



# High Performance Software Defined Radio

Alex LP/HP Filter Board Testing  
September 2011

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**2011 TAPR/ARRL  
Digital Communications Conference**





# Alexiaries RF Bandpass Filters

- ❑ Alpha 1 boards funded by developers, August 2007
- ❑ Alpha 2 boards funded by T APR, January 2008
- ❑ Alpha 3 board funded by T APR, March 2008
- ❑ All pre-production testing complete, March 2011
- ❑ PCBs fabricated and delivered April 2011
- ❑ Cables, enclosure and custom panels done, May 2011
- ❑ Production run complete, July 2011
- ❑ Testing complete, September 2011

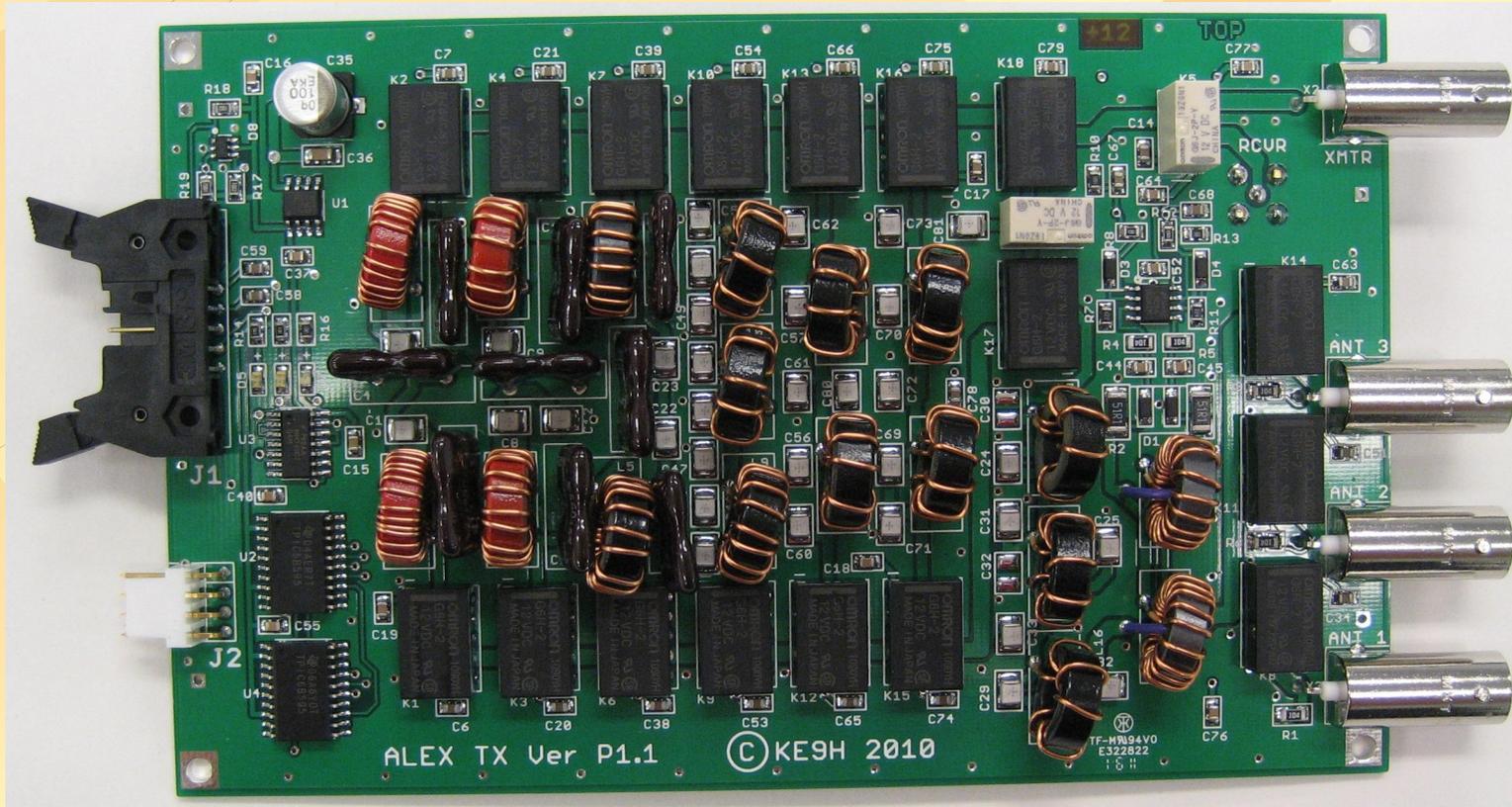
## Status:

Fully assembled/tested and bare PCBs,  
enclosure, cables, silk screened end panels  
available from TAPR now





