4-noks s.r.l.

WIRELESS FAMILY DEVICES

ZB-CONNECTION

Router ZR-TIREL2

(product code: ZR-TIREL2-EM)

Document version Number	Date	Firmware Revision	Author
V4.2	26/09/2011	V8.3.147 (2051)	Franco Pierazzoli

4-noks s.r.l. – Via per Sacile, 158 - 31018 Francenigo di Gaiarine (TV) - Italy
Tel. (+39) 0434.768462 Fax (+39) 0438.694617 info@4-noks.com www.4-noks.com

INDEX

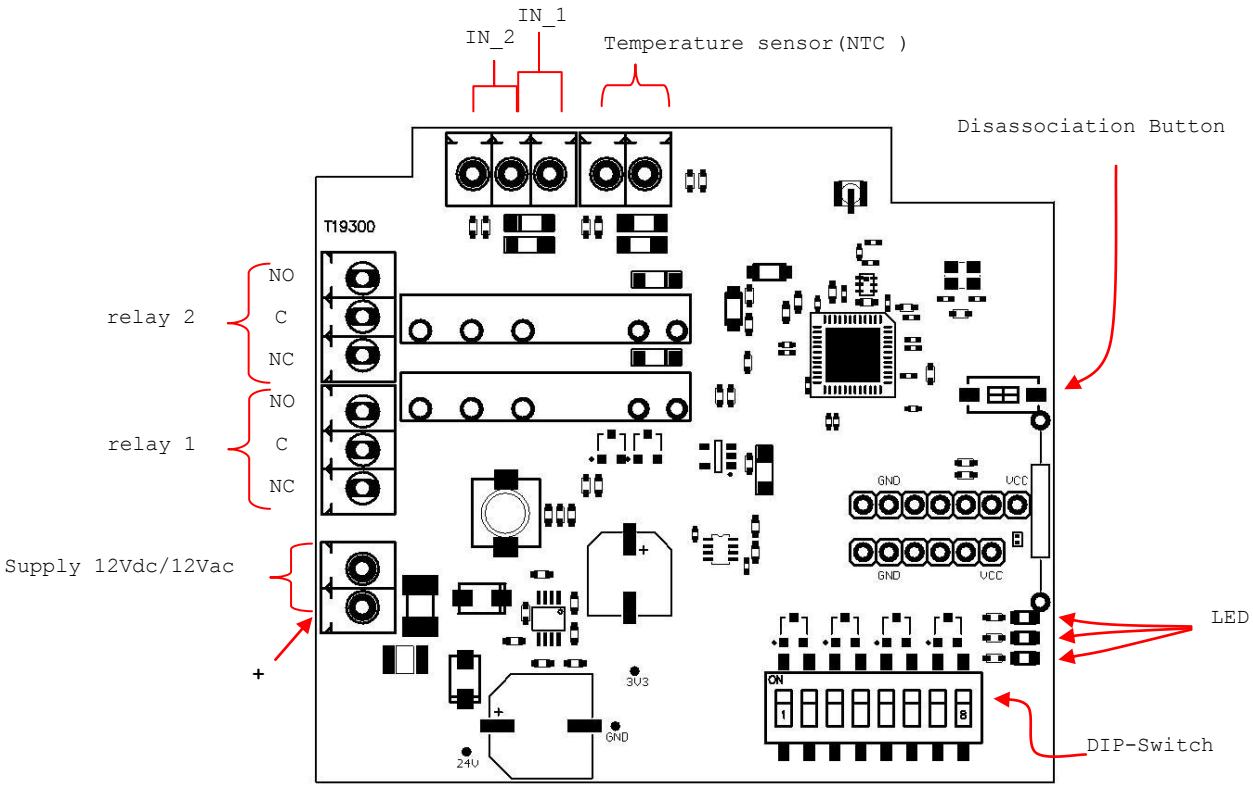
1) GENERAL DEVICE CHARACTERISTICS

Router TIREL2 (ZR-TIREL2-EM) belongs to ZB-Connection devices family.
It has a thermal sensor input, two digital inputs and two relay outputs.
It has the fundamental task of acquiring its inputs, actuating an regulation process that allows it to manage its relays and sending the data it acquires and generates at regular intervals, to a compatible Gateway.
The device requires an uninterruptible 24 Vdc (or 24 V ac) power supply.
For network purposes, it is a Router i.e. it has the active function of maintaining radio traffic from and to other similar devices and it can also act as a parent device for battery-powered nodes of the same family.

