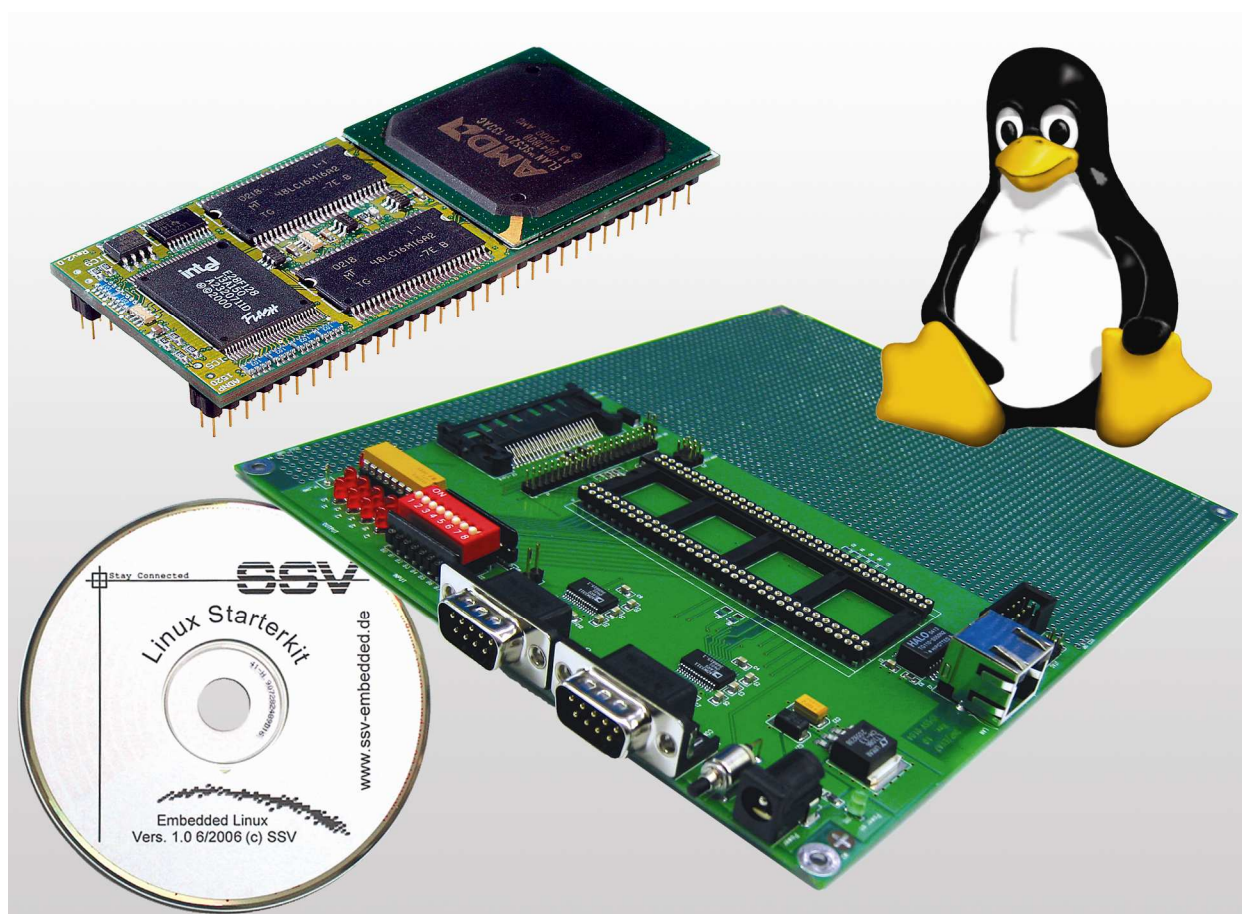


DNP/SK18

Embedded Linux Starter Kit

First Steps



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1 INTRODUCTION

The DIL/NetPC ADNP/1520 Starter Kit contains everything you need to get started with your x86-based (IA-32) embedded networking application. The Starter Kit includes a ADNP/1520 module with a pre-installed ROM-DOS – which acts as boot loader – and an embedded Linux, the Evaluation Board DNP/EVA7, 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 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 builds executable files for a x86-based (IA-32) 32-bit micro-controller.

For using the ADNP/1520 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 ADNP/1520 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++ tool chain, it is necessary to run Linux on the development system.

1.1 Features and Technical Data

The ADNP/1520 comes with a pre-installed ROM-DOS and an embedded Linux operating system. The ADNP/1520 Linux consists of two main components: 1. the Linux kernel and 2. the root file system.

The ADNP/1520 ROM-DOS allows downloading new Linux kernel versions and root file systems to the ADNP/1520 RAM and Flash. This in-system programming feature can be used by a simple serial and Ethernet link between the development system and the ADNP/1520.

- DIL/NetPC ADNP/1520 with AMD 133 MHz SC520, 16 Mbytes Flash and 64 Mbytes SDRAM, 3.3 VDC Vcc
- ROM-DOS and embedded Linux pre-installed in Flash memory
- Evaluation Board DNP/EVA7
- CompactFlash (CF) card
- 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 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
- Many source code samples

2 GETTING STARTED

2.1 Serial Link between DNP/EVA7 and PC

Setup the serial link between the Evaluation Board DNP/EVA7 and your PC. Use a null modem cable for this connection.

