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# libembroidery 0.1

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*The Embroidermodder Team*

## Abstract

Libembroidery is a library for manipulating, converting and creating embroidery files between all major embroidery machine formats and some graphics formats to aid the creation of designs.

Most of the supported formats are in an experimental state as the library is under active development.

The library has 3 intended user interfaces: the GUI in EmbroiderModder2, the CLI in **embroider** (see `embroider-main.c`) and Arduino embedded systems (`libembroidery.ino`). The most actively maintained user interface is the CLI **embroider**.

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## The Embroidermodder Team

Credits for Embroidermodder 2, libembroidery and all other related code

Please note that this file is not in alphabetical order. If you have contributed and wish to be added to this list, create a new credit section and increment the number. Fill it in with your information and submit it to us.

Here is a summary of the values used:

Name The full name of the contributor starting with first name.

GitHub The GitHub account name of the contributor (in parentheses).

CoreDeveloper This is reserved for long term contributors.

Documentation If you have contributed changes to README files or help files, set this to true.

Artwork If you have contributed artwork or related changes, set this to true

BugFixes If you have contributed bug fixes or added new features, set this to true.

Translation If you have provided language translations, set this to true.

Designs If you have contributed an embroidery design sample, set this to true.

Bindings If you have contributed programming language bindings for libembroidery, set this to true.

Commands If you have contributed a command for Embroidermodder 2, set this to true.

## Credits

Credit 0 Jonathan Greig (**redteam316**)

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Credit 1 Josh Varga (**JoshVarga**)

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Credit 2 Jens Diemer (**jedie**)

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Credit 4 Martin Schneider (**craftoid**)

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Credit 5 Edward Greig (**Metallicow**)

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GOD Virginia (011 **Em**)

Credit 13 Robin Swift (**robin-swift**)

CoreDeveloper, Documentation

## Features

### Help Message

The user is presented with this help message when the program is given no arguments.

#### EMBROIDER

A command line program for machine embroidery.  
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<https://github.com/Embroidermodder/libembroidery>  
<https://embroidermodder.org>

Usage: embroider [OPTIONS] fileToRead...

#### Conversion:

-t, -to Convert all files given to the format specified by the arguments to the flag, for example:  
\$ embroider -t dst input.pes  
would convert \"input.pes\" to \"input.dst\"  
in the same directory the program runs in.

The accepted input formats are (TO BE DETERMINED).  
The accepted output formats are (TO BE DETERMINED).

#### Output:

-h, -help Print this message.  
-f, -format Print help on the formats that embroider can deal with.  
-q, -quiet Only print fatal errors.  
-V, -verbose Print everything that has reporting.  
-v, -version Print the version.

#### Graphics:

-c, -circle Add a circle defined by the arguments given to the current pattern.  
-e, -ellipse Add a circle defined by the arguments given to the current pattern.  
-l, -line Add a line defined by the arguments given to the current pattern.  
-P, -polyline Add a polyline.  
-p, -polygon Add a polygon.  
-s, -satin Fill the current geometry with satin stitches according to the defined algorithm.  
-S, -stitch Add a stitch defined by the arguments given to the current pattern.

#### Quality Assurance:

-test Run the test suite.

For each of the flags described here we will go into greater detail in this manual.

**To Flag**

**Circle Flag**

**Ellipse Flag**

**Line Flag**

**Polyline Flag**

**Polygon Flag**

**Satin Flag**

**Stitch Flag**

**Test Suite**

## **Formats**

### **Toyota Embroidery Format (.100)**

- Stitch Only Format.
- Uses an external color file.
- ☒ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

The stitch encoding is in 4 byte chunks.

### **Toyota Embroidery Format (.10o)**

- Stitch Only Format.
- Uses an external color file.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

The stitch encoding is in 3 byte chunks.

### **Bernina Embroidery Format (.art)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

We don't know much about this format. TODO: Find a source.

### **Bitmap Cache Embroidery Format (.bmc)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

We don't know much about this format. TODO: Find a source.



### **Bits and Volts Embroidery Format (.bro)**

- Stitch Only Format.
- Uses an external color file.
- ☒ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

The header is 256 bytes. There's a series of unknown variables in the header.

The stitch list uses a variable length encoding which is 2 bytes for any stitch

### **Melco Embroidery Format (.cnd)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

We don't know much about this format. TODO: Find a source.

### **Embroidery Thread Color Format (.col)**

- Stitch Only Format.
- ☒ Basic Read Support
- ☒ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

### **Singer Embroidery Format (.csd)**

- Stitch Only Format.
- ☒ Basic Read Support
- ☒ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

### **Comma Separated Values (.csv)**

- Stitch Only Format.
- ☒ Basic Read Support
- ☒ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

### **Barudan Embroidery Format (.dat)**

- Stitch Only Format.
- ☒ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

### Melco Embroidery Format (.dem)

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

### Barudan Embroidery Format (.dsb)

- Stitch Only Format.
- ☒ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

### Tajima Embroidery Format (.dst)

- Stitch Only Format.
- ☒ Basic Read Support
- ☒ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

.DST (Tajima) embroidery file read/write routines Format comments are thanks to tspilman@dalcoathletic.com who's notes appeared at <http://www.wotsit.org> under Tajima Format.

### Header

The header seems to contain information about the design. Seems to be ASCII text delimited by 0x0D (carriage returns). This must be in the file for most new software or hardware to consider it a good file! This is much more important than I originally believed. The header is 125 bytes in length and padded out by 0x20 to 512 bytes total. All entries in the header seem to be 2 ASCII characters followed by a colon, then it's value trailed by a carriage return.

Table 1: The sections of the dxf header.

C memory	Description
<code>char LA[16+1];</code>	First is the 'LA' entry, which is the design name with no path or extension information. The blank is 16 characters in total, but the name must not be longer than 8 characters and padded out with spaces (0x20).
<code>char ST[7+1];</code>	Next is the stitch count ST, this is a 7 digit number padded by leading zeros. This is the total stitch count including color changes, jumps, nups, and special records.
<code>char CO[3+1];</code>	Next, is CO or colors, a 3 digit number padded by leading zeros. This is the number of color change records in the file.

Table 1: The sections of the dxf header.

C memory	Description
char POSX[5+1];	Next is +X or the positive X extent in centimeters, a 5 digit non-decimal number padded by leading zeros.
char NEGX[5+1];	Following is the -X or the negative X extent in millimeters, a 5 digit non-decimal number padded by leading zeros.
char POSY[5+1];	Again, the +Y extents.
char NEGY[5+1];	Again, the -Y extents.
char AX[6+1]; char AY[6+1];	AX and AY should express the relative coordinates of the last point from the start point in 0.1 mm. If the start and last points are the same, the coordinates are (0,0).
char MX[6+1]; char MY[6+1];	MX and MY should express coordinates of the last point of the previous file for a multi-volume design. A multi-volume design means a design consisted of two or more files. This was used for huge designs that can not be stored in a single paper tape roll. It is not used so much (almost never) nowadays.
char PD[9+1];	PD is also storing some information for multi-volume design.