2) ELECTRICAL DEVICE CHARACTERISTICS

POWER SUPPLY:	24Vdc (±10%); 100mA 24Vac (±10%); 50/60Hz; 2,4VA
WIRELESS CHARACTERISTICS:	2405 MHz ÷ 2480 MHz DSSS Modulation Nominal transmission Power +10dBm IEEE 802.15.4 compliant Stack EmberZNet3.5.x Stack version 0 Proprietary profile ID Proprietary encryption key
THERMAL SENSOR INPUT:	NTC type sensor 103AT type (R25 = 10 KOhm; Beta = 3435K) Measurement range -50°C - +50°C Reading resolution 0.1°C Reading precision ±0.5°C
DIGITAL INPUT CHARACTERISTICS:	not insulated inputs for clean contact
RELAY CHARACTERISTICS:	Coil 12Vdc Contacts 5A 250V
CONNECTIONS:	Pull-out terminals (3.81 mm pitch)
PROTECTION CLASS:	IP55

3) CARD LAYOUT AND CONNECTION DIAGRAM

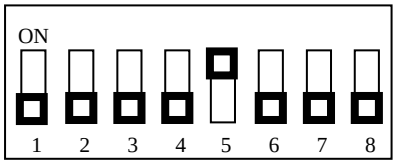


4) DEVICE ADDRESSING

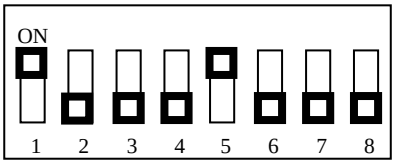
The device can be addressed by a DipSwitch.
Valid address ranges between 16 and 127.
DipSwitch is read only at the reset event. A modification to DipSwitch position is only taken into consideration after device reset.
Set the DipSwitch before switching on the card and before it is inserted into the network.

DipSwitch reading is achieved as follows:
DIP1 = least significant bit; status ON=1.

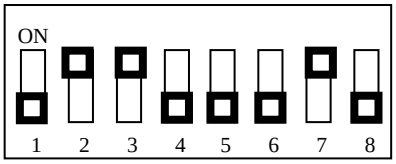
Examples:



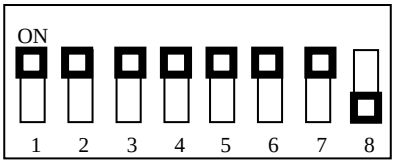
Address =16



Address =17



Address =70



Address =127

Attention: Be careful when assigning the addresses. Two devices with the same address would insert their data into the same container on 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 be followed when annexing the TIREL2 node to a network is the same as for all ZB-Connection routers.
The annexing process is activated automatically by the device if the node does not have network parameters, this happens if the device is new or if it has been voluntarily disassociated.
The annexing process consists in scanning all 16 radio channels, in search of an "open" and compatible network (i.e. a ZB-Connection network).
Scanning lasts about 20 seconds. If the annexing process terminates unsuccessfully, the device resets and the annexing process is re-started.
Network opening is performed by suitably stimulating the Gateway, by pressing the push-button onboard the device or sending the appropriate command password (for further information, refer to the document relating to the Gateway).

6) DISASSOCIATING THE DEVICE FROM THE NETWORK

Device disassociation causes the loss of network parameters, with the consequent exiting of the device from the network it belongs to.
In addition to the loss of network parameters, the device loads the default value for each of its operation parameters (HoldingRegister).

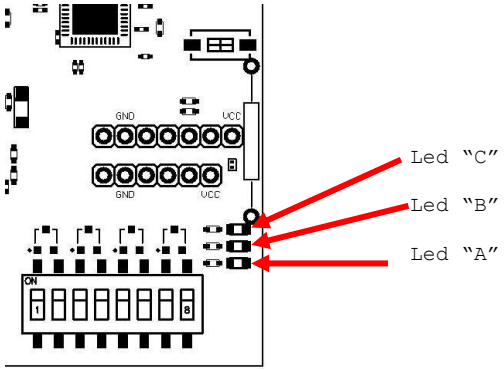
Disassociation can be commanded in two ways:

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) LED/PUSH-BUTTON INTERFACE

TIREL2 has three leds through which it is possible to obtain information on the device's operating state.
Furthermore, the Router-Bridge has a push-button which makes it possible to send commands to the device.

Nomenclature of TIREL2 leds:



Behaviour of leds at the start-up:
At the reset of TIREL2 all leds lighted for 2 seconds, then all leds flash fast for another 2 seconds.
At the end of flashing device starts the normal functioning.

