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OPERATING INSTRUCTIONS

HamController USB

PCB Version: D

CONTENTS :

1.0 OVERVIEW2
2.0 GUI2
3.0 FIRMWARE UPGRADE3
4.0 MAIN PCB.3
5.0 OPERATIONAL PARAMETERS.4
6.0 RADIO PCB6
7.0 LEDs6
8.0 PCB INSTALLATION.7
9.0 CONNECTIONS.7
9.1. Main PCB Connections	8
9.2. Radio PCB Connections.	9
9.3. Auto patch PCB Connections	9
10.0 CONNECTIONS ENCLOSURE9
11.0 JUMPERS	10
12.0 REPEATER ACCESS	10
13.0 ALARMS	11
14.0 CROSS-BAND REPEATER MODE	11
15.0 SYSTEM OPERATOR'S CODE	11
16.0 REPEATER SHUT DOWN CODE.	14
17.0 VOICE MESSAGES	14
18.0 AF SIGNALS ADJUSTMENTS	14
18.1.Main PCB adjustments	14
18.2.Radio PCB adjustments	15
18.3.Cross-band repeater adjustments .	15
19.0 AUTO PATCH	16
19.1.Incoming call	16
19.2.Outgoing call	16
19.3.Auto dial slots	16
20.0 REPEATER COVERAGE	16
21.0 DTMF TO CCIR CALL	17

1.0

OVERVIEW

The HamController64 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), which runs under Windows on a PC. Use the GUI to configure the controller parameters, and uploading of firmware updates and speech synthesizer voice files.

If you have bought any of the additional cards, these have to be plugged onto the Main PCB.

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

The controller operates from a 13.6V (7 – 15V) DC power supply, and power consumption is less than 30 mA.

If you want to use the controller for a cross-band repeater, the Radio PCB has to be ordered. This PCB has also to be ordered if you want to use a separate command radio, or a radio link to another repeater.

An analogue land line for phone patch can also be connected when the Auto Patch PCB is ordered.

Please read the GUI help-file for more information about parameter settings.

2.0

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 “**HamController64_USB.exe**”, and please also locates the help file named “**HamController64.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 HamController64 properly, and a file with your settings can be stored to 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.

When connecting the controller to your PC for the first time, the PC is looking for a driver. Put the supplied CD in the CD drive and follow the screen instructions for the driver installation.

When the driver is installed, then launch the GUI by clicking on the “**HamController64_USB.exe**” file, no Windows installation is necessary.

If GUI is launched before connecting the USB cable, the GUI will not find the USB port and no controller connection possible.

When the GUI is started, all available COM-ports are listed in the "Select COM-Port" groupbox.