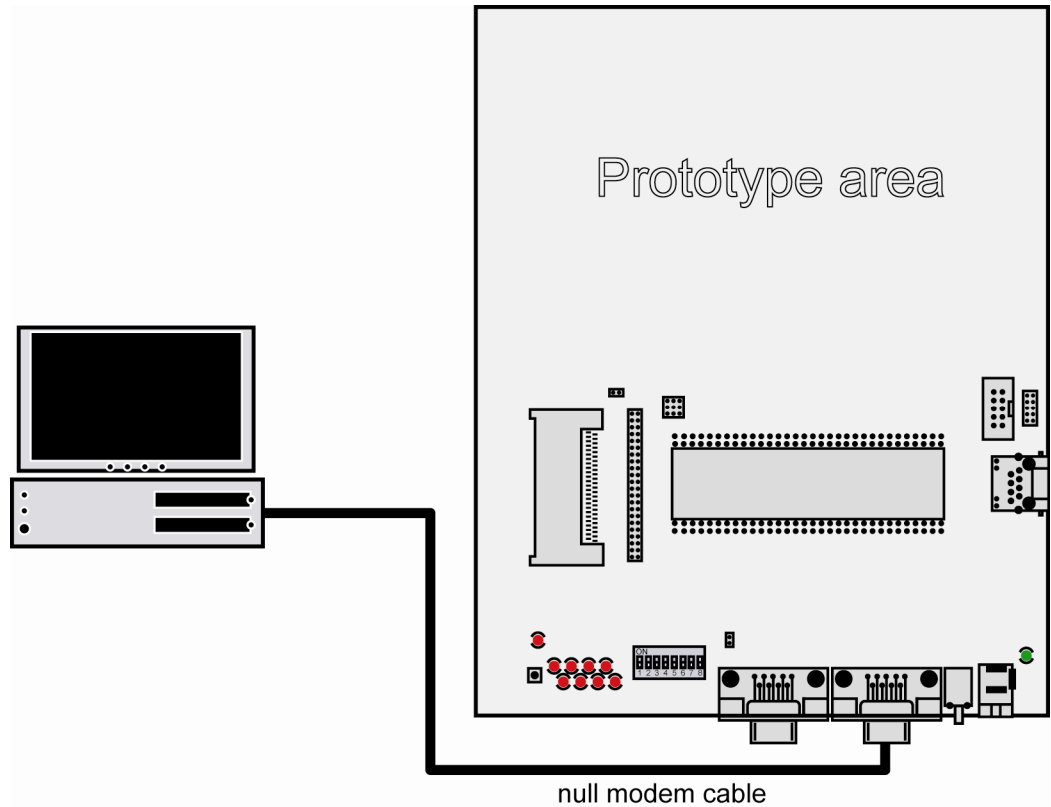


Figure 1: Serial link between Evaluation Board and PC

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/EVA7 and PC

Setup the Ethernet LAN link between the Evaluation Board DNP/EVA7 and your PC. Use an Ethernet cross-over cable or a switch-based infrastructure for the first LAN connection.

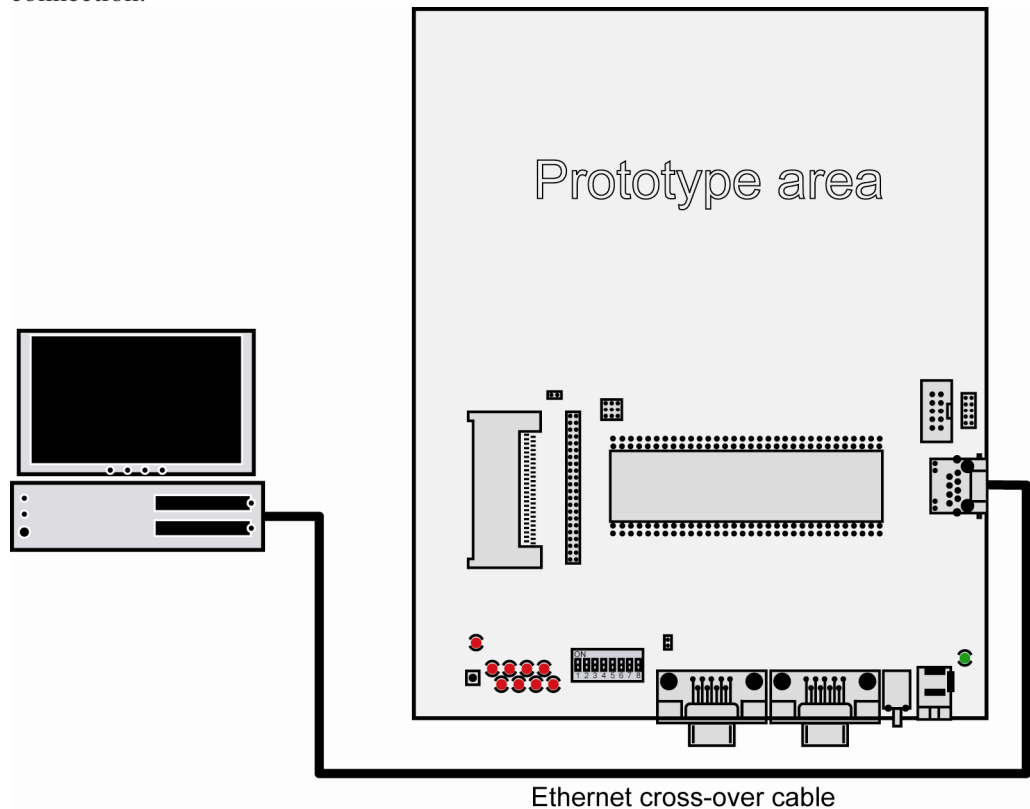


Figure 2: Ethernet link between Evaluation Board and PC

Please note: The ADNP/1520 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.

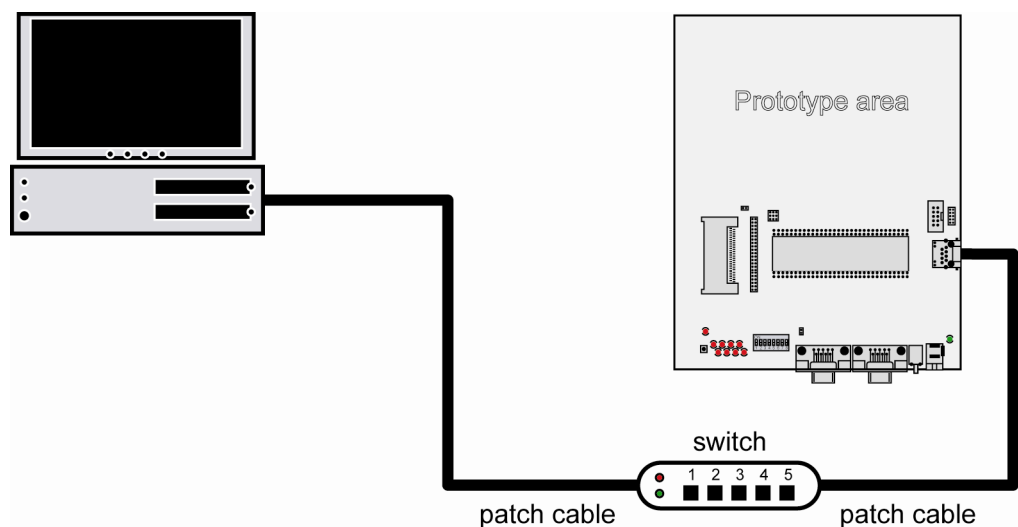


Figure 3: Switch-based Ethernet link between Evaluation Board and PC

2.3 Connecting Power Supply and Power-up the Starter Kit

Connect a 5 VDC power supply with a 5.5 mm x 2.5 mm jack plug to the Evaluation Board DNP/EVA7.

