4-noks s.r.l.

WIRELESS FAMILY DEVICES
ZB-CONNECTION
End Device ZED-THL
(product code: ZED-THL-M)

| Document version Number	Date	Firmware Revision	Author
V3.2	26/09/2011	V8.3.150 (2051)	Franco Pierazzoli

4-noks s.r.l.

CONTENTS

1) GENERAL DEVICE CHARACTERISTICS

ZED-THL (ZED-THL-M) belongs to ZB-Connection devices family.
It has a temperature sensor, humidity sensor and light sensor.
Its task is to read inputs and send the data it acquires to a compatible Gateway
at regular programmable time intervals.
It generates alarms when adjustable thresholds are exceeded;
Modbus address is set trough Dip-Switches.
The device must be supplied with a 3.6V battery.
Its role in the network is End-Device.

2) DEVICE ELECTRICAL CHARACTERISTICS

SUPPLY:	3,6V Battery
WIRELESS CHARACTERISTICS:	2405 MHz ÷ 2480 MHz DSSS Modulation Nominal transmission Power +3dBm IEEE 802.15.4 compliant Stack EmberZNet3.5.x Stack version 0 Proprietary profile ID Proprietary encryption key
SENSOR TYPE:	Digital
MEASUREMENT ACCURACY:	Temperature -20°C to + 70 °C Resolution 0.1 °C Relative humidity +- 5% Light +- 20% depending on the spectrum of lighting source
OPERATING CONDITIONS	-20 + 55 °C +10÷30°C for nominal battery duration
BATTERY DURATION:	> 3 years (+10°C÷30°C when transmission time > 3 minutes)
CONNECTION:	None
DEGREE OF PROTECTION:	IP 55

4-noks s.r.l.

3) CIRCUIT BOARD AND CONNECTION LAYOUT

Push Button

LED LD1
LED LD2
LED LD3

DIP-Switch
address setup
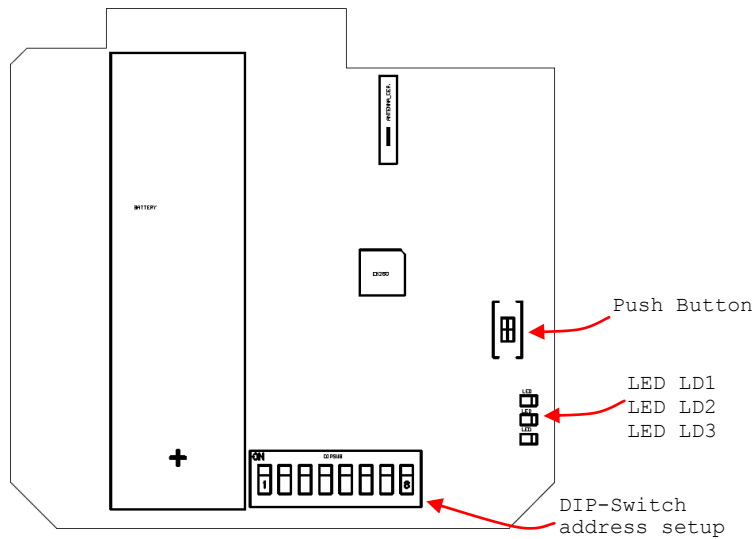
4) DEVICE ADDRESSING

The device can be addressed by DipSwitch. Valid addresses range from 16 and 127.
The DipSwitch is read only when switching the circuit board on; a modification
in the Dipswitch's position is taken into consideration only after that device
has been reset. In order to reset the device, remove the battery from the
device, press the pushbutton so that to make the residual energy in the circuit
run out, then install the battery.

Set the DipSwitch before switching the circuit board on and before it has gone
onto the network.

The DipSwitch is read as follows:
DIP1 = least significant bit; ON=1.

