



MATERIAL IDENTIFICATION IN ELECTRONICS

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GOING GREEN – CARE INNOVATION 2014





OVERVIEW



- ▶ Material declarations
- ▶ Models for estimating material content
- ▶ Identification of materials in a PBA
- ▶ Challenges



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MATERIAL DECLARATIONS

- ▶ Expectations
- ▶ Existing Standards
- ▶ IPC 1752
- ▶ Issues

EXPECTATIONS

Identify all materials in an electronic assembly



Au

Pb

Ni

Cu

Ag

Epoxy

EXPECTATIONS

Identify the weight of each of the materials



Au

Pb

Ni

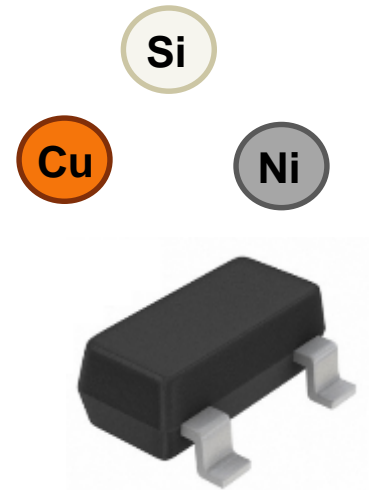
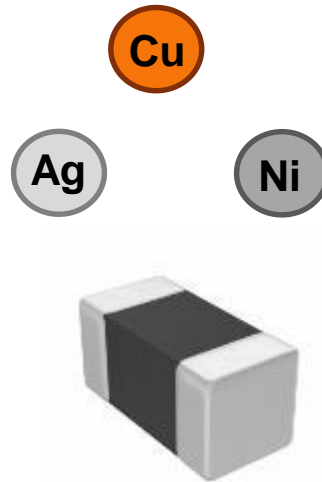
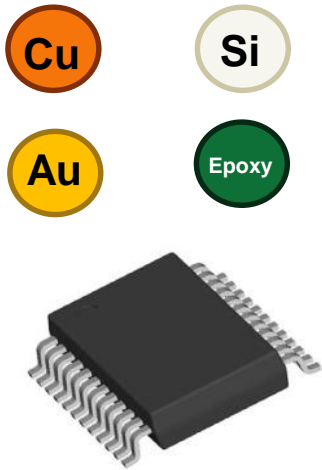
Cu

Ag

Epoxy

EXPECTATIONS

Identify location of each of the materials



EXPECTATIONS

Can be used by software tools

- ▶ 'Readable' format: XML



- ▶ Use of CAS numbers





EXISTING STANDARDS

- ▶ JIG – 101
- ▶ IEC 62474
- ▶ IPC 1752

EXISTING STANDARDS

	JIG - 101	IEC 62474	IPC 1752
Location of material	✓	✓	✓
CAS numbers	✓	✓	✓
XML format	✗	✓	✓
Report all materials	✗	✗	✓
Report weight	✗	✗	✓

- Declaration per component
- Only regulated substances are reported
- Weight only reported when above threshold

IPC 1752

Information at homogeneous level !

Homogeneous M...	Material Group	Mass	UoM	+	-	Level	Substance Category	+	-	Substance	CAS	Exe...	Mass	UoM
Bond Wire		3.57	mg	+	-	Supplier	Gold and Gold Com...	+	-	Gold	7440-57-5		3.57	mg
Leadframe Plating		4.55	mg	+	-	Supplier	Silver and Silver Co...	+	-	Silver	7440-22-4		4.55	mg
Die Attach Material		5.04	mg	+	-	Supplier	Silver and Silver Co...	+	-	Silver	7440-22-4		3.9312	mg
				+	-	Supplier	Proprietary Material...	+	-	Epoxy (EP)			1.1088	mg
Ext. Plating		6.16	mg	+	-	Supplier	Tin and Tin Compo...	+	-	Tin	7440-31-5		6.16	mg
Silicon Die		37.87	mg	+	-	Supplier	Silicon and Silicon ...	+	-	Silicon	7440-21-3		37.87	mg
Leadframe		178.85	mg	+	-	Supplier	Copper and Copper...	+	-	Copper	7440-50-8		176.79...	mg
				+	-	Supplier	Chromium and Chr...	+	-	Chromium	7440-47-3		0.53655	mg
				+	-	Supplier	Tin and Tin Compo...	+	-	Tin	7440-31-5		0.4471...	mg
				+	-	Supplier	Zinc and Zirconium ...	+	-	Zinc	7440-66-6		1.0731	mg
Mold Compound		463.96	mg	+	-	Supplier	Proprietary Material...	+	-	Epoxy Resin (EP)			41.7564	mg
				+	-	Supplier	Proprietary Material...	+	-	Phenolic Resin			32.4772	mg
				+	-	Supplier	Carbon and Carbon...	+	-	Carbon black	1333-86-4		2.3198	mg
				+	-	Supplier	Silicon and Silicon ...	+	-	Silica, vitreous	60676-86-0		382.767	mg
				+	-	Supplier	Bismuth/Bismuth C...	+	-	Bismuth	7440-69-9		4.6396	mg

