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一 博 科 技

“高可靠”的设计与生产

暨迎接更高速的挑战

一博科技-SI研究部

1

数字、模拟、射频的特征

那些年，我们一起设计的高速信号

设计哲学，思路决定出路

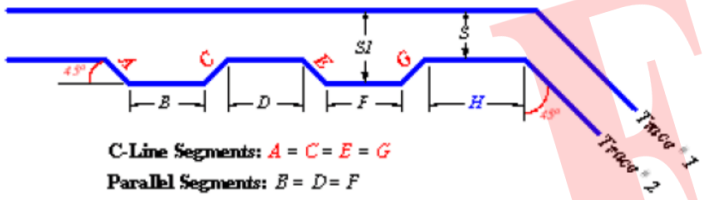
- A：细节决定成败，精益求精

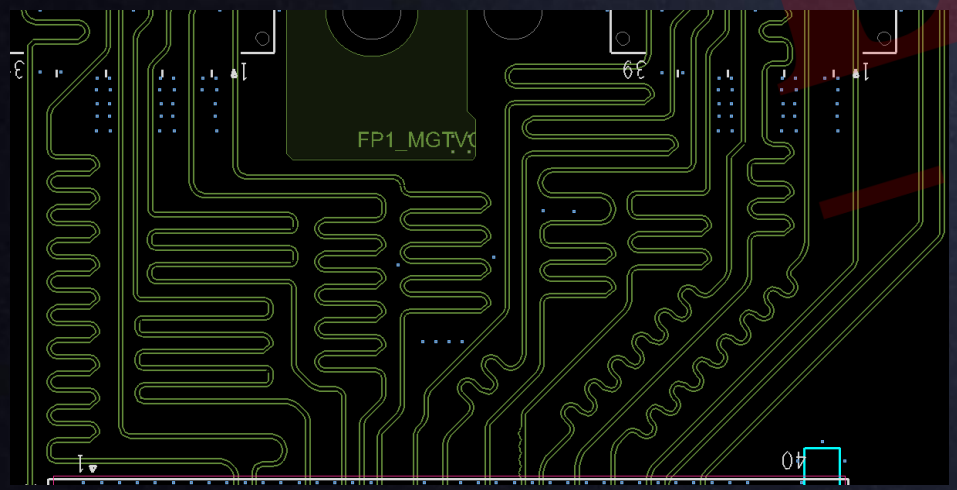
- B：抓住问题主要矛盾，不纠缠细枝末节

细节决定成败

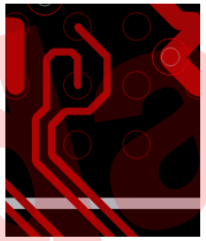
- 2H、3W绕线
- 圆弧、圆弧、圆弧

Picture below shows the recommended length matching serpentines:
Rule: S1 < 2 x S, B=D=F=H=3 x w, 45 degree bend, where w is the trace width.

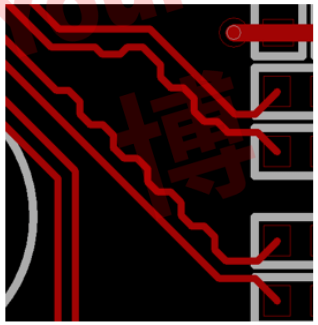


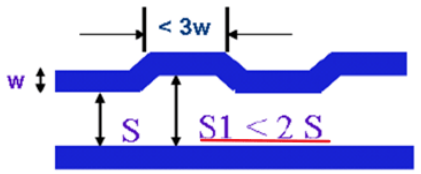


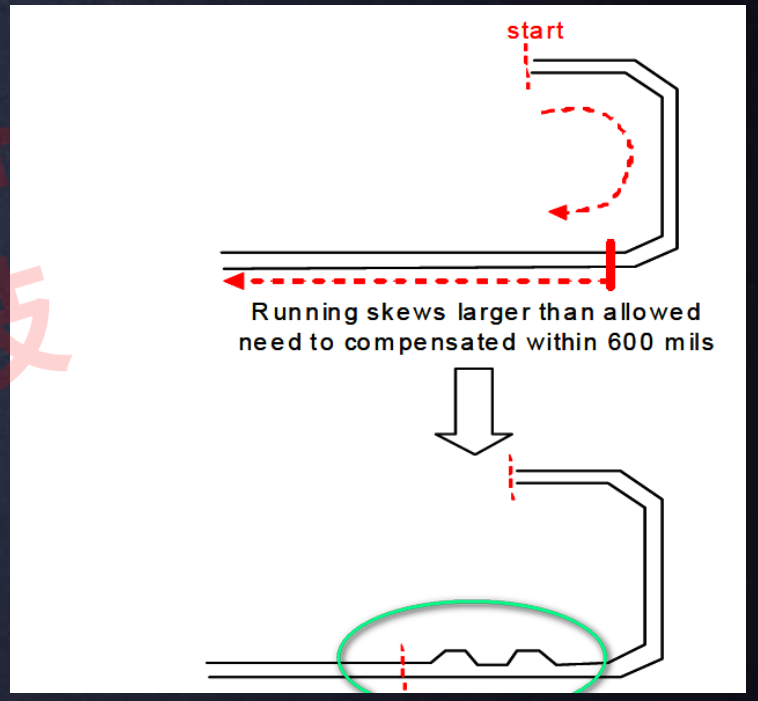
其中一个部门希望这样做,只能在一头一尾绕



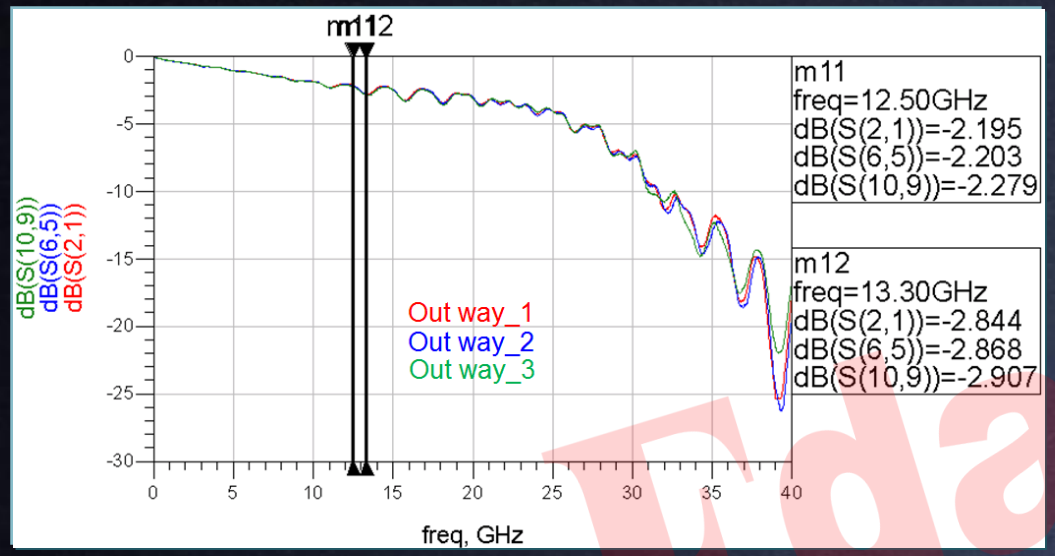
另一个却希望这样做,起始端一点都不让绕

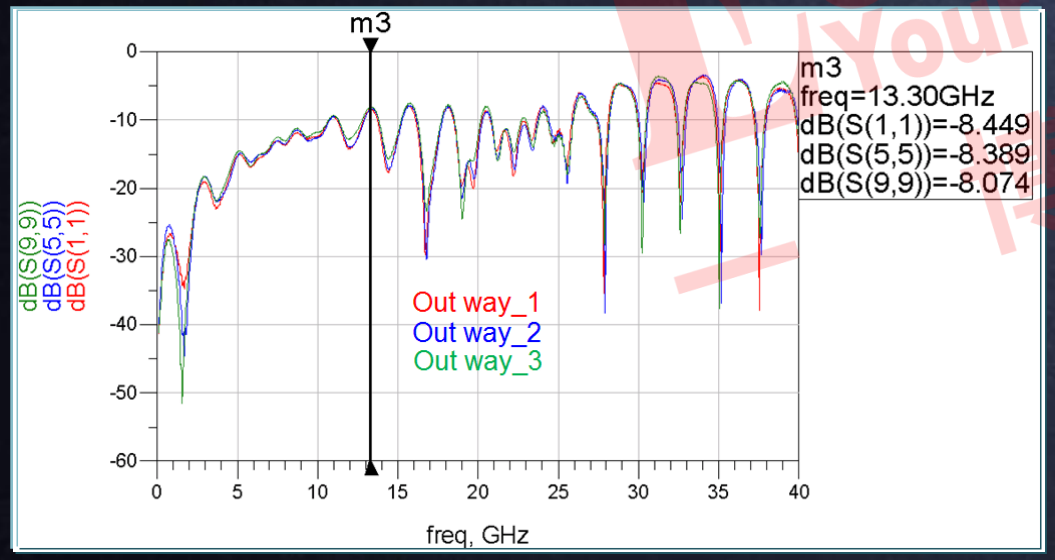


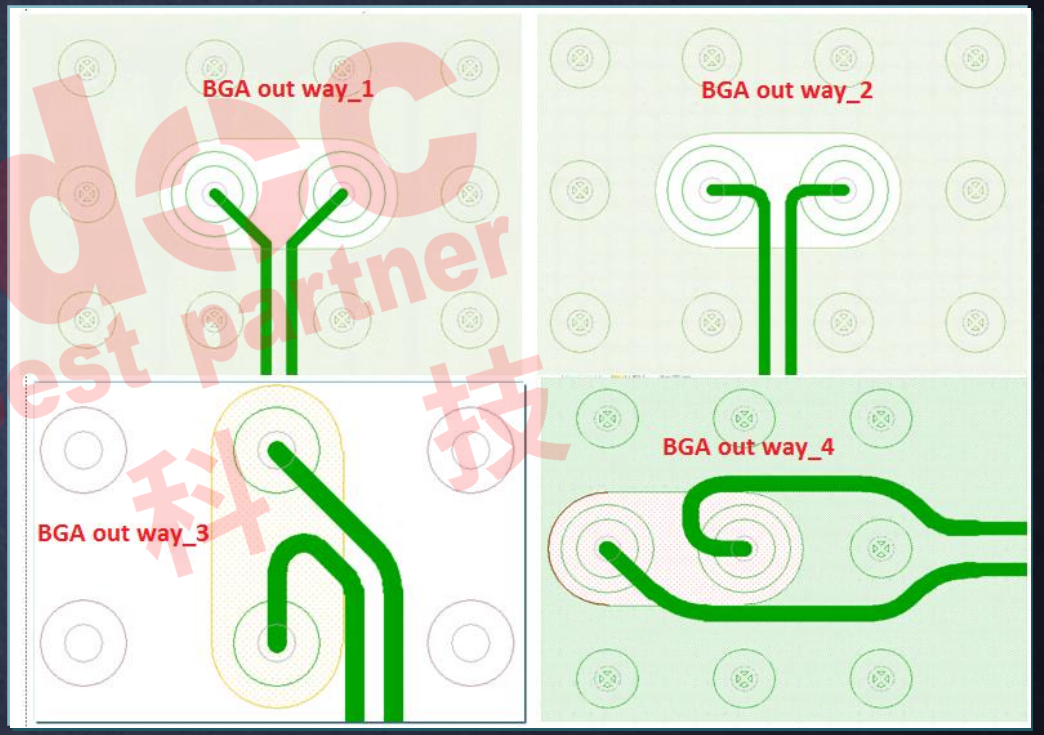




细节决定成败







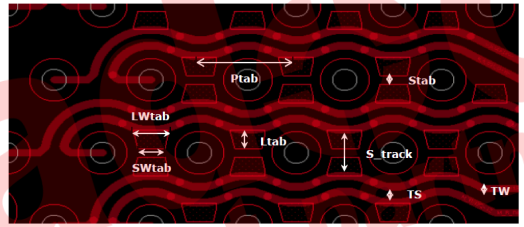
抓住问题主要矛盾

- 什么时候需要用到高速板材，什么时候需要背钻?
- Tabbed Routing
- U-turn 在什么时候可以用
- AC 耦合电容要不要优化?
- 金手指位置怎么优化?

