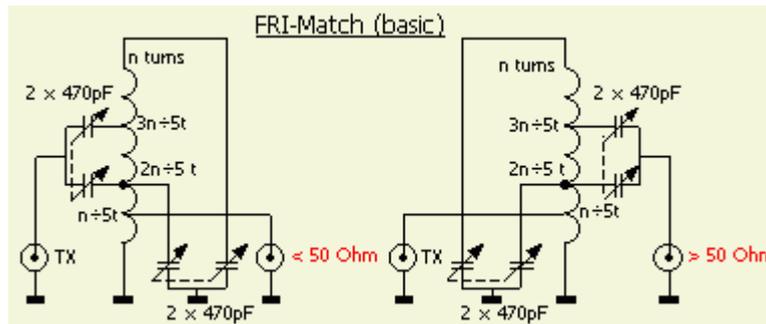
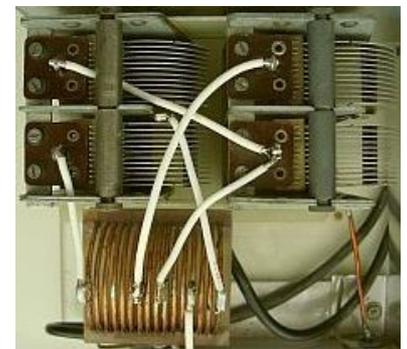
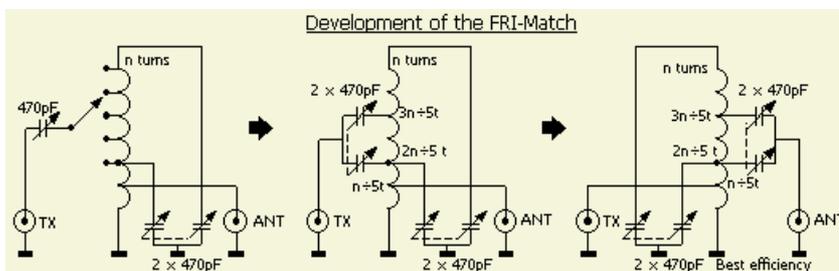


# Free-Match ATU, a single-coil Z-Match type:



## DESIGN

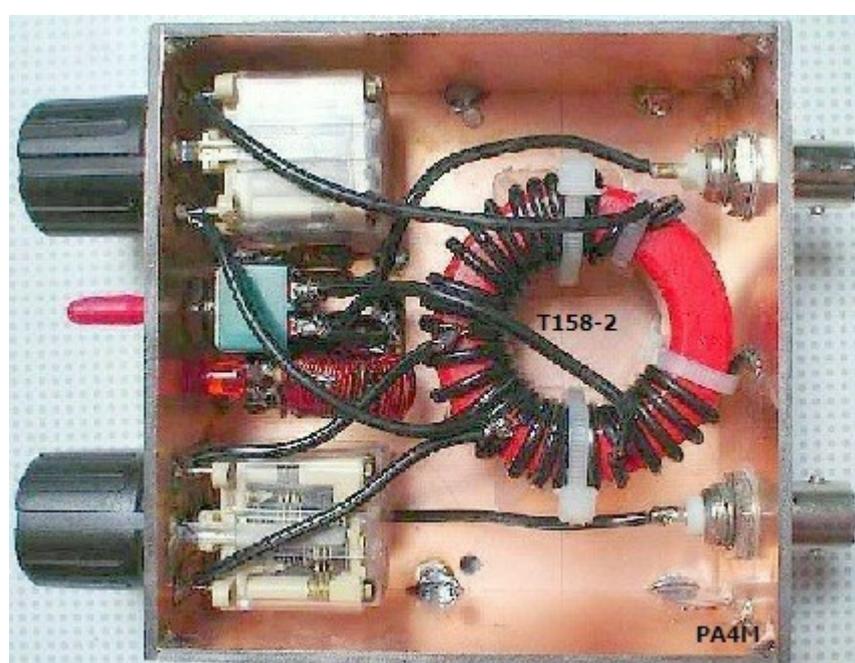
This ATU, I call my design Free-Match, has been devised in 1972 as an unbalanced tuner for improving the SWR at the transmitter end of coaxial feeders to resonant antennas (vertical dipole, trapped dipole, G5RV, Yagi loop quad etc.).



It is a modified version of the well-known Z-match and is designed as the result of many experiments in reducing the SWR between 3.5 and 28 MHz (incl. the WARC bands) without the necessity for switching coils and with a minimum of knobs.

