

## Font bit maps

A font is made up of glyphs (or characters), each glyph is made up of columns and rows of pixels.

Glyphs come as bit maps, sizes 5x7 and 3x5, that is 5 cols x 7 rows, or the very small 3 cols x 5 rows. They are stored in an array, part of which is shown below. The first column is the glyph in ASCII that can be scanned to find the following bit map. for example, 3x5:

```
byte glyphs[][4] = {
  {' ', 0x00, 0x00, 0x00}, // Space
  {'0', 0x20, 0x10, 0x08}, // 0
  {'1', 0x00, 0x7C, 0x00}, // 1
  {'2', 0x64, 0x54, 0x48}, // 2
  {'3', 0x44, 0x54, 0x28}, // 3
  {'4', 0x1C, 0x10, 0x7C}, // 4
  {'5', 0x4C, 0x54, 0x24}, // 5
  {'6', 0x38, 0x54, 0x20}, // 6
  {'7', 0x04, 0x74, 0x0C}, // 7
  {'8', 0x28, 0x54, 0x28}, // 8
  {'9', 0x08, 0x54, 0x38}, // 9
  {'A', 0x78, 0x14, 0x78}, // A - shown below as 3x5 bit map
```

Data is stored in an array of bytes for each column. e.g. 5 columns of 7 rows. For example:

		5x7		3x5			
b7	1	1	1	b7	hi freq		
b6	1		1	b6			
b5	1		1	b5	1		
b4	1	1	1	1	b4	1	1
b3	1		1	b3	1	1	1
b2	1		1	b2	1	1	
b1	1		1	b1	1	1	
b0				b0	lo freq		
		USB		USB			

When transmitted the columns are scanned in the direction of bottom to top and the output frequency is shifted from the BASEFREQ, upwards in steps of SHIFT. a pixel is transmitted if the map contains a '1'. The pixels are transmitted for a PIXTIME of 200-500ms, scanning only the area defining the glyph, from bottom to top: so b1-b7 for 5x7 or b1-b5 for 3x5.

There are two variants, the two as above for USB TX, plus the same sizes but up-side-down maps for LSB TX, also scanned bottom to top for TX.

Fonts are in the sketch files font\_3x5.ino and font\_5x7.ino, these are the up-side-down

LSB fonts. A fonts can be inverted with `font_reverse.ino` the output of which goes to the SerialMonitor and can be cut and pasted into a sketch array as a normal right-side-up font.

The transmission speeds are, according to others, related as follows

20Hz and 20pix/sec = 1 pix/50ms  
10Hz and 10pix/se = 1pix/100ms  
2Hz and 2pix/sec = 1pix/500ms

Currently I use 2Hz and 200ms pixels.

### Hellschreiber (S/MT-HELL)

Transmissions are made either for LSB or USB reception. Hellschreiber is transmitted for USB reception. Using USB the output audio frequency increases as the pixel frequency increases. Which means that scanning the normal font in columns from bottom to top b0-b7 will output increasing frequencies and display correctly at the receiver. The output will be a right leaning text.

