Instruction manual

TNC7multi

Firmware-Version (TOS) 1.22

IfD Güttner

Contents

1 Introduction

The new TNC7multi as the successor of the well known TNC2multi has many new features that cannot find with other TNC. Because of several firmware modes, it works with any packet radio software that support Hostmode, KISS or Flexnet.

Features:

- USB port
- RS232 port
- 32bit controller with high calculation power
- low current consumption
- 9 software configurations are programmable
- build in 1200/9600 bps modem
- internal connector for an additional low cost modem for higher data rates
- update of TNC firmware and modem software via serial connection

Please read the manual carefully (especially chapter 4) to understand the operation concept that differs from the predecessor TNC2multi.

2 Specifications

Radio channel data rate:

internal modem: 1200bps AFSK, 9600bps FSK, (4800bps FSK)
additional modem: Data rates between 19200bps FSK and 115200bps FSK (depends on modem)

Serial interface data rate:

RS232 interface: 1200bps, 2400bps, 4800bps, 9600bps, 19200bps, 38400bps, 57600bps, 115200bps
USB interface: 1200bps, 2400bps, 4800bps, 9600bps, 19200bps, 38400bps, 57600bps, 115200bps, 230400bps, 460800bps, (921600bps)

Modulation voltage:

Output modulation voltage: typ. 0,1Vpp...2,2Vpp adjustable
Input modulation voltage: typ. 0,1Vss...2Vss
Input resistence: typ. 30KOhm

Power supply:

DC in jack, 6 pin Mini DIN connector:

        11...14V DC @ about 70mA
        power input: about 0,9W

USB connector:

        4,5...5,5V DC @ cbout 95mA
        power input: about 0,5W

Controller:

Processor: ARM7TDMI 32bit 58,9824 Mhz
SRAM: 64 kByte, 32bit
Programm memory (Flash): 128 kByte, 32bit (128bit)
Data memory (Flash): 512 kByte, 8bit

Connections:

PC <-> TNC: RS232 9-pin Sub-D-connector (Pins) (DTE pin layout like a PC!)
        USB 1.1, USB 2.0
TRX <-> TNC: 6 pin MiniDin Connector (Standard pin layout)

Power supply: DC in jack (outer connector 5,5mm, inner connector 2,1mm)

Dimensions (case): 113mm* 31mm * 93mm (W*H*D)

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Firmware updates: www.tnc7multi.de -> download

This device meets the intend of directive 89/336/EEC for electromagnetic compatibility:

    CE EN 50082-1 „Fachgrundnorm Störfestigkeit"
EN 55022 Klasse B „Grenzwerte und Messverfahren für Funkstörungen von Einrichtungen der Informationstechnik". Die Konformität des Gerätes mit den o.g. Richtlinien wird duch das CE-Zeichen bestätigt.

3 Installation

It is recommend to use the USB port to connect the TNC7multi to your PC because you do not need seperate power supply for the TNC7multi and you can use higher data rates (up to 921600bps between TNC and PC). If the PC has no USB ports or you want to use a DOS software, connect the TNC7multi to your PC with a special NULL modem cable (crossed cable) and connect a power supply to the TNC.

Use a ready made 6 pin mini DIN cable to connect the TNC7multi to your transceiver if the transceiver has a 6 pin mini DIN connector, too or built your own cable (chapter 8.4)

You find a detailed description for installation in the following chapters.

3.1 USB driver installation (Windows98se, XP, 2000)

Before using the TNC7multi with USB, you have to install a USB driver that create a new <u>exclusive</u> virtual COM port for your TNC7multi (if you plug in another TNC7multi, the driver creates a second virtual COM port for the other TNC7multi).

If you have no experience in installing USB drivers, read the following manuals (CD-ROM):

Win98se, ME: Windows_98_Installation_Guide.pdf (Chapter 2.2 Installing VCP Drivers)
WinXP: Windows_XP_Installation_Guide-1.pdf (Chapter 2.2 Installing VCP Drivers)
Win2000:   Windows_2000_Installation_Guide.pdf (Chapter 2.2 Installing VCP Drivers)

1. Plug in the TNC7multi

2. Install the driver(s) (CD-ROM: /usb_drv/)

3. Configure the drivers (chapter 3.1.x)

Remarks:

After Win98 driver installation, the PC may hang for about 30 seconds because the driver is looking for plug and play devices. You should disable plug and play in the driver settings (chapter 3.1.1).

DOS software is not able to use a virtual COM port.

