control solutions
TERACOM

TCG140 GPRS remote IO module

Version 1.4/September 2018

USER MANUAL

www.teracomsystems.com

1. Short description

TCG140 is a GSM-GPRS remote IO controller. It has 2 digital inputs, 4 analog inputs, digital interfaces for external sensors and 4 relays. Two of analog inputs can be switched either in a current (0-20mA) or voltage modes. The relays can be activated either remotely (via SMS or HTTP API command) or locally - from the status of the monitored parameter.

TCG140 supports all digital sensors of Teracom.

All monitored parameters and status of relays can be periodically saved in the embedded data logger. It is also possible to arrange records on any alarm condition.

The controller supports HTTP API for easy M2M communication. The GSM-GPRS remote IO controller can periodically send data to a remote server or can be polled by the server if data card with public static IP is used.

2. Features

- Quad-bands connectivity;
- GPRS data logger with up to 70000 records;
- Setup via USB, SMS and HTTP API;
- 2 digital "dry contact" inputs;
- Up to 4 analog inputs with 0 to 10VDC range;
- Up to 2 current loop (4-20mA) inputs;
- Settable multiplier, offset, and dimension for analog inputs;
- 4 relays with NO and NC contacts;
- 1-Wire support for all Teracom sensors;
- MODBUS RTU sensors support (optional);
- SMS alarm alerts for up to 5 numbers;
- Email alarm alerts for up to 5 email recipients;
- Single call relay control for up to 5 numbers;
- Periodical HTTP post with current status in XML or JSON file to remote server;
- Periodical HTTP post with logger data in CVS format to remote server;
- HTTP API commands in server mode (with public static IP address data card);
- Firmware update over USB or GPRS.

3. Applications

TCG140 is suitable for industrial automation, data acquisition systems, environmental monitoring, local control of an electrical and non-electrical parameter, building automation etc.:

- SCADA

  The controller is designed for easy SCADA systems integration. It supports either client or server mode communication with the dedicated server. In both ways, HTTP protocol is used with a POST or GET messages.

- Stand-alone data logger

  The device can be used as a standard data logger with minimum record time as low as 1 minute. The logged data can be periodically uploaded to a dedicated server as CSV file.

- Environmental monitoring and control

4. Specifications

- Physical characteristics

  Dimensions: 158 x 119 x 32 mm
  Weight: 470 g
  Mounting: wall and DIN rail
- Environmental limits

  Operating Temperature: -20 to 55°C
  Storage Temperature: -40 to 85°C
  Ambient Relative Humidity: 5 to 85% (non-condensing)
- Standards and Certifications

  Safety: EN 60950-1:2006+A11:2009+A1:2010+A12:2011+A2:2013, EN 62311:2008
  EMC: EN 55022:2010, EN 55024:2010, EN 61000-3-2:2014, EN 61000-3-3:2013
  EN 301489-1 V1.9.2, EN 301489-7 V1.3.1
  RFSU: EN 301511 V9.0.2
  Green Product: RoHS
- Warranty

  Warranty period: 3 years
- Power requirements

  Input Voltage: 10 to 24 VDC
  Input Current: 340 mA @ 12 VDC
- Cellular interface

  Standards: GSM/GPRS
  Bands: 850/900/1800/1900 MHz
  GPRS multi-slot class: 12, 1~12 configurable
  GPRS terminal device class: Class B
  Compliant to GSM Phase 2/2+: Class 4 (2W@850/ 900MHz), Class 1 (1W@1800/1900MHz)
  SIM card size: Micro
  Antenna connector: SMA-F
- Analog inputs

  Isolation: Non isolated
  Type: Single ended
  Resolution: 10 bits
  Mode (Analog inputs 1 and 2): Voltage
  Mode (Analog inputs 3 and 4): Voltage / Current (WEB interface selectable)
  Input Range: 0 to 10 VDC, 0 to 20 mA
  Accuracy: ±1%
  Sampling Rate: 500mS per channel (averaged value of 250 samples)
  Input Impedance: 1 mega-ohms (min.)
  Built-in resistor for current mode: 410 ohms
- Digital inputs

  Isolation: Non isolated
  Type: Dry contact
  Sampling rate: 10mS
  Digital filtering time interval: 30mS
- Relay outputs

  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)
Pulse output: 0.1 Hz at rated load

- Digital sensor interfaces (1-Wire and RS-485)

  Output voltage: 5.0 ± 0.3 VDC
  Maximum output current (for both interfaces): 200 mA
- Internal FLASH memory

  Endurance: 100 000 cycles (Every relay status and settings change is a memory cycle.)

5. Installation

This device must be installed by qualified personnel. The installation consists of mounting the device, connecting the GSM antenna, connecting inputs and outputs, providing power and configuring via a web browser. This device must not be installed directly outdoors.

Attention! Before installing the SIM card in the card slot, please ensure that the PIN code is disabled.

5.1. Mounting

TCG140 should be mounted in a clean and dry location on a not flammable surface. Ventilation is recommended for installations where ambient air temperature is expected to be high.

Mount the device to a wall by using two plastic dowels 8x60mm (example Würth GmbH 0912 802 002) and two dowel screws 6x70mm (example Würth GmbH 0157 06 70). See Appendix C, fig. 1 for mechanical details.

Maintain spacing from adjacent equipment. Allow 50 mm of space on all sides, as shown in fig.2 in Appendix C, this provides ventilation and electrical isolation.

For DIN rail mounting, a DIN-RAIL-MOUNT-KIT should be used.

5.2. Connectors

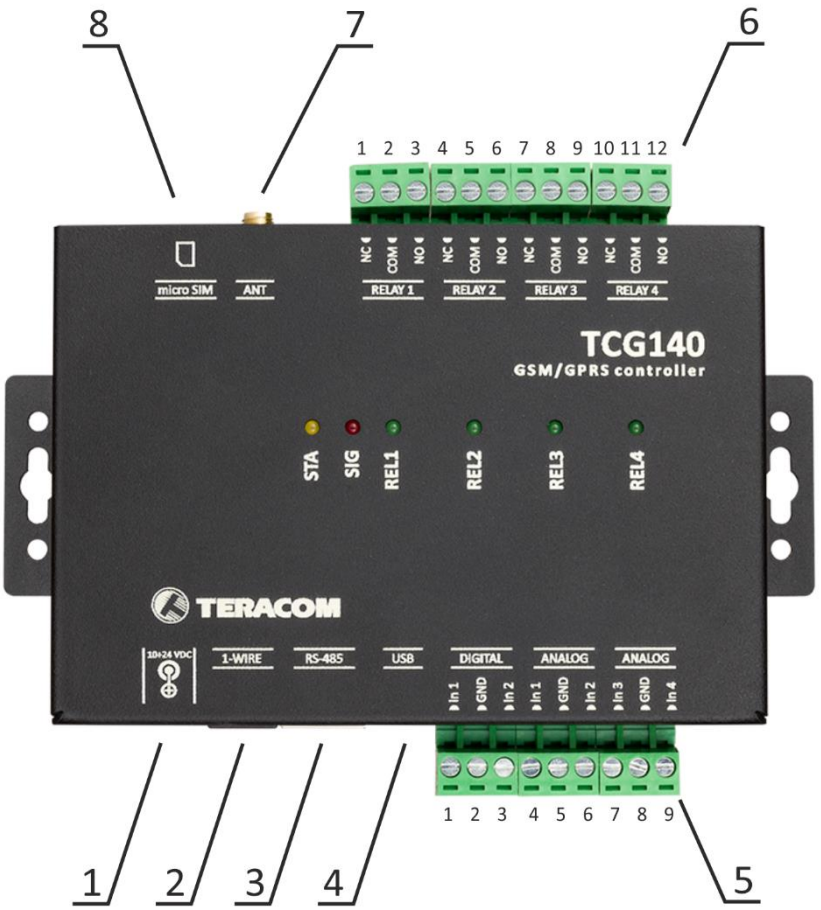
Attention! Disconnect power supply before wiring.

The correct wiring procedure is as follows:

- Make sure power is turned off;
- Make wiring connections to the terminals;
- Apply power.

It is recommended to test and configure TCG140 without any controlled device.

Make sure that wires are properly attached to the terminals and that the terminals are tightened. Not proper wiring and configuration can cause permanent damage to the controller or the equipment to which it is connected or both. Inputs and outputs locations are shown below:



Connector 1 Power - central positive

Connector 2
Pin1 – GND(most left)
Pin2 – GND
Pin3 – 1-Wire data
Pin4 – 1-Wire GND
Pin5 – 1-Wire +VDD
Pin6 – 1-Wire +VDD(most right)

Connector 3 RS-485
Pin1 – not connected (most left)
Pin2 – not connected
Pin3 – not connected
Pin4 – Line B-
Pin5 – Line A+
Pin6 – not connected
Pin7 – +VDD
Pin8 – GND

Connector 4 mini USB

Connector 5
Pin1 – Digital In 1
Pin2 – Ground
Pin3 – Digital In 2
Pin4 – Analog In 1
Pin5 – Ground
Pin6 – Analog In 2
Pin7 – Analog In 3
Pin8 – Ground
Pin9 – Analog In 4

Connector 6
Pin1 – NC Relay 1
Pin2 – COM Relay 1
Pin3 – NO Relay 1
Pin4 – NC Relay 2
Pin5 – COM Relay 2
Pin6 – NO Relay 2
Pin7 – NC Relay 3
Pin8 – COM Relay 3
Pin9 – NO Relay 3
Pin10 – NC Relay 4
Pin11 – COM Relay 4
Pin12 – NO Relay 4

Connector 7 GSM Antenna

Connector 8 SIM card holder

5.2.1. Power supply connection

TCG140 is designed to be supplied by adapter SYS1308-2412-W2E or similar, intended for use in the conditions of overvoltage category II. The power supply equipment shall be resistant to short circuit and overload in a secondary circuit.

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

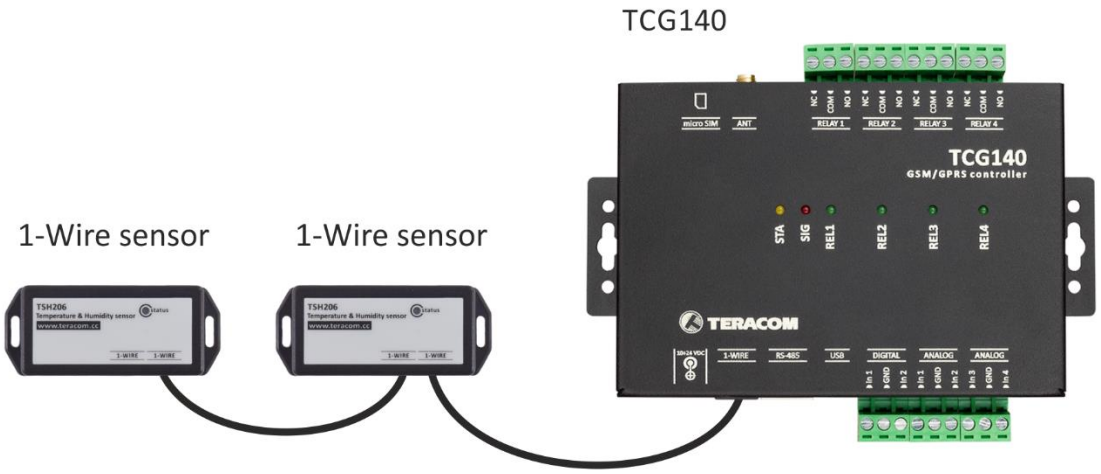
5.2.2. 1-Wire interface

1-Wire is a registered trademark of Maxim Integrated Products, Inc. It is designed to connect several sensors over a short wiring. It is not suitable for long distances or environments with EMC interference.

The maximum number of sensors (1-Wire or RS-485) connected to TCG140 is 8.

The device supports temperature and humidity-temperature sensors. Connected sensors are automatically detected and appropriate dimension is assigned.

It is strongly recommended to use “daisy-chained” (linear topology) for multi-sensors systems:



It is strongly recommended to use only UTP/FTP cables and keep total cable length up to 30m. Although functionality has been achieved in the longer distance, we cannot guarantee error-free operation over mentioned wiring length. We recommend reading Maxim’s 1-Wire tips at http://www.maxim-ic.com/app-notes/index.mvp/id/148.

We guarantee proper operation only with Teracom 1-Wire sensors.

5.2.3. RS-485 interface

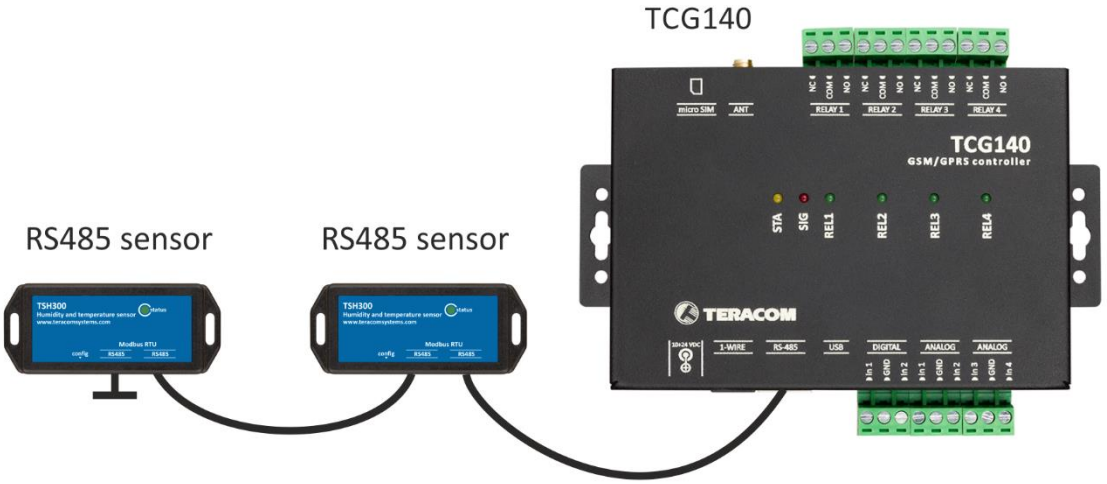
RS-485 is a standard for serial communications systems defined by Telecommunications Industry Association (TIA) and Electronic Industries Alliance (EIA). Implementing the standard, communication systems can be used effectively over long distances and in electrically noisy (industrial) environments.

The maximum number of sensors (1-Wire or RS-485) connected to TCG140 is 8.

The device supports temperature and humidity-temperature sensors.

MODBUS RTU protocol specifies that address of the device should be between 1 and 247. The user should take care of appropriate address settings.

For multi-sensors systems “daisy-chained” (linear topology) should be used:



Interconnections are realized by UTP/FTP cables with RJ-45 connectors. The popular Ethernet wiring standard ANSI/TIA/EIA T568B is used:

It is recommended to use standard patch cables for LAN networks.

Special attention should be paid on termination of the bus in the last sensor.

We recommend keeping total cable length up to 30 m, although the RS-485 interface works over much longer distance.

Attention!

Special attention should be paid on termination of the bus.

The last sensor in the chain should have a terminator installed on the free RJ-45 socket.

