DL28 Industrial Linux Computer
Installation and User Manual

Release 1.0 08.05.2013.

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V1.0	08.05.2013.	Goran Dragišić	Initial release

1 OVERWIEV

DL28 is multi-purpose industrial computer in compact enclosure, suited to remote monitoring, control and measurement systems, data acquisition and establishing communication links of remote locations. It is based on powerful 450Mhz processor with 256MB SDRAM, 2GB flash memory and Linux OS. For remote connections to SCADA several solutions are available: local computer networks (LAN), wireless computer networks (WLAN), CATV modems, GSM/GPRS/3G routers as well as other line and wireless modems. Six featured serial connectors allow linking different control, measuring and communication devices.

Figure 1. DL28 appearance

Installed application software is automatically retrieved and executed upon device start-up. Replacements and updates of application software can be done through TFPT protocol remotely, by using Ethernet connector (ETH) or through XMODEM protocol via USB connector (USB0).

Parameters setting and device diagnostics can be realised through USB connector (USB0), device web server and Ethernet connector (ETH).

Built-in monitoring mechanism, usually called “watchdog timer”, enables reliable operation under most severe environment conditions.

2 Device Description

DL28 is contained in plastic enclosure with 70x86x72.8mm dimensions and attachment for DIN 35 mm supporting rail.

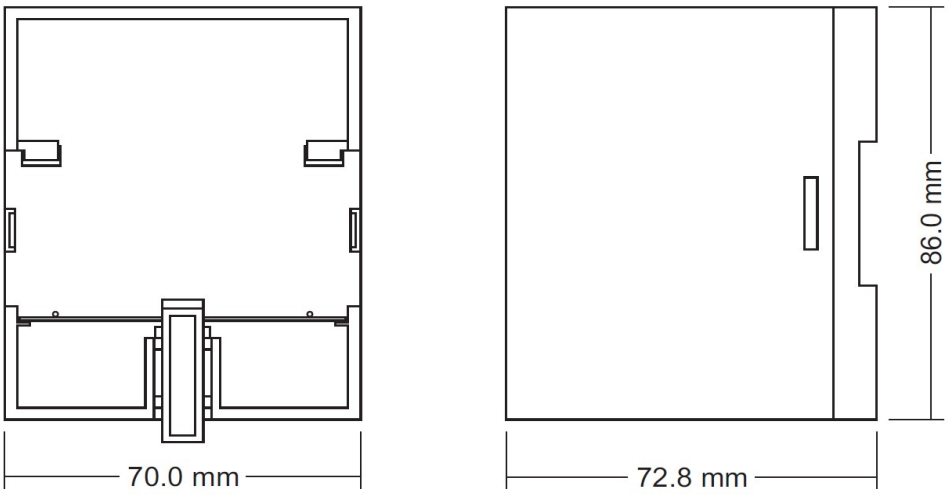

Figure 2. Back and side view of DL28

Front plate is equipped with connectors for power supply, USB peripheral devices, memory cards, Ethernet and serial connected devices, as well as indicator lights. Following figure shows DL28 front face with featured connectors explained.

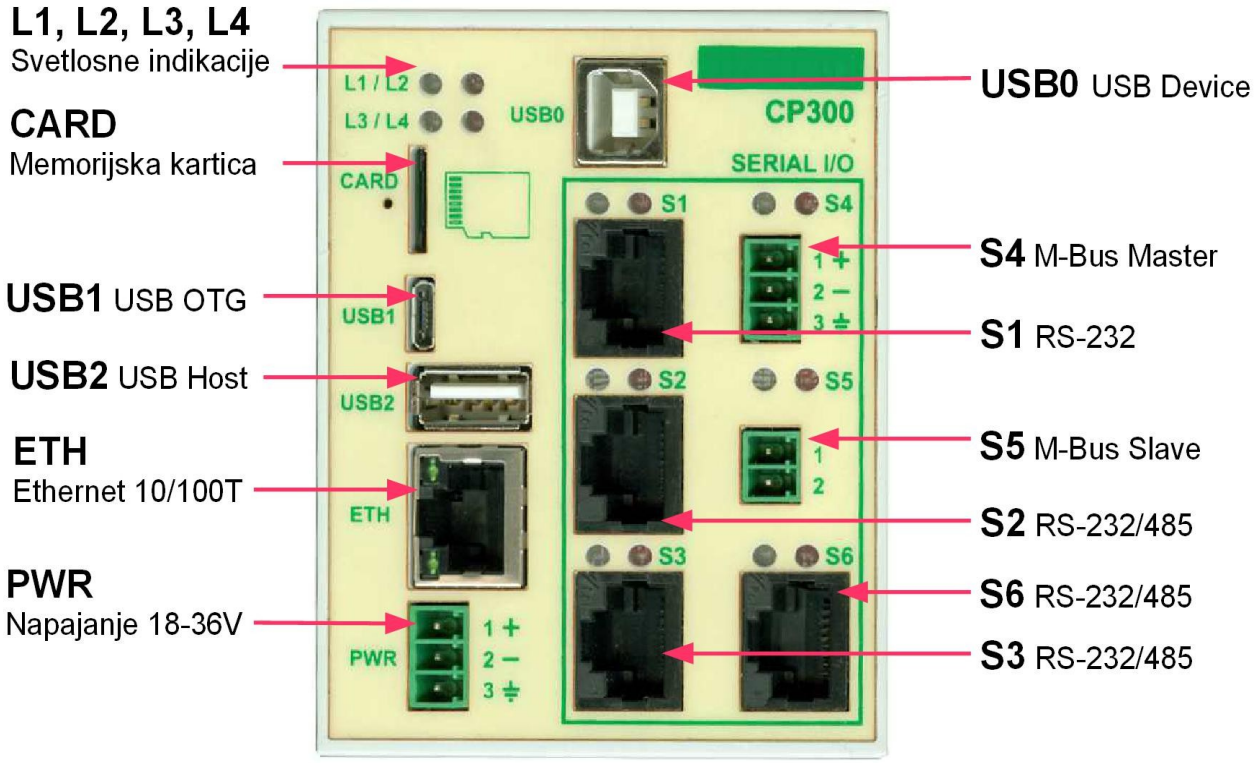

Figure 3. DL28 front face connectors

DL28 has modular design, consisting of four boards: processor board, communication board, M-Bus board and base board connecting all of them into single unit. All communication ports are galvanic isolated, the same applies to power supply connector.