3.1.1 USB driver configuration for Windows98se

Open the device manager (located in „Control Panel\System" then select the „Hardware" tab and click „Device Manager"), select „View Device by Type" and open „Ports (COM & LPT)". The device appears as an additional COM port with the label „USB Serial Port".

Double click on this device, then select „Port Settings" and click „Advanced...". Now you can set the parameters you can see in the picture (but do not change the COM port number). The parameter „Latency (msec)" should set to 1. It is important to disable PNP to avoid a 30 seconds delay while booting the PC.
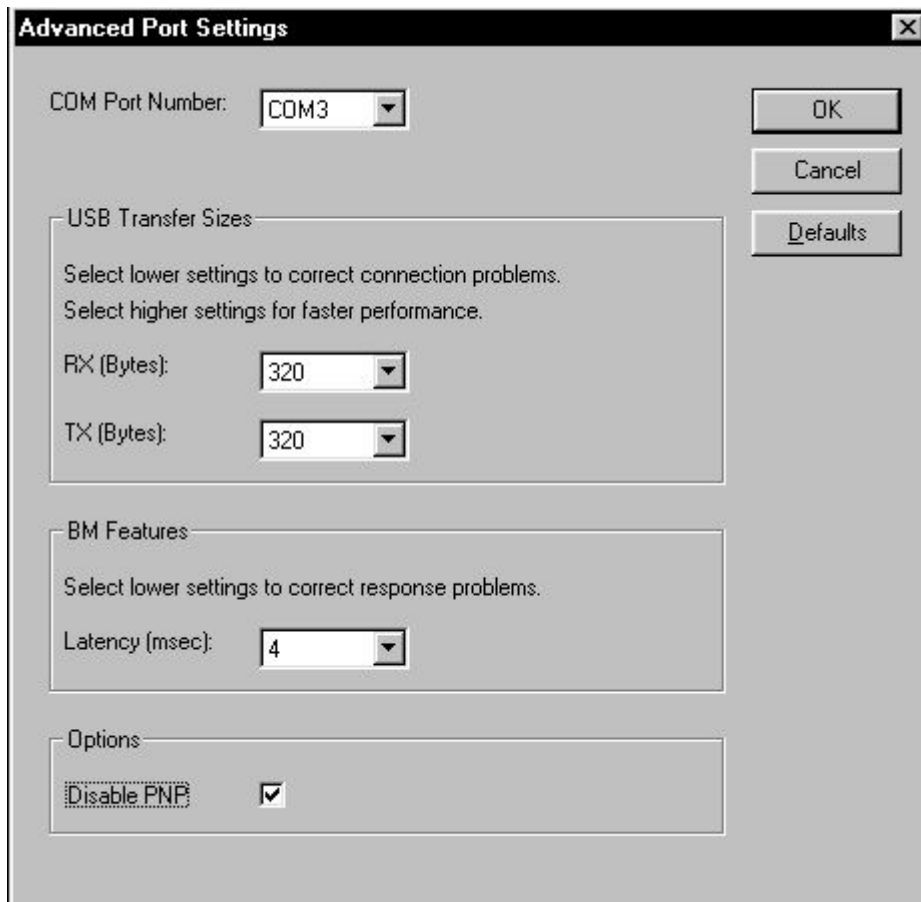
Uninstalling the VCP USB driver

see:

Windows_98_Installation_Guide.pdf (Chapter 4: Uninstalling FT232BM....)

3.1.2 USB driver configuration for Windows XP

Open the device manager (located in „Control Panel\System" then select the „Hardware" tab and click „Device Manager"), select „View Device by Type" and open „Ports (COM & LPT)". The device appears as an additional COM port with the label „USB Serial Port".

