

# **S-parameter interconnect model ports and terminals**

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## From “Draft 30” of the package/interconnect proposal:

For an Interconnect Model using File\_TS with N ports, N shall match the number of ports present in the data of the associated Touchstone 1.x file, or the value associated with the [Number of Ports] field in the associated Touchstone 2 file. The Number\_of\_terminals entry in the Interconnect Model shall be an integer equal to N+1. Terminal rules are described below:

- The EDA tool shall use the pin\_name or signal\_name specified for the associated Terminal “N+1” entry as the reference node for each of the N ports. For an Interconnect Model with N ports, the Terminals and Ports are associated as follows:

<u>Terminal</u>	<u>Port</u>
○ 1	1
○ 2	2
○ ...	
○ N	N
○ N+1	reference
- If a Terminal with number less than or equal to N is not connected, then it shall be terminated by the EDA tool with a resistor to the node on Terminal N+1. The value of this resistance shall be the value associated with the Port Reference Impedance subparameter.
- Terminal N+1 shall be connected to a Pin, Pad, or Buffer Terminal which is in turn connected to a Pin with a signal\_name of POWER or GND.

**How many ports (N) are used for a given number of pins+pads for a package model?**

**If Number\_of\_Terminals (=N+1) = pins+pads *then* N=(pins+pads)-1**

**If Number\_of\_Terminals (=N+1) = pins+pads+1 *then* where is the reference terminal connected?**

## From “Draft 30” of the package/interconnect proposal:

Number\_of\_terminals rules:

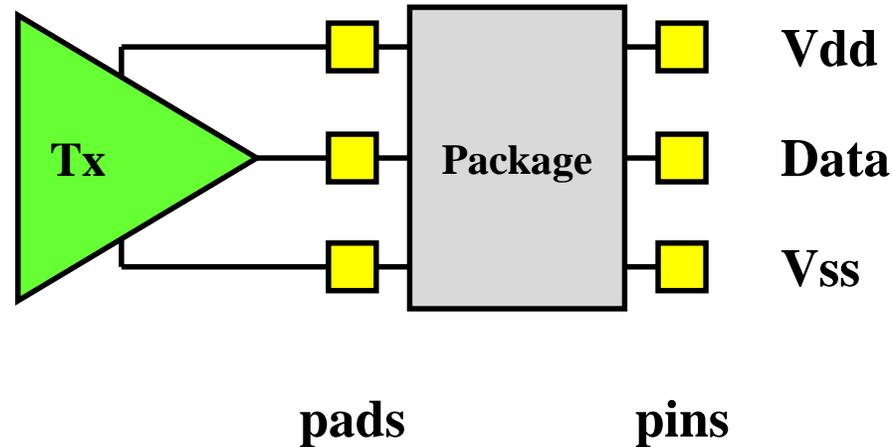
The Number\_of\_terminals subparameter is required and defines the number of Terminals associated with the Interconnect Model. The subparameter name shall be followed by a single integer argument greater than zero on the same line. The argument shall be separated from the subparameter name by the “=” character. The subparameter name, “=” character, and argument may optionally be separated by whitespace. Only one Number\_of\_terminals subparameter may appear for a given [Begin Interconnect Model] keyword. The Number\_of\_terminals subparameter shall appear before any Terminal lines and after all other subparameters for a given Interconnect Model.

### **What does the underlined text really mean?**

- **does Number\_of\_Terminals refer to the physical interconnect model (pins+pads)?**
- **or does it refer to the number of terminals of the S-parameter model (pins+pads+1)?**

# How many ports do we expect from the model maker for this 3-pin, 3-pad device?

[Pin]	signal_name	model_name
1	Vdd	POWER
2	Data	Tx
3	Vss	GND



## option 1:

Number\_of\_terminals (N+1) = 7  
Number of ports (N) = 6  
(where is the reference connected?)

## option 2:

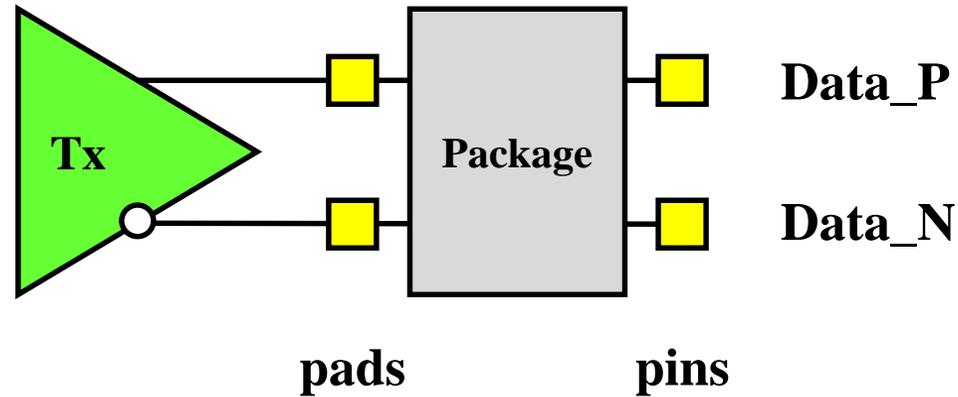
Number\_of\_terminals (N+1) = 6  
Number of ports (N) = 5  
(Vss pin used as reference)

## option 3:

Number\_of\_terminals (N+1) = 5  
Number of ports (N) = 4  
(Vss pin and pad are shorted and are used as reference)

# How many ports do we expect from the model maker for this 2-pin, 2-pad device?

[Pin]	signal_name	model_name
1	Data_P	Tx
2	Data_N	Tx



## option 1:

Number\_of\_terminals (N+1) = 5  
Number\_of\_ports (N) = 4  
(where is the reference connected?)

## option 2:

Number\_of\_terminals (N+1) = 4  
Number\_of\_ports (N) = 3  
(Data\_X pin used as reference)

## Which option works consistently for most cases?

- **A shortcut is not a general solution, i.e. cannot cover all possible cases**
- **But we can try to cover the most frequent situations**
- **.ibs files which only have signal pins listed are common**
  - **option 3 is not possible in this case**
- **.ibs files which include power and ground pins are also common**
- **If it is true that most model makers generate models with as many ports as the sum of the pins and pads ( $N = \text{pins} + \text{pads}$ ) then we need to define where the extra reference terminal ( $N+1$ ) should be connected**
  - **can't be a pin or pad if they are all "used up" for ports**