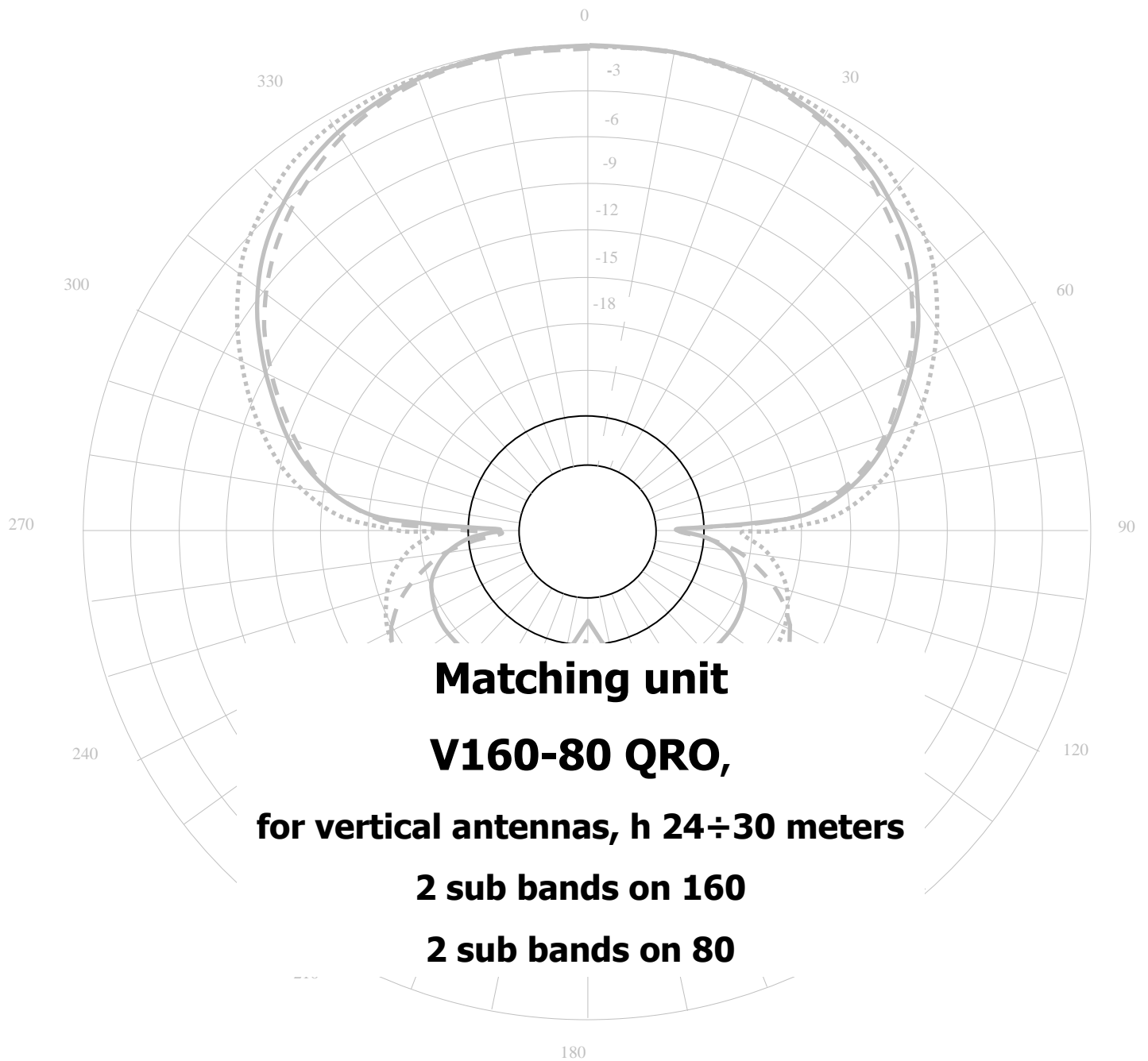


LBS Antennas



User manual

Ver. 1

www.lowbandsystems.com

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I. Vertical Antenna and Matching unit

This matching unit designed to match 24-30 meters high Vertical antenna with 2-4 Top Loading wires, each 6-8 meters long on 160 and 80 meters bands.