U-Turn

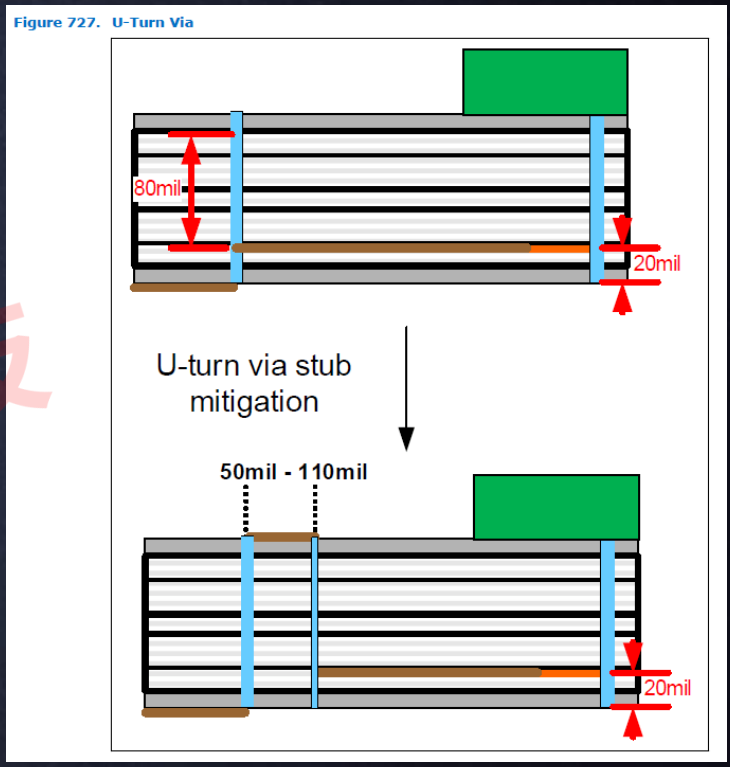
Tabbed Routing

Pin Field Tabbed Routing Variable Definitions

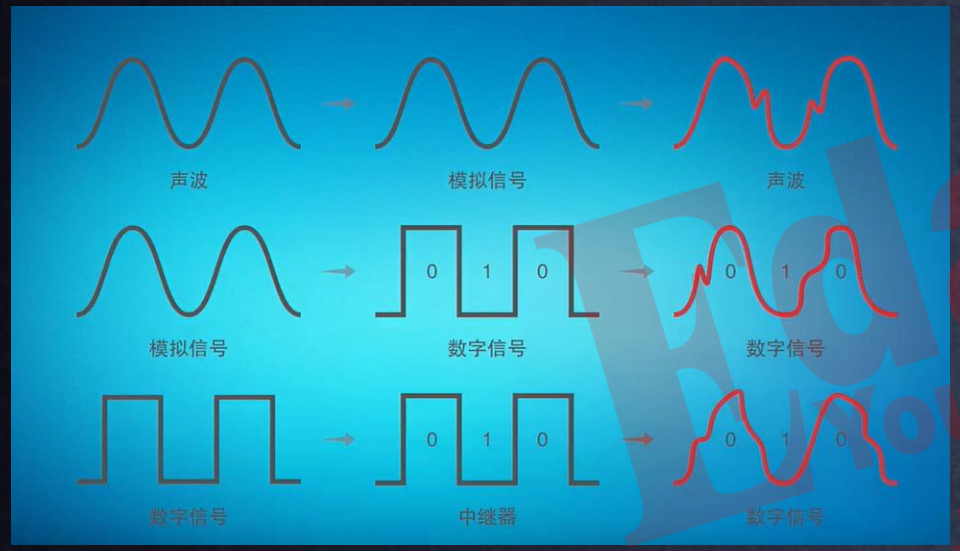


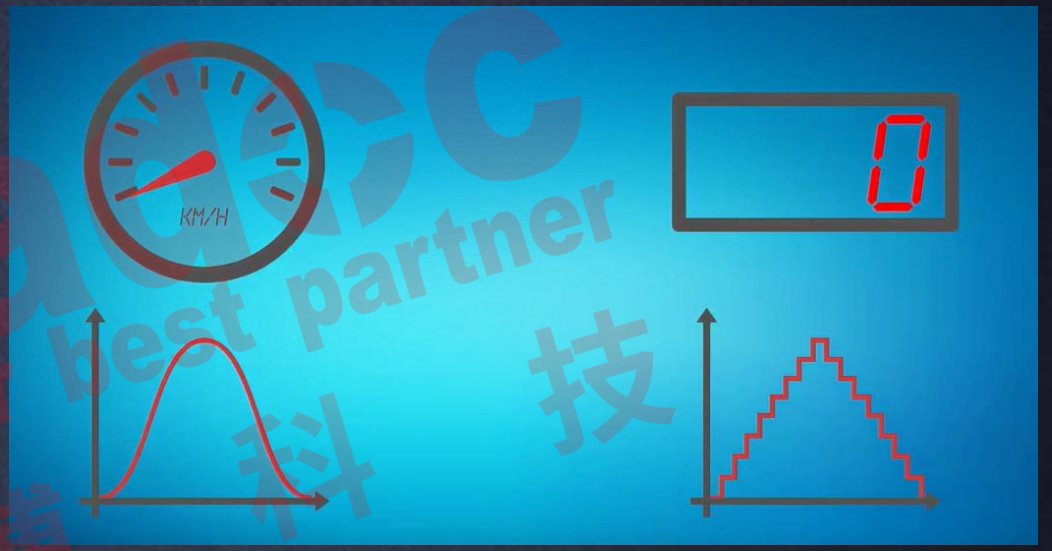
Pin Field Tabbed Parameters	Description
S_track	Spacing of two track routing
TW	Width of nets in a tab route section
TS	Line-Line spacing in tab route section
SWtab	Width of short base of tab
LWtab	Width of long base of tab
Ltab	Tab length on inner nets
Ptab	Tab to tab pitch on same side of trace
Stab	Spacing between tabs facing each other

