

ZABBIX SNMP MONITORING

User Guide for Morningstar Devices

Overview

Zabbix is an open-source monitoring software tool for diverse IT components, including networks, servers, virtual machines (VMs), and cloud services. Native integration with Morningstar-SNMP-enabled devices accelerates the setup process. Zabbix will automatically query the devices for many variables such as battery voltage, temperature, device state status for every minute. If a specified threshold is reached or an abnormal value is detected, the system will warn about it via an email, SMS, or other notification channel specified in the configuration.

Supported devices

Supported Morningstar Devices

- Tristar PWM (Charge/Load/Diversion Control)
- Tristar MPPT
- Tristar MPPT 600V
- Prostar PWM
- Prostar MPPT
- Sunsaver MPPT
- Suresine

Connection: Each Morningstar device must be connected to your Zabbix monitored network using a Morningstar [Ethernet MeterBus Converter \(EMC-1\)](#).

System requirements

Memory

Zabbix requires both physical and disk memory. 128 Mb of physical memory and 256 MB of free disk space could be a good starting point. However, the amount of required disk memory obviously depends on the number of hosts and parameters that are being monitored. If you're planning to keep a long history of monitored parameters, you should be thinking of at least a couple of gigabytes to have enough space to store the history in the database. Each Zabbix daemon process requires several connections to the database server. The amount of memory allocated for the connection depends on the configuration of the database engine.

CPU

Zabbix, especially the Zabbix database, may require significant CPU resources, depending on the number of monitored parameters and chosen database engines.

Supported Platforms

Due to security requirements and the monitoring server's mission-critical nature, UNIX is the only operating system that can consistently deliver the necessary performance, fault tolerance, and resilience. Zabbix operates on market-leading versions.

More information about the system requirements can be found [here](#).

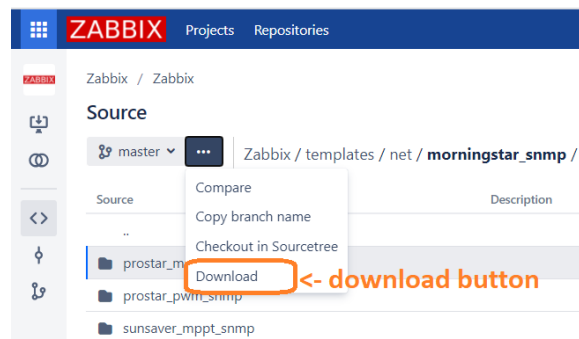
Prerequisites and installation

Zabbix is an open-source product that can be installed on a majority of Unix-like distributions at no cost - see [a full list of supported distributions](#). Alternatively, Zabbix is available on certain [cloud services](#).

1. Install Zabbix following instructions from the [Downloads](#) page for your preferred installation method. You can refer to this installation video: <https://www.youtube.com/watch?v=yYmkFf3AEBo>
2. Download monitoring Morningstar templates suitable for your Morningstar devices to the computer.

Zabbix setup

1. Download Morningstar Templates
 - Morningstar SNMP monitoring templates are universally compatible with all Zabbix instances.
 - A user also can download the templates from Zabbix website
 - [Link](#) to download Morningstar SNMP templates (For Zabbix 5.2 and higher). Template is a `.YAML` file.
 - [Link](#) to download Morningstar SNMP templates (For Zabbix 5.0 and higher. Template is a `.XML` file.
 - Click on the “download” button