2 sub-bands on each band will let you use both CW and SSB allocation.

Components selection, schematic and parts will allow you to match wide range of input impedances.

Vacuum relays, vacuum capacitor and high power ceramic door knob capacitors used in this matching unit.

For best antenna performance you must use a descent radial system. 30-60 radials, each 30 meters long are recommended as a starting point. Fewer and shorter radials will work, but with diminished results.

The wire radials should be placed as symmetrically as possible straight from the feed point around the vertical antenna and spaced evenly, regardless of how many radials are used.

As a good compromise, you can use elevated radials, 2 or 4 per band, at 2-4 meters above the ground, adjusted as dipoles elements at the target frequencies.

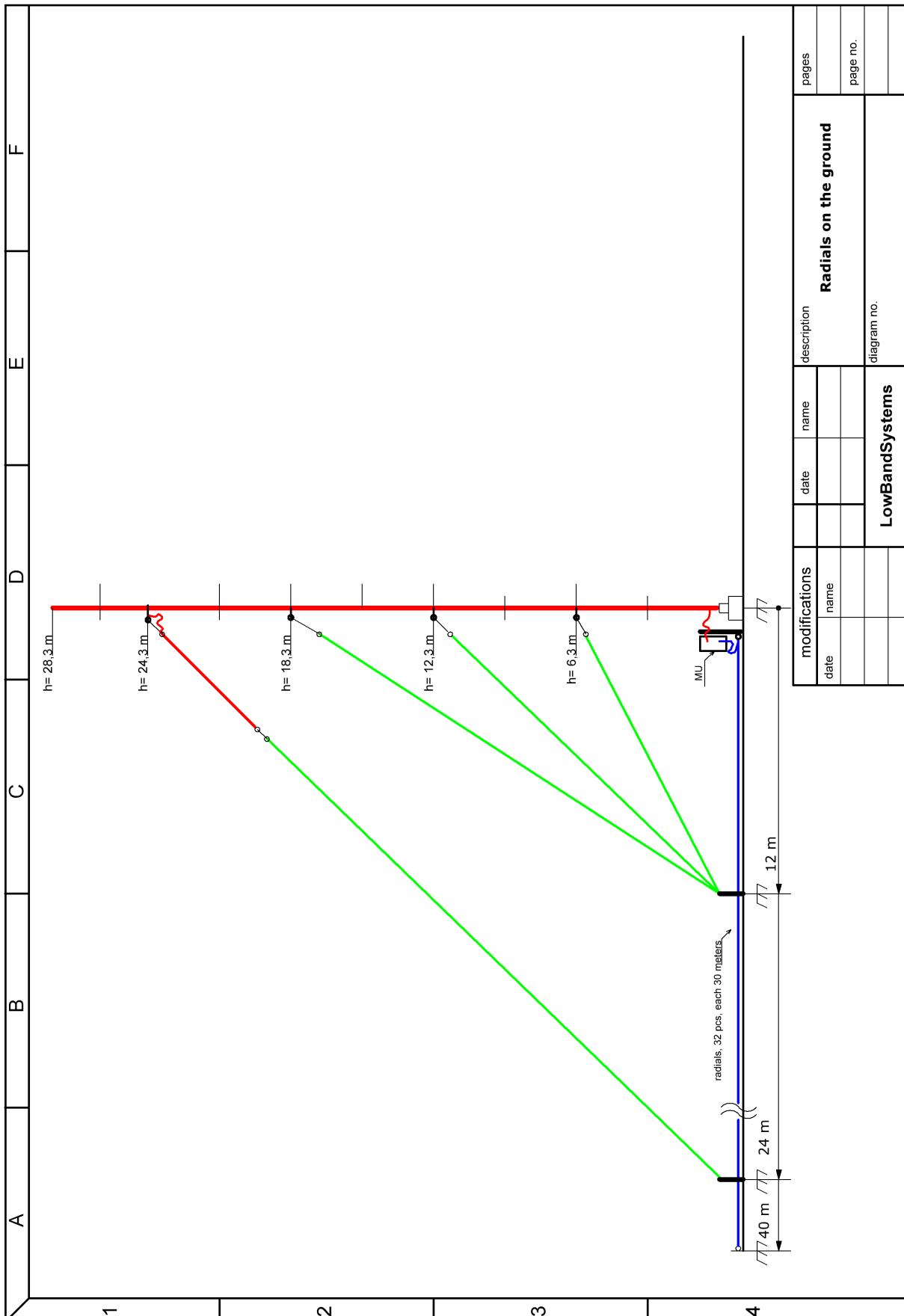
Vertical radiator can be made of aluminum tubing or metal tower sections with good intersection joints.

