DIPL.ING. KLAUS BEMMERER
ING.BÜRO FÜR NACHRICHTENTECHNIK
NIENDORF-MIDDELDOR 11
D-23769 BANNESDORF/FEHMARN

1.5 kW Automatic Remote Controlled Antenna Balanced Tuner

Model AT- 615B

Short Form Manual

10/2010



Dipl.Ing. Klaus Bemmerer
RF Communication Electronics
Niendorf-Middeldor 11
23769 Fehmarn
GERMANY
Phone +49 4371 869145
Fax +49 4371 869154
www.hamware.de
eMail: service@hamware.de

DIPL.ING. KLAUS BEMMERER
ING.BÜRO FÜR NACHRICHTENTECHNIK
NIENDORF-MIDDELDORF 1.1
D-23769 BANNESDORF/FEHMARN

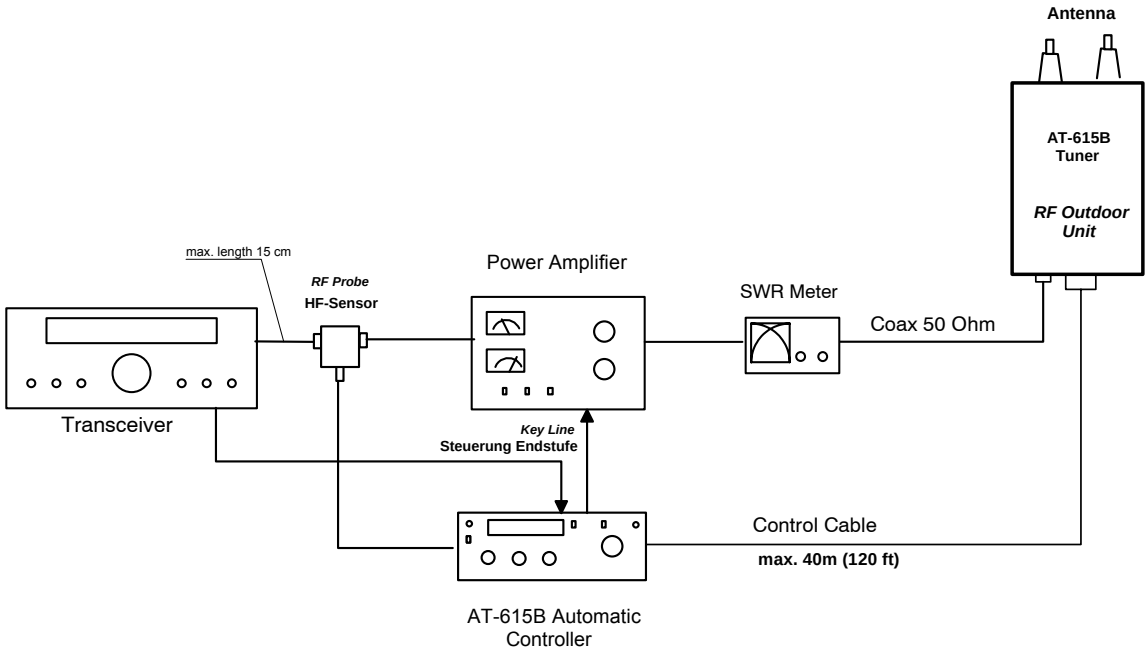
Antenna Tuner System AT-615B Description

This tuner is designed to match remotely, balanced HF antennas. This unit features automatic selection of tuner settings based upon transmitted frequency. Unique to this tuner, no special cabling or adapters are required. The operator simply transmits into the antenna and the tuner detects the transmitted frequency and selects the correct settings from memory. The Ham bands are divided into 85 operator programmable memory locations. It will handle 1500 watts of SSB or CW power, and it can be used in either automatic or manual mode.

The matching circuit consists of a remotely tuned balanced π circuit. The balun is placed at the input of the tuner. The Output capacitor is a stepper motor controlled High Voltage variable capacitor.

The Control Cabinet contains the tuning controls, memory location selection, Automatic or Manual switching and a display that indicates the memory location in use, the frequency range as well as the span, and the tuner settings.

Tuner System Block Diagram



DIPL.ING. KLAUS BEMMERER
ING.BÜRO FÜR NACHRICHTENTECHNIK
NIENDORF-MIDDELDORF 11
D-23769 BANNESDORF/FEHMARN

Controller Unit:

Antenna matches are stored into a bank of 85 memory locations. Each memory location is a fraction of an amateur band. Refer to the technical section for the fractional segments for each band. As shown in the picture below, the upper line of the LCD shows the actual memory location chosen (lower edge frequency 1840 kHz) with its span (20 kHz). The control settings for this frequency are shown in the lower line of the LCD. In the Automatic Mode the memory location and its stored settings is selected by the transmitted input frequency. The input frequency is obtained from an RF probe. The memory location contents can be erased by a push button on the back of the controller.

