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OPERATING INSTRUCTIONS
HamControllerMK1/2
PCB Version: E, F, G

CONTENTS:

1. OVERVIEW

The HamControllerMK1/2 repeater controller is developed to be used in amateur radio repeaters, and will take care of all necessary features to operate the repeater. The controller can also be set in cross-band repeater mode, operating a repeater using two different radios on different bands.

On the distributed CD, you will find a Graphical User Interface (GUI) application, which runs under Windows on a PC. Use the GUI to configure the controller parameters, uploading of firmware updates and speech synthesizer voice files.

The size of the Main PCB is 100x112 mm, and the PCB have 3,2 mm mounting holes, located in each corner.

The controller is having 3 radio ports. One for the repeater TX/RX connection, one for a link radio TX/RX connection and one for a command RX.

Specifications:

Power supply:	13.6VDC nominal, 7 – 15 VDC
Power consumption:	Less than 30mA
Input AF level:	50-700 mV peak-to-peak, max 1V
Output AF level:	Adjustable up to 2 V peak-to-peak
Outputs:	Open drain, maximum 300 mA
Digital inputs:	Maximum 5V DC
RSSI:	Maximum 7V DC (/2 power divider fitted)
BCD outputs:	3.3V TTL

2. GUI

Along with the controller a CD is distributed. This CD contains all documentation and the GUI running under the Windows platform, and USB driver. The GUI is called "**HamControllerMK1.exe**", and please also locates the help file named "**HamControllerMK1.chm**".

If you are copying the files to your hard drive, please remember to copy the help file to the same folder as the exe-file, otherwise the help file will not open in GUI.

The GUI will take care of all repeater settings needed to operate the HamControllerMK1 properly, and a file with your settings can be stored on your hard drive.

Connecting the controller:

Use the supplied USB cable, and connect to a USB port of your PC and the controller, then power-up the controller. For the controller delivered in a enclosure, you have to open the enclosure to locate the USB B connector.

When connecting the controller to your PC for the first time, Windows is looking for a driver, and if found, it will be automatically installed. If you are using Windows2000 or older, you may have to install the supplied driver. Just follow the on screen information. When the driver is installed, then launch the GUI by clicking on the HamControllerMK1.exe file, no Windows installation is necessary.

When the GUI is launched, click the **"Connect Controller"** button, and when the GUI finds the controller, parameters will be read to the GUI.

The "Squelch" LED will be on and the "Status" LED will flash fast while the GUI is doing any operation on the USB port.

Then you can do your changes, and click menu item **"Link>Write Parameters"**, and all parameters will be uploaded to the controller, and the controller will start working with the new settings immediately.

3. FIRMWARE UPGRADE

When upgrading, only the correct HEX file will be accepted by the GUI. The firmware file is named **HamControllerMK1.hex.** Click menu item **Link>Firmware update"**. In the file load dialog box, locate the HEX file and double click it. The upgrade then starts, and do nothing until the upgrade is finished. Progress is shown in the red text box.

