iUPS - Intelligent Uninterruptible Power Supply: User Manual for the LAN Management

Abstract

This document describes the capabilities of the LAN Management hardware and firmware.

Contents

1 Hardware

The LAN Management Unit is build as one PCB on which there are external connectors and switches. Recommended connections of each part are described in this section. The device PCB can be seen on the Figure 1.

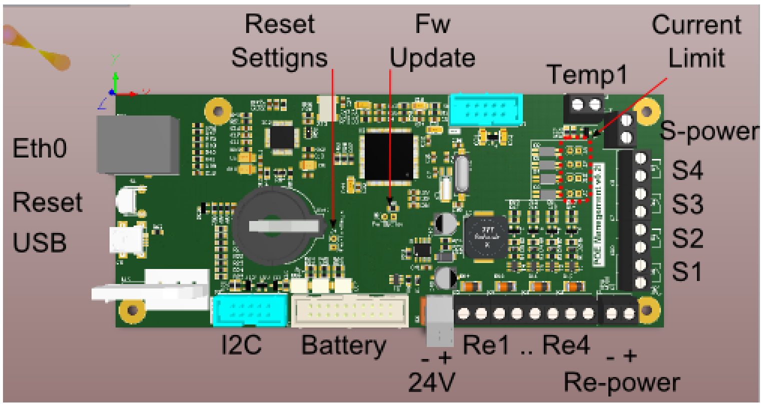


Figure 1: Hardware parts description.

1.1 Communication interfaces

Several interfaces are build in on this board.

1.1.1 Ethernet

There is Eth0 connector on the left side of PCB. This connector represents standard 100/10 Mbit ethernet device which can be connected into a standard IPv4 network. The web and the telnet interfaces are accessible through this connector.

1.1.2 USB

The miniUSB connector is mounted on the left PCB side below Eth0. This connector provides virtual COM port functionality.[1] The communication baud rate, used in this interface, must be set to 9600 bps and used command set is nearly same as the one used in the telnet.

1.1.3 I2C

The I2C connector is placed ad left-bottom part of the PCB. It si primary used for a communication with other modules; therefore, the communication protocol is closed and isn't described in this manual. The following table describes the I2C connector pinout.

I2C connector pin description

Pin	Function	Pin	Function
1	NC	10	GND
2	NC	9	
3	IRQ	8	
4	SDA	7	
5	SCL	6	

[1] For MS Windows the special driver is requested.

1.2 Battery connector

The battery connector, placed in the bottom-middle part of the PCB, is designed to use with a battery calibration circuit. Therefore, it includes seven GPIO pins and three ADC inputs. The GPIO pins function is not implemented in fimware yet. On the other hand the ADC inputs can be read by software. It can measure voltage in 0-5V range.

Battery connector pin description

Pin	Function	Pin	Function
1	GPIO/SPI_CLK[1]	2	GND
3	GPIO/SPI_CS1[1]	4	
5	GPIO/SPI_MISO[1]	6	
7	GPIO/SPI_MOSI[1]	8	
9	GPIO/Status2[1]	10	
11	GPIO/Status1[1]	12	
13	GPIO/Status0[1]	14	
15	ADC_IN_2	16	
17	ADC_IN_1	18	
19	ADC_IN_0	20	

[1] Not implemented in FW yet.

1.3 Binary inputs

The board contains 4 binary inputs insulated by optrons. They are placed on the right side of PCB. For right function, the S-power connector have to be connected to a voltage source with the voltage level range 5-48V and the corresponding current limiting resistor have to be calculated and connected. The values of the current limiting resistor can be calculated as

$$R = \frac{U_{S-power} - 1.2}{0.005}[ohm] \tag{1}$$

1.4 Binary outputs

The board contains 4 binary outputs which are ended with mosfet transistors. They can be used to switching relays directly. The maximal switching current can be 5A and maximal connected voltage can be 30V. For the right function the voltage source have to be connected to the Re-power connector. Notice that the GND pin is common with main power source.

1.5 Analog inputs

The board contains 5 analog inputs scanned periodically by ADC. The first three ADC inputs are connected to the battery connector as is described in "Battery connector" section. Other two analog inputs are wired to measure input voltage - the first for 3V3 branch and second for 24V branch.

1.6 Temperature sensor

The thermometer connector is placed on the top of the PCB. It is prepared to Dallas DS18B20 connection but it isn't implemented in SW yet.