The controller contains 3 rotary encoders that control the tuner elements TRX, L, and ANT. TRX controls the Input Capacitance, L controls the Inductance and ANT the output capacitance values. The lower line on the display shows these values.

A manual selector switch is provided for memory selection in the Manual mode.

Controller Unit



Memory: Read out of the stored settings in either automatic or manual mode.
Tune: Matching the antenna with the rotary switches Input, L and ANT
Mem In: By pressing this momentary switch down the indicated control settings are stored into memory

Mode switch „Manual“ or „Automatic“ or “Thru”

Yellow LED lights, as long as tuning proceeds. Don’t key the transmitter during this time

LED is lighted when Power Supply operates and Power Switch is off

Power Switch

LC Display
The upper row shows the actual memory location (lower edge frequency with the span)
The lower row shows the actual control settings for the antenna

Input Capacitors switchable in 256 steps, 17pF each. Steps appear upon LC Display following “Txxx”

L values switchable in 31 steps.
Never switch with full poser! Max. switching power 300W

Control of the variable output capacitor. 1 step corresponds to 0.9° tuning angel. Max. 200 steps

In „Manual“ mode all memory locations can be selected

Controller Connections (Rear Side)



RF Probe

25-pin. Control Cable to Tuner Unit

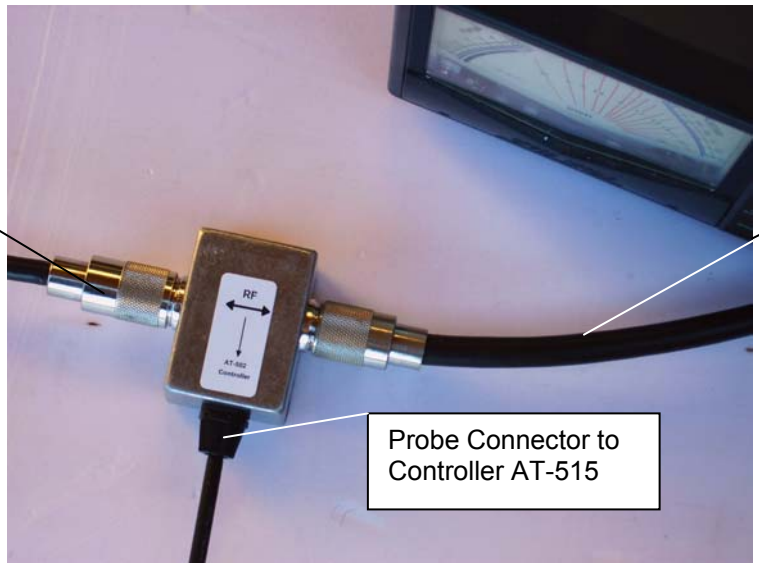
Cinch-Connectors to loop-in the key line of Power Amp

Power Supply

If the Memory Erase Button is pressed, all memory locations associated with the band indicated on the LC Display will be erased

RF Probe Installation

The connection to the Transceiver should made as short as possible.



To Power Amplifier

Probe Connector to Controller AT-515

RF Probe

If possible, the RF Probe should be attached directly to the antenna jack of the transceiver using an adaptor or a very short cable.

DIPL.ING. KLAUS BEMMERER
ING.BÜRO FÜR NACHRICHTENTECHNIK
NIENDORF-MIDDELDOR 1.1
D-23769 BANNESDORF/FEHMARN

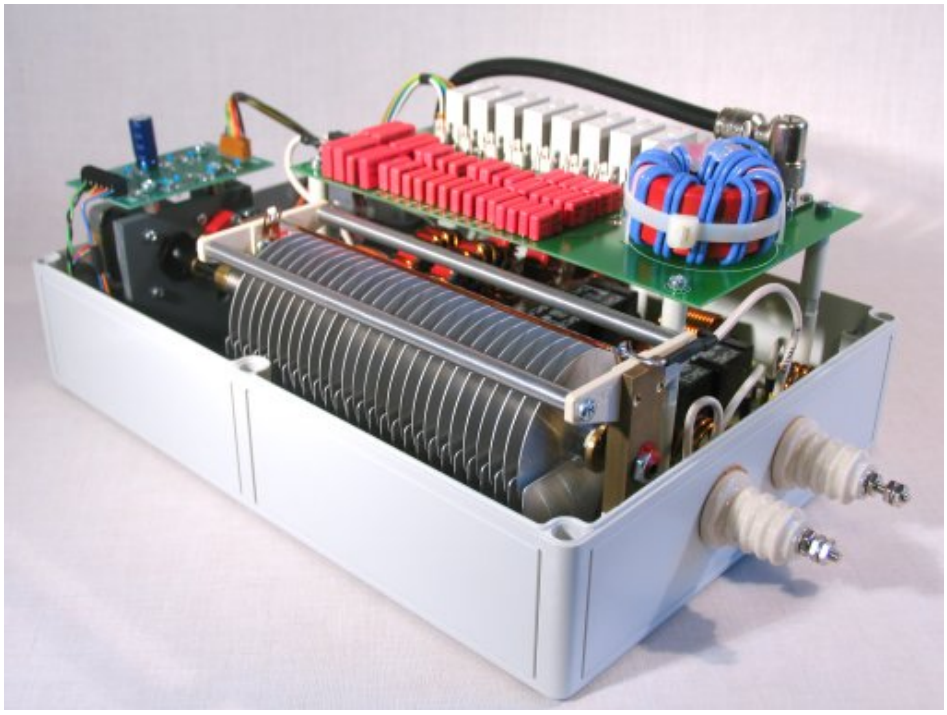
RF Unit:

The RF Unit is contained in a weather-protected cabinet (IP66) and is UV resistant. There are two feed-thru insulators to connect to the antenna elements. The coaxial cable and the control cable are connected via a N and a 254 pin connectors. There is no active circuitry inside the RF Unit. This is to insure reliable operation even under non-matched condition.

The LC network is known as Balanced PI. At the front end of the network there is a balun transformer that matches the unsymmetrical coax cable to the symmetrical tuner elements. This is the only place where the impedance of the system is purely resistive (when matched) and is the ideal place for the Balun. The regular station SWR meter (or the built-in meter in the TRX) is used as an indicator to match the antenna.

The capacitors at front end are switched in 256 steps of 17 pF per step. The capacitor at antenna side is a variable capacitor of 400 pF. The control of this capacitor is by a stepper motor with 0.9° per step. The inductive paths between the capacitors are switched in 31 steps from 0.2 µH to 35 µH. Switching is done by power relays. With the circuit components used it is possible to match short antennas up to an unlimited antenna length within the RF range from 1.8 to 30 MHz.

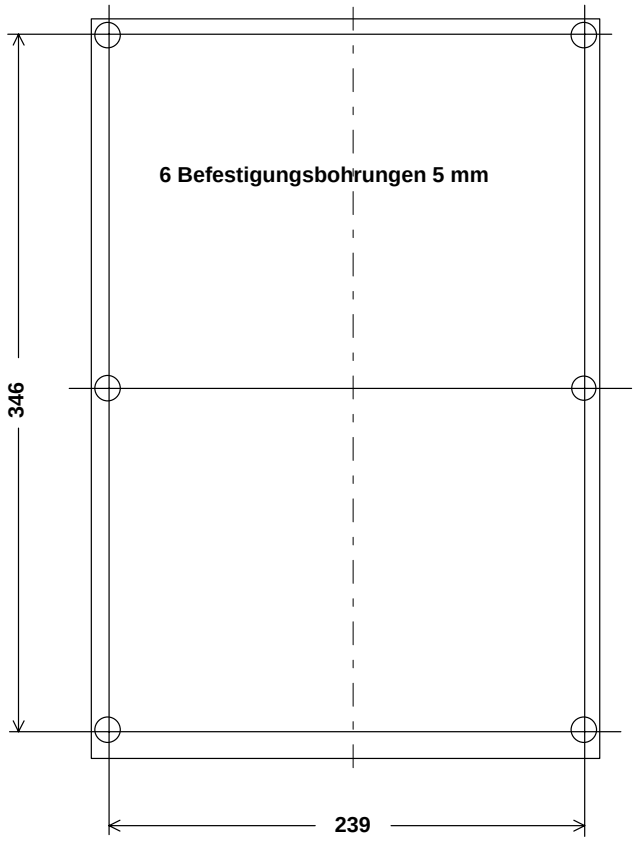
.



Interior view of the RF unit looking at the capacitor board, the inductor board is located below

DIPL.ING. KLAUS BEMMERER
ING.BÜRO FÜR NACHRICHTENTECHNIK
NIENDORF-MIDDELDOR 1.1
D-23769 BANNESDORF/FEHMARN

Installation of the RF Unit



The weather proof cabinet has 6 mounting holes.

The backside of the cabinet should be mounted on a flat surface.

Hole spacing is 13.62”H x 9.41”W (346mm x 239mm)

Connect the ground bolt between the two antenna insulators with the lightning rod.

An application example

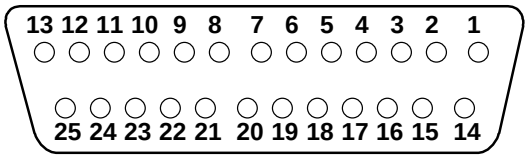


If the RF Unit is installed outside, a small roof or overhang is recommended to protect the unit from direct sun. If the tuner is not protected, the excessive temperatures inside the cabinet could damage the antenna tuner elements.