Uses 3 byte per stitch encoding with the format as follows:

Table 2: The 3 byte encoding for the dxf format.

Bit	7	6	5	4	3	2	1	0
Byte 0	y+1	y-1	y+9	y-9	x-9	x+9	x-1	x+1
Byte 1	y+3	y-3	y+27	y-27	x-27	x+27	x-3	x+3
Byte 2	jumpcolor	change	y+81	y-81	x-81	x+81	set	set

T01 and Tap appear to use Tajima Ternary.

Where the stitch type is determined as:

- Normal Stitch ‘00000011 0x03’
- Jump Stitch ‘10000011 0x83’
- Stop/Change Color ‘11000011 0xC3’
- End Design ‘11110011 0xF3’

Inclusive or’ed with the last byte.

Note that:

1. The max stitch length is the largest sum of ‘1+3+9+27+81=121’ where the unit length is 0.1mm so 12.1mm.

2. The coordinate system is right handed.

Sources on the Tajima dst format: [3], Edutech format description[2], KDE Liberty Description[4], ACHATINA[1].

#### **ZSK USA Embroidery Format (.dsz)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

#### **Drawing Exchange Format (.dxf)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

#### **Embird Embroidery Format (.edr)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

#### **Elna Embroidery Format (.emd)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

#### **Melco Embroidery Format (.exp)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

#### **Eltac Embroidery Format (.exy)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

#### **Sierra Expanded Embroidery Format (.eys)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

#### **Fortron Embroidery Format (.fxy)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

#### **Smoothie G-Code Embroidery Format (.fxy)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

#### **Great Notions Embroidery Format (.gnc)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

#### **Gold Thread Embroidery Format (.gt)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

#### **Husqvarna Viking Embroidery Format (.hus)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

#### **Inbro Embroidery Format (.inb)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

#### **Embroidery Color Format (.inf)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

#### **Janome Embroidery Format (.jef)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

#### **Pfaff Embroidery Format (.ksm)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

#### **Pfaff Embroidery Format (.max)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

#### **Mitsubishi Embroidery Format (.mit)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

#### **Ameco Embroidery Format (.new)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

#### **Melco Embroidery Format (.ofm)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

#### **Pfaff Embroidery Format (.pcd)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

**Pfaff Embroidery Format (.pcm)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

**Pfaff Embroidery Format (.pcq)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

**Pfaff Embroidery Format (.pcs)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

**Brother Embroidery Format (.pec)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

**Brother Embroidery Format (.pel)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

**Brother Embroidery Format (.pem)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

**Brother Embroidery Format (.pes)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

#### **Brother Embroidery Format (.phb)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

#### **Brother Embroidery Format (.phc)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

#### **AutoCAD Embroidery Format (.plt)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

#### **RGB Embroidery Format (.rgb)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

#### **Janome Embroidery Format (.sew)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

#### **Husqvarna Viking Embroidery Format (.shv)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

#### **Sunstar Embroidery Format (.sst)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write



#### **Data Stitch Embroidery Format (.stx)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

#### **Scalable Vector Graphics (.svg)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

#### **Pfaff Embroidery Format (.t01)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

#### **Pfaff Embroidery Format (.t09)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

#### **Happy Embroidery Format (.tap)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

#### **ThredWorks Embroidery Format (.thr)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

#### **Text File (.txt)**

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

### Barudan Embroidery Format (.u00)

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

### Barudan Embroidery Format (.u01)

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

### Pfaff Embroidery Format (.vip)

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

### Pfaff Embroidery Format (.vp3)

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

### Singer Embroidery Format (.xxx)

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

### ZSK USA Embroidery Format (.zsk)

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

## Threads

### DraftSight DXF color table

Table 3: DraftSight DXF color table




id	label	red	green	blue	swatch
0	BYBLOCK	0	0	0	
1	red	255	0	0	
2	yellow	255	255	0	

Table 3: DraftSight DXF color table
















































id	label	red	green	blue	swatch
3	green	0	255	0	
4	cyan	0	255	255	
5	blue	0	0	255	
6	magenta	255	0	255	
7	white	255	255	255	
8	dark gray	128	128	128	
9	light gray	192	192	192	
10	dxfl0	255	0	0	
11	dxfl1	255	127	127	
12	dxfl2	204	0	0	
13	dxfl3	204	102	102	
14	dxfl	153	0	0	
15	dxfl	153	76	76	
16	dxfl	127	0	0	
17	dxfl	127	63	63	
18	dxfl	76	0	0	
19	dxfl	76	38	38	
20	dxfl	255	63	0	
21	dxfl	255	159	127	
22	dxfl	204	51	0	
23	dxfl	204	127	102	
24	dxfl	153	38	0	
25	dxfl	153	95	76	
26	dxfl	127	31	0	
27	dxfl	127	79	63	
28	dxfl	76	19	0	
29	dxfl	76	47	38	
30	dxfl	255	127	0	
31	dxfl	255	191	127	
32	dxfl	204	102	0	
33	dxfl	204	153	102	
34	dxfl	153	76	0	
35	dxfl	153	114	76	
36	dxfl	127	63	0	
37	dxfl	127	95	63	
38	dxfl	76	38	0	
39	dxfl	76	57	38	
40	dxfl	255	191	0	
41	dxfl	255	223	127	
42	dxfl	204	153	0	
43	dxfl	204	178	102	
44	dxfl	153	114	0	
45	dxfl	153	133	76	
46	dxfl	127	95	0	
47	dxfl	127	111	63	
48	dxfl	76	57	0	
49	dxfl	76	66	38	

Table 3: DraftSight DXF color table
















































id	label	red	green	blue	swatch
50	dxs	255	255	0	
51	dxs	255	255	127	
52	dxs	204	204	0	
53	dxs	204	204	102	
54	dxs	153	153	0	
55	dxs	153	153	76	
56	dxs	127	127	0	
57	dxs	127	127	63	
58	dxs	76	76	0	
59	dxs	76	76	38	
60	dxs	191	255	0	
61	dxs	223	255	127	
62	dxs	153	204	0	
63	dxs	178	204	102	
64	dxs	114	153	0	
65	dxs	133	153	76	
66	dxs	95	127	0	
67	dxs	111	127	63	
68	dxs	57	76	0	
69	dxs	66	76	38	
70	dxs	127	255	0	
71	dxs	191	255	127	
72	dxs	102	204	0	
73	dxs	153	204	102	
74	dxs	76	153	0	
75	dxs	114	153	76	
76	dxs	63	127	0	
77	dxs	95	127	63	
78	dxs	38	76	0	
79	dxs	57	76	38	
80	dxs	63	255	0	
81	dxs	159	255	127	
82	dxs	51	204	0	
83	dxs	127	204	102	
84	dxs	38	153	0	
85	dxs	95	153	76	
86	dxs	31	127	0	
87	dxs	79	127	63	
88	dxs	19	76	0	
89	dxs	47	76	38	
90	dxs	0	255	0	
91	dxs	127	255	127	
92	dxs	0	204	0	
93	dxs	102	204	102	
94	dxs	0	153	0	
95	dxs	76	153	76	
96	dxs	0	127	0	

