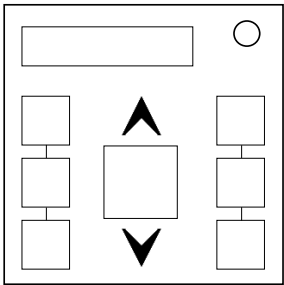# On the Subject of Alpha-Bits

Part of a well-balanced breakfast!

This module displays an ID number, six small screens containing single alphanumeric characters, and a large screen that can be controlled by up- and down-arrows.

It takes a maximum of three boolean operations to uniquely determine the values of two ordered bits. Each small screen is associated with a letter (displayed on the screen) and a boolean operation (determined from the ID number). The binary representation of the letter on the screen represents the converted bitwise result of the associated boolean operation being performed on the two unknowns in each stage.

Characters whose binary representations need more than five digits will not appear anywhere on this module. Numbers use standard binary representations. Letters are to be converted to base 36 before being converted to binary; A = 01010, B = 01011, ..., U = 11110, V = 11111.

Truth Tables

Truth tables for each of the 8 bitwise operations that may appear in this module (shown with their ID number equivalents) are shown here. The two left columns are the inputs in order, and the right column is the output.

0: OR		
1	1	1
1	0	1
0	1	1
0	0	0

1: AND		
1	1	1
1	0	0
0	1	0
0	0	0

2: XOR		
1	1	0
1	0	1
0	1	1
0	0	0

3: IMP		
1	1	1
1	0	0
0	1	1
0	0	1

4: NOR		
1	1	0
1	0	0
0	1	0
0	0	1

5: NAND		
1	1	0
1	0	1
0	1	1
0	0	1

6: XNOR		
1	1	1
1	0	0
0	1	0
0	0	1

7: IMPBY		
1	1	1
1	0	1
0	1	0
0	0	1

Solving the module

The ID number can be split into two triplets of numbers; the first is associated with the left column going down and Stage 1, and the second is associated with the right column going down and Stage 2. The value of a small display is determined as follows:

- Two characters are converted to binary. One is picked to be the first character, and the other is second character.
- A boolean operation is performed on the first bits of the two characters, maintaining their order. The result of this operation is the first bit of a new character.
- This process is repeated for the second, third, fourth, and fifth bits of the unknown characters to form a five-bit new character.
- This new character is converted into a character and displayed on the screen.

It is the goal of the expert to determine what the original two characters were for each stage.

If an incorrect character is inputted, then a strike will be incurred and the current stage's inputs will reset.

For example, let the screens on one side be (U, NAND), (R, OR), and (D, IMP). Consider the **second** bits in reading order of the two answers. Note that U = 11110, R = 11011, and D = 01101. It is known from the first screen that at least one bit is a zero, and from the second screen that at least one bit is a 1; the bits are 0 and 1 in some order. Screen three gives (0,1) as the correct bits in order. This may be repeated to determine that the correct characters are I and 9, respresented by 10011 and 01001 respectively.