Discrete Mathematicians
600 W. Walnut Street
Danville, KY 40422

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Circuit Design Company
600 W. Roush Street
Danville, KE 44444

Dear Mr. Setag,

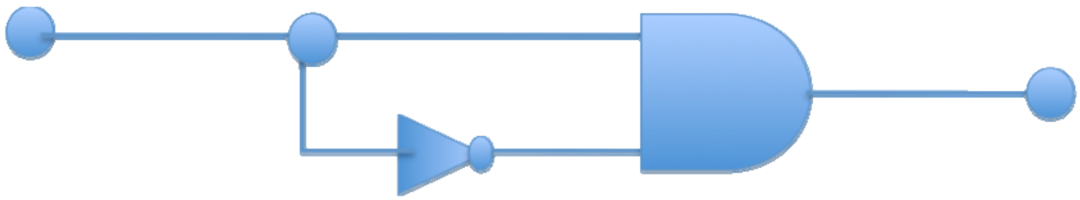
First, let me thank you for acting on Dr. Wiglesworth's reference and presenting me with the opportunity to decipher your dilemma with the presented circuit. Second, let me applaud your intuitive sense that this circuit component seems able to be simplified. Fortunately for your company you were correct, and a great deal of money and energy will be saved if you follow my simplification recommendation.

Before I give you the solution to this specific circuit simplification, let me explain to you the process I used so that in the future you are able to thwart similar dilemmas on your own. There is a disclaimer I would like to share, however, before I begin: There are multiple ways to determine if a circuit is able to be simplified, and there is no correct order to complete the different methods. Moreover, I like to compute a solution more than one way to ensure the correctness of the simplification.

In this situation, I began searching for a minimization of this circuit by transforming the circuit into a Boolean logical statement by assigning each of the three inputs to P, Q, and R. Next, I converted the gates to their corresponding logical equivalence AND= ^, OR= v, and NOT=~. The statement formed is: [(~P ^ Q) ^ R] ^ [(P v ~R) v (~Q v ~R)]. After making logically equivalent substitutions (using the Double Negation Law, DeMorgan's Law, and Distribution Law), the transformed statement did not appear much more simple. In some cases, however, this does produce a minimized circuit.

Since the first strategy did not produce desirable results, my next strategy consisted of creating a truth table (True's corresponding with 1s and False's corresponding with 0s) with the Boolean statement given above. The first three columns contain all the possible combinations of 1s and 0s for P, Q, and R. The final column represents the truth values (combinations of 1s and 0s) for the given circuit's output. It was this step that revealed a much more simple circuit due to the results of the final column.

The truth table reveals the circuit is a contradiction, or all 0s; thus, the circuit will always yield a 0 no matter what combination of 1s and 0s for P, Q, and R (inputs) are entered. The simplest circuit that yields a contradiction is obtainable with only one input, expressible by the Boolean statement (P ^ ~P) and the following circuit:



This circuit is my recommendation for the current design for this circuit component of the clock your company is working on. The simplification will save your company a significant amount of money and energy, which is very important during this financially-difficult time.

If in future minimization-attempts the final column does not yield a contradiction, but a combination of 1s and 0s, then a disjunctive statement-ORing each combination of Ps, Qs, and Rs that result in 1 in the final column- will symbolically represent a simpler circuit.

Good luck with Circuit Design's future business endeavors. I am glad that I was able to offer you assistance with this current simplification problem, and I am confident you will be able to apply my tutorial on circuit simplification to future dilemmas. If you do need further assistance, however, do not hesitate to contact me through Dr. Wiglesworth.

Sincerely,

Group X