User Manual

TTS MULTISWITCH PANEL PLUGIN

Content

Abbreviations

MSD – Multifunctional switching device

HTTP – Hypertext Transfer Protocol

API – Application Programming Interface

TTS – The Things Stack

URL – Uniform Resource Locator

TTN – The Things Network

UTC – Coordinated Universal Time

RTC – Real Time Clock

LPP – Low Power Payload

Selected meanings

TTS – LoRaWAN Internet of Things (IoT) network

Downlink – a message sent from the TTS network to the end device

Uplink – a message sent from an end device to the TTS network

Cayenne LPP – data encoding type

Introduction and basic information about the plugin

TTS Multiswitch Grafana panel plugin is used to send configuration data to HTTP (Hypertext Transfer Protocol) API (Application Programming Interface) of TTS (The Things Stack) using HTTP POST requests. After processing, the configuration data is sent from the TTS network using a downlink to the Multifunctional Switching Device (hereinafter referred to as "MSD"). This panel plugin is suitable when using Grafana to visualize measured data from the MSD, because it is possible to have both together, the visualization of the measured data and the option of setting MSD.

Author

Ondřej Knebl

Plugin version

1.0.0

Plugin signed

Loravsbcz

Requirements

Grafana >= 9.3.8

TTS settings

1) **TTN server**
   The URL of the TTN network cluster in which the application is created with the registered MSD.
   a. **Europe 1** – https://eu1.cloud.thethings.network/
   b. **North America 1** - https://nam1.cloud.thethings.network/
   c. **Australia 1** - https://au1.cloud.thethings.network/

2) **Application name**
   Application ID from TTS.

3) **API key**
   API key generated in application with registered MSD. API key generation is described in the last chapter of this user manual (TTS – API Key generation).

4) **End device name**
   End Device ID (MSD) from TTS.

5) **Save TTS settings**
   By pressing the button, the information entered in fields 1-4 is saved. Then it is necessary to save the "Dashboard" to preserve this information, otherwise the saved information will not be available after reloading the page (the previous settings will be loaded).

Downlink settings

1) **FPort**
   FPort number for transferring application data.
   >   Valid input: 1-223

2) **Insert mode**
   Choice of whether the downlink should be queued behind scheduled downlinks or should replace (delete) the scheduled downlinks queue and send downlink immediately when possible.
   >   a. Push to downlink queue
   >   b. Replace downlink queue

3) **Priority**
   Choice with which priority the downlink should be sent.
   >   Priority options in order from lowest: Lowest, Low, Below normal, Normal, Above normal, High a Highest

4) **Confirmed downlink**
   Checking the box will send a downlink that requires acknowledgment from the end device (MSD). If the box is not checked, the downlink will be sent without confirmation of receipt.

Downlink settings will reset to default values and settings after reloading the "Dashboard" page.

Downlinks

1) **Settings password**
   In this block, a numerical password is entered, which is added to all sent downlinks in blocks 2-5.

2) **Common settings**
   Common settings for all MSD working modes and the MSD working modes themselves are entered or selected in this block. Furthermore, in this block it is set which data and at what interval should be sent in the uplinks from the MSD.

3) **Light intensity settings**
   In this block, the light intensity setting is entered for the MSD Light intensity and Light intensity in Time working modes.

4) **Switching times settings**
   In this block, the settings of the contactor switching / opening times for the MSD Time and Light intensity in Time working modes is entered.
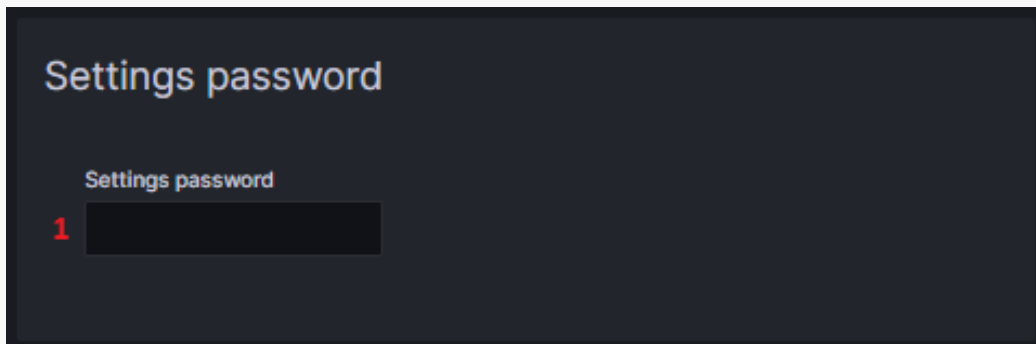
5) **Sunset / sunrise settings**
   In this block, the location settings for the MSD Sunset / sunrise times working mode are entered.

