GCPW


| Variables |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Name | Nominal | Sweep | Sweep Type | Start | Stop | Npts | Step |
| freq | 1 GHz | V | Linear | 0.1 GHz | 10 GHz | 10 | 1.1 GHz |
| Length | 10 mm | $\square$ | Linear | 1 mm | 10 mm | 10 | 1 mm |
| top_layer_Thickness | 0.035 mm | $\square$ | Linear | 1 mm | 10 mm | 10 | 1 mm |
| top_layer_Angle | 90 deg | $\square$ | Linear | 45 deg | 135 deg | 10 | 10 deg |
| Thickness_1 | 10 um | V | Linear | 7 um | 30 um | 10 | 2.55556 um |
| Thickness_2 | 70 um | $\square$ | Linear | 1 um | 10 um | 10 | 1 um |
| Thickness_3 | 0.71 mm | $\square$ | Linear | 1 mm | 10 mm | 10 | 1 mm |
| Prepreg_1080_35_Er_Real | 3.5 | $\square$ | Linear | 1 | 10 | 10 | 1 |
| Prepreg_1080_35_Er_TanD | 0.01 | $\square$ | Linear | 1 | 10 | 10 | 1 |
| SolderMask_3_7_Er_Real | 3.7 | $\square$ | Linear | 1 | 4.5 | 10 | 0.388889 |
| SolderMask_3_7_Er_TanD | 0.01 | $\square$ | Linear | 1 | 10 | 10 | 1 |
| FR_4_5_Er_Real | 5 | $\square$ | Linear | 1 | 10 | 10 | 1 |
| FR_4_5_Er_TanD | 0.01 | $\square$ | Linear | 1 | 10 | 10 | 1 |

## SolderMask_3_7_Er_Real=1.000

## Marker_1 $1=9.556$ <br> Thickness_1=9.556

permute(māg(ZCc)[m3_SolderMask_3_7_EEr__Real_index,:.:.:.])=54.104 Marker 2
Thickness_1=9.556
jermute(mäg(Zc) [m3_SolderMask_3_7_Er__Real_index,:::,::])=53.98 freq $=10.00 \mathrm{GH}$
Marker_3
hickness $1=9.556$ SolderMask 37 Er Real index, $\cdot \cdots$..]) $=53.97$ permute $(\mathrm{mag}(\mathrm{Zc})$
freq $=8.900 \mathrm{GHz}$
Marker_4
Thickness_1=9.556
permute(mäg(Zc)[m3_SolderMask_3_7_Er_Real_index,,$::,:: 1])=53.964$
freq $=7.800 \mathrm{GHz}$ freq $=7.800 \mathrm{GH}$
Marker 5
bermute(mäg(ZC)[m3_SolderMask_3_7_Er__Real_index,:.:.::])=53.950 permute (mag(Zc)
freq $=6.700 \mathrm{GHz}$
Marker_6
Thickness_1=9.556
permute(mag=(ZCZ)[m3_SolderMask_3_7_Er__Real_index,::,::])=53.936 freq $=5.600 \mathrm{GH}$
Marker_7
ermute $(\operatorname{mag}(Z \mathrm{Zc})[\mathrm{m} 3$ SolderMask 37 Er Real index,:.:.:: $]=53.91$ freq $=4.500 \mathrm{GHz}$
Marker_8
Thickness_1=9.556
ermute (magg (Zc)[m3_SolderMask_3_7_EE__Real_index,:.:::])=53.900 freq $=3.400 \mathrm{GH}$
Marker_9
Thickness
$1=9.556$
permute(màg(Zc)[m3_SolderMask_3_7_Er__Real_index,:.:.::])=53.880 freq $=2.300 \mathrm{GHz}$
Marker_10
Thickness_1=9.556
permute $(\operatorname{mag}(Z \mathrm{Zc})[\mathrm{m3}$ _SolderMask_3_7__Er__Real_index,,$:,:::])=53.864$
freq $=1200 \mathrm{GHz}$ freq $=1.200 \mathrm{GHz}$