After much experimentation with various antennas and complex loads, the design with one 5 - 8  $\mu\text{H}$  coil turns out to be the best tuning system for 10 to 80 m. The efficiency of the tuner is good, because it can be considered as an autotransformer with inductive and capacitive taps on the coil. Originally the design was a three knobs tuner (the left model). The results of further experiments were the middle and right model (with two knobs). The dual varicap has almost the same effect as the switched capacitor at the input of the left model. So a switch could be saved.

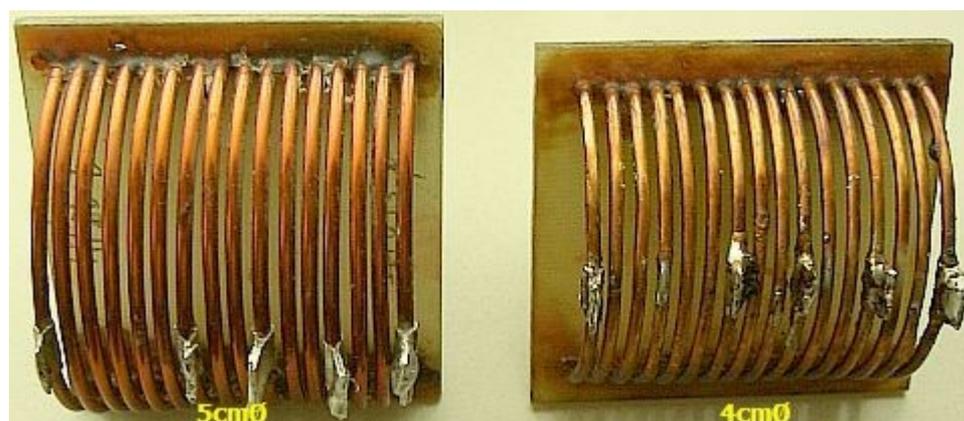
One of my first constructions was with two tiny plastic varicaps as used in portable AM radios.



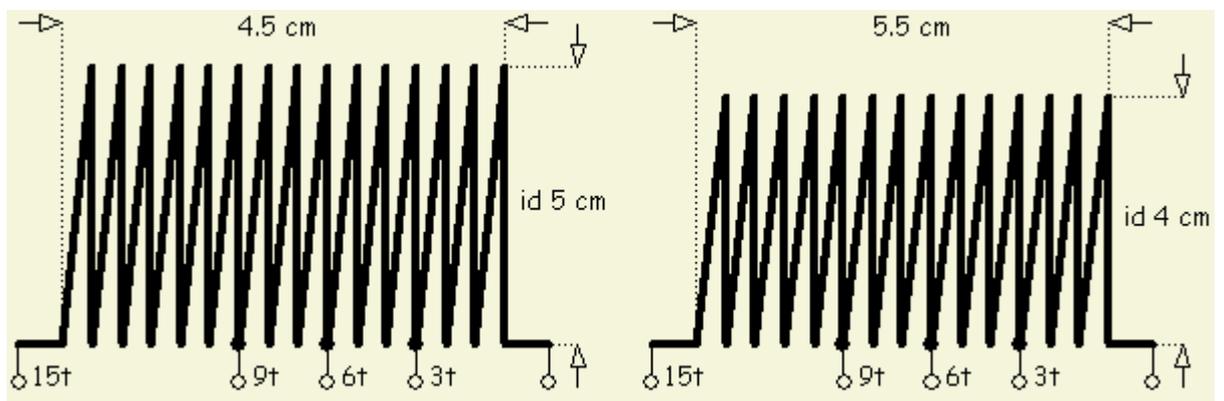
Although intended for QRP, they were often suitable for even 100 W if the loaded impedance was relative low, e.g. very close to 50 Ohms. My QRP ATU no longer exist, but accidentally PA4M build an device (fig ») almost similar to my former unit.

## COIL INFORMATION

COIL		
Long	4.5 cm	5.5 cm
ID	5 cm	4 cm
Turns	15	15
Taps on	3, 6, 9	3, 6, 9



Wire diameter of at least 1 to 2 mm.



