IoT Gateways

1 IoT Gateways

This Manual describes how to set up the IoT Gateways. There are three different Gateways available:

- Analog (0(2)–10 V, 0(4)–20 mA)
- Digital (Modbus, (BACnet))
- Temperature (pt 100 rtd probes with 2,3,4 - wires)

1.1 Analog Gateway

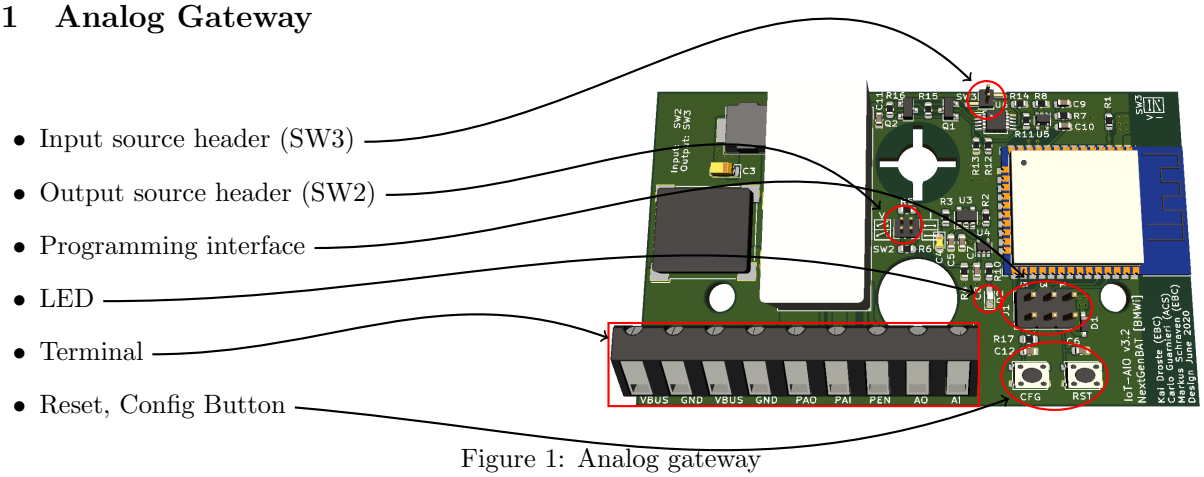


Figure 1: Analog gateway

Table 1: Analog terminal

VBUS	+ 24 V	Input
GND	GND	Input
VBUS	+ 24	Output to field device
GND	GND	Output to field device
PAO	AO to plc	Not in use
PAI	AI to plc	Not in use
PEN	+ 24 V	Enable Gateway (necessary)
AO	0 -10 V / 0 - 10 mA	Analog output (single-ended)
AI	0 -10 V / 0 - 10 mA	Analog input (single-ended)

To set the input to voltage mode, both headers at SW2 need to be disconnected. To set the input to current mode, both headers need to be connected with header jumpers according to the pictogram (I) .
To set the output to voltage mode, the header at SW3 need to be connected with header jumpers according the pictogram (V). To set the output to current mode, the header need to be disconnected.

