gEDA/gaf File Format Document

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Contents

1 Overview

This file is the official documentation for the file formats in gEDA/gaf (Gschem And Friends). The primary file format used in gEDA/gaf is the schematic/symbol format. Files which end with .sch or .sym are schematics or symbol files. Until there is another file type in gEDA/gaf, then this document will only cover the symbol/schematic file format.

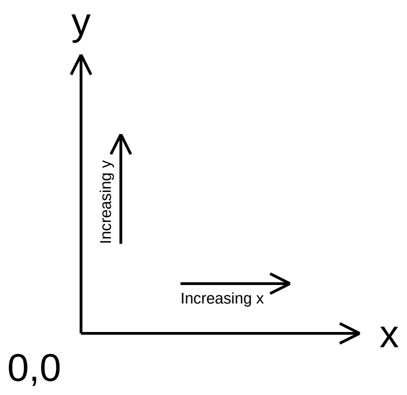
This file format document is current as of gEDA/gaf version 20040111. This document covers file format version **1**.

Note, this file format and any other file formats associated with gEDA are placed under the General Public License (GPL) version 2.0. The gEDA/gaf symbol and schematic file format is Copyright (C) 1998-2004 Ales Hvezda.

2 Coordinate Space

- All coordinates are in mils (1/1000 or an inch). This is an arbitrary decision. Remember in there is no concept of physical lengths/dimensions in schematics and symbols (for schematic capture only).
- Origin is in lower left hand corner.
- The size of the coordinate space is unlimited, but it is recommended that all objects stay within (120.0, 90.0) (x, y inches).
- It is generally advisable to have positive x and y coordinates, however, negative coordinates work too, but not recommended.

The following figure shows how the coordinate space is setup:



X axis increases going to the right. Y axis increase going up. Coordinate system is landscape and corresponds to a sheet of paper turned on its side.

3 Filenames

Symbols end in .sym. The only symbol filename convention that is used in gEDA/gaf is that if there are multiple instances of a symbol with the same name (like a 7400), then a -1, -2, -3, ... -N suffix is added to the end of the filename. Example: 7400-1.sym, 7400-2.sym, 7400-3.sym...

Schematics end in .sch. There used to be a schematic filename convention (adding a -1 .. -N to the end of the basename), but this convention is now obsolete. Schematic filenames can be anything that makes sense to the creator.

4 Object types

A schematic/symbol file for gEDA/gaf consists of:

- A version (v) as the first item in the file. This is required.
- Any number of objects and the correct data. Objects are specified by an "object type"
- Most objects are a single line, however text objects are two lines long.
- No blank lines at the end of the file (these are ignored by the tools)
- For all enumerated types in the gEDA/gaf file formats, the field takes on the numeric value.

The "object type" id is a single letter and this id **must** start in the first column. The object type id is case sensitive.

The schematic and symbol files share the same file layout. A symbol is nothing more than a collection of primitive objects (lines, boxes, circles, arcs, text, and pins). A schematic is a collection of symbols (components), nets, and buses.

The following sections describe the specifics of each recognized object type. Each section has the name of the object, which file type (sch/sym) the object can appear in, the format of the data, a description of each individual field, details and caveats of the fields, and finally an example with description.

For information on the color index (which is used in practically all objects), see the Color section.

4.1 version

Valid in: Schematic and Symbol files

type version

Field	Type/unit	Description
type	char	v
version	int	version of gEDA/gaf that wrote this file
fileformat_version	int	gEDA/gaf file format version number

- The type is a lower case ”v” (as in Victor).
- This object must be in every file used or created by the gEDA/gaf tools.
- The format of the first version field is YYYYMMDD.
- The version number is not an arbitrary timestamp. Do not make up a version number and expect the tools to behave properly.
- The ”version of gEDA/gaf that wrote this file” was used in all versions of gEDA/gaf up to 20030921 as the file formats version. This field should no longer be used to determine the file format. It is used for information purposes only now.
- Starting at and after gEDA/gaf version 20031004, the fileformat_version field is used to determine the file format version. All file format code should key off of this field.
- fileformat_version increases when the file format changes.
- The starting point for fileformat_version is 1.
- fileformat_version is just an integer with no minor number.
- Valid versions include: 19990601, 19990610, 19990705, 19990829, 19990919, 19991011, 20000220, 20000704, 20001006, 20001217, 20010304, 20010708, 20010722, 20020209, 20020414, 20020527, 20020825, 20021103, 20030223, 20030525, 20030901, 20040111
- CVS or test versions (should not be used): 20030921, 20031004, 20031019, 20031231
- Keep in mind that each of the above listed versions might have had file format variations. This document only covers the last version’s file format.