IPC 1752

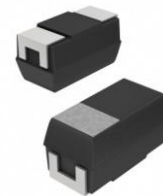
One IPC form for each component



Product List



Product: (MfrItemName=""MfrItemNumber="CR 16 - 1202 F L")



IPC 1752

One IPC form for an entire PBA

Product List

- Product: (MfrItemName="MDNG-5121 BB MA" MfrItemNumber="K9300267B")
 - SubProduct: (MfrItemNumber="CR16-1101-FL")
 - SubProduct: (MfrItemNumber="CR16-10R0-FL")
 - SubProduct: (MfrItemNumber="CR16-1003-FL")
 - SubProduct: (MfrItemNumber="CR16-1002-FL")
 - SubProduct: (MfrItemNumber="CR16-1001-FL")
 - SubProduct: (MfrItemNumber="CR16-1000-FL")
 - SubProduct: (MfrItemNumber="CR16-000-ZL")
 - SubProduct: (MfrItemNumber="NACE2R2M50V4X5.5TR13F")
 - SubProduct: (MfrItemNumber="CRH0603-FW-2204ELF")
 - SubProduct: (MfrItemNumber="AT24C128C-SSHM-T")
 - SubProduct: (MfrItemNumber="51021-1200")



→ Suitable as database



ISSUES



- ▶ Supplied formats
- ▶ Undisclosed information
- ▶ No FMD available at all



OVERVIEW



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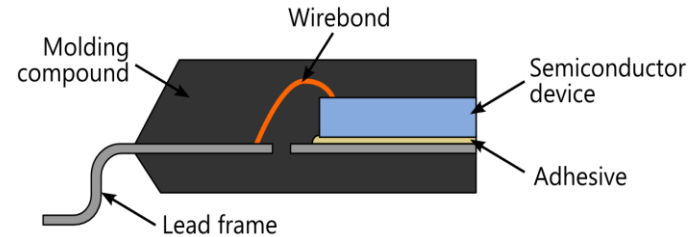
MODELS



- ▶ Components
 - IC
 - Passive
- ▶ PCB
- ▶ Solder

IC COMPOSITION MODEL

E.g. QFP package



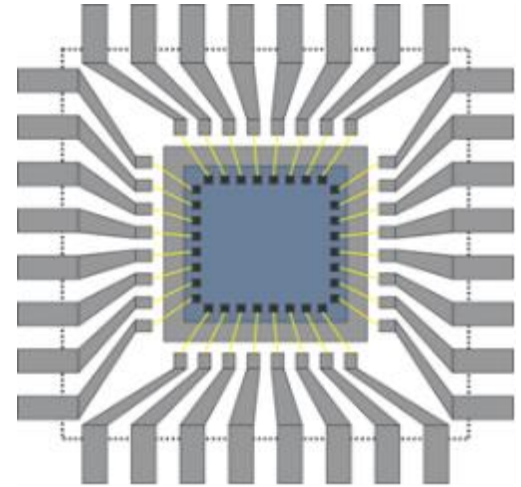
Estimate material composition based on:

- Package size
- Type of molding compound
- Number of terminals
- Type of leadframe alloy

IC COMPOSITION MODEL

Calculate volumes of homogeneous materials

- Lead frames
- Lead frames plating
- Bondwires
- Silicon chip
- Die attach
- Mould compound