Leds functioning when device is NOT on the network:
Led "A" on lighted steady, leds "B" and "C" off

Leds functioning when device is on the network:

Led "A": Working State
- Slow flashing (1Hz) -> Closed Router
- Fast flashing (4Hz) -> Opened Router

Led "B" (middle led): Radio Link
- Turned off -> No router with good link in the proximity
- 1 flash -> One router with good link in the proximity
- 2 flashes -> Two routers with good link in the proximity
- 3 flashes -> Four or more routers with good link in the proximity

Led "C": Radio Activity
- Usually turned off
- Shortly Lighted on transmitting or receiving a radio message

8) DEFAULT PARAMETERISATION AND PROGRAMMING MAXIMUMS/MINIMUMS

The device has six operating parameters, which are saved in non-volatile memory and at the time of initialisation are loaded with default values.
Default parameter loading also takes place following device disassociation.
At the time of the programming of one of the operation parameters, the device checks that the new value is within the preset minimum maximum limits.
If the new value is lower than the preset minimum, the value effectively written will be equal to the minimum. If the new value is higher than the preset maximum, the value effectively written will be equal to the maximum.

Parameter	MIN	MAX	DEFAULT	unit
Transmission time	1	3600	20	[sec]
Low temperature alarm threshold	-50,0	50,0	0,0	[°C]
High temperature alarm threshold	-50,0	100,0	30,0	[°C]
Regulation hysteresis	1,0	10,0	2,0	[°C]
Regulation set point	-50,0	50,0	20,0	[°C]
Regulation mode (0=off ; 1=cold ; 2=hot; 3,4,5=manual)	0	5	0	//

9) DESCRIPTION OF THE TEMPERATURE ACQUISITION PROCESS

The device executes continuous acquisitions (once a second) of a NTC sensor (not delivered with the product) 103AT type (R25=10KOhm; Beta=3435K).
The temperature acquisition range is between -50°C and +100°C.
For temperature values outside these limits, the device indicates the sensor error through a specific flag.
If the sensor input is short-circuited, the temperature showed is +100,0°C; conversely, if the sensor input is open, the temperature showed is -50,0°C.

10) DESCRIPTION OF THE TEMPERATURE ALARM MANAGEMENT PROCESS

The device constantly compares (once a second) the temperature detected by the sensor to the parameters that define alarm limits.
There are no alarm signal activation delays. The relevant fault flag is activated as soon as the temperature rises above the high temperature limit or drops below the low temperature limit.

If Temperature > High Temperature Limit --> High alarm flag =1
If Temperature <= High Temperature Limit --> High alarm flag =0

If Temperature < Low temperature limit --> Low alarm flag =1
If Temperature >= Low temperature limit --> Low alarm flag = 0

Sensor fault is not taken into condition during temperature alarm analysis.
If the sensor input short circuits (signalling +100,0°C) in addition to the sensor fault flag, the high temperature alarm flag is also activated.
If the sensor input is open (signalling -50,0°C) in addition to the sensor fault flag, the low temperature alarm flag is also activated.

11) DESCRIPTION OF THE REGULATION PROCESS (RELAY MANAGEMENT)

The regulation process is conducted continuously (once a second) and is adjusted by the regulation mode parameter.

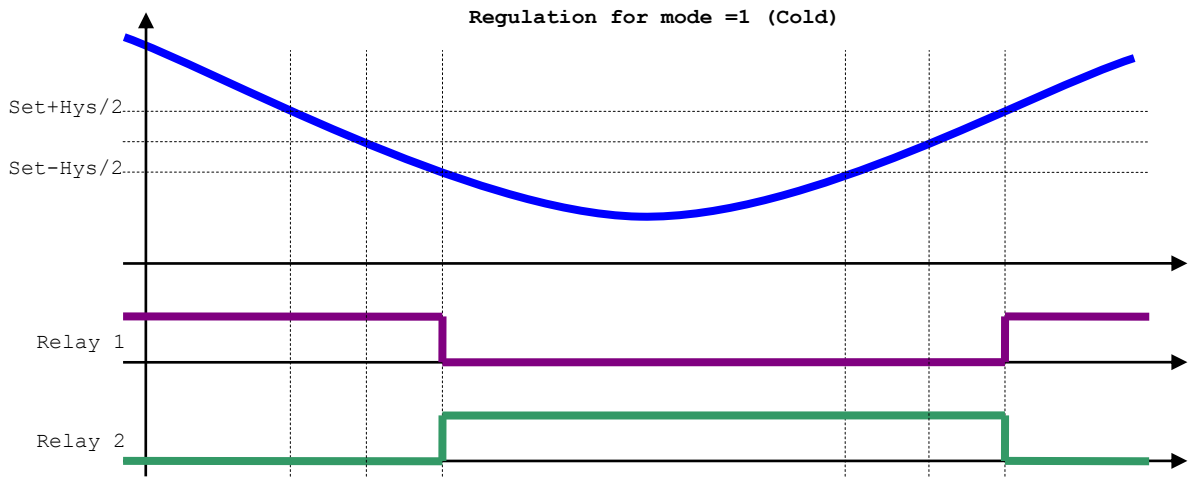
Mode =0
the regulation is disabled and both relays are deactivated.