Figure 727. U-Turn Via

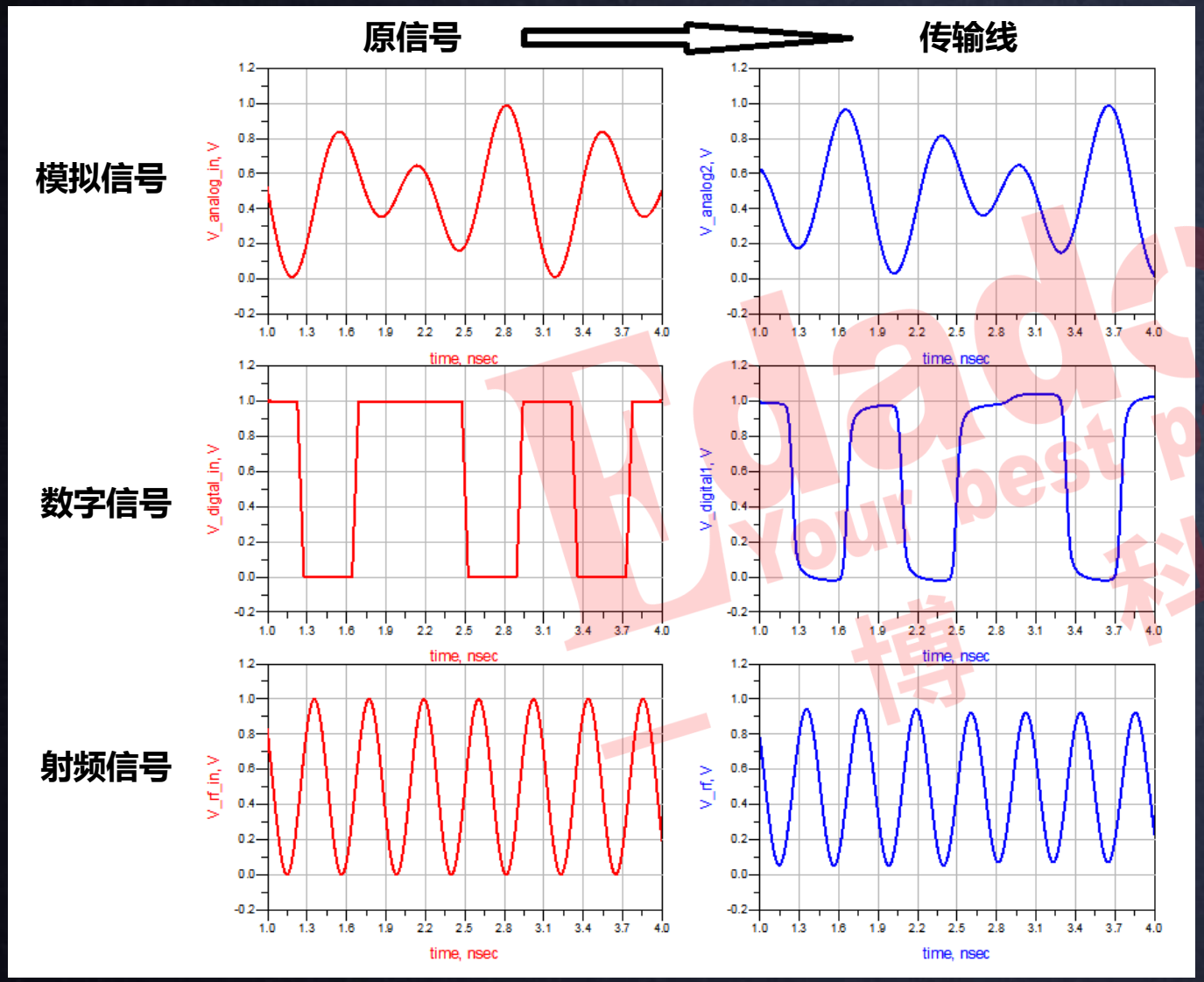


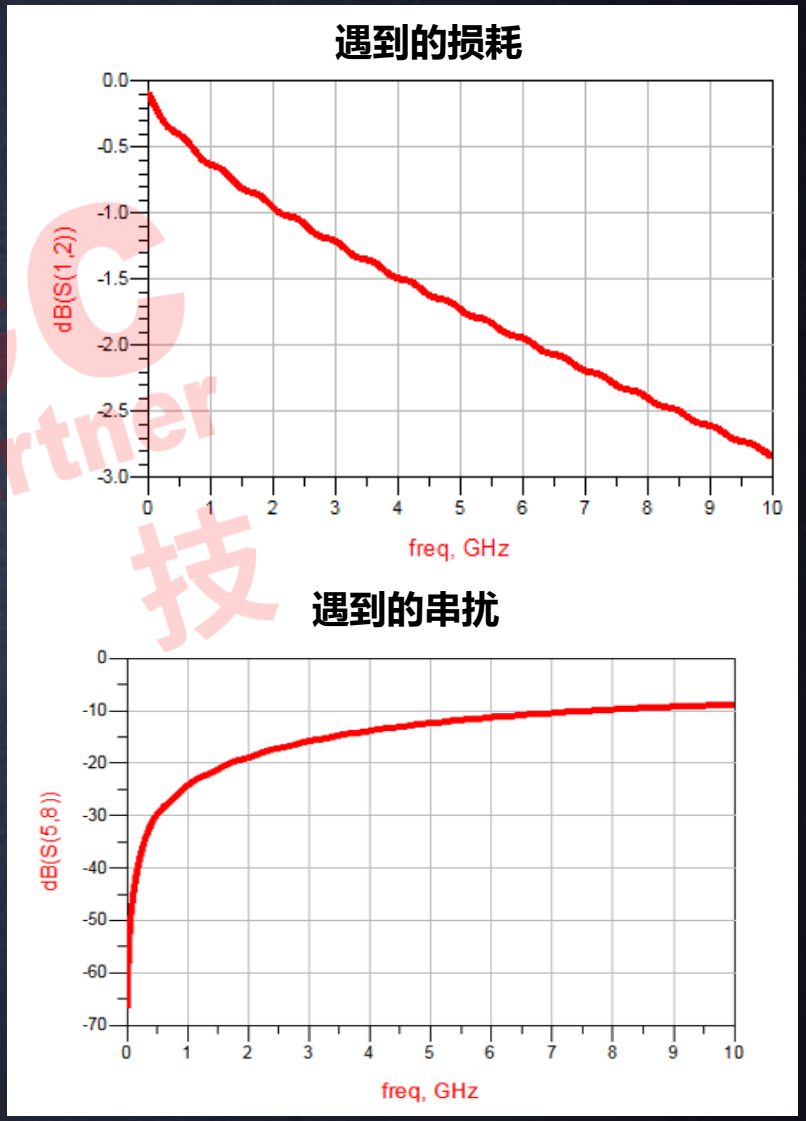
信号传输的本质 – 模拟 VS 数字





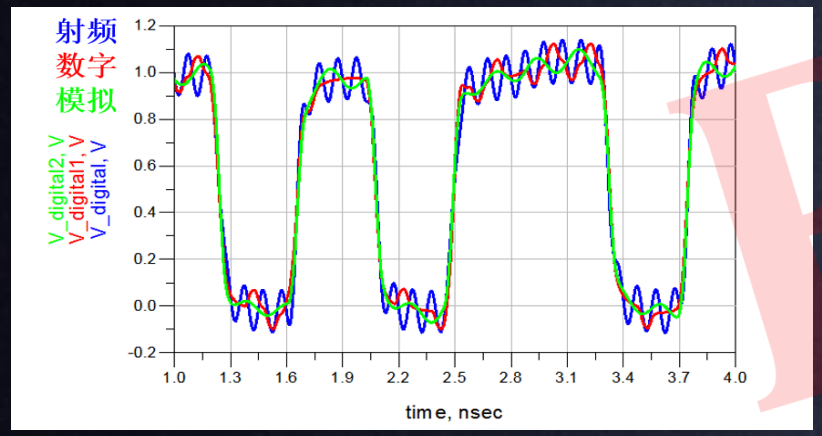
再来看看数字、模拟、射频

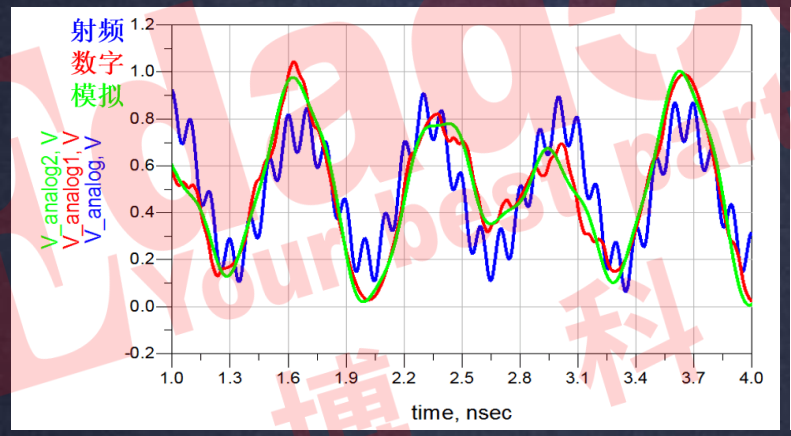


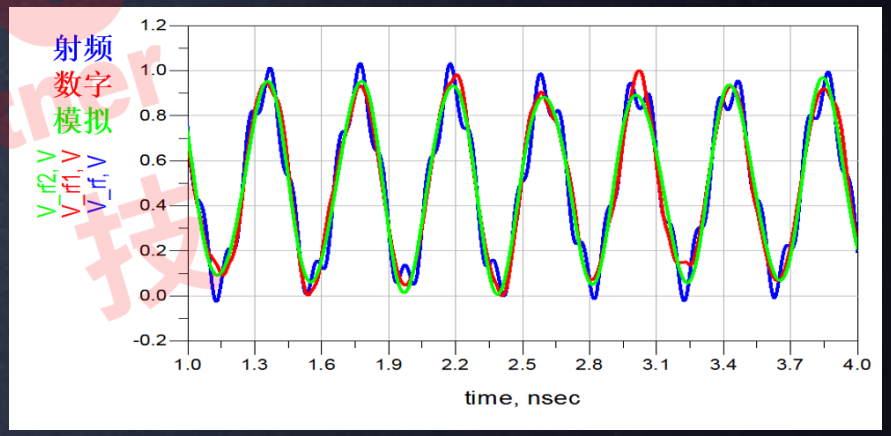


再来看看数字、模拟、射频

- 数字信号2.4GBPS，射频信号2.4GHz，模拟最高1.5GHz
- 串扰射频变成10GHz，数字信号变成10Gbps，模拟最高4.5GHz



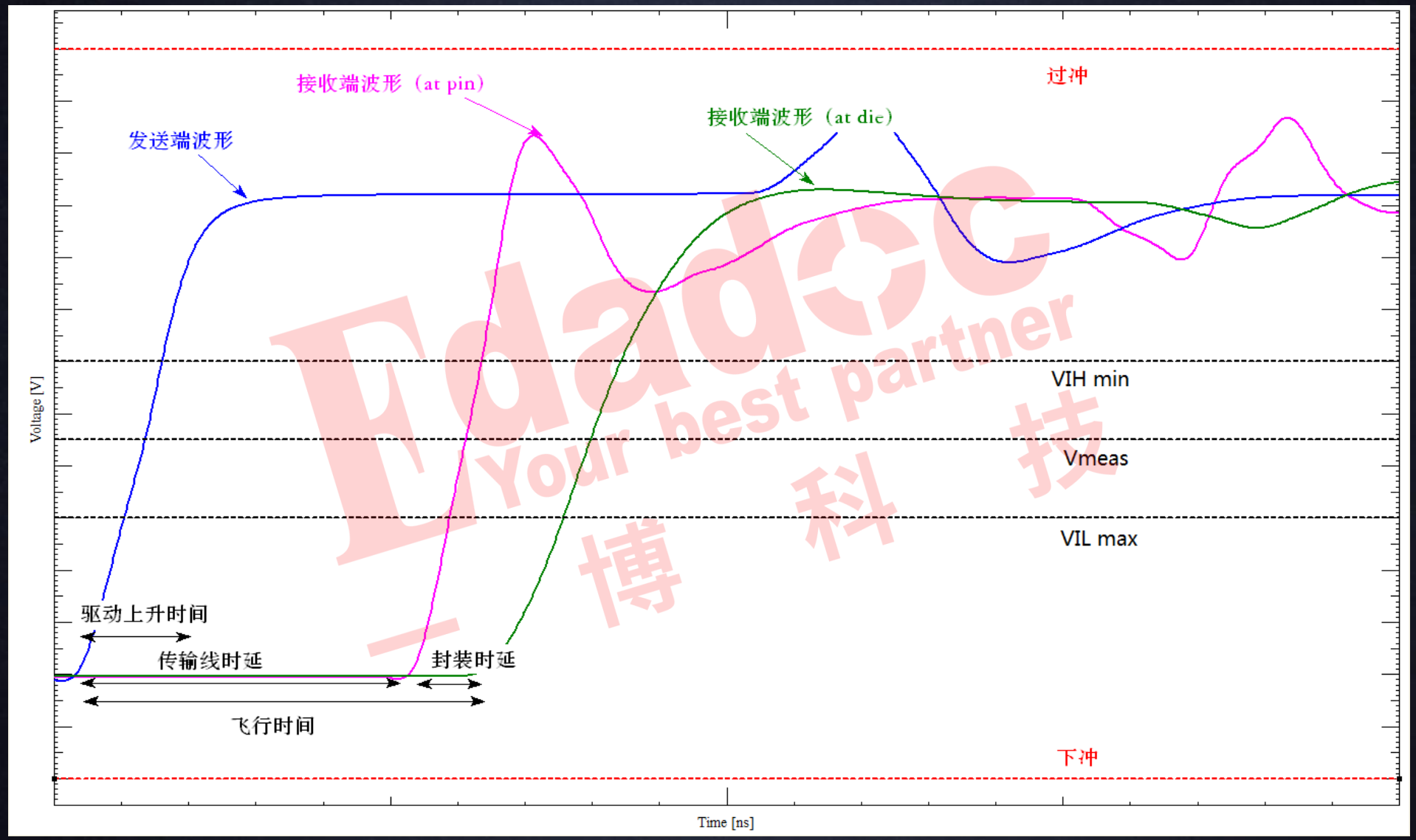




2

数字信号的特点及SI问题

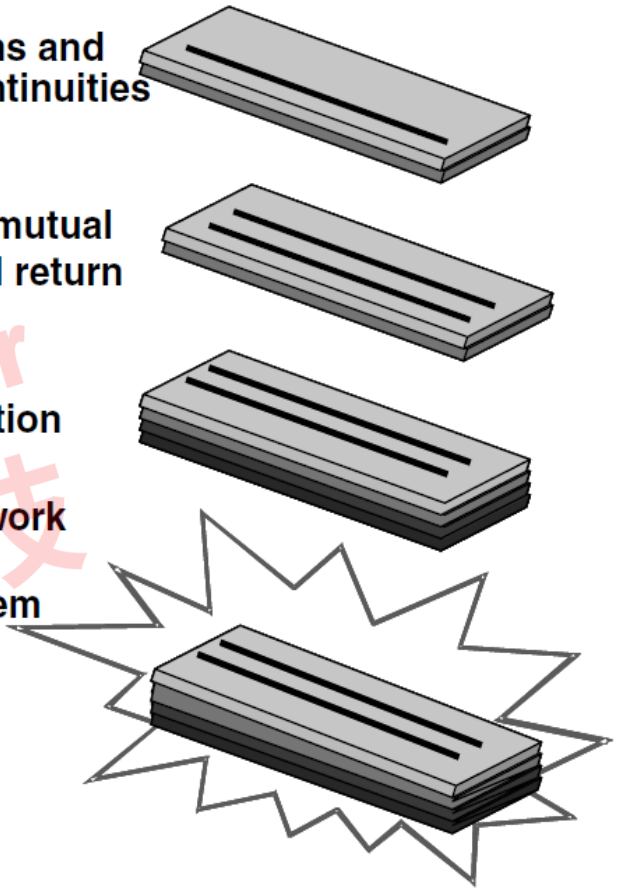
数字信号的特点



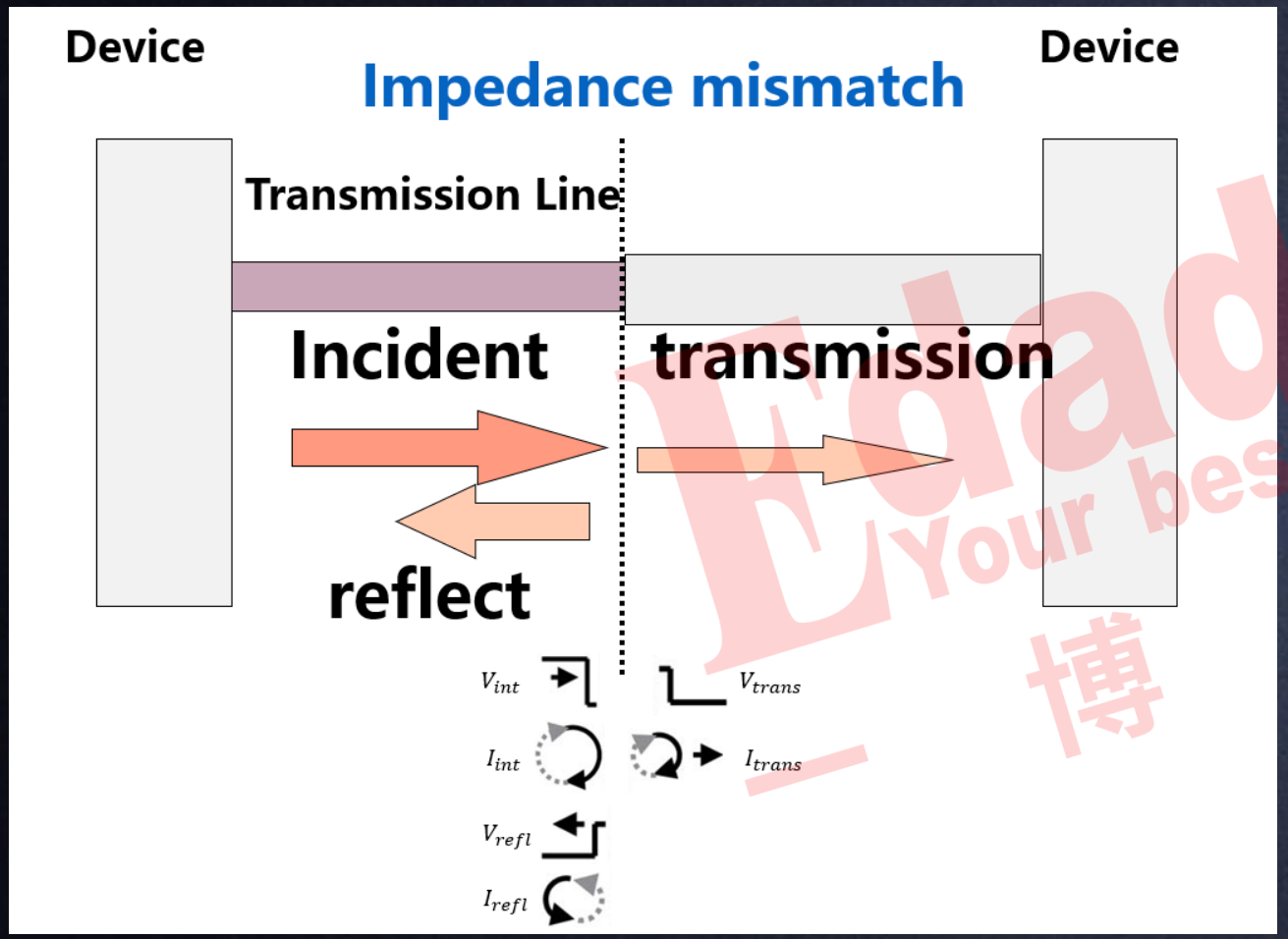
SI和PI