Example:
```
v 20040111 1
```

4.2 line

Valid in: Schematic and Symbol files

type x1 y1 x2 y2 color width capstyle dashstyle dashlength dashspace

Field	Type/unit	Description
type	char	L
x1	int/mils	First X coordinate
y1	int/mils	First Y coordinate
x2	int/mils	Second X coordinate
y2	int/mils	Second Y coordinate
color	int	Color index
width	int/mils	Width of line
capstyle	int	Line cap style
dashstyle	int	Type of dash style
dashlength	int	Length of dash
dashspace	int	Space inbetween dashes

- The capstyle is an enumerated type:
  - END_NONE = 0
  - END_SQUARE = 1
  - END_ROUND = 2
- The dashstyle is an enumerated type:
  - TYPE_SOLID = 0
  - TYPE_DOTTED = 1
  - TYPE_DASHED = 2
  - TYPE_CENTER = 3
  - TYPE_PHANTOM = 4
- The dashlength parameter is not used for TYPE_SOLID and TYPE_DOTTED. This parameter should take on a value of -1 in these cases.
- The dashspace paramater is not used for TYPE_SOLID. This parameter should take on a value of -1 in these case.

Example:
```
L 23000 69000 28000 69000 3 40 0 1 -1 75
```
A line segment from (23000, 69000) to (28000, 69000) with color index 3, 40 mils thick, no cap, dotted line style, and with a spacing of 75 mils in between each dot.

4.3 box

Valid in: Schematic and Symbol files

type x y width height color width capstyle dashtype dashlength dashspace filltype fillwidth angle1 pitch1 angle2 pitch2

Field	Type/unit	Description
type	char	B
x	int/mils	Lower left hand X coordinate
y	int/mils	Lower left hand Y coordinate
width	int/mils	Width of the box (x direction)
height	int/mils	Height of the box (y direction)
color	int	Color index
width	int/mils	Width of lines
capstyle	int/mils	Line cap style
dashstyle	int	Type of dash style
dashlength	int/mils	Length of dash
dashspace	int/mils	Space inbetween dashes
filltype	int	Type of fill
fillwidth	int/mils	Width of the fill lines
angle1	int/degrees	First angle of fill
pitch1	int/mils	First pitch/spacing of fill
angle2	int/degrees	Second angle of fill
pitch2	int/mils	Second pitch/spacing of fill

- The capstyle is an enumerated type:
  - END_NONE = 0
  - END_SQUARE = 1
  - END_ROUND = 2
- The dashstyle is an enumerated type:
  - TYPE_SOLID = 0
  - TYPE_DOTTED = 1
  - TYPE_DASHED = 2
  - TYPE_CENTER = 3
  - TYPE_PHANTOM = 4
- The dashlength parameter is not used for TYPE_SOLID and TYPE_DOTTED. This parameter should take on a value of -1 in these cases.
- The dashspace paramater is not used for TYPE_SOLID. This parameter should take on a value of -1 in these case.
- The filltype parameter is an enumerated type:
  - FILLING_HOLLOW = 0
  - FILLING_FILL = 1
  - FILLING_MESH = 2

  - FILLING_HATCH = 3
  - FILLING_VOID = 4 **unused**

- If the filltype is 0 (FILLING_HOLLOW), then all the fill parameters should take on a value of -1.
- The fill type FILLING_FILL is a solid color fill.
- The two pairs of pitch and spacing control the fill or hatch if the fill type is FILLING_MESH.
- Only the first pair of pitch and spacing are used if the fill type is FILLING_HATCH.

Example:

```
B 33000 67300 2000 2000 3 60 0 2 75 50 0 -1 -1 -1 -1 -1
```

A box with the lower left hand corner at (33000, 67300) and a width and height of (2000, 2000), color index 3, line width of 60 mils, no cap, dashed line type, dash length of 75 mils, dash spacing of 50 mils, no fill, rest parameters unset.