# Alexiares RF Bandpass Filters



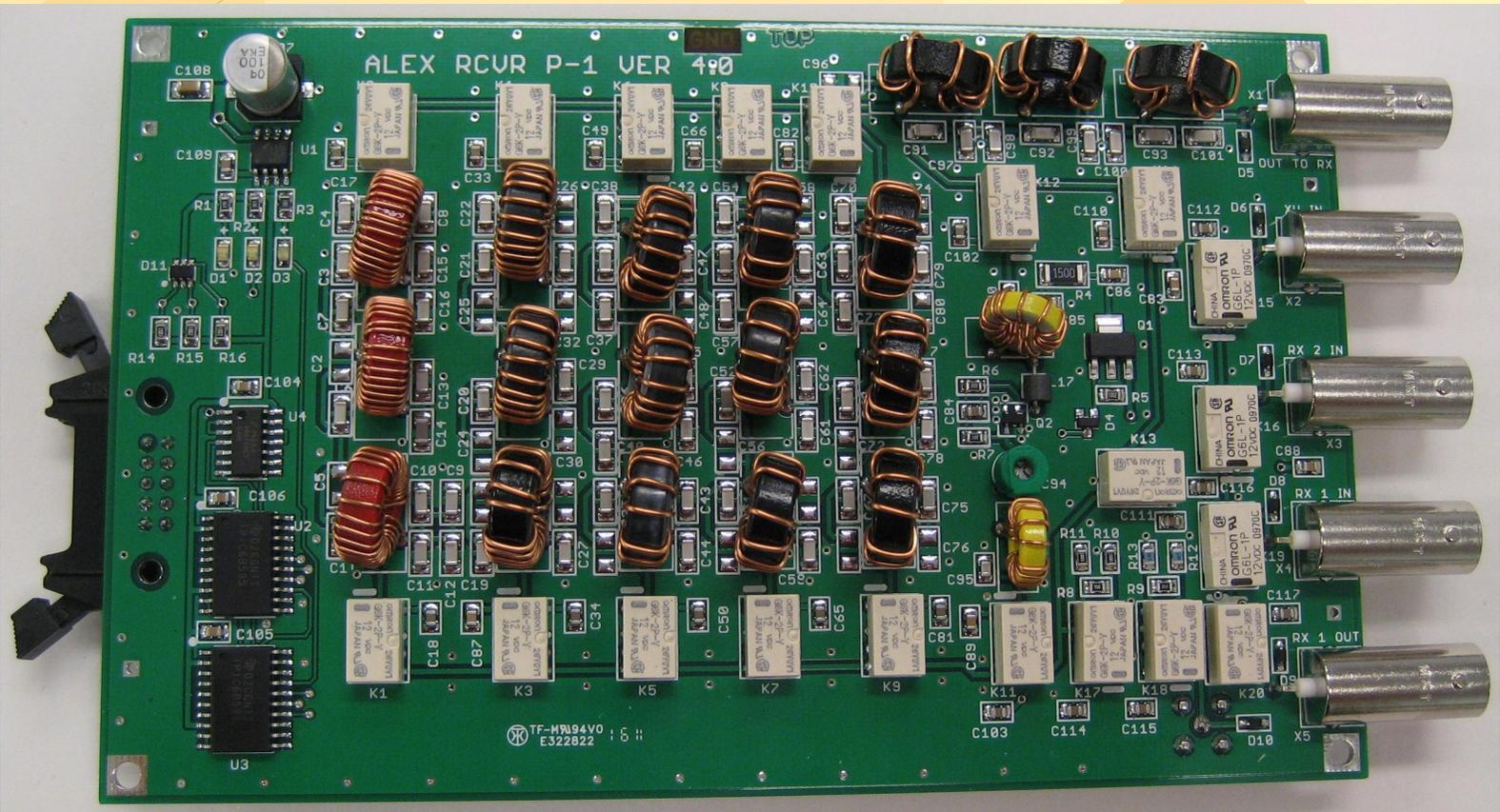
## Alex TX-LPF Board



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# Alexiares RF Bandpass Filters