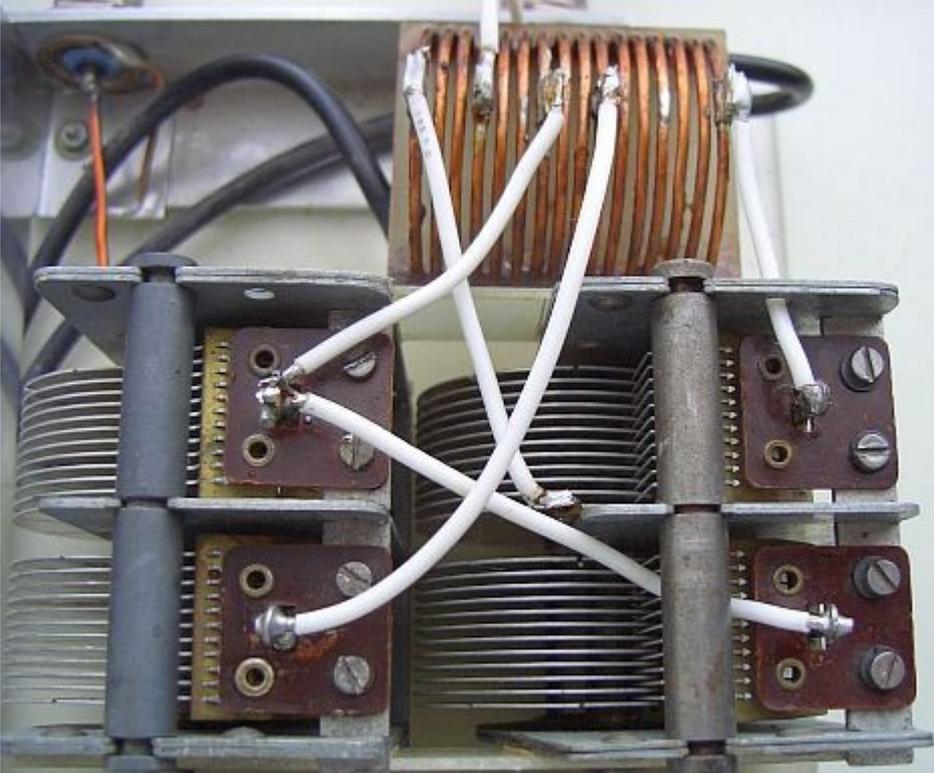
The coil is made with: 15 turns of 2.5 mm diameter enamelled copper wire or 6 mm<sup>2</sup> tinned copper wire, 4.5 cm long with 5 cm ID or 5.5 cm long with 4 cm ID. Taps on 3, 6, and 9 turns from earthy end.

### CALCULATION OF THE TAPS

If random sized 5 – 8 μH coils with *n* turns (see PE1ADY's ATU) are used the taps for equal efficiency on all bands should be at:

<b>Coil</b>	<b>Random size but: ± 5 – 8 μH</b>
<b>Turns</b>	<b><i>n</i></b>
<b>Tap 1</b>	<b><math>n \div 5</math> turns from earthy end</b>
<b>Tap 2</b>	<b><math>2n \div 5</math> turns from earthy end</b>
<b>Tap 3</b>	<b><math>3n \div 5</math> turns from earthy end</b>

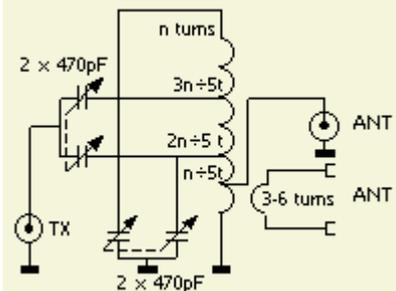
### PRACTICE



It is essentially a "kiss" approach cheaper and almost faster than an automatic ATU provided that the calibrated settings on each band for minimum SWR are known so that the capacitors can be quickly reset.

In practice the ATU has proved more flexible than expected and in many cases permits matching to non-resonant antennas.

With an extra 3 – 6-turn bifilar winding over the

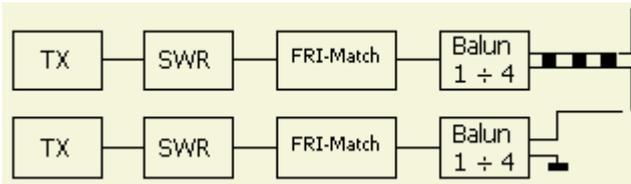


earthy end of the coil (fig») a "balanced" output for 50/75 Ω twin wire or 300 Ω ribbon feeder is feasible.

