

HF Digital Keyboard Modes

by

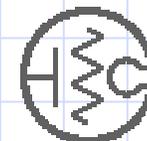
Mikel Lechner, KN6QI

Foothills Amateur Radio Society

April 27, 2007

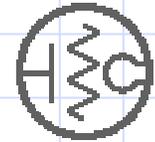
Mikel Lechner, KN6QI
Foothills Amateur Radio Society

What is it?



- ◆ Utilizes DSP Technology
- ◆ Uses High Speed PC's or DSP Chips
- ◆ Implemented in S/W
 - Reduces Cost
 - Easy to Update
 - Most S/W is FreeWare (unlike other modes)
- ◆ Simple Inexpensive Interface (no TNC needed)
- ◆ Performance Similar to CW, but Easier

Summary

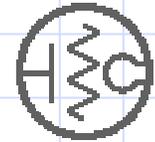


- ◆ Theory
- ◆ Modes
- ◆ Equipment
- ◆ Software
- ◆ Operating
- ◆ References
- ◆ Conclusions

April 27, 2007

Mikel Lechner, KN6QI
Foothills Amateur Radio Society

Theory

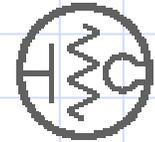


- ◆ Digitize Audio
- ◆ Use Digital Filters to Encode/Decode
- ◆ Use Efficient Coding Schemes
- ◆ PSK/FSK are Fade Tolerant
- ◆ Soft Keying for Narrow Bandwidth

April 27, 2007

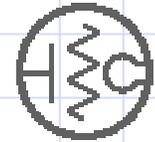
Mikel Lechner, KN6QI
Foothills Amateur Radio Society

Modes



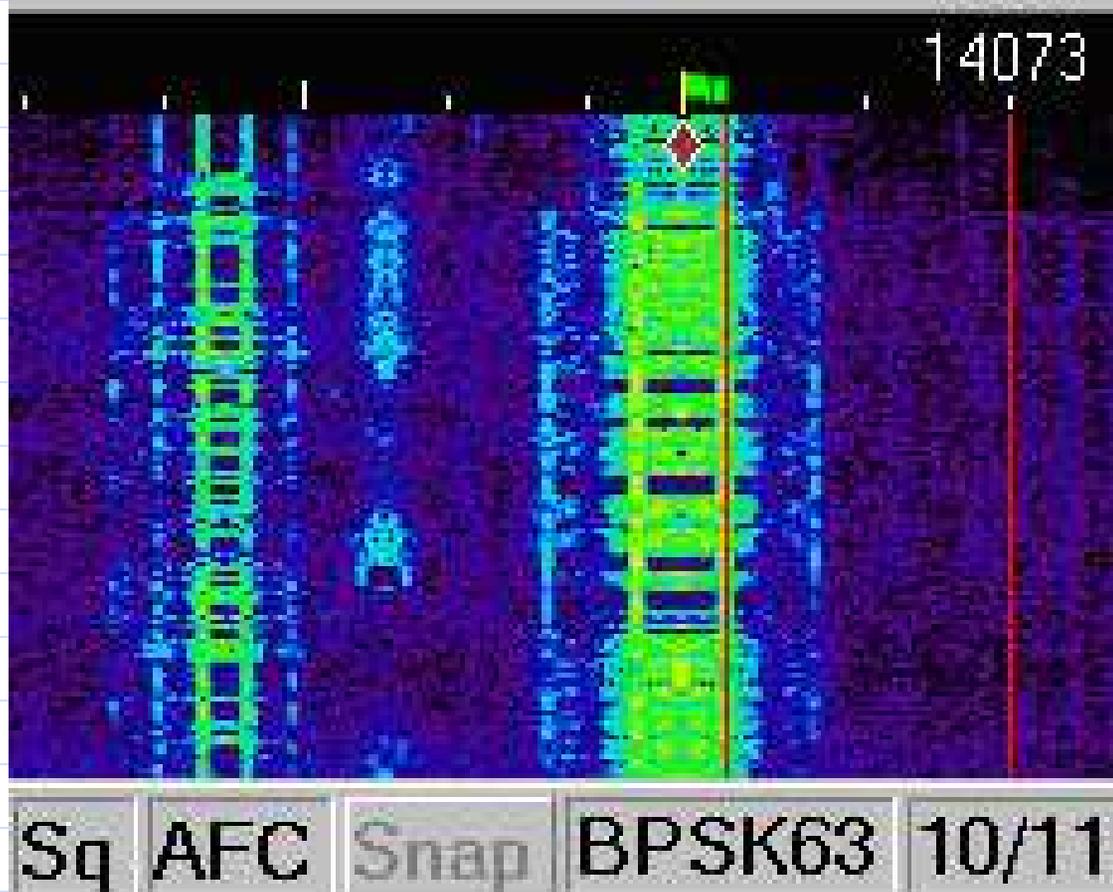
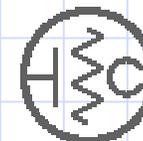
- ◆ PSK 31 – Two Phases, 31Hz
- ◆ QPSK 31 – Four Phases, 31Hz
- ◆ MFSK 16 – Sixteen FSK Channels
- ◆ Variations:
 - PSK 63, PSK 125
 - MFSK 8, MFSK 16

