

Conversion of Philips FM1000 STM23 (ex german Bündelfunk) for 70 cm amateur radio use

The FM1000 series of PMRs can be easily converted for 2 m or 70 cm amateur radio use. Excellent descriptions of the conversion can be found at www.fm1000.com or www.pa4den.nl/fm1200.html, including the contents of the necessary EPROMs. All these conversion instructions assume that you have the numeric keypad control head or the standard control head, but not the standard control head for trunking systems.

However, there are lots of ex Bündelfunk STM23 type radios with exactly that trunking control head available for a moderate prices. It seemed as if it was impossible to convert these STM23s for amateur radio use. As an engineer, I was unwilling to accept this, but realized that I had to start my own activities to make them usable for amateur radio.

The starting point was a working STM23 with numeric control head using the excellent firmware of PA4DEN. This combination is the ultimate solution for 70 cm amateur radio; you get a really nice transceiver. Why should I not use parts of Dennis' work? I tried to figure out the communications between main radio unit and control head. Storage oscilloscope, logic analyzer and async sniffer are mandatory for that. However, it was not as easy as I thought it could have been. That was the point where I contacted PA4DEN and just asked if he could tell me the protocol used. He kindly sent the protocol description, that saved a lot of work. Thanks, Dennis!

After several weekends of programming and testing, I finally had a firmware for the standard trunking control head that was basically working. Of course, you have to keep in mind that the feature list is somewhat modest due to the limited display capabilities of the control head. You have only two group of numeric displays, one with 2.5 digits and one with 3 digits, plus a few symbols. Another limitation is that Dennis' firmware for the main radio unit was not intended for use with a control head with only limited capabilities.

These are the features of my firmware:

- Frequency up/down in 12.5 kHz steps
- Memories
- VFO and memories scan
- Repeater shift 7.6 MHz (others possible)
- Reverse shift to listen at the repeater input
- Squelch open function

Important: A lot of these parameters (step size, repeater shift, power, squelch etc.) depend on configuration stored in the EEPROM. Presently these are standard settings I think to be OK. They can be changed using temporarily a numeric control head. This is not too nice, but there may be a PC program to generate the configuration EEPROM content in the future.

Important: This firmware is in BETA state (2004 Sept). There are known bugs an probably will be more.

Conversion of the trunking control head

This part is recommended for experienced experimenters only!

Verification of control head type

First, verify if you really have a trunking control head. This usually cannot be seen without activating it. Switch on the radio using the original trunking software. In the first second, all segments of the display come up. The trunking control head LCD should look like this:



If it does not look like this, it is probably not a trunking control head. You are lucky then, you don't have to use my firmware! In this case, please refer to www.fm1000.com; there is plenty of information how to convert a non-trunking FM1000.

Conversion of control head

The conversion of the trunking control head is definitely not as easy as the conversion of the numeric control head. You have to remove the original PLCC EPROM without damaging the PCB tracks and then you have to replace it with a new one. With the trunking control heads I have seen, there is no PLCC socket and it is not possible to add a PLCC socket since then it is not possible to fit the enclosure anymore.

Personally, I use a quite crude trick to remove PLCC PROMs which are directly soldered to the PCB and I never ruined a PCB using this method. I take a very sharp knife or blade and just cut the PLCC pins directly at the IC body. Be careful to cut orthogonal in respect to the PCB and do not bend the cut pins. When you have cut all 32 pins, the IC body (with no pins anymore) can be taken off easily. The 32 pins remain on the PCB pads and can be removed by carefully heating them up with a fine tip soldering iron and pulling them away from the PCB.

Now the programmed replacement 27C256 can be soldered in. Inspect all 32 pins for firm contact to the PCB pads; missing soldering joints are easily overlooked.

Conversion of main radio unit

Please refer to PA4DEN's instructions to convert the main radio unit.

Test

After switching on the radio, it should be possible to step the frequency up and down. You may want to checkout if receiving and transmitting work. Remember to use a dummy load; never transmit without antenna or dummy load.

Operation

Key number (from left)	Function
1	Squelch open (RX), 1750 Hz (TX)
2	Frequency/Memory down
3	Frequency/Memory up
4	VFO - Memory (indicator when Memory mode)
5	Memory frequency - Memory number (indicator when number)
6	Scan '*'
7	Repeater shift '#'
8	Function button

1750 Hz repeater access tone can be generated by pushing either SQ/1750 Hz button or the auxiliary button at the microphone while transmitting. To use the 1750 Hz option, you have to do the ZVEI/CTCSS modification of the main radio unit as described in PA4DEN's manual.

Please refer to the original PA4DEN manual for operation - please keep in mind that all functions rely on his firmware for the main radio unit.

LCD photos



Normal operation, squelch closed, RX 439.225 MHz





Reverse shift, listening on repeater input 439.225 MHz - 7.6 MHz



Memory mode, 438.900 MHz



Receiving, squelch open





Transmitting on 439.350 MHz - 7.6 MHz

Differences/Special cases

There are some special cases due to the limited capabilities of the trunking control head:

1. *Frequency is displayed with the leading "4" missing*, e.g. 438.900 MHz is displayed as "38 900". When using 12.5 kHz steps, e.g. 439.3875 MHz is display as "39 387".
2. *Entering scan edge frequencies*: Select lower edge frequency using up/down keys in VFO mode. Press FUNC, SCAN, FUNC. Select upper edge frequency, press FUNC, SCAN, SCAN. Now the edge frequencies are programmed. You may start scanning with SCAN. When in Memory Mode, the used memories are scanned.
3. *Repeater shift*: Unfortunately, there is no visual feedback. Press FUNC, REPEATER until the second beep is a low one. This is Simplex. FUNC, REPEATER switches to -7.6 MHz (high second beep), another FUNC, REPEATER switches to +7.6 MHz (high second beep), yet another FUNC, REPEATER (low second beep) switches back to Simplex. Pressing REPEATER without FUNC while in VFO or memory mode switches to the repeater input.
4. *Entering memory frequencies*: Switch to Memory number mode (Key 5). Select the desired frequency with the up/down keys and possibly repeater shift. Press FUNC, VFO/MEMORY and select a free memory channel with the up/down keys. Only empty memories are displayed, but you may select used ones by counting the beeps [this may be considered a bug... will try to fix that]. Press FUNC twice to store.

Acknowledgements

Thanks to Dennis Koller, PA4DEN, who wrote the main radio firmware and kindly provided for details on the communication between main radio unit and control head. Thanks to James Miller, G3RUH, who proofread this text.

EPROM images

Until the firmware is out of the BETA stage, I would like to send out the images by personal email. Please send an email with your call sign to fm1000@dl1ydd.de

LCD transparencies

Will follow shortly.

Known bugs

1. Display goes crazy when switching repeater offset on/off. Operation can be completed by

listening beeps, normal operation is restored by switching radio off/on (with front panel switch! When switching the power supply, changes in configuration are not stored)

Bug reports

Bug reports (as detailed as possible please) are highly appreciated, send email to fm1000@dl1ydd.de (due to spam protection, you have to enter this email adress manually into your mail client).

Important statement

This is a hobby project. It started because I was unwilling to accept that all these STM23's, with the trunking control head, should be useless. It is my intention to help fellow radio amateurs convert these fine radios for their personal use. The trunking control head firmware is provided free of charge for non-commercial amateur radio use, but any possible liability is denied. Use it, get happy, if you blow up your radio, it's not my fault.

Last modified: 02.01.2005