Characteristic Impedance


## SolderMask_3_7_Er_Real=1.778

## Marker_1 1-9.550

 permute(mag(Zc)
freq $=100.0 \mathrm{MHz}$
Marker 2
Thickness_1=9.556
 freq $=10.00 \mathrm{GH}$
Marker_3
Thickness $1=9.556$

| permute(mág(Zc) |
| :---: |
| freq $=8.900 \mathrm{GHz}$ |
| _SolderMask_3_7__Er__Real_index,::.:: $:])=52.656$ | Marker 4

Marker_4
Thickness_1
2
ermute $\left(\operatorname{mag}(Z \mathrm{Zc})\left[\mathrm{m} 3 \_S o l d e r M a s k \_3 \_7 \_E r \_\right.\right.$Real_index,,$\left.\left.::,::\right]\right)=52.645$
freq $=7800 \mathrm{GHz}$ freq $=7.800 \mathrm{GH}$
Marker_5
 permute $(\operatorname{mag}(Z \mathrm{Zc})$
freq $=6.700 \mathrm{GHz}$
Marker_6
Thickness_1=9.556
 freq $=5.600 \mathrm{GH}$
Marker_7
Thickness_1=9.556 SolderMask 37 Er Real index, $\cdot \cdots$..])=52.60 permute $(\mathrm{mag} \mathrm{Zc}$
freq $=4.500 \mathrm{GHz}$
Marker_8
Thickness_1=9.556
permute (mag=(Zc)[m3_SolderMask_3_7_Er__Real_index,::,::])=52.584
freq $=3.400 \mathrm{GHz}$
Marker_9
Thickness
$1=9.556$
permute(mäg(ZC)[m3_SolderMask_3_7_Er_Real_index,:.:::])=52.565 freq $=2.300 \mathrm{GHz}$
Marker_10
Thickness_1=9.556
ermute $\left(\operatorname{mag}(Z \mathrm{Zc})\left[\mathrm{m} 3 \_S o l d e r M a s k \_3 \_7 \_E r \_\right.\right.$Real_index,:.:,::])=52.551
freq=1.200GHz


## SolderMask_3_7_Er_Real=2.167

## Marker-1 $1=9.556$

 permute $(\mathrm{mag}(\mathrm{Zc}$
freq $=100.0 \mathrm{MHz}$
Marker 2
Thickness 1=9.556
 freq $=10.00 \mathrm{GH}$
Marker_3
Thickness 1=9. 556
permute(mág(Zc)[m3_SolderMask_3_7_EE__Real_index,:.:.::])=52.300 Marker 4
Marker_4
Thickness_1=9.556
permute( $\mathbf{m a g}(Z \mathrm{Zc})[\mathrm{m} 3$ _SolderMask_3_7_Er__Real_index,:.:,::])=52.288 freq $=7.800 \mathrm{GH}$
Marker_5
 permute $(\operatorname{mag}, \mathrm{Zc}$
freq $=6.700 \mathrm{GHz}$
Marker_6
Thickness_1=9.556
permute( mag (Z. Zc )[m3_SolderMask_3_7_Er__Real_index,:.:.:])=52.262 freq $=5.600 \mathrm{GH}$
Marker_7
 freq $=4.500 \mathrm{GHz}$
Marker_8
Thickness_1=9.556
permute(magg(Zc)[m3_SolderMask_3_7_Er_Real_index,:.:.:])=52.229 freq $=3.400 \mathrm{GH}$
Marker_9
Thickness
$1=9.556$
permute:(māg(Zcc)[m3_SolderMask_3_7_Er__Real_index,:.::::])=52.210 freq $=2.300 \mathrm{GHz}$
Marker_10
Thickness ${ }^{1=9.556}$ SolderMask 37 Er Real index ....])=52. 196 permute $(\operatorname{mäg}(Z \mathrm{Zc})[\mathrm{m3}$ _SolderMask_3_7_Er_Real_index,:::,::])=52.196
freq=1.200GHz


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Results
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## SolderMask_3_7_Er_Real=2.556