(B)PSK 31



- ◆ (Bi) Phase Shift Keyed (BPSK)
- ◆ Two Phases (180° apart)
- ◆ Transmits at 31.25 Baud (Symbols/Second)
- ◆ Fundamental Data Rate is 31.25 b/s
- ◆ Text is Encoded in Varicode for Speed
- ◆ Narrow Bandwidth (31.25 Hz)
- ◆ First used in 1998 ?

BPSK16 and BPSK63

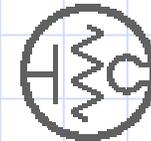


www.mymorninglight.org/ham/psk.htm

April 27, 2007

Mikel Lechner, KN6QI
Foothills Amateur Radio Society

Varicode Examples



◆ All characters start and end with "1"

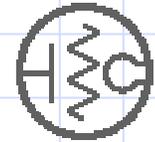
Symbol	Ascii	Varicode	CW
" "	0100000	1	
a	0111101	1011	• -
b	0111110	1011111	- • • •
c	0111111	101111	- • - •
d	1000000	101101	- • •
e	1000001	11	•
t	1010000	101	-

QPSK 31



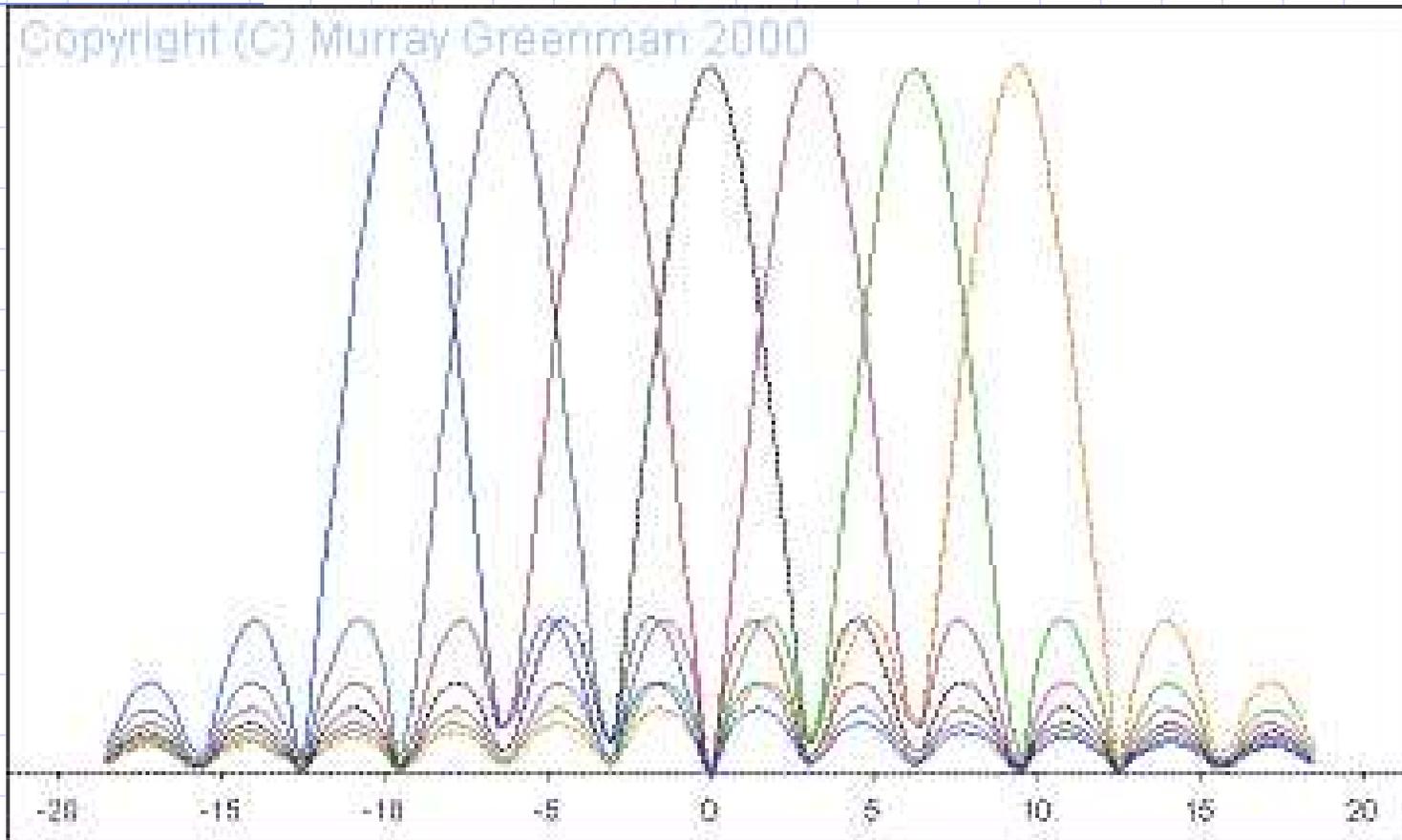
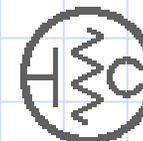
- ◆ Quadrature Phase Shift Keyed
- ◆ Four phases (90° apart)
- ◆ Transmits at 31.25 Baud (Symbols/Second)
- ◆ Fundamental Data Rate is 62.5 b/s (2 bits/symbol)
- ◆ Convolution Encoding for Error Correction
- ◆ Reduced Noise Immunity vs. BPSK31
- ◆ 3dB Weaker than PSK31

MFSK 16



- ◆ Sixteen (16) Carrier Tones @ 15.625 Hz Spacing
- ◆ Compare w/ RTTY (Two Tones (Mark/Space))
- ◆ Data Rate per Channel is 15.625 b/s
- ◆ Total Date Rate is: $C_r \times \log_2(C_n) \times F_r = 31.25 \text{ b/s}$
 - $15.625 \times \log_2(16) \times 1/2 \Rightarrow 16.25 \text{ b/s}$
- ◆ Convolution Coded FEC w/ Bit Interleaving
- ◆ Wider Bandwidth vs. PSK31: $C_n \times C_s = 250 \text{ Hz}$
- ◆ Tuning is Critical (5 Hz)
- ◆ First used in 2000