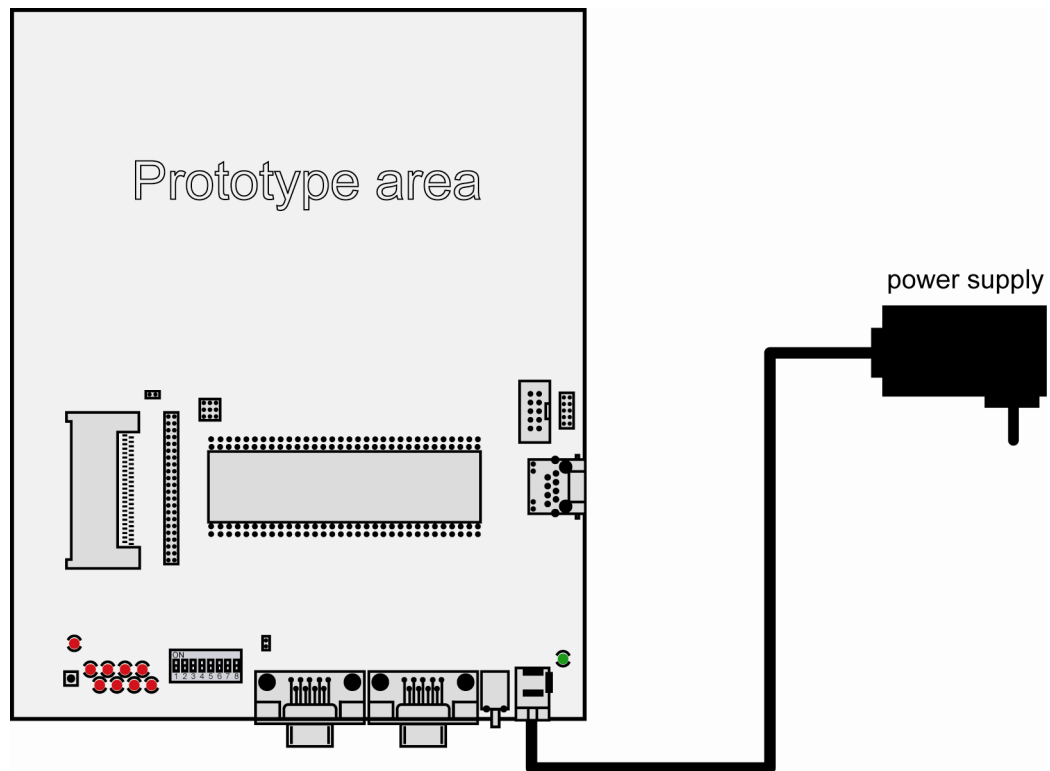


Figure 4: Power supply for the Evaluation Board

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

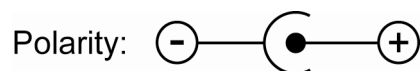


Figure 5: Polarity of the power connector

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 1. Make sure, that the PC COM port supports 115.200 bps.

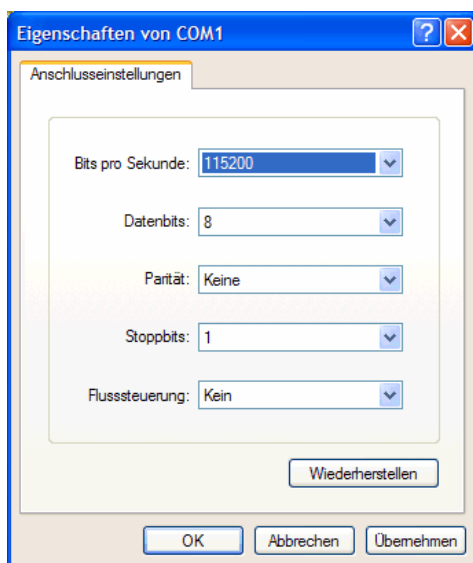


Figure 7: Parameter setup with HyperTerminal

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

Table 1: Setup parameters for the serial link

2.5 Power-up ADNP/1520 without RCM Jumper (RCM disabled)

After power-up the DIL/NetPC ADNP/1520 starts an automatic boot process from the on-board flash memory chip. This process consists of two steps:

1. Directly after power-up, the ADNP/1520 runs the BIOS and then the ROM-DOS for some milliseconds. The BIOS initializes the hardware components (hardware init). **With RCM disabled** (please see the *DNP/EVA7 hardware reference manual* for details), there is no BIOS and ROM-DOS text message output over the ADNP/1520 COM1 serial interface. Direct after the hardware init, the ROM-DOS runs AUTOEXEC.BAT and starts the Linux OS.
2. Linux takes control over the ADNP/1520 hardware from ROM-DOS and runs all necessary processes for coming up to live. **HyperTerminal shows the first output after some seconds.**

```

ttyS00 at 0x03f8 (irq = 4) is a 16550A
RAMDISK driver initialized: 16 RAM disks of 8192K size 1024 blocksize
ADNP/1520-3V flash: 0x1000000 at 0x10000000
Creating 8 MTD partitions on "ADNP Flash Bank":
0x00200000-0x01000000 : "Root Filesystem"
0x00080000-0x00200000 : "Kernel Files"
0x00060000-0x00080000 : "Default Configuration"
0x00020000-0x00060000 : "Bootloader"
0x00000000-0x00020000 : "BIOS"
0x00080000-0x00400000 : "Partition 1"
0x00400000-0x00800000 : "Partition 2"
0x00800000-0x01000000 : "Partition 3"
NET4: Linux TCP/IP 1.0 for NET4.0
IP Protocols: ICMP, UDP, TCP
IP: routing cache hash table of 512 buckets, 4Kbytes
TCP: Hash tables configured (established 4096 bind 4096)
ip_conntrack version 2.1 (512 buckets, 4096 max) - 292 bytes per conntrack
ip_tables: (C) 2000-2002 Netfilter core team
arp_tables: (C) 2002 David S. Miller
NET4: Unix domain sockets 1.0/SMP for Linux NET4.0.
Ebtables v2.0 registered<6>NET4: Ethernet Bridge 008 for NET4.0
Bridge firewalling registered
RAMDISK: Compressed image found at block 0
  
