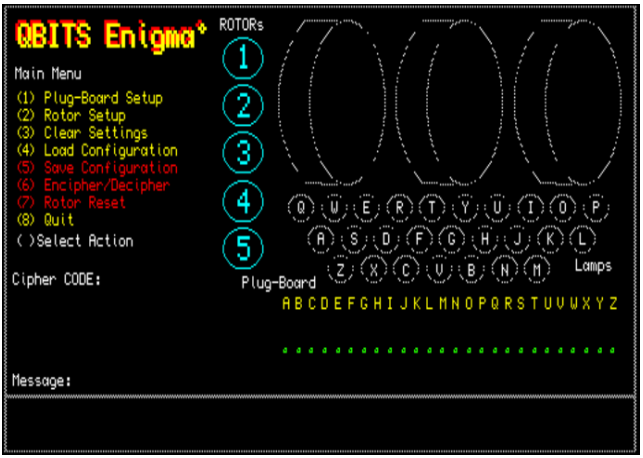


Introduction

The Enigma Machine is an Electrical-Mechanical device used to Encipher/Decipher Messages. It consists of a keyboard, Plug-Board and three or four Rotors one or more of which move on a keystroke and a set of lamps labelled A to Z.

The Plugboard allows rewiring of the connection between keyboard and first Rotor. The connection then feeds through the cross wiring of Three or Four Rotors to the Reflector, which then links back through the Rotors via a different route to the Plugboard and to light one of the A…Z lamps. Note that depressing a key, first steps the right Rotor and any subsequent engagements of other rotors upon completing each cycle of steps.

The Rotors are selected from a group of Five and inserted to any arrangement. Each rotates through the letters A…Z or as number 01 to 26. The Rotors fixed Ring on the right side has 26 contacts which are scramble wired to spring loaded contacts on the left. The second Ring can change the Alphabet letters with its notch to align with other positions (letters) of the first Rings cross wired outputs. This represents a substitution encryption and can be different for each rotor set. The combination of several rotors, in ever-changing positions, is what extends the Enigma Machines combinations.

Code Breaking

The breaking of the Enigma Machine Code by members of Bletchley Park British WWII Secret Code Breaking Centre was one of its greatest achievements. The electrotechnical nature of the Enigma Machine Code generation was cracked using a form of reverse engineering. The Invented decipher machines were built with a series of revolving drums that would click around seeking out code combinations that matched. Later development went on to create a programable code braking machine the Colossus, the forerunner to the modern computer.

It is a sobering thought as to where we might be today without our modern computers**.** Perhaps we owe a greater depth of gratitude than we realise to those who invented, built and worked on these WWII codebreaking machines.

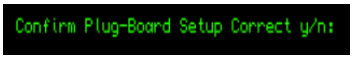
QBITS EnigmaSE
The Display shows all the components together and their settings and workings plus a space for a typed in Message and an area for the Cipher CODE output.

Top left the Title and below a Menu that reflects the actions to take place. A Plug-board to set A…Z crossovers. The Rotor Setup to Select Rotors, Ring Setting and Rotor Start positions. Clear Settings to reset the Plugboard, Rotors or Both. File management actions for Load & Save Configurations. Encipher/Decipher of Messages. Reset Rotors, setting Rotors back to Initial Setup for a new Message for Encipher or Decipher a Coding.

QBITS EnigmaSE - MainMenu
Menu items are shown available if coloured Yellow (White) or unavailable in Red or change to Green as a Setup is completed - the Plug-board and Rotors.

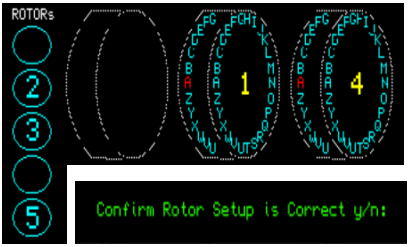
(1) Plug-Board Setup - Yellow or Green [Locked/Set]
(2) Rotor Setup - Yellow or Green [Locked/Set]
(3) Clear Settings - Yellow Available
(4) Load Configuration - Yellow Enter Filename
(5) Save Configuration - Red/Yellow Enter Filename
(6) Encipher/Decipher - Red/Yellow Enter Message
(7) Rotor Reset - Red /Green [unlocked]
(8) Quit
(?) Select Action – Displays number of Menu Item.

QBITS EnigmaSE – (1) Plug-Board Setup
This requires 10 Plug-Board settings, select two unused [different] Letters for each. The Letters change colour to Red with a line draw between upper and lower row now set with crossover Letter. The visa versa crossover Letter position is also set. The 10 Plug ups are therefore shown as twenty entries on the Plugboard. Upon completion confirm y/n: Prompt is displayed.



QBITS EnigmaSE – (2) Rotor Setup
The Rotors available are displayed on the left as Cyan/Green Circles labelled (1 to 5)

Select three Rotors in order, starting with the **Right** then **Middle** then **Left.** As a Rotor is selected the alphabet letters are displayed starting with ‘A’ centre left.



Each Rotors Input to Output is uniquely cross wired. Select from those shown available. The Rotor and its positioning give the Enigma Machine its many different combinations. Once the three Rotors are installed a y/n: Prompt allows a change if not correct.

QBITS EnigmaSE – (2) Ring Settings
Choose a Letter when prompted for **Right** and **Middle** Rotors, these are identified as **RED** Letters shown on the Right and Middle Rings. A Correct y/n Prompt then allows you to complete or make a change if necessary.

QBITS EnigmaSE – (2) Start Position
Again, choose a Letter when prompted for the **Right Middle Left** Rotors. The Rotor circles around until Letter shown left of centre matches the chosen Letter. On completion a y/n: Prompt then allows a change if not correct.

QBITS EnigmaSE – (3) Clear Settings
This resets (1)**Plug-Board** and (2)**Rotor** Setups so they can be changed. (5)(6)(7) are disabled [Red]. If only Rotor Setup is actioned and Plug-Board is still set both (1)&(2) are set back to [Green] and (5)(6)(7) are reactivated [Yellow].

QBITS EnigmaSE – (4) Load (5) Save
For Load and Save Configuration Enter Filename ie. 'win1_EnigmaConfig01'. This is entered via INPUT#0 directly into the QL Interpreter. The results can be precarious. The use of **WHEN ERR**or and **IF** statements cover some of the unwanted outcomes, but not all. If unavailable to Load, '**File NOT found**' should be displayed. **Save** to an unavailable Device or Directory, should return '**DEVICE ERROR**'. If the File exists the Interpreter returns an 'OK to overwrite... Y or N'. Note: If unconnected devices have been redirected to active Directories, they might end up with unwanted files.