Double click on this device, then select „Port Settings" and click „Advanced...". Now you can set the parameters you can see in the picture (but do not change the COM port number).
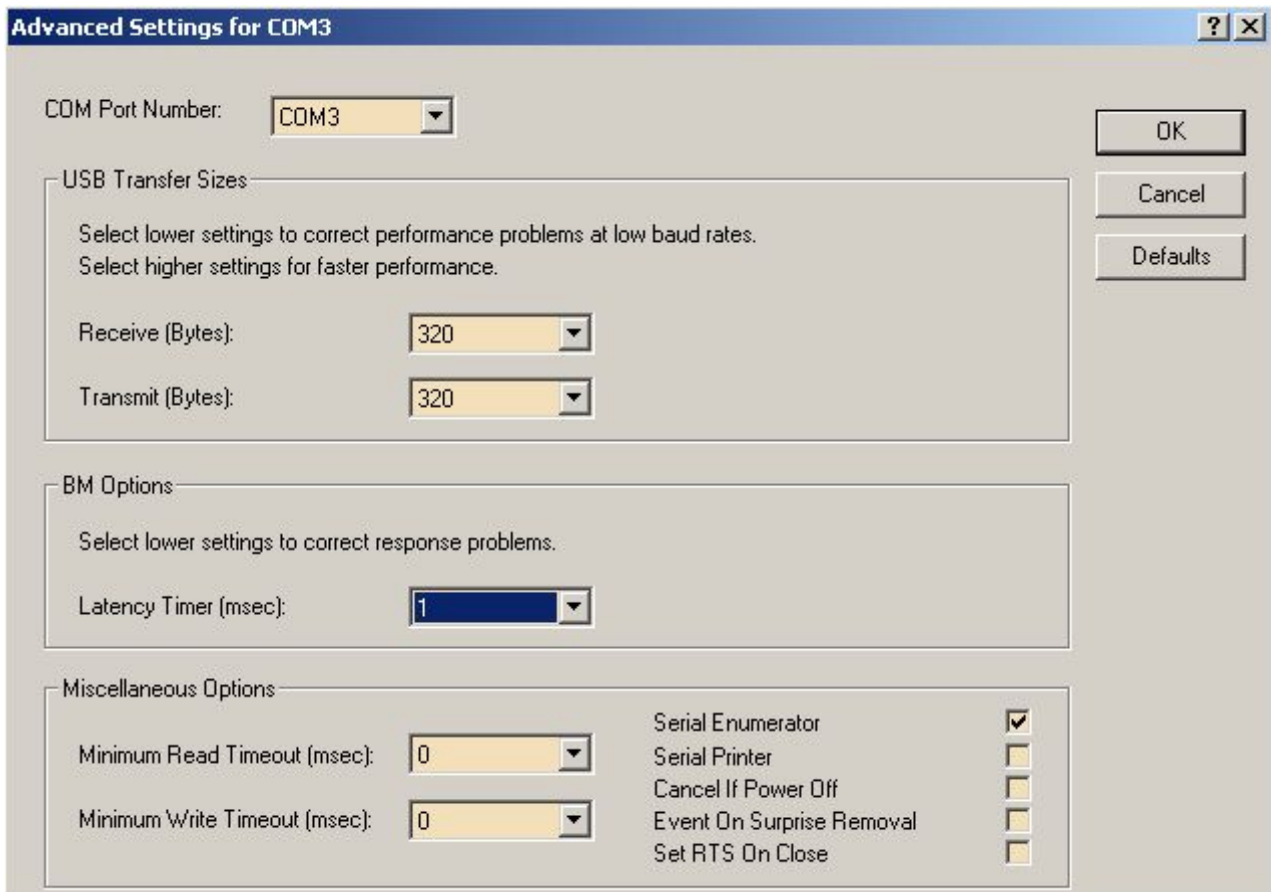
Uninstalling the VCP USB driver

see:

Windows_XP_Installation_Guide-1.pdf (Chapter 4: Uninstalling FT232BM....)

3.2 RS232 connection

If the PC has no USB ports or you want to use a DOS software, connect the TNC7multi to your PC with a special NULL modem cable (crossed cable) and connect a power supply to the TNC.

You should use a cable with the following layout:

9 pin connector (f) ---   9 pin Connector (f)

1	4
2	3
3	2
4	1
5	5
7	8
8	7
9	9

Shield: You should connect the shield of the cable at both sides, TNC and transceiver, to avoid damage of the devices.

3.3 9600/1200 bps data cable connection

Connect the TNC to the data connector of your 9600 bps transceiver. If the data connector of your transceiver is also 6 pin mini DIN, you can use a 1:1 cable (optional accessory). The data connector pin functions are the same with ICOM, YEASU and KENWOOD.

1. TX-Data (PKD) [output] Packet Data modulation (1200 bps and 9600 bps) from TNC to transceiver. The output is DC decoupled with 22µF (bipolar).

2. Ground (DE) GND for data signals

3. PTT (PKS) [output] While transmitting, this output is connected to ground, otherwise it is open. The maximal voltage allowed from the transceiver PTT input is 14V / 100mA.

4. RX-DATA (PR9) [input] detected data signal from transceiver (1200 bps, 9600 bps and optional highspeed modem).

5. 12V [input] Alternative current supply for the TNC7multi (11V...14V). If the pin is not used, there is no output voltage at this pin.