Downlinks will reset to default values and settings after reloading the "Dashboard" page.

In blocks 2-4, check boxes on the left side of each setting (input) select whether this setting should be sent in the downlink of the respective block. If no box is checked, only the password is sent in the downlink (this way it is possible to find out the current settings on the MSD).

Settings password

1) **Settings password**

A numeric password that is programmed into the MSD.
    Valid input: 0-9999

Common settings

1) Check boxes

These (1) checkboxes to the left of each setting (input) select whether that setting should be sent in the downlink. If no box is checked, only the password is sent in the downlink (this way it is possible to find out the current settings on the MSD). For example, when the box on the left side of the setting (2) Send data every [s] is checked, this setting with the current value (currently the value 600 in the image) is added to the downlink.

2) Send data every [s]

Specifying the intervals (time in seconds) in which uplinks are to be sent from MSD.

Valid input: 60-3600

3) Number of samples

Specifying how many data samples (light intensity, battery voltage, etc.) between individual sent uplinks will be averaged to be sent in the uplink.

Valid input: 1-10

4) Power grid [V]

Choice of how many phases or what voltage is supplied to the MSD contactor.

When 400 V (three phases) is selected, the measured values of energy consumption (Active energy), current (Current), active power (Active power) and power factor (Power factor) are not sent, because the PZEM-004T-100A measuring device is designed for measuring only on one phase. The values of the mains voltage (Power line voltage) and the frequency of the mains (Power line frequency) are sent further and contain information about the mains voltage and frequency of the phase from which the MSD is powered.

Selecting 230 V (single phase) sends all the values described above.

Voltage options in volts: 230, 400

5) Working mode

The choice in which working mode the MSD will work. Uplinks with measured values are sent in all modes.

a. **OFF** – the contactor is still open
b. **ON** – the contactor is still closed
c. **Light intensity** – the contactor switches on and off according to the light intensity measured by the BH1750 sensor and the set values of the threshold (Threshold [lux]) and the safe zone (Safe zone [lux]) in lux (Downlinks – block 3)
d. **Time** – the contactor switches and opens according to the set times (0-3 switching times and 0-3 opening times) (Downlinks – block 4) in the selected (6) time zone (Timezone)
e. **Light intensity in Time** – the contactor switches and opens according to the set times (Downlinks - block 4) when the light intensity value measured by the BH1750 sensor is below the set threshold value (Threshold [lux]) or has not yet exceeded the safe zone (Safe zone [lux]) (Downlinks - block 3). (Light intensity in selected time periods.)
f. **Sunset / sunrise times** – the contactor switches on and off according to the sunrise and sunset times in the location specified by the coordinates (Downlinks - block 5)

6) Timezone

Choosing the time zone in which the device is located. Thanks to this, it is possible to operate the device in different time zones. The time on the device is converted from UTC to the time in the selected time zone.

a. Central European Time
b. United Kingdom
c. UTC
d. US Eastern Time Zone
e. US Central Time Zone
f. US Mountain Time Zone
g. US Arizona
h. US Pacific Time Zone
i. Australia Eastern Time Zone

7) Reset and load

Option to remotely restart the MSD and load the saved configuration from the MSD memory or delete the saved configuration from the MSD memory and restart the MSD with the default settings defined in the program.

   a. **Saved** – restarting the MSD and loading the saved configuration from memory
   b. **Default** – deleting the saved configuration from the MSD memory and restarting the MSD with the default settings defined in the program

8) Relay state

A check box for sending data in the uplink about whether the contactor was closed or opened at the time the uplink was sent. When checked, this data is sent.

