

Frequency Shift Keying (FSK) - Modulation

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Revisit: FM - Frequency Modulation

- Information is differentiated by different **carrier wave frequencies**
 - c.f. AM (Amplitude Modulation)?
- In detail...

$$\begin{aligned}
 y(t) &= A_c \cos \left(2\pi \int_0^t f(\tau) d\tau \right) \\
 &= A_c \cos \left(2\pi \int_0^t [f_c + f_\Delta x_m(\tau)] d\tau \right) \\
 &= A_c \cos \left(2\pi f_c t + 2\pi f_\Delta \int_0^t x_m(\tau) d\tau \right)
 \end{aligned}$$

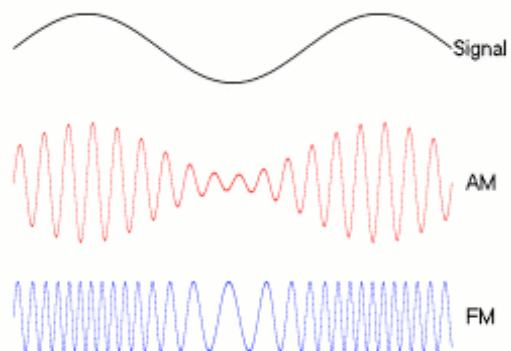
FM modulated signal → $y(t)$
Base carrier frequency → f_c
Instantaneous carrier frequency → $f_\Delta x_m(\tau)$
Message (baseband) signal → $x_m(\tau)$

- **Difference** between instantaneous and base frequency of carrier is directly **proportional** to instantaneous value of input signal

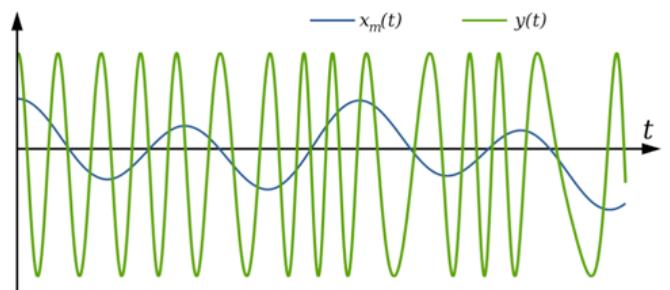


Illustration

- Message signal and its FM, AM

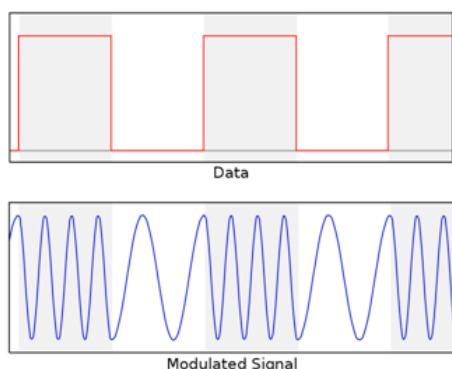


- Message signal and its FM



FSK - Frequency Shift Keying

- Unlike FM, FSK sends **digital data**
 - by shifting carrier's frequency among **a set of discrete values**
 - Digital Data: “0” or “1”
 - FM signal



Q: How many frequencies are used in this example?



■ Glossary -“Keying”

- shaping of a signal to convey information = modulation
- FSK
- PSK (Phase Shift Keying)

[Images for gear shift](#)

[Report images](#)



[More images for gear shift](#)

■ MATLAB illustration



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Line Encoding

■ NRZ (Non-Return-to-Zero)

- Remain fixed for the duration of the bit time (not return to zero).

■ RZ (Return-to-Zero)

- First half of bit time: represented by binary levels
- Second half-bit is always zero (returns to zero).

■ MAN (Manchester)

- First half of bit time: represented by binary levels
- Second half-bit time: its complement levels

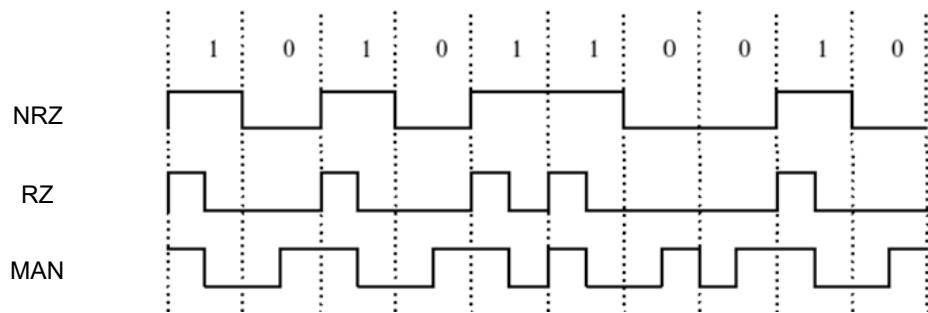


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Line Encoding - Examples

- Example:



- See also MATLAB illustration (and spectral density as well)

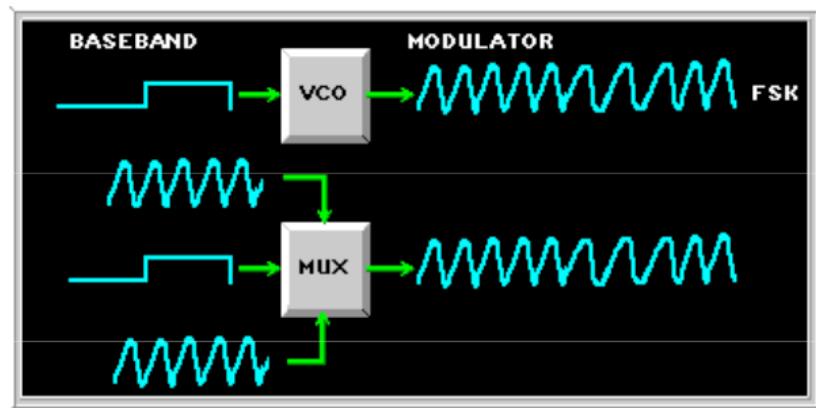


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In Experiments...