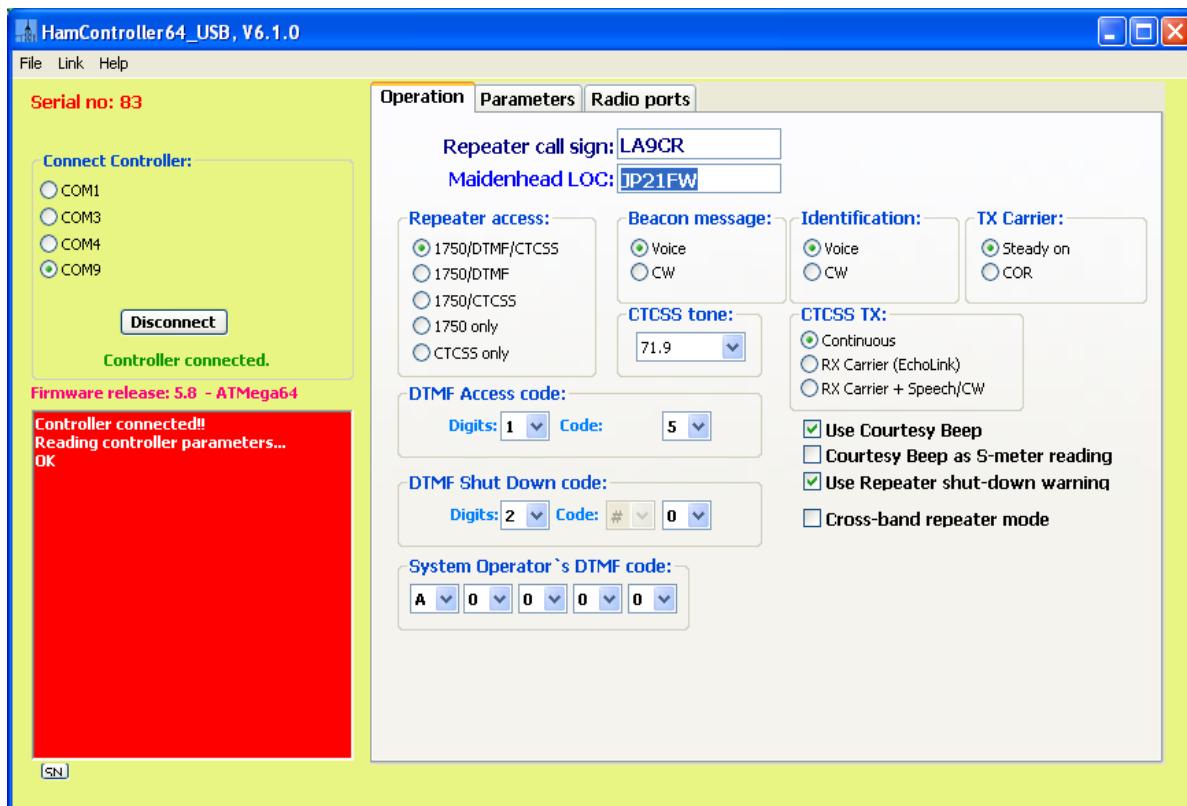
The USB port will show in the GUI as a serial RS232 port, and the USB port is most likely to be the highest numbered COM-port. Click on the port and the GUI will try to connect. If connection fails, you may have tried a wrong port if you have several, then try another. When the GUI is connected to the controller, all controller parameters will be downloaded to the GUI and updated. When clicking a port for connection, a text is displayed in the red text box telling the progress.

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 do your changes, and then 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.

If a new firmware hex-file is available, this can also be uploaded to the controller. Uploading of new voice message wav-files can also be performed.

When connecting the controller the next time you want to do any changes, driver installation will not be necessary, unless you are using another PC.



3.0 **FIRMWARE UPGRADE**

Two different micro controllers are used, ATMega64 and ATMega325 for controllers despatched later than October 2008. When upgrading, only the correct file will be accepted by the GUI. The firmware files are named **HamController64.hex** (ATMega64) and **HamController325.hex** (ATMega325) respectively.

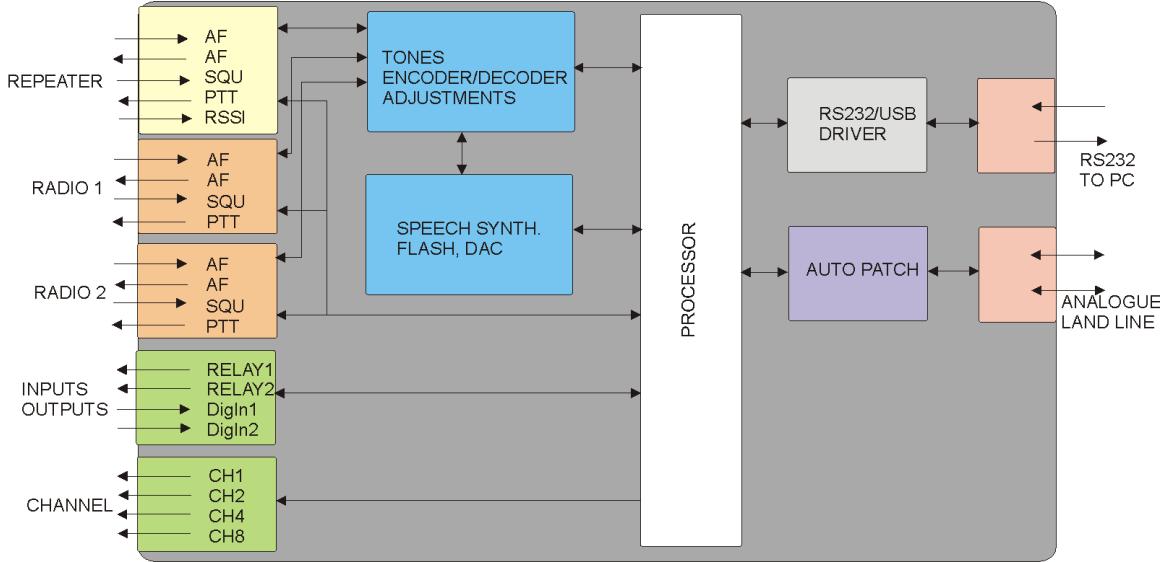
4.0 **MAIN PCB**

The Main PCB has all necessary functions to operate an amateur radio repeater.