## Alex RX-HPF Board

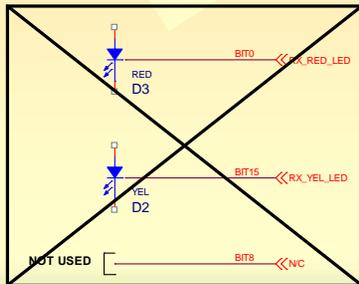
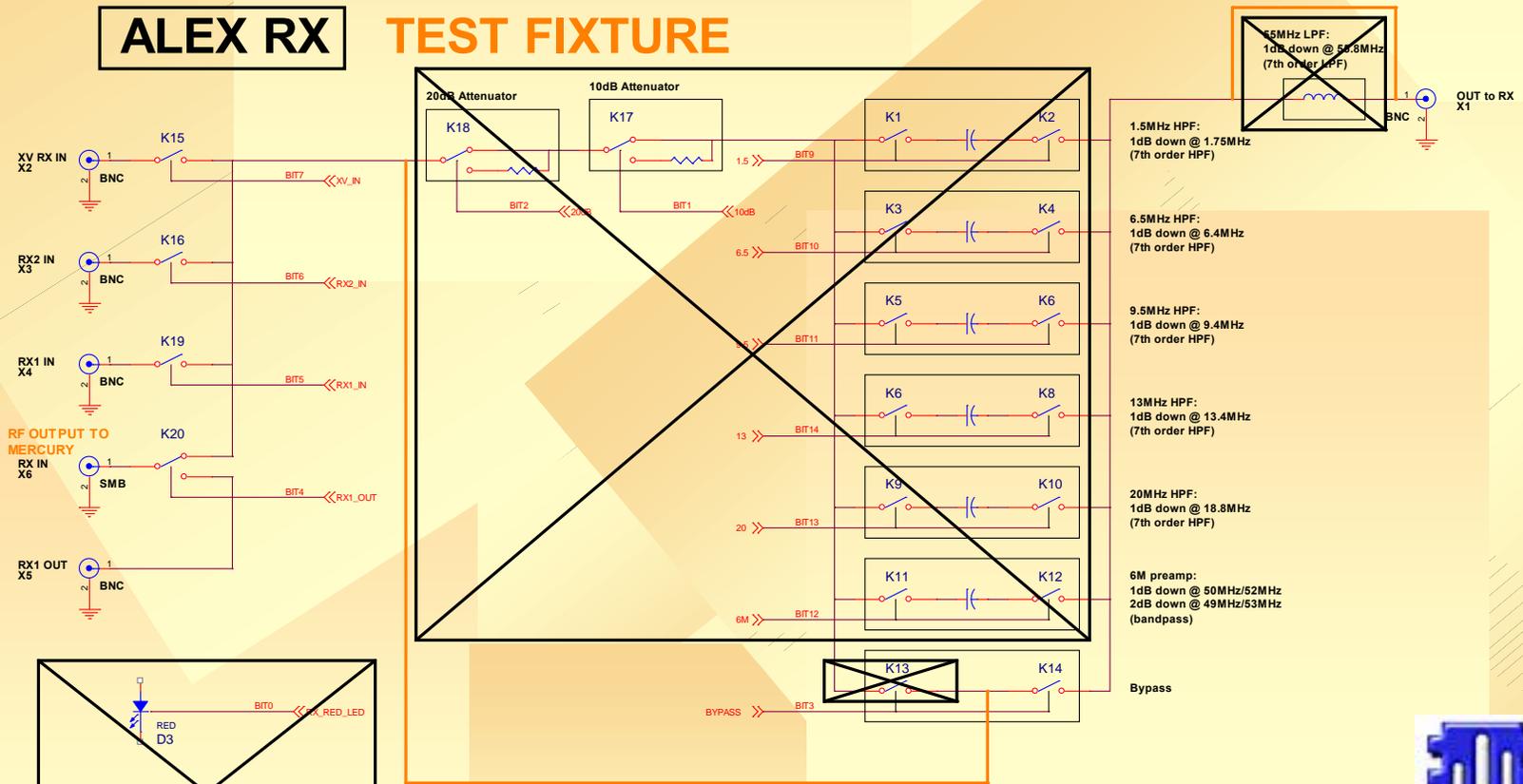




# Alexiaries RF Bandpass Filters

## Alex RX Testing – Test Fixture

### ALEX RX TEST FIXTURE



BIT0 is LSB (first serial data bit)  
 BIT15 is MSB (last serial data bit)  
 Bits are all active HIGH to engage relay or light LED

