



hamware.de AT-502 Firmware with transceiver interface

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Change history

Version	Datum	Wer	Änderungen
1.0	17. Mai 2012	DL2SBA	Erste Version
1.1	18. Mai 2012	DL2SBA	Überarbeitung
1.2	20. Mai 2012	DL2SBA	Erläuterungen bzgl. Antennenumschalter ASU-502 aufgenommen.
1.3	27. Mai 2012	DL2SBA	Erläuterungen zu Transceiver-Anbindung ICOM Mode erweitert
1.4	28. Mai 2012	DL2SBA	Befehl „FA“ wird nun auch beim Kenwood Protokoll unterstützt.
1.5	1. Juni 2012	DL2SBA	Ergänzungen bzgl. K2
1.6	10. Juni 2012	DL2SBA	Erläuterungen Split-Betrieb
1.7	16. Juni 2012	DL2SBA	Korrektur CI-V Schnittstelle
1.8	30. Juni 2012	DL2SBA	KX3 aufgenommen Speicherschritte auf 160m und 80m erhöht Zusatzsteuerung für 160m und 80m
1.9	12. Januar 2013	DL2SBA	Korrektur Schnittstellenwandler
2.0	22. November 2013	DL2SBA	Translated to English
2.1	29. December 2013	DL2SBA	EMI filter in interface detailed

Remark: Any changes that you make on the control unit of the AT-502, is at your own risk. Please note, in any case, the general guidelines for handling sensitive electronic equipment and components.

The firmware cannot be provided in the form of an Intel Hex file.

The microcontroller contains code which is protected by copyright. Please respect this!

Introduction

The original firmware for the HAMWARE AT-502 tuner has a built-in feature, that the frequency of a transmitter is measured and according to the frequency, the correct memory channel is selected.

This feature works relatively good in CW mode, in SSB mode it's more or less useless. Using this feature in QRP modes did not work.

I have now been developed a new firmware for the AT-502 controller, which takes advantage of the computer interface of the transceiver to select the matching memory.

Usually the transceiver is used in conjunction with a logbook program, then the firmware can read the information exchanged and react accordingly. Thus, a change in frequency of the connected transceiver leads to the selection of the correct memory of the AT-502 and thus to the correct tuning of the antenna.

The firmware provides, like the original firmware also, the opportunity to select the relevant memory by hand.

Memory channels

Currently the following memory channels are supported:

160m: 1800, 1810, 1820, 1830, 1840, 1850, 1860, 1870, 1880, 1890, 1900, 1910, 1920, 1930, 1940, 1950, 1960, 1970, 1980, 1990, 2000

80m: 3500, 3515, 3530, 3545, 3560, 3575, 3590, 3605, 3620, 3635, 3650, 3665, 3680, 3695, 3710, 3725, 3740, 3755, 3770, 3785, 3800, 3815, 3830, 3830, 3860, 3875, 3890, 3905, 3920, 3935, 3950, 3965, 3980, 4000

50m: 5320, 5360, 5400

40m: 7000, 7030, 7060, 7090, 7120, 7150, 7180, 7200

30m: 10100, 10130, 10150

20m: 14000, 14030, 14060, 14090, 14120, 14150, 14180, 14210, 14230, 14270, 14300, 14330, 14350

17m: 18060, 18100, 18140, 18168

15m: 21000, 21050, 21100, 21150, 21200, 21250, 21300, 21350, 21400, 21450

12m: 24890, 24940, 24990

10m: 28000, 28100, 28200, 28300, 28400, 28500, 28600, 28700, 28800, 28900, 29000, 29100, 29200, 29300, 29400, 29500, 29600, 29700

This means that for the above frequencies provided, in each case one memory is relevant for a pair of frequencies, e.g. 1.800MHz - 1820MHz or 24,990 MHz - 28.000MHz.

Using the toggle switch ANT 1/2 the memory bank and possibly the antenna on the connected ASU-502 can be selected. Each antenna has its own associated memory bank. If no ASU-502 is present, you can use the two banks for different memory configurations.

Supported AT-502 controllers

Currently the firmware supports the new and old hardware. The new hardware has a 64-step inductivity, the old hardware has a 128-step inductivity, but didn't support the ASU-502 switch.

Supported logging programs

Currently I've tested my firmware with:

- Swisslog
- RUMLOG

Supported manufacturers

Currently the firmware supports the following protocols:

