Conversion of SOP form to standard SOP form or Canonical SOP form

We can include all the variables in each product term of the SOP form equation, which doesn't have all the variables by converting into standard SOP form. The normal SOP form function can be converted to standard SOP form by using the Boolean algebraic law, (A + A' = 1) and by following the below steps.

Step 1:

By multiplying each non-standard product term with the sum of its missing variable and its complement, which results in 2 product terms

Step 2:

By repeating the step 1, until all resulting product terms contain all variables

By these two steps we can convert the SOP function into standard SOP function. In this process, for each missing variable in the function, the number of product terms will double.

Example:

Convert the non standard SOP function F = x y + x z + y z

Sol:

$F = x\,y + x\,z + y\,z$

$= x\,y\,(z + z') + x\,(y + y')\,z + (x + x')\,y\,z$

$= x\,y\,z + x\,y\,z' + x\,y\,z + x\,y'\,z + x\,y\,z + x'\,y\,z$

$= x\,y\,z + x\,y\,z' + x\,y'\,z + x'\,y\,z$

The standard SOP form is F = x y z + x y z' + x y' z + x' y z

Conversion of POS form to standard POS form or Canonical POS form

We can include all the variables in each product term of the POS form equation, which doesn't have all the variables by converting into standard POS form. The normal POS form function can be converted to standard POS form by using the Boolean algebraic law, (A * A' = 0) and by following the below steps.

Step 1:

By adding each non-standard sum term to the product of its missing variable and its complement, which results in 2 sum terms

Step 2:

Applying Boolean algebraic law, A + BC = (A + B) * (A + C)

Step 3:

By repeating the step 1, until all resulting sum terms contain all variables

By these three steps we can convert the POS function into standard POS function.

Example:
$$F = (A' + B + C) * (B' + C + D') * (A + B' + C' + D)$$

In the first term, the variable D or D' is missing, so we add D*D' = 1 to it. Then

$$(A' + B + C + D*D') = (A' + B + C + D) * (A' + B + C + D')$$

Similarly, in the second term, the variable A or A' is missing, so we add A*A' = 1 to it. Then

$$(B' + C + D' + A*A') = (A + B' + C + D') * (A' + B' + C + D')$$

The third term is already in the standard form, as it has all the variables. Now the standard POS form equation of the function is

$$F = (A' + B + C + D) * (A' + B + C + D') * (A + B' + C + D') * (A' + B' + C + D') * (A + B' + C' + D)$$