MFSK Modulation

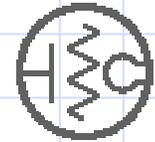


<http://www.qsl.net/z11bpu/MFSK>

April 27, 2007

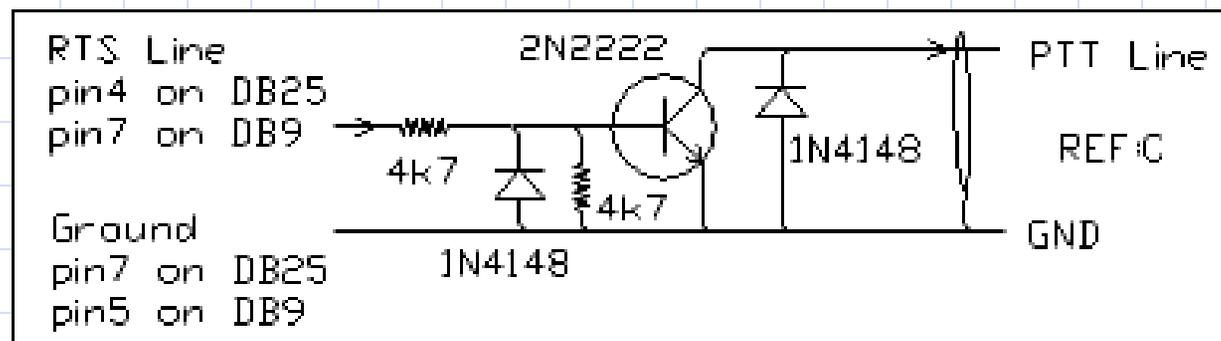
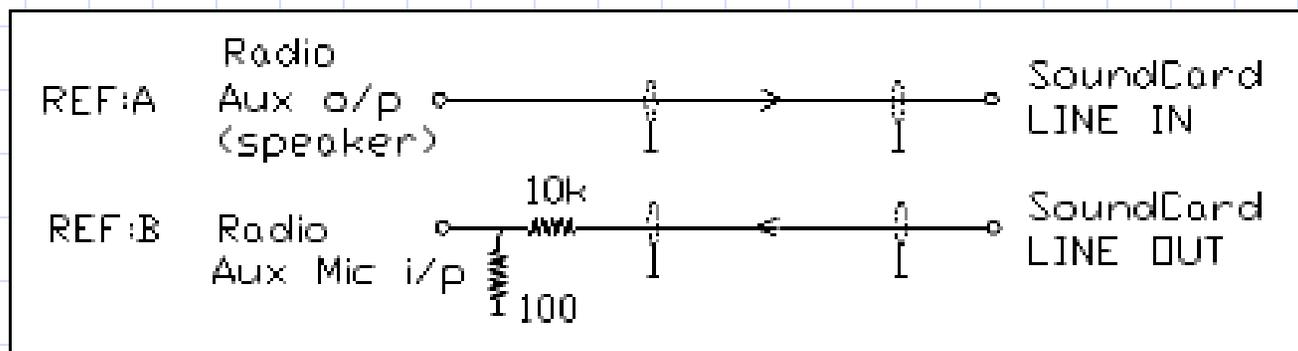
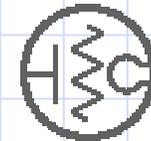
Mikel Lechner, KN6QI
Foothills Amateur Radio Society

Equipment



- ◆ SSB Capable HF Transceiver
- ◆ 100MHz Pentium Computer
- ◆ Interface Cable (make or buy)
- ◆ 16-bit Sound Card
- ◆ 16-bit SVGA

Simple PSK 31 Interface

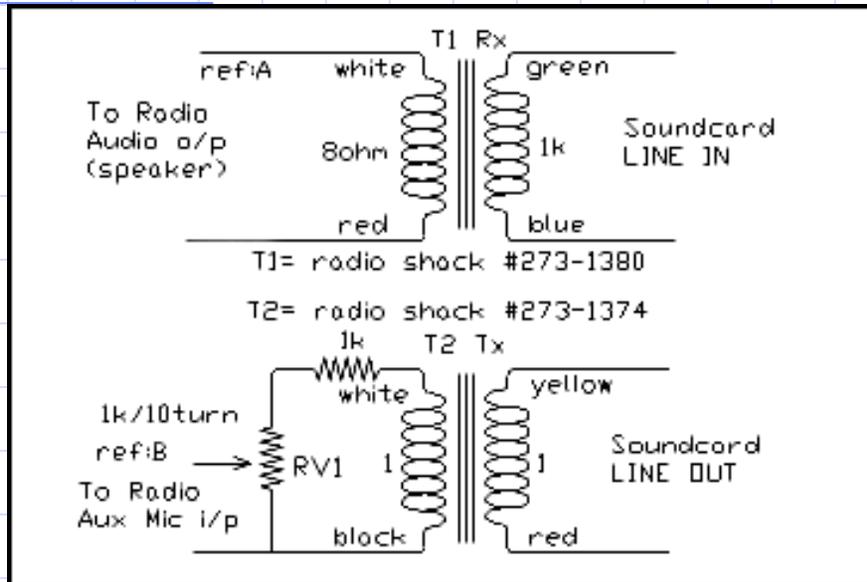
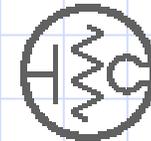


