ARCSI microEnigma Manual

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Release 1.03

Disclaimer: *ARCSI microEnigma simulates 13 Enigma machines for documentation and historical purposes. It is not intended for any serious encryption task as it was broken 75 years ago without the use of modern computers.*
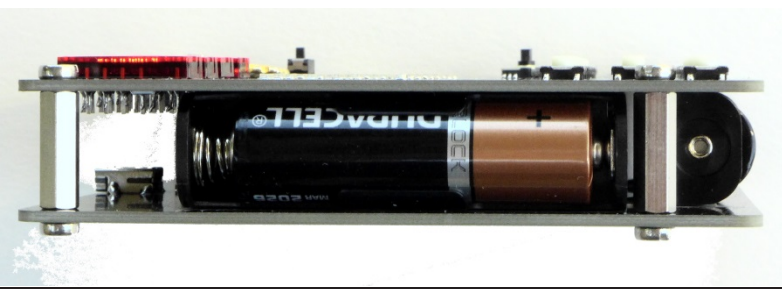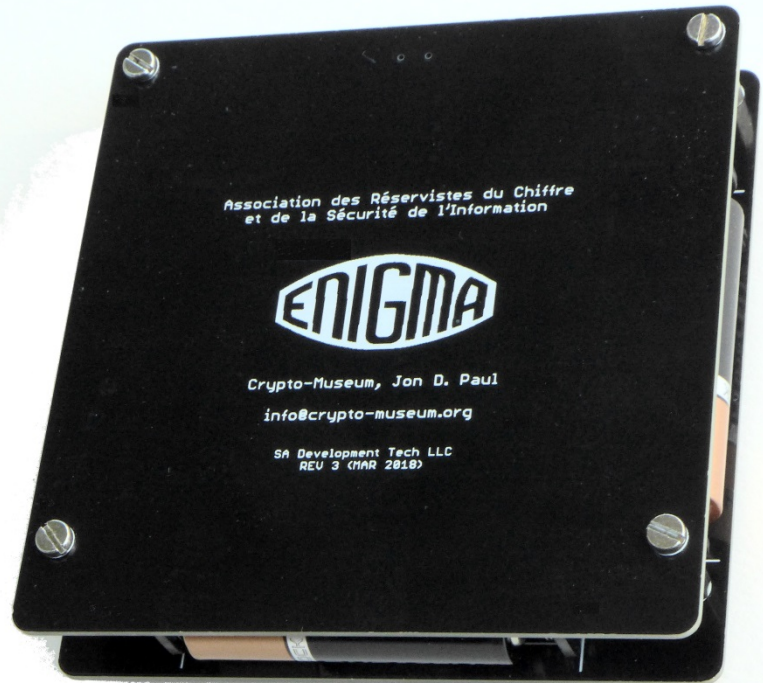
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1.Enigma Introduction

The microEnigma is an electronic simulation of 13 different Enigma machine variants. It attempts to support as many features as possible, and even supports some features that did not make it to the field before World War II ended, such as the GAP settable rotor.

The supported machines and features for each machine are:

Machine	Stepping Mech	Settable Reflector	Reflector Moves	Refl. Avail	Rotors	Plug Board	GAP** Rotors	Rotors Avail
A865	Gearbox	Yes	Yes	O	3	No	No	1-3
D	Lever	Yes	No	O	3	No	Yes	1-3
G111	Gearbox	Yes	Yes	O	3	No	No	1,2,5
G260	Gearbox	Yes	Yes	O	3	No	No	1-3
G413	Gearbox	Yes	Yes	O	3	No	No	1-3
I	Lever	No	No	A-D	3	Yes	Yes	1-5
KD	Lever	Yes	No	D	3	No	Yes	1-3
M3	Lever	No	No	B-D	3	Yes	Yes	1-8
M4	Lever	No	No	B-D	4*	Yes	Yes	1-8
N	Lever	No	No	N	3	Yes	Yes	1-5
R	Lever	Yes	No	R	3	No	Yes	1-3
Swiss K	Lever	Yes	No	O	3	No	Yes	1-3
T	Lever	Yes	No	T	3	No	Yes	1-8

*The M4 has 4 rotors, but only 3 of them move during use.

