PSK31 Without a PC

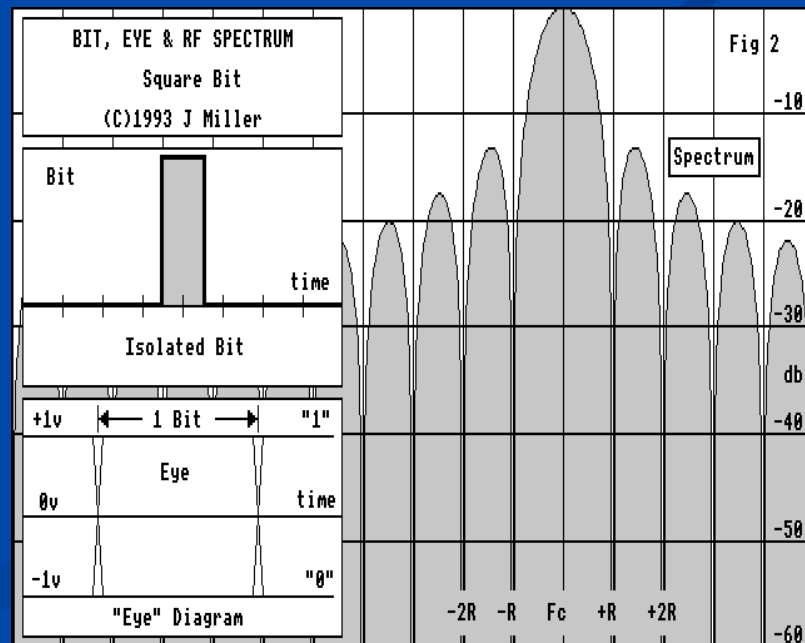## Lyle Johnson – KK7P

PSK31 Basics

- Narrow Band (~63 Hz wide)
- Designed for Real-Time QSOs
  - No Error Correction
  - No "Binary" Mode
  - Typing Speeds
  - Weak Signal
- Requires Linear Transmitter
  - Not Constant Envelope (CW, RTTY)
  - Use SSB Tx

PSK Modulation

- Accept Data from User
- Encode to Varicode "Alphabet"
  - Most Common Characters are Shorter
  - Similar Principle to Morse Code
- Modulate onto RF Carrier
  - Phase for Information
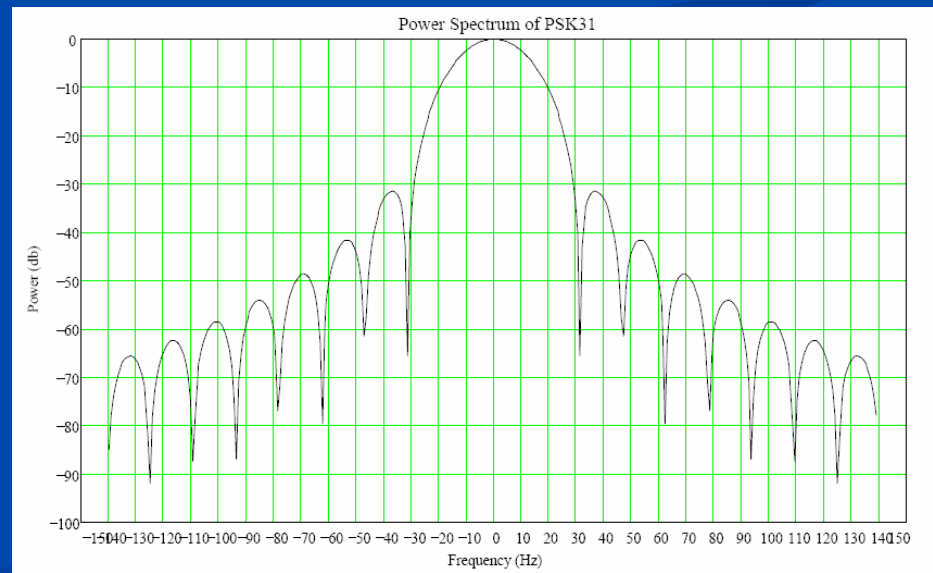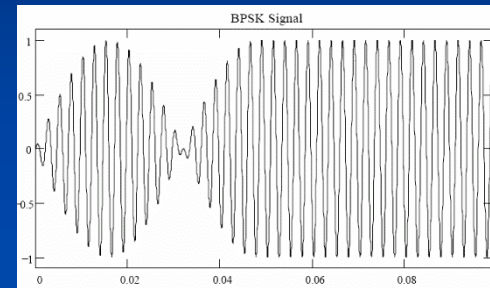 - Amplitude to Limit Bandwidth at Phase Transition
    - Why?

