Case Study:
Using IBIS Buffer Models for Pre-emphasis

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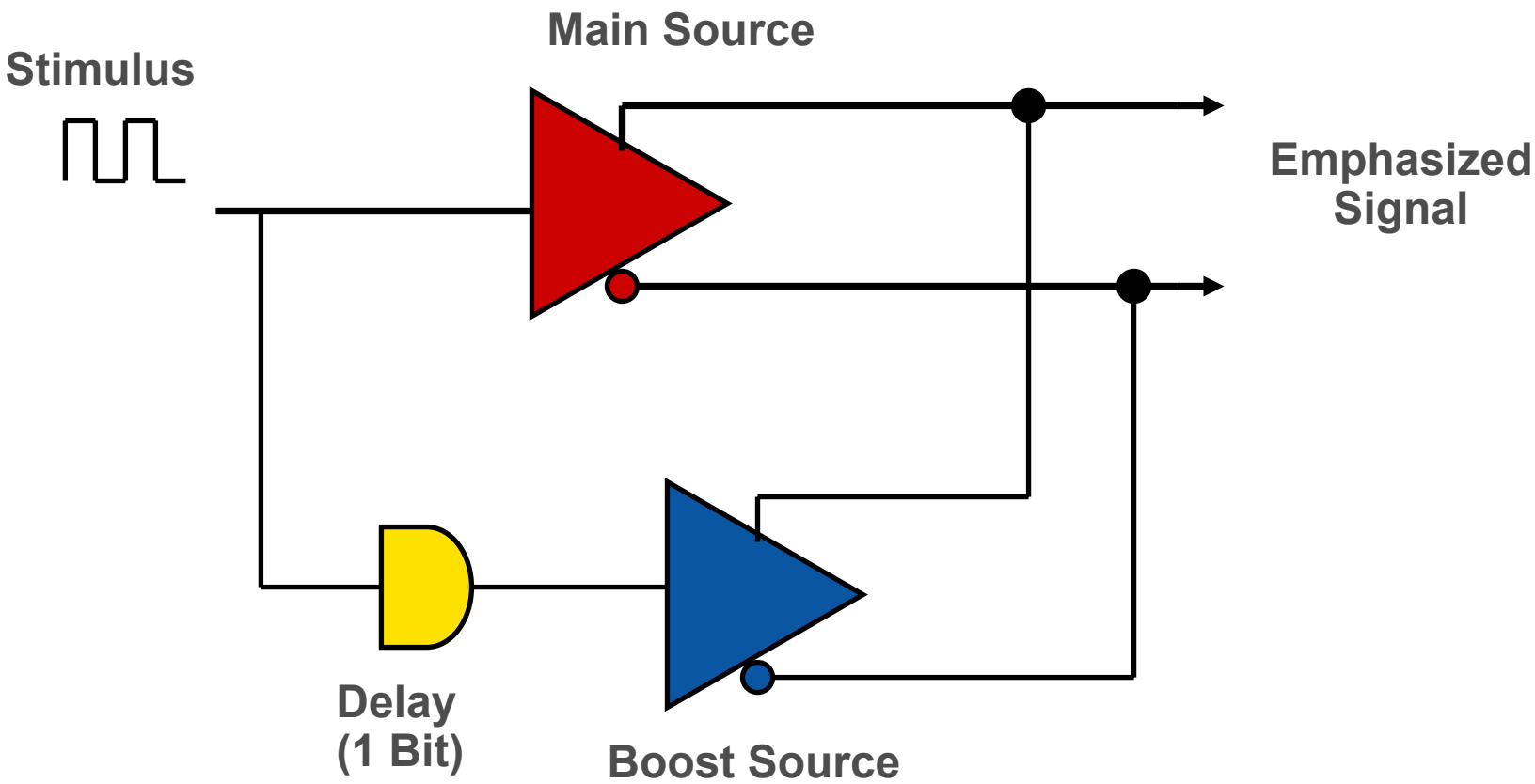
Pre-emphasis Application