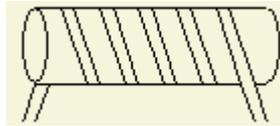
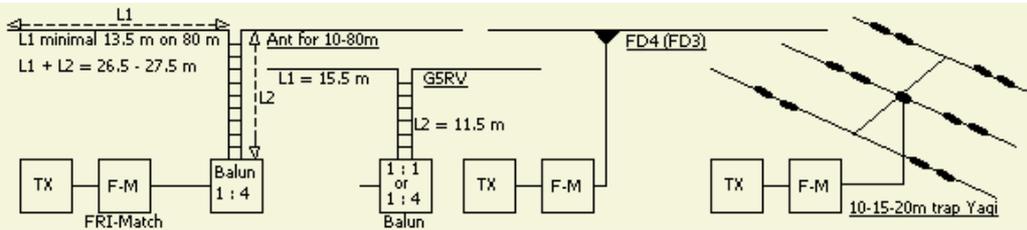
However, it should be noted that this design couldn't satisfy all possible conditions such as random length wires and antennas. This can sometimes be overcome by increasing or

decreasing the length of the coaxial feeder or ladder line and/or reversing the input/output terminals of the ATU. To meet all possible matching conditions a more complex arrangement should be necessary.

## MATCHING ANTENNAS



With this FRI-Match I do not recommend the use of a coupling coil but have the preference for a suitable balun at the output of the ATU.



The coiled ribbon performs similar as a choke balun.



Bij plaatsgebrek oprollen

If limited space in the back garden occurs eventually roll up the ribbon.

Roll up if there is too little space.

## TOROID



Toroid T200-2, 25 turns, taps on 5, 10 and 15 turns

<b>Toroid</b>	<b>T200-2</b>	
<b>Turns</b>	<b>25</b>	
<b>Taps on</b>	<b>5, 10, 15</b>	

A toroid, self-shielding because of its low external field, facilitates compact construction. For  $\pm 400$  W power, a T200-2 toroid can be used with 25 turns on 75% of the circumference.

Taps 5, 10 and 15 turns from earthy end. A 5 to 8  $\mu$ H coil seems to be the best as the result of experiments.