- ICOM serial (Also known as CI-V protocol)
- KENWOOD/ELECRAFT serial

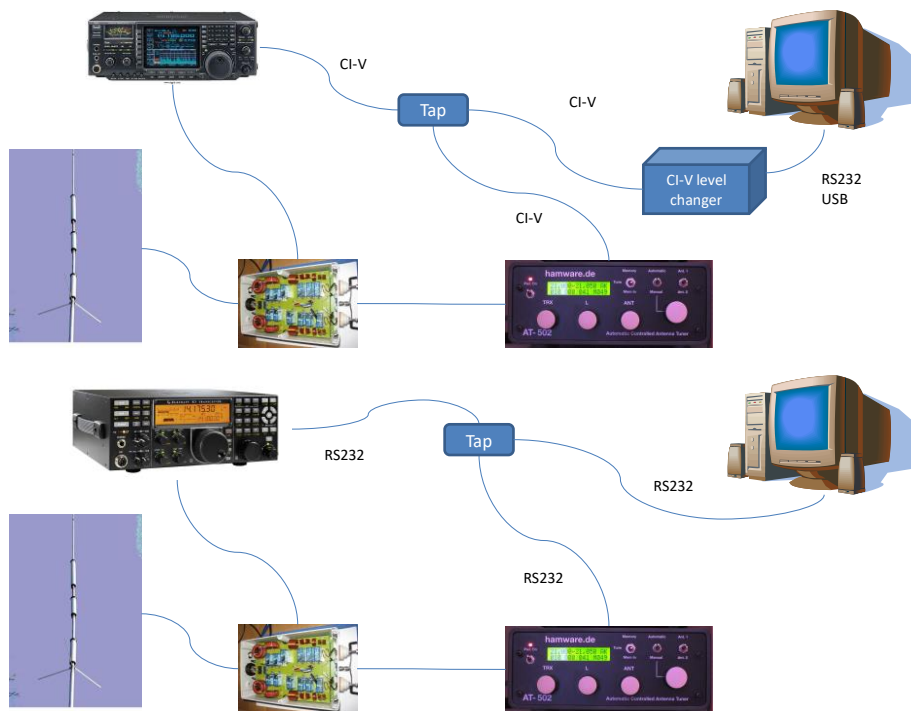
The configuration is described in chapter „Configuration mode" on page 21.

Computer interface

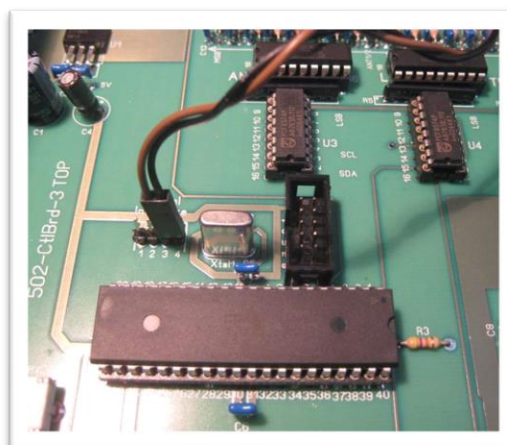
Hardware

The AT-502 controller must be connected to the computer interface of the transceiver. Usually this is done via a pick-up circuit, which is connected to the TX-data of the transceiver.

The picture shows an example for ICOM CI-V and serial RS232 interface.



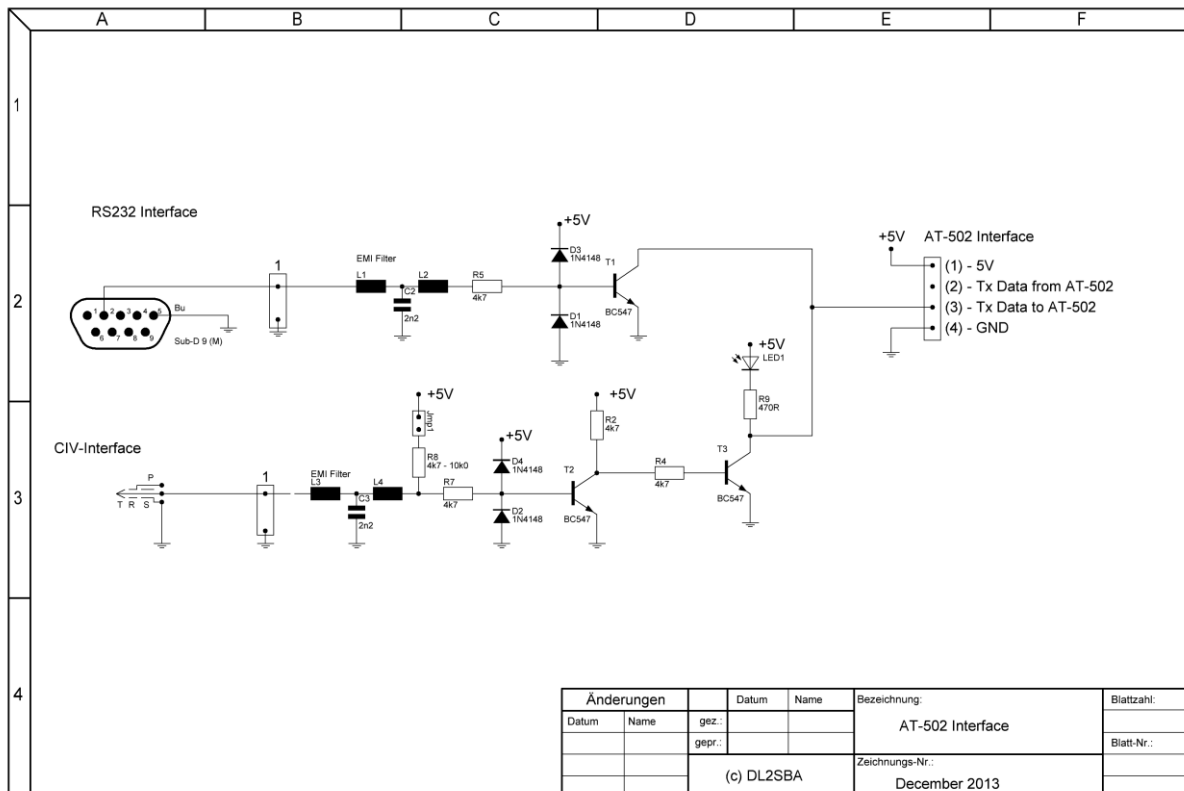
Inside the AT-502 the serial port of the ATMEGA32 can be found on a four-pin header. This makes the connection of an interface board fairly simple.