9) Number of changes

A check box for sending data in the uplink about how many times the contactor state has changed between sent uplinks. When checked, this data is sent.

10) Light intensity

A check box for sending data in the uplink about what the average measured value of the light intensity was. When checked, this data is sent.

11) Battery voltage

A check box for sending data in the uplink about what the average battery voltage reading was. When checked, this data is sent.

12) Battery percentage

A check box for sending data in the uplink about what the average measured value of the battery state of charge was. When checked, this data is sent.

13) Battery temperature

A check box for sending data in the uplink about what the average reading of the battery temperature was. When checked, this data is sent.

14) RTC temperature

A check box for sending data in the uplink about what the average reading of the RTC temperature was. When checked, this data is sent.

15) Power line voltage

A check box for sending data in the uplink about what the average measured value of the power line voltage was. When checked, this data is sent.

16) Power line frequency

A check box for sending data in the uplink about what the average measured value of the power line frequency was. When checked, this data is sent.

17) Active energy

A check box for sending data in the uplink about what the power consumption was.
When checked, this data is sent, but only when (4) Power grid [V] is set to 230 V and the contactor is closed.

18) Current

A check box for sending data in the uplink about what the average measured value of the current was.
When checked, this data is sent, but only when (4) Power grid [V] is set to 230 V and the contactor is closed.

19) Active power

A check box for sending data in the uplink about what the average measured value of the active power was.
When checked, this data is sent, but only when (4) Power grid [V] is set to 230 V and the contactor is closed.

20) Power factor

A check box for sending data in the uplink about what the average measured value of the power factor was.
When checked, this data is sent, but only when (4) Power grid [V] is set to 230 V and the contactor is closed.

21) Sunrise

A check box for sending data in the uplink about what the current sunrise time is. When checked, this data is sent.

22) Sunset

A check box for sending data in the uplink about what the current sunset time is. When checked, this data is sent.

23) Send common settings

Button to send downlink with (2-22) set values of selected fields using (1) checkboxes.

Light intensity settings

1) Check boxes

These (1) checkboxes to the left of each setting (input) select whether that setting should be sent in the downlink. If no box is checked, only the password is sent in the downlink (this way it is possible to find out the current settings on the MSD). For example, when the box on the left side of the setting (2) Threshold [lux] is checked, this setting with the current value (currently the value 0 in the image) is added to the downlink.

2) Threshold [lux]

Specifying what the threshold of the measured light intensity will be for the contactor to be switched on. When the measured light intensity is less than the threshold (Threshold [lux]), the contactor closes (the MSD must be in the appropriate working mode).
  Valid input in lux: 0-65535

3) Safe zone [lux]

Specifying what the safe zone of the measured light intensity will be for opening the contactor. This safe zone is added to the value (2) of the threshold (Threshold [lux]). When the measured value of the light intensity has fallen below the set (2) threshold (Threshold [lux]) and the contactor is switched on, to open the contactor it is necessary that the measured value of the light intensity exceeds the value of the sum of (2) threshold (Threshold [lux]) and (3) safe zone (Safe zone [lux]). (MSD must be in the appropriate working mode.)
  Valid input in lux: 0-65535

4) Send light intensity settings

Button to send downlink with (2-3) set values of selected fields using (1) checkboxes.

Switching times settings

1) Check boxes

These (1) checkboxes to the left of each setting (input) select whether that setting should be sent in the downlink. If no box is checked, only the password is sent in the downlink (this way it is possible to find out the current settings on the MSD). For example, when the box on the left side of the On time 1 setting is checked and (2) the radio button is in the not set state (Time not set), then this setting that On time 1 is not set is added to the downlink.

2) On time 1-3 and Off time 1-3 radio buttons

Selection of whether the respective switch-on / switch-off time should be set or not. (To switch the contactor on and off according to the times, the MSD must be in the appropriate working mode.)