Table 3: DraftSight DXF color table
















































id	label	red	green	blue	swatch
97	dxs	63	127	63	
98	dxs	0	76	0	
99	dxs	38	76	38	
100	dxs	0	255	63	
101	dxs	127	255	159	
102	dxs	0	204	51	
103	dxs	102	204	127	
104	dxs	0	153	38	
105	dxs	76	153	95	
106	dxs	0	127	31	
107	dxs	63	127	79	
108	dxs	0	76	19	
109	dxs	38	76	47	
110	dxs	0	255	127	
111	dxs	127	255	191	
112	dxs	0	204	102	
113	dxs	102	204	153	
114	dxs	0	153	76	
115	dxs	76	153	114	
116	dxs	0	127	63	
117	dxs	63	127	95	
118	dxs	0	76	38	
119	dxs	38	76	57	
120	dxs	0	255	191	
121	dxs	127	255	223	
122	dxs	0	204	153	
123	dxs	102	204	178	
124	dxs	0	153	114	
125	dxs	76	153	133	
126	dxs	0	127	95	
127	dxs	63	127	111	
128	dxs	0	76	57	
129	dxs	38	76	66	
130	dxs	0	255	255	
131	dxs	127	255	255	
132	dxs	0	204	204	
133	dxs	102	204	204	
134	dxs	0	153	153	
135	dxs	76	153	153	
136	dxs	0	127	127	
137	dxs	63	127	127	
138	dxs	0	76	76	
139	dxs	38	76	76	
140	dxs	0	191	255	
141	dxs	127	223	255	
142	dxs	0	153	204	
143	dxs	102	178	204	

Table 3: DraftSight DXF color table
















































id	label	red	green	blue	swatch
144	dxs	0	114	153	
145	dxs	76	133	153	
146	dxs	0	95	127	
147	dxs	63	111	127	
148	dxs	0	57	76	
149	dxs	38	66	76	
150	dxs	0	127	255	
151	dxs	127	191	255	
152	dxs	0	102	204	
153	dxs	102	153	204	
154	dxs	0	76	153	
155	dxs	76	114	153	
156	dxs	0	63	127	
157	dxs	63	95	127	
158	dxs	0	38	76	
159	dxs	38	57	76	
160	dxs	0	63	255	
161	dxs	127	159	255	
162	dxs	0	51	204	
163	dxs	102	127	204	
164	dxs	0	38	153	
165	dxs	76	95	153	
166	dxs	0	31	127	
167	dxs	63	79	127	
168	dxs	0	19	76	
169	dxs	38	47	76	
170	dxs	0	0	255	
171	dxs	127	127	255	
172	dxs	0	0	204	
173	dxs	102	102	204	
174	dxs	0	0	153	
175	dxs	76	76	153	
176	dxs	0	0	127	
177	dxs	63	63	127	
178	dxs	0	0	76	
179	dxs	38	38	76	
180	dxs	63	0	255	
181	dxs	159	127	255	
182	dxs	51	0	204	
183	dxs	127	102	204	
184	dxs	38	0	153	
185	dxs	95	76	153	
186	dxs	31	0	127	
187	dxs	79	63	127	
188	dxs	19	0	76	
189	dxs	47	38	76	
190	dxs	127	0	255	

Table 3: DraftSight DXF color table



































































id	label	red	green	blue	swatch
191	dxs	191	127	255	
192	dxs	102	0	204	
193	dxs	153	102	204	
194	dxs	76	0	153	
195	dxs	114	76	153	
196	dxs	63	0	127	
197	dxs	95	63	127	
198	dxs	38	0	76	
199	dxs	57	38	76	
200	dxs	191	0	255	
201	dxs	223	127	255	
202	dxs	153	0	204	
203	dxs	178	102	204	
204	dxs	114	0	153	
205	dxs	133	76	153	
206	dxs	95	0	127	
207	dxs	111	63	127	
208	dxs	57	0	76	
209	dxs	66	38	76	
210	dxs	255	0	255	
211	dxs	255	127	255	
212	dxs	204	0	204	
213	dxs	204	102	204	
214	dxs	153	0	153	
215	dxs	153	76	153	
216	dxs	127	0	127	
217	dxs	127	63	127	
218	dxs	76	0	76	
219	dxs	76	38	76	
220	dxs	255	0	191	
221	dxs	255	127	223	
222	dxs	204	0	153	
223	dxs	204	102	178	
224	dxs	153	0	114	
225	dxs	153	76	133	
226	dxs	127	0	95	
227	dxs	127	63	111	
228	dxs	76	0	57	
229	dxs	76	38	66	
230	dxs	255	0	127	
231	dxs	255	127	191	
232	dxs	204	0	102	
233	dxs	204	102	153	
234	dxs	153	0	76	
235	dxs	153	76	114	
236	dxs	127	0	63	
237	dxs	127	63	95	

Table 3: DraftSight DXF color table

id	label	red	green	blue	swatch
238	dxs	76	0	38	
239	dxs	76	38	57	
240	dxs	255	0	63	
241	dxs	255	127	159	
242	dxs	204	0	51	
243	dxs	204	102	127	
244	dxs	153	0	38	
245	dxs	153	76	95	
246	dxs	127	0	31	
247	dxs	127	63	79	
248	dxs	76	0	19	
249	dxs	76	38	47	
250	dxs	51	51	51	
251	dxs	91	91	91	
252	dxs	132	132	132	
253	dxs	173	173	173	
254	dxs254	214	214	214	
255	dxs255	255	255	255	
256	dxs256	0	0	0	

## HUS Colors

There are 29 HUS Colors encoded.

Table 4: HUS Color Table





















id	label	red	green	blue	swatch
0	Black	0	0	0	
1	Blue	0	0	255	
2	Light Green	0	255	0	
3	Red	255	0	0	
4	Purple	255	0	255	
5	Yellow	255	255	0	
6	Gray	127	127	127	
7	Light Blue	51	154	255	
8	Green	51	204	102	
9	Orange	255	127	0	
10	Pink	255	160	180	
11	Brown	153	75	0	
12	White	255	255	255	
13	Dark Blue	0	0	127	
14	Dark Green	0	127	0	
15	Dark Red	127	0	0	
16	Light Red	255	127	127	
17	Dark Purple	127	0	127	
18	Light Purple	255	127	255	
19	Dark Yellow	200	200	0	