QBITS EnigmaSE – (6) Encipher/Decipher
Once **Plug-Board Setup** and **Rotor Setup** are complete [shown as Green] (**6**) becomes available and changes to [Yellow]. A typed in Message will turn the Rotors and light the Cipher Lamps with the Cipher CODE printed to screen in five letter groups. The limit per individual Message is set at 75 Letters. For longer dialogs use multiple Messages, but the Plug-Board and Rotor settings must be Setup and correspond to the typed changes for the Rotors to correctly Decipher each Message.

[**Esc**] returns to the main menu, Select (6) again to continue Message. [**#**] Sends the CODE output as Morse dots and dashes, clears the CODE and Message displays, then resets the Rotors before returning to Main Menu.

QBITS EnigmaSE – (7) Reset Rotors
This clears any CODE and Message displayed then resets the Rotors back to last Setup. Type the Message output CODE and the Decipher should display the original Letters.

QBITS EnigmaSE – (9) DEMO
Option (9) the Special Edition is an accolade to the **Bletchley Park** codebreakers. **DEMO** displays the setting up of the **Plug-Board** and **Rotors**, a **Message** is then typed Letter by Letter to screen, the **Rotors** turn and **Cipher** L**amp** glows. The **CODE** output is printed to screen in five letter groups and each Letter Sent has its **Morse Code** dots & dashes displayed with accompanying 'di' & 'dah' sounds.

QL Enigma Program 2007

Here I'd like to thank Ian Pine for his SuperBASIC Enigma program and his informative accompanying article. However, as he stated, **'**My knowledge of the machine is limited to the brief description contained in a booklet I bought when I visited Bletchley Park - where the main wartime efforts to break the cipher were made - the components described have been implemented, though some of the internal 'wiring' has been subject to 'educated' guesswork.

The two most fundamental features of the original system have been retained:

(a) it is a 'self-inverting' cipher ie. the original plain-text can be recovered simply by typing the cipher-text back into the machine set to the same initial state;

(b) the plain-text letter and the cipher-letter can never be the same.

The main components of the machine are'

(1) a keyboard comprising the 26 alphabetic characters

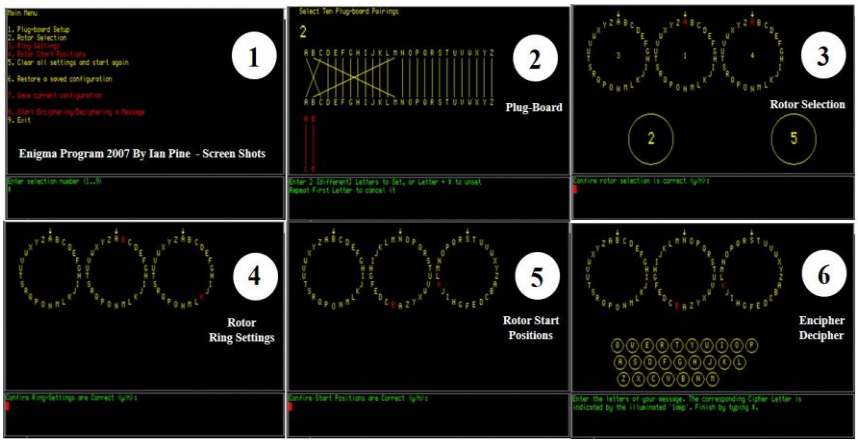
(2) a Plug-board

(3) a Set of three Rotors

(4) a 'Reflector' and

(5) a Set of 26 lamps in the same layout as the keyboard

QL Enigma 2007 Screen Shots



QBITS QL Enigma Review

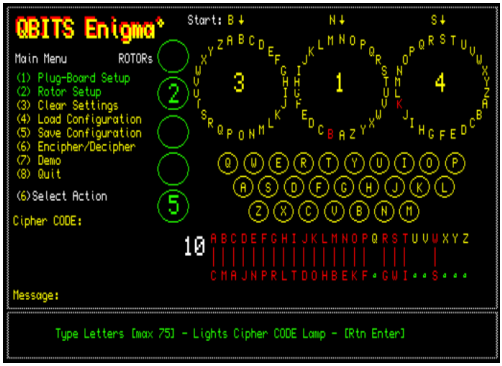
Downloading a pdf copy of Ian Pine's QL Today article, I finally managed after several attempts, to convert the lines of Program code it into a plain text format that the QL Interpreter would accept as a SuperBASIC Program. However, a number of lines with 'MISTAKE' needed to be corrected. The problem was the Optical Character Recognition (OCR) interpretation and also myself in scanning the articles print. The Font used in the scanned article had lower case 'l','I' and '1' numeral one, all looking very similar.

After some hours spent, and in some cases just by trial and error, the corrections were finally made and I got to see the program run. It did what Ian Pine had set out to do, but I was somewhat underwhelmed with the display arrangements for a 2007 written Program.

QBITS Enigma Makeover

The combining of screens began by repositioning and resizing the Rotor displays and Plug-Board with Lamps between.

That left space to fit a Title and Menu with a place for the Cipher CODE output and at the bottom of the screen to display a line of text for the Message.



QBITS Enigma Plug-Board

The arrangement chosen displays an upper line with the Alphabet A..Z and below this a line of small circles. As a Plug-up pair is chosen ie. A-C the **A** colour changes to Red with the lower circle over printed with the crossover Letter in this case a **C** and a line draw between upper and lower row. The corresponding pair **C-A** is changed likewise. Once 10 pairs have been chosen a y/n Prompt appears, accept or Plug-Board is cleared for a retry. Pressing [**Esc**] will abort and clear entries then Select (1) to Set a new arrangement.

QBITS Enigma Rotors

For a combined screen, I felt the Setup display of the Rotor Ring and Start positions were not truly represented. This prompted some further investigation into their actions.

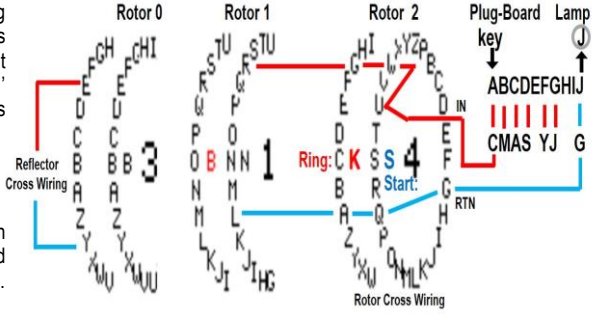
The Rotors are constructed as two Rings, The Rotors right-hand inputs represent the letters of the Alphabet A..Z or positions 0 to 25 and are cross wired to different outputs. These have spring contacts that connected to a second Ring. The positioning of the Second Rings contacts with respect to the first further redirects alphabetically adding to the cipher computation of a Rotors outputs. The procedure followed is for Rings to be Set on the Right and Middle Rotors.