3) On time 1-3 times

Specifying what the contactor switching times will be. To set the respective times, the (2) radio buttons in the set times row must be in the Set time position (Set time).
   a. Valid hours input: 0-23
   b. Valid minutes input: 0-59
   c. Valid seconds input: 0-59

4) Off time 1-3 times
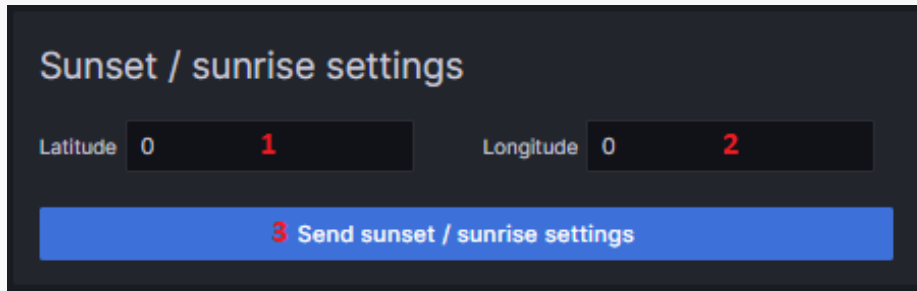
Specifying what the contactor opening times will be. To set the respective times, the (2) radio buttons in the set times row must be in the Set time position (Set time).
   a. Valid hours input: 0-23
   b. Valid minutes input: 0-59
   c. Valid seconds input: 0-59

5) Send switching times settings

Button to send downlink with set values of selected times using (1) checkboxes.

Sunset / sunrise settings

1) Latitude
Specifying the latitude of the location where the MSD is located.
    Valid input: -90 - 90

2) Longitude
Specifying the the longitude of the location where the MSD is located.
    Valid input: -180 - 180

3) Send sunset / sunrise settings
Button to send downlink with the set latitude and longitude values that will be used to calculate sunrises and sunsets for that location.

Tables of Cayenne LPP encoding of sent data in downlinks

Tab.1.: Encoding of sent data in downlinks using Cayenne LPP

Entry	Entry options	Channel (Cayenne LPP)	Type (Cayenne LPP)	Value before encoding
Settings password	-	100	addPower	0-9999
Send data every [s]	-	100	addSmallTime	60-3600
Number of samples	-	100	addPresence	1-10
Power grid [V]	230	103	addDigitalInput	0
	400	103	addDigitalInput	1
Working mode	OFF	101	addDigitalInput	0
	ON	101	addDigitalInput	1
	Light intensity	101	addDigitalInput	2
	Time	101	addDigitalInput	3
	Light intensity in Time	101	addDigitalInput	4
	Sunset / sunrise times	101	addDigitalInput	5
Timezone	Central European Time	102	addDigitalInput	0
	United Kingdom	102	addDigitalInput	1
	UTC	102	addDigitalInput	2
	US Eastern Time Zone	102	addDigitalInput	3
	US Central Time Zone	102	addDigitalInput	4
	US Mountain Time Zone	102	addDigitalInput	5
	US Arizona	102	addDigitalInput	6
	US Pacific Time Zone	102	addDigitalInput	7
	Australia Eastern Time Zone	102	addDigitalInput	8
Reset and load	Saved	100	addDigitalInput	1
	Default	100	addDigitalInput	2
Threshold [lux]	-	101	addLuminosity	0-65535
Safe zone [lux]	-	102	addLuminosity	0-65535
On time 1:	Time not set	101	addSmallTime	100000
	Set time	101	addSmallTime	(H*3600)+(M*60)+S
On time 2:	Time not set	103	addSmallTime	100000
	Set time	103	addSmallTime	(H*3600)+(M*60)+S
On time 3:	Time not set	105	addSmallTime	100000
	Set time	105	addSmallTime	(H*3600)+(M*60)+S
Off time 1:	Time not set	102	addSmallTime	100000
	Set time	102	addSmallTime	(H*3600)+(M*60)+S
Off time 2:	Time not set	104	addSmallTime	100000
	Set time	104	addSmallTime	(H*3600)+(M*60)+S
Off time 3:	Time not set	106	addSmallTime	100000
	Set time	106	addSmallTime	(H*3600)+(M*60)+S
Latitude, Longitude, Altitude		101	addGPS	-90-90, -180-180, 0