- Once downloaded, you'll need to unzip the folder. Following this directory **unzipped folder\templates\net\morningstar_snmp**, you can find the SNMP template for each Morningstar device.
2. Login to Zabbix
 3. Using a sidebar menu at the left, navigate to the *Configuration-> Templates* section. Import the downloaded Morningstar template into Zabbix by following these steps:
 - Press the *Import* button at the top right corner
 - Select the XML or YAML file of the required template on your machine
 - Press *Import*
 4. Now you need to reach Zabbix how to connect to the device. To do so, first create a host to represent your Morningstar device:
 - Using a sidebar menu at the left, navigate to the *Configuration->Hosts* section.
 - Press the *Create host* button at the top right corner
 - In the Host, the configuration window fills out the required fields:
 - *Hostname* - enter any unique name
 - *Groups* - select an existing host group or enter the name of a new group to be created
 - *Interfaces* - press Add and select SNMP from the drop-down list that appears.
 - Add an SNMP interface for the host:
 - Enter the IP address/DNS name and port number
 - Select the SNMP v2 from the drop-down
 - IN the *SNMP community* field enter "public"
 - Open the *Templates* tab. In the *Link new templates* field, start typing Morningstar, then select the imported template from the list.
 5. Repeat step 3 for each Morningstar device you want to monitor

Alerting setting and notification

By now, Zabbix is configured to generate alerts if something goes wrong with a Morningstar device. These alerts will be displayed in the Zabbix web interface. However, most people would prefer to receive a notification via the phone or email in case of a problem instead of the necessity to monitor the triggers all the time.

That is why sending notifications is one of the primary actions offered by Zabbix. Flexible settings allow precise defining who and when should be notified upon a certain event.

To be able to send and receive notifications from Zabbix you have to:

- [Define some media](#)
- [Configure an action](#) that sends a message to one of the defined media

Actions consist of *conditions* and *operations*. Basically, when *conditions* are met, *operations* are carried out. The two principal operations are sending a message (notification) and executing a remote command.

Advanced configuration

The detection of device operational voltage (12V/24V/48V) is done automatically by the templates, with trigger values for low and high battery set based on the detected system voltage. The default warning and fault values for the **12V** battery system are as follows:

- 11.5V Battery voltage low (critical)
- 12V Battery voltage low (warning)
- 15V Battery voltage high (warning)
- 15.5 Battery voltage high (critical)

For the **24V** battery system, the default warning and fault values are as follows:

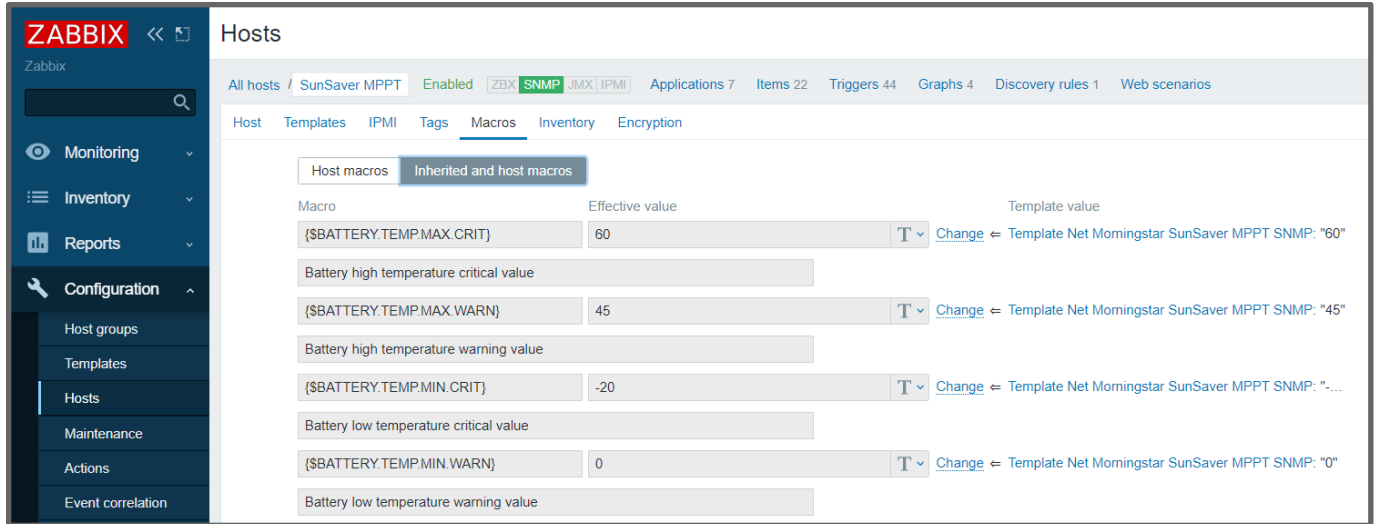
- 23V Battery voltage low (critical)
- 24V Battery voltage low (warning)
- 30V Battery voltage high (warning)
- 31 Battery voltage high (critical)