Table 4: HUS Color Table
















































id	label	red	green	blue	swatch
20	Light Yellow	255	255	153	
21	Dark Gray	60	60	60	
22	Light Gray	192	192	192	
23	Dark Orange	232	63	0	
24	Light Orange	255	165	65	
25	Dark Pink	255	102	122	
26	Light Pink	255	204	204	
27	Dark Brown	115	40	0	
28	Light Brown	175	90	10	
0	END	0	0	0	
0	Black	0	0	0	
1	Black	0	0	0	
2	White	255	255	255	
3	Yellow	255	255	23	
4	Orange	250	160	96	
5	Olive Green	92	118	73	
6	Green	64	192	48	
7	Sky	101	194	200	
8	Purple	172	128	190	
9	Pink	245	188	203	
10	Red	255	0	0	
11	Brown	192	128	0	
12	Blue	0	0	240	
13	Gold	228	195	93	
14	Dark Brown	165	42	42	
15	Pale Violet	213	176	212	
16	Pale Yellow	252	242	148	
17	Pale Pink	240	208	192	
18	Peach	255	192	0	
19	Beige	201	164	128	
20	Wine Red	155	61	75	
21	Pale Sky	160	184	204	
22	Yellow Green	127	194	28	
23	Silver Grey	185	185	185	
24	Grey	160	160	160	
25	Pale Aqua	152	214	189	
26	Baby Blue	184	240	240	
27	Powder Blue	54	139	160	
28	Bright Blue	79	131	171	
29	Slate Blue	56	106	145	
30	Nave Blue	0	32	107	
31	Salmon Pink	229	197	202	
32	Coral	249	103	107	
33	Burnt Orange	227	49	31	
34	Cinnamon	226	161	136	
35	Umber	181	148	116	
36	Blonde	228	207	153	

Table 4: HUS Color Table
















































id	label	red	green	blue	swatch
37	Sunflower	225	203	0	
38	Orchid Pink	225	173	212	
39	Peony Purple	195	0	126	
40	Burgundy	128	0	75	
41	Royal Purple	160	96	176	
42	Cardinal Red	192	64	32	
43	Opal Green	202	224	192	
44	Moss Green	137	152	86	
45	Meadow Green	0	170	0	
46	Dark Green	33	138	33	
47	Aquamarine	93	174	148	
48	Emerald Green	76	191	143	
49	Peacock Green	0	119	114	
50	Dark Grey	112	112	112	
51	Ivory White	242	255	255	
52	Hazel	177	88	24	
53	Toast	203	138	7	
54	Salmon	247	146	123	
55	Cocoa Brown	152	105	45	
56	Sienna	162	113	72	
57	Sepia	123	85	74	
58	Dark Sepia	79	57	70	
59	Violet Blue	82	58	151	
60	Blue Ink	0	0	160	
61	Solar Blue	0	150	222	
62	Green Dust	178	221	83	
63	Crimson	250	143	187	
64	Floral Pink	222	100	158	
65	Wine	181	80	102	
66	Olive Drab	94	87	71	
67	Meadow	76	136	31	
68	Mustard	228	220	121	
69	Yellow Ochre	203	138	26	
70	Old Gold	198	170	66	
71	Honeydew	236	176	44	
72	Tangerine	248	128	64	
73	Canary Yellow	255	229	5	
74	Vermillion	250	122	122	
75	Bright Green	107	224	0	
76	Ocean Blue	56	108	174	
77	Beige Grey	227	196	180	
78	Bamboo	227	172	129	
1	PCM Color 1	0	0	0	
2	PCM Color 2	0	0	128	
3	PCM Color 3	0	0	255	
4	PCM Color 4	0	128	128	
5	PCM Color 5	0	255	255	

Table 4: HUS Color Table
































id	label	red	green	blue	swatch
6	PCM Color 6	128	0	128	
7	PCM Color 7	255	0	255	
8	PCM Color 8	128	0	0	
9	PCM Color 9	255	0	0	
10	PCM Color 10	0	128	0	
11	PCM Color 11	0	255	0	
12	PCM Color 12	128	128	0	
13	PCM Color 13	255	255	0	
14	PCM Color 14	128	128	128	
15	PCM Color 15	192	192	192	
16	PCM Color 16	255	255	255	
0	Unknown	0	0	0	
1	Prussian Blue	14	31	124	
2	Blue	10	85	163	
3	Teal Green	0	135	119	
4	Cornflower Blue	75	107	175	
5	Red	237	23	31	
6	Reddish Brown	209	92	0	
7	Magenta	145	54	151	
8	Light Lilac	228	154	203	
9	Lilac	145	95	172	
10	Mint Green	158	214	125	
11	Deep Gold	232	169	0	
12	Orange	254	186	53	
13	Yellow	255	255	0	
14	Lime Green	112	188	31	
15	Brass	186	152	0	
16	Silver	168	168	168	
17	Russet Brown	125	111	0	
18	Cream Brown	255	255	179	
19	Pewter	79	85	86	
20	Black	0	0	0	
21	Ultramarine	11	61	145	
22	Royal Purple	119	1	118	
23	Dark Gray	41	49	51	
24	Dark Brown	42	19	1	
25	Deep Rose	246	74	138	
26	Light Brown	178	118	36	
27	Salmon Pink	252	187	197	
28	Vermillion	254	55	15	
29	White	240	240	240	
30	Violet	106	28	138	
31	Seacrest	168	221	196	
32	Sky Blue	37	132	187	
33	Pumpkin	254	179	67	
34	Cream Yellow	255	243	107	
35	Khaki	208	166	96	

Table 4: HUS Color Table









































































id	label	red	green	blue	swatch
36	Clay Brown	209	84	0	
37	Leaf Green	102	186	73	
38	Peacock Blue	19	74	70	
39	Gray	135	135	135	
40	Warm Gray	216	204	198	
41	Dark Olive	67	86	7	
42	Flesh Pink	253	217	222	
43	Pink	249	147	188	
44	Deep Green	0	56	34	
45	Lavender	178	175	212	
46	Wisteria Violet	104	106	176	
47	Beige	239	227	185	
48	Carmine	247	56	102	
49	Amber Red	181	75	100	
50	Olive Green	19	43	26	
51	Dark Fuschia	199	1	86	
52	Tangerine	254	158	50	
53	Light Blue	168	222	235	
54	Emerald Green	0	103	62	
55	Purple	78	41	144	
56	Moss Green	47	126	32	
57	Flesh Pink	255	204	204	
58	Harvest Gold	255	217	17	
59	Electric Blue	9	91	166	
60	Lemon Yellow	240	249	112	
61	Fresh Green	227	243	91	
62	Orange	255	153	0	
63	Cream Yellow	255	240	141	
64	Applique	255	200	200	
0	Black	0	0	0	
1	Blue	0	0	255	
2	Green	51	204	102	
3	Red	255	0	0	
4	Purple	255	0	255	
5	Yellow	255	255	0	
6	Grey	127	127	127	
7	Light Blue	51	154	255	
8	Light Green	0	255	0	
9	Orange	255	127	0	
10	Pink	255	160	180	
11	Brown	153	75	0	
12	White	255	255	255	
13	Black	0	0	0	
14	Black	0	0	0	
15	Black	0	0	0	
16	Black	0	0	0	
17	Black	0	0	0	

