

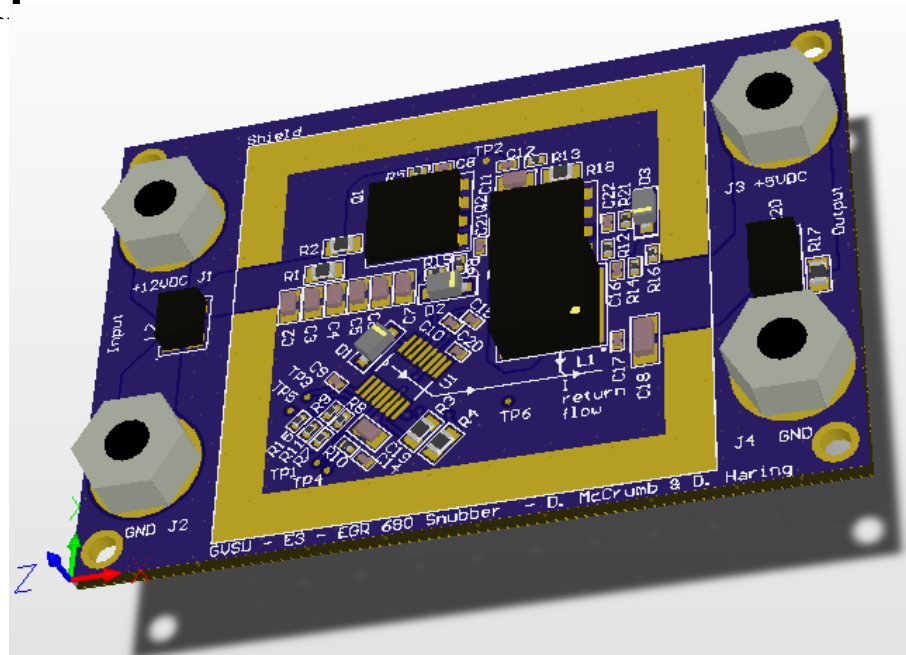
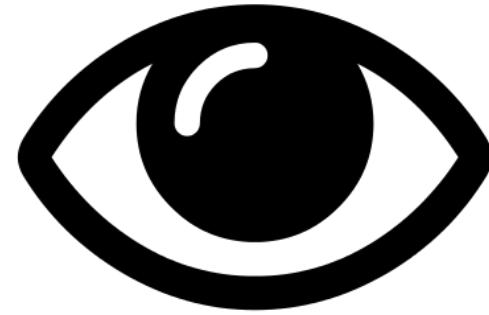
Altium Tutorial v15.1

EGR 643 - PCB Design and EMC

Dimitri Häring

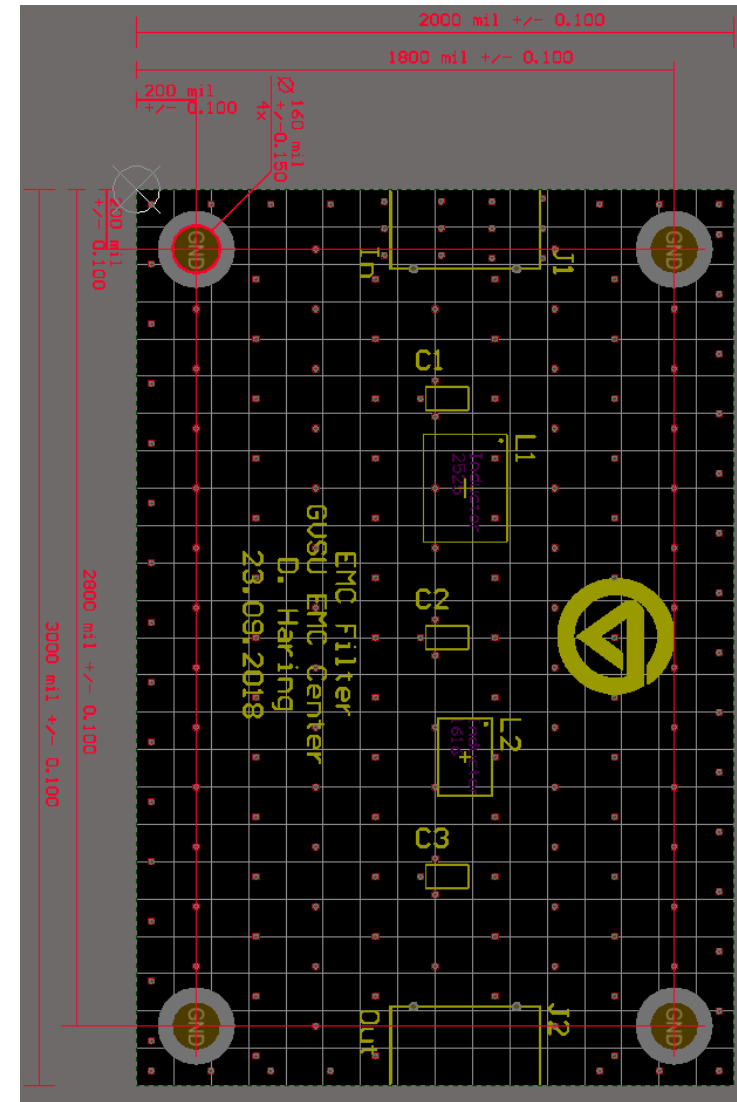
Overview

- Mechanical drawings
- Layer stack up
- Cost approximation
- Snubber
- Schematic
- Layout
- Q&A

