AD/DA Converters

CS321

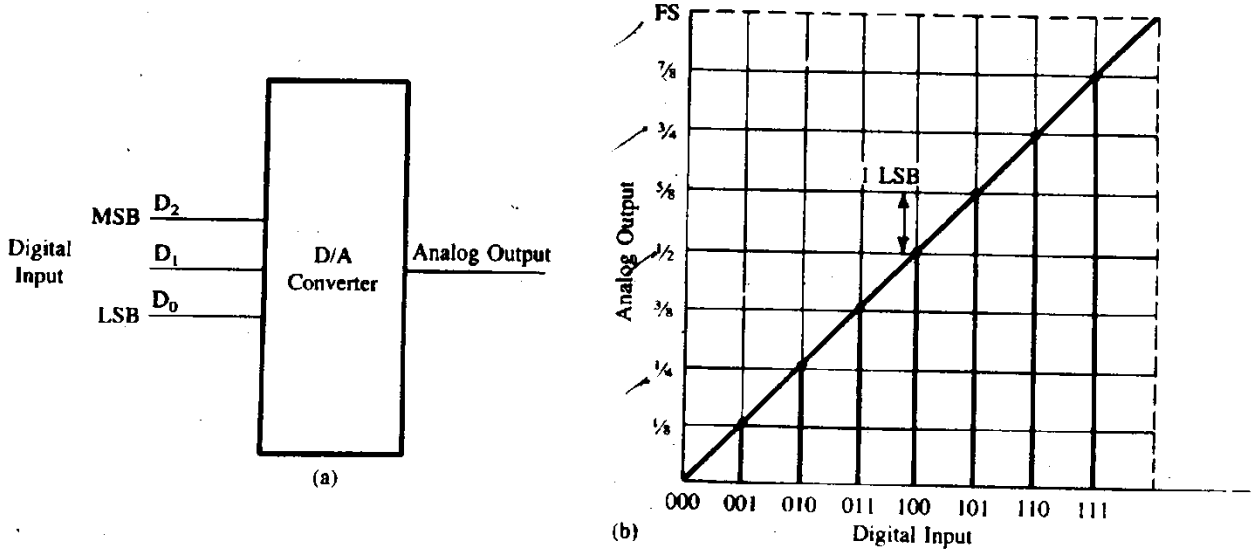


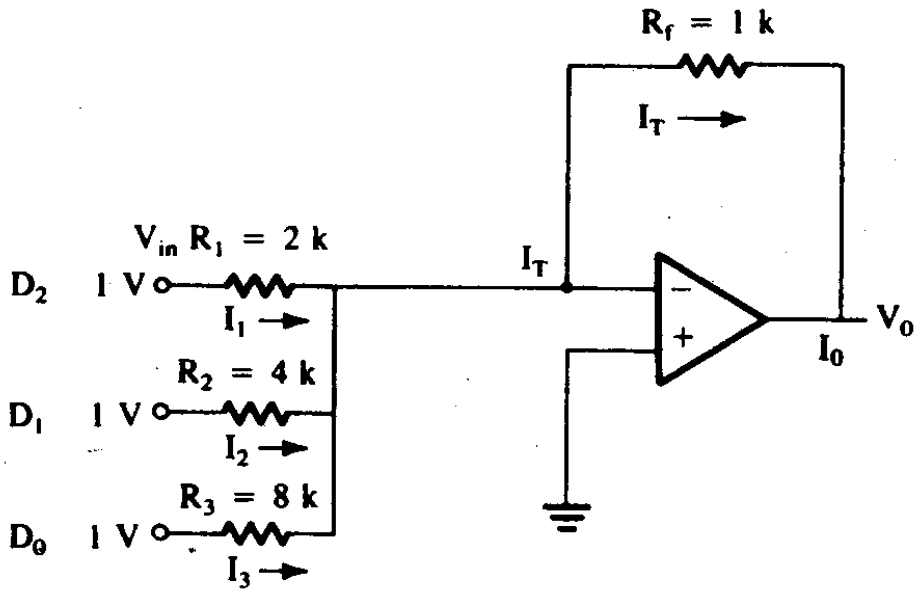
FIGURE 13.1
A 3-Bit D/A Converter: Block Diagram (a) and Digital Input vs. Analog Output (b)

3 bit D/AC has 8 combinations => n bit has 2^n combinations
If full scale analog voltage=1 V the smallest unit or LSB is 001B or 1/(2^n) of 1V.
This is called the Resolution of the DAC. If n=3, LSB = 1/8V.