1.7 Electrical characteristics

Parameter	Item		
	Min	Typ	Max
Main power source			
Source voltage	10V	24V	30V
Analog inputs			
Input count	-	3	-
Max input voltage	-	-	5V
Binary inputs			
Input count	-	4	-
Max input voltage	-	-	30V
Binary outputs			
Output count	-	4	-
Max output voltage	3V	24V	30V
Forward current	-	5mA	30mA

2 Firmware

2.1 Configuration

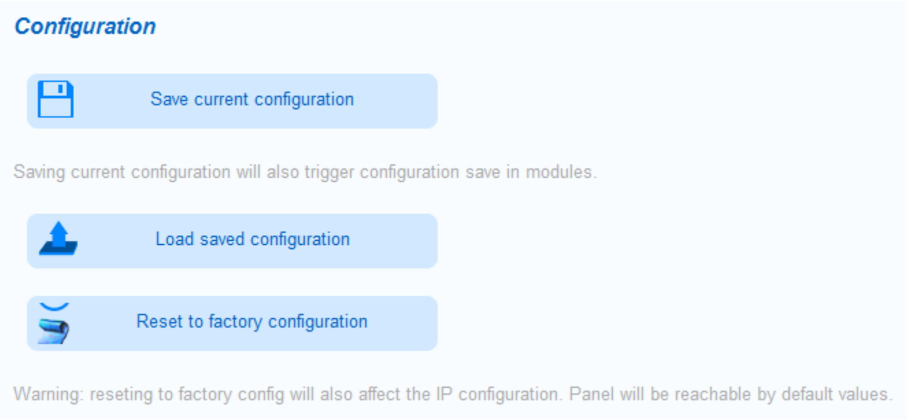
There are three sets of configuration in device.

Running configuration : When user modifies any of the settings or port configuration, the changes are saved inside running configuration. This configuration is not permanent and is lost upon device restart. To keep running configuration, it has to be saved to saved configuration.

Saved configuration : This configuration is saved inside flash memory of processor and is loaded to running configuration when the device starts.

Factory configuration : The factory configuration is set from production and cannot be modified by user. The only modification of factory config is possible through firmware upgrade.

The running configuration can be saved through web interface. Futhermore, it is possible to restore device to factory configuration. The Fig.2 displays web interface for manipulating fir configurations.



Configuration

Saving current configuration will also trigger configuration save in modules.

Warning: reseting to factory config will also affect the IP configuration. Panel will be reachable by default values.

Figure 2: Webpage for manipulating configurations.

2.2 Watchdogs

The system allows its user to monitor devices through the watchdogs. Up to 12 watchdogs can be defined, one for each port. Watchdog configuration consists of the following elements:

Target IP address : The IP address that is to be monitored.

Type of connection : Watchdogs can utilize one of three protocols to monitor the device:

ICMP

TCP

UDP

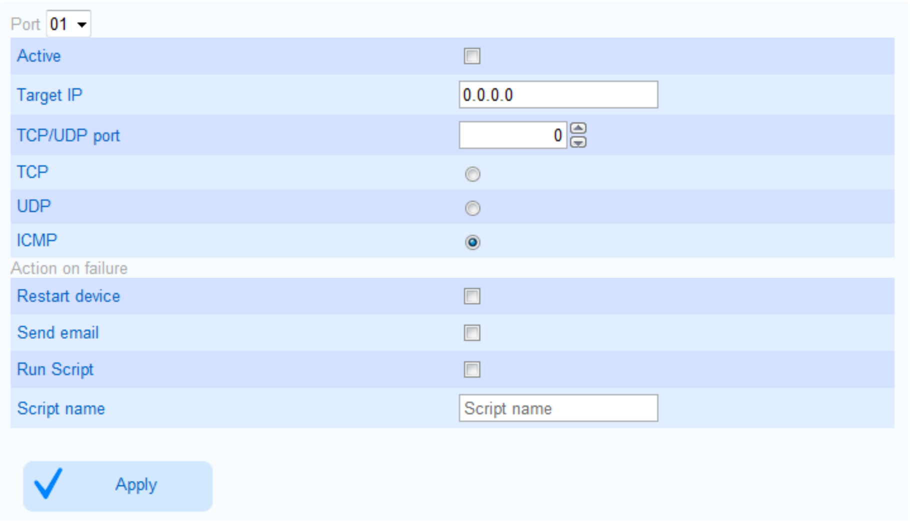
Connection port : If the TCP or UPD protocol is selected, user has to specify target port.

Actions on failure : User may specify one or more action on failure.

Restart device

Send email

Run script - runs the function that user specifies



Port 01 ▾

Active	□
Target IP	0.0.0.0
TCP/UDP port	0
TCP	○
UDP	○
ICMP	●

Action on failure

Restart device	□
Send email	□
Run Script	□
Script name	Script name

Figure 3: Webpage for configuring watchdogs.

