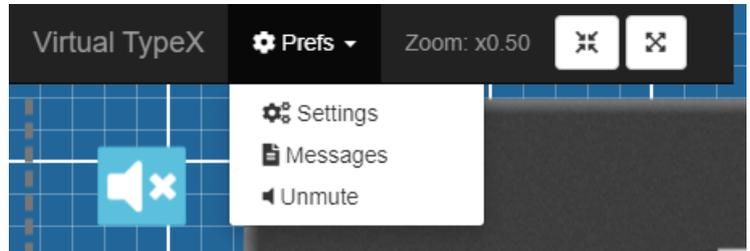# Virtual Typex

An online simulation of a Mark 22 Typex, developed in Britain in 1934.

by Virtual Colossus, 2020

An overview of the controls

When first starting up Virtual Typex, and to get the best out of the simulation, we suggest that you turn on the audio. The sound effects are authentic recordings from a working Typex machine from GCHQ. Simply click on the blue speaker icon shown here to mute/unmute.

Within the Preferences menu are options to view or alter the settings (including the rotor positions, settings and wiring), a list of example messages to encipher / decipher and a mute/unmute option.

To view closer or to get a better overview of the whole of Virtual Typex, click the two Zoom buttons to the right of the top menu.

At the top middle of Virtual Typex is a slider control which allows you to view beneath the cover to see the mechanism working. Slide to the far right to see the top cover and to the second point from the left for fully transparent. The point on the far left will also hide the document holder.

Getting Started

Before beginning, make sure that the Typex is powered on using the switch shown to the right, you should be able to see the motor running under the cover. Next, check that both printers are set to Letter mode initially by using one of two push buttons which are in front of each printer. Finally confirm that the cipher/decipher lever is in the cipher position.
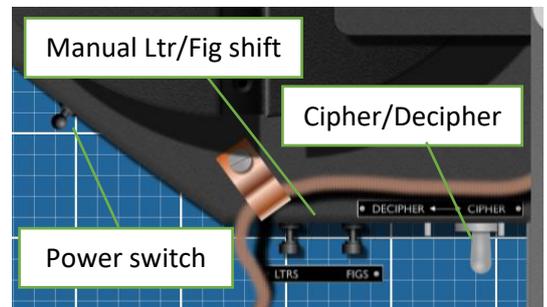
The keyboard can be activated by either clicking on each key or by typing on your computer keyboard (if you have one). Only the keys A-Z and space bar are available with the special buttons marked Fig[s] and Lett[s] (Figure shift & Letter Shift) available on the \ and / keys respectively. To type one of the number keys or to use punctuation you can see in red above each key, press the Fig[s] (\) button first, then press the relevant key. Press the Lett[s] (/) button to switch back to letter mode. The Z, X and V keys are physically linked to the Fig[s], Space & Lett[s] buttons so to type each of these letters, they are available as figure shifted characters on the D, G & C keys.

Try typing a few keys on the keyboard, whatever you type should be printed on the left-hand printer. Try moving the slider control fully to the left to make it easier to see what you're typing and to see the mechanism. Type out numbers by pressing Fig[s] once then pressing any of the QWERTYUIOP keys. Try entering the word TYPEX (hint: you'll need to use the Figure shift key to get the X).

There are two printers available on Typex which print onto 3/8" tape.

The left-hand printer will output the text you are typing while the right-hand printer will output the ciphered/deciphered text. If you need to feed paper out to see what you've typed, a rotary knob is available on of each printer which can output blank tape.

Altering the cipher/decipher lever does not actually change how the rotors mix the plain or cipher text entered, but it does alter how both printers' function. In cipher mode, the left-hand printer prints plaintext including numbers and punctuation while the right-hand printer outputs the cipher text using just the letters A-Z and automatically creates spaces every 5 characters, separating the cipher text into easily read sections. In decipher mode, the operation is reversed with the left-hand printer now echoing the cipher text being printed (with 5 character spacing) while the right-hand one outputs the plain text with numbers and punctuation.
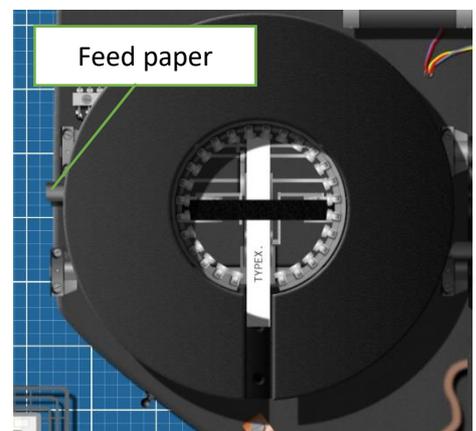
Reading a document

A document holder is available just above the keyboard (Note: If you have hidden the document holder using the slider, move this back to the right so you can see it again).