4. ACCESS

Select the combination you want to use. If "1750/DTMF/CTCSS" is selected, repeater is searching for a 1750 Hz tone, DTMF access code or CTCSS tone. If one of the 3 ways of accessing the repeater is detected, the repeater will key up transmitting the call sign. If "1750 only" is selected, the repeater is only searching for the 1750 Hz access tone. Select in the **"Repeater access"** box the way you want the users to open the repeater.
CTCSS:
The repeater can transmit and decode CTCSS (PL) tones. If "NOTONE" is selected, the CTCSS function is off. Select when you want the CTCSS tone to be transmitted in the **"CTCSS TX"** box. The CTCSS tone is transmitted even if the CTCSS decoder is off (no CTCSS access) when a tone is selected. When **"CTCSS only"** is selected, only users having the correct tone programmed in their radios will get threw the repeater. For the other options, also radios not using a CTCSS tone will get threw the repeater.
When the tone is detected, the repeater will go on the air at once.
DTMF:
Select number of digits in the access code (1 or 2) along with the code to be dialled from the operator's DTMF pad.
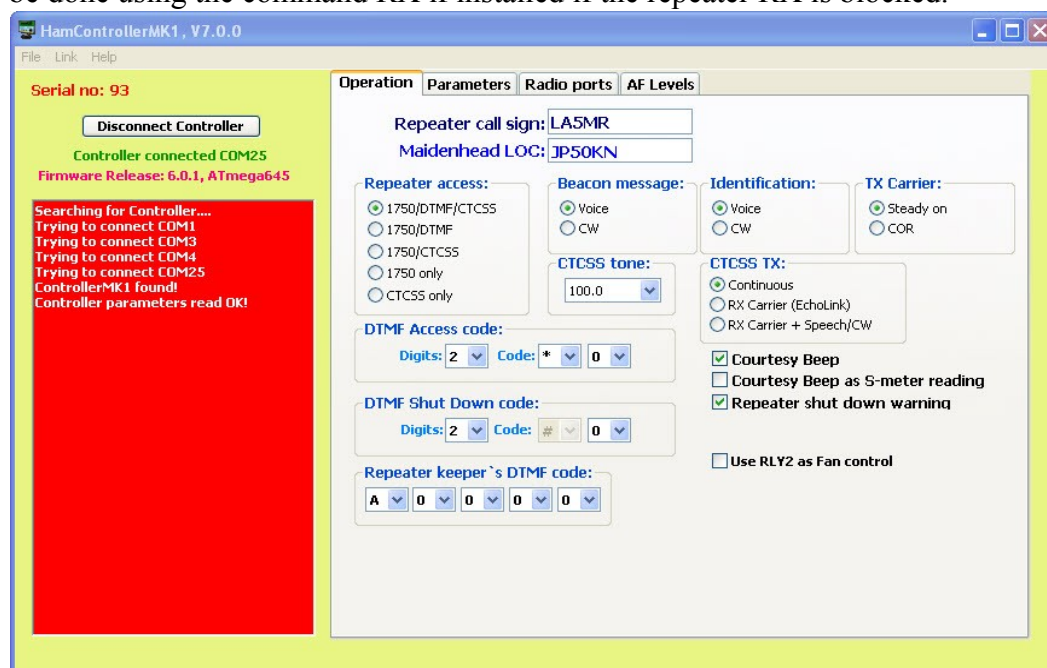Dial the 1 or 2 digit DTMF code set in the GUI. Use radio DTMF pad to dial the access code. The repeater will open when correct code is detected.
1750 Hz tone:
The repeater will key up when a 1750 Hz tone is detected for the time set in GUI.
Repeater shut down:
If the repeater is not operating properly, and you need to shut down the repeater while it is open, this can be done by dialling the GUI selected DTMF code. After dialling the code, the speech message "repeater is off" is played, and then repeater is reset. This can be done using the command RX if installed if the repeater RX is blocked.

5. OPERATIONAL PARAMETERS

You can change all repeater parameters using the GUI, and also some parameters can be changed remotely using the Repeater keepers DTMF code (read chapter 14 for more information).

Repeater call sign:

This is the repeater call sign transmitted in CW. If you want to use a voice message instead of CW when repeater is opened, the call sign voice message has to be recorded (read chapter 14 for more information).

Maidenhead LOC:

This is the Maidenhead Locator transmitted in the CW beacon message.

Identification:

When repeater is opened, the repeater is keying up transmitting call sign in CW or Voice. If CW is selected, the call sign in the **"Repeater call sign"** edit box is transmitted, and when selecting **"Voice"**, the repeater voice call sign message recorded is transmitted (read chapter 14 for more information).

TX carrier:

If **"Steady on"** is selected, the repeater TX is on the air even if there is no carrier detected at repeater RX when open, but if **"COR"** is selected, the repeater TX is keyed up only when a RX carrier is present.