Mode =1 (Cold)
the regulation is as follows:

High threshold = Set Point + Hysteresis/2
Low threshold = Set Point + Hysteresis/2

If Temperature > High Threshold --> Relay 1 On ; Relay 2 Off
If Temperature < Low Threshold --> Relay 1 Off ; Relay 2 On

The regulation process is summarized in the drawing below.

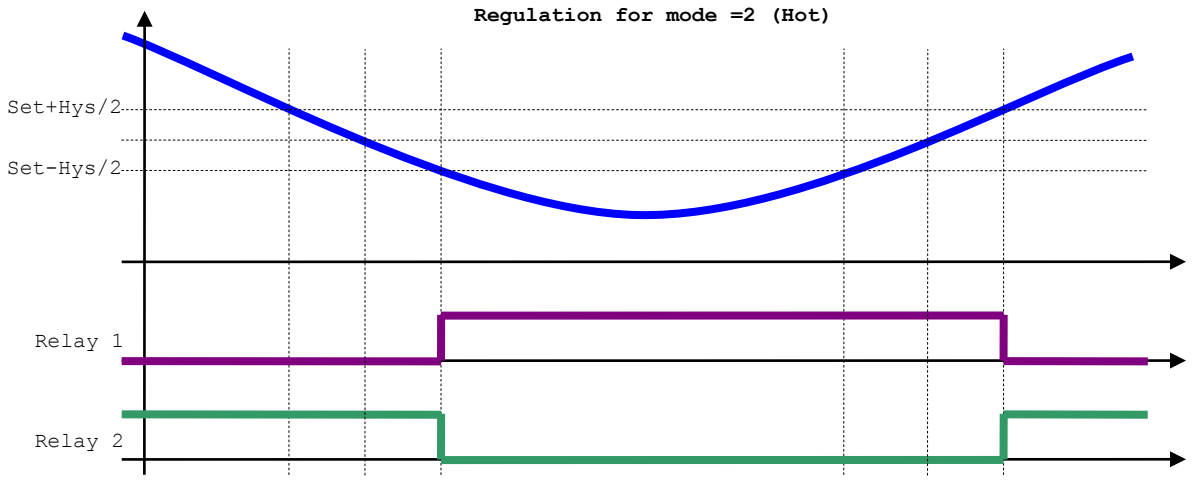


Mode =2 (Hot)
the regulation is as follows:

High threshold = Set Point + Hysteresis/2
Low threshold = Set Point + Hysteresis/2

If Temperature > High Threshold --> Relay 1 Off ; Relay 2 On
If Temperature < Low Threshold --> Relay 1 On ; Relay 2 Off

The regulation process is summarized in the drawing below.



Regulation in the case of a sensor fault.
In the event of a sensor fault, the regulation is disabled and both relays are deactivated.

Mode =3 (Manual)
In this case relay status is controlled by CoilStatus[1] and CoilStatus[2].

Mode =4 (Manual with push-button input control)
As for mode 3 relay status is controlled by CoilStatus[1] and CoilStatus[2].
Furthermore the state of the relay 1 is controlled by a push-button connected to digital input IN_1 and the state of the relay 2 is controlled by a push-button connected to digital input IN_2.
The action on the button causes the reversal of the related logic level of the relay.

Mode =5 (Manual with switch input control)
As for mode 3 relay status is controlled by CoilStatus[1] and CoilStatus[2].
Furthermore the state of the relay 1 is controlled by a switch connected to digital input IN_1 and the state of the relay 2 is controlled by a switch connected to digital input IN_2.
The action on the switch causes the reversal of the related logic level of the relay.

12) MAPPING DEVICE DATA (AGENT)

Like almost all ZB-Connection devices, TIREL2 device 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.