Table 4: HUS Color Table

id	label	red	green	blue	swatch
18	Black	0	0	0	
19	Light Red	255	127	127	
20	Light Purple	255	127	255	
21	Light Yellow	255	255	153	
22	Light Grey	192	192	192	
23	Black	0	0	0	
24	Black	0	0	0	
25	Light Orange	255	165	65	
26	Light Pink	255	204	204	
27	Light Brown	175	90	10	
28	Black	0	0	0	
29	Black	0	0	0	
30	Black	0	0	0	
31	Black	0	0	0	
32	Black	0	0	0	
33	Dark Blue	0	0	127	
34	Dark Green	0	127	0	
35	Dark Red	127	0	0	
36	Dark Purple	127	0	127	
37	Dark Yellow	200	200	0	
38	Dark Gray	60	60	60	
39	Black	0	0	0	
40	Black	0	0	0	
41	Dark Orange	232	63	0	
42	Dark Pink	255	102	122	

## Jef Threads

Table 5: Jef Color Table















id	label	red	green	blue	swatch
0	Black	0	0	0	
1	Black	0	0	0	
2	White	255	255	255	
3	Yellow	255	255	23	
4	Orange	250	160	96	
5	Olive Green	92	118	73	
6	Green	64	192	48	
7	Sky	101	194	200	
8	Purple	172	128	190	
9	Pink	245	188	203	
10	Red	255	0	0	
11	Brown	192	128	0	
12	Blue	0	0	240	
13	Gold	228	195	93	
14	Dark Brown	165	42	42	

Table 5: Jef Color Table








id	label	red	green	blue	swatch
15	Pale Violet	213	176	212	
16	Pale Yellow	252	242	148	
17	Pale Pink	240	208	192	
18	Peach	255	192	0	
19	Beige	201	164	128	
20	Wine Red	155	61	75	
21	Pale Sky	160	184	204	
22	Yellow Green	127	194	28	
23	Silver Grey	185	185	185	
24	Grey	160	160	160	
25	Pale Aqua	152	214	189	
26	Baby Blue	184	240	240	
27	Powder Blue	54	139	160	
28	Bright Blue	79	131	171	
29	Slate Blue	56	106	145	
30	Nave Blue	0	32	107	
31	Salmon Pink	229	197	202	
32	Coral	249	103	107	
33	Burnt Orange	227	49	31	
34	Cinnamon	226	161	136	
35	Umber	181	148	116	
36	Blonde	228	207	153	
37	Sunflower	225	203	0	
38	Orchid Pink	225	173	212	
39	Peony Purple	195	0	126	
40	Burgundy	128	0	75	
41	Royal Purple	160	96	176	
42	Cardinal Red	192	64	32	
43	Opal Green	202	224	192	
44	Moss Green	137	152	86	
45	Meadow Green	0	170	0	
46	Dark Green	33	138	33	
47	Aquamarine	93	174	148	
48	Emerald Green	76	191	143	
49	Peacock Green	0	119	114	
50	Dark Grey	112	112	112	
51	Ivory White	242	255	255	
52	Hazel	177	88	24	
53	Toast	203	138	7	
54	Salmon	247	146	123	
55	Cocoa Brown	152	105	45	
56	Sienna	162	113	72	
57	Sepia	123	85	74	
58	Dark Sepia	79	57	70	
59	Violet Blue	82	58	151	
60	Blue Ink	0	0	160	
61	Solar Blue	0	150	222	

Table 5: Jef Color Table
















































id	label	red	green	blue	swatch
62	Green Dust	178	221	83	
63	Crimson	250	143	187	
64	Floral Pink	222	100	158	
65	Wine	181	80	102	
66	Olive Drab	94	87	71	
67	Meadow	76	136	31	
68	Mustard	228	220	121	
69	Yellow Ochre	203	138	26	
70	Old Gold	198	170	66	
71	Honeydew	236	176	44	
72	Tangerine	248	128	64	
73	Canary Yellow	255	229	5	
74	Vermillion	250	122	122	
75	Bright Green	107	224	0	
76	Ocean Blue	56	108	174	
77	Beige Grey	227	196	180	
78	Bamboo	227	172	129	
1	PCM Color 1	0	0	0	
2	PCM Color 2	0	0	128	
3	PCM Color 3	0	0	255	
4	PCM Color 4	0	128	128	
5	PCM Color 5	0	255	255	
6	PCM Color 6	128	0	128	
7	PCM Color 7	255	0	255	
8	PCM Color 8	128	0	0	
9	PCM Color 9	255	0	0	
10	PCM Color 10	0	128	0	
11	PCM Color 11	0	255	0	
12	PCM Color 12	128	128	0	
13	PCM Color 13	255	255	0	
14	PCM Color 14	128	128	128	
15	PCM Color 15	192	192	192	
16	PCM Color 16	255	255	255	
0	Unknown	0	0	0	
1	Prussian Blue	14	31	124	
2	Blue	10	85	163	
3	Teal Green	0	135	119	
4	Cornflower Blue	75	107	175	
5	Red	237	23	31	
6	Reddish Brown	209	92	0	
7	Magenta	145	54	151	
8	Light Lilac	228	154	203	
9	Lilac	145	95	172	
10	Mint Green	158	214	125	
11	Deep Gold	232	169	0	
12	Orange	254	186	53	
13	Yellow	255	255	0	

Table 5: Jef Color Table






























id	label	red	green	blue	swatch
14	Lime Green	112	188	31	
15	Brass	186	152	0	
16	Silver	168	168	168	
17	Russet Brown	125	111	0	
18	Cream Brown	255	255	179	
19	Pewter	79	85	86	
20	Black	0	0	0	
21	Ultramarine	11	61	145	
22	Royal Purple	119	1	118	
23	Dark Gray	41	49	51	
24	Dark Brown	42	19	1	
25	Deep Rose	246	74	138	
26	Light Brown	178	118	36	
27	Salmon Pink	252	187	197	
28	Vermillion	254	55	15	
29	White	240	240	240	
30	Violet	106	28	138	
31	Seacrest	168	221	196	
32	Sky Blue	37	132	187	
33	Pumpkin	254	179	67	
34	Cream Yellow	255	243	107	
35	Khaki	208	166	96	
36	Clay Brown	209	84	0	
37	Leaf Green	102	186	73	
38	Peacock Blue	19	74	70	
39	Gray	135	135	135	
40	Warm Gray	216	204	198	
41	Dark Olive	67	86	7	
42	Flesh Pink	253	217	222	
43	Pink	249	147	188	
44	Deep Green	0	56	34	
45	Lavender	178	175	212	
46	Wisteria Violet	104	106	176	
47	Beige	239	227	185	
48	Carmine	247	56	102	
49	Amber Red	181	75	100	
50	Olive Green	19	43	26	
51	Dark Fuschia	199	1	86	
52	Tangerine	254	158	50	
53	Light Blue	168	222	235	
54	Emerald Green	0	103	62	
55	Purple	78	41	144	
56	Moss Green	47	126	32	
57	Flesh Pink	255	204	204	
58	Harvest Gold	255	217	17	
59	Electric Blue	9	91	166	
60	Lemon Yellow	240	249	112	