Hardware features:

- **DTMF encoder/decoder**
- **CTCSS encoder/decoder**
- **1750 Hz tone decoder**
- **Temperature sensor**
- **Speech synthesizer ADC and DAC**
- **8Mbit FLASH for voice message storage**
- **USB driver**
- **AF level potentiometers:** RX, TX, CTCSS, tones, speech synthesizer
- **AF Opamp buffers used for TX and RX signals**
- **Jumpers:** CTCSS and squelch level

- **Open collector outputs:** TX key up, relay 1 and 2
- **Digital inputs:** In 1 and 2
- **Digital outputs:** 4bit TTL bus for repeater channel selection, Relay 1 and 2
- **Analogue input:** RSSI
- **4 indicators:** rep open LED, speech LED, flashing status LED, squelch LED
- **Additional PCB's:** Radio PCB, Auto Patch PCB
- **Connections:** Screw terminal blocks



5.0 ***OPERATIONAL PARAMETERS***

Using the GUI can change all repeater parameters, and using the System operator's DTMF code (read chapter 15 for more information) can also change some parameters.

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 has to be recorded (read chapter 15 for more information).

Maidenhead LOC:

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

Repeater 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 set 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.

DTMF Access code:

Select number of digits in the access code (1 or 2) along with the code to be dialled from the operator's DTMF pad.

CTCSS tone:

Select the CTCSS (PL) tone for the repeater. This tone will be transmitted even if the repeater access is not the selected CTCSS tone.

Identification:

When repeater has detected a valid access, the repeater is keying up transmitting call sign in CW or Voice. If CW is selected, the call sign in the "Repeater call sign" editbox is transmitted, and when selecting "Voice", the repeater voice call sign is transmitted (read chapter 15 for more information).

TX carrier:

If "Steady on" is selected, the repeater TX is keyed up even if there is no carrier detected at repeater RX when it is opened, 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 to message bank #2 will be played.

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

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

CTCSS TX:

The CTCSS TX tone can be selected to be on when the repeater is modulated, or to be on only if RX carrier is present. Use the latter if the repeater is to be used along with a CTCSS squelch operated radio connected to an Internet PC. The EchoLink providers and others do not like the CW or voice messages to be transmitted into the Internet, so by selecting "RX Carrier" the CTCSS tone is only transmitted when a RX carrier is detected.

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 accessed by 1750 Hz tone, D if accessed by DTMF or S if accessed by CTCSS.

Repeater shutdown warning:

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

System operator's DTMF code:

This is the code used by the System operator to access the various repeater settings and readout of repeater operational timers and counters. Others than people responsible for the repeater should not know this code.

Repeater time out:

The repeater will remain opened as long as the time set in the "No activity timeout timer" has not elapsed. This timer is reset every time the RX carrier is lost.

Repeater alarm and link messages:

In the GUI "Voice messages if:" group box, several checkboxes may be ticked (read chapter 15 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 either link 1 or 2 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.

6.0 **RADIO PCB**

The Radio PCB is only delivered on request.

Radio PCB features:

- **Cross-band repeater mode**
- **Port defined as link or command radio**
- **AF OpAmp buffer for both TX and RX signals**
- **Potentiometers for audio level adjustment, RX and TX**
- **Squelch level jumpers**
- **Open collector output for TX key up**
- **Link radio RX AF mute**

The Radio PCB has 2 ports for connection of radios. The PCB is used when the repeater is to be connected with other repeaters in a chain or when a command radio is needed.

Each port can be defined to be used along with a link or command radio.

Please use-screened cable for radio connections.

Command radio:

When defined as a command radio port, the System operator can use the radio connected to operate the System operator's DTMF tasks. The repeater will not key up, so the System operator can make changes without others monitoring.