```

Figure 8: Linux booting process with HyperTerminal

The ADNP/1520 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. Then enter the user name **root**. This user name needs no password. Just hit Enter if the ADNP/1520 Linux asks for a password.

2.6 Power-up ADNP/1520 with RCM Jumper (RCM enabled)

The DIL/NetPC ADNP/1520 boot sequence with RCM enabled is similar to the boot procedure with RCM disabled. Only the first step is different:

1. Directly after power-up, the ADNP/1520 runs the BIOS and then the ROM-DOS for some milliseconds. The BIOS initializes the hardware components (hardware init). **With RCM enables** (please see the *DNP/EVA7 hardware reference manual* for details), there are some BIOS and ROM-DOS text message output over the ADNP/1520 COM1 serial interface.
2. Without interruption ROM-DOS the AUTOEXEC.BAT file starts a Linux OS image from the ADNP/1520 Flash memory.

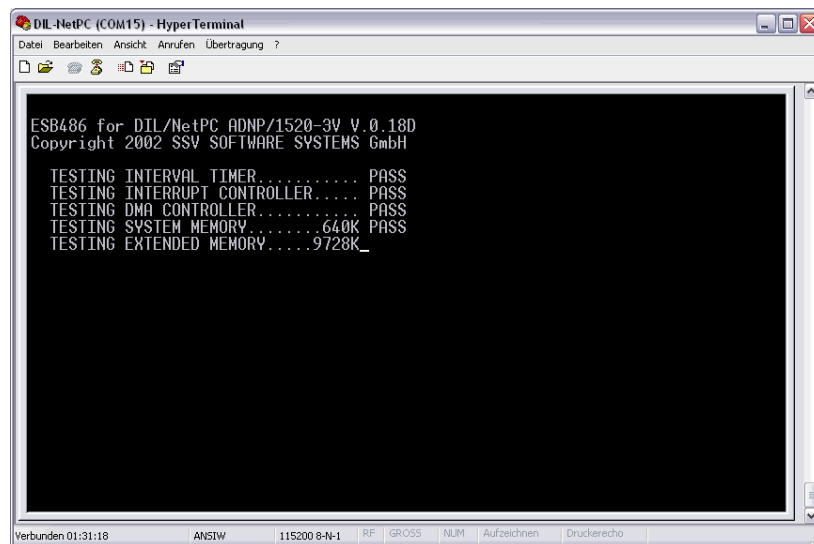


Figure 9: ADNP/1520 BIOS message

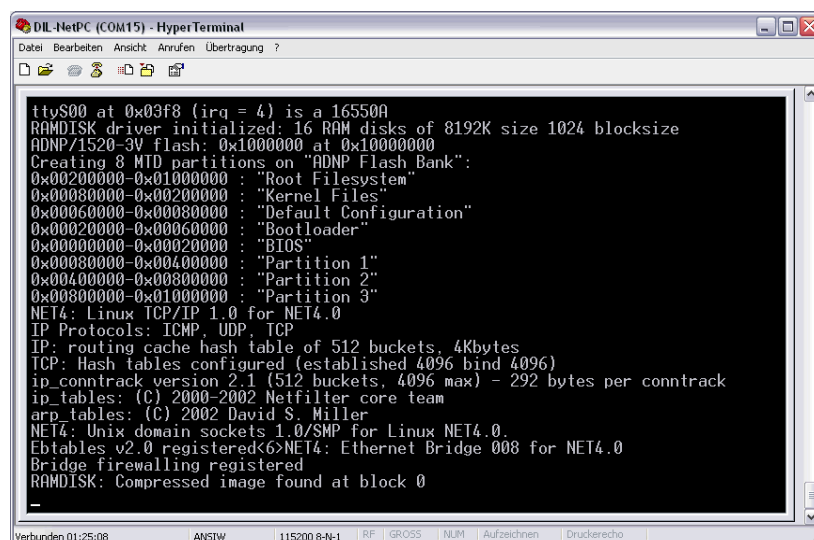
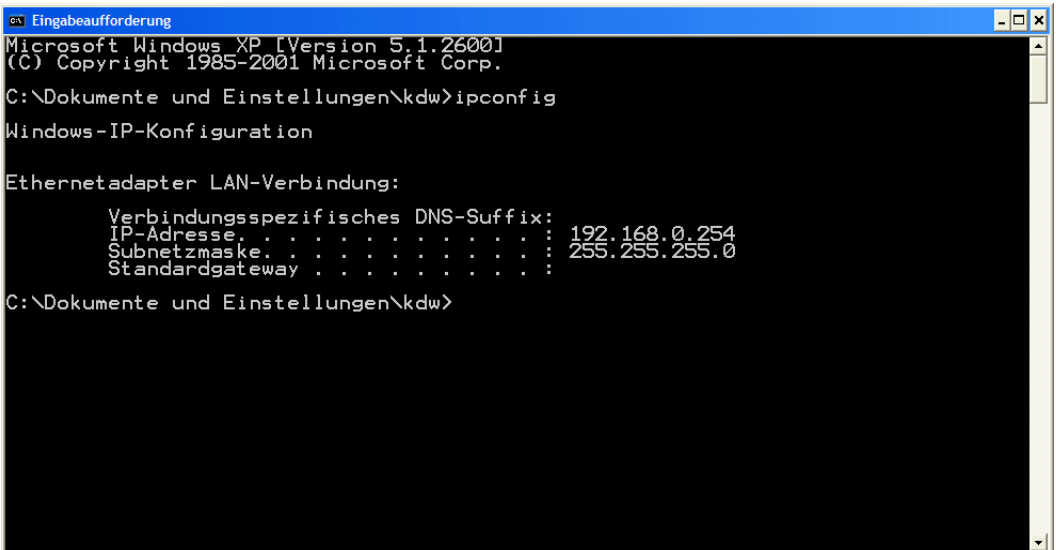