For the **48V** battery system, the default warning and fault values are as follows:

- 46V Battery voltage low (critical)
- 48V Battery voltage low (warning)
- 60V Battery voltage high (warning)
- 62 Battery voltage high (critical)

It is also possible to replace the default threshold voltages with custom values. To do so, navigate to *Configuration-> Hosts*. Click on the required host to open the host configuration form, then switch to the tab *Macros-> Inherited and host macros*. Adjust the values of the following macros:

- {\$Voltage.Max.Crit} - Battery voltage high (critical)
- {\$Voltage.Max.Warn} - Battery voltage high (warning)
- {\$Voltage.Min.Crit} - Battery voltage low (critical)
- {\$Voltage.Min.Warn} - Battery voltage low (critical)



A snapshot of host configuration to change default threshold values

Viewing data from Morningstar devices


After setting up the template, you are ready to start reviewing the data that you are receiving. Zabbix provides plenty of options for visualization and data usage.

Latest data

The section *Latest data in the Monitoring* menu can be used to view the most recent values gathered by items and to access various graphs for the items.

The list is grouped by the hostname (Host column) and the application name (Name column). The term application in Zabbix refers to a logical grouping of items. Locate the required host and application pair and click on the ► before a hostname to expand grouped item data. To expand all hosts and all applications, thus revealing data for all items, click on the ► in the header row.

Items are displayed with their name, last check time, last value, change amount, and a link to a simple graph/history of items values.

An icon with a question mark  is displayed next to the item name for all items that have descriptions. If you hover the mouse pointer over this icon, the item description will be displayed as a tooltip.

Note: If a host is disabled, its name is displayed in red. Data for disabled hosts, including graphs and items value lists, is still accessible in the *Latest data*.

Zabbix SNMP Monitoring – User Guide for Morningstar Devices

The screenshot shows the Zabbix 'Latest data' interface. The left sidebar contains navigation options: Monitoring, Dashboard, Problems, Hosts, Overview, Latest data, Screens, Maps, Discovery, Services, Inventory, Reports, Configuration, Administration, Support, Share, Help, and User settings. The main content area is titled 'Latest data' and includes a search bar and filter options. Below the search bar, there are fields for 'Host groups', 'Hosts', and 'Application'. The 'Hosts' field is populated with several device names: Prostar MPPT, SunSaver MPPT, SureSine, TriStar MPPT, and TriStar P-WM. Below these fields are 'Apply' and 'Reset' buttons. The main data table has columns for Host, Name, Last check, Last value, and Change. The data is organized into expandable sections: Prostar MPPT (Array of 4 items), Prostar MPPT (Battery of 4 items), Prostar MPPT (Counter of 3 items), Prostar MPPT (Load of 3 items), Prostar MPPT (Status of 6 items), and Prostar MPPT (Temperature of 3 items). Each item in the Battery and Temperature sections includes a checkbox, name, last check time, last value, change, and a 'Graph' link.