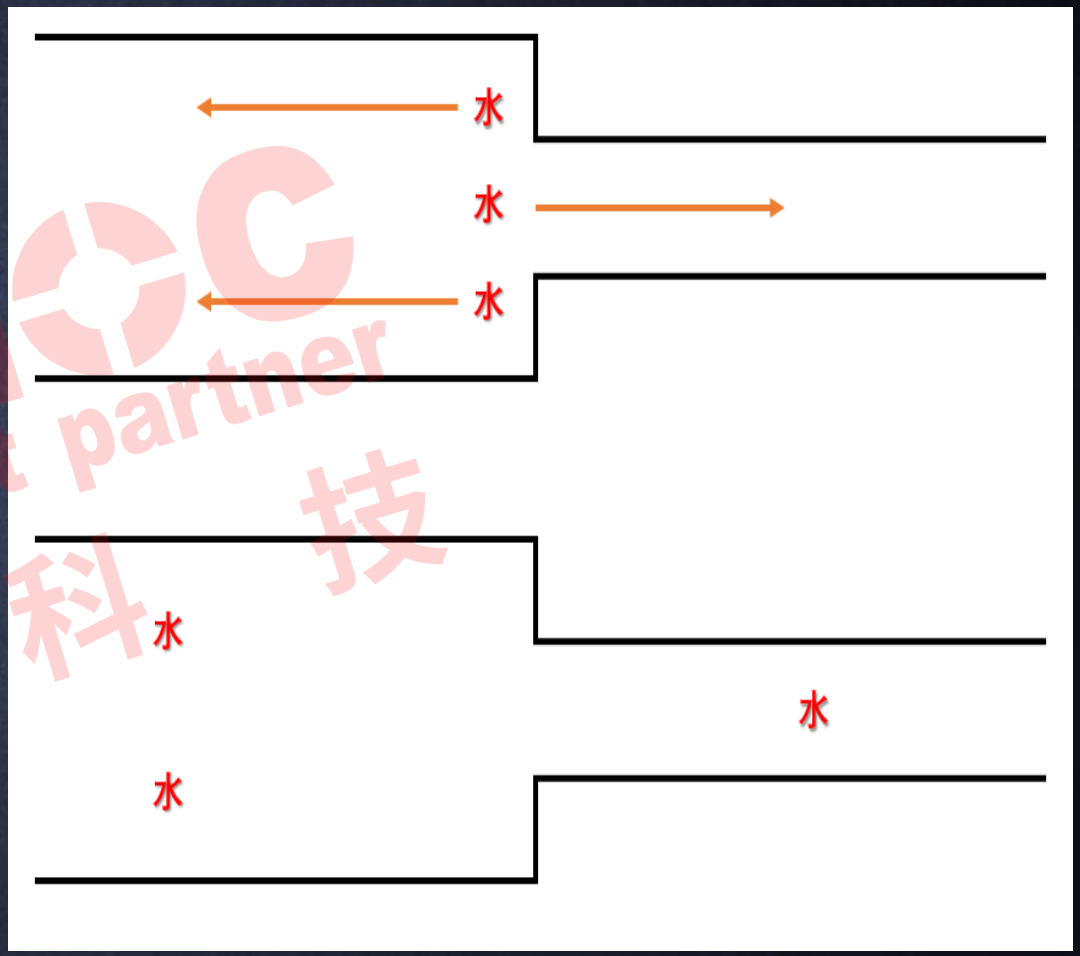
- 专业描述
  - 信号本身的问题
  - 信号之间的串扰
  - 地网络的问题
  - EMI
- 观点 SI就是解决“0-0；1-1”的问题
- 观点 PI就是解决“1V – 1V”的问题

1. Signal quality of one net: reflections and distortions from impedance discontinuities in the signal or return path
2. Cross talk between multiple nets: mutual C and mutual L coupling with ideal return paths and non-ideal return paths
3. Rail collapse in the power distribution system (PDS): voltage drop across the impedance in the pwr/gnd network
4. EMI from a component or the system

