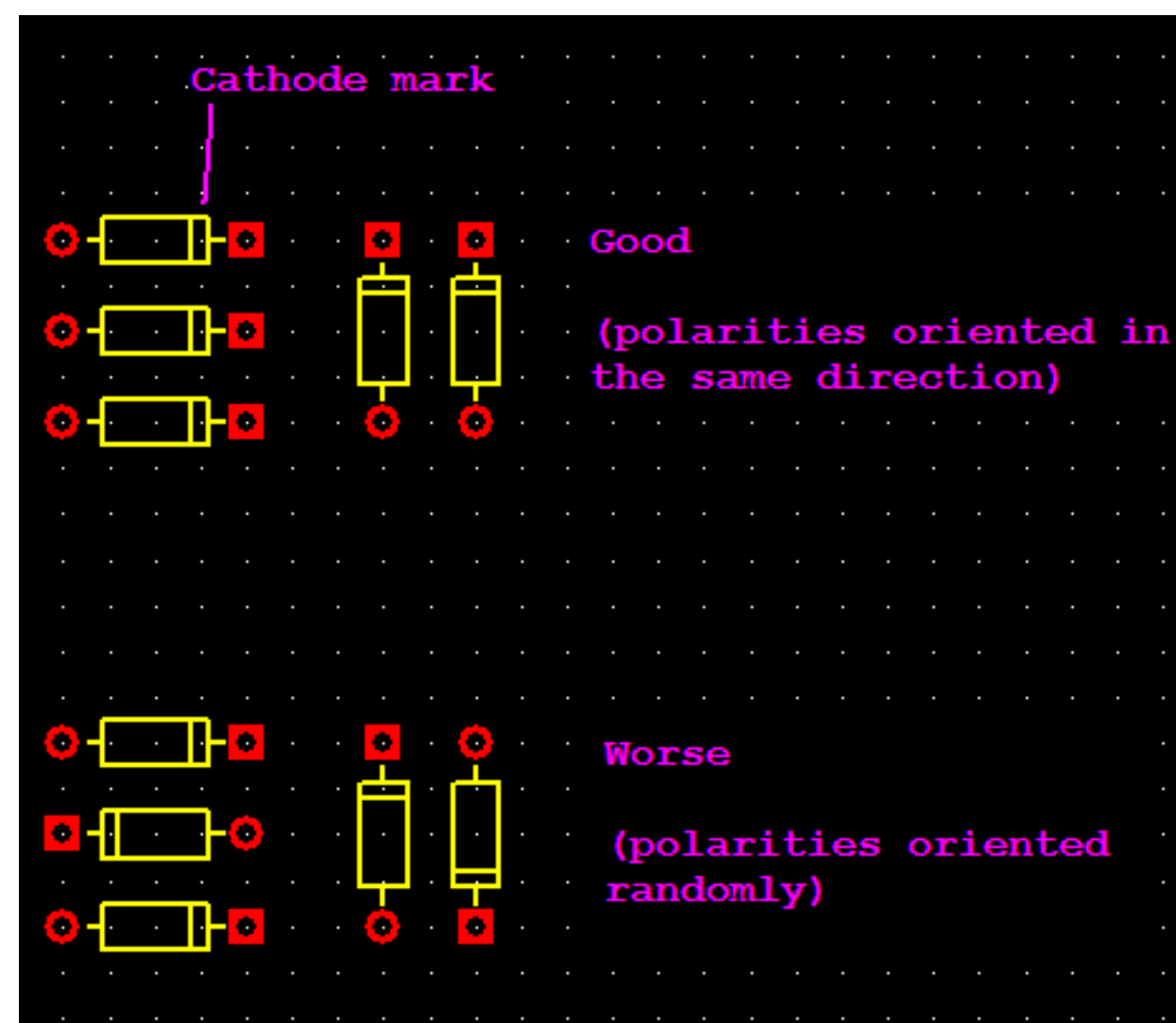
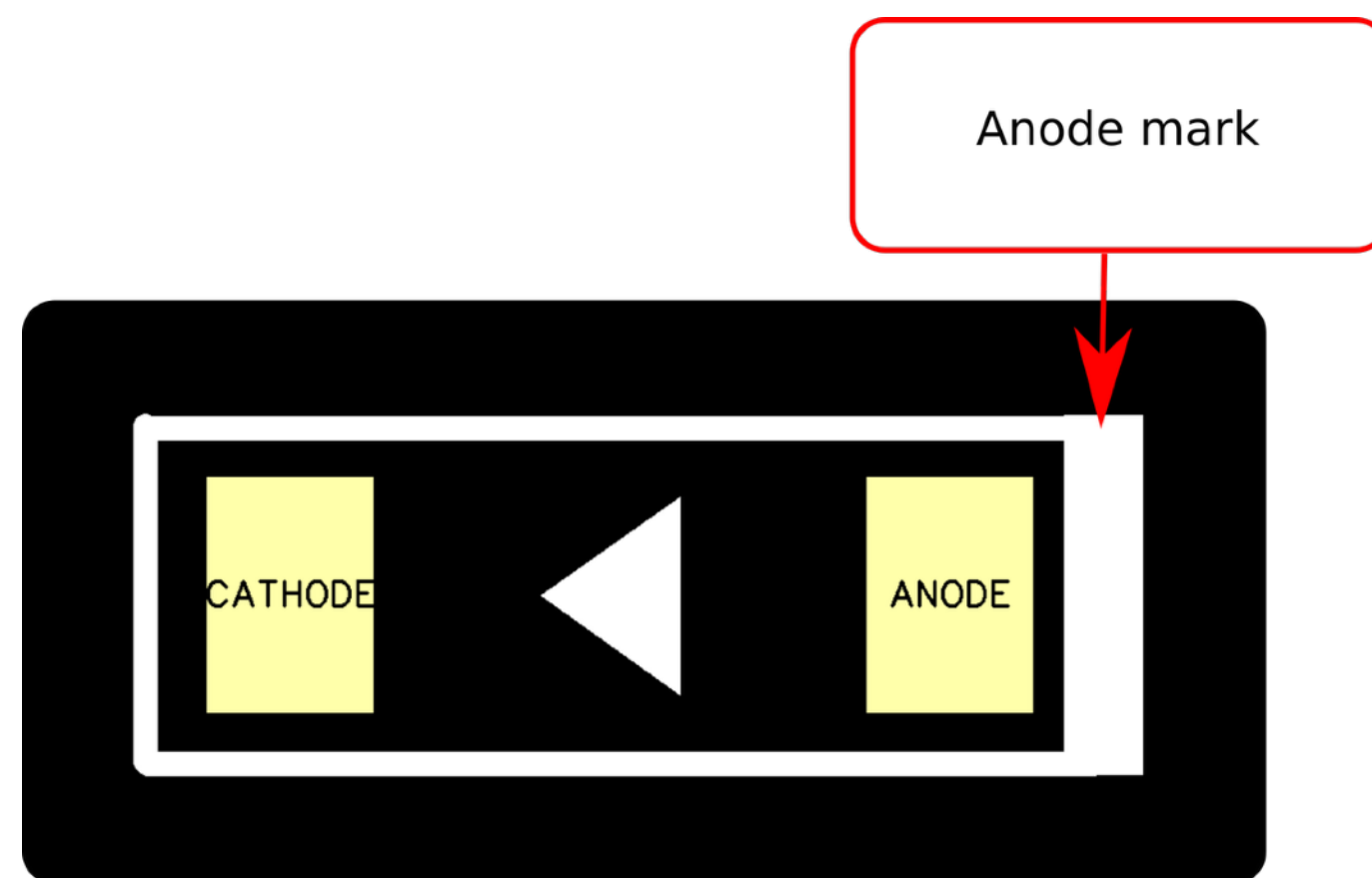
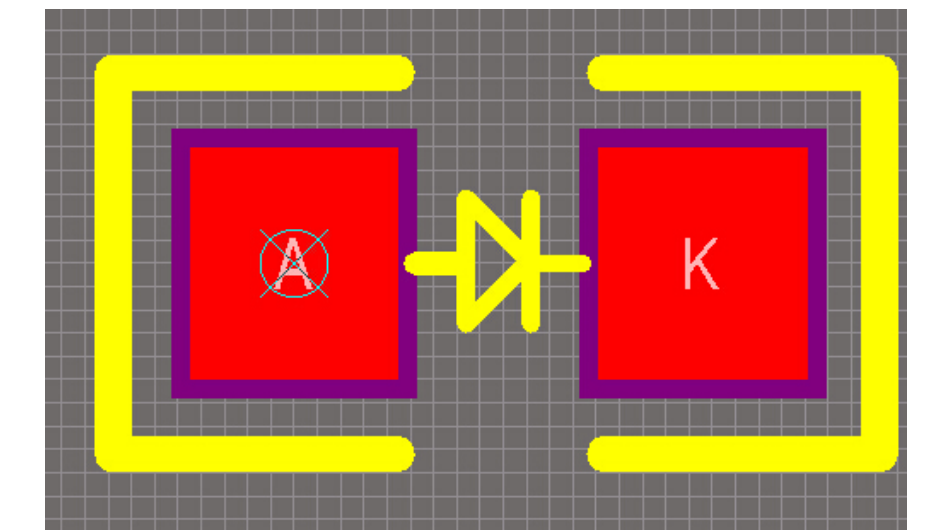
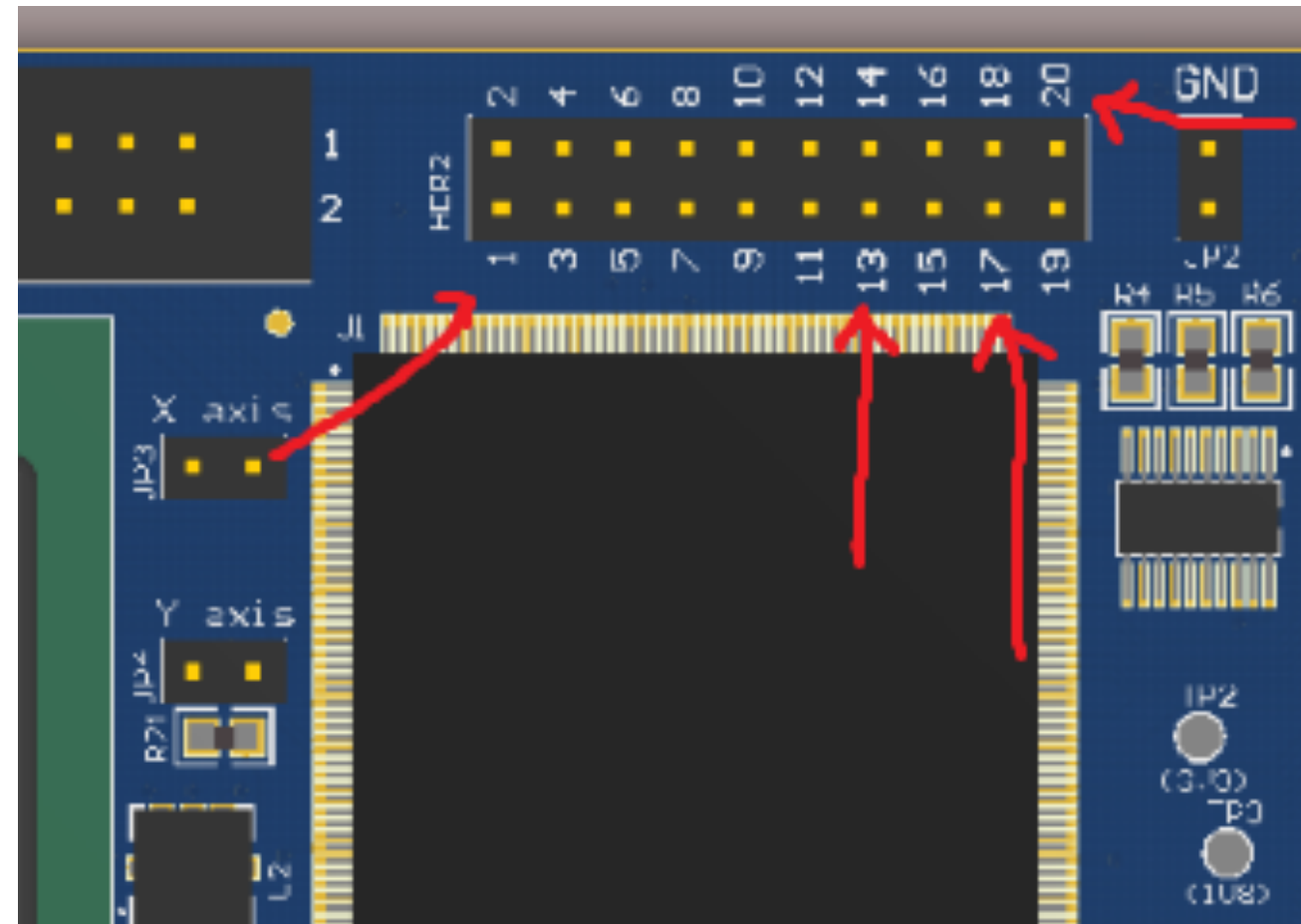
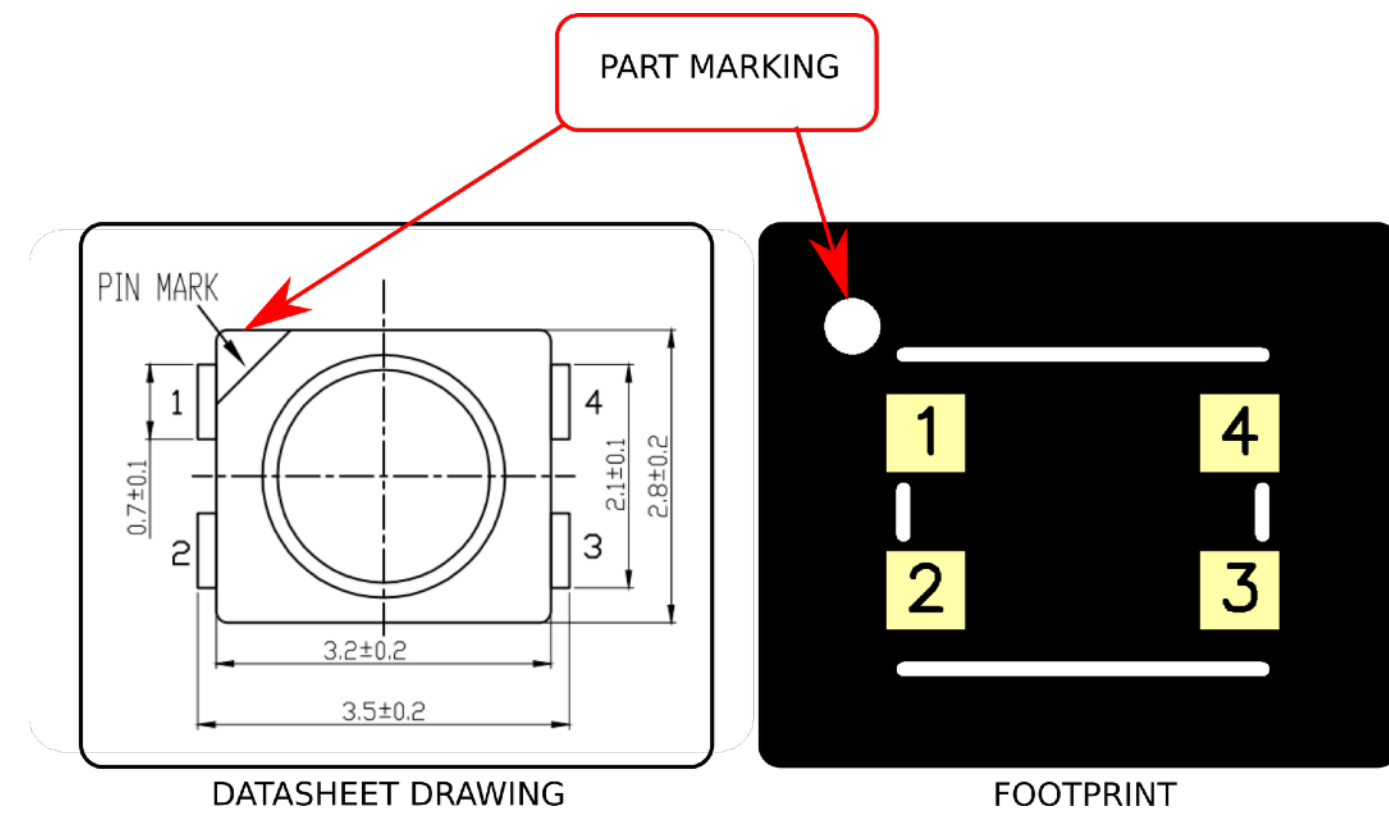
[Download Symbol and Footprint](#)  
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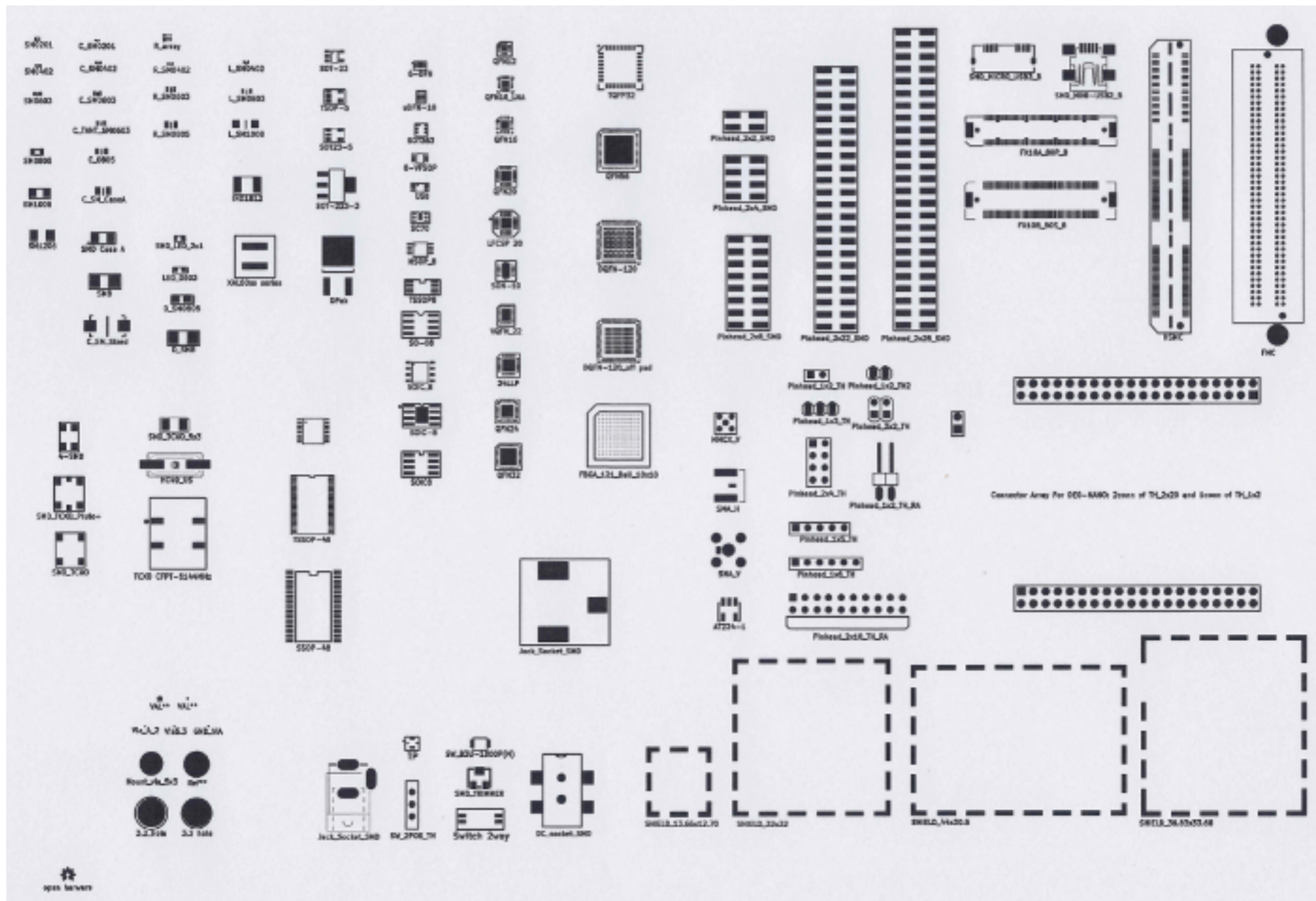
# 设定好原点

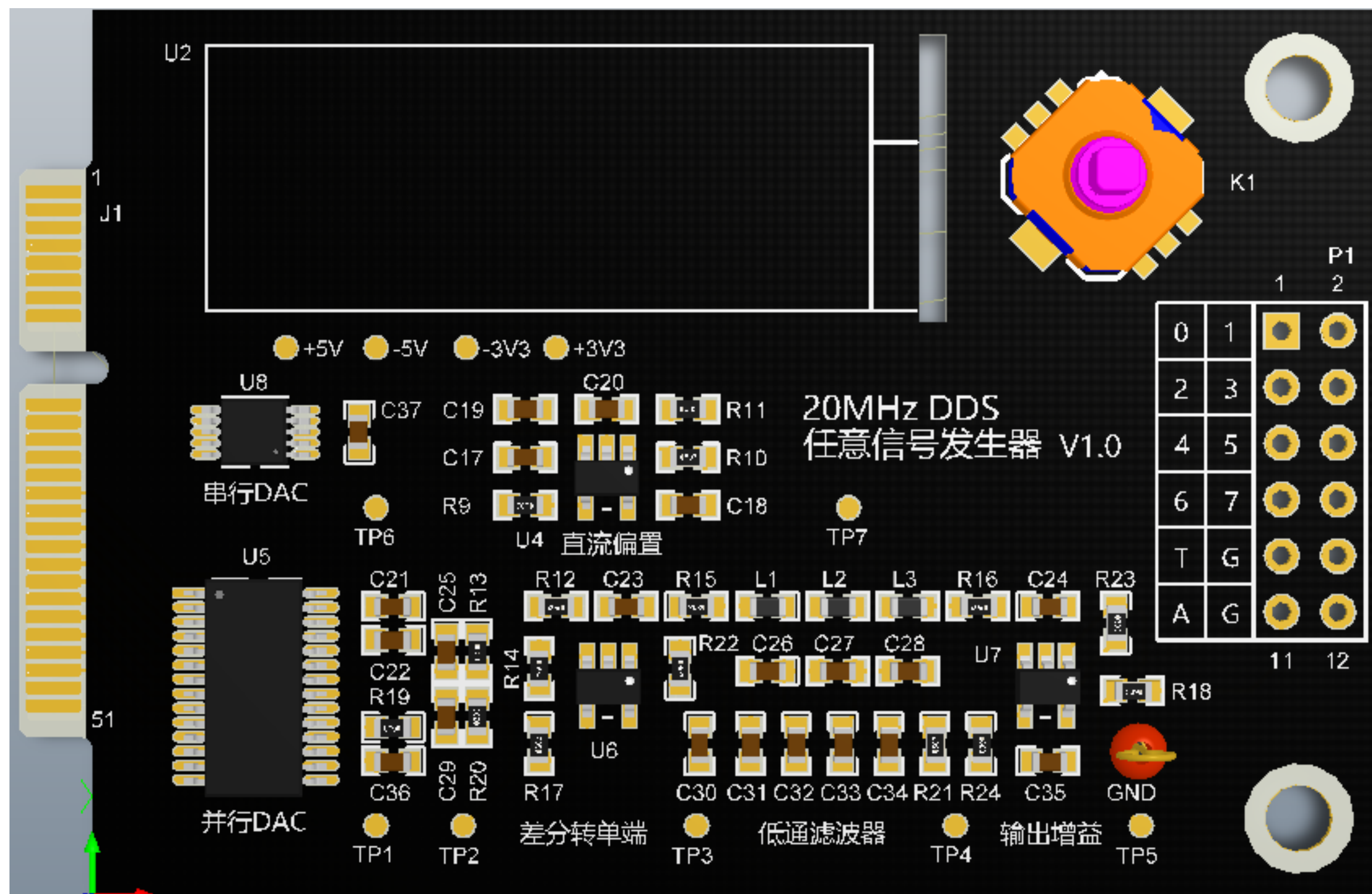


# 明确、正确的丝印标注

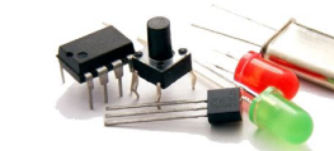


# 打印同实物进行对比验证





# PCB设计之元器件布局策略

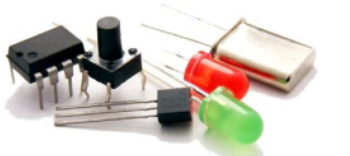
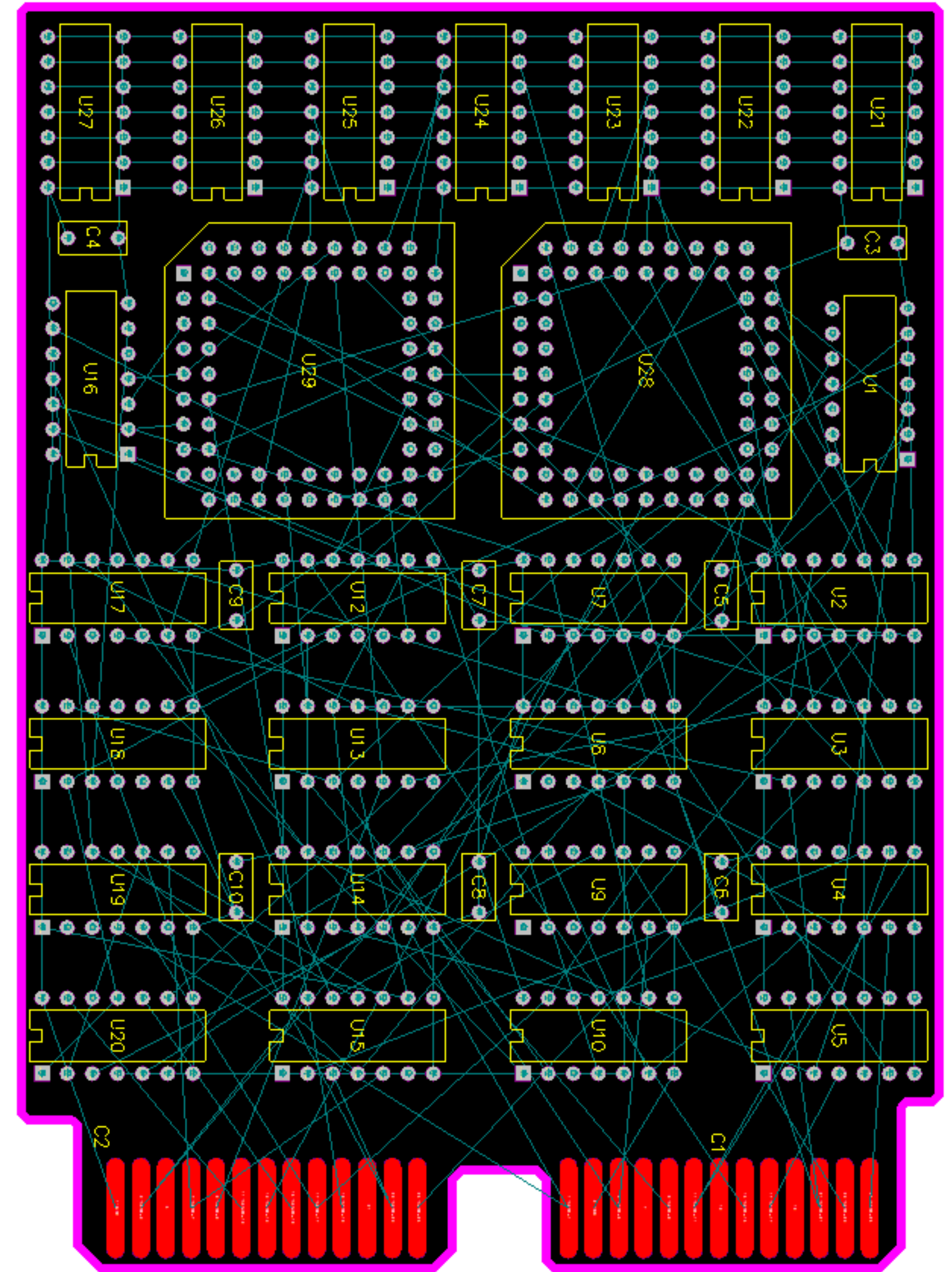