The TIREL2 device has the following data:

(10+5) InputRegister
80 InputStatus
(7+1) HoldingRegister
16 CoilStatus

12.1) TIREL2 DEVICE INPUT REGISTERS

InputRegister[0]	Type of device (=10)
InputRegister[1]	Firmware version (Major/Minor)
InputRegister[2]	Messages sent by device counter
InputRegister[3]	Level of the radio signal of the last message received by the device (2)
InputRegister[4]	Temperature (expressed in tenths of degree centigrade, -50,0°C -:- +100,0°C)
InputRegister[5]	*Seconds passed since receiving last messages* (1)
InputRegister[6]	*Counter of messages received from Gateway* (1)
InputRegister[7]	*Gateway Receiving instant time (100 * hours + minutes)* (1)
InputRegister[8]	*Signal Level of the last message received from Gateway* (1) (2)
InputRegister[9]	*Device network address* (1)
InputRegister[10]	Copy of InputStatus[0..15]
InputRegister[11]	Copy of InputStatus[16..31] (holdingRegister writing pendings flag) (1)
InputRegister[12]	Copy of InputStatus[32..47] (not used) (1)
InputRegister[13]	Copy of InputStatus[48..63] (CoilStatus writing pendings flag) (1)
InputRegister[14]	Copy of InputStatus[64..79] (General pending flag and presence flag) (1)

(1) This data is not sent by the device but generated by the Gateway.
(2) The radio signal level value provides information on the energy value in relation to the last hop performed by the radio message. The value is expressed in dB+100, it varies from a minimum of 8 (very poor signal) to a maximum of 70 (maximum signal)

12.2) TIREL2 DEVICE HOLDING REGISTERS

HoldingRegister[0]	Command password
HoldingRegister[1]	Transmission time (expressed in seconds)
HoldingRegister[2]	Low Temperature threshold alarm (expressed in tenths of degree centigrade)
HoldingRegister[3]	High Temperature threshold alarm (expressed in tenths of degree centigrade)
HoldingRegister[4]	Regulation hysteresis(expressed in tenths of degree centigrade)
HoldingRegister[5]	Regulation Set Point(expressed in tenths of degree centigrade)
HoldingRegister[6]	Regulation mode (0=off ; 1=cold ; 2=hot; 3,4,5=manual)
HoldingRegister[7]	*Copy of CoilStatus[0..15]*

12.3) TIREL2 DEVICE COIL STATUSES

CoilStatus[0]	Command password activation.
CoilStatus[1]	Setting Relay 1 status in manual mode
CoilStatus[2]	Setting Relay 2 status in manual mode
...	...
CoilStatus[15]	Not used

12.4) TIREL2 DEVICE INPUT STATUSES

InputStatus[0]	High temperature alarm
InputStatus[1]	Low temperature alarm
InputStatus[2]	Relay 1 status
InputStatus[3]	Relay 2 status
InputStatus[4]	Status of digital input IN_1 (1=open OC ; 0=closed CC)
InputStatus[5]	Status of digital input IN_2 (1=open OC ; 0=closed CC)
InputStatus[6]	Sensor error (1= sensor error ; 0 = sensor correct)
InputStatus[7]	Not used
...	...
InputStatus[16]	HoldingRegister[0] writing pendings (1)
InputStatus[17]	HoldingRegister[1] writing pendings (1)
InputStatus[18]	HoldingRegister[2] writing pendings (1)
InputStatus[19]	HoldingRegister[3] writing pendings (1)
InputStatus[20]	HoldingRegister[4] writing pendings (1)
InputStatus[21]	HoldingRegister[5] writing pendings (1)
InputStatus[22]	HoldingRegister[6] writing pendings(1)
InputStatus[23]	Not used
...	...
InputStatus[48]	CoilStatus[0..15] writing pendings (1)
InputStatus[49]	Not used
...	...
InputStatus[64]	Device presence status (agent data validity) (2)
InputStatus[65]	General status of pending (logic OR of all writing pendings) (1)
InputStatus[66]	Not used
...	...
InputStatus[79]	Not used

(1) These flags are managed by the Gateway and are set at the time a holding register or coil status group is written. They are reset at the time of effective receipt of the data by the device (which occurs immediately after transmission).
(2) the device presence flag is managed by the Gateway; it is set when the present data is valid. The flag is reset if the Gateway does not receive messages from the device for a time more than four times the automatic transmission time.

13) SPECIAL COMMANDS – COMMAND PASSWORD

Command passwords can be used to give the device certain special commands.
The command is performed when the CoilStatus[0] bit is set.

HoldingRegister[0] (HEX)	HoldingRegister[0] (DEC)	Action
0x1968	6504	Start device Bootloader
0x1970	6512	Device reset
0x1973	6515	Device disassociation
0x1975	6517	Network re-initialisation