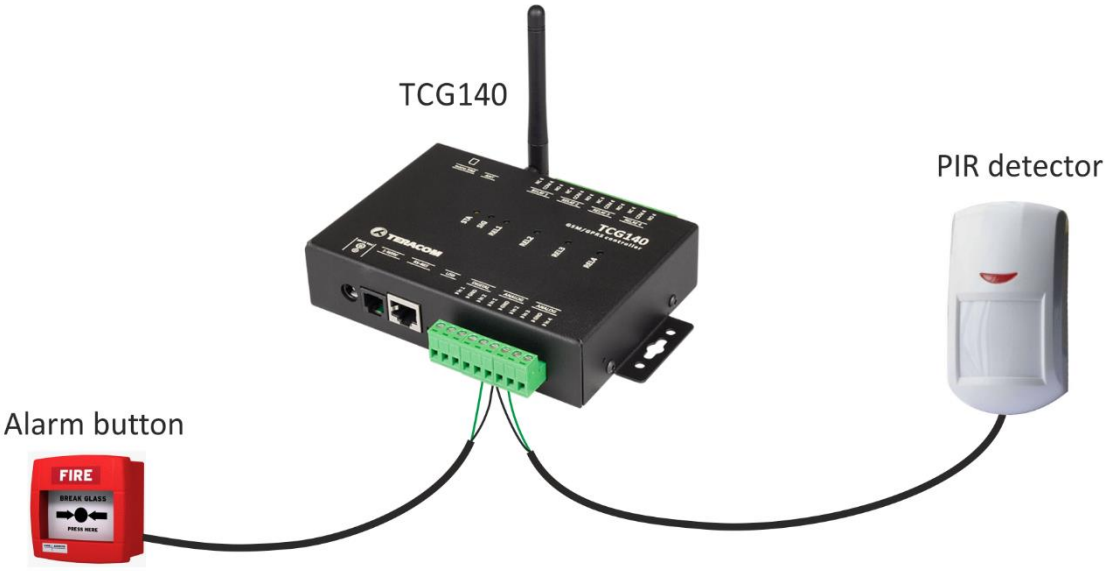
5.2.4. Digital inputs connection

Attention! Digital inputs are NOT galvanic isolated.

The TCG140 digital inputs can be used as “dry contact” only.

The term “dry contact” means that to this input can be connected devices with an open drain or relay outputs - door contact switch, push button, PIR detector etc.

The following picture illustrates how an alarm button can be connected to a digital input of TCG140. One side of the contact is connected to “Digital In” while the other side is connected to “GND” terminal.



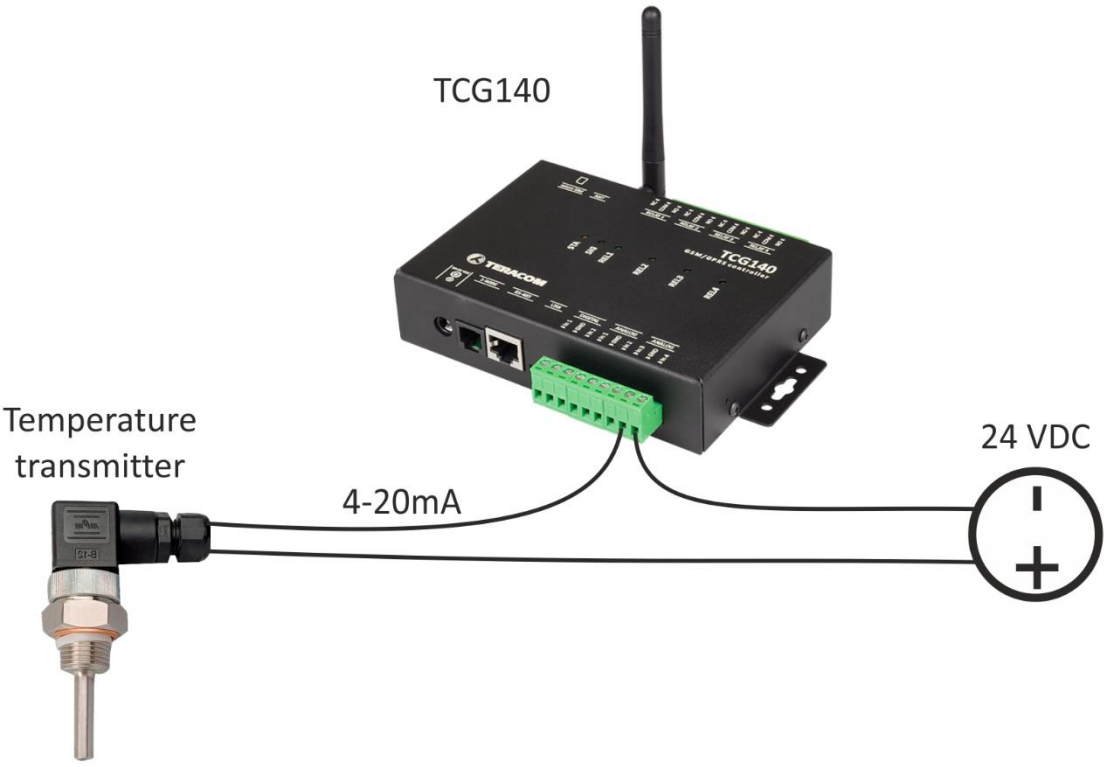
The maximum cable length for a digital input should be up to 30 meters.

5.2.5. Analog inputs connection

Attention! Analog inputs are NOT galvanic isolated.

Analog inputs of TCG140 can be used for monitoring of DC voltage up to 10VDC. They can be connected directly to sensors and transmitters with such analog output.

The “Multiplier”, “Offset” and “Dimension” for every analog input gives a possibility to monitor sensors with analog outputs and see directly the measured parameter.



It is possible to monitor voltages bigger than 10VDC with adding an external resistor in series. For every 1 mega-ohm, the voltage will be extended with 5.893V. The external resistor should be with 1% or better accuracy.

To analog inputs 3 and 4 internally can be assigned 410-ohm resistor in parallel of the input. In this case, the input can accept directly 0-20mA current loop sensors and transmitters.

The switching of the resistor is done by the user interface.

The following picture illustrates how 0-10V analog sensor is connected to the analog input 1 and 0-20mA current loop transmitter is connected to analog input 3. The analog input 3 is in current mode.

The maximum cable length for an analog input should be up to 30 meters.

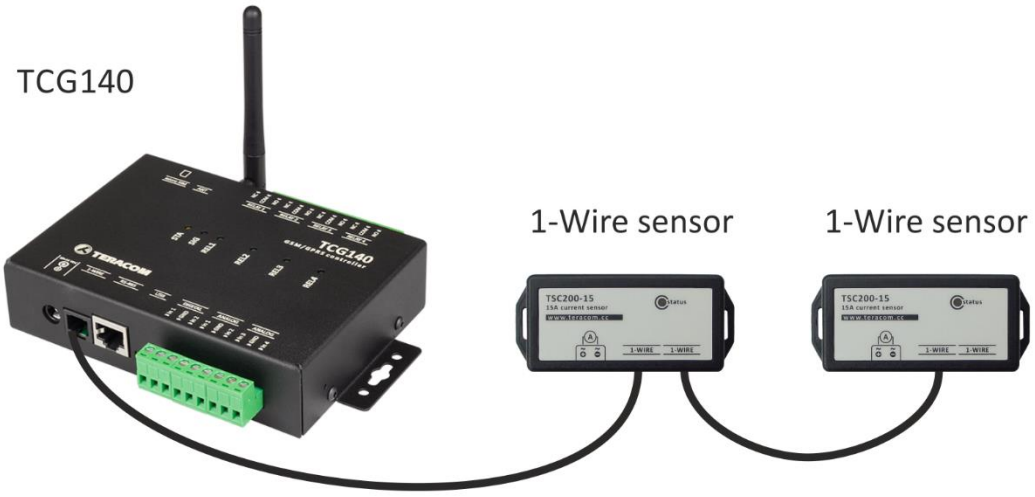
5.2.6. Sensors connection

Up to 8 1-Wire sensors can be connected to TCG140 controller. The device supports all Teracom 1-Wire sensors.

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

The sensors have three wires – positive voltage (+VDD), ground (GND) and bidirectional data (Data). The colors of wires for every sensor are specified in its user manual.

It is strongly recommended to use "daisy-chained" (linear topology) for multiple sensors:



"Star" topology can be used only as a last resort for up to 4 sensors and total cable length up to 10 meters.

There are many parameters which determine the maximum length of the wires - type of cable, the number of sensors, ambient electromagnetic noise and sensor network topology.

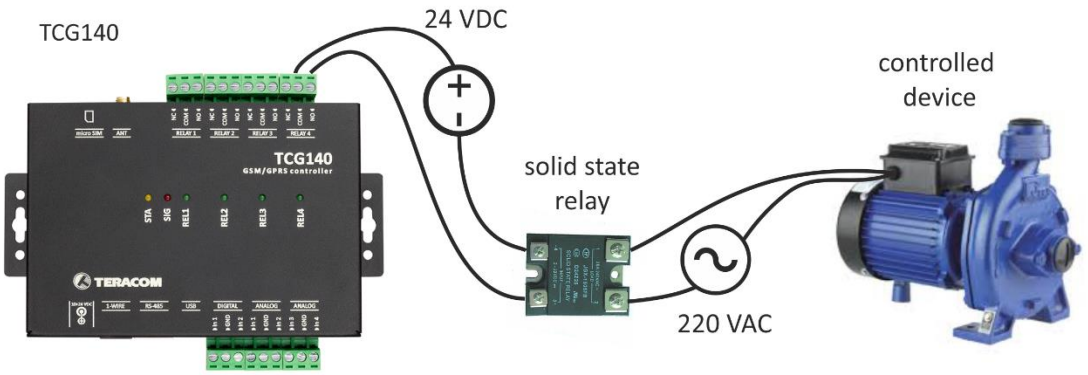
It is strongly recommended to use only UTP/FTP cables and keep total cable length up to 30 m. Although functionality has been achieved in a longer distance, we cannot guarantee error-free operation over mentioned wiring length.

We guarantee proper operation only with Teracom 1-Wire sensors.

5.2.7. Relays connection

The relay contacts are internally connected directly to the terminal connectors. For all relays normally open, normally closed and common contacts are available. For loads with higher switchable current/voltage than specified, an external relay should be used.

When mechanical relays switch inductive loads such as motors, transformers, relays, etc., the current will arc across the relay contacts each time the contacts open. Over time, this cause wears on the relay contacts which shorten their life. When switching an inductive load, it is recommended that relay contact protection devices are used.



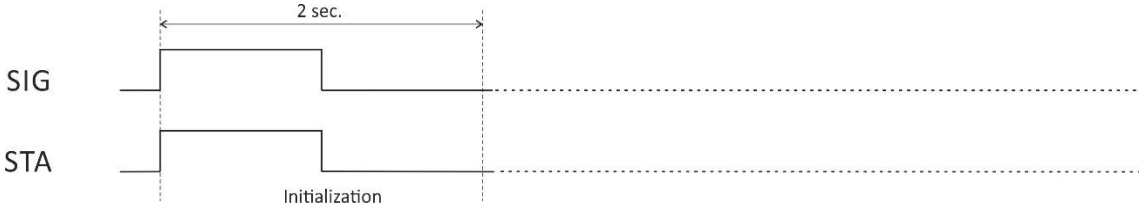
6. LED indicators

LED indicators show the status of the controller:

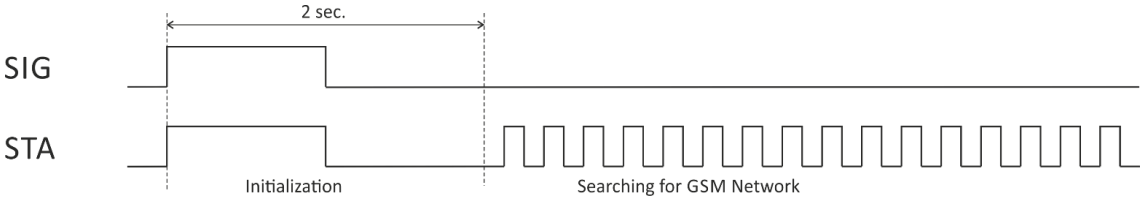
- **REL1 - REL4** (green) – the LED is ON when the corresponding relay is activated (the NO contact is connected to COM);
- **SIG** (red) – indicates the status of the device together with STA
- **STA** (yellow) – indicates the status of the device together with SIG.

The following states are displayed:

- **Controller initialization** – after power-on and firmware update SIG and STA turn ON for a second, after this turn OFF for another second.

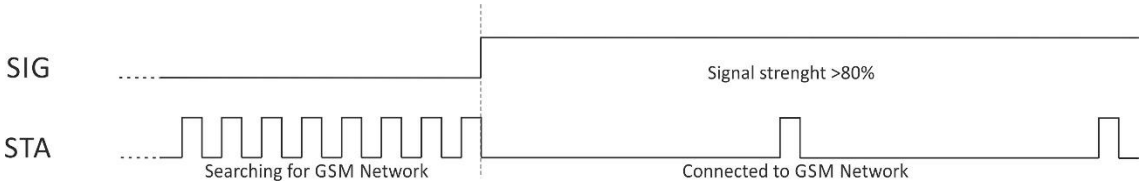


- **Searching for GSM network** – after initialization, SIG is OFF, STA flashes (flash length – 200ms)

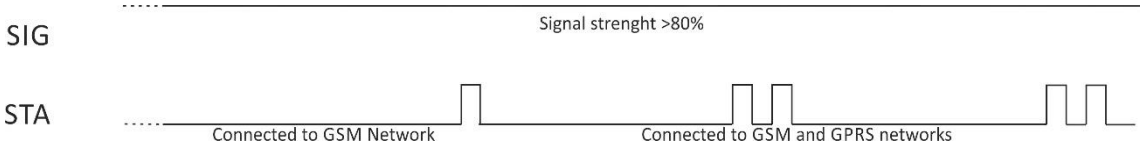


- **Connected to GSM network** – after successful connection to a mobile network, STA shows the type of connection, while SIG shows the signal strength.

  STA flashes ones for 200mS in period of 2S – there is GSM connection only;

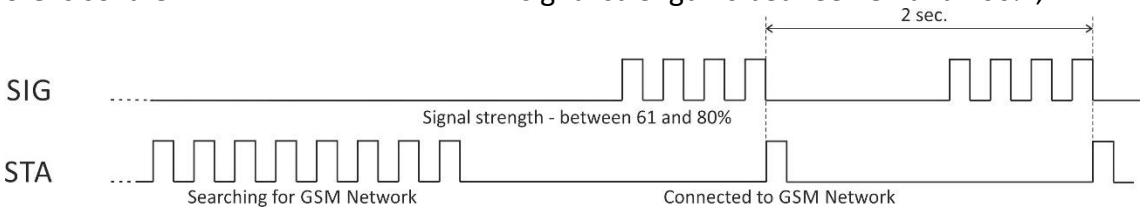


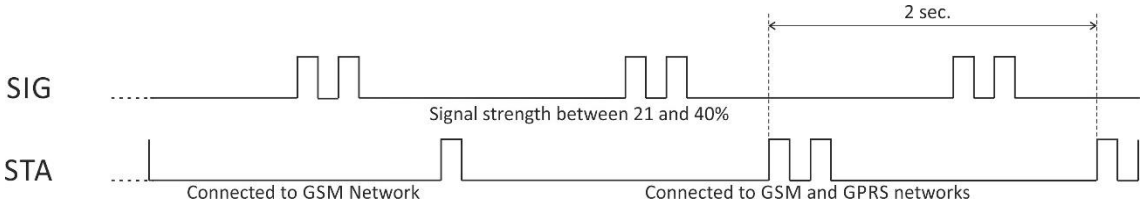
STA flashes twice for 200mS in a period of 2S – there is GSM and GPRS connection.



