

Decoders

Lecture 25

Section C.2 (on CD)

Robb T. Koether

Hampden-Sydney College

Wed, Oct 30, 2019

1 Decoders

1 Decoders

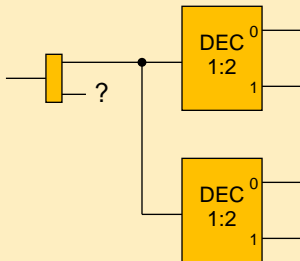
Decoders

Definition (Decoder)

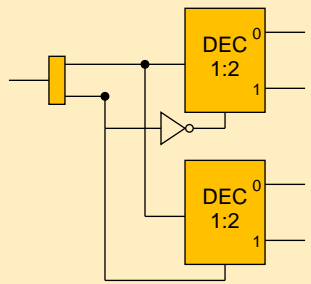
A **decoder** is an electronic circuit that receives n input signals and outputs 2^n signals, one of which is 1 and the rest are 0. The output that receives 1 is determined by the value of the input, when interpreted as an n -bit binary number.

- To build a 1:4 decoder, we need a 2-bit input and four 1-bit outputs, which we will combine into a single 4-bit output.
- We will use two 1:2 decoders.
 - Each decoder will receive the 0-bit of the input.
 - The 1-bit will be used to decide which decoder produces the output of 1.

1:2 Decoder



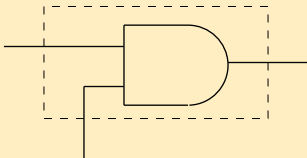
1:2 Decoder



- This design requires that the 1:2 decoder have a separate input that will activate it (1) or deactivate it (0).
- We will build a 1:2 “decoder with enable.”
- The “enabler” receives an input and a 1-bit signal.
 - If the signal is 1, the input passes through to the output unchanged.
 - If the signal is 0, the output is 0.

A 1-bit Enabler

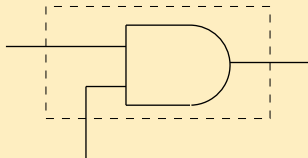
1-bit Enabler



- A 1-bit enabler.

A 1-bit Enabler

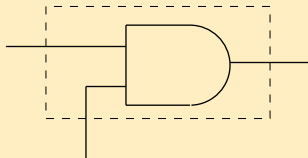
1-bit Enabler



- A 1-bit enabler.
- Simple, but we will have no use for it.

A 1-bit Enabler

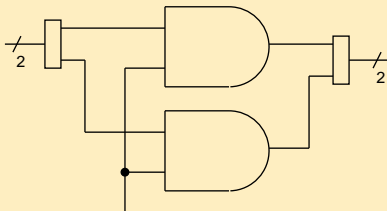
1-bit Enabler



- A 1-bit enabler.
- Simple, but we will have no use for it.
- But it gives us an idea of how to build a 2-bit enabler.

A 2-bit Enabler

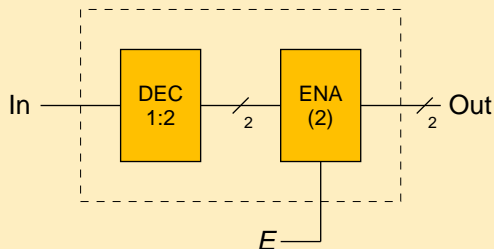
2-bit Enabler



- However, we will apply the enabler to the output, so we need a 2-bit enabler.

A 1:2 Decoder with Enabler

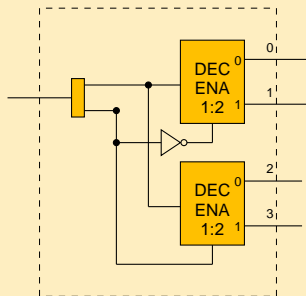
Decoder with Enabler



- Now we combine the 1:2 decoder with the 2-bit enabler to create the 1:2 decoder with enabler (DEC ENA 1:2).

A 2:4 Decoder without Enabler

Decoder with Enabler



- The 2:4 decoder (without its own enabler!)

Building Larger Decoders

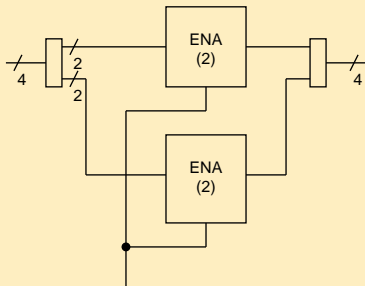
- To continue to build larger decoders, we need to build larger enablers.
- We will build a 4-bit enabler from two 2-bit enablers and use it to “enable” our 2:4 decoder.
- The result will be a 2:4 decoder with enable (DEC ENA 2:4).

Building Larger Decoders

- To continue to build larger decoders, we need to build larger enablers.
- We will build a 4-bit enabler from two 2-bit enablers and use it to “enable” our 2:4 decoder.
- The result will be a 2:4 decoder with enable (DEC ENA 2:4).
- This is now all done recursively!

A 4-bit Enabler

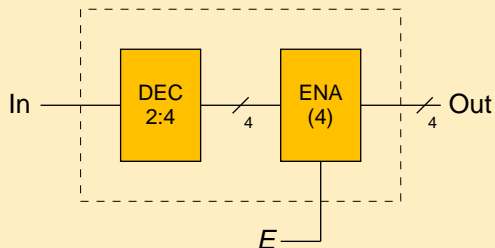
2-bit Enabler



- The 4-bit enabler

A 2:4 Decoder with Enabler

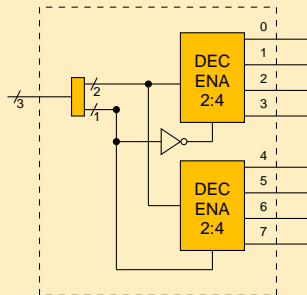
Decoder with Enabler



- The 2:4 decoder with enabler

A 3:8 Decoder without Enabler

Decoder with Enabler



- The 3:8 decoder (without enabler)