

## **General**

This handheld radio is also known as names above. It has been designed to be used in trunking networks, equipped with Fylde Microsystems trunking logic board. Trunking systems are usually using 1200 bps AFSK signalling and analogue FM-modulated speech in traffic channels. These instructions are referring to Kyodo KG109T radio, which has been sold in Finland under Nokia HD40 S02G2 name for Autonet network (old AC-1 network). More info about trunking systems can be found from Fylde www-pages.

## **Construction**

This handheld radio consists of RF parts (PLL, VCO, TX, RX), motherboard (audio, power supply), two displays (one for the dialled number in the front cover and one for other indicators in the top of the HT) plus the trunkin logic (processor) board installed in the back side of the radio. Trunking board, made by Fylde Microsystems, which includes all the necessary to make the radio work in trunking networks, e.g. the modem. The software (located in the PLCC32 EPROM) takes care of the control of the displays, PLL and the control of the audios and transmitter keying. Necessary parameters for the trunking operation are stored by using a PC in to a EEPROMs via serial interface in the side of the radio.

## **Modifications for HAM use**

This radio can be used by amateur radio operators just simply replacing the EPROM with the firmware (latest 1.4) for HAM use and of course retuning the RF units for 430 MHz band. Note that these instructions are made for Nokia HD40 S02G2 model, which is originally Kyodo KG109T, operating from 440 Mhz and up.

### **Tuning of VCO's**

Original radio is having frequency band 440 + MHz, so to take it down to 432 MHz both RX and TX VCO's must be retuned. Tuning is done by adjusting the VCO/PLL trimmer capacitor, seen from the front, under the cover in lower part of the radio. Both trimmers are marked with appropriated labels, while having also the test point marked.

Tuning must be done in the lower end of the band, because the VCO tuning voltage is lowest in the bottom of the band. By slowly turning the trimmer, you should achieve at least 1.0 V measured from the test point. More voltage, better it is. If you can achieve 3 volts, that is the optimum value. Lower voltages may cause the PLL to unlock in extreme conditions, such as very low temperatures or lower battery voltages. Too low or too high voltage causes also the radio transmitter spectrum to be very noisy, wich can be heard closely to the HT.

Some units required to add 2-3 pF capacitor in parallel with the SMD capacitor C12 (see drawing UHF-VCO/PLL UNIT). Do not press the trimmer capacitor with a tuning tool, because the capacitor is the going to be too loose. If you break the trimmer, you can replace it with a fixed 22 pF capacitor to get the voltage to 3-5 V (this has been worked in some radios). Check the control voltage in the ends of the bands, both RX and TX!

### **Tuning of the receiver**

Sensitivity of the receiver is tuned into maximum (better than -120 dBm @ 20 DB SINAD) by turning the four filter coils (brass cores) about one turn clockwise. Check with a RF generator or test set. No other adjustment is necessary. In 25 kHz channel spacings, deviation can be raised from 1-2 kHz to 3-4 kHz by turning the trimmer just above the PLL/VCO block. The radio is designed for 12.5 kHz channels, so more than 4 kHz deviation transmissions are going too wide and are distorting the received audio.

With a HAM firmware, there is 100/900 ms power saving feature, which is not making much but it will save a bit. Power saving is activated automatically after 5 sec of last manipulation or closing of the squelch or 10 sec after the last PTT press. Audio is disconnected when the squelch is closed. There must be at least 20 ms of signal to open the squelch. Receiver band is 430.0000 - 449.9875 MHz, but the VCO is not locked in the hold band at a time.

### **Transmitter**

In the transmitter there are two adjustments. First one is the maximum power, which can be adjusted if necessary. Some 4 watts gives good results and safety against damage to PA hybrid. The other one is the transmitter loading capacitor, which should be adjusted to maximum output power in the middle of the band. Remember that the original band is somewhere else. It is possible to get some 7-8 watts out, but the 4-5 watts is satisfactory, still taking some 2 amps from the battery.

