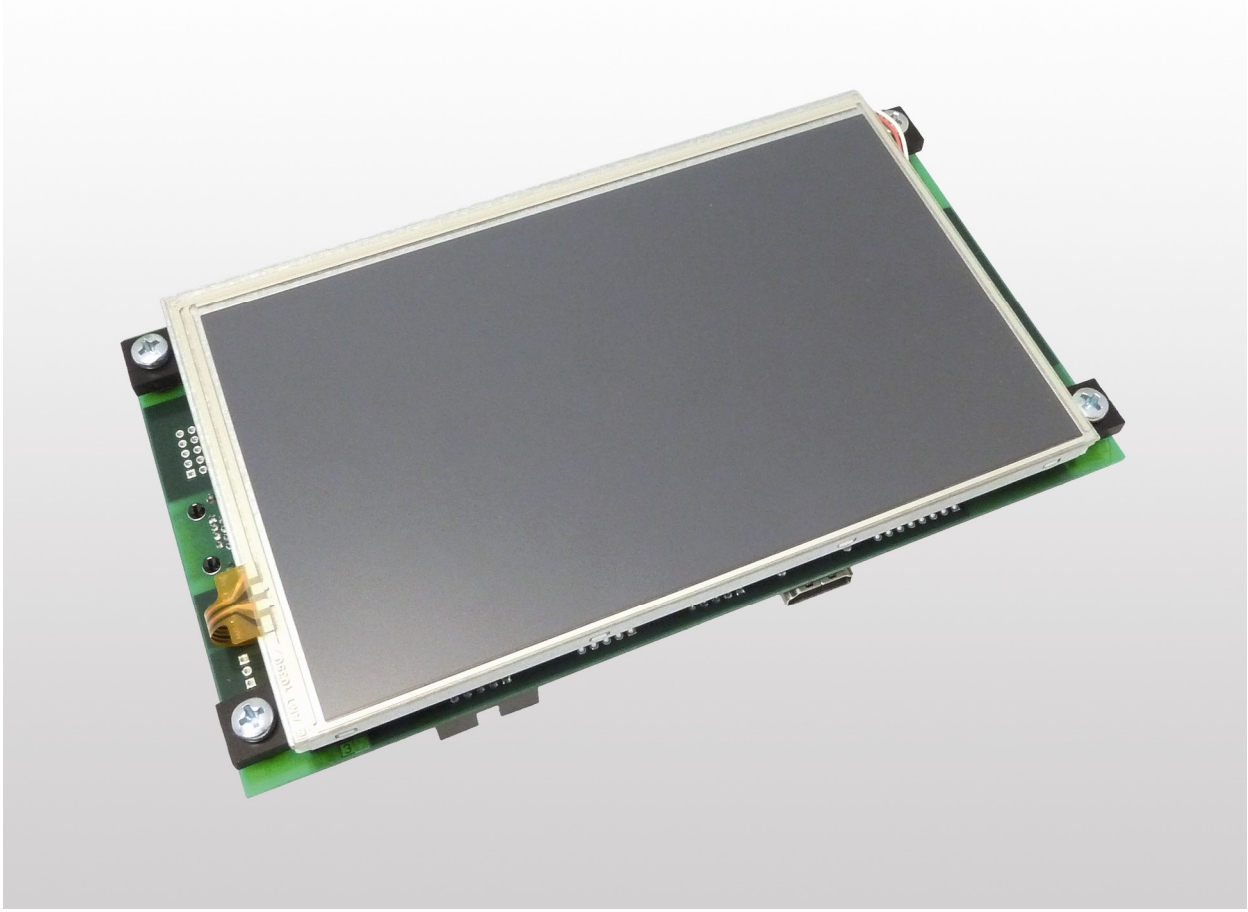
eSOM/SK5 eSOM/3517
Embedded Linux Starter Kit

First Steps



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CONTENT

1 INTRODUCTION

The Starter Kit eSOM/SK5 contains everything you need to get started with your embedded networking application. The Starter Kit includes an eSOM/3517 module with a pre-installed U-Boot boot loader and an embedded Linux, the Evaluation Board BB7/eSOM1 with a mounted 7" LCD Touchscreen, power supply, null modem cable, serial interface cable, a CD-ROM with software and documentation and a printed user manual for the first steps with the Starter Kit.

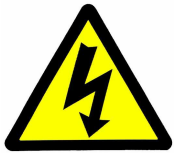
The Starter Kit CD-ROM comes with a full GNU cross tool chain for C/C++ software development. The binary files of this pre build tool chain run on an x86 Linux based host (SuSE, Red Hat or other).

For using the eSOM/SK5 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 eSOM/3517 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 eSOM/SK5 comes with a pre-installed U-Boot boot loader and an Embedded Linux operating system. The eSOM/3517 Linux consists of two main components: 1. the Linux kernel and 2. the root file system.

The eSOM/3517 U-Boot boot loader allows the downloading of new Linux kernel versions and root file systems to the eSOM/3517 RAM and Flash. This in-system programming feature can be used by a simple serial and Ethernet link between the development system and the eSOM/3517.

- eSOM/3517 with Texas Instruments AM3517 32-bit ARM Cortex-A8 SoC @ 600 MHz
- 256 MB DDR2 SDRAM
- 1 GB NAND Flash memory for O/S boot image and data files
- 8 MB NOR Flash memory
- U-Boot boot loader and Embedded Linux pre-installed in Flash memory
- Evaluation Board BB7/eSOM1 (107 x 187 mm)
- 7” LCD with touchscreen (resolution: 800 x 480 px)
- 110 VAC or 230 VAC to 12..24 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 BB7/eSOM1 and PC

Setup the serial link between the Evaluation Board BB7/eSOM1 and your PC. Use the serial interface cable and the null modem cable for this connection.