MSB= Half of Full Scale Value i.e. 100B = 1/2V

For Maximum input signal 111B, the output will be Full Scale Input – 1 LSB.

In this case 111B will give 7/8V as output.



$I_0 = I_T = I_1 + I_2 + I_3$

$= Vin/R_1 + Vin/R_2 + Vin/R_3$

$= Vin/1K(1/2+1/4+1/8)$

$= 0.875$ mA

$Vo = -R_f \cdot I_T$

$= -(1K)\ (0.875mA)$

$= -0.875V$

$= -7/8V$

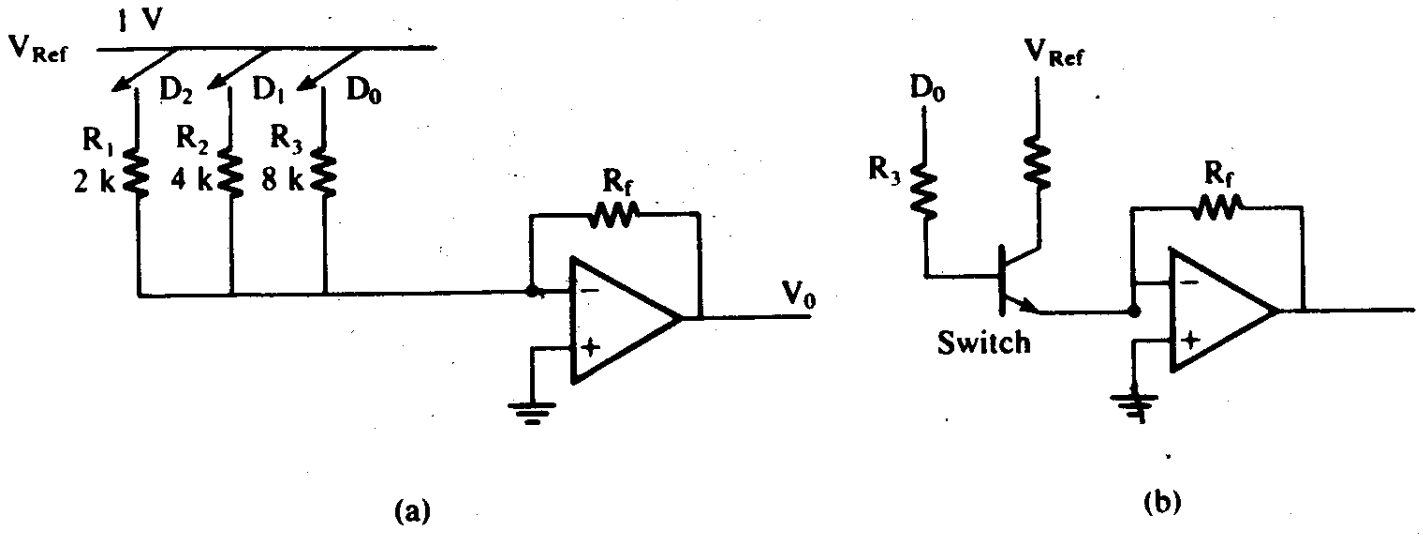
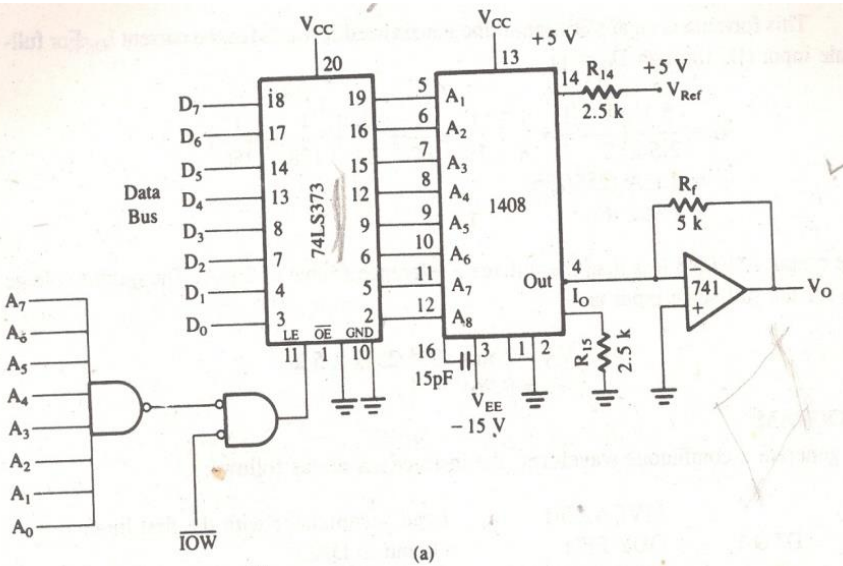