Table 5: Jef Color Table
















































id	label	red	green	blue	swatch
61	Fresh Green	227	243	91	
62	Orange	255	153	0	
63	Cream Yellow	255	240	141	
64	Applique	255	200	200	
0	Black	0	0	0	
1	Blue	0	0	255	
2	Green	51	204	102	
3	Red	255	0	0	
4	Purple	255	0	255	
5	Yellow	255	255	0	
6	Grey	127	127	127	
7	Light Blue	51	154	255	
8	Light Green	0	255	0	
9	Orange	255	127	0	
10	Pink	255	160	180	
11	Brown	153	75	0	
12	White	255	255	255	
13	Black	0	0	0	
14	Black	0	0	0	
15	Black	0	0	0	
16	Black	0	0	0	
17	Black	0	0	0	
18	Black	0	0	0	
19	Light Red	255	127	127	
20	Light Purple	255	127	255	
21	Light Yellow	255	255	153	
22	Light Grey	192	192	192	
23	Black	0	0	0	
24	Black	0	0	0	
25	Light Orange	255	165	65	
26	Light Pink	255	204	204	
27	Light Brown	175	90	10	
28	Black	0	0	0	
29	Black	0	0	0	
30	Black	0	0	0	
31	Black	0	0	0	
32	Black	0	0	0	
33	Dark Blue	0	0	127	
34	Dark Green	0	127	0	
35	Dark Red	127	0	0	
36	Dark Purple	127	0	127	
37	Dark Yellow	200	200	0	
38	Dark Gray	60	60	60	
39	Black	0	0	0	
40	Black	0	0	0	
41	Dark Orange	232	63	0	
42	Dark Pink	255	102	122	

Table 5: Jef Color Table

id	label	red	green	blue	swatch
----	-------	-----	-------	------	--------

## Pcm Threads

Table 6: Hoop Identifiers

id	hoop
0	126X110
1	110X110
2	50X50
3	140X200
4	230X200

There should be 65 Pcm Threads.

Table 7: Pcm Color Table































id	label	red	green	blue	swatch
1	PCM Color 1	0	0	0	
2	PCM Color 2	0	0	128	
3	PCM Color 3	0	0	255	
4	PCM Color 4	0	128	128	
5	PCM Color 5	0	255	255	
6	PCM Color 6	128	0	128	
7	PCM Color 7	255	0	255	
8	PCM Color 8	128	0	0	
9	PCM Color 9	255	0	0	
10	PCM Color 10	0	128	0	
11	PCM Color 11	0	255	0	
12	PCM Color 12	128	128	0	
13	PCM Color 13	255	255	0	
14	PCM Color 14	128	128	128	
15	PCM Color 15	192	192	192	
16	PCM Color 16	255	255	255	
0	Unknown	0	0	0	
1	Prussian Blue	14	31	124	
2	Blue	10	85	163	
3	Teal Green	0	135	119	
4	Cornflower Blue	75	107	175	
5	Red	237	23	31	
6	Reddish Brown	209	92	0	
7	Magenta	145	54	151	
8	Light Lilac	228	154	203	
9	Lilac	145	95	172	
10	Mint Green	158	214	125	
11	Deep Gold	232	169	0	
12	Orange	254	186	53	
13	Yellow	255	255	0	

Table 7: Pcm Color Table






id	label	red	green	blue	swatch
14	Lime Green	112	188	31	
15	Brass	186	152	0	
16	Silver	168	168	168	
17	Russet Brown	125	111	0	
18	Cream Brown	255	255	179	
19	Pewter	79	85	86	
20	Black	0	0	0	
21	Ultramarine	11	61	145	
22	Royal Purple	119	1	118	
23	Dark Gray	41	49	51	
24	Dark Brown	42	19	1	
25	Deep Rose	246	74	138	
26	Light Brown	178	118	36	
27	Salmon Pink	252	187	197	
28	Vermillion	254	55	15	
29	White	240	240	240	
30	Violet	106	28	138	
31	Seacrest	168	221	196	
32	Sky Blue	37	132	187	
33	Pumpkin	254	179	67	
34	Cream Yellow	255	243	107	
35	Khaki	208	166	96	
36	Clay Brown	209	84	0	
37	Leaf Green	102	186	73	
38	Peacock Blue	19	74	70	
39	Gray	135	135	135	
40	Warm Gray	216	204	198	
41	Dark Olive	67	86	7	
42	Flesh Pink	253	217	222	
43	Pink	249	147	188	
44	Deep Green	0	56	34	
45	Lavender	178	175	212	
46	Wisteria Violet	104	106	176	
47	Beige	239	227	185	
48	Carmine	247	56	102	
49	Amber Red	181	75	100	
50	Olive Green	19	43	26	
51	Dark Fuschia	199	1	86	
52	Tangerine	254	158	50	
53	Light Blue	168	222	235	
54	Emerald Green	0	103	62	
55	Purple	78	41	144	
56	Moss Green	47	126	32	
57	Flesh Pink	255	204	204	
58	Harvest Gold	255	217	17	
59	Electric Blue	9	91	166	
60	Lemon Yellow	240	249	112	

Table 7: Pcm Color Table
















































id	label	red	green	blue	swatch
61	Fresh Green	227	243	91	
62	Orange	255	153	0	
63	Cream Yellow	255	240	141	
64	Applique	255	200	200	
0	Black	0	0	0	
1	Blue	0	0	255	
2	Green	51	204	102	
3	Red	255	0	0	
4	Purple	255	0	255	
5	Yellow	255	255	0	
6	Grey	127	127	127	
7	Light Blue	51	154	255	
8	Light Green	0	255	0	
9	Orange	255	127	0	
10	Pink	255	160	180	
11	Brown	153	75	0	
12	White	255	255	255	
13	Black	0	0	0	
14	Black	0	0	0	
15	Black	0	0	0	
16	Black	0	0	0	
17	Black	0	0	0	
18	Black	0	0	0	
19	Light Red	255	127	127	
20	Light Purple	255	127	255	
21	Light Yellow	255	255	153	
22	Light Grey	192	192	192	
23	Black	0	0	0	
24	Black	0	0	0	
25	Light Orange	255	165	65	
26	Light Pink	255	204	204	
27	Light Brown	175	90	10	
28	Black	0	0	0	
29	Black	0	0	0	
30	Black	0	0	0	
31	Black	0	0	0	
32	Black	0	0	0	
33	Dark Blue	0	0	127	
34	Dark Green	0	127	0	
35	Dark Red	127	0	0	
36	Dark Purple	127	0	127	
37	Dark Yellow	200	200	0	
38	Dark Gray	60	60	60	
39	Black	0	0	0	
40	Black	0	0	0	
41	Dark Orange	232	63	0	
42	Dark Pink	255	102	122	

Table 7: Pcm Color Table

id	label	red	green	blue	swatch
----	-------	-----	-------	------	--------

## Pec Threads

Pec has 65 pre-programmed threads. To do: verify that colors marked with \* are correct.

