



Ucamco 

Gerber Generations

Karel Tavernier, June 8th, 2021

- ✱ 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 = 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

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 adds “attributes” to Gerber X1
- ✱ Attribute = *standardized* label attached to files, apertures or objects
 - Attributes to define what the file is
 - Attributes to define the function of an object, a pad in this example

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

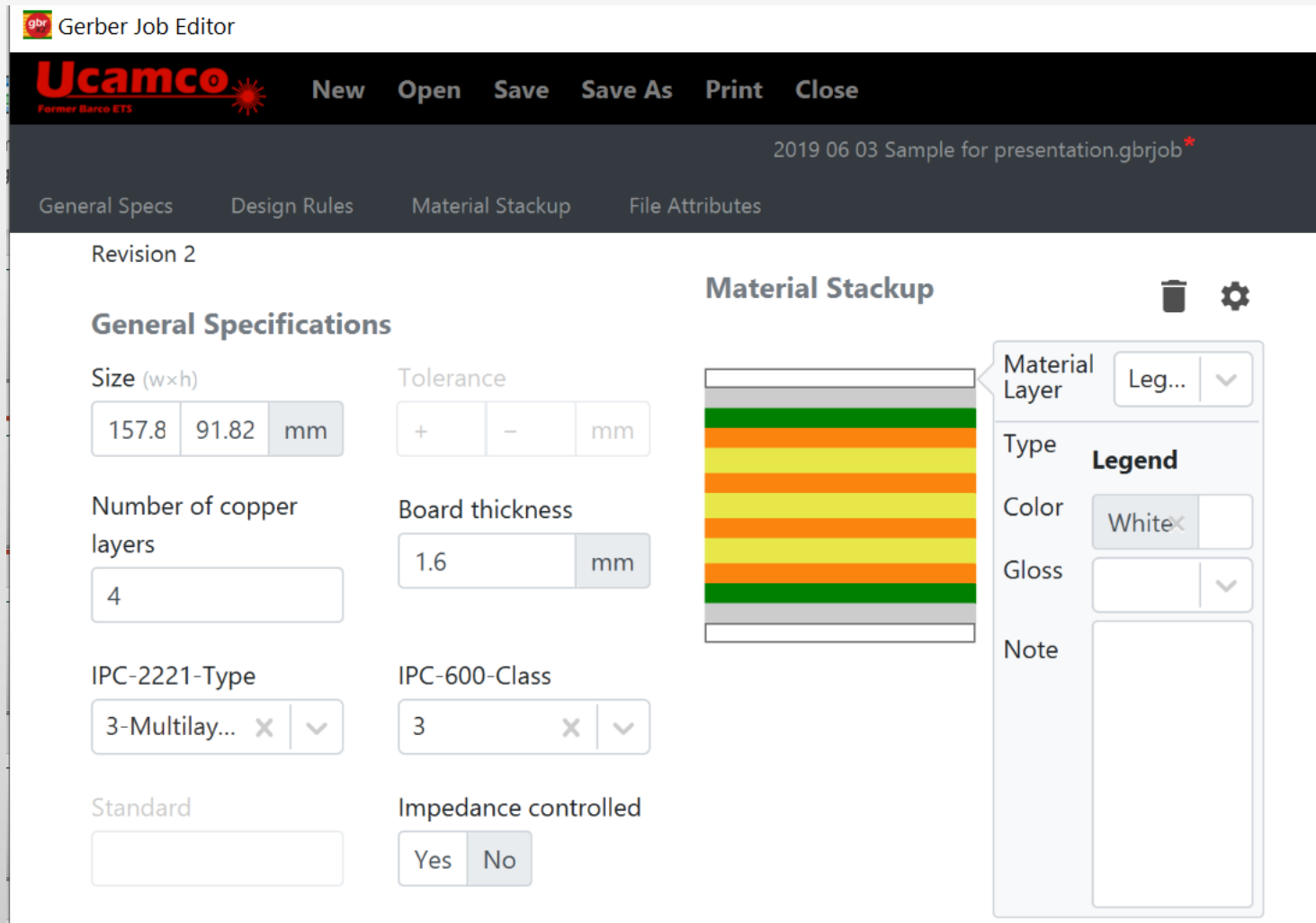
```
%TD*%  
%TA.AperFunction,ViaPad*%  
%ADD22C,0.500000*%  
%TD*%
```

- ✱ 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



The screenshot displays the Gerber Job Editor interface. At the top, there is a menu bar with options: New, Open, Save, Save As, Print, Close. Below the menu bar, the file name is shown as "2019 06 03 Sample for presentation.gbrjob". The main window is divided into several sections:

- General Specifications:** Includes fields for Size (w×h) (157.8, 91.82, mm), Tolerance (+, -, mm), Number of copper layers (4), Board thickness (1.6, mm), IPC-2221-Type (3-Multilay...), IPC-600-Class (3), Standard, and Impedance controlled (Yes/No).
- Material Stackup:** A central area showing a vertical stack of colored layers (green, yellow, orange, green, white) representing the board's construction. To the right of this stack is a legend panel with fields for Material Layer (Leg...), Type, Color (White), Gloss, and Note.

- ✱ 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.

