**Problem**

Design a 3-bit binary even/odd counter. The counting mode is determined by an external input x.

If x=0 it counts even else it counts odd.

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| |  |  |  |  |  | | --- | --- | --- | --- | --- | | Present | Next | ff’s | | | | x QA QB QC | QA QB QC | DA | DB | DC | | 0 0 0 0 | 0 1 0 | 0 | 1 | 0 | | 1 0 0 0 | 0 0 1 | 0 | 0 | 1 | | 0 0 0 1 | 0 1 0 | 0 | 1 | 0 | | 1 0 0 1 | 0 1 1 | 0 | 1 | 1 | | 0 0 1 0 | 1 0 0 | 1 | 0 | 0 | | 1 0 1 0 | 0 1 1 | 0 | 1 | 1 | | 0 0 1 1 | 1 0 0 | 1 | 0 | 0 | | 1 0 1 1 | 1 0 1 | 1 | 0 | 1 | | 0 1 0 0 | 1 1 0 | 1 | 1 | 0 | | 1 1 0 0 | 1 0 1 | 1 | 0 | 1 | | 0 1 0 1 | 1 1 0 | 1 | 1 | 0 | | 1 1 0 1 | 1 1 1 | 1 | 1 | 1 | | 0 1 1 0 | 0 0 0 | 0 | 0 | 0 | | 1 1 1 0 | 1 1 1 | 1 | 1 | 1 | | 0 1 1 1 | 0 0 0 | 0 | 0 | 0 | | 1 1 1 1 | 0 0 1 | 0 | 0 | 1 | | Use Karnaugh maps to minimize the functions for DA , DB and DC .  The final expressions are:  DA = QA Q’B + x’ Q’A QB + Q’A QB QC + x QA QB Q’C  DB = Q’B QC + x’Q’B + x QB Q’C  DC = x |