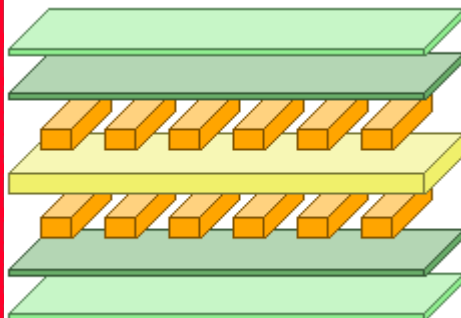


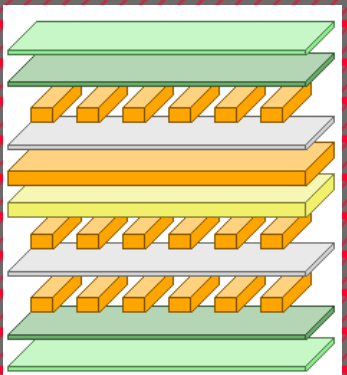
[1]

- Draftsman in Altium v17
- DrillDrawing Layer v15



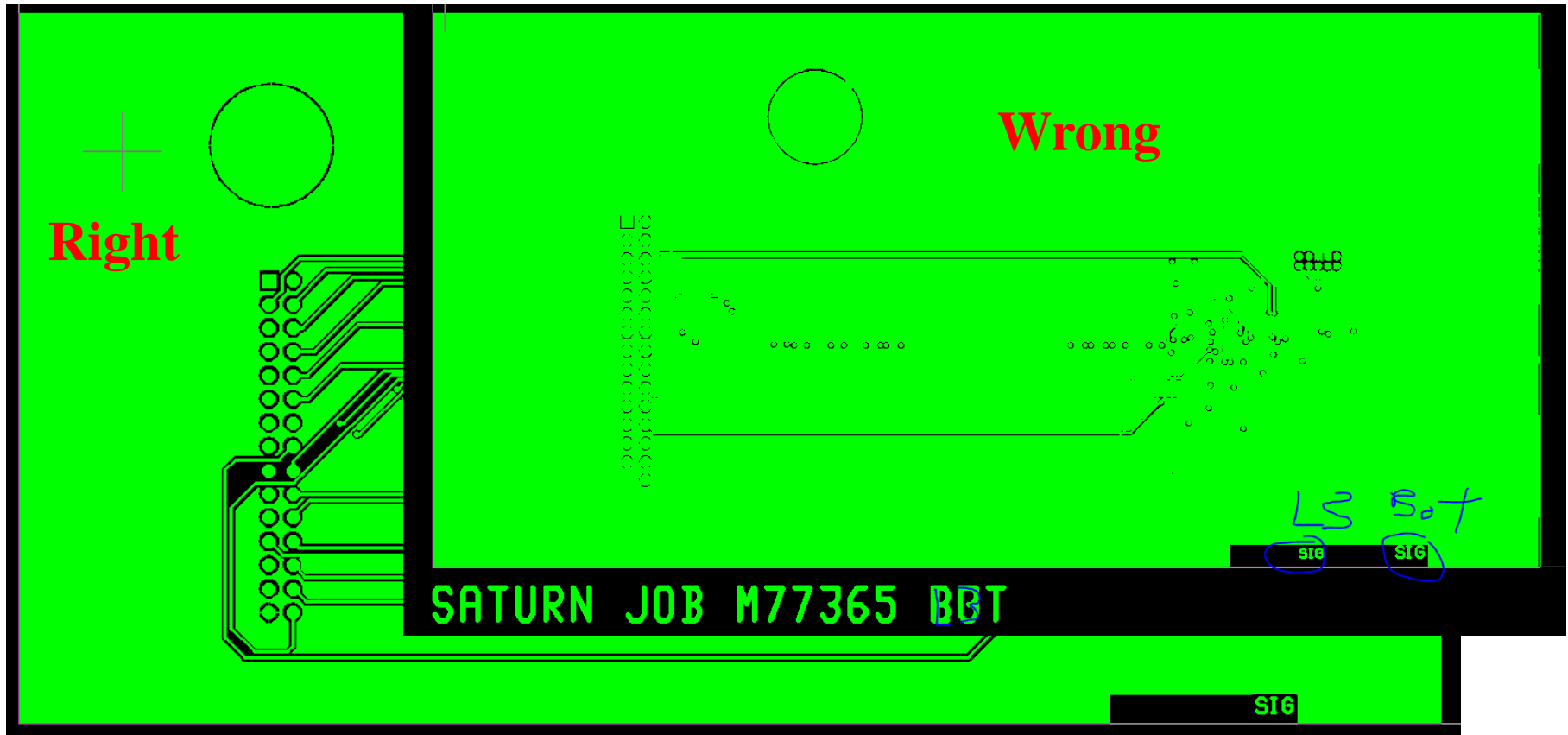
Layer stack up

Layer	Name	Material	Thickness	Constant	
1	Top Overlay				
2	Top Solder	Solder Resist	0.40mil	3.5	
3	Component Side	Copper	1.40mil		
4	Dielectric 1	FR-4	59.00mil	4.2	
5	Bottom Layer	Copper	1.40mil		
6	Solder Side	Solder Resist	0.40mil	3.5	
7	Bottom Overlay				