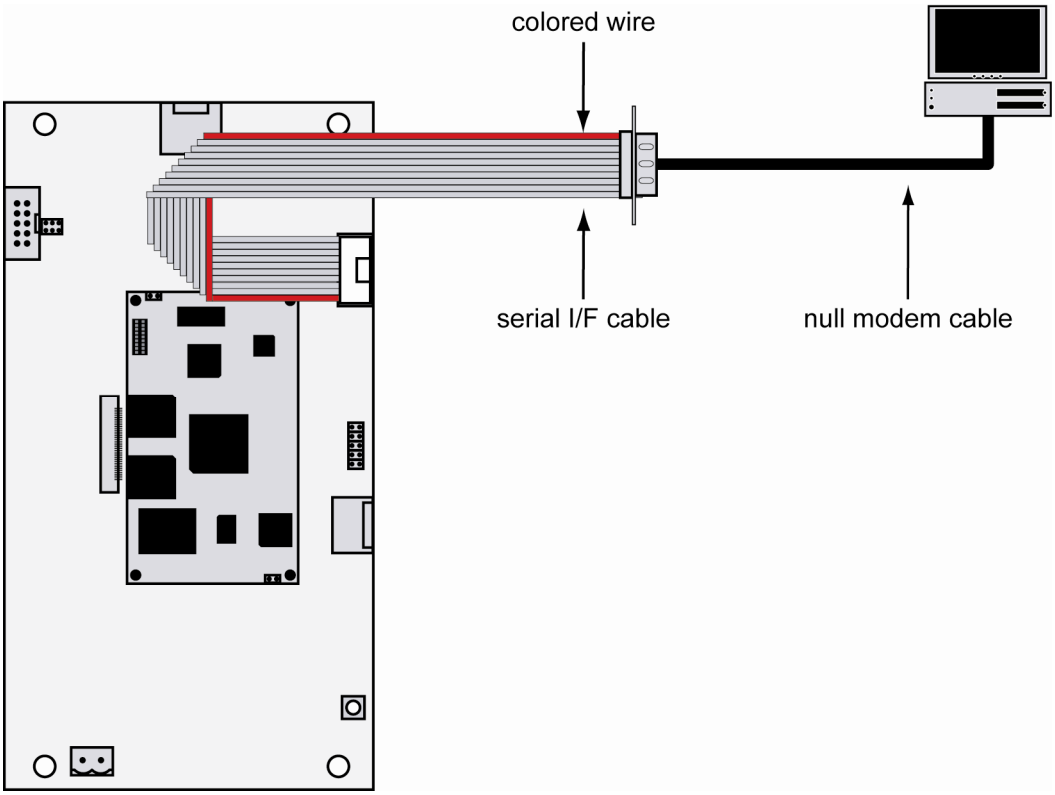


Figure 1: Serial link between BB7/eSOM1 and PC

First connect one end of the serial interface cable with COM1 port of the BB7/eSOM1. Then connect the serial interface cable over the null modem cable with an unused RS232 COM port of the PC. Make sure that this PC RS232 COM port supports 115.200 bps.

2.2 Ethernet Link between BB7/eSOM1 and PC

Setup the Ethernet LAN link between the Evaluation Board BB7/eSOM1 and your PC. Use an Ethernet cross-over cable or a switch-based infrastructure for the LAN connection.

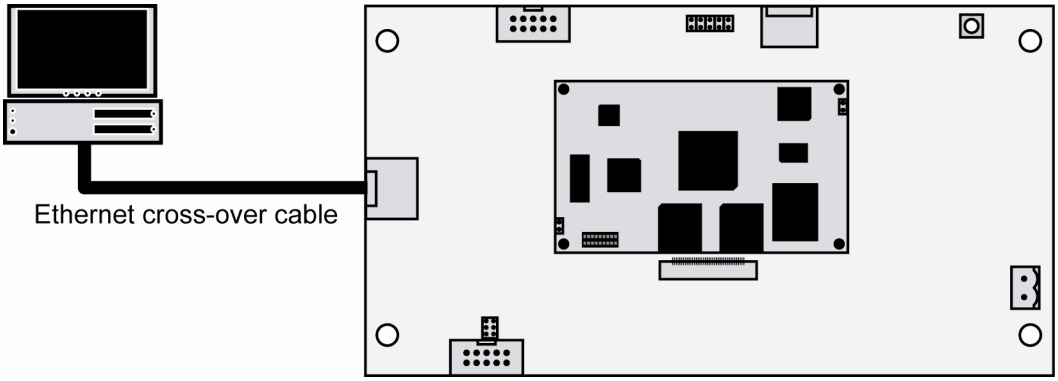


Figure 2: Ethernet link between BB7/eSOM1 and PC

Please note: The eSOM/3517 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.

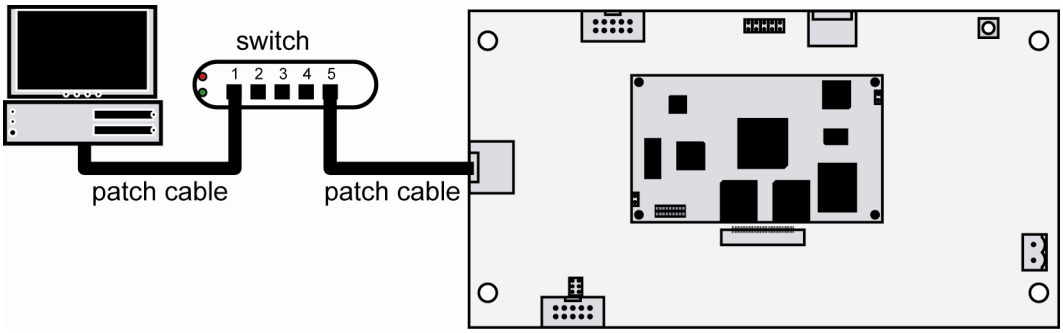


Figure 3: Switch-based Ethernet link between BB7/eSOM1 and PC

2.3 Connecting Power Supply and Power-up the Starter Kit

Connect the 12..24 VDC power supply (which is included in the scope of delivery of the eSOM/SK5) with the power connector of the BB7/eSOM1.