Figure 10: Linux booting process after the ROM-DOS AUTOEXEC.BAT

2.7 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. Use 192.168.0.1 or 192.168.0.254 for your PC and 192.168.0.126 for the ADNP/1520.



```
Eingabeaufforderung
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.
C:\Dokumente und Einstellungen\kdw>ipconfig

Windows-IP-Konfiguration

Ethernetadapter LAN-Verbindung:

    Verbindungsspezifisches DNS-Suffix:
    IP-Adresse. . . . . : 192.168.0.254
    Subnetzmaske. . . . . : 255.255.255.0
    Standardgateway . . . . . :

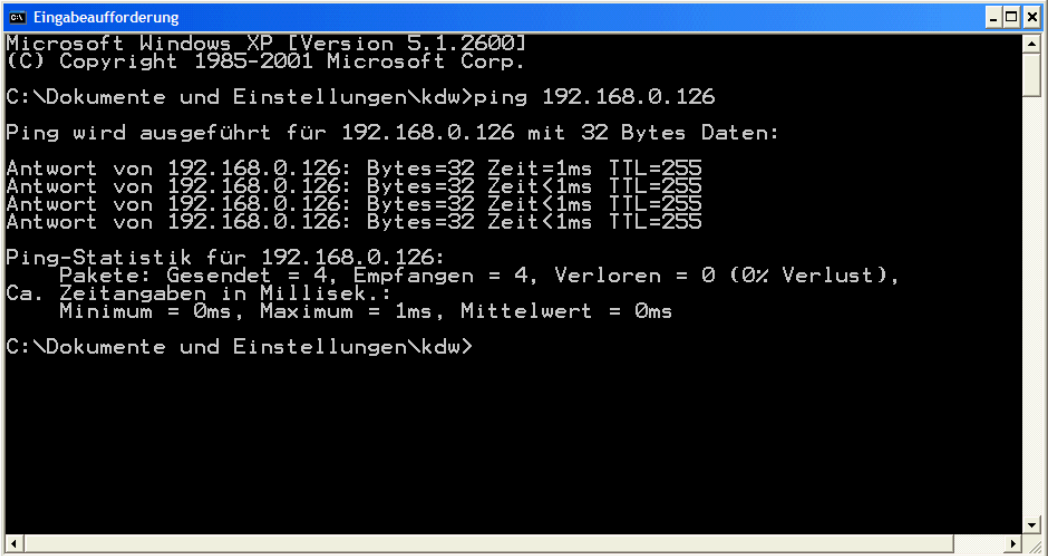
C:\Dokumente und Einstellungen\kdw>
```

Figure 11: Windows-PC IP address check with *ipconfig*

Talk to your network administrator if you have problems with the IP address understanding.

2.8 Checking Ethernet-based TCP/IP Communication

Check the Ethernet-based TCP/IP communication between the ADNP/1520 and the PC with a simple *ping* command.



```
Eingabeaufforderung
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

C:\Dokumente und Einstellungen\kdw>ping 192.168.0.126

Ping wird ausgeführt für 192.168.0.126 mit 32 Bytes Daten:

Antwort von 192.168.0.126: Bytes=32 Zeit=1ms TTL=255
Antwort von 192.168.0.126: Bytes=32 Zeit<1ms TTL=255
Antwort von 192.168.0.126: Bytes=32 Zeit<1ms TTL=255
Antwort von 192.168.0.126: Bytes=32 Zeit<1ms TTL=255

Ping-Statistik für 192.168.0.126:
    Pakete: Gesendet = 4, Empfangen = 4, Verloren = 0 (0% Verlust),
    Ca. Zeitangaben in Millisek.:
        Minimum = 0ms, Maximum = 1ms, Mittelwert = 0ms

C:\Dokumente und Einstellungen\kdw>
```

Figure 12: Windows-PC TCP/IP communication check with *ping*

First check the cable connections and then the IP addresses if your ping doesn't work. Then check the TCP/IP setup of your PC.

2.9 Using a Telnet Connection

Run a Telnet client program on your PC with the IP address of the ADNP/1520. You can use a Telnet session for remote entering Linux commands.

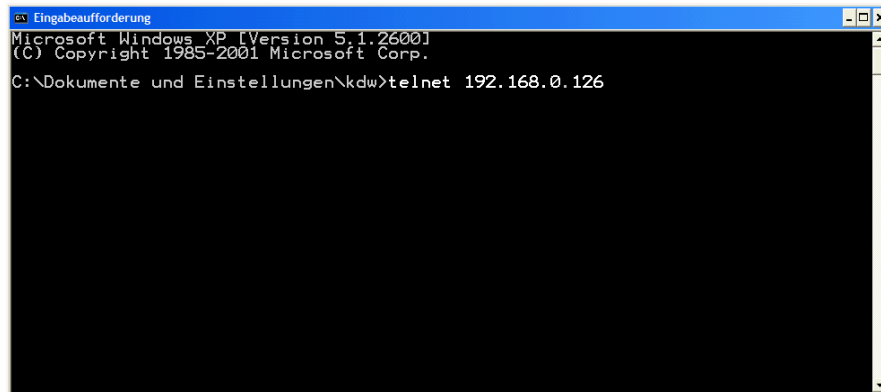


Figure 13: Run the Windows telnet client program

Wait until the ADNP/1520 Linux requests a user name. Please enter the user name **root**. This user name needs no password. Just hit Enter if the ADNP/1520 Linux requests a password.

Please note: The ADNP/1520 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.