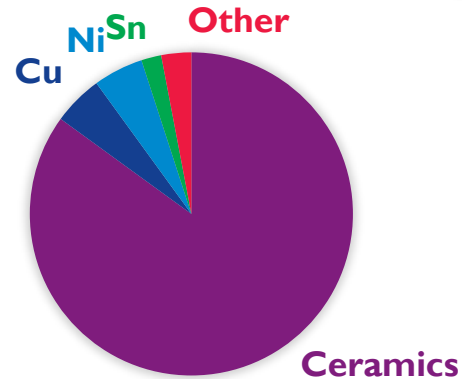


Translate volume to weight

PASSIVES COMPOSITION MODEL

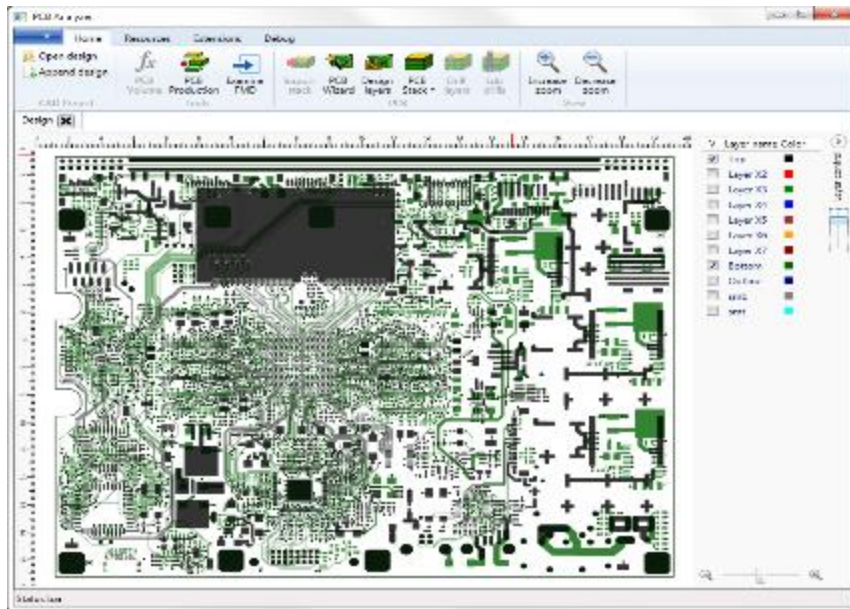
Based on weight percentages

- 85 % Ceramics (BaTiO_3)
- 5 % Cu
- 5 % Ni
- 2 % Sn
- 3 % other



PCB COMPOSITION MODEL

Layout and stackup data



8 LAYER STACKUP		
Basic material		
	PLATING	17 um
Cu_top	COPPER	18 um
	PREPREG	2x63 um
Cu_lay2	COPPER	35 um
	INNER	300 um
Cu_lay3	COPPER	35 um
	PREPREG	2x63 um
Cu_lay4	COPPER	35 um
	INNER	300 um
Cu_lay5	COPPER	35 um
	PREPREG	2x63 um
Cu_lay6	COPPER	35 um
	INNER	300 um
Cu_lay7	COPPER	35 um
	PREPREG	2x63 um
Cu_bot	COPPER	18 um
	PLATING	17 um
	TOTAL	1684 um

PCB COMPOSITION MODEL

Calculate material volumes PCB

Material	Volume (in mm ³)
Copper	4.585,2
Dielectric	40.740,6
Soldermask	1.554,8

ρ



Weight (in g)
41,08
67,63
3,28

Calculate material volumes Plating

Material	Volume (in mm ³)
Plating Ni (5 μ m)	68,06
Immersion Au (100 nm)	1,36

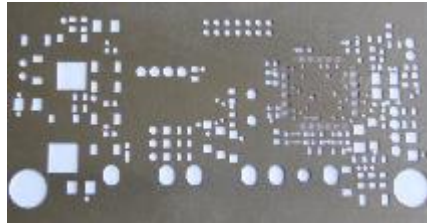
ρ



Weight (in g)
0,6
0,026

SOLDER COMPOSITION MODEL

Layout and stencil data



Calculate material volume of the solder

Material	Volume (in mm ³)
Solder (SAC 305)	680,63



Material	Weight (in g)
Tin	5,55
Silver	0,17
Copper	0,029

± 50% of volume remains after reflow



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IDENTIFICATION OF MATERIALS

- ▶ Requirements
- ▶ Identification
- ▶ Possibilities



REQUIREMENTS



- ▶ Bill of Material
- ▶ Material composition of all components
 - FMD
 - Models
- ▶ (Placement data)