1.2 Temperature Gateway

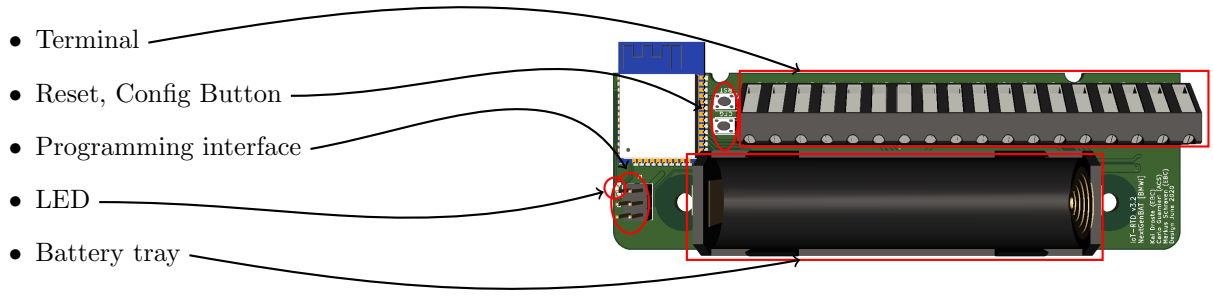


Figure 2: Temperature gateway

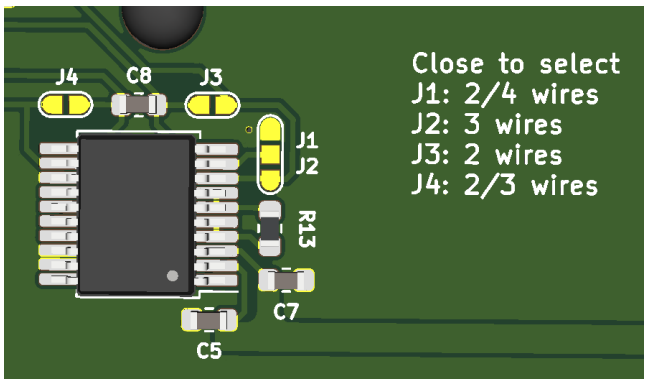
Table 2: Temperature terminal

GND	Do not connect	Not in use
PEN	Do not connect	Not in use
1I-		RTD probe 1
1V-		RTD probe 1
1V+		RTD probe 1
1I+		RTD probe 1
P1I-	to plc	RTD probe 1 not in use
P1V-	to plc	RTD probe 1 not in use
P1V+	to plc	RTD probe 1 not in use
P1I+	to plc	RTD probe 1 not in use
2I-		RTD probe 2
2V-		RTD probe 2
2V+		RTD probe 2
2I+		RTD probe 2
P2I-	to plc	RTD probe 2 not in use
P2V-	to plc	RTD probe 2 not in use
P2V+	to plc	RTD probe 2 not in use
P2I+	to plc	RTD probe 2 not in use

Set up the gateway for 2,3,4 - Wire RTD-probes

In the Configurator pt100 or pt1000 can be chosen. Since the gateways are all setup for pt100 probe, to use pt1000 probes the reference resistor has to be changed on the board (Reference resistor = R13 (or R5), see Figure 3).

To set the gateways for 2, 3 or 4 wires, it is required to solder bridges on the board according to the following image:



For example: For a three wire probe the solder joints J2 and J4 need to be closed.

- For a two wire probe, connect V+ and V- with the rtd-probe.
- For a three wire probe, connect I+, V+ and V- with the rtd-probe.
- For a four wire probe, connect I+, V+, I- and V- with the rtd-probe.

Figure 3: Setting the temperature gateway for different types

1.3 Digital Gateway

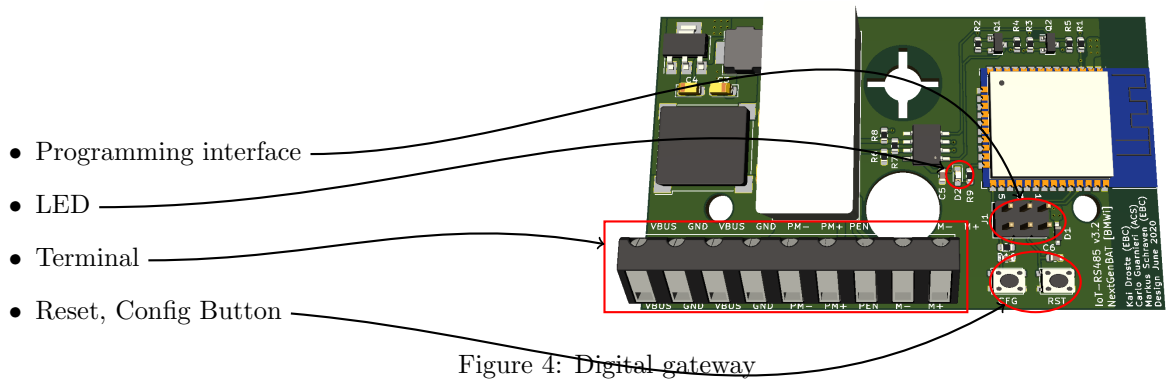


Figure 4: Digital gateway

Table 3: Digital terminal

VBUS	+ 24 V	Input
GND	GND	Input
VBUS	+ 24	Output to field device
GND	GND	Output to field device
PM-	M- to plc	Not in use
PM+	M+ to plc	Not in use
PEN	+ 24 V	Enable Gateway (necessary)
M-	RS485 - Line	
M+	RS485 + Line	

2 Buttons

The Gateways are equipped with two Buttons. The Reset (RST) button restarts the device. The Config (CFG) Button has different functions according to the duration it is pressed.