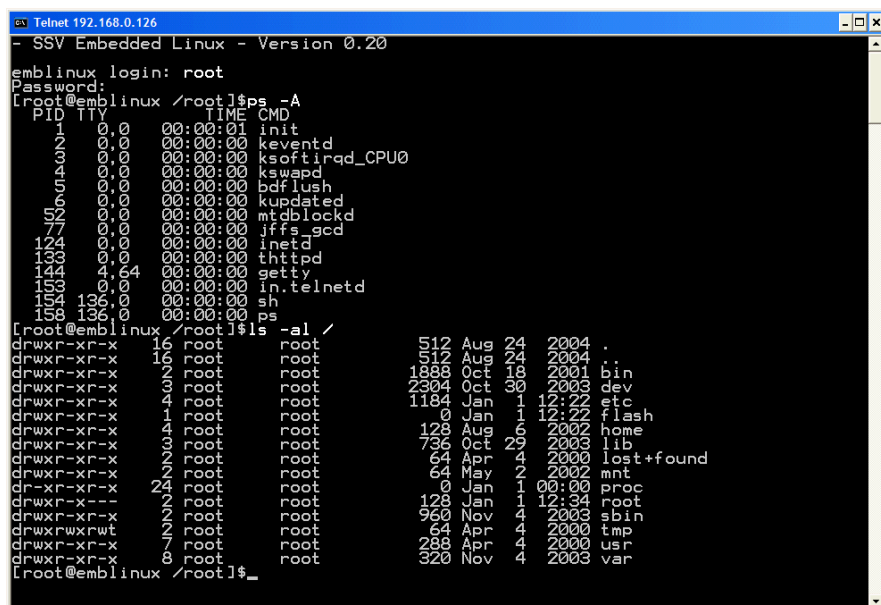


Figure 14: Using Linux commands within a Telnet client window

2.10 Checking ADNP/1520 Embedded Web Server

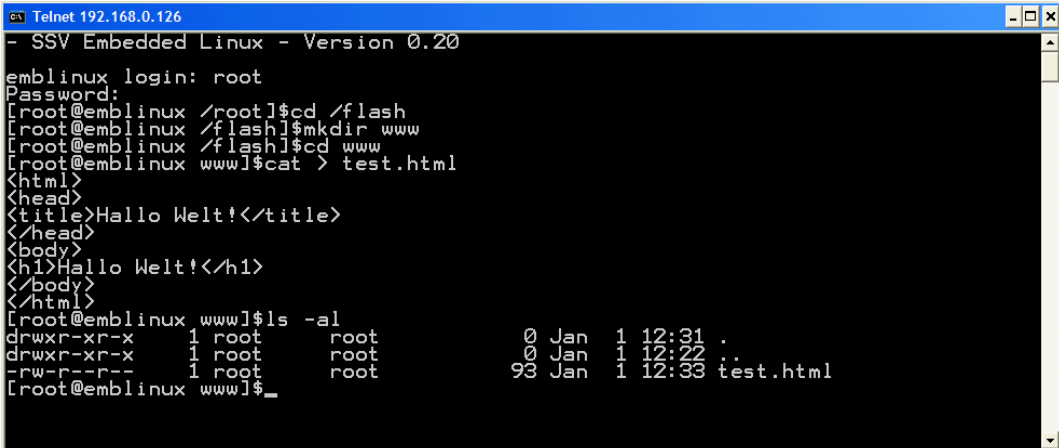
The DIL/NetPC ADNP/1520 default Linux configuration comes with a pre-installed embedded web server. The object storage space (HTML pages, pictures, CGI programs, Java Applets, ...) for this web server is located within the ADNP/1520 Flash memory.

Setup a Telnet session with root user rights from your PC to the ADNP/1520 (see chapter 2.9 if necessary). Enter the following command lines within this Telnet session:

```
cd /flash
mkdir www
cd www
cat > test.html
<html>
<head>
<title>Hallo Welt!</title>
</head>
<body>
<h1>Hallo Welt!</h1>
</body>
</html>
CTRL-D (CTRL-D stops the Linux cat command)
```

These command lines create an HTML file `/flash/www/test.html` within the ADNP/1520 Flash memory with the German version of “Hello World” (“Hallo Welt!”).

Reboot your ADNP/1520. This reboot defines `/flash/www/` as default directory for the web server.



The screenshot shows a Telnet window titled 'Telnet 192.168.0.126'. The prompt is '- SSV Embedded Linux - Version 0.20'. The user logs in as 'root' and enters the following commands: `cd /flash`, `mkdir www`, `cd www`, and `cat > test.html`. The HTML content is entered line by line: `<html>`, `<head>`, `<title>Hallo Welt!</title>`, `</head>`, `<body>`, `<h1>Hallo Welt!</h1>`, `</body>`, and `</html>`. After pressing CTRL-D, the prompt changes to `[root@emblinux www]$`. The user then enters `ls -al`, which shows the following output:

```
[root@emblinux www]$ls -al
drwxr-xr-x  1 root  root          0 Jan  1 12:31 .
drwxr-xr-x  1 root  root          0 Jan  1 12:22 ..
-rw-r--r--  1 root  root      93 Jan  1 12:33 test.html
[root@emblinux www]$
```

Figure 15: Create an HTML file within a Telnet session

Run your PC web browser and access the HTML file `test.html` with your browser. Use the URL `http://192.168.0.126/test.html`. This URL assumes that your ADNP/1520 is using the IP address 192.168.0.126 for the Ethernet LAN interface LAN1. Change this IP address if necessary.

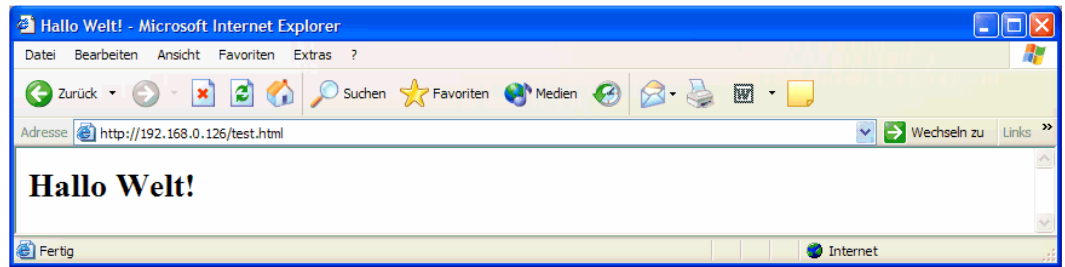


Figure 16: Check the embedded web server with Internet Explorer

Please note: `/flash/www` is the default directory for the ADNP/1520 embedded web server.