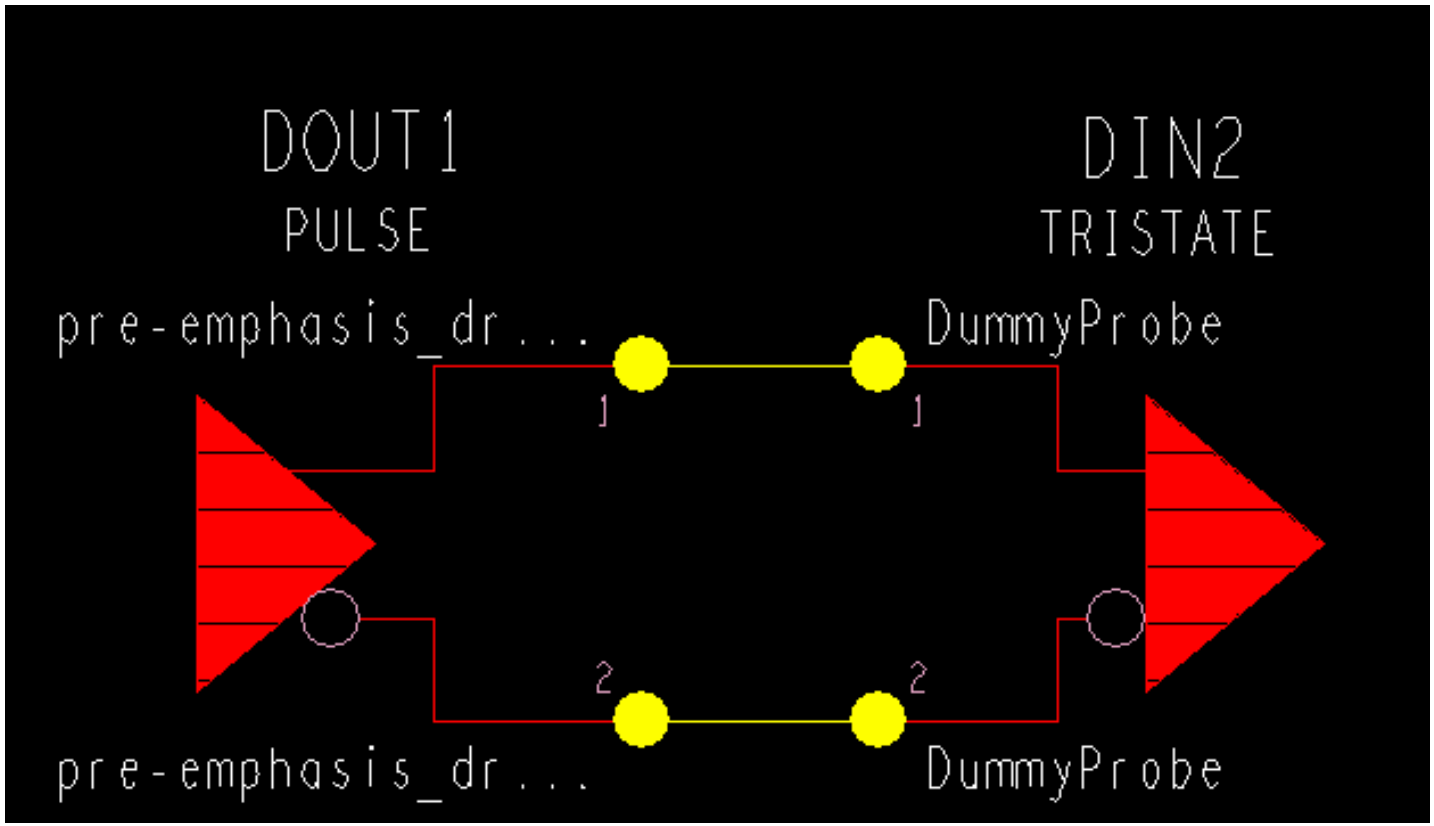


IBIS Buffer Models for Pre-emphasis

- Extract Buffer Data for Main Source
- Extract Buffer Data for Boost Source
  - From common applications, they could be scaled from Main Sources
- Stimulus Delay for Boost Source