It has a movable bar which can be used to keep track of your position on the document being used. Grab hold of the bar by the handle on the far right to drag it up and down. A document can be marked as completed by using the rubber stamp, drag it to the document and release to stamp.

You can swing the document holder up to give access to the rotor unit to enable setting or changing of the rotors. A button to toggle the holder up or down is available at the top right of the holder.
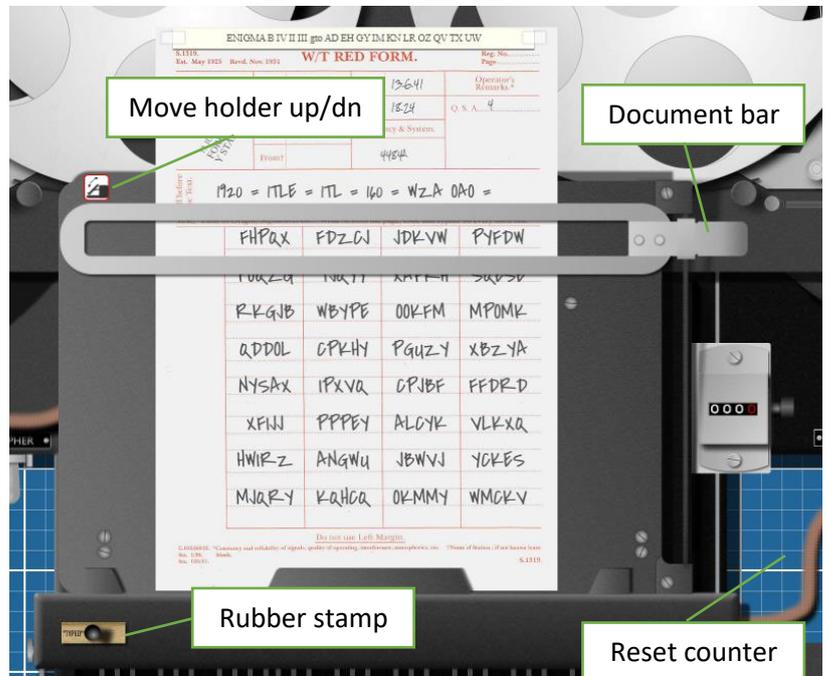
A rotary counter shows how many characters have been typed. The 0 and 5 units are shown in red which helps keep track of how much of the text has been completed when entering ciphertext split into groups of five. To reset the counter before starting a new text, click the rotary knob on the right of the counter until the display goes back to 0000.

The document can be dragged off the holder into one of the in or out trays on the far left or right of the screen. New documents, of both Typex and Enigma, can be loaded into the in tray by using the Prefs / Messages menu.

Changing the rotor settings

Typex has five rotors of which the first three rotate during enciphering while the last two on the right stay static. Each rotor has the letters A to Z marked around their circumferance which shows through the window in the top of the drum unit. The operator would set all five rotors to a new start position for each new message being sent.

The drum unit cover can be opened or closed to gain access or view the rotors themselves by clicking on the white button in the bottom-left of the drum unit.

You can change the start position letter which is shown, with the cover open or closed, by clicking on the up/down arrows that appear above each rotor.
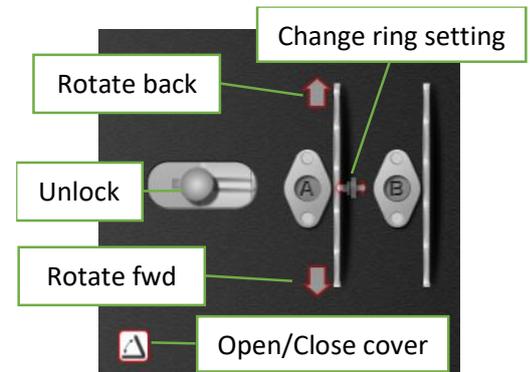
Each rotor can also have the wiring rotated to one of 26 positions with respect to the rotor body itself, changing the internal wiring (this was known as the Ringstellung on the Enigma).

To alter the ring position, you must first release a small spring-loaded pin by clicking on the locking pin release icon and then rotating the wheel up/down as before. Once the correct value has been set, click the locking pin release again.

Swapping the rotors

Originally, in 1939, the Typex Mark II machine came with a set of five "black" rotors, but from 1st June 1941, two additional drums were added from a set of five "red" rotors making a total of seven to choose from.

The rotor order was specified as part of the day key and it is possible to swap out the rotors on Virtual Typex just the same.