Restart the ADNP/1520 Linux after the creation of `/flash/www/test.html` and before the first access with a web browser.

The ADNP/1520 embedded web server looks out for `/flash/www` at boot time. If the directory `/flash/www` does not exist at boot time, the ADNP/1520 embedded web server works with the RAM disk-based directory `/usr/local/www`.

2.11 Checking ADNP/1520 FTP Server

The DIL/NetPC ADNP/1520 Linux comes with a pre-installed FTP server. This server allows the file transfer between a PC and the ADNP/1520.

Run an FTP client program on your PC. Set the session parameters for your FTP client to IP address **192.168.0.126**, user name **guest** and password **guest**. The ADNP/1520 default directory for the FTP user name guest is `/home/guest`. This directory is located within the ADNP/1520 RAM disk.

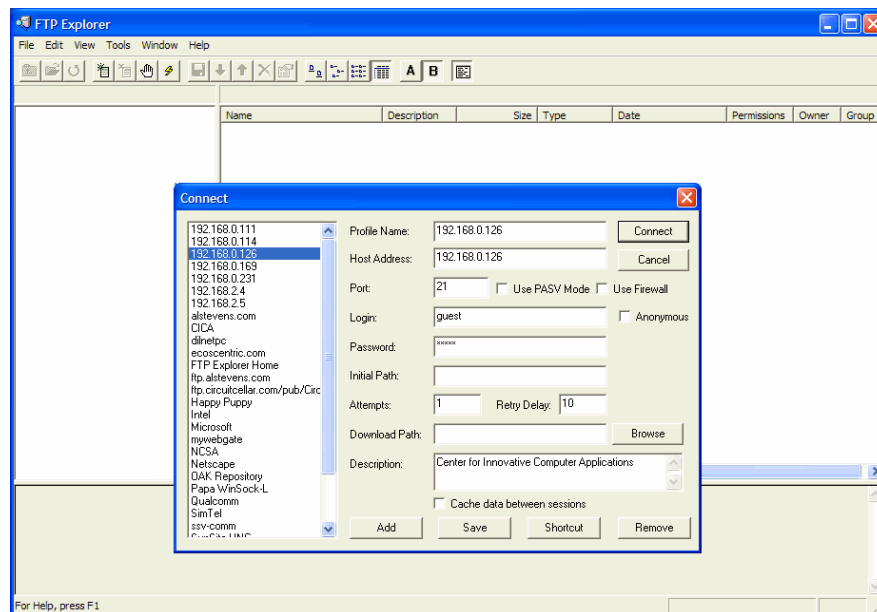


Figure 17: Set the session parameters for an FTP client program

Connect your FTP client with the ADNP/1520 FTP server. Please watch the ADNP/1520 default FTP directory. Transfer some files from your PC to the ADNP/1520. The ADNP/1520 stores these files in the ADNP/1520 default FTP directory.

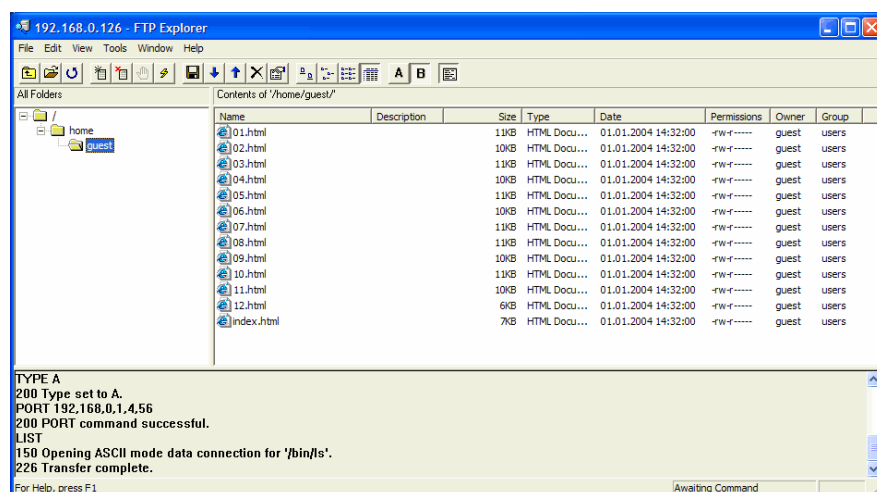
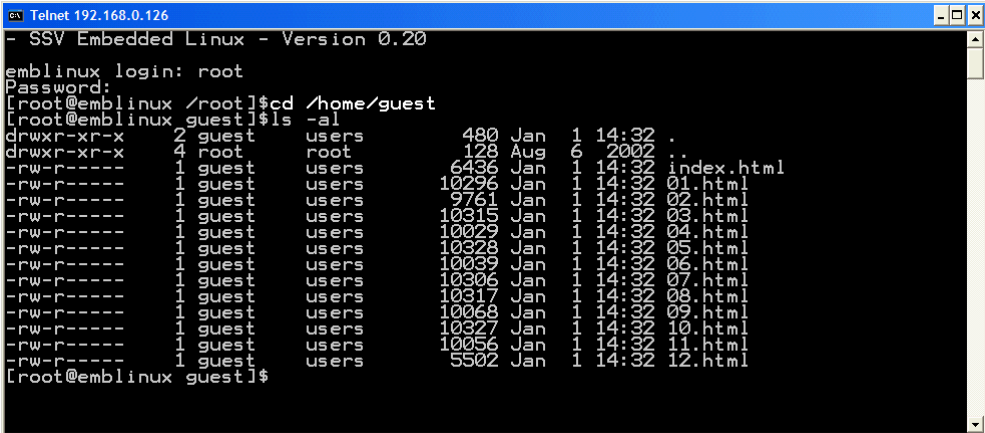