All three Rotors can now be rotated to have a different Start position so as to add a further layer to the ciphering process. Last but not least is the Reflector which cross wires the output of the third/last Rotor to be fed back through all three Rotors and finally the cross wiring of the Plug-Board to light one of the cipher lamps.

Note: Diagram depicts cross wiring off Plug-Bboard and Rotors. 'C' is connected to Rotor 02 pin 02 [C] but Start position has moved this to 'U' on Rotor, which is internally cross wired to W then G via Ring settings.

Rotor 1 & 0 input <> outputs are cross wired in a similar fashion.

The Reflector redirects back through Rotors via an alternative route and finally via Plug-Board to light a lamp.



QBITS EnigmaSE Rotor Display

Displaying a secondary Rotor Ring presented a challenge. Firstly, the Rotor screen space did not allow any expansion. Solving the problem, it seemed was to make the Rotors elliptical, keep the same hight, but reduce their width. The first result was not aesthetically appealing. Overlapping the second Ring and keeping a readable aspect was the one finally taken. Adding an ellipse around the Rotor and an arc to the Ring lettering joined top and bottom by horizontal lines just enhanced the Rotors appearance.

```
1437 REMark *** Pre-calculate Coordinates For Rotor Alphabet ***
1438 FOR i=0 TO 25:cx(i)=-9*COS(PI*i/13):cy(i)=21*SIN(PI*i/13)
```

Rotor & Ring Aligned

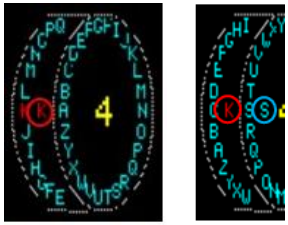
Character **cx, cy** values are calculated using COS and SIN with value 9 for width, 21 for height. These are used with the graphics Cursor positioning to Draw lettering of both Rotor and Ring. The **Rotor** displays all **26 Letters**, the **Ring** is reduced to those visible and achieved by the IF statement: IF i<7 OR i>19 AND i<26:

```
1137 DEFine PROCedure DrawRotor(n)
1138 LOCal i:INK 6:BEEP 1000,100,20,8,3,0,12,9
1139 FOR i=0 TO 25
1140   INK 5:CURSOR 104+36*n+cx(i),85+cy(i),-3,-5:PRINT CHR$(65+(cp%(n)+i) MOD 26)
1141   CURSOR 95+36*n+cx(i),85+cy(i),-3,-5
1142   IF n>0 AND rs%(n)=(cp%(n)+i+rs%(n)) MOD 26:INK 2
1143   IF i<7 OR i>19 AND i<26:PRINT CHR$(65+(cp%(n)+i+rs%(n)) MOD 26)
1145 END FOR i
1146 END DEFine DrawRotor
```

QBITS EnigmaSE Rotor Ring & Start

The number displayed in Yellow(White) at the centre of each Rotor is the Selected Rotor [ie. 1…5]. The current Letter position of the Rotor is at centre left.

The Ring Setting is shown in RED. The Rotor Start position Cyan (Green) is shown to the right of the current Rotor Letter position.

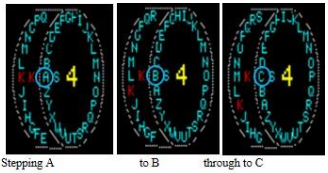


Ring Offset to Rotor Ring & Start

QBITS EnigmaSE Rotor Stepping

Each time a key is pressed the Rotor advances one step. On its 26 step it will advance the next Rotor one step and so on. By simply adding 1 to the current position cp%(n) value and re-Drawing the Rotor the lettering is shown to advance. When Rotor Step rs%(n) aligns with the penultimate Current step cp%(n)-1 the next step advances both Rotors.

```
1190 DEFine PROCedure AdvanceRotor(n)
1191 IF n<0 OR n>2:RETurn
1192 cp%(n)=(cp%(n)+1) MOD 26:DrawRotor n
1193 IF n>0:IF rs%(n)=(cp%(n)-1) MOD 26:AdvanceRotor n-1
1194 END DEFine AdvanceRotor
```



Stepping A to B through to C

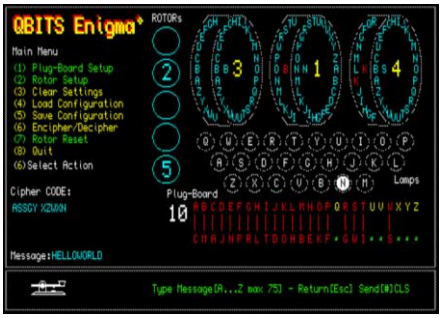
QBITS EnigmaSE Encipher/Decipher

Once the Plug-Board and Rotors are set a Message can be typed in to create a coded output or Decrypt the Code of a Message already made. Using the Test Example for setup, type a simple message and write down the codes. Exit with [Esc] and use (7) Rotor Reset option from the Menu, then go back to (6) Encipher/Decipher and type in the codes. All being well the original Message should appear.

Test Setup Example:

Plug board:	AC BM DJ EN FP GR HL IT K0 SW		
Rotors:	3 (Left),	1 (Middle),	4 {Right)
Rings:		B	K
Start:	B	N	S

The Message and CODE display is limited to 75 characters. The CODE is set out in five-character blocks in three rows. The Message is shown as a single row of characters no spaces that runs across the screen below the Plug-Board.



QBITS EnigmaSE Message Coding

The Plug-Board is represented by pb%(k) where k is 0 to 25, the output is held by 'O'. Taking **Rotors** positions from 2 through to 0 the variable 'O' is recalculated with the **Current Rotor** cp%(i) and relative **Ring In** ri%(i) positions. The output is changed by the cross wired **Reflector** O=rf%(O) and then fed back through the **Rotors 0 to 2** with the use of **Ring Return** rr%(i) and cp%(i) **Current positions** to return an output pb%(O).

```
1214 DEFine FuNction Encode(k)
1215 LOCal i,O :O=pb%(k)
1216 FOR i=2 TO 0 STEP -1:O=(ri%(i,(cp%(i)+O) MOD 26)-cp%(i)) MOD 26
1217 O=rf%(O)
1218 FOR i=0 TO 2:O=(rr%(i,(cp%(i)+O) MOD 26)-cp%(i)) MOD 26
1219 RETurn pb%(O)
1220 END DEFine Encode
```

Note: For the Enigma CODE to work the relative Rotor crossover wiring ro%(k,n) has to be applied, n being the Rotor position 2 to 0 and k being the Rotor selected 1 of 5.

```
1131 DEFine PROCedure CopyRotor(n,k)
1132 LOCal i
1133 FOR i=0 TO 25:ri%(n,i)=ro%(k,i):rr%(n,ro%(k,i))=i
1134 sp%(n)=0:cp%(n)=0:rs%(n)=0
1135 END DEFine CopyRotor
```

QBITS EnigmaSE Reset

Menu item (7) Rotor Reset is only active if both Plug-Board and Rotors are setup. This is shown by Menu items (1),(2) and (7) tuning Green. (1) & (2) are then inactive until (3) Clear Settings is activated, which will then make (7) inactive [turn Red].

