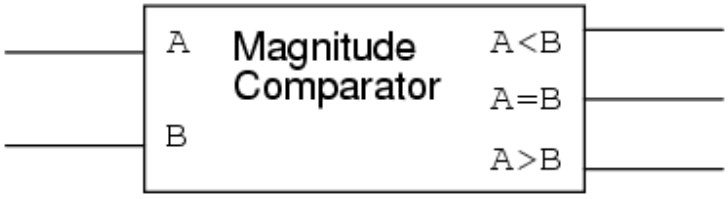
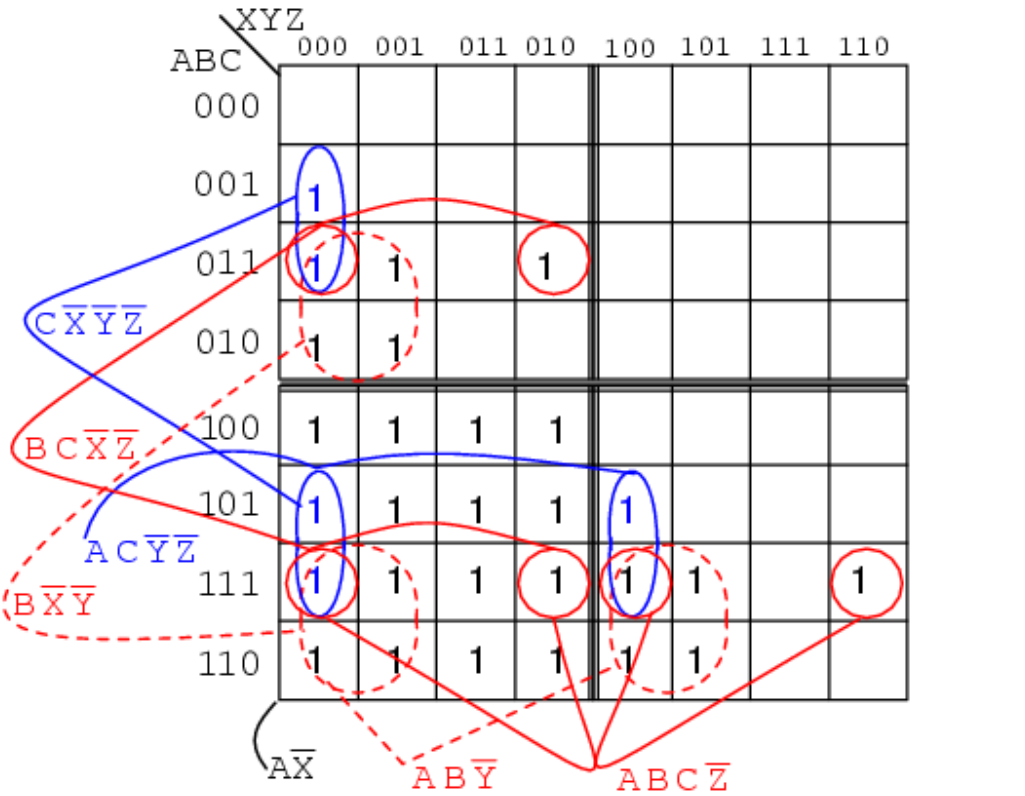
5 & 6-VARIABLE KARNAUGH MAPS

A magnitude comparator (used to illustrate a 6-variable K-map) compares two binary numbers, indicating if they are equal, greater than, or less than each other on three respective outputs. A three bit magnitude comparator has two inputs $A_2A_1A_0$ and $B_2B_1B_0$ An integrated circuit magnitude comparator (7485) would actually have four inputs, But, the Karnaugh map below needs to be kept to a reasonable size. We will only solve for the **A>B** output.

Below, a 6-variable Karnaugh map aids simplification of the logic for a 3-bit magnitude comparator. This is an overlay type of map. The binary address code across the top and down the left side of the map is not a full 3-bit Gray code. Though the 2-bit address codes of the four sub maps is Gray code. Find redundant expressions by stacking the four sub maps atop one another (shown above). There could be cells common to all four maps, though not in the example below. It does have cells common to pairs of sub maps.



The A>B output above is ABC>XYZ on the map below.



6- variable Karnaugh map (overlay)

Where ever **ABC** is greater than **XYZ**, a **1** is plotted. In the first line **ABC=000** cannot be greater than any of the values of **XYZ**. No **1**s in this line. In the second line, **ABC=001**, only the first cell **ABCXYZ= 001000** is **ABC** greater than **XYZ**. A single **1** is entered in the first cell of the second line. The fourth line, **ABC=010**, has a pair of **1**s. The third line, **ABC=011** has three **1**s. Thus, the map is filled with **1**s in any cells where **ABC** is greater than **XXZ**.

In grouping cells, form groups with adjacent sub maps if possible. All but one group of 16-cells involves cells from pairs of the sub maps. Look for the following groups:

- 1 group of 16-cells
- 2 groups of 8-cells
- 4 groups of 4-cells

The group of 16-cells, **AX'** occupies all of the lower right sub map; though, we don't circle it on the figure above.

One group of 8-cells is composed of a group of 4-cells in the upper sub map overlaying a similar group in the lower left map. The second group of 8-cells is composed of a similar group of 4-cells in the right sub map overlaying the same group of 4-cells in the lower left map.

The four groups of 4-cells are shown on the Karnaugh map above with the associated product terms. Along with the product terms for the two groups of 8-cells and the group of 16-cells, the final Sum-Of-Products reduction is shown, all seven terms. Counting the **1**s in the map, there is a total of 16+6+6=28 ones. Before the K-map logic reduction there would have been 28 product terms in our SOP output, each with 6-inputs. The Karnaugh map yielded seven product terms of four or less inputs. This is really what Karnaugh maps are all about!