Link radio:

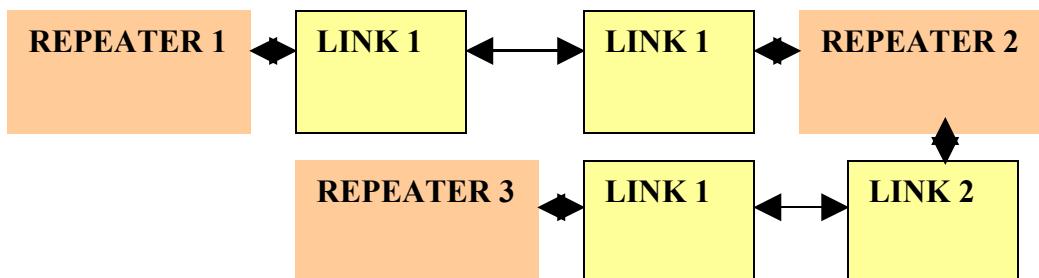
When defined as a link radio port, several repeaters can be connected in a chain of repeaters.

The link may be turned on/off by using a DTMF code set in the GUI. Each link having a 1, 2 or 3 digit code, and when a code is detected, a voice message will be transmitted telling if the link (1 or 2) state. When a link radio state is on, it will be turned off, and the other way around. The controller will store the setting, and the same settings will be used also after power down.

When a link state is on, the link radio will key up when repeater RX is detecting a carrier, the RX signal will be transmitted on the repeater and the link radio. The link radio at the other repeater will then detect the carrier, and this repeater will go on the air if the link state is on.

When a link state is off, the link radio will not key up when a repeater carrier is detected, and the repeater will not key up if a link radio carrier is detected.

For your safety, it is recommended to use tone-squelch (CTCSS tone) on your link radios.



7.0 *LEDs*

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 squelch is active.

8.0 *PCB 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.

If additional cards are used, these are plugged onto the Main PCB.

See below drawing for details.

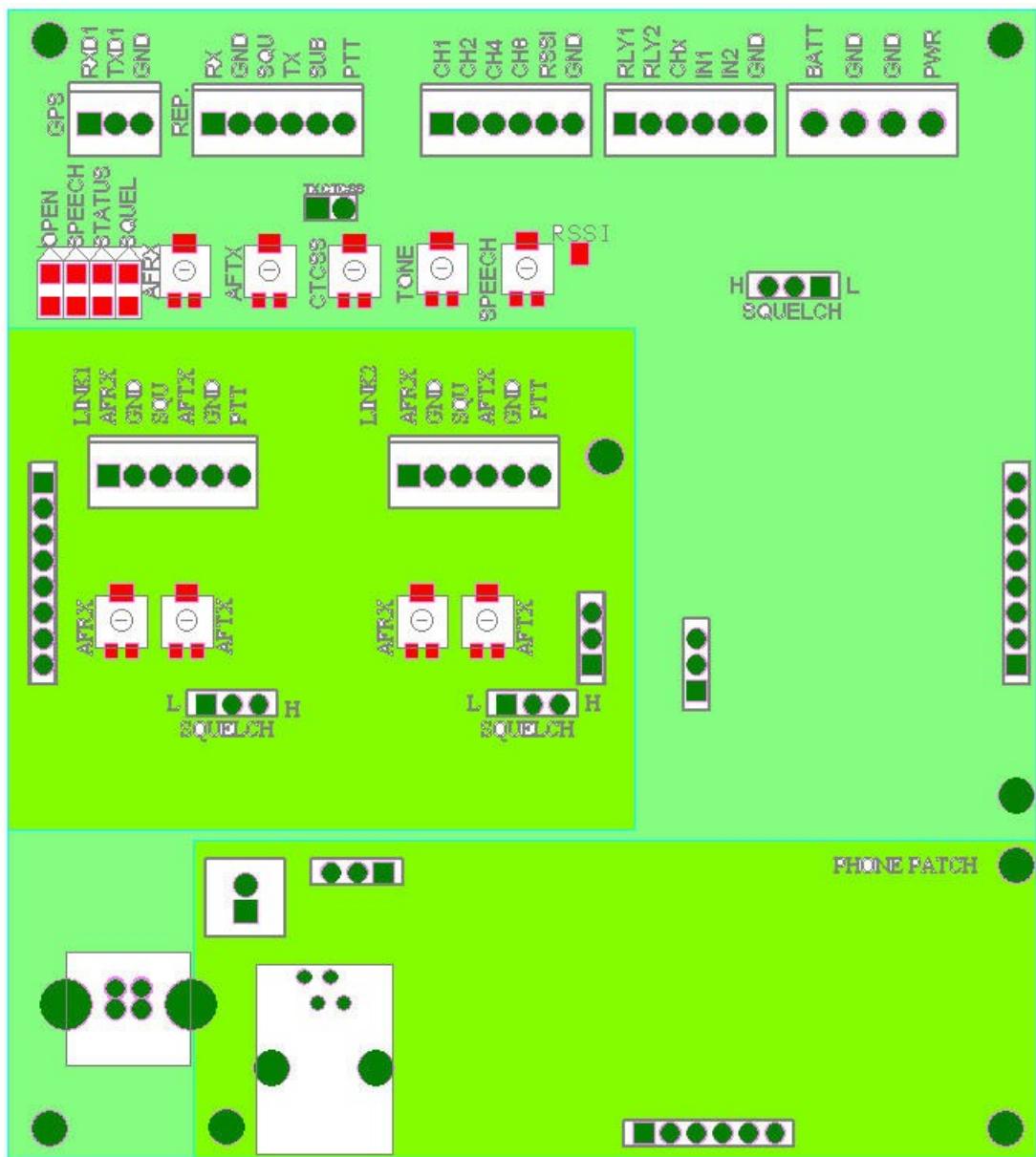
Use the screw terminal blocks provided for connections of the repeater, link radios, power supply and other equipment.

