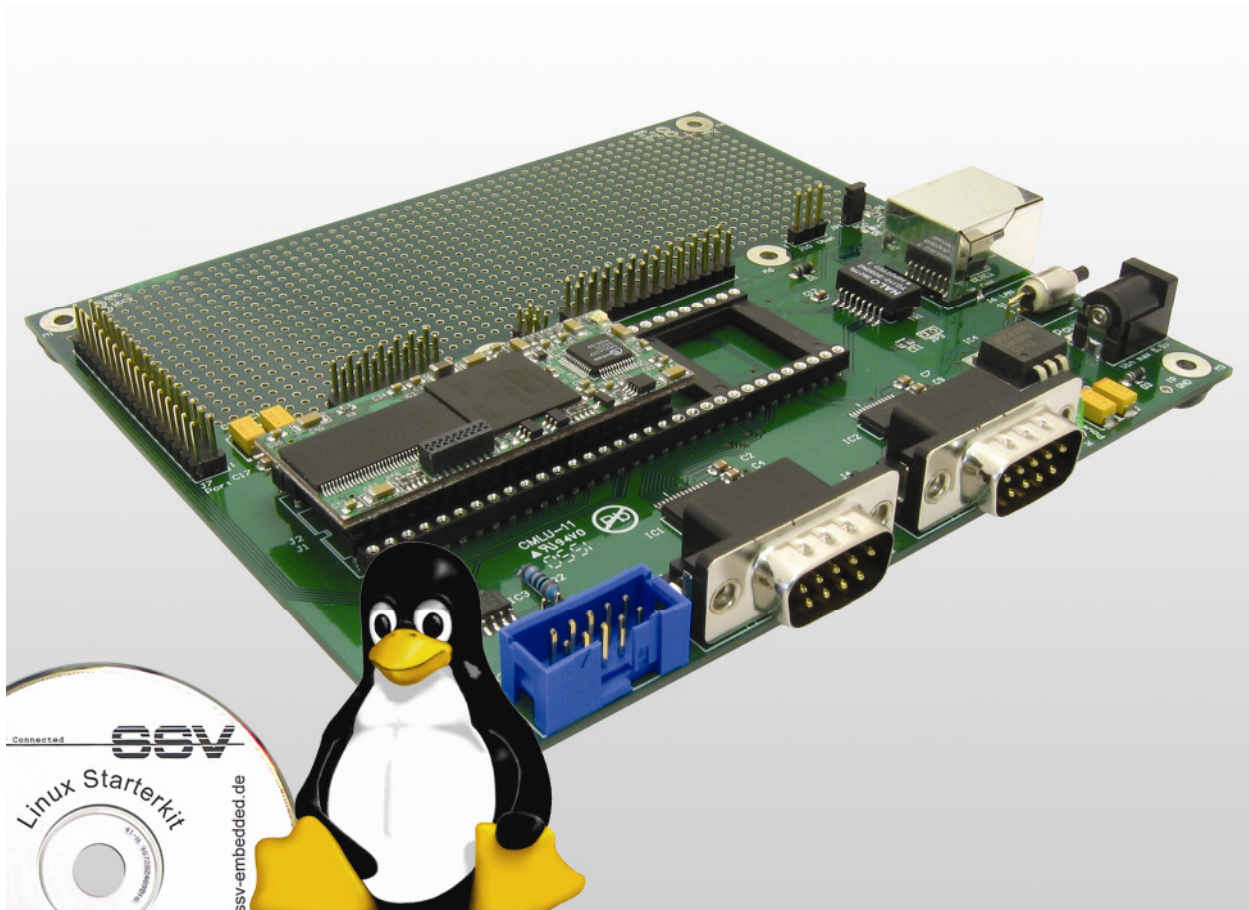# *DNP/SK30*
Embedded Linux Starter Kit

First Steps

SSV Embedded Systems

Heisterbergallee 72
D-30453 Hannover
Phone: +49 (0)511/40 000-0
Fax: +49 (0)511/40 000-40
E-mail: sales@ist1.de

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CONTENT

1   INTRODUCTION

The Starter Kit DNP/SK30 contains everything you need to get started with your embedded networking application. The Starter Kit includes a DNP/9265 module with a pre-installed U-Boot boot loader and an embedded Linux, the Evaluation Board DNP/EVA6, power supply, serial interface (null modem) cable, a CD-ROM with software and documentation and a printed user manual for the first steps with the Starter Kit.

The Starter Kit CD-ROM comes with a full GNU cross tool chain for C/C++ software development. The binary files of this pre build tool chain run on an x86 Linux based host (SuSE, Red Hat or other) and build executable files for the Atmel AT91SAM9263 ARM9 MCU.

For using the DNP/SK30 Embedded Linux Starter Kit you need a development system. The minimal configuration for this system is a Windows based PC with the *HyperTerminal* terminal emulation program and a free COM port (COM1, COM2 or USB based COMx) for the RS232 serial link between the DNP/9265 and *HyperTerminal*.

For using the Ethernet link, your PC needs an Ethernet adapter with 10 Mbps or 10/100 Mbps LAN interface. This environment allows Web server programming (HTML pages, Java applets) and Linux shell script programming. For using the GNU C/C++ cross tool chain, it is necessary to run Linux on the development system.

1.1   Safety Guidelines

Please read the following safety guidelines carefully! In case of property or personal damage by not paying attention to this document and/or by incorrect handling, we do not assume liability. In such cases any warranty claim expires.

ATTENTION: Observe precautions for handling – electrostatic sensitive device!

- Discharge yourself before you work with the device, e.g. by touching a heater of metal, to avoid damages.

- Stay grounded while working with the device to avoid damage through electrostatic discharge.

1.2   Conventions

Convention	Usage
bold	Important terms
italic	User inputs and other specials
`monospace`	Pathnames, internet addresses and program code

Table 1:   Conventions used in this Document

1.3   Features and Technical Data

The DNP/SK30 comes with a pre-installed U-Boot boot loader and an Embedded Linux operating system. The DNP/9265 Linux consists of two main components: 1. the Linux kernel and 2. the root file system.

The DNP/9265 U-Boot boot loader allows the downloading of new Linux kernel versions and root file systems to the DNP/9265 RAM and Flash. This in-system programming feature can be used by a simple serial and Ethernet link between the development system and the DNP/9265.

