DV4mini

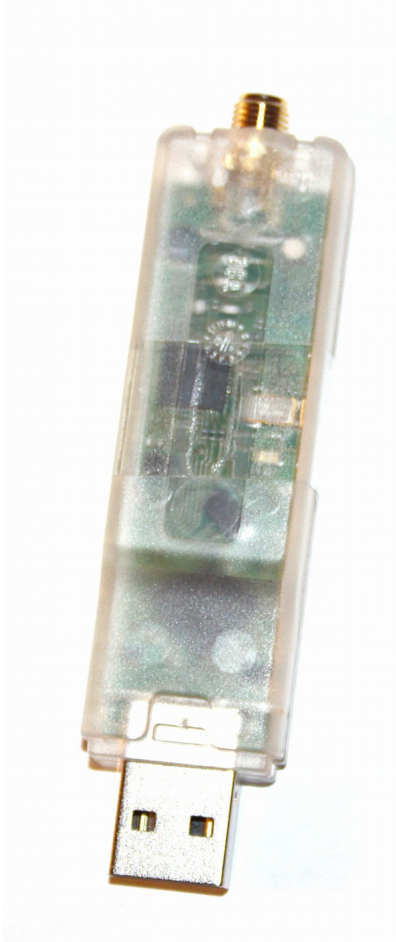## DV4mini: D-Star/DMR/C4FM/P25-Hotspot-USB-Stick User Guide

Version 9.2015

DV Development GroupVersion 1.61 Author German Version: DH5RAE (English translation: N1DL)

Table of Contents:

Capability of this board and Software:

The DV4mini is a very small but also very capable USB Stick that can expand any PC into a Hotspot for the D-STAR, DMR, C4FM and APCO P25 modes.
It consists of a powerful 32 bit micro controller, a complete 70 cm transceiver and a modulator/demodulator for GMSK and 4FSK (incl. Raised Cosine) and also a USB interface.

The DV4mini does not require external power as it is powered via the USB interface. Due to the
economical voltage converter even older USB interfaces suffice. The DV4mini is supplied together with a simple to use and comprehensive software package. This allows linking with DCS, XRF and REF reflectors for D-STAR as well s DMR, P25 and Fusion reflectors.

Many hams have a DV capable transceiver but cannot reach the closest DV repeater. With the DV4mini it has become possible to create a hotspot with minimal resources and thus get access to the DV network. We are talking about a small board inside a USB stick with a SMA antenna socket.
It is also possible to link C4FM repeaters with the reflector network.

Digital Modes:

The DV4mini can handle four digital modes:

D-Star:

D-Star was developed in Japan 1999/2000 especially for ham radio and due to its clear and relative simple user interface the worldwide leading system. Voice is being transformed by the AMBE
Vocoder into a compressed digital data stream of 3600 bits/s. In addition there is a data channel with 1200 bits/s for a total data rate of 4800 bits/s. This data signal modulates a carrier, so that a logical 0 is one frequency and a logical 1 a second frequency. This is called 2FSK (two frequency shift keying) or
GMSK (which is the same, however the signal is utilized with a Gauss curve). This signal can be used to modulate most FM transceivers (via the packet radio socket). This is the reason why there are any home made D-Star solutions.
For communication three reflector systems are utilized.DCS (the system with widest use), D-Plus REF
reflectors (mostly in the english speaking countries), and the x-Reflector system which plays a minor role. DV4mini enables communication via all these systems.

DMR:

DMR is a system designed for commercial applications. This is evident in the user interface where numbers are used in lieu of call signs. DMR modulates with 4FSK, indicating that it uses 4 frequencies (compared to D-Star with 2 frequencies). This allows to double the data rate to 9600 bit/s. This higher rate allows the transmission of 2 channels at the same time (2 time slots). The DV4mini always operates in time slot 1 and in simplex mode. The radios must be configured accordingly.
Today there are two DMR networks in use. One based on Hydra technology and the other on Motorola.
The DV4mini checks in to the Hytera network.However if Motorola repeaters have installed the appropriate software they can also be reached.
DMR reflectors have numbers in the range of 4000 to 5000, each region has its reflector

which can be selected in the DV4mini menu.