Beacon message:

Select if you want the beacon to be transmitted as a CW or voice message. If CW is selected, the repeater call sign and Maidenhead LOC will be transmitted, and if voice is selected the message recorded will be played.

Beacon message is only transmitted if set to on by Repeater keeper's control code task 2, and the message interval is the time in minutes selected in edit field **"Beacon interval (Min.):"** under Parameters tab.

Beacon is only transmitted if the repeater is not used, and the timer is reset every time the repeater is opened.

Courtesy Beep:

When ticked, the repeater will transmit a CW letter when the repeater is ready for the next operator to transmit. The CW letter will be a K if the repeater is opened by 1750 Hz tone, D if opened by DTMF or S if opened by CTCSS.

Courtesy Beep as S-meter reading:

When ticked, the repeater will transmit the RSSI signal level as a voice message, e.g «Strength five». The repeater RSSI output must be connected to the controller RSSI input. Calibrate the reading using the «RSSI ADC level» box int the Paramters tab. Please read chapter 17 for more information on how to do the calibration.

Repeater shut down warning:

When ticked, the repeater will transmit three warnings consisting of a CW "E" at an interval of about 1 second when the shut down timer has expired. If a carrier is detected before shut down, the timer will be reset.

Cross-band repeater mode:

When ticked, the controller can be used with a cross-band repeater. Please read chapter 13 for more information.

Use RLY2 as Fan control:

When ticked, the output will be active when repeater is open or if temperature exceeds 30°C. Do not connect the fan directly to the RLY2 output. The output can control a relay switching the fan on/off.

Rep. Squelch:

Select if the squelch output signal from the repeater RX is active low or high.

TIMING PARAMETERS:
1750 Hz access tone active for:
Select the time in mS the 1750 Hz access tone must be present before the repeater will open. If the tone is pressed for a time lower than the one set, the repeater will not open.
First DTMF tone active for:
Select the time in mS the first DTMF tone must be present to be acknowledged. For all DTMF tasks, the first tone in the code must be present for at least the set time.
No activity shut down timer:
Select the time in seconds the repeater remains open before shutting down if there is no traffic.
Timeout if RX SQU. is active:
Select the time in minutes the repeater remains on-air if there is a continuous carrier at the repeater RX. This timer will be reset each time the RX carrier is lost.
Beacon interval:
Select the time in minutes between each time the repeater will transmitt the beacon message. This feature must be switched on by using the Repeaters keepers code, task 2.
Repeater alarm and link messages:
In the **"Voice messages if:"** group box, several check boxes may be ticked (read chapter 14 for DTMF settings). If a check box is ticked, the alarm and link messages will be played when the repeater is opened by 1750 Hz tone or a DTMF code.
If "Links active" is ticked, a voice message telling if the link is active will be played.
If any alarm message is ticked, and if the ticked alarm is active, a voice message will tell the alarm state.
For digital inputs, the alarm will be active if the input state is high level.
Select the alarm levels in the "Alarm settings" box.
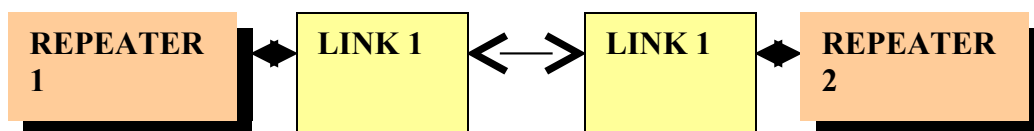

6. *LINK AND COMMAND RX*

A link radio can be connected to LINK1 and/or LINK2 terminals. LINK2 terminal can be configured to be used either as a link radio port or for connection of a command RX. When a link radio is connected, the repeater can be linked to a repeater at another QTH. The link should not use the same band as the repeater as this might cause interference.
Under the tab **"Links"** you can activate the links, and select if LINK2 is to be connected by a link radio or a command RX.
When the Link is activated, you can select if you want to have the possibility of switching the link on or off by using a DTMF code. If no code is selected, the link will always be on.
When the link is on, the link radio will be on the air when the repeater squelch is open, transmitting to the next repeater. When the link radio is receiving a signal, the repeater TX will be on the air transmitting the link signal.