- DIL/NetPC DNP/9265 with Atmel AT91SAM9263 ARM9 MCU @ 192 MHz, 32 Mbytes NOR-type Flash and 32 Mbytes SDRAM

- U-Boot boot loader and Embedded Linux pre-installed in Flash memory

- Evaluation Board DNP/EV6

- Null modem cable

- 110 VAC or 230 VAC to 5 VDC international power supply

- CD-ROM with user manual and hardware/programmers manuals

- Embedded Linux with source

- GNU cross tool chain for C/C++ software development for Linux-based PCs

- GNU gdb and gdbserver for Ethernet-based remote debugging

- Linux remote login with Telnet

- Web server setup sample

- FTP server setup sample

- TFTP client setup sample

- Many source code samples

2   GETTING STARTED

2.1   Serial Link between DNP/EVA6 and PC

Setup the serial link between the Evaluation Board DNP/EVA6 and your PC. Use a null modem cable for this connection.
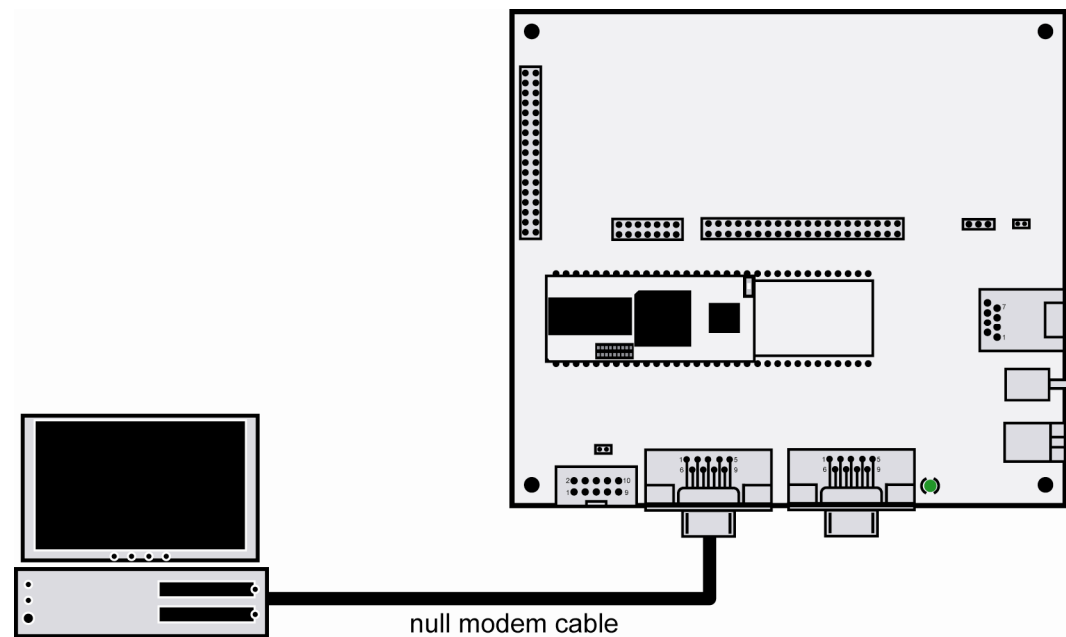

Figure 1:   Serial link between Evaluation Board and PC

Connect one end of the null modem cable with an unused COM port of your PC. Make sure that this PC COM port supports 115.200 bps.

2.2   Ethernet Link between DNP/EVA6 and PC

Setup the Ethernet LAN link between the Evaluation Board DNP/EVA6 and your PC. Use an Ethernet cross-over cable or a switch-based infrastructure for the LAN connection.

Ethernet cross-over cable
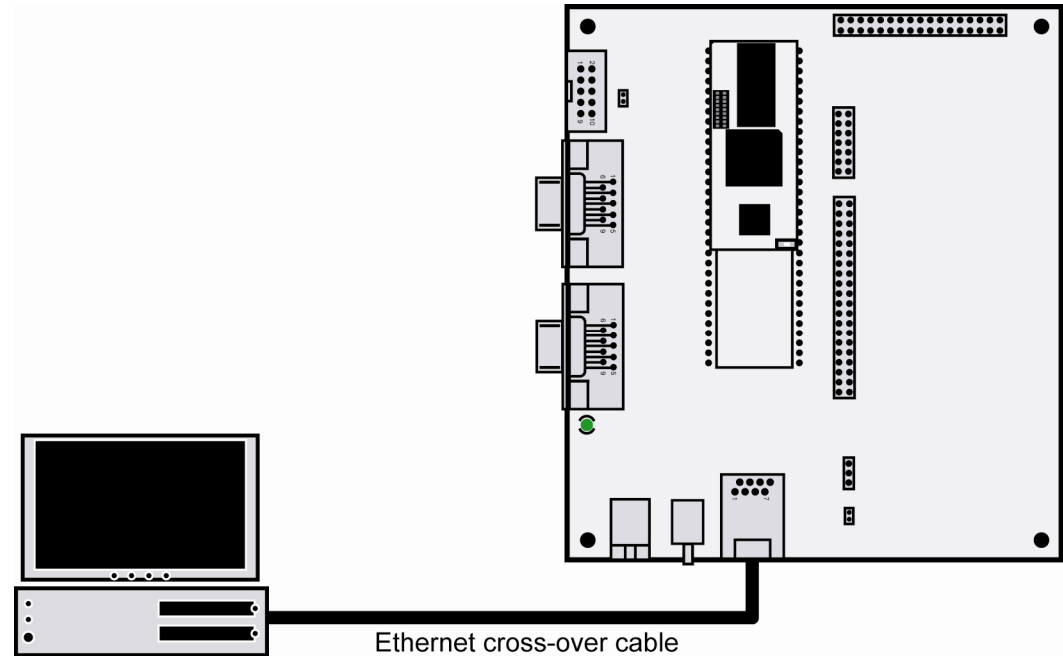
Figure 2:   Ethernet link between Evaluation Board and PC

Please note: The DNP/9265 comes with the default IP address **192.168.0.126**. Please make sure that your PC can work with the IP address range 192.168.0.x.
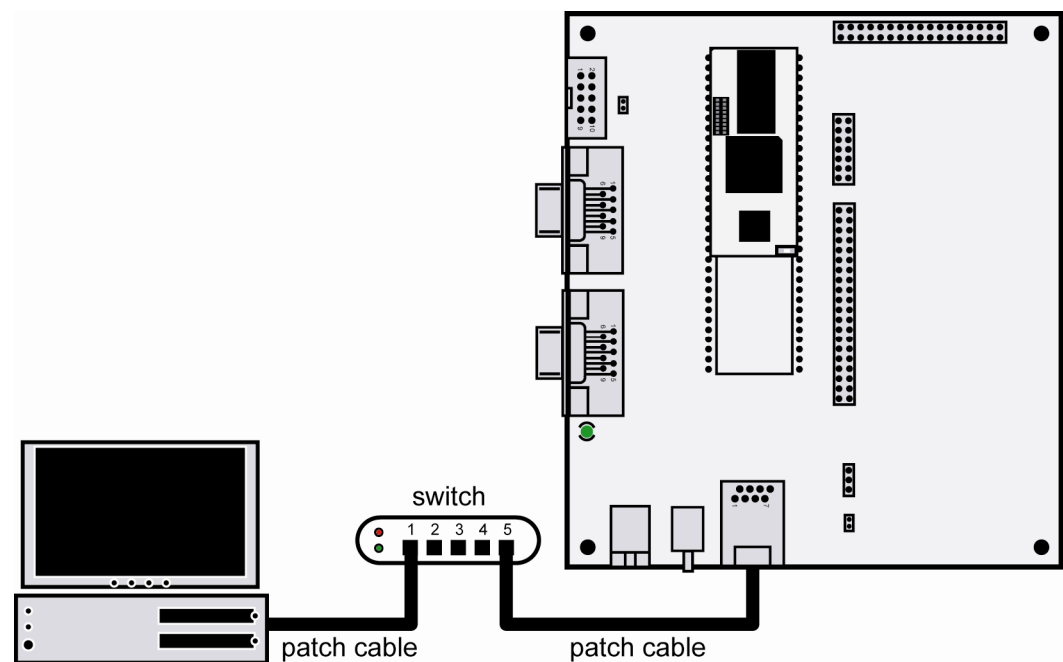