元器件布局：最耗时、最难、需要兼顾多种需求



# 核心要点

- 不建议自动布局，几乎没用
- 未完成布局，尽量不要布线，随时根据review可能调整
- 综合考虑：机械结构、散热、将来布线的方便性、电磁干扰、可靠性、信号完整性、先主后次
- 器件的摆放在保证关键器件的位置需求之外，要考虑到布局的规整、板卡的美观，尤其是无源器件的排列方向
- 布局完成以后可以对设计文件及有关信息进行返回标注于原理图，使PCB板中的有关信息与原理图一致
- 器件编号/名称摆放位置规则、易读、风格统一



# 布局步骤1 - 结构要求



- 根据需要划定外形轮廓，根据与外界的连接要求放置连接器
- 机械结构方面 - 外部接插件、显示器件等的安放位置应整齐，从3D角度考虑，板内部接插件应考虑总装时机箱内线束的美观，较重元器件应该分散放置
- 散热方面 - 散热器、风扇，与周围的电解电容、晶振等怕热器件隔开；竖放的板子发热器件放在板子最上面，双面放器件时底层不放发热的器件
- 电磁干扰方面 - 高频器件、EMI考虑，预留保护地线的走线空间、总线信号成组分布、微小信号的抗干扰隔离带的空间和保护、差分信号的成对出现
- 设计禁止布线层和机械结构：物理尺寸、定位孔/安装孔的位置、接插件的位置、禁止布线层的位置，标准板可调用现有的向导



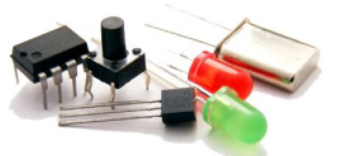
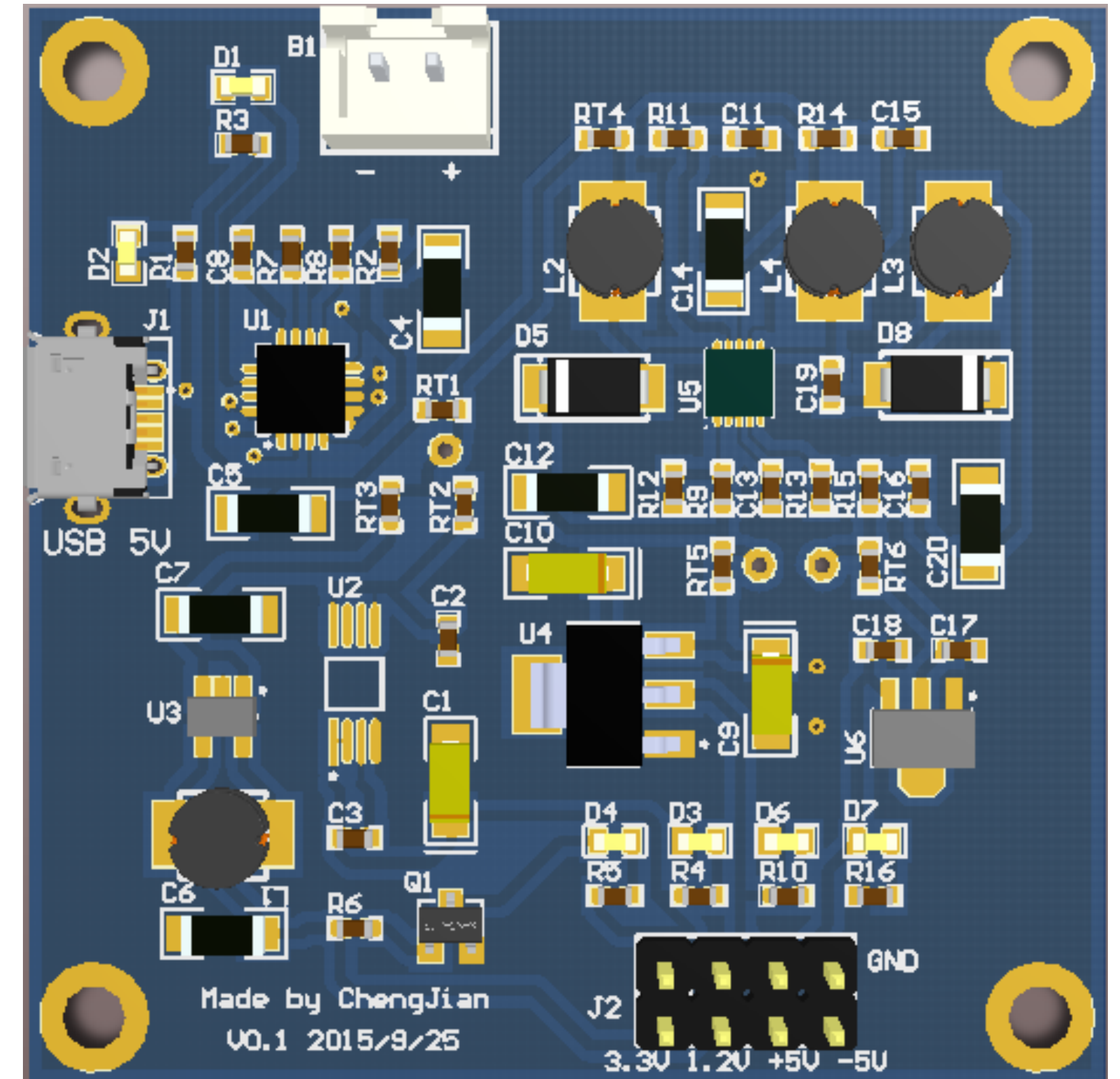
# 无物理限制的板卡尺寸设定

- 大小适中:

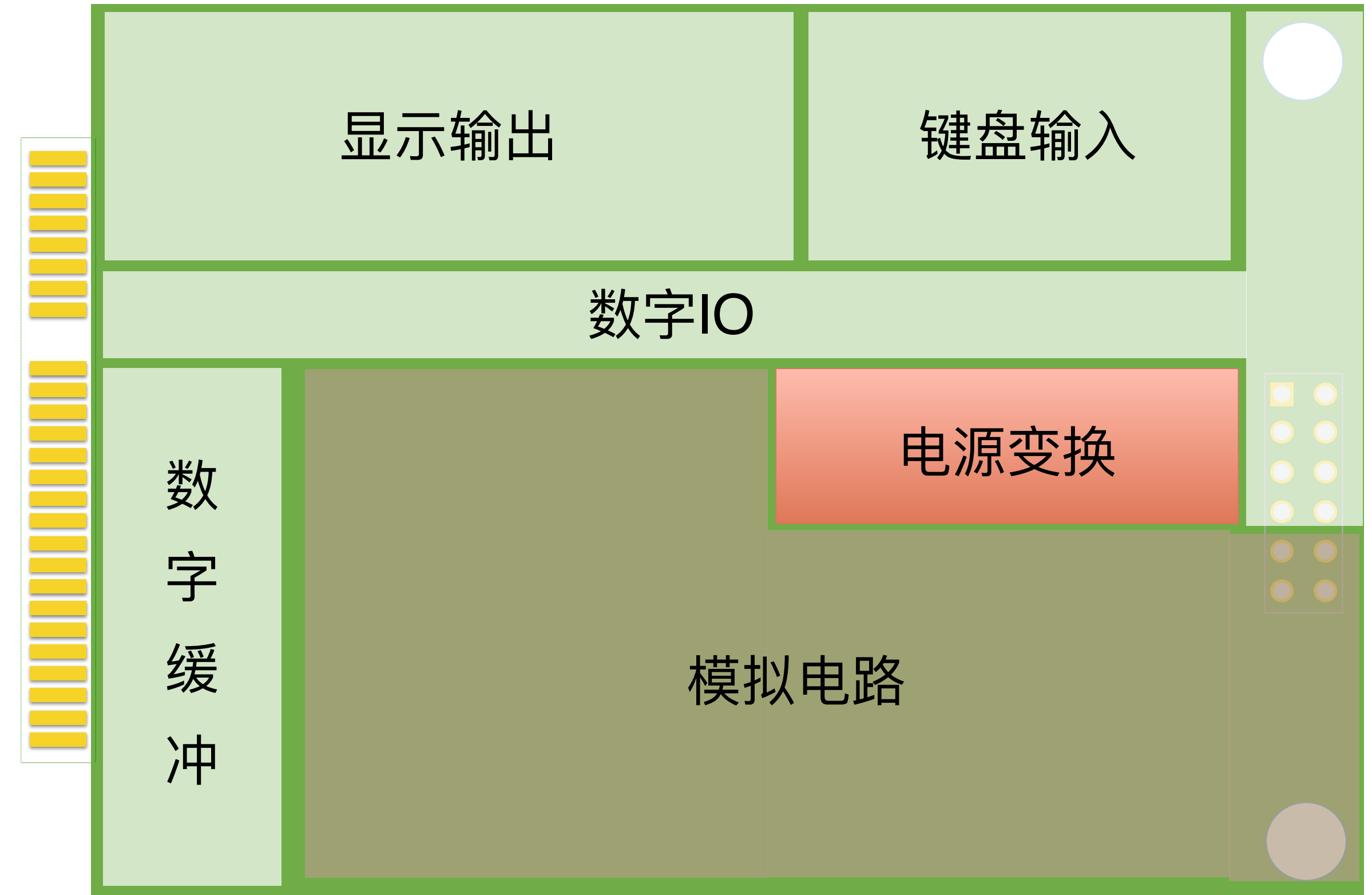
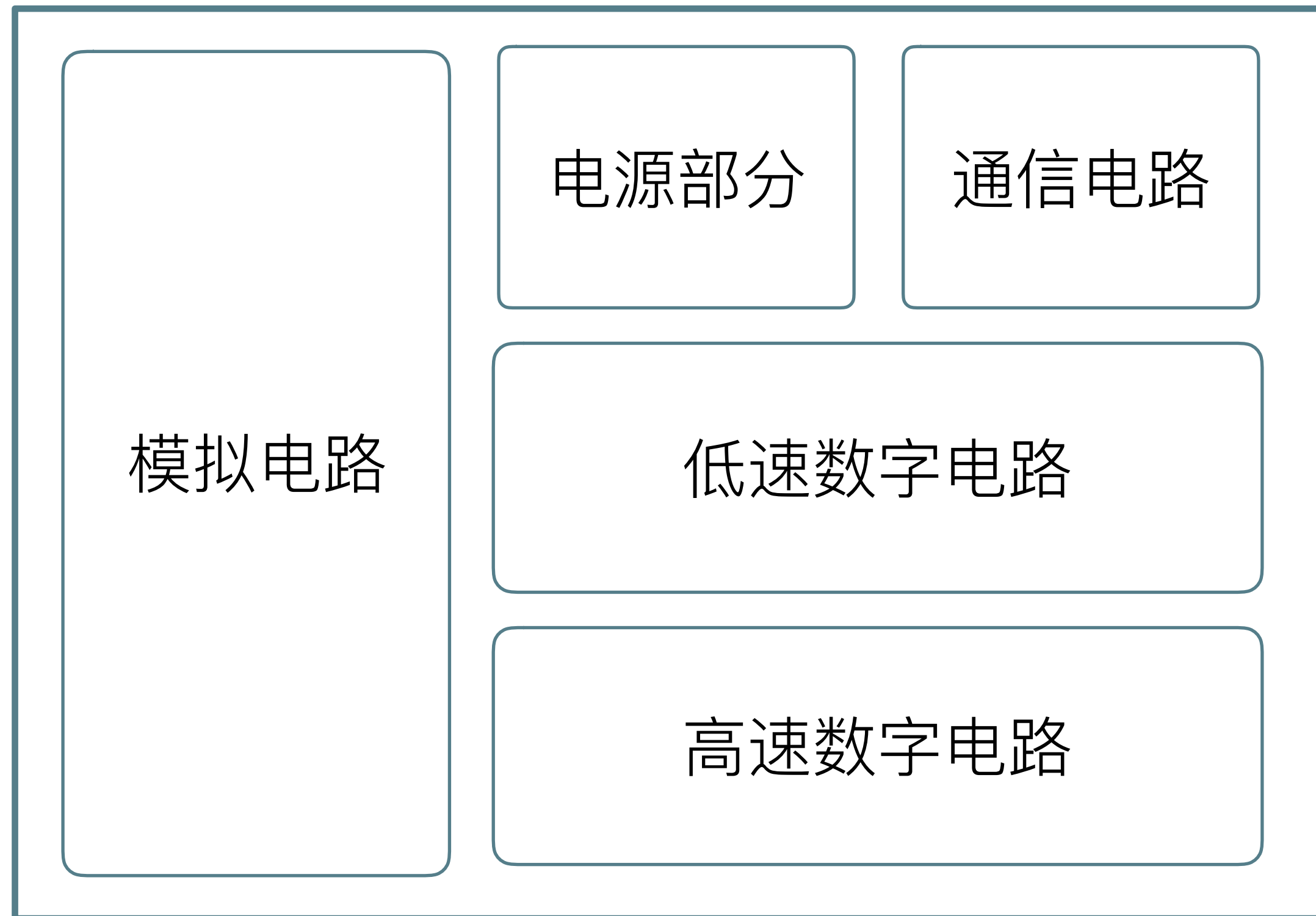
- 过大 - 线条长、阻抗增加、抗噪声能力下降、成本增加
- 过小 - 散热不好, 易受临近线条干扰
- 整体美观 - 布局均衡、疏密有致

- 成本:

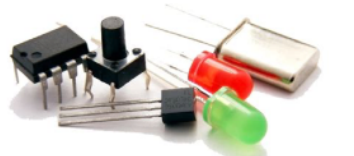
- 板子的层数 - 根据尺寸、性能要求和器件的封装决定
- 单板的面积 - 大小适中、加工方便
- 加工成本
  - ▶ 拼板
  - ▶ 原材料利用率: 1020mm\*1020mm和1020mm\*1220mm居多



## 布局步骤2 - 按照功能分割区块

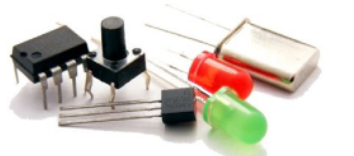
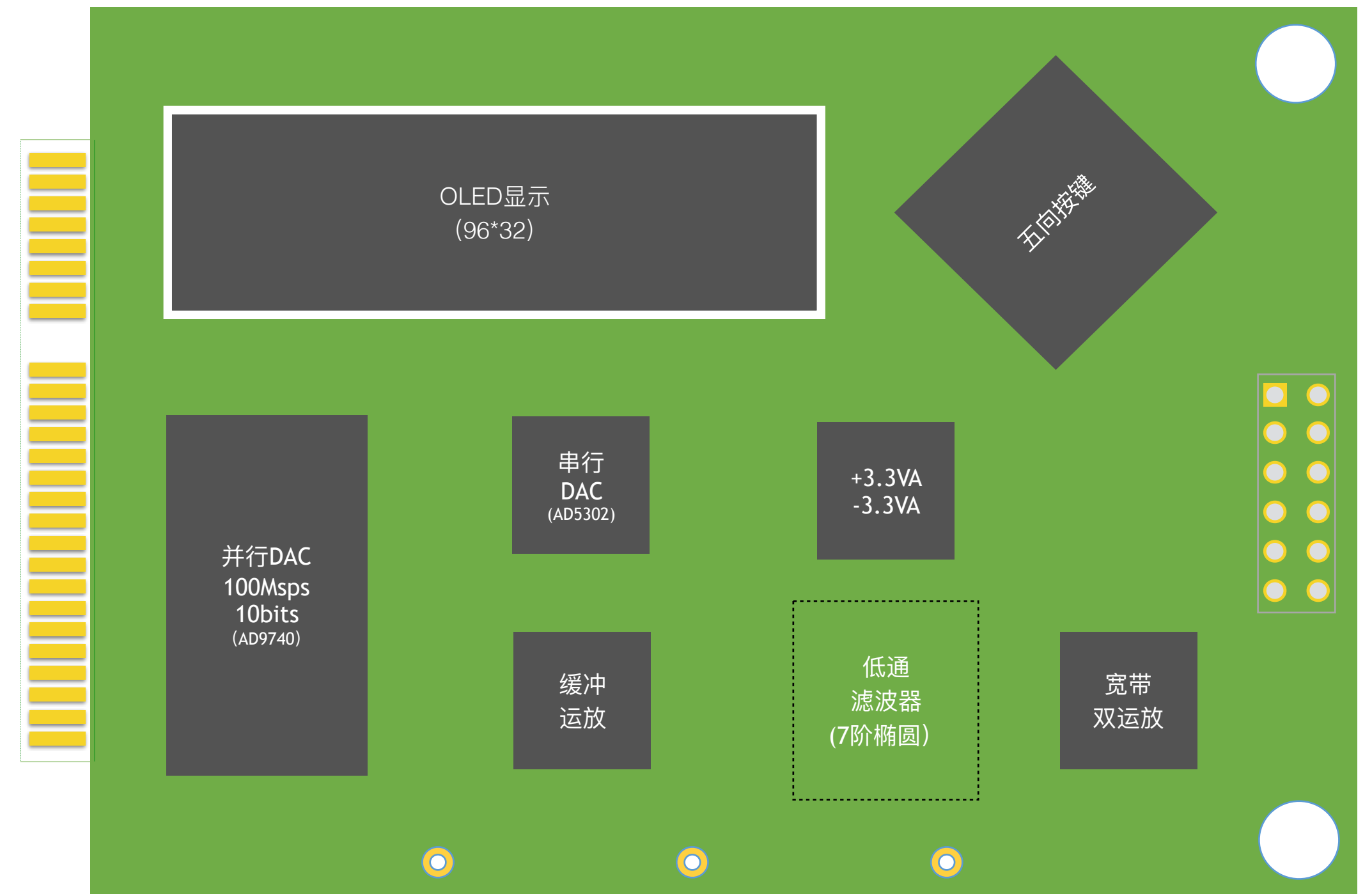


- 功能模块分区 - 功能、类型、连接关系分区，模拟/数字、高频/低频、大功率/小信号
- 不同功能区块的供电/接地可能不同



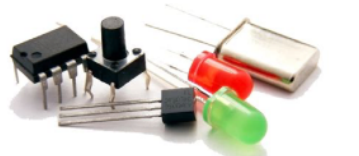
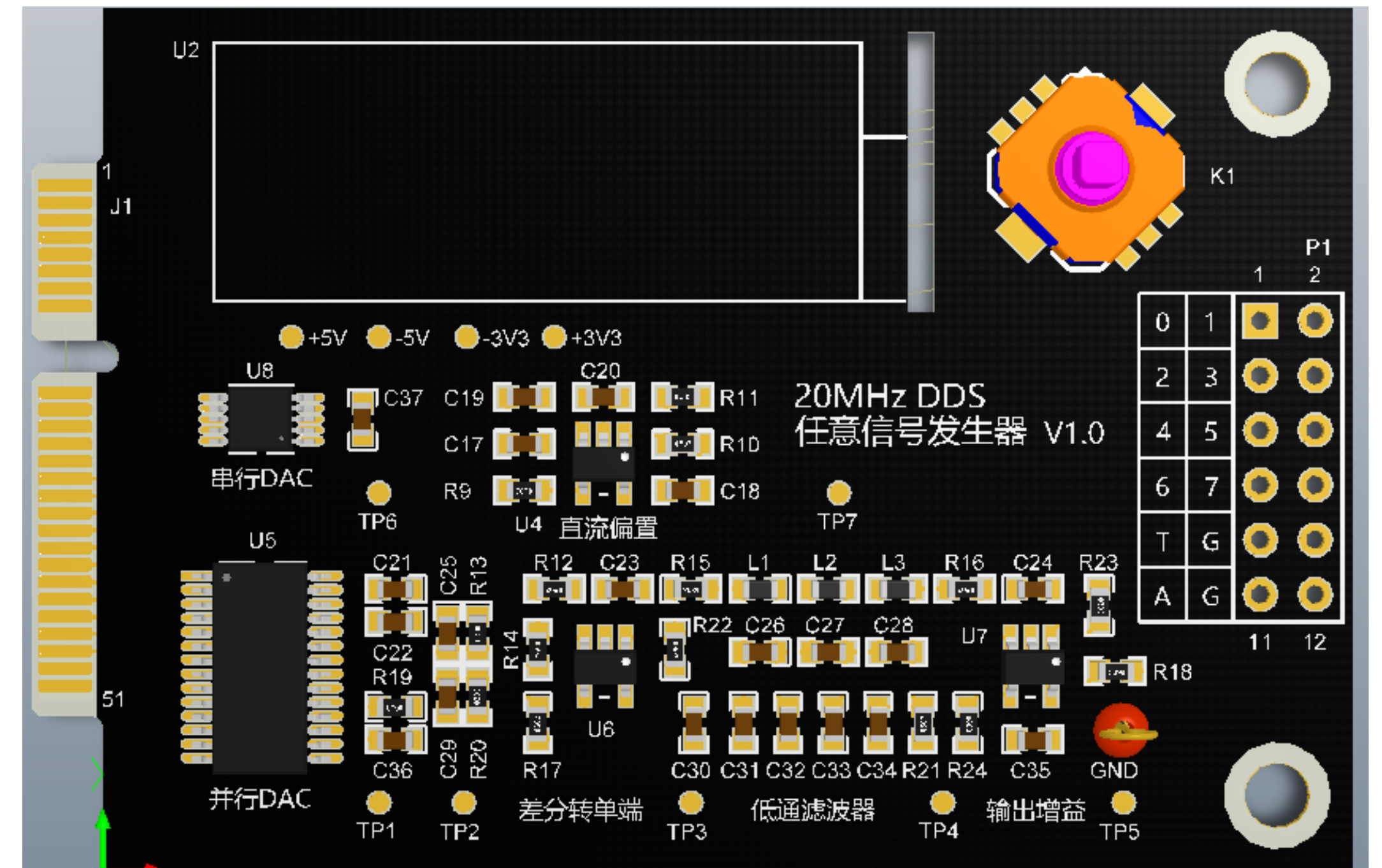
# 布局步骤3 - 摆放关键器件

- 单面板 - 元器件一律顶层
- 双面板 - 元器件一般放顶层，元器件过密时把高度有限、发热量少的器件（贴片阻、容、IC）放底层
- **MCU** - 注意MCU和周边辅助电路及其它芯片的联系，注意时钟线引脚以及晶振的放置位置
- **FPGA** - 管脚多、连线多，可以根据实际情况调整FPGA引脚的分配
- **混合型器件（ADC、DAC）** - 数字信号和模拟信号朝各自的布线区域，同时考虑到器件方向的一致性，将混合器件放在数字和模拟布线区的交界处
- 热敏器件和发热器件之间有适当的隔离