REPEATER 1	⬌	LINK 1	⬌	LINK 1	⬌	REPEATER 2

The command RX (only a RX is needed, no TX) is used by the Repeater keeper to change parameters using DTMF codes, or shutting the repeater down if the repeater RX frequency is busy by noise or other unwanted signals. The repeater keeper is transmitting on the command RX frequency, and listening on the repeater TX frequency. The AF threw the repeater is blocked, and will be on again after a repeater shut down.

7. LEDs

There are four LEDs on the PCB. When the controller is powered-up, the STATUS LED will flash fast, and the OPEN and SPEECH LED is on. After a couple of seconds the OPEN LED will go off, and then the SPEECH LED and the STATUS LED will flash once a second. The controller is only ready for use when the STATUS LED is flashing once a second, not when fast flashing.

The LEDs are also used when the GUI is communicating with the controller.

Normal LED behaviour:

REP OPEN:

Steady on state when the repeater is opened for use.

SPEECH:

Steady on state when repeater speech synthesizer is active

STATUS:

Slow flashing LED (1 flash/sec.) indicates normal operation.

Fast flash indicates an error or GUI communication, and the controller is not ready for normal operation.

SQUELCH:

Steady on state when repeater or link radio squelch is active.

8. INSTALLATION

The controller is delivered as a PCB for installation inside of a repeater or in an external enclosure. Enclosure will only be supplied if requested.

Use the 3,2 mm holes provided located in each corner of the Main PCB.

Use the screw terminal blocks provided for connections of the repeater, link radios, power supply and other equipment.

Shielded wire should be used for repeater and link radio connections.

If no battery is used, leave this terminal open. The repeater will detect if battery is supplied or not, making no alarm messages even if this feature is ticked in the GUI.

Please note that output RLY2 have two different functions, either ordinary relay output or fan control. When used as fan control (GUI selection), the output will be active when repeater is open or if temperature exceeds 30°C.

The RLY1 and 2 outputs can sink 300mA only; so don't connect high current equipment (fan) directly.

9. PCB CONNECTIONS

Screw terminal connections:

The terminal blocks are only supplied when not fitted in the enclosure. See chapter 10 for box connections.

The **REP** terminal is used for connecting to repeater TX and RX, the **LINK1** terminal to the link radio, and the **LINK2** terminal to command RX.

GND:	Ground. Negative supply
AFRX:	Audio signal input from RX.
SQU:	RX squelch signal. If level is high (>1V) when RX squelch state is on, set the squelch jumper to position "H", otherwise to "L". Read chapter 11 for more information.
AFTX:	Audio signal output to TX modulator.
PTT:	Open collector output for TX key-up
CH1 CH2 CH4 CH8:	3.3V BCD output. Read chapter 14 on how to change the outputs.
RSSI:	RSSI signal input from repeater RX for signal strength

		measurements.
RLY1:		Open collector output. Signals can be used to switch external equipment on/off. Output is set on/off by Repeater keeper's code. Read chapter 14 for more information.
RLY2:		This open collector output has 2 options, DTMF on/off or fan control. **DTMF on/off:** Signals can be used to switch external equipment on/off. Output is set on/off by Repeater keeper's code. Read chapter 14 for more information. **Fan control:** When selected in GUI, output will be active when repeater is open and if temperature exceeds 30°C.
CHx:		Not used
IN1 IN2:		Digital alarm inputs. Select in GUI if the inputs is to be used for alarms.
BATT:		Connect to battery (12V) + terminal
GND:		Connect to battery ground terminal
GND:		Connect to power supply ground terminal
PWR:		Connect to power supply (7 – 15VDC) + terminal. Power consumption <30 mA.