Layer	Name	Material	Thickness	Constant	Board Layer Stack
1	Top Overlay				
2	Top Solder	Solder Resist	0.40mil	3.5	
3	Component Side	Copper	1.38mil		
4	Dielectric 1	1x 7628 AT05 47% Resin TG130	5.00mil	4.29	
5	GND	Copper	1.38mil		
6	Dielectric 2	6x 7628M 43% Resin TG150	44.49mil	3.96	
7	Signal Layer 1	Copper	1.38mil		
8	Dielectric 3	1x 7628 AT05 47% Resin TG130	6.89mil	4.29	
9	GND Bottom	Copper	1.38mil		
10	Solder Side	Solder Resist	0.40mil	3.5	
11	Bottom Overlay				

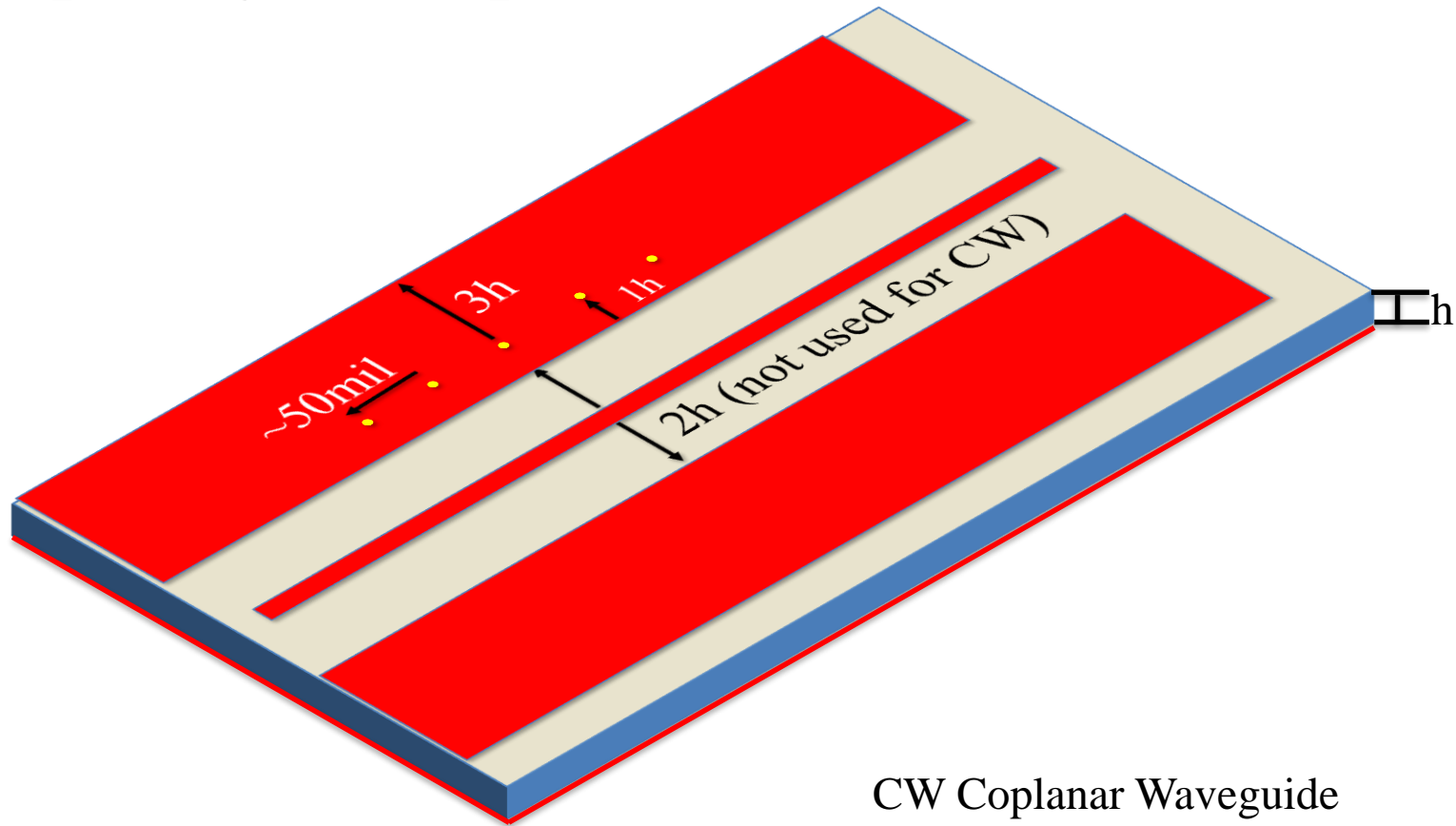
Layer stack up

- Check Gerbers from Manufacturer



RF Grounded Microstrip or Coplanar Waveguide (CW)

- spacing for impedance control



CW Coplanar Waveguide

Saturn PCB Design Toolkit

Saturn PCB Design, Inc. - PCB Toolkit V7.04 - www.saturnpcb.com

File Program Function Tools Help | Contact Saturn PCB Design, Inc.

Via Properties Conductor Properties Bandwidth & Max Conductor Length Differential Pairs Padstack Calculator Mechanical Information

Embedded Resistors PPM Calculator Crosstalk Calculator Wavelength Calculator Er Effective Ohm's Law Reactance

Conductor Spacing Conductor Impedance Conversion Data Planar Inductors Plane Calculator Thermal Fusing Current

Conductor Impedance

Conductor Width (W) mils

Conductor Height (H) mils

Frequency (MHz)

Note:
This calculator uses a complex formula, not the simplified formula. Results track the Sonnet 3D solver.

