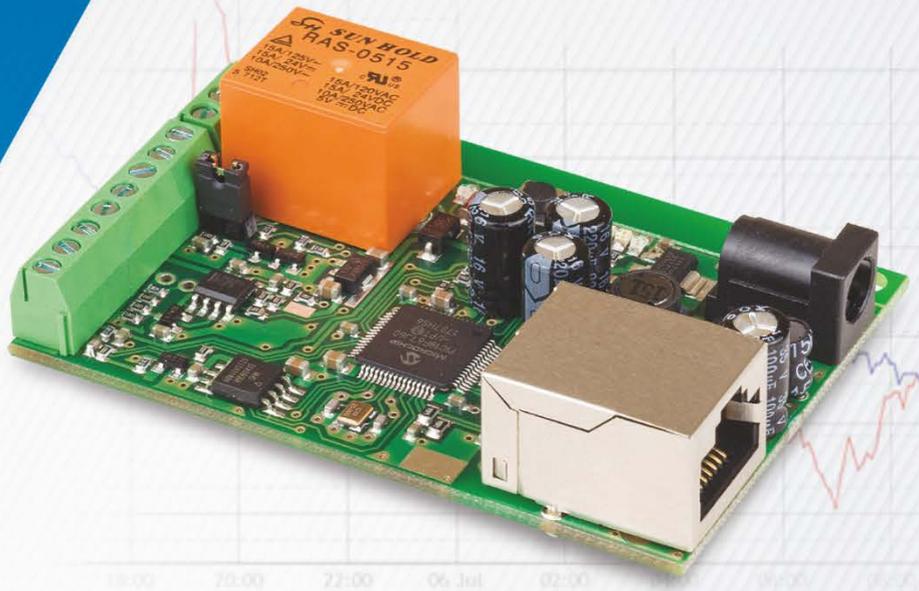




control solutions

**TERACOM**



# TCW112-WD IP watchdog relay board

Revision 3.3 / March 2019

## USER MANUAL

## 1. Short description

TCW112-WD is an IP watchdog relay board, which is designed to work in Ethernet networks. It has 1 digital and 1 analog input, 1-Wire interface and 1 relay output. It can be managed by WEB interface and/or SNMP programs.

The relay can be activated either remotely (WEB, SNMP etc.) or locally - from presence/absence of ping (echo request or echo reply). SNMP trap can be sent for every monitored parameter (temperature, humidity, analog voltage and dry contact) if it goes outside of a previously predefined range.

## 2. Features

- Password protected, web-based configuration and control;
- 1 digital input with "dry contact" and "logic level" modes;
- 1 analog input with 0 to 60VDC range;
- 1 relay with NO and NC contacts;
- Long 1-Wire support for 1 temperature (TST1XX) or temperature/humidity (TSH2xx) sensor;
- SNMP v.1 support;
- SNMP traps sending for alert conditions;
- VLAN support;
- MAC address filtering;
- Remote firmware update.

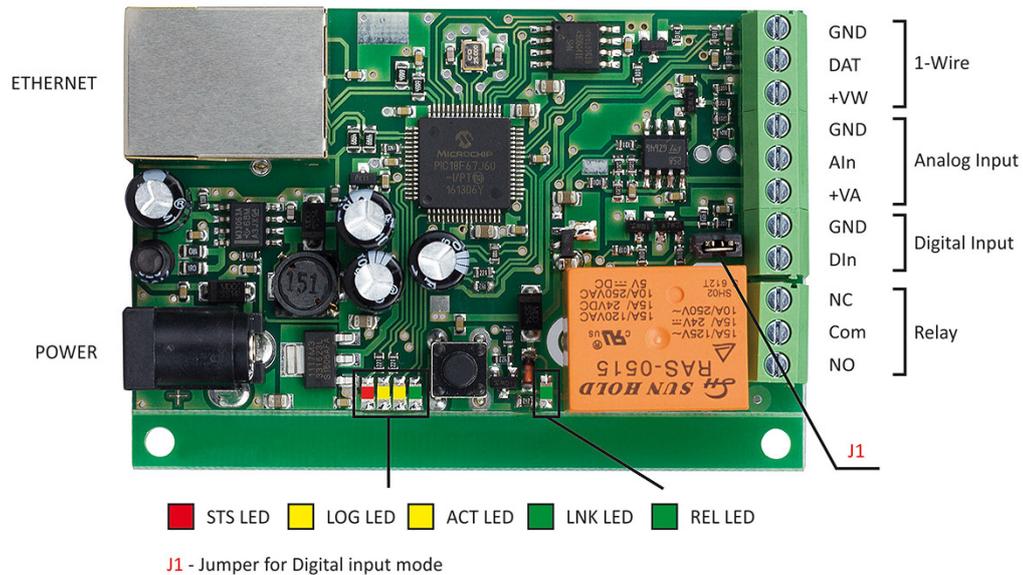
## 3. Specifications

- Physical characteristics  
Dimensions: 72 x 50 x 18 mm  
Weight: 45 g
- Environmental limits  
Operating temperature range: -20 to 55°C  
Storage temperature range: -25 to 60°C  
Operating relative humidity range: 5 to 85% (non-condensing)
- Warranty  
Warranty period: 3 years
- Power requirements  
Input Voltage: 10 to 14 VDC  
Input Current: 120 mA @ 12 VDC (with activated relay)
- Ethernet connectivity  
10 Mbit/s transfer rate  
Half-duplex mode only  
Auto-negotiation not supported