PSK31 Modulation

- Carrier Phase Reversal Indicates "0"
- No Phase Reversal Indicates "1"
- Phase Reversal of a Carrier Occupies a Lot of Bandwidth!
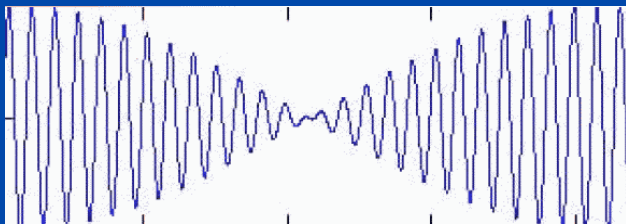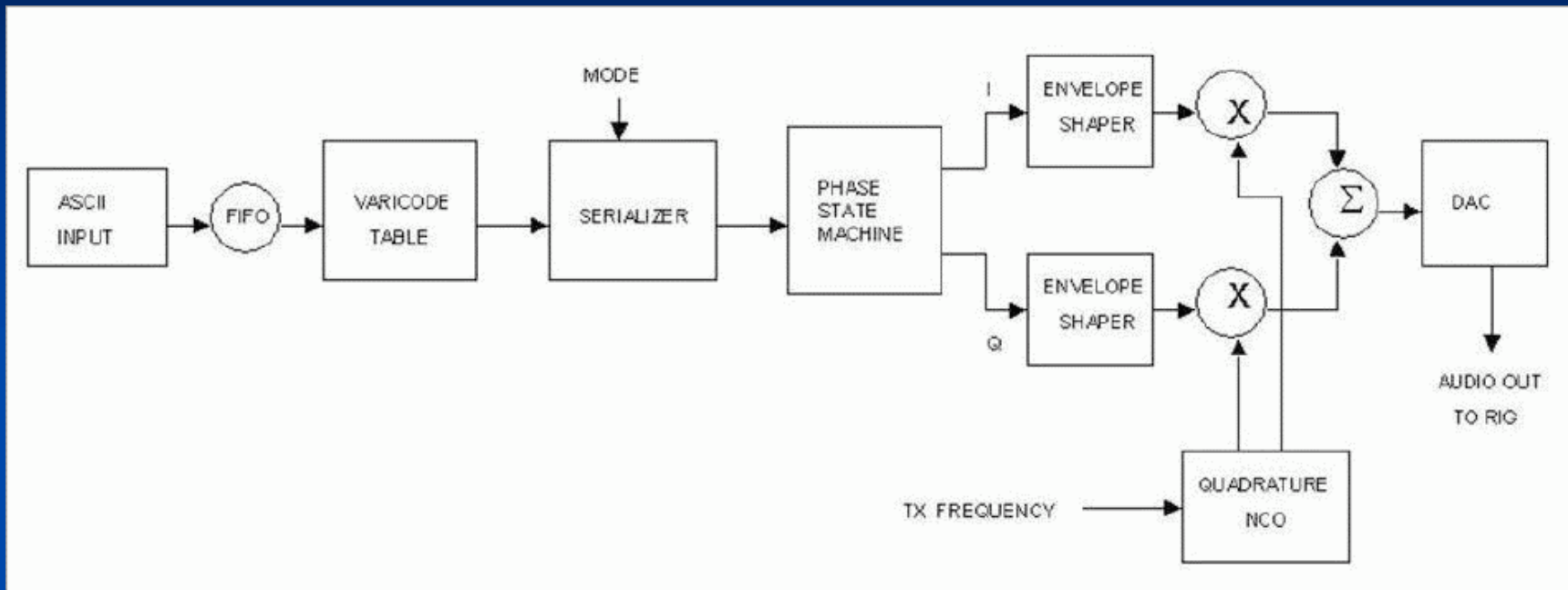 - (From Miller, The Shape of Bits to Come)

