ELECTRO-KNIT

Updated Tutorial for Windows users

Cable

The Brother KH900 series of electronic knitting machines came equipped with a data port intended for serial communication with a Brother FB-100 floppy disk drive. In the absence of a floppy disk drive, the knitting machine can be connected to a modern computer using a USB-to-serial cable and disk emulator software can be used to communicate with the machine. You can buy a USB-to-serial cable online through Digi-key or other electronic component distributors that contains a converter chip that translates between USB signals and the TTL signals used by the knitting machine. Any such cable that you buy will likely come with a 1x6 connector that will not fit the Brother knitting machine's nonstandard 2x4 pin data port. The cable will need to be physically modified before you can use it with your knitting machine. You will also need to make slight modifications to the EEPROM contents of the cable using a utility program.

What You Will Need:

- A pin or a small pair of tweezers to lift the tabs on the 1x6 cable connector
- Needle-nosed pliers
- Electrical tape
- A TTL to USB serial converter cable
- A 2x4 connector piece

For the cable and 2x4 connector, I used the FTDI TTL-232R-5V cable and Molex 90142-0008 connector respectively. If you are comfortable using alternative parts with the same specifications, you may use those instead.

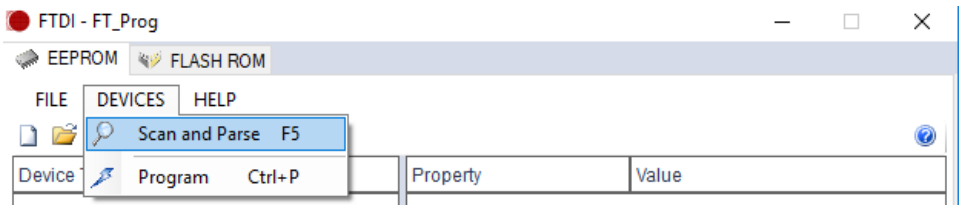
You will also need to download an EEPROM programming utility called FT_PROG to change the cable's polarity so that it will work with the knitting machine.

Install driver software and Configure the cable

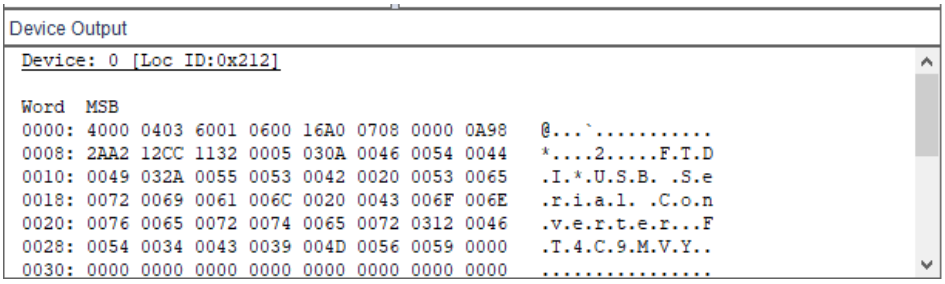
The knitting machine uses reversed-polarity signals, so the EEPROM contents of the converter chip must be reconfigured. If you haven't already, you need to download FT_PROG and extract the contents of the zip file. This must be done on a computer running Microsoft Windows, with the appropriate driver installed for the USB-to-serial cable. FT_PROG also requires Microsoft .NET Framework 4.0, which may need to be installed if you encounter difficulty running the software.

After downloading the utility program, double-click FT_PROG.exe to install and run the program. After this, you need to plug in your USB-to-serial cable to begin making modifications to the EEPROM contents.

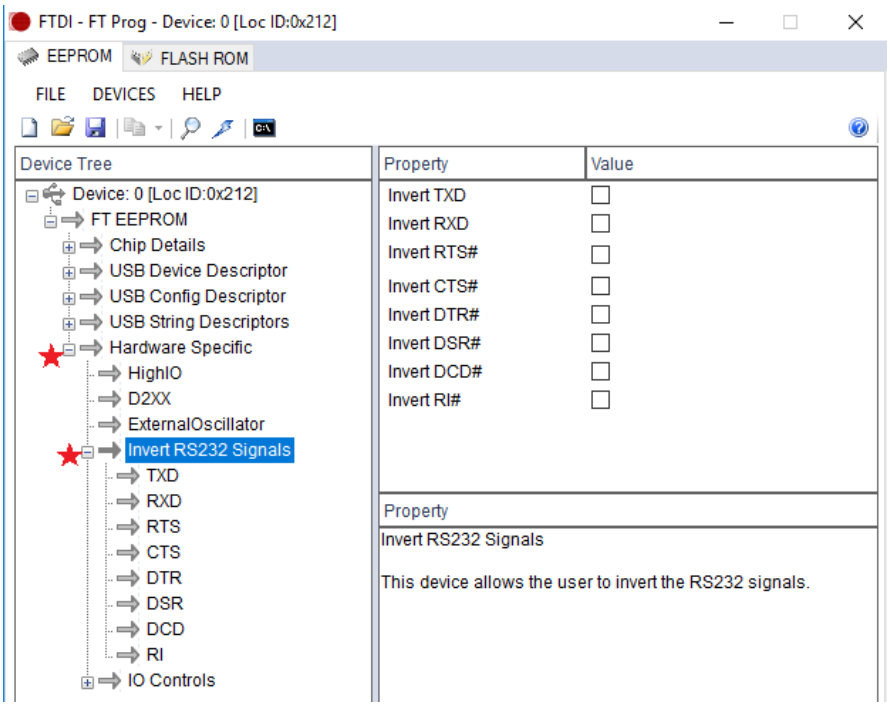
In the Devices menu, select 'Scan and Parse'. FT_PROG will scan the cable.