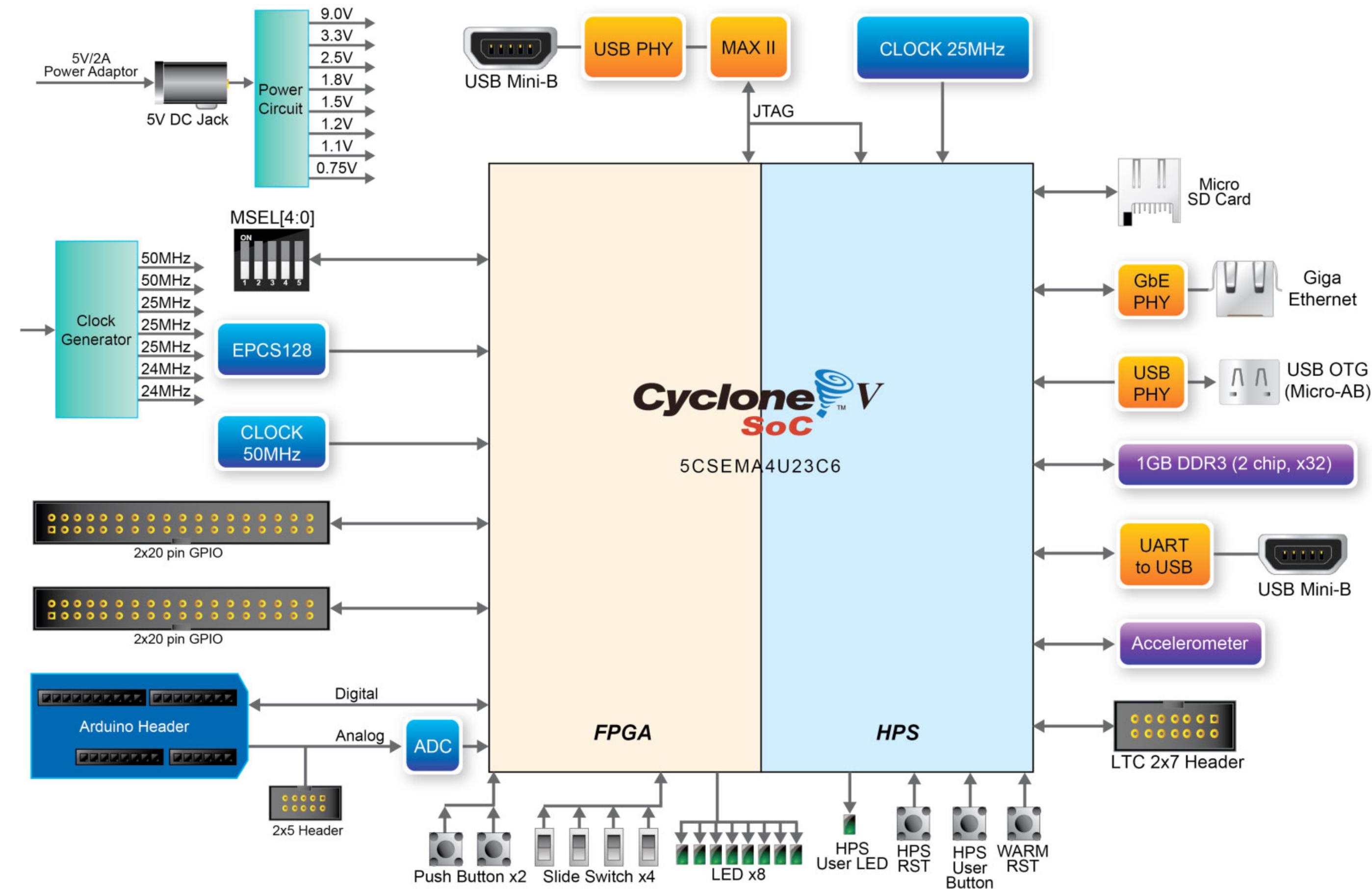


# 布局步骤4 - 摆放周边器件：性能、美观

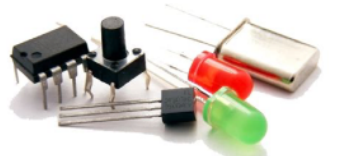
- 注意数字/模拟信号的区别，数字/模拟元器件以及相应走线尽量远离并限定在各自的布线区域内
- 注意元器件离板边缘的距离，所有的器件均放置在离板的边缘3mm以内或 至少大于板厚
- 特殊元器件要求 - BGA器件周围2mm不能有任何器件，晶振下面最好不要有信号走线
- 信号的测试点放置在方便观测仪器测试的位置，不影响信号质量，接地点要方便探头的连接
- 布线要求 - 分布密度适当，保证布线空间但不宜走线过长增加信号延时，去耦电容、匹配电阻注意位置
- 可安装性和可焊接性，器件的排列方向、波峰焊方向、焊接面元器件的高度



# FPGA器件的管脚灵活应用

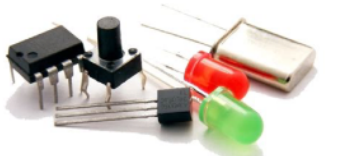


- 充分利用FPGA的IO可编程配置的优势
- 根据PCB的布局调整原理图的连接甚至原理图符号库的管脚排列
- 专用管脚不可动 - 时钟、JTAG等
- 注意同一组IO的属性一致性，比如LVDS
- 认真阅读数据手册
- 适用于IO可灵活配置的MCU



# 布局的检查

- 打印检查 - 拿实物验证
- 符合PCB制造工艺要求、有无定位标记？定位接插件要精确定位
- 元器件在2D、3D上不要有冲突，注意器件的实际尺寸，尤其是高度，在焊接面布局的元器件，高度一般不超过3mm
- 是否疏密有致、排列整齐、全部布完
- 需经常更换的器件是否方便更换？插件板插入设备是否方便？







# PCB的布线

最短路径、减少干扰

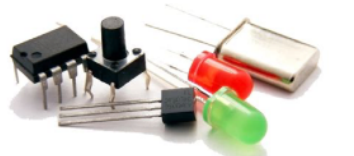


学技能上 **M**摩尔吧 **COORE8** [www.moore8.com](http://www.moore8.com)

买元器件用

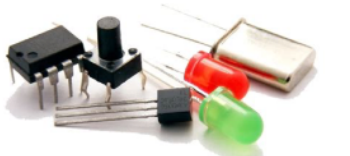


[www.mouser.cn](http://www.mouser.cn)



# PCB布线流程

1. 了解制造厂商的制造规范 - 线宽、线间距、过孔要求、层数要求
2. 确定层数并定义各层的功能
3. 设计布线规则 - 线宽、线间距、过孔大小
4. 定义不同net的走线宽度
5. 关键信号线走线 - 电源、时钟、差分信号、敏感的模拟信号....
6. 其它信号线走线
7. 铺地/电源
8. DRC检查
9. 对照原理图上的连线逐线高亮检查
- 10.调整丝印



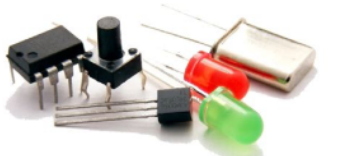
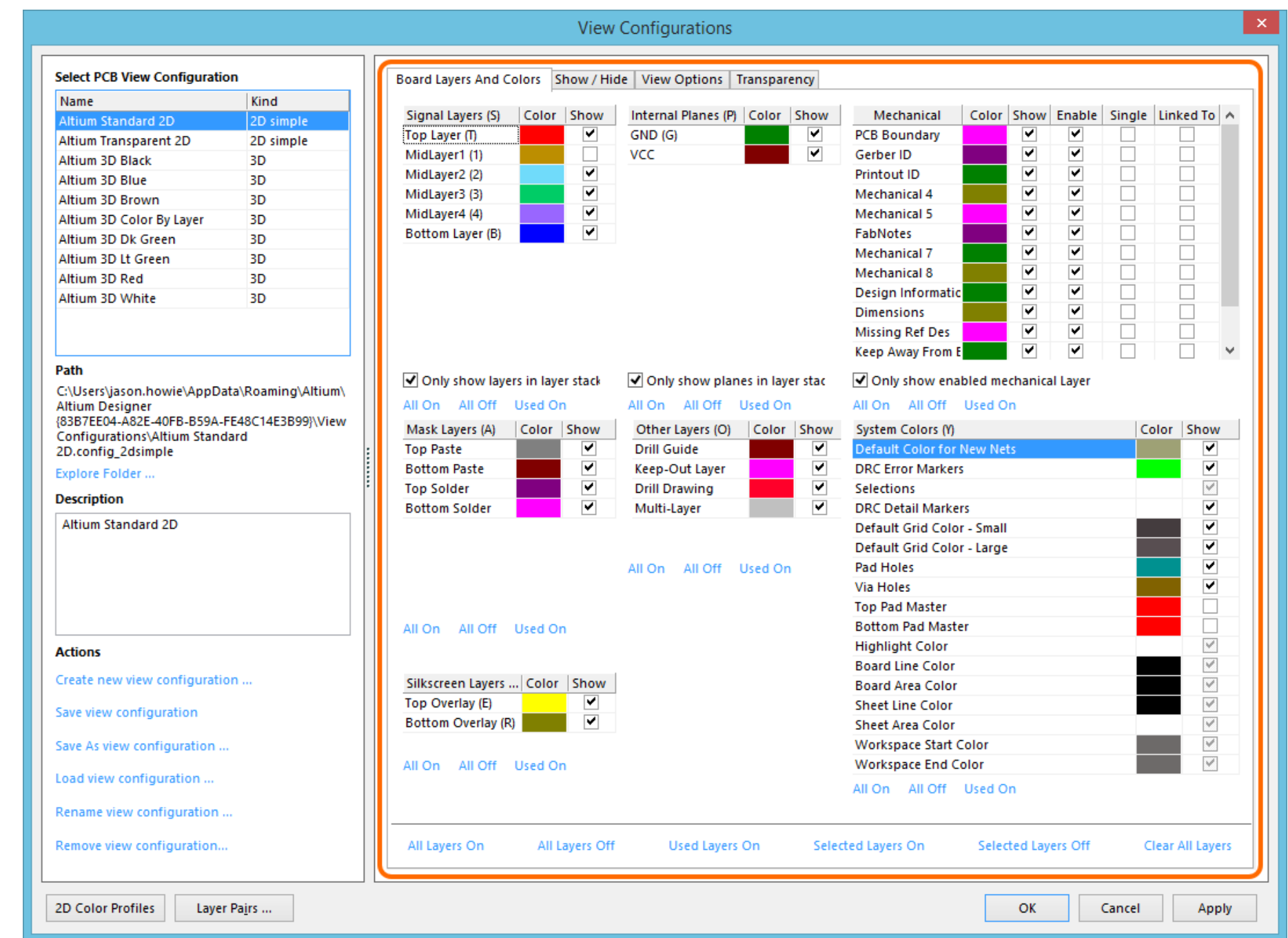
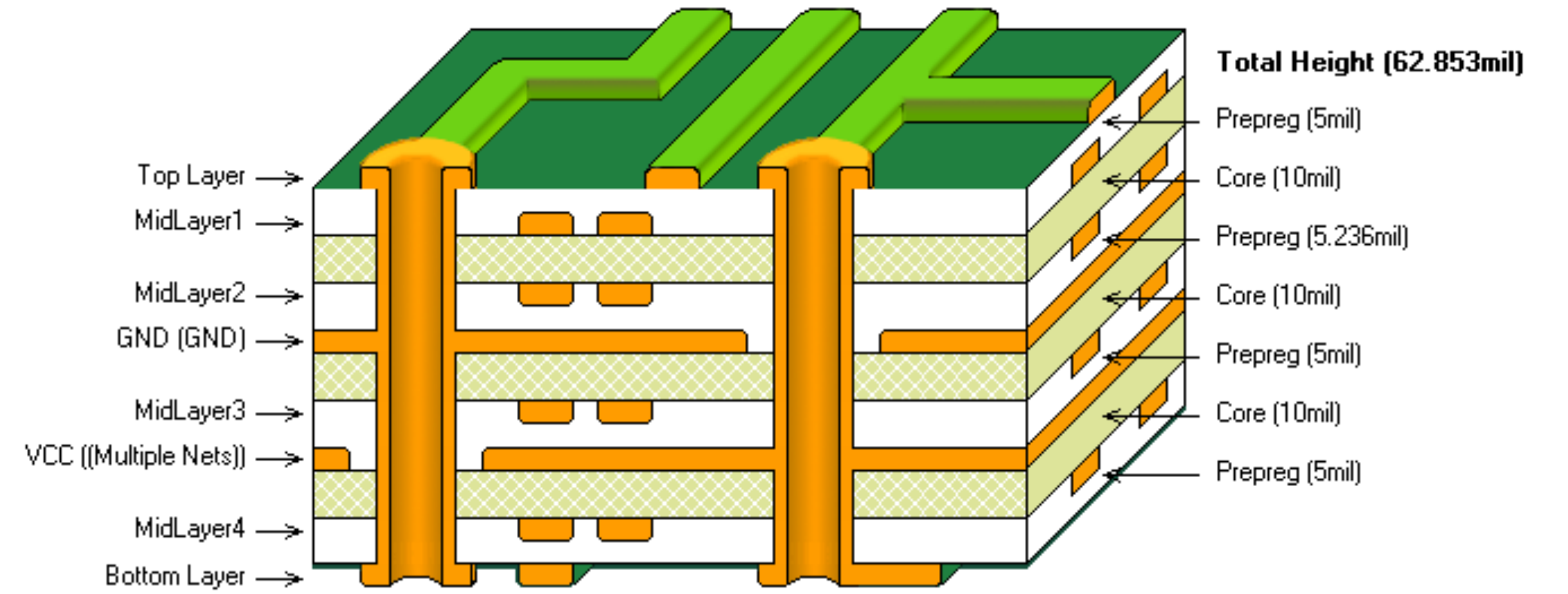
# 选择层数

- 根据电路特点规划层数:

- 高速/低速、模拟/数字、阻抗要求
- 器件封装及散出
- 抗干扰、可靠性要求
- 成本

- 定义各层的功能

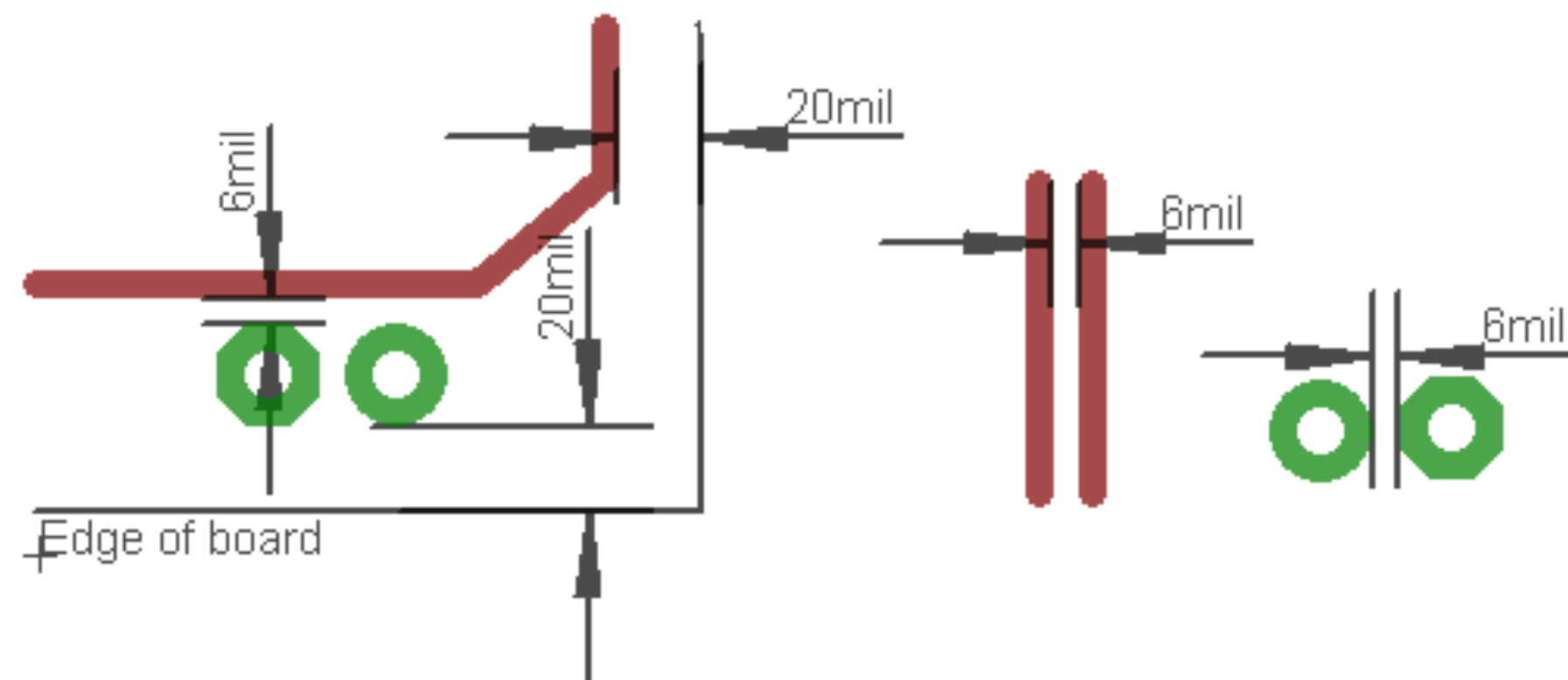
- 关闭未曾用过的层



# 设定布线规则

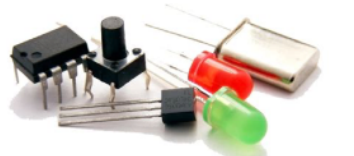


Minimum trace/silkscreen/text/hole size

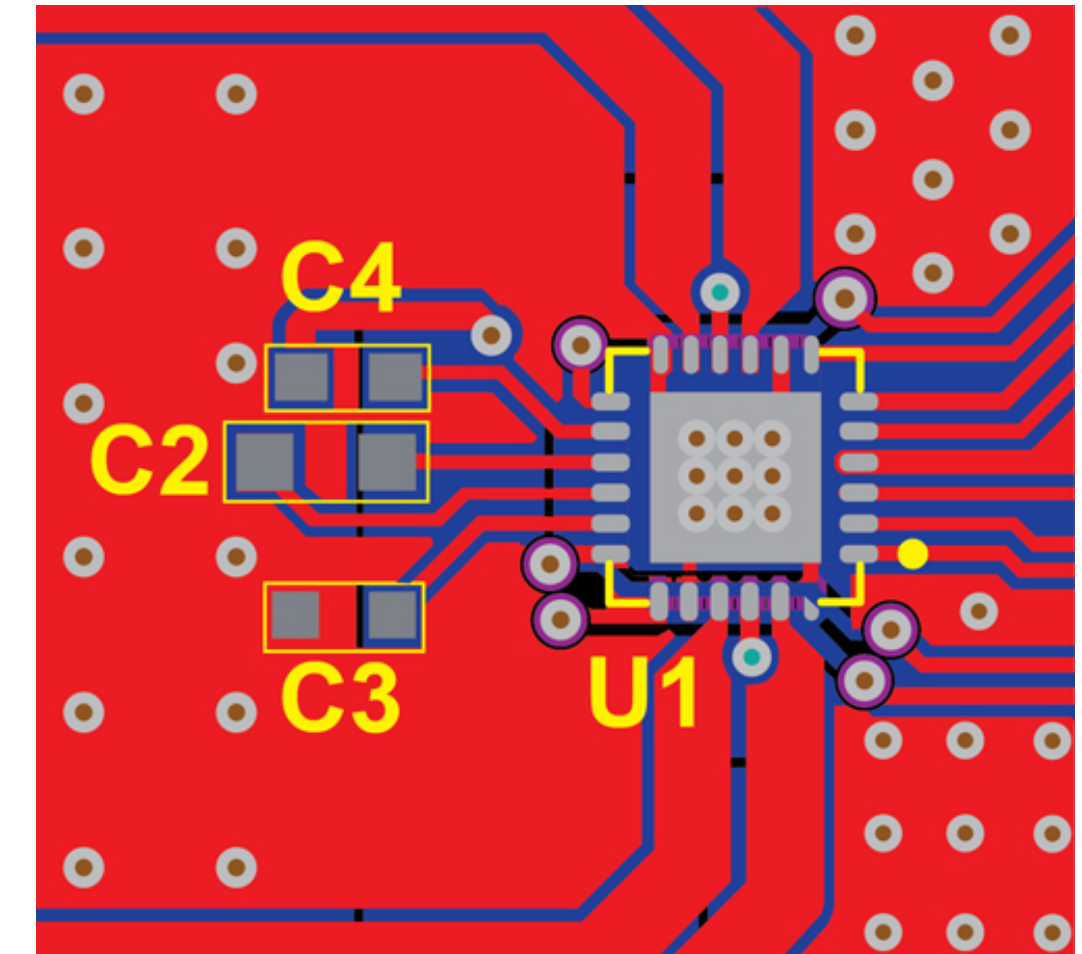
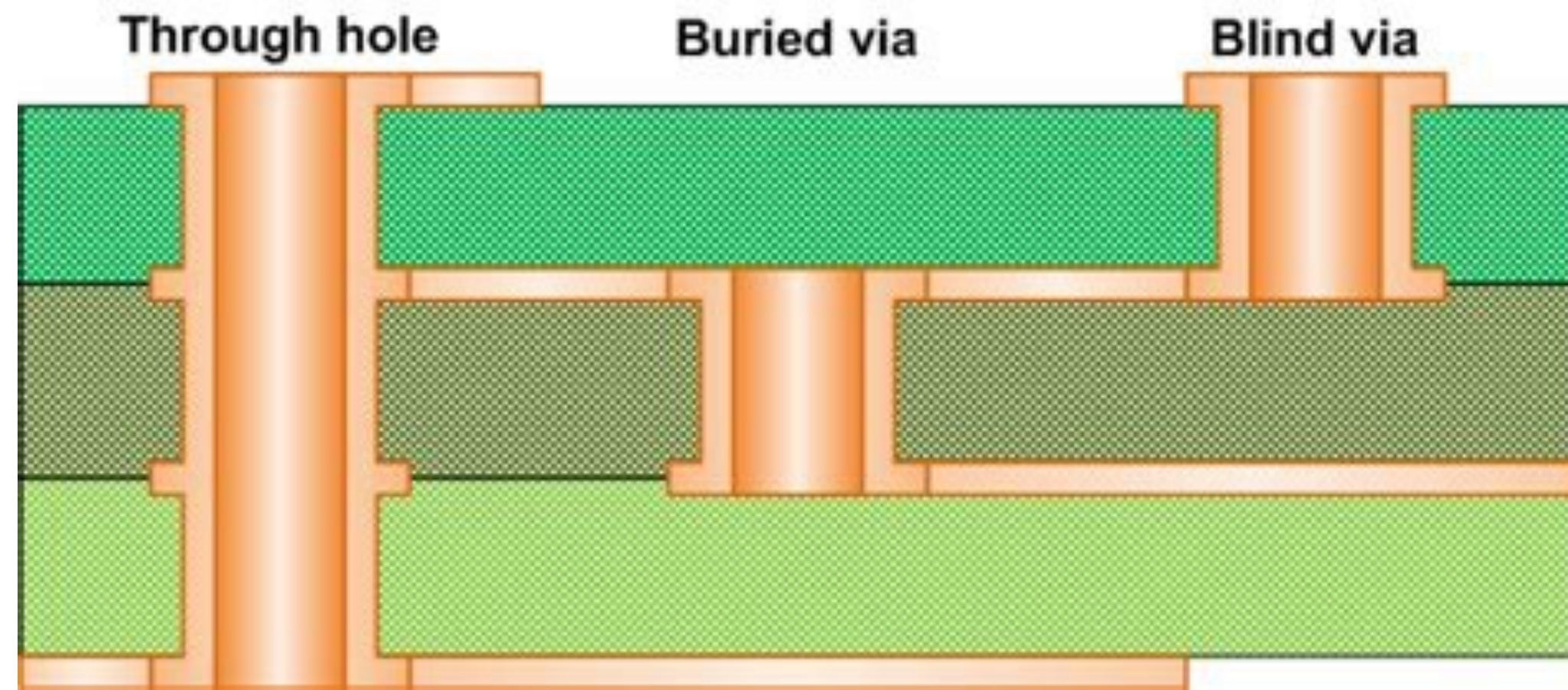