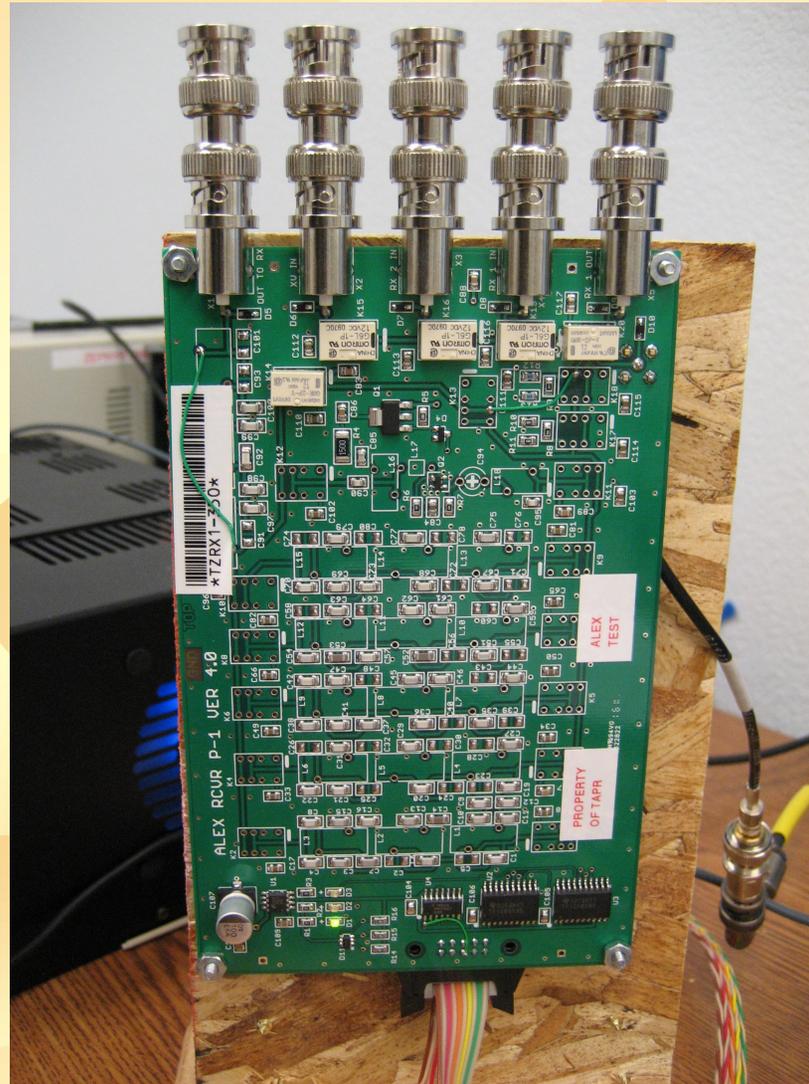




# Alexiaries RF Bandpass Filters

Alex RX  
Testing

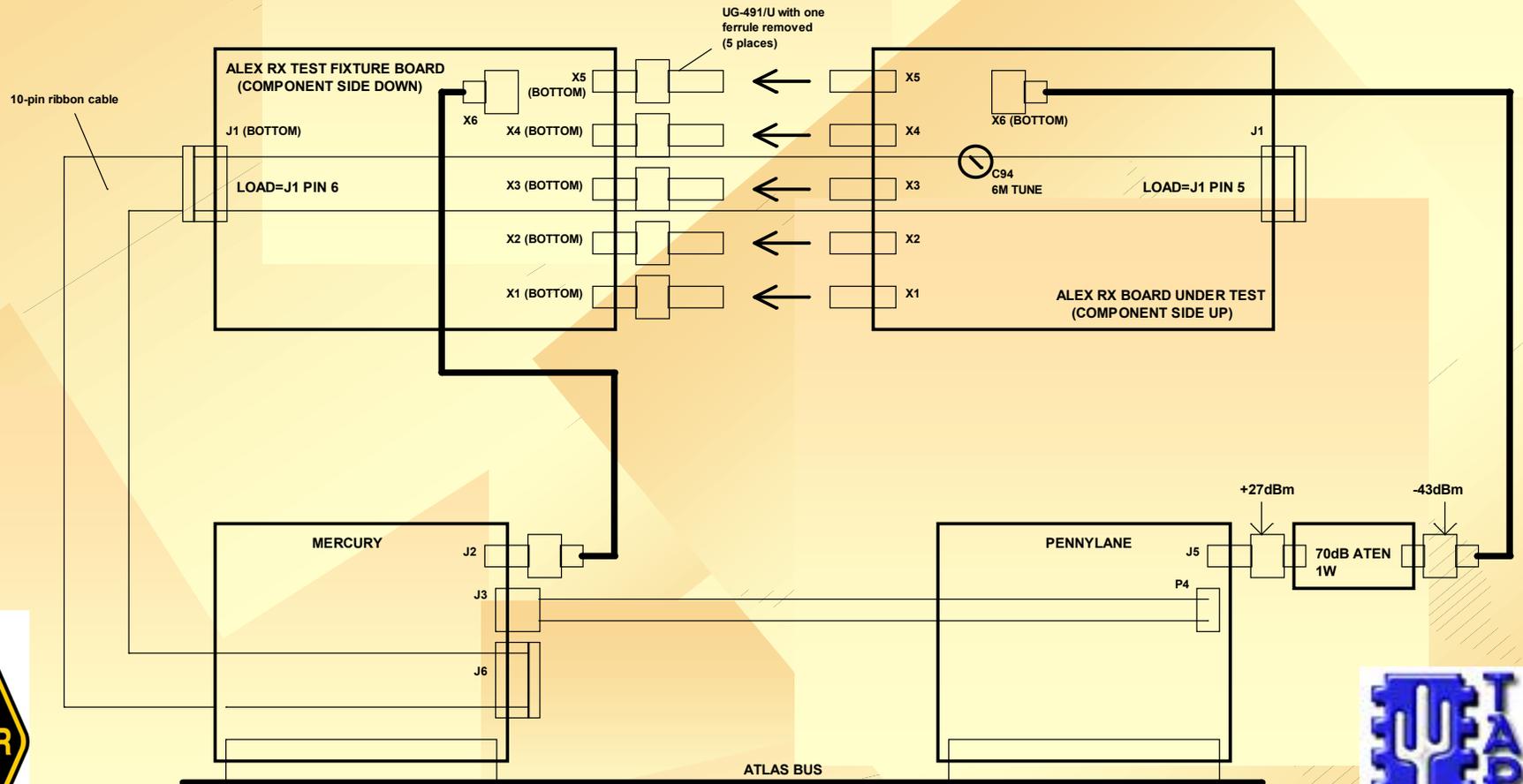
Test Fixture