In the same time SIG has 5 states:

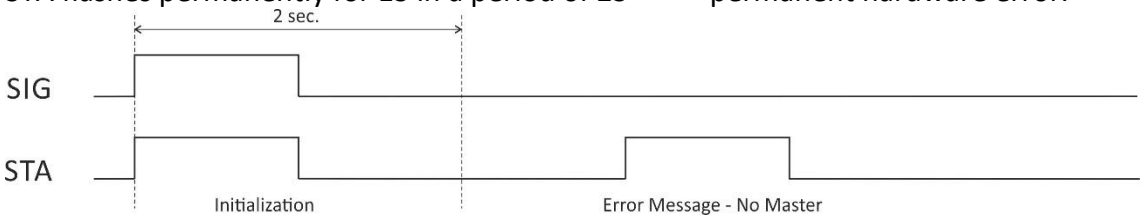
SIG flashes 1 time in period of 2S – signal strength is between 0 and 20%;
SIG flashes 2 times in period of 2S – signal strength is between 21 and 40%;
SIG flashes 3 times in period of 2S – signal strength is between 41 and 60%;
SIG flashes 4 times in period of 2S – signal strength is between 61 and 80%;
SIG is solid ON – signal strength is between 81 and 100%;

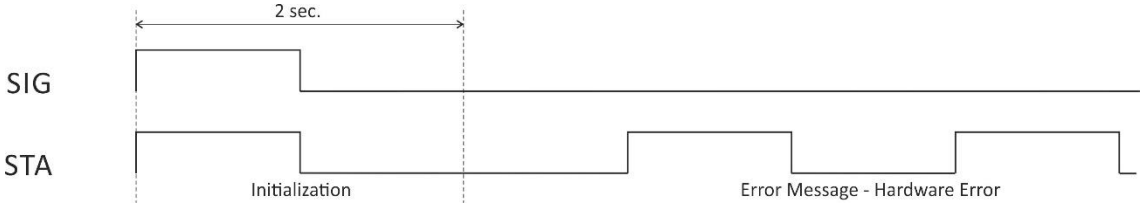




- **Error message** – in case of error after initialization, SIG will stay solid OFF, STA will flash showing the type of error.

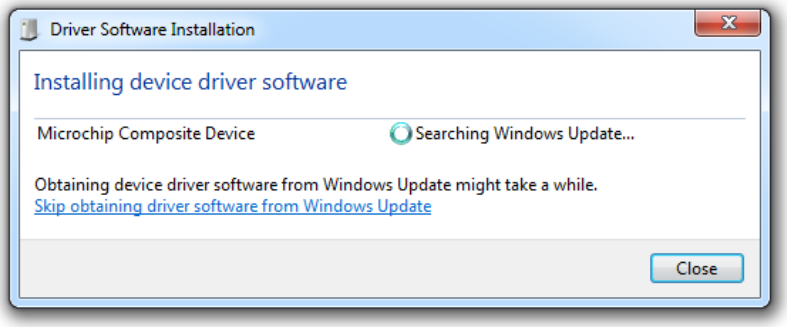
STA flashes ones for 1S – master phone number is not set;
STA flashes permanently for 1S in a period of 2S – permanent hardware error.





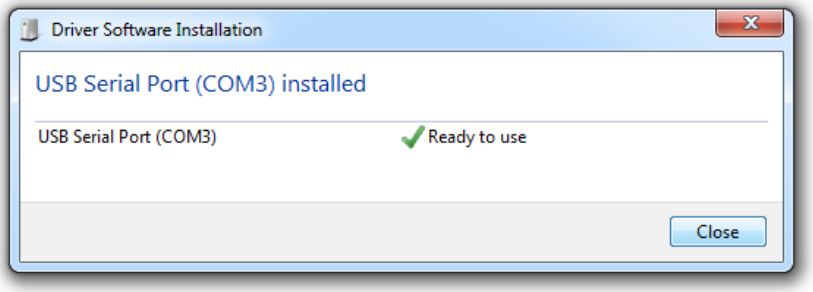
7. Initial setup via USB

The initial setup of TCG140 is done with a computer running Windows 7 or newer Microsoft Windows operating system. After power-up, the controller should be connected to the computer with USB cable. Once the USB cable is connected, the operating system automatically starts to install the drivers for the communication with the device. The following message appears:

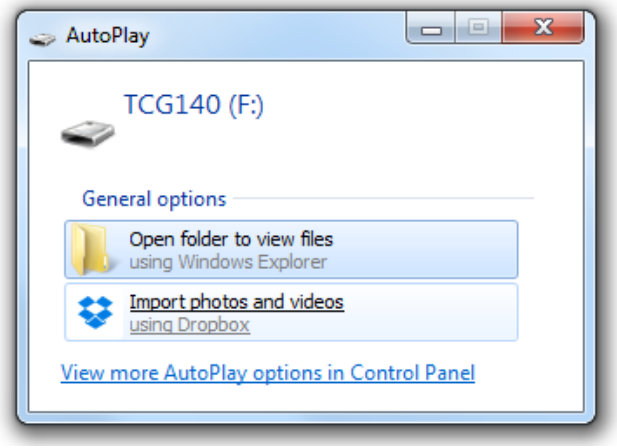


The following drivers will be installed:

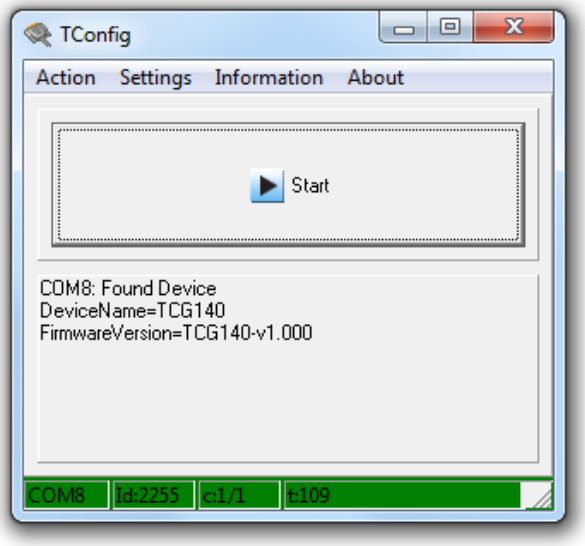
- Microchip composite device
- USB serial port driver



If for some reason the USB serial port driver cannot be installed automatically, it must be installed manually. The driver can be downloaded from the TCG140 product page at www.teracomsystems.com. After successful driver installation, the device will be recognized as Mass storage, the following window appears on the screen:



The only file stored on the mass storage is a tool called “TConfig”. This tool enables the communication between the TCG140 and PC. After starting the TConfig tool, the following program will appear:



Pressing the “Start” button will start your web browser and display the Monitoring page of your TCG140.

7.1. Monitoring page

Monitoring page displays the current I/O state of TCG140**.** The page has 4 sections – “Sensors”, “Digital inputs”, “Analog inputs” and “Relays”.

For every parameter (sensor, input, relay) there is a description of up to 15 characters. The default descriptions can be changed in “Setup-Input/Output” menu.

The Monitoring page is automatically refreshed on 1 second.

7.1.1. Sensors section

Pos	Description	Temperature	Humidity	Dew point	ID	Type	Lock
1	S1:TST1xx	22.6°C	------	------	[2867895F07000058]	1Wire	☑
2	S2:TSH2xx	23.0°C	50.8%RH	12.2°C	[015225B71700FF45]	1Wire	☑
3	S3:TST3xx	23.5°C	------	------	[3300744BFAFFFF06]	MB, 1	☑
4	S4:TST3xx	22.6°C	------	------	[3300744BFDFFFF7C]	MB, 2	☑
5	S5:TST3xx	24.0°C	------	------	[3300744BFCFFFFD7]	MB, 11	☑
6	S6:TST3xx	22.9°C	------	------	[3300744BFBFFFFAD]	MB, 15	☑
7	S7:TST3xx	23.5°C	------	------	[3300744BF8FFFF49]	MB, 100	☑
8	S8:TST3xx	23.0°C	------	------	[3300744BF9FFFFE2]	MB, 198	☑

Scan for new sensors

All detected 1-Wire sensors are shown in this section. Sensor detection is made either after power-on or by pressing “Scan for new sensors” button. All found sensors are shown in ascending order refer their unique ID number. For every sensor, there are a description, value, and ID information.

All sensors have value only in the Value 1 column. Only TSH2xx temperature and humidity sensors have the 2nd parameter shown in Value 2 column.

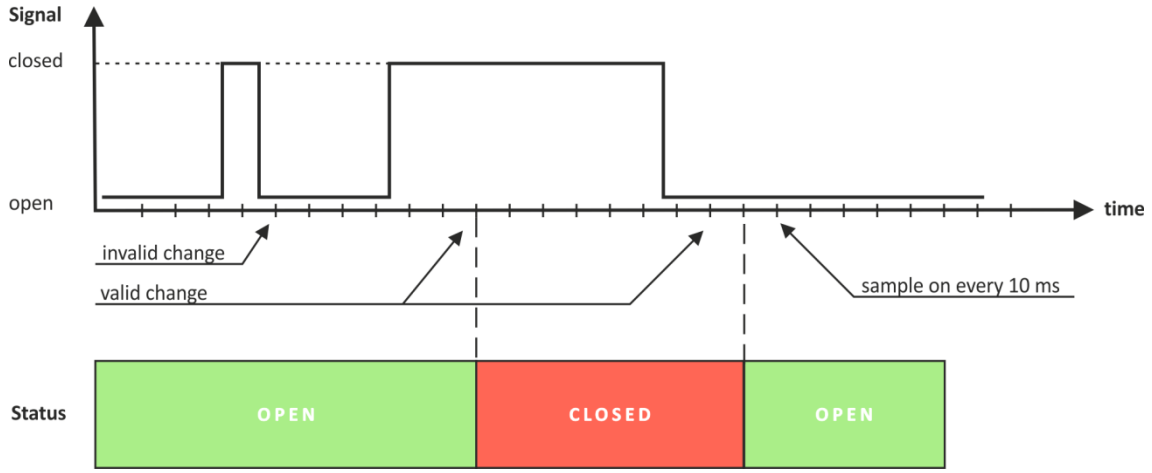
It is possible to lock sensors in a specific position. To do this all sensors should be added one by one. After every addition, a new scan should be made and newly found sensor should be locked in its position. If all sensors are locked, removing one “in the middle” will not change the positions of following sensors after reset. This option is very useful when TCG140 is used as a part of monitoring and control system managed by HTTP API.

7.1.2. Digital inputs section

Digital input	Status	Digital input	Status
Digital Input 1	CLOSED	Digital Input 2	OPEN

Digital inputs can be used for monitoring the state of discrete devices – motion sensor, door contact, relay contact, alarm output etc.

Digital inputs are sampled every 10mS. The change of input status is considered valid if the same value is read in 3 consecutive samples (30mS).



Status of every input is shown by text and by color.

The default descriptions and status names can be changed in “Setup-Input/Output”.

7.1.3. Analog inputs section

Analog input	Value	Analog input	Value
Analog Input 1	5.018V	Analog Input 2	0.021V
Analog Input 3	0.022V	Analog Input 4	0.031V

Analog inputs can be used for monitoring of DC voltage sources – analog sensors, batteries, power supplies, solar panels etc.

Analog inputs 3 and 4 can be also used for monitoring of 0-20mA current loop sensors/transmitters. The mode can be changed in “Setup-> Input/Output” section.

Analog inputs are sampled faster, but the new actual value is changed in 0.5 seconds. All 250 readings between the value changes are averaged.

For every analog input “Unit”, “Multiplier” and “Offset” can be set in “Setup-> Input/Output” section.

7.1.4. Relay section

Relay	Status	Control
Garage door	OFF	controlled by Phone call
Heating	OFF	controlled by S1:TST1xx Temperature
Relay 3	OFF	ON OFF Pulse
Relay 4	OFF	ON OFF Pulse
		All On All Off Pulse All

The section displays the current state of relays. Each relay can be activated either remotely or locally from the status of a monitored parameter. For locally activated relays a text description of the controlling parameter is displayed rather than buttons.

Pulse duration and parameters for local relay activation can be set separately for each relay in “Setup->Input/Output->Relay outputs”.

7.2. Setup

7.2.1. SMS/Call

SMS Setup		Alarm Notification
Master	+359886224455	Phone number format: [+][Country code][Network prefix][Number]
User 1		☐
User 2		☐
User 3		☐
User 4		☐
send test SMS		

SMS alarm recipients can be set in this section.

The “Master” has special rights to change the device settings using SMS commands. This number always receive the SMS alarm messages.

The remaining 4 recipients can receive SMS messages if any of the parameters is in an alarm state. To receive the SMS messages for every number should be enabled with the checkbox “Alarm Notification”. These 4 recipients can also ask by SMS for parameter state/value.

By pressing “send test SMS” button all SMS recipients will receive a test SMS.

All commands, their syntax, and answers are described in “Setup via SMS”.

Phone call setup		
User 1	+359888112233	Phone number format: [+][Country code][Network prefix][Number]
User 2		
User 3		
User 4		
User 5		

The relay outputs can be activated (pulse only) by a single call from an authorized number. The maximum number of the authorized numbers is five. These numbers can be set through the WEB interface or by sending an SMS from the Master.

7.2.2. SMTP

This page is used to enter valid SMTP settings for email alerts and recipients’ addresses.

7.2.2.1. SMTP setup

SMTP setup	
Mail server IP/URL	smtp.gmail.com
Mail server port	465
Type of encrypted connection	TLS
Sender e-mail	tcw.test.mail@gmail.com
Username	tcw.test.mail@gmail.com
Password	••••••
Test server settings	

Mail server address can be set either by hostname (smtp.gmail.com) or IP address.

The e-mails can be sent with or without an encrypted connection.

The default SMTP port without encryption is 25. Almost all ISP’s block this port to avoid hacker’s attacks. Ask your ISP for details.

The only supported method for encrypted connection from most of the public email servers is TLS. TCG140 supports TLS 1.0, TLS 1.1 and TLS 1.2 with RSA_WITH_AES_128_GCM_SHA256 and RSA_WITH_AES_128_CBC_SHA cipher suites. This ensures successful operation with almost all public servers.

Be careful with the terms SSL, TLS, and STARTTLS used in email server settings, supplied by the provider. Some providers as Gmail uses SSL instead of TLS and TLS instead of STARTTLS. This

can provoke mismatches with the port number. The right settings for Gmail for the field “Mail server port” is 465.

Sender e-mail, username, and password are standard authentication details. For the most SMTP servers, sender's e-mail and username are the same.

There is a button for server settings test with a feedback. In this test sender and recipient of the e-mail is the same.

7.2.2.2. Alarm destination

Alarm destinations		
Recipient e-mail	JohnSmith@gmail.com	☑
Recipient e-mail	test@gmail.com	☑
Recipient e-mail		☐
Recipient e-mail		☐
Recipient e-mail		☐

Up to 5 email recipients can be set. Every recipient can be activated independently by a checkbox.