Minimum trace/via/pad space

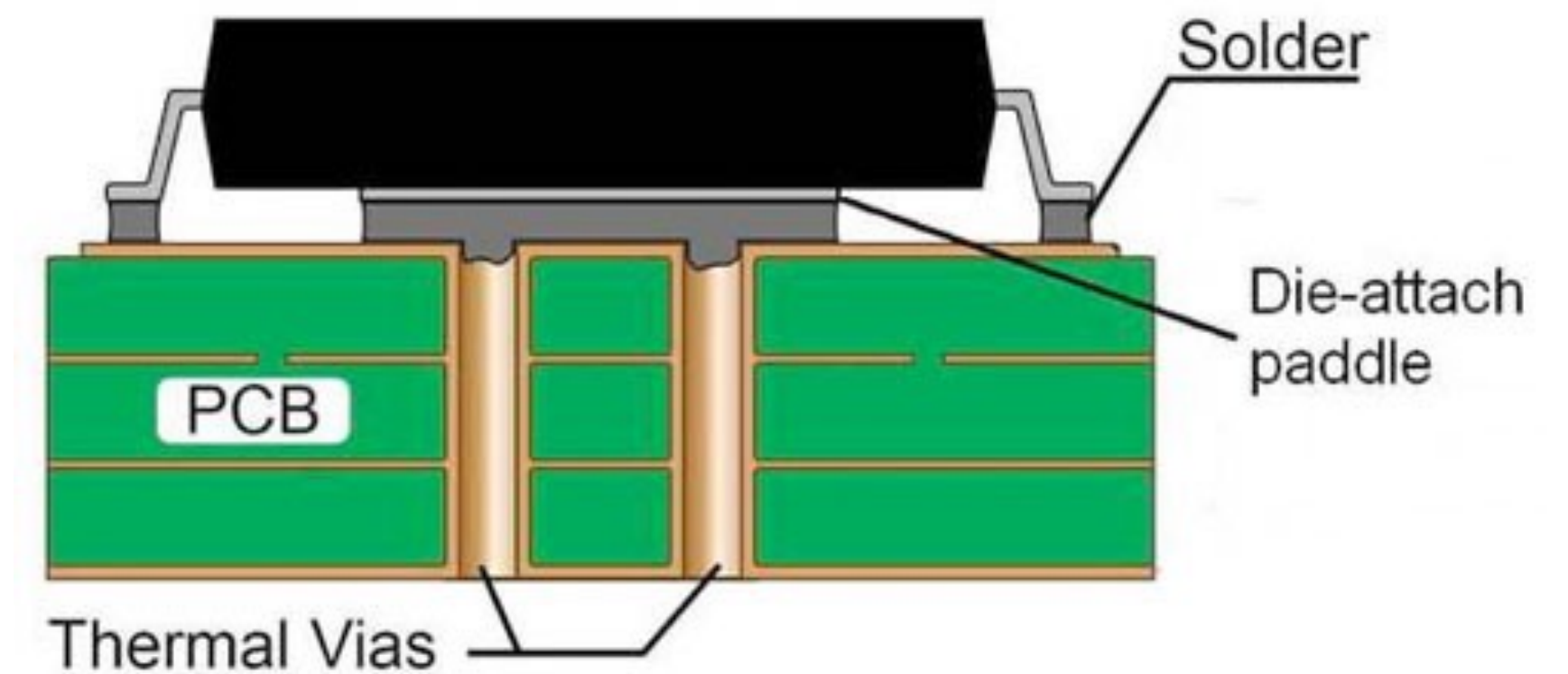
- 线宽 - 不同的net可以单独定义
- 过孔形状和孔径（内径、外径）
- 丝印的文字字体和字号
- 安全间距：
  - 走线和走线之间
  - 走线和孔径之间
  - 孔径和孔径之间
  - 走线/孔径和板卡边沿之间
- 走线层面和方向 - 此处可设置使用的走线层和每层的主要走线方向。



# 过孔的选择

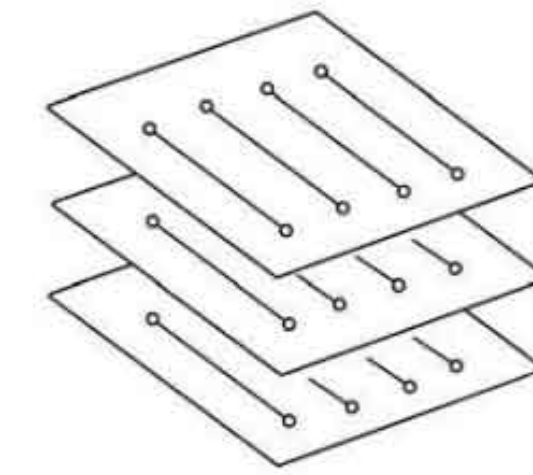


- 从成本和信号质量综合考虑选择合理的尺寸
- PCB板上的信号走线尽量在同一层，尽量不要使用不必要的过孔，布局的时候规划好走线
- 高速数字信号线（尤其是时钟信号）尽量避免跨层走线，减少过孔对信号的反射和干扰
- 电源和地的管脚要就近放置过孔，过孔和管脚之间的引线越短越好，同时电源和地的引线尽可能粗以减少阻抗
- 在信号换层的过孔附近放置一些接地的过孔，以便为信号提供最近的回路
- 利用过孔进行导热

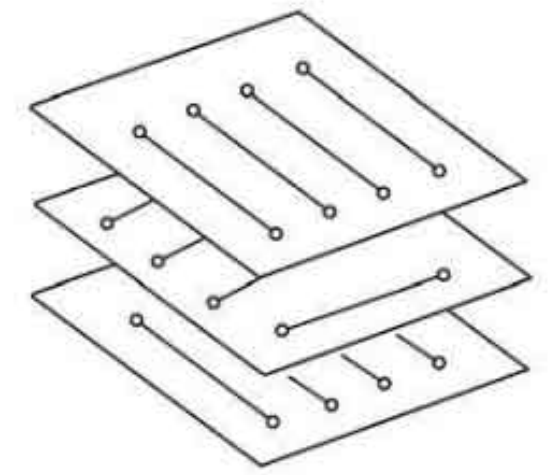


# 一般走线规则

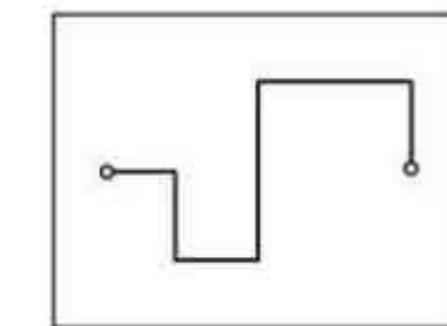
- 走线方向
  - 输入和输出端的导线应尽量避免相邻平行
  - 相邻层的走线方向成正交结构
  - 避免将不同的信号线在相邻层走成同一方向，以减少不必要的层间窜扰
  - 当 PCB 布线受到结构限制（如某些背板）难以避免出现平行布线时，特别是在信号速率较高时，应考虑用地平面隔离各布线层，用地线隔离各信号线
- 器件和器件之间的走线尽可能短且直
- 电源及临界信号走线使用宽线，电源线要根据电流的大小计算需要的宽度
- 确保模拟、数字线路相互分离，不要将数字信号线和模拟信号线并行布线，避免在ADC封装的下方铺设数字信号线
- 相同属性的一组总线，应尽量并排走线，做到尽量等长。同一级电路的接地点应尽量靠近，并且本级电路的电源滤波电容也应接在该级接地点上



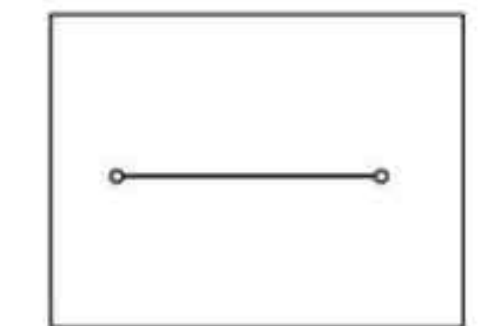
错误布线



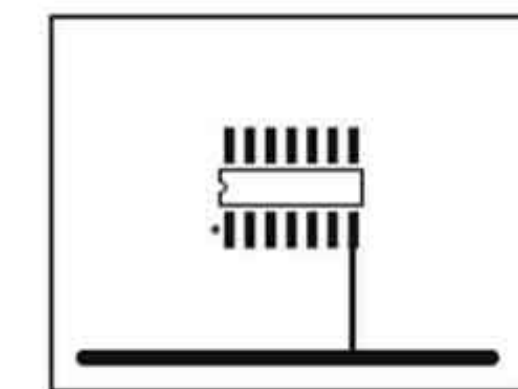
正确布线



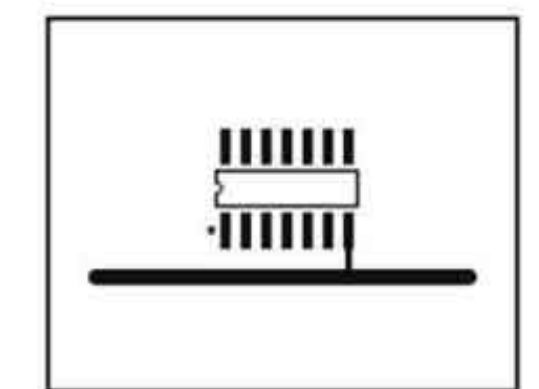
错误布线



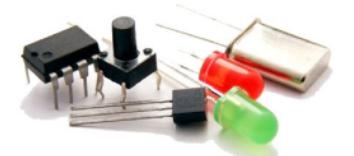
正确布线



错误布线



正确布线



# 时钟布线

Figure 4. Schematic of External Components

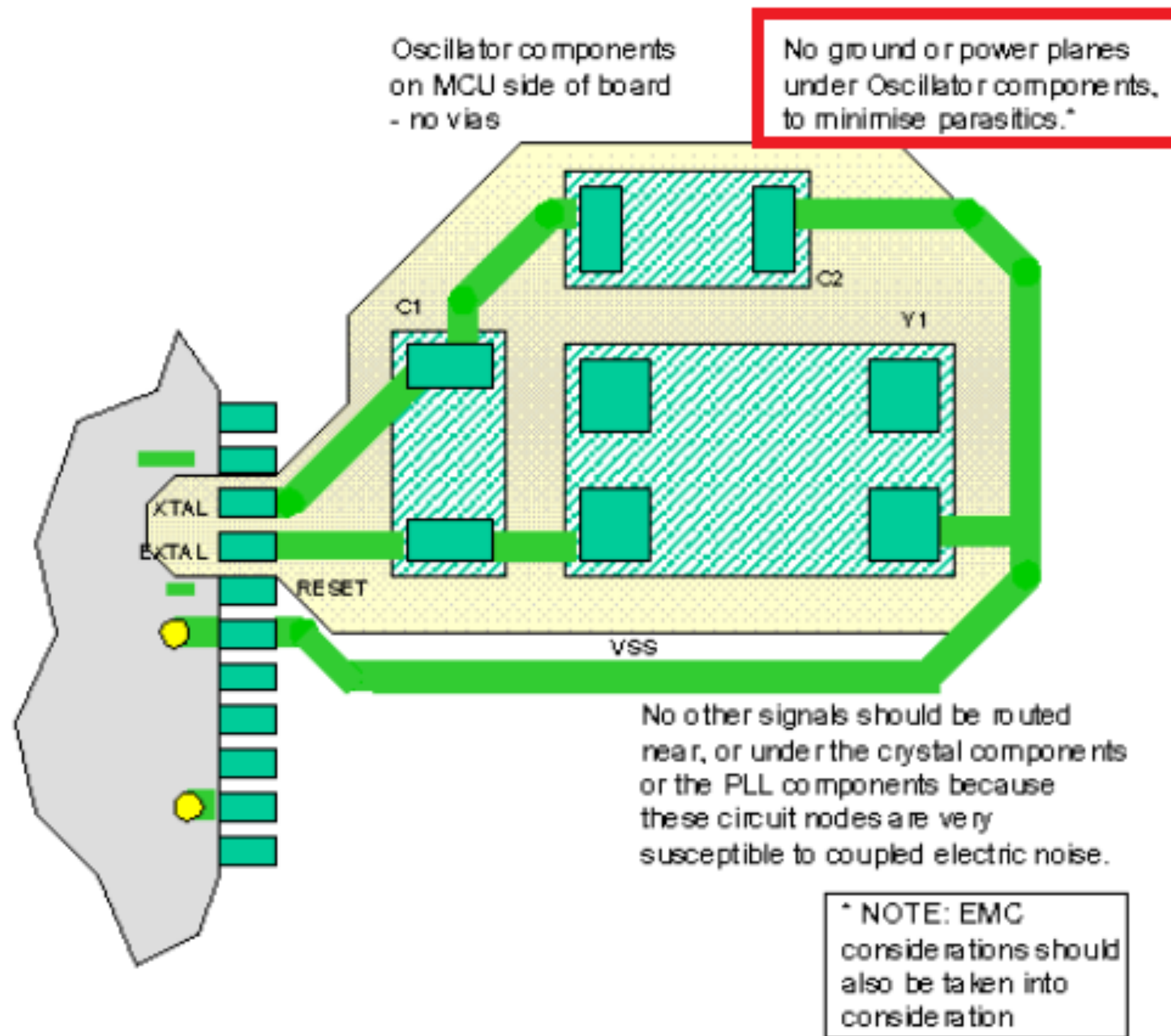
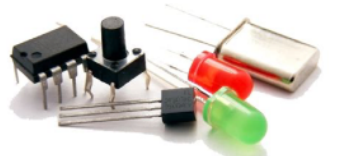
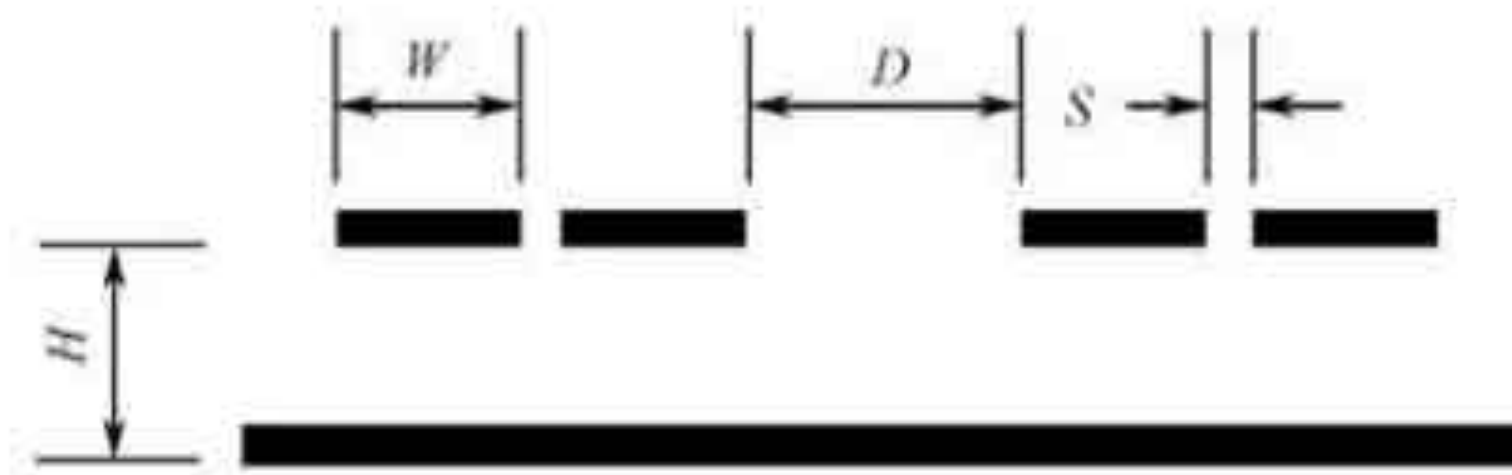


Figure 5. Recommended PCB Layout

- 晶振 - 连到其输入、输出端的线尽量短，最好不要有过孔，以减少噪声干扰以及分布电容的影响
- 晶振可以采用环绕敷铜，并将晶振外壳接地，以改善晶振对其他元器件的干扰。
- 尽量避免和其它信号线并行走线，且应远离一般信号线，避免对信号线的干扰。
- 应避开板上的电源部分，以防止电源和时钟互相干扰，时钟电路下面不要有电源层或地层
- 当一块电路板上用到多个不同频率的时钟时，两根不同频率的时钟线不可并行走线。
- 时钟线还应尽量避免靠近输出接口。



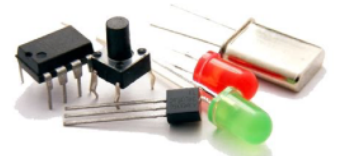
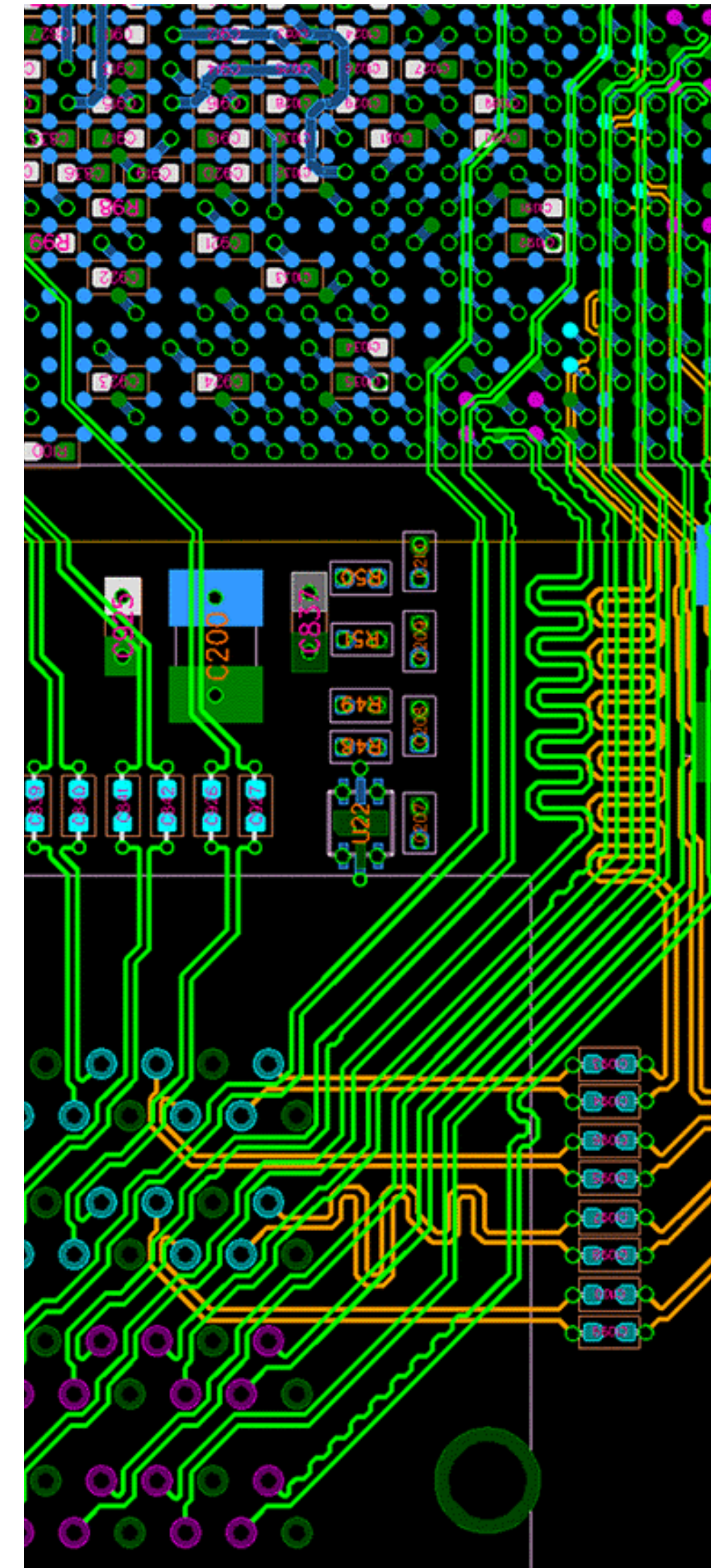
# 差分信号线



$D$ —两个差分对之间的距离； $S$ —差分对两根信号线间的距离； $W$ —差分对走线的宽度； $H$ —介质厚度

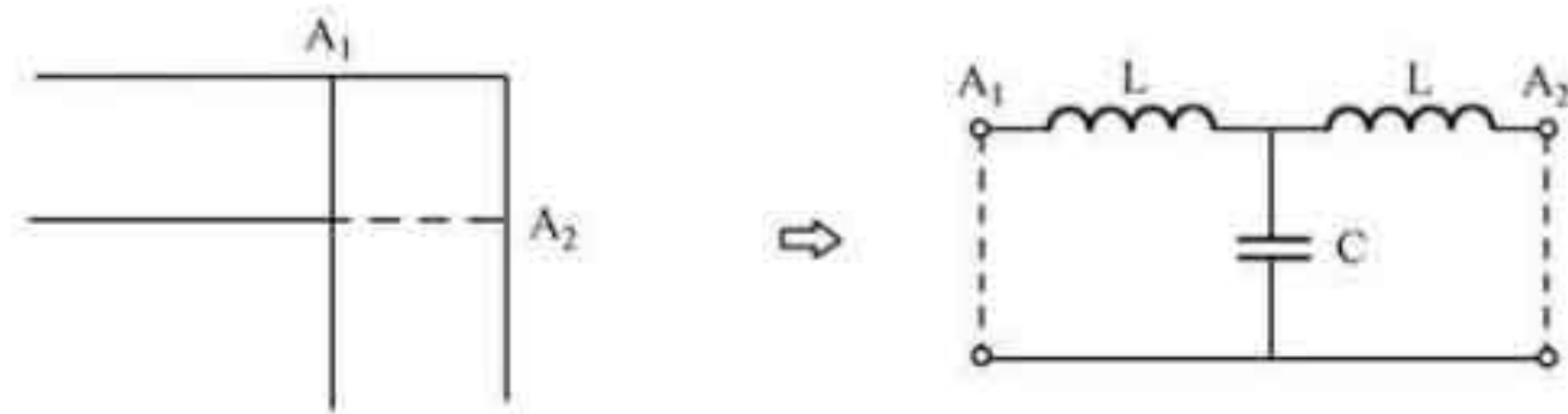
PCB 上的差分对走线

- 成对走线，尽量平行、靠近 - 保持差分对的两信号走线之间的距离 $S$ 在整个走线上为常数
- 确保 $D > 2S$ ，以最小化两个差分对信号之间的串扰。
- 将两差分信号线的长度保持相等，以消除信号的相位差。
- 避免在差分对上使用多个过孔，因为过孔会产生阻抗不匹配和电感，必须打孔的时候，应两线一同打孔。





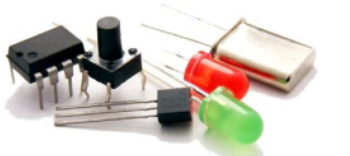
# 避免直角走线



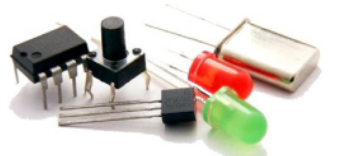
直角拐角的高频等效电路



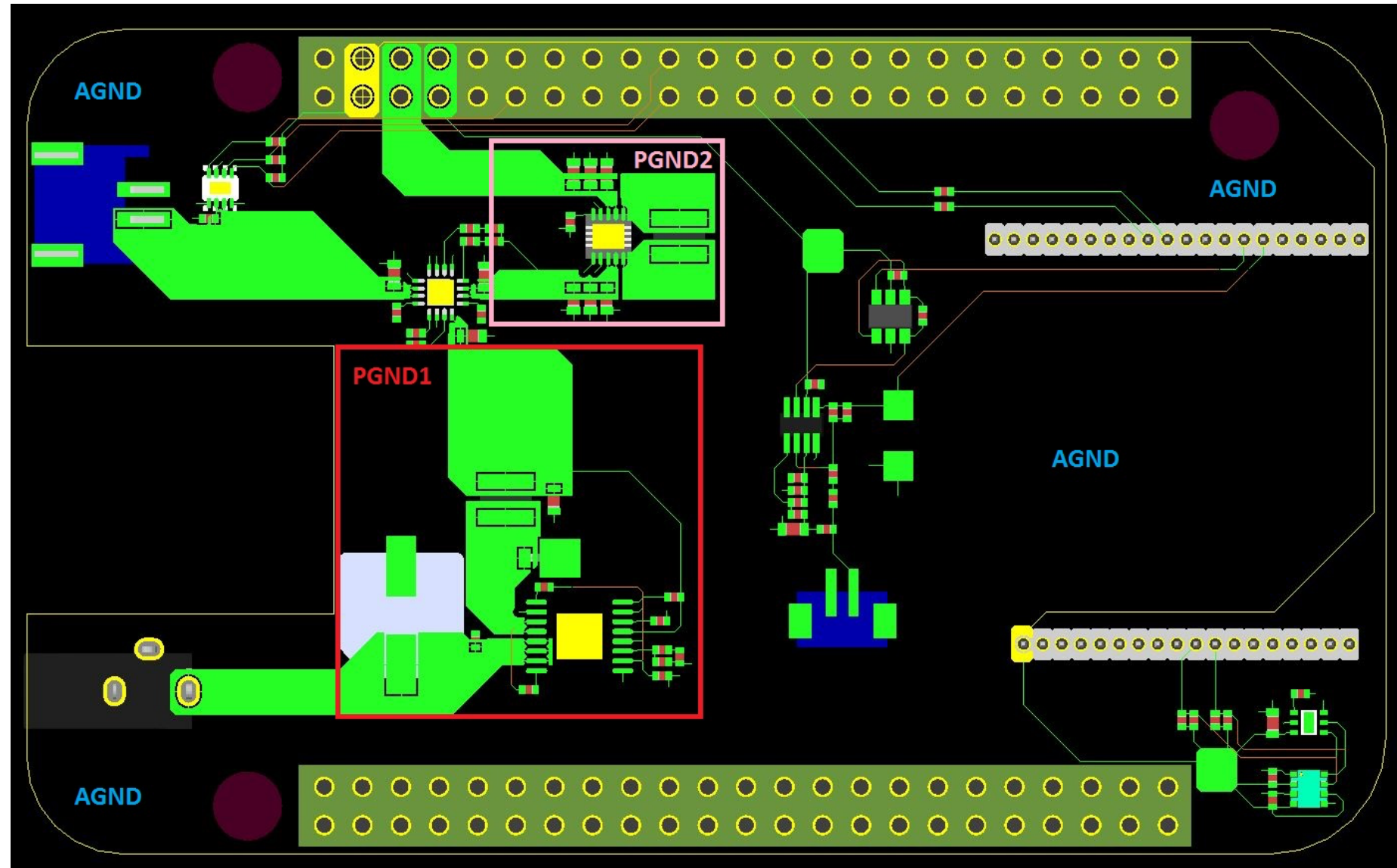
- 在高速传输的时候，直角或锐角走线在拐角处产生额外的寄生电容和寄生电感，影响高速信号的传输，对于低速的信号，影响可以忽略不计
- 尽量不采用直角的是为了避免工艺上的问题
- 在走线确实需要直角拐角的情况下，可以采取两种改进方法：
  - ① 一种是将90°拐角变成两个45°拐角
  - ② 另一种是采用圆角