6. TX-DATA (highspeed) [output] Packet Data modulation for the optional highspeed modem.

Shield: You should connect the shield of the cable at both sides, TNC and transceiver, to avoid damage of the devices.

3.4 1200Bps data cable connection for handheld transceivers

If your handheld transceiver has no data connector, you can connect the TNC at the microphone input and loudspeaker output for 1200 bps operation.

You can use the circuit shown below, if microphone input and PTT is the same pin at the transceiver. Otherwise you connect R3 to ground instead of PTT Pin 3 and use a seperate PTT line from TNC to transceiver. The voltage divider is necessary because of the high microphone sensitivity (some mV). The TNC output modulation should set around 1Vss.

Using R3 is sometimes necessary to avoid distortions of the loudspeaker output because of the high TNC input impedance.
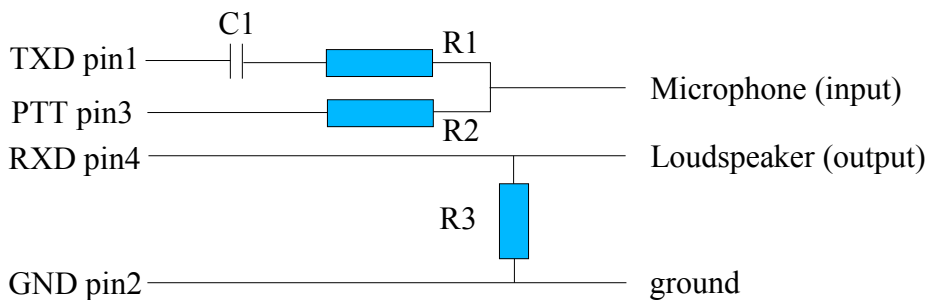
R1 = 47k...100k

R2 = 2k2

R3 = 100

C1 = 100nF

3.5 DC power supply

There are three possibilities to connect the power supply:

1. USB port (5V, max. 95 mA from PC).
2. DC in jack (11V...14V, max. 75mA from an external power supply)
3. Mini DIN connector pin 5 (11V...14V, max. 75mA from an external power supply)
   Outer connector diameter 5,5mm, polarity is negative (connected to the TNC case).
    Inner connector diameter 2,1mm, polarity is positive.

4 Mode selection and configuration

The firmware consists of several modules. After power on, the TNC operating system (TOS) starts, set up the hardware and test the switch position. Depending on the switch position, the TOS loads the configuration data stored in flash memory (modem data rate, Usb data rate, mode, etc)

CON and STA LED have different functions in each mode. The PTT, DCD and power LED have the same function in every mode:

PTT Led: flashes while transmitting

DCD Led: flashes while receiving a appropriate data signal (same data rate as selected)

Power Led: flashes when power on (and USB works correct, if connected to a USB port)

To select a specific mode, turn the switch to the position shown in the table. After turning the switch, the TNC7multi reset after one second and start in the selected mode. Then the TNC7multi checks if the USB Port is active. If it is active, the TNC uses the USB port, otherwise it uses the RS232 port.

Predefined modes:

Switch position	Mode	Radio channel data	USB- data rate	RS232-data rate
1k2	KISS/SMACK	1200bps AFSK	115200bps	38400bps
9k6	KISS/SMACK	9600bps FSK	115200bps	38400bps
1	TncLink (Flexnet)	Configurable in driver	460800bps	38400bps
2	Hostmode/Term	9600bps FSK	115200bps	38400bps
3	KISS/SMACK	38400bps FSK*	115200bps	115200bps
4	KISS/SMACK	76800bps FSK*	230400bps	115200bps
5	KISS/SMACK	102400bps FSK*	460800bps	115200bps
6	KISS/SMACK	115200bps FSK*	460800bps	115200bps
7	KISS/SMACK	57600bps FSK*	230400bps	115200bps
Conf	Configuration	---	9600bps	9600bps

* additional modem necessary

In the following chapters you find a detailed description of each mode.

4.1 KISS / SMACK Mode

KISS (Keep It Simple and Stupid) is a transparent communication protocol between PC and TNC. It is often used in

· APRS

· Satellite pacsat protocol

· Satellite telemetrie (e.g. AO-51)

· TCP/IP over packet radio

SMACK is an extended KISS protocol with error recognation (CRC) between PC and TNC.