**GAP rotors were not deployed, but they have been enabled for variants where the GAP wheel could physically fit.

***While the KD reflector is not settable, it is rewireable.

Reflector legend: O=Commercial, A=Reflector A, B=Reflector B, C=Reflector C, D=Rewireable Reflector, N=Norway Reflector, R=Railway Reflector, T=Tirpitz Reflector.

The stepping mechanism defines how the rotors move from letter to letter. **The lever mechanism** was a simpler system based on levers and notches that was easier to manufacture, but had some short comings in that it would allow for double stepping under certain conditions which meant that some of the key space is skipped or lost. A second side effect of the lever mechanism is that for any given set of rotor positions, there might be more than one previous set or rotor positions that could have led to it. This makes it impossible to go back to the previous positions unless they are remembered. The microEnigma keeps track of the previous 100 rotor settings when using a lever mechanism to allow easy indicator roll back. **The gearbox mechanism** was exactly that, gears that allowed the rotors to move perfectly like an odometer hence it could be wound forward or backward at any time for any number of positions. These machines also typically had a numeric counter that could also be used as part of the enciphering process. The microEnigma supports this numeric counter as an additional view when operating.

Reflectors were sometimes **settable** meaning their position could be changed and sometimes **fixed** meaning their position count not be changed. For ones that were settable, the gearbox machines also allowed them to be **moved during encipherment.** A few machines had more than one reflector that could be used, and some machines allowed the use of a **rewireable reflector** which allowed the user to configure the wiring of the reflector.

About number of rotors, all machines are 3 rotor machines except the M4, but because many of them had a settable and/or movable reflector, it often appeared that they were a 4 rotor machine when in fact they were not. The M4 was a true 4 rotor machine, the 4th rotor could be set by the key but did not move during use.

The military machines had a plugboard which swapped pairs of letters between the keyboard/lampboard and rotor basket. If a cable connected A and Q for example, it would exchange A <> Q and Q <> A from keyboard to rotors and also exchange A <> Q and Q <> A from rotors to lampboard. This added permutation was fixed during a message. By 1944, ~ 1000 pcs of UHR box were deployed. These switches replaced the plugs on the plugboard and were intended to change the setting ever hour.

The GAP settable rotor was not finished during the war, but would have been very formidable. It allows rotor turnover notches to be customized per letter which would have added greatly to the difficulty of breaking messages.

The number of rotors available allowed the user to change the rotor order. A machine with 8 rotors for example allowed the user to choose 8*7*6 or 336 rotor orders for example. The G111 machine was discovered with only rotors labeled 1, 2, and 5 which is why it has no 3 or 4.

Invented in the 1920s, the Enigma was a brilliant machine, and underwent many modifications and improvements. Starting in 1932, Polish, French, British and finally Americans breaking Enigma messages and keys made landmark inventions to counter the German machine.

2.2. Features

Though the Enigma has many variants and machine settings, the microEnigma has a simple user interface that makes it very simple to configure and operate.

It has a four character 5x7 dot matrix display that is primarily used to show the rotor positions (indicator), but also used for configuration and operation. The display will also show rotor movement in the form of animating the letter transition from the old to the new just like a rotor would during movement. The display is available in red or green glowing LED's.

It also has a lampboard which lights up each letter during typing just like the real enigma except that it uses solid state LED's available in red, green, yellow, or orange. Just like on a real Enigma, holding a letter down will cause the lampboard to stay lit until the key is released.

The keyboard is made of small momentary buttons and uses the Enigma style layout for the keys. P is in the lower left, L is to the right of M, and Y and Z are swapped. They have a tactile feedback when pressed and will make a tick noise on the piezo sounder (if sound is on).

The power is three AA batteries or USB. With batteries, the unit will start out bright and strong and begin to dim as the batteries wear down just like the real Enigma.

The user interface has been optimized to work in multiple ways. For example, if changing a rotor position, up or down can be used to move the rotor up or down one letter at a time. Additionally simply typing the letter on the keyboard will instantly set the rotor to that letter. The joystick allows for easy navigation through simple menus and settings that are consistent.

Three languages are supported for the menu text: English, German, and French. German language support was done with the help of D. Palloks. French language support was done by Jon Paul.

Power management can dim the display to save considerable power after a certain number of minutes without activity, and it can put itself in soft off power mode after a certain number of hours.