10. CONNECTIONS ENCLOSURE

REPEATER:

25-way male DSUB connections to REPEATER.

DSUB PIN:	SIGNAL	BESKRIVELSE
1	GND	Ground repeater
2	GND	Ground power supply
3	AFRX	AF from repeater RX.
4	AFTX	AF to repeater TX modulator
5	RLY1	Open collector output. Signals can be used to switch external equipment on/off. Output is set on/off by Repeater keeper's code. Read chapter 14 for more information.
6	RLY2	This open collector output has 2 options, DTMF on/off or fan control. **DTMF on/off:** Signals can be used to switch external equipment on/off. Output is set on/off by Repeater keeper's code. Read chapter 14 for more information. **Fan control:** When selected in GUI, output will be active when repeater is open and if temperature exceeds 30°C.
7	IN1	Digital alarm input. Select in GUI if the inputs is to be used for alarm.
8	IN2	Digital alarm input. Select in GUI if the inputs is to be used for alarm.
9	PTT	Open collector output for TX key-up
10	N/C	

11	SQU	RX squelch signal. If level is high (>1V) when RX squelch state is on, set the squelch jumper to position "H", otherwise to "L". Read chapter 11 for more information.
12	N/C	
13	PWR	Connect to power supply (7 – 15VDC) + terminal. Power consumption <30 mA.
14	N/C	
15	N/C	
16	N/C	
17	N/C	
18	N/C	
19	CH4	3.3V BCD output.
20	CH8	3.3V BCD output.
21	CH1	3.3V BCD output. Read chapter 15 on how to change the outputs.
22	CH2	3.3V BCD output.
23	RSSI	RSSI signal input from repeater RX for signal strength measurements.
24	N/C	Kanalskifte Motorola GM900 radio
25	BATT	Connect to battery (12V) + terminal

LINK:

9-way male DSUB connections to LINK1 and LINK2

For X-band repeater, connect one radio to LINK1 and the other to REP.

DSUB PIN:	SIGNAL	DESCRIPTION
1	PTT:	Open collector output for link radio key-up (LINK1 only).
2	AFTX:	AF to link radio TX modulator (LINK1 only).
3	SQU:	Link radio RX squelch signal. If level is high (>1V) when RX squelch state is on, set the squelch jumper to position "H", otherwise to "L".
4	GND:	Link radio earth terminal.
5	AFRX:	AF from link radio RX.
6		
7		
8		
9		

11. SQUELCH

The squelch LED will be at a steady on state when repeater RX or any link radio is detecting a carrier.

From your repeater RX and link radios, the level of your squelch signal might be a low- or high-level. The level is set in the GUI. If the repeater RX squelch level is at a high state when the receiver squelch is on, you have to check the **"Rep. Squelch low"** check box in "Operation" tab, and it will change to "Rep. Squelch high"

If a link radio or command RX is used, check the corresponding check boxes in the "Links" tab.

12. ALARMS

In the GUI you can configure several alarms to be enabled or not. These alarms are power supply voltage high or low, battery voltage low, temperature high or low and digital inputs.

The alarm condition can be read by using the Repeater keeper's code and task 4. If any set alarm is active, it is also indicated by a voice message when the repeater is opened using 1750 Hz tone or DTMF. There is also an alarm indication every 5 courtesy beeps, remining the users there is an alarm condition on the repeater.

13. CROSS-BAND REPEATER MODE

When the check box "Cross-band repeater" is checked in the GUI, the controller will operate in cross-band repeater mode. The controller will then operate two separate radios operating on two different bands.

Connect the radio for band one (e.g. two meters) to REP terminal and the other (e.g. a 70 cm radio) to LINK1 terminal.

The repeater will operate as an ordinary repeater except two different radios are used operating on two different bands.

