How to tune a relay box on 80/75.

This is not a straightforward issue. Please look carefully at the relay boxes on the previous pages to gain an understanding of how they are constructed and wired. There are pairs of coils on each relay, one for each half of the dipole.

Let's figure we are using a relay box with two (2) relays. This kind of box will yield four (4) places in the band to select from. Well, let's back up and start with a single relay box instead. In these examples, the terminology is used for the relays being DPST, with the "ST" being the important note here. This means there is no "normally open" contacts on the relay that are closed when the relay is not energized. The inductors are either in or out of the circuit (dipole).

One relay will provide a method to include a pair of inductors into the center of a dipole, for example. This means we have two (2) conditions: the inductors in and the inductors out of the dipole. With the inductors out of the circuit, the dipole will be higher in the band and with the inductors in the circuit, the dipole will be lower in the band.

Relay	
CW/SSB	Frequency
OFF	CW
ON	SSB

The relay need not move the antenna so far, CW to SSB. The inductors can be smaller and move the antenna within the phone portion, as in this table:

Relay	
CW/SSB	Frequency
OFF	Low SSB
ON	High SSB

Remember that besides the obvious inductance in the coils, there is also stray inductance inside the box, consisting of the leads in and out of the box (e.g. to and from the relay) and also from the relay itself. With all this in mind, the proper tuning sequence will be:

a) attach a test length of coax to the dipole through a balun, have the antenna as high as possible and remember that if you are using a test meter like an MFJ, you are looking at the VSWR meter for a dip and NOT the impedance meter (on the impedance for a 50-ohm reading;

b) energize the relay ("ON") so that the inductors are OUT of the circuit (relay "closed", shorting out the inductors). This will place the dipole in the higher part of the band;

c) tune the dipole to the desired frequency in the higher portion of the band;

d) make an initial setting of the matching device (i.e. a hairpin coil across the feed points);

e) de-energize the relay (relay "OFF"), placing the inductors IN the circuit (i.e. one inductor on each half of the dipole);

f) adjust the coils as equally as possible to set the dipole on the desired frequency in the lower part of the band;

g) expanding the coils will move the frequency up and compressing them will move the frequency down;

h) check to see how the VSWR is with your initial hairpin coil setting and make a compromise adjustment if desired.

Now let's look at a 2-relay box.

The general functions of a 2-relay box are one relay for changing between phone and CW and the other relay to change an "interval." The interval is a small excursion in frequency, such as 30-50 kHz. Using a range that allows the antenna to stay within the 2:1 VSWR bandwidth would be a good idea. This combination yields the following typical arrangement:

Relay		
Interval	CW/SSB	Frequency
OFF	OFF	Low CW
ON	OFF	High CW
OFF	ON	Low SSB
ON	ON	High SSB

As you can see, a 2-relay box provides four (4) operating segments. The key to tuning this arrangement is to set low SSB first. The sequence is:

a) attach a test length of coax to the dipole through a balun, have the antenna as high as possible and remember that if you are using a test meter like an MFJ, you are looking at the VSWR meter for a dip and NOT the impedance meter (on the impedance for a 50-ohm reading;

b) energize the CW/SSB relay ("ON") so that its inductors OUT of the circuit. The interval inductors are still IN;
c) tune the dipole to the desired frequency in the higher portion of the band;
d) make an initial setting of the matching device (i.e. a hairpin coil across the feed points);
e) energize the interval relay ("ON") and see if the move upwards in frequency is as expected. If it is more than expected (the interval coils have too much inductance), expand the interval coils to reduce the interval to the desired amount. When this is done, it will also affect the first tuning in step c), because the interval coil was in the circuit, so go back to step c) and adjust the dipole for the correct frequency with the (adjusted) interval relay OFF;
f) when the Low SSB frequency is as you want, de-energize the CW/SSB relay ("OFF") to place the antenna in "Low CW" and then adjust the inductors on this relay for the desired Low CW frequency;
g) adjust the coils as equally as possible to set the dipole on the desired frequency in the lower part of the band;
h) expanding the CW/SSB coils will move the frequency up and compressing them will move the frequency down;
i) check to see how the VSWR is with your initial hairpin coil setting and make a compromise adjustment if desired.

A relay box can have 3 relays, too. This will provide for the CW/SSB movement, plus a lot of others. It can provide contiguous coverage of the majority of the 80/75-meter band. We will set the "Interval 1" coils for a smaller increment than the Interval 2" coils. I will use actual frequencies for this example:

Relay			
Interval 1	Interval 2	CW/SSB	Frequency
OFF	OFF	OFF	3.505
ON	OFF	OFF	3.555
OFF	ON	OFF	3.615
ON	ON	OFF	3.665
OFF	OFF	ON	3.685
ON	OFF	ON	3.735
OFF	ON	ON	3.795
ON	ON	ON	3.845

The adjustment procedure is basically the same sequence, adjusting the Low SSB frequency first. This will be with only the CW/SSB relay "ON."

After it is set, make an initial hairpin match set and check the interval amounts to be sure they are as desired. A truth table like the preceding table will be very valuable. If any adjustments are made on the interval relay coils, the Low SSB frequency will be affected, so be prepared to reset it.

When the phone segments (the last 4 in the table) are done, then set de-energize the relays to set Low CW. This is the same as before, adjusting the coils on the CW/SSB relay. As a final check, see how the VSWR is across all the segments. Remember you are using a single match to cover a very wide percentage of the band and operating bandwidth of the antenna.

Five more points to mention:
1) keep a written record of what you are doing and this means each step you take;
2) man lifts are often used to make these adjustments on 80/75-meter Yagis. The lift can be positioned right at the center of the Yagi (dipole) element with little interaction. My experience shows that the lift in close proximity will lower the frequency about 8-10 kHz. You can check this at the beginning of your tuning efforts and it will make your tuning easier and quicker. Just remember to account for the lift in the right direction!;
3) if the antenna is on a crank-up tower, you probably are not adjusting it at full height. The antenna will shift when it is raised, so make a note of how much from the height at which you are tuning it. Antennas normally shift upwards when raised;
4) if you make a relay box like the ones in the photos, you can manually engage them by pressing on the center of the actuator. This might save you time from having another person switching them on and off;
5) these open frame relays are not dry-contact types and might need to be burnished before tuning. You can do this using a piece of brown paper bag between the contacts as you apply pressure with your finger. After tuning, once in a while run the relays on and off while running 30-50 watts to keep them clean. Enjoy!