FIGURE 13.3
Simulated D/A Converter (a) and Transister Switch to Turn On/Off Bit D_0 (b)

I0 = (Vref/R){A1/2+A2/4+…+An/(2**n)} where Ai = 0 or 1



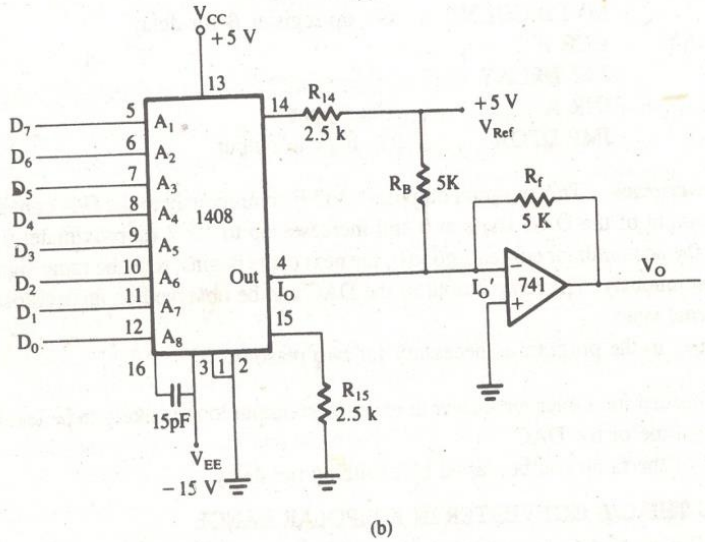
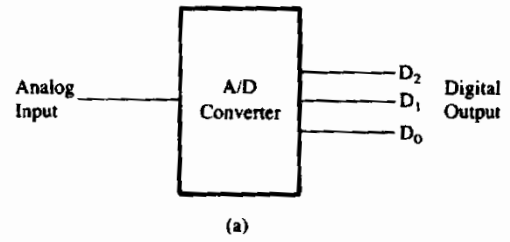


FIGURE 13.5
Interfacing the 1408 D/A Converter: Voltage Output in Unipolar Range (a) and in Bipolar Range (b)

