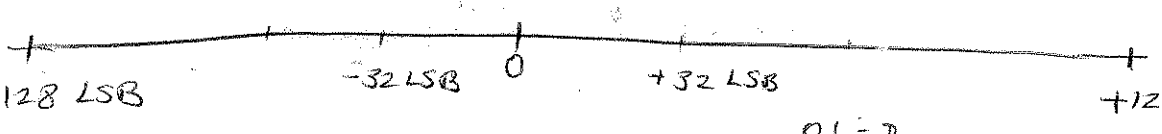
Digital Outputs of an 8-Bit 1.5-Bit/Stage ADC



$01 = D_0$

$V_{in} = +0.8\ LSB \Rightarrow V_{res1} = 2V_{in} = 1.6\ LSB \Rightarrow 01 = D_1$

$V_{res2} = 4V_{in} = 3.2\ LSB \Rightarrow 01 = D_2$

$V_{res3} = 8V_{in} = 6.4\ LSB \Rightarrow 01 = D_3$

$V_{res4} = 16V_{in} = 12.8\ LSB \Rightarrow 01 = D_4$

$V_{res5} = 32V_{in} = 25.6\ LSB \Rightarrow 01 = D_5$

$V_{res6} = 64V_{in} = 51.2\ LSB \Rightarrow 10 = D_6$

$V_{res7} = 128V_{in} - V_R = -25.6\ LSB \Rightarrow 0 = D_7$

$$D_{out} = D_0 + D_1 2^{-1} + D_2 2^{-2} + D_3 2^{-3} + D_4 2^{-4} + D_5 2^{-5} + D_6 2^{-6} + D_7 2^{-7}$$

$\Rightarrow D_{OUT} =$

```
  0 1
+   0 1
+     0 1
+       0 1
+         0 1
+           0 1
+             1 0
+               0
-----------------
D_OUT = 1 0 0 0 0 0 0 0
```

$\Rightarrow D_{OUT} = 128$

$V_{in} = -0.8\ LSB \Rightarrow$ $01 = D_0$

$V_{res1} = 2V_{in} = -1.6\ LSB \Rightarrow 01 = D_1$

$V_{res2} = 4V_{in} = -3.2\ LSB \Rightarrow 01 = D_2$

$V_{res3} = 8V_{in} = -6.4\ LSB \Rightarrow 01 = D_3$

$V_{res4} = 16V_{in} = -12.8\ LSB \Rightarrow 01 = D_4$

$V_{res5} = 32V_{in} = -25.6\ LSB \Rightarrow 01 = D_5$

$V_{res6} = 64V_{in} = -51.2\ LSB \Rightarrow 00 = D_6$

$V_{res7} = 128V_{in} + V_r = 25.6\ LSB \Rightarrow 1 = D_7$

$D_{out} =$

```
  0 1
+   0 1
+     0 1
+       0 1
+         0 1
+           0 1
+             0 0
+               1
-----------------
D_OUT = 0 1 1 1 1 1 1 1
```

$\Rightarrow D_{OUT} = 127$

$V_{in} = +32.8\ LSB \Rightarrow$ $10 = D_0$

$V_{res1} = (2V_{in} - V_R) = -62.4\ LSB \Rightarrow 00 = D_1$

$V_{res2} = (2V_{res1} + V_R) = 3.2\ LSB \Rightarrow 01 = D_2$

$V_{res3} = 2V_{res2} = 6.4\ LSB \Rightarrow 01 = D_3$

$V_{res4} = 2V_{res3} = 12.8\ LSB \Rightarrow 01 = D_4$

$V_{res5} = 2V_{res4} = 25.6\ LSB \Rightarrow 01 = D_5$

$V_{res6} = 2V_{res5} = 51.2\ LSB \Rightarrow 10 = D_6$

$V_{res7} = 2V_{res6} - V_R = -25.6\ LSB = 0 = D_7$

$D_{OUT} =$

```
  1 0
    0 0
      0 1
        0 1
          0 1
            0 1
              1 0
                0
-----------------
D_OUT = 1 0 1 0 0 0 0 0
```

$\Rightarrow D_{OUT} = 160$