- Digital input
  - Isolation: Non isolated
  - Mode: Dry contact or Logic level
  - Maximum input voltage: +5.5VDC
  - Minimum input voltage for high logic level: +2.5VDC
  - Maximum input voltage for low logic level: +0.8VDC
  - Sampling rate: 10mS
  - Digital filtering time interval: 30mS
  
- Analog input
  - Isolation: Non isolated
  - Type: Single ended
  - Resolution: 10 bits
  - Mode: Voltage
  - Input Range: 0 to 60 VDC
  - Accuracy:  $\pm 1\%$
  - Sampling Rate: 37.6mS per channel (averaged value of 64 samples)
  - Input Impedance: 1 mega-ohms (min.)
  - Supply voltage for analog sensor (+VA):  $5.0 \pm 0.1$
  - Maximum output current for analog sensor (+VA): 0.1A
  
- Relay output
  - Type: Form C (N.O. and N.C. contacts)
  - Contact current rating: 3 A @ 24 VDC/30 VAC (resistive load)
  - Initial insulation resistance: 100 mega-ohms (min.) @ 500 VDC
  - Mechanical endurance: 10 000 000 operations
  - Electrical endurance: 100 000 operations @ 3 A resistive load
  - Contact resistance: 50 milli-ohms max. (initial value)
  - Min. pulse output: 1 Hz at rated load
  
- 1-Wire interface
  - Output voltage (+VW):  $5.3 \pm 0.2$  VDC
  - Maximum output current (+VW): 0.2 A
  
- Internal FLASH memory
  - Endurance: 100 000 cycles (Every relay status and settings change is a memory cycle.)

## 4. Connectors and LED's

The location of the connectors and LED's are shown below:



### 4.1 Connectors

The device has following connectors:

- Power – 2.1x5.5mm connector, central positive;
- Ethernet - RJ45 connector;
- Screw terminals:
  - GND ground for 1-Wire sensor;
  - DAT data input/output of 1-Wire sensor;
  - +VW power supply for 1-Wire sensor;
  - GND ground for analog input;
  - AIn analog input;
  - +VA power supply for analog sensors;
  - GND ground for digital input;
  - DIn digital input, operates either in “dry contact” mode (J1 is closed) or “logic level” mode (J1 is open);
  - Relay normally open and normally closed contacts are available.

### 4.2 LED indicators

The following LED's show the status of the controller:

- STS (red) – flashes when the main program of the controller is executed;
- LOG (yellow) – indicates that somebody is logged via WEB interface;
- ACT (yellow) – flashing when there is an activity;
- LNK (green) – ON when the link is up, OFF when no or bad connection;
- REL (green) – indicates that the relay is activated.

## 5. Powering

TCW112-WD is designed to be supplied by adapter SYS1421-0612-W2E or similar, intended for use in the conditions of overvoltage category II, and priorly assessed for compliance with safety requirements. The power supply equipment shall be resistant to short circuit and overload in the secondary circuit.

When in use do not position the equipment so that it is difficult to disconnect the device from the power supply.

## 6. Installation

The installation consists of mounting the device, connecting to an IP network, connecting inputs and outputs, providing power and configuring via a web browser.

This device must be installed by qualified personnel.

This device must not be installed directly outdoors.

This device should be mounted in a clean and dry location room. Ventilation is recommended for installations where the ambient air temperature is expected to be high.

The device should be installed in the not flammable box. See Appendix-A, fig. 1 for mechanical details. Maintain spacing from adjacent equipment. Allow 50 mm of space on all sides, as shown on fig.2 on Appendix A. This provides ventilation and electrical isolation.

## 7. Configuration

Please follow the steps below for proper installation:

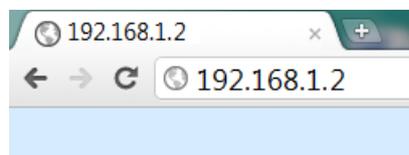
1. Mount the controller in a dry and ventilated place.
2. Connect the Ethernet port to a 10/100MB Ethernet network. For direct connection to a PC using a “crossover” cable.
3. Connect the I/O pins of the controller according to the required application.
4. Connect the power supply.

If the red LED (STS) blinks, the main program of the controller is executed.

By default TCW112-WD is delivered with the following network settings:

*IP address: **192.168.1.2**, Subnet Mask: **255.255.255.0**, Default Gateway: **192.168.1.1***

Communication with TCW112-WD can be established by assigning a temporary IP address to the computer. This address should be on the same network (for example 192.168.1.3). To get access to the web interface, you should type <http://192.168.1.2> into the browser address field.



If the network settings are correct, the “Login” page will appear.

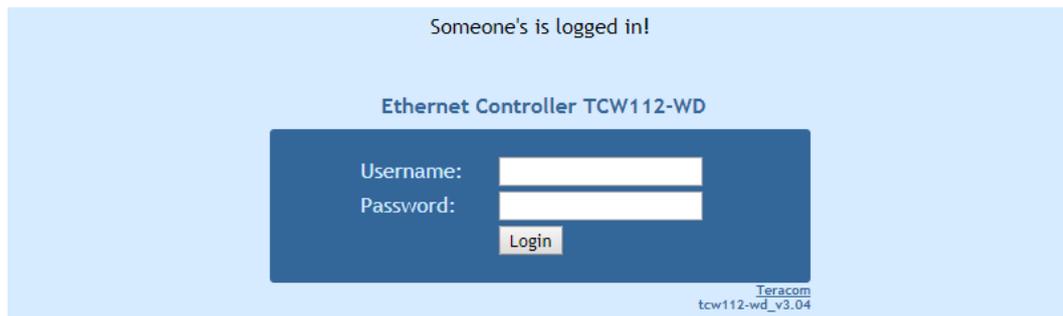
The web-based interface allows configuration, monitoring, and control.