To use 1200bps AFSK KISS/SMACK mode, switch the TNC7multi to position 1k2
To use 9600bps FSK KISS/SMACK mode, switch the TNC7multi to position 9k6

You should set some channel access parameters and TX-delay in your programm (e.g. UI-view). The TNC7multi uses the following commands:

1. TX-Delay   Transmitter keyup delay in 10ms units. Default: 15 (150ms)

2. Persistence   0..255. Default 64 (64/255*100% = 25%)

3. Slottime   Slot interval in 10ms units. Default: 5 (50ms)

4. TX-Tail   not implemented

5. Duplex   1 = on default: 0 = off

6. SetHardware   not implemented

Other default values, which can change only in Config mode:

Modulation voltage: 1000mVpp (peak to peak)

Seriell data rate (RS232): 38400 bps

USB Data rate: 115200 bps

LED functions in KISS mode:
CON Led: flashes, when the TNC transmits a packet to the PC
STA Led: flashes, when the PC transmits a packet to the TNC

You can change and save all default values in config mode (chapter 5).

4.2 Flexnet 32 mode with TncLink driver

Flexnet is often used for TCP/IP over AX.25. If you want to use flexnet32 with the TNC7multi, you have to copy the TncLink driver (TncLink.dll) in your flexnet32 directory, select the driver in the „FlexNet Channel Parameters" window and set the parameters:
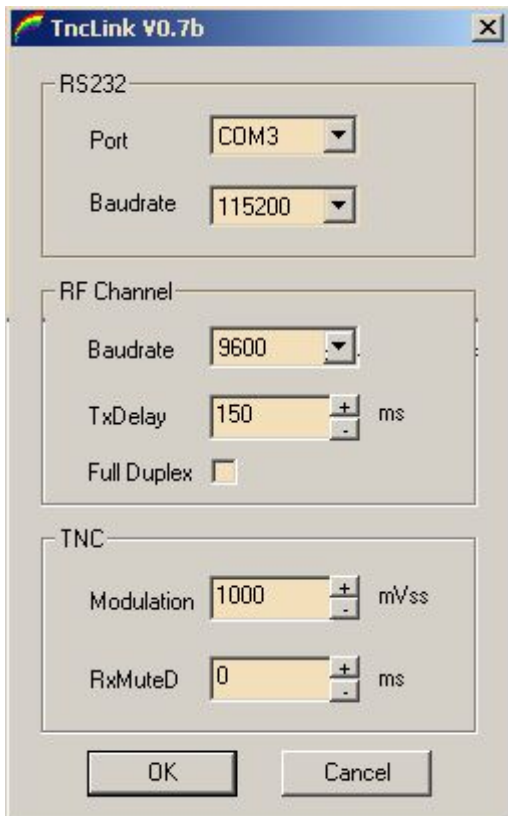
RS232 or USB data rate between PC and TNC7multi: If you are using the RS232 connection, set the baudrate to 38400 (default TNC7multi). If you are using the USB connection, set the baudrate to 460800 (default TNC7multi TOS 1.22 or 115200 with TOS 1.20 or lower). Choose the correct COM port (mostly COM1 or COM2 for RS232 or the new virtual COM port for USB).

Radio channel data rate:
9600 bps (FSK) , 1200 bps (AFSK) or higher if the additional modem is plugged in.
TX-Delay: minimum transmitter keyup delay (depends on your transceiver).
Full Duplex. If activated, Flexnet does not check the channel activity before transmitting.

Modulation voltage: 100mV to 2190mV (peak to peak) depends on your transceiver.

RxMuteD mutes the modem input for some milliseconds after switching from TX to RX to supress switching transients.

To use Flexnet32 mode, switch the TNC7multi to position 1

LED function in Flexnet32 mode:
CON Led: flashes while connected to a digipeater
STA Led: flashes while a packet is sent. Stop flashing, when the packet is confirmed by the digipeater.

You can change and save all default values in config mode (chapter 5).

4.3 Hostmode and terminal mode (WA8DED compatible)

There are a couple of hostmode packet radio software available. To use this software, you have to switch the TNC7multi to position 2.

It is necessary to set up the hostmode packet radio software to communicate with the TNC7multi:

If you are using the RS232 connection, set the baudrate to 38400 (default TNC7multi).
If you are using the USB connection, set the baudrate to 115200 (default TNC7multi).

Choose the correct COM port (mostly COM1 or COM2 for RS232 or the new virtual COM port for USB).