- H – hour, M – minute, S – second (0-86399 seconds of the day)
- addSmallTime is a custom added type for time (see next page for type details)

addSmallTime – custom added type

Type: C0

Size: 3 bytes

Multiplier: 1

Sign: no (positive values only)

Minimum value: 0

Maximum value: 16777215

Defining the type in JavaScript:

addSmallTime: { type: "C0", size: 3, multipl: 1, signed: false, min: 0, max: 16777215, arrLen: 3 },

Send only selected

Tab.2.: Send only selected - Encoding of sent data stored in bit fields using Cayenne LPP

Entry	Bit position in field	Channel (Cayenne LPP)	Type (Cayenne LPP)	Value before encoding
Relay state	7	1	addDigitalOutput	0-255
Number of changes	6			
Light intensity	5			
Battery voltage	4			
Battery percentage	3			
Battery temperature	2			
RTC temperature	1			
Power line voltage	0			
Power line frequency	7	2	addDigitalOutput	0-255
Active energy	6			
Current	5			
Active power	4			
Power factor	3			
Sunrise	2			
Sunset	1			
-	0			

TTS – API key generation

1) In **TTS** -> **Applications** -> **YourAppName** -> **API keys** click button **+Add API key.**
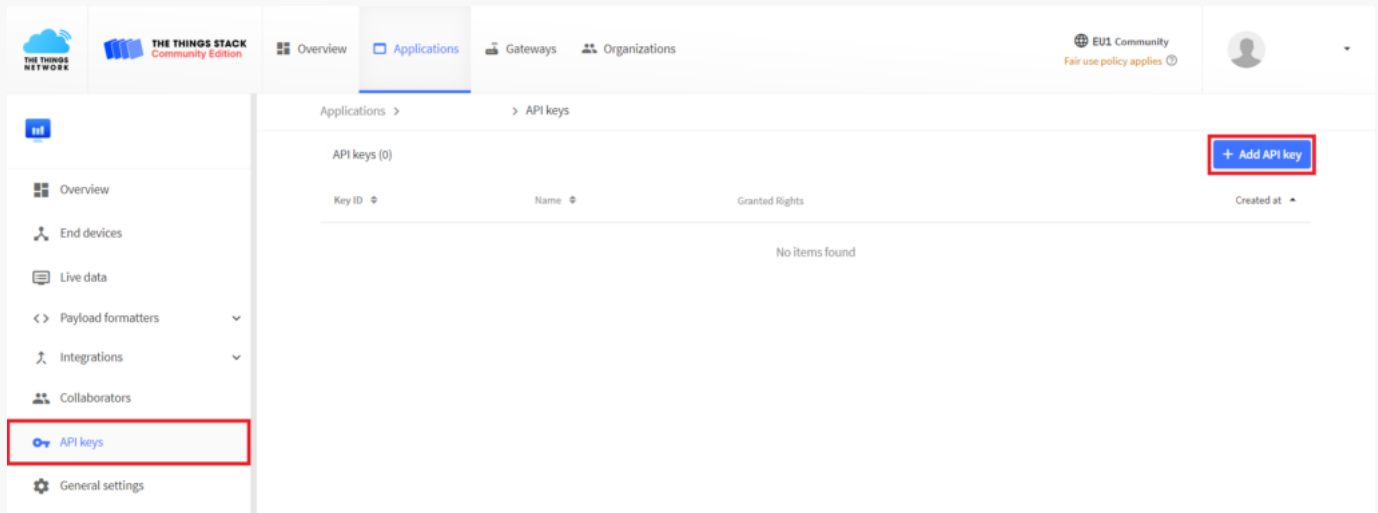
2) Write something in the **Name.**
3) Select **Grant individual rights.**
4) Check **Write downlink application traffic.**
5) Click on button **Create API key.**

6) Click the **Copy to clipboard** button and paste the key into the TTS Multiswitch panel plugin.
7) Save TTS Settings as described in the chapter **TTS settings.**