IDENTIFICATION

Total Weight

Material: All

Total weight PBA

Item	Mass (in g)
PBA	635,1616

Total weight PCB

Item	Mass (in g)
PCB	84,859

Total weight Solder

Item	Mass (in g)
Solder	5,01500034

Total weight for each of the components

Item	Mass (in mg)
C5	23510,2324
C6	23510,2324
C11	23510,2324
C12	23510,2324
C18	23510,2324
C25	23510,2324
C33	23510,2324
C36	23510,2324
C37	23510,2324
C43	23510,2324
C55	23510,2324
C59	23510,2324
C60	23510,2324
C82	23510,2324
C133	23510,2324
C134	23510,2324
C135	23510,2324
C163	23510,2324

Total Weight

Material: Gold

Total weight PBA

Item	Mass (in g)
PBA	0,103068

Total weight PCB

Item	Mass (in g)
PCB	0,026

Total weight Solder

Item	Mass (in g)
Solder	0

Total weight for each of the components

Item	Mass (in mg)
I19	28,85841
I32	8,84
I44	8,84
I7	3,57
I16	2,9468
I17	2,9468
I1	2,871
I8	2,871
I20	2,871
I29	1,988
I12	1,2
I21	1,1
I36	0,890544
I5	0,82
I18	0,6
J28	0,54
I11	0,496
I37	0,402336

IDENTIFICATION

Material Content

Item Component

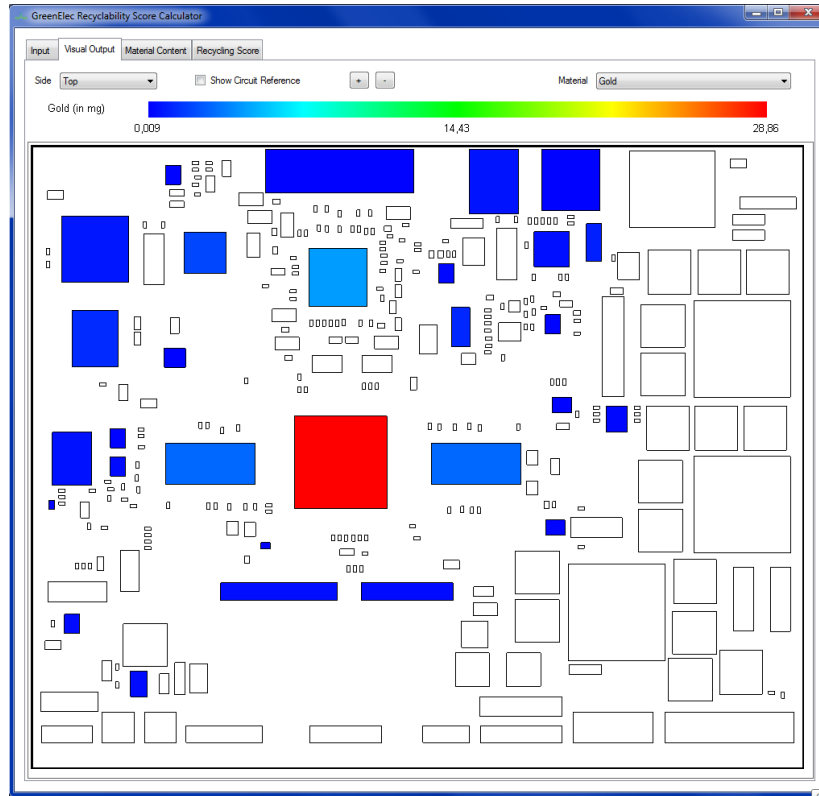
Material	CAS nr	Mass (in g)
Aluminium	7429-90-5	233,246231
Undisclosed		95,94726
1,3-Butadiene, 2...	9010-85-9	84,4039154
Copper	7440-50-8	83,36967
Polythio-1,4-phe...	25212-74-2	38,0026779
Iron	7439-89-6	23,9142017
Cellulose	9004-34-6	18,9976
Silica, vitreous	60676-86-0	10,8784838
Zinc	7440-66-6	6,81440067
Tin	7440-31-5	6,696389
Ditantalum penta...	1314-61-0	3,95289946
Benzene, 1,4-dic...	26125-40-6	3,917476
Quartz (SiO2)	14808-60-7	3,7644515
1-Propene, polym...	106565-43-9	2,99708962
Glass, oxide, che...	65997-17-3	2,544533
Epoxy Resin	61788-97-4	1,80578673
Nickel	7440-02-0	1,7279774
Cresol Novolac E...	29690-82-2	1,27320659
Barium titanium tri...	12047-27-7	1,25437832
Manganese dioxide	1313-13-9	0,8953441
Poly(imino(1-oxo...	25038-54-4	0,77556
1,4-Benzenedicar...	25776-72-1	0,767518
1,4-Benzenedicar...	26062-94-2	0,764421046
reaction product: ...	25068-38-6	0,758038759
Carbon black	1333-86-4	0,608217
Polyurethane est...	9009-54-5	0,5037984