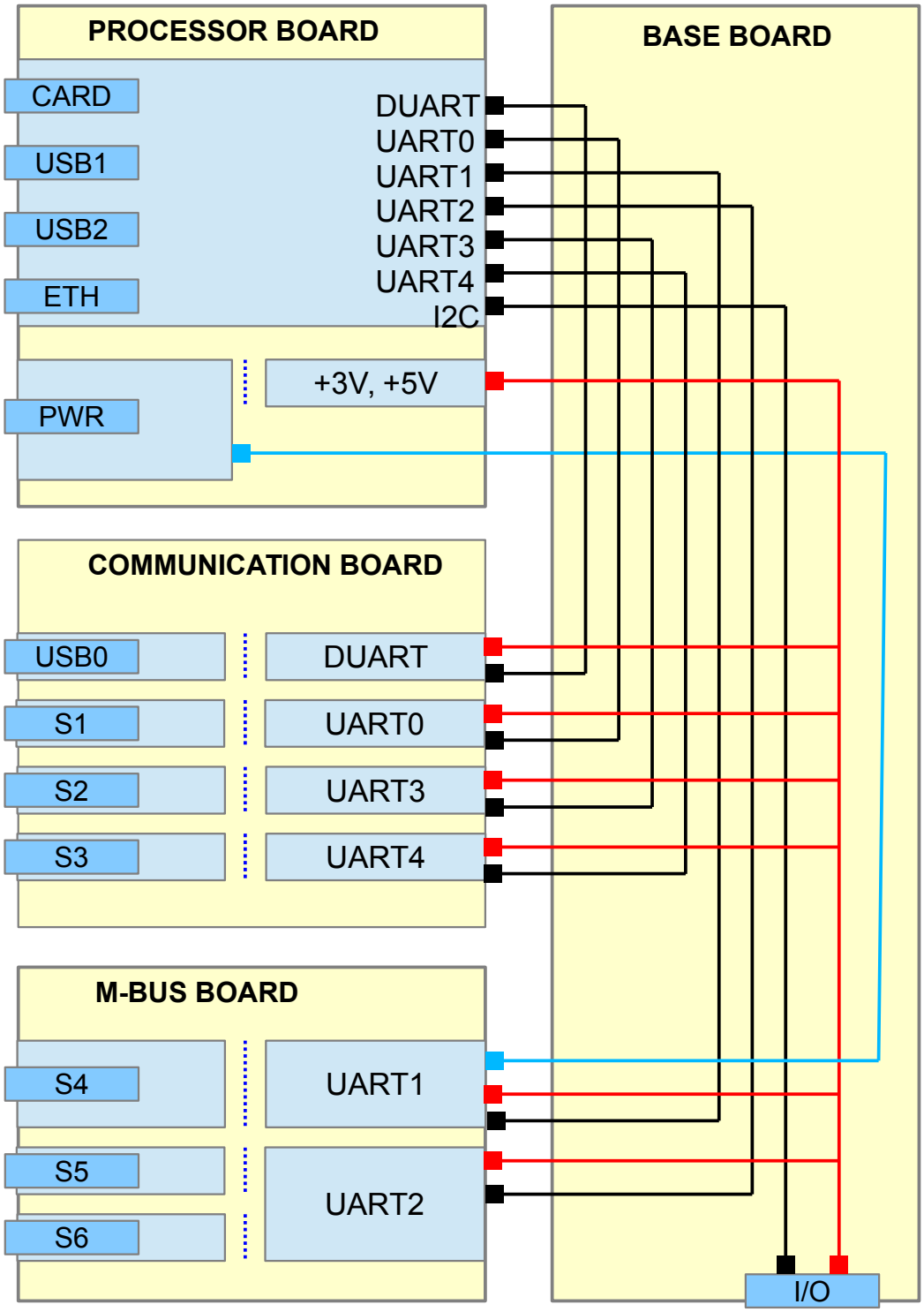

Figure 4. DL28 block diagram

2.1 Processor Board

The processor board is central part of DL28. It contains power section, processor module and headers for peripheral connectors, memory cards and Ethernet connector.

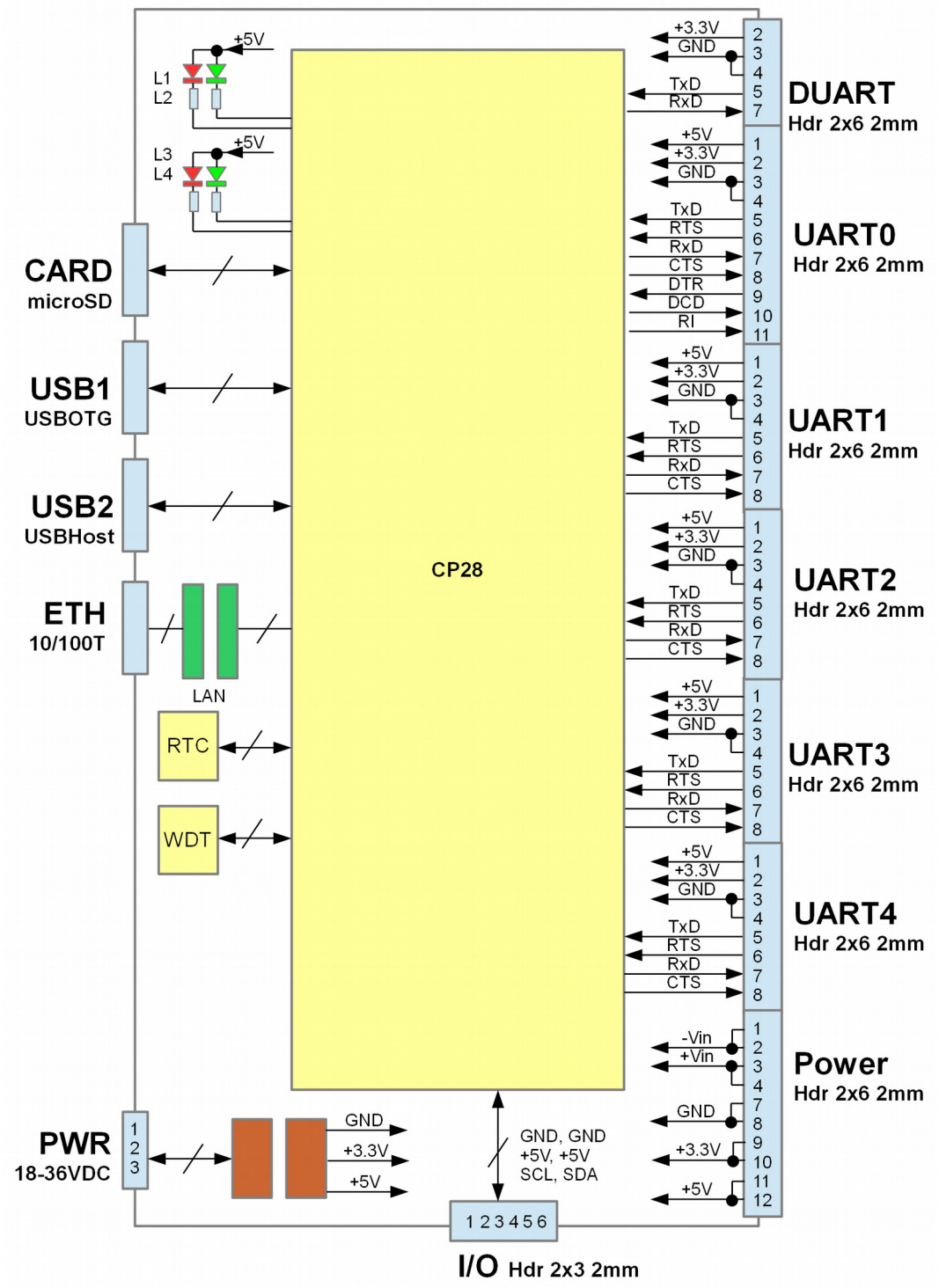

Figure 5. DL28 Processor Board Block Diagram

2.1.1 Indicator Lights

Indicator Lights use LEDs to show DL28 status and modes of operation.

Marking	Colour	Purpose
L1	green	power indicator
L2	red	processor indicator
L3	green	TBD
L4	red	TBD

2.1.2 Memory Card

DL28 supports use of flash memory cards belonging to microSD format. As the Figure 3. shows, card should be introduced to slot with contact elements leading, while remaining on the left side of the card.

2.1.3 USB Connectors

Three featured USB connectors are pre-determined as Host, Device and OTG connectors. USB0 behaves as “Device”, type “B”, and is being used for Linux “command line” interface. To connect USB0 as device to PC host, VCP driver should be installed to PC after downloading from following web address: http://www.ftdichip.com/Drivers/VCP.htm USB1 behaves as OTG, type “microAB”, while USB2 behaves as “Host” of type “A”. Both of them can be used for connecting different USB peripherals such as memory cards and similar.

2.1.4 Ethernet Connector

Ethernet Connector enables plugging into local computer networks (LAN), wireless network modems (WLAN), cable modems, GSM/GPRS routers ans similar communication devices. It supports 10/100TBase specification. RJ45 connector features indicators for device operation (upper LED) and network activities (lower LED).

2.1.5 Power Connector

DL28 can be powered by DC sources ranging from 18 to 30V. If used power source has 24V the power consumption is up to 5W. Indicator light L1 shows presence of power voltage.

Pin No.	Signal	Type
1	+V	Positive voltage 18-36V
2	-V	Negative voltage 18-36V
3	⏚	Ground terminal

2.2 Communication Board

Communication board features USB0 connection as well as three serial RS232/485 connections S1, S2, and S3. All of them are galvanic isolated.