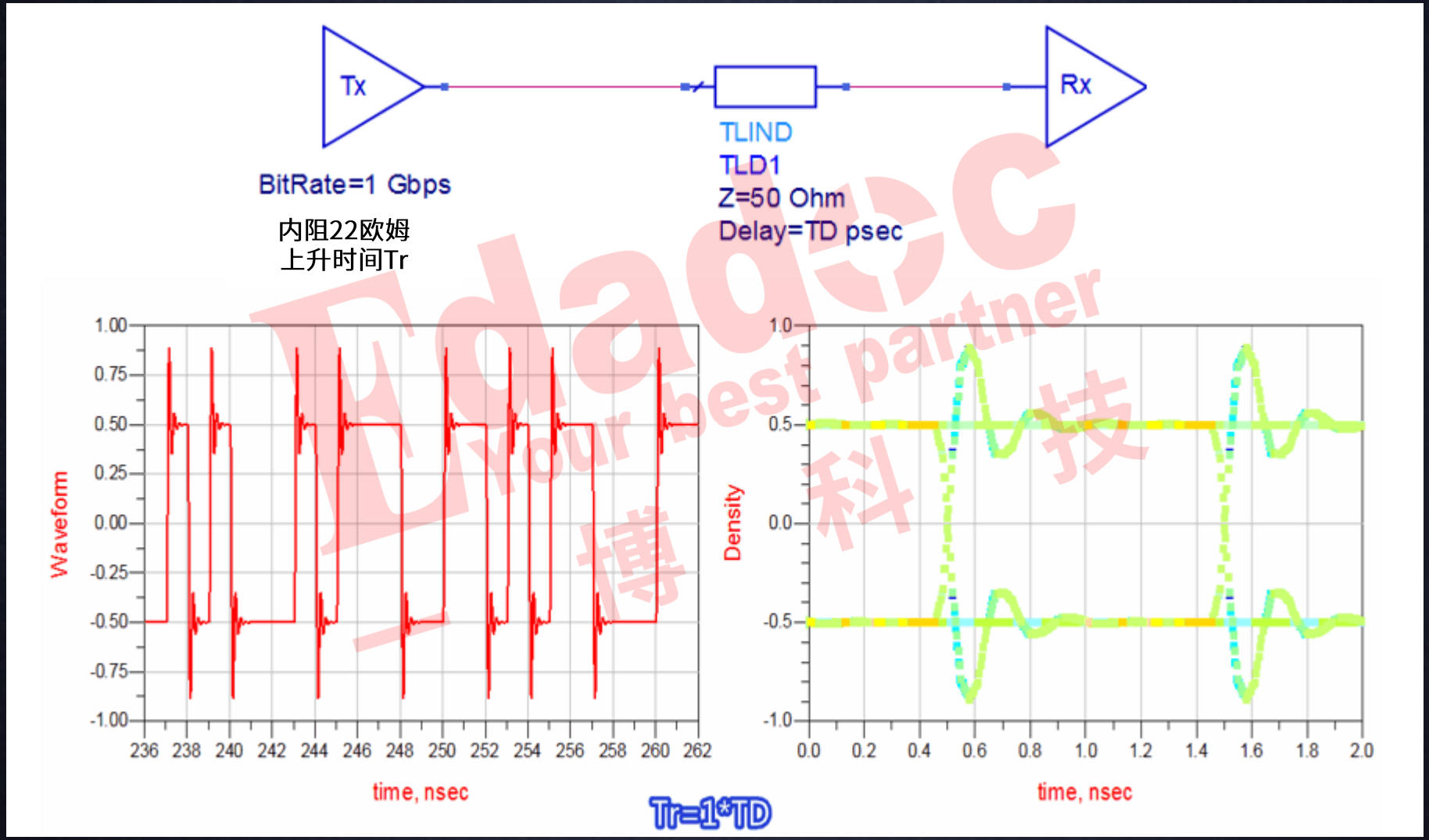


为什么信号会反射

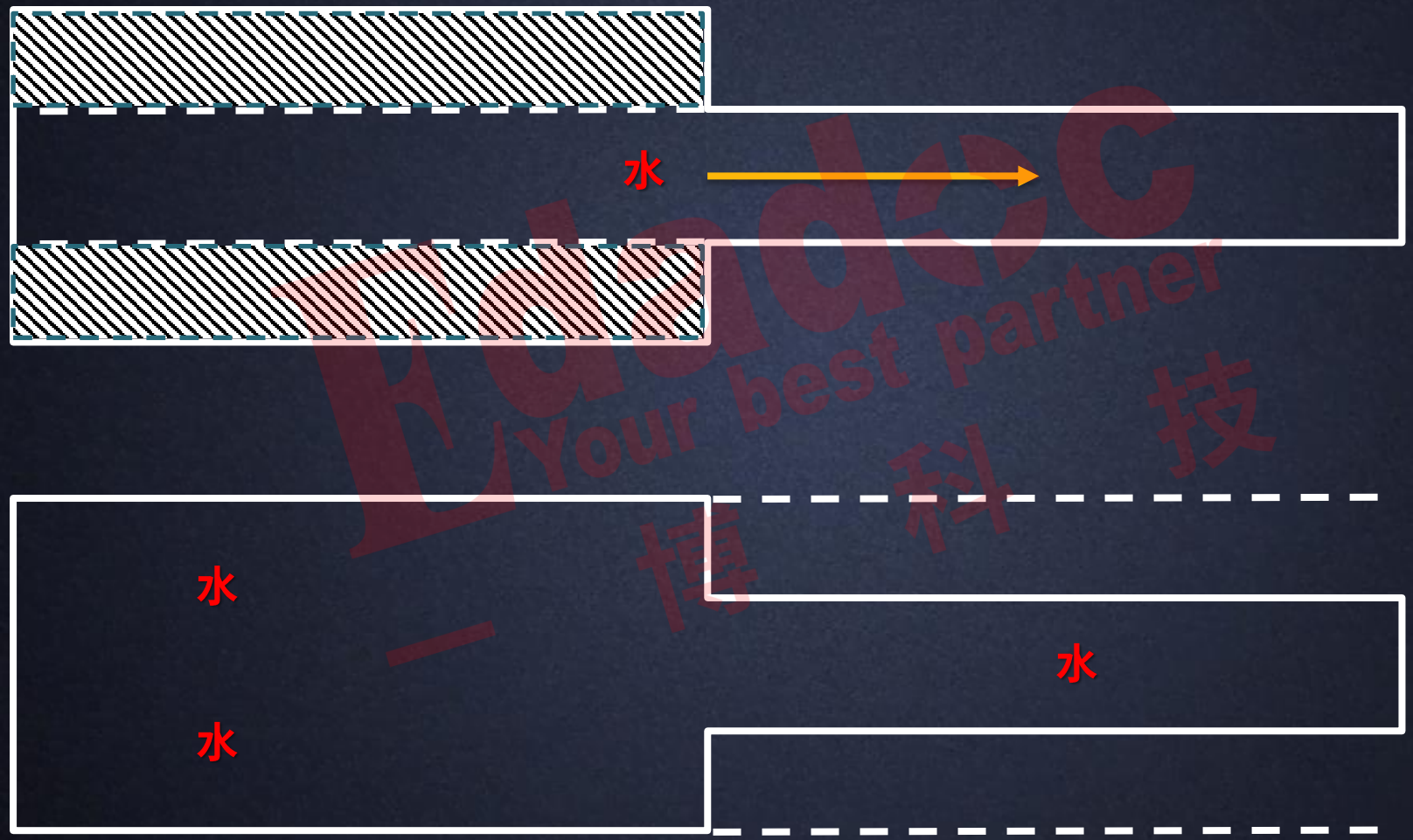




一个信号反射的案例

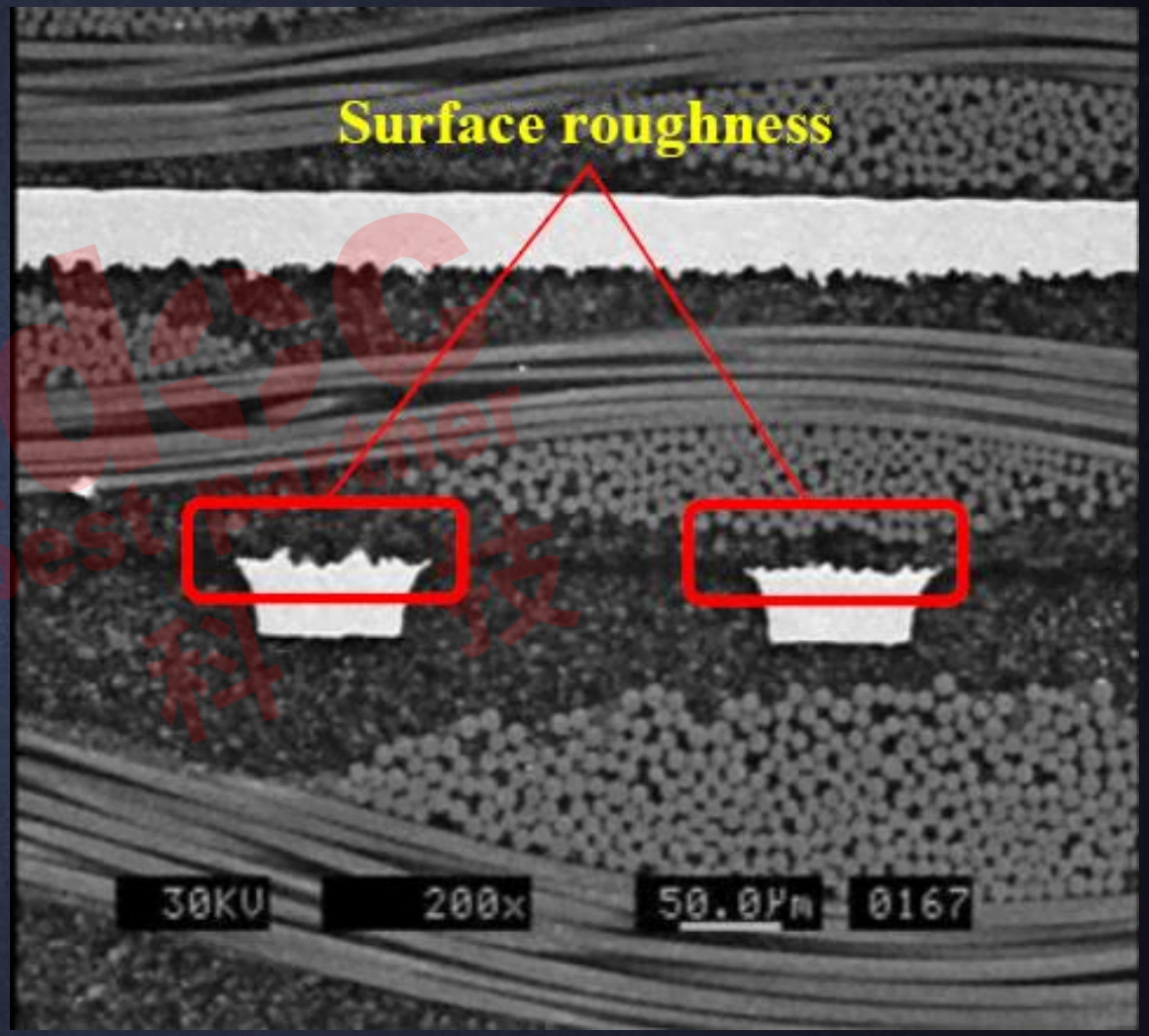


信号反射了我们怎么办

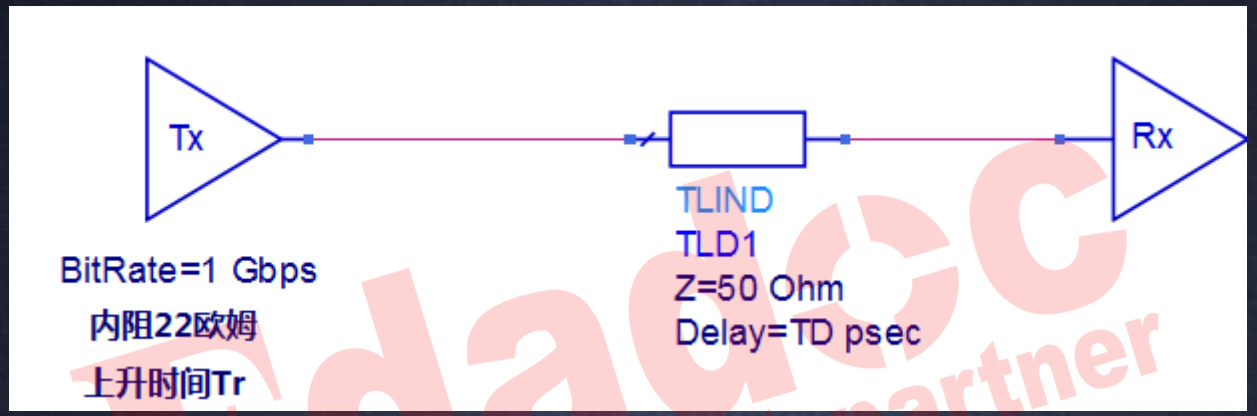


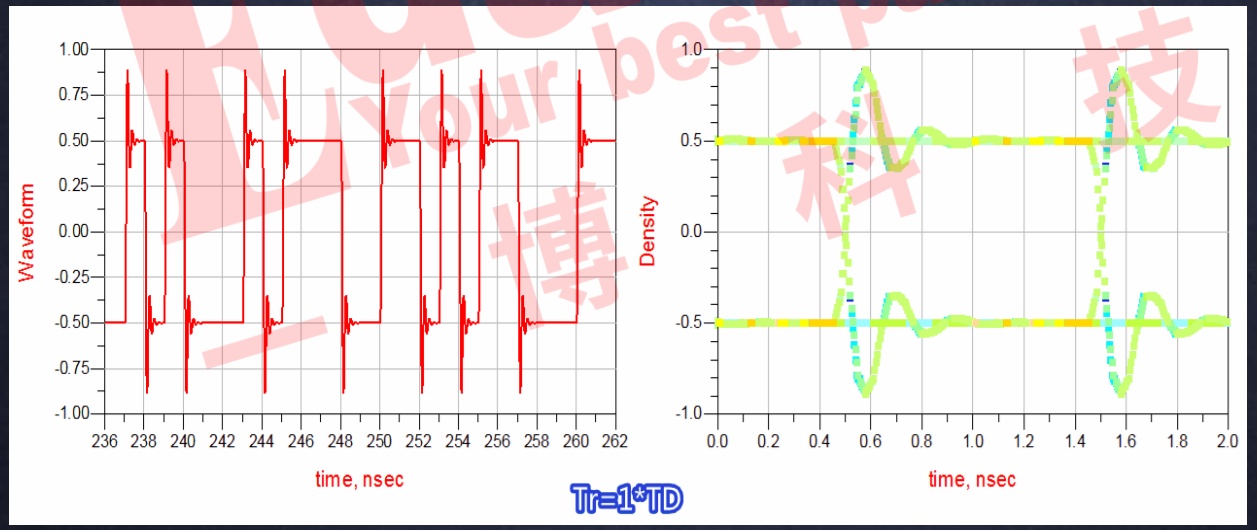
设计阻抗真的都能一致吗?

- 不同层阻抗不一致，换层布线
- 过孔产生的垂直方向阻抗不一致
- BGA出线区域
- 走线跨分割
- 表贴焊盘带来的阻抗不连续
- 参考平面不连续（反焊盘等）
- 玻纤布及加工因素
- 其他