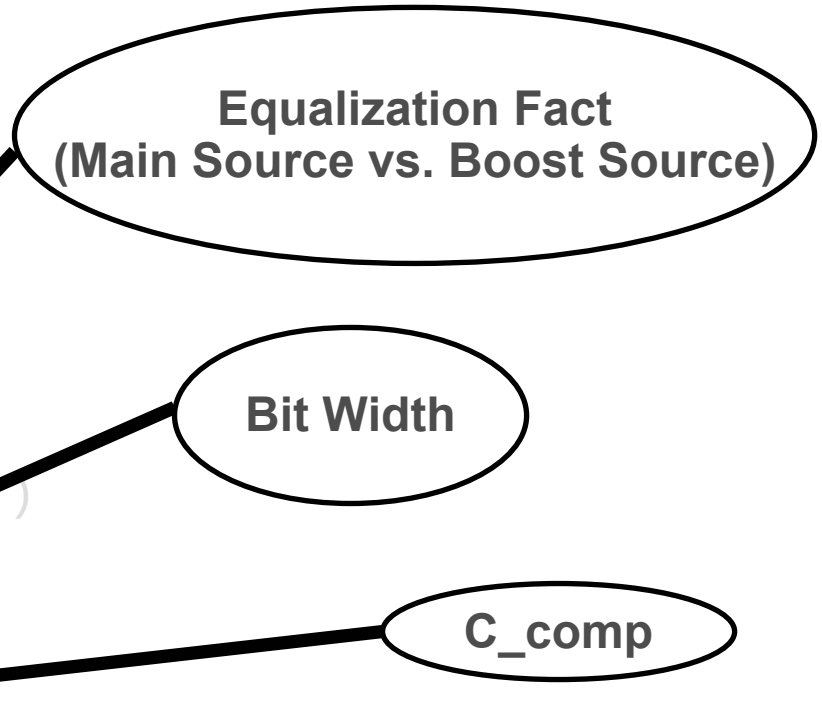
It works

- An example



It works
(Parameter Setting)

```
("pre-emphasis_driver"
 (MacroModel
  (MacroType TDiffIO )
  (NumberOfTerminals 8 )
  (Parameters
   (Buffers
    (BUFF pre_emph_dB_drvr ) )
   (MinTypMaxParams
    (eqdb -3.5 )
    (bitp 400p )
    (padcap 0.3p) ) )
  (SubCircuits "
```



It works
(Boost Source Scaling)

```
.param eqf='1.0 - (10.0 ^ (eqdb/20.0))'
.param cf1='cf0 * eqf'
```

Scale conversion

```
xtx0 nvdd out ngnd in0 en tx scale='cf0'
xtx1 nvdd out ngnd in1 en tx scale='cf1'
```

Circuit calls with Scaling fact

```
.subckt tx nvdd out ngnd in en scale=1
bdrvr nvdd out ngnd in en Model=BUFF File=ibis_file c_compX=0
+ VIScale_pulldown='scale'  ……
.ends tx
```

Bdrvr element

You can use other Spice Syntax to produce the same functionality

It works
(Stimulus Delay)

```
xin0 in0 in ngnd delayin inv=inv0
xin1 in1 in ngnd delayin inv=inv1 del='bitp'
```