Table 4: CFG Button modes

Time [sec]	Function	Reaction(LED)
$t < 1$	Eddystone Beacon enable config mode	- -
$1 < t < 3$	Enable Access Point (works only if not connected to station)	... ...
$3 < t < 7$	Starts OTA update	Finished: - - - Fail : ...
$t > 7$	Reset to default settings	

- = Long flash of the LED (1sec)
. = Short flash of the LED (<0.5 sec)

Since the Gateways support deep sleep mode, it could be necessary to initiate the configuration process with a short press on the RST button. After pressing the RST button, the device needs up to 4 seconds to fully boot up.

3 Iot Configurator

The IoT Configurator is the Webinterface from the IoT-Gateway-Software. It is accessed by redirecting to the IP of the gateway. To find out the right IP of the gateway, the Eddystone-BLE-Beacon (see section 2) can be used.

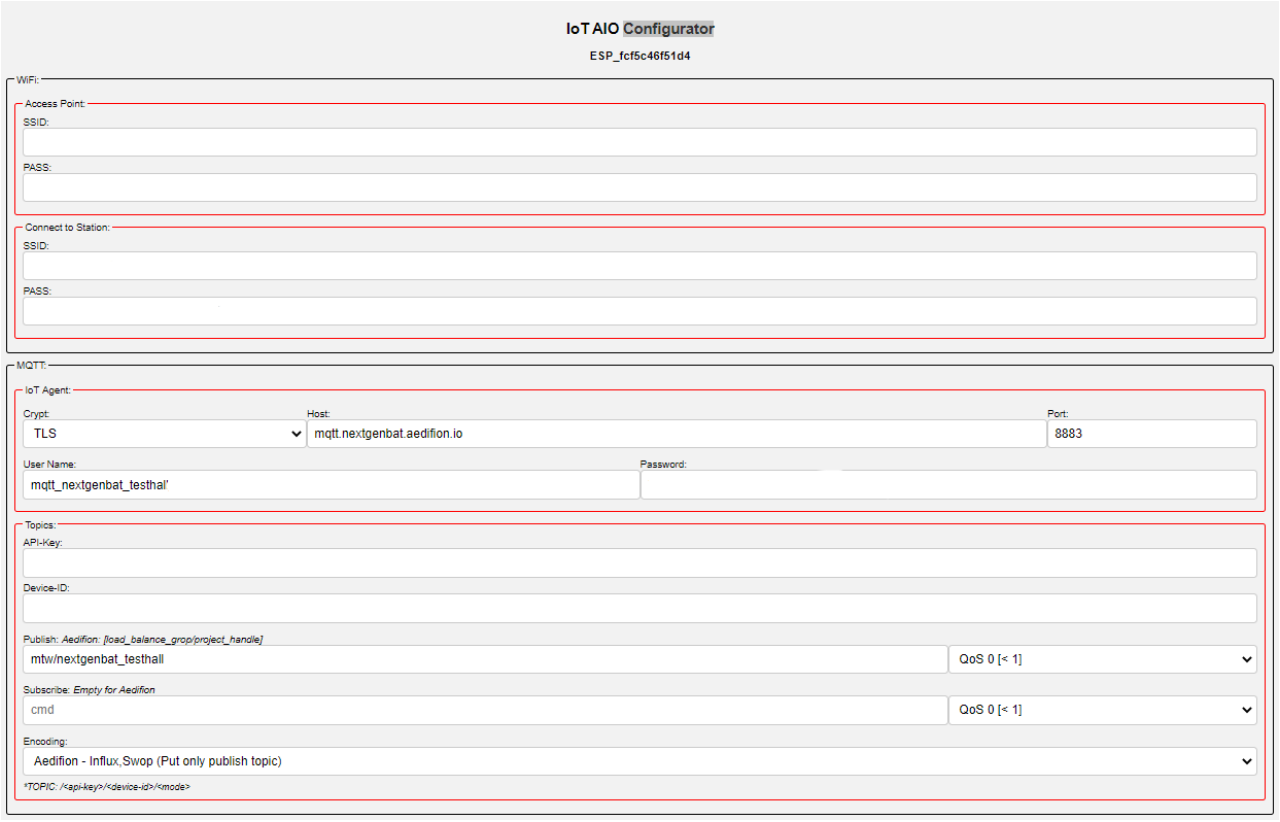


Figure 5: IoT Configurator

3.1 Wifi

The gateway operates as WiFi Access Point or allows connecting to an existing one. Both of this can run in parallel.