- ✱ 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



- ✱ 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 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

- Identified by the usual attribute

```
%TF.FileFunction,Component,L1,Top*%  
%FSLAX46Y46*%  
%MOMM*%  
G04 APERTURE LIST*
```

- 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*%
```

- ✱ 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



The screenshot displays the Ucamco Gerber X3 viewer interface. At the top, a browser window shows the URL <https://gerber.ucamco.com>. The left sidebar contains a file list under 'Displayed layers' with the following items:

- dvk-mx8m-bsb-F_Fab.gbr assembly
- dvk-mx8m-bsb-pnp_top.gbr component**
- dvk-mx8m-bsb-F_Paste.gbr paste
- dvk-mx8m-bsb-F_SilkS.gbr silk
- dvk-mx8m-bsb-F_Mask.gbr mask
- dvk-mx8m-bsb-F_Cu.gbr top
- dvk-mx8m-bsb-In1_Cu.gbr inner
- dvk-mx8m-bsb-In2_Cu.gbr inner
- dvk-mx8m-bsb-In3_Cu.gbr inner
- dvk-mx8m-bsb-In4_Cu.gbr inner
- dvk-mx8m-bsb-B_Cu.gbr bottom
- dvk-mx8m-bsb-B_Mask.gbr mask
- dvk-mx8m-bsb-B_SilkS.gbr silk

The central canvas shows a PCB layout with components highlighted in orange. The bottom banner features the text 'Gerber X3 Visualize components' and a component data panel with the following information:

- Footprint name: "CP_EIA-7343-31_Kemet-D"
- Library name: "Capacitor_Tantalum_SMD"
- Mount type: SMD
- Rotation: 0
- Value: "220uF"

The bottom right corner of the banner includes the Ucamco logo and the text 'www.ucamco.com'.

Gerber X3 – Zoom on a Centroid

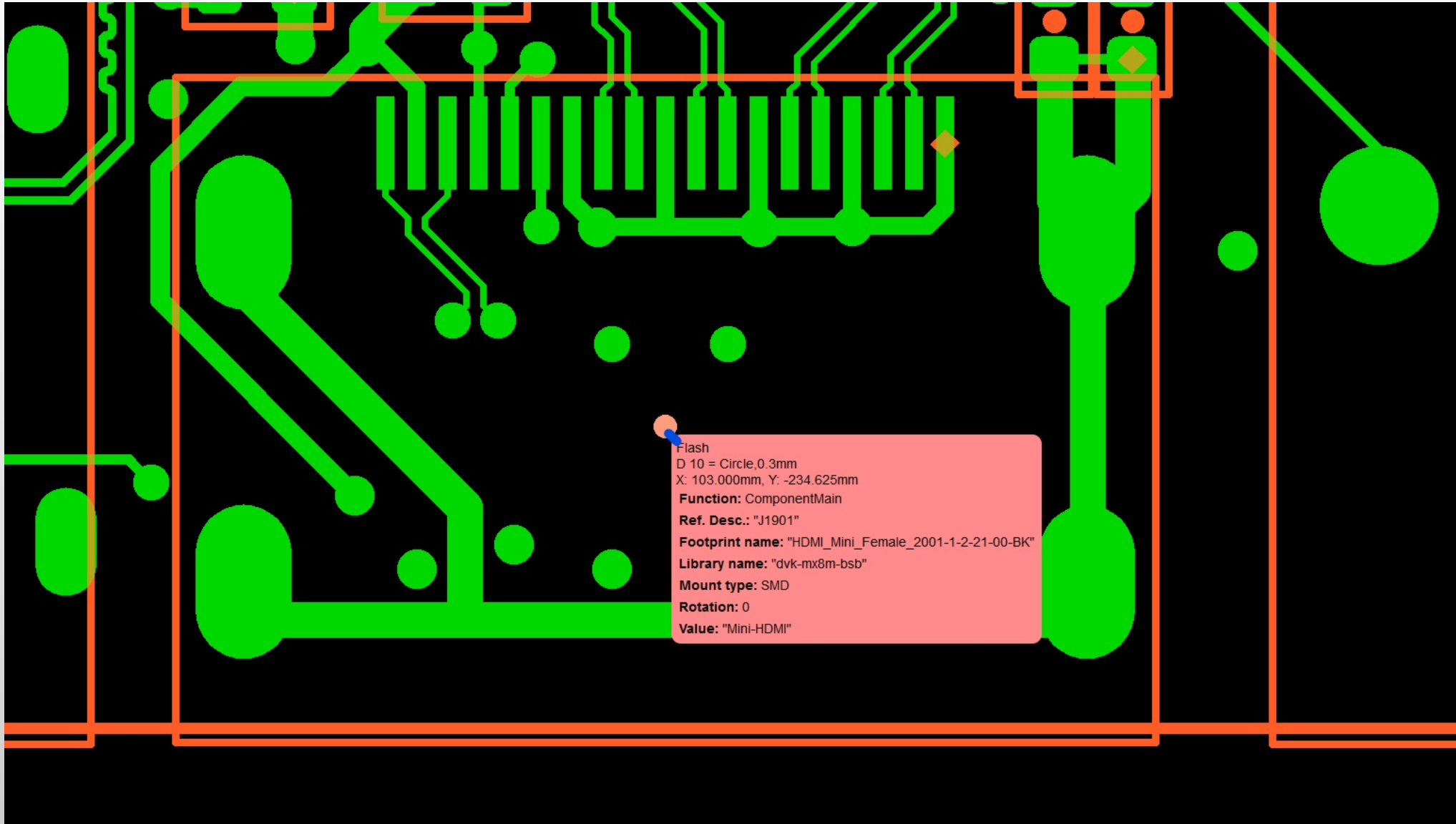


Gerber X3 – Zoom on Pin 1



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.

- ✱ 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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