2.3 User scripts

User script file is saved in the reserved part of flash memory inside processor. The size of this reserved block is 16kB. Consequently, the size of supplied script can be up to 16kB-4B used to store script size.

User script can be written in *ANSI C language with limited macro and standard library support*. Furthermore, to access non-standard device functions, it is required to include the *stk.h* header file.

! → The `main` function has to be always defined, even if the user is not using the scripting system.

2.3.1 Function set

void portOn(int)

Description : This function powers up specified port (in case associated module is connected). Ports status is also modified in running configuration.

Parameters : port number

Return value : Returns nothing.

void portOff(int)

Description : This function powers off specified port (in case associated module is connected). Ports status is also modified in running configuration.

Parameters : port number

Return value : Returns nothing.

unsigned char portStatus(int)

Description : This function returns power status of specified port.

! → The port status is determined from the running configuration, not by querying module.

Parameters : port number

Return value : Returns 0 or 1 depending on power status of port.

void signalBinSet(unsigned int, unsigned int)

Description : Sets the value of the specified binary output.

Parameters : number of binary output in range (0 - 3)

requested value in range (0 - 1)

Return value : Returns nothing.

unsigned int signalBinGet(unsigned int)

Description : Returns the value of the specified binary input.

Parameters : number of binary input in range (0 - 3)

Return value : Returns 0 or 1 depending on status of input.

double signalAnaGet(unsigned int)

Description : Returns the value of the specified analog input.

Parameters : number of analog input in range (0 - 4)

Return value : Returns analog value of the specified analog input.

unsigned int currentTimeMs()

Description : Returns current time from the start of the device in milliseconds.

Parameters : none

Return value : Current time in milliseconds.

void sendMail(char *, char *)

Description : Sends email to the address specified in settings.

Parameters : Email subject

Email text

Return value : none

2.3.2 Script examples

Script for controlling binary outputs with the aid of timer

```
#include <stk.h>
#include <stdio.h>

void main(void)
{
  unsigned int time_seconds = currentTimeMs() / 1000;

  if(time_seconds % 20 < 10) {
    #Set binary_output_0 to 1 and binary_output_1 to 0
    signalBinSet(0, 1);
    signalBinSet(1, 0);
  } else {
    #Set binary_output_0 to 0 and binary_output_1 to 1
    signalBinSet(0, 0);
    signalBinSet(1, 1);
  }
}
```

Script for watching analog inputs and sending warning through email if one of the input value exceeds specified threshold

```
#include <stk.h>
#include <stdio.h>

#define THRESHOLD          3.3
#define TIME_BETWEEN_MAILS  60000
unsigned int time_guard = 0;

void main(void)
{
  unsigned char i;

  for(i = 0; i < 5; i++) {
    if(signalAnaGet(i) > THRESHOLD) {
      if(time_guard < currentTimeMs()) {
        sendMail("Threshold exceeded",
                 "One of the analog inputs exceeded specified threshold");
        time_guard = currentTimeMs() + TIME_BETWEEN_MAILS;
      }
    }
  }
}
```

Script that powers up binary output if one or more binary inputs are at 0

```
#include <stk.h>
#include <stdio.h>

void main(void)
{
  unsigned char num_of_off_inputs = 0;
  unsigned char i;

  for(i = 0; i < 4; i++) {
    if(signalBinGet(i) == 0) {
      num_of_off_inputs++;
    }
  }

  if(num_of_off_inputs > 0) {
    signalBinSet(0, 1);
  }
}
```

2.4 User webpage

To allow users to tailor device to their requirements, the device contains user changeable webpage. Similarly to user script file, the webpage file is timited to size 16kB - 4B. The webpage can use both SSI and CGI features of the embedded webserver to deliver dynamic webpages.

2.4.1 SSI

The SSI[2] is a way to include dynamic information inside webpage during its composition. The SSI is used in form of so-called tags, which are replaced by the requested information. The number of tags inside page is not limited.

The tags are used as `<!--#TagName-->` inside the code of webpage.

Table of tags and dynamic content they represent

Tag	Content
IPAddress	The devices IP address
Netmask	The devices Network mask
Gateway	The devices Gateway
MACAddress	The devices MAC address
PanelName	Device name
SMTPServer	The address of SMTP server
SMTPOutMail	Source mail address
SMTPRecMail	Target mail address
SignalBinIn1	The value of binary input 1
SignalBinIn2	The value of binary input 2
SignalBinIn3	The value of binary input 3
SignalBinIn4	The value of binary input 4
SignalAnaIn1	The value of analog input 1
SignalAnaIn2	The value of analog input 2
SignalAnaIn3	The value of analog input 3
SignalAnaIn4	The value of analog input 4
SignalAnaIn5	The value of analog input 5

2.4.2 CGI

The CGI[3] can be used to send information to device. For example, if the user requests url `192.168.0.1/signals.cgi?SigBinOut1=1`, the device sets SigBinOut1 to 1. The following table displays complete set of user CGI requests. It is possible to set multiple signals through one request.

```
function setOutputState(port, value)
{
  var xmlhttp;
  xmlhttp=new XMLHttpRequest();
  var request = "signals.cgi?BinOut" + port + "=" + value;
  xmlhttp.open("GET", request, true);
  xmlhttp.send();
}
```

Figure 4: Javascript code for utilizing CGI.

