

Continuity Tester – Supplement

This supplement provides additional details about the Coax Continuity Tester project summarized at <http://lloydj.net/Demos/index.html#coax>. The referenced summary includes a logic diagram for 'Revision 4' of the circuit. Before this revision, the XOR gate (IC number 3) was an OR gate. Everything else was the same.

In the diagram, bold letters: A, B, X, Y, etc. label individual inputs or outputs. The operations performed by individual gates can be represented as equations, using the letters on the diagram. For example, L1, the 'Good' indicator LED at the bottom of the diagram, is at the output of an AND gate (part of IC 4) whose inputs are M and N. The corresponding equation would be $L1 = M N$. In this notation, OR is '+' and AND is indicated by juxtaposition. NOT is a tick mark and XOR is denoted '^'.

In this way we construct an equation for each gate (treating the XOR as an OR, in other words the Revision 3 version).

```
M = (P Q) '      in words, M is not (P and Q) ...
N = (E Q)
J = (E F) '
E = (X Y) '
P = J '
Q = A + B
F = (C D)
C = (A X) '
D = (B Y) '
```

As noted above, illumination of LED L1 (indicating Good) is equivalent to $(M N)$. For this particular target, the computer procedure leads to the following rather messy equation:

```
Good = (((((((X Y) ')) ((A X) ')) ((B Y) '))) ')) (A + B) ')) (((X Y) ')) (A + B)))
```

Letters A and B stand for the center and shield of one end of the coax to be tested, while X and Y stand for center and shield of the other end.

From this equation [Logic Friday](#) computes the following Truth Table:

X	Y	A	B	=>	Good
0	1	0	1		1
0	1	1	1		1
1	0	1	0		1
1	0	1	1		1

The two expected rows are highlighted (green). The other rows (light grey) were not expected. [Note: the 12 unlisted input combinations evaluate to 0.] Interestingly, the false positive 'Good' indication that arises from an unusual combination of test conditions might not have been noticed if it had not come out of the equation in this purely logical or mathematical way.

Revision 4 of the circuit substitutes XOR for OR (IC 3 in the diagram). The resulting expression for 'Good' has $A \wedge B$ in place of $A + B$ and the Truth table is:

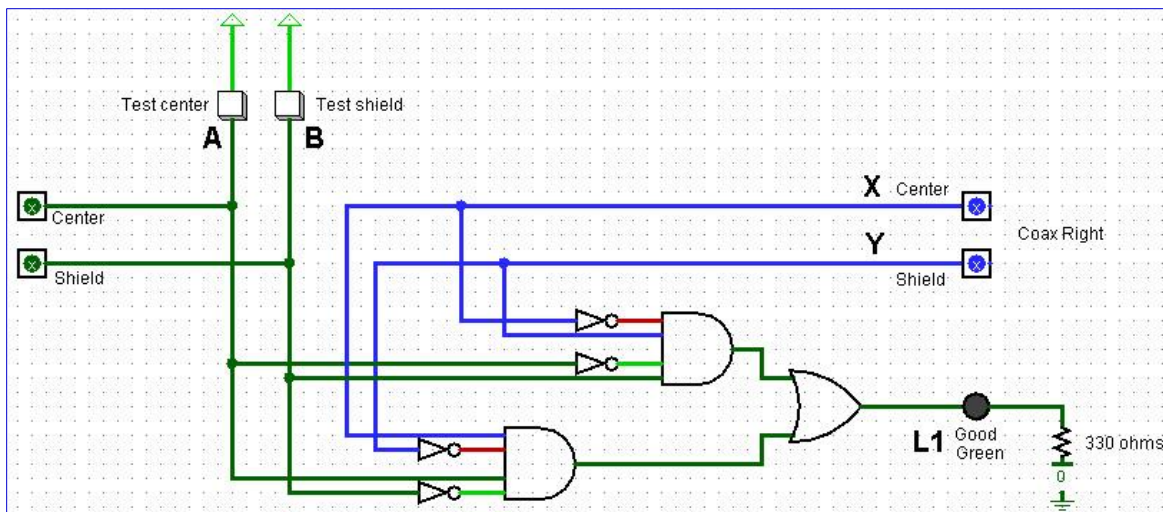
X	Y	A	B	=>	Good
0	1	0	1		1
1	0	1	0		1

This is the table that was expected. [The 14 unlisted input combinations produce 0.] Thus, according to this table, pressing the two buttons together will not produce a spurious 'Good' indication.

As remarked in the summary at <http://lloydmc.net/Demos/index.html#coax> it was unclear whether the overall chip count could be reduced while preserving the meaning of the three separate indicator LED's 'Good', 'Open', and 'Short'. However, minimization of the logic expression for 'Good' may be interesting in its own right. Logic Friday says:

$$\text{Good} = X' Y A' B + X Y' A B';$$

This translates to the following circuit (for just the one indicator LED):



On the summary page, the above circuit is shown combined with two others that are based on analogous Logic Friday expressions for the two fault LEDs, and without additional simplification.