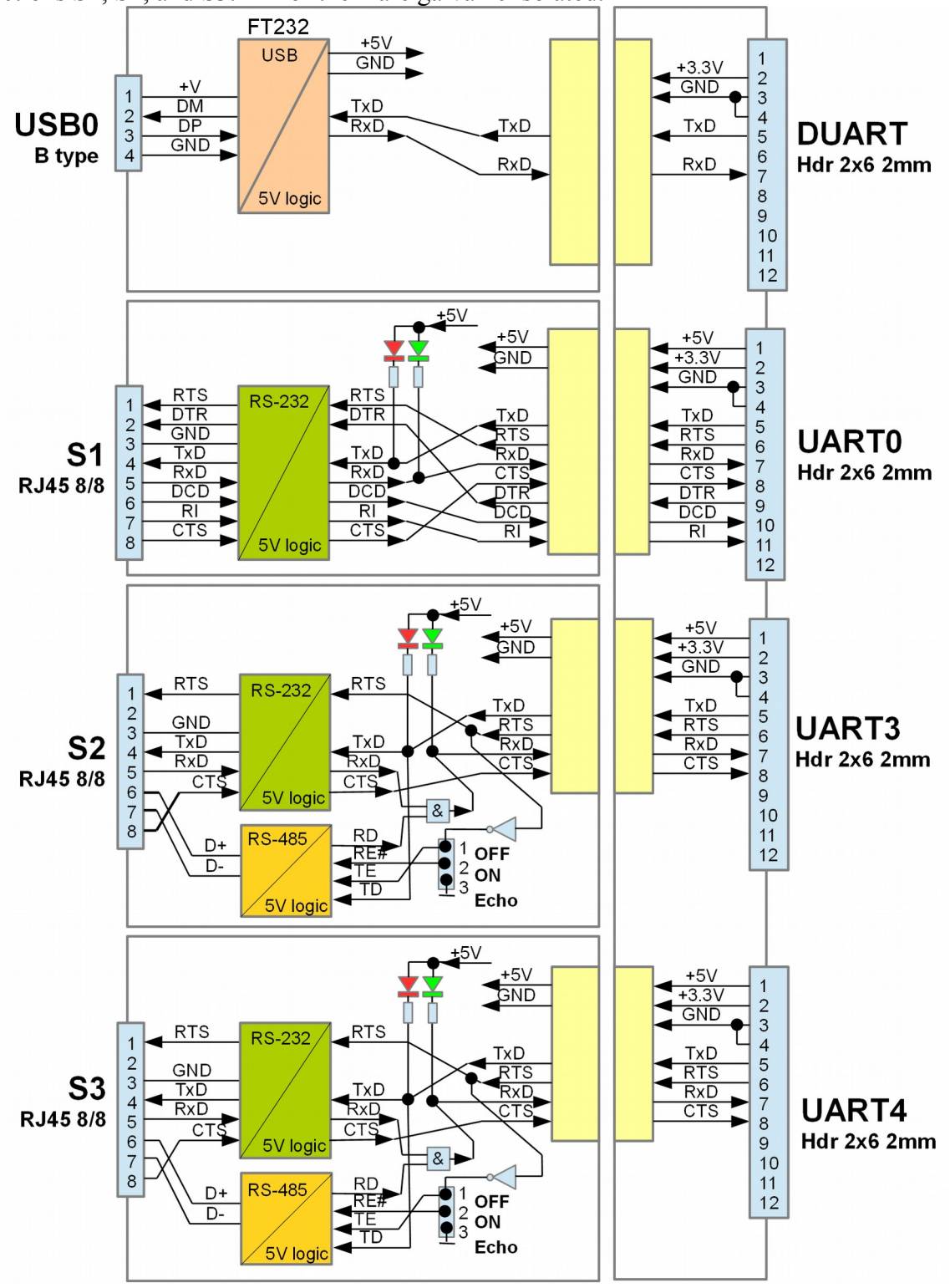

Figure 7. DL28 Communication Board Block Diagram

2.2.1 Serial Connector S1

RJ45 8/8 port connects external devices to UART0 processor having seven RS-232C signals. This port is used for connecting “dial-up”, GSM or other similar modem. Indicator lights located above the RJ45 show status signals for sending TXD (red LED on the right) and receiving RXD (green LED on the left).

Pin No.	Signal	Type
1	RTS	Output
2	DTR	Output
3	GND1	-
4	TXD	Output
5	RXD	Input
6	DCD	Input
7	RI	Input
8	CTS	Input

2.2.2 Serial Connector S2

RJ45 8/8 port connects external devices to UART4 processor having four RS-232C and two RS-485 signals. This port is used for connecting devices that use asynchronous serial communications, such as personal computers (PC), programmable logic controllers (PLC) and similar devices. Indicator lights located above the RJ45 show status signals for sending TXD (red LED on the right) and receiving RXD (green LED on the left). Both signal types (RS-232C and RS-485) can be active and operate simultaneously. With “Echo” jumper on the communication board, two operating modes of RS-485 receiving can be set: OFF (1-2 position) for disabled sending echo and ON (2-3 position) for enabled sending echo. Jumper “Term” enables 120Ω termination on RS-485.

Pin No.	Signal	Type
1	RTS	RS-232 Output
2	-	not connected
3	GND2	-
4	TXD	RS-232 Output
5	RXD	RS-232 Input
6	A (+)	RS-485 +
7	B (-)	RS-485 -
8	CTS	RS-232 Input

2.2.3 Serial Connector S3

RJ45 8/8 port connects external devices to UART3 processor having four RS-232C and two RS-485 signals. This port is used for connecting devices that use asynchronous serial communications, such as personal computers (PC), programmable logic controllers (PLC) and similar devices. Indicator lights located above the RJ45 show status signals for sending TXD (red LED on the right) and receiving RXD (green LED on the left). Both signal types (RS-232C and RS-485) can be active and operate simultaneously. With "Echo" jumper on the communication board, two operating modes of RS-485 receiving can be set: OFF (1-2 position) for disabled sending echo and ON (2-3 position) for enabled sending echo. Jumper "Term" enables 120Ω termination on RS-485.

Pin No.	Signal	Type
1	RTS	RS-232 Output
2	-	not connected
3	GND3	-
4	TXD	RS-232 Output
5	RXD	RS-232 Input
6	A (+)	RS-485 +
7	B (-)	RS-485 -
8	CTS	RS-232 Input

2.3 M-Bus Board

M-Bus board serves as connection to systems and devices through standard EN1434 connector, usually being used for meters and other measuring devices.