7.2.2.3. E-mail details

Email details	
Subject	Att. to #C
Body header	From #N, located at #L
Body	#S,#D=#V#U in #T
Body footer	IP Address:#A, MAC Address:#M
Subject, Header and Footer Variables	**Body Variables**
#N System Name	#D Sensor Description
#L System Location	#V Measured Value
#C System Contact	#U Unit of measured value
#A IP Address of device	#T Time stamp of message
#M MAC address of device	#S Status of parameter-ALARM/NORMAL
#H Host Name	#I ID of message
	#W LoW limit
	#G HiGh limit

The subject, body header, body and body footer can be customized. For this customization, a set of keys is used. All they are described on the page.

7.2.3. Input/Output

7.2.3.1. Sensors

Sensors				
Sensor #	Description	Unit	Multiplier	Offset
S1	S1:TST1xx	°C	1.000	0.00

S2	S2:TSH2xx	°C	1.000	0.00
		%RH	1.000	0.00
S3	S3	---		

S4	S4	---		

S5	S5	---		

S6	S6	---		

S7	S7	---		

S8	S8	---		

For every sensor, a description, up to 15 symbols can be set. These descriptions will appear in the monitoring page, conditions page, XML/JSON data, SMS and e-mail alerts.

7.2.3.2. Digital inputs

Digital inputs			
Input #	Description	Low level	High level
DI1	Door	CLOSED	OPEN
DI2	Fuel	Empty	Full

For every digital input, a description, up to 15 symbols and states up to 15 symbols can be set. These descriptions will appear in the monitoring page, conditions page, XML/JSON data, SMS and e-mail alerts.

7.2.3.3. Analog inputs

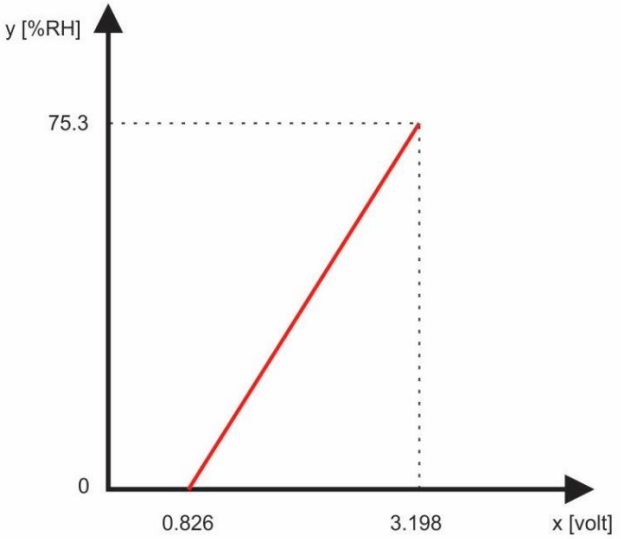
Analog inputs					
Input #	Description	Unit	Multiplier	Offset	Type
AI1	Batery	VDC	1.000	0.0000	
AI2	Sensor	kg	1.600	0.0000	
AI3	Tank Level	mBar	50.000	0.0000	4-20ma
AI4	Analog Input 4	V	1.000	0.0000	voltage

For every analog input, a description, up to 15 symbols can be set. These descriptions will appear in the monitoring page, conditions page, XML/JSON data, SMS and e-mail alerts.

For every analog input, fields “Unit”, “Multiplier” and “Offset” are available to convert the raw voltage/current into meaningful engineering units. The scaled value is calculated by:

SV[Un] = RV * MU + OF
Where:
SV – scaled (displayed) value;
Un – unit;
RV – raw voltage from the source;
MU – multiplier;
OF – offset.

<u>Example:</u>
For humidity sensor HIH-4000-003 following data (from the datasheet) is available:
VOUT = 0.826 at 0% RH
VOUT = 3.198 at 75.3% RH



The raw values are voltages on the sensor's output. Actually, we need to know relative humidity (scaled value) not voltages. The two relations are enough to calculate multiplier and offset. When we know them we can calculate what relative humidity corresponds to every voltage in the working range.

The multiplier (MU) is calculated as ΔY/ΔX, for this sensor ΔRH%/ΔV:

MU = (75.3 - 0)/(3.198-0.826) = 75.3/2.372 = 31.745 %RH/V

The offset is calculated from the already known multiplier and relation for one of the points:

OF = MU * (0 – VOUT1) + RH1 = 31.745*(0-0.826) + 0 = 31.745*(-0.826) = -26.22

The same result can be calculated for the second point:

OF = MU * (0 – VOUT2) + RH2 = 31.745*(0-3.198) + 75.3 = -101.52 + 75.3 = -26.22

For this sensor, the formula will looks like:

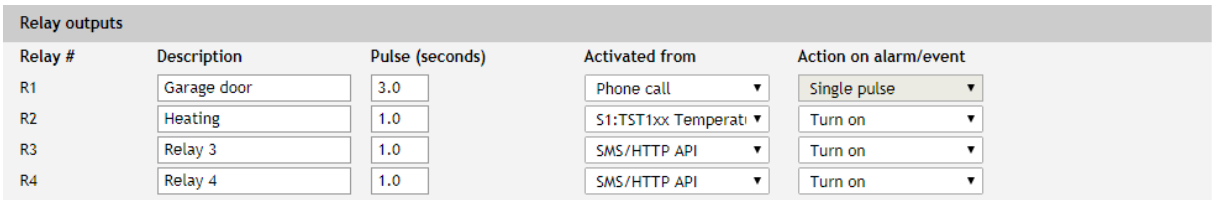
SV = RV * 31.745 – 26.22

Check for VOUT = 0.826 V (0%RH):

SV = 0.826 * 31.745 – 26.22 = 26.22 – 26.22 = 0 %RH

The same value is written in the datasheet.

7.2.3.4. Relay outputs



Relay outputs

Relay #	Description	Pulse (seconds)	Activated from	Action on alarm/event
R1	Garage door	3.0	Phone call	Single pulse
R2	Heating	1.0	S1:TST1xx Temperat	Turn on
R3	Relay 3	1.0	SMS/HTTP API	Turn on
R4	Relay 4	1.0	SMS/HTTP API	Turn on

For every relay, a description, up to 15 characters can be set. These descriptions will appear in the monitoring page, XML/JSON data, SMS and e-mail alerts.

The pulse duration can be different for every relay. The resolution is 0.1 second, the maximum pulse value is 3600 seconds.

Both relays can be activated either remotely by SMS/single call/HTTP API or locally from the status of a monitored parameter. This setting is made from the "Activated from" drop-down menu, the possible options are:

- **SMS/HTTP** - by selecting this option the relay outputs can be activated by SMS from authorized number or by sending HTTP API commands;
- **Phone call -** by selecting this option the relay outputs can be activated (pulse only) by a single call from an authorized number.

For local activation, alarm conditions for different sources are used. They are set up in section "Setup->Conditions". To assign a parameter to the relay, following choices are possible:

- **S?** – "S" stands for "**S**ensor 1-Wire". The relay is activated from the value measured from specified 1-Wire sensor and rules for ranges specified in "Setup->Conditions". Question mark masks a number from 1 to 8;
- **Analog input?**. The relay is activated from the value measured by specified analog input and rules for ranges specified in "Setup->Conditions". Question mark masks a number from 1 to 4;
- **Digital input?**. The relay follows the state of the specified digital input. Question mark masks a number from 1 to 2;

All changes in above sections are saved by pressing the "Save" button.

7.2.4. Conditions

This section is used for parameterization of a trigger and alert conditions for sensors, analog, and digital inputs.

7.2.4.1. Sensors and analog inputs

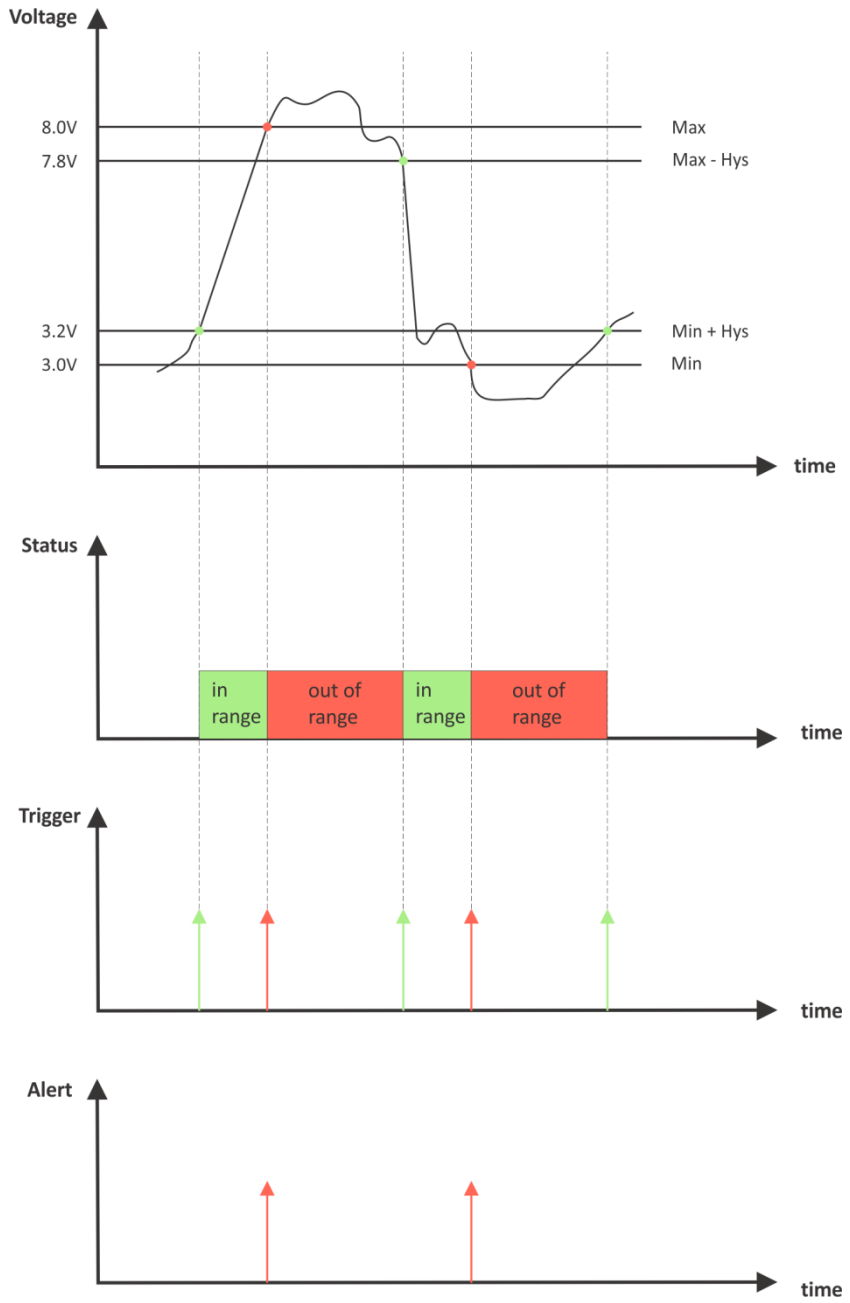
Sensors						If out of range		
#	Description	Type	Min.	Max.	Hys.	mail	sms	post
1	S1:TST1xx	Temperature, °C	19.0	100.0	0.5	☑	☑	☐
		---	---	---	---	☐	☐	☐
2	S2:TSH2xx	Temperature, °C	-40.0	85.0	8.5	☐	☐	☐
		Humidity, %RH	0.0	100.0	10.0	☐	☐	☐
3	S3	---	---	---	---	☐	☐	☐
		---	---	---	---	☐	☐	☐
4	S4	---	---	---	---	☐	☐	☐
		---	---	---	---	☐	☐	☐
5	S5	---	---	---	---	☐	☐	☐
		---	---	---	---	☐	☐	☐
6	S6	---	---	---	---	☐	☐	☐
		---	---	---	---	☐	☐	☐
7	S7	---	---	---	---	☐	☐	☐
		---	---	---	---	☐	☐	☐
8	S8	---	---	---	---	☐	☐	☐
		---	---	---	---	☐	☐	☐
Return notification		☐		Notification delay (seconds)		0	(0-3600)	

Analog inputs						If out of range		
#	Description	Dimension	Min.	Max.	Hys.	mail	sms	post
1	Batery	VDC	4.500	6.000	0.100	☑	☐	☐
2	Sensor	kg	0.000	5.000	0.100	☑	☑	☐
3	Tank Level	mBar	0.000	1000.000	1.000	☑	☑	☑
4	Analog Input 4	V	0.000	10.000	0.000	☐	☐	☐
Return notification		☐		Notification delay (seconds)		0	(0-3600)	

For every sensor two type of fields are presented – one for the trigger conditions (“Min”, “Max” and “Hys.”) and another one for the wanted action.

“Min” and “Max” indicate the border of working range for the monitored parameter. A “Max” trigger condition occurs when the value exceeds the trigger set point. A “Min” trigger condition occurs when the value is lower than the trigger set point. In both cases, the monitored parameter goes out of range.

Coming back in range for the observed parameter is considered when the value goes higher than (Min + Hys) or lower than (Max – Hys). Hysteresis (“Hys”) is used to prevent from excessively triggering when the value fluctuates around the trigger point.



Example:

TCG140, TST100, and appropriate heater are used to control the room temperature. The wanted minimum temperature is 19°C. The initial temperature is 17°C.

TST100 is assigned on the first position for 1-Wire sensors.

For Relay1 local activation from Sensor1 is set.

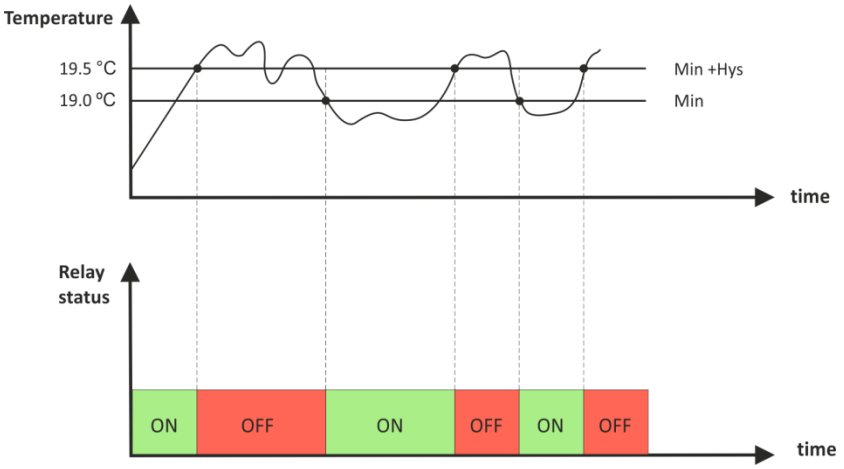
Following parameters are set for Sensor1: Min=19, Max=100 and Hys=0.5.

Sensors						If out of range		
#	Description	Type	Min.	Max.	Hys.	mail	sms	post
1	S1:TST1xx	Temperature, °C	19.0	100.0	0.5	☑	☑	☐
		---	---	---	---	☐	☐	☐

When the controller is switched on, Relay1 is immediately activated because the monitored temperature is out of range. This switches the heater on. The temperature is going higher.

When temperature reaches 19.5°C (19.0 + 0.5) it goes in range (trigger condition) and Relay1 is deactivated. The heater is switched off.

The temperature falls and when it reached 19°C it goes out of range (trigger and alert conditions). The relay is activated (heater is switched on) and e-mail is sent.