## Marker_1 $1=9.556$ <br> Thickness $1=9.556$

permute $(\operatorname{mag}(Z \mathrm{Zc})[\mathrm{m3} 3$ SolderMask_3_7_Er__Real_index,::.:.:])=51.842 Marker 2
Thickness 1=9.556
permute( $\operatorname{mäg}(Z \mathrm{Zc})\left[\mathrm{m} 3 \_\right.$SolderMask_3_7_EE__Real_index,::.,::])=51.734 freq $=10.00 \mathrm{GH}$
Marker_3
Thickness $1=9.556$
permute(māg(Zc)[m3_SolderMask_3_7_EE__Real_index,:.:.:])=51.723 Marker_4
Thickness_1=9.556
permute(
fragag $=7.800 \mathrm{GHz}$ Zc [m3_SolderMask_3_7_EE__Real_index,::.:::])=51.712 freq $=7.800 \mathrm{GH}$
Marker_5
Thickness_1=9.556
permute(mag (Zc)[m3_SolderMask_3_7__Er__Real_index,:.:::]) $=51.699$ permute $(\operatorname{mag}, \mathrm{Zc}$
freq $=6.700 \mathrm{GHz}$
Marker_6
Thickness_1=9.556
permute(mag=(ZCZ)[m3_SolderMask_3_7__Er__Real_index,:.:::])=51.684 freq $=5.600 \mathrm{GH}$
Marker_7
ermute(mäg(Zc) [m3 SolderMask_3_7 Er Real index,:.:::])=51.668 freq $=4.500 \mathrm{GHz}$
Marker_8
Thickness_1=9.556
sermute (magg(Zc)[m3_SolderMask_3_7_Er__Real_index,:.:::])=51.650 freq $=3.400 \mathrm{GH}$
Thickness $1=9.556$
permute(mäg(Zc)[m3_SolderMask_3_7__Er__Real_index,:::,:])=51.630 freq $=2.300 \mathrm{GHz}$
Marker_10
Thickness_1=9.556 SolderMask 37 Er Real_index,: : : $: 1)=51.61$ permute $(\mathrm{mag}(\mathrm{Zc}$
freq $=1.200 \mathrm{GHz}$


## SolderMask_3_7_Er_Real=2.944

| Marker_1 |
| :--- | :--- |
| Thickness_1 |
| 1 |

 permute
freq $=100.0 \mathrm{MHz}$
Marker 2
Thickness 1=9.556
 freq $=10.00 \mathrm{GHz}$
Marker_3
Thickness_1=9.556
 Marker_4
Thickness
Thickness_1=9.556
 freq $=7.800 \mathrm{GH}$

| Marker_5 |
| :--- |
| Thickness_1 |
| 1.556 |

 permute $(\operatorname{mag}, \mathrm{Zc}$
freq $=6.700 \mathrm{GHz}$
Marker_6
Thickness_1=9.556
permute(mag=(ZCZ)[m3_SolderMask_3_7_EEr_Real_index,:.:::])=51.042 freq $=5.600 \mathrm{GH}$
Marker_7
permute(mäg(ZZZ)[m3 SolderMask_3_7_Er_Real_index,:: :::])=51.026 freq $=4.500 \mathrm{GHz}$
Marker_8
Thickness_1=9.556
permute(magag(Zc)[m3_SolderMask_3_7_Er__Real_index,::,::])=51.009 freq $=3.400 \mathrm{GH}$
Marker_9 ${ }^{\text {Thickness }} 1=9.556$
permute (magg(Zc)[m3_SolderMask_3_7_Er__Real_index,::,::])=50.989 freq $=2.300 \mathrm{GHz}$
Marker_10
Thickness_1=9.556
permute(mag(ZC)[m3_SolderMask_3_7_Er__Real_index,:.:.::])=50.974
freq=1.200GHz permute $(20 \mathrm{~m}$
freq $=1.200 \mathrm{GHz}$