DIPL.ING. KLAUS BEMMERER
ING.BÜRO FÜR NACHRICHTENTECHNIK
NIENDORF-MIDDELDORF 1.1
D-23769 BANNESDORF/FEHMARN

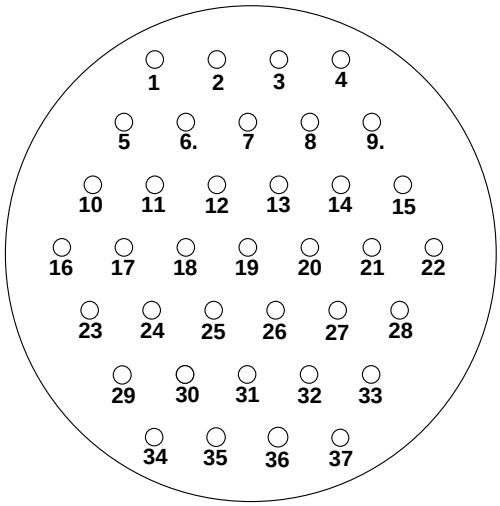
Control Cable

With a 25conductor (AWG22) wire control cable, the RF Unit can be controlled within a length of 120ft. (40 meters). Lengths in excess require larger wire diameters. Cable shield is not necessary.



DB-25 Controller Plug

View upon selder side of the plug



Anschluss der HF-Einheit
Blick auf die Lötseite der
Buchsenkupplung

Control Cable Interface
RF Unit
View upon solder side
of the jack

Nr.	Farbe		Funktion
1	Black		Stepper Motor A
2	Wht/Blue		Stepper Motor B
3	Red		Stepper Mptor D
4	Blue		GND
5	Pink		+15VDC
6	Pink/Bwn		RFU C9
7	Grey		L-Ctl. 2^5
8	Yellow		L-Ctl. 2^3
9	Wht/Pink		L-Ctl. 2^1 (LSB)
10	Green		Input-C Ctl. 2^7
11	Brown		Input-C Ctl. 2^5
12	White		Input-C Ctl. 2^3
13	Violet		Input-C Ctl. 2^1 (LSB)

Nr.	Farbe		Funktion
14	Blue/Bwn		+15VDC
15	Grey/Pink		Stepper Mptor C
16	Wht/Yel		+36VDC
17	Wht/Red		Stepper End Position Sw.
18	Yel/Bwn		RFU C10
19	Bwn/Red		L-Ctl. 2^6 (MSB)
20	Blue/Red		L-Ctl. 2^4
21	Wht/Grey		L-Ctl. 2^2
22	Wht/Grn		Input-C Ctl. 2^8 (MSB)
23	Grey/Bwn		Input-C Ctl. 2^6
24	Grn/Bwn		Input-C Ctl. 2^4
25	Wht/Blck		Input-C Ctl. 2^2

Hints to mount the DB-25 plug at controller side

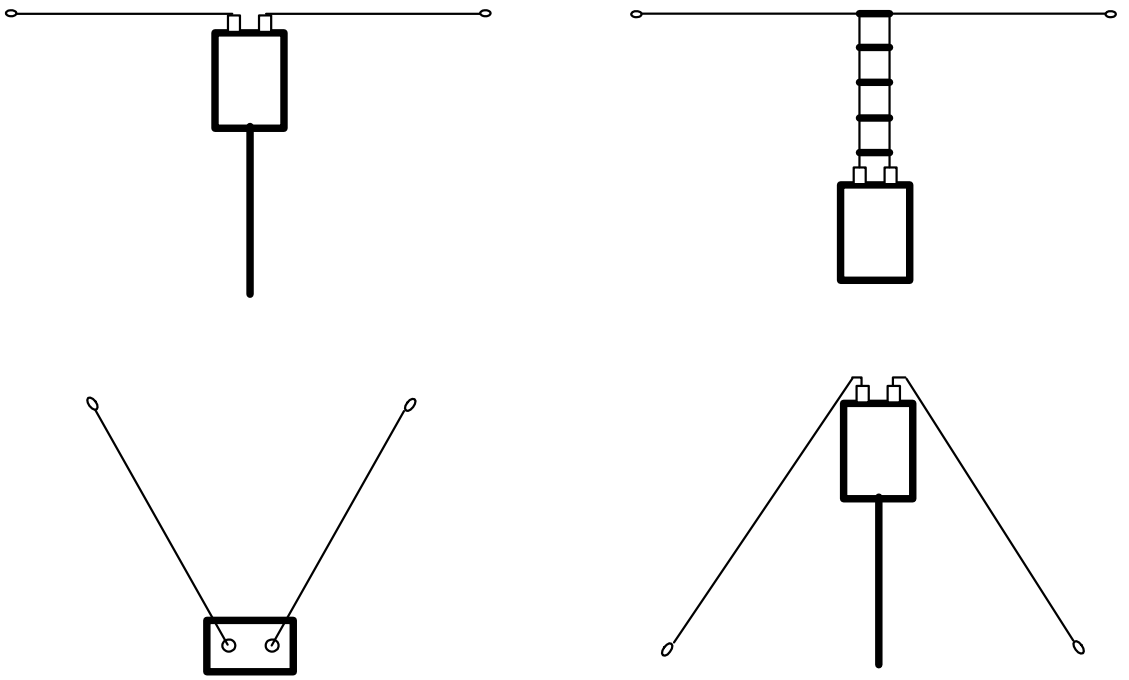
- Strip the cable coat abour 30mm
- Form the conductors in 2 rows 1 to 13 and 14 to 25
- Strip stranded wires 3 to 4 mm
- Solder the plug according drawing