In order to access the repeater use 1750 Hz tone or a DTMF code. If CTCSS is required, tone has to be defined in the used radios. When an access is detected, the repeater will go on the air transmitting the call sign on both frequencies.

Then the repeater keys down, and the operator can start transmitting on one band, and this signal will be transmitted on the other band. The other operator then has to answer using the other band than operator one.

The controller will operate the same way as for ordinary repeater use, except no extra link radios can be used.

14. REPEATER KEEPER'S CODE

Select the 5 digits DTMF Repeater keeper's code (only known by the repeater keeper) in the GUI. All changes and status reports will be responded with a speech message. The repeater will also respond to the code when received from a command RX. When code is dialled on the operator's radio DTMF pad when the repeater is open, the repeater will respond with "verify". Then dial the task code from the list below. When a operation is finished, the repeater will be ready for next task indicated with a short "Beep". If no task is received within 5 seconds, the repeater will return to normal operation, and Courtesy beep is transmitted, if activated.

Tasks:

1   **Repeater on/off.** Repeater may be switched off for no operation. Turn on again by dialling the Repeater keeper's code, wait for "verify", and task1. If repeater is off, the repeater will not respond to any access codes. Speech: "Repeater is off", "Repeater is on".

2   **Beacon on/off.** If beacon message is set to on, beacon message will be changed to off, and the other way around. If beacon set to on, the beacon message will be transmitted when no repeater activity at time intervals set in the GUI "Beacon interval" edit field. Speech: "Beacon is on", "Beacon is off".

3   **Record voice messages.** A voice message and the repeater call sign can be recorded. When DTMF task 3 is dialled, the repeater responds with "verify" once again, and then dial the message task. Release radio PTT, and when the Speech synthesizer is ready for recording the repeater responds with "Start", and then

push your radio PTT, and radio audio will be recorded. Just release radio PTT when recording is finished.

1 **Record voice message.** Message length is up to 40 seconds.

C **Record repeater call sign.** Message length is up to 8 seconds.

4 **Alarm condition.** For active alarms, voltage level for power supply and battery, and temperature will be read out. If no alarm, "alarm is off" is played. Messages: power supply, battery, temperature and digital inputs.

5 **Repeater operation.** Several parameters can be changed over-air, instead of using the GUI. When DTMF 5 is dialled, release radio PTT and the repeater responds with "verify" once again. Then dial the change parameters task from the list below. Release radio PTT, and the repeater responds using a voice message telling the new parameter state.

1 **Repeater carrier operated on/off.** If carrier operated mode is set to off, the repeater TX will be keyed up as long as the repeater is open, and if set to on, the TX will key up only if a RX carrier is present. If function was set to on, carrier off function will be selected and the other way around. This task is not functional in cross-band repeater mode.

2 **Repeater identification CW/Voice.** If identification is set to CW, repeater identification will be changed to voice, and the other way around. If voice is selected, the call sign message recorded (task 3+C) will be played when the repeater opens.

31 **Courtesy beep on/off.** If Courtesy beep is set to on, it will be changed to off, and the other way around. If state is on, a CW letter will be transmitted 30 mS after the repeater RX carrier is lost, depending on which way the repeater was accessed - CW "K" = 1750 Hz, CW "S" = CTCSS, CW "D" = DTMF.

32 **S-meter Courtesy beep on/off.** If S-meter Courtesy beep is set to on, it will be changed to off, and the other way around. If state is on, a S-meter reading will be transmitted 30 mS after the repeater RX carrier is lost.

4 **Repeater shut down warning on/off.** If warning beep is set to on, it will be changed to off, and the other way around. If state is on, the repeater will transmit 3 "E"s in CW with a interval of 1 second, then sending the CW shut down signal.

5 **Beacon message CW/Voice.** If beacon message is set to CW, beacon message will be changed to voice, and the other way around. If voice is selected, the message no 2 recorded (task 3+2) will be played at the interval set when no repeater activity. When CW is selected, the CW message will be call sign + Maidenhead locator.