A normal font 5x7 right-side-up, from `HELL_5x7_USB.ino` sketch

```
byte glyphs[][6] = {
  { ' ', 0x00, 0x00, 0x00, 0x00, 0x00, },
  { '/', 0x04, 0x08, 0x10, 0x20, 0x40, },
  { '0', 0x7C, 0x8A, 0x92, 0xA2, 0x7C, },
  { '1', 0x00, 0x42, 0xFE, 0x02, 0x00, },
  { '2', 0x42, 0x86, 0x8A, 0x92, 0x62, },
  { '3', 0x84, 0x82, 0xA2, 0xD2, 0x8C, },
  { '4', 0x18, 0x28, 0x48, 0xFE, 0x08, },
  { '5', 0xE4, 0xA2, 0xA2, 0xA2, 0x9C, },
  { '6', 0x3C, 0x52, 0x92, 0x92, 0x0C, },
  { '7', 0x80, 0x8E, 0x90, 0xA0, 0xC0, },
  { '8', 0x6C, 0x92, 0x92, 0x92, 0x6C, },
  { '9', 0x60, 0x92, 0x92, 0x94, 0x78, },
  { 'A', 0x7E, 0x88, 0x88, 0x88, 0x7E, },
  { 'B', 0xFE, 0x92, 0x92, 0x92, 0x6C, },
  { 'C', 0x7C, 0x82, 0x82, 0x82, 0x44, },
  { 'D', 0xFE, 0x82, 0x82, 0x44, 0x38, },
  { 'E', 0xFE, 0x92, 0x92, 0x92, 0x82, },
  { 'F', 0xFE, 0x90, 0x90, 0x90, 0x80, },
  { 'G', 0x7C, 0x82, 0x92, 0x92, 0x5E, },
  { 'H', 0xFE, 0x10, 0x10, 0x10, 0xFE, },
  { 'I', 0x00, 0x82, 0xFE, 0x82, 0x00, },
  { 'J', 0x04, 0x02, 0x82, 0xFC, 0x80, },
  { 'K', 0xFE, 0x10, 0x28, 0x44, 0x82, },
  { 'L', 0xFE, 0x02, 0x02, 0x02, 0x02, },
  { 'M', 0xFE, 0x40, 0x30, 0x40, 0xFE, },
  { 'N', 0xFE, 0x20, 0x10, 0x08, 0xFE, },
  { 'O', 0x7C, 0x82, 0x82, 0x82, 0x7C, },
  { 'P', 0xFE, 0x90, 0x90, 0x90, 0x60, },
  { 'Q', 0x7C, 0x82, 0x8A, 0x84, 0x7A, },
  { 'R', 0xFE, 0x90, 0x98, 0x94, 0x62, },
  { 'S', 0x62, 0x92, 0x92, 0x92, 0x8C, },
  { 'T', 0x80, 0x80, 0xFE, 0x80, 0x80, },
```

```

    {'U', 0xFC, 0x02, 0x02, 0x02, 0xFC, },
    {'V', 0xF8, 0x04, 0x02, 0x04, 0xF8, },
    {'W', 0xFC, 0x02, 0x1C, 0x02, 0xFC, },
    {'X', 0xC6, 0x28, 0x10, 0x28, 0xC6, },
    {'Y', 0xE0, 0x10, 0x0E, 0x10, 0xE0, },
    {'Z', 0x86, 0x8A, 0x92, 0xA2, 0xC2, },
};

```

A normal font 3x5 right-side-up from HELL\_3x5\_USB.ino sketch

```

byte glyphs[][4] = {
    {' ', 0x00, 0x00, 0x00, },
    {'0', 0x04, 0x08, 0x10, },
    {'1', 0x00, 0x3E, 0x00, },
    {'2', 0x26, 0x2A, 0x12, },
    {'3', 0x22, 0x2A, 0x14, },
    {'4', 0x38, 0x08, 0x3E, },
    {'5', 0x32, 0x2A, 0x24, },
    {'6', 0x1C, 0x2A, 0x04, },
    {'7', 0x20, 0x2E, 0x30, },
    {'8', 0x14, 0x2A, 0x14, },
    {'9', 0x10, 0x2A, 0x1C, },
    {'A', 0x1E, 0x28, 0x1E, },
    {'B', 0x3E, 0x2A, 0x14, },
    {'C', 0x1C, 0x22, 0x22, },
    {'D', 0x3E, 0x22, 0x1C, },
    {'E', 0x3E, 0x2A, 0x22, },
    {'F', 0x3E, 0x28, 0x20, },
    {'G', 0x1C, 0x22, 0x2C, },
    {'H', 0x3E, 0x08, 0x3E, },
    {'I', 0x00, 0x3E, 0x00, },
    {'J', 0x04, 0x02, 0x3C, },
    {'K', 0x3E, 0x08, 0x36, },
    {'L', 0x3E, 0x02, 0x02, },
    {'M', 0x3E, 0x10, 0x3E, },
    {'N', 0x3E, 0x20, 0x3E, },
    {'O', 0x3E, 0x22, 0x3E, },
    {'P', 0x3E, 0x28, 0x10, },
    {'Q', 0x1C, 0x22, 0x1E, },
    {'R', 0x3E, 0x28, 0x16, },
    {'S', 0x12, 0x2A, 0x24, },
    {'T', 0x20, 0x3E, 0x20, },
    {'U', 0x3E, 0x02, 0x3E, },
    {'V', 0x3C, 0x02, 0x3C, },
    {'W', 0x3E, 0x04, 0x3E, },
    {'X', 0x36, 0x08, 0x36, },
    {'Y', 0x38, 0x06, 0x38, },
    {'Z', 0x26, 0x2A, 0x32, },
};

```