Table 8: HUS Color Table































id	label	red	green	blue	swatch
0	Unknown	0	0	0	
1	Prussian Blue	14	31	124	
2	Blue	10	85	163	
3	Teal Green	0	135	119	
4	Cornflower Blue	75	107	175	
5	Red	237	23	31	
6	Reddish Brown	209	92	0	
7	Magenta	145	54	151	
8	Light Lilac	228	154	203	
9	Lilac	145	95	172	
10	Mint Green	158	214	125	
11	Deep Gold	232	169	0	
12	Orange	254	186	53	
13	Yellow	255	255	0	
14	Lime Green	112	188	31	
15	Brass	186	152	0	
16	Silver	168	168	168	
17	Russet Brown	125	111	0	
18	Cream Brown	255	255	179	
19	Pewter	79	85	86	
20	Black	0	0	0	
21	Ultramarine	11	61	145	
22	Royal Purple	119	1	118	
23	Dark Gray	41	49	51	
24	Dark Brown	42	19	1	
25	Deep Rose	246	74	138	
26	Light Brown	178	118	36	
27	Salmon Pink	252	187	197	
28	Vermillion	254	55	15	
29	White	240	240	240	
30	Violet	106	28	138	
31	Seacrest	168	221	196	
32	Sky Blue	37	132	187	
33	Pumpkin	254	179	67	
34	Cream Yellow	255	243	107	
35	Khaki	208	166	96	
36	Clay Brown	209	84	0	
37	Leaf Green	102	186	73	

Table 8: HUS Color Table
























































id	label	red	green	blue	swatch
38	Peacock Blue	19	74	70	
39	Gray	135	135	135	
40	Warm Gray	216	204	198	
41	Dark Olive	67	86	7	
42	Flesh Pink	253	217	222	
43	Pink	249	147	188	
44	Deep Green	0	56	34	
45	Lavender	178	175	212	
46	Wisteria Violet	104	106	176	
47	Beige	239	227	185	
48	Carmine	247	56	102	
49	Amber Red	181	75	100	
50	Olive Green	19	43	26	
51	Dark Fuschia	199	1	86	
52	Tangerine	254	158	50	
53	Light Blue	168	222	235	
54	Emerald Green	0	103	62	
55	Purple	78	41	144	
56	Moss Green	47	126	32	
57	Flesh Pink	255	204	204	
58	Harvest Gold	255	217	17	
59	Electric Blue	9	91	166	
60	Lemon Yellow	240	249	112	
61	Fresh Green	227	243	91	
62	Orange	255	153	0	
63	Cream Yellow	255	240	141	
64	Applique	255	200	200	
0	Black	0	0	0	
1	Blue	0	0	255	
2	Green	51	204	102	
3	Red	255	0	0	
4	Purple	255	0	255	
5	Yellow	255	255	0	
6	Grey	127	127	127	
7	Light Blue	51	154	255	
8	Light Green	0	255	0	
9	Orange	255	127	0	
10	Pink	255	160	180	
11	Brown	153	75	0	
12	White	255	255	255	
13	Black	0	0	0	
14	Black	0	0	0	
15	Black	0	0	0	
16	Black	0	0	0	
17	Black	0	0	0	
18	Black	0	0	0	
19	Light Red	255	127	127	

Table 8: HUS Color Table

id	label	red	green	blue	swatch
20	Light Purple	255	127	255	
21	Light Yellow	255	255	153	
22	Light Grey	192	192	192	
23	Black	0	0	0	
24	Black	0	0	0	
25	Light Orange	255	165	65	
26	Light Pink	255	204	204	
27	Light Brown	175	90	10	
28	Black	0	0	0	
29	Black	0	0	0	
30	Black	0	0	0	
31	Black	0	0	0	
32	Black	0	0	0	
33	Dark Blue	0	0	127	
34	Dark Green	0	127	0	
35	Dark Red	127	0	0	
36	Dark Purple	127	0	127	
37	Dark Yellow	200	200	0	
38	Dark Gray	60	60	60	
39	Black	0	0	0	
40	Black	0	0	0	
41	Dark Orange	232	63	0	
42	Dark Pink	255	102	122	

## SHV Colors

There are 42 preprogrammed shv threads. (TODO: the ? ids)

Table 9: SHV Color Table












































id	label	red	green	blue	swatch
0	Black	0	0	0	
1	Blue	0	0	255	
2	Green	51	204	102	
3	Red	255	0	0	
4	Purple	255	0	255	
5	Yellow	255	255	0	
6	Grey	127	127	127	
7	Light Blue	51	154	255	
8	Light Green	0	255	0	
9	Orange	255	127	0	
10	Pink	255	160	180	
11	Brown	153	75	0	
12	White	255	255	255	
13	Black	0	0	0	
14	Black	0	0	0	
15	Black	0	0	0	

Table 9: SHV Color Table

id	label	red	green	blue	swatch
16	Black	0	0	0	
17	Black	0	0	0	
18	Black	0	0	0	
19	Light Red	255	127	127	
20	Light Purple	255	127	255	
21	Light Yellow	255	255	153	
22	Light Grey	192	192	192	
23	Black	0	0	0	
24	Black	0	0	0	
25	Light Orange	255	165	65	
26	Light Pink	255	204	204	
27	Light Brown	175	90	10	
28	Black	0	0	0	
29	Black	0	0	0	
30	Black	0	0	0	
31	Black	0	0	0	
32	Black	0	0	0	
33	Dark Blue	0	0	127	
34	Dark Green	0	127	0	
35	Dark Red	127	0	0	
36	Dark Purple	127	0	127	
37	Dark Yellow	200	200	0	
38	Dark Gray	60	60	60	
39	Black	0	0	0	
40	Black	0	0	0	
41	Dark Orange	232	63	0	
42	Dark Pink	255	102	122	

### Other Supported Thread Brands

The thread lists that aren't preprogrammed into formats but are indexed in the data file for the purpose of conversion or fitting to images/graphics.

- Arc Polyester
- Arc Rayon
- Coats and Clark Rayon
- Exquisite Polyester
- Fufu Polyester
- Fufu Rayon
- Hemingworth Polyester
- Isacord Polyester
- Isafil Rayon
- Marathon Polyester
- Marathon Rayon



- Madeira Polyester
- Madeira Rayon
- Metro Polyester
- Pantone
- Robison Anton Polyester
- Robison Anton Rayon
- Sigma Polyester
- Sulky Rayon
- ThreadArt Rayon
- ThreadArt Polyester
- ThreaDelight Polyester
- Z102 Isacord Polyester

## Development

A *right-handed coordinate system* is one where up is positive and right is positive. Left-handed is up is positive, left is positive. Screens often use down is positive, right is positive, including the OpenGL standard so when switching between graphics formats and stitch formats we need to use a vertical flip (`embPattern_flip`).