DIPL.ING. KLAUS BEMMERER
ING.BÜRO FÜR NACHRICHTENTECHNIK
NIENDORF-MIDDELDOR 1.1
D-23769 BANNESDORF/FEHMARN

Antenna Descriptions and Design Hints

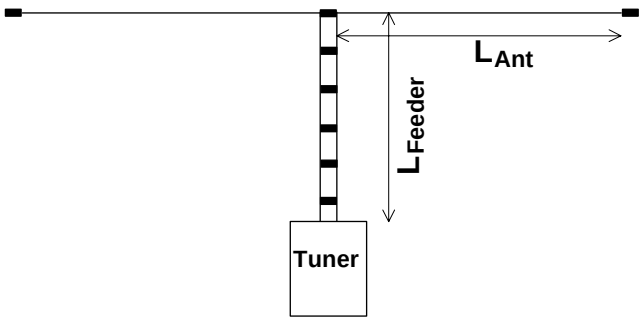
The remote controlled matching system AT-615B is capable of matching symmetrical antennas from a minimum length of 62 ft. within a frequency range of 1.8 to 30 MHz. The antenna length is dictated by the space available rather than the usual resonant length. It easily covers all amateur bands (including WARC) using a single wire dipole without traps. Traps have long been known to induce losses and antenna's designed using them are frequently limited in overall bandwidth.

Some possible Installation Configurations



DIPL.ING. KLAUS BEMMERER
ING.BÜRO FÜR NACHRICHTENTECHNIK
NIENDORF-MIDDELDOR 1.1
D-23769 BANNESDORF / FEHMARN

Some baseline rules for matching "random" antenna lengths to specific frequencies or frequency bands:



- If the antenna is fed via a balanced feeder (ladder, twin lead etc.) the value of the relation L_{Ant} / L_{Feeder} should be more than 2/1

- The length L_{Ant} + L_{Feeder} should be more than λ/2

- The antenna system L_{Ant} + L_{Feeder} need not be resonant. Some antennas that are less than a quarter wavelength per side exhibit impedances that are very low. These very low impedances can be difficult to match and some adjustments to lengths may be necessary. Antennas are multiples of a half wave present very high impedances to the tuner and may result in internal arcing of the tuner elements

- If L_{Ant} + L_{Feeder} is small in comparison to the wavelength (i.e. 160m Amateur Radio band); the internal tuner elements are exposed to very high RF voltages. An antenna i.e. 2 x 10 meters length could be matched at a wavelength of 160 meters, but the output power of the transmitter must be reduced (see "Antenna Matching")

DIPL.ING. KLAUS BEMMERER
ING.BÜRO FÜR NACHRICHTENTECHNIK
NIENDORF-MIDDELDOR 1.1
D-23769 BANNESDORF/FEHMARN

Antenna Matching (a way to start)

- Set the Mode switch to “Manual”
- Starting in the 14 MHz band
- Turn the Memory selection rotary switch to the indicated memory location “14000 +30k”
- Set the transmitter frequency to 14015 kHz (half the span of the memory location).

Do not exceed a power level of 200 Watts.

Note!
Damage to the Tuner caused by RF over voltage is not covered by the warranty!

- Begin with TRX control set to 15 and the ANT control set to 10

1. - Turn the L knob until you note a (possibly weak) movement of the SWR meter’s needle in the Reflected position
2. - Try to maximize the forward power with the ANT control knob, the reflected power may increase as well.
3. - Try to keep the forward power at its maximum by tuning the TRX and ANT controls so that the reflected power is minimum
4. - Store the final values by pressing the momentary switch position “Mem In”

- Keeping the same values found, switch to the next memory location (14030+30k, set you transmitter to 14045 kHz (center frequency). Watch your SWR Meter; if little or no change can be found, store this value in memory. If changes are necessary, follow steps 1 thru 4. Go though all memory locations on this band and correct and store the settings.