Examples:

Address =16

Address =17

Address =70

Address =127
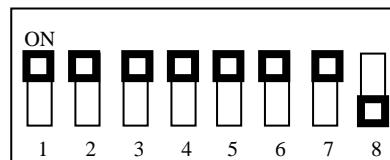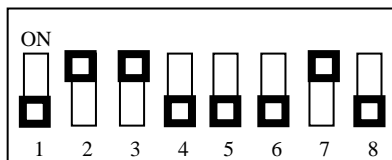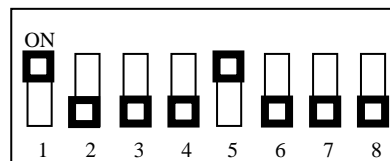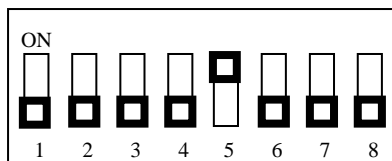
Attention: Be careful when assigning addresses. Two devices with the same
address would put their data into the same container in the Gateway and this
would generate ambiguity which would be difficult to identify in subsequent
network operations.

5) ASSOCIATING THE DEVICE TO A COMPATIBLE NETWORK

The process to follow when join ZED-THL node to a network is the same as for all ZB-Connection end-devices.

The association process is activated by pressing the push button.

The association process is enabling only if the device is not already part of a network, i.e. if it is a new device or if it has been voluntarily disassociated.

5.1) Press the push button, led LD2 turns on and node starts the scanning process of all 16 radio channels in order to find an "open" compatible network (i.e. a ZB-Connection process). The scan process takes about 20 seconds; if the device detects an available network, all 3 leds flash quickly and afterward they turn off (network opening is performed by suitably stimulating the Gateway, for more information refer to the Gateway document);

5.2) otherwise, if the scan process ends without having found any available network, the device goes in a power-safe mode waiting for new push-button stimulating.

6) DISASSOCIATING THE DEVICE FROM THE NETWORK

Disassociating the device involves losing the network parameters and consequently leaving the network of which it had been a part.

Moreover device loads to the default value all of its operating parameters (HoldingRegister).

Disassociation can be commanded in two ways:

1) Receipt of the appropriate command password.
2) Holding the pushbutton on the card down for at least 6 seconds. Disassociation using the push-button is only possible within 20 seconds from when the device is switched on.

7) DEVICE LED/PUSH BUTTON INTERFACE

ZED-THL has three leds through which it shows information about its operating state.

The device has also a push button which is used to activate the joining process, to activate disassociation and to stimulate the device in order to send data to the Gateway.

Nomenclature of ZED-THL leds:

Led LD1
Led LD2
Led LD3
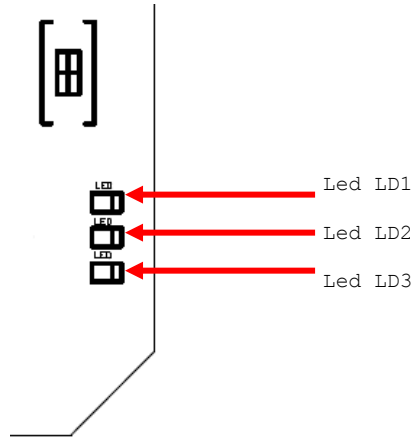
Behaviour of leds at the start-up:
At the reset of ZED-THL all leds lighted for 2 seconds, then all leds flash fast for another half seconds.
At the end of flashing device starts the normal functioning.

How leds work when ZED-THL is NOT joined with a network:
All leds off

How leds work when ZED-THL is joined with a network:
Usually all leds off.
Led LD1 briefly switched on at acquisition of the probes and at transmission of a message towards the gateway.
LD2 LED briefly switched on at receiving of an answer from the gateway.

Behaviour of leds during joining process
Led LD1 switched on for whole joining process.
Fast blinking of all leds at the successful association with a network.

Radio Link Quality Analysis
The device has a functional mode that permits to know the radio link quality, counting the number of blink of led LD3.
This functional mode is activate by pressing the button (only if node is joined to a network).
This functional mode continues for 60 seconds.
When this mode is active node ignores normal transmit time and transmits a message each 5 seconds.
When this mode is active, after the successful communication process node analyzes the signal strength (Rssi) associated to the message received from Gateway.
Based on this value node performs one, two or three flashes of LED LD3.

3 flashes of LD3 --> Rssi of received message >= -65dB (optimal level)
2 flashes of LD3 --> Rssi of received message >= -85dB (medium level)
1 flash of LD3 --> Rssi of received message < -85dB (low level)

4-noks s.r.l.