C4FM-Fusion:

C4FM-FUsion is a system developed by YAESU. It is based like DMR on 4FSK, and transmits also 4 frequencies with a total data rate of 9600 bits/s. It also uses the same AMBE+ Codec as DMR, but needs only 3600 bits/s. The extra bits are used in D4FM-Fusion in a different way. They can be utilized for data transfer (e.g. GPS) but also for additional error correction to make the speech more robust during interference. There is also a mode for high speech quality which uses all bits for speech only.
C4FM -Fusion reflectors are named FCS001 etc. All DV4minis connected to a reflector can hear each other. It is very easy to to connect a C4FMFusion repeater to the FCS reflector system.
Just put a Raspberry computer with a DV4mini next to the repeater and enter the reverse RX/TX frequencies. Done.

P25:

In Germany and increasingly in the USA Motorola repeaters are in use that utilize this mode. Because of the similarity with C4FM we included this mode in the DV4mini. There is also a reflector for it in "reflector.net"

System requirements:

These components are a prerequisite:

1. DV4mini USB stick
2. PC Software: DV4mini Control Panel
3. A DV capable radio (D-Star, DMR, C4FM, P25).
4. A PC with Windows XP, 7, 8.1, 10; Linux on a PC or an ARM computer like a Raspberry, BananaPi or Odroid.
5. Internet access

The DV4mini will be connected thru the USB interface with a PC or a single board computer and the required software will be installed. After starting and setting up the software one now has a Hotspot for the 70 cm band and can use it with a D-STAR or DMR transceiver.

This picture shows a DV4mini connected to a Raspberry PI 2 Mod. B:
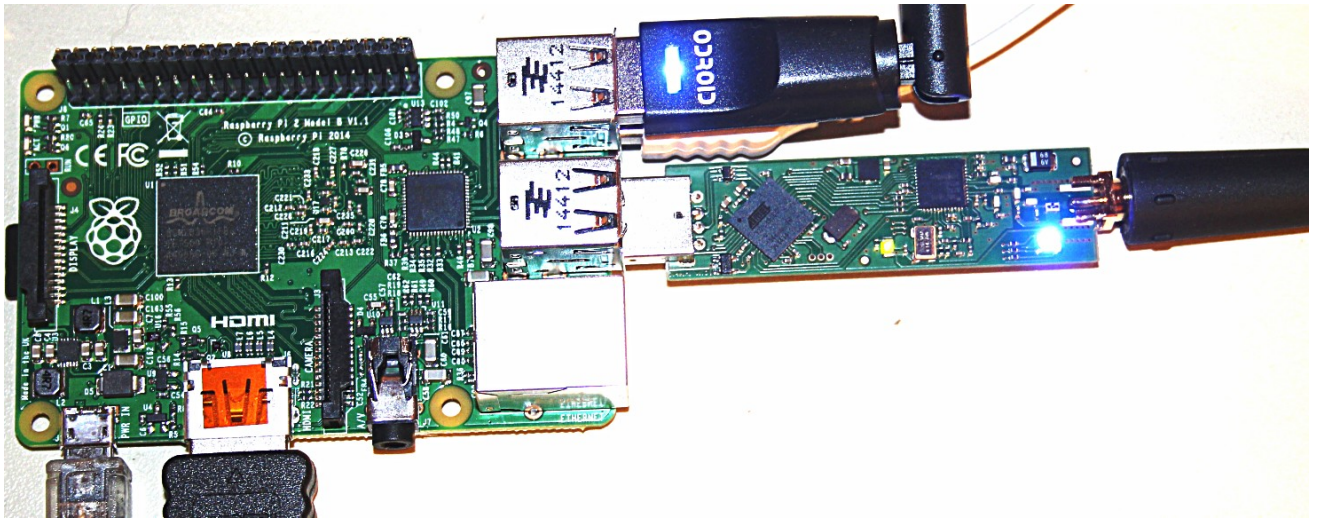
On the upper right is a WLAN stick and below it the DV4mini. In addition there are also connections to a keyboard, a mouse and a HDMI display. This configuration allows for a power saving continuos operation at low expense.

Reflectors:

A reflector is a server connected to the Internet or HamNET and is linked to a number of digital Ham Radio repeaters. If one of these repeaters is active it will send the voice data stream to the reflector. The reflector sends a copy of these voice data to all of the connected repeaters. This means that a QSO can be heard on all connected repeaters simultaneously.