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

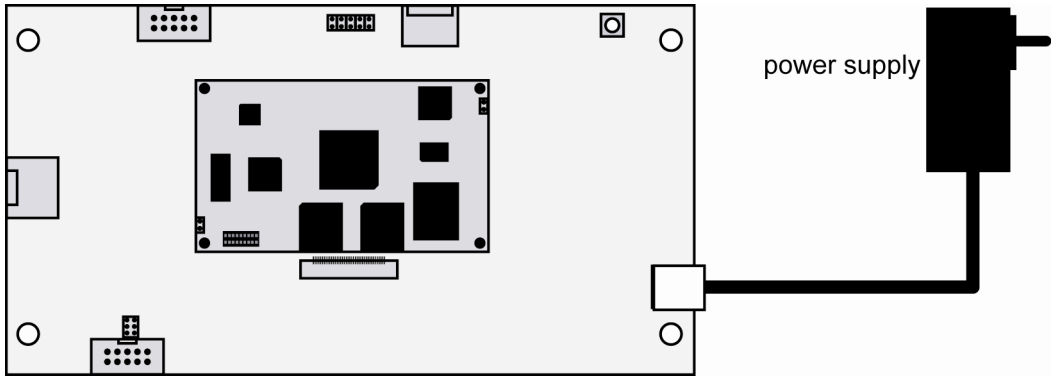
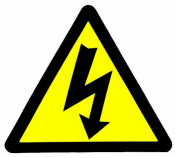


Figure 4: Power supply for the BB7/eSOM1



CAUTION: Providing the BB7/eSOM1 with a voltage higher than the regular 12..24 VDC ±10% could resolve in damaged board components!

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 5: 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.

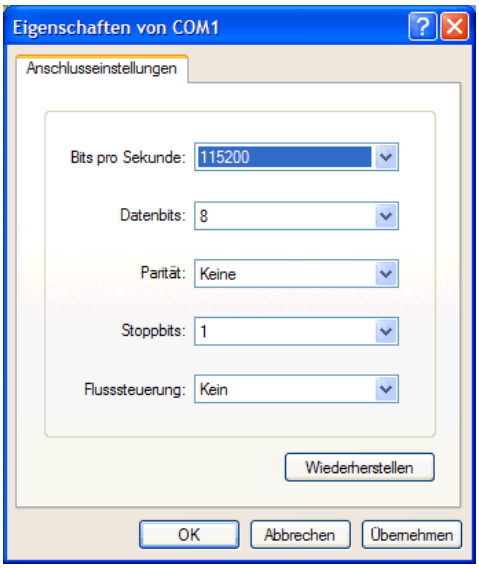


Figure 6: Parameter setup with HyperTerminal

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 eSOM/3517 with RCM disabled

After power-up the eSOM/3517 starts an automatic boot process from the on-board flash memory chip. This process consists of two steps:

1. Directly after power-up, the eSOM/3517 runs the U-Boot boot loader program for some milliseconds. U-Boot initializes the hardware components (hardware init). **With RCM disabled** (please see the *eSOM/3517 hardware reference manual* for details), there is no U-Boot text message output over the eSOM/3517 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 eSOM/3517 hardware and runs all necessary processes for coming up to live.

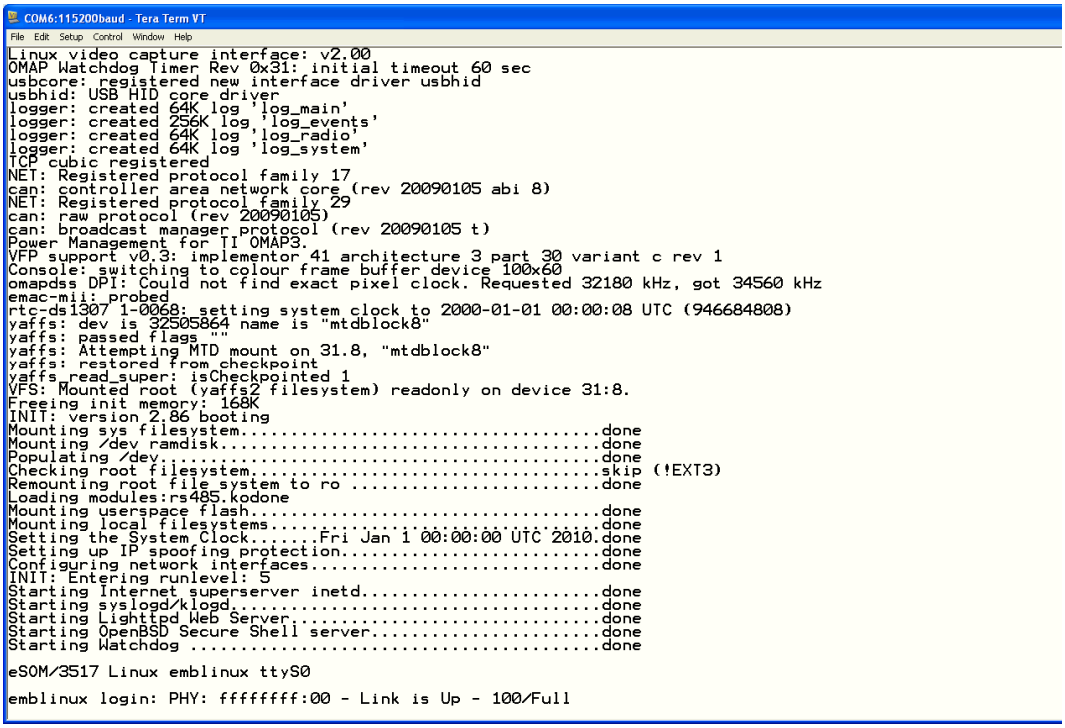


Figure 7: Linux booting process with HyperTerminal

Please note: The U-Boot environment variable **boot delay** does not influence the eSOM/3517 boot process with RCM (Remote Console Mode) disabled.

The eSOM/3517 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.

"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 eSOM/3517 with RCM enabled

The eSOM/3517 boot sequence with RCM enabled is similar to the boot procedure with RCM disabled. Only the first step is different:

1. The eSOM/3517 runs the U-Boot boot loader program. This software shows a wait message over the eSOM/3517 COM1 serial interface if RCM is enabled (please see the *eSOM/3517 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 eSOM/3517 Flash memory.