AT-502 - Firmware with transceiver interface

Next picture shows a simple level converter for RS-232 (interface of the ELECRAFT K3) and for the CI-V interface (ICOM IC-756 PRO 3):

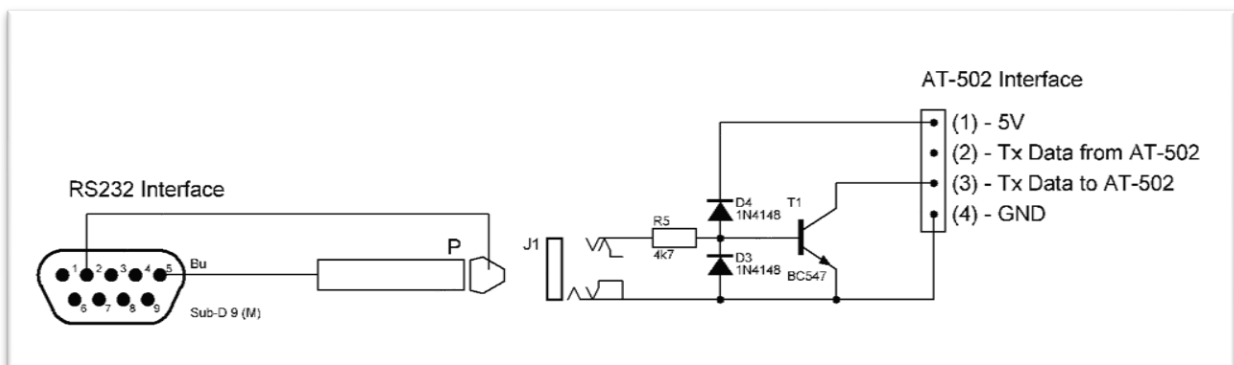
AT-502 - Firmware with transceiver interface



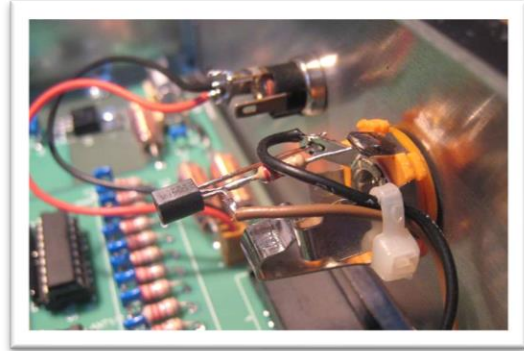
Hint: If the CI-V interface is not working, means the LED is not flashing when tuning the transceiver, close the jumper JMP1 and see, if it works then. The jumper enables the pull-up resistor on the CI-V bus, which may be needed in some cases.

The EMI filter can be ordered in the REICHEL online-shop (<http://www.reichelt.de>) with part number [DSN6 NC51H 222](#).

The next picture shows a really simple level-converter, which is working fine with my K3:



AT-502 - Firmware with transceiver interface

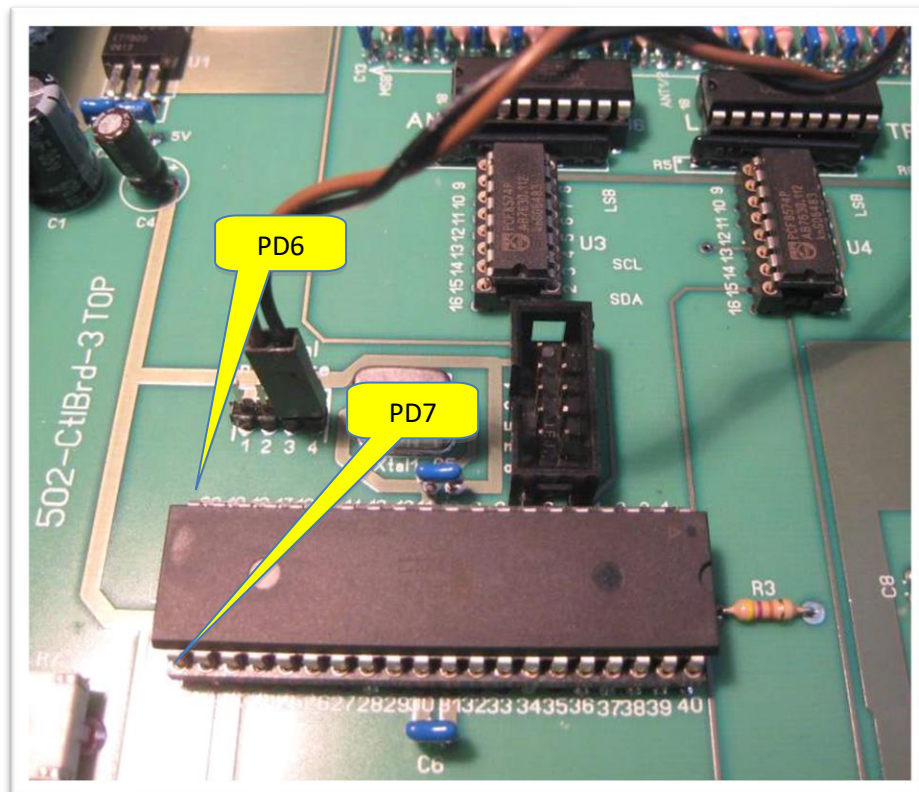


Extended relays control

Since software version „30 June 2012“ the firmware supports two additional relays outputs:

PIN	uC Port	Usage
20	PD6	This port is active, if any frequency in the 160m band is selected.
21	PD7	This port is active, if any frequency in the 80m band is selected.