Low power can be used by connecting suitable resistor between the SCAN line (second pin from right, going to the upper display via the MOLEX connector) and the RFP-pin in the CN4 connector (to the left). Following resistors gave these power levels vs. current consumption:

120 k	1.2 W	0.90A
100 k	0.80 W	0.80A
68 k	0.5 W	0.67A
56 k	0.2 W	0.50A

Same feature can be achieved by connecting a 1N4148 diode from RFP to SCAN line, cathode to SCAN. Then the low power is limited to about 1.0 W. I am using 68 k resistor, having then 10 dB power and 5 dB current consumption reduction.

Radio bandwidth is 430 – 450 MHz. Attempt to transmit outside of these limits makes a warning beep. If the receiver is going out, OOPS is displayed in lower display.

### **Audio and processor**

Deviation is adjusted for 12.5 kHz (spacing) channels, and there is normally no need to touch this. Still someone may want to raise the deviation a bit. More than 4 kHz deviations are having distorted audio when received with this radio, especially when the basic frequency = channel frequency is not adjusted exactly to the channel. Check! Note that the output of the audio amplifier is DC coupled, so the external speaker must be connected between the output lines, not against the ground. Connecting the ext. speaker to the ground produces some smoke, first from the audio amplifier and the from the soldering iron....

When using the HT in packet radio, it is advisable to bypass the delay circuit used to reduce the signalling noise, like in the NMT systems. The circuitry can be completely removed, which will save some fractions of milliamperes. In place of the delay circuit you can install a resistor with a value of 22-47 kohms to maintain the correct audio levels (maybe a bit less). The radio is not tested in packet use, according to my knowledge at a time writing this. If you test it, please tell me the results!

### **Control firmware**

HAM firmware (latest 2.0) must be programmed in to the address 2000<sub>H</sub> of the EEPROM.

Frequency setting is maintained over the power off. Memories are stored into a EEPROM. Keypress gives a tone, long press (abt. 1 sec) gives another tone. Just a one press gives a 'tick' tone, while a long press gives then 'tic...toc...toc ...') This will continue until you release a button. When the battery is dying, you will first get an alarm and BATT-display, and then a longer beep and 'Er' text when in a final limit. Limits are a bit low, somewhere 7 volts (9.6 V battery!).

In some radios the new firmware generates some unwanted noise to the audio, which can be removed either connecting more filtering capacitor to the right leg of the discrete transistor in the bottom of the control board, or the missing 10 nF capacitor from the PTT1 line to the ground. The jumper in the middle must of course be open. This jumper allows the direct use of channels when having the trunking software. The correct setting of the FFSK deviation trimmer is about  $\frac{3}{4}$  position.

Repeater duplex spacing is automatic when in repeater band (434.600-434.9875 MHz). With a D-button you can change between normal, reverse or without. The display is always showing the receiver (or transmitter) frequency. By turning the knob in the top, you can select 25 kHz channels. 12.5 kHz channels must be entered from the keyboard using the frequency without the last .5 kHz, e.g. 433.437# gives 433.4375 MHz.

### **Known oddities**

A loud noise when releasing the PTT is probably coming because the microphone casing is short circuited to ground. Re-glue it or cut the small foils from the mic soldering pads to the casing. Short circuit means continuous activation of the microphone, even when not keying the transmitter.

The level of the repeater beep is may be too loud. ALARM-signal can be of course reconnected via the FFSK line, and then also the key pressing beeps can be adjusted. The bad feature is that the audio amplifier is activated according to the received ALARM signal level, so having less level is maybe not enough to start the audio amplifier (see diagram!). Is there really someone doing the mods without diagrams? Wish him a luck...

### **Additions and amendments**

If you want to use DTMF function (firmware 2.0 and forward), you must install one IC, one crystal and one 10 kohm resistor. IC, of type PCF3312, is to be installed into a control unit, left from the FFSK deviation trimmer so that it's pin 1 is pointing to left and down. Crystal, 3.58 MHz standard DTMF crystal, is to be installed between the PCF and FFSK trimmer. A 10 kohm resistor (below new crystal) connects the audio from PCF to the FFSK audio line.

If you know more about this handheld, please tell it to me so I can update this document!