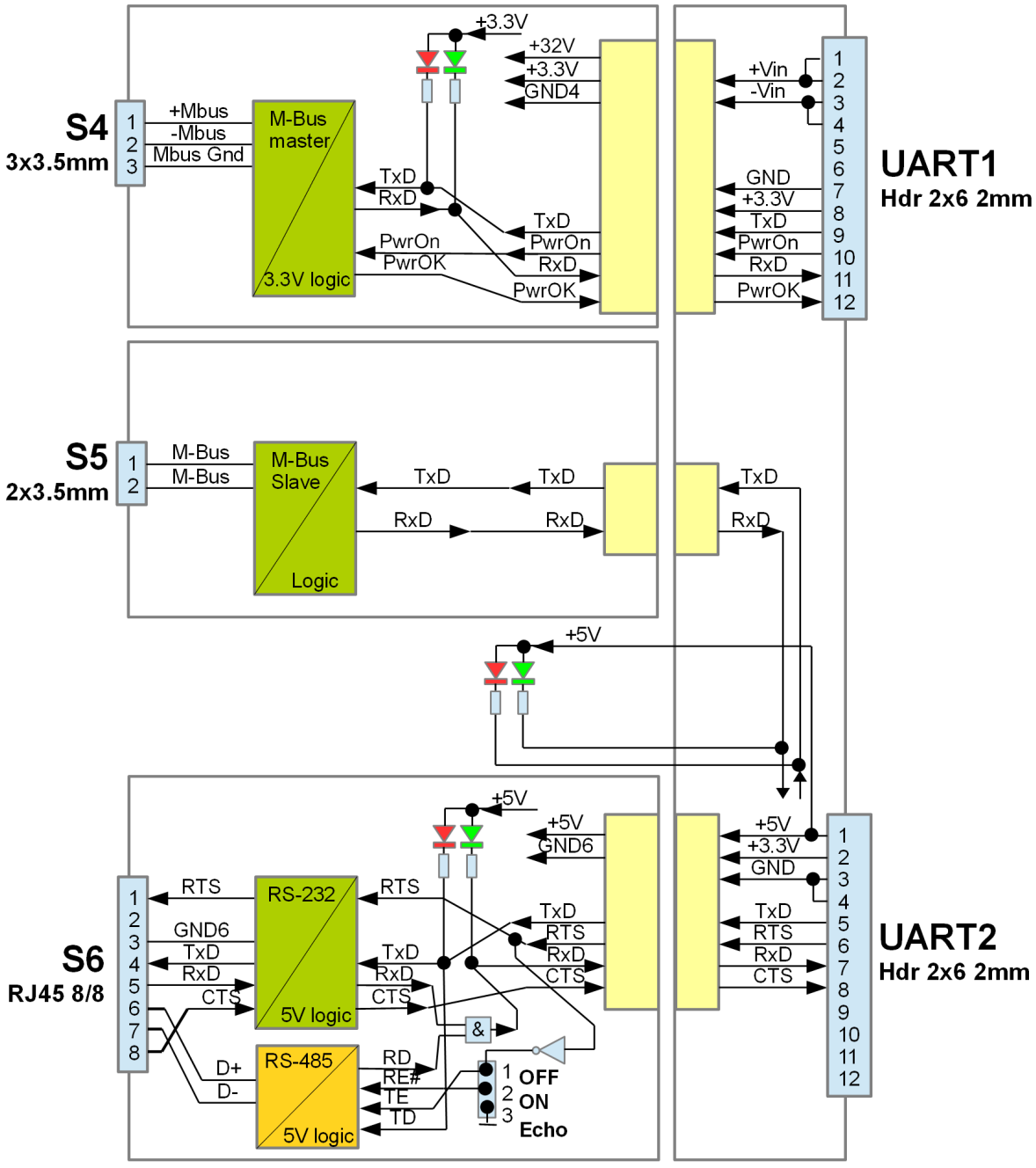

Figure 8. DL28 M-Bus Board Block Diagram

2.3.1 Serial Connector S4

3x3.5 mm connection blocks are used to link external devices to UART1 processor with M-Bus master interface according to EN1434. Up to 3 slave devices can be connected. S4 connector accepts devices with M-Bus slave output such as heath meters, water meters or gas meters. Speeds for this port connection should be in range from 300b/s to 2400b/s while data format is 8E1. Indicator lights located above the connection blocks show status signals for sending TXD (red LED on the right) and receiving RXD (green LED on the left).

Pin No.	Signal	Type
1	+MBus	M-Bus master + connector
2	-MBus	M-Bus master - connector
3	⏚	Grounding

2.3.2 Serial Connector S5

2x3.5 mm connection blocks are used to link external devices to UART2 processor with M-Bus slave interface. Acceptable speeds for this port should be from 300b/s to 2400b/s while data format should be set to 8E1. Indicator lights located above the connection blocks show status signals for sending TXD (red LED on the right) and receiving RXD (green LED on the left).

Pin No.	Signal	Type
1	MBus	M-Bus slave connector
2	MBus	M-Bus slave connector

2.3.3 Serial Connector S6

RJ45 8/8 port connects external devices to UART2 processor having four RS-232C and two RS-485 signals. Both types (RS-232C and RS-485) are active and operate simultaneously. With “Echo” jumper on the communication board, two operating modes of RS-485 receiving can be set: OFF (1-2 position) for disabled echo sending and ON (2-3 position) for enabled sending of echo. Jumper “Term” enables termination on RS-485. S6 connector has parallel connection to S5 connector to enable UART2 sending/receiving through both ports.
Acceptable speeds for this port should be from 300b/s to 2400b/s while data format should be set to 8E1. Indicator lights located above the connection blocks show status signals for sending TXD (red LED on the right) and receiving RXD (green LED on the left).

2.4 Base Board

Base board serves as mechanical and electrical junction of above mentioned boards.

2.4.1 Expansion Port

DL28 features expansion port for adding other input/output communication modules. In this manner basic features can be enhanced and upgraded.

Pin No.	Signal	Type
1	GND	Ground
2	GND	
3	+5V	expansion power supply having 5V /100mA
4	+5V	
5	SDA	Data I/O
6	SCL	Clock I/O

3 DL28 Connection Ports Testing

To execute tests, personal computer should be used and connected by USB cable (A-B type). “B” end of the cable should be plugged into USB0 port on the front of DL28. Since USB0 is realised by integrated circuit FT232 (www.ftdichip.com), virtual serial port driver should be installed to PC after downloading from the web address: http://www.ftdichip.com/Drivers/VCP.htm

On PC side the terminal application (Windows Hyper Terminal or Linux Terminal) should be started and set to listen newly installed virtual serial port (COM3 for instance) with communication parameters 115200bps, 8N1. The next step is powering DL28. Terminal application returns following while DL28 is starting. Last text row shows info about possibility to cancel OS booting, within 3 seconds, by hitting any key on the PC keyboard. After passing of 3 seconds, OS will continue booting by default. Otherwise, if any key was activated, to start normal OS booting, DL28 should be turned off and powered again.

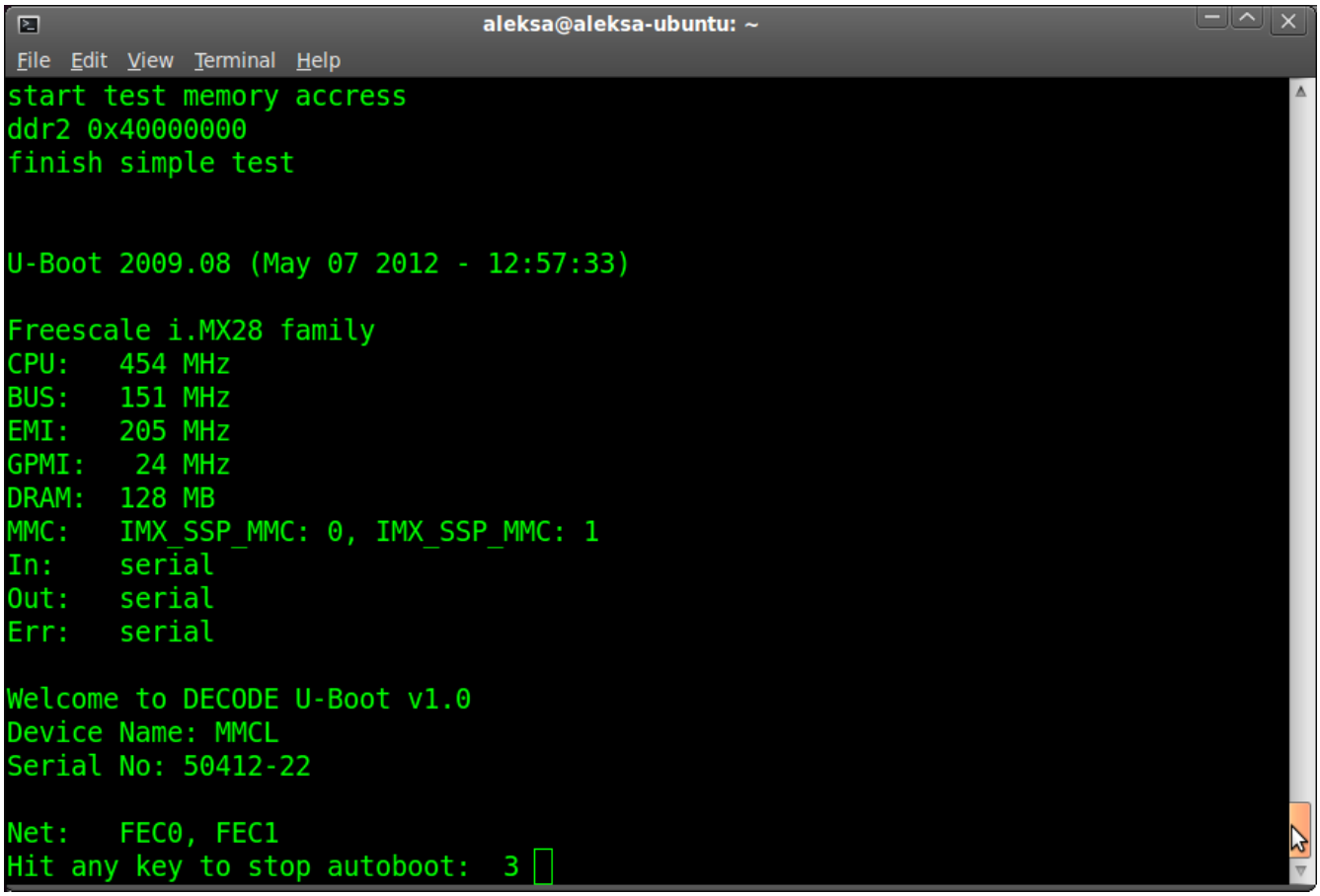

Figure 9: Terminal window appearance after starting device OS

USB0 can be regarded as successfully tested after the terminal application on the PC has shown DL28 boot listing.