Thus the chance to find a QSO partner is considerably increased - which is one of the reasons reflectors are quite popular.

Today the following systems are in operation:

DCS (Digital Call Server):

DCS is the most modern D-STAR reflector system and in worldwide use. Many countries use their own reflectors which differ from each

other by their 3 digit number. (DCS001, DCS002 etc).
Each DCS reflector has 26 rooms which are allocated to various regions of a country or continent. These rooms (A to Z) have been given names to make their identification easier and are shown on the user surface of the DV4mini.

FCS:

FCS reflectors are similar to DCS reflectors but planned for the Yaesu C4FM system. FCS001 and rooms 0-99.

PCS:

PCS reflectors are also similar to DCS reflectors but used by the P25 system. PCS001 and rooms 0-99.

Xreflectors:

Xreflectors are the second generation of D-STAR reflectors and no longer widely in use. However in some countries like Italy they are still used as the hams have not yet agreed to a uniform concept.
Also Xreflectors have less ports over which simultaneous QSOs be run. Xreflectors are named XRF001, XRF002 etc.

X-Reflector IP Adresse:

Unfortunately XReflectors are not centrally organized thus it is not possible to come up with a reliable list of all Xreflecors. The file xref.ip contains the Xreflector name and the matching IP address or URL. This list can be modified or updated by the user. This file is in the same directory as DV4mini.exe

D-Plus reflectors:

They were the first generation D-STAR reflector system. Although it is getting old it is still used intensively in a number of countries (mostly english speaking ones like USA, UK and Canada but even in Germany are a few operational). D-Plus reflectors are named REF001, REF002

etc.
They also use a number of ports allowing for simultaneous QSOs.

DMR reflectors:

DMR reflectors consist of several regional servers that are connected with each other via a superordinate network. Two nets exist. One based on Hytera and the other based on Motorola technology. As Hytera is open towards Ham Radio the DV4mini sticks check into the Hytera based network. In the meantime there are also some cross connections existing that allow communication beyond ones net limits.

Net organization (CCS7):

The many reflectors, repeaters and also Dongle users (the DV4mini is a Dongle too) require a structured organization, so that the network technology works properly.

D-Star works with call signs to identify a station. DMR however uses numbers. That is why it is necessary that an amateur radio station gets a number assigned in addition to its call sign and that this call sign - number combination is known to the network.

Every ham can go to the web site xreflector.net and request a 7 digit number to be assigned. This number is then entered into the specific field on the DV4mini software. This facilitates reporting into the network and conduct worldwide contacts in D-Star or DMR and the use of D-Star/DMR bridges.

Operating modes:

Digital ham radio repeaters are connected via reflectors. This allows for worldwide connections from one repeater to another.

With a hotspot (DV4mini) one creates ones own connection to this reflector network and gets access to all connected ham radio

repeaters.

The hotspot includes a low power 70 cm transceiver. All voice communications on the connected reflector will be transmitted by the hotspot on 70 cm and one can listen with a digital radio and of course also transmit.

Thus a hotspot is an ideal solution in one has no good access to a digital repeater e.g. inside buildings,
due to distance or at a vacation spot.

For such a hotspot you use your own call sign. Reduce your transmit power to just enough to cover your living area for reliable communication.

Hardware:

Use the Hotspot Mode to enter the frequency to be utilized for DV operation. (check your band plan).
Your transceiver will be set up for Simplex use - RX and TX on the same frequency.

The DV4mini takes the 5 Volt operating voltage from the USB interface. On a few PCs this voltage however may be too low (we measured below 4.5 V on some). In this case you can't operate. The best solution is then to use a USB adapter with its own power supply.

Technical Data:

Frequency range:	420-450 MHz
Resolution:	ca 250 Hz
RX/TX D-Star:	Duplex +/0/- any shift
RX/TX DMR:	Simplex (TX=RX QRG)
Modulation D-Star:	GMSK (Gaussian 2FSK)
Modulation DMRPLUS:	4FSK Raised Cosine
Antenna connector:	SMA female 50 Ohm
USB interface:	USB type A
Operating Voltage:	4.75 - 5.25 V
Current max RX	15 mA

```
               TX   (with 12 mW)          188 mA
S-Meter                                    1dBm resolution
                                           accuracy +- 1dBm (> -100 dBm
and <-50dBm)
DV4mini output power steps:                10 steps
                                           0 = 0.03 mW
                                           1 = 0.4 mW
                                           2 = 1.2 mW
                                           3 = 2.4 mW
                                           4 = 3.9 mW
                                           5 = 5.5 mW
                                           6 = 7.1 mW
                                           7 = 8.8 mW
                                           8 = 10.5 mW
                                           9 = 12 mW
```

Antenna:

Comply with your country's regulations regarding automatic operation!