switch

1 2 3 4 5

patch cable   patch cable

Figure 3:   Switch-based Ethernet link between Evaluation Board and PC

2.3 Connecting Power Supply and Power-up the Starter Kit

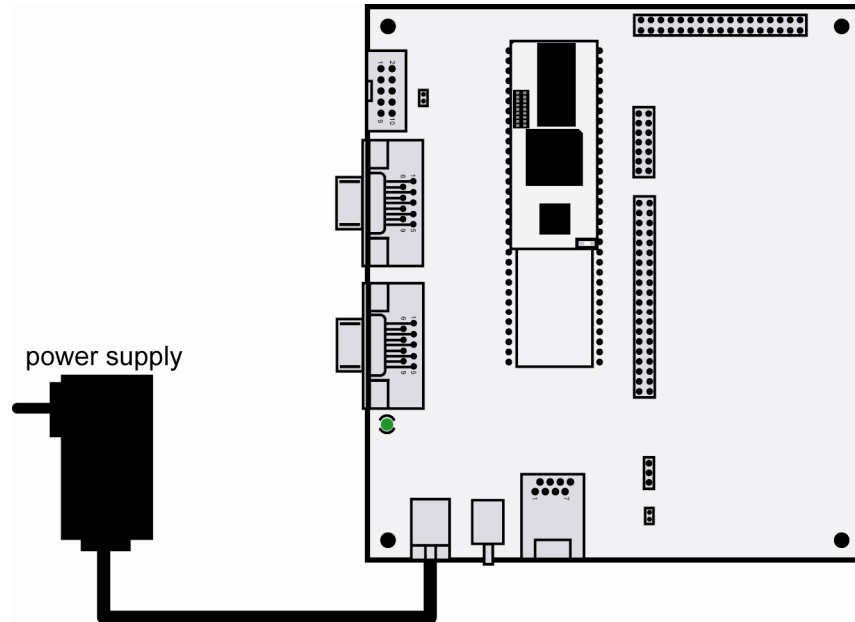Connect the 5 VDC power supply with the barrel plug with the Evaluation Board DNP/EVA6.

Figure 4: Power supply for the Evaluation Board

CAUTION: Providing the DNP/EVA6 with a voltage higher than the regular 5 VDC ±10% could resolve in damaged board components!

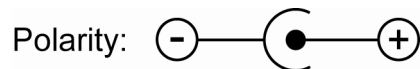Please pay attention to the polarity of the power connector: the **+ pole is in the center!**

Polarity: (−)————(●————(+)

Figure 5: Polarity of the power connector

Please note: Make sure that all cable connections are OK. Then power-up the Starter Kit.

2.4 Using Serial Link with Terminal Program

Run *HyperTerminal* on your Windows-PC, *minicom* or a similar simple terminal emulation program on your Linux-based PC.

Figure 6: Direct connection setup with HyperTerminal

Setup a direct connection with the parameters of table 2. Make sure, that the PC COM port supports 115.200 bps.
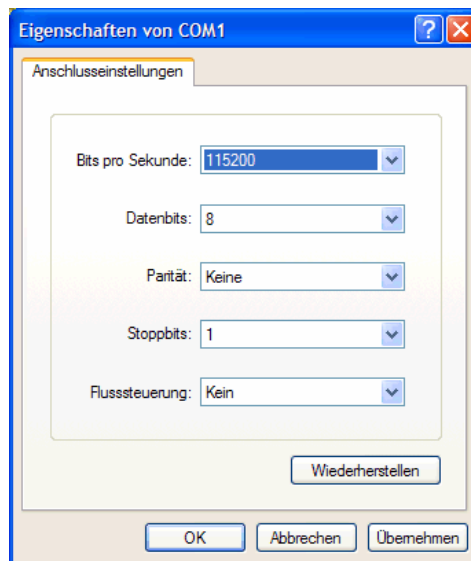

Figure 7: Parameter setup with HyperTerminal

Parameter	Value
Speed	115.200 bps
Data Bits	8
Parity	None
Stop Bits	1
Protocol	No (Xon/Xoff, RTS/CTS or similar)

Table 2: Setup parameters for the serial link

2.5   Power-up DNP/9265 with RCM disabled

After power-up the DIL/NetPC DNP/9265 starts an automatic boot process from the on-board flash memory chip. This process consists of two steps:

1. Directly after power-up, the DNP/9265 runs the U-Boot boot loader program for some milliseconds. U-Boot initializes the hardware components (hardware init). **With RCM disabled** (please see the *DIL/NetPC DNP/9265 hardware reference manual* for details), there is no U-Boot text message output over the DNP/9265 COM1 serial interface and no **boot delay**-based[1] wait period. Direct after the hardware init, the U-Boot boot loader starts the Linux OS image.

2. Linux takes control over the DNP/9265 hardware and runs all necessary processes for coming up to live.

Figure 8:   Linux booting process with HyperTerminal

> **Please note:** The U-Boot environment variable **boot delay** does not influence the DNP/9265 boot process with RCM (Remote Console Mode) disabled.

The DNP/9265 Linux supports a serial console. It allows running a Linux-based system in a headless configuration without a monitor or keyboard. Wait until the Linux boot process finishes. Please use the username *root* and the password *root*. Then press Enter.

---

[1] **"boot delay"** is a U-Boot environment variable. The value defines a wait time before U-Boot starts the Linux operating system.

2.6   Power-up DNP/9265 with RCM enabled

The DIL/NetPC DNP/9265 boot sequence with RCM enabled is similar to the boot procedure with RCM disabled. Only the first step is different:

1. The DNP/9265 runs the U-Boot boot loader program. This software shows a wait message over the DNP/9265 COM1 serial interface if RCM is enabled (please see the *DIL/NetPC DNP/9265 hardware reference manual* for details). It is possible to interrupt the boot process and switch to the U-Boot command line interface. Just hit a key of your terminal emulation program.

