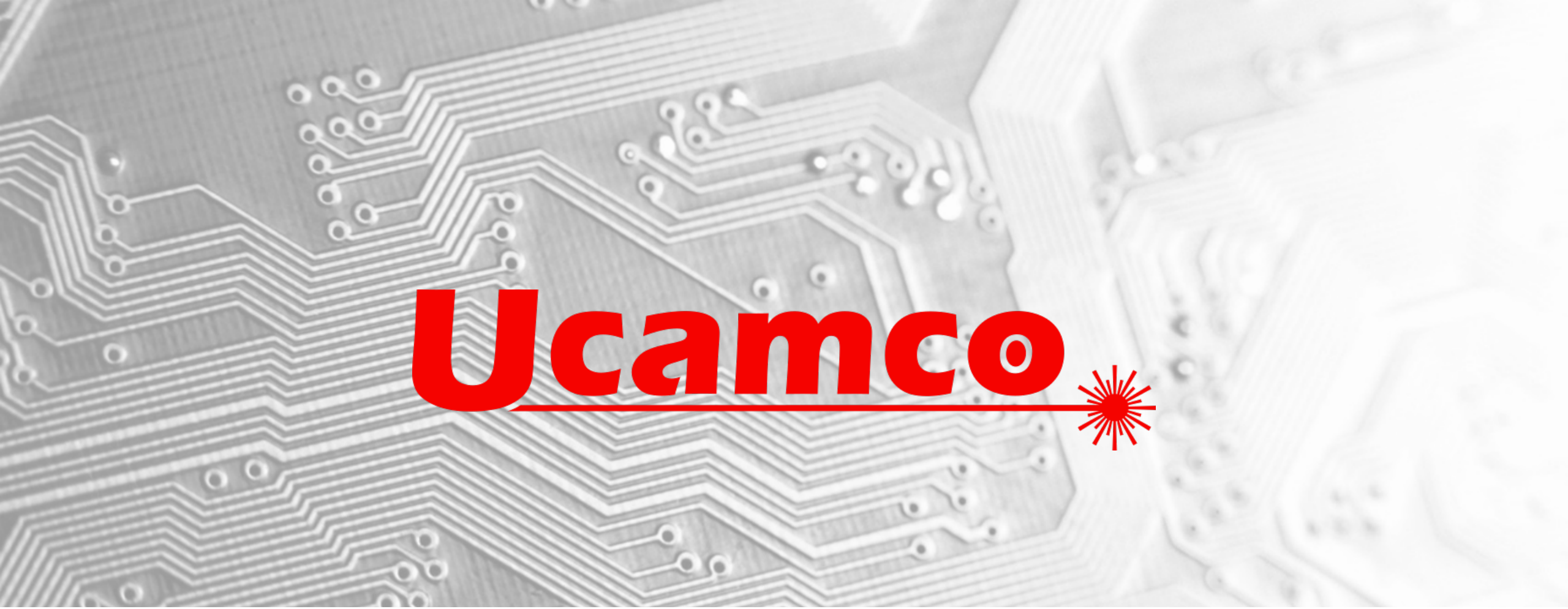


Gerber Generations

Karel Tavernier, June 8th, 2021

Gerber Generations

- Gerber X0 = Gerber RS274D -> revoked
- Gerber X1 = Gerber RS274X (Extended Gerber, GerberX) = fabrication image info
- Gerber X2 = Gerber X1 + bare board attributes = full bare-board fabrication info
- Gerber X3 = Gerber X2 + assembly attributes = full assembly and bare-board info

Gerber X1

Ucamco

- Gerber X1 = Gerber RS274X = Extended Gerber = GerberX
  - Released in 1998
  - Supported by all PCB CAD/CAM systems
  - Very precise specification
  - Thoroughly field tested and debugged
- What does it contain?
  - An accurate image for each layer
    - One layer = one file
    - Perfectly handles drill data
  - Location and shape of all objects

Gerber X1 cont'd

What is Gerber X1 lacking for bare board fabrication?