BIT, EYE & RF SPECTRUM
Square Bit
(C)1993 J Miller

Bit

Isolated Bit

+1v   ← 1 Bit →   "1"

Eye

0v   time

-1v   "0"

"Eye" Diagram

Fig 2

Spectrum

-2R -R Fc +R +2R
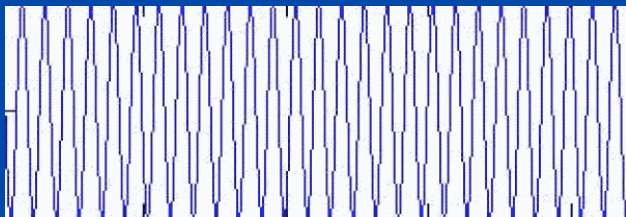
PSK31 Modulation

- PSK31 Carrier Has Envelope Modulation to Minimize Occupied Bandwidth

  BPSK Signal

  - Carrier Amplitude is Reduced to Zero at Instant of Reversal
  - Requires Linear Transmitter
  - (From AE4JY)

  Power Spectrum of PSK31
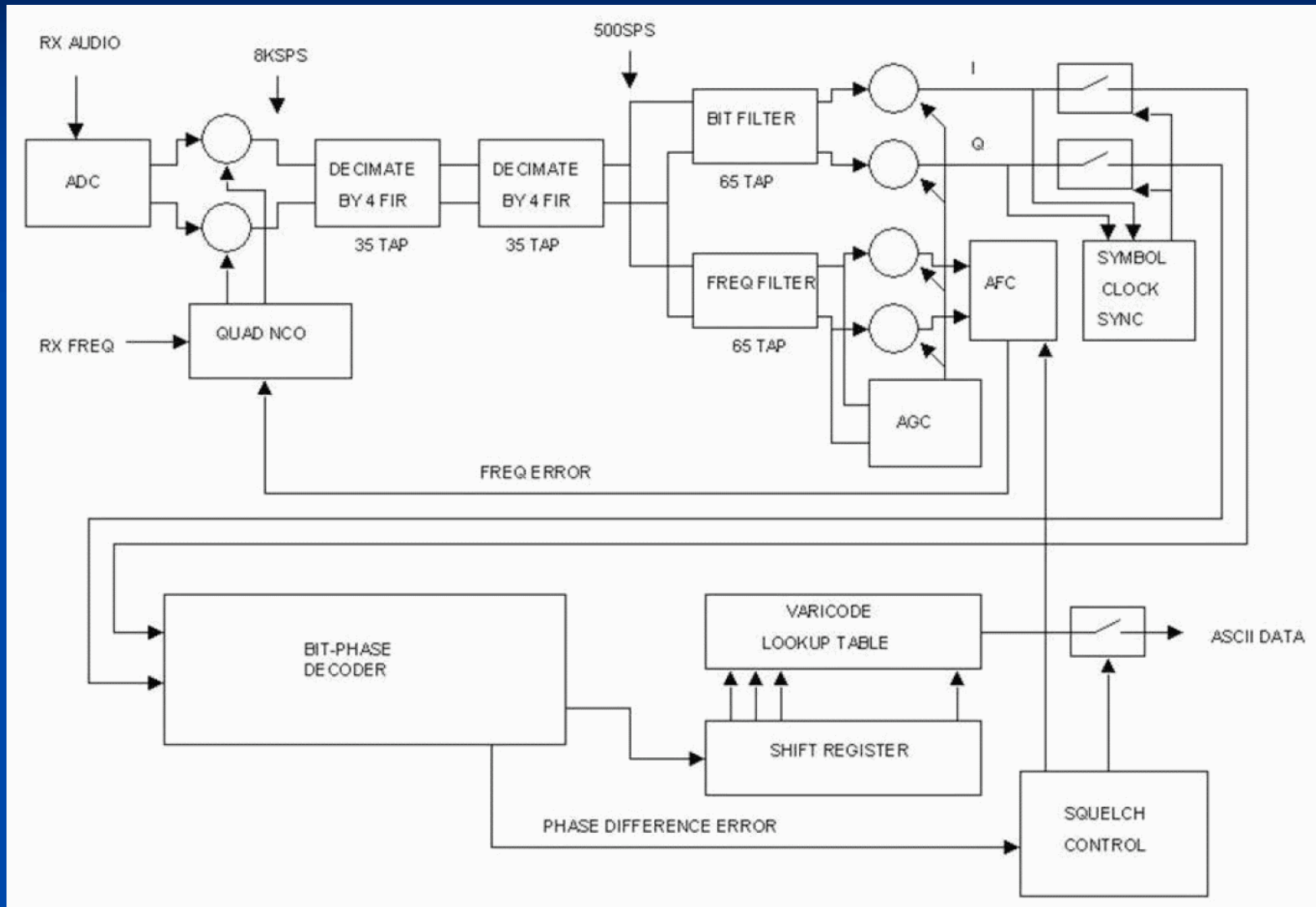
PSK Modulation

Sending a ZERO

Sending a ONE

PSK Demodulation

- Need to Lock onto Phase Information
  - Align Bit Timing
  - Recover Clock
  - Recover Data
- Need to Lock onto Frequency
  - "Zero beat" with Other Station
- Send Clocked Bitstream to Varicode Decoder
  - Decoded Characters to Display

PSK Demodulation

Early PSK31 Work

- G3PLX built on PSK work on the DSP56001
  - SLOWPSK by SP9VRC
- First Implementations with DSP Eval Boards
  - EVK56001
  - TI TMS320C5x
- DOS User Interface Programs
- Became Popular with Soundcard Freeware
  - Requires Modern Computer

Traditional PSK31 Operation

Traditional PSK31 Operation

- SSB Transceiver
- Computer with Soundcard
  - In General, not a '386SX Running DOS 3.3
- Computer / Radio Interface
  - Isolated Audio
  - May Contain Soundcard Function
    - SignaLink USB
    - US Interface Navigator
    - RigExpert Standard and Plus

Traditional PSK31 Operation

- OK for Home Stations
  - Power
  - Physical Space
  - Lighting
- Difficult for Portable Operation
  - Laptop Screen in Direct Sunlight
  - Lots of Cables and "Stuff"
  - Power?
  - No Room for Lunch on the Picnic Table…