Access Point

The Access Point mode should only be used for configuration. For example, to save the station credentials on the device. The SSID defaults to a device specific name which is composed from ESP and the device's MAC-Address(for example: ESP_fcf5c46f51d4). Hence, every gateway has it's own unique name to distinguish the devices from each other. The password is by default: 123456789

Station

If credentials are entered here, the gateway will try to connect to this Access Point.

3.2 MQTT

The Device will communicate with a cloud server using the MQTT protocol (https://github.com/mqtt/mqtt.github.io/wiki). This manual will focus on the connection to the Aedifion (https://www.aedifion.com/) Cloud-platform. However, the gateways also support different MQTT brokers.

Topics

For connection with Aedifion, the API-Key and Device-ID boxes are not used. Changes to the QoS(Quality of Service) will have no affect on the device's behavior either.
The Publish topic requires only the main Aedifion topic name: For example: 'mtw/nextgenbat_testhall'. The following topics will be automatically generated by the device:

- META/mtw/nextgenbat_testhall
- CONTROLS/mtw/nextgenbat_testhall
- mtw/nextgenbat_testhall/update

The Aedifion encoding will send the values through the InfluxDB protocol (see Figure 6). (https://docs.influxdata.com/influxdb/v1.8/write_protocols/line_protocol_tutorial/)

```
1        Datapointname value=20.0 1465839830100400200
```

Figure 6: Influx message: datapoint, observation, timestamp

The device will receive SWOP(https://aedifion.gitlab.io/swop/) messages on the CONTROLS/... Topic (see Figure 7).

```
1 {
2         "type":          "NEWSPT",
3         "swop-version":  0.1,
4         "datapoint":     "bacnet93-4120-External-Room-Set-Temperature-RTs",
5         "value":         20.3,
6         "priority":      13
7 }
```

Figure 7: SWOP message

If the name of a data point matches the name of the SWOP message, the gateway will set the connected device to the given value. On each Startup of the gateway, the Metadata will be send to the META/... topic. (see Figure 8)

```
1 {
2         "name":          "Name of device",
3         "IP":            "192.168.xxx.xxx",
4         "source":        "Analog Gateway"
5 }
```

Figure 8: META tag

3.3 Data point names

For data point naming, we use BUDO (https://github.com/RWTH-EBC/BUDO). BUDO is intended to provide META data in a hierarchical structure allowing artificial-intelligence-based algorithms to identify interrelated devices and topologies. The Gateway will automatically parse the unit and send it together with the META-Tags to the Aedifion server. Other names or device keys are applicable as well.

3.4 Periodic or Threshold

The gateway can publish recorded values periodically or using change of value (COV) (compare Figure 9). If COV is used the device will check every second the values. If the deviation of one value exceeds the threshold, all values of the gateway will be published to the MQTT server. In periodic mode the unit is millisecond. In threshold mode, the values are absolute values.

4 Analog Gateway configuration

Figure 9: Analog configurator

For the analog gateway, data point names and a user-defined scaling are configured in the Analog Gateway Configuration section. The analog gateway supports the following interfaces:

- 0(2) - 10 V
- 0(4) - 20 mA

The gateway will scale the input and output according to the user-defined values for minimum and maximum. For example, a 2-10 V signal with a 0-100 % scaling will map 0 % to 2 V and 100 % to 10 V and values within this range accordingly.

