The Return of Hands-On Ham Radio

Wayne Burdick – N6KR
Eric Swartz - WA6HHQ
Who Are We?

- **Both hams since 1971** (WN6HQH, WN6HHQ)

- **Wayne Burdick:**
  - QRP rig design (NC40, sierra, SST…)
  - B.S. Cognitive Science, Univ. of CA, San Diego
  - Silicon valley guy (HW/FW/UI – Interval Corp.)

- **Eric Swartz**
  - Instrumentation, HW/SW design & management
  - B.S. Engineering & Applied Science, Yale Univ.
  - Silicon valley guy (startup addict: Mountain, Verisys..)
Elecraft Started 1998

Goal: Reintroduce high performance kits to the Amateur Radio market. (Following in the footsteps of Heathkit.)

Headquarters: Aptos, CA

Virtual Staff: Silicon Valley, Phoenix AZ, OR & WA

First K2s Ship: January 1999

Full Production: June 1999

Almost 5,000 K2s, 2100 K1s, 1200 KX1s Shipped

Thousands of other kits and accessories shipped
"I built this 16-bit computer and saved money. Learned a lot, too!"

The HEATHKIT AJ-1600 is a 16-bit computer designed to be built by the user. It is a complete system that includes a CPU, memory, and input/output devices. The AJ-1600 is based on the Z80 microprocessor and uses a 16-bit data bus. It has 16K of RAM and supports 8-bit and 16-bit modes.

The AJ-1600 comes with a 4K ROM card that contains the operating system and a variety of software applications. The operating system is a file manager, a text editor, and a simple programming language.

The AJ-1600 is targeted at hobbyists and educators who want to build their own computer. It is a cost-effective way to get started in the world of computer hardware and software development.

The AJ-1600 comes with a detailed manual that provides step-by-step instructions for building the computer. The manual also includes troubleshooting tips and a reference manual for the operating system.

The AJ-1600 is available at most electronics stores and online retailers.
Field Day 1999
Safari-4,
1990

4 bands, 1W
Ant. tuner
0.8 Ah batt.
3 lbs.
105 in.$^3$
Safari-4 interior

4 transverters

12 (!) RG174 cables
Early Designs  *(Before Elecraft)*

NorCal 40

Sierra

SST
Elecraft K2

High Performance
Portability
10/100W

Stealth Amateur
Radio, cover
K2 Side View (1997 Concept)

- FRONT PANEL
- IF
- RF
- AMP/ATU
- 12V, 3AH
- MOTHER BOARD
- EXTENDER BOARD
K2 Prototype Demo - 1998
The K2/100 CW/SSB HF Transceiver
Fundamental RX Goals

- **Sensitivity** (MDS, -135 dBm or Better)
- **Selectivity** (B/W, Shape Factor, Ringing)
- **IMD Dynamic Range** (Intermod)
- **Blocking Dynamic Range** (Desense)
- **Low Audio In Band IMD** (Distortion)
- **Proper application of DSP** (Narrow Cascaded Filters, Noise Reduction, Auto Notch)
K2 Design Areas

- Analog
  - Small signal Rx (Low Noise & Distortion
  - Wide Dynamic Range
  - Crystal Filter Design
  - Phase Lock Loop – Synthesizer

- Digital
  - Microprocessor Control system
  - Multi Processor Aux. Bus
  - KDSP2 DSP Processor (located after crystal filters)
  - Built In Test (Freq. Counter, Volt/Current Metering)
Dynamic Range Versus MDS

Diagram showing dynamic range with key points:
- 122 dB blocking
- 90 dB IMD
- -174 dBm (noise floor or MDS)
- -137 dBm
- -47 dBm (IMD level)
- -15 dBm (blocking level)
- 0 dBm
## IMD Dynamic Range and Blocking Dynamic Range

### 5 kHz Signal Spacing (ARRL Lab Tests)

<table>
<thead>
<tr>
<th>Rig</th>
<th>IMDDR3</th>
<th>BDR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elecraft K2</td>
<td>91</td>
<td>135</td>
</tr>
<tr>
<td>Ten-Tec Orion</td>
<td>92</td>
<td>130</td>
</tr>
<tr>
<td>ICOM IC-7800</td>
<td>89</td>
<td>115</td>
</tr>
<tr>
<td>Ten-Tec Omni 6+</td>
<td>86</td>
<td>119</td>
</tr>
<tr>
<td>ICOM IC-756 Pro</td>
<td>80</td>
<td>104</td>
</tr>
<tr>
<td>ICOM IC-775DSP</td>
<td>77</td>
<td>104</td>
</tr>
<tr>
<td>ICOM IC-706 MkII G</td>
<td>74</td>
<td>86</td>
</tr>
<tr>
<td>Kenwood TS-570D</td>
<td>72</td>
<td>87</td>
</tr>
<tr>
<td>ICOM IC-756</td>
<td>67</td>
<td>98</td>
</tr>
</tbody>
</table>
Elecraft K1  
4 bands, 5 W, MCU, LCD  
ATU, 2 Ah battery  
2.2 lbs, 65 in.$^3$
K1 Internals
K1 Internals
KX1 Transceiver
(Hands Optional)
Day-hike station

1.7 lbs
KX1 Internals
KX1 interior

ATU (top) and main PCB
Close call . . .
KXPD1 Paddle
KXPD1 R&D
BNC to dual banana adapter
T1 Pocket Sized ATU

[Image of T1 Pocket Sized ATU]

- **Quick Reference**
  - **Tune/WR**: Hold TUNE; TX within 3 sec.
  - **Power**: Tap PWR; TX within 3 sec.
  - **Bypass**: Tap PWR; then BYP. Status indicated by green (IN) or yellow (OUT).
  - **Info (In CW)**: Tap PWR; hold INFO.
  - **Low Battery**: Red LED flashes briefly.

**ELECRAFT T1**
- **Automatic Antenna Tuner**
- **HF - 6 m**
- **20 W max.**

[Image of T1 Pocket Sized ATU's battery and internal components]
XV Transverters for 50, 144 and 222 MHz
XG1, N-Gen, BL1, DL1

Mini-Modules