Table of CGI requests and associated action

[2] Server Side Includes

[3] Common Gateway Interface

Request	**Action**
signals.cgi?BinOut1=0	Sets SigBinOut1 to 0
signals.cgi?BinOut1=1	Sets SigBinOut1 to 1
signals.cgi?BinOut2=0	Sets SigBinOut2 to 0
signals.cgi?BinOut2=1	Sets SigBinOut2 to 1
signals.cgi?BinOut3=0	Sets SigBinOut3 to 0
signals.cgi?BinOut3=1	Sets SigBinOut3 to 1
signals.cgi?BinOut4=0	Sets SigBinOut4 to 0
signals.cgi?BinOut4=1	Sets SigBinOut4 to 1

2.4.3 Example webpage

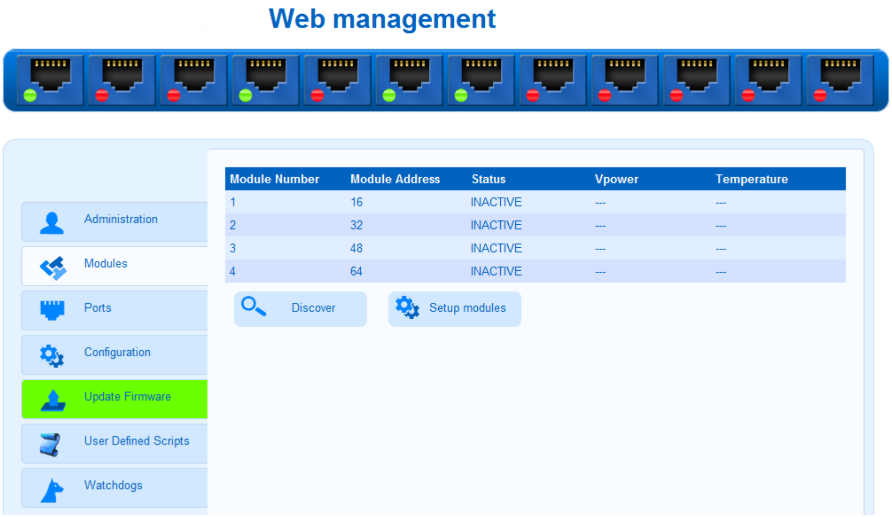
```
<!DOCTYPE html>
  <html>
  <head>
    <meta charset="UTF-8">
    <title>Web management</title>
    <link rel="stylesheet" href="styl.css" media="all" type="text/css" />
  </head>
  <body>
    <h1>User webpage</h1>
    <br>
    <br>
    <h2>Analog inputs</h2><br>
    Input 1: <!--#SignalAnaIn1--> V<br>
    Input 2: <!--#SignalAnaIn2--> V<br>
    Input 3: <!--#SignalAnaIn3--> V<br>
    Input 4: <!--#SignalAnaIn4--> V<br>
    Input 5: <!--#SignalAnaIn5--> V<br>
    <br>
    <br>
    <h2>Binary inputs</h2><br>
    Input 1: <!--#SignalBinIn1--><br>
    Input 2: <!--#SignalBinIn2--><br>
    Input 3: <!--#SignalBinIn3--><br>
    Input 4: <!--#SignalBinIn4--><br>
    <br>
    <br>
  </body>
</html>
```

2.5 Updating firmware and user files

The firmware and user files can be updated after jumping to bootloader. As can be seen on Fig. 5 the bootloader can be opened from the web interface.

The process of uploading firmware has been tested in Internet Explorer, other browsers were not fully tested. The process does not work currently in Opera browser.

! → The firmware upgrade may invalidate existing saved configuration, at which point, the factory configuration is used.



Module Number	Module Address	Status	Vpower	Temperature
1	16	INACTIVE	---	---
2	32	INACTIVE	---	---
3	48	INACTIVE	---	---
4	64	INACTIVE	---	---

Figure 5: Menu item for entering bootloader.

3 Known bugs

1. The bootloader does not work properly in Opera browser.
2. The status leds are currently used for informing user about connected modules.
3. SNTP module for retrieving current date and time is not completely implemented and tested.