5 Temperature Gateway configuration

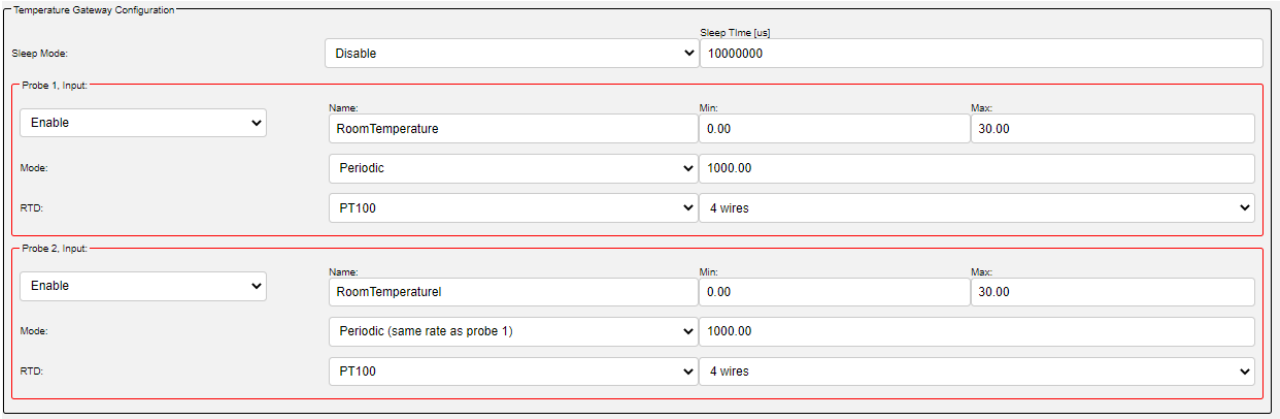


Figure 10: Temperature configurator

For the temperature gateway, data point names, the operational limits and the type of the rtd probe are configured in the Temperature Gateway configuration section.

If the measured value is not within the min and max values, no new value is sent to the cloud server. This is used to protect the device from sending values outside of the operational limits.

To achieve the longest possible battery life, it is necessary to set Sleep Mode to enable and use the threshold mode.

6 Digital Gateway configuration

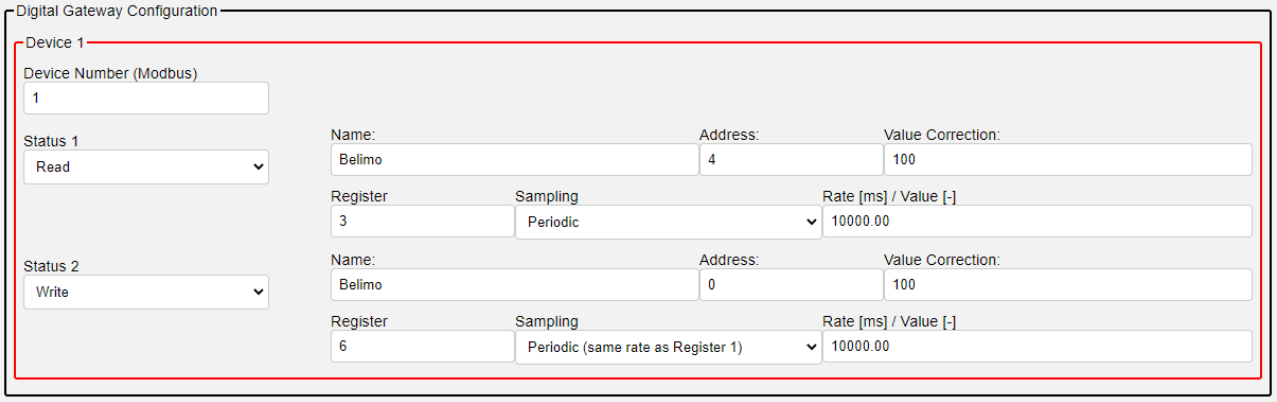


Figure 11: Digital configurator

For the digital gateway, data point names, a user-defined scaling and the connected Modbus device are configured in the Digital Gateway Configuration section.

This configuration is limited to one device and two registers. This limit is only given by the configuration interface. The implemented Modbus stack will support multiple devices and registers.

The Device Number is the Modbus device number. This can be found in the manual of the connected device or can be set manually. The name box declares the data point name. This is used for the communication with the Aedifion server.

Each Modbus register can be set up with a read or write command. The function code relates to the register type (input, holding, coil, discrete input; for reference see the Modbus documentation) and should be defined in the Register box. The correct values can be found in the manual of the field device. In the address field, the corresponding register address has to be entered which is usually given by the vendor in the data sheet of the field device.

To adjust the output value, the correction box needs to be filled. The real value from the field device is then divided by the given value in the input box.
For example:
The Belimo Modbus devices store their set points in a value between 0 and 10000. If a 0 to 100 % representation is desired, the incomming signal has to be divided by factor 100.