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 100mA only; so don't connect high current equipment (fan) directly.



9.0 **CONNECTIONS**

9.1 Main PCB screw terminal connections.

RXD1:	RS232 RX data from GPS (not used)
TXD1:	RS232 TX data to GPS (not used)
GND:	GPS ground (not used)
RX:	Audio signal input from repeater RX. AF can be unmuted. If CTCSS is used, CTCSS signal must not be filtered in repeater AF path.
GND:	Repeater earth terminal.
SQU:	Repeater 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.
TX:	Audio signal output to repeater TX modulator. If CTCSS tone is used and the repeater do not have a separate CTCSS tone input terminal, use jumper "SUB TX".
SUB:	CTCSS tone output. Used if repeater has separate CTCSS tone input terminal. Read chapter 11 for more information.
PTT:	Open collector output for repeater key up
CH1 CH2 CH4 CH8:	Not used
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 System operator's code. Read chapter 15 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 System operator's code. Read chapter 15 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 – 25VDC) + terminal. Power consumption <30 mA.

9.2 Radio PCB screw terminal Connections.

Use screw terminal blocks marked "LINK1" and "LINK2" for link radio connections.

RX:	Audio signal input from link radio RX. AF can be unmuted.
GND:	Link radio earth terminal.
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".
TX:	Audio signal output to link radio TX modulator
PTT:	Open collector output for link radio key up

9.3 Auto patch PCB Connections.

LINE:	Connection of analogue subscriber landline. A GSM adapter may be used.
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10.0 CONNECTIONS ENCLOSURE

If a controller for X-band repeater is ordered, two 9-way female DSUB connectors are used, connected to LINK1 and LINK2 respectively.

Repeater connections are only used for power supply.

REPEATER:

Use the 9-way male DSUB.

DSUB PIN:	SIGNAL	DESCRIPTION
1	PTT:	Open collector output for repeater key up
2	TX:	Audio signal output to repeater TX modulator. If CTCSS tone is used and the repeater do not have a separate CTCSS tone input terminal, use jumper "SUB TX".
3	SQU:	Repeater 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.
4	GND:	Repeater earth terminal.
5	RX:	Audio signal input from repeater RX. AF can be unmuted. If CTCSS is used, CTCSS signal must not be filtered in repeater AF path.
6	PWR:	Connect to power supply (7 – 25VDC) + terminal. Power consumption <30 mA.
7	GND:	Connect to power supply ground terminal
8	BATT:	Connect to battery (12V) + terminal
9	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 System operator's code. Read chapter 15 for more information. Fan control: When selected in GUI, output will be active when repeater is open and if temperature exceeds 30°C.

LINK:

9-way female DSUB connected to LINK1 and LINK2 (If two link radios used)

For X-band repeater, connect one radio to LINK1 and the other to LINK2.