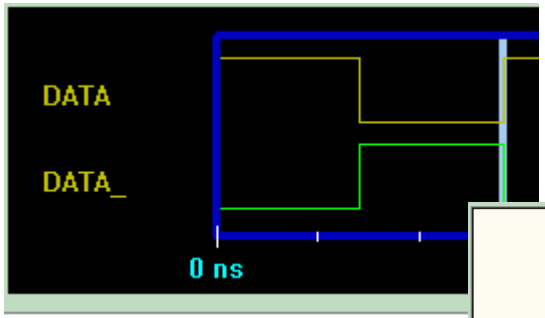
Stimulus Delay On Boost Source

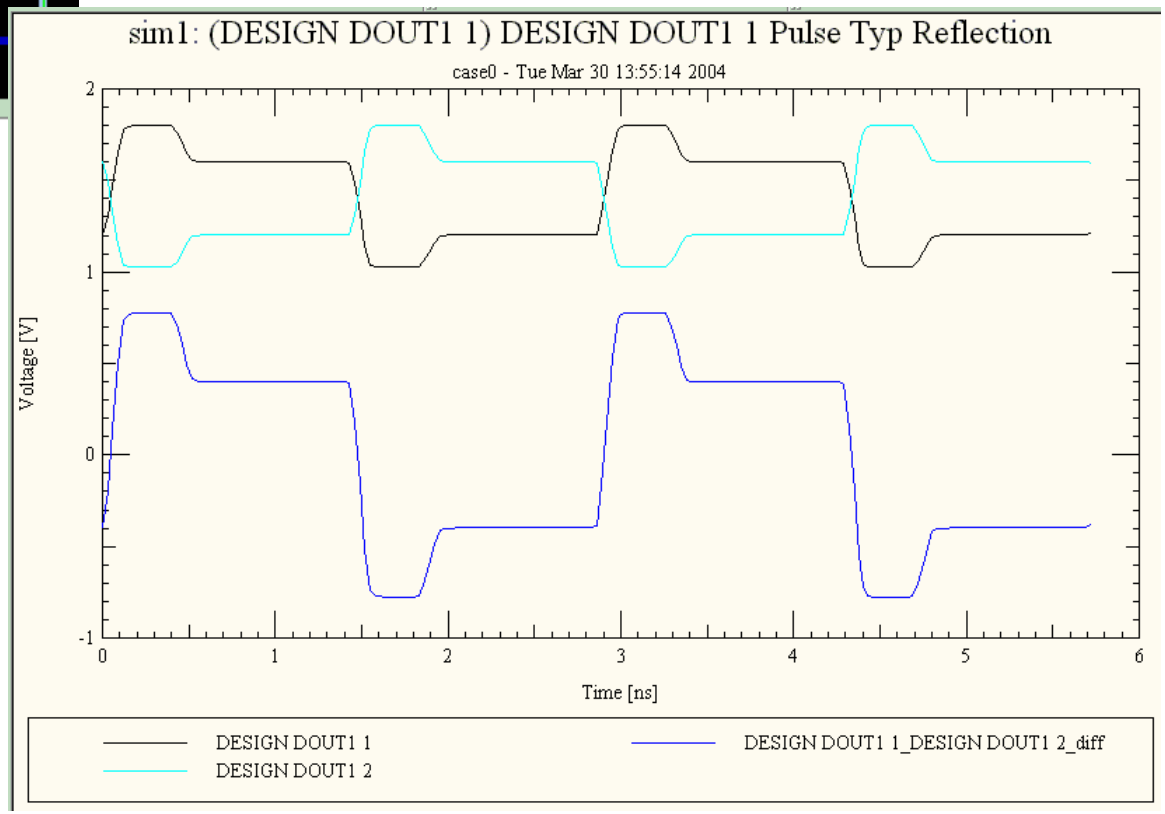
```
.subckt delayin in1 in ngnd inv=0 del=0
einp in2 ngnd v='inv * (1 - v(in,ngnd)) + (1-inv) * v(in,ngnd)'
ein1 in1 ngnd pwl in2 ngnd delay=del
datapoints vv
0 0
1 1
end vv
.ends delayin
```

Stimulus Delay circuit

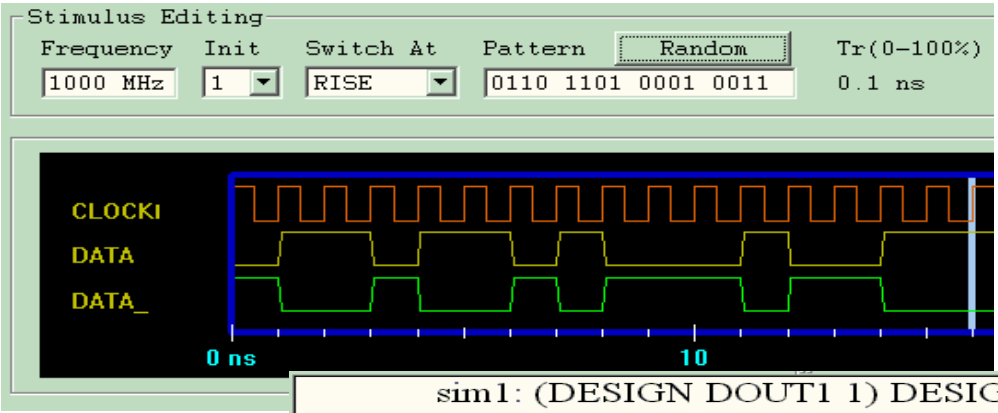
You can use other Spice Syntax to produce the same functionality