2
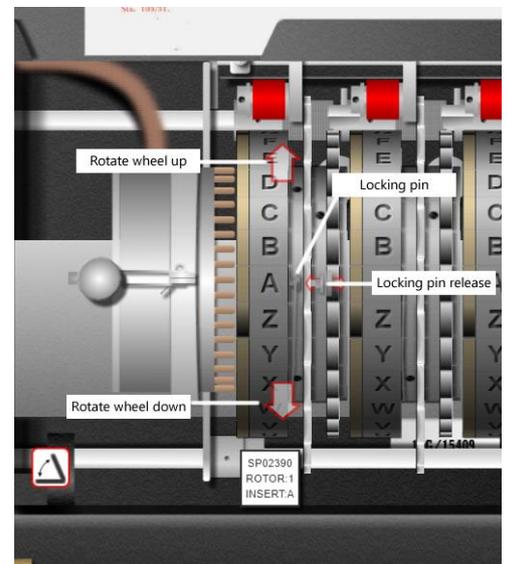
Each rotor can be replaced with one of the others available. Releasing the rotors is a matter of firstly, releasing the wheel locking lever, then, pressing the unlock button on top of the reflector head to allow them to be removed. Fitting the rotors back in should be done in reverse order, lock the reflector head then release the wheel locking lever.
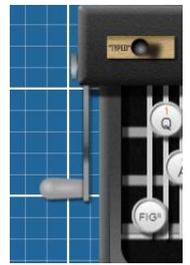
Once the rotors are released, you can drag them, one at a time, back to the storage box below the keyboard or back to one of the five rotor positions in the drum unit. Drag the rotor until you get the dotted white line around the section you wish to drop into then release.

Virtual Typex comes with several sets of rotors for you to use:

- A set of five Enigma I compatible rotors along with two special blank rotors (coloured white) for use with the two extra static rotor positions. (The Engima I had three rotor positions, so the last two need to be filled with straight through rotors on Typex)
- Three sets of Typex rotors with reversable inserts, each with seven rotors. The set marked Y269 also includes 14 wiring inserts which can be swapped into each of the rotor bodies.
- A set of five Typex test rotors. These straight through connected rotors were used to test after manufacture or repair of a Typex unit.
- A set of eight rotors with wiring matching the CyberChef application written by GCHQ (https://gchq.github.io/CyberChef/). The rotor wiring was randomly generated but is included for testing compatibility with their emulation which was tested against a real Typex machine.

Each set of rotors can be switched over into the rotor box by clicking one of the blue buttons along the bottom of the web page. Clicking one of the rotor switch buttons will open the drum unit and remove all inserted rotors, then swap to the new set in the box ready for refitting. A separate button is available to just return all rotors to the box without changing the set.

As referenced above, the Typex Y269 rotors have an additional set of wiring inserts which could be removed and swapped with another from a set of fourteen. The inserts could also be replaced back into the rotor body reversed doubling the number of possible wiring configurations available. The insert, body and rotor order would all have been referenced on the settings for each day key.

To swap an insert, firstly select the Typex Y269 rotors and then drag one of them over onto the workbench space (next to the screwdriver). The insert will then be removed for you to view. Change the current insert by using the up/down arrows to the left of the insert and use the rotate button between them to turn over the insert. The initial side is marked with a letter of the alphabet from A to N while the reverse side is also marked with the letter R (eg, B and BR). Click the insert itself to return it to the rotor body which can then be dragged back to the box or into the drum unit.

The rewireable reflector

The original reflector head on Typex was a fixed unit with wiring which connects each letter back to one other. The reflector returns the electrical signal back through the rotors via a new route and also means that the encryption/decryption is reciprocal (e.g. if a signal encrypts with the signal coming in to the letter A, it will be reflected back into the wiring of letter Y and likewise, when decrypting, the letter Y will be sent back through the path of letter A). From around November 1941, a rewireable reflector was introduced where the wiring from the reflector head was brought out to a plugboard mounted to the left of the keyboard. A set of 13 wires were included which meant the reflecting wires could be altered regularly, increasing the security of the device while still maintaining the ability to have a reflector which is Enigma compatible.
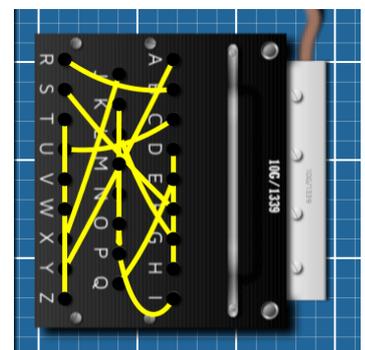
The reflector on Virtual Typex can be rewired by dragging the black end circles of each wire away from the plug socket. To swap cables, it can be easier to completely remove both ends of the cable and dropping it. To reconnect, pick up and drag the black end circles onto a free socket until you see the white circle showing you can connect. To make a complete valid reflector, all 13 wires must be connected filling all 26 sockets.