It has configuration settings that allow the user to select display brightness, lampboard brightness, sound level (for keyboard tick/Morse code volume), animation, turnover notation. Test features allow testing the display, lampboard, keyboard, and piezo sounder.

The Morse code feature allows the user to view and hear Morse code for the alphabet. It also allows typing and playback a Morse code message up to a 64 characters. It can easily roll back to previous rotor positions – up to the last 100 are remember for lever machines and gearbox machines are infinite.

A feature to copy the current keyboard text or lampboard text to the indicator allows quick setting of the indicator.

The display can be used in multiple ways. It can show the indicator, the last 4 characters from the lampboard, the last 4 characters from the keyboard, both the last keyboard and last lampboard character, the counter for gearbox machines, or navigate through settings and configuration.

Searchable menus allow keyboard entry for quick navigation. A good example is the machine menu where the 13 Enigma variants are listed. Pressing M will instantly jump to the first M (M3). Pressing it again will jump to the next M (M4). Pressing it again will return to the first one again. For menus where a number needs to be entered, the keyboard has numbers that can be quick typed as well.

Smart menus will only show menus that the current machine allows. For example, if a machine is selected that does not have a plugboard, the plugboard menu will not be visible.

The entire machine state is stored in EEPROM so that if power is lost, it will start back up in the same state.

3. Operation

There are 5 areas on the microEnigma. The upper left has four character indicator display, the upper right has a slide power switch, the center area has a LED lampboard, the center right above the keyboard has a joystick, and finally at the bottom there is a keyboard.

To turn the unit on or off simply use the slide switch. Toward the left is ON and toward the right is OFF. At power on, the display and the lampboard will all turn on briefly as a test, and then the current indicator position will be shown.

The unit has two modes of operation. Operation mode and configuration mode. Operation mode will encipher/decipher keys that are typed on the keyboard and configuration mode will configure the machine (covered in the next chapter).

While the joystick is the primary means of configuring the machine, the keyboard can often be used to enter something faster. Typing a key in a menu will try to search the menu for the key and position to the item beginning with that letter. Typing the same key again will cycle through multiple menu options beginning with that letter automatically. Anywhere a letter or number is being entered, the keyboard can also enter it quickly instead of using UP/DOWN to set the value.

Operation mode has 4 or 5 views depending on the configured machine:

View Name	Description
Indicator View	Shows the positions of the rotors.
Lampboard View	Shows the last 4 characters lit on the lampboard.
Keyboard View	Shows the last 4 characters entered on the keyboard.
Both View	Shows the last character on the keyboard and lampboard.
Counter View	Shows the numeric counter (only visible in gearbox Enigma machines)

These three joystick commands are the same for all views:

Joystick	Operation
UP	Reverse Rotors (backspace). This will attempt to reverse the rotors like using backspace on a keyboard. This is very handy for correcting a mistyped key. On a gearbox Enigma, it can go back infinitely because of the mechanism design, but on a lever Enigma, there can be more than one possibility for what came before a particular indicator value. For this reason, the microEnigma uses a buffer for lever

	previous indicator position to return to. Use joystick center push (SELECT) to ~~manually set the indicator instead. The buffer memory is cleared at power off.~~
LEFT	Rotate View. To change the view simply press LEFT on the joystick to rotate through them. Like holding a key on the keyboard, when the LEFT key is held down, it will light up a letter on the lampboard. This letter will show which view is active and will indicate I, L, K, B, or C. It is easy to quickly learn which view is active and how to move to the
RIGHT	Enter Configuration. This will leave operation mode and enter configuration mode. ~~See the section below on configuration for more details.~~

These joystick commands are available in the Indicator and Counter views:

Joystick	Operation
DOWN	Advance Rotors. This will advance the rotors forward as if a character was typed except that the lampboard will not be lit and a space will be put in the
SELECT	Edit Indicator or Counter. SELECT will enter editing mode which changes the positions of the rotors in the indicator or counter views. A blinking cursor will show which rotor is being changed. Use UP or DOWN to change it or simply type the value ~~on the keyboard. LEFT or RIGHT will move the cursor left or right and SELECT will~~

These joystick commands are available in the Lampboard, Keyboard, and Both views:

Joystick	Operation
DOWN	Clear Display. This will erase the last four remembered keyboard or lampboard ~~characters. They are also cleared at power off.~~
SELECT	Copy to Indicator. If on the lampboard indicator views and all 4 characters are present, SELECT can quickly set the indicator to the value on the display. The display will indicate copy and the lampboard C will be lit to show that the value was

In any view (unless editing indicator/counter), typing a character on the keyboard will result in that key being ciphered or deciphered to the lampboard for as long as the key is held down. Just like on a real enigma, when the key is released, the character on the lampboard will be unlit. The technique to use here is to press a key, note the letter that is lit, then release the key just like an original operator would have done.