- To emulate two different carrier frequencies (because of FSK),
 - MUX (multiplexer) is used
 - Pass only one signal selected by control signals



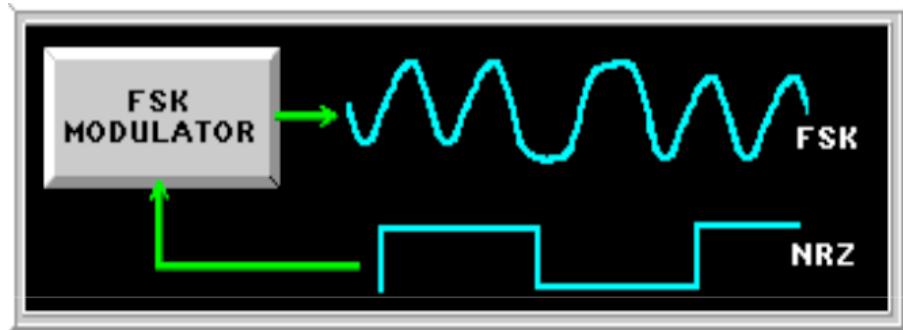
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In Experiments...

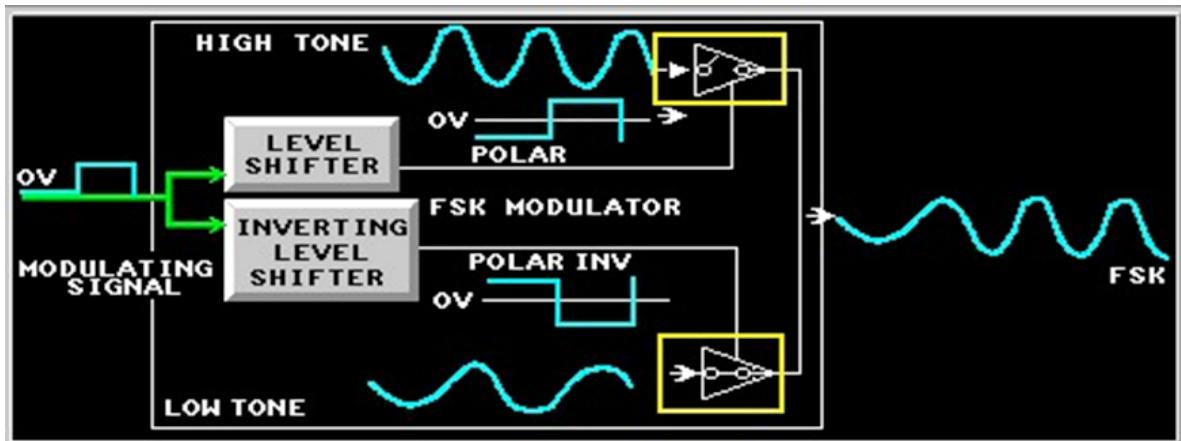
■ FSK Modulator

- Digital Input (0: low or 1:high) two different frequencies



In Experiments...

- In order to emulate FSK, analog switches are used:



In Experiments...

- Terms: $M = 2^N$ symbols $\rightarrow N$ bits/symbol
Symbol rate: F symbol/sec (or, baud)
 $\rightarrow NF$ bits/sec

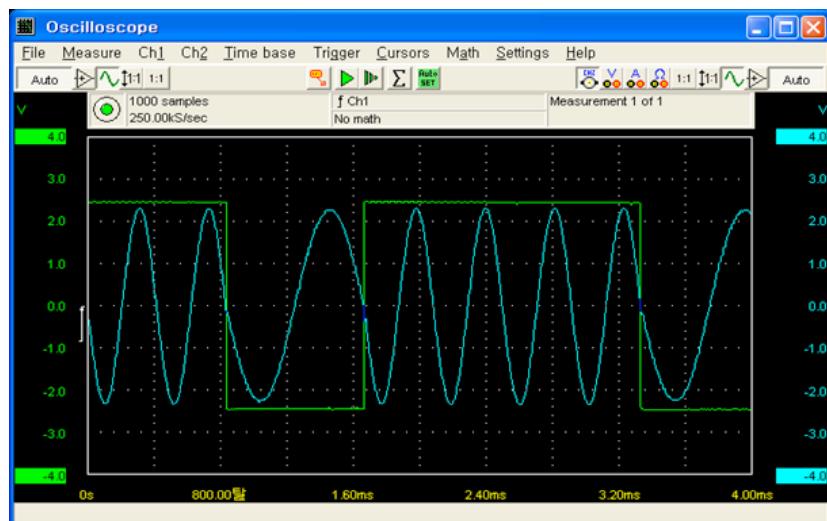


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In Experiments...

- Possible FSK modulated output



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