6 **Link message on/off when repeater opens.** If link message is set to on, it will be changed to off and the other way around. If state is on, the repeater will respond with "Link" after the call sign when the repeater opens, to indicate that a link to another repeater is active.

7 **Alarm power supply message on/off when repeater opens.** If PS message is set to on, it will be changed to off and the other way around. If state is on, the repeater will respond with "Alarm supply" after the call sign if alarm active when the repeater opens, to indicate the alarm condition.

8 **Alarm battery message on/off when repeater opens.** If battery message is set to on, it will be changed to off and the other way around. If state is on, the repeater will respond with "Alarm battery" after the call sign if alarm active when the repeater opens, to indicate the alarm condition. If no battery connected, no message will be created if set to on.

9   **Alarm temperature message on/off when repeater opens.** If temperature message is set to on, it will be changed to off and the other way around. If state is on, the repeater will respond with "Alarm temperature" after the call sign if alarm active when the repeater opens, to indicate the alarm condition.

0   **Alarm digital inputs message on/off when repeater opens.** If digital message is set to on, it will be changed to off and the other way around. If state is on, the repeater will respond with "Alarm digital input 1/2" after the call sign if alarm active when the repeater opens, to indicate the alarm condition.

A1   **Repeater access:** 1750 Hz tone, DTMF access code, CTCSS tone

A2   **Repeater access:** 1750 Hz tone, DTMF access code

A3   **Repeater access:** 1750 Hz tone, CTCSS tone

A4   **Repeater access:** 1750 Hz tone only

A5   **Repeater access:** CTCSS tone only

B   **CTCSS TX Continuous/RX Carrier:** If CTCSS TX is set to continuous it will be changed to RX Carrier, and the other way around. When continuous is selected, the CTCSS tone will be transmitted all the time, and when RX Carrier is selected, the tone will only be transmitted when a RX carrier is present.

6   **Repeater carrier operated (VOX) mode.** The repeater shut down timer is disabled, and TX will be keyed up if a carrier is detected at RX. When RX carrier is lost, the repeater will transmit a short tone (beep) after a delay of 100 mS, and repeater will key down. The repeater will remain in this mode until released by dialling DTMF code **66.** If in cross-band repeater mode, System operator's code has to be dialled followed by task 6 in order to release the mode.

7   **STATUS:** Power supply and battery voltages, and temperature played as a voice messages.

8   **STATUS:** The time the repeater has been on air along with the repeater access counter played as a voice message. The time will be played as hh(hours) comma mm(minutes) the repeater has been on air.

9   **Reset task 8 counters.** All counters and timers set to zero. When this task is dialled, the repeater responds with "verify" once again, then dial DTMF ***** to reset the counters, and counter setting is played as a voice message, all zero.

0   **Firmware version.** Speech: "Firmware + version"

B   **Relay1 on/off.** Output "RLY1" on or off. If output state is on, it will be set to off. Speech: "Relay one is on/off".

C   **Relay2 on/off.** Output "RLY2" on or off. If output state is on, it will be set to off. Speech: "Relay two is on/off". Not active if "Use RLY2 as Fan control" ticked in GUI.

*   **Change BCD output.** Change of CH1, CH2, CH4 and CH8 state. Outputs will change to the digit followed by DTMF * task. When DTMF task * is dialled, the repeater responds with "verify" once again, and then dial the DTMF code corresponding the BCD setting.

0-#   **BCD output state.** The DTMF code 0-# corresponds the binary state of CH1 to CH8 outputs like this:
0=0000, 1=0001, 2=0010, 3=0011, 4=0100, 5=0101, 6=0110, 7=0111, 8=1000, 9=1001, A=1010, B=1011, C=1100, D=1101, *=1110, #=1111.

**RSSI.** Repeater coverage. (Read chapter 19 for more information)
This task is not functional in cross-band repeater mode.