Operation mode is very easy to use; simply type and it will run it on the machine just like a real Enigma.

3.4. Configuration

It uses a joystick based menu system that is easy an intuitive to use. After only a few uses, it is likely that the manual will no longer be necessary!

Joystick	Operation
UP	Move Up, Decrease Value, or Clear All Typed Pairs.
DOWN	Move Down, Increase Value, or Clear Current Typed Pair
LEFT	Move Left, Exit Menu/View
RIGHT	Move Right, Enter Menu/View/Edit
SELECT	Enter or Exit View/Edit

Here is a menu map of all options. Some options will automatically be skipped if a machine or configuration does not support them; for example, if a machine without a plugboard is selected, it will skip right over the PLUG menu option.

Main Menu:

MACH

     Allows the user to select an Enigma machine variant. It will attempt to keep as many machine settings as possible from the current configuration, but may not always be able to. An example would be an 8 rotor machine with the rotors 218 switching to a 3 rotor machine. The 8 in this case will likely be defaulted to a 1 resulting in 211. After changing a machine, a review of all settings is necessary to make sure the machine is setup as desired.

REFL

     Allows the user to select a reflector. This menu does not appear for machines that only have one reflector. If the rewireable D reflector is available for the selected machine, it will appear as D.

REFD

     Allows the user to configure the rewireable D reflector. This menu does not appear unless the D reflector is selected. Pressing UP will clear the entire reflector and return it to the default for the machine. The lampboard will show letters that are used (lit) and still available (unlit). In this case, J and Y are always lit because they are hardwired. Any letter to the left of the cursor will also be lit and is unavailable for entry. This technique prioritizes letters that are already entered (before the cursor) and prevents them from being used again. Use left or right to move through the pairs. Use select to exit. UP and DOWN do not change a letter, they must be typed.

Allows the user to select the rotors. If the M4 is selected (without the D reflector), the first rotor is beta or gamma. Use left or right to change which rotor is being edited. UP and DOWN will change the value or it can be changed by direct entry. It will allow the use the same rotor number in multiple positions. SELECT will exit.

RING

Allows the user to configure the ring settings. Use left or right to change which ring is being edited. UP and DOWN will change the value or it can be changed by direct entry. SELECT will exit.

GAP

Allows the user to enable/disable and configure the GAP filled rotors. This menu does not appear if the machine is unable to use GAP rotors. This only applies to the three right most rotors where a GAP rotor would have an effect on the stepping mechanism. Use left or right to change which GAP rotor is being edited and it will show which letters are gaps on the lampboard. UP and DOWN will enable or disable the GAP rotor. If disabled, a rotor will use the default gaps on a particular rotor, hence NNN will completely disable the GAP rotor feature using only the gaps found on the selected rotors from the ROTR menu. When a GAP rotor is enabled however, it will override those default gaps and use the ones indicated by the lampboard. Direct entry will toggle them on or off. SELECT will exit. *It is important to know that the turnover notation set in configuration is relevant to what is displayed on the lampboard. For example, if the letter Q is set under indictor turnover notation and then it is reconfigured to use notch turnover notation, it will then show that Q as a Y to reflect the new notation. SELECT will exit.

PLUG

Allows the user to configure the plugboard. This menu does not appear if the machine does not have a plugboard. Pressing UP will clear the entire plugboard. Pressing DOWN will clear the current selected pair. The lampboard will show letters that are used (lit) and still available (unlit). Use left or right to move through the pairs. UP and DOWN do not change a letter, they must be typed. SELECT will exit.

UHR

Allows the user to enable and configure the UHR. This menu does not appear if the machine does not have a plugboard, or if the plugboard does not have 10 pairs enabled. It can take a value from 00 to 39. Use LEFT or RIGHT to change which digit is being edited. UP and DOWN will change the value or it can be changed by direct entry. SELECT will exit.