Demo of Traditional PSK31

- QRX…

NUE-PSK31 Modem

NUE-PSK31 Modem

- Details in March 2008 QST and QEX
- Portable Operation
  - Low Power, Sunlight Readable Display
- Low Cost
  - ~$200 Ready-to-Operate or ~$150 Kit
  - Open Source Hardware and Software for DIY
- Produced by AmQRP
  - George Heron, N2APB and Milt Cram, W8NUE
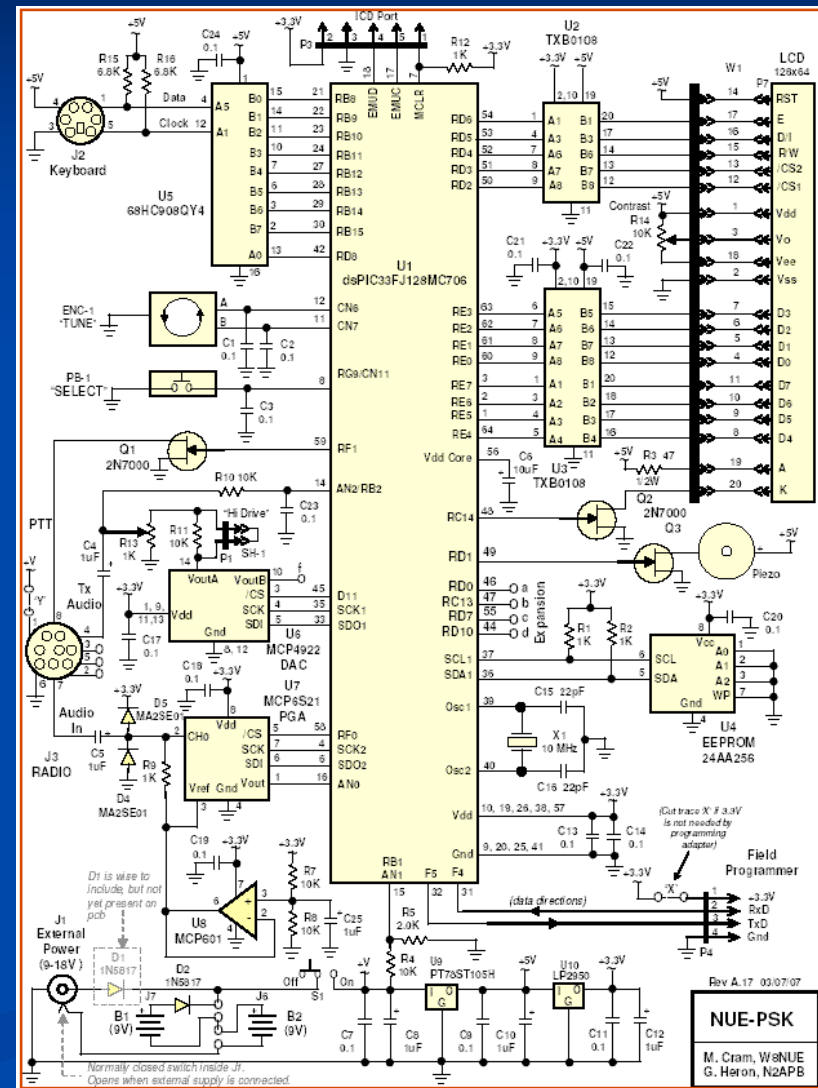
NUE-PSK31 Modem

- Eliminate PC for Portable Operation

- Straightforward User Interface

- Low Power Enables Field Use

  - Internal Batteries

- New Technology

  - dsPIC = Microcontroller + DSP

- Cheap Tools

  - Free Counts as Cheap!