Host	Name	Last check	Last value	Change
Prostar MPPT	Array (4 Items)			
Prostar MPPT	Battery (4 Items)			
	Battery: Charge Current	2020-11-14 01:00:37	0.01 A	
	Battery: Charge State	2020-11-14 00:19:38	Night (3)	
	Battery: Target Voltage	2020-11-14 00:11:48	0 V	
	Battery: Voltage	2020-11-14 01:00:46	12.17 V	
Prostar MPPT	Counter (3 Items)			
Prostar MPPT	Load (3 Items)			
Prostar MPPT	Status (6 Items)			
Prostar MPPT	Temperature (3 Items)			
	Temperature: Ambient	2020-11-14 01:00:49	24.92 C	-0.02 C
	Temperature: Battery	2020-11-14 01:00:50	24.92 C	-0.02 C
	Temperature: Heatsink	2020-11-14 01:00:51	25.5 C	-0.02 C

A snapshot of the latest data

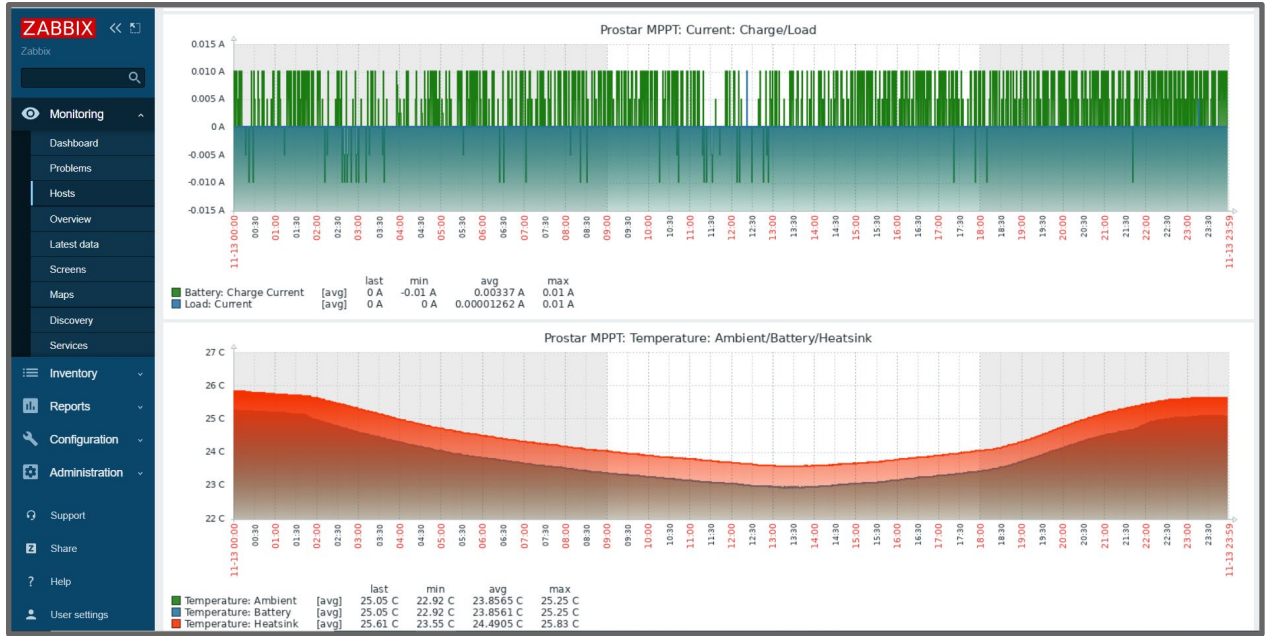
Historical data

You can view older data in the *Monitoring -> Hosts* session. This session displays a full list of monitored hosts with detailed information about host interface, availability, tags, current problems, status (enabled/disabled), and links to easy navigation to the host's latest data, problem history, graphs, dashboards, and web scenarios.

To view the historical data, you can proceed to *Graphs*, where this information is presented visually on graphs.

The screenshot shows the Zabbix 'Hosts' interface. The left sidebar is the same as in the previous screenshot. The main content area is titled 'Hosts' and includes a search bar and filter options. Below the search bar, there are fields for 'Name', 'Host groups', 'IP', 'DNS', and 'Port'. There are also checkboxes for 'Show hosts in maintenance' and 'Show suppressed problems'. Below these fields are 'Apply' and 'Reset' buttons. The main data table has columns for Name, Interface, Availability, Tags, Problems, Status, Latest data, Problems, Graphs, Screens, and Web. The data is organized into rows for each host, including Prostar MPPT, ProStar P-WM, SunSaver MPPT, SureSine, TriStar MPPT, TriStar MPPT 600V, TriStar P-WM, and Zabbix server. Each row includes a checkbox, interface, availability status, tags, problem count, status, latest data link, problem link, graph link, screen link, and web link.