8) DEFAULT PARAMETERS

Device has seven operating parameters, which are saved in its non-volatile memory, and at the moment of initializing are loaded as default settings.
The default parameters are loaded even after device disassociation.

Parameter	DEFAULT	unit
Transmission time	60	[sec]
Threshold of Low Temperature alarm	-50,0	[°C]
Threshold of High Temperature alarm	+100,0	[°C]
Threshold of Minimum Light alarm	0	[Lux]
Threshold of Maximum Light alarm	100	[Lux]
Threshold of Minimum Humidity alarm	0	[%Ur]
Threshold of Maximum Humidity alarm	100	[%Ur]
Light multiplicative coefficient (/ 1000)	1000	[//]
Temperature Offset	0,0	[°C]
Temperature measurement unit (0 = Celsius, 1 = Fahrenheit)	0	[//]

9) DESCRIPTION OF THE ACQUISITION PROCESS

The device provides to the acquisition of all the values before transmitting its state to the Gateway.
Device's sampling interval is equal to the Transmission time.

10) DESCRIPTION OF THE ALARM MANAGEMENT PROCESS

The device compares the temperature, humidity and the light value in reference to the parameters that set the alarm limits.
The alarm warning's activation is not delayed; should the values acquired prove to be over or under the limit the relevant fault flag is activated.

If Temperature > Limit High Temperature --> flag alarm: High Temp. =1
If Temperature <= Limit High Temperature --> flag alarm: High Temp. =0
If Temperature < Limit Low Temperature --> flag alarm: Low Temp. =1
If Temperature >= Limit Low Temperature --> flag alarm: Low Temp. =0

If Humidity > Limit Maximum Humidity --> flag alarm: Maximum Humidity =1
If Humidity <= Limit Maximum Humidity --> flag alarm: Maximum Humidity =0
If Humidity < Limit Minimum Humidity --> flag alarm: Minimum Humidity =1
If Humidity >= Limit Minimum Humidity --> flag alarm: Minimum Humidity =0

If Luce > Limit Maximum Light --> flag alarm: Maximum Light =1
If Luce <= Limit Maximum Light --> flag alarm: Maximum Light =0
If Luce < Limit Minimum Light --> flag alarm: Minimum Light =1
If Luce >= Limit Minimum Light --> flag alarm: Minimum Light =0

4-noks s.r.l.

11) DEVICE DATA MAPPING

Like almost all ZB-Connection devices, ZED-THL shows its data through an agent.
The agent of a particular device resides locally in the Gateway, and is made up
by data sent via radio and by data generated by the Gateway itself.
The Gateway allows access in read and write mode to the agents relating to the
devices belong to the network and the Gateway data through a serial interface
and Modbus protocol.
Given the nature of the Modbus protocol, the data is split into four memory
areas:

```
InputRegister (16-bit variables in read only mode)
InputStatus (1-bit variables in read only mode)
HoldingRegister (16-bit generally non-volatile variables)
CoilStatus (1-bit variables)
```

The Gateway is compatible with the most common modbus commands such as single
and sequential reading of all memory spaces and single and sequential writing of
all holding registers and coil statuses.

ZED-THL device has the following data:

```
(14+5) InputRegister
    80 InputStatus
(11+1) HoldingRegister
    16 CoilStatus
```

11.1) ZED-THL INPUT REGISTERS

InputRegister[0]	Device Type (=1)
InputRegister[1]	Firmware Version (Major/Minor)
InputRegister[2]	Transmission Counter
InputRegister[3]	Signal Level of the last message received by the device [2]
InputRegister[4]	Battery Level (in mils of volts)
InputRegister[5]	Light Rms(expressed in Lux)
InputRegister[6]	Temperature(in tenths of a centigrade)
InputRegister[7]	Light(expressed in Lux)
InputRegister[8]	Humidity (expressed in % Relative Humidity)
InputRegister[9]	*Seconds passed since receiving last messages [1]*
InputRegister[10]	*Counter of messages received from Gateway [1]*
InputRegister[11]	*Gateway message receiving instant time (100 * hours + minutes) [1]*
InputRegister[12]	*Signal Level of the last message received from Gateway [1] [2]*
InputRegister[13]	*Device network address [1]*
InputRegister[14]	Copy of InputStatus[0..15]
InputRegister[15]	Copy of InputStatus[16..31] (flag of pending writes of holdingRegister) [1]
InputRegister[16]	Copy of InputStatus[32..47] (not used) [1]
InputRegister[17]	Copy of InputStatus[48..63] (flag of pending writes of CoilStatus) [1]
InputRegister[18]	Copy of InputStatus[64..79] (general pending flag and presence flag) [1]