0x20 is the space symbol, so when padding either 0 or space is preferred and in the case of space use the literal ' '. Use the macros:

```
#define PAD_SPACE(n) \
    embFile_pad(currentFile, ' ', n)
#define PAD_ZERO(n) \
    embFile_pad(currentFile, 0, n)
```

to save writing functions that may not inline.

## Design Philosophy and Coding Standards

- No GUI code will be present here.
- The library will be written in pedantic ANSI C/C90, aiming for no compiler warnings under GCC for compatibility with the most possible platforms.
- The command line program 'embroider' targets 32-bit and 64 bit systems that comply to POSIX or current Windows/MacOS standards. Practically, this means we only call C99 standard library functions.
- Don't use any of the C Standard Library. All interfacing should be done by linux system calls or their equivalents.
- Never use dynamic memory allocation (malloc/free) all memory that would need those functions uses temporary files instead.
- Share heavy memory usage between functions, for example use `embBuffer` for buffering headers rather than having a separate `char header[]` variables.

## Image Fitting

A currently unsolved problem in development that warrants further research is the scenario where a user wants to feed embroider an image that can then be .

## To Do

1. Basic features.
  1. Incorporate `#ifdef` parts of `libembroidery.c`.
  2. Interpret how to write formats that have a read mode from the source code and vice versa.
  3. Document the specifics of the file formats here for embroidery machine specific formats. Find websites and other sources that break down the binary formats we currently don't understand.
  4. Find more and better documentation of the structure of the headers for the formats we do understand.
2. Code quality and user friendliness.
  1. Document all structs, macros and functions (will contribute directly on the web version).
  2. Incorporate experimental code, improve support for language bindings.
  3. Make stitch x, y into an `EmbVector`.
3. embroider CLI
  1. Make `-circle` flag to add a circle to the current pattern.
  2. Make `-rect` flag to add a rectangle to the current pattern.
  3. Make `-fill` flag to set the current satin fill algorithm for the current geometry. (for example `"-fill crosses -circle 11,13,10"` fills a circle with center 11mm, 13mm with radius 10mm with crosses).
  4. Make `-ellipse` flag to add to ellipse to the current pattern.
  5. Make `-bezier` flag to add a bezier curve to the current pattern.

## Finding fixes

To find jobs marked within the source code rather than the list above, use:

```
grep "TODO" *.c *.h
```

## Testing

Build `embroider` then run:

```
./embroider -test &> report.txt
```

If any of the tests return a fail in the summary (see `tail report.txt`) then it would help the project to send us an issue attaching the file to your message along with a description of the system you ran the program on.

## On Embedded Systems

The library is designed to support embedded environments, so it can be used in CNC applications.

## Compatible Boards

We recommend using an Arduino Mega 2560 or another board with equal or greater specs. That being said, we have had success using an Arduino Uno R3 but this will likely require further optimization and other improvements to ensure continued compatibility with the Uno. See below for more information.

## Arduino Considerations

There are two main concerns here: Flash Storage & SRAM.

libembroidery continually outgrows the 32KB of Flash storage on the Arduino Uno and every time this occurs, a decision has to be made as to what capabilities should be included or omitted. While reading files is the main focus on arduino, writing files may also play a bigger role in the future. Long term, it would be most practical to handle the inclusion or omission of any feature via a single configuration header file that the user can modify to suit their needs.

SRAM is in extremely limited supply and it will deplete quickly so any dynamic allocation should occur early during the setup phase of the sketch and sparingly or not at all later in the sketch. To help minimize SRAM consumption on Arduino and ensure libembroidery can be used in any way the sketch creator desires, it is required that any sketch using libembroidery must implement event handlers. See the ino-event source and header files for more information.

There is also an excellent article by Bill Earl on the Adafruit Learning System which covers these topics in more depth: <http://learn.adafruit.com/memories-of-an-arduino?view=all>.

## Space

Since a stitch takes 3 bytes of storage and many patterns use more than 10k stitches, we can't assume that the pattern will fit in memory. Therefore we will need to buffer the current pattern on and off storage in small chunks. By the same reasoning, we can't load all of one struct before looping so we will need functions similar to `binaryReadInt16` for each struct.

This means the `EmbArray` approach won't work since we need to load each element and dynamic memory management is unnecessary because the arrays lie in storage.

TODO: Replace `EmbArray` functions with `embPattern` load functions.

## Tables

All thread tables and large text blocks are too big to compile directly into the source code. Instead we can package the library with a data packet that is compiled from an assembly program in raw format so the specific padding can be controlled.

In the user section above we will make it clear that this file needs to be loaded on the pattern USB/SD card or the program won't function.

TODO: Start file with a list of offsets to data with a corresponding table to load into with macro constants for each label needed.

## Current Pattern Memory Management

It will be simpler to make one file per EmbArray so we keep an EmbFile\* and a length, so no malloc call is necessary. So there needs to be a consistent tmpfile naming scheme.

TODO: For each pattern generate a random string of hexadecimal and append it to the filenames like `stitchList_A16F.dat`. Need to check for a file which indicates that this string has been used already.

## Special Notes

Due to historical reasons and to remain compatible with the Arduino 1.0 IDE, this folder must be called “utility”. Refer to the arduino build process for more info: <https://arduino.github.io/arduino-cli/0.19/sketch-build-process/>

libembroidery relies on the Arduino SD library for reading files. See the ino-file source and header files for more information.

## Experimental Projects

Anything contained within the experimental/ folder is unstable and unsupported. Items in here may eventually be moved elsewhere or may not. If you have an interesting concept or prototype that you would like us to add, contact us and we may add it here.

## Dependencies

To build additional language bindings for libembroidery from source you will need at least:

Ubuntu repository packages:

```
sudo apt-get install swig python-dev
```

Mac

```
brew install swig
```

An example for building for use in C#

```
swig -csharp -o ./csharp/binding/swig_wrap.c -I../ swig.i
```

## The Assembly Split

One problem to the problem of supporting both systems with abundant memory (such as a 2010s or later desktop) and with scarce memory (such as embedded systems) is that they don't share the same assembly language. To deal with this: there will be two equivalent softwares which are hand engineered to be similar but one will be in C and the other in the assembly dialects we support.

All assembly will be intended for embedded systems only, since a slightly smaller set of features will be supported. However, we will write a x86 version since that can be tested.

That way the work that has been done to simplify the C code can be applied to the assembly versions.

## Utility Functions

Avoiding the use of libc

Avoiding the use of libm

The cos and sin functions are calculated using

The arctan2 function in the source is calculated using Euler's series for the inverse tangent[5]:

$$\tan^{-1}(x) = \sum_{n=0}^{\infty} \frac{2^{2n}(n!)^2}{(2n+1)!} \frac{x^{2n+1}}{(1+x^2)^{n+1}} \quad (1)$$

## References

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