(7) Rotor Reset – turns the Rotors back to their Initial Start position for the beginning of a message and checks if Plug-Board setup has not changed i.e. pcb=10.

QBITS EnigmaSE Code

```
1000 REMark QBITS_EnigmaSE_bas [QBITS Enigma SE 2024 QL40th - QPC2] vM30

1002 dev$='win1_':MODE 4:gx=0:gy=0     :REMark Screen Settings

1004 WHEN ERRor :IF NOT ERR_EX :eck=1:CONTINUE:END IF :END WHEN

1006 REMark Import QBITSconfig Settinbs - QPC2
1007 OPEN_IN#9,dev$&'QBITSConfig':INPUT#9,gx\gy\dn$:CLOSE#9

1010 REMark QBITS REMake of QL Enigma Prog by Ian Pine 2007
1011 REMark SE adds Message Code displays & Morse Code Playback
1012 REMark SE For DEMO Select (9)

1014 REMark ARRAYS for Plug-Board & Rotor Configurations
1015 DIM pb%(25),ro%(4,25),ri%(2,25),rr%(2,25),rf%(25),rs%(2),gr%(4),ts%(35)
1016 DIM sp%(2),cp%(2),cx(25),cy(25),kcx%(25),kcy%(25),kr$(2,10),Morse%(26,4)

1018 Init_win:Enigma_Menu

1020 DEFine PROCedure Enigma_Menu
1021 REPeat EnigmaMenu
1022   CLS#0:INK 6:CURSOR 0,46            :IF pbdone=1:INK 4
1023   PRINT ' (1) Plug-Board Setup'   :INK 6:IF rodone=1:INK 4
1024   PRINT ' (2) Rotor Setup'            :INK 6
1025   PRINT ' (3) Clear Settings'
1026   PRINT ' (4) Load Configuration'         :IF NOT(AllDone):INK 2
1027   PRINT ' (5) Save Configuration': INK 6:IF NOT(AllDone):INK 2
1028   PRINT ' (6) Encipher/Decipher'  :INK 2:IF rodone:INK 4
1029   PRINT ' (7) Rotor Reset'            :INK 6
1030   PRINT ' (8) Quit'                           :BLOCK 6,10,13,129,0
1031   r$=INKEY$(-1):r=CODE(r$)-48:CURSOR 12,128:PRINT r$
1032   SELect ON r
1033     =1:IF pbdone=0:ResetPlugBoard:PlugBoard
1034     =2:IF rodone =0:ResetRotors   :SetRotors
1035     =3:pbdone=0:rodone=0
1036     =4:LoadConfig
1037     =5:IF AllDone:SaveConfig
1038     =6:IF AllDone:Cipher
1039     =7:IF Alldone:LoadSetup 0
1040     =8:INK 6:CSIZE 0,0:CLS:CLS#0:PRINT#0,'Program Ends':STOP
1041     =9:EnigmaDEMO:PAUSE 30:BLOCK 48,20,112,142,0
1042   END SELect
1043 END REPeat EnigmaMenu
1044 END DEFine
```

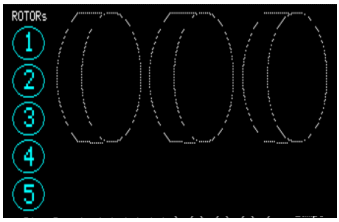
```
1046 DEFine FuNction AllDone:RETurn pbdone AND rodone:END DEFine

1048 DEFine PROCedure ResetPlugBoard
1049 LOCal i:FOR i=0 TO 25 : pb%(i)=i
1050 pbc=0:pbdone=0:BLOCK 312,38,176,164,0
1051 INK 6:FOR i=0 TO 25:CURSOR i*4+84,28,0,0:PRINT CHR$(65+i)   Note: CURSOR Graphic Coordinates
1052 INK 4:FOR i=0 TO 25:CIRCLE i*4+85,12,.6
1053 END DEFine
```


```
1055 DEFine PROCedure PlugBoard
1056 LOCal k1,k2:CLS#0:INK#0,4
1057 REPeat PBloop1
1058   CURSOR#0, 32,10:PRINT#0,'Select TEN Pairings of ';
1059   PRINT#0,'Two unused Letters          [Esc] Reset'
1060   REPeat PBloop2
1061     IF pbc=10:CSIZE#0,0,0:EXIT PBloop2
1062    REPeat key1:k1=GetLetter(1):IF k1=27 OR pb%(k1)=k1:EXIT key1
1063     IF k1=27:ResetPlugBoard:RETurn
1064     INK 2:CURSOR k1*4+84,28,0,0:PRINT CHR$(65+k1)
1065    REPeat key2:k2=GetLetter(0):IF k1<>k2 AND pb%(k2)=k2:EXIT key2
1066     pb%(k1)=k2:pb%(k2)=k1:pbc=pbc+1:ShowPlugUp
1067   END REPeat PBloop2
1068   IF Confirm('Confirm Plug-Board Setup Correct'):EXIT PBloop1
1069   CLS#0:ResetPlugBoard
1070 END REPeat PBloop1
1071 pbdone=1:FOR i=0 TO 25:ts%(i)=pb%(i)
1072 END DEFine
```


```
1074 DEFine FuNction GetLetter(f)
1075 LOCal k
1076 REPeat GL_Lp
1077   k=CODE(INKEY$(-1) )
1078   IF f=1 AND k=27 :RETurn k
1079   IF f=2 AND k=27 OR f=2 AND k=35 : RETurn k
1080   IF k>96 AND k<123:k=k-32
1081   IF k>=65 and k<=90 : RETurn k-65
1082 END REPeat GL_Lp
1083 END DEFine
```


```
1085 DEFine PROCedure ShowPlugUp
1086 INK 2:BEEP 300,80,20,5,8,0,0,0
1087 CURSOR k1*4+84,28,0,0:PRINT CHR$(65+k1)
1088 CURSOR k2*4+84,28,0,0:PRINT CHR$(65+k2)
1089 CURSOR k2*4+84,14,0,0:PRINT CHR$(65+k1)
1090 CURSOR k1*4+84,14,0,0:PRINT CHR$(65+k2)
1091 LINE k1*4+85,22 TO k1*4+85,15:PAUSE 5
1092 LINE k2*4+85,22 TO k2*4+85,15:INK 7
1093 CURSOR 190,164:CSIZE 2,1:PRINT FILL$(' ',2-LEN(pbc));pbc:CSIZE 0,0
1094 END DEFine
```