(1) These data are not sent from the device but generated by the Gateway
(2) The signal level gives information on the energy values relative to the last hop that the
    wireless message has completed. The value is expressed in dB+100 and its value ranges from
    70 (maximum value) to 8 (very low value).

4-noks s.r.l.

11.2) ZED-THL HOLDING REGISTERS

HoldingRegister[0]	Command password
HoldingRegister[1]	Transmission time (expressed in seconds)
HoldingRegister[2]	Low temperature alarm threshold (expressed in tenths of a degree centigrade)
HoldingRegister[3]	High temperature alarm threshold (expressed in tenths of a degree centigrade)
HoldingRegister[4]	Minimum light alarm threshold
HoldingRegister[5]	Maximum light alarm threshold
HoldingRegister[6]	Minimum humidity alarm threshold
HoldingRegister[7]	Maximum humidity alarm threshold
HoldingRegister[8]	Light multiplicative coefficient (/ 1000)
HoldingRegister[9]	Temperature Offset (expressed in tenths of a degree)
HoldingRegister[10]	Temperature measurement unit (0 = Celsius, 1 = Fahrenheit)
HoldingRegister[11]	*Copy of CoilStatus[0..15]*

11.3) ZED-THL COIL STATUSES

CoilStatus[0]	Command password activation
CoilStatus[1]	Not used
...	...
CoilStatus[15]	Not used

11.4) ZED-THL INPUT STATUSES

InputStatus[0]	High temperature alarm
InputStatus[1]	Low temperature alarm
InputStatus[2]	High light alarm
InputStatus[3]	Low light alarm
InputStatus[4]	High humidity alarm
InputStatus[5]	Low humidity alarm
InputStatus[6]	Probe Fail
InputStatus[7]	Low Battery
InputStatus[8]	Not used
...	...
InputStatus[15]	Not used
InputStatus[16]	HoldingRegister[0] write pending [1]
InputStatus[17]	HoldingRegister[1] write pending [1]
InputStatus[18]	HoldingRegister[2] write pending [1]
InputStatus[19]	HoldingRegister[3] write pending [1]
InputStatus[20]	HoldingRegister[4] write pending [1]
InputStatus[21]	HoldingRegister[5] write pending [1]
InputStatus[22]	HoldingRegister[6] write pending [1]
InputStatus[23]	HoldingRegister[7] write pending [1]
InputStatus[24]	HoldingRegister[8] write pending [1]
InputStatus[25]	Not used
...	...
InputStatus[47]	Not used
InputStatus[48]	CoilStatus[0..15] write pending [1]
InputStatus[49]	Not used
...	...

...	...
InputStatus[63]	Not used
InputStatus[64]	device presence state (validity of agent's data) [2]
InputStatus[65]	General pending status (logic OR of all write pending) [1]
InputStatus[66]	Not used
...	...
InputStatus[79]	Not used

(1) These flags are managed by Gateway and are set at the moment of writing a holding register or a group of coil status; they are reset when the device receives the datum (this immediately succeeds its transmission).
(2) The device's presence flag is managed by Gateway; it is set when the data present are valid. The flag is reset if the Gateway does not receive messages from the device for a period greater than four times that of the automatic transmission time.

13) SPECIAL COMMANDS - COMMAND PASSWORD

With command passwords it is possible to send special commands to the device.
The commands are executed when the CoilStatus[0] bit is set.

HoldingRegister[0] (HEX)	HoldingRegister[0] (DEC)	Action
0x1968	6504	Activate device Bootloader
0x1970	6512	Device reset
0x1973	6515	Device Disassociation