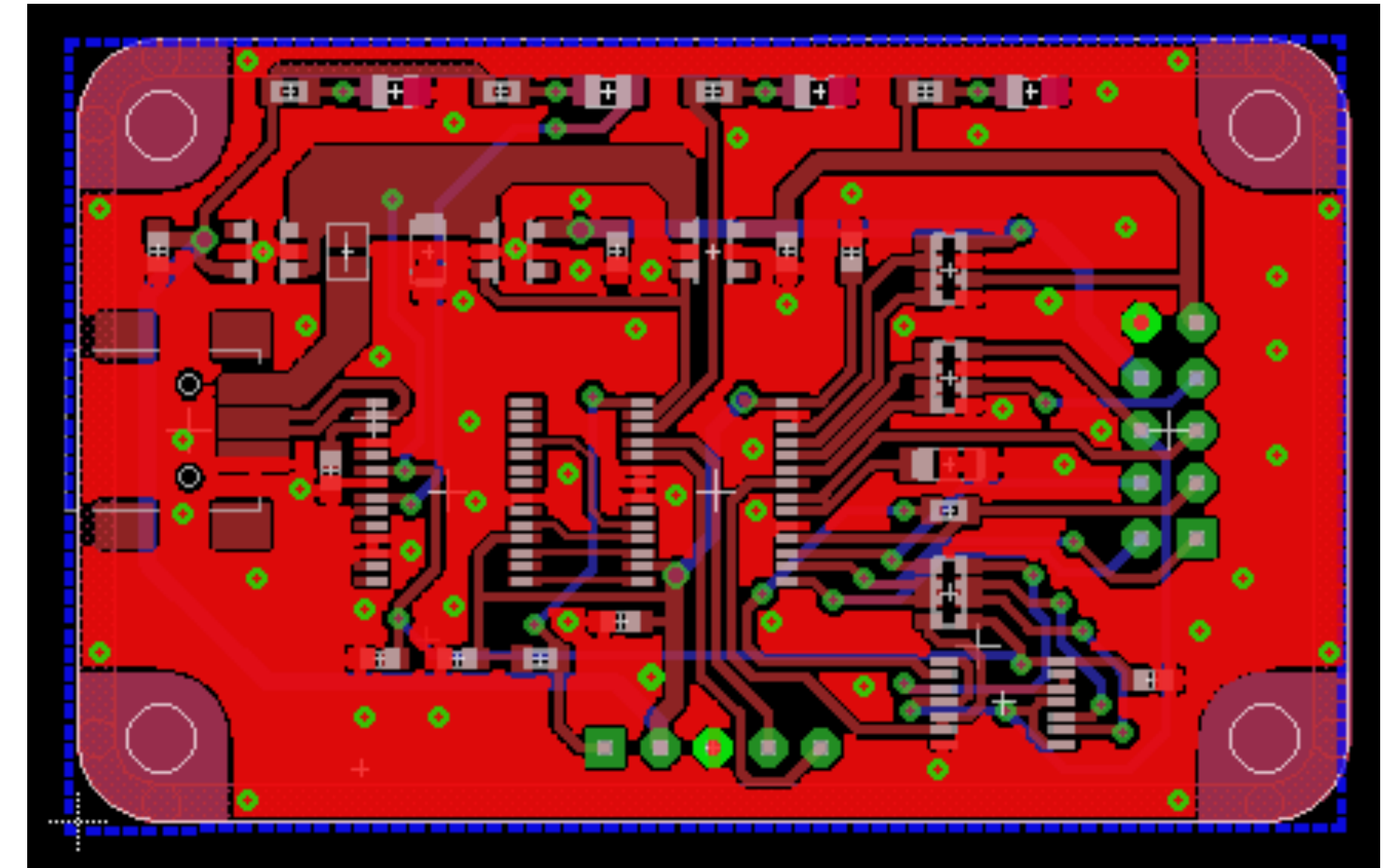
# 在安装孔和走线之间保留一定的距离



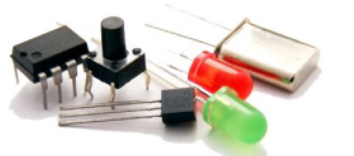
# 接地和填充



- 多层板可以采用独立的地层，数字信号分布在一侧，模拟信号分布在另一侧
- 最好是地线比电源线宽，它们的关系是：地线 > 电源线 > 信号线。
- 数字地与模拟地分开



- 用大面积铜层做地线用，把没被用上的地方都与地相连接作为地线用
- 抑制高频干扰、降低电源或地线的阻抗、方便布线
- 注意分割铺设的区域、设定好铺设规则



# 电源布线及去偶

- 电源线尽可能粗 - 减少环路阻抗，从而降低压降、干扰。
- 供电方向 - 与数据、信号的传递方向相反，即：从未级向前级推进的供电方式，这样有助于增强抗噪声能力。
- 采用两个电源平面分别连接所有AVDD和DVDD，每个PCB板的AVDD和DVDD引脚至少增加一个10 $\mu$ F去耦电容。
- 在器件的AVDD和DVDD的引脚与地之间连接0.1 $\mu$ F陶瓷去耦电容，电容须靠近器件放置，以便降低寄生电感，尽可能采用贴片电容
- 去耦电容的多少和值取决于器件工作的速度、负载、管脚数量、布线难度，数字电路的如果有多个电源管脚，尽可能在每一个电源管脚放置一个0.1 $\mu$ F的去耦电容，当有些电源管脚距离很近且布局困难的时候，这些电源管脚可以共享一个去耦电容

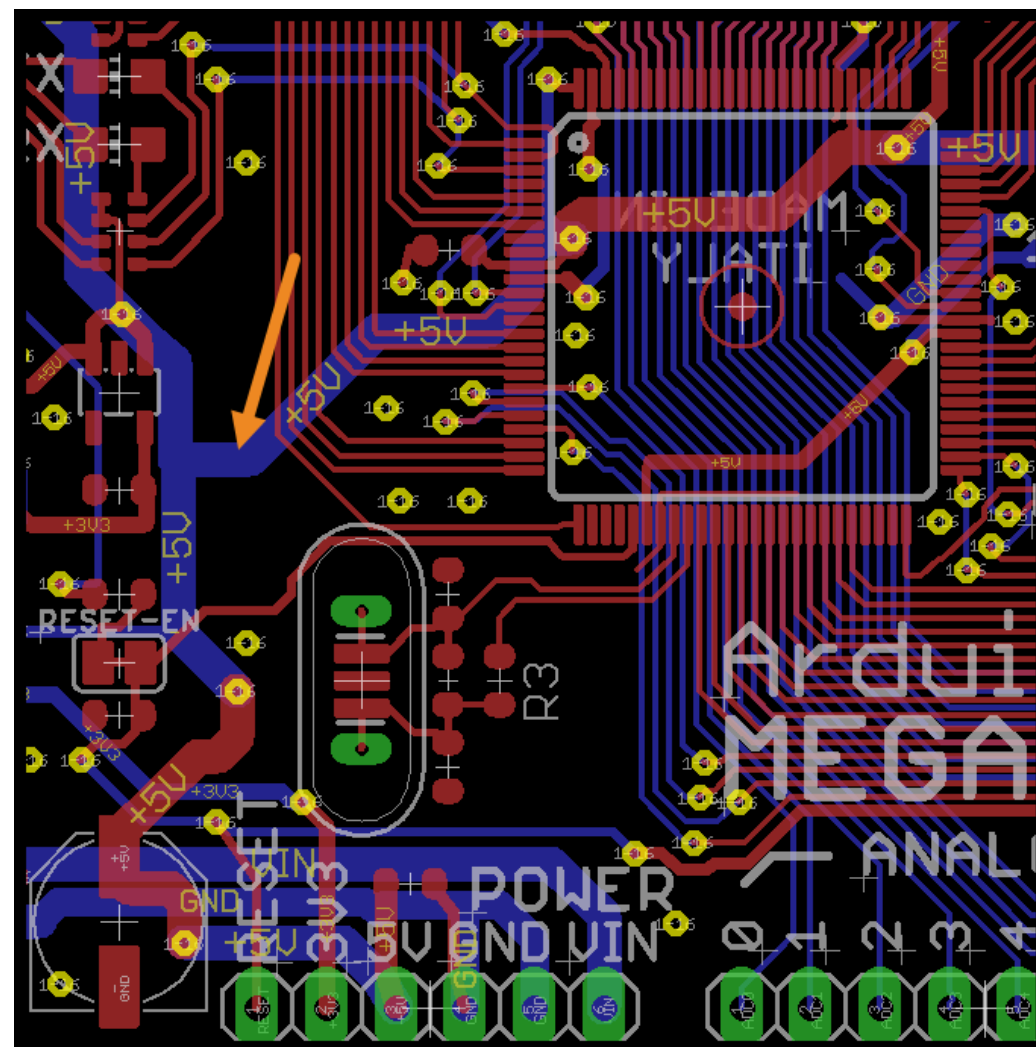
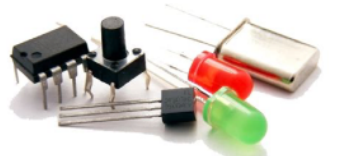
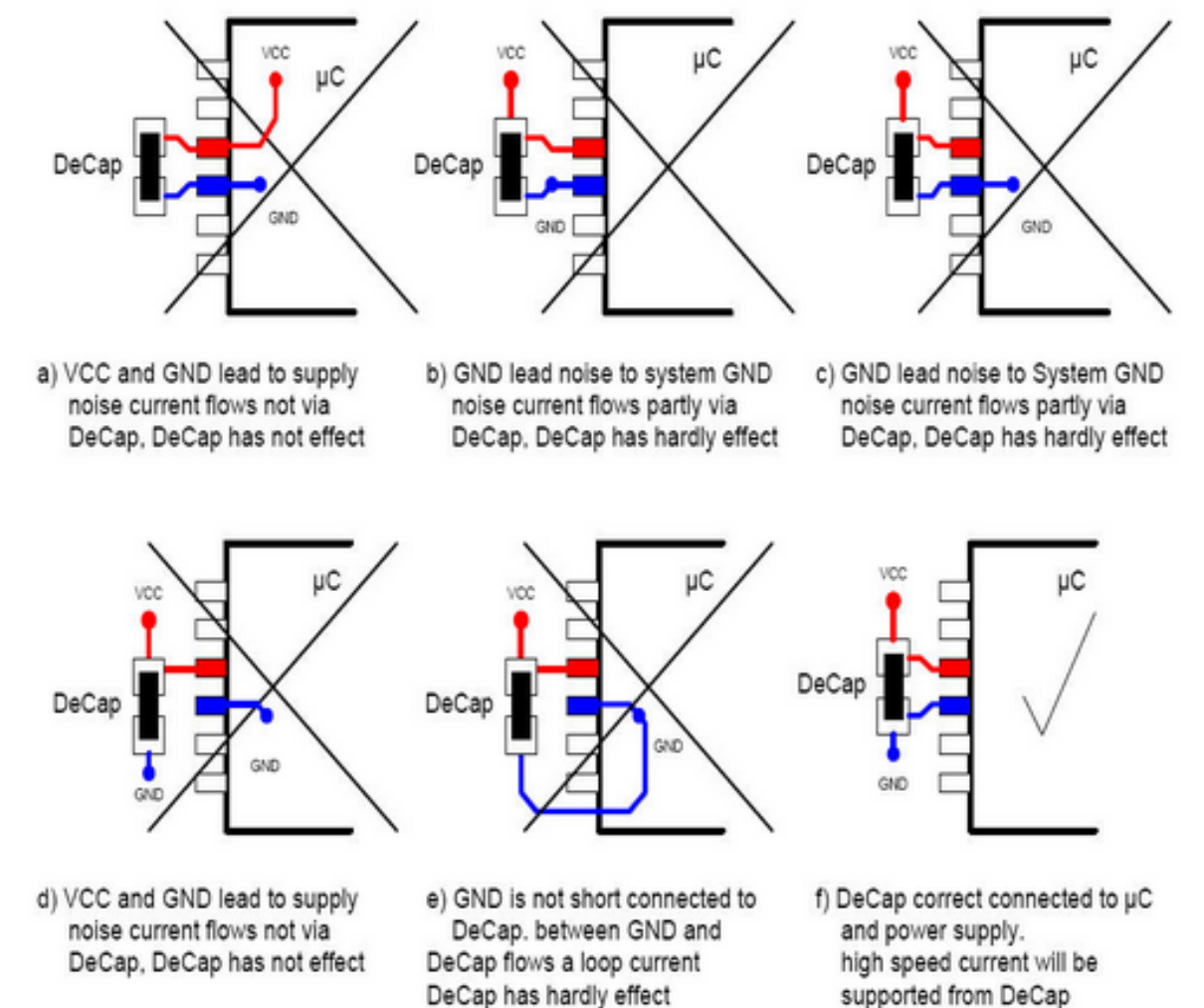
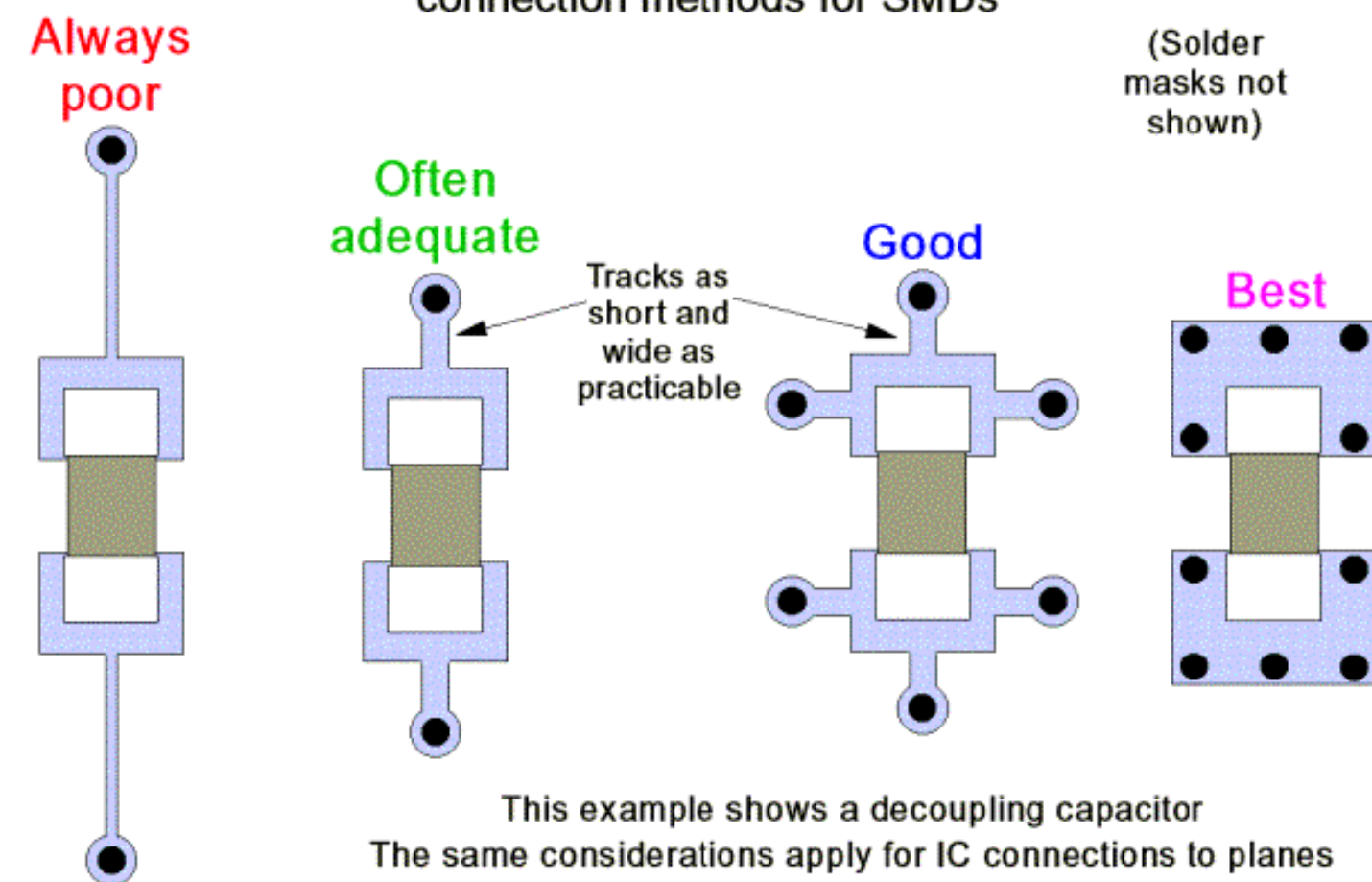
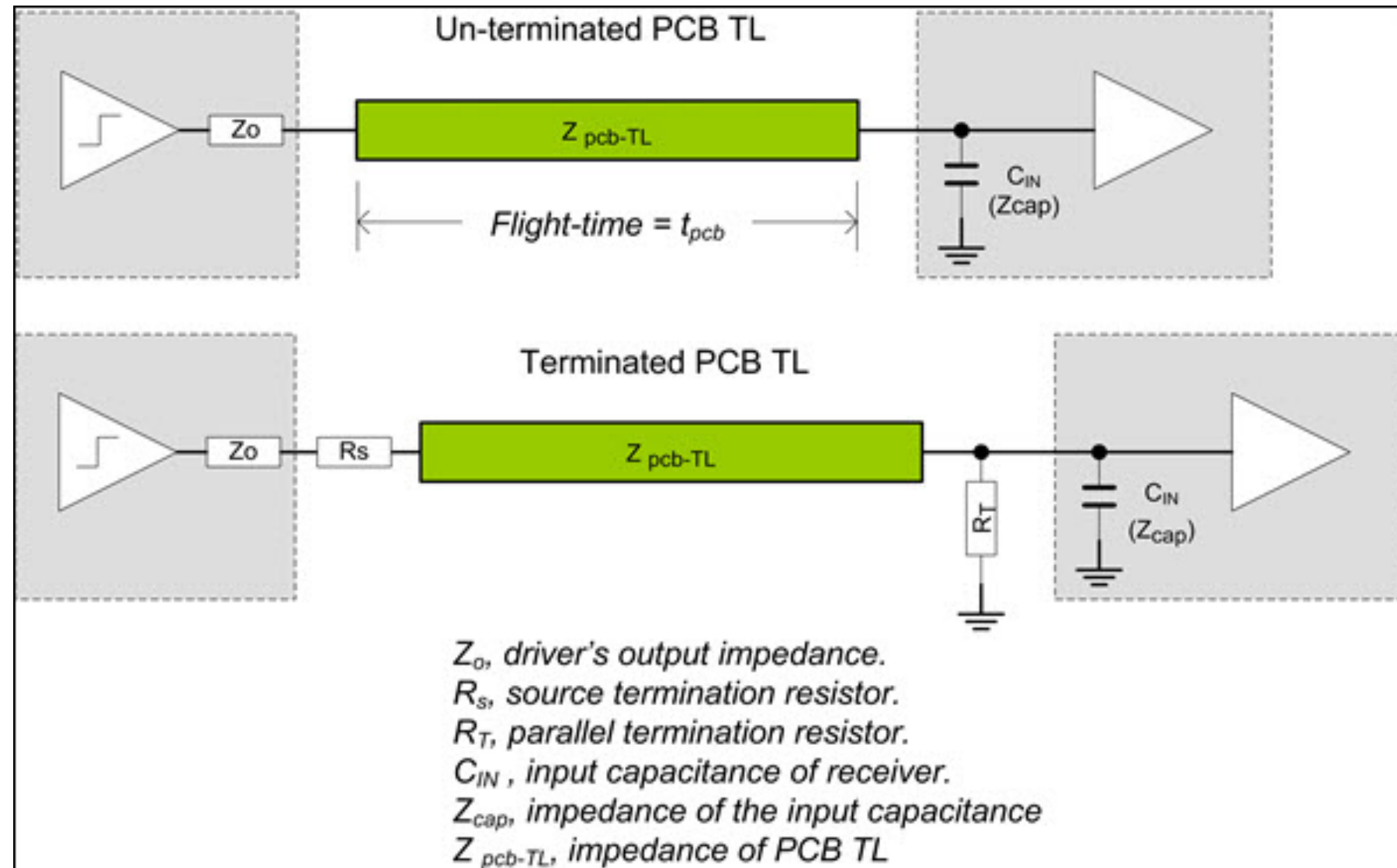


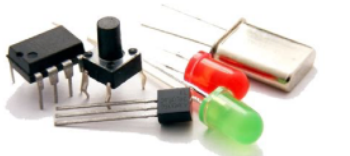
Figure 5C A comparison of the partial inductances of various plane connection methods for SMDs



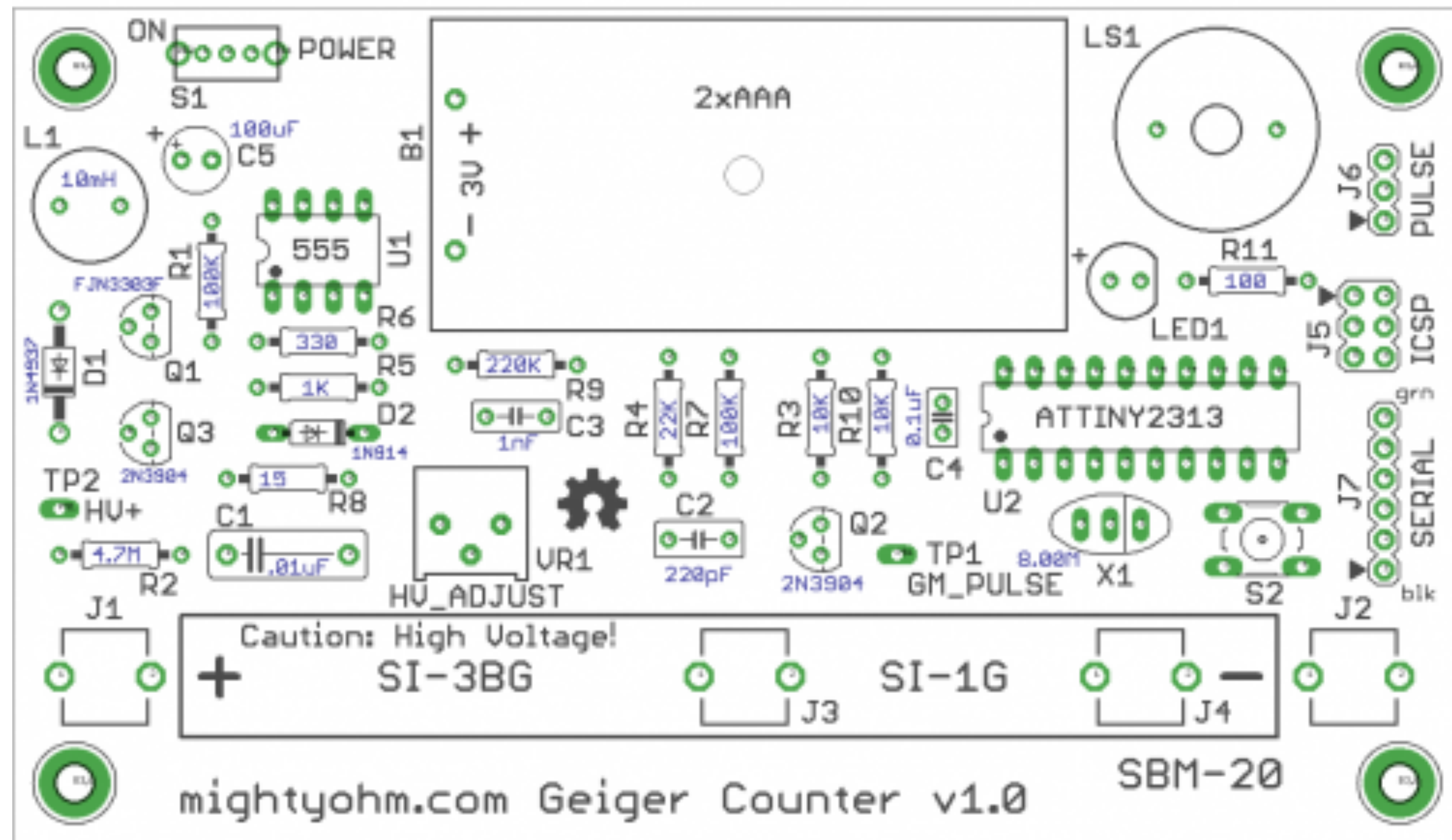
# 走线阻抗及终端匹配



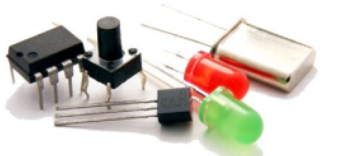
- 高速数字电路和射频电路，对PCB导线的阻抗是有要求的，低速电路可以忽略
- 发送端阻抗 == 走线阻抗 == 接收端阻抗要匹配，以达到最佳的传输效果，降低反射
- 走线阻抗要根据板材计算其宽度，走线过程中尽可能不要出现阻抗的变化 - 线宽一致
- 减少跨层走线，尽可能少用过孔
- 注意发送端阻抗匹配 - 串行匹配电阻，接收端阻抗匹配 - 并行匹配电阻，放置的位置