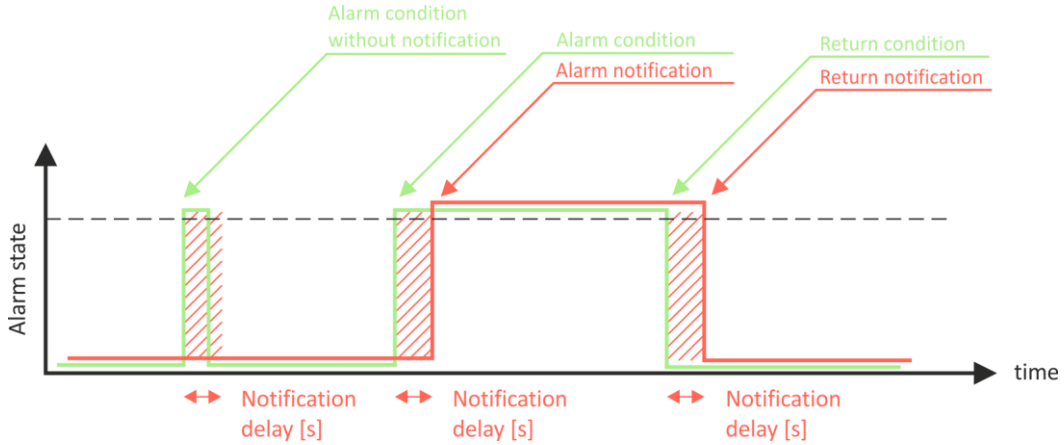


The "Max" value is set far enough from the wanted temperature to avoid trigger/alert conditions around it.

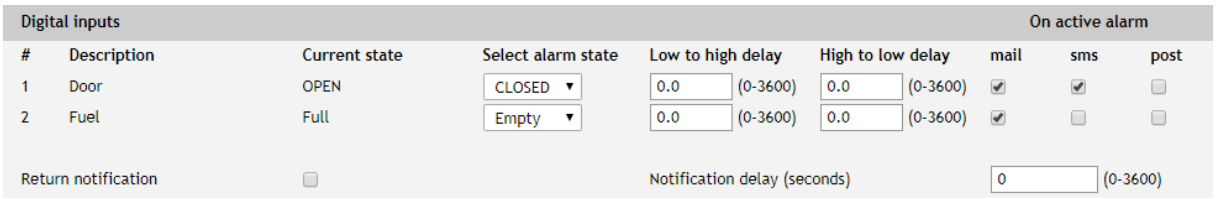
For every sensor or analog input, there are 3 independent ways of alert when there is an alarm condition – email, SMS, and post (HTTP post with XML/JSON file). Each alarm notification method is activated by a checkbox.

Globally for all sensors and for all analog inputs, there is a checkbox "Return notification". If this option is chosen there will be notification also when parameter returns in range.

Globally for all sensors and for all analog inputs, there is a "Notification delay" parameter. It is very useful like a filter for short alarm conditions.



7.2.4.2. Digital inputs



Digital inputs						On active alarm		
#	Description	Current state	Select alarm state	Low to high delay	High to low delay	mail	sms	post
1	Door	OPEN	CLOSED	0.0 (0-3600)	0.0 (0-3600)	☑	☑	☐
2	Fuel	Full	Empty	0.0 (0-3600)	0.0 (0-3600)	☑	☐	☐
Return notification		☐		Notification delay (seconds)		0 (0-3600)		

For every digital input, the alarm state should be chosen – Open or Close.

When the input goes in alarm state 3 independent way of alert are possible – email, SMS, and post (HTTP post with XML/JSON file). Each alarm notification method is activated by a checkbox.

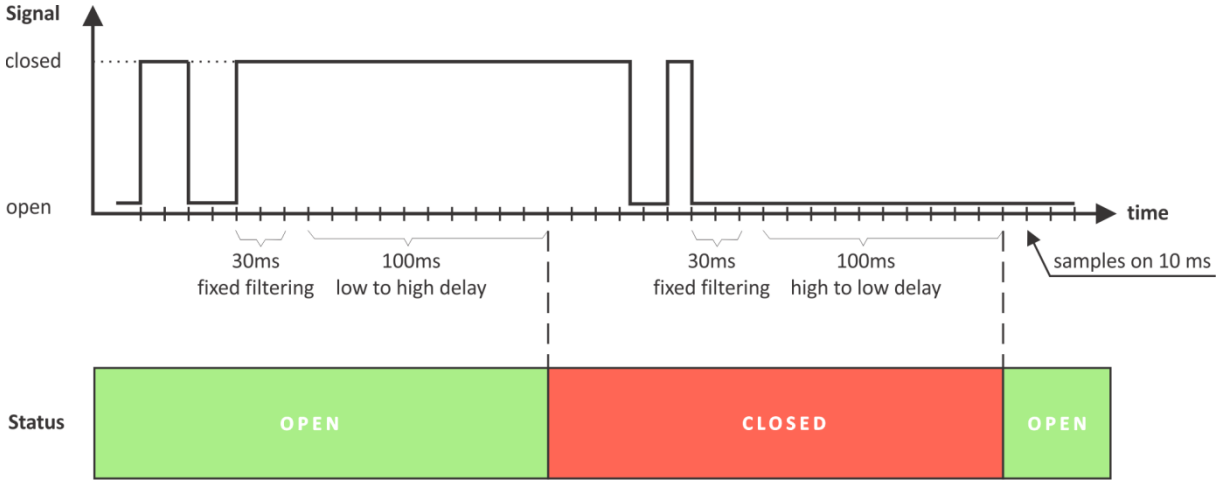
Globally for all digital inputs, there is a checkbox "Return notification". If this option is chosen there will be notification also when parameter returns in range.

Globally for all digital inputs, there is a "Notification delay" parameter. It is very useful like a filter for short alarm conditions.

In the time when the input is in an alarm state, on „Monitoring page", the appropriate input will be colored in red.

There are two delays - low-to-high and high-to-low for digital input change. These delays are added to the standard delay of 30mS. They have 0.1-second resolution and by default are zero.

These options can be used for additional filtering.



On the picture above low-to-high and high-to-low delays are set to 0.1 seconds.

7.2.5. System

The page for some general settings.

7.2.5.1. System status

System status			
GSM connection	Yes	Data in roaming	☐
GPRS connection	Yes	GPRS in roaming	No
Signal strenght	-51dBm(100%)	Service	1
IP address	10.161.31.75	GSM FW version	M95FAR02A08
Service provider	Mobiltel EAD(28401-359)	IMEI	862462037125480

There is information about the general status of the controller here.

The only possible setting here is “Data in roaming” checkbox. By default, it is disabled to avoid extra charges for data transfer in roaming.

If you are using another operator's card, you must activate “Data in roaming”. Otherwise, you will not be able to use all GPRS services – emails, HTTP Post, NTP, etc.

7.2.5.2. GPRS setup

GPRS Setup	
APN	internet
Username	
Password	

To set the GPRS connection it is necessary to enter the APN (Access Point Name). This setting can be different for each mobile operator. By default, it is set to “internet”. Some mobile operators may require also username and password.

7.2.5.3. General setup

General setup			
Temperature units	Celsius	Sensors	☑
Pressure units	hPa	Analog inputs	☑
Host name	TCG140	Digital inputs	☑
Writing mode	left-to-right	Relay outputs	☑
System name	TCG140		
System location	Location		
System contact	info@teracomsystems.com		

The section for some general settings.

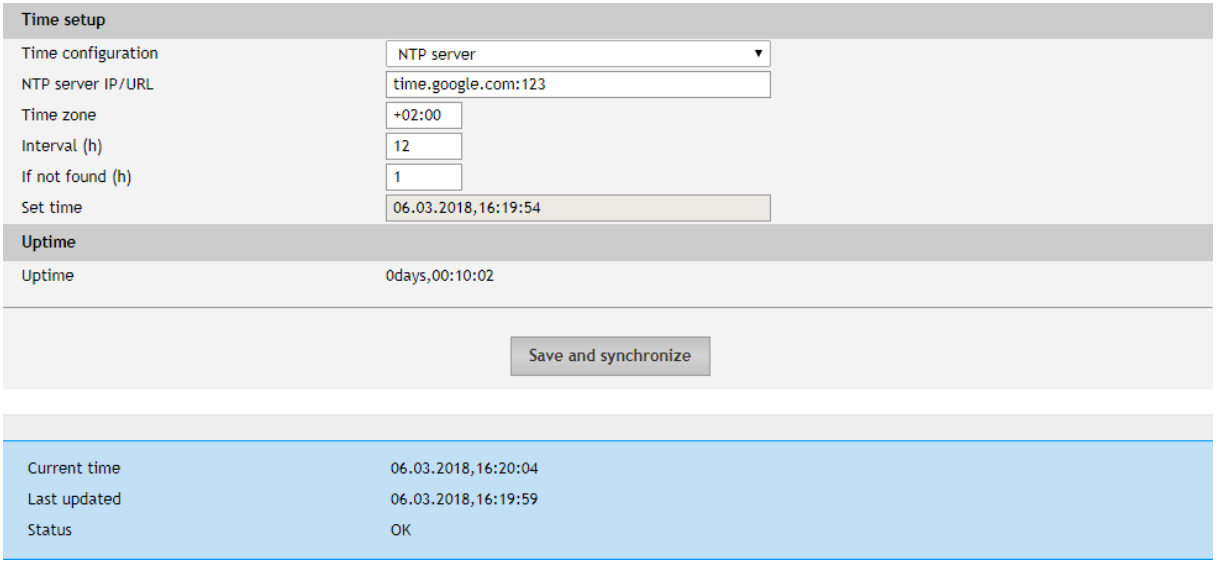
The temperature and pressure units can be changed with preferable ones.

Writing mode change the alignment in the WEB interface and SMS.

Hostname, System name, System location, and System contact are sent in XML/JSON files and can be used for flexible identification of the device. These parameters can be also included in the body of the e-mails.

The checkboxes on the right define what to see on the “Monitoring page”. By default, they all are enabled.

7.2.6. NTP



Internal RTC (real-time clock) of the controller can be set either manually or automatically.

For automatic clock synchronization, the controller supports NTP (Network Time Protocol) and all necessary parameters for automatic synchronization are available in this section.

The clock synchronization is made on “Interval” time. If the attempt was not successful, the next synchronization will be on “If not found” time.

Pressing the “Save and synchronize” button initiate time synchronization. The information for “Status” in the blue box is very useful for the availability of time server and Internet at all.

The current system time is sent in XML/JSON file when HTTP Post is enabled

By default, NTP synchronization is disabled, server – time.google.com:123, Timezone 00.00 and interval of 12 hours.

7.3. Services

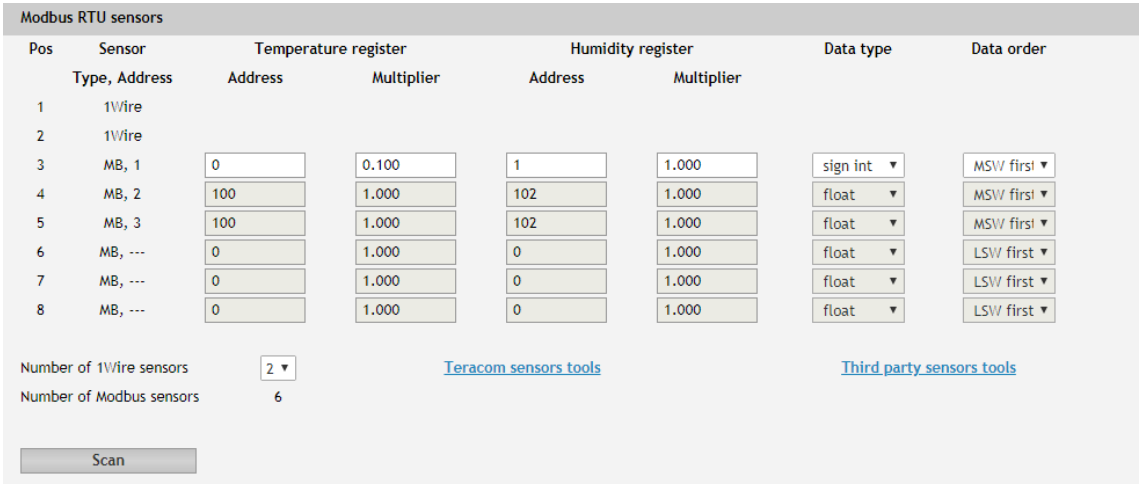
7.3.1. Modbus

7.3.1.1. MODBUS RTU communication setup

TCG140 supports MODBUS RTU over RS-485 interface. All sensors connected to this interface should work with the same communication settings.

By default, TCG140 works with the standard for MODBUS RTU settings – 19200, E, 1.

7.3.1.2. MODBUS RTU sensors



TCG140 supports up to eight sensors. They can be connected to both interfaces in a random ratio. By default, the number of MODBUS RTU sensors are 8.

The 1-Wire sensors are shown always on top of the table. Their temperature and humidity register addresses, multipliers, data type and data order can't be edited.

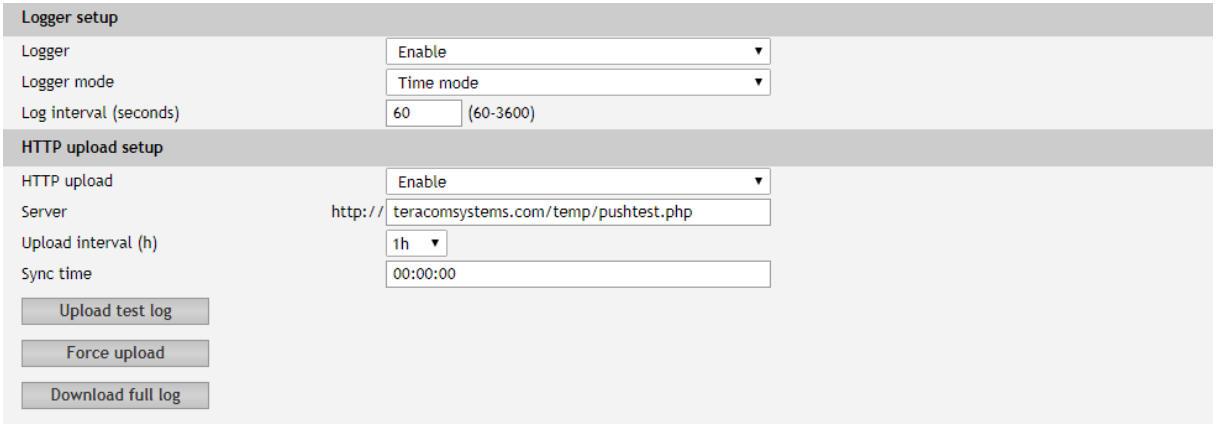
Before to add MODBUS RTU sensors, the user should take care of their address setting. It is not allowed to use two sensors with the same address. It is recommended to scan for new sensors before to make any changes.

TCG140 supports Teracom and third-party MODBUS RTU sensors.

Teracom sensors are with known register addresses and they can't be edited.

For the third-party sensors, appropriate register addresses should be set. It is possible to change the multiplier, data order and data type for these sensors. Float and signed integer, with a multiplier, formats are supported.

7.3.2. Logger



This section is for logger setup.

The logger works in three modes – Time, Alarm and Time&Alarm. The mode specifies what initiates a record in the logger's memory. In Time mode, records are made periodically on "Log interval" time. In Alarm mode, records are made on every alarm condition. In Time&Alarm mode, a mix of both conditions for records is used. To be used the logger should be enabled. By default, it is disabled.

There are two ways to reach the logger records:

- download of the full log file, using "Download full log" in the WEB interface*;*
- periodical upload the last unsent records to the dedicated HTTP server.