2. Without interruption the U-Boot boot loader starts a Linux OS image after the wait period from the DNP/9265 Flash memory.
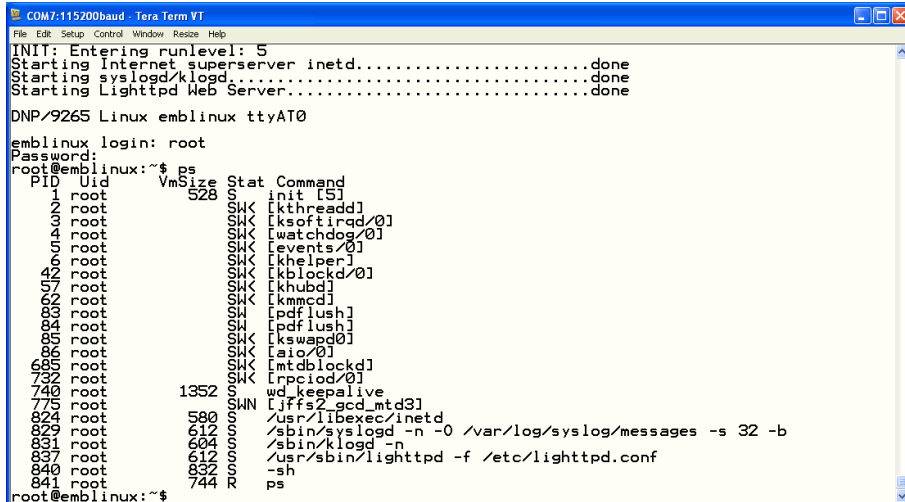

Figure 9:   U-Boot wait message

> **Please note:** The U-Boot command line interface allows you to change the wait time of the first step. Please see the U-Boot environment variable **boot delay** for details.

Figure 10: Linux booting process after the U-Boot boot delay

```
COM7:115200baud - Tera Term VT
File  Edit  Setup  Control  Window  Resize  Help
INIT: Entering runlevel: 5
Starting Internet superserver inetd........................done
Starting syslogd/klogd....................................done
Starting Lighttpd Web Server..............................done

DNP/9265 Linux emblinux ttyAT0

emblinux login: root
Password:
root@emblinux:~$ ps
  PID  Uid      VmSize Stat Command
    1 root         528 S    init [5]
    2 root             SW<  [kthreadd]
    3 root             SW<  [ksoftirqd/0]
    4 root             SW<  [watchdog/0]
    5 root             SW<  [events/0]
    6 root             SW<  [khelper]
   42 root             SW<  [kblockd/0]
   57 root             SW<  [khubd]
   62 root             SW<  [kmmcd]
   83 root             SW   [pdflush]
   84 root             SW   [pdflush]
   85 root             SW<  [kswapd0]
   86 root             SW<  [aio/0]
  685 root             SW<  [mtdblockd]
  732 root             SW<  [rpciod/0]
  740 root        1352 S    wd_keepalive
  775 root             SWN  [jffs2_gcd_mtd3]
  824 root         580 S    /usr/libexec/inetd
  829 root         612 S    /sbin/syslogd -n -O /var/log/syslog/messages -s 32 -b
  831 root         604 S    /sbin/klogd -n
  837 root         612 S    /usr/sbin/lighttpd -f /etc/lighttpd.conf
  840 root         832 S    -sh
  841 root         744 R    ps
root@emblinux:~$
```

Figure 11: After a login the serial console offers a Linux command line interface

Wait until the Linux boot process finishes. Please use the username *root* and the password *root*. Then press Enter.

2.7 DNP/9265 Linux File System

After booting the DNP/SK30 all directories in the root file system are **read-only**. There are only three exceptions, which are shown in the following table:

Directory	Remark
/flash	R/W directory, non-volatile memory within Flash
/home/root	R/W directory, RAM disk, volatile memory
/var/volatile	R/W directory, RAM disk, volatile memory

Table 3: R/W directories in the file system

The read-only restriction protects all files of the file system. Under ordinary operating conditions it is not possible to overwrite or delete a file which is necessary for the DIL/NetPC. To disable the write protection just login with the username **root** and the password **root** and enter the following command:

mount / –o remount,rw

This command „mounts„ the file system as **read/write**. All files are now writable and deletable. Please pay attention not to damage important system files! With the command

mount / –o remount,ro

the system is set to the read-only initial condition after the boot process.

Figure 12: Disabling the write protection with the mount command

2.8   Checking IP Address of PC

Make sure that your PC is using the right IP address for the Ethernet-based TCP/IP communication with the DIL/NetPC.

Please use `192.168.0.1` or `192.168.0.254` for your PC and `192.168.0.126` for the DNP/9265.

Figure 13: Windows-PC IP address check with *ipconfig*
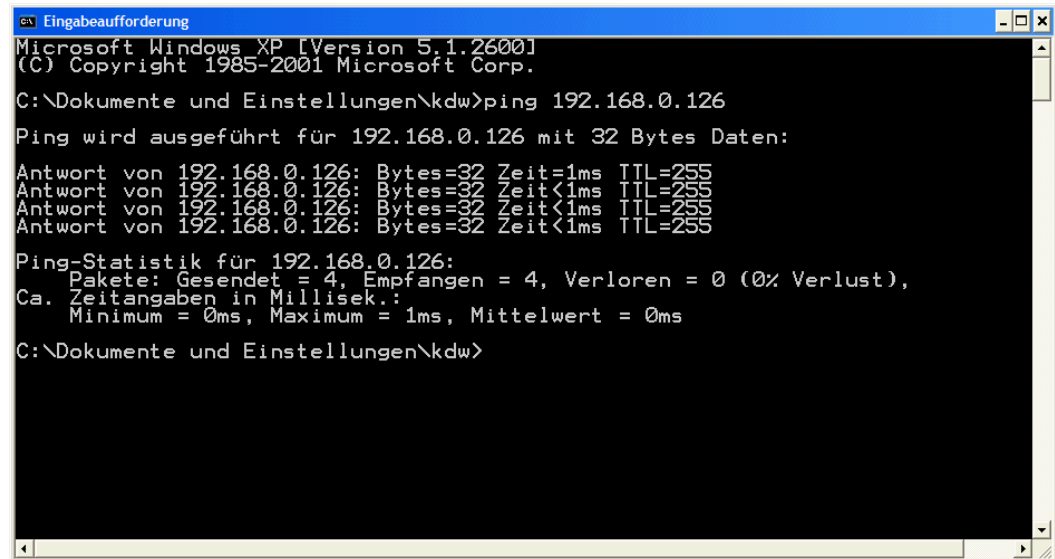
Talk to your network administrator if you have problems with the IP address understanding.

Please note: To change the ex factory IP address `192.168.0.126` of the DNP/9265 please refer to **chapter 2.16**.