Figure 18: Transfer some files to the ADNP/1520

Check the new files with a Telnet session. Change to the ADNP/1520 default FTP directory /home/guest within your Telnet session.



```
Telnet 192.168.0.126
- SSV Embedded Linux - Version 0.20
emblinux login: root
Password:
[root@emblinux /root]#cd /home/guest
[root@emblinux guest]#ls -al
drwxr-xr-x  2 guest users      480 Jan  1 14:33 .
drwxr-xr-x  4 root  root      128 Aug 16 14:33 ..
-rw-r----- 1 guest users    6436 Jan 14 14:33 index.html
-rw-r----- 1 guest users    9761 Jan 14 14:33 1.jpg
-rw-r----- 1 guest users    10296 Jan 14 14:33 2.jpg
-rw-r----- 1 guest users    10315 Jan 14 14:33 3.jpg
-rw-r----- 1 guest users    10328 Jan 14 14:33 4.jpg
-rw-r----- 1 guest users    10338 Jan 14 14:33 5.jpg
-rw-r----- 1 guest users    10338 Jan 14 14:33 6.jpg
-rw-r----- 1 guest users    10338 Jan 14 14:33 7.jpg
-rw-r----- 1 guest users    10314 Jan 14 14:33 8.jpg
-rw-r----- 1 guest users    10314 Jan 14 14:33 9.jpg
-rw-r----- 1 guest users    10314 Jan 14 14:33 10.jpg
-rw-r----- 1 guest users    10314 Jan 14 14:33 11.jpg
-rw-r----- 1 guest users    10314 Jan 14 14:33 12.jpg
-rw-r----- 1 guest users    5502 Jan 14 14:33 13.jpg
```

Figure 19: The new files within /home/guest

2.12 Changing ADNP/1520 Ex Factory IP Address (ipaddree usage)

Every device connected to an IP network must have a unique IP address. This address is used to reference the specific unit.

The DIL/NetPC ADNP/1520 is automatically assigned an IP address on DHCP-enabled networks as it is DHCP-enabled by default. If DHCP doesn't work (i.e. no DHCP server available), the ADNP/1520 takes a default IP address.

The ex factory value for this default IP address is **192.168.0.126**. The network mask for this address is **255.255.255.0**. You can change this IP address over an RS232-based serial link with help of the program called **ipaddree**.

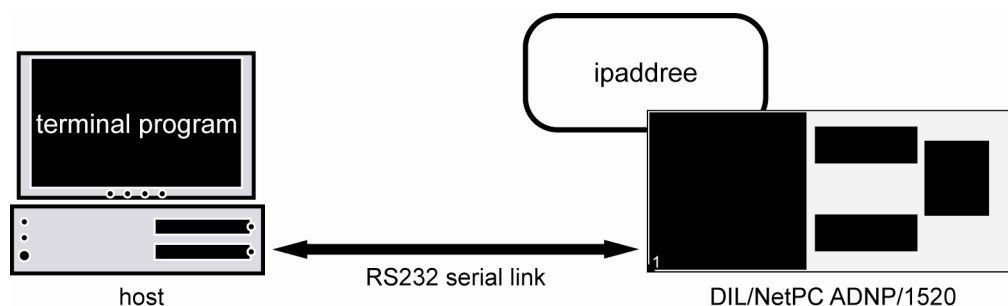


Figure 20: Environment for ipaddree usage

Use a serial console and enter the user name **root**. This user name needs no password. Just hit Enter if the ADNP/1520 Linux requests a password. Then execute the following command:

```
ipaddree -w 192.168.2.126 -m 255.255.255.0
```

“ipaddree” is the name of a command line IP setup tool. “192.168.2.126” is an IP address. Use the IP address of your choice for your setup on this position. “255.255.255.0” is a network mask. Use a valid network mask for your IP address.

```

DIL-NetPC (COM15) - HyperTerminal
Datei Bearbeiten Ansicht Anrufen Übertragung ?
0x00400000-0x00800000 : "Flash spare 1"
0x00800000-0x01000000 : "Flash spare 2"
dnp2110 - jffs - JFFS version 1.0. (C) 1999, 2000 Axis Communications AB
JFFS2 version 2.1. (C) 2001 Red Hat, Inc., designed by Axis Communications AB.
jffs2 -
Starting flash
Starting autoinit
Starting network Configuring and Starting Network : lo dhcpd[98]: timed out waiting for a valid DHCP server response
eth0
Starting inetd: inetd
Starting httpd
Starting autostart
- SSV Embedded Linux - Version 0.20
emblinux login: root
Password:
login[144]: root login on 'ttyS0'
[root@emblinux /root]$ ipaddree -w 192.168.2.126 -m 255.255.255.0
[root@emblinux /root]$
  
```

Figure 21: Serial console with ipaddree command line

Reboot the ADNP/1520. The new IP address and network mask are valid after the next boot process if no DHCP server is available or if DHCP doesn't work. Check the new IP address with *ping*.



```
C:\>ping 192.168.2.126
Ping wird ausgeführt für 192.168.2.126 mit 32 Bytes Daten:
Antwort von 192.168.2.126: Bytes=32 Zeit<1ms TTL=64
Antwort von 192.168.2.126: Bytes=32 Zeit<1ms TTL=64
Antwort von 192.168.2.126: Bytes=32 Zeit<1ms TTL=64
Antwort von 192.168.2.126: Bytes=32 Zeit<1ms TTL=64
Ping-Statistik für 192.168.2.126:
    Pakete: Gesendet = 4, Empfangen = 4, Verloren = 0 (0% Verlust),
    Ca. Zeitangaben in Millisek.:
        Minimum = 0ms, Maximum = 0ms, Mittelwert = 0ms
C:\>
```

Figure 22: Check the new IP address with *ping*

Please note: Don't forget to change the IP address of your PC to 192.168.2.1 or similar.

HELPFUL LITERATURE

DIL/NetPC ADNP/1520 hardware reference manual (SSV Starter Kit item)
DNP/EVA7 hardware reference manual (SSV Starter Kit item)

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Internet: www.ssv-embedded.de
www.dilnetpc.com

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1.0	2006-01-13	first version	WBU

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