These ports can be used to control external relays circuits for 160m and 80m bands. The related controller pins are marked in the following picture:



Both ports are programmed with active pull-up resistors, means the outputs are high (+5V) on the respective band.

To drive external relays, port drivers like the ULN2003 (as used on the main board too) should be used.

Software

Currently only ICOM and Kenwood communication protocols are supported.

I've successfully tested the firmware with these transceiver:

- ICOM
 - IC-756 PRO III
 - IC7400
 - IC7600
 - IC7700
 - IC706 MKII
- ELECRAFT
 - K2
 - K3
 - KX3
- Kenwood
 - TS-2000
 - TS-2000 mit W4MQ Software

This firmware works in passive mode. This means, that the data exchange between the transceiver and the computer is picked-up and analysed. Usually the used logging programs, regularly scan the transceiver for the current operation frequency. This information is used by the firmware.

If you're not using any logging program, which regularly scans the transceiver, this firmware only works, if your transceiver has also an operation mode, in which it transmits the operation frequency independently. As far as I know, currently only ICOM and the newer ELECRAFT transceivers support this operation mode.

ICOM protocol

Transceive = ON

ICOM transceivers usually have the function "CIV-Transceive = ON" set. In this mode, the transceiver transmits its operation parameter on each frequency change via the CI-V interface.

The data packet usually transmitted by the transceiver looks like this:

FE FE 00 6E 00 80 81 26 14 00 FD

This is a state message for a transmit frequency of 14.268.180Hz.

Position	Wert	Bedeutung
1	0xFE	1st start char
2	0xFE	2nd start char
3	0x00	Target address In case of „CIV-Transceive=ON“ always 0x00
4	0x6E	Source address In case of an IC-756 PRO 3 it is 0x6E or 110d ¹
5	0x00	Command In case of „CIV-Transceive=ON“ always 0x00
6	0x80	BCD-coded the digits 1Hz and 10Hz
7	0x81	BCD-coded the digits 100Hz and 1kHz
8	0x26	BCD-coded the digits 100kHz and 10kHz
9	0x14	BCD-coded the digits 10MHz and 1MHz
10	0x00	BCD-coded the digits 1GHz and 100MHz
11	0xFD	End char

The AT-502 firmware configuration has to be set like this:

```
MODE=Icom
ADR=6e
CMD=00
```

¹ Check your transceiver CI-V manual for the correct device address
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Transceive = OFF

In this operation mode, the computer regularly scans the transceiver for its transmitter frequency:

FE FE 6E E0 03 FD

Position	Wert	Bedeutung
1	0xFE	1st start char
2	0xFE	2nd start char
3	0x6e	Target address In case of an IC-756 PRO 3 it is 0x6E ²
4	0xE0	Source address Computers address is always 0xE0
5	0x03	Command „read operating frequency“
6	0xFD	End char

The transceiver responds on this command with the following sequence:

FE FE E0 6E 03 80 81 26 14 00 FD

Position	Wert	Bedeutung
1	0xFE	1st start char
2	0xFE	2nd start char
3	0xE0	Target address Computers address is always 0xE0
4	0x6E	Source address In case of an IC-756 PRO 3 it is 0x6E ³
5	0x03	Befehl On query command 0x03 always 0x03
6	0x80	BCD-coded the digits 1Hz and 10Hz
7	0x81	BCD-coded the digits 100Hz and 1kHz
8	0x26	BCD-coded the digits 100kHz and 10kHz
9	0x14	BCD-coded the digits 10MHz and 1MHz
10	0x00	BCD-coded the digits 1GHz and 100MHz
11	0xFD	End char

For this configuration, the AT-502 firmware must be setup like this:

```
MODE=Icom
ADR=6e
CMD=03
```

² Check your transceiver CI-V manual for the correct device address

³ Check your transceiver CI-V manual for the correct device address

Kenwood protocol

Currently the firmware supports the commands

- „IF“ *Read status of transceiver*
- „FA“ **Frequency VFO A**

An active polling of the AT-502 is **not** supported!

Kenwood transceiver are only working with this firmware, if you're using a logging program, which regularly scans the transceiver using the **FA** or **IF** command.

It also works, if the logging program sets the parameter **AI** to **1, 2** or **3** which results in auto-transmission of the operation frequency by the transceiver.

On the ELECRAFT K3 or K3X you can set the function "**Autoinfo = 1**". This enables the transceiver to transmit every change in frequency using the **IF** command.