2.9 Checking Ethernet-based TCP/IP Communication

Check the Ethernet-based TCP/IP communication between the DNP/9265 and the PC with a simple *ping* command.

Figure 14: Windows-PC TCP/IP communication check with *ping*

First check the cable connections and then the IP addresses if your *ping* does not work. Then check the TCP/IP setup of your PC.

2.10   Using a Telnet Connection

Run a Telnet client program on your PC with the IP address of the DNP/9265. You can use a Telnet session for remote entering Linux commands.
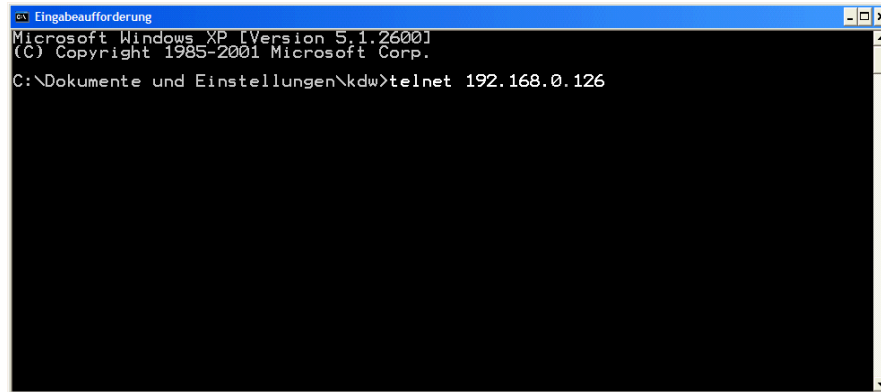
Figure 15: Run the Windows Telnet client program

Wait until the DNP/9265 Linux requests a user name. Please use the login name *root* and the password *root*. Then press Enter.

Please note: The DNP/9265 Linux comes with *BusyBox*. All Linux command line commands are implemented in *BusyBox*. *BusyBox* combines tiny versions of many common UNIX utilities into a single small executable. It provides replacements for most of the utilities you usually find in GNU *fileutils*, *shellutils*, etc. The utilities in *BusyBox* generally have fewer options than their full-featured GNU cousins; however, the options that are included provide the expected functionality and behave very much like their GNU counterparts. *BusyBox* provides a fairly complete environment for any small or embedded system.

Figure 16: Using Linux commands within a Telnet client window

2.11 Checking FTP Server

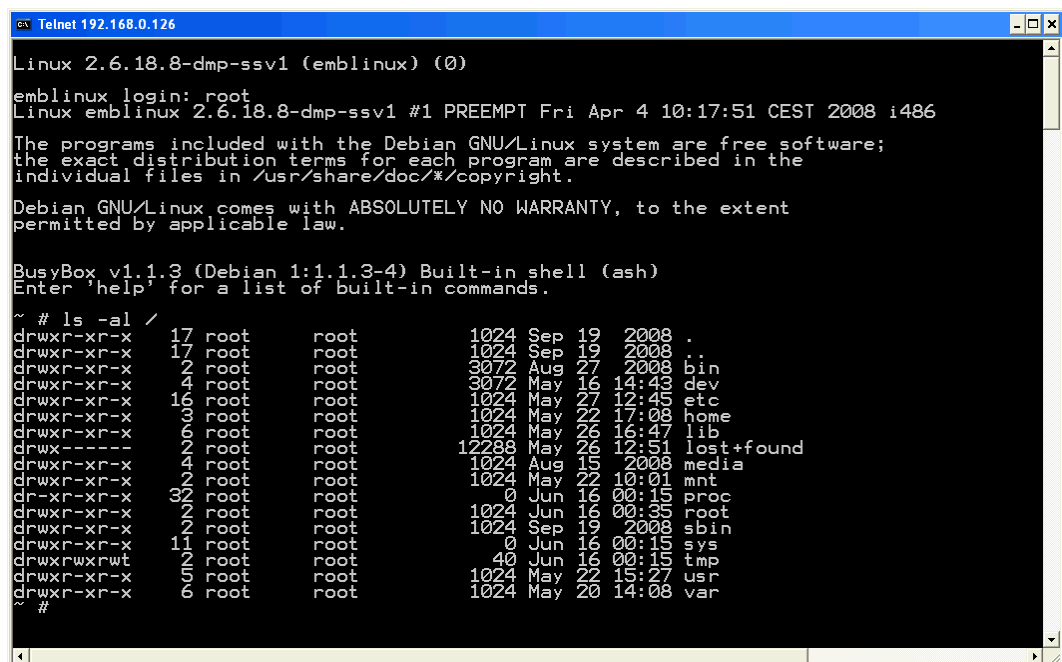The DNP/SK30 Linux comes with a pre-installed FTP server. This server allows the file transfer via Ethernet between a PC and the DNP/SK30. Run an FTP client program like *FileZilla* on your PC for a test.
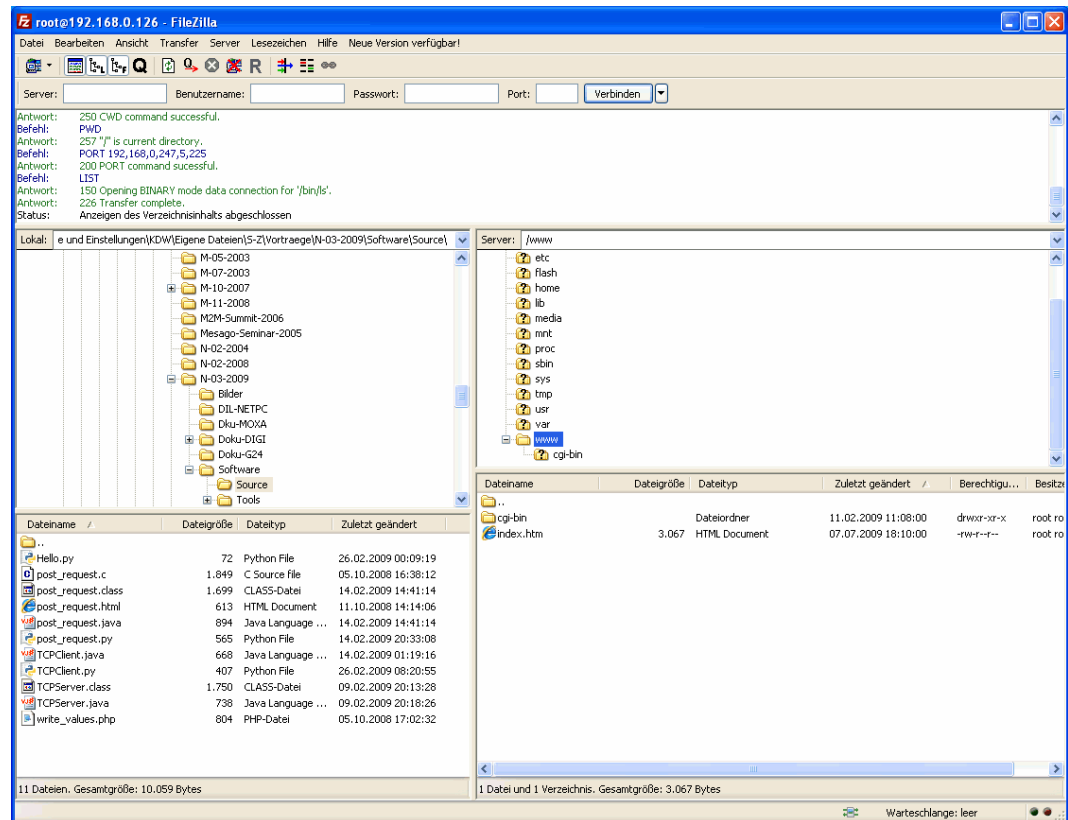
Figure 17: FileZilla as FTP client to access the FTP server