Er Effective = 2.9060

Zo

Lo

Co

Tpd

Options

Base Copper Weight

☐ 0.25oz
☒ 0.5oz
☐ 1oz
☐ 1.5oz
☐ 2oz
☐ 2.5oz
☐ 3oz
☐ 4oz
☐ 5oz

Plating Thickness

☐ Bare PCB
☐ 0.5oz
☒ 1oz
☐ 1.5oz
☐ 2oz
☐ 2.5oz
☐ 3oz

Passive Circuits

☒ Microstrip
☐ Microstrip Embed
☐ Stripline
☐ Stripline Asym
☐ Dual Stripline
☐ Coplanar Wave

Information

Total Copper Thickness 2.10 mils

Conductor Temperature
Temp in (°C) = N/A
Temp in (°F) = N/A

Via Thermal Resistance N/A

Via Count:

Via Voltage Drop N/A

Units

☒ Imperial
☐ Metric

Substrate Options

Material Selection

Er Tg (°C)

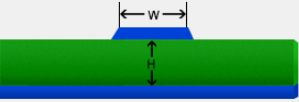
Temp Rise (°C)

Temp in (°F) = 36.0

Ambient Temp (°C)

Temp in (°F) = 71.6

Print Solve!



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Turnkey Electronic Engineering Solutions

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f t in g+ y

A microstrip line with 50 Ohm impedance and a dielectric height of 10 mil, $f_c = 866$ MHz, $BW = 2$ MHz, and 70 μm copper, calculate;

Width:

Calculate the width and distance of CW for the same properties mentioned above:

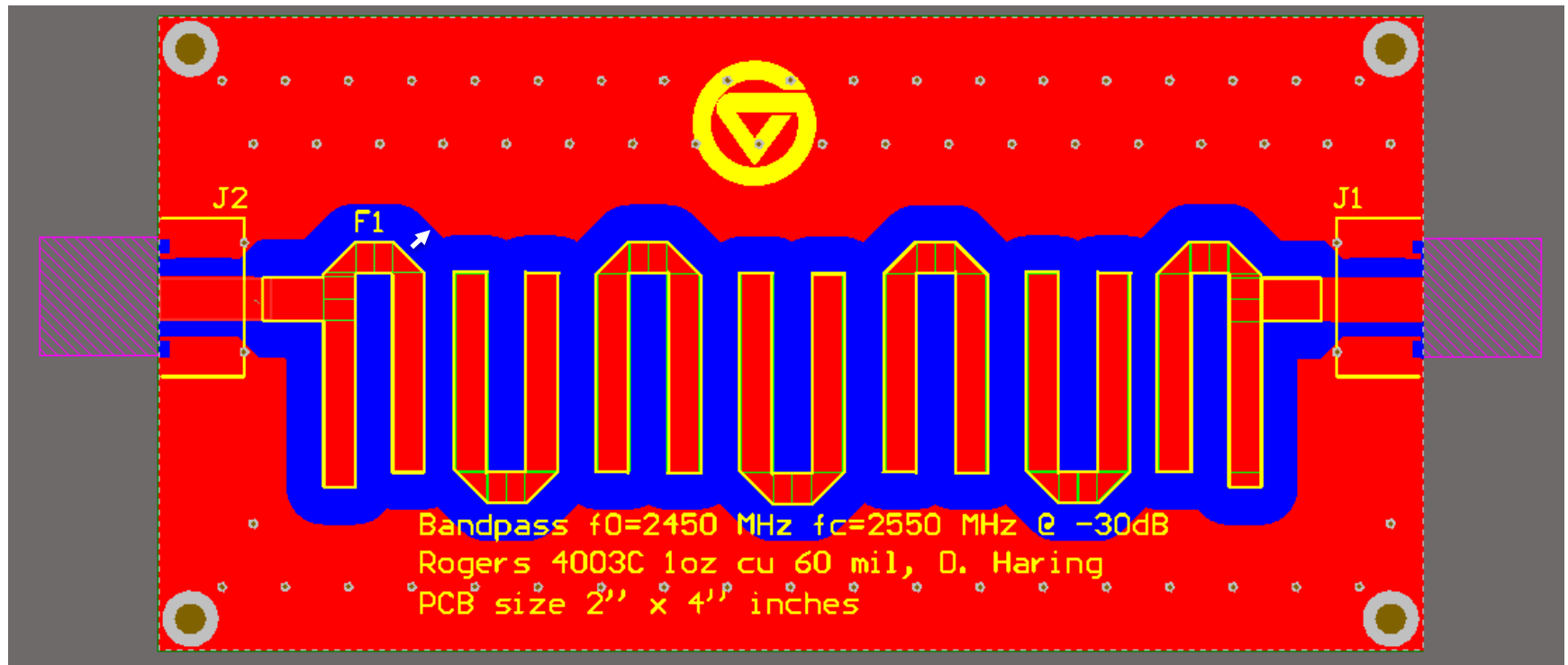
Width:

Distance:

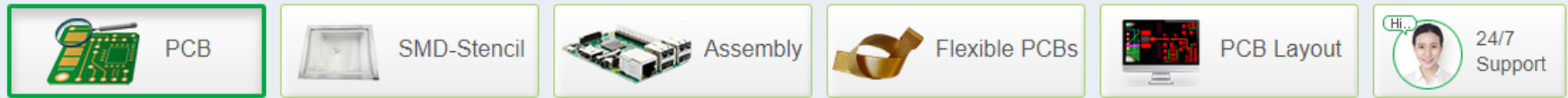
[Link Saturn PCB Toolkit](#)

Filter with Microstrip design

Distance between coupled elements is the same as the $2h$ distance for the microstrip line. In this case, the distance rule of $2h$ is not valid.