# Alexiaries RF Bandpass Filters

## Alex RX Testing – Test Setup



NOTE: MAGISTER AND PC CONNECTION NOT SHOWN

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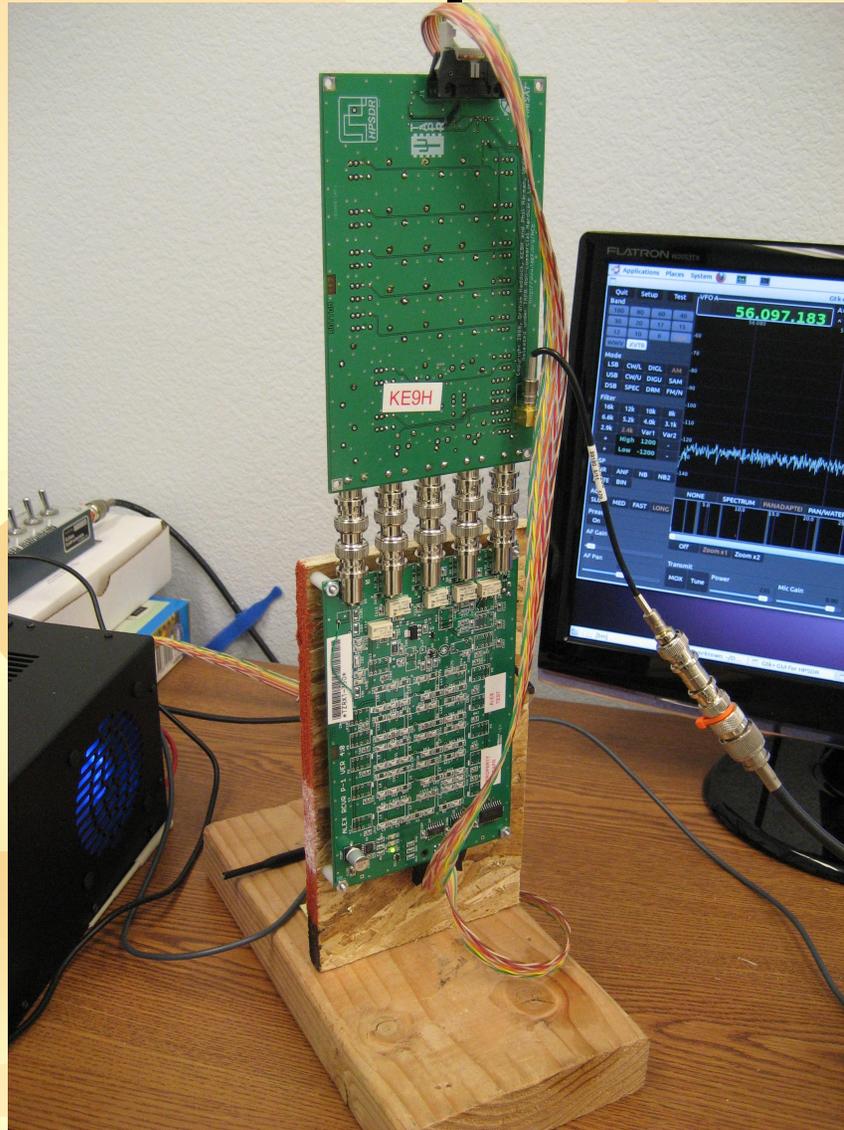