## 7.1 Login page

After opening the Login page, authorization data must be entered (by default username = admin, password = admin). It is recommended to change the username and password to prevent unauthorized access to the controller.



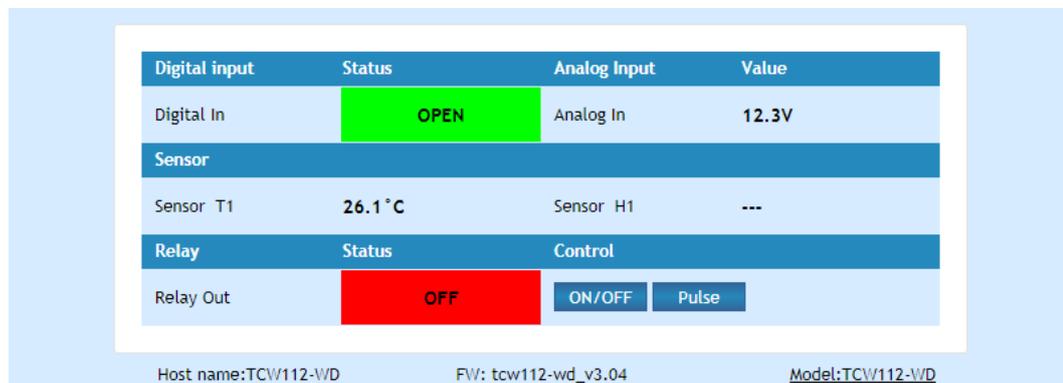
The controller supports one active session – only one user can operate the device over the WEB interface. If another user tries to login, the message “Someone is logged in” appears:



The active session will stay open until the "Monitoring" page is open. Inactivity on other pages or closing the browser without logoff will terminate the session automatically in 4 minutes.

## 7.2 Monitoring page

After successful authorization, the “Monitoring page” appears:

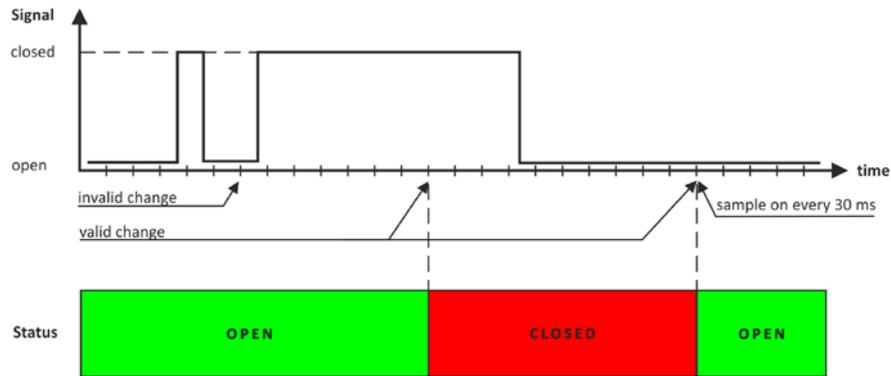


Digital input	Status	Analog Input	Value
Digital In	OPEN	Analog In	12.3V
Sensor			
Sensor T1	26.1 °C	Sensor H1	---
Relay	Status	Control	
Relay Out	OFF	ON/OFF	Pulse

Host name:TCW112-WD      FW: tcw112-wd\_v3.04      Model:TCW112-WD

The “Monitoring page” provides information about the state of the digital and analog input, relay status, temperature, and humidity (if a sensor is connected).

Digital input can be used for monitoring the state of discrete devices – motion sensor, door contact, relay contact, alarm output etc. The digital input is not galvanic isolated. One side of the contact is connected to “Digital In” and another side is connected to “GND” pins. Digital input is sampled every 30mS. The change of input status is considered valid if the same value is read in seven consecutive samples.



### 7.3 Network Setup page

The Network parameters are set on this page. The following parameters can be changed:

- Static/DHCP – IP Address can be static or dynamic (DHCP server should be present in the network);
- IP address, Subnet mask, Default gateway – these fields are active if IP address is static;
- Host Name – up to 16 symbols;
- MAC – device MAC address.

IP configuration	
Static/DHCP	Static
IP address	192.168.1.2
Subnet mask	255.255.255.0
Default gateway	192.168.1.1
Host name	TCW112-WD
MAC address	
MAC	00:04:A3:AA:0F:B6

The good practice is to change the default IP address of controller immediately after first power-on. This will avoid collisions if many devices are used on the same network. It may be necessary to clear the arp cache, each time you connect a new device to the network. This is done by typing `arp -d` in the command prompt window of the computer.

VLAN and MAC address filtering are supported. Up to 3 MAC addresses (including Default Gateway) can be active in MAC filtering.

**Attention!** If you are not familiar with VLAN and MAC filtering, leave these sections by default.

MAC filter	
MAC address 1	00:00:00:00:00:00 <input type="checkbox"/>
MAC address 2	00:00:00:00:00:00 <input type="checkbox"/>
MAC address 3	00:00:00:00:00:00 <input type="checkbox"/>
VLAN	
Status	Disabled
VLAN ID	0

Authentication details for WEB access to TCW112-WD can be set in the last section. Only one user is supported.