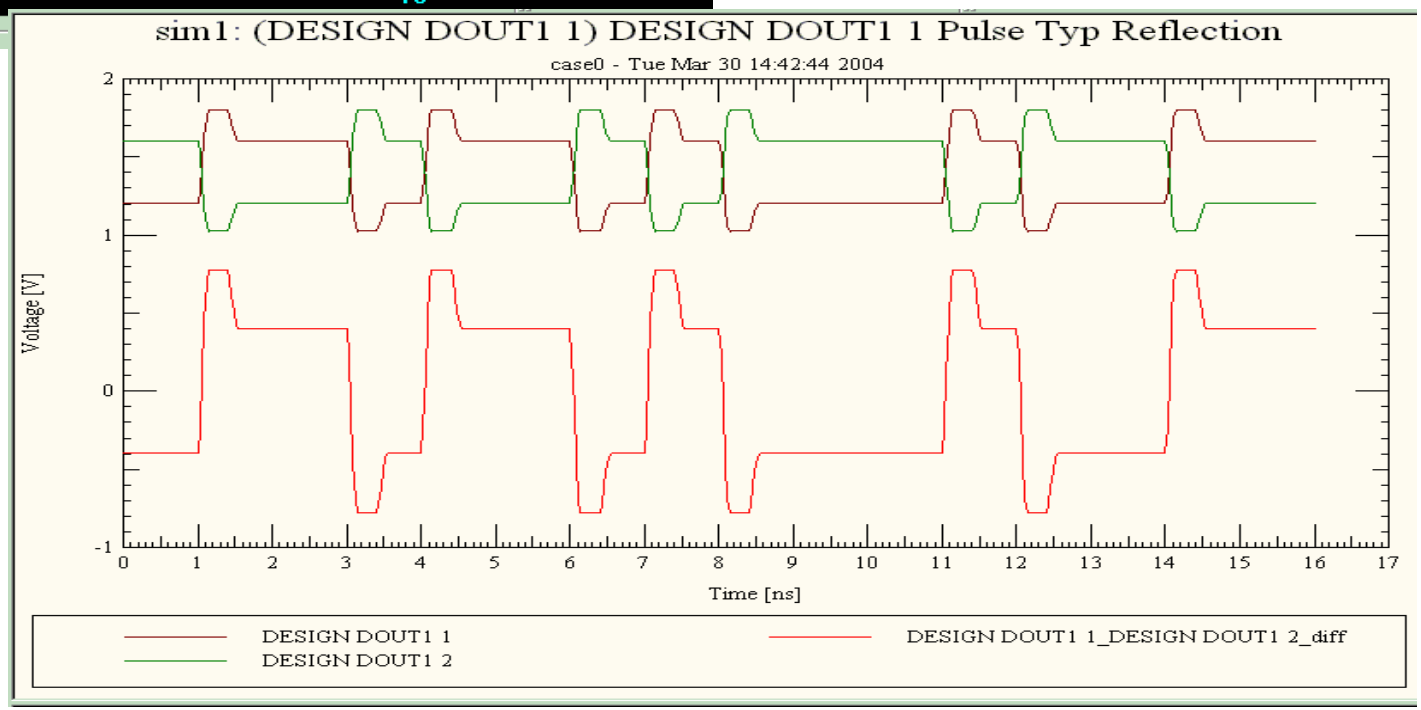
It works
(Results)





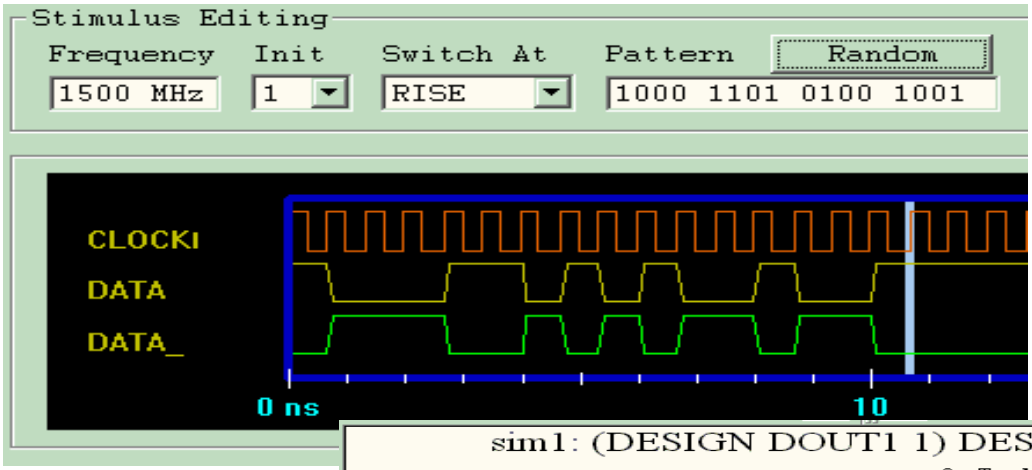
It works
(Results)