Use for the FTP login the IP address **192.168.0.126**, the username **root** and the password **root**. With this login you have FTP read/write permission in the file system of the DNP/SK30.

> **Please Note:** Before you start an FTP file transfer to the SK30, please make sure you have the read/write permission in the file system. For further information about the file system please refer to **chapter 2.7**.

2.12   Checking TFTP Client

The DNP/SK30 Linux comes with a pre installed TFTP client. This client allows the file transfer via Ethernet between a PC and the DNP/SK30. Run a TFTP server like *TFTPD32* on your PC for a test.

To transfer a file with the name *autostart.sh* into the directory `/var` of the DNP/SK30 execute the following commands within a Telnet session:
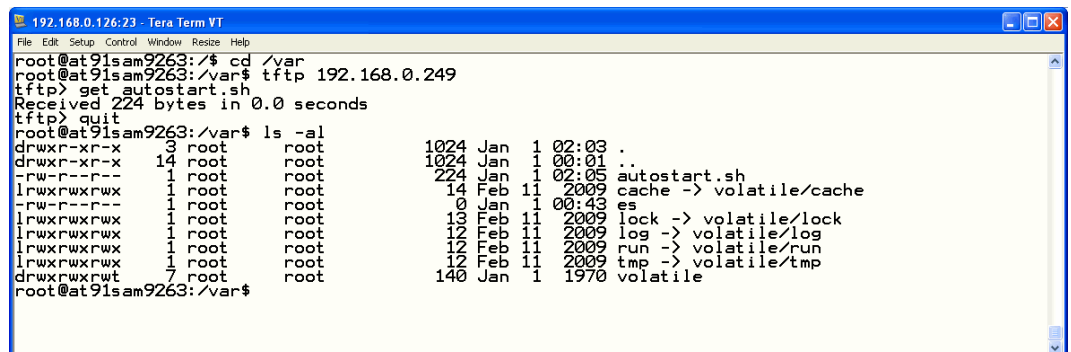
```
cd /var
tftp 192.168.0.249
get autostart.sh
quit
```

With the first command you change into the directory `/var` of the DNP/SK30.

The second command establishes a connection to the TFTP server. In this example the PC with the TFTP server has the IP address `192.168.0.249`.

The third command transfers the file with TFTP-GET. After the file transfer Linux shows how many bytes have been transferred.

The fourth command disconnects the TFTP server. You can now access the new file in the file system of the DNP/SK30.

Figure 18: File transfer via TFTP

Please Note: Before you start a TFTP file transfer to the SK30, please make sure you have the read/write permission within the file system. For further information about the file system please refer to **chapter 2.7**.

2.13   Checking HTTP Server

The DNP/SK30 Linux comes with a pre-installed Web server. Run a Web browser on your PC for a test and enter the following address

http://192.168.0.126

into the address bar of the browser. The browser shows the file *index.html* which is stored in the directory /www of the DNP/SK30. Into this directory you can load own files.
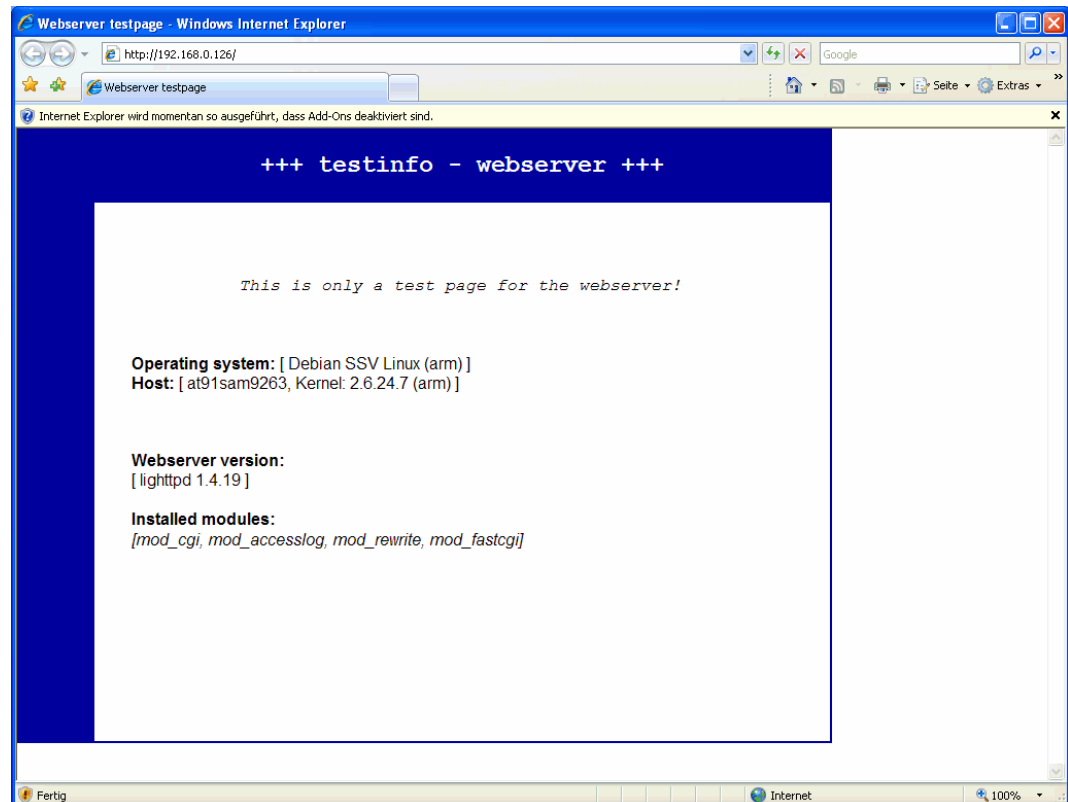
Figure 19: Checking the Web server of the DNP/SK30 with a browser