www.w5bbr.com/soundbd.html

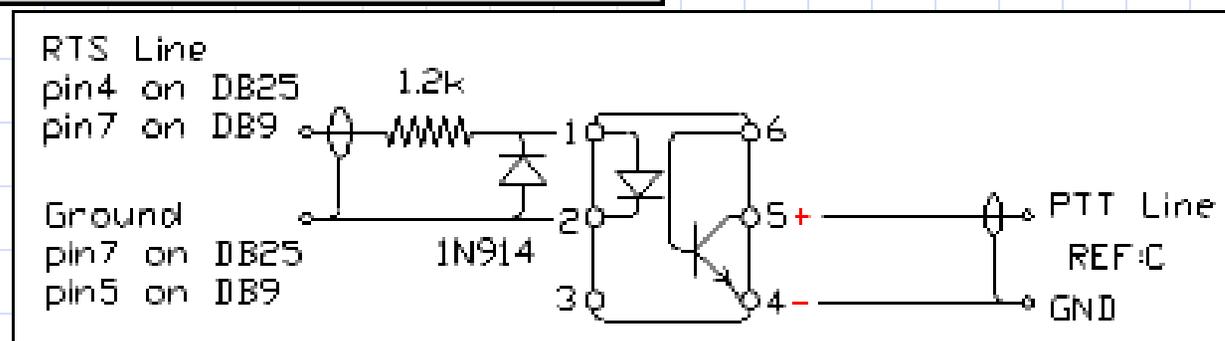
April 27, 2007

Mikel Lechner, KN6QI
Foothills Amateur Radio Society

Better PSK 31 Interface



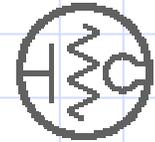
www.w5bbr.com/soundbd.html



April 27, 2007

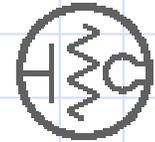
Mikel Lechner, KN6QI
 Foothills Amateur Radio Society

Software



- ◆ HamScope (1.56)
- ◆ Digipan (2.0)
- ◆ Stream (1.2)
- ◆ PSK31SBW (?)
- ◆ WinPSK (2.13)
- ◆ gMFSK (for Linux, etc.)
- ◆ KPSK (Linux, etc.)
- ◆ Much more...

HamScope 1.56

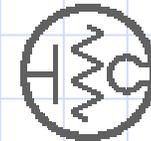


- ◆ Supports BPSK, QPSK, MFSK, and RTTY
- ◆ Spectrum & Standard Waterfall Displays
- ◆ Phase Meter (for tuning & quality)
- ◆ Integrates w/ MMTTY for RTTY

April 27, 2007

Mikel Lechner, KN6QI
Foothills Amateur Radio Society

Hamscope 1.56



The screenshot shows the HamScope software interface. At the top, there is a menu bar with options: File, Edit, View, Settings, Rig Control, Clear Rcv, Clear Xmit, DemoMode, and Help. Below the menu bar is a control panel with various buttons for functions like F1/DENT, F2/BU, F3/NAME, F4/BRAG, F5/CALL3, F7/SK, F8/RES, F9/CQ, F10/CQDX, F11/AFC1, F12/AFC2, CW ID, Tune, Pause, Panel, Home, and a green indicator light.

The main display area is divided into several sections. The top section is a log window with a yellow background, showing the following text:
W6WLB W6WLB W6WLB de KD5HIO KD5HIO KD5HIO kn
W6WLB W6WLB W6WLB de KD5HIO KD5HIO KD5HIO kn
<<TX Ended - Sound Freq 1364 Hz - 08 May 2001 04:17:04 UTC>>

The middle section has a grey background and contains the text:
on 20m PSK.
73 George KF6VSG DE WB0TRA SK Logged off at 8 May 2001 04:i:50z

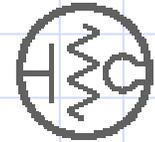
The bottom section has a light blue background and contains the text:
Good evening Bill and tnx fer call...