Firmware-Upgrade

The firmware upgrade is fairly simple:

1. Write down every memory setting of your AT-502. This will give you a good starting point for the new firmware.
2. Switch the AT-502 controller off
3. Remove all cables from the AT-502
4. Remove the old ATMEGA32 controller from the AT-502
5. Build and integrate the interface converter
6. Insert the new ATMEGA32 with the new firmware. Be careful not to bend any pins and check the orientation using the sketch on the main board
7. Connect power to the AT-502
8. Launch the AT-502 in configuration mode (see chapter „Configuration mode“ on page 21)
9. Setup the desired parameters. Check chapter „Configuration mode“ on page 21.
10. Save the configuration
11. Switch the AT-502 off and on again
12. Press the „save“ button at the back of the AT-502
13. Switch the AT-502 off
14. Connect your external tuner
15. Switch the AT-502 on again
16. Switch into tuning mode (see chapter „Tune-mode“ on page 19)
17. Setup the correct tuning values for each memory slot.
18. Connect your transceiver to the interface converter
19. Switch into automatic-mode (check chapter „Automatic-mode“ on page 18)
20. Setup the corresponding parameters in your transceiver. See chapter „Configuration mode“ on page 21
21. Change the operation frequency on your transceiver
22. be happy :-)

Usage

The usage of the new firmware is nearly identical to the original firmware.



After power-on depending on the operation mode, either the configuration or standard data is displayed.

The firmware support two operation modes:

- Standard-mode
- Configurations-mode

Standard-mode

This mode is controlled using the two switches **Memory-Tune-MemIn** and **Automatic-Manual**.

In the right-most position on the first display line, the mode is displayed. Either KENWOOD-Mode (**K**) or ICOM-Mode (**I**). Check chapter "Configuration mode" on page 21 for details.

Automatic-mode

This mode is selected, if the switch **Automatic-Manual** is in the **Automatic** position. This is indicated by the character A in the display



In this mode, the rotaries have no function. The memory channel is controlled via the transceiver interface.

Memory-Mode

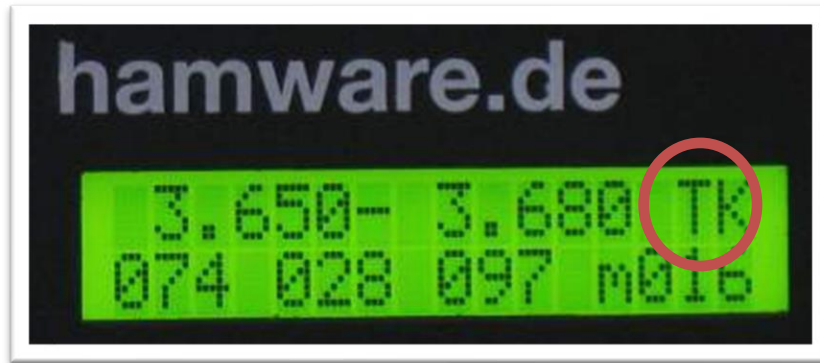
This mode is selected, if the switch **Automatic-Manual** is in the **Manual** position and the switch **Memory-Tune-MemIn** is in the **Memory** position. This is indicated by the character M in the display.



In this mode, only the right-most rotary **Manual** is active. It can be used to select the desired memory channel.

Tune-mode

This mode is selected, if the switch **Automatic-Manual** is in the **Manual** position and the switch **Memory-Tune-MemIn** is in the **Tune** position. This is indicated by the character M in the display.:



In this mode, the tuner components can be selected using the rotaries **TRX**, **L** and **ANT**.

The memory channel can be selected with the **Manual** rotary switch. Pressing the switch **Memory-Tune-MemIn** into the **MemIn** position, writes the settings into the controller memory.

This is indicated by the letter **"M"** in front of the memory channel.

Auto configuration save

If the parameters

- selected memory channel in Manual-Mode
- the capacity values for ANT and TRX
- the inductivity value

are changed, the letter „m“ in front of the memory channels changes to „M“. This indicates, that the current configuration is currently not saved to the EEPROM.

If no further actions are done, the configuration is saved after abt. 10minutes into the EEPROM of the controller. This is indicated in the display_:



You can enforce the writing to the EEPROM using the button **Erase Memory bandwise** on the backside of the AT-502:



Configuration mode

Pressing the rear-button **Erase Memory band wise** during power-up, the AT-502 enables the configuration mode.



Using the rotary switch **Manual** switches between **ICOM**



and **KENWOOD** mode



Use the rotary switch **L** for selecting the **Baudrate** of the transceiver serial interface.

ICOM Mode

The command for frequency scan can be set using the rotary switch **ANT**. The command is displayed in hex format. A decimal-to-hex conversion table can be found in chapter „Decimal-hex-conversion table“ on page 25.

The transceiver address can be selected using the rotary switch **TRX**. The address is also displayed in hex format.

More details on the ICOM-interface can be found in chapter „ICOM “ on page 13.

Remark: It is important, that the address of the transceiver is set correctly in the AT-502. On a CI-V bus, multiple transceiver can be connected in parallel, so the transceiver, relevant for the AT-502 must be defined.

Saving configuration

The configuration is saved by pressing the switch **Memory-Tune-MemIn** into **MemIn** position.



Now the AT-502 has to be switched off and on.

Split-mode

The ICOM protocol always transmits the transmission-frequency of the transceiver. So the antenna is always tuned to the transmission frequency.

The KENWOOD protocol always transmits the VFO-A frequency. This means, in split-mode, the antenna is always tuned to the RECEIVE frequency!

