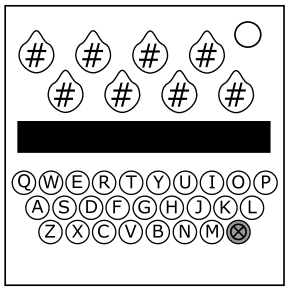
On the Subject of The Ultimate Cycle



How much security does one word need?

This module consists of a screen, eight dials with red labels, and a QWERTY keyboard.

The labels on the dials, when decrypted and read from left to right, spell out an eight letter word.

The word has been encrypted through a series of ciphers, indicated by the direction each dial is pointing, from left to right.

Once deciphered, find the word in the table below, the word written below it is the word that should be entered.

Apply the same sequence of encryptions to the response word, and type out the encrypted response word using the keys.

The word is automatically submitted when eight keys are pressed.

The red button can be pressed at any time before the eighth key is pressed to cancel the input.

Inputting any of the eight letters incorrectly will cause a strike to be issued and reset the module.

Note: Unless stated otherwise, any reference to a letter's alphabetic position starts at A = 1. Similarly, any reference to the position of a dial starts from the leftmost dial = 1.

N: Atbash Cipher

Each letter in the word is swapped with the letter with the same alphabetic position in the reversed alphabet.
That is, a letter with alphabetic position X will become the letter with alphabetic position 27 - X.

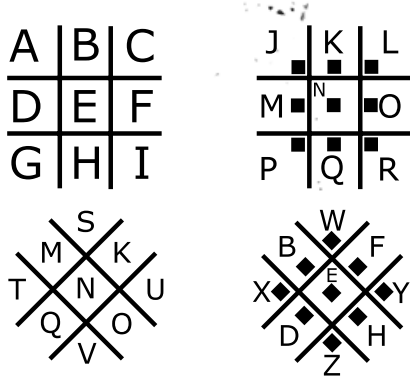
However, letters with an alphabetic position less than the position of the dial (and similarly, letters with an alphabetic position greater than 27 minus the position of the dial) do not change.

NE: Caesar Cipher

Each letter in the word has been shifted forwards through the alphabet by the position of the dial corresponding to this cipher.

E: Pigpen Cipher I

Each letter is translated using the pigpen cipher below.
Starting from north, the pigpen characters are rotated to face the direction the dial is pointing.
The rotated pigpen characters are then translated back, as though they are still facing north, to produce the encrypted letter.



SE: Monoalphabetic Substitution Cipher

The position of the dial corresponds to which of the eight words in the list below is the keyword for this cipher:

DOCUMENTARILY, FLAMETHROWING, FLOWCHARTINGS, HYDROMAGNETIC, METALWORKINGS, MULTIBRANCHED, TROUBLEMAKING, UNPREDICTABLY

The remaining thirteen letters of the alphabet are left in alphabetical order.

- If there are an even number of batteries, the keyword preceeds the remaining letters to construct a cipher alphabet.
- Otherwise, the keyword follows the remaining letters to construct a cipher alphabet.

Each letter of the alphabet is mapped onto the letter of the cipher alphabet with the same alphabetic position.
The letters in the word change accordingly with these mappings.

S: Playfair Cipher

The indexing of the lists start at zero.

- The number of rotations, starting from north, of the **next** dial corresponds to which of the words in the lists below is the keyword for this cipher.
  - If there are less than three unique* ports on the bomb, use the keyword from List A.
  - Otherwise, use the keyword from List B.
- The keyword gives the first ten letters of the keysquare in reading order.
- The remaining 15 letters fill the rest of the keysquare in alphabetical order, excluding X, which is never used.
- The word is split into four pairs of letters.
  If a pair contains the same letter twice, the second is changed to a Z.
- Each pair of letters is altered:
  - If both letters belong to the same row of the keysquare, shift both letters one space to the right along the row.
  - If both letters belong to the same column of the keysquare, shift both letters once space down the column.
  - Otherwise, the letters lie on diagonally opposite corners of a rectangle, the encrypted pair consists of the letters in the horizontally opposite corners from the original pair.

*A port is unique if there is only one of its type on the bomb.

List A: ALGORITHMS, AUTHORIZED, BLUEPRINTS, DESPICABLY, FORMIDABLE, HYPERBOLIC, IMPORTANCE, LABYRINTHS

List B: WANDERLUST, VANQUISHED, ULTRASONIC, SCRAMBLING, PRECAUTION, OSTRACIZED, METHODICAL, MAGNITUDES

Important:

- If the pair of letters is either **XX, XZ, ZX,** or **ZZ,** the pair is unchanged by the cipher.
- If the pair of letters is either **X#** or **#X,** where # is neither X nor Z, the X is changed to a Z and enciphered normally.
  Then, the new letter is changed back to an X.
- **Be careful about ambiguities in the deciphering of double letter pairs; ## and #Z become the same pair of letters when encrypted.**
  Take this into account when working through the remaining decryptions.