Name	Interface	Availability	Tags	Problems	Status	Latest data	Problems	Graphs	Screens	Web
Prostar MPPT	127.0.0.1: 10050	ZBX SNMP IMX IPM	Morningstar		Enabled	Latest data	Problems	Graphs 4	Screens	Web
ProStar P-WM	127.0.0.1: 10050	ZBX SNMP IMX IPM	Morningstar	2	Enabled	Latest data	Problems 2	Graphs 4	Screens	Web
SunSaver MPPT	127.0.0.1: 10050	ZBX SNMP IMX IPM	Morningstar		Enabled	Latest data	Problems	Graphs 4	Screens	Web
SureSine	127.0.0.1: 10050	ZBX SNMP IMX IPM	Morningstar		Enabled	Latest data	Problems	Graphs 3	Screens	Web
TriStar MPPT	127.0.0.1: 10050	ZBX SNMP IMX IPM	Morningstar		Enabled	Latest data	Problems	Graphs 5	Screens	Web
TriStar MPPT 600V	127.0.0.1: 10050	ZBX SNMP IMX IPM	Morningstar		Enabled	Latest data	Problems	Graphs 5	Screens	Web
TriStar P-WM	127.0.0.1: 10050	ZBX SNMP IMX IPM	Morningstar		Enabled	Latest data	Problems	Graphs 4	Screens	Web
Zabbix server	127.0.0.1: 10050	ZBX SNMP IMX IPM		1 1	Enabled	Latest data	Problems 2	Graphs 19	Screens 3	Web



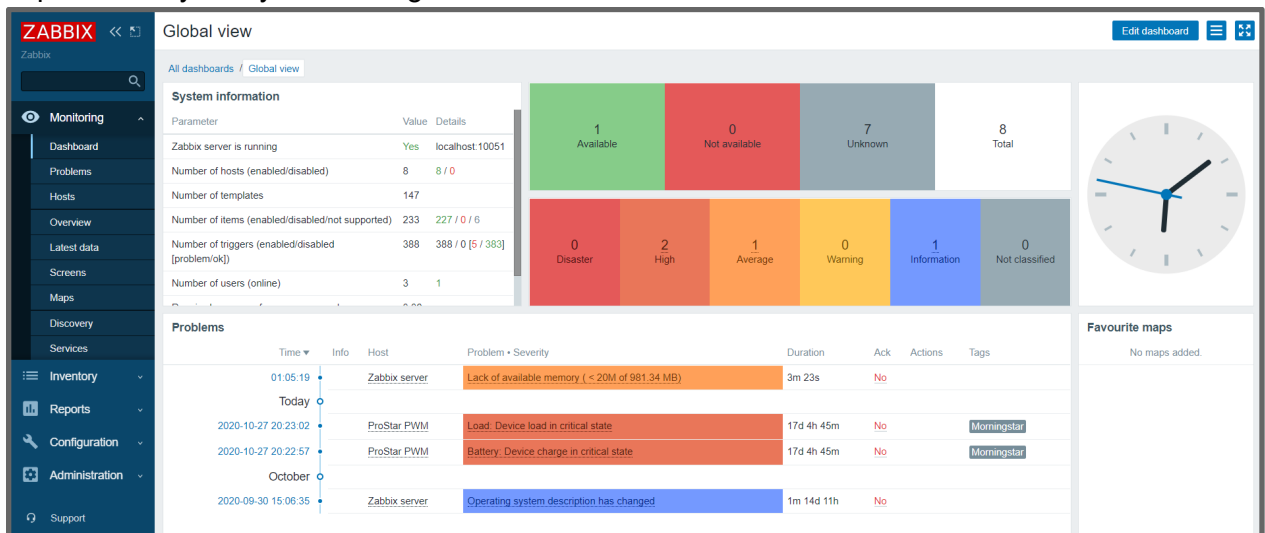
Snapshots of historical data

Monitoring Dashboard

The Monitoring -> Dashboard section is designed to display summaries of all the important information.