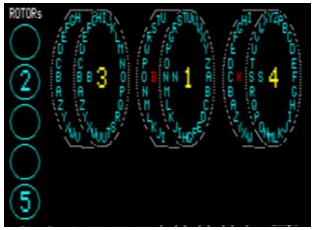
```
1096 DEFine PROCedure ResetRotors
1097 sp%(0)=0:sp%(1)=0:sp%(2)=0:rs%(1)=0:rs%(2)=0
1098 cp%(0)=0:cp%(1)=0:cp%(2)=0
1099 CURSOR 0,0:CSIZE 2,1:INK 5
1100 FOR i=0 TO 4
1101     gr%(i)=-1:CIRCLE 72,98-i*14,6:CURSOR 72,98-i*14,-6,-9:PRINT i+1
1102 END FOR i
1103 CURSOR 0,0:CSIZE 0,0:INK 248:BLOCK 290,96,210,4,0:rodone=0
1104 FOR n=0 TO 2
1105     LINE 91+36*n,109 TO 101+36*n,109:CIRCLE 104+36*n,85,24,.48,PI
1106     LINE 91+36*n,61.5 TO 101+36*n,61:ARC 91+36*n,109 TO 91+36*n,61.5,PI/2.4
1107 END FOR n
1108 END DEFine
```




```
1110 DEFine PROCedure SetRotors
1111 LOCal i,k,n:CLS#0:INK#0,4
1112 REPeat SRloop1
1113   CURSOR#0,32,10:PRINT#0,'Select in the Sequence:';
1114   PRINT#0,' RIGHT MIDDLE LEFT: Enter Rotor Number [1..5]'
1115   FOR n=2 TO 0 STEP -1
1116     REPeat SRloop2
1117       k=CODE(INKEY$(-1))
1118       SELect ON k=49 TO 53:k=k-49:IF gr%(k)=-1:EXIT SRloop2
1119     END REPeat SRloop2
1120     INK 0:FILL 1:CIRCLE 72,98-k*14,5:FILL 0:CopyRotor n,k
1121     INK 6:CSIZE 2,1:CURSOR 103+n*36,87,-3,-5:PRINT k+1:CSIZE 0,0
1122     gr%(k)=n:DrawRotor n
1123   END FOR n
1124   IF Confirm('Confirm Rotor Setup is Correct'):EXIT SRloop1
1125   ResetRotors
1126 END REPeat SRloop1
1127 FOR i=0 TO 4:ts%(i+26)=gr%(i):END FOR i:IF pbc=10:pbdone=1
1128 SetRotorRings:ts%(34)=rs%(1):ts%(35)=rs%(2):SetRotorStarts:rodone=1
1129 END DEFine
```



```
1131 DEFine PROCedure CopyRotor(n,k)
1132 LOCal i
1133 FOR i=0 TO 25:ri%(n,i)=ro%(k,i):rr%(n,ro%(k,i))=i
1134 sp%(n)=0:cp%(n)=0:rs%(n)=0
1135 END DEFine

1137 DEFine PROCedure DrawRotor(n)
1138 LOCal i:INK 6:BEEP 1000,100,20,8,3,0,12,9
1139 FOR i=0 TO 25
1140     INK 5:CURSOR 104+36*n+cx(i),85+cy(i),-3,-5:PRINT CHR$(65+(cp%(n)+i) MOD 26)
1141     CURSOR 95+36*n+cx(i),85+cy(i),-3,-5
1142     IF n>0 AND rs%(n)=(cp%(n)+i+rs%(n)) MOD 26:INK 2
1143     IF i<7 OR i>19 AND i<26:PRINT CHR$(65+(cp%(n)+i+rs%(n)) MOD 26)
1144 END FOR i
1145 END DEFine
```

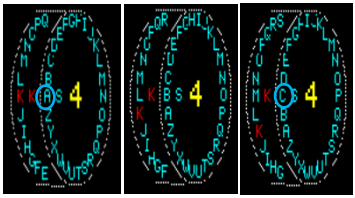


```
1147 DEFine PROCedure SetRotorRings
1148 LOCal k,n : INK#0,4
1149 REPeat RSloop1
1150   FOR n=2 TO 1 STEP -1
1151     CLS#0 :PRINT#0,\,'Select Ring Setting for the ';
1152     IF n=2:PRINT#0,"Righthand";
1153     IF n=1:PRINT#0,'Middle';
1154     PRINT#0,' Rotor [A..Z]:      ' :k=GetLetter(0):rs%(n)=k:DrawRotor n
1155     INK 2:CURSOR 234+n*94,47:PRINT CHR$(65+k)
1156   END FOR n
1157   IF Confirm('Confirm Ring-Settings are Correct'):EXIT RSloop1
1158 END REPeat RSloop1
1159 END DEFine
```


```
1161 DEFine PROCedure SetRotorStarts
1162 LOCal k,n,tp%(2) :INK#0,4
1163 REPeat SPloop1
1164   FOR n=2 TO 0 STEP -1
1165     CLS#0:PRINT#0,\,'Select Start Position for the ';
1166     IF n=2:PRINT#0,'Righthand ';
1167     IF n=1:PRINT#0, 'Middle ';
1168     IF n=0:PRINT#0,'Lefthand ';
1169     PRINT#0,'Rotor [A. . Z]:    ' : k=GetLetter(1):tp%(n)=k
1170     REPeat SPloop2
1171       IF cp%(n)=k:CURSOR 257+n*94,47:PRINT CHR$(65+k):EXIT SPloop2
1172       AdvanceRotor n:PAUSE 6
1173     END REPeat SPloop2
1174   END FOR n
1175   IF Confirm('Confirm Start Positions are Correct'):EXIT SPloop1
1176 END REPeat SPloop1
1177 sp%(0)=tp%(0):sp%(1)=tp%(1):sp%(2)=tp%(2):STRIP 0:INK 6
1178 ts%(31)=sp%(0):ts%(32)=sp%(1):ts%(33)=sp%(2):STRIP 0:INK 6
1179 END DEFine
```


```
1181 DEFine FuNction Confirm(m$)
1182 LOCal r$
1183 REPeat Cloop1
1184   CLS#0:CURSOR#0,24,10:PRINT#0,m$;' y/n: ';:r$=INKEY$(#0,-1):PRINT#0,r$
1185   PAUSE 20:IF r$=='y' OR r$=='yes':CLS#0:RETurn 1
1186   PAUSE 20:IF r$=='n' OR r$=='no' :CLS#0:RETurn 0
1187 END REPeat Cloop1
1188 END DEFine Confirm
```

```
1190 DEFine PROCedure AdvanceRotor(n)
1191 IF n<0 OR n>2:RETurn
1192 cp%(n)=(cp%(n)+1) MOD 26:DrawRotor n
1193 IF n>0:IF rs%(n)=(cp%(n)-1) MOD 26:AdvanceRotor n-1
1194 END DEFine
```