# Alexiaries RF Bandpass Filters

## Alex RX Testing

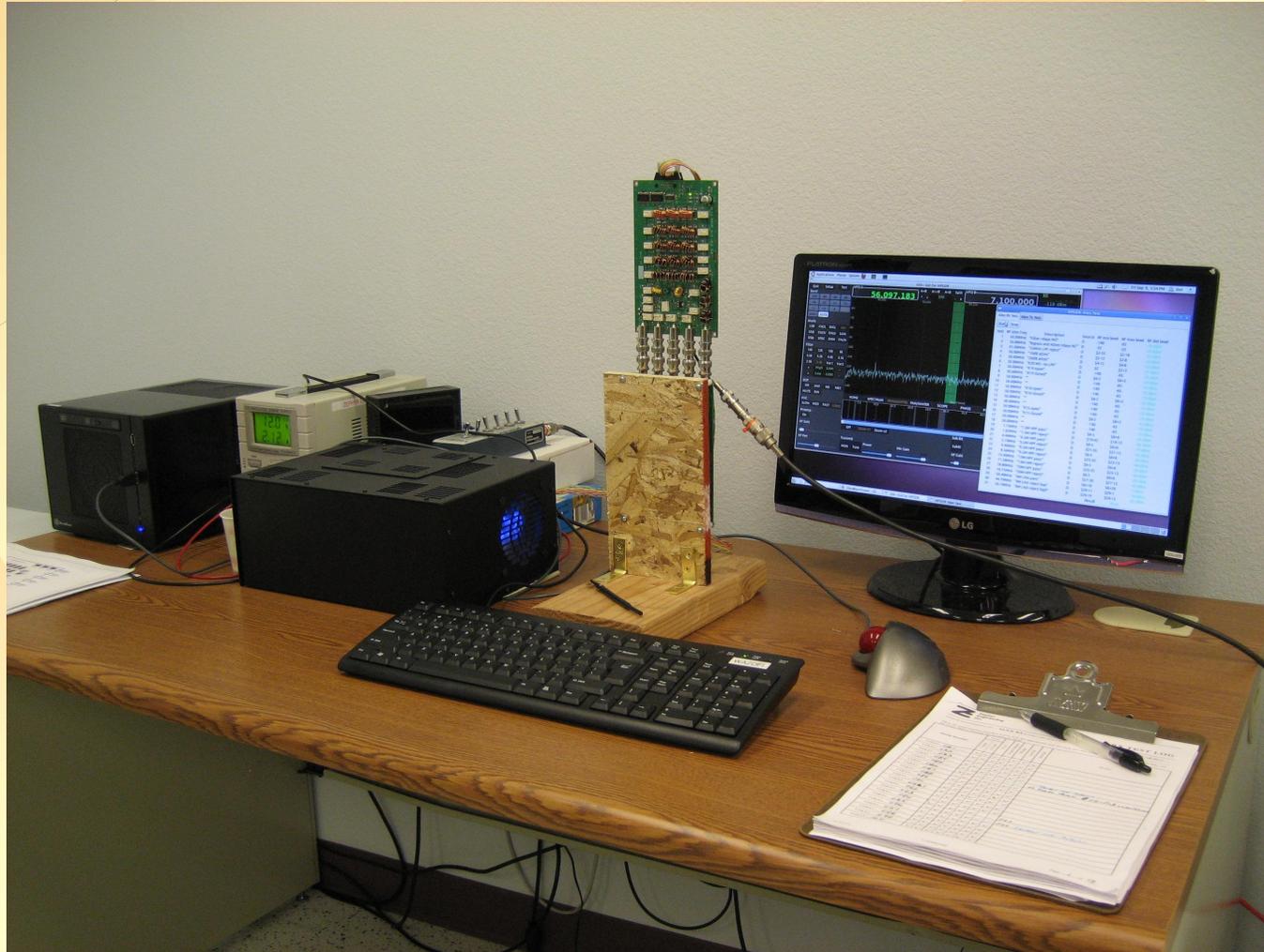
## Test Setup





# Alexiaries RF Bandpass Filters

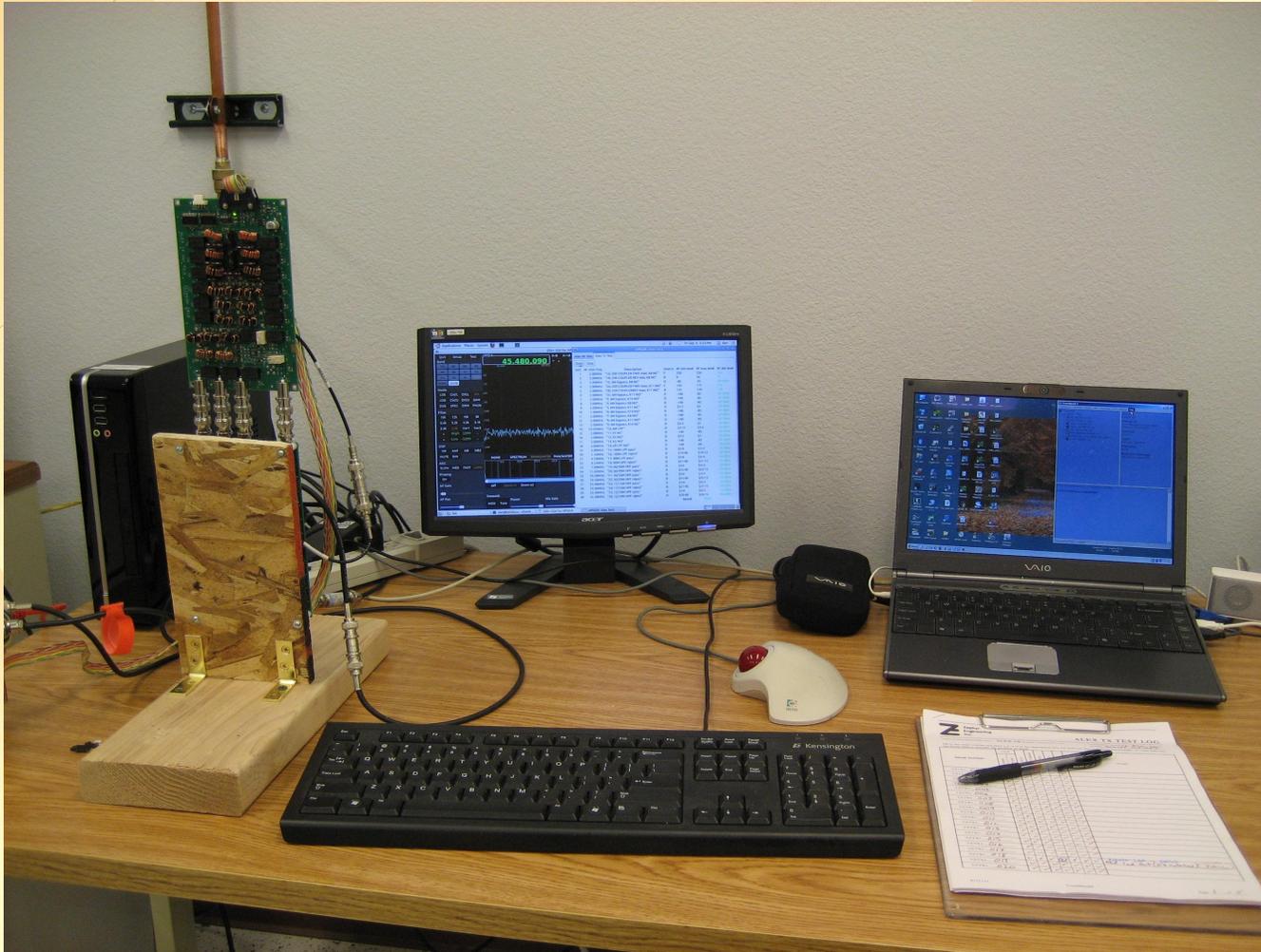
## Alex RX Testing - Test Station





# Alexiaries RF Bandpass Filters

## Alex TX Testing - Test Station





# Alexiaries RF Bandpass Filters

## Alex RX Testing – Filter Selection

### Problem:

Alex uses a single SPI interface for both RX and TX boards

One select pin for Alex-RX and a different one for Alex-TX

Since the test fixture is made from the same board as the board under test, both boards use the same select pin!





# Alexiaries RF Bandpass Filters

## Alex RX Testing – Filter Selection

### Solution:

Cut-and-jump the test fixture board to use the opposite select line.

Alex-RX test fixture now uses TX select pin

Alex-TX test fixture now uses RX select pin

This allows use of a standard control cable





# Alexiaries RF Bandpass Filters

## Alex RX Testing – Filter Selection

### Problem:

Mercury selects filters based on frequency.

- But -

For some tests, we want to select the wrong filter *on purpose* to test the filter's stop-band response

We also need to activate relays on the test fixture board which is masquerading as an opposite-type board

