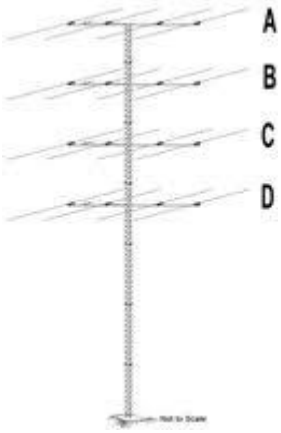
Switching Sack Yagis using HamStack *W1GQ*



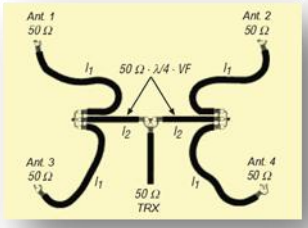
Contesting is all about obtaining the most gain into a particular part of the world to work as many stations per minute as possible. One method to do this is stacking Yagis in order to increase the gain over that from one Yagi. In addition, Stacking provides a greater range of transmission angles to maximize band openings.

Stacking a pair of Yagis can provide 2.5 to 3.0 dB of stacking gain; three antennas provide 4.0 to 5.0 dB and so on. We can use bigger Yagis instead of Stacking. As an example, increase in gain due to stacking two Yagis approaches 3dB, so we have to double the size to make a Yagi 3dB increase in gain which creates mechanical challenges. Stacking Yagis provides gain and control over the radiation pattern more readily and with less mechanical strain than can be done with one big Yagi which makes this solution ideal.

Generally, stacked Yagi antennas are separated vertically by one-quarter wavelength, free space (246/frequency in MHz = λ/4 **(**1/4 Wavelength) in Feet). Detailed information on the appropriate distances for the separation between the stacked Yagis, to create a versatile, high performance array, is discussed fully in the *ARRL Antenna Book*, 20th Edition, chapter 11.

To feed a Stacking system, most use a common junction by means of quarter wave matching transformers of such impedance as to transform the 50Ω of each Yagi to that impedance which is equal to 50xN where N is the number of Yagis in the stack. Then, of course, the parallel impedance of the lot finishes at 50 Ω again matching the line to the shack.

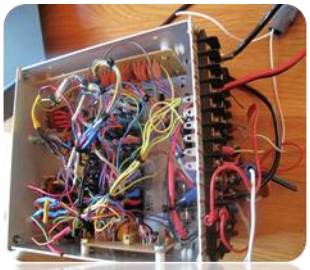
The impedance of the matching transformers is found by the formula Z = sqrt(50x50N). As illustrated to the right, this is 70.71Ω, four Yagis 50 Ω, λ/4 (¼ wave transformers). These matching transformers are connected to the common connector providing the 50 Ω input / output to the line to the shack in the form of four leg “power divider”.



I switch each stacked antenna for various configurations (top, bottom, and

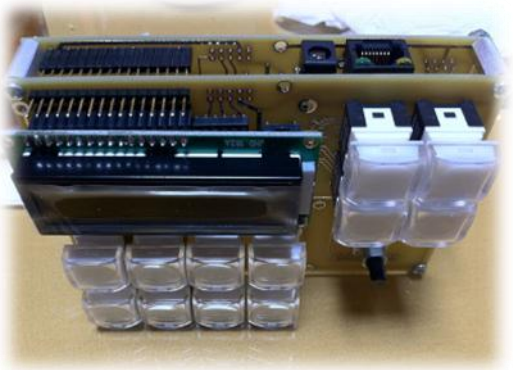
stack) with its own relay box mounted on the tower at the array center. I use vacuum relays that control antenna phasing for reliability and minimum insertion loss. The switching boxes are fairly large Hammond boxes mounted insight a Home Depot electrical control box to prevent moisture problems.

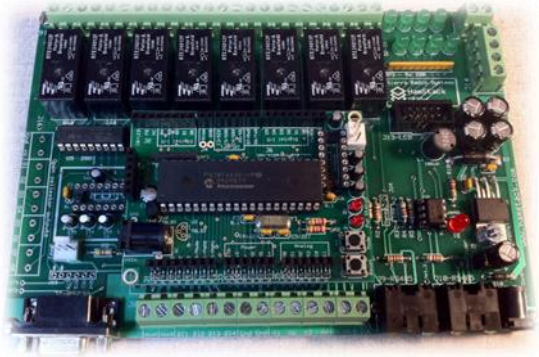
My struggle centered on moving from a homebrew control switchbox which turned out to be unreliable and a real mess, as



illustrated to the right, into clean and efficient control system.

Recently I've been using HamStack for temperature control and as a way to learn how PIC processors work and to program them. The HamStack team came up with a Control Head and Relay Board which lends itself well to controlling stacked Yagis.





In addition they came up with a way that the Control Head manages the Relay Board over RS-485 enabling antenna control hundreds of feet away from the station. With the Northeast tough weather and severe RF environment, I used high-end Belden (1633A) shielded Ethernet cable.

The basic specifications for the two boards follow:

Relay Board

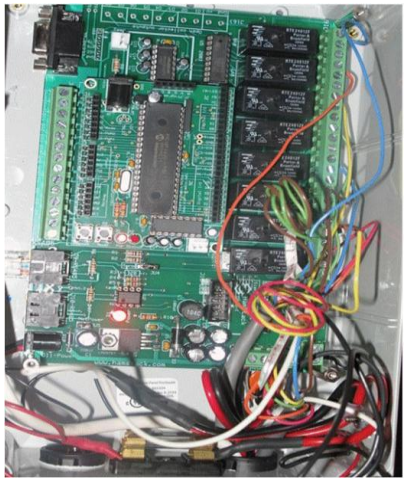
- 8 SPDT relays that can handle up to 8 amps with LED indicators
- 4 Digital inputs with 10k pull up resistors
- 4 Analog DC voltage inputs. Jumper selectable ranges: 0-5v or 0-22v DC
- Jumper selectable serial options include TTL, RS-232 or RS-485
- 10 pin header connector supports character-based LCD displays
- 5v DC switching power supply runs cool and quiet

Control Head

- The 12 buttons can be set to light up either red, yellow or green or turn off.
- LCD is a 2 line x 16 character backlit display.
- The lower right is an optical encoder.
- Board using standard CAT5 8 conductor cable for 485 connection

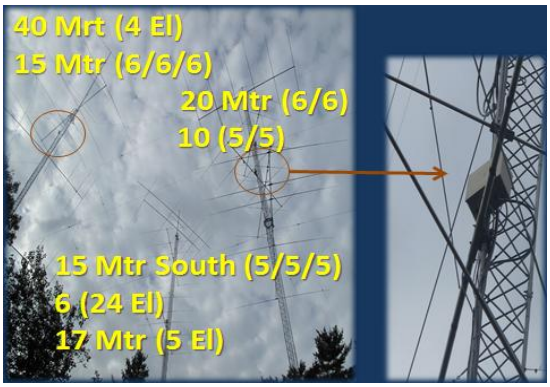
I'm stickler for anything on the table top to be well laid out for ease of control during long contesting weekend. The result has been terrific. I put this into practice for the CQ WW SSB 2011 contest and the entire system worked flawlessly. As most contesters know, sleep deprivation for a 48-hour contest is a challenge, the simplest tasks become

difficult. I was able to easily manage the stack Yagis with zero problems both from the user point of view and hardware holding up to the RF environment.



Relay Board on the 20Meter tower controlling the vacuum Stacking phase lines

Relay Board mounted inside a Hammond watertight box inside a Home Depot watertight electrical box



Stacked Yagis on 10, 15 and 20 -Meters

Stacked Yagis on 10 - Meters