Most important concern is vertical`s mechanical strength and stability of the structure, it`s resistance to the wind, icing, corrosion and other bad weather condition.

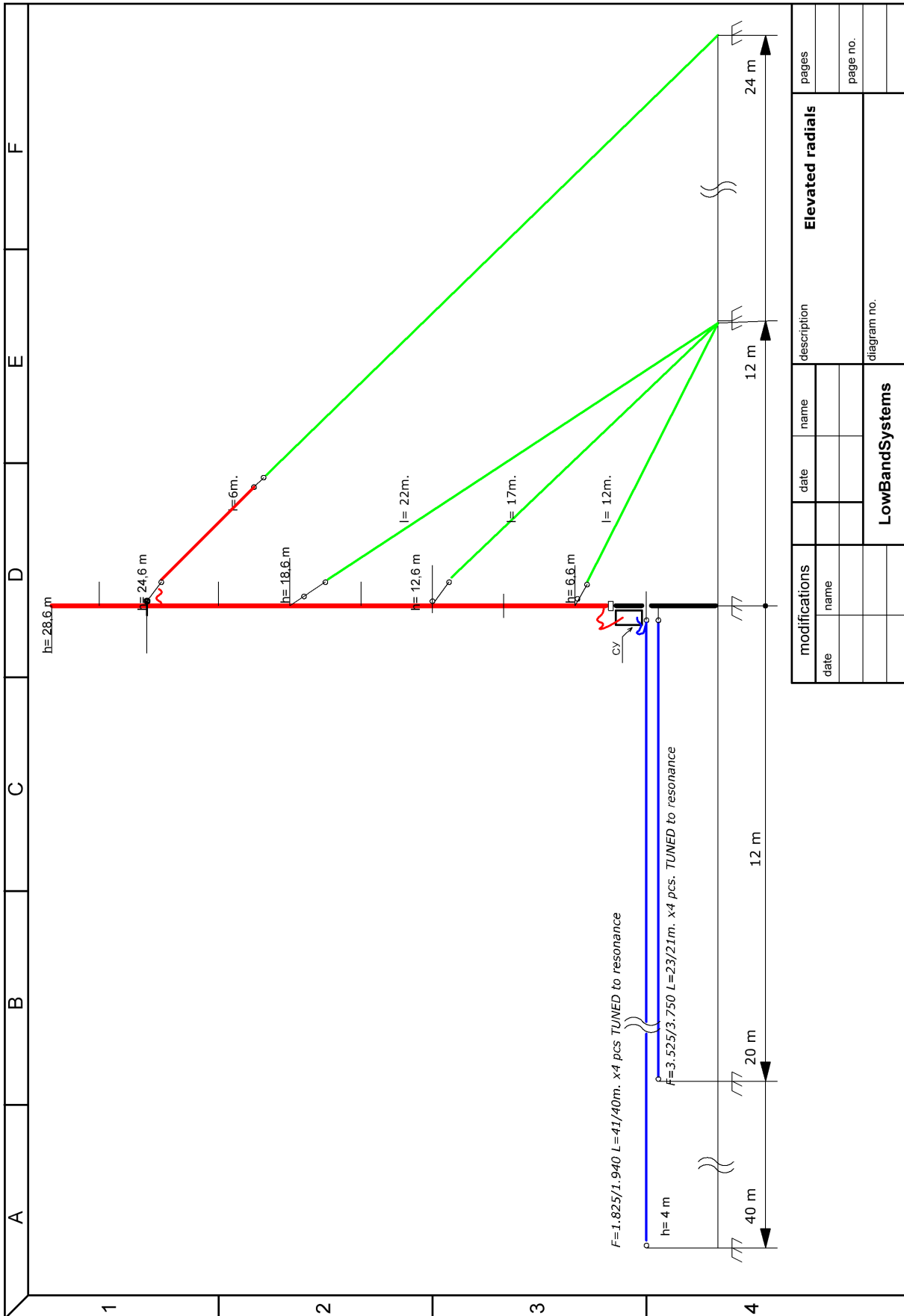
For best performance on reception it is strongly advised to use a dedicated, well-spaced off the vertical, receive only antenna system and Detuning function of this matching unit and its controller.