3.1 User Login

After several seconds from starting device OS should be up and ready. Following screen shows terminal program appearance after OS start, having the prompt for user login at the bottom.

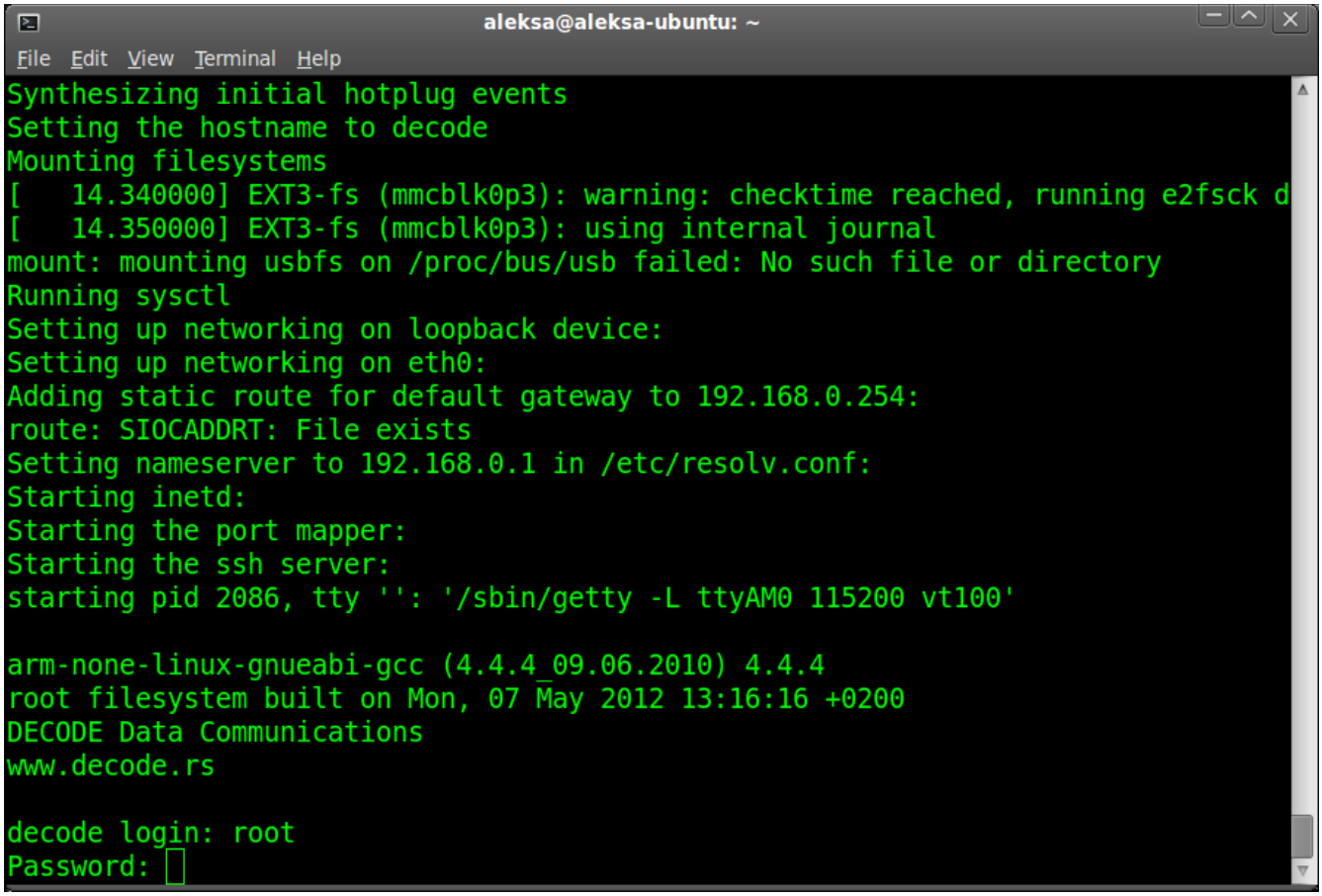

Figure 10: Terminal application screen with user login prompt

Default access parameters are:

decode login: **root**
Password: **root**

3.2 Ports S1 ... S6 Testing

After successful login serial ports S1 ... S6 can be tested by starting following system application:
root@decode~$./TestPort

After successful login serial ports S1 ... S6 can be tested by starting following system application:

root@decode ~$ ./TestPort

Test has 3 phases:

TEST1 – testing communication between serial ports S1 and S2
TEST2 – testing communication between serial ports S3 and S6
TEST3 – testing communication between ports S4 (M-Bus master) and S6 (M-Bus slave)

The outcome of tests can be observed from the terminal window.

For serial ports testing cross-linked serial cable with RJ45 connectors should be made as following:

RJ45 CONNECTOR 1		RJ45 CONNECTOR 2	
Pin No.	**Signal**	**Signal**	**Pin No.**
3	GND	GND	3
4	TXD	RXD	5
5	RXD	TXD	4

For M-Bus ports testing two-wire cable with 2 poles and 3 poles connectors should be prepared as following:

2 POLES CONNECTOR		3 POLES CONNECTOR	
Pin No.	**Signal**	**Signal**	**Pin No.**
1	MBus	+MBus	1
2	MBus	-MBus	2

3.2.1 TEST1

Following terminal screen shows execution of **TestPort** system application. After the **TestPort** is started, user is asked to connect cross-linked RJ45 serial cable to ports **S1** and **S2**, confirming this action with **y** and **ENTER** keys.