Other relays (such as the T/R relay) are directly operated by the PC software





# Alexiaries RF Bandpass Filters

## Alex RX Testing – Filter Selection

### Solution:

Modify the Mercury FPGA firmware to:

Ignore all direct relay commands

Set all relays based on the bottom 7 bits of the frequency

Beware the decimal to hex conversion!





# Alexiaries RF Bandpass Filters

## Alex RX Testing – Software

### Problem:

There are LOTS of boards to test

Do you really want to manually sweep *each one*?

The answer would be ñ

**NO!**

Repetitive tasks are best done with?

A computer!

We're in luck, since we have one or two of those!





# Alexiaries RF Bandpass Filters

## Alex RX Testing – Software

### Solution:

~~Coerce~~ encourage someone else to write a test program

John Melton G0ORX/N6LYT graciously took on the task,  
and provided us with many revisions and f ixes  
throughout the testing phase.





# Alexiaries RF Bandpass Filters

## Alex RX Testing – Software

### Alextest:

- ❑ Separate tests for RX and TX
- ❑ Allows stepping (for debug)
- ❑ Allows pause (for 6M trimmer adjustment)
- ❑ Test sequence and timing are directed by a text file
- ❑ Color-coded pass/fail results on screen
- ❑ Compiled for Ubuntu 10.10
- ❑ **Fast** execution!