II. Suggested Vertical Antenna layouts:

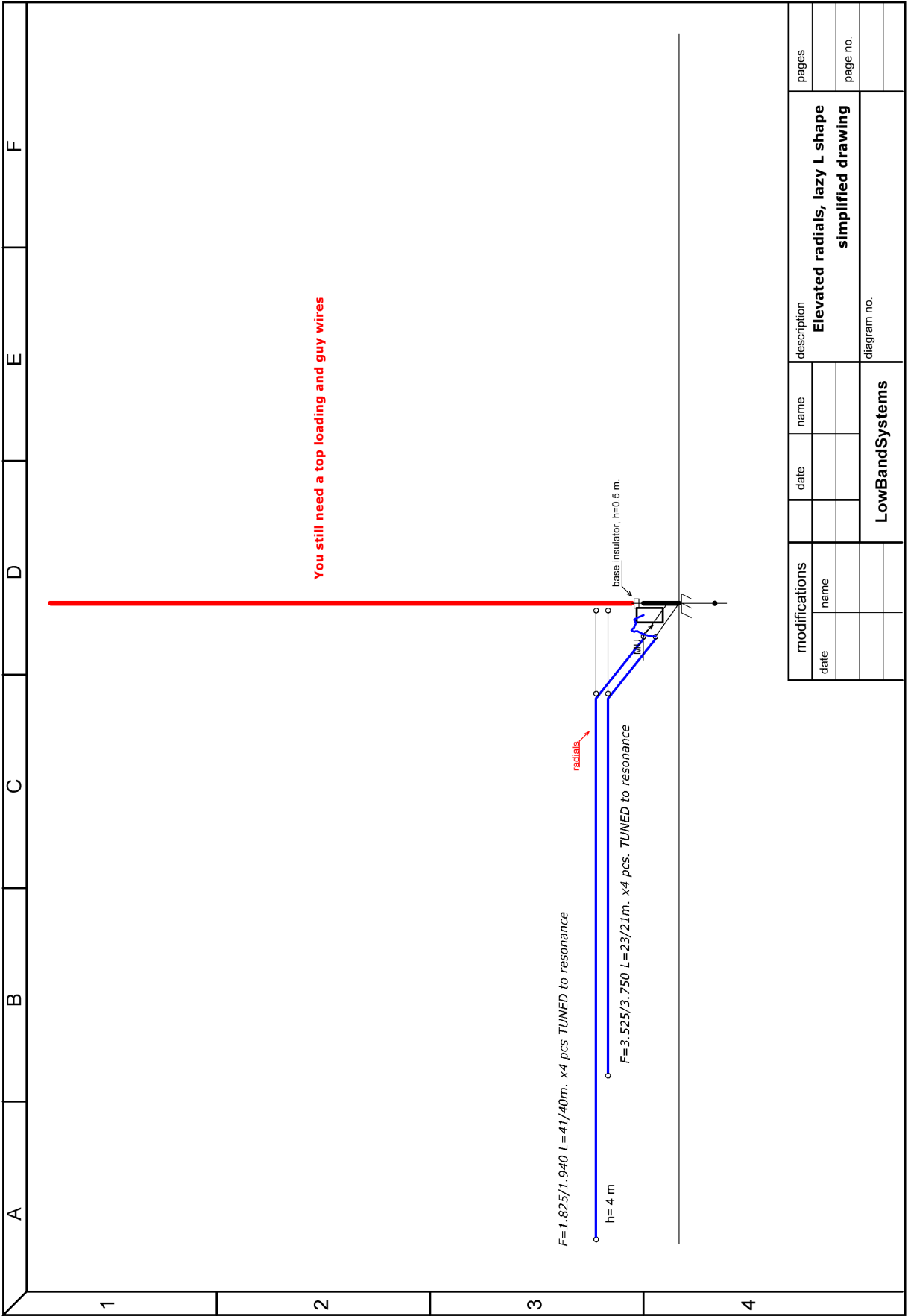
a) Classic, Radials on the ground



b) Elevated Radials, elevated feed point



c) Elevated Radials, from the ground level (less total height)