Web access	
Authentication	Enabled
Username	admin
Password	•••••
HTTP port	80

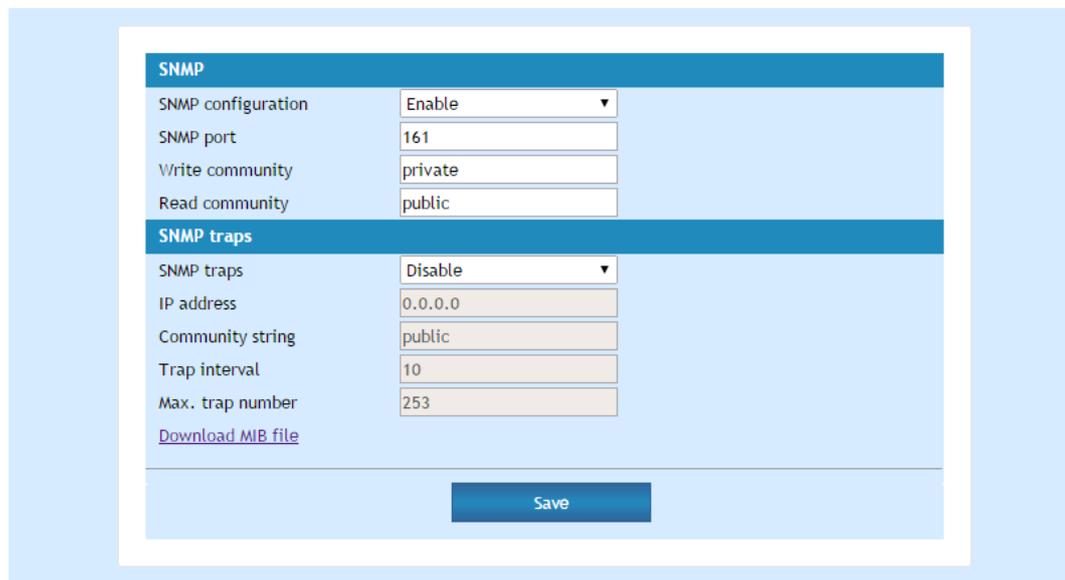
## 7.4 SNMP Setup page

TCW112-WD supports SNMP v.1. This enables the device to be part of large monitoring and control networks. The possible settings for “SNMP” section are:

- SNMP Configuration – enable/disable SNMP;
- SNMP Port – allows standard port changing;
- Write/Read community – performs client authentication;
- SNMP Traps – enable/disable SNMP trap messages;
- IP address – IP address of the receiving host;
- Community string – performs client authentication;
- Trap Interval - time interval in seconds for SNMP trap messages;
- Max. Traps number – maximum number of SNMP trap messages sent if trap condition is present.

SNMP traps are sent if:

- event occurs (status change) on Digital Input 1 or Digital Input 2;
- measured voltage on Analog Input 1 or Analog Input 2 goes outside the range;
- measured temperature goes outside the range;
- measured humidity goes outside the range;
- restart condition.



The screenshot displays the SNMP configuration interface. It is divided into two main sections: 'SNMP' and 'SNMP traps'. The 'SNMP' section includes fields for 'SNMP configuration' (set to 'Enable'), 'SNMP port' (161), 'Write community' (private), and 'Read community' (public). The 'SNMP traps' section includes fields for 'SNMP traps' (set to 'Disable'), 'IP address' (0.0.0.0), 'Community string' (public), 'Trap interval' (10), and 'Max. trap number' (253). A 'Download MIB file' link is present below the 'Max. trap number' field. A 'Save' button is located at the bottom of the form.

SNMP	
SNMP configuration	Enable
SNMP port	161
Write community	private
Read community	public

SNMP traps	
SNMP traps	Disable
IP address	0.0.0.0
Community string	public
Trap interval	10
Max. trap number	253

[Download MIB file](#)