Sample configurations

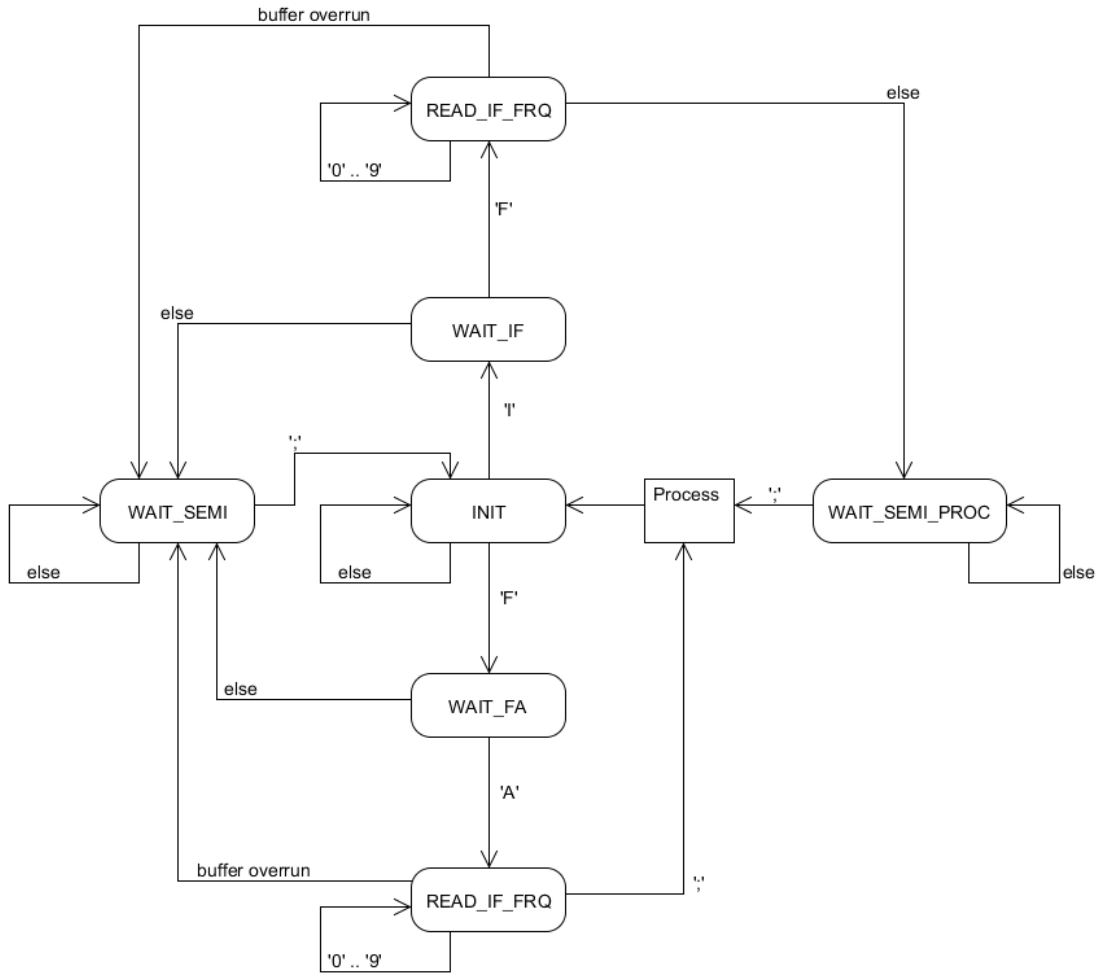
Transceiver Typ	Transceiver Parameter	Value	AT-502 Parameter	Value
ICOM IC-756 PRO 3 ICOM IC-7700	CIV-Baudrate	9600	Mode	ICOM
	CIV-Transceive	ON	Baud	9600
			Cmd	00
			Adr	6e
ICOM IC-7300	CIV-Baudrate	9600	Mode	ICOM
	CIV-Transceive	ON	Baud	9600
			Cmd	00
			Adr	94
ELECRAFT K3	RS232	38400 b	Mode	KENWOOD
	AUTOINFO	Auto 1	Baud	38400
ELECRAFT KX3	RS232	38400 b	Mode	KENWOOD
	AUTOINFO	ANT CTRL	Baud	38400