There should be device output information at the bottom of the window that will look something like this:

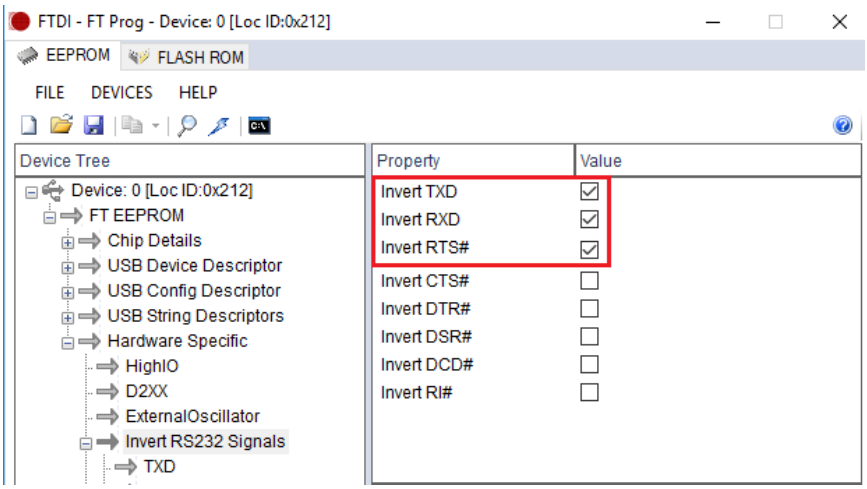


Select ‘Hardware Specific’ followed by ‘Invert RS232 Signals’.

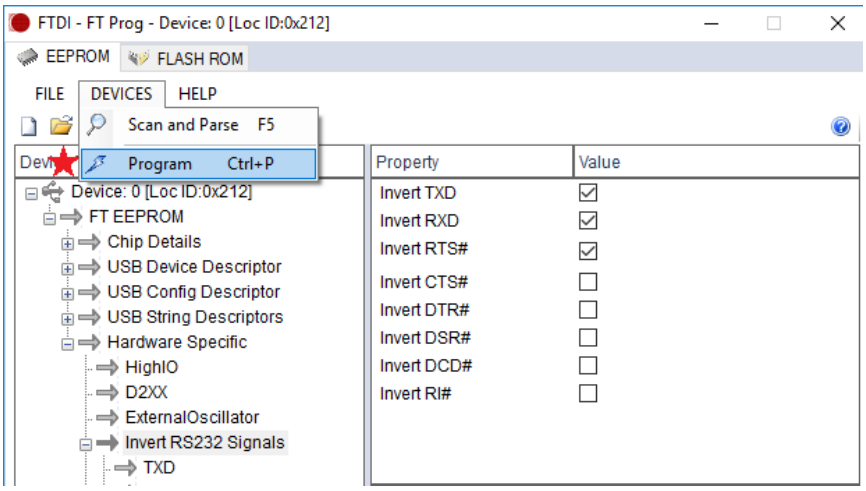


On the right, check the ‘Value’ boxes of these three Properties:

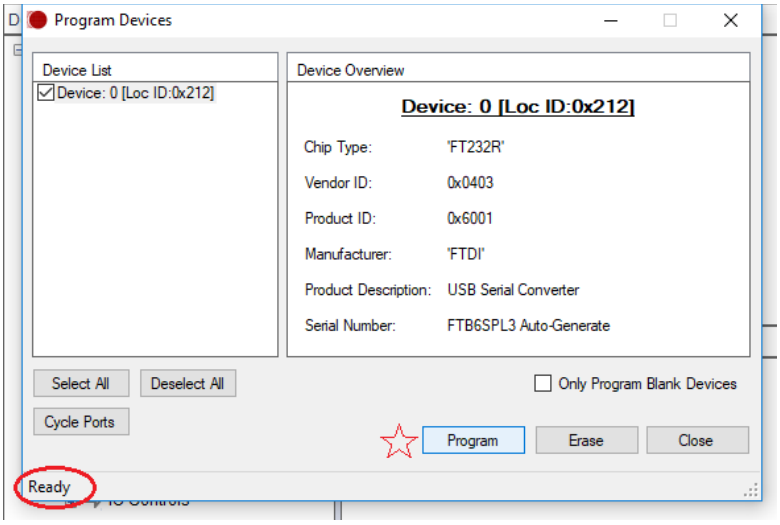
- Invert TXD
- Invert RXD
- Invert RTS#



In the Devices menu, select ‘Program’.