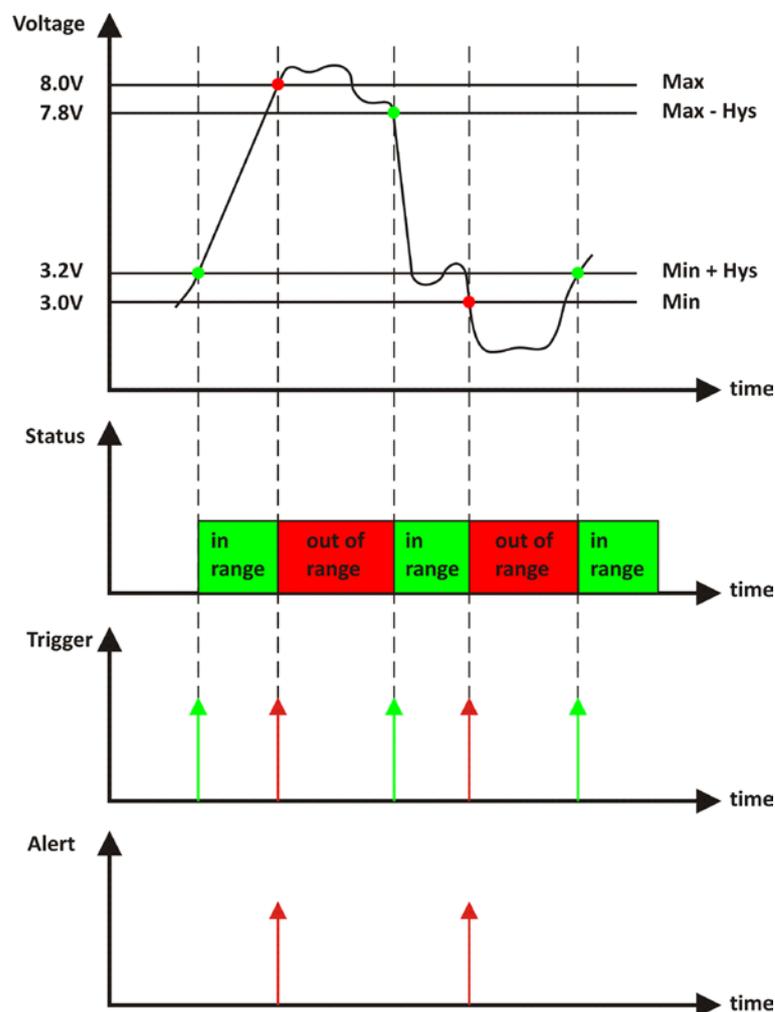
Save

## 7.5 I/O setup page

I/O settings can be made here. For temperature, humidity and analog value MIN, MAX, and HYSTERESIS values can be set. These values define the thresholds for all monitored parameters.

Sensor			
	Min.	Max.	Hysteresis
Temperature, °C	<input type="text" value="-40.0"/>	<input type="text" value="20"/>	<input type="text" value="1.0"/>
Humidity, %RH	<input type="text" value="0.0"/>	<input type="text" value="45"/>	<input type="text" value="1.0"/>
Analog input			
	Min.	Max.	Hysteresis
Voltage, V	<input type="text" value="0.0"/>	<input type="text" value="60.0"/>	<input type="text" value="1.0"/>

When the measured value goes out of range SNMP trap (if enabled) will be sent. Leaving range is considered when the parameter goes lower than MIN values or higher than MAX. Coming back in the range is considered when the parameter goes higher than (MIN + HYSTERESIS) or lower than (MAX – HYSTERESIS).



For IP watchdog monitoring following parameters can be set:

- Mode – outgoing (echo request) or incoming (*echo replay*) mode can be chosen;
- Outgoing ping interval – the time between two echo requests;
- Ping timeout for restart – timeout before activation of Relay;
- IP address - IP address of ICMP corresponding host;
- Maximum number of restarts – maximum number of activation of the relay (restarts) after the timeout has expired.

Ping timeout for restart should be longer than Outgoing ping interval.

Watchdog		
Mode	outgoing ping	
Outgoing ping interval	1	sec(1-253)
Ping time out for restart	10	sec(2 - 65000)
IP address	192.168.32.30	
Max. number of restarts	1	(1 - 253)

Relays can be activated manually or automatically in function of the watchdog:

Relay output		
Pulse duration	1	sec(1-253)
Relay activated from	manual	
Save relay state after change via WEB	Yes	100 000 write cycles are guaranteed

When manual activation is selected, “Pulse” and “ON/OFF” buttons on “Monitoring” page are active. The duration of the pulse for relay activation can be set from 1 to 253 seconds.

By default, relay state changes via the WEB interface are memorized in a non-volatile memory. After the power on, the relay goes in its last state, before the power down.

If the “Save relay state after change via WEB” is No, after power on the relay is always OFF.

The guaranteed write cycles (every change saving) are 100000.

For every sensor, analog input, digital input and relay description with a length of 11 characters can be set.

Descriptions	
Sensor	Sensor
Analog input	Analog In
Digital input	Digital In
Relay	Relay Out

Temperature units can be changed between Fahrenheit and Celsius.

Units	
Temperature units	C

Automatic monitoring page refresh interval can be set from 1 to 253 second.

Monitoring page	
Refresh interval	1

## 7.6 Update page

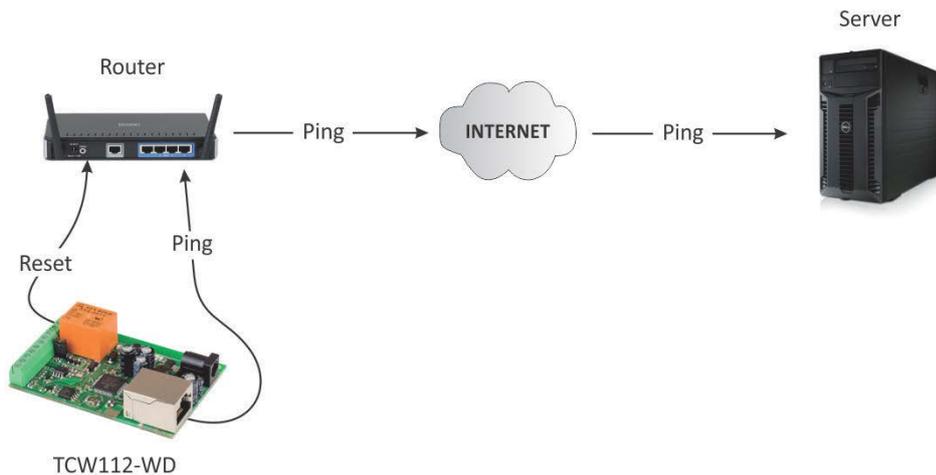
For details see chapter 13. Firmware update.

## 8. Application examples

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Teracom Ltd. cannot assume responsibility or liability for actual use based on the examples and diagrams.