15.   VOICE MESSAGE

The Speech synthesizer can store a voice message and the repeater call sign. Message bank can store a message up to 40 seconds long, and the call sign message bank is 8 seconds long.

To play the message, dial **#1** on your radio DTMF pad, and if the flash memory storage location is not empty, the corresponding message will be played. If Beacon Message Voice is activated and the Beacon set on, the message will be played at the set Beacon intervals.

To record a new message or repeater call sign, use your radio (see chapter 14 for more details) or a WAV-file can be uploaded from GUI. The WAV-file must be recorded using 8bit mono sampled at 8 kHz.|

16.   AF SIGNAL ADJUSTMENTS

The AF signal path threw the controller is linear, no de/pre-emphasis.
Test equipment needed:
* Oscilloscope
* Signal generator operating on your repeater frequency
* Deviation meter

All AF signal adjustments are made from the GUI, setting the correct deviation on repeater and link radio TX.
Choose the **"AF Levels"** tab in the GUI.

There you will find several buttons, and click the button for the adjustment you want to perform. There is a on-screen instruction on how to connect the test equipment.

Click the **"Dev.1"** and **"Dev.2"** buttons up or down until you have a proper deviation setting. The button settings will overlap each other, so select a combination giving the best setting.

Use a oscilloscope to check the AF fed to the TX. The signal should be a clean sinus with no distortion. Compare with the signal from the RX.

Set the signal generator deviation to 3 kHz, using a 1 kHz tone.

Repeater RX – Repeater TX

Allignment of repeater deviation. Deviation on the TX should be exactly the same set on the signal generator connected to repeater RX.

Repeater RX – Link TX

Allignment of link radio deviation. Deviation on the link radio should be exactly the same set on the signal generator connected to repeater RX.

Link RX – Repeater TX

Allignment of repeater deviation. Deviation on the TX should be exactly the same set on the signal generator connected to the link radio.

Speech – Repeater TX

Allignment of speech synthesizer. Adjust to about 2-3 kHz deviation.

Tones – Repeater TX

Allignment of tones sent. Adjust to about 2 kHz deviation. The tone level should be a bit lower than speech levels.

17.   REPEATER COVERAGE

Dial the DTMF Repeater keeper's code followed by the RSSI (#) task. The repeater responds with "Repeater signal strength mode is on", and then repeater is keyed down. When the repeater is receiving DTMF #, the repeater will key up and the signal strength 1 – 9 will be transmitted by voice (e.g. "signal strength 5") followed by the corresponding DTMF tone for 1 second.

To terminate this mode, dial DTMF *, and repeater returns to normal operation.

If you have equipment in your car recording the DTMF tone along with GPS position, you can store this information for future use.

Different repeaters may have different RSSI voltage levels, and measurements have to be set for your repeater by using the settings in the **"RSSI ADC level"** group box. Use the signal generator, and select the S1 and S9 levels and measure the voltages for both on the RSSI terminal. The voltage step between each S-meter reading can then be calculated using the equation:

Step=(S9-S1)/9

The S1 reading and the Step value have to be updated in the GUI parameters.

To prevent any damage if the RSSI voltage is higher than 3.3V, there is a voltage divider (R14, R15) on the PCB dividing the voltage by 2. If the RSSI voltage does not exceed 3.3V at maximum reading, remove R15 and replace R14 by a link or low value resistor.

18.   DTMF TO CCIR CALL

If you are using a radio with DTMF pad and no CCIR function, and you want to alert an operator or other equipment whose radio is only activated by a CCIR code, the controller can take care of this.

When repeater is ready for use, dial DTMF 60* followed by the CCIR radio code in one sequence. If the CCIR code is 77853, then dial **60*77853** (the 3 first digits are always 60*, and is not a part of the code), and when PTT is released; the repeater will transmit

the 77853 codes as CCIR tones. The first digit tone length is 700mS, and the following 4 tones having duration of 100mS.