In the dialog window that opens, click the Program button and wait until ‘Ready’ shows in the bottom left corner of the dialog.

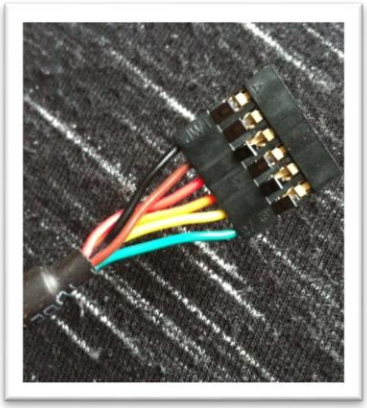


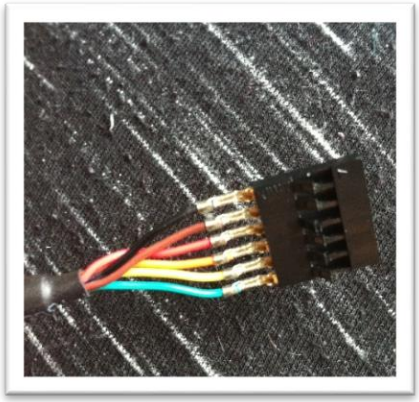
In the File menu, select "Exit" to quit FT_PROG.

Change the connector

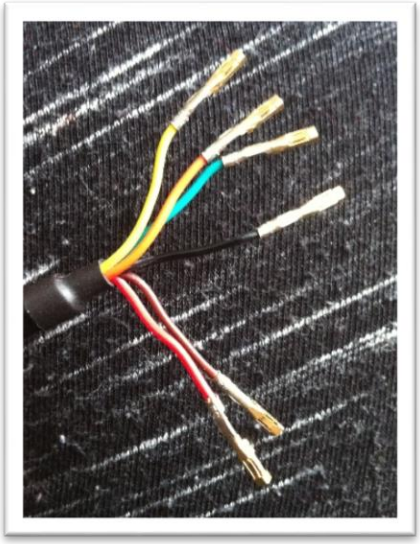
To attach the 2x4 pin connector on the USB-to-serial cable, you must first remove the 1x6 connector that the cable comes with. Once removed, the tiny metal sockets attached to each wire will be carefully connected to specific slots in the new 2x4 connector housing.

With a pin or pliers, bend back the plastic tabs on the 1x6 connector and gently pull on each wire to remove the sockets from the 1x6 connector.





Rearrange the wires in this order: RXD, TXD, RTS#, GND. Move the other wires to the side – you won't be using them. Twist the orange wire 180 degrees so that its socket is facing in the opposite direction compared to the other wires as it will go in the bottom row of the 2x4 connector.



Position each socket in the 2x4 connector exactly as shown in the following diagrams:

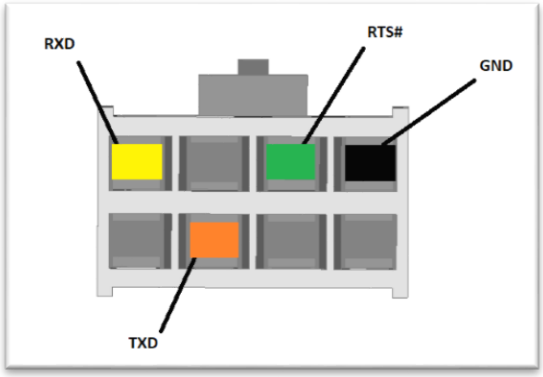


Figure a: 2x4 Connector from the front

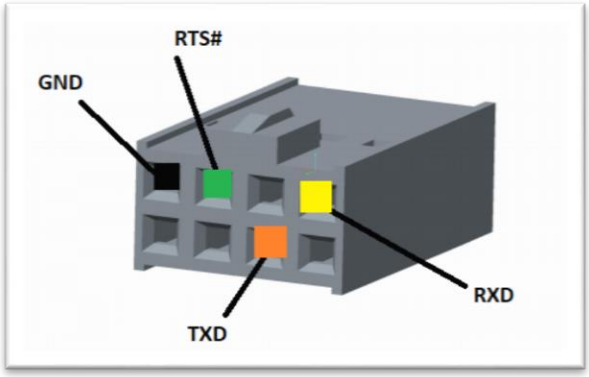
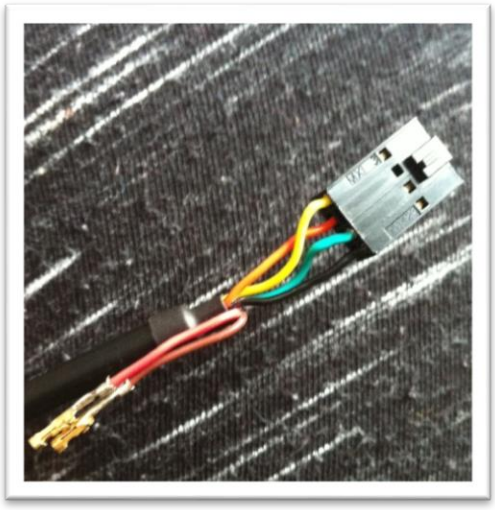
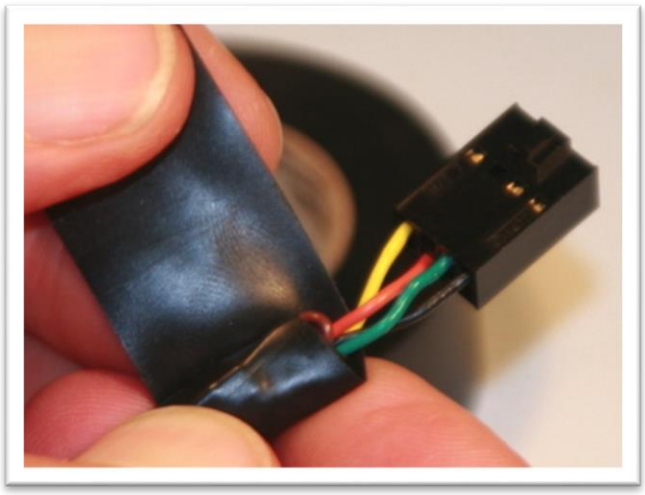


Figure b: 2x4 Connector from the back

Carefully grab each wire with a needle-nosed plier just below the socket, and push the socket entirely into the 2x4 connector





Wrap the unused brown and red wires against the cable with electrical tape. Use two layers of tape between them. The connector will be plugged into the knitting machine data port with the notch on the top.

Software

Now that you have the cable built, its time to download the software. Visit the my github repository and click on Download to download the source code. This code is based previous work by several talented people, adapted to work properly with the Microsoft Windows file system and updated to Python 3. Download the file and unzip it a directory of your choosing. Mine is located in Documents\brother3.

What You Will Need

If you have not already done so, you will need to download and install Python 3 to run the code. There is a Python 3 installer for Windows that makes the process quite simple but detailed installation instructions can be found here.

You will also need to have Python libraries installed for imaging and serial port communication but before you do that, I recommend installing another third-party Python package called pip which will let you download, install and uninstall any compliant Python software product with a single command. You can install pip doing the following:

- Download get-pip.py to a folder on your computer.
- Launch the command prompt and navigate to the folder containing get-pip.py.
- Type in this command followed by the enter key: `python get-pip.py`

If you have pip installed successfully, you can easily download and install the following:

- PySerial – A Python serial port extension library that encapsulates the access for the serial port.
- Pillow – A fork of the now defunct Python Imaging Library that adds support for opening, manipulating, and saving image file formats.

There should be an option in the upper left corner of each page to copy the pip install command which can then be run from the command line like so:

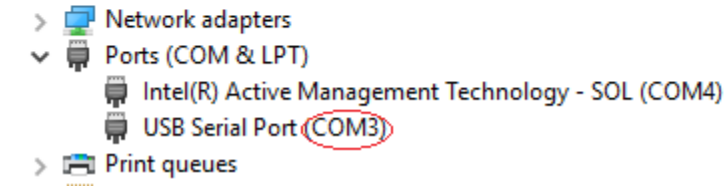
```
C:\Users\mande>pip install Pillow
```

Determining the Serial Port

Now you need to figure out what the name of the FTDI cable is. You can do this by opening Device Manager by pressing the Windows Key + R, typing in 'devmgmt.msc', and pressing enter. The name of the FTDI cable will be under the 'Ports (COM & LPT)' section. Alternatively, you can see a list of your serial ports by launching a command prompt, typing in 'powershell' to get into PowerShell mode, followed by: `[System.IO.Ports.SerialPort]::getportnames()`

```
C:\Users\mande>powershell
Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.

PS C:\Users\mande> [System.IO.Ports.SerialPort]::getportnames()
COM4
COM3
```