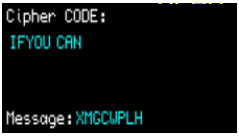


Stepping A to B through to C

```
1200 REMark Enigma CODE

1202 DEFine PROCedure Cipher
1203 LOCal lk:lk=0:num=0:CLS#0,:INK#0,4
1204 CURSOR#0,172,10:PRINT#0,'Type Message[A...Z max 75] - Return[Esc] Send[#]CLS'
1205 Draw_Morse_Key 0,2,24,8:nk=GetLetter(2)
1206 REPeat Cipher_lp
1207   IF nk=35:Send_Morse:LoadSetup 0:EXIT Cipher_lp
1208   IF nk=27 OR num>75:EXIT Cipher_lp
1209   STRIP 0:INK 5:CipherMess:lk=Encode(nk):CipherCODE:num=num+1
1210   CipherLamp 7,0:nk=GetLetter(2):CipherLamp 0,7:AdvanceRotor 2
1211 END REPeat Cipher_lp
1212 END DEFine
```

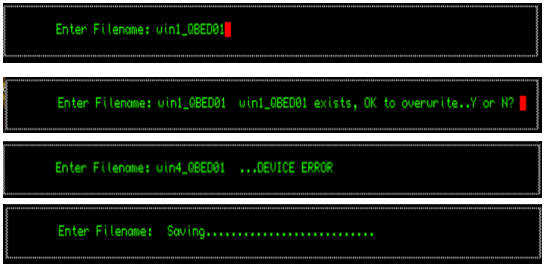

```
1214 DEFine FuNction Encode(k)
1215 LOCal i,O :IF >25:RETurn: ELSE O=pb%(k)
1216 FOR i=2 TO 0 STEP -1:O=(ri%(i,(cp%(i)+O) MOD 26)-cp%(i)) MOD 26
1217 O=rf%(O)
1218 FOR i=0 TO 2:O=(rr%(i,(cp%(i)+O) MOD 26)-cp%(i)) MOD 26
1219 RETurn pb%(O)
1220 END DEFine
```


```
1222 DEFine PROCedure CipherLamp(lnk1,lnk2)
1223 IF lk>25:RETurn
1224 INK lnk1:STRIP lnk1:FILL 1:CIRCLE kcx%(lk),kcy%(lk),2.8:FILL 0
1225 INK lnk2:CURSOR kcx%(lk),kcy%(lk),-3,-4:PRINT CHR$(65+lk)
1226 END DEFine

1228 DEFine PROCedure CipherCODE
1229 If lk>25:RETurn
1230 Code$=Code$&CHR$(65+lk):xc=xc+6:num=LEN(Code$)
1231 CURSOR xc,yc:PRINT Code$(num)
1232 IF num MOD  5=0:xc=xc+4
1233 IF num MOD 25=0:xc=0 :yc=yc+10
1234 END DEFine
```




```
1236 DEFine PROCedure CipherMess
1237 IF kk>25 : RETurn
1238 xs=xs+6:CURSOR 48+xs,208:PRINT CHR$(65+nk):str$=str$&CHR$(65+nk)
1239 END DEFine

1241 DEFine PROCedure Send_Morse
1242 FOR i=1 TO LEN(Code$)
1243     lk=CODE(Code$(i))-65:Write_Morse_key lk+1::Beep_Morse_key lk+1,1
1244 END FOR i
1245 END DEFine

1247 DEFine PROCedure Write_Morse_key(lk)
1248 CURSOR#0,84,10:PRINT#0,CHR$(ML+64);'           '
1249 mx=100:FOR a=1 TO 4:mw=Morse%(lk,a):BLOCK#0,mw,3,mx,14,7:mx=mx+mw+4
1250 END DEFin

1252 DEFine PROCedure Beep_Morse_key(lk%,sp)                    Note; sp  single pause length
1253 FOR a=1 TO 4:ps=Morse%(lk,a):IF ps>0:BEEP 250*ps*sp,5,0,0,0,0,0,0:PAUSE 8*sp
1254 PAUSE 12*sp
1255 END DEFine
```

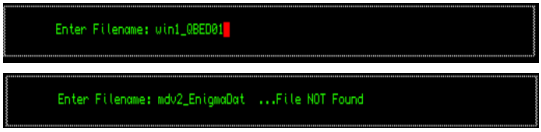
```
1300 REMark Enigma File Access

1302 DEFine PROCedure SaveConfig
1303 LOCal i:CLS#0:eck=0:f$=''
1304 INPUT#0,\,'Enter Filename: ';f$;'  ';:OPEN_NEW#3,f$
1305 IF KEYROW(7)=64:RETurn
1306 IF eck=1:PRINT#0,'...DEVICE ERROR':CLOSE#3:PAUSE 50:eck=0:CLS#0:RETurn
1307 IF eck=0:CURSOR#0,140,10:PRINT#0,'  Saving.';:CLS#0,2:CLS#0,4
1308 FOR i=0 TO 35:PRINT#3,ts%(i):PRINT#0,'.';:PAUSE 2:END FOR i:CLOSE#3
1309 END DEFine
```



Note: New venture SAVE and LOAD use IINPUT#0 for Filename entry, which includes the device name.

If the local setup has device and DIRectory reroutes in place. Saved Files could be sent there instead of being shown as a 'DEVICE ERROR'

```
1311 DEFine PROCedure LoadConfig
1312 LOCal i:CLS#0:f$='':eck=0:f$=' '
1313 INPUT#0,\,'Enter Filename: ';f$;'  ';:IF f$='':eck=1:END IF :OPEN_IN#3,f$
1314 IF eck=1:PRINT#0,'...File NOT Found':CLOSE#3:PAUSE 50:eck=0:CLS#0:RETurn
1315 FOR i=0 TO 35:INPUT#3,ts%(i)\:END FOR i:CLOSE#3:pbc=10:LoadSetup 1
1316 END DEFine
```