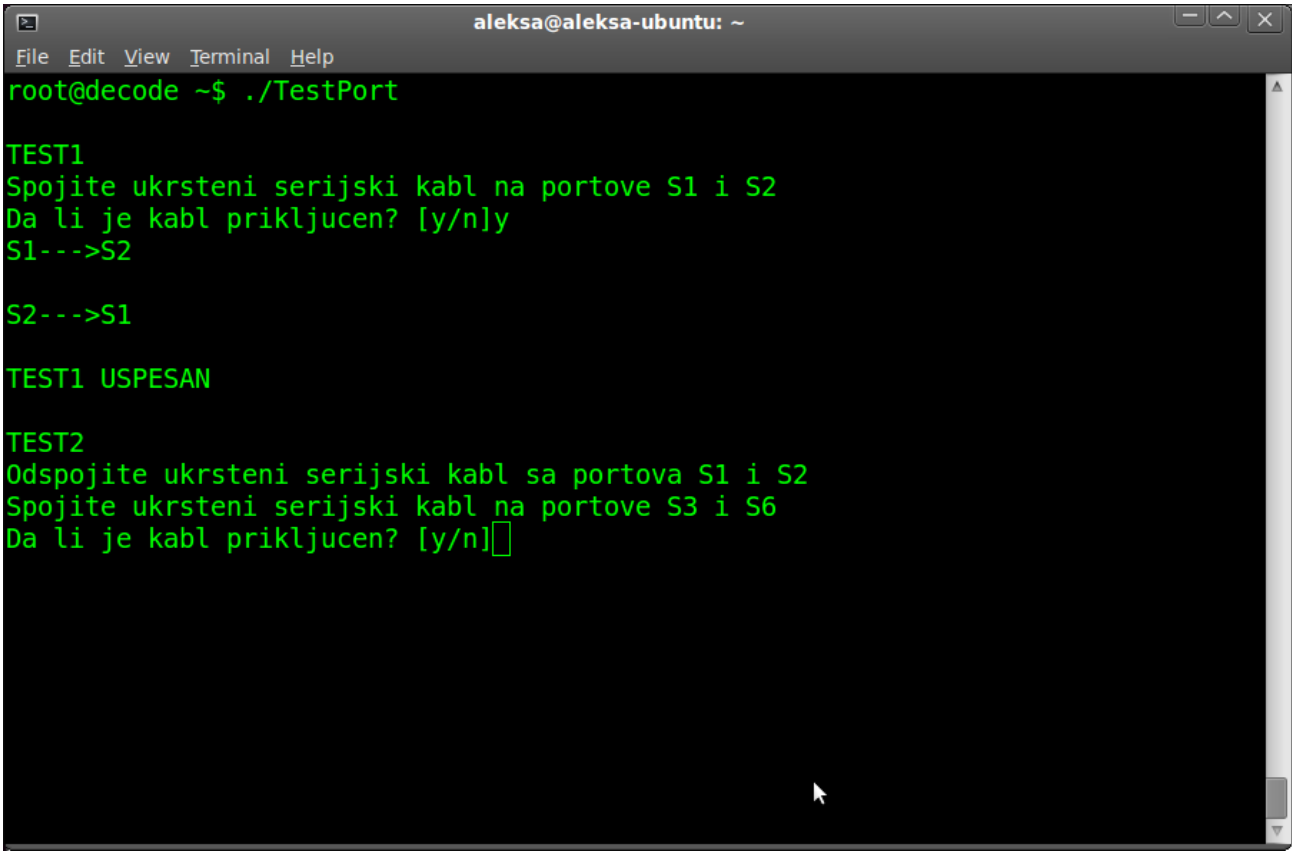

Figure 11: Terminal screen output after TEST1 execution

After communication testing in both ways (S1--->S2 and S2--->S1) the TEST1 is completed and application advances to TEST2 automatically.

3.2.2 TEST2

For this test cross-linked RJ45 serial cable should be placed to ports S3 and S6 and confirmed by entering **y** and **ENTER** keys.

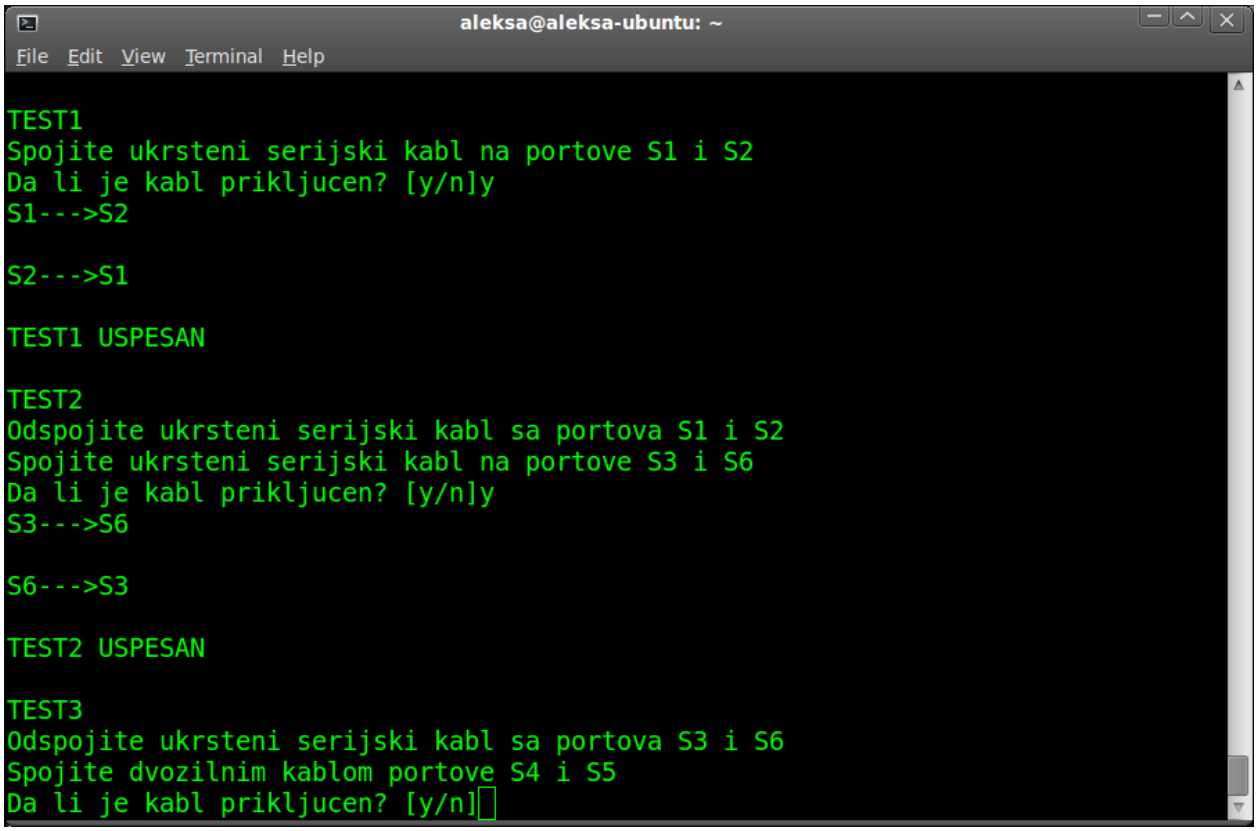

Figure 12: Terminal screen output after TEST2 execution

After communication testing in both ways (S3--->S6 and S6--->S3) the TEST2 is completed and application advances to TEST3 automatically.

3.2.3 TEST 3

All serial cables with RJ45 connectors should be removed from DL28 device for this test. Two-wire conductors prepared earlier should be used between S4 and S5 ports.
During test communication in S4--->S5 direction few unprintable characters will show in terminal window, which is normal behaviour - it shouldn't be regarded as error state or ports failure