At the bottom of the interface is a control panel with various settings and a spectrum display. The control panel includes sections for Zoom, Freq (RX: 1362, TX: 727), Mode (BPSK), Display Gain, Receiver (AFC, No, 2AFC, 2Nar), RTTY (Baud: 45.5, Shift: 170), and CW WPM (TX: 15, RX: 15). There are also checkboxes for BPF, NOT, Net, 100Hz, Spectrum, Watertail, Input, Data Sync, Options, HAM Det, Dual Receive, and Reverse Polarity. The spectrum display shows a signal peak at approximately 1362 Hz. The status bar at the bottom indicates: Receiving, CPU = 32%, Clk ppm = 0, 8 May 2001, 4:20:22 UTC.

April 27, 2007

Mikel Lechner, KN6QI
Foothills Amateur Radio Society

Digipan 2.0

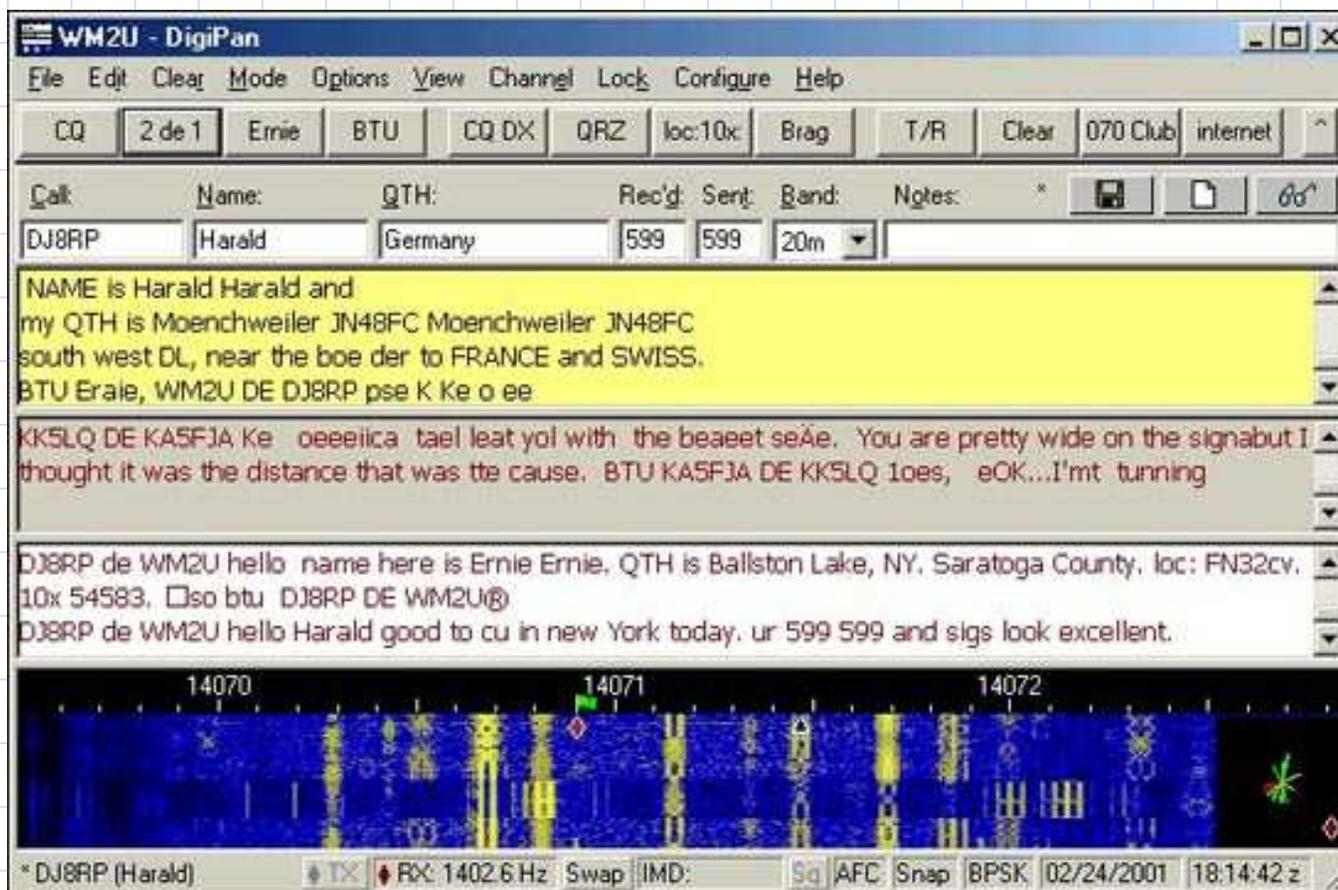
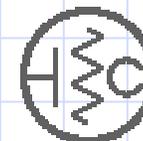