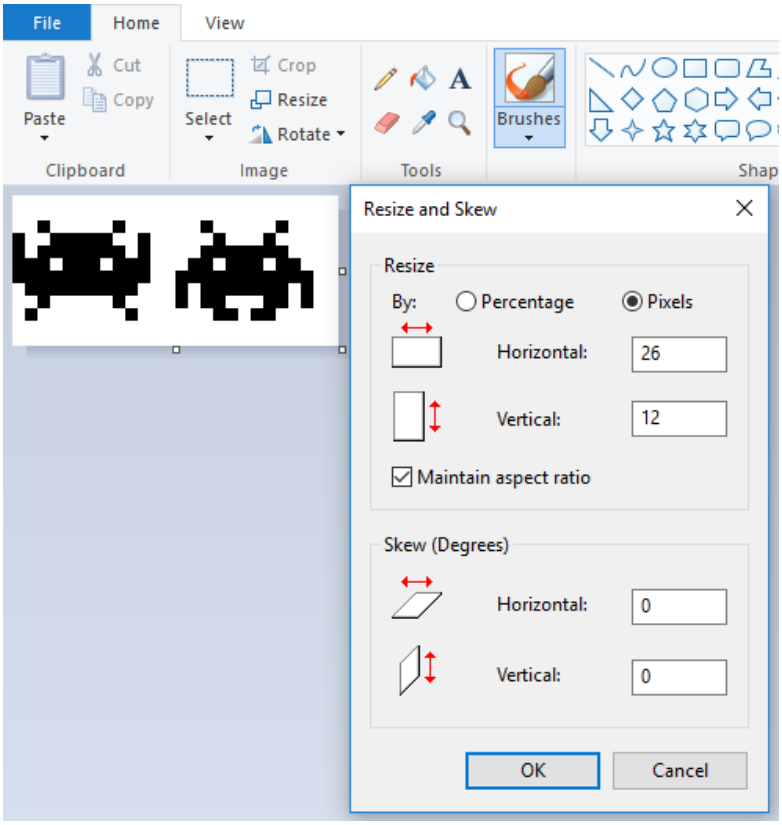
As you can see, my USB-to-serial cable is called 'COM3'. You will need to know the name of your cable to run the disk emulator software in later steps.

Preparing Pattern Data

Now we get to the fun part of creating an image on your computer that can be inserted into the memory file. While it is possible to create custom patterns using the keypad of the knitting machine, it is a very tedious process that involves entering each stitch manually without the use of a graphical user interface to aid in preventing mistakes.

The first thing you will need to do is find an appropriate image that is in or can be converted to monochrome bitmap format. There are some practical limitations on the size of the image – While the machine has 2 KB of RAM that is theoretically capable of holding 16384 stitches worth of pattern data, the reality is that much of the storage space is occupied by memo information used by the machine. If the image you choose is too big, it may collide with memory addresses that are reserved for storing other information that the machine needs. If this happens, it's not the end of the world but to avoid such an occurrence try to keep your pattern to around 13000 stitches total or roughly 144 stitches and 92 rows. The image file that I am using for this tutorial is spaceinvaders.bmp, which you can find amongst the source code you downloaded to run this project.

Once you have chosen an appropriate monochrome bitmap file, you need to make note of its dimensions for use in the next step. I usually do this when I'm finished editing the image in MS Paint by clicking on resize and choosing the 'Pixels' radio button to view the current dimensions like so:

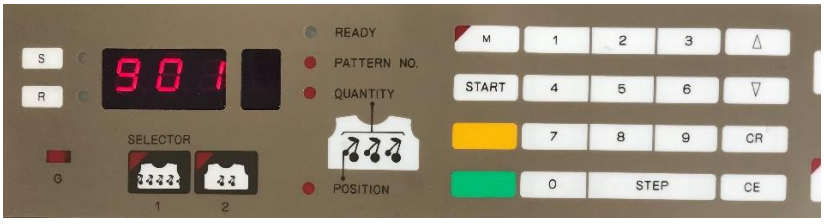


Creating a Container Pattern

The current Electro-knit software cannot add new patterns to the memory file but it can edit existing patterns. Before you attempt to load pattern data into to the machine's memory, you must first create a blank container pattern on the knitting machine. The container pattern needs to have the same dimensions as the bmp file from which you will be creating the pattern data.

In this step, you're going to create the blank container pattern of the appropriate dimensions using the knitting machine control panel. This pattern is going to be 26 x 12 and will have pattern ID #901.

Press **INPUT** and make note of the pattern number that appears. User input patterns are assigned a number in ascending order between 901 and 999:



Press **STEP**. Enter your pattern's width (number of stitches), then press **STEP** again.

The machine will display the maximum number of rows that your pattern can have. Press **CE** to clear the screen.

Enter the pattern's height (number of rows) and press **STEP**.

Now you are finished creating the container patter. Press **INPUT** one more time to exit input mode.

You can repeat this process to add more patterns for as much free memory space as the machine has remaining. As mentioned previously, you can make up to 99 custom patterns on the machine but the number of available rows will be less and less with each additional container pattern you create.

Backup

Now its time to start using the source code you downloaded previously to download the container patterns from the knitting machine memory to your computer, add the data from the bitmap image to the file, and re-upload it to the machine so that you may begin knitting your custom pattern.

It is worth noting at this point that this process is only intended for downloading and uploading custom pattern data. The built-in patterns that come with the machine will be unaffected because they are stored permanently in read-only memory which is completely separate from the memory used to store custom pattern data.