SW: Railfence Cipher

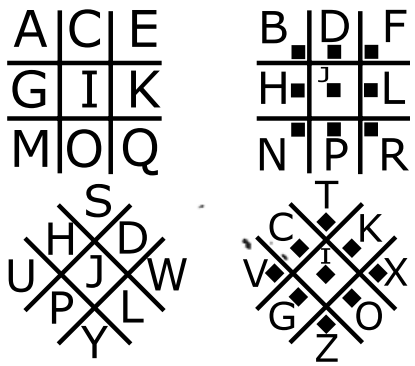
The letters in the word are written in zigzag lines across a number of rows, starting from the top left.

The letters are then read row by row in reading order to produce the encrypted word.

To determine how many rows there are, add one to the position of the dial modulo four.

W: Pigpen Cipher II

Each letter is translated using the pigpen cipher below.
Starting from north, the pigpen characters are rotated to face the direction the dial is pointing.
The rotated pigpen characters are then translated back, as though they are still facing north, to produce the encrypted letter.



NW: Hill Cipher

If there are more lit than unlit indicators, the keyword for this cipher belongs to list A.
Otherwise the keyword for this cipher belongs to list B.

The keyword used depends and the rotations of the dials adjacent to the one corresponding to this cipher:

The indexing of the lists start at zero.

- If the last dial is pointing NW, use the keyword corresponding to twice the number of 45° rotations, starting from north, of the seventh dial.
- Otherwise, use the keyword corresponding to the sum of the numbers of 45° rotations, starting from north, of the two dials adjacent to this one.

List A: AEON, COPY, EACH, GOOD, IOTA, KILO, MARK, ONCE, QUIT, SYNC, UNDO, WORK, YEAR

List B: BUSY, DICE, FAUX, HUSK, JUKE, LOCI, NAME, PUSH, RISE, TASK, VOID, XYST, ZOOM

The alphabetic positions of the letters in the keyword modulo 26 form the entries of a 2x2 square keymatrix in reading order.
The word to be enciphered is broken into four pairs of letters and their alphabetic positions modulo 26 form entries in 2x1 vectors.
The vectors are multiplied by the keymatrix and taken modulo 26 to obtain the alphabetic positions of the encrypted pairs of letters.
(Because Z has an alphabetic position of 26, its corresponding entry in the encrypted vector is zero.)

Keyword Table

ADVANCED	ADVERTED	ADVOCATE	ADDITION	ALLOCATE	ALLOTYPE	ALLOTTED	ALTERING
PROGRESS	ZYGOTENE	QUARTICS	LINKAGES	QUICKEST	ORDERING	UNDOINGS	ZUGZWANG

BINARIES	BINORMAL	BINOMIAL	BILLIONS	BULKHEAD	BULLHORN	BULLETED	BULWARKS
YOKOZUNA	COMMANDO	GLOOMING	TRICKIER	GATEWAYS	INCOMING	ZYGOMATA	FORMULAE

CIPHERED	CIRCUITS	CONNECTS	CONQUERS	COMMANDO	COMPILER	COMPUTER	CONTINUE
BULKHEAD	RELATION	LINKWORK	NANOTUBE	MONOTONE	YIELDING	ILLUMINE	KILOBYTE

DECRYPTS	DECEIVED	DECIMATE	DIVISION	DISCOVER	DISCRETE	DISPATCH	DISPOSAL
NANOBOTS	QUINTICS	ZIGZAGGY	MONOMIAL	ULTERIOR	KNUCKLED	UNDERWAY	ULTRARED

ENCIPHER	ENCRYPTS	ENCODING	ENTRANCE	EQUALISE	EQUATORS	EQUATION	EQUIPPED
JUNKYARD	QUADRANT	TRIANGLE	RELAYING	NANOGRAM	CONNECTS	INDICATE	BINORMAL

FINALISE	FINISHED	FINDINGS	FINNICKY	FORMULAE	FORTUNES	FORTRESS	FORWARDS
DISCRETE	JUNCTION	KILOWATT	ROTATION	POSITRON	DISPATCH	ENCIPHER	STANDOUT

GARRISON	GARNERED	GATEPOST	GATEWAYS	GAUNTLET	GAMBLING	GATHERED	GLOOMING
STOCKADE	FINDINGS	ADVANCED	JOURNEYS	STOPPING	LANDMARK	EQUATION	VICELESS

HAZARDED	HAZINESS	HOTLINKS	HOTHEADS	HUNDREDS	HUNKERED	HUNTSMAN	HUNTRESS
DISCOVER	JUNCTURE	TOGETHER	GARRISON	WHATNOTS	DIVISION	TOGGLING	YEASAYER