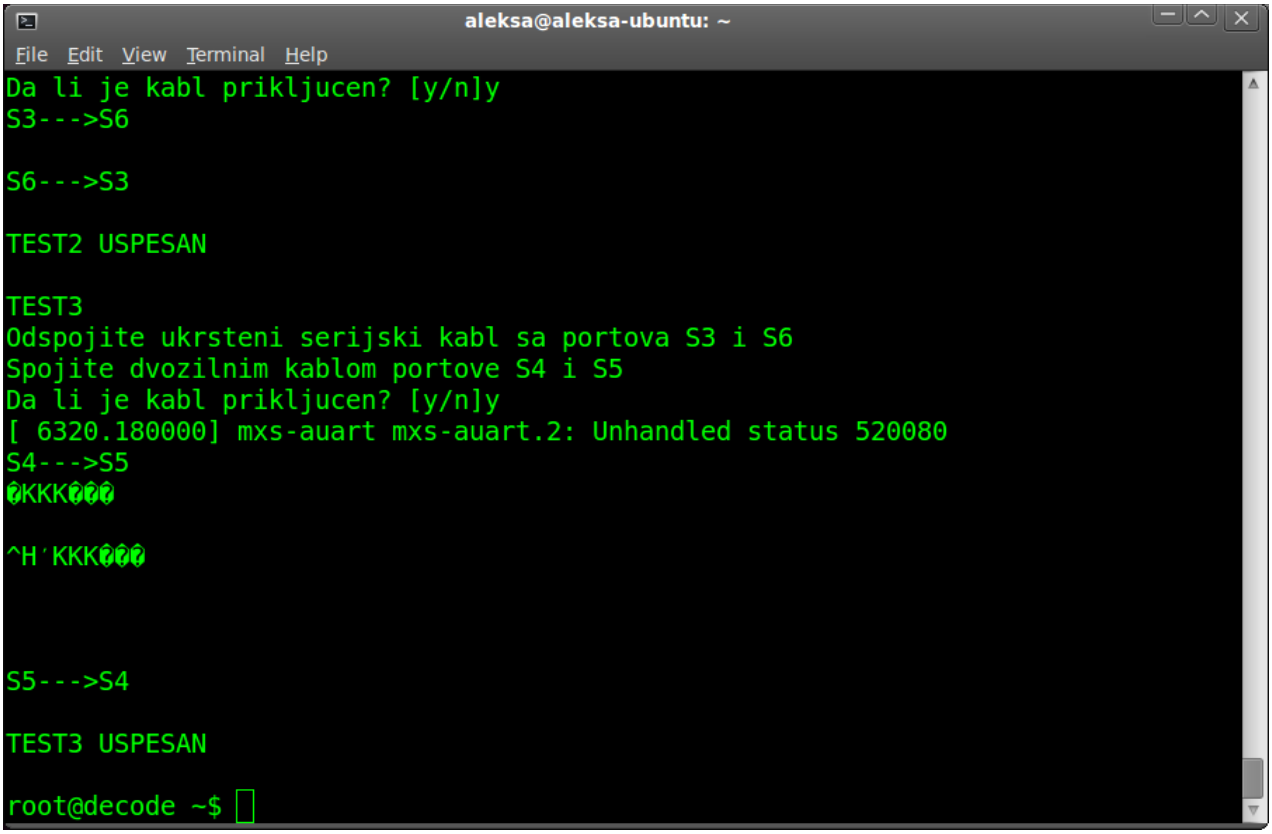

Figure 13. Terminal screen output after TEST3 execution

After communication testing in S5--->S4 direction the TEST2 is successfully completed.

Particular test can be run separately by entering **n** and **ENTER** keys to all other, unnecessary tests.

Following screen shows successfully finished TEST2, while TEST1 and TEST3 were not run at all, they finished unsuccessfully therefore.

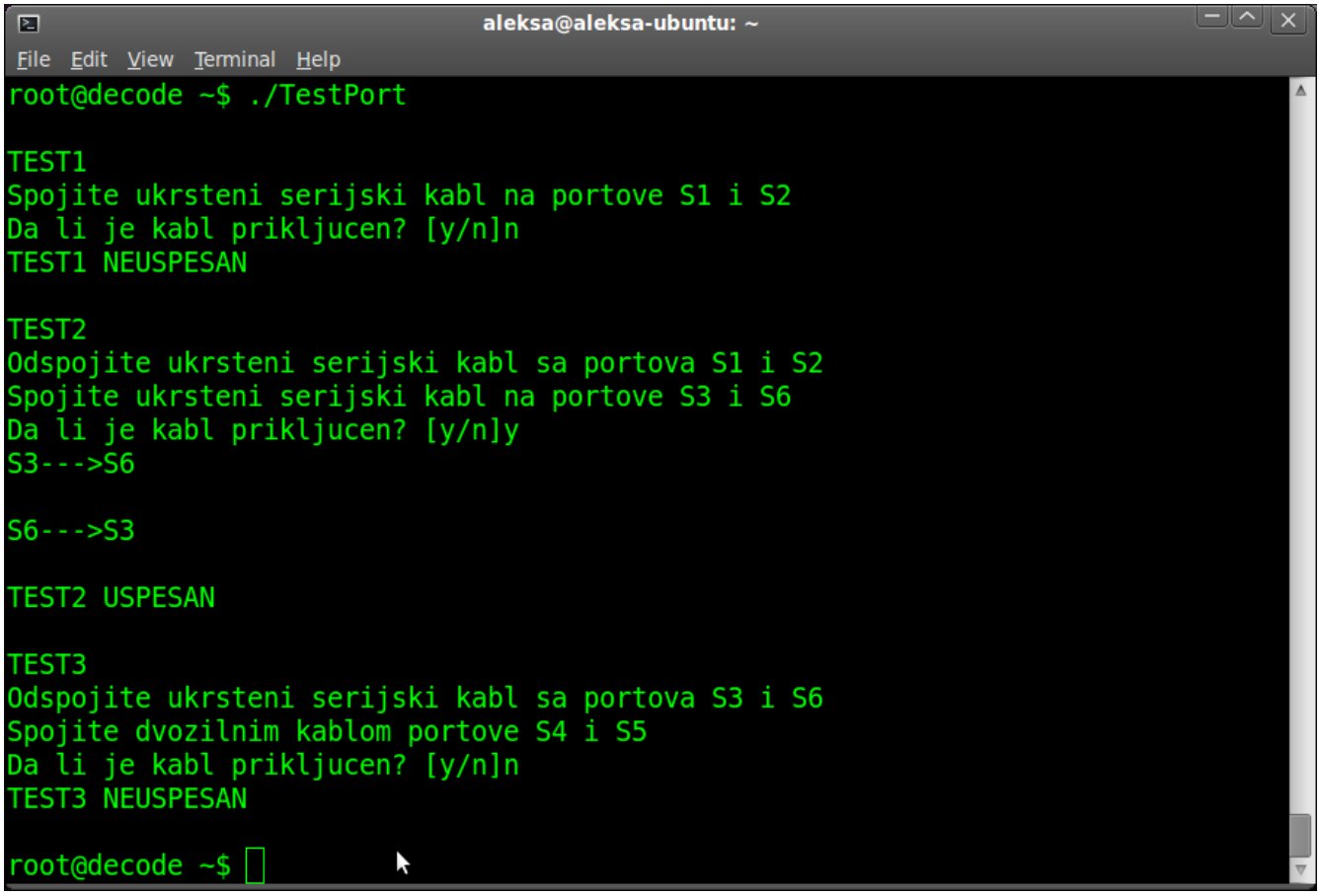

Figure 14. Terminal screen output after separate TEST2 was finished

3.3 USB Ports and Memory Card Testing

USB Host port can be tested by attaching USB flash memory for instance. Following screen shows the output while attaching and later, during ejecting of USB flash memory stick.