INIT

Will initialize to a stock machine (M4). Entering this menu will prompt for confirmation. Pressing Y or pressing SELECT will initialize. Pressing N or left will exit without initializing.

Enter the configuration menu (see below).

VER   Display the firmware version. LEFT will exit.

SN   Display the unit serial number. LEFT will exit.

Configuration Menu:

DISP

> Adjust the display brightness (0-7). UP and DOWN will change the value or it can be changed by direct entry. The display brightness will immediately change to reflect the value. The display brightness is responsible for the most amount of power consumed to light up all those LED pixels. SELECT will exit.

LAMP

> Adjust the lampboard brightness (0-7). UP and DOWN will change the value or it can be changed by direct entry. The lampboard brightness will immediately change to reflect the value. SELECT will exit.

SND

> Adjust the volume (off, low, high). UP and DOWN will change the value or it can be changed by direct entry. The sound will immediately change to reflect the value. Pressing RIGHT will make a tick sound for evaluation, and using a key that doesn't change the value (like P) will make the longer error sound for evaluation. SELECT will exit.

ANIM

> Adjust the animation of rotors when changing. This will determine whether the display shows animation or rolling of the rotors in the indicator in operation mode. UP and DOWN will change the value or it can be changed by direct entry. SELECT will exit.

TURN

> Adjust the turnover notch notation (indicator, notch). Indicator notation reflects the indicator value which causes a turnover. Notch notation reflects the actual position of the notch on the rotor. UP and DOWN will change the value or it can be changed by direct entry. SELECT will exit.

LANG

> Adjust the language (English, German, French). This will change all the menu labels between English/German/French. UP and DOWN will change the value or it can be changed by direct entry. SELECT will exit.

PWR

Enter the power menu (see below).

TEST

Enter the test menu (see below).

Test Menu:

DISP

Will light all display segments. Press LEFT to exit.

LAMP

Will light all lampboard LED's. Press LEFT to exit.

SND

Will make a beep noise.

KEY

Will allow testing each key on the keyboard. As a key is typed, it will be lit on the lampboard. The joystick direction are displayed with arrows and the select is displayed with a dot. Use LEFT twice to exit.

MORS

Morse code tool. See Morse code tool chapter for usage.

Power Menu:

BATT

Displays the voltage the system is running on. Press LEFT to exit.

DIM

Will dim the display and lampboard to minimum brightness after inactivity. Set in minutes, 00 will disable the feature. Use LEFT or RIGHT to change which digit is being edited. UP and DOWN will change the value or it can be changed by direct entry. SELECT will exit.

OFF

Will turn the unit to the soft off power mode off after inactivity. This is not the same thing as turning off the unit which will consume zero current but cutting off the power from the unit. What it can do however is reduce power to the absolute minimum it can which is to shut everything down and put the unit in the deepest sleep mode it can. This will typically consume around 500uA which means it will deplete a set of AA batteries in about 8 months. Set in hours, 00 will disable the feature. Use LEFT or RIGHT to change which digit is being edited. UP and DOWN will change the value or it can be changed by direct entry. SELECT will exit.

5. Example

My notes are that this example is from an Enigma Instruction Manual, 1930. Machine Settings
for Enigma I
Reflector: A
Wheel order: II I III
Ring positions: 24 13 22
Plug pairs: AM FI NV PS TU WZ Message key:
ABL

To configure the machine, press RIGHT to enter configuration. MACH will display. Use UP/DOWN or type a letter
I to get to INIT. Press RIGHT to enter INIT and type a Y to accept. This clears all settings in the machine.

Use UP/DOWN or type a letter M to get to MACH. Press RIGHT to enter MACH. Use UP/DOWN to select I (or
press the letter I). Once the I machine is selected, use SELECT (press the joystick center) to select it. Now the
correct machine is selected.

Typically a good way to proceed at this point is to use the DOWN to see which options are available for this
machine. Different machines have different options. Pressing DOWN now displays REFL for reflector. Press
RIGHT and select the A reflector in the same was the machine was selected (Use UP/DOWN or just type the letter
A). Use SELECT (press the joystick center) to select it. Now the correct reflector is selected.