反射是固定的吗？ - 上升时间

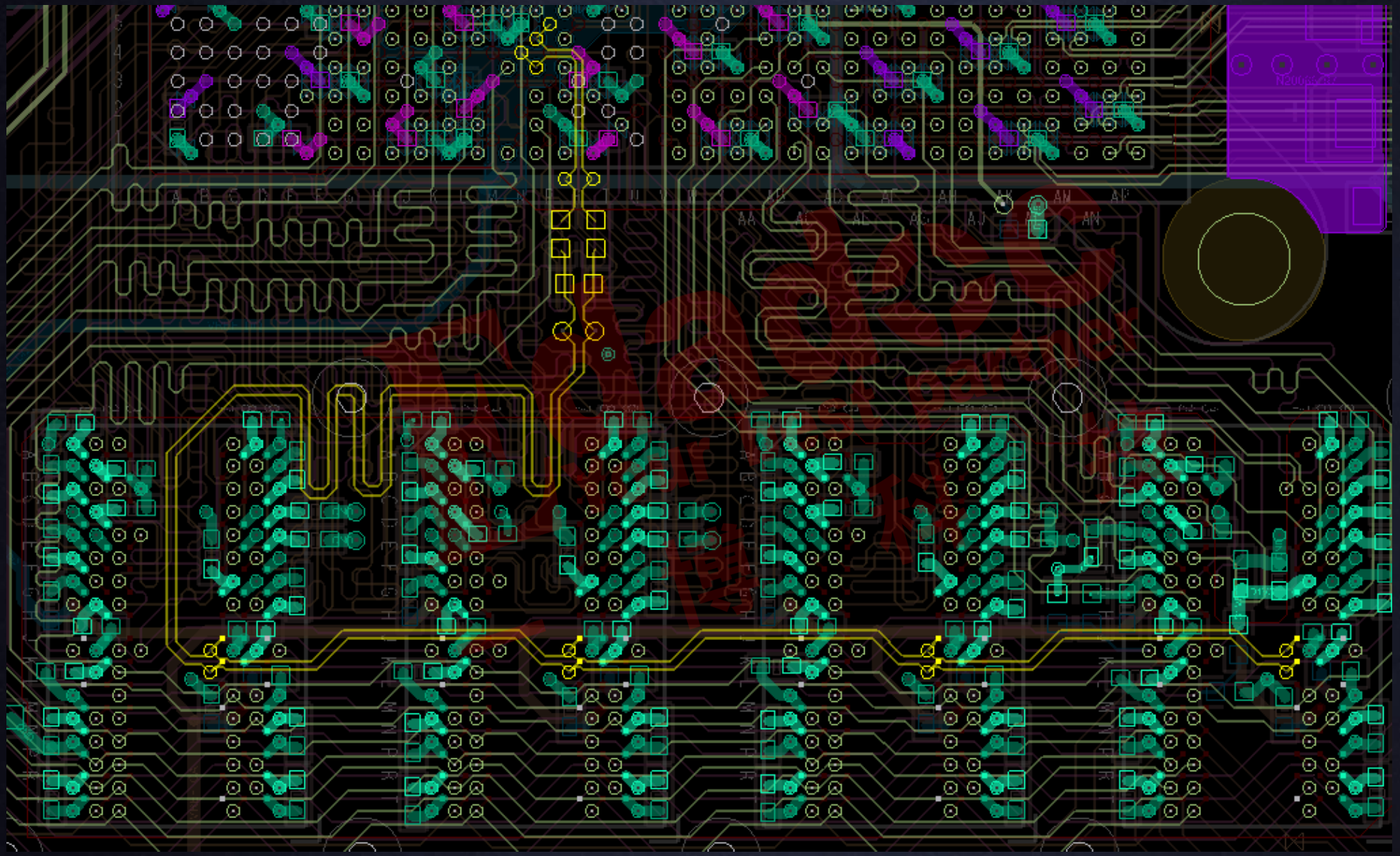




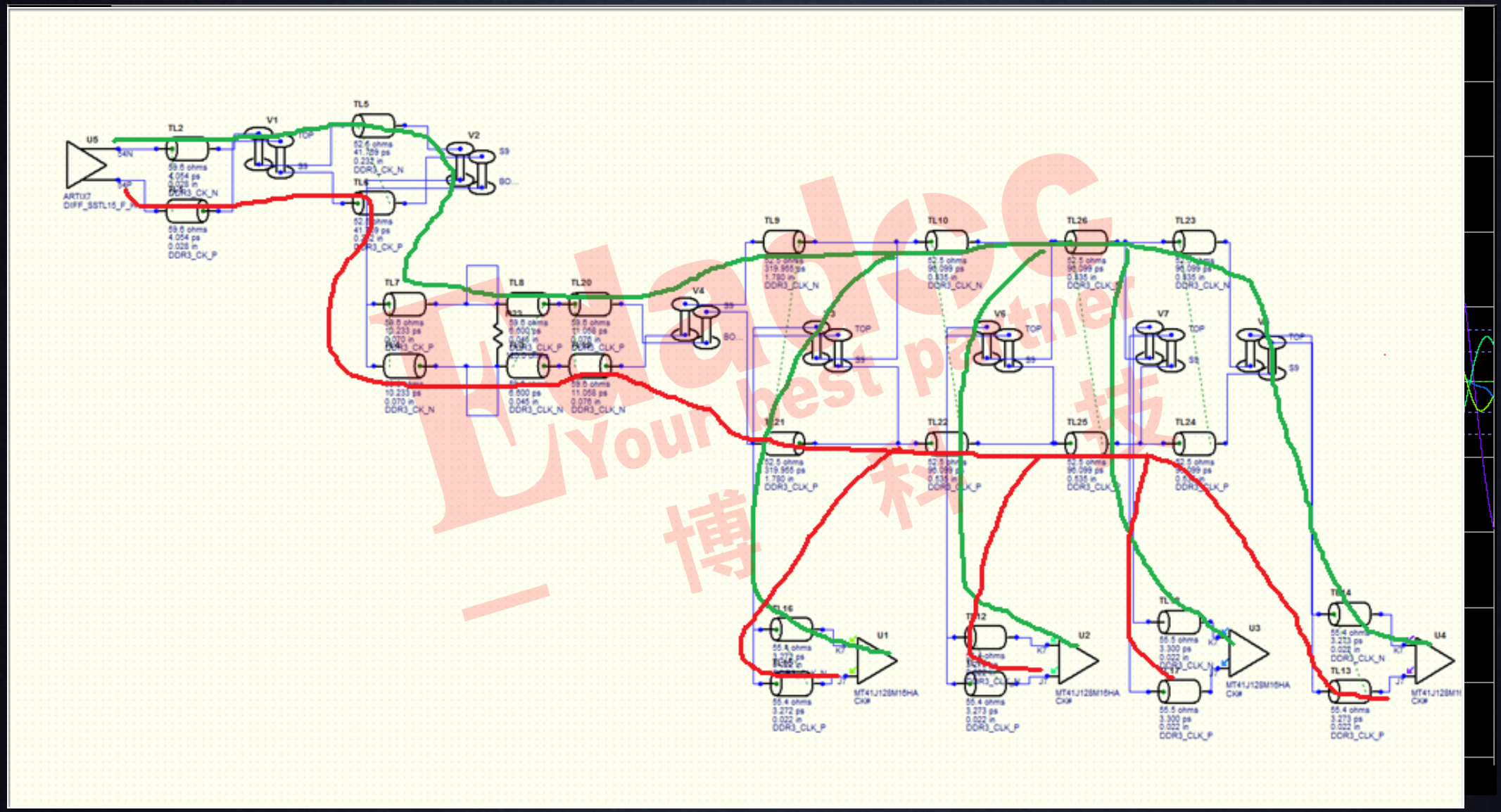
3

对的时间，做对的事情 – 案例

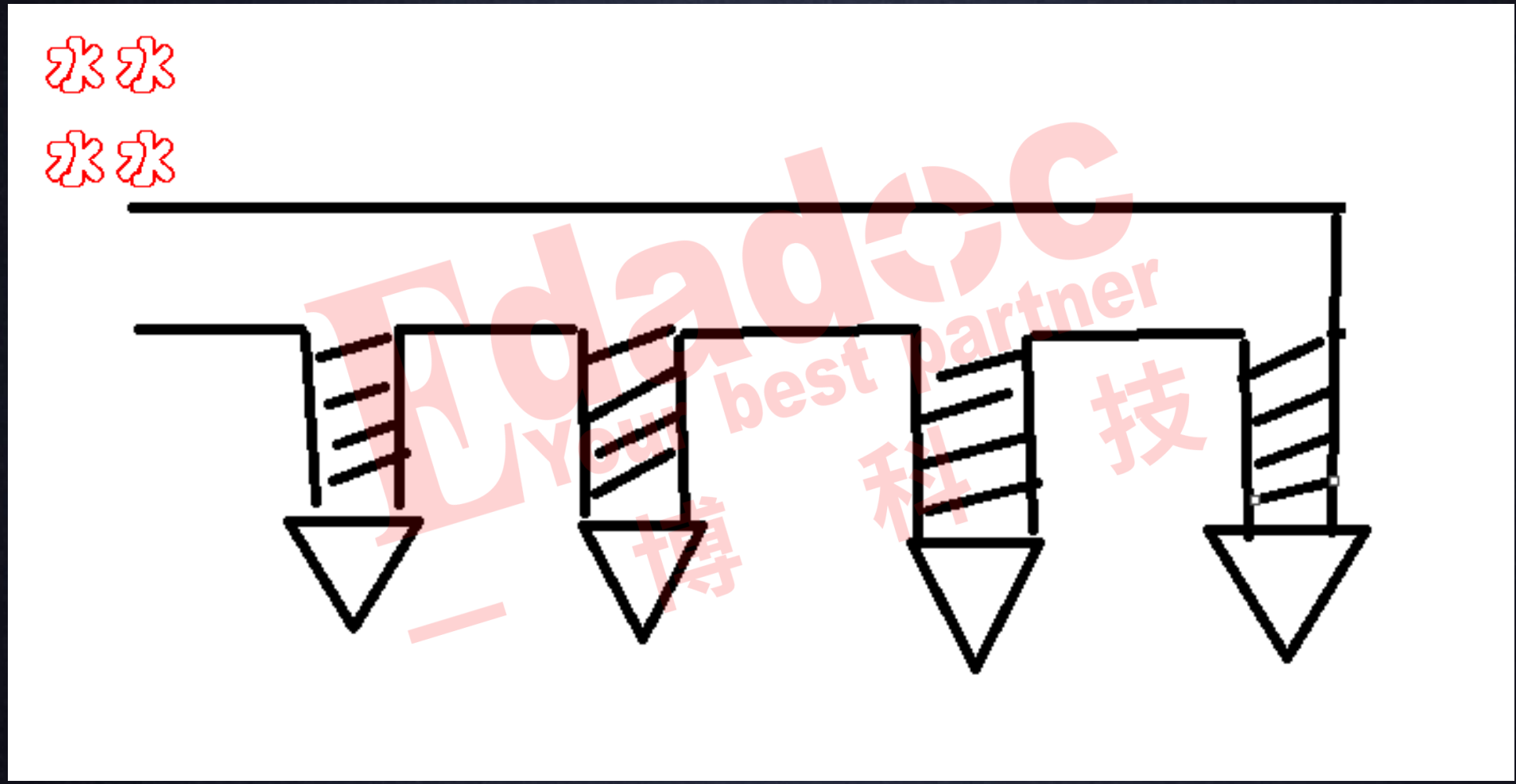
这个DDR时钟，做的怎么样?