Several reflector settings are available to pick in the Prefs / Settings page, including the three Enigma UKW-A, B & C variants.

The plugboard

The initial versions of Typex did not include a separate plugboard like the military Enigma but instead, the two extra static rotors act in a similar way as the Enigma one. Again, around November 1941, a plugboard was added to the Typex Mark II (which was called the Mark 22) between the keyboard and the drum unit entry disc.

Swap module

One difference between the Enigma and the Typex plugboard is that Enigma plugboard cables always swapped two letters with each other (e.g. C to S and S back to C) while Typex allowed each letter to be swapped to different letters (C could go to S but S might swap to X). Again, this increased the number of possible ways to mix the cipher text and therefore increased the security while still allowing the ability to connect like Enigma.
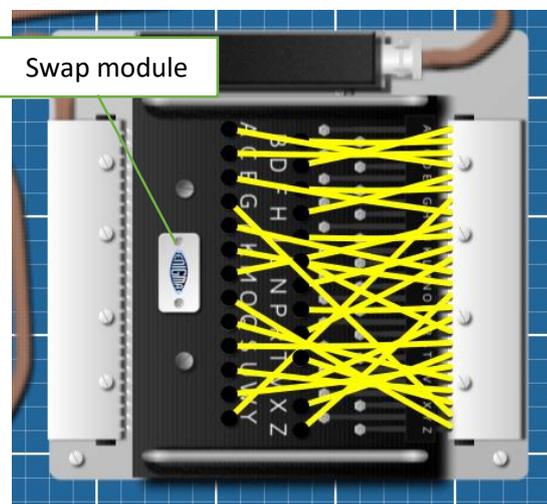
The plugboard itself was modular and could be unplugged and replaced with another module which meant that a new wiring configuration could be setup while the initial one was being used and then swapped quickly. Two different modules are included with Virtual Typex: a Typex module and an Enigma module. The entry disc on the far right of the drum unit's wiring was different on the Typex and on Enigma, so a way was required to change the wiring between the keyboard and entry disc. While it is difficult to find information on how exactly this was done, I believe that the simplest option was to have a new plugboard module for Enigma which altered the wiring internally. This meant that a Typex machine could quickly be swapped between being in Typex mode and Enigma emulation mode simply by swapping in a plugboard module. To do this on Virtual Typex, simply click on the white label on top of the plugboard. There are twenty-six wires, each connected to one letter of the alphabet on the keyboard. To make or change a connection, click and drag on the black circle at the left end of the wire and drag it to an empty socket or simply release it clear a socket. All wires are required to be connected, if a letter is not one that requires swapping for another, just connect the wire directly to the same letter socket.

The plugboard wiring can also be configured within the Prefs / Settings menu by entering 13 space separated letter pairs or a list twenty-six letters each of which are connected A-Z.

Setting a Day Key

You are hopefully ready to encipher your first message on Typex. As this is the first message of the day, we'll need to setup the day key to set each of the rotors, inserts, ring positions and plugboards to the correct settings.

We need a message to encipher, so go to the Prefs / Messages menu where you will find several examples of Typex and Enigma messages you can use to learn how this machine works.

From the section marked Typex – Encipher, choose Bundle 1

The document from this bundle will be deposited in your in tray (to the left of the screen), so drag it out onto the document holder on the top of Typex. The day key to use is shown attached on the top of each message. This first example has the settings "Y269 TPXA 4B 1D 7GR 2A 5J rvowk ABCDEFGHIJKLMNOPQRSTUVWXYZ". If you would rather skip the day key settings and jump straight to the enciphering part, a button is available on Virtual Typex just above the keyboard marked "Set Day Key". Pressing this will set the correct rotors, reflector, wheel inserts, order and ring settings all for you.

To best understand the Typex, we can set this day key the hard way as follows. The way Virtual Typex shows the day key is as a group of codes separated by spaces. The first of these, Y269, shows the rotor type you should be using. One way to choose which rotors are available is to use the blue buttons at the bottom of the screen, under the rotor box so do that now. **Press the Typex Y269 blue button**

This will return all the existing rotors to the box then swap for a new set of rotors, the Y269 rotors. There are seven rotors in this set and it also includes a total of 14 different inserts which can each be swapped into any of the rotors in one of two orientations.

The second section of the day key is the reflector name to use. The reflector can be wired directly by dragging the ends of the wires, but to make it easier, you can **click on the white label on the right hand plugboard to swap to the different available reflector plugboards until it says "TPXA".**

The next five groups of numbers/letters are the rotors/inserts to use and which order to put them into the five positions on the Typex. Each rotor has been marked with a number (the rotor body to use) followed by a letter (the insert to use). Optionally, there can be the letter R as the third character which denotes that the insert should be inserted reversed.

