

Encoder:

$$Y_0 = I_1 + I_3 + I_5 + I_7$$

$$Y_1 = I_2 + I_3 + I_6 + I_7$$

$$Y_2 = I_4 + I_5 + I_6 + I_7$$

Binary to gray code:

Equations:

$$G_0 = B \oplus A$$

$$G_1 = C \oplus B$$

$$G_2 = D \oplus C$$

$$G_3 = D$$

Gray to Binary:

Equations:

$$A = (G_3 \oplus G_2) \oplus (G_1 \oplus G_0)$$

$$B = G_3 \oplus G_2 \oplus G_1$$

$$C = G_3 \oplus G_2$$

$$D = G_3$$

BCD to Excess-3:

Equations:

$$z = D'$$

$$y = CD + C'D' = CD(C+D)'$$

$$x = B'(C+D) + B(C+D)'$$

$$w = A + B(C+D)$$

Excess-3 to BCD:

Equations:

$$\begin{aligned} A &= wx + wyz \\ B &= x'y' + x'z' + xyz \\ C &= y'z + yz' \\ D &= z' \end{aligned}$$