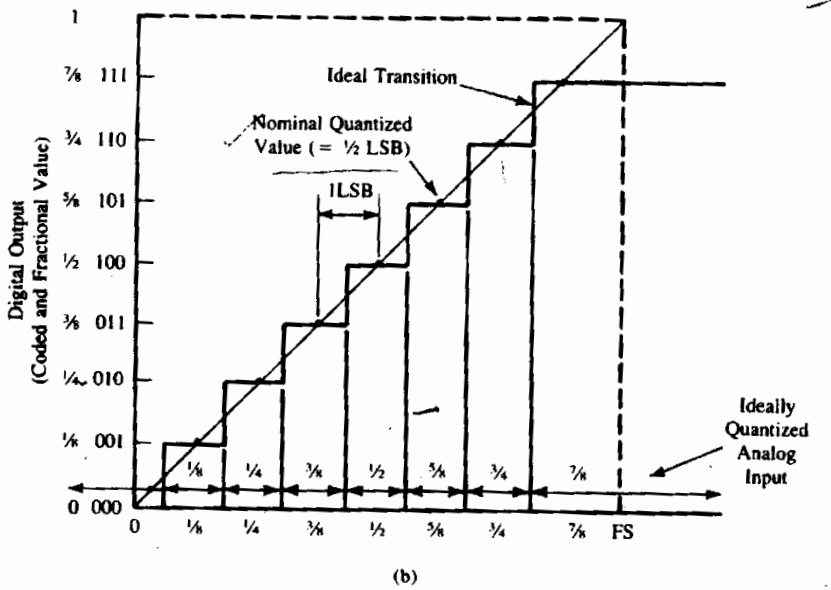
Io = Vref/R14(A1/2+A2/4+A3/8+…A8/256)
= 2mA(255/256) if all Ai=1
= 1.992mA
Vo = 2mA(255/256)x5K = 9.961V

```
        MVI A,00H
HERE:   OUT 0FFH
        MVI B, CNT
DELAY:  DCR B
        JNZ DELAY
        INR A
        JMP HERE
```

FIGURE 13.8
A 3-Bit A/D Converter: Block Diagram (a) and Analog Input vs. Digital Output (b)
SOURCE: Analog Devices, Inc., *Integrated Circuit Converters, Data Acquisition Systems,* and *Analog Signal Conditioning Components* (Norwood, Mass.: Author, 1979), p. I-18.



(a)

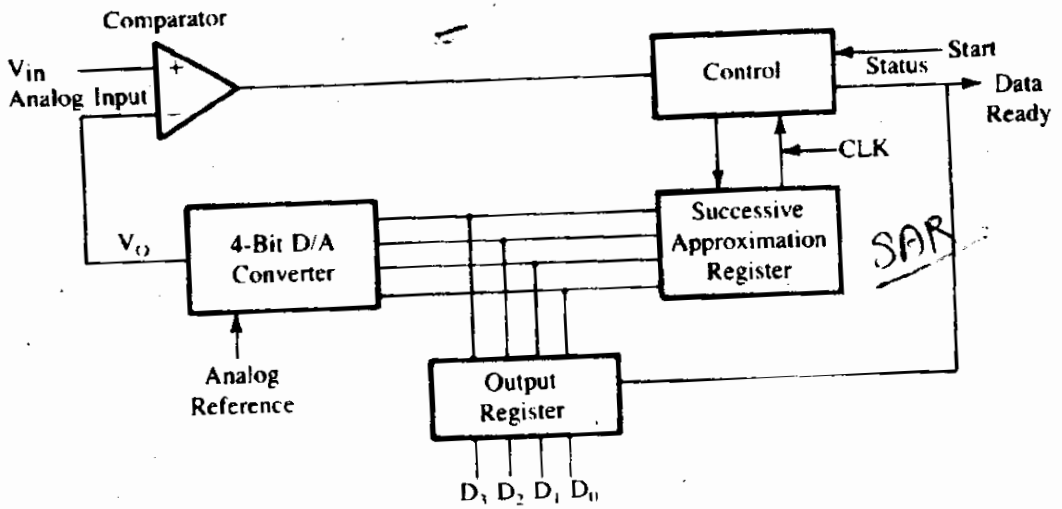


(b)