The first rotor for the far left of the drum unit is 4B. This means we want rotor number 4 with insert B inside, but if you look at the box of rotors, rotor 4 has insert D currently so we need to swap it over.

Drag rotor 4 over to the workbench and drop it in the space provided (a white dotted section next to the screwdriver) and the current insert will be removed for you. Click the up/down arrows to switch inserts until you find the one marked with a letter B. **Click on the insert to fit it back in the rotor**. Now we have the correct rotor 4B, drag it in the Typex drum unit into the left-hand position.

The second rotor is 1D so repeat the instructions above, selecting rotor body 1, fitting insert D and dragging it into position number 2 in the drum unit.

Rotor number three is shown as 7GR which means rotor body 7 and insert G, but this time, we want to reverse the insert. **Drag rotor 7 onto the workbench and find insert G. To reverse the insert, click the flip icon** between the up/down arrows, then click the insert to fit it back as normal. Drag this rotor to position 3.

Finally, fit rotor 2A and 5J the same way then lock the rotors into position by first **pressing the button on top of the reflector head** (to the left of the first rotor) and then **release the wheel locking lever** to the left of the keyboard.

The next part of the day key is the rotor ring settings, it is shown as the five letters, rvowk, that you need to set each of the five rotors rings to that you just selected. The ring setting is changed by releasing the small pin which you should be able to see just to the right of the letter A on each rotor.

Click the locking pin release icon on rotor 1 which you should then see pulled out of the locking hole. **Use the up/down arrows above/below the rotor to rotate the ring wheel until the letter R is shown** next to the pin. **Click the locking pin release icon again** to lock this in place. **Repeat this for each of the other rotors** for the other ring setting letters V,O,W and K. We have completed setting the rotors, so we can close the cover by clicking the white open/close button at the bottom left of the drum unit.

Finally, the last set of 26 letters are the settings for the plugboard on the right-hand side of the keyboard which is showing **C**BA**M**EFGHIJKL**ON**DPQRSTUVWXYZ. First, make sure the plugboard type is the Typex one (if it says Enigma on the label, click the label to swap to the Typex version – they are wired slightly differently). Each of the letters listed are where each of the wires, in alphabetical order, are connected to. The first letter is which plug you should connect wire A to, the second which plug to connect wire B etc. In this case, to make it simpler, just a few of the wires are changed from their default. The letters that are different from the normal alphabet need changing, these include the letters A,C,D,M and O so **click and drag on each of the black circle connectors on the end of each yellow wire and drop them away from a connector to disconnect them. Now grab the A wire connector (it should have sprung back to the right hand side to make it easier to find) and drag it onto the C socket until you see the white circle to show you can connect. Repeat this for the C wire, connecting it to the A socket, the D goes to M, M goes to O and finally O goes to D.** The other wires are plugged directly, therefore can be left straight through, b-B, e-E down to z-Z.

Each of these settings would have been set at the start of the day from a supplied list that would be supplied to both sender and recipient and would have stayed the same until the next morning. In future, if you'd rather do this the quick way, simply click the "Set Day Key" button to have all this part done for you.

Enciphering a Typex message

To encipher a new message, we firstly must setup a new random rotor position for each of the five rotors. As we are in 1939, at the beginning of the war, a random letter for each of the rotors was picked by the operator and transmitted to the recipient in plain text. For this example, we will choose the setting **OFKCR**.

Using the up and down arrows which appear over each rotor, change the position of the wheels so that the letters O,F,K,C and R, are shown through the windows of the drum unit cover.

Before we begin, we also need to confirm whether we are enciphering or deciphering using the lever to the left of the drum unit. Make sure this is set to "Cipher", if it is wrong, simply click on the lever to change position, this changes the mode of the left and right hand printers output to give the correct character set and spacing.

Another check is to confirm that the printers are both set to Letter mode, it is possible that after the last message sent, one of the printers would be left in Figure mode which would cause the printout to be garbled. This can be done using the manual button in front of each printer marked LTRS. To check that the printer is switching, try pressing the FIGS and LTRS buttons a few times now, you should see the printer carriage shift, but make sure you leave both printers in LTRS mode.

You can choose to leave the document holder raised up if you wish to see the movement of the rotors, but it can be lowered towards the keyboard if required by pressing the white button on the top left of the document holder. Click and drag the document holder's position bar to move it so that the first line of the message to be enciphered is displaying, you can use this to keep track of where you are on the document.

We're all ready to go – **try typing the first letters W, A and R on the keyboard.** You should see (and hear if you have the sound on) the printers type the first letter and the letter counter to the right of the drum unit move to show 0003 letters printed. If you are wondering why you didn't see Typex print anything, it is probably due to the fact that our viewing perspective on Virtual Typex is directly over the Typex machine so the top cover and printer paper is obstructing our view of the actual printout.