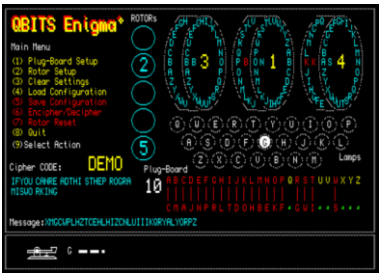

```
1318 DEFine PROCedure LoadSetup (sm)
1319 IF sm=1
1320    ResetPlugBoard:ResetRotors:FOR i=0 TO 25:pb%(i)=ts%(i)
1321    pbc=10:FOR i=0 TO 25:k1=i:k2=pb%(i):IF k1<>k2:ShowPlugUp
1322 END IF
1323 IF sm=2:ResetRotors:PAUSE 20
1324 FOR i=0 TO 4:gr%(i)=ts%(i+26):IF gr%(i)<>-1:CopyRotor gr%(i),i
1325 FOR i=2 TO 0 STEP -1
1326   r=-1:REPeat RotorIp:r=r+1:IF gr%(r)=i:EXIT RotorIp
1327   INK 0:FILL 1:CIRCLE 72,98-r*14,5:FILL 0:DrawRotor i:PAUSE 10
1328   INK 6:CURSOR 103+i*36,88,-3,-5:CSIZE 2,1:PRINT r+1:CSIZE 0,0
1329 END FOR i
1330 rs%(1)=ts%(34):rs%(2)=ts%(35)
1331 FOR i=2 TO 1 STEP -1:DrawRotor i:INK 2:CURSOR 234+i*94,47:PRINT CHR$(65+rs%(i))
1332 sp%(0)=ts%(31):sp%(1)=ts%(32):sp%(2)=ts%(33):pbdone=1:rodone=1
1333 FOR i=2 TO 0 STEP -1
1334   cp%(0)=sp%(0):cp%(1)=sp%(1):cp%(2)=sp%(2):DrawRotor i
1335   CURSOR 257+i*94,47:PRINT CHR$(65+sp%(i)):PAUSE 5
1336 END FOR i
1337 CURSOR 54,204:CLS 4:xc=0:yc=164:str$='':BLOCK 170,34,6,162,0:Code$='':xs=0
1338 END DEFine
```

```
1350 REMark Enigma Machine Simulator: View Working DEMO

1352 DEFine PROCedure EnigmaDEMO
1353 ResetPlugBoard:ResetRotors
1354 BLOCK 170,34,6,162,0:CURSOR 52,204:CLS#1,4
1355 INK 6:CURSOR 112,142:CSIZE 2,1:PRINT 'DEMO':CSIZE 0,0
1356 lk=0:num=0:sx=0:x=0:y=164:Code$="":str$="":CLS#0
1357 :
1358 REMark *** PlugBoard Setup ***
1359 RESTORE 1365:FOR i=0 TO 25:pb%(i)=i
1360 FOR i=1 TO 10
1361   READ P$:k1=CODE(P$(1))-65:k2=CODE(P$(2))-65
1362   pb%(k1)=k2:pb%(k2)=k1:pbc=i:ShowPlugUp:PAUSE 8
1363 END FOR i
1364 REMark *** PlugBoard Data ***
1365 DATA 'AC','BM','DJ','EN','FP','GR','HL','IT','KO','SW'
1366 :
1367 REMark *** Rotors Setup ***
1368 FOR n=2 TO 0 STEP -1
1369   READ k:k=k-1
1370   INK 0:FILL 1:CIRCLE 72,98-k*14,5:FILL 0:CopyRotor n,k
1371   INK 6:CURSOR 103+n*36,88,-3,-5:CSIZE 2,1:PRINT k+1:CSIZE 0,0
1372   gr%(k)=n : DrawRotor n:PAUSE 10
1373 END FOR n
1374 FOR i=2 TO 1 STEP -1
1375   READ P$:rs%(i)=CODE(P$)-65:DrawRotor i
1376   INK 2:CURSOR 234+i*94,47:PRINT CHR$(rs%(i)+65)
1377 END FOR i
1378 FOR i=2 TO 0 STEP -1
1379   READ P$:sp%(i)=CODE(P$)-65:cp%(i)=sp%(i)
1380   DrawRotor i:CURSOR 256+i*94,47:PRINT CHR$(65+sp%(i)):PAUSE 10
1381 END FOR i
1382 REMark *** Rotor Settings [Note: Rotors READ Right to Left] ***
1383 DATA 4,1,3,'K','B','S','N','B'
1384 :
```

Test example'

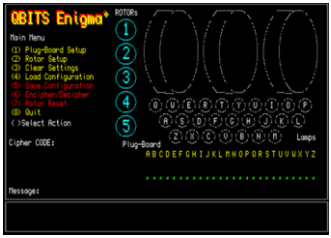
Plug board:	AC BM DJ EN FP GR HL IT K0 SW		
Rotors:	3 (Left),	1 (Middle),	4 {Right)
Rings:		B	K
Start:	B	N	S