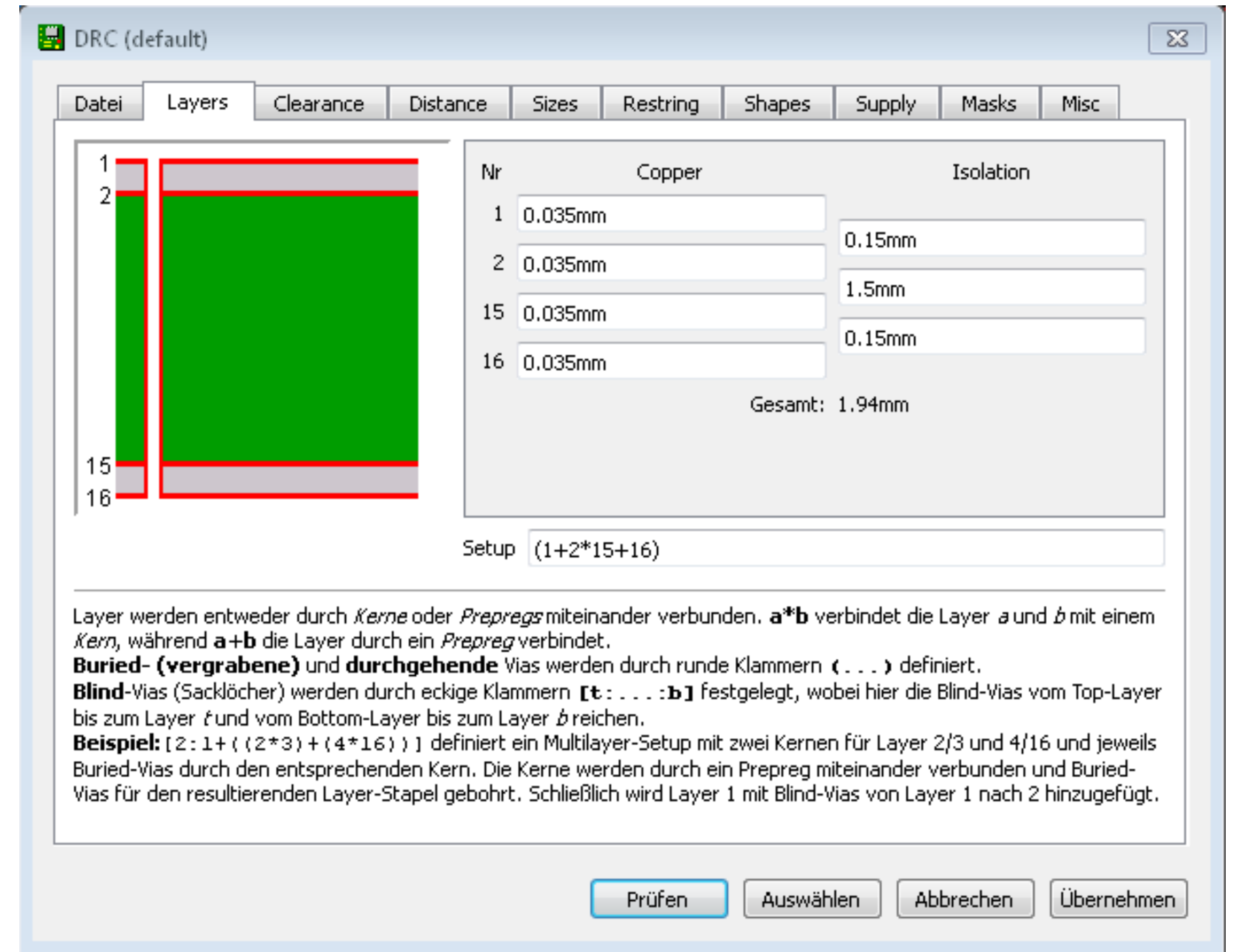
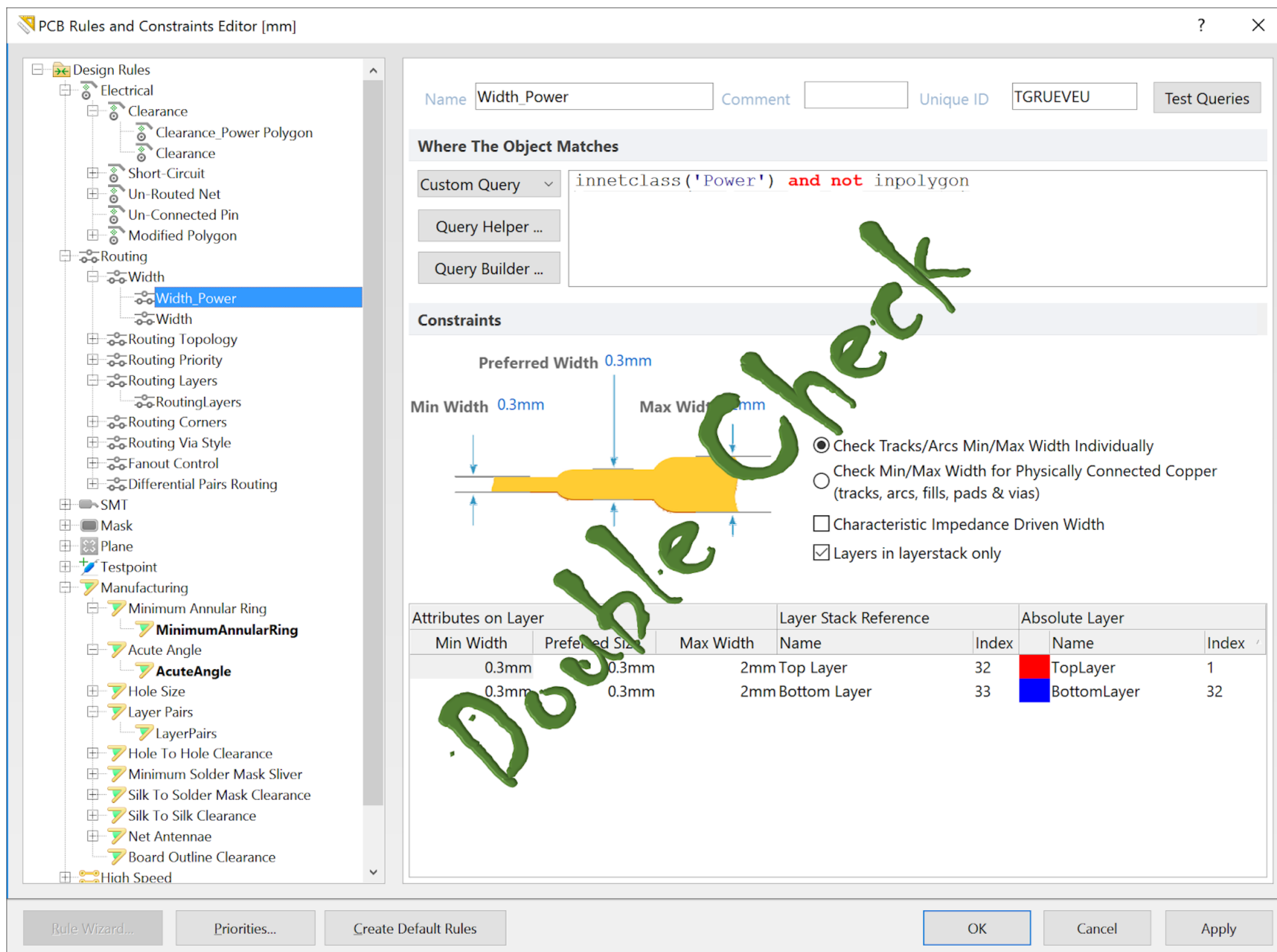


# 丝印



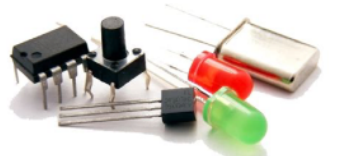
- 在PCB上下两表面印刷上标识图案和文字代号的专用层，开发者、测试、安装者、使用者都会用到
- 清楚、规则、整齐、归属明确、无歧义
- 字符不能覆盖在焊盘或过孔上，同一层的丝印不能互相重叠
- 清楚表明元器件、连接器装联的方向，极性器件如指示灯、三极管、跳塞、开关、端子、配线需要明确的极性标识
- 器件密集的区域可以将丝印字符对应、有序地放置在其他区域并加上适当标识
- 丝印字体一般采用EDA软件支持的缺省字体，AD的不好，需要修改



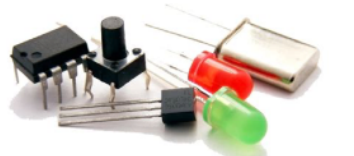


## 检查

1. ERC (电气规则检查)
2. DRC (设计规则检查) - 线宽、线间距、加工厂工艺要求、高速设置、短路
3. 对照原理图逐线高亮检查

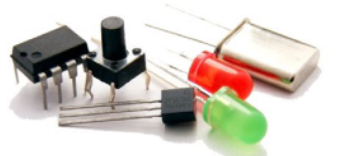


# BOM文件的产生及元器件备料

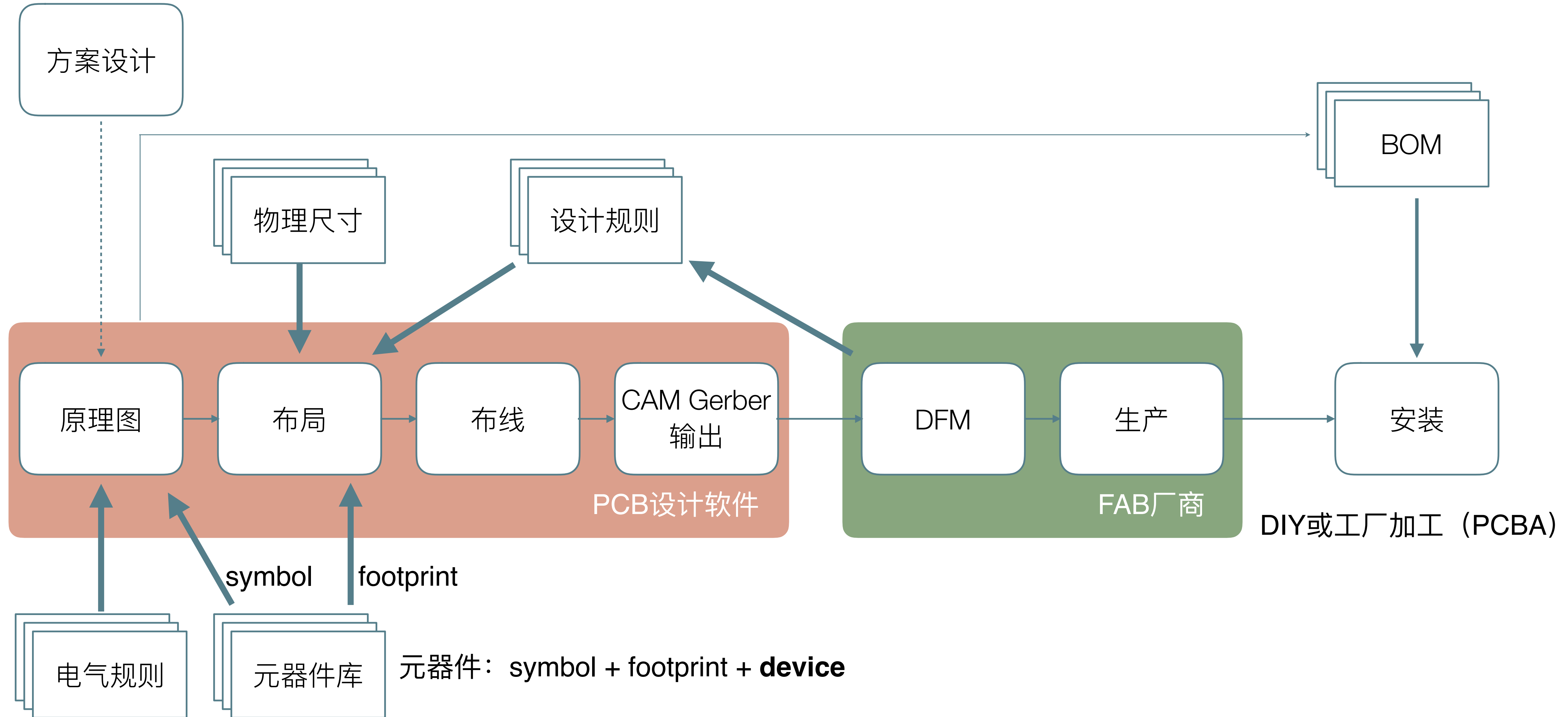




- **什么时候产生BOM? 并开始备料?**
- **如何才能是一个合格的BOM?**
- **到哪里去备料?**



# 从原理图到生产文件输出

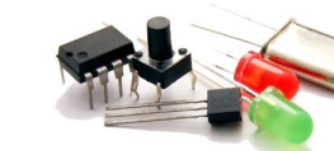


## TIDA-00771 REV E2 Bill of Materials

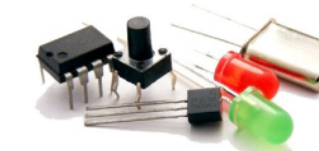
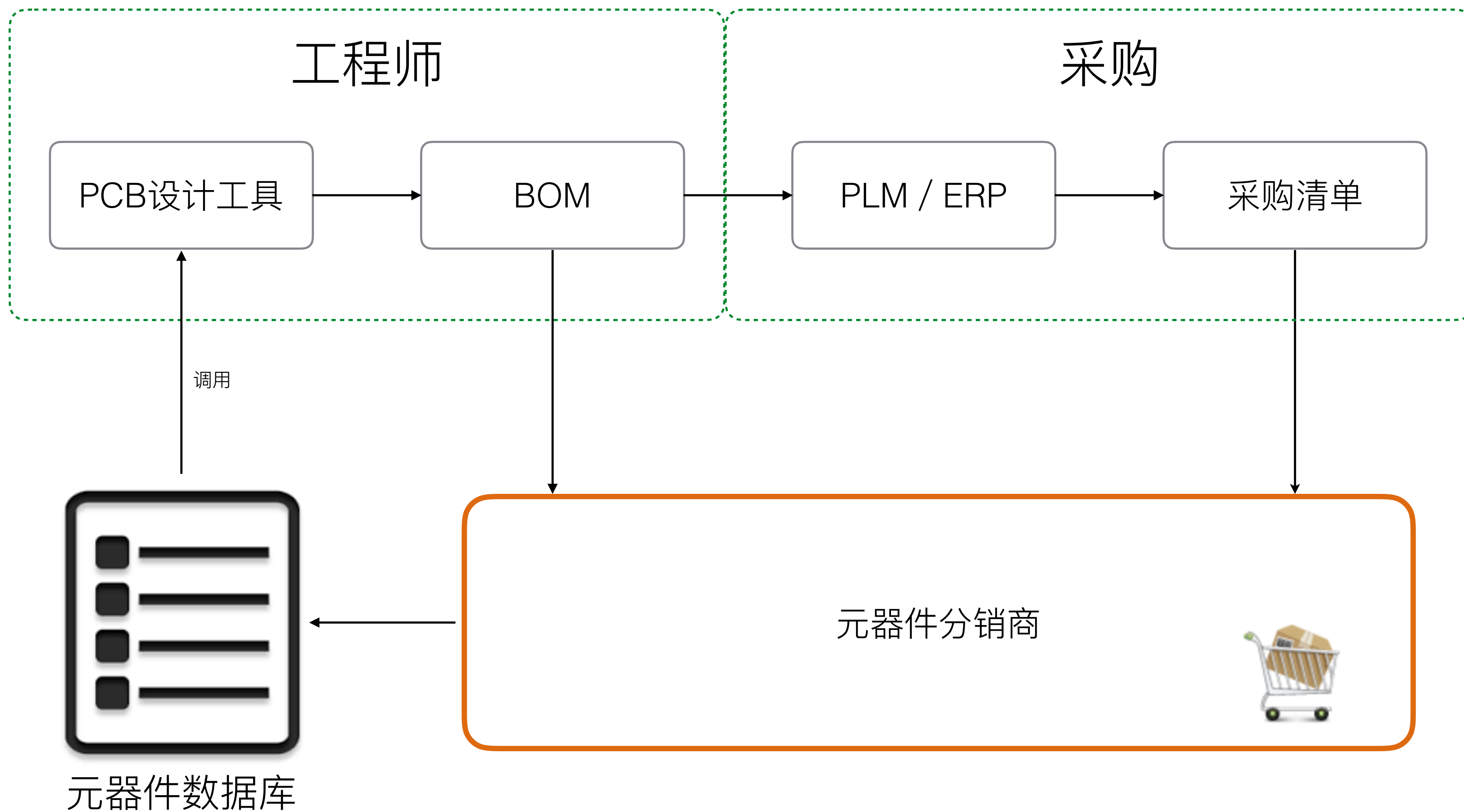
Item #	Designator	Quantity	Value	PartNumber	Manufacturer	Description	PackageReference
1	C1, C3, C15	3	1uF	C1608X7R1C105K	TDK	CAP, CERM, 1 $\mu$ F, 16 V, +/- 10%, X7R, 0603	0603
2	C2, C4	2	0.047uF	C1608X7R1E473K	TDK	CAP, CERM, 0.047 $\mu$ F, 25 V, +/- 10%, X7R, 0603	0603
3	C5	1	4.7uF	GRM31CR71H475KA12L	MuRata	CAP, CERM, 4.7 $\mu$ F, 50 V, +/- 10%, X7R, 1206	1206
4	C6	1	4.7uF	GRM21BR61C475KA88L	MuRata	CAP, CERM, 4.7 $\mu$ F, 16 V, +/- 10%, X5R, 0805	0805
5	C7, C8, C9	3	2.2uF	GRM32ER72A225KA35L	MuRata	CAP, CERM, 2.2 $\mu$ F, 100 V, +/- 10%, X7R, 1210	1210
6	C10, C14, C26, C27, C30	5	1000pF	885012205061	Würth Elektronik	CAP, CERM, 1000 pF, 50 V, +/- 10%, X7R, 0402	0402
7	C11	1	3300pF	C1005X7R1H332K	TDK	CAP, CERM, 3300 pF, 50 V, +/- 10%, X7R, 0402	0402
8	C12	1	2.2uF	GRM31CR71H225KA88L	MuRata	CAP, CERM, 2.2 $\mu$ F, 50 V, +/- 10%, X7R, 1206	1206
9	C13, C18, C23, C25, C28, C31	6	0.1uF	885012105016	Würth Elektronik	CAP, CERM, 0.1 $\mu$ F, 16 V, +/- 20%, X5R, 0402	0402
10	C16	1	10uF	0805YD106MAT2A	AVX	CAP, CERM, 10uF, 16V, +/-20%, X5R, 0805	0805
11	C17, C29	2	0.1uF	0603YC104JAT2A	AVX	CAP, CERM, 0.1 $\mu$ F, 16 V, +/- 5%, X7R, 0603	0603
12	C19, C20	2	270uF	EKZN350ELL271MJC5S	United Chemi-Con	CAP ALUM 270UF 20% 35V RADIAL	10x20
13	C21	1	0.1uF	C2012X7R1E104K	TDK	CAP, CERM, 0.1 $\mu$ F, 25 V, +/- 10%, X7R, 0805	0805
14	C22	1	2200pF	GRM155R71H222KA01D	MuRata	CAP, CERM, 2200 pF, 50 V, +/- 10%, X7R, 0402	0402
15	C24	1	0.01uF	C0603X103K5RACTU	Kemet	CAP, CERM, 0.01 $\mu$ F, 50 V, +/- 10%, X7R, 0603	0603
16	D1	1	RED	150060RS75000	Würth Electronics Inc	LED RED CLEAR 0603 SMD	LED 0603
17	D2	1	30V	SMAJ30CA	Littelfuse	Diode, TVS, Bi, 30 V, 400 W, SMA	SMA
18	D3	1	YELLOW	150060YS75000	Würth Electronics Inc	LED YELLOW CLEAR 0603 SMD	LED 0603
19	D4	1	GREEN	150060GS75000	Würth Electronics Inc	LED, Green, SMD	LED 0603
20	D5	1	40V	NSR0240V2T1G	ON Semiconductor	Diode, Schottky, 40 V, 0.25 A, SOD-523	SOD-523
21	J1	1	PEC04SAA N	PEC04SAAN	Sullins	Header, Male 4-pin, 100mil spacing,	0.100 inch x 4
22	J2	1		800-10-003-10-001000	Mill-Max	Header, 100mil, 3x1, TH	Header, 3x1, 100mil, TH
23	J3	1		800-10-005-10-001000	Mill-Max	Header, 100mil, 5x1, TH	Header, 5x1, 100mil, TH
24	J4	1		800-10-002-10-001000	Mill-Max	Header, 100mil, 2x1, TH	Header, 2x1, 100mil, TH
25	LBL1	1		TIDA-00771	Any	Printed Circuit Board	
26	Q1, Q2, Q3, Q4, Q5, Q6	6	30V	CSD17576Q5B	Texas Instruments	MOSFET, N-CH, 30 V, 100 A, SON 5x6mm	SON 5x6mm
27	R1, R3	2	10k	CRCW060310K0JNEA	Vishay-Dale	RES, 10 k, 5%, 0.1 W, 0603	0603
28	R2	1	100	CRCW0603100RJNEA	Vishay-Dale	RES, 100, 5%, 0.1 W, 0603	0603
29	R4, R16, R17	3	3.30k	RG1608P-332-B-T5	Susumu Co Ltd	RES, 3.30 k, 0.1%, 0.1 W, 0603	0603
30	R5, R18	2	0.001	CRE2512-FZ-R001E-3	Bourns Inc.	RES SMD 0.001 OHM 1% 3W 2512	2512
31	R6, R7, R22, R27, R28, R39, R42, R43, R44	9	100	ERJ-2RKF1000X	Panasonic	RES, 100, 1%, 0.1 W, 0402	0402
32	R8	1	5.11	RC0603FR-075R11L	Yageo America	RES, 5.11, 1%, 0.1 W, 0603	0603
33	R9	1	47.5k	CRCW040247K5FKED	Vishay-Dale	RES, 47.5 k, 1%, 0.063 W, 0402	0402
34	R10	1	2M	RC0603FR-072ML	Yageo	RES SMD 2M OHM 1% 1/10W 0603	0603
35	R11	1	3.3	CRCW06033R30JNEA	Vishay-Dale	RES, 3.3, 5%, 0.1 W, 0603	0603
36	R12	1	499k	RC0402FR-07499KL	Yageo	RES SMD 499K OHM 1% 1/16W 0402	0402
37	R13, R14, R15	3	3.3k	CRCW04023K30JNED	Vishay-Dale	RES, 3.3 k, 5%, 0.063 W, 0402	0402
38	R19, R21, R32, R36, R37, R38	6	10.0k	ERJ-2RKF1002X	Panasonic	RES, 10.0 k, 1%, 0.1 W, 0402	0402
39	R20	1	0	ERJ-2GE0R00X	Panasonic	RES, 0, 5%, 0.063 W, 0402	0402
40	R23	1	51.1k	CRCW040251K1FKED	Vishay-Dale	RES, 51.1 k, 1%, 0.063 W, 0402	0402
41	R24	1	78.7k	CRCW040278K7FKED	Vishay-Dale	RES, 78.7 k, 1%, 0.063 W, 0402	0402

# BOM要素

- 编号 - Designator
- 数量 - Quantity
- 型号 - Part number
- 值 - Value
- 生产商 - Manufacture
- 描述 - Description
- 封装 - Package/Footprint

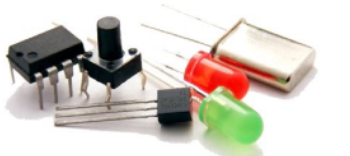


# 流程

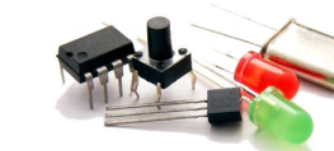


# 采购原则

1. 质量可靠
2. 货期受控
3. 服务保障
4. 价格尽可能低



货源	主要厂商	质量	货期	数量	价格
现有库存		可靠	现在		
现有可信的供货渠道		可靠	不一定		
原厂 - 样品/小批量	TI、ADI、美信	可靠	快		免费或较贵
原厂授权分销商	Arrow、Avnet、Future	可靠	期货，较久	量大	便宜
授权现货供应商	Mouser、Digikey、E14、RS、Verical	可靠	1-2周	小批量	较贵
BOM2BUY平台	SupplyFrame/EEFocus	可靠	1-2周	小批量	较贵
贸易商	华强北、中发市场	不可靠	快	小批量	便宜
淘宝		不可靠	快	小批量	便宜



全部 物料编号/关键字

有库存 RoHS

所有产品 > 半导体 > 放大器 IC > 特殊用途放大器 > Analog Devices AD604ARZ

看到错误?