Cost approximation \$62 -> \$107



Reset



Calculate

PCB Specification Selection



Board type: ☒ Single pieces ☐ Panel by Customer ☐ Panel by PCBWay

Different Design in Panel: e.g.

* Size (single): X mm

* Quantity (single): pcs

Layers:

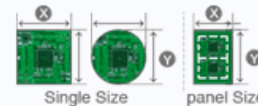
Material:

FR4-TG:

Thickness: * Unit: mm

Min Track/Spacing:

Min Hole Size:



Pricing And Build Time

PCB Price

Build Time	Qty	Total
<input checked="" type="radio"/> 4-5 days	10	\$50
<input type="radio"/> Express 48hours	10	\$142
<input type="radio"/> Express 72hours	10	\$97

Final price is subject to our review.

Shipping Cost:

3-5 Days, wt : 2.11 kg **\$42**

Payment before 2018/04/18 18:00 (GMT+8 Only PCB)

Delivery time 2018/4/23 Receipt confirm 2018/4/27

PCB Cost: US \$ 50
Stencil Cost: US \$ 15
Shipping: US \$ 42
Total: US \$ 107

Email

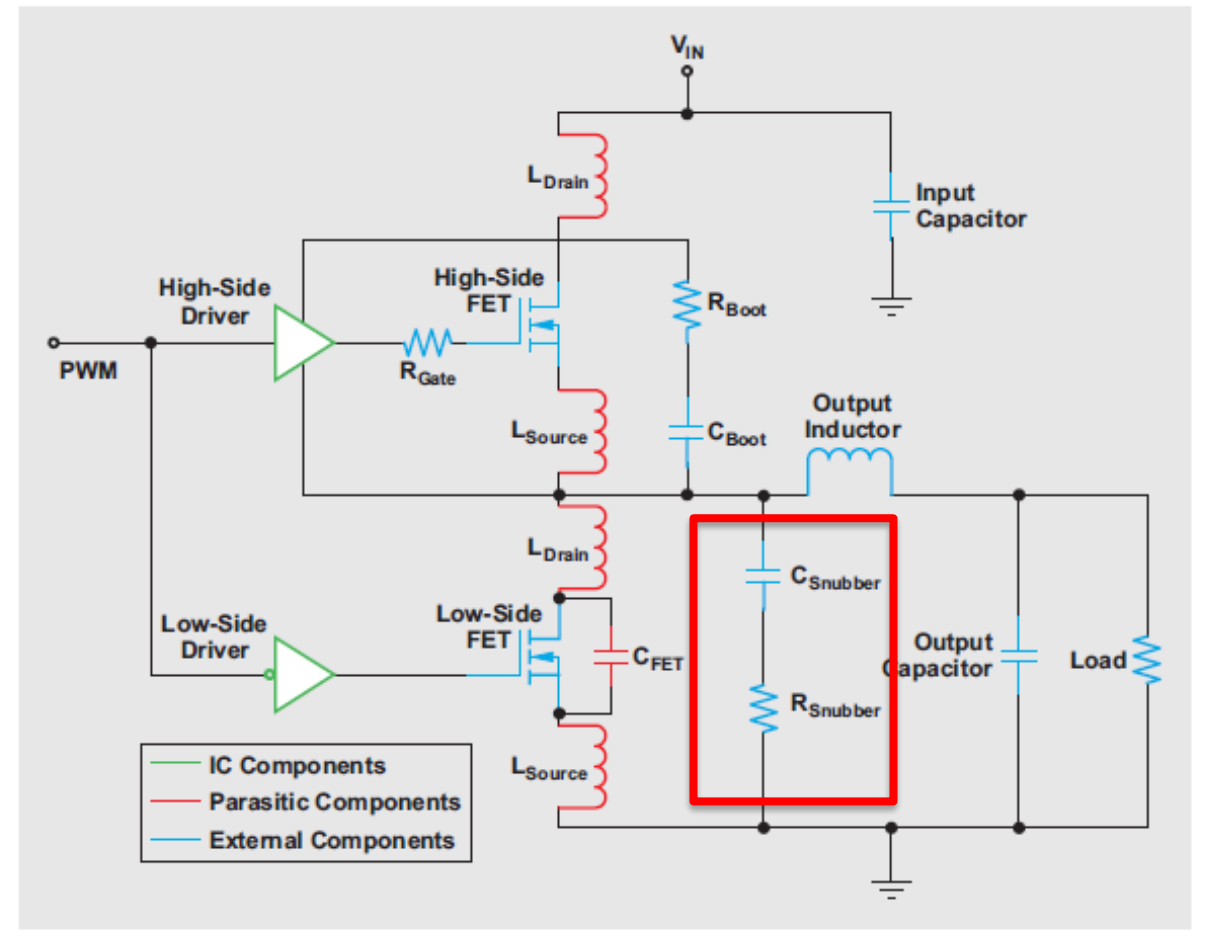
Snubber

Figure 1. Schematic showing parasitics of a buck converter

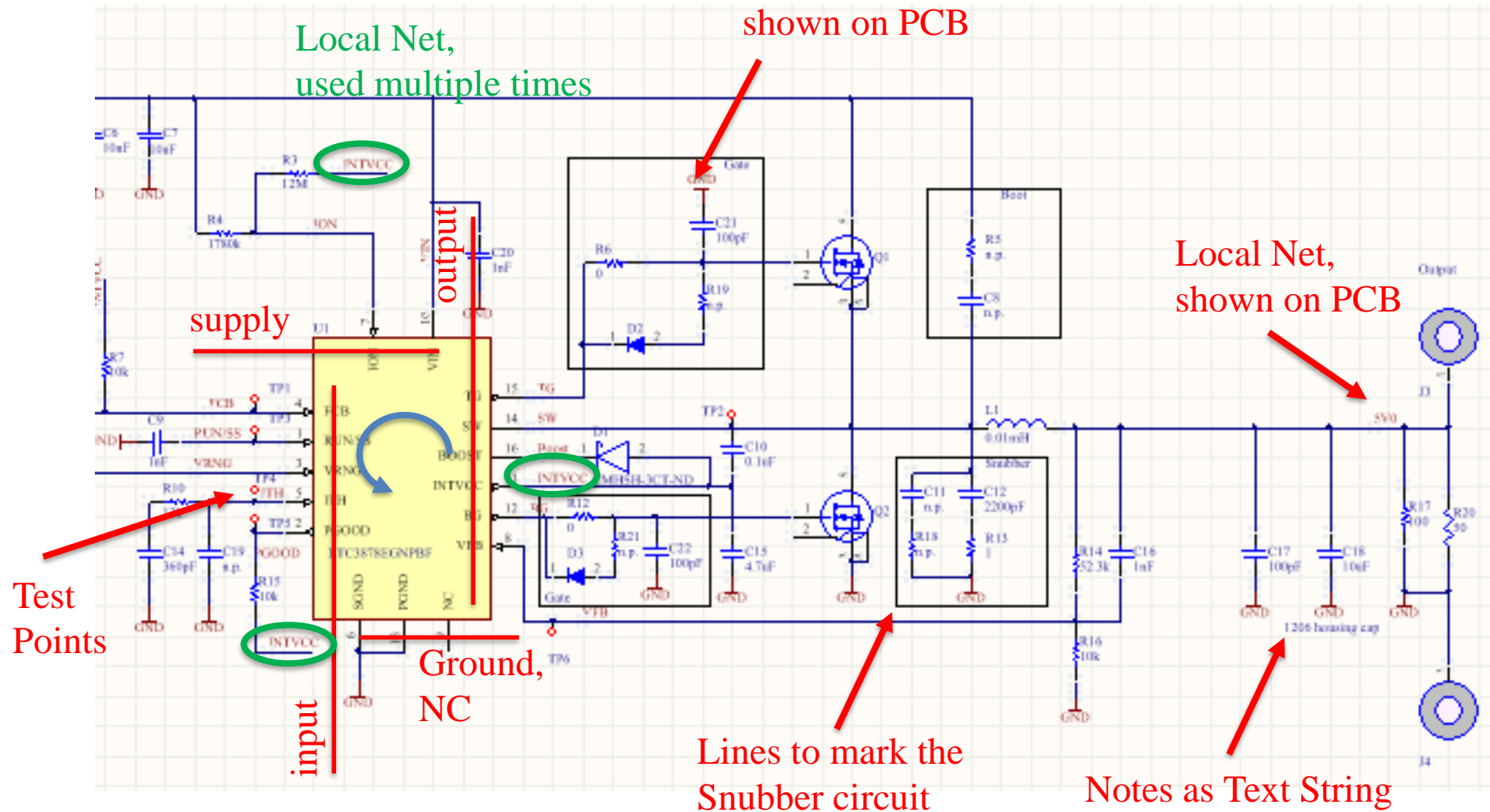
Using a snubber

The third option to consider for reducing ringing is a snubber. The snubber circuit consists of a resistor and capacitor that are connected in series from the switch node to ground. The snubber circuit is used to damp the parasitic inductances and capacitances during the switching transitions. This circuit reduces the ringing voltage and frequency and also reduces the number of ringing cycles. This helps to reduce the EMI emitted by the system.

The procedure for choosing the capacitor and resistor components starts with measuring the ringing frequency of the original circuit. Once the frequency is determined, a capacitor is put in parallel with the low-side FET to change the ringing frequency to half the original value. When the frequency is half the original value, the parallel capacitor is equal to three times the parasitic capacitance of the original circuit. With the capacitance and frequency known, the parasitic inductance can be calculated by using the formula $f = \frac{1}{2\pi\sqrt{LC}}$, where f is the original ringing frequency and C is the parasitic capacitance. The resistor to critically damp the circuit is calculated from the equation $R = \sqrt{L/C}$. This resistor may or may not provide the necessary ringing reduction. Increasing the resistance results in an underdamped system, which allows more ringing but decreases power dissipation. Increasing the capacitance reduces the ringing but increases power dissipation. For the example, using a 2200-pF capacitor and a 1- Ω resistor reduced ringing to 19.1 V.



Schematic



IC, pins are numbered counter clock wise in the footprint!