We can resolve this and see what's happening by using the blue drag bar at the top-middle of the screen to hide the top cover. Drag the bar down until it is at the second from left position (the fully left position hides the document holder too). Now you should be able to see the output tape on both printers, the left hand one in cipher mode should be showing the beginning of the plain text message you are typing (WAR), while the right-hand one is showing the cipher text which has been enciphered through the plugboards and rotors (DJS).

We can continue typing the message now (don't forget the space), but there is a special case to trip you up on the second word, having! If you recall, the keys Z, X and V on the keyboard have been used to encipher spaces and to change between letters and figures, so to type the V in having, we need to remember to switch to figure shift and use the shifted key C. Remember to watch for documents where you have to type the letter Z, X or V, I can imagine this caused much frustration until the operators got used to it!

Type H, A, FIGs (\ on your computer keyboard), C, LETTs (/), then I, N and G. If you watch as you type, the FIGs and LETTs keys will do two things, the left-hand printer's shift mechanism will activate, meaning any further characters will use the alternate shifted characters on the printheads and the right hand printer will encipher an extra letter when pressing the FIGs or LETTs keys. This means you should see the word HAVING on the plain text printer, but it has enciphered with eight characters!

Hopefully, all being well, the enciphered tape should be automatically grouping the output into sections of five characters so while you've only typed ten letters, you'll end up with twelve enciphered letters! As the FIGs and LETTs keys are physically connected to the Z and V keys, and the space is connected to the X key, those letters are the ones being enciphered. Typex rotors only have 26 contacts, just like Enigma's, and can only encipher the letters A-Z. The letters that are being sent through the rotors and therefore being enciphered are WARXHAZCVING which should hopefully be showing DJSMI EXUOX QO.

Continue to encipher the entire message if you wish, don't type too fast – each key on Typex would be mechanically held down once pressed until the print had completed and a key lock activated so two keys could not be activated together. Try to keep a steady pace and watch to make sure every key press activates the printers.

Once complete, if you've typed carefully, you should end up with the counter showing 0159 characters printed. It was required practice to make sure a full five-character group was completed on the enciphered text so press the space key an extra time to make it up to 160 characters total. You should see the letter counter shows the 0 and 5 in red for this purpose so the operator knew they were on a five-character boundary. If you ever need to reset the letter counter, just click on the knob on the right until the display returns to 0000. Note that always having the same set of up to four X characters always at the end of a message is very bad in encryption terms and this did appear to

be noted by German cryptographers (see http://chris-intel-corner.blogspot.com/2014/11/the-british-typex-cipher-machine.html), although this security did appear to be tightened up later in the war with random uses of figure/letter and spaces allowed to pad the last group.

To see the last few characters of the tape, there is a manual paper feed knob you can use at the outside edge of each printer. Click the right-hand printer paper feed a few times to see that you have completed the group correctly.

Finally, the cipher text was removed from the Typex machine and the paper tape cut up and stuck onto documents ready to be transmitted. The five-character setting that was chosen at the beginning of encipherment was written onto the message into the first and last groups and sent along with the message.

Cut the tape by clicking on it, the message should be pasted onto a document for you to view. Your final message should read

DJSMI EXUOX QOUYN FHABG PODUG HREYO LMTBJ
TXNVE ODDGC JSKLN FSKIN EUFXX XYMRA SQZBB
RHYVB JVVDK TWOWW IMXNQ JJNSA YUUTI OVBIA
CSQQT PRXLV LVQAT NRLLI HARUH XALEE UAUPP
KGTNM ZOIYD ZBXRO UKVLY

Click the bin icon in the bottom right to clear the document. To complete your message, why not grab the "Typed" stamp (just above the keyboard on the left) and drag and drop it over your document. This will stamp that the document has been completed – you can drag it over to the out tray.

Deciphering a Typex message

Deciphering a message is much the same as enciphering above with just a couple of minor changes.

Load up an enciphered message which needs decrypting by going to the Prefs / Messages menu and choosing Bundle 1 from the Typex – Decipher section. This is a set of six pages which is an example of a re-enciphered Typex message sent from the Air Ministry to the Prime Minister, Winston Churchill.

Drag the first page to the document holder and then make sure that you have the day key setup correctly (use the instructions above or **click the "Set Day Key" button**).

Set up the Typex for decipher by **moving the Decipher-Cipher lever to be set to Decipher**. This means that the left-hand printer will now output just the received message in standard A-Z character set with five-letter grouping while the right-hand printer will automatically shift to and from figure/letter mode as it receives the correct characters, outputting the final plain text.

Again, we should **press the LTRS button on the front of each printer** to make sure they are in letter mode initially and confirm that the letter counter is at 0000. If not, click the knob to the right until it revolves back to 0.