- No standard to define what each file represents
  - Is it the top copper layer, or the bottom solder mask?
- No standard to define the type of each pad
  - Is it a via pad, or a component pad, or an SMD Pad?

This extra information is defined in drawings or in additional documents

- It requires manual work on data input in CAM

Enter Gerber X2

Gerber X2

- Gerber X2 adds “attributes” to Gerber X1
  - Attribute = *standardized* label attached to files, apertures or objects
    - Attributes to define what the file is

```
%TF.FileFunction,Soldermask,Bot*%
%TF.FilePolarity,Negative*%
%FSLAX46Y46*%
%MOMM*%
```

    - Attributes to define the function of an object, a pad in this example

```
%TD*%
%TA.AperFunction,ViaPad*%
%ADD22C,0.500000*%
%TD*%
```

Gerber X2 cont'd

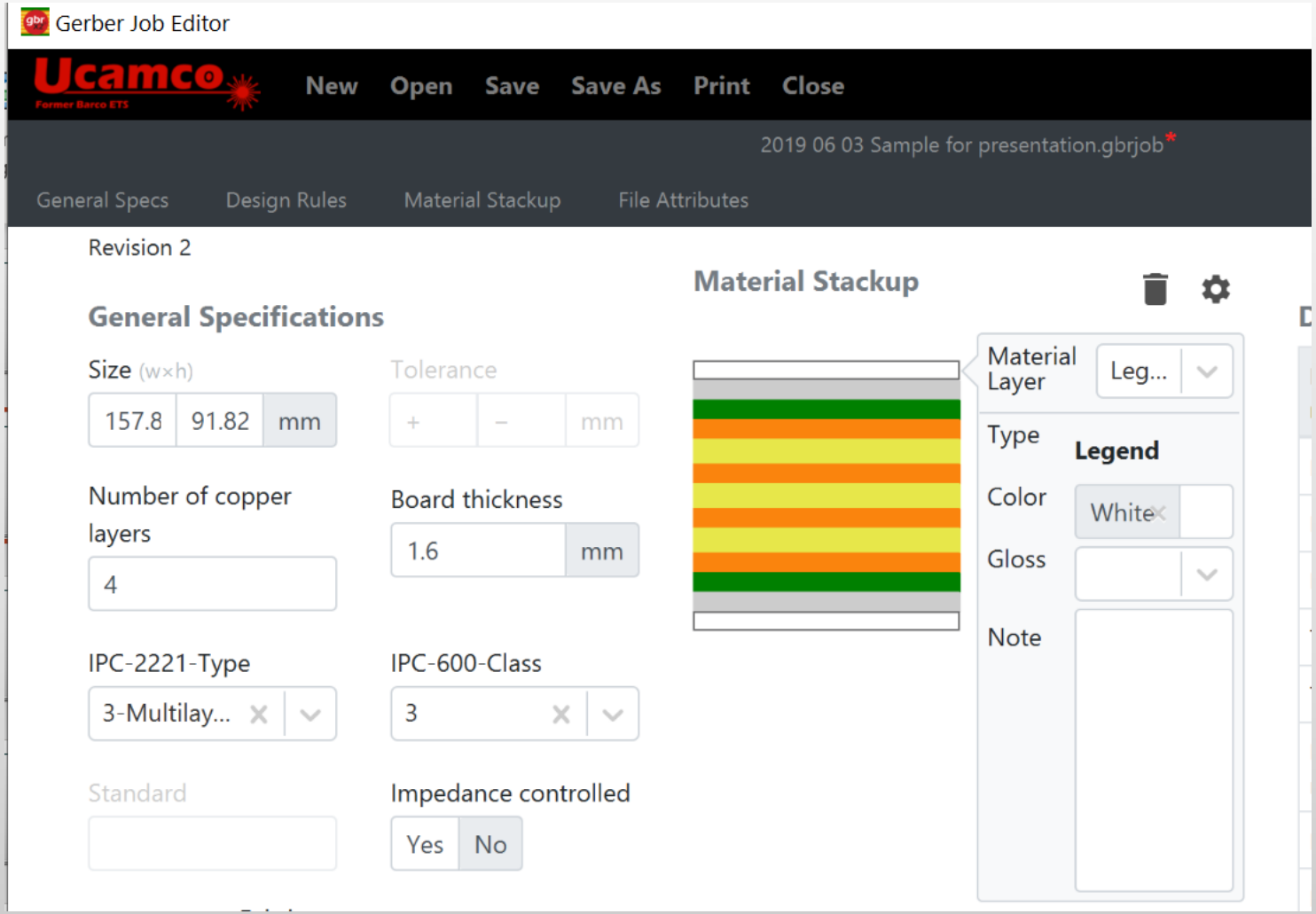
Ucamco

- Some characteristics to not belong a layer or a single object
  - Overall thickness, finish, IPC class
- These attributes are put in a separate standardized file, the Gerber Job File
  - Using JSON standard for easy implementation
  - Standardized attributes
  - Extension .gbrjob
- Exemple, taken from a gerber job file generated by KiCad

```
"GeneralSpecs":
{
  "Size":
  {
    "X": 90.150,
    "Y": 180.150
  },
  "LayerNumber": 6,
  "BoardThickness":  1.100,
  "Finish":  "EPENIG"
},
```

Gerber X2 cont'd

- A free Gerber Job Editor is available on the Gerber page ucamco.com/en/gerber



Gerber X2 cont'd

- First version released in 2014
  - Very precise specification
  - Widely adopted by CAD and CAM systems
- Compatible with X1
  - An X1 reader that ignores the attributes returns to correct image
  - Easy to implement
  - Human readable
  - The difficult part of any format is the image, and that is field tested