Resolution is same as a DAC

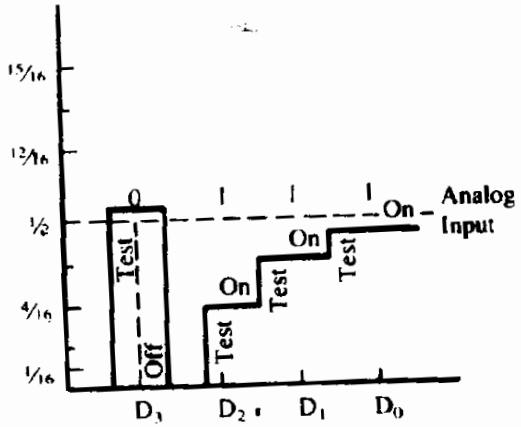
Critical factor is the Conversion time

Depends on the technique used &
the propagation delays within the circuits



(a)

FIGURE 13.9
Successive-Approximation A/D Converter: Block Diagram (a) and Conversion Process for a 4-Bit Converter (b)



(b)

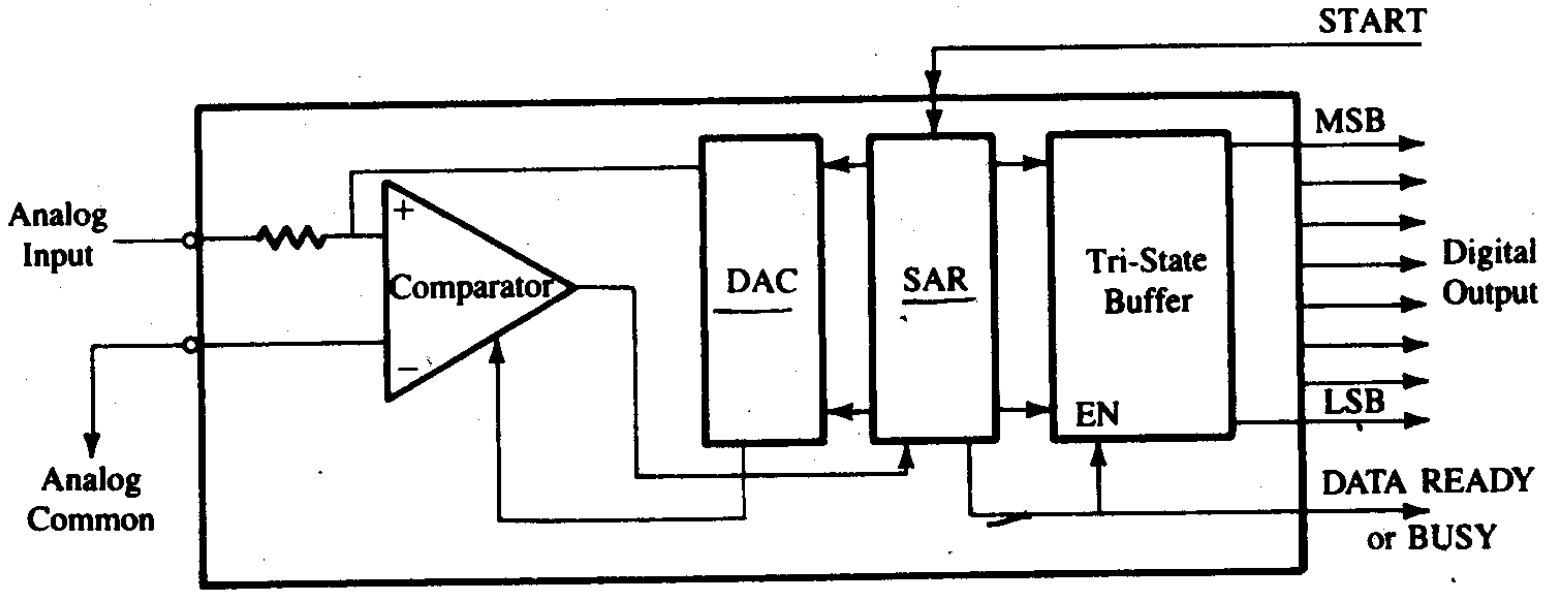


FIGURE 13.10
Block Diagram of a Typical Successive-Approximation A/D Converter as an Integrated Circuit