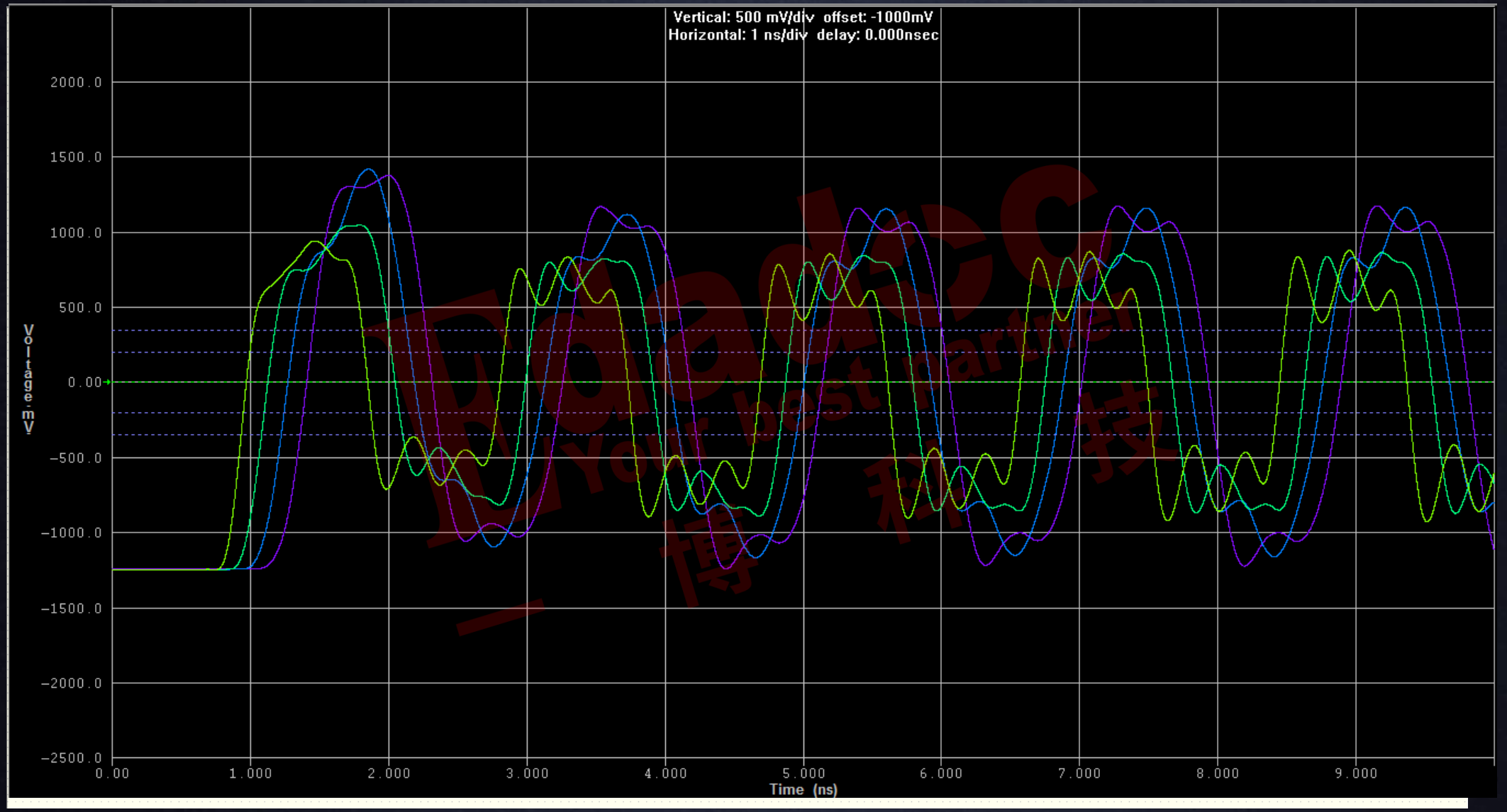
刚刚的时钟信号波形



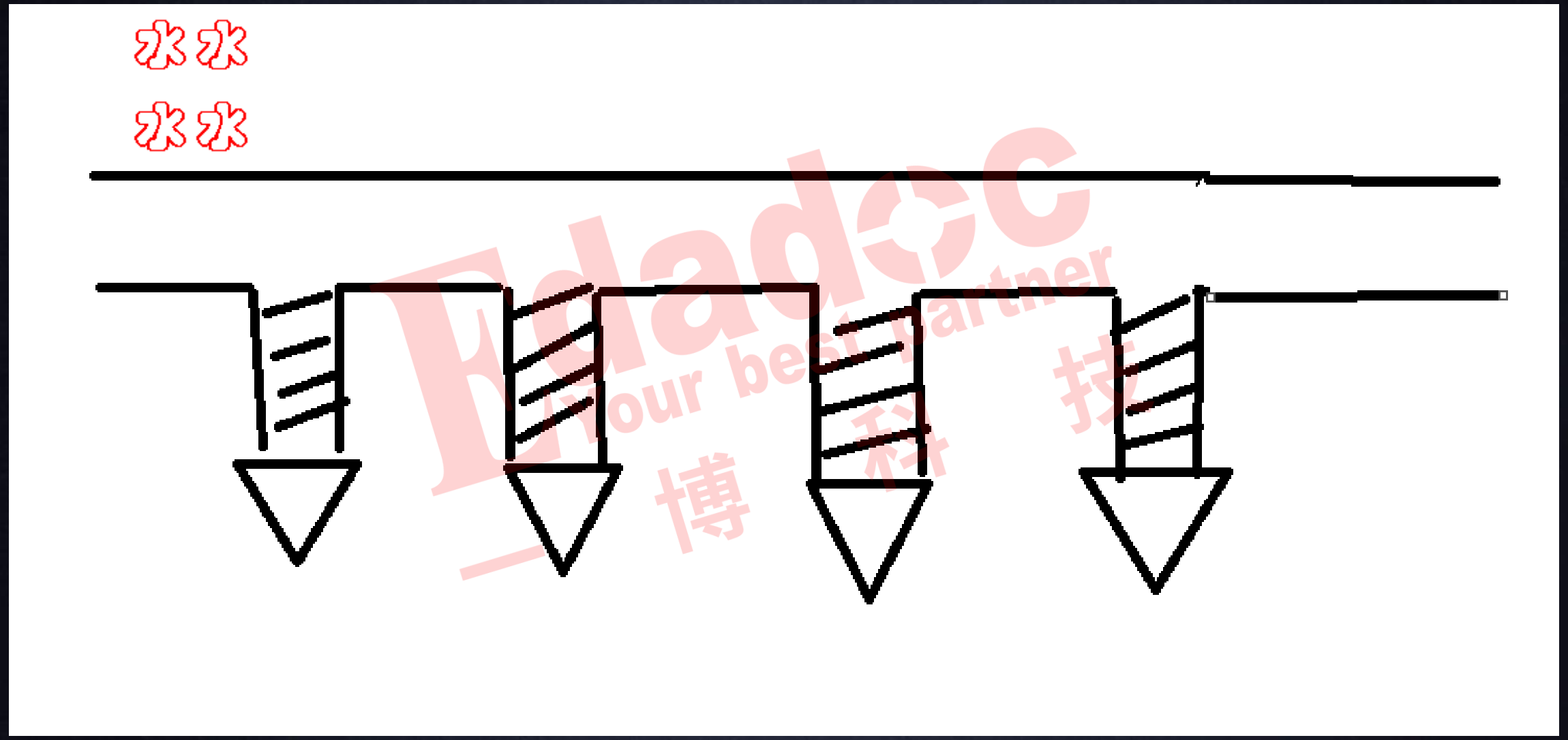
刚刚的时钟信号波形



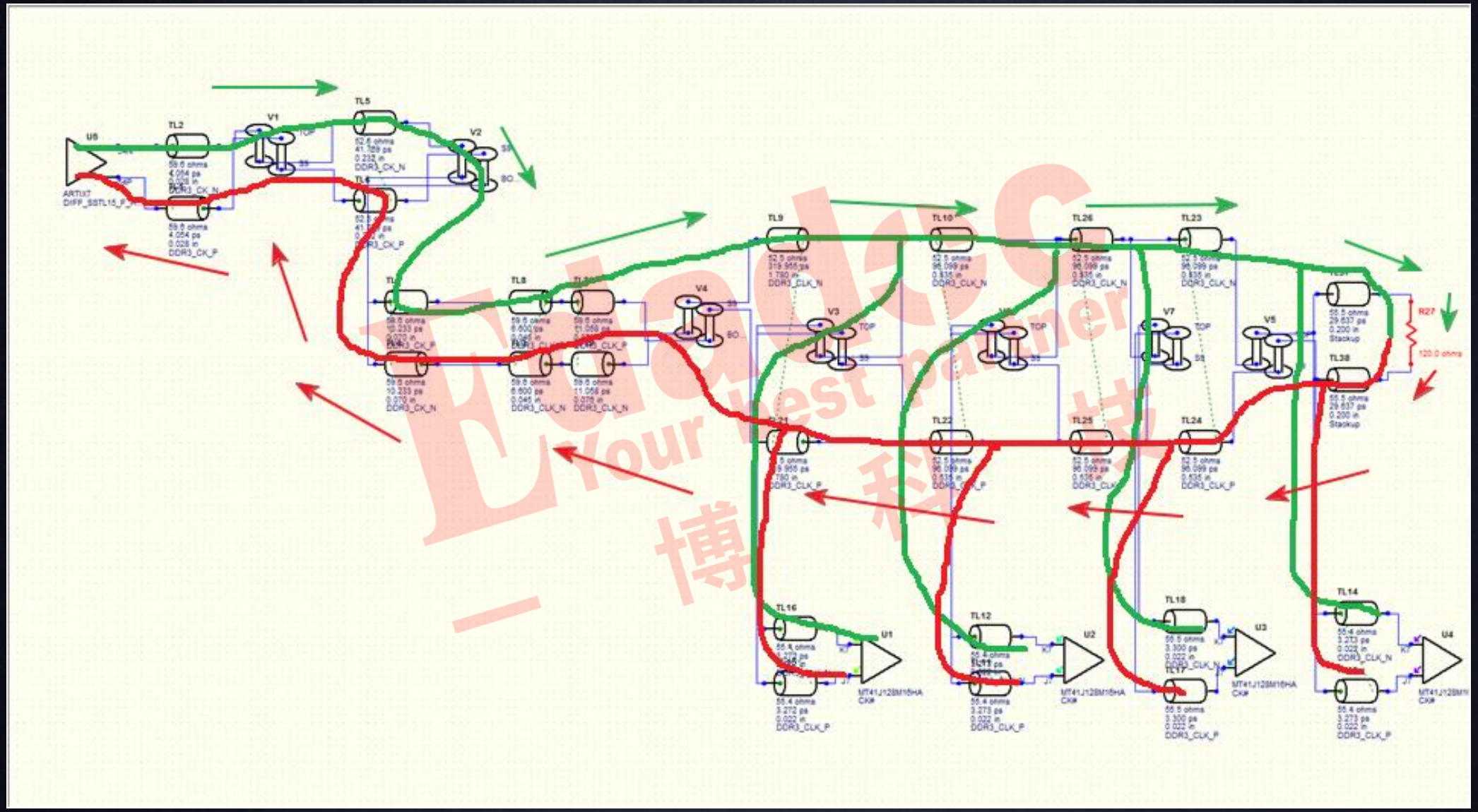
解决方案一


Vertical: 500 mV/div offset: -1000mV
Horizontal: 1 ns/div delay: 0.000nsec
2000.0
1500.0
1000.0
500.0
0.00
-500.0
-1000.0
-1500.0
-2000.0
-2500.0
Voltage-mV
0.00
1.000
2.000
3.000
4.000
5.000
6.000
7.000
8.000
9.000
Time (ns)