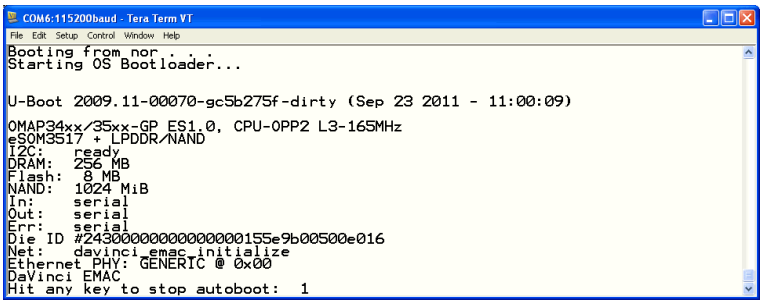


Figure 8: U-Boot wait message

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

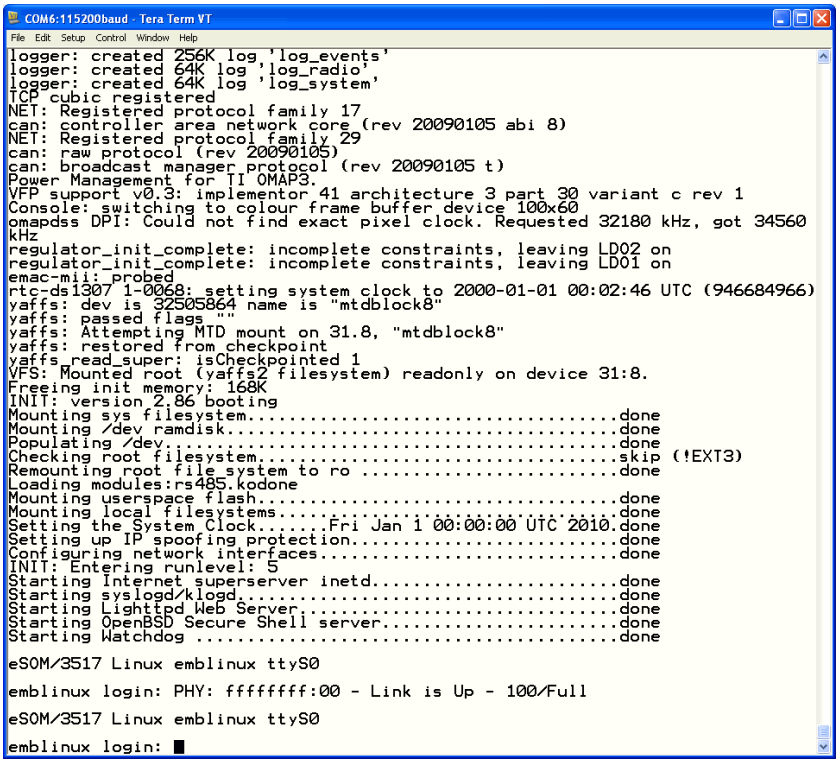


Figure 9: Linux booting process after the U-Boot boot delay

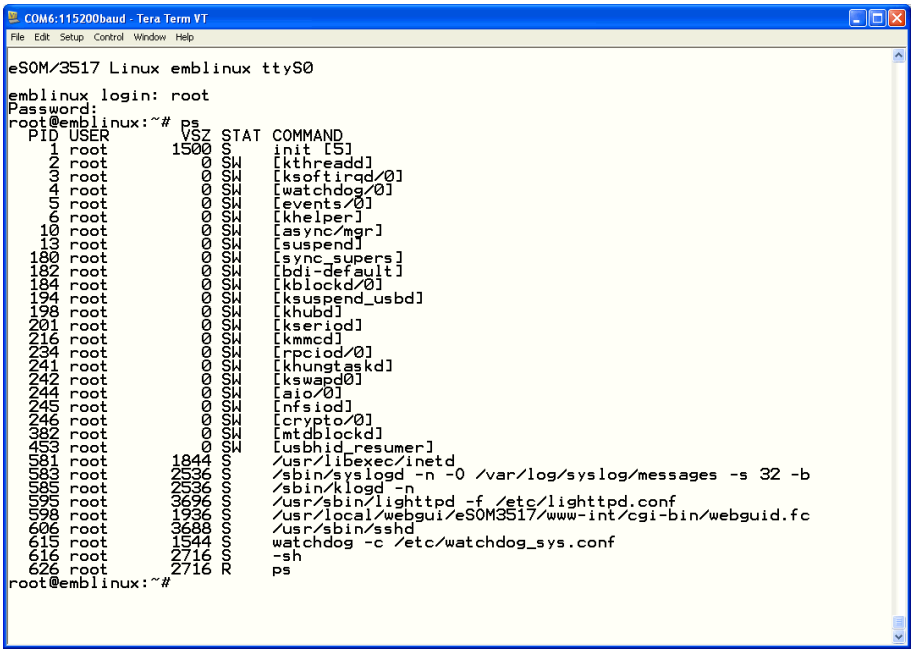


Figure 10: After a login the serial console offers a Linux command line interface

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

2.7 eSOM/3517 Linux File System

After booting the eSOM/SK5 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 eSOM/3517. 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.