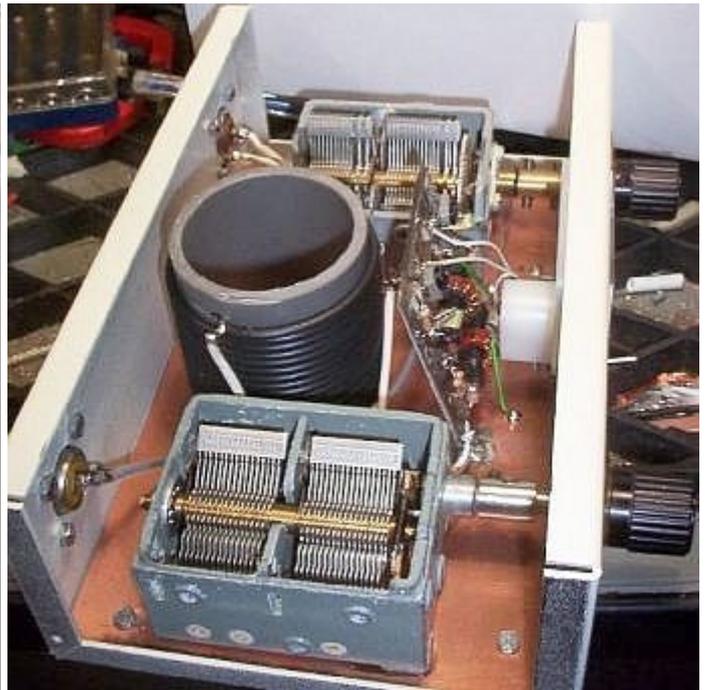
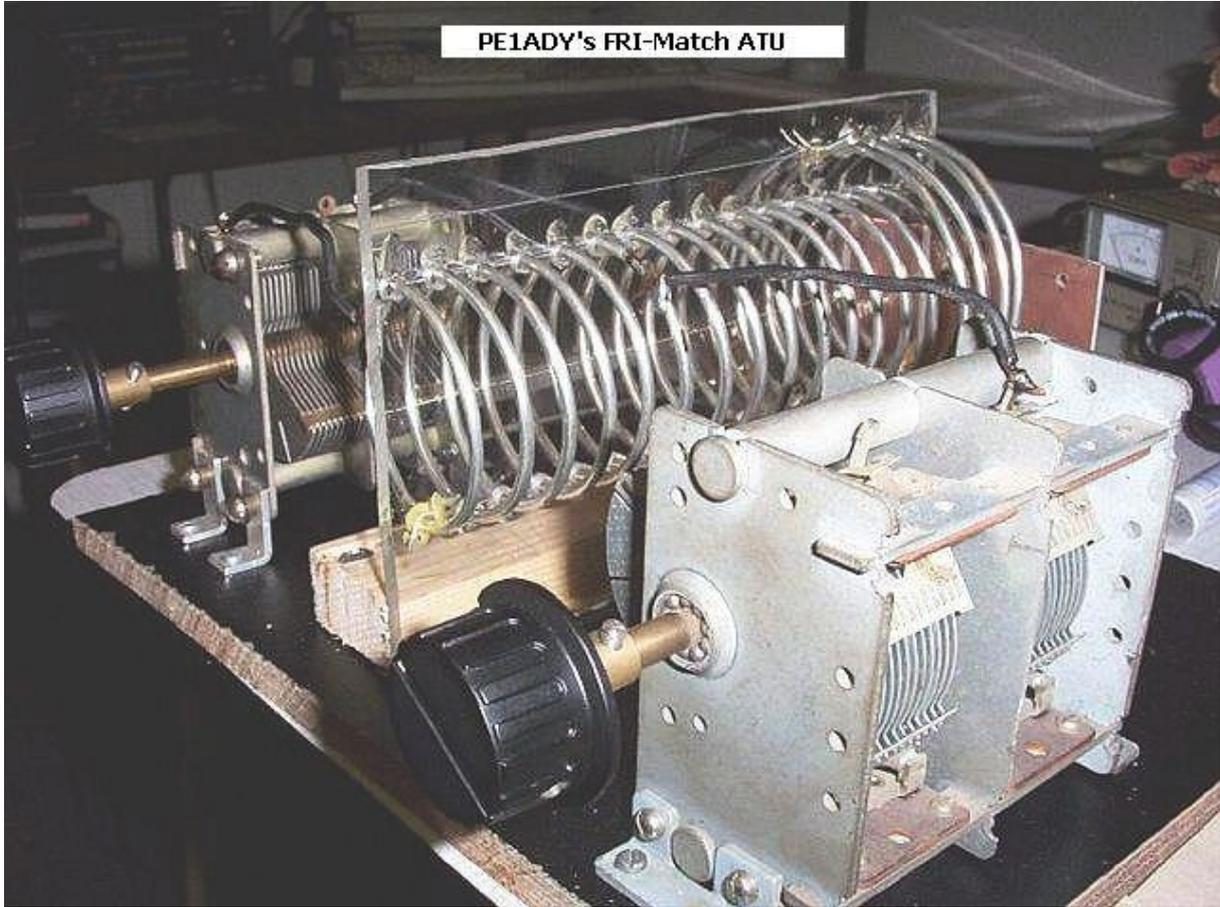
Before winding, several layers of Teflon plumbing tape must be applied to the core, to insulate it from the coil-windings. Another

method of insulation is to cement two flat isolating washers (e.g. made from bare glass fibre board, see figure) on each side of the bare core. Apply a small quantity of super glue, possibly only a few drops, around the sides of the core. Work swiftly; the glue hardens quickly. The glue prevents the washers from moving out of alignment while the core is being prepared for winding. For a T200-2 core, the inner diameter should be 28 mm and the outer diameter 55 mm. With this last construction it might be even possible to use bare copper wire for the windings.



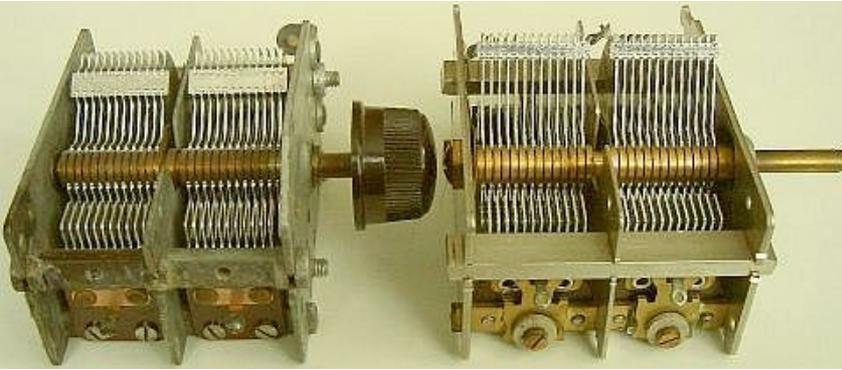
**Home-made ATU (w × h × d), 17.5 × 6 × 12 cm with a T200-2 toroid.**

PE1ADY's FRI-Match ATU



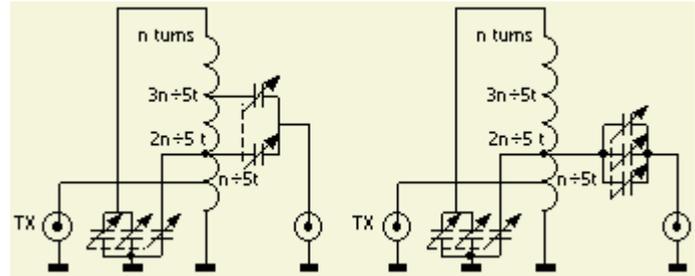
Home-made FRI-Match ATU's.