NUE-PSK31 Modem

- Software Based on AE4JY PSK Core
  - Ported from PC
  - Well Documented
  - Open Source
- DSP Functions from Microchip Library
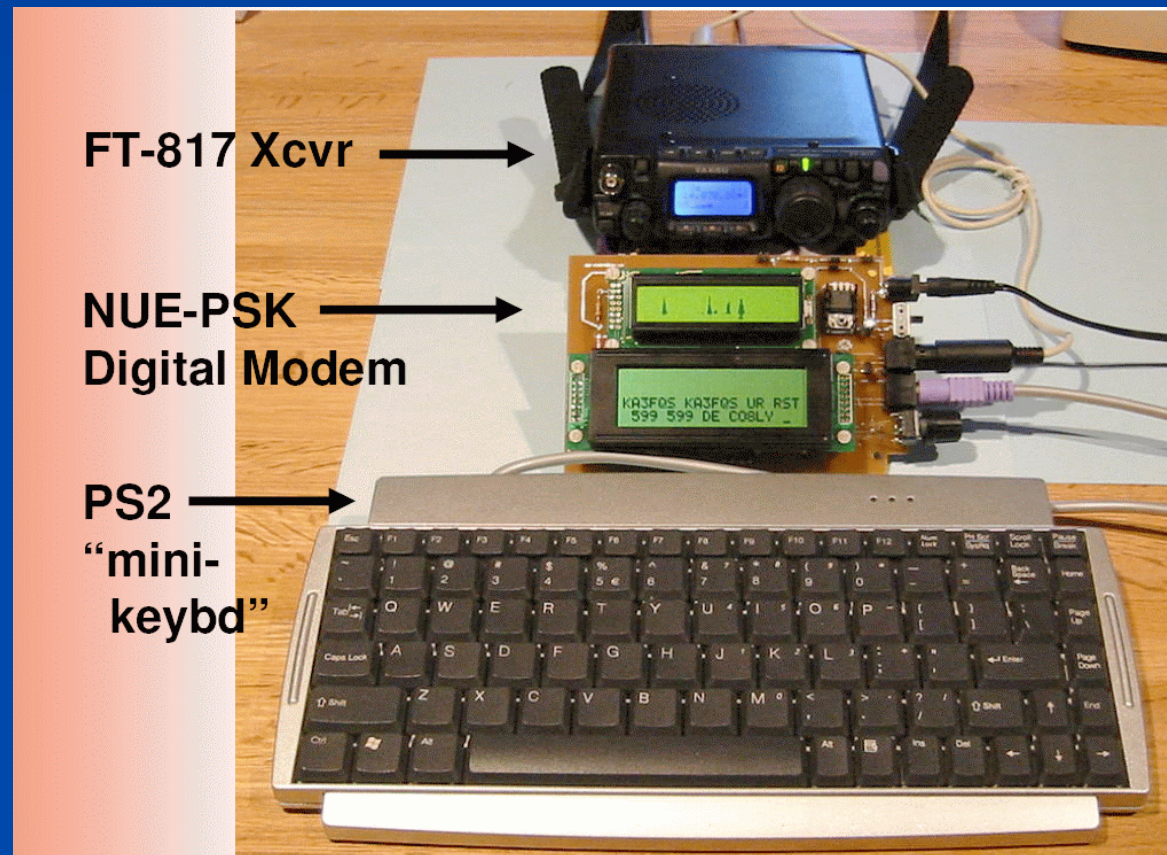- Modules from Austin QRP Project
- Required Writing Graphics Driver

NUE-PSK31 Modem

- Simple Hardware
- Can Be Adopted to
  - RTTY
  - PSK63
  - Other Digital Modes
- Improvements?
  - Isolate Radio AF
  - Isolate Radio PTT

NUE-PSK31 Station

- Prototype System

FT-817 Xcvr

NUE-PSK
Digital Modem

PS2
"mini-
keybd"

Demo of NUE-PSK31

- QRX…

Elecraft K3: PSK in a Box

- Complete Digital Station!
- Just Add an Operator!