Material Content

Item Component

Material	CAS nr	Mass (in mg)
Silicon	7440-21-3	60,4
Silver	7440-22-4	24,1006584
Resin	Trade Secret	1,4
Epoxy Resins	Trade Secret	88,1
SiO2	60676-86-0	645,9
Gold	7440-57-5	28,85841
Copper	7440-50-8	63,50013
Iron	7439-89-6	0,000132
Calcium	7440-70-2	0,000526
Palladium	7440-05-3	0,260584
Magnesium	7439-95-4	0,000132
Laminate	Trade Secret	232,8
Solder Mask	Trade Secret	66,2000046
Nickel	7440-02-0	14,9
Tin	7440-31-5	460,8

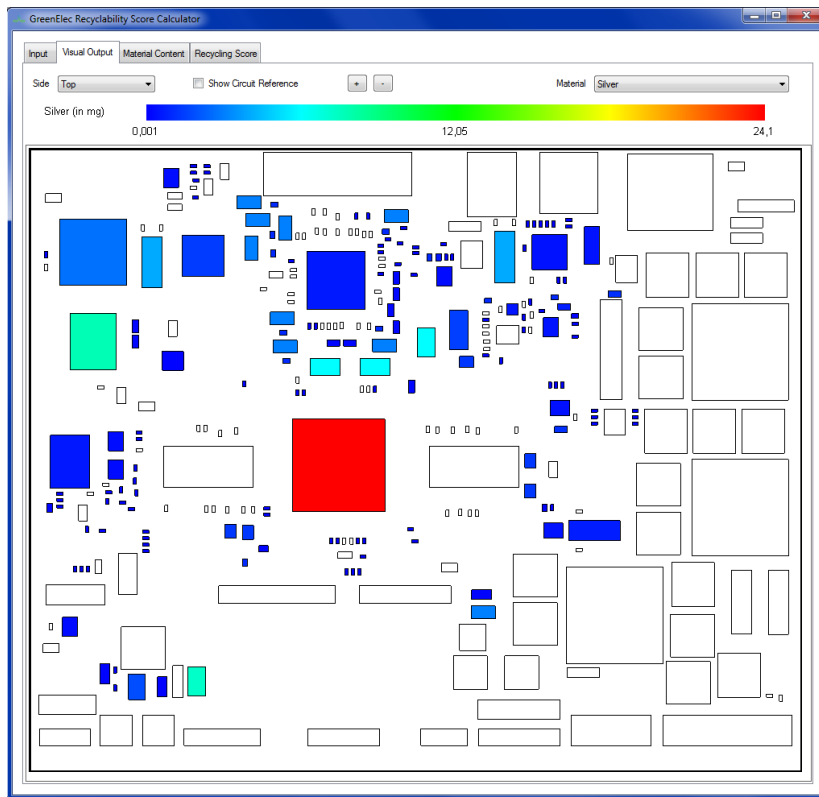
IDENTIFICATION



GOLD

Location and concentration on the top side.