The records are uploaded in CSV file format. The period of upload can be chosen from menu between 1 and 24 hours.

The HTTP server can be addressed either by domain name or IP address.

"Sync time" is a moment in the day when a period of upload is synchronized.

Example:

Current time is 19:31, Upload period is 3 hours and Sync time is 9:00.

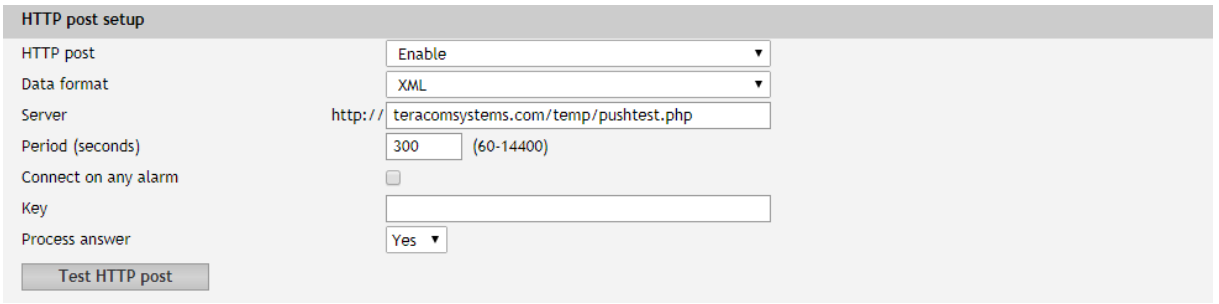
To synchronize the logger to 9:00 it means that time for uploads will be: **09:00**, 12:00, 15:00, 18:00, 21:00, 24:00, 03:00 and 06:00. The first upload, after enabling the logger in 19:31, will be in 21:00.

The button "Force upload" initiates upload recorded information between previous periodical upload and now.

By default HTTP upload of logger data is disabled. If you enable this service take care of the real-time clock (NTP service).

More about the logger can be found in Data logger section.

7.3.3. HTTP Post



HTTP Post is used for periodically upload an XML/JSON file to HTTP server by HTTP requests (POST method). The XML/JSON file contains current status of all monitored parameters and extra system information. The file format is chosen from the drop-down menu.

The HTTP server can be addressed either by domain name or IP address.

The “Period” can be set between 60 and 14400 seconds. This parameter can be changed remotely also by HTTP API. The "Period" determines at what time the control software receives up-to-date information from TCG140 and can, therefore, make changes to some of the parameters. The shorter is "Period", the closer to the real-time operation is the system. On the other hand, as shorter is the "Period" as higher is the data traffic through the mobile network.

If the checkbox “Connect on any alarm” is selected, the HTTP Post request will be sent in an alarm condition.

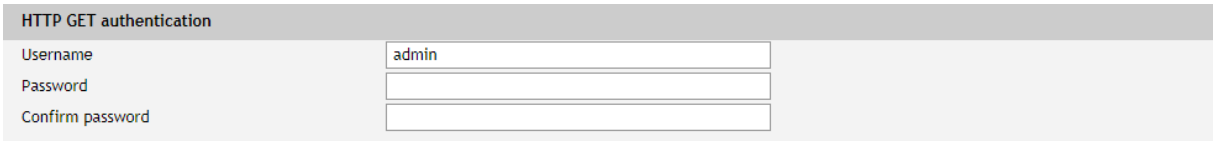
The “Key” field is user defined. Its value is sent in XML/JSON file and can be used for device identification.

If “Process Answer” option is enabled, TCG140 will execute the commands, sent by the remote server as an answer of HTTP Post.

More about HTTP Post can be read in HTTP API section.

7.4. Administration

7.4.1. User/Pass

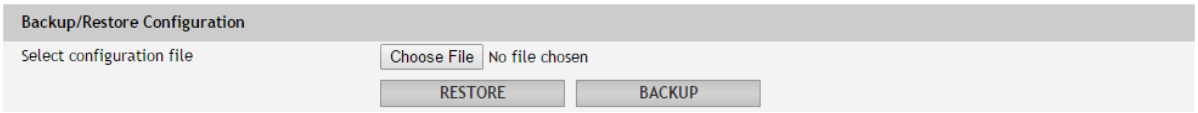


TCG140 supports one user only. It has administrative rights.

The user and password can be up to 31 characters long.

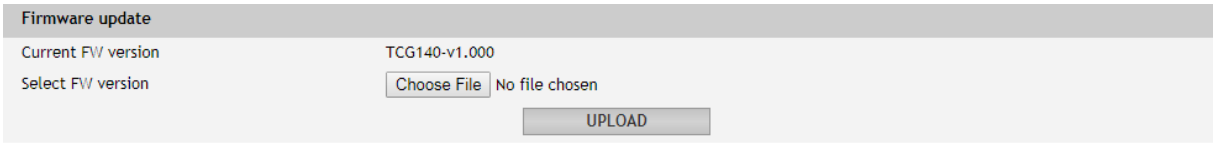
By default, authentication is admin/admin.

7.4.2. Backup/Restore



TCG140 supports backup and restore of all user setting. All settings are saved in XML backup file. This file can be used after this for restore on many devices. This is very useful for multiplying similar settings to a batch of controllers.

7.4.3. FW update



TCG140 supports firmware update over the WEB interface.

It is very simple. Download the latest firmware from www.teracomsystems.com, choose the file and press “upload” button.

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

8. Setup via SMS

TCG140 supports SMS commands for parameters change and status reports, including firmware update over the air. The commands will be executed if they come from previous set 5 phone number. For every command needs different rights.

Below is a list of the supported SMS commands. Note that the underscore character "␣" must be replaced by one space character.

- **Set new master number**

  Rights: Master
  Syntax: set␣master␣<number>
  Where
  <number> is a mobile number in the international format
  Example
  Command: *set master +359885885885*
  Answer: *You are the new master!*

- **Set SMS users numbers -** this message is used to add/delete SMS users

  Rights: Master
  Syntax: set␣sms␣user␣<user>:<number>
  Where
  <number> is a mobile number in the international format
  <user> can be u1, u2, u3 or u4
  Example
  Command: *set sms user u1:+359885887766*
  Answer: *u1:+359885887766,u2,u3,u4*
  Command: *set sms user u2:+359885999888*
  Answer: *u1:+359885887766, u2:+359885999888,u3,u4*
  Command: *set sms user u1:*
  Answer: *u1, u2:+359885999888,u3,u4*

- **Display SMS users numbers**

  Rights: Master, Users
  Syntax: display␣sms␣users
  Example
  Command: *display sms users*
  Answer: *m:+359885885885,u1:+359885887766,u2:+359885999888,u3,u4*

- **Set email users -** this message is used to add/delete email users

  Rights: Master
  Syntax: set␣email␣user␣<user>:<email>
  Where
  <email> - a valid email address
  <user> can be e1, e2, e3, e4 or e5
  Example
  Command: *set email user e1:mail1@teracomsystems.com*
  Answer: *e1:mail1@teracomsystems.com*
  Command: *set email user e2:mail2@teracomsystems.com*
  Answer: *e2:mail2@teracomsystems.com*
  Command: *set email user e2:*
  Answer: *e2:*

- **Display email users** - this message is used to request the email of a user

  Rights: Master, Users

Syntax: display␣email␣<user>
Where
<user> can be one of: e1, e2, e3, e4 or e5

Example
Command: *display email e1*
Answer: *e1:mail1@teracomsystems.com*
Command: *display email e2*
Answer: *e2:mail2@teracomsystems.com*

- **Set call users numbers -** this message is used to add/delete call users

Rights: Master
Syntax: set␣call␣user␣<user>:<number>
Where
<number> is a mobile number in the international format
<user> can be c1, c2, c3,c4 or c5

Example
Command: *set call user c1:+359885887766*
Answer: *c1:+359885887766, c2,c3,c4,c5*
Command: *set call user c2:+359885999888*
Answer: *c1:+359885887766,c2:+359885999888,c3,c4,c5*
Command: *set call user c1:*
Answer: *c1,c2:+359885999888,c3,c4,c5*

- **Display call users** - this message is used to request a list of call users

Rights: Master, Users
Syntax: display␣call␣users

Example
Command: *display call users*
Answer: *c1:+359885122112,c2:+359885322343,c3:+359885431276, c4:+359885128734,c5:+359888343434*

- **Status of system** - requests main parameters of the device

Rights: Master, Users
Syntax: status␣system

Example
Command: *status system*
Answer:
27.06.2017,16:09:06,gprs=y,ss=80%,fw=1.00,call=2/5,post=on,period=60,url=www.teracomsystems.com:8801/posttest.php

- **Status of parameter** - requests status of digital input (di), analog input (ai), relay (r) and sensor(s)

Rights: Master, Users
Syntax: status␣<param>
Where
<param> is one of: di1, di2, ai1, ai2, ai3, ai4, r1, r2, r3, r4, s11, s12, s21, s22, s31, s32, s41, s42, s51, s52, s61, s62, s71, s72, s81, s82

Example
Command: *status di1*
Answer: *di1(Garage_door)=CLOSED*
Command: *status s22*
Answer: *s22(Office)=34.5%RH*

- **Set a relay** - this message is used to switch on/off the selected relay output

  Rights: Master, Users
  Syntax:set␣<relay>=<state>␣[option]
  Where
  <relay> is r1, r2, r3 or r4
  <state> is on, off
  [option] -w
  Example
  Command: *set r1=on*
  Answer: *r1=on,r2=off,r3=off,r4=off*
  Command: *set r1=off*
  Answer: *r1=off,r2=off,r3=off,r4=off*
  Command: *set r2=on -w*
  Answer: *no answer*
  Command: *set r2=off -w*
  Answer: *no answer*

- **Set pulse a relay** - this message is used to pulse the selected relay output

  Rights: Master, Users
  Syntax: set␣<pulse relay>=<state>␣[option]
  Where
  < pulse relay > is pl1, pl2
  <state> is on
  [option] –w
  Example
  Command: *set pl1=on*
  Answer: *r1=on,r2=off,r3=off,r4=on*
  Command: *set pl2=on*
  Answer: *r1=off,r2=on,r3=off,r4=on*
  Command: *set pl1=on -w*
  Answer: *no answer*

- **Post URL** – sets URL for HTTP Post

  Rights: Master
  Syntax: set␣purl=<link>
  Where
  <link> is the address of remote server (domain or IP)
  Example
  Command: *set purl=www.teracomsystems.com:8801/posttest.php*
  Answer: *post=off,period=5, url= www.teracomsystems.com:8801/posttest.php*

- **Post period** – sets HTTP Post period

  Rights: Master
  Syntax: set␣pper=<value>
  Where
  <value> is a number between 60 and 14400 (seconds)
  Example
  Command: *set pper=120*
  Answer: *post=off,period=120,url= www.teracomsystems.com:8801/posttest.php*

- **Post on** – sets HTTP Post on

  Rights: Master
  Syntax: set␣post=on
  Example
  Command: set post=on
  Answer: post=on,period=120,url= www.teracomsystems.com:8801/posttest.php

- **Post off** – sets HTTP Post off

  Rights: Master
  Syntax: set post=off
  Example
  Command: set post=off
  Answer: post=off,period=120,url= www.teracomsystems.com:8801/posttest.php

- **Set a time server**

  Rights: Master
  Syntax: set␣ts=url:port
  Example
  Command: set ts=time.google.com:123
  Answer: ts=time.google.com:123,tz=+02:00

- **Set a time zone**

  Rights: Master
  Syntax: set␣tz=±hh:mm
  Example
  Command: set tz=+03:00
  Answer: ts=time.google.com:123,tz=+03:00

- **Restart** – restarts the device

  Rights: Master
  Syntax:restart
  Example
  Command: restart
  Answer: Device is restarting!

- **Send test email** – a message for sending a test email to the email users

  Rights: Master
  Syntax: test␣email
  Example
  Command: test email
  Answer: Emails are sending!

- **Send test SMS** – a message for sending a test SMS to the authorized users

  Rights: Master
  Syntax: test␣sms
  Example
  Command: test sms
  Answer: This is a test SMS!

- **Update** – a message for update the device over the air (GPRS)

  Rights: Master
  Syntax: update␣<URL>
  Where

<URL> is a valid URL to public server, pointing update (.cod) file

Example
Command: *update www.teracomsystems.com/docs/TCG140-v1.000-P-S.cod*
Answer 1: *Downloading firmware...*
Answer 2: *Firmware file downloaded. Updating...*

Following answers are also possible in different situations:
Answer: *File corrupt or wrong version!*
Answer: *Can't connect to server!*
Answer: *Download time out!*
Answer: *GPRS is not connected!*
Answer: *Connection lost!*
Answer: *Response timeout!*
Answer: *Socket error!*

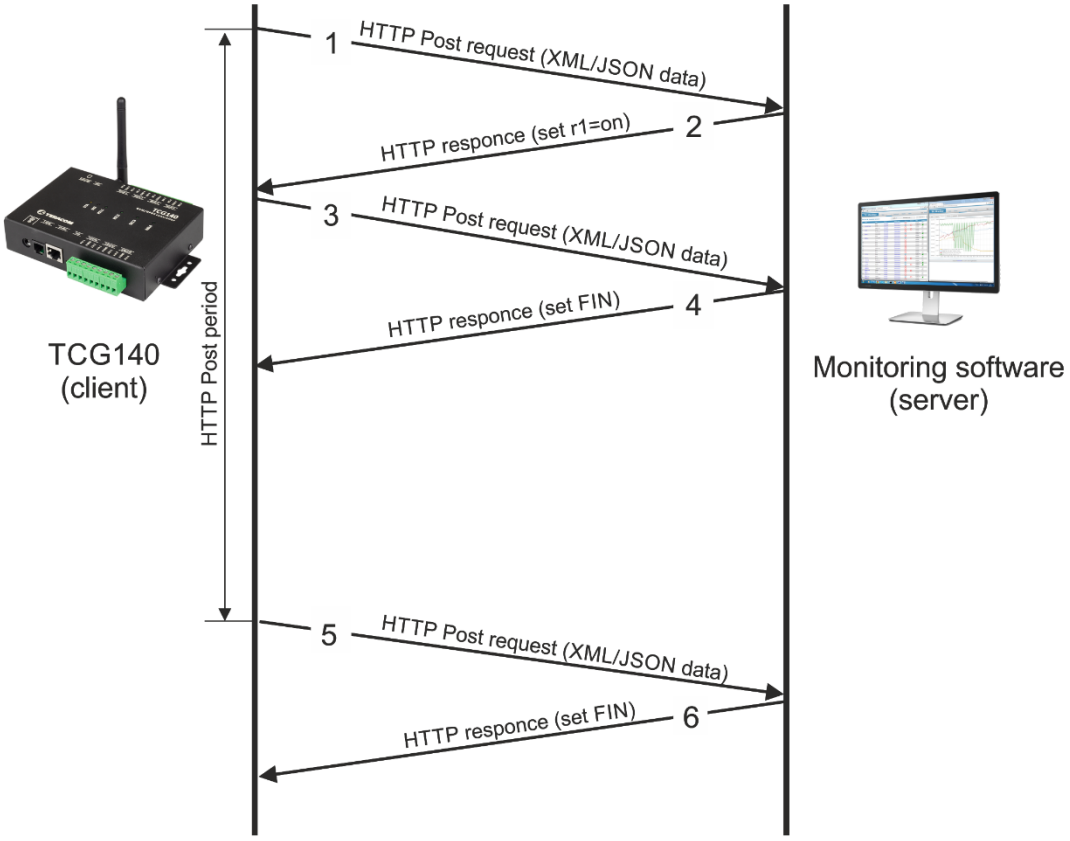
9. HTTP API

HTTP is a very popular protocol for implementation of remote monitoring and control SCADA systems. These systems are built on the client-server technology.