A Dashboard consists of widgets and each widget is designed to display information of a certain kind and source, which can be a summary, a map, a graph, the clock, etc. On the default Global dashboard, you can see system information status, host availability, and most important problems.

Additionally, it is possible to create your own dashboards with graphs and widgets that are important for your system configuration.



A snapshot of the default global view dashboard

Viewing Health Status

To check system health status, navigate to the *Monitoring -> Problems* section. This section displays the triggers that are currently in the “Problem” state and may require attention.

The screenshot shows the Zabbix interface for the 'Problems' section. On the left is a navigation sidebar with options like Monitoring, Dashboard, Problems, Hosts, Overview, Latest data, Screens, Maps, Discovery, Services, Inventory, Reports, Configuration, and Administration. The main area contains filters for Host groups, Hosts, Application, Triggers, Problem severity (Not classified, Warning, High, Information, Average, Disaster), and Age less than (14 days). There are also filters for Host inventory, Tags, Show tags, Tag display priority, Show operational data, Show suppressed problems, Compact view, Show details, and Highlight whole row. Below the filters is a table of problems:

Time	Severity	Recovery time	Status	Info	Host	Problem	Duration	Ack	Actions	Tags
01:05:19	Average	01:11:19	RESOLVED		Zabbix server	↑ Lack of available memory (< 20M of 981.34 MB)	6m	No		
2020-11-11 12:14:17	Average		PROBLEM		Zabbix server	↑ ↓ High memory utilization (>90% for 5m)	2d 12h 59m	No		
2020-10-27 20:23:02	High		PROBLEM		ProStar PWM	↑ Load: Device load in critical state	17d 4h 50m	No		Morningstar
2020-10-27 20:22:57	High		PROBLEM		ProStar PWM	↑ Battery: Device charge in critical state	17d 4h 50m	No		Morningstar
2020-09-30 15:06:35	Information		PROBLEM		Zabbix server	↑ ↓ Operating system description has changed	1m 14d 11h	No		

A snapshot of health status

Operational Data for Problems

It is possible to view operational data for current problems, such as the latest item values as opposed to the item values at the time of the problem.

Operational data display mode is determined by the parameter *Show operational data*, available in the configuration of the Problems [dashboard widget](#). You can select one of the three available options:

- None - no operational data is displayed
- Separately - operational data is displayed in a separate column
- With problem name - operational data is appended to the problem name and in parentheses

Additionally, it is possible to export problems from the page to .csv format for post-processing in third party software.

Report and data exporting

To have a full system overview, navigate to *Monitoring -> Overview*. It is possible to select either:

- *Data overview* - provides a helicopter view of all collected data for the system
- *Trigger overview* - provides a report for all of the trigger statuses and/or problems in the system.

Zabbix SNMP Monitoring – User Guide for Morningstar Devices



A snapshot of “Trigger Overview”

The screenshot shows the Zabbix Data Overview page. The left sidebar is the same as in the Trigger Overview screenshot. The main area displays a table of data points for several hosts. The table has columns for various metrics such as Array Current, Array Sweep Pmax, Array Sweep Vmp, Array Sweep Voc, Array Voltage, Battery Voltage discovery, Battery Charge Current, Battery Charge State, Battery Output Power, Battery Target Voltage, Battery Voltage, Counter Amp-hours, Counter Charge Amp-hours, Counter Charge kWh, Counter kWh, Counter kWh, Counter Load Amp-hours, Load A/C Current, Load Current, Load PWM Duty Cycle, Load State, Load Voltage, Status Alarms, Status Alarms PREPROCESSED (FOR TEST), and Status Alarms RAW DATA (FOR TEST). The table shows data for hosts like ProStar MPPT, ProStar PWM, SunSaver MPPT, SureSine, TriStar MPPT, TriStar MPPT 600V, and TriStar PWM.