Appendix

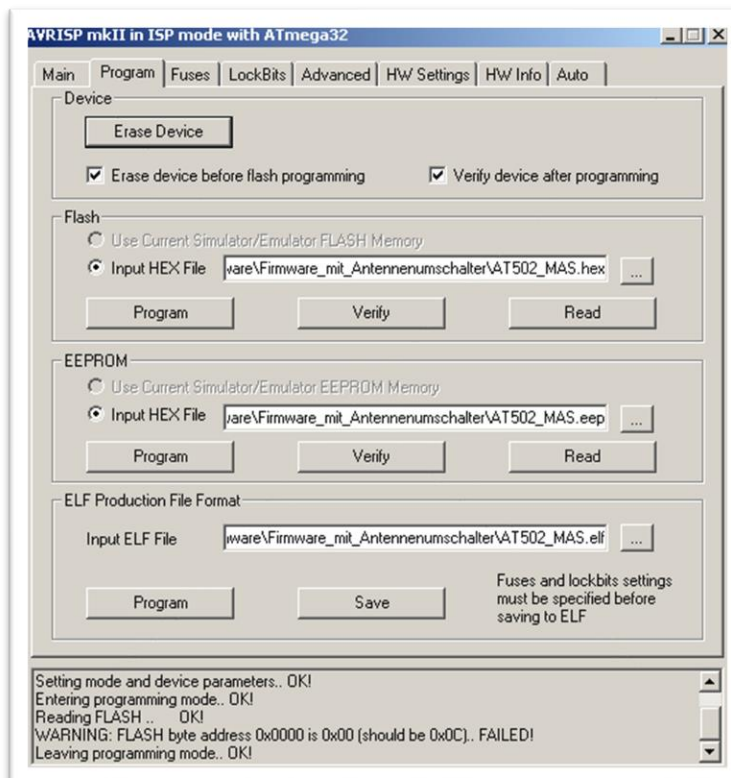
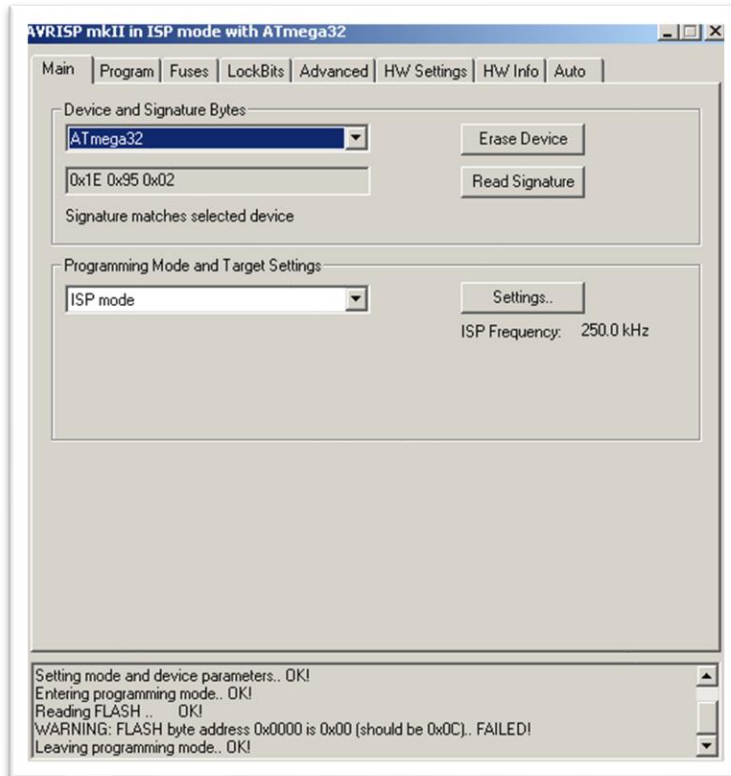
Decimal-hex-conversion table

Dez	Hex	Dez	Hex	Dez	Hex	Dez	Hex
0	00	64	40	128	80	192	C0
1	01	65	41	129	81	193	C1
2	02	66	42	130	82	194	C2
3	03	67	43	131	83	195	C3
4	04	68	44	132	84	196	C4
5	05	69	45	133	85	197	C5
6	06	70	46	134	86	198	C6
7	07	71	47	135	87	199	C7
8	08	72	48	136	88	200	C8
9	09	73	49	137	89	201	C9
10	0A	74	4A	138	8A	202	CA
11	0B	75	4B	139	8B	203	CB
12	0C	76	4C	140	8C	204	CC
13	0D	77	4D	141	8D	205	CD
14	0E	78	4E	142	8E	206	CE
15	0F	79	4F	143	8F	207	CF
16	10	80	50	144	90	208	D0
17	11	81	51	145	91	209	D1
18	12	82	52	146	92	210	D2
19	13	83	53	147	93	211	D3
20	14	84	54	148	94	212	D4
21	15	85	55	149	95	213	D5
22	16	86	56	150	96	214	D6
23	17	87	57	151	97	215	D7
24	18	88	58	152	98	216	D8
25	19	89	59	153	99	217	D9
26	1A	90	5A	154	9A	218	DA
27	1B	91	5B	155	9B	219	DB
28	1C	92	5C	156	9C	220	DC
29	1D	93	5D	157	9D	221	DD
30	1E	94	5E	158	9E	222	DE
31	1F	95	5F	159	9F	223	DF
32	20	96	60	160	A0	224	E0
33	21	97	61	161	A1	225	E1
34	22	98	62	162	A2	226	E2
35	23	99	63	163	A3	227	E3
36	24	100	64	164	A4	228	E4
37	25	101	65	165	A5	229	E5
38	26	102	66	166	A6	230	E6
39	27	103	67	167	A7	231	E7
40	28	104	68	168	A8	232	E8
41	29	105	69	169	A9	233	E9
42	2A	106	6A	170	AA	234	EA
43	2B	107	6B	171	AB	235	EB
44	2C	108	6C	172	AC	236	EC
45	2D	109	6D	173	AD	237	ED
46	2E	110	6E	174	AE	238	EE
47	2F	111	6F	175	AF	239	EF
48	30	112	70	176	B0	240	F0
49	31	113	71	177	B1	241	F1
50	32	114	72	178	B2	242	F2
51	33	115	73	179	B3	243	F3
52	34	116	74	180	B4	244	F4
53	35	117	75	181	B5	245	F5
54	36	118	76	182	B6	246	F6
55	37	119	77	183	B7	247	F7
56	38	120	78	184	B8	248	F8
57	39	121	79	185	B9	249	F9
58	3A	122	7A	186	BA	250	FA
59	3B	123	7B	187	BB	251	FB
60	3C	124	7C	188	BC	252	FC
61	3D	125	7D	189	BD	253	FD
62	3E	126	7E	190	BE	254	FE
63	3F	127	7F	191	BF	255	FF