2.14   First HTML Page

Create a simple HTML file on the PC. Therefore at least a simple text editor or a special HTML editor like *PSPad* is needed.
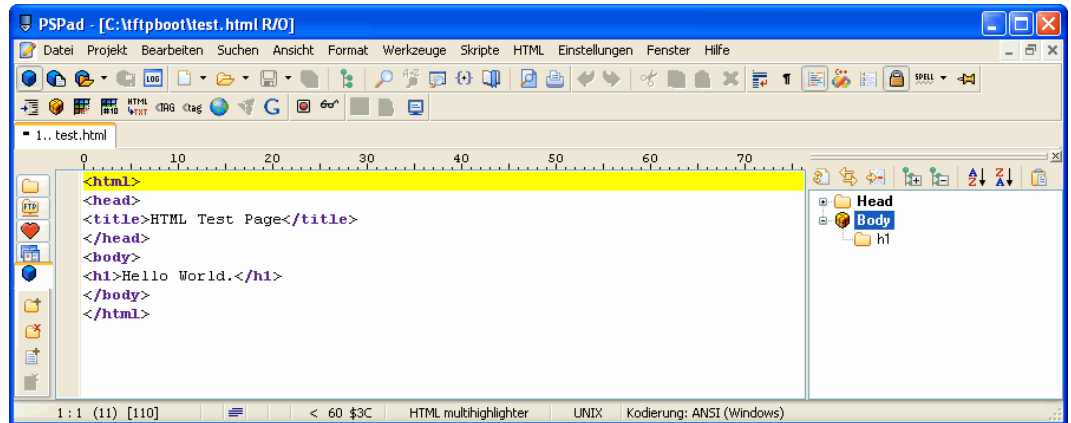
Figure 20: Creation of a simple HTML file on the PC

Transfer the new HTML file (e.g. *test.html*) via FTP or TFTP into the directory /www of the DNP/SK30. Then enter the following URL in the address bar of the browser:

`http://192.168.0.126/test.html`

The browser displays the new file.
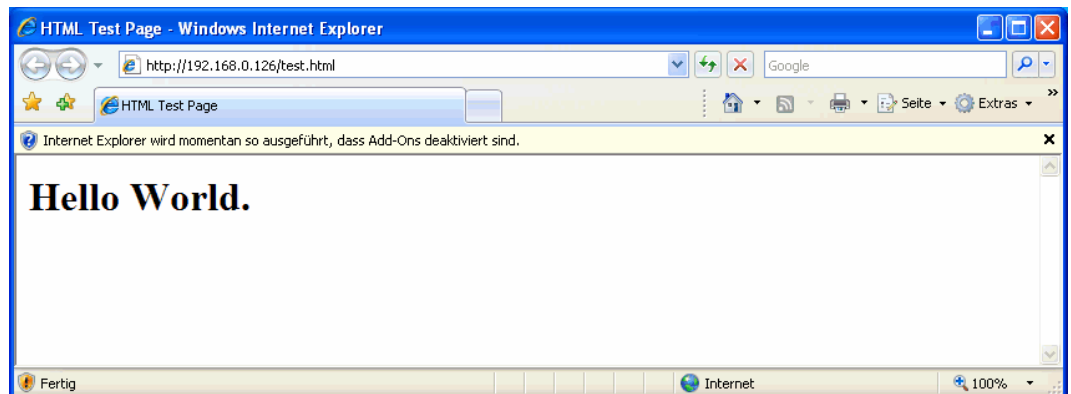
Figure 21: The new HTML file is displayed by the browser

> **Please Note:** Before you start an FTP or TFTP file transfer to the SK30, please make sure you have the read/write permission within the file system. For further information about the file system please refer to **chapter 2.7**.

2.15   First CGI Program

Create a Linux shell script with an adequate editor on your PC. Please regard that Linux shell text files expect only an LF (line feed) as end of line. In this example the script file is named *test.sh*.


Figure 22: Creation of a shell script on a Windows PC
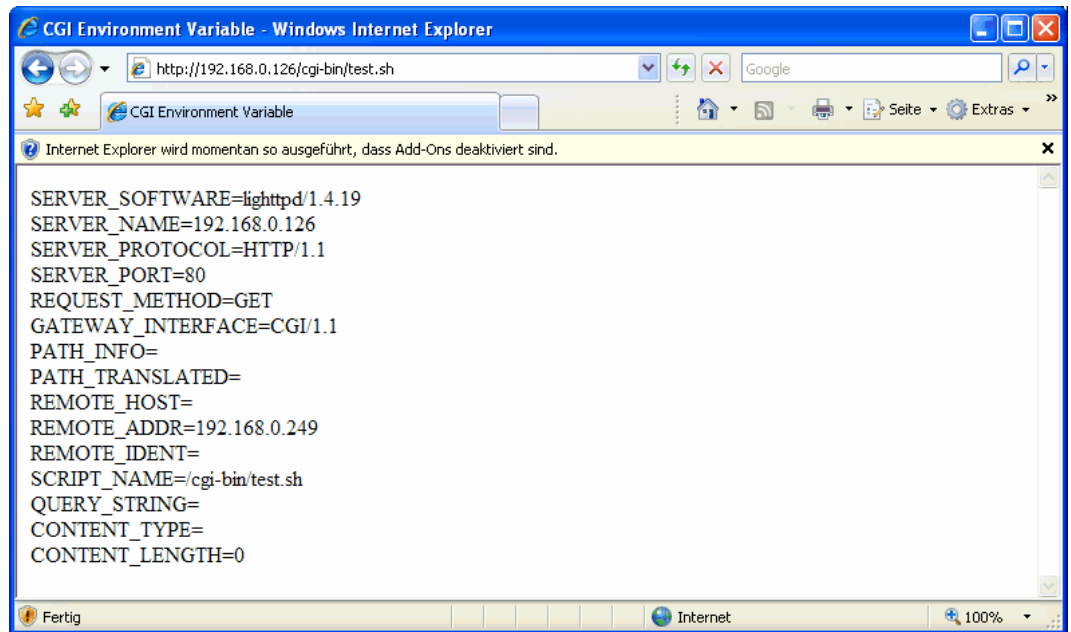
Transfer the new shell script via FTP or TFTP into the directory `/www/cgi-bin` of the DNP/SK30. Start a Telnet session and execute the following command:

```
chmod +x test.sh
```

This command converts the shell script into an executable program. Enter the following URL in the address bar of a Web browser:

```
http://192.168.0.126/cgi-bin/test.sh
```

The program is now running and shows its messages within the browser.

Figure 23: Outputs of the shell script within a browser

> **Please Note:** Before you start an FTP or TFTP file transfer to the SK30, please make sure you have the read/write permission within the file system. For further information about the file system please refer to **chapter 2.7**.