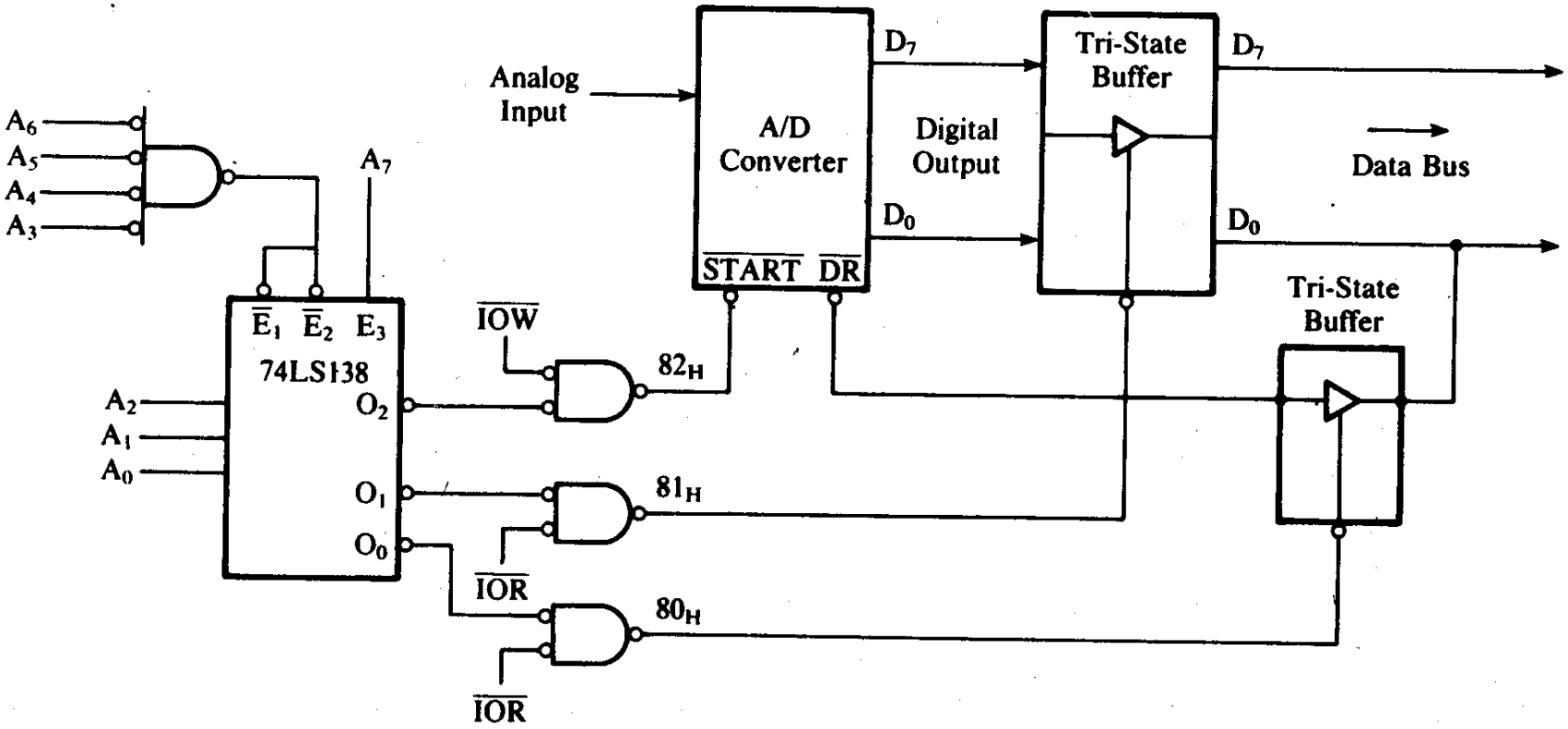


FIGURE 13.11
Interfacing an A/D Converter Using the Status Check