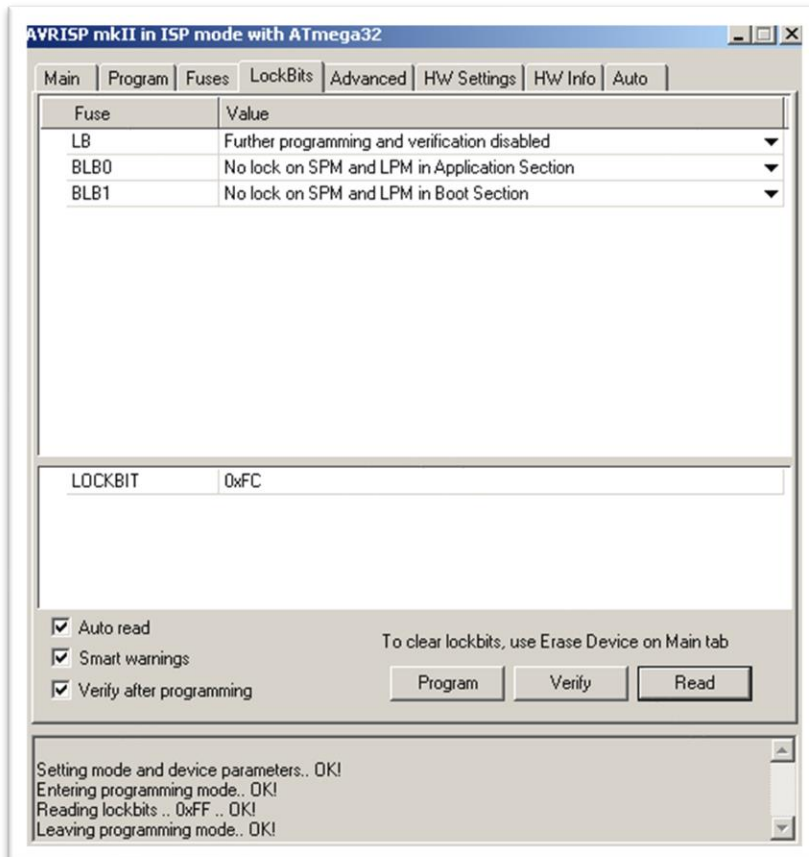
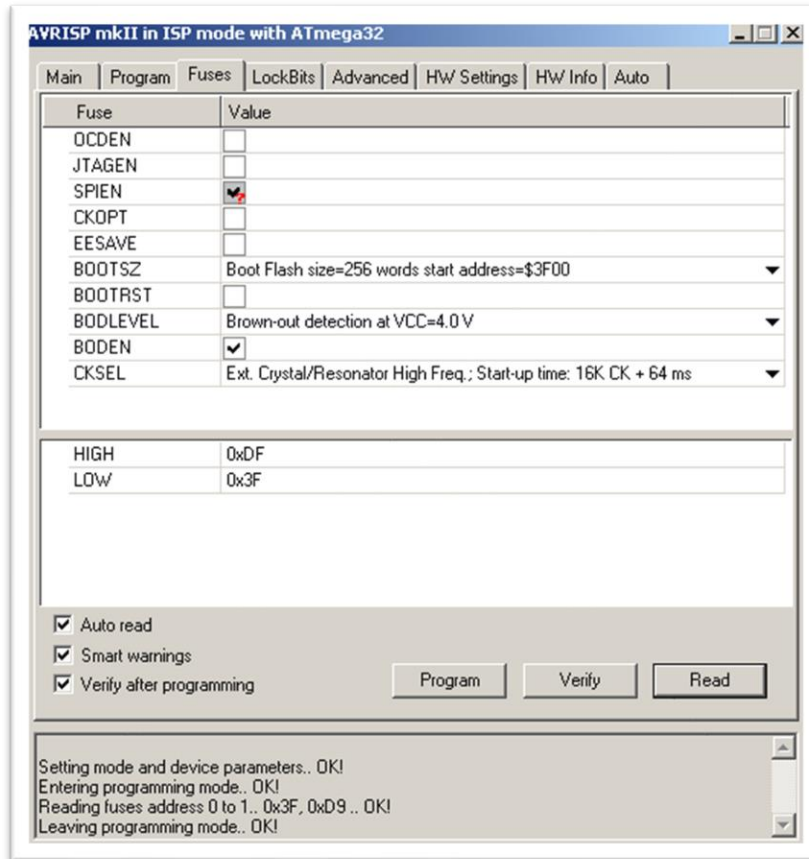
State-Chart Kenwood Interface



AMEGA32 Fuses



AT-502 - Firmware with transceiver interface



Links

http://hamware.de	Hersteller des Tuners
http://www.plicht.de/ekki/civ/index.html	Eine sehr gute Zusammenfassung des CI-V Protokolls
http://www.dl2sba.de	Hersteller dieser Firmware
http://www.elecraft.de	Informationen zum KENWOOD Protokoll des K3
http://winavr.sourceforge.net/	C-Compiler für den ATMEL μ Controller
http://homepage.hispeed.ch/peterfleury/	Exzellente Bibliotheken für den μ Controller
http://www.umlet.com/	Zeichnen von State-Charts
http://www.dl2rum.de/rumsoft/RUMLog.html	Logbuchprogramm für MAC
http://www.informatix.li/english/Frame_EN.htm	Logbuchprogramm für Windows
http://www.w4mq.com/	Internet Remote Base Software