III. Matching unit description

Specification:

Bands of operation:	160CW - 160SSB - 80CW - 80DX;
Maximum power, ICAS:	7000 Watts ICAS;
Input impedance:	50 ohms;
Coaxial connector to transmitter:	UHF style, SO-239, Silver plated, FTPE insulator;
Recommended control cable:	5 conductor, min cross area requirement 0,7 mm ² ;
Control voltage:	18-24VDC, 0.5A max;

Matching schemes:

160:

On 160 it is a shunt inductance with 2 TAPs remotely controlled.
2 Sub-bands matching makes operation of basically narrow band Vertical in a wide band.
You will not be limited to only small portion of the band.

Total coil inductance (TAP#2 and #3) determines frequency of matching and TAP#1 positions determines degree of matching i.e. resulting SWR.

You have a TAP for CW and one extra TAP for better matching in higher part of the band.
You must obtain a perfect, almost 1:1,0 SWR match on CW and a very good match on SSB.

Matching on 160 is the very first step, as a jumper wire from TX connector (TAP#1) sets a starting point of coil (inductance) for both, CW and SSB parts of the 80 meters band.

80:

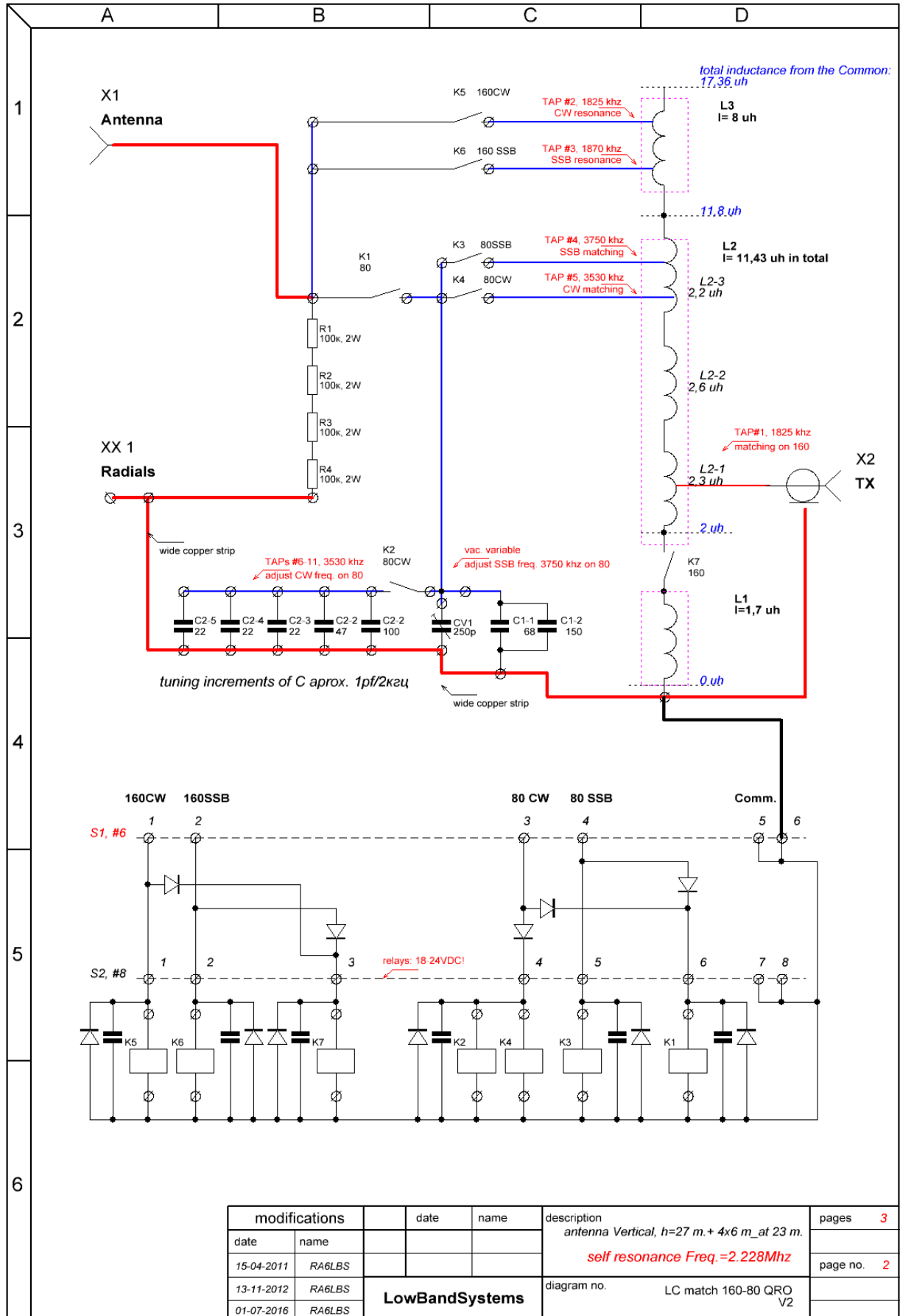
On 80 meters it is L network of capacitor and a coil (inductance). Vacuum capacitor and 2 remotely controlled TAPs on the coil and a relay to add extra capacitance (choice of 5 door knobs).