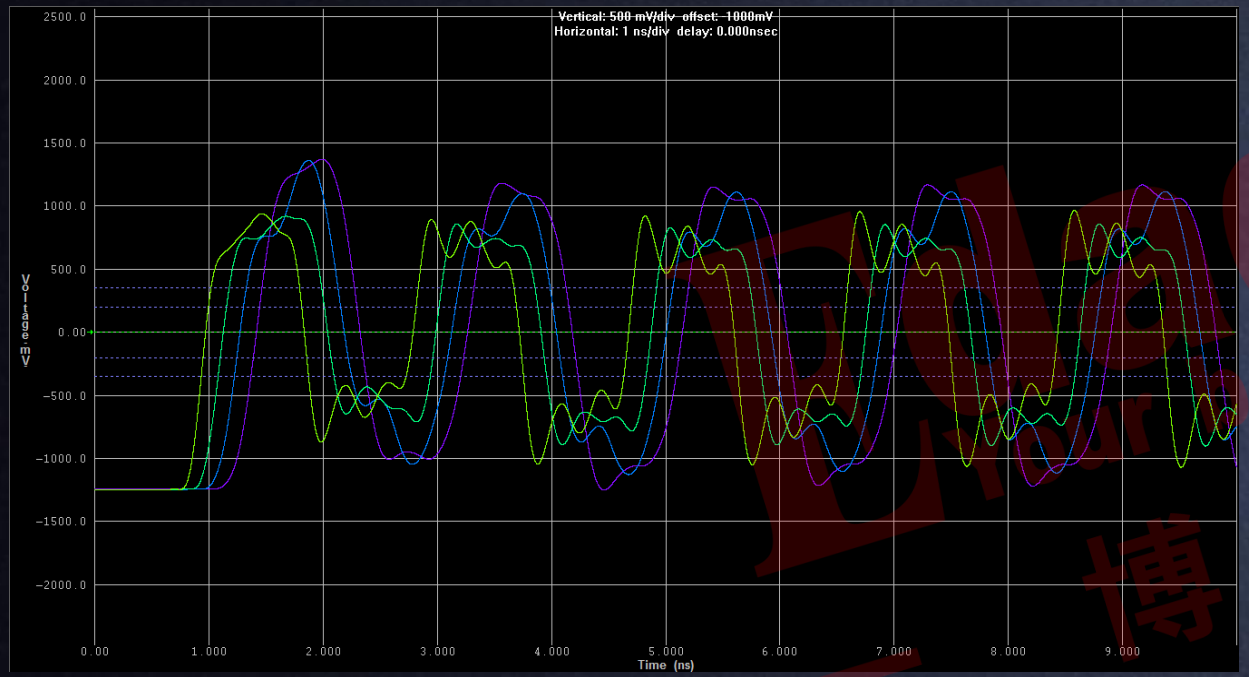
解决方案一

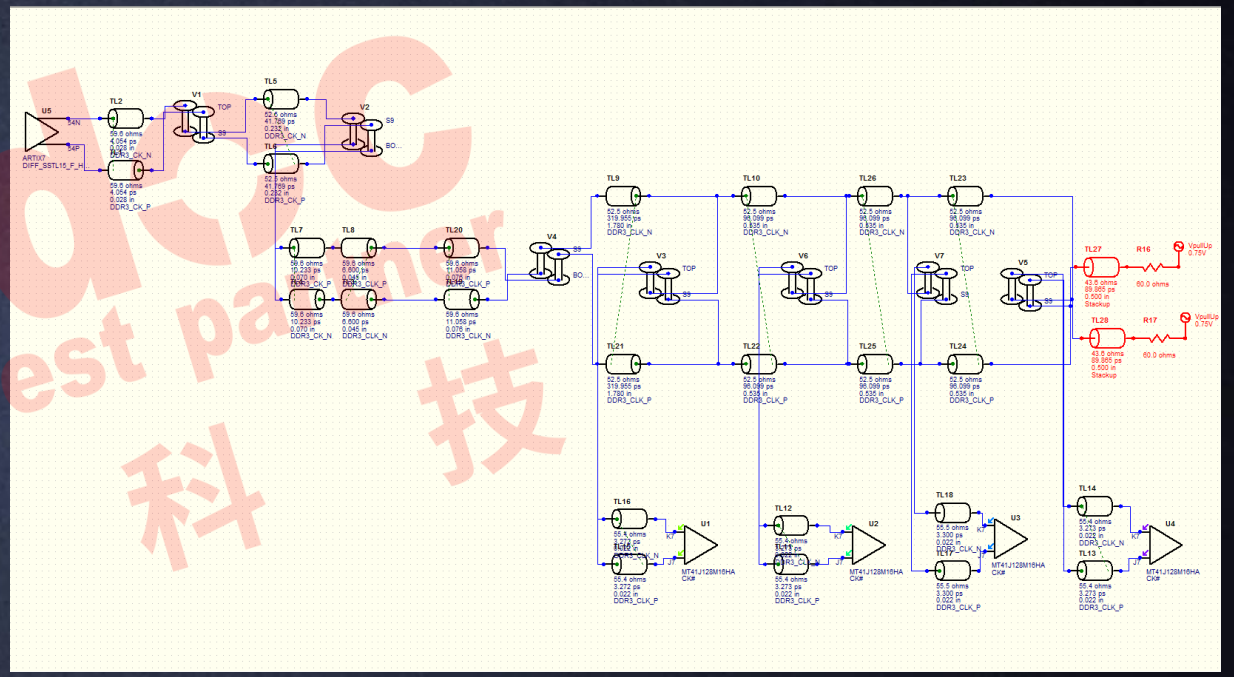


解决方案一

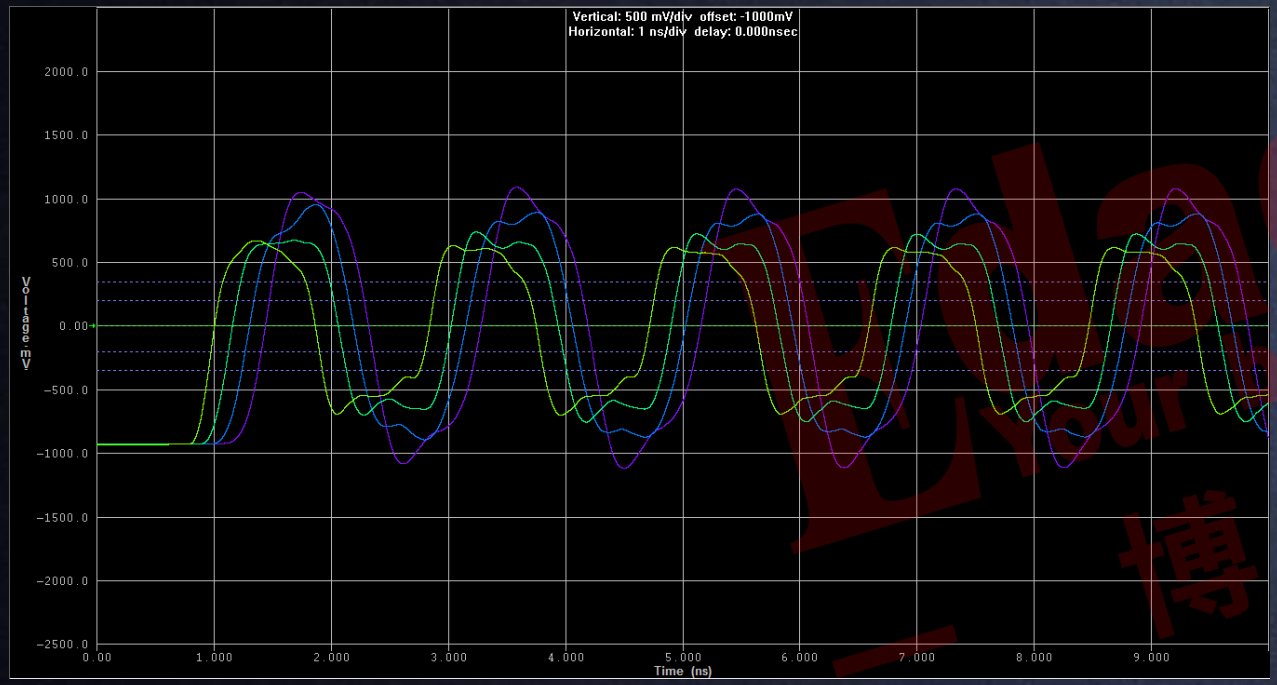


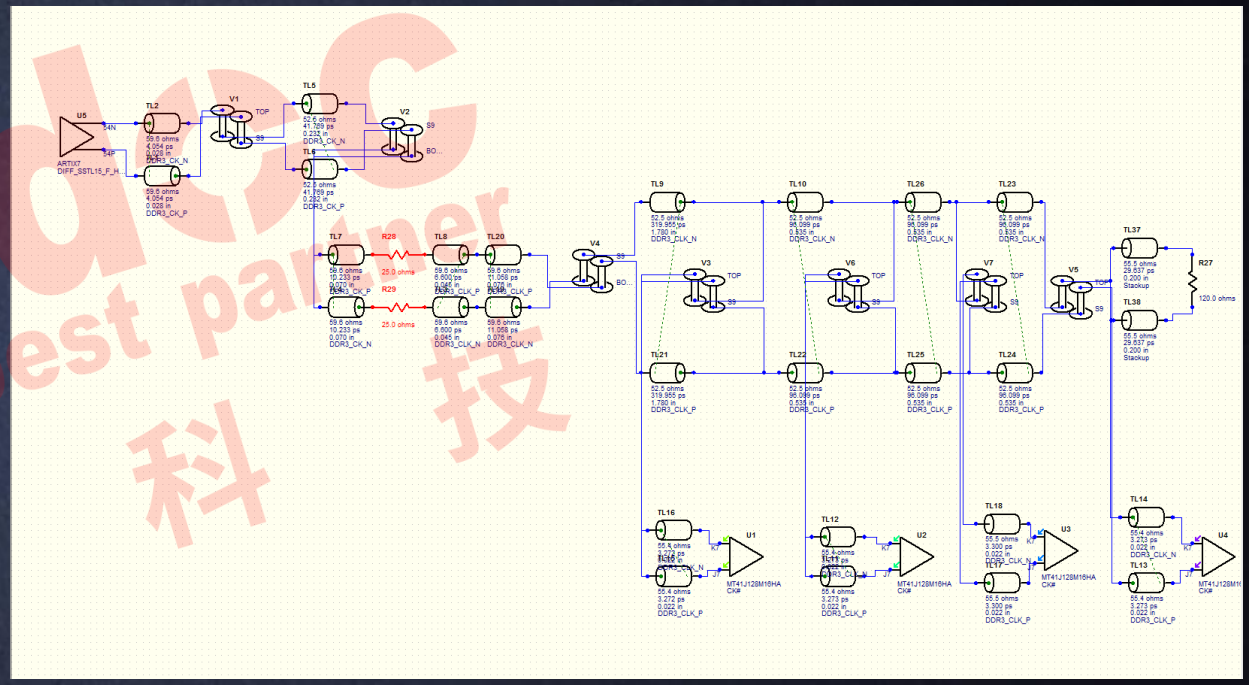
解决方案一 （类似）



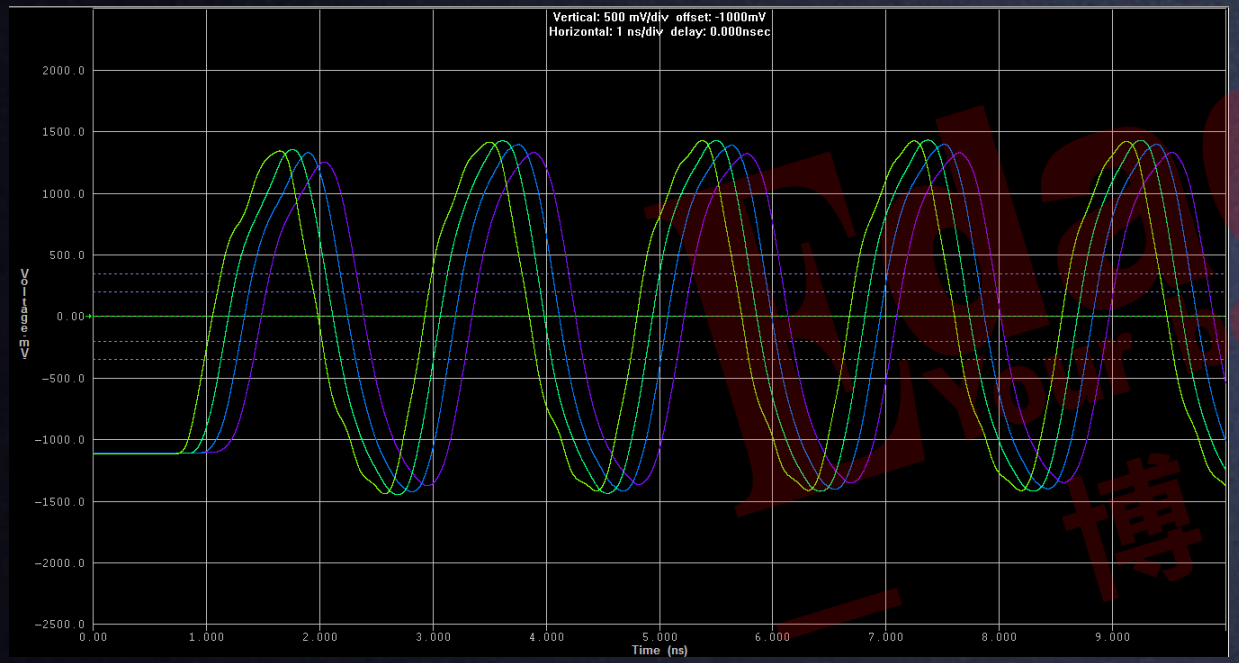


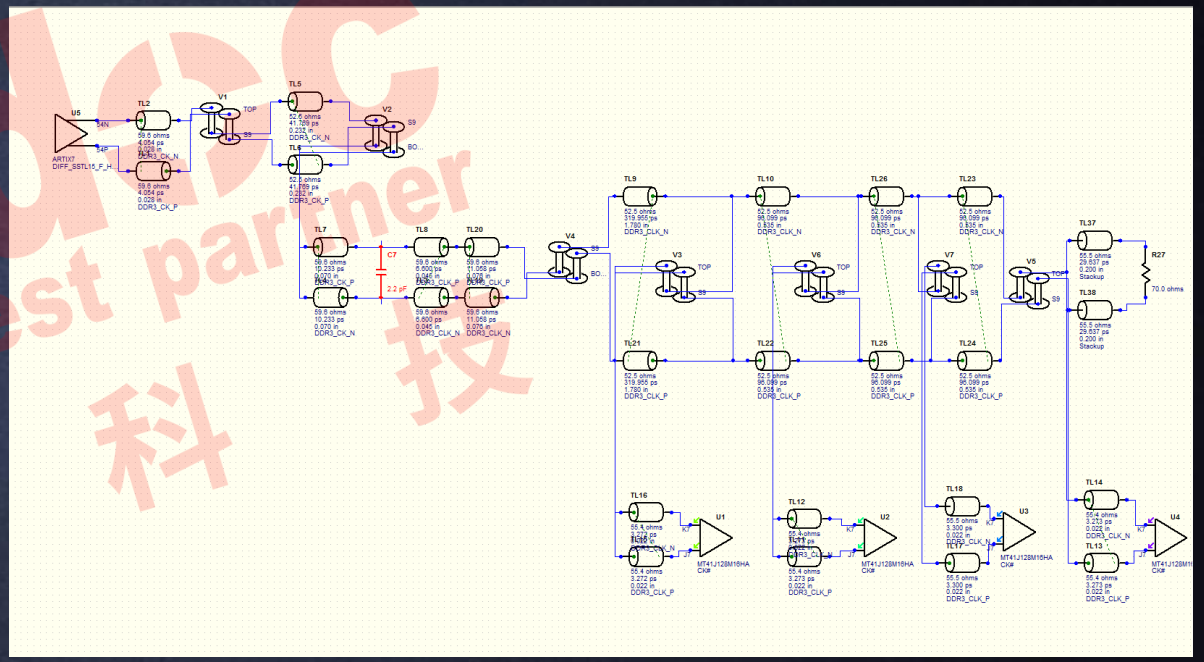
解决方案 二



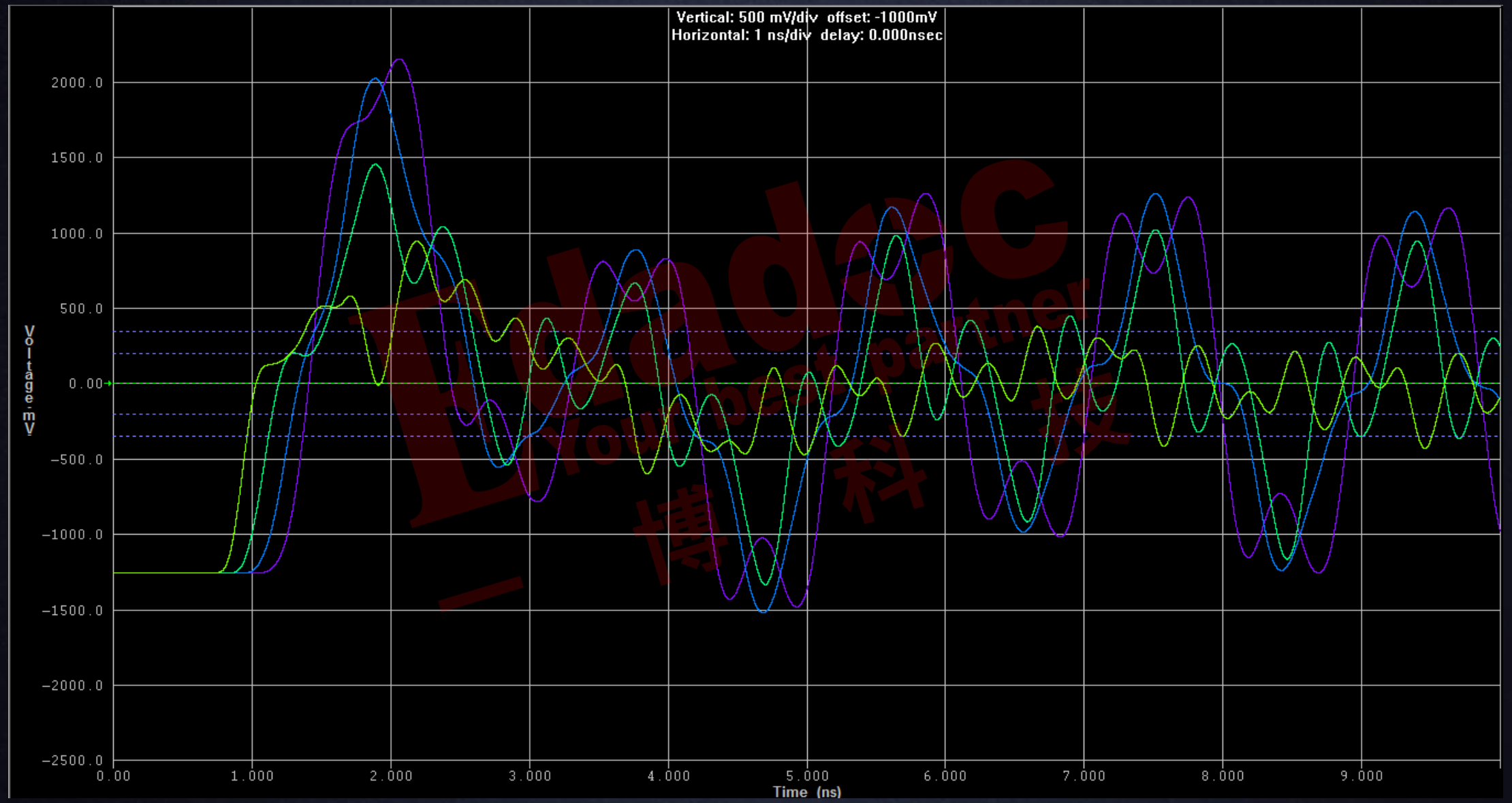


解决方案 三





再看看开始的时钟信号波形



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