### AD604ARZ



放大

图像仅供参考  
请参阅产品规格

共享

对比产品

Mouser编号:	584-AD604ARZ
制造商编号:	AD604ARZ
制造商:	<a href="#">Analog Devices</a>
客户编号:	<input type="text"/>
说明:	特殊用途放大器 Dual Variable Gain AMP Ultra Low Noise
数据表:	<a href="#">AD604ARZ 数据表</a>

添加至项目 | 添加注释:

### 规格

产品属性	属性值	搜索类似
制造商:	Analog Devices Inc.	<input type="checkbox"/>
产品种类:	特殊用途放大器	<input checked="" type="checkbox"/>
RoHS:	<a href="#">详细信息</a>	
系列:	AD604	<input type="checkbox"/>
放大器类型:	VGA	<input type="checkbox"/>
通道数量:	2 Channel	<input type="checkbox"/>

### 有库存: 12

库存: 12 可立即发货

在订货物: 0

最少: 1 倍数: 1

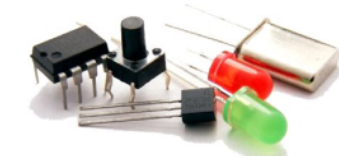
输入数量:  [购买](#)

### 定价 (含16% 增值税)

数量	单价	总价
1	¥247.5208	¥247.52
5	¥239.1688	¥1,195.84
10	¥230.5616	¥2,305.62
25	¥219.5184	¥5,487.96
50	¥211.5608	¥10,578.04
100	¥200.274	¥20,027.40
250	¥185.136	¥46,284.00
500	¥175.0324	¥87,516.20
1,000	报价	

### 备用包装

制造商零件编号:	AD604ARZ-RL
包装:	Reel
供货情况:	无库存
单价 (含16%增值税):	¥168.4088
最小:	1000



全部型号

🛒 现货可买

🕒 等待询价

🚫 需要修正

总共 30 个型号  
 现货可买 17 个型号 →  
 等待询价 12 个型号 →  
 需要修正 1 个型号 →

有价格信息 27 个型号  
 预估成本 (基于需求量) ¥565.08

+ 型号 数量 添加型号

型号	需求量	可购买	需求制造商 匹配制造商	分销商	单价	操作	更多
1 C2012X7R0J106K125AB ■ 可替换型号(2) ■ 相似型号(10)	4	4	TDK Corporation of America 描述: X7R, 10UF, 6.3V, 0805 🚫 不含铅 🟢 RoHS认证	element14 Asia-Pacific 库存: 5 包装: *1 起订量: 1	¥3.5264	加入购物车	⋮
2 C2012X7R1A475K125AC ■ 可替换型号(1) ■ 相似型号(4)	10	10	TDK Corporation of America 描述: 多层陶瓷电容器MLCC - SMD/SMT 0805 10V 4.7uF X7R 10% ... 🚫 不含铅 🟢 RoHS认证	Mouser Electronics 库存: 57497 包装: *1 起订量: 1	¥1.4384	加入购物车	⋮
3 C0805C104K8RACTU ■ 相似型号(1)	3	0	KEMET Corporation 描述: CAP CER 0.1UF 10V X7R 0805 🚫 不含铅 🟢 RoHS认证	Digi-Key 库存: 0 包装: 带卷(TR) *4000 起订量: 4000	¥0.2262	立即询价	⋮
4 C2012X7R1A106K125AC ■ 相似型号(2)	6	6	TDK Corporation of America 描述: CAP CER 10UF 10V X7R 0805 🚫 不含铅 🟢 RoHS认证	Digi-Key 库存: 18989 包装: Digi-Reel® *1 起订量: 1	¥4.2900	立即询价	⋮
5 C2012X7R1C475K125AE ■ 可替换型号(1) ■ 相似型号(10)	1	0	TDK Corporation of America 描述: CAP CER 4.7UF 16V X7R 0805 🚫 不含铅 🟢 RoHS认证	Digi-Key 库存: 0 包装: 带卷(TR) *1 起订量: 2000		立即询价	⋮
6 CL21B106K0QNNNE ■ 相似型号(10)	1	1	Samsung Electro-Mechanics 描述: CAP CER 10UF 16V X7R 0805 🚫 不含铅 🟢 RoHS认证	Digi-Key 库存: 20000 包装: 剪切带(CT) *1 起订量: 1	¥2.2300	立即询价	⋮



N2510-6002RB

Connectors | Headers and Edge Type Connectors  
 Board Connector, 10 Contact(s), 2 Row(s), Male, Straight, 0.1 inch Pitch, Solder 显示更多

加入

BOM

选择制造商  
 3M Interconnect

价格浮动  
 \$0.7821 ~ \$4.0000

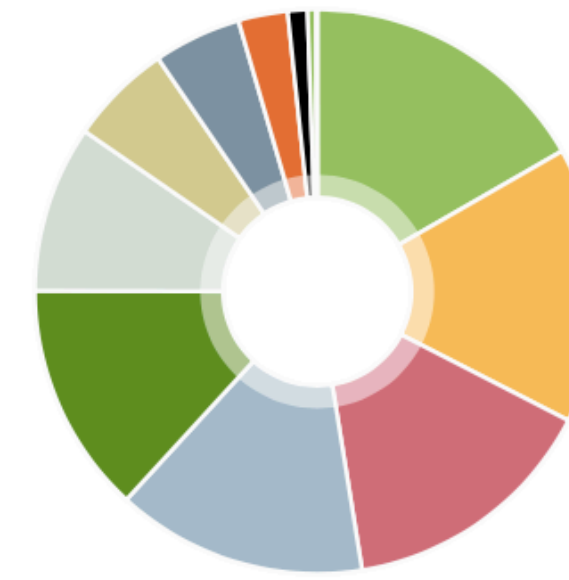


型号详情

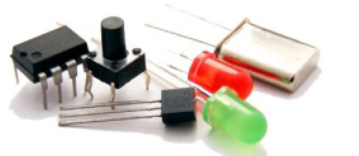
制造商型号: N2510-6002-RB  
 是否无铅: Yes  
 是否RoHS认证: Yes  
 生命周期: Active  
 包装说明: ROHS COMPLIANT  
 制造商: 3M Interconnect  
 风险等级: 0.77  
 辅助特征: 3M, LOW PROFILE

显示更多

分销商库存



1. TTI	54,081	查看详
2. Arrow Electronics	51,258	查看详
3. Heilind Electronics	48,269	查看详
4. Verical	46,470	查看详
5. Interstate Connecting Components	42,840	查看详
6. Chip1Stop	30,940	查看详
7. Farnell element14	18,970	查看详





### Connectors全球排行

排行: **4,324**  
共2,758,547 个型号  
相比去年变化**0%**

#### 全球热门型号

1. **C0603C104K5RACTU**  
KEMET Corporation
2. **GRM155R71C104KA88D**  
Murata Manufacturing Co Ltd
3. **2N7002LT1G**  
ON Semiconductor
4. **C0805C104K5RACTU**  
KEMET Corporation
5. **GRM188R71H104KA93D**  
Murata Manufacturing Co Ltd
6. **06035C104KAT2A**  
AVX Corporation
7. **08055C104KAT2A**  
AVX Corporation
8. **C1005X7R1H104K050BB**  
TDK Corporation of America
9. **2N7002-7-F**  
Diodes Incorporated
10. **RC0603FR-0710KL**  
YAGEO Corporation

### Connectors 排行

排行: **769**  
共183,198 个型号  
相比去年变化**0%**

#### 热门 Connectors

1. **500075-1517**  
Molex
2. **0878321420**  
Molex
3. **1054500101**  
Molex
4. **U,FL-R-SMT-1(10)**  
Hirose Electric Co Ltd
5. **5015**  
Keystone Electronics Corp
6. **105450-0101**  
Molex
7. **5015714007**  
Molex
8. **Q-710**  
Qualtek Electronics Corporation
9. **0878311420**  
Molex
10. **10118194-0001LF**  
Amphenol FCi

### Headers and Edge Type Connectors 排行

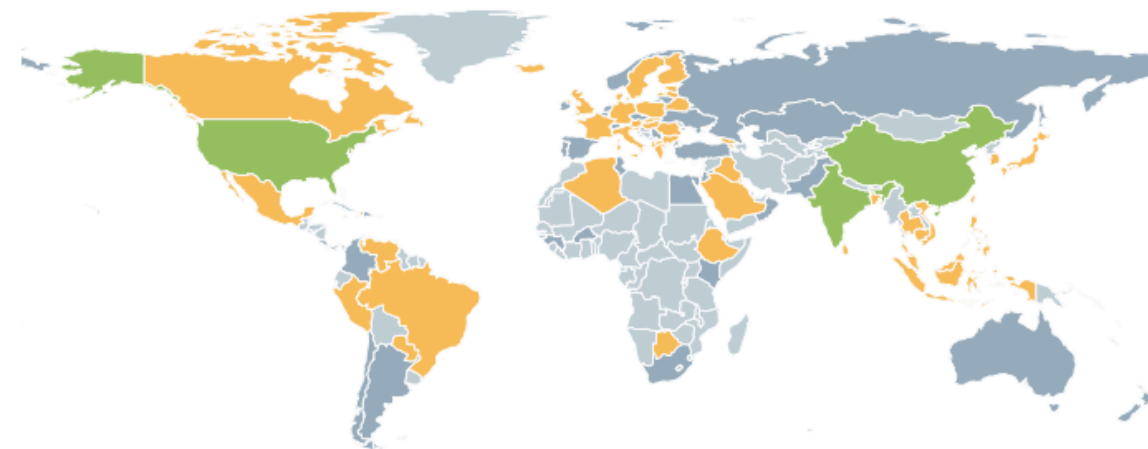
排行: **769**  
共85,285 个型号  
相比去年变化**+0.01%**

#### 热门 Headers and Edge Type Connectors

1. **0878321420**  
Molex
2. **5015714007**  
Molex
3. **0878311420**  
Molex
4. **FTSH-105-01-L-DV-K**  
Samtec Inc
5. **5015680407**  
Molex
6. **501568-1507**  
Molex
7. **0022232031**  
Molex
8. **XF2M-5015-1A**  
OMRON Electronic Components LLC
9. **0532610471**  
Molex
10. **5015680207**  
Molex

### 区域热度

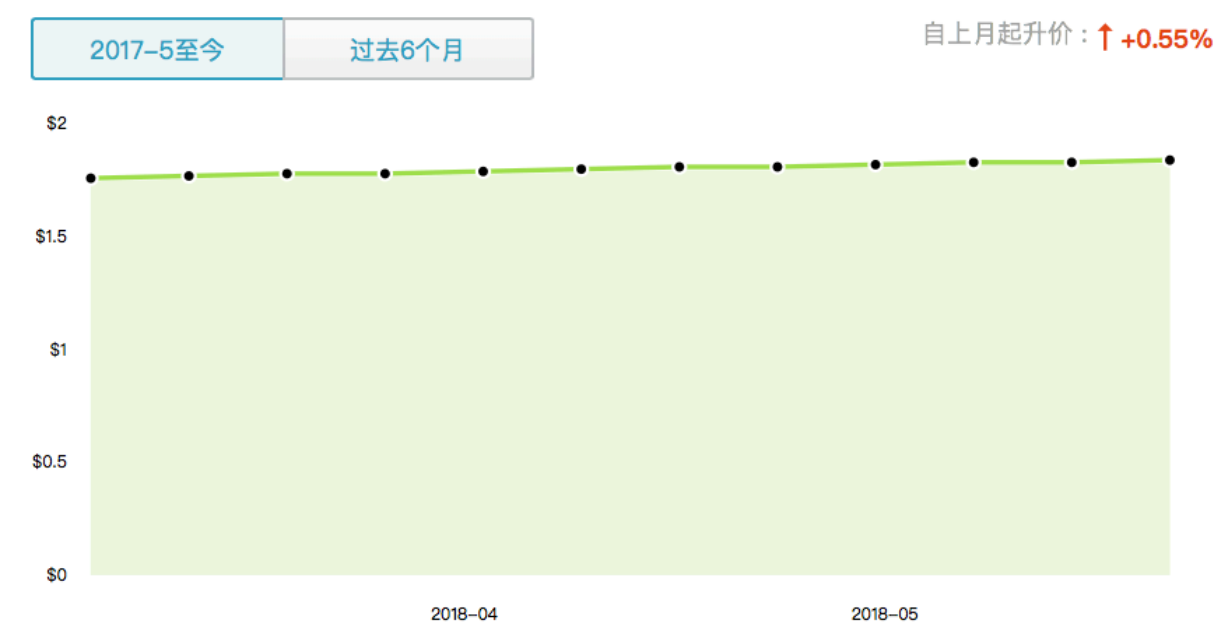
- |     |     |                 |
|-----|-----|-----------------|
| 1.  | 100 | United State... |
| 2.  | 93  | China           |
| 3.  | 83  | India           |
| 4.  | 73  | Philippines     |
| 5.  | 71  | HKG, China      |
| 6.  | 64  | Austria         |
| 7.  | 64  | Iraq            |
| 8.  | 63  | Denmark         |
| 9.  | 63  | Slovakia        |
| 10. | 61  | Venezuela       |



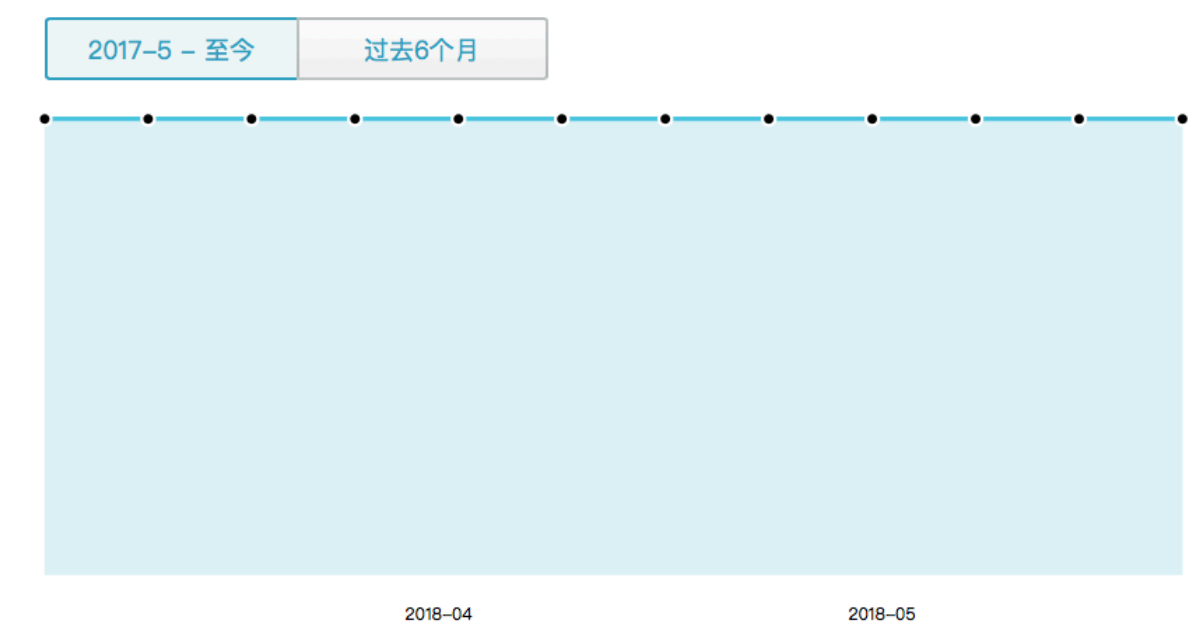
< 1 - 10 / 93 个国家 >

■ 非常高 ■ 较高 ■ 一般 ■ 较低

### 价格走势

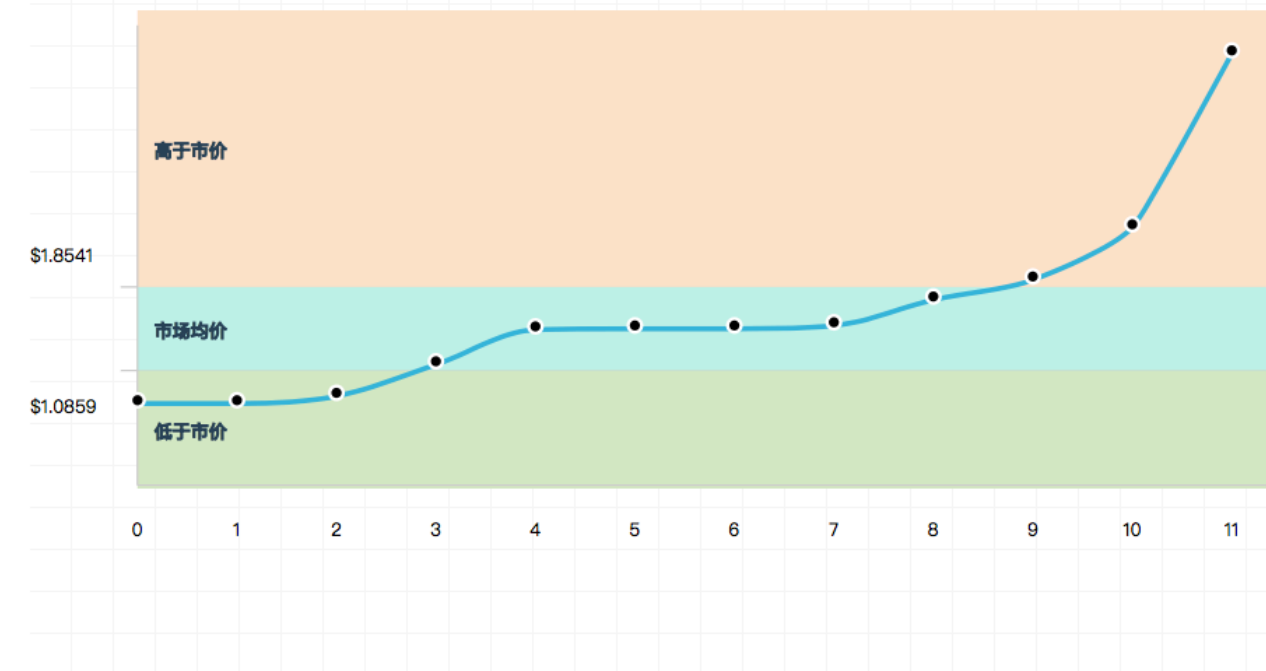


### 库存走势



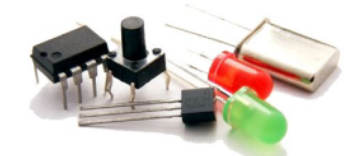
### 市场价格分析

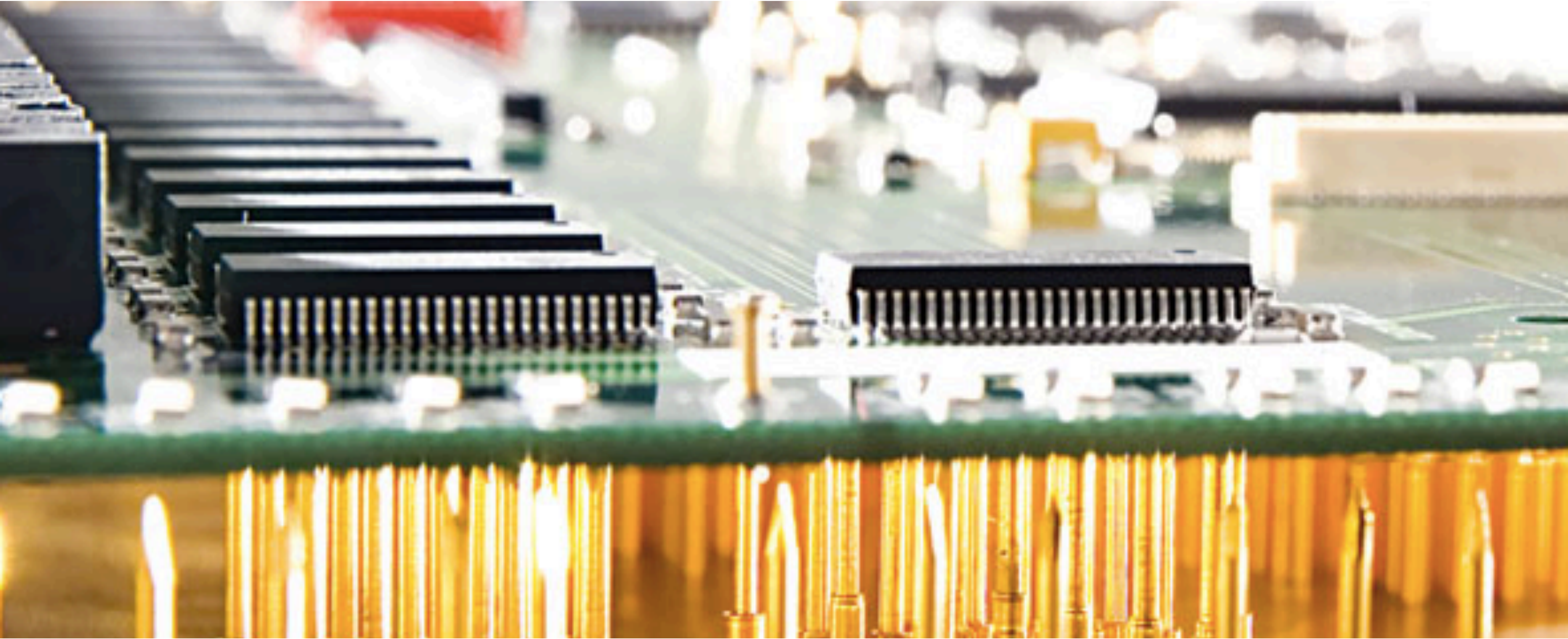
数量:  [修改](#)



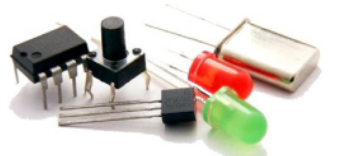
- |     |                                  |          |                      |
|-----|----------------------------------|----------|----------------------|
| 1.  | Heilind Electronics              | \$0.7821 | <a href="#">查看详情</a> |
| 2.  | Interstate Connecting Components | \$0.7821 | <a href="#">查看详情</a> |
| 3.  | Powell Electronics               | \$0.8500 | <a href="#">查看详情</a> |
| 4.  | Farnell element14                | \$1.4685 | <a href="#">查看详情</a> |
| 5.  | Arrow Electronics                | \$1.4613 | <a href="#">查看详情</a> |
| 6.  | Avnet                            | \$1.4700 | <a href="#">查看详情</a> |
| 7.  | Mouser Electronics               | \$1.4700 | <a href="#">查看详情</a> |
| 8.  | Avnet                            | \$1.4990 | <a href="#">查看详情</a> |
| 9.  | element14 Asia-Pacific           | \$1.7360 | <a href="#">查看详情</a> |
| 10. | Quest Components                 | \$1.9200 | <a href="#">查看详情</a> |