As discussed, when enciphering a message above, the settings of the five rotors chosen is sent in plain text at the first and last groups of the message. If you look at the received document, you should see that the first and last groups are GPWBN – this is our key which we need to set the rotors to. **Either set each of the five rotors manually, or if you're in a hurry, press the "Set Start" button which will do this for you.**

Now we're ready to begin typing, an important note is that the key GPWBN is not part of the encrypted message and should not be typed. Make sure you start typing from the second group, AYVHS. We do not need to worry about the special keys Z,X and V this time, we're only ever typing the letters A-Z, exactly as specified on the document. Do not type the space key between the groups, it's all one long string of letters!

Type the groups from the first two lines of the message, AYVHSNYYIL…FHOJOYKGLR.

If all has been correctly setup, you should begin to see the English plain text coming out of the right-hand printer – well done! Continue until the end of the message, you can use the letter counter and document slide to keep track of where you are, the final number of the letter counter should always be on a red 0 or 5 after each group. You should also remember not type the last group GPWBN (it's just the start setting and not part of the message).

Stamp the document as completed and drop it in the out tray.

Each part of the document is enciphered with a different start position but using the same day key, so you won't need to remove rotors between pages, just set the new start position of the five rotors. Try to retrieve the whole message!

Deciphering an Enigma message

Typex was built based on the commercial Enigma available before the war started and so, with a few minor changes, retained the ability to be able to decipher Enigma messages. This ability was used at Bletchley Park during the Second World War to read the German messages once the codebreakers had managed to break the daily key using the Bombes. Once they had the settings for the wheel order and rotor positions for the day, these would have been set on each of the Typex machines which meant the messages could be deciphered just like the intended recipient.

We can test a real enciphered Enigma message to see if you can read the message contained within.

Load up an enciphered message which needs decrypting by going to the Prefs / Messages menu and choosing Bundle 1 from the Enigma – Decipher section. This is a set of five authentic messages, enciphered using Enigma in 1941, and used with permission of Crypto Cellar Research (Breaking German Wehrmacht Ciphers). The messages originate with German Army SS units from Heeresgruppe Nord (Army group North) taking part in Operation Barbarossa, the attack on the Soviet Union.

Drag the first page to the document holder

The day key for each message in Virtual Typex has been taped onto the top of the message for ease of use. You can set the day key automatically by clicking the blue Set Day Key button or follow the below instructions to do this manually.

The day key for this message shows the text "**ENIGMA B IV II III sbv CT EM FI GJ HK NQ OR SW UY VX**". The first text tells us it's an Enigma message while the second letter B lets us know it's the B Umkehrwalze (Reflector) we need to use. The main German Army Enigma had three different reflectors, UKW-A, B and C with different internal wiring which could be swapped in the machine.

Click the label on the left-hand plugboard until it shows UKW-B

The next three groups of the key, the Roman numerals, shows which three of the five available rotors were selected for that day. It is showing us we need to insert the IV (4th), II (2nd) and III (3rd) rotor in that order from left to right. Firstly, make sure we have chosen the Enigma rotors by clicking the blue "Enigma I" button below the rotor storage box.

The first rotor we need is the fourth one marked IV so drag that rotor into the first position from the left on the drum unit. This is the "slow" rotor, the one that turn the least during deciphering.

Drag in the second rotor, II onto the second position and rotor III into the third position.

The standard Enigma I model used three rotors, but our Typex has five spaces so we need to fill the two gaps with special blank rotors which were wired straight through to enable it to work correctly. These two special rotors are coloured white on Virtual Typex and should be the two rotors in the box on the far right called S1 and S2.

Drag the special rotors S1 and S2 to fill the final two gaps in the drum unit.

Finally, lock the rotors into position by first **pressing the button on top of the reflector head** (to the left of the first rotor) and then **release the wheel locking lever** to the left of the keyboard.

The next part of the day key is the Ringstellung (ring setting) which, in this example, is shown as the three letters sbv. This is the position of the wiring ring for each of the three rotors just fitted. To set this, you need to release the spring-loaded pin on each rotor and rotate the alphabet tyre until it shows the letter required next to the pin.

On the first rotor, **click the pin release button** (it will appear just to the right of the letter A on the rotor), you should see the pin pulled out. Now **use the up/down arrows on that rotor to rotate the wheel until it shows the letter** S at the top then click the pin release button again to fix it in position.

Do this same method on the second and third rotors until they show the letters B and V respectively.

The last set of letter groups on the day key are the settings for the Steckerbrett (plug board). Each day key used a set of ten wires to swap two letters over so, for example, you can see the letters C and T, E and M, F and I down to V and X are all connected with each other.