- Contains all information needed for bare-board CAM
- What is there not to like?
- Send X2 to your fabricator = give clear instructions.

Assembly

- Gerber X2 contains all information needed for bare-board fabrication
- But what about assembly?
  - Assembly needs component information
    - BOM info: part number, …
    - Location on the board
    - Orientation
    - Footprint
- Enter Gerber X3

Gerber X3 Development

Ucamco

- In 2018 a prototype spec was developed by Karel Tavernier (Ucamco)
- Intense discussions with a group of people from CAD, assembly, CAM,…
  - Wim De Greve (EuroCircuits), Jean-Pierre Charras (KiCad), others
  - Five revisions
- In October 2019 a draft was published for review by the user community
- Several revisions during public review
  - Feedback from very diverse people
- In February 2020 the final spec was published
- Several implementations already

Gerber X3 Overview

- Gerber X3 reuses existing infrastructure
  - X3 reuses the image format from X2
  - X3 reuses the X2 attribute syntax
- Gerber X3 is not a new format, it is new content
  - Two new layers: top and bottom component layers
  - Attributes to identify centroid, pin 1, component outline,…
  - Attributes with the BOM info
- Gerber X3 can be read by existing software with Gerber X1 or X2 input
  - A decisive advantage for development
  - Current viewers can already view the component layers

Gerber X3 Component Layers

Ucamco

- Identified by the usual attribute

```
%TF.FileFunction,Component,L1,Top*%
%FSLAX46Y46*%
%MOMM*%
```

- Centroid, pin 1, component outline defined by the usual attributes using *existing* image constructs
  - Alignment with copper layers guaranteed