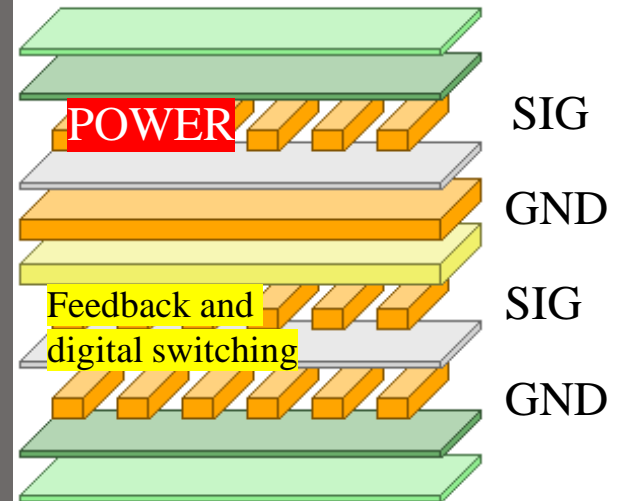
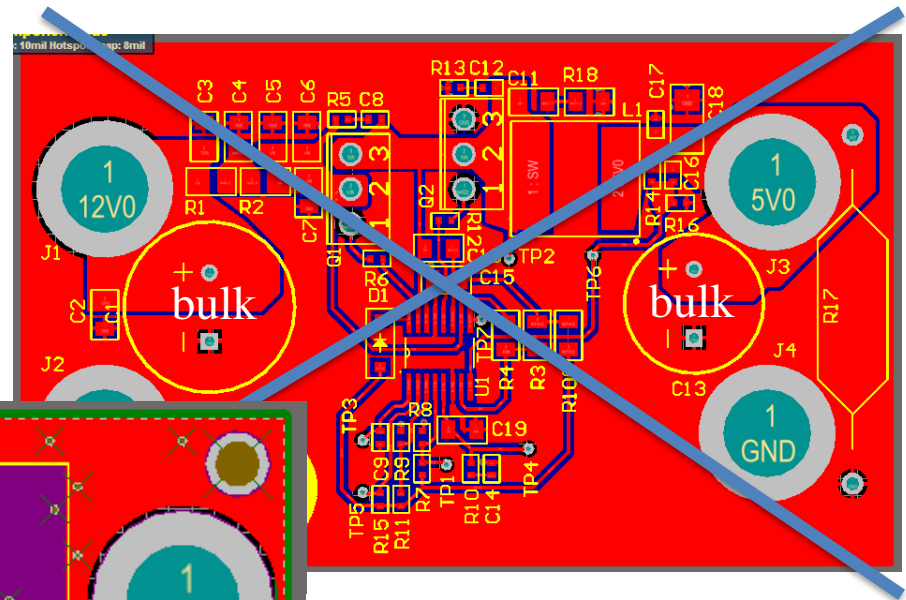
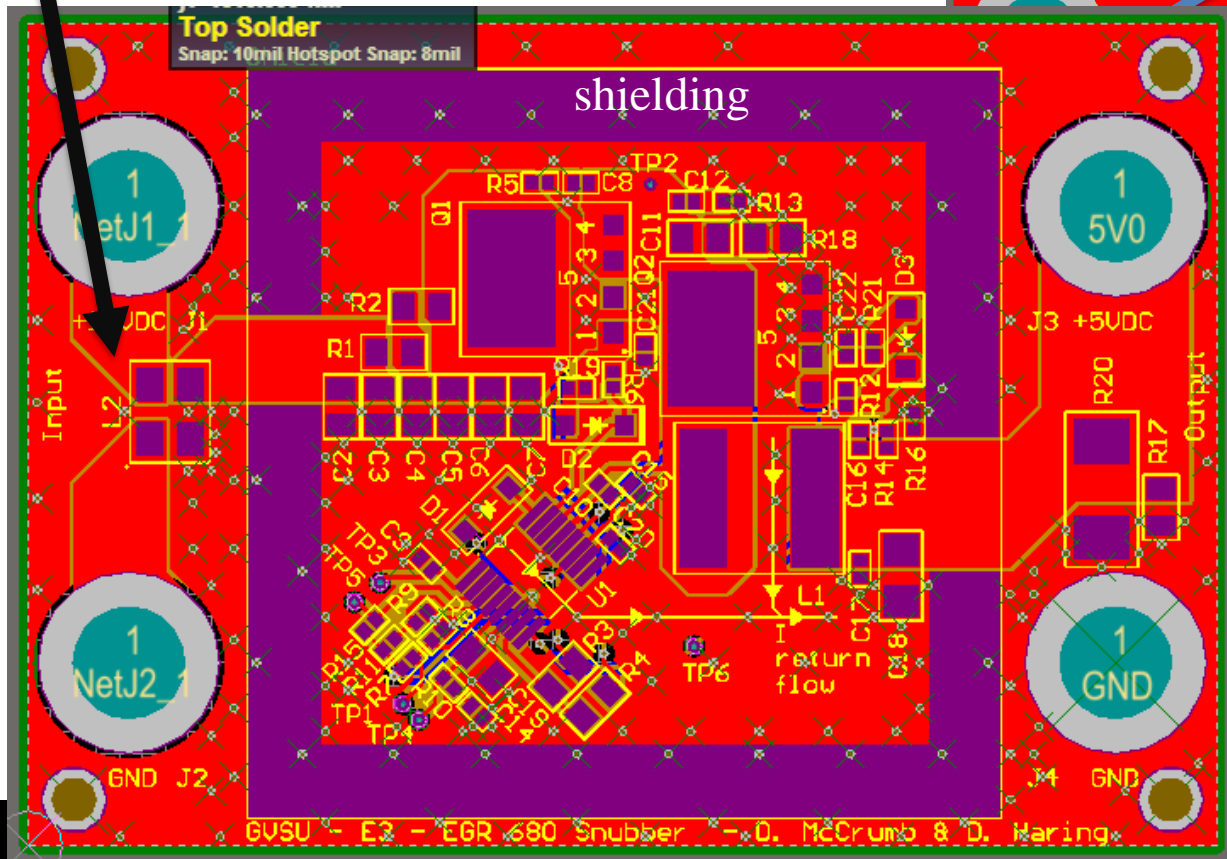
10/3/2018