4.4 circle

Valid in: Schematic and Symbol files

type x y radius color width capstyle dashtype dashlength dashspace filltype fillwidth angle1 pitch1 angle2 pitch2

Field	Type/unit	Description
type	char	V
x	int/mils	Center X coordinate
y	int/mils	Center Y coordinate
radius	int/mils	Radius of the circle
color	int	Color index
width	int/mils	Width of circle line
capstyle	int/mils	0 **unused**
dashstyle	int	Type of dash style
dashlength	int/mils	Length of dash
dashspace	int/mils	Space inbetween dashes
filltype	int	Type of fill
fillwidth	int/mils	Width of the fill lines
angle1	int/degrees	First angle of fill
pitch1	int/mils	First pitch/spacing of fill
angle2	int/degrees	Second angle of fill
pitch2	int/mils	Second pitch/spacing of fill

- The dashstyle is an enumerated type:
  - TYPE_SOLID = 0
  - TYPE_DOTTED = 1
  - TYPE_DASHED = 2
  - TYPE_CENTER = 3
  - TYPE_PHANTOM = 4
- The dashlength parameter is not used for TYPE_SOLID and TYPE_DOTTED. This parameter should take on a value of -1 in these cases.
- The dashspace paramater is not used for TYPE_SOLID. This parameter should take on a value of -1 in these case.
- The filltype parameter is an enumerated type:
  - FILLING_HOLLOW = 0
  - FILLING_FILL = 1
  - FILLING_MESH = 2
  - FILLING_HATCH = 3
  - FILLING_VOID = 4 **unused**
- If the filltype is 0 (FILLING_HOLLOW), then all the fill parameters should take on a value of -1.
- The fill type FILLING_FILL is a solid color fill.
- The two pairs of pitch and spacing control the fill or hatch if the fill type is FILLING_MESH.
- Only the first pair of pitch and spacing are used if the fill type is FILLING_HATCH.

Example:

```
V 38000 67000 900 3 0 0 2 75 50 2 10 20 30 90 50
```

A circle with the center at (38000, 67000) and a radius of 900 mils, color index 3, line width of 0 mils (smallest size), no cap, dashed line type, dash length of 75 mils, dash spacing of 50 mils, mesh fill, 10 mils thick mesh lines, first mesh line: 20 degrees, with a spacing of 30 mils, second mesh line: 90 degrees, with a spacing of 50 mils.

Field	Type/unit	Description
type	char	A
x	int/mils	Center X coordinate
y	int/mils	Center Y coordinate
radius	int/mils	Radius of the arc
startangle	int/degrees	Starting angle of the arc
sweepangle	int/degrees	Amount the arc sweeps
color	int	Color index
width	int/mils	Width of circle line
capstyle	int	Cap style
dashstyle	int	Type of dash style
dashlength	int/mils	Length of dash
dashspace	int/mils	Space inbetween dashes

4.5 arc

Valid in: Schematic and Symbol files

type x y radius startangle sweepangle color width capstyle dashtype dashlength dashspace

- The startangle can be negative, but not recommended.
- The sweepangle can be negative, but not recommended.
- The capstyle is an enumerated type:
  - END_NONE = 0
  - END_SQUARE = 1
  - END_ROUND = 2
- The dashstyle is an enumerated type:
  - TYPE_SOLID = 0
  - TYPE_DOTTED = 1
  - TYPE_DASHED = 2
  - TYPE_CENTER = 3
  - TYPE_PHANTOM = 4
- The dashlength parameter is not used for TYPE_SOLID and TYPE_DOTTED. This parameter should take on a value of -1 in these cases.
- The dashspace paramater is not used for TYPE_SOLID. This parameter should take on a value of -1 in these case.

Example:
`A 30600 75000 2000 0 45 3 0 0 3 75 50`

An arc with the center at (30600, 75000) and a radius of 2000 mils, a starting angle of 0, sweeping 45 degrees, color index 3, line width of 0 mils (smallest size), no cap, center line type, dash length of 75 mils, dash spacing of 50 mils.