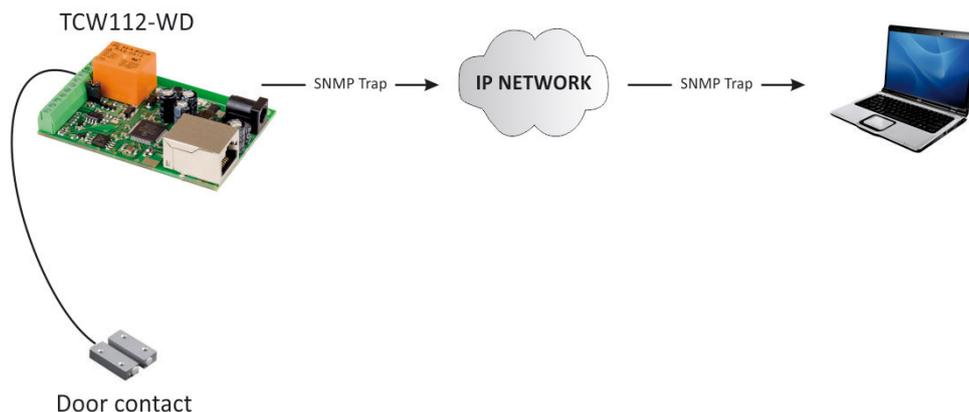
### 8.1 Watchdog with outgoing ping (echo request)

TCW112-WD is set to send a periodic ping (**Outgoing ping interval**) to an internet server via a local router. If the server doesn't answer in "**Ping timeout for restart**", the relay of the controller is activated for "**Pulse duration**" time. This activation switch-off and after this switch on the power supply of router, which restarts it.



### 8.2 Dry contact monitoring

The monitored contact is connected to the digital input (DIn) and ground (GND). Changes in the state of dry contact can be monitored either by WEB or SNMP interface. If SNMP traps are allowed and properly set, every change of state will generate a trap to the server.



## 9. 1-Wire Bus

1-Wire is a registered trademark of Maxim Integrated Products, Inc. It is designed to connect several sensors over a short wiring. The bus carries power and a single data wire. It is not suitable for long distances or environments with EMC interference. We strongly recommend reading Maxim's 1-Wire tips at <http://www.maxim-ic.com/app-notes/index.mvp/id/148>.

We recommend keeping the total wiring length under 30m, although functionality has been achieved in the longer distance. We cannot guarantee error-free operation over mentioned wiring length.

We guarantee proper operation only with our 1-Wire sensors series TST1XX and TSH2XX.

## 10. Control and monitoring using SNMP

TCW112-WD can be configured and monitored through SNMP (Simple Network Management Protocol). This could be done using every SNMPv.1 compatible program. Parameters that can be changed, are grouped according to their functions in the tables below. To obtain a valid OID number it is necessary to replace "x" symbol with "1.3.6.1.4.1.38783". To save the changes **configurationSaved** (OID x.3.7.0) should be set to "1".

### 10.1 Product

OID	Name	Access	Description	Syntax
x.1.1.0	name	read-only	Device name	String
x.1.2.0	version	read-only	Firmware version	String
x.1.3.0	date	read-only	Firmware release date	String

### 10.2 Setup -> network

network				
OID	Name	Access	Description	Syntax
x.2.1.1.0	deviceIPAddress	read-write	Device IP address	IpAddress
x.2.1.2.0	subnetMask	read-write	Subnet Mask	IpAddress
x.2.1.3.0	gateway	read-write	Gateway IP address	IpAddress
x.2.1.4.0	deviceMACAddress	read-write	Device MAC address	OCTET STRING (SIZE(6))
x.2.1.5.0	dhcpConfig	read-write	DHCP configuration ON/OFF	INTEGER { off(0), on(1) }
x.2.1.6.0	dns	read-write	Domain Name Server Address	IpAddress
x.2.1.7.0	hostName	read-write	Host Name	String (SIZE (0..38))

### 10.3 Setup -> network -> VLAN

network -> VLAN				
OID	Name	Access	Description	Syntax
x.2.1.10.1.0	vlanStatus	read-write	VLAN Status ENABLED/DISABLED	INTEGER { disabled(0), enabled(1) }
x.2.1.10.2.0	vlanId	read-write	VLAN ID (0-4095)	INTEGER (0..4095)

## 10.4 Setup -> network -> macFilter

network -> macFilter				
OID	Name	Access	Description	Syntax
x.2.1.11.1.0	filterMACAddress1	read-only	filter1 MAC address (Gateway)	OCTET STRING (SIZE(6))
x.2.1.11.2.0	filterMACEnable1	read-write	MAC filter 1 Enable ENABLED/DISABLED	INTEGER { disabled(0), enabled(1) }
x.2.1.11.3.0	filterMACAddress2	read-write	Filter2 MAC address	OCTET STRING (SIZE(6))
x.2.1.11.4.0	filterMACEnable2	read-write	MAC filter 2 Enable ENABLED/DISABLED	INTEGER { disabled(0), enabled(1) }
x.2.1.11.5.0	filterMACAddress3	read-write	Filter3 MAC address	OCTET STRING (SIZE(6))
x.2.1.11.6.0	filterMACEnable3	read-write	MAC filter 3 Enable ENABLED/DISABLED	INTEGER { disabled(0), enabled(1) }

## 10.5 Setup -> oneWireSensor -> temperature

oneWireSensor -> temperature				
OID	Name	Access	Description	Syntax
x.2.2.1.1.0	temperatureMin	read-write	Temperature minimum value	INTEGER (-400..1250)
x.2.2.1.2.0	temperatureMax	read-write	Temperature maximum value	INTEGER (-400..1250)
x.2.2.1.3.0	temperatureHyst	read-write	Temperature hysteresis	INTEGER (0..1250)