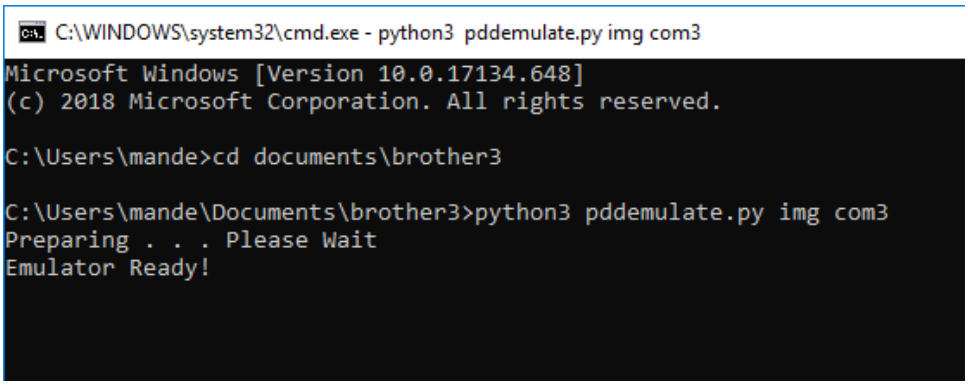
Using the Disk Emulator

Plug in the cable into the back of the machine. There is a notch on the top of the plug so you should be able to use it without accidentally putting it backwards.

Open a command prompt and navigate to the folder containing the Electro-Knit software you downloaded earlier. Start the disk drive emulator in the command line by typing in

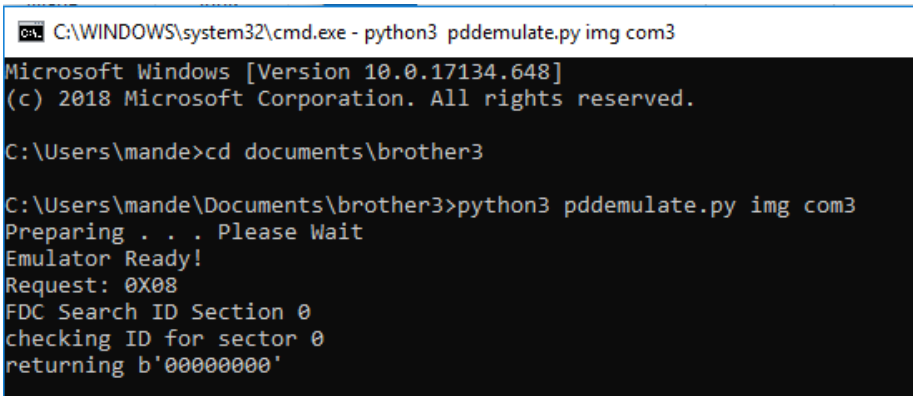
```
python PDDemulate.py img CABLENAME
```

where CABLENAME is the serial port for your USB-to-serial cable that you made note of earlier. Mine is called ‘COM3’, so the command that I type in looks like this:

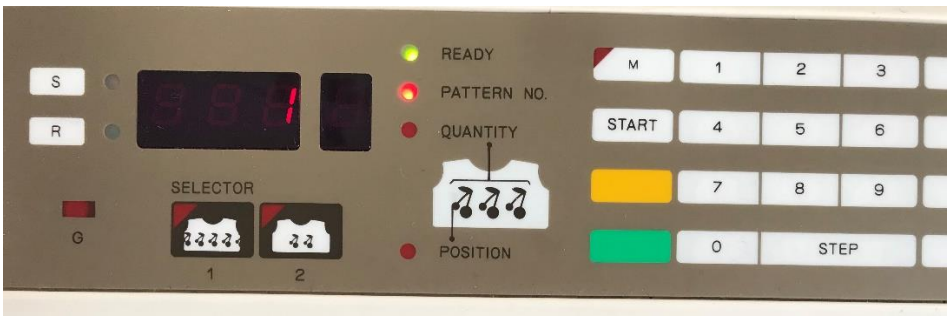


When you see ‘Emulator Ready’ and the ‘ready’ lamp on the machine is lit, clear the display with the **CE** key then enter **552 STEP**.