DSUB PIN:	SIGNAL	DESCRIPTION
1	RX:	Audio signal input from link radio RX. AF will be muted.
2	GND:	Link radio earth terminal.
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	TX:	Audio signal output to link radio TX modulator
5	PTT:	Open collector output for link radio key up
6		
7		
8		
9		

11.0 JUMPERS

CTCSS:

Locate the jumper "TX CTCSS (SUB TX)" on Main PCB.

If your repeater TX has a CTCSS tone input terminal, connect this to terminal "SUB", and the CTCSS jumper has to be left open.

If your repeater TX does not have a separate CTCSS tone terminal, the CTCSS tone has to be mixed with the AF, and the jumper has to be closed.

SQUELCH:

The squelch LED will be at a steady on state when repeater RX is detecting a carrier. From your repeater RX, the level of your squelch signal might be a low- or high-level. If the signal is high level when a repeater RX carrier is detected, the position of your jumper is "H" on the 3-pin header marked "SQUELCH", and "L" if signal is low level. The squelch LED will have a steady on state when RX carrier (squelch state is on) is detected.

If link/command radios are used, similar 3-pin header is located on the Radio PCB.

12.0 REPEATER ACCESS

The way of accessing the repeater is set in the GUI along with codes.

You can select several combinations on repeater access. If "1750/DTMF/CTCSS" is selected, the repeater will search for a 1750 tone, the DTMF code or the CTCSS tone. If "1750 only" is selected, access is only by using the 1750 Hz tone.

The set CTCSS tone is always available at the "SUB" terminal.

1750 Hz tone:

The repeater will key up when a 1750 Hz tone is detected for the time set in GUI.

DTMF:

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.

CTCSS:

When the set CTCSS tone is detected, the repeater will key up. There is a 150mS delay where the CTCSS tone must be active before repeater is opened. This is to prevent false openings due to noise.

If check box "Cross-band repeater" is checked, the controller will operate in cross-band repeater mode. When this mode is selected in the GUI, no CTCSS tones will be transmitted or received. CTCSS tones then have to be defined in the used radios.

13.0 *ALARMS*

In the GUI you can configure several alarms to be enabled or not and there settings. 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 System operator'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 for every 5 courtesy beeps, reminding the users there is an alarm condition on the repeater.

14.0 *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

The radio PCB must be installed to operate this mode.

Connect the radio for band one (e.g. two meters) to Link 1 port and the other (e.g. a 70 cm radio) to Link 2 port. The Main PCB “REP.” terminal is not used.

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. Also the System operator's DTMF code tasks will operate as described in chapter 15.

15.0 *SYSTEM OPERATOR'S CODE*

Select the 5 digits DTMF System operator's code (only known by the repeater keeper) in the GUI. All changes and status reports will be responded with a speech message. 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 System operator'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.** Up to 2 different voice messages can be recorded and the repeater call sign. 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 to stop.

- 1 **Record voice message 1.** Message length is up to 24 seconds.
- 2 **Record voice message 2.** Message length is up to 16 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 with task setting by voice.
 - 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 1” or “Link 2” 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 time out 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”
- A** **TX test:** Active links and repeater will be keyed up for tone deviation adjustment, and an 870 Hz tone is transmitted for 30 seconds. Read chapter 18 for more details.
- 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 20 for more information)
This task is not functional in cross-band repeater mode.

16.0 REPEATER SHUT DOWN CODE

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.

17.0 VOICE MESSAGES

The Speech synthesizer can store 2 different voice messages and the repeater call sign. Message bank 1 can store a message up to 24 seconds long, and message banks 2 up to 16 seconds, and the call sign message bank is 8 seconds.

To play a message, dial #1, #2 on your radio DTMF pad, and if the flash memory storage location is not empty, the corresponding message will be played.

To record a new message or repeater call sign, use your radio (see chapter 15 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.

18.0 AF SIGNALS 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

18.1 Main PCB adjustments.

Locate the 5 trimmer potentiometers for several AF signal adjustments.

Adjustments have to be done in correct order for best alignment, so please follow the procedure carefully.

You need an oscilloscope, signal generator for repeater RX frequency, and deviation meter.

Repeater must be open for AF signal path RX to TX.

Preset all trimmers in centre position.