2.16   Changing Ex Factory IP Address

The default IP address of the DNP/SK30 is `192.168.0.126`. The IP address settings are stored in the file `/etc/network/interfaces`. Run a Telnet session and start the editor *nano* which is part of the Linux with the following command:

TERM=vt102 nano /etc/network/interfaces

Figure 24: The editor nano within a Telnet session

Change the file `/etc/network/interfaces` to your needs and save it.

The changes of the IP address settings will not be active until a system reboot.

Please Note: To change a file with the editor *nano*, you need the read/write permission within the file system. For further information about the file system please refer to **chapter 2.7**.

3   LINUX BOOT MESSAGES

```
Linux version 2.6.24.7 (mha@hareangle-saturn) ↵
(gcc version 4.1.2) #2 PREEMPT Thu Jul 2 15:42:14 CEST 2009
CPU: ARM926EJ-S [41069265] revision 5 (ARMv5TEJ), cr=00053177
Machine: SSV Hardware 9263/1
Memory policy: ECC disabled, Data cache writeback
Clocks: CPU 192 MHz, master 96 MHz, main 16.000 MHz
CPU0: D VIVT write-back cache
CPU0: I cache: 16384 bytes, associativity 4, 32 byte lines, ↵
128 sets
CPU0: D cache: 16384 bytes, associativity 4, 32 byte lines, ↵
128 sets
Built 1 zonelists in Zone order, mobility grouping on. ↵
Total pages: 8128
Kernel command line: mem=32M console=ttyAT0,115200 ↵
noinitrd root=/dev/mtdblock2 rootfstype=jffs2 ro
AT91: 160 gpio irqs in 5 banks
PID hash table entries: 128 (order: 7, 512 bytes)
Console: colour dummy device 80x30
Dentry cache hash table entries: 4096 (order: 2, 16384 bytes)
Inode-cache hash table entries: 2048 (order: 1, 8192 bytes)
Memory: 32MB = 32MB total
Memory: 29356KB available (2740K code, 240K data, 100K init)
Mount-cache hash table entries: 512
CPU: Testing write buffer coherency: ok
net_namespace: 64 bytes
NET: Registered protocol family 16
SCSI subsystem initialized
usbcore: registered new interface driver usbfs
usbcore: registered new interface driver hub
usbcore: registered new device driver usb
NET: Registered protocol family 2
Time: pit clocksource has been installed.
IP route cache hash table entries: 1024 (order: 0, 4096 bytes)
TCP established hash table entries: 1024 (order: 1, 8192 bytes)
TCP bind hash table entries: 1024 (order: 0, 4096 bytes)
TCP: Hash tables configured (established 1024 bind 1024)
TCP reno registered
NetWinder Floating Point Emulator V0.97 (double precision)
JFFS2 version 2.2. (NAND) © 2001-2006 Red Hat, Inc.
io scheduler noop registered
io scheduler anticipatory registered (default)
atmel_usart.0: ttyAT0 at MMIO 0xfff8c000 (irq = 7) is a ↵
ATMEL_SERIAL
console [ttyAT0] enabled
atmel_usart.1: ttyAT1 at MMIO 0xfff90000 (irq = 8) is a ↵
ATMEL_SERIAL
atmel_usart.3: ttyAT3 at MMIO 0xfeffee00 (irq = 1) is a ↵
ATMEL_SERIAL
MACB_mii_bus: probed
eth0: Atmel MACB at 0xfffbc000 irq 21 (02:80:ad:1f:12:34)
eth0: attached PHY driver [Davicom DM9161E] ↵
(mii_bus:phy_addr=ffffffff:00, irq=-1)
physmap platform flash device: 02000000 at 10000000
physmap-flash.0: Found 1 x16 devices at 0x0 in 16-bit bank
```

```
 Intel/Sharp Extended Query Table at 0x010A
 Intel/Sharp Extended Query Table at 0x010A
 Intel/Sharp Extended Query Table at 0x010A
 Intel/Sharp Extended Query Table at 0x010A
 Intel/Sharp Extended Query Table at 0x010A
Using buffer write method
cfi_cmdset_0001: Erase suspend on write enabled
cmdlinepart partition parsing not available
RedBoot partition parsing not available
Using physmap partition information
Creating 8 MTD partitions on "physmap-flash.0":
0x00060000-0x00260000 : "kernel"
0x00260000-0x02000000 : "rootfs"
0x00260000-0x00a60000 : "rootfs small"
0x00a60000-0x02000000 : "scrap"
0x00008000-0x00010000 : "u-boot config"
0x00010000-0x00018000 : "ssv config"
0x00000000-0x00008000 : "boot.bin"
0x00020000-0x00060000 : "u-boot"
at91_ohci at91_ohci: AT91 OHCI
at91_ohci at91_ohci: new USB bus registered, assigned bus number 1
at91_ohci at91_ohci: irq 29, io mem 0x00a00000
usb usb1: configuration #1 chosen from 1 choice
hub 1-0:1.0: USB hub found
hub 1-0:1.0: 1 port detected
Initializing USB Mass Storage driver...
usbcore: registered new interface driver usb-storage
USB Mass Storage support registered.
mice: PS/2 mouse device common for all mice
at91sam9_wdt: Watchdog register already programmed.
TCP cubic registered
NET: Registered protocol family 1
NET: Registered protocol family 17
RPC: Registered udp transport module.
RPC: Registered tcp transport module.
VFS: Mounted root (jffs2 filesystem) readonly.
Freeing init memory: 100K

INIT: version 2.86 booting

Mounting sys filesystem...................................done
Mounting /dev ramdisk.....................................done
Populating /dev...........................................done
Mounting local filesystems................................done
Setting up IP spoofing protection.........................done
Configuring network interfaces............................done

INIT: Entering runlevel: 5

Starting Internet superserver inetd.......................done
Starting syslogd/klogd....................................done
Starting Lighttpd Web Server..............................done

DNP/9265 Linux emblinux ttyAT0

emblinux login:
```

Please note: This symbol "↵" shows that the following line belongs to the previous line.

4   HELPFUL LITERATURE

- Evaluation Board DNP/EVA6 hardware reference manual

- DIL/NetPC DNP/9265 hardware reference manual

- AT91SAM9263 Preliminary `www.atmel.com`

- AT91SAM9263 Preliminary Summary `www.atmel.com`

- ARM926EJ-S Technical Reference manual `www.atmel.com`

CONTACT

SSV Embedded Systems
Heisterbergallee 72
D-30453 Hannover
Phone: +49 (0)511/40 000-0
Fax: +49 (0)511/40 000-40
E-mail: sales@ist1.de
Internet: `www.ssv-embedded.de`
Support: `www.ssv-comm.de/forum`

For actual information about the DNP/SK30 visit us at `www.dilnetpc.com`.

DOCUMENT HISTORY

Revision	Date	Remarks	Name
1.0	2009-07-31	first version	WBU