Press DOWN to proceed to ROTR for rotors. Press RIGHT and it will display "123". The above says the rotor
order should be "213" so this needs to be entered. You can type it in by using the lettered keys with numbers on
them, or use LEFT/RIGHT to select the rotor and UP/DOWN to change it. When you have "213" entered, press
SELECT to select it. Now the correct rotors and rotor order is selected.

Press DOWN to proceed to RING for ring settings. Press RIGHT and it will display "AAA". Rings are entered here
by letter, so the above numbers need to be translated, 24→X, 13→M, 22→V. Enter these by typing or using the
joystick. When you have "XMV" entered, press SELECT to select it. Now the correct ring settings are selected.

Press DOWN to proceed to GAP. Skip this for now by pressing DOWN again to get to PLUG. Press RIGHT and it
will display dashes. This is because the plugboard connections are empty at this time. You must type these
connections in, joystick UP/DOWN work differently in this entry. DOWN will clear the pair you are on to dashes and
UP will erase all plugboard connections. Type in "AM FI NV PS TU WZ". It will scroll automatically as entered.
LEFT and RIGHT can be used to move left or right to see all the selected pairs. Additionally, the lampboard will
light up the pairs that are selected or already used to show which are connected and which are still avaialable.
When these 6 pairs are entered, press SELECT to select it. Now the plugboard settings are selected.

Pressing DOWN again will show INIT (Do NOT go into it). This is one way to see that there are no more specific settings for this machine. To review any of the settings, press UP and go back into them to make sure they are correct. When satisfied that everything is correct, press LEFT to leave configuration mode and enter operation mode. "AAA" should be displayed showing the indicator.

Press SELECT and a cursor will begin blinking on the indicator. Type "ABL" or use the UP/DOWN and LEFT/RIGHT to select them. Press SELECT to leave editing. Now the machine configuration and key is fully entered. It is ready for encipherment or decipherment.

Here is a message encoded with this machine configuration and key:

Begin by pressing the G in the top message. You should see it light the F in the bottom message. Note that it will keep the F lit up as long as you hold the G key down just like the real Enigma operated.
Release the G, and press the C so that I lights the E, and so on. If you make a mistake, the UP joystick will go back one character each time it is pressed if the unit remembers the previous indicator setting (lever mechanism). DOWN will advance the rotors as if a key were pressed as well.

GCDSE AHUGW TQGRK VLFGX UCALX VYMIG MMNMF DXTGN VHVRM MEVOU YFZSL RHDRR XFJWC FHUHM UNZEF RDISI KBGPM YVXUZ

FEIND LIQEI NFANT ERIEK OLONN EBEOB AQTET XANFA NGSUE DAUSG ANGBA ERWAL DEXEN DEDRE IKMOS TWAER TSNEU STADT

There are different views that can be used in operation mode. Toggle between them by pressing left. Each time a letter will light on the lampboard indicating which view it is. L for lampboard view (it displays the lampboard letters on the display), K for keyboard view (it displays the letters typed on the keyboard), B for both view (it displays each key pressed and the lampboard letter for it), and I for indicator view (it shows the indicator / rotor positions). A gearbox mechanism machine also has a counter view that shows the counter.

6. Morse Code Tool

To enter the Morse code tool:

Press RIGHT to get into configuration (MACH will be displayed).
Press C (CONF will be displayed) then SELECT (DISP will be displayed).
Press T TWICE (TEST will be displayed) then SELECT (DISP will be displayed).
Press M (MORS will be displayed) then SELECT (blank screen).

(Same as navigating menus CONF → TEST → MORS)

Typing a letter will play the Morse code on the sounder (if the sound is not off) and display the Morse code for the letter on the display. The letter will also be shown on the lampboard.

Typing more letters will keep sounding and displaying them. It can handle typing faster than it can display and/or sound them as well.

It remembers up to 64 letters in a buffer and can replay the entire message by pressing UP. Pressing a key during playback will stop playback.

To clear the buffer and start over press DOWN. To insert a space between words use the RIGHT. To leave Morse code tool mode just press LEFT.

7. Design

The Enigma machines are very much elegant art as they are machine. Fantastic human thinking and design in an age where technology limitations forced humans to truly push themselves to brilliance.

One of the main goals with microEnigma was to make it fully usable and handheld. It is both beautiful and functional and reflects the look and feel of the original Enigma machines as much as possible.