## 10.6 Setup -> oneWireSensor -> humidity

oneWireSensor -> humidity				
OID	Name	Access	Description	Syntax
x.2.2.2.1.0	humidityMin	read-write	Humidity minimum value	INTEGER (0..1000)
x.2.2.2.2.0	humidityMax	read-write	Humidity maximum value	INTEGER (0..1000)
x.2.2.2.3.0	humidityHyst	read-write	Humidity hysteresis	INTEGER (0..1000)

## 10.7 Setup -> analogInput

10.8 analogInput				
OID	Name	Access	Description	Syntax
x.2.3.1.0	voltageMin	read-write	Voltage minimum value	INTEGER (0..1000)
x.2.3.2.0	voltageMax	read-write	Voltage maximum value	INTEGER (0..1000)
x.2.3.3.0	voltageHyst	read-write	Voltage hysteresis	INTEGER (0..1000)
x.2.3.4.0	voltageDescription	read-write	Voltage description	DisplayString (SIZE (0..11))

## 10.9 Setup -> SNMP

SNMP				
OID	Name	Access	Description	Syntax
x.2.4.1.0	snmpConfiguration	read-write	SNMP Configuration ENABLED/DISABLED	INTEGER { disabled(0), enabled(1) }
x.2.4.2.0	trapEnabled	read-write	Indicates if this trap entry is enabled or not	INTEGER { no(0), yes(1) }
x.2.4.3.0	trapReceiverIPAddress	read-write	Trap receiver IP address	IpAddress
x.2.4.4.0	trapCommunity	read-write	Trap community	String (SIZE (0..13))
x.2.4.5.0	trapInterval	read-write	Trap Interval	INTEGER (1..253)
x.2.4.6.0	maxNumberOfTraps	read-write	Max Number of Traps	INTEGER (1..253)

## 10.10 Setup -> Relay

Relay				
OID	Name	Access	Description	Syntax
x.2.5.1.0	relayControl	read-write	Relay Control Item	INTEGER { manual(0), watchdog(1) }
x.2.5.2.0	relayPulseWidth	read-write	Relay Pulse Width	INTEGER (1..253)
x.2.5.3.0	relayDescription	read-write	Relay description	DisplayString (SIZE (0..11))
x.2.5.4.0	digitalInputDescription	read-write	Digital input description	DisplayString (SIZE (0..11))

## 10.11 Setup -> Watchdog

Watchdog				
OID	Name	Access	Description	Syntax
x.2.7.1.0	watchdogMode	read-write	Watchdog Mode - Incoming or Outgoing Ping	INTEGER { disabled(0), incomingPing(1), outgoingPing(2) }
x.2.7.2.0	outgoingPingInterval	read-write	Outgoing Ping Interval	INTEGER { 1..253 }
x.2.7.3.0	pingTimeOutForRestart	read-write	Ping Time out for restart	INTEGER { 2..65000 }
x.2.7.4.0	pingIPAddress	read-write	Ping IP address	IpAddress
x.2.7.5.0	numberOfRestarts	read-write	Max Number of restarts	INTEGER (1..253)

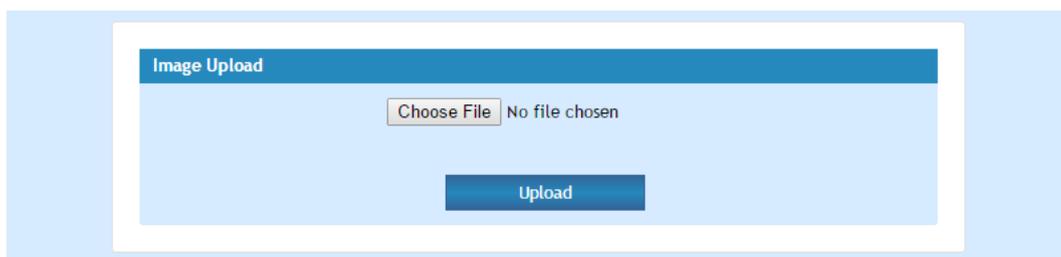
## 10.12 Monitor and control

OID	Name	Access	Description	Syntax
x.3.1.0	digitalInputState	read-write	Digital Input State	INTEGER { closed(0), open(1) }
x.3.2.0	relayState	read-write	Relay State	INTEGER { off(0), on(1) }
x.3.3.0	relayPulse	read-write	Relay Pulse	INTEGER { off(0), on(1) }
x.3.4.0	voltx10Int	read-only	Voltage x10 in Integer format	INTEGER (0..1000)
x.3.5.0	tempx10Int	read-only	Temperature x10 in Integer format	INTEGER (-400..1250)
x.3.6.0	humix10Int	read-only	Humidity x10 in Integer format	INTEGER (0..1000)
x.3.7.0	configurationSaved	read-write	Configuration save status SAVED/UNSAVED	INTEGER { unsaved(0), saved(1) }
x.3.8.0	restartDevice	read-write	Restart Device	INTEGER { cancel(0), restart(1) }
x.3.9.0	temperatureUnits	read-write	Temperature Units	INTEGER { celsius(0), fahrenheit(1) }

## 11. Firmware update

TCW112-WD supports remote firmware update. To update the device follow the steps below:

- Go to [www.teracomsystems.com](http://www.teracomsystems.com) and download the latest firmware version file from TCW112-WD product page;
- Go to the device login page, enter username and password and press the “Login” button;
- Go to “Update” menu, select the update .cod file and press “upload” button;



- After the firmware update is completed, you will be forwarded to the device Login page.