The result should look something like this:



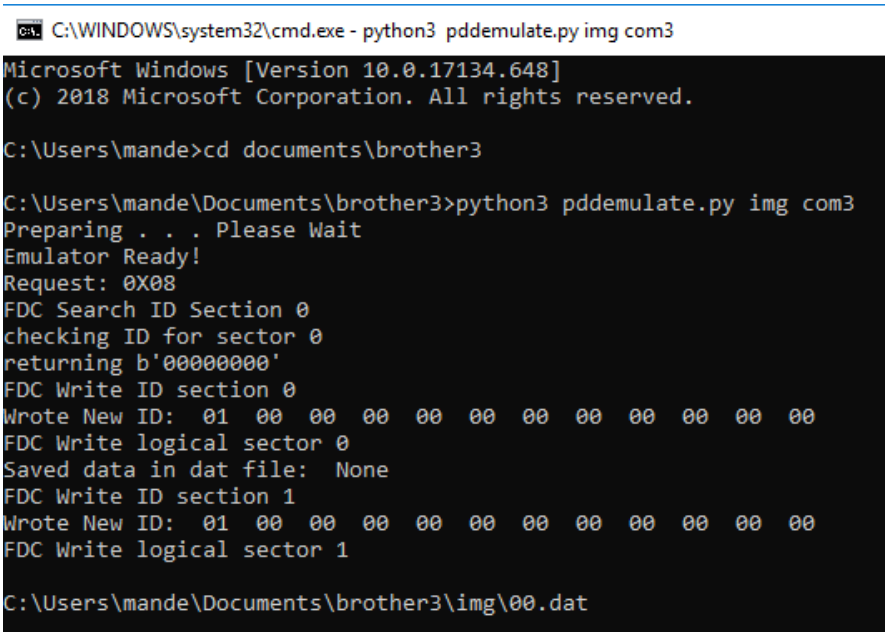
The display should go blank momentarily and then the ‘ready’ and ‘pattern no’ lamps will light up with track number 1 appearing in the display.



Press **STEP**.

This step will save the pattern data to the img folder in 80 .dat files numbered 00 to 79. The machine will beep when finished, and the track data will now be in the img folder.

Your command prompt should now look something like this:



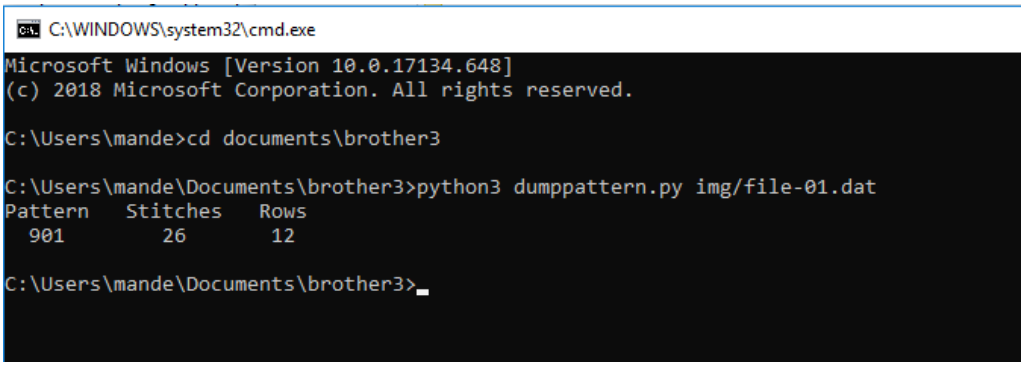
Viewing Patterns

The file-01.dat file contains any pattern data that you entered into the machine by hand. After creating a container pattern and backing up the machine's memory to your laptop, this will include basic information such as the pattern number and the number of rows and stitches. You can use dumppattern.py to view pattern data.

Using dumppattern.py is simple and you don't need to be connected to the knitting machine to perform this step. Open a command line and navigate to your directory where the software is. Type in

```
python dumppattern.py img/file-01.dat
```

Where 'img' is the name of the folder specified by the disk emulator software and file-01.dat is the file holding the pattern information. Dumppattern.py will tell you how many patterns are in the memory and their sizes like so:



You can view individual patterns by running

```
python dumppattern.py myfile.dat PATTNUMBER
```

Where 'PATTNUMBER' is the id of the pattern number you wish to view. Patterns are numbered from 901 to 999 in the knitting machine.

Inserting Patterns

After you have chosen an appropriate monochrome bitmap image, made a container pattern on the machine and backed up the machine's memory to your computer, you are ready to insert the pattern data to the memory file. It's important to make sure these previous steps have been followed before attempting to insert pattern data into the memory file. The memory file is the file in the img folder named file-01.dat.

Run insertpattern.py by typing the following into the command line window:

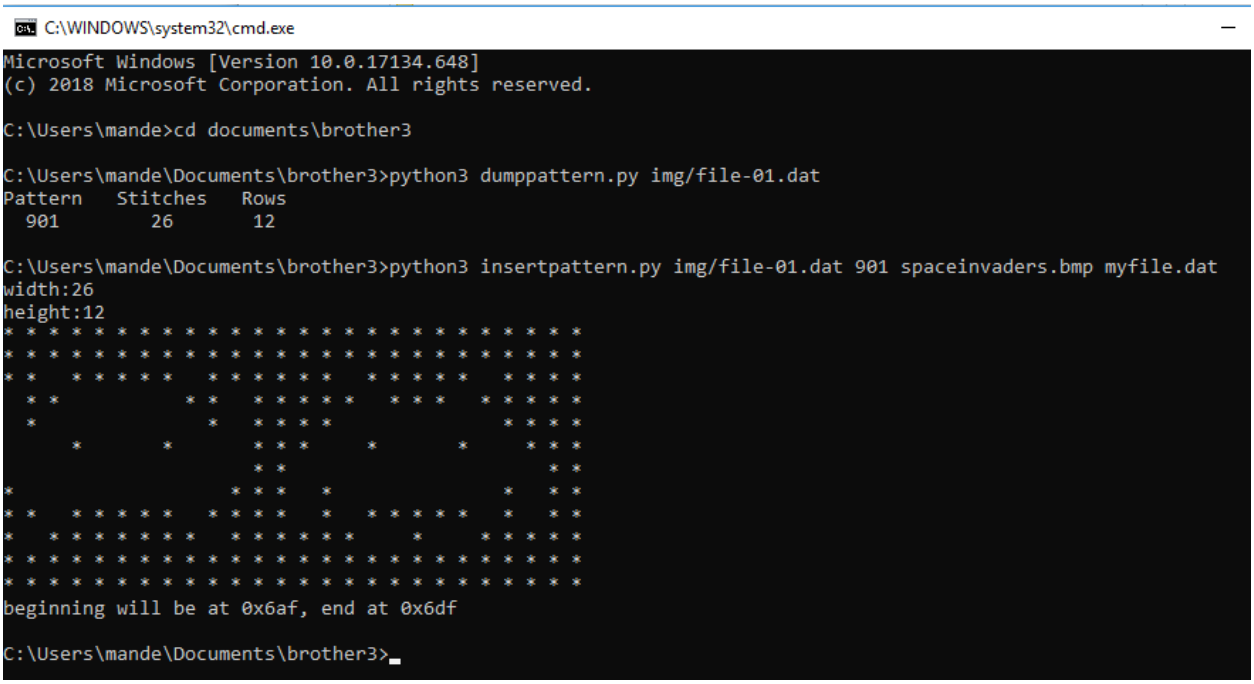
```
python insertpattern.py img/file-01.dat PATTNUMBER BMPFILE myfile.dat
```

where 'PATTNUMBER' is the pattern number where you previously created the container pattern in the machine ('901' in most cases), 'BMPFILE' is the name of your bitmap image, and myfile.dat is a new file that will contain all the pattern data. As an example, running insertpattern.py with the spaceinvaders image I created would look something like this:

```
python3 insertpattern.py img/file-01.dat 901 spaceinvaders.bmp myfile.dat
```

If the pattern size doesn't match the image size, there will be an error – this is why it is important to properly follow the previous steps.

If successful, a representation of your pattern data will appear in the command line window as well as the width and height of your pattern:



Split File

The next step is the split the 2 KB myfile.dat into two 1 KB files which can then be dropped into the img folder in preparation for loading the pattern data to the knitting machine's memory. This lets the emulator load the files back like it was a diskette. You can accomplish this very simply by typing the following into the command line:

```
python splitfile2track.py myfile.dat
```

This will create two files, 00.dat and 01.dat. Drag these two files to the img folder and replace the old ones. Now you are ready to upload your custom pattern to the machine's memory!

Uploading Patterns

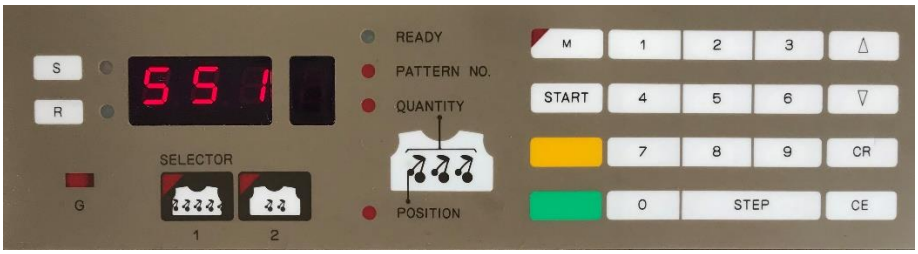
Start this step by clearing the knitting machine's memory. In the machine's keypad, make sure the display is clear by pressing **CE**. Press **888** followed by **STEP**. After a few seconds, the machine will beep and the memory will be cleared. You will also need to turn the machine off and then on again with the power switch as clearing the memory requires a power cycle.

Now you can run the disk emulator software again as you did previously by typing the following into the command line:

```
python PDDemulate.py img CABLENAME
```

Again, 'CABLENAME' should be the name of the serial port assigned to your USB-to-serial cable.

Clear the display with the **CE** key, then prepare to load new data into memory by typing **551**, then **STEP**.



The display should go blank, then "ready" and "pattern no" lamps should illuminate.

Press **1** to indicate which "track" to load from the disk drive emulator, then press **STEP**.

Machine will beep when finished. Pick a pattern and knit as normal, according to the machine manual for knitting a pattern from memory.