# Alexiaries RF Bandpass Filters

## Alex Testing – Summary

- ❑ Test fixtures built from modified production boards
  - ❑ No custom test fixture required
- ❑ Parallel connect -disconnect using BNC F/F, SMB
  - ❑ Fast setup with minimal cable connections
- ❑ Custom Mercury FPGA image to select filters
  - ❑ Flexible approach simplifies test software design
- ❑ Custom software for fast and repeatable test results
  - ❑ Text config file eliminates compiles to change test parameters





# Alexiaries RF Bandpass Filters

## Alex Testing – Summary

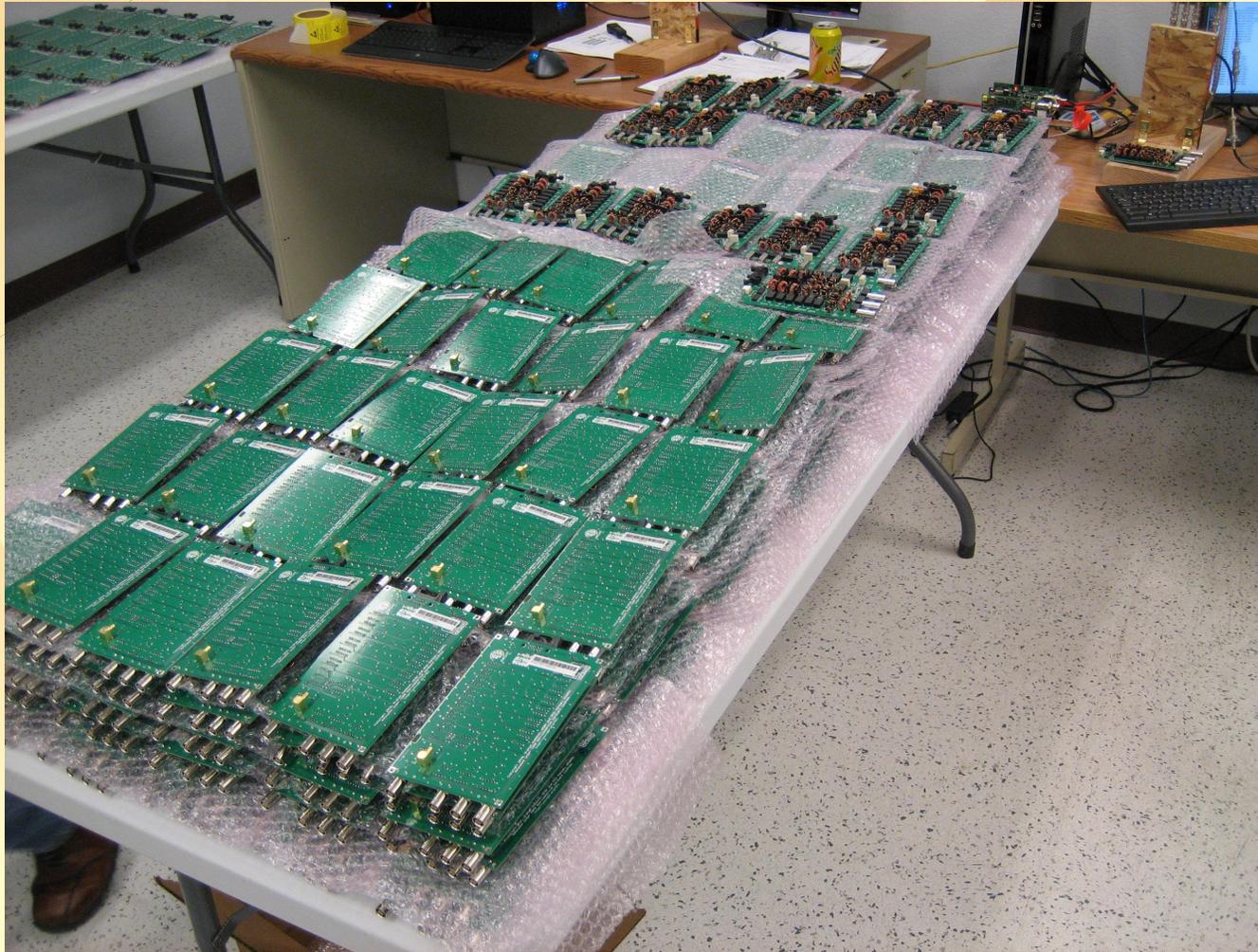
- ❑ Color-coded pass/fail results on screen
  - ❑ Simple, unambiguous results
- ❑ Compiled for Ubuntu 10.10
  - ❑ Supported and readily available PC platform
- ❑ **Fast** execution!
  - ❑ Prevents hair loss (too late!)





# Alexiaries RF Bandpass Filters

## Alex Final Test





# Alexiares RF Bandpass Filters

## Alex Final Test, Action Photo!



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# Alexiares RF Bandpass Filters

## The Moral is?



**Rooster Sez:  
Don't let a simple task get your goat!**





# Thank you!

Alex Designer:

Graham, KE9H

Test Software:

John, G0ORX/N6LYT

Boards available at:

[www.tapr.org](http://www.tapr.org)