The DV4mini requires an antenna. It must not be used without an antenna. You can use the commonly available 'rubber ducks' with a SMA connector like the ones used with walkies. The DV4mini must not be connected to a high Yagi or similar antenna.
If you use a physically adjustable antenna, be careful that when you adjust the position of the antenna you hold onto the base and not the housing. Otherwise you may damage the SMA connector. The DV4mini must be used only when you are nearby. Unmanned operation requires in almost all countries separate licenses or permits.

ATTENTION: Do not overload the SMA connector when handling the antenna. Always hold on to the base and not the stick. Damaged SMA connectors are not covered by warranty.

In order to utilize the stick in many countries the DV4mini covers a large range of frequencies from 420 to 450 MHz. It is the operators

responsibility to utilize only the frequencies appropriate in his country.

Software installation:

The software for the DV4mini includes the following files:

dv4mini.exe
dv-serial (.exe)

Windows:

For Window 7 and higher the driver will be installed automatically as soon as you plug in the stick into the USB interface.

Windows XP is not longer supported.

See: http://dv4m.ham-dmr.ch
That is where you also find the setup program for Windows. Download it from the site and start it. It will install all program segments and the needed additional programs by Microsoft. This will create a DV4mini icon to let you start the program.
Additionally you need to install the Microsoft Package: "Visual Studio 2013 Redistributable" in the 32 bit Version. Attention: Even if you use 64 bit Windows you still need to install the 32 bit Visual Studio 2013 Redistributable, or install both 32 and 64 bit.

Driver installation:

A standard driver by Microsoft is used. After plugging in the stick Windows will search for the driver in the internet.
This search can sometimes take a long time - up to 20 minutes. Wait until this driver is installed. If you are lucky it happens in seconds. Do not interrupt the process - have a cup of coffee and wait it out.
Should Windows not look for a driver you can go to Device Manager, find the stick and click on update the driver.

Linux-PC:

The program requires the complete installation of Mono. You install for example with apt-get the packet mono-complete.

Until an installation packet is available at a later time one has to install manually. Download the proper zip file to your PC. (http://dv4m.ham-dmr.ch) and unpack it into a directory of your choice below the home directory.

In order to gain access tot he USB/serial interface the user account must become a member of the group "dialout". Open the Console and enter sudo gpasswd —add myusername dialout

The DV4mini program gets started by entering mono dv4mini.exe in the console. Or you can create a screen icon.

Linux-ARM:

The same info as in PC-Linux is valid. However one has to assemble the required mono version oneself.
You can use the example given for the WSPR program on the website http://dj0abr.de/german/technik/dds/wsprbanana_install.htm

An alternative approach was found by DL3MX which is described in detail in a separate document
(http://dv4m.ham-dmr.ch) and works on nearly all Debian based computers and is simple and quick.

We realize that this may overwhelm some hams, so we created complete images for the important computers which are also downloadable from http://hddv4m.ham-dmr.ch

Screen - DV Control:

After starting the program the following window appears on the screen:
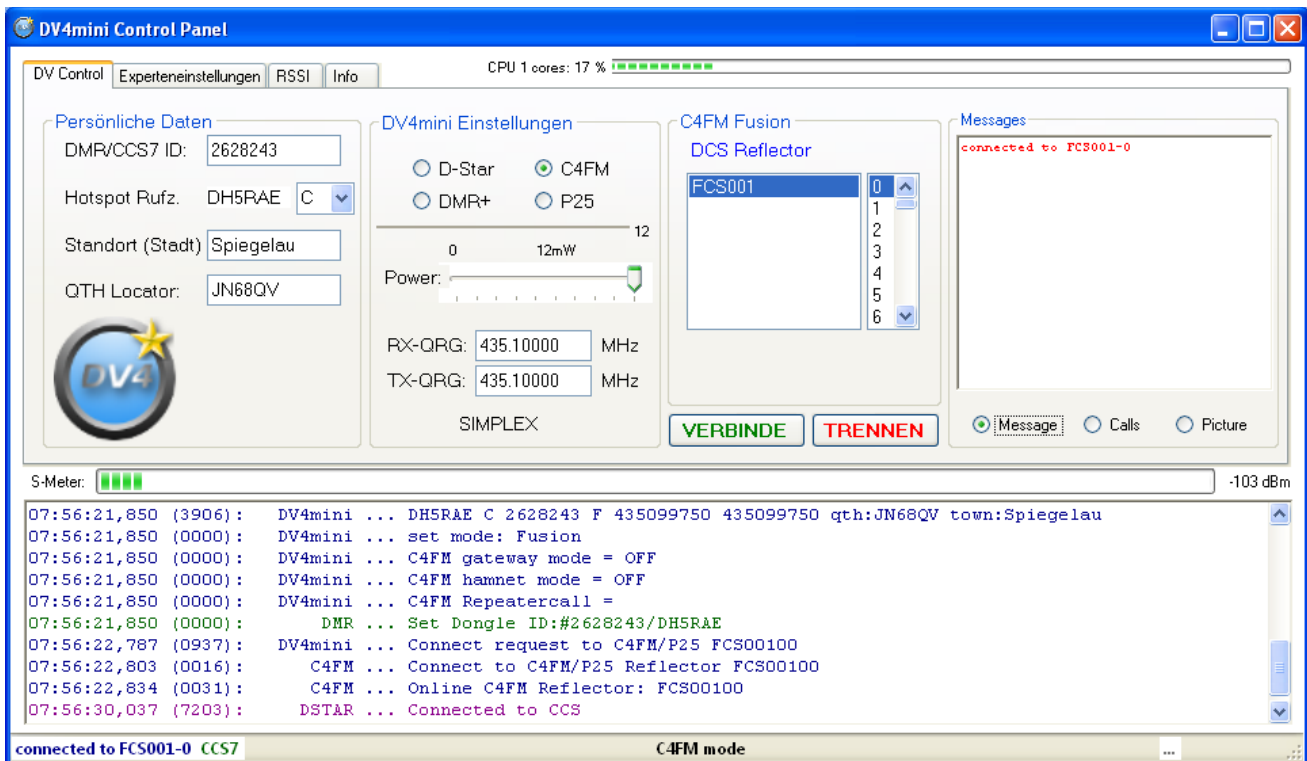
The user surface is pretty simple and should not create problems.

DMR/CCS7 ID: the 7 digit number ID. If you don't have one yet or have forgotten yours go to xreflector.net and query under USER Register or apply for one.

Hotspot call sign: If you entered your CCS7 ID the own call will automatically be inserted and the letter D is pre-entered. One cannot enter it manually. If several hotspots are used then different letters must be used.

Location and QTH locator: They will be shown on the Xreflector page

D-STAR, DMR, C4FM and P25: select the mode you use

Power: Adjust the power output - see technical data

RX-QRG: this is the frequency the DV4mini receives on. When using DMR it is also the transmit frequency.

TX-QRG: in D-Star mode you can operate in duplex mode (not in DMR) and you can enter the transmit frequency here

After inputting these the DV4mini will store them.

Reflector selection: select a reflector of your choice (in D-Star also specify the port) and click "CONNECT" to create a connection or "DISCONNECT" to cut an existing connection.

As already utilized in D-Star reflector selection is possible by using the touch tone (DTMF) feature. For example to change to reflector DCS024C type D2403. In C4FM it would be A and the room number = A10.

"#" disconnects from the room. In DMR one cannot use DTMF.

I**nfo field:** Here is information displayed that is transmitted. For example the picture stored in www.qrz.com for a received call sign is shown. You can actually select what is displayed by using the knobs below the window.

Below you see the S-meter. The RSSI value will be stored over a 24 hour period and shown in the RSSI window. The display of the noise level may be different from PC to PC. Depending on the noise level display values of -90 to -120 dBm are possible.

In the monitor window you may find diagnostic info created by various program segments. They are for experts but may be of interest for normal users to get a better feel what is happening.