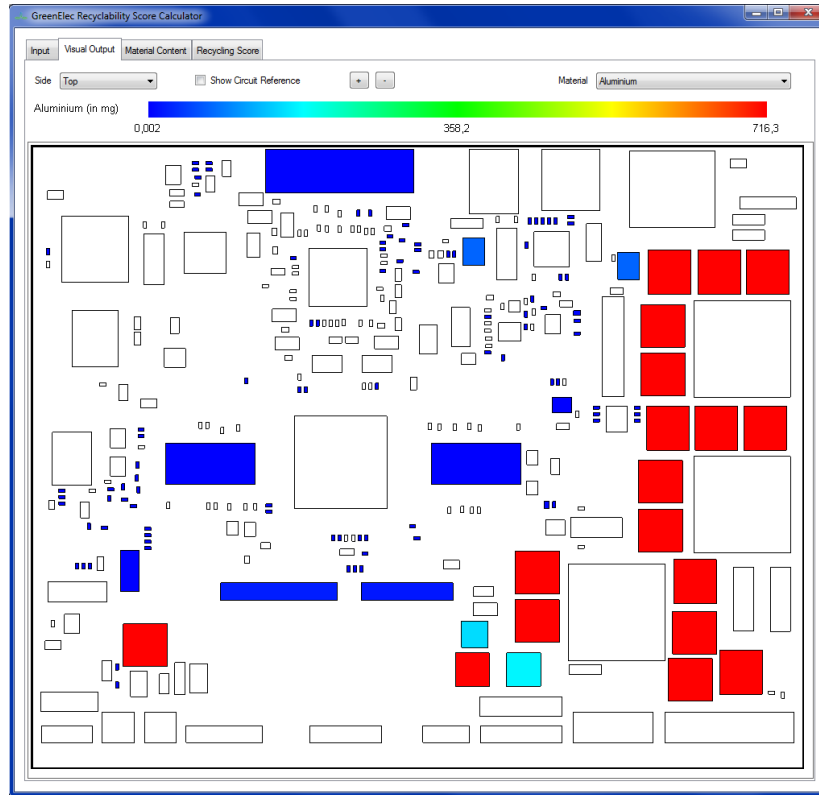
IDENTIFICATION



SILVER

Location and concentration on the top side.

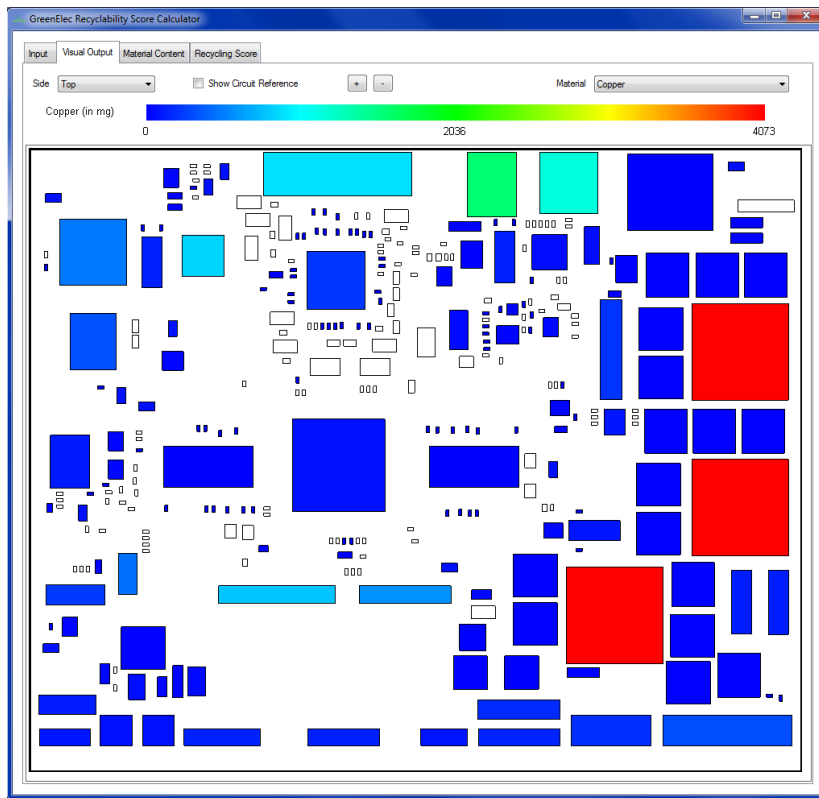
IDENTIFICATION



ALUMINUM

Location and concentration on the top side.

IDENTIFICATION



COPPER

Location and concentration on the top side.



POSSIBILITIES



- ▶ Better sorting possible
- ▶ Possibility for design for recycling
- ▶ More efficient recycling possible



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CHALLENGES

- ▶ FMD reporting more widely used
- ▶ Unique FMD format
- ▶ Getting the data to the recyclers

Thank you



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