< 1 - 10 / 共12个分销商 >

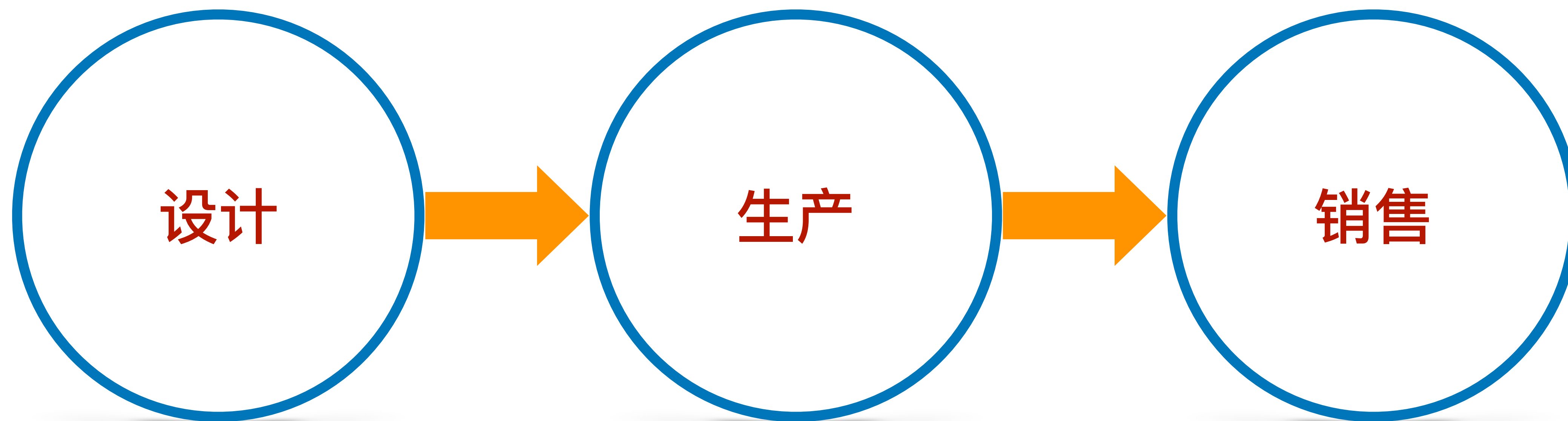




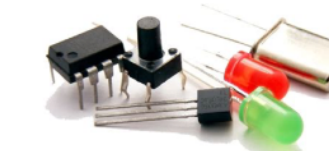
# PCB设计之可制造性设计 - 优化器件/系统组装



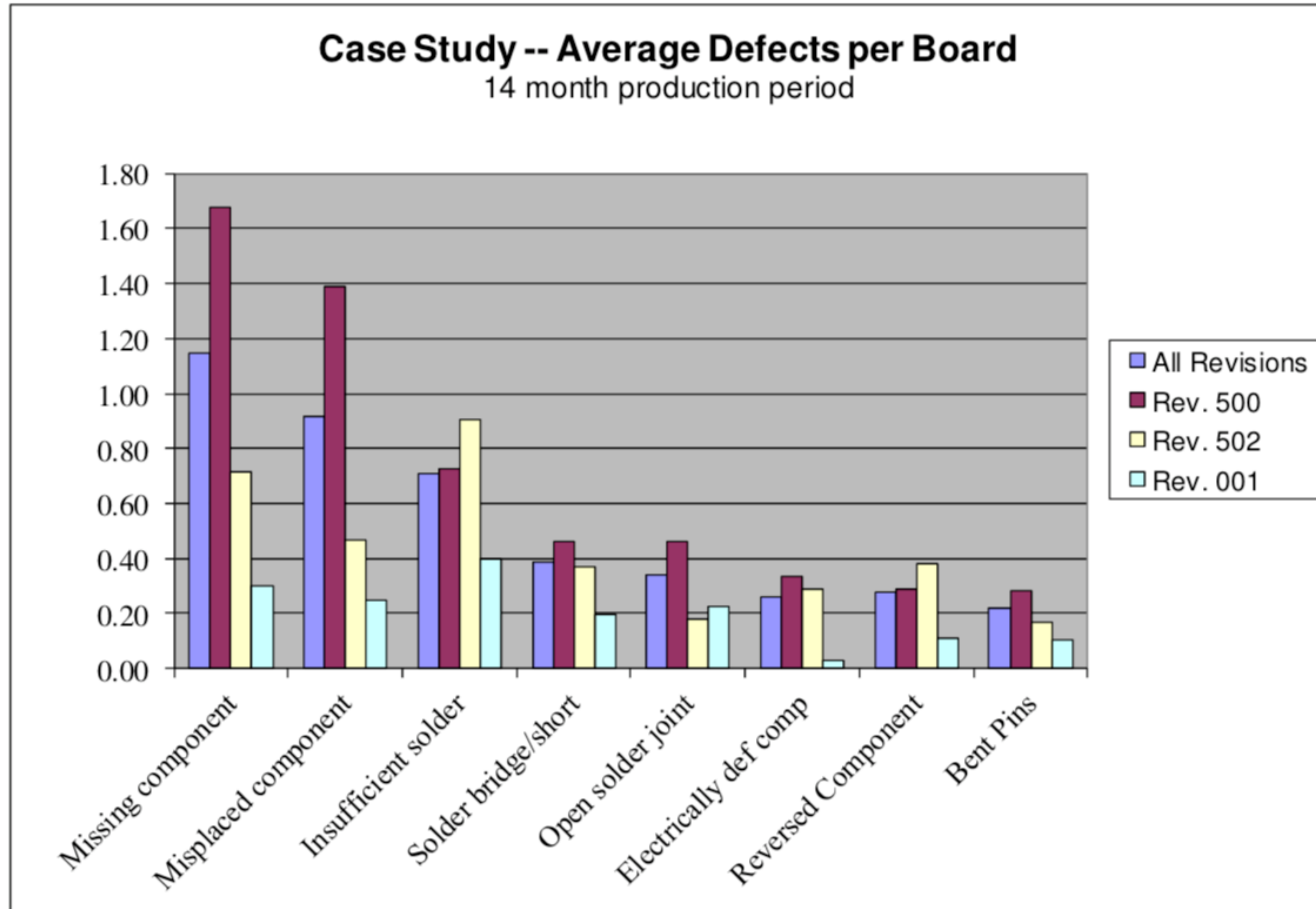
# 产品生命周期



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

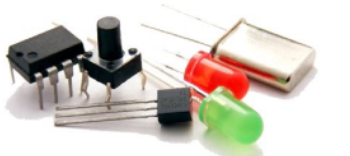


# 产品常见问题



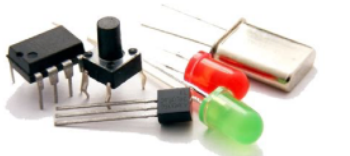
# DFX

- 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



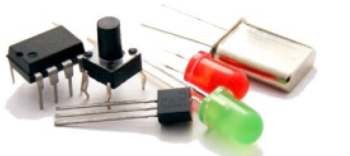
# DFM的目标

- 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



# DFM设计原则

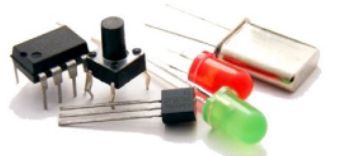
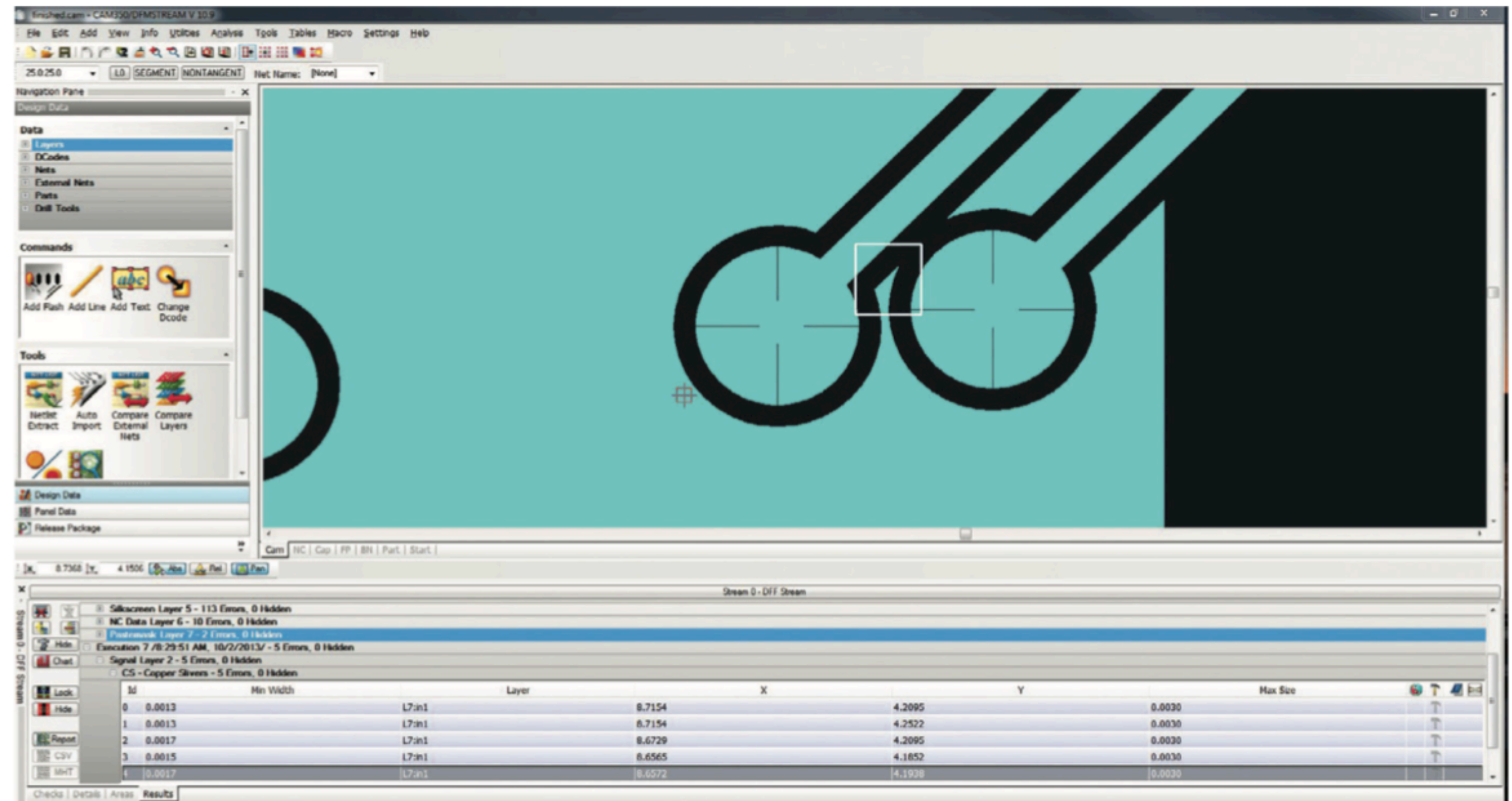
- 尽量少出错，减少上市时间！
- 了解PCB加工、组装工艺要求
- 从机械、电子两方面共同考虑对设计的要求和限制
- 对其它系统的影响以及其它系统带来的影响
- 预测加工误差导致的风险 - 线间距、孔距、孔间距等



# 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.





# DFM工具

Mentor Graphics Corporation [US] | <https://www.mentor.com/pcb-manufacturing-assembly/>

PRODUCTS & SOLUTIONS TRAINING & SERVICES COMPANY BLOGS SUPPORT Sign In | Create Account

PCB Manufacturing, Assembly & Test Search Mentor.com

Valor PCB Manufacturing Systems Solutions

## Valor PCB Manufacturing Solutions

Valor is the PCB industry's first true end-to-end software solution, extending Mentor offering from product design to the manufacturing shop floor. Valor software covers all phases of PCB manufacturing from new product introduction to assembly and test.

Valor Process Preparation Virtual Lab

Valor IoT Manufacturing

Valor Solutions

Valor Software

Resources

Blog

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Chat Online  
No agents are available

1-800-547-3000  
Direct: (503) 685-7000

Valor MSS Valor IoT Manufacturing

### One platform supports your entire manufacturing process

Valor seamlessly integrates the entire PCB manufacturing process with one easy-to-manage platform. Available as an end-to-end suite, each module may be also installed separately.

Valor MSS brochure  
DATASHEET (PDF, 2mb)

- Foundation >
- Process Preparation >
- Production Planning >
- Parts Library >
- Business Intelligence >
- Quality Management >
- All Valor MSS Modules >

Contact

Secure | <https://www.protoexpress.com/betterdfm/>

SIERRA CIRCUITS

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## Introducing Not Just FREE, But... Better DFM

Online Design For Manufacturability Check For PCB Designers Get a FREE Report!

**Benefits**

- Easy 3 step process: 1 Upload files 2 Assign Layers 3 Get Report
- Free DFM Check against your design rules
- Compare your Netlist against Gerbers — get hints to fix
- Confirm that you have all the files needed for manufacturing
- Prevent delays from on-holds or re-spins
- Get instant price quote

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## FREE PCB File Check

FreeDFM™

YOUR RESULTS

\$100 DISCOUNT CODE

SHOW STOPPERS

AUTOMATICALLY FIXED

INSUFFICIENT SMT SOLDERMASK CLEARANCE

Ensure your PCB design is free of manufacturability issues. Our FREE tool is fast & easy to use.

UPLOAD FILES

Save up to \$100 when you use it!

Products/Services

- connection center
- GET INSTANT QUOTE
- Place PCB & Assembly Order
- Capabilities
- FREE PCB Layout Software
- FREE PCB File Check
- Student Program
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- DOWNLOAD BROCHURE

PCB Artist

Download the industry's best FREE PCB design software

- ✓ 500,000+ PARTS
- ✓ UP TO 28 LAYERS
- ✓ EASY SCHEMATICS
- DOWNLOAD

- Easy to Read Graphical Report [view sample report]
- Ensures Your Files Contain All Necessary Data
- Some Design Issues Are Automatically Corrected
- Receive Detailed PCB Quote & Up to \$100 Discount Code
- FREE (Unlimited & Available 24/7)

"...My two boards I just sent for fab had global issues with the solder mask and silk screen. I wouldn't have found the issues without your DFM tool." - A.V.

Not Secure | [www.sunstone.com/pcb-products/dfm-solutions-for-cad-tools](http://www.sunstone.com/pcb-products/dfm-solutions-for-cad-tools)

SUNSTONE CIRCUITS

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## DFM Solutions for CAD

Studies show that 70-80% of the quality and manufacturing yield of you from design, not manufacturing. Furthermore, finding and fixing design orders of magnitude more expensive as your design proceeds through. As a result, it pays to catch manufacturability issues as early as possible. Circuits offers DFMPplus for you to increase your odds of achieving a win on the first build spin.

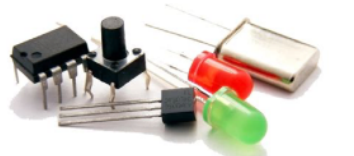
DFMplus

With Sunstone's DFMPplus tool, you can submit your final design file to DFM service. We'll create a comprehensive report for your board. This only help you determine which of our manufacturing services is most a your design specifics, but it will also help you look forward to production details in your current design that may cause yield or reliability issues. not only helps verify your prototype, but keeps you focused on the end goal - a reliable, profitable final product. DFMPplus is available through your Sunstone My Account section.

PCB PRODUCTS & SERVICES

- PCB Manufacturing
- PCB123
- DFMPPlus
- DFM Throughout Your Design Cycle
- Layout Services
- PCB Solder Stencils
- Bundled Assembly

Questions?  
We're here for you 24/7/365  
1.800.228.8198



# 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

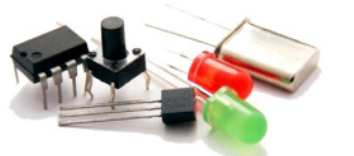
- Solder Mask Clearance
- Coverage
- Rout to Mask
- Spacing
- Missing Solder Mask Clearance
- Exposed Lines
- Partial Clearances

## 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



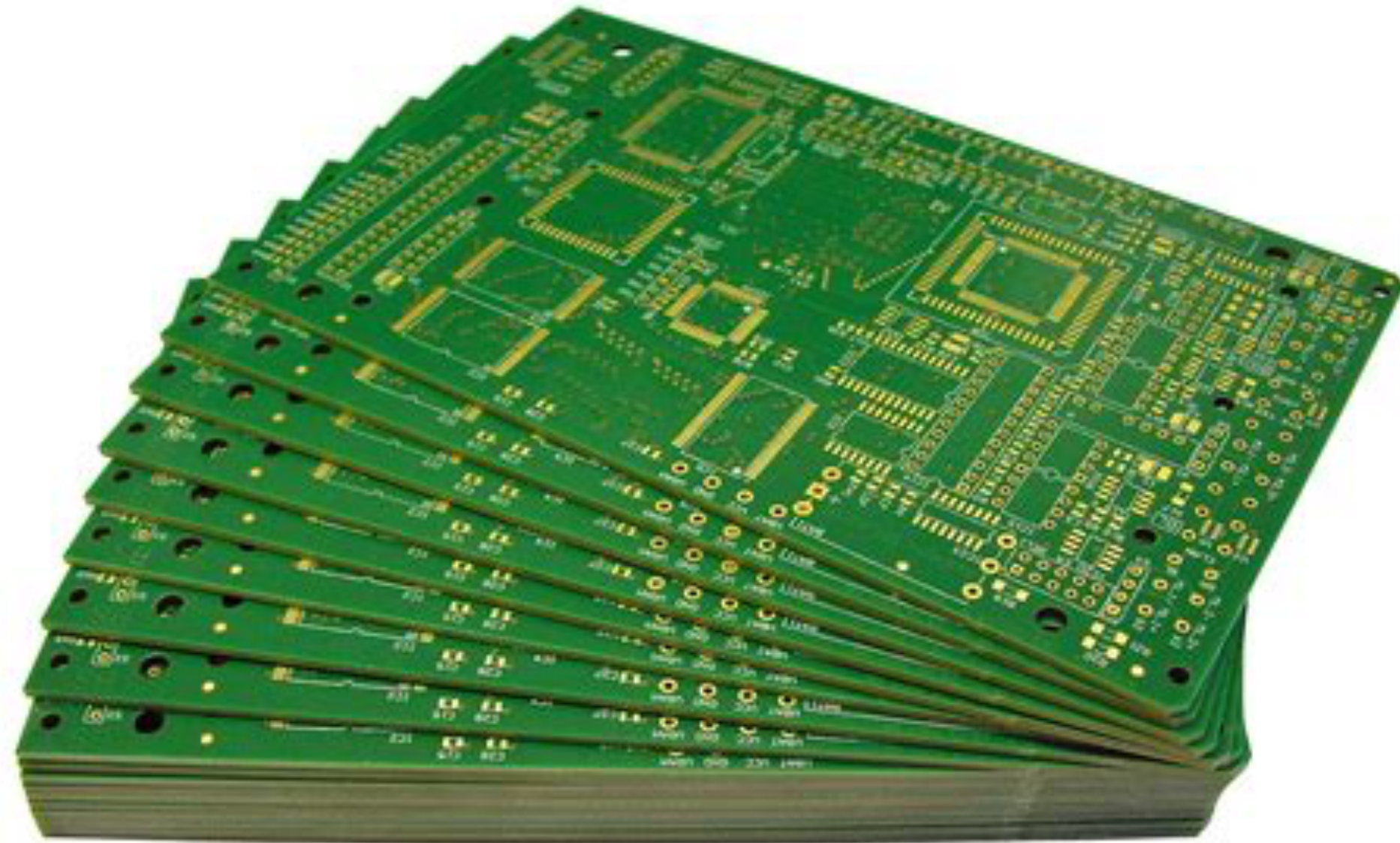
# 器件的选择



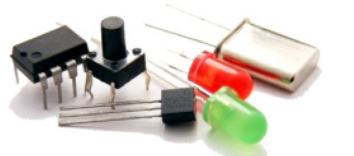
- 影响成本及焊接合格率
- 穿孔器件还是贴片器件?
- 值尽可能统一
- 封装尽可能统一



# 板材的选择

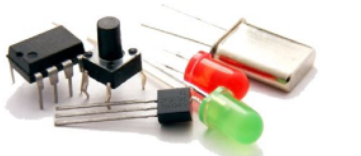
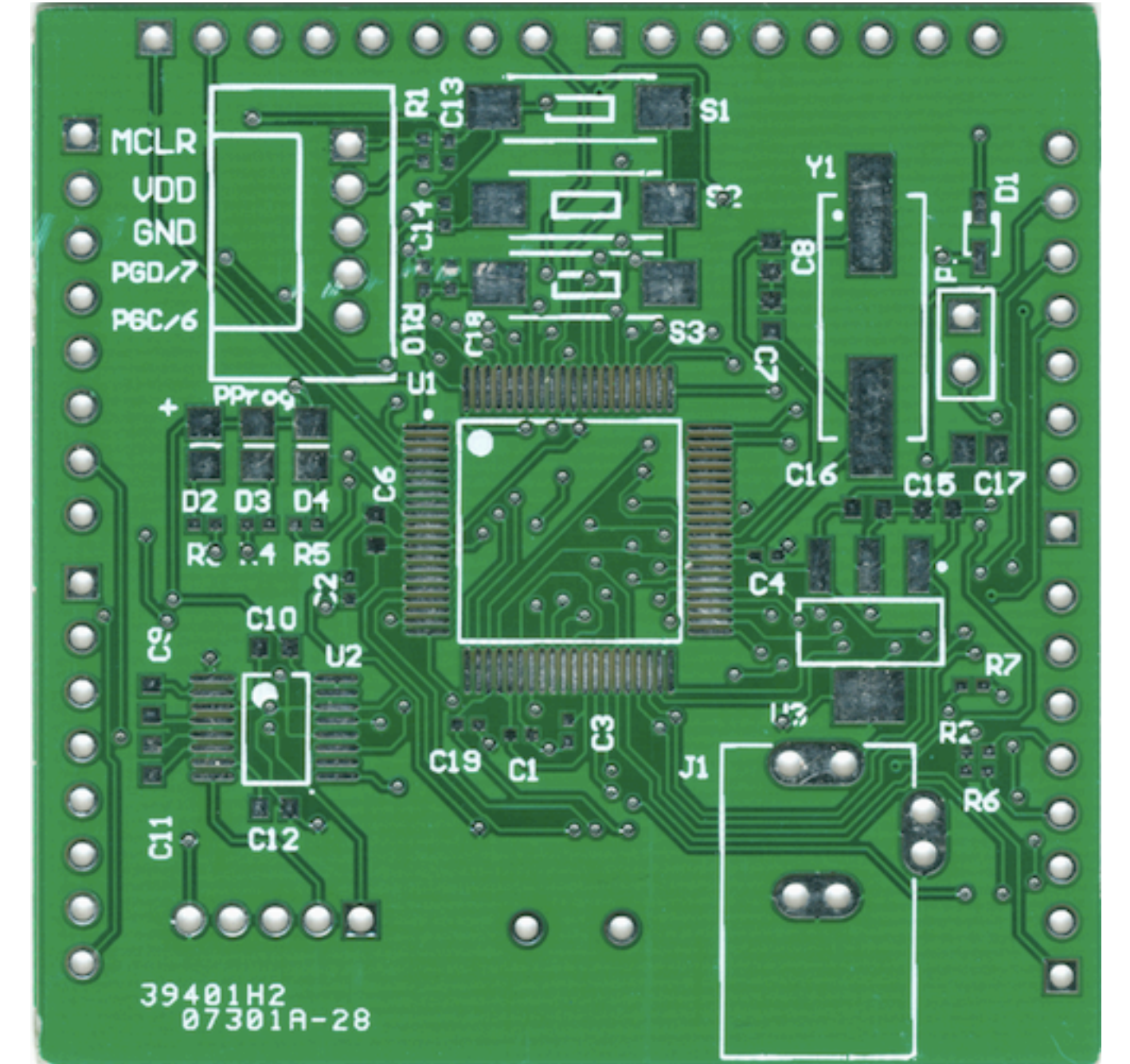


- 层数的选择
- 板材料的选择
- 工艺的选择



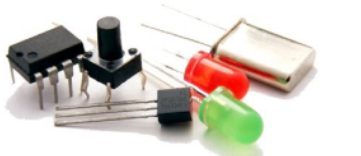
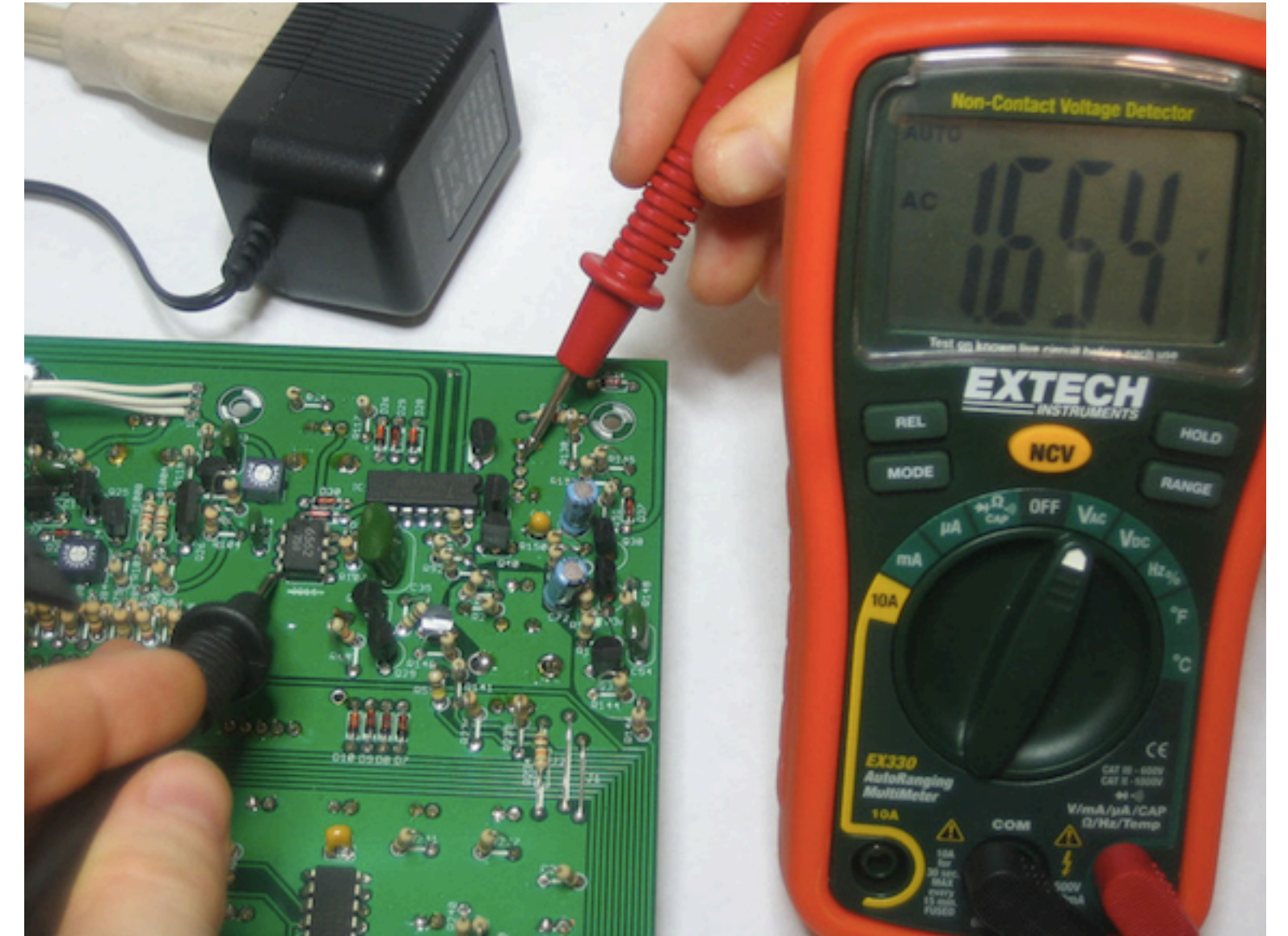
# 丝印

- 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



# 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



# 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