SMPS

Switched Mode
Power Supply

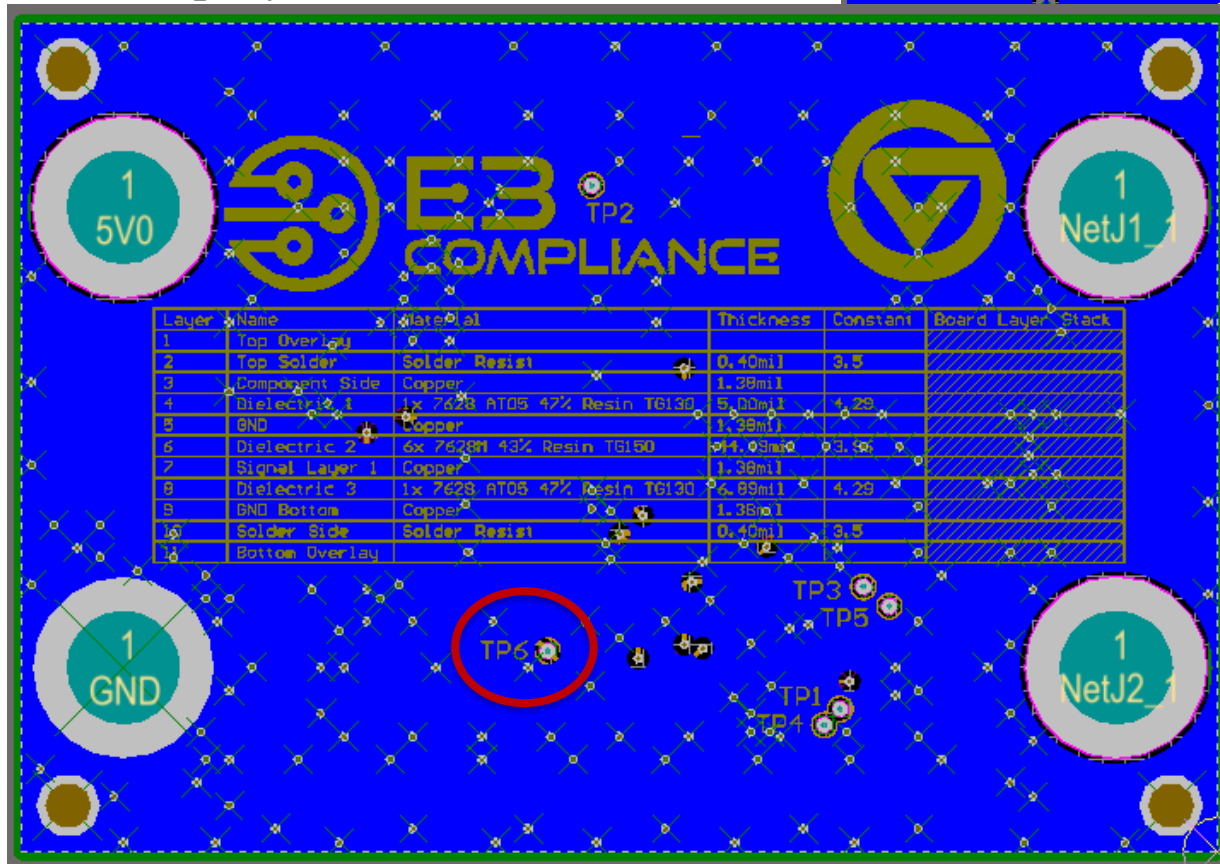
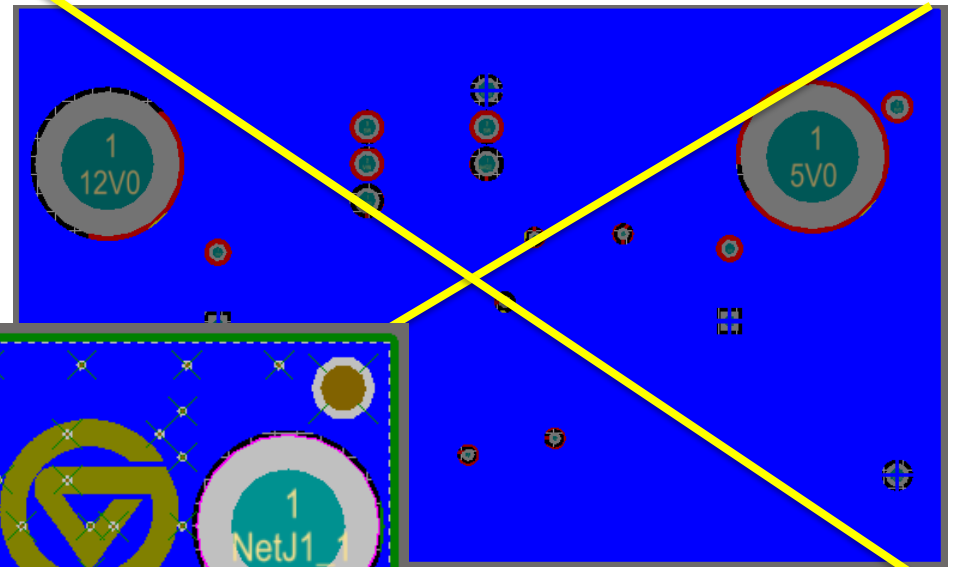
- Shielding, Top Paste
- 45° degree angel safes space
- Flat packages
- Improv: Reverse Bias Protection

CHOKER



Bottom Layer

The bottom overlay can be used for additional information or to save space on the top layer.



Questions



Thank you for your attention.

References

[1] “File:Overview icon.svg - Wikimedia Commons.” [Online]. Available: https://commons.wikimedia.org/wiki/File:Overview_icon.svg. [Accessed: 10-Apr-2018].