## SolderMask_3_7_Er_Real=3.333

| Marker_1 |
| :--- | :--- | :--- |
| Thickness_1=9.556 |

Thickness_1=9.556
permute $($ mag
ZCc $)[$ m3_SolderMask_3_7_Er__Real_index,:.:.::] $)=50.664$ permute(mag(Zc)
freg $=100.0 \mathrm{MHz}$
Marker_2
Thickness_1=9.556
permute( $\left(\operatorname{mäg}(Z \mathrm{Cc})\left[\mathrm{m} 3 \_\right.\right.$SolderMask_3_7_Er_Real_index,::.:::])=50.558
freq=10.00GHz freq $=10.00 \mathrm{GHz}$
Marker_3
Thickness_1=9.556
 Marker-4
Thickness_1=9.556
 freq $=7.800 \mathrm{GH}$

| Marker_5 |
| :--- |
| Thickness_1 |
| 1.556 |

 ermute( $\mathrm{mag}(\mathrm{Zc}$
freq $=6.700 \mathrm{GHz}$
Marker_6
Thickness_1=9.556
permute(maga (ZCC)[m3_SolderMask_3_7_EEr_Real_index,:.:::])=50.510 freq $=5.600 \mathrm{GH}$
Marker_7
permute $(\operatorname{mag}(Z \mathrm{Zc})[\mathrm{m} 3$ SolderMask_3_7_Er_Real_index,:.:.:: $]=50.49$ freq $=4.500 \mathrm{GHz}$
Marker_8
Thickness_1=9.556
permute(mäg(Zc)[m3_SolderMask_3_7_Er_Real_index,:.:.:])=50.476 freq $=3.400 \mathrm{GH}$
Marker-9 ${ }^{\text {Thickness }} 1=9.556$
permute(mäg(Zc)[m3_SolderMask_3_7__Er__Real_index,:.:.::])=50.45 freq $=2.300 \mathrm{GHz}$
Marker_10
Thickness_1=9.556 $\quad$ SolderMask 37 Er Real index, $\cdot \cdots])=50.441$ permute $\left(\operatorname{mäg}(Z \mathrm{Zc})\left[\mathrm{m} 3 \_\right.\right.$SolderMask_3_7_Er__Real_index,:.:,::])=50.44
freq=1.200GHz


## SolderMask_3_7_Er_Real=3.722

## Marker-1 $1=9.556$


Marker_2
Thickness_1=9.556
permute( $\operatorname{mäg}(Z \mathrm{Zc})\left[\mathrm{m} 3 \_\right.$SolderMask_3_7_EE__Real_index,:::,::])=50.054 freq $=10.00 \mathrm{GH}$
Marker_3
Thickness_1=9.556
permute(māg(Zc)[m3_SolderMask_3_7_Er__Real_index,::,:: $:]=50.043$ Marker 4
Marker_4
Thickness_1=9.556
permute( mag (ZC) $)\left[\mathrm{m} 3 \_\right.$SolderMask_3_7_Er__Real_index,::,::])=50.032 freq $=7.800 \mathrm{GHz}$
Marker_5
 permute $(\mathrm{mag}(\mathrm{Zc}$
freq $=6.700 \mathrm{GHz}$
Marker_6
Thickness_1=9.556
permute(maga(ZC))[m3_SolderMask_3_7_EEr_Real_index,:.:::])=50.005 freq $=5.600 \mathrm{GH}$
Marker_7
ermute(mäg(Zc) 5 ) 3 SolderMask 37 Er Real index,:.:::])=49.989 freq $=4.500 \mathrm{GHz}$
Marker_8
Thickness_1=9.556
ermute(mäg(Zc)[m3_SolderMask_3_7_Er_Real_index,:.:.:])=49.972 freq $=3.400 \mathrm{GH}$
Thickness 1=9.556
permute (maga(Zc)[m3_SolderMask_3_7_Er__Real_index,::,::])=49.952 freq $=2.300 \mathrm{GHz}$
Marker_10
Thickness_1=9.556
permute(mäg(ZCc)[m3_SolderMask_3_7_EEr_Real_index,:.:.::])=49.937 freq= 1.200 GHz