Before we change the wiring on the right-hand plugboard, we need to make sure we're using the right plug board. The Typex rotor entry head and the Enigma one are wired differently so to alter this when using the Typex machine to read Enigma messages, they used a rewired plugboard making it easy to swap between Typex and Enigma mode without having to actually physically change wiring in the machine. **If the plugboard label on the right shows Typex, click it so the "Enigma" plugboard is fitted in the slot.**

The first set of connected wires on our day key shows C and T connected. Grab the black circle connector of the wire marked C and drop it just off the socket, It should spring back to the right (to make it easier to find, the wires were not spring-loaded on the real Typex!). Repeat this with the wire connected to the letter T.

Now, to swap the letters**, grab the C wire and drag it to the socket marked T** (you should see a white circle showing when you can connect up) and likewise, **drop the T wire on the C socket**. Complete the other 9 cable swaps in the same way. Our day key setup is now complete.

Typex has a Cipher / Decipher lever, so you would imagine that we need to set it to Decipher for this message, but in Decipher mode, the right-hand printer will try to decode the letters received into the full letter/number/punctuation format allowed by standard Typex while Enigma only allowed the letters A-Z. Therefore, I believe the Typex was left set to Cipher mode which then prints the output of just letters correctly on the right-hand printer (even though the left-hand one doesn't always print the received message correctly. This method matches up with the known received Typex tapes showing the deciphered German message broken down into groups of five and stuck the backs of some of the real received message forms. (see Bletchley Park Collections Uncovered 4 for examples: https://bletchleypark.org.uk/news/collections-uncovered-4).

Make sure the Cipher/Decipher lever is in the right-hand Cipher position.

We need to make sure that both printers are in letter mode so **press the LTRS button on the front of each printer** to make sure they are in letter mode initially.

Now we can, at last, start to decipher our message we've received. We need to discover the start positions of the three rotors that was chosen by the Enigma operator at the beginning of their message. At this time, the actual three letters were not sent in plain text, but were themselves enciphered first on Enigma, so we need to do a little work to find the three actual letters required.

If you look on the received message, just above the groups of five letters comprising the actual message, there is a line of text showing "0500 - 143 - TCV IEI". This was the text sent in Morse Code just before the actual message itself, it shows the time sent, the number of characters in the message then a set of two three-character strings (TCV IEI). These letters are what we need to find the real start positions, just the same as the real Enigma operator.

The first three letters, TCV, we need to set as our initial start positions on the first three rotors. This can be easier to see if you firstly close the cover on the drum unit so the letters show through the windows. Click on the white button in the bottom-left of the drum unit to close it if it's open.

Click the up/down arrows to set the first three letters on the rotors shown to T, C and V.

Historical note here: The German operator has not changed the letters very far from their initial set Ringstellung settings of SBV! The first and second rotor have only moved one place and the third didn't move at all. This message was sent at 5am so was probably the first message using the new set day key. This laziness of the operator to not bother to move the initial settings very far was spotted by Bletchley Park codebreaker John Herivel and known as the Herivel tip. This insight could be used to sometimes quickly guess the initial ring settings (https://en.wikipedia.org/wiki/John_Herivel)

The second group of three letters are the letters we need to type to retrieve the real start position. **Type the letters I, E and I on the keyboard.**

The result will be typed on the right-hand printer. If you cannot see the result as, from our viewpoint above, it is underneath the cover, either drag the blue slider to the left to hide the cover or use the paper feed knob to the right

of the right-hand printer to output the tape far enough to see the result. You should find the resulting three letters are **CGU.**

This then is our actual start position we need to use to decipher the message. **Set the first three rotors to the start positions C, G & U.**

To make it easier to keep track of where we are in the message, we can use the letter counter to the right of the drum unit. It probably isn't showing zero now, so click on the knob to the right until it shows 0000 in the window.

Now we're ready to begin typing, an important note is that the first group sent on the message, LYASO, is not part of the encrypted message and should not be typed. This set of five letters was called the Buchstabenkenngruppe (letter identifier group) and was used to show the German recipient which day key was used, we don't need this. Make sure you start typing from the second group, CDPSK. Do not type the space key between the groups, it's all one long string of letters!

Type the groups from the first two lines of the message, CDPSKLDFHV … LHUJZZGUNO.

If all has been correctly setup, you should begin to see the German plain text coming out of the right-hand printer – well done! The message should start ZWO NEUN NULL BEWEGUNGIUNFAEHIG (TWO NINE ZERO and possibly misspelling of BEWEGUNGSUNFÄHIG, INACTIVE?). Continue until the end of the message, you can use the letter counter and document slide to keep track of where you are, the final number of the letter counter should always be on a red 0 or 5 after each group.

Stamp the document as completed and drop it in the out tray. Well done codebreaker! Try out some of the other messages in the in tray and see what you can decipher.