XMGCW PLHZT CEHLH IZCNT UITK QRYAI YORPZ




```
1385 REMark *** Cipher CODE Display ***
1386 Mes$='XMGCWPLHZTCEHLHIZCNLUIIIKQRYALYORPZ'
1387 Draw_Morse_key 0,2,24,8
1388 FOR i=1 TO 35
1389    nk=CODE(Mes$(i))-65 : STRIP 0:INK 5:CipherMess
1390    lk=Encode(nk):CipherCODE
1391    Write_Morse_key lk+1   : CipherLamp 7,0
1392    Beep_Morse_key lk+1,1:CipherLamp 0,7:AdvanceRotor 2
1393 END FOR i
1394 END DEFine
```

```
1400 REMark Enigma Screen Setup

1402 DEFine PROCedure Init_win
1403 WINDOW#1,512,256,gx,gy   :PAPER#1,0:CLS#1:SCALE#1,112,0,0
1404 WINDOW#2,512,220,gx,gy
1405 WINDOW#1,512,220,gx,gy   :PAPER#1,0:BORDER#1,1,255:INK#1,6:CSIZE#1,0,0:CLS#1
1406 WINDOW#0,512,34,gx,gy+222:PAPER#0,0:BORDER#0,1,255:INK#0,4:CSIZE#0,0,0:CLS#0
1407 CSIZE#1,2,1:OVER#1,1
1408 INK#1,2:FOR i=0 TO 1:CURSOR#1,5+i,4:PRINT#1,'QBITS Enigma°'
1409 INK#1,6:FOR i=0 TO 1:CURSOR#1,7+i,6:PRINT#1,'QBITS Enigma°'
1410 CSIZE#1,0,0:OVER#1,0:INK 7:RESTORE 1311
1411 :
1412 CURSOR 6,32:PRINT 'Main Menu'          :CURSOR 172,4:PRINT 'ROTORs'
1413 CURSOR 6,128:PRINT '(  )Select Action ':CURSOR 460,140:PRINT 'Lamps'
1414 CURSOR 4,150:PRINT 'Cipher CODE:'    :CURSOR    4,208:PRINT 'Message:'
1415 CURSOR 190,152:PRINT 'Plug-Board'  : ResetPlugBoard : ResetRotors
1416 pbdone=0 : rodone=0 : str$='' : xs=0 : Code$='' :xc=0 : yc=164
1417 :
1418 REMark *** Establish Keyboard Layout ***
1419 RESTORE 1432 : L=LANGUAGE:IF L<>33 AND L<>44 AND L<>49 :L=44
1420 REPeat Getlang
1421   READ l1,r1$,r2$,r3$:IF l1=0:EXIT Getlang
1422   IF l1=L:kr$(0)=r1$:kr$(1)=r2$:kr$(2)=r3$
1423 END REPeat Getlang
1424 FOR i=0 TO 2
1425   FOR j=0 TO LEN(kr$(i))-1
1426     p=CODE(kr$(i,j+1))-65:kcx%(p)=90+j*10+i*6:kcy%(p)=54-i*9
1427     INK 248:CIRCLE 90+j*10+i*6,54-i*9,3.8
1428     INK 7:CURSOR 90+j*10+i*6,54-i*9,-3,-4:PRINT kr$(i,j+1)
1429   END FOR j
1430 END FOR i
1431 :
1432 DATA 33,'AZERTYUIOP','QSDFGHJKLM','WXCVBN'
1433 DATA 44,'QWERTYUIOP','ASDFGHJKL' ,'ZXCVBNM'
1434 DATA 49,'QWERTZUIOP','ASDFGJKL'  ,'YXCVBNM'
1435 DATA 0, '', ''
1436 :
1437 REMark *** Pre-calculate Coordinates for Rotor Alphabet ***
1438 FOR i=0 TO 25:cx(i)=-9*COS(PI*i/13):cy(i)=21*SIN(PI*i/13)
1439 :
1440 REMark *** Load Wiring Definitions for the Five Rotors ***
1441 RESTORE 1443:FOR i=0 TO 4:FOR j=0 TO 25 : READ ro%(i,j):END FOR j:END FOR i
1442 :
1443 DATA 13,6,1,8,19,2,14,16,9,10,3,11,4,0,22,20,5,7,23,15,21,12,18,25,24,17
4444 DATA 19,23,17,13,5,11,15,16,7,0,14,3,12,2,21,22,1,6,9,10,4,8,20,18,25,24
1445 DATA 18,9,0,14,22,11,8,10,12,15,13,19,25,1,7,3,2,23,17,20,21,16,6,4,5,24
1446 DATA 10,1,5,2,23,3,13,6,8,25,20,19,21,11,7,0,14,12,9,16,18,22,17,24,15,4
1447 DATA 12,22,13,7,15,2,25,17,3,1,14,18,0,4,5,11,6,19,23,20,21,9,16,8,10
1448 :
1449 REMark *** Load 'Wiring' Definition for the Reflector' ***
1450 RESTORE 1452:FOR i=0 TO 25:READ rf%(i)
1451 :
1452 DATA 6,24,16,19,9,7,0,5,15,4,18,25,17,23,21,8,2,12,10,3,22,14,20,13,1,11
```



```
1454 REMark *** Load Morse Code dots & dashes ****
1455 RESTORE 1457:FOR k=1 TO 26:FOR c=1 TO 4:READ Morse%(k,c):END FOR c:END FOR k
1456 :
1457 DATA 4,12,0,0, 12,4,4,4, 12,4,12,4, 12,4,4,0, 4,0,0,0, 4,4,12,4, 12,12,4,0
1458 DATA 4,4,4,4, 4,4,0,0, 4,12,12,12, 12,4,12,0, 4,12,4,4, 12,12,0,0, 12,4,0,0
1459 DATA 2,12,12,0, 4,12,12,4, 12,12,4,12, 4,12,4,0, 4,4,4,0, 12,0,0,0
1460 DATA 4,4,12,0, 4,4,4,12, 4,12,12,0, 12,4,4,12, 12,4,12,12, 12,12,4,4
1461 END DEFine

1463 DEFine PROCedure Draw_Morse_Key(ch,col,mx,my)
1464 INK#ch,col:LINE#ch,mx-10,my+5 TO mx+6,my+5 TO mx+5,my+7 TO mx+9,my+7
1465 LINE#ch TO mx+8.5,my+4 TO mx-10,my+4 TO mx-10,my+5
1466 LINE#ch,mx-10,my TO mx+9,my TO mx+7,my+1 TO mx-8,my+1 TO mx-10,my
1467 LINE#ch,mx-6,my+1 TO  mx-6,my+5:ARC#ch TO mx-2,my+5,-PI:LINE#ch TO mx-2,my+1
1468 LINE#ch,mx+1,my+1 TO mx+1,my+2 TO mx+3,my+2 TO mx+3,my+1
1469 FILL#ch,1:CIRCLE#ch,mx-4,my+4.4,1.2:FILL#ch,0:CIRCLE#ch,mx+2,my+3.5,.5
1470 END DEFine
```

QBITS EnigmaSE – Encryption Notes

The Enigma machine could process letters only, therefore, numbers were written out in full ZERO, ONE, TWO, THREE … TEN, to reduce multiple Zeros, CENTA(00) MILLE(000) ; MYRIA(000) were used. For punctuations rare letter combinations, Comma [ZZ], Full Stop [XX] and names defined by [X] such as XLONDONX.

Note: Two Additional Programs from Ian Price's QL Today Enigma Article

Make a **New Reflector** Load the main program then MERGE the data file.

```
110 0PEN-NEW#3, win3_enigma_reflector_dat
120 DIM r%(25) : RANDOM]SE
130 FOR i=0 T0 25 : r%(i)=i
140 FOR i=0 T0 25
150    IF r%(i)=i THEN
160       REPeat lp1 :a%-RllD(25) :IF a%<>i AND r%(a%)=a% :EXIT 1p1 : r%(i)=a% : r%(a%)=i
170    END IF
180 END FOR i
190 PRINT#3,'5040 DATA '; :FOR i=0 TO 24 : PRINT#3,r%(i);',';:END FOR I : PRINT#3,r%(25)
200 CLOSE #3
```

Make **Five New Rotors** Load the main program then MERGE the data file.

```
110 0PEN_NEW#3,win3_enlgna_rotors_dat
120 DIM r%(25) : RANDOMISE : lnum=4980
130 FOR rotor=1 T0 5
140    FOR i=0 T0 25 : LET r%(i)=i
150    PRINT #3,lnun; ' DATA '; :last=25
160    REPeat rlp1
170       IF last=0 THEN EXIT rlp1
180       a=RND(last-1) : PRINT#3,r%(a); ',' r%(a)=r%(last) : last=last-1
200    END REPeat rlp1
210    PRINT#3,r%(0) : lnum=lnum+10
220 END FOR rotor
230 CLOSE#3
```