The TNC7multi has some additional hostmode commands to set up the data rates:

command	value	description
@xC	0,1,2	Select the TNC communication port (after next start): 0: the TNC7multi uses RS232 1: the TNC7multi uses USB **2: automatic selection:** at power on or after turning the switch, the TNC7multi checks if the USB Port is active. If it is active, the TNC uses the USB port, if not, it uses the RS232 port.
@xN	10...220	Modulation voltage in 10mV units (100mVpp...2200mVpp) default:**100** (1000mVpp)
@xM	0...255	Mute in 1 ms units.RxMuteD mutes the modem input for some milliseconds after switching from TX to RX to supress switching transients **0**: Mute not activated
@xR	1200...115200	Modem receive data rate(**9600**) bps (sets the receive modem data rate)
@xS	1200...115200	Modem transmit data rate (**9600**) bps (sets the transmit <u>and</u> receive modem data rate)
@xU	1200...921600	USB data rate (**115200**) bps
@xV	1200...115200	RS232 data rate (**38400**) bps
@x!	0,1	1: save all hostmode values in flash memory 0: clear all saved values and set to default hostmode values

Example:

A typical init sequence of a hostmode packet radio software looks like:

```
i DL9ZZZ      ;set own callsign
t10           ;set TX delay to 100ms (keyup time depends on your TRX!)
o7            ;set maxframe to 7
@xS9600       ;set receive and transmit baudrate to 9600bps on radio channel
@xN200        ;set modulation voltage 2000mVpp (2V peak to peak)
```

You can save all values in flash memory with @x1. The firmware uses the new values as default values at the next startup.

4.3.1 Configuration example: Paxon
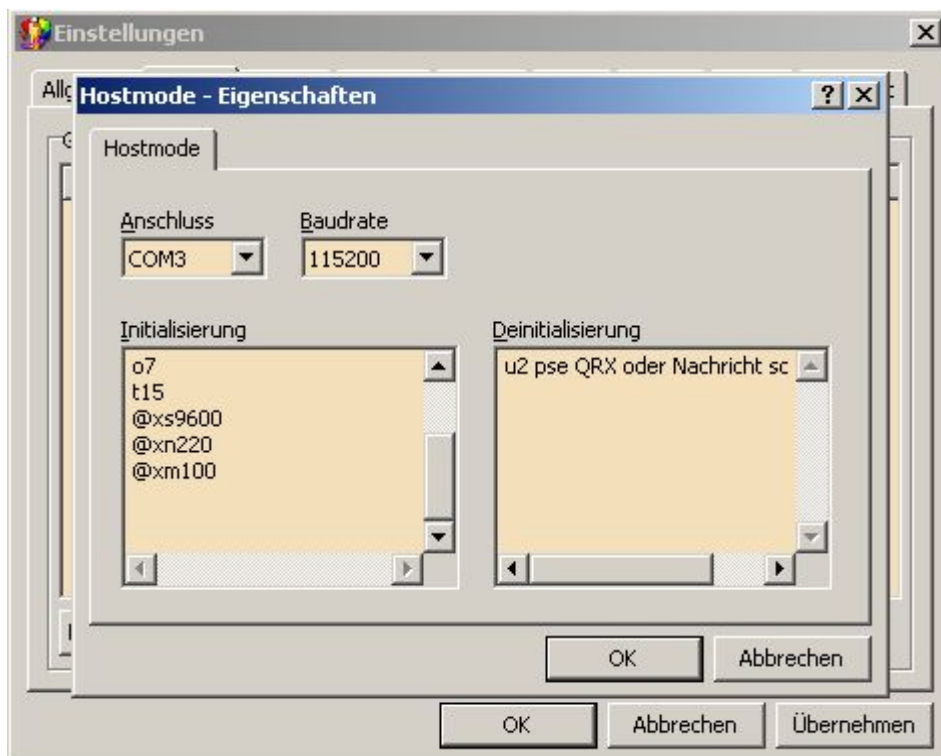
USB: Baudrate 115200, Anschluss z.B. COM3
RS232:   Baudrate 38400, Anschluss z.B. COM1

Initialisierung (init):
o7   set maxframe to 7
t15   set TX delay to 100ms (keyup time depends on your TRX!)
@xs9600   set receive and transmit baudrate to 9600bps on radio channel (1k2: @xs1200)
@xn220   set modulation voltage 2200mVpp (2,2V peak to peak)
@xm100   set mute delay to 100ms (depends on your TRX) [optional]

Deinitialisierung (deinit):
u2 pse QRX.. connect text that will transmit, if Paxon is not active [optional]

You can add all other hostmode commands in these two windows.