On the lower screen segment you find status reports. The CPU use is displayed as a bar on the upper right.

Bootloader/Firmware update:

In order to update the firmware a boot loader is installed in the DV4mini:

First you save the new firmware file on your computer. Normally you will find it at http://dv4m.ham-dmr.ch

In the Expert Tab click on "Flash Firmware". This makes the LEDs on the stick blink in color and then the red one will stay on. A file selection window opens and you navigate to the location of the new firmware file. After selecting it the firmware will be updated. Now end the program and restart it again. It may take a little while until the stick is found again. Be patient.

Generally nothing bad should happen because if any error occurs the boot loader will be protected. Even with a power outage or interruption of the USB interface one can just repeat the update.
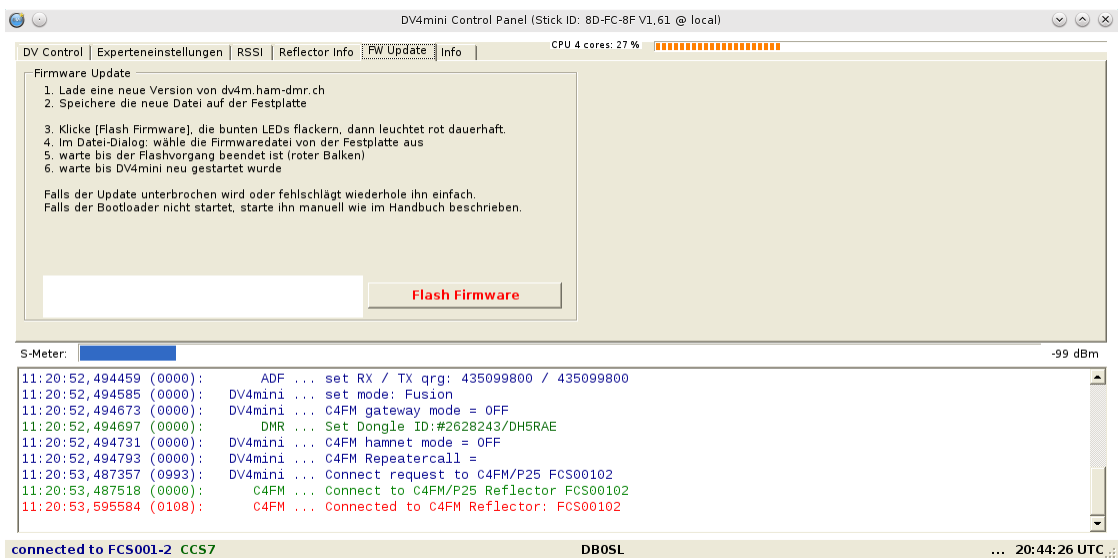
If the boot loader does not start (no red LED) you can start it manually (this is usually NEVER required).
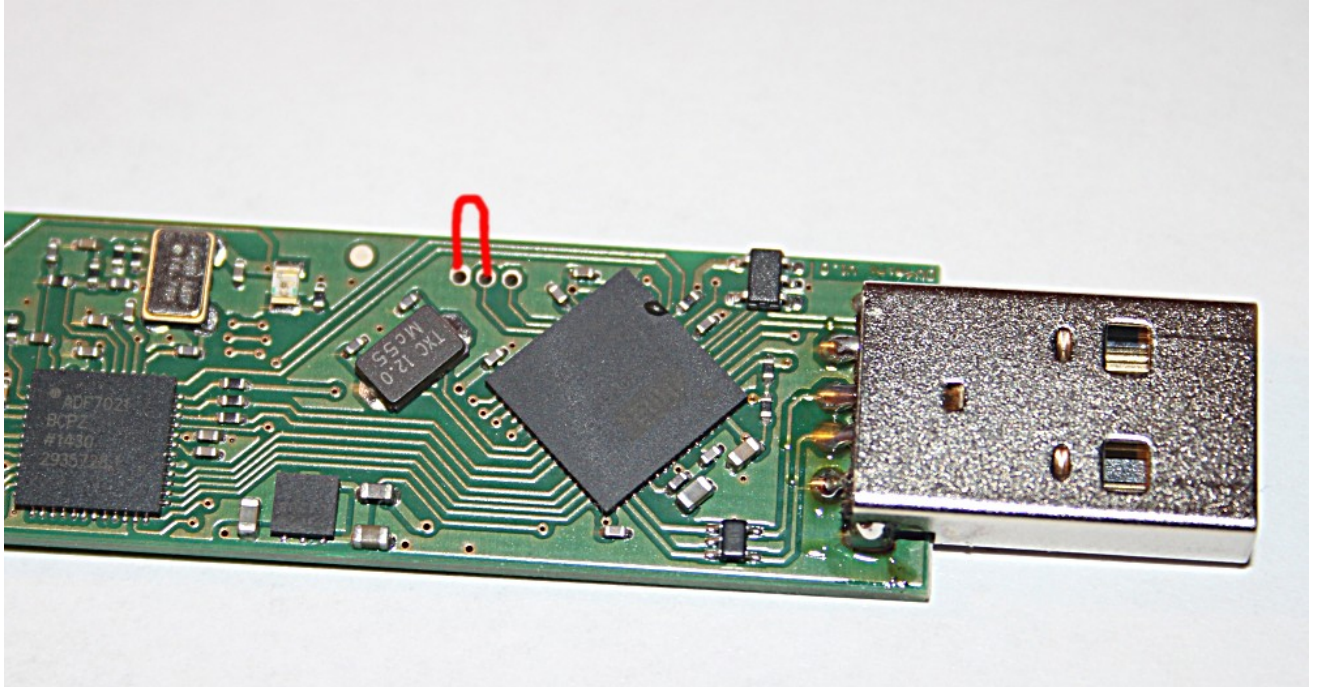
You connect the red marked points for example with tweezers while inserting the stick into a USB interface. The boot loader starts now with LEDs in color. Now you can start the user interface dv4mini and utilizing the Expert setup load the new firmware by clicking on "Flash Firmware".