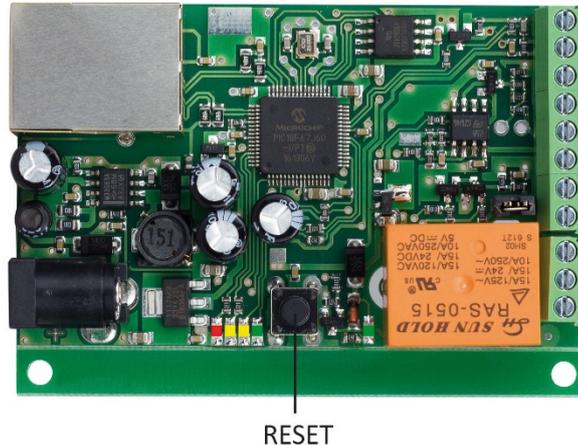
**Attention! Don't turn off the power supply during the update. Turning off the power supply will damage the device.**

For some updates factory default settings procedure is mandatory.

## 12. Factory default settings

TCW112-WD can be restored to its factory default settings following the steps below:

- Turn off the power supply from the unit;
- Press and hold the RESET button then turn on the power supply;
- After turning the power supply release the RESET button. The LED's STS and LOG will flash 14 times, after that only the STS LED will continue to blink. The controller is restored to its default settings.



The factory default settings are:

User Name (Admin)	admin
Password (Admin)	admin
IP Address	192.168.1.2
Subnet Mask	255.255.255.0
Default Gateway	192.168.1.1
SNMPConfiguration	disabled
readCommunity	public
writeCommunity	private

## 13. Environment information

This equipment is intended for use in a Pollution Degree 2 environment, at altitudes up to 2000 meters.

When the controller is a part of a system, the other elements of the system shall comply with the EMC requirements and shall be intended for use in the same ambient conditions.

## 14. Safety

This device must not be used for medical, life-saving purposes or for any purpose where its failure could cause serious injury or the loss of life.

To reduce the risk of fire, only flexible stranded wire, with cross section 0.5mm<sup>2</sup> or larger for wiring of digital and analog inputs and relay output of the device should be used.

To avoid electric shock and fire hazard, do not expose this product to liquids, rain, or moisture. Objects filled with liquids, such as vases, should not be placed on this device.

There is a risk of overheating (damage) of the controller, if recommended free spaces to adjacent devices are not ensured. The joint part with external component shall have space for attachment/removal of the cable after installation.

Teracom does not guarantee successful operation of the product if the product was used under conditions deviating from the product specifications.

To ensure that the device works correctly follow the steps below:

- ensure that the device is installed correctly, refer this user manual;
- log into the devices via browser program;
- make proper setup;
- set up the digital inputs to work in “dry contact” mode;
- short the “DI” and “GND”;
- install sensor TSH1XX or TST1XX on the 1-Wire bus;
- go to “Monitoring page” of WEB interface – proper parameters value should be displayed at the same time flashing “STS” led should indicate the proper operation.

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

In no event will Teracom Ltd. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

## **15. Maintenance**

Upon completion of any service/repair to the device or once per year, safety check must be performed to determine that this product is in proper operating condition.

Clean the device only with dry cloth. Do not use a liquid cleaner or an aerosol cleaner. Do not use a magnetic/static cleaning device (dust remover) or any kind of abrasive materials to clean the device.

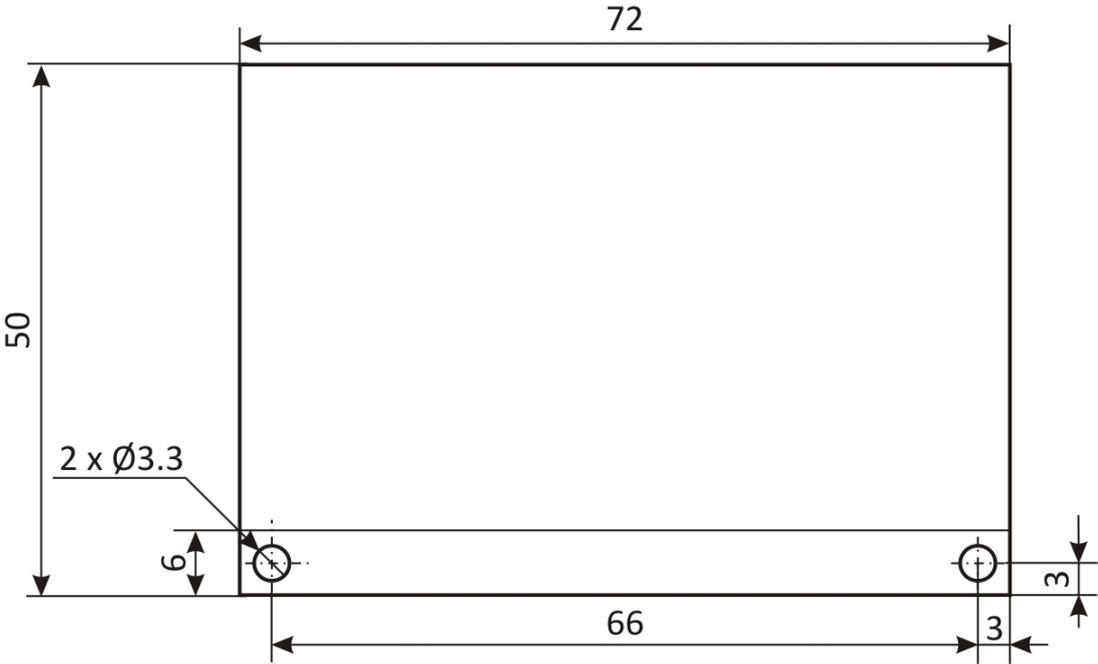


Fig.1