- Go to an next band and proceed as before. It is a good idea to start with a setting found in the previous band.

NOTE

During SSB operation, the frequency counter may detect the wrong frequency due to the speech frequencies impressed on the signal. This will cause incorrect tuner settings to be selected. Simply place the tuner in manual and select the correct frequency range on the display.

DIPL.ING. KLAUS BEMMERER
ING.BÜRO FÜR NACHRICHTENTECHNIK
NIENDORF-MIDDELDOR 1.1
D-23769 BANNESDORF/FEHMARN

Table of Programmed Memory Cells (Memory Allocations)

160m Band

Memory Cell	Center Freq. kHz
1800+20k	1810
1820+20k	1830
1840+20k	1850
1860+20k	1870
1880+20k	1890
1900+20k	1910
1920+20k	1930
1940+20k	1950
1960+20k	1970
1980+20k	1990

80m Band

3500+30k	3515
3530+30k	3545
3560+30k	3575
3590+30k	3605
3620+30k	3635
3650+30k	3665
3680+30k	3695
3710+30k	3725
3740+30k	3755
3770+30k	3785
3800+40k	3820
3840+40k	3860
3880+40k	3900
3920+40k	3940
3960+40k	3980

60m Band (US and UK only)

5320+40k	5340
5360+40k	5380

40m Band

7000+30k	7015
7030+30k	7045
7060+30k	7075
7090+30k	7105
7120+30k	7135
7150+30k	7165
7180+30k	7195
7210+30k	7225
7240+30k	7255
7270+30k	7285

30m Band

Memory Cell	Center Freq. kHz
10100+30k	10115
10130+30k	10145

20m Band

14000+30k	14015
14030+30k	14045
14060+30k	14075
14090+30k	14105
14120+30k	14135
14150+30k	14165
14180+30k	14195
14210+30k	14225
14240+30k	14255
14270+30k	14285
14300+30k	14315
14330+30k	14345

17m Band

18060+40k	18080
18100+40k	18120
18140+40k	18160

15m Band

21000+50k	21025
21050+50k	21075
21100+50k	21125
21150+50k	21175
21200+50k	21225
21250+50k	21275
21300+50k	21325
21350+50k	21375
21400+50k	21425

12m Band

24890+50k	24915
24940+50k	24965

10m Band

28000+100k	28050
↓	↓
29600+100k	29650

Operating with Power amplifier

- Preferably start with 14 MHz or 7 MHz. To recall the appropriate tuning values from the memory place the Tune/Memory switch in Memory position and select the appropriate frequency cell. Check the adjustment for lowest reflected power.
- Switch on the power amplifier and set the Output power to approximately 200 Watts. If you are using a tuneable (Plate and Load) PA, tune it for max. Output power by reading Forward Power on the SWR meter.
  Increase the power step by step while you readjust the PA accordingly.

- **Keep the On time to less than 30 Seconds during full power tuning**

- For small corrections to bring the SWR to 1:1 use the ANT control knob only.

- **Never change L under full power condition!**

When there is a sudden increase of the backward power while the amplifier power is increased, most probably an arcing happened in the RF Unit.
Immediately switch of the transmitter.

The antenna is too short for this band (frequency) or it is resonant.

Example Values for a Matched Antenna

Dipole 2 x 40ft. (2 x 13,5 meters), average height over ground 21ft. (7 meters) with 27ft. (9 meters) Wireman feeder line (here the shown antenna is too short in relation to the feeder length, see 1.8 MHz band)

Band MHz	TRX	L	ANT	Remarks
28	007	000	016	
24	014	000	021	
21	004	000	051	
18	012	002	013	
14	003	003	016	
10	036	003	083	
7	059	002	116	
3,5	100	003	118	
1,8	255	029	019	antenna too short, max. output power 400 Watts

DIPL.ING. KLAUS BEMMERER
ING.BÜRO FÜR NACHRICHTENTECHNIK
NIENDORF-MIDDELDOR 1.1
D-23769 BANNESDORF/FEHMARN

Technical Specifications

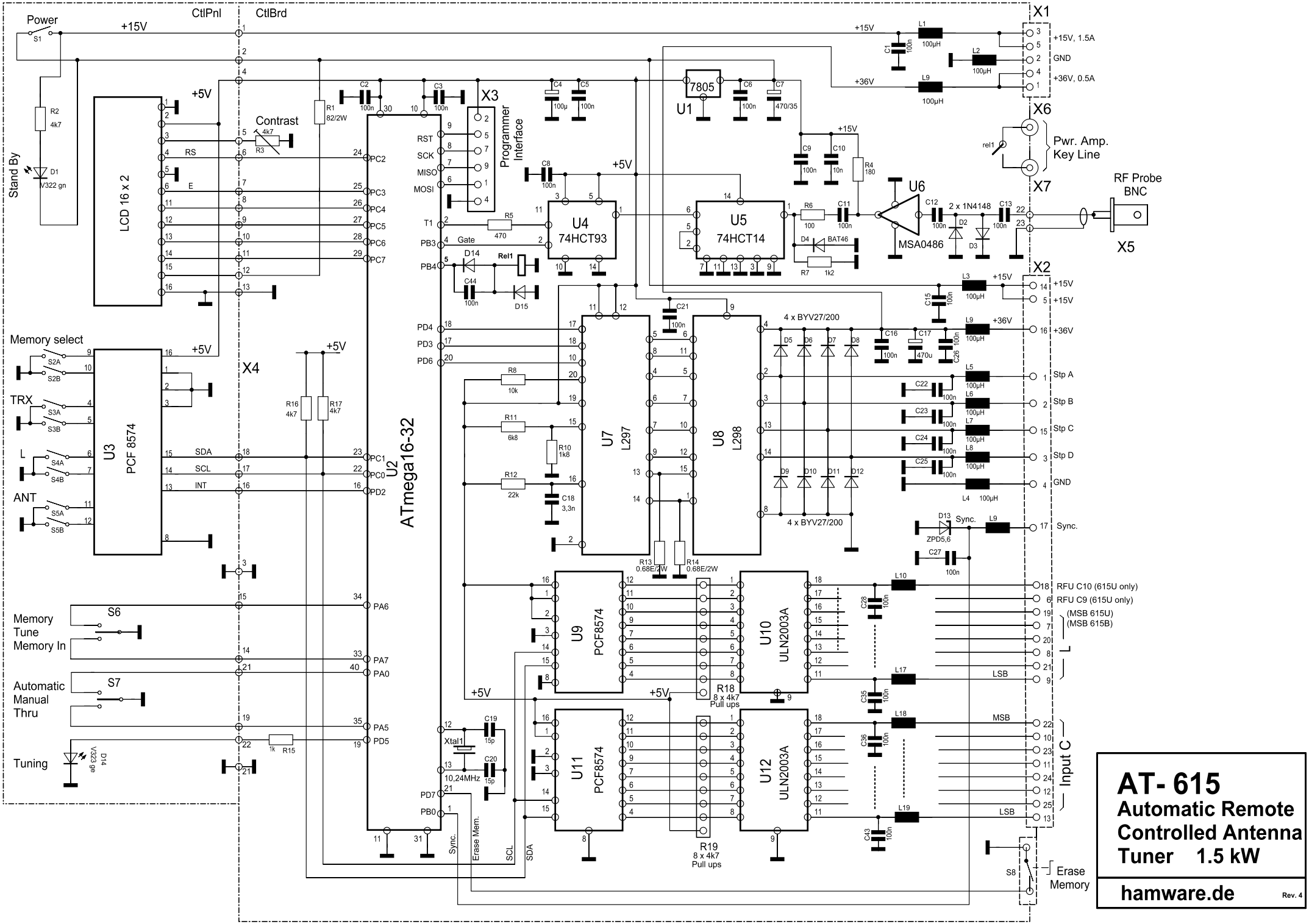
RF Unit

Frequency Range	Amateur Bands 1.8 to 30 MHz
Matching Circuit	balanced pi filter
	Input capacitors in 256 steps, 17 pF ea.
	Inductivities 32 steps exponential increasing 0,2 µH to 35 µH
	variable output capacitor 400 pF tuned by stepper motor with 200 steps of 0.9° ea.
Input	50 Ω, N-connector
RF Power	1500 Watts SSB/CW when tuned
Lightning Protection	2-Electrode-Arrester 2.5 kAmps
Control Cable	24 x AWG22 (0,35mm^2), AMP plug
Outdoor Cabinet	Polycarbonate, water tight, UV resistant
Dimensions	L x W x H = 14 x 10.2 x 6.5 inches
Weight	6 kg (13 lbs)

Controller	3 rotary encoders are used to adjust tuner elements
Tuning Memories	85, automatic or manual selectable
Automatic Mode	Frequency dependent selection of the memory locations. Frequency is sensed by RF probe
Displays	- LCD Display indicating single steps for input C, L and output C - Frequency Memory Location - Standby LED - LED while tuner is matched
Safety Circuit	Power Amp. Key Line Interruption when Input, L, Channel Selector, “Thru” will be changed. 30ms Delay