TCG140 supports both - client mode (HTTP Post) and server mode (HTTP Get). This makes the device compatible with all SCADA software running HTTP protocol.

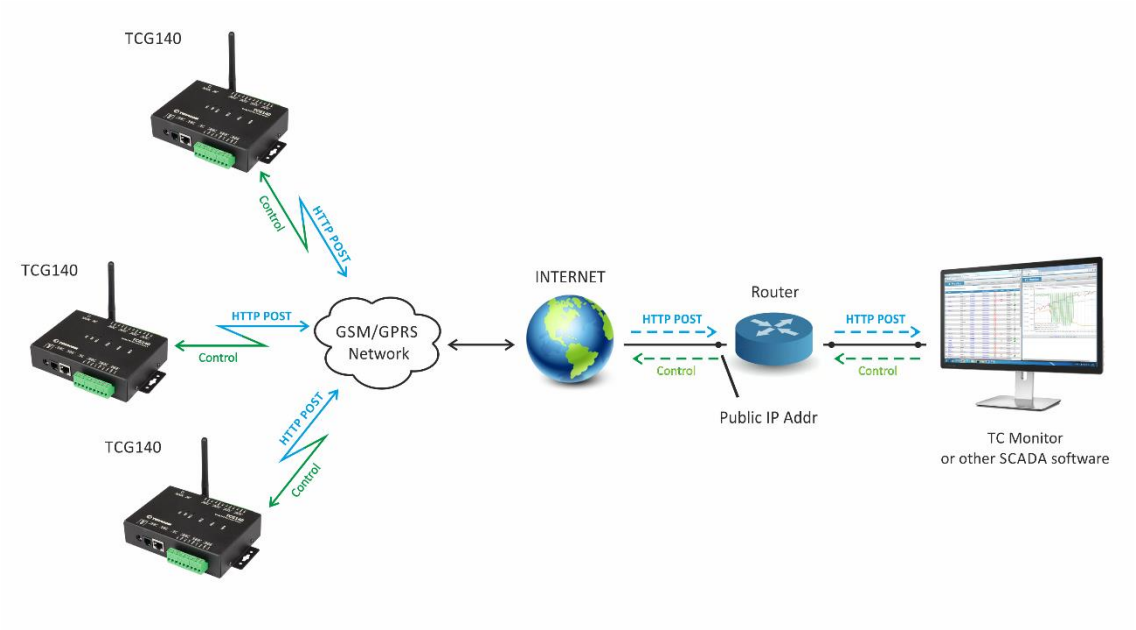
9.1. HTTP Post

The HTTP Post service is used when TCG140 utilizes a data card that has no fixed public address. In this case, the controller has an internal IP address from the network of the mobile operator and can’t be accessed via the Internet.
If the service is active, the controller periodically sends the HTTP Post to a server. This post contains an XML/JSON file with the current status of monitored parameters.
The post can be sent also on an alarm condition - there is an analogy with SNMP trap.
On every HTTP Post, the server returns command or FIN to terminate the connection.
A very important parameter in this communication is the HTTP Post period. With shorter time period the device generates more data traffic, but this keeps the information and possibility to control the device closer to "real-time".
The HTTP Post period can be changed by the server with appropriate HTTP command. This makes the communication very flexible.
Below is a typical communication session between TCG140 and remote server:



- The device sends HTTP Post request (1) with XML/JSON data to the remote server either on post period or on alarm condition;
- The server returns HTTP response (2), which contains “set r1=on” command as a brief text in the message body;
- The device sends a new HTTP Post request (3) with updated XML/JSON data, which confirms the execution of “set r1=on” command;
- The server returns a new HTTP response (4), which includes “set FIN” in the message body. This indicates that there are no pending commands and the session can be closed;
- On next HTTP Post period, TCG140 sends a new HTTP POST request (5) to the server;
- The server answers with “set FIN” (6)– there is no pending commands and the session can be closed.

A typical monitoring application is shown on the picture below:



HTTP Post service can be test following the steps below:

- Save following code like post.php:

```
<?php
    define("FILENAME", 'status.xml');
    define("FOLDER", '');
    define("SEPARATOR", '');
    define("STR_SUCCESS", 'set FIN');
    define("STR_ERROR", 'error');

    if($_SERVER['REQUEST_METHOD'] == 'POST'){
        $datePrefix = date('YmdHis', strtotime('now'));
        $pathname = FOLDER.SEPARATOR.$datePrefix.'_'.FILENAME;
        $postdata = file_get_contents("php://input");
        $handle = fopen($pathname, 'w+');
        $content = var_export($postdata, true);
        fwrite($handle, substr($content, 1, strlen($content)-2));
        fclose($handle);
        echo (($handle === false) ? STR_ERROR : STR_SUCCESS)."\r\n";
    }
        else {
            echo "The PHP script is working!";
        }
?>
```

- Copy the *post.php* file on a WEB server with PHP support. The server should have visibility from the Internet. The UniServer and XAMP are the most popular WEB servers for Windows.
- To verify that the script is working properly, type the URL (for example www.yourserverURL.com/post.php) in the WEB browser. If all is OK, a WEB page with “The PHP script is working!” will be shown.
- Activate HTTP Post service, setting www.yourserverURL.com/post.php in the URL field.
- Click on “Test HTTP Post” button.
- If the HTTP POST is received and processed, “OK” will be shown close to the button. Along with this, an XML file will be created in the same directory, where *post.php* is located. The file name will contain time information and looks as 20171020103318_status.xml.

9.1.1. XML file structure

Please see the Appendix A.

9.1.2. JSON file structure

Please see the Appendix B.

9.2. HTTP commands

TCG140 supports following commands, sent with HTTP Post:

Command	Description
set r1=on	Turn Relay 1 ON
set r2=on	Turn Relay 2 ON
set r3=on	Turn Relay 3 ON
set r4=on	Turn Relay 4 ON
set r1=on&r2=on&r3=on&r4=on	Turn four relays ON
set r1=off	Turn Relay 1 OFF
set r2=off	Turn Relay 2 OFF
set r3=off	Turn Relay 3 OFF
set r4=off	Turn Relay 4 OFF
set r1=off&r2=off&r3=off&r4=off	Turn four relays OFF
set r1=tg	Toggle Relay 1 state
set r2=tg	Toggle Relay 2 state
set r3=tg	Toggle Relay 3 state
set r4=tg	Toggle Relay 4 state
set r1=pl	Pulse Relay 1
set r2=pl	Pulse Relay 2
set r3=pl	Pulse Relay 3
set r4=pl	Pulse Relay 4
set pper=x	HTTP Post period in seconds (x is between 60 and 14400)
set FIN	Terminate session

10. Data Logger

The logger utilizes circular buffer in FLASH memory. When it is full, the new data overwrites the oldest one. In this manner FLASH memory stores full log all the time. There isn't a command to clear the log. A copy of the full log is always available for download.

The number of records depends on how long descriptions and what kind of characters are used. In the worst case (15 bytes description with characters from the highest part of UTF-8) a number of records are about 37000. This number is enough for 25 days with records on every 1 minute.

In most of the cases, the data logger can keep 53000 records, which is enough for 36 days with records on every 1 minute.

The new records can be periodically uploaded as a file to a dedicated HTTP server in time intervals – 1, 2, 3, 4, 6, 8, 12 and 24 hours. The file is in CSV format. A semicolon is used as a delimiter.

The first row of the log file is always header. All rows, including the header, start with record ID and time stamp.

The structure of one row (record) of the log is as follows:

ID	Time	Type of record	Inputs value	Relays	Alarm conditions

ID	32-bit unique number for every row (record).
Time	a time stamp of record, in format yyyy.mm.dd, hh:mm:ss.
Type of record	following types of records are available:
	"Time" for periodical record;
	"Event" for record initiated by alarm condition;
	"Type" for header record;
	"Start" after power-up condition;
	"Restart" after reset condition;
	"Power Down" after power-down condition;
	"Bad" for a problematic record.
Inputs value	in orders – sensors, analog inputs and digital inputs.
Relays	the relays conditions.
Alarm conditions	show condition for every input, “1” means an active alarm.

An example of the log file:

1131901;15.10.2017,01:02:23;Type;S11/°C;S12;S21/°C;S22;S31/°C;S32;S41/°C;S42;S51/°C;S52;S61/°C;S62;S71/°C;S72;S81/°C;S82;A1/V;A2/V;D1;D2;R1;R2;S11/°C;S12;S21/°C;S22;S31/°C;S32;S41/°C;S42;S51/°C;S52;S61/°C;S62;S71/°C;S72;S81/°C;S82;A1/V;A2/V;D1;D2;
1131902;15.10.2017,01:02:23;Time;18.250;;18.375;;18.125;;18.500;;18.188;;18.125;;18.375;;18.375;;11.352;0.065;1;0;1;0;1;;1;;1;;1;;1;;1;;1;;1;;1;0;1;0;
1131903;15.10.2017,01:02:23;Event;18.250;;18.438;;18.125;;18.500;;18.188;;18.125;;18.313;;18.375;;11.352;0.066;0;1;0;1;1;;1;;1;;1;;1;;1;;1;;1;;1;0;0;1;
1131904;15.10.2017,01:02:24;Time;18.250;;18.438;;18.125;;18.500;;18.188;;18.125;;18.313;;18.375;;11.352;0.066;0;1;0;1;1;;1;;1;;1;;1;;1;;1;;1;;1;0;0;1;
1131905;15.10.2017,01:02:25;Time;18.250;;18.375;;18.125;;18.500;;18.188;;18.125;;18.313;;18.375;;11.352;0.066;0;1;0;1;1;;1;;1;;1;;1;;1;;1;;1;;1;0;0;1;
1131906;15.10.2017,01:02:26;Time;18.250;;18.375;;18.125;;18.500;;18.188;;18.125;;18.313;;18.313;;11.352;0.066;0;1;0;1;1;;1;;1;;1;;1;;1;;1;;1;;1;0;0;1;
1131907;15.10.2017,01:02:27;Time;18.250;;18.375;;18.125;;18.438;;18.188;;18.125;;18.313;;18.313;;11.352;0.066;0;1;0;1;1;;1;;1;;1;;1;;1;;1;;1;;1;0;0;1;
1131908;15.10.2017,01:02:27;Event;18.250;;18.375;;18.125;;18.438;;18.188;;18.125;;18.313;;18.313;;2.198;9.092;0;1;0;1;1;;1;;1;;1;;1;;1;;1;;0;0;0;1;

11. Firmware update

TCG140 supports firmware update over the WEB interface and over the air.

For firmware update over the WEB interface please see 7.4.3. FW update.

For firmware update over the air (GPRS) please follow the steps below:

- Upload the update file (.cod extension) on public HTTP server ;
- Send firmware update command (the syntax of the SMS message is described in 8. Setup via SMS).

  Please note that only the Master can send this message.

The firmware will be downloaded and verified. The download via GPRS takes around 3 minutes. If the file is correct, the Master will receive confirmation SMS message. The update procedure takes around 2 minutes. Once the firmware update is complete (about 5 minutes), TCG140 will restart.

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

12. Factory default settings

TCG140 can be restored to its original factory default settings by following the steps:

- Turn off the power supply;
- Press and hold the RESET button then turn on the power supply;
- STA and SIG LEDs will turn ON;
- Release the RESET button.

The controller will restore its default settings.

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 0.5mm² 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 controller, if recommended free spaces to adjacent devices are not ensured. 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.

15. Maintenance

Upon completion of any service or repairs 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.

16. Package content

The box contains:

- TCG140
- GSM antenna
- Quick start guide

The XML file (status.xml) structure:


```
<Monitor>
  <DeviceInfo>
      <DeviceName>TCG140</DeviceName>
      <HostName> TCG140</HostName>
      <ID>862462032599374</ID>
      <FwVer>TCG140-v1.000</FwVer>
      <MnfInfo>www.teracomsystems.com</MnfInfo>
      <SysContact>info@teracomsystems.com</SysContact>
      <SysName>Name</SysName>
      <SysLocation>Location</SysLocation>
  </DeviceInfo>
  <S>
      <S1>
            <description>S1:TST1xx</description>
            <id>28C4C109030000C5</id>
        <item1>
            <value>12.7</value>
            <unit>°C</unit>
            <alarm>0</alarm>
            <min>-40.0</min>
            <max >85.0</max>
            <hyst>8.5</hyst>
        </item1>
        <item2>
            <value>---</value>
            <unit>---</unit>
            <alarm>0</alarm>
            <min>---</min>
            <max>---</ max>
            <hyst>---</hyst>
        </item2>
    </S1>
    <S2>
        <description>S2:TST1xx</description>
        <id>2819D009030000FA</id>
        <item1>
            <value>12.8</value>
            <unit>°C</unit>
            <alarm>0</alarm>
            <min>-40.0</min>
            <max>85.0</max>
            <hyst>8.5</hyst>
        </item1>
        <item2>
            <value>---</value>
            <unit>---</unit>
            <alarm>0</alarm>
            <min>---</min>
            <max>---</max>
            <hyst>---</hyst>
        </item2>
    </S2>
    <S3>
        <description>S3:TST1xx</description>
        <id>2867895F07000058</id>
        <item1>
            <value>13.0</value>
            <unit>°C</unit>
            <alarm>0</alarm>
            <min>-40.0</min>
            <min>85.0</min>
            <hyst>8.5</hyst>
        </item1>
        <item2>
```

```
            <value>---</value>
            <unit>---</unit>
            <alarm>0</alarm>
            <min>---</min>
            <max>---</max>
            <hyst>---</hyst>
        </item2>
    </S3>
    <S4>
        <description>S4:TSH2xx</description>
        <id>01D01FB71700FFF8</id>
        <item1>
            <value>12.9</value>
            <unit>°C</unit>
            <alarm>0</alarm>
            <min>-40.0</min>
            <max>85.0</max>
            <hyst>8.5</hyst>
        </item1>
        <item2>
            <value>57.2</value>
            <unit>%RH</unit>
            <alarm>0</alarm>
            <min>0.0</min>
            <max>100.0</max>
            <hyst>1.0</hyst>
        </item2>
    </S4>
    <S5>
        <description>S5</description>
        <id>0000000000000000</id>
        <item1>
            <value>---</value>
            <unit>---</unit>
            <alarm>0</alarm>
            <min>---</min>
            <max>---</max>
            <hyst>---</hyst>
        </item1>
        <item2>
            <value>---</value>
            <unit>---</unit>
            <alarm>0</alarm>
            <min>---</min>
            <max>---</max>
            <hyst>---</hyst>
        </item2>
    </S5>
    <S6>
        <description>S6</description>
        <id>0000000000000000</id>
        <item1>
            <value>---</value>
            <unit>---</unit>
            <alarm>0</alarm>
            <min>---</min>
            <max>---</max>
            <hyst>---</hyst>
      </item1>
      <item2>
          <value>---</value>
          <unit>---</unit>
          <alarm>0</alarm>
            <min>---</min>
            <max>---</max>
            <hyst>---</hyst>
      </item2>
  </S6>
```

```
<S7>
    <description>S7</description>
    <id>0000000000000000</id>
      <item1>
          <value>---</value>
          <unit>---</unit>
          <alarm>0</alarm>
          <min>---</min>
          <max>---</max>
          <hyst>---</hyst>
      </item1>
      <item2>
          <value>---</value>
          <unit>---</unit>
          <alarm>0</alarm>
          <min>---</min>
          <max>---</max>
          <hyst>---</hyst>
      </item2>
    </S7>
    <S8>
      <description>S8</description>
      <id>0000000000000000</id>
      <item1>
          <value>---</value>
          <unit>---</unit>
          <alarm>0</alarm>
          <min>---</min>
          <max>---</max>
          <hyst>---</hyst>
      </item1>
      <item2>
          <value>---</value>
          <unit>---</unit>
          <alarm>0</alarm>
          <min>---</min>
          <max>---</max>
          <hyst>---</hyst>
      </item2>
    </S8>
</S>
<AI>
    <AI1>
        <description>Analog Input 1</description>
        <value>9.300</value>
        <unit>V</unit>
        <multiplier>1.000</multiplier>
        <offset>0.000</offset>
        <alarm>0</alarm>
        <min>0.000</min>
        <max>10.000</max>
        <hyst>0.100</hyst>
  </AI1>
  <AI2>
        <description>Analog Input 2</description>
        <value>4.95</value>
        <unit>V</unit>
        <multiplier>1.000</multiplier>
        <offset>0.000</offset>
        <alarm>1</alarm>
        <min>0.000</min>
        <max>6.000</max>
        <hyst>0.100</hyst>
  </AI2>
  <AI3>
        <description>Analog Input 3</description>
        <value>0.000</value>
        <unit>V</unit>
```

```
        <multiplier>1.000</multiplier>
        <offset>0.000</offset>
        <alarm>0</alarm>
        <min>0.000</min>
        <max>10.000</max>
        <hyst>0.100</hyst>
  </AI3>
  <AI4>
        <description>Analog Input 4</description>
        <value>0.000</value>
        <unit>V</unit>
        <multiplier>1.000</multiplier>
        <offset>0.000</offset>
        <alarm>0</alarm>
        <min>0.000</min>
        <max>10.000</max>
        <hyst>0.100</hyst>
  </AI4>
</AI>
<DI>
  <DI1>
        <description>Digital Input 1</description>
        <value>OPEN</value>
        <valuebin>1</valuebin>
        <alarmState>CLOSED</alarmState>
        <alarm>0</alarm>
  </DI1>
  <DI2>
        <description>Digital Input 2</description>
        <value>OPEN</value>
        <valuebin>1</valuebin>
        <alarmState>CLOSED</alarmState>
        <alarm>0</alarm>
  </DI2>
</DI>
<R>
  <R1>
        <description>Relay 1</description>
        <value>OFF</value>
        <valuebin>0</valuebin>
        <pulseWidth>1</pulseWidth>
        <control>S1:TST1xx Temperature</control>
  </R1>
  <R2>
        <description>Relay 2</description>
        <value>OFF</value>
        <valuebin>0</valuebin>
        <pulseWidth>1</pulseWidth>
        <control>0</control>
  </R2>
  <R3>
        <description>Relay 3</description>
        <value>OFF</value>
        <valuebin>0</valuebin>
        <pulseWidth>1</pulseWidth>
        <control>0</control>
  </R3>
  <R4>
        <description>Relay 4</description>
        <value>OFF</value>
        <valuebin>0</valuebin>
        <pulseWidth>1</pulseWidth>
        <control>0</control>
  </R4>
</R>
<HTTPPush>
  <Key/>
  <PushPeriod>300</PushPeriod>
```

</HTTPPush>
<signalpercent>80</signalpercent>
<hwerr/>
<Alarmed>1</Alarmed>
<Scannig/>
<Time>
<Date>06.03.2018</Date>
<Time>09:05:14</Time>
</Time>
</Monitor>

Where:

<value>--- </value> and <unit>--- </unit> means no 1-Wire sensor on this position;

<alarm>1</alarm> means there is a trigger condition.

The JSON file (status.json)structure:


```
{
  "Monitor": {
    "DeviceInfo": {
      "DeviceName": "TCG140",
      "HostName": " TCG140",
      "ID": "862462032599374",
       "FwVer": " TCG140-v1.000",
      "MnfInfo": “www.teracomsystems.com”,
      "SysContact": "info@teracomsystems.com",
      "SysName": "Name",
      "SysLocation": "Location"
    },
    "S": {
      "S1": {
        "description": "S1:TST1xx",
        "id": "28C4C109030000C5",
        "item1": {
          "value": "14.9",
          "unit": "B°C",
          "alarm": "0",
            "min": "-40.0",
            "max": "85.0",
            "hyst": "8.5"
        },
        "item2": {
          "value": "---",
          "unit": "---",
          "alarm": "0",
            "min": "---",
            "max": "---",
            "hyst": "---"

        }
      },
      "S2": {
        "description": "S2:TST1xx",
        "id": "2819D009030000FA",
        "item1": {
          "value": "15.1",
          "unit": "°C",
          "alarm": "0",
            "min": "-40.0",
            "max": "85.0",
            "hyst": "8.5"
        },
        "item2": {
          "value": "---",
          "unit": "---",
          "alarm": "0",
            "min": "---",
            "max": "---",
            "hyst": "---"
        }
      },
      "S3": {
        "description": "S3:TST1xx",
        "id": "2867895F07000058",
        "item1": {
          "value": "15.0",
          "unit": "°C",
          "alarm": "0",
            "min": "-40.0",
            "max": "85.0",
            "hyst": "8.5"
```

```
    },
    "item2": {
      "value": "---",
      "unit": "---",
      "alarm": "0",
        "min": "---",
        "max": "---",
        "hyst": "---"
    }
  },
  "S4": {
    "description": "S4:TSH2xx",
    "id": "01D01FB71700FFF8",
    "item1": {
      "value": "15.9",
      "unit": "°C",
      "alarm": "0",
        "min": "-40.0",
        "max": "85.0",
        "hyst": "8.5"

    },
    "item2": {
      "value": "58.8",
      "unit": "%RH",
      "alarm": "0",
       "min": "0.0",
        "max": "100.0",
        "hyst": "10.0"
    }
  },
  "S5": {
    "description": "S5",
    "id": "0000000000000000",
    "item1": {
      "value": "---",
      "unit": "---",
      "alarm": "0",
       "min": "---",
        "max": "---",
        "hyst": "---"
    },
    "item2": {
      "value": "---",
      "unit": "---",
      "alarm": "0",
       "min": "---",
        "max": "---",
        "hyst": "---"
    }
  },
  "S6": {
    "description": "S6",
    "id": "0000000000000000",
    "item1": {
      "value": "---",
      "unit": "---",
      "alarm": "0",
        "min": "---",
        "max": "---",
        "hyst": "---"
    },
    "item2": {
      "value": "---",
      "unit": "---",
      "alarm": "0",
        "min": "---",
        "max": "---",
```

```
            "hyst": "---"
        }
    },
    "S7": {
        "description": "S7",
        "id": "0000000000000000",
        "item1": {
            "value": "---",
            "unit": "---",
            "alarm": "0",
              "min": "---",
              "max": "---",
              "hyst": "---"

        },
        "item2": {
            "value": "---",
            "unit": "---",
            "alarm": "0",
              "min": "---",
              "max": "---",
              "hyst": "---"
        }
    },
    "S8": {
        "description": "S8",
        "id": "0000000000000000",
        "item1": {
            "value": "---",
            "unit": "---",
            "alarm": "0",
              "min": "---",
              "max": "---",
              "hyst": "---"
        },
        "item2": {
            "value": "---",
            "unit": "---",
            "alarm": "0",
              "min": "---",
              "max": "---",
              "hyst": "---"
        }
    }
},
"AI": {
    "AI1": {
        "description": "Analog Input 1",
        "value": "9.300",
        "unit": "V",
        "multiplier": "1.000",
        "offset": "0.000",
        "alarm": "0",
            "min": "0.000",
            "max": "9.500",
            "hyst": "0.100"
    },
    "AI2": {
        "description": "Analog Input 2",
        "value": "4.950",
        "unit": "V",
        "multiplier": "1.000",
        "offset": "0.000",
        "alarm": "1",
            "min": "4.500",
            "max": "6.000",
            "hyst": "0.100"
    },
```

```
    "AI3": {
      "description": "Analog Input 3",
      "value": "0.000",
      "unit": "V",
      "multiplier": "1.000",
      "offset": "0.000",
      "alarm": "1",
        "min": "0.000",
        "max": "10.000",
        "hyst": "1.000"
    },
    "AI4": {
      "description": "Analog Input 4",
      "value": "0.000",
      "unit": "V",
      "multiplier": "1.000",
      "offset": "0.000",
      "alarm": "1",
        "min": "0.000",
        "max": "10.000",
        "hyst": "1.000"
    }
  },
  "DI": {
    "DI1": {
      "description": "Digital Input 1",
      "value": "OPEN",
      "valuebin": "1",
      "alarmState": "CLOSED",
      "alarm": "0"
    },
    "DI2": {
      "description": "Digital Input 2",
      "value": "OPEN",
      "valuebin": "1",
      "alarmState": "CLOSED",
      "alarm": "0"
    }
  },
  "R": {
    "R1": {
      "description": "Relay 1",
      "value": "OFF",
      "valuebin": "0",
      "pulseWidth": "1",
      "control": "S1:TST1xx Temperature"
    },
    "R2": {
      "description": "Relay 2",
      "value": "OFF",
      "valuebin": "0",
      "pulseWidth": "1",
      "control": "0"
    },
    "R3": {
      "description": "Relay 3",
      "value": "OFF",
      "valuebin": "0",
      "pulseWidth": "1",
      "control": "0"
    },
    "R4": {
      "description": "Relay 4",
      "value": "OFF",
      "valuebin": "0",
      "pulseWidth": "1",
      "control": "0"
    }
```

```
        },
        "HTTPPush": {
          "Key": "",
          "PushPeriod": "300"
        },
        “signalpercent”: "80",
        "hwerr": "",
        "Alarmed": "1",
        "Scannig": "",
        "Time": {
          "Date": "06.03.2018",
          "Time": "09:05:14"
        }
    }
}
```

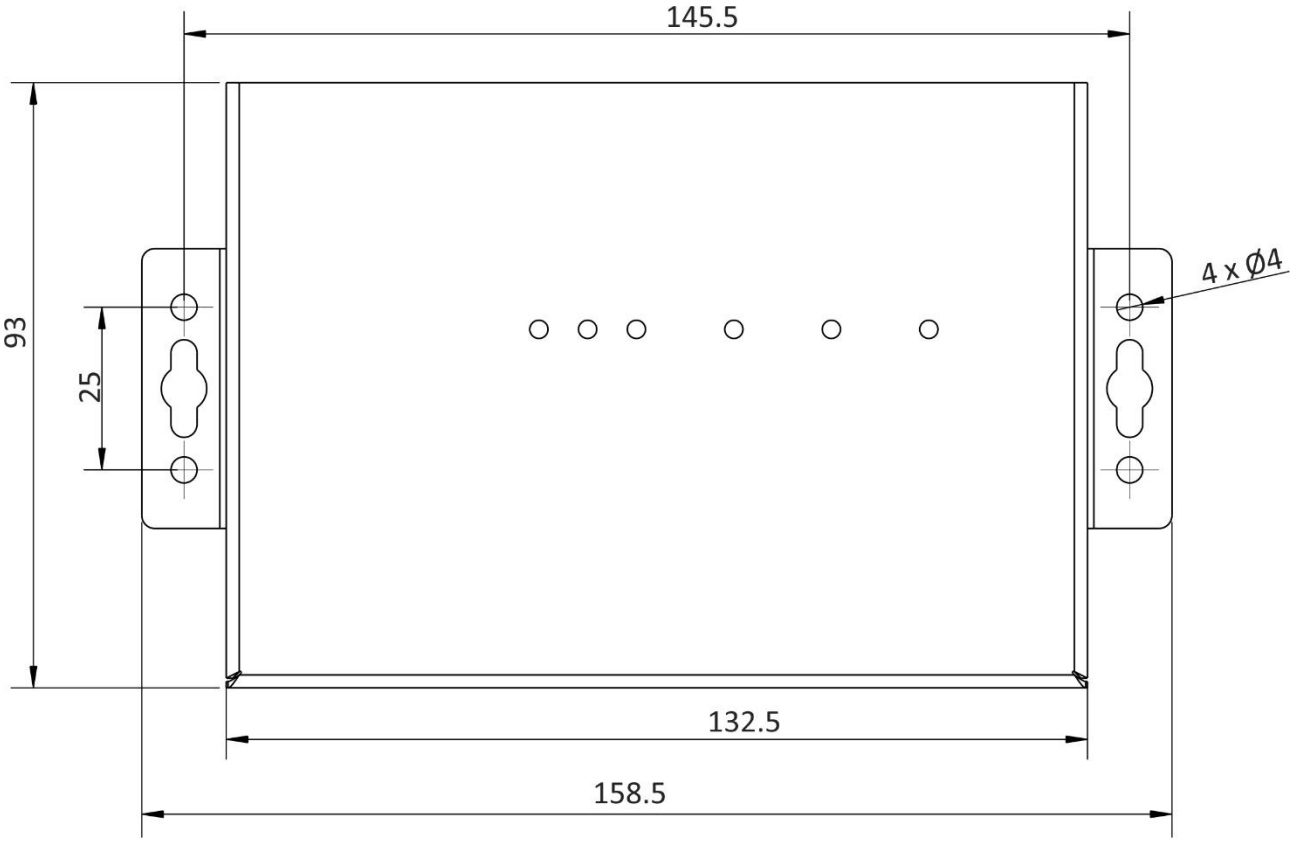


Fig.1

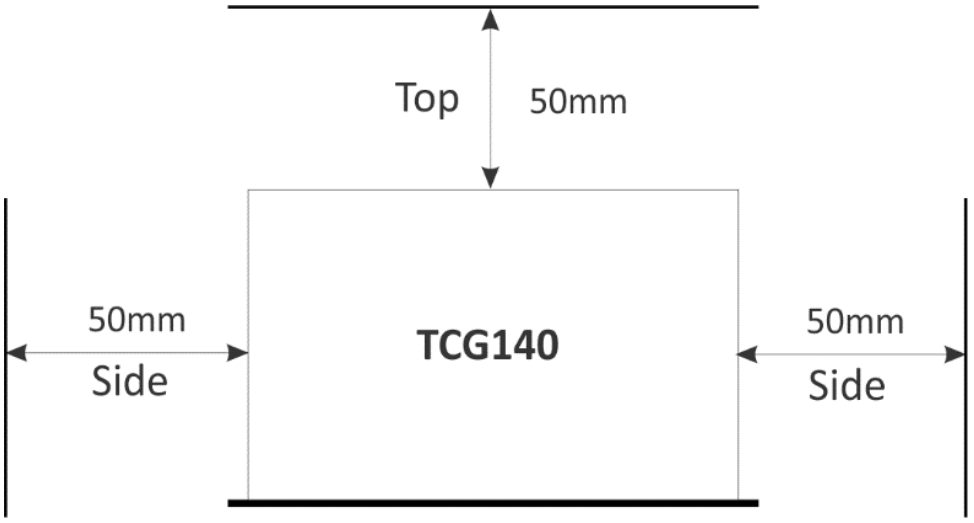


Fig.2