Each of the 5 door knob capacitors, can be "switched on/off", at the initial tuning, using its M5 connecting bolt and the connection bar. This fixed value capacitors allows adjusting of CW matching frequency in a small increments.

You can make a perfect match on SSB frequency carefully adjusting vacuum capacitor and a TAP#4 at inductor. And this is the first step of matching on 80.

Then you shifts "matching frequency" down by connecting fixed capacitors to the vacuum one and finding TAP#5 position for best SWR on any desired frequency.

IV. Matching unit schematic:



V. Matching your antenna, step by step:

160 CW sub-band

Switch controller to 160SSB

Check Toggle switch S2, "Detuning" position on control console

Switch power ON

TAPs #1 - #2 is in use on this sub-band

- 1) At factory`s preset TAPs position, check there are solid, while temporary, connection between TAP`s lug and the coil;
- 2) Using your antenna analyzer find the best SWR, it should be somewhere from 1.5 to 2.3Mhz;
- 3) Adjusting TAP#1 on L2-1 coil, find best matching on this frequency, even if it is outside of the HAM band;
- 4) Adjusting TAP#2 to nearby turn of L3, find a spot with low SWR closer to your target frequency.

Tip #1:

more turns – lower the frequency, less turns – higher the frequency;

Adjusting TAP#1 (may be half a turn), find a spot of best SWR you can do on this new frequency;

- 5) Doing few interactions with TAPs #1 and #2 you can find perfect match on your target frequency and it should be very close to ideal 1:1,0 matching;

Caution:

TAP#1 is the most important one as it determines matching on all 4 sub-bands. Once it is found for 160CW, it should not be changed latter, adjusting 160 SSB or 80 meters sub-bands (otherwise you will miss matching on 160CW).

160 SSB sub-band

Switch controller to 160CW

TAPs #1 and #3 is in use on this sub-band

- 1) At factory`s preset TAP#3 position, check there are solid, while temporary, connection between TAP`s lug and the coil;
- 2) Adjusting TAP#3, change matching frequency to your second favorite part of the band. As you are not changing TAP#1 now, this matching is not the best, but still should be very good.

Tip #2:

You can change now position of TAP#1 a bit, to make a compromise matching on both 160CW and 160SSB;

80 SSB sub-band

Switch controller to 80 SSB

TAP#4 and Variable capacitor is in use on this sub-band

- 1) At factory's preset TAP position, check there are solid, while temporary, connection between TAP's lug and the coil;
- 2) Using your antenna analyzer find the best SWR frequency, it should be somewhere from 3.0 to 4.5Mhz;
- 3) Rotating vacuum capacitor's shaft (release its brake first), shift frequency of matching closer to your target frequency in SSB sub-band;

Tip #3:

More capacitance – lower the frequency of matching;

Tip #4:

If vacuum capacitor value is too big for you setup, you may cut off one of the capacitors (C1-1 or C1-2) connected in parallel;

- 4) Adjusting TAP#4 at nearby turns of L2-3, make best SWR possible;
- 5) Once again rotating vacuum capacitor's shaft, shift frequency of good matching closer to your target frequency in SSB sub-band;
- 6) Adjusting TAP#4 to the nearby turns of L2-3, make best SWR possible;
- 7) Doing few interactions of steps #5 and #6, you can obtain perfect match on your target SSB frequency. It should be very close to 1:1,0 SWR;

80 CW sub-band

Switch controller to 80 SSB

TAP#5 and set of door knob capacitors is in use on this sub-band

- 1) Watching SWR in the range 3.3-3.8Mhz, connect or disconnect door knob capacitors to the L network scheme using its screws and a copper bar. You have to shift frequency of matching closer to you target;
- 2) Adjusting TAP#5 on L2-3, watching SWR, find best spot to have perfect match on this frequency;
- 3) Doing few interactions of steps #1 and #2, you can obtain very good match on your target SSB frequency. It should be very close to 1:1,0 SWR.

As fixed capacitors are not perfect for smooth shifting off frequency, matching will be best in some steps. Our advice is to find perfect match even some KCs away of your target frequency;

Tip #5:

You can change adjustment of vacuum capacitor a bit, to get a perfect matching on particular frequency in CW portion of the band at the price of not perfect matching on SSB sub-band.

Capacitance needed to move frequency by 20khz is approximately 10pf. Switching ON/OFF doorknob capacitors and adjusting Vacuum caps you can obtain any value;

VI. Safety first!

Don't forget to always follow common safety rules working with the matching unit and vertical antenna.

Do not locate the antenna near overhead power lines or other electric light or power circuits, or where it can come into contact with such circuits. When installing the antenna, take extreme care not to come into contact with such circuits, because they may cause serious injury or death.

Verticals will absorb all the nearby strike, lightings! Be very careful when doing any work with the matching unit, vertical.

Except radials, you MUST DO grounding at the base of vertical and connect all the radials to the ground rod.

It is a good idea to make adjustments of the network components with swiping antenna analyzer. Then please check SWR, bandwidth applying 100W or less.

Please make a firm soldering of the lugs to the coil`s wire after initial adjustment. You will need a powerful solder, liquid flux and alloy. Clean the joint after soldering. Make sure all the gaps between lugs and nearby wires is big enough to prevent arching and similar issues.

If you are lucky to be near sea or ocean, with great amount of salted air, moisture, it is better to apply some liquid coating to the copper wires inside the matching unit after adjustments is done.

Before applying full power it is a good idea to double check all the connection to relays, coils and vacuum capacitor.

They might lose when shipping and doing some work.

The vacuum relays and capacitor used are sensitive to mechanical tension. Be careful tightening its screws.

Do not mount this matching unit on your vertical antenna!

Verticals (even guyed towers) are always vibrates and this may case a serious damage for vacuum devices, mechanical connections and lead to BIG problem.

VII. Matching unit controller MC4R

Specification:

Bands of operation:	160CW - 160SSB - 80CW - 80DX;
Indication:	4 LEDs
Input voltage:	220VAC;
Output voltage:	30VDC, non-regulated;
Max. output current :	1A;
Recommended control cable:	5 conductor, min cross area requirement 0,7 mm ² ;
Detuning control method:	short on transmit (TX GND)
TX GND input connector:	RCA

Detuning of vertical antenna during Receive:

Re-radiation of you vertical antenna can significantly decrease signal/noise ratio even of best receive antennas spaced far away.

It is a common practice to shift resonance of transmit antennas while receive.

Vertical antennas self-resonance is between 2.2-2.7Mhz, this is far enough from the Ham bands and this property can be used to minimize transmit antenna impact on receive antennas.

When matching schemes is not connected to the vertical its resonance and most of the re-radiated signals lies off the ham bands and has lower impact on receive.

You should switch S2 toggle switch to ON position to use this feature and of course to connect controller to the TX GND output of transceiver.

All the relay is de-energized during Receive state of transceiver.