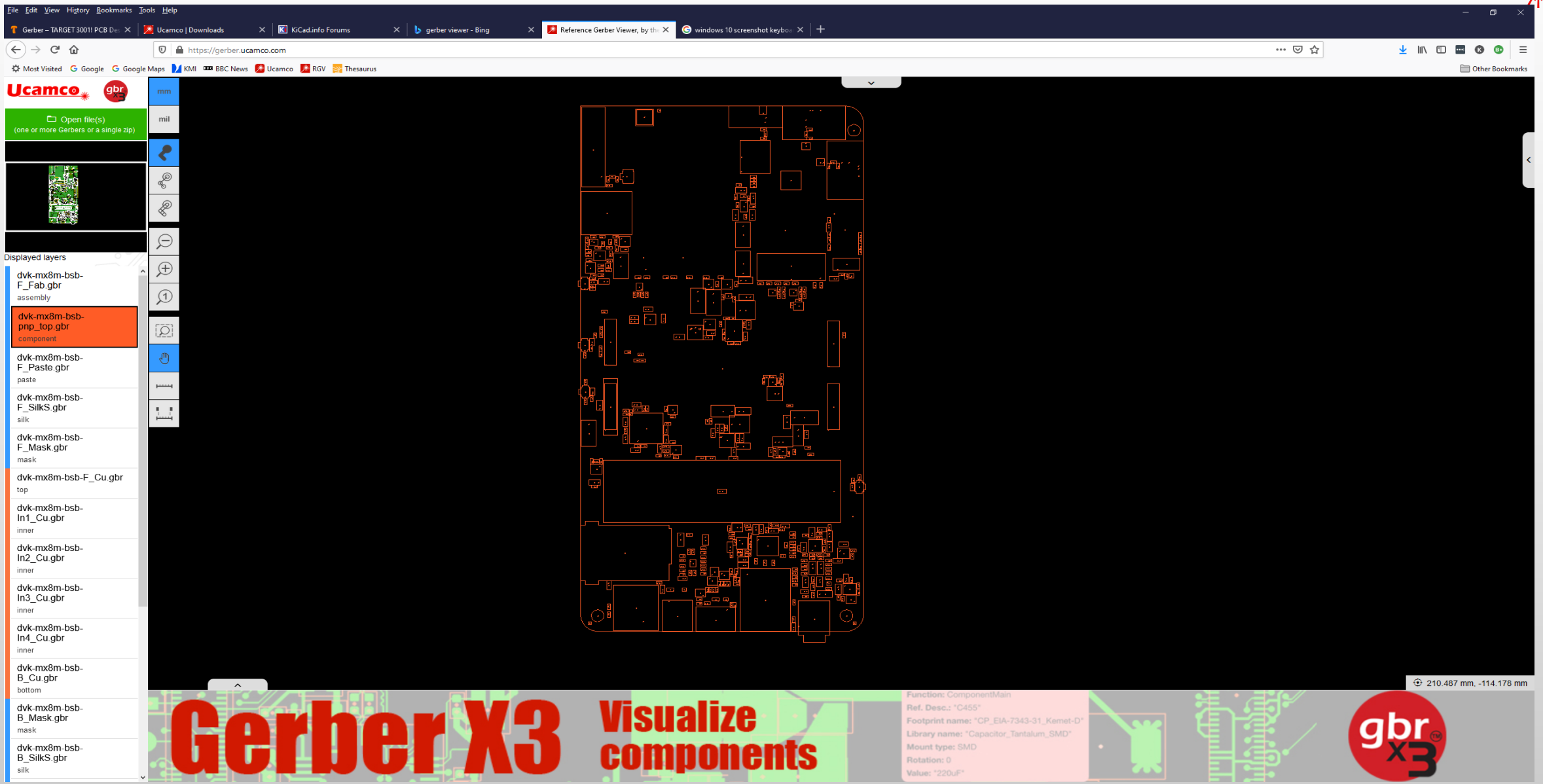
```
G04 APERTURE LIST*
%TA.AperFunction,ComponentMain*%
%ADD10C,0.300000*%
%TD*%
%TA.AperFunction,ComponentOutline,Courtyard*%
%ADD11C,0.100000*%
%TD*%
%TA.AperFunction,ComponentPin*%
%ADD12P,0.360000X4X0.000000*%
%TD*%
%TA.AperFunction,ComponentOutline,Footprint*%
%ADD14C,0.100000*%
```

Gerber X3 - Screenshots

- Screenshots from current Gerber X2 Viewer e.g. Ucamco's Reference Gerber Viewer
- No development needed to display info below
- Applications such as linking to a component database of course need development