- OK, OK
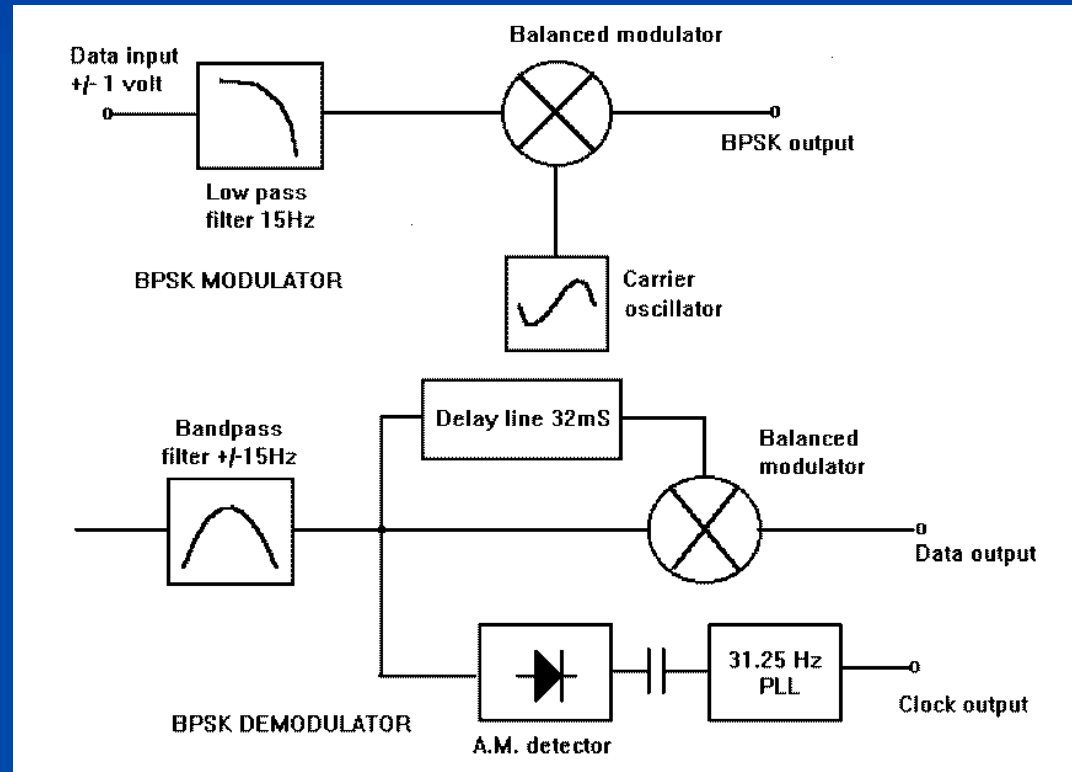 - Antenna
  - 12VDC Power, too!

Elecraft K3: PSK in a Box

- During K3 Development, Wayne and I Wanted a "Fun" Mode
- My IC746PRO has an Internal RTTY Decoder
  - Fun, but Rx Only
  - More PSK Activity than RTTY
- Wanted PSK and RTTY
  - Also Wanted Tx!
  - Minimalist, but Practical

Elecraft K3: PSK in a Box

- Good Performance Does Not Require Complex Algorithms or Structures

- From G3PLX ->

Elecraft K3: PSK in a Box

- Seven Character Alphanumeric VFOB Display
  - Surprisingly Effective
  - Retain Context
- What About a Keyboard?

Elecraft K3: PSK in a Box

- Seven Character Alphanumeric VFOB Display
  - Surprisingly Effective
  - Retain Context
- What About a Keyboard?
  - Don't Need No Stinkin' Keyboard!
  - We Are, After All, Hams!
- Universal Input Device ->

Elecraft K3: PSK in a Box

- Suitable for Casual Digital Operation
    - In the Field
    - CW, RTTY, PSK31 Now
    - PSK63, Others Real Soon Now!
    - Just Plain Fun!
- Several Reports of "Never Operated Digital Modes Before, But Had to Try It!"

Demo of K3 PSK31

- QRX…

PSK31 Without a PC

- PSK and Other Digital Modes Can Be Operated Without a PC
- Dedicated, Purpose-Built Hardware
  - NUE-PSK Modem
- Radios with Built-In Digital Modems
  - Elecraft K3

References

- PSK31
  - http://aintel.bi.ehu.es/psk31.html
  - http://www.psk31.com/
- NUE-PSK Modem
  - http://www.nue-psk.com/
- K3
  - http://www.elecraft.com/news.htm

PSK31 Without a PC

THANK YOU!

Questions?

MicroHAMS Digital Conference 2008