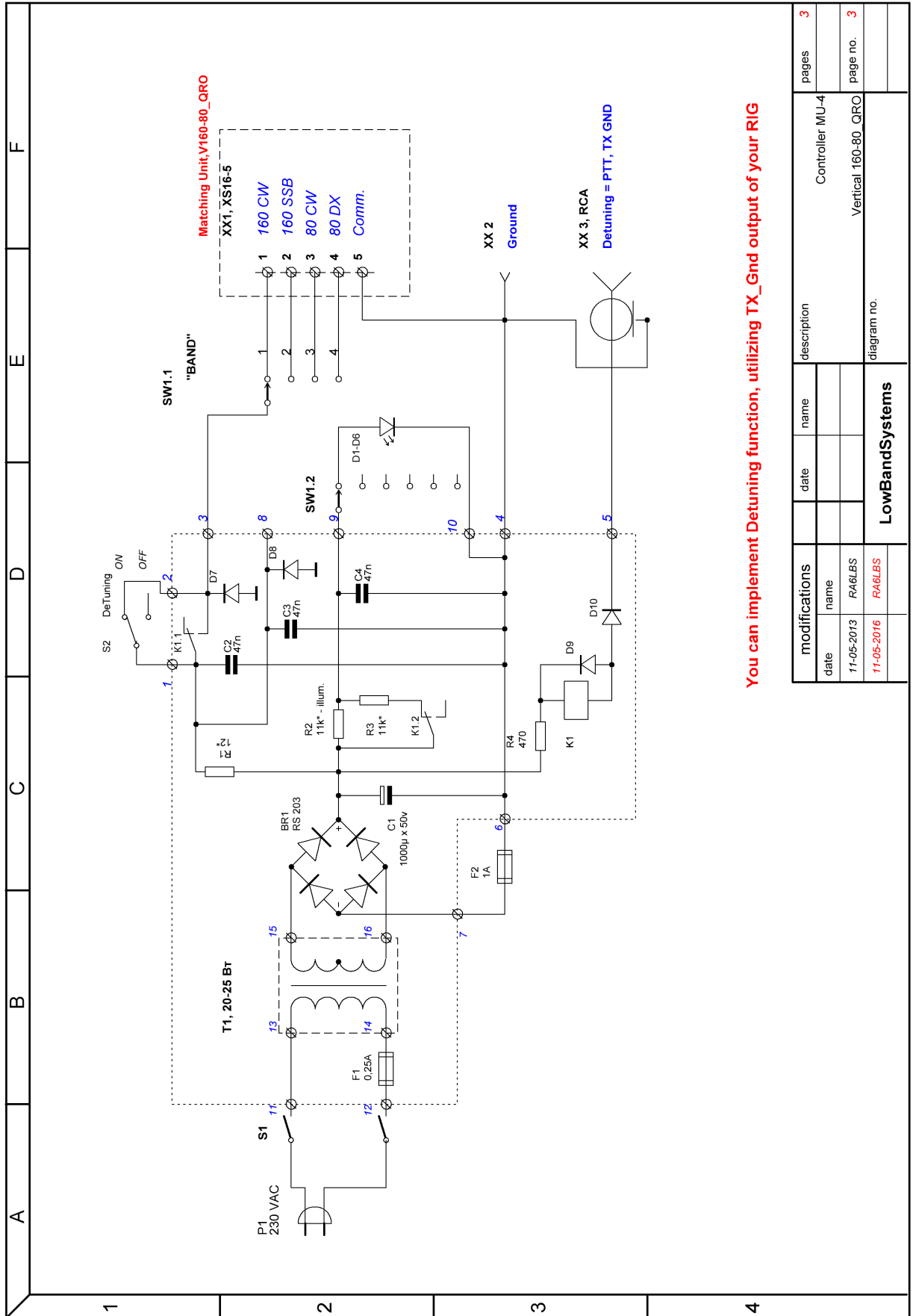
When you are going to transmit, all the relay goes to ON, matching network is ON, antenna is matched.

Transfer time of this vacuum relays per datasheet is 10 msec. You have to count this if there are some other sequencers in use.

When Receive, the LEDs are diminished a bit to show you operation of controller.

S2 should be in OFF position if you are not using Detuning function.

Controller schematic:



Controller connection to the Matching unit:

