

# Laws and Theorems of Boolean Algebra

Operations with 0 and 1:

1.  $X + 0 = X$

1D.  $X \cdot 1 = X$

2.  $X + 1 = 1$

2D.  $X \cdot 0 = 0$

Idempotent laws:

3.  $X + X = X$

3D.  $X \cdot X = X$

Involution law:

4.  $(X')' = X$

Laws of complementarity:

5.  $X + X' = 1$

5D.  $X \cdot X' = 0$

Commutative laws:

6.  $X + Y = Y + X$

6D.  $XY = YX$

Associative laws:

7.  $(X + Y) + Z = X + (Y + Z)$   
 $= X + Y + Z$

7D.  $(XY)Z = X(YZ) = XYZ$

Distributive laws:

8.  $X(Y + Z) = XY + XZ$

8D.  $X + YZ = (X + Y)(X + Z)$

Simplification theorems:

9.  $XY + XY' = X$

9D.  $(X + Y)(X + Y') = X$

10.  $X + XY = X$

10D.  $X(X + Y) = X$

11.  $(X + Y')Y = XY$

11D.  $XY' + Y = X + Y$

DeMorgan's laws:

12.  $(X + Y + Z + \dots)' = X'Y'Z' \dots$

12D.  $(XYZ \dots)' = X' + Y' + Z' + \dots$

Duality:

13.  $(X + Y + Z + \dots)^D = XYZ \dots$

13D.  $(XYZ \dots)^D = X + Y + Z + \dots$

Theorem for multiplying out and factoring:

14.  $(X + Y)(X' + Z) = XZ + X'Y$

14D.  $XY + X'Z = (X + Z)(X' + Y)$

Consensus theorem:

15.  $XY + YZ + X'Z = XY + X'Z$

15D.  $(X + Y)(Y + Z)(X' + Z)$   
 $= (X + Y)(X' + Z)$