



Figure 1: Heat sink mounted Thermal N-port generated directly from analytical solution of the heat diffusion equation, and represented by thermal impedance matrix, $R_{THij}(s)$ with varying temperatures at the top surface.

fREEDA™ Form: thermalheatsink:<instance name> < top surface terminals, thermal ground>
 <parameter list>

Example:

thermalheatsink:test3 301 302 303 304 305 306 307 308 309 310 311 312 313 314
315 316 717 718 719 720 721 722 723 724 725 1002 xl=2.4188e-2 xr=2.2564e-2
yU=1.3235e-2 yD=1.1765e-2 d=381e-6 ks=17.3 rho=8359 c=502 time.d=1 Ntimesteps=nsteps
dt=deltat l=5.0e-2 w=2.5e-2 Tambient=temp xi=0 narray=5 ndevices=1 read_input=0

Model Parameters:

Name	Description	Units	Default
ntimesteps	Number of time steps in transient simulation		0
dt	Length of timestep	s	0.0
tambient	Ambient Temperature	K	300.0
time.d	Flag if true calculate in the time domain.		False
read_input	Flag read_input thermal resistance matrices from file.		False
l	Substrate x-dimension.	m	0.05
w	Substrate y-dimension.	m	0.05
d	Substrate z-dimension.	m	0.0016
xl	x-coordinate of left edge of heating element.	m	220.0e-6
xr	x-coordinate of right edge of heating element.	m	180.0e-6
yu	y-coordinate of upper edge of heating element.	m	220.0e-6
yd	y-coordinate of lower edge of heating element.	m	180.0e-6
Ks	Thermal conductivity	W/m.K	0.294
rho	Density	(kg.m-3)	1900
C	Specific heat	J/kg.K	1150
xi	Adjustment for T**4 non linearity		1.3
eta	Adjustment for natural convection		3.0
epsilon	Emissivity		0.7
narray	Order of NxN grid array		3
ndevices	Number of heat dissipating devices		1
b	Exponent of temperature dependence of thermal conductivity		0.0

Standard Calculations

$$R_{TH} = \frac{1}{\kappa_s LW} \sum_{mn} \frac{4 \tanh \gamma_{mn} D}{(1 + \delta_{m0})(1 + \delta_{n0}) \gamma_{mn}} \frac{I_{mn}^i}{I_{00}^i} \frac{I_{mn}^j}{I_{00}^j} \quad (1)$$

Bugs:

Frequency domain model not implemented.

Version:

2006.05.01

Credits:

Name	Affiliation	Date	
Sonali Luniya	North Carolina State University	May 2006	NC STATE UNIVERSITY
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Publications:

1. Sonali Luniya, William Batty, Vincent Caccamesi, Mikael Garcia, Carlos Christoffersen, Samson Melamed, W. Rhett Davis, and Michael Steer, "Compact Electrothermal Modeling of an X-band MMIC," *2006 IEEE International Microwave Symposium*, June 11 2006.