4.6 text

Valid in: Schematic and Symbol files

type x y color size visibility show_name_value angle alignment num_lines
string line 1
string line 2
string line 3
...
string line N

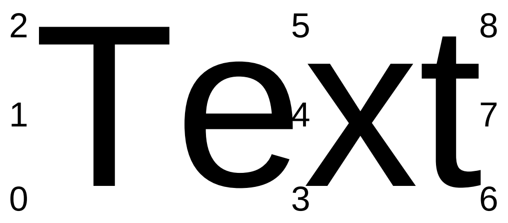
Field	Type/unit	Description
type	char	T
x	int/mils	First X coordinate
y	int/mils	First Y coordinate
color	int	Color index
size	int/points	Size of text
visibility	int	Visibility of text
show_name_value	int	Attribute visibility control
angle	int/degrees	Angle of the text
alignment	int	Alignment/origin of the text
num_lines	int	Number of lines of text (1 based)
string line 1 ... N	string	The text strings, on a seperate line

- This object is a multi line object. The first line contains all the text parameters and the subsequent lines are the text strings.
- There must be exactly num_lines of text following the T ... string.
- The maximum length of any single text string is 1024, however there is no limit to the number of text string lines.
- The minimum size is 2 points (1/72 of an inch).
- There is no maximum size.
- The coordinate pair is the origin of the text item.
- The visibility field is an enumerated type:

    - INVISIBLE = 0
    - VISIBLE = 1

- The show_name_value is an enumerated type:
    - SHOW_NAME_VALUE = 0 (show both name and value of an attribute)
    - SHOW_VALUE = 1 (show only the value of an attribute)
    - SHOW_NAME = 2 (show only the name of an attribute)
- The show_name_value field is only valid if the string is an attribute (string has to be in the form: name=value to be considered an attribute).
- The angle of the text can only take on one of the following values: 0, 90, 180, 270. A value of 270 will always generate upright text.
- The alignment/origin field controls the relative location of the origin.
- The alignment field can take a value from 0 to 8.
- The num_lines field always starts at 1.
- The num_lines field was added starting with file format version 1. Past versions (0 or earlier) only supported single line text objects.

  The following diagram shows what the values for the alignment field mean:



Example:
```
T 16900 35800 3 10 1 0 0 0 1
Text string!
```
A text object with the origin at (16900, 35800), color index 3, 10 points in size, visible, attribute flags not valid (not an attribute), origin at lower left, string: Text string!

Example:
```
T 16900 35800 3 10 1 0 0 0 5
Text string line 1
Text string line 2
Text string line 3
Text string line 4
Text string line 5
```

This is a similar text object as the above example, however here there are five lines of text.

4.7 net

Valid in: Schematic files ONLY

type x1 y1 x2 y2 color

Field	Type/unit	Description
type	char	N
x1	int/mils	First X coordinate
y1	int/mils	First Y coordinate
x2	int/mils	Second X coordinate
y2	int/mils	Second Y coordinate
color	int	Color index

- Nets can only appear in schematic files.
- You cannot have a zero length net (the tools will throw them away).

Example:
```
N 12700 29400 32900 29400 4
```
A net segment from (12700, 29400) to (32900, 29400) with color index 4.

4.8 bus

Valid in: Schematic files ONLY

type x1 y1 x2 y2 color ripperdir

Field	Type/unit	Description
type	char	U
x1	int/mils	First X coordinate
y1	int/mils	First Y coordinate
x2	int/mils	Second X coordinate
y2	int/mils	Second Y coordinate
color	int	Color index
ripperdir	int	Direction of bus rippers

- The ripperdir field for an brand new bus is 0.

- The ripperdir field takes on a value of 1 or -1 when a net is connected to the bus for the first time. This value indicates the direction of the ripper symbol. The ripper direction is set to the same value for the entire life of the bus object.
- Buses can only appear in schematic files.
- You cannot have a zero length bus (the tools will throw them away).

Example:
```
U 27300 37400 27300 35300 3 0
```
A bus segment from (27300, 37400) to (27300, 35300) with color index 3 and no nets have been connected to this bus segment..

4.9 pin

Valid in: Symbol files ONLY

type x1 y1 x2 y2 color pintype whichend

Field	Type/unit	Description
type	char	P
x1	int/mils	First X coordinate
y1	int/mils	First Y coordinate
x2	int/mils	Second X coordinate
y2	int/mils	Second Y coordinate
color	int	Color index
pintype	int	Type of pin
whichend	int	Specifies the active end

- The pintype is an enumerated type:
  - NORMAL_PIN = 0
  - BUS_PIN = 1 **unused**
- The whichend specifies which end point of the pin is the active connection port. Only this end point can have other pins or nets connected to it.
- To make the first end point active, whichend should be 0, else to specify the other end, whichend should be 1.
- Pins can only appear in symbol files.
- You cannot have a zero length pen (the tools will throw them away).