Trimmer AFRX:

Connect scope to test point “MOD”. Adjust signal generator to 1 kHz tone and set deviation to about 5kHz (or maximum deviation allowed on repeater RX). Adjust trimmer to a clean sinus on your scope, with no clipping of the signal.

Trimmer AFTX:

Adjust your signal generator deviation to 3 kHz, and adjust trimmer so the deviation on your TX deviation meter is also 3 kHz. Adjust signal generator deviation up and down to see that the TX deviation follows the RX signal. You then have a correct repeater deviation.

Trimmer CTCSS:

Read chapter 11 for CTCSS jumper.

Adjust your deviation meter to filter all tones above 300 Hz (300 Hz low pass filter). Adjust trimmer for 400-500 Hz deviation on your meter.

Trimmer TONE:

This is for adjustment of tones (CW) created by the controller.

Dial the System operator's DTMF code followed by task A. The controller will send an 870 Hz test tone for 30 seconds. Adjust trimmer for 2-2.5 kHz deviation on your meter.

Trimmer SPEECH:

This is for adjustment of speech synthesizer voice level.

Dial the System operator's DTMF code followed by task 7. Adjust trimmer for 2.5-3 kHz deviation on your meter.

18.2 Radio PCB adjustments.

Locate the trimmers “AFRX” and “AFTX”, one for each link radio. Only to be aligned if link/command radio(s) are used.

Trimmers AFTX:

This is for adjustment of link radio TX deviation.

The link has to be switched to on state.

If both link radios are connected, the one not connected to your deviation meter has to be connected to a dummy load.

Connect your deviation meter to the link radio and the signal generator to repeater RX. Set the signal generator deviation level to 3 kHz. Adjust trimmer for 3 kHz reading on the deviation meter.

Trimmers AFRX:

Connect your signal generator, to the link radio and deviation meter to repeater TX.

Set the signal generator deviation level to 3 kHz. Adjust trimmer for 3 kHz reading on the deviation meter.

18.3 Cross-band repeater adjustments.

When in cross-band repeater mode, the two radios are connected to the radio PCB, marked “Link1” and “Link2” respectively.

Deviation adjustments:

Connect the signal generator to radio 1 RX and deviation meter to radio 2 TX.

Connect scope probe to “TX” terminal of radio 2. Adjust signal generator to 1 kHz tone and set deviation to about 5kHz (or maximum deviation allowed on repeater RX). Adjust trimmer “AFRX” of radio 1 to a clean sinus on your scope, with no clipping of

the signal. Then adjust the signal generator to 3 kHz deviation, and then adjust “AFTX” of radio 2 deviation to 3 kHz reading on the deviation meter.
Use the same procedure for radio 2 to radio 1 adjustment.
Set the “TONE” and “SPEECH” trimmers as described above. If CTCSS (sub) tones are used, these have to be set in the radio.

19.0 **AUTO PATCH**

The Auto Patch PCB is only delivered on request.
Connect the analogue landline to the 2 pole terminal block on the Auto patch PCB. To activate this card, tick the check box “Use Auto patch”. Controller will then search for incoming calls.
Remember that a repeater is not a full duplex device; so only one part can talk. The radio operator has to push radio PTT button to talk, and will not hear anything of what the phone operator is saying when talking in the radio.
To terminate a call, radio operator has to dial DTMF #, or transmit a 2400 Hz (CCIR 10) tone.

19.1 Incoming calls

When a call is detected, the repeater will key up transmitting a tone ring signal. Any radio operator can answer the call by just transmitting.

19.2 Outgoing calls.

If a radio operator is to make a call, a radio with DTMF pad has to be used. Access the repeater, and when repeater is ready for operation, dial DTMF *, wait for the dial tone from the exchange, and then dial subscriber's number. Wait for the subscriber to answer.

19.3 Autodial slots.

In the GUI 8 different numbers can be typed in for auto dialling. Access the repeater, and when repeater is ready for operation, dial DTMF ##>no< where no is the auto dial number (1 – 8). If you dial DTMF ##3, the subscriber number typed in position number 3 will be dialled.

20.0 **REPEATER COVERAGE**

Dial the DTMF System operator'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:

$$\text{Step} = (\text{S9} - \text{S1}) / 9$$

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 (R19, R20) on the PCB dividing the voltage by 2. If the RSSI voltage does not exceed 3.3V at maximum reading, remove R20 and replace R19 by a link or low value resistor.

21.0 *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.