## SolderMask_3_7_Er_Real=4.111

Marker_1
Thickness_1=9.556
Thickness $1=9.556$
permute(mag(Zc)[m3_SolderMask_3_7_Er__Real_index,:.:.:])=49.670 Marker 2
Thickness 1=9.556
permute( $\operatorname{mäg}(Z \mathrm{Zc})\left[\mathrm{m} 3 \_\right.$SolderMask_3_7__Er__Real_index,::.,::])=49.570 freq $=10.00 \mathrm{GH}$
Marker_3
Thickness $1=9.556$ SolderMask 37 Er Real index $\cdot \cdots$...) $=49.55$ permute $(\operatorname{mag}(Z \mathrm{Zc})$
freq $=8.900 \mathrm{GHz}$
Marker 4
Thickness_1=9.556
permute $(\operatorname{mäg}(Z \mathrm{Zc})[\mathrm{m3}$ _SolderMask_3_7__Er__Real_index,:.:.::])=49.548 freq $=7.800 \mathrm{GH}$
Marker_5
Thickness $1=9.556$
 permute
freq $=6.700 \mathrm{GHz}$
Marker_6
Thickness_1=9.556
permute( $(\operatorname{ang}(Z .5)[$ [m3_SolderMask_3_7__Er__Real_index,:.:.::] $]=49.52$ freq $=5.600 \mathrm{GH}$
Marker_7
permute(mäg(Zc) [m3 SolderMask_3_7_Er__Real_index,:.: ::: $]$ )=49.506 freq $=4.500 \mathrm{GHz}$
Marker_8
Thickness_1=9.556
sermute $(\operatorname{mag}(Z \mathrm{Zc})[m 3$ SolderMask_3_7_Er__Real_index,:.:::])=49.488 freq $=3.400 \mathrm{GH}$
Marker_9 ${ }^{\text {Thickness }} 1=9.556$
permute(māg(Zc)[m3_SolderMask_3_7_EE__Real_index,::,::])=49.469 freq $=2.300 \mathrm{GH}$
Marker_10
Thickness_1=9.556
permute(mag_(Zc)[m3_SolderMask_3_7_Er__Real_index,:.::::])=49.453
freq $=1.200 \mathrm{GHz}$ freq $=1.200 \mathrm{GHz}$


## SolderMask_3_7_Er_Real=4.500

| Marker_1 |
| :--- |
| Thickness_1=9.556 |

Thickness $1=9.556$
permute(mag(Zc)[m3_SolderMask_3_7_Er__Real_index,:.:.::])=49.20 Marker 2
Thickness_1=9.556
permute( $\operatorname{mäg}(Z \mathrm{Zc})\left[\mathrm{m} 3 \_\right.$SolderMask_3_7_Er__Real_index,::.,::])=49.103 freq $=10.00 \mathrm{GHz}$
Marker_3
Thickness $1=9.556$ SolderMask 37 Er Real index $\cdot \cdots \cdot \cdot]$ ) $=49.093$ permute(mag(Zc)
freq $=8.900 \mathrm{GHz}$
Marker_4
Thickness_1=9.556
 freq $=7.800 \mathrm{GH}$

| Marker_5 |
| :--- |
| Thickness_1 |
| 1.556 |

 ermute( $\mathrm{mag}(\mathrm{Zc}$
freq $=6.700 \mathrm{GHz}$
Marker_6
Thickness_1=9.556
 freq $=5.600 \mathrm{GH}$
Marker_7
permute(mag(Zc)[m3 SolderMask_3_7 Er Real index,:.:.::])=49.039 freq $=4.500 \mathrm{GHz}$
Marker_8
Thickness_1=9.556
permute(magg(Zc)[m3_SolderMask_3_7_Er__Real_index,::,::])=49.022 freq $=3.400 \mathrm{GH}$
Marker-9
Thickness
$1=9.556$
permute (māg(Zc)[m3_SolderMask_3_7_Er__Real_index,:.:::])=49.003 freq $=2.300 \mathrm{GHz}$
Marker_10
Thickness_1=9.556
华mute(mag(Zc)[m3_SolderMask_3_7_Er__Real_index,:.:.::])=48.987
freq $=1.200 \mathrm{GHz}$