It was important that it feel real as you use it. Real buttons to press, real lights to light up, a clicking noise during typing, and a power switch to turn it on or off were all features that go into the feel real design plan. It also maintains the basic Enigma layout where the keyboard, lamp board, rotor indicators, and power switch are in the correct locations. The keyboard and lamp board use the exact layout of the Enigma.

Another goal was that it also be beautiful and artistic. The top of the board is very clean with only necessary components and labeling. The underside of the board contains all the logic components. Surface mount components were extensively except the indicator display which is made up of four classic style 5x7 LED display modules that can display any letter or number very cleanly. The graphics and layout have all been carefully selected. On the printed circuit boards every component has been hand soldered under a stereo microscope. It includes battery or USB power. It has a pair of PCB's that sandwich the battery holders. The Enigma logo on the front can be blackened and 3 holes drilled to place an ARCSI pin. The goal was to make something unique and very much out of the ordinary like someone walking up on an Enigma machine must have been originally.

8. Firmware Update with Bootloader

WARNING: This is not a process for a novice. Danger of failure and "bricking" the machine! You must know very well, serial terminal usage including file transfer along with how to connect and disconnect wiring.

Five things are required to perform a firmware update:
- The microEnigma that you have already has firmware 1.03 or newer.
- A firmware update file (enigma_xxx.upd) where xxx is the version number.
- Terminal software (such as Teraterm) with the XMODEM CRC protocol.
- TTL level serial adapter such as part TTL-232R-5V (microEnigma requires TTL level serial, do NOT use RS232 voltages).
- A way to connect the TTL level serial adapter to the microEnigma update pads (JGND, JTX, and JRX).

How to perform the update:

IMPORTANT: The RX and TX pins used for updating the unit are normally used to drive the lampboard LED's. **Do NOT** connect the TTL level serial adapter unless the unit is in bootloader mode, and make sure to disconnect it before leaving bootloader mode.

STEP 1 - Get into bootloader mode. Hold down the U, P, and D buttons while turning the unit on (UPD for update). The display will show all dots on at the lowest brightness and the keys will be unresponsive if you press them. This is bootloader mode. It might end up in this mode without pressing UPD if it does not have valid firmware loaded.

STEP 2 - Launch your terminal software, connect to the TTL level serial adapter, and set the baud rate to 38400, no parity, 8 data bits, 1 stop bit.

STEP 3 - Connect the AVR JGND pad to the TTL level serial adapter ground (GND) signal. There mounting holes on the microEnigma are also ground if they are more convenient to connect to.

STEP 4 - Connect the AVR JTX pad to the TTL level serial adapter RX signal. It is **IMPORTANT** that this is TX to RX (NOT TX to TX!). At this point the terminal should show a letter C every 3 seconds. If it doesn't, something is wrong, do not proceed but go back through these steps until it is corrected.

STEP 5 - Connect the AVR JRX pad to the TTL level serial adapter TX signal.

STEP 6 - Use the terminal software to upload the firmware file using XMODEM CRC. During the upload the T lampboard light will flicker. If you do not see it flicker, then it is possible the connection in step 5 is not good.

STEP 7 - The transfer should take around 30 seconds total and then complete. There should be no more T flickering and no more C's on the terminal every 3 seconds. **Disconnect the TTL level serial adapter** first and then power cycle the unit.

STEP 8 – Go into configuration and look at the version. It should show the new firmware version number.

Update Troubleshooting:
The microEnigma uses an internal oscillator and may not have a perfect baud rate. If STEP 7 fails, it might be worth trying to up or down the baud rate in Teraterm by 4% such as 39936 or 36923 and reattempting the upload. When it is sending C's, trying various baud rates to find where it stops working properly may identify the slow and fast edge of failure so that the average of those two values can be used.

A reset can also be performed by holding down the R, S, and T keys during power up. It will flash RST on the screen and then startup. All settings will be lost and it will return to factory defaults.

10. Release Notes

1.03 – Improved internal oscillator accuracy, bootloader tested and working.

1.02 – Changes to prepare for bootloader, not deployed.

1.01 – Added French language.

1.00 – Initial release.

Many thanks to my good friend, Jean-Louis Desvignes for his kind assistance, encouragement, and advice!

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