- ◆ Supports BPSK & QPSK
- ◆ Supports Dual Receive Channels
- ◆ Full Spectrum Display (find signals)
- ◆ Phase Meter (for tuning & quality)

April 27, 2007

Mikel Lechner, KN6QI
Foothills Amateur Radio Society

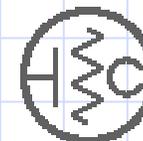
Digipan 2.0



April 27, 2007

Mikel Lechner, KN6QI
Foothills Amateur Radio Society

WinPSK 2.1.3



WinPsk 2.13 -- AE4JY

File Edit View Wave File Setup Settings Clear Rcv Clear Xmit TX Tune Send File Help

ro t so ea 4" doweling and w3d 4 tv.s around it fro, D 1/P te wave ends that hang straiGH down. I was lucky when I thd it the swr is 1

PX Freq 1983

AFC

TxOffset -20

Net

PSK63

BPSK

QPSK (usb)

Spectrum Waterfall Input Data Sync

Auto Text Select

Their Call

Their Name

Text Grab

Clear QSO Info

Rx F12

(Rt-Click on Macros to Edit)

F1=QSO Start	F6=Undefined
F2=QSO BTU	F7=Undefined
F3=QSO Final	F8=Undefined
F4=CQ	F9=Undefined
F5=Brag File	F10=Undefined

<<< Home F11 >>>

Macro Set = 1

IMD > 24 Clk ppm=-3600 Wave Files Off 24 May 2003 1:23:58 UTC

April 27, 2007

Mikel Lechner, KN6QI
Foothills Amateur Radio Society

Operating



- ◆ Use USB
- ◆ Can use SSB or CW Filters for Contesting
- ◆ For PSK, lower case is FASTER (varicode)
- ◆ Adjust Audio Levels
 - Avoid Hum and Noise
 - Don't Overdrive
 - Use PROC as an XMIT ALC
- ◆ Use Software for Fine Tuning

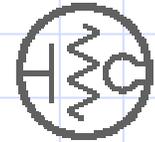
References



◆ Web Sites

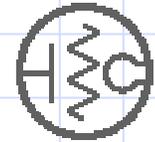
- www.fars.k6ya.org/docs/digital (Links)
- aintel.bi.ehu.es/psk31.html (official site)
- www.psk31.com (general information)
- www.w5bbr.com/soundbd.html (interfaces)
- www.qsl.net/wm2u/psk31.html (general)
- www.mymorninglight.org/ham/psk.htm (Elmer)
- www.qsl.net/zl1bpu/MFSK (MFSK article)

HF Frequencies



- ◆ 160 m @ 1838 KHz
- ◆ 80 m @ 3.580 MHz
- ◆ 40 m @ 7.070 MHz (region 1 7.035 MHz)
- ◆ 30 m @ 10.142 MHz
- ◆ 20 m @ 14.070 MHz
- ◆ 17 m @ 18.100 MHz
- ◆ 15 m @ 21.070 MHz (official 21.080)
- ◆ 18 m @ 24.920 MHz
- ◆ 10 m @ 28.120 MHz

VHF Frequencies

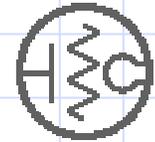


- ◆ 6 m @ 50.290 MHz
- ◆ 2 m @ 144.144 MHz
- ◆ 1.25 m @ 222.07 MHz
- ◆ 70 cm @ 432.2 MHz
- ◆ 33 cm @ 909 MHz

April 27, 2007

Mikel Lechner, KN6QI
Foothills Amateur Radio Society

Conclusions



- ◆ New Modes Bring Vitality to the Hobby
- ◆ Easy and Inexpensive to get Started
- ◆ Encourages Experimentation

April 27, 2007

Mikel Lechner, KN6QI
Foothills Amateur Radio Society