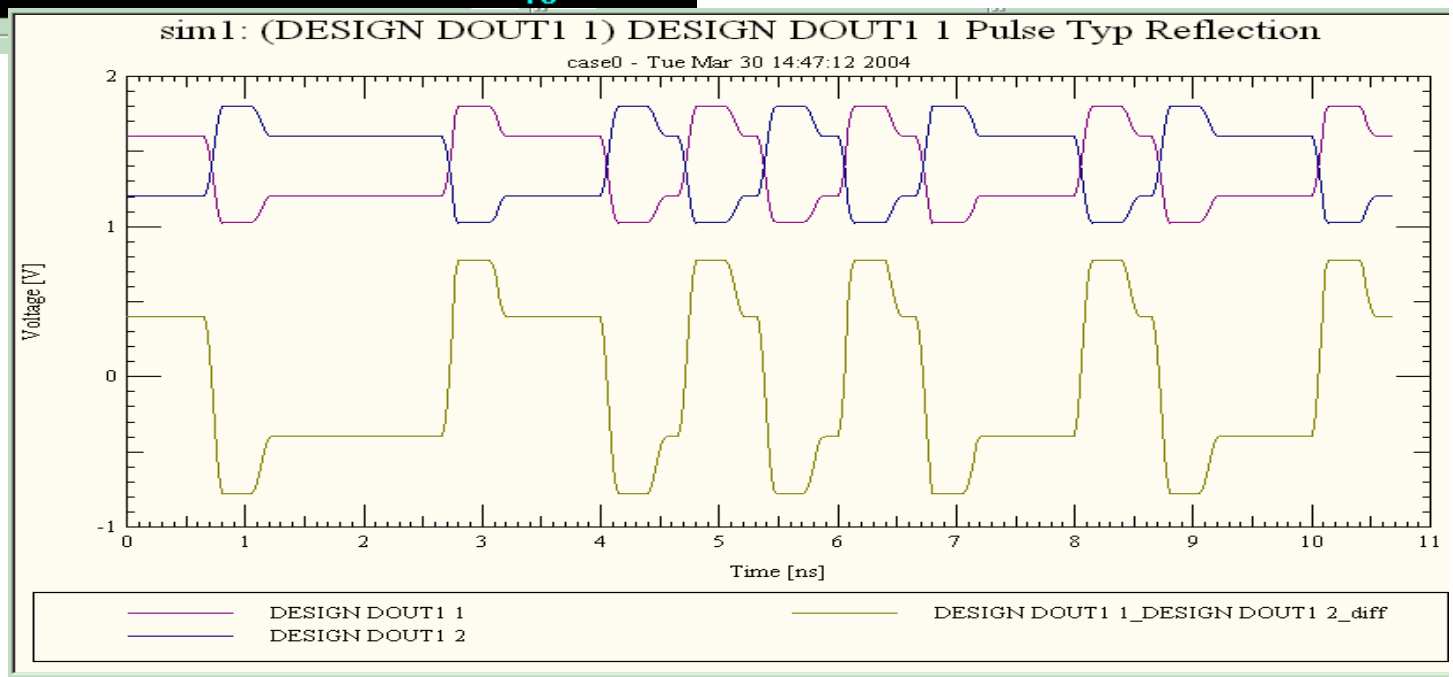




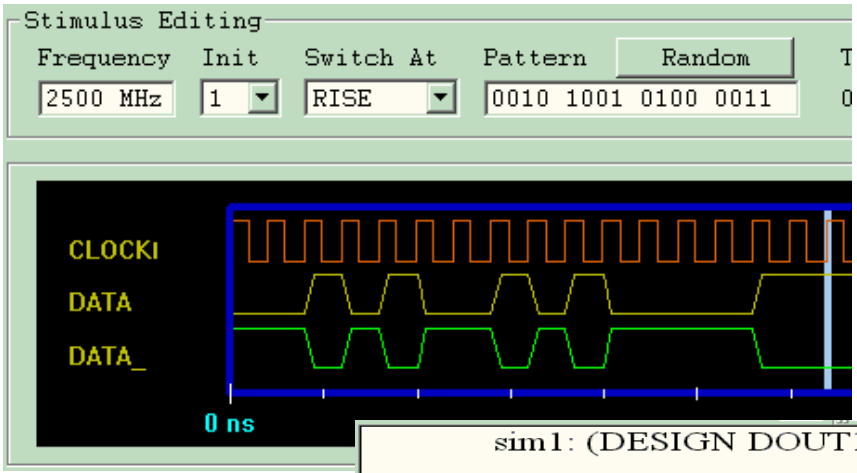
It works

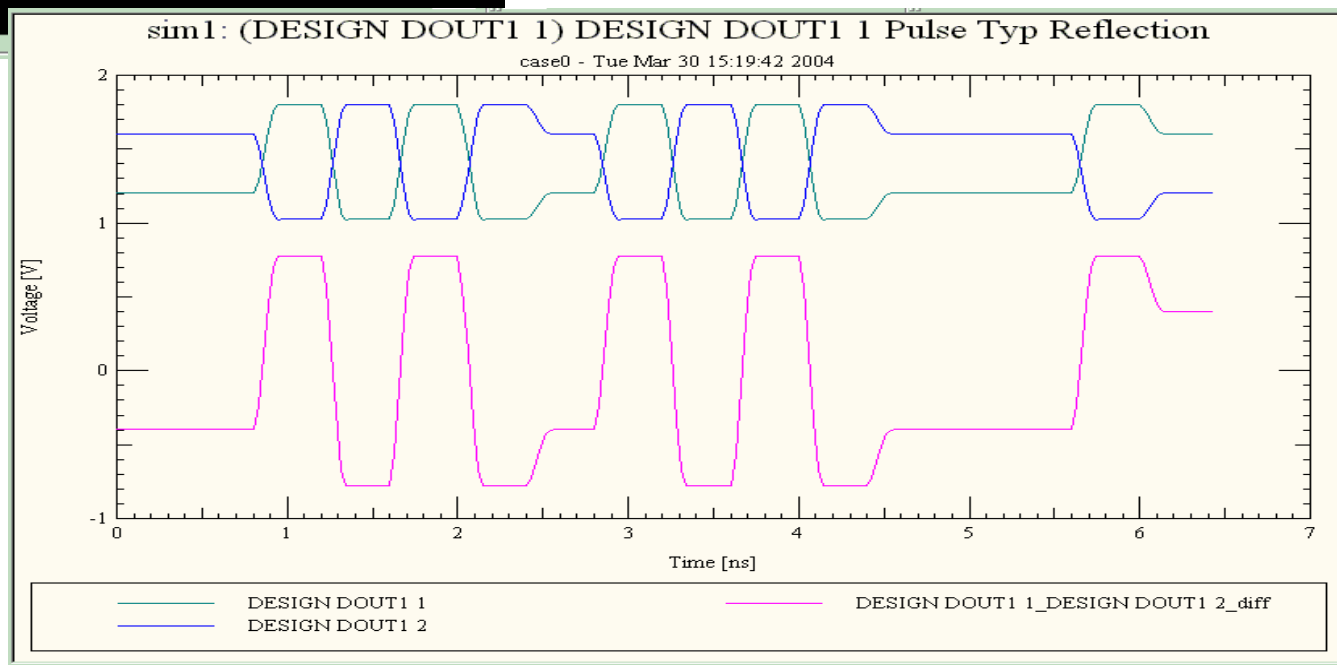