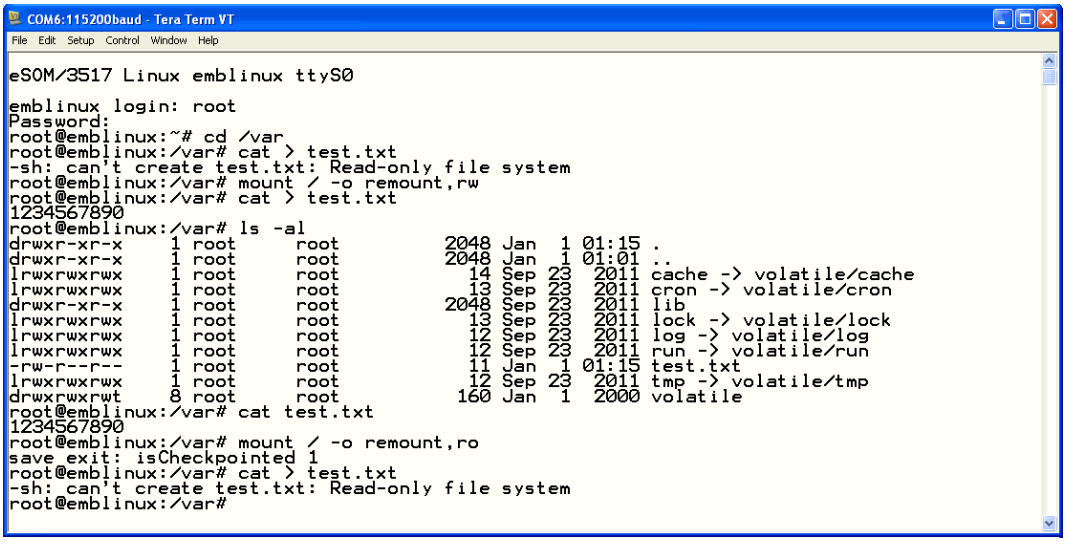


Figure 11: Disabling the write protection with the mount command

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 eSOM/3517.

Please use `192.168.0.1` or `192.168.0.254` for your PC and `192.168.0.126` for the eSOM/3517.

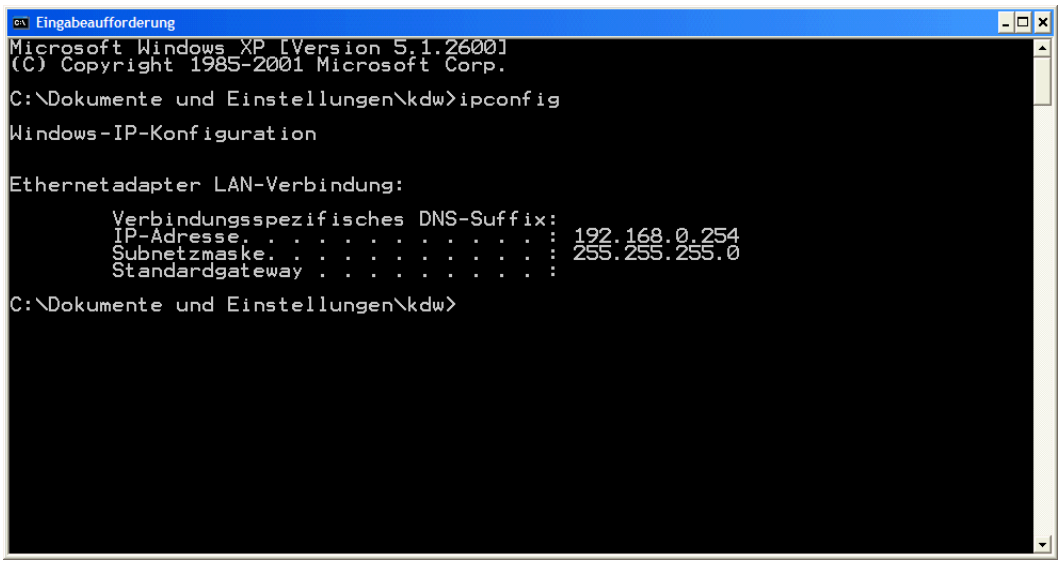


Figure 12: Windows-PC IP address check with *ipconfig*

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 eSOM/3517 please refer to **chapter 2.14**.

2.9 Checking Ethernet-based TCP/IP Communication

Check the Ethernet-based TCP/IP communication between the eSOM/3517 and the PC with a simple *ping* command.

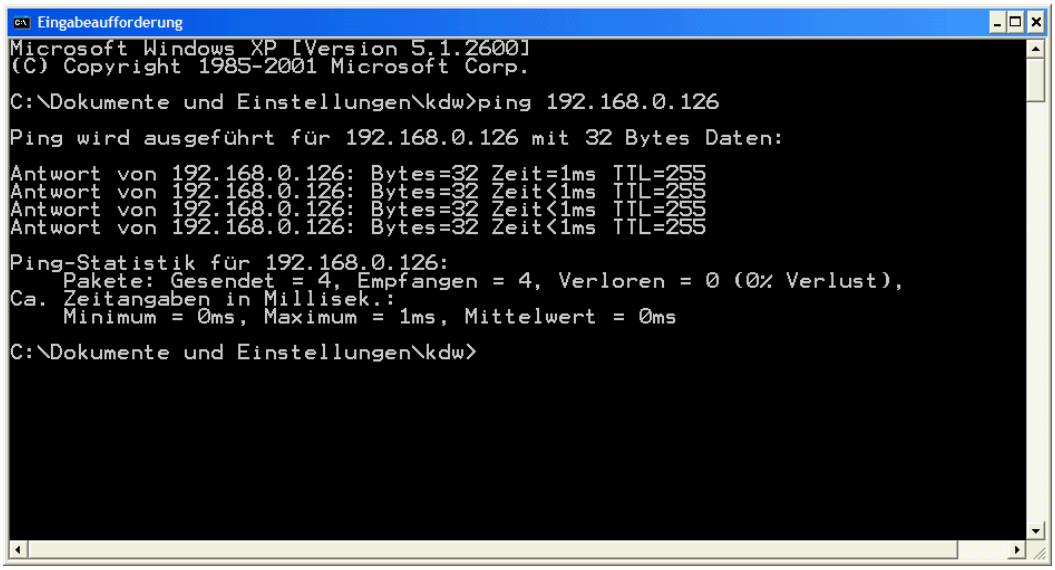


Figure 13: Windows-PC TCP/IP communication check with *ping*

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 eSOM/3517. You can use a Telnet session for remote entering Linux commands.