Hosts	Array Current	Array Sweep Pmax	Array Sweep Vmp	Array Sweep Voc	Array Voltage	Battery Voltage discovery	Battery Charge Current	Battery Charge State	Battery Output Power	Battery Target Voltage	Battery Voltage	Counter Amp-hours	Counter Charge Amp-hours	Counter Charge kWh	Counter kWh	Counter kWh	Counter Load Amp-hours	Load A/C Current	Load Current	Load PWM Duty Cycle	Load State	Load Voltage	Status Alarms	Status Alarms PREPROCESSED (FOR TEST)	Status Alarms RAW DATA (FOR TEST)
ProStar MPPT	0 W	0 V	0 V	0.16 V	0.01 A	Night (3)	0 V	12.17 V	3.65 KAh	55.41 kWh	1.01 KAh	0 A	Normal (1)	12.16 V	rtsOpen	80 00 00 00									
ProStar PWM					0 A	Fault (4)	0 V	26.27 V	574 Ah	15.2 kWh	812.4 Ah	0 A	Fault (4)	0 V	rtsOpen										
SunSaver MPPT	0 W	15.35 V	20.47 V	20.47 V	0.31 A	Floater (7)	13.66 V	13.65 V	1.77 KAh	240 kWh	0 Ah	0 A	Normal (1)	13.63 V	rtsOpen										
SureSine								12.85 V			0	LoadOn (1)	No alarms												
TriStar MPPT	0 A	0 W	39.08 V	52.11 V	0.06 V	0 A	Night (3)	0 W	0 V	52.08 V	2.43 KAh	105 kWh				No alarms									
TriStar MPPT 600V	-0.05 A	44.25 W	100 V	51.53 V	17.23 V	-0.04 A	Night (3)	0 W	0 V	51.88 V	15.6 KAh	691.5 kWh				No alarms									
TriStar PWM					Bulk (5)	28 V	26.32 V	1.11 KAh			63.25 kWh	0 A	0	0 V	rtsOpen										

A snapshot of “Data Overview”

To export data collected by Zabbix, proceed to *Monitoring* -> *Latest Data* and select an item for which you would like to review raw data. In the top menu select *View as* -> *Values*.

```
Prostar MPPT: 3 items
2020-11-14 01:21:51 1605309711 25.44 "Prostar MPPT: Temperature: Heatsink"
2020-11-14 01:21:51 1605309711 24.86 "Prostar MPPT: Temperature: Battery"
2020-11-14 01:21:49 1605309709 24.86 "Prostar MPPT: Temperature: Ambient"
2020-11-14 01:20:51 1605309651 25.45 "Prostar MPPT: Temperature: Heatsink"
2020-11-14 01:20:50 1605309650 24.88 "Prostar MPPT: Temperature: Battery"
2020-11-14 01:20:49 1605309649 24.88 "Prostar MPPT: Temperature: Ambient"
2020-11-14 01:19:51 1605309591 25.44 "Prostar MPPT: Temperature: Heatsink"
2020-11-14 01:19:50 1605309590 24.88 "Prostar MPPT: Temperature: Battery"
2020-11-14 01:19:49 1605309589 24.88 "Prostar MPPT: Temperature: Ambient"
2020-11-14 01:18:51 1605309531 25.45 "Prostar MPPT: Temperature: Heatsink"
2020-11-14 01:18:50 1605309530 24.88 "Prostar MPPT: Temperature: Battery"
```

A snapshot of raw data in plain text format

Learn more

To learn more about Zabbix you can refer to the official [documentation](#). In addition to the documentation, you can find many how-to videos about Zabbix installation and configuration on the official Zabbix [youtube channel](#).