(Results)





It works
(Results)





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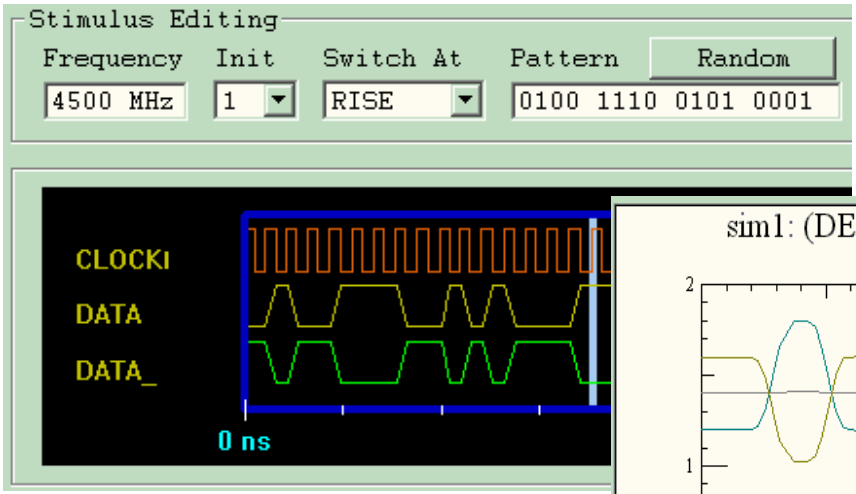