## CAPACITOR INFORMATION



### Twin-gang from vintage AM radios

Variable capacitors can be receiver-type twin-gang 10 – 490 pF per section, for power up to 400 W. For QRP to 100W operation a T200-2 toroid and two air-dielectric variable capacitors salvaged from vintage AM radios can be used. If  $2 \times 350$  pF capacitors are used the coil should be increased to about  $8 \mu\text{H}$ . If  $3 \times 350$  or  $3 \times 490$  pF are used in some cases the FRI-match permits **limited** matching on the 160 m band. It will then still work on 10 m.



It will then still work on 10 m.

## MATCHING WIRE ANTENNAS

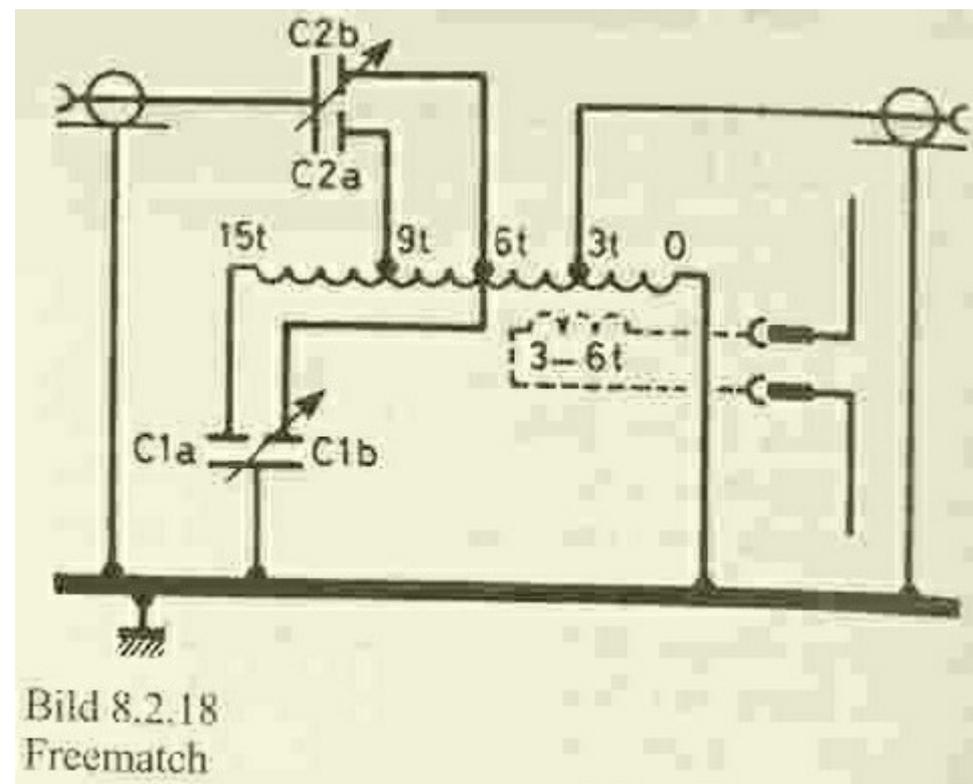
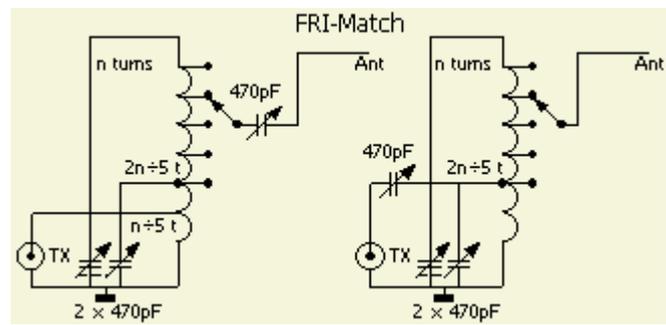


Bild 8.2.18  
Freematch