5 Config Mode

In config mode you can change all default values and assign a firmware mode for every switch position (default values are printed in **bold** type):

comm and	value	comments
c	0,1,2	Select the TNC communication port: 0: the TNC7multi uses RS232 1: the TNC7multi uses USB **2: automatic selection:** at power on or after turning the switch, the TNC7multi checks if the USB Port is active. If it is active, the TNC uses the USB port, if not, it uses the RS232 port.
d	0,1	Duplex: **0 = off**, 1 = on
f	0,1,2, 255	Select the Firmware **1: KISS/SMACK** 2: Flexnet 3: Hostmode/Terminalmode TF2.7b (WA8DED) 255: clear configuration and use default configuation
g	0...65535	PTT watchdog. If the ptt is active longer than g seconds, the TNC7multi will reset itself. 0: disable PTT watchdog **20** seconds (Grundeinstellung)
b	0,1	Calibrate mode: 1: Switch on the modem and TRX. While transmitting, it is possible to change the modulation voltage (n command). 0: off
m	0...255	Mute in 1ms units.RxMuteD mutes the modem input for m milliseconds after switching from TX to RX to supress switching transients. **0**: Mute disabled
n	10...220	Modulation voltage in 10mV units (100mVpp...2200mVpp) **100** (1000mVpp)
p	0...255	Persistence. Probability for channel access (only KISS mode) **64** == 25%, 255 == 100%
r	1200...115200	Modem receive data rate (**9600**) bps
s	1200...115200	Modem transmit data rate (**9600**) bps
t	0...511	TX delay in one ms units (**150**)
u	1200...921600	USB data rate (**115200**) bps
v	1200...115200	RS232 data rate (**38400**) bps
w	0...255	Slottime in 10ms units (**5**) (only KISS)
z		TOS version number (122 == 1.22)
@	1200,9600,1-7	Select a configuration for modifying
!	1200,9600,1-7	Save the modifyed configuration.

In most cases, it is only necessary to change some KISS/SMACK parameters, e.g. the baudrate because KISS mode does not support those commands.

Switch the TNC7multi to position Conf to use the config mode and exit the packet radio software to free the COM port.

To use the config mode, use the terminal program you can find on CD-ROM (/terminal/cterm.exe) or any other terminal program.

When using cterm.exe you have to type the COM port number that you use for the TNC7multi. To exit cterm.exe type Q.

5.1 Example 1:Changing the modulation voltage in KISS mode

You want to change the modulation voltage and USB data rate in 1200bps KISS mode for use with UI-view (UI-view 2.39 works correct up to 38400bps USB or RS232 data rate).

>@1200	call the 1k2 configuration. <enter>
>empty	answer of the TNC7multi, because it is the default configuration (no change before)
>f1	use KISS/SMACK mode
>n10	set modulation voltage 100mVpp (0,1V peak to peak). <enter>
>s1200	set receive <u>and</u> transmit baudrate to 1200bps on radio channel. <enter>
>u38400	set USB data rate to 38400bps. <enter>
>!1200	save the parameters in flash memory. <enter>

5.2 Example 2: Changing the datarate for satellite operation

>@3	call the configuration for switch position 3. <enter>
>empty	answer of the TNC7multi, because it is the default configuration (no change before)
>f1	use KISS/SMACK mode
>n150	set modulation voltage 1500mVpp (1,5V peak to peak). <enter>
>s9600	set receive <u>and</u> transmit data rate to 9600bps on radio channel. <enter>
>r38400	set receive data rate to 38400bps on radio channel. <enter>
>!3	save the parameters in flash memory. <enter>

6 Operation settings

6.1 Modulation voltage

It is very important to set the TNC7multi to the correct modulation voltage to achieve a low bit error rate when using 9600bps FSK or higher. The deviation should be 3...3,5 Khz.

The best way is to receive the signal with a second receiver and compare this with the signal of a digipeater (use an oscilloscope or try to compare it with your ear).

You can use the calibrate function in config mode (chapter 5) to key up the transmitter (b1).

Attention:

Some transceiver will not transmit if the modulation voltage is to high.

If you want to use 1200bps and 9600bps with the same transceiver, set the transceiver always to 9600bps because the transceiver needs different modulation voltages in 1200bps and 9600bps mode (the mode that you can set up in your transceiver!).

Starting point for modulation voltage:

Kenwood TM V7E   1800...2200 mVpp (9600bps tranceiver mode!)