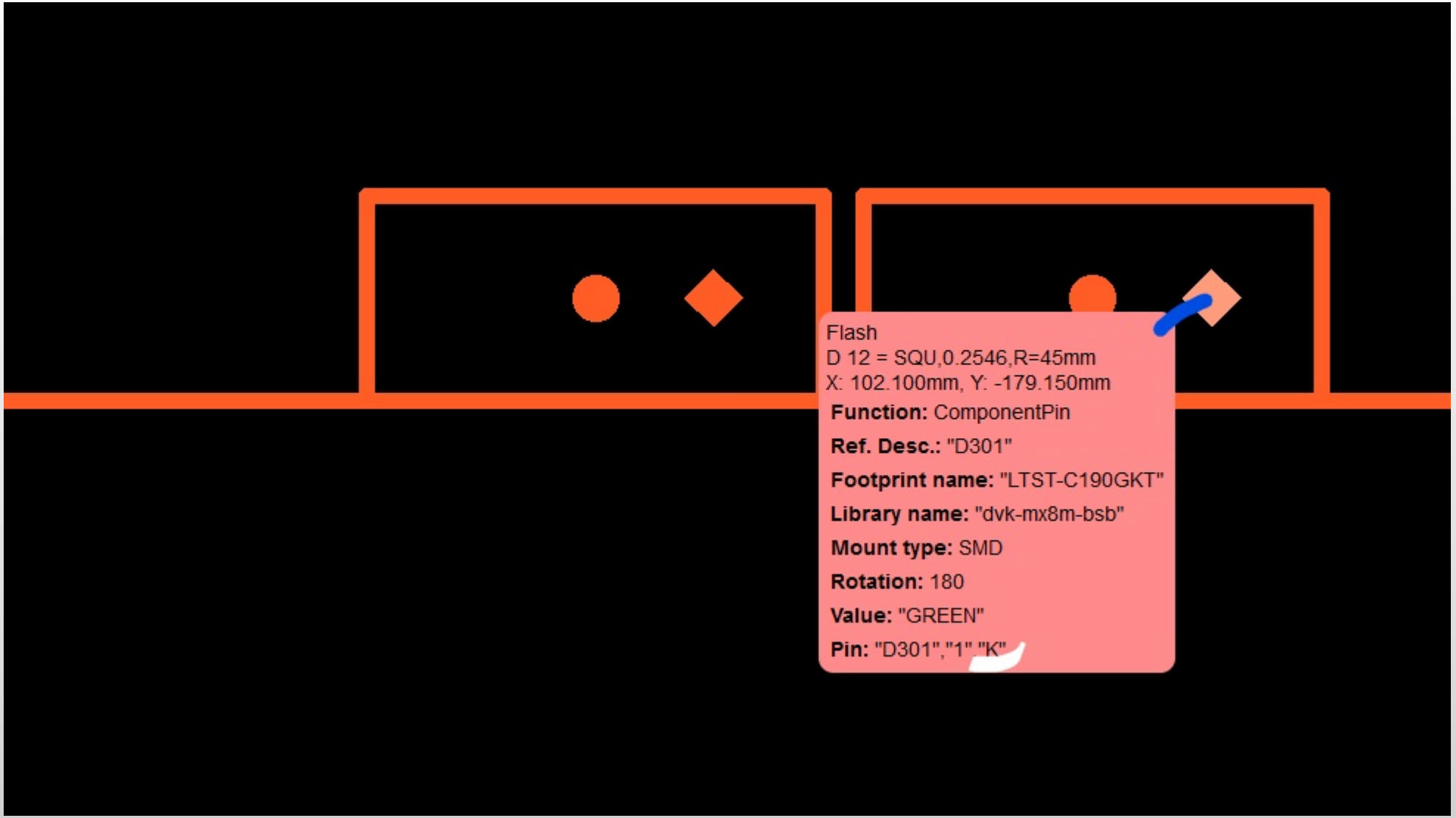
Gerber X3 – Component Layer

Ucamco



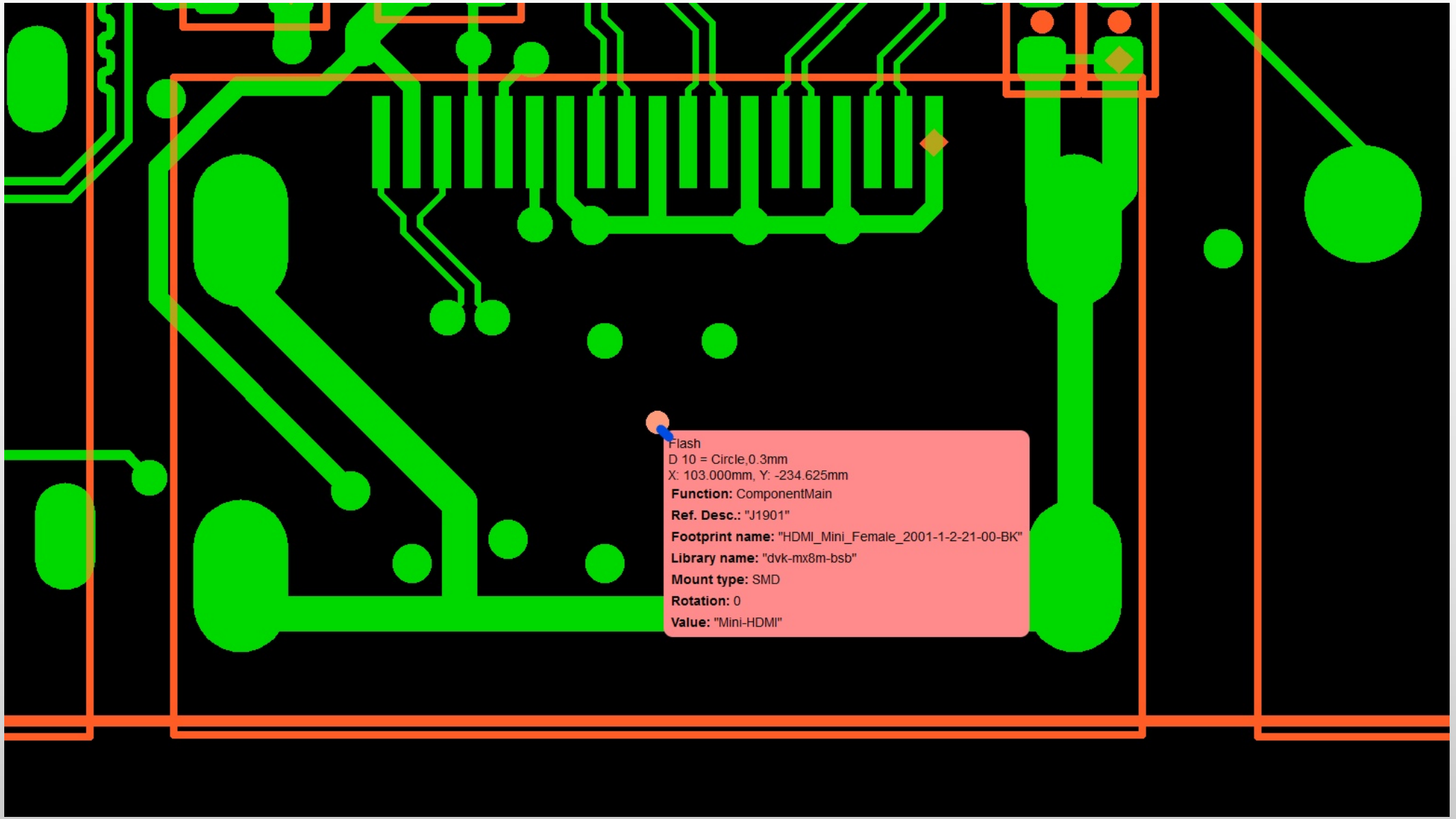
Gerber X3 – Zoom on a Centroid

Gerber X3 – Zoom on Pin 1



Note the pin function "K" (Cathode).
This eliminates the ambiguity on the orientation of diodes and elco's.

Gerber X3 – with Copper Layer



When displayed together with the copper layer the *exact* footprint is displayed, exactly located and rotated.

Gerber X3 - Summary

Ucamco

- Guaranteed registration with copper, exact footprints, P&P data
  - By reusing copper image constructs
- Full BOM information
- No development needed for input
  - By sticking to Gerber X2 syntax and image constructs
- In a simple, human readable format
- What is there not to like?

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