Screen - Expert setup
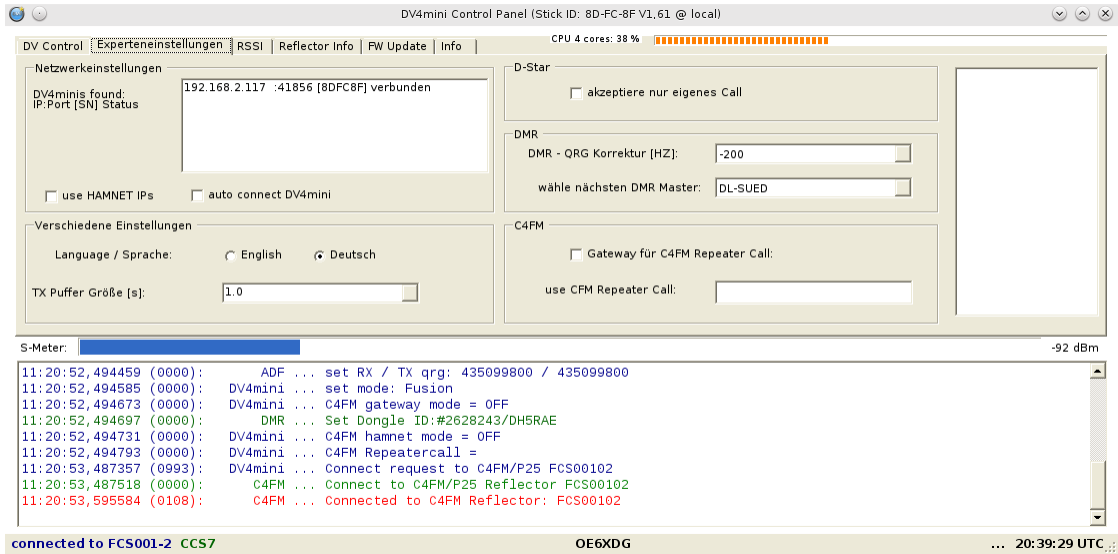
DV4mini list and auto connect:

The list shows all sticks found in your local network and the sticks's status. If you run a stick without user interface then you have to start the program "dv_serial" on this computer.

Usually "auto connect" should be checked. The user interface will automatically connect to the next available stick.

You can run more than one sticks in your local network (with dv_serial started) and then select one of them by clicking in the list.

Accept only own call sign:

if this entry is active then only one D-Star transceiver with the same call sign as the DV4mini call sign can operate via the hotspot. All others are locked out. This is a requirement in some countries regulations. This is only doable for D-Star mode.