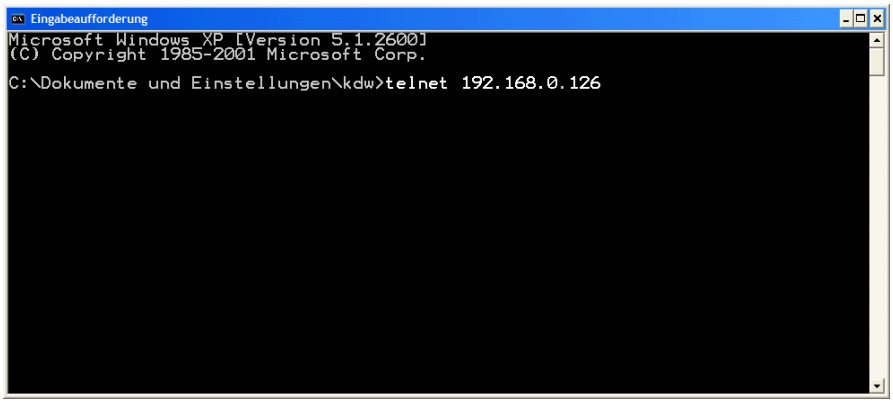


Figure 14: Run the Windows Telnet client program

Wait until the eSOM/3517 Linux requests a user name. Please use the login name ***root*** and the password ***root***. Then press Enter.

Please note: The eSOM/3517 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.

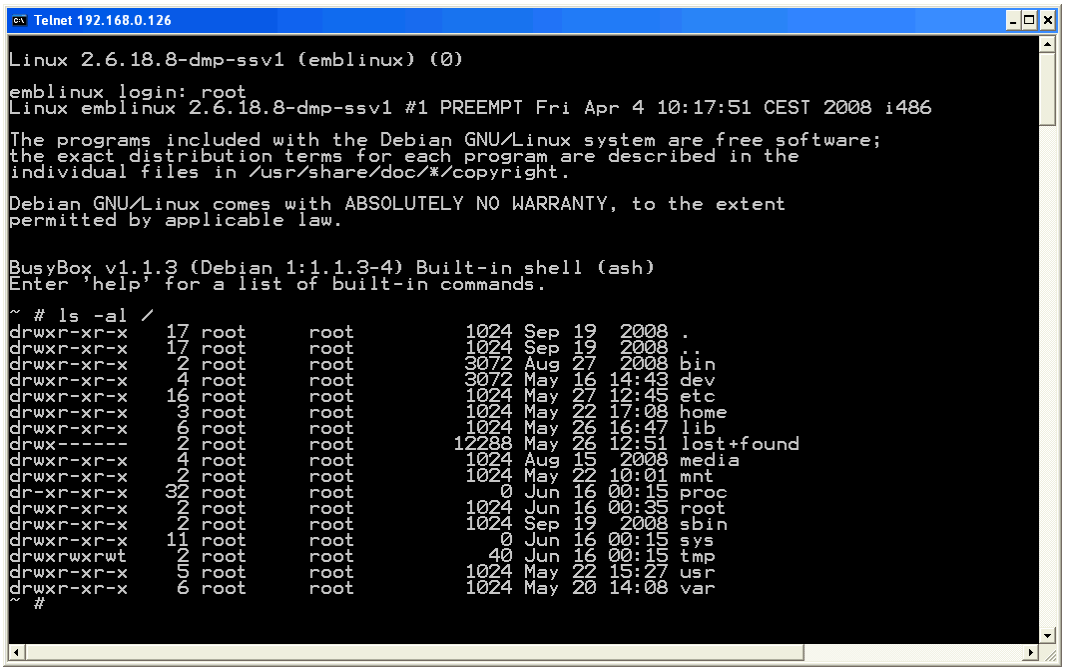


Figure 15: Using Linux commands within a Telnet client window

2.11 Checking FTP Server

The eSOM/SK5 Linux comes with a pre-installed FTP server. This server allows the file transfer via Ethernet between a PC and the eSOM/SK5. Run an FTP client program like *FileZilla* on your PC for a test.

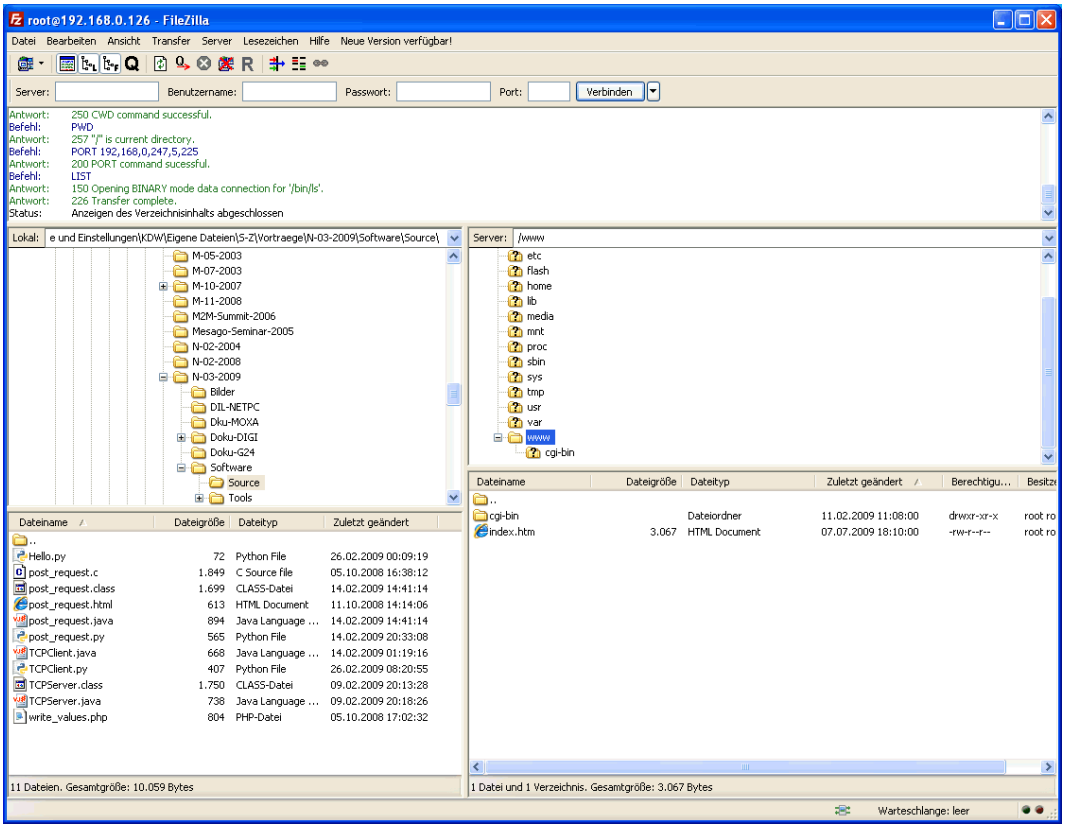


Figure 16: FileZilla as FTP client to access the FTP server

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 eSOM/SK5.