INCOMING	INDICATE	INDIRECT	INDIGOES	ILLUDING	ILLUSION	ILLUSORY	ILLUMINE
VENOMOUS	FORTUNES	OBSERVED	QUITTERS	HUNKERED	HOTHEADS	TOMOGRAM	KNOWABLE

JIGSAWED	JIMMYING	JOURNEYS	JOUSTING	JUNCTURE	JUNCTION	JUNKYARD	JUDGMENT
YEARNING	TRIGONAL	VOLITION	DECRYPTS	LABELING	STARTING	OCTUPLES	ROTATORS

KILOWATT	KILOVOLT	KILOBYTE	KINETICS	KNOCKING	KNOCKOUT	KNOWABLE	KNUCKLED
POSITIVE	BILLIONS	WHATEVER	FINALISE	ENCRYPTS	OBSTACLE	ENCODING	ADVOCATE

LANGUAGE	LANDMARK	LIMITING	LINEARLY	LINGERED	LINKAGES	LINKWORK	LABELING
CONQUERS	EQUATION	GATEPOST	ILLUSION	QUIRKISH	NUMERATE	STANDARD	POSTSYNC

MONOGRAM	MONOLITH	MONOMIAL	MONOTONE	MULTITON	MULTIPLY	MULCTING	MULLIGAN
HUNTRESS	WINNABLE	ZYMOLOGY	ILLUSORY	VOLATILE	TOMAHAWK	OCTANGLE	ADVERTED

Keyword Table cont.

NANOBOTS	NANOGRAM	NANOWATT	NANOTUBE	NUMBERED	NUMEROUS	NUMERALS	NUMERATE
ZIPPERED	STOCCATA	VENDETTA	LINGERED	FINNICKY	JUDGMENT	HUNDREDS	ILLUDING

OCTUPLES	OCTANGLE	ORDERING	ORDINALS	OBSERVED	OBSCURED	OBSTRUCT	OBSTACLE
KNOCKING	WINGDING	UNDERLIE	LINEARLY	TRIGGERS	PROJECTS	ALLOTYPE	YIELDERS

PROGRESS	PROJECTS	PROPHASE	PROPHECY	POSTSYNC	POSSIBLE	POSITRON	POSITIVE
JIGSAWED	KILOVOLT	ALLOTTED	RELATIVE	PROPHASE	COMPILER	LIMITING	NANOWATT

QUADRANT	QUADRICS	QUARTILE	QUARTICS	QUICKEST	QUIRKISH	QUINTICS	QUITTERS
YELLOWED	MULCTING	GATHERED	WEAKENED	WHATNESS	HAZINESS	REVOLVED	ENTRANCE

REVERSED	REVOLVED	REVEALED	ROTATION	ROTATORS	RELATION	RELATIVE	RELAYING
FORTRESS	WHATSITS	BULLHORN	GARNERED	INDIGOES	LANGUAGE	CIRCUITS	VOLTAGES

STARTING	STANDARD	STANDOUT	STANZAIC	STOCCATA	STOCKADE	STOPPING	STOPWORD
REVERSED	JIMMYING	DECEIVED	QUARTILE	GAUNTLET	HAZARDED	MULTIPLY	ZYMOGRAM

TRICKIER	TRIGONAL	TRIGGERS	TRIANGLE	TOMOGRAM	TOMAHAWK	TOGGLING	TOGETHER
MULLIGAN	ZIGGURAT	ALLOCATE	NUMERALS	BULWARKS	BINARIES	INDIRECT	REVEALED

UNDERRUN	UNDERWAY	UNDERLIE	UNDOINGS	ULTERIOR	ULTIMATE	ULTRARED	ULTRAHOT
JOUSTING	VICINITY	QUADRICS	MONOLITH	ORDINALS	KNOCKOUT	NUMEROUS	STOPWORD

VENOMOUS	VENDETTA	VICINITY	VICELESS	VOLITION	VOLTAGES	VOLATILE	VOLUMING
UNDERRUN	DISPOSAL	WEAPONED	HUNTSMAN	BULLETED	ALTERING	MONOGRAM	POSSIBLE

WEAKENED	WEAPONED	WINGDING	WINNABLE	WHATEVER	WHATNESS	WHATNOTS	WHATSITS
EQUALISE	OBSTRUCT	COMPUTER	STANZAIC	DECIMATE	EQUIPPED	BINOMIAL	YEARLONG

YELLOWED	YEARLONG	YEARNING	YEASAYER	YIELDING	YIELDERS	YOKOZUNA	YOURSELF
CIPHERED	CONTINUE	KINETICS	FORWARDS	ADDITION	FINISHED	GAMBLING	MULTITON

ZIPPERED	ZIGGURAT	ZIGZAGGY	ZUGZWANG	ZYGOMATA	ZYGOTENE	ZYMOLOGY	ZYMOGRAM
VOLUMING	ULTIMATE	HOTLINKS	NUMBERED	PROPHECY	YOURSELF	ULTRAHOT	OBSCURED