Language:

English or German. This setting changes the language of the user interface and also the language of the announcements.

Select next location:

This is where the closest DMR Master is selected. One can actually operate via any master worldwide but should select the closest for the shortest ping time. Not all offered Masters are online. If a connection to a DMR reflector doesn't work - pick another one.

Gateway for C4FM Repeater, Call:

If you use the DV4mini as a gateway for a C4FM repeater you need to click on this field and add the call sign of the repeater. Otherwise the repeater will not retransmit.

Hamnet IP

If this is elected HAMNET IP addresses will be used instead of the normal IP addresses. This function may not work in all modes yet. It works for C4FM and as soon as the reflector servers can support it it will be implemented.

Only own call:

This function is only supported in D-Star mode. If selected the call of the user must be identical to the call of the DV4mini or the transmission will not be relayed to the reflector.

Frequency Correction:

Experience has shown that sometimes the frequency of the stick and the transceiver used don't match well. The bandwidth of the filter is approx. 800 Hz especially in DMR. The accuracy of the TRX in the stick is 2.5ppm which on 70 cm is approx. 600 Hz. This control lets you get to the middle of the filter in 250 Hz steps. Without using expensive test gear it is simple to get to an accurate adjustment.

You should be able to simultaneously listen to D-Star reflector DCS001V. In DMR mode for to reflector 4012 which is connected to the D-Star DCS001V. Now change the receive frequency of the stick and listen to the signal in D-Star. The point between no data, bad modulation and good modulation is 100 Hz. Now find the frequency going down and up where no longer data come through or in T-Star PTT no longer works. The arithmetic center between these two frequencies is the optimal setting and can be entered in this field.

TX buffer size:

Before being transmitted through the built in 70 cm transceiver the signal is being buffered. This is necessary to fill data holes that develop in the internet transmissions. (ping times)
If you have a good and fast DSL connection you won't need buffers and keep this setting small.
However if you use mobile networks (H+, Edge, LTE etc) holes in the data stream can be substantial. In this case you pick buffer sizes of 1 or 1.5 seconds.His will delay the transmission a bit but will close the holes and thus eliminate many interruptions.

Remote Control:

One can control the DV4mini additionally from another computer.

Computer 1:
This is where the DV4mini USB stick is plugged in. One starts the program "dv_serial" in console mode.

Computer 2:
Here you start dv4mini.exe - the user surface. In order to fine computer 1 is IP address needs to be entered in the field "distant *DV4mini IP/URL*" and you activate *Remote Control on/off.*

Now one can control with computer 2 computer 1. You will get all displays and full control over all set up as if you are sitting in front of computer 1.

Operating without a user interface:

If one only starts the program dv_serial from a console then the DV4mini stick starts up with the last
selected configuration and connects to the last used reflector. This allows for an extremely power saving operation which should make Linux purists happy. However it also works in Windows the same way.

Copyright:

The rights for the DV4mini stick and its software are reserved with DG8FAC (Stefan Reimann), DG1HT (Torsten Schultze) and DJ0ABR (Kurt Moraw).
The rights for the DMRPLUS and P25 software module are entirely with DG1HT (Torsten Schultze).

Important Links:

Software, Firmware, Operating Manuals, Drivers: http://dv4m.ham-dmr.ch
Developer info and interfaces: www.dj0abr.de
DMR/CCS7 number allocation at www.xreflector.net

Operating conditions:

This product must only be used within the technical data limits provided. All other not specifically listed operations are not permitted.

The product is exclusively for use by licensed Amateur Radio Operators. Commercial use or operation outside the ham bands is specifically prohibited.

Damaged or moist units may not be operated. The same goes for defective or abnormal appearing units. Use in vehicles, aircraft or under dangerous conditions is not permitted. As the installation, use and operation of this product cannot be monitored the full responsibility rests with the user. The product may only be operated if the user is fully aware of the risks and dangers which may result from

the operation. The manufacturer will not be liable for personal damages, property damage, losses or expenses which result from misuse or operation of this product.

This includes claims for damages for failure or malfunctions. If the user does not have the necessary know-how to assemble, install or operate or is not in agreement with the operating conditions he/she may not use the product. Standard warranty conditions apply. All further claims are excluded.