DIPL.ING. KLAUS BEMMERER
ING.BÜRO FÜR NACHRICHTENTECHNIK
NIENDORF-MIDDELDOR 1.1
D-23769 BANNESDORF/FEHMARN

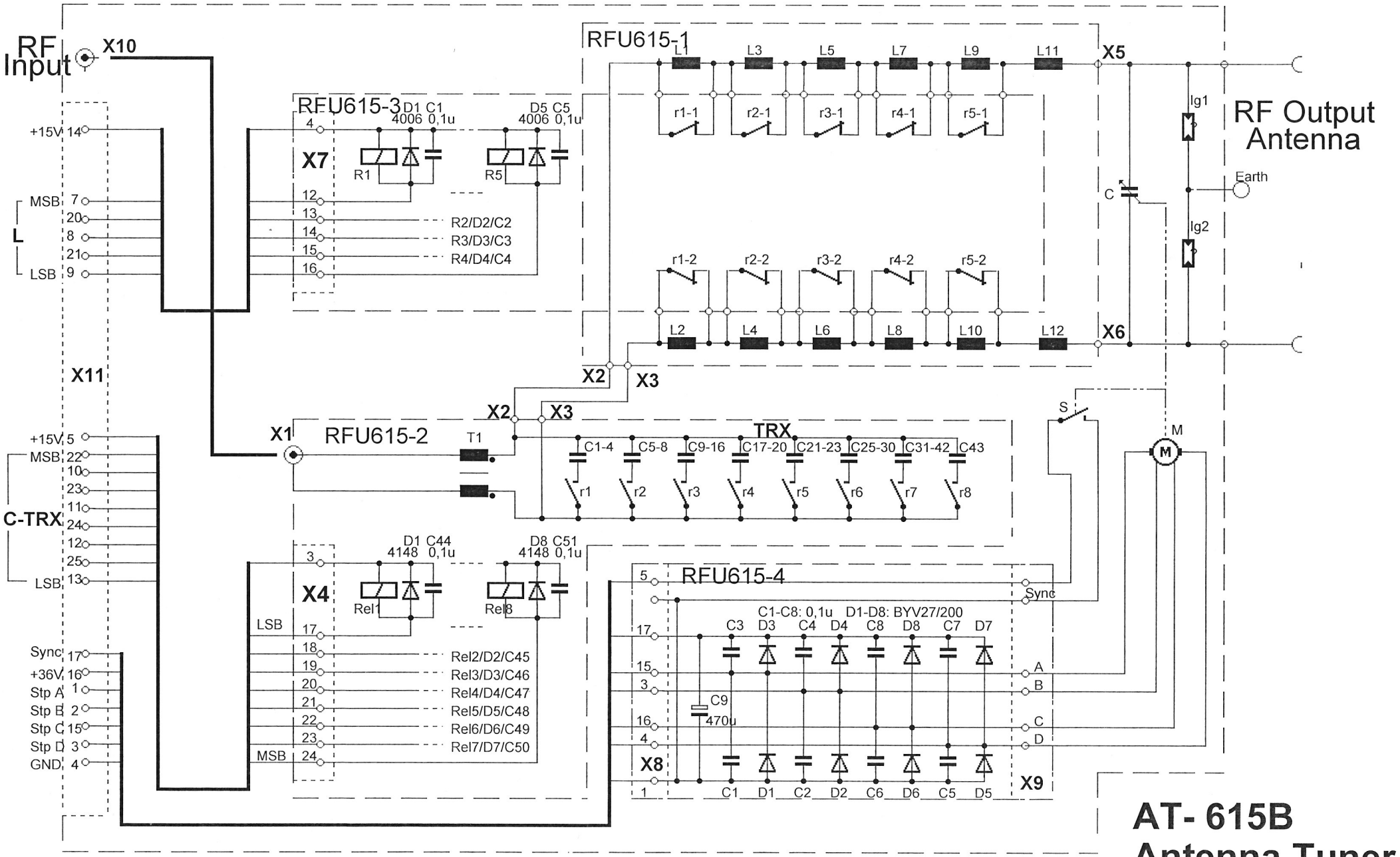
"Thru" Function	Input switched directly to Output
Displays	- LCD Display indicating single steps for input C, L and output C - Frequency Memory Location - Standby LED - LED while tuner is matching
Power	+15VDC, 1.5A and +36VDC, 0.5A
Metal Bench Cabinet	W x D x H = 11 x 3.5 x 6.9 inches
Weight	1,8 kg (4 lbs)
Power	+15VDC, 1.5A and +36VDC, 0.5A
Metal Bench Cabinet	W x D x H = 11 x 3.5 x 6.9 inches
Weight	1,8 kg (4 lbs)



AT- 615

Automatic Remote Controlled Antenna Tuner 1.5 kW

hamware.de Rev. 4



AT- 615B
Antenna Tuner
RF Unit

Rev. 0