Please Note: Before you start an FTP file transfer to the eSOM/SK5, 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 eSOM/SK5 Linux comes with a pre installed TFTP client. This client allows the file transfer via Ethernet between a PC and the eSOM/SK5. 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 eSOM/SK5 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 eSOM/SK5.

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 eSOM/SK5.

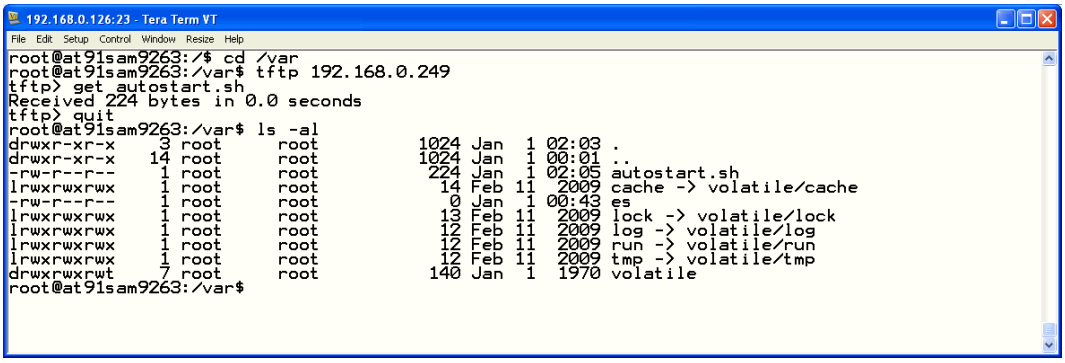


Figure 17: File transfer via TFTP

Please Note: Before you start a TFTP file transfer to the eSOM/SK5, 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 eSOM/SK5 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 eSOM/SK5. Into this directory you can load own files.

Figure 18: Checking the Web server of the eSOM/SK5 with a browser

2.14 Changing Ex Factory IP Address

The default IP address of the eSOM/SK5 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 *mcedit* which is part of the Linux.

To start *mcedit* with HyperTerminal in ANSI mode enter the following command:

```
TERM=ansi mcedit /etc/network/interfaces
```

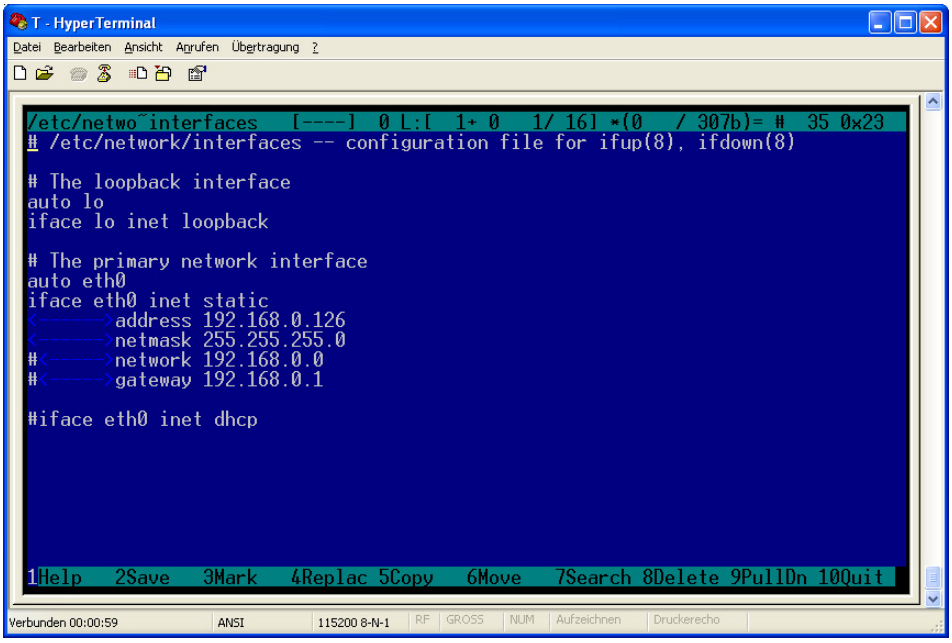


Figure 19: The editor mcedit within HyperTerminal

To start *mcedit* with PuTTY enter the following command:

```
TERM=xterm mcedit /etc/network/interfaces
```

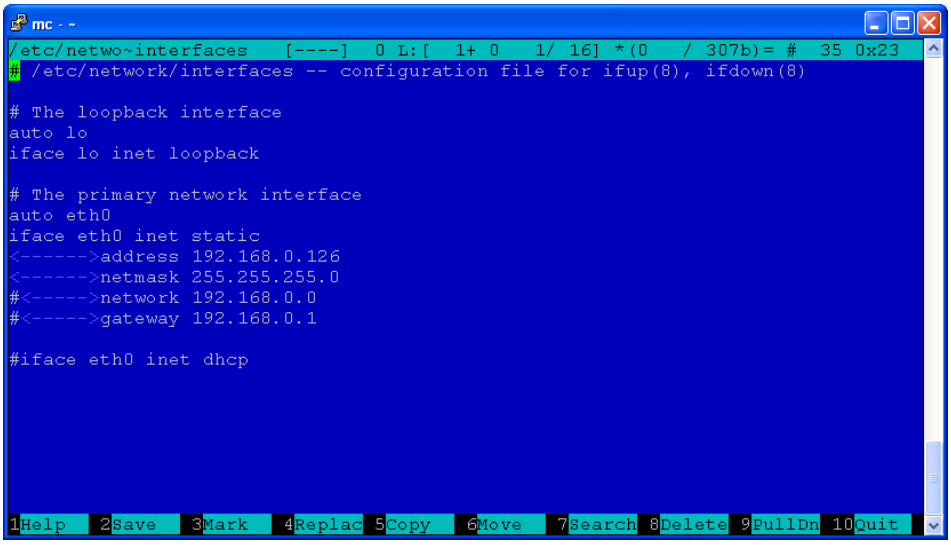


Figure 20: The editor mcedit within PuTTY

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.