Regards,

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*Undersigned is not responsible of the possible damages, troubles, breaking laws and regulations or anything which is related to the use of the radio or following these instructions. These instructions has been made when doing modifications to my own radio, and they are working well.*

**HAM firmware instructions 2.0**

Long keypress is indicated with a superscript L, e.g. 0<sup>L</sup> and a 2 sec press with <sup>L</sup>L's.

<b>90#, 99#</b>	Low power, high power
<b>PTT</b>	Transmitter on
<b>MONI</b>	Backlights, display of frequency or memory in upper display
<b>PTT+MONI</b>	repeater beep 1750 Hz (also PTT+D which is more silent)
<b>KKK#</b>	Frequency setting in kHz 433.000-433.975, e.g. 400# = 433.400
<b>MKKK#</b>	Frequency setting in MHz, e.g. 2725 = 432.725
<b>MMKKK#</b>	Frequency setting in ten MHz, e.g. 40012 = 440.0125 MHz
<b>MMMKKK#</b>	Frequency setting in MHz, e.g. 433400 = 433.400 MHz
<b>0# ... 63#</b>	Reading memory
<b>0#<sup>L</sup> ... 63#<sup>L</sup></b>	Writing memory
<b>0#<sup>L</sup><sup>L</sup></b>	Writing to memory without scanning (°)
<b>0#<sup>L</sup><sup>L</sup><sup>L</sup></b>	Deleting memory. Memory can be read, but it is not scanned nor viewed with knob
<b>0<sup>L</sup> ... 9<sup>L</sup></b>	Memory reading with single, long keypress
<b>#<sup>L</sup></b>	Enabling (beep), skipping (beep beep), or removing memory (3 beeps)
<b>C</b>	Change mode VFO > CALL > MEM > VFO etc. Call channel is indicated with 'C' in place of the memory channel number
<b>C<sup>L</sup></b>	Writing of call channel. First give the frequency and then a long C.
<b>D</b>	Repeater spacing S > D > REV > etc Spacing is shown as , - ` - or nothing.
<b>MKKK D<sup>L</sup></b>	Setting of duplex spacing. E.g. 1600 D <sup>L</sup> corresponds -1.6 MHz. Positive spacing can be obtained by D <sup>LL</sup> . Every memory has it's own duplex setting. Max. 20 MHz.
<b>A</b>	Scanning in VFO 433.400 - 433.575 and repeater channels. When in call channel, C, VFO and selected memory. When in memory, all enabled memory channels.
<b>A<sup>L</sup></b>	Skipping of scanning freq. in VFO:lla (max 10 last, 1 sec press, scanner will not stop
<b>A<sup>LL</sup></b>	Resetting skipped freqs in VFO. ( 2 sec press). Scanning ceases with PTT or keypress when it goes back to original freq. When in MEM, ° shows skipped channel.
<b>B</b>	Abort, stop scanning.
<b>KNOB</b>	Viewing VFO or MEM. From C goes to VFO. Empty MEM's are not viewed.
<b>MONI + *</b>	Keyboard lock, can be opened in a same way with 2 sec keypress. Will not stop scanning. Knob is operating allways!
<b>#</b>	Selecting 5 last TX/scanning/VFO freqs.
<b>01MMMMM#</b>	Setting of own call
<b>NNNNN*</b>	Sending a call. * sends last one. 66# shows last received. (using a modem, works also with RD58)
<b>N...N+PTT</b>	Sending of DTMF. Microphone is activated after 100 ms of last DTMF (tic). Clearing string with B.
<b>PTT+N</b>	Sending of DTMF by pressing PTT and required key. Mic muted during this over.
<b>70# (80#)</b>	PLL output 1 (2) off
<b>71# (81#)</b>	PLL output 1 (2) on, indicated with a short bar in upper display
<b>73#</b>	Software version

**Display indicators:**

<b>Upper:</b>	TX BUSY BATT H L Er Scan _- or two digits frequency or memory channel.			
<b>Lower:</b>	C	433500	=	Call channel 433.500 Mhz
	31°	432725	=	Memory channel 31, 432. 725 Mhz, skipped
	32,	-434600	=	Memory channel 32, 434.600 Mhz, -duplex
	33`	-433000	=	Memory channel 33, 433.000 Mhz, +duplex
		OOPS	=	Receiver out of band limits.