Example:
```
P 0 200 200 200 1 0 0
```
A pin from (0, 200) to (200, 200) with color index 1, a regular pin, and the first point being the active connection end.

4.10 component

Valid in: Schematic files ONLY

type x y selectable angle mirror basename

Field	Type/unit	Description
type	char	C
x	int/mils	Origin X coordinate
y	int/mils	Origin Y coordinate
selectable	int	Selectable flag
angle	int/degrees	Angle of the component
mirror	int	Mirror around Y axis
basename	string	The filename of the component

- The selectable field is either 1 for selectable or 0 if not selectable.
- The angle field can only take on the following values: 0, 90, 180, 270.
- The angle field can only be positive.
- The mirror flag is 0 if the component is not mirrored (around the Y axis).
- The mirror flag is 1 if the component is mirrored (around the Y axis).
- The just basename is the filename of the component. This filename is not the full path.

Example:
```
C 18600 19900 1 0 0 7400-1.sym
```
A component whos origin is at (18600,19900), is selectable, not rotated, not mirrored, and the basename of the component is 7400-1.sym.

4.11 font

Valid in: Special font files ONLY

type character width flag

Field	Type/unit	Description
type	char	F
character	char	The character being defined
width	int/mils	Width of the character (mils)
flag	int	Special space flag

- This is a special tag and should ONLY show up in font definition files.

- If the font character being defined is the space character (32) then flag should be 1, otherwise 0.

Example:

```
F _ 11 1
```

The above font definition is for the space character.

5 Colors

In the gEDA/gaf schematic and symbol file format colors are specified via an integer index. The relationship between integer and color is based on object type. Each object type typically has one or more colors. Here is a table of color index to object type:

Color Index	Object type
0	BACKGROUND_COLOR
1	PIN_COLOR
2	NET_ENDPOINT_COLOR
3	GRAPHIC_COLOR
4	NET_COLOR
5	ATTRIBUTE_COLOR
6	LOGIC_BUBBLE_COLOR
7	GRID_COLOR
8	DETACHED_ATTRIBUTE_COLOR
9	TEXT_COLOR
10	BUS_COLOR
11	SELECT_COLOR
12	BOUNDINGBOX_COLOR
13	ZOOM_BOX_COLOR
14	STROKE_COLOR
15	LOCK_COLOR
16	OUTPUT_BACKGROUND_COLOR

The actual color associated with the color index is defined on a per tool bases. Objects are typically assigned their corresponding color index, but it is permissible (sometimes) to assign other color index values to different object types.

6 Attributes

Attributes are enclosed in { } and can only be text. Attributes are text items which take on the form name=value. If it doesn't have name=value, it's not an attribute. Attributes are attached to the previous object. Here's an example:

```
P 988 500 1300 500 1
{
T 1000 570 5 8 1 1 0
pinseq=3
T 1000 550 5 8 1 1 0
pinnumber=3
}
```

The object is a pin which has an attribute pinnumber=3 and pinseq=3 (name=value). You can have multiple text objects (both the T ... and text string are required) in between the { }. As of 20021103, you can only attached text items as attributes. Attaching other object types as attributes is unsupported.

You can also have "toplevel" attributes. These attributes are not attached to any object, but instead are just text objects that take on the form name=value. These attributes are useful when you need to convey some info about a schematic page or symbol and need the netlister to have access to this info.

7 Embedded Components

Embedded components are components which have all of their definition stored within the schematic file. When a users place a component onto a schematic page, they have the option of making the component embedded. Other than storing all the symbol information inside of the schematic, an embedded component is just any other component. Embedded components are defined as:

```
C 18600 21500 1 0 0 EMBEDDED555-1.sym
[
...
...  Embedded primitive objects
...
]
```

In the example above, 555-1.sym is the component. The EMBEDDED tag and the [ ] are the distinguishing characteristics of embedded components. componentname.sym must exist in one of the specified component-libraries if you want to unembed the component.

8 Document Revision History

November 30th, 2002	Created fileformats.tex from fileformats.html.
December 1st, 2002	Continued work on this document.
October 4th, 2003	Added new file format version flag info.
October 19th, 2003	Added num_lines text field.