T7F   300...400mVss

6.2 TX-Delay

The key up time depends on the your transceiver and the digipeater. Set up the tx delay to the lowest value that works without retransmissions.

Starting point for TX delay:

Kenwood TM V7E   70...100ms

T7F   30...70ms

6.3 RX-Mute-Delay

RxMuteD mutes the modem input for some milliseconds after switching from TX to RX to supress switching transients. In many cases set this value to 0 (default). If the transceiver has problems to receive a frame directly after switching from TX to RX, try to increase the value of Rx mute delay up the value of TX delay.

7 Additional modem

7.1 Plug in

1. Remove all cables.

2. Remove the upper cover.

3. Insert the additional modem, 5 pin connector first. (Do not touch the pins because of static discharge)

7.2 Operation

To use the additional modem, the firmware must be TOS 1.16 or higher.

The additional modem and the internal 1k2/9k6 modem use the same input signal (pin 4).
The output signal (modulation voltage) of the additional modem is connected to pin 6.

Set the TNC7multi to the data rate of the additional modem (Use hostmode commands, flexnet driver settings or config mode for KISS operation). The serial data rate (USB or RS232 schould be 4 times the modem datarate).

While transmitting, both outputs (internal modem pin 1 and additional modem pin 6) are active. Use the appropriate output. Do not solder them together!

8 Port pin outs

8.1 RS232 interface

The pinout of the port is the same as the pinout of a PC COM port (DTE). So you <u>need a NULL modem cable</u> (cross cable) to connect the TNC7multi and a PC.
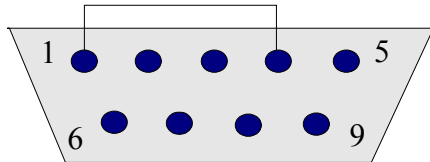
This drawing shows the serial port of the TNC7multi when looking from the back to the port.

pin	direction	description
1	---	Connected to pin 4
2	input	RXD (TNC <-- PC)
3	output	TXD (TNC --> PC)
4	---	Connected to pin 1
5	---	Signal ground
6	---	Not connected
7	output	RTS (TNC --> PC)
8	input	CTS (TNC <-- PC)
9	---	Not connected

It is important to connect the shield of the cable (TNC and PC) to avoid damages.

8.2 USB interface

The USB interface of the TNC7multi is USB specification 1.1 and 2.0 compatible (Full Speed 12Mbit/s).

8.3 DC in jack

To connect the TNC7multi to a regulated power supply, use a dc connector.
Outer connector diameter 5,5mm, polarity is negative (connected to the case).
Inner connector diameter 2,1mm, polarity is positive.
The supply voltage must be between 11V and 14V DC, the current consumption is 75 mA.

8.4 6 pin mini DIN connector (tranceiver connection)

The pin layout is the same for all transceivers which have also a 6 pin mini DIN connector for TNC connection (ICON, Kenwood, Yaesu). You can use a 1:1 cable (shielded) to connect the TNC7multi to the transceiver for standard 1200bps and 9600bps operation.
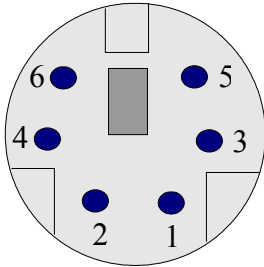
This drawing shows the mini DIN connector of the TNC7multi when looking from the back to the connector equipped on this TNC.

pin	direction	description
1	output	TX-DATA (PKD) 1k2/9k6 modulation signal from TNC to transceiver
2	--	GND (DE) Signal ground
3	output	PTT: (open collector) tied to ground while transmitting **(max. 100mA!)**
4	input	RX-DATA (PR9) 1k2/9k6/19k2/38k4... RX signal from Transceiver
5	input	Alternative power supply <u>input</u> (11..14V, 75mA)
6	output	TX-DATA (additional modem) modulation signal from TNC to transceiver

It is important to connect the shield of the cable (TNC and transceiver case) to avoid damages.

Pin 1,4 and 6 are decoupled with a capacitor (bipolar). There is no need to add capacitors between the TNC-transceiver lines.

The differene in pin layout (pin 5 and pin 6) does not cause any problems for standard 1200bps and 9600bps operation with a 1:1 cable.
Pin 5 is a power supply input alternative to the DC in jack. There is no voltage at this pin when not connected.
Pin 6 is the modulation signal output from the additional modem when plugged in.

Use the transceiver in 9600bps packet mode also for 1200bps operation to avoid changing the modulation voltage.