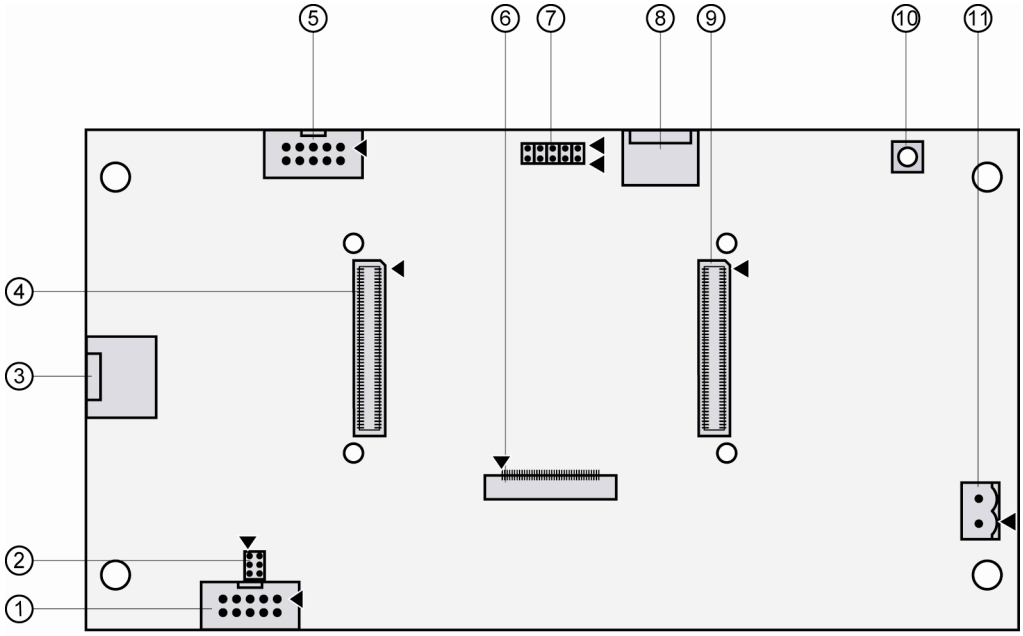
The commands shown at the bottom of HyperTerminal and PuTTY are available with the shortcut **ESC + number**, e.g. for SAVE the shortcut is ESC+2.

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

3 BB7/ESOM1 HARDWARE REFERENCE

The following chapters describe the main hardware components of the BB7/eSOM1.

3.1 BB7/eSOM1 Board Layout



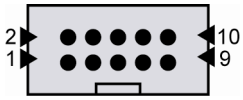
① J6: COM3 connector
② JP1: COM3 termination jumper
③ J9: 10/100 Mbps Ethernet connector
④ J2: eSOM-200 module connector 2
⑤ J4: COM1 connector
⑥ J3: LCD connector
⑦ J8: USB1 + USB2 connector
⑧ J10: DVI port
⑨ J1: eSOM-200 module connector 1
⑩ S1: Reset button
⑪ J11: Power connector

Figure 21: Board layout of BB7/eSOM1

3.2 Pinout COM1 Connector – J4

Pin	Name	Function
1	DCD	COM1 Serial Port, DCD Pin
2	DSR	COM1 Serial Port, RXD Pin
3	RXD	COM1 Serial Port, TXD Pin
4	RTS	COM1 Serial Port, DTR Pin
5	TXD	Ground
6	CTS	COM1 Serial Port, DSR Pin
7	DTR	COM1 Serial Port, RTS Pin
8	RI	COM1 Serial Port, CTS Pin
9	GND	COM1 Serial Port, RI Pin
10	---	Not connected

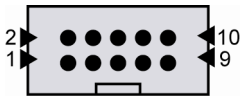
Table 4: Pinout COM1 connector



3.3 Pinout COM3 Connector – J6

Pin	Name	Function
1	---	---
2	---	---
3	RX/TX+	COM3 Serial Port, RX/TX+ Pin (RS485)
4	RX/TX-	COM3 Serial Port, RX/TX- Pin (RS485)
5	---	---
6	---	---
7	---	---
8	---	---
9	---	---
10	---	---

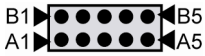
Table 5: Pinout COM3 connector



3.4 USB1/USB2 Connector – J8

Pin	Name	Function
A1	VCC5	5 VDC Power Output
A2	DATA1-	USB1 Host -
A3	DATA1+	USB1 Host +
A4	GND	Ground
A5	Shield	---
B1	Shield	---
B2	GND	Ground
B3	DATA2+	USB2 Host +
B4	DATA2-	USB2 Host -
B5	VCC5	5 VDC Power Output

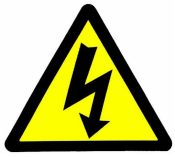
Table 6: Pinout USB1/USB2 connector



3.5 Pinout Power Connector – J11

Pin	Name	Function
1	Vin	Power In 12..24 VDC
2	GND	Ground

Table 7: Pinout power connector

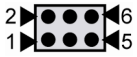


CAUTION: Providing the BB7/eSOM1 with a voltage higher than the regular 12..24 VDC ±10% could cause damaged board components!

3.6 COM3 Termination Jumper (RS485) – JP1

COM3 Jumper	Function
---	no Termination or Biasing for COM3
	only Line-Biasing for COM3 (32 Nodes + 2 Rterm)
	only 120R Termination-Resistor for COM3
	Termination and Line-Biasing for COM3

Table 8: COM3 termination jumper settings



4 HELPFUL LITERATURE

- eSOM/3517 hardware reference manual

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DOCUMENT HISTORY

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1.0	2012-03-22	first version	WBU