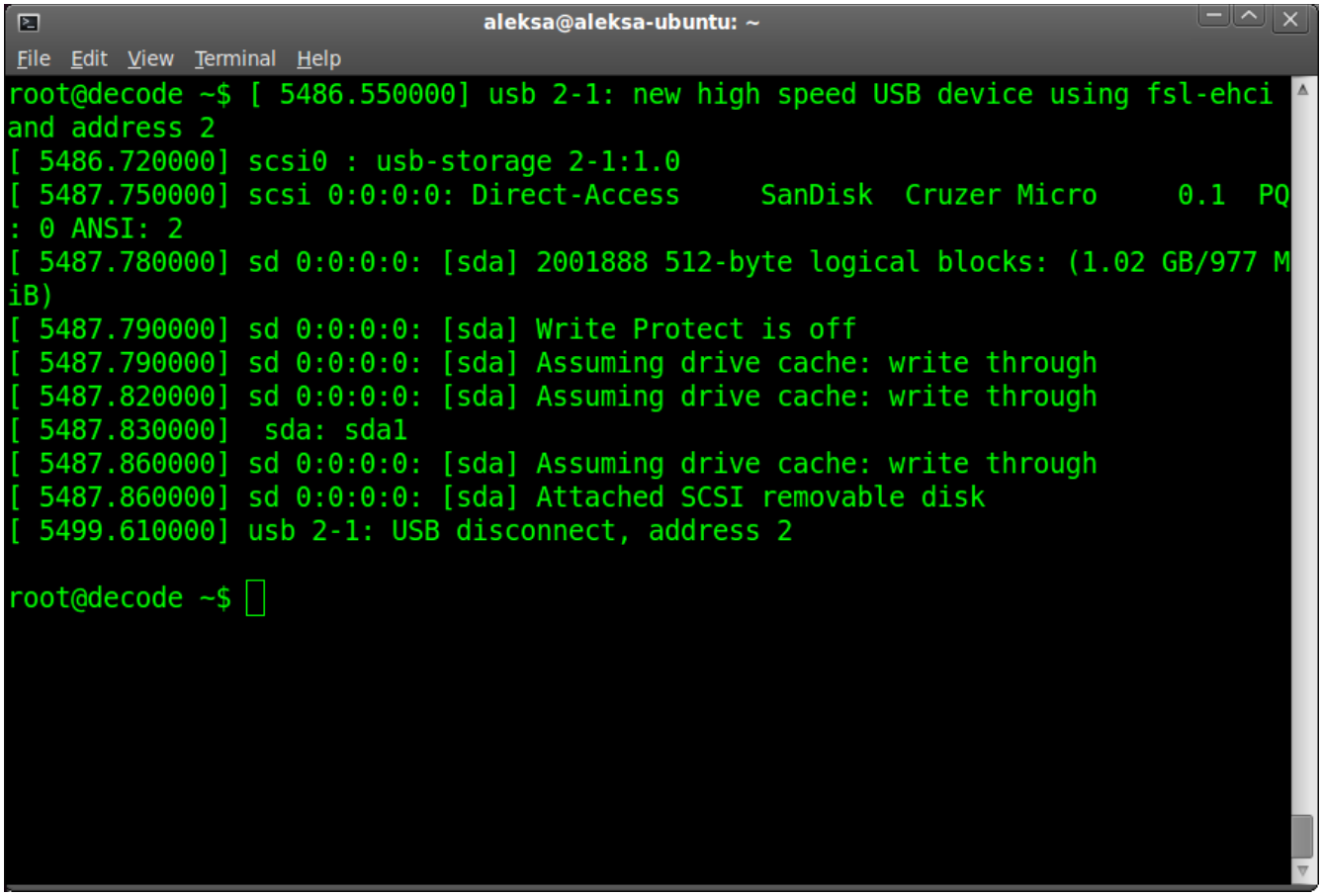

Figure 15: Terminal screen output after attaching the flash memory to USB port

USB OTG port testing can be done in similar way, by attaching an USB Device (mobile phone, digital camera, external hard disc, flash memory...). This port is also used for uploading of OS to DL28 device.

Memory card of CARD type isn't supported by current OS version, tests aren't functional either.

3.4 Ethernet Port Testing

Ethernet port can be tested by connecting DL28 with network cable to local network or personal computer and starting the web interface. Enter following IP address to your browser:

http://192.168.0.67:90/

Device's web presentation shows general device info, settings and maintenance pages as well as access to uploading of application to be executed on DL28.

REMARK: CP300 is one of commercial names for DL28 device when application CP-300 MUC is being used for main functions.

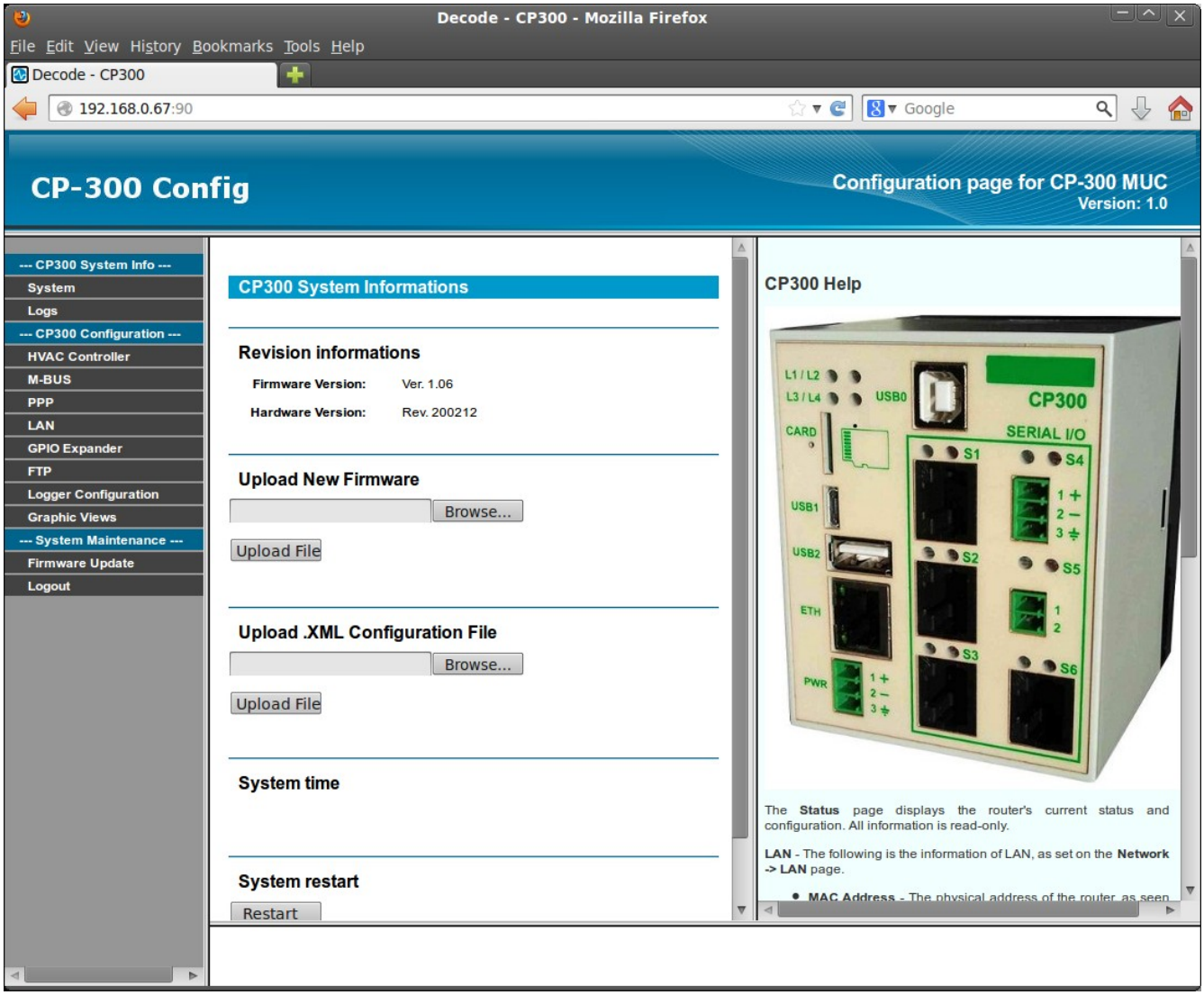

Figure 16: Web page of DL28 device

By finishing above-mentioned routines all connection ports of DL28 have been tested.

4 Technical Specification

Processor board

Central processor	32-bit, operating frequency 454MHz, core ARM926EJ-S
Operating system	Linux 2.6
Memory	256MB DDR2 SDRAM
Disc storage	2GB Flash
USB	1 x USB2.0 Hi-Speed Host, 1 x OTG Hi-Speed
Ethernet	RJ45, 10/100TBase
Memory card slot	MicroSD, push-push connector
Real time clock	yes, powered by CR1220 battery
Supervision	by software and hardware „Watch-dog“

Communication board

USB	1 x USB2.0 Hi-Speed device, galvanic isolated, FT232R
Serial connections	galvanic isolated with indicator lights for transmit and receive S1 – RS-232C (signals: TD, RD, DTR, RTS, CTS, RI, DCD) S2 – RS-232C (signals: TD, RD, RTS, CTS) or RS-485 (A+ and B-) S3 – RS-232C (signals: TD, RD, RTS, CTS) or RS-485 (A+ and B-)

M-Bus Board

Serial connections	galvanic isolated with indicator lights for transmit and receive S4 – M-Bus Master, connects up to 3 slave devices S5 – M-Bus Slave S6 – RS-232C (signals: TD, RD, RTS, CTS) or RS-485 (A+ and B-)

Expansion Port

Type	Male connector 2 x 3 pins with 2.54mm raster
Signals	GND, +5V, SDA, SCL
Purpose	adding of other input/output communication modules

Common Specifications

Power supply	DC voltage 18-36V, over voltage protection, galvanic isolated
Consumption	up to 5W
Enclosure	Plastic, dimensions 70 x 85(91) x 73mm
Mounting	DIN rail 35mm
Network protocols	TCP, IP, UDP, PPP, TFTP
Siemens® protocols	PPI, ASCII
Danfoss® protocols	ECL300 serial
Modbus protocol	Modbus TCP
M-Bus protocol	EN13757-2, EN13757-3