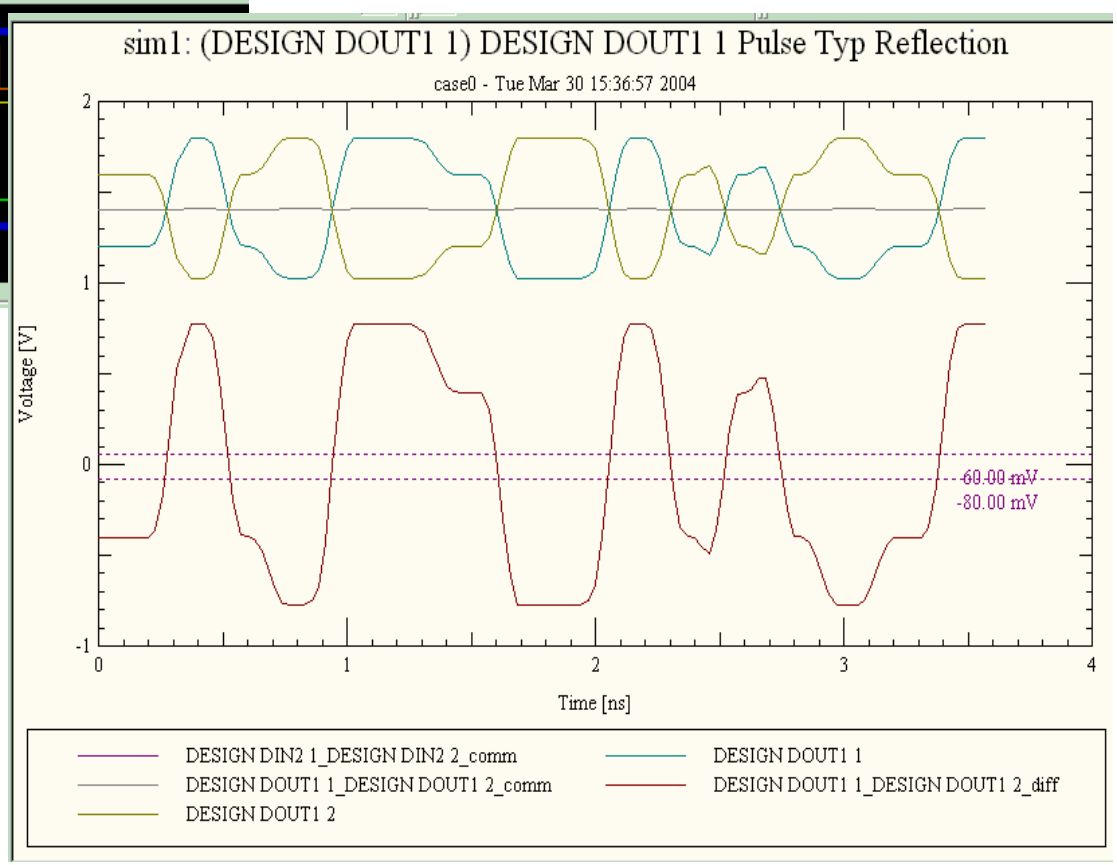

Conclusions

- Keys for IBIS Implementation
  - Boost Source Data Extraction
    - Main Source Scaling
    - C-comp and Internal Terminations
  - Stimulus Delay (1 bit for Pre-emphasis)
- More Complicated DSP Applications are coming

What IBIS could do (Discussion)

- Support Scalable Current Sources
  - Add “Scale Fact” into [Pin] section
  - Or, Introduce “Scaled” [Model] Refer to the Main Source
- Support Multiple Stimulus Inputs with Delays
  - Add “Stimulus Delay” into [Model] section
  - Or, Introduce new [Signal] keyword for Signal Grouping with Stimulus Delays, Signal Logic Operations (OR, AND, …) etc. Even Scaling Facts.